International Aircraft Materials Fire Test Forum Meeting

University of South Alabama, Mobile, Alabama, USA

Hosted by Airbus Mobile and University of South Alabama Engineering Department

March 10-11, 2020

TUESDAY, MARCH 10, 2020

Update – J. Gardlin (FAA)

Jeff provided a brief overview of objectives of regulatory standard. NPRM Comments received: 350. Q: Are ACs and new Handbook intended to be issued at the same time the final rule will be issued? Gardlin: As of now, yes, the intention to have everything out as one large bundle. Campbell: I think those of us in industry would like the 3X to come earlier if it could come earlier.

Various Project Updates – T. Marker (FAATC)

Tim briefly reviewed the responses to IAMFTF and IASFPF Questionnaire to date. April will send one additional reminder for responses and a cutoff date for responses. Tim briefly reviewed the topics covered during the International Aircraft Systems Fire Protection Forum meetings. The January 2020 update of the Aircraft Materials Fire Test Handbook Appendix F has been published on the FAA Fire Safety website. No update requests for Appendix G were received.

Dick Hill asked Tim to mention the Lavex MPS Test to see if anyone from industry conducts this test in their lab. Please let Tim know if your lab conducts test or knows of a company that conducts this test. Campbell: was the test being used as a general method of compliance test? Marker: yes, it was more about the agent and not the installation.

Tim reviewed some of the work Mike Burns has been doing on the HR2 test. Comment: There is concern about multiple updates to HR2 test.

Magnesium Alloy Testing Update – T. Marker (FAATC)

Objective: To develop a flammability test for magnesium alloy components in inaccessible areas of aircraft. Tim reviewed current test parameters. Tim discussed status of the Interlab Study. Eight (8) labs involved in the Interlab Study: Airbus, Boeing, Accufleet, DGA, Skandia, FAA, Govmark, and Honda. EDM (Electrical Discharge Machining): FAA contracted a U.S. company to mill samples down from 0.125-inch supplied thicknesses to specific .025-thickness. However, milled samples were not good (roughness, not even, etc.). Only about half the samples were usable. FAATC sent them to the participating labs. Comment: The samples that we had from Boeing almost seemed like sheet to me. They did not have a milling mark. Tim reviewed items for discussion during today's Magnesium Alloy Testing Task Group meeting.

Sonic Burner Assembly and Operation Video – T. Salter (FAATC)

Tim Salter briefly reviewed highlights of the Sonic Burner Instructional Video and provided information on location of the video link on the FAA Fire Safety website: (https://www.fire.tc.faa.gov/Training/SonicBurnerAssemblyandOperation).

Sonic Cargo Liner Air Shroud Study – T. Salter (FAATC)

The Interlab Study is complete. Nine (9) out of 10 labs submitted data. This was a very successful Interlab Study. Tim summarized results of this study. Interference issues with shroud and test. Are the benefits of the shroud enough to consider adding it to the test method? Marker: you should stick to results-oriented. Salter: yes, it does work as intended.

Insulation Burnthough Test Update – T. Salter (FAATC)

Phase 3: FAATC Test Results. Interlab Study Phase 3: Complete. The results were presented. Need to test Phase 3 burner configuration

Seat Cushion Update – T. Salter (FAATC)

We have been trying to do a shroud study with the seat cushion test. We are looking for labs to participate in this Interlab Study. Please contact Tim Salter if your lab wants to participate. Email: timothy.salter@faa.gov. Phone: 609-485-6952.

Update for Oil Burner Testing for Power Plants – T. Salter (FAATC)

New focus on developing the Sonic burner in-house at the Technical Center. Industry is reluctant to use the Sonic burner for power plant testing due to heat flux. Burner Comparison Study (FAATC). Tim described the set up for the comparative testing. Question: Are you putting the elbow on the Sonic burner? Salter: It will be the same as for the seat tests, so yes.

Vertical Flame Propagation (VFP) – R. Whedbee (FAATC)

Rick reviewed the objective: Proposed new test method for non-metallic, extenstively used materials located in inaccessible areas. Where are we? Varying diameters of ducts and their results: flat vs. round and varying thicknesses. Heater uniformity was brought to our attention: varying heat output per watt. We did an Interlab Study of Heat Flux Gauges: 4 labs, 5 gauges, set power to host gauge (reference), compared all other gauges. Rick reviewed the results of comparisons conducted at each lab.

Baseline Material Assessment: Series of tests conducted on an aircraft grade CFRP, 1/8" thick, 10 tests. Rick described the experiment set up. Experiment #1: Effect on Burn Length – close to one inch effect on burn length - summary of results presented. Experiment #2: varied heat flux and room temp. Experiment #3: varied heat flux and room temp again. Effect on burn length decreased in Experiment #2 and again in Experiment #3. Conclusion: relationship between heat flux variation and the effect on burn length. We can discuss this in more detail during the Vertical Flame Propagation Testing Task Group meeting. Bashford: In Europe, they now require you to monitor the temperature of the water as well. Whedbee: We do monitor it, but we do not require it. Jensen: So the room temp testing was done at what heat flux? Emami: It was all done simultaneously. Tina explained this in detail. Schall: Were all the gauges the same type? Whedbee: They were all Gardon gauges. Marker: I think you are going to have to come up with some type of spec. Whedbee: We may have to put a tolerance on our room temperature as well as heat flux.

RTCA Update/Round Robin – S. Rehn (FAATC)

Electronic Boxes test development work. Ventilation Limit Testing: We tested the max ventilation that will not allow flames to pass through. The goal is to determine future enclosure designs that would not need to be tested by creating worst case scenario fire inside box to see if flames penetrate through vent holes. Test small amounts of ventilation (0 to 11%). Steve presented videos of the ventilation limit testing conducted in the FAATC lab. Highest open area percentage that "passed" this test was 1.43%. Is this too severe of a test? Is there a more realistic worst case scenario we can try in the future? Campbell: What was the most critical: hole size diameter or open area percentage? Comment: Open area percentage. Oesterich: Why ignite from the outside? Rehn: Flammable gases outside the box would ignite. This was to determine boxes that would not need testing. Oesterich: You are looking for no flame propagation out of the box, right? Rehn: Yes.

Test Standard Contradictions: RTCA DO-160G reviewed. Change proposal submitted was based on AC 25-17A. Steve went to AC 20-168 for more information. Steve reviewed the contradictions between the RTCA DOs and the ACs relating to testing required for the electronic boxes. The FAA is concerned that if a small fire were to start inside a sealed box made from 12s VBB material, it could spread. 12 VBB Box testing conducted at FAATC: 3D printed box of ULTEM™ 9085 with removable top. A video of these tests was shown. Photos of results of these tests were presented. We drilled holes in the bottom of the box to simulate a box that isn't perfectly sealed. We tested again. Flame melted through top and stayed lit for full 4:30 minute test. Next test: test again with material inside. Also, different material for box lid.

Pass/Fail Criteria: Telecom industry test method ATIS-0600319.2014, SLIIM material. A more flammable material could possibly work but would still have the problem of material consistency over the years. We are going to move to temperature measurement above the box. Conclusion: Ventilation limit testing: almost anything will fail with enough fuel inside. Try again with more realistic scenario? Need to reconcile ACs and RTCA documents: need more testing? Pass/Fail Criteria: SLIIM material would not work well. Moving on to thermocouples placed above box. Krause: You may want to look into the presentation we gave at the 2016 International Aircraft Fire and Cabin Safety Research Conference. Warping issues: It's not just a plastic thing, it's a metal thing, too. Question: Will we have a list of cleared box designs in the end? Rehn: Box designs that would not need to be tested? It is something we could work on, but the priority is to work on the test method. Jensen: Did it include giant holes on sides or only holes on top? Rehn: The holes on top of box. The point of that was to give the flames a lot of air. Jensen: Isn't that what we are trying to prove: the box is able to shut down oxygen inflow and keep the fire inside? The hole patterns that I saw did not represent actual boxes. Campbell: Can you take a normal box and try to simulate a capacitor going off early? Maybe something equivalent to a capacitor? Rehn: That might be more realistic.

<u>Airflow in the OSU</u> – T. Emami (FAATC)

Create a reproducible air flow in the OSU. Current testing: We are currently analyzing the differences of pipe layout when entering the OSU, after the orifice plate. This can be set up differently in different labs. Photos of variations being tested were shown. Airflow measurements are being done with a hot wire anemometer. Photos shown of airflow measurement locations. The hot wire anemometer was inserted at 5 points. Using the hot wire anemometer, airflow direction was chosen to be upwards. Used incense smoke to test airflow at specific points within the clear OSU. Photos of inflow pipe bends to be tested next at FAATC were shown.

<u>HR2 Progress Update, Sonic Choke Research</u> – M. Burns (FAATC)

Mike reviewed background work/items completed to date.

Current work: (March 2020): TRL 6 (Reproducibility) – In progress: R&D heater development and investigation into MFC (mass flow controller) replacement with sonic choke.

HR2 Sonic Choke: Schematic of HR2 Sonic choke was presented. Photo of location of: mass flow meter, inlet pressure transducer, pressure regulator, inlet air temperature, mass flow controller, HR2 air inlet, % RH sensor.

HR2 Sonic Choke Theoretical Data: Volume Flow vs. Temperature & Pressure graph was presented.

HR2 Task Group Input: HR2 Sonic Choke: cost $950. CEESI Calibration: $1785. Mike reviewed some questions for HR2 Task Group members. Temperature requirements will change from the lower plenum temp to the sonic choke inlet temp.

CEESI does not give a specific re-calibration interval. Krause: what is your plan with the sonic choke? Airbus is reluctant to buy upgrade kits. When will we get certainty that a certain level of hardware is fixed? Burns: The current configuration is the mass flow controller. We are in research and development. We are now trying to gather data for improvement. We will continue advancing forward with the TRL 6. Krause: I cannot buy anything now. Marker: I think you have to proceed like the mass flow controller is it right now. Oesterich: I bought a chamber, I bought an update, the next month I bought another update. We cannot keep buying updates. Campbell: To integrate the new configuration, is it a simple swap in and out? It would be very helpful to know the swap is simple. Burns: You would need to do a little wiring, add a thermocouple. The temp range has not changed from the OSU, so everyone should have that capability down.

<u>HR2 TRL 6 Reproducibility Assessment</u> – M. Burns (FAATC) for B. Johnson (Boeing)

Goal: To define a robust test method to determine peak and total heat release that improves repeatability and reproducibility when compared with OSU. HR2 is in TRL Phase 6 – Reproducibility. Instruments: Marlin Engineering HR2 and Deatac HR2 at FAATC (NJ). Future implementation: Marlin Engineering HR2 – Airbus test lab, Bremen, Germany, future purchase – Boeing test lab, Seattle, Washington, USA.

Phase 2 – Specimen Test Measurements: test procedure reviewed, forms reviewed, Next Steps reviewed.

<u>HR2 Response Parameters Ranges and Sonic Choke Evaluation</u> – M. Burns (FAATC) for Y. Agyei (Boeing)

Goal: To improve reproducibility. Boeing did an OSU Study looking at the Calibration Factor. A graph of Heat Release Properties vs. Calibration Factor was presented. Mike Burns (FAATC) conducted a Calibration Factor Experiment at the FAATC. The goal was to set required response parameter ranges (control limits). A graphical summary of this experiment was presented.

Sonic Choke Evaluation: Mike Burns introduced the Sonic Choke at Fall 2019 Task Group meeting as a possible alternative to the (MFC) Mass Flow Controller to distribute HR2 air. Lower initial cost. Experiment Goal: To gather evidence to assess sonic choke performance. Replace MFC with sonic choke if performance criteria is met. Mike reviewed the Experiment Objectives. Graphs of Sonic Choke Evaluation analysis were presented.

<u>HR2 Zone Heater Development Update</u> – T. Marker (FAATC) for M. Spencer (Marlin Engineering)

Zone Heater developed to eliminate globars and to provide a more uniform and safer heater assembly. Martin Spencer is currently working on a 3-zone heater unit. Photos of HR2 Zone Heater were presented. Heater tested using regulated power supplies with 48V DC output. FAA would like to use the lower resistance element. The lower element is the same resistance as the globars.

<u>Waste Compartment Fire Containment Task Group Update/Next Steps</u> – S. Campbell (SARFRAN)

Scott provided a summary of the presentation he gave at the 2019 Ninth Triennial International Aircraft Fire and Cabin Safety Research Conference. Harmonizing Test Aspects: For the Aircraft Materials Fire Test Handbook, Chapter 10: Shimming designs with nested doors, overlapping door and door trims that overlap the door surround panels – a photo example was shown. Shimming guidelines were determined and were presented.

Fire Load: Fire loads in the current requirements do not reflect today's operational environment. Jim Davis (Accufleet) performed an airline trash study that showed many airlines are going green and using more paper vs. plastic. Trash Conditioning: The Task Group recommends that test trash be stored in a conditioned area prior to test: an air conditioned office with lower humidity. The Task Group study showed that lower density trash fires are typically worst-case. The Task Group determined that trash should be roughly crumbled as if a passenger had put it in trash. What must be 45-degree Bunsen Burner Test compliant?: Panels and substrates that make up the ceiling and vertical walls – yes, mortise and tenon panel joints- no, sealant/seals or other materials used to fill gaps that create a barrier to exit the waste compartment – yes, waste containers installed in compartments that require waste containers to be installed. We may need to consider repairs for continued compliance.

The Aircraft Materials Fire Test Handbook states data should be recorded no greater than every 10 seconds. The Task Group recommends for most tests a one (1) second time interval to ensure that the peak temperature is captured – especially for small compartments that extinguish quickly. Test Facility Guidelines:

Test facilities currently come in many forms. The test facility/test conditions should be relatively draft free. Wind causes worst-case test conditions and should be minimized. Test unit should be observable from multiple angles.

Similarity MOCs- The next focus of the Task Group will be to revisit and flesh out Similarity MOCs. Marker: Are you thinking Red-Line process for some of these? Campbell: yes.

<u>Policy Statement on Flammability Testing of Interior Materials – Update to (AC) Advisory Circular</u> – M. Jensen (Boeing)

Update of Policy Statement-ANM 25.853-01-R2 to AC 25.853.3X The (FSTG) Flammability Standardization Task Group provided comments on the NPRM based on the differences and proposed new MOCs as well. Michael reviewed some of the comments to the NPRM AC25.853-3X.

<u>Additive Manufacturing, Progress on ULTEM™ 9085</u> – T. Krause (Airbus)

This is wrap up from the October 2019 Ninth Triennial International Aircraft Fire and Cabin Safety Research Conference presentation. Results of 100% infill, influence of orientation were presented. Results of XY ± 45°, variation of infill were presented. Photos of these tests were presented. Results of variation of infill for different orientations were presented. Discussion: Infill- the pilot flame needs to warm up less material to the point of melting and gasification + air is present from all sides – combustion front can move quicker – higher burn length. After-flame can stay lit longer. Orientation: Densest packing leaves no room for particularities. For lower infill, two types can be distinguished. Discussion: DoE – the number of different factors and their dependence or independence could be used in a DoE. Expand database for other materials printed via DFM. Thomas reviewed the Next Steps. Campbell: Is most of what we know in industry 100% infill? The parts we are doing are 100% infill. Krause: That question goes back to industry. I asked it at the Triennial conference in October 2019, but I don't want to rule out the possibility that somebody is using something less than 100% infill.

<u>Relationship Between 3-D Printed Materials and Flammability</u> – S. Rehn (FAATC)

Steve reviewed the test plan. Calculating Infill Percentage: infill percentage calculated from insight program material estimate; create toolpath of single layer; delete outer contours to only calculate infill; divide material used by material used in sold sample to get infill percentage.

Print Infill Patterns: We tested 10 infill patterns. Test results for Varying Infill - ULTEM™ Support material were presented. Results of varying infill – ULTEM™ 9085 were presented. Conclusion: Less infill percentage is more severe case than more infill. Agrees with Airbus test results using ULTEM™ 9085. Next parameter to test: Raster angle or raster width? Krause: I can provide you the other calculation of the info.

<u>Evaluation of Measuring Input Power for Calibrating the Evacuation Slide Test</u> – S. Rehn (FAATC)

Poor reproducibility was observed. Recently Steve did a Heat Flux Gauge Comparison (before painting/after painting photos shown). Heat Flux Gauge Comparison results were presented. Tested 6 heaters and 3 heat flux gauges at FAATC lab. Heat and Heat Flux Gauge Comparison results were presented. There was a much bigger difference switching heaters than switching heat flux gauges. Why are the heaters so different? Coils in the heaters weren't all on the same plane. Condition of surface emissivity. Heater Internal Resistance vs. Power Required for Calibration results were presented. Steve completed the Final Report on the completed work. It should be published soon and will be available on the FAA Fire Safety website later. Schall: Heat flux gauge 3 looked different in the center which could affect the data.

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Material Change Similarity Task Group – M. Jensen (Boeing) for J. Harris (Boeing)

Michael provided an overview of the work of this Task Group. The Task Group uses the microscale combustion calorimeter (MCC) method to compare flammability properties. Goal: To develop guidance using the MCC. MCC method can identify material component heat release properties. Since November 2019: MCC baseline correction developed by FAATC. Baseline correction incorporated into beta-version of Boeing MCC Tool data reduction software – results consistent with FAA results. Baseline correction submitted as ASTM D7309 Ballot. An example of one of the Case Studies on adhesive film was presented. Updated Guidance was released. ASTM revisions needed to support Material Change Similarity. Other ASTM activities: Interlab Study to be completed. A 15-item list of Road Map to Advisory Circular was reviewed.

Task Group Reports

Task Group Report for Magnesium Alloy Flammability Test
Prepared by Tim Marker (FAATC), Task Group Lead
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1. Interlab Study Discussion. The Task Group discussed the results of the interlab study. All members were in agreement that the key to moving forward with a repeatable and reproducible flammability test for magnesium used in inaccessible areas is the need for consistent test samples. Some of the samples distributed to the labs for this initial study were machined using an Electrical Discharge Machining (EDM) process. The resulting test samples were very inconsistent, and likely impacted the test results. The EDM process was complicated by the fact that the raw materials sent to the machining facility were already cut into 3- by 6-inch coupons, and were already very thin at only 0.125 inches thickness. This likely caused difficulties for the machining facility, as it was challenging to hold such a thin coupon in place for machining. More favorable machining results would likely occur if a larger block of raw material was offered to start the process. The other observation was that varying amounts of oxidation were present on the surface of the EDM samples, which may also have impacted the test results. In contrast, the test samples supplied by Boeing were very consistent in terms of thickness, surface finish, flatness, etc. Boeing confirmed that these samples were rolled, not machined.

Action #1: FAATC to initiate acquisition of additional samples for follow-up interlab study. FAATC to contact Boeing to determine possibility of having large quantity of samples rolled, since these worked very well for the study. If this is not possible, explore the possibility of obtaining larger mass of magnesium alloy for subsequent EDM machining.

2. Test Method Discussion. The Task participants agreed that the test is very easy to run, and the interlab study was not overly time consuming. One tester noted damage to the backer board under the sample occurred if the material ignited and puddled in one area. This resulted in a void in the backer board, which allowed more air under the subsequent sample in this localized area. The development of this void could allow more and more air undrthe sample, producing a creep effect.

Action #2: FAATC to develop additional language in Chapter 26 that will address this occurrence.

Several labs also reported a negative weight loss (i.e. weight gain). Participants cautioned that the weights being recorded are very low, and there is a possibility that the scales being used could be influenced by HVAC air currents, due to the sensitivity of the scale. Participants suggested using a protective shroud or similar arrangement to protect the scale, to minimize or eliminate external influence during the weight measurements. Participants also discussed the video recording of the tests. One tester described the recording of the tests with an IPhone, and how the ignition of the sample was still too bright, even after applying various filters to minimize intensity. Participants agreed that much information could be gained by having a recording of the burning event, but if this is not possible, still pictures of the post-test samples is also very helpful. Only a couple of the labs shared post-test photos during this study, so the FAATC is recommending all labs to include post-test photos along with the test data in future studies.

3. Pre-heating of Test Samples Discussion. The Task participants discussed the 3 different temperature phases that a typical test sample goes through. The initial temperature would be the temperature just prior to the sample being set into the sliding drawer. This can vary approximately 20°- 30°F, depending on the temperature in the lab, and the length of time the sample is exposed to laboratory temperature, after being removed from the conditioning chamber. The second temperature is when the sample is placed into the sliding drawer, prior to being inserted into the test position. Again, this temperature can vary widely, depending on the amount of time the sample is allowed to sit in this position. The final temperature would be the actual temperature of the sample as it is exposed to the radiant heat and the pilot ignition. Since the current test procedure does not take into account these influences, it would be beneficial to apply some tolerances or additional procedures to better control these temperatures, so that all testing is executed consistently. One suggestion would be to pre-heat the sample for a prescribed period of time. The FAATC has experimented with 1-minute pre-heating of the samples in the past, which produced reasonably consistent results.

Action #3: FAATC will conduct some experiments to determine the range of temperatures of the samples as they are taken through the various stages, from conditioning chamber to test completion. In particular, the experiments will measure the time required to reach a steady state condition, once inserted into the test chamber.

4. Robustness of Test. Participants discussed the impact of increasing and decreasing the heat flux of the apparatus to the upper and lower boundaries, to determine the corresponding ranges of measured weight loss of the samples. This would indicate the sensitivity of the current test configuration.

Action #4: FAATC will perform a series of tests at upper and lower limits to determine current test robustness.

5. Randomization Discussion (from previous meeting 6/2019). The FAATC and Boeing collaborated on interlab studies for the new HR2 heat release rate apparatus. During this effort, Boeing has implemented a randomization process to prevent certain parameters from influencing the test results. Boeing has offered to assist the FAATC during the magnesium alloy interlab study by implementing the randomization process on the test samples being shipped.

Action #5: FAATC to contact the participating labs to disclose their lab codes from the recent interlab study, as well as subsequent studies.

Task Group Report for Vertical Flame Propagation (VFP)
Prepared by Tina Emami and Rick Whedbee (FAATC), Task Group Leads
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- Objective of task group: To develop a new flammability test for extensively used materials in hidden areas of an aircraft.
- The group spent time reviewing the importance of using heat flux gauges properly. This includes monitoring the water flow rates, the temperature, surface damage and surface painting.
- During the presentation given in the main meeting, the FAATC demonstrated the importance of room temperature and its effect on sample burn length. A Task Group participant suggested placing a thermocouple underneath the air inlet of the VFP. The FAATC agreed, and will establish this

thermocouple as a data point for the upcoming interlab study to better understand (evaluate) the effect of room temperature on burn length.

- The importance of sample temperature and humidity was discussed. The task group members reminded one another not to leave too many samples exposed prior to testing so that they aren't affected by ambient conditions. It was suggested to leave 3 or fewer samples exposed to ambient conditions before completing the test and retrieving more samples for additional testing.
- The Task group participants agreed to initiate interlab study testing with a heat flux tolerance of 1.8 +/- 0.05 Watts/cm^2. If participants are unable to achieve this heat flux tolerance, they should note it in their test report.
- It was suggested to test 10 samples at a time per each specimen configuration during the interlab study. The original plan of 30 samples was deemed excessive. The FAATC will be moving forward with the interlab study with 10 samples per specimen per thickness.
- The task group participants requested a more accurate definition/understanding of the term "extensively used". There may be some materials that lay on the borderline of the definition of "extensively used".
- Prior to the COVID19 pandemic, the task group agreed that the FAATC would ship test samples by April 1. Now that employees do not have access to the FAATC, the shipment of samples will be delayed until further notice.

Task Group Report for OSU Airflow
Prepared by Tina Emami (FAATC), Task Group Lead
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- During the OSU Airflow presentation given at the main meeting, the FAATC reiterated its objective of studying the airflow patterns inside the apparatus, using a variety of technologies (PIV, video of visible smoke, thermocouples, etc). The purpose is to determine if an asymmetrical or inconsistent airflow exists in the combustion section, and if so, are there simple techniques or devices that could be installed or used to minimize these disruptive airflows. At this phase of the research, the FAATC will be studying different variations in the configuration of the air inlet tubes downstream (after) the orifice plate. During the task group discussion, some examples of different labs' intake air piping setups were shown, to gain a better understanding of the variability amongst labs.
    - Although the various arrangements appeared different at first, they were actually very similar. These piping arrangements will be incorporated into future testing configurations at the FAATC.
- A point was made that some labs may have their orifice plates situated horizontally instead of vertically. This will be incorporated into future testing as well, to understand how much of an affect this may have.
- Task Group participants suggested several additional flow visualization techniques that may be useful in this effort, in order to better visualize the flow pattern of air as it traverses through the apparatus. One example involved coating a wire with oil, and then running current through it. The current flow will cause the wire to heat up, ultimately creating a small amount of smoke to be released through the chamber.
- A suggestion was made to analyze the flow without the globars or sample holder in place, in order to better isolate the effect of each. This could help determine more accurately where the problem lies.
- The participants also discussed the use of flow straightening techniques inside the main chamber, to produce a more stable airflow pattern. Although it would seem logical to add some kind of foam or airflow straightening system inside the main chamber, this isn't a viable option, as the materials being tested could drip downwards, damaging the system for further tests.

Task Group Report for Cargo Liner Test

Prepared by Tim Salter (FAATC), Task Group Lead
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The cargo liner Task Group discussion focused mainly around the perforated shroud that has been a concept for the past few years. The purpose of the shroud is to minimize the influence of laboratory air currents on the test results, in particular, the backface temperature measurement. There were a number of different topics discussed, including the distancing between the sample frame to the sides of the shroud, the size of the shroud relative to the sample, and an issue at one lab in which the aluminum shroud actually melted. It was suggested that in the next phase of the interlab study ("round robin") to use a rigid material such as a steel plate to see what the backface thermocouple would read when a conductive material is used in place of a cargo liner material, with and without the shroud. Another topic discussed involved the potential interference of the shroud with the actual materials being tested. This could become a problem, especially when testing design features such as lights or fire detectors that might be part of the cargo liner test. In these instances, the test configuration may be such that the shroud could interfere with these features. The FAATC acknowledged this potential clearance issue, but indicated that only flat cargo materials were being studied in this effort. Task Group participants questioned if this air shroud concept will be implemented into the current Handbook or is the effort focused only on the new Handbook as part of the new Rule effort. The FAATC indicated this concept could be introduced into the current Handbook, if the results from the interlab study conclusively show that it is beneficial. There were a number of task group members that participated that are interested in continuing the interlab study, and thought it was a good idea to continue the effort. One of the problems that slowed the effort was the lack of test materials, as the FAATC ran out of cargo liner materiel halfway through the study. That will be corrected in the next phase of the study.

Task Group Report for Seat Cushion Flammability Test/Sonic Burner Video

Prepared by Tim Salter (FAATC), Task Group Lead
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The FAATC has been planning an air shroud study for the seat cushion flammability test for over a year at this point. Similar to the study done using the cargo liner apparatus, the purpose of the study is to determine if a perforated air shroud positioned around the test sample can effectively minimize the influence of laboratory air currents on test results. The FAATC's proposal was to distribute identical sets of seat cushion test samples to participating labs, along with explicit instructions on how to set up the apparatus and conduct the tests. However, progress on the study has been delayed, as the FAATC's stock of seat test samples was nearly depleted, and has only recently been restocked. There are currently six labs willing to participate in the new study, not including the FAATC. The FAATC is still waiting on one other seat test sample supplier to deliver samples. Any seat test lab that is willing to participate is welcome to do so, regardless of their burner type or manufacturer. The FAATC asks that those who wish to participate to please keep in mind that the materials are costly and have taken a great deal of time and effort to acquire. Please keep this in mind before deciding to participate in the study, if it may not be possible to return test data in a timely manner. After the main discussion, the group reviewed the newly-completed "Sonic Burner Assembly and Operation" instructional video. The video was well received by the task group members, and the location on the Fire Safety website was provided to members who wished to go back and review it at a later date.

Task Group Report for Insulation Burnthrough/Powerplants

Prepared by Tim Salter (FAATC), Task Group Lead
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Burnthrough Testing

The task group discussed the findings after having completed Phase 3 of the Insulation Burnthrough Study initiated by Dr. Robert Ochs in 2016. The efforts of the study have been focused on updating the Sonic burner from the original stator/igniter configuration to the updated igniterless setup. Phase 3 differed from Phase 2 by standardizing the use a 6.0 gl/hr Delevan, Type-B fuel nozzle. The materials tested in this study included two different thicknesses of PAN TexTech felt often used for burner calibration purposes. After the final results of the study were returned, it was noted that two out of the nine labs showed abnormally long burnthrough times on the material. After further review, it was not possible to determine the reason for the extended burnthrough times. However, it was also noted that the insulation blankets used for the study allowed higher heat flux rates with the settings for Phase 3 as opposed to previous Phase 1 and 2 configurations. The previous studies all produced shorter burnthrough times, and is an indication that the settings for Phase 3 will need further review and reworking. The insulation blanket materials previously used to measure the output of the burner have been depleted as of recently. This may require a recheck of the newly acquired insulation materials for previous phases of the study to ensure consistency.

Powerplant Testing

The FAATC is preparing to perform an intensive study involving three different burner types in an effort to further the development of the powerplant test method. This will include a Park, Carlin, and Sonic type burner. Efforts are focused on adding the Sonic burner for use in the powerplant test method. The two legacy burners are included to use as a baseline for comparison to the Sonic burner to ensure equivalent test results with the addition of the new burner. The powerplant task group members reviewed the new "Sonic Burner Assembly and Operation" video for those who were not present for the seat task group video viewing.

Task Group Report for Radiant Panel Test
Prepared by Steve Rehn (FAATC), Task Group Lead
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During the radiant panel insulation test Task Group meeting, a few issues with the handbook were discussed. Some of the simpler items were:
1. the handbook does not state that the exhaust hood should be on for the entire test duration.
2. the handbook does not state that there should be zero airflow through the chimney of the radiant panel apparatus when the exhaust hood is running and the radiant panel is off.

These should be straightforward changes. Another issue is the ± 5% tolerance on the heat flux calibration. The chart in the handbook only shows where calibration numbers "should" be, but not the full tolerance. The FAATC doesn't want to add the tolerance to the chart, as the recommended practice is to get the heat flux reading as close to the target number as possible. Also, the error in the heat flux gauges themselves needs to be factored into the ± 5% number. The FAATC will add some clarification to the text in the document regarding this issue. Another point was that the handbook only applies the ± 5% tolerance to the zero position, not position one or two, so that will be added.

The Task Group participants also discussed ongoing testing projects. Results were reported from two out of three labs involved in the study comparing different backing boards placed below the test sample in 2019, but the FAATC is still waiting on results from the third lab. Those results should be coming soon. The FAATC also previously planned a study comparing old and new electric radiant panels, but the testing was held up because borderline materials were not available to test to get an adequate comparison. During this Task Group discussion, a few new ideas of materials were suggested to test – one was a material that passes the 30-second test but fails the 15-second test, another was the same material as used in the backing board study, and another was a felt/foam material bonded to aluminum. The next step for the FAATC will be to evaluate a few materials to determine which would work best for this testing.

Task Group Report for RTCA (Electronic Boxes Test)
Prepared by Steve Rehn (FAATC), Task Group Lead
Email: Steven.Rehn@faa.gov

Task Group participants discussed the worst-case scenario testing that was shown in the RTCA presentation during the general meeting. This testing was done using electronic enclosures with minimal ventilation, in order to determine ventilation limits on black boxes that would preclude them from being tested. This testing only proved that nearly any amount of ventilation can allow flames to escape an enclosure if there is enough fuel inside. Task Group participants brainstormed some ideas for a more realistic worst-case scenario fire, such as placing capacitors or lithium batteries in the box being tested, but ultimately decided this was not the best way to proceed. If a worst case scenario was agreed to, and placed in an enclosure to certify a box design in which anything can be placed inside without further testing, this would be an entirely new test method, and a departure from the one being developed over the last few years. In addition, it is possible that the realistic worst case scenario may not be accurate a few years from now, thus rendering the test unrealistic in the future.

A more practical solution discussed during the Task Group would be to add some guidance to the test method stating that if an enclosure is used with multiple configurations of internal components, then it can be tested with the highest fuel load to substantiate all the rest. For example, a black box could be tested with the biggest lithium battery or with the most capacitors and a passing test would also qualify boxes with less of a fuel load. Another application of this is that if a change is made to a component inside of an enclosure that has already been certified, it would not need to be retested if the circuit board material is the same, and other parts that could add to the fuel load have not been increased. This guidance could potentially be placed in DO-160H or an updated AC.

Task members also discussed AC 25-17, which states that the components inside of a black box do not need to be tested, if the enclosure is nonvented and constructed of 12-second vertical Bunsen burner compliant material. None of the task group participants agreed with this statement, because any potential flame inside the enclosure could melt through a 12-second material before a fire inside the box is extinguished due to lack of oxygen, thus allowing the fire to grow, since the components inside the box would not have to pass any fire test standards.

This sentence in AC 25-17 (“Material in "black boxes" which are completely self-contained by self-extinguishing material need not be tested.”) was first written in 1968 and none of the participants had any knowledge of how it got in there or if any testing was done at the time to prove that further testing wasn’t necessary. There were also much fewer electronics on aircraft in 1968 so it was a much different situation at the time. Therefore, the Task Group agreed that an action item would be to determine what can be done about the AC since it contradicts other documentation.

For future work planned, the Task Group agreed that additional testing is necessary to further refine the pass/fail criteria. The next test series will involve the placement of a thermocouple grid above the box being tested and define a temperature threshold that determines whether a black box passes or fails.

Task Group Report for Heat Release Rate Testing
Prepared by Mike Burns (FAATC), Task Group Lead
Email: Mike.Burns@faa.gov

<u>TRL 6 Test Plan</u>:

The current TRL6 test plan is designed to look at reproducibility between several HR2 units. The goal of this research is to achieve good reproducibility between four units (Marlin Engineering, Deatak, Boeing and Airbus) by first starting with two units located at the FAATC lab (Marlin Engineering and Deatak units). The testing protocol is broken up into two phases as described below. Currently, Phase 1 of the Deatak unit is nearing completion. The FAATC is looking to start Phase 2 in early April 2020. TG members reviewed the test procedures, lab condition checks, and list of tools that will be shipped to each lab. The testing will be conducted over a two day period testing 20 specimens per day. The specimens will be randomized but the sample holders are used sequentially (1 through 4). There is no delay in testing between coupons (test a sample, remove it, and insert next sample etc.). TG members were asked for input or comments to the test plan with no responses. There is a possibility that initial results will be shown at the next forum but that may be too soon to predict given the current covid-19 status.

Note: This test series will use the current Mass Flow Controller configuration and not the Sonic Choke.

HR 2 TRL 6 – Reproducibility Assessment

Project Description

Heat Release Rate 2 development has successfully progressed to TRL 6. In TRL 6, the Heat Release Rate test method shall be assessed for reproducibility. Reproducibility assessment begins with qualification of participating HR 2 units and concludes with material assessment using only qualified units. To be qualified, new units' response parameters must fall within HR 2 prototype set parameter ranges. Material assessment will consist of testing 40 specimen for three configurations for a total of 120 test runs. Reproducibility will be assessed by a measure of variation using coefficient of variation and ANOVA analysis.

Goal

Progress to TRL 7 by showing:

- Phase 1 - Participating units' response parameters falls within all set parameter ranges and
- Phase 2 - Specimen test measurements variation meet the reproducibility criteria set by the OSU / HR 2 task group.

Objective

Unit response evaluation shall first be conducted on participating units. Units that meet the unit response requirements will progress to test 40 specimens from three configurations for a total of 120 runs. Test measurements shall be statistically analyzed to measure variation in measurements amongst the four units for each configuration. Statistical analysis shall be shared with OSU / HR 2 task group for a Go / No Go decision on TRL 7.

TRL 6 Success Criteria

HR 2 TRL 6 success criteria to be determined by OSU / HR 2 Task Group. Reproducibility shall be measured by variation in measurements as observed with coefficient of variation (CoV) and ANOVA analysis.

Specimen Configuration, Randomization, and Distribution

All prepared specimen will be provided to Boeing for randomization. Boeing will randomize and re-distribute specimen equally to all participating parties. Specimen will be stored in conditioning chamber at 70F and 50% relative humidity upon receipt from Boeing.

Specimen configuration

1. Boeing standard panels with heat activated adhesive (BPD) – provided by Boeing
2. Schneller Panel coupons (SP) – provided by FAA Tech Center
3. Aluminum with tape (AT) – provided by Airbus

Phase 1 – Unit Response Evaluation

Candidate units' will be evaluated by following Section A4.6.3 of Aircraft Materials Fire Test Handbook Revision 3 to determine the calibration factor. A minimum of 30 data points, obtained during methane gas calibration over a period of three weeks will be collected for evaluation. The response factors will be statistically analyzed and compared to pre-determined operating response ranges set using the prototype HR 2 unit, FAA MarlinEngineering unit. Units will be qualified if mean responses fall within range of all three response factors.

Response Parameters Ranges

1.	Calibration Factor (W/°C)	17.28 ± 0.60	3.47%	(16.68 – 17.88)
2.	Baseline Exhaust Gas Temperature (°C)	284.3 ± 3.9	1.37%	(280.4 – 288.2)
3.	Thermal Stability Temperature, TST (°C)	385.2 ± 3.2	0.83%	(382.0 – 388.4)

Determination of Response Factor Ranges (see reference)

The FAA Marlin Engineering HR 2 prototype unit was used to set the operating response parameter ranges. Mike Burns of FAA Tech Center conducted 102 runs of calibration factor procedure over from July 2019 – December 2019. Tolerance interval (99-95%) analysis was conducted on the data set to determine the ranges for each response parameter that is expected to cover 99% of the distribution at 95% confidence level. The mean response of candidate units must fall within the 99-95% confidence interval to be qualified to participate.

Phase 2 – Specimen test measurements

Prepare HR 2 unit and pre-conditioned specimen for testing per item 2 of this section. Calibrate and test specimen per Section A4 of Aviation Materials Fire Test Handbook Revision 3and item 4 of this section.

Test Preparations and Procedure

1. **Sample Conditioning**
    a. Condition all specimen upon receipt from Boeing.
    b. During testing, remove three (3) coupons from conditioning chamber and seal in plastic bag. Remove single coupons from plastic bag to prepare sample for immediate testing.

2. **Daily Machine Preparations**
    a. **Cold Start**
        i. Ensure gas bottle is charged (≥ 250 psi)
        ii. Clean upper chimney and inner walls with brush
        iii. Brush off air mixing plate and verify position in upper chimney
        iv. Brush soot and contaminates from thermocouples using a soft-bristled brush. Properly position thermocouples. Use a poke-yoke to assist with thermocouple positioning.
        v. Clean upper pilot tube using wire brush
        vi. Verify lower and upper pilot position
        vii. Vacuum test and holding chamber
        viii. Visually check that air holes in floor of chamber are clear
        ix. Clean window
        x. Check position of diamond
        xi. Ensure holding chamber doors close completely around sample insertion rod
        xii. Check condition of sample holders, visually check wires on holders.
        xiii. Ensure sample holders fit tightly on insertion platform. Mechanical adjust if necessary.
        xiv. Check position of sample holder. Ensure sample holder is 100mm from inner door.
        xv. Check condition of calorimeters in calibration apparatus for possible damage. Ensure calorimeters are flushed with the millboard. Ensure heat flux gauges are positioned 100mm from inner radiation doors.
        xvi. Position and secure HFG calibration assembly into the holding chamber ensuring an airtight seal. Verify HFG cooling water flow and water temperature. Insert the heat flux gauges into the environmental chamber hot zone, close the inner radiation doors.
        xvii. Turn on supply air and set to 20 ± 0.4 SCM @ 72.5 ± 2.5 F.
        xviii. Turn on glow-bars.
        xix. Allow unit to equilibrate - when center heat flux stabilizes between 3.60-3.70 W/cm^2. Corner heat flux density must also be within 3.65 ± 0.1 W/cm^2. Thermopile temperature must not vary more than 2.0% standard deviation over the last 15 minutes of equilibration.

    b. **Hot Start – Record measurements in Machine Calibration Records**
        i. Record power output to achieve desired heat flux density
        ii. Record thermopile output at desired heat flux density
        iii. Ignite lower and upper pilots
        iv. Wait 20 minutes and record thermopile output with pilots lit (B_0)

3. **Sample preparations**
    a. Designate and mark four sample holders to conduct tests at all locations. Alternate sample holders in order and record for each run.
    b. Use the same batch of aluminum foil, same tools, and process to prepare coupons before placing in sample holder.
    c. Wear latex or vinyl gloves and avoid contact with the test face of all coupons.
    d. Prepare samples on a clean surface and in an area free of debris, oils, and other possible contaminants.
    e. Clean sample holders with wire brush after each test.

4. **Test Method Procedure**
    a. Test per A4 Test Method organized in Aircraft Materials Fire Test Handbook Revision 3.
        i. Conduct center and corner heat flux calibrations daily.
        ii. Conduct methane gas calibration on day 0 of testing.
    b. Weigh wrapped and trimmed sample in holder prior to testing (pre-test weight)
    c. Weigh tested sample in holder after test (post-test weight)
    d. Clean thermocouples after every three (3) runs.
    e. Load samples after thermopile stabilizes within 1% of B_0.

Record ambient temperature and humidity prior to each run using hand held weather station (provided by Boeing).

Machine Preparations Log

Heat Flux Gauge Calibration Records		
	Center	Corner
HFG Identifier		
Heat Flux Gauge Type		
Manufacture		
Calibration Facility		
Calibration Date		
Calibration Method		
Calibration Responsivity		

Material Test Assessment Log

Machine Preparations Records								
Day #	Center Heat Flux (W/cm^2)	Corner Heat Flux (W/cm^2)	Power Output (W) Up / Low	Thermopile Output (w/o Flames)	Thermopile Output (B_0) (w/ Flames)	Lab Temperature (F)	Lab Relative Humidity (%)	**Notes / Observations**
1								
2								
3								
4								
5								

Unit	Day	Set	Order	Specimen Type	Specimen ID	File Name	Sample Holder #	Sample Weight (Pre-test)	Sample Weight (Pre-test)	Test Start Time	Room Temp (°F	Room Humidity (% RH)	Supply Air Temp (°	Air Pressure (mmHg	Supply Air Humidity (%RH)	Tpile Baseline (mV/°	Peak (kW/m	Peak Time (sec)	2-Min Total HR (kW-min/m2)
FAA-ME	1	1	1	SP	21	FAA-ME-Day1-Set1	1												
FAA-ME	1	1	2	SP	15	FAA-ME-Day1-Set1	2												
FAA-ME	1	1	3	SP	94	FAA-ME-Day1-Set1	3												
FAA-ME	1	1	4	AT	68	FAA-ME-Day1-Set1	4												
FAA-ME	1	1	5	BPD	140	FAA-ME-Day1-Set1	1												
FAA-ME	1	1	6	AT	82	FAA-ME-Day1-Set1	2												
FAA-ME	1	1	7	BPD	33	FAA-ME-Day1-Set1	3												
FAA-ME	1	1	8	SP	56	FAA-ME-Day1-Set1	4												
FAA-ME	1	1	9	AT	99	FAA-ME-Day1-Set1	1												
FAA-ME	1	1	10	AT	90	FAA-ME-Day1-Set1	2												
FAA-ME	1	2	11	SP	162	FAA-ME-Day1-Set2	3												
FAA-ME	1	2	12	BPD	52	FAA-ME-Day1-Set2	4												
FAA-ME	1	2	13	SP	24	FAA-ME-Day1-Set2	1												
FAA-ME	1	2	14	AT	146	FAA-ME-Day1-Set2	2												
FAA-ME	1	2	15	BPD	46	FAA-ME-Day1-Set2	3												
FAA-ME	1	2	16	AT	33	FAA-ME-Day1-Set2	4												
FAA-ME	1	2	17	SP	14	FAA-ME-Day1-Set2	1												
FAA-ME	1	2	18	AT	105	FAA-ME-Day1-Set2	2												
FAA-ME	1	2	19	AT	42	FAA-ME-Day1-Set2	3												
FAA-ME	1	2	20	SP	9	FAA-ME-Day1-Set2	4												
FAA-ME	1	3	21	SP	165	FAA-ME-Day1-Set3	1												
FAA-ME	1	3	22	BPD	106	FAA-ME-Day1-Set3	2												
FAA-ME	1	3	23	SP	107	FAA-ME-Day1-Set3	3												
FAA-ME	1	3	24	SP	25	FAA-ME-Day1-Set3	4												
FAA-ME	1	3	25	AT	119	FAA-ME-Day1-Set3	1												
FAA-ME	1	3	26	AT	93	FAA-ME-Day1-Set3	2												
FAA-ME	1	3	27	SP	57	FAA-ME-Day1-Set3	3												
FAA-ME	1	3	28	AT	12	FAA-ME-Day1-Set3	4												
FAA-ME	1	3	29	SP	151	FAA-ME-Day1-Set3	1												
FAA-ME	1	3	30	AT	58	FAA-ME-Day1-Set3	2												
FAA-ME	2	1	31	SP	99	FAA-ME-Day2-Set1	3												
FAA-ME	2	1	32	BPD	67	FAA-ME-Day2-Set1	4												
FAA-ME	2	1	33	BPD	104	FAA-ME-Day2-Set1	1												
FAA-ME	2	1	34	BPD	147	FAA-ME-Day2-Set1	2												
FAA-ME	2	1	35	SP	30	FAA-ME-Day2-Set1	3												
FAA-ME	2	1	36	SP	158	FAA-ME-Day2-Set1	4												
FAA-ME	2	1	37	BPD	51	FAA-ME-Day2-Set1	1												
FAA-ME	2	1	38	BPD	113	FAA-ME-Day2-Set1	2												
FAA-ME	2	1	39	SP	50	FAA-ME-Day2-Set1	3												
FAA-ME	2	1	40	SP	146	FAA-ME-Day2-Set1	4												

Week of Testing Schedule – TBD

FAA Tech Center Trip Preparations

Package the following and ship to Mike at least a week before scheduled testing at FAA Tech Center

1. Specimens – randomized, identified
2. Handheld weather station
3. Sample preparation kit
    a. Mat
    b. Tools
    c. Gloves
    d. Foil

References

For information on the calculation of the tolerance interval plot for calibration factor, baseline exhaust, and thermopile stability temperature, please see Yaw Agyei's presentation titled, "HR 2 Response Parameters Ranges and Sonic Choke Evaluation", which was presented by Mike Burns during the main meeting. The presentation will also be available on the Fire Safety Branch website with all of the other presentations given at the March 10-11 meeting in Mobile, AL.

<u>Prototype Heater Discussion</u>:

The FAATC R&D is interested in trying to remove the globars from the air stream within the HR2 unit. TG members reviewed the Marlin Engineering presentation showing the new prototype design as a collaborative effort with the FAATC and TG team. The current estimated cost of this unit is not available at this time. TG members were asked for input or recommendations to consider. Some concerns that were mentioned included:

- Products of combustion from certain materials/plastics/etc may affect the useful life of the heating elements. They are separated from the chamber by glass but a recommendation was put forward to attempt to seal the unit as best as possible.
- TG members mentioned concerns about debris or cleaning products on the glass possibly affecting transparency level changes and whether or not it will make a difference over time.
- There was mention of CE labeling (European Conformity) for electrical parts used in the machine and items that are different in Europe. This could potentially be quite a problem.

FAATC was informed by Marlin Engineering that the prototype unit is fabricated and ready to be shipped. The target date for testing would occur once TRL 6 is completed. Eventually the hope would be to publish a specification for the heater in the current placeholder document if this is a successful product.
The FAATC's objective is also to reduce the size of the transformers and optimize the power for the HR2. The power required to achieve the same heat flux is reduced by removing the globars from the airstream. Longevity of the heater/durability are additional concerns that need to be investigated. Variability between heater and globars is a concern, however having three zones for control may help. There was also a desire to have lateral adjustment capability.

<u>Sonic Choke R&D Project</u>:

In the short term there is no immediate desire to incorporate the sonic choke into the HR2, it is currently a R&D project. If the temperature and pressure can be precisely controlled, then it may be a viable option in the future. The manufactured sonic choke was sent for an independent calibration upon completion. The cost of the choke is just under $1000 (US). The cost of the calibration by CEESI is $1785 (US).

There was very good input from TG members on this topic. Below are some bullet items discussed:

- Pressure regulation products available
- Ability to continue to monitor the lower plenum TC
    - The reference TC may change from the lower plenum to the choke inlet temperature (TBD).
- Benefits of the mass flow controller vs. the sonic choke
    - Ability to maintain constant flow automatically with slight changes in input temperature and pressure that an operator may not be aware of
- Desire to standardize the installation if incorporated
    - Piping diameter and length - Currently will remain 1.5" diameter; length TBD
    - The choke piping will be mounted directly to the input of the HR2 lower plenum
    - FAATC will attempt to collect data with 3 different pipe lengths prior to entering the chamber. This can help assess piping change impacts on lower plenum temperature if any
- Absolute pressure requirement (digital transducer)
    - Calibration frequency
- Sonic choke calibration
    - Require a one-time calibration of sonic choke? Concerns over relying on manufacturing quality assurance and machining tolerances.
- Recently conducted DOE showed that flow is extremely sensitive to slight changes in pressure
- Filtration requirements to be considered? Micron size?
- Cleaning requirements
    - Annual cleaning requirement? Consensus: yes
- Choke contamination
    - When does it happen/how does it happen
    - The desire would be to have a mass flow meter inline to monitor/validate flow

- FAATC looked into non-intrusive clamp type meters that did not require drilled holes in piping. Unfortunately, the flow rate is too low to use this technology at this time.

There is still a lot of work to do in order to incorporate this into the HR2 with many unanswered questions. TG members were reminded the purpose of this TG was to develop an easier, simpler product. Are we making it more complex? Are we making it easier and cheaper for ourselves or not?

Task Group Report for Fire Containment
Prepared by Scott Campbell (SAFRAN CABIN), Task Group Leader
Email: Scott.Campbell@safrangroup.com

The task group agreed to redline chapter 10 of the Fire Test Handbook with our testing recommendations & guidelines presented at the meeting. Will set up a WEBEX in April to review proposed changes before submittal to Tim.

Next, reviewed 25 proposed MOCs to determine compliance by similarity. The task group has actions to flesh out MOCs requiring more data and proposed a few more MOCs to consider.

Task Group Report for Additive Manufacturing
Prepared by Steve Rehn (FAATC), Task Group Leader
Email: Steven.Rehn@faa.gov

The main topic of discussion focused on infill percentage and how it affects flammability. Less infill was a more severe case than more infill for all scenarios except for one. Flame time when testing the infill-only without solid outer layers using Ultem 9085 was higher in the middle infill percent ranges (around 40-60%). This type of sample would burn more quickly with less infill and run out of fuel by the time the Bunsen burner flame was moved away, causing reduced after flame times in samples with low infill percentages. However, this type of sample is most likely not a realistic representation of an actual part on an aircraft because it is essentially a mesh without solid outer layers. More testing can be done to obtain more accurate results of which infill percentage produces the highest flame time for the 12-second and 60-second vertical Bunsen burner tests. Additional testing on samples with solid outer layers is planned as well.

Some other variables were also brought up, including differences in material printed from different batches of spool material for the printer. Another is color; Ultem 9085 is offered in black or tan. It may be possible to test these parameters in the Microscale Combustion Calorimeter (MCC) to determine if there are any differences. Painted samples were discussed as well. One participant pointed out that they were able to get ABS material to pass the horizontal Bunsen burner test if they painted it, but it would fail without paint.

The main action item desired by this task group is the creation of guidance on testing PEI material first. Based on this, the FAATC's main goal is to complete testing with Ultem 9085 and also test with Ultem 1010 to obtain data on changing as many design variables as possible. Airbus is in contact with Stratasys regarding additional coupons. Ultem 1010 coupons have been discussed and Airbus has received coupons to complement the range of 40 % - 100 % infill for Ultem 9085. The next testing planned for the FAATC is to test infill percentage with solid outer layers at a 5-6 mm sample thickness, as this is a more realistic case. Varying raster width with Ultem 9085 will also be investigated. The FAATC and Airbus (and any other lab) that has conducted testing on varying printing parameters should to compile their data together to generate the most complete data set possible. Table 1 shows the action items from each task group meeting (developed by Airbus).

Table 1. Additive Manufacturing Task Group Action Sheet

See next page.

DESCRIPTION OF ACTION							
Project: Develop a testing methodolgy and guidance material for Additive Manufactured Parts							
Team Members: Steve Rehn, Thomas Krause, Thivi Edrisinha, Andreas Grewing, Bart Mooij, Bartosz Gladysz, Brian Griesbach, Buoniconti, Ralph, Chris Schofield, Applegren, Christine, Christoph Klinkowski, Charles Wilson, Claire Devemy, Donald Hone, Elizabeth A Rusch-Franck, Enzo Canari, Fei Liang, Franck Poutch, Gilberto Imamura, Giovanni Santarelli, Greg Hooker, Weichert Ingo, PONSICH Isabelle, James Hall, Jean-Claude Lerminiaux, Jeff Gardlin, Ken Young, Kristopher Notestine, Matthias Enz, Moritz Reifferscheid, Panade Sattayatam, Brian Alexander, Serge Le Neve, Thomas Fabian, Tim Lübcke, Tim Walker, Tim Wright, Tod Maurmann, Torben Kempers, Volker Müller, Loges, Holger, Skander KHELIFI, Frank Klatt, Dan Ireland, Brian Alexander							
	STATUS/ Date entered	Suggested (WHO) Site	INTERMEDIATE STEPS TO COMPLETE THE REQUIRED ACTION	RESPONSIBLE (WHO) Name	ECD (WHEN)	Effectivity	Action Items / Comments
1	6/7/18	Thomas	Identify key variables affecting fire safety requirements	Task Group	On-Going	TBD	
2	6/7/18	Steve	Simplify Testing Methodology for Compliance	Task Group	On-Going	TBD	
3	6/7/18	Thomas	Develop Guidance Materials	Task Group	On-Going	TBD	
4	10/30/18	Thomas	Evaluate Build & Material parameters of Additive Manufacturing	Task Group	3/6/2019	TBD	~~Review results of Ultem 9085 and Nylon 12 samples.~~ Complete. Look into procuring new AM materials.
5	3/6/19	Steve	Test Different In-Fill Percentage	Task Group	On-Going	TBD	Stratasys offered burn coupons to support group activities Steve to repeat Nylon 12 tests after 24hr conditioning
6	3/6/19	Steve/Thomas	Generate a Draft Policy for Ultem 9085	Thomas/Steve	On-Going	TBD	Wording similar to Policy Statement Item
7	5/9/19	Thomas	Evaluate test results received since March 2019	Thomas/Steve	06/18/19	TBD	Results yielded lower in-fill generally leads to a higher burn length and after flame.
8	3/11/20	Christoph Karpe	Thermography of burnt coupon, filament and raw material	Christoph Karpe / Thomas	On-Going	TBD	
9	3/11/20	Steve/Thomas	Put results together	Steve/Thomas	On-Going	TBD	
10	3/11/20	Steve/Thomas	Add results for one infill % with various thicknesses	Steve/Thomas	On-Going	TBD	
11	3/11/20	ufthansa/Thoma	ULTEM 1010 study with varying infill and 1.5 mm	Lufthansa/Thomas	On-Going	TBD	
12							
13							
14							
15							
	R		Behind Schedule or Impacting Downstream Task				
	Y		At Risk				
	G		On Track				

Task Group Report for Material Change Similarity –
Prepared by Michael Schall (Deatak) on Behalf of John Harris (Boeing)
Email: michael.schall@deatak.com

3 people in attendance

- Updated group for the proposed ASTM acceptance processes and schedule regarding baseline correction and FGC calculation
- Timeline is very aggressive. March 2020 ASTM meeting cancelled due to COVID-19. Presented schedule will most likely be delayed due to this
- No new studies or additions to method since last meeting
- Ultimately, the Material Change Similarity rule is waiting for the ASTM updates and inter-laboratory study to be completed
- No further action items
- No questions

Additional Discussion

Next Meeting

Dates: June 9-10, 2020

Meeting Format: June 9 full day/June 10 half day morning

Location:
3M Deutschland GmbH
Carl-Schurz-Straße 1, 41453 Neuss, Germany

Fall 2020 Meeting:

FAA Fire Safety has submitted a request to FAA Headquarters for the Fall 2020 Materials and Systems meetings as follows. Upon approval, April will send notification to those on her Materials and Systems Forums E-Distribution Lists, and the information will be available on the FAA Fire Safety website.

Dates: October 20-22, 2020

Meeting Format:
October 20 Materials Meeting (full day)
October 21 Materials Meeting (half day morning)
October 21 Systems Meeting (half day afternoon)
October 22 Systems Meeting (full day)

Location:
Resorts Casino-Hotel
1133 Boardwalk
Atlantic City, New Jersey, USA 08401