Designation: D 4496 – 04

An American National Standard

Standard Test Method for D-C Resistance or Conductance of Moderately Conductive Materials[1]

This standard is issued under the fixed designation D 4496; 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 the measurement of electrical resistance or conductance of materials that are generally categorized as moderately conductive and are neither good electrical insulators nor good conductors.

1.2 Test measurements of electrical resistance (or conductance) and specimen geometry data are used to compute an electrical resistivity for the material.

1.3 This test method applies to all materials that exhibit volume resistivity in the range of 1 to $10^7\Omega$-cm or surface resistivity in the range of 10^3 to $10^7\Omega$ (per square).

1.4 This test method is designed for measurements at standard conditions of 23°C and 50 % relative humidity, but its principles of operation can be applied to specimens measured at lower or higher temperatures and relative humidities.

1.5 *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 precautionary statements are given in 8.3.

2. Referenced Documents

2.1 *ASTM Standards:* [2]

D 257 Test Methods for D-C Resistance or Conductance of Insulating Materials

D 374 Test Methods for Thickness of Solid Electrical Insulation

D 991 Test Method for Rubber Property Volume Resistivity of Electrically Conductive and Antistatic Products

D 1711 Terminology Relating to Electrical Insulation

D 6054 Practice for Conditioning Electrical Insulating Materials for Testing

3. Terminology

3.1 *Definitions:*

3.1.1 *moderately conductive*—a solid material having volume resistivity between 1 and $10^7\Omega$·cm.

3.1.2 For definitions of other terms used in this standard, refer to Terminology D 1711.

3.2 *Description of Term Specific to This Standard:*

3.2.1 *steady state*—for the purpose of this test method, steady-state is attained if any rate of change in the observed resistance (or conductance) averages less than 0.25 %/s.

4. Summary of Test Method

4.1 Specimens of material are conditioned in prescribed environments and subjected to direct-voltage stress. Resistance or conductance is measured and used with the dimensional aspects of the specimen to compute a resistivity of the material. The apparatus and techniques used in this test method are in accordance with the general principles set forth in Test Methods D 257.

5. Significance and Use

5.1 This test method is useful for the comparison of materials, as a quality control test, and may be used for specification purposes.

5.2 This test method is useful in the selection and use of materials in wires, cables, bushings, high-voltage rotating machinery, and other electrical apparatus in which shielding or the distribution of voltage stress may be of value.

5.3 Commercially available "moderately conductive" materials frequently are comprised of both conductive and resistive components (that is, cellulose fibers with colloidal carbon black particles attached to portions of the surfaces of those fibers, or discrete conductive particles adhered to the surfaces of electrical insulating polymers). Such commercially available materials are often manufactured in a manner that may result in anisotropy with respect to electrical conduction. Hence, the significance of tests using this test method may depend upon the orientation of the specimen tested to the electric field and

[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] 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.

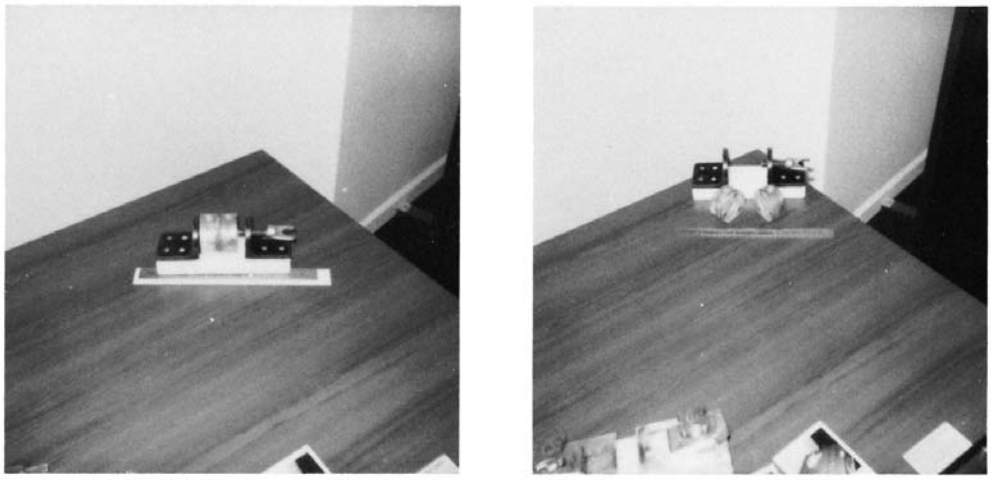


FIG. 1 Cell For Volume Resistivity 1-in.^{2} Electrode (Mercury)

the relationship between this orientation and the orientation of the material in the electrical apparatus which uses these materials.

6. Apparatus

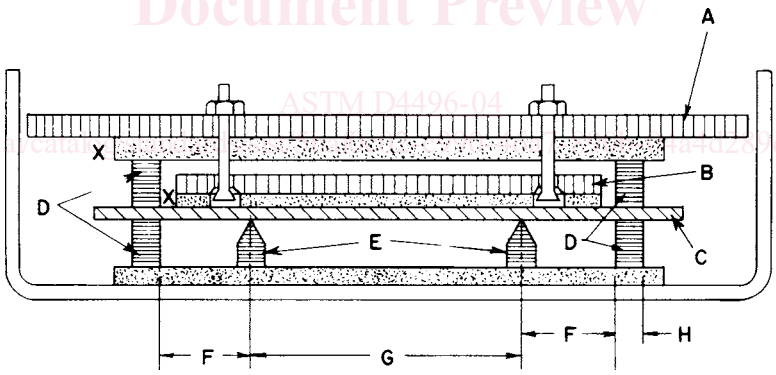
6.1 Use apparatus conforming to the general requirements set forth in Test Methods D 257.

6.2 *Voltage Device*—Capable of limiting the magnitude of the direct voltage applied to the specimen. (See Appendix X1 for discussion of voltage stress and specimen heating.)

6.3 *Test cells*, that have been found to be satisfactory are depicted in Fig. 1, Fig. 2, and Fig. 3.[3]

NOTE 1—Conductive paint may provide suitable electrodes on specimens of certain materials and testing such specimens may not require test cell assemblies as shown in Fig. 1, Fig. 2, and Fig. 3[3] (see Annex A1 for additional information).

[3] Drawings suitable for construction of test cells are available from ASTM Headquarters, 100 Barr Harbor Drive, West Conshohocken, PA 19428. Request adjunct No. ADJD4496.



A—Mass for applying contact force between current electrodes and the specimen (300 N/m times the specimen width in metres) (Note 1).
B—Mass for applying contact force between potential electrodes and the specimen (60 N/m times specimen width in metres) (Note 2).
C—The specimen.
D—Current electrodes.
E—Potential electrodes.
F—Distance between the current and potential electrodes (20 mm minimum).
G—Distance between potential electrodes depends on specimen size.
H—Width of current electrode, 5 to 8 mm (0.2 to 0.3 in.).
X—Electrical insulating material (10 tera Ω·cm volume minimum resistivity).
Note 1—For a specimen 150 mm (6 in.) wide, mass is approximately 4.5 kg (10 lb).
Note 2—For a specimen 150 mm (6 in.) wide, mass is approximately 0.9 kg (2 lb).
Note 3—Fig. 2 is taken from Test Method D 991.

The electrode assembly (Fig. 2) shall consist of a rigid base made from an electrical insulating material having a volume resistivity greater than 10 tera Ω·cm (for example, hard rubber, polyethylene, polystyrene, etc.) to which a pair of potential electrodes are fastened in such a manner that the four electrodes are parallel and their top surfaces are in the same horizontal plane. Another pair of current electrodes identical with the first pair shall be fastened to a second piece of insulating material so that they can be superimposed on the specimen directly above the first pair. The current electrodes shall have a length at least 10 mm (0.4 in.) greater than the specimen width, a width between 5 and 8 mm (0.2 and 0.3 in.), and a height uniform with 0.05 mm (0.002 in.) between 10 and 15 mm (0.4 and 0.6 in.). The potential electrodes shall have a length and height equal to the current electrodes, and shall be tapered to an edge having a radius of 0.5 mm (0.02 in.) maximum at the top surface. The distance between the potential electrodes shall be not less than 10 mm (0.4 in.) nor more than 66 mm (2.6 in.) and shall be known within + 2 %. The current electrodes shall be equidistant outside the potential electrodes by at least 20 mm (0.8 in.). The electrodes shall be made from a corrosion-resistant metal such as brass, nickel, stainless steel, etc. Insulation resistance between electrodes shall be greater than 1 TΩ.

FIG. 2 Electrode Assembly