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IEC 61191-1:2013

**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**

IEC 61191-1:2013

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
info@iec.ch
www.iec.ch

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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 second edition cancels and replaces the first edition, published in 1998, and constitutes a technical revision.

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

– reference standard IEC 61192-1 has been replaced by IPC-A-610;
– some of the terminology has been updated;
– references to IEC standards have been corrected;
– the use of lead-free alloys in the assembly have been added.

The text of this standard is based on the following documents:

FDIS	Report on voting
91/1089A/FDIS	91/1098/RVD

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

A list of all parts of IEC 61191 series, published under the general title *Printed board assemblies* can be found in the IEC website.

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

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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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, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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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 – Section 1: Storage*

IEC 61188-1-1, *Printed boards and printed board assemblies – Design and use – Part 1-1: Generic requirements – Flatness considerations for electronic assemblies*

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 61190-1-2, *Attachment materials for electronic assembly – Part 1-2: Requirements for soldering pastes for high-quality interconnects 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*

IPC-A-610E:2010, *Acceptability of Electronic Assemblies*

3 Terms and definitions

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

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

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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 standard

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3.3
objective evidence
documentation, agreed to between user and 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 standard

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 standard

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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 standard

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 standard shall take precedence. However, nothing in this standard supersedes applicable laws and regulations.

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4.1.2 Conflict

In the event of conflict between the requirements of this standard and the applicable assembly drawing(s), the applicable user approved assembly drawing(s) shall govern. In the event of conflict between the requirements of this standard and assembly drawing(s) 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 drawings, which shall then govern.

4.1.3 Conformance documentation

Where this standard 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 standard, 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, e.g., via assembly drawing, 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 standard 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.

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4.4 Defects and process indicators

Table 2 lists the defects that are unacceptable and require attention (e.g., rework, repair, etc.). The manufacturer is responsible for identifying other areas of risk and treating those additional concerns as additions to Table 2. Such items should be documented on the assembly drawing. Other than the unacceptable defects listed in Table 2, 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 be consistent with IPC-A-610E, and match the level of classification identified in 4.3.

4.5 Process control requirements

This standard 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 standard, 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 standard 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 standard 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 Design requirements

Some structural and layout design requirements are given in the following subclauses.

4.7.2 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 (e.g., 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 standard, the user and manufacturer should agree on the changes, and the layout be modified appropriately.

4.7.3 Existing designs

The requirements of this standard 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 standard and the manufacture of quality end products, the user is under no obligation to accept the proposed redesign.

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4.8 Visual aids

Line drawings and illustrations are depicted herein to assist in the interpretation of the written requirements of this standard. 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 standard, and results of periodic reviews of proficiency (see ISO 9001 and IPC-A-610E).

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.

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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.

4.11.4 Lighting

Illumination at the working surface of manual soldering and inspection stations shall be 1 000 lm/m^2 minimum.

4.11.5 Field conditions

In field operations, where the controlled environment conditions required by this standard cannot be achieved effectively, special precautions shall be taken to maximize the quality of solder connections and minimize the effects of the uncontrolled environment on the operation being performed on the hardware.

4.11.6 Clean rooms

The assembly of electronics may necessitate the use of clean rooms to ensure compliance with the end production performance requirements of this standard. If required, the class of clean room shall be agreed upon between user and manufacturer.

4.12 Assembly tools and equipment

4.12.1 General

The manufacturer is responsible for the selection and maintenance of tools and equipment used in the preparation and soldering of components and/or conductors. Tools used shall be selected and maintained so that no damage results from their use. Tools and equipment should be clean prior to use and be kept clean and free of dirt, grease, flux, oil and other