

INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

Ensembles de cartes imprimées –
Partie 1: Spécification générique – Exigences relatives aux ensembles
électriques et électroniques brasés utilisant les techniques de montage en
surface et associées



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IEC 61191-1

Edition 3.0 2018-09

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INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 31.190; 31.240

ISBN 978-2-8322-5953-5

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CONTENTS

| | |
|---|----|
| FOREWORD..... | 6 |
| 1 Scope..... | 8 |
| 2 Normative references..... | 8 |
| 3 Terms and definitions | 9 |
| 4 General requirements | 10 |
| 4.1 Order of precedence | 10 |
| 4.1.1 General remark | 10 |
| 4.1.2 Conflict | 10 |
| 4.1.3 Conformance documentation | 10 |
| 4.2 Interpretation of requirements..... | 11 |
| 4.3 Classification | 11 |
| 4.4 Defects and process indicators | 11 |
| 4.5 Process control requirements | 12 |
| 4.6 Requirements flowdown | 12 |
| 4.7 Physical designs | 12 |
| 4.7.1 New designs | 12 |
| 4.7.2 Existing designs | 12 |
| 4.8 Visual aids | 12 |
| 4.9 Proficiency of personnel | 13 |
| 4.9.1 Design proficiency | 13 |
| 4.9.2 Manufacturing proficiency..... | 13 |
| 4.10 Electrostatic discharge (ESD) | 13 |
| 4.11 Facilities | 13 |
| 4.11.1 General | 13 |
| 4.11.2 Environmental controls..... | 13 |
| 4.11.3 Temperature and humidity..... | 13 |
| 4.11.4 Lighting | 14 |
| 4.11.5 Field conditions..... | 14 |
| 4.11.6 Clean rooms | 14 |
| 4.12 Assembly tools and equipment | 14 |
| 4.12.1 General | 14 |
| 4.12.2 Process control | 14 |
| 5 Requirements of materials | 14 |
| 5.1 Overview..... | 14 |
| 5.2 Solder..... | 14 |
| 5.3 Flux | 14 |
| 5.4 Solder paste | 15 |
| 5.5 Preform solder | 15 |
| 5.6 Adhesives | 15 |
| 5.7 Cleaning agents | 15 |
| 5.7.1 General | 15 |
| 5.7.2 Cleaning agents selection | 15 |
| 5.8 Polymeric coatings | 16 |
| 5.8.1 Solder resists and localized maskants | 16 |
| 5.8.2 Conformal coating and encapsulants | 16 |
| 5.8.3 Spacers (permanent and temporary)..... | 16 |

| | | |
|-------|---|----|
| 5.9 | Chemical strippers | 16 |
| 5.10 | Cleaning Agents..... | 16 |
| 5.11 | Heat shrinkable soldering devices | 16 |
| 6 | Components and printed board requirements | 16 |
| 6.1 | General..... | 16 |
| 6.2 | Solderability | 17 |
| 6.2.1 | Parts solderability | 17 |
| 6.2.2 | Reconditioning | 17 |
| 6.2.3 | Solderability testing of ceramic boards | 17 |
| 6.3 | Solderability maintenance | 17 |
| 6.3.1 | General | 17 |
| 6.3.2 | Preconditioning | 17 |
| 6.3.3 | Gold embrittlement of solder joints | 17 |
| 6.3.4 | Tinning of non-solderable parts | 18 |
| 6.4 | Solder purity maintenance | 18 |
| 6.5 | Lead preparation | 19 |
| 6.5.1 | General | 19 |
| 6.5.2 | Lead forming..... | 19 |
| 6.5.3 | Lead-forming limits..... | 19 |
| 7 | Assembly process requirements..... | 20 |
| 7.1 | Overview..... | 20 |
| 7.2 | Cleanliness | 20 |
| 7.3 | Part markings and reference designations | 20 |
| 7.4 | Solder connection contours | 20 |
| 7.5 | Moisture traps | 20 |
| 7.6 | Thermal dissipation | 20 |
| 8 | Assembly soldering requirements..... | 20 |
| 8.1 | General..... | 20 |
| 8.1.1 | Soldering process | 20 |
| 8.1.2 | Machine maintenance | 21 |
| 8.1.3 | Handling of parts..... | 21 |
| 8.1.4 | Preheating | 21 |
| 8.1.5 | Carriers | 21 |
| 8.1.6 | Hold down of surface mount leads | 21 |
| 8.1.7 | Heat application | 21 |
| 8.1.8 | Cooling | 21 |
| 8.2 | Reflow soldering | 21 |
| 8.2.1 | Requirements | 21 |
| 8.2.2 | Process development for reflow soldering..... | 22 |
| 8.2.3 | Flux application..... | 22 |
| 8.2.4 | Solder application | 22 |
| 8.3 | Manual/hand soldering | 23 |
| 8.3.1 | Non-reflow manual soldering | 23 |
| 8.3.2 | Reflow manual soldering | 23 |
| 9 | Cleanliness and residue requirements..... | 24 |
| 9.1 | General..... | 24 |
| 9.2 | Qualified cleaning/manufacturing process | 24 |
| 9.2.1 | General | 24 |

| | | |
|--------|--|----|
| 9.2.2 | Cleaning designator | 25 |
| 9.2.3 | Upper specification limit | 25 |
| 9.3 | Visual requirements | 25 |
| 9.4 | Correlation of ionic testers..... | 26 |
| 9.5 | Non-ionic residues | 26 |
| 9.6 | SIR testing | 26 |
| 10 | Assembly requirements..... | 26 |
| 10.1 | General..... | 26 |
| 10.2 | Acceptance requirements | 26 |
| 10.2.1 | Process control | 26 |
| 10.2.2 | Corrective action limits..... | 27 |
| 10.2.3 | Control limit determination..... | 27 |
| 10.3 | General assembly requirements | 27 |
| 10.3.1 | Assembly integrity..... | 27 |
| 10.3.2 | Assembly damage..... | 27 |
| 10.3.3 | Markings..... | 28 |
| 10.3.4 | Flatness (bow and twist)..... | 28 |
| 10.3.5 | Solder connection | 28 |
| 10.3.6 | Interfacial connections | 30 |
| 11 | Coating and encapsulation..... | 30 |
| 11.1 | Conformal coating | 30 |
| 11.1.1 | Coating instructions | 30 |
| 11.1.2 | Application..... | 30 |
| 11.1.3 | Performance requirements | 31 |
| 11.1.4 | Rework of conformal coating | 32 |
| 11.1.5 | Conformal coating inspection | 32 |
| 11.2 | Encapsulation | 32 |
| 11.2.1 | Encapsulation instructions..... | 32 |
| 11.2.2 | Application..... | 32 |
| 11.2.3 | Performance requirements | 33 |
| 11.2.4 | Rework of encapsulant material..... | 33 |
| 11.2.5 | Encapsulant inspection | 33 |
| 12 | Rework and repair | 33 |
| 12.1 | Rework of unsatisfactorily soldered electrical and electronic assemblies | 33 |
| 12.2 | Repair..... | 34 |
| 12.3 | Post rework/repair cleaning | 34 |
| 13 | Product quality assurance | 35 |
| 13.1 | System requirements..... | 35 |
| 13.2 | Inspection methodology..... | 35 |
| 13.2.1 | Verification inspection | 35 |
| 13.2.2 | Visual inspection..... | 35 |
| 13.2.3 | Sampling inspection | 36 |
| 13.3 | Process control | 36 |
| 13.3.1 | System details | 36 |
| 13.3.2 | Defect reduction..... | 36 |
| 13.3.3 | Variance reduction | 37 |
| 14 | Other requirements..... | 37 |
| 14.1 | Health and safety | 37 |

| | | |
|--------------|---|----|
| 14.2 | Special manufacturing requirements | 37 |
| 14.2.1 | Manufacture of devices incorporating magnetic windings | 37 |
| 14.2.2 | High-frequency applications | 37 |
| 14.2.3 | High-voltage or high-power applications | 37 |
| 14.3 | Guidance on requirement flowdown | 37 |
| 15 | Ordering data | 37 |
| Annex A | (normative) Requirements for soldering tools and equipment | 39 |
| A.1 | Requirements for tools and equipment..... | 39 |
| A.2 | Abrasives..... | 39 |
| A.3 | Benchtop and hand-soldering systems..... | 39 |
| A.4 | Soldering iron holders | 40 |
| A.5 | Wiping pads | 40 |
| A.6 | Soldering guns..... | 40 |
| A.7 | Solder pots | 40 |
| A.8 | Process control | 40 |
| Annex B | (normative) Quality assessment | 41 |
| B.1 | Process control (PC) | 41 |
| B.2 | Reduction of quality conformance testing..... | 41 |
| B.3 | Audit plan | 42 |
| Bibliography | | 43 |
| Figure 1 | – Solder contact angle..... | 29 |
| Figure 2 | – Solder wetting of plated through-holes without leads | 30 |
| Figure 3 | – Coating conditions..... | 31 |
| Table 1 | – Solder contamination limits; maximum contaminant limit (percentage by weight) | 19 |
| Table 2 | – Designation of surfaces to be cleaned..... | 25 |
| Table 3 | – Residue testing for process control | 25 |
| Table 4 | – Maximum acceptable rosin flux residues | 26 |
| Table 5 | – Electrical and electronic assembly defects | 34 |
| Table 6 | – Magnification requirements | 35 |

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

PRINTED BOARD ASSEMBLIES –

Part 1: Generic specification – Requirements for soldered electrical and electronic assemblies using surface mount and related assembly technologies

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International Standard IEC 61191-1 has been prepared by IEC technical committee 91: Electronics assembly technology.

This third edition cancels and replaces the second edition published in 2013. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) the requirements have been updated to be compliant with the acceptance criteria in IPC-A-610F;
- b) the term "assembly drawing" has been changed to "assembly documentation" throughout;
- c) references to IEC standards have been corrected;
- d) Clause 9 was completely rewritten;

e) Annex B was removed because there are already procedures for circuit board assemblies.

The text of this International Standard is based on the following documents:

| CDV | Report on voting |
|-------------|------------------|
| 91/1481/CDV | 91/1510/RVC |

Full information on the voting for the approval of this International Standard can be found in the report on voting indicated in the above table.

This document has been drafted in accordance with the ISO/IEC Directives, Part 2.

A list of all parts of IEC 61191 series, published under the general title *Printed board assemblies*, can be found in 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 "<http://webstore.iec.ch>" in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn,
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PRINTED BOARD ASSEMBLIES –

Part 1: Generic specification – Requirements for soldered electrical and electronic assemblies using surface mount and related assembly technologies

1 Scope

This part of IEC 61191 prescribes requirements for materials, methods and verification criteria for producing quality soldered interconnections and assemblies using surface mount and related assembly technologies. This part of IEC 61191 also includes recommendations for good manufacturing processes.

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.

IEC 60068-2-20, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-58, *Environmental testing – Part 2-58: Tests – Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

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

IEC 60721-3-1, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Storage*

IEC 61189-1, *Test methods for electrical materials, interconnection structures and assemblies – Part 1: General test methods and methodology*

IEC 61189-3, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 3: Test methods for interconnection structures (printed boards)*

IEC 61190-1-1, *Attachment materials for electronic assembly – Part 1-1: Requirements for soldering fluxes for high-quality interconnections in electronics assembly*

IEC 61190-1-3, *Attachment materials for electronic assembly – Part 1-3: Requirements for electronic grade solder alloys and fluxed and non-fluxed solid solders for electronic soldering applications*

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 61249-8-8, *Materials for interconnection structures – Part 8: Sectional specification set for non-conductive films and coatings – Section 8: Temporary polymer coatings*

IEC 61340-5-1, *Electrostatics – Part 5-1: Protection of electronic devices from electrostatic phenomena – General requirements*

IEC/TR 61340-5-2, *Electrostatics – Part 5-2: Protection of electronic devices from electrostatic phenomena – User guide*

IEC 61760-2, *Surface mounting technology – Part 2: Transportation and storage conditions of surface mounting devices (SMD) – Application guide*

ISO 9001:2008, *Quality management systems – Requirements*

IPC-A-610, *Acceptability of Electronic Assemblies*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60194 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

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

3.1 bow

deviation from flatness of a board characterized by a roughly cylindrical or spherical curvature so that, if the product is rectangular, its four corners are in the same plane

3.2 manufacturer assembler

individual or company responsible for the procurement of materials and components, as well as all assembly process and verification operations necessary to ensure full compliance of assemblies with this document

3.3 objective evidence

documentation agreed to between the user and the manufacturer

Note 1 to entry: The documentation can be in the form of a hard copy, computer data, computer algorithms, video or other media.

3.4 process indicator

detectable anomaly, other than a defect, that is reflective of material, equipment, personnel, process and/or workmanship variation

3.5

proficiency

capability to perform tasks in accordance with the requirements and verification procedures detailed in this document

3.6

shadowing

phenomenon where parts create a shadow of leads, lands, or other parts, which obstruct heating at reflow soldering or spreading solder at flow soldering

3.7

supplier

individual or company responsible for assuring, to the manufacturer (assembler), full compliance of components and base materials with the requirements and verification procedures of this document

Note 1 to entry: Components include electronic, electromechanical, mechanical components, printed boards, etc.

Note 2 to entry: Base materials include solder, flux, cleaning agents, etc.

3.8

twist

deviation of a rectangular sheet, panel or printed board that occurs parallel to a diagonal across its surface, so that one of the corners of the sheet is not in the plane that contains the other three corners

3.9

user

procuring authority

individual, company or agency responsible for the procurement of electrical/electronic hardware, and having the authority to define the class of equipment and any variation or restrictions to the requirements of this document

EXAMPLE The originator/custodian of the contract detailing these requirements.

4 General requirements

4.1 Order of precedence

4.1.1 General remark

In the event of a conflict between the text of this standard and the applicable standard cited herein, the text of this document shall take precedence. However, nothing in this document supersedes applicable laws and regulations.

4.1.2 Conflict

In the event of conflict between the requirements of this document and the applicable assembly documentation, the applicable user approved assembly documentation shall govern. In the event of conflict between the requirements of this document and assembly documentation that has not been approved, the differences shall be referred to the designated user activity for approval. Upon such approval, the provisions shall be documented (by official revision notice or equivalent) on the assembly documentation, which shall then govern.

4.1.3 Conformance documentation

Where this document requires documentary evidence to support conformance claims, each record shall be retained and be available for inspection for a minimum of two years from the date of the recorded occurrence (see ISO 9001).

4.2 Interpretation of requirements

The introduction of product classification according to the levels and their end use (see 4.3) permits the user to differentiate the performance requirements. When the user elects to specify compliance with the mandatory requirements of this document, the following conditions apply:

- unless otherwise specified by the user, the word "shall" signifies that the requirements are mandatory,
- deviations from any "shall" requirement requires written acceptance by the user, for example via assembly documentation, specification or contract provision. The word "should" is used to indicate a recommendation or guidance statement. The word "may" indicates an optional situation. Both "should" and "may" express non-mandatory situations. "Will" is used to express a declaration of purpose.

4.3 Classification

This document recognizes that electrical and electronic assemblies are subject to classifications by intended end-item use. Three general end-product levels have been established to reflect differences in producibility, functional performance requirements, and verification (inspection/test) frequency.

It should be recognized that there may be overlaps of equipment between levels. The user (see 3.5) of the assemblies is responsible for determining the level to which the product belongs. The contract shall specify the level required and indicate any exceptions or additional requirements to the parameters, where appropriate.

Level A: General electronics products

Includes consumer products, some computer and computer peripherals, and hardware suitable for applications where the major requirement is function of the completed assembly.

Level B: Dedicated service electronics products

Includes communications equipment, sophisticated business machines, and instruments where high performance and extended life is required, and for which uninterrupted service is desired but not mandatory. Typically, the end-use environment would not cause failures.

Level C: High-performance electronics products

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

IPC-A-610 shall be used as workmanship standard.

NOTE Level A corresponds to class 1 in IPC-A-610

Level B corresponds to class 2 in IPC-A-610

Level C corresponds to class 3 in IPC-A-610

4.4 Defects and process indicators

Table 5 lists the defects that are unacceptable and require attention (for example, rework, repair). The manufacturer is responsible for identifying other areas of risk and treating those additional concerns as additions to Table 5. Such items should be documented on the assembly documentation. Other than the unacceptable defects listed in Table 5, anomalies and variances from "shall" requirements are considered as process indicators, and shall be

monitored when their occurrence is observed. The disposition of process indicators is not required.

Workmanship requirements shall match the defined level of classification according to 4.3.

IPC-A-610 shall be used as workmanship standard.

4.5 Process control requirements

This document requires the use of process control methodologies in the planning implementation and evaluation of the manufacturing processes used to produce soldered electrical and electronic assemblies. The philosophy, implementation strategies, tools and techniques may be applied in different sequences depending on the specific company, operation, or variable under consideration, to relate process control and capability to end-product requirements. The manufacturer, subject to agreement by the user, may be exempt from performing specific quality conformance evaluations and inspections, detailed in this document, provided objective evidence of a comprehensive and current continuous improvement plan is available (see 13.3).

4.6 Requirements flowdown

The applicable requirements of this document shall be imposed by each manufacturer or supplier on all applicable subcontracts and purchase orders. The manufacturer or supplier shall not impose or allow any variation from these requirements on subcontracts or purchase orders other than those that have been approved by the user.

Unless otherwise specified, the requirements of this document are not imposed on the procurement of off-the-shelf (catalogue) assemblies or subassemblies (see 14.3). However, the manufacturer of these items may comply as deemed appropriate.

4.7 Physical designs

4.7.1 New designs

The printed board layout and mechanical and thermal structure of the electrical/electronic assembly should, where relevant, be based on an appropriate design standard (for example IEC 61188-5-1) or as approved by the user. When a manufacturer has objective evidence that a revised layout will produce good end product quality that fulfills the requirements of this document, the user and manufacturer should agree on the changes, and the layout should be modified appropriately.

4.7.2 Existing designs

The requirements of this document should not constitute the sole cause for redesign of a currently approved design. However, when existing electronic or electrical designs undergo changes that have an impact on hardware configuration, the design of the latter shall be reviewed and user-approved changes made that allow for maximum practical compliance. Any manufacturer-proposed design changes shall be approved by the user; however, even though the proposed changes result in compliance with this document and the manufacture of quality end products, the user is under no obligation to accept the proposed redesign.

4.8 Visual aids

Line drawings and illustrations are depicted herein to assist in the interpretation of the written requirements of this document. The written requirements take precedence.

4.9 Proficiency of personnel

4.9.1 Design proficiency

The design facility shall have documentation which demonstrates that formal design training for all technical workforce personnel has been accomplished. Training shall be given irrespective of whether such personnel have direct responsibility for product electronic/electrical design (see ISO 9001).

4.9.2 Manufacturing proficiency

Prior to commencing work, all instructors, operators and inspection personnel shall be proficient in the tasks to be performed. Objective evidence of that proficiency shall be maintained and be available for review. Objective evidence shall include records of training for the applicable job functions being performed, testing to the requirements of this document, and results of periodic reviews of proficiency (see ISO 9001 and IPC-A-610).

4.10 Electrostatic discharge (ESD)

The ESD control programme shall be in accordance with IEC 61340-5-1 and IEC/TR 61340-5-2. Documented procedures, electrostatic discharge control for the protection of ESD sensitive electrical and electronic parts, components, assemblies and equipment shall be maintained during, but not limited to:

- a) receipt and test of incoming items;
- b) board, component and parts storage and kitting;
- c) manufacturing and rework;
- d) inspection and test cycles;
- e) storage and shipping of completed product;
- f) transport and installation.

Procedures for analysis of failures arising from ESD shall be documented and be available for review by an authorized inspectorate.

4.11 Facilities

4.11.1 General

Cleanliness and ambient environments in all work areas shall be maintained at levels that prevent contamination or deterioration of soldering tools, materials and surfaces to be soldered. Eating, drinking and use of tobacco products or illegal drugs shall be prohibited in the work area.

4.11.2 Environmental controls

The soldering facility should be enclosed, temperature and humidity controlled, and maintained at a positive pressure.

4.11.3 Temperature and humidity

When relative humidity decreases to a level of 30 % or lower, the manufacturer shall verify that electrostatic discharge control is adequate, and that sufficient moisture is present for flux performance and solder paste applications. For operator comfort and solderability maintenance, the temperature should be maintained between 18 °C and 30 °C and the relative humidity should not exceed 70 %. For process control, the need for more restrictive temperature and humidity limits should be evaluated.