

NFPA 386

Portable Shipping Tanks for Flammable and Combustible Liquids 1985



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There is a concern that the growing use of synthetic materials may produce more or additional toxic products of combustion in a fire environment. The Board has, therefore, asked all NFPA technical committees to review the documents for which they are responsible to be sure that the documents respond to this current concern. To assist the committees in meeting this request, the Board has appointed an advisory committee to provide specific guidance to the technical committees on questions relating to assessing the hazards of the products of combustion.

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NFPA 386

Standard for

Portable Shipping Tanks for

Flammable and Combustible Liquids

1985 Edition

This edition of NFPA 386, *Standard for Portable Shipping Tanks for Flammable and Combustible Liquids*, was prepared by the Technical Committee on Transportation of Flammable Liquids, released by the Correlating Committee on Flammable Liquids, and acted on by the National Fire Protection Association, Inc. at its Fall Meeting held November 12-15, 1984 in San Diego, California. It was issued by the Standards Council on December 7, 1984, with an effective date of December 27, 1984, and supersedes all previous editions.

The 1985 edition of this standard has been approved by the American National Standards Institute.

Origin and Development of NFPA 386

This standard was first officially adopted in 1970, and revised in 1974 and 1979. This edition is a reconfirmation of the 1979 edition.

Committee on Flammable Liquids Correlating Committee

Paul C. Lamb, *Chairman*
Englewood, NJ

Martin F. Henry, *Secretary*
National Fire Protection Association
(Nonvoting)

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Steven Landon, Washex Machinery Corp.
Rep. Laundry-Cleaners Allied Trades Assn.
William R. Rucinski, Dept. of State Police

Nonvoting
Ing Gert Magnus, Bränddirektor

Technical Committee on Transportation of Flammable Liquids

William R. Rucinski, *Chairman*
Dept. of State Police
(Rep. Fire Marshals Assn. of North America)

Martin F. Henry, *Secretary*
National Fire Protection Association
(Nonvoting)

H. M. Faulconer Phillips Petroleum Co.
Rep. American Petroleum Institute
Clifford J. Harvison, Natl. Tank Truck Carriers,
Inc.
Donald M. Johnson
Rep. Western Oil & Gas Assn.
Oliver W. Johnson, Palo Alto, CA

Harold T. Rock, Tennessee Eastman Co.
Rep. Chemical Manufacturers Assn.
Donald W. Vierimaa, Truck Trailer Manufacturers Assn.
Billie C. Wilson, US Dept. of Transportation
Michael P. Wilson, American Insurance Assn.

Alternates

A. B. Rosenbaum III, Natl. Tank Truck Carriers, Inc.
(Alternate to C. J. Harvison)

E. R. Smith, American Petroleum Institute
(Alternate to H. M. Faulconer)

Nonvoting

Paul Seay, Dept. of Transportation

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Since that time, changes in the membership may have occurred.*

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NFPA 386
Standard for
Portable Shipping Tanks for
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Chapter 1 General Provisions

1-1 Scope and Application.

1-1.1 This standard applies to portable shipping tanks with capacity larger than 60 gal (227 L) and not exceeding 660 gal (2498 L) used for the transportation of normally stable flammable and combustible liquids having a flash point below 200°F (93.4°C) and handled at temperatures below their boiling point.

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 and combustible 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.

1-1.2 Attention is directed to the fact that cutback asphalts can have flash points in the range of Class I liquids. Also liquids having a flash point higher than 200°F (93.4°C) may assume the characteristics of lower flash point liquids when heated. Under such conditions it shall be appropriate to apply the provisions of this standard unless otherwise specifically exempted.

1-1.3 Additional safeguards may be necessary for portable shipping tanks used in the transportation of liquids having special properties which dictate safeguards in addition to those specified here.

1-1.4 This standard does not apply to:

1-1.4.1 The use of portable shipping tanks as storage containers. See NFPA 30, *Flammable and Combustible Liquids Code*, for information on storage.

1-1.4.2 Drums as defined by the United States Department of Transportation when constructed according to specifications of the United States Department of Transportation.

NOTE: For construction and use of portable shipping tanks exceeding 660 gal (2498 L) capacity, reference may be made to the specifications of the United States Department of Transportation or equivalent authorities having jurisdiction.

1-2 Definitions.

Asphalt. The term asphalt shall include other materials having similar characteristics when heated above ambient temperatures.

Baffle. A nonliquidtight partition in a portable shipping tank.

Compartment. A liquidtight division in a portable shipping tank.

Flash Point. The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with the air near the surface of the liquid within the tank as determined by appropriate test procedure and apparatus as specified.

The flash point of liquids having a viscosity less than 45 SUS at 100°F (37.8°C) and a flash point below 200°F (93.4°C) shall be determined in accordance with ASTM D-56-82, *Standard Method of Test for Flash Point by the Tag Closed Tester*.

The flash point of liquids having a viscosity of 45 SUS or more at 100°F (37.8°C) or a flash point of 200°F (93.4°C) or higher shall be determined in accordance with ASTM D-93-80, *Standard Method of Test for Flash Point by the Pensky-Martens Closed Tester*.

Liquid. For the purpose of this standard, liquid shall mean any material which has a fluidity greater than that of 300 penetration asphalt when tested in accordance with ASTM D-5-73 (1978), *Test for Penetration for Bituminous Materials*. When not otherwise identified, the term liquid shall include both flammable and combustible liquids.

Combustible Liquid. A liquid having a flash point at or above 100°F (37.8°C).

Combustible liquids shall be subdivided as follows:

Class II Liquids shall include those having flash points at or above 100°F (37.8°C) and below 140°F (60°C).

Class IIIA Liquids shall include those having flash points at or above 140°F (60°C) and below 200°F (93.4°C).

Class IIIB Liquids shall include those having flash points at or above 200°F (93.4°C).

This standard does not cover Class IIIB liquids (*see 1-1.1*). Where the term combustible liquids is used in this standard, it shall mean only Class II and Class IIIA liquids.

NOTE: The upper limit of 200°F (93.4°C) is given because the application of this standard does not extend to liquids having flash points above 200°F (93.4°C) and should not be construed as indicating that liquids with higher flash points are noncombustible.

Flammable Liquid. A liquid having a flash point below 100°F (37.8°C) and having a vapor pressure not exceeding 40 psi (absolute) (2,068 mm Hg) at 100°F (37.8°C) shall be known as a Class I liquid.

Class I Liquids shall be subdivided as follows:

Class IA shall include those having flash points below 73°F (22.8°C) and having a boiling point below 100°F (37.8°C).

Class IB shall include those having flash points below 73°F (22.8°C) and having a boiling point at or above 100°F (37.8°C).

Class IC shall include those having flash points at or above 73°F (22.8°C) and below 100°F (37.8°C).

NOTE: This classification does not apply to:

1. Liquids without flash points that may be flammable under some conditions, such as certain halogenated hydrocarbons and mixtures containing petroleum fractions and hydrocarbons.
2. Mists, sprays or foams.

Portable Shipping Tank. Any container having a liquid capacity in excess of 60 U.S. gal (227 L) and not exceeding 660 U.S. gal (2498 L) which is readily movable from place to place either with or without special handling equipment and which is not permanently attached to its transporting vehicle.

Vapor Pressure. The pressure measured in psi (absolute) (mm Hg) exerted by a volatile liquid, as determined by ASTM D-323-82, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)*.

Chapter 2 Design and Construction of Portable Shipping Tanks

2-1 Basic Design.

2-1.1 Portable shipping tanks shall be of all welded construction and fabricated in accordance with good engineering practice.

2-1.2 Portable shipping tanks built under Specifications of the United States Department of Transportation shall be permitted when used in accordance with the conditions specified by the United States Department of Transportation.

2-1.3 The material used in the construction of tanks shall be compatible with the chemical characteristics of the liquid to be transported. In case of doubt, the supplier or producer of the liquid, or other competent authority, shall be consulted as to the suitability of the material to be used in construction.

2-1.4 Tank Mountings. Tanks shall be designed and fabricated with mountings to provide a secure base while in transit. "Skids" or similar devices shall be deemed to be included within this requirement.

2-1.5 Safety Factor. All tank mountings such as skids, fastenings, brackets, and lifting or hold-down lugs shall be permanently secured to tanks and shall be designed to withstand static loadings in any direction equal to twice the weight of the tank and attachments when filled with the product being carried without significant permanent deformation.

2-2 Construction Materials.

2-2.1 Steel used in the construction of mild steel (MS) tanks shall meet the following minimum requirements:

Yield Point, minimum 25,000 lbs per sq in.
Ultimate Strength, minimum 45,000 lbs per sq in.
Minimum Elongation, standard
2-in. (50.8-mm) sample 20 percent

2-2.2 Steel used in the construction of low alloy low carbon (high tensile) steel (HS) tanks shall meet the following minimum requirements:

Yield Point, minimum 45,000 lbs per sq in.
Ultimate Strength, minimum 60,000 lbs per sq in.
Minimum Elongation, standard
2-in. (50.8-mm) sample 25 percent

2-2.3 Steel used in the construction of stainless steel (SS) tanks shall meet the following minimum requirements:

Yield Point, minimum 25,000 lbs per sq in.
Ultimate Strength, minimum 70,000 lbs per sq in.
Minimum Elongation, standard
2-in. (50.8-mm) sample 30 percent

2-2.4 Aluminum used in the construction of tanks of aluminum alloys for high strength welded construction shall meet the following minimum requirements:

All sheets for shells including tops and bottoms, baffles, and bulkheads of portable shipping tanks shall be of aluminum alloys (commercial designation) 5052, 5454, 5154, 5086, 5254, or 5652, conforming to ASTM B-209-82, *Specification for Aluminum and Aluminum-Alloy Sheet and Plate*. All bulkheads, baffles, tops and bottoms 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 in. or thicker are used, the H112 temper is additionally permitted.

2-2.5 Material thickness shall not be less than shown in the following table:

	Manf. Std. Gage Number**				Approx. Thick. Decimal In.		
	Gage No. MS	Approx. Thick. Deci- mals of In.	Gage No. HS	Approx. Thick. Deci- mals of In.	Gage No. SS	Approx. Thick. Deci- mals of In.	AL
Cylindrical							
120-300	13	0.0897	14	0.0747	14	0.0747	.090
301-450	13	0.0897	14	0.0747	14	0.0747	.125
451-660	11	0.1196	12	0.1046	12	0.1046	.125
Bottoms of vertical and ends of hori- zontal tanks	7	0.1793	7	0.1793	10	0.1345	.250
Tops of vertical tanks	13	0.0897	14	0.0747	14	0.0747	.125
Cubical Tanks							
Sides and Tops							
120-300	11	0.1196	12	0.1046	14	0.0747	.250
301-500	9	0.1495	10	0.1345	12	0.1046	.250
501-660	7	0.1793	7	0.1793	12	0.1046	.250
Bottoms							
120-300	7	0.1793	7	0.1793	12	0.1046	.250
301-500	7	0.1793	7	0.1793	10	0.1345	.250
501-660	7	0.1793	7	0.1793	10	0.1345	.3125

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

2-3 Construction of Tanks.

2-3.1 Joints. All side, top and bottom joints shall be welded.

2-3.2 Aluminum Alloys. All welded aluminum joints shall be made in accordance with recognized good engineering practice, and the strength of a joint shall be not less than 85 percent of that of the adjacent metal. Alloys shall be jointed by an inert gas arc welding process using aluminum-magnesium-type filler metal which is consistent with material suppliers' recommendations.

2-3.3 Mild Steel, High Tensile Steel, Stainless Steel. Joints shall be welded in accordance with recognized good engineering practice and the efficiency of all joints shall be not less than 85 percent of that of the adjacent metal in the portable shipping tank.

2-3.3.1 Combinations of mild steel (MS), high tensile steel (HS) or stainless steel (SS) may be used in the construction of a single tank, provided that each material, where used, shall comply with the minimum requirements specified in Section 2-2 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 metal, on condition that the stainless steel electrodes or filler metal 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 metal.

2-4 Tests.

2-4.1 Portable shipping tanks shall be tested at the time of manufacture, when alteration or repairs are made which involve tank integrity or when there is an indication of necessity for a retest.

2-4.2 Portable shipping tanks shall be tested to a minimum pressure of 7.5 psig (51.7 kPa). Such pressure shall be maintained for a period of at least 5 minutes. Hydrostatic pressure, if used, shall be gaged at the top of the tank.

Chapter 3 Appurtenances

3-1 Acceptability and Protection.

3-1.1 All valves, piping, and appurtenances shall be acceptable to the authority having jurisdiction and shall be attached to the tank in a substantial manner.

3-1.2 All valves, piping, fittings, accessories, and safety devices shall be adequately protected against handling damage, overturn, or other mechanical forces.

3-2 Vents.

3-2.1 Emergency Venting for Fire Exposure. Tanks shall be provided with one or more devices installed in the top with sufficient venting capacity to limit the tank internal pressure under fire exposure conditions to 10 psig (68.9 kPa) or not to exceed 30 percent of the bursting pressure of the tank, whichever is greater. At least one pressure actuated vent shall be used. It shall be set to

open at not less than 5 psig (34.4 kPa) and have a minimum through area of at least 0.44 sq in. (287.8 mm²). If fusible vents are used to meet the additional emergency venting requirements, they shall be activated by elements that operate at a temperature not less than 220°F (104.4°C) and not exceeding 300°F (148.9°C) when the tank pressure is between 5 and 10 psig (34.4 and 68.9 kPa).

3-2.2 Capacity. The total emergency venting capacity shall be not less than that determined from Table 3-2.2 using the entire external surface of the tank as the exposed area.

3-2.3 Tank Openings. Tanks shall have at least one opening in the top not less than 6 in. (152.4 mm) in diameter provided with an approved closure device. Provision shall be made to prevent cover from fully opening when there is internal pressure. The closure shall be liquid-and vaportight and shall be left closed while the tank is in transit. If gaskets are used, they shall be compatible with the product being transported. In addition, there shall be on the top of the tank a 1½-in. or larger nominal pipe size threaded opening for attaching vent piping for "off highway" use. Openings in the tank shall not release vapor or liquid at pressure below 5 psig (34.4 kPa) while the tank is in transit.

Table 3-2.2 Minimum Emergency Vent Capacity in Cubic Feet Free Air/Hour [14.7 psia (101.3 kPa) and 60°F (15.6°C)]

Exposed Area Square Feet	Cu Ft Free Air per Hour
20	15,800
30	23,700
40	31,600
50	39,500
60	47,400
70	55,300
80	63,300
90	71,200
100	79,100
120	94,900
140	110,700
160	126,500

NOTE 1: Interpolate for intermediate sizes.

NOTE 2: The venting capacities have been calculated on the basis of 75 percent of the sq ft of the total exposed area of the cargo tank, using the formulas for heat input contained in NFPA 30, *Flammable and Combustible Liquids Code*, where the derivation of these formulas is explained.

3-2.4 Outlet Valves, Fittings or Piping. The drawoff outlet of each tank shall be equipped with a suitable shutoff valve, located internally, designed so the valve will remain closed if the external piping is broken off.

Exception No. 1: When exterior valve or piping is provided with substantial and adequate protection against damage in handling. Bottom outlet equipment shall not extend closer than 1 in. (25.4 mm) to the bottom bearing surface of the skids or tank mountings. Discharge or drawoff valve shall be equipped with liquidtight plugs or caps while in transit.

Exception No. 2: When drawoff outlet is located on top of tank.

3-2.5 Bottom Connection. Bottom internal valves or drawoff piping shall be attached directly to a welded flange or boss except that threaded joints may be used if such opening does not exceed 2½-in. nominal pipe size.

Chapter 4 Operation and Use

4-1 Filling and Emptying.

4-1.1 Outage. No tank shall be filled liquid full. To prevent leakage from or distortion of the tank by expansion of its contents due to rise of temperature while in transit, outage shall be not less than 5 percent of the total tank volume when filled, unless outage calculated by the method in 4-1.2 demonstrates a lesser outage is adequate.

NOTE: In portable containers containing alcohol, cologne spirits, high wines, or other distilled spirits of 150 proof or over, the vacant interior space must be the maximum permitted by law such as the United States Internal Revenue Regulations, Alcohol Tax Unit.

4-1.2 The following chart may be used to determine the required outage when filling portable shipping tanks.

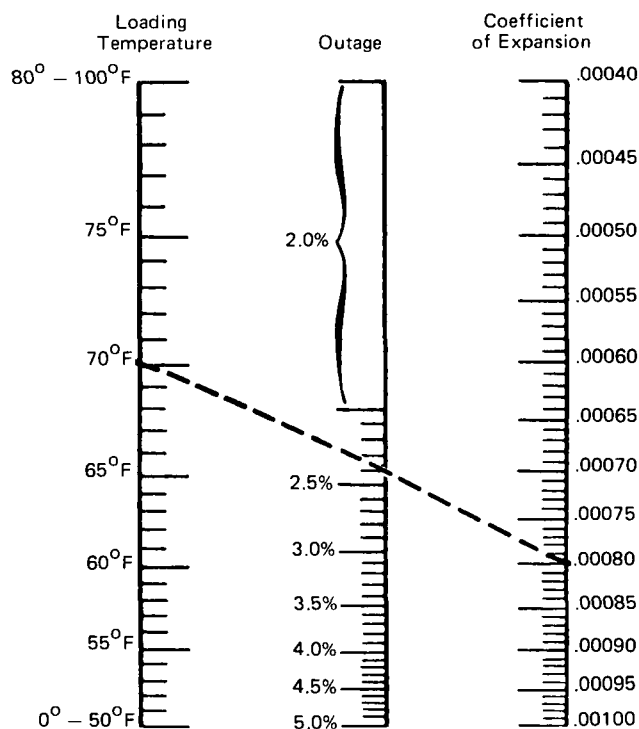
The following coefficients of expansion, per degree Fahrenheit, of the principal flammable liquids shall be used in determining outages:

Acetone.....	0.00085
Amyl acetate.....	.00068
Benzol (benzene).....	.00071
Carbon bisulfide.....	.00070
Ether.....	.00098
Ethyl acetate.....	.00079
Ethyl (grain) alcohol.....	.00062
Methyl (wood) alcohol.....	.00072
Toluol (toluene).....	.00063
Gasoline or Naphtha:	
50-55° API ¹	.00055
55.1-60° API ¹	.00060
60.1-65° API ¹	.00065
65.1-70° API ¹	.00070
70.1-75° API ¹	.00075
75.1-80° API ¹	.00080
80.1-85° API ¹	.00085
85.1-90° API ¹	.00090

¹API (American Petroleum Institute), according to the following formula:

$$^{\circ}\text{API} = \frac{141.5}{\text{Specific Gravity}} - 131.5$$

Example: Suppose the temperature of the liquid at time of loading is 70°F (21.1°C) and its coefficient of expansion is 0.0080; lay a ruler on the chart running from 70 degrees to 0.0080 as shown by the dotted line and the required outage is 2.4 percent where the ruler crosses the outage scale.



4-1.3 Partial Deliveries Prohibited. Portable shipping tanks shall be filled at the point of origin and, except for sampling, no product shall be withdrawn therefrom until the tank has been properly placed at its point of final use.

4-2 Designation of Contents. Every portable shipping tank used for the transportation of any flammable or combustible liquid shall be marked in accordance with the requirements of the U.S. Department of Transportation Hazardous Materials Regulations.

4-3 Transporting Vehicle.

4-3.1 When tanks are loaded on vehicles for transit, they shall be secured to the transporting vehicle in accordance with the applicable provisions of the U.S. Department of Transportation, Federal Motor Carrier Safety Regulations.

4-3.2 Exhaust Systems. The exhaust system of transporting vehicle, including muffler (or silencer) and exhaust line, shall have ample clearance between it and the fuel system or any combustible materials, and shall not be exposed to leakage or spillage of product or accumulations of grease, oil, or gasoline.

4-3.3 Fire Extinguishers. Vehicles transporting one or more tanks shall be equipped with at least one approved fire extinguisher in accordance with NFPA 512, *Standard for Truck Fire Protection*.

Chapter 5 Referenced Publications

5-1 The following documents or portions thereof are referenced within this standard and shall be considered part of the requirements of this document. The edition indicated for each reference is current as of the date of the NFPA issuance of this document. These references are listed separately to facilitate updating to the latest edition by the user.

5-1.1 NFPA Publications. National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

NFPA 30-1984, *Flammable and Combustible Liquids Code*

NFPA 512-1984, *Standard for Truck Fire Protection.*

5-1.2 ASTM Publications. American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.

ASTM B-209-82, *Specification for Aluminum and Aluminum-Alloy Sheet and Plate*

ASTM D-5-73 (1978), *Test for Penetration of Bituminous Materials*

ASTM D-56-79, *Standard Method of Test for Flash Point by the Tag Closed Tester*

ASTM D-93-80, *Standard Method of Test for Flash Point by the Pensky-Martens Closed Tester*

ASTM D-323-82, *Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method).*