DGP-WG/24-IP/6
19/10/24

DANGEROUS GOODS PANEL (DGP)
WORKING GROUP MEETING (DGP-WG/24)

Montreal, 21 to 25 October 2024

Agenda Item 4: Managing safety risks posed by the carriage of lithium batteries by air (Ref: Job Card DGP.003.05)

INFORMATION ON THE STATUS OF EUROPEAN UNION AVIATION SAFETY AGENCY (EASA) RESEARCH PROJECTS

(Presented by L. Calleja Barcena)

SUMMARY

The European Union Aviation Safety Agency (EASA) has been working on research related to lithium batteries in the last few years. The presentation provided in the appendix contains the most relevant information and updates of this work.

The DGP is invited to consider this information and continue to follow up on the progress of the projects, noticing the potential impact that their outcome may have on the transport of lithium batteries and, thus, on the work of the Panel.

ICAO Dangerous Goods Panel 2024, Montreal, Canada

Lia Calleja-Barcena, Simon Holz, Victor Norrefeldt

Lithium batteries in pOrtable electronic devices – risk of fIre and smoke

www.loki-ped.de

1

LOKI-PED: Lithium Batteries Fire/Smoke Risks in Cabin

Overview

Sponsor: European Union Aviation Safety Agency EASA

Partners

- Fraunhofer Institute for Highspeed Dynamics, Ernst-Mach-Institute, EMI
- Fraunhofer Institute for Building Physics
- Airbus Operations GmbH & Airbus SAS

including 20 experts, researcher and technicians.

Focus

- Cabin and cockpit
- Not cargo nor checked luggage

Tasks

- Characterization of the main hazards posed by PEDs
- Consequences of fire and smoke in cockpit and cabin
- Risk assessment regarding number and energy content of PEDs
- Assessment of emergency procedures
- Assessment of additional mitigation measures
- Identification of gaps in the regulatory provisions

Duration: 01/2023 – 06/2025

2

PED characterization tests

Hazard: Fire from Laptop, 100Wh, 9cylCells, LCO

PED abuse

Battery Test Center

PED characterization tests

Hazard: Smoke from Laptop, 96Wh, 6prismCells, ???

PED abuse

Battery Test Center

PED characterization tests
Summary

PED abuse

Battery Test Center, Fraunhofer EMI

#	Device	Capacity [Wh]	Cells	Cell Type	Chemistry	Hazard
1	Laptop	100	9	Cylindrical	LCO	Fire
2	Laptop	100	9	Cylindrical	LCO	Fire
3	Laptop	100	9	Cylindrical	LCO	Fire
4	Laptop	100	6	Pouch	LFP	Smoke
5	Laptop	99	6	Pouch	LFP	Smoke
6	Laptop	99	6	Pouch	LFP	Smoke
7	Laptop	96	6	Prismatic	-	Fire
8	Laptop	96	6	Prismatic	-	Smoke
9	Laptop	96	6	Prismatic	-	Smoke
10	Laptop	43	3	Prismatic	NMC	Smoke
11	Laptop	40	3	Prismatic	NMC	Smoke
12	Laptop	40	3	Prismatic	NMC	Smoke
13	Laptop	58	6	Cylindrical	NMC	Fire
14	Laptop	58	6	Cylindrical	NMC	Fire
15	Laptop	58	6	Cylindrical	NMC	Smoke
16	Laptop	94	9	Cylindrical	LCO	Fire
17	Laptop	94	9	Cylindrical	LCO	Fire
18	Laptop	94	9	Cylindrical	LCO	Fire
19	Smartphone	13	1	Pouch	-	Smoke
20	Smartphone	13	1	Pouch	-	Smoke
21	Smartphone	13	1	Pouch	-	Smoke
22	Tablet	43	3	Pouch	-	Smoke
23	Tablet	43	3	Pouch	-	Smoke
24	Tablet	43	3	Pouch	-	Smoke
25	Power Tool	99	10	Cylindrical	NMC	Fire
26	Power Tool	99	10	Cylindrical	NMC	Fire

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6

WP 2.2 A320 mockup test
Test setup

Cabin fire

A320 mockup

9 Tests without human intervention at **4 positions** with realistic ventilation conditions and PED in thermal runaway

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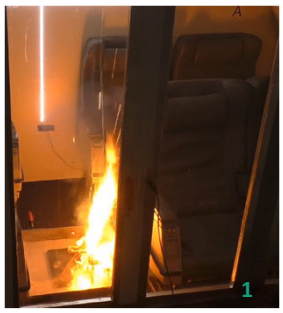
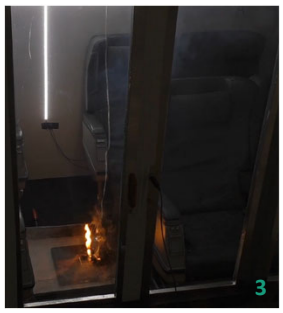
7

WP 2.2 A320 mockup test
V31

Cabin fire

A320 mockup

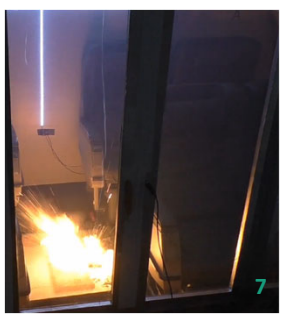




WP 2.2 A320 mockup test
V31

Cabin fire

A320 mockup



WP 2.2 A320 mockup test

V31 – Video

Cabin fire

A320 mockup

Event #1 735 s | Event #2 742 s | Event #3 758 s | Event #4 785 s | Event #5 793 s

  The LOKI-PED Project - www.loki-ped.de

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10

WP 2.2 A320 mockup test

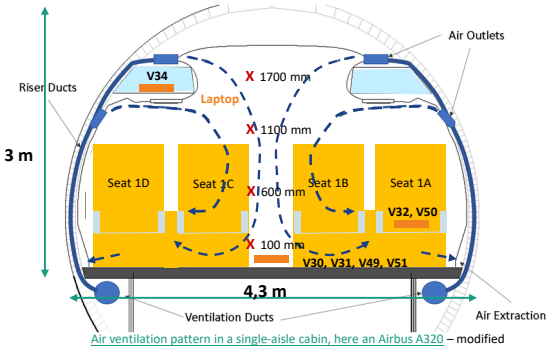
Smoke spread in single aisle cabin without human intervention

Cabin fire

A320 mockup

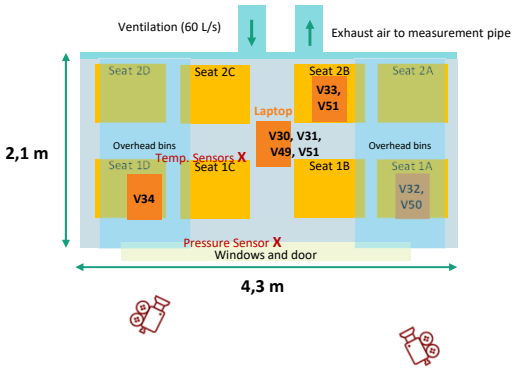
Front

Position PED | Position Temp. Sensors



Air ventilation pattern in a single-aisle cabin, here an Airbus A320 – modified

Top



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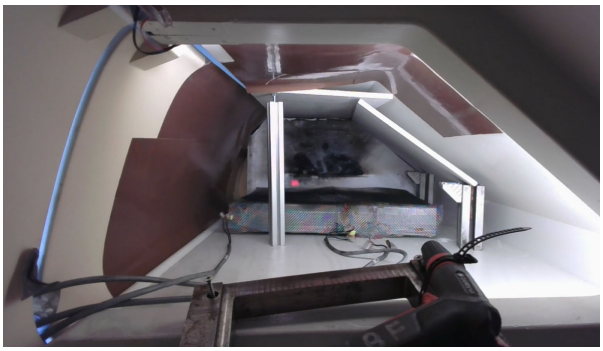
11

WP 2.2 A320 mockup test
V34

Cabin fire

A320 mockup



12

Full-scale cabin test conduct

FTF

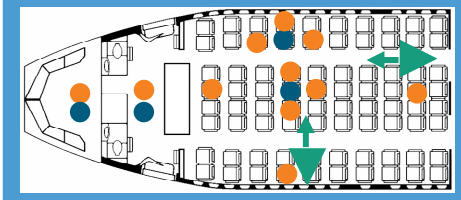
Wide-body

Test setup Cabin:

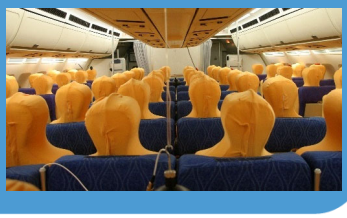
72 Dummies, 75W each
Use of theatre smoke and tracergas
- Visual spread of gas
- Measured spread of gas

Variations
- Ventilation scenarios
  - Normal flow per PAX: 0.55 lb./min. fresh
  - Flow, incl. Recirculation: +50% recirc
  - Normal flow with gaspers
- Emission locations
  - Below seat 4F & 4H
  - Overhead locker closed 4H, short intermediate small opening (simulate extinguisher discharge) and closing
  - Newspaper holder 4F & 4H
  - Galley
  - Cockpit

Flight Test Facility FTF, FhG IBP



Emission
CO2
Camera



13

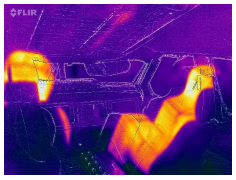
Full-scale cabin test conduct – ventilation flow pattern

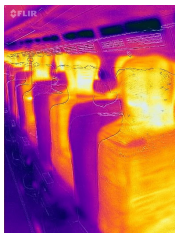
Ventilation flow rates:

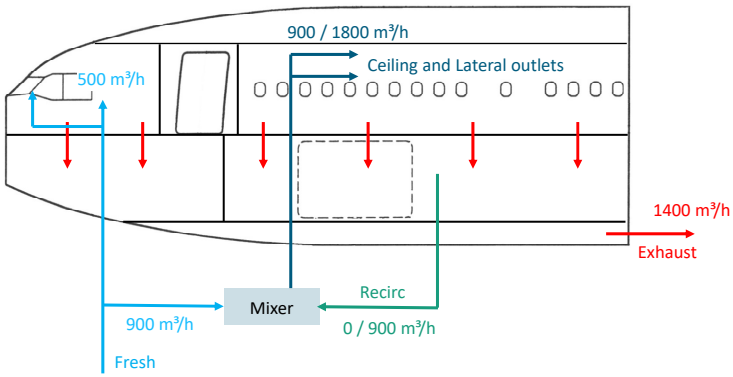
- Cabin Fresh: ~900 m³/h → 3.5 l/s for 72 passengers
- Cabin Recirc: 0 or ~900 m³/h (50%)
- Cockpit Fresh: ~500 m³/h

Occupancy

- 72 heated dummies in cabin
- 2 heated dummies in cockpit







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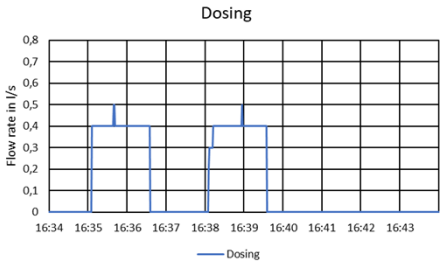
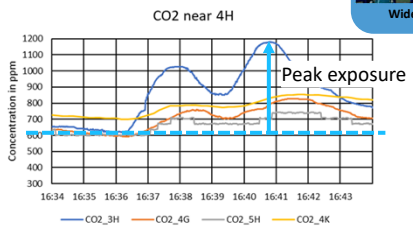
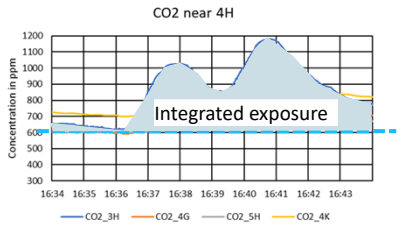
14

Test conduct and data evaluation







1. CO2-dosing through artificial laptop: 2x90s, Total 70l
2. Continuous measurement of local concentration profile
3. Determination of concentration peak and integrated exposure
4. Generation of 2D-plots with color scale, comparison plots

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15

4G Emission

FTF

Wide-body

After 90s Smoke emission

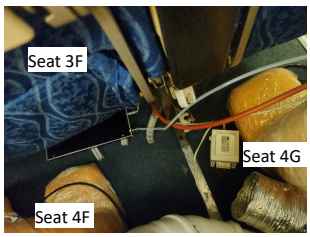
120s
(30s after stop of smoke)

31.7.24 12:47, Emission 4F below seat

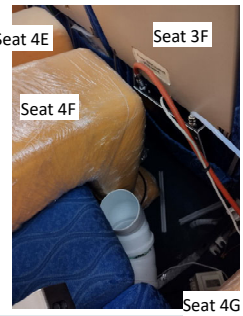
Emission locations in cabin

FTF

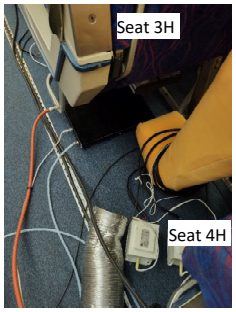
Wide-body



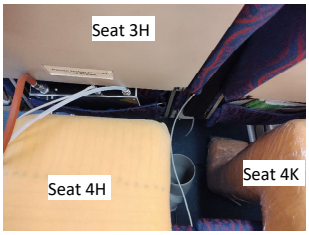
4F below seat



4F newspaper holder



4H below seat



4H newspaper holder

4H overhead locker

Conclusion for cabin emission tests

Elevated concentrations found 1-2 seats away from source

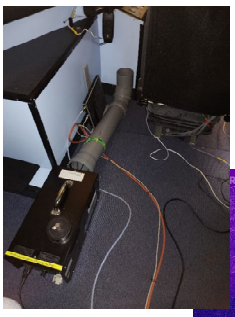
With / without recirc does not show major overall difference for cabin exposure

Without recirc double exposure in galley
→ unventilated in test

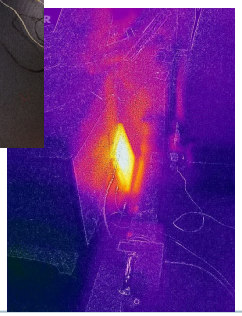
- Side flow paths may overflow to galley
- Recirc draws air downwards from cabin → effect weakened when disactivating recirc

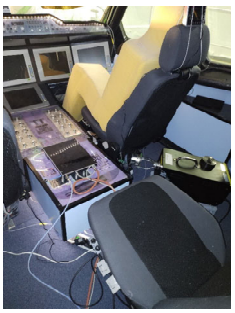
Gaspers show to redirect the peak (4HK lowered, 4E increased)

Cockpit and Galley Emissions



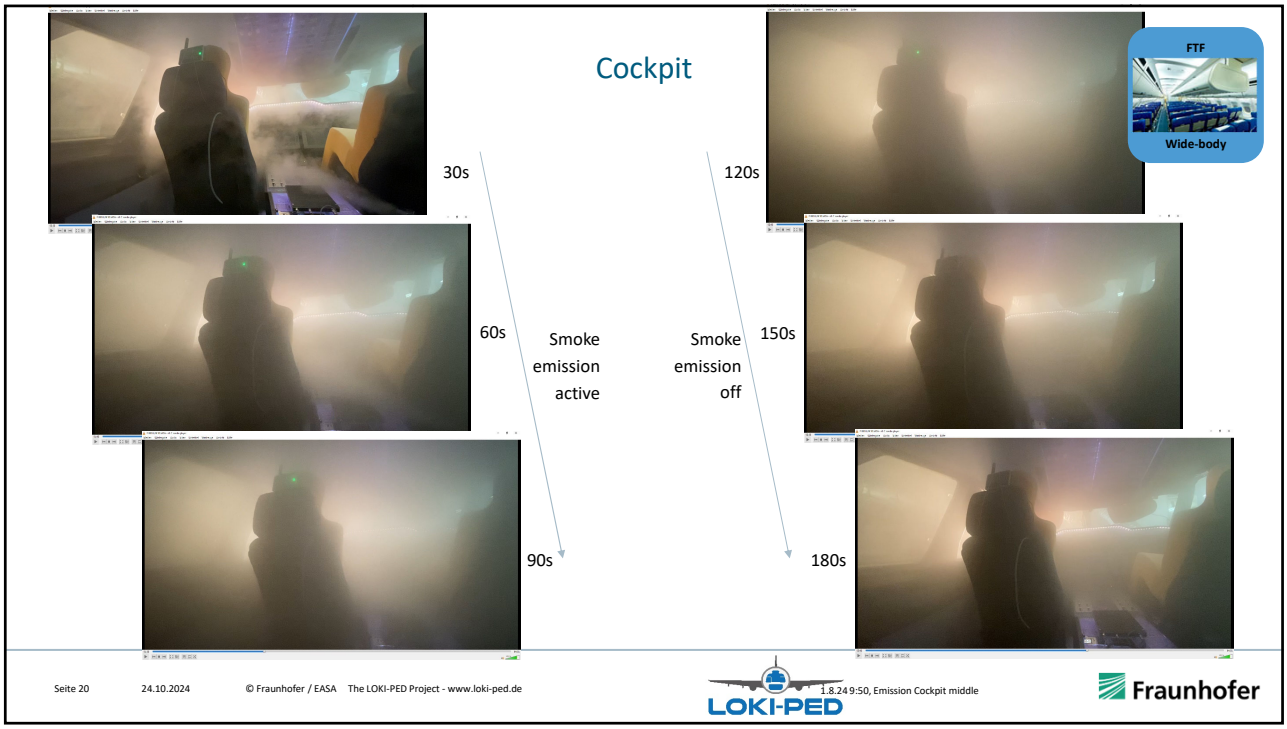
Cockpit left





Cockpit middle

Galley



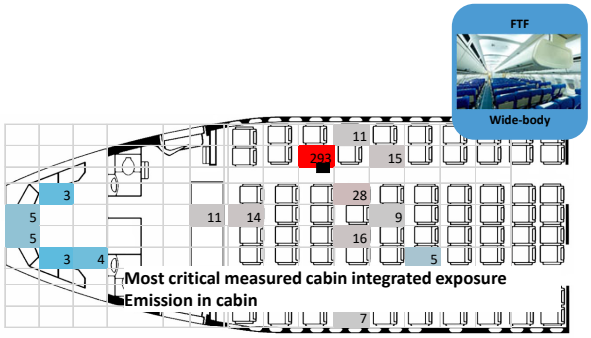
20

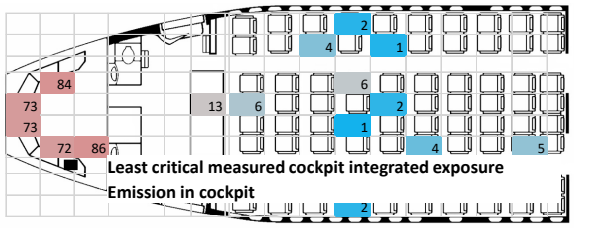
Conclusion Cockpit and Galley emission results

Compared to cabin, the emission test in cockpit and galley shows higher CO2-concentrations

With / without recirc shows to alter flow balance of galley flowing towards cabin / cockpit → to be considered for full-size aircraft to avoid overflow to cockpit

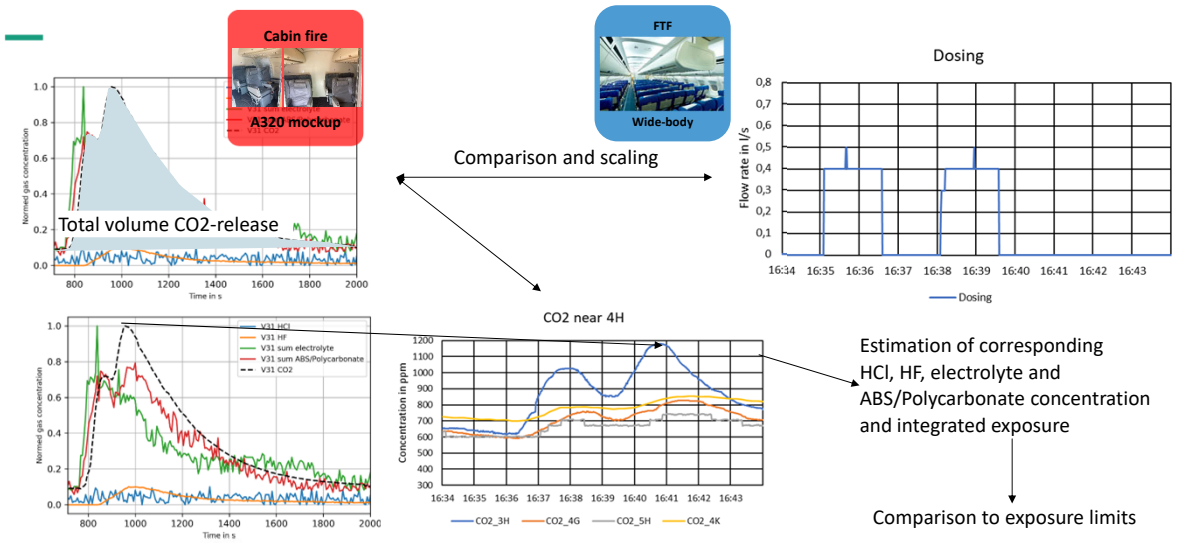
Emission in cockpit shows only low impact on cabin (with and without recirc)





21

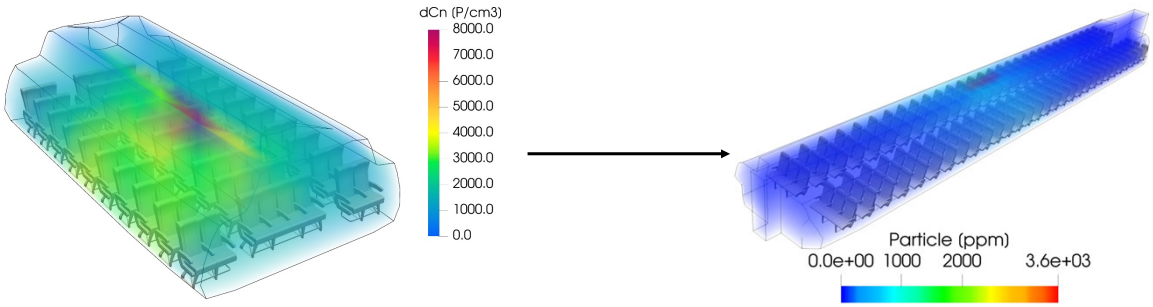
Test data usage way forward



22

Model validation based on emission measurements and scaling

Example for particle distribtion (Covid-related project ViruKab)



Validation of distribution in Flight Test Facility

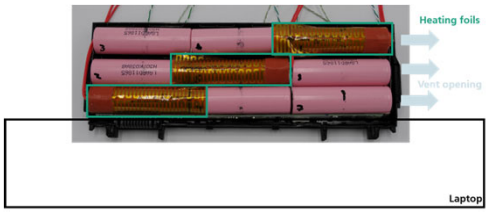
Scaling to full size cabin, addition of galley / cockpit

23

PEDs to be tested

Status

- 24 refurbished laptops
- New batteries: 11 on site, 13 delivered end of August
  - One order
  - Two shipments with different battery chemistry (new, new 2)

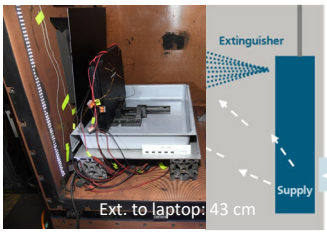


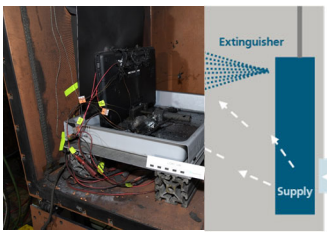
#	Test	Battery cells	Status
1	Characterization 1	9 cells 97 Wh	new
2	Characterization 2	9 cells 97 Wh	new
3	Bag 1	9 cells 97 Wh	new
4	Bag 2	9 cells 97 Wh	new
5	Bag 3	9 cells 97 Wh	new
6	Bag 4	9 cells 97 Wh	new
7	Bag 5	9 cells 97 Wh	new
8	Bag 6	9 cells 97 Wh	new
9	Bag 7	9 cells 97 Wh	new
10	Bag 8	9 cells 97 Wh	new
11	Characterization 3	9 cells 99 Wh	used
12	Extinguisher 1	9 cells 99 Wh	used
13	Extinguisher 2	9 cells 99 Wh	used
14	Extinguisher 3	9 cells 99 Wh	used
15	A320 w/o intervention 1	9 cells 99 Wh	used
16	A320 w/o intervention 2	9 cells 99 Wh	used
17	A320 w/o intervention 3	9 cells 99 Wh	used
18	A320 w/o intervention 4	9 cells 99 Wh	used
19	A320 w/o intervention 5	9 cells 99 Wh	used
20	Characterization 4	6 cells 66 Wh	used
21	A320 w/o intervention 6	9 cells 97 Wh	new 2
22	A320 w/o intervention 7	9 cells 97 Wh	new 2
23	A320 w/o intervention 8	9 cells 97 Wh	new 2
24	A320 w/o intervention 9	9 cells 97 Wh	new 2

Cool down capability of extinguishers

Cooling

Battery Test Center



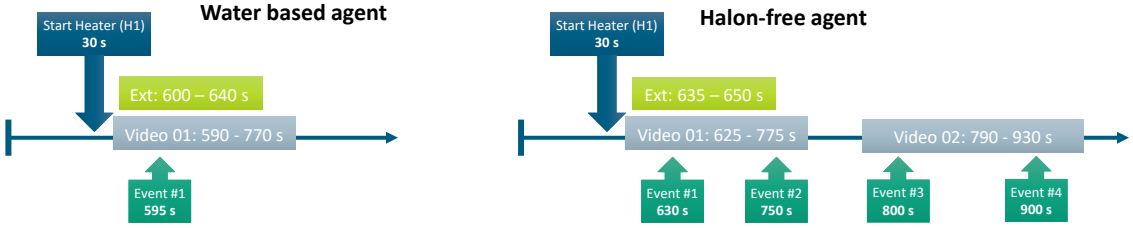


Cool down capability of extinguishers

Cooling

Water based agent

Halon-free agent



26

Cool down capability of extinguishers
Summary

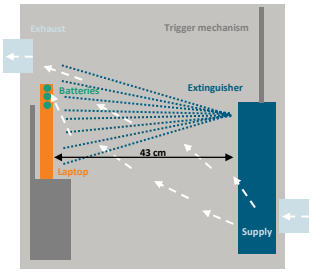
Tested extinguishers
- Manufactures from Europe and US
- 3 of 3 especially for lithium battery fires
- 3 of 3 do not contain halon
- 3 of 3 commercially available
- 2 of 3 in service on aircraft

Test conditions
- Laptop with 9 cylindrical cells (100 Wh)
- One cell heated to enforce thermal runaway
- Ext. In operation when flames are observed until it is empty
- Ext are empty after 15s to 45s

Findings
- 1 of 3 supressed thermal propagation
- 3 of 3 suppressed flames during operation

Cooling

Temporal characteristics
- Duration of operation varies
- Multiple events possible
- 2 to 5min from first to next observed



27

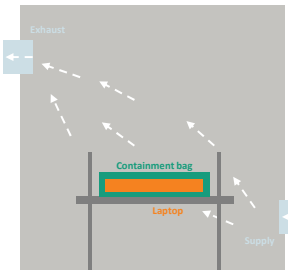
Containment capability of bags
Preliminary summary

Tested bags
- Manufactures from Europe and US
- 2 of 8 bags in early design stage
- 6 of 8 commercially available
- 3 of 8 in service on aircraft

Test conditions
- Laptop with 9 cylindrical cells (100 Wh) packed in bag
- One cell heated to enforce thermal runaway
- Adopted from UL 5800 standard

Hazards observed
- Thermal propagation from cell to cell: 8 of 8
- Venting of smoke: 8 of 8
- Venting of hot particles: 8 of 8
- Venting of flames: 5 of 8
- Opening of bag closure: 2 of 8
- Destruction of bag: 2 of 8

Temporal characteristics
- Duration highly variable
- Multiple events possible
- 1h from first to last event observed



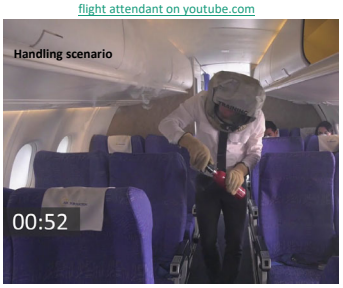
29

Upcoming tests in Flight Test Facility
Fraunhofer IBP, Holzkirchen, Germany

Realistic ventilation and scenarios

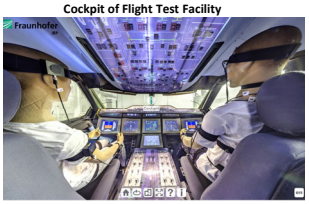
Topics
- Influence of air ventilation on smoke spread
- Emergency procedures
- Handling of containment bags using artificial PEDs

DSAC: Treatment of a thermal runaway in cabin with 1 flight attendant on youtube.com



Artificial PED in action

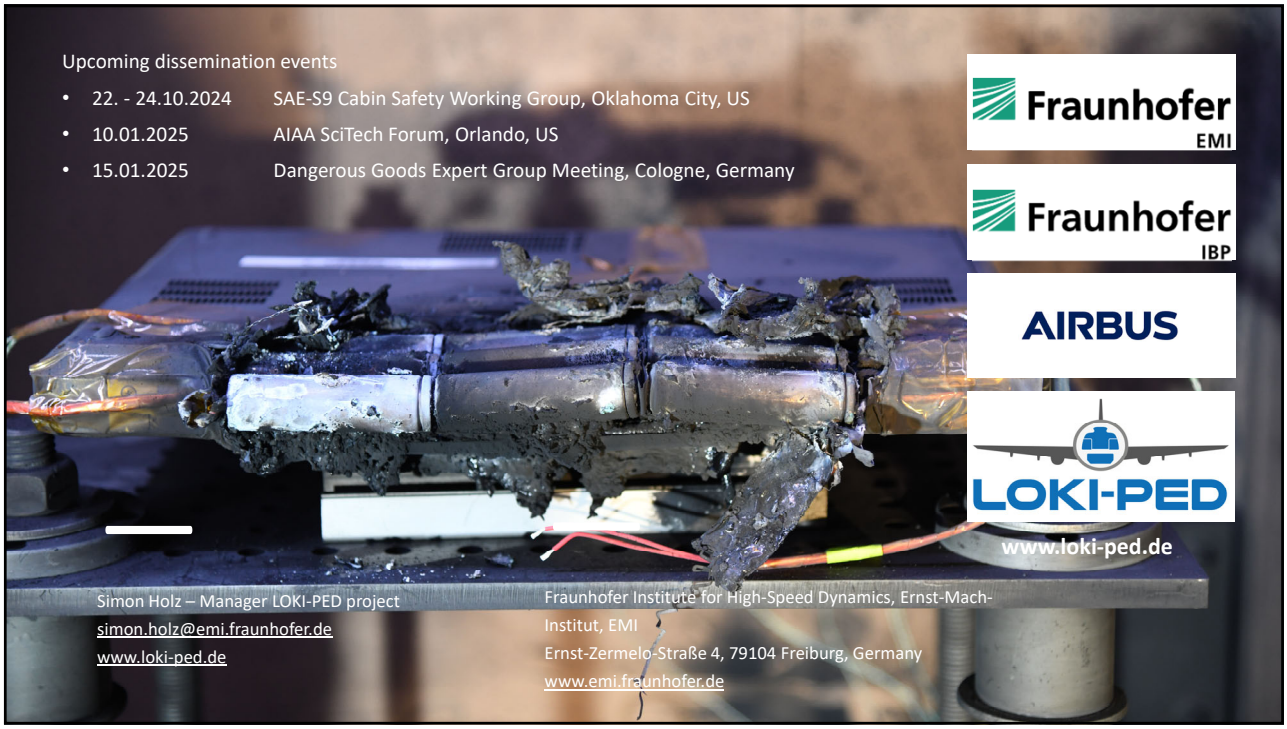
Cockpit of Flight Test Facility



Cabin of Flight Test Facility

Cabin with heating dummies in FTF

30


Upcoming dissemination events
• 22. - 24.10.2024 SAE-S9 Cabin Safety Working Group, Oklahoma City, US
• 10.01.2025 AIAA SciTech Forum, Orlando, US
• 15.01.2025 Dangerous Goods Expert Group Meeting, Cologne, Germany
Fraunhofer EMI
Fraunhofer IBP
AIRBUS
LOKI-PED
www.loki-ped.de
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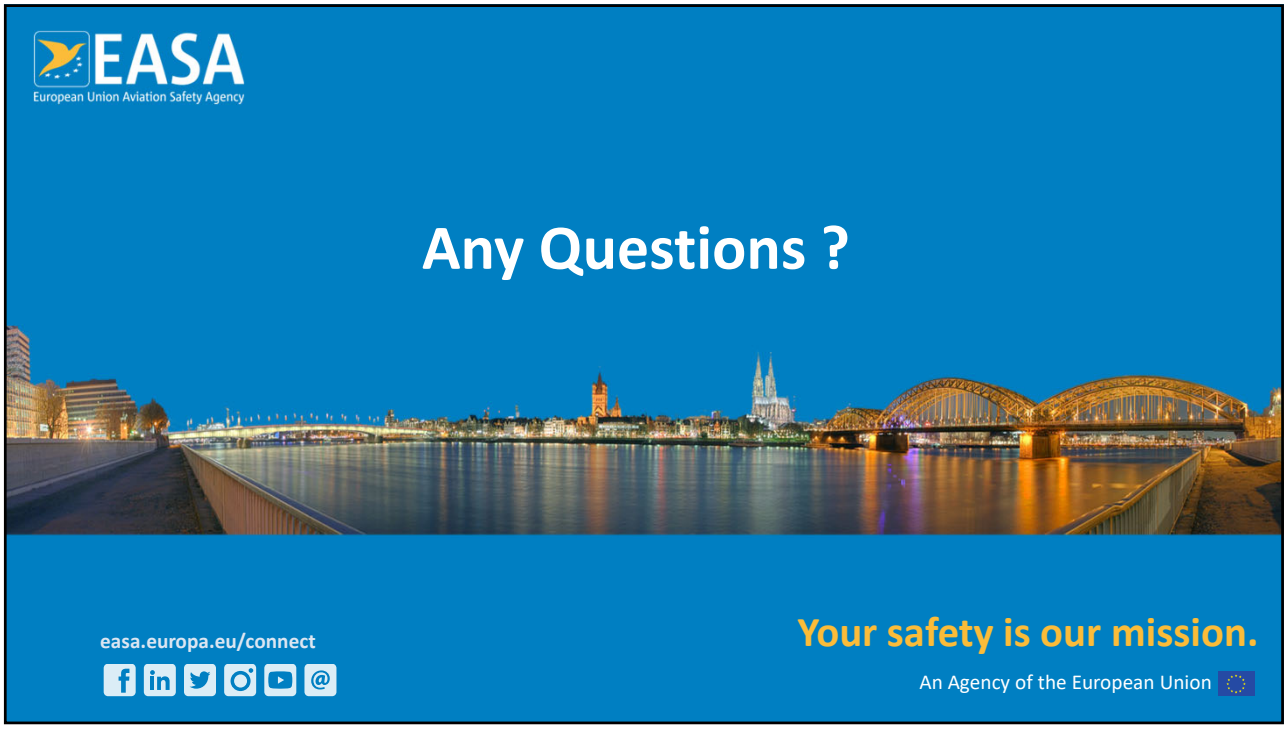
31


EASA
European Union Aviation Safety Agency
Any Questions ?
easa.europa.eu/connect
Your safety is our mission.
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32

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European Union Aviation Safety Agency

EASA update on AIRPED research project

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Cabin Safety Expert
25 September 2024

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33

EASA research

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: 600.000 €
- Project started in September 2021
- Report to be published in Q4 2024

vito AIRBUS DLR Deutsches Zentrum für Luft- und Raumfahrt German Aerospace Center

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34

34

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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)

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35

35

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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.

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36

36

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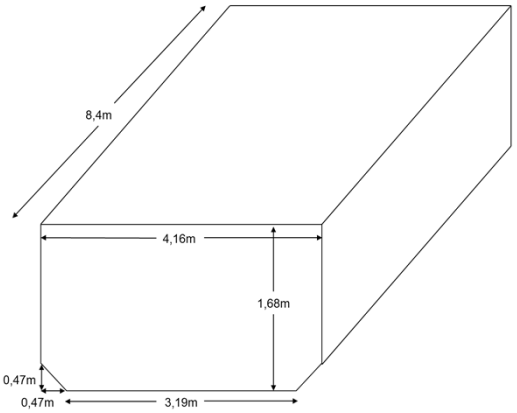
The tests are conducted in the cargo compartment Halon replacement MPS test chamber at DLR (Trauen, Germany)



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37

37

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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

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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.

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39

39

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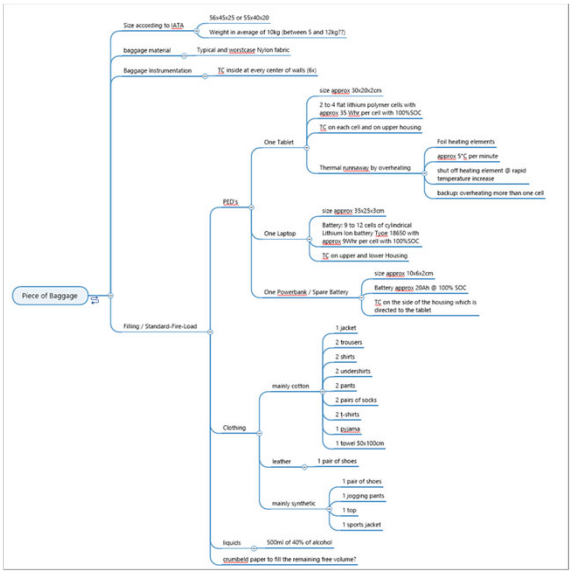
SCENARIO 1: Baseline – Calibration of baggage

- 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



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40

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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.

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41

41

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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)).

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42

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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 maximum 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.

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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).

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44

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SCENARIO 6: Halon Replacement

→ Show that a candidate replacement agent can pass the cargo MPS, including the Multiple Fuel F[illegible] scenario.

Test Scenario
S[illegible]face burn[illegible] & Halon 1301
Bulk [illegible]oad & Halon 1301
Containerized & Hal[illegible]1301
Multiple [illegible] T[illegible]t & Halon 1301
M[illegible]ltipl[illegible] Fi[illegible]e Test & Halon replacement agent
[illegible]urface Burning & Halon replacement agent
Bulk Load & Halon replacement agent
Containerized & Halon replacement agent

Only MFF with Nitrogen

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45

45

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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.

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46

46

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Timeline

- September 2021 : project start
- October 2022: interruption of testing activities at DLR
- June 2023: restart of communication with DLR
  - Maintenance on the test chamber and test equipment
- June 2024: restart of testing activities at DLR:
  - Unsuppressed MFF tests (fire scenario 5)
  - Baggage calibration test (fire scenario 1)

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47

47

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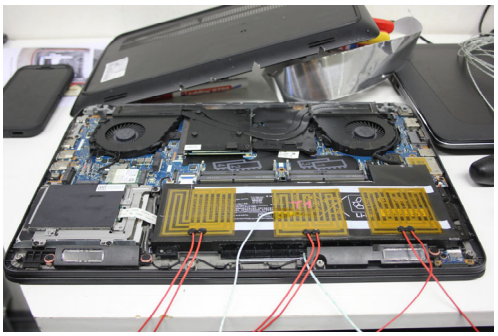
Baggage Calibration (Fire Scenario 1)

- 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.



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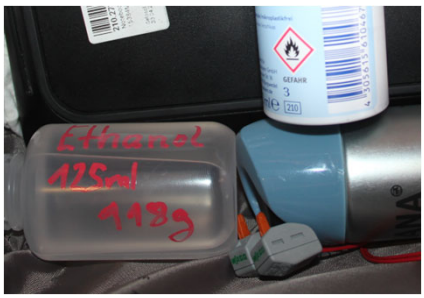
48

48

Baggage Calibration (Fire Scenario 1)

- 6 calibration tests already performed
- Thermal runaway initiated on a laptop battery (pouch cells, 100 Wh) not sufficient to achieve propagation outside the box
- Flame propagation outside the baggage was achieved only when aerosol cans (containing flammable gases) were placed adjacent to the laptop battery
- Aerosol can testing in the MPS chamber resulted in an explosion that damaged the chamber door



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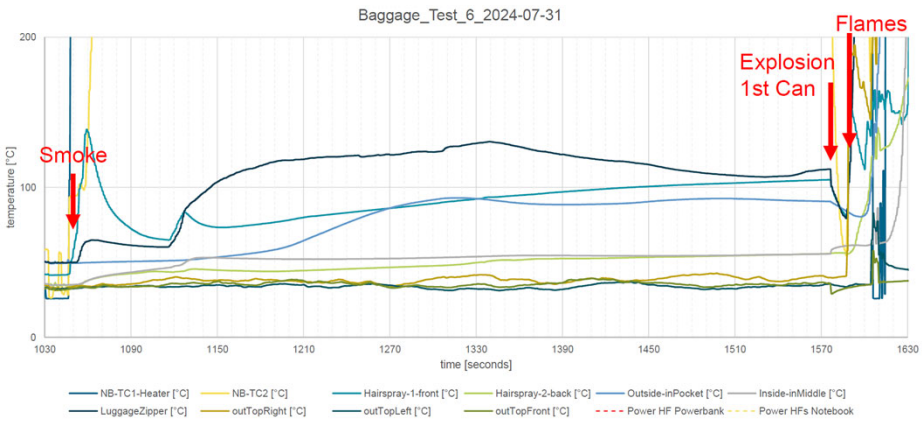
Baggage Calibration (Fire Scenario 1)



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Baggage Calibration (Fire Scenario 1)

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51

51

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Baggage Calibration (Fire Scenario 1)

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52

52

AirPED Baggage Calibration (Fire Scenario 1)

- New calibration tests will be performed using an artificial fire source based on the UL5800 definition
- No aerosol cans in the initiation baggage
- Fire Scenarios 2 and 3 will be run with aerosol cans and power banks inside bags located in the periphery of the fire load.
- The objective of the tests will be to demonstrate that Halon 1301 can stop fire propagation from the initiation baggage

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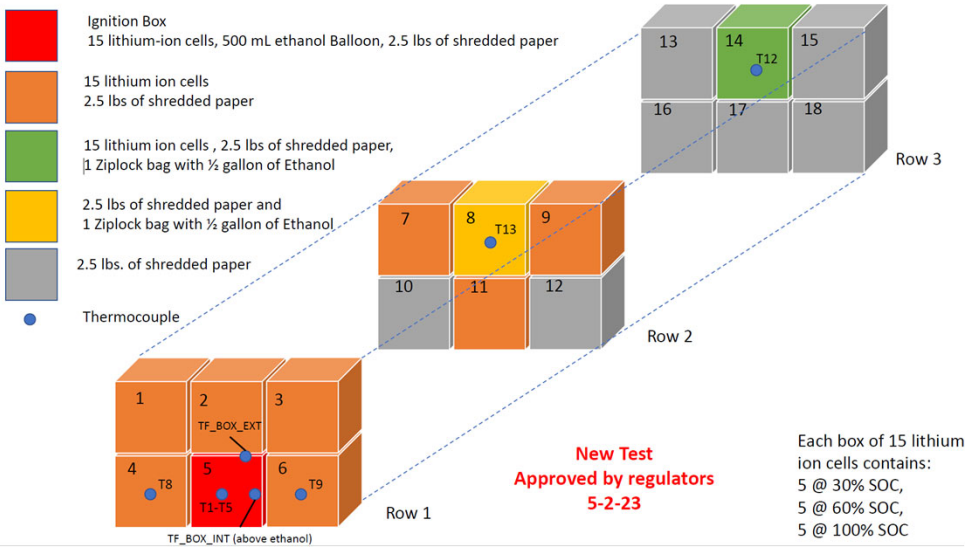
AirPED Multiple Fuel Fire (MFF) Test

SCENARIO 5: Multiple Fuel Fire Scenario



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Unsuppressed MFF Test

Test Set-Up

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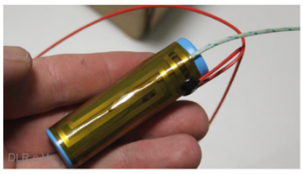
18650 Cells

Heating foils and TCs on two cells with 60 % SoC	Cells held together with tape and free space filled with cardboard	Cells placed in cardboard box with 2 additional TCs (red dots)
		

- In each box 5x 100 % SoC, 5x 60 % SoC, 5x 30 % SoC as in Halon Handbook Draft 3
- Polymide foil heaters 60 x 60 mm, 48 Watts
- TC1 and TC2 attached beneath film heaters, TC3 and TC4 attached to adjacent cells

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Unsuppressed MFF Test

Inspection of fire damage

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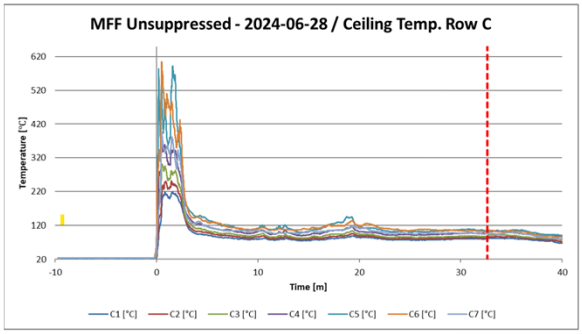
Unsuppressed MFF Test

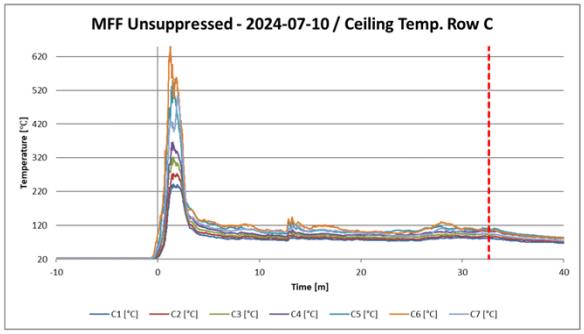
Inspection of fire damage

- 4 cells missing
- 3 small boxes (from box 14, 7 and one unknown) with each 15 cells unburned

57

Unsuppressed MFF Test





58

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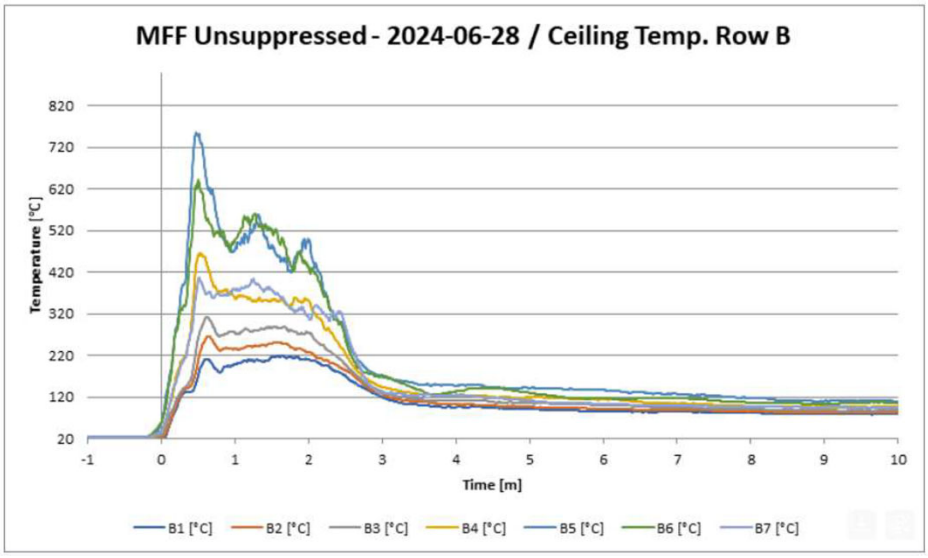
Unsuppressed MFF Test



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59

59

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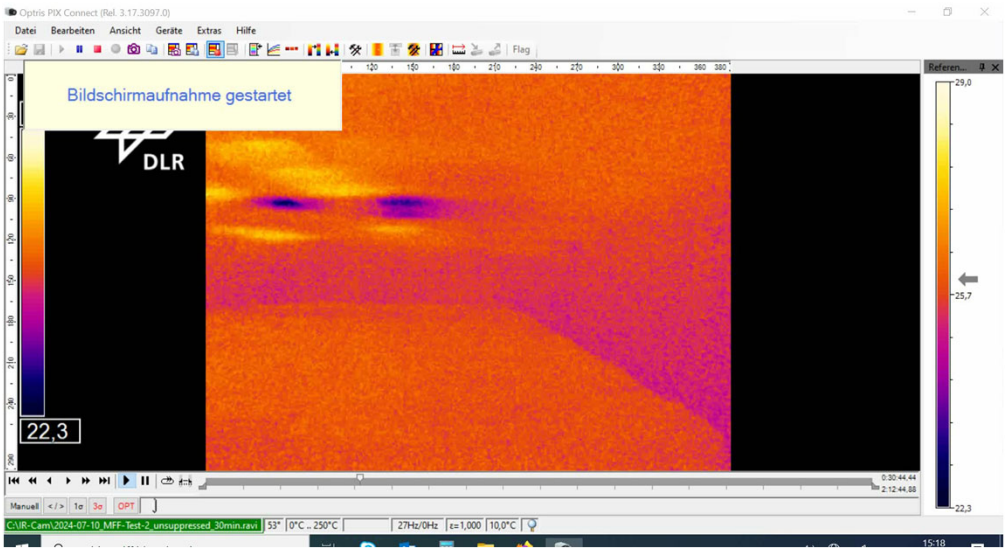
Unsuppressed MFF Test



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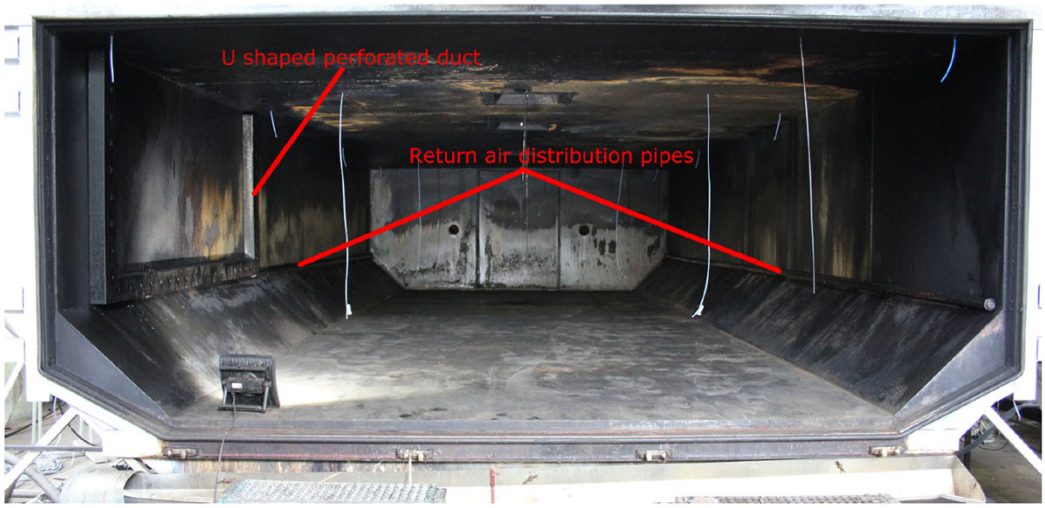
60

60

AirPED Test Chamber Ventilation System



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61

61

AirPED Test Chamber Ventilation System

This procedure is based on the test data recovered from the fire test performed within the AirPED project in 2022.

1. Close cargo compartment access doors.
2. Close return air valve for fresh air distribution.
3. Switch on gas analyzing pumps.
4. Blow in compressed air with a total mass flow of 1400 slpm (~23.3 slps).
5. Start and adjust leakage pump settings to compensate the overpressure build up inside the test cell. The pressure in the cargo bay should now be the same as the ambient pressure.
6. Open inlet air valve of the return air ducting. Ideally this shall be draft free during leakage calibration with correct pump settings.
7. Stop compressed air flow into the test cell. A negative pressure will establish itself due to the airflow resistance of the return air ducting.
8. The leakage rate is now calibrated.

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62

62

AirPED Test Chamber Ventilation System

180-Minutes Bulk-Load with Halon (30th May)

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AirPED Test Chamber Ventilation System

- Blocking was found, because leakage calibration for the last 30-minutes BL test with Halon failed (4th June)
- Leakage pipes were not cleaned before end of 180-minutes test (one containerized and one bulk load tets, both with halon, were conducted before)
- As a leassons learned, pipe are now investigated cleaned after each test
- Clogging seems to be worse with Halon tests (A cooling effect of smoke gases?)

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64

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MFF Tests results

- The first two Unsuppressed MFF tests were not considered sufficiently severe to allow the assessment of the performance of an agent
- Leakage tests using N2 did not reveal any issue with meeting the leakage levels specified in the MPS
- Two options were considered:
  - Increasing airflow into the chamber during the test
  - Increasing the criticality of the fire load (e.g. increased SOC of the lithium cells)

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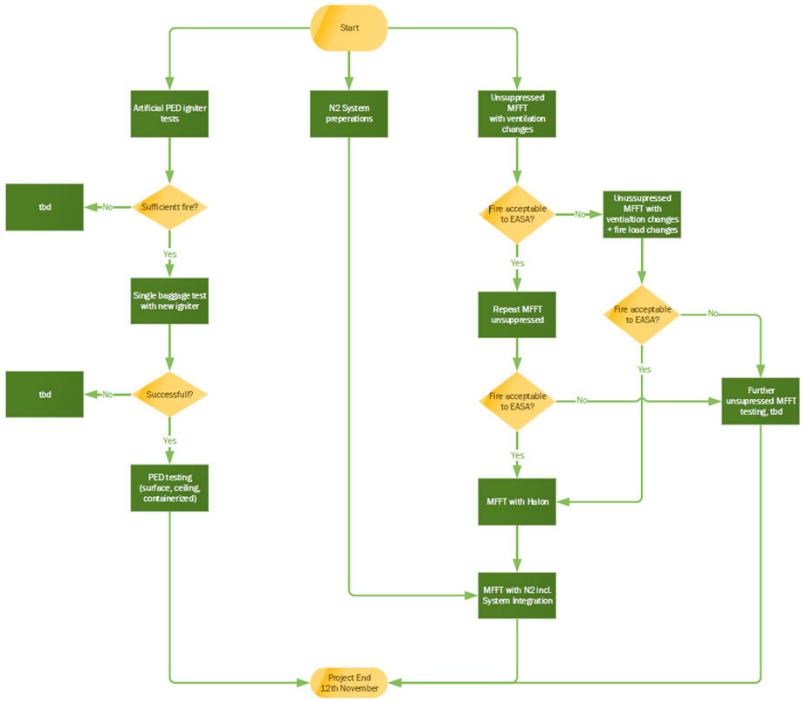

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66

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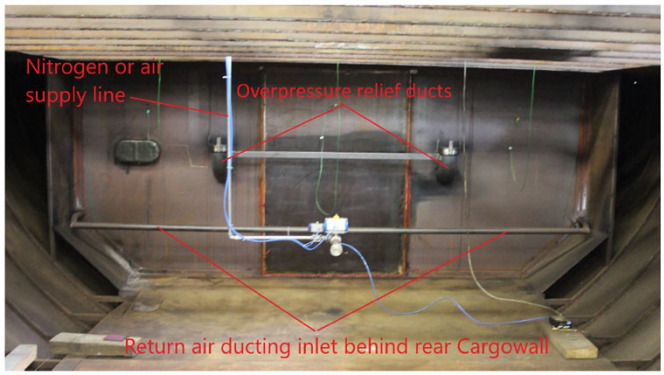
New calibration procedure



1. Close cargo compartment access doors.
2. Close return air valve for fresh air distribution.
3. Open air supply line valve.
4. Switch on gas analyzing pumps.
5. Introduce compressed air with a total mass flow of 1400 slpm (~23.3 slps) over the injection line into the return air ducting. The mass flow will be set using a mass flow controller.
6. Start and adjust leakage pump settings to compensate the overpressure build up inside the test cell. The pressure in the cargo bay should now be the same as the ambient pressure.
7. The leakage rate is now calibrated.

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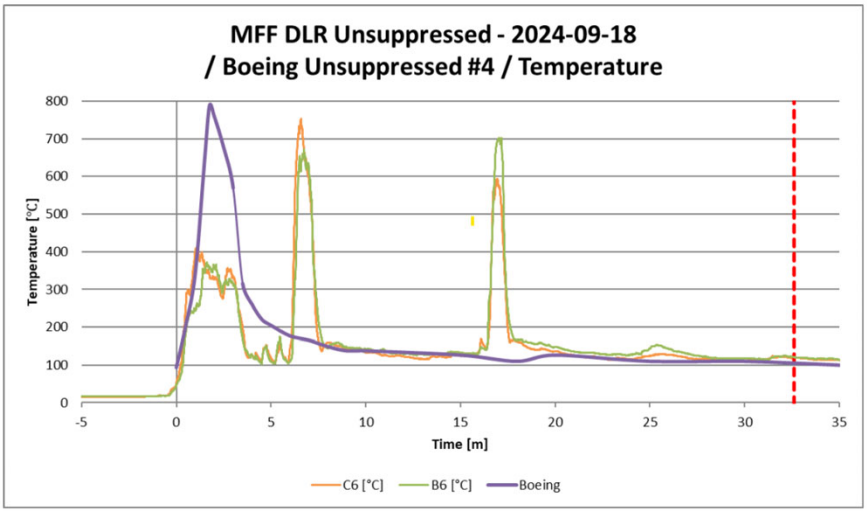
Unsuppressed MFF



Boeing test data are taken from the report published on the FAA Fire Safety Branch website “A Comparison of Suppressed and Unsuppressed Multiple Fuel Fires with Verdagent and Halon”.

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Unsuppressed MFF

Boeing	unsuppressed	MFF	AirPed Data	unsuppressed	MFF
	TTI [°C*min] 3-31min	PeakT [°C]	run	TTI [°C*min] 3-31min	PeakT [°C]
	4462,222	569	1	3305,105	175,517
			2	3232,599	184,149
			3	4736,228	753,473

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Boeing test data are taken from the report published on the FAA Fire Safety Branch website "A Comparison of Suppressed and Unsuppressed Multiple Fuel Fires with Verdagent and Halon".

69

69

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Project Status

- Task 1 is pending finalization of unsuppressed fire test scenarios
- Task 2 and Task 3 are on-going. Activities performed since January 2024:
  - unsuppressed fire test scenarios (issues with the Multiple Fuel Fire scenario)
  - Halon 1301 fire suppression system calibration tests
- Fire scenario 6 (replacement agent): test with N2 only the MFF scenario
- All fire test scenarios to be run by 12 November 2024
- Final report and project deliverables due by the end of Q4 2024

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70

70

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MPS update

- Impact on the MPS (to be further discussed with the MPS Task Group):
  - Conducting unsuppressed tests should be required by the MPS
  - Define minimum conditions for the acceptance of the results of unsuppressed fire tests
  - allow testing in conditions that are more severe than the ones specified in the MPS to increase the level of severity of the unsuppressed fire events

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71

71

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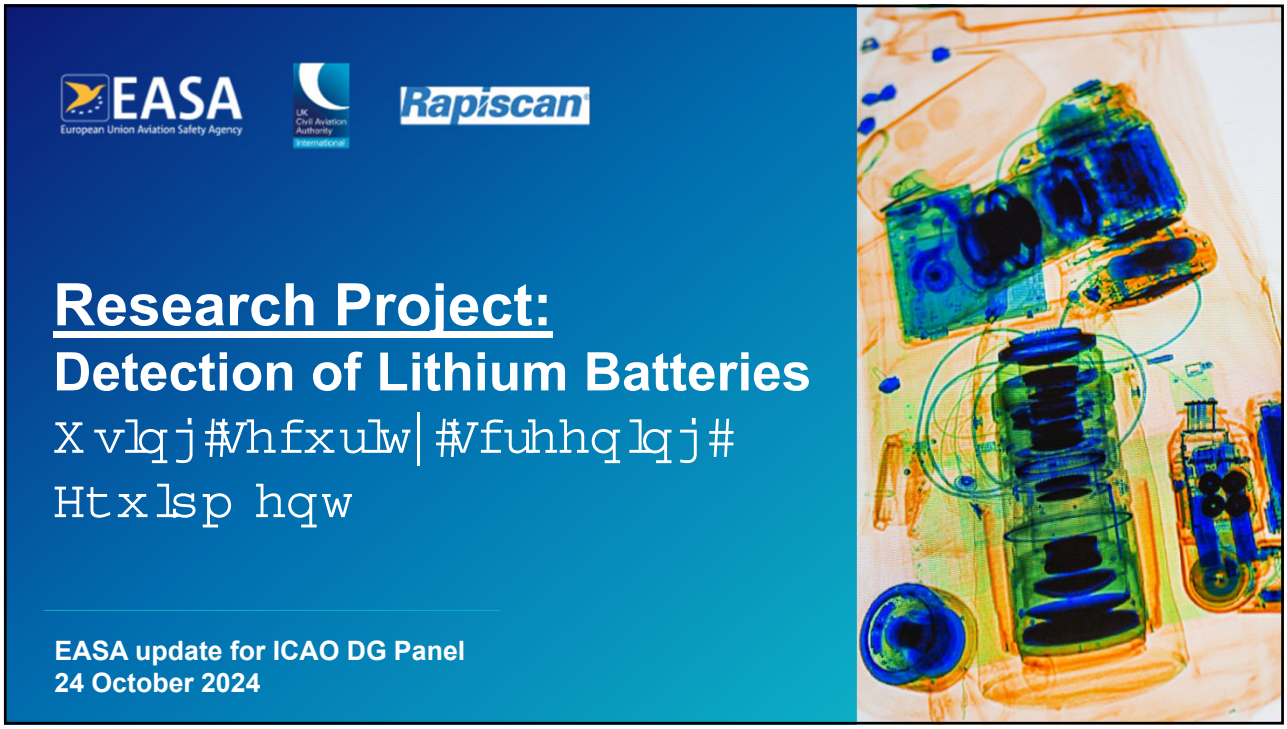
72



74

Introduction

Research project:	Detection of lithium batteries using screening equipment
Focus:	Viability of hold baggage screening for Li-batteries detection
EASA objective:	Ensure and improve safety of flights
Safety concerns:	Increasing number of incidents involving lithium batteries on board the aircraft Increasing number of items containing lithium batteries by passengers Increasing power of such items Passengers not complying with the regulations – **carriage of undeclared items**
Research objectives:	Explore how to prevent Li-batteries from reaching the aircraft by screening hold baggage without creating negative impact on security performance

Risks posed by lithium batteries are mainly fire and smoke but also explosion.
The event occurs very quickly and might have catastrophic consequences due to the high temperatures reached and the amount of toxic smoke.

75

75

Overview

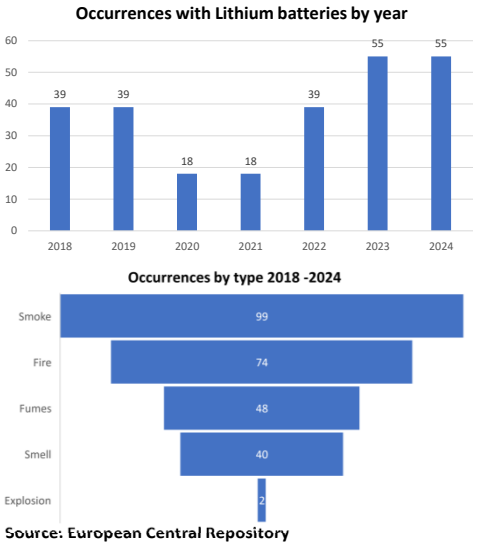
- A study that could support detection of lithium batteries in checked baggage by providing objective and reliable data on performance and impact
- A look at how lithium battery detection is performed today and current data
- Operational and performance data from an on-site test using an EDS machine + dedicated detection algorithm
- Views from across the industry
- Summary report

- This lithium battery detection project is focused on checked baggage
- On-site algorithm trial at a Rapiscan customer




76

Size of the Issue



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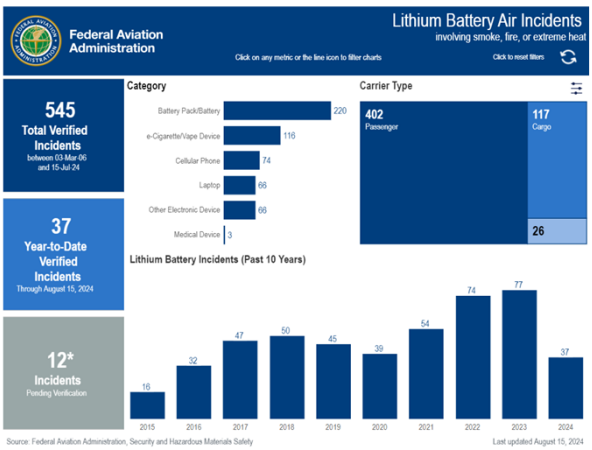
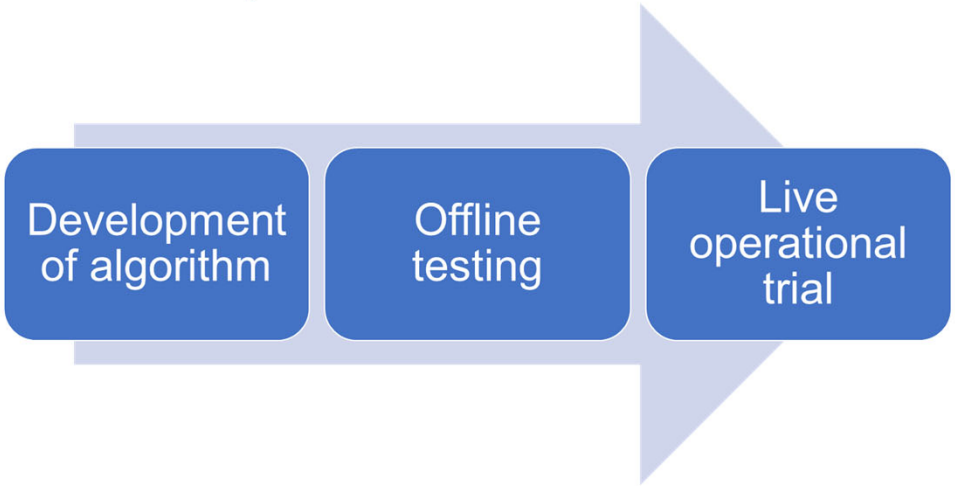


77

77

Lithium Battery Algorithm Airport Trial



78

78

Key Findings
In-House Test (off-line)

- 200 random bags from trial airport
- 15% Lithium battery alarm rate
  - 10% real alarms (prohibited and allowed)
  - false alarm rate of 5%
- 50Wh was the threshold (we did detect much lower than this)
- Did not discriminate between batteries on their own or in devices

79

79

Bag Data

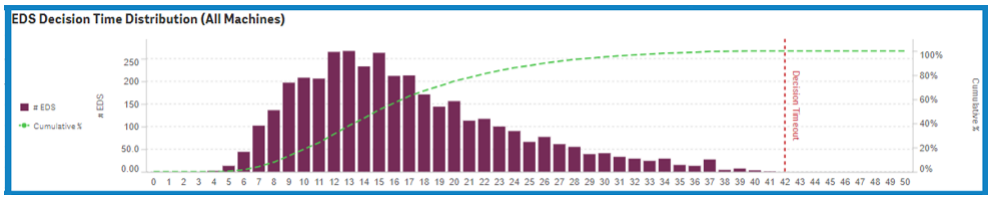
Airport Trial

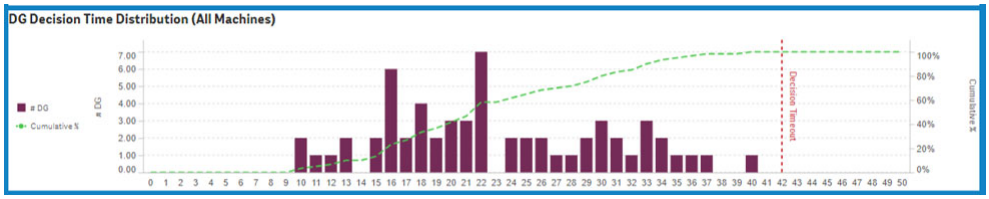
- 748 bags were screened
- 144 (21%) of these had a lithium battery alarm
- At level 1, the reject rate was 32% (explosives + shield + lithium)
- At level 2, the reject rate was 49% (of the 32%, all alarms)
- Lithium battery false alarm rate was 18% (of the 32%)
- Non-compliant lithium battery prevalence: 1.34% of all bags

80

80

Screener Performance





81

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Key Findings
Airport Trial

- Algorithm proved capable of detecting in-scope lithium batteries
- Screeners adapted well:
  - No negative impact on on-screen resolution process for security threats perceived
- The novel alarm increased the screeners' decision times
- The reject rate was elevated during the trial
- Any challenges with implementing such an algorithm would appear to centre on operational process
- Further research is likely necessary, if new solution is to be put in place

82

82

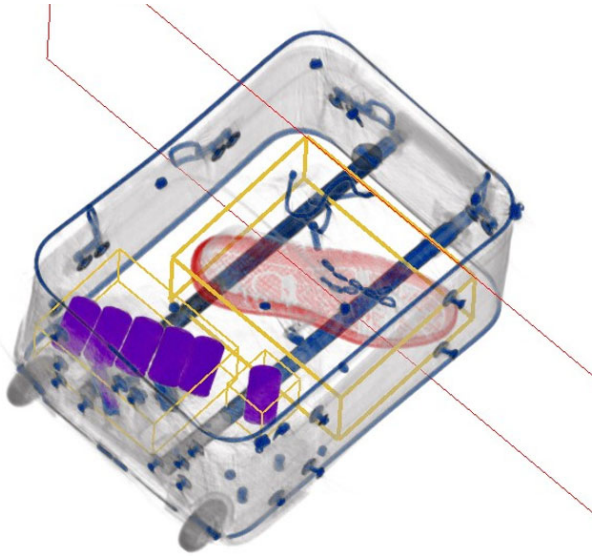
Key Findings
Airport Trial - Screener Performance

- Screeners briefed ahead of trial, set of working instructions provided
- Little perceived negative impact on performance
- Decision times for each image increased
- Work rate was increased
- EDS alarms took priority, followed by LiBAT
- Enhancements used mirrored those for EDS
- **Potential for the new alarm for identifying IED components (positive security impact)**

83

83

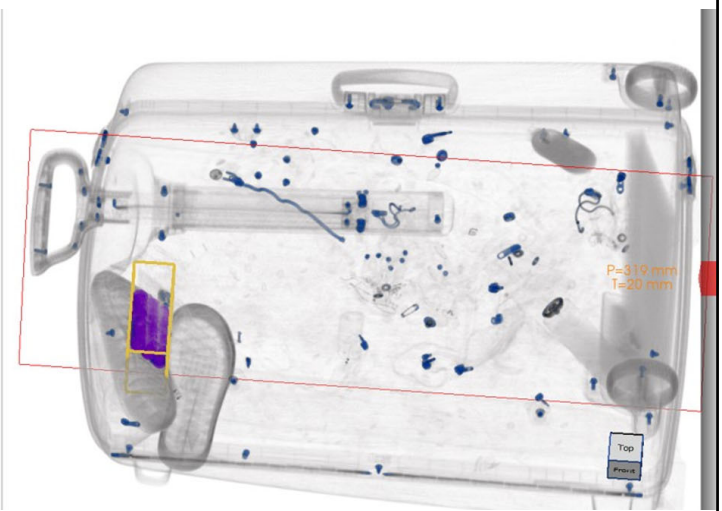
Lithium Alarms



84

84

Lithium Alarms



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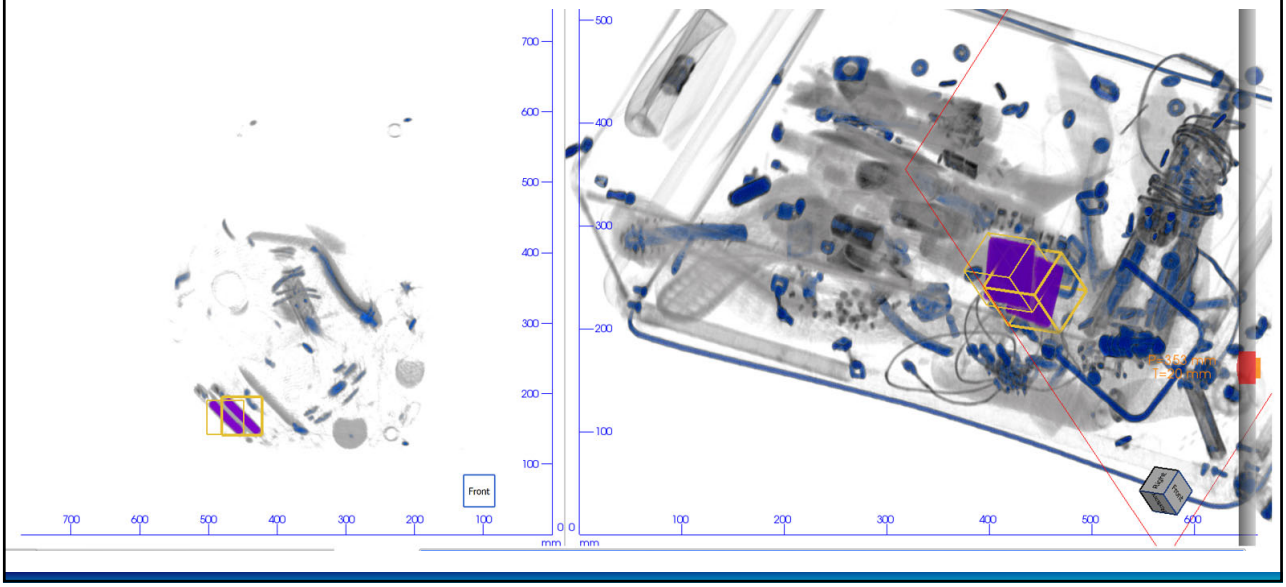
Lithium Alarms



86

Post-trial conclusions

- The algorithm as deployed can detect relevant lithium batteries in the live, operational environment
- Screeners can utilise the algorithm to perform the task of lithium battery detection
- There was an impact on airport operations
- The on-screen resolution process for security threats was not compromised by the on-screen resolution process for safety threats
- Focusing on operational processes appears to be key to successful deployment

87

87

Post-trial considerations

- Evident safety benefits
- Potential security benefits
- The outcomes of the project and recorded safety incidents will be made available to the relevant authorities to explore potential improvements in the regulatory system
- The Agency welcomes the possibility of exploring any potential synergies in the areas of safety and security with all the relevant stakeholders

88

88

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89