



**Rescue and Fire Fighting Service (RFFS)**

## **Fire Fighting Foam**

**Information Paper**

**IP-04**

**Aviation Fire Fighting Foam - Performance Testing and Environmental Impact**

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## Preface

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## Introduction

This Information Paper (IP) sets out the background and requirements of the UK CAA Qualified Product List (QPL) for aviation fire fighting foam. To have a product entered on the list a foam manufacturer must provide:

1. Accredited evidence of its fire performance in accordance with the International Civil Aviation Organisation (ICAO) fire test method as set out in its publication Doc 9137-AN/898, Airport Services Manual, Part 1, Rescue and Fire Fighting, Chapter 8.
2. Evidence for verification to determine an environmental classification based on the Environmental Impact System set out in Section 2 of this IP.

The process to be followed for a product to be placed on the QPL is set out in Section 3 of this IP.

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## Section 1 – Performance Testing of Aviation Fire Fighting Foam

### 1 Introduction

ICAO Annex 14<sup>1</sup> to the Convention on International Civil Aviation sets out the Standards and Recommended Practices (SARPs) for Contracting States.

The following sets out the ICAO status of SARPs<sup>2</sup>:

*‘Standard: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as necessary for the safety or regularity of international air navigation and to which Contracting States will conform in accordance with the Convention; in the event of impossibility of compliance, notification to the Council is compulsory under Article 38.*

*Recommended Practice: Any specification for physical characteristics, configuration, matériel, performance, personnel or procedure, the uniform application of which is recognized as desirable in the interest of safety, regularity or efficiency of international air navigation, and to which Contracting States will endeavour to conform in accordance with the Convention.’*

The UK CAA has always aligned closely to the SARPs and has very few differences between its requirements and the SARPs. With regard to fire fighting foam the UK requirements match the ICAO SARPs.

Standard 9.2.1 says that rescue and fire fighting equipment shall be provided at an aerodrome and Recommendation 9.2.9 says the principal agents should be foams meeting the minimum performance level A, B or C.

### 2 Fire Test Method

The fire test method for performance level A, B or C fire fighting foam is set out in ICAO Doc 9137-AN/898, Airport Services Manual (ASM), Part 1, Rescue and Fire Fighting, Chapter 8.

An amended wording was introduced into the ASM which sets out the requirements for the quality control of the test:

*‘8.1.4 Where states or individual users do not have facilities for conducting the tests which will establish the specified properties and performances, certification of the qualification of a concentrate should be obtained from a recognized third party testing authority.’*

### 3 Evidence Requirement

A certificate setting out the results of an ICAO performance level A, B or C test and including the following must be submitted as part of the QPL process as set out in Section 3 of this IP.

1. Name and address of the testing organisation
2. Name and address of the accreditation authority
3. Date and time of the test
4. Name of the product
5. Induction percentage
6. Performance level tested – A, B or C
7. Extinction time in seconds
8. Burnback percentage in 5 minutes

<sup>1</sup> Annex 14, Volume I, Aerodrome Design and Operations, ICAO AN14-1, ISBN 978-92-9231-332-6, 2009

<sup>2</sup> Annex 14, Volume I, Aerodrome Design and Operations, ICAO AN14-1, ISBN 978-92-9231-332-6, 2009, Status of Annex Components, page xiii.

9. Result of the test – pass/fail
10. Signature

A recognised third party testing authority is an organisation that has been assessed against internationally recognised standards to demonstrate their competence, impartiality and performance capability. For the purposes of the performance test the CAA will identify such organisations in the UK. Accreditation of the testing authority to carry out such tests by the United Kingdom Accreditation Service is suitable evidence of competence.

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## Section 2 – The Environmental Impact System (EIS)

### 1 Introduction

There is a need for clear, consistent and concise information on the environmental impact of fire fighting foams. It is an area that can give rise to confusion because of its complex scientific basis. The Environmental Impact System (EIS) set out in this section aims to inform purchasers and users of foam of its impact upon the environment.

The EIS is based on the UK government's guidance on environmental management systems and the provision of environmental point of sale data. It is intended to cover the relevant risks to the environment and provide visual and background information. It relies on the manufacturer providing information commonly found on a product's Safety Data Sheet (SDS) and that information being validated and presented in a common, easy to understand format.

The information that the system provides will allow a purchaser to make an informed decision regarding the environmental impact of any rated foam product and to ensure its impact is mitigated to an acceptable level. The rating system is intended to satisfy the need of end-users for summarised environmental impact information for fire fighting foams both now and in the future. In this sense it is a general rating system not specifically targeted at addressing current detailed environmental issues but is flexible enough to be applied to any formulations.

### 2 Purpose

The purpose of an EIS is to give end-users such as procurement departments working on behalf of airport Rescue and Fire Fighting Services (RFFS) a completely objective and independent assessment of the probable overall environmental impact of a product in terms of both short-term (acute) and long-term (chronic) effects.

In order to maintain objectivity and to avoid the pitfall of commercially driven vested interest the classification will be overseen by the CAA, providing information as part of a QPL. The classification is based on full and original documentary evidence being supplied for verification, for example, certified test house data on aquatic toxicity and BOD/COD or an independent laboratory's measurement of total fluorine content. A complete list of individual chemical components of the formulation will also be required but, if necessary, under a Confidential Disclosure Agreement (CDA) to preserve commercially sensitive information. Once classified the product will be given an EIS code, together with an approval number, and be included on the QPL. Refusal to provide the necessary original data and documentation would automatically preclude the assignment of an approved EIS code and result in exclusion from the QPL. Manufacturers will not be allowed to assign their own EIS codes, or claim that their product meets the requirements of the QPL, without reference to the CAA and the issue of an approval number.

The advantages for the end-user include being able to compare the environmental footprint of similar products without being confused by contradictory and frequently incorrect information. The advantages for manufacturers and suppliers are inclusion on a CAA QPL and an independently verified and approved environmental impact (EIS) code providing potential customers and users with information in which they can have confidence.

### 3 EIS Coding

The EIS code is made up of a letter A-G indicating acute aquatic toxicity, followed by a number 0-6 indicating an overall assessment of chronic effects in terms of persistence, bio-accumulation and toxicity (PBT). Persistence, bio-accumulation and toxicity are individually scored 0-2 giving a total score of 0-6. In addition the letter 'X' may be included at the end of the code if the product contains or gives rise by degradation to any substance for which discharge to the aquatic environment may be controlled or conditionally prohibited. Examples include organohalogens such as fluorosurfactants and their fluorinated degradation products which counted as List I substances under the EU Groundwater Directive (incorporated by EU Member States into local legislation under the principle of subsidiarity, e.g. The Groundwater Regulations 1998 Statutory Instrument No.2746 in the United Kingdom) but which will be replaced as from 2013 by the Water Framework Directive 2000/60/EC and its associated Groundwater Daughter Directive 2006/118/EC. Heavy metals, high levels of iron or zinc in protein foams, biocides, or certain glycol ethers may also be of concern. In the UK the Environmental Permitting Regulations 2010 SI 0675 (EPR) have brought together and rationalised environmental and pollution legislation, including the provisions of the EU Water Framework and Groundwater Daughter Directives. Under the Daughter Directive '*.....the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.....*', thus potentially greatly extending control over the discharge of non-hazardous substances. The main impact of this is in Article 6.1(b) where for non-hazardous pollutants Member States must take all measures "*...necessary to limit inputs into groundwater so as to ensure such inputs do not cause deterioration or significant and sustained upward trends in the concentration of pollutants in groundwater...*' (see Crowhurst, G., European Environmental Law Review (2007) July pages 203-210). This has significance for the discharge of environmentally highly persistent materials such as some highly fluorinated substances which may be otherwise non-hazardous, directly or indirectly to groundwater.

Acute aquatic toxicity is measured using recommended freshwater test species according to internationally established OECD protocols. These species include fish, usually rainbow trout or fathead minnow, water fleas (*Daphnia spp.*), and algae (*Scenedesmus spp.*). The offshore industry (OSPAR) has developed its own range of test species more suited to the marine environment including bottom-feeders and crustacea<sup>3</sup>. Aquatic toxicity results are expressed in milligram/litre (mg/l) either for the LC<sub>50</sub> or EC<sub>50</sub> for each test species. The LC<sub>50</sub> (concentration for death of 50% of the organisms used) is usually higher than the EC<sub>50</sub> for the same organism (concentration for effects to be seen in 50% of the test population). Both LC<sub>50</sub> and EC<sub>50</sub> represent the reciprocal of toxicities, i.e. lower values in mg/l indicate greater toxicity than higher values. Aquatic toxicity values are then categorized according to an internationally accepted classification based on a base-10 logarithmic scale as shown below. It must be stressed that this classification is accepted internationally and is based on material in the literature and used by regulatory bodies (US Forestry Service, US Fish and Wildlife Service, US Geological Survey, etc; Passino & Smith (1987)<sup>4</sup>). Individual and idiosyncratic toxicity classifications invented by independent consultants or commercial concerns will not be accepted.

<sup>3</sup> <http://www.cefas.co.uk/industry-information/offshore-chemical-notification-scheme/ocns-ecotoxicology-testing.aspx>

<sup>4</sup> Passino, D.R.M. and S.B. Smith. (1987) 'Acute bioassays and hazard evaluation of representative contaminants detected in Great Lakes fish' Environ. Toxicol. Chem. 6:901-907.

LC50 or EC50 mg/l	Toxicity Descriptor
<0.1 mg/l	Extremely toxic
0.1-1.0 mg/l	Highly toxic
1-10 mg/l	Moderately toxic
10-100 mg/l	Slightly toxic
100-1000 mg/l	Practically harmless
>1000 mg/l	Relatively harmless

Based on Passino and Smith (1987)

It should also be realised that there is no significance in quoting LC<sub>50</sub> or EC<sub>50</sub> values to more than two significant figures at most. Most measurements are not done in such a way so as to yield statistically significant confidence limits; errors for individual measurements may amount to at least  $\pm 50\%$  and inter-laboratory variation may be as high as 4-fold<sup>5</sup>. In addition there are no mandatory species that must be used even within any one group; some species such as the rainbow trout are significantly more sensitive than others. Because of this degree of variability inherent in the available acute aquatic toxicity results, any product with an LC<sub>50</sub> or EC<sub>50</sub> value that is within  $\pm 20\%$  of a category borderline would be given the benefit of the doubt and assigned the less toxic classification, e.g. a value of 88 mg/l would be classified as 'practically harmless/practically non-toxic' rather than 'slightly toxic'.

These seven categories A-G for acute toxicity fit very well as a modification based on EU Directives<sup>6,7</sup> on the environmental marking of energy-using devices and UK Government Office of Fair Trading (OFT) policy<sup>8</sup>. The recommended EU Labelling Scheme for domestic equipment lends itself to use as an indication of acute aquatic toxicity for fire fighting foams with a grading of A-G as shown below. When acute toxicities are available from a range of species such as fish, daphnia and algae, and in order to prevent subjective 'cherry picking' of data, the average toxicity should be obtained as shown below by taking the mean of the *reciprocals* of the LC<sub>50</sub> or EC<sub>50</sub> values. This is more reasonable than taking the arithmetic mean of the LC<sub>50</sub> or EC<sub>50</sub> values because (i) toxicity is inversely proportional to the value of LC<sub>50</sub> or EC<sub>50</sub> in mg/l, and (ii) taking the average of the reciprocals weights the average in favour of the most sensitive species as recommended under the UN globally harmonized system of classification and labelling<sup>9</sup>. In all cases LC<sub>50</sub> or EC<sub>50</sub> values for the *foam concentrate*, not finished foam, rather than for individual components of the formulation should be used to estimate overall aquatic toxicity.

<sup>5</sup> Ted H. Schaefer, Solberg Asia-Pacific Ltd Pty, Sydney, Australia; Schimmel, S.C. 1981. 'Results: Interlaboratory comparison-acute toxicity tests using estuarine animals', U.S. Environmental Protection Agency Publication EPA-600/4-81-003, Gulf Breeze, FL. 14 pp.

<sup>6</sup> Eco-design of Energy-using Products (EuP) Framework Directive 2005/32/EC.

<sup>7</sup> EU Energy Labelling Council Directive 22 September 1992 92/75/EC.

<sup>8</sup> UK Government Office of Fair Trading (OFT) 'The competition impact of environmental product standards'. A report prepared by Frontier Economics for the OFT October 2008 OFT1030.

<sup>9</sup> 'Globally harmonized System of Classification and Labelling of Chemicals (GHS)', 3<sup>rd</sup> revised edition, United Nations, New York and Geneva, 2009; see A9.3.4.3 and 4.1.3.5.2.

Chronic toxicity data is generally less available than acute toxicity data for fire fighting foams. Analysing the PBT profile in terms of scoring persistence, bio-accumulative potential and chronic toxicity for a complex mixture such as a foam concentrate requires some simplifying assumptions. Taking values for the most persistent individual components, for those with the greatest bio-accumulative potential and for those of the highest chronic toxicity, may not altogether be reliable because of possible synergism between components, especially given the relatively high concentrations of glycol solvents and surfactants (detergents) which almost certainly will affect cell uptake and metabolism. Moreover, the PBT profile of any possible degradation products must be taken into account, if any of these are more persistent, bio-accumulative or toxic than the starting materials, since it is they that will determine the overall long-term PBT profile.

Persistence refers to the environmental persistence of an individual chemical component or its degradation products; it must be distinguished from bio-persistence which involves the rate at which material is cleared from the body of a test species such as the rat. Cross-species extrapolation from rats to humans is unreliable at best; it is known that certain fluorinated compounds such as perfluorocarboxylic acids are cleared 100-1000 times more slowly in humans than in rats and that the clearance rates are markedly sex-hormone dependent<sup>10,11</sup>, with males clearing more slowly than females. Bio-persistence is often used by the industry to deflect interest from the extreme environmental persistence of poly- and perfluorinated materials and their degradation products.

There is a complex relationship between persistence, biological oxygen demand (BOD) and acute aquatic toxicity. Foam concentrates that degrade rapidly and completely in the environment, such as Class A and fluorine-free Class B foams containing only hydrocarbon surfactants, are likely to be more acutely toxic than Class B foams containing AFFF-type fluorotelomer-based fluorosurfactants and hydrocarbon surfactants which degrade more slowly and *never completely* because of their organo-fluorine content. Claims that an AFFF is 100% biodegradable based on the BOD/COD ratio are nonsense since current analytical methods do not oxidize the highly stable organo-fluorine compounds and thus omit these from both the determination of the chemical oxygen demand (COD) and total organic carbon (TOC), which are in the main due to the high concentrations of glycol solvent present. A recent procurement document<sup>12</sup> containing the requirement that any AFFF should be >99% degradable within 28 days only highlights the lack of understanding of what is in a typical AFFF concentrate and actually excludes any AFFF currently on the market.

<sup>10</sup> Kudo, N., et al. (2000) Chem. Biol. Interact. 124, 119-132; (2002) Chem. Biol. Interact. 139, 301-316; Toxicol. Sci. 86(2), 231-238 (2005).

<sup>11</sup> Harada, K., et al. (2004) J. Occup. Health 46, 141-147; (2005) Env. Res. 99, 253-261.

<sup>12</sup> Australian Government Department of Defence (2008) "Aqueous Film-Forming Foam (AFFF) Procurement and Usage Interim Policy" Version 1.

Although less acutely toxic, AFFF-type concentrates produce exceedingly environmentally persistent breakdown products that accumulate in groundwater with unknown long-term toxicity, as shown by studies of former military foam training areas<sup>13,14</sup>. It is prudent to require a total organo-fluorine content in mg/l even for foams which claim to be fluorine-free since the presence of small amounts of fluoropolymer will also give rise to environmentally persistent degradation products. The relative toxicity of Class A and some fluorine-free Class B foams should not be overestimated as done by some in the industry. Compared to AFFF-type products, which are classified as 'relatively harmless' or 'practically harmless or non-toxic', Class A foams are generally classified as 'slightly toxic' (but continue to be used in huge quantities for wildland fire fighting!) with fluorine-free Class B foams falling on either side of the borderline between 'slightly toxic' to 'practically harmless or non-toxic', depending on manufacturer.

Persistence is scored on a scale of 0-2. A score of '0' indicates an environmental half-life less than 28 days corresponding to the classification 'readily biodegradable' and appropriate to preparations containing just hydrocarbon surfactants or simple glycols, including such non-foam products as aircraft de-icing fluids; a score of '1' points to components being present that degrade with half-lives between 1 and 12 months; a score of '2' indicates a half-life for a component or its degradation products that exceeds 12 months and is appropriate for formulations containing fluorosurfactants or fluoropolymers.

An estimate of bio-accumulative potential for the components of a complex mixture such as a foam concentrate represents a problem. Bio-accumulation is normally assessed for individual components using the octanol-water partition coefficient  $\log(P_{ow})$  or, in cases where this is not possible such as for fluorosurfactants, a direct measurement of the bio-concentration factor (BCF). The presence of surfactants (detergents) and substantial levels of glycol-based solvents in foam concentrate complicates the picture<sup>15</sup>. Although substances with a molecular weight >700 are considered unlikely to bio-accumulate in fish, a potential for bio-accumulation (and bio-magnification) should be assumed if the material is *highly adsorptive* or *belongs to a class of substances known to have a potential to accumulate in living organisms*<sup>16</sup>, such as is the case for many poly- and perfluorinated materials. In any case we are not especially interested in individual BCFs which are measured in water but in overall trophic bio-magnification up the food-chain. In unfavourable cases, such as for PFOS, BCF multiplication can result in  $\times 10^5$ – $\times 10^6$  concentration of the pollutant up the predator chain<sup>17</sup>, corresponding to ~10 multiplication species-to-species.

<sup>13</sup> Moody, C.A., Field, J.A. (1999) *Env. Sci. Technol.* 33(16), 2800-2806; (2000) *Env. Sci. Technol.* 34(18), 3864-3870.

<sup>14</sup> Schultz, M.M., Barofsky, D.F., Field, J.A. (2004) *Env. Sci. Technol.* 38(6), 1828-1835.

<sup>15</sup> OSPAR Guidelines for Completing the Harmonised Offshore Chemical Notification Format (HOCNF) (Reference number: 2005-13).

<sup>16</sup> European Chemicals Bureau (2003) Technical Guidance Document on Risk Assessment Part II EUR 204 18 EN/2.

<sup>17</sup> AMAP, 2009. Arctic Pollution 2009. Arctic Monitoring and Assessment Programme, Oslo. xi+83pp ISBN 978-82-7971-050-9, p.20.

For these reasons, we have chosen to use the single substance GHS regulatory cut-off for determining potential for bioaccumulation, i.e.  $BCF > 500$  in fish<sup>18</sup> rather than the EU TGD value  $BCF > 2000$ , as indicating the need for serious concern over potential bioaccumulation or trophic bio-magnification (scored as '2'),  $50 < BCF < 500$  as of low concern but nonetheless caution is required (scored as '1'), and a  $BCF < 50$  of as no significant concern (scored as '0'). It should be noted that some longer chain perfluorocarboxylic (perfluoroalkanoic) acids have very high BCF values<sup>19</sup>, for example, C10=450, C12=18000, and C14=23000. Perfluoroalkanoic acids  $> C10$  and perfluoroalkane sulphonates  $> C6$ , such as PFOS, all have BCF values greater than 500.

As mentioned previously, chronic toxicity data for foam components are much less commonly available than acute toxicity data, especially when considered in a mixture. Where measured NOECs (no observable effect concentrations for environmentally relevant end-points) or PNECs (predicted no-effect concentrations) are available for individual components or, better, actual data on groundwater, riverine or oceanic concentrations have been also determined, it is then possible to estimate whether discharge of an environmentally persistent degradation product over time has resulted in the NOEC or PNEC being exceeded and by how much. Data in the literature and presented at meetings suggests that this is indeed the case for both PFOS and the fluorotelomer sulphonate (6:2 FtS) in groundwater at former foam training sites<sup>20,21,22</sup>. If data are available indicating that there are instances known of a persistent breakdown product having already achieved groundwater concentrations in excess of a measured NOEC, then this would automatically attract a score of '1' irrespective of the actual value for chronic toxicity unless this would result in the higher score of '2'. For example, 6:2 FtS would be scored '1' but PFOS would be scored '2' because its NOEC is less than 1 mg/l.

The last category 'X' is used to indicate that the foam formulation contains a substance or substances for which discharge to the aquatic environment may be controlled or conditionally prohibited under local environmental legislation. Such substances could include organohalogens, e.g. fluorosurfactants, as well as heavy metals, copper, iron or zinc, or certain biocides.

The combined label shown in Label 3 is suitable for both individual foam containers and storage facilities.

<sup>18</sup> United Nations (2009) Globally Harmonized System of Classification and Labelling of Chemicals (GHS) 3<sup>rd</sup> edition, Geneva.

<sup>19</sup> Krop. H., de Voogt, P. (2007) 'Bio-concentration Factors of Surfactants in Seawater' OSPAR Convention for the Protection of the Marine Environment of the North-East Atlantic, Meeting of the OSPAR Offshore Industry Committee (OIC). Paris, 12-16 March 2007

<sup>20</sup> Moody, C., Field, J.A. (1999) 'Determination of Perfluorocarboxylates in Groundwater Impacted by Fire-Fighting Activity', *Environ. Sci. Technol.* 33(16): 2800-2806; Moody, C., Field, J.A. (2000) 'Perfluorinated Surfactants and the Environmental Implications of Their Use in Fire-Fighting Foams', *Environ. Sci. Technol.* 34 (18): 3864-3870; Schultz, M.M., Barofsky, D.F., Field, J.A. (2004) 'Quantitative Determination of Fluorotelomer Sulfonates in Groundwater by LC MS/MS', *Environ. Sci. Technol.* 38 (6): 1828-1835.

<sup>21</sup> Korzeniowski, S.H. (2007) 'Fluorotelomer Products in the Environment – an Update', 3<sup>rd</sup> Reebok Seminar, Bolton UK, 3<sup>rd</sup> September 2007.

<sup>22</sup> 3M Company, Minnesota (2003) "Environmental and Health Assessment of Perfluorooctane Sulfonic Acid and its salts" in consultation with Moore, J., Rodricks, J., Tunbull, D., Warren-Hicks, W.

### Label 1

Environmental Impact – Fire Fighting Foam – Acute Aquatic Toxicity	Classification
<p><b>A</b> &gt;1000 mg/L</p> <p><b>B</b> 100 – 1000 mg/L</p> <p><b>C</b> 10 - 100 mg/L</p> <p><b>D</b> 1.0 - 10 mg/L</p> <p><b>E</b> 0.1 - 1.0 mg/L</p> <p><b>F</b> 0.01 - 0.1 mg/L</p> <p><b>G</b> &lt;0.01 mg/L</p>	 <p>Relatively harmless</p> <p>Practically non-toxic</p> <p>Slightly toxic</p> <p>Moderately toxic</p> <p>Highly toxic</p> <p>Extremely toxic</p> <p>Super-toxic</p>
<p><b>Notes:</b></p> <p>a) Classification of Acute Aquatic Toxicity follows the internationally accepted standard classification used by the USFWS, USGS, etc., based on original work by Passino and Smith (1987) Env. Toxicol. Chem. 6, 901-907. LC<sub>50</sub> or EC<sub>50</sub> values are based on a maximum exposure to test substance of 96 hours.</p> <p>b) In order to avoid 'cherry picking' and distortion by large outliers, average aquatic toxicity should be obtained by summing the reciprocals of individual LC<sub>50</sub>/EC<sub>50</sub> values (fish, daphnia and algae), followed by taking the reciprocal of this sum, i.e.,</p> $\text{Average toxicity} = \frac{3}{\left( \frac{1}{\text{fish toxicity}} + \frac{1}{\text{daphnia toxicity}} + \frac{1}{\text{algal toxicity}} \right)}$ <p>thus, for example, for Gold Orf LC<sub>50</sub> = 84 mg/l, <i>Daphnia magna</i> EC<sub>50</sub> = 48 mg/l, <i>Scenedesmus subspicatus</i> EC<sub>50</sub> = 138 mg/l, giving an average aquatic toxicity = 75 mg/l, rather than the arithmetic mean of 90 mg/l. This procedure is required because toxicity is inversely proportional to the LC<sub>50</sub> or EC<sub>50</sub> rather than to the absolute arithmetic value in mg/l. Weighting factors may be used if required.</p> <p>c) LC<sub>50</sub> or EC<sub>50</sub> values for the foam concentrate should be used in calculating average aquatic toxicity, with account being taken that finished foam will be between one and two categories less toxic.</p>	
<p><b>Ecological Information</b></p> <p>Typical data required for the <i>foam concentrate</i> in the form of test-house results, for example:</p> <p>X Chemical Oxygen Demand (COD) - 203,500 mg/l</p> <p>X Biochemical Oxygen Demand (BOD)</p> <p>- 5 days - 107,500 mg/l (52.8%)</p> <p>- 28 days - 180,000 mg/l (88.5%)</p> <p>X Total organic carbon (TOC) = 77,000 mg/l</p> <p>X Total organic fluorine (TOF) = &lt;1 mg/l</p> <p>X TOF as % of TOC = &lt;0.002%</p>	<p><b>Calculating Overall Environmental Rating</b></p> <p>Assign PBT score plus discharge rating (total 0-6 followed by "X" if discharge is prohibited).</p> <p>Combine with rating A-G for acute aquatic toxicity to give an overall environmental rating, e.g., for a typical Class A foam rating = D0,; for a PFOS-containing AFFF rating = A6X; for a fluorotelomer AFFF rating = A2X; for a Fluorine-Free rating = B0 or C0.</p>

## Label 2

Environmental Impact – Chronic Effects – Persistence, Bioaccumulation, Toxicity (PBT)	Significance
<p><b>PERSISTENCE</b></p>  <p><b>0</b> Low (<math>t_{1/2} &lt; 28</math> days)</p> <p><b>1</b> Moderate (<math>t_{1/2}</math> 1 - 12 months)</p> <p><b>2</b> High (<math>t_{1/2} &gt; 1</math> year)</p>	<p>Of little concern</p> <p>Caution required</p> <p>Serious concern</p>
<p><b>BIOACCUMULATION</b></p> <p><b>0</b> Low (BCF &lt; 50)</p> <p><b>1</b> Moderate (BCF 50 – 500)</p> <p><b>2</b> High (BCF &gt; 500)</p>	<p>Of little concern</p> <p>Caution required</p> <p>Serious concern</p>
<p><b>TOXICITY (CHRONIC)</b></p> <p><b>0</b> Low (&gt;100 mg/L)</p> <p><b>1</b> Medium (1 – 100 mg/L)</p> <p><b>2</b> High (&lt; 1 mg/L)</p>	<p>Low risk</p> <p>Environmental damage likely</p> <p>Containment essential</p>
<p><b>GROUNDWATER/CONTROLLED WATERS</b></p> <p><b>X</b> Discharge forbidden / controlled</p>	<p>Organohalogenes (fluorosurfactants)</p>
<p><b>Impact on the Environment – Persistence, Bioaccumulation, Toxicity (PBT)</b></p> <p><u>Notes:</u></p> <ul style="list-style-type: none"> <li>i) Persistence quantified as half-life (<math>t_{1/2}</math>) of parent substance <i>including any degradation products</i>.</li> <li>ii) Substances or their degradation products whose discharge may be controlled or conditionally prohibited under local legislation derived from the EU Groundwater Directive 80/68/EEC or, after 2013, from the new Water Framework Directive 2000/60/EC and its Groundwater Daughter Directive 2006/118/EC, for example, <i>organohalogen compounds and substances which may form such compounds in the aquatic environment, i.e., poly- or perfluorinated compounds</i>. Care should also be taken with the discharge of any foam concentrate or finished foam with high zinc (Zn) or high iron (Fe) concentrations.</li> <li>iii) Runoff containing organohalogenes should be collected and high-temperature incinerated.</li> <li>iv) Total PBT score obtained by adding individual ratings, e.g., a maximum score of 2+2+2 = 6 with a minimum score = 0. Additionally X may be used to indicate prohibited or controlled discharge.</li> </ul>	

**Label 3 - Example of consolidated environmental information**

**Acute Aquatic Toxicity**      **B3X**      

**B**      100 - 1000 mg/L

**Chronic - Persistence/Bioaccumulation/Toxicity (PBT)**

**P=2**      High ( $t^{1/2} > 1$  year)

**B=0**      Low (BCF < 50)

**T=1**      Medium (1 – 100 mg/L)

**X**      Discharge forbidden / controlled

DRAFT

## Section 3 – Qualified Product List

### 1 Introduction

A Qualified Product List (QPL) is a list of those products which have qualified against a set of specifications. In the case of aviation fire fighting foam, the two sets of specifications, performance and environmental impact, are set out in Sections 1 and 2 of this IP.

This section details the procedure that a foam manufacturer should follow for a product to be placed on the QPL.

### 2 Application

An application form can be found at Appendix A. This form should be completed and submitted to the address on the form together with the required evidence and the appropriate fee.

If a confidentiality agreement is required by the manufacturer this should also be attached.

### 3 Charge for product to be added to the QPL

The charges for submitting a product to be added to the QPL are set out in the CAA Scheme of Charges (TBA).

(Estimate of charges - adding to list [including validating evidence] - £1,000)

If a product has been reformulated or its composition changed so as to necessitate re-approval or recertification under any relevant foam test standards, e.g. ICAO, EN1568 or UL162, then revised evidence must be re-submitted and a further fee paid.

## Appendix A

**Application for an aviation fire fighting foam to be added to the UK CAA Qualified Product List**

Name and address of company

Product name

**ICAO Performance Test**Is accreditation of a test required? or  
Accredited certificate attached
  

**Environmental Impact System**

Property	Measurement	Amount	Test Species
Acute Toxicity	LC50 or EC50 - mg/l		
Persistence	Half Life - days		
Bio Accumulation	BCF		
Chronic Toxicity	NOEC/PNEC		
Components	IUPAC Name	Concentration	CAS Number
Organohalogenes Fluorine content - Total - Organic			
Hydrocarbon surfactants			
Silicon surfactants			
Fluorosurfactants			
Fluoropolymers			
Metal content - Fe - Pb - Cu - Zn			
Glycols - Identity			
Biocides			
Controlled/Prohibited	Yes/No		

Independent documentary evidence must be submitted for all the above. Individual chemical compounds must be identified, using IUPAC nomenclature together with a CAS number.

[Charge, Payment Details etc]