International Aircraft Materials and Systems Forum Meeting

April 16-18, 2024

Hosted by Airbus – Bremen, Germany

Airbus Welcome – Joachim Betker (Site Manager, Airbus Bremen)

FAA Fire Safety Branch Overview – D. Dadia (FAATC)

Vertical Flame Propagation Test (VFP) – T. Emami (FAATC)

Tina provided a general overview of the VFP test.

Previously learned: Heater & Ribbon Burner

Radiant Heater:

Reset on heater design required – not the heat output.

Specific call-out of an exact heater build is desired by some and more room for varied design is desired by others.

Heat Flux Mapping Upon Sample:

Ideal for the requirement of build for the heater, not frequent calibration for the user

Values that were measured were presented.

Display of a different heater meeting the requirement (Concept Equipment Ltd.)

Concept Equipment utilized their smoke box heater in a trial.

Tina did a Comparison of Heaters: Preliminary measurements were presented. Concept Equipment / Marlin Engineering (Boeing).

Boeing will share how they did their measurements with the Task Group this week.

VFP Ribbon Burner:

It was noted that there were some differences in the VFP ribbon burner design between VFP manufacturers. Baffle plate / Burner length.

Ribbon Burner: baffle vs. no baffle. Tina reviewed issues noted by the manufacturers. She showed FAATC burner photos with and without baffle. Tina did not see a huge difference with and without the baffle.

Burns Plate: Copper plate with thermocouple embedded. Measured temperature of plate for 30 minutes.

Tina ran 3 times: Ribbon burner – Baffle vs. No Baffle. With the baffle about 10°F difference.

Ribbon Burner updated design: No baffle plate / ¼ inch longer to properly fit plug for cleanout port without intruding on gas exit holes.

Flame Check: A potential option for ensuring the flame is correct moving forward. Deatak suggested this and provided drawing of proposed flame check tool.

Radiant Heater: Current design of heater needs to be updated. This is open for further Task Group discussion.

R. Walters: What was the purpose of the baffle plate? For mixing? T. Emami: It predates me, but from what I understand, it was for mixing. R. Walters: There are inline static mixers. I have one in the lab I can show you.

Revised Rate of Heat Release Test Method (HR2) – M. Spencer (Marlin Engineering) for Mike Burns (FAATC)

Diamond Mask Position and Effect:

Recent observation of vague or non-existent dimension called out in FAA Fire Test Handbook. Mike sent a survey request out to industry requesting the center dimension of the diamond mask measurement relative to the 120-hole air distribution plate. Results of survey were compiled /presented.

Industry HR2 Updates:

Boeing HR2 Update:

Sierra Instruments MFC (mass flow controller) repaired. / Alternative MFC comparative testing underway. / Sonic choke procurement complete (but currently not installed). / Lower plenum pressure comparative testing underway with the FAATC and other HR2 units (validate system air flow similarity).

HCI Lab (Herb Curry Inc.):

Deatak HR2 moved out of FAATC and returned to Herb Curry Inc. (Thank you Kent Wenderoth). / All MFCs returned to manufacturer for calibration. / FAA visit (March 4, 2024) for tear down and measurement validation of equipment. / Developed checklist of equipment modifications required. / Return visit for training and testing (TBD). / Airbus (Germany) / Chemitox (Japan) – HR2s

HR2 MFC (Alternative Manufacturer): Currently using a Sierra Instruments MFC / Manufacturer stated they would no longer support this device. / Desire to find alternative replacement MFC. / The use of sonic choke was added to the placeholder document as an alternative option.

Alicat™ Scientific Mass Flow Controller: P/N MCR-500SLPM-D/5M. Mike has been happy with the results using this MFC so far. Company is Alicat™ Scientific (alicat.com). A photo of this MFC installed was shown. It is about half the size of the original Sierra MFC.

Current Calibration Method: Unlike the OSU, the HR2 calibration captures steady state thermopile values at a ‘zero’ flow condition and a ’span’ flow condition. Mike did some experimentation using a T-shaped burner during calibration. Slight differences were discovered due to the change in position of calibration gas entry (from upper pilot burner to lower pilot burner).

Changes to consider - changes in plumbing to divert calibration gas form the upper burner to the lower burner position. / Potential changes to software to account for this change.

T-Burner Calibration: Videos shown.

Smoke Monitoring (SNRPM):

Initial system used single beam signal and thermopile type receiver. / New system uses a flat-sheet signal and an optical power meter.

A photo of the filters Mike purchased was shown. Photos of 'flat beam' HR2 smoke monitoring system components were shown. Photo of Edmund Optics: Laser System installed was shown. The Lessons Learned so far were reviewed – additional work will be done on this.

Miscellaneous / Next: Validate new Alicat™ Scientific mass flow controller (MFC) and radius T-burner. / Complete 100 calibration cycle as needed. / Complete TRL6 testing as needed. / TRL 7 planning and acquisition of materials continues. / Formalize endgame for TRL test series (define activities, goals, etc.). / Continue work with Laser System. M. Magee: What is the intent of the smoke monitoring? M. Spencer: the intent of the new rule was to eliminate the smoke test. There was a lot of discussion from industry still wanting smoke values, so this was Mike's attempt to use the HR2 for smoke monitoring. I think Mike is about to start on a test protocol with samples Boeing sent him. We can ask him during the Task Group on Thursday.

HR2 Development TRL 6 – Status Update – B. Johnson (Boeing)

HR2 Development Goal and Status: Define a robust method to determine peak and total heat release that improves repeatability and reproducibility when compared to OSU.

TRL 6 will evaluate reproducibility. We are looking to get as many instruments as possible participating. Marlin HR2 unit installed in Boeing Seattle Flammability Lab. Primary operator is Yonas Behboud. Sierra and Alicat™ Scientific MFCs connected and functional. Air pressure measured in two locations (images shown).

Recent change to 3-liter methane calibration flow location: was: upper pilot burner / is: lower pilot – new T-Burner.

Sierra mass flow controller (MFC) Operating Parameter Data: – Baseline / TST Stability / Cal Factor presented. Alicat™ Scientific MFC Operating Parameter Data: Baseline / TST Stability / Cal Factor presented. We can discuss this data further in the Task Group meeting on Thursday. We think we are ready to start TRL 6 in the next couple of months.

We anticipate starting TRL 7 once we complete TRL 6. Brian discussed the TRL 7 Plan.

The Next Steps were reviewed. Estimated start of TRL 6 at Boeing lab is June 2024. Herb Curry Inc. (HCI) lab estimated start in July 2024. We hope to have Chemitox lab participate, also.

Sensitivities of Using a Sonic Choke on HR2 – T. Spanos (Boeing)

Background: Multiple studies have been presented in this Forum documenting the various sources of variability in OSU heat release.

Sonic Choke in Gas: Theo briefly described this.

Parameter Study: Questions arose on whether there are some external factors that affected variability.

Input Parameters: What affect does inlet pressure, ambient pressure and inlet temperature have?

Theo presented the Parametric Study Results: There are interactive effects between throat diameter, inlet pressure, ambient pressure, and temperature. As throat diameter increases, the inlet pressure required to maintain a particular flowrate decreases.

Extremely sensitive to throat diameter. A difference in throat diameter of 0.001 inch results in a need to adjust inlet pressure by about 0.25 psi to maintain a given flowrate.

Takeaways: For a given throat diameter, with constant ambient pressure, inlet pressure required to maintain flowrate increases as the temperature increases.

For a given throat diameter, with constant temperature, inlet pressure required to maintain flowrate decreases as ambient pressure increases.

To achieve a nominal flowrate, knowledge of the precise throat diameter and awareness of environmental factors is needed.

Examples were presented. See Theo's presentation for details.

Summary:
Parametric study conducted using piping of 0.82" inner diameter (3/4-inch schedule 40). Equations are not dependent on piping diameter.

Critical input parameters to volumetric flowrate at exit are inlet pressure, ambient pressure, inlet temperature, and throat diameter.

Sonic Choke provides effective passive airflow control with lower costs and lower maintenance, provided the input parameters are understood and accounted for.

RTCA Development of a New Flammability Test for Electronic Equipment – S. Rehn (FAATC)

Purpose of this presentation: provide an overview of the 10-year development of a new, alternative flammability test for electronic equipment; and then decide if this new test task is still worth continuing/pursuing. There has been a lack of interest lately.

Timeline: 2009-2024

Lindsey created a timeline for the work conducted since the FAA Fire Safety researchers became involved in 2009 (see Slide 5 of the presentation). 2024: Looking for Interlab Study participants and comments on draft (final draft due July 2024). Steve provided brief descriptions of the highlights of the work done through the years.

New Test Method: Programmable Line Burner: based on telecom industry ANSI T.1.319. The Test Procedure was explained. Additional test details were reviewed: test specimens / similarity / multiple burn tests.

Pass/Fail Criteria: Camera/Blue LED Systems (Flame Detection) – system requirements and specs on the equipment needed are available in the presentation.

The Difficulties of Testing Aircraft Electronics were reviewed.

Shortfalls of Proposed New Test were reviewed. Burning enclosure whole would 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.

"Non-Vented" Definition Added to Test Exemption Criteria (DO-160H).

Summary & Decision Point:

There has been a severe lack of interest in developing a new test method for Section 26(C) over the last 10 years.

Current DO-160 referenced FAA fire test methods are not well-defined for aircraft electronic equipment (PCBs), causing variability of flammability certification techniques among aircraft electronics manufacturers.

Proposed alternate test method still has gaps/uncertainties that can only be addressed with outside input/ILS participation.

As of now the FAA will not be able to endorse the new method for inclusion into DO-160H Section 26 by the July 2024 deadline.

If we continue this Test Method:

Inter-laboratory Study is ready for participants.

Contact Lindsey at Lindsey.p.anaya@faa.gov.

G. Imamura: When will the chart "Non-Vented Definition Added to Test Exemption Criteria (DO-160H)" be included in DO-160? S. Rehn: The final is due in July 2024 and then there is a review process that it will go through, so it could take until sometime in 2025.

Additive Manufacturing (AM) Update – D. Keslar (FAATC)

FAA report "DOT/FAA/TCTN-23/65" published in December 2023.
Provides all vertical Bunsen burner testing conducted by FAA on flammability of AM produced parts.

Aircraft Certification Product Issue List: Available to the public / Additive Manufacturing for flammability of interior materials was recently included.

Link: https://www.faa.gov/aircraft/air_cert/design_approvals/product_issues_lists

See Slide 4 of this presentation for a screenshot of the webpage with information on where to find Additive Manufacturing in the Issue List. There is a Task Group meeting on Thursday.

Handheld Extinguisher Toxicity Update – N. Safronava (FAATC) [Recorded]

Motivation: Evaluate the difference in thermal and toxic hazards of handheld extinguishing agents used on lithium-ion battery fires in small compartments. Four agents were used. The project started in summer 2022 with 18650 5 cells pack and two agents. The instrumentation used for these tests was presented including photos of set-up. Details of the Test Compartment were presented. Specifics are available in the presentation slides. The volume of the compartment is 240 ft^3 (flight deck). There is no air exchange. The battery box is on the floor. The Test Details were presented: 3D printed battery case + lid using thermoplastic material. The right most cell was fitted with a cartridge heater, rate 15°C/minute. Test Details for the pouch cells were also reviewed.

Test Results: Water pours and water extinguishers were effective in stopping thermal propagation of the cells. This has been presented at previous meetings, but we feel it is important to review again.

Toxicity Assessment, Previous Approach: Previously our approach to assess the toxicity was to track the concentrations of certain gases (AEGLs) 10 minute (CO, HF, HBr, HCl).

Toxicity Assessment, New Approach: Survival model uses incapacitation data to obtain a fractional effective dose for incapacitation (FED_i).

> *Toxicity Assessment of Combustion Gases and Development of a Survival Model, Louise C. Speitel, DOT/FAA/AR-95-5.

FED_i Results were presented. We collected acid gas data for 8 minutes during the 30-minute tests. CO was the main contributor to FED_i. HF contributed insignificantly only for 2-BTP scenario.

Summary: Water and water extinguisher were effective in stopping the cells propagation. FED_i model was applied to assess the toxicity of combustion gases. No significant differences were noticed…

Contact Natallia Safronava at natallia.i.safronava@faa.gov.

Question: Does she plan next steps? D. Dadia: This is the end of the testing series. The FAATC will prepare a report that will be available on the FAA Fire Safety website. Question: Can you give any information on the cells used? D. Dadia: 18650 lithium-cobalt oxide, but I will confirm that with Natallia.

Waste Compartment Fire Containment Update & Other Handbook Proposals – S. Campbell (Safran)

Waste Compartment Fire Containment Task Group: 14 CFR 25. 853(h)

Task Group has been assessing non test proposed MOCs & critical similarity design criteria. Only a few of these are specifically mentioned in the FAA ACs. The others are straightforward often using aspects of the flammability Policy Statement.

In February 2024 the Boeing company submitted additional comments for review and potential incorporation to further improve the test method. Key comment topics included: smoke, alternate test unit shimming strategy, alternate method to condition trash before testing, more discussion on testing standard containers / meal boxes, ensuring test unit latch is engaged with minimum tolerance overlap, door and flap seal installations. We will discuss these further in the Task Group meeting this week.

Methods of Compliance (MOC) – Similarity

We have identified 15 non-test MOCs and 7 critical Similarity Design Criteria. Six Task Group members have currently agreed to formalize MOC proposals for submittal to the regulators for acceptance.

Fire Test Handbook Update Requests:

1: Chapter 4: Wire Test Update Request (proposal)

What to do if a wire that requires testing is not readily available in 30-inch lengths. Scott reviewed the proposed shorter wire length and how that would be set up in the test apparatus.

2: Chapter 6: Para: 6.3.1.6.4 Smoke Heat Flux Density Gauge

Update this paragraph to provide provisions/ requirements (furnace coil) to be able to use water-cooled heat flux transducer consistent with what most labs are using.

3: Chapter 6 Para: 6.3.1.8 Smoke Flamelets

Scott polled a few labs and provided a diagram of how these labs get their flamelets. Experience has shown that it is not always possible to meet the requirements for both gas and airflow rates to produce 6 flamelets AND figure with measurements of the acceptable inner and outer cones of the flamelets. Scott reviewed requested changes to this Section.

4: Chapter 6: Para: 6.6.2.1 Smoke Linearity Check Instructions

Update Chapter 6 to replicate FAA Round Robin procedure (filter combinations) to demonstrate the light beam and photometer are functioning – no erratic behavior. Recommend engaging industry to define what is good. Commercial ND-filters are not scientific instruments, so there will be some drift from theoretical. G. Imamura: How are you going to proceed with improving the idea to put those instructions in the Handbook? S. Campbell: I am noting that there should be some discussion with the FAA on these. G. Imamura: From here, what do you want to do, what is the next step? S. Campbell: Next step is to get some feedback from the FAA. I think we would want to involve whoever is responsible for Chapter 6. T. Krause: The ND filters when you get them commercially from the photoshop, so we encourage the use of master filters so you can correct the value of your ND filters. We will pitch in with ideas if you want.

Detection of Signatures from Internal Contaminant Sources – L. Anaya (FAATC) [Recorded]

FAA sponsored research grant with the University of Maryland.

Research Motivation: Electrical odors and smoke incidents in aviation have become a pressing concern, with over half of the detector activations resulting in false alarms, leading to uncertainties for flight crews.

Research Goal: Identify sensor technology capable of detecting signatures/significant markers from system and/or component failures in the flight deck. Lindsey explained the study, sensors used, contaminant sources. The test procedure was described. Tests were first conducted at the University of Maryland and then tests were conducted at FAATC. Each setup was described.

The focus was on the capability to distinguish between samples during the smoldering phase, leveraging a multivariate approach and gas analysis.

Additional description of the Sensigent MSEM 160 E-nose and the Bosch ME 688 gas sensor was given.

Conclusions: MSEM 160 E-nose: Gas Analysis: elevated odor levels were observed across all samples compared to ambient conditions. Overall Performance: Respectable performance even with limited aspirating capacity compared to VESDA (auxiliary smoke detector).

Bosch BME 688 Gas Sensor: Effective in categorizing distinct classes but faced challenges identifying samples within the classes. AI capabilities of BME 688 AI studio beneficial for neural network training.

This thesis will soon be published as FAA report number: DOT/FAA/TCTT-24/10.

Any questions or concerns, contact Lindsey at lindsey.p.anaya@faa.gov.

FAA Fire Safety Research Grants Update – R. Walters (FAATC)

FAA-supported Research at University of Massachusetts Amherst: Non-Halogenated Polymers and Additives with Low Flammability and High Char Yields – P.I. Todd Emrick

Project Objectives from Materials Discovery to Workforce Development: Designing Fire Safety and Sustainability into Synthetic Polymers.

Bottom-Up Approaches: Monomer Designs Yield Ultra-Low Flammability Polymers.

Deoxybenzoin as a versatile starting material in FR Materials.

Inherent FR Characteristics of Deoxybenzoin Polymers: Principles underlying deoxybenzoin FR properties place it deep into FR category.

Dissemination: The presentation includes the list of recent publications, patents, presentations, etc.

S. Campbell: Did they happen to do any heat release tests? R. Walters: No, they did not.

University of Maryland: Measurement and Modeling of Hazardous Substances in Fires Produced in Fires Fueled by Polymeric Materials

Three Phases of this work:

Apparatus Enhancement (Complete)

Instruments Precision and Accuracy Validation (Ongoing)

Constant Ventilation Condition Tests (Ongoing)

Apparatus Enhancement (complete): Redesigned the construction of the Fire Propagation Apparatus (FPA), improving measurement capabilities.

Instruments Precision and Accuracy Validation (ongoing).

Constant Ventilation Condition Tests (ongoing).

Gas Sampling Systems diagram was reviewed.

Rich reviewed the future plans:

Corrected issues of air entrainment. / A new more sensitive FID analyzer was added to address hydrocarbons not detected in preliminary tests. / Experiments across a wider range of equivalence ratios will be conducted for different types of polymers. Results will be compared with FAA ANG E-21 MCC data.

FAA Microscale Combustion Calorimeter Inter-Laboratory Study Update- R. Walters (FAATC)

FAA Microscale Combustion Calorimeter (MCC) (ASTM D7309-21). The MCC test measures Materials Properties related to flammability on a milligram size scale. One of the outputs: Fire Growth Capacity (FGC). The FGC is a measure of ignitability and burning rate of the material (i.e.: total fire hazard). MCC is proposed method. Rich described the MCC design. He explained the Fire Growth Capacity (FGC) created by Dr. Rich Lyon at the FAA Technical Center. Rich showed a diagram and explained the design of the MCC. He explained the MCC procedure for FGC.

ASTM E691: Is conducting an Inter-Laboratory Study to Determine the Precision of a Method:

Repeatability and Reproducibility are being investigated.

Preliminary Lab Comparison – Polystyrene: Total Heat Release and Fire Growth Capacity results were presented.

Study Participants:

Four (4) manufacturers/licensees of the MCCs out there: Deatak / Fire Testing Technologies / Concept Equipment Ltd. / Rich Walters (prior to becoming an FAA employee).

Samples shipped to labs: 18 labs claimed they are able to participate / several labs have more than one unit.

The test data will be sent directly to ASTM.

Summary and Future Work: Round 1 (FAA): Preliminary results received. / Offered suggestions to operators to reduce errors. Round 2 (ASTM): Participants verified (20+MCCs). / Sample set selected (6 samples). / Input values into ASTM ILS website. / FGC software created. / Results to be submitted directly to ASTM. / Later: Rich will write an FAA report on this.

Several FAA Reports are available on the FAA Fire Safety website (www.fire.tc.gov) with info on the MCC. See last page of Rich's presentation for the report titles.

S. Campbell: In a previous session we talked about the FAA putting training videos online like optimizing oxygen, etc. Is there anything planned to create these training videos? R. Walters: I have my own YouTube channel where I have some techniques on some of that. We also looked at high precision method in the MCC that eliminates a lot of the baseline noise. Question: Sample preparation - is there a sample preparation technique? R. Walters: Because the sample is only a couple millimeters, contamination is going to be a huge factor – you don't want to touch it or breath on it. I have methods for that in some of the videos on my YouTube Channel (Everything-MCC). I have information on how to handle every type of sample that I have encountered.

FAATC Engine Nacelle Testing Update – D. Dadia for D. Ingerson (FAATC)

Powerplant Halon Replacement: Currently working with a sodium Bicarbonate Solid Aerosol as a potential halon 1301 candidate for this application: Need to complete 3 test conditions. / First condition's results indicate proposed criteria plausible. / Currently reviewing 2nd condition's results for plausibility.

Previously completed MPSHRe/rev04 testing with CF3I: Local testing complete. /Reporting incomplete and in process. Doug Ingerson's June 2023 presentation (available at https://www.fire.tc.faa.gov/systems.asp) has substantial information on the testing conducted.

SAE A-22 and AS6826 Status – D. Laborie (GE Aerospace)

The background of this work was provided. The SAE A-22 fire protection and flammability testing committee initially formed in March 2018 to support the update of FAA AC20-135. Committee Objectives and Initial Program of Work were reviewed. Objectives of committee: Develop and publish SAE Technical Reports for testing of fire protection systems, components, and structure. Define fire test requirements for aircraft and propulsion systems. Current SAE A-22 roster includes 220+ individual participants from across the industry. The Committee is currently organized into seven (7) Groups to

develop multiple Standards. Documents: AS 6826, AS 6828, AS 4273, ARP 8704, ARP 8580, ARP xxxx, and AIR 8635.

AS 6826 Powerplant Fire Test Standard: 2024 Significant Accomplishments:

1st ballot – Aug 28 to Sept 24, 2023: 240 comments addressed by the Committee.

2 ballot – March 20 to April 16, 2024

AS6826 Powerplant Fire Test Standard: Significant Changes: Calibration for heat transfer rate only uses copper tube water apparatus: Apparatus design included in the Standard. / No change to 4500 BTU/Hr minimum requirement. Added post-test heat transfer heat validation (no temperature calibration required). Pre-test calibration for flame temperature will use rake of 7 thermocouples (TC), 1/16-inch nominal diameter. 2000°F (1093°C) minimum for average of 5 center thermocouples (calculation excludes the 2 edge thermocouples).

Existing legacy burners allowed, consistent with AC20-135 Change 1: ISO2685 gas burner not allowed. Sonic burner allowed if calibrated same as legacy burners. Added instructions for defining boundary conditions: loads, vibration, pressure, flow, etc. / Ground and flight conditions. Pass/Fail criteria defined.

SAE A-22 Documents Timeline was presented.

R. Walters: The tube you are using to measure heat flux? D. Laborie: You measure the temperature through the water. R. Walters: Rate of response or equilibrium temperature? How does that correlate with other methods like the Gardon Gauge? D. Laborie: This is not a very precise piece of equipment, but it's what the FAA wants.

AC20-135 Revision Update – P. Dang (FAA)

FAA tasked SAE in 2018 to develop industry standards to supplement AC 20-135 Change 1: Powerplant Installation and Propulsion System Component Fire Protection Test Methods, Standards, and Criteria.

AC 20-135 Revision A – Target release for public comments ~ 12 months after AS6826 publication. Phil reviewed the Section 2.0 Principal Changes. A table that correlates the current AC 20-135 Paragraphs to updated AS6826 Sections was presented. Under review for future tasking: Draft CATA 25.1103(b)(2) inlet fireproofness – APU clarifies the inlet boundary, components, and fire requirements for external and internal fire conditions. Draft AC25.XXXX Powerplant Residual Flames during AC 20-135 Fire Testing – provides acceptable MOC (Means of Compliance).

F. Aimar: Why only large airplanes and why not helicopters too draft CATA 25.1103(b)(2)? P. Dang: CATA is for airplanes. You can send any concerns/questions to Rémi Deletain at EASA.

High Fidelity Modeling and simulation of the NexGen Burner – D. Dadia (FAATC) for Professor P. Khare (University of Cincinnati)

Much of this work was presented at the October 2023 Forum meeting by Professor Prashant Khare. You can review the presentation on the FAA Fire Safety website. It is located with the October 2023 Forum meeting presentations. Development and Validation of Thickened Flame Combustion Model: They will present this work when they finish writing the paper.

Questions: Please contact Dr. Prashant Khare at University of Cincinnati (Prashant.Khare@uc.edu).

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

SAE A-22 Powerplant Fire Testing is supported by EASA.

ARP8580 Fire Protection of Aircraft Engine Mounts, Flight Controls, and Other Flight Structures: Draft dated February 26, 2024.

ARP8704 Minimizing Hazards of Engine Combustor Case Burnthrough: 1st ballot November 1, 2023, till November 28, 2023: EASA Comment sent November 28, 2023.

SAE AS5127/2D – Test Method for Aerospace Firewall Sealant Flame Penetration: Need to ensure a consistent interfacing between that standard and AS6826.

CATA – CWI EASA-001 – 2D Nacelle (CS 25.867): We hope to close this activity by June 2024. Once adopted by CATA will be published on the EASA website. Regulatory adoption plan (subject to consolidation).

H2 Activities: Remi reviewed EASA's involvement in various H2 activities.

H2 Fire & Explosion Risk: Initiative launched in November 2022 with Regulator-only and Regulator-Industry exchange: There was little success. Repeated in June 2023. April 15, 2024: Regulator-only meeting, April 17, 2024: Regulator-Industry meeting.

Cargo Research Area Updates – D. Dadia (FAATC)

Disinfectant Study: Concern: Spontaneous Combustion of Chemical Disinfectants in Cargo – July 2022 Shanghai, China: There was a fire involving large quantity of disinfectants transported in cargo compartment.

FAATC Research/Testing: Phase 1 conducted at WJHTC Building 298 Runway #1.

Phase 2: Lindsey Anaya is now moving on to Phase 2.

HFC Replacement Task Group: HFCs have been used in refrigerant applications in aircraft. Kigali Amendment to the Montreal Protocol requires a significant reduction of the use of HFCs, in order to address global warming: 85% reduction in HFC total carbon footprint by 2036. This Task Group will meet on Thursday.

Class E Cargo Compartment Task Group: Last Task Group meeting conducted in June 2023. Tasking for industry: if there have been any developments in fire safety enhancement concepts for class E cargo compartments, contact Dhaval Dadia @ dhaval.dadia@faa.gov.

Cargo MPS – Multiple Fuel Fire Scenario: Addition of a multiple fuel fire scenario to the Cargo MPS. Test setup, test methodology, number of tests, acceptance criteria. Dhaval described the test setup. Test Methodology: Fire initiated with initiating thermal runaway in lithium-ion cells in Box 5. Fire suppression agent is initiated 1 minute after a ceiling thermocouple reaches 200°F. For the 180-minute version of the test, thermal runaway is initiated in the lithium cells in Box 14 60 minutes from the start of the fire suppression agent. The Number of Tests required and the Acceptance Criteria were reviewed. The Multiple Fuel Fire Scenario will be discussed in the Task Group on Thursday morning. M. Jensen: The performance criteria for the replacement of the current has to be significantly better than the current, is that what you said? D. Dadia: The performance of the new agent has to be either similar to Halon 1301 or better than Halon 1301. S. Holz: What is behind the differences in the SOC? D. Dadia: The intent was to make sure we have a significant fire in the cargo area. When we developed the challenge

fire scenario, I think all the cells were at 50% SOC. When we developed this, we were trying to cover the various states of charge of the batteries that could be in the cargo compartment. Question: Did you do post-test inspections on some of the batteries? D. Dadia: There is a very interesting presentation by Boeing tomorrow morning.

Minimizing Halon Emissions & Improve MRO of Aircraft Fire Extinguishers by Acoustic Emission Technology – A. Balka (Aviasonic)

Anna's presentation is available on the FAA Fire Safety website with the other presentations from this meeting. Question: Hydrostatic test is specified/referenced in NFPA for rechargeable fire extinguishers.

Anna Balka: Hydrostatic is more sensitive so, the more you look, the more you will find. Question: What will be needed to advance this use in the industry? A. Balka: The greatest difficulty for using this technology in the industry is documentation. Question: What temperature do you need for the acoustic emission tests? Do you have to take the fire bottle out of the aircraft? A. Balka: Temperatures are around 150°F. Today there is not the technology to do that onboard the aircraft.

Status of SAE AS8992 – D. Dadia (FAATC)

Fire Safety Branch aids in development of test standards through the SAE process. AS8992 Fire Resistant Container Design, Performance, and Testing Requirements. AS 6453A: Fire Containment Cover: Design, Performance, and Testing Requirements.

Current status: Fire Resistant Container Standard has a Class A fire load. Battery Fire Working Group to include an additional battery fire load: Combination of Class A fire load and bulk packages of lithium-ion cells.

FAA Input to AS 8992 for consideration: FAA is concerned the number of operational levels will confuse operators – consider the following framework instead: Level 1: Batteries in equipment – Class A fire container test + oil burner / Level 2: Replicate ion battery fire + oil burner / Level 3: Metals + projectile/ballistic standards (future). Important to address a valid minimum State of Charge (SOC). Discussions on the SOC are ongoing within the group. / External Fire: Industry choice at this time.

SAE should develop an ARP and AIR: ARP for Translation to Operational Use. / AIR for background on both FCC and FRC standards development. ARP and AIR can be referred to in FAA-published materials. R. Buoniconti: UL is working on a containment test for LI batteries for electric vehicles. It is more of an indicative test. D. Dadia: Some of the participants in that group are part of the testing team at UL, so we have some of that information.

WEDNESDAY, APRIL 17, 2024

Battery Fire Simulator – Small Scale Testing Results – D. Dadia (FAA)

Objective: Develop a test method to simulate lithium-ion battery fires to replace the physical testing of batteries in standardized tests.

Dhaval described the FAA Proposed Setup that will replicate a physical lithium-ion battery fire in bulk quantities. The goal is to have a repeatable and reproducible fire load for standardized tests. Fire load can be changed based on evolving variables such as cell chemistry, SOC, capacity, and quantity of cells. Lower cost to conduct standardized tests.

Test Setup:

Gas Generation, Propagation Rate, Gas Generation Data (18650 cells), Test Results – Propagation Rate for different quantities of batteries (25 cell, 49 cell, 100 cell, 200 cell). Dhaval showed a short video of the test. Photos of the batteries tested before and after the test were shown.

This work will be part of developing a test method to simulate lithium-ion fires is ongoing. / More tests need to be conducted to validate gas generation data.

E. Canari: How is this data going to be used to develop the conditions? D. Dadia: We are testing these cells at 50% SOC, so we can ask the gas manufacturers to create that mix. They can be fed to a burner. We have not developed what type of burner will be used yet. The gases will still continue to flow after the fire is extinguished but the gases would still continue to flow. Question: What kind of 18650 cells were tested? There are different types. Did you take a look at the different variants? D. Dadia: We did not look at that, but we can. Question: Did you recycle the batteries? D. Dadia: We just did that once. Question: Slide 10: Gas volumes: When you showed the amount of cells. D. Dadia: This is just one cell. Our initial work is geared towards developing the standardized test, but later we have plans to look at the gases later. N. Olsen: The gas mixture as we have observed in many of these tests has a heavy aerosol content – you probably want to aerosolize the mixture. In your tests did you need to put a top on the box? D. Dadia: No, we didn't. N. Olsen: When we first started testing 18650 cells they blew their sides out, now it's down to about 4-5% that blow their sides out regardless of their SOC, and that generates a different flow pattern, and finally we found that there was a lot of venting of flammable gases prior to thermal runaway. D. Dadia: We have purchased an FTIR analyzer, so we can continuously monitor as the test progresses. N. Olsen: I think we can compare that data against data that we would collect with the PTRMS at Boeing. I'll talk to George about that later. C. Thomas: When you look at the prop rate of your cell arrangement it is impacted a lot by the heat transfer from cell to cell. Have you considered doing these tests in the open environment? D. Dadia: In the large pressure vessel it has enough access to oxygen. The other thing is that it does not have to be 100% equivalent to a battery fire. Around 80% you still save quite a bit of money. That is something we are still looking at. We know we cannot replicate everything as if doing a full-scale test. J. Damazo: We have put thermal shielding on the gauge. We shield the opening to the gauge.

<u>Boeing MPS Chamber: A Comparison of Suppressed and Unsuppressed Multiple Fuel Fires Verdagent & Halon 1301</u> – R. Darr / W. Quigley (Boeing)

The test setup was described. Photos of aftermath of Unsuppressed Fire, Verdagent suppressed test, and Halon suppressed multiple fuel fire (MFF) tests were shown. Photos of batteries after the tests for each scenario were shown, and Rachel provided the numbers of batteries in various states after the tests for each scenario (unsuppressed, Verdagent, and Halon 1301). Wes provided details on % V Oxygen and Ceiling TC Temperature calculations for each scenario (unsuppressed, verdagent, and Halon 1301). The data for the two unsuppressed fires, 5 Verdagent suppressed fires, and 5 Halon 1301 fires was presented. % V Oxygen and TTOP Box Temperature Plots were presented for Halon and Verdagent.

Conclusions: The Halon tests seems to follow the same pattern as Verdagent tests with regard to the number of boxes burned / number of batteries burned / fire spread. Verdagent performed a little better than Halon with regards to time temp integral. / Peak T. / Verdagent will pass the MFF Criteria based on Halon Baseline Testing.

EASA Update on Rulemaking and Research – E. Canari (EASA)

PED Battery Fire on the Flight Deck: Continuing Airworthiness Activities (CAW):

May 2018 EASA issued CAW Review Item (ref CARI 25-09) to request TCHs to assess the hazard associated to a lithium battery fire on the flight deck. The CARI identifies a minimum set of measures necessary to address the hazard.

Initial Airworthiness activities (IAW):

December 2021 EASA published proposed special conditions to address the safety concern highlighted in the CARI for new design certification project. April 26, 2022, EASA published the final Special Condition SC-G25. 1585.01.

Potential Risks due to devices containing lithium batteries located on the flight deck. PEDs commonly found on flight deck are EFB and those carried by flight crew for personal use.

CARI 25-09: Enzo reviewed what the Type Certificate Holder (TCH) is requested to do. He also reviewed the Means of Compliance (MOC) for EASA SC-G25.1585-01.

CARI 25-09 Data Review Status:

Several non-EU TCHs have not provided any data. / Review of the data received from EU TCHs is almost finalized.

Main Findings:

Unambiguous information on safe stowage locations available on the flight deck should be provided to operators (through placards and training material). / Donning fire gloves is essential to handle PEDs: not always available on the flight deck or in its proximity & minimum performance standard for fire gloves should be specified. / Use of fire containment bags: not acceptable for fire fighting but may be used as stowage facilities (in the cabin and on the flight deck) if adequate performance is demonstrated. A strategy needs to be defined to address Continuing Airworthiness of EFB mounts installations.

Fire Containment Bags (FCB):

FCBs 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). Relocation of bag to another compartment (e.g., a lavatory) is essential to address smoke released by the PED during the thermal runaway event. / As of today, no FCB has passed fire containment tests requested and witnessed by EASA (performed using UL5800 as a reference). / Fire containment performance significantly depends on the strict application of the instructions for closure of the bag.

Considerations on UL5800:

Lack of definition of the configuration of the artificial battery fire source: Orientation of the 18650 cells with respect to critical features in the construction of the box (holes, joints, etc.). / Orientation of the artificial battery fire source with respect to critical features of the fire containment bag.

Next Steps:

Implementation of the SC in the certification of basis of large airplanes. / Make progress in the definition of a standard for FCBs addressing PEDs handling and battery fire containment: Ongoing EASA research

project LOKI-PED. / Definition of a MPS for fire gloves. / Address IAW and CAW of EFB mounts: EASA is developing a new CARI and a revision of the MOC to SC-G25.1581-01.

EASA Research:

LOKI-PED: Started in August 2022 scheduled to be completed in July 2025.

Expected Outcome: Provide experimental evidence for the establishment of limits (power output and quantity) for the transport of PEDs and study the effects of an increase/decrease in the risks involved. / Develop new and improve existing emergency procedures to cope with lithium batteries and PEDs transported in the cabin, thus rendering it a safer environment for both passengers and aircrew. Enzo presented the breakdown of the Tasks of LOKI-PED. Simon Holz from Fraunhofer: We are focusing on PEDs in cabin and flight deck. This year we are going to assess the consequences of fire and smoke in the cabin and cockpit. Characterization of the main hazards of PEDs. Testing is conducted at the Battery Test Center at Fraunhofer EMI. Simon explained the Experimental Approach – PED and Battery abuse characterization, the instrumentation used in the tests. A diagram of the test setup was presented. He shared some results: We also have to consider the plastics emissions/breakdown as well as the battery emissions and hazards. We will conduct single aisle cabin simulator tests: Scenarios on floor, on/in/under seat/pocket, overhead bin. Flight Test Facility: Smoke Spread and Handling in Widebody Cabin: This provides the opportunity to have realistic ventilation and smoke spread within aircraft cabin.

AirPED: Research project EASA.2020.HVP.12 Lithium battery fires in cargo compartments: PEDs in checked baggage. Objectives: Evaluation of the effectiveness of cargo fire suppression systems (Halon-based and Halon-free).

Enzo reviewed the status and Tasks of this project. Project Status: Task 1 is completed. Task 2 and 3: testing restarted in January 2024.

New Research Project: HEALTH

RES-CA.3

HEALTH: New health safety measures in aircraft. Call for Tender finalized in Q1 2024. Expected project start is Q3 2024. Duration: 36 months. Expected outcome: Identification of scientifically proven solutions to reduce the spread of airborne infectious agents with the aircraft environment.

Question: From our tests we found that there are a lot of electrolytes being released. What about looking into the effect of the condensed electrolytes on the flight deck? E. Canari: In every project we design we have expected outcome, etc., if we have some interesting findings. It is an interesting topic and is part of the issues we are looking at.

UN Lithium Battery Classification Test Method Development – S. Rehn (FAATC)

Shipping large quantities of batteries. During the December 6-8, 2023, meeting the “draft hazard-based classification” document was introduced. The Classification would work: By default, no testing will be required, all hazards would be considered worst case. / Purpose of this testing is to determine worst case as well as developing test methods for individual batteries to be classified on their own. / Battery Propagation Test would be used to determine how the battery would be classified. Steve described the test setup.

Steve presented the group's previous Decision Tree and the FAA Proposed Decision Tree. The group's Current Decision Tree was presented, and Steve explained the changes made to it.

Recent Flammability Testing:

Decision Tree still has separate category for fire and gas explosion hazard. Batteries are not always consistent in when they ignite. FAATC conducted the same propagation test 5 times. Only 2 out of the 5 tests had self-ignition. Steve showed video of these tests. FAA has conducted approximately 200 tests in support of the UN battery classification working group over the past 2 years. Future work is to help the Working Group design a round robin and participate in testing. R. Walters: Did you do any tests where the vapors were not able to escape that readily? S. Rehn: That was not really part of it. These tests were for propagation not ventilation. Question: What would be the functional difference between classifications A & B? S. Rehn: Fire is if the battery catches on fire easily. It seems like potentially B could be even worse because it could explode.

SAE G27 Committee Update – B. Johnson (Boeing)

Background on G27 committee was provided. It is available in the presentation slides.

AS6413 – The standard provides a test method to demonstrate and document the control of the potential hazards from lithium metal batteries (UN 3090) and lithium-ion batteries (UN 3480) when transported as cargo on aircraft. Intention is to address the safety of the cell/battery and packaging material (box, etc.) together. Can allow for less protection from the package if the cell is inherently safer.

Validation testing is taking a bit longer than expected.

Plans:

Incorporate discussion from March 2024 meeting to release "narrow scope" standard only applicable to small cylindrical lithium-ion cells. / Incorporate responses to latest ballot comments and release Aerospace Information Report (AIR) with appropriate intended use, rationales for various parameters.

Upcoming:

Ballots April/May AIR 6840 / April/May AS6413 / Third or fourth quarter 2024: AS 6413/1 and AS6413/2.

D. Hill: The Standard has progressed down to no longer a packaging test but a propagation test, so all the testing that has been done for the standard now. Presently, we do not allow bulk shipping of batteries at a SOC of greater than 30%. My concern is that the current testing is moving away from the intent of the Standard. The intent originally was to develope a packaging Standard so the packaging would take care of the thermal runaway of the cells. B Johnson: This testing is a check of the Standard to make sure it contains everything it needs to contain before it is published. E. Canari: We started with an intention to screen certain packaging types.

FAA G-27 Round Robin Testing – S. Rehn (FAATC)

Steve described the test setup. Six labs ran 9 tests each. Three labs have submitted their results. A photo of the G-27 test chamber was shown and Steve described how it can be varied.

Leak Rate Calibration: Leak Test conducted at two chamber sizes.

Ignition Point Calibration: Methane flowed into the chamber at 2 L/min. Tested with spark ignitor at three positions. High location concentration is 5.4% less than low location.

Steve described the Round Robin Testing setup and the Pass-Fail Criteria. Tests: 33% SOC Test 1: heater rated for 56V, tested with a 30V power supply. Max battery temp of 231°C with no thermal runaway. Held above 200°C for 62 minutes with no thermal runaway.

A video of 33% SOC Test 2 was shown and results of that test were presented.

44% SOC Test 1 video was shown, and results of that test were presented.

Test Setup Problems: Initiating cell as received had too much thermal grease which caused the thermocouple and tape to not stay in place. / Heater and TC setup was redone for all tests except 44% SOC Tests 2 and 3. / This caused heating rates to be more variable in those tests.

Steve presented results of 44% SOC Tests 2 & 3.

55% SOC Test 1 video was shown, and test results were presented. No fire, no propagation. Same for Test 2 and 3.

Post-Test Calibration was conducted.

Conclusion:

Procedure generally worked well. Similar test results from the three labs that conducted round robin tests. Since the SOC was too low to allow for propagation, it will be difficult to learn much without a failing case. / Holding cell at 200°C for one hour is likely inadequate to drive many cells into thermal runaway. / Tests will be prepared at a higher SOC that will lead to failures.

S. Holz: You push fresh air into the chamber, right? Do you know how much air you push in? S. Rehn: The chamber is not ventilated. It has leaks but is not ventilated. S. Holz: Is the mixture of air and gas the same as you would have in a cargo compartment? B. Johnson: The actual performance of the cargo compartment? The volume of air is calculated as a ratio to approximate the free air space in the cargo compartment. D. Hill: The volume in the box remains at atmospheric conditions. You are off gassing an amount of gas that could raise the pressure. The volume of the box was defined by testing we did in a 737 cargo compartment. Question: What was your consideration for environmental conditioning of the cardboard and the use of the tape to close the box? S. Rehn: That is part of the Standard. The box is placed in a conditioning chamber for at least 24 hours. The chamber was not conditioned. Comment: It is cellulosic materials which could be affected by humidity. N. Olsen: What was the rationale for using a fan? D. Hill: I think in the initial tests we conducted we did not use a fan. We wanted a Standard for a package. Realistically, if this passed the way it is the Standard could be used for 100% SOC cells that all propagate, but no has ever tested that as part of developing the Standard.

<u>Fire Containment Bags for PEDs</u> – D. Keslar (FAATC)

Background was provided. PEDs: Phones, laptops, tablets, etc. Significant increase in lithium battery incidents involving smoke, fire, or heat in passenger aircraft. Dan reviewed the FAA guidance. PED fire training videos are available on the FAA Fire Safety website (www.fire.tc.faa.gov).

Lithium Battery Watt-hour Restrictions: Limited to 100 watt-hour (Wh) on aircraft. With airline approval, passengers may also carry two spare larger lithium-ion batteries (101-160 Wh).

Fire Containment Bag Test Setup: Fire Containment products tested with three different fuel loads. PEDs charged to 100% SOC. Products evaluated only to the maximum advertised capacity it could withstand. Thermocouples were places throughout the interior and exterior of the bag. Dan described

the types of fire containment bags tested and showed photos of the bags tested. Dan described the tests conducted. Manufacturer instructions were followed for use of each fire containment bag.

Conclusions: Test results show that the effectiveness of commercially available fire containment products vary significantly between manufacturers. / Testing suggests that a test standard may need to be developed or adopted to ensure airline occupant safety. / FAA does not recommend moving a flaming device –even if the manufacturer suggests doing so in their products directions. / Best use cases of FCBs may be preventative. / Airlines may have expectations for product performance that certain products cannot currently deliver. / Testing suggests that a standard may need to be developed or adopted to ensure airline occupant safety.

Future Work: Testing with additional fire containment products will be conducted. Once testing is complete, FAA will publish a final report.

Question: Mfr. D – It was showing that it was a dry agent, or was a liquid agent also included in the testing? D. Keslar: This manufacturer did not recommend any water or other liquid agent. S. Holz: Each product has a certain limit, a passenger does not know the watt hours (Wh) of their PED. If your device has more energy than the bag can contain. D. Schlichting (ALPA): Has there been enough testing on what would be a preemptive state? We have had people with swollen devices, warm devices at what point are we reaching a preemptive state? D Keslar: Any signs of thermal runaway such as swelling of device, discoloration of the screen, etc., as early as you can in the process to transfer the device into the case. S. Campbell: You said there is an incidence of one per week. Of those incidents are they already on fire or preemptive? D. Keslar: The organization that collects that information for us is the Hazmat group. The overall includes fire, smoke, and heat.

State of Charge Verification of UN 3480 Lithium-ion Cells – D. Keslar (FAATC)

The transportation of lithium batteries on aircraft is heavily regulated. Li-ion cells and batteries not packed with or contained within equipment must be classified as UN 3480. / UN 3480 cells cannot exceed 30% SOC when transported in bulk on cargo aircraft.

SOC Testing:

Lithium-ion cells were ordered from e-commerce platforms and sent for analysis to the FAA Technical Center. Specialized battery analysis equipment was used to measure a cell's SOC. In total, 124 cells from 30 different shipments were evaluated. A photo of the different cells evaluated was shown. A lot of the packages did not include important information: Where they were shipped from, no package tracking, no identifiable business address. The results of these tests were presented.

New Battery Hazard Measurement Capabilities DC-GC-MS – R. Walters (FAATC)

FAA Fire Safety Branch now has DC-GC-MS analysis equipment. Rich reviewed work done previous to receipt of this new equipment (Bomb Calorimeter was used). Reports are available on the FAA Fire Safety website (www.fire.tc.faa.gov). He plans to do the same work with the Detonation Calorimeter. Forced thermal runaway tests are planned: Thermal, mechanical, and electrical. Battery Gas Analysis: Gas Chromatograph: Separates gas/liquid mixtures into individual components. We will be looking for H2, C2H6, etc. It is method specific. Mass Spectrometer: Fragments molecules into smaller pieces (mass spectrum). / Fragment patterns can be searched for identification of unknown.

Planned Research:

GC-MS training and method development in June 2024.

Characterize battery systems for energetics & pressures generated in different atmospheres – Chemical energy vs. combustion energy. Characterize gases generated from battery/cell degradation.

THURSDAY, APRIL 18, 2024

Task Group Reports

Additive Manufacturing Task Group Report
Prepared by Dan Keslar (FAA), Task Group Lead
Email: daniel.keslar@faa.gov

Prior to the meeting, a discussion paper was distributed to the members of the task group, which provided an unofficial summary of the additive manufacturing (AM) issue paper the FAA has developed. Members were given a few minutes to review the document. The group expressed a desire to alter some points within the paper.

Coordination with the FAA Policy and Standards Division, Cabin Safety Section (AIR-624) is required to determine if a method of compliance issue paper is needed for AM parts that must meet part 25 flammability. As a result of extensive testing performed by the FAA on ULTEM 9085, parts constructed with this material do not need special coordination with AIR-624, but must still demonstrate compliance with flammability requirements. The group expressed interest in updating the issue paper, so other fire resistant materials could be included within this exception. If the material could demonstrate that it has a lower heat release than the current “baseline” material ULTEM 9085, then it would be reasonable to include the material within that exception.

Furthermore, the group requested a stipulation within the issue paper be removed. Currently, the issue paper specifies that the applicants should define the process that was used to construct the 3D printed part. This includes the machine the part was printed on, the print parameters used, the computer-aided design (CAD) program, and the part design specifications. The group requested the part in the statement above requiring the CAD program be removed, as it is unnecessary.

Lastly, the group expressed interest in testing with other types of AM, particularly those that are powder based. It was established that the Tech Center will try to reach out to AM printer manufacturers to see if they could potentially provide samples for future testing.

Vertical Flame Propagation Task Group Report
Prepared by Tina Emami (FAA), Task Group Lead
Email: tina.emami@faa.gov

VFP Task Group Summary April 2024 - Bremen

1. The task group members agreed on looking into a fully defined new heater and utilizing the heat flux gradient measurements in the definition of the new heater output. This is done with the understanding that the heat flux values may not be exact, but they will have the same relative trend.
2. A few labs have volunteered to record the measurements of heat flux upon their machine’s sample to develop a stronger average of the heat flux guidance for the new heater.
3. It was acknowledged that heat flux gauges may not be calibrated properly, as has been an issue with other applications and we will work this into testing as a variable.

4. A heat flux measurement procedure will be written to distribute to the group so that everyone is on the same page in performing regular heat flux measurements as well as the heat flux mapping measurements.
5. The three manufacturers have all agreed on one design for the body of the ribbon burner. They have also now agreed on their imprint on the bottom portion of the heater to be the same as well, they will all have the same width leading up to the body of the heater.
6. It was brought up to standardize the method of cleaning the burners so that they are not damaged in the process or may affect the flame output.
7. There was a discussion on the height of the VFP unit and standardizing what the base looks like (the honeycomb and perforated plate location) along with where the height of the machine is measured (from the table top its sitting on to the base of the unit).
8. Discussed using the flame length tool to understand the practicality of its use before moving forward with standardizing it.

Waste Compartment Fire Containment Task Group Report
Prepared by Scott Campbell (Safran), Task Group Co-Lead
Email: scott.campbell@safran.com, lindsey.p.anaya@faa.gov

Chapter 10 discussion

1/ Smoke- Jeff Gardlin addressed the task group stating that the intended function of the waste compartment is to contain fire and that it wouldn't be regulatory appropriate to extend 25.1301 to require a smoke requirement. Companies are welcome to develop smoke requirements in addition to the regulatory fire containment requirements.

2/ Meal Boxes- Task group received information confirming that meal boxes and galley standard containers are synonymous terms. Task group members representing catering equipment manufacturers do not manufacture non-metallic meal boxes/ standard containers. Received images for half carts that can carry meal boxes for cabin service. Will include image in the next Chapter 10 update.

MOC Reports

1/ Reviewed report addressing MOC #3 [Material Substitution for Waste Containers].

a/ Comment to only allow MOC for waste compartments with an integral floor.

b/ Comment to clarify paragraph 3 options.

We will continue to meet monthly to work through Chp 10 comments and review task group member MOC reports.

OSU/HR2 Task Group Report
Prepared by Brian Johnson (Boeing), Onsite Lead
Email: brian.e.johnson@boeing.com

Review of Martin and Mike's Presentation

- Discussed the unspecified dimension from the center of the diamond mask to the top of the lower plate and its effect on dwell time/air temperature due to chamber volume.
- Mike took an action to attempt to correlate the data with the last OSU round robin.
- Deatak HR2 from the FAA TC has been installed in at Herb Curry – the next step is to gather operating parameters.

- Discussed the new T-Burner and relocation – goal was to get a cal factor similar to OSU, however it is likely that HR2 will be 9-11% lower than OSU, which may require a correction factor or pass/fail criteria change, which may be difficult as values are published in the NPRM.
- Mike mentioned that the HR2 design is fixed.
- R. Buoniconti expressed a concern that some materials may behave differently in HR2, some worse, some better
- M. Spencer observed that the OSU and HR2 used in material comparison should have the same diamond mask to lower plate dimension (agreed, noted)
- Brian took an action to define and conduct a simple comparison of current OSU and HR2 performance (will involve M. Burns, M. Spencer, Y. Behboud)
- Discussed laser smoke monitoring system development – system may need to be shrouded to protect from stray light and protect operators.
- C. Thomas commented that this is usually done in a duct at certain distances to ensure mixing.
- M. Burns mentioned that the objective is to compare the single beam laser to a planar approach.
- R. Buoniconti asked the team to consider a cone calorimeter as an option, as it is tried and true.

Boeing Presentation Review

- Brian briefly reviewed the similarity between the FAA TC and Boeing current pressures and parameters.
- Y. Behboud discussed the calibration of heat flux gauges and the intent to calibrate the methane and air mass flow controllers prior to proceeding to TRL 6
- Reviewed T. Spanos presentation on the sonic choke parameter sensitivities
- It was noted that the Deatak HR2 at Herb Curry has the sonic choke installed (Fox serial #2, 0.208 throat diameter)
- The number of labs participating in TRL 6 will be reviewed and finalized in September 2024.

The list of OSU/HR2 Task Group Attendees is provided on the last page of these Minutes.

HFC Refrigerant Replacement Task Group Report
Prepared by Wade Stoelting (Boeing), Task Group Lead
Email: wade.b.stoelting@boeing.com

Thanks to all of you whom participated.

- Wade Stoelting, HFC Refrigerant Replacement task group leader, presented the Mission Statement, in short "…*mutually accepted strategy in showing alternative flammable refrigerants are safe for use on commercial passenger aircraft."*
- Margaret Sheppard, US EPA representative, provided a US EPA Regulatory Update regarding SNAP, US AIM ACT, Technology Transitions Final Rule compliance, PFAS Strategic Roadmap, California and Washington State HFC restrictions:
    - See attached presentation EPA Regulations HFC Refrigerant Task Group Meeting_April 2024.pdf
    - Members were alerted by the discussion as Margaret identified "Supplemental Cooling Units (SCU's)" immediately impacted by the Final Technology Transitions rule with refrigerant restrictions starting as early as January 1st, 2025. Boeing identifies SCU's are used on the 787, AIRBUS acknowledges SCUs are used on the A350. From EPA's understanding it appears the terminology, "SCU" is associated with residential and light commercial air conditioning and heat pumps subsector in EPA transitions rule discussions. John Reynolds identified "SCU" applications on aircraft are associated with

chilling of a liquid medium that is flowed to galleys for food chilling and other areas of the airplane for equipment, cargo and passenger cabin temperature management. Mike Zimmerman, Collins, inquired why commercial airplane equipment is being associated with ground-based, retail food refrigeration and suggested aircraft products are more related to transportation sector. Marcelo Merzvinskas, Embraer, identified the Embraer aircraft utilizes the vapor-compression cycle refrigeration principles for the aircrafts environmental cooling system and questioned the transition rule schedule of phasedown. Margaret indicated that this system may also fall under the transitions rule to find alternative refrigerant by January 1st, 2025. Margaret captured several questions by the participants and is sharing with her colleagues at EPA to ensure a well-considered unified response is provided.

- Joerg Rommerskirchen, Safran, presented EU F-Gas status.
  - See attached F-Gas status 2024.pptx.
  - Aircraft food chilling equipment is not immediately impacted by the next phasedown rulings for January 1st 2025.
  - During conversation committee participants again identified that alternative refrigerants will results in increased aircraft weight, power usage, and fuel burn which tallies up to a larger carbon footprint than if remaining to use the current HFC refrigerants.
- Due to lack of remaining time allotted Wade Stoelting quickly identified without going into details that further investigation & study of UL 60335-2-40: Household and Similar Electrical Appliances-Safety, UL 60335-2-89: Household and Similar Electrical Appliances – Safety and related IEC documents would benefit the committee with developing a MOC strategy for use of flammable refrigerants.
- Monthly Virtual Task Group Committee meetings will be scheduled beginning in May.

Hydrogen Fire & Explosion Research Task Groups
Reported at Meeting by Enzo Canari (EASA)

The authorities formed a Steering Group. We will refine the membership by the end of April 2024.

Four Task Groups proposed to work different areas – each group with different scope. Task Groups: Cabin Safety: Post Crash / Cabin Safety: In-Flight / Powerplant: Post Crash / Powerplant: In-Flight. Identify safety gaps, identify research from other areas/organizations/etc., that may be useful.

The draft Research Plan is to be ready in September 2024. By April 30, 2024: Identify the roster for each Task Group. If you want to join one of these Task Groups, email April (April.ctr.Horner@faa.gov) to let us know which Task Group you want to join by April 30, 2024.

MCC Task Group Report
Prepared by Rich Walters (FAATC), Task Group Lead
Email: richard.walters@faa.gov

The MCC Task Group had 24 participants The meeting lasted the entire 90 minutes. There was an initial presentation by me on an overview of the MCC inter-laboratory study, a review of the similarity study that was completed last year, and inquiring if there was a need or want for an MCC users group meeting. I was able to recruit at least 4 more labs to participate in my MCC inter-laboratory study. Industry was definitely interested in making the case for similarity, utilizing the MCC as an alternate means of compliance when a small change to a construction is made. The main discussions focused on running the MCC properly. Users are looking for guidance on standardization, a standard operating procedure or a checklist for optimizing the sample prep and test conditions. I told them about the evolution of the technique and the optimum conditions the test was designed around. I also described sample

preparation methods for different forms of sample and performing pre-test screening of materials to optimize sample size, signal to noise ratio, heating rates, temperature range, baseline drift, oxygen analyzers and more to ensure the best quality data. I referred them to some videos I made for some MCC sample prep basics. Overall, the participation, genuine interest, and enthusiasm about the technique showed there is a need for an MCC users group.

Task Group presentation slides and the Task Group Summary slide are available on the FAA Fire Safety website with the April 16-18, 2024, Meeting Presentations.

RTCA Task Group Report
Prepared by Steve Rehn (FAATC), Task Group Co-Lead
Email: lindsey.p.anaya@faa.gov / steven.rehn@faa.gov

The main goal coming into this meeting for the RTCA electronic equipment fire test was to get volunteers for an interlab study to evaluate our new test method. We only had five people show up to the task group meeting, but we did get some interest in participating in this study. Prior to the task group meeting, Embraer volunteered to participate, and then during the meeting Airbus volunteered to participate as well. These two labs, in addition to the FAA and two other test labs that previously volunteered brings us to five total. This should be enough to get a good evaluation of the test method text and reproducibility data.

Also in the task group meeting, there was some general conversation about how the interlab study will be setup. Several identical enclosures have been made and will be sent to each lab with different circuit board materials. Each lab will run several tests on their enclosure burning the different materials inside. There will be specific instructions for how to handle the test articles, but besides that we will just be following our written test procedure that we have developed with this task group over the years.

In addition, we talked about how testing of electronic equipment is currently done with the vertical Bunsen burner. There is some guidance specific to testing printed circuit boards listed in the FAA Policy Statement on Flammability Testing of Interior Materials. Representatives from Airbus detailed how they make their test samples for the vertical Bunsen burner test.

The FAA will be reaching out shortly to the test labs who volunteered to participate in this interlab study.

Cargo MPS Task Group
Prepared by Dhaval Dadia (FAATC), Task Group Lead
Email: dhaval.dadia@faa.gov

The cargo MPS task group participant George McEachen, representing Boeing Co., mentioned that they are working towards recording the results of the testing completed at the Boeing test facility through reports that will be published on the tech centers website. They intend to publish the associated videos of the testing along with the reports. The discussion progressed to re-evaluating the use of time-temperature integral as one of the key acceptance criteria and whether there is a need to alter the timeframe during which the integral is evaluated or a new value to be used in place of the time temperature integral. The group decided to accept the time-temperature integral as defined and an additional value of an average temperature over the 28-minute timeframe can be used to make the criteria more relatable.

The task group further discussed the idea of developing a relationship between the time temperature integral of an unsuppressed fire scenario to the time temperature integral of the suppressed fire. The correlation can be used for facilities that aren’t able to conduct full scale testing to establish a baseline

acceptance criteria using Halon 1301. A smaller group will work on the datasets and present to the task group in June.

The task group also proposed discussing the measurement technique for calculating the ventilation in the compartment. Two prominent techniques used in the field are calibrated flow tube and pressurized airflow. Each technique has an effect on the calculation.

The next cargo MPS task group will meet virtually on June 18th, 2024.

Next Forum Meeting:

Status: The FAA meeting request is currently in the internal FAA approval process.

Dates requested: September 24-26, 2024.

Location: Resorts Casino-Hotel, Atlantic City, New Jersey, USA

To be added to the Forum Distribution List contact April Horner (april.ctr.horner@faa.gov).

The meeting dates will be available on the FAA Fire Safety website (www.fire.tc.faa.gov) as soon as everything is finalized.

OSU/HR2 Task Group Meeting Attendees – Thursday, April 18, 2024

Brian Johnson (Boeing)
Yonas Behboud (Boeing)
Chad Gadberry (ZIM Aircraft Cabin Solutions)
Martin Spencer (Marlin Engineering)
Ken Young (Boeing)
Michael Yue (Safran)
Jan Christian Thomas (Airbus)
Scott Campbell (Safran)
Martin Mueller (Lufthansa Technik)
Tim Luebcke (Lufthansa Technik)
Peter Perdijk (Collins Aerospace)
Gregoire Ghilbert (VVC)
Gunner Hansen (Mankiewicz)
Heiko Nussel (Lantal)
David Heyes-Fisher (AVIC Cabin Systems UK Ltd.)
Thomas Pitts (Collins Aerospace)
Ander Montero (CTA)
Laura Vega (CTA)
Jeff Gardlin (FAA)
Tina Emami (FAA)
Ray Bashford (Concept Equipment)
Michael Przybilla (DLR – Inst. AT – MPB Trauen)
Rich Walters (FAA)
Wes VanHuss (Deatak)
Yaw Agyei (Boeing)
Raimund Fritzl (Isovolta)
James Nauman (Testcorp)
Thomas Ntentes (Mankiewicz)
David Baker (Schneller)
Bob Plants (Schneller)

OSU/HR2 Task Group Meeting Attendees – Thursday, April 18, 2024 (continued)

Doris Strudhoff (Airbus)
Sandra Struebing (Airbus)
Dominik Bruchmann (Airbus)
Finn Holldorf (Airbus)
Hauke Henning (Airbus)
Gilberto Imamura (Jamco)
Yoshiyuki Shimojo (Jamco)
Lydia Meli (EASA)
Nikolai Gerasimov (Airbus)
Sebastian Mittlebach (Airbus)
Jeronimo Carrascal (Airbus)
Juan Hidalgo Medina (Airbus)
Ralph Buoniconti (SABIC)
Theodoros Spanos (Boeing)
Gicela Zambon (Embraer)
Paulo Nunes (Embraer)