U. S. Department of Commerce
Maurice H. Stans
Secretary

National Bureau of Standards
A. V. Astin, Director

Certificate

STANDARD REFERENCE MATERIALS
1516, 1517, 1518, 1519
for
Permittivity
(10^3 Hz and 23 °C)

W. P. Harris and D. E. Roberts

These Standard Reference Materials are intended for use in the calibration of systems for the measurement of permittivity and related dielectric quantities. More explicitly, permittivity as used in this certificate is relative to vacuum, not to air. This quantity is also called the dielectric constant. The samples were prepared from a fluorinated ethylene-propylene copolymer, and are physically identified by the following approximate dimensions.

No. 1516	38 mm diameter, 2.5 mm thick
No. 1517	38 mm diameter, 5 mm thick
No. 1518	51 mm diameter, 2.5 mm thick
No. 1519	51 mm diameter, 5 mm thick

Measurements of permittivity, loss tangent, and thickness were made by a three-terminal method using the two-fluid technique. Since values for individual specimens differ from the mean of all specimens by a factor of 10 greater than the standard deviation of a single specimen, each specimen is individually identified and certified as follows:

Specimen identification
* Relative permittivity
* Average thickness of central portion
Diameter of central portion
* Dissipation factor

The certified measurements (*) were made at 10^3 Hz and 23.0 ± 0.2 °C. A statement of the estimated uncertainties is given on the reverse page.

The work leading to the certification of this Standard Reference Material was performed in the Polymers Division, Institute for Materials Research, National Bureau of Standards.

Washington, D. C. 20234
July 9, 1969

J. Paul Cali, Acting Chief
Office of Standard Reference Materials

(over)

ESTIMATED UNCERTAINTIES.—Each Standard Reference Material (individual specimen) was measured three separate times. The pooled standard deviations for single relative permittivity measurements in each set of three was found to be 0.0042 percent.

The dissipation factor (loss tangent) is very low, approximately 55×10^{-6}. Although the pooled standard deviation is only about 7×10^{-6}, the uncertainty is estimated to be 10 to 20 $\times 10^{-6}$ based on previous experience. While the value for each specimen is supplied, the range of values of dissipation factor is small.

The two-fluid method yields a value for the thickness of the specimen more accurately than micrometer measurements. This value is certified for each specimen. The pooled standard deviation for thickness measurement is 0.015 percent. The thickness certified is the average thickness of the central portion actually located between the electrodes during the three-terminal electrical measurement. The diameter of this central portion (electrode diameter) is stated for each specimen.

It is expected that these Standard Reference Materials will be little affected by varying conditions of humidity either during storage or at the time of measurement. Exposure to temperatures above 200 °C should be avoided because of the possibility of changing the degree of crystallinity of the polymer and, therefore, of the dielectric properties.

Since each Standard Reference Material has its own certified values, it is important that they be handled in a manner to avoid confusion. Therefore, it is recommended that only one specimen be removed from its container at any given time.

For further details on the dielectric properties of the fluorinated ethylene-propylene polymer (FEP), see A. H. Scott and J. R. Kinard, Jr.: Polymeric Materials for Dielectric Specimens. J. Res. Nat. Bur. Stand. (U.S.), 71C, (Eng. and Instr.), No. 2,119 (Apr.-June 1967).