



# Are your firefighting foams fluorine free?

## TOF analysis in Fire Fighting Foams to 1ppm

There are health concerns about the use, handling and storage of per- and polyfluoroalkyl substances (PFAS) containing aqueous film forming foams (AFFF). PFAS are persistent in the environment and in the human body, and evidence suggests that exposure to PFAS can lead to adverse health outcomes in humans.<sup>1</sup>

Manufacturers of replacement fluorine-free foams say these foams have less impact on the environment and meet international approvals for firefighting requirements and end-user expectations<sup>2</sup>. Of the industries that presented at the recent ALGA Firefighting Foam Transition Symposium, the consensus approach was a transition straight to fluorine-free foams (F3) as opposed to intermediate transition to short-chain (C6 pure) fluorinated foams. The main reason being increasing concern around shorter chain PFAS compounds and associated costs of environmental management.

## ALS Capability

ALS is now NATA accredited for Total Organic Fluorine (TOF) in Aqueous Film Forming Foam (AFFF) products by Combustion Ion Chromatography (CIC) to a low 1ppm reporting limit (ALS method EP040-LL).

Existing ALS methodology (EP040) targeted the Queensland Foam Policy limit for long chain (>C7) PFAS in fluorinated foams of 50ppm, where TOF represents a conservative measure. However, there is increasing interest in the application of TOF analysis at lower reporting limits for verification/certification of fluorine-free replacement foams. Alternatively, this methodology can support end users to assess the efficacy of decontamination of firefighting equipment from legacy fluorinated foams.

GreenScreen, a non-government organisation based in the US, offers certification of Class A & B foam concentrates and wetting agents as fluorine free. Under the certification, PFAS-free is defined as PFAS contamination below 0.0001% by weight of the product (1 part per million) measured as total organic fluorine by combustion ion chromatography. This reflects an extremely conservative limit given the level of PFAS intentionally added to achieve foaming/filming properties is in the region of 0.1% by mass.

## GreenScreen utilises ALS Australia to perform TOF analysis for its certification of fluorine free firefighting foam products.

[GreenScreen Certified™](#) | [GreenScreen® For Safer Chemicals \(greenscreenchemicals.org\)](#)

### 10. PRODUCT-LEVEL ANALYTICAL TESTING

Manufacturers shall submit documentation demonstrating the product meets all analytical testing requirements.

#### 10.1 Analytical Testing—Total Organic Fluorine

Analytical testing is required on three product samples from three different lots to verify total organic fluorine content by combustion ion chromatography is below the RSL threshold of 0.0001% by mass (1 ppm).

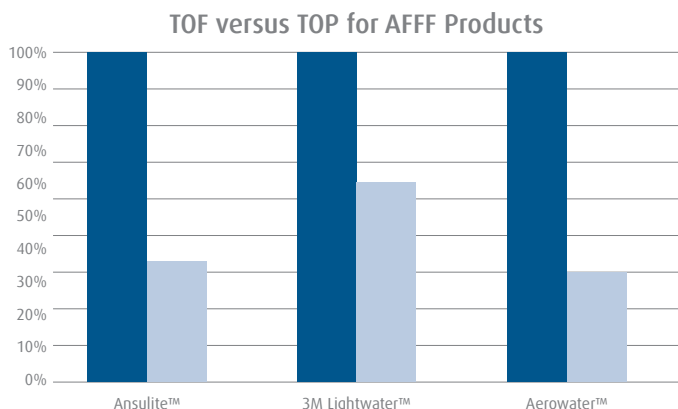
The testing laboratory is selected by Clean Production Action. Clean Production Action provides the applicants with information necessary to submit samples for testing.

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## TOF versus TOP for Organic Fluorine Accounting

While the Total Oxidisable Precursor (TOP) Assay<sup>3</sup> has its place in characterising PFAS, and has superior sensitivity to TOF, it suffers significant limitations which make it less suitable for quantitative PFAS accounting. The assay relies on the typical analytical scope provided by conventional LC/MSMS analysis and therefore fails to account for oxidation products with carbon chain lengths <C4 and >C14. The oxidation process also forms perfluoroalkyl carboxylic acid products from fluorotelomer “precursors” with chain lengths shorter than the parent fluorotelomer; the fluorinated portions of the carbon chains lost during this process are therefore also excluded. This quantitative shortfall is demonstrated below, where the TOP sum of PFAS as fluorine determined on three AFFF products only accounts for 30-60% of the organic fluorine measured by TOF. The TOP Assay would therefore not be suitable for classifying AFFF products as “fluorine-free”.



Apart from AFFF testing, ALS offers a comprehensive scope of TOF analysis on a wide range of matrices. The full scope of NATA accredited services is as follows;

	Water & Leachate	Soil, Sediment & Biosolid	AFFF Products
	µg/L	mg/kg	mg/kg
EP040	20	1	50
EP040-LL	--	0.1	1

## Sample Containers

### Water/AFFF Product

60mL HDPE plastic bottle (unpreserved), grey label

### Soil/Sediment/Biosolid

200mL HDPE plastic specimen jar (unpreserved), grey label

**Note:** for soils, sediments, biosolids and AFFF products, the same sample container can be used for PFAS, TOF and TOP Assay. For waters/leachate a separate 60mL bottle is required if also testing for PFAS/TOP Assay. Click on the following link for more information on bottle requirements for PFAS analysis.

### Enviromail 136

[Focus on Quality PFAS](#)

## Holding Time

Water - 28 days

Soil / Sediment / Biosolid - 28 days

Product - 180 days

For more information on ALS capabilities for TOF analysis, access previous Enviromail publications via the following links, or contact your local client services representative.

### Enviromail 125

[ALS Now NATA Accredited for Total Organic Fluorine \(TOF\)](#)

### Enviromail 126

[TOF for Compliance with QLD Waste Disposal Guideline ERA 60](#)

### Enviromail 132

[PFAS, TOP Assay & TOF](#)

## Reference

1. [Basic information PFAS](#)
2. [Fighting fire with fluorine-free foams - ECHA \(europa.eu\)](#)
3. Houtz, F.E. & Sedlak, L.D. (2012). Oxidative Conversion as a Means of Detecting Precursors to Perfluoroalkyl Acids in Urban Runoff. Environmental Science & Technology, 46, pp 9342-9349.

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