



IEC 61189-3

Edition 2.0 2007-10

INTERNATIONAL STANDARD

**Test methods for electrical materials, printed boards and other interconnection structures and assemblies –
Part 3: Test methods for interconnection structures (printed boards)**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

PRICE CODE **XE**

ICS 31.180

ISBN 2-8318-9324-0

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope and object.....	7
2 Normative references.....	7
3 Accuracy, precision and resolution.....	8
4 Catalogue of approved test methods.....	11
5 P: Preparation/conditioning test methods.....	11
6 V: Visual test methods.....	11
7 D: Dimensional test methods.....	14
8 C: Chemical test methods.....	17
9 M: Mechanical test methods.....	30
10 E: Electrical test methods.....	48
11 N: Environmental test methods.....	75
12 X: Miscellaneous test methods.....	93
Annex A (informative) Worked examples.....	117
Figure 1 – Glow wire.....	19
Figure 2 – Test apparatus.....	20
Figure 3a – Horizontal specimen – Flame applied to surface.....	24
Figure 3b – Horizontal specimen – Flame applied to edge.....	24
Figure 3c – Vertical specimen – Lower edge horizontal – Flame applied to edge.....	25
Figure 3d – Vertical specimen – Lower edge horizontal – Flame applied to surface.....	25
Figure 3e – Needle burner test – Side views of test board and burner.....	26
Figure 3 – Needle burner test.....	26
Figure 4 – Flux type classification by copper mirror test.....	30
Figure 5 – Copper foil peel test.....	33
Figure 5a – Hold down clamping system.....	32
Figure 5b – Single load mode.....	32
Figure 5c – Multiple load mode.....	32
Figure 5d – Keyhole hold down fixture.....	33
Figure 6 – Bow.....	36
Figure 7 – Twist.....	36
Figure 8 – Test set-up for bow measurement.....	37
Figure 9 – Specimen set-up for twist measurement.....	37
Figure 10a – Specimen set-up for referee test for twist, raised parallel surfaces.....	39
Figure 10b – Specimen setup for referee test for twist, supporting jacks or blocks.....	39
Figure 10c – Specimen setup for referee test for twist measurements.....	39
Figure 10 – Specimen setup for referee test.....	39
Figure 11 – Bow measurement.....	40

Figure 12 – Twist measurement	40
Figure 13 – Measuring equipment for peel strength of flexible printed boards	43
Figure 14 – Pencil holder	46
Figure 15a – Location of test specimens	54
Figure 15b – Location of test specimens	55
Figure 15 – Composite test pattern	55
Figure 16 – Test specimen artwork	61
Figure 17 – Fluidized sand bath	64
Figure 18 – Possible equipment configuration	68
Figure 19 – Schematic showing undisturbed interval	68
Figure 20 – Test wave form example	70
Figure 21 – Incident wave voltage showing (2 X) air line delay	70
Figure 22 – Details of test specimen	72
Figure 23 – Circuit diagram for measurement of contact resistance	73
Figure 24 – Keypad contact patterns	75
Figure 25 – Plier fixture for thermal shock test, dip soldering	82
Figure 26 – Temperature cycles for moisture and insulation resistance test graph	92
Figure 27 – Insulation resistance coupon (μm)	92
Figure 28 – Typical “comb pattern”	93
Figure 29 – Suggested test specimen for surface mount features	104
Figure 30 – Suggested test specimen for plated through holes	104
Figure 31 – Rotary dip solderability test equipment	107
Figure 32 – Effectiveness of solder wetting on plated through holes	110
Figure 33 – Test specimen	116
Table 1 – Student’s “t” distribution	10
Table 2 – Preferred land, hole and wire dimensions	44
Table 3 – Resistance values	61
Table 4 – Chamber temperatures for one cycle	86
Table 5 – Accelerated ageing and test requirements	105
Table 6 – Maximum limits of solder bath contaminants	106

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**TEST METHODS FOR ELECTRICAL MATERIALS, PRINTED BOARDS AND
OTHER INTERCONNECTION STRUCTURES AND ASSEMBLIES –****Part 3: Test methods for interconnection structures
(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 preparatory work. 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 provides no marking procedure to indicate approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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.

International Standard IEC 61189-3 has been prepared by IEC technical committee 91: Electronics assembly technology.

This second edition cancels and replaces the first edition, published in 1997, its amendment 1 (1999), and constitutes a technical revision.

The document 91/698/FDIS, circulated to the National Committees as Amendment 2, led to the publication of the new edition.

The major technical changes with regard to the previous edition concern the addition of 25 new tests, as follows:

- 6 V: Visual test methods: 3V01, 3V02 and 3V03;
- 7 D: Dimensional test methods: 3D03;

- 8 C: Chemical test methods: 3C02, 3C13 and 3C14;
- 9 M: Mechanical test methods: 3M01, 3M03, 3M04, 3M07 and 3M09;
- 10 E: Electrical test methods: 3E03, 3E04, 3E05, 3E11, 3E12, 3E13, 3E16, 3E17 and 3E18;
- 11 N: Environmental test methods: 3N03, 3N07 and 3N12;
- 12 X: Miscellaneous test methods: 3X01

This edition also includes the deletion of Annex B: Conversion table, as the referred documents were disbanded in 2005 and do not officially exist. Should any one wish to consult such information, they should refer to the first edition of IEC 61189-3 (1997).

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

FDIS	Report on voting
91/698/FDIS	91/727/RVD

Full information on the voting for the approval of this amendment 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.

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

NOTE Future standards in this series will carry the new general title as cited above. Titles of existing standards in this series will be updated at the time of the next edition.

This standard should be used in conjunction with the following parts:

- Part 1: General test methods and terminology
 - Part 2: Test methods for materials for interconnection structures
 - Part 3: Test methods for electronic components assembling characteristics
 - Part 5: Test methods printed board assemblies and also the following standard
 - Part 6: Test methods for materials used in manufacturing electronic assemblies
- IEC 60068 (all parts), Environmental testing

The committee has decided that the contents of the base publication and its amendments 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 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 evaluating printed boards and other forms of interconnection structures. 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 obtain 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. The "3D02" represents the second dimensional test method described in this publication.

In short, for this example, 3 is the part of IEC standard (61189-3), D is the group of methods, and 02 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 3: Test methods for interconnection structures (printed boards)

1 Scope

This part of IEC 61189 is 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 60051 (all parts), *Direct acting indicating analogue electrical measuring instruments and their accessories*

IEC 60068-1: 1988, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-20: 1979, *Environmental testing – Part 2: Tests – Test T: Soldering* Amendment 2 (1987)

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

IEC 60169–15, *Radio-frequency connectors – Part 15: RF coaxial connectors with inner diameter of outer conductor 4,13 mm (0,163 in) with screw coupling – Characteristic impedance 50 ohms (Type SMA)*

IEC 60454-1:1992, *Specifications for pressure-sensitive adhesive tapes for electrical purposes – Part 1: General requirements*

IEC 60454-3-1:1998, *Pressure-sensitive adhesive tapes for electrical purposes – Part 3: Specifications for individual materials – Sheet 1: PVC film tapes with pressure-sensitive adhesive*

IEC 60584-1, *Thermocouples – Part 1: reference tables*

IEC 6095-11-5, *Fire hazard testing – Part 11-5: Test flames – Needle flame test method – Apparatus, confirmatory test arrangement and guidance*

IEC 61188-1-2:1998, *Printed boards and printed board assemblies – Design and use – Part 1-2: Generic requirements – Controlled impedance*

IEC 61189-1:1997, *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 61190-1-2, *Attachment materials for electronic assembly – Part 1-2: Requirements for*

solder pastes for high quality interconnections in electronic assembly

IEC 62326-4:1996, *Printed boards – Part 4: Rigid multilayer printed boards with interlayer connections – Sectional specification*

IEC 62326-4-1:1996, *Printed boards – Part 4: Rigid multilayer printed boards with interlayer connections – Sectional specification – Section 1: Capability Detail Specification – Performance levels A, B and C*

ISO 4046:1978, *Paper, board, pulp and related terms – Vocabulary (withdrawn)*¹

ISO 9002:1994, *Quality systems – Model for quality assurance in production, installation and servicing (withdrawn)*

ISO 9453:2006, *Soft solder alloys – Chemical compositions and forms*

¹ ISO 4046 has been withdrawn and replaced by ISO 4046: Parts 1 to 5.