AIRPORT TECHNOLOGY RESEARCH &
DEVELOPMENT BRANCH

Fluorine-free Foam (F3) Transition Awareness

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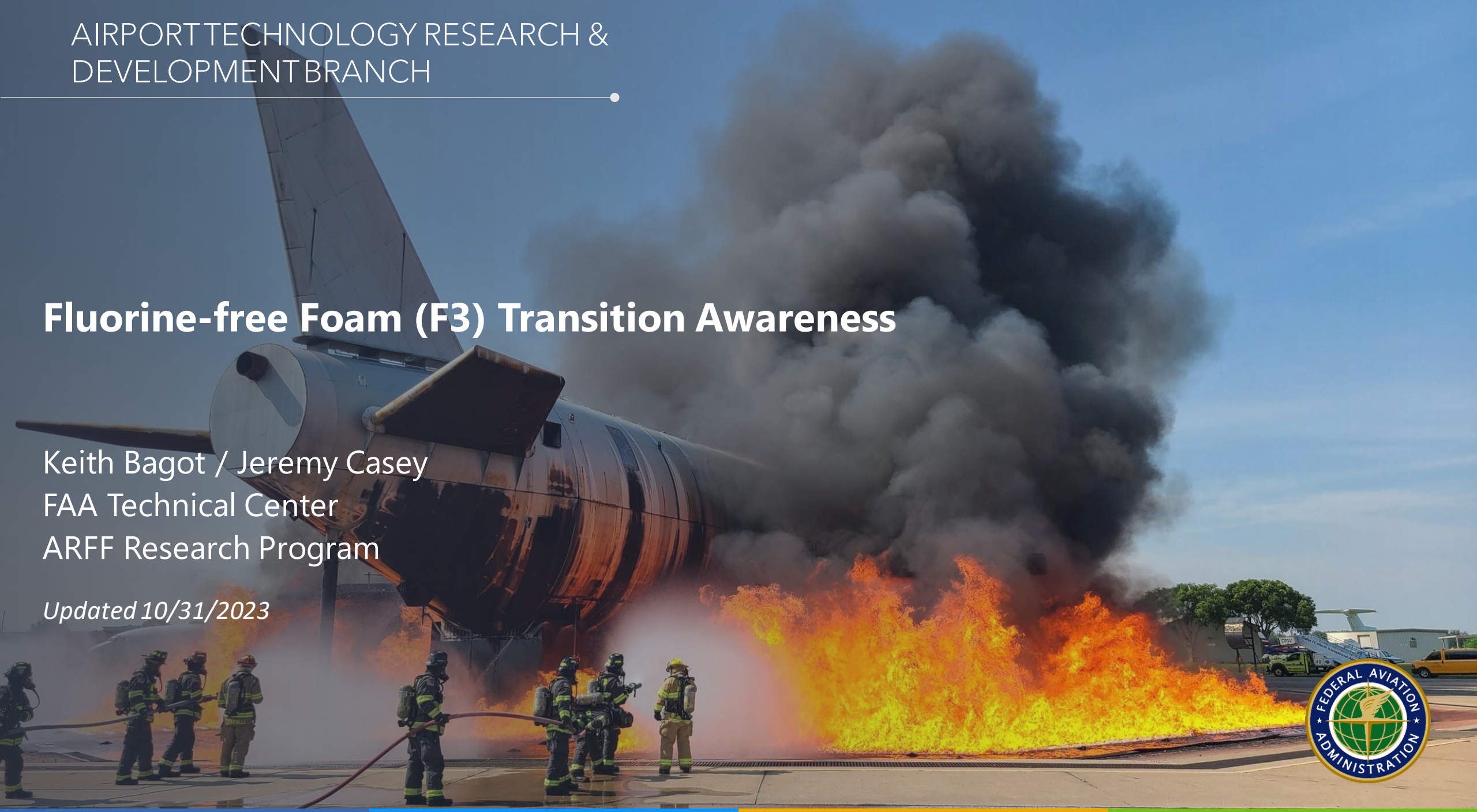


Objective

FAA is providing guidance on the transition to F3 products and the implementation of firefighting personnel training at Part 139 airports.

- What are the differences between AFFF and F3s?
- How does foam quality impact the effectiveness of fire extinguishment?
- What are the best nozzles to use?
- What is the best spray pattern and application technique?
- What is the timeline for F3 information dissemination

F3 products implementation

Policy & Guidance Timelines

MilSpec Published

Jan. 6, 2023

The US Navy published a new MilSpec outlining the performance requirements F3s must meet to be certified and listed on the Navy's Qualified Products List (QPL).

FAA CertAlert 23-01

Jan. 12, 2023

FAA stated it will accept the use of F3s listed on the Navy's QPL for aircraft rescue & firefighting (ARFF) purposes at Part 139 airports as an alternative to legacy aqueous film forming foams (AFFFs).

First Product Approval

September 13, 2023

The Navy was required by Congress to have products approved and listed on the QPL by October 1, 2023.

Transition Training

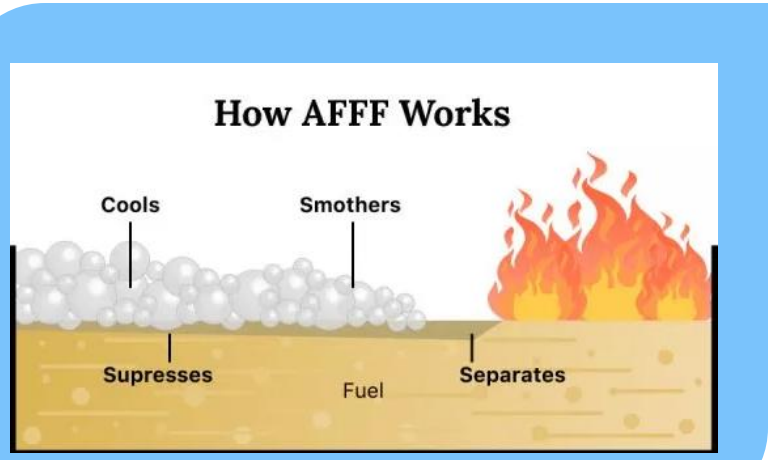
TBD Timeframe

Once F3s are posted to the QPL, civil airports can begin their transition to these new foams.

Understanding key differences

Legacy AFFF vs New F3s

ARFF personnel must understand the differences in F3 performance when battling Class B, liquid fuel spill fires



Legacy AFFF

Extinguishes fuel spill fires in *3* ways:

1. Foam blanket suppresses the combustible fuel vapors
2. Water cools the fire
3. Fluorinated surfactant drains from the foam bubbles and **creates a vapor suppressing film between the foam and fuel** layers

The **film** helps the foam blanket travel across fuel spills and reseals itself when the foam blanket breaks.

Even when the foam blanket has degraded, film from the fluorinated surfactant continues to provide vapor suppression.

New F3s

Extinguishes fuel spill fires in *2* ways:

1. Foam blanket suppresses the combustible fuel vapors
2. Water cools the fire

F3s do not have the film forming properties of AFFFs. When a foam blanket is disturbed, there are no resealing properties of a film formation.

Without the film, the structure & maintenance of the foam blanket is critical to the success of suppressing the fire!

Understanding key differences

Insights

Fire fighters should review basic foam operations & foam application methods.

Poor fire fighting methods while using AFFF did not always impede fire extinguishment. AFFF's superior fire suppressing characteristics + the fluorinated surfactants role in aiding the foam blanket's ability to travel across the fuel spill, often compensated for poor fire fighting technique.

F3 will not be as forgiving if poor application methods and foam blanket management are used.

☑

Consider conducting another Resource Task Analysis for emergency responses using F3s.

Key Considerations for Foam Operations

- **Correct foam-to-water ratio:** 3% ratio = 3 gallons of foam to 97 gallons of water
- **Application rate:** the amount of foam solution that must be applied to readily extinguish a fuel fire, absorb the heat, and smother the vapors
  - Poor application rate causes the foam blanket to break down
- **Proper angle of attack:** the 'sweet spot' between plunging and raindrop
- **Multiple discharges:** forming one cohesive blanket using applications from multiple sources
  - The use of two different foams (e.g., dispensed from two different ARFF response vehicles) in response to a fire may not have any significant impact on the firefighting performance of the individual foams.

TERMS

Base Sweep: Stream is directed at the base of fire with sweeping motions to spread blanket.

Plunging: A downward angled discharge which pushes the foam into the fuel causing mixing.

Raindown: A high arching stream which causes vertical or near vertical foam application onto the fire.

Plunging

Raindown

Tactics & Techniques

F3 Basic Techniques & Skills

- **Do not plunge the fuel fire**
- **F3s are not oleophobic (repel oils) and will mix with the hydrocarbon fuels creating low burning flames across the foam blanket**

Suggested approach

- ✓ Slowly move the nozzle and let the foam build up
- ✓ Walk slowly through the foam
- ✓ For reach, use a low expansion nozzle
  - Low expansion nozzles adjusted to straight stream provide the best reach but least expansion/aeration
  - If possible, adjust the pattern to a 15° fog to increased expansion of finished foam
  - When using a low expansion nozzle, consider using the bank-down and roll-on methods to create thicker finished foam

Initial Fire Attack

Goals for an effective initial attack remain the same:

- ✓ Separate the fire from the fuselage
- ✓ Establish and maintain evacuation paths
- ✓ Quickly knockdown and control fire
- ✓ Establish foam blanket for protection

A base sweep technique is recommended for the initial attack.

☑ Use a spotter for all handline fire attack operations

Base Sweep Guidelines

The Base Sweep provides effective and rapid-fire knockdown due to the localized high application rate.

Important factors to consider when using a Base Sweep application:

- Speed of sweep is critical for effective fire control
  - Too *fast* causes no blanket formation and a low localized application rate
  - Too *slow* and the fire will destroy an already established blanket
- Focus on maintaining a level nozzle position to avoid plunging into pooled fuel
- Foam blanket cohesiveness can cause any established blanket to break or be pulled away
- Blanket can rapidly degrade causing re-ignition
- Aggressive sweeping can push pooled fuel into undesirable areas

F3 Considerations & Responsibilities

⚠ **A poor-quality foam blanket can lead to the fuel spill reigniting and wrapping behind responders. Without the film formation, maintaining awareness of the foam blanket's condition becomes critical.**

✓ Handline crew should **use a spotter**

- Spotter can be a backup fire fighter positioned further back on the handline to provide a clearer view of the foam blanket
- The spotter function can also be filled by a second backup handline crew

✓ Truck driver/operator must **maintain awareness of the foam blanket**

- The driver/operator can reapply foam to the blanket as handline operations are ongoing to provide added protection to the handline crew

Blanket Formation & Maintenance

Roll On technique

Deflect stream off of the ground in front of the spill to create a "rolling" blanket that can be pushed forward onto fire.

Bank Down technique

Deflect stream off of vertical surface to flow onto pooled fuel.

Rain Down technique

A high arching stream that falls vertically (or close to) onto the fire .

Foam Blanket Management

Rapid foam blanket breakdown

Understanding Draindown Times

Draindown is significantly different between AFFF and F3, with F3 draindown being significantly slower than AFFF.

Why?

- **AFFF** draindown is the combination of loss of foam blanket and the building of the film formation for vapor suppression
- **F3s** have a slower draindown since the mechanical structure of the foam blanket is the only vapor suppressing characteristic

KEY TERM

Draindown: The time it takes for the liquid to drain from the foam bubbles. This is used as a measurement for foam quality and the ability of the foam blanket to stay intact.

Foam Blanket Management

Initial fire attack with base sweep application

Foam blanket rapidly breaks down to left of hose team

Exposed fuel reignites causing attack team to reapply foam prior to fire control

Types of nozzles

Variable Stream Nozzle

- Provides the widest range of spray pattern options
- Provides the best throw range
- Does not provide aspiration – usually produces a lower foam expansion

Variable Stream with Foam Tube

- Removes the ability to adjust the spray pattern
- Adds aeration to the foam discharge & provides higher foam expansion
- The foam tubes can severely impact throw distance

Compressed Air Foams (CAFs)

- Removes the ability to adjust the spray pattern
- Adds aeration to the foam discharge & provides higher foam expansion
- CAFS can negatively impact throw distance

Throw Distance with Foam Tube

Task Force Tip Metro 1 (TFT-STD)
- *75ft Effective Reach*

Task Force Tip – Metro 1 with Long Foam Tube (TFT-LFT)
- *65ft Effective Reach Task*

Task Force Tip – Metro 1 with Short Foam Tube (TFT-SFT)
- *45ft Effective Reach*

F3 Training & Info Distribution

Training Facility Considerations

While the initial transition training from AFFF to F3 will be through webinars, journal publications, etc., firefighters will ultimately need hands-on training.

Future capabilities of ARFF Training Facilities still need to be determined.

- How many facilities exist that can still use liquid hydrocarbon fuels?
- How many current training facilities do not/will not have foam discharge restrictions for F3?
- What instructional techniques can be developed for getting F3 techniques across to students using propane facilities?

Where we're headed

Disseminating Training Material

Immediate Methods

01 Print/Online Material

- FAA Release (Cert Alert, website, emails)
- ARFF Working Group
- National Fire Protection Association (NFPA) Journal
- NFPA Research Foundation Firefighting Foams: Fire Service Roadmap

02 Webinars

03 Conference Presentations

Future Methods

01 Fire Training Centers

- Classroom instruction
- Hands-on live fire training

02 Training Video Production

Information Gaps

01 Where additional information about F3 performance is needed

02 Training Material/Technology

- Simulator modifications
- Further software development

03 Training Facilities

- Need for expanded capacity of fuel vs. LP gas trainers

F3 Vehicle Transitioning

Conversion considerations

ARFF Vehicle Transitioning

1. **Coordinate with State and Airport environmental officials prior to beginning transition**
2. **Ensure adequate storage for any old concentrate and rinsate**
3. **F3 concentrates CANNOT be mixed**
4. **Key steps during vehicle transition**
   - ✓ Remove old concentrate from entire system, including all plumbing past the foam tank valve and proportioner
   - ✓ Ensure the entire system is dry before refilling with F3
   - ✓ Ensure the tank is FULL to reduce the air gap in the tank
   - ✓ Conduct a proportioning test to ensure the solution concentration is accurate
     - Mechanical Systems (poppet/orifice system) typically require slight modification to achieve the proper proportioning rate. Consult with vehicle manufacturer on requirements and procedures.
     - Electronic systems typically do not need adjustment but still require verification of proportioning rate.

ARFF Vehicle Transitioning

- F3 concentrates are **more viscous** than AFFF concentrates. Different F3 concentrates have differing viscosities.
- F3 concentrates **CANNOT** be premixed.
- Consult **Vehicle Manufacturer or Service Provider** prior to transition to understand if and what modifications are necessary. Vehicle manufacturer may need to know what foam will be used in vehicle.
- **All Vehicles should complete an output-based proportioner test (refractometer/conductivity meter) after transitioning to ensure the proper proportioning rate is achieved.** May need to conduct multiple tests per discharge to achieve proper rates. Be prepared to capture and clean up all discharged foam.
- Input-based testing can continue to be used following the output-based confirmation test to determine the new acceptable values for input-based tests. If an input-based test system is to be used for proportioner testing, it is suggested to conduct input-based tests immediately following the final output-based confirmation test.

Resources & Projected Timeline

Anticipated next steps

Suggested Targets & Dates

Within 180 days after the release of F3 products

FAA will evaluate and provide guidance materials on the impacts of F3 products on current list of certified & approved training facilities.

Within 180 days of new F3 being added to the QPL

FAA will update applicable Advisory Circulars on impacts to training techniques & application of the new F3 foams and disseminate updated information through the field inspectors representing Part 139 airports.

Upon completion of the above

FAA will sponsor and host three webinars in calendar year 2024 with an open invitation to all Part 139 airport staff & personnel to share lessons learned and best practices.

Frequently Asked Questions

Q1. With the release of the F3 MilSpec, can airports now purchase MILSPEC F3 foam?
A1. Yes, with the first product passing the qualification testing and being listed on the Navy's QPL, airports now have an approved F3 to select for transition.

Q2. How long will it take for DoD to test the foam?
A2. DoD indicates that due to the number of required tests, it will take a minimum of 90 to 120 days for the testing to be completed. This does not mean that products will be placed on the Qualified Product List (QPL) immediately after testing. DoD will determine when an approved foam is added to the QPL. There are currently multiple products in the testing cycle.

Q3. Is there a date by when DoD must publish approved foams to the QPL?
A3. Yes. Per the National Defense Authorization Act for FY 2020, the Secretary of the Navy shall ensure that F3 is available for use no later than October 1, 2023. The first QPL listed product was added on September 13, 2023.

Q4. Will the FAA require airports to transition to F3 products?
A4. No. FAA regulations (14 CFR Part 139) do not require a particular type of foam and therefore do not mandate that airports transition to F3. However, upon the adoption of the MILSPEC, the FAA will issue a Cert Alert indicating that the use of F3 foam is an acceptable means of complying with the Part 139 regulation. Congress has not passed legislation prohibiting airports from using AFFF. Airport operators should check with their state and local municipalities for any local requirements.

Q5. Will the FAA assist airports in purchasing F3 type products and disposing of AFFF?
A5. At this point, no decision has been made in reference to financial assistance to airports in transitioning to F3.

Q6. Can airports purchase and mix different types of MILSPEC F3 products in Aircraft Rescue Fire Fighting (ARFF) vehicles?
A6. No. MILSPEC F3 products cannot be mixed.

Frequently Asked Questions

Q7. Will the FAA require airports to clean the ARFF vehicles and if so, will they assist with the associated expenses?
A7. The FAA will offer airports information and best practices to assist airports that want to clean their vehicles.

Q8. Will the FAA be assisting airports in transitioning to F3?
A8. Congress requested that the FAA, in coordination with DoD and the Environmental Protection Agency (EPA), develop a transition plan no later than 120 days after DoD issues the new MILSPEC for F3. The transition plan informs Part 139 airports on the use of F3 and include information on any supplemental equipment needed to use F3. The Transition Plan was released May 8, 2023 and can be downloaded from the FAA's ARFF web page (link available at the end of the presentation).

Q9. Will airports need to change any equipment or systems on their vehicles to use the new F3?
A9. The new F3 has similar viscosity as AFFF, but adjustments to proportioner systems may be needed. With very few exceptions, the FAA expects no major modifications to, or addition of extra equipment on, current vehicles.

Q10. Will there be any new required firefighter training needed?
A10. No. There will be no new regulatory training requirements, application of the types of extinguishing agents required for compliance is already covered in 14 CFR part 139.319(h). However, it is STRONGLY encouraged that all ARFF personnel receive familiarization with F3 application and tactics.

Q11. At a joint-use airfield, can the civilian side use one type of F3 and the military use another type of F3 or AFFF to successfully fight a fire?
A11. Yes. There is a small sample of data from testing indicating that AFFF and F3 or a combination of F3s applied to the same fire do not have adverse effects on each other's extinguishing performance. More testing is planned.

Q12. Will the FAA be updating Advisory Circular 150/5210-6D - *Aircraft Fire Extinguishing Agents*?
A12. Yes. The FAA is currently updating 150/5210-6D - *Aircraft Fire Extinguishing Agents* to reflect the use of F3.

Resources

FAA RESOURCES

- FAA Aircraft Rescue and Fire Fighting Webpage
- F3 Aircraft Firefighting Foam Transition Plan
- Part 139 CertAlert 23-01
- Part 139 CertAlert 23-07
- Fluorine-Free Foam Testing (DOT/FAA/TC-22/23)

ADDITIONAL RESOURCES

- Department of Defense (DoD) Qualified Products Database (QPD)
- MIL-PRF-32725, Fire Extinguishing Agent, Fluorine-Free Foam (Enter **MIL-PRF-32725** in the Document ID Search)
- Fluorine-Free Foam (F3) Application Techniques and Firefighting Tactics