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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for thermal fatigue of fine ceramics substrate

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National foreword

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A list of organizations represented on this committee can be obtained on request to its secretary.

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INTERNATIONAL STANDARD

ISO 17841

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Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for thermal fatigue of fine ceramics substrate

Céramiques techniques — Méthode d'essai de la fatigue thermique des substrats des céramiques techniques

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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The committee responsible for this document is ISO/TC 206, *Fine ceramics*.

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INTERNATIONAL STANDARD ISO 17841:2015(E)

Fine ceramics (advanced ceramics, advanced technical ceramics) — Test method for thermal fatigue of fine ceramics substrate

1 Scope

This International Standard describes the test methods for determining thermal fatigue property of fine ceramic substrates applied to power modules, electronic control unit and similar devices.

2 Normative references

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

ISO 4287, *Geometrical Product Specifications (GPS) — Surface texture: Profile method — Terms, definitions and surface texture parameters*

ISO 3611, *Geometrical product specifications (GPS) — Dimensional measuring equipment: Micrometers for external measurements — Design and metrological characteristics*

ISO 13385-1, *Geometrical product specifications (GPS) — Dimensional measuring equipment — Part 1: Callipers; Design and metrological characteristics*

ISO 80000-1, *Quantities and units — Part 1: General*

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
ceramic substrate
electrical circuits substrate which joined the metal plate to ceramics, applied to power modules and similar devices

3.2
thermal cycling
temperature which is simply and cyclically repeated between a specific high value and a specific low value

3.3
four-point bending strength
maximum value of stress generated in a test specimen obtained by a four-point bending test

3.4
residual strength ratio
value ($\sigma_b / \overline{\sigma_{b0}}$) of four-point bending strength of a test specimen exposed to thermal cycling (σ_b) divided by the mean four-point bending strength of test specimens not exposed to thermal cycling ($N = 0$) ($\overline{\sigma_{b0}}$)

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4 Testing machine and equipment

4.1 Thermal cycling testing equipment

Two types of thermal cycling equipment may be used. Type 1 provides two chambers one at a high temperature and the other at a low temperature and a means of moving the test specimen from one to the other within a specified time period. Type 2 provides a single chamber in which the temperature can be changed. The equipment shall be able to maintain the specified temperatures. Attachments and supports used with the test specimens shall have low thermal conductivity and the test specimens shall be thermally insulated. Test specimens shall be arranged so as not to disturb the circulation in the chambers and between specimens when multiple specimens are tested simultaneously.

4.2 Four-point bending strength testing equipment

This testing equipment shall be so constructed that compressive stress can be applied to a test specimen at a constant crosshead speed. The testing machine shall be equipped with an apparatus measuring or indicating the load with an accuracy of at most 1 % of the maximum load.

4.3 Supports for four-point bending strength testing

Four-point flexure configurations measured four-point bending strength shall be used as illustrated in Figure 3. Supports wherein a testing specimen is supported as supporting points, or a load is applied to the specimen, shall be of the same shape in left and right and have a length exceeding a width of the specimen. The material of the supports shall be at least 147 GPa in elastic modulus, and free from plastic deformation and being broken midway through testing. The diameter of supports shall be 4,0 mm to 6,0 mm, and its surface roughness shall be at most 0,40 µm *Ra* as specified in ISO 4287. Also, supports should be able to be rotated and not to disturb the transformation of the test specimen by load.

4.4 Micrometre callipers

Micrometre callipers shall be those for external measurement specified in ISO 3611 or shall have better precision.

4.5 Vernier callipers

Vernier callipers shall be those for external measurement specified in ISO 13385-1 or shall have better precision.

5 Test specimens

5.1 Test specimen form and dimensions

5.1.1 General

The shape of test specimens shall be two metal plates joined respectively to the front and back of a fine ceramics plate, i.e. a total of four metal sheets, as shown in Figure 1. The standard dimensions of the fine ceramics shall be: total length h = 40,0 mm, width w = (10,0 ± 0,5) mm, and metal plate dimensions shall be: total length h_m = 17,0 mm, width w_m = (8,0 ± 0,5) mm. Metal plate spacing shall be d = 2 mm. The four corner portions of metal plates shall be chamfered to R = 1,0 mm, as shown in Figure 1. Any dimensions differing from the standard dimensions shall be mentioned in the test report.

5.1.2 Fine ceramics plate thickness t and metal plate thickness t_m

Fine ceramics plate thickness t and metal plate thickness t_m shall follow product specifications, but in principle, t and t_m shall be selected from the plate thicknesses listed in 5.1.2.1 and 5.1.2.2.

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