U.S. DEPARTMENT OF AGRICULTURE
FOREST SERVICE

SPECIFICATION 5100-307b

SPECIFICATION FOR FIRE SUPPRESSANT FOAM FOR WILDLAND FIREFIGHTING

CLASS A FOAM

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FIRE SUPPRESSANT FOAM FOR WILDLAND FIREFIGHTING

(CLASS A FOAM)

1. SCOPE AND CLASSIFICATION.

1.1. Scope. The fire suppressant foams described in this specification are for use in wildland fire management. They may be applied from aerial or ground application equipment, directly to the fire area to slow or stop combustion.

Fire suppressant foams depend on the water that they contain to be effective and when that water has evaporated, they are no longer effective.

The foam concentrate shall be added to water to create a solution which can be used as a wetting agent or when aerated creates foam. The foam bubbles and the solution draining from them attach to and penetrate ordinary combustible materials, such as wood, due to the reduced surface tension of the water contained in the foam solution. The bubbles hold moisture and release it as the foam breaks down, prolonging the time the moisture may be absorbed by the fuels. The foam tends to cling to horizontal and vertical fuels excluding air from the fuel, enveloping the volatile combustible vapor and the fuel interface when applied in adequate quantities, and resisting disruption due to wind, heat, and flame.

Higher amounts of concentrate in the foam solution produce drier, slower draining foam for exposure (vertical surface) protection. Moderate amounts produce wetting, faster draining foam for vegetation (horizontal surface) application. Low amounts can be used to make wet water having enhanced penetration for mop up.

A wide range of foam characteristics can be prepared from the same concentrate by changing the mix ratio and adjusting the foam generation and application method used.

1.1.1. Foam Product Types Covered by This Specification. All Class A fire suppressant foams and wetting agents are covered by this specification. Wetting agents that do not produce foam do not meet the requirements of this specification.

1.2. Classification. The submitter shall specify the classifications of the wildland fire chemical product, according to the following sections, for which qualification is sought. These classifications determine the specific tests to be performed and performance required.

1.2.1. Form of Concentrate. All foam concentrates shall be wet concentrates. Products shall be one component, i.e., foam solutions shall be prepared by blending a single concentrate

with water. For use during fire management operations, the foam concentrates shall be added to water to make 0.1-percent to 1.0-percent solutions and aerated to produce foam.

1.2.2. Storability.

1.2.2.1. Concentrates shall be classified and evaluated as storable products.

1.2.2.2. Mixed Products shall be classified and evaluated as not storable.

1.2.3. Application Methods. Each mixed product shall be classified based on the listed application methods.

HF	Helicopters having a fixed tank, either internal or external in direct contact with the helicopter.
FW/Multi-Engine	Fixed-wing (all delivery systems) land-based, multi-engine aircraft having a tank and delivery system for aerial application of wildland fire chemicals.
FW/Single-Engine	Fixed-wing (all delivery systems) land-based, single-engine (SEAT) aircraft having a tank and delivery system for aerial application of wildland fire chemicals.
FW/WS	Fixed-wing (all delivery systems) water-scooping aircraft having a tank and delivery system for aerial application of wildland fire chemicals.
HB/G	Helicopters having a bucket suspended below the helicopter such that no chemical is likely to contact the helicopter during normal fire operations and all ground-based application equipment, such as wildland engines, portable pumps, and other such devices.

2. APPLICABLE DOCUMENTS.

2.1. Order of Precedence. In the event of conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, shall supersede applicable laws and regulations unless a specific exemption has been obtained.

2.2. United States Government Documents. The specifications, standards, and handbooks referenced form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents in effect on the date of the invitation for bids or request for proposals shall apply.

2.2.1. Code of Federal Regulations (CFR). The text of the Codes of Federal Regulation is available at https://www.govinfo.gov/help/cfr

2.2.2. U.S. Department of Agriculture (USDA), Forest Service, National Technology and Development Program (NTDP-Missoula).

Manufacturer Submission Procedures for Qualification Testing of Class A Foam Products. Available at https://www.fs.fed.us/rm/fire/wfcs/submit.htm

Standard Test Methods for the Evaluation of Wildland Fire Chemical Products, version in effect on the date of submission for evaluation. Available at www.fs.fed.us/rm/fire/wfcs/tests/index.htm

USDA Forest Service Handbook (FSH) 5109.16, Zero Code – Fire Management Equipment, Supplies and Chemicals. Available at https://www.fs.fed.us/cgi-bin/Directives/get_dirs/fsh?5109.16

2.2.2.1. Paper copies of the submission documents can be obtained from the Program Leader or Project Leader, Wildland Fire Chemical Systems (WFCS), 5785 Highway 10 West, Missoula, MT, 59808, if web access is not available.

2.2.3. U.S. Department of Agriculture (USDA) and U.S. Department of Interior (DOI).

Interagency Standards for Fire and Fire Aviation Operation. Department of Agriculture, Forest Service, and Department of the Interior Agencies: Bureau of Land Management, National Park Service, and U.S. Fish and Wildlife Service. Available at https://www.nifc.gov/policies/pol_ref_redbook.html

2.2.4. U.S. Environmental Protection Agency (EPA), Office of Chemical Safety and Pollution Prevention (OCSPP).

EPA documents can be obtained from the web site at https://www.epa.gov/aboutepa/about-office-chemical-safety-and-pollution-prevention-ocspp

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

2.2.5. United States Department of Health and Human Services.

National Toxicology Program: Report on Carcinogens is available at https://ntp.niehs.nih.gov/

2.2.6. International Agency for Research on Cancer (IARC).

IARC Monographs of Carcinogens are available at https://monographs.iarc.fr/

2.2.7. Federal Standards.

Federal Standards can be obtained from https://www.gsa.gov/acquisition/purchasing-programs/requisition-programs/gsa-global-supply/supply-standards/index-of-federal-specifications-standards-and-commercial-item-descriptions

2.2.8. Military Specifications.

Military Specification can be obtained from http://www.dsp.dla.mil/

2.2.9. Freedom of Information Act (FOIA).

The Forest Service FOIA information can be found at http://www.fs.fed.us/im/foia/

2.3. Other Publications. The following publications of the issue in effect on the date of the specification acceptance form a part of this specification.

2.3.1. American Society for Testing and Material (ASTM).

Copies of ASTM publications can be obtained on the web at http://astm.org or by mail from ASTM, 100 Barr Harbor Drive, West Conshohocken, PA 19428-2959.

2.3.2. National Association of Corrosion Engineers International (NACE).

Copies of NACE publications can be obtained at https://nace.org/home.aspx

By mail from NACE International, 15835 Park Ten Pl, Houston, TX 77084.

2.3.3. Society of Automotive Engineers, Inc. (SAE).

2.3.4. Copies of SAE publication can be obtained on the web at https://www.sae.org/ or by mail from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001.

3. REQUIREMENTS.

3.1. Wildland Fire Chemical Product Qualification Testing. Qualification testing for wildland fire chemical products shall be performed prior to use (Forest Service Handbook (FSH) 5109.16, Zero Code). Testing shall include a laboratory evaluation and may include a field evaluation during firefighting operations.

3.1.1. Additional Testing at the Discretion of the Forest Service. Additional tests not specified in this document may be required at the discretion of the Forest Service when information provided in the product information or otherwise known to the Forest Service suggests a need.

The submitter shall be informed, before any additional testing is performed, of the specific tests to be performed and the reason for the tests.

3.2. Manufacturer Submission Process. The submitter (manufacturer, distributor, or supplier) shall make a request for evaluation to the USDA Forest Service, Branch Chief for Fire Equipment and Chemicals.

3.3. Product Information. All product information described below shall be provided to the Forest Service and reviewed by the designated agency representative, as summarized in 3.4.2.1 and described in "Manufacturer Submission Procedures for Qualification Testing of Class A Foam Products," prior to acceptance of samples for testing.

3.3.1. Formulation Disclosure Sheet. The submitter shall submit a Formulation Disclosure Sheet (Form number FS 5100-35) including the required information on all ingredients contained in the formulation.

Full disclosure of the types and amounts of each chemical in the product, the Chemical Abstract Services (CAS) number, quality or grade, and manufacturer or source shall be included for each ingredient.

The manufacturing process, manufacturing site, and other related information about each ingredient and for the product shall also be provided.

3.3.2. Mix Ratio Range. The Class A foam product shall be evaluated over the range of mix ratios from 0.1 percent to 1.0 percent, by volume.

3.3.3. Health and Safety Information. The submitter shall submit the following safety information to the Government for review, prior to shipping the product for testing.

Safety Data Sheet (SDS) for the concentrated product as supplied by the manufacturer.

- SDS for each ingredient of the proposed product from the manufacturer/supplier shown on the formulation disclosure sheet.
- SDS for the proposed product from the manufacturer/supplier shown on the formulation disclosure sheet.

Summary of any toxicity or related safety test results conducted by or for the manufacturer prior to submission to the Government.

3.3.4. Technical Data Sheet. The submitter shall provide a completed Technical Data Sheet (Form number FS 5100-36) giving all required information on the physical properties and

characteristics of the foam. A description of the field mixing and handling requirements shall be included.

3.3.5. Reaction Ingredient Residual. When the submitted product is the result of a chemical reaction, information explaining the reaction process and listing the residual amounts of the reaction ingredients shall be provided.

3.3.6. Other Technical Information. The submitter shall provide information regarding laboratory mixing, field mixing and handling, and any special cleanup procedures that may be of use to the laboratory or field personnel.

3.3.7. Patents. Copies of patents covering any aspect of the formulation or its application in wildland fire operations should be included in the submission documentation.

3.4. Chemicals of Concern.

3.4.1. Unacceptable Ingredients. The following ingredients shall not be accepted:

- Sodium ferrocyanide (Yellow Prussiate of Soda or YPS)
- Dichromate
- Thiourea
- Borate or other boron-containing compounds
- Polychlorinated biphenols (PCB)
- Polybrominated diphenyl ethers (PBDE)
- Nonylphenol ethoxylates (NPE)
- Per- and polyfluoroalkyl substances (PFAS), including but not limited to:
    - Perfluorooctanoic acid (PFOA)
    - Perfluorooctanesulfonate (PFOS)

3.4.2. Environmental and Health Regulations. A review of environmental regulations as they apply to the formulation and the ingredients of the formulation shall be completed at the same time. Specifically, the status of each chemical with regard to the regulatory lists shown below shall be determined.

a. 40 Code of Federal Regulations (CFR) 355 Appendix A. – Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), List of Extremely Hazardous Substances and Their threshold Planning Quantities.

b. National Toxicology Program's Annual Report on Carcinogens

c. International Agency for Research on Cancer (IARC) Monographs for Potential Carcinogens

d. 40 CFR 302.4. – CERCLA, List of Hazardous Substances and Reportable Quantities

e. 40 CFR 261.33. – Resources Conservation and Recovery Act (RCRA), Acutely Hazardous and Toxic Wastes

f. 40 CFR 372. – Superfund Amendment and Reauthorization Act (SARA) Title III, sec 313, Emergency Planning and Community Right to Know (EPCRA), Toxic Release Inventory (TRI)

3.4.2.1. Review Prior to Product Submittal (STP-1.1). The Project Leader, WFCS shall review the documentation package for completeness and consistency. Any questions that may arise shall be resolved at that time.

3.4.3. Chemical Profile and Risk Assessment. Chemical profiles shall be prepared and a risk assessment shall be performed on all products prior to being placed on the Qualified Products List (QPL).

All chemical profiles and risk assessments shall be performed by the Government or by an approved third party selected by the Government, using accepted methodology.

Based on the information provided in accordance with 3.3, at the discretion of the Government, chemical profiles and/or a risk assessment as described in 3.4.3.1 and 3.4.3.2 may be required before lab-work begins.

3.4.3.1. Chemical Profile. When there is no existing chemical profile or the existing profile is out of date, a new profile shall be developed by the Government or qualified third party selected by the Government, at Government expense.

3.4.3.2. Risk Assessment. A risk assessment shall be performed by the Government or a qualified party selected by the Government, at submitter expense, prior to a product being placed on the Qualified Products List (QPL).

If a risk assessment is required before the laboratory evaluation is performed, based on the information developed in 3.4, the Government shall make a written notification to the submitter of these concerns and include the acceptable remedies and the associated costs.

3.4.3.3. Environmental Consultation with Regulatory Agencies. A new product may be included in an environmental consultation with the regulatory agencies [U.S. Fish and Wildlife Service (FWS) and National Oceanic and Atmospheric Administration – National Marine Fisheries Service (NMFS)]. The extent of the consultation will be based on the similarities and differences to other products from the same supplier.

The composition of a product, the results of laboratory testing required by this specification, applicable chemical profiles, and product risk assessments will be shared with these regulatory agencies to inform them of the characteristics of the product and assist them in making their determination.

The consultation will result in a formal statement of findings from each regulatory agency.

3.5. Performance Requirements.

3.5.1. Determination of Laboratory Mixing Procedures. A suitable set of conditions and methods for preparing laboratory samples of the mixed product shall be determined.

These procedures shall be used to prepare all samples for the laboratory evaluation.

All dilutions shall be prepared with 70° F fresh water unless otherwise specified.

If standard mixing operations are not acceptable/sufficient, the submitter shall provide acceptable mixing equipment, capable of accurately measuring to 0.1%, and procedures. Costs of additional equipment and/or personnel time shall be the responsibility of the submitter.

3.5.2. Health and Safety.

3.5.2.1. Mammalian Toxicity and Irritation Tests. As required by 3.5.2.1.1. and 3.5.2.1.2., the mammalian toxicity and irritation performance of the concentrate and mixed product shall be determined in accordance with 4.1.1.

3.5.2.1.1. Concentrate. The toxicity of the concentrate shall meet the requirements in Table 1 when tested in accordance with 4.1.1

Table 1. Toxicity and Irritation Requirements for Concentrate

Test	Requirement
Acute oral toxicity	LD_{50} > 500 mg/kg.
Acute dermal toxicity	LD_{50} > 2000 mg/kg.
Primary eye irritation for washed and unwashed eyes	Mildly irritating or less. If more irritating, recommend protective gear and safe handling procedures.
Primary dermal irritation	Primary irritation index < 5.0. If more irritating, recommend protective gear and safe handling procedures.

3.5.2.1.2. Mixed Product. The toxicity of a 1.0-percent foam solution shall meet the requirements in Table 2 when tested in accordance with 4.1.1.

Table 2. Toxicity and Irritation Requirements for Foam Solutions

Test	Requirement
Acute oral toxicity	LD_{50} > 5000 mg/kg.
Acute dermal toxicity	LD_{50} > 2000 mg/kg.
Primary eye irritation for washed and unwashed eyes	Mildly irritating or less.
Primary Dermal Irritation	Primary irritation index < 5.0.

3.5.2.1.3. Report of Mammalian Toxicity and Irritation Test Results. The results of the toxicity testing shall be certified by the testing laboratory and submitted to the Government, in accordance with 4.1.1.1.

3.5.2.1.4. Review of Mammalian Toxicity and Irritation Test Results. When the test results for a concentrate indicate that protective gear / safe handling procedures are needed, the manufacturer shall make recommendations to be added to the product label.

In accordance with 4.1.1.2, the results and related recommendations shall be reviewed by the Government.

3.5.2.2. Fish Toxicity. The LC_{50} for rainbow trout exposed to the concentrate shall be greater than 10 mg/L when tested in accordance with 4.1.2.

3.5.2.3. Biodegradability. When tested in accordance with 4.1.3, the concentrate shall be either readily biodegradable or biodegradable. The results will be made available to users as performance information.

3.5.2.4. Open Cup Flash Point and Fire Point. As required by 3.5.2.4.1 and 3.5.2.4.2, the open cup flash point and fire point of the foam concentrate shall be determined.

3.5.2.4.1. Open Cup Flash Point. When tested in accordance with 4.1.4, the open cup flash point of the concentrate shall not be less than 140 ºF (60 ºC).

The results will be made available to users as performance information.

3.5.2.4.2. Open Cup Fire Point. The open cup fire point of the concentrate shall be determined in accordance with 4.1.4.

The results will be made available to users as performance information.

3.5.3. Exposure Protection Effectiveness. In accordance with 4.2, the mixed product shall be tested for exposure protection effectiveness using the Lateral Ignition and Flame Spread Test (LIFT).

The reduction index for products mixed at 1.0% shall be greater than 1.20 to meet acceptance criteria. The reduction index is defined in 4.2. The results will be made available to users as performance information.

3.5.4. Physical Properties. In accordance with 4.3, the physical properties of the foam concentrate and foam solution shall be determined as required in 3.5.4.1. and 3.5.4.2.

These test results shall define the standard characteristics for the submitted product and be used to address quality issues.

3.5.4.1. Physical Properties of the Foam Concentrate. In accordance with 4.3, the density, viscosity, pH, fluidity, and total water content of the foam concentrate shall be determined.

The values determined shall be used as baseline values for stability tests as required in 3.8.

The results will be made available to users as performance information.

3.5.4.1.1. Density of Foam Concentrates. In accordance with 4.3.1, the density of the foam concentrate shall be determined.

The density of the concentrate shall not exceed 1.15 grams/milliliter.

The values determined shall be used as baseline values for stability tests as required in 3.8.1.1.

The results will be made available to users as performance information.

3.5.4.1.2. pH of Foam Concentrates. In accordance with 4.3.2, the pH of the foam concentrate shall be determined.

The values determined shall be used as baseline values for stability tests as required in 3.8.1.1.

The results will be made available to users as performance information.

3.5.4.1.3. Viscosity of Foam Concentrates. In accordance with 4.3.3, the viscosity of the 70°F foam concentrate shall be determined and shall not exceed 150 centipoise (cP).

The values determined shall be used as baseline values for stability tests as required in 3.8.1.1.

The results will be made available to users as performance information.

3.5.4.1.4. Viscosity of Foam Concentrates for Application from Water-Scooping Aircraft. In accordance with 4.3.3, the viscosity of the foam concentrate shall be determined.

The viscosity of the foam concentrate for applications from water-scooping aircraft shall not exceed 75 centipoise (cP).

3.5.4.1.5. Concentrate Fluidity. In accordance with 4.3.4, the fluidity of foam concentrate shall be determined as a function of temperature.

The foam concentrate shall maintain fluidity at 35 ºF.

The results at all temperatures will be made available to users as performance information.

3.5.4.1.6. Water Content of Foam Concentrate. In accordance with 4.3.6, the water content of the foam concentrate shall be determined using standard methods.

The results will be made available to users as performance information.

3.5.4.2. Physical Properties of the Foam Solution. In accordance with 4.3, the density, pH, and surface tension range of 0.1-percent to 1.0-percent foam solutions shall be determined.

The values determined shall be used as baseline values for stability tests as required in 3.8.1.2.

The results will be made available to users as performance information.

3.5.4.2.1. Density of the Foam Solution. In accordance with 4.3.1, the density of 0.1-percent and 1.0-percent foam solutions shall be determined.

The values determined shall be used as baseline values for stability tests.

The results will be made available to users as performance information.

3.5.4.2.2. pH of the Foam Solution. In accordance with 4.3.2, the pH of 0.1-percent and 1.0-percent foam solutions shall be determined.

The values determined shall be used as baseline values for stability tests.

The results will be made available to users as performance information.

3.5.4.2.3. Surface Tension of Foam Solutions. In accordance with 4.3.5, the surface tension of 0.1-percent, 0.3-percent, 0.6-percent, and 1.0-percent foam solutions shall be determined.

The results shall be used as the baseline for stability tests as required in 3.8.1.2.

The results will be made available to users as performance information.

3.6. Effectiveness Characteristics. As required by 3.6.1 through 3.6.5, the foam concentrate and its solutions shall be tested to determine the effects of water quality (type) and temperature on performance. All effectiveness testing results will be made available to users as performance information.

3.6.1. Foam Rating, Categories, Types.

This rating and categorization scheme use foam expansion results. Samples are mixed at 1.0-percent with deionized water and aerated with a foam generator as outlined in 4.4.2.1.

Description	Status	Expansion value
Non foaming, wetting agent	Not acceptable	0 – 5.0 times
Wetter foam, faster draining	Acceptable	5.1 – 15.0 times
Drier foam, slower draining	Acceptable	Greater than 15.1

3.6.2. Foam Expansion and Drain Time. In accordance with 4.4.2, the expansion of 0.1-percent and 1.0-percent foam solutions prepared using several water qualities (types) and temperatures shall be determined.

3.6.2.1. Expansion and Drain Time of Foam Solution Prepared with Deionized Water at 70 °F. In accordance with 4.4.2.3, the expansion and drain time of foam solution prepared using deionized water at 70 °F shall be determined.

The results shall be used as the baseline for stability tests as required in 4.6.

3.6.2.2. Expansion and Drain Time of Foam Solution Prepared with Fresh Water at 70 °F. In accordance with 4.4.2.4, the expansion and drain time of foam solution prepared using fresh water at 70 °F shall be determined.

3.6.2.3. Expansion and Drain Time of Foam Solution Prepared with Artificial Sea Water at 70 °F. In accordance with 4.4.2.5, the expansion and drain time of foam solution prepared using artificial sea water at 70 °F shall be determined.

3.6.2.4. Expansion and Drain Time of Foam Solution Prepared with Fresh Water at 40 °F. In accordance with 4.4.2.6, the expansion and drain time of foam solution prepared using fresh water at 40 °F shall be determined.

3.6.3. Wetting Ability of Foam Solution (Drave's Skein Test). The wetting ability of foam solutions prepared as required in 3.6.3.1 through 3.6.3.3 shall be determined in accordance with 4.4.3.

3.6.3.1. Wetting Ability of Foam Solution Prepared with Deionized Water. The wetting ability of 0.1-percent, 0.3-percent, 0.6-percent and 1.0-percent foam solutions prepared with deionized water at 70 °F shall be determined in accordance with 4.4.3.

A sink time of 20 seconds or less for the 1.0-percent solution shall be acceptable.

The results shall be used as the baseline for stability tests as required in 3.8.1.2.

3.6.3.2. Wetting Ability of Foam Solution Prepared with Fresh Water. The wetting ability of the 1.0% solutions prepared with fresh water at 70 °F shall be determined in accordance with 4.4.3.

3.6.3.3. Wetting Ability of Foam Solution Prepared with Artificial Sea Water. The wetting ability of the 1.0% solutions prepared with artificial sea water at 70 °F shall be determined in accordance with 4.4.3.

3.6.4. Miscibility of Foam Concentrate. In accordance with 4.4.4, the foam concentrate shall be tested to determine its ability to mix with water and concentrate at 70°F and 40°F. This uses several different water qualities as outlined in 3.6.4.1 through 3.6.4.3

3.6.4.1. Miscibility of Concentrates in Deionized Water. When tested in accordance with 4.4.4, the foam concentrate at 70 °F shall be miscible in deionized water at 70 °F. The same testing is repeated for 40°F concentrate and 40°F deionized water.

3.6.4.2. Miscibility of Concentrates in Fresh Water. When tested in accordance with 4.4.4, the foam concentrate at 70 °F shall be miscible in fresh water at 70 °F. The same testing is repeated for 40°F concentrate and 40°F fresh water.

3.6.4.3. Miscibility of Concentrates in Artificial Sea Water. When tested in accordance with 4.4.4, the foam concentrate at 70 °F shall be miscible in sea water at 70 °F. The same testing is repeated for 40°F concentrate and 40°F sea water.

3.6.4.3.1. Miscibility of Concentrates for Application from Water-Scooping Aircraft. When tested as required in 3.7.5.3, the foam concentrate at 70 °F shall be miscible in 40 °F artificial sea water.

3.6.5. Foaming Ability. In accordance with 4.4.5, the foaming ability of a 1.0-percent solution of concentrate in deionized water shall be determined.

The results shall be the basis for a field quality control test.

3.7. Material Effects.

3.7.1. Uniform Corrosion. When tested in accordance with 4.5.1, the foam concentrate, 0.1-percent foam solution, and 1.0-percent foam solution shall not have corrosion rates exceeding those shown in Table 4 for the alloys listed.

3.7.2. Intergranular Corrosion. When tested in accordance with 4.5.2, the alloys as specified in 3.7.2.1 through 3.7.2.4 shall show no evidence of intergranular corrosion as summarized in Table 3.

Table 3. Intergranular Corrosion

Application Method	Alloy	
	Aluminum 2024-T3	Magnesium Az-31-B
Helicopter Fixed-Tank	No detectable IGA	No detectable IGA
Multi-Engine, Fixed-Wing Airtanker	No detectable IGA	Not Applicable
Single-Engine, Fixed-Wing Airtanker	No detectable IGA	Not Applicable
Helicopter Bucket.	Not Applicable	Not Applicable
Ground Based Equipment	Not Applicable	Not Applicable

3.7.2.1. Helicopter Fixed Tank. When tested in accordance with 4.5.2, coupons made of alloy 2024-T3 aluminum and Az-31B magnesium shall not exhibit intergranular corrosion following exposure to foam solution during the uniform corrosion tests.

3.7.2.2. Multi-Engine, Fixed-Wing Air Tanker. When tested in accordance with 4.5.2, coupons made of alloy 2024-T3 aluminum shall not exhibit intergranular corrosion following exposure to foam solution during the uniform corrosion tests.

3.7.2.3. Single-Engine, Fixed-Wing Air Tanker. When tested in accordance with 4.5.2, coupons made of alloy 2024-T3 aluminum shall not exhibit intergranular corrosion following exposure to foam solution during the uniform corrosion tests.

3.7.2.4. Helicopter Bucket and Ground Based Application Equipment. There are no intergranular corrosion requirements for helicopter buckets or ground-based application equipment.

3.7.3. Effect of Foam Concentrate and Foam Solution on Non-Metallic Materials. In accordance with 4.5.3, the foam concentrates and foam solutions shall be tested to determine their effect on the non-metallic materials listed in Table 5 and their ability to meet the requirements of 3.7.3.1.

Table 4. Maximum Allowable Corrosion Rates (mils-per-year) for Wildland Fire Chemical Products.[1]

	2024-T3 Aluminum				4130 Steel				Yellow Brass	Az31B Magnesium			
	Total		Partial		Total		Partial		Partial	Total		Partial	
Temperature: °F	70	120	70	120	70	120	70	120	120	70	120	70	120
	mils-per-year												
Concentrates													
Wet concentrates for fixed-tank helicopters	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0
Wet concentrates [2] except fixed-tank helicopters	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0	5.0				
Mixed Products													
Fixed-tank helicopters [3]	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0	4.0	4.0	4.0	4.0
Fixed-wing air tankers [4]	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0				
Helicopter bucket and [2] Ground-based application	2.0	2.0	2.0	2.0	5.0	5.0	5.0	5.0	5.0				

[1] All uniform corrosion rates shall be determined by 90-day weight loss tests. All uniform corrosion rates are the maximum allowable average of all replicates.

[2] Magnesium uniform corrosion tests shall be performed for performance information. Intergranular corrosion tests are not required on aluminum or magnesium.

[3] Intergranular corrosion tests shall be performed on aluminum and magnesium coupons; no intergranular corrosion is allowed.

[4] Intergranular corrosion tests shall be performed on aluminum coupons; no intergranular corrosion is allowed. Magnesium uniform corrosion tests shall be performed for performance information. Intergranular corrosion tests are not required on magnesium.

Table 5. Materials To Be Tested To Determine The Effect Of Exposure To Foam Concentrate And Foam Solutions.

Material	Material Specification
- - Shall Be Tested And Performance Provided To User Agencies. - -	
Chloroprene rubber	AMS 3208M
PVC Plastic, Flexible	MIL A-A-55859A
Fiberglass/Epoxy Resin	AMS C-9084
High-Density Polyethylene	ASTM D 4976
Low-Density Polyethylene	ASTM D 4976
Flexible Cross-Linked Polyolefin	AMS DTL-23053/5

3.7.3.1. Effect of Exposure to Foam Concentrate and Solution on the Hardness and Volume of Non-Metallic Materials. When tested as required in 3.7.3, the changes in hardness and volume of each of the materials listed in Table 5 shall meet the requirements for acceptable change as shown in Table 6.

All results will be reported to user agencies as performance information.

Table 6. Non-metallics acceptance limits.

Characteristics	Allowable Change
Hardness	≤ 10-percent decrease
Hardness	≤ 20-percent increase
Volume	≤ 0.5 mL from initial

3.8. Product Stability. When tested in accordance with 4.6, the foam concentrate and the foam solution shall meet all applicable requirements of 3.8.1.

3.8.1. Outdoor Storage. When tested in accordance with 4.6.1, the foam concentrate and foam solution prepared from that concentrate shall meet all applicable requirements of 3.8.1.1 through 3.8.1.3.

3.8.1.1. Foam Concentrate. When tested in accordance with 4.6.1.1, the foam concentrate shall meet the following requirements.

The stored concentrate shall have no separation resulting in particles larger than 0.25-inch (0.635 cm) sieve size.

The stored concentrate shall be tested to determine the following properties:

a. Density, in accordance with 4.3.1,

b. pH, in accordance with 4.3.2, and

c. Viscosity, in accordance with 4.3.3.

The values for the viscosity, density, and pH shall be within the allowable variation, shown in Table 7, from the original values determined in 3.5.4.1.

The stored concentrate shall be used to prepare foam solution as required in 3.8.1.2 and 3.8.1.3.

The results will be made available to users as performance information.

Table 7. Allowable Variation Of Physical Properties Of Stored Foam Concentrate From Fresh Concentrate.

Property	Allowable Variation from Initial Value
Density	± 1 percent
pH	± 1 unit
Viscosity	Must remain below 150 cP

3.8.1.2. Foam Solution from Stored Concentrate. As required by 3.8.1.1 and in accordance with 4.6.2, a 1.0-percent foam solution prepared from stored concentrate and deionized water shall be tested to determine the following properties:

a. Foam expansion and drain time, in accordance with 4.4.2,

b. Wetting ability, in accordance with 4.4.3, and

c. Surface tension, in accordance with 4.3.5.

Changes in these properties, from the values determined in 3.6, shall be within the allowable variation of Table 8.

The results will be made available to users as performance information.

Table 8. Allowable Variation of Physical Properties Of Mixed Product From Stored Concentrate.

Property	Allowable Variation from Initial Value
Density	± 1 percent
pH	± 1 unit
Viscosity	Must remain below 100 cP

3.8.1.3. Corrosivity of Foam Solution from Stored Concentrate. As required by 3.8.1.1 and in accordance with 4.6.2.1, 0.1-percent and 1.0-percent solutions of the stored concentrate in fresh water shall be tested for uniform and intergranular corrosion and shall meet the uniform and intergranular corrosion requirements of 3.7.1 and 3.7.2.

3.9. Resistance of Foam Solution to Microbial Growth. In accordance with 4.6.3, after 14 days in storage the foam solution shall show no visible sign of microbial contamination, including growths on the surface or within the fluid, significant discoloration, or other change in appearance.

4. **TEST PROCEDURES**. Detailed test methods are described in Standard Test Procedures for the Evaluation of Wildland Fire Chemical Products (STP).

4.1. Health and Safety.

4.1.1. Mammalian Toxicity and Irritation Tests (STP-1.3). As required by 3.5.2.1, mammalian toxicity and irritation testing on foam concentrate and 1.0-percent foam solution shall be conducted by an independent biological testing laboratory approved by the Forest Service.

All testing shall be conducted in compliance with 40 CFR 160 and 792 Good Laboratory Practice Standards, in accordance with EPA/ OCSPP Health Effects Test Guidelines, series 870 and shall include:

a. OCSPP 870.1100, Acute Oral Toxicity;

b. OCSPP 870.1200, Acute Dermal Toxicity;

c. OCSPP 870.2400; Primary Eye Irritation;

d. OCSPP 870.2500; Primary Dermal Irritation.

4.1.1.1. Report of Test Results. The results of the mammalian toxicity and irritation testing shall be certified by the testing laboratory and submitted directly to the Government as required by 3.5.2.1.3.

4.1.1.2. Review of Mammalian Toxicity and Irritation Test Results. When required in accordance with 3.5.2.1.4, the Government shall review the results of the testing and the submitter's recommended protective gear and safe handling procedures to ensure adequate protection for workers and the general public who may come into contact with the product.

4.1.2. Fish Toxicity (STP-1.5). As required by 3.5.2.2, the fish toxicity of the foam concentrate to rainbow trout (Oncorhynchus mykiss) shall be determined in accordance with OPPTS 850.1075, Ecological Effects Test Guidelines, Fish Acute Toxicity Test, Freshwater and Marine.

Static test conditions in ASTM soft water (described in ASTM E 729) at 54 ± 2ºF (12 ± 1ºC) shall be maintained throughout the 96-hour test period.

All fish shall be 60 ± 15 days post hatch.

4.1.3. Biodegradability (STP-1.4). As required by 3.5.2.3, the biodegradability of the foam concentrate shall be determined in accordance with OPPTS 835, Section M, Fate, Transport and Transformation Test Guidelines, CO2 evolution (modified Sturm Test).

If biodegradation has not reached 60 percent at 28 days, biodegradation shall be allowed to continue for up to 42 days.

A commercial inoculum may be used rather than activated sewage sludge.

4.1.4. Open Cup Flash and Fire Point (STP-1.6). As required in 3.5.2.4, the open cup flash point and the fire point of the foam concentrate shall be determined in accordance with ASTM D 92, Standard Test Method for Flash Point and Fire Point by Cleveland Open Cup.

4.2. Exposure Protection Effectiveness Test (STP-2.2). As required by 3.5.3, the concentrate shall be tested for exposure protection effectiveness using the vertical LIFT apparatus and general method in ASTM E 1321 Standard Test Method for Determining Material Ignition and Flame Spread Properties as summarized below.

A foam solution at 1.0-percent shall be prepared, aerated, and applied to a piece of T1-11 siding that was conditioned at 70 °F and 50-percent relative humidity.

The sample shall be drained and exposed to the radiant panel immediately.

Treated and untreated T1-11 siding, in a vertical orientation, shall be exposed to a 40 kW/m^2 radiant panel and the time to ignition determined.

The time for the treated siding to ignite shall be compared to the time for untreated siding to ignite. Method control materials can be used for quality control and comparative purposes. The reduction index (R.I.) is defined as:

R.I. = time to ignition of the mixed product ÷ time to ignition of deionized water

4.3. Physical Properties. As required by 3.5.4.1, the foam concentrate and solution shall be tested to determine the physical properties.

4.3.1. Density Test (STP-4.3). As required by 3.5.4.1.1 and 3.5.4.2.1, the density of the foam concentrate and foam solution shall be determined to the nearest 0.001 g/mL using fluid displacement or an electronic density meter.

4.3.2. pH Value Test (STP-4.4). As required by 3.5.4.1.2 and 3.5.4.2.2, the pH of the foam concentrate and foam solution shall be determined with a full range pH meter readable to 0.1 pH unit.

4.3.3. Viscosity (STP-4.5). As required by 3.5.4.1.3, the viscosity at 70 ºF of the foam concentrate shall be determined.

A Brookfield Viscometer model LVF, or equivalent, set at 60 rpm with the appropriate spindle shall be used to measure the viscosity.

4.3.4. Concentrate Fluidity Test (STP-4.7). As required by 3.5.4.1.5, the ability of the foam concentrate to flow shall be determined following the general method found in ASTM D 97.

A small beaker of the concentrate shall be cooled to the test temperature, without being disturbed. Sufficient time shall be allowed for the entire contents of the beaker to reach the test temperature.

The beaker shall be tilted slightly and the behavior of the concentrate observed.

A fresh sample of the concentrate shall be used for each test temperature.

Concentrate Fluidity Test Temperatures

Fahrenheit:	40 ºF ± 2 °F	35 ºF ± 2 °F	5 ºF ± 2 °F

4.3.5. Surface Tension Test (STP-8.1). As required by 3.5.4.2.3, the surface tension of foam solutions at 70 °F shall be determined in accordance with ASTM D 1331.

Each foam concentrate shall be diluted with deionized water to prepare 0.1-percent, 0.3-percent, 0.6-percent, and 1.0-percent foam solutions.

Reported values shall be corrected for the diameter of the platinum-iridium wire and the diameter of the formed ring.

4.3.6. Water Content Test. As required by 3.5.4.1.6, the foam concentrate shall be tested for water content. ASTM E203 is used for this determination and results reported for user information.

4.4. Effectiveness Characteristics Tests. As required by 3.6, the foam concentrate and foam solution shall be tested in accordance with 4.4.1 through 4.4.5 to determine their ability to perform over a range of operational conditions.

4.4.1. Foam Rating, Categories. As required by 3.6.1, products are evaluated at 1.0-percent using deionized water and evaluated using 4.4.2. These results are then categorized by expansion of the foam.

4.4.2. Foam Expansion and Drainage Test. As required by 3.6.2., 0.1-percent and 1.0-percent foam solutions shall be prepared and converted to foam under controlled conditions using standard settings of the foam generator shown in Figure 1.

The test method is summarized below.

4.4.2.1. Foam Expansion Test.

For two standard settings, the foam shall be allowed to flow into a 4600-mL capacity, shallow container, with drain holes in one corner of the bottom.

The excess foam shall be removed from the surface of the foam and from the exterior of the container and the filled container weighed.

$$Expansion = \frac{weight\ of\ foam\ solution\ (grams)}{density\ of\ foam\ solution\ (g/mL}$$

4.4.2.2. Foam Drain Time Test.

A container filled with foam generated in 4.4.2.1, shall be placed on a balance in such a manner as to allow fluid draining from the foam to flow from the holes in one corner of the container.

The weight loss shall be recorded as a function of time for a 15-minute period and a curve prepared showing Percent of Initial Weight Remaining versus Time.

From the graph, the percent of fluid drained after 5 and 10 minutes shall be determined along with the time for 25 percent of the fluid to drain from the container.

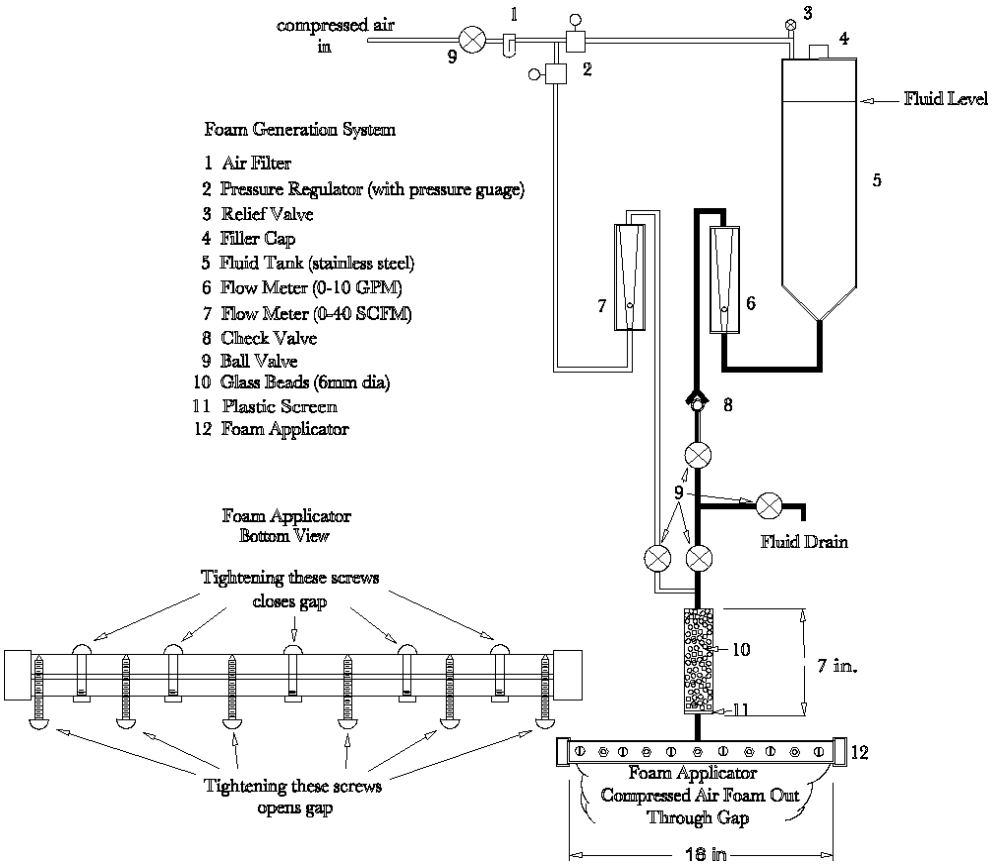

Figure 1. Foam Generator Schematic

4.4.2.3. Expansion and Drainage of Foam Solution Prepared with Deionized Water at 70 °F. As required by 3.6.2.1, the expansion and drainage tests shall be performed using foam solutions prepared using deionized water at 70 °F.

4.4.2.4. Expansion and Drainage of Foam Solution Prepared with Fresh Water at 70 °F. As required by 3.6.2.2, the expansion and drainage tests shall be performed using foam solutions prepared using fresh water at 70 °F.

4.4.2.5. Expansion and Drainage of Foam Solution Prepared with Artificial Sea Water at 70 °F. As required by 3.6.2.3, the expansion and drainage tests shall be performed using foam solutions prepared using artificial sea water at 70 °F.

4.4.2.6. Expansion and Drainage of Foam Solution Prepared with Fresh Water at 40 °F. As required by 3.6.2.4, the expansion and drainage tests shall be performed using foam solutions prepared using fresh water at 40 °F.

4.4.3. Wetting Ability Test, Drave's Skein (STP-8.2). As required by 3.6.3, the wetting ability of solutions prepared using the foam concentrate and 70 °F water each deionized, fresh, and seawater shall be determined. The test method is summarized below.

A cotton skein, weighing 5.00 g, shall be attached to a hook weighing 1.5 g.

The time for the skein to sink when immersed in the test solution shall be measured.

The test shall be repeated at least twice more using a fresh skein and fresh solution for each test, and the results averaged.

4.4.4. Miscibility Test (STP-8.6). As required by 3.6.4, the ease of mixing concentrate with water at temperatures shown in the table shall be determined as summarized below.

Tests Conditions for Miscibility of Foam Concentrate

Water Temperature	Concentrate Temperature
70 ºF	70 ºF
40 ºF	40 ºF

An offset stirring attachment, shown in Figure 2, shall be attached to a variable speed stirring motor and inserted in 500 milliliters of water at the specified temperature.

The stirrer speed shall be adjusted to 60±10 rpm.

5 milliliters of concentrate shall be quickly added, with stirring.

After 10 revolutions, the stirrer shall be stopped, and the fluid observed.

The solution shall be considered to be homogeneous if it is:

- Uniform throughout,
- Has no visible striations or phases
- Uniformly clear, cloudy or milky

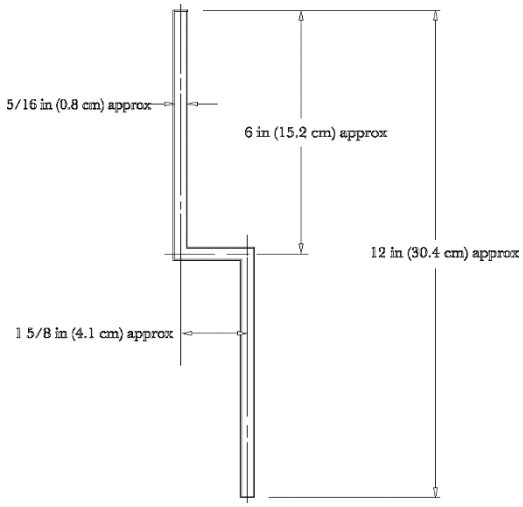

Figure 2. Stirring shaft for miscibility tests.

If the sample is not homogeneous, it shall be stirred for an additional 10 revolutions, the stirrer stopped, and the appearance of the solution again observed.

The sequence shall be repeated until the sample is homogenous or a maximum of 100 revolutions is reached.

A sample shall be considered to be miscible if it is homogeneous with 100 revolutions or less.

A sample shall be considered to be not miscible if it is not homogeneous after 100 revolutions.

This testing is repeated in each water type, deionized (3.6.4.1), fresh (3.6.4.2), and seawater (3.6.4.3).

4.4.5. Foaming Ability Test (STP-8.3). As required by 3.6.5, the ability of a 1.0-percent foam solution to foam shall be determined.

10 milliliters of foam solution prepared with deionized water shall be placed in a 50-milliliter, stoppered graduated cylinder.

The cylinder shall be agitated by shaking forcefully for 10 seconds. It shall be noted immediately whether any solution remains.

The volume of foam in the cylinder shall be noted and recorded immediately. The volume of solution drained from the foam shall be noted and recorded at 1-minute intervals for 5 min. Additional measurements shall be made and recorded at 10 min and 15 min.

The test shall be repeated to obtain at least three data sets. Results of all replicates and the average shall be reported.

4.5. Material Effects Tests. In accordance with 4.5.1 through 4.5.3, the effects of foam concentrates and solutions on metallic and non-metallic materials shall be determined.

4.5.1. Uniform Corrosion (STP-5.1). As required by 3.7.1, the uniform corrosion caused by the foam concentrate and the 0.1-percent and 1.0-percent foam solutions, prepared with fresh water, shall be determined as summarized below.

Test coupons of 2024-T3 aluminum, 4130 steel, UNS C26000 yellow brass, and Az31B magnesium shall be engraved with a unique identification number, measured, cleaned, dried, and weighed.

Each coupon shall be immersed in the test solution and allowed to remain undisturbed at the required conditions for 90 days.

At the end of the test duration, each coupon shall be cleaned, dried, and weighed, and the corrosion rate calculated.

All corrosion rates for the same product, alloy, immersion condition and temperature shall be averaged.

4.5.2. Intergranular Corrosion Test (STP-5.2). As required by 3.7.2, foam solution shall be tested for intergranular corrosion as summarized below.

At least one coupon from each exposure and temperature from the uniform corrosion tests on the specified alloys shall be sliced as shown in Figure 3.

The coupon shall be mounted, polished to 0.3 micron alumna finish, and etched using Keller's reagent for aluminum coupons and Nital reagent for magnesium coupons.

The etched coupons shall be examined microscopically with a magnification of 500X.

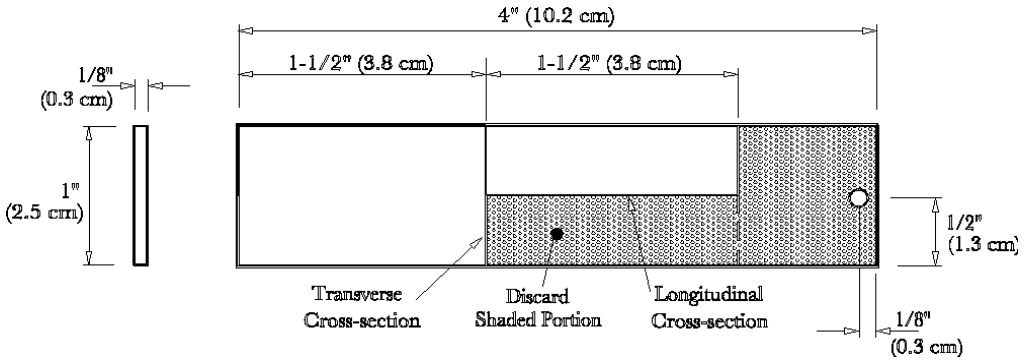

Figure 3. Diagram for cutting and examining coupons for intergranular corrosion.

4.5.3. Effects of Foam Concentrates and Foam Solutions on Non-Metallic Materials (STP-5.3). In accordance with 3.7.3, the foam concentrate and solutions shall be tested to determine their effect on non-metallic materials as summarized below.

Prior to exposure of the non-metallic materials, the hardness and volume of each non-metallic sample shall be determined. A hand-held durometer, of the prescribed type, shall be used to measure the hardness and either fluid displacement or dimensional analysis shall be used to determine the volume.

The test pieces of each non-metallic material shall be exposed for 20 cycles. Each cycle shall consist of the material being immersed in the fluid at night and on weekends and in the air during the workday.

At the end of the test period, each test piece shall be rinsed, wiped with a disposable tissue, allowed to air dry, and the hardness and volume of each piece determined on the same day as the exposure ends.

The change in hardness and volume from the initial value of each shall be calculated.

If the results of either hardness or volume change are outside the acceptance criteria listed in Table 6, the measurements shall be repeated the next day and the change calculated. No additional measurements shall be allowed.

The results of the last set of measurements taken shall be used to determine if performance is acceptable.

4.6. Product Stability (STP-6.1). As required by 3.8, the foam concentrate and the foam solution shall be tested for product stability in accordance with 4.6.1 and 4.6.2.

4.6.1. Outdoor Storage Test. As required by 3.8.1 and in accordance with 4.6.1.1 through 4.6.2.1, the foam concentrate shall be tested to determine the effects of storage in outdoor conditions.

4.6.1.1. Foam Concentrates. As required by 3.8.1.1, each foam concentrate shall be evaluated for outdoor stability.

To document the initial condition of the product, the fresh concentrate shall be examined visually to determine the general condition of the concentrate, including the presence or absence of crystals or other solids greater than 0.25 inch (0.635 cm).

The fresh concentrate shall then be stored in large sample containers, outdoors at NTDP-Missoula and NTDP-San Dimas for 52 weeks.

At the end of the 52-week storage period, the sample shall be inspected visually to determine if there are changes in the general condition of the concentrate (crystals or other solids greater than 0.25 inch [0.635 cm]) from the original samples.

The samples shall be recirculated or agitated for 1 minute with low shear, tested to determine viscosity, density, and pH, and then used to prepare foam solutions.

In accordance with 4.6.2 and 4.6.2.1, the foam solutions from stored concentrate shall be prepared and tested as required by 3.8.1.1 and 3.8.1.2.

4.6.2. Foam Solution from Stored Concentrate. As required by 3.6 and 3.8.1.2, a 1.0-percent foam solution of the stored concentrate in deionized water shall be prepared and tested as shown below.

The surface tension of the foam solution shall be determined in accordance with 4.3.5.

The foam expansion, foam drain time, and wetting ability shall be determined in accordance with 4.4.2 through 4.4.3.

4.6.2.1. Corrosivity of Solution from Stored Concentrate. As required by 3.8.1.3 and in accordance with 4.6.1, 0.1-percent and 1.0-percent foam solutions of the stored concentrate in fresh water shall be tested to determine the uniform and intergranular corrosion in accordance with 4.5.1 and 4.5.2.

4.6.3. Resistance to Microbial Growth Test (STP-6.3). As required by 3.9, the foam solution shall be tested, observed, and assessed for microbial contamination.

The same foam solution/samples used for the corrosion test shall be observed in the incubator for indications of microbial degradation. The physical appearance, including growths on the surface or within the fluid, significant discoloration, or other changes shall be described and recorded at the initiation of the test and on day 14.

5. PREPARATION FOR DELIVERY

5.1. Submission of Samples for Laboratory Evaluation. When requested, and at no cost to the Government, the submitter shall provide the required amount of concentrate for use in the laboratory evaluation tests.

5.2. Packaging and Labeling. Upon completion of documentation submission as required by 3.3.1 through 3.3.7., the product shall be supplied to the laboratory for testing. Labeling shall be legible, clear and permanent.

5.2.1. Packaging. The packaging of all wildland fire chemicals submitted for evaluation shall conform to regulations governing the ground and air transport of materials.

The concentrates, in the quantities shown, shall be packaged as specified in Table 9.

Table 9. Test sample quantity and packaging.

Product Type	Packaging	Quantity
Wet concentrate	5-gallon (18.9 liters) plastic pails	50 gallons (189 liters) ≤ 50 lbs (22.7 kg) per pail

5.2.2. Labeling. Individual containers of products submitted for evaluation shall be legibly marked in accordance with Federal Standard 123.

Labeling shall comply with Department of Transportation, Occupational Safety and Health Administration, and applicable State and Local requirements and in addition shall include the following:

a. Manufacturer's name or trademark.

b. Product identification including formulation codes and production information codes.

c. Volume of concentrate per container.

d. Month and year of submission.

5.3. Safety Data Sheets (SDS).

5.3.1. Product SDS. An SDS for the product from the submitter of the product, typically the manufacturer, shall accompany the application for qualification and each shipment of product.

5.3.2. Ingredient SDS. All individual ingredients. The SDS from the manufacturer or the supplier of the chemical ingredient, as indicated on the Formulation Disclosure Sheet (FS 5100-35) shall be included for every ingredient, as a part of the submission paperwork.

5.3.3. Updated/Modified SDS. It is the responsibility of the submitter to send copies of the SDSs when updates become available.

5.4. Additional Quantities. When additional supplies are required, each container shall be marked with the original formulation identification and a secondary name or formulation identification number clearly identifying this as a remake of the original formulation.

This remake shall contain all of the original ingredients from the original sources and no other ingredients.

5.4.1. Labeling Additional Quantities. All containers of the remake shall be clearly labeled and identified as a new or additional production using the original formula or recipe.

Example: Product XYZ, original product name and product ID; unique remake code/identifier 123 for the remake – this can be the production code or other identification.

5.5. Shipping Submission Sample to Wildland Fire Chemical Systems (WFCS). The laboratory test sample shall be shipped at the submitter's expense to WFCS at the National Technology and Development Program (NTDP) in Missoula, Montana.

The complete address shall be provided as part of the shipping instructions when the product is requested.

An SDS for the product shall accompany the shipment.

If the product is imported, the submitter / supplier shall be responsible for the entire process necessary to deliver the product to the WFCS laboratory.

5.5.1. Excess Submission Sample. After the evaluation has been completed, any remaining unused and excess product shall be returned to the submitter at the submitter's expense.

6. GENERAL INFORMATION.

6.1. Intended Use. The products covered by this specification are intended for use in wildland firefighting.

The prescribed tests were selected to assess the effectiveness of the products to meet this goal.

The toxicity and environmental tests were selected to minimize hazards to firefighters, members of the general public, and the environment.

6.2. Qualification. Products that have been submitted for evaluation as described in this specification and submission procedures and have successfully met the requirements stated herein shall be added to the Forest Service Qualified Products List (QPL).

Specific use designations, based on the requirements for each use or application, will be included.

6.3. Collection Agreement and Test Fees. A Collection Agreement between the submitter and Wildland Fire Chemical Systems (WFCS) National Technology and Development Program (NTDP); USDA Forest Service shall be prepared.

This document describes the roles and responsibilities of the Government, WFCS laboratory personnel, and the submitter.

Specific information in the agreement includes a list of authorized contacts for the Government and for the submitter, as well as an estimate of the cost and time required for the evaluation.

6.4. Submission of Manufacturer Documentation and Information. All product information described shall be provided to the Government and reviewed by the designated agency representative, as summarized in 3.3 and described in "Manufacturer Submission Procedures for Qualification Testing" prior to acceptance of samples for testing.

6.4.1. Paper copies available. Paper copies of the required forms and documents can be obtained from the Program Leader or Project Leader, Wildland Fire Chemical Systems (WFCS), 5785 Highway 10 West, Missoula, MT, 59808, if web access is not available.

6.5. Mixing and Loading Equipment. Suppliers are responsible for providing information relative to the equipment needs associated with the mixing and loading of their product at portable or permanent sites. They are responsible for demonstrating acceptable performance of their systems with their product.

6.6. Definitions. The definitions below may be specific to the fire chemical products although most of the terms are in general use. A few of the definitions may not appear in this specification but may be found in related documents such as the "Manufacturers' Submission Procedures." They are provided here as a convenience to the reader.

ASTM Soft & Hard Water – defined in ASTM E729 1996 (2007), Standard Guide for Conducting Acute Toxicity Tests on Test materials with Fishes, Macroinvertabates and Amphibians.

ASTM E729 1996 (2007) Table 1 - Add to high quality water conductivity less than 1 micro-ohm/cm and either total organic carbon (TOC) less than 2 mg/L, OR chemical oxygen demand (COD) less than 5 mg/L.

Acceptable water can usually be prepared using properly operated deionization, distillation, or reverse osmosis units.

See text of standard for additional info and details. Numbers listed are in mg/L.

Salts, mg/L	Very Soft	Soft	Hard	Very Hard
$NaHCO_3$	12	48	192	384
$CaSO_4 \cdot 2H_2O$	7.5	30.0	120.0	240.0
$MgSO_4$	7.5	30.0	120.0	240.0
KCl	0.5	2.0	8.0	16.0

Class A Fuels. Materials such as vegetation, wood, cloth, paper, rubber, and some plastics in which combustion can occur at or below the surface of the material.

Component. Each combination of ingredients packaged together by the manufacturer for use in preparation of the mixed product by the user.

Coupon, Corrosion. A metal test specimen, approximately 1 in x 4 in x 1/8 in (2.5cm x 10.2 cm x 0.3 cm), made of 2024-T3 aluminum, AISI 4130 steel, C26000 yellow brass, or Az31B magnesium for use in uniform corrosion testing.

Coupon, Large Stability. A metal sample, approximately 2 in x 12 in x 1/8 in (5 cm x 30 cm x 0.3 cm), made of mild steel or 2024-T3 aluminum for use in outdoor stability testing.

Density. The mass in grams of 1 milliliter (mL) of product.

Dry Concentrate. A dry, single component which is mixed with water to prepare the mixed product.

Fire Retardant, Long-Term. A product containing one or more inorganic salts to reduce the intensity of a fire. It contains water which serves to aid in uniform distribution of the retardant salts over the target fuel.

The product continues to be an effective fire retardant after the water it originally contained has completely evaporated.

Fire Suppressant. Any agent used to extinguish the flaming and glowing phase of combustion by direct application to the burning fuel. Forest Service. The term Forest Service as used throughout this document refers to the U.S. Department of Agriculture, Forest Service.

Fugitive Color. A coloring agent which imparts a high degree of visibility to the mixed product when first applied to wildland fuels but will gradually disappear over several months.

GPC. (Gallons per 100 square feet). A measure of the application of mixed product onto forest fuels to prevent or slow the spread of wildland fire. Gallons of mixed product per 100 square feet.

Hydration. The action of a combination of concentrate with water required to produce a thickened product.

Ingredient. Each single chemical used by the manufacturer in the formulation of the product. The supplier and quantity of each ingredient shall be specified in the submission paperwork.

Intergranular Corrosion. A corrosive attack on metal at the grain boundary.

LC_{50}. The concentration of product in water that results in the death of 50 percent of the aquatic test specimens within a specified time frame. LC_{50}, in this document, expressed as milligrams of product in a liter of solution.

LD_{50}. The dosage of a product at which 50 percent of the test animals die within a specified time frame. LD_{50}, in this document, expressed as milligrams of the product per kilogram of body weight of the test animal.

Manufacturer. The company or other entity who makes a product.

Mixed Product. The combination of a wet or dry concentrate and water at the qualified mix ratio for use in fire management activities.

Mix Ratio. The proportion of concentrate and water in the mixed product.

The mix ratio can be expressed in several ways:

- Pounds of dry concentrate added to a gallon of water
- Gallons of wet concentrate to be added to a gallon of water
- Volume percentage of concentrate and water – typical for foams and wet concentrate water enhancers

pH. A measure of the acidity or alkalinity of a solution represented on a numeric scale with 7 representing neutral solutions. Higher numbers represent alkaline solutions and lower numbers represent acidic solutions.

Reduction Index. A measure of the reduction in fire intensity (flame spread and weight loss) during the combustion retarding effectiveness test.

Retarding Salt. A single salt or combination of salts that impart combustion retarding effectiveness.

Sample Container, large. A 5.5-gallon (20 liter), low-density polyethylene carboy without spigot. Carboy shall be closed with a size 13.5 rubber stopper secured by a polypropylene screw cap.

Standard Chemical. Technical grade diammonium phosphate (DAP) mixed with water to produce a 10.6-percent (weight/weight) solution. This solution is used as a reference for the combustion-retarding effectiveness test.

Steady State Viscosity. The viscosity after hydration is complete and viscosity is stable.

Temperature. Each temperature included in the specification consists of a Fahrenheit temperature and allowable variation from that temperature and the Celsius equivalents for the temperature and range.

Commonly used temperatures and variations are shown in the first section below and included in the specification requirements and test descriptions by listing a simple Fahrenheit temperature.

Fahrenheit	Celsius
5 °F± 5 °F	-15 °C ± 2.8 °C
15 °F± 5 °F	-9.4 °C ± 2.8 °C
35 °F± 2 °F	1.7 °C ± 1.1 °C
40 °F± 5 °F	4.4 °C ± 2.8 °C
70 °F ± 5 °F	21.1 °C ± 2.8 °C

100 °F± 5 °F	37.8 °C ± 2.8 °C
120 °F± 5 °F	48.9 °C ± 2.8 °C

Uniform Corrosion. Removal of metal by chemical means over the entire surface.

Viscosity. A measure of the resistance of a liquid to flow, reported in centipoise (cP).

Water, Deionized. Water treated by distillation, ion exchange, reverse osmosis, or a combination of these methods to remove most salts in conformance to ASTM D-1193 Type IV reagent water.

Water, Fresh. Tap water with a hardness of 120 to 180 ppm of calcium carbonate.

Wet Concentrate. A liquid, single component which is added to water to prepare the mixed product.