IEC 62137-1-1

Edition 1.0 2007-07

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Surface mounting technology – Environmental and endurance test methods for surface mount solder joint –
Part 1-1: Pull strength test

Technologie de montage en surface – Méthodes d'essais d'environnement et d'endurance des joints brasés montés en surface –
Partie 1-1: Essai de résistance à la traction

IEC 62137-1-1:2007

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX **P**

ICS 31.190
ISBN 2-8318-9782-3

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

Part 1-1: Pull strength test

FOREWORD

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International Standard IEC 62137-1-1 has been prepared by IEC technical committee 91: Electronics assembly technology.

This bilingual version, published in 2008-05, corresponds to the English version.

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

FDIS	Report on voting
91/681/FDIS	91/697/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.

The French version of this standard has not been voted upon.

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- withdrawn;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.

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

Part 1-1: Pull strength test

1 Scope

The test method described in this part of IEC 62137 is applicable to gull-wing lead surface mounting components.

The method is designed to test and evaluate the endurance of the solder joint between component leads and lands on a substrate, by means of a pull type mechanical stress. This test is suitable for evaluating the effects of repeated temperature change on the strength of the solder joint between component 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: Tests – Test N: Change of temperature*

IEC 60194, *Printed board design, manufacture and assembly – Terms and definitions (only available in English)*

IEC 61188-5-5, *Printed boards and printed board assemblies – Design and use – Part 5-5: Attachment (land/joint) considerations – Components with gull-wing leads on four sides (only available in English)*

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 soldering pastes for high-quality interconnects in electronics assembly (only available in English)*

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 (only available in English)*

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*

3 Terms and definitions

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

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

3.1
gull-wing lead
lead stretching out from a surface mount component as illustrated in Figure 1

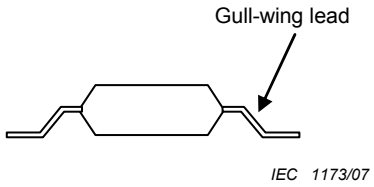


Figure 1 – Gull-wing leaded component

3.2
pull strength
maximum force to break the joint of a lead to board when a gull-wing lead of a surface mount component is pulled using a pulling tool at an angle of 45 ° to the board surface

3.3
pull speed
moving speed of the pulling tool holding a gull-wing lead of a component mounted on board in pull strength test

4 General remarks

The mechanical properties of the joint between leads to lands 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 stress have been applied.

In this test method, the test specimens are mounted on a substrate either by flow soldering or by reflow soldering. The durability of the solder joints is evaluated first by exposing the electronic components to rapid changes of temperature and after that applying pull strength to the soldered joint.

Users of gull-wing components subjected to these tests should check that the results ensure an adequate margin of attachment strength bearing in mind the mass of the component, the number of leads and the specified mechanical environment of the electronic assembly for which the component is intended.

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.

NOTE 3 Where the tests on a single component have been performed on more than one lead, the lowest strength figure should be assumed for all leads when calculating the overall attachment strength.

The area of a joint to be evaluated is illustrated in Figure 2.

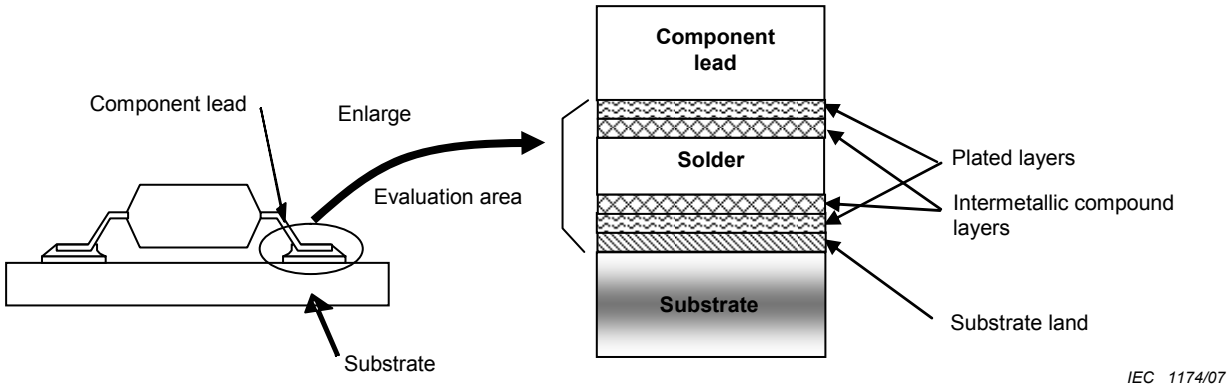


Figure 2 – Area under evaluation in the pull strength test

5 Test equipment and materials

5.1 Flow soldering equipment

The equipment used for the flow soldering is a solder bath that can realize the temperature profile as specified in 6.1. An example of the temperature profile is given in Figure 3.

5.2 Reflow soldering equipment

The reflow soldering oven shall be able to realize the temperature profile as specified in 6.2. An example of the temperature profile is given in Figure 4.

5.3 Pull strength test equipment

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

The pull strength test equipment is composed of tension testing machine, a pulling tool, a jig to fasten a substrate, and an electronic recorder. The tension testing machine shall realize the pull speed specified in Annex A. The jig to fasten a substrate shall be designed so that a pull force can be applied to a specimen lead at an angle of 45° to the substrate. The recorder shall be able to record the maximum force applied to a lead to break the soldered joint. The accuracy of the recorded data shall be better than ±1 % of measured values.

5.4 Optical microscope

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

5.5 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 pull test equipment.

c) **Land geometry**: The shape and size of a land shall comply with IEC 61188-5-5 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 6.2.

5.6 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.

5.7 Flux for flow soldering

Unless otherwise specified, the flux used in this test shall comply with IEC 61190-1-1.

5.8 Solder paste

Unless otherwise specified, the solder paste used in this test shall comply with IEC 61190-1-2. The solder specified in 5.6 shall be used for the solder paste.

6 Mounting method

The test specimen shall be mounted to the substrate by one of the methods given in 6.1 and 6.2.

6.1 Flow soldering

The following steps shall be taken.

a) The test specimen shall be fixed to the substrate specified in 5.5 by an adhesive.

b) A flux as specified in 5.7 shall be supplied by means of foam or by spraying.

c) Unless otherwise specified, a flow-soldering equipment specified in 5.1 shall be used to solder the leads under the conditions given below. The temperature is measured at the land immersed to molten solder.

d) Preheating temperature is 100 °C to 120 °C. The soldering temperature (temperature of the solder bath) is (250 ± 5) °C for 3 s to 5 s. A typical soldering profile is given in Figure 3.

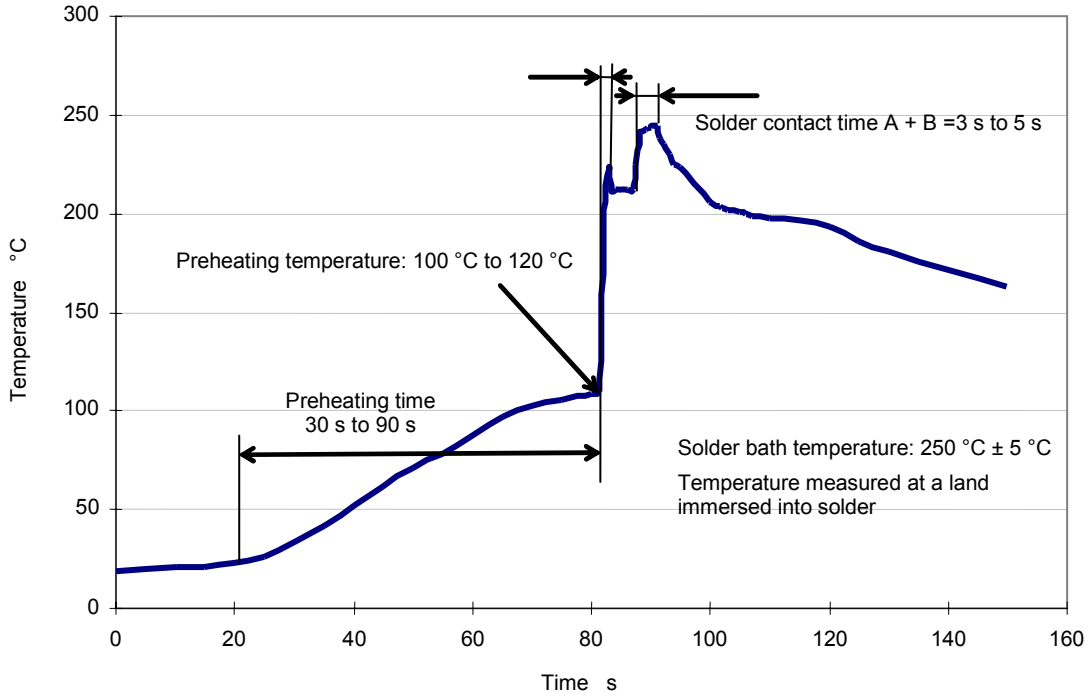


Figure 3 – Example of a flow soldering profile (actual measurement for double-wave soldering)

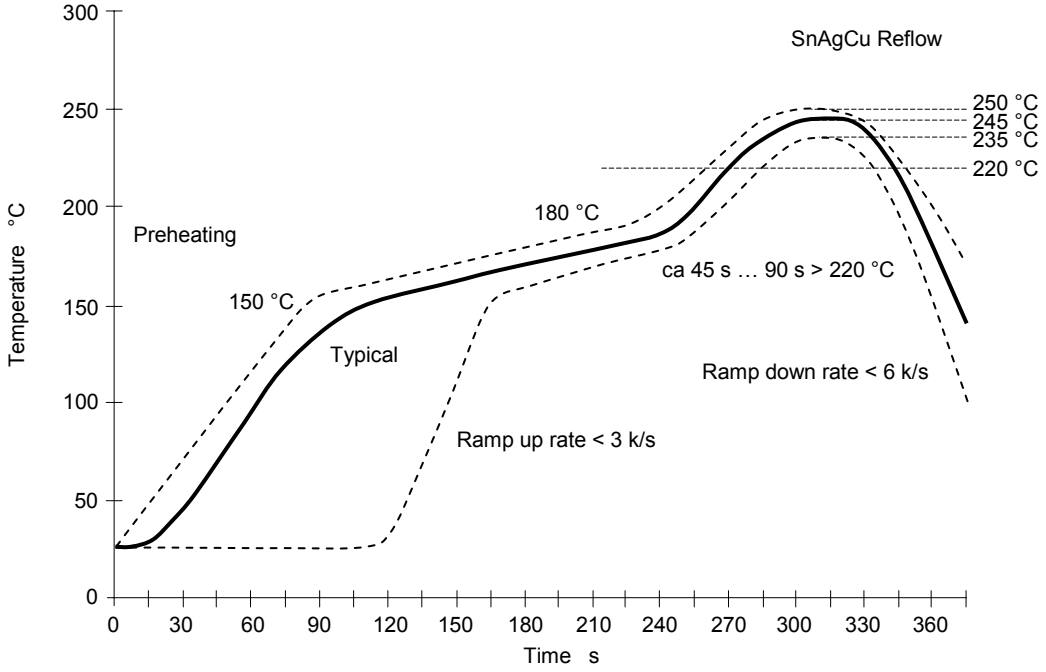
6.2 Reflow soldering

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 5.5, 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 5.2 to solder the terminals under the conditions given below. Typical temperature profile of reflow soldering is given in Figure 4 as proposed in IEC 61760-1. The temperature is measured at the land.



Continous line: typical process (terminal temperaure)

Dotted line: process limits. Bottom process limit (terminal temperature). Upper process limit (top surface temperature)

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Figure 4 – Typical reflow profile

7 Test conditions

7.1 Test: Rapid change of temperature

Unless otherwise specified, the following test conditions shall be applied:

a) rapid change of temperature; test Na, specified in IEC 60068-2-14;

b) the lower temperature (T_A) is -40 °C and the higher temperature (T_B) is +125 °C;

c) the exposure time to both higher and lower temperatures is 30 min;

d) the number of temperature cycles is 500 (intermediate) and 1 000 (final).

7.2 Pull strength test

Unless otherwise specified, the pull strength test shall be performed according to the test procedure described in Annex A.

8 Test procedure

8.1 Test sequence

Unless otherwise specified, the sequence of tests shall comply with Figure 5.

NOTE This test is a destructive test. The tested specimen is not to be used for further tests in the test sequence.