

Aircraft Wiring

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Purpose

- Develop an improved and simplified test method and procedure for aircraft electrical wiring.
- This test method is intended for determining the resistance of electric wire insulation to flame using test methods according to the Technical Report No. DOT/FAA/AR-10/2 “Development of an Improved Fire Test Method and Criteria for Aircraft Electrical Wiring”.
- This is the new wire test we are currently developing at the FAA Technical Center.

Test Specimens

- XLETFE wire insulation type from two manufacturers, AWG # 20, with 0.006, 0.008 & 0.010” wall thicknesses, compatible with SAE AS22759/41, /42, /45 specifications. For cable construction were used twisted pairs with same component wires as above, AWG # 2, # 20 and # 22, flat and round shields & jacket, compatible with NEMA WC 27500 specification
- And COMPOSITE – POLYTETRAFLUOROETHYLENE/POLYIMIDE wire insulation type, smooth surface, light weight and normal weight, nickel-coated copper conductor, AWG # 20 and 22, compatible with SAE AS22759/187 & /192 specifications from two manufacturers. For cable construction we used twisted pairs with the same component wires as above, AWG # 20 and # 22, round shields & jacket, compatible with NEMA WC 27500 DK and DR specifications.

Test Methods and Apparatus

- With exception of number of wires and cables in the bundles and bundle diameters, test methods and apparatus were in accordance with Draft version 5.7, Chapter 4 (Flammability Test Method and Criteria for Aircraft Electrical Wiring).
- Tests were performed on individual wires and cables and on bundles with 7 wires and 7 cables.

Conclusions

- Results of these tests demonstrate that no significant difference in resistance to flame of electric wire or cable with XLETFE or Composite (Polytetrafluoroethylene/Polyimide) insulation are noted when tested in the wire bundle configuration or as individual components, with different wall thicknesses, different shields (for cables), or with different AWG.

Recommendations to Working Group

Discussion on testing a single wire/cable versus bundles.

- Testing three (3) specimens of single wires from same manufacturer of AWG = 20, 0.008" wall thicknesses for XLETFE insulation type, and normal weight for Composite insulation type (as per SAE AS or EN specs).

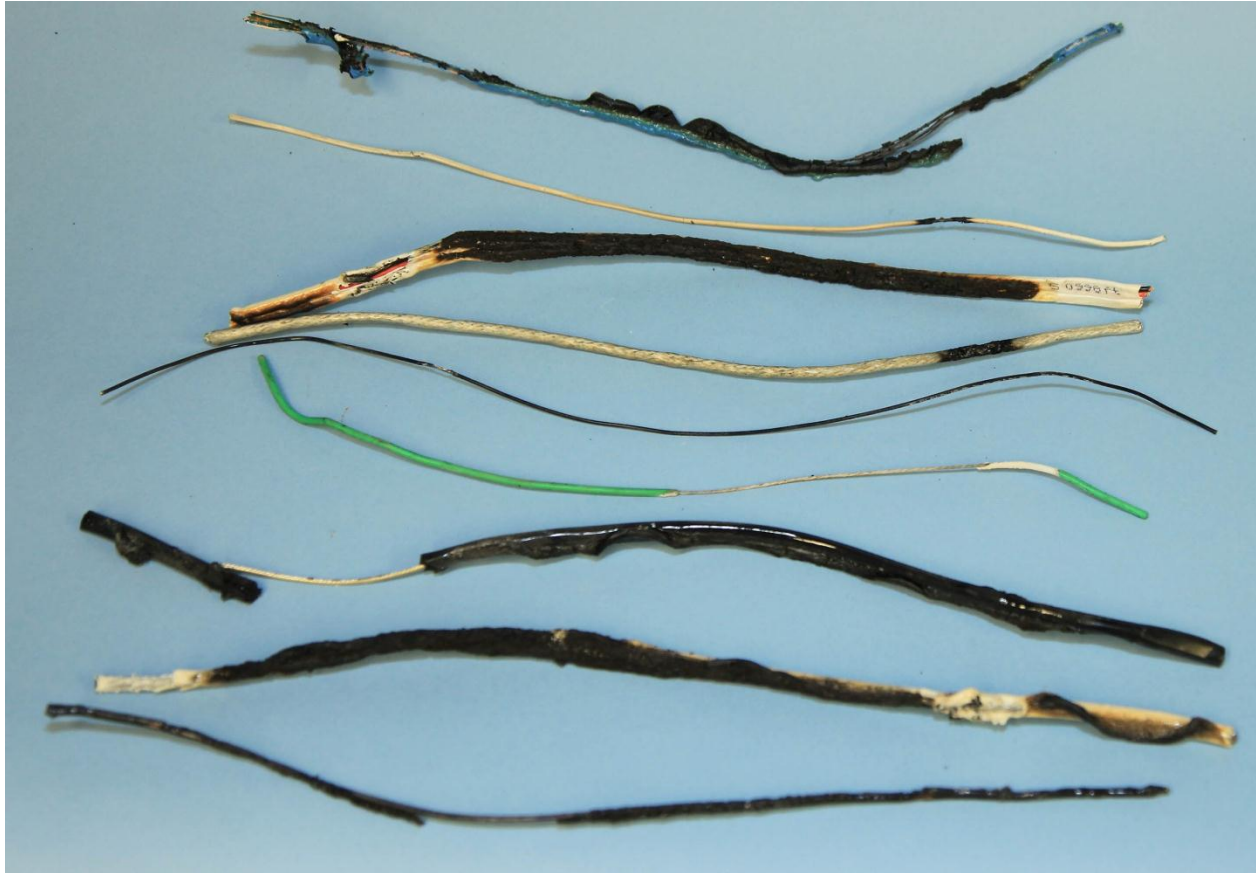
Or

- Three (3) specimens of the cables, having twisted pair, component wires from above (AWG = 20, 0.008" wall thicknesses or normal weight for Composite insulation) from same manufacturer and in accordance with NEMA WC 27500 or EN specs.

Wire Testing

- Many different wires have been tested including non-aviation grade wires. Each of these wires was tested as a single wire (not a bundle).
- The following are pictures of some of these wires:
 - 12 AWG THNN black solid
 - 10 AWG THNN white stranded
 - Transformer GTO-15 ignition cable
 - Green braid less silicone rubber
 - MIL-W-22759/11 black
 - Clear communication
 - CCTV PTZ cable white
 - MIL –W-81044 20 AWG
 - Blue Cat 3
- From these pictures, it is obvious that this new test is quite stringent and very few (if any) non-aviation grade wires can pass this test.

Wire Testing



Sleeves and Heat Shrink Tubing

- **Sleeves**

- We made the decision to use copper tubing as the non-combustible core for sleeves and heat shrink tubing.
- A 13 inch +/- 0.125 inch (330mm+/_ 6.35mm) long piece of ¼ inch (6.35mm) outer diameter (OD) copper tube is the size used for sleeves.
- A 14 ½ inch (368mm) long piece of ½ inch (12.7mm) sleeve material is the size for use over the copper tube.
- Lacing cord or safety wire should be used to tie the sleeving around the copper tube.
- Videos of testing are available on our website in my presentation at the last meeting in June 2012.

Sleeves and Heat Shrink Tubing

- **Heat Shrink Tubing**

- A 13 inch ± 0.125 inch (330mm ± 6.35 mm) piece of 3/8 inch OD (9.52mm) copper tube is used for heat shrink tubing.
- A 14 inch (355mm) long 2:1 piece of 0.47inch (11.9mm) shrink tubing is the size for use over the copper tube.

TFE Heat Shrink Tubing over 3/8 inch Copper Tube



Task Group Discussion

- What labs will conduct wire testing?
- Questions concerning the test method.
- Sentiments on single wire testing, sleeve and heat shrink tubing methods using the copper tube.
- Plans for a Round Robin.
- Finding a wire (other than riser cable) that passes the 60° flammability test but fails the new wire flammability test method has been futile, to date.
- Remember, this is a **test method** to evaluate **wire flammability**, not a **materials test**.

Under Investigation

- Radiant Panel oriented vertically in small chamber.
- We will begin evaluating wire samples in this chamber.
- This test method is going to be evaluated for this application and this evaluation should not be interpreted as a planned change in test method.
- For now, the current wire test performed in the standard Radiant Panel Test Chamber is the test method we are focusing on.