

Printed board assemblies —

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

The European Standard EN 61191-1:1998 has the status of a
British Standard

ICS 31.180

National foreword

This British Standard is the English language version of EN 61191-1:1998. It is identical with IEC 61191-1:1998.

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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Cross-references

Attention is drawn to the fact that CEN and CENELEC Standards normally include an annex which lists normative references to international publications with their corresponding European publications. The British Standards which implement these international or European publications may be found in the BSI Standards Catalogue under the section entitled “International Standards Correspondence Index”, or by using the “Find” facility of the BSI Standards Electronic Catalogue.

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Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, the EN title page, pages 2 to 32 and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

Amendments issued since publication

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English version

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

(IEC 61191-1:1998)

Ensembles de cartes imprimées
Partie 1: Spécification générique Exigences
relatives aux ensembles électriques ou
électroniques brasés utilisant les techniques de
montage en surface et associées
(CEI 61191-1:1998)

Elektronikaufbauten auf Leiterplatten
Teil 1: Fachgrundspezifikation Anforderungen
an gelötete elektrische und elektronische
Baugruppen unter Verwendung der
Oberflächenmontage und verwandter
Montagetechniken
(IEC 61191-1:1998)

This European Standard was approved by CENELEC on 1998-10-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the Central Secretariat has the same status as the official versions.

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CENELEC

European Committee for Electrotechnical Standardization
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Foreword

The text of document 91/131/FDIS, future edition 1 of IEC 61191-1, prepared by IEC TC 91, Surface mounting technology, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61191-1 on 1998-10-01.

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) 1999-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2001-07-01

Annexes designated “normative” are part of the body of the standard.

Annexes designated “informative” are given for information only.

In this standard, Annex A, Annex B, Annex C and Annex ZA are normative and Annex D is informative.

Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61191-1:1998 was approved by CENELEC as a European Standard without any modification.

In the official version, for Annex D, Bibliography, the following note has to be added for the standard indicated:

IEC 61189-2

NOTE Harmonized als EN 61189-2:1997 (not modified).

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1 Scope

This specification prescribes requirements for materials, methods and verification criteria for producing quality soldered interconnections and assemblies using surface mounted and related assembly technologies. Also included are recommendations for good manufacturing processes.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this part of IEC 61191. At the time of publication, the editions indicated were valid. All normative documents are subject to revision, and parties to agreements based on this part of IEC 61191 are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. Members of IEC and ISO maintain registers of currently valid International Standards.

IEC 60050(541):1990, *International Electrotechnical Vocabulary — Chapter 541: Printed circuits*.

IEC 60721-3-1:1987, *Classification of environmental conditions — Part 3: Classification of groups of environmental parameters and their severities — Section 1: Storage*.

IEC 61188-1-1:1997, *Printed boards and printed board assemblies — Design and use — Part 1-1: Generic requirements — Flatness considerations for electronic assemblies*.

IEC 61188-2:—, *Design and use requirements of printed boards and printed board assemblies — Part 2: Guide to the use of printed wiring board substrate materials — Surface mount technology*¹⁾.

IEC 61189-1:1997, *Test methods for electrical materials, interconnection structures and assemblies — Part 1: General test methods and methodology*.

IEC 61189-3:1997, *Test methods for electrical materials, interconnection structures and assemblies — Part 3: Test methods for interconnecting structures (printed boards)*.

IEC 61190-1-1:—, *Attachment materials for electronic assemblies — Part 1-1: Requirements for soldering fluxes*¹⁾.

IEC 61190-1-2:—, *Attachment materials for electronic assemblies — Part 1-2: Requirements for soldering pastes*¹⁾.

IEC 61191-2:1998, *Printed board assemblies — Part 2: Sectional specification — Requirements for surface mount soldered assemblies*.

IEC 61191-3:1998, *Printed board assemblies — Part 3: Sectional specification — Requirements for through-hole mount soldered assemblies*.

IEC 61191-4:1998, *Printed board assemblies — Part 4: Sectional specification — Requirements for terminal soldered assemblies*.

IEC 61192-1:—, *Soft soldering — Part 1: Assessment of the quality of soldered joints*¹⁾.

IEC 61249-8-1:—, *Materials for interconnection structures — Part 8-1: Sectional specification set for non-conductive films and coatings — Adhesive coated flexible polyester film*¹⁾.

IEC 61249-8-2:—, *Materials for interconnection structures — Part 8-2: Sectional specification set for non-conductive films and coatings — Adhesive coated flexible polyimide film*¹⁾.

IEC 61249-8-3:—, *Materials for interconnection structures — Part 8-3: Sectional specification set for non-conductive films and coatings — Transfer adhesive film*¹⁾.

IEC 61249-8-8:1997, *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: Specification for the protection of electronic devices from electrostatic phenomena — General requirements*¹⁾.

IEC 61340-5-2:—, *Electrostatics — Part 5-2: Specification for the protection of electronic devices from electrostatic phenomena — User guide*¹⁾.

IEC 61760-2:—, *Surface mounting technology — Part 2: Transportation and storage conditions of surface mounting devices (SMD) — Application guide*¹⁾.

IEC 62326-1:1996, *Printed boards — Part 1: Generic specification*.

IEC QC 200 012:1996, *Process assessment schedule for printed board design facilities*.

CECC 100015, BS — *Protection of electrostatic sensitive devices*.

ISO 9001:1994, *Quality systems — Model for quality assurance in design, development, production, installation and servicing*.

ISO 9002:1994, *Quality systems — Model for quality assurance in production, installation and servicing*.

¹⁾ To be published.

ISO 9453:1990, *Soft solder alloys — Chemical compositions and forms*.

ISO 9454-1:1990, *Soft soldering fluxes — Classification and requirements — Part 1: Classification, labelling and packaging*.

ISO/DIS 9454-2:—, *Soft soldering fluxes — Classification and requirements — Part 2: Performance requirements*.

3 Terms and definitions

For the purpose of this part of IEC 61191, the definitions of IEC 60050(541) and the following definitions apply.

3.1

manufacturer; assembler

the 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 specification

3.2

objective evidence

documentation, agreed to between user and manufacturer, in the form of hard copy, computer data, computer algorithms, video or other media

3.3

proficiency

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

3.4

supplier

the individual or company responsible for assuring, to the manufacturer (assembler), full compliance of components (electronic, electromechanical, mechanical components, printed boards, etc.) and base materials (solder, flux, cleaning agents, etc.) with the requirements and verification procedures of this specification

3.5

user; procuring authority

the 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 specification (i.e., the originator/custodian of the contract detailing these requirements)

3.6

process deviation indicator (PDI)

a process deviation indicator is used for continuous process improvement when it is reflective of variation in material, equipment, personnel, process, and/or workmanship. It is not necessarily a defect

3.7

bow

the 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

3.8

twist

the 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

4 General requirements

4.1 Order of precedence

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

4.1.1 Conflict

In the event of conflict between the requirements of this specification 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 specification 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.

4.1.2 Conformance documentation

Where this specification 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 9002).

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 specification, 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 term “must” is used only to describe unavoidable situations. 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.

Refer to ISO/IEC Directives, part 3.

4.3 Classification

This specification 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 electronic 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 electronic 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 electronic 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 must function when required, such as life support systems and other critical systems.

4.4 Defects and process deviation indicators (PDIs)

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. Disposition of process indicators is not required.

4.5 Process control requirements

This specification 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 specification, provided objective evidence of a comprehensive and current continuous improvement plan is available (see 13.2).

4.6 Requirements flowdown

The applicable requirements of this specification 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 specification 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

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

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 (e.g. IEC 61188-5-1 to IEC 61188-5-7) or as approved by the user. When a manufacturer has objective evidence that a revised layout will produce good end product quality that fulfils the requirements of this standard, the user and manufacturer should agree on the changes, and the layout be modified appropriately.

4.7.2 *Existing designs*

The requirements of this specification 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 specification 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 specification. 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 and IEC QC 200012).

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 specification, and results of periodic reviews of proficiency (see ISO 9002).

4.10 *Electrostatic discharge (ESD)*

The ESD control programme shall be in accordance with IEC 61340-5-1 and IEC 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*

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.

4.11.1 *Environmental controls*

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

4.11.2 *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.

4.11.3 *Lighting*

Illumination at the working surface of manual soldering and inspection stations shall be 1 000 lm/m² minimum.