

GUIDANCE DOCUMENT

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DOCUMENT GUIDE

LEITFADEN

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English version

**Guidance document:
Visual inspection of soldered
surface mounted assemblies**

(N'existe pas en français)

Leitfaden:
Sichtprüfung von aufgelöteten
oberflächenmontierbaren
Bauelementen



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CENELEC

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Foreword

This guidance document was prepared by Working Group CLC/TC CECC/WG Surface Mounting Devices (SMT).

The text of the draft based on document CECC(Secretariat)3518 was submitted to the formal vote; together with the voting report, circulated as document CECC(Secretariat)3651, it was approved as CECC 00 803 on 1995-06-17.

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1. Introduction

This specification applies to electronic assemblies containing surface mounted components and produced by using soldering techniques. It is targeted for human visual inspection. Although the wetting and contour requirements for solder joints are equally applicable to automatic visual inspection, some differences in approach will be necessary in a future version for such methods.

Surface mounted component terminations are designed for direct attachment to pre-determined conductive footprint geometries which form part of the interconnection pattern on a supporting insulating substrate.

The terminations may be either leads in disciplined format or leadless metallized areas on the surface of the component body. The leads provide a degree of mechanical flexibility between the component body and the substrate. In the case of leadless components, the metallized areas are joined directly to the footprint pads on the substrate and a comparatively rigid attachment structure results.

Adhesives may be used to secure component bodies to the substrate prior to soldering.

Even though many investigations have been dedicated to the interrelation of visual appearance of the joint and joint reliability, the results of such investigations do not allow a quick and simple assessment of the joint. Therefore the data given in this guideline reflects consensus practice rather than proven fitness for use.

Post-mounting visual inspection of surface mounted components, joints and substrates should therefore be regarded primarily as a means of subjective decision on the likelihood of their suitability from mechanical, electrical and cleanliness standpoints.

Secondly, the inspection is an important means of feedback in respect of substrate design, solder paste and adhesive quantity, placement accuracies, component termination and substrate footprint solderabilities, resistance to solder heat, cleaning - and all related process controls. This fact underlines the need for thorough training of the operators and inspectors involved.

New surface mount component types are continually emerging and the list of inspection points in this document should not be regarded as exhaustive. The limits given are considered applicable to board assemblies operating in a wide spectrum of industrial, automotive, computer, telecommunications and consumer products. Special considerations (not given in this document) apply to surface mount assemblies in high stress environments e.g. extended temperature range requirements, high power dissipation, shock, vibration.

In specifying the criteria for acceptance, a careful balance is required between the respective needs of process control, cosmetic factors and fitness for purpose. Unnecessarily restrictive dimensional tolerances can lead to excessive rework which, even if closely controlled, may deteriorate the long term reliability of solder joints.

Where approved quantitative methods are applied in determining joint strength, results from these should take precedence over cosmetic alignment, wetted area and joint contour aspects - though due allowance would be made for known reductions in strength with time and the effects of long term cyclic stresses.

The need for printed board designers and engineers to take note of this document before proceeding to surface mount printed board layout is strongly emphasized. If pad sizes or deposited solder paste quantities emerging from the design team (e.g. via CAD systems) are not correct, these specifications may not be met.

To avoid repetition, the guidelines in Section 6 are divided into general requirements and those specific to each termination type. Both are needed when compiling the complete visual inspection requirement for any given component.

It is not practicable to specify every possible combination of shapes in three dimensions. Use of experienced judgement in visual inspection is inescapable in many cases, for example, in assessing nominal minimum and 'average' solder fillet heights on leads and small components.

The visual assessment criteria identified in this specification can be used in a manufacturing environment employing statistical process control techniques. This can be achieved by viewing the requirements specified as product quality attributes and conducting the appropriate analysis. The application of the criteria is recommended to assist in process control in an environment where structured continuous improvement is sought for manufactured products.

2. Scope

This guidance document applies to visual inspection criteria for electronic assemblies containing surface mounted components.

The solder joint inspection requirements of this specification are applicable for component lead pitches down to 0.635 mm and for leadless components down to plan size 0603 (1.5 x 0.75 mm) or to 1.0 mm diameter. An extended version of this specification will apply both to smaller components and to thermode (hot bar) and laser soldering - the latter methods not being covered by the present text and drawings.

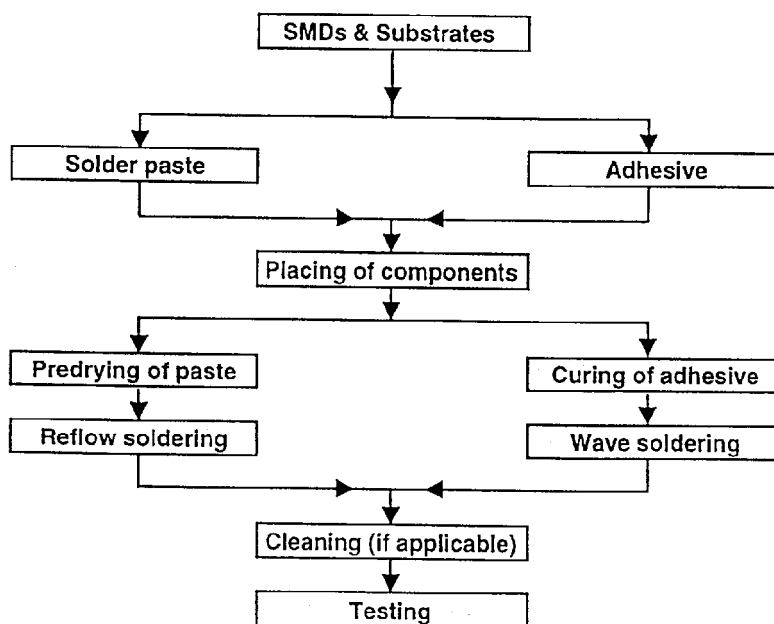
The following areas, based upon tin lead alloy soldering are covered:

- 1) unpopulated printed boards;
- 2) solder paste and adhesive deposition;
- 3) shape of the soldered joint;
- 4) position of the component and soldered joint;
- 5) conditions of the components;
- 6) degree of wetting between component termination and the substrate.

The inspection shall lead to decisions as to whether:

- the soldered joints are acceptable;
 - the soldered joint(s) should be rejected and eventually repaired
- and/or
- the assembly process should be improved
 - the component is in an acceptable condition.

Typical steps in manufacturing



3. Related Documents

CECC 00 802 : Issue 2 - Guidance Document : *CECC Standard Method for the specification of Surface Mounting Components (SMDs) of Assessed Quality*

prEN 160 100 : Issue 1 - Sectional Specification: *Capability approval of manufacturers of printed board assemblies of assessed quality* (currently CECC(Sec)3316)

4. Terminology

4.1 Definitions

4.1.1 Bridging

The unwanted connection by solder of adjacent conducting surfaces.

4.1.2 Conductive adhesive

An adhesive used for both electrical connection and mechanical attachment of component terminations to conductor footprints on a printed board.

4.1.3 Dewetting

The withdrawal of molten solder from a metal surface which was initially wetted by the solder. It is characterized by dispersed and often irregularly shaped solder droplets, between which a thin coating of solder may be left.

4.1.4 Disturbed joint

A joint which has been mechanically disturbed at the moment of solidification.

4.1.5 Footprint

A pattern of conductor areas on a printed board, designed for connection to a specific surface mounted component termination format.

4.1.6 Dissolution of metallization (Leaching)

The dissolution of a metallized surface layer into molten solder to the point where patchy local withdrawal of the original metallization occurs.

4.1.7 Non-conductive adhesive

An adhesive used for mechanical attachment of surface mounted components to a printed board to keep them in place during a soldering operation.

4.1.8 Pinhole

Pinhole is an imperfection in the form of a small hole that penetrates entirely through a layer of material.

4.1.9 Pit

A small, shallow depression in the surface of the solder joint.

4.1.10 Sign of solder wetting

A condition at the interface between the periphery of a mass of solder and a metallic surface, which indicates that wetting at molecular level has occurred. Normally this is signified by a wetting angle within the solder of less than 90 degrees.

4.1.11 Solder ball

A small particle of solder, usually nearly spherical, which results from paste deposition and the soldering operation.

4.1.12 Solder icicle

An elongated protrusion from a solder pad surface, usually rounded at its tip and which may result from incorrect printed board layout design, wave soldering conditions or contaminated solder alloy.

4.1.13 Solder spike

A sharp, pointed protrusion of solder from a soldered surface which can result from wave soldering with incorrect solder bath conditions or from poor quality hand soldering e.g. during rework.

4.1.14 Substrate

In the context of this specification, the word substrate means printed board.

4.1.15 Void and Blowhole

A cavity, either inside the solder (a void) or on its surface (a blowhole), which results from the emission of trapped gases within molten solder, or from other causes.

4.1.16 Web

A solder oxide residue adherent to a printed board in the form of one or more thin threads after wave soldering. It may contain small solder particles.

4.1.17 Wicking

The movement of solder along the wettable surface of a conducting material due to the combination of thermal and surface tension effects. This can result in insufficient solder at the required joint.

4.2 Abbreviations, letter symbols and signs

4.2.1 Abbreviations

SMD	Surface mounted device
SMT	Surface mounting technology
SOT	Small outline transistor
SOD	Small outline diode
MELF	Metal electrode faced component
LED	Light emitting diode
PLCC	Plastic, leaded chip carrier
LCCC	Leadless ceramic chip carrier
TCE	Thermal coefficient of expansion
DIL	Dual in line
QFP	Quad Flat Pack.