INTERNATIONAL STANDARD

IEC 61189-2

Second edition
2006-05

Test methods for electrical materials, printed boards and other interconnection structures and assemblies –

Part 2: Test methods for materials for interconnection structures

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Test methods for electrical materials, printed boards and other interconnection structures and assemblies –

Part 2: Test methods for materials for interconnection structures

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 2: Test methods for materials for interconnection structures

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.
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International Standard IEC 61189-2 has been prepared by IEC technical committee 91: Surface mounting technology, in cooperation with technical committee 52: Printed circuits (now disbanded), and technical committee 50: Environmental testing.

This second edition replaces the first edition, published in 1997, and its Amendment 1 (2000). It constitutes a technical revision.

The document 91/564/FDIS, circulated to the National Committees as Amendment 2, led to the publication of this new edition.

The text of this standard is based on the first edition, its amendment 1 and on the following documents:

FDIS	Report on voting
91/564/FDIS	91/572/RVD

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

The significant technical changes with respect to the previous edition concern the addition of several new tests in the following categories:

– C: Chemical test methods
– D: Dimensional test methods:
– E: Electrical test methods
– M: Mechanical test methods
– N: Environmental test methods
– X: Miscellaneous test methods

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This standard forms part of a series and should be used in conjunction with other parts in the same series, all under the main title *Test methods for electrical materials, interconnection structures and assemblies*:

Part 1: General test methods and methodology

Part 2: Test methods for materials for interconnection structures
Part 3: Test methods for interconnection structures (printed boards)
Part 4: Test methods for electronic components assembling characteristics[1]
Part 5: Test methods for printed board assemblies
Part 6: Test methods for materials used in electronic assemblies

It should also be read in conjunction with IEC 60068: Environmental testing.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

A bilingual version of this publication may be issued at a later date.

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1 Under consideration.

INTRODUCTION

IEC 61189 relates to test methods for printed boards and printed board assemblies, as well as related materials or component robustness, irrespective of their method of manufacture.

The standard is divided into separate parts, covering information for the designer and the test methodology engineer or technician. Each part has a specific focus; methods are grouped according to their application and numbered sequentially as they are developed and released.

In some instances test methods developed by other TCs (e.g. TC 50) have been reproduced from existing IEC standards in order to provide the reader with a comprehensive set of test methods. When this situation occurs, it will be noted on the specific test method; if the test method is reproduced with minor revision, those paragraphs that are different are identified.

This part of IEC 61189 contains test methods for materials used to produce interconnection structures (printed boards) and electronic assemblies. The methods are self-contained, with sufficient detail and description so as to achieve uniformity and reproducibility in the procedures and test methodologies.

The tests shown in this standard are grouped according to the following principles:

P: preparation/conditioning methods
V: visual test methods
D: dimensional test methods
C: chemical test methods
M: mechanical test methods
E: electrical test methods
N: environmental test methods
X: miscellaneous test methods

To facilitate reference to the tests, to retain consistency of presentation, and to provide for future expansion, each test is identified by a number (assigned sequentially) added to the prefix (group code) letter showing the group to which the test method belongs.

The test method numbers have no significance with respect to an eventual test sequence; that responsibility rests with the relevant specification that calls for the method being performed. The relevant specification, in most instances, also describes pass/fail criteria.

The letter and number combinations are for reference purposes, to be used by the relevant specification. Thus "2D01" represents the first dimensional test method described in this publication.

In short, for this example, 2 is the part of IEC standard (61189-2), D is the group of methods, and 01 is the test number.

A list of all test methods included in this standard, as well as those under consideration is given in Annex B. This annex will be reissued whenever new tests are introduced.

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

Part 2: Test methods for materials for interconnection structures

1 Scope

This part of IEC 61189 provides a catalogue of test methods representing methodologies and procedures that can be applied to test materials used for manufacturing interconnection structures (printed boards) and assemblies.

2 Normative references

The following referenced documents are indispensable for the application 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 60068-1:1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-2:1974, *Environmental testing – Part 2: Tests – Tests B: Dry heat*

IEC 60068-2-78:2001, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60093:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

IEC 60243-1:1998, *Electrical strength of insulating materials – Test methods: Tests at power frequencies*

IEC 61189-3:1997, *Test methods for electrical materials, interconnection structures and assemblies – Part 3: Test methods for interconnection structures (printed boards)*

ISO 3274:1996, *Geometrical Products Specifications (GPS) – Surface texture: Profile method – Nominal characteristics of contact (stylus) instruments*

ISO 9001:2000, *Quality systems – Model for quality assurance in production, installation and servicing*

ANSI/UL-94:1993, *Standard for tests for flammability of plastic materials for parts in devices and appliances, Tests for*

3 Accuracy, precision and resolution

Errors and uncertainties are inherent in all measurement processes. The information given below enables valid estimates of the amount of error and uncertainty to be taken into account.

Test data serve a number of purposes which include:

– monitoring a process;
– enhancing confidence in quality conformance;
– arbitrating between customer and supplier.

In any of these circumstances, it is essential that confidence can be placed upon the test data in terms of:

– accuracy: calibration of the test instruments and/or system;
– precision: the repeatability and uncertainty of the measurement;
– resolution: the suitability of the instruments and/or system for the test.

3.1 Accuracy

The regime by which routine calibration of the test equipment is undertaken shall be clearly stated in the quality documentation of the supplier or agency conducting the test, and shall meet the requirements of ISO 9001:2000.

The calibration shall be conducted by an agency having accreditation to a national or international measurement standard institute. There should be an uninterrupted chain of calibration to a national or international standard.

Where calibration to a national or international standard is not possible, round robin techniques may be used, and documented, to enhance confidence in measurement accuracy.

The calibration interval shall normally be one year. Equipment consistently found to be outside acceptable limits of accuracy shall be subject to shortened calibration intervals. Equipment consistently found to be well within acceptable limits may be subject to relaxed calibration intervals.

A record of the calibration and maintenance history shall be maintained for each instrument. These records should state the uncertainty of the calibration technique (in ± % deviation) in order that uncertainties of measurement can be aggregated and determined.

A procedure shall be implemented to resolve any situation where an instrument is found to be outside calibration limits.

3.2 Precision

The uncertainty budget of any measurement technique is made up of both systematic and random uncertainties. All estimates shall be based upon a single confidence level, the minimum being 95 %.

Systematic uncertainties are usually the predominant contributor, and will include all uncertainties not subject to random fluctuation. These include:

– calibration uncertainties;
– errors due to the use of an instrument under conditions which differ from those under which it was calibrated;
– errors in the graduation of a scale of an analogue meter (scale shape error).

Random uncertainties result from numerous sources but can be deduced from repeated measurement of a standard item. Therefore, it is not necessary to isolate the individual contributions. These may include:

– random fluctuations such as those due to the variation of an influence parameter. Typically, changes in atmospheric conditions reduce the repeatability of a measurement;
– uncertainty in discrimination, such as setting a pointer to a fiducial mark, or interpolating between graduations on an analogue scale.

Aggregation of uncertainties: Geometric addition (root-sum-square) of uncertainties may be used in most cases. Interpolation error is normally added separately and may be accepted as being 20 % of the difference between the finest graduations of the scale of the instrument.

$$U_t = \pm\sqrt{(U_s^2 + U_r^2)} + U_i$$

where

U_t is the total uncertainty

U_s is the systematic uncertainty

U_r is the random uncertainty

U_i is the interpolation error

Determination of random uncertainties: Random uncertainty can be determined by repeated measurement of a parameter, and subsequent statistical manipulation of the measured data. The technique assumes that the data exhibits a normal (Gaussian) distribution.

$$U_r = \frac{t \times \sigma}{\sqrt{n}}$$

where

U_r is random uncertainty

n is the sample size

t is the percentage point of the "t" distribution (from 3.5), statistical tables

σ is the standard deviation (σ_{n-1})

3.3 Resolution

It is paramount that the test equipment used is capable of sufficient resolution. Measurement systems used should be capable of resolving 10 % (or better) of the test limit tolerance.

It is accepted that some technologies will place a physical limitation upon resolution (e.g. optical resolution)

3.4 Report

In addition to requirements detailed in the test specification, the report shall detail:

– the test method number and revision;
– the identity of the sample(s);
– the test instrumentation;
– the specified limit(s);
– an estimate of measurement uncertainty, and resultant working limit(s) for the test;
– the detailed test results;
– the test date, and operators' signature.

3.5 Student's "*t*" distribution

Table 1 gives values of the factor "*t*" for 95 % and 99 % confidence levels, as a function of the number of measurements. It is sufficient to use 95 % limits, as in the case of the worked examples shown in Annex A.

Table 1 – Student's "*t*" distribution

Sample size	*t* value 95 %	*t* value 99 %		Sample size	*t* value 95 %	*t* value 99 %
2	12,7	63,7		14	2,16	3,01
3	4,3	9,92		15	2,14	2,98
4	3,18	5,84		16	2,13	2,95
5	2,78	4,6		17	2,12	2,92
6	2,57	4,03		18	2,11	2,9
7	2,45	3,71		19	2,1	2,88
8	2,36	3,5		20	2,09	2,86
9	2,31	3,36		21	2,08	2,83
10	2,26	3,25		22	2,075	2,82
11	2,23	3,17		23	2,07	2,81
12	2,2	3,11		24	2,065	2,8
13	2,18	3,05		25	2,06	2,79

3.6 Suggested uncertainty limits

The following target uncertainties are suggested:

a) Voltage < 1 kV: ± 1,5 %
b) Voltage > 1 kV: ± 2,5 %
c) Current < 20 A: ± 1,5 %
d) Current > 20 A: ± 2,5 %

Resistance

e) Earth and continuity: ± 10 %
f) Insulation: ± 10 %
g) Frequency: ± 0,2 %

Time

h) Interval < 60 s: ± 1 s
i) Interval > 60 s: ± 2 %
j) Mass < 10 g: ± 0,5 %
k) Mass 10 g to 100 g: ± 1 %
l) Mass > 100 g: ± 2 %
m) Force: ± 2 %
n) Dimension < 25 mm: ± 0,5 %
o) Dimension > 25 mm: ± 0,1 mm
p) Temperature < 100 °C: ± 1,5 %
q) Temperature > 100 °C: ± 3,5 %
r) Humidity 30 to 75 % RH: ± 5 % RH

Plating thicknesses

s) Backscatter method: ± 10 %
t) Microsection: ± 2 µm
u) Ionic contamination: ± 10 %

4 Catalogue of approved test methods

This standard provides specific test methods in complete detail to permit implementation with minimal cross-referencing to other specific procedures. The use of generic conditioning exposures is accomplished in the methods by reference, for example IEC 61189-1 and IEC 60068, and when applicable, is a mandatory part of the test method standard.

Each method has its own title, number and revision status to accommodate updating and improving the methods as industry requirements change or demand new methodology. The methods are organized in test method groups and individual tests.

5 P: Preparation/conditioning test methods

5.1 Test 2P01: Dry heat (under consideration)

5.2 Test 2P02: Solder float stress (under consideration)

6 V: Visual test methods

7 D: Dimensional test methods

7.1 Test 2D01: Thickness of base materials and rigid boards

7.1.1 Object

This test method covers the procedure for the determination of the thickness of base materials, clad or unclad.

7.1.2 Test specimens

Standard sheet sizes of metal-clad or unclad base materials.

Standard panel sizes of metal-clad or unclad base materials.

7.1.3 Test apparatus and material

A suitable micrometer having a resolution of 0,01 mm or better shall be used.

7.1.4 Procedure

a) General conditions

- Test specimens shall be placed between the two faces of the micrometer, so that the whole face of the pressure-foot will fall within the area of the material. The pressure-foot shall be lowered gently, slowly and with great care onto the test specimen so that all punching effect is avoided.
- No stress shall be imposed by hand on the instrument or the material when a reading is being taken. The reading shall be taken as soon as the pointer has ceased to move. It is necessary to take care in avoiding parallax errors and vibrations which may significantly affect the results.

b) Method 1

- This procedure is intended for the thickness measurement of the sheets of metal-clad or unclad base materials.
- The specimen shall be held vertically or horizontally.