

NFPA® 18A

Standard on Water Additives for Fire Control and Vapor Mitigation

2011 Edition



NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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NFPA® 18A

Standard on

Water Additives for Fire Control and Vapor Mitigation

2011 Edition

This edition of NFPA 18A, *Standard on Water Additives for Fire Control and Vapor Mitigation*, was prepared by the Technical Committee on Water Additives for Fire Control and Vapor Mitigation. It was issued by the Standards Council on December 14, 2010, with an effective date of January 3, 2011, and supersedes all previous editions.

This edition of NFPA 18A was approved as an American National Standard on January 3, 2011.

Origin and Development of NFPA 18A

In 1998, the NFPA Standards Council approved the formation of the Technical Committee on Water Additives for Fire Control and Vapor Mitigation. The committee was tasked with having primary responsibility for documents on the manufacture, testing, application, and use of water additives for the control and/or suppression of fire and flammable vapor mitigation, including water additives used to prevent or reduce the spread of fire and the use of water additives in fixed, semi-fixed, mobile, and portable fire suppression systems. The standard they were given was NFPA 18, *Wetting Agents*.

Initially, the committee proposed to combine wetting agents and water additives under one standard. This effort was returned to the committee by Association action in June 2003. As a result, the committee decided to divide this work into two subject areas and standards, retaining and revising NFPA 18 and creating a new standard addressing water additives, NFPA 18A, the first edition of which was issued in 2007.

Changes in the 2011 edition include a reorganization of Chapters 5 and 6, clarification of test procedures and criteria, and the removal of secondary (U.S.) units throughout much of the text.



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This list represents the membership at the time the Committee was balloted on the final text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the back of the document.

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 manufacture, testing, application, and use of water additives for the control and/or suppression of fire and flammable vapor mitigation including water additives used to prevent or reduce the spread of fire and the use of water additives in fixed, semi-fixed, mobile, and portable fire suppression systems.



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Standard on

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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 E. 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.

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

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

Chapter 1 Administration

1.1 Scope. This standard provides the minimum requirements for water additives used for the control and/or suppression of Class A and Class B fires and the mitigation of flammable vapors.

1.2 Purpose. This standard is intended for the use and guidance of those responsible for purchasing, testing, listing, and using water additives for use on fires in Class A and Class B fuels.

1.3* Application. This standard applies to water additives utilized in preventing or reducing the spread of fire in Class A and Class B fuels.

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. The primary system of measurement for this standard is the International System of Units (SI). Inch-pound units are provided where necessary and applicable.

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.

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

NFPA 13, *Standard for the Installation of Sprinkler Systems*, 2010 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*, 2010 edition.

NFPA 15, *Standard for Water Spray Fixed Systems for Fire Protection*, 2007 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*, 2011 edition.

NFPA 1901, *Standard for Automotive Fire Apparatus*, 2009 edition.

2.3 Other Publications.

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

ASTM D 92, *Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester*, 2005a.

ASTM D 97, *Standard Test Method for Pour Point of Petroleum Products*, 2002.

ASTM D 1293, *Standard Test Methods for pH of Water*, 1999 (2005).

ASTM D 2196, *Standard Test Methods for Rheological Properties of Non-Newtonian Materials by Rotational (Brookfield type) Viscometer*, 2010.

ASTM D 2240, *Standard Test Method for Rubber Property — Durometer Hardness*, 2005.



ASTM E 729, *Standard Guide for Conducting Acute Toxicity Tests on Test Materials with Fishes, Macroinvertebrates, and Amphibians*, 1996.

ASTM G 1, *Standard Practice for Preparing, Cleaning, and Evaluating Corrosion Test Specimens*, 2003.

ASTM G 31, *Standard Practice for Laboratory Immersion Corrosion Testing of Metals*, 1972 (2004).

2.3.2 ISO Publications. International Organization for Standardization, 1 rue de Varembe, Case postale 56, CH-1211, Genève 20, Switzerland.

ISO/IEC 17025, *General requirements for the competence of testing and calibration laboratories*, 2005.

2.3.3 NACE Publications. NACE International, 1440 South Creek Drive, Houston, TX 77084-4906.

NACE TM0169, *Standard Test Method — Laboratory Corrosion Testing of Metals*, 2000.

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

UL 162, *Foam Equipment and Liquid Concentrates*, 1994, revised 1999.

ANSI/UL 711/CAN/ULC S508, *Rating and Fire Testing of Fire Extinguishers*, 2004, revised 2009.

2.3.5 ULC Publications. Underwriters' Laboratories of Canada, 7 Underwriters Road, Toronto ON M1R 3B4.

CAN/ULC S560, *Category 3 Aqueous Film-Forming Foam (AFFF) Liquid Concentrates*, 2006.

2.3.6 U.S. EPA Publications. Environmental Protection Agency, National Service Center for Environmental Publications (NSCEP), P.O. Box 42419, Cincinnati, OH 45242.

OPPTS 835.3110, *Ready Biodegradability*, Section M, CO₂ Evolution (Modified Sturm) Test, Fate, Transport and Transformation Test Guidelines, January 1998.

OPPTS 850.1075, *Fish Acute Toxicity Test, Freshwater and Marine*, Ecological Effects Test Guidelines, 1996.

OPPTS 870.1100, *Acute Oral Toxicity*, Health Effects Test Guidelines, 1998.

OPPTS 870.1200, *Acute Dermal Toxicity*, Health Effects Test Guidelines, 1998.

OPPTS 870.2400, *Acute Eye Irritation*, Health Effects Test Guidelines, 1998.

OPPTS 870.2500, *Acute Dermal Irritation*, Health Effects Test Guidelines, 1998.

2.3.7 U.S. Government Publications. U.S. Government Printing Office, Washington, DC 20402.

Title 40, Code of Federal Regulations, Part 86.113-94, Air Programs, "Fuel Specifications."

Title 40, Code of Federal Regulations, Part 160, Pesticide Programs, "Good Laboratory Practice."

Title 40, Code of Federal Regulations, Part 792, Toxic Substances Control Act, "Good Laboratory Practice."

2.3.8 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*, 2010 edition.

NFPA 36, *Standard for Solvent Extraction Plants*, 2009 edition.

NFPA 1145, *Guide for the Use of Class A Foams in Manual Structural Fire Fighting*, 2011 edition.

NFPA 1150, *Standard on Foam Chemicals for Fires in Class A Fuels*, 2010 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 Standard. A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

3.3 General Definitions.

3.3.1 Application Rate. Amount of water additive solution applied over a specified period of time.

3.3.2 Biodegradability. A measure of the decomposition of organic matter through the action of microorganisms. [1150, 2010]

3.3.3 Class A Fire. A fire in ordinary combustible materials, such as wood, cloth, paper, rubber, and many plastics. [10, 2010]

3.3.4* Class B Fire. A fire in flammable liquids, combustible liquids, petroleum greases, tars, oils, oil-based paints, solvents, lacquers, alcohols, and flammable gases. [10, 2010]

3.3.5 Combustible Liquid. Any liquid that has a closed-cup flash point at or above 37.8°C.

3.3.6* Concentration. The percent of water additive concentrate contained in a water additive solution.

3.3.7* Demulsification. A process either physical or chemical by which an emulsion is broken down to its original constituents.

3.3.8* Discharge Device. A device designed to discharge water or foam-water solution or water additive solution in a predetermined, fixed, or adjustable pattern.

3.3.9 Eductor (Inductor). A device that uses the Venturi principle to introduce a proportionate quantity of water additive concentrate into a water stream; the pressure at the throat is below atmospheric pressure and will draw in liquid from atmospheric storage.

3.3.10 Emulsification. The process of forming an emulsion. (See also 3.3.12, *Emulsion*.)

3.3.11 Emulsifier. A chemical or mixture of chemicals that along with some energy input promotes the formation of an emulsion.

3.3.12* Emulsion. A heterogeneous system, consisting of at least one immiscible liquid dispersed in another in the form of droplets.

3.3.13* Fixed Monitor (Cannon). A device that delivers a large water additive solution stream and is mounted on a stationary support that either is elevated or is at grade.

3.3.14 Flammable Liquid. A liquid that has a closed-cup flash point that is below 37.8°C and a maximum vapor pressure of 2068 mm Hg at 37.8°C.

3.3.15* Handline. A hose and nozzle that can be held and directed by hand.

3.3.16 Hydrocarbon. A chemical substance consisting of only hydrogen and carbon atoms. [36, 2009]

3.3.17 Indirect Attack. Fire-fighting operations involving the application of extinguishing agents to reduce the buildup of heat released from a fire without applying the agent directly onto the burning fuel. [1145, 2011]

3.3.18 LC₅₀ (Lethal Concentration₅₀). The concentration of agent in water, usually expressed as milligrams of agent in a liter or solution, that results in the death of 50 percent of the aquatic test specimens within a specified time frame. [1150, 2010]

3.3.19 LD₅₀ (Lethal Dosage₅₀). The dosage of a chemical, usually expressed as milligrams of the chemical per kilogram of body weight of the test animal, at which 50 percent of the test animals die within a specified time frame. [1150, 2010]

3.3.20* Micelle. The basic building unit of an emulsion.

3.3.21 Miscibility. The property of being capable of mixing in any ratio without separation into phases. [1150, 2010]

3.3.22 Portable Monitor (Cannon). A device that delivers a large water additive solution stream and is mounted on a movable support or wheels so it can be transported to the fire scene.

3.3.23 Proportioning. The introduction of water additive concentrate at the recommended ratio into the water stream to form a water additive solution.

3.3.24 Surface Active Agent (Surfactant). A chemical agent that materially reduces the surface tension of water.

3.3.25 Surface Tension. The elastic-like force at the surface of a liquid, which tends to minimize the surface area, causing drops to form. [1150, 2010]

3.3.26 Synthetic or Artificial Sea Water. A solution consisting of 1.10 percent magnesium chloride hexahydrate, 0.16 percent calcium chloride dihydrate, 0.40 percent anhydrous sodium sulfate, 2.50 percent sodium chloride, and 95.84 percent deionized or distilled water.

3.3.27 Three-Dimensional Fire. A liquid fuel fire that flows freely from a vertical height, falling on associated equipment or structure down to a static pooled surface fire.

3.3.28* Water Additive. An agent that, when added to water in proper quantities, suppresses, cools, mitigates fire and/or vapors, and/or provides insulating properties for fuels exposed to radiant heat or direct flame impingement.

3.3.29* Water Additive Concentrate. The chemical or chemical composition as received from the manufacturer.

3.3.30* Water Additive Solution. A homogeneous mixture of water and water additive concentrate.

Chapter 4 Uses and Limitations

4.1 General.

4.1.1 Water additive concentrate for fire fighting shall be listed and approved by the authority having jurisdiction.

4.1.2 Water additive concentrate shall be mixed only with water.

4.2 Limitations.

4.2.1 General. The use of water additive solution shall be limited to those applications identified by the manufacturer's listing and Section 4.2.

4.2.2 Water-Reactive Chemicals. Water additive solution shall have the same limitations as water with respect to extinguishing fires involving chemicals that react with water to create additional hazards.

4.2.3 Class B Fires.

4.2.3.1 The use of water additive solution for the extinguishment of fires involving Class B flammable or combustible liquids shall be limited to those fuels not soluble in water.

4.2.3.2* The use of fire extinguishers and fixed fire-extinguishing systems using water additive solution shall not be permitted for the extinguishment of fires in commercial cooking equipment that involve combustible cooking media (vegetable or animal oils and fats) unless specifically listed for this hazard.

4.2.4* Class C Fires. Water additive solution shall have the same limitations as water with respect to extinguishing fires involving energized electrical equipment.

4.2.5* Class D Fires. Water additive solution shall not be used on Class D fires unless specifically listed for that purpose.



4.3* Compatibility of Water Additive Concentrate and Solutions.

4.3.1 Water additive concentrate of different brands and other types of concentrate intended for fire prevention, control, suppression, extinguishment, or vapor mitigation shall not be mixed.

4.3.2 Premixed solution prepared with water additive concentrate of different brands and premixed solution prepared with other types of concentrate intended for fire prevention, control, suppression, extinguishment, or vapor mitigation shall not be mixed within the same storage container.

4.3.3 Solution generated separately with water additive concentrate of different brands shall be permitted to be applied to a fire in sequence or simultaneously.

4.3.4 Solution generated with water additive concentrate and solution generated with other types of concentrate intended for fire prevention, control, suppression, extinguishment, or vapor mitigation shall be permitted to be applied to a fire in sequence or simultaneously if approved by the authority having jurisdiction.

4.4 Concentrations. Water additive solution shall be used only in concentrations specified by their listing.

Chapter 5 Properties and General Test Protocols for Evaluation of Water Additive Concentrate and Solution

5.1 General.

5.1.1 Water additive concentrate and water additive solution prepared at the concentrations specified for use by the manufacturer shall be subjected to the tests in this chapter.

5.1.2 The tests detailed in this chapter shall be conducted by an approved independent laboratory using laboratory practices in accordance with 40 CFR 160 and 40 CFR 792 and calibration competency in accordance with ISO/IEC 17025, or equivalent as applicable.

5.1.3 The information developed in response to the requirements of this chapter shall be reported on the manufacturer's technical data sheet and made available to potential users.

5.2 Toxicity and Environmental Tests.

5.2.1 Mammalian Toxicity.

5.2.1.1 Water additive concentrates and water additive solution prepared at the maximum concentration specified for use by the manufacturer shall be tested in accordance with the following U.S. EPA OPPTS tests or an equivalent test procedure that is recognized by the authority having jurisdiction where the water additive is to be used:

- (1) OPPTS 870.1100, for acute oral toxicity
- (2) OPPTS 870.1200, for acute dermal toxicity
- (3) OPPTS 870.2400, for acute eye irritation
- (4) OPPTS 870.2500, for acute dermal irritation

5.2.1.2* The water additive concentrate and water additive solution prepared at the maximum concentration specified for use by the manufacturer shall not exceed the toxicity limits acceptable to the authority having jurisdiction.

5.2.2 Aquatic Toxicity.

5.2.2.1 Water additive concentrates and water additive solution prepared at the maximum concentration specified for

use by the manufacturer shall be tested, using *Oncorhynchus mykiss* (rainbow trout), in accordance with U.S. EPA OPPTS 850.1075, ASTM E 729, or an equivalent test procedure that is recognized by the authority having jurisdiction where the water additive is to be used.

5.2.2.2 In accordance with ASTM E 729, 10 fish that are 60 days $\pm$ 15 days posthatch shall be exposed under static conditions to each level of a water additive solution in soft water as defined in ASTM E 729 for 96 hours at $12^{\circ}\text{C} \pm 1^{\circ}\text{C}$.

5.2.2.3* The water additive concentrate shall have an LC_{50} acceptable to the authority having jurisdiction when tested in accordance with ASTM E 729 and when measured after 96 hours of static exposure.

5.2.3 Biodegradability.

5.2.3.1* The concentrate shall be readily biodegradable or biodegradable when tested in accordance with 5.2.3.2 through 5.2.3.5.

5.2.3.2 The biodegradability of the concentrate shall be determined in accordance with EPA OPPTS 835.3110 Section M, CO_2 evolution test (modified Sturm test) or equivalent test recognized by the authority having jurisdiction.

5.2.3.3 Testing shall be conducted for a minimum of 28 days and shall be continued until an oxygen depletion plateau is reached.

5.2.3.4 Testing shall be discontinued at the end of 42 days, even if the plateau has not been reached.

5.2.3.5 At least one reference substance shall be used to monitor inoculum activity.

5.3 Physical Properties.

5.3.1 Concentrate Pour Point. The concentrate pour point shall be determined in accordance with ASTM D 97.

5.3.2 Concentrate Miscibility.

5.3.2.1 The concentrate shall be miscible in water and result in a homogenous solution at the concentrations specified for use by the manufacturer. Opalescence shall be considered equivalent to homogeneity.

5.3.2.2 The concentrate miscibility shall be determined in accordance with 5.3.2.2.1 through 5.3.2.2.9.

5.3.2.2.1 The water and the concentrate shall be conditioned to each of the temperature combinations shown in Table 5.3.2.2.1.

Table 5.3.2.2.1 Temperature Combinations of Water Additive Concentrates and Water for Miscibility Testing

Water Additive Temperature	Water Temperature
$^{\circ}\text{C}$	$^{\circ}\text{C}$
4 ± 1	21 ± 1
21 ± 1	21 ± 1
4 ± 1	4 ± 1
21 ± 1	4 ± 1