INTERNATIONAL AIRCRAFT MATERIALS FIRE TEST WORKING GROUP MEETING

MARCH 4-5, 2008

Hosted by EMBRAER at Novotel Hotel, Sao Jose dos Campos, Brazil

TUESDAY, MARCH 4, 2008

EMBRAER Welcome: Mr. Antonio Vitorazzo

Development of a Next Generation Oil Burner for Testing Thermal Acoustic Insulation Burnthrough Resistance – R. Ochs (FAATC)

Background: The final rule on thermal acoustic insulation burnthrough was issued in August 2003, but the compliance date was delayed until September 2009.

Diagram of NexGen Burner identifying all parts of burner.

Schematic of the Pressurized Fuel System

Main goal to match parameters of Park Oil Burner

Graphs of Air Velocity Observations and Fuel Temperature Observations

Diagram of Heat Exchange System

Burner Operational Parameters:

Fuel: Type JP8, Jet A or equivalent
Nozzle: Monarch 5.5 gph 80 degrees PL
Pressure: 120 psig (+/- 2)

Flame Temperature Measurement Graph
Proof of Concept: RRVIII-Material A
Proof of Concept: RRVIII-Materials B
Repeatability-Relative Standard Deviation

Summary of Concept Phase:

A burner can be fabricated from easily obtainable parts and materials.

Construction and Calibration of Multiple Burners:

Construct 10 identical burners to show reproducibility, package and ship to a participating lab, conduct tests to show repeatability

List of labs that currently have a NexGen burner

New Blanket Holder:

Diagram and photos of Picture Frame Blanket Holder, photos of tests conducted using Picture Frame Blanket Holder, Initial Results reviewed

NexGen Comparative Test Results and NexGen Repeatability
Material Averages Chart
Overall Reproducibility Chart
Summary of Results:

Overall, the picture frame test method was useful in determining if burners are performing properly at different locations.

The test method was found to be more repeatable and reproducible than when testing the same materials on the original blanket holder.

Near-Future Work:

Set up and administer a picture frame round robin test with all NexGen burner labs with tight control.

Muffled Muffler: Reticulated foam in muffler made a huge difference in the noise output of the sonic burner. Rob described this installation.

Thermal Acoustic Insulation Blanket Comparative Testing:

Boeing created 3 types of thermal acoustic insulation specimen samples: Material A, B, and C Results of these tests were presented and explained.

Summary: The NexGen burner performance was proven to be similar to that of the FAA Park Oil Burner. The burner was shown to perform similarly when moved from one lab to another. Multiple burners were constructed.

Rob has written an FAA Tech Note "Development of a Next Generation Burner for Use in Testing Thermal Acoustic Insulation Burnthrough Resistance". It is currently in the editing phase at the FAA Tech Center and will be available on the FAA Fire Safety Website in the "Reports" section once it is approved and finalized.

George Danker (Unifrax): Is there advisory circular material on rogue material failures when testing with the sonic burner? Jeff Gardlin (FAA): If you find yourself in a situation where one of the samples fails before 4 minutes and you believe that material is usable, there are some instructions in the AC on how to proceed. The deviation from procedure is explained in the AC. A lab can propose a modification in their test plan, but be sure there is a prepared test plan that includes all details/information on the modified test plan.

George Danker: Is there somewhere where the draft AC can be viewed? Jeff: There isn't a location where the draft AC can be found. The FAA no longer publishes them in the Federal Register. Jeff will look into posting a link to the draft AC on the Materials Page of the FAA Fire Safety website.

<u>Particle Image Velocimetry: Explanation of Methodology and Planned Materials Fire Safety Research</u> – R. Ochs

What is PIV and how does it work?
Particle Image Velocimetry (PIV) is a whole-flow-field visualization technique that provides instantaneous velocity vector measurements in a cross-section of a flow.

PIV for Fire Safety:

Material Fire test methods involve burners, and burners are driven by fluid-thermal processes. Insight into the fundamental burner parameters will lead to optimization of these parameters. With modern materials processing technology and increased levels of industrial quality control, a more clearly defined level of failure is desired so that manufacturers can design to a specific level of safety. Analysis of post-crash fuel fires. PIV also has applications in systems fire safety research.

Photo of FAA Fire Safety's PIV Laboratory and description of set-up.

Aquired Data – Fuel Nozzle: Initial images of results were shown an explained.
Acquired Data – Burner Air Flow: Initial images were shown.

Future PIV Work:

Refine PIV Skills
Create test matrix for oil burner
Perform measurements
Analyze data
Use knowledge to determine critical burner parameters
Optimize burner parameters to provide more accurate results

Does anyone have questions/suggestions on what else to use PIV for?

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

Growing popularity of magnesium use in automotive industry
Renewed interest in commercial aviation
Current SAE/FAA ban on use of magnesium in seats

Benefits:

Magnesium is very lightweight (seat frames)
Very machinable

Disadvantages:

Flammability
Corrosion

What are fire threats of magnesium alloy use in the cabin? Inflight fire (hidden areas, wiring, insulation, ducting) and postcrash fire.

Magnesium Alloy Flammability:

Inflight:
Electrical arc to magnesium component
Hidden fire adjacent to magnesium component
Oxygen canister next to magnesium component
Consider terroristic threat from magnesium shavings?

Postcrash:

External fuel fire entering cabin
Primary concern: safety of passengers
Secondary concern: safety of firefighters

Development of an appropriate lab-scale test method:

Clearly define threats

What has been done?

Initial lab scale “Fact-Finding” Experiments have been conducted at FAATC lab.
Oil burner testing
Handheld extinguisher testing
Miscellaneous “can-I-get-this stuff to burn” testing

Diagram of Initial Oil Burner Testing of Magnesium Alloy test set-up/Photo of test set-up

Graph showing results of Mag Alloy Tests Using Oil Burner

Findings of Oil Burner Testing:

None of the magnesium bar samples melted prior to 2 minutes
Extending exposure time beyond 2 minutes caused melting and ignition
78% of samples (18 of 23) continued to burn after burner flame was removed

Critical Elements of Postcrash Lab Test for Magnesium

Flame duration/exposure time
Size, shape, thickness of sample
Orientation of sample
Time to reach melting

Handheld Extinguisher Testing of Magnesium Alloy Samples:

Photo of test set-up with Halon 1211 extinguisher

7 tests conducted on ignited mag-alloy samples

Magnesium Alloy Flammability:

Preliminary lab scale fact-finding testing
Handheld extinguisher testing
Define critical elements of preliminary testing
Conduct full scale test using mag-alloy seat frames
Develop lab scale test based on full-scale results

Proposed Testing at FAA Tech Center:

Full-scale Postcrash Fire Testing (3 testsI)

Baseline using OEM aluminum frames, FB seat cushions
Subsitute poor-performing mag alloy for aluminum frames

Outcomes:
Determine if any difference exists between 3 scenarios
Determine if difference exists between mag alloys

Development of lab-scale test based on findings/outcomes of full-scale tests.

Interim Task Group Meeting at FAATC (Feb. 2008):

Attended by representatives from seat manufacturers, airframes, and mag-alloy supplier
Discussed proposed mock-up seat, advantages, drawbacks, how realistic is it?
Consensus was that full-scale tests are obvious next step
New proposal to use an actual aircraft seat in full-scale testing
Conduct 4 full-scale tests

Consider 'good' performing mag-alloy, which alloy should be used?
Certification based on material type?
Interaction of other materials (Feedback)
Impact of using water on burning mag-alloy seats? Impact on CFR crews?
Effect of block seats vs. fire hardened foam (unblocked)?
Proposed AZ31 for poor performer, WE43 for good performer
Baseline test could be performed by June 2008

Future Considerations:

A full-scale test would help define an appropriate lab-scale test method or methods, which is the primary goal of the research.

Manufacturer's perspective necessary to determine value of developing new test methodology.

SAE Aircraft Seat Committee Magnesium in Seats Update – B. Gwynne (Magnesium Elektron)

Bruce provided information on the SAE Standard AS849 rev A "Performance Standard for Seats in Civil Rotorcraft, Transport Aircraft, and General Aviation"

This SAE Standard feeds into FAA – TSO-C127, Rotorcraft and Transport Airplane Seating systems.

Magnesium Elektron has been an active member of this SAE Committee since January 2007.

Bruce reviewed the points of the presentation he gave at the January 2008 SAE Committee meeting. He explained the questions he posed to the SAE Committee.

Regarding Full-scale Testing Question:

Concerns regarding proprietary seat designs and distribution of project cost stymied open discussion at this point. A Task Group meeting was held at the FAATC with some of the manufacturers' participation in February 2008 to settle some of these concerns.

This SAE Committee meets three times per year.

Fire Behaviour of Magnesium Alloys – CEAT Testing – S. LeNeve (CEAT)

Synthesis of work performed at CEAT for aircraft suppliers

The tests were performed on 8 alloys (with or without protection layer).

Serge described the conditions the test specimens were exposed to during the tests.
Serge presented results of WE43 and Elektron 21T6 tests. Laptop specimens were also tested.
Results of the following tests were presented and explained:
Heat Release Test Chamber (OSU): Test on AZ91 samples with black paint
Oil Burner Tests – small scale tests (Stema Aero Seat/EADS-IW/Meridian) Photos were presented.
Serge showed videos of some of the tests – samples with and without intumescent paint.

A real scale seat test was performed on a TGV Seat (French high-speed train). Serge described the composition of the test specimen. He reviewed the test results for the group and showed video of the tests. Post-test seat photos were shown. To note: There was no fire propagation on MG outside of the flame impingement.
Conclusions:

Ignition under the seat cushion test conditions with an extended flame time)
Ignition (thickness <0.9 mm) under the heat release test conditions (OSU)
No ignition (thicknesses >1.2 mm)

The ignition of MG alloys occurs when the T of the test sample is close to the melting point (600 degrees C). Magnesium is a good conductor of heat.

In-flight fire: except in case of Hidden fire, the usage of magnesium alloys inside cabin is probably not a factor of risk.

A massive usage of magnesium alloys could e a factor of risk for passengers.

Development of a Lab-Scale Test for Evaluating Toxicity of Burnthrough Compliant Insulation Systems – T. Marker

Burnthrough resistant thermal acoustic insulation materials: FAA issued NPRM, 2003 Final Rule issued, compliance delayed until 2009.

Pending: determine concentration scaling factor between la and full-scale tests in order to develop appropriate pass/fail criteria for lab-scale test.

Diagram of Apparatus for Evaluating Toxic Gas Decomposition

Schematic of FTIR and THC Sampling System Use in Lab-Scale Testing

Material Systems Tested in Lab-scale Apparatus:
PAN/Metalized PVF, Advanced Composite Material, FG/Ceramic Barrier/Meatlized PVF

Comparison of FTIR and Gas Analyzers for Open Box (Baseline) Test chart shown.

The report “Development of a Laboratory-Scale Test for Evaluating the Decomposition Products Generated Inside an Intact Fuselage During a Simulated Postcrash Fuel Fire” written by Tim

Marker and Louise Speitel should be available on the FAATC Fire Safety website in the next few months.

Full-scale Test Article for Evaluating Toxicity of Burnthrough Compliant Insulation Systems and Non-Metallic Fuselage Structure

Photos and Results of the Full-scale Test Results for PAN Insulation System, Ceramic Barrier Insulation System I, Ceramic Barrier Insulation System II (modified configuration), and Structural Composite System.

What do we do with all this data?

Determination of Full Scale Test Article Volume
Determination of Gas Concentration Scaling Factor

Development of an In-Flight Fire Condition for Evaluating Performance of Composite Skin – T. Marker (for Harry Webster, FAATC)

Hidden/Inaccessible areas. Composite material may not be capable of dissipating heat from an in-flight fire, causing elevated temperatures in the crown area.

Photo of high speed test section.
Tim described the Test Design.
Fire source selection.
Jet Fuel Pool Fire Configuration Photo
Instrumentation description.

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

There is a need to evaluate the fire properties of a composite fuselage (burnthrough, toxicity, in-flight burnthrough, and flame propagation)

Evaluation of Flame Propagation Risk:

An intermediate scale test was performed using the foam block fire source.

Radiant Panel Test Apparatus:

The radiant panel test is very useful for evaluating flame propagation tendencies for materials. Material thickness and thermal conductivity play a role in this test. Test parameters must be adjusted for composite materials of various thicknesses.

Status:
Work is in the initial phase right now.

Task Group:
FAATC would like to form a Task Group to obtain input from members, etc.
If you are interested in participating in this Task Group, please contact Rob Ochs at Robert.Ochs@faa.gov.

Development of a New Flammability Test for Aircraft Ducting – T. Marker (for John Reinhardt – FAATC)

Systems of interest in the hidden area include thermal/acoustic insulation, aircraft ducting, wiring, etc.

12-second vertical Bunsen burner test did not provide realistic results.

Video of Intermediate Scale Fire Test New Fire Threat vs. 12-Second Vertical Bunsen Burner video (was a poor screener for these materials)

Publish Test Method: Final report DOT/FAA/AR-08/4 was published February 11, 2008. The report is available on the FAATC Fire Safety website (http://www.fire.tc.faa.gov) in the Reports section.

Development of an Improved Fire Test Method and Criteria for Aircraft Electrical Wiring – T. Marker (for John Reinhardt – FAATC)

Video of Flammability Test of Riser Cable
Planning Process – Tim ran through John's project plan.
A list of the aircraft-grade wiring John will be testing was presented.

John's milestone for publication of test method is June 2009.

Anyone interested in joining this Task Group, please contact John Reinhardt at 609-485-5034 or John.Reinhardt@faa.gov

Update on NBS Smoke Chamber – T. Marker (for Mike Burns – FAATC)

2007 Independent Mini-Study: Follow-on Mini Study being conducted to investigate why results were so variable. One international and 6 domestic labs participating.

Site inspections uncovered several issues that may have affected the outcome of past tests: Including furnace defects, alterations of equipment, OSU 'cold' inspection issues, OSU 'hot' inspection issues, furnace defect (a "dark" eye in the center of the furnace even after calibration), and use of alternate equipment in some smoke chambers (changes to furnace, non-sanctioned Heat Flux measuring devices).

Scott Campbell mentioned that he has had discussions with Mike about creating an inspection sheet. Tim mentioned that Mike addresses this in a later slide.

Mini Study findings should be completed and submitted to Mike Burns by June 1, 2008.

Contact Michael Burns at Mike.Burns@faa.gov, or via telephone at 609-485-4985.

Chapter 6 of the Aircraft Materials Fire Test Handbook is currently being updated/reviewed. Comments on Chapter 6 will be accepted through July 15, 2008.

Chapter 5 of the Aircraft Materials Fire Test Handbook will be updated next.

WEDNESDAY, MARCH 5, 2008

Task Group Meeting Reports

Magnesium Task Group – T. Marker

The Task Group reviewed the 4 full-scale tests that will be conducted. Tim will summarize the test sequence and send it out to the Task Group members in the near future. Do we want to install water deluge heads inside to see what kind of reaction we get when the fire is hit with water.

Burnthrough Task Group – R. Ochs

We discussed rogue failures and how they are addressed in the Advisory Circular. Some people feel that they can let them run for an indefinite amount of time. Some members are concerned about being able to view draft Advisory Circulars and maybe a link could be created on the Fire Safety website. We also discussed keeping up with round robins to keep labs in check. May look into a standard thermal acoustic insulation blanket. We talked about timing for picture frame round robin.

NexGen Burner for Seat Testing – R. Ochs

Procedure:
Matching Air Velocity
Matching Fuel Flow Rate
Matching Calibration

Work to be Completed:

Side by side comparison between a properly calibrated Park oil burner and the NexGen burner
Enter the NexGen burner into a possible future round robin

The FAATC still gets calls from labs wanting to set up a seat lab. That's why this is so important.

Formulation of New Task Groups – T. Marker

Current Task Groups:

Burnthrough
Magnesium Seats
Contamination

Possible New Task Groups:

Wiring Task Group

International Seat Test Round Robin Final Results – T. Marker (for Pat Cahill – FAATC)

Background:
Request from industry and the ACOs to review the aircraft seat flammability test

3 Materials Tested:

Fire Hardened Foam 1
Fire Blocking Layer
Fire Hardened Foam 2

List of participating labs was reviewed.

Final Results of International Round Robin:

Comparison of Test Methods:
Testing per rule or testing per Handbook

Test Method, Lab Equipment and Fuel Differences Used at Participating Labs

Pass/Fail criteria were reviewed.

Horizontal Fire Blocking Layer Cushions: Hook and loop closure strips and blocking layer were breached leaving the polyurethane foam exposed to the flame. Photo of this phenomenon was shown.

6 labs failed Fire Hardened Foam 1
11 labs failed Fire Blocking Layer
15 labs failed Fire Hardened Foam 2
Labs D, L, M and S failed all samples

There is no correlation in the pass/fail data among those labs that run according to the Rule or the Handbook.
The majority of failures reported by all of the labs were due to weight loss.

Scott Campbell: Did she put together any graphs correlating pass/fail data for labs using tabs?
Tim: She can do that.

Thomas Ohnimus: Will the authorities or participating labs be receiving any data/feedback on the results of the round robin? And, will the participating labs be receiving a copy of this presentation?
Tim: This presentation will be available on the Fire Safety website with the Minutes and other presentations from this meeting.

Bunsen Burner Testing of Seat Cushion Materials – T. Marker

Why is Vertical Bunsen Burner testing of seat cushion materials still required?

Reason: Untreated foam was banned in the state of California

Jeff Gardlin: Generally speaking, in principal that's the reason. There was a desire to have some type of screening tool for what was inside the fire-blocking layer.

Chapter 1 of Aircraft Materials Fire Test Handbook indicates specimen thicknesses and Supplement 1 indicates burner placement. Section 1.6.2.4 of the Chapter 1 Supplement also discusses Placement of Burner.

Diagram of layers of recent example brought to the attention of the FAATC.

What about a sample with 3 or 4 different foams? If you center the burner under the front face or back face of the sample, you are not involving the foams in the center of the sample. Scott Campbell: We also center the vertical Bunsen burner under the center of the sample. Jim Davis: We also do the same for samples over 1-inch thick. The reason we also test the middle, because the adhesive is usually the most flammable part of the specimen.

Update on Advanced Materials – Fire Research – T. Marker (for Rich Lyons – FAATC)

Goal of Fire Research Program is to develop a fire proof cabin and mitigate post-crash fires by providing >10 minutes of escape time (10X lower heat release)

Fire Research Projects:

Fireproof cabin
Ultra fire resistant non-halogen plastics
Flammability of cabin structures

Microscale calorimeter was developed by Rich Lyons is now an ASTM standard, April 1, 2007. It measures heat release of mg samples. The microscale calorimeter is able to test microgram size specimens of the ultra expensive materials.

FY08/09 Planned Activities:

Demonstrate halogen-free fire smart thermosetting resin for sidewall panels

FY07 Accomplishments:

Low Cost Building Block for Family of Environmentally friendly Halogen-Free, Fire Smart Plastics (patents pending) Material: BHDB

Large area transparencies must comply with 14 CFR 25 Heat Release Rate Test

Transparent plastics:

The FAATC Fire Research group has collaborated with GE Plastics to develop non-halogen transparent plastic that meets Boeing service requirements and FAR flammability for new 787 aircraft.

Next Generation Aircraft Structures (787, A380)
Goal: Equivalent Level of Fire Safety

Diagram of BMS 8-276 Composite for B787

Conference Feedback/Fire Safety Website – A. Horner (SRA International)

April asked the attendees for feedback on the 2007 International Aircraft Fire and Cabin Safety Research Conference held in Atlantic City, New Jersey, October 29-November 1, 2007. She indicated that the conference proceedings are now available on the Fire Safety Website and welcomed comments/questions from the attendees on future conference locations, timing of

conference-related information/location details, etc. An inquiry was made regarding the location of the future conferences. April explained that the location must be related to the location of one of the sponsoring international aviation authorities (Atlantic City – FAATC, Lisbon – JAA/CAA). For example, the conference would probably not be held in Orlando, Florida (for example), since the three sponsoring FAA offices are not located in Florida.

If you are cannot access the Fire Safety website (www.fire.tc.faa.gov), please contact the web designer, Mike Donio at Michael.CTR.Donio@faa.gov and request that the port be opened. You will need to provide your IP address in order for Mike to make this request to the IT group at FAA Headquarters.

April provided some information on the location of the International Aircraft Materials Fire Test Working Group information on the Fire Safety website. She also sought questions/feedback from the attendees related to the Working Group. A request was made to have the meeting agendas available as early as possible.

Is anyone interested in hosting a 2009 Materials meeting? The "Meeting Host Form" is available on the Fire Safety website or you can email April for it at April.CTR.Horner@faa.gov.

Please send any additional questions/comments related to this presentation to April.

Next Meeting:

Mid-June 2008
Co-hosted by Unifrax, Accufleet, and Evonic
Niagara Falls, NY, USA

Federal Aviation Administration Website (http://www.faa.gov) – Jeff Gardlin

Advisory Circulars open for comment can be found in the 'Aviation Safety Draft Documents Open for Comments' section of the FAA website. Jeff emailed the attendees the link to this section of the website.