INTERNATIONAL AIRCRAFT MATERIALS FIRE TEST WORKING GROUP MEETING

Hosted by FAA Technical Center, Trump Taj Mahal, Atlantic City, New Jersey, USA

October 21-22, 2008

TUESDAY, OCTOBER 21, 2008

Burnthrough Update – R. Ochs

NexGen Burner Description, Reasons for Development, Advantages of NexGen Burner

The drawings of the NexGen Burner are available in the Materials Section of the FAATC Fire Safety Website.

Ignitors are available from Westwood Products – URL available in presentation slides

Rob reviewed the recent inquiries regarding the NexGen burner (parts, operation, availability, etc). He also provided a list of those labs that have NexGen burners.

General Burnthrough Information:

Location of Boeing designed burner measurement tools. These drawings and other information will be available in the future with a direct link instead of only hidden in presentations. The Materials Section of the FAA Fire Safety website is being reorganized, and a lot of the information from meeting presentations will be available through direct links on the page. Rob reviewed the new design/layout of the Materials Section of the website.

European Aviation Safety Agency (EASA) RFP on Burnthrough – R. Hill

EASA has recently started issuing requests for proposals for several types of research. Dick provided the location of the Request for Proposals on the EASA website and gave a brief description of the request for proposal for burnthrough research.

Particle Image Velocimetry (PIV) Applied to Fire Safety Research – R. Ochs

Rob explained the objectives of this work, the methodology, provided an overview of PIV and its parameters and how PIV can be used for fire safety research.

Update on Flammability Testing of Magnesium Alloy Components – T. Marker

Background and potential uses for magnesium alloy components in commercial aircraft

Tim presented photos and provided results of magnesium alloy component sample lab-scale tests conducted at the FAATC to date.

4 full-scale tests at the FAATC were proposed, seats were acquired for the tests, photos of the FAATC full-scale test article and schematic of full-scale test article with instrumentation were shown, results of initial baseline test were presented.

Future Considerations: all full-scale test results will help in determining an appropriate lab-scale test program for magnesium alloy components if these components are determined safe for use in aircraft applications. We plan to run another baseline test with zero wind conditions (initial baseline had approximately a 1/3-mph wind condition).
Next Steps: another full-scale baseline with zero wind conditions possibly in about one month
Tim showed the video of the initial baseline test.

<u>Toxicity Testing of Burnthrough Compliant Insulation Systems</u> – T. Marker

Tim provided results of Laboratory-Scale Testing. Photos of test sample set-up prior to testing were shown. How do these tests equate to a full-scale test. 9,258 cubic feet of volume in FAATC test article. Tim explained the scaling factors. Comment: the correlation from small-scale to full-scale is not there at this time. Is the FAA willing to put more time and effort into alternative tests or are you wrapping this up? R. Hill: the FAA is not going to come out with toxicity requirements for thermal-acoustic insulation at this time. We came up with the box test in lieu of full-scale tests and said if you run it, we'll know what we can accept if the numbers are real low. It was designed to show equivalence. We were looking for numbers the FAA would be comfortable with so the regulatory side could determine if full-scale tests were necessary. The results did not come out clean enough for the FAA to say the box test was enough without running full-scale tests, but at this time we do not intend on issuing toxicity requirements for thermal-acoustic insulation or doing further work on this. The FAATC report on this work is in draft phase at this time.

<u>Relationship of Flammability to Altitude</u> – R. Hill

FAATC has been conducting some experiments related to fire procedures in freighters. Dick presented results of some of these tests. All the tests we have were developed at sea level. Most of the experience we have is at an altitude of 8,000 feet, so there is some conservativeness involved.   There is a difference at altitude.

<u>Development of a Lab-Scale Flame Propagation Test for Composite Fuselages</u> – R. Ochs

Rob highlighted some of the previous work on composites at the FAATC (J. Quintiere study) including flame spread experiments. Preliminary FAATC measurements taken, drawing of configuration used in this round of tests, summary of initial testing.

<u>Fire Behavior of Structural Composite Materials</u> – S. LeNeve (CEAT)

DGAC, CEAT, and Airbus effort. Serge provided some background on this test program for structural composite materials and the goals of the program. The types of tests that will be conducted on these materials were listed.

Burnthrough Smoke and Toxicity of Structural Composite Materials: the plans for these tests were explained and preliminary results were presented including all the toxicity results from these tests.

Development of a Repeatable Hidden Fire Source: description of the test apparatus and its flame characteristics, test results for each configuration presented, and conclusions presented. Next steps were described.

Development of a New Flammability Test for Aircraft Ducting – J. Reinhardt

Report Revision – John corrected the two data points that were transposed. These have been corrected in the report on the Fire Safety website.

Round Robin – John would like to start a round robin for results reported by March 2009. He will send an email to previous participants to determine lab interest.

Development of an Improved Fire Test Method and Criteria for Aircraft Electrical Wiring – J. Reinhardt

Objective of Project: to develop a test for aircraft wiring that can adequately discriminate between poorly performing materials and aircraft worthy materials. The work has to be completed by June 2009. This work will not look at design, installation or arc issues. It is just to look at the flammability properties. The program includes about 22 types of wires and cables – some are aircraft rated and some are commercial or residential type wires. He ran a number of lab-scale tests to determine flammability properties of the wires and cables in the test program. Results were presented. Videos of some of the tests conducted were shown.

What test apparatus can be used to replace the 60-degree Bunsen burner test? John described two options and showed videos of good and poor performers in the initial tests he conducted. The microscale combustion calorimeter provided some good information about the flammability properties of these materials. There are 19 more types of wires to be tested.

Restraint of Leather Seat Cushions During Appendix F Seat Cushion (Fire Block) Testing – J. Davis

Materials Evolution: fire hard foam, variability in the results with leather, full cabin use of leather in transport type aircraft, “leeway” in rules and guidance on fastening effect on pass or fail. Video of “good” performing leather seat cushions. Video of “poor” peforming leather seat cushions.

Objectives: review the available information on the subject, fastening methods at labs, experiment with Velcro fastening, research is it the leather or top coat that shrinks?

Review available information: leather aircraft seat fastening methods – a number of airlines use two Velcro strips and one uses five Velcro strips. Lab fastening methods-various ways labs fastening seat cushions to test fixture were shown and described.

What’s Next?: complete list of how test labs are fastening seat cushions to test fixtures, agree on ‘preferred’ method, etc.

WEDNESDAY, OCTOBER 22, 2008

Task Group Reports

Magnesium Alloy Flammability/Full-Scale Testing Task Group – T. Marker

The Task Group Chairman, Tim Marker, provided the following summary notes from the Task Group meeting:

Magnesium Alloy flammability Task Group Meeting Minutes 10/22/08

The FAATC described the planned activities in the coming months. As discussed in the general meeting, the FAATC had conducted a full-scale baseline test on standard, aluminum-framed, OEM seat structures that were purchased several months ago. The purpose of this test was to establish the current hazard level during a typical postcrash fire accident scenario. Subsequent tests using magnesium-alloy seat structures will determine if there is an increase in the overall hazard level as a result of the magnesium alloys.

During the initial baseline test, a very slight wind condition was simulated, in order to draw the fire into the cabin more quickly than a fire with zero wind. To accomplish this, a small evacuation fan was mounted in the ceiling of the test article near the forward end. By exhausting out, the fan essentially draws the fire into the fire door, causing involvement with the interior materials more quickly. The intent of the wind condition for this test scenario was to insure that a robust cabin fire resulted, thereby exposing the seat structures to enough heat to cause melting of the primary structures. Melting the primary seat structure offers the best opportunity to achieve ignition of the magnesium alloy.

Immediately following the fuel pan ignition, it became clear that the conditions inside the fuselage would become non-survivable in a short period of time. Internal cameras became completely obscured by 2 minutes 30 seconds, and so the external fire pan was extinguished at 3 minutes. A post-test inspection of the cabin revealed widespread burning of the non-metallic seating materials, however there was very little damage to the primary metallic components. It appeared the fire had progressed so quickly that there was little time for the seat structures to heat up and melt. Only one spreader bar from the seat located directly in the fire door sustained any melting. As a result of this outcome, it was decided that a subsequent baseline test be performed with zero wind. It is anticipated that the zero wind test will produce a more slowly developing cabin fire, enabling a longer test time. By extending the time of the test, the seat structures will be exposed to the heat from the fuel fire for a longer period, thereby inducing more melting of the primary structure, which is the intended outcome.

During the task group session, the duration of the planned test was discussed. It was agreed that the test would be run until a discernable “flashover” condition results inside the cabin, and then the external fire will be extinguished 30 seconds thereafter. The addition of an infrared camera inside the fuselage was recommended to help with determining the actual surface temperature of the seat structures. As a result of this suggestion, the FAATC plans to install an IR camera inside the test apparatus. Similarly, the thermocouples used to measure the temperature of the seat structure must be installed in such a manner as to prevent the erroneous measurement of the surrounding air. This will be accomplished by drilling small holes, mounting the thermocouples inside, and filling in the drilled area with an epoxy material. This will ensure that the thermocouple doesn’t move out of the structure during the test. A planned pre-test of this configuration will be performed in the lab, to ensure proper function. Additional safeguards will be used to protect the lead wires from becoming fire damaged during the test, which will also cause erroneous temperature readings.

The obscuration of the cameras became an issue during the baseline test as the thick, smoke-filled layer adhered to the glass panels on the protective camera boxes, rendering the internally mounted video cameras useless in 2 minutes 30 seconds. There were a number of suggestions made to prevent the obscuration of the camera box glass, including the use of pressurized (clean) air blowing across the glass, or a physical wiping mechanism. The FAATC will attempt to resolve the obscuration issue prior to the next test.

An important point in the discussion was the performance (or lack thereof) of the seat cushions used during the tests. Although the cushions contained the required airworthiness tag that references FAR 25.853 (c), the seat back cushions appeared to become involved in the fire very quickly, and burned vigorously. Several participants suggested that laboratory tests be conducted on the seat materials to determine their performance. The difficulty with this suggestion is that only enough cushions were purchased to complete this test series, with no spare materials. In addition, the seat flammability test only considers the flammability of the cushion material, and not the seat back frames, which were constructed of epoxy reinforced fiberglass. Two task group participants agreed to help locate additional spare cushion/dress cover materials that could be used in lab scale testing to assess their flammability.

One task group member made a suggestion regarding subsequent full-scale testing of the magnesium alloy seat structures. One of the primary goals of the testing is to determine if there is an increased hazard using these materials. It is not necessarily a foregone conclusion that if the mag-alloy components ignite, it results in a more hazardous condition. If they ignite during the full-scale test, it may be more beneficial to allow the mag-alloy materials the opportunity to self-extinguish, since this occurred during many of the lab-scale mag-alloy tests. If the materials do not self extinguish after a pre-determined amount of time, then it would be appropriate to attempt to extinguish the materials, using either a cabin-mounted water nozzle, or possibly a firefighter with hand line. The FAATC has agreed to investigate the possibility of using a firefighter to extinguish any residual fire on the mag-alloy components, but cautioned the task group members on the dangers of live firefighting. It may be more appropriate to install an array of nozzles inside the test article, in an attempt to replicate what a firefighter might accomplish. The actual test progression and details will be refined in the coming weeks, in order to have a clear understanding of how the magnesium alloy tests will be conducted, and what the expected outcomes will be.

One task group member questioned what the standard practice is for fighting a postcrash fuel fire on the airport, and whether or not these standardized procedures differ from country to country. The FAATC had assumed that a fuel fed fire was normally attacked with AFFF (aqueous film forming foam), and any internal fire was attacked with water. The FAATC will check this information to determine its accuracy.

Hidden Fire on Composite Fuselage – R. Ochs

The group discussed the preliminary test results of tests conducted using the radiant panel. They discussed getting samples of other composite materials for future test in order to develop a test method.

Wiring Flammability Test Task Group – J. Reinhardt

The Task Group Chairman, John Reinhardt, provided the following summary notes from the Task Group meeting:
WIRING TASK GROUP MEETING MINUTES

Members Present:
Serge Le Neve
Martin Spencer
John Blinne
Chris Bresciano
Gary Palmer
Thivanka Edrisinha
Scott Campbell
Raymond Tom
Stephen Winn
John Reinhardt

Summary:
On 21 October 2008, the Wiring Task Group had a meeting to discuss the presented results and obtain feedback from the members about their experiences and concerns with this test methodology. The following requests and issues were raised:

1. Run the 30-degree Radiant Panel Test without the radiant heat, but with only the intense pilot flame: samples to include the BMS13-60. MS81044/6, and Mil-17/28-RG58 wires and cable.
2. Measure the temperature of the RHP and the 60 degree pilot flames
3. Run the same 3 samples using the 30-degree RHP test with the 60-degree pilot flame intensity.
4. Film the wire with a FLIR camera to see if there is a heat sink at the end of the wire that has the weight suspended.
5. Test a bundle of wire wrapped with heat shrink – this sample will be provided by one of the members.
6. Send wire/cable samples to a few members for a round-robin to re-do some of the 60 Degree Flammability tests, especially the ones that passed the FAA wire flammability test, but failed the intermediate-scale fire test.
7. Members would like to see the length of the wire sample reduced from 30 inches to something less.
8. Members would like clamp ends of wire/cable samples instead of using weight. The weight seems to promote wire breakage.
9. Members would like to include a special condition in the test to address the mounting of short wires (for samples less than 30 inches); for example, using alligator clips to attach to a longer wire or tying to a longer wire with a non-flammable mechanical means.
10. Members would like to continue using the average burn length and average after flame extinguishing time as in the original test.
11. Members requested the testing of the same 3 wires on a horizontal position and perpendicular to the pilot flame.
12. Re-invite members to join online group forum to share information – they will contact task group manager if not received by 7 November 2008.

Update on NBS and OSU Round Robin – M. Burns (previously recorded)

This presentation is available on the Materials Page of the Fire Safety website.

Mike is starting Quarterly Tips and Reminders for the OSU and NBS that will be addressed at Working Group meetings. He provided a few for each (OSU and NBS).
Handbook: The FAA is continuing to update Chapter 6 of the Handbook.
Mike may be contacted via email at Mike.Burns@faa.gov or at 609-485-4985.

<u>Microscale Combustion Calorimeter Testing of Contaminated Insulation Films</u> – R. Lyon

Incident EVA Air in Bangkok, Thailand, smoke coming out of sidewalls next to seats (Boeing 747). The burned insulation blankets were removed and sent to the Boeing lab and the Fire Safety Advanced Materials lab. Boeings' analysis showed that the surface contamination consisted of corrosion inhibiting compound, synthetic and natural fibers, insects, animal hairs. The FAATC will be publishing a Technical Note on this work. All of these blankets passed the 12-second vertical Bunsen burner test. Pat Cahill did the cotton swab test as well on moderately contaminated and severely contaminated blankets from this aircraft. Rich looked at affect of localized contamination on combustibility with the microscale calorimeter. Rich described how the microscale calorimeter works and how they tested the samples from the contaminated blankets.

<u>RTCA Discussion, New Task Group</u> – R. Hill

This will be a participative/active Task Group. Members will have to do work – run tests, literature searches, gather data. It definitely will involve more than just coming to the Materials Working Group meeting. It will involve distribution of work between Materials WG meetings. All the requirements must be ready for the 2010 RTCA documents – that's less than two years away. If you want to participate in this Task Group, let April Horner know (business card, contact information) or contact Pat Cahill directly at 609-485-6571, or at Patricia.Cahill@faa.gov.

<u>Comparision of Park Oil Burner to Gas Burner according to ISO 2685 or AC 20.135</u> - S. LeNeve

This presentation is available on the FAA Fire Safety website on the Materials Page.

FAATC will make the FAA Propulsion side aware of the findings of the research Serge presented.
<u>Mining and Generation of Magnesium Alloys</u> – K. Clark, Magnesium Elektron

Magnesium, machining magnesium, wrought plate manufacturing, alloy development history, etc., were covered in his presentation.

<u>Next Meeting</u>:

The dates and location of the spring 2009 Materials WG meeting will be emailed to WG members as soon as it is available.