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Surface mounting technology – Environmental and endurance test methods for surface mount solder joint –

Part 1-2: Shear strength test

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

SURFACE MOUNTING TECHNOLOGY – ENVIRONMENTAL AND ENDURANCE TEST METHODS FOR SURFACE MOUNT SOLDER JOINT –

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FOREWORD

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International Standard IEC 62137-1-2 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
91/683/FDIS	91/699/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 the parts in the IEC 62137 series, under the general title *Surface mounting technology – Environmental and endurance test methods for surface mount solder joint*, 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- withdrawn,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.

SURFACE MOUNTING TECHNOLOGY – ENVIRONMENTAL AND ENDURANCE TEST METHODS FOR SURFACE MOUNT SOLDER JOINT –

Part 1-2: Shear strength test

1 Scope

The test method described in this part of IEC 62137 is applicable to leadless surface mounting components and surface mounting connectors to which pull test is not applicable. It is not applicable to multi-lead components and gull-wing leads.

The method is designed to test and evaluate the endurance of the solder joint between component terminals and lands on a substrate, by means of a shear type mechanical stress. This test is applicable to evaluate the effects of repeated temperature change on the strength of the solder joints between terminals and lands on a substrate.

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, *Environmental testing – Part 1: General and guidance*

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

IEC 60194, *Printed board design, manufacture and assembly – Terms and definitions*

IEC 61188-5-2, *Printed boards and printed board assemblies – Design and use – Part 5-2: Attachment (land/joint) considerations – Discrete components*

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

IEC 61188-5-5, *Printed boards and printed board assemblies – Design and use – Part 5-5: Sectional requirements - Attachment (land/joint) considerations – Components with gull-wing leads on four sides*[1]

IEC 61249-2-7, *Materials for printed boards and other interconnecting structures – Part 2-7: Reinforced base materials clad and unclad – Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

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1 In preparation.

NOTE Key terms used in this standard are taken mostly from IEC 60068-1 and IEC 60194.

3.1
shear strength
maximum force applied parallel to the substrate and perpendicular to the specimen lateral surface to break the joint of SMD mounted on a board

3.2
displacement rate
speed of the pushing tool, which is used to break the joint

3.3
shear height
distance between the bottom surface of the pushing tool and the surface of the substrate

4 General remarks

The mechanical properties of the joint between a terminal to a land on a printed wiring board using lead-free solder are not the same for the joint using tin-lead solder due to the difference in composing elements of the solders. Thus it becomes important to test the mechanical properties of solder joints, using different solder alloys, and after temperature cycling stresses have been applied.

In this test method, the test specimens are mounted on a substrate by reflow soldering. The durability of the solder joint is evaluated by exposing the electronic components to a rapid change of temperature and applying a shear stress to the solder joint.

NOTE 1 The exposure temperatures in this test may exceed the rated temperature range of the specific electronic component.

NOTE 2 This test is not a test to measure the strength of the electronic components. The test method to evaluate the robustness of the joint to a board is described in IEC 60068-2-21.

The area of a joint to be evaluated is illustrated in Figure 1. This shear strength test is applicable to most leadless surface mounting devices, except multi-leadless components (QFN, LGA etc.) and gull-wing lead components to which a pull strength test is applicable.

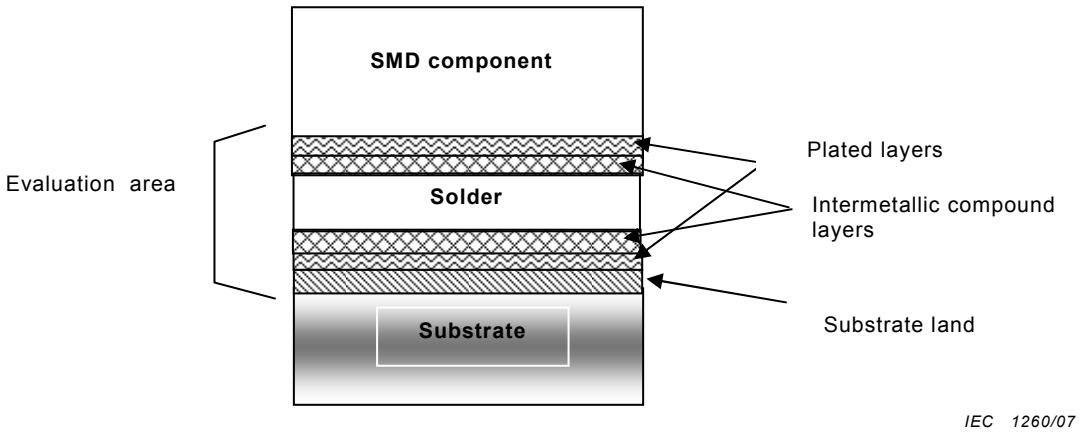

Figure 1 – Area under evaluation in the shear strength test

5 Test equipment and materials

5.1 Shear test equipment

Unless otherwise specified, equipment with the following features shall be used for the shear test.

The shear type strength test equipment shall have a mechanism to fasten a substrate with electronic component mounted on it. The equipment shall be capable of applying a shear force to the solder joint of the terminal of an electronic component, which is higher than the mechanical strength of the joint, so that it can break off the joint. The equipment shall be capable of measuring the shear force. Preferably the distance between the tool used to apply the shear force and the substrate surface should be precisely controlled.

5.2 Pushing tool

Unless otherwise specified, the pushing tool shall have the following properties:

– the side of the pushing tool to apply a force to the side of a specimen shall be flat;

– the height of the tool shall be higher than the height of the specimen and the width of the jig shall be equal or larger than the width of a specimen to which a shear force is applied (see Figure A.2).

5.3 Optical microscope

The microscope shall be able to observe an object with a magnification approximately of 50X to 250X. It shall also be equipped with a lamp that can give an illumination level of approximately 2 000 lx to the object.

5.4 Scanning electron microscope (SEM)

The scanning electron microscope shall be able to generate a focused electron beam probe of 3 nm to 10 nm using an electric lens system and can scan over a specimen held in a vacuum chamber. The SEM shall detect secondary electrons or reflected electrons and display an enlarged image of the detected signal on a CRT or another display device.

5.5 Reflow soldering oven

The reflow soldering oven shall be able to realize the temperature profile given in Figure 2.

5.6 Test substrate

Unless otherwise prescribed by the relevant specification, the test shall be conducted on a specimen (device) mounted by its normal means on the following substrate.

a) **Material**: Epoxide woven glass fabric copper-clad laminated sheet, general purpose grade (IEC 61249-2-7), with foil bonded to one side and a nominal thickness of the sheet, including the metal foil, of 1,6 mm with a tolerance of ±0,20 mm. The copper foil shall have a thickness of 0,035 mm ± 0,010 mm.

b) **Size**: The size of the substrate depends on the size and shape of a surface mount device soldered on the substrate. The substrate shall be able to be fastened to the shearing test equipment.

c) **Land geometry**: The shape and size of a land shall comply with IEC 61188-5-2 or the land geometry recommended by the respective component supplier. Since IEC 61188-5-5 provides for three different land pattern geometries, and different suppliers provide different recommendations, the relationship between the component gull-wing foot print and the land pattern used in the testing shall be recorded in accordance with the following:

   – land protrusion at the lead toe: minimum;

– land protrusion at the lead heel: minimum;

– land protrusion at the lead side: minimum.

d) **Surface protection**: The solderable areas of the substrate (lands) shall be protected against oxidization by suitable means, e.g. by an organic surface protection layer (OSP). This protective layer shall not adversely have an effect on the solderability of the lands under the soldering conditions of the reflow soldering equipment described in Clause 6.

5.7 Solder alloy

Unless otherwise specified, the solder alloy shall consist of a ternary composition of Sn, Ag and Cu with the Ag content ranking from 3,0 % to 4,0 % by weight and the Cu content ranking from 0,5 % to 1,0 % by weight with Sn for balance, e.g. SnAg3.0Cu0.5. The solder alloy shall be in accordance with IEC 61190-1-3.

5.8 Solder paste

Unless otherwise specified, the solder paste used in this test shall comply with IEC 61190-1-2. The solder alloy specified in 5.7 shall be used for the solder paste.

6 Mounting method for reflow soldering

The following steps shall be taken:a) Apply the solder paste specified in 5.8 to the lands of a test substrate as specified in 5.6, using a metal mask with openings of the same size, shape and configuration as the lands on the substrate, made of stainless steel with a thickness of 100 µm to 150 µm.

b) Mount the test specimen on the test substrate with solder paste applied.

c) Use the reflow-soldering equipment specified in 5.5 to solder the terminals under the conditions given below. A typical temperature profile of reflow soldering is given in Figure 2, as proposed in IEC 61760-1. The temperature is measured at the land.