IEC 61189-2-809

Edition 1.0 2024-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

colour inside

Test methods for electrical materials, circuit boards and other interconnection structures and assemblies – Part 2-809: X/Y coefficient of thermal expansion (CTE) test for thick base materials by TMA

Méthodes d'essai pour les matériaux électriques, les circuits imprimées et autres structures d'interconnexion et ensembles – Partie 2-809: Essai du coefficient de dilatation thermique (CTE) X/Y pour matériaux de base épais à l'aide d'un analyseur thermomécanique (TMA)

IEC 61189-2-809:2024-12(en-fr)

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The text of this International Standard is based on the following documents:

Draft	Report on voting
91/1983/FDIS	91/1994/RVD

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/publications.

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

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

Part 2-809: X/Y coefficient of thermal expansion (CTE) test for thick base materials by TMA

1 Scope

This part of IEC 61189 defines the method to be followed for the determination of the X/Y coefficient of thermal expansion of electrical insulating materials by the use of a thermomechanical analyser (TMA).

This method is applicable to materials that are solid of the entire range of temperature used and retain sufficient hardness and rigidity over the temperature range so that irreversible indentation of the specimen by the sensing probe does not occur.

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*

IEC 60194-2, *Printed boards design, manufacture and assembly – Vocabulary – Part 2: Common usage in electronic technologies as well as 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 and IEC 60194-2 apply.

ISO and IEC maintain terminology 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

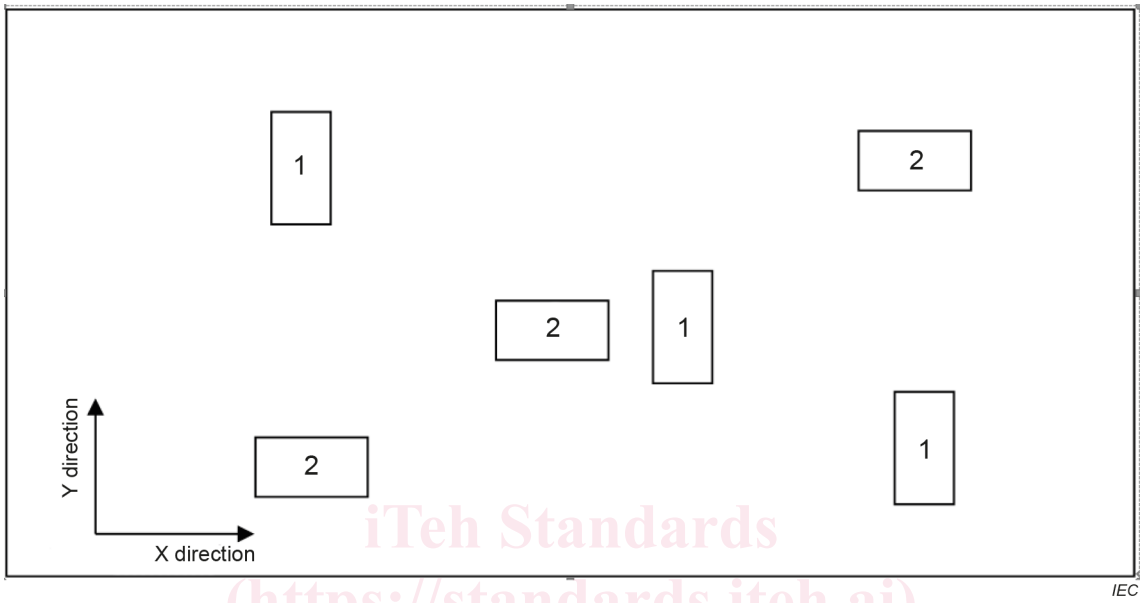
4 Test specimens

4.1 The test specimens shall be between 0,5 mm to 7,5 mm thick. This thickness may be "as received" or may be laminated by the user from pre-impregnated "B" stage material. If laminated by the user, the user shall be responsible for the layup and curing parameters used for quality acceptance by the manufacturer.

NOTE The repeatability of the test results will vary by the factors, such as layup used, the resin to glass ratio and the ultimate cure of the laminated stack, etc.

4.2 The test specimens shall be between 5 mm to 12 mm in length and between 5 mm to 10 mm in width. The width of the specimen shall be less than the length.

4.3 Unless otherwise specified, three specimens shall be prepared in both warp and weft direction of the glass fibre from the same piece of material, and mark with "X" or "Y" directions, as shown in Figure 1. The "X" direction is the fill (weft) of the woven fibre and the "Y" direction is the machine direction (warp) of the woven fibre.



NOTE Sample 1 is CTE sample in "X" direction, the width direction of the sample is the "X" direction; Sample 2 is CTE sample in "Y" direction, the width direction of the sample is the "Y" direction.

Figure 1 – Diagram of sample direction

4.4 Opposing sides of the test specimens shall be parallel, and surfaces shall be polished with sandpaper to remove debris and protruding fibres (e.g. 600 grit sandpaper). After that then be cleaned using isopropyl alcohol and dried for 1 hour at 110 °C ±2 °C.

NOTE The one-hour prebake can be eliminated if condition [see Clause 6 item a)] is performed immediately after final polish.

5 Test apparatus

The test apparatus is composed of the following elements:

– thermomechanical analyzer (TMA) capable of determination of dimensional change to within 0,001 mm over the specified temperature range;

– circulating air oven capable of maintaining 110 °C ± 2 °C;

– dessicator or low humidity drying cabinet capable of maintaining an atmosphere less than 30 % relative humidity at 23 °C ± 2 °C.

6 Test procedure

The test procedure is as follows:

a) Immerse the specimen in isopropyl alcohol with agitation for 20 seconds, and then dried for 1 hour ± 10 minutes at 110 °C ± 2 °C in oven. After removal from the oven, the specimen shall be cooled for 40 minutes in desiccator or drying cabinet before testing.

b) Calibrate the TMA instrument in accordance with the manufacturer's instructions.

c) Test the CTE of "X" direction, measure the initial width of the specimen which marked with "X" direction, recorded as H.

d) Place the specimen on the stage of the TMA, the width direction of the test sample should always be perpendicular to the test sample placement platform. The specimen should be centred and rest flat on the stage. The thermocouple wire should be in contact with the specimen or as near to the specimen as possible.

e) Place weights on the sensing probe and lower the TMA probe to ensure that the probe is in contact with the specimen with a 0,04 N to 0,10 N load.

f) Heat the specimen at the rate of 5 ± 0,5 °C/min to a temperature which is 10 °C greater than the required temperature range. The testing temperature range shall be specified by the user so that the manufacturer and the user can test under the same temperature range. The repeatability can be unacceptable if tested over different temperature ranges. The general test temperature range is 30 °C to 260 °C.

g) Record the dimensional change of the specimen with an appropriate range on X-Y recorder, recorded as ΔH.

h) Three specimens at least should be tested of the same material. Retest of a specimen may only be used as reference and shall not be treated as an independent test of a new specimen.

i) Repeat the procedure described in items a) to h) to test the CTE of **"**Y**"** direction using the specimens marked with "Y".

7 Calculations

Calculate the coefficient of thermal expansion over the temperature interval of the three specimens according to the following formula:

$$\alpha = \frac{\Delta H}{H \times \Delta T} \times 10^6$$

where

α is the coefficient of thermal expansion, in μm/(m·°C);

ΔH is dimensional change of the specimen over the temperature interval (see Figure 2), in mm;

H is the initial width of the specimen, in mm;

ΔT is the temperature interval (see Figure 1), in °C.

NOTE In most of the modern TMA instruments, the calculations are handled by the system software.

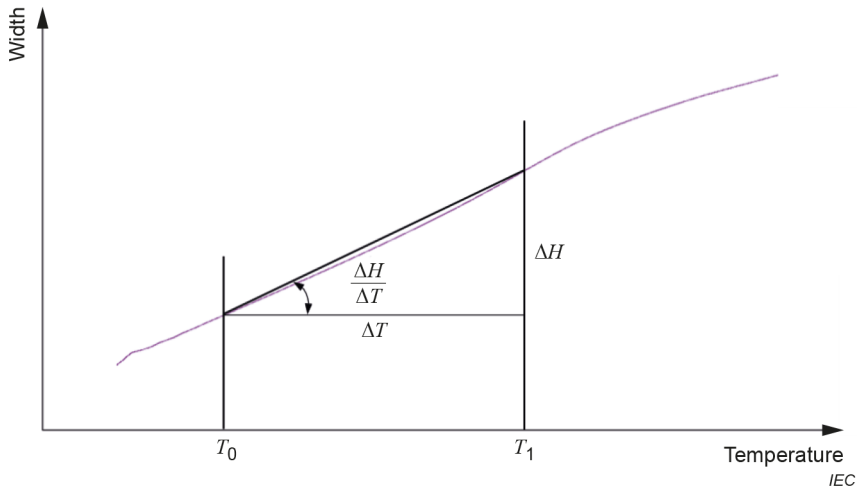


Figure 2 – Specimen size versus temperature

8 Report

The report shall include:

a) the test method number and revision level;
b) the identification and description of the material tested;
c) the initial width of the specimen;
d) the room temperature and the relative humidity under which the test was conducted;
e) the date of the test;
f) the temperature ramp up rate;
g) the calculated average "X" coefficient of expansion for three specimens;
h) the calculated average "Y" coefficient of expansion for three specimens;
i) any deviation from the test method;
j) the name of the person conducting the test.