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**NATIONAL STANDARD OF THE  
PEOPLE'S REPUBLIC OF CHINA**

**GB/T 46583-2025**

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**Test methods for dielectric properties of microwave dielectric  
ceramics - Open cavity method and closed cavity method**

微波介质陶瓷介电性能测试方法 开腔法、闭腔法

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### Foreword

This document conforms to GB/T 1.1-2020 "Standardization Work Guidelines Part

1. Structure and Drafting Rules of Standardization Documents". Drafting is scheduled. Please note that some content in this document may involve patents. The issuing organization of this document assumes no responsibility for identifying patents. This document was proposed by the China Building Materials Federation. This document is under the jurisdiction of the National Technical Committee on Standardization of Industrial Ceramics (SAC/TC 194). This document was drafted by: Zhejiang University, Jiangsu Canqin Technology Co., Ltd., Jiaying Jiali Electronics Co., Ltd., and Wuhan Bailiboke. Technology Co., Ltd., Zhejiang Jiakang Electronics Co., Ltd., Guangdong Sulian Technology Co., Ltd., Tsinghua University, University of Electronic Science and Technology of China Tongji University, Southern University of Science and Technology, Huazhong University of Science and Technology, Shaanxi Normal University, Guilin University of Technology, Shanghai Institute of Ceramics, Chinese Academy of Sciences Institute, Qilu University of Technology (Shandong Academy of Sciences), Wenzhou Advanced Manufacturing Technology Research Institute of Huazhong University of Science and Technology. The main drafters of this document are: Li Lei, Zhu Hui, Hu Yuanyun, Fang Hui, Hu Shanliang, Qiao Quanbao, Yue Zhenxing, Chen Xiangming, Zhang Shuren, and Zhai Jiwei. Wang Hong, Lü Wenzhong, Liu Peng, Fang Liang, Liu Zhifu, Tang Bin, Shi Feng, Lei Wen.

Microwave dielectric ceramics are one of the key materials in microwave communication technology, and are widely used in microwave dielectric resonators, filters, duplexers, etc. Core components include substrates, antennas, and capacitors. Relative permittivity, loss tangent (or  $Q_f$  value), and temperature coefficient of resonant frequency are also important parameters. Electrical performance parameters are the most important technical indicators of microwave dielectric ceramics. Accurate testing of these parameters is crucial for the development, application, and... The design of related components is of great significance. Compared with other microwave dielectric materials, microwave dielectric ceramics have a wide range of relative permittivity, low loss tangent, and stable temperature. Due to its high qualitative requirements and other prominent characteristics, the requirements for dielectric property testing methods are also higher. Based on the microwave dielectric resonance

principle and employing TE<sub>011</sub>... The open-cavity and closed-cavity methods for resonant modes are advantageous because the excitation and testing of the resonance are less affected by the relative permittivity of the sample, and the metal wall has a high quality factor. Because electrical energy is concentrated within the sample, it can adapt to the performance characteristics of microwave dielectric ceramics and is widely used in applications related to the dielectric properties of microwave dielectric ceramics. This document presents tests using both open-cavity and closed-cavity methods, proposing the relative permittivity, loss tangent, and resonant frequency of microwave dielectric ceramics. Methods for testing the temperature coefficient. Comparing two methods, the closed-cavity method has lower uncertainty in testing the relative permittivity and loss tangent. The test range for the loss tangent is wider, and the cavity method can be used to test the temperature coefficient of the resonant frequency. Combining the two methods makes... It can be used to fully meet the testing needs of various microwave dielectric ceramic dielectric properties. Microwave dielectric ceramic dielectric property testing method Open cavity method, closed cavity method

## 1 Scope

GB/T 46583-2025 is the Chinese national standard covering measuring permittivity and loss at microwave frequencies - the dielectric resonator in an open or a closed cavity, the mode identification, the temperature coefficient of resonant frequency, and the corrections the geometry demands. These ceramics are what every base station filter is made of. First edition, in force from 1 May 2026. Issued on 31 October 2025, it has been in force since 1 May 2026.

This document describes the testing principles, testing conditions, and instrumentation of microwave dielectric ceramic dielectric property testing methods (open cavity method and closed cavity method). Preparation, test samples, test procedures, test reports, calculation process, and measurement uncertainty. This document applies to uniform cylindrical microwave dielectric ceramics. In the open-cavity method, the test frequency range is 2 GHz to 24 GHz, relative to the dielectric... The test range for electrical constant is 3~300, the test range for loss tangent is  $10^{-4}$ ~ $6 \times 10^{-3}$ , and the test range for temperature coefficient of resonant frequency is... The temperature range is  $-1500 \times 10^{-6}$ °C to  $1500 \times 10^{-6}$ °C. In the closed-cavity method, the test frequency range is 1 GHz to 32 GHz, and the relative permittivity is... The test range is 3~300°, and the test range for the loss tangent is  $2 \times 10^{-5}$ ~ $10^{-2}$ . This document also applies to other low-loss, non-magnetic materials. Testing of microwave dielectric properties of solid dielectrics.

## 2 Normative references

The contents of the following documents, through normative references within the text, constitute essential provisions of this document. Dated citations are listed below. For

references to documents, only the version corresponding to that date applies to this document; for undated references, the latest version (including all amendments) applies. This document.

GB/T 1216-2018 Outside Micrometer

### 3 Terms and Definitions

The following terms and definitions apply to this document.

3.1 Microwave dielectric ceramics Used in various microwave devices, it achieves various device functions through the interaction between the ceramic bulk and microwaves, such as filtering, wave guiding, and microwave inversion. Ceramic dielectric materials for transmitting and receiving signals. Note

1. Microwave dielectric ceramics are generally composite oxides, such as titanates, niobates, and tantalates. Generally, microwave dielectric ceramics are required to have suitable properties in the microwave frequency band. It has a relatively high permittivity, low loss tangent (or high Qf value) and small temperature coefficient of resonant frequency. Note

2. Microwave dielectric ceramics are key materials for mobile communications, satellite communications, etc. [Source: GB/T 17991-2009, 2.1.28, with modifications]

3.2 Dielectric properties The comprehensive dielectric properties of a material measured using AC voltage within a given frequency range. [Source: GB/T 31838.1-2015, 3.3, with modifications]

3.3 absolute permittivity Potential removal is achieved by electric field strength.

Note. The unit is F/m.