Designation: D495 – 22

Standard Test Method for High-Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation[1]

This standard is issued under the fixed designation D495; the number immediately following the designation indicates the year of original adoption or, in the case of revision, the year of last revision. A number in parentheses indicates the year of last reapproval. A superscript epsilon (ε) indicates an editorial change since the last revision or reapproval.

This standard has been approved for use by agencies of the U.S. Department of Defense.

1. Scope*

1.1 This test method covers, in a preliminary fashion, the differentiation of similar materials' resistance to the action of a high-voltage, low-current arc close to the surface of insulation, when a conducting path is formed causing the material to become conducting due to the localized thermal and chemical decomposition and erosion.

1.2 The usefulness of this test method is very severely limited by many restrictions and qualifications, some of which are described in the following paragraphs and in Section 5. Generally, this test method shall *not* be used in material specifications. Whenever possible, alternative test methods shall be used, and their development is encouraged.

1.3 This test method will not, in general, permit conclusions to be drawn concerning the relative arc resistance rankings of materials that are potentially subjected to other types of arcs: for example, high voltage at high currents, and low voltage at low or high currents (promoted by surges or by conducting contaminants).

1.4 The test method is intended, because of its convenience and the short time required for testing, for preliminary screening of material, for detecting the effects of changes in formulation, and for quality control testing after correlation has been established with other types of simulated service arc tests and field experience. Because this test method is usually conducted under clean and dry laboratory conditions rarely encountered in practice, it is possible that the prediction of a material's relative performance in typical applications and in varying "clean to dirty" environments will be substantially altered (Note 1). Caution is urged against drawing strong conclusions without corroborating support of simulated service tests and field testing. Rather, this test method is useful for preliminary evaluation of changes in structure and composition without the complicating influence of environmental conditions, especially dirt and moisture.

NOTE 1—By changing some of the circuit conditions described herein it has been found possible to rearrange markedly the order of arc resistance of a group of organic insulating materials consisting of vulcanized fiber and of molded phenolic and amino plastics, some containing organic, and some inorganic, filler.

1.5 While this test method uses dry, uncontaminated specimen surfaces, Test Method D2132, Test Methods D2303, and Test Method D3638 employ wet, contaminated specimen surfaces. Their use is recommended for engineering purposes and to assist in establishing some degree of significance to this test method for quality control purposes.[2]

1.6 This test method is not applicable to materials that do not produce conductive paths under the action of an electric arc, or that melt or form fluid residues that float conductive residues out of the active test area thereby preventing formation of a conductive path.

1.7 The values stated in inch-pound units are to be regarded as standard. The values given in parentheses are mathematical conversions to SI units that are provided for information only and are not considered standard.

1.8 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of the user of this standard to establish appropriate safety, health, and environmental practices and determine the applicability of regulatory limitations prior to use.* For specific precautionary statements, see 6.1.14, 6.1.19, Section 7, and 10.1.1.

NOTE 2—Due to the deficiencies covered in Section 1, Committee D09 has proposed that without significant proposed improvements this standard be withdrawn in 2027 during its next 5 year review. This notice is provided so that referencing standards can transition.

1.9 *This international standard was developed in accordance with internationally recognized principles on standardization established in the Decision on Principles for the*

[1] This test method is under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.12 on Electrical Tests.

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[2] Also helpful is Test Method D2302 for Wet Tracking Resistance of Electrical Insulating Materials with Controlled Water-to-Metal Discharges. This test method was withdrawn and last appeared in the *1982 Annual Book of ASTM Standards*, Part 39.

***A Summary of Changes section appears at the end of this standard**

Development of International Standards, Guides and Recommendations issued by the World Trade Organization Technical Barriers to Trade (TBT) Committee.

2. Referenced Documents

2.1 *ASTM Standards:*[3]

D1711 Terminology Relating to Electrical Insulation

D2132 Test Method for Dust-and-Fog Tracking and Erosion Resistance of Electrical Insulating Materials

D2303 Test Methods for Liquid-Contaminant, Inclined-Plane Tracking and Erosion of Insulating Materials

D3638 Test Method for Comparative Tracking Index of Electrical Insulating Materials

D6054 Practice for Conditioning Electrical Insulating Materials for Testing (Withdrawn 2012)[4]

2.2 *IEC Standard:*

IEC 61621 Dry Solid Insulating Materials—Resistance Test To High-Voltage, Low-Current Arc Discharges[5]

NOTE 3—IEC 61621 is technically equivalent to D495, and is directly based upon Test Method D495. IEC 61621 describes only the tungsten electrodes, and does not include the stainless steel electrodes.

3. Terminology

3.1 *Definitions:*

3.1.1 For definitions of terms used in this test method, refer to Terminology D1711.

3.2 *Definitions of Terms Specific to This Standard:*

3.2.1 *arc resistance, n*—the total elapsed time in seconds from the start of this test procedure until failure occurs (see Section 14).

3.2.2 *failure, n*—the end-point of the test procedure employed in this test method (see Section 14).

3.2.3 *normal orientation, n*—a test condition in which the electrodes are located on the upper surface of the specimen.

3.2.4 *inverted orientation, n*—a test condition in which the electrodes are located on the under surface of the specimen.

3.2.4.1 *Discussion*—Tests made with inverted orientation are more severe than tests made with normal orientation. Reduced data dispersion has been encountered when testing certain materials using inverted orientation. With other materials, increased data dispersion has been encountered, especially with materials that evolve considerable gas during test.

3.3 *Abbreviations:*

3.3.1 The stainless steel strip electrodes are referred to as s.s.s. electrodes.

4. Significance and Use

4.1 The high-voltage, low-current type of arc resistance test is intended to simulate only approximately such service conditions as exist in alternating current circuits operating at high voltage, but at currents limited to units and tens of milliamperes.

4.2 In order to distinguish more easily among materials that have low arc resistance, the early stages of this test method are mild, and the later stages are successively more severe. The arc occurs intermittently between two electrodes resting on the surface of the specimen, in normal or inverted orientation. The severity is increased in the early stages by successively decreasing to zero the interval between flashes of uniform duration, and in later stages by increasing the current.

4.3 Four general types of failure have been observed:

4.3.1 Many inorganic dielectrics become incandescent, whereupon they are capable of conducting the current. Upon cooling, however, they return to their earlier insulating condition.

4.3.2 Some organic compounds burst into flame without the formation of a visible conducting path in the substance.

4.3.3 Others are seen to fail by "tracking," that is, a thin wiry line is formed between the electrodes.

4.3.4 The fourth type occurs by carbonization of the surface until sufficient carbon is present to carry the current.

4.4 Materials often fail within the first few seconds after a change in the severity stage. When comparing the arc resistance of materials, much more weight shall be given to a few seconds that overlap two stages than to the same elapsed time within a stage. Thus, there is a much greater difference in arc resistance between 178 and 182 s than between 174 and 178 s.

NOTE 4—Some investigators have reported attempts to characterize the remaining insulating value of the damaged area after failure by allowing the specimen to cool to room temperature, without disturbance of the original position of the electrodes, and then either (1) measuring the insulation resistance between the electrodes or (2) determining the percentage of breakdown voltage remaining relative to that obtained on an undamaged area of the specimen. A recommended circuit arrangement and test procedure for carrying out the second of these two means of characterizing the remaining insulating value of the damaged area is described in Appendix X1. Still another, and obvious, method of reevaluating the damaged area after failure is to repeat the arc resistance test after the specimen has cooled, with the electrodes undisturbed from their original positions. However, keep in mind that none of these methods will be universally applicable because of the severe physical damage to the test area in many instances.

5. Interferences

5.1 Changes in both the timing of the intermittent arc and the current, as well as other changes affecting the nature of the discharge, has the potential to affect the duration of a test of most specimens taken from a group of dissimilar materials. Any of these changes have the potential to drastically alter a material's position in order of rank. Regardless of the conditions of anticipated use, do not use data obtained by this test method to infer that the materials examined occupy an unchanging quality relationship to each other.

5.2 This test method describes two electrode systems: stainless steel strip and tungsten rod. When testing materials with poor to moderate arc resistance (up to 180 s), use the stainless steel strip electrodes as the preferred technique. This technique decreases the variability often associated with the use of rod

[3] For referenced ASTM standards, visit the ASTM website, www.astm.org, or contact ASTM Customer Service at service@astm.org. For *Annual Book of ASTM Standards* volume information, refer to the standard's Document Summary page on the ASTM website.

[4] The last approved version of this historical standard is referenced on www.astm.org.

[5] Available from American National Standards Institute (ANSI), 25 W. 43rd St., 4th Floor, New York, NY 10036, http://www.ansi.org.