

# Solid Aerosol and Halon1301 results during Full-scale Demonstration Testing

## *Halon Replacement for the Engine/APU application*

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# Agenda

- Context
- Full Scale Fire Demonstration principle
- New project
- Test Results

# Context

For many years Airbus has been looking to develop a viable fire extinguishing agent alternative to halon 1301, this is a multi constraint challenge. Halon 1301 is a very good fire extinguishing agent : light weight ; efficient ; accepted toxicology level ; no cleaning need ; etc.. This is the standard but this standard is an Ozone Depleting Substance that must be replaced by ICAO recommendation and European law.

To meet this challenge, Airbus continues the efforts on different directions including testing a Kidde product and others and working within HAAPS.

The Kidde product is a solid aerosol KSA™.

The KSA™ has environmentally attractive qualities as seen in this comparative table.

Agent	Efficiency vs Halon		Environmental	
	Weight	Volume	ODP	GWP
Halon 1301	1	1	12-13	5,400
HFC-125	2.1	2.75	0	3,400
KSA™	<1	<1	0	0

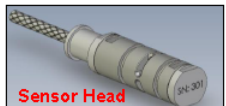
KSA™ is also efficient in terms of weight and volume of agent compared to Halon 1301 based on the MPSE concentration established on the FAA ENFS. (Part A of MPSe).

This solid aerosol was tested back in 2012 against the Full Scale Fire Demonstration (Part B of MPSe) to challenge the agent in terms of dispersion within a cluttered environment. None of the fire threats were extinguished by the agent discharge. Further details have been presented by Doug Ingerson from the FAA in 2012 (IASFP Working Group Meeting, Long Beach, CA, USA 14-15Nov2012 “Full-scale Demonstration Testing with a Solid Aerosol Fire Extinguishing Agent, Discussion Transitioning”).

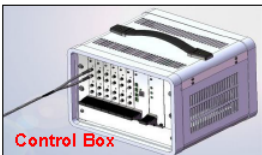
We have been working to understand the disconnect between Part A and B of MPSE

# Full Scale Fire Demonstration principle

- Test on #2 engine of FAA 747SP equipped with JT9D engines.  
Engine running before fire extinguishing test to “heat” nacelle environment
- **Undercowl flow** : JT9D nacelle forcibly ventilated @ 0.5 kg/s by external blower
- **Nacelle fire threat**
  - simultaneously burning JP-8 spray & pool fires
  - JP-8 spray delivered @ ~180 mL/min @ 46°C
  - JP-8 pool of 19.1 x 26.8 x ~1.3 cm deep
  - Fires electrically ignited; igniters de-energized after fire ignition
- **Agent discharge** based on targeted concentration previously verified

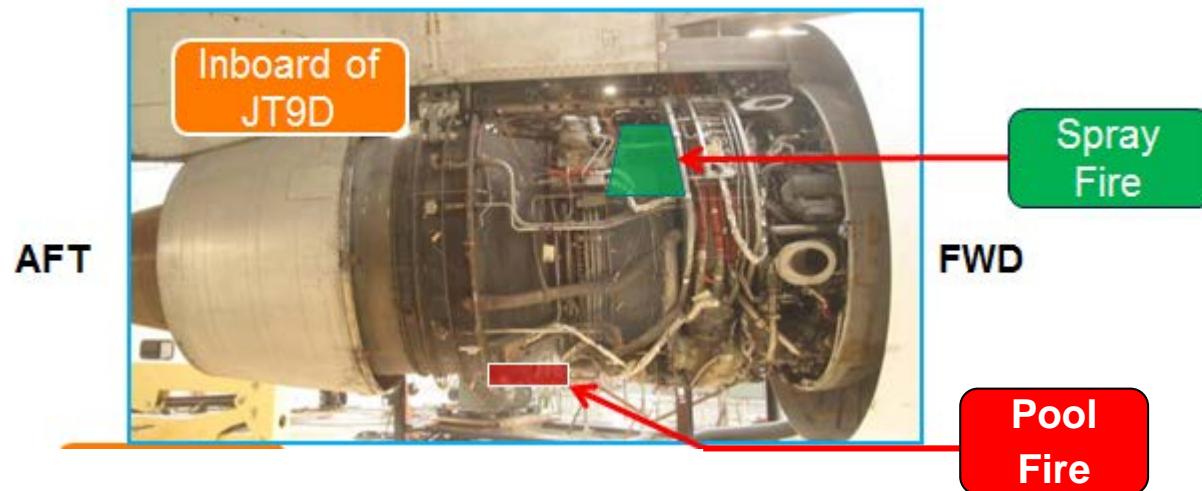


Sensor Head



Control Box

PowderizerTM (patented)



## New Project

Based on a industry panel review (NIST, NRL, UTRC, UTC Fellows) and root cause analysis of the failure encountered in 2012 with the KSA™, Airbus/Kidde agreed with the FAA and EASA to pursue investigating on the KSA by deploying some mitigation measures like:

- Increasing the concentration to be tested compared to the one established on the ENFS,
- Build a CFD model of the Full Scale Fire demo test bench to better understand undercowl flow and define a suitable firex distribution piping
- Building cold test bench in Kidde facility to fine tune the firex distribution system before going back to the Tech Center



# Full Scale Fire Demo at FAA Tech Center

## Spray Fire

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Camera01

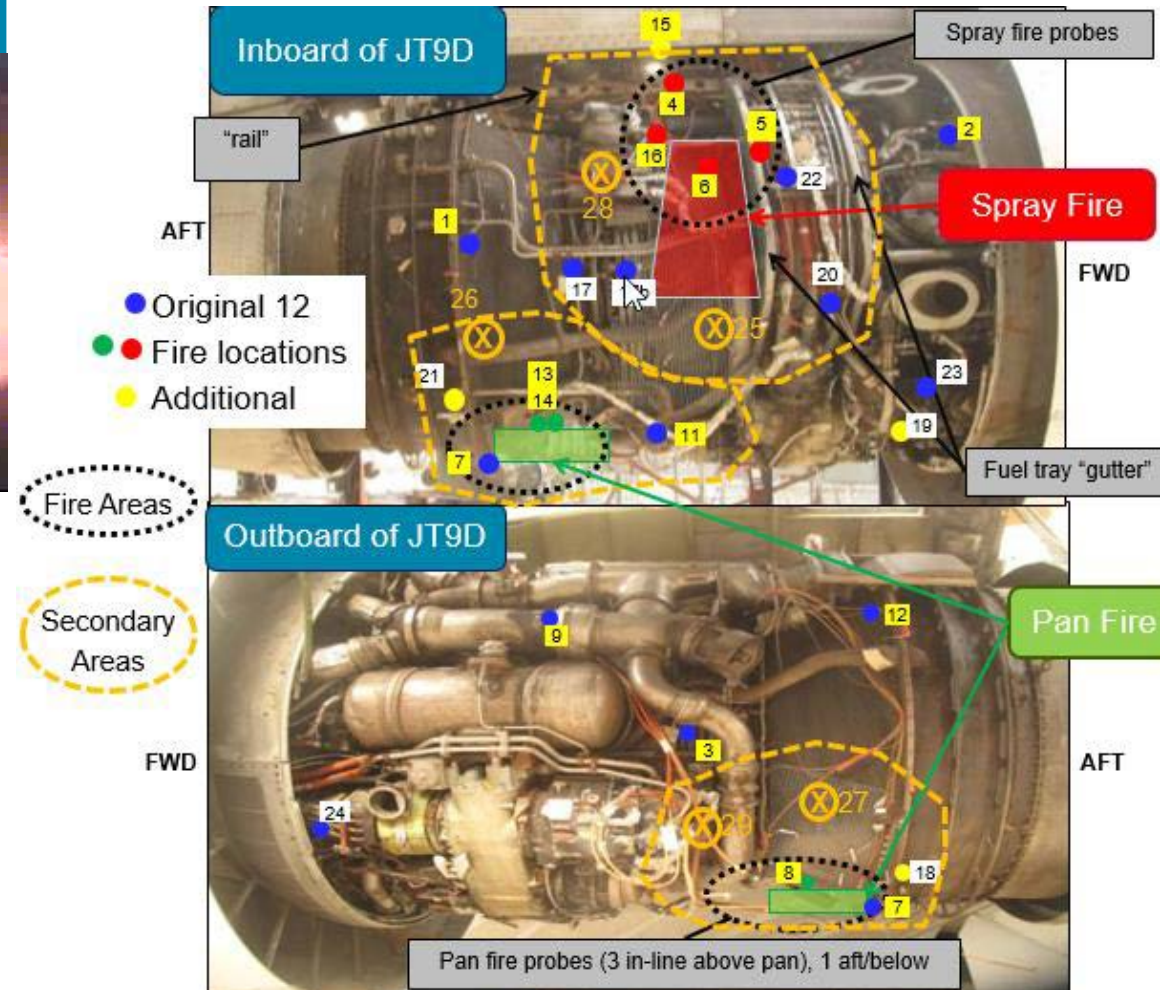
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## Pan Fire



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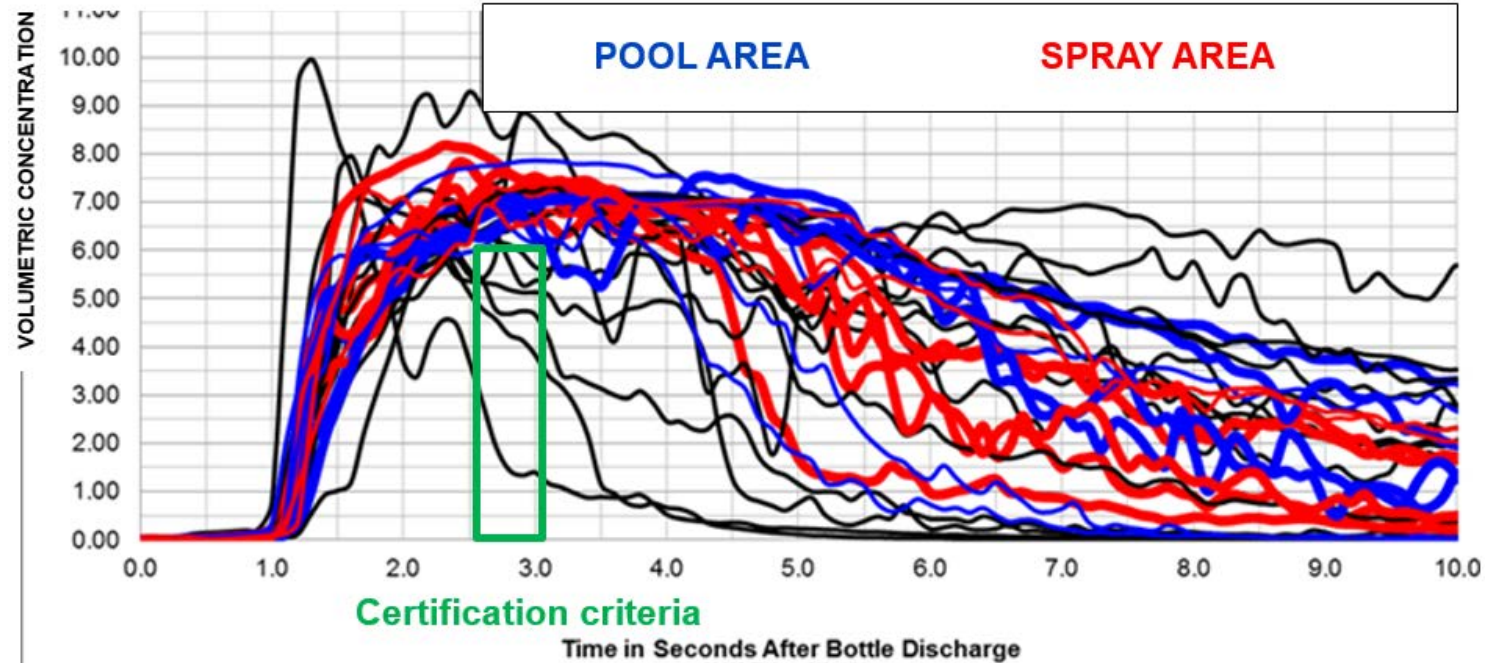
Tue, Apr 09, 2019 12:51:35  
Camera03

Tue, Apr 09, 2019 12:51:37  
Camera04






# H1301 Reference

- Concentration tests performed with distribution system similar to solid aerosol one
- Halon 1301 discharge test performed at the Full Scale Fire Demo
  - **Spray Fire** was **extinguished** 
  - **Pan Fire** was **extinguished** 
- Halon 1301 performs as expected.  
Reference validated

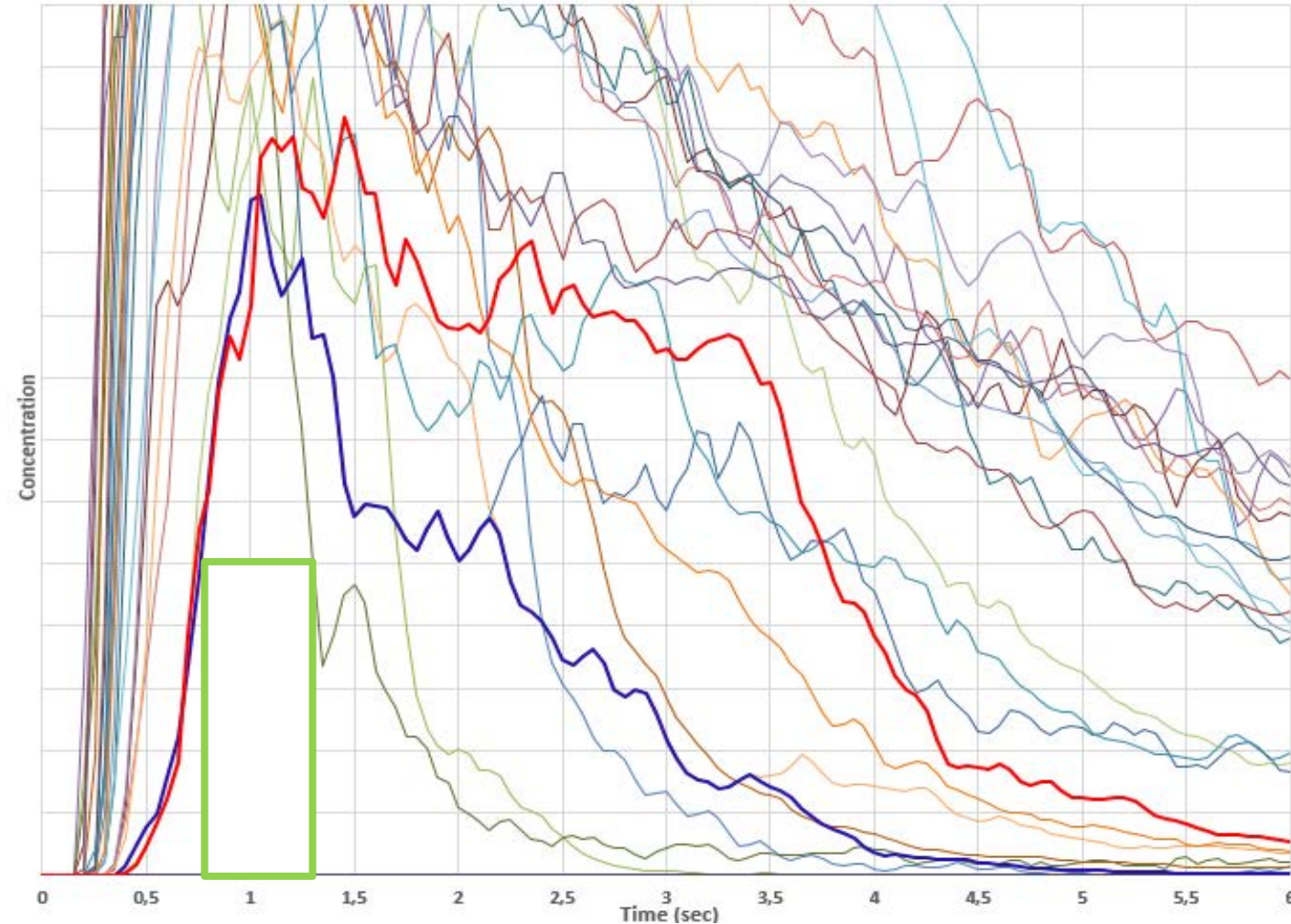




# Targeted “Certifiable” configuration Tests

- Concentration tests performed with “Certifiable” plumbing showing significant margin in Fire Threat Areas vs target concentration during 0,5sec
- Solid Aerosol Discharge test performed at the Full Scale Fire Demo in April 2019
  - **Spray Fire** was **extinguished** 
  - **Pan Fire** not fully extinguished  

→ Demonstration test failed



Targeted certification criteria

MIN POOL AREA

MIN SPRAY AREA



# Way Forward

## 1. Understand phenomenon:

- Perform **Small Scale Testing** to replicate JT9D Pool Fire challenge
- Understand physics of MPSe Pool vs JT9D Pool disconnect

## 2. Replicate FSFD pool challenge in FAA ENFS → Demonstrate robustness

## 3. Return to FSFD on JT9D for full scale demonstration

Agent	Efficiency vs Halon		Environmental	
	Weight	Volume	ODP	GWP
Halon 1301	1	1	12-13	5,400
KSA™	?	?	0	0

Thank you

Thu, Mar 21, 2019 16:15:09

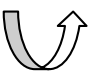
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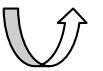




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APR. 09, '19

12:51:27





