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

Federal Aviation Administration

New Name, Same Group

We are now:

International Aircraft Materials Fire Test Forum (IAMFTF)

Previously:

International Aircraft Materials
Fire Test Working Group (IAMFTWG)

Red Line Process for Updating Fire Test Handbook

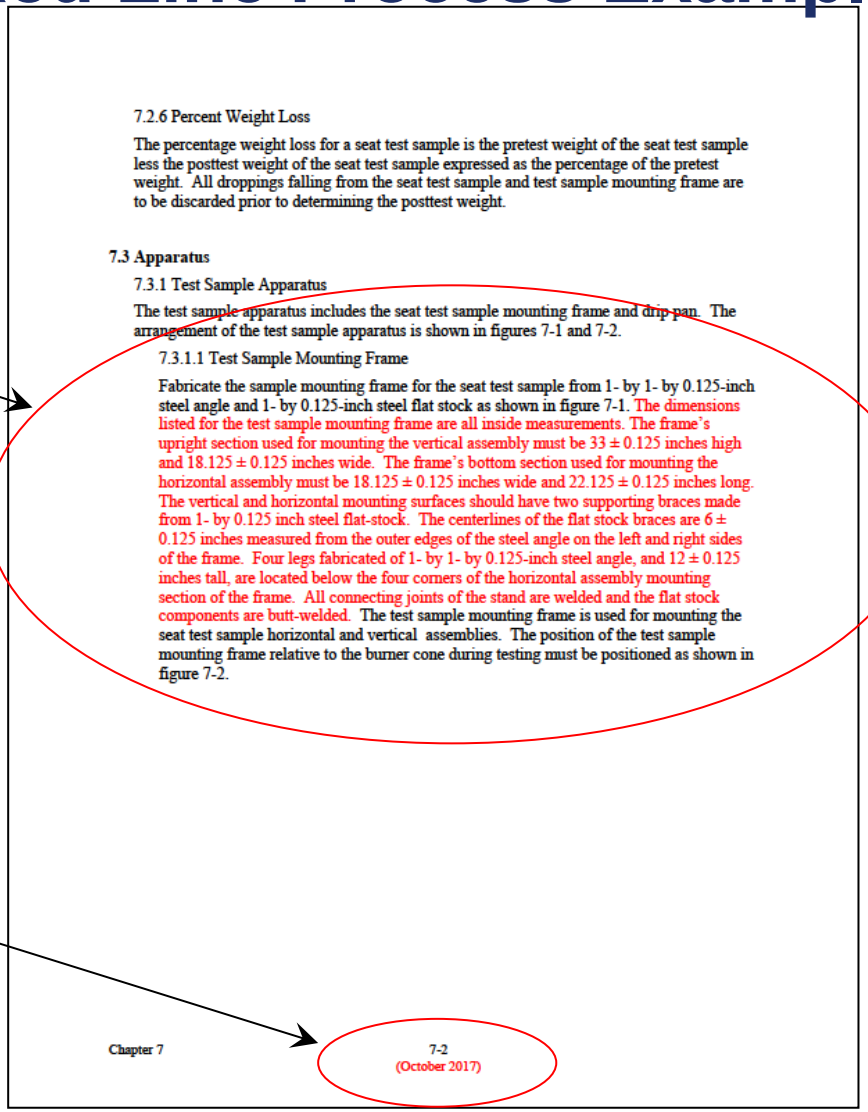
Posted 4/10/18

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



7.2.6 Percent Weight Loss

The percentage weight loss for a seat test sample is the pretest weight of the seat test sample less the posttest weight of the seat test sample expressed as the percentage of the pretest 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 33 ± 0.125 inches high 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 centerlines 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.

Chapter 7

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/ft^{2}sec (2.27 W/cm^2) 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

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Appendix F Updated in January

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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 October Update	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 October Update	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 Updated	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 June Update	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

What's New

Date	Section	Description
02/27/19	Aircraft Cargo Compartment Minimum Performance Standard	Updated section.
02/11/19	Handbook	Updated Chapter 26.
02/05/19	Materials	March meeting agenda posted and registration opened.
01/22/19	Handbook	Updated Appendix F.
12/14/18	Systems and Materials	Future meeting dates posted.
11/15/18	Systems	Oct. meeting presentations, minutes and attendee list posted.
11/14/18	Materials	Oct. meeting presentations, minutes and attendee list posted.
10/22/18	Handbook	Chapter 26 posted.
10/18/18	Materials	MCC Guidance Updated Rev B. posted.
10/11/18	Reports	Posted report DOT/FAA/TC-18/16.
09/13/18	Materials	Posted Oct. meeting details, agenda, and opened registration.
09/12/18	Systems	Posted Oct. meeting details, agenda, and opened registration.

Announcements

Federal Register: Notice of Meetings; A Notice by the Federal Aviation Administration

SAFO: Risks in Transporting Lithium Batteries in Cargo by Aircraft

Final Policy: Policy Statement on Flammability Testing of Interior Materials Issued (link opens small window)

UPDATED 11/15: Statement on the Use of Magnesium in Airplane Cabins

Released: AC 20-42D - Hand Fire Extinguishers for Use in Aircraft

Cabin Safety Research Technical Group: Accident Database now available online.

InFO: Availability of a Federal Aviation Administration (FAA) In-flight Firefighting Training Video (see VIDEOS below)

SAFO: Fighting Fires Caused By Lithium Type Batteries in Portable Electronic Devices (see VIDEOS below)

VIDEOS: View videos on Cabin Crew Fire Fighting Training (updated 03/09/09), Laptop Battery Fires &

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

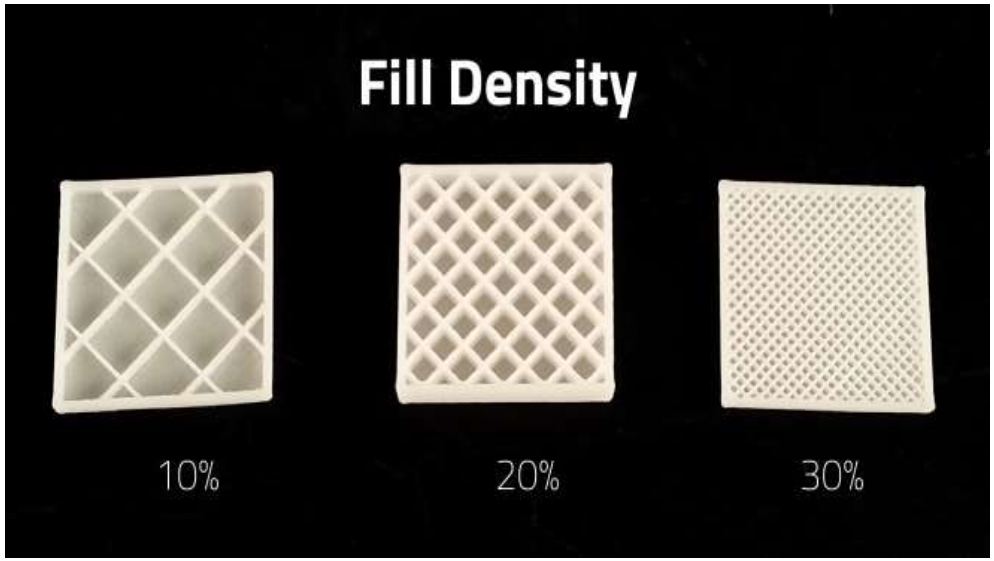
Air Duct in MD 10-30

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

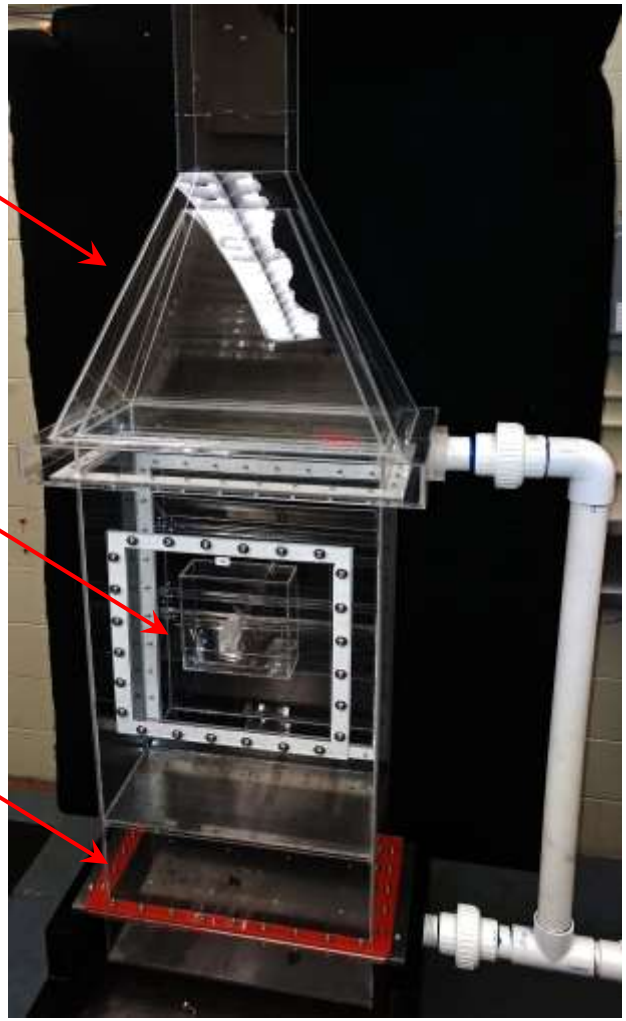
How can we make this better?

Particle Image Velocimetry (PIV) Research in OSU

Transparent OSU model

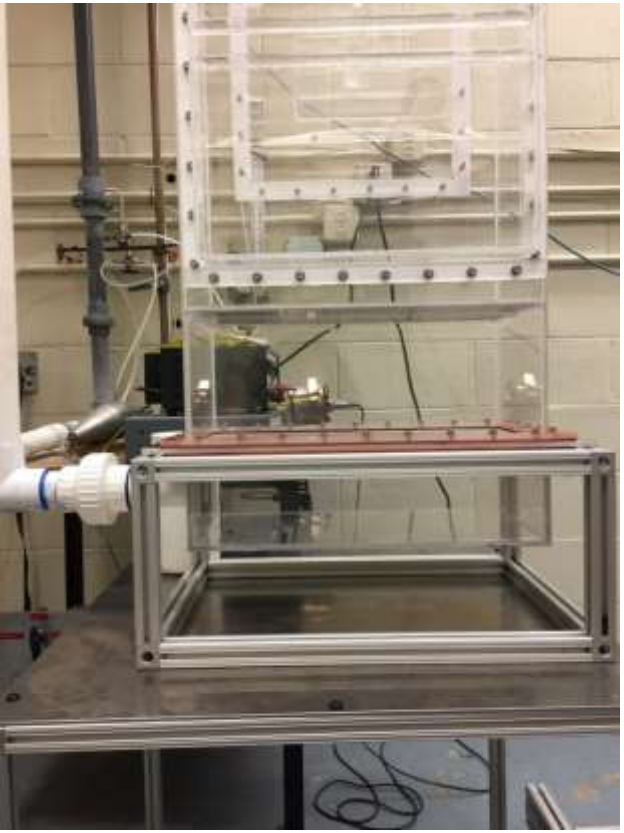
Determine flow paths in hot section

Focus on intake plenum

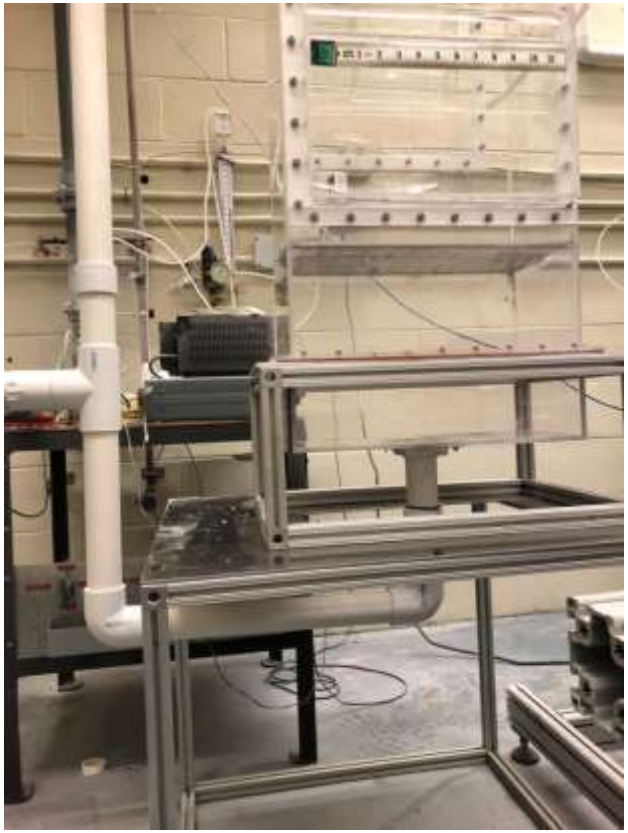


Particle Image Velocimetry (PIV) Research in OSU

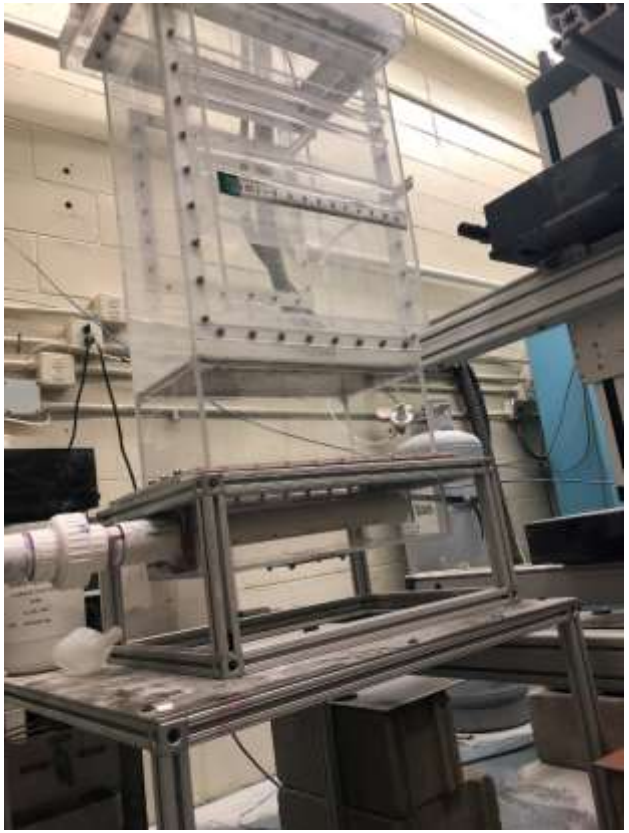
Original Side Feed



Bottom Feed



New Side Feed



Particle Image Velocimetry (PIV) Research in OSU

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.

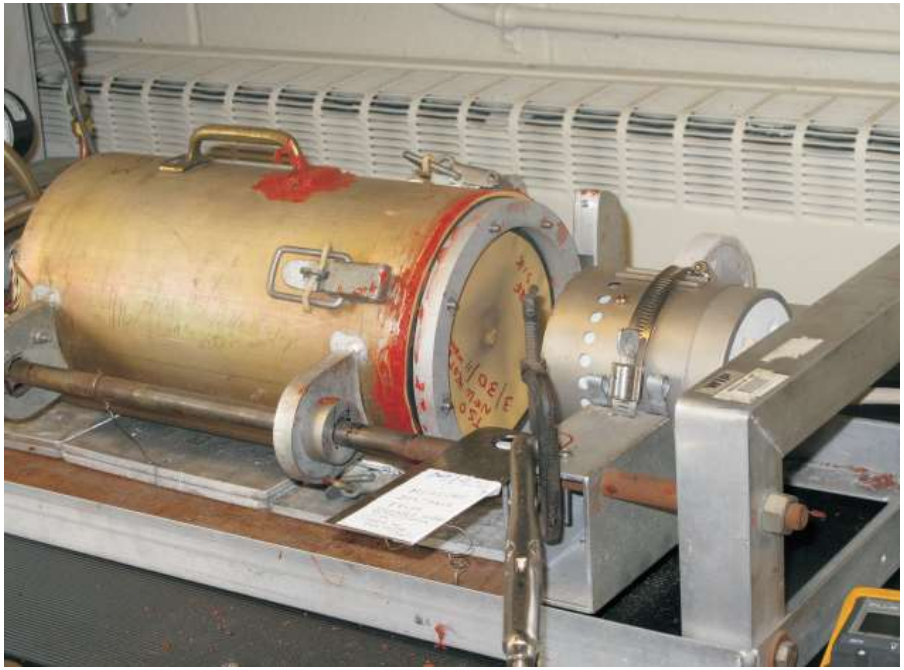
Evacuation Slide Test Update

Conducted Evacuation Slide Tests with:

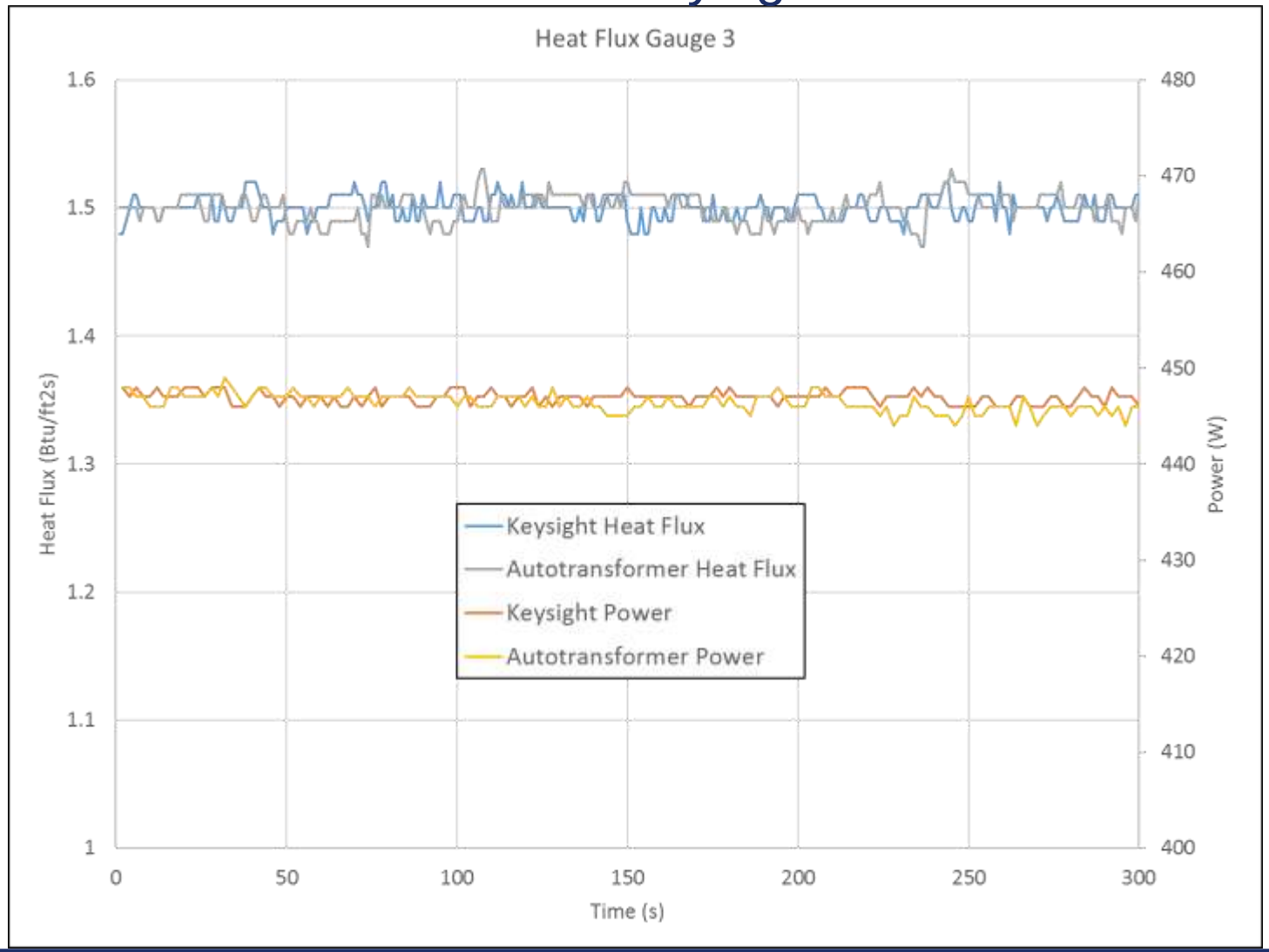
- 3 heat flux gauges
- 2 power controllers

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

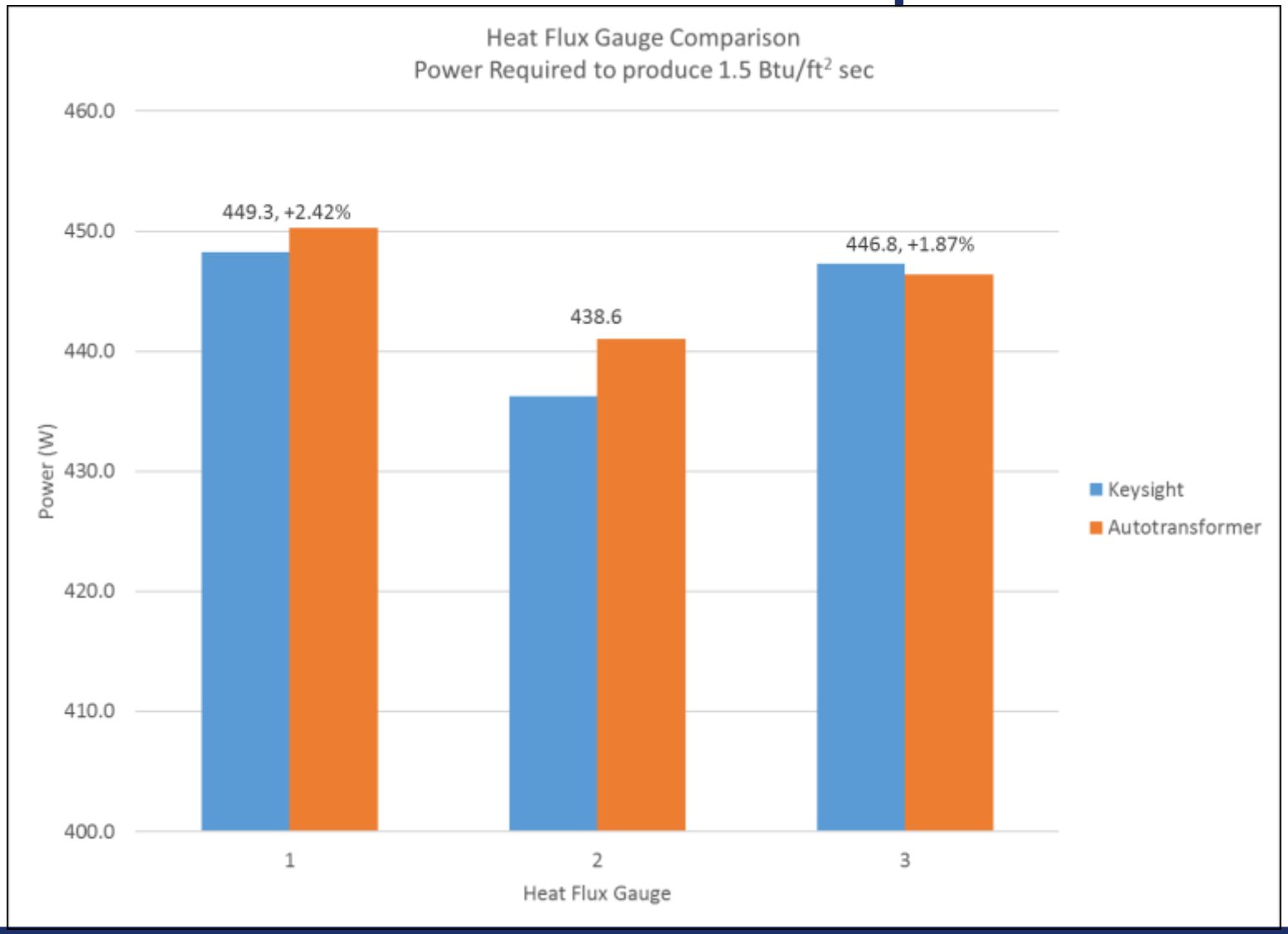
	Std. Deviation	Heat Flux	Power
(Automatic)	Keysight	0.009	0.653
(Manual)	Autotransformer	0.011	0.962

Standard Deviation slightly higher with autotransformer

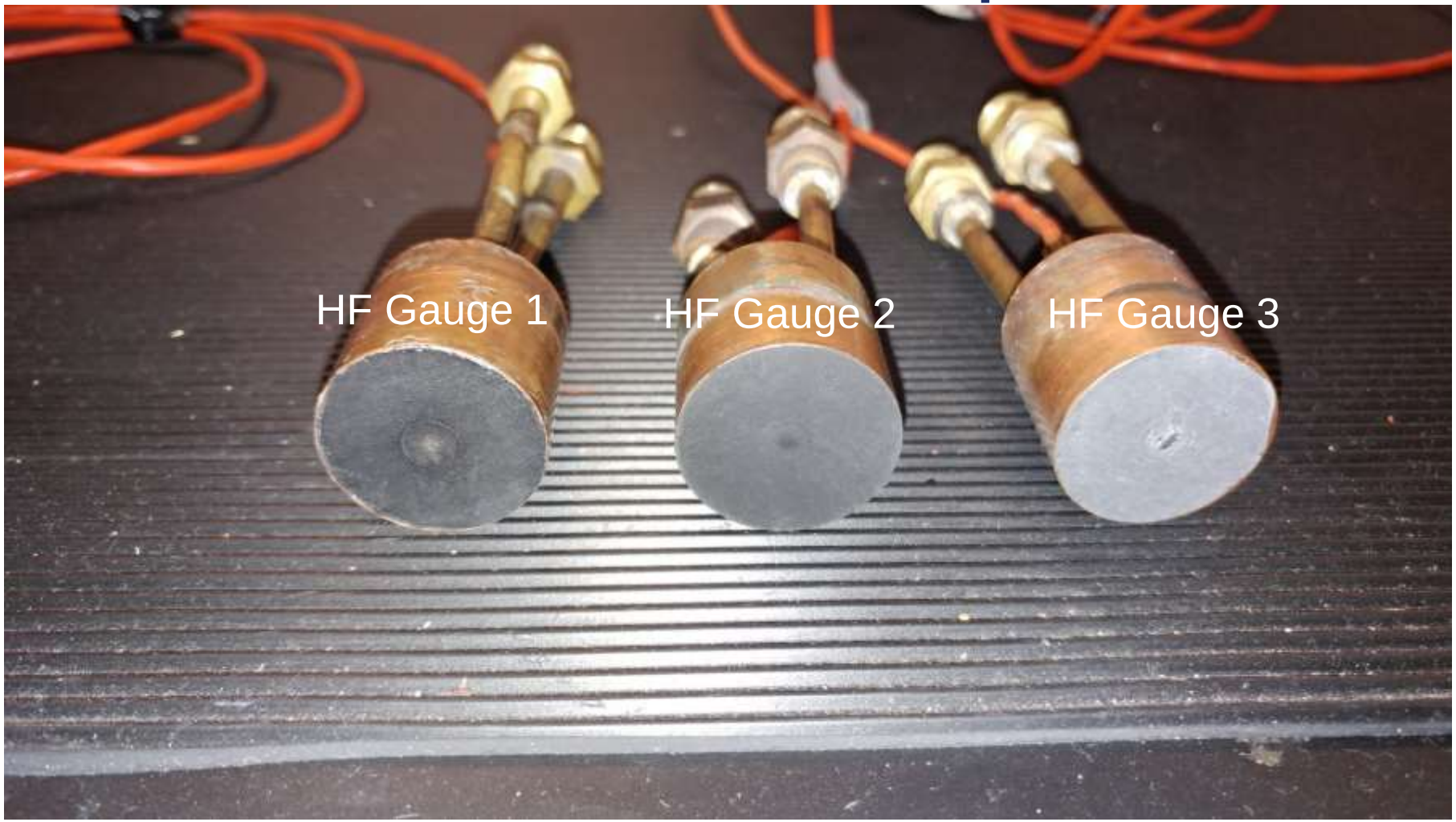
Power is much easier to set with Keysight – type in voltage to nearest 0.1V

Voltage dial on autotransformer is much less precise

Evacuation Slide Test Update



Evacuation Slide Test Update



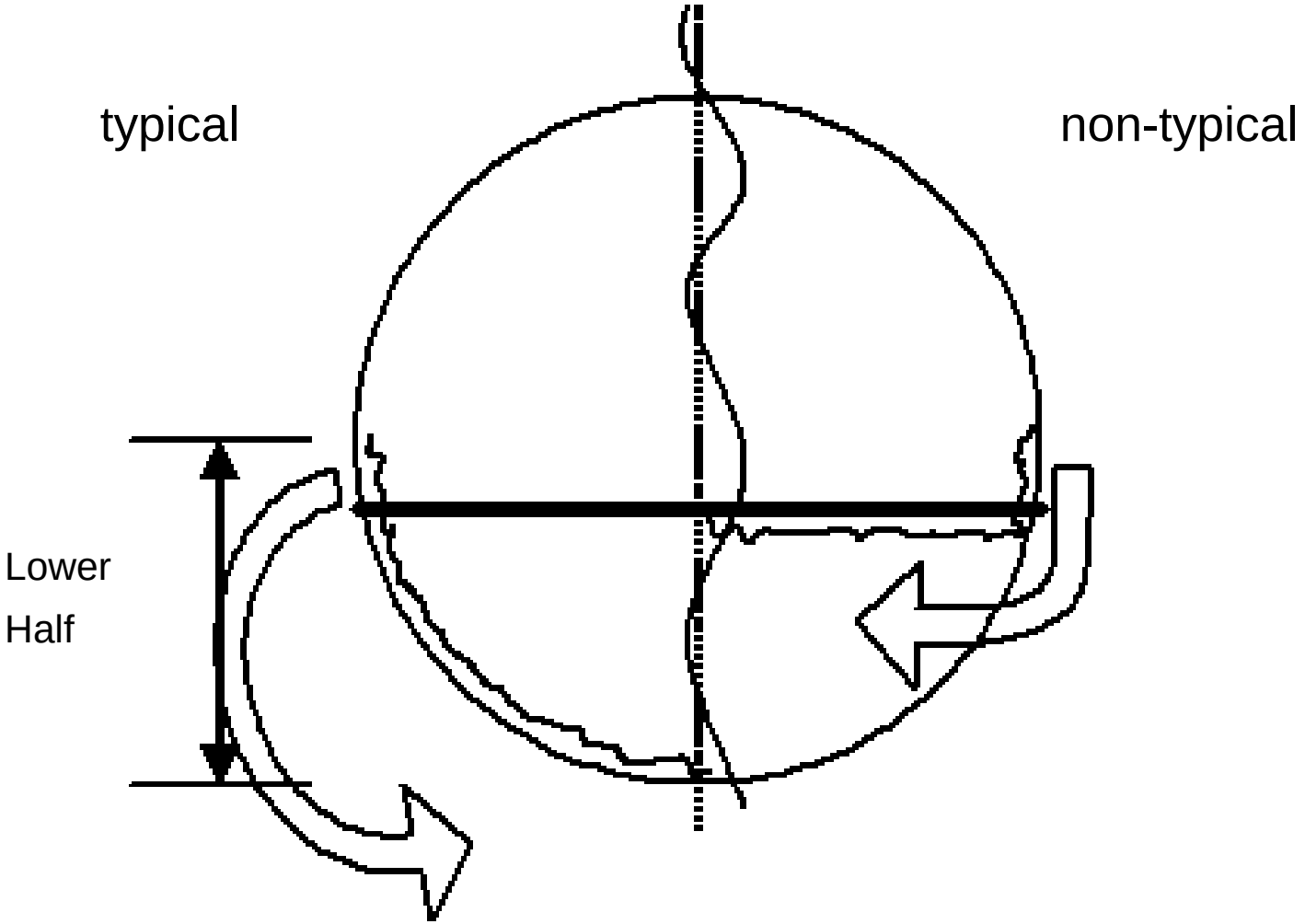
Different heat flux gauges were not as repeatable as different power sources

Close-up of Heat Flux Gauge #3

Fuselage Fire Penetration Resistance Research

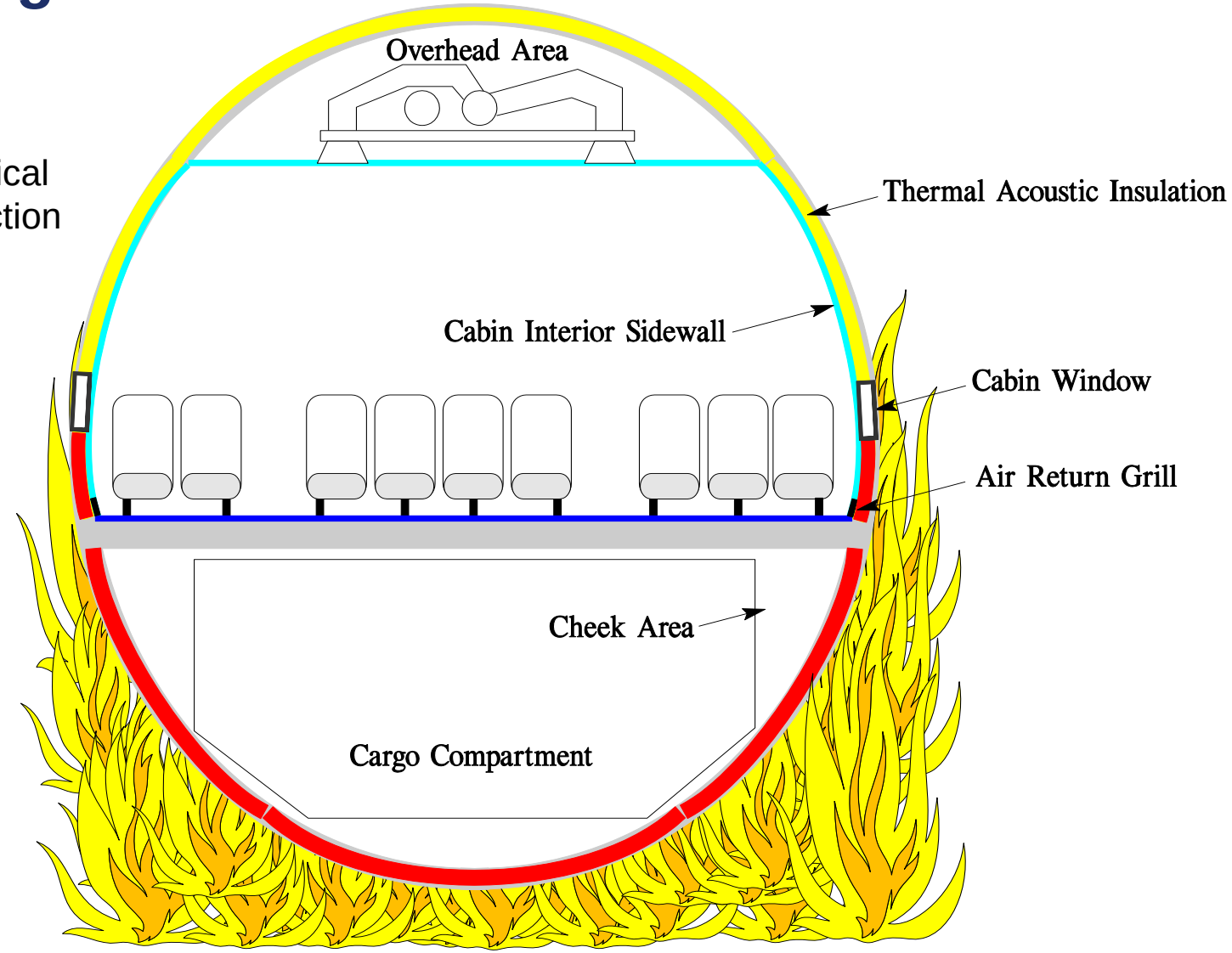
Fuselage Fire Penetration Resistance Research

…from AC 25.856-2A



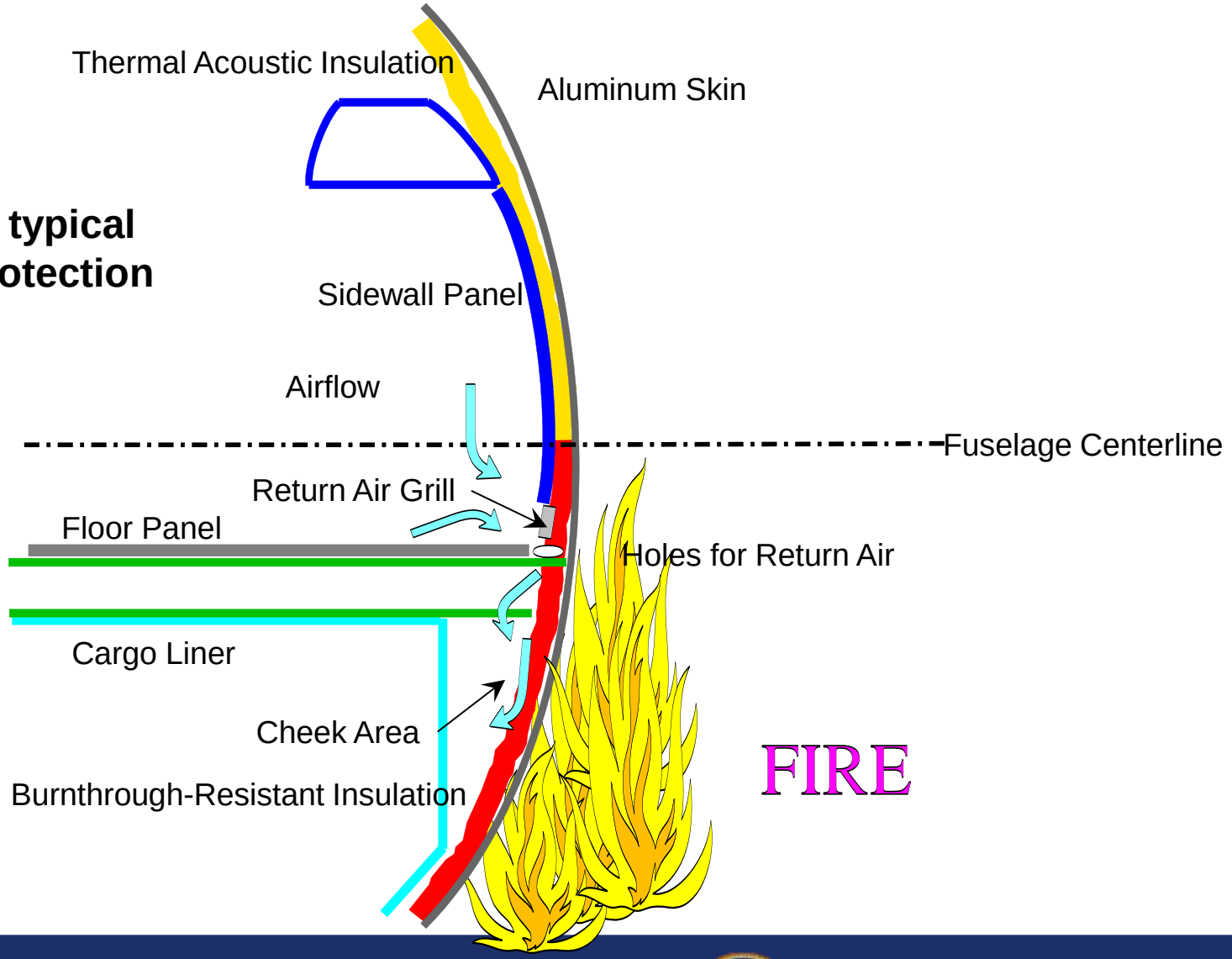
Fuselage Fire Penetration Resistance Research

Example of typical fuselage protection



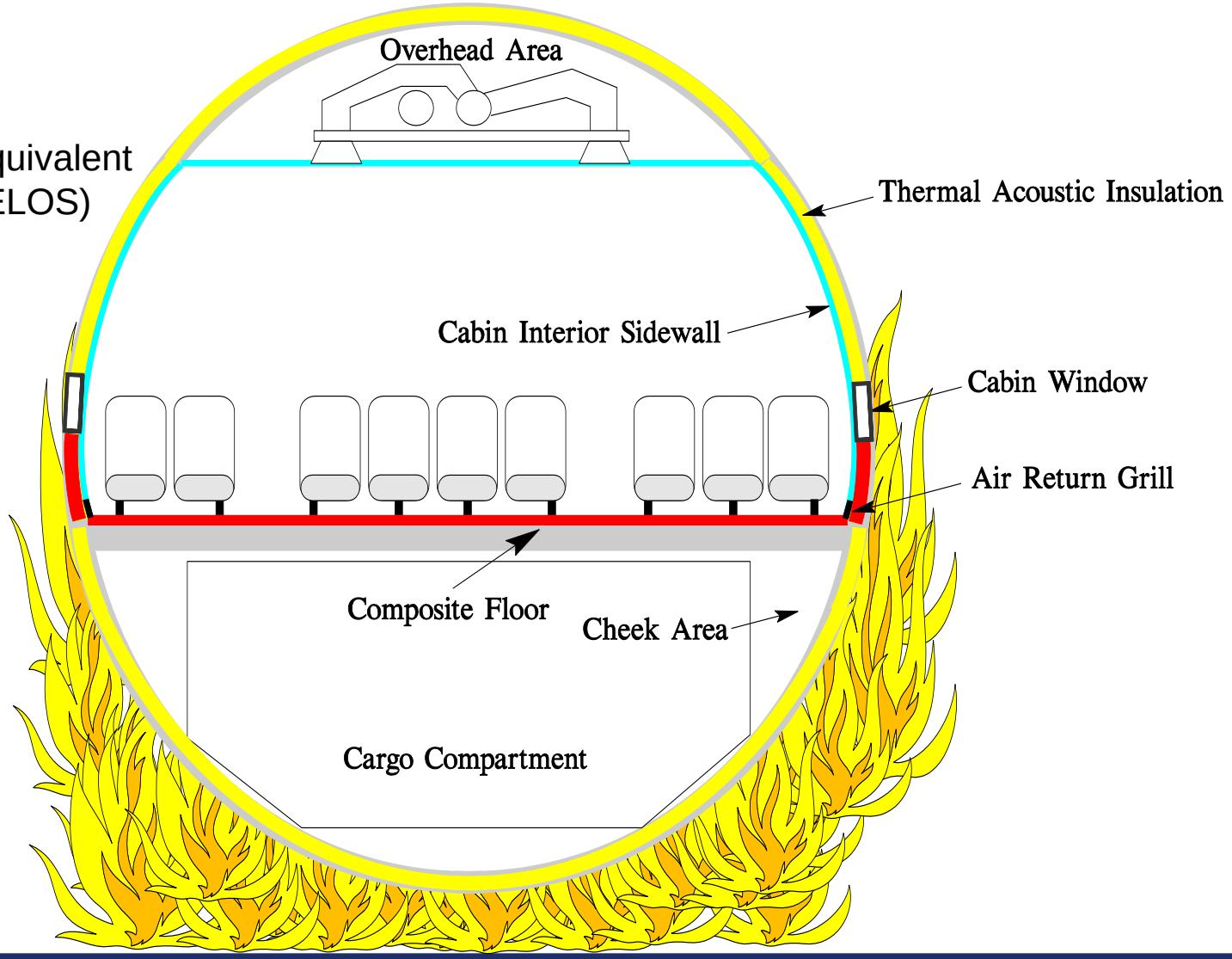
Fuselage Fire Penetration Resistance Research

Example of typical fuselage protection

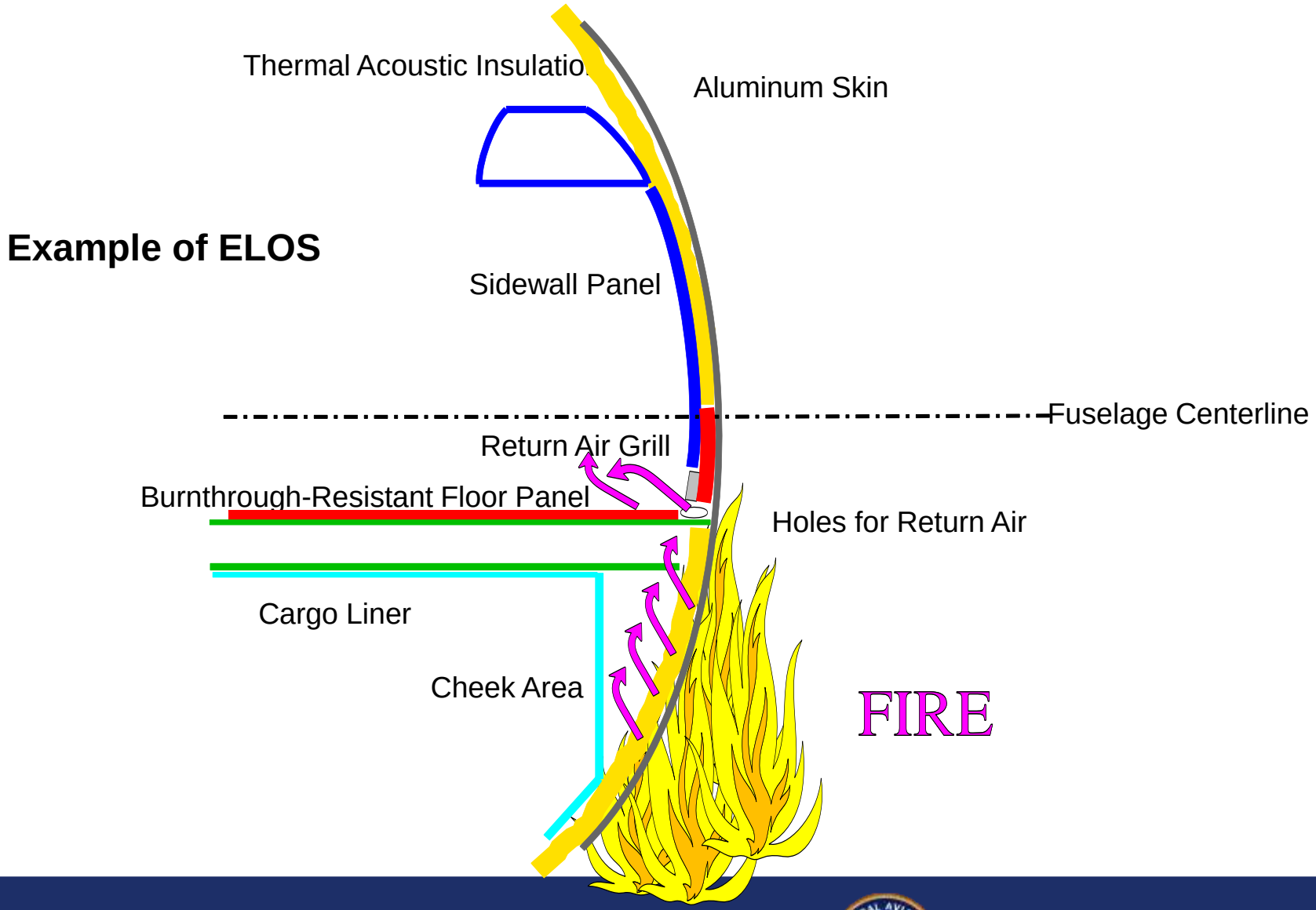


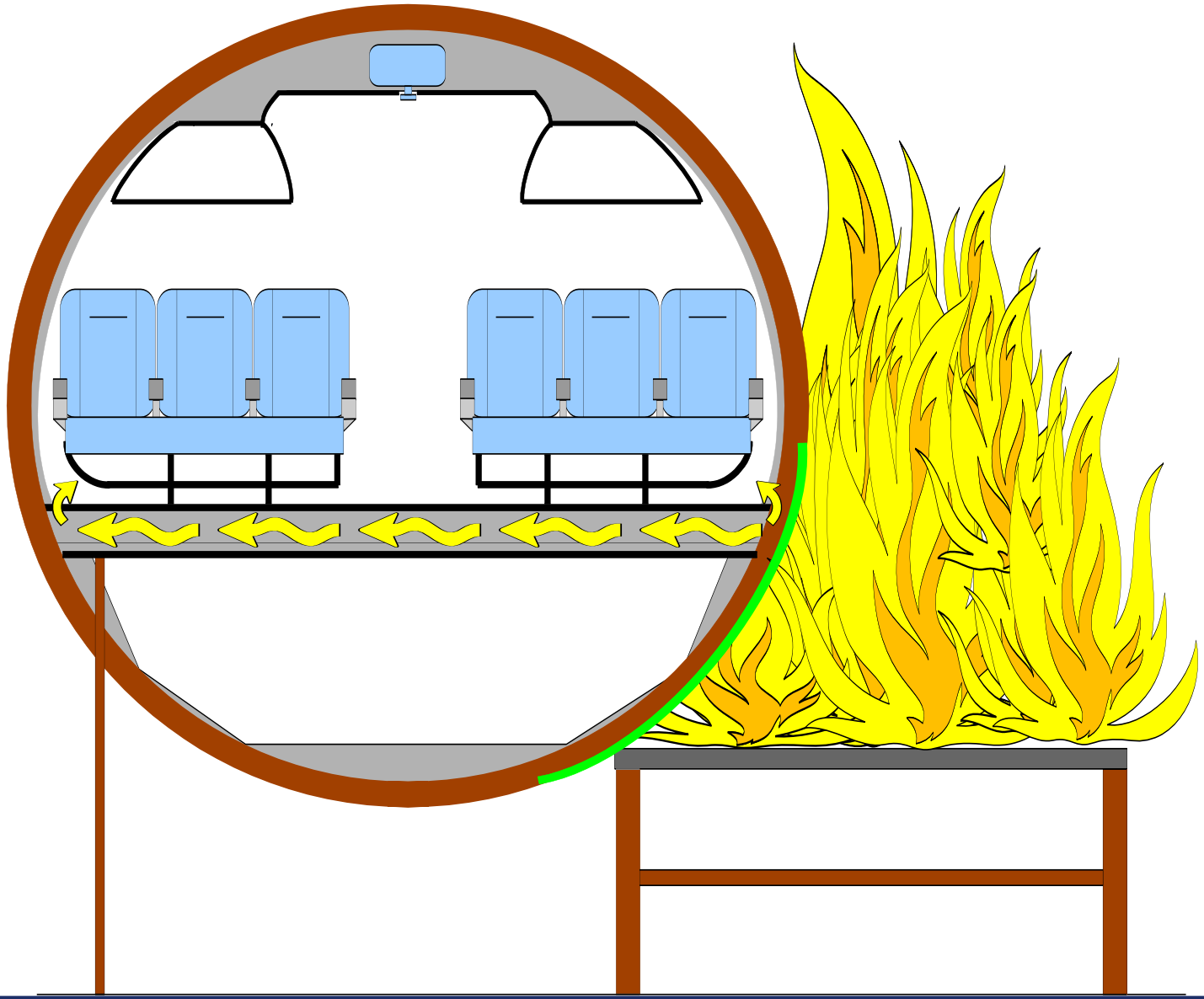
Fuselage Fire Penetration Resistance Research

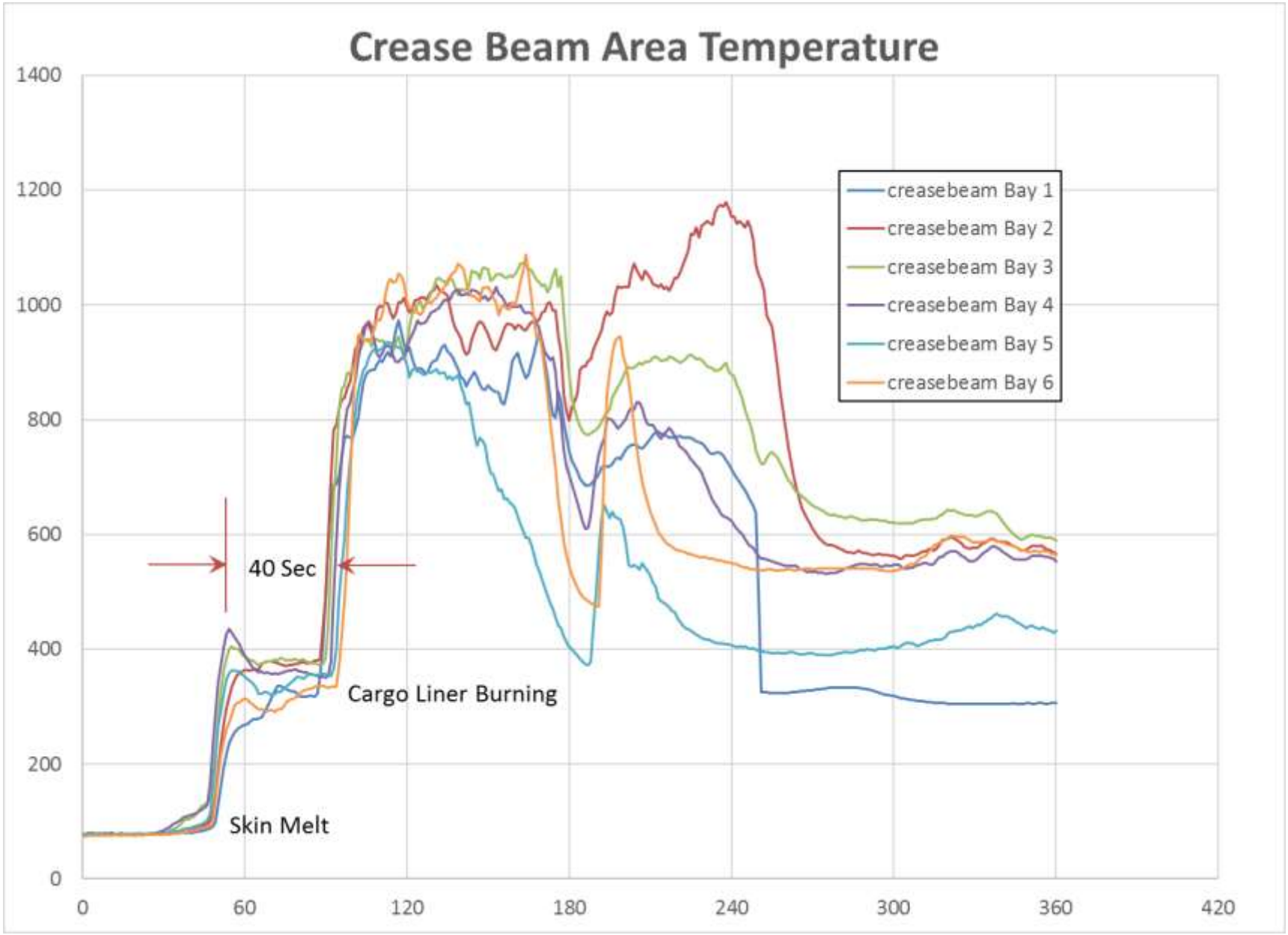
Example of an Equivalent Level of Safety (ELOS)

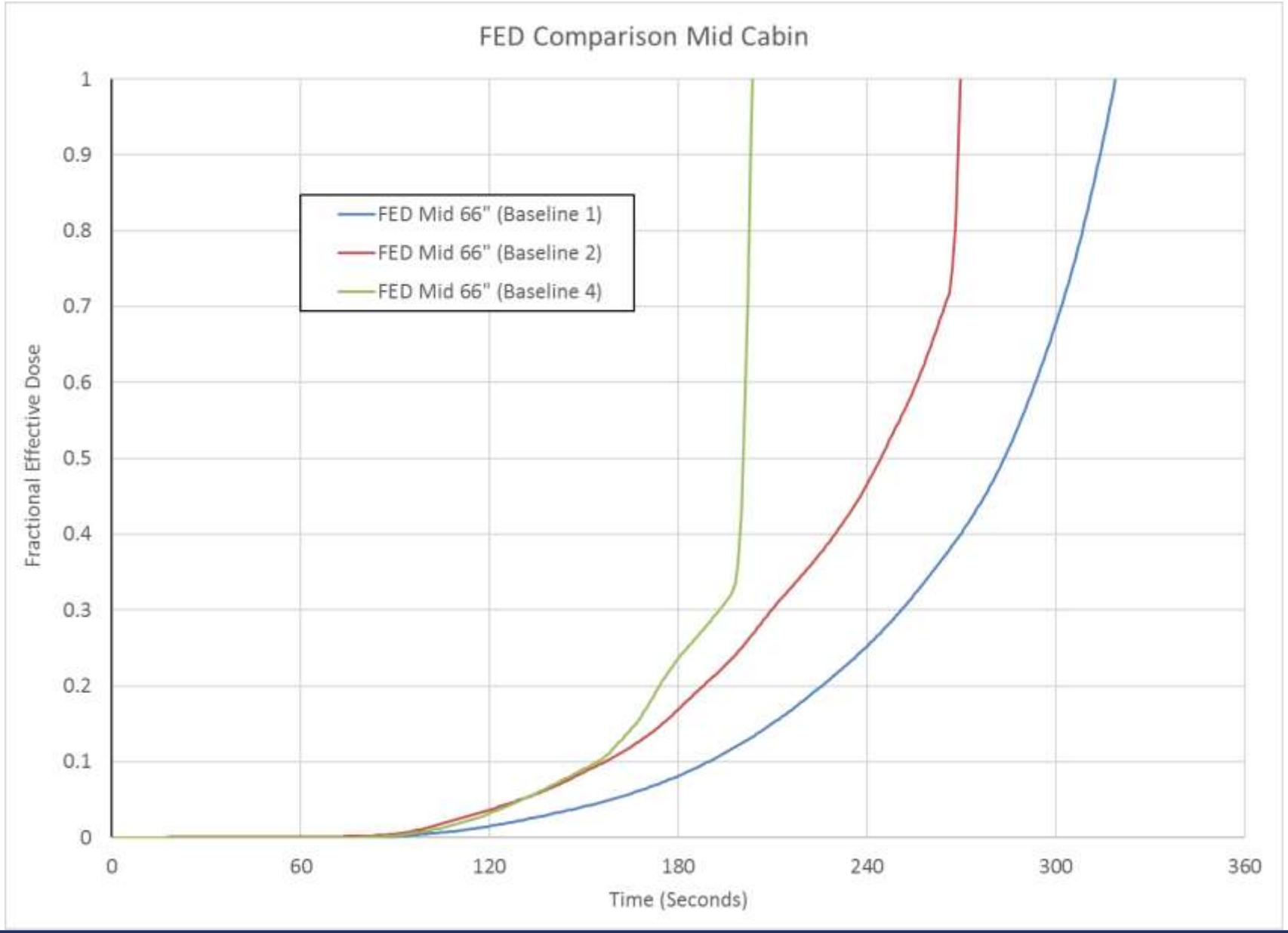


Fuselage Fire Penetration Resistance Research






Crease Beam Area Temperature
1400
1200
1000
800
600
400
200
0
0
60
120
180
240
300
360
420
creasebeam Bay 1
creasebeam Bay 2
creasebeam Bay 3
creasebeam Bay 4
creasebeam Bay 5
creasebeam Bay 6
40 Sec
Cargo Liner Burning
Skin Melt


FED Comparison Mid Cabin
Fractional Effective Dose
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
0
60
120
180
240
300
360
Time (Seconds)
FED Mid 66" (Baseline 1)
FED Mid 66" (Baseline 2)
FED Mid 66" (Baseline 4)

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?