RTCA Development of a New Flammability Test for Electronic Boxes

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Introduction

- RTCA DO-160G is the current international standard for environmental testing of commercial avionics
- Section 26, Category C defines the flammability testing requirements for electronic housings and component parts
- Next revision for DO-160(H) is due January 2019
- The goal is to create an alternative test procedure where the electronic enclosure with its internal components is tested whole instead of testing each part individually
## Current test standards

### Table 26-2  
Type of Test Determination

<table>
<thead>
<tr>
<th>Components</th>
<th>Method</th>
<th>Paragraph</th>
</tr>
</thead>
<tbody>
<tr>
<td>All materials other than rubber or elastomer parts, wire and cable</td>
<td>Vertical 12 second bunsen burner test</td>
<td>26.6.2</td>
</tr>
<tr>
<td>Rubber or elastomer parts</td>
<td>Horizontal bunsen burner test</td>
<td>26.6.3</td>
</tr>
<tr>
<td>Wire and cable</td>
<td>60 degree bunsen burner test</td>
<td>26.6.4</td>
</tr>
</tbody>
</table>

- Small part exemptions
Draft Test Procedure

• First Draft October 2016
• Based on telecom Industry test (ANSI T.319)
• Methane line burner as fuel source
• \( 11 \frac{7}{64} " \) holes spaced \( \frac{1}{2} " \) apart
• Fuel regulated by a methane flow controller (simulates circuit board igniting and burning through to completion)

![Diagram](image-url)
Draft Test Procedure

• If printed circuit boards (PCB) are oriented horizontally, methane flow rate is fixed at 5L/min for 120s

• If PCBs are vertical, methane flow rate follows a curve based on PCB height

\[ Q_{\text{peak}} = (0.071 \times h^{1.26} - 0.03) \times 1.8 \]

- \( Q_{\text{peak}} \) = Maximum methane flow rate (L/min)
- \( h \) = vertical dimension of tallest PCB (cm)
Draft Test Procedure

Scaled Methane Flow Rate Examples

Methane Flow Rate (L/min)

Time (s)

- 7 cm Board
- 15 cm Board
- 22 cm Board
- 29 cm Board
Draft Test Procedure

• Requires insertion of a programmable burner into the equipment chassis
• Flame is placed to impinge area within chassis with most fuel load
• Burner placed at 45° angle towards PCB for vertical PCBs.
• Pass/Fail Criteria: As a starting point, we agreed to use 12 second flame with 1.5” height as the maximum allowable flame to escape, based on vertical Bunsen Burner test
FAA Line Burner

- Line burner set up at FAA Tech. Center for testing
- Fully functional, just need to finish the programming which should be done within the next week or two
Future Work

• Much more testing needs to be done to refine test procedure
  – Number of burns required
  – Changes to fuel flow rate?
  – Changes to pass/fail criteria
  – Burner placement for testing wire bundles
  – Placement of burner for vertical and horizontal PCBs
  – Procedure currently states that burner should be placed at the edge of PCB for fan cooled equipment as far from the fan as possible
  – Placed at the middle of the PCB for non-fan cooled equipment
  – Improve test procedure for the burner flame extinguishing when inserted into the box
Planned FAA Testing

• Comparison testing with Bunsen Burner
  – Must retain or improve level of safety
  – Compare material ignition times

• Test horizontal and vertical PCBs
• Test fan-cooled equipment
• Test different fuel flow rates
• Need to source electronic boxes
• Possibly make a generic box that can be tested several times with only replacing the insides
Questions?

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