INTERNATIONAL STANDARD

IEC 60068-2-58

Third edition
2004-07

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)

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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

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International Standard IEC 60068-2-58 has been prepared by IEC technical committee 91: Electronics assembly technology.

This edition includes the following significant technical changes with respect to the previous edition:

- expansion of the scope so that it includes lead-free solder alloy in addition to the existing tin-lead eutectic or near eutectic solder alloy (the structure of the document has been changed accordingly);
- addition of the definitions of "solderability" and "resistance to soldering heat" for SMDs;
- specification of the reflow temperature profiles for the resistance to soldering heat using lead-free solder;
- addition of an Annex C enabling a quick overview of the test conditions.

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

FDIS	Report on voting
91/447/FDIS	91/459/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.

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- withdrawn;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 may be issued at a later date.

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)

1 Scope and object

This part of IEC 60068 outlines test Td, applicable to surface mounting devices (SMD), which are intended to mount on substrates. This standard provides the standard procedures for solder alloys containing lead (Pb) and for lead-free solder alloys.

This standard provides standard procedures for determining the solderability and resistance of soldering heat to lead-free solder alloys.

This standard provides standard procedures for determining the solderability, dissolution of metallization (see B.3.3) and resistance of soldering heat to solder alloys which are eutectic or near eutectic tin lead solders.

The procedures in this standard include the solder bath method and reflow method. The solder bath method is applicable to the SMD designed for flow soldering and the SMD designed for reflow soldering when the solder bath (dipping) method is appropriate. The reflow method is applicable to the SMD designed for reflow soldering, to determine the suitability of SMD for reflow soldering and when the solder bath (dipping) method is not appropriate.

The objective of this standard is to ensure that component lead or termination solderability meets the applicable solder joint requirements of IEC 61191-2 using each of the soldering methods specified in IEC 61760-1. In addition, test methods are provided to ensure that the component body can resist against the heat load to which it is exposed during soldering.

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

IEC 60194:1999, *Printed board design, manufacture and assembly – Terms and definitions*

IEC 60749-20:2002, *Semiconductor devices – Mechanical and climatic test methods – Part 20: Resistance of plastic-encapsulated SMDs to the combined effect of moisture and soldering heat*

IEC 61190-1-1:2002, *Attachment materials for electronic assembly – Part 1-1: Requirements for soldering fluxes for high-quality interconnections in electronic assembly*

IEC 61190-1-2:2002, *Attachment materials for electronic assembly – Part 1-2: Requirements for solder pastes for high-quality interconnections in electronic assembly*

IEC 61190-1-3:2002, *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*

IEC 61191-2:1998, *Printed board assemblies – Part 2: Sectional specification – Requirements for surface mount soldered assemblies*

IEC 61249-2-7:2002, *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 61760-1:1998, *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 as defined in IEC 60068-1, IEC 60068-2-20, IEC 60194, as well as the following apply.

3.1
solderability
ability of the termination or electrode of SMD to be wetted by solder at the temperature of the termination or electrode which is assumed to be the lowest temperature in the soldering process within solderable temperature of solder alloy

3.2
resistance to soldering heat
ability of SMD to withstand the highest temperature of the termination or electrode in soldering process, within applicable temperature range of solder alloy

4 Grouping of soldering processes using lead-free solder alloys

The melting temperatures of lead-free solder alloys selected currently for industrial processes are significantly different from those for Sn-Pb solder alloy. Moreover, the melting temperatures of lead-free solder alloys are different from each other but can be clustered in groups.

According to the ability of the SMD to withstand the typical temperature and dwell time conditions that match the exposure to the processes using the selected lead-free alloys, the following groups of soldering processes outlined in Table 1 are given as a a guideline for selecting the severities for the wetting and resistance tests against the specified soldering heat:

Table 1 – Grouping of soldering processes related to lead-free solder alloys

Group	Typical process temperature		Alloys (examples)
	Flow soldering	Reflow soldering	
1 Low temperature	---------	170 °C – 210 °C	Sn-Bi
2 Medium temperature	---------	210 °C – 235 °C	Sn-Zn-Bi Sn-Zn
3 Medium-high temperature	245 °C – 255 °C	235 °C – 250 °C	Sn-Ag Sn-Ag-Cu Sn-Ag-Bi
4 High temperature	250 °C – 260 °C	---------	Sn-Cu

NOTE 1 Flow soldering applies to both wave soldering and dip soldering.

NOTE 2 Typical process temperatures for flow soldering are identical to the solder temperature. Typical process temperatures for reflow soldering are the terminal and top surface temperature of the SMDs.

NOTE 3 In Group 2 reflow soldering under inert atmosphere (e.g. nitrogen) is required.

NOTE 4 The basic solder alloys listed in this table represent compositions that are currently preferred for lead-free soldering processes. However, other solder alloys when matching with the specified group should not be excluded.

5 Preconditioning

5.1 The specimen shall be tested in the "as-received" condition unless otherwise specified by the relevant specification. Care should be taken that no contamination, by contact with the fingers or by other means, occurs.

5.2 When accelerated ageing is prescribed by the relevant specification, one of the methods of 4.5 of IEC 60068-2-20 shall be used or, when appropriate, 4 h/155 °C dry heat shall be used.

5.3 The preconditioning and resistance to soldering heat test of semiconductor SMDs in plastic encapsulation shall be done conform the test procedure as described in IEC 60749-20.

6 Solder bath method

6.1 Test apparatus and materials for the solder bath method

6.1.1 Solder bath

The solder bath dimensions shall comply with the requirements of 4.6.1 of IEC 60068-2-20. The material of the solder bath container shall be resistant to the liquid solder alloy.

6.1.2 Flux

The flux shall consist of 25 % by weight of colophony in 75 % by weight of 2-propanol (isopropanol) or ethyl alcohol (as specified in Appendix C of IEC 60068-2-20). Preferably the flux activity should conform with the "Low (0)" level, corresponding to a halide content of <0,01 wt % (Cl, Br, F) (see IEC 61190-1-1). When non-activated flux is inappropriate, the above flux with the addition of diethylammonium chloride (analytical reagent grade), up to an amount of 0,5 % chloride (expressed as free chlorine based on the colophony content), may be used. Information concerning the used flux type shall be given in the product detail specification.

6.1.3 Solder

6.1.3.1 Lead-free solder alloys

When testing solderability, the solder composition shall be as defined in Table 2. For the resistance to soldering heat test, any alloys may be used, provided they are completely liquid at the required temperature.

6.1.3.2 Solder alloys containing lead

The solder composition shall be either 60 % tin and 40 % lead according to Annex B of IEC 60068-2-20 (Sn60Pb40A, according to IEC 61190-1-3) or 63 % tin and 37 % lead (Sn63Pb37A, according to IEC 61190-1-3).

6.2 Test procedure for solder bath method

6.2.1 Specimens

A specimen shall not be used for more than one test.

6.2.2 Clamping

Unless otherwise specified in the relevant specification, the specimen shall be placed in a stainless steel clip as shown in Figure 1. No part of the clip jaws shall make contact with the areas to be examined. The specimen shall remain in the clip while being fluxed and dipped in the solder.

6.2.3 Fluxing

Unless otherwise specified in the relevant specification, the specimen shall be completely immersed in flux and withdrawn slowly. Any excess flux shall be removed by contact with absorbent paper.

6.2.4 Solder immersion

When preheating is prescribed by the relevant specification, the specified duration and temperature shall be applied immediately prior to the immersion of the specimen in the solder bath.

The oxide film on the solder bath shall be skimmed off immediately before immersion.

The immersion and withdrawal speed shall be between 20 mm/s and 25 mm/s.

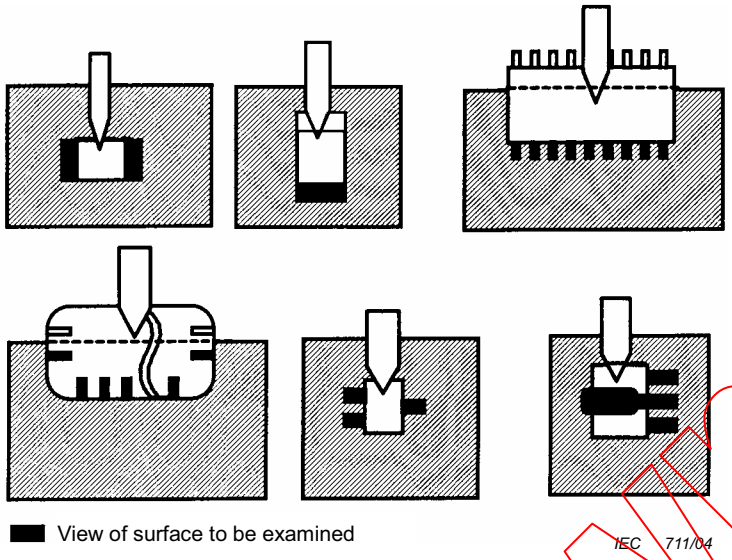

Figure 1 – Examples of immersion

6.2.5 Attitude

Two attitudes of immersion are standardized:

Attitude A: For most specimens, the areas to be examined shall be immersed not less than 2 mm below the solder meniscus (but not to a greater depth than necessary; see Figure 1) with the seating plane vertical.

Attitude B: For certain specimens (see B.3.4), the specimen may be floated on the solder, but only when testing resistance to soldering heat.

If the relevant specification does not mention the attitude, attitude A shall be adopted.

7 Solder reflow methods

7.1 Test apparatus and materials for solder reflow methods

7.1.1 Reflow equipment

As long as the test conditions are fulfilled, any reflow equipment may be used:

a) forced gas convection;

b) infrared;

c) vapour phase;

d) hot plate soldering; metallic plate (carrier), floating on a molten solder bath or an electrically heated plate.

NOTE 1 Forced gas convection is preferred; including infrared assistance.

NOTE 2 Infrared reflow equipments are known to have variations of peak reflow temperature (PRT) of 30 °C or more across the board in a PC board.

NOTE 3 In case of vapour phase soldering, a specific liquid is necessary for each test temperature.

NOTE 4 Hot plate soldering is a method which at times may have large PRT variations in the order of 40 °C.