



DEPARTMENT OF THE NAVY
NAVAL RESEARCH LABORATORY
4555 OVERLOOK AVE SW
WASHINGTON DC 20375-5320

IN REPLY REFER TO:
3905

Ser 6180/0047

30 JUN 1997

From: Commanding Officer, Naval Research Laboratory

To: Commander, Naval Sea Systems Command (Code 03R42 E. Minor)

Subj: RESULTS OF QUALIFICATION TESTING OF AQUEOUS FILM-FORMING FOAM
(AFFF) LIQUID CONCENTRATE FIRE EXTINGUISHING AGENT
MANUFACTURED BY CHEMGUARD, INC.

Ref: (a) NAVSEA Ltr 03R42/454 of 24 Jun 96, "Authorization to Perform
Qualification Testing on Chemguard's Fire Extinguishing Agent"

Encl: (1) Two copies of subject report

1. In accordance with reference (a), Chemguard's 3% AFFF C-301 fire extinguishing agent, Lot 061196A, was tested to determine compliance with the requirements of the AFFF Military Specification MIL-F-24385F. Detailed results of these tests are forwarded for your review as enclosure (1). This work was sponsored by Chemguard, Inc.

2. Chemguard's AFFF 3% C-301, Lot 061196A, as supplied by the manufacturer complied with the requirements of the Military Specification MIL-F-24385F, 7 January 1992, except for the requirement specified in paragraph 5.1.1.1f of the Military Specification that the torque necessary to remove the cap of the five gallon container not exceed 50 in/lbs.

3. Chemguard's AFFF 3% C-301, Lot 061196A is recommended for inclusion in the Qualified Products List when Chemguard, Inc. demonstrates compliance with the cap opening torque requirement required by Military Specification MIL-F-24385F, 7 January 1992.

4. The point of contact at the Navy Technology Center for Safety and Survivability is Dr. Frederick W. Williams (202) 767-2476; email, fwilliams@itd.nrl.navy.mil. For further information about the Center, visit our Web Site at <http://chemdiv-www.nrl.navy.mil/6180/6180.html-ssi>.

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Subj: RESULTS OF QUALIFICATION TESTING OF AQUEOUS FILM-FORMING FOAM (AFFF) LIQUID CONCENTRATE FIRE EXTINGUISHING AGENT MANUFACTURED BY CHEMGUARD, INC.

- Ref: (a) NAVSEA letter Ser.. 03R42/454 of 24 June 1996, "Authorization to Perform Qualification Testing on Chemguard's Fire Extinguishing Agent".
(b) Military Specification, "Fire Extinguishing Agent, Aqueous Film-Forming Foam (AFFF) Liquid Concentrate, for Fresh and Sea Water," MIL-F-24385F, 7 January 1992.
(c) Qualified Products List, QPL-24385-25, May 1992, which lists products that have been qualified in accordance with reference (b)

1. Chemguard Incorporated submitted a 3% Aqueous Film Forming Foam Fire Extinguishing Agent, designated as 3% AFFF C-301, Lot 061196A, to the Naval Research Laboratory (NRL) for qualification testing (reference (a)) for compliance with the requirements of reference (b). Chemguard's 3% AFFF Lot 061196A passed the criteria required by reference (b) for qualification and inclusion in reference (c), except that it exceeded the cap opening torque required by paragraph 5.1.1.1.1f of reference (b). The results of the qualification testing that demonstrated compliance with the requirements are presented in Tables 1 through 7; the cap torque criteria that it was not in compliance with, and results of the tests, are listed in bold, under lined print in Table 1, and outlined briefly below in paragraph 2a.

2. The contents of each Table are briefly outlined as follows, with a summary in 2a of the failed criteria required by reference (b) for the cap opening torque.

a. Table 1: Chemical and Physical requirements. The torque necessary to open all of the 5 gallon containers submitted for testing exceeded the specified maximum of 50 in/lbs. The average torque as tested was 114 in/lbs.

b. Table 2: Fire Performance Test, 28 ft² fire, fresh concentrate.

c. Table 3: Fire Performance Test, 50 ft² fire, fresh concentrate.

d. Table 4: Concentrate Stability Fire Performance Test, 28 ft² fire, aged concentrate.

e. Table 5: Solution Stability Fire Performance Test, 28 ft² fire, aged solution.

f. Table 7: Agent Compatibility Fire Performance Test, 28 ft² fire, aged concentrates.

Encl (1) to NRL Ltr
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Table 1. Chemical and Physical Requirements for Concentrates or Solutions.

Requirement	Pass / Fail Criteria	Results
Refractive index, minimum	1.3630	1.3657
Viscosity (Centistoke) Maximum @ 5°C Minimum @ 25°C	20 2	9 7
Hydrogen Ion Concentration (pH)	7.0 to 8.5	8.22
Spreading Coefficient, dynes/cm, minimum	3	4.1
Film Formation and Sealability	No sustained ignition	No ignition
Foamability: Foam Expansion Ratio, minimum Fresh Agent Test: Fresh Water / Sea Water Stability Test, concentrate: Fresh Water / Sea Water Stability Test, solution: Fresh Water / Sea Water Compatibility Tests: Fresh Water / Sea Water Foam 25% Drainage Time, minutes, minimum Fresh Agent Test: Fresh Water / Sea Water Stability Test, concentrate: Fresh Water / Sea Water Stability Test, solution: Fresh Water / Sea Water Compatibility Tests: Fresh Water / Sea Water	5.0:1 2.5	8.85 / 8.30 9.95 / 8.65 8.95 / 7.65 9.30 / 8.40 3.7 / 3.0 3.9 / 3.7 2.8 / 3.4 3.7 / 3.7
Corrosion Rate: General Cold rolled, Low carbon steel (UNS G10100) mili in/yr, maximum Copper-Nickel (90-10) (US C70600) mili in/yr, maximum Nickel-Copper (70-30) (US N04400) mili in/yr, maximum Bronze (UNS C90500), milligrams maximum Localized, corrosion-resistant (CRES) steel, UNS S30400	 1.5 1.0 1.0 100 No pits	 1.24 0.48 0.41 4.0 No Pits
Total Halides, ppm maximum	500	160
Dry chemical compatibility, burn -back resistance time 360 seconds minimum	360	474
Environmental impact: Toxicity, LC ₅₀ , mg/L, minimum COD, mg/L, maximum BOD ₂₀ , minimum COD	500 1,000,000 0.65	566.7 mg/L 260,544 mg/L 1.27
Fluorine content, mg/L	-----	9,920 mg/L
Stratification : Stability Test Compatibility Test	None None	None None
Precipitation, % by Volume: Stability Test Compatibility Test, 1:1 Ratio Mixes Compatibility Test, All Agent Mix	<0.05 <0.05 <0.05	None None <0.05
Container cap opening torque (average)	50 in/lbs max	114 in/lbs

Table 2. 28 ft² Fire Performance Test Results: Chemguard Fresh Concentrate.

PROPERTY MEASURED	EXTINGUISHMENT TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME CRITERIA	ACTUAL TIMES
Fresh Water Full Strength	30 Sec (Max)	25	360 Sec (Min)	378
Fresh Water Half Strength	45 Sec (Max)	42	300 Sec (Min)	460
Sea Water Full Strength	30 Sec (Max)	23	360 Sec (Min)	433
Sea Water Half Strength	45 Sec (Max)	45	300 Sec (Min)	474
Quintuple Strength (15%) Sea Water	55 Sec (Max)	31	200 Sec (Min)	406

Table 3. 50 ft² Fire Performance Test Results: Chem Guard Fresh Concentrate

PROPERTY MEASURED	EXTINGUISHMENT TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME CRITERIA	ACTUAL TIMES	40 SECOND SUMMATION	ACTUAL TOTAL
Sea Water Full Strength	50 Sec (Max)	34	360 Sec (Min)	395	320 (Min)	323

Table 4. 28 ft² Fire Performance Stability Test Results: Chemguard Aged Concentrate.

PROPERTY MEASURED	EXTINGUISHMENT TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME CRITERIA	ACTUAL TIMES
Fresh Water Full Strength	30 Sec (Max)	25	360 Sec (Min)	510
Fresh Water Half Strength	45 Sec (Max)	45	300 Sec (Min)	440
Sea Water Full Strength	30 Sec (Max)	28	360 Sec (Min)	424
Sea Water Half Strength	45 Sec (Max)	37	300 Sec (Min)	620

Table 5. 28 ft² Fire Performance Stability Test Results: Chemguard Aged Solution.

PROPERTY MEASURED	EXTINGUISHMENT TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME CRITERIA	ACTUAL TIMES
Fresh Water Full Strength	30 Sec (Max)	26	360 Sec (Min)	428
Sea Water Full Strength	30 Sec (Max)	29	360 Sec (Min)	459

3. The 3% AFFF agents from the QPL (reference (c)) used for the Compatibility Tests were from NRL stock, and are listed in Table 6. Chemguard's concentrate was mixed individually with each of the five concentrates in a 1:1 volume ratio, and with all the concentrates listed in Table 6 in a 1:1 volume ratio. These six concentrate mixtures were aged in accordance with reference (b) and then used to prepare the solutions used for fire performance testing. A slight cloudiness at the bottom of the container of the mixture of all the agent concentrates was noted. The cloudiness disappeared with agitation prior to mixing the working solutions.

Table 6. 3% AFFF Agents from the Qualified Products List used in the Compatibility Fire Performance Test.

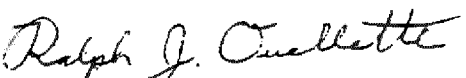
QUALIFIED AGENT	MANUFACTURER	LOT / BATCH	DATE OF MANUFACTURE
Angus	Angus Fire Armour, Corp.	010493	May 1993
3EM	Chubb National Foam (CNF)	91175	May 1991
Ansulite AFC5A	Ansul Fire Protection	27001	February 1987
FC-203CF	Minnesota, Mining & Manufacturing, Co., (3M)	101	March 1991
FC-203CE	Minnesota, Mining & Manufacturing, Co., (3M)	501	May 1983

Table 7. 28 ft² Fire Performance Concentrate Compatibility Test Results: Aged Concentrates.
Solutions for fire performance tests were mixed at full strength (3%).

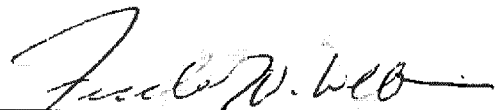
QUALIFIED AGENT	PROPERTY MEASURED	EXTINGUISHMENT TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME CRITERIA	ACTUAL TIMES
Angus	Fresh Water	30 Sec (Max)	21	360 Sec (Min)	377
Angus	Sea Water	30 Sec (Max)	25	360 Sec (Min)	405
Chubb 3EM	Fresh Water	30 Sec (Max)	28	360 Sec (Min)	444
Chubb 3EM	Sea Water	30 Sec (Max)	26	360 Sec (Min)	419
Ansulite AFC5A	Fresh Water	30 Sec (Max)	23	360 Sec (Min)	493
Ansulite AFC5A	Sea Water	30 Sec (Max)	22	360 Sec (Min)	400
3M-FC203CF	Fresh Water	30 Sec (Max)	27	360 Sec (Min)	423
3M-FC203CF	Sea Water	30 Sec (Max)	29	360 Sec (Min)	378
3M-FC203CE	Fresh Water	30 Sec (Max)	30	360 Sec (Min)	400
3M-FC203CE	Sea Water	30 Sec (Max)	22	360 Sec (Min)	409
All of the Above	Fresh Water	30 Sec (Max)	30	360 Sec (Min)	380
All of the Above	Sea Water	30 Sec (Max)	22	360 Sec (Min)	395

4. Chemguard's AFFF 3% C-301, Lot 061196A is recommended for inclusion in the Qualified Products List (reference (c)) when Chemguard, Inc. demonstrates compliance with that part of MIL-F-24385F (reference (b)) pertaining to the cap opening torque of the five gallon container, which was exceeded in these tests as noted in paragraph 2a, and in Table 1 of this report.


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