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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Connectors for electronic equipment – Tests and measurements – Part 16-21: Mechanical tests on contacts and terminations – Test 16u: Whisker test via the application of external mechanical stresses

Connecteurs pour équipements électroniques – Essais et mesures – Partie 16-21: Essais mécaniques des contacts et des sorties – Essai 16u: Essai des trichites au moyen de l'application de contraintes mécaniques extérieures

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FOREWORD

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International Standard IEC 60512-16-21 has been prepared by subcommittee 48B: Connectors, of IEC technical committee 48: Electromechanical components and mechanical structures for electronic equipment.

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

FDIS	Report on voting
48B/2284/FDIS	48B/2294/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.

A list of all parts of IEC series 60512, under the general title *Connectors for electronic equipment – Tests and measurements*, can be found on the IEC website.

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

The committee has decided that the contents of this publication will remain unchanged until the stability 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- withdrawn,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.

CONNECTORS FOR ELECTRONIC EQUIPMENT – TESTS AND MEASUREMENTS –

Part 16-21: Mechanical tests on contacts and terminations Test 16u: Whisker test via the application of external mechanical stresses

1 Scope and object

This part of IEC 60512, when required by the detail specification, is used for testing connectors within the scope of IEC technical committee 48. It may also be used for similar devices when specified in a detail specification.

The object of this standard is to define a standard test method to assess the possibility of whisker growth by external mechanical stress on the tin and tin-alloy plated parts of a connector in its application (after wire termination, after soldering, after mounting, mated with counterpart).

This standard does not cover internal stress type whisker.

NOTE 1 The test method dealing with internal stress type whisker, which is caused by the formation of intermetallic compound by diffusion, or by the formation of oxide film of the plating surface, or by the difference between coefficients of thermal expansion, is specified in IEC 60068-2-82.

While for internal stress type whisker, it is possible to apply accelerated test conditions, e.g.: by damp heat or temperature cycling, for the external mechanical stress type whisker covered by this standard, due to the different whisker generation mechanism, there are no accelerated conditions. The test detailed in this standard shall then be conducted under normal ambient conditions.

NOTE 2 Physical changes during the application process may cause changes of the material qualities, so that this test cannot be used as a qualification test of a connector in ‘as produced’ condition.

NOTE 3 The conditions specified in this test may accelerate the growth of tin whiskers in a test specimen, but no correlation has been demonstrated between the extent of whisker growth, which may occur in this test, and the extent of whisker growth which may be expected in actual use. Whisker growth in actual use may therefore be less than or greater than the extent of whisker growth found when using this test.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050-581, *International Electrotechnical Vocabulary (IEV) – Part 581: Electromechanical components for electronic equipment*

IEC 60068-68-1, *Environmental testing – Part 1: General and guidance*

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 60068-2-82:2007, *Environmental testing – Part 2-82: Tests – Test XW_1: Whisker test methods for electronic and electric components*

IEC 60512-1, *Connectors for electronic equipment – Tests and measurements – Part 1: General*

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 of IEC 60050-581, IEC 60512-1, IEC 60068-2-82 and the following additional terms and definitions apply.

3.1
whisker
metallic protrusion, which spontaneously grows from the surface of a plating on a base metal during storage and use

Note 1 to entry: For the purpose of this standard, whiskers have the following characteristics:

– an aspect ratio (length/width) greater than 2;

– straight, kinked, bent and twisted with a uniform cross-sectional shape.

3.2
whisker length
the straight-line distance from the point of emergence of the whisker to the most distant point on the whisker (i.e., the radius of a sphere containing the whisker with its centre located at the point of emergence.)

4 Test equipment

4.1 Optical microscope

An optical stereomicroscope with an appropriate illumination and with at least 50X magnification, capable of detecting whiskers with a minimum length of 10 μm shall be provided.

For the measurement of whisker length, the microscope shall be equipped with a scale or electronic detection system capable of length measurements with accuracy of at least ±5 μm.

4.2 Scanning electron microscope (SEM)

A SEM capable of at least 250X magnification for investigating the surface of the specimen preferably equipped with a handling system for tilting and rotating the specimen shall be provided.

5 Preparation of the specimens

5.1 General

The number of specimens shall be specified in the detail specification or in accordance with IEC 60068-2-82.

The specimens shall be directly collected from the manufacturing line.

The specimens shall be prepared as they are intended to be used in final application. The specimens may additionally require special processing to allow observation of whisker growth, if any, inside the specimens, without affecting the primary function of the connector.

Each test shall be performed independently on separate specimens.

5.2 Handling of the specimens

When handling the specimens, care shall be taken to prevent contamination, external mechanical stress or unexpected damage.

In addition, care shall be taken to prevent whisker falling off.

5.3 Preconditioning

Unmated specimens shall be subjected to heat treatment.

Table 1 shows specimens preconditioning heat treatments required before whisker growth test of Clause 7.

After heat treatment, the specimens shall be placed under standard atmospheric conditions for at least 1 h, as specified in IEC 60068-1 to proceed to the next test.

While handling specimens, care shall be taken in order to avoid contamination of any soldering area by contact with naked hand or other objects.

Table 1 – Preconditioning heat treatment of specimens for whisker test

Specimen	Heat treatment	Remarks
SMT[a] and THR[b] connectors	Test 1 or test 2 in Table 4 of IEC 60068-2-58	The used reflow profile should be less than the maximum limited reflow profile described in Table 4 of IEC 60068-2-58
Connectors with dip-solder contacts or for handmade soldering	6.1 of IEC 61760-1, using SnAgCu solder	The used soldering profile should be less than the maximum limited soldering profile described in 6.1 of IEC 61760-1
Connectors with solderless contacts	Not applicable	

[a] SMT: Surface Mount Technology.

[b] THR: Through Hole Reflow.

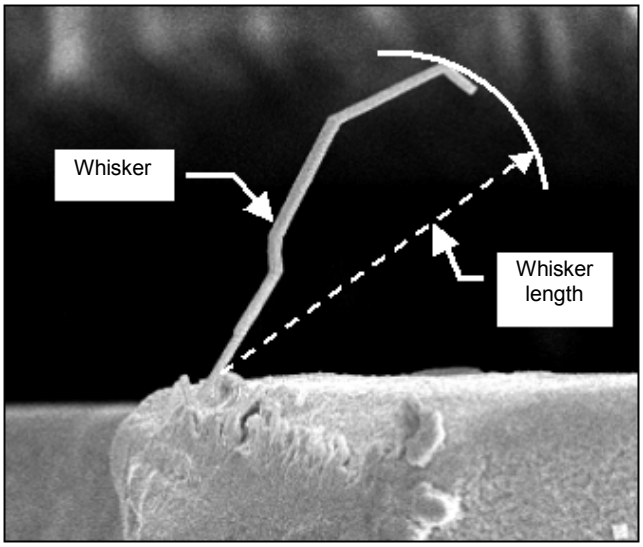
6 Measurement of whisker length

The whisker length shall be measured according to the following procedure.

a) The specimen shall be placed on the stage of the optical microscope according to 4.1.

b) The specimen shall be observed as shown in Annex A at an appropriate magnification.

c) The length of the whisker shall be measured according to Figure 1.



IEC 120/12

Figure 1 – Whisker length

NOTE The length of whisker shall be measured according to its definition given in 3.2, by the straight-line distance from the point of emergence of the whisker to the most distant point on the whisker (i.e., the radius of a sphere containing the whisker with its centre located at the point of emergence).

For detailed observation, SEM should be used. For SEM observation, low accelerating voltage shall be applied to avoid melting and disappearance of thin whiskers.

7 Test method

7.1 Initial measurement

Specimens shall be examined for the presence of tin whiskers using an optical microscope.

The length of each whisker identified shall be measured according to Clause 6.

The number of whiskers with a length as specified in the detail specification shall be recorded according to Clause 10.

For detailed measurement, SEM should be used.

7.2 Test

7.2.1 General

Test shall be started with specimens subjected to mechanical stress by the mating with the counterpart, and after specified durations, observation shall be conducted around whisker generation area.

After initial measurement, specimens shall be subjected to the following conditions.

The specimens shall be mated and/or unmated in accordance with detail specifications.

Whisker may be generated around the external mechanical stressed areas.

Observation areas are different depending on the connector type as below.

– General purpose connector: terminal holding area and contact area.

– FFC/FPC[1] connector: terminal holding area, terminal contact area with FFC/FPC and spacer.
– Wire termination, wire crimping: external areas mechanically stressed by terminating.

7.2.2 Test conditions

Temperature: 25 °C ± 10 °C

Relative humidity: 50 %RH ± 25 %RH

Duration: 1 000 h (unless otherwise specified in the detail specification)

7.2.3 Accelerated conditions

The external stress type whisker will generate and grow in normal conditions more than in damp heat or temperature cycling conditions. Therefore there are no accelerated conditions for external stress type whisker and the test shall be conducted in standard atmospheric condition.

7.2.4 Test duration

In the case of FFC/FPC connectors and of crimp type wire terminations, which shall be stressed respectively by mating or terminating, the starting time of this test shall be at the application of the stress time. On the other hand, for general purpose connectors, which are stressed only at the assembly time, the duration between assembly time and test starting time shall be included in the overall test duration.

7.3 Final measurement

After 1 000 h, the specimen shall be examined for the presence of tin whiskers using an optical microscope.

The length of each whisker identified shall be measured according to Clause 6.

The number of whiskers with a length as specified in the detail specification shall be recorded according to Clause 10.

For detailed measurement, SEM should be used.

8 Requirements

The acceptance criteria of the whisker length shall be as specified in the detail specification.

The guideline of the acceptance length should be 1/2 of the shortest distance between adjacent terminals.

9 Information to be recorded

The following information shall be recorded in the test report.

a) identification of the specimen:
   – base material;

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[1] FFC: Flexible Flat Cable; FPC : Flexible Printed Circuit.