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Test methods for electrical materials, interconnection structures and assemblies –

Part 6: Test methods for materials used in manufacturing electronic assemblies

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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TEST METHODS FOR ELECTRICAL MATERIALS, INTERCONNECTION STRUCTURES AND ASSEMBLIES –

Part 6: Test methods for materials used in manufacturing electronic assemblies

FOREWORD

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International Standard IEC 61189-6 has been prepared by IEC technical committee 91: Electronic assembly technology.

The text of this standard is based on the following documents:

FDIS	Report on voting
91/593/FDIS	91/610/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.

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

This standard should be used in conjunction with the following parts of IEC 61189, 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

Part 5: Test methods for printed board assemblies,

and also the following standard:

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- withdrawn;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.

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 IEC 61189 series 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 104) 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 evaluating materials used in manufacturing 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 criterion.

The letter and number combinations are for reference purposes, to be used by the relevant specification. Thus "6C02" represents the s chemical test method described in this “Part 6” of IEC 61189. In this example, 6 is the part of IEC standard (61189-6), C is the group of methods, and 02 is the test number.

TEST METHODS FOR ELECTRICAL MATERIALS, INTERCONNECTION STRUCTURES AND ASSEMBLIES –

Part 6: Test methods for materials used in manufacturing electronic assemblies

1 Scope

This part of IEC 61189 is a catalogue of test methods representing methodologies and procedures that can be applied to materials used in manufacturing electronic 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 61189-1, *Test methods for electrical materials, interconnection structures and assemblies – Part 1: General test methods and methodology*

IEC 61190-1-1, *Attachment materials for electronic assembly – Part 1-1: Requirements for soldering fluxes for high-quality interconnections in electronics assembly*

IEC 61190-1-3, *Attachment materials for electronic assembly – Part 1-3: Requirements for electronic grade solder alloys and fluxed and non-fluxed solid solders for electronic soldering applications*

ISO 9001, *Quality management systems – Requirements*

ISO 9455 (all parts), *Soft soldering fluxes – Test methods*

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 test instrument and/or system.

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.

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 specimen 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:

a) the test method used;

b) the identity of the specimen(s);

c) the test instrumentation;

d) the specified limit(s);

e) an estimate of measurement uncertainty, and resultant working limit(s) for the test;

f) the detailed test results;

g) 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 a 95 % limit, as in the case of the worked examples shown in Annex A.

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

Specimen size	*t* value 95 %	*t* value 99 %	Specimen 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	v2,81
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 – 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 – 75) % RH: ±5 % RH