

# FUTURE OF FIRE FIGHTING FOAMS



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# Recent Testing and ICAO Concerns

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# 2012 Danish ICAO Testing

ICAO Level B Fire test Results - Denmark 2012								
Test Fuel: Jet A1 ; Premix: Freshwater								
Test product	Nozzle	Exp. Ratio	25% DT (Mins: Secs)	90% control (secs)	99% control (secs)	Extinction (Min:Secs)	25% Burnback (Min: Secs)	PASS/FAIL
Mfr 1- F3: Product A	UNI86	9.64	18m 26	35	45	None	N/A	FAIL
	<b>MMS</b>	<b>4.8</b>	<b>10m 56</b>	<b>30</b>	<b>45</b>	<b>1m 58*</b>	<b>6m 45</b>	FAIL
Mfr 1- F3: Product B	UNI86	9.6	16m 16	50	1m 05	2m 00	8m 30	FAIL
	<b>MMS</b>	<b>4.5</b>	<b>18m 38</b>	<b>50</b>	<b>1m 45</b>	<b>None</b>	<b>N/A</b>	FAIL
Mfr 2- F3: Product C	UNI86	10.2	15m 07	40	45	1m 24	7m 50	FAIL
	<b>MMS</b>	<b>4.93</b>	<b>5m 35</b>	<b>35</b>	<b>55</b>	<b>None</b>	<b>N/A</b>	FAIL
Mfr 3- F3: Product D	UNI86	8.5	22m 57	55	1m 05	1m 40	9m 50	FAIL
Mfr 4- F3: Product E	UNI86	7.4	17m 00	40	55	1m 50	8m 05	FAIL

Key: UNI86 - Standard test nozzle; **MMS** - Modified Military Specification nozzle. **\*= fuel & premix temps cooler.**  
Source: Resource Protection International.

Reduced expansion ratios and drainage times from MMS, more closely represents typical nozzles used by most Airport Fire Services (*than high spec. UNI86 test nozzle*). Tests were conducted at ambient temperatures between 10.6°C and 14.7°C, when 60s extinction was required to PASS.

**\* = Fuel temps: 8.7-10.2°C & premix temps: 8.9-10.5°C. Standard requires premix & ambient ≥15°C.**

As ambient temperatures increase, ...also expect any foam's quality to be decreasing.

**What about typical summer temperature performances at 30-40°C?**



# 2016 -Spain testing

## More Comparisons F3 v ≤C6

Spain 2016 Fire Testing:  
Control Time Results **compared to C6 AFFF** showing:

**at 2.5L/min/m<sup>2</sup>**

F3 60% slower on Gasoline (3 x F3 product failed to extinguish)  
F3 50% slower on Jet A1 (all 5x F3 products failed to extinguish)

**at 1.25L/min/m<sup>2</sup>**

F3 100% slower on Gasoline  
F3 100% slower on Jet A1

**at 3.75L/min/m<sup>2</sup>**

F3 50% slower on Heptane  
F3 25% slower on Gasoline  
F3 10% slower on Jet A1

**Why were none of the five F3 agents able to extinguish Jet A1 fuel?**

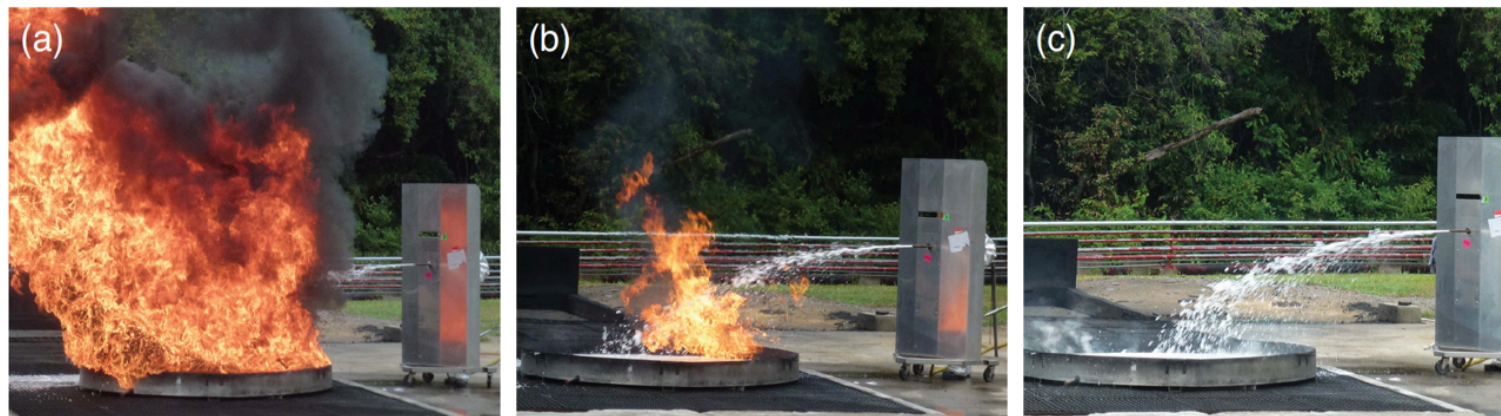
**Table: All ≤C6 AFFFs PASS ALL fuel fire tests at 2.5L/min/m<sup>2</sup>**  
(1,3,4 = C6s; 2&5 = C8s)

Test/Fuel	FFF (F3)					AFFF				
	1	2	3	4	5	1	2	3	4	5
Gas. 950	YES	NO	NO	NO	Late	YES	YES	YES	YES	Late
Heptane	YES	NO	NO	YES	Late	YES	YES	YES	YES	YES
Jet A1	NO	NO	NO	NO	NO	YES	YES	YES	YES	YES
Diesel	YES	YES	YES	YES	YES	YES	YES	YES	YES	YES

NB: 1-5 above represent five unique, commercially available AFFFs and F3 foams

- Differences increased with:**
- lowering application rates
    - more volatile fuels
    - tougher conditions

# 2016 Singapore F3 replaced by C6 AFFF



ICAO Level B Fire test demo in Singapore, 2016.

(a) pre-burn; (b)  $\leq$ C6 AFFF fire control; (c) ICAO Level B  $\leq$ C6 AFFF extinguishment

An F3 agent intended to be Conference highlight by showcasing its effectiveness. Had to be replaced by  $\leq$ C6 AFFF last minute because ...***“too many environmental factors were not under our control to do F3”!*** ie it was too hot at 32°C for F3 to be effective (Such fire tests are usually conducted at 15-20 °C).

Twice the day before at 32°C, the same fire was unable to be extinguished using F3 agents, ...and reportedly caught the training facility’s fuel separator alight.

***A demo can be cancelled...REAL EMERGENCIES cannot!***

# 2016 Dubai

## B777 plane burned out



- Boeing 777 crashed (Aug 16) during “attempted go-around” , 48 °C heat with wind-shear conditions.
- All 300 passengers and crew safely disembarked, despite fuel fire developing.
- Foam applied to suppress the fire.
- A brave firefighter tragically lost his life when fuel tank exploded, 9 mins after crash.
- Extensive foam application to the fuselage continued... **full control not achieved until 16 hours after impact! ...Plane destroyed - apparently first ever in Emirates fleet.**
- Final investigation not yet concluded.
- Cause of firefighting failure, ...whether foam or very high ambient temperatures contributed, not yet known - Remains a possibility... **Need to know - Why did it burn out?**

# ICAO Concerns: Test Changes



*ICAO Level B fire test showing  
F3 edge flickers after  
60seconds foam application*

## 2013 ICAO Fire test Changes:

- Fuel was **Jet A1** (Avtur) (Flash Pt. 38° C, Freezing -47° C).
- Now **Kerosene** also permitted (Flash Pt 37-65° C freezing -40° C or below).
- Level B test **changed from 60 seconds to 120 secs extinction**... allows edge flickers for 60 secs! = Lower quality AFFFs & F3s previously excluded now PASS! **Why?**
- ARFF application rates (L/min/m<sup>2</sup>) typically double test rates (Level B at 2.5 and Level C just 1.56)! **...Is that enough to ensure life safety under such changes?**
- **Do we risk more foam for longer = potentially more harm to life & environment?**
- **Surely 15° C ambient temp. is unrealistic for Australia ..why not test at 40° C?**

# Why are temperature and Fuel so Important?



## ICAO fire test requires

- Ambient and foam solution temperatures  $\geq 15^{\circ}\text{C}$  required for testing
- Jet A1 and Kerosene fuels are not close to their flashpoints for testing (but are in Australia!)
- Flammable vapours not delivered at ignition point, takes time for fuel to warm up during preburn, so **easier to control and extinguish**
- Does this adequately reflect summer temperatures in most of the world? **No.**
- Does the safety margin allow for this between test application rate (2.5L/min/m<sup>2</sup>) and ARFF application on fires at around 5L/min/m<sup>2</sup> on all foams? Maybe... Who knows? **Has F3 been used in anger on major fire in Australia or UK? ...Apparently Not!**
- Nothing says fuel cannot also be cooled ...no rule prevents making the test easier?

## Australian airports conditions

- Airport ambient temperatures around 35-40°C much of year - across much of Australia
- Jet A1 is main aircraft fuel (flashpoint 38°C), fuel more volatile, vapourising at ignition point as flashpoint regularly exceeded - so **harder to control and extinguish**
- Fuel cannot be easily cooled below flashpoint
- Foam blanket stability drops as ambient temperature increases
- Fuel volatility increases with increased risk of fuel pickup into foam blanket - unless contains fuel shedding additives

ALL foams F3 & C6 used at Australian airports, should pass ICAO level B at 40°C AND 15°C with Jet A1 fuel to **ensure sufficient safety margin to protect life safety ...year round**



# ICAO Concerns: Life Safety



## Life Safety Concerns:

- Seems to contradict 2014 Airport Services Manual Pt 1 -requires control of any fire occurring (not necessarily extinguishing) ...**before** rescue begins ...***isn't reliable, fast, effective, fire control critical? Are sudden unpredictable flashbacks OK?***
- ***Do we risk extricating passengers into areas still vulnerable to sudden & unpredictable re-involvement in flames - increased risk in summer?***
- ARFF Response - fire crews practice to ensure typical 3 min survivable atmosphere inside fuselage ***achievable. ...Is it still?***
- ***What impacts do such changes have on travelling public's safety?...*** most airports exceed 32°C in summer, & most of year across N Australia, Asia & Middle East? ***Are we safe enough?... ICAO Level B doesn't currently tell us!***

# Conclusions

## Most agree:

- **≥C8s (PFOS, PFOA and PFHxS) = undesirable legacy issues & should be banned/restricted**
- **All fire types can pollute:** especially firewater runoff/fuel alone .... Even without any foam use!
- **F3 can bring problems** – flashbacks, slower control, diminished life safety, escalation, fuel emulsification, increased foam use + more runoff + more overflows
- **Fuel repellency and fast spreading seem critical** to deliver key performance objectives, *when* more environmentally benign (NOT Bioaccumulative, NOT Toxic)
- **Careful risk assessment of whole incident** critical to protecting life safety, minimising escalation & reducing environment impacts
- **Reducing risks, liabilities and exposures** facilitates best practice, ...without always re-engineering existing fire systems



**Most ≤C6 agents achieve fire performance & environmental performance objectives: fast, reliable, effective, efficient fire control... with reduced runoff, less overflow, less BOD etc.**

**BUT ...does F3?**

**Most realistic conclusion:**

**Fast; efficient; robust; effective; reliable; environmentally responsible incident control is still needed for good MHFs fire protection.**

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