INTERNATIONAL AIRCRAFT MATERIALS FIRE TEST WORKING GROUP MEETING

OCTOBER 21-22, 2009

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

WEDNESDAY, OCTOBER 21, 2009

NexGen Burner Review – R. Ochs (FAATC)

Rob reviewed the design and purpose of the NexGen burner. The drawings of this burner are available on the FAA Fire Safety website for any lab that will be building one. The new stator and turbulator had no significant effect on overall flame temperature.

PIV Measurements on the FAA Fire Test Oil Burner – Particle Image Velocimetry Applied to Fire Safety Research – R. Ochs (FAATC)

Difficulty with achieving calibration and inconsistency of burner performance worldwide has motivated the use of particle image Velocimetry. Future measurements – spray: effect of viscosity on velocity field (vary fuel temperature), study nozzle uniformity, etc.
PIV images of air flow measurements were shown and discussed. Future: study behavior of swirling airflow as a function of axial location (stereo-PIV). Perform same measurements – study effects of variables. Investigate use of PIV for flame measurements by using two PIV cameras and a beam splitter arrangement. Dan Slaton asked about future potential of using PIV as a certification tool as we head into the future due to very small changes to certain material types. Rob explained that it is primarily a research/investigative tool at this point.

Radiant Panel – P. Cahill (FAATC)

The last two panels we received were out of specification (found this during the 3-position check and the "very high" set point temperature). Both panels were sent back to our distributor who in turn, sent them back to Watlow in St. Louis. Watlow has informed us that they have replaced the emitter strips on both panels. It is imperative that a 3-position check be performed when installing a new panel. Labs should work with their distributors if problems are found.

Dan Slaton - any future plans for round robins or optimizing certain parameters? Pat – always- as technology progresses there are new materials. Pat mentioned her presentation from the 2007 conference that is available on the FAA Fire Safety website – the presentation included things to check for regarding the panel.

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

Materials Evolution: originally – fire blocked cushions, fire hard foam, leather seat covers in first class cabin, leather seat cushions throughout aircraft cabin. Objectives: review of available information on the subject, survey- real world fastening methods, research on why leather materials shrink up (ongoing- no conclusions). Effect of wires baseline tests – one wire, six wires, one continuous wire wrap. Wire restraints on leather – tests were conducted with one wire, three wires, and six wires – percent weight loss was reviewed. Conclusion: as with fabric, tighter fastening resulted in less shrinkage. Hook and loop fasteners were used as restraints to frame – back cushion fell down – seat bottom char length was reviewed. Additional hook and loop tests will be conducted. Seek consensus on "preferred method" by email, online group. Present results – final recommendation for preferred method.

Overview of Standardization Task Group – R. Hill (FAATC)

The FAATC is looking into three areas including developing a test method for fillers and potting compounds, a test method for glues and adhesives, and a better definition of small parts.

Flammability Standardization Task Group - M. Jensen (Boeing)

The FAA Transport Airplane Directorate issued an Issue Paper that can be found at http://www.faa.gov/aircraft/draft_docs/ - click on "Policy" and it is the second item at this time. Part 1 of Issue Paper: items acceptable without additional data, Part 2 – methods of compliance that require supporting data, total of 44 items.
Task at Hand: validate each item is stated clearly so it is understood and applied equally by all and develop analysis/test plan to provide substantiation that Part 2 items hold true.

Standardization of Flammability Requirements Project Structure: Interested industry, FAA contact (Jeff Gardlin), team leads, task group members. The kickoff meeting was held in August. CDZodiac has put together a Sharepoint site for task group. Task Group has 18 months from release of FAA Issue Paper to resolve Part 2 items. Team needs Task Leaders for the open items. Team also needs members on each item. A question was asked about EASA acceptance of the items in Part 1. Enzo Canari (EASA) answered that EASA intends to accept the items in Part 1 with some minor clarifications/explanations.

Discussion of Fill Compounds – T. Marker (FAATC)

What is filler? A composition, especially a semisolid that hardens on drying, used to fill holes or cracks. It is used in edge fillers, close-outs, surface fillers. Contact Tim Marker to discuss this topic further.

Qualification Test for A/C Panel Adhesives – R. Lyon (FAATC)

Objective: develop a qualification test for flammability of adhesives used in bonded details. Purpose; establish similarity of bonded details. Applications: certification of new parts. Adhesive Qualification Test Issues: FAR 25 versus other measurement method, sample form, effect of adhesives. Rich described their 3-layer bonded construction with a thin adhesive layer and the results of tests recently in the OSU. Contact Rich Lyon to discuss this topic further (Richard.E.Lyon@faa.gov or 609-485-6076).

What is a Small Part? - R. Ochs (FAATC)

The small parts can be found in different areas of the cabin – fire threat: post crash – test method: OSU/NBS. Hidden Areas: surrounding materials meet: Radiant panel, V-BB, H-BB, how should these be tested? Also small parts in Hidden Areas in Future Aircraft. Contact Rob Ochs to discuss this topic further.

RTCA Update – P. Cahill (FAATC) and A. Thompson (Environ Laboratories LLC)

The Section 26 Draft, Fire and Flammability was sent to the Task Group members in early October for their review. Modified sections of the Fire Test Handbook have replaced the entire Category C. Vertical Bunsen Burner Test – Task Group will discuss need for further guidance. Small Parts: parts/materials which are considered small may be exempt due to their small size and amount because they would not contribute significantly to the propagation of the fire. Examples of small parts could be: knobs, handles, rollers, fasteners, clips, grommets, rub strips, pulleys, etc. Small parts exemption does not apply to wire and cable. Consideration must be given when more than one small part is located together. This will be given some further consideration. Closing Points: comments from Task Group members will be discussed in October 21, 2009, Task Group meeting.

Update on Flammability of Magnesium Alloy Full-Scale Testing – T. Marker (FAATC)

The primary components of the aircraft seat: spreader bars, cross tubes, leg assembly are the target components to be replaced with magnesium alloy materials. The results of Baseline 1 Test and Baseline 2 Test were reviewed. Primary damage of Baseline 2 Test was discussed and the summary of this test was reviewed. Baseline 3 Test was conducted in July 2009. Baseline 3 Test Configuration photo was shown and results photo was shown. The Baseline Comparison graph showing all three Baseline tests was presented. Summary: pan fire extinguished at 5 minutes using AFFF, interior fire extinguished at 10 minutes using water, incapacitation reached at 4 min. 31 sec at forward location, seat backs, mostly consumed on port side, largely intact on starboard side.
Good acting mag-alloy supplied by Magnesium Elektron (WE-43) was used for seat components. Photos of WE-43 Test configuration, and photos from various angles of the results were shown, also. The summary of WE-43 test findings were reviewed: pan fire extinguished at 5 minutes using AFFF and incapacitation reached in 5 min 5 sec at forward location, seat backs mostly consumed on port side. Graphs of results were reviewed.
Next Steps: continue with assembly of seats using new back cushions/covers, preparing for test using AZ31 mag-alloy components. Future considerations: all full-scale test results would help define an appropriate lab-scale test method or methods, which is the primary goal of the research. Tim showed video of Baseline 3 Test conducted in July 2009 and WE-43 mag-alloy Test 2 conducted September 10, 2009.
The next mag-alloy test will be conducted late October/early November 2009 at the FAATC.
We still have a ways to go before considering development of a test method. There are still a number of things to be investigated after the AZ-31 test coming up next.

Development of In-Flight Flammability Test for Composite Fuselage Aircraft– R. Ochs (FAATC)

Modern composite aircraft are being designed with increased amounts of composite materials in the aircraft fuselage and structures in hidden areas. Composite resins have a very wide range of flammability. Objective: develop a lab-scale test with test criteria to be based upon intermediate-scale testing. Rob showed schematic for proposed test configuration for intermediate-scale test. Rob showed photos of the updated test rig design/set-up. He presented results (graph) of foam block test on Kaowool, 45-degree angle, simulated hidden area. Fiberglass insulation was added to test rig to closely simulate a hidden area in an aircraft. ½" plywood and ¼" aircraft sandwich panel were tested in 45-degree uninsulated and 72-degree insulated configurations. Park Advanced Composite Materials sent some carbon fiber composites they are seeking to use in aircraft structures. They sent composite panel samples for our test program. Summary: preliminary intermediate scale testing has commenced with various materials, etc.

Development of a Repeatable Hidden Fire Source – S. Le Neve (CEAT)

Fire behavior of structural composite materials – focus of today's presentation is hidden fire damages in in-flight fires. A repeatable hidden fire source is needed to expose a large surface of the test samples. CEAT is developing a repeatable hidden fire source based on the FAA foam block fire source characteristics assuming that these characteristics are representative. CEAT performed several tests to characterize the foam block fire. Many tests were performed to verify the repeatability of the fire source. CEAT built an experimental gas propane burner. Serge reviewed the test results including results of many comparative damaging tests that were conducted by CEAT. He showed photos of the design and configuration of the propane burner. A damaging test on an aluminum plate was conducted. The fire source was close to the FAA fire source wind tunnel test (under static conditions). 45-degree test results were reviewed. Conclusions: the gas fire source at 6" demonstrates the same characteristics as the FAA foam block fire source at 3". Next: run the first fire test and the mechanical characterizations after a fire exposure, to define the other various scenarios of exposure, to define the test procedures for under load fire test, and to run fabrication of various composite materials to be tested. Part of the reason for developing this fire source is

the large number of tests CEAT must conduct and to create a test that damages an area larger than the foam block test.

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

Do composite skinned aircraft require more agent to control external fire and facilitate evacuation? External Fire Control Defined: extinguishment of the body of external fire – our question: will the composite skin continue to burn after the pool fire is extinguished? John described the actual test set-up. A diagram of the location of the 5 thermocouples was presented. The testing is being conducted in two stages. We are in stage 1 of testing now. Ogden ALC at Ogden AFB has supplied composite panels for the tests. First stage of testing: attachment and placement of thermocouples and method to secure panel had to be adjusted. John showed video of Air Force Carbon Fiber 12"x18" panel test. Results: based on thermocouple data, the average temperature on the backside has been 653.1°F in a range from 599.8°F to 720.8°F. Graphs of the results were presented. FLIR images show panel surface is not one uniform temperature as the temperature increases. Longer exposure times inflicted heavy damage on the panels – longer exposures burned out almost all of the resin, backside has hard 'crunchy' feel. Shorter pre-burns showed some flaming combustion after exposure. Moving Forward: need to perform more repetitions at various intervals, 10 min, 1 min particularly, will perform at least 2 tests with the addition of a fan to simulate driven wind conditions. Anyone interested in participating in this Task Group contact John Hode at SRA at John_Hode@sra.com. Peter Busch asked if any tests had been conducted with an insulation blanket behind. Tests including an insulation blanket have not been conducted yet.

NexGen Burner for Seat Cushion Fire Testing – R. Ochs (FAATC)

Lack of availability for seat cushion fire testing has resulted in the need for a readily available burner. FAATC is investigating configuring a NexGen burner to achieve seat test performance similar to a Park burner calibrated to the standards set in Chapter 7 of the *Aircraft Materials Fire Test Handbook*. Rob reviewed the results of the tests Dung Do of the FAATC conducted using NexGen burner for seat tests. Seat test results vs. Inlet Air Pressure: photos of seat cushions tested at various psi (30-56 psi) were presented. Bar graph of comparison of NexGen burner with seat round robin of 2006 was presented. Summary: the NexGen burner was able to achieve temperature calibration and has compared well to results from seat test round robin described in DOT/FAA/TN06/55.

Use of NexGen Burner for Firewall Tests – R. Hill (FAATC)

FAA certification engineers met and the question of the flammability test for engine hoses and parts came up. FAATC is starting a project developing the use of the NexGen burner for components on engine (hoses, etc.).

Task Group Meetings:

Session 1:

Magnesium
Burnthrough & PIV
RTCA
Harmonization (Standardization) of Flammability Requirements
Composite Firefighting Issues

Session 2:

Restraint of Leather Seat Cushions
In-Flight Flammability of Composite Structures
Wiring/Ducting

THURSDAY, OCTOBER 22, 2009

Task Group Reports:

Magnesium Alloy Task Group – T. Marker

Magnesium Alloy Flammability Task Group Meeting Minutes October 21, 2009

During the general meeting the FAATC described the results of the most recent full-scale baseline test (baseline 3) they had conducted using standard, aluminum-framed, OEM seat structures. The purpose of this test was to establish the current hazard level during a typical postcrash fire accident scenario. A subsequent test using WE-43 magnesium-alloy seat structures was also conducted to determine if there was an increase in the overall hazard level as a result of the magnesium alloy material. This test was also described in detail. Photos and video of both tests were shown.

During the Task Group session, the full-scale results were discussed in further detail, with additional discussion of the upcoming test using the poor-performing AZ-31 magnesium alloy. The new seatback configuration used in the baseline test (baseline 3) resulted in a satisfactory test condition that was not expected to mask the performance of the magnesium alloy components during subsequent tests. By extending the time of the test during baseline 3, the primary seat structure components were exposed to the heat from the fuel fire for a longer period, thereby inducing more melting of the primary structure, which was the intended outcome. The increased performance of the newly designed seat back also enable a longer viewing time prior to smoke obscuration.

Additional items discussed during the Task Group session:

Planned Tests. The agreed-upon plan is to conduct the next full-scale test using the AZ-31 mag-alloy in the primary seat components during the first week in November, 2009. Visitors interested in witnessing this test were advised to contact Tim Marker for specific details. It is anticipated that additional ignition and burning of the primary components will result during this test. A final test using a good-performing (WE-43) mag-alloy in additional seating components is also scheduled following the AZ-31 test. The intention of this test is to use WE-43 mag alloy to form the seat back frame and lower baggage bar, in addition to the primary components.

Test Details. For the purposes of having a good comparison between the baseline test and the subsequent magnesium-alloy tests, it was agreed at the previous meetings that water would be used in all tests, not just the magnesium-alloy tests. This would be accomplished using both a deluge nozzle positioned to knock down the cabin fire, and an additional stream nozzle aimed directly at the seat in the fire door. After discussing this plan again, it was determined that more useful information might be gained from the test by allowing a 5-minute observation period following fuel fire extinguishment. For the mag-alloy tests, there are several possibilities that may exist during this observation period. For example, the fire could either be self extinguishing/diminishing without intervention, or conversely it could be increasing in intensity. Another possibility is it lies somewhere between these 2 extremes. The task group members agreed that useful information could be gained by not initially applying water to the cabin interior immediately following fuel pan extinguishment. Water application could be performed during the 5-minute observation period in the event the fire is obviously increasing in intensity, or there are visible signs of magnesium-alloy ignition. If it is difficult to determine if the fire is increasing in intensity or decreasing, water could be applied after certain parameters are met, for example increasing cabin temperature or seat frame temperatures.

During the baseline 3 test, the external fire was allowed to burn for 5 minutes, at which point it was extinguished using AFFF (foam) according to plan. The interior fire was permitted to burn for an additional 5 minutes (10 minutes from pan fire ignition), at which point the water nozzles were activated to flood the interior. This sequence was repeated for the WE-43 mag-alloy test. In both of these tests, flashover and

incapacitation were reached at approximately 4 minutes 30 seconds to 5 minutes. In the planned AZ-31 test it is anticipated that flashover would occur at roughly the same time period, or perhaps a bit sooner due to the potential of increased burning of materials as a result of the ignition of the mag-alloy (incapacitation would occur in roughly the same time frame). It is anticipated however that increased ignition and burning will occur during the post-fuel-fire observation. During this observation period, a determination will be made as to when the water nozzles will be activated to fight the interior fire.

Oil Burner Testing. As agreed upon at the previous task group meeting, lab-scale oil-burner tests will be conducted on the finalized seat configuration, which utilizes a fire-blocked cushion in the seat bottom, and a fire-hardened foam in the newly-fabricated seat back. This will involve a minimum of 6 oil-burner tests, since the requirement calls for the bottom and back cushions to be run independently. It will also require the FAATC to obtain block sample representations of the cushion system used in the seat bottoms. If block samples of the bottom cushion foam are difficult to obtain, it may be necessary to simply run the completed configuration in the oil-burner test as is. This was the methodology used to evaluate the cushion materials used in the first two baseline tests.

Standardization Task Group

Team Leader Updates:

Overall Task – M. Jensen

This was the third meeting of the entire team. Potential approaches and what types of data would be necessary to address each of the items in the bonded items category (ie: bonded trim strips).

Color and Texture Similarities of Decorative Tedlar Laminates – M Miler

Most of our discussion focused on the definitions in the memo regarding what items are included in this category. We tried to get an industry group consensus on what we think the memo refers to. We looked into who already has some test data that would substantiate some of these items.

Colors of Paints – I. Weichert

The wording of the memo needs some interpretation: clarification of terms especially including chemistry of paint at the manufacturer level. We will evaluate existing test data to see what we can use from previous test data. This may be difficult since most of this testing may have been done without recording the paint layer signas. We assume it may not be sufficient to evaluate existing test data, we may conduct some tests. We will investigate to see if there is a difference between organic an inorganic ingredients in the paints.

Panels General – D. Slaton

Bunsen Burner Test – no need to investigate

Heat Release – may be a need to standardize cross-industry, will investigate, this discussion is ongoing

Items 2 & 24: Item 2: definitions of included items in category will be investigated

Thickness range table – heat release – can there be a tolerance band on the thicknesses? Under investigation.

Thermoplastics - does this criteria apply to thin films? This will be clarified.

Item 24: thermoplastics – there is a proposal to pull thermoplastics out and refine it (thickness range, etc., investigation).

Item 42: bonded inserts: we will put together a proposal on the bonded inserts. Is there a parallel activity on how to qualify the material itself? How does this fit in with small part criteria and figure out if there is any testing required to go along with this support.

Edge Fill (Items 33 and 43) – P. Zimmerman

How will these configurations be burn tested? We are requesting data to see how labs test these items. Tab ad slot and mortise and tenon – what test data is available? We talked about the configuration for the heat release test.

Fillers and Potting Compounds – T. Marker

There may be two tests: one for fillers and one for potting compounds.

Burnthrough Task Group – R. Ochs

The discussion focused on the NexGen burner and its use for seat tests and propulsion tests. The propulsion tests research will fall under the work of the International Aircraft Systems Fire Protection Working Group. The NexGen burner is in the Appendix of the AC. It may eventually be included in the *Aircraft Materials Fire Test Handbook*.

RTCA Task Group – P. Cahill

The group agreed to address the issue of the smaller thermoformed parts inside the electronic enclosure and what to do if there is not a standard 3x12-inch size sample.

Restraint of Leather Seat Cushions – J. Davis

There was some discussion on status of testing. We will do some additional hook and loop testing. Please join our yahoo group if you have any input on this Task Group and its activities. We are working towards finalizing and making one recommendation.

NBS/OSU Update – M. Burns (FAATC)

NBS Photometric System Round Robin Results – Mike described these filters. 20 labs participated (24 NBS Chambers), ND2, ND4, ND8, ND8+2, and ND8+4 Filter Data was reviewed. Going forward: each lab will receive its lab code and a follow up study to see what the furnace is doing with a non-flaming test.

Chapter 5 Update to the *Aircraft Materials Fire Test Handbook*: Paragraph 5.6.6. See *Handbook* Chapter 5 on FAA Fire Safety website for update effective 9/29/2009.

Flammability Test Method and Criteria for Aircraft Electrical Wiring – J. Reinhardt (FAATC)

Comments and questions from the Task Group were incorporated into the test method. Scope: To determine flammability characteristics of aircraft electric wire insulation and materials used to provide additional protection to wires. Details of the test apparatus were provided. John presented schematics of the single and triple calorimeter fixture. Test Specimens: John reviewed the preferred specimens, specimen lengths, specimen diameter, specimen conditioning, test procedure, report, and requirements (acceptance criteria). John presented results of electrical wires/cable tests conducted. He is looking for labs to participate in a Round Robin and a one-day workshop prior to the start of the Round Robin. Contact

John if your lab is interested in participating. Chris Bresciano: this test does not address the testing of small wire specimens and the use of the micro-scale calorimeter. John: the belief is that that is new wire, and there should be plenty to test. There was some discussion regarding the sleeve material. There were a number of questions related to wires from specific areas and their testing. There was some concern from industry regarding the materials included under this test method. Dick indicated that the purpose of this test method is to raise the level of safety to the block of foam type requirement for everything that would be in an accessible area. This is what the FAATC was tasked to do by the FAA Transport Airplane Directorate.

Aircraft Ducting Flammability Test Method Precision Analysis – J. Reinhardt (FAATC)

Round Robin Results: 11 samples were tested in this Round Robin. The radiant heat panel test was used. ASTM-691-99 Analysis was used. Final Comments: Purpose per ASTM-691-99 to develop the information needed for a precision statement pertaining to both within-laboratory repeatability and between-laboratory reproducibility. Some of the critical values were exceeded – labs #3 and #4 were contacted to determine source of within-lab imprecision (ie: specimen placement, material fabrication variability, burn length measuring technique, AFET reported decimal place). Lab #3 re-tested, lab #4 did not respond. John reviewed the conclusions – error sources need to be considered. Is the ASTM approach going to be adopted for future FAA round robins? John said he would like to use this approach, but he cannot speak for the other project managers in FAATC Fire Safety.

Response to Aircraft Ducting Working Group Members' Questions – J. Reinhardt (FAATC)

Two letters were received regarding the ducting test method. John presented the questions raised in these letters and the FAA response to these industry questions.

Heat Flux Sensitivity Study in NBS/OSU/RP Seat Test – R. Hill (FAATC)

FAATC recently received calorimeters with NIST calibration. 4 gages were purchased from Medtherm, Vatell, and Hukseflux,. The gages were calibrated by comparison to a NIST calibrated HFG. The transfer method was made using a heated graphite plate. FAATC then had 2 calibrations – from manufacturer and as transferred from a NIST transducer. Dick described the Heat Flux Sensitivity Study plan for these devices. For each gage, the manufacturer's calibration factor was found to be higher than the NIST calibration factor. Results of materials tested in NBS Chamber and OSU were presented – 3 materials tested. Seven materials were tested in the radiant panel. FAA compared Rule and Handbook methods to determine which would have the most affect. Summary is available on FAA Fire Safety website in Presentations section for this meeting. Where do we go from here? The Gardon gage transducer is more accurate for measuring radiant heat. We hope to have a calibration procedure that can be used by the manufacturers by the next Materials WG meeting. And, remember to clean your transducers! This is a quality control issue. Question: In the meantime what are we supposed to be doing – FAA would like you to use a transducer calibrated to the NIST standard. Assess what you have and what you have been doing. Mike Burns will calibrate it to the NIST calibration for you – contact him regarding this. This is a transition time for labs to find out where they are and to know that this is still under investigation until FAA has sorted out this problem.

IAMFTWG Announcements – A. Horner

2010 Sixth Triennial International Aircraft Fire and Cabin Safety Conference

The conference will be held at the Tropicana Hotel Casino in Atlantic City, New Jersey, USA, October 25-28, 2010. There are seven (7) opportunities for Refreshment Break Sponsors. Sponsors will have an opportunity to provide a Powerpoint containing a short video marketing/advertising piece that will be shown in each breakout room and on a large monitor in the Conference Registration Area during the break they sponsor.

Next Meeting

The next meeting will be held March 3-4, 2010, in Renton, Washington.

The summer meeting will be held in June 2010 in Cologne, Germany. April will send an email to the WG distribution list once the meeting dates are confirmed.