



IPC-7525C

# Stencil Design Guidelines

Developed by the members of the Solder Stencil Task Group (5-21e) of the Assembly & Joining Committee (5-20) of IPC.

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Users of this publication are encouraged to participate in the development of future revisions.

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# Stencil Design Guidelines

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## 1.0 SCOPE

**1.1 Purpose** This document provides guidance for the design and fabrication of stencils for solder paste and surface-mount adhesive. It is intended as a guideline only. Much of the content is based on the experience of stencil designers, fabricators, and users. Printing performance depends on many different variables and therefore no single set of design rules can be established. Although this Handbook uses mandatory terminology, e.g., **shall**, **must**, etc., nothing within this Handbook is considered mandatory unless this document is specified as a mandatory requirement in the contract documentation.

**1.2 Classification** There are three general Performance Classes

CLASS 1 General Electronic Products

- Includes products suitable for applications where the major requirement is function of the completed assembly.

CLASS 2 Dedicated Service Electronic Products

- Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically, the end-use environment would not cause failures.

CLASS 3 High Performance/Harsh Environment Electronic Products

- Includes products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

**1.3 Measurement Units** All dimensions and tolerances in this specification are expressed in precise SI (metric) units and bracketed soft imperial [inch] units. Users of this specification are expected to use metric dimensions. All dimensions  $\geq 1$  mm [0.0394 in] will be expressed in millimeters and inches. All dimensions  $< 1$  mm [0.0394 in] will be expressed in micrometers and microinches.

**1.4 Definition of Requirements** The words **shall** or **shall not** are used in the text of this document wherever there is a requirement for materials, preparation, process control or acceptance.

The word “should” reflects recommendations and is used to reflect general industry practices and procedures for guidance only.

Line drawings and illustrations are depicted herein to assist in the interpretation of the written requirements of this Standard. The text takes precedence over the figures.

**1.5 Order of Precedence** The contract **shall** take precedence over this Standard, referenced standards and drawings.

In the event of conflict, the following order of precedence applies:

- 1) Procurement as agreed and documented between customer and supplier.
- 2) Master drawing reflecting the customer’s detailed requirements.
- 3) When invoked by the customer or per contractual agreement, this standard.

When documents other than this standard are cited, the order of precedence **shall** be defined in the procurement documents.

The User has the opportunity to specify alternate acceptance criteria.

**1.5.1 Conflict** In the event of conflict between the requirements of this standard and the applicable drawing(s) and documentation, the applicable user-approved drawing(s) and documentation govern.

Some examples of documentation include the contract, purchase order, technical data package, engineering specification or performance specification. In the event of a conflict between the text of this standard and the applicable documents cited herein, the text of this standard takes precedence. In the event of conflict between the requirements of this standard and drawing(s) and documentation that has not been user approved, this standard governs.

**1.5.2 Clause References** When a clause in this document is referenced its subordinate clauses apply, unless the requirement references specific subordinate clauses.

**1.5.3 Appendices** Appendices to this standard are not binding requirements unless separately and specifically required by this standard, the applicable contracts, assembly drawing(s), documentation or purchase orders.

**1.6 Use of “Lead”** For readability and translation, this document uses the noun lead only to describe leads of a component. The metallic element lead is always written as Pb.

**1.7 Abbreviations and Acronyms** Periodic table elements are abbreviated in the standard.

**1.7.1 PCB** Printed Circuit Board

**1.7.2 BGA** Ball Grid Array

**1.7.3 FPT** Fine-Pitch Technology

**1.7.4 SMT** Surface Mount Technology

**1.7.5 THT** Through-Hole Technology

**1.8 Terms and Definitions** All terms and definitions used throughout this handbook are in accordance with IPC-T-50. Definitions noted with an asterisk (\*) are quoted from IPC-T-50. Other specific terms and definitions, essential for the discussion of the subject, are provided below.

**1.8.1\*Aperture** An opening in the stencil foil.

**1.8.2 \*Area Ratio** The ratio of the area of aperture opening to the area of aperture walls.

**1.8.3 \*Aspect Ratio** The ratio of the width of the aperture to the thickness of the stencil foil.

**1.8.4 Border** For mesh mount stencil format, this is peripheral tensioned mesh, either polyester or stainless steel, which keeps the stencil foil flat and taut. For mesh exempt (i.e. frameless) stencil format this refers to the frame engagement devices located on the foil perimeter. The border connects the foil to the frame in both formats.

**1.8.5 Enclosed Print Head** A stencil printer head that holds, in a single replaceable component, the squeegee blades and a pressurized chamber filled with solder paste.

**1.8.6 Etch Factor** Etched Depth/Lateral; Etch in a chemical etching process.

**1.8.7 Relief Etch** Also known as Etch Relief and Under Etch. Adding an under etch of the foil to create a pocket for raised features, labels, or a multi-print function. In this document Relief Etch is defined as Relief Pocket.

**1.8.8 Fiducials** Reference marks on the stencil foil (and other board layers) for aligning the board and the stencil

**1.8.9 Fine-Pitch Ball Grid Array (BGA)** Ball grid array (BGA) with less than 1 mm [39 mil] pitch. This is also known as chip scale package (CSP) when the package size is no more than 1.2 times the area of the original die size.

**1.8.10 Fine-Pitch Technology (FPT)** A surface-mount assembly technology with component terminations on centers less than or equal to 0.625 mm [24.6 mil].

**1.8.11 Foil** The sheet used to create the stencil, typically stainless steel or nickel, containing aperture openings corresponding to a specific land pattern design.

**1.8.12 Frame** A traditional mesh mount stencil frame may be made of tubular or cast aluminum to which a tensioned mesh (border) is permanently bonded using an adhesive. The foil is also permanently attached to the inside perimeter of this mesh. Mesh exempt foils can be mounted into a re-usable tensioning master frame and do not require a mesh border and negate a permanent bonding of the foil to the frame.

**1.8.13 Intrusive Soldering** A process in which the solder paste for the through-hole components is applied using the stencil. The through-hole components are inserted and reflow-soldered together with the surface-mount components. Also known as Paste-In-Hole, Pin-In-Hole, or Pin-In-Paste Soldering.

**1.8.14 \*Land** A portion of a conductive pattern on the surface of a circuit board usually used for the connection and/or attachment of components and onto which the stencil aperture openings are aligned to print electronic assembly material.

**1.8.15 Modification** The process of changing an aperture in size or shape.

**1.8.16 \*Overprinting** The use of stencils with apertures larger than the lands or annular rings on the board.

**1.8.17 \*Pad** See “Land”.