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2006-04

Surface mounting technology –

Part 1:
Standard method for the specification of surface mounting components (SMDs)

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SURFACE MOUNTING TECHNOLOGY –

Part 1: Standard method for the specification of surface mounting components (SMDs)

FOREWORD

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International Standard IEC 61760-1 has been prepared by IEC technical committee 91: Surface mounting technology.

This second edition cancels and replaces the first edition, published in 1998, and constitutes a technical revision.

The main changes with regard to the previous edition concern:

– requirements related to leadfree soldering;
– extension of the scope to include also components mounted by gluing;
– direct reference to IEC 60068-2-58 for requirements on solderability and resistance to soldering heat;
– classification into categories based on the component's ability to withstand resistance to soldering heat has been deleted.

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

FDIS	Report on voting
91/577/FDIS	91/588/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 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- withdrawn;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.

INTRODUCTION

Specifications for electronic components have in the past been formulated for each component family. The regulations for environmental tests have been selected from IEC 60068 and other IEC and ISO publications. The overriding condition for this procedure was that all components, once installed in a piece of equipment, had to satisfy certain criteria.

The introduction and increasing use of surface mounting components make it necessary to extend the existing requirements to include those arising from processing during assembly.

Irrespective of the component family involved, all components on one and the same side of a printed circuit board are exposed to the same mounting process (see flow charts in Clause 5).

Nevertheless there exists no harmonized standard that prescribes the content of a component specification. It is the purpose of this standard to define the general requirements for component specifications derived from the assembly processes. This is done in three steps.

In the first step general requirements for component specifications and component design related to the handling and placement of the component on the substrate are given (Clause 4). In the second step the definition of reference process conditions as representative of a group of assembly conditions are given (Clauses 5 and 6).

In the third step the additional requirements resulting from these reference process conditions are given (Clause 7).

Mixed technology boards, i.e. boards containing through-hole components and SMDs, require additional consideration with respect to the through-hole components. These may be subject to the same requirements as the SMDs. Persons responsible for drafting specifications for “non-surface mounting components” wishing to include a statement on their ability to withstand surface mounting conditions should use the classifications and tests set out in the present standard.

SURFACE MOUNTING TECHNOLOGY –

Part 1: Standard method for the specification of surface mounting components (SMDs)

1 Scope and object

1.1 Scope

This International Standard gives a reference set of process conditions and related test conditions to be used when compiling component specifications of electronic components that are intended for usage in surface mount technology.

1.2 Object

The object of this standard is to ensure that a wide variety of SMDs (passive and active) can be subjected to the same placement and mounting processes during assembly. This standard defines tests and requirements that need to be part of any SMD component general, sectional or detail specification. In addition, this standard provides component users and manufacturers with a reference set of typical process conditions used in surface mount technology.

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 60062, *Marking codes for resistors and capacitors*

IEC 60068 (all parts), *Environmental testing*

IEC 60068-2-21, *Environmental testing – Part 2: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-45:1980, *Environmental testing – Part 2: Tests – Test XA and guidance: Immersion in cleaning solvents*
Amendment 1 (1993)

IEC 60068-2-58, *Environmental testing – Part 2: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMDs)*

IEC 60068-2-77, *Environmental testing – Part 2: Tests – Test 77: Body strength and impact shock*

IEC 60191-6:2004, *Mechanical standardization of semiconductor devices – Part 6: General rules for the preparation of outline drawings of surface mounted semiconductor device packages*

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

IEC 60286-3, *Packaging of components for automatic handling – Part 3: Packaging of surface mount components on continuous tapes*

IEC 60286-4, *Packaging of components for automatic handling – Part 4: Stick magazines for electronic components encapsulated in packages of form E and G*

IEC 60286-5, *Packaging of components for automatic handling – Part 5: Matrix trays*

IEC 60286-6, *Packaging of components for automatic handling – Part 6: Bulk case packaging for surface mounting components*

IEC 60749 (all parts), *Semiconductor devices – Mechanical and climatic test methods*

IEC 61340-5-1, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*

IEC 61340-5-3, *Electrostatics – Protection of electronic devices from electrostatic phenomena – Test methods for packagings intended for electrostatic discharge sensitive devices*

IEC 61760-2, *Surface mount technology – Part 2: Transportation and storage conditions of surface mounting devices (SMD) – Application guide*

IEC 62090, *Product package labels for electronic components using bar code and two dimensional symbologies*

ISO 8601, *Data elements and interchange formats – Information interchange – Representation of dates and times*

3 Terms and definitions

For the purposes of this document, the following definitions apply, as do those of IEC 60194.

NOTE Use of the term “chip” as for a surface mounting component is deprecated. Only the terms "SMD" or "surface mounting component" should be used within IEC.

3.1
adhesive
substance such as glue or cement used to bond objects together

NOTE In surface mounting technology different gluing systems are used.

– Non conductive adhesive (only for mechanical connection)
– Electrical conductive adhesive (for electrical and mechanical connection)
– Thermal conductive adhesive (for thermal and mechanical connection)
– Combination of electrical and thermal conductive adhesive.

Most used adhesives are thermal curing systems but there are also UV-curing systems in use.

3.2
centring force
force required by the pick-up tooling to centre a surface mounting device in its proper location on a substrate

3.3
coplanarity
distance in height between the lowest and highest leads when the component is in its seating plane

3.4
dewetting
condition that results when molten solder coats a surface and then recedes to leave irregularly-shaped mounds of solder that are separated by areas that are covered with a thin film of solder and with the basis metal not exposed

3.5
dissolution of metallization
process of dissolving metal or a plated metal alloy, usually by introduction of chemicals. For the purpose of this document the dissolution of metallization also includes dissolution by exposure to molten solder

3.6
immersion attitude
positioning of an object when immersed in a solder bath

3.7
lead-free component
component where lead content in the materials is equal or less than 0,1 % by weight per material used

3.8
Montreal protocol
agreement by industrialized nations, at a meeting held in Montreal, Canada, to eliminate chlorofluorocarbons from all processes by 1995

3.9
pick-up force
dynamic force exerted on the body of a component – generally from above – and its seating plane during the pick-up of the component (e.g. from a tape or tray); the maximum level is normally taken into account

3.10
placement force
dynamic force exerted on the component body – generally from above – and its seating plane

NOTE This occurs during the period between the component's first contact with the substrate (or the soldering paste or adhesive etc.) and its coming to rest. The maximum level is normally taken into account.

3.11
resistance to soldering heat
ability of a component to withstand the effects of the heat generated by the soldering process

3.12
seating plane
surface on which a component rests

3.13
solderability
ability of a metal to be wetted by molten solder

3.14
solder meniscus
contour of a solder shape that is the result of the surface tension forces that take place during wetting

3.15
stand-off
distance between seating plane of the component and the seating plane of the terminations

3.16
substrate
basic material, forming the support structure of an electronic circuit

3.17
surface mounting component
electronic component designed for mounting on to terminal pads or conducting tracks on the surface of substrate

3.18
wetting
physical phenomenon in which surface tension of a liquid, usually when in contact with solids, is reduced to the point where the liquid diffuses and makes intimate contact with the entire substrate surface in the form of a thin layer

4 Requirements for component design and component specifications

4.1 General requirement

A component specification for SMDs shall, in addition to the requirements listed in 4.2 to 4.10 below, contain specifications of the relevant tests and requirements from Clause 7.

4.2 Packaging

Information about the packaging form including packaging dimensions and data on clearances within the packaging shall be included in the component specification.

Component specifications shall require that, packaging for SMD applications in tapes, on reels, in stick magazines, on tray, bulk case, or in bulk shall comply with the relevant specification of the IEC 60286 series (IEC 60286-3, IEC 60286-4, IEC 60286-5, IEC 60286-6).

Components that need to be entered into ESD protected production environment shall be packaged accordingly in line with IEC 61340-5-1 and IEC 61340-5-3.

Moisture sensitive components need special packaging in line with IEC 60749.

Components with specific orientation or polarity shall be placed in the packaging with a fixed orientation (e.g. see Figure 1).

4.3 Labelling of product packaging

Labelling of the product packaging shall comply with IEC 62090.

According to IEC 62090 the product packaging shall include the following:

a) item identification (e.g. customer part number or manufacturer part number or both);
b) traceability identification (e.g. batch number or serial number);
c) quantity;

Additional to the requirements of IEC 62090, this standard prescribes that the product packaging for moisture sensitive components shall include the following:

d) moisture sensitivity level (MSL) according to IEC 60749;

Additional to the requirements of IEC 62090, this standard recommends that the product packaging should include the following:

e) date code (ISO 8601, and IEC 60062);

f) identification code for the manufacturer;

g) Description of the polarity of the component, if applicable.

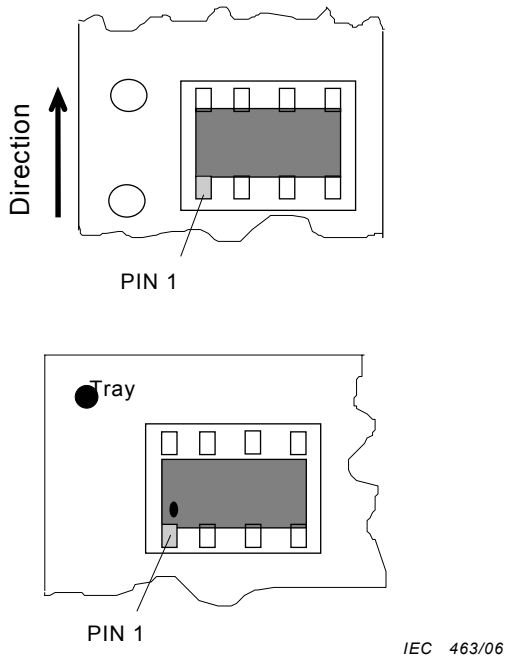


Figure 1 – Example of a component with marked specific orientation put in tape and tray

4.4 Component marking

4.4.1 Marking of multipin components

Pin 1 (see Figure 1) shall be clearly marked on a multipin component (e.g. SO-IC, QFP).

4.4.2 Marking of components with polarity

For components with polarity, the polarity of the component shall be clearly marked on the component (e.g. for electrolytic capacitors).

4.4.3 Durability of component marking

Specifications shall require that the specified component marking shall remain legible after the test specified in 7.5.2 has been performed. This test shall be performed after completion of the relevant test for resistance to soldering heat or for solderability, as specified in the component specification.

4.5 Storage and transportation

Component specifications shall refer to IEC 61760-2 for storage and transportation conditions.

The component specification shall contain information concerning the maximum period for storage. Within this period the component shall comply with its specification.

4.6 Component outline and design

4.6.1 Drawing and specification

An inverted-plan view of the component showing all dimensions and tolerances of its body and terminals shall be part of the component specification. The plan shall include reference to the positioning of the component body and terminals on the mounting land pattern.

Where necessary (e.g. in the case of mechanically fixed components with an overall length of more than 25 mm), the detail specification shall contain data on thermal expansion, at least along the X and Y axes.

4.6.2 Pick-up area requirements

Design of the component shall take into account that it shall be possible to grip the component by suction and transport it to the exact placement position on the substrate. It shall be possible to create a vacuum strong enough to fix the component in its position under the pipette. During the total transport process, which may include optical inspection, the component shall remain exactly in its position under the pipette, until the component is placed.

The centre of the suction area should match the centre of gravity and the geometrical centre.

The opening of the pipette (Y), the dimension (L) of the component or its pick up area (X) and the tolerances on the position of the component inside the compartment of packaging with length dimension (A_0) and width dimension (B_0) shall match in such a way, that the vacuum needed for pick up can be created. It shall be possible to apply the vacuum irrespective of the component's position in its compartment.

For further requirements concerning the position of the component inside the packaging, see IEC 60286-3 for taping and IEC 60286-5 for matrix trays.

NOTE Dimension L may be the length or the width of the component, as applicable.

Requirement: $X - Y > Z$

$Z = (Z_1 + Z_2) = (A_0 - L)$

$Z = (Z_1 + Z_2) = (B_0 - L)$

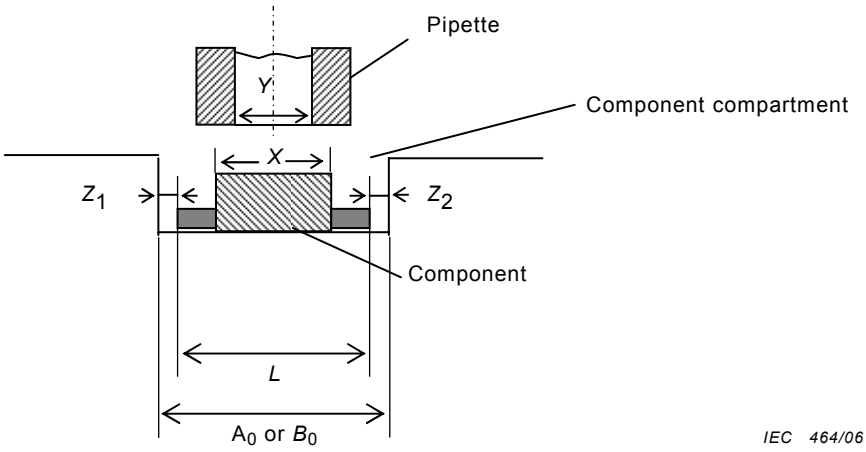


Figure 2 – Vacuum pipette, pick-up area and component compartment: Example for a component with a flat surface

4.6.3 Bottom surface requirements

In cases where the component is to be bonded to the substrate with adhesive, its lower surface (except for the terminals) must be capable of retaining the applied adhesive.

The stand-off between the lower surface of bonded components and the seating plane shall be specified. The detail specification shall state the maximum stand-off. Normally a value of 0,3 mm should not be exceeded.

For components which are fixed by an additional fixing adhesive or in case a cleaning process is used the minimum stand-off should be included in the component specification, because with use of the additional fixing adhesive all pins have to be inside the material for the electrical connection (solder paste or conductive adhesive).

4.6.4 Requirements for terminals

4.6.4.1 Coplanarity

Detail specifications of multipin components intended for reflow soldering/ conductive gluing shall state the coplanarity of the lower surfaces of all terminals in accordance with 3.5 of IEC 60191-6:2004. The typical value of coplanarity needed for reflow soldering is 0,1 mm – 0,15 mm, but depends on the size of the component and the thickness of printed solder. The components terminals shall be sufficiently coplanar to ensure that contact is made with the solder on the solder surfaces after solder printing or with the conductive adhesive. Detail specifications of two pin components for mounting with conductive adhesive shall state the coplanarity of both terminals in relation to the bottom surface of the component.

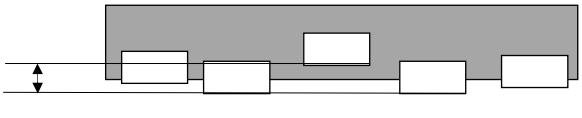


Figure 3 – Coplanarity of terminals

4.6.4.2 Arrangement of terminals

The terminals shall be arranged in such a way that stable seating in the solder paste or glue is ensured and tilting is avoided (see Figures 4, 5 and 6).

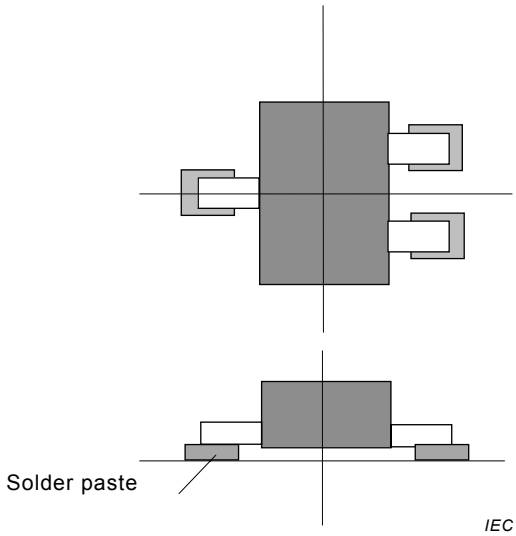


Figure 4 – Stable seating of component

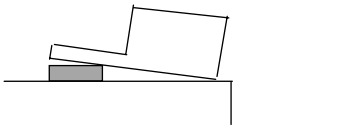


Figure 5 – Unstable seating of component

NOTE The land pattern of the component and its contacts should be analysed by the placement machine. The terminals should be preferably arranged peripherally or otherwise symmetrically. Asymmetrical arrangements of terminals can cause problems, because the identification algorithms are not always capable of identifying asymmetrical structures. For small sized components symmetrical terminals are needed to prevent tombstoning.

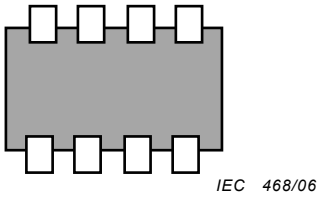


Figure 6 – Terminals arranged peripherally in two rows

4.6.4.3 Optical recognition

The optical contrast between the terminal bottom surface and the component bottom surface shall be high enough to enable optical recognition of the position of the terminals, seen from the bottom side. Preferably the terminal bottom surface should be reflecting (see Figure 7).

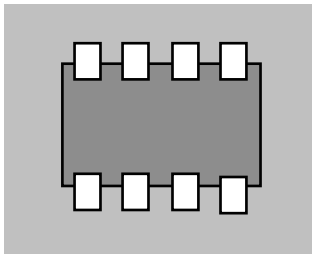


Figure 7 – Good contrast to component body and surroundings

4.6.4.4 Shape of the terminals

The shape of the contact shall comply with that defined in the component specification. Flattened wires that should be round, are an example of a shape not complying with specification.

4.6.4.5 Hardness of the terminals

The terminal shall be hard enough to ensure that its shape remains unchanged during placement.

4.6.4.6 Wettable surface

When specified for double side reflow soldering the surface forces of the molten solder affecting the wettable area of the component's terminals, shall be at least twice as high as the gravity force resulting from the weight of the component. This is to assure that the component remains adhered to the substrate during the second run of reflow soldering,

4.6.4.7 Material content

For components intended for mounting by gluing information on the material content should be provided. Details on composition, thickness and layer structure of the surfaces to be glued should be given.

4.6.4.8 Cleanliness of the surface

For components intended for mounting by gluing information on the cleanliness of the surfaces should be provided. The adhesion of an adhesive may be prevented by a thin surface layer of organic materials, for example by a thin layer of silicon oil. Therefore it is important, that the surface of the components/terminal is free of any residues. Therefore the cleanliness of the surface has to be defined by analysis (for example by ESCA (electron scattering for chemical analysis)) or by a gluing test.

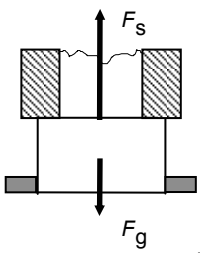
4.6.5 Component height

The component height is limited by the length of the pipette and the space traversed between pick-up and placement. A proper clearance is required by the length of the pipette and the component height for the traverse from pick-up to placement.

The component height and the component department of packing shall be matched to each other to enable the pipette to safely pick up the component. If standardized packaging complying with the IEC 60286 series of standards is used, the component height shall relate to the packing dimensions specified therein.

4.6.6 Component weight

The net force (F_g), resulting from the weight and the acceleration forces of the component shall not exceed one third of the gripping force (F_S) of the pipette (see Figure 8).



IEC 470/06

Figure 8 – Component weight/pipette suction strength

4.7 Mechanical stress

Components need to withstand the stresses applied by placement machinery and bending of the substrate. In order to ensure this, component specifications shall comply with the following test and test methods: Specification performance shall be specified in line with the relevant sectional or generic specification.

– pick-up/impact force: IEC 60068-2-77
– centring force: IEC 60068-2-77
– placement force: IEC 60068-2-77
– bending stress: IEC 60068-2-21.

Mechanical fixing aids (e.g. guide pins, detents) should be avoided as much as possible.

4.8 Component reliability assurance

Requirements and related test methods that define the long term performance of a component shall be part of the component specification. Test methods shall be applied that use components mounted on a substrate. Test methods shall be preferably selected from IEC 60068 series.

The component specification shall state the operating temperature range. Derating may be applied. The operating temperature range shall be in accordance with the long term performance of the component.

Reliability assurance for some components may require restrictions to the choice of soldering process and its parameters. It should be noted that components may experience typically up to three consecutive reflow soldering processes. When the allowed parametric and mechanical changes in the resistance to soldering heat test are determined, this multiple soldering shall be taken into consideration. The number of allowed reflow soldering steps shall be specified in the detail specification.

4.9 Additional requirements for compatibility with lead-free soldering

In component specifications the compatibility of the terminations with the solder used shall be defined. This is as important to lead-free terminations in connection with lead-free solders as it is in connection with lead containing solders.

5 Specification of assembly process conditions

5.1 General

5.1.1 Mounting by soldering

The steps in a production process depend on the mounting method used. Figure 9 shows a typical flow chart.

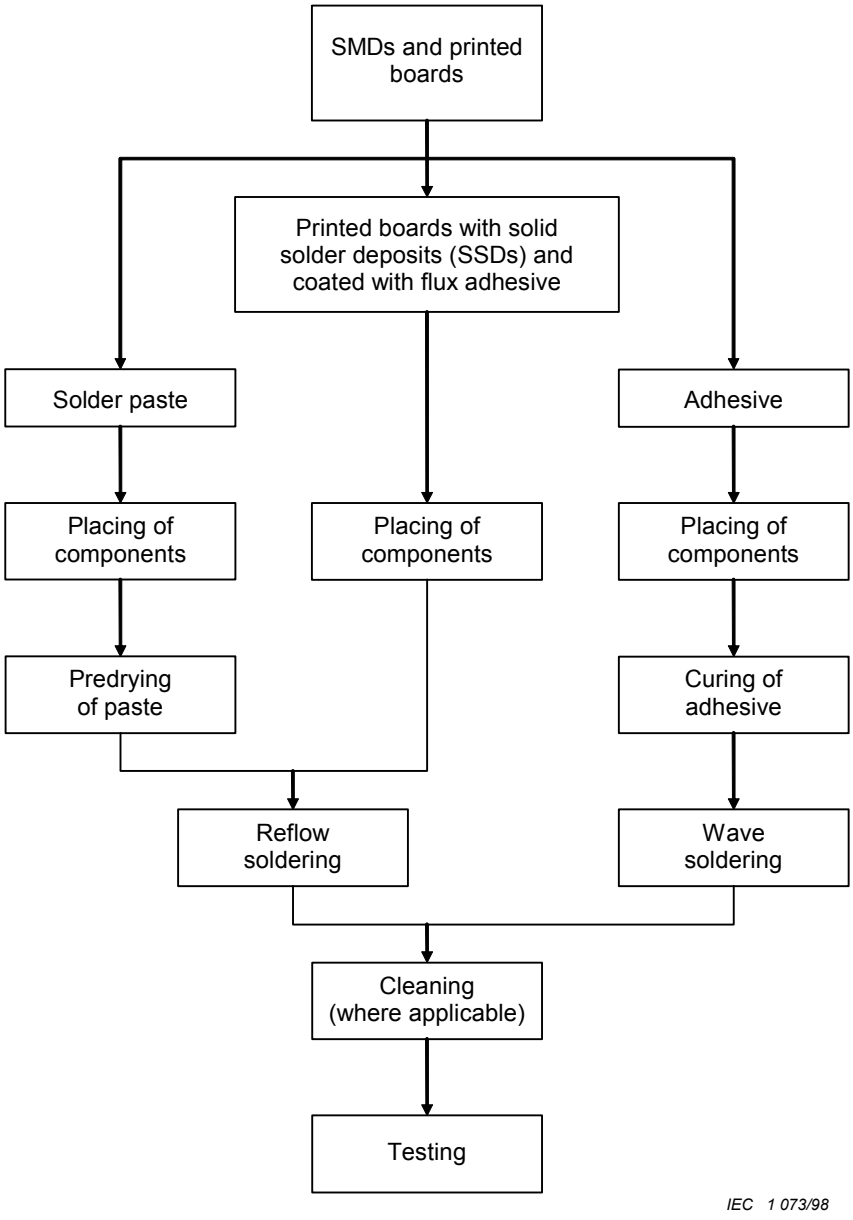


Figure 9 – Process steps for soldering

5.1.2 Mounting by gluing

The steps in a production process depend on the mounting method used. Figure 10 shows a typical flow chart.

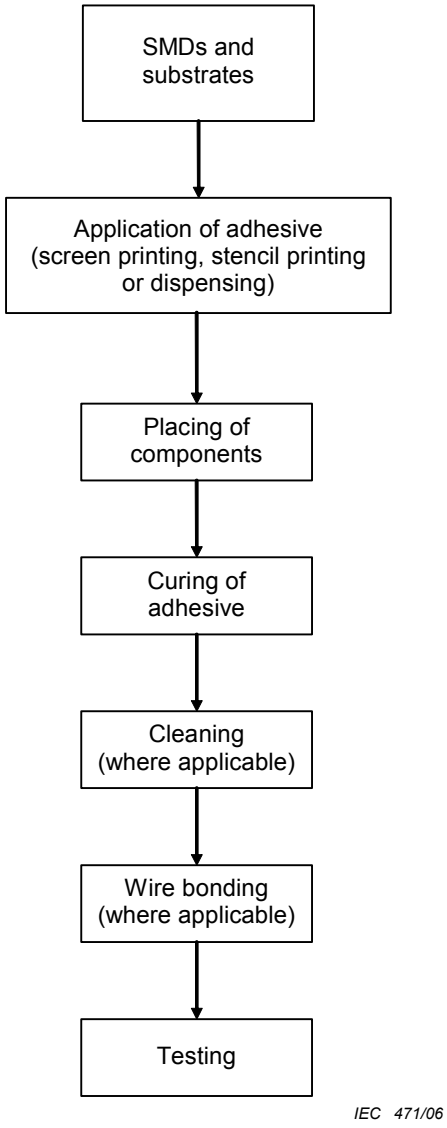


Figure 10 – Process steps for gluing

5.2 Securing the component on the substrate prior to soldering

Components may be secured to the substrate prior to soldering by using either an adhesive or by the applied solder paste.

Heat treatment is used to cure the adhesive, for example, 120 °C for 30 min in a batch process, or 150 °C for 120 s in a continuous process.

The times and temperatures for predrying of the solder paste depend on the type of solder paste used.

5.3 Mounting methods

Several methods can be used to mount components on to the substrate. The following list is not exhaustive.

5.3.1 Reflow soldering

a) Vapour phase reflow

This involves soldering in saturated vapour and is also called condensation soldering. This process can be used either as a batch system (with two vapour zones) or as a continuous system with a single vapour zone. Both systems may also require preheating of the assemblies to prevent thermal shock and other undesirable side-effects.

Typical temperature/time profiles for the full process are shown in Figure 11 for soldering with lead containing SnPb solders and in Figure 12 for soldering with lead-free SnAgCu solder. The specific equipment used has influence on the resulting profile, especially the type of preheating and whether controlled vapour heating power is used or not.

b) Forced air convection reflow soldering

This is the dominating reflow soldering method in which most of the energy for heating the assembly is derived from gas (air or inert gas or a mixture of both). A small proportion of the energy may be derived from direct infrared radiation. There is no contact with the assemblies during heating.

The following parameters influence the temperature of the component, leading to temperature differences between different components on a substrate and between parts of the components (e.g. between terminal and top surface of the component):

- time and thermal power input;
- component mass;
- component size;
- substrate size;
- package density and shadowing;
- wavelength spectrum of radiation source;
- absorption coefficient of surfaces;
- ratio of radiation to convection energy.

Warning: There is a tendency for small components to warm up more than the large ones under the same process conditions and this may lead to exceeding the resistance to soldering heat conditions.

Typical temperature/time profiles for the full process are shown in Figure 13 for soldering with lead containing SnPb solders and in Figure 14 for soldering with lead-free SnAgCu solder (see NOTE). The typical profile represents the terminal temperature of a mid size component. The coldest terminal temperature on an assembled substrate shall be above the lower process limit line to ensure good solder joints.

NOTE The experience with SnAgCu soldering is rapidly increasing at the time of writing of this standard. Therefore changes in this typical profile can be expected.

The maximum temperature, measured on the top surface of a component shall not exceed the upper process limit to avoid component damage by heat exceeding the component resistance to soldering heat specification. Depending on factors as indicated in the paragraph above the maximum temperature measured at the top surface of each component is different. The upper process limit indicated in Figures 13 and 14 represents an upper limit for small sized components.

c) Hotplate reflow soldering

Used mainly for repair.

d) Laser soldering

In development phase.

e) Hot bar soldering

This is a soldering method using temperature-controlled tools (thermodes) for making soldered joints.

5.3.2 Wave soldering

In wave soldering a layer of flux is first applied and dried. Then the printed boards are drawn in one direction across the crests of two continuously replenished waves of molten solder. This method can be performed in an inert atmosphere.

Figure 15 shows typical temperature/time profiles for the full process. Differences for lead-free soldering are indicated in Figure 15.

5.3.3 Other soldering methods

Soldering iron.

This process is difficult to control. If used, care should be taken to ensure that reliability is not adversely affected.

5.3.4 Conductive gluing

The following processes are typical for mounting by an conductive adhesive: First the adhesive is applied to the substrate by screen printing, stencil printing or dispensing. Then the components are placed in the wet adhesive. The adhesive is then cured in a batch oven or in an inline oven. Typical curing conditions are up to 150 °C and up to 2 h holding time at the curing temperature.

5.4 Cleaning (where applicable)

The following cleaning methods may be used in cases where the substrates have to be cleaned after soldering/gluing:

– fluid (boiling or with ultrasonic oscillation);
– liquid (bath plus vapour);
– spray cleaning;
– plasma cleaning.

Cleaning materials prohibited by the Montreal Protocol shall be avoided.

Resonance due to ultrasonic waves may expose the components to excessively high stress levels.

a) Fluid

The substrate is immersed in a cleaning fluid. For details see Table 1.

b) Ultrasonic cleaning

The substrate is immersed in a cleaning fluid and also subjected to ultrasonic oscillation. For details see Table 1. Refer to the relevant detail specifications for information on whether a component is capable of withstanding ultrasonic cleaning procedures.

c) Vapour

A cleaning vapour condenses on the substrate. For details see Table 1.

d) Spray

A cleaning fluid is sprayed on to the substrate. For details see Table 1.

e) Plasma cleaning

The substrate with mounted components is cleaned by a plasma (for example oxygen plasma) in a vacuum chamber.

5.5 Removal and/or replacement of SMDs

5.5.1 Removal and/or replacement of soldered SMDs

This subclause defines procedures for removal and replacement of soldered SMDs.

The normal sequence is as follows:

– removal of conformal coating (if necessary);
– cleaning (if necessary);
– fluxing (and possibly application of solder);
– heating of the soldered joints with either a circumferential thermode, a hot air jet or other suitable heat sources;
– removal of the component;
– cleaning (if necessary);
– addition of solder paste (if necessary);
– placing of the new component;
– fluxing;
– soldering;
– cleaning (if necessary).

NOTE 1 Minimize mechanical force to avoid substrate damage during removing of glued/soldered components.

NOTE 2 Removed components should not be reused without first ensuring that the removal process has not impaired the reliability of the substrate and the component.

5.5.2 Removal and/or replacement of glued SMDs

This subclause defines procedures for removal and replacement of glued SMDs.

The normal sequence is as follows:

– heating of the substrate and/or of the component up to a temperature higher than the glass-transition-temperature of the adhesive;
– removal of the component;
– cooling of the substrate;
– cleaning of the mounting area on the substrate;
– dispensing of adhesive;
– placing of the new component;
– curing of the adhesive;
– cleaning (if necessary).

NOTE Removed components should not be reused without first ensuring that the removal process has not impaired the reliability of the substrate and the component.

6 Typical process conditions

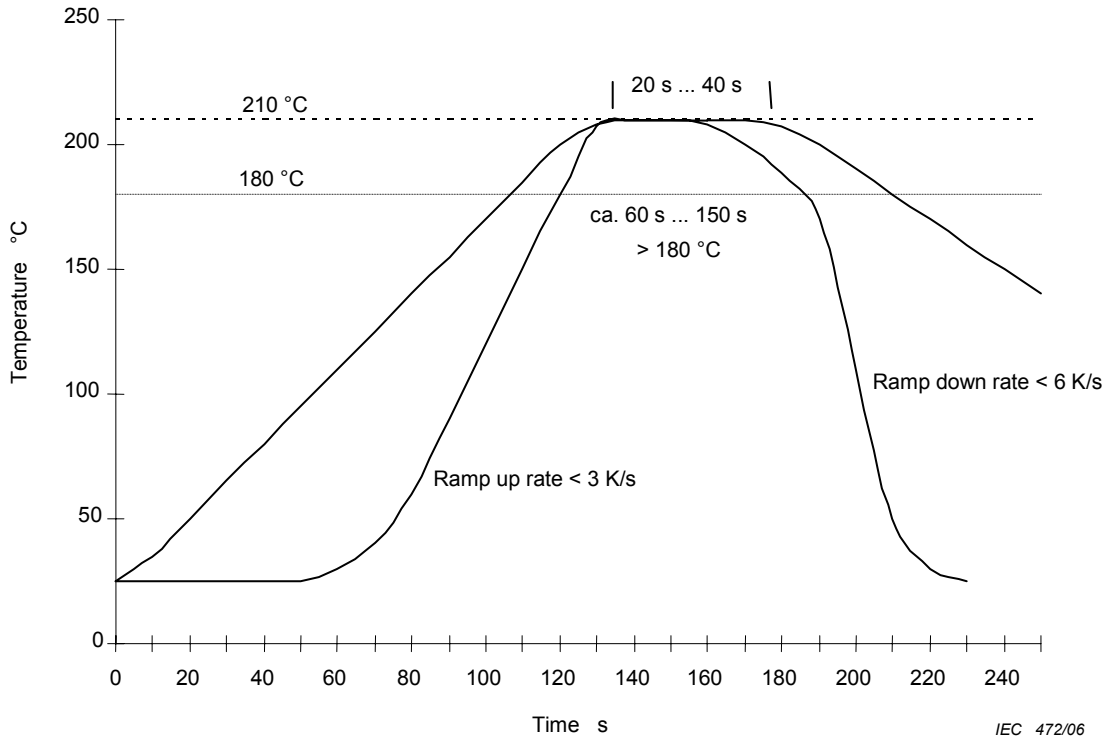
6.1 Soldering processes, temperature/time profiles

The following diagrams are intended as an aid to SMD users and component manufacturers in determining typical process conditions to which components will be subjected in a specific soldering process. Requirements for components and component specifications related to suitability for usage in various mounting processes are given in Clause 7.

Figures 11 to 15 show temperature/time profiles for five commonly used soldering processes. As described in 5.3.1 time/temperature profiles for the surface of the component usually differ from the time/temperature profile for the terminal of the product.

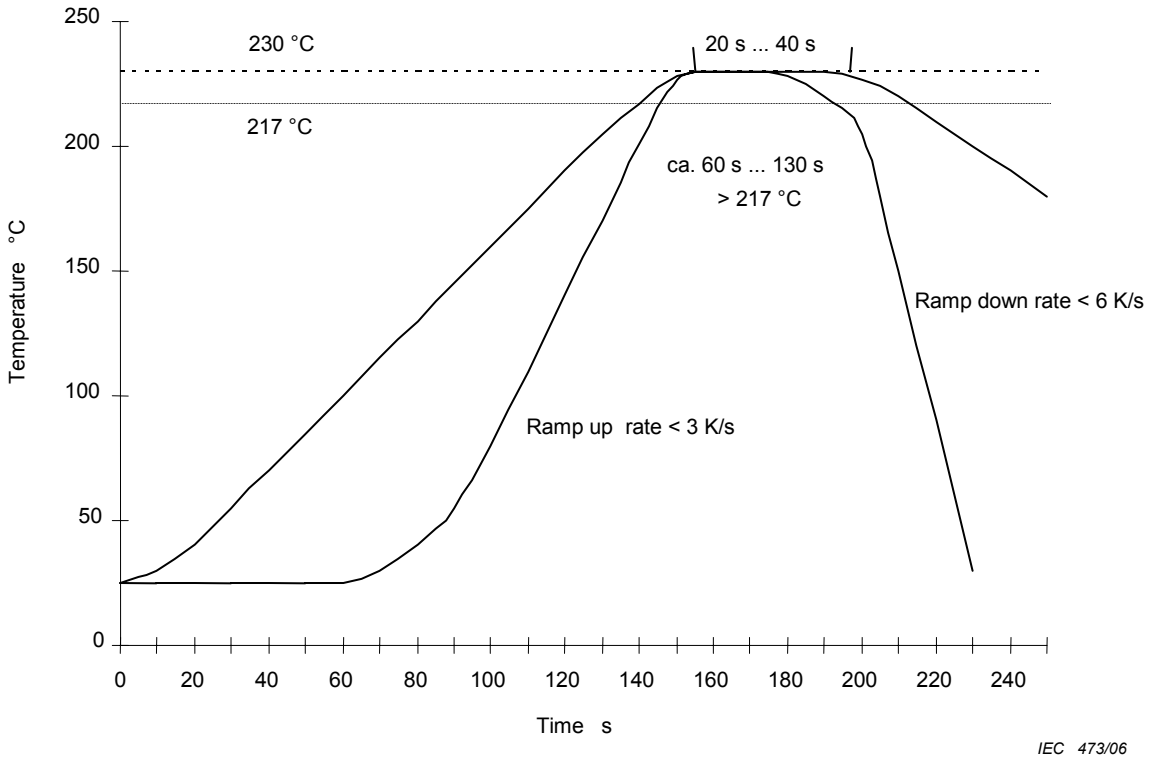
NOTE The unit Kelvin (K) is used in case of an interval or difference of temperatures.

6.1.1 Vapour phase soldering



NOTE The lines indicate upper and lower limits of typical processes.

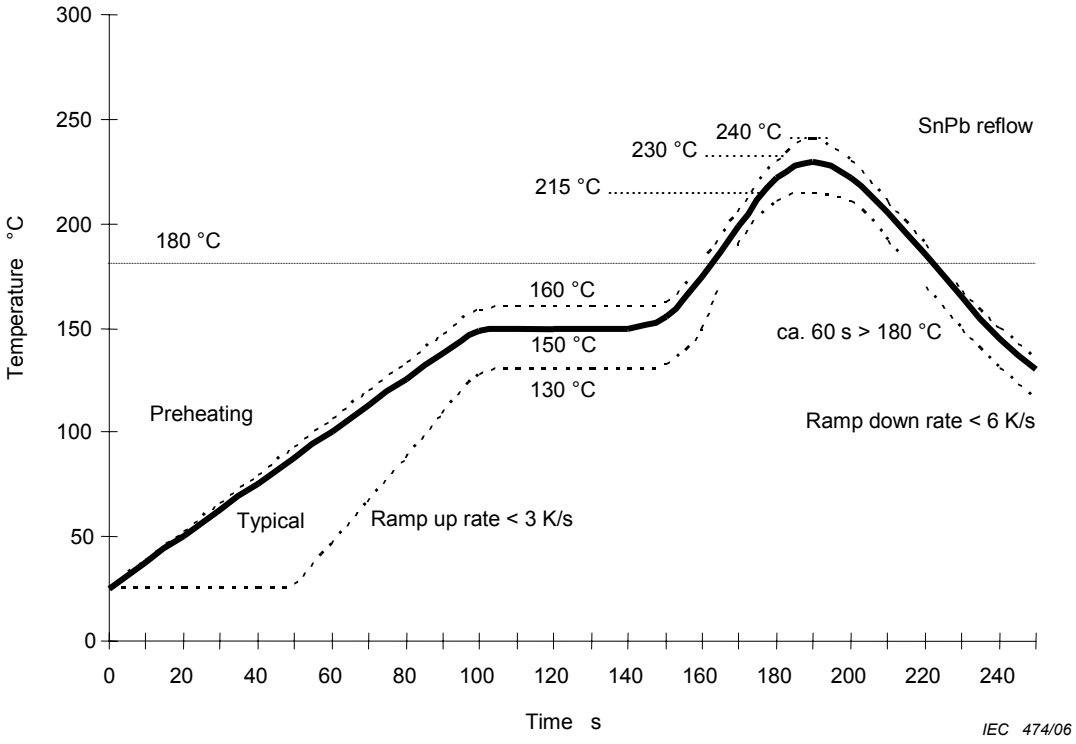
Figure 11 – SnPb Vapour phase soldering – Temperature/time profile (terminal temperature)



NOTE The lines indicate upper and lower limits of typical processes.

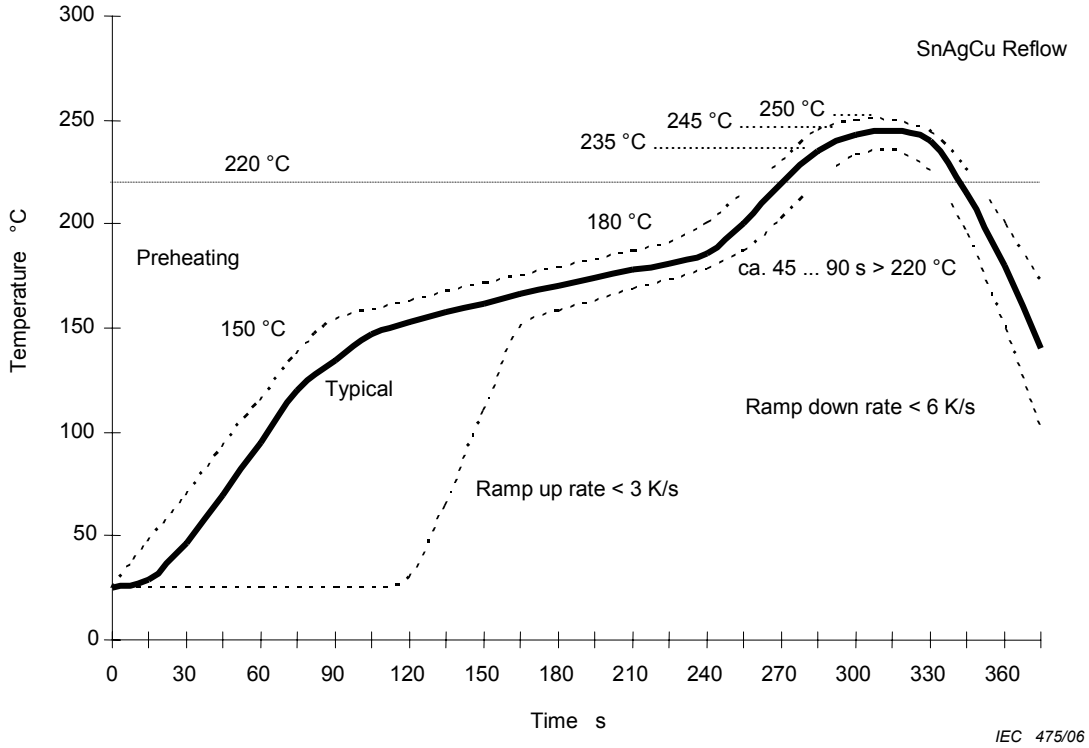
Figure 12 – Lead-free SnAgCu Vapour phase soldering – Temperature/time profile (terminal temperature)

6.1.2 Infrared soldering, forced gas convection reflow soldering



Key
Continuous line: typical process (terminal temperature).
Dotted line: process limits; bottom process limit (terminal temperature), upper process limit (top surface temperature).

Figure 13 – Infrared soldering, forced gas convection reflow soldering – Temperature/time profile for SnPb solders

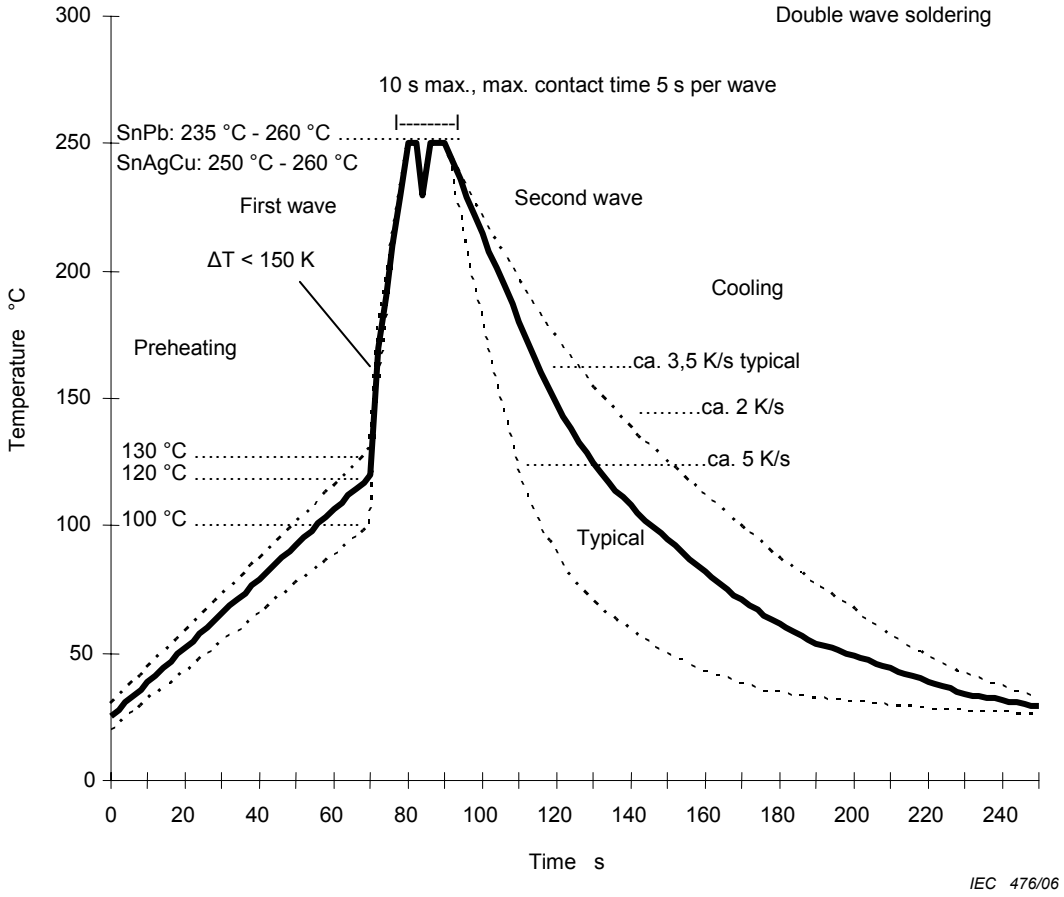


Key
Continuous line: typical process (terminal temperature).
Dotted line: process limits; bottom process limit (terminal temperature); upper process limit (top surface temperature**).**

Figure 14 – Infrared soldering, forced gas convection reflow soldering – Temperature/time profile for lead-free SnAgCu solders[1]

[1] Typical profile as used at time of publication. The experience with SnAgCu soldering is rapidly increasing at the time of the writing of this standard. Therefore changes in this typical profile may occur.

6.1.3 Wave soldering



Key
Continuous line: typical process.
Dotted line: process limits

Figure 15 – Double wave soldering for SnPb and lead-free SnAgCu solder– Temperature/time profile (terminal temperature)

6.2 Typical cleaning conditions for assemblies

Table 1 – Basic cleaning processes

Process		Conditions	Cleaning media [1)]
Liquid	Washing	40 °C – 80 °C/4 min	Water, isopropyl alcohol (propan-2-ol), Ethyl alcohol, terpenes
	With ultrasonic oscillation	25 °C – 40 °C/2 min 10 W/l – 30 W/l 25 kHz – 40 kHz	
	Vapour	80 °C/30 s	
	Spray	45 °C/16 bar	
Plasma		60 °C – 100 °C/3 min 0,2 mbar – 1 mbar	Oxygen
[1)] The cleaning materials prohibited by the Montreal Protocol shall be avoided.			

Cleaning liquids may include various additives. Amendment 1 to IEC 60068-2-45:1993 stipulates that isopropyl alcohol shall be used whenever possible.

Resonance caused by ultrasonic oscillation may lead to overstressing of the components.

7 Requirements for components and component specifications related to suitability with various mounting processes

7.1 General

Individual component specifications shall contain information on test methods and requirements for tests related to the suitability of the component for soldering processes and conductive gluing. Test methods, detail specifications and severities related to soldering shall be in accordance with IEC 60068-2-58. The component specification shall include specifications for the tests in 7.2 to 7.5.

NOTE The component specification can be either generic, sectional or detail specification.

In case special handling conditions e.g. preconditioning, predrying of components are needed, the manufacturer shall include these in the specification.

7.2 Wettability

Acceptance criteria shall be in accordance with IEC 60068-2-58.

The component specification shall specify the following details from IEC 60068-2-58:

a) Preconditioning (if needed)

b) The method used

Solder bath method or reflow soldering on a substrate. In the case of the solder bath method, the duration of immersion, the temperature of the solder bath and the immersion attitude shall be specified. Guidance on the relation between the soldering process and the immersion conditions can be derived from IEC 60068-2-58. In the case of the reflow soldering on a substrate method, the solder reflow process, solder composition and the applied flux shall be specified. Dimensional details of the substrate and thickness of the solder deposition shall be given in the component specification. For the lead-free reflow method, the soldering profile group shall be specified.

c) Details of the flux removal procedure

d) Dewetting test

The test and conditions shall be specified in accordance with IEC 60068-2-58.

7.3 Resistance to dissolution of metallization

The component specification shall contain information if the resistance to dissolution of metallization is relevant for the component. If relevant the test method shall be as specified in IEC 60068-2-58. Visual acceptance criteria shall be in accordance with IEC 60068-2-58 unless otherwise specified in the component specification.

7.4 Resistance to soldering heat

The visual and electrical inspection method and acceptance criteria shall be specified in the component specification.

For plastic-encapsulated semiconductor SMDs, the component specification shall specify details and requirements in accordance with the procedure given in Clause 5 of IEC 60749-20, or in accordance with IEC 60068-2-58.

For other components the component specification shall specify the following details from IEC 60068-2-58:

a) Preconditioning (if needed)

b) The method used

Solder bath method or reflow soldering on a substrate method. In the case of the solder bath method the duration of immersion, the temperature of the solder bath and the immersion attitude shall be specified. Guidance for the relation between the soldering process and the immersion conditions can be derived from IEC 60068-2-58. In the case of the reflow soldering on a substrate method, the solder reflow process, solder composition and the applied flux shall be specified. In addition to this the number of cycles that a component can withstand the reflow soldering process shall be specified. For the lead-free reflow method, the soldering profile group shall be specified. Dimensional details of the substrate and thickness of the solder deposition shall be given in the component specification.

c) Details of the flux removal procedure

d) Recovery period and conditions before final inspection

7.5 Resistance to cleaning solvent

The component specification should contain information on Test XA as described in IEC 60068-2-45:1980. The following detailed test instructions apply:

7.5.1 Component resistance to cleaning solvent

a) Solvent to be used: see IEC 60068-2-45:1980, 3.1.2; isopropyl alcohol recommended.

b) Solvent temperature: (23 ± 5) °C, unless otherwise stated in the relevant specification.

c) Test conditions: method 2 (without rubbing).

d) Recovery time: 48 h, unless otherwise stated in the detail specification.

7.5.2 Marking resistance to cleaning solvent

a) Solvent to be used: see IEC 60068-2-45, 3.1.2; isopropyl alcohol recommended.

b) Solvent temperature: (23 ± 5) °C, unless otherwise stated in the relevant specification.

c) Test conditions: method 1 (with rubbing).

d) Rubbing material: cotton wool.

e) Recovery time: not applicable, unless otherwise stated in the detail specification.

7.6 Soldering profiles

This standard recommends to use the profiles as given in Clause 6 when recommending soldering profiles in component specifications.

7.7 Bonding strength test for the component glue interface test

A test method for the mechanical strength of an adhesive connection (for example a shear-force test) and acceptance criteria for this test shall be specified in the component specification. A shear test method that complies with IEC 60068-2-21 should be used. In addition to the requirements of IEC 60068-2-21, the relevant specification should give information on substrate material, type of adhesive, dimension of applied adhesive (connecting area at the component and thickness after component attach), curing conditions and the shear force.

There are two acceptance criteria important for a shear force test:

– shear force criteria (force per connecting area at which the component breaks from the substrate)

– visual inspection criteria (amount of adhesive which is on the component after the shear force test).

Bibliography

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

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

IEC 60068-2-69, *Environmental testing – Part 2: Tests – Test Te: Solderability testing of electronic components for surface mounting technology by the wetting balance method*

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