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TECHNICAL SPECIFICATION

Piezoelectric and dielectric devices for frequency control and selection – Glossary –
Part 4-3: Materials – Materials for dielectric devices

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PIEZOELECTRIC AND DIELECTRIC DEVICES FOR FREQUENCY CONTROL AND SELECTION – GLOSSARY –

Part 4-3: Materials – Materials for dielectric devices

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IEC 61994-4-3, which is a technical specification, has been prepared by IEC technical committee 49: Piezoelectric and dielectric devices for frequency control and selection.

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The text of this technical specification is based on the following documents:

Enquiry draft	Report on voting
49/768/DTS	49/780/RVC

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

A list of all parts of IEC 61994 series, published under the general title *Piezoelectric and dielectric devices for frequency control and selection – Glossary* can be found on the IEC website.

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 maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- transformed into an International standard,
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- replaced by a revised edition, or
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PIEZOELECTRIC AND DIELECTRIC DEVICES FOR FREQUENCY CONTROL AND SELECTION – GLOSSARY –

Part 4-3: Materials – Materials for dielectric devices

1 Scope

This part of IEC 61994 specifies the terms and definitions for materials applied for devices using waveguide type dielectric resonators representing the state-of-the-art, which are intended for use in the standards and documents of IEC TC 49.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 61338-1: 2004, *Waveguide type dielectric resonators – Part 1: Generic specification*

3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 61338-1 apply, notably the following.

3.1
dielectric material
material which predominantly exhibit dielectric properties

[IEC 61338-1]

3.2
dielectric resonator material
dielectric materials defined to be used for resonator application at high frequency, i.e. UHF or SHF range. The dielectric material is required to have high relative permittivity, a low loss factor and a minimal temperature coefficient of permittivity

[IEC 61338-1]

3.3
electric constant
ε_0
constant equal to $8,8542 \times 10^{-12}$ $AsV^{-1}m^{-1}$, defined by the permittivity of vacuum

[IEC 61338-1]

3.4
relative permittivity
ε_r
absolute permittivity of a material or medium divided by the electric constant ε_0

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NOTE The complex relative permittivity $\underline{\varepsilon}_\mathrm{r}$ is defined as

$$\underline{\varepsilon}_\mathrm{r} = \varepsilon' - j\varepsilon'' ,\ \varepsilon' = Re(\underline{\varepsilon}_\mathrm{r}),\ \varepsilon'' = Im(\underline{\varepsilon}_\mathrm{r})$$

where

ε' is usually called dielectric constant;

ε'' corresponds to the dielectric loss of the material.

[IEC 61338-1]

3.5
absolute permittivity
ε
quantity which when multiplied by the electric field strength E is equal to the electric flux density D

$$D = \varepsilon E ,\ \varepsilon = \varepsilon_0 \varepsilon_\mathrm{r}$$

[IEC 61338-1]

3.6
loss angle
δ
phase displacement between the component of the electric flux density and the electric field strength

[IEC 61338-1]

3.7
loss factor
tangent of the loss angle δ

$$\tan\delta = \varepsilon'' / \varepsilon'$$

NOTE The loss factor can be determined by the ratio of the negative part to the real part of the complex relative permittivity.

[IEC 61338-1]

3.8
quality factor of a material
Q_0
reciprocal of the tangent of the loss angle

$$Q_0 = \varepsilon' / \varepsilon'' = 1/\tan\delta$$

NOTE The quality factor of a material is also defined as 2π times the ratio of the stored electromagnetic energy to the energy dissipated in the material per cycle. It is frequency dependent.

[IEC 61338-1]

3.9
temperature coefficient of permittivity
$TC\varepsilon$
fractional change of permittivity due to a change in temperature divided by the change in temperature

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$$TC\varepsilon = \frac{\varepsilon_T - \varepsilon_{\text{ref}}}{\varepsilon_{\text{ref}}(T - T_{\text{ref}})} \times 10^6 \ [1 \times 10^{-6}/\text{K}]$$

where

ε_T is the permittivity at temperature T;

ε_{ref} is the permittivity at reference temperature T_{ref}.

[IEC 61338-1]

3.10
coefficient of linear thermal expansion
α
fractional change of dimension due to a change in temperature divided by the change in temperature

$$\alpha = \frac{l_T - l_{\text{ref}}}{l_{\text{ref}}(T - T_{\text{ref}})} \times 10^6 \ [1 \times 10^{-6}/\text{K}]$$

where

l_T is the dimension at temperature T;

l_{ref} is the dimension at reference temperature T_{ref}.

[IEC 61338-1]

3.11
dielectric resonator
resonator using dielectrics with a high dielectric constant and the structure of which is a dielectric waveguide of finite length

NOTE The dielectric resonators in use are always shielded with conductors.

[IEC 61338-1]

3.12
dielectric support
element supporting a dielectric resonator. The support is generally used for $TE_{01\delta}$ mode resonators and has a low dielectric constant

[IEC 61338-1]

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