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Edition 1.0 2022-06

TECHNICAL REPORT

Surface mounting technology –
Part 3-1: Standard method for the specification of components for through hole reflow (THR) soldering – Guidelines for through hole diameter design with solder paste surface printing method

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SURFACE MOUNTING TECHNOLOGY –

Part 3-1: Standard method for the specification of components for through hole reflow (THR) soldering – Guidelines for through hole diameter design with solder paste surface printing method

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IEC TR 61760-3-1 has been prepared by IEC technical committee 91: Electronics assembly technology. It is a Technical Report.

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

Draft	Report on voting
91/1734/DTR	91/1773/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 61760 series, published under the general title *Surface mounting technology*, 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

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- withdrawn,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

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SURFACE MOUNTING TECHNOLOGY –

Part 3-1: Standard method for the specification of components for through hole reflow (THR) soldering – Guidelines for through hole diameter design with solder paste surface printing method

1 Scope

This Part of IEC 61760 supplements IEC 61760-3 to describe examples of solder paste supply methods, the relationship between the terminal position tolerance and the through hole diameter, and provides guidelines for the design of printed circuit boards with solder paste surface printing method, including specific examples.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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.

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IEC 61760-3:2021, *Surface mounting technology – Part 3: Standard method for the specification of components for through-hole reflow (THR) soldering*

3 Terms and definitions

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For the purposes of this document, the terms and definitions given in IEC 61760-3 and the following apply.

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

3.1
stencil aperture
stencil opening
opening area for solder paste printing in the stencil

4 Solder paste application methods

4.1 General

The amount of solder paste required for through-hole reflow soldering is much greater than for surface mount. In the industry marketplace, various methods to supply the solder paste are utilised. All these methods have specific advantages and disadvantages and are depending upon the board lay-out, the solder material to be used, the trough-hole components to be inserted. Other points to be considered are production efficiency, cost and quality requirements.

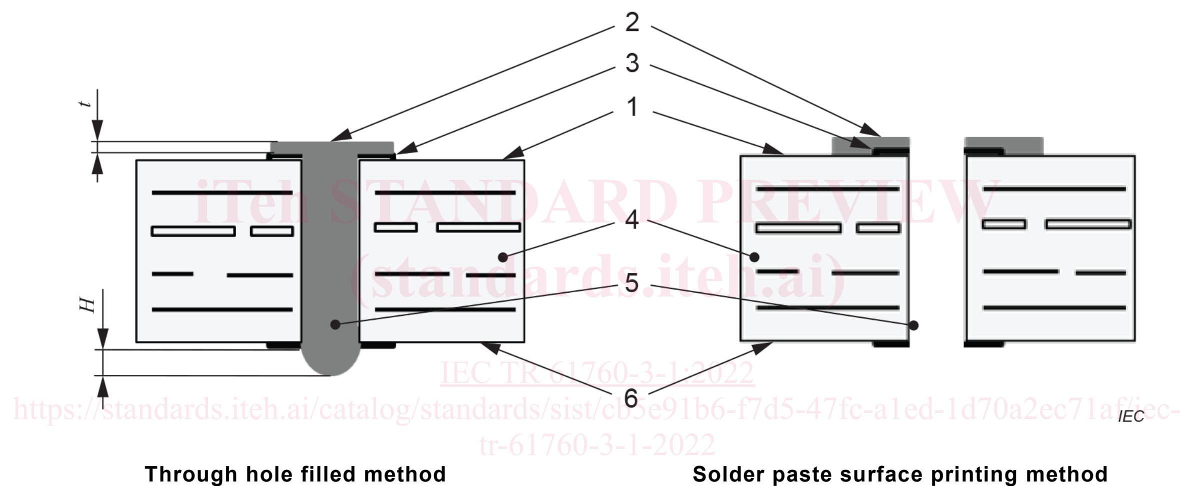
The most common method used is printing solder paste into plated through-holes and over the pad surface during normal surface mount paste printing (solder paste surface printing method, see 4.3). The size of the aperture in the solder paste stencil may be adjusted to allow paste to fill the hole, cover the pad or extend over the surface of the solder mask to obtain the solder volume required.

Another method is the solder paste surface printing method (through hole vacant method), see 4.3.

Refer to Figure 1 to Figure 4 for comparison of both methods.

In this document, the features (advantage and disadvantage) of the solder paste surface printing reflow technology are introduced from the following two perspectives:

- Solder paste printing stencil aperture design guidelines (see Clause 5);
- Influence of position tolerance between component terminals and through holes on through hole diameter and stencil aperture design guidelines (see Clause 6).



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key

1	top side (assembly side)
2	solder paste
3	Land
4	circuit board
5	through hole
6	bottom side
t	solder paste thickness
H	solder paste protrusion height

Figure 1 – Solder paste application method

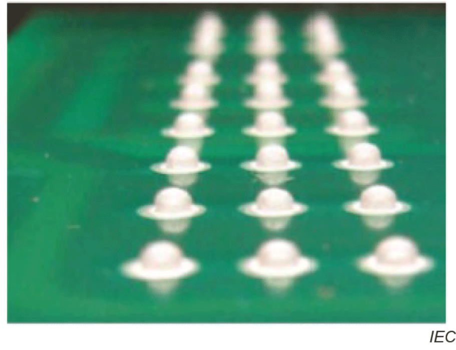

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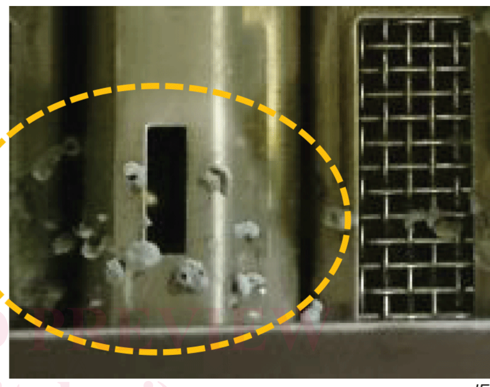
Figure 2 – Through hole filled method (bottom side view)

IEC

Reflow oven side view



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Reflow oven top view

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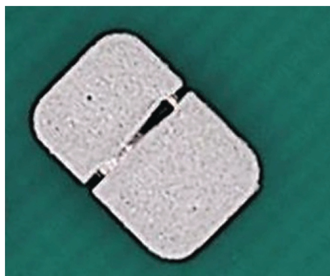
Figure 3 – Solder paste fallen inside the reflow oven (through hole filled method)



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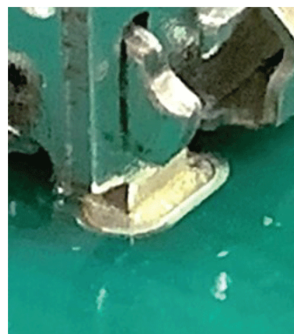
a) After print



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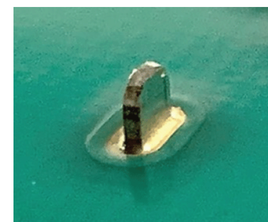
b) After reflow (top side)



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c) After reflow (bottom side)

Figure 4 – Solder paste state of solder paste surface printing method

4.2 Through hole filled method

4.2.1 Overview

As the name indicates, the through hole filled method is a method of filling the through hole with the required amount of solder paste using a printing method or a dispenser.

4.2.2 Advantages

The advantage of this method is that it is applicable in cases where the solder paste surface printing method does not provide enough space for solder printing, such as when the distance between adjacent through holes or between through holes and adjacent component electrodes is close.

4.2.3 Disadvantages

A disadvantage of this method is that the solder paste can drop down during the surface mounting process. The reason for this is that the solder paste filled in the through hole is pushed down by the terminal when the component terminals are inserted.

In addition, the amount of filled solder paste varies depending on various printing conditions, such as printing speed, printing pressure and squeegee angle, and it is difficult to check.

4.3 Solder paste surface printing method

4.3.1 Overview

The solder paste surface printing method is a method of filling a through hole by melting solder of which the solder paste printed in vicinity of the through hole on the circuit board by reflow heating and then spread wetting it to the through hole sides and component terminals.

This method has been popularized recently as a means of reducing of dropping solder paste, which is a disadvantage of the hole-filling method. However, since the through hole is not filled with solder paste, it is necessary to ensure that the volume (actually, about twice the volume to include flux, etc.) of the solder paste as a surface printing area in the vicinity of the component arrangement. Another disadvantage is that if the distance from the through-hole is increased to secure the printing area, it is difficult for the printed solder paste to move into the through hole during the melting phase.

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4.3.2 Advantages

The amount of solder paste required can be adjusted by designing the stencil opening area (see Figure 4).

The risk of solder paste dripping into the reflow oven during the soldering process is reduced (see Figure 3).

Since the amount of solder paste depends on the stencil aperture, the amount of solder paste can be easily adjusted and stabilized.

4.3.3 Disadvantages

Adequate printing area of solder paste on components mounting surface is required (see Figure 4).

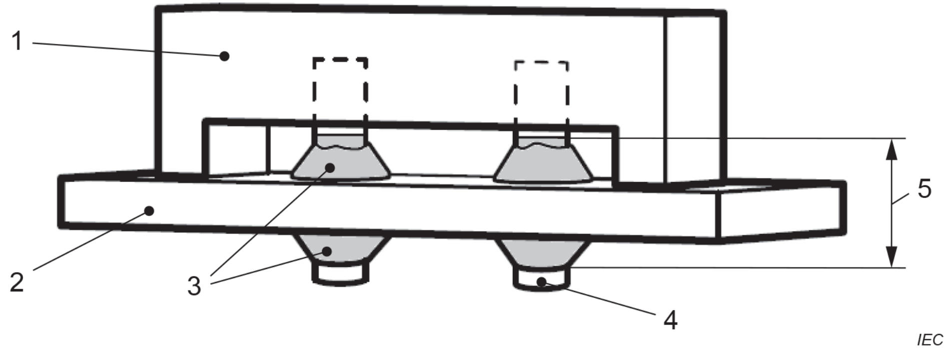
It can be difficult to secure the amount of solder paste supply (see Figure 4).

The solder paste does not move to the through holes when the solder paste is melted if the supply position of solder paste is separated from the through holes by more than a certain distance.

5 Solder paste printing stencil aperture design guidelines

5.1 General

The required solder amount for a component terminal is the sum of the clearance volume in between through hole and the component terminal, and the solder fillet volume on the component terminal of top and bottom side (see Figure 5).



key

1 component body

2 circuit board

3 solder fillet

4 component terminal

5 terminal solder wetting length

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Figure 5 – Conceptual view of solder wetting of component terminals after reflow soldering

During reflow process, The printed solder paste will shrink to almost a half of the printed volume. See Annex B, Formula (B.1)

5.2 Amount of solder paste

5.2.1 Needed amount of solder paste

The solder paste surface printing method assumes stencil printing, and the stencil aperture geometry is determined from the amount of solder to be supplied as described in 5.1.

The principle, how to calculate the amount of solder paste to be supplied is shown in Formula (1). See Annex A for details of the calculation methods for solder fillet volume of the round terminal.

$$A=(B-C)\times x \tag{1}$$

where

A is the amount of solder paste to be supplied (mm^3);

B is the solder volume after reflow sum of to fill the through hole and required top and bottom side solder fillet volume (mm^3);

C is the volume of the component terminal in a through hole (mm^3);

x is the volume coefficient of solder paste after melting: see Annex B;