



Standard Test Method for Relative Resistance to Vented Water-Tree Growth in Solid Dielectric Insulating Materials¹

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1. Scope

1.1 This test method covers the relative resistance to vented water-tree growth in solid translucent thermoplastic or cross-linked electrical insulating materials. This test method is especially applicable to extruded polymeric insulation materials used in medium-voltage cables.

1.2 The values given in SI units are to be regarded as the standard.

1.3 *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 limitation prior to use.* For specific hazard statements see 8.1.

1.4 There is no similar or equivalent IEC standard.

2. Referenced Documents

2.1 ASTM Standards:

D 1898 Practice for Sampling of Plastics²

D 1928 Practice for Preparation of Compression-Molded Polyethylene Test Sheets and Test Specimens³

D 2275 Test Method for Voltage Endurance of Solid Electrical Insulating Materials Subjected to Partial Discharges (Corona) on the Surface⁴

D 3756 Test Method for Evaluation of Resistance to Electrical Breakdown by Treeing in Solid Dielectric Materials Using Diverging Fields⁵

3. Terminology

3.1 Definitions of Terms Specific to This Standard:

3.1.1 *water tree length (WTL), n* —the maximum length of a stained tree-like micro-channel path in millimetres, measured from the tip of the conical defect in the direction of the conical axis.

3.1.2 *resistance to water-tree growth (RWTG)*— a dimensionless value which is L divided by the WTL.

3.1.3 *thickness of point-to-plane specimen (L), n* —the vertical distance in millimetres from the tip of the conical defect to the opposite surface of the solid dielectric material.

4. Summary of Test Method

4.1 Ten compression-molded disk specimens, each containing a conical-shaped defect, are subjected to an applied voltage of 5 kV at 1 kHz and $23 \pm 2^\circ\text{C}$ in an aqueous conductive solution of 1.0 N NaCl for 30 days. This controlled conical defect is created by a sharp needle with an included angle of 60° and a tip radius of 3 μm . The electrical stress at the defect tip is enhanced and can be estimated by the Mason's Hyperbolic point-to-plane stress enhancement equation.⁶ This enhanced electrical stress initiates the formation of a vented water-tree grown from the defect tip. Each treed specimen is stained and sliced. The water-tree length and point-to-plane specimen thickness measured under microscope are used to calculate a ratio that is defined as the resistance to water-tree growth.

5. Significance and Use

5.1 This is a laboratory test designed to simulate the growth of vented water-trees in the solid dielectric insulating material initiated by a sharp protrusion at the insulating and conductive interface under a wet environment in a high electrical field. Water-treeing is the phenomenon which describes the appearance of tree-like growth in organic dielectrics under an ac field when exposed to moist environments. Two types of water-trees are formed. Bow tie trees (within the dielectric) and vented water-trees formed from conductive/insulating material interface into the insulating material. The water-trees referred to in this test method are the vented type. The insulating material is the solid dielectric organic material. The conductive material is the salt solution. This salt solution is used on both sides of the insulating material to simulate the same inner and outer

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² Discontinued; see 1997 *Annual Book of ASTM Standards*, Vol 08.01.

³ *Annual Book of ASTM Standards*, Vol 08.01.

⁴ *Annual Book of ASTM Standards*, Vol 10.01.

⁵ *Annual Book of ASTM Standards*, Vol 10.02.

⁶ The sole source of supply of the base, Dow Corning 3110RTV, the catalyst, Dow Corning RTV Catalyst S, and the sealant, Dow Corning Multipurpose Silicone Sealant 732, known to the committee at this time is Dow Corning, Inc., Midland, MI 48686. If you are aware of alternative suppliers, please provide this information to ASTM International Headquarters. Your comments will receive careful consideration at a meeting of the responsible technical committee, which you may attend.

