



AEROSPACE INFORMATION REPORT

AIR23054™

Issued 2023-10

AS23053/12 Heat Shrink Sleeving Specification Change
from Dielectric Strength to Breakdown Voltage

RATIONALE

Eliminate the steps used to measure and calculate dielectric strength and use the direct breakdown voltage measurement for product acceptance.

1. SCOPE

Establish justification for the use of breakdown voltage for product electrical properties instead of calculated dielectric strength.

2. 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 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.

AS23053/12 Insulation Sleeving, Electrical, Heat Shrinkable, Polytetrafluoroethylene

2.2 ASTM Publications

Available from ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959, Tel: 610-832-9585, www.astm.org.

ASTM D149 Standard Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies

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3. TECHNICAL JUSTIFICATION FOR BREAKDOWN VOLTAGE

The dielectric strength of a solid is recognized to vary inversely as a fractional power of material thickness. The inverse relationship between dielectric strength and specimen thickness is further supported in Appendix X of ASTM D149-20. Heat shrinkable tubing manufactured under AS23053/12 possesses a range of nominal wall thicknesses. A constant dielectric strength requirement may have a deficiency as wall thicknesses increase over the range of products offered. In addition, dielectric strength is typically seen as a material characteristic instead of a product capability requirement. Two measurement values are needed to directly calculate dielectric strength which are breakdown voltage, a machine measurement, and wall thickness at the failure location, a manual measurement. The wall thickness is typically a manual measurement where error can occur affecting the reported value for dielectric strength. Whereas a breakdown voltage requirement would require only the machine voltage output and verification that the test specimen meets the wall thickness specification of the applicable part number.

Utilizing a breakdown voltage requirement instead of dielectric strength would be more prudent due to the nature of how the AS23053/12 products are used. The breakdown voltage of the heat shrinkable tubing is considered a product capability requirement of the configuration rather than a material characteristic. The voltage breakdown shall be calculated by an equation that correctly reflects the relationship of wall thickness and electrical performance of the material while considering the wall thickness tolerance for each part number. The various product sizes under AS23053/12 contain varying nominal wall thicknesses with tolerances. The breakdown voltage is calculated using the least material condition (LMC; minimum wall thickness) for the applicable nominal wall thickness size because of the relationship between dielectric strength and wall thickness, as described above. The following equation calculates the minimum required breakdown voltage while the applicable wall thickness is at the least material condition using mils as the wall thickness unit of measure.

AS23053/12 Breakdown Voltage

where:

t = wall thickness (LMC) in mils (mil = inch x 1000)

BV = breakdown voltage

$$BV = t(LMC) * \frac{1725}{t(LMC)^{0.22}}$$

Lastly, the minimum required breakdown voltage for all part numbers in AS23053/12 using the method described herein is not less than the previous requirement of 800 volts/mil while at the least material condition of the applicable sizes with nominal wall thicknesses up through 0.035 inch (as displayed by the line labeled 800 V/mil LMC in Figure 1).