

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**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2023 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

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

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.



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**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.180

ISBN 978-2-8322-7264-0

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	3
1 Scope.....	5
2 Normative references	5
3 Terms and definitions	5
4 Preparation of test specimens	5
5 Test specimens	5
6 Test apparatus	6
7 Test procedure	6
8 Calculation	6
9 Report	7
Bibliography.....	8
Figure 1 – Example TMA data output	6

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[IEC 61189-2-803:2023](https://standards.iteh.ai/catalog/standards/sist/8c8eccbd-9f81-487d-8bd5-5d4b4aab596e/iec-61189-2-803-2023)

<https://standards.iteh.ai/catalog/standards/sist/8c8eccbd-9f81-487d-8bd5-5d4b4aab596e/iec-61189-2-803-2023>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**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**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61189-2-803 has been prepared by IEC technical committee TC 91: Electronics assembly technology. It is an International Standard.

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.

A list of all parts in the IEC 61189 series, published under the general title *Test methods for electrical materials, printed boards and other interconnection structures and assemblies*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 61189-2-803:2023](https://standards.iteh.ai/catalog/standards/sist/8c8eccbd-9f81-487d-8bd5-5d4b4aab596e/iec-61189-2-803-2023)

<https://standards.iteh.ai/catalog/standards/sist/8c8eccbd-9f81-487d-8bd5-5d4b4aab596e/iec-61189-2-803-2023>

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

7 Test procedure

- a) Calibrate the TMA instrument as per the manufacturer's guidelines.
- b) 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.
- c) 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.
- d) The TMA probe is to be lowered onto the specimen and a force applied of between 1 mN and 100 mN.
- e) Lower the furnace around the test stage.
- f) Begin the temperature scan; the start temperature is to be no greater than 30 °C .
- g) The scan rate shall be maintained at 10 °C/min , unless specified otherwise.
- h) 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 .

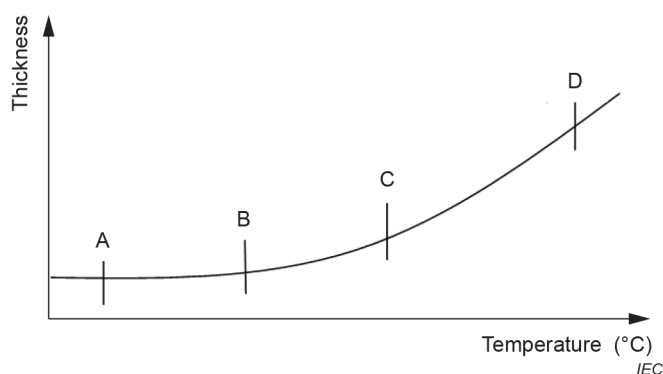


Figure 1 – Example TMA data output

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*

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[IEC 61189-2-803:2023](https://standards.iteh.ai/catalog/standards/sist/8c8eccbd-9f81-487d-8bd5-5d4b4aab596e/iec-61189-2-803-2023)

<https://standards.iteh.ai/catalog/standards/sist/8c8eccbd-9f81-487d-8bd5-5d4b4aab596e/iec-61189-2-803-2023>

