IAMFTWG MEETING

March 6-7, 2018

Hosted by Gulfstream Aerospace – Georgia Tech Savannah, Georgia, USA

AGENDA:

TUESDAY, MARCH 6, 2018

Welcome & Logistics – T. Marker/Thivi Edrisinha
Participant Introductions
Various Project Updates – T. Marker (FAATC)
Magnesium Alloy Test Update – T. Marker (FAATC)
Cargo Liner Test/Airflow Study/Seat Test/Sonic Burner Video Status – T. Salter (FAATC)
Burnthrough – T. Salter (FAATC)
VFP Testing Update – R. Whedbee (FAATC)
Inaccessible Area Composite Flammability – T. Marker (FAATC)
Radiant Panel Update – S. Rehn (FAATC)
RTCA Update – S. Rehn (FAATC)
Evacuation Slide Test – T. Marker (FAATC)
Heat Release Update – M. Burns (FAATC)
OSU Guidance Document Outline – Yaw Agyei (Boeing)
Voltage Round Robin – Brian Johnson (Boeing)
TRL 5 Activity Plan – Brian Johnson (Boeing)
OSU and HR2 Comparative Data – Ralph Buoniconti (SABIC)
Characterization of OSU Airflow Using Particle Image Velocimetry – T. Emami (FAATC)
Material Change Similarity Status – D. Slaton (Boeing)
Waste Receptacle Fire Containment Task Group – S. Campbell (Zodiac Aerospace)

Task Group Meetings Session I:
- Magnesium Alloy – T. Marker
- Cargo Liner – T. Salter
- VFP Test – R. Whedbee
- Radiant Panel - S. Rehn
- OSU/HR2 – M. Burns
- Flame Retardants/Material Change Similarity – D. Slaton
- Waste Receptacle Fire Containment – S. Campbell

WEDNESDAY, MARCH 7, 2018

Task Group Meetings Session II:
- Magnesium Alloy - T. Marker
- Seat Cushion Flammability – T. Salter

Ducting/Wiring – R. Whedbee
RTCA Flammability Test – S. Rehn
OSU/HR2/Heat Flux Calibration – M. Burns
OSU Flow Visualization – T. Emami

Task Group Reports
Additional Discussion/Next Meeting

MINUTES:

TUESDAY, MARCH 6, 2018

Various Project Updates – T. Marker (FAATC)

Short Takes and Current Projects:

Aircraft Materials Fire Test Handbook: Update to Chapter 1, Bunsen Burner Location

FSTG Formulation, Development of a Policy Statement: Industry/FAA concern over lack of standardization in MOCs for flammability. Draft Policy Memo ANM-115-09XXX (2009) was drafted: Part I: Acceptable Methods of Compliance and Part II: Methods of Compliance requiring substantiation. Flammability Standardization Task Group (FSTG) was formed. FSTG submitted a final report for FAA review. Final Policy Statement PS-ANM-25.853-01 (2012). FSTG reconvened to develop recommended additions and clarifications (2016-2017).

FAA Fire Safety Branch recently procured a commercial-grade printer for evaluation of flammability of 3D printed parts. Additive manufacturing is becoming more common in aviation applications. We can build parts for a number of aircraft applications for evaluation to determine the influence on the flammability tests. Slaton: are you thinking this might become a new Task Group? Response from Group: yes, there is interest. Marker: we will go forward with setting up a Task Group. Buoniconti: UL has a blue card for variables from additive materials. Alcorta: additive manufacturing is being used in other industries (automotive, trains, etc.).

Fuselage Fire Penetration "Burnthrough" Resistance Research: Tim provided an overview on this project. Question: do you have any timeframe on this work? Marker: no, not yet.

Development of New Test Method for Magnesium Alloys – T. Marker (FAATC)

Photo of updated truncated perimeter sample holder was shown and some photos of it in use. Tim reviewed the test results using the truncated vs. perimeter sample holder. Future Work: insert Test Method as Chapter 26 in Aircraft Materials Fire Test Handbook.

Tim reviewed info provided by Prem at Magnesium Elektron on Magnesium Alloy Applications in Aircraft Passenger Cabin. Campbell: if you were to do a Round Robin on the 3 alloys, could we lean on that data? Prem: that was one of the things we wanted to bring up in the Task Group meeting. Marker: we would have to discuss with FAA Regulatory. Alcorta: what would be the logic in doing a more demanding test for

the applications that are accessible than for the ones that are inaccessible? Marker: we are trying to do threat based testing. Gardlin: in the current postcrash methodology is basically size and mass based. The nature of the risk is different in the inaccessible areas vs. postcrash where it is basically a combination of byproducts that might catch fire. Canari: EASA is trying to have one test method depending on the type of part and location of the part. I think the discussion of hierarchy comes later. Tim reviewed the discussion items for the Task Group meeting on March 6, 2018.

Cargo Test Airflow Study & Sonic Burner Video Update – T. Salter (FAATC)

Cargo Liner Airflow Study: Purpose: reduce the result disparities among test labs. Six anemometers total 0 air velocities measured in the vertical and horizontal directions for each exhaust hood fan setting used for study. Airflow allowed to stabilize for 5 minutes, then collected data for 30 seconds. Tim described the burner shroud he designed, showed video with and without use of shroud, and reviewed vertical air velocities with shroud and reviewed test results with and without the shroud. Tim listed highlights of the benefits of using the shroud. The next phase of the airflow study was discussed. Campbell: I know of a large volume lab that does not need to have any airflow on during the test. I tested that and can show you the data in the Task Group. Danker: excellent work. Slide 8: you've got a green circle on there. It could be argued that the zone extends all the way to the right beyond the circle. Salter: Yes, you could certainly extend it beyond the green circle. I was trying to point out the red line that indicates the airflow rate continues to climb. Little: How many samples did you run for shrouded and unshrouded results? Salter: I believe we ran 6. Little: Would you be able to put the shroud as it exists now on your other configuration or no because space is limited? Salter: Yes. Little: do you have enough room for it? Salter: yes. There is more than enough room. Slaton: it does appear that with the shroud, the backside temperature is a bit higher – Task Group should discuss how to address this. Question: are you going to look at the influence of other materials that have backside burning? Salter: we are just at the beginning of working with the shroud.

Sonic Burner Assembly and Operation Assembly Video: currently finalizing script for video. Not based on test method as past videos. Shooting will begin in the near future. Input from Task Group members on footage or instruction not in Fire Test Handbook or videos currently available. Jensen: what does video not based on test method, what does that mean? Salter: this video is assembly, operation, and troubleshooting for sonic burner.

Burnthrough Round Robin – T. Salter (FAATC)

Tim Salter is the new point of contact for the Burnthrough Test at the FAATC. Insulation burnthrough test method being evaluated for within lab and lab-to-lab consistency. 11 labs across three continents participated in the Round Robin. Testing was done with both style igniters. Phase 1 Results were shown (8 of 11 labs reporting). Tim also described the Phase 2 set up. Planned work: labs are still using Monarch type fuel nozzles. At FAATC, we moved away from using Monarch type nozzles on the FAATC sonic burners. Conduct comparative testing at FAATC: Monarch vs. Delevan fuel nozzles. Danker: I think there should be a standardization or more guidance material for using or not using supplemental clamps (when you should use them, when you should not use them, and if it's optional to use them at all times).

VFP Update – R. Whedbee (FAATC)

Sleeving: no current test method, various sizes of sleeving, securing sample during tests (maintain the intended in-use shape throughout a test), and accommodate wraps and tube type. Rick Walters (FAATC chem lab) suggested alumina substrate materials. Rick showed drawings of the set up with the alumina rods he is thinking of testing. Wiring: the current 60-degree test does not accommodate wire bundles. Single wire not a good real-world representation. Rick is going to try custom alumina rods for this test, also. We will discuss this in more depth in the Task Group. Fuel Comparison: Propane vs. methane fuel comparison. Marlin Engineering VFP was delivered to the FAATC in late 2017. The fuel temperature for each gas was measured – results were shown. We purchased carbon fiber materials (OTS) from McMaster Carr to use in some fuel comparison tests.

VFP 3 – Marlin VFP: Rick described the new VFP 3 and showed a photo.

Future work: additional mods/features?, validate sleeving concepts.

Inaccessible Area Fire Tests on Composite Structure Update – T. Marker (FAATC)

Tim reviewed work presented by Dr. Ochs (FAATC) during the October 2017 IAMFTWG meeting. He gave background on reasons for this work. Tim described the test rig. Heat Transfer Calculation was reviewed. Next Test: during previous test, the most damage was found on structure that was not in direct contact with outboard cooled surface. A second test will be performed.

Radiant Panel Update – S. Rehn (FAATC)

The *Aircraft Materials Fire Test Handbook* Radiant Panel Chapter was updated in December 2017. Steve gave a brief review of these updates: removed air-propane panel, replace Kaowool M with Superwool 607, removed voltage requirement, 5 minutes average on heat flux measurement, and reduced +/-5% error on heat flux to +/-1%.

Radiant Panel Aging: temperature set point steadily increases to obtain same heat flux as panel ages – eventually leads to more material failures, biggest difference seems to be black paint surface, need to add guidance about when to replace electric panel. Steve reviewed some previous test results. Future work: we now have 4 old panels from 3 different labs. We also received new metalized PEEK material. We need to determine the parameters of when a panel needs to be replaced, test 4 old panels and compare with new panels to determine which ones are out of spec and how do we know, discuss test plans in Task Group, refurbishing panel is a secondary goal. Alcorta: how do you know the paint is the same and the same thickness? The paint and thickness of the paint will factor into the emissivity.

RTCA Update – S. Rehn (FAATC)

We are still working on a new test method to fire test electronic boxes whole, rather than test individual components with Bunsen burner. Test method will go into RTCA-DO160H – our draft is due to committee in spring 2020. Steve described the tests that have been conducted and presented results of these tests. Videos and photos of tests were shown. Conclusions: box size and air hole pattern has a small effect on ability to sustain a

flame. If line burner self-extinguishes soon after test begins, box likely won't need further testing, capacitors have the potential to explode, but can also be made safely. Future work and discussions: Pass/Fail Criteria: currently 1.5 inch flame for 12 seconds, what if bigger flame for shorter time? Discuss limits on boxes that do not need to be tested. Question: do you plan on any testing with super capacitors. They are slightly more dangerous. These are beginning to be used on aircraft. Rehn: it sounds like something we can look into. Jensen: did you vary the hole sizes or was that previous work? Rehn: we tested that before. I have data for that from the previous tests. For these tests, I matched the size of the holes that were already there.

Evacuation Slide Test – T. Marker (FAATC)

Tim reviewed Round Robin 6 activity. Photos of the two different heaters used in Round Robin 6 were shown. Conclusions: the slide material tests result correlation determined that both of the heaters are acceptable in the revised test method. Tests on additional slide materials will be conducted to evaluate the new AC power controller function. Future work: calibration tests will be conducted to evaluation the stabilization of the power input to the heater.

Voltage Round Robin – Brian Johnson (Boeing)

Brian explained this new Round Robin, and encouraged labs to participate. It will be discussed in more detail in the OSU/HR2 Task Group meeting this afternoon/tomorrow.

Recap HR2 Development & DOE II Review: We met our target and are now able to move into TRL 5. Objective: determine HR2 repeatability using the FAATC Marlin Engineering HR2 prototype by testing a large number of randomized coupons under the same conditions. The proposal and procedure were reviewed. A sample of the proposed test matrix was shown.

OSU and HR2 Data Comparisons – Thermoplastics – Ralph Buoniconti (SABIC)

Ralph reviewed OSU and HR2 comparison data for materials tested in September 2016, and August 30-31, 2017. Overall Objective: ensure the HR2 test does not cause materials that currently pass** OSU 65/65 to fail new requirements, nor cause non-OSU 65/65 materials to pass. Compare forced-ranking of materials in each test. **if HR2 significantly reduces scatter/variability vs. OSU, one could reasonably expect some "borderline" materials to become consistently passing or failing. Any initial comparison and forced-rankings should focus on materials with established pass/fail results in the OSU. Ralph covered SABIC and other materials to consider. Jensen: is the melt point of Ultem somewhere between the OSU and HR2 temperature? Buoniconti: If I remember correctly, we would see double peaks in the OSU. In the HR2, the curve was up and down.

Characterization of OSU Airflow Using Particle Image Velocimetry (PIV) – T. Emami (FAATC)

PIV system was set up around an OSU rate of heat release apparatus. Tina described the set up used for this project. She also investigated what the airflow is doing near the test sample in the OSU. We next moved the air inlet to the bottom center of the chamber to see if airflow within chamber changed. There is clearly a lot of turbulence

and motion in the new set up that is not good. Ideas for further testing: fill bottom with reticulated foam or a potential design where plates can be inserted above the first chamber to straighten the flow that is introduced to the test sample. Question: could you use aluminum honeycomb? Emami: that is a good idea. We can talk about it in more detail in the Task Group meeting tomorrow. Little: is the FAATC actively looking into making changes to the OSU? Marker: if we can find out through flow visualization that there is a simple fix to the OSU, then this should be pursued. I don't want to say we don't want to do any work on it especially if there are easy fixes to it. Question: when you prioritize, consider materials dripping into things like the reticulated foam where you might need to be replacing after every test.

Material Change Similarity – Dan Slaton (Boeing)

Microscale Combustion Calorimetry – providing the flammability properties of materials; a key to managing fire safety.

Dan reviewed the Task Group goal. MCC is a molecular level material property and determines flammability properties. Develop test procedure and process to determine if a material change can be considered a "minor change" using MCC. Proposed draft guidance developed was published in June 2016. The MCC development timeline was presented. MCC Component Procedure (Updated): Rich Lyon and his team have come up with a new procedure to calculate this. This will be discussed in more detail in the Task Group meeting. Task Group meeting: new definitions and updated reference material, calculation of MCC criteria. Marker: you are still going to have to do some type of case studies or testing to vet this out, right? Slaton: yes, absolutely. Canari: is it correct to say that the approach we discussed in October in Atlantic City is going to be replaced by this approach? Slaton: yes, Rich Lyon believes this is a better way to compare two similar materials. He is writing a report on this new calculation approach that he believes is a better indication of similarity of materials. Question: are you using ASTM Method A or B? Slaton: I believe it is Method A. Question: these are material level tests that you are planning on doing? How does this relate to application level where materials are glued or combined together? Slaton: we should look to the future applications.

Waste Compartment Fire Containment MOCs – Scott Campbell (Zodiac Aerospace)

14 CFR 25.853(h)

Zodiac Aerospace compiled approximately 15-17 MOCS accepted by various customers including our ODA. Scott provided a few potential similarity examples and a few potential similarity requirements. This Task Group will meet on March 7, 2018.

WEDNESDAY, MARCH 7, 2018

Task Group Reports:

Magnesium Alloy Flammability Test Task Group – T. Marker (FAATC)

Summary provided by Tim Marker (FAATC), Task Group Lead
(Tim.Marker@faa.gov)

1. Discussion of an Advisory Circular (AC) for magnesium alloy use in the cabin. Over the past several years, the FAA and Task Group participants have developed proposed methodologies for allowing the use of magnesium alloy in aircraft cabin interiors. These methodologies are based on the results of full-scale and laboratory tests conducted at the FAA Technical Center, and have been refined, and thoroughly discussed within the Task Groups and general meeting sessions. The methodologies have been captured in several flowcharts, which were part of Tim Marker's presentation, "Development of New Flammability Test for Magnesium-Alloy Cabin Components" on March 6. Prem Mahendran of Magnesium Elektron (Luxfer Group) developed the flowcharts based on Task Group discussions and Tim's prior flowcharts shown at meetings. During previous Task Group meetings, the participants have discussed the value in developing an Advisory Circular that would detail these methodologies in a more formal manner. Task Group participants agreed that an AC would be a useful document in the future applications of magnesium alloy components in the cabin. Although useful, the FAA indicated that the development of any Advisory Circular is a sizable effort, and could not be justified in this case, based on the relatively small benefit to industry. The FAA indicated a more appropriate plan would be to wait for the Notice of Proposed Rulemaking (NPRM) to be issued for the revamping of Appendix F to Part 25, and once the industry review process is complete, release an Advisory Circular that includes additional information on the flammability testing of magnesium alloy.

2. Discussion of magnesium components used throughout the cabin. Over the past several years, the FAA has conducted numerous full-scale tests and laboratory-scale tests that have paved the way for the safe use of magnesium alloy inside the cabin. The initial effort targeted the 5 primary components comprising a typical coach seat (legs, spreaders, crosstubes, seat back frame, and baggage bar). Subsequent efforts have targeted smaller components used in inaccessible areas. Although special conditions must be granted for the use of magnesium in an aircraft seat, it is no longer banned as per SAE standard AS8049. Despite these milestones, there has been a lack of formal proposals submitted to the airworthiness authorities on magnesium alloy use in the cabin. There seems to be shift in interest from the 5 primary seat components to smaller components that could be used in both the accessible and inaccessible areas of the cabin. The problem is that most of the components being discussed would not meet the surface-area-to-volume (SAV) ratio developed by the Task Group (the SAV ratio requirements were based on the magnesium components used in previous full-scale tests). The Task Group participants questioned if there were other options that could be discussed for allowing these non-SAV-ratio-compliant components to be used in the cabin. The FAA/EASA agreed to investigate the possibility of requiring the current flammability test outlined in Chapter 25 of the Handbook, plus additional restrictions. One example of this would be to allow only a certain mass of magnesium alloy in the cabin, provided the flammability test requirement in Chapter 25 is met. The difficulty in developing any type of

additional restriction is that there are no specific project proposals to evaluate at this time. Having a specific proposal would allow the FAA/EASA the ability to investigate the suitability of a particular installation, which would allow for a more accurate evaluation of the threat.

The participants and the FAA/EASA discussed the efficacy of conducting additional full-scale tests to determine the impact on passenger survivability when using magnesium cabin components that were not accounted for in previous full-scale tests. The difficulty in this approach is that the test conditions must be adequately bounded to allow for the interpretation of a result. Excessive variables will not allow the accurate determination of an additional hazard. The result would also have to be incorporated into a laboratory test, so that applicants interested in using such components could then meet a specific flammability standard in order to proceed. The FAA cautioned that conducting full-scale tests is very expensive and time-consuming, and cannot be carried out every time a new proposal is made to fabricate a component of magnesium alloy. The intention of full-scale tests would be to evaluate a general concept, and to develop a corollary laboratory-scale test and appropriate pass/fail criteria based on the full-scale test result. It is simply not feasible to carry out full-scale tests for proving the suitability of each and every specific item. The FAA/EASA agreed to continue their internal dialogue on how full-scale tests could possibly be conducted, in order to provide the most accurate results and interpretation to proceed with additional laboratory-scale tests or restrictions.

3. Review of the current flammability test for magnesium alloy used in inaccessible cabin areas. The FAATC briefly discussed the results of the most recent tests conducted using the radiant panel apparatus and thin magnesium alloy test samples. Over 280 tests have been conducted to date (13 since prior meeting). The recent tests were conducted using 0.025-inch thickness samples held in place using the truncated (shortened) perimeter holder. A direct comparison was made between the truncated sample holder and the full-length, 3-sided perimeter holder. Results indicated the truncated holder provided more consistency. Overall testing indicates the test methodology is repeatable, and a new draft procedure has been written up by the FAATC for future placement in the Fire Test Handbook (Chapter 26). Drawings of the latest sample holder are now available (included in Tim's presentation), so that laboratories can fabricate them. In an effort to expedite the testing at various laboratories outside the FAA, several sample holders were constructed and sent to interested facilities. The FAATC proposed the commencement of an interlab study to determine differences when using identically-prepared materials. There are now 3 interested laboratories that were sent a complimentary sample holder, with a 4th lab requesting one as well. Including the FAATC, this would be a total of 5 labs that could participate in the study. The FAA agreed to obtain magnesium alloy material and begin the tedious process of milling this down to the appropriate thickness to provide samples for the interlab study. Once the interlab study is completed, the draft test standard will be updated as necessary, and circulated to

Task Group participants for review and comments. Boeing has also offered to review the test data to perform a statistical analysis, to provide feedback on the robustness of the test method and recommended pass/fail criteria.

4. Additional Discussion Items. Task Group participants inquired about the possibility of having the 3 favorable magnesium alloys tested by the FAATC included in an approved materials list, since there are so few alloys, and because the FAATC has an extensive track record with each. The suggestion is that by having the alloys on an approved list, no further testing would be required. This topic has been discussed at prior Task Group meetings. In general, magnesium alloys are classified by the major alloying elements, according to the percentage of each. For example, AZ31 is a magnesium alloy containing approximately 3% aluminum (A), and 1% Zinc (Z). However, magnesium alloy manufacturers have pointed out that this classification system is only an estimate of the actual percentages of alloying elements in the particular alloy. In the AZ31 example, it is possible for one supplier to use 2.8% aluminum, and another supplier to use 3.2%. At this point, it is unknown what influence these variations in the percentages would have on flammability. As a result, the FAA has made it clear that an approved list of qualifying magnesium alloys is not possible at this time, and each manufacturer would be required to conduct flammability testing on their particular alloy being used in the aircraft.

Flow Visualization through the OSU - Task Group – T. Emami (FAATC)

Task Group Summary provided by Tina Emami (FAATC), Task Group Lead (Tina.Emami@faa.gov)

The goal of this task group is to determine if there are simple and cost-effective ways to improve the airflow characteristics through the OSU Rate of Heat Release Apparatus. This is not an effort to drastically redesign the OSU apparatus, since the FAA Technical Center has a current research project to develop a new apparatus (HR2) for measuring the heat release rate of interior materials. Previous research has determined that there is a significant amount of variability in the construction of the OSU, which can affect the airflow and ultimately impact the heat release measurement readings. The Task Group discussed a number of topics related to the optimization of the airflow through the apparatus as listed below:

- The air-inlet diameter can change and affect the airflow.
- The spacing of the holes through the air distribution plates have shown to alter thermopile readings in the past.
- Pressure measurements taken at the holes in the air distribution plate have yielded varying output readings through each separate hole.
- The glow bars effect on the flow and turbulence throughout the OSU apparatus as compared to the new flat plate heater in the HR2.
- The form of air distribution in the bottom chambers of the OSU.

The importance of turbulence through the OSU was also discussed. Reasons to keep the airflow through the OSU turbulent are summarized below:

- Turbulence can mix the air in the OSU near the thermopile to produce more even temperature readings.
- The air turbulence patterns could alter the combustion effects of the sample.

Plans and goals for moving forward with this project include:

- Measuring the airflow near the thermopile, with and without the exhaust fan on.
- Closing the second airflow inlet near the top of the OSU to understand its effects.
- Understanding the airflow difference between the exhaust of the OSU and the HR2.

RTCA Task Group – S. Rehn (FAATC)

Task Group Summary provided by Steve Rehn (FAATC), Task Group Lead (stevn.rehn@faa.gov)

In the RTCA task group meeting, we discussed a lot of the details that still need to be worked through in the draft flammability test method. One of the first things we talked about was when holes in electronic boxes are considered ventilation and when they are not. There could be small holes in the corners of a box from manufacturing or small holes drilled for pressure equalization or water drainage. If these were the only holes in a box, it would not need to be tested because there would not be enough intake air to sustain a flame. If there are multiple holes in a box intended for cooling, then this is considered ventilation and it would need to be tested. Similar wording will need to be added to the draft flammability test method.

We may also be able to add that if a box has very little ventilation for cooling, then it would not need to be tested either based on experiments from the FAA Technical Center. Testing has shown that there is a point in which the methane flame from the line burner cannot be sustained if there is not enough airflow into the box. More testing will likely need to be completed to find the absolute minimum airflow required to sustain a flame by varying the burner position in the box and varying the individual ventilation air hole size.

Other details of the draft test method were discussed, such as testing with printed circuit boards (PCB) positioned horizontally. It is currently written to use a 5L/min fuel flow rate for 2 minutes on the burner placed under the PCB. Alan Thompson previously contacted the ANSI group (the telecommunications industry test on which our test method is based is ANSI T1.319) to ask about the reason for this test being different than testing a vertical PCB. The people contacted did not know why this was chosen. Horizontal PCB testing will likely require more testing but for now, the RTCA task group is leaning toward keeping the fuel flow rate and test duration the same as a vertical PCB test.

There was a lot of discussion on the pass-fail criteria of the test method. It is currently written that if a 1.5-inch flame escapes the box for more than 12 seconds, the test is considered a failure. This would be very difficult to determine in practice because flames escaping might not stay in one spot, they could flicker on or off, the height could keep changing, etc. The ANSI test method uses a UL94-V0 flammability certified material to place above the burner and if it ignites, the test is a failure. This material was

discussed as well as other potential materials, such as a cotton cloth material that would ignite more easily. The UL94-V0 test method is more stringent than the 12-second vertical Bunsen burner test so that may not work for us. The key, however, would be to use a material that we will be able to reliably obtain for years into the future. Testing would need to be done to validate using a material above the box as the indicator of failure as well.

Future plans include going through the draft test procedure in detail and updating it based on testing that has been completed. We plan to make some type of flow chart of when an electronic box needs to be tested and exactly how. For example, if a box has very little ventilation it will not need to be tested. If it has enough ventilation to warrant testing, where does the burner get placed, how many tests need to be run, etc. The placement of the burner in a box needs to be defined with more detail because the worst-case scenario needs to be tested, but it may not always be clear where that would be. The group plans to make drawings to help explain and simplify the process.

Radiant Panel Task Group – S. Rehn (FAATC)

Task Group Summary provided by Steve Rehn (FAATC), Task Group Lead (stevn.rehn@faa.gov)

In the radiant panel task group meeting, the initial discussions were about reducing the ±5% margin of error on the heat flux calibration to ±1%. The reason for this reduction is because previous testing has shown changes in heat flux can have a large effect on test results. In addition, 21 out of 24 labs in the previous round robin all had a heat flux measurement within 1% of the standard calibration value. Of the three labs that were not, one was off by 1.3%, one by 1.7%, and one by 3.1%. They were all contacted in March of 2016 and had no problem with getting their heat flux value within 1%. However, at this task group meeting there was still a lot of concern about tightening up the spec. The participants asked to have a chance to go back and check with their labs to see if this will change anything for them or cause any problems. Another concern was that the calorimeters and data acquisition systems used might not be accurate enough to stay within 1%, so that is something we need to check as well. In the handbook, the change from ±5% to ±1% will remain in red for the time being because it has not become a permanent change and is still being debated.

The rest of the task group meeting mainly covered the topic of electric panel aging. As a panel ages over several months or years depending on use, its temperature set point must be steadily increased to reach the required calibration heat flux. This can eventually lead to an increased number of material failures or other inconsistencies compared to when a panel is new. Currently, most labs replace their panel when it gets too old, but there is no guidance as to how it is known that a panel is out of spec. Some labs use a standard material that they know should pass, so if it fails more than usual, they know something is wrong. This wouldn't be practical to add to the handbook because it will be impossible for every lab to get the same material and for that material to remain perfectly consistent over the coming years. The goal of this discussion was to brainstorm ideas about which parameters to study to determine that a panel no longer functions correctly.

The FAA Technical Center has four old panels from different labs that were replaced because of age, two brand-new unused panels, and one relatively new panel currently installed in the radiant panel testing apparatus that can be used to study the effects of aging.

One of the parameters we know changes as a panel ages is the quality of the black paint on its surface. Old panels look faded and discolored from heat and soot. One parameter that we can measure is the emissivity of the paint, however there wasn't much experience with the group in doing this. One way it can be done is by measuring the temperature at the surface of the panel with a thermocouple and compare it with the temperature measured by an infrared camera. In order to get an accurate measurement with an infrared camera, it requires you to set the emissivity of the object being measured. Since we will know the actual temperature with the thermocouple, we can set the emissivity to match the temperature measured with the thermocouple in order to find the emissivity. More research, such as talking to the manufacturer of the infrared cameras, still needs to be completed before testing to be sure this will be an accurate measurement method. The emissivity would need to be measured at several points on the panel since it does not discolor evenly.

Another parameter to measure is the electrical resistance of the emitter strips in the panel. This may change over time, but nobody in the group knew if this had been done before. One of the questions that came up was whether to measure this when the panel is cold or at operating temperature. It would be much easier to measure when cold, but one member brought up that the hot/cold resistance might have a bigger difference in an old panel than a new panel. In future testing, the FAA tech center will likely measure the resistance of each panel when hot and cold.

Other ideas were thrown around as well. If we could study how much the set point temperature of an individual panel increased (compared to when it was new) before it became out of spec, it might become a useful method of determining when to replace a panel. However this would require a long term study if we were to do it with actual panel usage. If it is found that the emissivity of the paint is the largest factor in panel aging, the panel could be artificially aged by painting it with a lower emissivity paint than flat black. A few paint combinations could be tested to determine the lower limit of paint emissivity to keep a panel in spec. If the set point temperature increase is consistent/proportional to the decrease in emissivity, then this could be a useful method in determining when it is time to replace a panel. Another idea was to measure the average power draw of the panel during calibration or testing, so if the power consumed increases by a certain amount, the additional heat could cause more material failures.

If it does turn out that the surface paint is the major factor in panel aging, panels could likely be refurbished by repainting them instead of replacing them every time. This would reduce the cost of panel replacement which should help test results stay more repeatable across all labs. A standard method of refurbishing would need to be developed in order to accomplish this.

Question during Task Group Report:
Q: Are you going to measure the resistance when it is cold or hot? Rehn: Cold. Q: did you discuss the change from +/- 5% to +/- 1%? Marker: if it something that is well-vetted within the group, we will make the change. If this is something that the group still wants additional discussions on, maybe we will not put it in there yet. You guys should plan to discuss this again and come up with an appropriate deviation.

<u>VFP Test Task Group</u> – R. Whedbee (FAATC)

Task Group Summary provided by Rick Whedbee (FAATC), Task Group Lead (Rick.Whedbee@faa.gov)

-The group agreed that test parameters and dimensions need to be updated and defined. These will include critical dimensions, fuel/air flow rates, furnace power, clocking of furnace coil and burner impingement time. From there, tolerances will be established.
-Agreed to move forward with the larger internal volume of the test chamber and those dimensions are to be provided to Deatak.
-The possible need for side baffles when testing smaller diameter ducts, wires, sleeves or conduits was discussed again and needs to be determined.

In attendance:

Rick Whedbee, FAA
Tina Emami, FAA
Steve Larson, Deatak
Mark Pischulla, Technifab
Phillip King, Gulfstream
Jeremy Hanson, Gulfstream
Thomas Krause, Airbus
Ed Nixon, Gulfstream
Chuck Wilson, Gulfstream
Randy Rundhaug, R2M Tech
Doug Maben, Boeing
Matt Anglin, Boeing
Tod Maurmann, General Plastics
Bill Haywood, Flexfab
Steven Lee, Flexfab
Gary Palmer, Skandia
Jeff Gardlin, FAA

Ducting/Wiring Task Group – R. Whedbee (FAATC)

Task Group Summary provided by Rick Whedbee (FAATC), Task Group Lead (Rick.Whedbee@faa.gov)

The proposed spiral sample holder was discussed further and will not work for all wire diameters. If we proceed with this configuration there will limits and an additional configuration will need to be used on larger diameter wires.
-If we do proceed with the spiral sample holder, a spacing of coils and groove depth & diameters need to be tested and specified.
-FAA will conduct a comparison between copper and Alumina substrates.
-Will flexible conduits be tested as a duct or as a sleeve?-Michael Jensen
-There was open discussion about the guidance material associated with wires and ducts, what exactly needs to be tested & why, and what, if anything are we trying to eliminate (specific product or material)-Jeff Gardlin, Dan Slaton, Enzo Canari, and others.
-FAA will review wire data currently available from various test methods and determine how to proceed.

In attendance:

Rick Whedbee, FAA
Jeff Gardlin, FAA
Dan Slaton, Boeing
Doug Maben, Boeing
Florian Schmaus, Diehl
Mark Pischulla, Technifab
Luka Sovul, M.G. Chemicals
Kristopher Notestine, Damping Tech
Jesse Beck, American Airlines
Andre Pinard, Astronics & AMP Aviation
Sam Frandella, Brooke One Corp.
Serge LeNeve, DGA
Ed Nixon, Gulfstream
Cherly Hurst, AAL
Sandeep Singh, 3M
Marla Craig, Gulfstream
Kimberly Orlando, Zodiac
Michael Jensen, Boeing
Euangle Patagan, FACC
Melanie Prince, F-List
Bill Haywood, Flexfab
Steven Lee, Flexfab
Steven den Dikken, Zodiac
Travis Gift, Technifab
Bill Windsor, Zotefoams
Michael Schall, Deatak
John Johnson, Nordam
Enzo Canari, EASA

After Task Group Report Tim Marker asked, “have you considered stacking the wires horizontally?” Whedbee: we can try that.

Cargo Liner Task Group – T. Salter (FAATC)

Task Group Summary provided by Tim Salter (FAATC), Task Group Lead (timothy.salter@faa.gov)

The topic of discussion for this task group was the ongoing airflow study of the cargo liner test method. The purpose of the study is to reduce the test result disparities among labs by measuring localized air velocities around the test sample, and standardizing an air velocity range, which could reduce the test result disparities. Since the previous meeting in Atlantic City of 2017, a 6-point anemometer rig was developed and constructed that could be mounted on the cargo liner sample test rig and used to measure air velocities at multiple exhaust fan speeds under two different exhaust hood

configurations. Liner samples were tested under both hoods using the same fan settings used for air velocity measurements. An analysis of the data showed the erratic air velocities measured under hood #2 caused liner sample test results to have greater peaks and valleys in the test temperature data plots. A "shroud" device was constructed and attached to the sample frame to reduce the influence of the airflow disruptions during sample testing and data results. The shroud was successfully able to reduce the variations in both air velocities around the sample and created a smoother test sample temperature data plot. One drawback of the shroud was a small increase in the peak temperatures measured above the test samples as compared to test data collected without the use of the shroud. The task group members were concerned that the shroud may cause some passing materials to experience failures because of this. Additionally, the shroud obscures the visibility of the liner sample and flame penetration of the liner material and/or backside flare-up of the sample. The study and use of the shroud will continue with the ongoing airflow study. New shroud designs will be constructed to address the temperature increase and sample visibility issues, and then tested under three different exhaust hood configurations at the FAA Technical Center. An interlab study may then be conducted with the shroud, depending upon the results obtained at the FAA TC. The addition of a shrouding device would need to be vetted through the working group before it could be implemented into the cargo liner test method.

Seat Cushion Task Group – T. Salter (FAATC)

Task Group Summary provided by Tim Salter (FAATC), Task Group Lead (timothy.salter@faa.gov)

The subject matter for this task group was the new Sonic Burner Assembly and Operation Instructional video. The script for the video is currently being finalized, and filming of video footage will begin when the video crew is available at some point before the next materials working group meeting. The current outline of the script for the video was presented to the task group members. Each item on the outline was explained in detail regarding what to expect in the new Sonic burner video. The video will be broken down into main chapters that are then broken down further into detailed subchapters. The main chapters include Introduction and Background, Sonic Burner Design and Components, Sonic Burner Assembly Procedures, Calibration of Fuel and Air Delivery, Burner Preparation and Operating Procedures, Scheduled Maintenance, and Troubleshooting of the Sonic Burner. After reviewing the outline of the video, task group members were asked for feedback, suggestions, or additional items to include. Overall, the task group was satisfied with the video content. One item of concern was with regard to warpage of the burner cone, and allowing the use of a frame around the cone exit perimeter to reduce the possibility of warpage. The current Fire Test Handbook does now allow the use of such a frame, but an interlab study is currently underway to determine any influence the frame may have on test results.

OSU/HR2 Task Group – Brian Johnson (Boeing)

Voltage Round Robin was discussed. We will continue to pursue solutions for voltage power control. TRL 5: there was a discussion about whether we should tackle the voltage issue before starting TRL 5. Marker: do you have more than one data logger? Johnson: we have three. Marker: is there any interest in going to something like a power controller? Johnson: yes, we will be looking into power controller devices.

M. Burns (FAATC) – thanks to the members who contributed.

OSU/HR2/Heat Flux Calibration – M. Burns (FAATC)

Task Group Report for Heat Release Rate Flammability Test and Heat Flux Gauge Calibration

Task Group Summary provided by Mike Burns (FAATC), Task Group Lead (Mike.Burns@faa.gov)

1. OSU / HR2. Yaw Agyei (Boeing) presented information on the continuing development of the OSU guidance document currently being developed through the IMFTWG. Additionally Brian Johnson (Boeing) presented information on the development of a voltage-monitoring round robin (OSU) and TRL5 activity planned for the HR2 validation effort.

A. Voltage Round Robin – Boeing will generate a draft test plan. Once completed it will be sent to the Tech Center for distribution to task group members for comment before being finalized.
    a. Draft Test Plan
    b. Instructions on how to connect equipment
B. TRL5 – Task group discussions included the following topics:
    a. During testing of blank sample holder, the holder will use of ½" thick millboard to simulate the presence of a test coupon.
    b. HR2 will use the drip pans for all tests whereas the OSU will not
    c. Time interval between tests – a 1-minute moving average of thermopile signal will be used looking for stability within ± 2% STDEV.

The Task group discussed Voltage and power control for the HR2 by using feedback signals or other methods. It was agreed that there needs to be assurances that we will not introduce issues with feedback loops and heaters (by burning materials) or other strange phenomena.

Ralph Buoniconti (SABIC) presented some comparative data (OSU/HR2) of thermoplastic materials. The group reviewed Ultem 9085 data from 2016 & 2017 tests in more detail/depth. Group discussions indicated that it might be time to assemble a matrix of test materials for later TRL activities.

2. HR2 Prototype Heater Development. Tech Center presented a prototype heater to the group. There was lengthy discussion covering many pros & cons of changing the heater type. Some issues included uniformity criteria, durability & longevity of the heater and difficulties maintaining a clean glass surface (of the heater) over long periods of testing. The Tech Center will install the new heat and begin to gather data for future discussions.

3. HR2 Placeholder Document. Discussions concerning the frequency of calibration for Corner heat flux and Methane gas calibration. It was agreed to the following:

Calibration	Old	New
Corner HF	Monthly	Daily (When testing)
Methane Gas Calibration	Monthly	Weekly (When Testing)

4. Prototype Heat Flux Calibrator. Preliminary equipment and calibration data was presented for discussion. A complete review of the calibration placeholder document was conducted and all group members still agree that it is sufficient with the exception of one item. A desire to use stronger wording on the swapping of positions of heat flux gauges needs to be incorporated. This is with respect to reproducibility of the calibration process.

5. Additional Discussion Items. Philadelphia Eagles Super Bowl victory review.

6. Action Items:

FAA Tech Center

- Distribute voltage-monitoring draft test plan to task group members for comment
- TRL5 activity – Update software to determine Time interval stability criteria on HR2
- Begin testing new R&D Radiant Heater on HR2
- Update HR2 placeholder document as needed.
- Continue initial testing of prototype HFG calibration apparatus
- Update Heat Flux Calibration placeholder document as needed.

Boeing Team

- Build upon OSU guidance document
- Develop voltage-monitoring round robin draft test plan (OSU) and submit to Tech Center for distribution to task group members (based on previous OSU RR participation).
- Develop TRL5 test plan – Update software to determine Time interval stability criteria on OSU

IMFTWG Members

- Begin to assemble a matrix of test materials for later TRL activities.

Waste Compartment Fire Containment Task Group – Scott Campbell (Zodiac)

Task Group Summary provided by Scott Campbell (Zodiac Aerospace), Task Group Lead (scott.campbell@zodiac.com)

Approximately 25 participants discussed the topic. Brain stormed ideas for future work in categories of
Similarity requirements, Similarity Methods of Compliance, and test method standardization.

- Similarity requirements and MOCs found on the next page were discussed for future consideration.
- Reviewed the hinge gap example and concluded that there were as many calculations as participants who tried it. Can we standardize a simple method?

Brain storm ideas:

- Bonded door or flap seals
  - Must be mechanically attached to all to be included in a test?
  - Compressed seals- Zero gap in the gap analysis? (If shown still compressed in worse-case tolerance)
- Outside décor does not impact fire containmen testing
- 45-degree test (F5)- should it be applied to the plastic waste container, door seals, door nesting closeout frame, sealant [anything through which the fire may penetrate to exit the compartment]
- Area of the door vs. shape: Shape most important.
- Trash fill line in compartment test higher than lower edge of vertically mounted waste flappush
  trash back for test to allow waste flap to open.
- Flame front- 50% flame front not mandated to be centered under thermocouple which can cause lower temperatures recorded in a compartment that extinguishes very quickly.
- Fans- test per typical operation
- Using FC test for COTS (Commercial off the shelf- general electronics, printers , etc). Standardized method
- Holding screen to aide in holding trash while filling tall waste compartments for test.
- Trash compactors- piston up = worse-case
- Waste weight- how much to wad/crumple/ trash for test? How to standardize If there is an impact?
- Potty bottles (lav fire extinguisher bottles)- test with an empty one or remove and patch holes?
- Fire load- Recommend a change [eliminate cigarette boxes- should we change anything else?
- Smoke requirement- very subjective. Depends on test chamber size and no guidance for if smoke ever prohibits fire fighting activies within reasonable time frame of detection or after late detection. Smoke requirement not in the rule!
- Trash- does it need to be conditioned (like all other fire tests)?
- Best practice to light test
- Floor Seals- Large waste compartments without integrated floor: Test is done with waste container/cart installed only. Test should be done with compartment seals that close out the walls to aircraft floor? And good if there is no damage to the seals after the test.
- What causes a new test? A placard- hopefully not.
- Horizonta vs. Vertical gaps on smaller drawer waste compartments.

Lots and Lots of ideas. Please review and send more ideas and thoughts. Next meeting we will begin to
develop and assign tasks. If you can't make the meeting- express to me what tasks you are most interested in or would like to lead.

Thanks
scott
MOC Item / Design Requirements Descriptions
1/ Greater compartment volume substantiates lesser volume. [FAA AC25-17A]
2/ Greater air gap substantiates lesser air gap. [FAA AC25-17A]
3/ Thinner core panels substantiate thicker core panels (same materials) for the same application (sides ceilings, etc)
4/ Less skin plies substantiate more skin plies (same material) for the same application (sides, ceilings, etc)
5/ Latch features: must have similar or greater engagement. Must be in a similar location and same quantity (some W.C has two latches but most with just one).
6/ Ratio of air gap to volume must be less than tested. (Galleys Europe experience)
7/ Testing a compartment with a non-metallic waste bin can substantiate a waste compartment with a metal waste bin (with the same or lesser volume).
8/ Waste flap design features must be similar (hinge, movement, overlap, material, thickness, etc).
9/ Waste compartment door features must be the same (same hinge type, similar door closeout features- does door metal trim overlap the door gap? Or does it nest with closeout metallic rubstrips on the inside?)
10/ Compartments with unique access panel/removable panel designs or pass through plumbing features must be similar to the test unit tested.
11/ Waste flap location must be similar (ceiling vs side). [Does anyone substantiate the same waste flap design located on the side by the same flap tested in the ceiling configuration?]
12/ Nonmetallic panels can substantiate aluminum sheet/ panels. (minimum thickness for aluminum sheet? .06"?)
13/ Design requirement: All seals may be bonded but additionally must be mechanically fastened.
14/ Nomex and Kevlar core are interchangeable and can substantiate aluminum core.
15/ Thinner aluminum skins substantiates thicker aluminum skins.
16/ For Galley carts: Similarity must be 1st based on same generic design (meal cart, entrée cart, waste cart or standard container box. These applications have different test methods (different combustibles). cart
Next, cart ventilation must be taken into account. Some have galley air over carts, air piped through the cart, or ice cooling. Then similarity technique in 1-15 may be taken into account.
17/ Waste door with edge cast can substantiate waste door with aluminum edge trim.
18/ Tested waste compartment with split line can be used to substantiate the one without split line. (same or less airgap, volume)
Some simulate the bonded door seal by cutting a chunk of seal away for the test.

MCC Material Change Similarity Task Group – Dan Slaton (Boeing)

Task Group Summary provided by Dan Slaton (Boeing), Task Group Co-Lead (Daniel.B.Slaton@boeing.com)

During the task group break-out session there was further review of the new proposal to calculate a new term FRC (Fire Resistance Capacity) that combines HRC (Heat Release Capacity) and IGC (Ignition Capacity) into a single criterion. The method to calculate each of these terms from the MCC output data was described and the process steps for

comparing a changed material to the original material was reviewed. The task group discussed other applications of the process including using the process to evaluate replacement materials for obsoleted materials and second source evaluation to a material specification.

Tom Little of Boeing provided an overview of the recommended statistical methodology for comparing two datasets. The information has been attached to the MCC Status Presentation provided by Dan Slaton during the full FTWG session. This presentation will be posted on the FAATC website. The statistical methodology is very robust and is applicable to many of the development activities being worked at the FAATC.

Material change case studies are now needed to prove out the process. Zodiac and Boeing have supplied multiple phenolic resin samples to assist in the validation. 3M (Patrick Zimmerman) will locate prior MCC data on some of their materials and determine if the new calculations can be assessed from the MCC raw data. Schneller volunteered to get involved to evaluate decorative laminates. Mike Schall of DEATAK invited folks to come out to their Illinois facility and get hands on experience testing their materials on the MCC.

To better define a standard approach for this activity, a generic “Test Plan/Report” will be developed. The Test Plan/Report template from the 2012 Flammability Standardization Task Group will be used. Please contact Rich Lyon or Dan Slaton is you have any questions on how to get involved with your materials.

Additional Discussion:

Next Meeting:

June 6-7, 2018
Hosted by Hutchinson
Châlette sur Loing, France

See www.fire.tc.faa.gov Materials page for details.