

PERFORMANCE SPECIFICATION
FIRE EXTINGUISHING AGENT, FLUORINE-FREE FOAM (F3) LIQUID CONCENTRATE,
FOR LAND-BASED, FRESH WATER APPLICATIONS

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers fluorine-free (see 6.5.6) foam (F3) liquid concentrate fire extinguishing agents intended for use on class B hydrocarbon liquid fuel fires in land-based applications. These agents are not intended for use on polar solvents (see 6.5.9). These concentrates are to be diluted with fresh water (see 6.5.7) at time of use (see 6.1) to form a foam solution (see 6.5.12). Additional requirements for mis-proportioned (see 6.5.8) foam solutions are specified herein.

1.2 Applications. This specification applies strictly to land-based applications that use fresh water to produce the foam solution.

1.3 Classification. Concentrates covered by this specification are type 3 and are to be used as 3 parts concentrate to 97 parts fresh water by volume solution.

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications, standards, and handbooks form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

FEDERAL SPECIFICATIONS

O-D-1407 - Dry Chemical, Fire Extinguishing, Potassium Bicarbonate

DEPARTMENT OF DEFENSE SPECIFICATIONS

MIL-D-43703 - Drum, Shipping and Storage, Molded Polyethylene

Comments, suggestions, or questions on this document should be addressed to Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy.mil, with the subject line "Document Comment". Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

DEPARTMENT OF DEFENSE STANDARDS

- MIL-STD-130 - Identification Marking of U.S. Military Property
- MIL-STD-882 - System Safety

(Copies of these documents are available online at <https://quicksearch.dla.mil>.)

2.2.2 Other Government documents, drawings, and publications. The following other Government documents, drawings, and publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

CODE OF FEDERAL REGULATIONS (CFR)

- 49 CFR 178.2 - Applicability and responsibility

(Copies of this document are available online at www.ecfr.gov.)

DEPARTMENT OF DEFENSE PUBLICATIONS

- DoD AFFF01 - Determination of Perfluorooctanoic acid and Perfluorooctanesulfonic acid in Aqueous Film Forming Foam (AFFF) for Demonstration of Compliance to MIL-PRF-24385
- DoD/DOE QSM - Department of Defense (DoD) Department of Energy (DOE) Consolidated Quality Systems Manual (QSM) for Environmental Laboratories

(Copies of these documents are available online at <https://www.denix.osd.mil/edqw/>.)

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA) PUBLICATIONS

- EPA Draft Method 1633 - Analysis of Per- and Polyfluoroalkyl Substances (PFAS) in Aqueous, Solid, Biosolids, and Tissue Samples by LC-MS/MS

(Copies of this document are available online at <https://www.epa.gov/>.)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AEROSPACE INDUSTRIES ASSOCIATION (AIA)

- NAS 411-1 - Hazardous Materials Target List

(Copies of this document are available online at www.aia-aerospace.org/standards/.)

AMERICAN PUBLIC HEALTH ASSOCIATION

- Standard Methods for the Examination of Water and Wastewater 5210 - Biochemical Oxygen Demand (BOD)
- Standard Methods for the Examination of Water and Wastewater 5220 - Chemical Oxygen Demand (COD)

(Copies of these documents are available online at www.standardmethods.org.)

ASTM INTERNATIONAL

- ASTM D445 - Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and Calculation of Dynamic Viscosity)
- ASTM D1141 - Standard Practice for Preparation of Substitute Ocean Water

- ASTM D1331 - Standard Test Methods for Surface and Interfacial Tension of Solutions of Paints, Solvents, Solutions of Surface-Active Agents, and Related Materials
- ASTM D1655 - Standard Specification for Aviation Turbine Fuels
- ASTM D1796 - Standard Test Method for Water and Sediment in Fuel Oils by the Centrifuge Method (Laboratory Procedure)
- ASTM D4814 - Standard Specification for Automotive Spark-Ignition Engine Fuel
- ASTM E11 - Standard Specification for Woven Wire Test Sieve Cloth and Test Sieves
- ASTM E70 - Standard Test Method for pH of Aqueous Solutions With the Glass Electrode
- ASTM E527 - Standard Practice for Numbering Metals and Alloys in the Unified Numbering System (UNS)
- ASTM E729 - Standard Guide for Conducting Acute Toxicity Tests on Test Materials with Fishes, Macroinvertebrates, and Amphibians
- ASTM G31 - Standard Guide for Laboratory Immersion Corrosion Testing of Metals

(Copies of these documents are available online at www.astm.org.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

- NFPA 412 - Standard for Evaluating Aircraft Rescue and Fire-Fighting Foam Equipment
- NFPA 1963 - Standard for Fire Hose Connections

(Copies of these documents are available online at www.nfpa.org.)

SAE INTERNATIONAL

- SAE AMS-STD-595 - Colors Used in Government Procurement

(Copies of this document are available online at www.sae.org.)

UNDERWRITERS LABORATORIES, INC. (UL)

- UL 162 - Standard for Safety Foam Equipment and Liquid Concentrates
- UL 969 - Standard for Safety Marking and Labeling Systems

(Copies of these documents are available online at www.ul.com.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Qualification. Liquid concentrate fire extinguishing agents furnished under this specification shall be products that are authorized by the qualifying activity for listing on the applicable qualified products list (QPL) before contract award (see 4.2 and 6.4).

3.2 Materials. Concentrates shall consist of surfactants plus other compounds, as required, to conform to the requirements specified herein.

3.3 Toxicity and prohibited materials.

3.3.1 Toxicity. When evaluated in accordance with 4.4.1, the concentrate shall pose no serious or high risk to the health of personnel or the environment as defined by the risk assessment matrix in MIL-STD-882 when used for its intended purpose (see 4.4.1 and 6.8).

3.3.2 Prohibited materials. The concentrate shall not contain any chemicals categorized as “prohibited” in accordance with NAS 411-1.

3.3.3 PFAS content. The concentrate shall not contain more than 1 part per billion (ppb) per- and polyfluoroalkyl substances (PFAS) (see 4.4.5 and 4.5.7).

3.4 F3 characteristics. The concentrate shall conform to the chemical and physical requirements shown in [table I](#).

TABLE I. Chemical and physical requirements for concentrates and full-strength solutions.

Characteristic	Type 3 Requirement	Standard	Test Paragraph
Refractive index, minimum ^{1/}	1.3600	--	4.5.1
Viscosity (kinematic), maximum at 5 °C, centistokes ^{1/}	300	ASTM D445	4.5.2
Hydrogen-ion concentration (pH) ^{1/}	6.5 to 9.0	ASTM E70	4.5.3
Surface tension, maximum variation ^{2/}	15%	ASTM D1331	4.5.4.1
Interfacial tension, maximum variation ^{2/}	75%	ASTM D1331	4.5.4.2
Foamability: ^{2/}			
Foam expansion, minimum	7.0	NFPA 412	4.5.5
Foam 25% drainage time, minutes, minimum	3.5		4.5.5
Corrosion rate: ^{3/}			
General			
Cold-rolled, low carbon steel (UNS G10100), milli-inch/year, maximum	1.5	ASTM G31	4.5.6
Brass (UNS C46400), milli-inch/year, maximum	1.0		4.5.6
Bronze (UNS C90500), milligrams, maximum	100		4.5.6
Copper-nickel (90-10) (UNS C70600), milli-inch/year, maximum	1.0		4.5.6
Nickel-copper (70-30) (UNS N04400), milli-inch/year, maximum	1.0		4.5.6
Localized			
Corrosion-resistant steel (CRES) (UNS S30400 and S31600)	No pits	--	4.5.6
PFAS content: ^{3/}			
Specific PFAS content	Non-detect ^{4/}	EPA Draft Method 1633	4.5.7.2

TABLE I. Chemical and physical requirements for concentrates and full-strength solutions – Continued.

Characteristic	Type 3 Requirement	Standard	Test Paragraph
Environmental impact: ^{3/}			
Aquatic acute toxicity, LC ₅₀ , mg/L, minimum	30	ASTM E729	4.5.10.1
COD, mg/L, maximum	900K	Standard Method 5220 ^{5/}	4.5.10.2
Biodegradability, $\frac{BOD_{20}}{COD}$, minimum	0.65	Standard Method 5210 ^{6/} Standard Method 5220 ^{5/}	4.5.10.3
Stratification, visible evidence ^{7/}	No	--	4.5.12
Precipitation, percent by volume, maximum ^{7/}	0.10	ASTM D1796	4.5.13
NOTES:			
^{1/} Tests are conducted with unaged and aged concentrates.			
^{2/} Tests are conducted with: (1) unaged concentrate, full-strength solutions and (2) aged concentrate, full-strength solutions.			
^{3/} Tests are conducted with unaged concentrates.			
^{4/} Value below the method detection limit (MDL).			
^{5/} Standard Methods for the Examination of Water and Wastewater 5220.			
^{6/} Method C of Standard Methods for the Examination of Water and Wastewater 5210.			
^{7/} Tests are conducted with aged concentrate.			

3.4.1 Stability. After aging at 65±2.0 °C for a period of 10 days, the samples shall conform to the following requirements as applicable (see 4.5.9):

- a. Refractive index of concentrate shall meet the requirements in [table I](#).
- b. Viscosity of concentrate shall meet the requirements in [table I](#).
- c. Hydrogen ion concentration (pH) shall meet the requirements in [table I](#).
- d. Surface and interfacial tension shall meet the requirements in [table I](#).
- e. Foamability of full-strength solution shall meet the requirements in [table I](#).
- f. Fire performance, three 28-square foot (ft²) fire tests (as specified in 3.5): (1) aged concentrate, half-strength solution, Jet A (see 6.5.1 and 6.5.2), (2) aged concentrate, full-strength solution, Jet A, and (3) aged concentrate, full-strength solution, gasoline.
- g. Stratification shall meet the requirements in [table I](#).
- h. Precipitation shall meet the requirements in [table I](#).

3.5 Fire performance. The foam solutions shall conform to the fire performance requirements shown in [table II](#). Tests required for conformance, retention of qualification, and approval of additional facilities are identified in the notes for [table II](#).

TABLE II. Firefighting performance requirements.

Test Paragraph	Intent	Solution	Concentration	Fuel Type ^{1/}	Maximum Extinguishing Time (seconds)	Minimum Burnback Time (seconds)
28-ft² Fire Tests Unaged Products						
4.5.11.1	Capabilities	Unaged concentrate	Full-strength	Jet A	30	300
4.5.11.1 ^{2/ 3/}	Capabilities	Unaged concentrate	Full-strength	Gasoline	60	240
4.5.11.1 ^{2/ 3/}	Capabilities	Unaged concentrate	Half-strength	Jet A	30	300
4.5.11.1	Capabilities	Unaged concentrate	Double-strength	Jet A	30	300
4.5.8	Dry Chemical Compatibility	Unaged concentrate	Full-strength	Jet A	30	240
50-ft² Fire Tests Unaged Products						
4.5.11.2 ^{3/ 4/}	Capabilities	Unaged concentrate	Full-strength	Jet A	60	270
28-ft² Fire Tests Aged Products						
4.5.9	Stability	Aged concentrate	Full-strength	Gasoline	60	240
4.5.9	Stability	Aged concentrate	Full-strength	Jet A	30	300
4.5.9	Stability	Aged concentrate	Half-strength	Jet A	30	300
NOTES:						
^{1/} Unleaded gasoline in accordance ASTM D4814 that is ethanol-free and Jet A in accordance ASTM D1655 shall be used during testing.						
^{2/} Fire test required for conformance inspection (see table III).						
^{3/} Fire tests required for retention of qualification and approval of additional facilities (see table III).						
^{4/} Products are required to achieve 75% extinguishment within 20 seconds of the start of foam application.						

3.6 Containers. The liquid concentrate shall be furnished in 5-gallon plastic containers or 55-gallon plastic containers, as specified (see 6.2). The containers shall be white in color and an approximate match to color number 17925 of SAE AMS-STD-595.

3.6.1 Five-gallon plastic containers. The 5-gallon plastic containers shall be molded polyethylene as specified herein. The containers shall be as follows:

- a. Capacity: 5 gallons (minimum).
- b. Height, body (overall): 15 inches (maximum).
- c. Diameter, body (overall): 11¾ inches (maximum).
- d. Pour opening (inside diameter): 1½ inches (minimum).
- e. UL-listed as “Component – Containers for Foam Liquid Concentrates” in accordance with UL 162.
- f. Stackable and self-supporting.
- g. Provided with a threaded-type plastic cap fitted with a gasket for the pour opening.
- h. Provided with an integrally molded or recessed plastic handle.
- i. Conform to the color specified in 3.6.
- j. The pour opening cap shall be designed to be opened using a spanner wrench compatible with 1.5-inch hose couplings that are in accordance with NFPA 1963 or similar commercially available opening device. For shipping, the caps shall be tightened to container manufacturer’s specification in accordance with 49 CFR 178.2(c)(1)(i)(B).

3.6.2 Fifty-five-gallon plastic containers. The 55-gallon plastic containers shall be molded polyethylene, size 4, in accordance with MIL-D-43703. The color shall conform to the color specified in 3.6.

3.7 Marking. Marking shall be as specified (see 3.7.1 through 3.7.5.2 and 6.2).

3.7.1 Identification marking. Identification marking shall be in accordance with MIL-STD-130. In addition, the marking on the containers shall be in black characters against a white background. The background color shall be in accordance with 3.6.

3.7.2 Marking location. Two identical markings conforming to [figure 1](#) shall be applied to the 5-gallon and 55-gallon containers so that the markings are located diametrically opposite each other.

3.7.3 Marking application. The markings shall be applied on the container in such a manner that water immersion, contact with the contents of the container, or normal handling will not impair the legibility of the marking. Paper labels shall not be used. Marking shall be applied by either a label prepared in accordance with UL 969 or screen printing.

3.7.4 Size of marking text. The height of characters in lines where words are capitalized on [figure 1](#) shall be at least 0.27 inch and the height of characters in other lines shall be at least 0.16 inch. The text shown in bold on [figure 1](#) shall be printed in bold text on the label and shall be at least 0.5 inch in height.

3.7.5 Marking content. Marking content shall conform to 3.7.5.1, 3.7.5.2, and [figure 1](#).

3.7.5.1 Batch number. Each container shall be marked with a batch number. A separate batch number shall be used for each production batch (see 6.5.3).

3.7.5.2 PFAS content marking. Each container shall be marked to state that the contents contain a maximum of 1 ppb PFAS.

THIS END UP

U.S.

FLUORINE-FREE FOAM (F3) LIQUID CONCENTRATE FOR LAND-BASED, FRESH WATER
APPLICATIONS

In accordance with

DEPARTMENT OF DEFENSE SPECIFICATION MIL-PRF-32725

TYPE 3 (3%)

DO NOT MIX WITH OTHER FOAM CONCENTRATES

This fire extinguishing concentrate is for use by dilution with fresh water in fixed or mobile systems at volume proportions of 3% (i.e., 3 gallons concentrate to 97 gallons of fresh water) at the time of use. This concentrate is not compatible and cannot be mixed in tanks with other foam concentrates including other MIL-PRF-32725 concentrates. The concentrate shall not be stored at temperatures below 35 °F or at temperatures above 120 °F.

The contents contain a maximum of 1 ppb of PFAS.

MANUFACTURER'S NAME

MANUFACTURER'S CORPORATE ADDRESS

MANUFACTURING ADDRESS

PRODUCT NAME

NSN _____

BATCH NO.

DATE OF MANUFACTURE

MANUFACTURER'S EXPIRATION DATE

THIS PRODUCT IS NOT AUTHORIZED FOR U.S. NAVY SHIPBOARD USE

FIGURE 1. Container markings.

4. VERIFICATION

4.1 Classification of inspections. The inspection requirements specified herein are classified as follows and are shown in [table III](#):

- a. Qualification inspection (see 4.2.1).
- b. Retention of qualification inspection (see 4.2.2).
- c. Conformance inspection (see 4.3).

TABLE III. Qualification, conformance, and retention of qualification inspections.

Examination or Test	Reference Paragraph		Qualification	Conformance ^{1/}	Retention of Qualification
	Requirement	Test			
Toxicity and prohibited materials	3.3	4.4	X		X
Specific PFAS content	3.3.3	4.5.7.1	X		X
Manufacturer's PFAS certification	3.3.3	4.5.7.2	X	X	X
Refractive index	3.4	4.5.1	X	X	X
Viscosity	3.4	4.5.2	X	X	X
pH value	3.4	4.5.3	X	X	X
Surface and interfacial surface tension	3.4	4.5.4	X	X	X
Foamability	3.4	4.5.5	X	X	X
General corrosion	3.4	4.5.6.1	X		
Localized corrosion	3.4	4.5.6.2	X		
Stability	3.4.1	4.5.9	X		X
Environmental impact	3.4	4.5.10	X		
Stratification	3.4	4.5.12	X		X
Precipitation	3.4	4.5.13	X		X
28-ft ² fire tests	3.5	4.5.11	X	X ^{2/}	X ^{3/}
Dry chemical compatibility	3.5	4.5.8	X		X
50-ft ² fire tests	3.5	4.5.11	X		X ^{3/}
Examination of filled containers	3.6 & 3.7	4.3.2		X	
Container cap inspection	3.6.1.j	4.5.14	X	X	X

NOTES:

^{1/} Conformance testing is conducted by the manufacturer on unaged concentrates and solutions.

^{2/} Two 28-ft² fire tests shall be conducted: (1) unaged concentrate, full-strength solution with gasoline as the fuel and (2) unaged concentrate, half-strength solution with Jet A as the fuel (see [table II](#)). Acceptance shall be as specified (see 4.5.11.1.5).

^{3/} Three fire tests shall be conducted: (1) unaged concentrate, half-strength solution against a 28-ft² fire using Jet A as the fuel, (2) unaged concentrate, full-strength solution against a 28-ft² fire using gasoline as the fuel, and (3) unaged concentrate, full-strength solution against a 50-ft² fire using Jet A as the fuel (see [table II](#)). Acceptance shall be as specified (see 4.5.11.1.5 and 4.5.11.2.5).

4.2 Qualification and retention of qualification inspections.

4.2.1 Qualification inspection (see 6.5.10). Unless otherwise specified herein, qualification inspection will be conducted by the Naval Research Laboratory (NRL). Qualification inspection is conducted on initial product submittals and shall consist of the examinations and tests specified in [table III](#).

4.2.1.1 Samples for qualification inspection. Fifty gallons of foam concentrate in 5-gallon containers shall be taken from a single production batch (see 6.5.3) for qualification inspection.

4.2.2 Retention of qualification inspection (see 6.5.11). In order to retain qualification, every 4 years the manufacturer shall obtain satisfactory test results from retention of qualification inspection conducted as specified in [table III](#). The samples for retention of qualification inspection shall be selected in accordance with 4.2.2.1. Unless otherwise specified herein, retention of qualification inspection will be conducted by NRL.

4.2.2.1 Samples for retention of qualification inspection. Fifteen gallons of foam concentrate in 5-gallon containers shall be taken from a single production batch for retention of qualification inspection.

4.2.3 Additional facilities. The inspection requirements for concentrates produced at additional facilities located in different countries shall be the same as qualification inspection (see 4.2.1). The inspection requirements for concentrates produced at additional facilities located within the same country shall be the same as retention of qualification inspection (see 4.2.2).

4.2.4 Change approval. Changes in qualified products may require requalification if any of the following have changed: formulation, materials, water source, surfactants, surfactant manufacturer, manufacturing process, or manufacturing facility location. Unless otherwise specified by the qualifying activity, changes require written approval by NAVSEA.

4.2.5 Failure. Failure to meet the requirements specified herein shall be cause for disapproval of or removal of product qualification.

4.3 Conformance inspection (see 6.5.5). The conformance inspection shall be conducted on a sample from every production batch. The samples selected in accordance with 4.3.1 shall be subjected to the examinations and tests specified in [table III](#). If the sample tested fails to meet any of the conformance inspection requirements, the production batch represented by the sample shall be rejected. The values measured for the parameters in [table III](#) shall be recorded (see 6.11).

4.3.1 Samples for conformance inspection. Five gallons of foam concentrate in a 5-gallon container shall be selected at random from every production batch or the concentrate shall be withdrawn from the agitated mixing tank prior to packaging.

4.3.2 Examination of filled containers. Each sample-filled container selected in accordance with 4.3.2.1 shall be visually examined for defects in construction of the container and the closure, for evidence of leakage, for unsatisfactory markings (see 3.7), and to ensure conformance with the container requirements (see 3.6). Each filled container shall also be weighed to determine the amount of content.

4.3.2.1 Sampling for examination of filled containers. Samples shall be randomly selected from each production batch of filled containers as specified in [table IV](#) and examined in accordance with 4.3.2. The sample size depends on the production batch size. If one or more defects are found in any container, the defective container shall be rejected and each of the remaining containers in the production batch shall be inspected.

TABLE IV. Sample size for examination of filled containers.

Production Batch Size (Number of Containers)	Sample Size (Number of Containers)
2–5	All
6–50	5
51–90	7
91–150	11
151–280	13
281–500	16
501–1,200	19
1,201–3,200	23

4.3.3 Conformance inspection reports. As specified (see 6.2), test reports shall be prepared.

4.4 Toxicity and prohibited materials.

4.4.1 Toxicity. A health and environmental risk assessment will be conducted by the qualifying activity using the framework described in the severity categories, probability levels, and risk assessment matrix in MIL-STD-882 to ensure conformance to 3.3.1. The risk assessment will be based on the results of 4.4.2 and 4.4.3.

4.4.2 Health hazard assessment (HHA). An HHA will be conducted to ensure conformance to 3.3.1 as required by the qualifying activity. The Navy and Marine Corps Public Health Center (NMCPHC) will evaluate the concentrate using data provided by the manufacturer to the NMCPHC (see 3.3.1 and 6.8.1).

4.4.3 Developmental environment, safety, and occupational health evaluation (DESHE). A DESHE will be conducted to ensure conformance to 3.3.1 as required by the qualifying activity. The Army Public Health Center (APHC) will evaluate the concentrate using data provided by the manufacturer to the APHC (see 3.3.1 and 6.8.2).

4.4.4 Prohibited materials. Concentrates will be confirmed by the NMCPHC to contain no prohibited materials in accordance with 3.3.2.

4.4.5 PFAS content. The PFAS content shall be determined as specified (see 4.5.7).

4.5 Test procedures.

4.5.1 Refractive index. The refractive index of both aged and unaged concentrates shall be determined at 25 °C using a digital refractometer.

4.5.2 Viscosity. The kinematic viscosity of both aged and unaged concentrates shall be determined at a temperature of 5 °C using capillary viscometers in accordance with ASTM D445.

4.5.3 pH value. The pH value of both aged and unaged concentrates shall be determined in accordance with ASTM E70 using a pH meter with a glass electrode and a reference electrode at 25 °C.

4.5.4 Surface and interfacial tension.

4.5.4.1 Surface tension. Comparison testing of the surface tension between unaged concentrate, full-strength solutions and aged concentrate, full-strength solutions shall be conducted using distilled water in accordance with ASTM D1331 at 25 °C.

4.5.4.2 Interfacial tension. Comparison testing of the interfacial tension with cyclohexane between unaged concentrate, full-strength solutions and aged concentrate, full-strength solutions shall be conducted using distilled water in accordance with ASTM D1331 at 25 °C.

4.5.5 Foamability. The expansion and drainage of the foam solution shall be measured using Method A of NFPA 412. The foam shall be generated by means of a 2-gallon-per-minute (gal/min) aspirating nozzle (see 6.9). During foam sample collection, the nozzle inlet pressure shall be maintained at a gauge pressure of 100 pounds per square inch (lb/in²) and the foam solution temperature at 23±5.0 °C. The nozzle shall be held at hip height and directed onto the backboard from a distance of 4 to 6 feet.

4.5.6 Corrosion. The liquid for immersion of the metal specimens for general corrosion and localized corrosion tests shall consist of a solution of 10 percent unaged concentrate and 90 percent saltwater by volume in accordance with ASTM D1141.

4.5.6.1 General corrosion.

4.5.6.1.1 Test specimens. The test specimens shall consist of the following metals identified in accordance with Unified Numbering System (UNS) designations of ASTM E527: G10100 steel, S30400 and S31600 corrosion-resistant steel (CRES), UNS C46400 brass, C90500 bronze, C70600 copper-nickel alloy, and N04400 nickel-copper. All specimens with the exception of brass and bronze shall be milled to finished dimensions of approximately $\frac{1}{16}$ inch thick, $\frac{1}{2}$ inch wide, and 3 inches long. The brass and bronze samples shall have sand-cast faces and shall be approximately $\frac{3}{16}$ inch thick, $\frac{1}{2}$ inch wide, and 3 inches long. All specimens shall be degreased in acetone, rinsed with distilled water, air dried, and weighed before exposure.

4.5.6.1.2 Test procedures. The tests shall be conducted in accordance with ASTM G31. Six weighed specimens, one of each metal, shall be fully immersed in the test medium in separate 600-milliliter (mL) beakers and held at 21 ± 3.0 °C for a period of 60 days. A watch-glass cover shall be used to retard evaporation. At the end of the exposure period, the weight loss shall be determined and the corrosion rate calculated as required.

4.5.6.2 Localized corrosion.

4.5.6.2.1 Test specimens. The test specimens shall consist of UNS S30400 and S31600 CRES milled to finished dimensions of approximately $\frac{1}{16}$ inch thick, $\frac{1}{2}$ inch wide, and 3 inches long. After degreasing with acetone, rinsing with distilled water, and air drying before exposure, the specimens shall be pretreated by immersion in a 1:9 concentrated nitric acid-water solution for a period of 5 minutes.

4.5.6.2.2 Test procedure. Ten specimens shall be girdled lengthwise with a clean $\frac{1}{16}$ to $\frac{1}{8}$ -inch wide band of gum rubber of a size such that the band is taut during the test. Because of the poor quality of most commercial rubber bands, it is recommended that the bands for this test be cut from $1\frac{3}{4}$ -inch flat width, $\frac{1}{32}$ -inch-thick pure gum amber tubing. This tubing is most easily cut into uniform strips with a blade-type paper cutter, but it can also be cut with sharp shears. The specimens girdled with the rubber bands shall be placed in a 600-mL beaker so that no contact is made between individual specimens. A $\frac{1}{4}$ -inch layer of glass beads shall be introduced into the beaker to aid in stabilizing specimen position. Enough liquid shall be added to completely immerse the specimens. A watch-glass cover shall be placed over the beaker to retard evaporation but allow air access and act as a dust cover. The assemblies shall be allowed to stand at 21 ± 3.0 °C for 60 days.

4.5.6.2.3 Results. The specimens shall be monitored weekly over the 60-day period to ascertain the presence or absence of pitting. These weekly examinations shall be made without disturbing the test. Results of the weekly examinations shall be recorded. Corrosion is customarily signaled by the appearance of a dark spot which, if removed after sufficient exposure, discloses a corrosion pit. If the suspected area cannot be positively identified by the naked eye, it can be at a magnification of $10\times$. At the end of the test, each specimen shall be inspected carefully with particular attention being given to the edges of the specimens and those areas of the specimens under or adjacent to the rubber bands. A magnification of $10\times$ shall be used, if necessary.

4.5.7 PFAS content.

4.5.7.1 Specific PFAS content.

4.5.7.1.1 Collection of samples. Collection of samples for specific PFAS testing shall be accomplished in accordance with DoD AFFF01.

4.5.7.1.2 Specific PFAS content testing provisions. Qualification inspection and retention of qualification inspection tests for specific PFAS shall be conducted by a DoD Environmental Laboratory Accreditation Program (ELAP) laboratory that is accredited to perform the analysis of aqueous film forming foam (AFFF) samples using EPA Draft Method 1633 for all of the PFAS in the method analyte list for aqueous media.

4.5.7.1.3 Testing for specific PFAS content. The evaluation of specific PFAS content shall be performed in accordance with the requirements for the evaluation of AFFF samples contained in the PFAS Analysis by LC/MS/MS table of the DoD/DOE QSM. The subsample prepared in accordance with the DoD/DOE QSM requirements shall be prepared using 0.020 gram of the F3 concentrate.

4.5.7.2 Manufacturer's PFAS certification. When specified (see 6.2) and as required by the qualifying activity, the manufacturer shall certify in writing that PFAS has not been intentionally added to the concentrate.

4.5.8 Dry chemical compatibility. The foam's compatibility with potassium bicarbonate dry chemical extinguishing agent shall be determined by measuring the burnback time (see 6.5.4) in the presence of dry chemical.

4.5.8.1 Test materials. The test shall be conducted with Jet A as the fuel in accordance with [table II](#). The dry chemical agent shall be in accordance with O-D-1407. The sieve shall be an 8-inch-diameter, 2-inch-nominal height, 40-mesh sieve in accordance with ASTM E11.

4.5.8.2 Test procedure. A 28-ft² fire test shall be conducted in accordance with 4.5.11.1 with successful fire extinguishment. Within 90 seconds after the completion of foam application, 1 pound of dry chemical agent shall be evenly distributed over the foam blanket with the aid of a sieve as specified in 4.5.8.1 and the burnback pan (1-foot diameter with 3-inch side) containing approximately 1 gallon of gasoline shall be ignited and placed in the center of the 28-ft² pan. The burnback time shall be determined as specified in 4.5.11.1.4.

4.5.9 Stability.

4.5.9.1 Sample preparation. Two gallons of foam concentrate shall be aged in lightly stoppered, 1-gallon glass containers to be used later for fire testing. The samples shall be aged at 65±2.0 °C for a period of 10 days. The sample shall be allowed to cool to 21±3.0 °C prior to testing.

4.5.9.2 Test procedure. After aging as specified in 4.5.9.1 is complete, the samples shall be subjected to the examinations and tests specified in [table V](#).

TABLE V. Stability tests.

Examination or Test	Test Paragraph	Concentrate or Solution
Refractive index	4.5.1	Aged concentrate
Viscosity	4.5.2	Aged concentrate
pH	4.5.3	Aged concentrate
Surface and interfacial tension	4.5.4	Aged concentrate, full-strength solutions
Foamability	4.5.5	Aged concentrate, full-strength solutions
Fire performance (28 ft ²)	4.5.11	Aged concentrate, full-strength solutions (gasoline) Aged concentrate, full-strength solutions (Jet A) Aged concentrate, half-strength solutions (Jet A)
Stratification	4.5.12	Aged concentrate
Precipitation	4.5.13	Aged concentrate

4.5.10 Environmental impact.

4.5.10.1 Aquatic acute toxicity. The toxicity test shall be performed on the Fathead Minnow (*Pimephales promelas*) in accordance with ASTM E729 using dynamic procedures. The minimum acceptable dissolved oxygen content of water used in this procedure shall be 5 parts per million.

4.5.10.2 Chemical oxygen demand (COD). COD shall be determined in accordance with the procedures specified in Standard Methods for the Examination of Water and Wastewater 5220.

4.5.10.3 Biodegradability. Biodegradability shall be determined by dividing the value expressed in milligrams per liter (mg/L) for the ultimate biochemical oxygen demand (BOD), determined from a 20-day BOD test in accordance with the procedures specified in method C of Standard Methods for the Examination of Water and Wastewater 5210, by the value expressed in mg/L for the COD (see 4.5.10.2).

4.5.11 Fire tests. The fire tests shall not be conducted outdoors when the wind speed is above 5 miles per hour or when there is any form of precipitation. When performing the fire tests, the ambient temperature shall be between 5 and 32 °C. To avoid adverse weather conditions, the fire tests may be performed indoors.

4.5.11.1 Twenty-eight-square-foot (28-ft²) fire test.

4.5.11.1.1 Test equipment. The fire test shall be conducted in a level, circular pan that is 6 feet in diameter, fabricated from ¼-inch-thick stainless steel with a 4-inch-high side. A shallow water layer (¾- to 1-inch depth) shall be used to protect the pan bottom and to ensure complete coverage of the area with fuel. The 2-gal/min nozzle (see 6.9) operated at a residual gauge pressure of 100 lb/in² shall be used to apply the foam to the pan.

4.5.11.1.2 Test materials. Foam solutions at 23±5.0 °C shall be made with fresh water at each of the concentration values specified in [table II](#). Acceptable ranges for these concentrations are shown in [table VI](#). The test fuels shall be as specified in [table II](#). Ten gallons of fuel shall be used for the test. Fuel and water substrate temperatures shall be 21±11.0 °C.

TABLE VI. F3 test concentration values.

Foam Solution	Concentration
Half-strength	1.45 – 1.55 % by volume
Full-strength	2.9 – 3.1 % by volume
Double-strength	5.8 – 6.2 % by volume

4.5.11.1.3 Test procedure. The fuel shall be poured into the pan within a 30-second period. The fuel shall be ignited with a propane torch at a single location near the center within 30 seconds of fueling and allowed to burn freely for 10 seconds after full involvement for both gasoline and Jet A. During the tests conducted with Jet A as the fuel, 500 mL of gasoline shall be used as an accelerant for ignition. The gasoline shall be poured into the center of the pan just prior to ignition. After the pre-burn period, the fire shall be attacked and extinguished in an expeditious manner. The fire extinguishing time shall be recorded at the exact cessation of all flame, but foam application shall continue for a total of 90 seconds. The foam shall be directed onto the fuel at all times during the test.

4.5.11.1.4 Burnback procedure. Forty-five seconds (±15 seconds) after the completion of foam application, a burnback pan (1-foot diameter with 3-inch side) containing approximately 1 gallon of gasoline shall be ignited and placed in the center of the 28-ft² pan, and a timer shall be started. The burnback pan shall be removed once sustained burning is achieved outside of the pan. Burnback time for the 28-ft² pan shall be recorded once 7 ft² (25 percent) of the total area is involved in flames (see 6.5.4).

NOTE: Intermittent flaming on the foam blanket surface may occur. Small flickers of flame over the foam surface that usually self-extinguish are not considered a part of the burnback area unless sustained burning occurs. All isolated, sustained burning areas shall be included in determining the 7-ft² total area.

4.5.11.1.5 Acceptance criteria. Each foam solution shall pass each of the 28-ft² fire tests a total of two times. A maximum of three tests may be performed in an attempt to pass each test. If two successful tests cannot be achieved within the three allowed, the concentrate shall be rejected.

4.5.11.2 Fifty-square-foot (50-ft²) fire test.

4.5.11.2.1 Test equipment. The fire test shall be conducted in a level, circular pan that is 8 feet in diameter, fabricated from ¼-inch-thick stainless steel with a 4-inch-high side. A shallow water layer (¾- to 1-inch depth) shall be used to protect the pan bottom and to ensure complete coverage of the area with fuel. The nozzle specified in 4.5.5 shall be equipped with the 3-gal/min orifice and receiver (see 6.9) to apply foam to the pan at a rate of 3 gal/min at a residual gauge pressure of 100 lb/in².

4.5.11.2.2 Test materials. Foam solutions at 23±5.0 °C shall be made with fresh water at full-strength as specified in [table II](#). The fuel shall be 15 gallons of aviation Jet A fuel as specified in [table II](#). Fuel and water substrate temperatures shall be 21±11.0 °C.

4.5.11.2.3 Test procedure. The fuel shall be poured into the pan within a 30-second period. Gasoline (500 mL) shall be used as an accelerant for ignition. The gasoline shall be poured into the center of the pan just prior to ignition. The fuel shall be ignited at a single location in the center of the pan and allowed to burn freely for 60 seconds after full involvement. After the 60-second pre-burn period, the fire shall be attacked and extinguished in an expeditious manner. The time to achieve 75 percent extinguishment shall be recorded based on visual observations. The fire extinguishing time shall be recorded at the exact cessation of all flame, but foam application shall continue for a total of 90 seconds. The foam shall be directed onto the fuel at all times during the test.

4.5.11.2.4 Burnback procedure. Forty-five seconds (± 15 seconds) after the completion of foam application, a burnback test shall be conducted as specified in 4.5.11.1.4, except that the burnback area shall be 12.5 ft² (25 percent).

4.5.11.2.5 Acceptance criteria. The foam solution shall pass the 50-ft² fire test a total of two times. A maximum of three tests may be performed in an attempt to pass the test. If two successful tests cannot be achieved within the three allowed, the concentrate shall be rejected.

4.5.12 Stratification. The presence of stratification shall be determined by visual examination of the samples.

4.5.13 Precipitation. The amount of precipitation shall be determined in accordance with the procedures of ASTM D1796.

4.5.14 Container cap inspection. The pour cap of the 5-gallon container shall be visually inspected to ensure conformance with 3.6.1.j.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or in-house contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. The concentrates covered by this specification are intended for use in land-based foam delivery systems and equipment such as firefighting trucks or foam sprinkler systems for extinguishing liquid fuel fires such as gasoline or aviation fuels. The concentrates covered by this specification are not tested to assess their adequacy for suppressing fuel in depth scenarios. The firefighting capabilities may be degraded if used on hydrocarbon fuels with alcohol additives. These concentrates are intended for use in equipment capable of proportioning at 3 percent by volume with fresh water. The foam generated by this equipment is intended to quickly extinguish liquid fuel fires, which is especially important where personnel and ordnance are in close proximity to a fire. The fire performance of foam concentrates is evaluated to this specification based on testing with air-aspirated nozzles. End users procuring foam concentrate for use in foam systems with non-air-aspirated nozzles should consult with the appropriate authority having jurisdiction and the foam manufacturer to ensure suitability for their application. For fixed systems, the discharge devices and proportioning systems should be listed for use with the foam concentrate where required.

6.1.1 DoD's future intent. DoD's goal is to acquire and use non-fluorinated foams that meet the performance requirements for critical DoD firefighting applications as replacements for the legacy Aqueous Film Forming Foam (AFFF). DoD's ultimate goal is to identify commercially available fluorine-free foams that have equivalent firefighting performance, and chemical and physical properties of the legacy AFFF covered by MIL-PRF-24385. It is important to note that AFFF performance capabilities improved over time and the performance requirements in MIL-PRF-24385 were changed as the technology developed. A similar approach is planned for this specification. DoD intends to include total fluorine or PFAS content testing as a conformance inspection requirement once multiple laboratories have been accredited to conduct the testing.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- a. Title, number, and date of this specification.
- b. Size of container required (see 3.6).
- c. Specific marking of container (see 3.7.2).
- d. Conformance inspection reports and retention of data (see 4.3.3 and 6.11).
- e. Certificate of conformance that the product does not contain any intentionally added PFAS (see 4.5.7.2).
- f. Packaging requirements (see 5.1).
- g. Activities requiring copies of completed safety data sheets (SDS) (see 6.10).
- h. A minimum shelf-life requirement of 10 years (see 6.12).

6.3 Future product development. Since F3s at the time of publication of this specification cannot meet the legacy AFFF performance, F3 manufacturers are encouraged to continue to improve their formulations in order to:

- a. Increase their extinguishment capabilities, especially against lower flashpoint fuels (e.g., gasoline) and polar solvents. Currently, the F3s take about 1.5 to 2 times longer than AFFF to extinguish fires for the same application rate.
- b. Improve burnback resistance and vapor suppression.
- c. Increase capabilities at low aspiration and expansion.
- d. Provide concentrates with spreading coefficients that approach or exceed current legacy AFFFs.
- e. Allow for the use of saltwater to make the solutions.
- f. Allow for the use of the concentrate in stored premixed solutions (e.g., portable extinguishers).
- g. Provide concentrates that are compatible and can be mixed in tanks with other F3s on the QPL.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are, at the time of award of contract, qualified for inclusion in Qualified Products List QPL No. 32725 whether or not such products have actually been so listed by that date. The attention of the contractors is called to these requirements, and manufacturers are urged to arrange to have the products that they propose to offer to the Federal Government tested for qualification in order that they may be eligible to be awarded contracts or orders for the products covered by this specification. Information pertaining to qualification of products may be obtained from Commander, Naval Sea Systems Command, ATTN: SEA 05S, 1333 Isaac Hull Avenue, SE, Stop 5160, Washington Navy Yard, DC 20376-5160 or emailed to CommandStandards@navy.mil. An online listing of products qualified to this specification may be found in the Qualified Products Database (QPD) at <https://assist.dla.mil>.

6.4.1 Provisions governing qualification. Copies of SD-6 “Provisions Governing Qualification” are available online at <https://quicksearch.dla.mil> or <https://assist.dla.mil>.

6.4.2 Additional approvals. Although not required, additional commercial listings/approvals of the concentrate, such as International Civil Aviation Organization (ICAO) Level C or UL 162, are also recommended.

6.5 Definitions.

6.5.1 Aged concentrate. Concentrate that is subjected to an elevated temperature of 65±2.0 °C for a period of 10 days.

6.5.2 Aged concentrate solution. A mixture of concentrate that has been aged and then mixed with fresh water.

6.5.3 Batch. The concentrate that is produced during a single mixing process of chemicals and transferred from one mixing tank to the shipping container(s).

6.5.4 Burnback time. The time from insertion of the burnback pan until the fire has spread to involve 25 percent of the fire test pan area.

6.5.5 Conformance inspection. A quality control measure consisting of tests and examinations conducted after contract award by the manufacturer to ensure the concentrate has not changed since it was originally qualified or has not changed from the latest approved formulation.

6.5.6 Fluorine-free. A term used to indicate that the concentrate contains a maximum of 1 ppb PFAS.

6.5.7 Fresh water. Water that contains low concentrations of dissolved salts and solids (e.g., potable water and municipal water supplies).

6.5.8 Mis-proportioned. F3 concentrations in foam solution greater or less than 3 percent by volume.

6.5.9 Polar solvents. For this specification, hydrocarbon fuels that are soluble in water or contain more than 10 percent of alcohol by volume.

6.5.10 Qualification inspection. An inspection consisting of tests and examinations conducted in advance of and independent of an acquisition to determine if the concentrate meets all the requirements of this specification. Qualification inspections are conducted as specified by the qualifying activity.

6.5.11 Retention of qualification inspection. An inspection conducted on a periodic basis consisting of tests and examinations conducted independent of an acquisition to ensure the concentrate has not changed since it was originally qualified or has not changed from the latest approved formulation, allowing the product to remain on the QPL.

6.5.12 Solution. A mixture of foam concentrate and fresh water.

6.6 DoD end-users. Products that are not marked and packaged in accordance with this specification may be acceptable to some DoD end-users.

6.7 Raw materials. The packaging requirements of referenced documents listed in section 2 do not apply to the raw materials procured for use in the concentrate formulation.

6.8 Toxicity evaluations.

6.8.1 HHA evaluation. The NMCPHC requires sufficient information to permit an HHA of the concentrate. Upon completion of the HHA, a copy will be provided by the NMCPHC to NAVSEA for evaluation. The reports may also be reviewed by the Office of the Deputy Assistant Secretary of Defense (Environment and Energy Resilience). The HHA process is guided by BUMED INSTRUCTION 6270.8, "Occupational Health Hazard Assessments" and is described on the NMCPHC's website, at <https://www.med.navy.mil/Navy-Marine-Corps-Public-Health-Center/Environmental-Health/Industrial-Hygiene/Acquisition-Technical-Support/Health-Hazard-Assessments-HHA/>).

6.8.2 DESHE evaluation. The APHC also requires sufficient information to permit a DESHE of the concentrate. The DESHE framework will be applied to assess environmental toxicity including chemical fate and transport and will incorporate environmental impact data (see 4.5.10). Upon completion of the DESHE, a copy will be provided by the APHC to NAVSEA for evaluation. The reports may also be reviewed by the Office of the Deputy Assistant Secretary of Defense (Environment and Energy Resilience). The DESHE process is described in the APHC Technical Guide No. 389, "Guide to Performing a Developmental Environment, Safety, and Occupational Health Evaluation (DESHE)." Copies of Technical Guide No. 389 are available online at <https://phc.amedd.army.mil/Pages/Library.aspx>.

6.9 Nozzle construction. A print of the nozzle construction is available from the NRL, Code 6186, Washington, DC 20375. The drawing also includes a description of the 3-gal/min orifice and receiver used during the 50-ft² fire test (see 4.5.11.2.1).

6.10 SDSs. Contracting officers will identify in the contract those activities requiring copies of completed SDSs prepared in accordance with FED-STD-313. In order to obtain the SDS, FAR clause 52.223-3 must be in the contract.

6.11 Conformance inspection reports and retention of data. Records of conformance inspections including the results of the examinations or tests specified in [table III](#) and any resulting rejections should be maintained by the manufacturer or contractor for a period of 10 years after contract completion or at an interval specified in the contract (see 6.2), whichever is greater.

6.12 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a materiel quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoDM 4140.27, DoD Shelf-Life Management Program. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for shelf-life management may be obtained from DoDM 4140.27, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Service and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life Program can be contacted through the DoD Shelf-Life Management website: <https://www.shelflife.dla.mil>.

6.13 Subject term (key word) listing.

AFFF

ARFF

FFSF

Firefighting

Fire-fighting

PFAS-Free

SFFF

CONCLUDING MATERIAL

Custodians:

Army – AV
Navy – SH
Air Force – 03
DLA – CQ

Preparing activity:

Navy – SH
(Project 4210-2022-006)

Review activities:

Army – MI
Navy – AS, CG, YD
Air Force – 84
DLA – CC

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.