

Cargo Compartment Halon Replacement MPS

Status Update

Presented to: The Tenth Triennial International Fire & Cabin Safety
Research Conference

By: Dhaval Dadia

Date: Oct. 20, 2022



**Federal Aviation
Administration**



Agenda

❖ Halon Handbook

❖ Progress



Task Group Participants



Transports
Canada

Transport
Canada



AIRBUS



MEGGITT DIEHL
Aerospace



Federal Aviation
Administration

Halon Handbook

- Combining the Halon Replacement Standards into a single document
 - Lavatory
 - Handheld
 - ***Cargo Compartment***
 - Engine Nacelle
- Adopt the “living document” approach to be able to make changes to the document more easily



Progress

- **MPS Test Facilities**
- **Updates to MPS Document**
 - Aerosol Can Explosion Simulation
 - Surface Burning Fire
 - Multiple Fuel Fire Scenario



Review of MPS Test Facilities

- Boeing
 - Reviewed with FAA
 - Task group meeting at the facility in Oct. 2019
- DLR
 - Planned for 2023
- University of Cranfield
 - Planned for 2023



Aerosol Can Explosion Simulation

“The criterion for the aerosol can explosion and reaction simulation scenario is that there is *no evidence* of an *explosion or unacceptable reaction*. Evidence of an explosion is that there shall be *no pressure rise more than the measurement of the baseline* simulator pressure release into a compartment. The baseline test shall be conducted at least three times in the presence of the agent being tested without an ignition source. The baseline pressure will be calculated as the maximum value of the conducted tests and one standard deviation. The criteria of an unacceptable reaction is based on the observed performance with Halon 1301. With Halon 1301 it is typical to see evidence of a *local flame or illumination near the ignitor* in most tests and to see a small flash in 1 of 5 tests. The small flash involved a flame that separated from the ignitor and spread about 2 feet and self-extinguished in 2 seconds. In the event of more than one test having a "small flash" event, it is acceptable to perform additional tests to demonstrate that the frequency of these events is *not greater than 20%*. In addition, when the agent concentration is below its inert concentration, the explosion intensity and peak pressures shall not be greater than the values exhibited during an explosive event when no suppression agent is present in the compartment.”

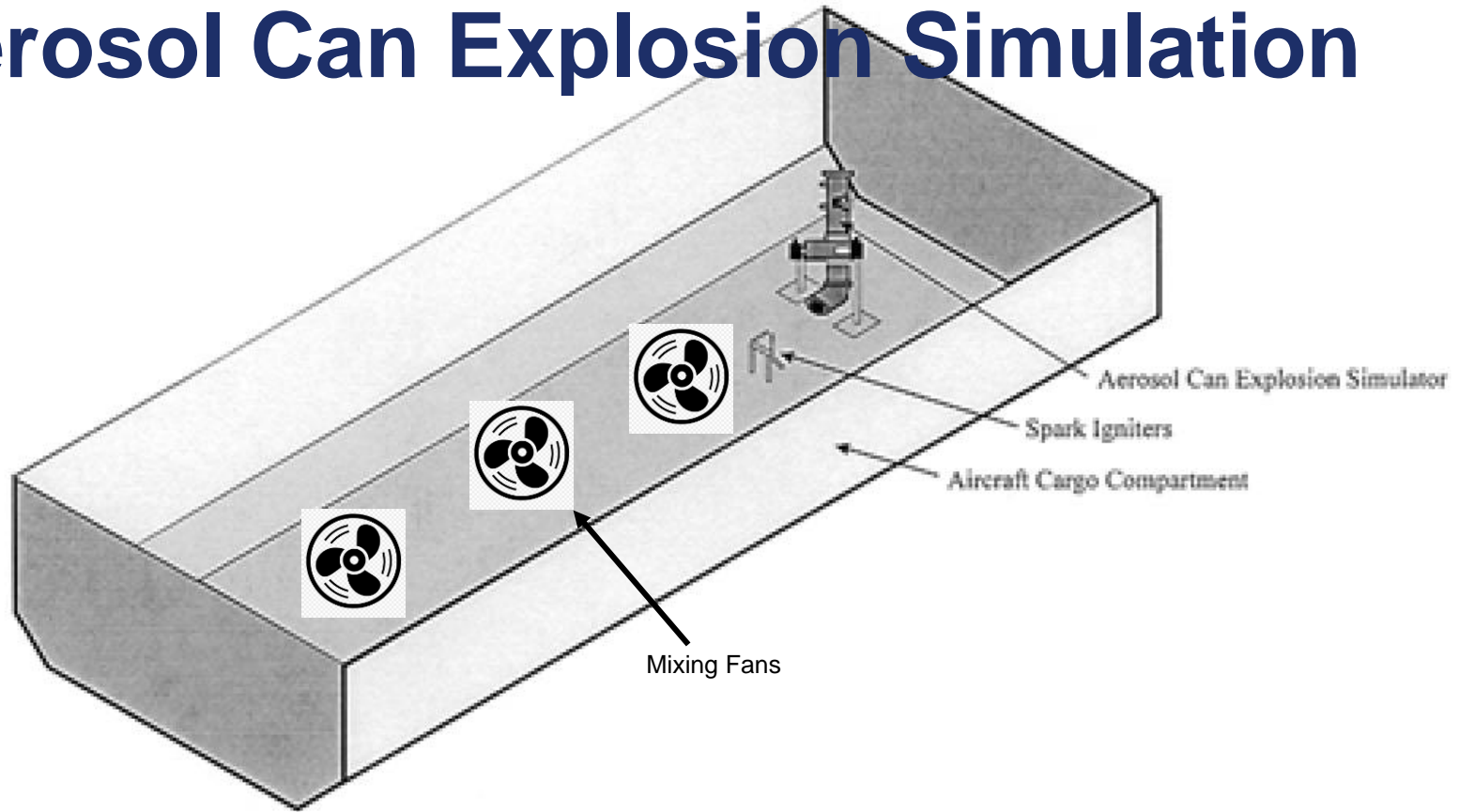


Aerosol Can Explosion Simulation

- Test procedure includes addition of mixing fans to stabilize the test concentration
 - Fans are turned off 1 minute prior to setting of the simulator.



Aerosol Can Explosion Simulation



Surface Burning Fire Scenario

“The criteria for the surface burning fire scenario is that the *fire is extinguished within 2 minutes* of the suppression system is activation. Supporting *video evidence* shall be provided to show the extinguishment of the flame. In case video evidence is not conclusive, *temperatures* shall show a *decreasing trend after 2 minutes* of activation of the suppression system or temperature has returned to and stabilized/staying at ambient. *Stabilized oxygen concentration* measurements along with temperatures can also support the extinguishment of the flame. This is a secondary requirement in case video evidence is not conclusive.”



Multiple Fuel Fire Scenario

Test Setup

178 cardboard boxes (bulk scenario)

18 of which are configured as shown



Ignition Box

15 lithium-ion cells, 500 mL ethanol, 2.5 lbs of shredded paper



2 – 1Gal. Jugs filled with $\frac{1}{2}$ Gal. Ethanol

6 – Jug Configuration

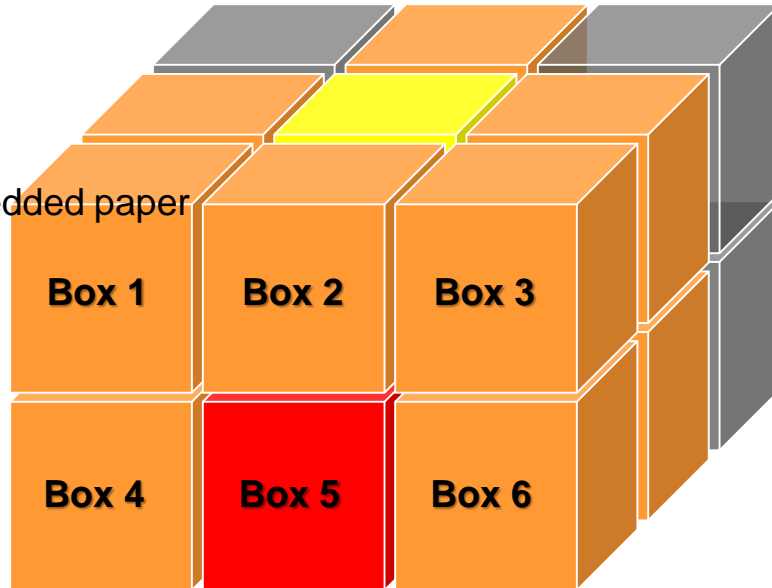


15 lithium ion cells & 2.5 lbs of shredded paper

5 @ 30% SOC, 5 @ 60% SOC, 5 @ 100% SOC

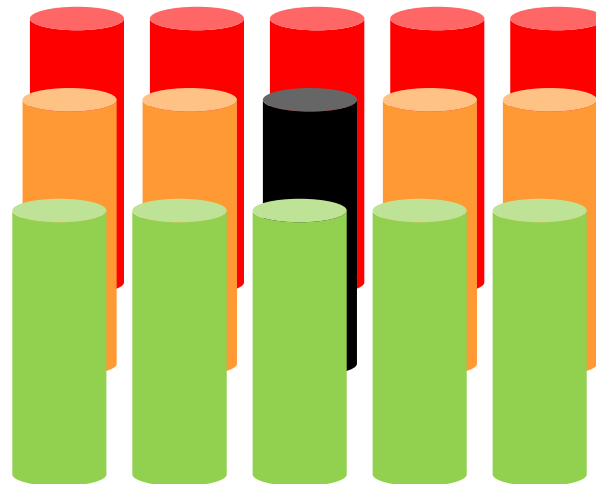
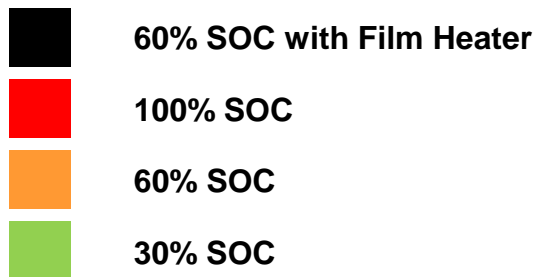


2.5 lbs. of shredded paper



Multiple Fuel Fire Scenario

Cell Package Configuration



Multiple Fuel Fire Scenario

Ethanol Jug Configuration

● ½ Gallon of Ethanol in a 1 Gal. Jug

● Empty 1 Gallon Jug



Box 2



Multiple Fuel Fire Scenario

Test Procedure

- Initiate thermal runaway with cell in Box 5
- If ceiling temperature hasn't reached 200°F after 3 cells undergo thermal runaway
 - Ignite balloon in Box 5
- Wait 1 min after ceiling temp. is reached to activate fire suppression system
- Test length
 - 3 tests @ 30 mins
 - 2 tests @ 180 mins (initiate thermal runaway in Box 14 @ 60 mins.)



Multiple Fuel Fire Scenario

Acceptance Criteria

- No flames may be visible 1 minute after discharge of the high rate discharge bottle.
- Avg. peak temp TBD from Halon 1301 tests
- Avg. time-temperature integral TBD from Halon 1301 tests



Future Work

- Discuss Acceptance Criteria for Multiple Fuel Fire Scenario based on results from EASA's Halon 1301 tests at DLR
- Visit MPS test sites
- Develop a criteria to establish similarity between facilities



Questions?

Dhaval Dadia
dhaval.dadia@faa.gov
(609) 485-8828

