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INTERNATIONAL STANDARD

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Cylindrical cavity method to measure the complex permittivity of low-loss dielectric rods

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The text of this standard is based on the following documents:

CDV	Report on voting
46F/242/CDV	46F/260/RVC

Full information on the voting for the approval of this standard can be found in the report on voting indicated in the above table.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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CYLINDRICAL CAVITY METHOD TO MEASURE THE COMPLEX PERMITTIVITY OF LOW-LOSS DIELECTRIC RODS

1 Scope

This International Standard relates to a measurement method for complex permittivity of a dielectric rod at microwave frequency. This method has been developed to evaluate the dielectric properties of low-loss materials in coaxial cables and electronic devices used in microwave systems. It uses the TM_{010} mode in a circular cylindrical cavity and presents accurate measurement results of a dielectric rod sample, where the effect of sample insertion holes is taken into account accurately on the basis of the rigorous electromagnetic analysis.

In comparison with the conventional method described in IEC 60556 [2][1], this method has the following characteristics:

- the values of the relative permittivity ε' and loss tangent $\tan\delta$ of a dielectric rod sample can be measured accurately and non-destructively;
- the measurement accuracy is within 1,0 % for ε' and within 20 % for $\tan\delta$;
- the effect of sample insertion holes is corrected using correction charts presented;
- this method is applicable for the measurements on the following condition:
  - frequency: 1 GHz ≦f ≦10 GHz;
  - relative permittivity: 1 ≦ε' ≦100;
  - loss tangent: 10^{-4} ≦$\tan\delta$ ≦10^{-1}.

2 Normative references

Void.

3 Measurement parameters

The measurement parameters are defined as follows:

$$\varepsilon_r = \varepsilon' - j\varepsilon'' \quad (1)$$

$$\tan\delta = \varepsilon''/\varepsilon' \quad (2)$$

where ε' and ε'' are the real and imaginary parts of the complex relative permittivity ε_r.

4 Theory and calculation equations

A resonator structure used in these measurements is shown in Figure 1. A cavity, made with copper, with diameter D and height H has sample insertion holes with diameter d_2 and depth g oriented coaxially. A dielectric rod sample of diameter d_1 having ε' and $\tan\delta$ is inserted into the holes.

[1] Figures in square brackets refer to the Bibliography.