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IN REPLY REFER TO:
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Ser 6180/0018

From: Commanding Officer, Naval Research Laboratory
To: Commander, Naval Sea Systems Command (SEA 05P5 S. Fletcher)

Subj: RESULTS OF MIL-F-24385F QUALIFICATION TESTING OF THE DAFO
FOMTEC AB's FOMTEC AFFF 3%M "USA" AND "SWE" CONCENTRATE
FORMULATIONS

Encl: (1) One copy of subject report

1. Enclosure (1) is forwarded for your information and retention.
2. This report provides results of the qualification testing for the Dafo Fomtec AB's FOMTEC AFFF 3%M "United States of America (USA)" and "Sweden (SWE)" concentrate formulations, which were evaluated against the MIL-F-24385F, "Fire Extinguishing Agent, Aqueous Film Forming Foam (AFFF) Liquid Concentrate for Fresh and Seawater" fire performance test protocol. Both of the FOMTEC AFFF 3%M formulations exhibited similar performance and demonstrated exceptional fire knock down and burn back resistance capabilities. Based on these test results, it is recommended that the FOMTEC AFFF 3%M concentrate product be listed on the AFFF Qualified Products List (QPL).
3. The Naval Research Laboratory's point of contact is John P. Farley Code 6186, (202) 404-8459, e-mail: john.farley@nrl.navy.mil.

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By direction

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Results of Mil-F-24385F Qualification Testing of the Dafo Fomtec AB's FOMTEC AFFF 3%M “USA” and “SWE” Concentrate Formulations

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**Test results--Paragraphs denoted below refer to the applicable section
of MIL-F-24385F**

Paragraph 3.3 Chemical and Physical Requirements for Concentrates:

Property	Type 3 Criteria	Type 3 "USA" Value	Pass/ Fail	Type 3 Criteria	Type 3 "SWE" Value	Pass/ Fail
Viscosity @ 25 °C cSt	≥ 2	3.29	Pass	≥2	3.20	Pass
Viscosity @ 5 °C cSt	≤20	6.70	Pass	≤20	6.15	Pass
Hydrogen Ion (pH)	7-8.5	7.42	Pass	7-8.5	7.37	Pass
Spreading Coefficient on cyclohexane (dynes/cm)	≥3.0	6.62	Pass	≥3.0	6.50	Pass
Index of refraction	≥1.3630	1.3693	Pass	≥1.3630	1.3686	Pass
Foamability (average of two measurements for each condition):						
Fresh Water Expansion Ratio	≥5.0	7.6	Pass	≥5.0	7.6	Pass
Fresh Water Drain Time (minutes)	≥2:30	5:14	Pass	≥2:30	5:07	Pass
Salt Water Expansion Ratio	≥5.0	7.7	Pass	≥5.0	7.8	Pass
Salt Water Drain Time (minutes)	≥2:30	5:20	Pass	≥2:30	5:55	Pass
Film Formation:						
Full Strength Fresh	No Ignition	No Ignition	Pass	No Ignition	No Ignition	Pass
Full Strength Salt	No Ignition	No Ignition	Pass	No Ignition	No Ignition	Pass
Corrosion Rate:						
steel (10 ⁻³ inches/yr)	≤1.5	0.56	Pass	≤1.5	0.79	Pass
Cu-Ni (10 ⁻³ inches/yr)	≤1.0	0.02	Pass	≤1.0	0.04	Pass
Ni-Cu (10 ⁻³ inches/yr)	≤1.0	0.03	Pass	≤1.0	0.01	Pass
Bronze (mg)	≤100	15.50	Pass	≤100	32.32	Pass
Localized pitting (Corrosion- resistant steel)	No Pits	No Pits	Pass	No Pits	No Pits	Pass
Total Halides (ppm)	≤500	469	Pass	≤500	439	Pass
Dry Chemical Compatibility:						
Burn Back time (s)	≥360	596	Pass	≥360	508	Pass
Environmental Impact:						
Toxicity (LC ₅₀) mg/L	≥500	≤2000*	Pass	≥500	≤2000*	Pass
COD (g O ₂ /L)	≤1000	500	Pass	≤1000	500	Pass
BOD ₂₀ /COD	≥0.65	.76	Pass	≥0.65	.78	Pass

NOTE* – No fish (killifish (*Fundulus Heteroclitus*)) mortality observed at a concentration ≤ 2000 mg/L for both the FOMTEC AFFF 3%M "USA" and the FOMTEC AFFF 3%M "SWE" concentrates.

Paragraph 3.3.2 Stability:

Property	Type 3 Criteria	Type "USA" Value	Pass/ Fail	Type 3 Criteria	Type 3 "SWE" Value	Pass/ Fail
Spreading Coefficient on cyclohexane (dynes/cm):						
using aged concentrate mixed with fresh water	≥3.0	6.51	Pass	≥3.0	6.80	Pass
using aged premix with fresh water	≥3.0	6.33	Pass	≥3.0	6.05	Pass
using aged premix with salt water	≥3.0	6.29	Pass	≥3.0	6.33	Pass
Foamability using aged concentrate(average of two measurements):						
Fresh Water Expansion Ratio	≥5.0	7.6	Pass	≥5.0	7.6	Pass
Fresh Water Drain Time (minutes)	≥2:30	5:14	Pass	≥2:30	5:07	Pass
Salt Water Expansion Ratio	≥5.0	7.7	Pass	≥5.0	7.8	Pass
Salt Water Drain Time (minutes)	≥2:30	5:20	Pass	≥2:30	5:55	Pass
Foamability using aged premix (average of two measurements):						
Fresh Water Expansion Ratio	≥5.0	7.7	Pass	≥5.0	7.6	Pass
Fresh Water Drain Time (minutes)	≥2:30	5:22	Pass	≥2:30	4:41	Pass
Salt Water Expansion Ratio	≥5.0	7.6	Pass	≥5.0	7.4	Pass
Salt Water Drain Time (minutes)	≥2:30	5:18	Pass	≥2:30	4:45	Pass
Film Formation:						
from aged concentrate, full strength, fresh water	no ignition	no ignition	Pass	no ignition	no ignition	Pass
from aged concentrate, full strength, salt water	no ignition	no ignition	Pass	no ignition	no ignition	Pass
from aged premix, full strength, fresh water	no ignition	no ignition	Pass	no ignition	no ignition	Pass
from aged premix, full strength, salt water	no ignition	no ignition	Pass	no ignition	no ignition	Pass
Fire Performance:						
Aged Concentrate, ½ strength, fresh						
Extinguishment time (s)	≤45	38	Pass	≤45	36	Pass
Burn back time (s)	≥300	380	Pass	≥300	470	Pass
Aged Concentrate, ½ strength, salt						
Extinguishment time (s)	≤45	33	Pass	≤45	36	Pass
Burn back time (s)	≥300	623	Pass	≥300	609	Pass
Aged Concentrate, full strength, Fresh						
Extinguishment time (s)	≤30	23	Pass	≤30	24	Pass
Burn Back time (s)	≥360	452	Pass	≥360	476	Pass
Aged Concentrate, full strength, Salt						
Extinguishment time (s)	≤30	23	Pass	≤30	26	Pass
Burn Back time (s)	≥360	603	Pass	≥360	565	Pass
Aged Premix, full strength, fresh						
Extinguishment time (s)	≤30	22	Pass	≤30	23	Pass
Burn back time (s)	≥360	566	Pass	≥360	496	Pass
Aged Premix, full strength, salt						
Extinguishment time (s)	≤30	27	Pass	≤30	22	Pass
Burn back time (s)	≥360	535	Pass	≥360	530	Pass
Aged Premix, ½ strength, fresh						

Extinguishment time (s)	≤45	39	Pass	≤45	41	Pass
Burn back time (s)	≥300	409	Pass	≥300	445	Pass
Aged Premix, ½ strength, salt						
Extinguishment time (s)	≤45	31	Pass	≤45	40	Pass
Burn back time (s)	≥300	490	Pass	≥300	436	Pass

Property	Type 3 Criteria	Type 3 “USA” Value	Pass/ Fail	Type 3 Criteria	Type 3 “SWE” Value	Pass/ Fail
Stratification:						
using aged concentrate mixed with fresh water	N.O.*	N.O.*	Pass	N.O.*	N.O.*	Pass
using aged premix with fresh water	N.O.*	N.O.*	Pass	N.O.*	N.O.*	Pass
using aged premix with salt water	N.O.*	N.O.*	Pass	N.O.*	N.O.*	Pass
Precipitation (vol%):						
using aged concentrate mixed with fresh water	≤0.05 mL	N.O.*	Pass	≤0.05	N.O.*	Pass
using aged premix with fresh water	≤0.05 mL	N.O.*	Pass	≤0.05	N.O.*	Pass
using aged premix with salt water	≤0.05 mL	N.O.*	Pass	≤0.05	N.O.*	Pass

N.O.* = None Observed.

Paragraph 3.3.3 Compatibility:

Mixture: FOMTEC AFFF 3%M “USA”/ National 3EM¹ (50/50) Type 3

Requirement	Criteria	Value “USA”	Pass/ Fail
Stratification:			
using aged concentrate	N.O.*	N.O.*	Pass
Precipitation (vol%):			
using aged concentrate	≤0.05	N.O.*	Pass
Foamability using aged concentrate(average of two measurements):			
Fresh Water Expansion Ratio	≥5.0	8.0	Pass
Fresh Water Drain Time (minutes)	≥2:30	5:34	Pass
Salt Water Expansion Ratio	≥5.0	7.6	Pass
Salt Water Drain Time (minutes)	≥2:30	6:00	Pass
Film Formation:			
from aged concentrate, ½ strength, fresh water	no ignition	no ignition	Pass
from aged concentrate, ½ strength, salt water	no ignition	no ignition	Pass
Fire Performance:			
Aged Concentrate, fresh water			
Extinguishment time (s)	≤30	21	Pass
Burn back time (s)	≥360	599	Pass
Aged Concentrate, salt water			
Extinguishment time (s)	≤30	24	Pass
Burn back time (s)	≥360	614	Pass

*N.O. = None Observed.

¹ National Lot Number L15311, Date 11/2015

Mixture: FOMTEC AFFF 3%M "USA" / Tridol (Angus)² (50/50) Type 3

Requirement	Criteria	Value "USA"	Pass/ Fail
Stratification:			
using aged concentrate	N.O.*	N.O.*	Pass
Precipitation (vol%):			
using aged concentrate	≤0.05	N.O.*	Pass
Foamability using aged concentrate(average of two measurements):			
Fresh Water Expansion Ratio	≥5.0	7.7	Pass
Fresh Water Drain Time (minutes)	≥2:30	4:45	Pass
Salt Water Expansion Ratio	≥5.0	7.3	Pass
Salt Water Drain Time (minutes)	≥2:30	4:00	Pass
Film Formation:			
from aged concentrate, ½ strength, fresh water	no ignition	no ignition	Pass
from aged concentrate, ½ strength, salt water	no ignition	no ignition	Pass
Fire Performance:			
Aged Concentrate, fresh water			
Extinguishment time (s)	≤30	24	Pass
Burn back time (s)	≥360	393	Pass
Aged Concentrate, salt water			
Extinguishment time (s)	≤30	26	Pass
Burn back time (s)	≥360	567	Pass

*N.O. = None Observed.

Mixture: FOMTEC AFFF 3%M "USA" / Solberg³ (50/50) Type 3

Requirement	Criteria	Value "USA"	Pass/ Fail
Stratification:			
using aged concentrate	N.O.	N.O.*	Pass
Precipitation (vol%):			
using aged concentrate	≤0.05	N.O.*	Pass
Foamability using aged concentrate(average of two measurements):			
Fresh Water Expansion Ratio	≥5.0	7.9	Pass
Fresh Water Drain Time (minutes)	≥2:30	4:49	Pass
Salt Water Expansion Ratio	≥5.0	7.9	Pass
Salt Water Drain Time (minutes)	≥2:30	5:23	Pass
Film Formation:			
from aged concentrate, ½ strength, fresh water	no ignition	no ignition	Pass
from aged concentrate, ½ strength, salt water	no ignition	no ignition	Pass
Fire Performance:			
Aged Concentrate, fresh water			
Extinguishment time (s)	≤30	25	Pass
Burn back time (s)	≥360	538	Pass
Aged Concentrate, salt water			
Extinguishment time (s)	≤30	26	Pass
Burn back time (s)	≥360	535	Pass

² Tridol (Angus) Lot Number L15311, Date 10/20/2014

³ Solberg Lot Number AA1500137, Date 03/22/2015

Mixture: ¼ FOMTEC AFFF 3%M “USA”/National/Tridol/Solberg Type 3

Requirement	Criteria	Value “USA”	Pass/ Fail
Stratification:			
using aged concentrate	N.O.*	N.O.*	Pass
Precipitation (vol%):			
using aged concentrate	≤0.05	N.O.*	Pass
Foamability using aged concentrate(average of two measurements):			
Fresh Water Expansion Ratio	≥5.0	7.8	Pass
Fresh Water Drain Time (minutes)	≥2:30	5:00	Pass
Salt Water Expansion Ratio	≥5.0	7.4	Pass
Salt Water Drain Time (minutes)	≥2:30	5:30	Pass
Film Formation:			
from aged concentrate, ½ strength, fresh water	no ignition	no ignition	Pass
from aged concentrate, ½ strength, salt water	no ignition	no ignition	Pass
Fire Performance:			
Aged Concentrate, fresh water			
Extinguishment time (s)	≤30	27	Pass
Burn back time (s)	≥360	470	Pass
Aged Concentrate, salt water			
Extinguishment time (s)	≤30	26	Pass
Burn back time (s)	≥360	602	Pass

*N.O. = None Observed.

Mixture: FOMTEC AFFF 3%M “SWE” / National 3EM⁴ (50/50) Type 3

Requirement	Criteria	Value “SWE”	Pass/ Fail
Stratification:			
using aged concentrate	N.O.	N.O.*	Pass
Precipitation (vol%):			
using aged concentrate	≤0.05	N.O.*	Pass
Foamability using aged concentrate(average of two measurements):			
Fresh Water Expansion Ratio	≥5.0	7.7	Pass
Fresh Water Drain Time (minutes)	≥2:30	4:49	Pass
Salt Water Expansion Ratio	≥5.0	7.5	Pass
Salt Water Drain Time (minutes)	≥2:30	3:14	Pass
Film Formation:			
from aged concentrate, ½ strength, fresh water	no ignition	no ignition	Pass
from aged concentrate, ½ strength, salt water	No ignition	no ignition	Pass
Fire Performance:			
Aged Concentrate, fresh water			
Extinguishment time (s)	≤30	25	Pass
Burn back time (s)	≥360	450	Pass
Aged Concentrate, salt water			
Extinguishment time (s)	≤30	22	Pass
Burn back time (s)	≥360	595	Pass

⁴ National Lot Number L15311, Date 11/2015

Mixture: FOMTEC AFFF 3%M "SWE" / Tridol⁵ (50/50) Type 3

Requirement	Criteria	Value "SWE"	Pass/ Fail
Stratification:			
using aged concentrate	N.O.*	N.O.*	Pass
Precipitation (vol%):			
using aged concentrate	≤0.05	N.O.*	Pass
Foamability using aged concentrate(average of two measurements):			
Fresh Water Expansion Ratio	≥5.0	7.7	Pass
Fresh Water Drain Time (minutes)	≥2:30	5:03	Pass
Salt Water Expansion Ratio	≥5.0	7.1	Pass
Salt Water Drain Time (minutes)	≥2:30	4:48	Pass
Film Formation:			
from aged concentrate, ½ strength, fresh water	no ignition	no ignition	Pass
from aged concentrate, ½ strength, salt water	no ignition	no ignition	Pass
Fire Performance:			
Aged Concentrate, fresh water			
Extinguishment time (s)	≤30	22	Pass
Burn back time (s)	≥360	560	Pass
Aged Concentrate, salt water			
Extinguishment time (s)	≤30	27	Pass
Burn back time (s)	≥360	567	Pass

*N.O. = None Observed.

Mixture: FOMTEC AFFF 3%M "SWE" / Solberg⁶ (50/50) Type 3

Requirement	Criteria	Value "SWE"	Pass/ Fail
Stratification:			
using aged concentrate	N.O.	N.O.	Pass
Precipitation (vol%):			
using aged concentrate	≤0.05	N.O.	Pass
Foamability using aged concentrate(average of two measurements):			
Fresh Water Expansion Ratio	≥5.0	7.7	Pass
Fresh Water Drain Time (minutes)	≥2:30	5:30	Pass
Salt Water Expansion Ratio	≥5.0	7.8	Pass
Salt Water Drain Time (minutes)	≥2:30	5:44	Pass
Film Formation:			
from aged concentrate, ½ strength, fresh water	no ignition	no ignition	Pass
from aged concentrate, ½ strength, salt water	no ignition	no ignition	Pass
Fire Performance:			
Aged Concentrate, fresh water			
Extinguishment time (s)	≤30	23	Pass
Burn back time (s)	≥360	499	Pass
Aged Concentrate, salt water			
Extinguishment time (s)	≤30	29	Pass
Burn back time (s)	≥360	560	Pass

⁵ Tridol (Angus) Lot Number L15311, 10/20/2014

⁶ Solberg Lot Number AA1500137, Date 03/22/2015

Mixture: ¼ FOMTEC AFFF 3%M “SWE”/National/Tridol/Solberg Type 3

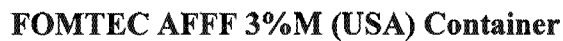
Requirement	Criteria	Value “SWE”	Pass/Fail
Stratification:			
using aged concentrate	N.O.	N.O.	Pass
Precipitation (vol%):			
using aged concentrate	≤0.05	N.O.	Pass
Foamability using aged concentrate(average of two measurements):			
Fresh Water Expansion Ratio	≥5.0	7.6	Pass
Fresh Water Drain Time (minutes)	≥2:30	5:03	Pass
Salt Water Expansion Ratio	≥5.0	7.4	Pass
Salt Water Drain Time (minutes)	≥2:30	4:50	Pass
Film Formation:			
from aged concentrate, ½ strength, fresh water	no ignition	no ignition	Pass
from aged concentrate, ½ strength, salt water	no ignition	no ignition	Pass
Fire Performance:			
Aged Concentrate, fresh water			
Extinguishment time (s)	≤30	23	Pass
Burn back time (s)	≥360	464	Pass
Aged Concentrate, salt water			
Extinguishment time (s)	≤30	24	Pass
Burn back time (s)	≥360	524	Pass

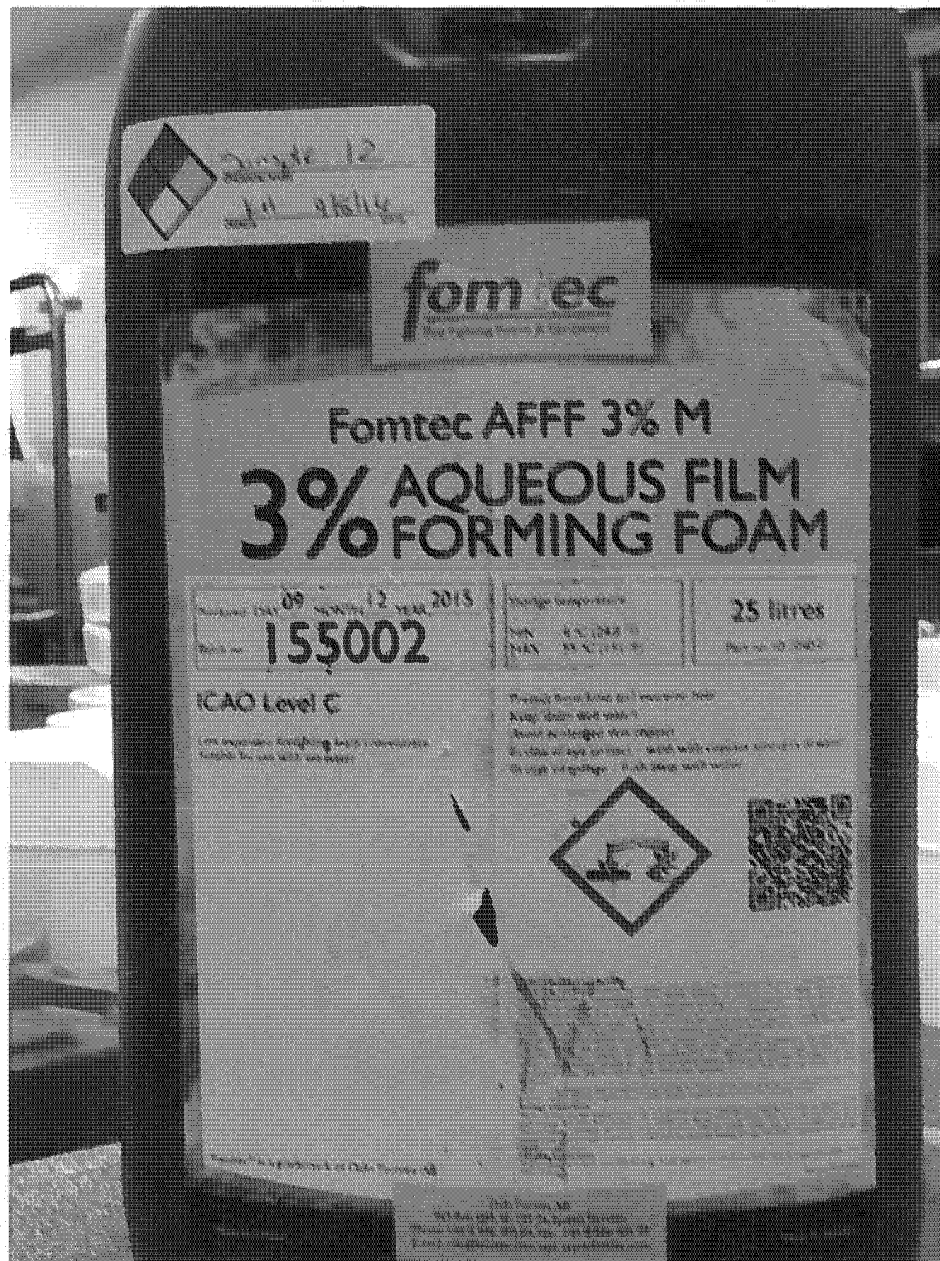
Paragraph 3.4 Fire Performance:

Fire Performance Test	Type 3 requirement	Type “USA” Value	Pass/Fail	Type 3 requirement	Type 3 “SWE” Value	Pass/Fail
28 ft³ Extinguishment Time (s)						
Fresh Water ½ strength	≤45	39	Pass	≤45	33	Pass
Fresh Water full strength	≤30	27	Pass	≤30	25	Pass
Salt Water ½ strength	≤45	38	Pass	≤45	33	Pass
Salt Water full strength	≤30	24	Pass	≤30	25	Pass
Salt Water Quintuple Strength	≤55	27	Pass	≤55	35	Pass
Burn Back Time (s)						
Fresh Water ½ strength	≥300	469	Pass	≥300	507	Pass
Fresh Water full strength	≥360	566	Pass	≥360	587	Pass
Salt Water ½ strength	≥300	587	Pass	≥300	33	Pass
Salt Water full strength	≥360	620	Pass	≥360	25	Pass
Salt Water Quintuple Strength	≥200	458	Pass	≥200	406	Pass
50 ft³ Fire Test (Salt Water)						
Extinguishment time (s)	≤50	43	Pass	≤50	35	Pass
Burn back time (s)	≥360	461	Pass	≥360	442	Pass
40 second summation	≥320	348	Pass	≥320	345	Pass

Additional Measurements:

- (1) Container cap torque test results: FOMTEC AFFF “USA” Type 3 – 30 in/lbs. & FOMTEC AFFF “SWE” Type 3 – 40 in/lbs.
- (2) Total Fluorine: FOMTEC AFFF “USA” Type 3 – 0.9% & FOMTEC AFFF “SWE” Type 3 – 0.8% (Analysis Method: GLI Procedure E9-3).





FOMTEC AFFF 3%M (SWE) Container