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·ft²·°F (0.072W/m·K) at 500°F (260°C)
  – Minimum density of 15 lb/ft³ (240 kg/m³)
  – 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
More FAA Testing

- Increased heat flux from 1.500 Btu/ft\(^2\)s to 1.575 Btu/ft\(^2\)s (+5%)
More FAA Testing

• Installed new panel

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

<table>
<thead>
<tr>
<th></th>
<th>Original</th>
<th>Open</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>0.375</td>
<td>2.125</td>
</tr>
<tr>
<td>Right</td>
<td>0.125</td>
<td>1.875</td>
</tr>
<tr>
<td>Rear</td>
<td>2.25</td>
<td>2.25</td>
</tr>
<tr>
<td>Front</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
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

<table>
<thead>
<tr>
<th></th>
<th>Original</th>
<th>½” Gaps</th>
</tr>
</thead>
<tbody>
<tr>
<td>Left</td>
<td>2.25</td>
<td>0.5</td>
</tr>
<tr>
<td>Right</td>
<td>2.5</td>
<td>0.5</td>
</tr>
<tr>
<td>Rear</td>
<td>1</td>
<td>0.5</td>
</tr>
<tr>
<td>Front</td>
<td>1.5</td>
<td>0</td>
</tr>
</tbody>
</table>

Triumph - Met. PEEK 50% Top Coat Original Gaps

Triumph - M. PEEK 50% Top Coat - 1/2” Air Gaps
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
Backling 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

<table>
<thead>
<tr>
<th></th>
<th>Superwool 607 (67% Silica (SiO₂), 27% Calcium Oxide + Magnesium Oxide)</th>
<th>Fermacell Gypsum Fibreboard Greenline (Gypsum and Recycled Paper Fibers)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Density (kg/m³)</strong></td>
<td>320 – 350</td>
<td>1150 ± 50</td>
</tr>
<tr>
<td><strong>Thermal Conductivity (W/m·K)</strong></td>
<td>0.06 @ 260°C (500°F) (increases with temperature)</td>
<td>0.32 @ 10°C (50°F)</td>
</tr>
</tbody>
</table>
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)

25mm Sample Fermacell - One Board

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

25mm Sample Superwool - 1 Board

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

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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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