International Aircraft Materials Fire Test Forum Meeting

October 16-17, 2023

William J. Hughes Federal Aviation Administration (FAA) Technical Center, New Jersey, USA

Monday, October 16, 2023

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

Tina provided an overview of the VFP test apparatus and its use.

Differences in internal chamber sizes: differences were found in the internal height and width of VFP chambers. Depth of all machines is the same. Internal sizes: 21"x21" and 22"x22". Tina conducted tests to compare the two apparatuses with different internal chamber sizes. She reviewed the results with different materials: a composite material and a unplasticized PVC. Photos of some of the test samples were shown. Heat flux gradient upon sample: Tina described this testing process and presented the results. The Task Group will discuss Heat Flux Gradient moving forward from here. Airbus will give a presentation on the differences of different VFP chambers during today's VFP Task Group meeting. B. Johnson: You added more material to the chamber to test, but your conclusion was that the chamber size didn't make a difference. T. Emami: I will think on that and get back to you. Question: Do you have any of the Round Robin test results to share during this meeting? T. Emami: I can bring that to the Task Group meeting.

Heat Release Rate (HR2) Updates – Mike Burns (FAATC)

Updated Appendix L: HFG (Heat Flux Gauge): Two (2) manufacturers, sonic choke information (part number and company contact information), L.1.1.1.16 Efficiency Estimation of Globar Heating and Unit insulation was updated. Hot Surface Igniter (HSI) and Calibration: possible error induced during thermopile calibration when hot surface igniter rod is installed. Data with HSI brackets installed and rod removed and with HSI brackets and rod installed was presented. Induced error could increase HRR test results by approximately 5 percent. We will have to come to a consensus as to whether the rod should be in place during calibration or not.

HR2 Reflector plate aging issue: The flat plate is now curling forward on our machine (FAATC lab has had this machine about 4-5 years. FLIR images presented to show the impact made by the aging of this plate. We do not have a good feel for what it might be doing to the airflow coming up through the machines. This is a common problem in OSUs. Our hope is to be able to try to redesign the plate. We will talk about that more in the Task Group meeting.

TRL 6 Update: Boeing HR2: heater activation turning off Mass Flow Controller (MFC) airflow. Manufacturer has been working with Boeing to resolve this issue. Chemitox HR2: Chemitox has offered to participate as much as they can. They have been unable to proceed with 100 calibration cycles due to heavy workload of the lab. They will meet internally to determine if they have enough time to continue participating in the TRL6.

OSU Thermopile Discussion: The confusion lies in the lower plenum. The 5 wires do a crossover in the lower plenum. You end up with 4 that are red and yellow beaded together, but you have 2 wires left over. The proper location is it must be in the lower plenum area, so you have a red with the copper and a yellow with the copper. Mike showed images of what he has seen in the past. Please go back and double check your equipment.

Next: Continue TRL6 testing. Define normal operation parameters range (baseline [BL], test [TST], calibration factor [CF]). Additional unit buildups for comparative testing (TRL6). TRL7 planning and acquisition of materials is underway. Formalize endgame for TRL test series (define activities, goals, etc.).

J. Davis: There are some improvements on HR2 that could easily be taken back to the old OSU. M. Burns: Going forward the old can be used but it will not be supported by this group.

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

Our HR2 is back up and running. HR2 – Next Generation OSU: A photo of the Boeing HR2 was shown as well as schematic of unit. HR2 Development Goal and Status: HR2 Goal: Define a robust method to determine peak and total heat release that improves repeatability and reproducibility when compared with OSU. TRL 6: Reproducibility-The HR2 Tailored TRL Development Model was reviewed. TRL 6 Test Plan – Part 2: was re-presented. Note: Final TRL 6 decision requires data from more instruments (units). Results and Takeaways were presented. Discussion on Boeing lab HR2 initial challenges: Marlin HR2 unit installed in Seattle Flammability lab. Initial challenges with low pressure and airflow. HR2 heater activation caused the Omega MFC to stop airflow (MFC remained powered on). Repair attempts resulted in Omega MFC failure. Mike Burns loaned FAATC MFC. FAATC MFC installed but lower plenum pressure and observed flow were still lower than expected. Repaired Boeing Omega MFC received and installed with new assembly. Heater activation MFC interface was discovered to be a grounding issue. Also corrected an issue with lower thermocouple electrical interference – Task Group discussion. These challenges lead us to reconsider a few things. We learned that the Omega company was no longer producing the higher airflow MFC. We started looking into the sonic choke from Fox Valve, Inc., due to these issues. Boeing HR2 is now functioning properly. Operating parameter collection has begun. Brian will share the results during the Task Group meeting tomorrow. TRL 7 – Notional Plan was mentioned. Next Steps: The anticipated schedule was briefly reviewed.

RTCA Development of a New Flammability Test for Electronic Equipment – Lindsey Anaya (FAATC)

Section 26, Category C Programmable Line Burner Method

RTCA DO-160G – DO-160H

Current standards: electronic equipment must be broken down into its individual parts and tested using various Bunsen burner tests. New Test Method: Programmable Line Burner – based on telecom industry test ANSI T1.319. FAATC looked into non-vented boxes (Non-Vented Exemption). What does no ventilation really mean?: An enclosure is considered to have no ventilation if the total open area is less than 4 times the longest outside dimension up to a maximum of 700 mm^2. We will discuss this more in the Task Group meeting today and determine if it needs to be reevaluated. Lindsey reviewed the Pass/Fail Criteria and provided more description of what a flame is. Camera/Blue LED System for Flame Detection: Lindsey came up with this system to identify the flames. This is outlined in the DO-160 draft. Lindsey also reviewed the optional Video Capture and Analysis Software she uses. See her presentation for this information. A Video Analysis Round Robin was conducted. Lindsey sent out 4 FAA test video files to be analyzed by 11 participating labs. The Round Robin results were presented. Validation Status: FAA submitted new method as a Change Proposal (CP) to RTCA committee in February 2023 for comments. Next Steps: Complete a traditional lab Round Robin to verify test set up and Round Robin results are similar/acceptable. Question: Is there any consideration for boxes that have fan cooling? Linsey: It is however it is set up in production.

Materials Oil Burner Test Update – Tim Salter (FAATC)

Updates to Materials Fire Test Handbook Chapters: 7, 8, and 24. Tim is finalizing a report on the use of the air shroud for the cargo liner oil burner test.

Handbook Chapters 7 & 8 Updates: Most recent update was June 2023. Tim reviewed the June 2023 updates to these Chapters: Burner cone diagram and dimensions. Cone reinforcement frame added to reduce the chance of cone warpage. Comparison data for Frame and No Frame for Seat Cushion Type 1 and Seat Cushion Type 2 was presented. Chapter 24 Updates: Updates to recommended fuel nozzle type and air pressure setting have been made. Test data showed the previous fuel nozzle and air pressure setting to be too severe during testing. New data shows need for change to make test results more equivalent to original Sonic burner test results. These updates apply to the Sonic burner only. They do not apply to the legacy burner.

Cargo Liner Air Shroud Report: FAATC is currently publishing a report on the shroud. Optional use of shroud may be added to Chapter 8.

M. Jensen: On the results where you had differences between labs, did you note what the other differences in the labs were? T. Salter: We did ask for type of burner, lab size, etc. M. Jensen: Will that be published in the report? T. Salter: Yes.

Bunsen Burner Burn Length Determination – Kimberly Orlando (Safran)

Burn length definition from 14 CFR 25.853(a) Appendix F. The *Aircraft Materials Fire Test Handbook* also includes burn length determination. Kimberly showed a few videos of different material samples and discussed identifying the burn length on these materials. H. Nuessel: Maybe you can add a remark on the test report like burn length of 2-3" but melt away of material to 7-8". This presentation will be available on the FAA Fire Safety website with the presentations from this Materials meeting.

Tim Marker: Does anyone have any questions on what has been discussed/presented to this point? There were no additional questions/comments from attendees.

Relationship Between 3-D Printed Materials and Flammability – Dan Keslar (FAATC)

Work done by Dan Keslar and Steve Rehn at FAATC.

Objective: Determine the worst-case flammability scenario for each parameter to simplify future testing and certification. Parameters were tested according to the vertical Bunsen burner (VBB) test. A review of previous testing was provided. Parameters looked at: Infill pattern and infill percentage, raster angle and raster width, thickness of sample, and print orientation. Examples of infill percentage and thickness data: data presented. Examples of Infill Pattern and Print Orientation data were presented. Print Orientation Material Comparisons: Ultem™ 9085 and Nylon 12 results were presented. Design of Experiments (DOE) Testing: Dan described the Test Set Up and explained the factors altered within the DOE that included: material, thickness (# of inner layers), infill percentage, infill pattern, raster angle, and raster width. DOE Results: All parameters significant as either main or interaction effect for predicting burn length. All parameters except the infill pattern were significant in predicting the flame time. Worst- and best-case scenarios were generated. FAATC is working on releasing a Technical Note DOT/FAA/CTN-23/65 that will be published at a later date. FAATC will also be releasing an Issue Paper that will provide further guidance. Future Steps: Additional testing on other fused filament fabrication (FFF) parameters will be needed such as extrusion flow rate, various layer thicknesses, nozzle diameter, and extruder movement speed. K. Orlando: With the publication of the Technical Note and Issue Paper, will that take additive manufacturing parts out of the novel and new category? T. Marker: We can ask Jeff Gardlin that in a few minutes after his presentation. Question: Did you study if you switched materials in your machine if the residue from a

previously tested material impacted the next material? Did you have a procedure to clean out your machine? D. Keslar: Usually we test one material, and it is purged out. Question: Do we need to test the sample in both directions? D. Keslar: Steve and I want to talk about that during the Task Group meeting tomorrow. Question: How about the print orientation? D. Keslar: That is something that we are going to talk about in the Task Group, also. D. Keslar: There is a study that was conducted elsewhere a few months ago on the extruder temperature and impact on the sample.

MCC Update – Richard Walters, Ph.D. (FAATC)

Microscale Combustion Calorimeter (MCC). Standard Test ASTM D 7309 (Method A). Rich presented a graph that outlined all the information provided by an MCC test (the test takes about 10-15 minutes). Rich explained MCC procedure for Fire Growth Capacity (FGC).

ASTM 7309 Standard: FAA Microscale Combustion Calorimeter: Fire Growth Capacity is a measure of ignitability and burning rate of the material, i.e., the total fire hazard. MCC is proposed method for alternate means of compliance when a small change is made to a construction. Rich provided the background of the Similarity Project. The Materials Change Similarity Task Group came up with a Similarity Criterion. ASTM D7309 Standard Revision: Negative: Specified data window is wrong (temperature based). Replace pages of changes with a single reference. Endpoint selection.

Preliminary Inter-Laboratory Study: Rich has done a preliminary study: Four (4) manufacturers/licensees of the MCC participated. Lab Comparison-Total Heat Release and Fire Growth Capacity results from preliminary study were presented.

ASTM E691: The main inter-laboratory study will be conducted through ASTM E691. Rich described the materials that will be tested in this study. Summary and Future Work: The Inter-laboratory study Round 2 will be run through ASTM.

Micro- and Bench-Scale Fire Growth Parameters – Richard Lyon, Ph.D. (FAATC)

How the MCC number relates to a real fire behavior. Objective: Compare fire behavior of materials for regulatory purposes. Bench scale method using ASTM E1354 Cone Calorimeter: Rich explained the key experimental parameters and derived properties. Fire Growth Potentials are Consistent with Material Fire Performance. Fire Growth Capacity (FGC) is Microscale Metric for FAA Similarity. OSU data was explained (FGC and Heat Release Rate in OSU Fire Calorimeter). H. Nuessel: Did you explain that the cone calorimeter has the potential to replace the OSU and HR2? R. Lyon: I cannot say. If this information gets vetted by the community, I would think it would be a way of alternate means of compliance. H. Nuessel: I believe a project would be to do comparison tests between the OSU/HR2 and the cone calorimeter. R. Lyon: There are a lot of those. It is more or less proportional, but the slope is not 1 to 1.

Smoke Monitoring using Revised Rate of Heat Release Test Method (HR2) – Mike Burns (FAATC)

All materials, parts, and components that must meet the heat release rate (HRR) test requirements are also required to pass the smoke emissions test in accordance with current FAR 25.853(d). This presentation details an optional alternative method of monitoring smoke characteristics of materials using laser technology mounted in the HR2 HRR pparatus, and compares results with the traditional NBS Smoke Density Chamber. Many years ago, smoke was monitored in the OSU. HR2 Smoke Monitoring: Mike presented a table covering the differences between the NBS and HRR test methods. Mike provided the laser equipment information: Coherent Powermax USB Laser/Thermopile Power Sensor. HR2 Smoke Monitoring (E906) was explained. Photos of the laser equipment mounted in the NBS chamber and on the HR2. Mike described the three types of materials tested (5 of each). J. Davis: Have you had a heat

release sample where flames are coming out of the chimney that passed heat release? Mike Burns: No. Mike reviewed Measurement of cumulative smoke release (CSR) in NBS/HR2. Summary: The laser/sensor was affected by the elevated temperatures at the HR2 exhaust opening providing an increase in sensor output. This was compensated for by allowing the HR2 to reach a stable operating temperature prior to setting the sensor baseline power-output. M. Jensen: Did you use any aircraft plastics where we have the smoke issues? M. Burns: I did. I used foam, several layers of foam, stencil board, and thermoplastics. It was a long list. R. Lyon: Did you use a thermal sensor for the laser rather than an optical sensor? M. Burns: This was equipment that was available in our labs. I did not go out and look for specific equipment. R. Bashford: What sort of procedure did you have to do the zero part of the calibration? M. Burns: It was very much like heat release testing. M. Anglin: The Ds 200 to 50 correlation, how many materials did that work for? How many different materials? M. Burns: That one material. Are we saying that if we get 50 with the laser, you are good? M. Burns: Based on the limited testing that was done, yes. M. Jensen: I would like to see more testing to see what the true failure point is given aircraft materials. M. Burns: This was just showing an optional alternative method. Question: Is your thought behind the whole thing that you can use the method is because smoke is not going to be required in the new regulations? You are just looking for a baseline, right? M. Burns: Correct. T. Marker: For typical 65/65 passing material, what does it generally produce in the NBS chamber? Answer: Anywhere between 0 and 195. T. Marker: Moving forward we should test more materials. M. Burns: If you have other materials in mind, maybe you can provide me with some materials. E. Canari: The idea is to have data for test materials for which you have no idea what the results will be in the NBS chamber once the NBS test is no longer required. How will we be doing this when we have no idea what the results would be in the NBS? What do I do with the number, say 50? How will I judge this number? This is my concern.

Miscellaneous Actions – Jeff Gardlin (FAA)

Certification Issues: Additive Manufacturing: Proposals for use starting to ramp up. Main concerns related to structural capability and materials variability. Flammability is a concern many times even if there are no structural concerns. Task Group continues to generate good information. FAA intending to flag Additive Manufacturing as needing attention relative to flammability on the “Issues List”. Companion Issues: What is the type design? What kinds of tests are needed to adequately evaluate the type design?

Proposed ACs Not Exclusive to NPRM 19-09: Seat Cushions 25.853-1 (or-2); Cargo Liners (25.855-1); Thermal/Acoustic Insulation 25.856-1 and -2; Bunsen Burner 25.853-4, Policy Statement 25.853-3.

SNPRM for NPRM 19-09: SNPRM published in August. Comment period extended to November 30, 2023, from October 2, 2023. Comment period on draft AC similarly extended.

The intent of Mike’s work on Smoke Monitoring in the HR2 was to show that the methodology will work. It will probably be a while before that method would be the sole method to make an assessment. We recognized that there would be a lot more work to do to use it as a substitute for the NBS.

TUESDAY, OCTOBER 17, 2023

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

EASA Plan for the harmonization with FAA NPRM: EASA has been involved in the development of the new regulatory material and confirms the intention to harmonize the FAA.

Impact of FAA NPRM: 14 CFR Parts 25, 27, 29, 91, 121, 125 and 135.

Impact of the EASA NPA: CS-25, CS-27, CS-29, and CS-26.

EASA expects that the NPA will receive comments generated by the first phase of implementation of the new FAA rule and the associated guidance material.

Update of CM-CS-001 (Use of Aircraft Materials Fire Test Handbook DOT/FAA/AR-00/12). The CM will be updated to include a reference to Chapter 23 (Radiant Panel Test) and Chapter 24 (Burnthrough) of the *Aircraft Materials Fire Test Handbook*. The revised CM should undergo public comment in Q2 2024.

EASA Proposed Certification Memorandum on Miscellaneous Flammability Topics: Enzo discussed the list of addressed topics: SAE ARP6199 rev. A and rev. B are an acceptable MOC with the seat HR/SE Special Conditions, Magnesium alloys for seats, additive manufacturing, and hierarchy of testing.

Thermal or acoustic insulation: EASA retroactive requirements were discussed.

HEALTH: New Health Safety Measures in Aircraft: This is part of a broader group of projects EASA has worked on during the past six to eight months. Enzo reviewed the tentative list of projects. Horizon Europe Project: Call for Tender to be published in Q4 2024. Project duration 36 months. Expected outcome: Identification of scientifically proven solutions to reduce the spread of airborne infectious agents within the aircraft environment. Impact of various disinfection and cleaning methods implemented by operators on continued airworthiness and maintenance.

Hydrogen Fuel Testing at FAATC – Dick Hill (FAATC)

One of the main green proposals is going from hydrocarbon fuels to hydrogen fuel in aviation which leads to how do we certify them. Two of the concerns are flammability and leakage. The following presentations cover some of the work we have been doing. We are just starting on this work.

Bunsen Burner Testing in Low Concentration Hydrogen Environment – Steve Rehn (FAATC)

Steve described the Bunsen burner tests he conducted and presented results of these tests. He showed videos of the tests. The hydrogen concentrations below the lower flammability limit (LFL) can have significant impact on material fires.

HR2 HRR Apparatus Hydrogen Testing – Mike Burns (FAATC)

Test Set Up: Bottled hydrogen was plumbed into the main air supply just prior to entering the HR2 unit. Three series of tests were conducted: 0%, 1%, and 2% hydrogen by volume (in air). Standard heat flux and airflow conditions established prior to calibration and testing. Calibrations conducted with and without hydrogen (modified equation). Four (4) materials selected in sets of 5 (60 count). A photo of the test set up is available in the presentation. Mike reviewed the calibration data. Mike reviewed the test results and data collected. Summary: Baseline temperature showed significant increases in the presence of hydrogen. Elevated peak heat release rate (PHR), total heat release (THR), and exhaust gas temperature (EGT) were observed with increased hydrogen concentrations.

Hydrogen Flame Characteristics – John Kurtanidze (Rutgers University)

John reviewed the challenges with hydrogen, including easy to ignite and explosive (minimum ignition energy [MIE]: 0.019 mJ; flammability limit 4-75% by volume), difficult to store, hydrogen embrittlement, dangerous in confined spaces. Hydrogen flames are invisible in daylight. Project Objective: Experimentally imitate tiny hydrogen leak ignition; study hydrogen flame characteristics; and note the effects of leak size and shape, standard flow rate, and exit-plate spacing. Photos of the test set up were shown. John described the experimental method. Test results were presented. Takeaway: flame length increase with standard flowrate (SFR); more buoyant → shorter flame. Change in leak size does not have as much influence as SFR for flame length. Flame Heat Flux: Takeaway: unburned H_2 gas zone is more. Flame

Temperature: Takeaway: Temperature increase along the z-axis and reduces radically away from the centerline. Circular vs. Slot Shaped Nozzles: The difference is marginal. SFR and leak size matter. Future Work: Possibly use vertical burner to create a buoyancy effect. Test bigger hydrogen leaks.

Future Impact of Alternate Fuels on Material Flammability – Dick Hill (FAATC)

Inflight: We tried to look at what would happen if you had small concentrations mostly on materials that would be in the crown area because that is likely where the hydrogen leak would be located. How does hydrogen flow if you have a leak? How many detectors would you need for hydrogen? Postcrash concerns/considerations as well.

Task Group Reports:

OSU/HR2 Task Group– Brian Johnson (Boeing)

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

Task Group Report prepared by Brian Johnson (Boeing) brian.e.johnson8@boeing.com

Classroom Session:

TRL 7 Plan Review

- 1 OSU and 1 HR2 are targeted for participation in TRL 7

- TRL 6 will demonstrate that all HR2's are equivalent, so that any one can be used for TRL 7 testing

- The group decided to use one of the units at the Tech Center as Mike is the most experienced operator

- It was proposed to review prior OSU round robin data and pick 5-10 labs from the distribution center for potential use for TRL 7 OSU testing

- The method of selection will be further discussed in our next monthly meeting in early November

- Reviewed constructions in the current matrix and discussed that we believe these specimen types represent a range of materials that are used in current production

- It was suggested that panels could be painted with one or more layers of paint to increase heat release results

- Discussed a proposed method for coupon manufacturing, painting, ship to Boeing for numbering, randomization, and grouping, and then shipped to FAA TC for conditioning chamber storage

Boeing HR2 Status Review

- Briefly reviewed historical slides presented

- Yonas discussed results for data gathered so far for the 3 operating parameters (53 measurements)

- Three data points collected were out of the accepted range for Thermal Stability Temperature (above/high) and Calibration Factor (below/low)

- Discussed the fact that ranges were developed based on data from the FAA TC instruments only and may need to be adjusted

- Also discussed current measurements of lower plenum and air supply pressures than what is observed at the FAA TC (11.6 vs. 13.9 in H2O)

- Boeing will continue to complete measurement of 100 operating parameters

- Boeing will also move quickly toward making the sonic choke airflow option viable

- Once the sonic choke is operating, Boeing will compare plenum and supply pressures, and generate additional operating parameter data

- Group will continue to work with Chemitox to encourage / secure their participation in TRL 6

Lab Session:

Tour of Mike's Lab

Mike's Presentation

Appendix changes:

- Heat flux gauge specification updated to include the use of Gardon heat flux gauges in addition to current Schmidt-Boelter

- Sonic choke air supply option added

- Insulation efficiency estimation technique and calculation discussion (optional)

- HSI Impact on calibration during 3 liter flow was discussed – Mike's data showed heat sinking affect (>10%) on calculated calibration factor due to increased conductive heat transfer with rod in place

- Based on this data, it was decided to remove the HSI during calibration due to this observed effect

- Decision to further investigate methods to improve safety in the rod replacement procedure with a heated instrument

- Mike described the proposed alignment fixture and explained the benefits and drawbacks, and the next steps in the design (drip tray)

- Mike reviewed the material he presented on Reflector Plate Aging and how the plate can warp and deform over time to potentially impact radiated heat and airflow in the unit

VFP Task Group – Tina Emami (FAATC)

Lead: Tina Emami (FAATC) tina.emami@faa.gov

Airbus Vertical Flame Propagation Testing – Thomas Krause (Airbus) [FAATC Auditorium] October 16, 2023

Airbus encountered a number of challenges in the comparison of its VFP chambers. Thomas described these challenges. Points for discussion: industrial chamber spec required; heat source and assembly – can we apply changes to make them more comparable; pilot flame – size and appearance definition?

T. Emami: When was the last time you replaced the ribbon burner? T. Krause: We did not replace it in the Deatak machine, but we did replace it in the Marlin Engineering machine. T. Krause: Does anyone have any thoughts on those results or the flame? E. Nixon: What are the differences between the two machines' burners? T. Krause: The baffle is the only difference we found. Question: You mentioned that the inlet was also different. T. Krause: This is where we really need to hear from Marlin Engineering and Deatak to

know if they built to the Spec. M. Spencer: I will look into the dimensions of the internal diameter. M. Schall: I believe our burners were built before the spec. I can look into how we spec'd and share what that internal opening is in the design. T. Emami: Working towards understanding the differences in how they are built and having another calibration method. Thomas: If we move towards a tighter industrial spec, this will be eliminated. M. Anglin: We took pictures of ours, so we will look and see. T. Krause: Does anyone have any comments about standardization? T. Emami: In my original presentation, I had the mapping out of the heat flux gauges, and you kind of addressed that here. T. Emami: Does anyone have input on the heater? Y. Behboud: In a couple of your slides where you showed some of the gradients on the sample. I think I might have a reason for that. I think it is because of the recess of the heater on the Deatak machine. On one heater, the heater coil is protruding a little bit. In addition, I looked at some of the pictures that we have taken of our Deatak and the flame profile matches exactly what you have shown here. M. Anglin: We also noted that where the coil shape is there is more open space on one machine than the other. R. Bashford: We haven't done that work yet on developing the heater gradient specifications. T. Emami: If you see something important that should be quantified in designing these types of heaters, bring it up now. T. Krause: would anyone be willing to replicate our thermal imaging? We can supply you with the details of our painting. I can get you the contact details for my colleague who worked on this with our student. T. Emami: Does anyone want to participate? T. Emami: I think we should decide if that specific size of the port on the end is the important part or if there is something else affecting this. R. Bashford: The point where the gas enters the burner, maybe the baffle needs to be relieved. T. Krause: So we are coming back to the same thing, more standardization/specification. R. Bashford: I think it wants to be as big as possible to allow as much gas as possible. T. Emami: Does anyone want to join Thomas' study for the heater imprint? I think we do need to go back and think about it for next month's meeting. E. Canari: We need to have a spec that is used to accept or reject the machine for certification purposes. We cannot approve something that is clearly needing some fix. We need to put this on the top of our list to accept or reject chambers for certification testing. T. Krause: For me, the question is are we trying to find tolerances for using both chambers as they are right now? If we don't take the decision now, we are losing when we come to certification. E. Canari: We have to decide if certain differences make a difference while we are doing the Round Robin. I think the effort should be done now. M. Schall: Could you list the top three metrics to measure or look at to evaluate the instruments by? Could you tell me the top three you think would have the most significant impact? T. Krause: I think the pilot flame would be very, very relevant for me. I am not routing for baffle yes or no. For me, it's the flame size that is important because I think it has a really relevant influence on the sample ignition. For the heaters, there is some flexibility on how to arrange the heaters. The two heaters are a little bit different. I would try to eliminate those differences. The chamber size, do we need this variation? Pilot flame, heater, distribution and then we can talk about heat distribution. M. Schall: As far as the fabrication of the pilots, they are getting fabricated from a block of brass, I believe. You can run into a lot of very, very qualitative items just as far as how it is machined, inspected, accessibility to perform these things. It can be a lot more difficult than one can think. Two different machinists can consider it fabricated the same when we would consider it different. We would have to work together on the terminology on how it is called out as well. T. Emami: There is a point of impossibility with very, very specific specs as Michael just said. We will have to think about general specs that the group agrees on, on top of some type of calibration method. M. Schall: .0015 difference had a difference in the visibility of the flame height. M. Anglin: These differences whatever they are, are giving us different results to Enzo's point. We can see that there are definitely impacts to the differences. T. Emami: These are very important points. Think on these for tomorrow's meeting in the lab. Y. Behboud: When you were presenting earlier today and you had the two different internal chamber sizes, I think that was a step in the right direction in trying to understand what the differences in the chambers are. I think at the end of this process from operating a lab perspective, I have to be able to marry my lab and my test equipment. There may be some dimensions in the spec that can have tolerances and other dimensions that are more critical

to results where we would have to make changes in our equipment. T. Emami: We will have to decide what to prioritize what needs to be very tightly specified, because I would want to do studies on that to make sure it is not affecting the results. R. Bashford: Did you go through all of the comments on the spec? T. Emami: I am still working on it, and I will send it out to the Task Group when it is completed.

VFP Task Group Meeting – Session 2 [FAATC Building 202] October 17, 2023

Ribbon Burners: The VFP manufacturers had a discussion and decided to agree on any parts that are not defined in the FAA spec, i.e., ribbon burners will be the same in all manufacturers' machines.

R. Bashford: The trouble with putting any type of template on/near the burner, the flame is attracted to that surface. If we had a template that we could mount in the background and looked at it from the specimen side, the template would have to be black to see the blue glow.

T. Krause: The standby position should be defined in the spec.

Flame Review: The manufacturers will use the same ribbon burner build. R. Bashford: I wonder if we could mount a template in the sample holder. It would be better if it is behind it. If we are going to do some observation measurement, it should be in the test position. T. Krause: The difficulty is that the windows are not ideally located for that. R. Bashford: That is why the video. T. Krause: It is hard to observe some things in the video. T. Emami: During the test you have to look at it. It is hard that the window is not going to be perfect. T. Krause: The window is a source of heat loss. The chamber is hotter in the front. D. Maben: Another thing you could do is have a spec on the burner, including how it attaches. R. Bashford: We all make them, so we would make them to the spec. M. Anglin: There are big implications to this. We all need it to be the same. T. Krause: Why do we have those exterior large peaks for the Deatak machine? Would you run a CFD on that? D. Maben and M. Anglin: You would have to get the geometry of each burner. We will go back and see if we can use our CFD resources. T. Krause: It is a critical change because there is no easy way of adjusting the X and Y positions for the burner. For the Deatak machine, it is harder, so we had to disassemble part of the machine. Mike Schall had to show us how to do this. T. Krause: Would it be possible to add a support point for the tube? R. Bashford: We have a support point. We have gauges we use at the front lip of the sample holder. ***ACTION***: The manufacturers will work together on the build and connection of ribbon burner and a template to check. M. Anglin: I would not discount looking at it in the standby position. T. Krause: We have to account for the manufacturing tolerances. I think we need to allow an adjustment of the flame. Realistically, how long will it take to get the same burners from the manufacturers? A year? R. Bashford: It will take some time. We probably need to tighten the tolerances in the spec even more. T. Krause: The holes are getting so small that I will have to x-ray every burner that I receive, because I will not be able to measure by hand. D. Maben: You can measure the holes with some type of go, no go, pins.

Heaters: T. Emami: Does the heater specification need to be more specific? T. Krause: We tweaked our Deatak heater a lot. The heater we received, the coils are not evenly spaced, so we had to move the heater assembly to center the heater to the coupon. I learned from Deatak that it might have been a batch of heaters that had imperfections. R. Bashford: European manufacturers will not make the heaters. T. Emami: Does the group have any ideas of what would be important to characterize the heaters to work the same way? R. Bashford: Ours and Marlin's have a flange on the front that is going to radiate. Deatak does not have a flange.

T. Krause: The geometry of the board that contains the heat flux gauge needs to be standardized.

Basic/simple project tracking Suggestion: Create an Excel file with columns to track each area of investigation and outcomes/status/work done in column next to it.

E. Nixon: Are there any issues with the MFCs? T. Emami: The Deatak machines are digital and will automatically adjust. R. Bashford: When you use a MFC, the input of the gas that you want to use has to be the same. Then the flow meter will measure as good as it possibly can measure. T. Krause: This is something we can check once we have the same burner and fitting.

VFP Task Group Meeting – Session 3 [FAATC Building 202] October 17, 2023

Tina reviewed discussion and outcomes from VFP Session 2. Ribbon Burner: M. Schall: We as manufacturers will rule out as much of the tolerances as possible before it is machined. Heater: Users want more uniformity of the heater coils. M. Schall: That would have to be done on an assembly level (controlling the assembly). T. Krause: What if we just copied the NBS heater design? T. Emami: That coil is double the thickness of the coils we are using now. M. Schall: It is not a catalog part. It is a proprietary design.

Materials Oil Burner Task Group – Tim Salter (FAATC)

Lead: Tim Salter (FAATC) timothy.salter@faa.gov

There were some concerns voiced by members of the group about making the cargo liner test air shroud optional in the test method. While the intent of the shroud is to make testing more consistent and repeatable, making the shroud optional could introduce variability in test data among labs that use the shroud versus labs that do not. Currently, there are no definite plans to add the shroud to the test method. The burner cone reinforcement frame was added to the Aircraft Materials Fire Test Handbook Chapters 7, 8, and 24 and is also optional. However, tests were performed at the FAA Technical Center to ensure the frame would not have any influence on test results.

Chapter 24 of the Aircraft Materials Fire Test Handbook was also updated with a new fuel nozzle type for the oil burner and a new air pressure supply setting. It was asked by the group if using the previously described fuel nozzle and air pressure could still be used until such time the labs have a chance to switch over to the new setup. Labs are allowed to continue to use the previous setup in the meantime as the test method is more conservative and acceptable from the FAA's viewpoint.

For the seat cushion test method and other oil burner tests, the flame emitted from the burner may look visibly skewed to one side. This typically results in the flame being hotter on one side than the other, but occasionally a skewed flame can still produce even flame temperatures across the seven-thermocouple rake used for flame validation/calibration. The question arose of what to do in this case. Is it ok to move onto testing with a flame such as this? There was some talk about performing a study to determine an answer to the question. There has not been a known study done on this in the past. The FAATC may participate in this type of study with another lab.

The subject of oil burner seat test failure criteria also was brought up. Specifically, in the case where newer style production seats sometimes have hardware built in that is not addressed in the test method (wires, air bladders, heaters, etc.) It was suggested that the seat construction criteria be updated to include how to approach such features when testing.

Additive Manufacturing Task Group – Dan Keslar (FAATC)

Task Group Leads: Dan Keslar (Daniel.keslar@faa.gov), Steve Rehn (steven.rehn@faa.gov)

At the start of the Task Group meeting, Dan Keslar and Steve Rehn provided an update on the status of the additive manufacturing technical note and issue paper. The technical note will provide all data and conclusions from the current testing that the FAA has conducted. An issue paper is in the process of being edited, which will provide further guidance and aims to simplify certification.

Although a draft copy of the issue could not be distributed, a “discussion paper” that highlighted key points from the issue paper draft was given for review to task group members. Task group members suggested adding several statements, such as including that the policy statement on Flammability Testing of Interior Materials is still valid and the issue paper would not replace it. Furthermore, recommendations were made to further specify that the production process of a part needs to be defined.

From the testing that the FAA conducted, the highest after flame time was around 40% infill. In certain samples with less than 40%, the samples would melt prior to the end of the test and produce longer burn lengths but the flame times were shorter. It was suggested that any sample tested at 40% infill could substantiate greater infills, but additional testing would be required for samples less than 40%. However, testing with these samples had no solid outer layers, so the data may not apply to real world parts.

A lot of requests have been made for a separate section only on Ultem™ 9085, as testing has shown that most parameters have little to no effect on flammability.

Next steps would be to further revise the issue paper based upon task group member feedback. Steve and Dan will have further discussions on revisions for the issue paper and will send it out to the task group when ready.

There was interest expressed in other types of Additive Manufacturing, such as powder bed fusion. Further testing would be necessary for different types of 3-D printing. However, the FAA is looking to release the issue paper focused solely on FDM (also referred to as FFF).

RTCA Task Group – Lindsey Anaya (FAATC)

Waste Compartment Fire Containment Task Group – Lindsey Anaya (FAATC)

Lead: Lindsey Anaya (FAATC) lindsey.p.anaya@faa.gov

Lindsey Anaya introduced the DO-160 Section 26 Line Burner Method draft proposed by the FAATC to task group members. The Line Burner Method is a proposed alternative test method for flammability certification of aircraft electronic enclosures. The task group discussed the test exemption criteria that allows for an enclosure to be exempt from testing if its total open area is less than 4 times the longest outside dimension, L (in mm), ($A < 4 \times L$) up to a maximum of 700 mm^2. Enclosures that exceed an open area total of 700 mm^2 must be tested.

Russ Roth from Panasonic Avionics had questioned if a 43-inch display monitor installed in the cabin could still be exempt, as 3 key-slot mounting holes increased the area to over 700 mm^2. He also cited another example involving a seat box with electrical receptacles for charging personal electronic devices, which also exceeded the 700 mm^2 requirement. These items brought up two points of discussion. The first was - does the exemption requirement need to be adjusted? A task group member suggested using an aspect ratio to associate overall enclosure dimensions to the area requirement. This also led into the second topic of discussion/question – how would the line burner fit into equipment so slender, as in the case of the display monitor? And more fundamentally, there seems to be confusion as to which pieces of electronic equipment would fall under this test method. The current Flammability section in DO-160G states: “Applies to enclosures housing electronics and non-metallic material, component parts, sub-assemblies installed in pressurized or non-pressurized zones and non-fire zones.” The Line Burner Method, which is the FAATC-proposed contribution to Section 26, has only been developed and tested using line replaceable units (LRUs) found in an aircraft’s E&E bay. There will need to be further discussion if there is a need to specify the electronic enclosure definition so that only LRUs are applicable for this method or if the test scope needs to be modified to include any electronic enclosure, such as a display in the cabin or flight deck areas. Currently, it is assumed the display, seat box, and similar cabin electronics should be tested in accordance with DO-313, “Certification Guidance for Installation of Non-Essential, Non-Required Aircraft Cabin System & Equipment”. More clarification on this topic is needed and will be sought out by the task group lead.

The task group was able to view the Line Burner Test method set up at the WJHTC. Lindsey Anaya walked them through the test method and showcased videos of previous testing that was completed, highlighting the advantage of using blue light to see flaming more clearly outside of the enclosure. Element Aerospace Testing participated in a recent interlab study in which they conducted 5 tests using the Line Burner method. The task group viewed one of their test videos as well.

Lindsey Anaya is looking for more interlab study participation from aerospace flammability test labs in both the United States and internationally. This method is a novel approach to traditional flammability tests, and in order for this method to be adopted as an alternative into DO-160 Revision H, there must be high fidelity as a result of many different laboratories conducting successful tests in which the pass-fail criteria is easy to evaluate.

If you would like to participate in the study, please contact Lindsey Anaya at lindsey.p.anaya@faa.gov.

MCC/Similarity Task Group – Rich Lyon, Natallia Safronava, Rich Walters (FAATC)

Task Group Contacts: Rich Lyon (Richard.e.lyon@faa.gov), Natallia Safronava (Natallia.i.safronava@faa.gov), Rich Walter (Richard.walters@faa.gov)
Date: IAMFTF October 17, 2023

Location: FAA Technical Center, B210 + Zoom

Attendees: 20 in person + 20 remote via Zoom (FAA, Boeing, Gulfstream, Embraer, Collins Aerospace, Diehl Aviation, Safran, Deatak, Lantal, Bell Helicopter Canada, Airbus Canada, BlazeTech, CAAI)

Topics discussed:

- ***Revision of ASTM D7309 Standard to Include Baseline Correction***

Revision of ASTM D7309 standard governing MCC has been balloted for vote in ASTM. Purpose is to introduce baseline correction method into D7309 that will accurately measure and discriminate between materials that are at/near the limit of detection of the MCC (3 W/g), e.g., phenolic resins used in aircraft interiors are 20-50 W/g. FAA has voted negative on the ballot as written. MCC Baseline correction is the subject of FAA Repot DOT/FAA/TC-22/31, September 2022.

- ***Constraints on Similarity Approach.***

Subsequent changes to a previously changed component of a construction need to be referenced to the original certified component and documented to avoid flammability drift. The methodology for determining MCC similarity of multi-layer systems is unresolved.

- ***Implementing Similarity in the Regulatory Process.***

MCC testing for equivalent flammability of changed components (similarity) has been added to the FAA Transport Airplane Issues List (TAIL), 13 September 2023 as Item 180: “Use of Microscale Combustion Calorimeter to Substantiate Small Changes to Material Composition.”
According to AVS, a proposal to use MCC for similarity would be identified in a certification plan as a proposed method of compliance or as part of a method of compliance. That would trigger development of an issue paper to document what, why, and how. The issue paper would draw on the draft guidance as to

what would be expected. The first step would be for the FAA to agree that the proposal was in keeping with the intent of how to use the method, with a little back and forth expected as people get familiar with the method.

- ***Status of Similarity Task Group.***

FAA noted that technical work on MCC Similarity is pretty much complete at FAA, except for working with ASTM to implement baseline correction in the MCC standard. Industry partners need to step up and bring specific cases to regulatory officials. The future of this alternate means of compliance depends on how, and how many, cases are brought to regulatory officials for adjudication. FAA will support an Industry-led Similarity Task Group moving forward.

Waste Compartment Fire Containment Task Group – Lindsey Anaya (FAATC)

Leads: Scott Campbell (Safran) scott.campbell@safrangroup.com / Lindsey Anaya (FAATC) lindsey.p.anaya@faa.gov

The task group convened online and in person at the WJHTC to continue development of methods of compliance (MOC) to be proposed to FAA Certification for the qualification of waste compartments. There are 22 MOCs being discussed; some of which relate to FAA Policy Statement (PS-ANM-25.853-01-R2) and others that address compartment design criteria.

Specifically, the task group focused on MOC 9.1, which discusses how to substantiate a change in structural joint adhesives. Previous proposals targeted the glass-transition temperature (Tg) as a means of compliance, but after reviewing past test performance of epoxy-bonded waste compartments, Tg was deemed unnecessary as a MOC criteria. Epoxies perform well, as they do not melt at higher temperatures and become flexible past their respective Tgs. Industry has used epoxy adhesives to bond waste compartments for decades without any waste compartment test failures being attributed to the adhesive bonded joints. This is also in line with findings made during the development of PS-ANM-25.853-01-R2 item 24 (pg 18). Boeing performed a medium-scale foam block test fire on a bonded joint that held together and did not propagate fire. Test data supports the ability to substitute a 2-part epoxy joint adhesive with an alternate 2-part epoxy adhesive qualified to the same aerospace specification, ensuring stress considerations are met.
Scott Campbell proposed that no data is required for policy statement related MOCs that we want to extend to fire containment.

The group also discussed MOC 9: “How to substantiate a change in panel skin-to-honeycomb core adhesive films”. Collectively, the group agreed that panels with film-to-core enhancement adhesive films also do not contribute to fire containment failures. Again, a changed panel would need to satisfy all stress considerations and other applicable flammability test requirements.

Scott Campbell proposed MOC 25 (trash container replacement) be limited to waste compartments that have successfully met waste compartment test requirements without the waste container installed.

Scott Campbell proposed to potentially separate MOCs from design related requirements to establish similarity. The MOCs can be used to substantiate other compartments given other design related aspects are the same/similar. This effort will need to be further developed.

Action Items:
Scott Campbell and Michael Jensen to propose a standard report format for the task group to populate the proposed MOCs.

Handbook Chapter 10 Go-Back: Chapter 10 proposal to be revised to better generically allow test material sizes that are available in other world regions.

Additional Discussion:

There was no additional discussion.

Next Meeting:

EASA will host during April 2024 at its Headquarters in Cologne, Germany. April will send the meeting dates once they are confirmed by EASA.

J. Davis: The NBAA convention is scheduled for October 22-24, 2024. There are a few of us that would like to attend it and these meetings. Is it possible to avoid these dates for fall 2024 Forums meetings?