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NFPA 412
Evaluating Aircraft Rescue and Fire Fighting Foam Equipment
1993 Edition

NFPA

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101

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Policy Adopted by NFPA Board of Directors on December 3, 1982

The Board of Directors reaffirms that the National Fire Protection Association recognizes that the toxicity of the products of combustion is an important factor in the loss of life from fire. NFPA has dealt with that subject in its technical committee documents for many years.

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.

Statement on NFPA Procedures

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NFPA 412

Standard for

Evaluating Aircraft Rescue and Fire Fighting Foam Equipment

1993 Edition

This edition of NFPA 412, *Standard for Evaluating Aircraft Rescue and Fire Fighting Foam Equipment*, was prepared by the Technical Committee on Aircraft Rescue and Fire Fighting and acted on by the National Fire Protection Association, Inc. at its Annual Meeting held May 24-27, 1993, in Orlando, FL. It was issued by the Standards Council on July 23, 1993, with an effective date of August 20, 1993, and supersedes all previous editions.

The 1993 edition of this document has been approved by the American National Standards Institute.

Changes other than editorial are indicated by a vertical rule in the margin of the pages on which they appear. These lines are included as an aid to the user in identifying changes from the previous edition.

Origin and Development of NFPA 412

Work on this material started in 1955 when the NFPA Subcommittee on Aircraft Rescue and Fire Fighting (as then constituted) initiated a study on methods of evaluating aircraft rescue and fire fighting vehicles. A tentative text was adopted by the Association in 1957 and a revised text officially adopted in 1959. Revisions were made in 1960, 1964, 1965, 1969, 1973, and 1974. With the introduction of new types of foam liquid concentrates over the years for this specialized service, the text has been broadened to cover these concentrates.

In 1987 the standard was completely revised to bring it into conformance with the *Manual of Style* and to refine the test methods.

The 1993 edition of the standard establishes a single test method for expansion and drainage for all foams (previously there were two). Additionally, information on using the conductivity meter for determining foam solution concentration was added.

The following task group was appointed to assist in the 1993 revision of this standard:

Task Group on Evaluating Foam Fire Fighting Equipment on Aircraft Rescue and Fire Fighting Vehicles

Joseph L. Scheffey, Chair, Hughes Associates Inc., MD; William M. Carey, Underwriters Laboratories Inc., IL; Robert L. Darwin, Dept. of the Navy — Fire Protection Div., DC; James F. O'Regan, Westboro, MA; John M. Schuster, 3M Company, MN

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Dan Lanzdorf, Oshkosh Truck Corp., WI
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David F. Short, Carmichael Int'l Ltd., England

Mark T. Conroy, NFPA Staff Liaison

This list represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred.

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 the criteria for aircraft rescue and fire fighting services and equipment, procedures for handling aircraft fire emergencies, and for specialized vehicles used to perform these functions at airports with particular emphasis on saving lives and reducing injuries coincident with aircraft fires following impact or aircraft ground fires. The Committee also shall have responsibility for developing aircraft fire investigation procedures as an aid to accident prevention and the saving of lives in future aircraft accidents involving fire.

Contents

NFPA 412

Standard for

Evaluating Aircraft Rescue and Fire Fighting Foam Equipment

1993 Edition

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

Information on referenced publications can be found in Chapter 5.

Chapter 1 Administration

1-1 Scope.

1-1.1 This standard establishes test procedures for evaluating the foam fire fighting equipment installed on rescue and fire fighting vehicles designed in accordance with the applicable portions of NFPA 414, *Standard for Aircraft Rescue and Fire Fighting Vehicles*.

1-2 Purpose.

1-2.1 The tests specified in this standard provide procedures for the evaluation of foam fire fighting equipment in the field to determine compliance with NFPA 414, *Standard for Aircraft Rescue and Fire Fighting Vehicles*, and NFPA 403, *Standard for Aircraft Rescue and Fire Fighting Services at Airports*.

1-3 Definitions.

Foam. An aggregation of small bubbles used to form an air-excluding, vapor-suppressing blanket over the surface of a flammable liquid fuel.

Foam, Alcohol-Resistant. Used for fighting fires involving water soluble materials or fuels that are destructive to other types of foams. Some alcohol-resistant foams may be capable of forming a vapor-suppressing aqueous film on the surface of hydrocarbon fuels.

Foam, Aqueous Film Forming (AFFF). A concentrated aqueous solution of one or more hydrocarbon or fluorochemical surfactants that forms a foam capable of producing a vapor-suppressing aqueous film on the surface of hydrocarbon fuels. The foam produced from AFFF concentrates is dry-chemical compatible and is therefore suitable for use in combination with that agent.

Foam Concentrate. A concentrated liquid foaming agent that is mixed with water and air in designated proportions to form foam.

Foam Drainage Time (Quarter Life). The time in minutes that it takes for 25 percent of the total liquid contained in the foam sample to drain out from the foam.

Foam Expansion. The ratio between the volume of foam produced and the volume of solution used in its production.

Foam, Film Forming Fluoroprotein (FFFP). A protein-based foam concentrate incorporating fluorinated surfactants that forms a foam capable of producing a vapor-suppressing aqueous film on the surface of hydrocarbon fuels. This foam may show an acceptable level of compatibility with dry chemicals, and may be suitable for use with those agents.

Foam, Fluoroprotein (FP). A protein-based foam concentrate, with added fluorochemical surfactants, that forms a foam showing a measurable degree of compatibility with dry chemical extinguishing agents and an increase in tolerance to contamination by fuel.

Foam Pattern. The ground area over which foam is distributed during the discharge of a foam-making device.

Foam, Protein (P). A protein-based foam concentrate that is stabilized with metal salts to make a fire-resistant foam blanket.

Foam Solution. The solution that results when foam concentrate and water are mixed in designated proportions prior to aerating to form foam.

Foam Stability. The degree to which a foam resists spontaneous collapse or degradation caused by external influences such as heat or chemical action.

Foam Weep. That portion of foam that is separated from the principal foam stream during discharge and falls at short range.

Heat Resistance. The property of a foam to withstand exposure to high heat fluxes without loss of stability.

Shall. Indicates a mandatory requirement.

Should. This term, as used in the Appendix, indicates a recommendation or that which is advised but not required.

Chapter 2 Rescue and Fire Fighting Vehicle Foam Production Performance Testing

2-1 Foam and Foam System Tests.

2-1.1 The expansion and 25 percent drainage time are the foam characteristics that shall be determined. Additionally, the foam concentration shall be determined, both as a test of the vehicle proportioning system, and to establish the legitimacy of the expansion and drainage data obtained. Foam distribution patterns shall be determined for use in calculating the area of fire that the vehicle is capable of controlling.

2-2 Turret Nozzles.

2-2.1 The foam distribution patterns shall meet the requirements of 2-15.6.3 for major RFF vehicles, 3-13.9.3 for rapid intervention vehicles, and 4-13.9.3 for combined agent vehicles of NFPA 414, *Standard for Aircraft Rescue and Fire Fighting Vehicles*, when tested as specified in Section 4-1 of this standard.

2-2.2 Foam samples shall be obtained by the methods given in 4-3.1.2 of this standard.

2-2.3 Foam samples shall be analyzed for expansion and drainage time using the method specified in Section 3-1 of this standard.

2-2.4 Foam samples shall be analyzed for concentration as specified in Section 3-2 of this standard.

2-3 Ground Sweep Nozzles.

2-3.1 The foam distribution patterns shall meet the requirements of 2-15.8.1 of NFPA 414, *Standard for Aircraft Rescue and Fire Fighting Vehicles*, when tested as specified in Section 4-2 of this standard.

2-3.2 Foam samples shall be obtained by the methods given in 4-3.1.2 of this standard.

2-3.3 Foam samples shall be analyzed for expansion and drainage time using the method specified in Section 3-1 of this standard.

2-3.4 Foam samples shall be analyzed for concentration as specified in Section 3-2 of this standard.

2-4 Hand Line Nozzles.

2-4.1 The foam distribution patterns shall meet the requirements of 2-15.7.3.3 for major RFF vehicles, 3-13.10.2.3 for rapid intervention vehicles, and 4-13.10.2.3 for combined agent vehicles of NFPA 414, *Standard for Aircraft Rescue and Fire Fighting Vehicles*, when tested as specified in Section 4-2 of this standard.

2-4.2 Foam samples shall be obtained by the methods given in 4-3.1.2 of this standard.

2-4.3 Foam samples shall be analyzed for expansion and drainage time using the method specified in Section 3-1 of this standard.

2-4.4 Foam samples shall be analyzed for concentration as specified in Section 3-2 of this standard.

2-5 Undertruck Nozzles.

2-5.1 The foam distribution pattern shall provide protection for the area beneath the vehicle.

2-5.2 Foam samples shall be collected and analyzed for concentration as specified in Section 3-2 of this standard.

Chapter 3 Performance Criteria

3-1 Expansion Ratio and Drainage Time Requirements. Foams shall be tested as specified in 4-3.2 of this standard and shall meet at least the performance requirements specified in Table 3-1 of this chapter.

3-2 Foam Solution Concentration.

3-2.1 Foam solution concentration shall be tested in accordance with Section 4-4 of this standard.

Table 3-1 Foam Quality Requirements

Foam Agents	Minimum Expansion Ratio	Minimum Solution 25% Drainage Time in Minutes
AFFF		
Air-Aspirated	5:1	2.25
FFFP		
Air-Aspirated	5:1	2.25
AFFF Non-		
Air-Aspirated	3:1	0.75
FFFP Non-		
Air-Aspirated	3:1	0.75
Protein	8:1	10
Fluoroprotein	6:1	10

3-2.2* For nominal 6 percent concentrates, the concentration shall be between 5.5 and 7.0 percent for turret and ground sweep nozzles, and between 5.5 and 8.0 percent for hand line and undertruck nozzles.

3-2.3 For nominal 3 percent concentrates, the concentration shall be between 2.8 and 3.5 percent for turret and ground sweep nozzles, and between 2.8 and 4.0 percent for hand line and undertruck nozzles.

Chapter 4 Test Methods and Calculations

4-1 Turret Ground Pattern Test.

4-1.1 Prior to the start of the tests, the water tank shall be full, the foam concentrate tank shall be full with the type of foam concentrate to be used during the actual emergencies, and the proportioner shall be set for normal fire fighting operation. For premixed systems, the tank shall be full with the premixed solution in the correct proportion for normal fire fighting operations.

4-1.2* Discharge tests shall be conducted to establish the fire fighting foam discharge patterns produced and the maximum range attainable by the turret nozzle. The test shall be conducted under wind conditions of 5 mph or less. To determine maximum discharge range, the turret nozzles shall be tilted upward to form a 30-degree angle with the horizontal.

4-1.3 Foam shall be discharged onto a paved surface for a period of 30 seconds at the specified pressure, in both the straight stream and fully dispersed nozzle settings. Immediately after foam discharge has stopped, markers shall be placed around the outside perimeter to preserve the identity of the foam pattern as it fell on the ground. For purposes of defining the edge of the pattern, any foam of less than $1/2$ inch in depth shall be disregarded. Distances between markers shall be plotted on graph paper. The vertical axis shall show the reach, and the horizontal axis shall show the pattern width for each nozzle setting. The distance from the nozzle to the end of the effective foam pattern shall be measured and plotted on the graph paper.

4-2 Ground Sweep and Hand Line Nozzle Tests.

4-2.1 Ground sweep nozzles and hand line foam nozzles shall be discharged onto a paved surface for a period of 30 seconds.

4-2.2 Ground sweep nozzles shall be discharged from their fixed positions.

4-2.3 Hand line nozzles shall be held at their normal working height and tilted upward to form a 30-degree angle with the horizontal.

4-2.4 Markers shall be set out to denote the outline of the effective foam pattern and plotted, as described under the turret test in 4-1.3.

4-2.5 Patterns from both the straight stream and the fully dispersed nozzle settings shall be established, measured, and recorded.

4-3 Foam Tests.

4-3.1 General Requirements for All Test Methods.

4-3.1.1 The tests shall be conducted with the temperature of the water or foam solution in the range of 60°–80°F (16°–27°C).

4-3.1.2 The following corrections shall be applied to protective foams:

Expansion: If the solution temperature is higher than 70°F, no correction shall apply. If the temperature is lower than 70°F, 0.1 unit of expansion shall be added for each 3°F below 70°F.

Drainage Time: If the solution temperature is higher than 70°F, 0.1 minute shall be added for each 3°F above 70°F. If the solution temperature is lower than 70°F, 0.1 minute shall be subtracted for each 3°F lower than 70°F.

4-3.1.3 Foam samples selected for analysis shall be representative of the foam produced by the nozzle as it would be applied onto the fire hazard. This shall be accomplished by placing a foam sample collector in the center of the ground pattern as determined in the nozzle pattern test.

4-3.2 Test Method.

4-3.2.1 Foam Sampling Apparatus.

4-3.2.1.1 The object is to obtain a sample of foam that is typical of that to be applied to the burning fuel surface under anticipated fire conditions. The foam collector shall be constructed as specified in Figure 4-3.2.1.1.

4-3.2.1.2 The foam sample shall be collected in a cylindrical 1600-ml container. The foam sample container shall be constructed as specified in Figure 4-3.2.1.2.

4-3.2.2 Test Procedure.

4-3.2.2.1 The empty weight of the foam sample container shall be recorded to the nearest gram on a balance having a maximum capacity sufficient to weigh the foam sample container, on a suitable support, and the foam sample. The foam sample collector shall then be located in the center of the discharge pattern determined in Section 4-1 of this standard. The foam sample container shall be positioned at the bottom of the foam collector so that the foam hitting the collector will flow into the container. The foam nozzle shall be aimed off the side of the foam collector, adjusted to its normal operating pressure, and then moved so as to discharge foam onto the foam sample collector. As soon as the foam sample container has been completely filled with foam, the discharge nozzle shall be shut off and the timing of the 25 percent drainage started.

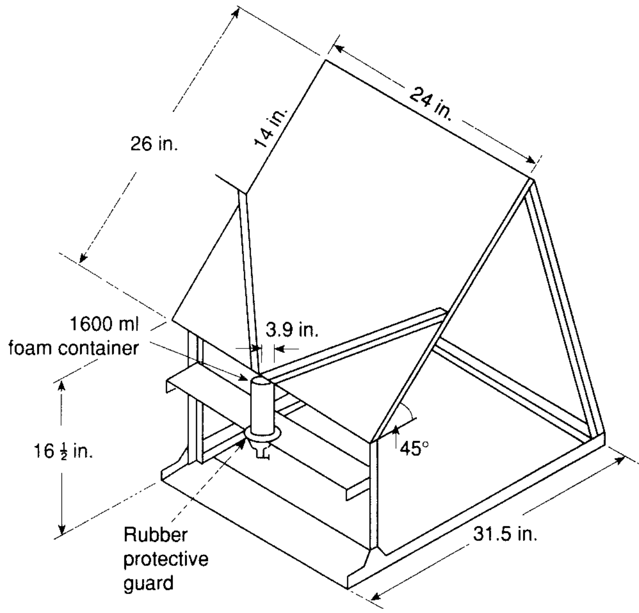


Figure 4-3.2.1.1 Foam sample collector.

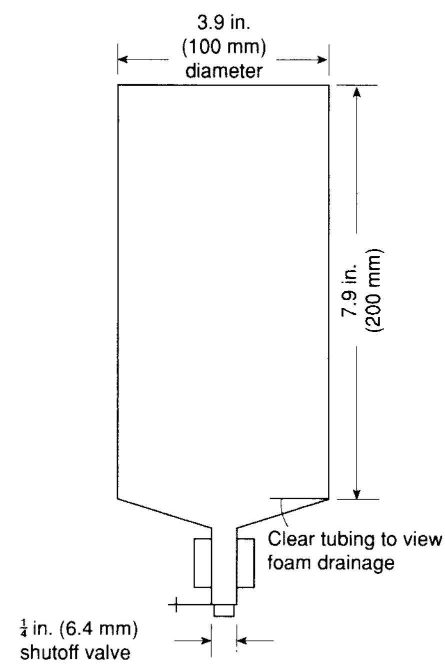


Figure 4-3.2.1.2 1600-ml foam sample container.

4-3.2.2.2 The foam sample container shall be removed from the base of the foam collector, excess foam struck off the top of the foam container using a straight edge, and any remaining foam wiped from the outside surface of the container. The container shall then be placed on the balance. The total weight of the foam sample and container shall be determined to the nearest gram. The weight of the foam sample in the container shall be determined by subtracting the weight of the empty container from the weight of the container filled with the foam. The weight of the foam sample in grams shall be divided by four to obtain the equivalent 25 percent drainage volume in milliliters.

4-3.2.2.3 The foam sample container shall then be placed on a suitable support and a graduated cylinder placed below the drain spout. At 30-second intervals, the accumulated solution in the bottom of the foam sample container shall be drawn off into a graduated cylinder and the amount recorded. If the expected expansion ratio is more than 5:1, then a 100-ml graduated cylinder shall be used to collect the drainage, and if the expected expansion ratio is 5:1 or less, then a 250-ml graduated cylinder shall be used.

4-3.2.2.4* Foam samples shall be weighed to the nearest gram. The expansion of the foam shall be calculated by the following equation:

$$\text{Expansion: } = \frac{1600 \text{ ml}}{\text{full weight minus empty weight in grams}}$$

4-4 Foam Solution Concentration Determination.

4-4.1* A hand-held refractometer or conductivity meter shall be used to measure the refractive index or conductivity of the solution, from which the solution concentration may be calculated. Special care shall be taken when determining the concentration of AFFFs by means of refractive index due to the very low refractive index exhibited by these products.

4-4.2 A calibration curve shall be prepared using the following apparatus:

(a) three 100-ml graduates

(b) one measuring pipette (10-ml capacity)

(c) one 100-ml beaker

(d) one 500-ml beaker.

(e)* one hand-held refractometer — American Optical Co. Model No. 10430 or equivalent; or one hand-held conductivity meter — Omega Model CDH-70 or equivalent.

4-4.3* Using water and foam concentrate from the tanks of the vehicle to be tested, three standard solutions shall be made up by pipetting into three 100-ml graduated cylinders, volumes of foam concentrate in milliliters equal to:

(a) the nominal concentration of the foam concentrate

(b) $1/3$ more than the nominal concentration

(c) $1/3$ less than the nominal concentration.

The graduated cylinders shall then be filled to the 100-ml mark with the water. After thoroughly mixing, a refractive index reading shall be taken of each standard by placing a few drops of the solution on the refractometer prism, closing the cover plate, and observing the scale reading at the dark field intersection. Or, if using conductivity, the probe shall be dipped into the solution and the digital scale read. A plot shall be made on graph paper of the scale reading against the known foam solution concentrates and shall serve as a calibration curve for this particular series of foam tests.

4-4.4* Portions of solution drained out during the previously described drainage test shall be used as a source of test sample for the concentration determination. Refractive index or conductivity readings of the unknown shall be compared to the calibration curve and the corresponding foam solution concentration read from the graph.

4-5 Report of Results of Tests.

4-5.1* All test reports shall include a statement of the operating conditions, such as pressures, temperatures, wind velocities and direction in relation to vehicle position, and a full description of the materials and equipment used.

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 the current edition as of the date of the NFPA issuance of this document.

5-1.1 NFPA Publications. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 403, *Standard for Aircraft Rescue and Fire Fighting Services at Airports*, 1993 edition.

NFPA 414, *Standard for Aircraft Rescue and Fire Fighting Vehicles*, 1990 edition.

Appendix A Explanatory Material

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

A-3-2.2 The amount of foam concentrate in the solution fed to the foam maker plays an important part, not only in the making of foam with the proper expansion and drainage rate, but also in making a fire-resistant foam. Therefore, it is essential that correct proportioning is maintained and that the concentration meets the required level even if the foam meets the minimum expansion and drainage time values at other levels of concentration.

A-4-1.2 See Figure A-4-1.2 on the following page.

A-4-3.2.2.4 The following shows the calculation of expansion. The net weight of the foam sample (see drainage example) is assumed to be 200 g; therefore, the volume of foam solution contained in the 1600 ml foam sample is 200 ml.

$$\text{Expansion: } = \frac{\text{volume of foam}}{\text{volume of solution}} = \frac{1600 \text{ ml}}{200 \text{ ml}} = 8$$

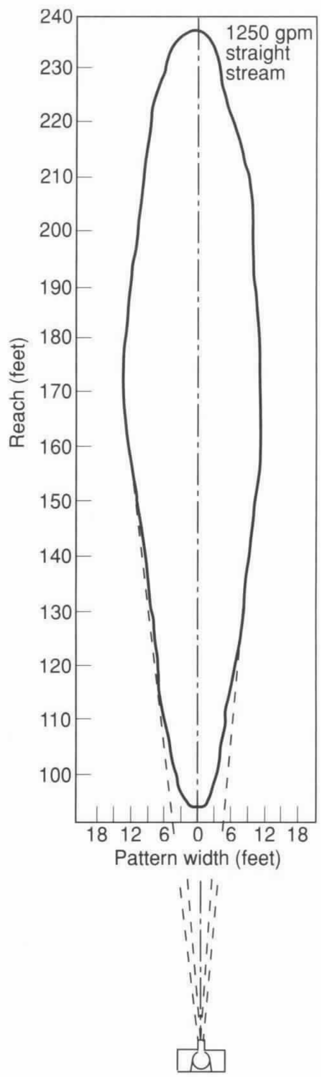


Figure A-4-1.2 Typical foam discharge pattern.

A-4-4.1 The conductivity method is not recommended where seawater is used for making foam solution.

When the conductivity method is used and samples are to be stored and analyzed at some time other than during testing, clean glass containers should be used to store the samples.

Storage of solution in other types of containers (metal, low density polyethylene) may affect the conductivity reading over a period of time.

Care should be taken that conductivity measurements are made when the water and foam solution are at the same temperature. Small differences in temperature may substantially change conductivity measurements.

The recommended meter automatically compensates for different temperatures. If other meters are used, the instructions for the conductivity meter calibration and temperature compensation should be carefully followed.

A-4-4.2 (e) ATAGO Co. Ltd. Model No. N10, AO Model No. 10441, or equivalent showing 0-10 on the BRIX scale is recommended to enable low readings given by AFFF solutions to be read easily.

A-4-4.3 See Figures A-4-4.3(a), A-4-4.3(b), and A-4-4.3(c).

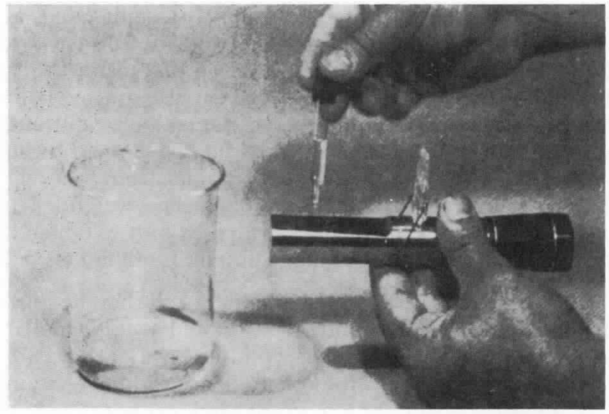


Figure A-4-4.3(a) The index of refraction is measured by placing a few drops of the solution to be tested on the prism of a refractometer and closing the cover plate. This is a typical refractometer suitable for this purpose.

Figure A-4-4.3(b) When this type refractometer is held up to a light source, a reading is taken where the dark field intersects the numbered scale.

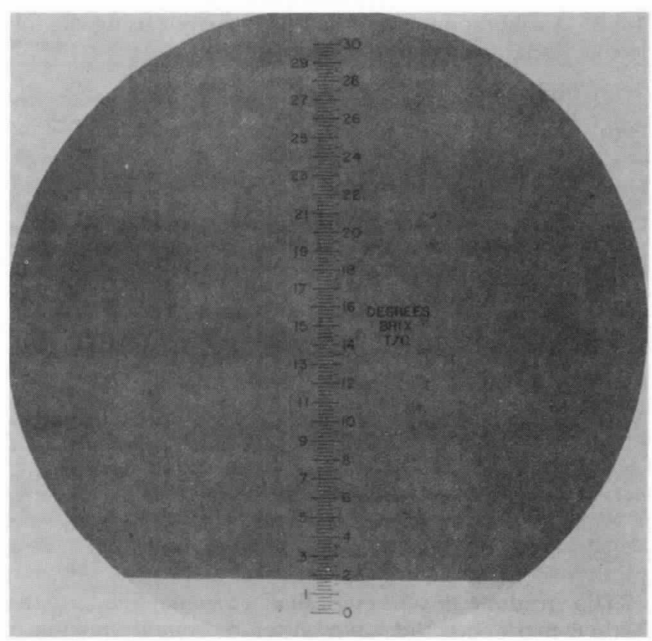


Figure A-4-4.3(c) This illustrates the field of view looking into the refractometer illustrated in Figures A-4-4.3 (a) and A-4-4.3 (b) containing a 6 percent AFFF solution. The dark intersects the scale at 1.7 and this value is recorded as the reading for a 6 percent concentration

A-4-4.4 Because of the high sensitivity of the conductivity meter, it is necessary to collect a larger sample of drainage before making the determination. This will allow for the variation in conductivity of the drained liquid caused by small changes in the chemical composition of AFFF solution as it drains out over a period of time.

A-4-5.1 Foam Physical Property Tests Work Sheets

FOAM PHYSICAL PROPERTY TESTS WORK SHEET
(In accordance with NFPA 412)

DATE: ....

TEST NO: ....

LOCATION: ....

TEST SUBJECT: ....

....

....

VEHICLE: ....

TYPE FOAM LIQUID CONCENTRATE: ....

FOAM MAKER: .... PATTERN SETTING: ....

OPERATING PRESSURE: .... psi AT PUMP, NOZZLE

FLOW: .... gpm

AIR TEMP: .... °F WATER TEMP: ....°F

WIND: ....mph DIRECTION RELATIVE TO PATTERN AXIS: ......

Gross weight of full foam container* .... grams

Weight of empty container .... grams

Net weight of foam sample .... grams

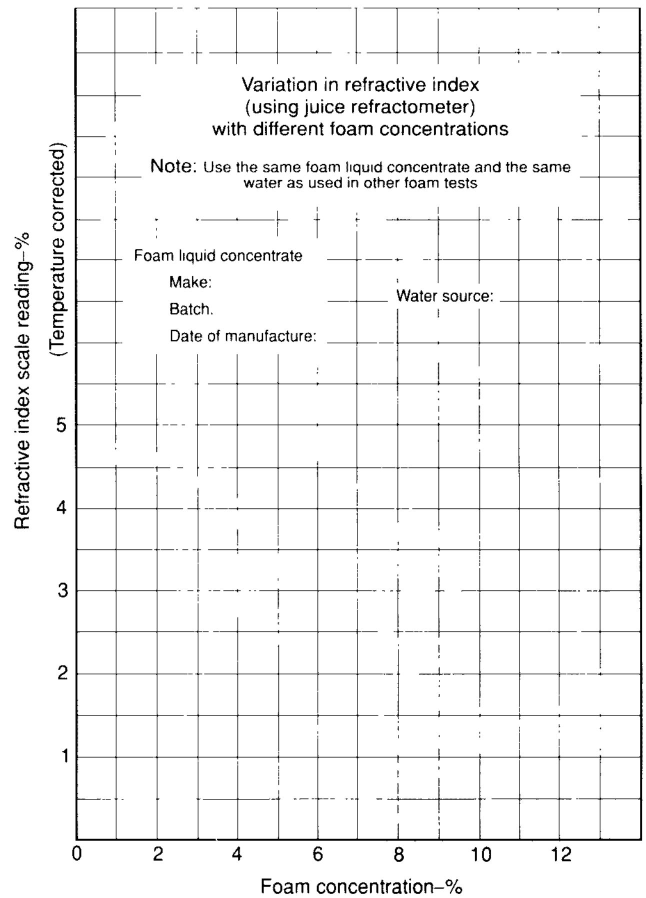
*Foam container must have the dimensions as specified in NFPA 412.

Foam expansion = $\frac{\text{Volume of foam container}}{\text{Net weight of foam sample}}$

= $\frac{\text{.......... ml}}{\text{....... grams (from above)}}$ = ...

25% volume = $\frac{\text{Net weight of foam sample}}{4}$

= $\frac{\text{.......... grams (from above)}}{4}$ = ... milliliters



Appendix B

This Appendix is not a part of the requirements of this NFPA document, but is included for information purposes only.

B-1 Foam Extinguishing System Capability.

B-1.1 The following is a suggested method for evaluating the basic extinguishing capability of the foam fire fighting system.

B-1.2 Basic Extinguishing Capability.

B-1.2.1 Foam performance is judged on two criteria: (1) ability for quick knockdown of flames, and (2) ability to keep fuel area secure against re-ignition. To obtain meaningful information, it is necessary that the foam be applied at low rates per square foot of fuel surface. This will represent the performance to be expected when the system is pushed to its ultimate capability on a large fire. High application rates will overwhelm the fire and obscure any possible shortcomings. Fire tests sufficiently large to challenge the foam equipment are very costly and difficult to conduct without creating undue environmental problems. Therefore, an attempt is made in this standard to devise a restricted but still significant procedure.

B-1.2.2 A foam vehicle user might utilize the basic test procedure in several ways. For example, it might be desired to establish the minimum rate of foam application at which a fire can be extinguished. By using this rate and the time for extinguishment, the volume of water required to extinguish one unit fire area (square foot or square meter), and the maximum fire area the vehicle is capable of extinguishing, can be calculated. It should be kept in mind, however, that the most efficient use of water lends to long extinguishing times. In practice, a high application rate is required because it gives the most rapid knockdown of flame, although it will be less efficient in terms of agent consumed. Operation of the turret to achieve complete extinguishment also wastes water. Generally, after the fire has been 90 percent extinguished, it is better to shut down the turret and complete the extinguishment by application of foam from handlines or by the application of one of the complementary agents.

B-1.2.3 A user might desire to compare the system used on two different fuels or under several different weather conditions such as high winds, heavy rain, or extreme low temperatures, or with obstacles within the fire area. In this type of testing, care must be taken to change only one variable at a time. All other conditions must remain the same.

B-1.2.4 A user might desire to check the foam used against its "as purchased" condition. Here the tests must be conducted under the same conditions as those prevailing during the original tests.

B-1.3 Turret or Hand Line Extinguishing Tests.

B-1.3.1 The exact size of the fire to be used is not critical; however, it should be not less than 100 ft^2 (10 ft × 10 ft) in area. Large-scale testing has shown that larger fire areas do not necessarily require higher application rates or greater quantities of agent (foam) per unit area.

B-1.3.2 The choice of fuel is optional depending on the data desired. Gasolines are normally the most difficult fuels to extinguish, a Jet A (JP-5) the easiest. Jet B (JP-4) is a variable fuel without a definitive flash point.

B-1.3.3 Water may be used to level a large pit to ensure a level fuel area, and bare ground should be presoaked to prevent the loss of fuel. The amount of fuel to be used is partially dependent on the length of preburn to be allowed. With preburn times of 1 min, at least 1 gal of fuel for each 2 ft^2 of area should be used.

B-1.3.4 Local clean air regulations might dictate the length of preburn as this is the period of greatest smoke generation.

B-1.3.5 Establishing and maintaining the desired rate of foam application will require some work and practice prior to the conducting of the fire test. The object is to sweep the turret or nozzle back and forth over the fire area at an even rate in order to apply the foam at the desired gallons per minute (gpm) per square foot.

B-1.3.6 The actual rate is checked by placing 1 ft^2 (or other known convenient size of known area) shallow pans near the edges of the fire area. After the foam discharge pattern has been swept back and forth over the fire area and pans for a measured period of time, the stream is shut off, the weight of the contents of each pan determined, and the application rate calculated. If the rate was too high, a faster rate and wider angle of sweep will be required and vice versa. Once the proper technique has been worked out, the fire is extinguished in the same manner. The pans can be used during the fire test to verify the application rate. NFPA 403 requires a rate of 0.13 gpm per square foot for AFFF, 0.20 gpm per square foot for protein foam, and 0.18 gpm per square foot for fluoroprotein foam.

B-1.3.7 The following calculations are typical of those used in the determination of the basic extinguishing capability of an aircraft rescue and fire fighting vehicle of 1000 gal water capacity:

Gross weight of pan with collected foam	412 oz
Empty weight of pan	350
Net weight of foam sample	62 oz

$$\text{Water collected} = \frac{\text{foam wt. oz}}{133.3} = \frac{62}{133.3} = 0.465 \text{ gallons}$$

$$\text{Total water applied} = \frac{\text{water collected, gal}}{\text{area of pan, ft}^2} = \frac{0.465}{3.5}$$

$$= 0.133 \text{ gal/ft}^2$$

$$\text{Basic extinguishing capability} = \frac{1000 \text{ gal}}{0.133 \text{ gal/ft}^2}$$

$$= 7600 \text{ ft}^2/1000 \text{ gal water}$$

B-1.4 Burnback Test.

B-1.4.1 The resistance of the foam blanket to the fire is important. Wind plays a big role in the determination of this property and repeat results are difficult to obtain with an outdoor test. Another factor, but one easier to control, is the size of the fire area at the start of re-ignition. To standardize this, a short section of stovepipe 12 in. in diameter is dropped into the foam blanket like a cookie cutter. The foam is removed from the inside, and the fuel surface is ignited and allowed to burn for one minute before the stovepipe is removed. The rate of enlargement of the fire is then observed. A long period of confinement is desired. The delay period after end of foam application and start of re-ignition may be varied, but for comparative tests, it must be kept constant.

B-1.4.2 Burnback resistance is related to the amount of foam that has been applied to the fire. A burnback test on a fire area that has been extinguished with a minimum application of foam will not afford a high level of protection.

B-1.4.3 To compare the degree of burnback protection of different agents and depths of foam, and to familiarize crew with the degree of protection afforded, repeated tests using varied delays between end of foam application and start of re-ignition are suggested.

Appendix C Referenced Publications

C-1 The following documents or portions thereof are referenced within this standard for informational purposes only and thus are not considered part of the requirements of this document. The edition indicated for each reference is the current edition as of the date of the NFPA issuance of this document.

C-1.1 NFPA Publication. National Fire Protection Association, 1 Batterymarch Park, P.O. Box 9101, Quincy, MA 02269-9101.

NFPA 403, *Standard for Aircraft Rescue and Fire Fighting Services at Airports*, 1993 edition.

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SUBMITTING PROPOSALS ON NFPA TECHNICAL COMMITTEE DOCUMENTS

Contact NFPA Standards Administration for final date for receipt of proposals on a specific document.

INSTRUCTIONS

Please use the forms which follow for submitting proposed amendments. Use a separate form for each proposal.

1. For each document on which you are proposing amendment indicate:
   (a) The number and title of the document
   (b) The specific section or paragraph.

2. Check the box indicating whether or not this proposal recommends new text, revised text, or to delete text.

3. In the space identified as "Proposal" include the wording you propose as new or revised text, or indicate if you wish to delete text.

4. In the space titled "Statement of Problem and Substantiation for Proposal" state the problem which will be resolved by your recommendation and give the specific reason for your proposal including copies of tests, research papers, fire experience, etc. If a statement is more than 200 words in length, the technical committee is authorized to abstract it for the Technical Committee Report.

5. Check the box indicating whether or not this proposal is original material, and if it is not, indicate source.

6. If supplementary material (photographs, diagrams, reports, etc.) is included, you may be required to submit sufficient copies for all members and alternates of the technical committee.

NOTE: The NFPA Regulations Governing Committee Projects in Paragraph 10-10 state: Each proposal shall be submitted to the Council Secretary and shall include:

(a) identification of the submitter and his affiliation (Committee, organization, company) where appropriate, and

(b) identification of the document, paragraph of the document to which the proposal is directed, and

(c) a statement of the problem and substantiation for the proposal, and

(d) proposed text of proposal, including the wording to be added, revised (and how revised), or deleted.