International Aircraft Materials Fire Test Forum Meeting

Short Takes and Current Projects

Presented to: International Aircraft Materials Fire Test Forum, Savannah, GA

By: Tim Marker, FAA Technical Center

Date: March 5, 2019
New Name, Same Group

We are now:

International Aircraft Materials Fire Test Forum (IAMFTF)

Previously:

International Aircraft Materials
Fire Test Working Group (IAMFTWG)
The Fire Test Handbook can be considered a living document, which can be edited and updated as new information becomes available. Some of these updates are simple corrections that are discovered with wording, terminology, or unit conversions. Other updates are procedural in nature, in which the execution of the test or the test arrangement or apparatus is improved.
Red Line Process Example

Revised Text

Date

Chapter 7

7.2.6 Percent Weight Loss
The percentage weight loss for a seat test sample is the prettest weight of the seat test sample less the posttest weight of the seat test sample expressed as the percentage of the prettest weight. All droppings falling from the seat test sample and test sample mounting frame are to be discarded prior to determining the posttest weight.

7.3 Apparatus
7.3.1 Test Sample Apparatus
The test sample apparatus includes the seat test sample mounting frame and drip pan. The arrangement of the test sample apparatus is shown in figures 7-1 and 7-2.

7.3.1.1 Test Sample Mounting Frame
Fabricate the sample mounting frame for the seat test sample from 1 by 1 by 0.125 inch steel angle and 1 by 0.125 inch steel flat stock as shown in figure 7.1. The dimensions listed for the test sample mounting frame are all inside measurements. The frame’s upright section used for mounting the vertical assembly must be 14.125 ± 0.125 inches long and 18.125 ± 0.125 inches wide. The frame’s bottom section used for mounting the horizontal assembly must be 18.125 ± 0.125 inches wide and 22.125 ± 0.125 inches long. The vertical and horizontal mounting surfaces should have two supporting braces made from 1 by 0.125 inch steel flat stock. The centers of the flat stock braces are 6 ± 0.125 inches measured from the outer edges of the steel angle on the left and right sides of the frame. Four legs fabricated of 1 by 1 by 0.125-inch steel angle, and 12 ± 0.125 inches tall, are located below the four corners of the horizontal assembly mounting section of the frame. All connecting joints of the stand are welded and the flat stock components are butt-welded. The test sample mounting frame is used for mounting the seat test sample horizontal and vertical assemblies. The position of the test sample mounting frame relative to the burner cone during testing must be positioned as shown in figure 7-2.

7-2 (October 2017)
Red Line Process for Updating Fire Test Handbook

(Cont’d)

With the exception of minor corrections to spelling, wording, or incorrectly converted units, all changes must first be discussed during International Aircraft Materials Fire Test Forum (IAMFTF) meetings, which are held three times per year.

All changes will remain in red text for a minimum period of 6 months, to allow sufficient time for review and discussion at IAMFTF meetings. Following the 6-month discussion period, if there are no objections, the change will be made permanent with all strikethrough removed, and red text changed to black.*

*Please note the previous version of the Handbook chapter will remain current until the revised chapter becomes permanent. This may require more than a 6-month period, to allow for additional experimentation and discussion.
Chapter 24 Updated in September

Chapter 24 Test Method to Determine the Burnthrough Resistance of Thermal/Acoustic Insulation Materials

24.1 Scope

24.1 Applicability

Use the following test method to evaluate the burnthrough resistance characteristics of aircraft thermal/acoustic insulation materials when exposed to a high intensity open flame.

24.2 Definitions

24.2.1 Burnthrough Time

Burnthrough time means the time, in seconds, for the burner flame to penetrate the test sample, and/or the time required for the heat flux to reach 2.0 Btu/ft² sec (2.27 W/cm²) on the inboard side, at a distance of 12 inches (30.5 cm) from the front surface of the insulation blanket test frame, whichever is sooner. The burnthrough time is measured at the inboard side of each of the insulation blanket samples.

24.2.2 Insulation Blanket Sample

Insulation blanket sample means one of two samples positioned in either side of the test rig, at an angle of 30° with respect to vertical.

24.2.3 Sample Set

Sample set means two insulation blanket samples. Both samples must represent the same production insulation blanket construction and materials, proportioned to correspond to the sample size.
Chapter 24 Updated in September

24.3.3.3 Thermocouples

Provide seven 0.125-inch (3.2 mm) insulation packed, metal sheathed, type K (Chromel-Alumel), grounded junction thermocouples with a nominal 24 American Wire Gauge (AWG) size conductor for calibration. Thermocouples purchased with a certificate of calibration may provide more accurate readings but are not required. Attach the thermocouples to a steel angle bracket to form a thermocouple rake for placement in the calibration rig during burner calibration (figure 24-6).

NOTE: The thermocouples are subjected to high temperature durations during calibration. Because of this type of cycling, the thermocouples may degrade with time. Small but continuing decreases or extreme variations in temperature or “no” temperature reading at all are signs that the thermocouple or thermocouples are degrading or open circuits have occurred. In this case, the thermocouple or thermocouples should be replaced in order to maintain accuracy in calibrating the burner. Although not required, it is recommended that a record be kept for the amount of time the thermocouples are exposed to the oil burner’s flame.
## Appendix F Updated in January

<table>
<thead>
<tr>
<th>Company</th>
<th>Contact Information</th>
<th>Chapters Offered</th>
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| Aearo Technologies, LLC, a 3M Company | 7911 Zionsville Road, Indianapolis, IN 46268  
Phone: 317-982-3304  
Website: www.earsc.com  
Contact: Mary Colston  
Email: mary.colston@mmm.com | Chapters: 1, 3, 23 (not offered commercially) |
| Aeroblaze Laboratory         | 12819 Harmon Road, #575, Fort Worth, TX 76177  
Phone: 817-668-0628  
Email: info@aeroblazelab.com  
Website: www.aeroblazelab.com | Chapters: 1*, 2*, 3*, 4*, 7*, 10*, 18* |
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<td>Email: <a href="mailto:office.bih@greiner-aerospace.com">office.bih@greiner-aerospace.com</a></td>
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Test Method Training Videos

Chapter 23, Radiant panel test for insulation (2015)
Chapter 8, Cargo liner flame penetration test (2016)
Chapter 7, Seat cushion flammability test (2017)
Sonic Burner set-up and operation (in progress)
Chapter 24, Insulation burnthrough (planned)
Chapter 7: Oil Burner Test for Seat Cushions
Advisory Circular on Flammability Requirements for Aircraft Seat Cushions.
Lab Test Form - Oil Burner Seat Cushion Test
Seat Cushion Test Procedures Training Video: View Online | Download

Chapter 8: Oil Burner Test for Cargo Liners
Lab Test Form - Oil Burner Cargo Liner Test
Cargo Liner Test Procedures Training Video: View Online | Download

Chapter 9: Radiant Heat Testing of Evacuation Slider, Ramps, and Rafts

Chapter 10: Fire Containment Test of Waste Stowage Compartments

Chapter 11: Powerplant Hose Assemblies Test

Chapter 12: Powerplant Fire Penetration Test

Chapter 13: Test for Electrical Connectors used in Firewalls

Chapter 14: Test for Electrical Wire used in Designated Fire Zones

Chapter 15: Two Gallon per hour Oil Burner Certification Testing for Repaired Cargo Compartment Liners

Chapter 18: Recommended Procedure for the 4-Ply Horizontal Flammability Test for Aircraft Blankets
Lab Test Form - Bunsen Burner Test

Chapter 19: Smoke test for Insulated Aircraft Wire

Chapter 20: Dry Arc Tracking Test Procedure

Chapter 21: Dry Arc-Propagation Resistance

Chapter 22: Cotton Swab Test for Thermal Acoustic Insulation Blankets

Chapter 23: Test Method To Determine the Flammability and Flame Propagation Characteristics of Thermal/Acoustic Insulation Materials
Advisory Circular on Thermal/Acoustic Insulation Flame Propagation Test Method Details
Radiant Panel Procedures Training Video: View Online | Download
Fire Safety Website Tagging

Internal Branch activity to “tag” all presentations by subject

Website currently being updated; new version 2019?

Tagged presentation will greatly improve the search function

Current search function does not mine the Fire Safety website
<table>
<thead>
<tr>
<th>Date</th>
<th>Section</th>
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<tr>
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<td>Aircraft Cargo Compartment Minimum Performance Standard</td>
<td>Updated section.</td>
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<td>02/11/19</td>
<td>Handbook</td>
<td>Updated Chapter 26.</td>
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<td>Materials</td>
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<td>Updated Appendix F.</td>
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<td>Future meeting dates posted.</td>
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Questions on Red Line or Website?
Additive Manufacturing

- FAA Fire Safety Branch procured Stratasys 450mc commercial-grade 3D printer for evaluation of flammability of 3D printed parts
  - 16 x 14 x 16 inch build envelope
  - Ultem 9085 option
  - 0.01 inch layer thickness
  - Produces finish-quality parts for use in cabin interiors
Additive Manufacturing

Additive Manufacturing (AM) becoming more common in aerospace applications, particularly cabin interiors:

Fold Down Cocktail Tray

Air Duct in MD 10-30

Cabin sidewall panel
Additive Manufacturing: Influence on Flammability

Determine impact on flammability of test coupons from these variables:

- printing direction
- infill percentage
- raster angle
- layer thickness
- printing width
- material type
- varying oven temperature

Develop test matrix to evaluate each of these parameters to determine influence on flammability in FAA tests:

- Bunsen burner
- OSU
OSU and HR2 Refinement Work

How can we make this better?
Particle Image Velocimetry (PIV) Research in OSU

Transparent OSU model

Determine flow paths in hot section

Focus on intake plenum
Particle Image Velocimetry (PIV) Research in OSU

Original Side Feed  Bottom Feed  New Side Feed
What is expected outcome of this work?

Determine if a simple modification could be made to the intake

Can this work be performed on the HR2?

Currently HR2 is still under development. We plan to use the OSU apparatus as the “testbed” first, to develop a simple fix if possible. This modification could always be implemented into the HR2 at a later date.
Research on Updating Heat Release Test (HR2)

Goal: Simplify, Standardize, Improve Repeatability

2007 through 2010

(Fact finding, review past data, conduct round robins, lab visits, mini-study, HFG work, troubleshooting, head-scratching, HRR2 born)

2010 through 2015

OSU → HR2

Maintain bypass airflow vs eliminate (simplify)

Thermopile (simplify)

Calibration process (simplify): reduced from 30 minutes to 6 minutes
Research on Updating Heat Release Test (HR2)

Goal: Simplify, Standardize, Improve Repeatability

2016 through 2018

Mass Flow Meter → Mass Flow Controller

Design of Experiment (DOE) II

Thermopile Change/Update

Misaligned lower pilot flame

Frequency of calibration

Test new prototype flat radiant heater
Research on Updating Heat Release Test (HR2)

Present work (concern over HR2 having slightly higher HRR values)

Researched cooled vs. non cooled exhaust with instrumented OSU (results were expected in some aspects yet surprising in others)

A new observation during the ramp down calibration approach that may help explain the higher HRR values.

TRL5 repeatability testing to validate findings of study conducted in Fall 2018

OSU Voltage Round Robin – Industry wide daily monitoring of voltage feed to OSU

OSU Guidance document – Recommendations relative to all aspects of OSU manufacturing, installation, and operation that may not be evident in the FAA Aircraft Materials Fire Test Handbook.
Evacuation Slide Test Update

Conducted Evacuation Slide Tests with:

3 heat flux gauges
2 power controllers

Calculated 5 minute average on power and heat flux data

Power was measured using same power meter for both power controllers
Heat Flux and Power Measurements comparing old Autotransformer and new Keysight Power Controller
Evacuation Slide Test Update

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<th>Std. Deviation</th>
<th>Heat Flux</th>
<th>Power</th>
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<tr>
<td>(Automatic) Keysight</td>
<td>0.009</td>
<td>0.653</td>
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<tr>
<td>(Manual)  Autotransformer</td>
<td>0.011</td>
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Standard Deviation slightly higher with autotransformer

Power is much easier to set with Keysight – type in voltage to nearest 0.1V

Voltage dial on autotransformer is much less precise
Evacuation Slide Test Update

Heat Flux Gauge Comparison
Power Required to produce 1.5 Btu/ft² sec

- Heat Flux Gauge 1: 449.3 W, +2.42%
- Heat Flux Gauge 2: 438.6 W
- Heat Flux Gauge 3: 446.8 W, +1.87%

Legend:
- Blue: Keysight
- Orange: Autotransformer
Evacuation Slide Test Update

Different heat flux gauges were not as repeatable as different power sources
Close-up of Heat Flux Gauge #3
Fuselage Fire Penetration Resistance Research
Fuselage Fire Penetration Resistance Research

...from AC 25.856-2A

Typical

Non-typical

Lower Half
Fuselage Fire Penetration Resistance Research

Example of typical fuselage protection

Cabin Interior Sidewall

Overhead Area

Cabin Window

Air Return Grill

Cheek Area

Thermal Acoustic Insulation

Cargo Compartment
Fuselage Fire Penetration Resistance Research

Example of typical fuselage protection

- Thermal Acoustic Insulation
- Aluminum Skin
- Sidewall Panel
- Airflow
- Return Air Grill
- Floor Panel
- Cargo Liner
- Cheek Area
- Burnthrough-Resistant Insulation
- Holes for Return Air
- Fuselage Centerline

FIRE
Fuselage Fire Penetration Resistance Research

Example of an Equivalent Level of Safety (ELOS)
Example of ELOS

- Thermal Acoustic Insulation
- Aluminum Skin
- Sidewall Panel
- Return Air Grill
- Burnthrough-Resistant Floor Panel
- Cargo Liner
- Cheek Area
- Holes for Return Air

Fuselage Fire Penetration Resistance Research

FIRE
Fuselage Fire Penetration Resistance Research
Tentative…

The Ninth Triennial International Aircraft Fire and Cabin Safety Research Conference

October 28-31, 2019
Resorts Casino-Hotel, Atlantic City, New Jersey, USA

Sponsored by International Aviation Authorities.
Further details to follow.
No Fall 2019 Materials or Systems Forum meetings.
Questions?