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IN REPLY REFER TO

3905

Ser 6180/0307

25 JUL 2001

From: Commanding Officer, Naval Research Laboratory
To: Commander, Naval Sea Systems Command (Code 05L4 Barylski)

Subj: RESULTS OF QUALIFICATION TESTING OF 6% (P/NC - 601MS) AQUEOUS
FILM FORMING FOAM (AFFF) LIQUID CONCENTRATE FIRE EXTINGUISHING
AGENT MANUFACTURED BY CHEMGUARD INCORPORATED

Ref: (a) NAVSEA ltr 05Q/2000-414 of 16 Oct 00, "Authorization of Perform Qualification
Testing on Chemguard's Fire Extinguishing Agent"

Encl: (1) Two copies of subject report

1. In accordance with reference (a), Chemguard Inc.'s 6% (P/NC - 601MS) AFFF was tested for compliance with Military Specification MIL-F-24385F (SH), Amendment 1, 5 August 1994. Detailed results of this test are forwarded for your review as enclosure (1).
2. Chemguard Inc.'s 6% (P/NC - 601MS) AFFF as supplied by the manufacturer complied with the requirements of the Military Specification MIL-F-24385F (SH), Amendment 1, 5 August 1994.
3. Chemguard Inc.'s 6% (P/NC - 601 MS) AFFF is recommended for inclusion in the Qualified Products List, QPL-24385-31, 30 October 1998.
4. The Naval Research Laboratory technical point of contact is Dr. Patricia Tatem, Code 6183, (202) 767-6965, e-mail: tatem@ccs.nrl.navy.mil.

WARREN W. SCHULTZ
By direction

Copy to:
NAVSEASYS COM (Code 05Q)

Subj: RESULTS OF QUALIFICATION TESTING OF 6% (P/NC - 601 MS) AQUEOUS FILM-FORMING FOAM (AFFF) LIQUID CONCENTRATE FIRE EXTINGUISHING AGENT MANUFACTURED BY CHEMGUARD INCORPORATED

Ref: (a) NAVSEA Ltr 05Q/2000-414 of 16 Oct 00, "Authorization of 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 Seawater," MIL-F-24385F (SH) Amend 1, 5 Aug 94
(c) Qualified Products List, QPL-24385-31, 30 Oct 98, which lists products that have been qualified in accordance with ref (b)

1. Chemguard Inc. submitted a 6% AFFF Fire Extinguishing Agent, designated as P/NC - 601MS, manufacturer's date 022101, to the Naval Research Laboratory (NRL) for qualification testing (reference (a)) for compliance with the requirements of reference (b)). Chemguard Inc.'s 6% AFFF passed the criteria for qualification and inclusion in reference (c) required by reference (b). The results of the qualification testing are presented in Tables 1 through 7.

2. The contents of each table are briefly outlined as follows:

- a. Table 1: Chemical and Physical Requirements for Concentrates or Solutions
- b. Table 2: 28 ft² Fire Performance Test Results: Chemguard 6% 022101 Fresh Concentrate
- c. Table 3: 50 ft² Fire Performance Test Results: Chemguard 6% 022101 Fresh Concentrate
- d. Table 4: 28 ft² Fire Performance Stability Test Results: Chemguard 6% 022101 Aged Concentrate
- e. Table 5: 28 ft² Fire Performance Stability Test Results: Chemguard 6% 022101 Aged Solution
- f. Table 6: 6% AFFF Agent from the Qualified Products List Used in the Compatibility Fire Performance Test
- g. Table 7: 28 ft² Fire Performance Concentrate Compatibility Test Results: 6% 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	6% 022101 Results
Refractive index, minimum	1.358	1.3595
Viscosity (Centistoke) Maximum @ 5°C Minimum @ 25°C	10 2	9.08 6.3
Hydrogen Ion Concentration (pH)	7.0 to 8.5	7.6
Spreading Coefficient, dynes/cm, minimum	3	23.7
Film Formation and Sealability	No sustained ignition	No sustained 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	5.0	9.0 / 8.2 9.1 / 8.8 9.6 / 9.1 5.1 / 7.9
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	2.5	4.25 / 4.20 3.5 / 4.25 4.0 / 4.0 3.15 / 4.0
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	0.69 0.02 0.03 0.03 No pits
Total Halides, ppm maximum	250	186
Dry chemical compatibility, burn -back resistance time 360 seconds minimum	360	427
Environmental impact: Toxicity, LC ₅₀ , mg/L, minimum COD, mg/L, maximum BOD ₂₀ minimum COD	1,000 500,000 0.65	>1000 279,000 0.80
Fluorine content, mg/L	-----	5,250 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	< 0.05 < 0.05 < 0.05
Container cap opening torque (average)	50 in/lbs max	>50 in/lbs max

**Table 2. 28 ft² Fire Performance Test Results:
Chemguard 6% 022101 Fresh Concentrate.**

PROPERTY MEASURED	EXTINGUISH TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME CRITERIA	ACTUAL TIMES
Fresh Water Full Strength	30 Sec (Max)	25	360 Sec (Min)	551
Fresh Water Half Strength	45 Sec (Max)	43	300 Sec (Min)	436
Sea Water Full Strength	30 Sec (Max)	30	360 Sec (Min)	555
Sea Water Half Strength	45 Sec (Max)	41	300 Sec (Min)	491
Quintuple Strength (15%) Sea Water	55 Sec (Max)	40	200 Sec (Min)	325

**Table 3. 50 ft² Fire Performance Test Results:
Chemguard 6% 022101 Fresh Concentrate**

PROPERTY MEASURED	EXTINGUISHMENT TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME	ACTUAL TIMES	40 SECOND SUMMATION	ACTUAL TOTAL
Sea Water Full Strength	50 Sec (Max)	36	360 Sec (Min)	406	320 (Min)	325

**Table 4. 28 ft² Fire Performance Stability Test Results:
Chemguard 6% 022101 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)	438
Fresh Water Half Strength	45 Sec (Max)	43	300 Sec (Min)	345
Sea Water Full Strength	30 Sec (Max)	29	360 Sec (Min)	472
Sea Water Half Strength	45 Sec (Max)	37	300 Sec (Min)	485

**Table 5. 28 ft² Fire Performance Stability Test Results:
Chemguard 6% 022101 Aged Solution**

PROPERTY MEASURED	EXTINGUISHMENT TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME CRITERIA	ACTUAL TIMES
Fresh Water Full Strength	30 Sec (Max)	27	360 Sec (Min)	428
Sea Water Full Strength	30 Sec (Max)	23	360 Sec (Min)	472

3. The AFFF agents from the QPL, reference (c), used for the Compatibility Tests were from NRL stock, and are listed in Table 6. The Chemguard concentrate was mixed individually with each of the four concentrates in a 1:1 volume ratio, and with all the concentrates listed in Table 6 in a 1:1:1:1:1 volume ratio. These concentrate mixtures were aged in accordance with reference (b) and then used to prepare the solutions used for fire performance testing. .

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

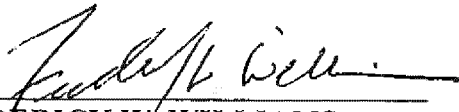
QUALIFIED AGENT	MANUFACTURER	LOT / BATCH	DATE OF MANUFACTURE
Angus	Angus Fire Armour, Corp.	041993	May 1993
Ansul AFC-5	Ansul Fire Protection Wormald U.S., Inc.)	X17039	April 1987
FC-206CF	Minnesota, Mining & Manufacturing, Co., (3M)	101	March 1991
L15606B	Minnesota Mining & Manufacturing, Co., (3M)	1	September 1999

Table 7. 28 ft² Fire Performance Concentrate Compatibility Test Results: 6% Aged Concentrates.

(Solutions for fire performance tests were mixed at full strength)

QUALIFIED AGENT	PROPERTY MEASURED	EXTINGUISH TIME CRITERIA	ACTUAL TIMES	BURNBACK TIME CRITERIA	ACTUAL TIMES
Angus	Fresh Water	30 Sec (Max)	24	360 Sec (Min)	426
Angus	Sea Water	30 Sec (Max)	28	360 Sec (Min)	428
Ansul	Fresh Water	30 Sec (Max)	26	360 Sec (Min)	399
Ansul	Sea Water	30 Sec (Max)	30	360 Sec (Min)	370
3M-FC206CF	Fresh Water	30 Sec (Max)	26	360 Sec (Min)	368
3M-FC206CF	Sea Water	30 Sec (Max)	27	360 Sec (Min)	438
3M-L15606B	Fresh Water	30 Sec (Max)	24	360 Sec (Min)	442
3M-L15606B	Sea Water	30 Sec (Max)	26	360 Sec (Min)	457
All of the Above	Fresh Water	30 Sec (Max)	24	360 Sec (Min)	489
All of the Above	Sea Water	30 Sec (Max)	25	360 Sec (Min)	427

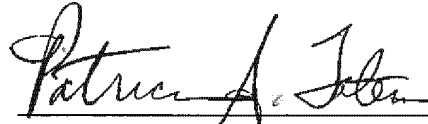
4. Chemguard P/NC – 601MS (manufactured 022101) 6% AFFF is recommended for inclusion in the Qualified Products List (reference (c)).



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