

# International Aircraft Materials Fire Test Forum and International Aircraft Systems Fire Protection Forum Meeting

EASA Headquarters, Cologne, Germany

June 13-15, 2023

## TUESDAY, JUNE 13, 2023

### Vertical Flame Propagation Test Method Update (VFP) – Tina Emami (FAA)

Inter-Lab Study 1: There were two analyses completed through statistical software: IBM® SPSS® Statistics. Study to compare the three VFP manufacturers. 3 VFPs, 10 samples per machine.

Inter-Lab Study 2: The purpose of this study was to determine burn length definition. S. Campbell: have we established a pass/fail criteria for this test method? Emami: I am working on it.

### Heat Release Rate Updates – Mike Burns (FAA) [recorded presentation]

Review of Materials Fire Test Handbook Chapter 5 updates from 4/18/23.

HR2 Background was provided. TRL 6 Update (Reproducibility) Phase I completed in winter 2021. It was inconclusive and indicated that more work was needed. HR2 Heat Transfer Coefficient was reviewed. TRL 7 Details and Planning: currently planning is underway for this follow-on activity. The goal of the TRL 7 is to evaluate the role of the relative performance of these samples on the HR2 vs. OSU to ensure there is no unexpected behavior.

### HR2 Development – TRL 6 Testing and Planning – Brian Johnson (Boeing)

HR2 anticipated improvements: repeatability and reproducibility. TRL 6 is reproducibility level. Brian reviewed the TRL 7 Notional Plan. TRL 6 – Part 2: status review and accomplishments and post-analysis actions.

Boeing HR2 Status: Sierra Instruments indicated they are no longer making the Mass Flow Controller (MFC) in this range. Omega is the single source now. We looked into the sonic choke, and Mike Burns is relooking into testing with the sonic choke. Brian reviewed the TRL 6 Next Steps. J. Davis: You must be having some internal discussions on when you think this will be on the street for certification? B. Johnson: I think it is currently written into the method as an option. For certification, that is beyond my area. J. Davis: when do you think you will get through TRL 9? B. Johnson: it is difficult to say. I wish I had a better answer.

### RTCA Development of a New Flammability Test for Electronic Equipment – Lindsey Anaya (FAA) [recorded presentation]

RTCA DO-160G >> DO-160H review.

Lindsey reviewed the current standards: electronic equipment must be broken down into its individual parts and tested with the Bunsen Burner. New Test Method: Programmable Line Burner. Lindsey explained the definition of 'non-vented'. The test procedure was reviewed. Pass/fail criteria was explained. Camera/Blue LED System for Flame Detection: minimum camera requirements and lighting requirements were provided. Blue LED and Camera Set-Up details were provided. Video Capture and Analysis Software: OBS Studio allows Lindsey to capture the two camera angles. Kinovea software was also used. These are simply software options. Video Analysis Round Robin: sent out 4 FAA test video files to be analyzed by anyone who wanted to participate. Goal: achieve consensus on the flame duration time (number of seconds) for each test. A sample video of what a test looks like was shown.

Round Robin results: 11 participants. Most results were pretty close together with the exception of one. Based on the size of the circuit board itself. M. Jensen: if flames are shooting out the top, the sides and the bottom, is that the same or is that counted independently? S. Rehn: yes, unless that is happening at the same time. Attendee Question: where does the test based on the number of vents come from? T. Marker: vented vs. non-vented, how did you arrive at that? S. Rehn: different sized boxes, different flow rates, and counted up the number of holes needed to sustain a flame. Obtained experimentally. Normalized it with making it linear.

#### Relationship Between 3-D Printed Materials and Flammability – Dan Keslar (FAA) [virtual presenter]

Dan Keslar and Steve Rehn did this work. Previous testing was described. Variables included: material, thickness, infill percentage, infill pattern, raster thickness, raster angle. Infill percentage and thickness were found to have a pretty significant influence on data. These variables seemed to not have much of an influence on the data: infill pattern and print orientation. Design of Experiments Testing: a Design of Experiments (DOE) test setup was performed. The DOE set up was described. DOE Analysis: all evaluated variables found to have some impact on recorded data. Ultem™ support material general recorded highest burn length and flame times. All variables except infill pattern were significant in predicting flame time. All variables significant as either main interaction effect for predicting burn length. 10 Worst and Best Case Scenarios were generated for each of the evaluated materials. Summary: all DOE variables were pertinent in predicting either burn length or flame time. Next Steps: A technical note is in the editing process. An issue paper will be released (Transport Airplane Issue List) which will provide more guidance. Additional testing on other variables will be tested. Attendee Question: did you have time to develop a hypothesis to explain the data? D. Keslar: Steve and I allowed Boeing to do the statistical analysis for all of the data collected. So, I am not sure how much further I can go into that. Christian from Airbus: have you thought about packing ratio (weight per volume) as a parameter to analyze the data? D. Keslar: We can look into that in the future. We have not done that yet.

#### Waste Compartment Fire Containment Update – Scott Campbell (Safran)

14 CFR 25.853(h).

Our task group is assessing 20 proposed MOCs & design guidelines and 8 test standardization guidelines.

Update: The task group submitted our proposed Chapter 10 (FAA Fire Test Handbook) improvements at the end of 2022. The FAA had a few comments that were incorporated earlier this year. All Task Group members have the proposed chapter updates.

#### Methods of Compliance (MOC) – Similarity

This work is still in progress. See our October 2022 10<sup>th</sup> Triennial International Aircraft Fire and Cabin Safety Research Conference ([https://www.fire.tc.faa.gov/2022Conference/session\\_details.asp?sessionID=24](https://www.fire.tc.faa.gov/2022Conference/session_details.asp?sessionID=24)) presentation for all the details. We hope to discuss this and more during our Task Group meeting on June 14, 2023.

FAA Fire Test Handbook – Chapter 4: Wires: wire length – Scott presented a proposal to be added to this Chapter of the Handbook. We can discuss this further in the Task Group meeting tomorrow if anyone wants. S. Hariram: in the galley area, there are planes that have a hatch that opens to the cargo compartment underneath and the trash is dumped into it. S. Campbell: this sounds like it is more than 25.853(h). S. Hariram: this has to meet many requirements. Catch up with me, and I will provide more information.

Toxic Hazards of Handheld Extinguishing Agents Used on Lithium-Ion Battery Fires – Natallia Safronava (FAA) [recorded presentation]

Motivation: evaluate the differences in thermal and toxic hazards of handheld extinguishing agents...

Test details were provided. A diagram of the test compartment was shown. No air exchange. A small fan was attached to the ceiling. Toxicity assessment is a very challenging topic. Acute Exposure Guideline Levels for CO, HF, HBr, HCl). Carbon Monoxide: hazardous concentrations of CO were observed for the battery fires with no agent and both agents used. Agent Halon 1211/Halotron BrX: there is slow buildup of Halotron BrX at both heights. Next Steps: expand the scope by including the water extinguisher to compare halon 1211 and Halotron BrX. B. Colton: seems to me there is something lacking in the data because there is not a perfect mixing and the agent will stratify. I've struggled with this test as it has been developed. T. Marker: This is ongoing work. It is mainly a series to look at toxicity of halon 1211 vs. 2BTP. It is challenging because we are looking at batteries that are going into thermal runaway. We wanted to make sure we had some good combustion in there before we used the extinguisher. There are differences between each test – not really repeatable. A. Freiling: what happens if in the end you come up with the toxicity is not acceptable for 2BTP? T. Marker: that is a question for the regulatory side. J. Davis: there are commercial products out there such as the fireproof pouch. Are you looking at this at something like this? T. Marker: we are looking at one or two types of cases (for example). We just received the approval to purchase a couple of those kits and should have the data by the next meeting. E. Canari: The important objective is to be aware of all of this. R. Hill: The FAA policy and procedures for a PED fire in a cabin is to use the handheld extinguisher only if you have flames and to knock down the flames. If you don't have flames, you are to use water to stop the propagation. Flight attendants tend to use the handheld extinguishers more, so that was part of the reason for this testing. H. Alcorta: considering that there are literally thousands of lithium batteries brought on board by the passengers, is it being considered for the future once those sleeves/packs are proven and standardized to be required for passengers to use onboard? E. Canari: EASA has launched a research project on the use of the bags for PEDs.

Preliminary Results from the MCC Inter-Laboratory Study – Richard Walters (FAA) [recorded presentation]

FAA Microscale Combustion Calorimeter (MCC) test measures Materials Properties related to flammability on a milligram size scale. Rich described the MCC test. Fire Growth Capacity (FGC) is a measure of ignitability and burning rate of the materials i.e., the total fire hazard. MCC is proposed method for alternate means of compliance when a small change is made to a construction. Rich provided the background of the Similarity Project. Similarity Criterion: the no-effect level of a material change at microscale is equal to the relative uncertainty of bench-scale FAR fire test results at the 95% confidence level i.e.: 30% as determined by testing. The Material Similarity Task Group was created to develop a method and criterion for comparing flammability at micro-scale using (ASTM D7309 (MCC).

Inter-Laboratory Study – Round 1: 4 manufacturers/licensees of the MCC. (Deatak, Fire Testing Technologies, Concept Equipment Ltd, and FAA Fire Safety lab [Rich Walters]). This data has been collected. See Rich's presentation available with the presentations from this meeting on the FAA Fire Safety website ([www.fire.tc.faa.gov](http://www.fire.tc.faa.gov)).

Future work: offer suggestions to operators to fix errors. Inter-Laboratory study – Round 2 (ASTM) – send set of 5-6 samples to labs. These results will be submitted directly to ASTM. Rich will summarize the results and publish an FAA report. Question: what do you call minor change? E. Canari: this has nothing to do with design change. Question: this is not a means of compliance test? E. Canari: correct. H. Alcorta: Will these labs be listed in the Appendix of the Handbook? T. Marker: If the companies ask April to be listed.

## Miscellaneous Actions – Jeff Gardlin (FAA)

Certification Issues: Similarity with the MCC. The idea is that it is a constituent type change (minor, small change). Originally a Task Group. Conceived as a possible advisory circular led to development of Fire Growth Capacity parameter (See October 2022 Triennial presentation “Microscale Combustion Calorimetry and Material Change Similarity” available at [https://www.fire.tc.faa.gov/2022Conference/session\\_details.asp?sessionID=24](https://www.fire.tc.faa.gov/2022Conference/session_details.asp?sessionID=24)). Now highlighted on the FAA’s “Issues List” Transport Airplane Issue List (faa.gov).

FAA Reauthorization Act of 2018: 2018 bill included some actions for FAA. In October 2023, we expect another reauthorization bill with new actions.

ACs Not Exclusive to NPRM 19-09:

Seat cushions

Cargo liners

Thermal/acoustic insulation

Bunsen burner

“Policy Statement”

There were lots of comments regarding the NBS test. There were lots of other comments. Final rule is still the objective.

Question: if we wanted to use the advisory material that exists for the MCC, who do we talk to? J. Gardlin: if your proposal is to use that, you would write a proposal to use that draft material including whatever it is you want to do with it. S. Campbell: how do you bring attention to that information on the FAA website? J. Gardlin: if someone proposes using that, we will track it in a means of compliance issue paper. M. Jensen: on the policy statement additions that were submitted as part of the NPRM comments, could that be used prior to an AC, etc.? J. Gardlin: the draft ACs as they were put out for comments. Those would have to be documented, but yes you could propose that.

## UN Battery Classification Test Method Development and Testing – Steve Rehn (FAA)

Currently all lithium batteries are classified as either lithium-ion or lithium metal. All lithium-ion or lithium metal batteries are not created equal. New classifications for these batteries are under development and take into account propagation, fire, gas hazard, and temperature hazard. Steve presented some of the test data. Battery Gas Volume Measurements of lithium-ion cells and lithium metal cells were reviewed. Steve provided a list of the types of lithium-ion and lithium metal batteries that were tested. Battery propagation tests were also conducted on lithium-ion and lithium metal batteries. Steve reviewed the results of the propagation tests.

Question: what is the purpose, how would this apply to bigger batteries? S. Rehn: we are working on testing some larger batteries in the near future. R. Hill: right now, what we are looking at in the UN is how to classify the cells. The test method is for a cell. When you are talking about batteries, batteries are multiple cells. The initial intent is to use the classification of the cells within the batteries as the default. A test for the package for the battery would have to be developed. C. Thomas: we are doing similar tests at Airbus in Bremen. In your tests, I see that a lot of the flaming combustion happens outside the package. If you have a packaging scenario, the heat would be contained. Do you have any thoughts on this? S. Rehn: I think we will have to look into that for the multi-cell battery test. R. Hill: This is part of an international UN test method development, and it is meant to classify the cells to tell

how hazardous they are for shipping. It is not meant to be how they are packaged or how they are packaged for shipping.

#### Fire Testing of Bluetooth and GPS Tracking Devices – Steve Rehn (FAA)

Background: Passengers using lithium battery powered tracking devices in their luggage to track their luggage. However, all lithium batteries are supposed to be in carry-on baggage not checked bags. Steve described the types of tracking devices tested. The tests conducted were described, video of tests shown, and test results presented. The batteries were fully charged before testing. This data was sent to our FAA Hazardous Materials sponsors on October 6, 2022. On October 13, 2022: The FAA released a statement saying “Luggage tracking devices powered by lithium metal cells that have 0.3 grams or less of lithium can be used in checked baggage. Apple AirTags meet this threshold, other luggage tracking devices may not.”

#### Status of SAE G-27 Lithium Battery Packaging Performance Committee – Doug Ferguson (Boeing)

This Committee was formed in 2016 at the request of ICAO Air Navigation Commission (ANC) to create a performance-based package standard (AS6413) for the transport of lithium batteries as cargo. SAE G-27 committee has about 300 members with 40 of them as voting members.

There are 4 documents in process:

AS6413: performance based package standard for lithium ion cylindrical cells as cargo on aircraft;

AS6413/1: performance based package standard for lithium batteries as cargo on aircraft – Package Testing with External Thermal Challenge;

AS6413/2: performance based package standard for lithium batteries as cargo on aircraft – Package Testing with Direct External Flame;

AIR6840: performance based package standard for lithium batteries as cargo on aircraft – Background Information and Rationales.

Doug reviewed the SAE G-27 Document Progress Timeline as of June 2023). AS6413: Doug described the details of this. He noted that many ‘variations’ or alternatives still require validation including cells in batteries. Next steps: finish validation testing of ‘baseline’ test method to include all lithium ion cells and reduced cell configuration to have a ‘narrow scope’ standard to be balloted before end of 2023.

Facilitate discussions outside the G27 committee between operators, shippers, test labs, and authorities. What requirements are expected to be contained within standard? How is standard expected to be incorporated into regulations? Use the released standard to conduct a true “round robin” review of the ability of the test standard to provide consistent results from multiple labs unfamiliar with the standard.

#### Lithium Battery Combustion Hazard Analysis and Packaging Testing – Matt Karp (FAA)

Large format cells are becoming more prevalent (e-scooters, e-bikes, e-vehicles). Matt presented the combustion analysis; vent gas volume and combustion energy; state of charge comparison; and heating rate comparison.

He described the G27 test with large format cells and the types of cells were tested. His presentations includes photos of the visual results of these tests.

#### A Study of the State of Charge of Lithium-Ion Batteries in Transportation – Steve Rehn (FAA)

Dan Keslar worked on this testing project.

Steve reviewed Li-ion battery transport hazards. He explained the SOC tests conducted and reviewed the results. Cells shipped from multiple e-commerce platforms were observed to fail. Largest violators of SOC requirements were second-hand sellers... Some batteries were shipped damaged and not packaged correctly and/or above 30% state of charge. These batteries are required to be shipped as a Class 9 (Miscellaneous) Dangerous Good. Battery classification was reviewed (Lithium-ion batteries categorized based on how they are packaged). Matt reviewed the results of these tests and provided the observations. A technical note with full data from this study will be released in the near future.

#### Cargo Safety Updates – Dhaval Dadia (FAA)

Cargo Safety Executive Committee – Purpose: one FAA approach to mitigate cargo safety risks.

Cargo Safety Risk Management – Fire Safety Branch developed a cargo safety website supporting AC 120-121. <https://www.fire.tc.faa.gov/cargosafety>

Dry Ice as Cargo: work completed: studying the effect of multiple variables on sublimation rate and studying the hazards from transporting dry ice to ground crew. Current work: identifying conditions necessary for gaseous CO<sub>2</sub> to infiltrate the occupied areas in a cargo aircraft.

Design Improvements in Class E Cargo Compartments – Objective: initiate a conversation and develop a research plan to enhance fire management systems in class E cargo compartments. Early smoke detection. Fire hardening cargo liner.

Battery Fire Standard – SAE standards for FRCs and FCCs require a class A fire load (paper, wood, cloth, etc.). Industry would like to develop a test to determine the capability of a FRC or FCC to suppress battery fires.

HFC Replacement – Kigali amendment to the Montreal Protocol requires a significant reduction in the use of HFCs. Industry moving to use refrigerants with hydrocarbons. Need strategy on how to move forward.

Cargo Halon Replacement MPS: Dhaval presented (and described these changes) a list of the changes made since the October 2022 triennial conference. The “Multiple Fuel Fire Scenario” was added to the Minimum Performance Standard (MPS).

#### International Coordinating Council of Aerospace Industries Associations (ICCAIA) Cargo Compartment Halon Replacement Advisory Group (CCHRAG) Status – Dr. André Freiling (Airbus)

CCHRAG issued a Working Paper for the 41<sup>st</sup> ICAO Assembly in September 2022. It acknowledged the significant impact of international PFAS regulations on the schedule of aircraft halon replacement efforts. Classify the application of aircraft fire protection as (permanent) essential use to ensure the safe continuation of air transportation using the best available solutions.

ICAO Conclusion: A harmonized approach between member States on the classification and restriction of chemicals as essential for the safety of aviation will be critical to ensure that aircraft can continue to safely fly.

Going beyond CCHRAG: Airframers Proprietary Information Agreement: see André’s presentations in the Presentations section for this meeting on the FAA Fire Safety website ([www.fire.tc.faa.gov](http://www.fire.tc.faa.gov)).

Airframers PIA participating to date: Boeing, Airbus, Embraer, Bombardier, Dassault Aviation. Additional participants are welcome.

## CFD Modeling of Agent Concentration in an Empty MPS Test Chamber – Ted Wu (Boeing)

Results of Verdagent® Discharge Performance Test – various discharge rates. Ted explained Boeing's CFD modeling approach. The CFD Model Geometry and test results were presented. Summary: Emerson Rosemount Continuous Gas Analyzer has demonstrated its robust repeatability and tight span on measuring VERDAGENT®(Note 1) volumetric concentration, which is important for CFD model validation. The CFD model was meshed with polyhedral cells and with the current approach the results have shown good correlations with the test data. Will continue studying effects of meshing, turbulence models, and modeling assumptions on agent concentration distribution. Will simulate other test configurations and make comparison with test data for the CFD model validation.

A. Chattaway: can you tell me what your mesh size was? T. Wu: billions of cells. A. Chattaway: a high-fidelity model.

Question: Condition you assumed? T. Wu: further upstream from the nozzle. Question: can you explain the trends you are showing between the CFD overestimate and the underestimate? T. Wu: You need to think about the uncertainty from both sides.

## Smoke Generator Qualification Standard Status and Challenges – Dr. André Freiling (Airbus)

Smoke Task Group – achieve internationally standardized approach for smoke quantities to be used for showing of compliance to CS25.858a.

Horizontal Smoke Transport: André shared a photo of the horizontal test apparatus and described some of the experiments conducted. Conclusion: benefit of horizontal smoke dynamics characterization is not justified.

Vertical Smoke Dynamics: vertical velocity considerations. Simulation of Vertical Velocity Scenarios: test set up influences the properties/dynamics of the smoke generator. Flow rates/speed are more realistic with open channel. Conclusion: re-discuss this in the Task Group setting.

Cargo Compartment Smoke Machines Comparison: Siemens and Concept Smoke Aviator UL are manufacturers. The architecture and heater arrangement is different between these machines. This is also something worthwhile to be discussed in the Task Group this week.

S. Hariram: Siemens deflector plate is it heated? A. Freiling: no, it is not heated.

## Unsuppressed and Suppressed Multiple Fuel Fire Tests with Verdagent® (MFF Test) in Boeing MPS Test Chamber – Rachel Darr (Boeing)

Test configuration and fuel load were described. Results of April 4, 2023 test were presented.

## Boeing MPS Chamber: A Comparison of Suppressed and Unsuppressed Multiple Fuel Fire (MFF) and Bulk Load Fire Data – Wes Quigley (Boeing)

There are three sections in this presentation. It is available with the meeting presentations on the FAA Fire Safety website at [www.fire.tc.faa.gov](http://www.fire.tc.faa.gov).

Wes covered specific boxes from the test in his presentation. All of these tests use ceiling thermocouple data to time align the data for direct comparison. Unsuppressed MFF 5/9/23 – MFF #4 data presented. Results of several tests were presented. A graph showing comparison of all 4 MFF tests to date was presented (test #1, 3, 5, and 6).

Boeing MPS Chamber Gas Sampling Locations: Emerson gas analyzer measures BTP and CO2 separately.

Question: What is the chamber made out of? W. Quigley: 3/8" plate steel.

## **WEDNESDAY, JUNE 14, 2023**

EASA Update on Rulemaking and Research– Enzo Canari and Remi Deletain (EASA)

EASA Fire/Explosion Problematics and Rulemaking Activities Overview – Remi Deletain (EASA)

SAE A22 Powerplant Fire Testing

EASA participation Remi Deletain, Regis Rossotto, Angus Brahams

Regulatory implementation of AS6826 standard? Create (\*) AMC 20-135: multi-product applicability

Cross refer to AS6826 into the new AMC

Update individual CS requirements and AMC's relating to powerplant fire testing:

With new AMC introduction

If any, removing non-relevant or superseded standards/guidance

CATA – CWI EASA-001 2D Nacelle:

(CS 25.867) Internal (FAA, EASA, TCCA, ANANC) consultations completed

Disposal of comments within CATA EASA-001 team and CATA Paper update – completed

CATA Paper release towards CATA: June 2023

CATA – CWI FAA-xxx – Definition of APU air inlet system boundary and fireproof compliance showing

Generic Guidance (CRI)

Flammable fluid (25.863) and drainage/ventilation (25.1187)

Note: FAA consulted in 2Q 2023 the draft AC 25.863

Residual flame

Halon Replacement

VTOL – Special Condition and Means of Compliance

MOC VTOL.2440 Propulsion Batteries Thermal Runaway

More than 250 comments received

H2, Electrical & Hybrid Propulsion

Research – TAC – IPC (CS-E, CS-25) and project application (CS-23, CS-25)

Multitude of concepts (liquid, gaseous, fuel cell, engine supply)

Special Condition SC E-19 – Electric/Hybrid Propulsion System

EUROCAE WG-80 on Fuel Cell Hydrogen Fuel Cell Systems

EASA participant: Linda Brussaard

EASA HW Fire Strategy shared by Regis Rossotto

H2: will work on CRI SC for CS-23

H2 Fire & Explosion Workshop – 12 June 2023:

Good community presence

Quite a wide range of problematics: some way beyond fire & explosion scope

Need to consolidate list (fire & explosion) topics

Put priorities and build some roadmap

Will explore a format of H2 Working Group and Sub-Group to focus on specific challenges

Will plan re-conducting similar workshop

G. Wozniak: could you elaborate on what work EASA is doing 25.867? R. Deletain: It is EASA, FAA, ANAC, TCCA work. We are looking into how to treat exotic configurations to protect from fire. We are trying to be specific on naming the surfaces and how to treat them.

Email address for hydrogen related comments: [Hydrogen\\_12June2023@easa.europa.eu](mailto:Hydrogen_12June2023@easa.europa.eu)

EASA Update on Rulemaking and Research – Enzo Canari (EASA)

Class D Cargo Compartments: EASA retroactive requirements

Enzo reviewed the EASA rulemaking process milestones. We introduced EASA Opinion 04-2019.

Cargo in the Cabin:

Transport of cargo in Passenger cabin concept emerged from Covid-19 logistics chain issues. Transport of cargo in passenger cabin is not compliant with CS-25.

October 2020: deviation from CS 25.855 published by EASA

2020-2022: Exemptions issued by European Member States (FS remit)

Risk Identified: “onboard fire” risk linked to smoke detection change (i.e.: no passengers); limited capability to extinguish/suppress cargo fires in the cabin; the deviation policy does not fully address all risks.

The Deviation was released in August 2021. The allowance to transport cargo in passenger compartment is limited to 2,000 FH following installation of the change or to July 31, 2022, whichever comes first.

The Transportation of the following cargo in the cabin shall be prohibited: dangerous goods, mail, batteries, including batteries contained in or packed with equipment, cargo of a piercing, dense, rigid, or penetrating nature, or cargo with sharp edges or corners, such as rods, pipes, extrusions, or beams that could become a projectile hazard during flight.

EASA Proposed CM on Smoke Generation Testing:

The purpose of this CM is to provide specific clarification and additional guidance regarding certification testing to be conducted to evaluate the entry of hazardous quantities of smoke into compartments occupied by the crew or passengers as a result of an in-flight fire/explosion event in the pressurized areas of the fuselage of a large airplane.

Proposed CM-CS-011-001 Issue 1 was published October 25, 2019. Comment period expired November 18, 2019. EASA reviewed 23 comments from 3 commenters. The comments will not drive

any significant change to the text of the final CM. The CRD and final CM are ready for publication (target: end of Q2 2023).

PED Fire on the Flight Deck:

Continuing Airworthiness (CAW) activities: EASA started this work in 2018. The CARI identifies a minimum set of measures necessary to address the hazard. Continuing Airworthiness Review Item (CARI 25-09).

Initial Airworthiness (IAW) activities: In December 2021 EASA published proposed special conditions to address the safety concern highlighted in the CARI for new design certification project. On April 26, 2022, EASA published the final Special Condition SC-G25.1585-01 Issue 2 and the related CRD.

CARI 25-09: Potential Risks due to devices containing lithium batteries located on the flight deck.

Special Condition SC-G25.1585-01. From the comment response document: EASA has launched an investigation to identify the need for continuing airworthiness action of large airplanes from EU TC Holders and foreign TC Holders for which our bilateral partners are the State of Design Authority. The outcome of such investigations confirmed that: a potential hazard exists on the majority of aircraft types; and in such case mandatory action would be required from the TCHs to define the necessary emergency procedures, training, equipment and improvements of the flight deck design as defined by Special Condition def. SC-G25.1585-01. Therefore, it is expected that the SC will become part of the type certification basis for most if not all of the EU and non-EU large aeroplanes, aircraft types and introduced in the associated TCDSs accordingly.

For the STC, the decision is more complex. We are trying to publish something soon.

EASA SIB 2022-08.

CAW Issues: with some exceptions, non-EU TCHs have not replied to the CARI yet. The review of the data received from TCHs has not been finalized.

Cargo Compartments and Cargo Systems:

Strategic Rulemaking Objectives: Extension of the scope of the Halon replacement cargo compartment MPS to include a new fire scenario including lithium cells and flammable fluids, in addition to typical Class A fire material (cardboard boxes filled with shredded paper).

Support to SAE G27 to improve lithium batteries/cells packaging standards.

Support to SAE AGE-2 in the development of: a challenge fire (including lithium cells in the fire load) to test FRCs and FCCs. Standards to address active fire detection and suppression features within a fire resistant container or under a fire containment cover.

New Performance Standard for Fire Containment Covers and Fire Resistant Covers: Enzo discussed why a standard is needed.

EASA Research:

SABATAIR <https://sabatair.vito.be/en/reports>

AirPED is an ongoing project. Estimated report publication is Q1 2024.

Enzo described the test scenarios planned.

AirPED Project Status: Final report and project deliverables due by end of Q1 2024.

LOKI-PED: <https://loki-ped.de>). 2023-2025 Task and Time Table were discussed. The Fraunhofer IBP Flight Lab will be used for testing. EASA is asking airlines to ask for crew members to participate in the testing. We are looking for contributions from OEMs for the test program.

Detection of Lithium Batteries Using Security Screening Equipment: Project Leader: Rapiscan Systems Limited. Eric Chevalier: technical lead from Rapiscan.

Health: New Health Safety Measures in Aircraft RES-CA.3. Enzo reviewed the tentative list of projects. Horizon Europe Project - Call for Tender to be published Q3 2023. Project duration: 36 months.

#### SAE A-22 and AS6826 Status – John Ostic (Boeing)

Main effort is on AS6826 (Powerplant Fire Test Standard). There are other items being discussed by the committee. Committee has gathered and addressed about 250 comments. John highlighted the AS6826 Powerplant Fire Test Standard significant changes. The Committee is working to harmonize several documents into one standard. John reviewed the fire test document roadmap and general timeline. The Committee Groups and Documents are listed in the presentation available on the FAA Fire Safety website ([www.fire.tc.faa.gov](http://www.fire.tc.faa.gov)). The SAE A-22 Fire Test Document Roadmap and General Timelines are also included in the presentation.

#### FAA AC 20-135 Revision Overview – Phil Dang (FAA)

Phil reviewed AC 20-135A proposed revisions. The purpose is to provide a high level overview of proposed revisions for Revision A of AC 20-135A, instead of a Change 2. A revision is required per FAA Order 1320.46D Advisory Circular Systems, Chapter 3, Section 2.d, if more than 35 percent of the content changes. AC 20-135A will be released after the publication of AS6826.

#### Halon Replacement Testing in a Generic Nacelle Fire Simulator with Iodotrifluoromethane (CF<sub>3</sub>I) – Doug Ingerson (FAA) [virtual presentation]

Doug reviewed the Overview Halon-Equivalence Fire Testing and described the Accomplished CF<sub>3</sub>I Testing. Overview, Assessment Concept: alter a fire zone perspective to a generic one. Doug explained how basic elements were used to generate applicable test results and minimize interfering with understanding them. The Task Group derived multiple revisions. MPSHRe/rev03 – 2003-2008; MPSHRe/rev04 – 2010-? Prove equivalence, retain much from rev03, but turn it into proof test.

Doug described the test environment. CF<sub>3</sub>I Testing, MPSHRe/rev 03, 2003-2006: accomplished by the FAA Fire Safety Branch. External interest faded, FAA Fire Safety reprioritized. There was interest in other potential replacement agents. Doug explained observations during CF<sub>3</sub>I testing during this time. CF<sub>3</sub>I Testing, MPSHRe/rev04, 2018-2022: Boeing/Parker-Meggitt initiative recognized by the FAA. Rev04 is a proof test; prove 7.1%v/v CF<sub>3</sub>I for ½ second. Doug described the 'cold' testing conducted. CF<sub>3</sub>I 'cold' testing distribution graph was presented. Doug described the fire extinction test. Results of "cold" testing: all fire extinguished, without ambiguity.

An applicable amount of investigation and testing occurred with CF<sub>3</sub>I per MPSHRe/rev03 & rev04. Sole focus here is defining proposed certification criteria.

#### Combustion Potential – Engine Compartment Fire – Aeon Brown (FAA) [virtual presentation]

##### Nature & Behavior of Fire in a Compartment

Objective: to understand the effects that dimensions, fuel flow, and air flow have on combustion inside of an engine nacelle type compartment. The data from this project will be used to provide an expeditious and small-scale validation method for CFD fire modeling. Aeon provided the background and explained the method. The background is detailed in Aeon's presentation available with the meeting presentations

on the FAA Fire Safety website at [www.fire.tc.faa.gov](http://www.fire.tc.faa.gov). A photo of the compartment design test apparatus was shown. A photo of the inside of the compartment test apparatus was shown and location of thermocouples was explained. 1.5 GPH Fuel Flow test video was presented.

## **THURSDAY, JUNE 15, 2023**

### Task Group Reports

#### Additive Manufacturing Task Group Report – Steve Rehn ([steven.rehn@faa.gov](mailto:steven.rehn@faa.gov))

At the beginning of the meeting, Steve Rehn gave an update on the status of the technical note the FAA is writing about all of the additive manufacturing (AM) Bunsen burner testing completed in the last few years, as well as an update on the issue paper the FAA is in the process of writing. The technical note is finished and will go through the editing process before being released. The release of the issue paper will follow the tech note because it will contain references to the tech note.

The FAA was not ready to send the draft issue paper out to the task group before the meeting but allowed the group to see it during the meeting. As of now, the issue paper essentially summarizes the findings of our testing as written in the tech note, but the task group requested to have more concrete statements, such as thinner samples can be used to substantiate thicker samples and less infill can be used to substantiate more infill. There were also requests for even more basic testing instructions than that, due to part manufacturers and testing labs still having problems with regulators and the lack of guidance material that is out there. Every company seems to have a different experience depending on who they have to work with. Therefore we will also add in more basic instructions stating how to produce samples to represent actual parts and stating that we can test the actual part itself.

The next steps are to continue working on the issue paper and when we are ready, we will send the draft out to the task group for comments. Then, depending on the timing, we can either have an online meeting or discuss it at the next task group meeting in October 2023.

#### RTCA Task Group – Steve Rehn ([steven.rehn@faa.gov](mailto:steven.rehn@faa.gov))

There was a very short RTCA DO-160H Flammability task group meeting and only a few people participated. The task group went over our current progress of the new test method for fire testing electronic equipment as a complete unit. The test method has been completed and submitted as a change proposal to RTCA Special Committee SC-135. We are waiting to hear back from RTCA to find out when the FAA will need to meet with SC-135 to review the change proposal and hopefully get it approved to be placed into revision H of the document DO-160.

#### OSU/HR2 Task Group Report – by Brian Johnson ([brian.e.johnson8@boeing.com](mailto:brian.e.johnson8@boeing.com))

FAA Task Group Lead: Mike Burns ([mike.burns@faa.gov](mailto:mike.burns@faa.gov))

- 1) Briefly addressed the outcome of Mike's closed heat release projects, including smoke monitoring, TC comparisons, DI water mist, alignment fixture, sonic choke (more on this later)
- 2) Discussed the relationships between remaining TRLs in more detail
  - a. We have a catch 22 - folks are hesitant to order HR2 prior to TRL 8 stable configuration

- b. Discussed how many instruments will be required for TRL 6 – general consensus on direction to lower required instruments to 4 (but more are desired)
  - i. Lantal (H. Nussel) will talk with Martin about potential OSU conversion to HR2
  - ii. DLR may be interested in building or buying an HR2
- 3) Reviewed TRL 6 status using Mike and Brian’s presentation points
  - a. Sonic choke will be added to the specification, as well as setup concerns and pressure variation. May require regulation component addition and/or upstream volume requirements to mitigate sudden pressure changes (e.g. compressor cycling).
  - b. Gardon HFGs will be added to the HR2 spec. Mike reiterated his confidence in their equivalence to Schmidt-Boelter gauges.
  - c. Need to review prior data presented:
    - i. The relationship between air pressure and flow was described in a presentation by Yaw Agyei (March 2020)
    - ii. Sonic choke system description and details were shared in a presentation by M. Burns (April 2021)
  - d. Yonas Behboud related status of Boeing HR2. Airflow and HFG challenges – Sierra no longer making MFC in range, Omega MFC may not meet expectations (customer service issues) – lead to inclusion of Sonic Choke into specification
  - e. Chemitox is in progress with 100 operating parameters, but has also had issues with the MFC. No representative was present, but we took an action to formally request and discuss TRL 6 participation and schedule.
- 4) TRL 7 specimen – reviewed proposed families and constructions
  - a. The matrix is very much a draft, and industry input is strongly requested
  - b. Recommended removal aluminum honeycomb construction and possibly replace with 0.25” aluminum or steel plate bonded to panel
  - c. Discussed the addition of an epoxy prepreg to the matrix
  - d. Replaced Lexan XHR with Lexan F6006 (0.040” opaque) based on M. Miler’s advice
  - e. Will add ‘thick paint’ requirement to Ultem 9085 0.060” coupons – to represent potential at or over regulatory limit coupon
  - f. We have had several companies offer to provide coupons since Tuesday, including:
    - i. Sekisui Kydex – Michael Miler – both Kydex and Lexan coupons, also recommended testing at the ‘critical thickness’ approximately 0.080”
    - ii. FAAC (Fischer Advanced Composite Components) – Euangel Patagan
    - iii. Mankiewicz - Gunnar Hansen
    - iv. Zotefoams – Dr. Karl Hewson
    - v. David Baker – Schneller can provide dec lams, prepregs, panels

We will be inviting these folks to our smaller monthly meetings to discuss coupons and timing once contact information is received.

We need to follow up with Ralph Buoniconti (Sabic) for input on this matrix

\*Please contact Brian if you are interested in including your materials in TRL 7 testing and / or supplying coupons.

### **Mass Flow Controllers:**

- There was a discussion on mass flow controllers and how they are calibrated. Members of the group explained that some flow controllers are digital and automatically adjust for changes in flow rate due to the calibrated pressure and temperature settings. Some mass flow controllers do not make this adjustment and must be accounted for manually.
- A standard needs to be placed moving forward after learning this new information.
- Manufacturers of the VFP will be in contact with the manufacturers of the mass flow controllers to confirm the assumptions made in the first bullet.
- It was noted that it is more expensive to perform calibrations away from the standards set in place already.
- Suggestions were also made to perform an inter-lab study to observe the flow rates between all of the labs that currently have VFP machines to ensure every lab is flowing the same amount of methane and air.
- There was also a discussion on calibration of the mass flow controller used for methane to also be calibrated using methane gas as opposed to air or nitrogen. This sparked conversation that while a correction factor is used to accommodate for this, the manufacturers of the VFP must be transparent in their methods of calibration when delivering the machines to the labs.
- The conclusion is to state our calibration factor and the accompanying flow rates, the labs accommodate for this internally, and an inter-lab study with in-line flow meters can be done to confirm if they are equivalent.

### **Differences in VFP Manufactured Dimensions:**

- There are differences in the sizes of the machines that are built. The VFP manufacturers believe it is unlikely that the chamber volume will be a critical factor to the burn length due to the airflow from the bottom to the top being in the same location in all machines. Although this assumption has been made, it is best to understand what the maximum tolerances available are through future studies.
- There was further discussion on the differences of the height of the chambers from the table to the base of the VFP machine. This is intended to be a safeguard for repeatability of burn length testing between machines. There is no forced air through the machine, only natural, so the area available underneath the machine should be uniform at this point.
- Further, it was pointed out whether or not the exhaust fan above the VFP in the lab should have a spec on the speed/settings. This needs to be further studied.
- The heater design itself was also discussed. There seems to be an issue with obtaining heaters that can hold the load of the current design. Manufacturers are to report back in October with their findings.

### **Running the VFP Test:**

- It was brought up that during this research portion of the VFP, that heat flux shouldn't be the only parameter we should rely on to confirm heat output of the radiant heater. One

person suggested to use power or voltage measurements of the machines as an option, but other methods are open for discussion as well.

- It was suggested to have a list of all the components of the test that need to be calibrated and to what frequency they should be calibrated at.
- The updates will be sent to the group for comment.

#### Cargo Safety Website Task Group Report – Dhaval Dadia (Dhaval.dadia@faa.gov)

We got some good input. Dick Hill provided some good background information on the purpose of the website. The group provided some good information like tracking cookies to see who is using the website and see what pages they are clicking on. Also, providing some videos and how to use the website to perform a safety risk assessment.

#### Class E Cargo Compartment Design Enhancements Task Group Report – Dhaval Dadia (Dhaval.dadia@faa.gov)

We came up with some ideas on what research the FAATC can do (evacuating smoke). There were some questions posed that we can take back and look into.

#### HFC Replacement Task Group –Dhaval Dadia (Dhaval.dadia@faa.gov)

Task Group Lead: Wade Stoelting (Boeing) (wade.b.stoelting@boeing.com)

This was to see if there is interest by industry to look into this for replacement in galley carts and large HVAC units. Industry is interested in acting upon it and moving towards a standard. Our plan is to send out an email and get the right participants. We plan to start meeting virtually so we can have a good in-person meeting in October.

#### Waste Compartment Fire Containment Task Group Report – Scott Campbell (scott.campbell@safrangroup.com)

Thank you for those who were able to attend our task group meeting last week in-person and those attending virtually. We had excellent attendance!

July and August are very busy months for work and vacations, so I plan on splitting the difference and just meeting on August 2<sup>nd</sup> and then mid-month again in September.

A quick summary of last week's meeting: (please comment if anyone catches any errors)

1/ Jeff & Enzo outlined potential strategies to publish non-test MOCs. The best is for the FAA to do a 'quick' update to AC 25-17A to add more non-test MOCs to those that already exist. They have a faster track update system for smaller changes to ACs such as this. Next, EASA can reference the updated AC in their AMC that already references AC25-17A.

2/ In the mean-time any agreed upon MOCs could be addressed in a FAA cert plan for use prior to the official AC update.

3/ The task group is charged with preparing a revision controlled report presenting the proposed MOCs, data/ rationale. We must also consider if there is any limit/impacts of applying 'too many' MOCs to be valid. I.e., are there any MOCs that should not be combined?

4/ The task group will then submit the report to the FAA (Jeff & Policy Standards rep) and to EASA (Enzo) for comment.

5/ Once finalized, the task group will be notified the status of the proposed MOCs.

6/ Our proposed chp 10 (fire test handbook) update has gone through reviews at the FAA and EASA and should be good to be published. Tim Marker noted that there is so much that changed that they likely won't publish a 'red line' copy, but that industry will still have time to comment after incorporation to the Fire Test Handbook website.

Our meeting on August 2<sup>nd</sup> will be to formalize our position of which MOCs are ready to submit for consideration. MOCs 1, 2 & 3 are already in the AC. Please review and be prepared to discuss which MOCs are ready for inclusion. Many of our items are design requirements to achieve similarity.

J. Davis: the MOCs if the regulators like them, is that going to be a modification of the existing AC, or is it going to be a new AC? J. Gardlin: It is possible to do limited changes to an AC. It would be a small limited change to one section of the AC.

Cargo Smoke Detection Task Group Report – Matt Karp (matthew.karp@faa.gov)

During the Cargo Smoke Detection Task Group meeting, attendees from various organizations were introduced. The discussions began with the review of the horizontal smoke transport investigation, which aimed to determine the speed and total amount of smoke produced. It was concluded that the benefit of characterizing horizontal smoke was not justified.

The meeting then moved on to introduce a newly developed experimental setup and computational simulation model for conducting vertical velocity tests. These methods were designed to accurately determine the vertical velocity of smoke. Furthermore, the attendees discussed an existing method that utilized a small-scale chimney cone to measure the volumetric flow rate and its vertical velocity. To establish correlations between small-scale and large-scale tests, chimney cone tests were conducted, revealing that higher heater wattage increased the volumetric flow rate and decreased detection time in large-scale scenarios.

A comparison between Siemens and Concept Smoke Aviator UL smoke generators was presented, highlighting their design differences. The discussion emphasized the quicker emission of smoke by the Siemens generator due to a deflection plate and the pulsed smoke generation. The development of a Smoke Generator Standardization Handbook was addressed. An open discussion covered various points to be included in the handbook, such as particle size, continuous versus intermittent smoke generation, and steady-state light obscuration. Attendees expressed the need for smoke generator manufacturers to specify the range of particle sizes emitted, as well as the importance of scientific analysis and independent laboratory testing. The preference for continuous smoke generation was voiced, and the consideration of ventilation for mixing the smoke and flexibility in chamber size specifications for steady-state light obscuration measurements was discussed.

The attendees shared their insights and findings, emphasizing the need for comprehensive guidelines and specifications in the Smoke Generator Standardization Handbook. The usefulness of the handbook for airframe manufacturers was acknowledged. The meeting concluded with plans to further elaborate on vertical velocity tests and the inclusion of repeatability criteria in the handbook, with a focus on defining methodologies for ensuring repeatability.

Suggestions for the fall 2023 meeting:

B. Johnson: I thought this was excellent with limited smaller meeting rooms, so I could attend more task group sessions. I prefer less simultaneous task group meetings, so I can attend more than one.

Next Meeting:

October 16-17, 2023 at the William J. Hughes FAA Technical Center.