Is life safety at increased risk?

How many of us recall when the International Civil Aviation Organisation (ICAO) significantly changed its firefighting foam test protocols? Are we as passengers, potential casualties, crew and emergency responders now unwittingly exposed to increasing life safety risks because of these ICAO changes and previously considered inferior foam usage? Drawing on his 25 years in the fire industry across all sectors, mike willson of Willson Consulting shares his thoughts on the matter.

icao fire test changes

Previously ICAO required all foams that passed their Level B fire test to extinguish fuel defined as Avtur (Aviation Turbine Fuel, Jet fuel or Jet-A1 with flashpoint 38°C and low freezing point of -47°C) within 60 seconds.

In 2013 subtle changes were made which seemed to dilute this **testing protocol. Not only was the fuel re-defined more broadly as potentially less volatile Kerosene (with broader flashpoint range** of 37-65°C, freezing at -40°C or below), it also allowed minute **flames or flickers between the foam blanket and the inner edge** of the tray after 60 seconds, providing they did not spread to more than 25% of the tray circumference, and they were totally extinguished within the second minute of foam application.

This may not sound much, but suddenly extinction was surprisingly doubled from 60 seconds to 2 minutes, in possibly **the most time critical fire application there is – Aviation Rescue and Fire Fighting (ARFF). Seconds can define life or death, when fire strikes.**

The 2014 ICAO Airport Services Manual Pt.1 (Doc 9137) **confirms that the main operational firefighting objective for aviation is to control any fire occurring, but not necessarily** extinguish it before rescuing survivors begins. This certainly makes sense when a fuel repelling foam agent like AFFF or FFFP is being used. Unwarranted delays or potential risk to survivors may **result from extinguishing all flame before commencing rescue. Accordingly ICAO defines a "Theoretical Critical Fire Area (TCA)"** as the length of the aircraft fuselage plus an extension of area based on upwind and downwind potential involvement, related to aircraft size.

In practice this entire TCA is seldom on fire, so firefighting efforts usually focus on the target around the fuselage and exits,

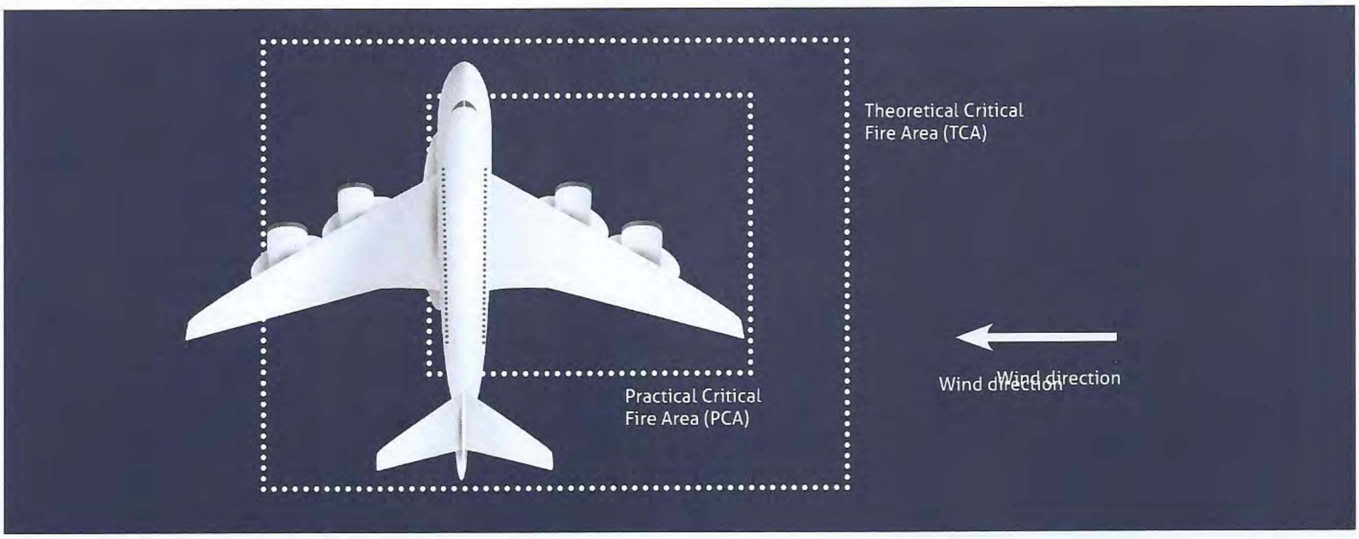

Diagram of Theoretical and Practical Critical Fire Areas, relative to a large fixed wing aircraft

called the "Practical Critical Fire Area (PCA)" - typically around 66 percent of TCA (based on analysis from actual aircraft incidents over time). This was seemingly used to justify changes to the fire test standard, reflecting "greater practicality".

response times are critical

ARFF response times have historically been based on a survivable atmosphere inside the fuselage during an external fuel fire, generally accepted as three minutes, assuming no fractures. Specialists confirmed fire typically takes three minutes to burn through an undamaged fuselage, so rapid fire control to rescue survivors is critical.

This underlines the historical importance of the 60 seconds or less extinguishment requirements under ICAO, and 30 seconds for the toughest US Military Specification (Mil F spec.) 28ft2 fire test. Consequently, a "rule of thumb" nominally allows 1 minute for arrival, 1 minute to extinguish the aircraft fire (PCA), and 1 minute to evacuate passengers and crew before they may be overcome by smoke.

Aviation fire crews practice regularly to ensure they can achieve this tight window of expectation, and keep both passengers and fire crews safe. Suddenly extinction time (and related incident control) seems to have effectively doubled... So what impact does this have on passenger safety? Are we extricating passengers into an area still on fire or liable to suddenly and unpredictably re-involve in flames?

You would hope not, since the foam application rate onto this ICAO Level B test fire is 2.5Litres per minute, per square metre of fire area (L/min/m2) and 1.56L/min/m2 for Level C. The actual application rate used by fire crews at most ICAO operated airports is typically doubled for Level B to 5L/min/m2 and presumably 3.1L/min/m2 for level C, although events are showing this may require further consideration. Especially when these changes have allowed previously unacceptable and lower quality AFFFs to now pass this critical Level B test, plus Fluorine Free Foams (F3) - previously generally unable to meet the strict 60 second extinction criteria. Both types can now be widely accepted for firefighting duties at major airports around the globe, including severe environmental conditions experienced across the Middle East. What impacts might this have on us, as both fire professionals and travelling public?

Most airports across the Middle East and large parts of the globe regularly face temperatures of ≥32°C in summer, for most of the year even, so does this mean F3 agents are not capable of effective use under most summer conditions? It set me thinking ... could this be related to those 2013 ICAO Level B fire test changes? Has it effectively "dumbed down" the standard and dangerously eroded safety margins, by moving from 60 seconds to allowing edge flickers and extinction within 120 seconds when fire testing is conducted at ≥ 15°C? It is often not appreciated that fuel volatility usually increases with increasing ambient temperatures, while foam quality usually decreases; making fires harder to extinguish in hot conditions.

dubai air-crash

In August 2016, a Boeing 777 aircraft crash-landed during an "attempted go-around" at Dubai airport in 48°C heat with wind-shear conditions. All 300 passengers and crew safely disembarked the plane despite a fuel fire developing. Foam was applied to suppress the fire. Only after evacuation a brave firefighter tragically lost his life in a fuel tank explosion after 9 minutes. Extensive foam application to the fuselage continued, but full control of the fire was not achieved until approximately 16 hours after the impact.

The plane was destroyed. The final investigation has not been concluded, so the cause of this firefighting failure and whether the foam type in use or the very high ambient temperatures were contributory factors is not yet known, but remains a possibility.

This raises further important questions...Are the current ICAO test requirements relevant to all locations, and is the foam's vulnerability to volatile fuels taken into account? Does ambient temperature perhaps play a more significant part than the current fire test suggests? Are we perhaps eroding our margins of safety beyond what is responsible, when many F3 (and perhaps lower quality AFFF agents) effectively have little or no fuel shedding capabilities when flames are still present nearby? Is there an increased incident escalation risk, when high performance C6 AFFFs are not used?

Fuel shedding additives are needed to prevent sudden flashbacks and re-involvement occurring. Could this be a contributory factor as fuel volatility increases with ambient temperatures, to a level where the foam may not be able to adequately control the fire?

Does such inferior performance of AFFFs and F3s (worryingly so at lower application rates representing Level C), indicate these agents may be unsuitable for reliable fire protection, particularly where forceful foam application onto volatile fuels under warm/hot conditions is routine?

environmental impacts

And what of the environmental impacts of using more foam agent for longer, allowing more noxious smoke and breakdown products to adversely affect communities and environments, even though the foam is less effective but non-persistent? Greater aquatic toxicity should also cause significant environmental harm. All firefighting foams and firewater runoff (even where no foam is used) can pollute our environment, so all should be captured wherever possible, using least foam and delivering fast control.

A 2017 Fluorotelomer based ≥C8 AFFF concentrate spill of 22,000 litres in a Brisbane airport hangar triggered alarm bells with the regulator and in the media about a "toxic disaster", as some spilled out into a coastal environment. The PFOA environmental sampling data from the Queensland environmental regulator immediately following the incident, showed there was no significant concern to water quality, fish, human health, wildlife or the receiving environment. Even when a Total Oxidisable Precursor (TOP) Assay was conducted, maximum combined PFOA plus all its related substances were found at 347 ppb in water quality testing, a low level equating to just 17.5 minutes in 100 years. This level was only detected closest to the spill location the day after the incident. Within 7 days it had dispersed down to 0.54ppb, presumed below background levels which averaged 1.3ppb for combined PFOA and related substance readings throughout the 2-month sampling period. A detailed case study confirmed no significant concerns and suggested what might result had a F3 agent been used instead. F3s are recognised as typically 10-25 times more toxic than AFFFs, so hundreds more dead fish are likely. Prawns, oysters and mussels are even more vulnerable which could have disrupted recreational and commercial fisheries for some time after the event, particularly since typically 2-3 times more F3 is required for a given sized incident, than C6 AFFF.

As legacy PFOS and PFOA based long-chain ≥C8 AFFFs are being phased out for environmental reasons, shouldn't we be moving towards short-chain ≤C6 AFFFs which seem to provide greater efficiency, effectiveness and reliability than F3s, particularly in large volatile fuel incidents.

Short-chain ≤C6 agents behave very differently, and are not restricted anywhere in the world outside Queensland(Australia), since although still persistent, they are neither shown bio-accumulative, nor toxic, and have a very short average half-life in humans of 32 days, being excreted through the kidneys in urine.

Lives will probably also be at risk, so why would anyone compromise on the best possible solution, ensuring our people, property, communities and our environment are protected as well as possible, by the fire incident's quick control and extinguishment. Modern environmentally more benign ≤C6 agents deliver fast, effective, efficient fire control, with minimal use of foam and water resources so noxious firewater runoff, and potential environmental harm, is also minimised.

in the april issue of fme Mike will explore extensive research and testing which will explain and support this article.

View publication stats