

NFPA[®]

11

Standard for Low-, Medium-, and High-Expansion Foam

2016



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NFPA® 11

Standard for

Low-, Medium-, and High-Expansion Foam

2016 Edition

This edition of NFPA 11, *Standard for Low-, Medium-, and High-Expansion Foam*, was prepared by the Technical Committee on Foam and acted on by NFPA at its June Association Technical Meeting held June 22–25, 2015, in Chicago, IL. It was issued by the Standards Council on August 18, 2015, with an effective date of September 7, 2015, and supersedes all previous editions.

This document has been amended by one or more Tentative Interim Amendments (TIAs) and/or Errata. See “Codes & Standards” at www.nfpa.org for more information.

This edition of NFPA 11 was approved as an American National Standard on September 7, 2015.

Origin and Development of NFPA 11

NFPA committee activity in this field dates from 1921, when the Committee on Manufacturing Risks and Special Hazards prepared standards on foam as a section of the general *Standard on Protection of Fire Hazards, Incident to the Use of Volatiles in Manufacturing Processes*. Subsequently the standards were successively under the jurisdiction of the Committee on Manufacturing Hazards and the Committee on Special Extinguishing Systems, prior to the present committee organization. The present text supersedes the prior editions adopted in 1922, 1926, 1931, 1936, 1942, 1950, 1954, 1959, 1960, 1963, 1969, 1970, 1972, 1973, 1974, 1975, 1976, and 1978. It also supersedes the 1977 edition of NFPA 11B.

The 1983 edition was completely rewritten to include all the material formerly contained in NFPA 11B, *Standard on Synthetic and Combined Agent Systems*. The standard was revised in 1988 and again in 1994 to more clearly state the requirements and to separate mandatory requirements from advisory text.

The standard was revised for the 1998 edition to include requirements for foam systems for marine applications and to provide guidance relating to the environmental impact of foam system discharges.

The 2002 edition was revised to address mixing of foam concentrates and to clarify requirements related to foam concentrate pumps. Requirements for medium- and high-expansion foam systems were included.

The 2005 edition was reorganized to provide the requirements for low-, medium-, and high-expansion foam, to better incorporate the requirements of NFPA 11A.

The 2010 edition added a new chapter to address compressed air foam systems. Unenforceable terms were removed to comply with the *Manual of Style for NFPA Technical Committee Documents*.

For the 2016 edition, the committee addressed several areas of concern. The piping requirements have been reorganized and clarified, issues regarding acceptance criteria for annual foam concentrate testing have been addressed, environmentally friendly methods of testing foam proportioners are recognized, and seal-only protection is permitted for composite roofs that meet specific criteria.

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NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on the installation, maintenance, and use of foam systems for fire protection, including foam hose streams.



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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Annex A.

A reference in brackets [] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex H. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex H.

Chapter 1 Administration

1.1* Scope.

1.1.1 This standard covers the design, installation, operation, testing, and maintenance of low-, medium-, and high-expansion and compressed air foam systems for fire protection.

1.1.2 It is not the intent of this standard to specify where foam protection is required.

1.2 Purpose.

1.2.1 This standard is intended for the use and guidance of those responsible for designing, installing, testing, inspecting, approving, listing, operating, or maintaining fixed, semifixed, or portable low-, medium-, and high-expansion and com-

pressed air foam fire-extinguishing systems for interior or exterior hazards.

1.2.2 Nothing in this standard is intended to restrict new technologies or alternative arrangements, provided the level of safety prescribed by the standard is not lowered.

1.2.3 Low-, medium-, and high- expansion foam and compressed air foam systems are intended to provide property protection and not life safety.

1.3 Application. This standard is not applicable to the following types of systems:

- (1) Chemical foams and systems (considered obsolete)
- (2) Deluge foam-water sprinkler or spray systems (See NFPA 16.)
- (3) Foam-water closed-head sprinkler systems (See NFPA 16.)
- (4) Combined agent systems
- (5) Mobile foam apparatus (See NFPA 1901.)
- (6) Class A foam and systems (See NFPA 1150.)

1.4 Retroactivity. The provisions of this standard reflect a consensus of what is necessary to provide an acceptable degree of protection from the hazards addressed in this standard at the time the standard was issued.

1.4.1 Unless otherwise specified, the provisions of this standard shall not apply to facilities, equipment, structures, or installations that existed or were approved for construction or installation prior to the effective date of the standard. Where specified, the provisions of this standard shall be retroactive.

1.4.2 In those cases where the authority having jurisdiction determines that the existing situation presents an unacceptable degree of risk, the authority having jurisdiction shall be permitted to apply retroactively any portions of this standard deemed appropriate.

1.4.3 The retroactive requirements of this standard shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, and only where it is clearly evident that a reasonable degree of safety is provided.

1.5 Equivalency. Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety over those prescribed by this standard.

1.5.1 Technical documentation shall be submitted to the authority having jurisdiction to demonstrate equivalency.

1.5.2 The system, method, or device shall be approved for the intended purpose by the authority having jurisdiction.

1.6 Units and Formulas. Metric units of measurement in this standard are in accordance with the modernized metric system known as the International System of Units (SI). The liter unit, which is not part of but is recognized by SI, is commonly used in international fire protection. Conversion factors for this unit are found in Table 1.6.

Chapter 2 Referenced Publications

2.1 General. The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

Table 1.6 Metric Units of Measure

Name of Unit	Unit Symbol	Conversion Factor
liter	L	1 gal = 3.785 L
liter per minute per square meter	L/min·m ²	1 gpm/ft ² = 40.746 L/min·m ²
cubic decimeter	dm ³	1 gal = 3.785 dm ³
pascal	Pa	1 psi = 6894.757 Pa
bar	bar	1 psi = 0.0689 bar
bar	bar	1 bar = 10 ⁵ Pa
kilopascal	kPa	1 psi = 6.895 kPa

Note: For additional conversions and information, see IEEE/ASTM SI 10.

2.2 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2016 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2012 edition.

NFPA 16, *Standard for the Installation of Foam-Water Sprinkler and Foam-Water Spray Systems*, 2015 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*, 2016 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*, 2016 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2015 edition.

NFPA 70®, *National Electrical Code*®, 2014 edition.

NFPA 72®, *National Fire Alarm and Signaling Code*, 2016 edition.

NFPA 220, *Standard on Types of Building Construction*, 2015 edition.

NFPA 1150, *Standard on Foam Chemicals for Fires in Class A Fuels*, 2010 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2016 edition.

NFPA 1961, *Standard on Fire Hose*, 2013 edition.

2.3 Other Publications.

2.3.1 ANSI Publications. American National Standards Institute, Inc., 25 West 43rd St., 4th Floor, New York, NY 10036.

ANSI B1.20.1, *Standard for Pipe Threads, General Purpose*, 1983 (R2006).

ANSI B16.1, *Gray Iron Pipe Flanges and Flanged Fittings*, 2010.

ANSI B16.3, *Malleable Iron Threaded Fittings: Classes 150 and 300*, 2011.

ANSI B16.4, *Gray Iron Threaded Fittings, Classes 150 and 300*, 2006.

ANSI B16.5, *Pipe Flanges and Flanged Fittings: NPS 1/2 through 24 Metric/Inch Standard*, 2013.

ANSI B16.9, *Factory-Made Wrought Butt Welding Fittings*, 2012.

ANSI B16.11, *Forged Fittings, Socket-Welding and Threaded*, 2011.

ANSI B16.15, *Cast Bronze Threaded Fittings*, 1985 (R1994).

ANSI B16.24, *Cast Copper Alloy Pipe Flanges and Flanged Fittings*, 1991 (R1998).

ANSI B16.25, *Butt Welding Ends*, 2012.

2.3.2 API Publications. American Petroleum Institute, 1220 L Street, N.W., Washington, DC 20005-4070.

API 607, *Fire Test for Quarter-turn Valves and Valves Equipped with Nonmetallic Seats*, 6th edition, 2010.

API 650, *Welded Tanks for Oil Storage*, 12th edition, 2013.

2.3.3 ASME Publications. American Society of Mechanical Engineers, Two Park Avenue, New York, NY 10016-5990.

ASME *Boiler and Pressure Vessel Code*, 2013.

ASME B31.1, *Power Piping Code*, 2012.

2.3.4 ASTM Publications. ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM A 53, *Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless*, 2012.

ASTMA 105, *Standard Specification for Carbon Steel Forgings for Piping Applications*, 2012.

ASTM A 106, *Standard Specification for Seamless Carbon Steel Pipe for High-Temperature Service*, 2011.

ASTM A 135, *Standard Specification for Electric Resistance-Welded Steel Pipe*, 2009.

ASTM A 182, *Standard Specification for Forged or Rolled Alloy and Stainless Steel Pipe Flanges, Forged Fittings, and Valves and Parts for High-Temperature Service*, 2012.

ASTM A 216, *Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding for High-Temperature Service*, 2012.

ASTM A 234, *Standard Specification for Piping Fittings of Wrought Carbon Steel and Alloy Steel for Moderate and High-Temperature Service*, 2011.

ASTM A 312, *Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes*, 2012.

ASTM A 395, *Standard Specification for Ferritic Ductile Iron Pressure-Retaining Castings for Use at Elevated Temperatures*, 1999.

ASTM A 795, *Standard Specification for Black and Hot-Dipped-, Zinc-Coated-, (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use*, 2008.

ASTM B 43, *Standard Specification for Seamless Red Brass Pipe, Standard Sizes*, 2009.

ASTM B 315, *Standard Specification for Seamless Copper Alloy Pipe and Tube*, 2012.

ASTM C 582, *Standard Specification for Contact-Molded Reinforced Thermosetting Plastic (RTP) Laminates for Corrosion-Resistant Equipment*, 2009.

ASTM D 323, *Standard Test Method for Vapor Pressure of Petroleum Products (Reid Method)*, 2008.

ASTM D 1331, *Standard Test Methods for Surface and Interfacial Tension of Solutions of Surface-Active Agents*, 2011.

ASTM E 84, *Standard Test Method for Surface Burning Characteristics of Building Materials*, 2013.

IEEE/ASTM SI 10, *American National Standard for Metric Practice*, 2010.

2.3.5 AWS Publications. American Welding Society, 550 NW LeJeune Road, Miami, FL 33126.



AWS B2.1, *Specification for Welding Procedure and Performance Qualification*, 2009.

2.3.6 IEEE Publications. IEEE, Three Park Avenue, 17th Floor, New York, NY 10016-5997.

IEEE 45, *Recommended Practice for Electric Installations on Shipboard*, 2002.

2.3.7 IMO Publications. International Maritime Organization, 4 Albert Embankment, London SE1 7SR.

Safety of Life at Sea, SOLAS Regulations II-2/4.3 and 4.3.5.

2.3.8 ISO Publications. International Organization for Standardization, 1, ch. de la Voie-Creuse, CP 56 – CH-1211 Geneva 20 Switzerland.

ISO 7-1, *Pipe Threads Where Pressure-Tight Joints Are Made on the Threads — Part 1: Dimensions, Tolerances and Designation*, 1994.

2.3.9 UL Publications. Underwriters Laboratories Inc., 333 Pfingsten Road, Northbrook, IL 60062-2096.

UL 162, *Standard for Safety Foam Equipment and Liquid Concentrates*, 1999.

2.3.10 Other Publications.

Merriam-Webster's Collegiate Dictionary, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

2.4 References for Extracts in Mandatory Sections.

NFPA 10, *Standard for Portable Fire Extinguishers*, 2013 edition.

NFPA 30, *Flammable and Combustible Liquids Code*, 2015 edition.

Chapter 3 Definitions

3.1 General. The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

3.2 NFPA Official Definitions.

3.2.1* Approved. Acceptable to the authority having jurisdiction.

3.2.2* Authority Having Jurisdiction (AHJ). An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

3.2.3 Labeled. Equipment or materials to which has been attached a label, symbol, or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production of labeled equipment or materials, and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

3.2.4* Listed. Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of

production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

3.2.5 Shall. Indicates a mandatory requirement.

3.2.6 Should. Indicates a recommendation or that which is advised but not required.

3.2.7 Standard. An NFPA Standard, the main text of which contains only mandatory provisions using the word “shall” to indicate requirements and that is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions are not to be considered a part of the requirements of a standard and shall be located in an appendix, annex, footnote, informational note, or other means as permitted in the NFPA Manuals of Style. When used in a generic sense, such as in the phrase “standards development process” or “standards development activities,” the term “standards” includes all NFPA Standards, including Codes, Standards, Recommended Practices, and Guides.

3.3 General Definitions.

3.3.1 Combustible Liquid. Any liquid that has a closed-cup flash point at or above 37.8°C (100°F), as determined by the test procedures and apparatus set forth in Section 4.4 of NFPA 30. [30, 2015]

3.3.1.1 Class II Liquid. A liquid that has a closed-cup flash point at or above 37.8°C (100°F) and below 60°C (140°F). [30, 2015]

3.3.1.2 Class IIIA Liquid. Any Liquid that has a closed-cup flash point at or above 60°C (140°F), but below 93°C (200°F). [30, 2015]

3.3.1.3 Class IIIB Liquid. Any liquid that has a closed-cup flash point at or above 93°C (200°F). [30, 2015]

3.3.2* Concentration. The percent of foam concentrate contained in a foam solution.

3.3.3* Discharge Devices. Devices designed to discharge water or foam-water solution in a predetermined, fixed, or adjustable pattern.

3.3.3.1 Air-Aspirating Discharge Devices. Devices specially designed to aspirate and mix air into the foam solution to generate foam, followed by foam discharge in a specific design pattern.

3.3.3.2 Compressed Air Foam Discharge Devices. Devices specifically designed to discharge compressed air foam in a predetermined pattern.

3.3.3.3* Non-Air-Aspirating Discharge Devices. Devices designed to provide a specific water discharge pattern.

3.3.4 Discharge Outlet.

3.3.4.1 Fixed Foam Discharge Outlet. A device permanently attached to a tank, dike, or other containment structure, designed to introduce foam.

3.3.4.2* Type I Discharge Outlet. An approved discharge outlet that conducts and delivers foam gently onto the liquid surface without submergence of the foam or agitation of the surface.