

MILITARY SPECIFICATION 24385F
AQUEOUS FILM FORMING FOAM (AFFF) CONCENTRATE - RESPONSE

ISSUE: The current military specification for firefighting foams mandates the use of fluorinated chemicals that are harmful to military personnel and the environment. New technologies are available that avoid these risks, but the specification has not been updated to allow their use. What must be done to correct this situation?

- Original Military Specification Issued in the 1970's.

COMMENT: Essentially correct; AFFF was first introduced into the Navy in 1970 (original MILSPEC (MIL-F-23905) was published on 01 Nov 1963 and was replaced with MIL-F-24385 on 21 Nov 1969).

- Current Military Specification for firefighting foam dated August, 1994 (F Version)

COMMENT: Correct.

- Requires all Products on the **Qualified Products List (QPL)** to contain fluorinated chemicals, which was the state of the art in the 1960's.

COMMENT: The current AFFF MILSPEC is specific for film forming agents, which provides rapid extinguishment (i.e., creates a vapor barrier at the fuel/foam surface interface and also limits fuel transport through the foam blanket) and explicitly specifies the use of a fluorsurfactant to enable film formation. To date no F3 foam product has demonstrated the ability to extinguish flammable liquid pool fires as quickly as AFFF under the MIL-F-24385F standard.

- The Specification does not allow for newer alternative technologies that are safer and less expensive

COMMENT: Alternative Class B (flammable liquid) foaming agent technologies have not been able to provide the requisite safety margins that are inherent to MILSPEC AFFF.

COMMENT (SAFETY): The principle DoD safety concerns relate to limiting personnel exposure to large unconfined fires, which may include ordnance, flight crew rescue, and limiting damage (both primary and secondary) to vital Fleet assets.

COMMENT (COST): The cost for the current MILSPEC AFFF concentrates provided to the Fleet is approximately \$63.00/5 gallon pail. Additionally, the cost of MILSPEC AFFF concentrate is very low in comparison to the vital assets, which they are expected to protect.

- Specific problems with current specification:
 - The fluorinated chemicals used in current Military Specification are:
 - Environmentally Persistent
 - Bio accumulative
 - Toxic

COMMENT: All AFFF (both MILSPEC AFFF and UL 162 commercial AFFF) products contain fluorsurfactants, which are environmental persistent as a class. Perfluorooctane Sulfonate (PFOS) is a specific class used in the original MILSPEC AFFF formulation, but its use was discontinued in the early 2000's by the U.S. EPA due to the PBT combination.

- Fluorinated foams will remain in the environment for centuries, no biodegradation

COMMENT: AFFF “concentrate” typically contains 2% fluorosurfactant, 2-5% hydrocarbon surfactant, and 15-20% solvents. The rest of the formulation is water (78-81%). This means that 98% of AFFF “concentrate” is biodegradable. NOTE: The DoD do not introduce AFFF “concentrate” into the environment. What is introduced into the environment are AFFF “solutions” Type 6 (94% water and 6% AFFF concentrate) and Type 3 (97% water and 3% AFFF concentrate). Therefore, considering the true amount of water and organic material (fluorosurfactant/hydrocarbon surfactant/solvents) present results in a finding that the AFFF introduced into the environment is 99.9% biodegradable. That said, considering 50 years of legacy emissions and any additional AFFF introduction there is a valid concern since there is no straightforward treatment approach once fluorosurfactants have been dispersed into the environment. The DoD Strategic Environmental R&D program (SERDP) has funded several research programs to characterize the types and occurrence of fluorosurfactant contamination and to develop remediation technology remedies.

- The 2015 USEPA Voluntary Stewardship Program targets:
 - Elimination (99.9%) of Toxic Fluorosurfactants
 - 2015 Compliance Date
 - All Current QPL Products must be re-qualified to Comply
 - Military Firefighters cannot conduct live training with Fluorinated Foams due to the safety and environmental concerns. The resulting lack of live fire training affects preparedness

COMMENT: Perfluorooctanoic Acid (PFOA), sometimes called “C8”, is not present in MILSPEC AFFF’s, but in some cases, the fluorochemical surfactants in AFFF can degrade into PFOA in the environment. The key factor for this to occur is the presence of an eight-carbon fluorinated “tail” on the surfactant molecule, which is biologically accumulative. The non-PFOS fluorosurfactants currently used in AFFF have used a fluorosurfactant, synthesized by telomerization (a polymerization process producing extremely short chains) that predominately have a six-carbon tail, which cannot form PFOA. The current U.S. EPA PFOA Stewardship Program has established a goal to eliminate PFOA, PFOA precursors, and related higher homologue chemicals from emissions and products including AFFF by end of 2015. In short, current MILSPEC AFFF products do not contain PFOS, and will not contain significant materials capable of degrading into PFOA, but they do contain fluorochemicals, which are environmentally persistent.

COMMENT (RECENTLY CERTIFIED MILSPEC AFFF): The most recent MILSPEC AFFF product certified by NAVSEA has been the first MILSPEC AFFF product to meet both the U.S. EPA PFOA Stewardship Program requirements and all of the requirements stipulated within the MIL-F-24385F performance standard.

COMMENT (MILITARY TRAINING): Due to environmental concerns, military firefighting training facilities use propane fires, which eliminates the use of Class A (combustible solid), Class B (flammable liquid), and Class C (electrical) fuel sources. As a result, actual firefighting agents are not used during firefighting evolutions, which includes AFFF. This does not impact firefighting effectiveness since the goal is to provide the students with firefighting equipment familiarization and to focus on proper firefighting doctrine (tactics & procedures). Additionally, all foam manufacturers market a foam

simulant that is recommended for training. This helps to limit the induction of foaming agents into municipal water treatment plants.

- Military Specification foam is the most expensive of all firefighting foams
 - Fluorine is the most expensive ingredient
 - Military Specification foam requires the greatest level of fluorine
 - Military Specification foam is the most environmentally persistent of all foams

I understand that there are newer technologies available that avoid these problems, but those products are not allowed under the outdated specification:

- Re-Healing Fluorine Free Firefighting Foam
 - 100% Biodegradable
 - More effective in fighting fires, extinguishes more rapidly and requires less reapplication than fluorinated foams
 - Globally Approved to all current International Standards
 - UL, FM, ICAO, EN, ULC, SSL, Among others
- Fluorine Free foam does not expose Military Personnel to dangerous PBT Chemicals
- Lack of fluorine allows live exercises that improve readiness
- Because of lack of fluorine, cost is significantly less
- Sample list of Current Customers:
 - Statoil Norway
 - ConocoPhillips
 - British Petroleum
 - All Australian Airports
 - Copenhagen, Frankfurt, Dubai, Manchester Airports
 - a. Enbridge
 - b. Flint Hills Refinery
 - c. Alert Disaster Control

COMMENT: NRL is well aware of the Solberg® (formally 3-M Australia) Re-Healing™ foam products, which are non-fluorinated foam with polysaccharide thickeners, which are designed to have mechanical properties to compensate for the lack of film formation. Under a previous Cooperative Agreement with 3-M Australia and with the current Non-Disclosure Agreement between NRL and Amerex Corporation, NRL has been conducting fire testing and laboratory studies to help further investigate the potential possibilities for developing a fluorine-free product that could meet the MILSPEC AFFF performance standard. Although the Solberg® products are superior to other F3 foams tested at NRL, they still fail to meet the MIL-F-24385F 28 ft² fire performance test at full strength. Since we have not been successful at the 28 ft² fire performance test at full strength, we have not pursued additional test requirements that include the 28 ft² ½ strength testing, 28 ft² testing (full and ½ strength) with aged concentrate, 28 ft² testing (full and ½ strength) with aged solutions, 28 ft² testing for cross-compatibility, 28 ft² quintuple test or the requisite 50 ft² fire performance test.

COMMENT: Although Solberg® has been somewhat successful in the commercial market, the western foreign Navies, USCG military vessels, and the FAA still relies on MILSPEC AFFF and requires their use for Class B (flammable liquid) fire applications.

What can be done to modify the specification to allow fluorine alternatives?

COMMENT: The first priority for DoD is to ensure that all MILSPEC AFFF products meet the current U.S. EPA PFOA Stewardship Program requirements. In addition to this ongoing effort, the DoD Emerging Contaminates (EC) Steering Group is pursuing an OSD study to analyze the cost/benefit of removing PFOA/PFOS Aqueous Film Forming Foam (AFFF) formulations from DoD stocks and supply systems. Finally, the DON research community will continue to investigate the potential “best valued” options to include either Fluorine-Free Foams or a Fluorine-Free AFFF that may include the development of a new class of silicone-based surfactants, which would eliminate the need for any fluorosurfactants in future AFFF products.