

Printed wiring boards —

Part 25: Guide to the rework and repair of soldered surface mounted printed board assemblies

ICS 31.180

Committees responsible for this British Standard

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- Association of Contract Electronics Manufacturers
- Federation of the Electronics Industry
- GAMBICA
- Ministry of Defence
- National Supervising Inspectorate
- Printed Circuit Interconnection Federation
- Surface Mounting and Related Technologies (Smart Group) Ltd

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Foreword

This British Standard has been prepared by Technical Committee EPL/501.

The target for all surface mount assembly operations should always be to avoid the need for rework, both in pre-assembly processes and after assembly prior to shipment. However, the comparatively high cost and/or high pincount of some printed board assemblies may make certain types of rework inevitable.

The objectives of this standard are:

- a) to support the use of rework and repair techniques that can maintain the quality and reliability of surface mounted assemblies;
- b) to promote the use of processes and methods that minimize any adverse effects on the environment and to maintain the safety and well-being of those who apply them. Attention is drawn to the health and safety regulations;
- c) to support the achievement of the process assessment schedule requirements in accordance with BS CECC 200025.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 23 and a back cover.

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1 Scope

This part of BS 6221 gives guidance on the procedures to be adopted in the rework of soldered surface mounted printed board assemblies. It is applicable to activities specific to the processes used to manufacture soldered surface mounted assemblies on printed boards and to the relevant parts of resulting products. The standard is also applicable to activities that can form part of the work in assembling mixed technology products.

The guidance given in the standard on rework activities is also applicable to repair.

This part of BS 6221 also contains guidance on design matters where they have relevance to rework.

NOTE Typical in-process surface mount rework activities to which this standard applies are shown in Figure 1.

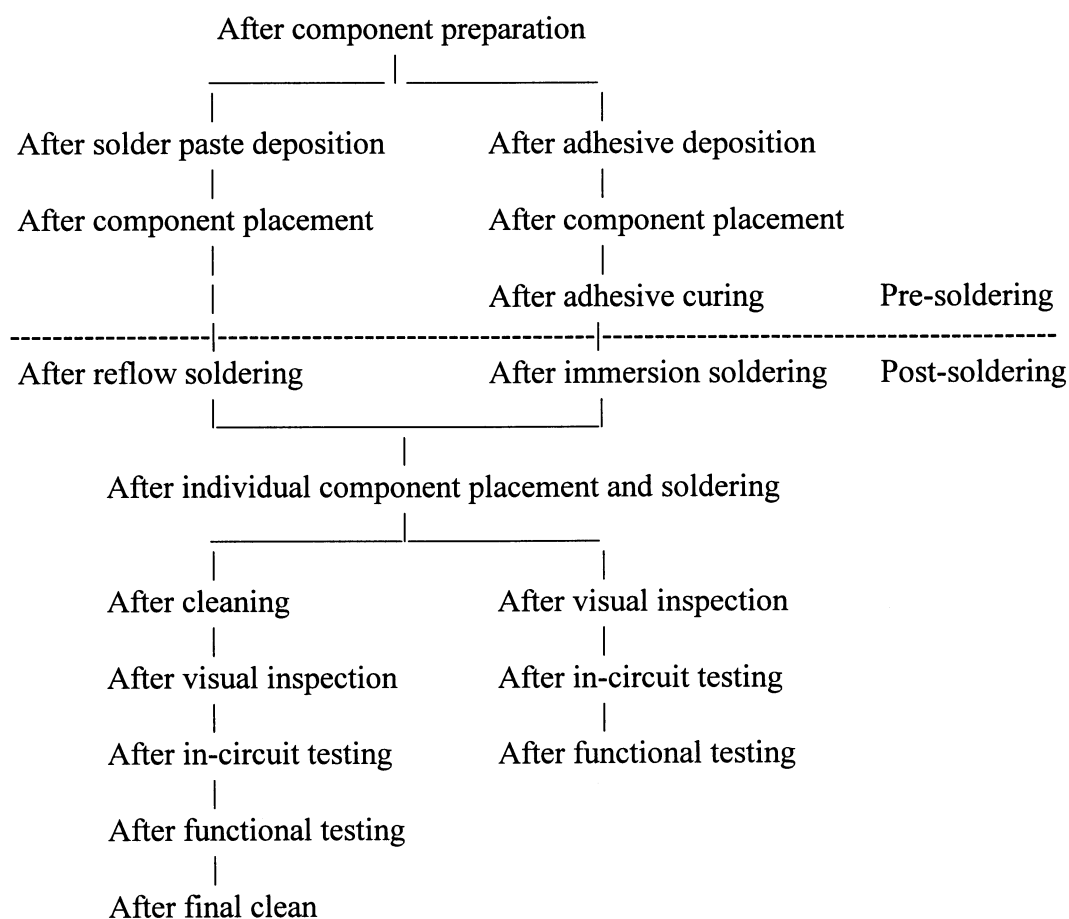


Figure 1 — Typical in-process surface mount rework activities

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS CECC 200025, *Harmonized system of quality assessment for electronic components — Process assessment schedule for printed board assembly facilities.*

BS QC 200012, *Process assessment schedule for printed board design facilities.*

BS EN 61191-2, *Printed board assemblies — Part 2: Sectional specification — Requirements for surface mount solder assembly*.

BS EN 100015, *Harmonized system of quality assessment for electronic components — Basic specification: Protection of electrostatic sensitive devices*.

BS EN 60249 (all parts), *Base materials for printed circuits*.

3 Terminology

3.1 Definitions

For the purposes of this part of BS 6221 the following terms and definitions apply.

3.1.1

rework

rectification of manufacturing errors on a printed board assembly prior to its release

NOTE The interpretation of this definition in commercial context is explained in BS CECC 200025.

3.1.2

repair

making good of a printed board assembly that has been damaged or become non-conforming after release

NOTE The interpretation of this definition in commercial context is explained in BS CECC 200025.

3.1.3

measle chart

copy of an assembly drawing (or of an actual printed board assembly) that is used to record the location of faults

NOTE Normally measle charts are used in the early stages of manufacture of a new circuit to reveal repetitive faults.

3.1.4

added component

electronic component that is mounted on a printed board by soldering or other attachment methods

NOTE Components that are integral with the printed board, e.g. printed resistors, are not added components.

3.2 Abbreviations

The following abbreviations are commonly used in relation to printed board assemblies. Not all of them are used in the text. Some are included for information only.

ASIC	application-specific integrated circuit
BGA	ball grid array
CDIL	ceramic dual-in-line package (metal seal)
CLCC	ceramic leaded chip carrier
CLLCC	ceramic leadless chip carrier
CQFP	ceramic quad flat package
CSO	ceramic small outline package
DBS	dual-in-line bent SIL package
DIP	dual-in-line package
DIY	do it yourself
LCCC	leadless ceramic chip carrier
LED	light-emitting diode
LQFP	plastic low profile quad flat package
MBGA	micro BGA
MELF	metal electrode face-bonded component

PLCC	plastic leaded chip carrier
PLLMC	plastic leadless module carrier
PMFP	plastic micro flat package
PTFE	polytetrafluoroethylene
QFP	plastic quad flat package
RBS	plastic rectangular bent SIL package
RMA	rosin, mildly active
SDIP	plastic shrink DIL package
SIL	single-in-line package
SMC	surface mounted component
SMD	surface mounted device
SMT	surface mount technology
SO	small outline
SOD	small outline diode
SOIC	small outline integrated circuit
SOP	plastic small outline package
SOT	small outline transistor
SQFP	plastic shrink quad flat package
SSOP	plastic shrink small outline package
TQFP	plastic thin quad flat package
TSOP	plastic thin small outline package
TSSOP	plastic thin shrink small outline package
UQFP	plastic ultra thin quad flat package
VSO	plastic very small outline package

4 Classification of rework activities

4.1 Pre-soldering rework

This includes rework following:

- a) deposition of solder (e.g. paste, preform, tinning);
- b) deposition of adhesive;
- c) component placement;
- d) curing of adhesive.

NOTE In the context of this standard, the word “component” includes all added components, printed boards and any components that are manufactured integrally with the printed board.

4.2 Post-soldering rework

Post-soldering rework activities, not necessarily occurring in the order given, include:

- a) preparation prior to rework or repair e.g. removal of conformal coating, preheating, baking, cleaning, removal of adjacent components and parts to enable access;
- b) component realignment;
- c) component removal;
- d) addition of flux and solder to a joint;
- e) removal of excess solder from a joint;
- f) removal of excess solder or adhesive from the printed board prior to remounting a component;

- g) placement and soldering of a replacement component;
- h) post-rework cleaning (if required);
- i) visual, thermal, mechanical and dimensional inspection and electrical test of reworked items.

4.3 Essential prerequisites for successful and reliable rework

The essential prerequisites for successful and reliable rework include the following:

- a) suitable printed board layout design to allow the preferred tool to be used for each component type;
- b) availability of the most efficient tool or equipment for the task;
- c) sufficient knowledge at operator or inspector level to enable correct judgement on whether rework is necessary or will do more harm than good;
- d) avoidance of rework processes that may create reliability hazards not detectable prior to shipment, e.g. excessive thermal shock, intermetallic growth at the copper-to-solder interface;
- e) adequate operator skill, particularly in manual rework or repair operations;
- f) ergonomically designed rework /repair stations;
- g) effective training;
- h) cost-effective operations;
- i) control of safety and environmental aspects.

The wide range of surface mounted component terminations and lead configurations in use and their differing resistance to thermal stress, means that no single rework equipment is likely to be suitable for all purposes.

5 Pre-soldering rework

5.1 General

In all cases, appropriate corrective action should ensure that the causes of non-conformity are rectified. Further guidance is given in IEC 61192-2¹⁾.

5.2 Reworking solder paste and non-conducting adhesive deposits

5.2.1 General

This should be carried out in accordance with 5.2.2 to 5.2.4. Further guidance is given in IEC 61192-2.

5.2.2 General misalignment or smudging of deposits

All the paste or adhesive should be thoroughly cleaned off the printed board. The printed board may be reused if it is cleaned properly, but paste and adhesive removed from boards should be scrapped.

5.2.3 Local misalignment or smudging of deposit

If the defect is confined to one or a few sites and the required quantity of deposit and its location can be sufficiently controlled using manual methods, the local or smudged material can be removed and replaced using a syringe or other means of dispensing a single charge. If this is not the case, the recommendations given in 5.2.2 should be followed.

5.2.4 General paste or adhesive quantity incorrect

Reworking should be carried out in accordance with 5.2.2.

5.2.5 Local paste or adhesive quantity incorrect

Reworking should be carried out in accordance with 5.2.3.

5.3 Reworking placed components

5.3.1 General component misalignment

All the added components should be removed from the printed board and all items thoroughly cleaned. The printed board may be reused if its cleanliness requirements are met, but all paste and adhesive removed

¹⁾ IEC 61192-2 is currently in preparation.

from boards should be scrapped. If added components are to be reused (not recommended), e.g. as spares for rework activity, they should be checked for mechanical damage (100 %) and retested electrically (100 %) before being returned to stores for reissue.

5.3.2 *Local component misalignment*

Immediately after placement is the best time to correct serious misalignment. In the case of solder paste, often there will be a corrective action due to surface tension forces when the solder becomes molten. This action is more effective with small components and ball grid arrays, but it should not be relied upon as local differences in solderability and temperature across the component terminations can bring counter-forces.

Where one or a few components are misaligned, they may be gently moved using tweezers with conductive plastic tips. If gloves are worn, they too should be conductive. To avoid spreading the paste or adhesive, a slight lifting movement should be applied before any horizontal realignment action, but care is needed to avoid the component losing contact with the paste or adhesive.

NOTE If realignment is undertaken, a higher incidence of shorting/bridging is likely.

5.4 **Realigning components after curing thermoplastic adhesive**

It is better to correct misalignment after curing the adhesive rather than to wait until after soldering. If it is clear that the component is outside the prescribed post-soldering positional limits, the component should be removed and replaced, if necessary using additional adhesive. Further guidance can be obtained from BS EN 61191-2, Section 5.

If only a small corrective movement is needed, e.g. 0.2 mm or 10° rotation, the thermoplastic adhesive can be melted and the component gently moved using tweezers with conductive plastic tips. If gloves are worn, they too should be conductive. Care is needed to avoid breaking contact between the component body and the adhesive layer. Before attempting the task, the maximum allowable remelt temperature should be checked with the adhesive manufacturer and it should also be checked that the material will provide adequate bond strength after remelt to avoid the risk of the component falling into the solder bath.

In this case, the component is not being taken off the printed board and replaced, hence the method of applying heat should be appropriate to the component type, e.g., a soldering iron should not be used on a multilayer ceramic capacitor. See also 6.3 and Table 1.

5.5 **Realigning components after curing thermosetting adhesive**

When a thermosetting adhesive is used, it is normal to leave the correction until after soldering because there is no need to replace it. When the adhesive is also used to provide additional strength during operational thermal cycling, it needs to be reapplied. In some cases it may be acceptable to use a thermoplastic adhesive for the rework. Although the strength of this type of resin may be lower, the advantage is that there is no need to apply a second high temperature curing operation.

If it is necessary to break the bond completely, for example by rotating the heated component with tweezers to fracture the adhesive bond before lifting it away from the printed board, the replacement component should not be applied until after immersion soldering when adhesive is no longer needed.

Where it is essential to realign a component after soldering, this requires simultaneously remelting the solder joints and weakening the adhesive so that appropriate corrective movement can be applied, by for example using tweezers.

6 **Factors affecting post-soldering rework**

6.1 **Component marking and unmarked components**

With lack of marking on many components and the tendency to omit “ident” or “legend” on surface mount printed boards, it is recommended that a full component layout diagram should be supplied to each rework operator and/or inspector, together with a detailed component list.

To minimize the risk of confusion, any surplus or loose components without marking on their bodies should be carefully identified as to value, type and batch number and stored in a protected environment such as a rigid plastic vial or drypack, near the workplace.

Where a printed legend on the printed board is completely omitted, a co-ordinate grid system may be needed to identify respective component positions.