

# INTERNATIONAL AIRCRAFT MATERIALS FIRE TEST WORKING GROUP MEETING

Hosted by FAATC, Tropicana Hotel-Casino, Atlantic City, New Jersey, USA

October 19-20, 2011

## WEDNESDAY, OCTOBER 19, 2011

Welcome and Introductions

### ARAC Update – J. Davis (Accufleet)

Aviation Rulemaking Advisory Committee (ARAC). This working group was given a specific task: Reorganization of Part 25 Flammability Regulations. The tasking was described in the Federal Register. A copy of Jim's presentation is available on the FAA Fire Safety website.

### Oil Burner Test for Cargo Liners (proposed) – T. Marker (FAATC)

Tim discussed the proposed edits/updates to this Chapter, and reviewed activities completed since June 2011 Materials Working Group meeting. Planned activities: finalize burner settings by conducting temperatures calibrations; complete testing of samples to ensure sonic equivalency to Park; check comments from KSN site and incorporate changes to test procedure; development of advisory material for cargo design features? Possible ARAC recommendation; conduct Round Robin?

### Task Group Session on New Flammability Test for Magnesium Alloys – T. Marker (FAATC)

Proposed magnesium alloy flammability test set-up diagram was described. This was agreed upon during the Task Group meeting in June 2011. The Task Group planned to test specific mag alloy samples during summer 2011. The list of specific alloys is included in the presentation available on the FAA Fire Safety website. When the WE-43 tests were underway using a truncated burner cone, there were some problems with repeatability. Tim showed photos of results of a number of the tests that were conducted. WE-43 hollow cylinder cones were tested horizontally and vertically. Summary: the truncated cone had repeatability issues. Hollow cross sections represented better repeatability than solid cross sections. Hollow cylinder represented better repeatability. Planned activities; continue with testing of hollow cylinders to determine repeatability and experiment with hollow cylinders in other mag alloys. What extinguishing agent is being used at the FAATC? Tim: we let the samples burn out. We do not use an extinguishing agent. Antonio Chiesa: did you test other mag alloys (other than WE-43) in the hollow tube shape? Tim: not yet, as I mentioned that is on our list of planned activities.

### Burnthrough Update and NexGen Burner – R. Ochs (FAATC)

Rob gave a brief background on the development of the NexGen burner for any Working Group meeting attendees new to the group. New information: Spray Nozzles: discussed with a spray industry expert/representative – industry standard flow rate is about +/- 10%. 25 Everloy nozzles were tested – these results were presented. Normalized temperatures for Everloy nozzles were compared to Monarch nozzles. Planned work: a variety of Delavan spray nozzles will be ordered in the near future for comparison. A large quantity of TexTech PAN materials (8579 and 8611) has been ordered for comparative testing at FAATC and round robin tests in the future. Peter Busch: discussed whether there was a need to cool down the air. Rob: we will consider that in future testing.

### Composite In-Flight Flammability Test – R. Ochs (FAATC)

Carbon fiber composites are being used more frequently in the aerospace industry. Objective: develop a standardized laboratory-scale flammability test method. A baseline test was conducted first. Peak temperature is indicative of conductivity of panel. This test rig simulates the effects of a moderately severe hidden fire test. A study will be performed to determine the boundaries of the validity of the correlation.

Other inaccessible area composites: One objective of Part 25 app. F activity is to require all materials in inaccessible areas to resist flame propagation when exposed to standard hidden fire source (foam block) except for: small parts (defined by ARAC task group) and Materials that meet another test equal to or greater in severity than foam block test (hierarchy of test methods needs to be established). This could potentially include backsides of sidewalls, stow bins, floor panels, and cargo liners. Rob reminded Working Group that the test method is being investigated. Peter Short: be sure to look at the materials that are actually being used by the airframe manufacturers. Rob: we welcome additional information from the manufacturers on these materials. This information has been difficult to obtain. Foam Block Testing: A variety of typical cargo liners and floor panels were donated by task group member for evaluation at FAATC. 5 floor panels and 7 cargo liners were tested at FAATC. A diagram of the test plan was shown. Rob showed videos of some of the floor panel and cargo liner material tests. He reviewed the results of these tests. Foam block characterization: measurements were taken on the foam block, various angles were tested. Temperature and heat flux graphs for the 30, 45, and 60 degree angles were shown. Summary: standard fire source was characterized with gardon gauge and thermocouple measurements in various configurations. We are investigating materials in the inaccessible areas: insulation, ducts, wires, skin. Dan Slaton: floor panels and cargo liners are a couple of the very unique configuration materials that act as boundary materials between the cabin and inaccessible areas.

#### Heat Flux Calibration Task Group – M. Burns (FAATC)

Mike reviewed the outline of the structure of the document. Develop Guidance Material: topics: paint/paint thickness, calibration of software, clamping/mounting/alignment fixture, standardized reporting form. Round Robin development.

#### HRR2 (OSU) Test – M. Burns (FAATC)

Mike reviewed the development plan and described what each sub task group was tasked with and work that had been done by each sub task group. HRR2 Improvement Plan Timeline: Phase: November 2011 (near completion) Phase II: May 2012, Phase III: November 2012. Testing Summary and What has been Learned: Overlap construction (upper section), insulation (upper section on), airflow (replacing orifice plate configuration), changes to methane gas calibration process, heat flux – specifics of these are provided in the presentation available on the FAA Fire Safety website. What's next: based on the data that was generated, recommendations will be discussed during today's Task Group meeting. We will also work on updating Chapter 5 of the Aircraft Materials Fire Test Handbook.

#### Aircraft Wiring – P. Cahill (FAATC)

Recent tests at FAATC – Cross-Linked ETFE – 3 different wall thicknesses were investigated in a number of configurations: single, bundles of 6 or 7 wires, cables of twisted pairs (22 and 22 AWG), flat and round shields, and jackets. The wire was supplied by 2 manufacturers. Bombardier prepared the bundles. Pat reviewed the results of the tests with all of these wire configurations. This series of testing will be performed with the hybrid construction which is PTFE/polyimide /PTFE. Task Group Discussion: the 7-wire bundle, single wire test, planning a Round Robin – these will be discussed during this afternoon's Task Group meeting.

### Aircraft Ducting – P. Cahill (FAATC)

We have to wait until the ARAC completes their work to get an answer. In the meantime, we must test all types of ducts. The Task Group decided in Bremen to test actual ducts in the Radiant Panel and not duct materials as we did at the Technical Center. This may be possible for labs with deep sliding platforms as long as the duct diameter is 10 inches or less, but not for those with 2-inch platforms. Flame placement may also be a problem. These will be discussed during today's Task Group meeting. Some Task Group members have requested more intermediate-scale tests be conducted to see if a correlation exists between these tests and radiant panel data. The FAATC has not conducted any ducting tests since the June 2011 Materials Working Group meeting.

### RTCA Update – P. Cahill (FAATC)

RTCA/DO 160 Rev. G has been published. AC21-16G was issued on June 22, 2011, and accepts Section 26-Flammability. The FAA strongly encourages the use of RTCA/DO 160G for new articles.

### Slide Evacuation Test Method TSO C69A – P. Cahill for D. Do (FAATC)

Furnace Study – Calorimeter Study – one of the participating labs sent their calorimeter to FAATC for recalibration due to questionable data. This calorimeter was then installed in the FAATC equipment and some tests were run. Three materials were tested and all failed with FAATC calorimeter. Tests conducted with this lab's calorimeter had some passes and some fails – it is possible this calorimeter needs a new furnace. For today's Task Group discussion: possible changes to TSO C69c and the Aircraft Materials Fire Test Handbook.

### Seat Cushion Oil Burner Test – T. Salter (FAATC)

Summary: flow testing new nozzles: checking for consistency in flow rates, Testing Nozzles in sonic burner: nozzle clocking to check for uniform flame temperature. 2.0 gph NexGen Burner set-up, stator positioning: rotational location and axial location, configuration: muffler and 90 degree elbow, changed location of muffler and elbow, fuel nozzle flow test rig: Delevan nozzle flow check – graph was shown, Everloy graph was shown. Tim described results of nozzle clocking for the Monarch nozzles and Delevan nozzles – a graph of the burner and nozzle calibration for each of these was shown. Seat Testing with NexGen Burner: sonic burner was then used to burn seat test cushions using Delevan and Everloy Nozzles. The Park burner was also used to test seat cushions with the Monarch nozzle. Results of tests showing seat cushion weight loss percent were shown. Thermocouple temperature drift: Extreme thermal cycling can cause thermocouples to display an increased error in readings. Exposing a SS sheathed 1/8" TC to a flame over 7 separate temperature tests showed a decrease in temperature reading of -80 degrees F. Met with representatives from TC supplier, and are working on a solution to the problem: development of a new thermocouple suited to withstand extreme thermal cycling. Type K thermocouples remain accurate under constant temperatures, or conditions where temperatures do not change by hundreds of degrees in a short period of time. New Air and Fuel cooling system: ice chest filled with ice water was not cold enough to keep fuel temperatures within specification. We replaced it with a small freezer setup to keep fuel temps within spec during summer months at the FAATC. Future adjustments and testing: continue to test using thermocouples and seat test articles; adjust sonic burner based on test results, keep in consideration that not all seat test articles are manufactured the same; use fiberboard seat cushion testing outfitted with 40 thermocouples to generate a 3D temperature model. Hank Lutz: which type thermocouples are you using? Tim: sheathed with a closed tip. We tried the ungrounded thermocouples as well. We are working with the manufacturer to look into all options in the development of the new thermocouples. What is the uncertainty in your flow measurement? Is it significant? How do you

know what the flow is? Tim: we have been flow bench-testing all of these nozzles. Are you controlling the temp of your fuel when you do the flow bench tests? Tim: Yes.

#### Radiant Panel Test for Thermal/Acoustic Insulation – P. Cahill (FAATC)

Updates since last meeting: The Task Group discussed the pros and cons of testing smaller samples and decided to stay with the full size samples specified in the Handbook. The general test method is now on the KSN site (uploaded recently). We will be discussing these during the Task Group meeting today. We will also discuss flame propagation measurement today. AC 25.856-1: we have started reviewing the AC. We were given a list of proposed changes and additions that we are also looking at. If there are any problems or issues with the Radiant Panel tests when you conduct them, please call Pat. A Round Robin is being considered.

#### Bunsen Burner Flame Discussion – P. Cahill (FAATC)

The methane flame is transparent and is difficult to see. There are no adjustments in setting the flame height except gas flow. The gas delivery pressure is set. Some labs use a “revealing (or illuminating medium)” such as salt or Formula 409 to enhance the flame profile. Be sure that you are using a Burner for natural gas. Pat sees no problem in using a revealing agent to help set the flame. The FAATC does not use a revealing agent. Serge Le Neve: the flame is stronger using the revealing agent. Hector Alcorta: what can we do if our flame does not look like the example you showed? Pat: first; make sure you are using a burner for natural gas not propane and check delivery of gas and the type of methane you are using. Dick Hill: join the Task Group for further discussion on this. Dick Hill: During the last Task Group meeting in Bremen in June 2011, we discussed running a Round Robin. During that meeting the Materials Working Group expressed interest in read-only access to the KSN sites for these Task Groups. April coordinated with the FAA KSN administrator a few months ago to have everyone on the Materials Working Group email distribution list read-only access to the KSN sites. Those folks should have received an email invitation from the FAA KSN Administrator during the summer (sometime after the June 2011 meeting). If have not been invited to join read-only access, give April your email address to set this up with the FAA KSN Administrator.

The test method for a specific material needs to be realistic and represent the scenario.

### **THURSDAY, OCTOBER 20, 2011**

#### Task Group Meeting Summaries

##### Cargo Liner Task Group – T. Marker (FAATC)

Discussed thermocouple degradation problem. Met with JMS thermocouple manufacturing company – they had some suggestions. FAATC asked them to build a super thermocouple. Nozzle selection was discussed – twisting and turning of nozzle is not sufficient. Tim Salter has been testing various nozzles, and once a nozzle is selected, we will recommend one for use with the sonic burner. Stephan Bonk was tasked with rewording a section of the Handbook Chapter. There was also some discussion on cone warpage and establishing a tolerance. Rob Ochs is going to do some work on this when the TexTech material comes in. Some wording is required regarding shimming of material on retaining frame.

##### Mag Alloy Task Group – T. Marker (FAATC)

We will continue work on mag alloy cylinders. Bruce Gwynne will look into getting some AZ31 cylinders for upcoming testing. There was a suggestion to test some vertical H-beam and some T's to see how they stack up as far as reproducibility and repeatability. Jim Davis suggested creating a light sensing tube to point directly at the sample to check when the sample actually

ignites and to know when the sample actually stops burning. We will look into this or a light sensing device for this purpose. We talked about the cylinder itself. A cross tube of this dimension will probably not be used onboard an aircraft.

#### Heat Flux Task Group – M. Burns (FAATC)

We are pretty much finished with the document. We discussed generating some advisory material. There was plenty of discussion regarding paint and paint thickness.

#### OSU Task Group – M. Burns (FAATC)

We will stay with type K wire and will replace the upper beads. We need to update the schematic for the thermopile itself. Overlap, we discussed the overlaps in the upper section. Insulation: range on density and heat capacity. Group agreed on looking into changing the flow rates for calibration – this will be part of a Round Robin. Mass flow meter, specify a flow rate to replace wet test meter. A new sub task group will be formed, and the information on this will be available on the KSN site.

#### Evacuation Slide Task Group – D. Do (FAATC)

We discussed a Round Robin. Do will check the location of the calorimeter and the sample during the test – check to see if the sample is centered.

#### Radiant Panel for Thermal Acoustic Insulation – P. Cahill (FAATC)

The General Test Method is on the KSN Site. Pat mentioned her radiant panel presentation from the 2007 Fire and Cabin Safety Conference. This presentation is included in the 2007 Conference Proceedings on the FAA Fire Safety website, click the “Conference” tab and scroll down to 2007 Conference Proceedings.

#### Wiring Task Group – P. Cahill (FAATC)

The Task Group will investigate the Round Robin data generated during the Round Robin conducted when John Reinhardt was the Task Group leader of the Wiring Task Group. We may look into revising the frame itself – it is slightly awkward. Mike Jensen: Did the use of sleeving come up? Pat: abrasion resistant jackets – we did discuss this and will work on these.

#### Ducting Task Group – P. Cahill (FAATC)

Boeing has presented to Pat a matrix of different ducting materials and different thicknesses and it will be posted to the KSN site for Task Group members to add any materials they have tested. We will run a Round Robin in the near future. We will need samples for this Round Robin.

#### Bunsen Burner Task Group – R. Hill (FAATC)

Major from last meeting: Round Robin testing of materials to compare burn length judgment from different labs and we found out that various organizations sent their materials to the company that was going to distribute the materials, but they have not done that yet. The rep from that company did not attend this meeting. Sarah Baillio found out that that rep is no longer with that company, but the company said they will get it back on track. We discussed how to proceed with the test method and reminded people to read the KSN site and make comments. There were some discussions to flame and how to set the flame and some believe that the Handbook is detailed enough and the problem is that people do not read it and some believe there has to be some additional advisory materials on how to set the flame generally. We agreed to include some color

photos on how to set the inner and outer cone in the Handbook. Task Group members can upload photos to the KSN site. We discussed the adjustment of the flame – moving it in and out or starting the flame under the sample and although there was some good opinion that it makes a difference if you do it one way or the other, there was not unanimous agreement that we should mandate moving it in, so we will consider this in the test method. We also talked about the use of a Bunsen burner type burner that is not straight to allow for drips so you don't clog up the orifice – but not mandate that it has to be used. Dan Slaton: near term general changes/edits to Handbook: before the long range changes are made. How do we capture the ideas for changes to the Handbook? Dick: we have been focusing on the test methods for the new/updated regulations in the future. Think about changes for existing test methods for the future. Advisory material on how you run the test does not require FAA Regulatory side approval – best practices for running the test can be included. Not what materials to test.

#### Oil Burner for Seats – T. Salter (FAATC)

Cone, thermocouples, and nozzles: cone: tolerances and defining tolerances for the cone and use of a jig; thermocouples: concern with error with thermocouple readings and FAATC is looking into a thermocouple that is more robust or use of another brand of thermocouple; nozzles: we will continue to investigate Delevan and Everloy and other nozzles. Leather seats were discussed – standardization of retaining method for leather seats: number of restraints, gauge of restraints, group suggested a survey uploaded to the KSN site on this. Testing of headrest and leg rest components was brought up. There really is not enough interest in the industry to incorporate this into the seat cushion test – FAATC is currently not using the seat cushion test to test these materials. We discussed running a Round Robin and will use KSN site to set a schedule for the Round Robin.

#### Insulation Burnthrough Task Group – R. Ochs (FAATC)

Standard definition for ways to interpret what a burnthrough is – Rob, Tim M., and TG members will work on definition. We will work on cone – tolerance of shape, cone materials.

#### Composite In-Flight Flammability Test – R. Ochs (FAATC)

Skin and structure in hidden areas: we will work with the test method with the radiant panel using the materials we have on order when they arrive. We discussed the work done by Boeing using a meeker burner. Boeing is going to continue looking into this. FAATC characterized the foam block and will translate that down to the radiant panel. We may have to work on different ways of orienting foam block to radiant panel. Ley Richardson will try to contact some material suppliers to obtain materials for this study. Others who would like to supply materials for us to test at our facility.

#### General Language for Common Test Apparatus in New Appendix F – R. Ochs (FAATC)

Objective: new Appendix F will have a different structure. A new Materials Fire Test Handbook will be produced – title may be changed slightly. This new document will include general descriptions of the test apparatus that is used in more than one test method. The specific test method chapters will include adjustments to the test apparatus for a specific test method (ie: Radiant panel, sonic burner, etc). A general procedure will also be included in this general section.

#### Composite Material Fire Fighting – J. Hode (SRA International)

Investigation into composite material fires in post-crash fires. Summary: several tests were conducted, results: neither CFRP nor OSB will burn for any extended period of time in the absence of an external exposure fire. They tried to identify a 'worst case' configuration. Test Method

Development: to include: Requirements, Variables, Test Parameters, Test Apparatus Set-Up. John reviewed the intermediate-scale results. Small-scale testing of GLARE was described and results were shown. A copy of this presentation is available on the FAA Fire Safety website with the other presentations from this meeting.

Flammability Standardization Task Group – M. Jensen (Boeing)

Objective of this presentation: show the differences between the current FAA draft policy memo and what is being proposed by the FSTG. A copy of this complete presentation is available on the FAA Fire Safety website with the presentations from this meeting.

Close of Meeting/Next Meeting – T. Marker (FAATC)

Next meeting: February 2012. An email will be sent to the Working Group email distribution list when the meeting details are confirmed.