Designation: D 1677 – 86 (Reapproved 1993)ε1

# Standard Methods for Sampling and Testing Untreated Mica Paper Used for Electrical Insulation[1]

This standard is issued under the fixed designation D 1677; 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.

ε[1] NOTE—Editorial changes were made throughout in June 1993.

## 1. Scope

1.1 These methods cover procedures for sampling and testing untreated mica paper to be used as an electrical insulator or as a constituent of a composite material used for electrical insulating purposes.

1.2 The procedures[2] appear in the following order:

| Procedures | Sections | ASTM Method References |
|---|---|---|
| Air Resistance | 29-32 | D 202, D 726 |
| Apparent Density | 12 | ... |
| Aqueous Extract Conductivity | 36 and 37 | D 202 |
| Conditioning | 4 | D 685 |
| Dielectric Strength | 16-19 | D 149 |
| Impregnation Time | 20-24 | D 202 |
| Moisture Content | 26-28 | D 644 |
| Roll Quality | 25 | ... |
| Sampling | 3 | ... |
| Tensile Strength | 13-15 | D 828 |
| Thickness | 6-10 | D 374 |
| Weight | 11 | D 646 |
| Weight Variability | 33-35 | ... |

1.3 The values stated in inch-pound units are to be regarded as the standard.

1.4 *This standard does not purport to address all of the safety concerns, if any, associated with its use. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.*

## 2. Referenced Documents

2.1 *ASTM Standards:*

D 149 Test Methods for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies[3]

D 202 Test Methods for Sampling and Testing Untreated Paper Used for Electrical Insulation[3]

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

D 644 Test Method for Moisture Content of Paper and Paperboard by Oven Drying[4]

D 646 Test Method for Grammage of Paper and Paperboard (Weight Per Unit Area)[4]

D 685 Practice for Conditioning Paper and Paper Products for Testing[4]

D 726 Test Methods for Resistance of Nonporous Paper to Passage of Air[4]

D 828 Test Method for Tensile Breaking Strength of Paper and Paperboard[4]

D 1711 Terminology Relating to Electrical Insulation[3]

## 3. Sampling

3.1 Sample in accordance with the requirements set forth in Test Methods D 202.

3.2 Make the tests for physical properties on each sample insofar as the specimens are of sufficient width.

3.3 Untreated mica papers are, in general, quite fragile and friable. At all times during the operations of sampling, conditioning, specimen preparation, and testing, great care must be taken to prevent flexing and tearing, and to minimize abrasion of particles from the surfaces. The test values may be significantly and adversely affected if these precautions are not taken.

## 4. Conditioning

4.1 Condition samples in accordance with Practice D 685, except that samples should remain in the conditioned air for not less than 16 h prior to the tests.

4.2 The following physical tests shall be made in the conditioned atmosphere: thickness, weight, tensile strength, dielectric strength, and impregnation.

## 5. Precision and Bias

5.1 Due to the range of types and grades, and nonuniform nature of commercially available mica papers, no statement can be made about the precision of these methods when used

[1] These methods are under the jurisdiction of ASTM Committee D-9 on Electrical and Electronic Insulating Materials and are the direct responsibility of Subcommittee D09.19 on Dielectric Sheet and Roll Products.

Current edition approved Feb. 28, 1986. Published April 1986. Originally published as D 1677 – 59 T. Last previous edition D 1677 – 80ε1.

[2] The test methods for other properties will be added in accordance with standard ASTM procedures as their need becomes generally desirable.

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

[4] *Annual Book of ASTM Standards,* Vol 15.09.

on these materials. Neither can a statement about bias be made because of the unavailability of standard reference materials. Nevertheless, these methods serve to distinguish basic, relative differences in properties, and variations in quality among mica papers used in electrical insulation.

## THICKNESS AND THICKNESS VARIATION

### 6. Terminology Definition

6.1 *thickness, n—of an electrical insulating material*, the perpendicular distance between the two surfaces of interest, determined in accordance with a standard method.

### 7. Significance and Use

7.1 Accurate determination of thickness is important for identification purposes. Thickness is related to weight and must be known in order to calculate apparent density and the dielectric strength.

7.2 Thickness variation affects the quality of roll winding and is useful in judging the uniformity of mica paper particularly with respect to dielectric breakdown voltage, impregnation time, and thickness of the end product.

### 8. Test Specimens

8.1 Take test specimens from the original samples obtained in accordance with Section 3 and conditioned as prescribed in Section 4, and tested under the same conditions.

8.2 For all thicknesses of mica paper, the specimen shall be a single sheet.

### 9. Procedure

9.1 Determine the thickness in accordance with Test Methods D 374. The preferred method shall be Method D with a drop rate of 12 ± 4 mil/s and a dwell time of 3 ± 1 s for thickness of 0.002 to 0.006 in. and 6 ± 2 s for + 0.006 in. Method C of Test Methods D 374 is an acceptable alternative.

9.2 Take at least five measurements of thickness at regular intervals across the entire width of each specimen, preferably in a line that is at right angles to the machine direction.

### 10. Report

10.1 Report in accordance with Test Methods D 202 and include:

10.1.1 Average, minimum, and maximum thickness.

## WEIGHT

### 11. Procedure

11.1 Determine the weight in accordance with Test Method D 646, except sample the material in accordance with Section 3, condition as prescribed in Section 4, and test under the same conditions. Report the results as weight in grams per square metre.

## APPARENT DENSITY

### 12. Procedure

12.1 Determine the apparent density from the thickness (Sections 8-10), and the weight (Section 11). Make the thickness and weight determinations on the same sample. Calculate the apparent density as follows:

$$D = A/B \quad (1)$$

where:

$A$ = basis weight, kg/m$^2$,
$B$ = thickness, µm, and
$D$ = apparent density, g/cm$^3$.

## TENSILE STRENGTH

### 13. Significance and Use

13.1 The results of the test are suitable for acceptance and product control. They are also a means of measuring the ability of mica paper to withstand the tensile stresses encountered in application processes.

### 14. Procedure

14.1 Determine the tensile strength in accordance with Test Methods D 202, except for specimen width and test span. Sample the material in accordance with Section 3 and condition in accordance with Section 4 and test under the same conditions. The specimen shall be 1 to 3 in. (25 to 77 mm) wide. The distance between the jaws shall be 5 in. (127 mm).

NOTE 1—If excessive fractures occur in or at the edge of either jaw, a cushion of soft kraft paper or other material may be used between the jaws of the clamps and the specimen.

### 15. Report

15.1 Report the following information:

15.1.1 The thickness of test specimen, and

15.1.2 The average, minimum and maximum tensile strength in pounds-force per inch of width (or newtons per metre of width).

## DIELECTRIC STRENGTH

### 16. Nomenclature

16.1 *dielectric strength*—Refer to Terminology D 1711.

### 17. Significance and Use

17.1 For mica paper to be used in the untreated state, this test gives some indication of the electrical strength. For mica paper to be subsequently treated, this test has value as a quality control test.

### 18. Procedure

18.1 Determine the dielectric strength in accordance with Test Method D 149, except sample the material in accordance with Section 3 and condition in accordance with Section 4, and test under the same conditions. Make tests in air using 2-in. (50.8-mm) electrodes and the short-time (continuous-rise) method. Determine the average dielectric strength on the basis of ten dielectric breakdowns.

### 19. Report

19.1 Report the following information:

19.1.1 Average thickness of the specimen,

19.1.2 Average, high, and low breakdown voltage, and