EASA
European Union Aviation Safety Agency

AirPED:
Fire Risk Associated to the Presence of PEDs/Batteries in the Cargo Hold

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Tenth Triennial International Aircraft Fire and Cabin Safety Research Conference
October 17-20, 2022

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AirPED: Fire Risk Associated to the Presence of PEDs/Batteries in the Cargo Hold

- Background
  - PEDs in cargo compartments
  - Halon replacement
  - Shipment of lithium batteries: SABATAIR

- AIRPED
  - Objectives
  - Test Scenarios
  - Status

Presence of PEDs in cargo compartments

- Portable electronic devices (“PEDs”) powered by lithium batteries can pose safety hazards to air transport when one battery is experiencing a thermal runaway resulting in the generation of fire, smoke and explosions.

- The subject of this new research project is to evaluate the impact of the presence of PEDs in the cargo hold of an aircraft, with focus on Class C cargo compartment equipped with fire suppression means.

- This subject has been under evaluation in the last years, especially during the consultation of aviation stakeholders that took place in Spring 2017 in the context of the US ban on PEDs in cabin for certain airliners.

Presence of PEDs in cargo compartments

In 2017 EASA established the following Line of action:

- → Concentration of large PEDs in the cargo hold should be avoided, if not prohibited.
- → Detailed Guidance for passengers on stowage of large PEDs in checked baggage shall be developed.
- → Large PEDs in passengers' checked baggage or collected at the gate should not be transported in Class D cargo compartments.
- → Specific testing shall be conducted by EASA to accurately establish the fire suppression and detection capabilities of the aircraft with regard to fires involving PEDs contained in passenger's baggage.

Halon replacement

Dates for halons replacement				
			Aviation standards	
Purpose	**Fire Extinguisher location**	***Ozone Regulation*** **Regulation (EC) No 1005/2009 as amended by (EU) 744/2010**	**ICAO Convention on International Civil Aviation**	**Regulation (EU) 2015/640 (Part-26) as amended by (EU) 2019/133**
Retrofit (end date)	Unoccupied cargo compartments	2040	Not specified	Not specified
	Hand-held in cabin & crew compartments	2025		
	Lavatory waste receptacles	2020		
	Engine nacelle & Auxiliary Power Units	2040		
Forward fit (new CofA)	Unoccupied cargo compartments	Not specified	Not specified	Not specified
	Hand-held in cabin & crew compartments		2016 (Annex 6) 39th Assembly: shift to 2018	May 18, 2019
	Lavatory waste receptacles		2011	February 18, 2020
	Engine nacelle & Auxiliary Power Units		Not specified	Not specified
Cut-off (new application for type certificate)	Unoccupied cargo compartments	2018	2024 (Annex 8) 39th Assembly: will be adapted within 2 years.	Not specified
	Hand-held in cabin & crew compartments	2014	Not mentioned	
	Lavatory waste receptacles	2011	2014	
	Engine nacelle & Auxiliary Power Units	2014	2014	

Halon replacement

Minimum Performance Standard (MPS) for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems (DOT/FAA/TC-TN12/11, May 2012 Update))

+

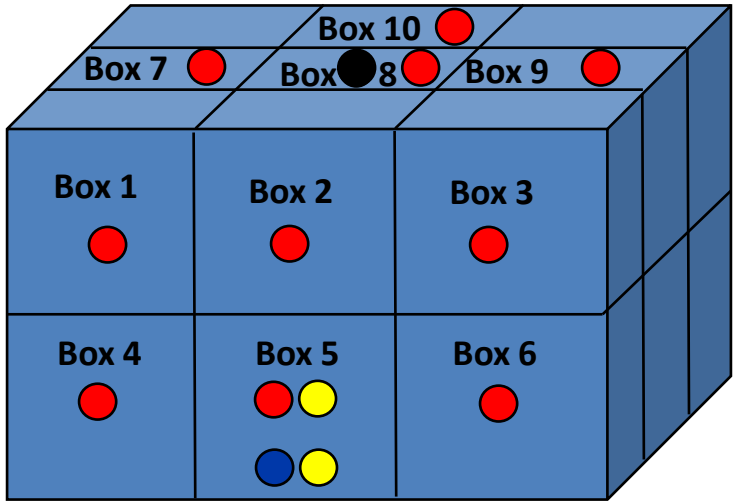
Multiple Fuel Fire Scenario

150 18650 Li-Ion batteries in groups of 15 batteries per box
5 at 30% SoC
5 at 60% SoC
5 at 100% SoC

500 ml ethanol

1 gallon (3.8 l) ethanol

Ignition Source



18 Standard MPS boxes (total)

Shipment of lithium batteries: SABATAIR

Main Results:

- Performed tests to improve and validate the packaging standard developed by the SAE G27
- Assessed and proposed additional mitigating measures to prevent the involvement of batteries in an external cargo fire
- Developed guidance to operators to perform risk assessments for the transport of lithium batteries as cargo

Final report and project deliverables published in December 2020 on the project website

(https://sabatair.vito.be/en/reports**)**

Shipment of lithium batteries: SABATAIR

- Only 18650 cells from two manufacturers were tested: additional tests should be performed with different cell designs from different manufacturers.

- FCC provide significant mitigation to the severity of the event: no testing was conducted with additional mitigating measures (thermal acoustic insulation).

Cold Test: Proof that the Halon concentration is 3% at the location of the battery box	Fire initiation test: Place half amount of cells (400) next to the ignition box – do not use the Fire Suppression System	Halon baseline test 800 cells	FCC test 800 cells	FCC + thermal insulation test 800 cells

Shipment of lithium batteries: SABATAIR

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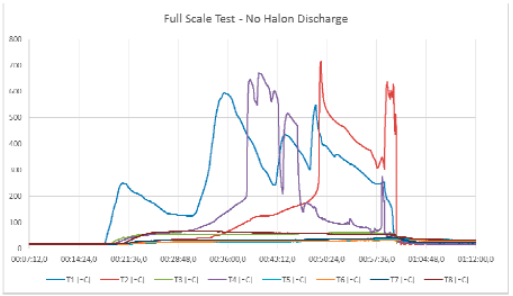
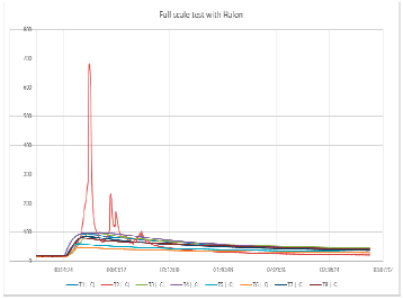
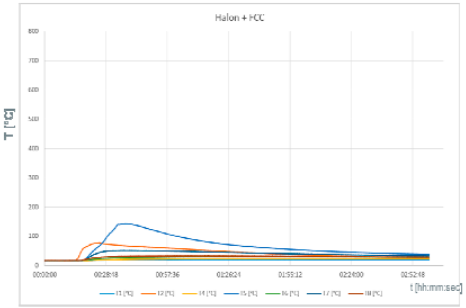


No Suppression



Halon Fire Suppression



Halon Fire Suppression + FCC

Horizon 2020

AirPED is based on the Horizon 2020 (H2020) Work Programme Societal Challenge 4 ‘Smart, green and integrated transport’, which has the scope to address several key research and innovation needs in the fields of aviation safety and environmental impact assessment:

- → mitigation of risks identified in occurred accidents/incidents,
- → Evaluation of the risk coming from perceived emerging threats
- → international obligations of EASA an EU Member States, namely in the framework of the new International Civil Aviation Organisation (ICAO) standards under development

AirPED

Research project EASA.2020.HVP.12
based on the Horizon 2020 Work Programme Societal Challenge 4
'Smart, green and integrated transport'

- Lithium battery fires in cargo compartments:
  - PEDs in checked baggage
  - Bulk shipment of lithium batteries
- Budget: 0.6 M€
- Project started in September 2021
- Report to be published **in Q2 2023**

vito

AIRBUS

DLR Deutsches Zentrum für Luft- und Raumfahrt
German Aerospace Center

New EASA research project: AIRPED

Objectives:

- To evaluate the effectiveness of cargo fire suppression systems (Halon-based and Halon-free) in case of thermal runaway events originating from battery-powered devices in checked baggage

- To generate data to support the revision of the MPS for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems : validation of the definition of a new cargo fire test scenario involving lithium batteries

- To perform additional tests with the same setup as Task 4 of the Sabatair project (external fire scenario, with FCCs protecting the batteries/cells)

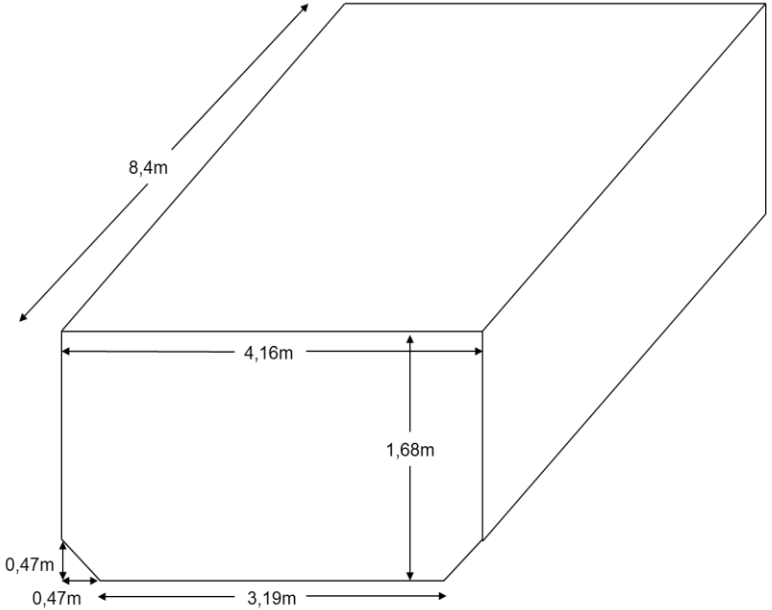
New EASA research project: AIRPED

TASK 1 – EVALUATE THE BASELINE PERFORMANCES OF THE SELECTED FIRE TEST CHAMBER FOR MPS TESTS

- The test chamber should meet the definition given in DOT/FAA/TC-TN12/11 (Minimum Performance Standard for Aircraft Cargo Compartment Halon Replacement Fire Suppression Systems (May 2012 Update)), considering the changes currently under development by the IASFPF Cargo MPS Task Group.
- Compliance in volume and shape, materials and, as one of the most important performance influencing parameters, the leakage and the way it is imposed.
- Perform full-scale fire tests to prove the performance of the chamber.
- Introduce any design change necessary to ensure that the test chamber is suitable to perform testing as per the MPS.

New EASA research project: AIRPED

The tests are conducted in the cargo compartment Halon replacement MPS test chamber at DLR (Trauen, Germany)



New EASA research project: AIRPED

TASK 2 – DEVELOP THE TEST PLAN AND PROTOCOLS

TASK 3 – PERFORMANCE OF FIRE TESTS

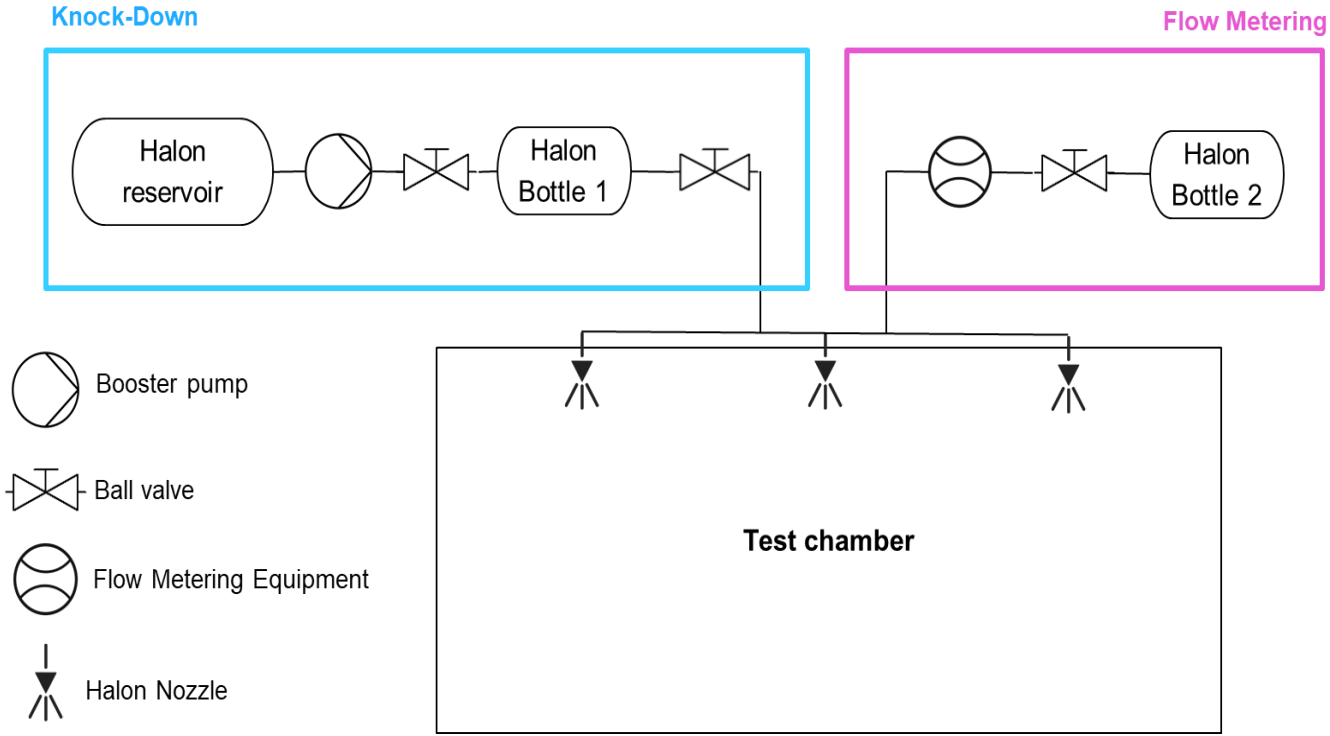
Test Scenario
Unsuppressed Surface Burning
Unsuppressed Bulk Load
Unsuppressed Containerized
Unsuppressed Multiple Fire Test

Test Scenario
Surface burning & Halon 1301
Bulk Load & Halon 1301
Containerized & Halon 1301
Multiple Fire Test & Halon 1301
Multiple Fire Test & Halon replacement agent
Surface Burning & Halon replacement agent
Bulk Load & Halon replacement agent
Containerized & Halon replacement agent

Test Scenario
Calibration of baggage
Compartment floor
Compartment ceiling
ULD container
Involvement of a bulk shipment of cells/batteries in an external fire event

New EASA research project: AIRPED

Architecture of the fire suppression system



New EASA research project: AIRPED

TASK 4 – ASSESSMENT OF TEST RESULTS AND AIRCRAFT FIRE PROTECTION EFFECTIVENESS

TASK 5 – PROJECT CONCLUSIONS, RECOMMENDATIONS AND PRESENTATION TO AVIATION STAKEHOLDERS

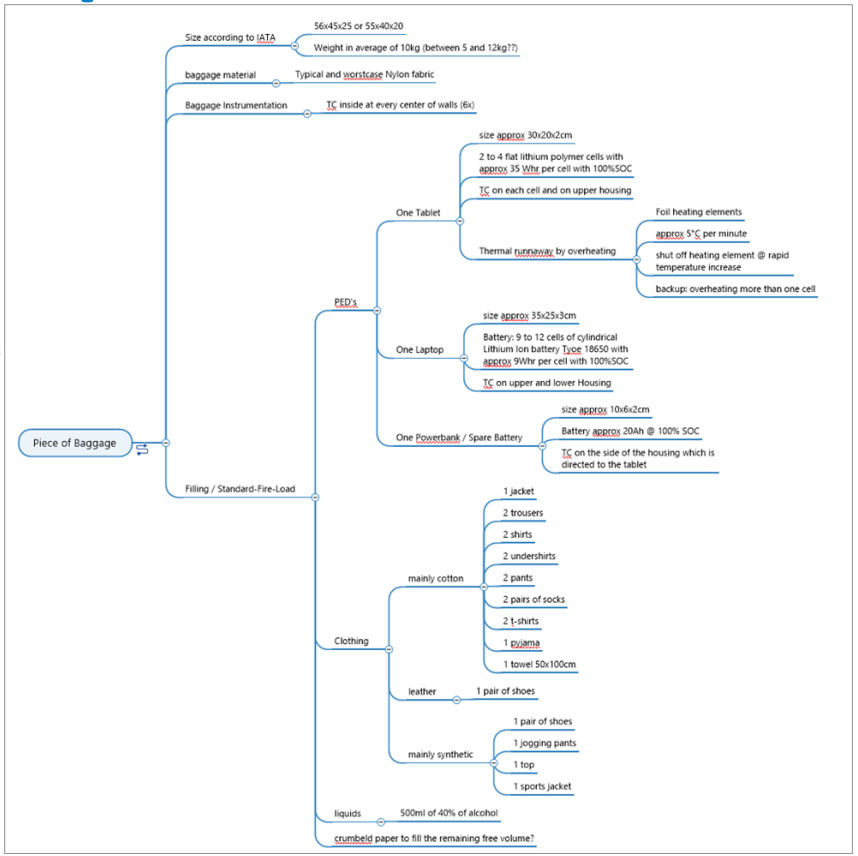
- The objective of Task 4 and Task is the assessment of the effectiveness of a state-of-the-art fire protection means of a Class C cargo compartment in suppressing a fire involving lithium batteries. This assessment will be done based on test data from the different test scenarios carried in the previous tasks and will include:
  - the evaluation of the level of performance of the tested aircraft fire protection systems in the tested cargo fire scenarios
  - recommendations for improvements of the MPS test protocols, with particular reference to the definition of the new Multiple Fuel Fire scenario involving lithium batteries.
- The final project report will also identify recommendations and further work on open issues that were not deeply investigated during this project.

PEDs in cargo compartments

SCENARIO 1: Baseline – Calibration of baggage

- The objective of this test is to define a representative single baggage configuration to be used for the thermal runaway test scenarios that will address possible fire events in representative check-in baggage of passenger aircrafts.

- Different baggage configurations including PEDs, power banks and/or spare batteries, together with other representative checked-in baggage content (e.g. clothes, permissible liquids and/or aerosol cans) will be tested until PEDs in thermal runaway are able to create a sustained internal fire that may propagate outside the baggage



PEDs in cargo compartments

SCENARIO 2: Compartment floor

- The objective of this test is to investigate the scenario in which fire starts from a piece of baggage that is not directly exposed to the extinguishing agent discharged in the compartment.
- The thermal runaway occurs inside the baggage located on the floor in the middle of the compartment and which is fully hidden below other baggage items with similar PED battery loadings.
- The extinguishing agent shall be released inside the compartment after a timeframe that is established with the objective to simulate the sequence of events that would occur in an actual cargo fire scenario, from the time at which fire detection occurs and a warning is provided to flight crew to the implementation of the cargo fire emergency procedure.

PEDs in cargo compartments

SCENARIO 3: Compartment ceiling

- The objective of this test is to evaluate the scenario in which the fire starts in a point as close as possible to the ceiling level and as far as possible from the fire suppression system nozzle(s). This scenario is critical for the effectiveness of the fire suppression system considering the stratification of Halon 1301.

- The thermal runaway occurs inside a baggage located in one corner of the mock-up as close as possible to the ceiling considering the typical limitations to the maximum loading height for cargo compartments of large aeroplane (ref. paragraph 12 of AMC 25.851(b)).

PEDs in cargo compartments

SCENARIO 4: ULD (container)

- The objective of this test is to investigate the scenario in which fire starts from a piece of baggage that is not directly exposed to the extinguishing agent because it is placed inside a standard ULD container.

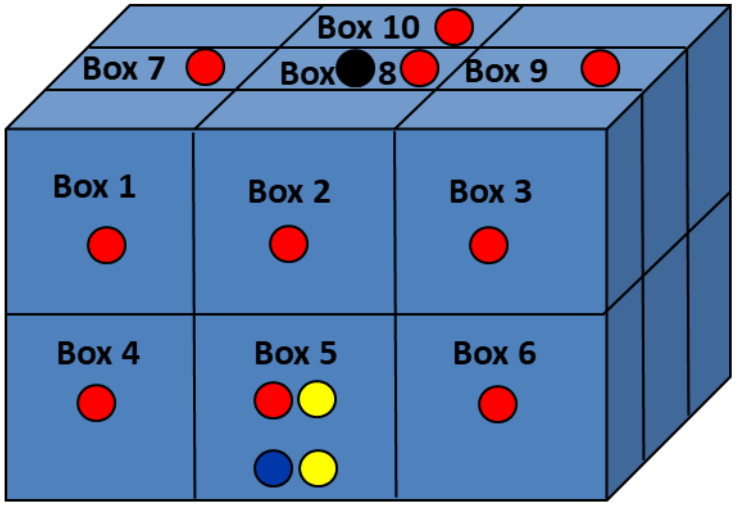
- Three LD-3 containers will be used for this test and arranged like the containerized scenario in the MPS. A minimum set of 6 baggage units having the configuration determined in scenario 1 will be placed inside the middle container. Dummy load will be used to fill up the whole container.

Halon replacement MPS

SCENARIO 5: Multiple Fuel Fire Scenario

- The intent of these tests is to ensure that Class C cargo compartment fire suppression systems can address a fire event developing from a complex fire load.

- The fire load for the Multiple Fuel Fire scenario consists of materials that when combusted produces a complex fire (i.e., after ignition, the resulting fire consists of Class A surface burning, Class B flammable liquid fire, and thermal runaway of some lithium cells).



18 Standard MPS boxes (total)

Halon replacement MPS

SCENARIO 6: Halon Replacement

→ Show that a candidate replacement agent can pass the cargo MPS (see reference 5) tests25, including the Multiple Fuel Fire scenario.

Test Scenario
Surface burning & Halon 1301
Bulk Load & Halon 1301
Containerized & Halon 1301
Multiple Fire Test & Halon 1301
Multiple Fire Test & Halon replacement agent
Surface Burning & Halon replacement agent
Bulk Load & Halon replacement agent
Containerized & Halon replacement agent

Shipment of lithium batteries

SCENARIO 7: Involvement of a bulk shipment of cells/batteries in an external fire event

- → The objective is to perform a series of tests to assess the external fire threat on the packaging solutions used for the transport as cargo of lithium cells/batteries (other than 18650 cells).
- → Assess fire suppression and non-propagation aspects with and without additional mitigating measures (e.g. FCCs) protecting the cell/batteries.

AIRPED: project status

- Task 1 is completed (pending finalization of unsuppressed fire test scenarios)

- Task 2 and Task 3 are on-going. Activities performed:
  - unsuppressed fire test scenarios (except for Multiple Fuel Fire scenario)
  - Halon 1301 fire suppression system calibration tests

- All Fire test scenarios to be run by the end of Q1 2023

- Task 4 and Task 5 to be completed in Q2 2023

- Final report and project deliverables due by the end of Q2 2023

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Any questions?

easa.europa.eu/connect

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