

AGING TRANSPORT SYSTEMS RULEMAKING ADVISORY COMMITTEE

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January 21, 2005

SAE International
400 Commonwealth Drive
Warrendale, PA 15096-0001
Attention: Chairman SAE AE-8

Dear Chairman:

The Aging Transport Systems Rulemaking Advisory Committee (ATSRAC) Harmonization Working Group #12 (HWG12) has recently reviewed the results of the draft FAA report titled *Effects of Related and Unrelated Maintenance on the Integrity of Aircraft Electrical Interconnect Systems (EWIS)* dated 28 November 2003. The results of this study lead ATSRAC to make several recommendations to SAE.

Research Findings

The above referenced report detailed issues that were found during a research program related to the inability of shield terminators to seal properly. The shield terminators were installed at the end of a twisted shielded pair, as is common practice in the industry. The resulting testing indicated that these shield terminator interfaces often could not seal against water at atmospheric pressure. These parts are qualified with an altitude immersion followed by a dielectric withstand voltage, and most installers assume that the resulting interface should be environmentally sealed unless a cable of four or more primaries is used. It is noted that qualification testing is performed only on terminations that are installed in a stripped center section of cable ("window installation"), which has significantly different characteristics than end installations. The report did not detail the safety ramifications of cables for which the environmental sealing is not known.

Based in part upon this report, ATSRAC HWG12 supports the development of an improved shield terminator to better seal the shield/pigtail interface. Prior to such development, provide limitations on or additional guidance to assembly and standard industry documentation.

Related documentation

AS50881 Wiring, Aerospace Vehicle

3.12.1.1 AS83519 shield terminators shall be used in terminating tin and silver coated shields except when the operating temperature they are to be installed in exceeds the maximum rated operating temperature of the device. Control temperature solder devices shall be installed in accordance with AS4461. The unterminated end of a shield shall be covered with shrink sleeving.

AS4461 Assembly And Soldering Criteria For High Quality/High Reliability Soldered Wire And Cable Termination In Aerospace Vehicles

4.8.5.3 Braided Shield Terminations: Controlled soldering devices for shield termination shall be installed in accordance with MIL-S-83519. Shield terminators shall be assembled in accordance with this document (see 5.2.3) or in accordance with detailed work instructions prepared to reflect the requirements and documented on an approved assembly drawing.

5.2.3.2 Shield Terminations (MIL-S-83519): A solder fillet shall be clearly visible along the interface between the shield and the ground lead or terminal. The solder preform shall have melted and the contour of the solder preform shall not be visible. If the solder device contains a thermal indicator to show proper heating, the applicable indication of proper heating shall be observable. Sealing inserts, if present, shall melt and flow along the wires. When more than one wire is terminated to the shield, the additional wires may be tinned prior to termination. The contours of the shield and the ground lead or terminal shall not be obscured by solder. The outer sleeve may be darkened, but the connection area shall be visible. Slight discoloration of the wire insulation outside of the sleeve is acceptable. (See Figure 14.)

Figure 14 – Controlled Soldering Devices – Shield Terminations

Figure (14) shows a window installation only.

The component slash sheets show both window and end configurations. In both slash sheets, a cautionary note is included for sealing with end stripped cables of greater than three primaries. A qualification note refers to the basic specification for how to terminate samples for qualification.

AS83519/1 Shield Termination, Solder Style, Insulated, Heat shrinkable, Environment Resistant For Cables Having Tin Or Silver Plated Shields (Class I)
and

AS83519/2 Shield Termination, Solder Style, Insulated, Heat shrinkable, Environment Resistant With Pre Installed Leads For Cables Having Tin Or Silver Plated Shields (Class I)

QUALIFICATION.

...THE TERMINATIONS SHALL BE INSTALLED PER THE "ASSEMBLY TO CABLE" PARAGRAPH IN MIL-S-83519 USING THE APPLICABLE CONVECTION AND INFRARED HEAT SOURCES.

NOTES:

1. WHEN PERFORMING END STRIPPED CABLE SEALING THE BEST RESULTS ARE OBTAINED WHEN THE SMALLEST SIZE TERMINATION FOR THE CABLE/LEAD WIRE COMBINED IS USED. SEALABILITY ON CABLES WITH MORE THAN THREE PRIMARIES OF AWG 22 AND LARGER REQUIRES SPECIAL PRECAUTIONS.

The basic specification defines the qualification samples as being window stripped only, but does not address how the termination is to be installed in an application.

AS83519A Shield Termination, Solder Style, Insulated, Heat-Shrinkable, Environment Resistant, General Specification For

(4.4 Qualification Inspection)

4.4.2 Assembly to cables: The terminations shall be attached to the specified cables by the testing activity using the specified tooling. The attachment shall be made in the center of an 8-inch length of cable, the ground lead shall be at least 4.5 inches total. The specified number of sample units shall be divided into four sets of equal size. The four sets shall be installed on the test cables in accordance with the following matrix. The termination shall extend at least .125 inch beyond stripped section of cable after installation.

Recommendations

Based upon this information, the following changes are recommended.

1. Reword the current component specification to add a minimum test in the end configuration, and change precaution to apply to any multi-conductor cable.
- a. Change the note in the slash sheets and basic specification to specify that special precautions should be taken any time an end stripped installation is to be performed. Change note 1 in each slash sheet to the following.

NOTES:

1. WHEN PERFORMING END STRIPPED CABLE SEALING THE BEST RESULTS ARE OBTAINED WHEN THE SMALLEST SIZE TERMINATION FOR THE CABLE/LEAD WIRE COMBINED IS USED. SEALABILITY ON CABLES WITH MORE THAN ~~THREE ONE~~ PRIMARY ~~IES OF AWG 22 AND LARGER~~ IS NOT ASSURED, AND REQUIRES SPECIAL PRECAUTIONS.

- b. Change the basic specification, AS83519, to require end installed terminations in addition to window installed terminations for Group VII testing. Add the following wording to Paragraph 4.4.2 Assembly to Cable.

4.4.1 Sample size: Forty ~~three seven~~ (437) terminations of each size for each specification sheet (see 3.1) for which qualification is sought shall be submitted to the activity responsible for qualification (see 6.5). See Paragraph 4.4.7.

4.4.2 Assembly to cables: The terminations shall be attached to the specified cables by the testing activity using the specified tooling. The attachment shall be made in the center of an 8-inch length of cable for all but four terminations, which shall be installed in an end configuration. The ground lead shall be at least 4.5 inches total. The specified number of sample units shall be divided into four sets of equal size, with each set containing one end installed sample unit. The four sets shall be installed on the test cables in accordance with the following matrix. The termination shall extend at least .125 inch beyond stripped section of cable after installation.

- c. Change Table I to increase the quantity tested in Group I by 4 (to 47 total) to cover additional items.
 - d. Change the quantity tested in Group VII to double the items tested (from 4 to 8 total) to include a set of 4 terminations end installed as well as the set of 4 terminations that are window installed. This will ensure that the qualified terminations, at a minimum, can meet the electrical requirements following immersion in an end installation on electrical cables with multiple primaries.
2. Insert wording in AS50881 to indicate that special precautions may be necessary to ensure proper sealing.

3.12.1.1 AS83519 shield terminators shall be used in terminating tin and silver coated shields except when the operating temperature they are to be installed in exceeds the maximum rated operating temperature of the device. Control temperature solder devices shall be installed in accordance with AS4461. End installations on cables with more than one primary may not assure a tight seal, and requires special precautions. The unterminated end of a shield shall be covered with shrink sleeving.

3. Encourage the development of an improved shield terminator that will allow users to install the shield terminator in the end configuration, with some assurance that environmental sealing will occur if installed properly. This shield terminator should be adopted into an industry standard. A diagram and charts would assist the user in choosing the appropriately sized terminator for end installations.

Adding the appropriate precautions and modifying the industry standards should provide better understood performance of end installed shield terminators as they currently exist. A new shield terminator, specifically designed for end installations, would provide users additional standardized methods to properly seal wiring installations resulting in enhanced performance of wiring installations.

ATSRAC appreciates your consideration of these important recommendations.

Sincerely,

Kent V. Hollinger
ATSRAC Chairman

Cc: FAA AVR-1, AIR-1, AFS-1, ARM-1, ANM-117