Designation: D4872 – 14

Standard Test Method for Dielectric Testing of Wire and Cable Filling Compounds[1]

This standard is issued under the fixed designation D4872; 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.

1. Scope*

1.1 This test method covers the determination of dissipation factor, permittivity (dielectric constant), and ac volume resistivity of wire and cable filling compounds and related materials that are solid at room temperature, but capable of being melted at elevated temperature.

1.2 Whenever two sets of values are presented, in different units, the values in the first set are the standard, while those in parentheses are for information only.

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 limitations prior to use.* Specific hazard statements are given in Section 7.

2. Referenced Documents

2.1 *ASTM Standards:*[2]

D150 Test Methods for AC Loss Characteristics and Permittivity (Dielectric Constant) of Solid Electrical Insulation

D257 Test Methods for DC Resistance or Conductance of Insulating Materials

D1321 Test Method for Needle Penetration of Petroleum Waxes

D1711 Terminology Relating to Electrical Insulation

D6054 Practice for Conditioning Electrical Insulating Materials for Testing (Withdrawn 2012)[3]

3. Terminology

3.1 *Definitions*—For definitions of terms used in this test method, refer to Terminology D1711.

4. Summary of Test Method

4.1 Place a measured volume of melted sample, free of entrapped air, into a level preheated specimen dish. Allow the specimen to cool and place primary and secondary electrodes in uniform contact with the specimen surface. Connect test leads to the specimen dish and the cover plate electrode; make measurements to obtain values from which dissipation factor, permittivity, and dc volume resistivity are calculated.

5. Significance and Use

5.1 Dissipation factor, permittivity, and dc volume resistivity are properties of communication cable fillers and filler components that are controlled in order that the cable's electrical performance falls within its design limits. Relatively small amounts of contaminants, such as polar compounds, water, or salts degrade the cable's electrical properties. Limits on the dielectric properties of the cable filling compound are usually specified by the cable manufacturer, by industry standards or both.

6. Apparatus

6.1 *Specimen Dish and Cover Electrode,* as shown in Fig. 1. Use a gold- or nickel-plated specimen dish and cover electrode plate to ensure a corrosion resistant, high conductivity surface.

6.1.1 Clean the specimen dish and electrode plate of oxidation by rinsing in a 5 % hydrochloric acid solution for a maximum of 5 s, followed by distilled water, isopropyl alcohol and, finally, by a low boiling petroleum distillate (naphtha) (see Section 7). Alternatively (preferred), use an ultrasonic cleansing bath. Store the dish and cover, wrapped in paper towels, in a desiccator or in an oven maintained at 50°C.

6.2 *Dial Comparator,* having a minimum travel of 0.4 in. (10.2 mm) or equivalent.

6.3 *Leveling Table,* adjustable to ±1 min of arc. The base from a Test Method D1321 penetrometer is satisfactory.

6.4 *Glass Syringe,* 10.0-mL capacity.

6.5 *Oven,* capable of maintaining the temperature used to determine viscosity for the particular compound under test.

6.6 *Q-Meter,* or equivalent.

6.7 *Teraohm Meter,* or equivalent.

[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 D09.18 on Solid Insulations, Non-Metallic Shieldings and Coverings for Electrical and Telecommunication Wires and Cables.

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[2] 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.

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

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

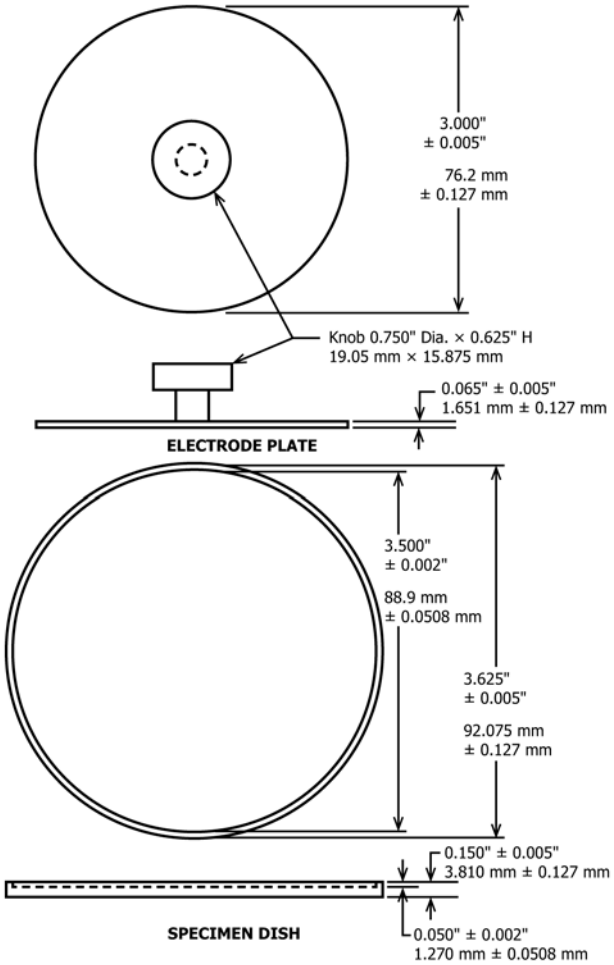

FIG. 1 Electrode Plate and Specimen Dish for Dielectric Testing of Wire and Cable Filling Compounds

7. Hazards

7.1 The chemicals used in cleaning the sample dish are considered hazardous. Exercise care in handling hydrochloric acid and naphtha. Naphtha is extremely flammable; do not use in an area near sparks or open flame.

8. Sample and Test Specimen

8.1 The sample is to be representative of the material to be tested. Approximately 100 g of material is sufficient for several specimens.

9. Calibration and Standardization

9.1 Follow the calibration and standardization procedures found in the operating manuals for the cited measuring equipment.

10. Conditioning

10.1 Condition the sample in an atmosphere of 23 ± 3°C and 50 ± 5 % relative humidity, in accordance with Practice D6054.

11. Procedure

11.1 Heat the sample, specimen dish, and syringe for 1.5 ± 0.5 h in an oven set at a temperature previously determined to produce a homogeneous liquid.

11.2 Remove the sample from the oven and stir gently to ensure uniformity, being careful to avoid entraining air bubbles.

11.3 Place the specimen dish on the leveled leveling table. With the hot syringe, transfer 5.0 mL of the sample to the specimen dish in a manner that avoids air bubble entrapment (discharge syringe at or below the specimen surface). Cool the specimen and specimen dish at 1/23/50, as defined in Practice D6054, except the tolerance for temperature shall be ±3°C.

11.4 Gently center the cover electrode on the solidified specimen. The cover electrode should contact the surface of the specimen.

11.5 Transfer the dish with specimen to the comparator. Measure the thickness of the dish base plus the specimen plus the electrodes to the nearest 0.001 in. (0.0024 mm) in 45° increments 0.5 in. (12.7 mm) from the periphery of the electrode plate. If the greatest difference between the largest and smallest readings is 0.003 in. (0.076 mm) or less, the specimen is satisfactory. Proceed with the electrical measurements. If the difference is greater than 0.003 in., the specimen is excessively wedge-shaped and cannot be used. Prepare a new specimen.

11.6 Position the specimen dish (which becomes the base electrode) for the dielectric tests.

11.7 Determine the dissipation factor and permittivity (dielectric constant) at 1 MHz, in accordance with the procedures found in the operating manuals for the test equipment being used and the calculations found in Test Methods D150.

11.8 Determine the volume resistivity, in accordance with the procedures found in the operating manuals for the test equipment being used and the calculations found in Test Methods D257.

12. Report

12.1 Report the following information:

12.1.1 Description of the material tested, that is, the name, grade, color, manufacturer, and other pertinent data,

12.1.2 Individual thickness measurements and their averages,

12.1.3 Conditioning of the specimen, and test conditions,

12.1.4 Method of measurement and measurement circuits,

12.1.5 Measured values, and

12.1.6 Calculated values of dissipation factor, permittivity, and volume resistivity.

13. Precision and Bias

13.1 *Precision*—The precision of this test method has not been determined and no work is planned.

13.2 *Bias*—A statement of bias is not possible due to a lack of a standard reference material.

14. Keywords

14.1 cable; dielectric testing; dissipation factor; filling compounds; permittivity; volume resistivity; wire

SUMMARY OF CHANGES

Committee D09 has identified the location of selected changes to this standard since the last issue (D4872 – 99 (2010)) that may impact the use of this standard. (Approved Nov. 1, 2014.)

(1) Revised subsection 6.1.1.