Radiant Panel Insulation Test Update

Presented to: International Aircraft Materials Fire Test Forum
By: Steve Rehn
Date: 3/5/2019

Introduction

- **Handbook update**
  - Updated June 2018
- **Electric Panel aging testing**
  - Panel runs hotter as it ages, can affect test results
  - Need “borderline” material to test
- **Backing board study**
  - Superwool 607 vs. Fermacell Gypsum Fibreboard

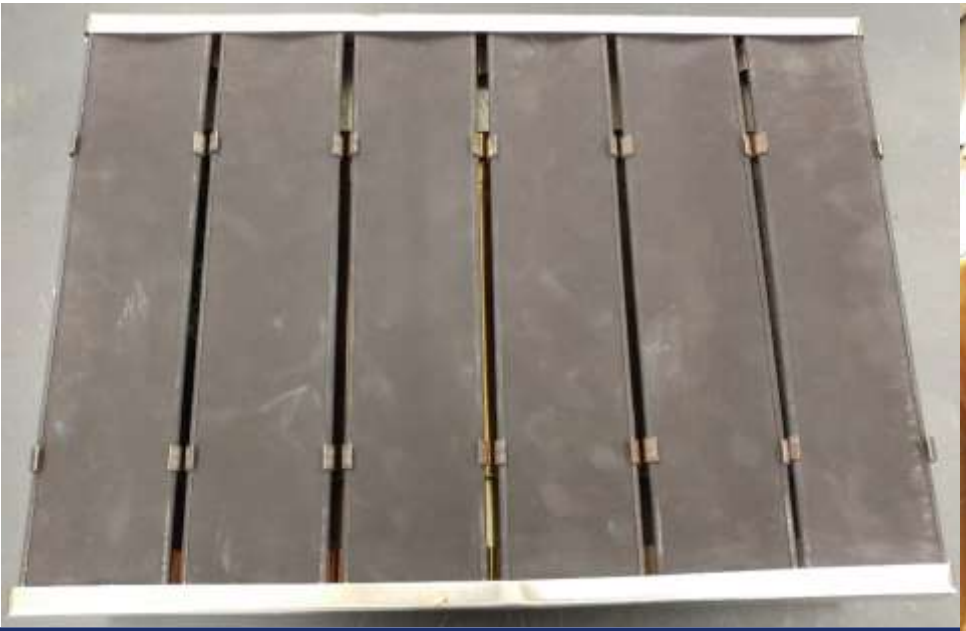
Handbook changes

- **Replaced Superwool 607 with Superwool Plus**
  - All references say “refractory board” with a recommendation of Superwool Plus at the beginning
- **Added requirements:**
  - Maximum thermal conductivity of 0.5 Btu·in/hr·ft^2·°F (0.072W/m·K) at 500°F (260°C)
  - Minimum density of 15 lb/ft^3 (240 kg/m^3)
  - Based on Kaowool M and Superwool 607 since they have been used most
- **This caused problems with other boards that have been used in the past**

Radiant Panel Aging

- **Temperature set point steadily increases to obtain same heat flux as panel ages – eventually leads to more material failures**
- **Biggest difference seems to be black paint on surface**
- **Need to find out what changes in the panel to make it run hotter**
- **Need to add guidance about when to replace electric panel**

New Panel



Old Panel

Radiant Panel Aging

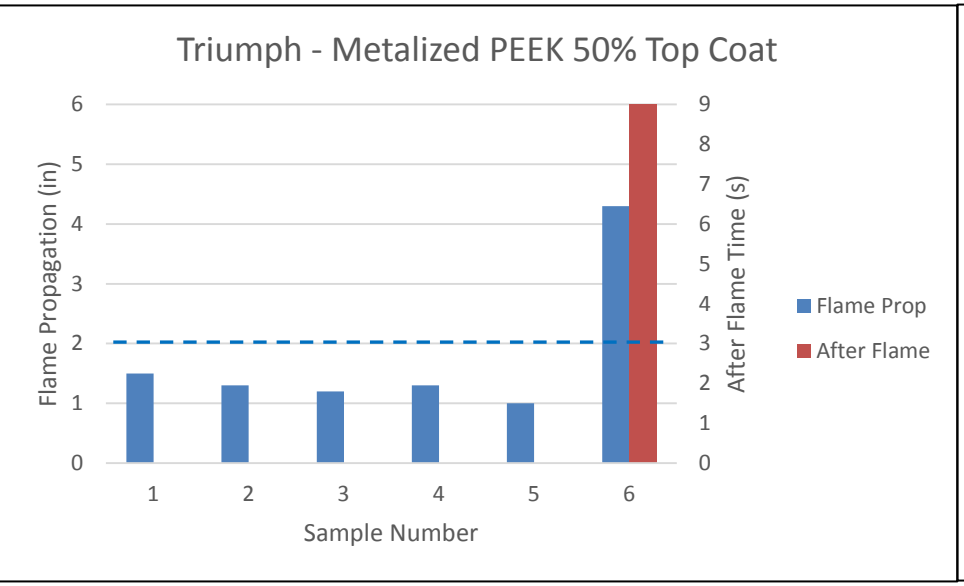
- Condition likely depends on amount of use and types of materials tested

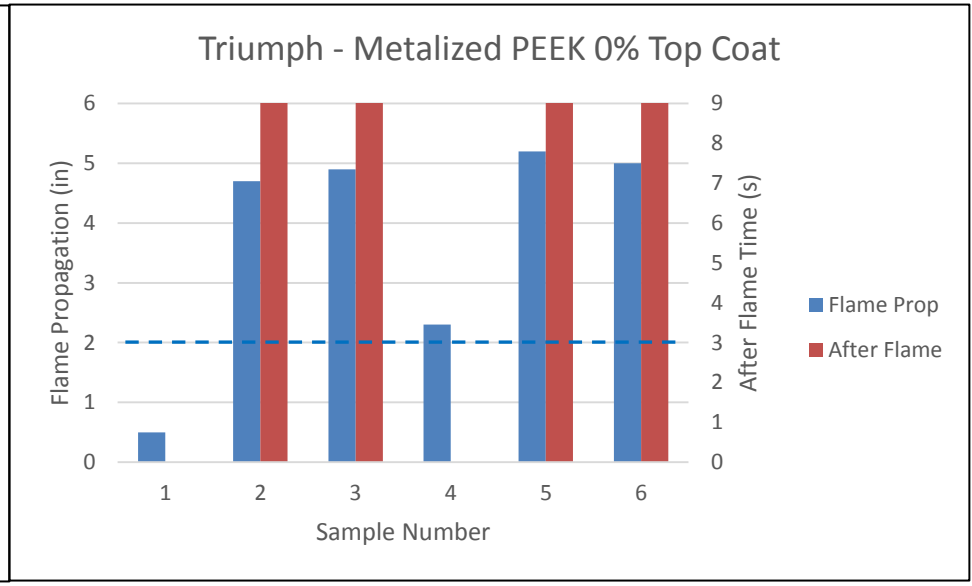
Radiant Panel Aging

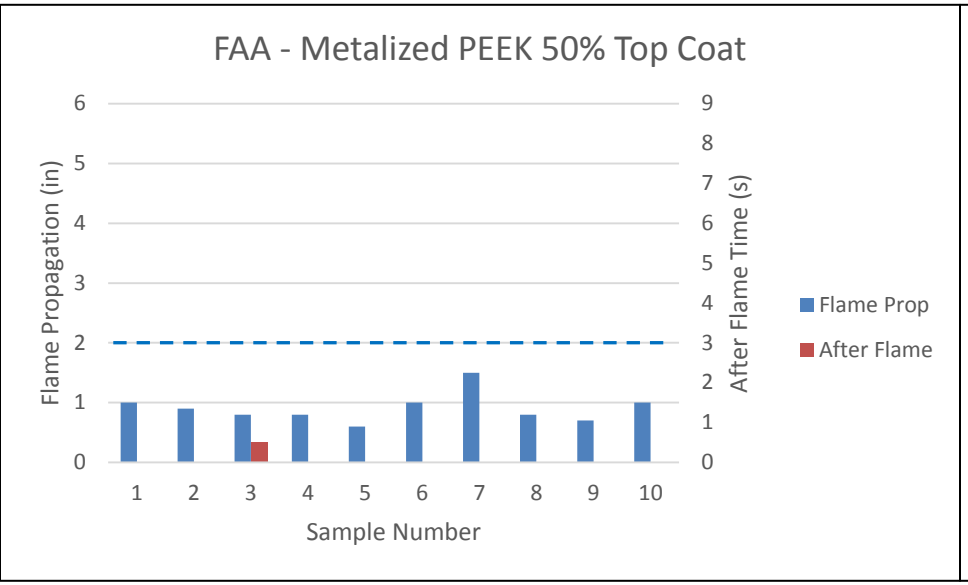
- **Test 7 electric panels**
  - 2 brand new, 1 in use, 4 old out of use
- **Panel set point**
- **3-position calibration check**
- **Measure emissivity of panel surface**
- **Measure internal resistance**
- **Measure power**
- **Measure temperature at sample surface**
- **Material testing**

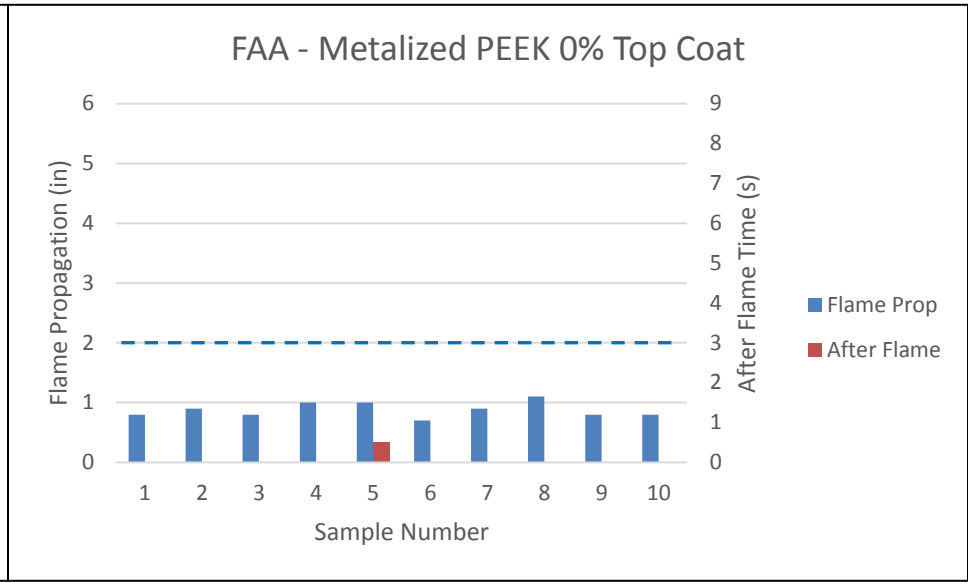
Metalized PEEK Material

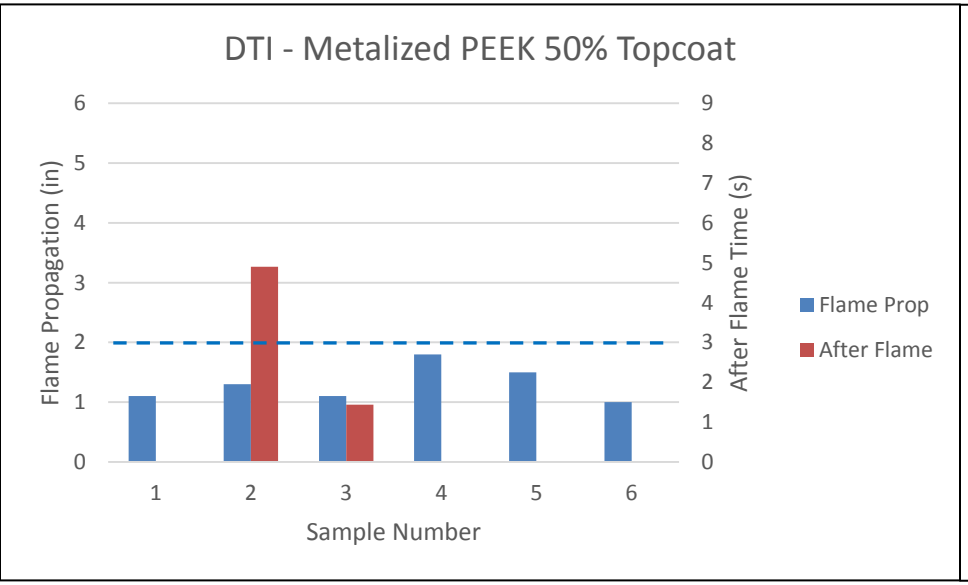
- Received two materials
  - Metalized PEEK with 50% Top Coat
  - Metalized PEEK with No Top Coat

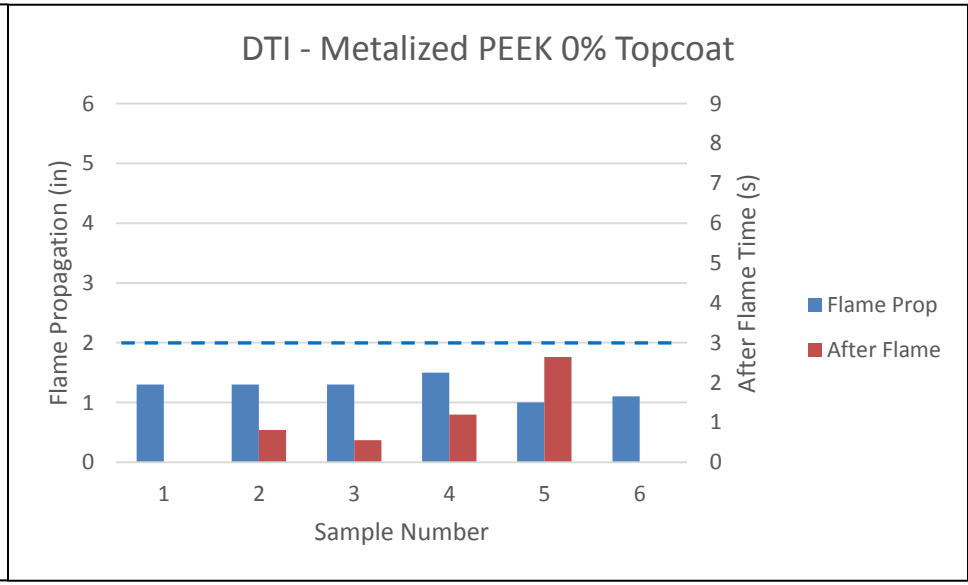





FAA - Metalized PEEK 50% Top Coat
Flame Propagation (in)
After Flame Time (s)
Sample Number
Flame Prop
After Flame

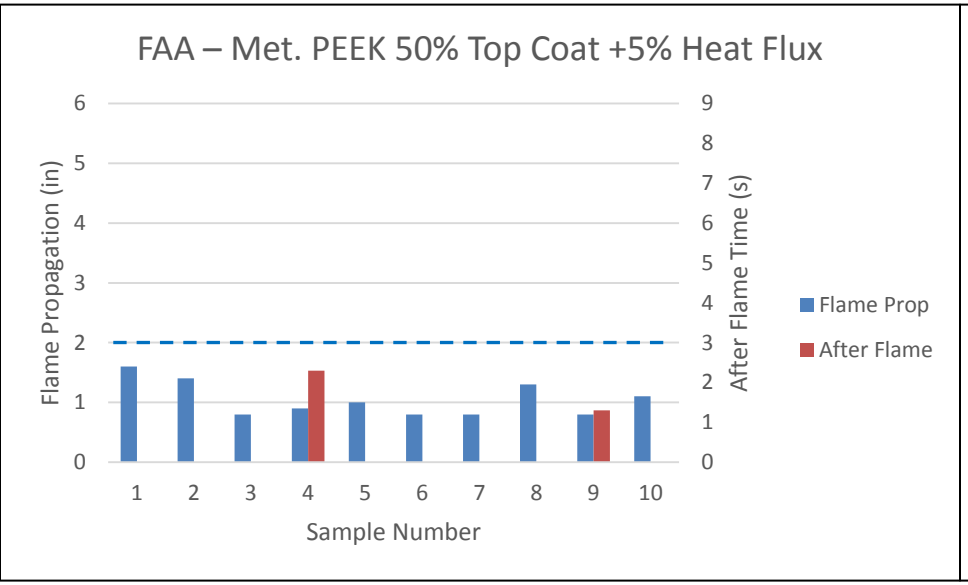

FAA - Metalized PEEK 0% Top Coat
Flame Propagation (in)
After Flame Time (s)
Sample Number
Flame Prop
After Flame

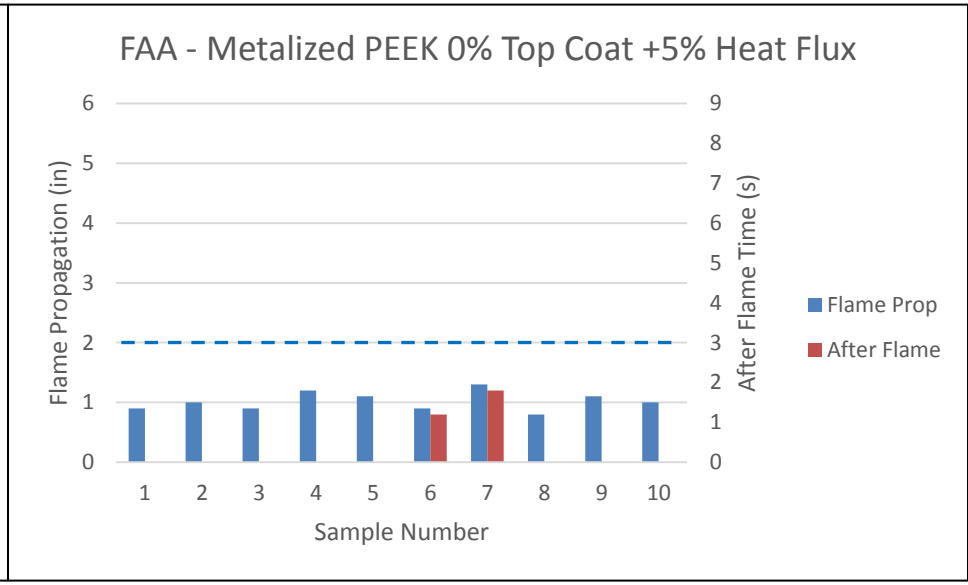

DTI - Metalized PEEK 50% Topcoat
Flame Propagation (in)
After Flame Time (s)
Sample Number
Flame Prop
After Flame


DTI - Metalized PEEK 0% Topcoat
Flame Propagation (in)
After Flame Time (s)
Sample Number
Flame Prop
After Flame

More FAA Testing

- Increased heat flux from 1.500 Btu/ft^{2}s to 1.575 Btu/ft^{2}s (+5%)



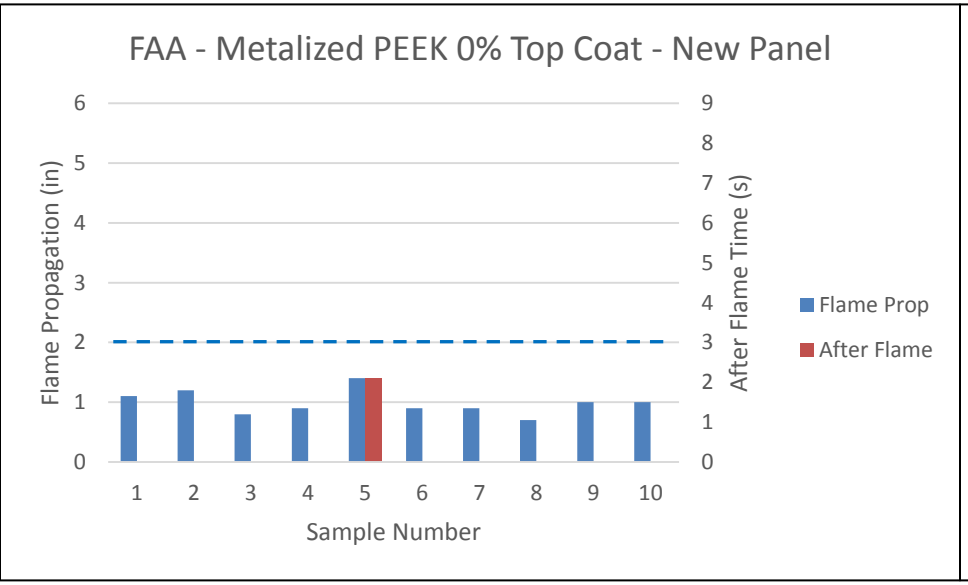


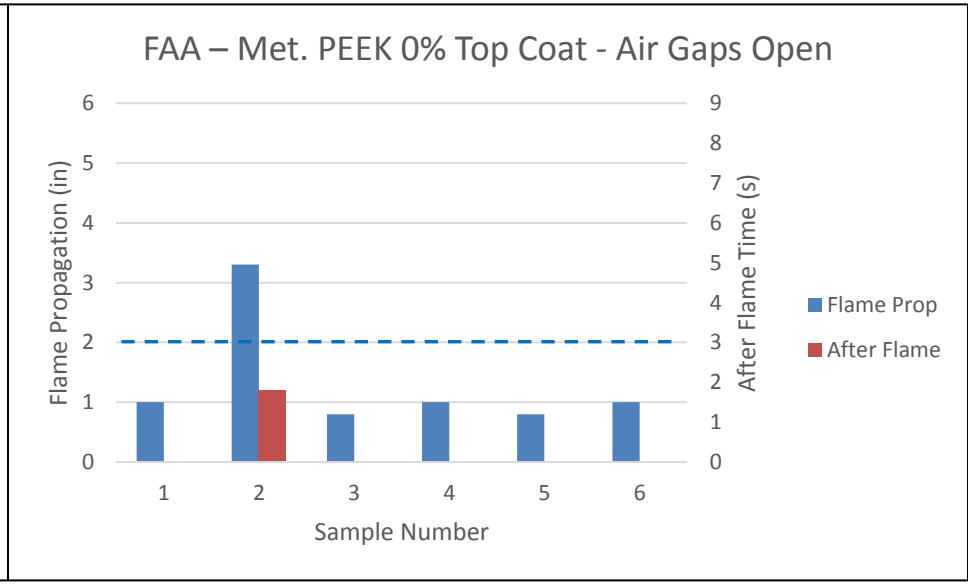
More FAA Testing

- Opened air gaps around drawer
  - Finally got a failure!

	Original	Open
Left	0.375	2.125
Right	0.125	1.875
Rear	2.25	2.25
Front	0	0

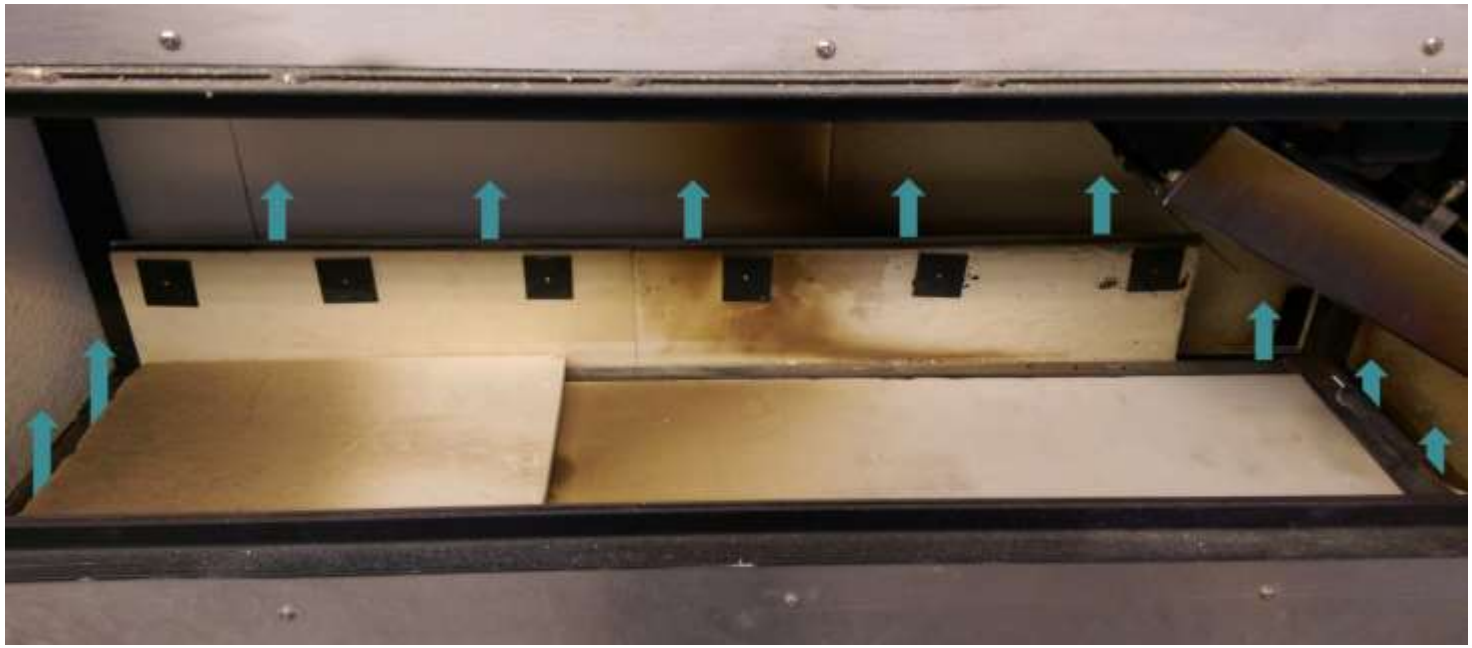
- Installed new panel





Air Gaps Around Drawer

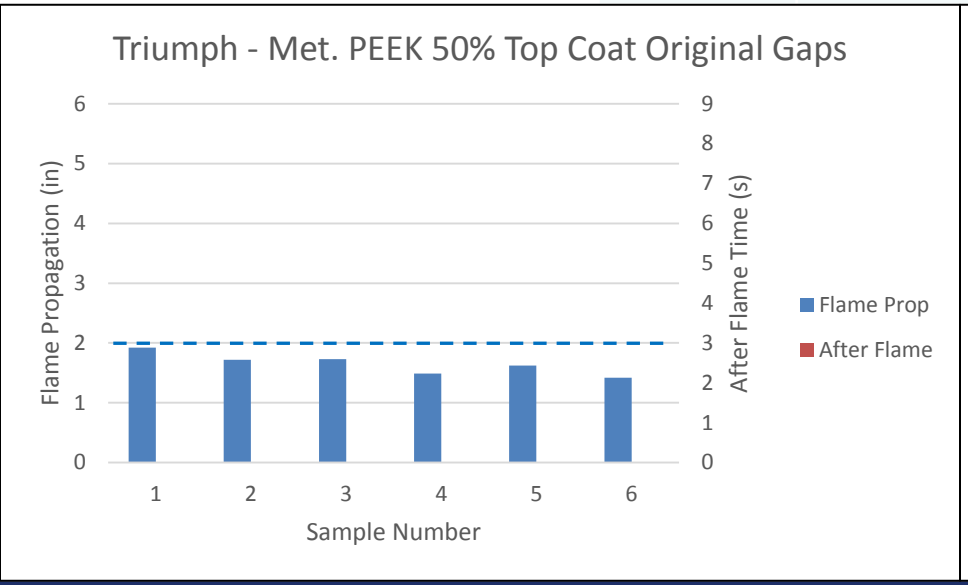
- **Previously Studied in 2016-2017**
- **2 out of 4 labs showed more failures with gaps closed, other 2 showed no statistical difference**

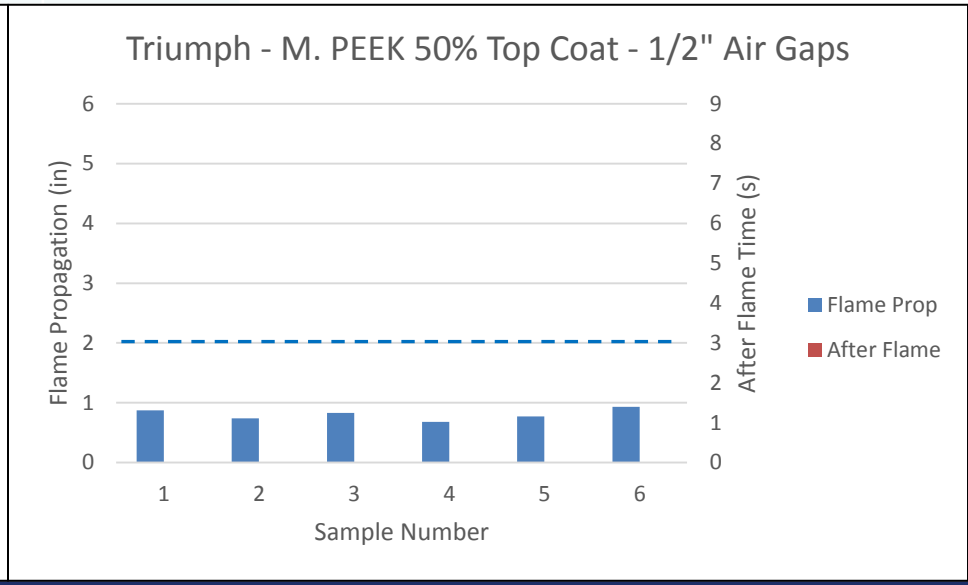


Triumph Testing

- Installed new panel since previous testing
- Larger air gaps around drawer than FAA Radiant Panel

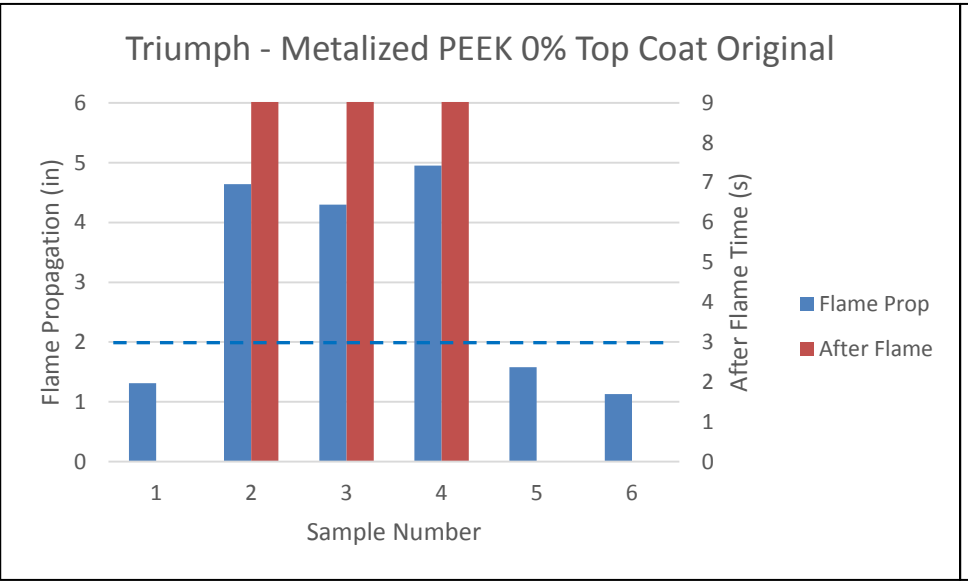
	Original	½” Gaps
Left	2.25	0.5
Right	2.5	0.5
Rear	1	0.5
Front	1.5	0

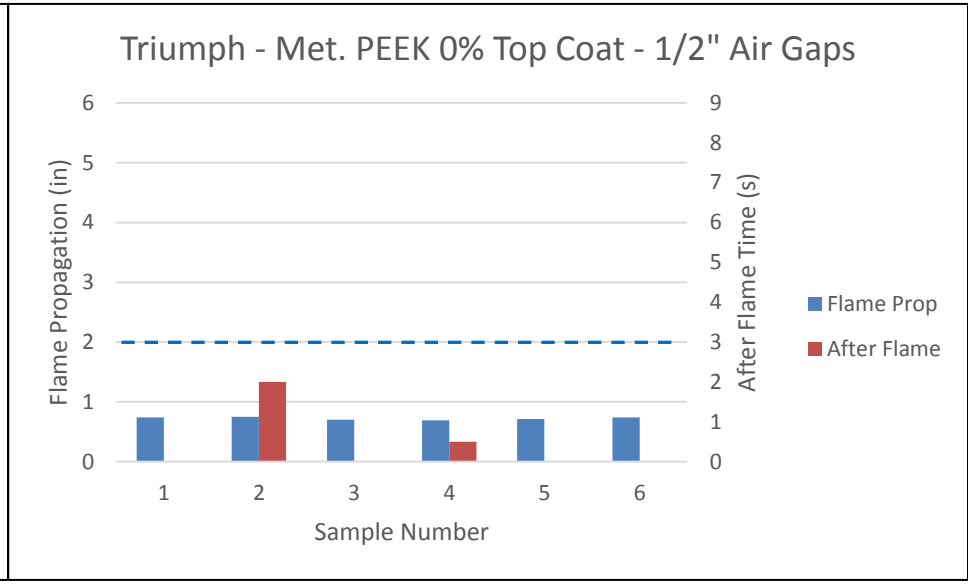




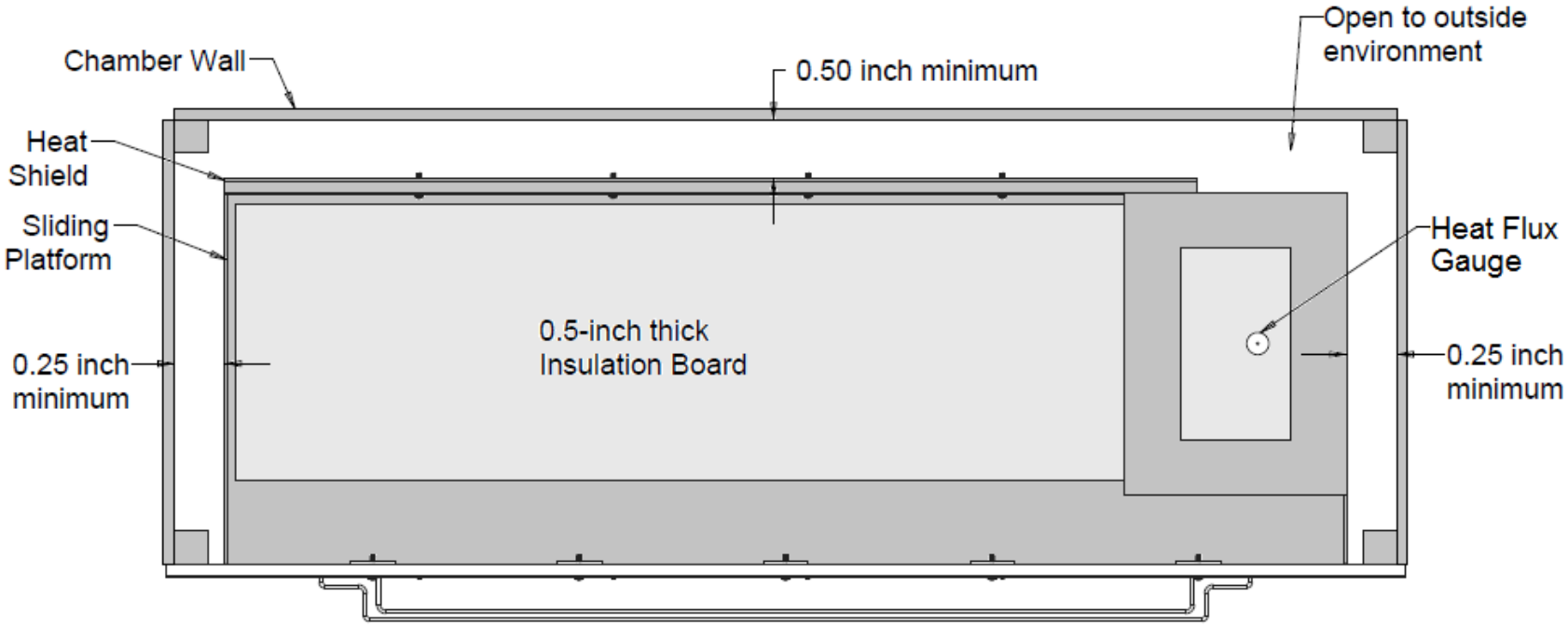
Triumph Testing

- All samples passed when air gaps around drawer were reduced
- In Previous 2016-2017 Study, more samples failed when gaps were closed rather than open





Airflow Around Drawer



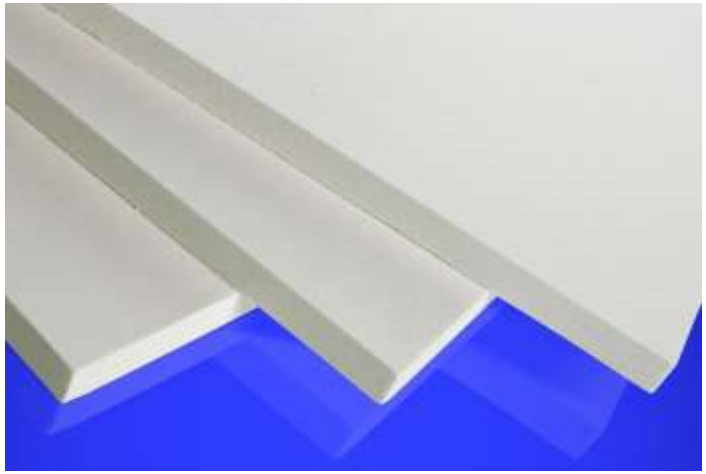
- Previously added this drawing to the new rule (not the current handbook)
- Essentially required that area around drawer not be completely closed off
- Do we need to get more specific?
- Gap on right side under panel has larger effect than left side

Backing Board Study

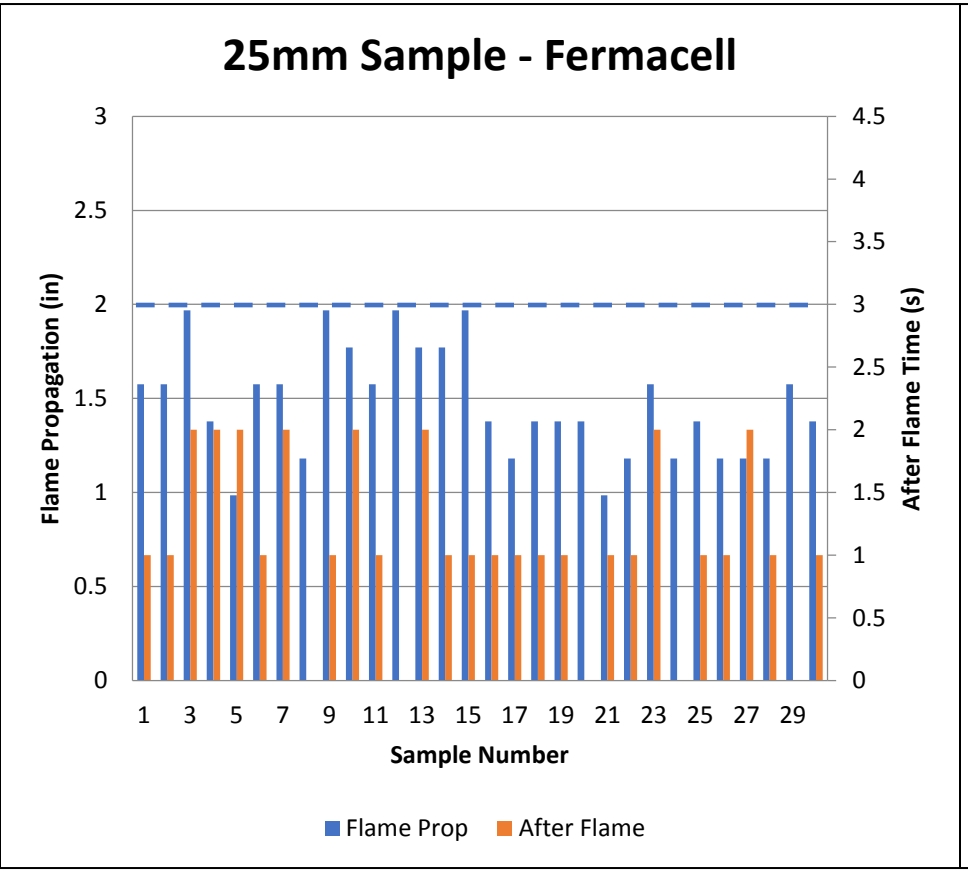
- **Reported problems with certain foam materials that melt and stick to the backing board affecting subsequent tests**
- **Backing board should not interfere with test**
- **Zotefoam organized a study with the FAA and Wulfmeyer**
- **Foam in 25 mm and 3 mm thicknesses**
- **Two different backing boards**
- **3 boards, rotate every test**
- **Melted foam scraped off between tests**
- **30 samples for each combination**

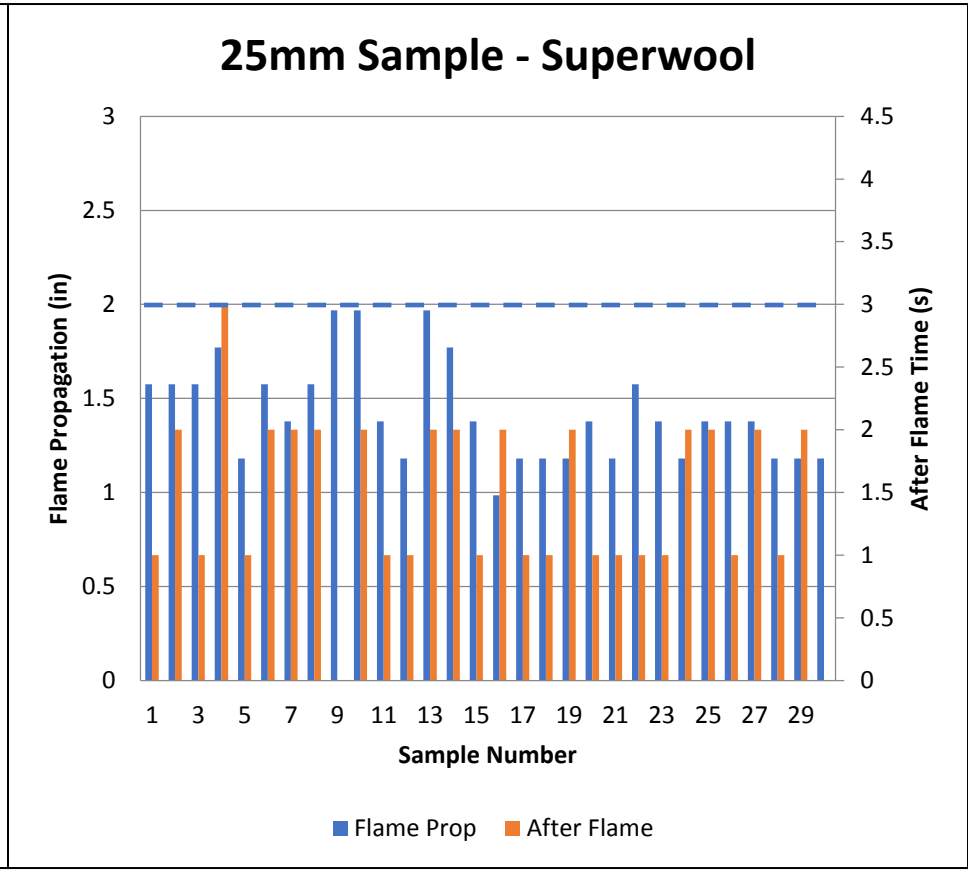
Backing Board Study

	Superwool 607 (67% Silica (SiO_2), 27% Calcium Oxide + Magnesium Oxide)	**Fermacell Gypsum Fibreboard Greenline** (Gypsum and Recycled Paper Fibers)
Density (kg/m³)	320 – 350	1150 ± 50
Thermal Conductivity (W/m·K)	0.06 @ 260°C (500°F) (increases with temperature)	0.32 @ 10°C (50°F)



Wulfmeyer Results

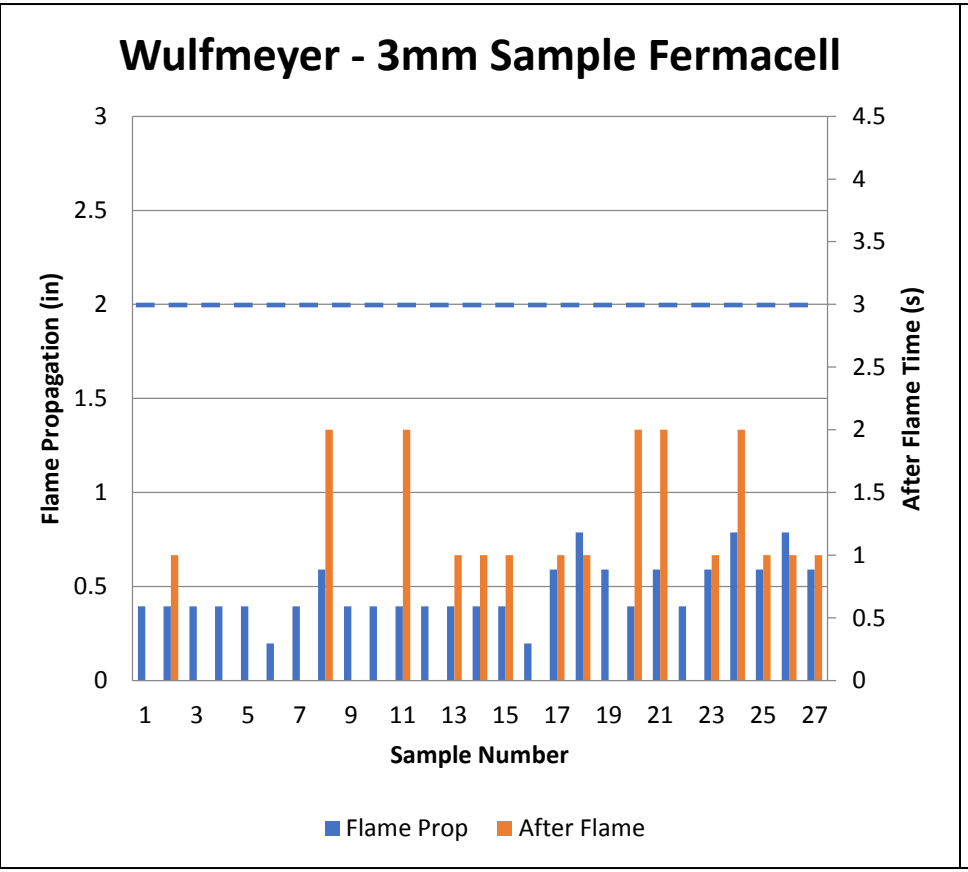


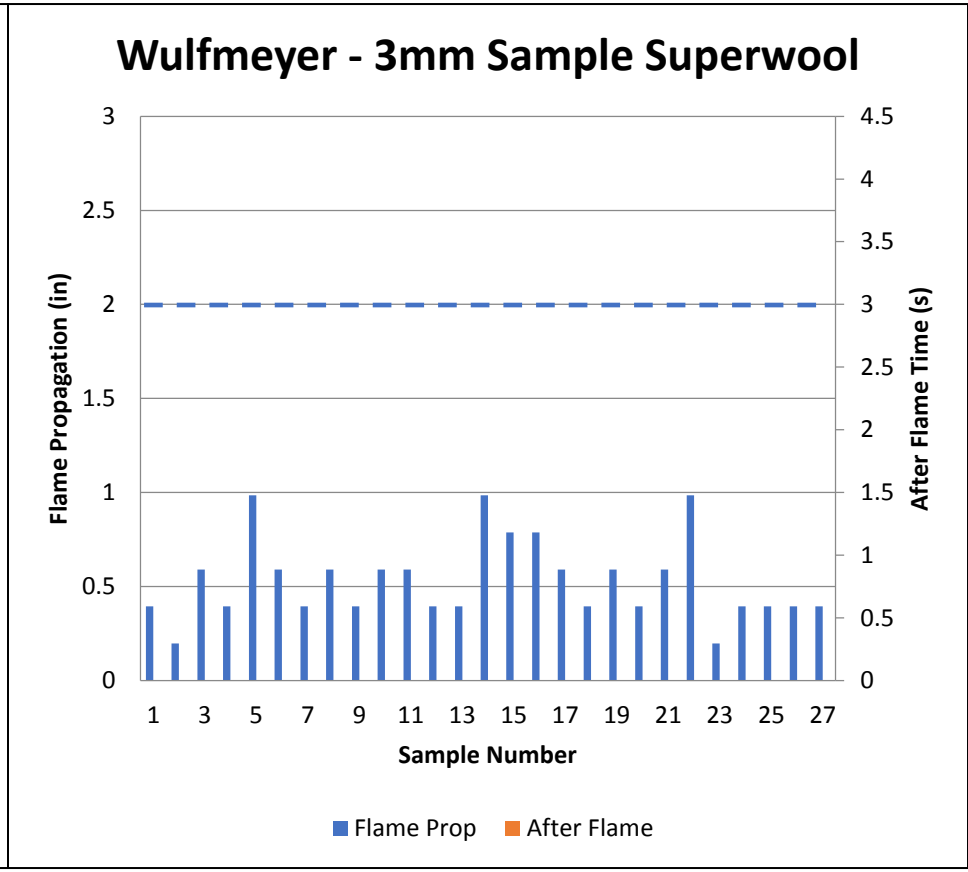


Flame Propagation Average: 1.47 in
After Flame Time Average: 1.1 s
Failures: 0

Flame Propagation Average: 1.42 in
After Flame Time Average: 1.43 s
Failures: 0

Wulfmeyer Results

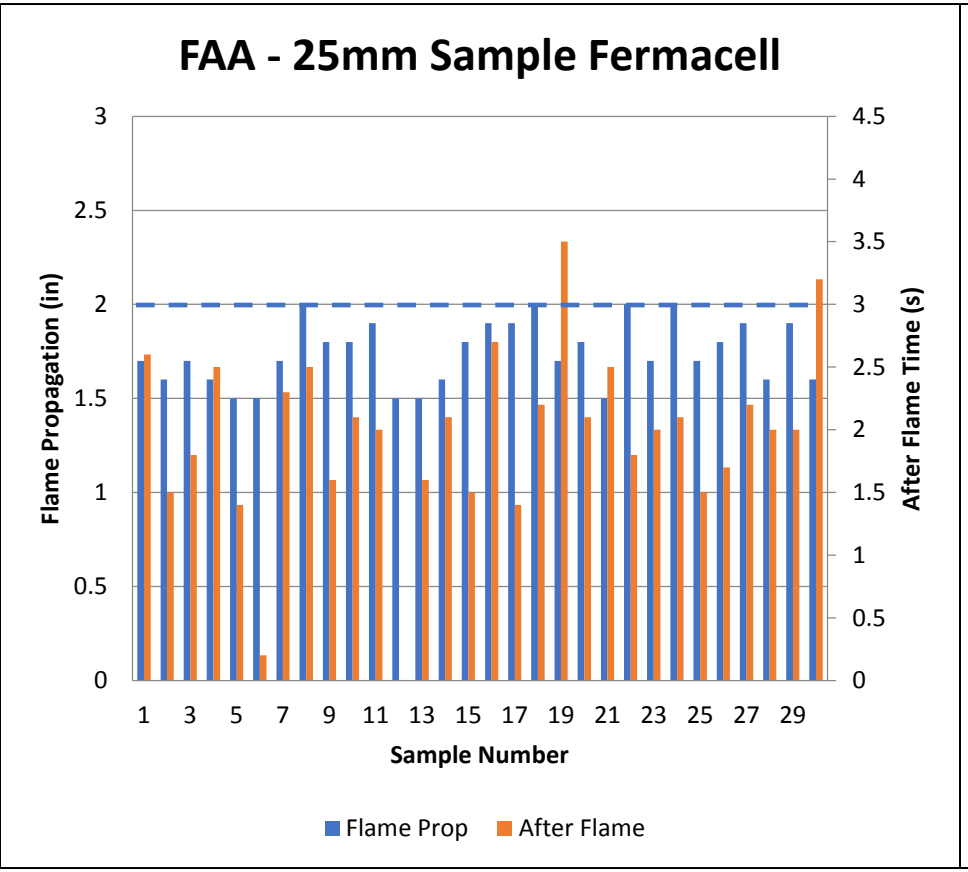


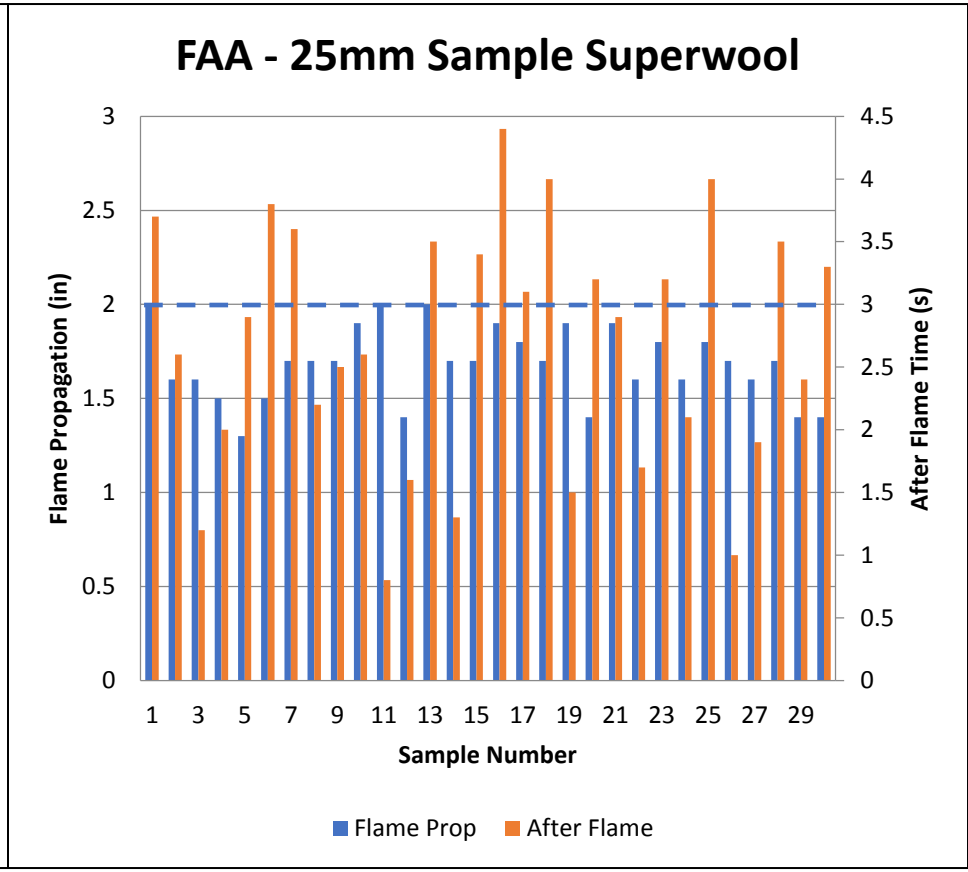


Flame Propagation Average: 0.47 in
After Flame Time Average: 0.74 s
Failures: 0

Flame Propagation Average: 0.53 in
After Flame Time Average: 0 s
Failures: 0

FAA Results

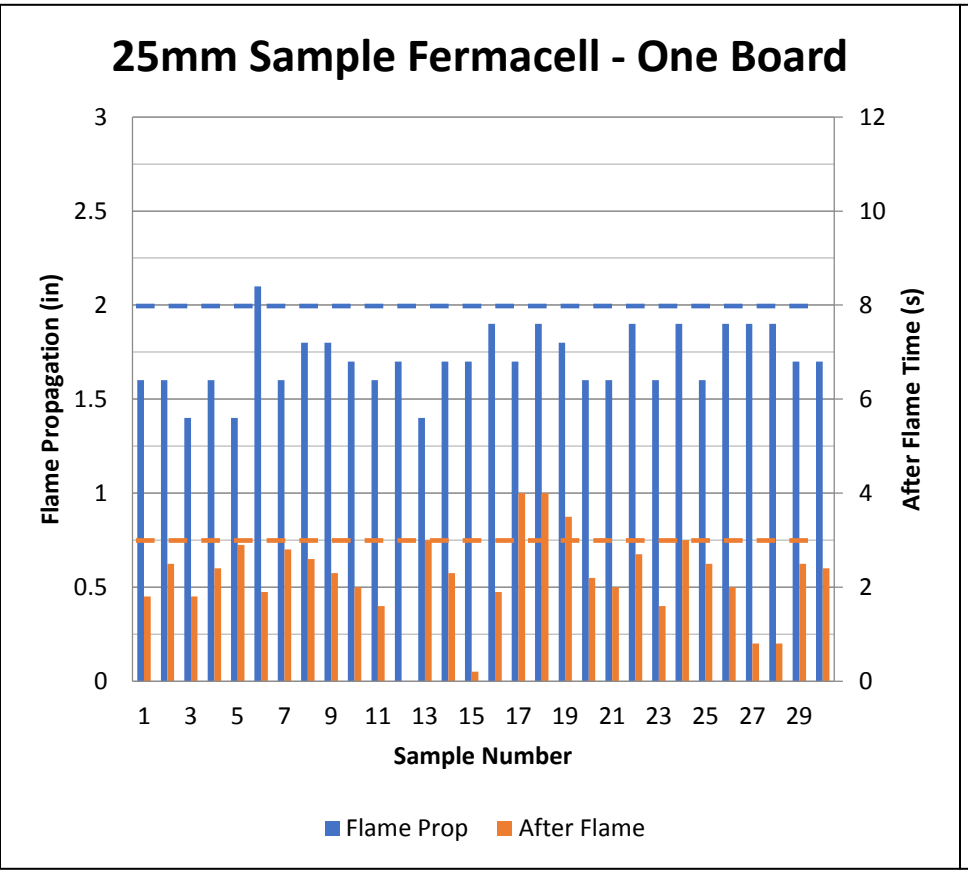


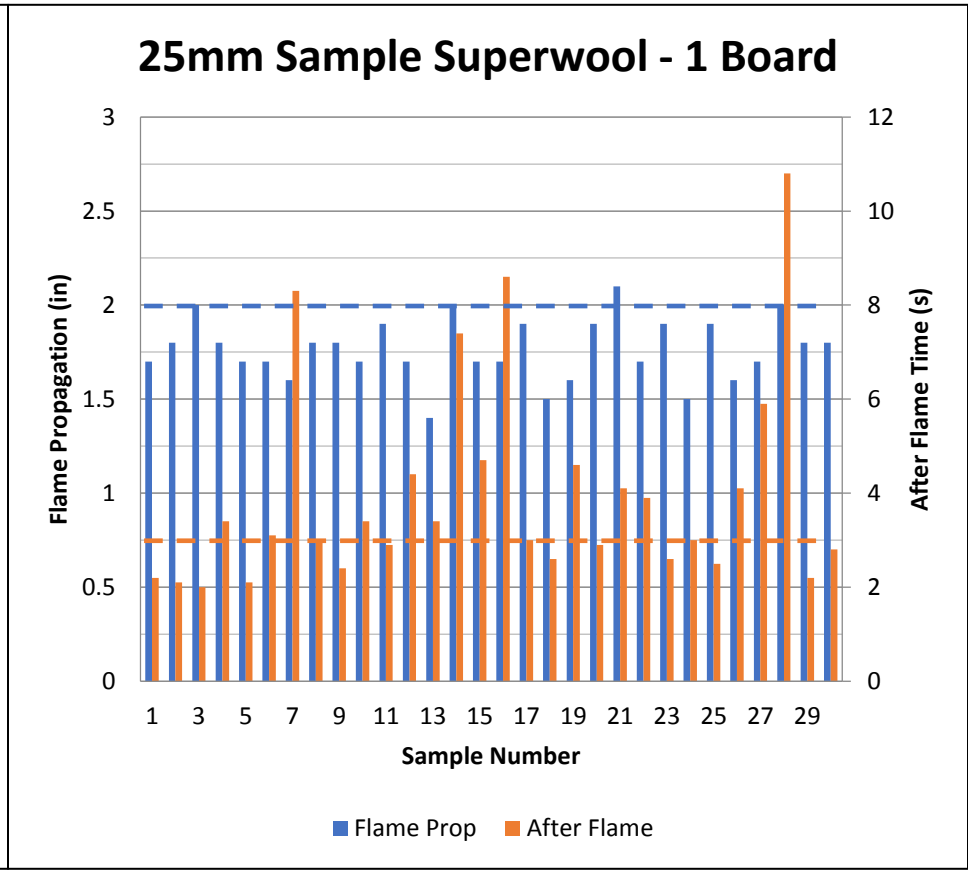


Flame Propagation Average: 1.74 in
After Flame Time Average: 1.95 s
Failures: 2

Flame Propagation Average: 1.68 in
After Flame Time Average: 2.66 s
Failures: 13

FAA Results (One board for all tests)





Flame Propagation Average: 1.71 in
After Flame Time Average: 2.20 s
Failures: 4

Flame Propagation Average: 1.76 in
After Flame Time Average: 3.95 s
Failures: 15

Conclusion

- **Need borderline material to test for panel aging study**
- **Do we need to be more specific for openings around drawer?**
- **Fermacell had higher after flame times for 3 mm sample in Wulfmeyer testing**
- **Superwool had higher after flame times for 25 mm sample in FAA testing**
- **Rotating Fermacell boards did not seem to have an effect**
- **More testing still to be done**

Questions?

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