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**Environmental testing—Part 2-82:
Tests—Test XW₁: Whisker test
methods for electronic and electric
components**

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal for establishment of Japanese Industrial Standard submitted by Japan Electronics and Information Technology Industries Association (JEITA) with a draft being attached, based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

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Environmental testing—Part 2-82: Tests—Test XW₁: Whisker test methods for electronic and electric components

Introduction

This Japanese Industrial Standard has been prepared based on the first edition of **IEC 60068-2-82** published in 2007 without modifying the technical contents.

The portions with dotted underlines are the matters not given in the corresponding International Standard.

1 Scope

This Standard 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.

NOTE : The International Standard corresponding to this Standard is as follows.
IEC 60068-2-82:2007 *Environmental testing—Part 2-82: Tests—Test Tx: Whisker test methods for electronic and electric components* (IDT)

In addition, symbols which denote the degree of correspondence in the contents between the relevant International Standard and **JIS** are IDT (identical), MOD (modified), and NEQ (not equivalent) according to **ISO/IEC Guide 21-1**.

2 Normative references

The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. For standards with the year indication, only the editions of the indicated year shall be applied and any revisions (including amendments) made thereafter shall not be applied.

JIS C 0025:1988 *Basic environmental testing procedures Part 2: Tests Test N: Change of temperature*

NOTE : Corresponding International Standard: IEC 60068-2-14:1984 *Environmental testing—Part 2-14: Tests—Test N: Change of temperature* (MOD)

JIS C 60068-1:1993 *Environmental testing Part 1: General and guidance*

NOTE : Corresponding International Standard: IEC 60068-1:1988 *Environmental testing. Part 1: General and guidance* and Amendment 1:1992 (IDT)

JIS C 60068-2-20:1996 *Basic environmental testing procedures Part 2: Tests. Test T: Soldering*

NOTE : Corresponding International Standard: IEC 60068-2-20:1979 *Environmental testing—Part 2-20: Tests—Test T: Soldering*, Amendment 1:1986 and Amendment 2:1987 (IDT)

JIS C 60068-2-58:2006 *Environmental testing—Part 2: Tests—Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

NOTE : Corresponding International Standard: 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)* (MOD)

JIS C 60068-2-78:2004 *Environmental testing—Part 2-78: Tests—Test Cab: Damp heat, steady state*

NOTE : Corresponding International Standard: IEC 60068-2-78:2001 *Environmental testing—Part 2-78: Tests—Test Cab: Damp heat, steady state* (IDT)

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 Standard, the terms and definitions given in **JIS C 60068-1**, as well as the following, apply.

3.1 whisker

metallic protrusion which spontaneously grows during storage or use

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 1 Whiskers have the following characteristics;

- they can be kinked, bent, or twisted; they usually have constant diameters;
- they may have rings around the circumference of the column;
- they have striations in growth direction;
- they have typically no branching.

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

NOTE 2 Whiskers typically do not require any electrical field for their growth and 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 (base material, underlayer and the final plating)

base material, underlayer and the final plating which comprise component terminations

In this Standard, the following elements are considered as the material system.

- a) base material: elemental gradient which comprise the termination material;
- b) underlayer, if any, located under the final 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.

- c) final tin or tin alloy plating.

3.2A preconditioning by heat treatment

heat treatment which simulates soldering

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 **JIS C 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 **JIS C 0025**, 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 $\pm 5 \mu\text{m}$.

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** and 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.

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 **JIS C 60068-1, 5.3** prior to any preconditioning or test.

5.4 Handling of the specimen

It is recommended to hold the specimen at the portion other than the termination of component with a fixture jig as specified in **4.6** to prevent them from being contaminated before or after or during the test. 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, Au, or Pt, 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 specified in table 6 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, JIS C 60068-2-58	None
Other	Bath with inert liquid ^{a)} according to test Ta, method 1 of JIS C 60068-2-20 Dipping depth: max. 4 mm.	None
Note ^{a)} e.g. Perfluoropolyether PFPE.		

After preconditioning the test shall be started within 168 h.

Conditions of thermal preconditioning shall be recorded in the test report.

- 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 specified in table 6 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 ^{a)} , low activity flux, according to table 3 (Group 3) of 8.1.2.1, JIS C 60068-2-58
Other	Wave soldering by use of a soldering profile according to 6.1 of IEC 61760-1 , using SnAgCu solder
Note ^{a)} 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 in the test report.

- 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 figure 2 and table 1, of **IEC 61192-3**.

6 Test conditions

6.1 Ambient test

Unless otherwise specified by the relevant specification, apply the conditions according to table 3 and in accordance with the severity selected from table 6:

Table 3 Severities of the ambient test

Severity	Temperature °C	Relative humidity %
A	30±2	60±3
B	25±10	50±25

Test duration: 4 000 h.

6.2 Damp heat (steady state) test

Unless otherwise specified by the relevant specification, use the humidity chamber specified in 4.2 and apply the conditions stated below:

- temperature: (55 ± 3) °C
- relative humidity: (85 ± 5) %
- test duration: 2 000 h.

Apply heating, cooling, moistening, and dehumidifying in the test in a way that dew does not condensate on the specimens.

6.3 Temperature cycling test

Unless otherwise specified by the relevant specification, apply the procedures specified in **JIS C 0025**, test Na with the conditions stated below:

For the lower temperature and upper temperature, one severity according to table 4 shall be used.

Table 4 Severities of the temperature cycling test—Temperature

Severity (First character)	Lower temperature °C	Upper temperature °C
K	-40±5	85±2
L	-55±5	85±2
M	-40±5	125±2
N	-55±5	125±2
NOTE 1 Severities for this test are given by two characters in combination with table 4 and table 5, e.g. KQ for -40 °C/85 °C/1 000 cycles. Reference to only one severity parameter can be made by using an “x” for the unspecified parameter, e.g. Kx for -40 °C/85 °C. NOTE 2 Neither the sequence of listed severities nor the range between lower and upper temperature impose a specific degree of severity, see Annex H.		

Apply a minimum dwell time of 20 min for both the low and high test temperature. The transfer time between the extremes shall be less than 30 s.

For the number of test cycles, apply the conditions according to table 5 and in accordance with the severity selected from table 6.