

Workmanship requirements for soldered electronic assemblies —

Part 2: Surface-mount assemblies

The European Standard EN 61192-2:2003 has the status of a British Standard

ICS 31.190

National foreword

This British Standard is the official English language version of EN 61192-2:2003. It is identical with IEC 61192-2:2003.

The UK participation in its preparation was entrusted to Technical Committee EPL/501, Electronic assembly technology, which has the responsibility to:

- aid enquirers to understand the text;
- present to the responsible international/European committee any enquiries on the interpretation, or proposals for change, and keep the UK interests informed;
- monitor related international and European developments and promulgate them in the UK.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Summary of pages

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Workmanship requirements for soldered electronic assemblies
Part 2: Surface-mount assemblies
(IEC 61192-2:2003)

Exigences relatives à la qualité
d'exécution des assemblages
électroniques brasés
Partie 2: Assemblage par montage
en surface
(CEI 61192-2:2003)

Anforderungen an die Ausführungsqualität
von Lötbaugruppen
Teil 2: Baugruppen
in Oberflächenmontage
(IEC 61192-2:2003)

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CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of document 91/357/FDIS, future edition 1 of IEC 61192-2, prepared by IEC TC 91, Electronics assembly technology, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61192-2 on 2003-04-01.

The following dates were fixed:

- latest date by which the EN has to be implemented
at national level by publication of an identical
national standard or by endorsement (dop) 2004-01-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2006-04-01

This standard should be used in conjunction with the following parts of EN 61192, under the general title *Workmanship requirements for soldered electronic assemblies*:

Part 1: General

Part 2: Surface-mount assemblies

Part 4: Terminal assemblies

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A and ZA are normative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61192-2:2003 was approved by CENELEC as a European Standard without any modification.

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INTRODUCTION

This part of IEC 61192, combined with IEC 61192-1, is used to meet the end-product requirements defined in IEC 61191-1 and IEC 61191-2.

This standard may be used to enable the suppliers and users of surface-mount electronic assemblies to specify good manufacturing practices as part of a contract.

The respective requirements for through-hole assemblies, terminal attachment and the mounting of bare semiconductor die and carrier-mounted die, are included in separate but related standards.

WORKMANSHIP REQUIREMENTS FOR SOLDERED ELECTRONIC ASSEMBLIES –

Part 2: Surface-mount assemblies

1 Scope

This part of IEC 61192 specifies requirements for workmanship in soldered surface-mounted electronic assemblies and multichip modules on organic substrates, on printed boards, and on similar laminates attached to the surface(s) of inorganic substrates.

It applies to assemblies that are totally surface-mounted and to the surface-mount portions of assemblies that include other related assembly technologies, for example, through-hole mounting. It does not include metal or ceramic-based hybrid circuits in which the conductor metallization is deposited directly on a ceramic substrate or onto a ceramic-coated metal substrate.

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

IEC 61191-1, *Printed board assemblies – Part 1: Generic specification – Requirements for soldered electrical and electronic assemblies using surface mount and related assembly technologies*

IEC 61191-2, *Printed board assemblies – Part 2: Sectional specification – Requirements for surface mount soldered assemblies*

IEC 61191-3, *Printed board assemblies – Part 3: Sectional specification – Requirements for through-hole mount soldered assemblies*

IEC 61191-4, *Printed board assemblies – Part 4: Sectional specification – Requirements for terminal soldered assemblies*

IEC 61192-1, *Workmanship requirements for soldered electronic assemblies – Part 1: General*

IEC 61192-3, *Workmanship requirements for soldered electronic assemblies – Part 3: Through-hole mount assemblies*

IEC 61192-4, *Workmanship requirements for soldered electronic assemblies – Part 4: Terminal assemblies*

IEC 61193-1, *Quality assessment systems – Part 1: Registration and analysis of defects on printed board assemblies*

ISO 9001, *Quality management systems – Requirements*

ISO 9002, *Quality systems – Model for quality assurance in production, installation and servicing*

3 Terms and definitions

For the purposes of this part of IEC 61192, the definitions of IEC 60194 apply.

4 General requirements

The requirements of IEC 61192-1 are mandatory for this standard.

4.1 Classification

The classification of assemblies is divided into three levels, that is levels A, B, and C. Definitions of the classification categories and the status of product for each level are given in IEC 61192-1. In general, status is divided into three workmanship conditions as follows:

- a) target;
- b) acceptable;
- c) nonconforming.

4.2 Conflict

Unless the user specifies compliance with all of the requirements (or with specific items) in this standard, for example, as part of a supply contract, the mandatory clauses and subclauses herein may be interpreted as guidance.

When the user elects to specify compliance with all or some of the mandatory requirements of this standard:

- a) In the event of conflict between the requirements of this standard and the applicable documents cited herein, refer to IEC 61191-1 for the relevant priorities and to IEC 61191-2 and IEC 61192-1 for technical requirements. However, nothing in this standard supersedes applicable laws and regulations.
- b) In the event of conflict between the requirements of this standard and the applicable user assembly drawing(s) and specifications, the latter shall govern.

When the conflict is between the requirements of this document and drawing(s) or specification(s) that have not been approved by the user, the latter shall be submitted to the user for approval. Upon such approval, the acceptance (or changes) shall be documented, for example, by official revision note or equivalent on the drawing(s) or specification(s) which shall then govern.

- c) Where the applicable user documentation requirements are less stringent than the applicable mandatory items in IEC 61191-1, IEC 61191-2, or in this standard, neither the supplier nor the user shall claim compliance with this or any of the standards listed in this clause, without identifying the specific clauses and related relaxations in each and every such claim.

4.3 Interpretation of requirements

Unless otherwise specified by the user, the word "shall", signifies that the requirement is mandatory. Deviation from any "shall" requirement requires written acceptance by the user, for example, via assembly drawing, specification or contract provision.

The words "should" and "may" reflect recommendations and guidance, respectively, and are used whenever it is intended to express non-mandatory provisions.

4.4 Antistatic precautions

All operators using workstations and assembly or cleaning equipment and carrying out inter-process handling shall strictly observe antistatic precautions at all times. Refer to 4.2.6 and 5.7 of IEC 61192-1.

5 Component preparation processes

Component preparation processes shall be carried out in accordance with the requirements of IEC 61192-1 using the methods described therein.

6 Solder paste deposition process qualification

Solder paste deposition processes are described in IEC 61192-1 and workmanship should enable the requirements stated therein to be met.

6.1 Solder paste characteristics

Solder paste is required to maintain a level of tackiness to ensure good physical contact with component leads or terminations and to prevent placed components from slipping or being accidentally dislodged from the paste mound(s) during board handling or mechanized transit into the soldering equipment. The length of time over which the paste retains adequate tackiness is specified by the supplier and all placement operations should be carried out well within this stated limit.

NOTE Where pastes designed to allow extended times between their deposition and component placement are used, for example, longer than 2 h, care should be taken to ensure that the required longer pre-heat time and temperature in reflow mass soldering are programmed. In some cases this may require physical extension of the pre-heat zones on standard reflow soldering machines.

6.2 Assessment of the process

The parameters requiring inspection are the amount, shape and position of the solder paste on the land patterns of the board or substrate. These are assessed using visual inspection, laser scan, or X-ray as appropriate.

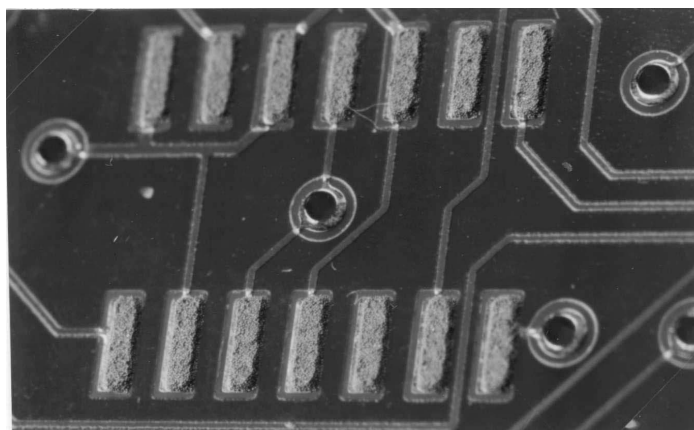
The deposited area and mean height are used to monitor the quantity of paste deposited and act as an indicator of its viscosity and the board surface condition. The wetted area is also used to monitor screen/stencil or syringe tip condition and the incidence of unwanted smudges. Positional measurement assesses the accuracy of deposition and monitors machine set-up and, if applicable, screen/stencil design.

The standard PPM baseline for solder paste deposition operations is the number of paste mound deposits attempted. Guideline assessment attributes and the method of calculating PPM are given in IEC 61193-1.

Target, accept and reject (nonconforming) criteria for solder paste deposition are given as process control limits in 6.3. These are the same for levels A, B and C.

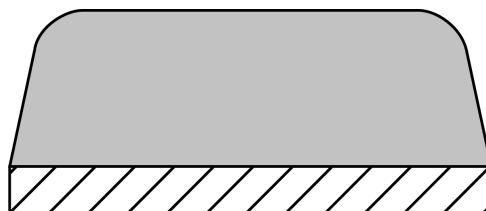
6.3 Solder paste deposition – Screen and stencil printing methods – Process control limits

In all cases, the accept and reject criteria shown in Figures 1 through 3 refer to the solder paste printing operation.



Target – Levels A, B, C

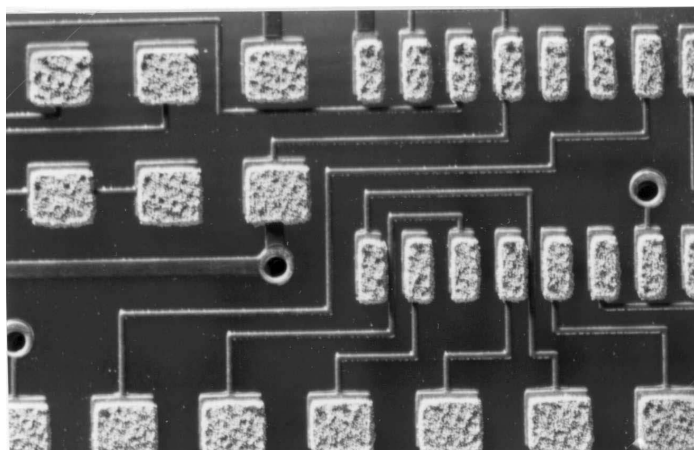
- 1 Paste contour sits central within land area.
- 2 Paste cross-section is mesa-shaped.
- 3 Designed quantity is achieved.



Cross-section

IEC 574/03

Figure 1 – Solder paste contour and cross-section – Target



Acceptable – Levels A, B, C

- 1 Paste contour slumped.
- 2 Overhang *A* is less than 25 % of the related *X* or *Y* dimension, or 0,2 mm, whichever is smaller.
- 3 Paste volume ± 20 % of designed quantity.

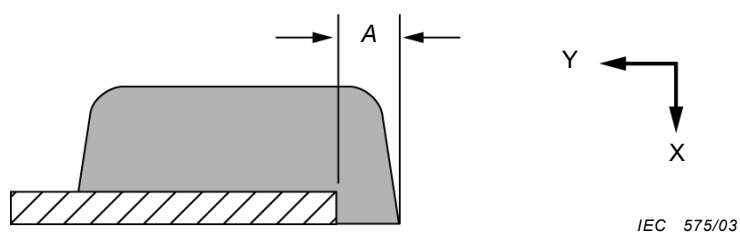
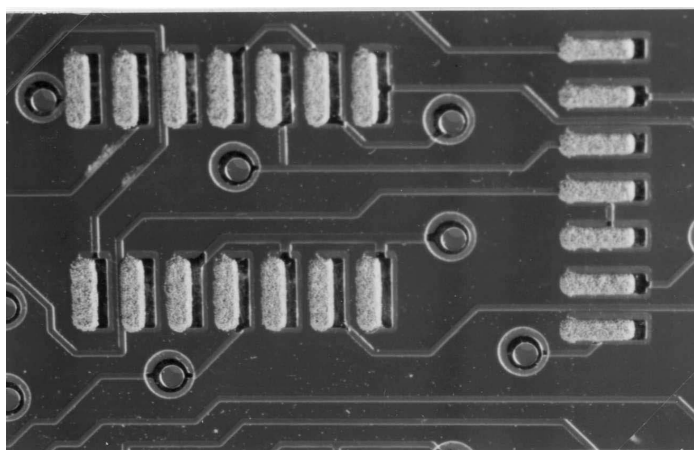


Figure 2 – Solder paste contour and cross-section – Acceptable



Nonconforming – Levels A, B, C

- 1 Paste quantity and/or overhang *A* exceeds acceptable limits.
- 2 Paste overhang *A* is more than 25 % of related *x* or *y* dimension or 0,2 mm whichever is smaller.
- 3 Paste quantity is more than 120 % or less than 80 % of designed quantity.

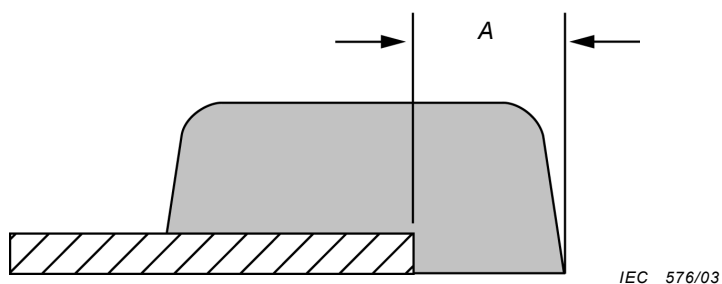


Figure 3 – Solder paste contour and cross-section – Nonconforming

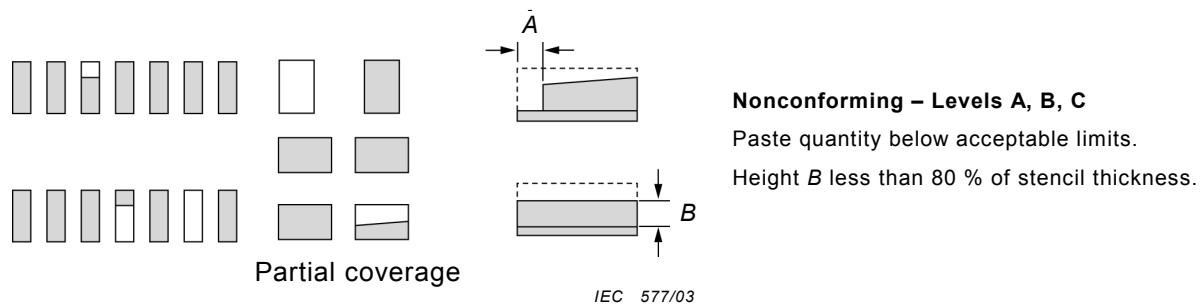


Figure 4 – Insufficient paste quantity – Nonconforming



Figure 5 – Smudged paste – Nonconforming

7 Non-conductive adhesive deposition process

Adhesive deposition workmanship is described in IEC 61192-1, Clause 9 and shall be carried out in accordance with the requirements stated therein.

7.1 Pot life

The time elapsed between the first exposure of the adhesive to the ambient factory atmosphere and the start of curing should be well within the suppliers' stated maximum.

7.2 Inter-stage storage and handling

Boards that have received deposited adhesive and require brief inter-stage storage should be handled with care to avoid component movement. Some adhesive materials cause dermatitis. Boards stored temporarily should be kept separate and in clean, dry conditions, or as specified by the adhesive manufacturer.

7.3 Adhesive tackiness

Adhesive is required to maintain a level of tackiness to assure good contact with placed components prior to curing. The length of time over which the adhesive retains adequate tackiness (the 'pot life') is specified by the supplier and all placement operations should be carried out well within this stated limit. Handling should avoid the risk of component movement.

7.4 Assessment of the adhesive attachment process

Assessment of the adhesive deposition process in production can be by manual or automatic visual inspection for positional and deposited area aspects; optical non-contact methods or laser scan for adhesive dot height.

The deposited area and mean height are used to monitor the quantity of adhesive deposited and act as an indicator of its viscosity and the board surface condition. The wetted area is also used to monitor screen/stencil or syringe tip condition and the incidence of unwanted smudges. Positional measurement assesses the accuracy of deposition and monitors machine set-up and, if applicable, screen/stencil design.

Adhesive dot height, shape and volume are key parameters because if the underside of the component does not make contact with the dot, adhesion will not occur. A suitable way of assessing the correctness of adhesive quantity is to pull off a component after curing. Refer to item d) of Clause 11.

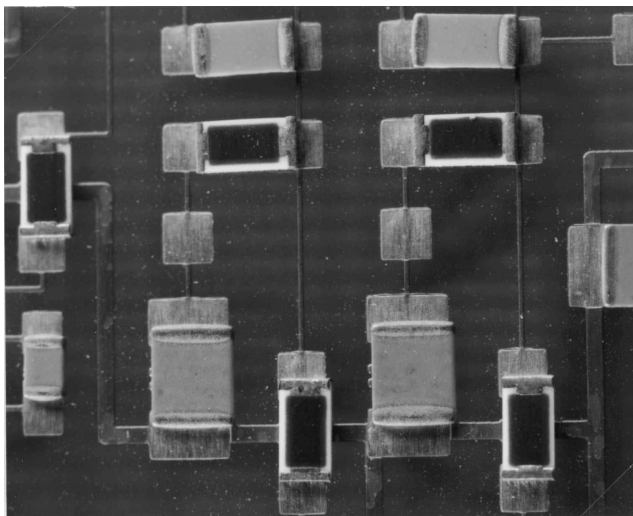
When adhesive deposition equipment uses an optical view of the deposited area of the adhesive dot to monitor its height, the deposition head and any associated time-pressure pulse system should be kept at a constant temperature. The wetted area on the component may be determined by examining the underside after placement and curing using a cross-section method.

The standard PPM baseline for adhesive deposition operations is the number of adhesive dot deposits attempted. Guideline assessment attributes and the method of calculation are given in IEC 61193-1.

Target, accept and reject (nonconforming) criteria for small components are given as process control limits in 7.5. These are the same for all levels.

7.5 Adhesive deposition – Syringe dispensing method – Small components – Process control limits

In all cases, accept and reject refer to the dispensing operation.



Target – Levels A, B, C

- 1 Adhesive contour central within designed area.
- 2 Adhesive quantity correct.
- 3 Cross-section not slumped or tailed.

NOTE When UV curing, design may require adhesive to appear outside component contour.

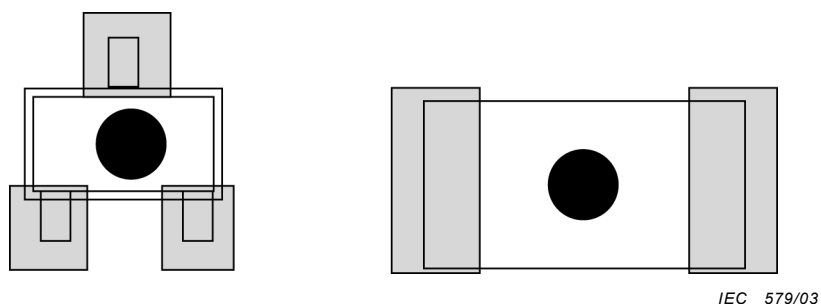
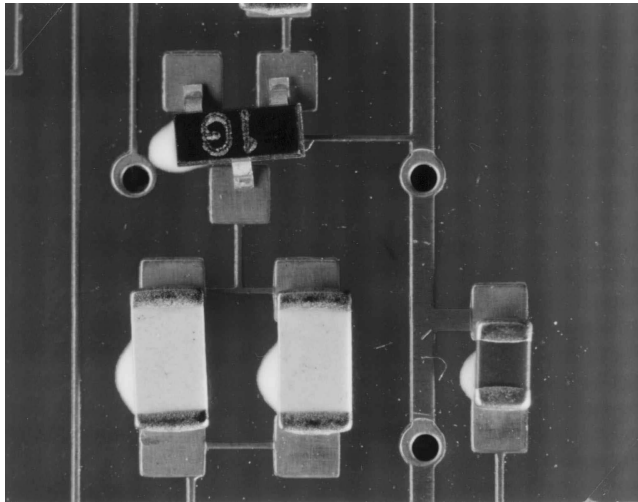
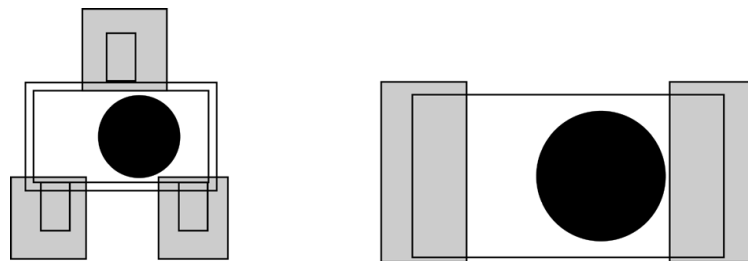


Figure 6 – Adhesive contour and quantity – Target



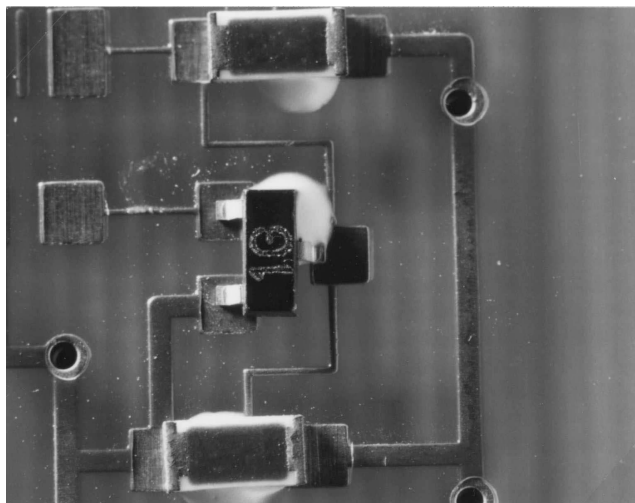
Acceptable – Levels A, B, C

- 1 Adhesive placement eccentric.
- 2 Dot touches but does not overlap land or component metallization.



IEC 580/03

Figure 7 – Adhesive placement – Acceptable



Nonconforming – Levels A, B, C

- 1 Adhesive dot overlaps land.
- 2 Adhesive overlaps component metallization.
- 3 Adhesive reduces solder joint wetting ability below specified limits.

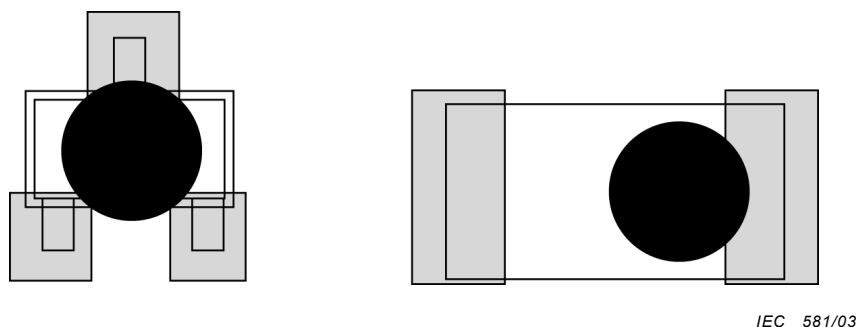


Figure 8 – Adhesive placement – Nonconforming

8 Temporary masking processes

Printed board temporary masking processes shall be carried out in accordance with the requirements of IEC 61192-1.

9 Component placement processes

Surface-mount component placement processes are described in IEC 61192-1 and shall be carried out in accordance with the requirements stated therein.

9.1 Assessment of the process

The following visual attributes apply to the component placement process, using manual or automatic inspection:

- a) the presence or absence of components;
- b) the location correctness of component types and correctness of their relevant parametric value(s);
- c) the relative x, y and rotational alignment of component terminations and leads with matching conductor footprint pads;

- d) the orientation of components for example, pin 1 on ICs, polarity of electrolytic capacitors and diodes;
- e) the z axis condition of components for example, cant (non-parallelism), component on edge;
- f) physical damage to components, for example, cracked or chipped component bodies, distorted leads;
- g) unwanted movement or excessive deformation of deposited solder paste or adhesive;
- h) location of adhesive after placement, for example, squeeze-out, spread.

NOTE 1 In no case should the deviation in placement accuracy exceed the product requirement. Refer to IEC 61191-2. Reliance on surface tension effects to correct placement errors should not be assumed.

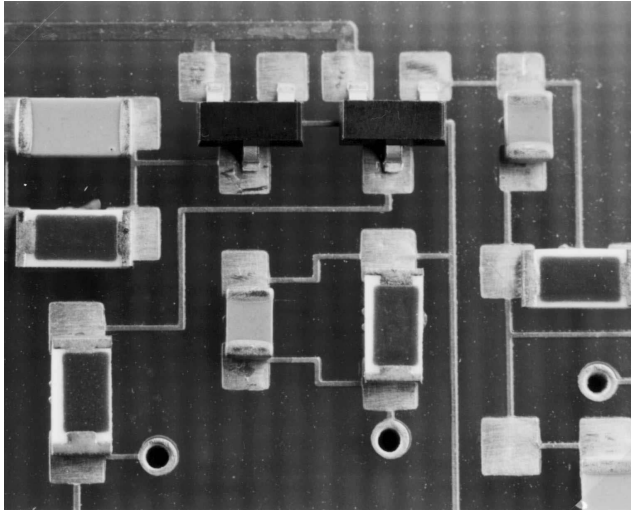
NOTE 2 Correction of placement 'process indicator' errors within the prescribed post-soldering alignment accuracy tolerance limits is optional but not recommended.

The standard PPM baseline for surface-mounted component placement operations is the number of placements attempted. Guideline assessment attributes and details of the method of calculation are given in IEC 61193-1.

Target, accept and reject (nonconforming) criteria for placement of surface-mounted components are given as process control limits in 9.2 through 9.13. In each case, the limits are given separately for levels A, B and C.

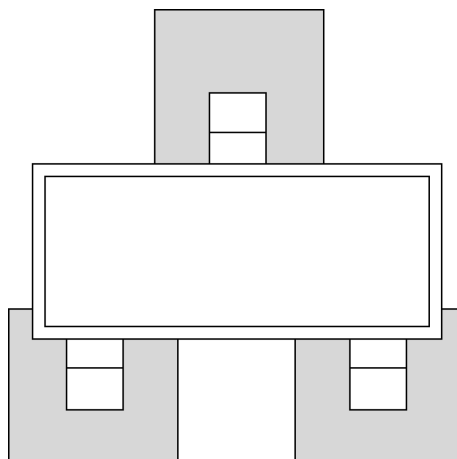
9.2 Discrete components with gull-wing leads

Discrete components with gull-wing leads are usually transistor or IC components, for example, SOT 23. Components may be shifted in X or Y or rotation direction. The accept and reject criteria relate to placement accuracy.



Target – Levels A, B, C

- 1 All lead feet, including heel regions and toes, sit centrally on lands.
- 2 Component body not rotated.



IEC 582/03

Figure 9 – Discrete component placement – Target