

INCH-POUND

MIL-F-24385F(SH)
AMENDMENT 1
5 August 1994

MILITARY SPECIFICATION

FIRE EXTINGUISHING AGENT, AQUEOUS FILM FORMING FOAM (AFFF) LIQUID
CONCENTRATE, FOR FRESH AND SEAWATER

This amendment forms a part of MIL-F-24385F(SH), dated 07 January 1992 and is approved for use by all Departments and Agencies of the Department of Defense.

PAGE 2

2.1.1: Delete the following under Federal Specifications:

"PPP-C-1337 Containers, Metal, with Polyethylene Insert.
TT-E-489 Enamel, Alkyd, Gloss, Low VOC Content."

2.1.1: Add the following under Military Specifications:

"MIL-D-43703 Drums, Shipping and Storage, Molded
Polyethylene"

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5.1.1: Delete and substitute:

"5.1.1 The AFFF liquid concentrate shall be furnished in a 5 gallon or in a 55 gallon plastic container as specified (see 6.2d)."

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5.1.1.2, a and b: Delete and substitute:

"5.1.1.2 Fifty-five gallon container. The 55 gallon container shall be molded polyethylene, size 4, conforming to MIL-D-43703."

5.1.1.3 Delete last sentence.

Preparing activity:
NAVY-SH
(Project 4210-N496)

AMSC N/A
DISTRIBUTION STATEMENT A.
distribution is unlimited.

FSC 4210
Approved for public release;

INCH-POUND

MIL-F-24385F
7 January 1992
SUPERSEDING
MIL-F-0024385E(SH)
30 November 1990
MIL-F-24385D
26 October 1989

MILITARY SPECIFICATION

FIRE EXTINGUISHING AGENT, AQUEOUS FILM-FORMING FOAM (AFFF) LIQUID CONCENTRATE, FOR FRESH AND SEA WATER

This specification is approved for use by all departments and agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for aqueous film-forming foam (AFFF) liquid concentrate fire extinguishing agents consisting of fluorocarbon surfactants and other compounds, as required, to conform to this specification. At the time of use they shall be diluted with fresh or sea water to form a fire-extinguishing solution. Certain proportioning equipment may produce AFFF solutions of extreme concentrations; requirements for such concentrations are specified herein.

1.2 Classification. Concentrates shall be of the following types, as specified (see 6.2):

- Type 3 — To be used as three parts concentrate to ninety-seven parts water by volume solution
- Type 6 — To be used as six parts concentrate to ninety-four parts water by volume solution.

Beneficial comments (recommendations, additions, deletions) and any pertinent data which may be of use in improving this document should be addressed to: Commander, Naval Sea Systems Command, SEA 55Z3, Department of the Navy, Washington, DC 20362-5101 by using the self-addressed Standardization Document Improvement Proposal (DD Form 1426) appearing at the end of this document or by letter.

AMSC N/A

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2. APPLICABLE DOCUMENTS

2.1.1 Specifications and standards. The following specifications, and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those listed in the issue of the Department of Defense Index of Specifications and Standards (DODISS) and supplement thereto, cited in the solicitation (see 6.2).

SPECIFICATIONS**FEDERAL**

NN-P-71	Pallets, Material Handling, Wood, Stringer Construction, 2-Way and 4-Way (Partial)
O-D-1407	Dry Chemical, Fire Extinguishing, Potassium Bicarbonate
PPP-C-1337	Containers, Metal, With Polyethylene Insert
QQ-S-781	Terminal; Wire Rope Swaying Military Standard
RR-S-366	Sieve, Test
TT-E-489	Enamel, Alkyd, Gloss, Low VOC Content

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MIL-I-17214	Indicator, Permeability; Low-Mu (GO-NO-GO)
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STANDARDS**FEDERAL**

FED-STD-595	Colors Used in Government Procurement
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MILITARY

MIL-STD-129	Marking for Shipment and Storage
MIL-STD-130	Identification Marking of U.S. Military Property
MIL-STD-147	Palletized Unit Loads
MIL-STD-731	Quality of Wood Members for Containers and Pallets

(Unless otherwise indicated, copies of federal and military specifications, standards and handbooks

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are available from the Standardization Documents Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.)

2.1.2 Other Government publications. The following other Government publications form a part of this document to the extent specified herein. Unless otherwise specified, the issues are those cited in the solicitation.

PUBLICATIONS

DEPARTMENT OF TRANSPORTATION

Code of Federal Regulations, Title 49

(Application for copies should be addressed to the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.)

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DAVID W. TAYLOR NAVAL SHIP RESEARCH AND DEVELOPMENT CENTER
(DTNSRDC)

Standard Marine Bioassay Procedure for Shipboard Chemicals.

(Application for copies should be addressed to Commander, David W. Taylor Naval Ship Research and Development Center, (Code 2865), Annapolis, MD 21402.)

2.2 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of the documents which are DOD adopted are those listed in the issue of DODISS cited in the solicitation. Unless otherwise specified, the issues of documents not listed in the DODISS are the issues of the documents cited in the solicitation (see 6.2).

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

D96	Standard Test Methods for Water and Sediment in Crude Oils (DoD adopted)
D439	Standard Specification for Automotive Gasoline (DoD adopted)
D445	Standard Test Method for Kinematic Viscosity of Transparent and Opaque Liquids (and the Calculation of Dynamic Viscosity) (DoD adopted)
D1141	Standard Specification for Substitute Ocean Water
D1331	Standard Test Methods for Surface and Interfacial

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	Tension of Solutions of Surface-Active Agents
D1821	Standard Test Method for Inorganic Chlorides in Askarels
E527	Standard Practice for Numbering Metals and Alloys (UNS)
E729	Standard Practice for Conducting Acute Toxicity Tests with Fish, Macroinvertebrates and Amphibians

(Application for copies should be addressed to the American Society for Testing and Materials, 1916 Race Street, Philadelphia, PA 19103.)

AMERICAN PUBLIC HEALTH ASSOCIATION

Standard Methods for the Examination of Water and Waste Water

(Application for copies should be addressed to the American Public Health Association, 1015 15th Street NW, Suite 300, Washington, DC 20005.)

NATIONAL FIRE PROTECTION ASSOCIATION (NFPA)

NFPA No. 412 Evaluating Foam Fire Fighting Equipment on Aircraft Rescue and Fire Fighting Vehicles

(Application for copies should be addressed to the National Fire Protection Association, Batterymarch Park, Quincy, Massachusetts 02269.)

UNIFORM CLASSIFICATION COMMITTEE, AGENT

Uniform Freight Classification Ratings, Rules, and Regulations

(Application for copies should be addressed to the Uniform Classification Committee Agent, Tariff Publication Officer, Room 1106, 222 South Riverside Plaza, Chicago, IL 60606.)

(Non-Government standards and other publications are normally available from the organizations that prepare or distribute the documents. These documents also may be available in or through libraries or other informational services.)

2.3 Order of precedence. In the event of a conflict between the text of this document and the references cited herein (except for related associated detail specifications, specification sheets, or MS standards), the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

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3. REQUIREMENTS

3.1 Qualification. Liquid concentrate fire extinguishing agents furnished under this specification shall be products which are qualified for listing on the applicable Qualified Products List at the time set for opening of bids (see 4.3 and 6.4).

3.2 Materials. Concentrates shall consist of fluorocarbon surfactants plus other compounds as required to conform to the requirements specified hereinafter. The material shall have no adverse effect on the health of personnel when used for its intended purpose.

3.3 Concentrate characteristics. Concentrates shall conform to the chemical and physical requirements shown in table I.

3.3.1 Film formation and sealability. The foam produced film shall spread over the fuel surface and seal off vapor production to prevent substained ignition (see 4.7.6).

3.3.2 Stability. The concentrate (Type 3 or Type 6) and a 3 percent premix solution of Type 3 or a 6 percent premix solution of Type 6 as applicable shall conform to the following requirements after 10 days storage at 65 Celsius ($^{\circ}\text{C}$) $\pm$ 2.0 $^{\circ}\text{C}$ (see 4.7.10):

- a. Spreading coefficient: (See table I)
- b. Foamability: (See table I)
- c. Film formation and sealability: As specified in 3.3.1
- d. Fire performance, 28 square feet (ft^2) fire, 1.5 and 3 percent of Type 3 and 3 and 6 percent of Type 6 fresh and sea water solutions: As specified in 3.4
- e. Stratification: No visible evidence following test (see 4.7.14)
- f. Precipitation: 0.05 percent by volume (see 4.7.15).

3.3.3 Compatibility. The concentrates of one manufacturer shall be compatible in all proportions with concentrate furnished by other manufacturers listed on the qualified products list. The material shall also be compatible with materials in inventory which were acquired under previous issues of this specification and known to be still in use in significant quantities. Information regarding these materials may be obtained from NAVSEA. The concentrate shall conform to the following requirements after 10 days storage at 65 $^{\circ}\text{C}$ $\pm$ 2.0 $^{\circ}\text{C}$ (see 4.7.11):

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- a. Foamability: (See table I)
- b. Film formation and sealability: As specified in 3.3.1
- c. Fire performance 28 ft², 3 percent of Type 3 and 6 percent of Type 6 fresh and sea water solution: As specified in 3.4
- d. Stratification: No visible evidence following test (see 4.7.14)
- e. Precipitation: 0.05 percent by volume (see 4.7.15).

TABLE I. Chemical and physical requirements for concentrates or solutions.

Requirement	Values		Applicable publication	Test paragraph
	Type 3	Type 6		
Refractive index, minimum	1.3630	1.3580	—	4.7.1
Viscosity, centistokes			ASTM D445-74	4.7.2
Maximum at 5 °C	20	10		
Minimum at 25 °C	2	2		
Hydrogen ion concentration (pH)	7.0 to 8.5	7.0 to 8.5	—	4.7.3
Spreading coefficient, minimum	3	3	—	4.7.4
Foamability:				
Foam expansion, minimum	5.0	5.0	NFPA STD 412	4.7.5
Foam 25% drainage time, minutes, minimum	2.5	2.5	NFPA STD 412	4.7.5
Corrosion rate:				
General				
Cold rolled, low carbon steel (UNS G10100), milli in/yr, maximum	1.5	1.5	ASTM E527	4.7.7
Copper-nickel (90-10) (UNS C70600), milli in/yr, maximum	1.0	1.0	ASTM E527	4.7.7
Nickel-copper (70-30) (UNS N04400), milli in/yr, maximum	1.0	1.0	ASTM E527	4.7.7
Bronze (UNS C90500), milligrams, maximum	100	100	ASTM E527	4.7.7
Localized, corrosion-resistant (CRES) steel, (UNS S30400)	No pits	No pits	—	4.7.7
Total halides, p/m, maximum	500	250	ASTM D1821	4.7.8
Dry chemical compatibility, burn-back, resistance time, seconds, minimum	360	360	—	4.7.9
Environmental impact:				
Toxicity, LC ₅₀ , mg/L, minimum	500	1000	—	4.7.12.1
COD, mg/L, maximum	1000K	500K	—	4.7.12.2
BOD ₂₀ , minimum	.65	.65	—	4.7.12.3
COD				

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3.3.4 Total fluorine content. The total fluorine content of the AFFF shall be determined and shall not deviate more than 15 percent of the value determined and reported at time of qualification report (see 4.7.16.1).

3.4 Fire performance. The foam shall conform to the fire performance requirements shown in table II.

TABLE II. *Fire performance.*

	AFFF solutions, percent		
	1.5% of Type 3 3% of Type 6	3% of Type 3 6% of Type 6	15% of Type 3 30% of Type 6
	(Fresh and sea)	(Fresh and sea)	(Sea)
<i>28 ft² fire (see 4.7.13.1):</i>			
Foam application time to extinguish, seconds, maximum	45	30	55
Burnback time of resulting foam cover, seconds, minimum	300	360	200
<i>50 ft² fire (see 4.7.13.2):</i>			
Foam application time to extinguish, seconds, maximum		50(Sea only)	
Burnback time of resulting foam cover, seconds, minimum		360	
40-second summation, minimum		320	

3.5 Marking.

3.5.1 Identification marking shall be in accordance with MIL-STD-130. In addition, the marking on the containers (see 5.3) shall be in white characters against a green background for Type 3, a blue background for the Type 6.

3.5.2 Two identical markings conforming to figures 1 and 2 shall be applied to containers so that the markings are located diametrically opposite. The markings shall be applied on the containers in such a manner that water immersion contact with the contents of the containers, or normal handling will not impair the legibility of the marking. Paper labels shall not be used.

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4. QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for inspection. Unless otherwise specified in the contract, the contractor is responsible for the performance of all inspection requirements as specified herein. Except as otherwise specified in the contract, the contractor may use his own or any other facilities suitable for the performance of the inspection requirements specified herein, unless disapproved by the Government. The Government reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure supplies and services conform to prescribed requirements.

4.2 Classification of inspections. The inspection requirements specified herein are classified as follows:

- a. Qualification inspection (see 4.3)
- b. Quality conformance inspection (see 4.5)
 - (1) Examination of filled containers
 - (2) Quality conformance inspection.

4.3 Qualification inspection. Qualification inspection shall be conducted at a laboratory satisfactory to the Naval Sea Systems Command. Qualification inspection shall consist of the inspections and tests shown in table III.

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TABLE III. *Qualification and quality conformance inspections.*

Examination or test	Reference paragraph		Qualification	Quality conformance
	Requirement	Test		
Refractive index	3.3	4.7.1	X	X
Viscosity	3.3	4.7.2	X	X
pH value	3.3	4.7.3	X	X
Spreading coefficient	3.3	4.7.4	X	X
Foamability	3.3	4.7.5	X	X
Film formation and sealability	3.3.1	4.7.6	X	X
General corrosion	3.3	4.7.7	X	
Localized corrosion	3.3	4.7.7	X	
Total halides	3.3	4.7.8	X	X
Fluorine content	3.3.4	4.7.16	X	X
Dry chemical compatibility	3.3	4.7.9	X	
Stability	3.3.2	4.7.10	X	
Compatibility	3.3.3	4.7.11	X	
Environmental impact	3.3	4.7.12	X	
28 ft ² fire test	3.4	4.7.13	X	
50 ft ² fire test	3.4	4.7.13	X	X
Examination of filled containers		4.6		X
Torque to remove cap ¹	5.1.1.1(f)	4.7.17.2	X	X

¹Torque test to be performed a minimum of 48 hours after initial closure.

4.3.1 Samples for qualification inspection. One hundred gallons of Type 3 and 200 gallons of Type 6 are required for the qualification inspection.

4.4 Sampling for quality conformance inspection.

4.4.1 Inspection lot. A lot shall consist of all foam manufactured as one unchanged process batch and transferred from one mixing tank to the shipping container.

4.4.2 Sampling for examination of filled containers. As a minimum, the contractor shall randomly select a sample quantity from each lot of filled containers in accordance with Table IV and examine them in accordance with 4.6, 5.1.1.1, and 5.1.1.2. The sample size depends on lot size. If one or more defects are found in any sample, the entire lot shall be rejected. The contractor has the option of screening 100 percent of the rejected lot for the defective characteristic(s), or providing a new lot, which shall be examined in accordance with the sampling plan contained herein. The contractor shall maintain for a period of three years after contract completion, records of inspections, tests, and any resulting rejections.

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TABLE IV. *Sample size for examination of filled containers.*

Lot size	Sample size
2-5	All
6-50	5
51-90	7
91-150	11
151-280	13
281-500	16
501-1200	19
1201-3200	23

4.4.3 Sampling for quality conformance inspection. Three filled 5-gallon containers shall be selected at random from each lot and used as one composite sample for the tests specified in 4.6, or three 5-gallon containers of the product shall be withdrawn from an agitated mixing tank prior to packaging. The results of the tests required by 4.5 shall be submitted to NAVSEA or the designated laboratory.

4.5 Quality conformance inspection. The samples selected in accordance with 4.4.3 shall be subjected to the quality conformance inspection of table III. If the sample tested is found to be not in conformance with any of the quality conformance tests, the lot represented by the sample shall be rejected (see 6.3).

4.6 Examination of filled containers. Each sample filled container shall be examined for defects of construction of the container and the closure, for evidence of leakage, and for unsatisfactory markings. Each filled container shall also be weighed to determine the amount of contents.

4.7 Test procedure. ¹Test procedures shall be as follows:

4.7.1 Refractive index. The refractive index shall be determined at $25\text{ }^{\circ}\text{C} \pm 0.1\text{ }^{\circ}\text{C}$, using sodium vapor source lamp illumination.

4.7.2 Viscosity. The viscosity shall be determined at temperatures of $5\text{ }^{\circ}\text{C} \pm 0.1\text{ }^{\circ}\text{C}$ and $25\text{ }^{\circ}\text{C} \pm 0.1\text{ }^{\circ}\text{C}$ in accordance with ASTM D445-74, using capillary viscosimeters in the appropriate size.

4.7.3 pH value. The pH value shall be determined potentiometrically, using a pH meter with a glass electrode and a reference electrode, at $25\text{ }^{\circ}\text{C} \pm 1.0\text{ }^{\circ}\text{C}$.

4.7.4 Spreading coefficient. The spreading coefficient shall be determined with reference to cyclohexane in accordance with the following relationship:

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where: $\mathcal{S}_{a/l} = \gamma_b - \gamma_a - \gamma_i$

$\mathcal{S}_{a/l}$ = Spreading coefficient

γ_b = Surface tension of cyclohexane as determined in 4.7.4.1

γ_a = Surface tension of AFFF solution as determined in 4.7.4.1

γ_i = Interfacial tension between liquids as determined in 4.7.4.2.

4.7.4.1 Surface tension. The surface tension of 3 ± 0.05 percent of type 3 or 6 ± 0.1 percent of type 6 by volume in distilled water, as appropriate, and of reagent grade cyclohexane shall be determined with a DuNoy tensiometer, or equal, at $23^\circ\text{C} \pm 2.0^\circ\text{C}$ in accordance with ASTM D1331.

¹Where sea water is required for tests, synthetic sea water in accordance with ASTM D1141 shall be used. A sea salt mixture conforming to this standard may be purchased from Lake Products Company, Inc., P.O. Box 2248, St. Louis, Missouri 63043.

4.7.4.2 Interfacial tension. The interfacial tension between 3 ± 0.05 percent of type 3 or 6 ± 0.1 percent of type 6 by volume in distilled water, as appropriate, and reagent grade cyclohexane shall be determined with a DuNoy tensiometer, or equal, at $23^\circ\text{C} \pm 2.0^\circ\text{C}$ until the readings come to equilibrium and in accordance with ASTM D1331.

4.7.5 Foamability. The foam shall be generated by means of a special 2 gallons per minute (gal/min) test nozzle. The basic nozzle, as made by National Foam System, Inc., Lionville, Pennsylvania, (or equal) shall be modified by shortening the length of the foam barrel from 2-1/2 to 1-1/4 inches, and by adding a "wing-tip" spreader on the outlet. The spreader shall have a 1/8 inch wide, circular orifice, 1-7/8 inches long. (It may be made by slightly compressing a Bernz-o-matic TX-1527, or equal, flame spreader). A print of the nozzle construction is available from the Naval Research Laboratory, Code 6180, Washington, DC 20375. During foam sample collection, the nozzle inlet pressure shall be maintained at a gauge pressure of 100 pounds per square inch (lb/in^2), and the solution temperature at $23^\circ\text{C} \pm 5.0^\circ\text{C}$. The nozzle shall be held at hip height and directed onto the backboard from a distance of 4 to 6 feet. The method and procedure shall be in accordance with NFPA 412. Foamability shall be run on 6 percent fresh and sea water solutions of the type 6 concentrate and 3 percent fresh and sea water solutions of the type 3 concentrate.

4.7.6 Film formation and sealability.

4.7.6.1 Test equipment. A CRES graduated measure of 1,000 milliliter (mL) capacity (4-1/2 inches in diameter, 5 inches deep; Cole-Parmer Co., Chicago, Illinois, or equal) shall be fitted with two retaining clips at the top edge. The clips serve to restrain a cone 5 inches in

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height and 4-3/4 inches in diameter, made of 80-mesh perforated CRES, in an inverted position inside the measure. The 2 gal/min nozzle specified in 4.7.5 shall be used for foam production.

4.7.6.2 Test procedure. After placing 400 mL of water and 200 mL of 98-percent cyclohexane in the measure, 200 mL of freshly-made foam shall be poured onto the fuel. The inverted cone shall be pushed down into the measure, thereby pushing most of the foam aside but allowing the film-producing liquid to creep in through the mesh openings. A foam-free surface shall be created by manually scooping out most of the residual foam from the center of the cone. After a 1-minute waiting period, a pilot flame shall be passed over the fuel surface at a height of about 1/2 inch. A small flash is permitted, but no sustained ignition shall result, if an effective vapor seal is present. A 1-inch long pilot flame shall be provided with a hand-held propane cylinder fitted with a capillary tubing outlet.

4.7.7 Corrosion. The liquid for immersion of the metal specimens for general corrosion and localized corrosion tests shall consist of the concentrate diluted by 10 percent by volume with sea water.

4.7.7.1 General corrosion.

4.7.7.1.1 Test specimens. The test specimens shall consist of the following metals, in accordance with UNS designations (see ASTM E527): G10100 steel, C70600 copper-nickel alloy, N04400 nickel-copper and C90500 bronze. All specimens, except the bronze, shall be milled to finished dimensions of approximately 1/16 inch thick, 1/2 inch wide, and 3 inches long. The bronze shall have sand cast faces and be approximately 3/16 inch thick, 1/2 inch wide, and 3 inches long. All specimens shall be degreased in acetone, rinsed with distilled water, and air dried before exposure. (Prepared metal specimens may be obtained from the Metaspec Company, Box 27707, San Antonio, Texas 27227-0707.)

4.7.7.1.2 Test procedures. Five weighed specimens of each metal shall be fully immersed in the test medium in a separate 600 mL beaker and held at room temperature 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.

4.7.7.2 Localized corrosion.

4.7.7.2.1 Test specimens. The test specimens shall consist of UNS S30400 CRES milled to finished dimensions of approximately 1/16 inch thick, 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.

4.7.7.2.2 Procedure. Ten specimens shall be girdled lengthwise with a clean 1/16 to 1/8 inch wide band of a good grade 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

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bands for this test be cut from 1-3/4 inch flat width pure gum amber tubing (Preiser Scientific Rubber tubing, Pure Gum, Gooch type, 1/32-inch thin wall, pure gum amber tubing, very elastic, especially made for Gooch crucibles, or equal). This tubing is most easily cut into uniform strips with a blade-type papercutter, but 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 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, and a watch-glass shall be placed over the beaker to retard evaporation (but allow air access) and act as a dust cover, and the assemblies allowed to stand at room temperature for 60 days.

4.7.7.2.3 Results. The specimens shall be monitored daily over the 60-day period to ascertain the presence or absence of pitting. These daily examinations shall be made without disturbing the test (other than removing the cover). 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 10X. 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. 10X magnification shall be used, if necessary.

4.7.8 Total halides. The halide content shall be determined to be in accordance with ASTM D1821, except for the following modifications:

a. Procedure:

- (1) Weight 4 ± 0.1 g or add 4 ± 0.1 mL of concentrate into a 250 mL beaker
- (2) Add 75 mL of acetone. Add 2 mL of dilute nitric acid (one volume of concentrated acid to 60 volumes of water).

b. The calculation shall be modified as follows:

$$\text{Halide content, p/m} = 44.4(A-B).$$

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

4.7.9.1 Test materials. The fuel shall be unleaded gasoline conforming to ASTM D439. The dry chemical agent shall conform to O-D-1407. The sieve shall be an 8-inch diameter, 40 mesh sieve conforming to type I, style A of RR-S-366.

4.7.9.2 Test procedure. A 28-square-foot fire test shall be conducted in accordance with 4.7.13.1 using type 3 or 6 AFFF sea water solution, as required. Before placing the burning pan, one pound of dry chemical agent shall be evenly distributed over the foam blanket with the aid of a sieve on a long handle. This shall be accomplished within a 30-second period so that the total time from end of foam application to placement of the burning pan will be not

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longer than 90 seconds. The burnback time shall be determined as in 4.7.13.1.4.

4.7.10 Stability.

4.7.10.1 Sample preparation. Samples of concentrate, and type 3 and type 6 AFFF fresh water and sea water solution, as appropriate, shall be prepared in sufficient quantity to perform the required tests. One liter (L) of each shall be placed in lightly stoppered glass cylinders. All samples shall then be stored at $65^{\circ}\text{C} \pm 2.0^{\circ}\text{C}$ for a period of 10 days. The samples shall then be subjected to the following tests:

- | | |
|--|---------------------|
| a. Spreading coefficient | 4.7.4 |
| b. Foamability | 4.7.5 |
| c. Film formation and sealability | 4.7.6 |
| d. Fire performance (28 ft^2) | 4.7.13.1 |
| e. Stratification | 4.7.14 |
| f. Precipitation | 4.7.15 ¹ |

¹In the preparation of the samples to be used for the precipitation test, the synthetic sea water shall be filtered prior to use.

4.7.11 Compatibility.

4.7.11.1 Sample preparation. The Government will provide samples of appropriate qualified product(s) to manufacturers officially authorized to submit candidate material for qualification (see 3.3.3). Mixtures, of the type 3 and type 6 concentrates, to be tested shall be prepared in sufficient quantities to perform the required tests. (For qualification testing, the testing activity will determine the number of product mixtures to be evaluated and the ratio of product comprising these mixtures.) Additionally, 3 percent of type 3 or 6 percent of type 6 AFFF fresh water and sea water solutions shall be prepared from each concentrate mixture. One L of each shall be placed in lightly stoppered glass cylinders. The samples shall be stored at $65^{\circ}\text{C} \pm 2.0^{\circ}\text{C}$ for a period of 10 days. The samples shall then be subjected to the following tests:

- | | |
|--|----------|
| a. Foamability | 4.7.5 |
| b. Film formation and sealability | 4.7.6 |
| c. Fire performance (28 ft^2) | 4.7.13.1 |
| d. Stratification | 4.7.14 |
| e. Precipitation | 4.7.15 |

4.7.12 Environmental impact.

4.7.12.1 Toxicity. Toxicity test shall be performed on the Killiefish (*Fundulus heteroclitus*) in accordance with ASTM E729, using dynamic procedures. The minimum acceptable dissolved oxygen content of water used in this procedure shall be 5 p/m.

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4.7.12.2 Chemical oxygen demand (COD). COD shall be determined in accordance with procedures in Standard Method for the Examination of Water and Waste Water (latest applicable edition).

4.7.12.3 Biodegradability. Biodegradability shall be determined by dividing the value expressed in mg/L for the 20-day biological oxygen demand (BOD₂₀) determined from 5-day BOD test in accordance with the procedure specified in Standard Methods for the Examination of Water and Waste Water (latest applicable edition) by the value expressed in mg/L for chemical oxygen demand (COD) determined as specified in 4.7.12.2.

4.7.13 Fire test.¹ No fire test shall be conducted when the wind speed is above 10 miles per hour (mi/hr).

4.7.13.1 Twenty-eight-square-foot fire test.

¹These tests are normally conducted indoors to avoid adverse weather conditions.

4.7.13.1.1 Test equipment. The fire test shall be conducted in a level, circular pan 6 feet in diameter, fabricated from 1/4-inch thick steel with a 4-inch high side. A shallow water layer shall be used to protect the pan bottom and to ensure complete coverage of the area with fuel. The nozzle used for foam application shall be the 2 gal/min device specified in 4.7.5.

4.7.13.1.2 Test materials. Foam shall be generated at 23 °C ± 5.0 °C from AFFF solutions made with fresh or sea water, as required, at concentration values shown in table V. The fuel shall be 10 gallons of unleaded gasoline conforming to ASTM D439.

TABLE V. AFFF test concentration values.

Solutions	Type 3	Type 6
Lean ¹	1.5 ± 0.03	3 ± 0.1
Normal strength	3 ± 0.05	6 ± 0.1
Rich ²	15 ± 0.2	30 ± 0.2

¹One test with fresh water and one with sea water.

²One test with sea water.

4.7.13.1.3. Test procedure. The fuel shall be dumped within a 30-second period. The fuel shall be ignited within 30 seconds of fueling and allowed to burn freely for 10 seconds. After the preburn period, the fire shall be attacked and extinguished as expeditiously as possible and 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.

4.7.13.1.4 Burnback procedure. Within 60 seconds of the completion of foam application, a burning pan (1-foot in diameter with 2-inch side) containing one gallon of unleaded gasoline

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shall be placed in the center of the 28-square-foot pan and a timer started. When it appears that the fire has spread outside the pan so that burning will continue after pan removal, the pan shall be removed. The burnback time is that time at which it is estimated that 7 square feet (25 percent) of the total area is involved in flames.

NOTE

Intermittent "flash-overs" may occur. They are characterized by creeping faint blue or invisible flames over the foam surface which usually self-extinguish. They are not considered a part of the burnback area unless sustained burning occurs. All isolated, sustained burning areas shall be included in arriving at the 7-square-foot total area.

4.7.13.2 Fifty-square-foot fire test.

4.7.13.2.1 Test site. The fire test shall be conducted on a level, circular area 8 feet in diameter. The base and surrounding wall shall be suitable for containment of the fuel on a substrate of water. The water depth shall be the minimum required to ensure complete coverage of the area with the fuel.

4.7.13.2.2 Test equipment. The nozzle used for foam application shall be the 2 gal/min device specified in 4.7.5, operated at a gauge pressure of 100 lb/in².

4.7.13.2.3 Test materials. The foam shall be generated at 23 °C ± 5.0 °C from 3 ± 0.05 percent of type 3 or 6 ± 0.1 percent of type 6 AFFF solutions made with sea water. The fuel shall be 15 gallons of unleaded gasoline conforming to ASTM D439.

4.7.13.2.4 Test procedure. The fuel shall be dumped into the area in less than 60 seconds and ignited in less than 30 seconds after fuel dumping is completed. After allowing a preburn period of 10 seconds the fire shall be attacked and extinguished in an expeditious manner. At 10-second intervals after the start of foam application, observers shall estimate the percentage of fire area extinguished. The percentages at 10, 20, 30, and 40 seconds shall be totaled to give the "40-second summation" value. The exact extinguishing time shall also be recorded at the cessation of all flame, but foam application shall continue for a total of 90 seconds.

4.7.13.2.5 Burnback procedure. Within 60 seconds of the completion of foam application, a burnback test shall be conducted as specified in 4.7.13.1.4, except that the burnback area shall be 12.5 square feet (25 percent).

4.7.14 Stratification. The presence of stratification shall be determined by visual examination of the samples contained in the glass cylinders.

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4.7.15 Precipitation. The amount of precipitation shall be determined by centrifuging the 100 mL sample withdrawn from the 1-L sample after thorough agitation in accordance with the primary method of ASTM D96

4.7.16 Fluorine content.

4.7.16.1 Qualification. The total fluorine content shall be determined. The total fluorine content and the test procedure used to determine the content shall be furnished as part of the qualification inspection report.

4.7.16.2 Quality conformance inspection. The total fluorine content shall be determined in accordance with the test procedure furnished with the qualification inspection report (see 4.7.16.1). The total fluorine content shall be included in the quality conformance inspection report.

4.7.17 Packaging inspection. Sample packages and packs and the inspection of preservation, packaging, packing, and marking for shipment and storage shall be in accordance with the requirements of 4.6, section 5 and the documents specified therein. The magnetic permeability test (for metal handles of 5-gallon containers) of 4.7.17.1 and the torque test (for the pour cap of 5-gallon containers) of 4.7.17.2 shall be included.

4.7.17.1 Magnetic permeability (metal handles of 5-gallon containers). The metal handles of the 5-gallon containers shall be checked to determine conformance with the magnetic requirements of 5.1.1.1.1.d using a permeability indicator, low-mu (GO-NO-GO) in accordance with MIL-I-17214.

4.7.17.2 Torque test (pour cap of 5-gallon container). The pour cap of the 5-gallon container shall be subjected to a torque test to determine conformance with 5.1.1.1.1.f.

5. PACKAGING

(The packaging requirements specified herein apply only for direct Government acquisitions. For the extent of applicability of the packaging requirements of referenced documents listed in section 2, see 6.5).

5.1 Preservation-packaging. Preservation-packaging for level A shall be as specified hereinafter.

5.1.1 The AFFF liquid concentrate shall be furnished in a 5-gallon plastic container or in a 55-gallon composite container as specified (see 6.2.d).

5.1.1.1 Five-gallon plastic container. The container shall be molded polyethylene as specified herein. The container shall be as follows:

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- | | |
|-------------------------------|----------------------|
| a. Capacity | 5-gallon (min.) |
| b. Height, body (overall) | 15-inches (max.) |
| c. Diameter, body (overall) | 11-3/4 inches (max.) |
| d. Pour opening (inside dia.) | 1-1/2 inches (min.) |

5.1.1.1.1 The container shall meet the requirements of Department of Transportation Specification Number 34 as specified in the Code of Federal Regulations, Title 49, Part 178.19, and as follows:

- a. Shall be stackable and self-supporting.
- b. Shall be provided with a threaded-type plastic cap fitted with a gasket for the pour opening.
- c. May be provided with a vent opening having an easily punctured membrane. When furnished, vent opening shall be provided with a threaded type plastic cap.
- d. Shall be provided with an integrally molded or recessible plastic or metal handle. Metal handles shall not exceed a magnetic permeability of 2.0.
- e. Shall have colors conforming to 5.1.1.3, type 3 green, type 6 blue.
- f. The torque required to remove the pour opening cap shall not exceed 50 inch pounds.

5.1.1.2 Fifty-five gallon container. The 55-gallon container shall be a composite comprised of a plastic insert and a steel drum overpack. The composite container shall conform to the requirements of type II, class 4 of PPP-C-1337, and the following:

- a. *Insert.* The insert shall contain two protruding openings in the top head – one 3/4-inch and one 2-inch. Openings shall be so designed that when positioned in the steel drum cover there will be no strain on the protruding openings. The protruding plastic openings shall be secured to the drum cover by means of lock or retaining rings and gaskets. Openings shall be closed by use of NPT threaded plastic plugs.
- b. *Covers.* The steel drum cover shall be provided with two openings to accommodate the protruding insert openings. Covers shall be fully removable. Cover gaskets are not required. Covers shall be secured to the steel drum with minimum 16-gauge bolt or lever lock type locking rings.

5.1.1.3 Exterior color and coating. The green color (see 3.5) shall be an approximate match to color number 14187 of FED-STD-595. The blue color (see 3.5) shall be an approximate match to color number 15123 of FED-STD-595. Exterior coating for steel drum overpacks shall conform to TT-E-489.

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5.2 Packing. For level A no further packing is required.

5.2.1 Method of shipment shall comply with Uniform Freight Classification Ratings, Rules, and Regulations or other carrier rules as applicable to the mode of transportation.

5.2.2 Palletization.

- a. Thirty-six 5-gallon plastic containers shall be palletized in accordance with the requirements of MIL-STD-147, load type XVII. Pallets conforming to NN-P-71, type V, class I, wood group optional, size 2, are acceptable. Containers shall be properly and firmly nested and arranged to ensure a snug, non-shifting load. Pallet dimensions may be adjusted to ensure a snug, non-shifting load, but shall not exceed 43 x 52 inches.
- b. *Inverted caps.* The inverted cap shall be the open sheathing type, wood group optional.
- c. *Top wood cap.* The top wood cap shall be the closed sheathing (plywood) wood cap, wood group optional for slats. In addition, each corner of the plywood cap shall be secured to the end and side slats with strapping. Strapping shall be 3/4 inch by 0.035 inch and shall extend a minimum of 3 inches into the plywood top and slats. Nails used to secure the strapping shall be clinched.
- d. *Strapping.* All primary, secondary, auxiliary, and horizontal strapping shall not be less than 1-1/4 inches by 0.035 inches. Strapping shall conform to QQ-S-781, class 1, type I or IV, finish B. Cross ties shall be applied in accordance with MIL-STD-147.
- e. *Side frames.* Minimum size of side frame members shall be a nominal 1 X 6 inches conforming to group I, II, III, or IV of MIL-STD-731. Nails used to secure flat surfaces of side frames shall be clinched not less than 1/4 inch.

5.3 Marking. In addition to the marking specified in 3.5 and any special marking required (see 6.2.), containers and palletized unit loads shall be marked in accordance with MIL-STD-129.

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 concentrate is intended for use in mechanical foam generating equipment such as fire-fighting trucks or foam sprinkler systems for extinguishing fires in flammable liquids such as gasoline or fuel oils. Type 6 is intended for use in proportioners designed to dispense only the 6 percent solution (usually shipboard fire protection systems).

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Type 3 may be used in any equipment capable of proportioning at variable rates or at fixed 3 percent solution.

6.2 Acquisition requirements. Acquisition document should specify the following:

- a. Title, number, and date of this specification
- b. Issue of DODISS to be cited in the solicitation, and if required the specific issue of individual documents referenced (see 2.1.1 and 2.2)
- c. Type of concentrate required (see 1.2)
- d. Size of container required (see 5.1.1)
- e. Special marking, if required (see 5.3).

6.3 Consideration of data requirements. The following data requirements should be considered when this specification is applied in a contract. The applicable Data Item Description (DID's) should be reviewed in conjunction with the specific acquisition to ensure that only essential data are requested/provided and that the DID's are tailored to reflect the requirements of the specific acquisition. To ensure correct contractual application of the data requirements, a Contract Data Requirements List (DD Form 1423) must be prepared to obtain the data, except where DOD FAR Supplement 27.475-1 exempts the requirements for a DD Form 1423.

Reference paragraph	DID number	DID title	Suggested tailoring
4.5 DI-T-2072	Test Report	—	

The above DID was cleared as of the date of this specification. The current issue of DOD 5010.12-L, Acquisition Management Systems and Data Requirements Control List (AMSDL), must be researched to ensure that only current, cleared DID's are cited on the DD Form 1423.

6.4 Qualification. With respect to products requiring qualification, awards will be made only for products which are at the time set for opening of bids, qualified for inclusion in the applicable Qualified Products List QPL 24385 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. The activity responsible for the Qualified Products List is Naval Sea Systems Command, SEA 51222, Department of the Navy, Washington, DC 20362-5101, and information pertaining to qualification of products may be obtained from that activity. Application for Qualification tests shall be made in accordance with Provisions Governing Qualification SD-6 (see 6.4.1).

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6.4.1 Copies of Provisions Governing Qualification SD-6 may be obtained upon application to Standardization Document Order Desk, Building 4D, 700 Robbins Avenue, Philadelphia, PA 19120-5099.

6.5 Sub-contracted material and parts. The packaging requirements of referenced documents listed in section 2 do not apply when material is acquired by the contractor for incorporation into the concentrate and lose separate identity when the concentrate is shipped.

6.6 Changes from previous issue. Marginal notations are not used in this revision to identify changes with respect to the previous issue, due to the extensiveness of the changes.

Preparing activity:
Navy – SH
(Project 4210-0445)

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THIS END UP

U.S.

AQUEOUS FILM FORMING FOAM (AFFF) LIQUID CONCENTRATE

in accordance with

MILITARY SPECIFICATION MIL-F-24385F

TYPE 3 (3%)

THIS FIRE EXTINGUISHING CONCENTRATE IS FOR USE BY DILUTION WITH WATER IN FIXED OR MOBILE SYSTEMS. IT MAY BE USED ALONE OR IN COMBINATION WITH "TWINNED" DRY CHEMICAL EQUIPMENT. THE CONCENTRATE MAY BE DILUTED FOR USE IN FLOW PROPORTIONING EQUIPMENT WITH SEA WATER OR FRESH WATER AT VOLUME PROPORTIONS OF THREE GALLONS CONCENTRATE TO 97 GALLONS WATER. IT MAY ALSO BE DILUTED FOR READY-USE STORAGE AT A THREE PERCENT PREMIX SOLUTION WITH FRESH WATER. FOR READY USE DO NOT STORE BELOW 32 °F. AVOID PROLONGED STORAGE ABOVE 120 °F. DO NOT MIX WITH OTHER THAN LIQUID CONCENTRATE IN ACCORDANCE WITH MIL-F-24385E(SH) (AND PREVIOUS ISSUES) AND WATER.

MANUFACTURER'S NAME
ADDRESS
BATCH NO.
DATE OF MANUFACTURE

FIGURE 1. *Type 3 container markings.*

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THIS END UP

U.S.

AQUEOUS FILM FORMING FOAM (AFFF) LIQUID CONCENTRATE

In accordance with

MILITARY SPECIFICATION MIL-F-24385F

TYPE 6 (6%)

THIS FIRE EXTINGUISHING CONCENTRATE IS FOR USE BY DILUTION WITH WATER IN FIXED OR MOBILE SYSTEMS. IT MAY BE USED ALONE OR IN COMBINATION WITH "TWINNED" DRY CHEMICAL EQUIPMENT. THE CONCENTRATE MAY BE DILUTED FOR USE IN FLOW PROPORTIONING EQUIPMENT WITH SEA WATER OR FRESH WATER AT VOLUME PROPORTIONS OF SIX GALLONS CONCENTRATE TO 94 GALLONS WATER. IT MAY ALSO BE DILUTED FOR READY-USE STORAGE AS A SIX-PERCENT PREMIX SOLUTION WITH FRESH WATER. FOR READY USE DO NOT STORE BELOW 32 °F. AVOID PROLONGED STORAGE ABOVE 120 °F. DO NOT MIX WITH OTHER THAN LIQUID CONCENTRATE IN ACCORDANCE WITH MIL-F-24385E(SH) (AND PREVIOUS ISSUES) AND WATER.

MANUFACTURER'S NAME
ADDRESS
BATCH NO.
DATE OF MANUFACTURE

FIGURE 2. *Type 6 container markings.*

STANDARDIZATION DOCUMENT IMPROVEMENT PROPOSAL

INSTRUCTIONS

1. The preparing activity must complete blocks 1, 2, 3, and 8. In block 1, both the document number and revision letter should be given.
2. The submitter of this form must complete blocks 4, 5, 6, and 7.
3. The preparing activity must provide a reply within 30 days from receipt of the form.

NOTE: This form may not be used to request copies of documents, nor to request waivers, or clarification of requirements on current contracts. Comments submitted on this form do not constitute or imply authorization to waive any portion of the referenced document(s) or to amend contractual requirements.

I RECOMMEND A CHANGE:		1. DOCUMENT NUMBER MIL-F-24385F	2. DOCUMENT DATE (YYMMDD) 7 JANUARY 1992
3. DOCUMENT TITLE FIRE EXTINGUISHING AGENT, AQUEOUS FILM- FORMING FOAM (AFFF) LIQUID CONCENTRATE			
4. NATURE OF CHANGE (Identify paragraph number and include proposed rewrite, if possible. Attach extra sheets as needed.)			
5. REASON FOR RECOMMENDATION			
6. SUBMITTER			
a. NAME (Last, First, Middle Initial)		b. ORGANIZATION	
c. ADDRESS (Include Zip Code)		d. TELEPHONE (Include Area Code) (1) Commercial (2) AUTOVON (If applicable)	7. DATE SUBMITTED (YYMMDD)
8. PREPARING ACTIVITY			
a. NAME COMMANDER NAVAL SEA SYSTEMS COMMAND (56Y5)		b. TELEPHONE (Include Area Code) (1) Commercial (703) 602-5545 (2) AUTOVON (AV) 332-5545	
c. ADDRESS (Include Zip Code) WASHINGTON, DC 20362-5101		IF YOU DO NOT RECEIVE A REPLY WITHIN 45 DAYS, CONTACT: Defense Quality and Standardization Office 5203 Leesburg Pike, Suite 1403, Falls Church, VA 22041-3466 Telephone (703) 756-2340 AUTOVON 289-2340	