



# Standard Test Method for Thermal Endurance of Electrical Insulating Varnishes by the Helical Coil Method<sup>1</sup>

This standard is issued under the fixed designation D 3145; 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 ( $\epsilon$ ) indicates an editorial change since the last revision or reapproval.

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

## 1. Scope

1.1 This test method covers the determination of the thermal endurance of electrical insulating varnishes alone or in combinations with wire insulation. Changes in the helical coil bond strength are used as the test criteria. The coils can be made from bare aluminum or copper wire, or from film- or fiber-insulated magnet wire.

1.2 *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.* For a specific precautionary statement, see Section 7.

1.3 The values stated in SI units are the standard. The values given in parentheses are for information only.

NOTE 1—There is no similar or equivalent IEC standard.

## 2. Referenced Documents

### 2.1 ASTM Standards:

- D 1711 Terminology Relating to Electrical Insulation<sup>2</sup>
- D 1932 Test Method for Thermal Endurance of Flexible Electrical Insulating Varnishes<sup>2</sup>
- D 2307 Test Method for Relative Thermal Endurance of Film-Insulated Round Magnet Wire<sup>2</sup>
- D 2519 Test Method for Bond Strength of Electrical Insulating Varnishes by the Helical Coil Test<sup>3</sup>
- D 3251 Test Method for Thermal-Aging Characteristics of Electrical Insulating Varnishes Applied Over Film-Insulated Magnet Wire<sup>3</sup>
- D 3850 Test Method for Rapid Thermal Degradation of Solid Electrical Insulating Materials by Thermogravimetric Method<sup>3</sup>
- D 5423 Specification for Forced Convection Laboratory Ovens for Evaluation of Electrical Insulation<sup>3</sup>

<sup>1</sup> This test method is under the jurisdiction of ASTM Committee D-9 on Electrical and Electronic Insulating Materials and is the direct responsibility of Subcommittee D09.01 on Electrical Insulating Varnishes, Powders, and Encapsulating Compounds.

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<sup>2</sup> *Annual Book of ASTM Standards*, Vol 10.01.

<sup>3</sup> *Annual Book of ASTM Standards*, Vol 10.02.

D 6054 Practice for Conditioning Electrical Insulating Materials for Testing<sup>3</sup>

2.2 *International Electrotechnical Commission Publications:*<sup>4</sup>

IEC 216 Guide for the Determination of Thermal Endurance Properties of Electrical Insulation Materials (Parts 1 and 2)

## 3. Terminology

### 3.1 Definitions of Terms Specific to This Standard:

3.1.1 *bond strength, n*—a measure of the force required to separate surfaces which have been bonded together.

3.1.2 *magnet wire, n*—a metal electrical conductor, covered with electrical insulation, for use in the assembly of electrical inductive apparatus such as coils for motors, transformers, generators, relays, magnets, etc.

3.1.2.1 *Discussion*—The electrical insulation is usually composed of a film covering formed from a magnet wire enamel applied over a bare conductor. In some specific applications, fibrous coverings, either taped or linear filament served, are also used as electrical insulation.

3.1.3 *varnish, electrical insulating, n*—a liquid resin system that is applied to and cured on electrical components providing electrical, mechanical and environmental protection.

3.1.3.1 *Discussion*—There are two types of electrical insulating varnishes—solvent-containing and solventless. Solvent-containing types are solutions, dispersions or emulsions of a polymer or a mixture of polymers in a volatile, nonreactable liquid. Solventless types are liquid resin systems free of volatile, nonreactable solvents.

3.1.4 Refer to Terminology D 1711 for definitions of other terms.

## 4. Summary of Test Method

4.1 Flexural strength of the helical coils is measured periodically after exposure to several aging temperatures. The time to reach an arbitrarily selected value of bond strength at each aging temperature is determined. The logarithms of these times in hours are plotted as a function of the reciprocal temperature (1/K) to give an Arrhenius plot.

<sup>4</sup> Available from American National Standards Institute, 11 West 42nd St., 13th Floor, New York, NY 10036.