

TECHNICAL REPORT



**Environmental testing –
Part 3-12: Supporting documentation and guidance – Method to evaluate a
possible lead-free solder reflow temperature profile**



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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	7
4 Determination of an envelope reflow profile	7
4.1 Temperature-time-envelope curve.....	7
4.2 Diagram of a theoretical envelope reflow profile.....	8
4.3 Key parameters of the envelope reflow profile.....	8
5 Temperature profile measurements	11
5.1 Determining the measurement locations.....	11
5.2 Selection and attachment of thermocouples	12
5.2.1 Types of thermocouples.....	12
5.2.2 Preparation of thermocouples	13
5.2.3 Attachment of thermocouples	13
5.2.4 Influence of attachment method and operator on measurement results	16
5.3 Temperature gradient.....	16
5.3.1 Gradient calculation	16
5.3.2 Sampling rate	18
5.4 Analysis, comparison and overlay of different reflow profiles and best practice.....	18
5.5 Measuring equipment.....	19
6 Tolerance analysis of the measurement chain	19
7 Optimizing a temperature profile	21
7.1 General procedure	21
7.2 Description of a typical test board and the used reflow oven	21
7.3 Schematic envelope reflow profile for the example board	22
7.4 Preparation of test board	24
7.5 Possibility of temperature profiling optimization with simulation tools	25
7.6 Iteration steps for finding reflow equipment setup	27
8 Examples of envelope reflow profiles.....	30
8.1 Key data for two different solders.....	30
8.2 Example of a qualification temperature profile for component used in lead-free reflow soldering (SAC)	31
Bibliography.....	33
Figure 1 – Schematic envelope reflow profile	8
Figure 2 – Recommended temperature measurement locations on a test board	12
Figure 3 – X-ray of a sheath thermocouple.....	12
Figure 4 – Example of a) acceptable and b) unacceptable attachment of the thermocouples	13
Figure 5 – Examples of good and bad thermocouple attachment.....	15
Figure 6 – Thermocouples (TC) fixed to an LED.....	16
Figure 7 – Results of the same test board prepared by different methods	16
Figure 8 – Gradient calculation	17

Figure 9 – Example of a gradient calculation on a temperature-time curve	18
Figure 10 – Overlay of different reflow profiles (origin at oven entry).....	19
Figure 11 – Overlay of different reflow profiles (overlap at start of peak zone)	19
Figure 12 – Measurement chain	20
Figure 13 – Description of a test board (electronic assembly)	22
Figure 14 – Envelope reflow profile for the test board	24
Figure 15 – Thermal images of the test board after cooling down from 150 °C	24
Figure 16 – Geometric and thermal description of the test board.....	26
Figure 17 – Geometric and thermal description of the reflow soldering equipment.....	26
Figure 18 – Predicted reflow profile with help of simulation (blue band)	27
Figure 19 – Overlay envelope curves of the temperature-time curves of three profiling steps, 0201-chip solder joint	29
Figure 20 – Overlay envelope curves of the temperature-time curves of three profiling steps, ERU25 solder joint	30
Figure 21 – Exemplary qualification reflow temperature profile for the qualification of components intended for use in assemblies with a wide variation of thermal masses	32
Table 1 – Temperature-time curve – Units	8
Table 2 – Envelope points of a reflow temperature-time-profile	9
Table 3 – Thermocouple attachment methods.....	14
Table 4 – Tolerances of the temperature measurement chain	20
Table 5 – Envelope points at the envelope reflow profile for the test board	23
Table 6 – Measurement locations on the sample assembly	25
Table 7 – Settings according to experience.....	28
Table 8 – Measurement results for the settings from Table 7	28
Table 9 – Settings for second run	28
Table 10 – Measurement results for the settings from Table 9	28
Table 11 – Settings after adjustment of the heating zone temperatures.....	29
Table 12 – Measurement results from Table 11, adaptation of heating zone temperatures	29
Table 13 – Examples for envelope reflow profile key data for two different solders	31
Table 14 – Key parameters for a lead-free SAC reflow temperature profile for component qualification	32

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ENVIRONMENTAL TESTING –

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Method to evaluate a possible lead-free solder reflow temperature profile**

FOREWORD

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IEC TR 60068-3-12 has been prepared by IEC technical committee 91: Electronics assembly technology. It is a Technical Report.

This third edition cancels and replaces the second edition published in 2014. This edition constitutes a technical revision.

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

a) Extended purpose

Guidance is added on how to create a reflow profile considering the tolerances resulting from the accuracy of the measuring equipment, preparation method and specifications of the component manufacturers (components, PCB, solder paste, etc.).

b) Distinction from existing standards

The envelope profile given in this document does not represent a temperature-time profile for the qualification of materials but defines the reflow process limits for the soldering of electronic assemblies.

The schematic temperature-time-limit curves of the envelope profile are derived from generally valid findings (literature data). Additionally, tolerance considerations are given for all envelope points of the envelope profile.

In contrast to IEC TR 60068-3-12:2014, the creation of the envelope profile is not primarily linked to a concrete example.

c) Subclause 8.2 presents an approach for establishing a possible temperature profile for a lead-free reflow soldering process using SnAgCu solder paste that is taken from IEC TR 60068-3-12:2014.

d) Synergies with existing standards

Limit values and tolerances from standards and guidelines for the qualification of materials are included in this document and are listed as examples in the references.

The text of this Technical Report is based on the following documents:

Draft	Report on voting
91/1776/DTR	91/1804/RVDTR

Full information on the voting for its approval can be found in the report on voting indicated in the above table.

The language used for the development of this Technical Report is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/standardsdev/publications.

A list of all parts in the IEC 60068 series, published under the general title *Environmental testing*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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INTRODUCTION

The enormous variety of materials and components processed in SMT requires to consider their thermal properties, especially in reflow soldering.

Since the second edition essentially limited its focus to lead-free soldering, there is a need to extend the contents in order to cover state of the art reflow soldering processes in general.

Reflow soldering is a joining process using an additional metal (solder) with a liquidus temperature of 450 °C or less, in which solder paste or preforms are reflowed (see ISO 857-2:2005).

Reflow soldering can be carried out with the technical processes of convection (air or nitrogen), condensation (vapour phase), radiation (e.g. infrared) or contact heat as well as with the help of low pressure (vacuum).

The goal of a qualified reflow soldering process is to create high quality and reliable solder joints at product level. It is important to avoid soldering defects and damage to components and printed circuit board.

In addition to the requirements for the formation of reliable solder joints, the specifications of the connection partners and the production requirements (temperatures, final layers, alloys, etc.), an adequate process control is an important factor. Primarily the resistance of the components and circuit boards to solder heat, as well as the specifications of the solder paste and/or flux, need to be considered. The sum of these physical limits is a theoretical temperature-time curve for a specific product (see DVS 2613).

This document is intended for engineers (e.g. development, manufacturing technology, work preparation) and operators (production) responsible for the creation and release of temperature-time ($T-t$) profiles for reflow soldering in surface mount technology.

This document initially was prepared by the German DKE GUK 682.2 "Thermal joining technology in electronics".

ENVIRONMENTAL TESTING –

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1 Scope

This part of IEC 60068, which is a Technical Report, describes the creation of temperature-time profiles (in specific envelope profiles) for reflow soldering of electronic assemblies, considering tolerances resulting from the accuracy of the measuring equipment, preparation method and specifications of the manufacturers of components, circuit boards, solder paste, etc.).

The envelope profile given in this document does not represent a temperature-time profile for qualification but defines the reflow process window for the soldering of electronic assemblies. Qualification profiles can be found, for example, in IEC 60068-2-58 for resistance to soldering heat, or in IEC 60749-20, IEC 61760-4 and IPC/JEDEC J-STD-020E for moisture sensitivity classification of components.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <http://www.iso.org/obp>

4 Determination of an envelope reflow profile

4.1 Temperature-time-envelope curve

According to IEC 61191-1:2018, 8.2.2, manufacturers of electronic assemblies need to determine the parameters of a soldering process as follows:

"The process shall include, as a minimum, a reproducible time/temperature envelope including the drying/degassing operation (when required), preheating operation (when required), solder reflow operation, and a cooling operation."

The necessary envelope points for the creation of a temperature-time-envelope curve result from the respective minima and maxima of the data for the solder heat resistance of the components and PCBs, their minimum solderability temperatures, as well as from the specifications of the solder paste and/or flux. The cycle time (time per electronic assembly) and the process time (T_0 to T_3 end) influence each other.

The temperature-time curve is described by the units in Table 1.