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**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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**Essais d'environnement –
Partie 2-58: Essais – Essai Td: Méthodes d'essai de la soudabilité, résistance de la métallisation à la dissolution et résistance à la chaleur de brasage des composants pour montage en surface (CMS)**

IEC 60068-2-58:2015-03(en-fr)

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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 fourth edition cancels and replaces the third edition, published in 2004 and constitutes a technical revision.

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

– the addition of Sn-Bi low temperature solder alloy;
– the addition of several reflow test conditions in Table 7 – Resistance to soldering heat – Test conditions and severity, reflow method;
– introduction of reflow test method for Test Td_3: Dewetting and resistance to dissolution of metallization;

– implementation of guidance for the choice of a test severity in Clause B.3.

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

FDIS	Report on voting
91/1222/FDIS	91/1250/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 parts in the IEC 60068, published under the general title *Environmental testing*, can be found on the IEC website.

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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

This part of IEC 60068 outlines test Td, applicable to surface mounting devices (SMD).

This standard provides procedures for determining the solderability and resistance to soldering heat of devices in applications using solder alloys, which are eutectic or near eutectic tin lead (Pb), or lead-free alloys.

The procedures use either a solder bath or reflow method and are applicable only to specimens or products designed to withstand short term immersion in molten solder or limited exposure to reflow systems.

The solder bath method is applicable to SMDs designed for flow soldering and SMDs designed for reflow soldering when the solder bath (dipping) method is appropriate.

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The reflow method is applicable to the SMD designed for reflow soldering, to determine the suitability of SMDs for reflow soldering and when the solder bath (dipping) method is not appropriate.

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The objective of this standard is to ensure solderability of component lead or termination. 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.

This standard covers tests Td_1, Td_2 and Td_3 as listed below:

Number of Td	Test	Method
Td_1	Solderability of terminations	Method 1: Solder bath Method 2: Reflow
Td_2	Resistance to soldering heat	Method 1: Solder bath Method 2: Reflow
Td_3	Dewetting and resistance to dissolution of metallization	Method 1: Solder bath Method 2: Reflow

NOTE 1 For specific components other test methods may exist.

NOTE 2 Test Td does not apply to printed wiring board (PWB), see IEC 61189-3.

NOTE 3 Specific through-hole devices (where the device supplier has specifically documented support for reflow soldering) are also included in this standard.

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

IEC 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

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

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

IEC 61190-1-2:2014, *Attachment materials for electronic assembly – Part 1-2: Requirements for solder pastes for high-quality interconnections in electronics assembly*

IEC 61190-1-3:2007, *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 61190-1-3:2007/AMD1:2010

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

IEC 61249-2-22, *Materials for printed boards and other interconnecting structures – Part 2-22: Reinforced base materials clad and unclad – Modified non-halogenated epoxide woven E-glass laminated sheets of defined flammability (vertical burning test), copper-clad*

IEC 61249-2-35, *Materials for printed boards and other interconnecting structures – Part 2-35: Reinforced base materials, clad and unclad – Modified epoxide woven E-glass laminate sheets of defined flammability (vertical burning test), copper-clad for lead-free assembly*

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

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ISO 9454-2:1998, *Soft soldering fluxes – Classification and requirements – Part 2: Performance requirements*

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3 Terms and definitions

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For the purposes of this document, the terms and definitions given in IEC 60068-1, IEC 60068-2-20, IEC 60194, and the following apply.

3.1
solderability
ability of the termination or electrode of the 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 the applicable temperature range of the solder alloy

3.2
resistance to soldering heat
ability of the component to withstand the highest temperature in terms of temperature gradient, peak temperature and duration of the soldering process, within the applicable temperature range of the solder alloy

3.3
flow soldering
wave, drag or dip soldering process where the product is brought into contact with molten solder in order to attach electronic components to the interconnecting surface

3.4
reflow soldering
joining of surfaces that have been tinned and/or have solder between them, placing them together, heating them until the solder flows, and allowing the surface and the solder to cool in the joined position

3.5
wetting
formation of an adherent coating of solder on a surface indicated by a small contact angle

3.6
dewetting
retraction of molten solder on a solid area that it has initially wetted

Note 1 to entry: In some cases an extremely thin film of solder may remain. As the solder retracts the contact angle increases.

3.7
non-wetting
inability to form an adherent coating of solder on a surface indicated by a contact angle greater than 90°

3.8
dissolution of metallization
process of dissolving metal, usually by introduction of chemicals

3.9
pinhole
small hole that penetrates from the surface of a solder to base material

4 Grouping of soldering processes and related test severities

The melting temperatures of lead-free solder alloys selected 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.

The following groups of soldering processes as indicated in Table 1, are given as a guideline to select the severities for the wetting and resistance tests against the specified soldering heat:

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Table 1 – Grouping of soldering processes and typical test severities – Overview

Process temperature group [a]		1 Low	2 Medium	3 Medium-high	4 High
Typical solder alloy group		Sn-Bi	Sn-Pb	Sn-Ag-Cu	Sn-Cu
Typical process temperature	Flow	–	235 °C to 250 °C	250 °C to 260 °C	250 °C to 260 °C [c]
	Reflow	170 °C to 210 °C	210 °C to 240 °C	235 °C to 250 °C	–
Test method	Test property	Temperature / Duration			
Solder bath	Solderability (6.5)	175 °C / 3 s	235 °C / 2 s	245 °C / 3 s	250 °C / 3 s
	Resistance to soldering heat (7.5)	230 °C / 10 s	260 °C / 5 s	260 °C / 5 s	260 °C / 10 s
			260 °C / 10 s	260 °C / 10 s	
	Dewetting (8.2)	–	260 °C / 5 s	–	–
			260 °C / 10 s		
	Resistance to dissolution of metallization (8.2)	–	260 °C / 30 s		
Reflow	Solderability [b] (6.6)	170 °C / 10 s	215 °C / 10 s	235 °C / 10 s	–
	Resistance to soldering heat (7.6)	–	235 °C / 20 s	230 °C / 30 s	–
				245 °C / 30 s	
	Dewetting (8.2)			250 °C / 30 s	
				260 °C / 30 s	

[a] Refer to the appropriate subclauses for the detailed test conditions.

[b] Measured at the solder joint.

[c] 255 °C to 265 °C may be an applicable soldering temperature range for boards with high thermal demand.

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The following statements shall be applied in Table 1;

– Flow soldering applies to both wave soldering and dip soldering.

– 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.

– The basic solder alloys listed in Table 1 present tin-lead solder and 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 Test equipment

5.1 Solder bath

As given in IEC 60068-2-20:2008, 5.2.1, the solder bath shall be not less than 40 mm in depth and not less than 300 ml in volume.

In case of high thermal capacity components, the volume of the solder bath shall be given by the relevant specification.

The material of the solder bath container shall be resistant to the liquid solder alloy.

5.2 Reflow equipment

As long as the test conditions are fulfilled, any reflow equipment may be used. The following two methods are preferred:

a) forced gas convection;

b) vapour phase.

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

NOTE 2 In case of vapour phase soldering, a specific vapour creating liquid is necessary for each test temperature.

6 Test Td_1: Solderability of terminations

6.1 Object and general description of the test

Test Td_1 provides two different test methods to determine the solderability of the metallized end cap terminations and metallic terminations which meets the applicable solder joint requirements of IEC 61191-2 using each of the soldering methods specified in IEC 61760-1.

– Method 1: Solder bath

– Method 2: Reflow

The test method to be used shall be prescribed in the relevant specification.

NOTE 1 The solder bath method is the one that simulates most closely the soldering procedures of flow soldering and similar soldering processes where the heat is applied directly through conduction from a molten solder.

NOTE 2 The reflow method is the one that simulates most closely the soldering procedures of reflow soldering processes, like forced gas convection or vapour phase, where the heat is applied by gas convection or vapour condensation.

6.2 Specimen preparation

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The surface to be tested shall be in the "as received" condition and needs to be shielded from any kind of contamination, e.g. it shall not be subsequently touched by fingers.

The specimens shall not be cleaned prior to the application of a solderability test. If required by the relevant specification, the specimens may be degreased by immersion in a neutral organic solvent at room temperature.

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6.3 Accelerated ageing

When accelerated ageing is prescribed by the relevant specification, one of the methods of IEC 60068-2-20:2008, 4.1.4 shall be used.

6.4 Initial measurements

The specimens shall be visually examined and, if required by the relevant specification, electrically and mechanically checked.

6.5 Method 1: Solder bath

6.5.1 Solder bath

See 5.1.

6.5.2 Solder and flux

The solder alloy shall be selected from Table 2, unless otherwise prescribed by the relevant specification.

Table 2 – Solder alloy and flux for test Td_1

Process temperature group	Solder alloy [a] and flux
1	Sn42Bi58 [b]
2	Sn60Pb40A or Sn63Pb37A
3	Sn96,5Ag3Cu,5
4	Sn99,3Cu,7

[a] Solder alloy designations and tolerance of composition according to IEC 61190-1-3:2007 and Amendment 1:2010, Annex B.

[b] Activated with 0,2 % chloride.

The flux shall consist of 25 % mass fraction of colophony in 75 % mass fraction of 2-propanol (isopropanol) or ethyl alcohol (as specified in IEC 60068-2-20:2008, Annex B). Preferably the flux activity should conform with the “low (<0,01)” level L0, corresponding to a halide mass fraction of <0,01 % (Cl, Br, F) (see IEC 61190-1-1).

If non-activated flux is inappropriate, the relevant specification may prescribe the use of the above flux with the addition of diethylammonium chloride (analytical reagent grade) of a mass fraction of 0,2 % or 0,5 % chloride (expressed as free chlorine based on the colophony content), see Table 2.

6.5.3 Test procedure and conditions

6.5.3.1 Specimen

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

6.5.3.2 Clamping

IEC 60068-2-58:2015
https://standards.iteh.ai/catalog/standards/sist/afd62f7c-c639-40cf-9b78-43b69073b8e8/iec-60068-2-58-2015

The specimen shall be placed in a stainless steel clip as shown in Figure 1, where the cross sectional area of that clip shall not exceed the smallest cross sectional area of the specimen, unless otherwise prescribed by the relevant specification. 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.

NOTE A clip with a thermal capacity of its dipped part significantly exceeding the thermal capacity of the specimen may lead to a decrease of the local bath temperature next to the specimen and thereby to an increase of the effective severity of this test.

6.5.3.3 Fluxing

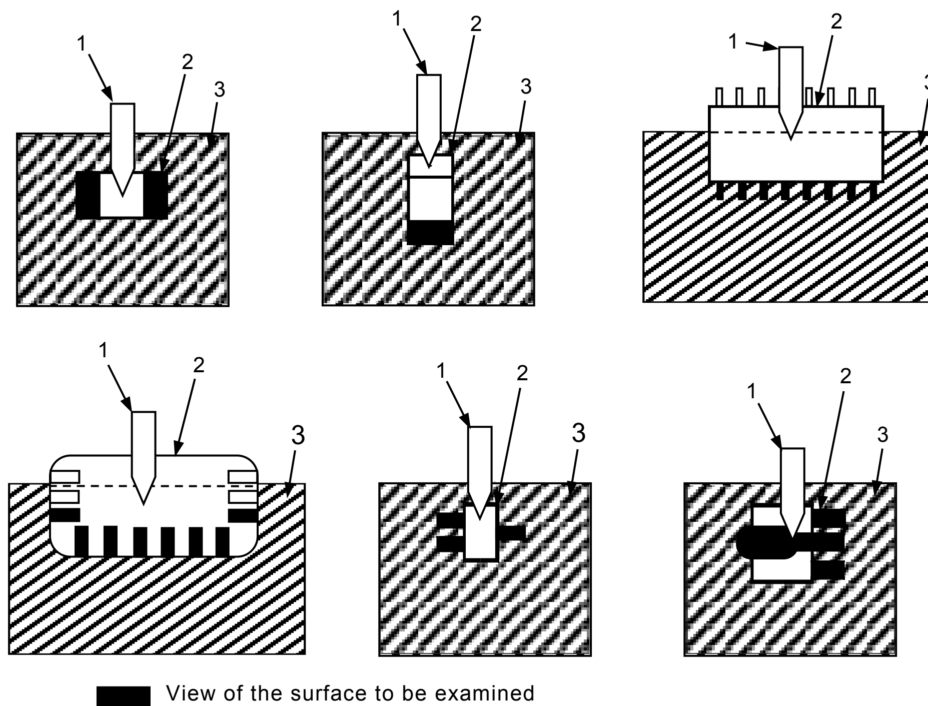
The specimen shall be completely immersed in flux and withdrawn slowly, unless otherwise prescribed by the relevant specification. Any excess flux shall be removed by contact with absorbent paper.

6.5.3.4 Solder immersion

The specified duration and temperature shall be applied immediately prior to the immersion of the specimen in the solder bath, unless otherwise prescribed by the relevant specification.

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

The immersion and withdrawal speed shall be in the range of 20 mm/s to 25 mm/s.



Key

1 Clip

2 Specimen

3 Solder

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https://standards.iteh.ai/catalog/standards/sist/afd621f7c-c639-40cf-9678-43b69073b8e8/iec-60068-2-58-2015

The immersion method may not be applicable for high thermal capacity components. The method to be applied for such components shall be given in the relevant specification.

Figure 1 – Examples of immersion attitudes

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.

Attitude A shall be applied, if the relevant specification does not prescribe an attitude to be used.

6.5.3.5 Test conditions

The duration and temperature of immersion shall be selected from Table 3, unless otherwise prescribed by the relevant specification.