



Standard Test Method for Evaluation of Resistance to Electrical Breakdown by Treeing in Solid Dielectric Materials Using Diverging Fields¹

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INTRODUCTION

When failure occurs in solid organic dielectrics that are subjected to very high, continuous, and nonuniform electrical gradients, it generally occurs by a mechanism called treeing. Materials of different molecular structures have different degrees of resistance to failure by treeing, and this resistance can sometimes be increased by the addition of other materials in low concentration.²

Trees that grow by a molecular degradation mechanism resulting from partial discharge (corona) are called electrical trees to distinguish them from water and electrochemical trees which are quite different.

This test method makes use of two opposing thin cylindrical electrodes, one sharpened to a point, the other with a hemispherical end. They are molded or inserted into blocks of the material to be tested. Because of the shape of the electrodes this is often called a needle test. This test provides a statistical estimate of electrical treeing initiation and propagation of solid dielectric materials in high, diverging electrical fields.

1. Scope

1.1 This test method covers the evaluation and comparison of the resistance of solid organic dielectric materials to the initiation or growth, or both, of tubular tree-like channels resulting from partial discharge (corona) and molecular decomposition that occur in the region of very high, diverging electric fields.^{3,4}

1.2 This test method is primarily for use at a power frequency of 50 or 60 Hz.

1.3 The test may be carried out at room temperature or temperatures above or below room temperature. The temperature should not exceed the softening or melting point of the sample material.

1.4 This test method can be used for any solid material into which needles can be cast, molded, or inserted with heat after molding. The resistance to tree initiation is measured by the double-needle characteristic voltage, which is only applicable to non-opaque materials so that tree can be observed optically. The resistance to tree initiation and growth is reported by the double-needle voltage life, which is applicable to both opaque and non-opaque materials.

1.5 The values stated in SI units are to be regarded as the standard.

1.6 *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 and health practices and determine the applicability of regulatory limitations prior to use.*

2. Referenced Documents

2.1 ASTM Standards:⁵

- D149** Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies
- D1711** Terminology Relating to Electrical Insulation

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 *Symposium on Engineering Dielectrics, ASTM STP 783*, ASTM, 1982, and *Symposium on Engineering Dielectrics, ASTM STP 926*, ASTM, 1986.

³ W. D. Wilkens, Chapter 7, "Statistical Methods for the Evaluation of Electrical Insulating Systems," *Engineering Dielectrics, Vol IIB, Electrical Properties of Solid Insulating Materials, Measurement Techniques*, R. Bartnikas, Editor, *ASTM STP 926*, ASTM, Philadelphia, 1987.

⁴ R. M. Eichorn, Chapter 4, "Treeing in Solid Organic Dielectric Materials," *Engineering Dielectrics, Vol IIA, Electrical Properties of Solid Insulating Materials: Molecular Structure and Electrical Behavior*, R. Bartnikas and R. M. Eichorn, Editors, *ASTM STP 783*, ASTM Philadelphia, 1983.

⁵ 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.