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Environmental testing – Part 2-82: Tests – Test XW_1: Whisker test methods for electronic and electric components

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CONTENTS

FOREWORD 4

1 Scope 6
2 Normative references 6
3 Terms and definitions 6
4 Test equipment 7
4.1 Desiccator 7
4.2 Humidity chamber 7
4.3 Thermal cycling chamber 7
4.4 Optical microscope 7
4.5 Scanning electron microscope microscopy 7
4.6 Fixing jig 8
5 Preparation for test 8
5.1 General 8
5.2 Selection of test methods 8
5.3 Storage conditions prior to testing 8
5.4 Handling of the specimen 8
5.5 Preconditioning by heat treatment 8
5.6 Specimen preparation by leads forming 9
6 Test condition 10
6.1 Ambient test 10
6.2 Damp heat test 10
6.3 Temperature cycling test 10
7 Test schedule 11
7.1 Procedure for test method selection 11
7.2 Initial measurement 12
7.3 Test 12
7.4 Recovery 12
7.5 Intermediate or final assessment 12
8 Information to be given in the relevant specification 12
9 Minimum requirements for a test report 13

Annex A (normative) Measurement of the whisker length 14
Annex B (informative) Examples of whiskers 15
Annex C (informative) Guidance on the sample lots and test schedules 17
Annex D (informative) Guidance on acceptance criteria 19
Annex E (informative) Background on whisker growth 21
Annex F (informative) Background on ambient test 22
Annex G (informative) Background on damp heat test 24
Annex H (informative) Background on temperature cycling test 27

Bibliography 32

Figure A.1 – Definition of the whisker length 14
Figure B.1 – Nodule 15
Figure B.2 – Column whisker 15
Figure B.3 – Filament whisker 15
Figure B.4 – Kinked whisker 16
Figure B.5 – Spiral whisker 16
Figure D.1 – Smallest distance of components and circuit boards 19
Figure F.1 – Whisker growth of tin plating in ambient test condition 23
Figure G.1 – Growth of the oxide layer in damp heat conditions 25
Figure G.2a – Growth of whiskers in damp heat conditions 25
Figure G.2b – Growth of whiskers in damp heat conditions 26
Figure G.2 – Growth of whiskers 26
Figure H.1 – Distribution of whisker length grown on FeNi (Alloy42) base material 28
Figure H.2 – Whisker grown on FeNi (Alloy42) base material 29
Figure H.3 – Relationship of $\Delta\vartheta$ and number of cycles for whisker growth on FeNi (Alloy 42) base material 29
Figure H.4 – Whisker growth on Cu based leadframes (QFP) in temperature cycling tests 31

Table 1 – Methods of preconditioning: Soldering simulation 9
Table 2 – Methods of preconditioning: Soldering 9
Table 3 – Severities of the ambient test 10
Table 4 – Severities of the temperature cycling test: temperature 10
Table 5 – Severities of the temperature cycling test: cycles 11
Table 6 – Suitability of test methods for different plating situations 11
Table H.1 – Example for a relationship between realistic application conditions and test conditions 30

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL TESTING –

Part 2-82: Tests – Test XW$_1$: Whisker test methods for electronic and electric components

FOREWORD

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International Standard IEC 60068-2-82 has been prepared by IEC technical committee 91: Electronics assembly technology.

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

FDIS	Report on voting
91/651/FDIS	91/685/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.

A list of all parts in the IEC 60068 series, under the general title *Environmental testing,* can be found on the IEC website.

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.

The contents of the corrigendum of December 2009 have been included in this copy.

ENVIRONMENTAL TESTING –

Part 2-82: Tests – Test XW_1: Whisker test methods for electronic and electric components

1 Scope

This part of IEC 60068 specifies whisker tests for electric or electronic components representing the finished stage, with tin or tin-alloy finish. However, the standard does not specify tests for whiskers that may grow as a result of external mechanical stress.

This test method is employed by a relevant specification (international component or application specification) with transfer of the test severities to be applied and with defined acceptance criteria.

Where tests described in this standard are considered for other components, e.g. mechanical parts as used in electrical or electronic equipment, it should be ensured that the material system and whisker growth mechanisms are comparable.

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 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

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

IEC 60068-2-58:2004, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

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

IEC 61192-3:2002, *Workmanship requirements for soldered electronic assemblies – Part 3: Through-hole mount assemblies*

IEC 61760-1:2006, *Surface mounting technology – Part 1: Standard method for the specification of surface mounting components (SMDs)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60068-1, as well as the following, apply.

3.1
whisker
metallic protrusion which spontaneously grows during storage or use

NOTE 1 Whiskers typically do not require any electrical field for their growth and may not be mixed with products of electrochemical migration. Typical signs of whiskers include:

– striations in growth direction;

– typically no branching;

– typically constant diameters.

Exceptions are known, but rare and may require detailed investigation.

For the purposes of this standard, whiskers are considered if

– they have an aspect ratio (length/width) greater than 2,

– they have a length of 10 µm or more.

NOTE 2 For the purposes of this standard, whiskers have the following characteristics:

– they can be kinked, bent, or twisted; they usually have a uniform cross-sectional shape;

– they may have rings around the circumference of the column.

NOTE 3 Whiskers are not to be confused with dendrites which are fern-like growths on the surface of a material which can be formed as a result of electro-migration of an ionic species or produced during solidification.

3.2
material system
termination consists of the following elements:

a) base material;

b) underlayer, if any, located under the final plating;

c) final tin or tin alloy plating.

NOTE There may be additional layers between the base material and the underlayer. The penultimate layer is the used bulk material or the deposited layer underneath the final tin or tin alloy plating of the component.

4 Test equipment

The test equipment shall comprise the following elements:

4.1 Desiccator

The desiccator shall be capable of providing the conditions of temperature and humidity specified in 6.1.

4.2 Humidity chamber

The humidity chamber shall meet all the requirements of IEC 60068-2-78 and be capable of providing the conditions specified in 6.2.

4.3 Thermal cycling chamber

The thermal cycling chamber shall meet all the requirements of IEC 60068-2-14, test Na and be capable of providing the conditions specified in 6.3.

4.4 Optical microscope

An optical stereo-microscope with a magnification of at least 50 times and an appropriate illumination, capable of detecting whiskers with a length of 10 µm.

If used for measurement, the microscope shall be equipped with a scale or electronic detection system capable for length measurement with an accuracy of at least ±5 µm.

4.5 Scanning electron microscope

A scanning electron microscope (SEM) capable of investigating the surface of the specimen, preferably equipped with a handling system capable to tilt and rotate the specimen.

4.6 Fixing jig

The fixture jig shall be capable of setting samples in any of the test chambers specified in 4.1, 4.2 and 4.3 without affecting compliance with the specified requirements.

The jig should also be attachable to the optical microscope or be appropriately small in size so that it can be inserted in the SEM sample chamber.

5 Preparation for test

5.1 General

The samples shall represent finished products as supplied to the market.

NOTE Guidance on suitable sample sizes is provided in Annex C.

5.2 Selection of test methods

Choose the appropriate test method according to the type of final plating, underlayer and base material of the specimen according to Table 6.

5.3 Storage conditions prior to testing

The specimen shall be kept for at least 2 h in the standard atmospheric conditions defined in IEC 60068-1, 5.3.1 prior to any preconditioning or test.

5.4 Handling of the specimen

It is recommended to hold the specimen with a fixture jig as specified in 4.6 to prevent them from being contaminated unexpectedly. The fixture jig shall not contact the metallic surfaces of the specimen to be tested. The sample shall be handled carefully to prevent the grown whiskers from falling away unexpectedly. Broken whiskers shall be recorded, see 7.4.

Where there is a possibility of grown whiskers to drop down, an appropriate fixture jig design shall be considered in advance of the test. Conductive sputter coating typically used to aid SEM inspection, such as C, Pt, or Au, shall not be deposited on the specimen.

5.5 Preconditioning by heat treatment

5.5.1 Soldering simulation prior to ambient and damp heat test (see 6.1 and 6.2)

a) Components intended for soldering

Before soldering simulation, the specimen of material descriptions case 1.1, case 3 or case 4 shall have been stored under room temperature for more than 30 days after the last manufacturing process, e.g. as indicated by the date code of the product.

Unless otherwise specified by the relevant specification, the components shall be submitted to a soldering simulation according to Table 1 without the use of solder and without contact to any metal surface.

Table 1 – Methods of preconditioning – Soldering simulation

Component type	Soldering simulation	
	First half of the sample	Second half of the sample
SMD	Reflow heat treatment according to Table 3 (Group 3) of 8.1.2.1, IEC 60068-2-58	None
Other	Bath with inert liquid [1] according to test Ta, method 1 of IEC 60068-2-20 Dipping depth: max. 4 mm.	None
[1] e.g. Perfluoropolyether PFPE.		

After preconditioning the test shall be started within 168 h.

Conditions of thermal preconditioning shall be recorded.

b) Components not intended for soldering

No thermal preconditioning shall be applied.

5.5.2 Soldering simulation prior to temperature cycling test (see 6.3)

a) Components intended for soldering

Before soldering, the specimen of material descriptions case 1.1, case 3 or case 4 shall have been stored under room temperature for more than 30 days after the last manufacturing process, e.g. as indicated by the date code of the product.

Unless otherwise specified by the relevant specification, the components may be assembled onto printed circuit boards. The circuit board material shall be epoxide woven glass with a thickness of (1,6 ± 0,2) mm. The assembly process shall be according to Table 2.

Table 2 – Methods of preconditioning – Soldering

Component type	Soldering
SMD	Hot air convection reflow soldering with SnAgCu solder [1], low activity flux, according to Table 3 (Group 3) of 8.1.2.1, IEC 60068-2-58
Other	Wave soldering by use of a soldering profile according to 6.1 of IEC 61760-1, using SnAgCu solder
[1] Apply 50 % of the solder paste volume recommended for typical production. This requirement shall ensure that after soldering a part of the terminal surface is not covered by solder and remains for inspection.	

After this preconditioning the test shall be started within 168 h.

The soldering conditions shall be recorded.

b) Components not intended for soldering

Unless otherwise described by the relevant specification, the components are tested in unassembled stage.

5.6 Specimen preparation by leads forming

In cases where components are subjected to mechanical stress after delivery, e.g. the forming of leads, a representative pre-conditioning is required. Unless otherwise specified by the relevant specification, each specimen shall be bent 90° to the consistent inner bending radius specified as the minimum radius in Table 1, of IEC 61192-3.