INTERNATIONAL AIRCRAFT MATERIALS FIRE PROTECTION WORKING GROUP

Hosted by Boeing & Zodiac Aerospace, Huntington Beach, California, USA

February 24-25, 2015

Agenda

TUESDAY, FEBRUARY 24, 2015

9:00-9:20 AM	Welcome & Logistics/Introductions
9:20-9:40 AM	Magnesium Alloy Flammability Test – T. Marker (FAATC)
9:40-9:50 AM	SAE Seat Committee Update on AS8049 – Paul Lyon (Magnesium-Elektron)
9:50-10:20 AM	Seat and Cargo Flammability Test Items – T. Salter (FAATC)
10:20-10:35 AM	*Break*
10:35-11:05 AM	VFP Composite Structure/Wiring/Ducting – R. Ochs (FAATC)
11:05-11:15 AM	Heat Flux Calibration – M. Burns (FAATC)
11:15-11:35 AM	OSU/HR2 Update/Testing – M. Burns (FAATC)
11:35-11:45 AM	OSU Round Robin Analysis – Yaw Agyei (Boeing)
11:45 AM-12:00 PM	OSU Airflow Analysis – Theo Spanos (Boeing)
12:00 PM-1:30 PM	Lunch
1:30-1:45 PM	Altitude Impact on Bunsen Burner Testing – S. Rehn
1:45-2:00 PM	Evacuation Slide Test – T. Marker (FAATC)
2:00-2:15 PM	Flame Retardants/Material Change Similarity – D. Slaton (Boeing)
2:15-2:30 PM	Approved Material List – Scott Campbell (Zodiac Aerospace)
2:30-2:45 PM	*Break*
2:45-4:00 PM	Task Group Meetings Session I: Magnesium Flammability Test – T. Marker VFP Composite/Ducting/Wiring – R. Ochs Heat Flux – M. Burns Cargo Liner Test – T. Salter Flame Retardants/Material Change Similarity – D. Slaton Radiant Panel – S. Rehn

WEDNESDAY, FEBRUARY 25, 2015

8:00 AM-9:30 AM	Task Group Meetings Session II: Magnesium Flammability Test – T. Marker VFP Composite/Ducting/Wiring – R. Ochs HR2 Test – M. Burns Seat Cushion Flammability Test – T. Salter Approved Material List – S. Campbell
9:30 AM-11:00 AM	Task Group Meetings Session III: Magnesium Flammability Test – T. Marker VFP Composite/Ducting/Wiring – R. Ochs Seat/Cargo – T. Salter Evacuation Slide OSU/HR2 – M. Burns RTCA – S. Rehn
11:00-11:15 AM	*Break*
11:15-12:00 PM	Task Group Reports
12:00-12:15 PM	Additional Discussion/Closing

TUESDAY, FEBRUARY 24, 2015

Magnesium Alloy Flammability Test – Tim Marker (FAATC)

Burner configuration well defined using ignitorless stator with spark plug. Busch: can this be used for other burners? Marker: we are working on that now.
Sample Holder: need to downselect either original or updated holder (will be discussed by Task Group). 785 magnesium alloy tests have been conducted. The Magnesium Alloy Test is now in the *Aircraft Materials Fire Test Handbook* (Chapter 25). Tim reviewed the changes that have been made in this Chapter of the Handbook since the last Materials WG meeting in October 2014. We are beginning to focus on other applications in the aircraft where magnesium alloys can be used and what tests would be used to test these components.

Magnesium in Aircraft Seats – SAE Update – Paul Lyon (Magnesium Elektron)

TSO 127b Issued 6/2014 Seat Appliance Standard/Deviation required

AS8049C Aircraft Seat Standard/ AS8049B prohibits Magnesium. Paul reviewed the items in place to remove the ban on Magnesium. 75% approval results, ballot passes, but 146 comments to address. Re-ballot (limited ballot) end of March for May meeting discussion. The new wording was reviewed – includes a document reference. Magnesium in Aircraft Seats: Certification: Can magnesium containing seats be certified? Special conditions needed for installation. But, Special Conditions are limited to Type Certification (TC) for one aircraft type. TSO is 'appliance removal' applicable to all qualifying aircraft.

Seat Cushion and Cargo Liner Oil Burner Update – Tim Salter (FAATC)

Updated Chapters 7 & 8 of the *Aircraft Materials Fire Test Handbook*. Tim reviewed the current burner configuration. Ignitorless stator configuration is currently being tested for use with the seat cushion and cargo liner oil burner test method. Testing has shown using the ignitorless stator for cargo liner is acceptable. Cargo liner test results were shown. Round Robin Studies are planned. Currently, we have planned "mini" interlab study for both seat and cargo liner oil burner test methods. 4 labs participating for seat cushion and 3 labs participating for cargo liner. Final copy of updated Chapter 8 for cargo liner is under review.
Muffler foam insert: a 3" diameter by 12" long reticulated foam cylinder is required to be used in the burner muffler. New and old style mufflers have slightly different inner and outer diameters, although, still share the same McMaster-Carr part number.
Air Pressure Regulator: constant air pressure control is crucial for repeatable burner test results. Many regulators commercially available are not suitable for use with the NexGen burner. Quality concerns (even new). Some pressure regulators may vary by +/- 3 psi or more. Handbook requires air pressure maintain 45 +/- 1 psi. Recommend McMaster-Carr regulator part #49305K23 with an operating range of 0-55 psi. Alternative regulators planned for testing.
Cone Alloy Comparison: Current standard for burner cone alloy is 310 stainless steel. Cones have been found to deform by up to ½ inch or more after a moderate number of heat cycles. We will test other cones.
Lab Variables: NexGen should always perform the same if assembled and operating correctly.
Test Cell Size: heat from the flame can be reradiated back toward test sample from nearby walls.
Ventilation Hood Height: The height of the ventilation hood can impact on test results.
Test Plan: Recently purchased two NIST traceable Dwyer Instrument model 641-6-LED anemometers for use in ventilation airflow testing. Minimize test cell volume using partitions. Maximize test cell volume using full scale lab. Vary ventilation fan speed.
Handbook Discussion: This will be discussed in the Seat and Cargo Task Group meetings. Question: is there a list of labs that run oil burner tests? Salter: It is in Appendix F of the Aircraft Materials Fire Test Handbook which is available at www.fire.tc.faa.gov.

Development of a Flame Propagation Test Apparatus for Inaccessible Materials –
Rob Ochs, Ph.D. (FAATC)

Rob provided a review of the background for the development of this test apparatus. A schematic of the test apparatus was shown. The components of the test apparatus were described. Thermoplastic issues: unreinforced thermoplastics present testing issues. A new sample holder and spacer were developed. Flame length measurement: borrowed idea from Boeing flammability lab – image capture. Flamelet Temperature Measurement: new VFP under construction. Small thermocouples used to assess relative flame temperature. An old pilot burner was used to align and traverse thermocouples. It was very difficult to align these very small thermocouples. Rob showed a video of thermoplastic tests conducted in VFP at FAATC. Question: impingement distance confusion. Ochs: we will standardize flame length, and the distance would also be standardized. Damping Materials: damping materials were provided for evaluation in the VFP. Four different samples of CFRP Materials were provided by Kris Notestine. Three different test scenarios were performed. The Draft Advisory Circular under development was sent to the Task Group members in late 2014 – input is necessary for this. Since Christmas, I have received one comment. I hope to receive more comments from the Task Group members. DOT/FAA/TC-TN15/1 has been published as a Tech Note and is available at www.fire.tc.faa.gov in the Reports Section. Winn: how did your results of the damping materials tests compare to radiant panel test results? Ochs: it was what was expected.

Heat Flux Updates – Mike Burns (FAATC)

Use of millboard during calibration process: HFG Calibrator – millboard has not been used previously. HFG – Millboard Backer Board – did millboard have an effect on cal factor? Currently Chapter HF requires HFG's be mounted through ½" millboard. The new wording in Chapter HF were reviewed. This concludes Chapter HF Placeholder Document. The Task Group will thoroughly go through this document to ensure everything has been addressed and nothing has been overlooked. Chapter HF only addresses the 0-5 gauges.

Heat Release Rate Updates – Mike Burns (FAATC)

Upper Pilot Burner Hot Surface Igniter for Old OSU. This would probably go into the Aircraft Materials Fire Test Handbook most likely placed in Supplement Bullet 5.3.8. It is critical that the upper pilot burner tube is not moved out of position once set correctly.

HR2 Update – Mike Burns (FAATC)

We have set this up exactly to the specifications we have written up in the Chapter HR2 Placeholder Document. Mike reviewed the input from the Task Group members for the Chapter HR2 Placeholder Document. The full details are available in Mike's presentation on the FAA Fire Safety website (February 24-25, 2015 Meeting Presentations/Minutes Section of the Materials Page). Next: Assemble larger Focus Group RR comparing HR2 (1) and industry OSU's (13). Develop and distribute Test Plan and materials to participating labs. We hope to have data from the RR compiled to present at the June 2015 Materials WG meeting.

2013/2014 OSU Round Robin Conclusion – Yaw Agyei (Boeing)

Yaw reviewed the Round Robin Comparison Correction for his October 2014 Materials WG presentation in Atlantic City. Round Robin Conclusion/Recommendation: attempts to control unit preparation, testing, and calculation methods had no noticeable effects or reducing variability. No major source of variability in this Round Robin analysis. Yaw sent the Round Robin report out late last week.

Numerical Acquisition of OSU Airflow Data and Its Effects on Heat Release Results – Theo Spanos (Boeing)

Theo described the test set-up and presented the results. Observations: the total airflow variation and split ratio variation are not accounted for during calibration. Proposed next steps: recommend same tests be performed on a different OSU unit to validate observations and trends. Question: Was data based on FAATC's compressor and dryer system? Spanos: No, this data was collected in Charleston, SC, at Boeing.

Impact of Altitude on Bunsen Burner Testing – Steve Rehn (TAMI – FAATC)

Environmental Chamber can simulate preset temperature, humidity, and air pressure (altitude) conditions. Steve explained the set-up. Flame tests were conducted – volumetric flow rate of methane increased as altitude increased – mass flow rate decreased. The temperature was measured 3/4" above the burner. Material Tests were conducted: 3 of each material at each altitude. Material tests in chamber at sea level and at simulated 8000 feet altitude. Steve showed video of the materials tested. Conclusion: fuel flow rate was the biggest difference from sea level to 8000 feet altitude.

Slide Evacuation Test Method – Tim Marker (FAATC) for Dung Do

Activities: tests were conducted to assess the power control input of the furnaces for the slide test. Furnaces have different depths of heating coils. A diagram of the basic set-up was shown. The test method methodology (calibration and test procedure) was described.

Depth of the heating coil is the distance from the opening of the furnace to the coil. Do was trying to standardize the power output of the furnaces correspondent to the heat flux of 1.5BTU/ft^2 sec at distance of 2" in front of the radiant heat furnace. Results of the tests on each material were presented. Future work: participants will use the power output of 437 to 447 watts and the location of the solid coil of 1 5/8" from the opening of the solid coil furnace for the slide tests.

Material Change Similarity Task Group – Proposal to Develop AC Guidance –
Dan Slaton (Boeing)

Dan reviewed the background of that led to establishment of this Task Group. Proposal: target – initially focus on material changes, define MCC test method to establish comparison between the existing material and new material change, establish equivalency of material performance using analysis methodology (e.g. ASTM D 7309-13). Dan briefly reviewed major and minor change processes for those not familiar with this topic. The Task Group will discuss this further.

Radiant Panel Update – Steve Rehn (TAMI – FAATC)

Steve sent a survey to radiant panel labs in November and received 13 responses. He reviewed the results of the lab survey. The first draft of the training video is completed. It is based on the new Workbook – purpose is to make the test procedure more consistent across all testing labs and to help new labs. A short segment of the training video was shown as an example.
He would like to get a Round Robin started soon. Request for participants and "borderline" materials. Certain materials are already selected. We would like to get this Round Robin started as soon as possible.

Approved Materials Task Group – Scott Campbell (Zodiac Aerospace)

Scott reviewed the background of this Task Group. Scott recapped the discussions over the last 4 meetings. The Task Group will discuss a Working Model. R. Hill: cargo area of halon replacement – airframe manufacturers have formed a consortium and worked through legal issues and other to share proprietary information/data (International Coordinating Council of Aerospace Industries Associations (ICCAIA) Cargo Compartment Halon Replacement Working Group (CCHRWG). Robin Bennett is the Boeing contact for this group if you want to contact her (robin.g.bennett@boeing.com).

WEDNESDAY, FEBRUARY 25, 2015

Task Group Reports

Magnesium Flammability Test Task Group – T. Marker

Task Group Report for Magnesium Alloy Flammability Test – provided by Tim Marker

Task Group participants discussed the new flammability test method for magnesium alloy seat components. The participants were in agreement that the updated test method (burner improvements and pass/fail criteria) is well-defined. The only addition needed at this point is to update the drawings for the revised sample holder. Once these new drawings are completed, the Handbook Chapter will be updated. The new sample holder greatly reduces the amount of time required to change out samples following a test. The holder also allows for the three main functions: elongation of sample during heating, prevention of sample rotation after melt-through, and accommodation of various thickness samples.

The participants discussed the recent results of coated test samples conducted at the FAATC. The problem was restated for clarification:
When the coated magnesium samples were tested, the coating ignited consistently at approximately 40 seconds, and then self-extinguished at approximately 80 seconds. After the coating self-extinguished, a short time later the magnesium alloy sample would melt and then ignite as it normally does during non-coated sample tests. Although the melting/ignition/burning of the magnesium alloy was similar, it appeared the burning of the coating would increase surface heating of the sample, causing slightly accelerated melting/burning. Although these particular coatings that were tested resulted in 2 distinctly separate events (coating burns initially, self-extinguishes, and then the magnesium burns later), there was concern over other coatings that could possibly continue to burn up to the point when the magnesium melted and burned. If this were the case, it would not be possible to view these as two separate events,but rather a continuous event, resulting in failure of the test due to burning prior to 2 minutes.

The Task Group participants discussed these observations, and posed several questions:
Does the ignition of the coating actually make the base magnesium alloy material unacceptable?
Coatings are widely used over aluminum seat components, but these combinations are not required to pass an oil burner test. Is this fair? Are we requiring the coatings to meet an unobtainable level of safety, based on what the underlying material is? The participants suggested that a more appropriate test would be the vertical Bunsen burner, in which the coating is used over a magnesium alloy substrate. This would be equivalent to what aluminum-coated components are currently required to meet. One participant made a good suggestion to help in determining if an oil burner test of coatings was even appropriate at all. The suggestion was to coat an acceptable magnesium alloy with the worst conceivable coating, to determine if the coating was capable of causing premature failure of the underlying magnesium alloy. The FAATC agreed to conduct some tests to determine the outcome.

The participants next discussed the use of magnesium alloys in other areas. This is essentially 2 broad areas of discussion: 1) the use of magnesium in the construction of other seat components, and 2) the use of magnesium in all other areas of the pressurized cabin. In terms of other seat component applications, the new magnesium flammability test recently inserted into the Aircraft Materials Fire Test Handbook lists the 5 primary seat components that the flammability test is intended for (legs, spreaders, cross tubes, seat back frame, and lower baggage bar frame). These 5 primary components were evaluated during full-scale testing conducted by the FAA. Participants discussed the possibility of also using magnesium for other similarly-constructed seat components, for example tray table arms. The argument for using magnesium alloy is that the tray table arms, and

possibly other components, are largely similar to the 5 primary components initially studied in the full-scale test, and should not be precluded from fabrication using magnesium. The FAA's position is that some additional use of magnesium would be acceptable, but it must be limited so that the entire seat, including very small parts, cannot be fabricated of magnesium alloy. The FAA's concern is that small and thin parts may be more easily ignitable than the primary components, and were not considered in the full-scale tests. The FAATC suggested that at some point, if a majority of the metallic components on the seat were fabricated from magnesium alloy, the seat would become more hazardous. The FAATC suggested that surface area-to-volume (SAV) ratio would be a reasonable concept for limiting the use of magnesium to certain components (this concept was also suggested at the previous two IAMFTWG meetings). Basically, the higher the SAV ratio, the more easily ignitable the component is. The FAATC suggested that a maximum allowable SAV ratio could be established, thus limiting the use of magnesium alloy to constructions that are inherently more ignition resistant. After considerable debate, the FAATC suggested that a limited amount of full-scale testing may be necessary to determine an appropriate solution. The purpose of the full-scale tests would be to determine at what point does a magnesium alloy seat construction become unacceptable in terms of overall flammability. The FAATC suggested a simplified methodology for conducting full-scale tests, to help aid in the decision-making process. The FAATC also suggested additional criteria that would be possible. For example, limiting the amount of magnesium alloy in the construction of a seat, based on the total weight percentage (i.e., a maximum allowable 75% magnesium components by weight, etc).

The participants also discussed the potential use of magnesium alloy in other cabin areas. This was a much more broad discussion area, since there are so many possible applications. These applications can be broken down further into 2 main areas: 1) components located in areas readily accessible with a handheld fire extinguisher, and 2) components in inaccessible areas. It is possible that readily accessible components could be treated similar to the seat components (i.e. using the SAV ratio as the determining criteria). However, components located in inaccessible areas would need to be investigated further, particularly thin components that could potentially be ignited from an electrical arc. The FAATC had previously agreed to conduct initial testing on two types of thin sheet (poor-performing AZ-31 and well-performing Elektron 43). The FAATC has begun the initial electrical arc testing using arc generation equipment obtained in early January.

Heat Flux Task Group– M. Burns

The Task Group discussed Chapter HF, and there were really no issues. We discussed how a round robin would be conducted.
Chapter HR2 discussion – group provided input on adjustments that may be needed due to altitude of lab conducting the tests; hot surface ignitor drawings requested; validation of HR2 with OSU.

OSU Task Group -M. Burns

Hot surface ignitor document was reviewed – generally well received. Early stages of DOE to look at HR2 were described.

VFP Composite/Ducting Wiring Task Group – R. Ochs

Apparatus was discussed on Tuesday. AC was discussed on Wednesday. Thermoplastic holder was discussed. Boeing will look into the ribbon burner – purchase a few and do some comparisons.
Wire discussion covered all sorts of wires.
AC discussion: The Task Group previously had an opportunity to review and make comments. Comments will be compiled into one document and continue to be reviewed. The Task Group will have a telecom sometime between now and June meeting to discuss AC further.

Cargo Liner Task Group – T. Salter

Chapter 8 of the Handbook has been updated to include the NexGen burner for use in the cargo liner oil burner test method. Industry has requested a chance to review the document before the final copy is released. A two week period was granted until 3:00 PM on Friday March 13th, at which time no more recommended changes will be accepted for review. All comments submitted before such time will be reviewed for inclusion in the document. A mini round robin will be held (4 labs) to prove the worthiness of the igniterless stator configuration for use in the cargo liner oil burner test. It has been asked that participating labs return test results by the next materials working group meeting in June. An updated chapter 7 for the seat oil burner test is also currently being rewritten to include the use of the NexGen burner. A mini round robin will be conducted for the seat oil burner test also to determine if the igniterless stator configuration is acceptable.
An upcoming FAA study will look into the impact of ventilation airflow in the test cell for both the seat and cargo liner test methods. It is believe that the burner has been sufficiently developed and repeatedly issues among labs may more likely be due to air conditions within the test cell. The importance of proper fuel and air flow control was discussed, including the recommendation of using air/fuel monitoring equipment with a NIST accuracy rating of +/- 2% or less.

Radiant Panel Task Group – S. Rehn

The Task Group discussed materials needed for the Round Robin and organization of the Round Robin.

RTCA Task Group – R. Hill

History and problems we ran into last time were discussed. Airbus has done quite a bit of work and has agreed to put together a general document that will be used in a survey that we will be sending out to the Task Group members in the near future. We will consolidate this into a document to send to the Task Group members to proceed in time for the June 2015 meeting. Steve Rehn will be the FAATC point of contact. Contact Steve if you want to participate in this Task Group.

Material Change Similarity Task Group – D. Slaton

Task Group notes provided by Dan Slaton:
During the full meeting, Dan Slaton presented the recent history about the "Material Change Similarity" task group and proposed to use MCC to compare flammability performance when a material changes. The break-out task group session was very well attended. With many new people, there were some basic questions about the overall proposed process and what the process is for. By developing and documenting a process in a future AC, the industry will have a method to test and evaluate a change in a material (e.g. chemistry formulation) to determine the effect on flammability performance. The goal is to utilize engineering data to compare the old and new materials and confirm there is no appreciable change in performance. If there is no appreciable effect on performance, the change would be considered a minor change (in the context of regulations FAR21.93 which is the end-goal for showing compliance for a change). One member brought up the topic of creating a certification approach for "Minor with Flammability Data." It is not clear how this would be defined or how it would fit in with this new AC process.

A brief review of FAR 21.93, 21.95 & 21.97 was provided in the presentation. The process would be applicable to chemistry changes of materials due to environmental regulations (solvents, fire retardants, …), for alternate raw material sources (solvents, pigments, etc…), and possibly for evaluating a new material due to an existing material becoming obsolete. This last item will be discussed further to determine if there are criteria that would be required before using this process, such as both materials (obsolete, new) being in the same polymer family. There

was discussion about the definition of equivalency in the context of comparing material properties. It was also discussed that sometimes the new material formulation has improved flammability performance and this would be acceptable to reach a conclusion of "equivalent." It will be important to clearly provide definitions of what is meant by "equivalent," "equivalent or better than," or "no worse than." Ultimately there should be a simple process when a changed material performs *better* that the current approved material. Finally it was suggested to consider developing an analysis method to determine "equivalency" when the flammability properties are well below the regulatory limits but may have slightly "worse" performance. An example of this is when a current material has a burn length around 1" and the new material results in 1.5". Being well below the regulatory limit would suggest no appreciable effect to fire safety. The concept of "minimum performance standard" (MPS) might help this particular scenario.

There was considerable discussion about material specifications and how this impacts the qualification of a material to a standard. Since a material specification has many requirements for the material besides flammability, this process would only support the evaluation of the flammability performance. The other requirements would need to be addressed separately to ensure the material change does not impact properties such as strength, durability, etc… The topic of "Letters of Similarity" from a material supplier was brought up and questions about how this fits in with this new process. Further discussion is needed, although it was believed the process would help provide the approach for determining "similarity (or equivalence)" to support the communication between material suppliers and the users.

With the proposed process to use MCC, there was discussion about ways to use other test methods such as the current certification test methods, but in a more streamlined approach. There was general agreement that identifying standard test configurations that could be used to reduce the total amount of testing needed to compare the material performance is a valuable part of this process. This is similar to the approach used by the Policy Statement standardization team. Some discussion about how to utilize both the MCC and standardized test configurations could be outlined to streamline the overall testing. The concept is to have a process with an initial phase using MCC and based on those results continue with some level of regulatory test methods on standard configurations. Further development of this process flow are required. Dick Hill mentioned two areas where the MCC test method may need further development or boundary conditions (criteria) developed to effectively utilize the test method. The first point, the MCC was initially developed to evaluate very small quantity of material (~5 – 20mg), usually a homogeneous material. There is research on-going in industry and the FAATC (Rich Lyon) to determine the ability to use the MCC for more complicated buildups. The second point, certain flame retardants can mask the overall performance when comparing MCC results to a larger scale test like the OSU or VBB. The industry and FAATC are continuing research in this area as well. Both these areas will need to be a watch item for the task group to consider what criteria need-to be defined to outline the boundary conditions of using the MCC.

The following actions items were identified for the task group members:
1) Develop proposed changes to the process flow chart for review at the next meeting.
2) Material and part suppliers consider identifying recent material changes for further testing by the FAATC, to develop the process and criteria for utilizing MCC and standardized test configurations.

Approved Material List Task Group – S. Campbell

The Approved Material List Task group discussed the following (provided by Scott Campbell):

1/ SAE Model for Qualified Products List.

- Need to work with SAE to generate a specification that could be referenced in a FAA AC.
- Qualified products are publicly available on the SAE website
- Qualified materials are listed at the cost of the applicant (roughly $500-$1000)
- Potential for Industry / Regulatory participation as members of the qualified products group
- Model is already accepted in other areas by Boeing, etc.

2/ A subgroup volunteered to participate in a WEBEX conference call later in March with SAE/PRI (Performance Review Institute)

Final Discussion/Comments – T. Marker

June 3-4, 2015 hosted by Airbus in Bremen, Germany

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4). Update your contact data and hit the “Update” button at the bottom.