Designation: D 1531 – 01

An American National Standard

Standard Test Methods for Relative Permittivity (Dielectric Constant) and Dissipation Factor by Fluid Displacement Procedures[1]

This standard is issued under the fixed designation D 1531; 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 Department of Defense.

1. Scope

1.1 These test methods provide techniques for the determination of the relative (Note 1) permittivity and the dissipation factor of solid insulating materials by fluid (Note 2) displacement.

NOTE 1—In common usage, the word "relative" is frequently dropped.

NOTE 2—The word "fluid" is a commonly used synonym for "liquid'' and yet a gas is also a fluid. In these test methods the words fluid and liquid appear as synonyms, but the word fluid is also used to show that liquid is not all that is meant.

1.2 Test Method A is especially suited to the precise measurements on polyethylene sheeting at 23°C and at frequencies between 1 kHz and 1 MHz. It may also be used at other frequencies[2] and temperatures to make measurements on other materials in sheet form.

1.3 Test Method B is limited to the frequency range of available guarded bridges. It is especially suited to measurements on very thin films since it does not require determination of the thickness of the specimen. The test method provides an estimate of the thickness of thin films which is more accurate and precise than thickness measurements obtained by other means.

1.4 Test Method B is also useful for measurements of polymer sheeting up to 2 mm thickness.

1.5 These test methods permit calculation of the dissipation factor of the specimens tested.

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.* For a specific precautionary statement, see Note 3.

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

2. Referenced Documents

2.1 *ASTM Standards:*

D 150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulating Materials[3]

D 374 Test Methods for Thickness of Solid Electrical Insulation[3]

D 6054 Practice for Conditioning Electrical Insulating Materials for Testing[4]

D 831 Test Method for Gas Content of Cable and Capacitor Oils[5]

D 924 Test Method for Dissipation Factor (or Power Factor) and Relative Permittivity (Dielectric Constant) of Electrical Insulating Liquids[5]

D 1711 Terminology Relating to Electrical Insulation[3]

E 1 Specification for ASTM Thermometers[6]

3. Terminology

3.1 Definitions—Definitions are in accordance with Terminology D 1711.

3.2 *Description of a Term Specific to This Standard:*

3.2.1 *compatibility*, *n*—A fluid is considered compatible with a test specimen if, during the time required to complete a test of the specimen in the fluid at the specified temperature and frequency, the calculated permittivity of the specimen does not change by more than 0.1 %, and the dissipation factor change is less than 0.0001.

4. Summary of Test Methods

4.1 *Test Method A— The single fluid technique:*

4.1.1 Measurements are made with a fixed-plate, two-terminal self-shielded test cell assembly. By two measurements, one with the cell filled with the fluid (which in this case is a liquid) only and the second one with the solid specimen immersed in the liquid, a change in capacitance is determined. This capacitance difference is used with the approximate thickness of the specimen, the plate spacing, and the precisely

[1] These test methods are under the jurisdiction of ASTM Committee D09 on Electrical and Electronic Insulating Materials and are the direct responsibility of Subcommittee D09.12 on Electrical Tests.

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[2] Coutlee, K. G., "Liquid Displacement Test Cell for Dielectric Constant and Dissipation Factor up to 100 Mc," 1959 Annual Report, Conference on Electrical Insulation, National Research Council, Publication 756, Washington, DC.

[3] *Annual Book of ASTM Standards*, Vol. 10.01.

[4] *Annual Book of ASTM Standards*, Vol. 10.02.

[5] *Annual Book of ASTM Standards*, Vol. 10.03.

[6] *Annual Book of ASTM Standards*, Vol. 14.03.

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