International Aircraft Materials and Systems Forums Meeting

September 24-26, 2024

Resorts, Atlantic City, New Jersey

Tuesday, September 24, 2024

Dhaval Dadia presented a summary of the research projects underway in the FAA Fire Safety Branch.

VFP Update – Tina Emami (FAATC)

Heat Flux Gradient upon sample: Radiant Heater Review: We learned previously that the current heater design needs improvement. A solution to this issue is a radiant heater that is built upon a required heat output instead of a required build – this will give slight freedom in the design but still hold on certain parameters such as heater body diameter and heated area.

Heat Flux Mapping Upon Sample: Ideal for requirement of the build for the heater, not frequent calibration for the user. Note that the board used for each location has only one slot for the heat flux gauge.

Heat Flux Gradient Testing: 5 machines participated in measuring the heat flux gradient. A newer style heater (manufactured by Concept Equipment) was included in these tests. The participating labs were within the same heat flux.

Heat Flux Gauge Holder: As a result of discussions during previous Task Group meetings, Tina compared two different heat flux gauge holders in the FAATC lab.

Heat Flux Gauge Holder Comparison: One machine, one heat flux gauge, and two heat flux gauge holders were used. Tina explained the test procedure she used. She presented the results of the comparison tests. Consensus of Task Group – this is not a large difference, so it should be fine.

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

Enzo discussed EASA's Plan for Harmonization with the FAA NPRM (Docket No.: FAA-2019-0491; Notice No. 09-09). FAA NPRM published July 3, 2019, and Supplemental SNPRM published on August 16, 2023. Final rule: not yet published. EASA rulemaking plan is outlined in the European Plan for Aviation Safety (EPAS) 2023-2025, published January 13, 2023. EASA will include this rulemaking task in the new EPAS 2026-2028 (to be published in January 2026). Impact of the FAA NPRM was reviewed. Update of CM-CS-001 (Use of the *Aircraft Materials Fire Test Handbook* DOT/FAA/AR-00/12 published September 7, 2011). The CM will be updated to include reference to Chapter 23 (radiant panel test) and Chapter 24 (burnthrough) of the *Handbook*. The revised CM should undergo public comment Q1-2025.

Update of CM-CS-004 (flammability testing of interior materials) was published on October 16, 2013. The CM recommends that design organizations develop their compliance documentation following the guidelines provided by FAA PS-ANM-25.853-01-R2, wherever applicable. In 2017, EASA and the FAA received proposals for the Flammability Standardization Task Group (FSTG) to update existing MOCs and include new items in FAA PS-ANM-25.853-01-R2. The revised CM should undergo public comment in Q1-2025.

EASA Proposed Certification Memorandum on Miscellaneous Flammability Topics: List of addressed topics includes: SAE ARP6199, rev.A and rev. B are an acceptable MOC with Seat HR/SE Special Conditions; magnesium alloy for seats; additive manufacturing; Hierarchy of Testing; and one of the main points is Demonstration of compliance with 2X.853 using similarity based on statistical analysis of available flammability test results. Public consultation in Q1-2025.

HEALTH: New Health Safety Measures in Aircraft: The project will be managed by DLR supported by Airbus and Lufthansa. Project started in September 2024. Project duration: 36 months. Enzo described the objectives of the project including new health safety measures in aircraft; color vision requirements in the new full glass cockpit environment and modern ATCO consoles. The project's main objectives were presented including to investigate the possibilities to further reduce the spread of a series of airborne infectious agents (viruses, bacteria, fungi) within the aircraft environment. To scientifically analyze proven solutions to reduce the spread of airborne infectious agents within the aircraft environment. Outcome: to provide scientific evidence to support regulatory decision making as well as an implementation roadmap for the Agency and Industry. Retrofit solutions will be taken into consideration as well as new aircraft cabin design.

VFP Heater and IR Work – Wilko Oestereich (Airbus)

Wilko reviewed the 2023 Airbus study of its two VFP machines (Marlin Engineering, Deatak). Airbus proposed tightening the specifications in the Handbook: tolerances, window positions, harmonization of HF gauge fitting.

Heat Flux Mapping: the methodology used for these tests was reviewed. The test results were presented. The main outcomes were discussed.

Temperature Mapping: The methodology used was described. Results of these tests were presented. The main outcomes were discussed.

Influence of Heater Shape: The methodology used was described. Four different heaters of different shapes are used in these tests. Results of tests were presented, and the main outcomes were discussed. The Next Step: For research purposes, a different type of heater has been procured from Watlow, and the empirical part of the feasibility assessment for using other type of heater is underway, complementing the theoretical analysis.

We will discuss this work more in depth during the VFP Task Group meeting.

HR2 Development TRL-6 – Status Update – Ralph Buoniconti (SABIC) for Brian Johnson (Boeing)

Ralph provided a brief overview of reasons for HR2 Development including reproducibility and repeatability of OSU. HR2 Goal: Define a robust test method to determine peak and total heat release that improves repeatability and reproducibility when compared with OSU. TRL 6 is Reproducibility. Ralph reviewed the approach, instruments tested, and the future testing plan including testing with a Deatak HR2 and Marlin HR2. The data test log was presented. Boeing TRL 6 – Statistics were presented. TRL 6 – Data Comparison – Schneller Panel statistics were presented.
TRL 7 is the next step. Sample collections have started. Test 10 coupons each on 1 – OSU

(‘golden unit’) and 1 – HR2 unit. A summary of the work completed, and next steps were presented.

HR2 Heat Transfer Model – Rich Lyon (FAATC)

Rich provided the background for this work and the HR2 Standard Operation according to the Fire Test Handbook. Problem Statement: the standard procedure with static methane calibration doesn’t tell us anything about how the dynamics of the HR2 affect the HRR results. Rich explained how the HR2 Heat Transfer Model works. The equations of the model were explained. See Rich’s presentation for the equations. Conclusions: Position of heat sources (globars, pilots, sample) and sinks (sample fixture) in HR2 determine how much heat will be lost to apparatus and the value of K_{auto} and K_h used to measure HRR.

New Burning Behavior Identification Approach Using Computer Vision –

Ahmed Ben Sidhom (Rowan University)

Problem: The flammability tests results and classification of the FAA agent rely on an analysis based on estimation, exposed to human error and lack standard measurement. Ahmed provided the background for this work. He described Computer Vision Based Fire Detection. Two FAA flammability tests were part of this study RTCA Box Test and FAA Vertical Flame Propagation Test (VFP). Ahmed explained the approach. Feature extraction: Object Detection was explained. He explained the image processing. VFP Results for carbon fiber sample were presented. Ahmed described the data Clustering: K-means and the Clustering Results. Next Steps: Classification: Binary Classification and Multi Class Classification (classification to identify the burned materials). Future Work and other test methods that will be studied. R. Lyon: Is there any comparison of your approach to actual measured VFP burn length? A. Sidhom: Yes. He referred to the graphs on Slide 10. Rich Walters explained that there was a limited data set for this initial work. S. Campbell: What did you measure as burn length? A. Sidhom: How long the duration of the burning was.

Measuring the Fire Growth Potential of a Combustible Solid in the Cone Calorimeter* – Rich Lyon (FAATC)

*DOT/FAA/TC-INT-24/1, August 2024 (FAA Report)

Objective: Determine the full-scale fire hazard of combustible material from a single cone calorimeter experiment. Hypothesis: Fire Growth of a combustible solid is a continuous and coupled process of ignition and burning. Approach: parameterize cone test data; define physically-based fire growth parameters; and compare fire growth parameters to fire test results.

The cone calorimeter was explained. Rich explained the metrology and presented graphs for several materials. Rich explained the equations used to Calculate Fire Growth Potential, Product of Fire Hazard, Material Fire Hazard. Conclusions: The potential of a product to be a fire hazard is only realized if the total heat released by the burning product (fie load) is sufficient to sustain the fire. R. Walters: I saw there was a lot of variation in your data. R. Lyon: I know, I noticed that, too. I didn’t understand it, and I still don’t.

The Impact of Material Composition on Burning Behavior and Fire Growth: Full-Scale Experiments for Fire Model Validation- Isaac Leventon (National Institute of Standards and Technology)

Isaac provided the background of this project. Development of the capabilities (experimental and computational analysis tools) needed to enable quantitative prediction of material and product flammability behavior (e.g.: ignition, fire growth rate). NIST Materials Flammability Database: We are building up the information to support the database. Three core parts of this database are material property measurements, fire model validation, and fire modeling. Do these parameters predict fire growth? Full-Scale Fire Growth in Electrical Cabinets in collaboration with the United States Nuclear Regulatory Commission (U.S. NRC). Flame spread tests for fire model validation design, instrumentation and experimental results were presented. Heat Release Rate (HRR) results for the materials used were presented. Correlation: Bench-Scale Fire Growth Parameter vs. Full-Scale Fire Growth Rate was presented. Summary of Measurement Results: Support a more realistic assessment of fire's growth behavior and the overall impact of material composition on key burning behaviors of interest to fire safety scientists and engineers. Comprehensive set of validation data for computational fluid dynamics (CFD) simulations of large-scale fire growth due to the flame spread over the surface of combustible solids. R. Lyon: On one of my graphs, product fire hazard of a urethane foam was kind of in the middle. What if you measured something else? I. Leventon: All that is there.

Wednesday, September 25, 2024

Fire Containment Bags for PEDs – Dan Keslar (FAATC)

Work conducted by Dan Keslar and Joe Sica at FAATC.

Background: Portable Electronic Devices (PEDs) containing lithium batteries have the potential to undergo thermal runaway. On average an incident occurs more than once per week in a passenger aircraft. Dan reviewed the FAA PED Firefighting Guidance. If anyone is interested in the guidance videos, they are available on the FAA Fire Safety website at www.fire.tc.faa.gov. FAA Perspective: Manufacturers have developed fire containment bags as a means to store overheating PEDs. The FAA does not support any one manufacturer of these bags. Dan showed a 96-Wh power bank going into thermal runaway. FAATC performed 3 test scenario tests on five products. The 96-Wh power bank and a 154 WH battery. Dan described each of the five Fire Containment products evaluated by FAATC.

Key Findings from testing:

Key Finding #1: Fire containment products performance varied amongst the different manufacturers: many bags struggled to contain the hazards of PED fires near the maximum allowable limits (100 Wh and 160 Wh).

Dan showed videos of some of the fire containment bags tested with 96 Wh power bank. Many products noted to release a significant amount of smoke/battery gas in the test cell. A lot of these gases are combustible/explosive and toxic.

Key Finding #2: Product performance was noted to be heavily affected by the rate at which cells underwent thermal runaway: many bags were unable to vent gases quickly enough leading to pressure increases and product mechanical failure.

Key Finding #3: The suppression equipment included with some products was: found to be capable of initially knocking down flames; unable to prevent propagation of heat to adjacent cells (continued thermal runaway events).

Conclusions: Airlines may have expectations for product performance, that certain products cannot currently deliver. Test results show that the effectiveness of commercially available fire containment products vary significantly between manufacturers. Use of fire containment products should not substitute for firefighting procedures. Best use for these products may be preemptive and stowage of a PED that has already undergone thermal runaway. Dan shared a photo captured from one of the products tested where flames and shrapnel were ejected 10-15 feet from product during test.

Bradford: There are two manufacturers that have bags on aircraft that I did not see there. Dan: We were originally going to test one bag, but the other four manufacturers reached out to us. The UL5800 Standard is on our radar, and we plan to work with them more closely in the future. Question: Any information on the battery chemistries? Dan: We purchased the batteries and power banks from regular ecommerce sites. We have had internal discussions within the FAA, and we have selected fire containment bags that would need to be updated in the future but there is no timeframe on this. It is something we are looking at. Question: Do you have a list of FAA approved fire containment bags? Dan: The FAA does not approve fire containment bags.

<u>Lithium-ion Batteries packed in Equipment</u> – Dan Keslar

Work conducted by Dan Keslar and Joe Sica at FAATC.

For transportation purposes, lithium batteries are currently categorized by their type (Ion or metal); manner in which they are shipped: stand-alone, packed with equipment, contained in equipment, etc.

ICAO Dangerous Goods Panel Meeting: Lithium-ion batteries packed with equipment required to be at 30% SOC or less, effective January 1, 2026. Lithium-ion batteries contained in equipment recommended to be at 30% SOC or less, effective January 1, 2025.

Project Motivation: Hong Kong Airport (2021). The FAA plans to conduct testing on lithium-ion batteries contained in equipment: testing will be conducted on used devices (phones and tablets), previously utilized as part of the FAA's National Wireless Program (NWP). First shipments consist of phones and tablets – future testing may include laptops.

Test Plan: Goal is to replicate realistic packaging layouts. Tests will progress from small to large scale tests. Three different phases of testing are planned. FAATC is currently doing preliminary testing. Reason: ignition of battery off-gasses is inconsistent and sporadic. Spark ignitors are commonly used in testing to provide consistency – cannot be used in these tests. We are doing preliminary testing now to determine how the following factors impact PED ignition: heating rate and battery SOC.

Summary: The FAA plans on doing testing on lithium batteries packed in equipment. Preliminary tests are ongoing. A. Freiling: You presented in the beginning the SOC for batteries inside equipment, does that mean there is no requirement for the one inside the equipment – small photo on slide 3? D. Keslar: The battery inside the equipment will be required to be at 30% SOC or less. The batteries packed with equipment will be required to be at 30% SOC or less.

UN Battery Classification Test Method Development – Steve Rehn (FAATC)

Work conducted by Steve Rehn and Joe Sica at FAATC.

Informal Working Group (IWG) responsible for creating a hazard-based classification system for batteries and cells. Steve reviewed the current decision tree going into the IWG meeting held at the end of August 2024.

Recent Flammability Testing: FAATC conducted same propagation test 5 times with no ignitor: 4 2.59Wh pouch cells placed in a line. Steve showed a video of these tests. 2 out of 5 tests had self-ignition. Ignition occurred after the 4th cell went into thermal runaway on both of those tests. Batteries like this could potentially lead to a situation where it gets a lower classification because it does not self-ignite in lab testing.

Simplified Decision Tree: FAA Simplified Decision Tree was presented to the UN Dangerous Goods Panel in December 2023.

Conclusion and Future Work: Decision Tree will be simplified. Next IWG is February-March 2025 in Shanghai, China. Test procedures for battery propagation test and gas volume test need more detail – Round Robin for those procedures.

State of Charge Round Robin: FAA has batteries ready to ship out to labs for a state-of-charge round robin. Steve reviewed the plan for this round robin. Participating labs are needed. If anyone in the Forum is willing to participate, please contact Steve Rehn.

SAE G-27 Committee Update – Boeing prepared presentation. S. Rehn (FAA) for B. Johnson (Boeing).

The Committee background was presented. The Committee currently has 4 documents in work: AS6413, AS6413/1, AS6413/2 and AIR 6840. Additional information on each document was presented including test descriptions. The future plans were presented.

SAE G-27 Battery Packaging Testing – Steve Rehn (FAATC)

Work conducted by Steve Rehn, Joe Sica, Matt Karp at FAATC.

Introduction: FAA received 18 test articles of the same configuration as previous round robin. FAATC conducted tests to determine worst-case initiating cell location, and the effect of varying the heating rate within the bounds stated in the AS6413 document. Steve described the AS6413 Initiation Cell Location test setup/requirements. A video of a passing case was shown. Steve explained the Leak Rate Calibration. Steve presented the results of these tests.

Conclusion: Impact of Heating Rates; Effect of Adjacent Cells; Risk of Failure at Actual SOC. Recommendations on Initiation Location and Heating Rate were presented.

Preliminary Detonation Calorimeter Results – R. Walters (FAATC)

Objective: Characterize the fire & toxicity hazards of lithium-ion and other battery chemistries on aircraft. Rich explained the methods of Forced Thermal Runaway he used in testing. Rich explained what the Detonation Calorimeter measures. DC Test Evaluation & Calibrations: Rich described Test setups, heater calibration, battery simulator, and the calculations/corrections. He described some of the calibrations he went through. Calibration – 18650 Simulator: 8 of 10 calibration runs so far. Different masses to get average from multiple temperatures.

Preliminary Battery Data – Battery Energies: 18650 Data was presented. Results of 3 18650 Cells were presented.

Preliminary Gas Analysis – Ion Chromatography (IC): IC was used to see what acids & other ions were generated during thermal runaway. We were primarily interested in F-ion Evaluations: Indicative of HF. It can destroy equipment. Ion Chromatograms from 18650 Cells were presented and explained. Battery Gas Analysis: Gas Chromatograph: separates gas/liquid mixtures into individual components. Rich explained how gas chromatograph and Mass Spectrometer work. Several replicate measurements were done, and gas composition changed over time. Data from the tests was presented.

Research Progress: Detonation Calorimeter battery test method developed & standardized – forced thermal runaway. Characterized Detonation Calorimeter for thermal mass…Future Work was described.

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

PED Battery Fire on the Flight Deck: Continuing Airworthiness (CAW) activities and Initial Airworthiness (IAW) activities were reviewed. EASA will release a Certification Memorandum to communicate all the IAW and CAW activities performed since the release of CARI 25-09. The minimum content of the CM was reviewed. CARI 25-09: Main Findings: Unambiguous information on safe stowage locations available on the flight deck should be provided to operators through placards and training material. Donning gloves is essential to safely handle PEDs. Use of fire containment bags not acceptable for fire fighting. Fire Containment Bags may be used as PED stowage facilities if adequate fire containment performance is demonstrated. Fire Containment Bags: May be used by TC holders as stowage means on the flight deck if adequate performance is demonstrated. Fire containment should be demonstrated against a standard test method (e.g.: UL5800). UL5800 needs improvement. Relocation of FCB to another compartment is essential to address smoke released by the PED during the thermal runaway event. Fire containment performance significantly depends on the strict application of the instructions for closure of the bag.

Considerations on UL5800: EASA has two main points of concern on this: Lack of definition of the configuration of the artificial battery fire source and how to achieve airtightness of the box. Next Steps: Release CM on PED battery fire on the flight deck. Make progress in the definition of a standard for FCBs addressing PEDs handling and battery fire containment: on-going EASA research project LOKI-PED. Revision of UL5800. Definition of MPS for fire gloves.

LOKI-PED: Started in August 2022 and will end in July 2025.

LOKI-PED: Lithium Batteries Fire/Smoke Risks in Cabin. Objective: Characterize of 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. The Experimental Approach used at Fraunhofer EMI was described. Scenarios for PED Fire in Single Aisle Cabin tests were described. A320 mockup test videos were shown. Full-scale Cabin Test set-up was presented including ventilation flow pattern and occupancy (heated test dummies). PEDs to be tested: 24 refurbished laptops. Testing of cool down capabilities of extinguishers was presented. Three different extinguishers have been tested. U.S. and European manufacturers. 8 Containment Bags have been tested from U.S.

and European manufacturers. Enzo reviewed the observations/results of these tests. Question: For the fire extinguishers, it was extinguishers sold with the bags? E. Canari: One was with the bag, and one was for use with battery fires.

Cargo Research Area Updates – Dhaval Dadia (FAATC)

Cargo Halon MPS – New test method MFF (Multiple fuel fire scenario) has been added to the MPS. The report should be published by the end of FY2025.

HFC Replacement Task Group: Task Group meeting on 9/26/24. Focus: refrigerants used in cabin. Replacements may be flammable.

Smoke Generator Task Group: Dr. André Freiling (Airbus) is now chairing the Task Group. It met on 9/25/24.

SAE AGE-2: Battery Fire Working Group establishing a battery fire standard for Fire Resistant Containers (FRCs). Currently establishing a standard with 600 cells. Discussions involve: SOC, manufacturer of cells, and configuration of the setup.

Battery Fire Simulator: FAATC is conducting research to develop a simulator that will replace the physical testing of lithium-ion cells in standardized tests. FAATC has conducted tests to determine rate of vent gas generation from lithium-ion cells in thermal runaway.

EASA AirPED Research Project (AirPED) – Enzo Canari (EASA)

Focus: Lithium battery fires in cargo compartments: PEDs in checked baggage and bulk shipment of lithium batteries. Report to be published in Q4 2024. Objectives of AirPED were discussed. One of the objectives was to test a replacement agent in the chamber. The test chamber is located at DLR in Trauen, Germany. The test scenarios were described. Scenario 4: ULD container has been cancelled. Scenario 5: multiple fuel fire scenario. Scenario 6: Halon Replacement – only MFF with nitrogen due to time constraints. Scenario 7: Involvement of a bulk shipment …is cancelled. June 2024: testing activities restarted at DLR. Enzo presented the Baggage Calibration test setup. 6 calibration tests have been performed. Aerosol can testing in the MPS chamber resulted in an explosion that damaged the chamber door. Enzo showed photos from the unsuppressed MFF test and post-test inspection of the battery cells tested. Enzo reviewed the MFF test results. The Project Status was reviewed.

International Coordinating Council of Aerospace Industries Association (ICCAIA) Cargo Compartment Halon Replacement Advisory Group (CCHRAG) Status –

Dr. André Freiling (Airbus)

André reviewed the group membership and organizational content and background for this work. Going beyond CCHRAG: HAC^3 Halon Alternatives Collaboration for Cargo Compartments was formed so members could share more than publicly available knowledge – an agreement was signed – open to new members. Agenda Item 31: Aviation Safety and Air Navigation Standardization – ICAO A41 WP 2022. ICAO Conclusion on WP96: 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.

Halon Replacement- Global environmental Footprint Impact Assessment – Dr. André Freiling (Airbus)

Review of Halon impact and work to find suitable Halon replacements. Removing Halon 1301 from Airbus fleet would void emitting around 250 metric tons of CFC-11 eq. every year and increase emissions of around 600,000 metric tons of CO2/10 kg of TriFluoroacetic Acid (TFA) every year. ECHA (European Chemical Agency) issued Feb 2023 a regulation proposal on Per- and polyfluoroalkyl (PFAS). The ICCAIA CCHRAG is now tasking how we want to proceed based on this. T. Cortina: On the PFAS issue, it impacts so many other things in the aviation industry beyond fire. Does this ever make it to the top of Airbus or others where they are concerned with other areas as well as fire concerns? A. Freiling: You are absolutely right. We have a whole department in Airbus that deals with these substance problematics.

Hydrogen Fire and Explosion Task Groups Update – Enzo Canari (EASA)

April 2024: Task Groups established. Intent: Maintain the same level of safety achieved by circa 70 years of fire/explosion regulatory evolutions for large airplane commercial transport – H2 presence shall not degrade this achieved level. Structure of the four Task Groups was reviewed. Status: Powerplant Task Groups: formed into one Task Group has held 14+ meetings to date. It has developed a spreadsheet with gap analysis. Cabin Safety/In-flight Task Group: has held 6 meeting to date. Cabin Safety/Post-Crash Task Group: change of Co-chair in June 2024. Decision to merge with In-Flight Fire Task Group in September 2024. Task Groups Future Steps: Consolidate accumulated material; finalize the content of the working files; develop a research subjects list; and define ranking of priority between the research subjects. Future Steps: Release the draft research plan in December 2024: introduction and explanation on the work methodology; research subjects list; recommendations for high priority research subjects; and working files as appendices. Enzo reviewed top level priority subjects as identified by the Cabin Safety Hydrogen Fire & Explosion Task Group during their meeting on September 23, 2024. Powerplant Task Group top level priority subjects for research were also reviewed. If anyone who participates in these Forums has any information that may be helpful to us, please let us know.

FAA Propulsion AC 20-135 Revision A Status – Phil Dang (FAA)

Purpose and Objective: To address wide variations in fire test methodologies, fire test pass/fail criteria, and to introduce FAA Sonic (NexGen) burner. SAE A-22 industry committee launched May 2018 including certification authorities. Initial Objective: develop and publish the AS6826 Powerplant Fire Test Standards document. AC 20-135 Revision A: target release for public comments about 12 months after AS6826 publication. Maintains Paragraph 8 Engine Case Burn-through (future update after publication of SAE ARP8704). Other FAA and SAE A-22 guidance materials was reviewed. Phil reviewed various work-in-progress SAE A-22 documents. Future AC 20-135 related guidance materials: CATA 25.1103(b)(2) under review by CATA team. Draft AC25.1191 under review by FAA before public release. B. Stewart: You mentioned the update coming out based on the AS6826, but you also mentioned Phil Haberlen's update on combustive burn-through – are you going to try to push it or are you going to multiple revisions to the AC? Phil D.: I will have to talk to Phil Haberlen about that.

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

John provided overview of the SAE A-22 Committee Groups: AS 6826, ARP 6828, AS 4273, ARP 8704, ARP 8580, ARP 8998, and AIR 8635. Future efforts: Sonic Burner, Emerging Technologies. AS 6826 Powerplant Fire Test Standard: pending successful 3rd ballot, will publish in late 2024. ARP 8704 Minimizing the Hazards of Engine Combustor Case Burn-through: Anticipate publication in 2025. John provided details on AS 6826 Significant Changes from AC 20-135 Change 1. T. Mallon: Has anybody successfully used the 1/16? are they in fact susceptible to failure? I wasn't planning on using them in our lab unless a customer requests them. J. Ostic: Our experience so far has been okay, but we do buy a lot of thermocouples. We switched to them about two years ago.

Powerplant Halon Replacement – Doug Ingerson (FAATC)

Doug provided a brief history on NaHCO3/KSA. 2023-current: MPSHRe/rev04 generic & full-scale/fire demonstration testing: generic testing.

Results for high-vent spray fire and high-vent pool fire tests were presented. Status: We have moved out to the aircraft engine onsite for testing.

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

SAE A-22 Powerplant Fire Testing review of EASA planned/related activities. Create (*) AMC 20-135: Multi-product applicability. 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): once adopted by CATA will be published on the EASA website. CATA – CWI FAA-xxx Definition of APU air inlet system boundary and fireproof compliance showings 25.1103(b)(2). VTOL activities: no change. Electrical & Hybrid propulsion (EHPS): EASA Special Condition SC E-19 released issue 1 on April 13, 2021.

EASA Certification Roadmap on H2 – International Workshop 2024: by invitation, on December 17, 2024, at EASA in Cologne, Germany (on-site only/in-person only).

Additional Discussion – Dhaval Dadia (FAATC)

Many thanks to Jeff Gardlin for his many years of dedicated work. Enjoy your retirement.

<u>Task Group Meeting Reports</u>:

<u>Radiant Panel Task Group Meeting Summary</u>

Steve Rehn (FAA), Task Group Lead, Steven.rehn@faa.gov

1. This was the first radiant panel task group meeting since June 2020. Steve went over the most recent presentation, which was Radiant Panel Insulation Test Update from June 2019
    a. Electric Panel aging testing – what causes panels to age?
        i. Panels run hotter with age and potentially leads to more failures.
    b. Emissivity measurements of used panels didn't correlate with wear and tear in panel paint.
    c. Backing board study
        i. Certain materials (foam) would melt and stick to the backing board affecting the following tests.
        ii. Three backing boards tested.
            1. Superwool 607
            2. Fermacell Gypsum Fibreboard Greenline
            3. JM Super Firetemp M
        iii. Most samples passed for flame propagation – not necessarily for after flame time.
        iv. Superwool and Firetemp failed more foam samples than Fermacell – as they provided more insulation – their purpose is to provide insulation and not pull heat away from the test sample.
2. One participant performed tests on the effects of preheating of backing boards placed under the test sample.
    a. Heated and room temperature backing boards may produce different results.
    b. Participant said he will send a data set from previously performed tests that show difference between hot/cold test samples.
    c. Need further clarification on procedures for what to do in that regard – need consistency.
    d. The handbook does not say whether to keep using the same backing boards or change them between each test.
    e. In the creation of this test method, the FAA never changed out the backing boards between tests – their standard procedure used the same backing board for all samples.
    f. Airbus test method states that cold boards should be used for every sample for maintaining consistency – however samples are probably more likely to pass when using cold insulation boards.
    g. Fermacell may have stopped producing their gypsum fibreboard, so European companies are looking for an alternative – some samples that have already passed using Fermacell are already on aircraft but may fail using different insulation materials.
    h. Task group participant asked if FAA could work with them to approve new material since Fermacell is no longer in production.
    i. FAA could potentially perform a study to determine difference between a hot/cold insultation backing boards.
        i. It needs to be standardized either way (hot/cold)
3. The panel has a correct orientation, but it is not written down in handbook how to position it.

    a. Emitter strips are ordered from most powerful on the bottom to least powerful on the top.
    b. Handbook should be updated to explain this.
4. Borderline material for testing – one participant said they could possibly provide that material or let know Tech Center where to get that material.
5. Another participant mentioned that they used a new burner tip made of ruby – it has made their pilot burner flame more consistent.
6. Task group participants want to keep the radiant panel insulation task group going in future IAMFTF meetings.

Additive Manufacturing Task Group Meeting Summary

Dan Keslar (FAA), Task Group Lead, Daniel.keslar@faa.gov

The task group meeting began by reviewing key points discussed at the previous task group meeting in Bremen, Germany. Recent Additive Manufacturing (AM) research published by the FAA in December 2023 was briefly discussed.

Moreover, the group discussed changes that were made to the Transport Airplane Issues List (TAIL) relating to AM in June 2024. As previously established, coordination with the FAA's Policy and Standards Division, Cabin Safety section (AIR-624) is required to determine if a method of compliance issue paper is need for AM parts that must meet part 25 flammability. Due to extensive testing performed by the FAA, parts constructed with ULTEM 9085 must still demonstrate compliance with flammability requirements, but do not need special coordination with AIR-624. The task group in Bremen had asked if other fire-resistant materials could be included within this exception.

Since the previous task group meeting, the FAA had updated the TAIL to include the request above. If a material can produce a Fire Growth Capacity (FGC) less than 70 J/gk in a microscale combustion calorimeter test, then a method of compliance issue paper is not needed. This update was discussed during the meeting.

An open discussion was then held in which several secondary discussion points were brought up. The group expressed interest in receiving flammability data for other types of Additive Manufacturing. Several labs conveyed interest in potentially collaborating with the FAA to achieve this endeavor.

Cargo Compartment Smoke Detection Task Group Report

Dr. André Freiling (Airbus), Task Group Lead, andre.freiling@airbus.com

Initial Agenda:
- short recap of André's presentation at IASFPF May 2023 (André)
- short recap of Matt's (André Co-Author) paper for AUBE (André) 2021
- presentation of AUBE paper 2024 (André)
- presentation of test for confirmation / improvement of steady state and vertical smoke velocity (André)
- proposal for vertical velocity test method (André)
- Discussion on way forward
- Schedule elaboration
- Extension to other applications than lower deck cargo compartments

Recall of the Objective of the Group:
The goal is to

- create a standardized international approach for qualification of smoke generators, particularly in the context of fire detection systems in aircraft
- develop a reliable qualification method that ensures that results tests are reproducible and consistent across different devices and manufacturers
- update certification guidance, such as those in Advisory Circular AC 25-9A from 1994.

Executive Summary

We have made remarkable strides in our work, but we must not lose momentum. The upcoming months will be critical as we finalize the handbook, continue our research, and hold key discussions on compartment sizes and calibration methods. By maintaining our commitment to these tasks, we will create a lasting, international standard that will elevate. fire safety across all types of aircraft.

Let’s continue to push forward, knowing that the work we do here will have far-reaching impacts on the safety of countless passengers and crew members. The standardization efforts we are leading will simplify the certification process, ensuring consistency and reliability in smoke detection systems worldwide.

Thank you for your dedication and valuable contributions to this project. Together, we are on the verge of accomplishing something truly significant. Let’s keep the momentum strong and continue working toward our shared goal of creating a safer aviation industry.

Historical Context:

The discussion references previous presentations, including one given in May 2023 (IASFPF, André Freiling) and a previous milestone in 2021 (AUBE, Matt Karp).

These presentations reviewed past achievements and the current status of the smoke testing methods being used in aircraft, particularly with two main types of smoke generators (Siemens and Concept). Technical differences in the chimney layout were presented by André.

Technical Differences Between Generators:

Two main types of smoke generators were discussed:

- Siemens smoke generator, which uses a deflection plate for upward smoke direction.
- Concept smoke generator, which has a different configuration with heating elements and a drip prevention mechanism for evaporating paraffin.

The design differences between these generators lead to different behaviors in smoke output and necessitate careful matching of test setups to ensure consistency.

Challenges in Testing:

The group encountered challenges in achieving consistent and standardized measurements of smoke due to variations in smoke distribution, particularly in horizontal smoke movement. It was noted that a previous test setup, which used a cone placed on top of the smoke generator to measure the airflow and smoke movement, influenced the results. Especially the power consumption and the temperature of the heaters were altered when using the cone. This could lead to undue results during the qualification process which are not representative for the use of the smoke generator.

Repeatability Testing

Tests were conducted in an EN 54 fire test room with a Siemens smoke generator. Multiple tests (20 identical ones) were run to observe variability in smoke emissions. Some outliers were noted, but in general, the approach to conducting multiple tests and calculating a mean value was validated.

Steady State Light Obscuration Procedure

Concerns were raised about whether the smoke properly mixes in the test chamber, potentially leading to inconsistent measurements in certain areas of the chamber. This issue was addressed by adding a mixing fan, but the fan was found unnecessary because the results remained consistent with or without it.

Smoke Generator Settings

The group has worked to match the performance of these two smoke generators in a standardized environment. Initial tests suggest that the generators can be aligned in terms of their output when placed in standardized test conditions (e.g., in the fire test lab at the University of Duisburg). However, the settings would have to be fixed and agreed upon.

Challenges in Smoke Emission Patterns:

Siemens smoke generators showed periodic emissions (intervals of smoke and pauses), which is a historical design issue.

Key Findings from Testing to date:

The research showed that the methodology for measuring steady-state emissions was effective and consistent.

The scaling of test chamber sizes (from FAA's standard to a smaller chamber used in University research) showed comparable results, confirming that the testing setup can be adapted across different scales without compromising accuracy. However, the test chamber

Upward Flow and Measurement Device:

One major area of investigation was the influence of adding a cone on top of the smoke generator to measure upward airflow.

It was discovered that placing the cone caused a higher temperature and lower power consumption in the generator, indicating an influence that could interfere with accurate qualification.

The group considered alternatives, including using a wire mesh sensor or air capture hood (commonly used in ventilation systems) to better capture flow rates without disrupting the natural airflow (less intrusive measurement method).

Research also involves using laser Doppler anemometry for precise velocity measurements of smoke particles. This technique offers highly localized and accurate data on smoke flow, providing valuable insights for validating the testing methods.

Future Research Directions:

The team is leaning toward using a commercial air capture hood or similar device, which is less intrusive, more reproducible, and commercially available off-the-shelf.

More detailed tests and campaigns will be conducted to refine these methods and finalize their inclusion in the standardization process.

Addressing Compartment Size Variability:

The group will continue to explore how best to account for different compartment sizes, possibly by focusing on geometric characteristics like the height of the compartment rather than its total volume. By doing this, we can ensure that the smoke generators are tested under conditions that reflect their real-world use cases.

Next Steps:

We will hold regular online meetings, **beginning with one dedicated to compartment sizes** in the next month.

Finalizing the Handbook: **Incorporate feedback and finalize the document**, aiming for a review meeting in the coming months.

Continued Research: Our ongoing research into smoke generator calibration and test setups will continue, with **results expected in the next quarter**.

Waste Compartment Fire Containment Task Group Report

Scott Campbell, Task Group Lead, scott.campbell@safrangroup.com

The waste compartment fire containment task group (WCFC) met and discussed the following resulting in a very productive meeting:

- Recently submitted similarity MOCs (from our task group Excel spreadsheet),
- Proposed additional improvements to Chapter 10 of Fire Test Handbook (Test Procedure).
- Disposition of several more of the Boeing comments to the existing RED Lined version of Chapter 10.

Next virtual meeting is being planned Wednesday October 23rd. Thank you for all who participated!!

HFC Replacement Task Group

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

Thank you to all who participated in the HFC Refrigeration Task Group Forum meeting. I apologize for those trying to call into the Teams Meeting and were not allowed in. Not sure why this occurred or why not notified to permit your access.

<u>9/25/2024 Meeting Summary</u>:

After a quick overview of what the task group had discussed over the last year and a revisit of our mission statement, the meeting focused on identifying CFR/CS 25.863 means of compliance test strategies for A2L refrigerants, namely R-1234yf. Some participants foresee HFO-1234yf refrigerant usage short-lived as PFAS restrictions may obsolete the product. With that knowledge participants suggest usage of “natural refrigerants” (i.e. -isobutane) as viable.

The task group consensus is aerospace specific testing should occur even though substantial R-1234yf test data is available from SAE for automotive usage, and A3 type refrigerant usage from UL/IEC data for the residential air conditioning/refrigeration systems. Kyle Palmer recommended review of the Refrigerant System Charge Limit Compliant Path (Figure 7-1, 7-2) decision tree provided in ASHRAE 15 Safety Standard for Refrigeration Systems. With the usage of R-1234yf in the airplane environment it is unlikely a competent ignition exists, narrow flammability limits minimize risk of ignition, and has a slow laminar flame speed.

Boeing participants will investigate if an existing lab flammability test facility could be used in support of our MoC development.

April Horner did a superb job of transcribing the meeting conversation, see the following recorded notes:

<u>CFR/CS 25.863 MoC Strategy for HFO-1234yf</u>:

K. Palmer: Looking our 1234yf, I was recommended by Paul Papas to look at some of the guidance materials from the past. There has been extensive work that looked into A2L in the past. There are a few documents I think could be useful as well as the UL Standard. There are two standards that seem relevant ASHRAE Standard 15 and ASHRAE Standard 34. In

ASHRAE Standard 15, there is an excellent REFR flowchart. If we apply this approach to airplane testing, thinking primarily of the 787-cooling unit. Let's say we need to up the amount of pounds, if it is self-contained in a commercial occupancy, we say no it is not in a commercial occupancy. This is my interpretation of these Standards. Kyle outlined his conclusions after reviewing these Standards. With some testing, we may be able to present our results to the FAA to show we are in compliance. E. Kvietkus: There is no clear direct answer on what would or wouldn't be compliant. We have talked about other things including where the airflow goes – and maybe a meter instead of a fan. K. Palmer: This is for the SCU not for the refrigeration unit. The argument there is where the condensing airflow is going. E. Kvietkus: There is some more nuance we can discuss later. K. Palmer: Using this as an example, I think what we need to do is instead of trying to show that we are in CFR requirements, we might need to propose some supplemental rules or changes with the same information that was applied. I think we might need to ask the FAA to consider that. G. McEachen: The requirement is vague in that it says we need to minimize that. It has been a real struggle to figure out how to get this conversation started. Comment: From our experience with 1234yf, is there any ignition source within any space in the airplane that could ignite the refrigerant when it is released? The refrigerant when it is released, it will go to the lower part of the volume. W. Stoelting: Is there a way forward with analysis? Is there testing that will be required every time? Are there ratios that can be examined and tested and recorded that we could all refer to that available data? P. Papas: If we go with deferring to ASHRAE Standards, a key point is that this compliance route is helpful for A2L. If you have very small charge systems, then even if you have a rupture, you only have a small amount that gets out. D. Dadia: Is there a possibility that if the refrigerant leaked, would you have an ignition problem at a later time? Was there any information collected on when the refrigerant collected in a confined space? P. Papas: We have done tests like that as well. D. Dadia: I wanted to see if the refrigerant was allowed to leak into the confined space and the ignition source was activated at a later time. P. Papas: Yes.

W. Stoelting: Does focusing on our approach for the A2L seem like an appropriate first step in moving forward? T. Trümper: I think this A2L could work for a drop in refrigerant for current designs. Maybe for new developments, we may have to look at natural refrigerants like propane or CO_2. K. Palmer: That is an excellent point. I think that is something we should be discussing as well. Going with an A3 refrigerant like propane, it is using an A3 refrigerant for a condensed occupancy that will require additional safety equipment. T. Trümper: Maybe also think about the energy. P. Papas: There is a low charge limit that in the U.S. I think is 150g. On an airplane, I think that would be very problematic. For small charge, maybe there is some type of certification testing that you could do. W. Stoelting: I understand when we move to new equipment that we have an opportunity to design for a particular refrigerant. My initial concern is for the airplanes going out the door currently. There was mentioned that our focus should be on the empirical and demonstrated testing. Is testing that has been done in other industries adequate or does it require testing that is specific to our aerospace application? K. Palmer: I think it may depend on the application. Maybe that is something we would need a review for. 1234yf has caught the interest of the automotive industry. If there is publicly available information, I think that could be sufficient for flammability. W. Stoelting: Do FAA or EASA or Boeing fire marshals agree with those last statements? J. Gardlin: In the absence of a better proposal, it seems like a decent approach. E. Canari: What you have been presenting today makes sense and seems like you are going in the right direction. W. Stoelting: What would be a proposal for review? Provide an example? E. Canari: I think that would be a great idea. If we could take a look at an example of a use for aviation for compliance. W. Stoelting: For our next steps, maybe Collins and Boeing will work together to put together a proposed example for review? K. Palmer: I don't think we discussed that yet. Nels, you put a link to an article in the Chat, thank you for showing that. P. Papas: We can point to some literature of the testing of 1234yf mixed with oils, etc. G. McEachen: I am curious because a lot of you are much more aware of the data than I am, I know there has been flammability testing and that 1234yf require significant additional energy to ignite, so unless some other open flame is available, it is not going to ignite. Is the data there, or would there be some other generic test needed with a refrigerant or refrigerant and oil mix? K. Palmer: I think there has been literature data testing of similar scenarios. It may be good to run a demonstrator test within the requirement. A. Chattaway: I'd second that suggestion, Kyle. I'll see if I can dig out some videos the military has conducted on 1234yf for the next Task Group meeting if you think that is a good idea. N. Olson: It's exactly why I dropped that paper into the Chat. Since 2015 or so, there have been hundreds of papers describing mixtures of the various refrigerants. There's a plethora of papers/data on that subject. I am making a bibliography of those for various different projects here at Boeing. I can make that available if anyone in the Task Group wants to see it. Is it everybody's impression that they are turning off our access to the carbon fluoride bond materials and understand the challenges for our industry? K. Palmer: I wonder if there is a compromise. What if we pick compounds that minimize TFA molar yield? There are other alternatives within the A1, A2 category. A. Chattaway: What I've seen in some of these side presentations in some of the UN meetings, there is a very enthusiastic anti-PFAS, pro-environment sentiment. I think something with a low molar yield will not pass based on what I've observed in these UN meetings. D. Dadia: Even if they make exceptions, if the industry gets an exception but the industry is small enough, the manufacturer may not want to make it. E. Canari: My advice is to keep on working on method of compliance. Let's see if we can find a solution. Other actions can be running parallel but not in this group.

Wade's Summary: Next Steps:

Provide an example showing of compliance with A2L (i.e.: R-1234yf).

Use existing facilities for performing testing, more representative of our aerospace application.

Perhaps Boeing/Collins propose testing. George: I'm positive that the Boeing and Collins team will want to regroup to come up with more on the proposed testing. Maybe Kyle and Eric can work on that. E. Kvietkus: That sounds good.

Consider small charge A3s.

Do we stay with GWP or PFAS or flammability issue?

Vertical Flame Propagation Task Group Summary

Tina Emami (FAA), Task Group Lead, tina.emami@faa.gov

September 24, 2024

- The task group session began with a review and discussion lead by Thomas Krause and Juan Hidalgo Medina (Airbus) on the work that they have been performing on the heat flux mapping of the radiant heat in the Vertical Flame Propagation Method. This was also presented by Wilko Oestereich during the main meeting. This work was done on a theoretical approach to determining tolerances on the heat flux values as well as measuring the radiant heat using an

IR camera and painted aluminum plates. They saw slight variation between the repeatability of the different heaters that they measured. They also reviewed the different theoretical heat outputs of different heater shapes (round or rectangular) although found that the different shaped heaters would produce different heat imprints upon the horizontal axis.

- The task group members also mentioned their concern with the heaters they have failing. The idea with the heat flux gradient is to make room for better heaters to be utilized for this test method.
- A presentation was given after this by Tina Emami (FAA) on a summary of the data taken the past few years to present a new pass-fail criteria of 5 inches burn length. Further research was explained alongside the Fire Growth Capacity work as well as the Full-Scale Fire Hazard work done by Rich Lyon to display not only the reasoning behind the burn length values but also the importance of after flame time in distinguishing a flammable vs non-flammable material. This led to a final pass-fail criteria presented of 5 inches burn length and 30 seconds after flame.
- Data shown in the presentation to the task group saw that duct materials both flat and round have either burned less than 6 seconds or near 100 seconds. 30 seconds is a good barrier to understand if a material is flammable or not.
- Task group members mentioned wanting to do inter-lab testing and testing between the manufactured machines to confirm when looking at pass/fail as well and this is in the future plans.

RTCA Task Group Report

Lindsey Anaya (FAA), Task Group Lead, Lindsey.P.Anaya@faa.gov

Agenda Items:

• Review Presentation from Bremen meeting - Review of Method
• Interlaboratory Study Primer/Update
• Discussion on how to address identified shortfalls.
• Future of Method

After surveying the room, most attendees were new to the task group and did not know the
objective of the task group or details of the proposed alternative test method, so I presented the April 2024 RTCA Update presentation again. Within the presentation I highlighted key shortfalls of the proposed method and asked for feedback.

Shortfalls of Proposed New Test

- Burning an enclosure whole would potentially be **more costly** than individually testing stock components that go into an enclosure.
- Burning an enclosure whole offers **no traceability** to the problematic/flammable component.
- Most avionics PCBs are **already UL94-V0** rated/coated with fire retardant
  - Tested actual avionics PCBs and none of the boards caused flaming outside the enclosure.
- Need to **address** what to do if a component within an **enclosure changes** – retest?
- "Highest Fuel Load" PCB to test can be **highly subjective**.
  - New test allows for **multiple burns** if unsure of highest fuel load/threat
    - Issue: If more than one burn, the other components in the enclosure are subjected to heat/flame – **next sample(s) become tainted**.

Feedback was the following:
What types of electronics does this method include? Many were interested not in the application of this method to LRUs, but to cabin and flight deck electronics.
Participants didn't seem to think that burning an enclosure whole would be more costly. since the resources and number of tests needed would be reduced to just one test (maybe a few more, depending on how many burns are decided – but all using the same unit). There would be no need for test repetitions either.
There was no resolution or comment regarding the traceability of flammable component within equipment, so this can be an outstanding issue for manufacturers.
Participants were agreeable to circuitry and inner components of aircraft electronics already being considered UL94-V0 certified, so most electronic enclosures are expected to pass if this test is used. I had shared that I had a hard time getting flames to exit the enclosure for both real and simulated circuit boards; I only was able to yield flaming outside of the enclosure when I designed an enclosure with approximately 7,000 mm^2 ventilation area in combination with a 5-inch by 5-inch Garolite sample (Garolite is the non-flame retardant version of FR-4 boards commonly used in aircraft electronics). The 7,000mm^2 area was much higher than the 700mm^2 criteria that deemed a box to be ventilated and therefore needing to undergo flammability testing.
Following, there was discussion regarding the newly defined "non-vented" test exception criteria. Current documentation states that an enclosure does not need to be flammability tested if it is non-vented, yet there is no definition of what non-vented means. FAA testing yielded a relation that an enclosure is considered to have no ventilation if the total open area, A (in mm2), is less than 4 times the longest outside dimension, L (in mm), ($A < 4 \times L$)

up to a maximum of 700 mm2. Total open area is any open area on the enclosure that air
can flow through, including but not limited to vent holes and worse-case scenario design tolerance gaps. There seemed to be some confusion on how this was determined. I had showed a draft of the RTCA technical report currently under peer review that explained this
determination and participants requested a copy. A copy of the report will be distributed once it becomes an official FAA report (hopefully by the end of the calendar year).
In terms of what to do if a component within the enclosure changes, depending on the magnitude/scope of the change, the component/board can be tested via traditional means
(FAA Test Handbook Bunsen Burner Methods) added as a supplement to the enclosure line
burner test documentation. If the component change is considered a small part, no additional testing would be required. This would need to be determined on a case-by-case
basis.
The FAA worked with the assumption that manufacturers of the electronics would have specifications regarding what components are on circuit boards so test engineers could estimate the worst-case fuel load with ease. Feedback from participants concluded that most electronic equipment manufacturers and test facility do not know what materials/components make up the electronic so determining the highest fuel load would
be subjective. This is where multiple burns in the same unit may be necessary. Test engineers can burn each board, and if each board passes, the enclosure passes.
The interlaboratory study directions and test materials will be sent out before the end of the
calendar year to the participating labs. More labs are always welcome. Test setup for labs
has taken a bit of time and FAA material fabrication has taken time, hence the delay.
In terms of the future of the method, interlaboratory study test results will influence modifications to the current method and more discussion is required to properly address shortfalls. The draft method will not be published in RTCA DO160H as intended but will continue to be worked on. The FAA is currently exploring ways to best present the draft method (i.e. Fire Safety Website, Fire Test Handbook, etc.) so that interested parties can
participate in the maturation of the method to a point where it becomes an approved, optional, method of compliance by the FAA certification office.
If you would like to join this task group, please email me at lindsey.p.anaya@faa.gov.
All stakeholders are welcome!
I appreciate the increase in interest at this meeting and welcome all feedback.

OSU/HR2 Task Group Meeting

Mike Burns (FAATC), Task Group Lead, mike.burns@faa.gov

September 25, 2024

Revised Rate of Heat Release Test Method (HR2 Task Group) Presentation –

This presentation summarized all the work we have done up to now.

HR2 Industry Updates: M. Burns: The Boeing HR2 is up and running and completed their TRL activities.

Airbus HR2 Update: Planning has started for 2025.

Chemitox HR2 Update: Ability to participate in TRL 6 not confirmed. Visit to Chemitox Shinjyo-shi testing center delayed. May possibly happen in January 2025.

Custom Scientific Instruments (CSI) is building 3 units. S. Vargas (CSI): We are putting together 3 units. They are basically design-wise by me. We are planning to have these completed possibly the last week of November 2024. We are a little bit behind with the software. We are working on the manufacturing. Some of the commercial parts have a long lead time.

Deatak HR2 Update – HCI Lab: Mike Burns visited 7/31 and 9/2. TRL 6 Tentative testing dates 10/16-18/2024. They have run 11 calibration cycles since Mike's visit in early September.

Sonic Choke: April 2024 Forum Meeting Boeing presentation highlighted potential difficulties in accurately setting airflow.

Placeholder Document Update: New description added to detail inlet air piping from mass flow controller to lower plenum connection: Mike reviewed the new description.

Sample Holder Venting: M. Burns: This was discovered by accident when I was at the Boeing lab. Where is the buildup of gas expected to go? We witnessed that sometimes it shot out the sides or popped up the top. We decided to get an old sample holder and trim out a 1" in the center. The gas pressure behind the sample was shooting out like a blow torch. Any buildup of gas is easily able to escape. Mike showed 2 videos vented (sample bulges toward globars) vs. non-vented (no bulge observed). I encourage everyone who has a spare sample holder to run a test like this and share the data/observations at the spring 2025 Forums meeting. This is only for the HR2. S. Campbell: We observe the bulging in the OSU all the time. M. Burns: I ran 5 materials vented and non-vented. Mike presented the results for these 5 panels: Schneller panel, black back panel, Boeing smoke panel, White Sidewall Panel, and Boeing BDP Panel. S. Campbell: There are some panels that such as aluminum panels that might pop. M. Burns: Does anyone want to volunteer to generate some data?

Sample Holder Venting Summary: Original results showed that if bottom or side venting occurred gases may not be burned by pilot flames (most likely the upper). Mike encouraged labs to try it.

OSU/HR2 Snapshot: Mike has observed about a 10% difference on the low side between OSU and HR2.

HR2 Smoke Monitoring: SNRPM was issued. FAA Technical Center did some work with a single laser beam. The intent was to improve upon capturing smoke. 'Flat Beam' HR2 Smoke Monitoring: Mike shared the lasers used. Edmund Optics: Laser Product List was shared. Mike showed photos of the laser setup and installation in FAATC lab. The laser did a pretty good job of capturing everything coming out. Mike contacted Edmund Optics, and they made Neutral Density Filters (about $165 each).

HR2 Smoke Monitoring System (SMS): Testing of Boeing Smoke Panel in NBS (avg D_s=203). Mike reviewed Boeing Smoke panel data. Mike has completed his work on the smoke monitoring system. It showed that it is easy to monitor the smoke if someone wants to do so.

Question: What was the cross section? M. Burns: It's a flat sheet. It's an angled laser. That beam is 2" wide just like the opening. If I were to tweak this one more time, I would probably lower the signal to just above the exhaust. S. Campbell: Did the graph show NBS Smoke? Mike re-showed the NBS data graphs.

TRL 6 Update: Boeing test coupon (with decorative) status? B. Johnson: We are unable to procure materials as we normally would for the test coupon due to the IAM strike. I am looking into the possibility that we might be able to get some alternative dec-lam materials, but I have not had time to look into that yet. We did not intend those to be used for TRL 6. I think we can stick with using the Boeing panel and the Schneller panel to complete TRL 6. We have a set put together for the Chemitox unit. We just need to ship them. Updated timeline is what Ralph Buoniconti shared in our presentation yesterday. Are we on track for HCI Lab for mid-October? M. Burns: Yes, testing is scheduled at HCI for October 16, 2024. B. Johnson: Kent, please send me the address to ship the panels to. K. Wenderoth: I will after the meeting. I've had some industry ask when we can start testing some products that burn for comparison? M. Burns: Probably during the TRL 7 activities. It may fit better there. That is scheduled to begin in January 2025. K. Wenderoth: I will let them know maybe first quarter or mid-next year.

TRL 7 Details and Planning: M. Burns: Brian, do we have all the materials on hand either at FAATC or at Boeing lab? If not, when can we expect them? B. Johnson: That's a good question. We need to check.

TRL 8 Details and Planning: M. Burns: We need to start planning for this activity and define exactly what needs to be done. I am going to start this in February 2025 and give it a three-month window to complete. Brian, who will lead this activity? Task Group expectations/tasks? B. Johnson: I think this is going to be a group activity and be Mike Burns providing the final equipment description and test procedure. Identifying who you want to review that material and developing all the feedback, addressing those items, that's in my mind what that activity encompasses. M. Burns: Task Group members, expect to hear more about this coming soon.

Miscellaneous/Next: M. Burns: We are looking to complete 100 calibration cycles as needed. This will better define HR2 nominal operating parameter ranges (BL, TST, CF). We are looking to wrap up the TRL 6 activity in late December 2024. We will confirm acquisition of materials for TRL 7 – testing to begin January 2025. Mike encouraged labs to conduct test using vented sample. TRL 8: Let's begin planning now for start date in February 2025.

Q&A: T. Krause: Smoke minimum on the HR2 – in which direction is this moving from the standpoint of rulemaking? Is this an option you want to offer to fulfill this or is it that you are contemplating making it mandatory on the HR2? M. Burns: This is just a tool that can be used.

It is not a requirement anymore. Industry had requested that we just give an idea of how smoke could be monitored going forward – that's where the project came from.

Revised Rate of Heat release Test Method (HR2 Task Group) – Introduction of Auto Cal.

Research into a new method for calculating HRR (Auto Cal) – took about a year in development.

Auto Cal is an automatic calibration of the unit – it calibrates itself – no thermopile calibration required. Dynamic, real-time calculation of CF. Removal of Kh averaging (moving average). Removal of 3 SLPM Methane flow rates. It will remove the TST criteria. IT removes the T-Burner and improves safety. There is less potential for operator error. Savings in time and money. The FAA report on this will be published soon.

Calculations:

Required recording parameters: The only difference is we need to record the average exhaust gas temperature. Mike explained the Auto Cal calculations. Mike explained the Principles of Operation. Mike explained the Details of the Method calculations including Details of C_1 and C_2.

Presentation of Research Data: Mike: I ran 10 different materials. Legacy, Auto Cal, and % Delta results were presented for these 10 materials.

Q&A: Question: Legacy would be the OSU results? M. Burns: Yes. The calibration on the Auto Cal was done after the Legacy test was run. T. Krause: Can you go back to the equation for C_1, please? So, the specific heat of air isn't it ultimately dependent. M. Burns: Those values are at standard temperature. Our mass flow controllers are calibrating at a rate of 0°C. The mass flow of the air is controlled for all those parameters. C_1 is just your globar and pilot flame and how much the air changes in the system. T. Krause: Does the cp have to match the calibration values? Does the cp have to be taken into account at 0 degrees C? M. Burns: Yes, which is in our requirement. T. Krause: Then you have to correct cp? B. Johnson: What volume of methane is this considering? M. Burns: 1 liter. We wanted to get watts per liter. This constant 25.6 is the same number as in the current Handbook. It is the perfect world calibration factor. That delta T is your thermopile minus your baseline throughout the test. It is including the sample burning. B. Johnson: Is it C_1 that accounts for the lower pilot and the upper pilots? M. Burns: Yes, that is C_1. Typically, we have about a 280°C temperature with no flames burning when you light the lower & upper pilots it increases to 350°C. That is what we use as the baseline. Once the test begins, now C_2 is the dynamic portion of the test.

M. Burns: So, what do we do with this? We have an opportunity to never have to run calibration again and save cost, money, & time? W. Oestereich: How will industry deal with these changes? M. Burns: You're right, The challenge is the HR2 by itself. B. Johnson: I think you are right--we will need to break this down. I'm not comfortable with this yet. I appreciate what you presented. I need more time with it. I think a lot of people will need to see how it is applied with material that we are familiar with. I think we need to stick to our TRL schedule and plan to evaluate it separately or at least in parallel. I don't know that those of us with HR2s now have bandwidth to do that in parallel. M. Burns: This applies to the HR2 only. We have a method now that is directly linked to a model. It is an opportunity – I ask that you all go back and study this Auto Cal. We can go back and calculate for all the TRL 6 and TRL 7 materials as an aside. S. Campbell: From what I am seeing, this is just a software change, no hardware change? Is the software change available now? M. Burns: Yes, Deatak and Marlin

Engineering have the software. R. Lyon: What you need to know to run this software is you need to know the inlet temperature and baseline temp? M. Burns: I ran these numbers on the Deatak unit, and I had the same exact numbers. R. Lyon: Didn't you mention at one point that if you changed the height of the pilot, you got a different number? M. Burns: That's the problems with the Legacy. But with this, it comes out in T2 and T1.