

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Test methods for electrical materials, printed boards and other interconnection structures and assemblies –
Part 2-803: Test methods for Z-axis expansion of base materials and printed boards**

IEC 61189-2-803:2023

**Méthodes d'essai pour les matériaux électriques, les cartes imprimées et autres structures d'interconnexion et ensembles –
Partie 2-803: Méthodes d'essai pour la dilatation suivant l'axe Z des matériaux de base et des cartes imprimées**



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IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

**TEST METHODS FOR ELECTRICAL MATERIALS, PRINTED BOARDS AND
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The text of this International Standard is based on the following documents:

Draft	Report on voting
91/1760/CDV	91/1863/RVC

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

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TEST METHODS FOR ELECTRICAL MATERIALS, PRINTED BOARDS AND OTHER INTERCONNECTION STRUCTURES AND ASSEMBLIES –

Part 2-803: Test methods for Z-axis expansion of base materials and printed boards

1 Scope

This part of IEC 61189 specifies a test method to determine the Z-axis expansion of base materials and printed boards using a thermomechanical analyser (TMA).

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60194-1, *Printed boards design, manufacture and assembly – Vocabulary – Part 1: Common usage in printed board and electronic assembly technologies*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60194-1 apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

4 Preparation of test specimens

Unless otherwise specified, a minimum of two specimens shall be tested. These specimens shall be taken from random locations of the material to be evaluated.

The test specimens shall be verified to be free of particles.

5 Test specimens

Test specimens shall be unclad laminate material or a printed circuit board. Multilayer printed boards may be tested but no internal conductors are to be present in the specimen.

All copper shall be etched from the test specimens using standard industry methods.

The specimen shall be taken at a distance ≥ 25 mm from the edge of the material / circuit board being evaluated. The dimensions of the specimens shall be approximately 6,35 mm $\times$ 6,35 mm and have a minimum thickness of 0,51 mm.

The specimen shall lie flat on the test surface, so all edges of the specimen shall be sanded, or equivalent, to make them smooth and free of burrs. Care should be taken that this process does not induce mechanical stresses or heat the specimen.

The specimen thickness shall be measured and recorded, to allow for the percentage of thermal expansion to be determined at the completion of the test.

6 Test apparatus

- A thermomechanical analyser (TMA) capable of determining a dimensional change within $\pm 0,001$ mm over the defined temperature range.
- An air circulating drying chamber capable of maintaining $105\text{ °C} \pm 2\text{ °C}$.
- A low humidity drying cabinet or desiccator capable of maintaining an atmosphere less than 30 % RH at 23 °C .

7 Test procedure

- Calibrate the TMA instrument as per the manufacturer's guidelines.
- Precondition the specimens for $2\text{ h} \pm 0,25\text{ h}$ at $105\text{ °C} \pm 2\text{ °C}$, then allow to cool to room temperature in a low humidity drying cabinet or desiccator.
- Once cooled, take the specimen from the low humidity drying cabinet and place it onto the stage of the TMA equipment. Care should be taken that the specimen is resting flat in the centre of the test stage.
- The TMA probe is to be lowered onto the specimen and a force applied of between 1 mN and 100 mN.
- Lower the furnace around the test stage.
- Begin the temperature scan; the start temperature is to be no greater than 30 °C .
- The scan rate shall be maintained at 10 °C/min , unless specified otherwise.
- Continue to scan until a temperature of 260 °C , or an alternative temperature (such as representative of a soldering operation), is achieved.

8 Calculation

Record the three different Z-axis properties, a typical data output of the TMA is shown in Figure 1. Temperature "A" shall be approximately the room temperature, normally 30 °C . Temperature points "B" and "C" shall be either side of the glass transition (T_g) point for the material. Temperature "D" will be the soldering temperature, typically 260 °C .

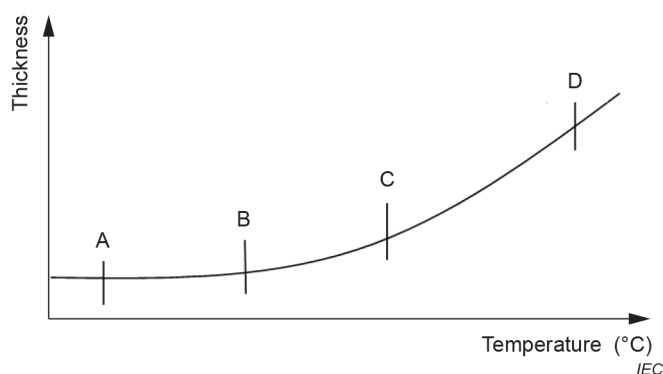


Figure 1 – Example TMA data output

To calculate the CTE below the glass transition (Tg): $\alpha(A-B) = \frac{(t_B - t_A)10^6}{t_A(T_B - T_A)}$

To calculate the CTE above the glass transition (Tg): $\alpha(C-D) = \frac{(t_D - t_C)10^6}{t_A(T_D - T_C)}$

where

T_A = temperature measured at point A of the data output;

T_B = temperature measured at point B of the data output;

T_C = temperature measured at point C of the data output;

T_D = temperature measured at point D of the data output;

t_A = measured thickness at point A of the data output;

t_B = measured thickness at point B of the data output;

t_C = measured thickness at point C of the data output;

t_D = measured thickness at point D of the data output.

The percentage Z-axis expansion is calculated using the temperature range of 50 °C to 260 °C.

9 Report

This report shall include the following information:

- a) test method reference number and revision level;
- b) name of the person performing the test;
- c) date testing was conducted;
- d) material tested: designation and description;
- e) initial thickness of test specimen;
- f) laboratory conditions (room temperature and relative humidity) at time of testing;
- g) scan rate used;
- h) calculated Z-axis expansion below and above the glass transition (Tg);
- i) calculated Z-axis expansion (%) between 50 °C and 260 °C;
- j) if a printed board was tested, the configuration of the test specimen;
- k) any variations from the defined test method.

Bibliography

IPC-TM-650 No. 2.4.24C, *Glass Transition Temperature and Z-Axis Thermal Expansion by TMA*

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