INTERNATIONAL AIRCRAFT MATERIALS FIRE TEST FORUM MEETING

Hosted by FAA Technical Center Fire Safety Branch at Resorts, Atlantic City, New Jersey, USA

October 29-30, 2018

AGENDA:

MONDAY, OCTOBER 29, 2018

Welcome/Logistics – Tim Marker (FAATC)
Participant Introductions
Various Project Updates – T. Marker (FAATC)
Magnesium Alloy Testing Update – T. Marker (FAATC)
Oil Burner Testing/Sonic Burner Video Status – T. Salter (FAATC)
Insulation Burnthrough Testing – T. Salter (FAATC)
VFP Testing Update – T. Emami/R. Whedbee (FAATC)

Break

Radiant Panel Update – S. Rehn (FAATC)
RTCA Update – S. Rehn (FAATC)
Characterization of OSU Airflow Using Particle Image Velocimetry – T. Emami (FAATC)
Heat Flux Calibration – M. Burns (FAATC)
HR2/OSU Update – M. Burns (FAATC)
Voltage Round Robin Update – Yonus Behboud (Boeing)
HR2 TRL 5 Testing Results and Analysis – Brian Johnson/Thomas Little (Boeing)
CFD Modeling of the OSU – Haiqing Guo, Ph.D. (C-Far)
Waste Compartment Fire Containment Task Group Update – S. Campbell (Zodiac)

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Additive Manufacturing – T. Krause (Airbus)
Additive Manufacturing – S. Rehn (FAATC)
Material Change Similarity Overview – D. Slaton (Boeing)
Material Change Similarity Testing, Material Consistency Using MCC – R. Lyon (FAATC)

Break

Task Group Meetings Session I:

Magnesium Alloy Testing (Atlantic 2) – T. Marker
Cargo Liner/Test Cell Barriers (Atlantic 8) – T. Salter
OSU Flow Visualization (Atlantic C) – T. Emami/R. Whedbee
Radiant Panel Test (Atlantic 7) – S. Rehn
OSU/HR2 (Atlantic D) – M. Burns/Boeing
Flame Retardants/Material Change Similarity (Atlantic 3) – D. Slaton/R. Lyon

Task Group Meetings Session II:

Seat Flammability and Sonic Video Development (Atlantic 8) – T. Salter
Heat Flux Calibration (Atlantic D) – M. Burns
Additive Manufacturing (Atlantic 7) – S. Rehn/T. Krause/T. Kempers
Vertical Flame Propagation Testing (Atlantic C) – Emami/Whedbee/Marker
Waste Receptacle Fire Containment (Atlantic 3) – S. Campbell

Lunch Break

Task Group Meetings Session III:

Insulation Burnthrough Testing (Atlantic 8) – T. Salter
RTCA Test Development (Atlantic 7) – S. Rehn
Vertical Flame Propagation Testing (Atlantic C) – Emami/Whedbee/Marker
OSU/HR2 [if needed] (Atlantic D) – M. Burns

Break

Task Group Reports
Additional Discussion / Next Meeting / Closing

MINUTES:

MONDAY, OCTOBER 29, 2018

Project Updates and Status of Rulemaking Activity – T. Marker (FAATC)

Review of Red Line process for updating *Aircraft Materials Fire Test Handbook*.
Discussion of some points of Handbook Chapter 1. Discussion of some points of Handbook 10. Discussion of research process for updating of Heat Release test.
Powerplant Fire Testing (Handbook Chapters 11 & 12: Currently, this work is part of the Systems Fire Protection Forum. Should it remain in the Systems Forum or should it be moved to the Materials Fire Testing Forum? Tim asked the Forum attendees to think about this and consider it.

Development of a New Magnesium Alloy Flammability Test – T. Marker (FAATC)

Tim reviewed the past significant activities related to this work (2008-2015). To be considered: non-primary seat components such as tray table arms, etc. What about components that exceed the SAV ratio?

Development of Flammability Test for Magnesium Components Used in Inaccessible Areas:
Discussion of Current Test Parameters. Information is now included in Handbook Chapter 26. Six labs participating in an Interlab Study. New Sample Holder and drawings were shown. Tim outlined the items for discussion during the Magnesium Alloy Task Group meeting on Tuesday, October 30, 2018.

Sonic Oil Burner Testing and Sonic Burner Video Update – T. Salter (FAATC)

Sonic Burner Cargo Liner Test:
Shroud Study Background – Purpose: reduce test result disparities among burn labs. Tim described Shroud Concepts #1, 2, 3 and the test results of each concept. Cargo Shroud Round Robin Study: test shroud in different lab environments. Tim reviewed what is planned for this Round Robin. It is undecided at this time if legacy burners will be included in this Round Robin. The shroud will be shipped in pieces due to its size. No modifications to individual lab set-ups will be required. Samples: 10 Epoxy resin-infused liner samples will be included.

Sonic Seat Cushion Test: shroud development for this test. Same purpose as cargo liner test shroud – modified cargo shroud design. Tim showed results and photos from seat test shroud testing. We are also interested in running a Round Robin similar to the cargo liner shroud study. Please let Tim Salter know if your lab is interested in participating in this Round Robin for the cargo liner or seat cushion test. Contact Tim at: timothy.salter@faa.gov, 609-485-6952.

Sonic Burner Assembly and Operation Instructional Video: a first cut of this video has been completed. The video addresses topics not previously documented. Final cut to be released shortly after this Forum meeting concludes.

Planned Research and Work for cargo liner, seat cushion test, and publication of sonic burner video. Tim Salter is the new POC for the Powerplant burner test.
Little: Slide 14: how many tests? Salter: one test. Anglin: have you tested any samples that burn through? Salter: yes, that was the first thing that I tested with the first shroud. There is a video in the March 2018 presentation that shows that.

Insulation Burnthrough Testing – T. Salter (FAATC)

2017 Comparative Test Series has been completed. 11 labs participated in this study. 8 out of 11 labs submitted results. Graphs showing comparison of Phases 1 and 2 for 8611 material were presented. Tim Salter picked up this project heading into Phase 3. Purpose of Phase 3: standardize fuel nozzle, Next: conduct study using Delavan nozzles and new burner settings. FAATC Phase 3 results were discussed. Final Notes: Handbook Chapter 24 was recently updated to match other Handbook Chapter formats and now includes the Sonic burner. We are seeking Round Robin lab participants. Phase 3 update at the spring 2018 Materials Forum meeting. Marker: why didn't you get a lot of data back in Phase 2? Salter: one of the problems was that a lot of labs did not have the ignitorless stator. It is probably a good idea for labs to get an ignitorless stator for the sonic burner.

VFP Testing Update – R. Whedbee (FAATC)

Background: proposed test method for non-metallic composite structure materials in hidden areas. Current updates at FAATC: there have been updates to Marlin VFP. A new sample holder. Test start switch is embedded in the chamber. Hold-open mechanism. Larger control enclosure. Repositioned exhaust hood. A photo of the new sample holder was shown. We also updated the wire sample holder at the FAATC. VFP Furnace: there were some differences between the furnace we used in the development of the VFP and the furnace we are currently using in the VFP: coil diameter, overall rod length, effective heated length, overall mass of the assembled furnace, and overall construction. Each of these differences was investigated at the FAATC. Furnaces conclusion: we will have to define furnace construction for all VFPs. We have been working on a Technical Document to include specs, photos, etc. We also updated the Test Method. Methane vs. Propane: FAA tasked to make final decision on methane or propane (summer 2018 IAMFTF meeting). Methane vs. Propane Conclusion: Short-term: correct for reference conditions. Long-term: FAA will specify reference conditions for calibration of MFCs.
Future Work: Evaluate the relationship between Methane and various materials. Evaluate the effects of varying degrees of curvature. Define furnace construction parameters. Continue to update Technical Document and Test Method Document as we move along.

Radiant Panel Update – S. Rehn (FAATC)

Handbook Chapter update in June 2018. Electric panel aging testing: panel runs hotter as it ages and can affect test results. Steve reviewed the Handbook changes. Radiant Panel Aging is being investigated. Test 7 electric panels: 2 new, 1 in use, 4 old and out of use. Material Problems: received two new metalized PEEK materials from manufacturer: 50% top coat: 1 out of 6 failed. 0% top coat: 4 out of 6 failed. FAA passed all samples. Radiant Panel Emissivity: infrared camera: FLIR T440, 320x240 infrared resolution. The results were presented. The panels will next be tested with materials. Internal Resistance of Radiant Panel Emitter Strips: results bar graph presented. Measuring AC Power: temperature controller on radiant panel effects resistance, inductance, and capacitance to control the power. Must measure phase angle between voltage and current. From previous testing: 15 thermocouples at sample surface. Old panel showed much higher temperatures. "New panel" installed in 2017. Conclusion: need borderline material to test with. Lots of testing to be done.

RTCA Test Update – S. Rehn (FAATC)

Working on a new test method. This will be added to RTCA-DO160H. Draft due to RTCA committee in Spring 2020. Since June 2018 meeting: focused on determining pass/fail criteria. Steve described the Pass/Fail

Criteria work at FAATC. Borderline test results will likely require video for assistance in measuring flame time: possibly use infrared camera.
Conclusion and Future Work: using only flame time as pass/fail criteria looks promising since larger flames do not seem to ignite materials easier. Will recommend that video is taken of tests to aid in measuring flame time. Need to do comparative testing. Q: have you considered another test method like the MCC as a possible solution to figure out ignition temperature? Rehn: how would the MCC be able to determine different flame heights? Q: it would give you a temperature at which a board begins to burn. Rehn: I was using that to show a bigger flame doesn't necessarily ignite. Q: how about using thermocouples above the box? Rehn: it is something to think about although thermocouples do not react too fast. Carlo: consider what the threat is that you are trying to protect from. Hill: are you going to go back and look at thermal acoustic insulation that passes the vertical radiant panel? Carlo: you just defined the threat you are trying to protect from. Rehn: it is something we can try. Carlo: we call the smaller flames 'transient flames'. Campbell: has the Task Group looked at defining the design of the box? Rehn: that is something we have talked about, but what if there is something more flammable inside.

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

Tina provided background on purpose of the project. The measurement location was shown. It has been about one year since Tina took the original data, so she retook the data. New Test Setup: air inlet was moved back to its original location. PVC tube with two rows of evenly spaced holes 45 degree from horizontal was constructed. Photos of the new test setup were shown. A potential new design was also shown. Conclusion: new setup shows a slower but even distribution of air flow in front of the sample face. Test second design. Question: have you considered changing any of the rest of the unit? It looks like a lot of this data is focused on the lower chamber? Emami: I have spent most of my time looking into the lower chamber, because if we control how the air enters the chamber it might be more manageable.

Heat Flux Calibration Updates – M. Burns (FAATC)

Comparative testing project at FAATC: compare calibration results and repeatability using the traditional calibrator and a new prototype design. Photos of heat flux gauges shown for reference only. Photos of the prototype heat flux calibration apparatus were shown and described. Mike described the calibration procedure for the prototype unit and the traditional unit. Punchlist items for prototype heat flux calibrator have been completed. Comparative test results of traditional unit and prototype unit were presented. We will discuss this further in the Task Group meeting. Development of a Heat Flux Gauge (HFG) Round Robin will be discussed during the Task Group.

HR2 Updates – M. Burns (FAATC)

New HR2 Prototype Heater: Dimensions: 10"x10"x2"D. 2 zones (upper and lower). Flush mounted glass with rear wall (sealed). Replaces the following components: globar pan, diamond shaped mask and reflector plate. Photo of this prototype heater was shown. Prototype heater Observations: after the heater was running a while Mike noticed the lower section being pushed out (away from the sample). Center heat flux was higher than the corners for most testing. Chamber air velocities graph was shown. HR2 prototype heater was inspected after the testing.
Bypass Cooling Effect in Heat Release Rate Apparatus: Cooled exhaust vs. non-cooled exhaust. Thermoplastic testing was conducted – 5 samples were tested instead of the normal 3 samples (Ultem white and Ultem tan).
Next: Task Group will discuss these items further.

Voltage Round Robin Status Update – Yonas Behboud (Boeing)

Yonas provided some background on this Round Robin. Purpose of RR: record the supply voltage and ambient load variations of FWG labs operating OSU HR. 22 labs participated in this study. We have received results from 13 of the participating labs so far. Questionnaire was sent to the 13 labs and only 7 questionnaires

were returned to date. A graphic representation of voltage recorder results was shown. For 'on' data: we went with a 95% Tolerance Interval Method. What does this mean? We have a 95% confidence that 95% of the data lies between the upper and lower voltage limits. Future Actions: 9 labs left. Collect, analyze, distribute data to each lab, present findings at March 2019 IAMFTF meeting. Q: a few questionnaire respondents said they had issues with calibrations, did that correlate with higher voltage range? Behboud: we will look into that for our March 2019 presentation.

HR2 Development – TRL 5 Test Results – Brian Johnson (Boeing)

Brian provided the background for this work. TRL 5 Test Plan: 30 randomized samples of 3 homogenous coupon types. Two test locations: Boeing lab and FAATC lab. TRL 5 Test Results for OSU and HR2 were presented. General Observations: Coupon complexity. OSU vs. HR2 peak time and shape: HR2 peaks appeared earlier and were larger than in OSU testing. Honeycomb w/ dec: panel peak exceeded dec peak – affected recorded time.

Analysis - TRL 5 Test Data – Tom Little (Boeing)

Summary: Tables and charts of peak and 2-minute totals (CoV %) were presented. There are three potential paths: stop HR2 development; stay in TRL 5; or proceed to TRL 6. Hill: historically, do we really see a repeatability problem with the OSU? Is repeatability the correct thing to be focusing on? Maybe the problems are material dependent and not machine dependent. Q: was all of the testing done on the same day in the same lab? B. Johnson: each one was 4 days. Q: during the 4 days did you happen to know if the supply voltage was monitored? B. Johnson: Yes, there was a difference in supply voltage. The voltage was more tightly controlled during the OSU testing. We monitored the supply voltage and will be presenting it during the Task Group. Buoniconti: did you take a cursory look at the data that Mike Burns generated on the thermoplastics? Little: no, I personally have not. I do not believe anyone at the Boeing team did either.

CFD Modeling of the OSU – H. Guo, Ph.D. (C-Far)

OSU Analysis with FDS – Haiqing provided a background for this work. Graphs of representative OSU tests were shown and discussed. Thermal Analysis on Inner Cone was done. CFD Modeling (2D Model): 2-D FDS model. Hot gas T is following a step change. Air T is constant. Both Ts are based on characterization results. Model of Sample/Holder Insertion was described. Sample holder effect results. Sample holder effect on Heat Flux was presented. Summary: upper region, the double-cone release signal. Blank run with a dummy sample needs to be done. Slaton: do you think you are at a point with the model to take some material samples and put them into your model? Guo: it's possible, but we want to do a step by step. Q: would one way to address the blank sample holder adding to the convective heat be to insulate the sample holder?

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

Scott provided a background of the Task Group's focus. The Task Group is assessing 26 proposed MOCs and design guidelines and 12 test standardization guidelines. We had some discussions on smoke during last session. We also discussed shimming. DO we shim designs with mechanically attached compressed seals that yield a 'zero' gap? How do we standardize this? Air gap through hinges was also discussed – standardized way was discussed. Explore waste density options – loosely or tightly crumpled. Explore visual guidelines. Or, explore alternate fuel loads. We want to simulate the threat and represent the fuel load on the airplane. We are committed to have the same threat. Tim Marker is asking our Task Group to review Chapter 10 of the Fire Test Handbook and make recommendations to support the imminent release of the new NPRM that will include the Fire Test Handbook.

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Additive Manufacturing Task Group – Thomas Krause (Airbus)

This is an FSTG-like approach to additive manufacturing. Identify key variables affecting fire safety requirements. Next steps: agree on materials that show just enough susceptibility to factors of interest (staring with printing direction). Move to more exotic printing angles. Move to other factors: infill, raster angle, etc.

Vertical Bunsen Burner Testing of 3D Printed Materials – S. Rehn (FAATC)

Three materials were printed in 3 orientations and tested. Steve showed photos and drawings of each printing pattern. Results of these tests were presented. Photos of the materials post-test were shown. On some 60-second tests material would melt down to the burner. Microscale Combustion Calorimeter results for 3D printed materials were shown. Future Work: need to test different infill percentage next. Jensen: why did you conclude the nylon 12 failed? Rehn: it did not actually self extinguish. If there is a large quantity of this material, I do not think it would go out. Campbell: what about different thicknesses? Rehn: we can try different thicknesses.

Material Change Similarity – Microscale Combustion Calorimetry – Dan Slaton (Boeing)

Dan gave and overview and goals of this Task Group: develop guidance using the MCC to determine the flammability performance characteristics of a material. Utilize the MCC method to compare the flammability properties of a currently certified material with those of he material that has been changed in some way to determine if there is a significant change in the fundamental flammability properties. The guidance has been updated and released. Dan gave a brief overview of some excerpts from the draft guidance. He reviewed the Task Group approach.

Material Change Similarity and Testing – R. Lyon, Ph.D.
Rich explained the Decision Tree approach for ASTM D7309 (MCC) – similar or different. Parametric Representation of Flammability Fingerprint for Comparison Purposes was shown and explained. Conclusions: Proposed MCC Method and Similarity Criterion is: sensitive to changes in composition at 10 mg scale. Sensitive to outliers. More sensitive to changes in composition than FAR tests.

Task Group Reports:

Task Group Report for Magnesium Alloy Flammability Test
Prepared by Tim Marker (FAATC), Task Group Lead, tim.marker@faa.gov

1. General Discussion. One task group member reported that their airframe manufacturing company now has a formal project on the planned use of a magnesium alloy in the fabrication of a primary seat component. This will involve an issue paper and application for special conditions to the FAA. This is the first reported project in which magnesium alloy is intended as the material of construction for a primary seat component, following numerous full- and laboratory-scale tests conducted by the FAA, which have paved the way for the safe use of magnesium alloy inside the cabin.

2. Discussion of magnesium alloy used in non-primary seat components. The FAA's initial effort to investigate the impact of magnesium alloy use in the cabin targeted the 5 primary seat components (legs, spreaders, crosstubes, seat back frame, and baggage bar). Subsequent efforts targeted smaller non-primary seat components and components used in inaccessible areas. The interest shifted from the primary components to smaller applications that could be used in both the accessible and inaccessible areas of the cabin. The problem is that most of the applications being discussed will not meet the surface-area-to-volume (SAV) ratio developed by the airworthiness authorities via the Task Group meetings (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 available for allowing these non-SAV-ratio-compliant components to be used in the cabin. The FAATC suggested the possibility of creating a custom test sample for the oil burner test based on the mass (or volume) of a standard test sample. The thickness of this custom sample would be the same length as a standard sample, but the thickness would be based on the thinnest cross section of the actual seat component. As a result, the overall height of the custom sample would increase. To illustrate this, consider the following example:

Solid Tray Table Arm for flip-up tray
SAV ratio: 30 (exceeds accepted criteria of 20)
Minimum thickness of tray arm: 0.100 inches
Material: XX-99 alloy

Step 1. Ensure that material XX-99 alloy meets the oil burner test in the standard sample configuration (i.e., no ignition prior to 2 minutes, maximum weigh loss less than 10%)

Step 2. Calculate the volume of the standard sample: L x W x H = 7.5 in^3

Step 3. Fabricate a custom sample of Material XX-99 having an equivalent volume of 7.5 in^3, a length of 20 inches, and a thickness of 0.100 inches (solve for H).

V= L x W x H
H = V / (L x W) = 7.5 in^3 / (20 in x 0.1 in) = 3.75 inches
Based on the above, a custom sample measuring 0.100 inches thick, by 3.75 inches high, by 20 inches long would be fabricated and tested. The FAATC has agreed to experiment with this approach to determine the feasibility, but have not yet received test samples to evaluate the approach. The FAA/EASA agreed to continue their internal dialogue on how this approach or a similar methodology could be incorporated to justify applications for magnesium use that are not within the current guidelines developed by the Task Group.

During the task group meeting, the participants discussed the above testing approach. One participant questioned the location of the altered test sample with increased height. In particular, he raised the issue of the burner with respect to the sample, since the sample would be much higher. The group agreed that the center of the sample should be located 1 inch above the horizontal centerline of the burner (same location as the thermocouple placement during calibration).

3. Transferability of Test Data. Task Group participants questioned the test requirements that will be imposed during certification of magnesium alloys. One specific example involved the certification of a particular magnesium alloy for a specific seat component. The participant asked if this certification data could then be used in a subsequent application involving another component, or would a new series of flammability tests be required. This was more of a certification question, and could not be definitively answered by the Task Group leader. The Task leader reminded the group that there are always quality control (QC) plans that would accompany any application, which will require further testing to ensure that the raw materials had not changed from the original material. These details will be determined during the application process by the appropriate airworthiness authority (FAA, EASA, etc).

4. Magnesium Alloy Use in Other Cabin Applications. Participants questioned the FAA's position on using magnesium alloy in other non-seat applications. In particular, for galley or class divider partition components. The Task Group leader detailed the FAA's current approach:

a. Primary seat components can be constructed of magnesium alloy if they meet the test requirements detailed in Chapter 25 of the Handbook;
b. Non-primary seat components can be constructed of magnesium alloy if they meet the surface area-to-volume (SAV) ratios agreed to by the airworthiness authorities, and they also meet the requirements detailed in Chapter 25 of the Handbook;
c. Components located in inaccessible areas during flight can be constructed of magnesium alloy if they meet the requirements detailed in Chapter 26 of the Handbook.
d. In addition to the above, the Task Group has previously agreed that other accessible cabin components located no higher than 60 inches above floor can also be constructed of magnesium alloy if they meet the surface area-to-volume (SAV) ratios agreed to by the airworthiness authorities, and they also meet the requirements detailed in Chapter 25 of the Handbook. This would include components such as galley carts or meal trolleys.

The Task Group agreed with the above criteria, but was interested in the FAA position for accessible cabin components located above 60 inches from the cabin floor. The Task leader indicated that this final area of the cabin had not been addressed, and no guidance was currently available. One participant discussed the current flammability requirements for most cabin materials, which were tested using either the vertical Bunsen burner (VBB), the radiant panel test (RP), or the heat release rate test (OSU). The participant asked the question, "what if a mag alloy met all three of these requirements?" The task leader indicated that heat release tests had not been conducted on magnesium alloy components as of yet, but was willing to conduct some testing to investigate this.

5. Discussion of Planned Interlab Study. The Task leader briefly discussed the proposed flammability test for magnesium components located in inaccessible areas. Over 280 radiant panel tests have been conducted to date using 0.025-inch thickness samples held in place using the truncated (shortened) perimeter-style sample holder. Results indicate the test methodology is repeatable, and a new draft procedure was written by the FAATC and added to the Fire Test Handbook as Chapter 26. Drawings of the latest sample holder are now available so that laboratories can fabricate them. In an effort to expedite the testing at various laboratories outside the FAA, several sample holders were constructed by the FAATC and sent to interested facilities. The FAATC has arranged an interlab study to determine test reproducibility when using identically-prepared materials. There are 5 interested laboratories that were sent a complimentary sample holder for a total of 6 labs that will participate in the study. The FAA has initiated the procurement of magnesium alloy material and will begin the tedious process of milling the purchased samples down to the appropriate 0.025-inch thickness for the interlab study. Once the interlab study is completed, the results will be compiled by the FAATC and presented. Additionally, 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.

Task Group Report for Vertical Flame Propagation (VFP) – T. Emami
Prepared by Tina Emami (FAATC), Task Group Lead, tina.emami@faa.gov

-There was a local agreement to move forwards with methane only and no longer propane. An email will be sent out to the rest of the task group that were not present to confirm moving forward only methane.
-There was an agreement to move forward with calibrating the mass flow controllers to the reference conditions of 25°C and 14.7 PSIA, while those who currently have the machine can calculate for the difference for now. Calculations are shown in the powerpoint.
-We will specify the height of the VFP relative to the working surface to eliminate restricting airflow.
-We have not yet agreed on the exact parameters of the furnace or radiant heat on the sample as well as the method of measurement of temperature or heat on the sample. This will be a continuous effort.

Task Group Report on OSU Flow Visualization Using Particle Image Velocimetry (PIV) – T. Emami
Prepared by Tina Emami (FAATC), Task Group Lead, tina.emami@faa.gov

-Discussed that residue of burning samples may land on the plates, clog holes, and affect airflow throughout. This will be taken into account and looked into for the future.
-Discussion of laminar flow not being the goal of the airflow through the OSU. The goal is uniform upwards flow and turbulent flow may not hurt it.
-Using mass flow controllers with the clear Plexiglas OSU would help to guarantee the measurements further.
-Measuring the hot air flow through the OSU is also important and will come once an optimal cold flow is reached.

Task Group Report on Cargo Liner Flame Penetration Test – T. Salter
Prepared by Tim Salter (FAATC), Task Group Lead, timothy.salter@faa.gov

The group discussion focused on the new air shroud that is intended to reduce the effect of turbulent airflow on sample thermocouple readings, and reduce test result disparity among test labs. The testing so far has been limited to smaller sample sets. It was suggested that more tests should be performed with more than one type of cargo liner material, including samples that would burn-through. Larger sample sets would also allow for a more statistical approach toward analysis of the test data. Some group members noted that the shroud may interfere with the hardware on the test rig including the clamping devices used on the sample test frame. The upcoming round robin is intended to assess the effectiveness of the shroud in reducing test result disparities as well as any issues that may arise when using the shroud during sample testing. The shroud design could be modified to address these issues should it be incorporated into the test method at a later date.

Task Group Report on Seat Cushion Flammability Test – T. Salter
Prepared by Tim Salter (FAATC), Task Group Lead, timothy.salter@faa.gov

A first cut of the new Sonic Burner Assembly and Operation video was shown during the task group. Members were asked to provide feedback on the video including any changes or additional footage that should be included. Based on the feedback, and section for the air and fuel cooling system will be included in the final draft. This section will include details on the chilling unit, coolant pump specifications, plumbing of the fuel supply line, air supply heat exchanger, and the type of coolant used in the chilling system. There will also be new footage addressing fuel tube alignment and the effect of test cell airflow on sample burning.
The group also discussed the new air shroud concept used to minimize the effect of test cell airflow on sample burning in an attempt to reduce test result variability among labs. A round robin involving the shroud is currently being planned for early 2019. Labs will be provided a shroud to mount on their test fixture and samples to test with and without the use of the shroud.

Task Group Report on Insulation Burnthrough – T. Salter
Prepared by Tim Salter (FAATC), Task Group Lead, timothy.salter@faa.gov

The main topic of discussion was the inclusion of the igniterless stator configuration for the Sonic burner in the Fire Test Handbook. The configuration was added to the FTH just prior to the Materials Fire Test Forum meeting in October 2018. Members asked if the original stator design would still be allowable for use in the Sonic burner. The current AC allowing the use of the original Sonic burner design does not pertain to the Fire Test Handbook. As a result, the original configuration will still be available for use in burnthrough testing.
A round robin is currently underway which includes testing PAN felt materials with the igniterless Sonic configuration and Delevan fuel nozzle. Tests at the FAATC have shown this configuration to be highly repeatable and an improvement over the original Sonic burner configuration. Test samples and fuel nozzle are being supplied to labs who wish to participate. Data is expected to be returned from labs by June of 2019.

Task Group Report on OSU/HR2 – M. Burns
Prepared by Mike Burns (FAATC), Task Group Lead, mike.burns@faa.gov

1. New Prototype Heater Development

Task group members discussed new prototype heater data presented at the meeting. The discussion included ways of improving the prototype heater design manufactured by Marlin Engineering. In a future design the quartz glass will be given more room in the fixture to allow for expansion to prevent cracking. For better uniformity control, a third zone would be added to allow for control of upper, mid, and lower power settings of the heating elements. Discussions also included the possibility of adding a lateral control feature on the heater. To help prevent warpage, more stiffening would be added to the panel and a more rigid millboard would be used able to handle the high heat capacity (prevent cracking). We discussed the 120°C cooler delta T within the chamber as a result of less surface area of the heating elements compared to globars within the air stream. Data showed overall reduced power consumption, higher test results (unknown cause) and unusual air velocity readings (left, center and right). At the conclusion, the group agreed to continue research on this new type of heater going forward.

2. Cooling Effect on Exhaust Gas Temperature (EGT)

Data was presented to task group members for discussion concerning an observed higher heated area above the test sample in the current non-cooled exhaust duct configuration. The question was raised whether to return to the cooled exhaust or continue on course. Task group members felt the need for more data to be gathered before a decision could be made. Additionally, members would like to test different types of thermoplastics along with the Ultem 9085 material. SEKISUI SPI and Schneller volunteered to provide KYDEX® materials and other products for additional testing.

Inner cone exhaust dimension:

There was discussion on the current exhaust opening that was standardized at 2" x 4" whereas current OSU exhaust openings may be slightly larger at approximately 2" x 5 ½" (this dimension could vary from machine to machine since it is not standardized). It was suggested to use PIV analysis to look at exhaust dimensions and what effect changing it would have to look for flow restrictions in exhaust outlet flow

Instrumentation and analysis of temperatures throughout the HR2:

In an effort to identify differences in temperature between the cooled exhaust (OSU) and the non-cooled (HR2) the FAATC OSU unit will be instrumented with thermocouples throughout. Initially, baseline conditions will be monitored (no flame), followed by burning known flow rates of methane. Finally, some materials will be tested, including thermoplastics. The OSU will have the ability to be configured in the cooled and non-cooled exhaust using mass flow meters for independent airflow control.

Task Group Report on Heat Flux – M. Burns

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

1. Heat flux calibrator

Task group members reviewed data presented showing calibration results between the FAA traditional calibrator and the Marlin Engineering prototype design calibrator. There was a desire to add power conditioning and voltage feedback into the software of the prototype.

A Round Robin draft test plan was reviewed with only one comment to include the 'reference' heat flux gauge in the validation portion of the round robin. The draft will be updated accordingly.

At the conclusion of the meeting, Martin Spencer (Marlin Engineering) and Tom Valenti (Boeing Company Metrology lab) reviewed the prototype apparatus at the FAATC. Although the current design works very well, suggestions were made to change from the current transient calibration method to stable data point calibrations (approximately 10). The HFG holding fixture would need to be modified in this case to allow for moving the gauges to different positions while maintaining the same radiant heat. Once stabilized, the HFG's would swap positions and capture voltage data (reference and working HFG). Once all data points are collected, a linear curve fit would be calculated for the new calibration factor. Marlin Engineering will look into the feasibility of building a 2nd prototype to accomplish this for further research.

Task Group Report on HR2 TRL 5 – Brian Johnson

We discussed the numbers in more detail. We did not make a decision on how to proceed based on the three options presented on Monday, October 29.

Task Group Report on Voltage Round Robin – Yonas Behboud

We discussed completing the study.

Task Group Report on Waste Receptacle Fire Containment – Scott Campbell

We decided to go into this in two phases. Phase I: EU and Asia versus the US. American Airlines agreed to give us a list of common catered items used on American Airlines. Accufleet offered to photograph trash loads that they remove from airplanes. That may be useful. Phase II: considering an alternate, more controlled method. We also discussed all the other items on our list. Designing and testing for maximum damage was also discussed. Types of thermocouples used were discussed, also.

Task Group Report on RTCA – S. Rehn
Prepared by Steve Rehn (FAATC), Task Group Lead, Steven.rehn@faa.gov

The first item discussed was the pass-fail criteria for the electronic box test. The FAATC proposed to only measure the time that flames escape from the box, and if it is 12 seconds or greater it is considered a failure. The other alternative would be to have a standard material that is placed above the box, and if that material ignites it would be a failure. The problem with this method is finding a consistent material that would be available in the future, indefinitely. So for now the Task Group agreed to move forward with the 12-second time of flames escaping as the pass-fail criteria.

Another point of discussion was that if there is a transient flame that escapes a box several times for a short amount of time for each event, then it would be less severe than if flames escaped for the same total time all at once. If we tried to make it equivalent such that the flames escaping had the same potential to ignite some material above the box, then we would either have to come up with a more complicated formula for timing the flames escaping, or we would be back to placing a standard material above the box for testing. Since having a flame escape several times for a short amount of time each would be less likely to ignite a material around it, it would make the test more conservative, so it shouldn't cause a problem.

Regulatory aspects of the test were also discussed. If there was a change of a single part inside the box it would not be feasible to have to test the entire box again. It would be more practical if the standard only required that new part be tested in the 12-second vertical Bunsen burner to allow it to be added to an existing box.

Future plans are to start round robin testing where every lab with the capability will test the same boxes with the same procedures and see if equivalent results are achieved. There are three labs currently set up with line burners and another lab has volunteered to set up a fourth burner at their facility. An additional Task Group participant may be able to obtain old production electronic boxes that could be tested. If not, we would have to make our own boxes with the same design and same materials, or we could do both. Another idea was to send box designs to every member of the task group and see if all participants come up with the same placement of the burner in the box and the amount of tests that need to be conducted.

Task Group Report on Radiant Panel – S. Rehn
Prepared by Steve Rehn (FAATC), Task Group Lead, Steven.rehn@faa.gov

The first item of discussion was reducing the tolerance on the heat flux calibration measurement from ±5% to ±1%. One of the questions that was brought up was whether we are allowed to reduce this tolerance since it could potentially change test results. Following internal FAA discussions, it was determined that reducing the

tolerance is allowed, as long as it can be proven that ±5% is too wide of a range, which was previously shown with certain materials producing different test results at the bottom and top end of this range. However, another lab indicated they had problems with voltage fluctuations, and a ±1% tolerance is too tight for them to achieve. In addition, labs are required to take their heat flux measurement value to 3 decimal places to be at the edge of the ±1% number, which not all labs do. One suggestion is to compromise to ±2% or just specifying a range of numerical values, but ±5% is too high.

The electric panel aging study that is in progress was also discussed, but it is currently on hold as the FAATC and Task members continue their search for a suitable "borderline" material to test that will show a difference between panels. Most labs have observed a difference in test results between new and old panels, we just need to replicate those results. All the FAA's test equipment for measuring each panel's emissivity, power, resistance, etc. is ready to go.

Another topic of discussion was the insulation board used under the test sample during testing. Generic requirements for the thermal conductivity and density of the boards were written in the handbook instead of only recommending which material to use, but it may need to be changed again. There is a material called Fermacell, which is a gypsum based board that is already in use by certain labs when testing certain materials. Some materials, such as certain foams, melt when tested and can be absorbed by Superwool insulation boards, and then continue to flame after the test, causing the material to fail. The backing board material is not supposed to interfere with the test, so this is unacceptable. The FAA will conduct testing of the Fermacell insulation material with test samples that melt. This will likely require a change in the description of the backing boards in the handbook because Fermacell does not fit the definition.

Task Group Report on Material Change Similarity

Prepared by Rich Lyon, Ph.D. (FAATC) and Dan Slaton (Boeing), Task Group Co-Leads,
Richard.E.Lyon@faa.gov / Daniel.b.slaton@boeing.com

A revision to the draft guidance for the Material Change Similarity process has been updated and posted on the FAATC website. The revised guidance is based on the last two years of development by the FAA Technical Center and MCC Similarity Task Group. The approach reduces the entire MCC specific heat release rate history to a single flammability parameter, the Fire Growth Capacity (FGC) of the material, that is used to compare a certified component to a changed component with respect to flammability.

During the main session of Fire Test Forum, Dan Slaton provided an overview and web link to the updated guidance, and highlighted the new sections. Examples showing calculation of FGC and use of the recommended statistical criterion for comparison were reviewed. Rich Lyon provided the details of the methodology and shared several examples of where materials were compared using the FGC values. The recommended statistical analysis method is a standard t-test to determine if the means of the two data sets are statistically different. Rich Lyon stated that the MCC is more sensitive to small changes in the molecular structure of materials than the FAR tests, so the method comparing FGC is rather strict (conservative). The ultimate goal is to set the sensitivity of the MCC comparison to a level that is commensurate with the sensitivity of the FAR test methods. Further case studies are needed to determine what the appropriate sensitivities are.

During the Task Group session, additional review of the revised guidance was shared. An example of a Task Group Report was shared showing the comparison of two materials and the analysis methodology for both MCC and OSU results. This report will be shared as a "Template" for further industry members to develop case studies to validate the guidance. An Excel spreadsheet was shared showing the calculation of the FGC and statistical analysis using the t-Test in the Data Analysis ToolPak within Excel.

The remaining discussion was around what types of materials would be appropriate to consider for case studies. Without a database of MCC data to draw on, industry should consider developing baseline MCC data on current/certified materials. Running MCC in parallel with new certification tests will provide the baseline data to use in the future when a change is made. Another area to consider is developing MCC data for

material quality control. Developing a data base of materials will provide a baseline to develop specific quality control levels for specific materials for batch control.

Task Group Report on Additive Manufacturing – Thomas Krause

This was the 2nd meeting of this Task Group. We discussed the results of the Nylon 12 and Ultem sample testing. The Task Group will look into how they can sponsor materials.

Task Group Report on Vertical Bunsen Burner Testing – T. Marker (FAATC)

The FAA reiterated that flame placement should be under the midpoint of the lower edge of the exposed face of the sample. The FAA policy memo that was released in 2012 speaks to this issue, and by following item 10, manufacturers will ultimately reduce the number of test samples required.

Proposal to Move Powerplant Testing to Materials Forum from Systems Forum – T. Marker (FAATC)

We may send a questionnaire out on this.

2019 Meetings:

March 5-6, 2019
Georgia Tech Savannah
210 Technology Circle
Savannah, GA 31407

June 18-19, 2019
EASA Headquarters
Konrad-Adenauer-Ufer 3
D-50668 Cologne, Germany