European Union Aviation Safety Agency

Fluorine Free Foams

Are European airports required to replace current foams (AFFF) with fluorine-free foams (F3)?

Answer

At this stage, the replacement of AFFF foams with fluorine-free foams is not mandatory under the regulatory framework in the domain of civil aviation rules by EU-EASA and European current regulations.

However, due to European environmental regulation, the use of some AFFF is banned and considering future deadlines and the European objective of a complete ban of PFAS in firefighting foams, airports should proactively plan the transition to fluorine-free foams.

The transition from AFFF foams to fluorine-free foams is driven by a phased ban - due to health and environmental concerns - on the production and use of certain fluorinated substances (PFAS) that are used in AFFF historically used by Aircraft Rescue and Fire Fighting Services at airports.

At this point, in accordance with the international Stockholm Convention, the European Regulation (EU) 2019/1021 “POPs" (Persistent Organic Polluants) bans on production and use the fluorinated foams containing PFOS (since 2009 and PFOA (since 2020) with some exemptions until end of 2022 and July 2025 for operational uses, depending on if discharges of foamed water are collected.

Additionally, the European Regulation (EC) 1907/2006 "REACH” **bans the production and use of additional PFAS in firefighting foams, including PFHxA**, to be banned before April 10, 2026, for regular firefighting uses and **before October 10, 2029, for civil aviation firefighting** (including airports)

Additional bans on any PFAS in firefighting foams are currently under discussion in the EU, leading many foam manufacturers to plan for discontinuing all PFAS-containing products.

As a result, depending on their chemical composition, some AFFF foams are now already banned or will be in future years:

- **"C8 foams", containing ‘long-chain” (more than 8 carbons) PFAS, are banned since 01/2023 at airports, where collecting foamed water is not ensured.**

- **Most of "C6 foams" (more recent generation of AFFF) will be banned in UE, with a specific 5-year delay (10/2029) for ARFF operations at airports.**

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What are the differences between AFFFs (Aqueous Film-Forming Foams) and the F3s (Fluorine-Free Foams)?

Answer

The main differences between the Aqueous Film-Forming Foams (AFFFs) and Fluorine-Free Foams (F3s) are chemical composition, firefighting performances and operational application methods.

AFFFs (Aqueous Film-Forming Foams) contain PFAS, that are responsible for these foams' ability to form an aqueous film which helps to quickly suppress fires and provides higher resistance to re-ignition, even when foam has been degraded due to time or weather conditions.

F3s (Fluorine-Free Foams) have in common to be designed to be free of intentional fluorinated chemicals. Without fluor surfactants and film forming abilities, **their firefighting efficiency mainly relies on the quality of the foam blanket applied in operation**.

Accordingly, level of performance highly depends on the initial **quality of the foam produced by nozzle**, the **quality of the foam blanket created by firefighters** and **maintaining this quality despite degradation by time, physical or weather conditions**.

F3 Foam concentrate also presents various compositions, e.g. various physical properties, such as a different viscosity, that may impact quality of foam produced with firefighting equipment.

As a result, whatever the foam fire performance level, the compatibility with firefighting equipment and the training and operational tactics are more important criteria when using F3 than AFFF.

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What are the main challenges for transition to Fluorine-Free Foam?

Answer

As for any change of foam, ensuring that the selected foam has demonstrated an appropriate and expected level of performance is fundamental.

However, considering general characteristics of Fluorine Free Foams, and considering the various products, the main challenges are, for an aerodrome operator, to ensure, with selecting and testing arrangements that:

- Selected foam suits with existing RFFS vehicles i.e.;
- Proportioning system vs. Viscosity of foam concentrate;
- Monitors and nozzles characteristics vs. Minimum quality of foam;
- Firefighting tactics are adjusted to F3;
- Firefighters are familiarized with the new foam;
- Handling or storage conditions assessment at the airport;
- Review and improve arrangements and criteria for initial and periodic testing of foam or vehicles.

In addition, aerodrome operators must plan transition to F3 considering:

- If or how existing vehicles are available for a future exploitation with F3 depending on:
  - Compatibility between vehicles and F3;
  - Impact of residual contamination with PFAS and environmental regulation.
- Already planned new vehicles, as it is advisable to limit contamination with PFAS;
- Existing stockpiles of AFFF, as far as it is usable foam considering PFAS regulation.

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What are the applicable safety regulatory requirements when changing foam?

Answer

ADR.OPS.B.010 requires that aerodrome operators ensure that adequate fire extinguishing agents are available. For this purpose, AMC4 ADR.OPS.B.010(a)(2) defines that:

(b) The foam (used as principal extinguishing agent) is meeting a minimum level of performance A, B or C;

(d)Minimum usable amounts of water are available for foam production (see table 1);

(j) A reserve supply of foam concentrate (200%) is maintained on the aerodrome (…);

(p) Arrangements are in place to manage extinguishing agents in terms of selection, storage, maintenance and testing.

As with any change of AFFF foam, the airport operator should ensure compliance with these provisions paying particular attention to those concerning the performance level.

In addition, it would be advisable to ensure that arrangements previously in place for selection, storage, maintenance and testing of AFFF are adapted to the characteristics and performance of new types of foam such as Fluorine-free foams, also with regard to the specifications of RFFS vehicles in use.

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What are the standards about performance level of fluorine-free foams at airports?

Answer

Although it is not clearly specified in AMC4 ADR.OPS.B.010(a)(2), it is commonly considered that the minimum level of performance A, B or C expected for extinguishing foams refers to performance levels defined by ICAO in Annex 14 and to information about fire performance test described in ICAO Airport Services Manual (Doc 9137), Part 1 (Rescue and Fire Fighting Services), Chapter 8.

As of today, there is no specific testing protocol defined for Fluorine Free Foam in the Airport Services Manual.

The current protocol allows measuring the minimum application rate whatever the tested Foam (Aqueous Film Forming (AFFF) or Fluorine Free (F3)).

As for AFFF, Aerodrome operators should refer to these information and the Airport Services Manual when requiring a minimum level of performances.

Selecting arrangements should include additional information such as expected conditions of

certification or qualification of foam (fire performance test, foam production acceptance test with vehicles) and considerations about specifications of RFFS vehicles in use.

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Does the use of F3s change the quantities of extinguishing agent (water & foam) required?

Answer

The quantities and flow rates required by the Aerodrome regulation have been determined according to the length and width of the aircraft to be protected, as well as the foam application rate, which depends on the performance level (A, B, or C) achieved by the foam used as the primary extinguishing agent.

At this stage, once the foam, whether F3s or AFFF, has demonstrated its performance level on kerosene Jet-A1, the required quantities will be the same, regardless of whether AFFF or F3 is used.

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Is it required to considers transition to F3s as a change that need to be approved by Authority?

Answer

A change of foam, even when changing from AFFF to F3, does not directly affect the RFFS level of protection to be ensured by the airport operator. As such, the change is not identified as one requiring prior approval by Competent Authority (see AMC1 ADR.0O.B.040 (a);(b).

However, using a new type of foam could have a potential impact on the efficiency and

organization of RFFS due to the different performances or application procedures as well as the challenges of such transition on the capacity to maintain an appropriate operational level of protection.

Therefore, it would be advisable for an airport operator to consider initiating and documenting a safety assessment – potentially supported by testing – before transitioning from AFFF to F3.

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Does fluorine-free foam offer equivalent performance and effectiveness on hydrocarbon fires?

Answer

Fluorine-free foams have generally demonstrated a different level of performance with regard to AFFF.

The lack of aqueous film-forming capability makes achieving initial fire suppression more difficult and affects resistance to re-ignition. This performance difference also depends on the type of flammable liquid or hydrocarbons to be extinguished.

However, many fluorine-free foams have demonstrated fire performance levels and effectiveness on kerosene that meet the minimum standards used to assess AFFF foams.

In practice, when using fluorine-free foam, **the ability to achieve quick**, **complete** and **lasting suppression largely depends on the firefighters' capacity to create and maintain a uniform foam blanket**.

In contrast, AFFF foams, with their aqueous film-forming properties, maintain better effectiveness even when the foam blanket is imperfect or degrades during the operation.

As a result, foam **application methods and firefighter training are to be considered as critical** when using fluorine-free foam than when using AFFF foam.

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Is on-site Fire performance testing necessary to evaluate the effectiveness of an extinguishing agent at an airport?

Answer

The legal provisions set in the Aerodrome regulation or in ICAO documents neither require nor recommend conducting on-site fire performance tests under airport condition (to be distinguished from on-site tests for verifying the compatibility of foam concentrate with the vehicles).

However, when selecting a foam concentrate, best practices should be adopted to ensure that the conditions under which the foam's performance was previously assessed (such as dosage, foam quality, and testing temperatures) match the conditions encountered at the airport or provide an acceptable level of performance.

If needed, especially when operating in temperatures that differ significantly from those experienced during the tests, it is recommended to consult the foam manufacturer for more information about the impact of temperatures on the foam performance.

Additional tests at a testing center may also be considered, or, ultimately, on-site tests if replicating the airport's specific conditions elsewhere proves too difficult.

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Can a Fluorine Free Foam be used in conjunction with AFFF (Aqueous Film-Forming Foam)?

Answer

Due to their distinct chemical compositions, F3 and AFFF exhibit different mechanisms in fire suppression, particularly due to the lack of a floating aqueous film in F3.

AFFF and F3 concentrates must never be mixed into tank or mixing systems of vehicles.

However, using these two types of foam simultaneously from separate vehicles during an intervention, in the event of an aircraft accident, may not have any significant impact on the

firefighting performance of the individual foams as far as respective application conditions are taken into account.

Moreover, it is suggested to minimize the duration of the period using both foams for transition purposes and to consult the manufacturers of the respective products for detailed technical guidance.

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Do airports need to change their firefighting vehicles or systems to use Fluorine Free Foam?

Answer

No, not necessarily. However, to ensure effectiveness of the new foam, the following aspects should be considered:

1. the compatibility of specifications of the intended foam concentrate with each firefighting vehicle and its firefighting systems;
2. sufficient cleaning of firefighting systems to avoid chemical interactions between previous foam (AFFF or F3) and new fluorine free foam.

Compatibility of F3s with vehicles depends on both the specifications of the vehicles and the on-board equipment, such as the foam proportioning system and nozzles, as well as the physical properties of the selected fluorine-free foam (e.g., viscosity or expansion rates), which could impact its performance with existing firefighting systems.

Depending on the chosen foam concentrate, **airports may need to adjust or replace foam proportioning systems or nozzles to ensure compatibility**. In some cases, if adjustments or replacements are not feasible, it may be necessary to **consider changing firefighting vehicles** or, if possible, selecting a foam product with more suitable physical properties.

Therefore, it is recommended (including by vehicles manufacturers) to check the compatibility of the vehicles with the intended product:

- Prior to the order and delivery of the product, through a verification of the declared specifications and consultation with the manufacturers (of the vehicle and of the foam). At this point, results obtained previously on similar vehicles can be useful and valuable;
- Then, before F3 is officially put into service, (in-site) measurements and tests, to ensure that

foam production by the airport's RFF vehicle is of an acceptable and expected standard considering proportioning system, foam quality and jet range (see ICAO Airport Service Manual "§ 8.1.6 "Foam performance acceptance test").

Considering sufficient cleaning of vehicle and firefighting systems, as it was usually recommended for any change of AFFF, a simple water rinse of the entire system (from tank to external equipment) may be considered as sufficient to prevent chemical interactions between new F3 and previous used foam.

However, it should also be noted that additional cleaning or vehicle replacement may be necessary to meet environmental requirements, due to the potential residual contamination of firefighting equipment with PFAS.

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What are foam production performance tests?

Answer

Whatever is the fire performance level of a selected foam, according to ICAO fire testing protocols, foam production by the airport's RFFS vehicles should be acceptable, considering fire testing conditions and expected performance of foam according to the foam manufacturer.

Foam production performance tests are measurements conducted with the airport's ARFF vehicles to verify:

- Performances of the proportioning system of the vehicle;
- Quality of foam (expansion ratio and 25% drainage time) produced with turret monitor and all other foam-making devices;
- Jet range of the main monitor.

Results of these tests, compared with expected performances, help to assess the compatibility of foam and vehicles in the foam acceptance process. Initial results may be also used as reference for periodic in-service tests to ensure the ongoing performances of foam and foam production equipment. Considering that with Fluorine Free Foams, the quality of produced foam is more critical, performances of the main turret, in particular non-aspirated nozzle, should be assessed with care.

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Do intervention protocols need to be changed with the use of fluorine-free foam?

Answer

Considering differences between AFFF and F3s, which do not guarantee the production of an aqueous film on the burning or spilled liquid, aerodrome operators with their RFFS team should assess and review, in coordination with the foam manufacturer, whether their firefighting techniques and tactics are still appropriate or need to be adapted.

In particular:

- Foam application techniques;
- Consideration on adverse conditions impacting the quality of the foam blanket during operation;
- Monitoring and regeneration of foam blanket.

Furthermore, changes in intervention protocols should be taken into account in the Tasks and Resource Analysis as changes in techniques and tactics could affect the required number of firefighting personnel.

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Do firefighters need specific training when using fluorine-free foam?

Answer

Considering the characteristics of Fluorine-Free Foams, it is recommended that aerodrome operators and RFFS identify and implement actions to familiarize firefighters with Fluorine-Free Foam properties and tactics. Special attention should be given to foam application conditions and on ensuring isolation from heat and flames to break the combustion chain reaction.

These actions may include information dissemination or various levels of training. It is advantageous to carry out training with live fire & foam drills, as real practice offers greater responsiveness and adequacy of procedures.

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