



AEROSPACE RECOMMENDED PRACTICE

ARP6216™

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EWIS Wiring Insulation Breakdown Testing

RATIONALE

Standardization of Electrical Wiring Interconnect Systems (EWIS) insulation breakdown testing for aerospace systems is critical for safety of maintenance personnel and preservation of aircraft systems. Reliable electrical insulation is a critical component of EWIS airworthiness. Wire insulation is constantly stressed over its life. Dirt, moisture, various fluids, corrosion, vibration, electrical spikes and surges, mechanical stresses from pulling and tugging, and many other factors add up to further deteriorate insulation. This can be instantaneous, but is more likely to be a slow and steady decline over time. The remaining life of the insulation could be measured in years, or it could break down at the next startup. Hipot (high potential voltage testing) or insulation breakdown testing can assist in finding wiring faults when electrical systems or components are functioning intermittently due to a wiring faults. This ARP provides guidance in effective and safe ways of performing insulation break down testing (hipot) through the use of a Low-Energy High Voltage (LEHV) signal, which induces a spark at a defect location. As with all wire test methods, adherence to recommended process and understanding the limitations of the test equipment and unit under test is pivotal to personnel safety and test outcome.

ARP6216 has been reaffirmed to comply with the SAE Five-Year Review policy.

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1. SCOPE

This SAE Aerospace Recommended Practice (ARP) identifies the minimum requirements for the testing of insulated electrical wiring for on-aircraft, aeronautical and aerospace applications. The testing requirements defined herein, ensure that a wire fault can be found safely when using a high potential voltage tester (hipot). This test is intended to aid in finding a breach in the wire insulation, and not for the identification of the resistance of the insulation. The test method defined herein is limited to equipment which is able to control and limit the DC output to 1500 VDC maximum. This type of wire dielectric tester is typically designed to trip on current leakage and not necessarily on arc detection. This test method is solely designed to identify gross/large wire insulation damage or degradation.

For additional related information on this topic and related test methods, refer to the documents cited in Section 2. They are intended to aid the reader in the direction of this ARP and to provide more indepth information on wire and component insulation testing.

2. REFERENCES

2.1 Applicable Documents

The following publications form a part of this document to the extent specified herein. The latest issue of SAE publications shall apply. The applicable issue of other publications shall be the issue in effect on the date of the purchase order. In the event of conflict between the text of this document and references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

2.1.1 SAE Publications

Available from SAE International, 400 Commonwealth Drive, Warrendale, PA 15096-0001, Tel: 877-606-7323 (inside USA and Canada) or +1 724-776-4970 (outside USA), www.sae.org.

ARP1278	Oscilloscopic Method of Measuring Spark Energy
AS4373	Test Methods for Insulated Electric Wire
AS22759	Wire, Electrical, Fluoropolymer-Insulated, Copper or Copper Alloy
AS50151	Connectors, Electrical, Circular Threaded, AN Type, General Specification For
AS85485	Cable, Electric, Filter Line, Radio Frequency Absorptive

2.1.2 U.S. Government Publications

Copies of these documents are available online at <http://quicksearch.dla.mil>.

MIL-DTL-38999	Connectors, Electrical, Circular, Miniature, High Density, Quick Disconnect (Bayonet, Threaded, And Breech Coupling), Environment Resistant, Removable Crimp and Hermetic Solder Contacts, General Specification For
MIL-STD-1560	Insert Arrangements for MIL-DTL-38999, MIL-DTL-27599 and SAE-AS29600, Series A Electrical Circular Connectors
MIL-T-81490	Transmission Lines, Transverse Electromagnetic Mode
MIL-DTL-17	Cable, Radio Frequency, Flexible and Semi-Rigid, General Specification For
MIL-PRF-28800	Test Equipment For Use With Electrical And Electronic Equipment, General Specification For

2.2 Related Publications

The following publications are provided for information purposes only and are not a required part of this SAE Aerospace Technical Report.

ArcSafe White Paper Defining Safe Operating Envelope of Low-Energy High-Voltage Techniques to Identify & Locate Defects in Electrical Wiring Interconnect Systems
(http://www.ewp.rpi.edu/hartford/users/papers/engr/ernesto/buih/EP/Supporting%20Materials/Literature_References/ref_13.pdf)

Society of Cable Telecommunications Engineers (SCTE) 108 2012 Test Method for Dielectric Withstand of Coaxial Cable
(<http://www.scte.org/documents/pdf/Standards/SCTE%20108%202012.pdf>)

2.3 Definitions

HIPOT TEST FAULT – when a spark or electrical event with greater than the set maximum current leak rate is induced between two wires or between a wire/contact and earth ground (connector case or shield).

HIPOT TEST NO FAULT – when a spark or electrical event with greater than the set maximum current leak rate is not induced between two wires or between a wire/contact and earth ground (connector case or shield). Arcing between two pins at the connector face are not faults rather are indications of too high of voltage being used. See Figure 6.

INTERMITTENT/MARGINAL FAULT - malfunction of a device or system that occurs at intervals, usually irregular, in a device or system that functions normally at other times.

3. EQUIPMENT REQUIREMENTS

3.1 Copper Wiring

For shielded and unshielded copper wiring, cable and wire harness assemblies; all tests shall be performed only after being isolated from the component or aircraft ground plane and from any other devices or components. Testing specifications and methods are defined in the following sections.

3.2 Coaxial Cable, Triaxial, and Quadrax Cable

For coaxial cabling, triaxial, quadrax cabling, and other transmission lines; the use of high voltage potential test gear is not approved. This restriction does not apply to twisted pair or shielded twisted pair wiring.

3.3 Dielectric Withstand Voltage Tester (Hipot Tester)

This test is limited to Dielectric Voltage Withstand DC testers rated at, or below 1500 V. A suitable tester is required for aircraft use which meets the explosion proof performance requirement as per MIL-STD-810. The tester must be able to output a DC voltage capable of being ramped to 1500 VDC maximum, with current limiting to 5 mA peak (3.5 mA rms), with adjustable output frequency mode, and ability to shut down immediately after the fault is detected (spark event). An advanced hipot tester which can also identify the distance to fault utilizing signal processing software can make it easier to locate the fault. Conventional battery powered high potential voltage testers are prohibited. They can only reliably aid in fault location utilizing continuous mode. Since this device continues to energize the wire while an arcing event is occurring, energy continues to disappate at the location of the arc. This energy can cause damage at the connector such as when it arcs from pin to pin. Additional performance requirements may apply as per procuring activity application needs, such as those in MIL-PRF-28800.