

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

The European Standard EN 61190-1-3:2002 has the status of a
British Standard

ICS 31.190

National foreword

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

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This British Standard, having been prepared under the direction of the Electrotechnical Sector Policy and Strategy Committee, was published under the authority of the Standards Policy and Strategy Committee on 12 August 2002

Summary of pages

This document comprises a front cover, an inside front cover, the EN title page, pages 2 to 34, an inside back cover and a back cover.

The BSI copyright date displayed in this document indicates when the document was last issued.

Amendments issued since publication

Amd. No.	Date	Comments

© BSI 12 August 2002

ISBN 0 580 40234 7

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 61190-1-3:2002)

Matériaux de fixation pour
les assemblages électroniques
Partie 1-3: Exigences relatives aux
alliages à braser de catégorie
électronique et brasures solides
fluxées et non-fluxées pour les
applications de brasage électronique
(CEI 61190-1-3:2002)

Verbindungsmaterialien für
Baugruppen der Elektronik
Teil 1-3: Anforderungen an
Elektroniklote und an Festformlote
mit oder ohne Flussmittel für das
Löten von Elektronikprodukten
(IEC 61190-1-3:2002)

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of document 91/279/FDIS, future edition 1 of IEC 61190-1-3, prepared by IEC TC 91, Electronics assembly technology, was submitted to the IEC-CENELEC parallel vote and was approved by CENELEC as EN 61190-1-3 on 2002-06-01.

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) 2003-03-01
- latest date by which the national standards conflicting
with the EN have to be withdrawn (dow) 2005-06-01

Annexes designated "normative" are part of the body of the standard.
Annexes designated "informative" are given for information only.
In this standard, annexes B and ZA are normative and annex A is informative.
Annex ZA has been added by CENELEC.

Endorsement notice

The text of the International Standard IEC 61190-1-3:2002 was approved by CENELEC as a European Standard without any modification.

CONTENTS

1	Scope	5
2	Normative references.....	5
3	Classification	6
3.1	Alloy composition.....	6
3.2	Solder form	6
3.3	Flux type	6
3.4	Flux percentage and metal content	7
3.5	Other characteristics.....	8
4	Terms and definitions	8
5	Requirements	10
5.1	Materials	10
5.2	Alloys	10
5.3	Solder forms.....	11
5.4	Flux type and form.....	13
5.5	Flux residue dryness.....	13
5.6	Spitting.....	13
5.7	Solder-pool.....	13
5.8	Labelling for product identification.....	14
5.9	Workmanship	14
6	Quality assurance provisions.....	14
6.1	Responsibility for inspection and compliance.....	14
6.2	Classification of inspections.....	15
6.3	Material inspection.....	20
6.4	Qualification inspection.....	20
6.5	Quality conformance	21
6.6	Preparation of solder alloy for test.....	21
7	Preparation for delivery.....	21
7.1	Preservation, packing, and packaging	21
	Annex A (informative).....	22
A.1	Intended use.....	22
A.2	Acquisition requirements.....	23
A.3	Standard solder product packages	24
A.4	Protocol for establishing short names for IEC 61190-1-3 alloys.....	24
A.5	Standard description of solid solder products	25
	Annex B (normative) Solder alloys	26
	Annex ZA (normative) Normative references to international publications with their corresponding European publications	34
	Bibliography	33

Figure 1 – Report form for solder alloy tests	16
Figure 2 – Report form for solder powder tests	17
Figure 3 – Report form for non-fluxed solder tests	18
Figure 4 – Report form for fluxed wire/ribbon solder tests	19
Table 1 – Solder materials.....	6
Table 2 – Flux types and designating symbols	7
Table 3 – Flux percentage	8
Table 4 – Standard solder powders	12
Table 5 – Solder inspections	20
Table B.1 – Composition and temperature characteristics of lead-free solder alloys	26
Table B.2 – Composition and temperature characteristics of common tin-lead alloys.....	27
Table B.3 – Composition and temperature characteristics for speciality (non-tin/lead) alloys.....	29
Table B.4 – Cross-reference from solidus and liquidus temperatures to alloy names by temperature.....	30
Table B.5 – Cross-reference from ISO 9453 alloy numbers and designations to IEC 61190-1-3 alloy names	32

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

1 Scope

This part of IEC 61190 prescribes the requirements and test methods for electronic grade solder alloys, for fluxed and non-fluxed bar, ribbon, and powder solders, other than solder paste, for electronic soldering applications as well as for special electronic grade solders. For the generic specifications of solder alloys and fluxes, see ISO 9453, ISO 9454-1 and ISO 9454-2, respectively. This standard is a quality control document and is not intended to relate directly to the material performance in the manufacturing process

Special electronic grade solders include all solders which do not fully comply with the requirements of standard solder alloys and solder materials listed herein. Some examples of special solders are anodes, ingots, preforms, bars with hook and eye ends, multiple-alloy solder powders, etc.

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 60194:1999, *Printed board design, manufacture and assembly – Terms and definitions*

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

IEC 61190-1-2, *Attachment materials for electronic assembly – Part 1-2: Requirements for solder pastes for high-quality interconnections in electronics assembly*¹⁾

ISO 9002, *Quality Systems – Model for Quality Assurance in Production, Installation and Servicing*

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

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

ISO-9454-2, *Soft soldering fluxes – Classification and requirements – Part 2: Performance requirements*

¹⁾ To be published.

3 Classification

Soldering materials covered by this standard shall be classified by alloy composition, solder form, flux type, flux percentage, and by other characteristics peculiar to the solder material form.

3.1 Alloy composition

The solder alloys covered by this standard are the alloys listed in annex B, table B.1, and include pure tin and pure indium. Each alloy is identified by an alloy name, which is composed of a series of alphanumeric characters that identify the component elements in the alloy by chemical symbol and nominal percentage by mass, and ending with an arbitrarily assigned alloy variation letter (A, B, C, D, E). Alloys are also identified by an alloy short name, which is a five-character alphanumeric designation composed of the chemical symbol for the key element in the alloy (see A.4), the nominal percentage of that element in the alloy, and the arbitrarily assigned alloy variation letter. Annex B, table B.1, identifies alloy composition, the alloy short name, and alloy temperature characteristics. Annex B, table B.2, cross-references solidus and liquidus temperatures to alloy names. Annex B, table B.3, cross-references alloy short names to alloy names. Annex B, table B.4, cross-references ISO alloy numbers and designations from ISO 9453 to alloy names.

3.2 Solder form

The forms of solder materials covered by this set of standards are listed with their single-letter designating symbols in table 1.

Table 1 – Solder materials

Identifying symbol	Solder form
F	Flux (only)
P	Paste (cream)
B	Bar
D	Powder
R	Ribbon
W	Wire
S	Special

3.3 Flux type

The flux types used in/on solders covered by this set of standards are listed in table 2. The requirements for fluxes are covered by IEC 61190-1-1.

Table 2 – Flux types and designating symbols

Flux materials of composition ^a	Flux activity levels (weight % halide) ^b		IEC flux designator ^c	ISO flux designator ^d
Rosin (RO)	Low (<0,01)	L0	ROL0	1.1.1
	Low (<0,15)	L1	ROL1	1.1.2.W, 1.1.2.X
	Moderate (0)	M0	ROM0	1.1.3.W
	Moderate (0,5-2,0)	M1	ROM1	1.1.2.Y, 1.1.2.Z
	High (0)	H0	ROH0	1.1.3.X
	High (>2,0)	H1	ROH1	1.1.2.Z
Resin (RE)	Low (<0,01)	L0	REL0	1.2.1
	Low (<0,15)	L1	REL1	1.2.2.W, 1.2.2.X
	Moderate (0)	M0	REM0	1.2.3.W
	Moderate (0,5-2,0)	M1	REM1	1.2.2.Y, 1.2.2.Z
	High (0)	H0	REH0	1.2.3.X
	High (>2,0)	H1	REH1	1.2.2.Z
Organic (OR)	Low (0)	L0	ORL0	2.1., 2.2.3.E
	Low (<0,5)	L1	ORL1	–
	Moderate (0)	M0	ORM0	–
	Moderate (0,5-2,0)	M1	ORM1	2.1.2, 2.2.2
	High (0)	H0	ORH0	2.2.3.0
	High (>2,0)	H1	ORH1	2.2.2
Inorganic (IN)	Low (0)	L0	INL0	Not applicable (Inorganic ISO flux is different)
	Low (<0,5)	L1	INL1	
	Moderate (0)	M0	INM0	
	Moderate (0,5-2,0)	M1	INM1	
	High (0)	H0	INH0	
	High (>2,0)	H1	INH1	

^a Fluxes are available in S (solid), P (paste/cream) or L (liquid) forms.

^b The 0 and 1 indicate absence and presence of halides, respectively. See 4.2.3 of IEC 61190-1-1 for an explanation of L, M and H nomenclature.

^c See 7.2 and 7.3 of IEC 61190-1-1 for comparisons of RO, RE, OR and IN composition classes and L, M and H activity levels with the traditional classes such as R, RMA, RA, water soluble and low solids “no-clean”.

^d ISO designations are similar to IEC designators with minor differences in characteristics.

3.4 Flux percentage and metal content

The nominal percentage of flux, by mass, in solid-form solder products is identified as the flux percentage. The flux percentage in/on solid solders is identified by a single alphanumeric character in accordance with table 3. Metal content refers to the percentage of metal in solder paste (see IEC 61190-1-2).

Table 3 – Flux percentage

Designation symbol	Nominal percentage	Allowable percentage range
0	None	
1	0,5	0,2 - 0,8
2	1,0	0,7 - 1,3
3	1,5	1,2 - 1,8
4	2,0	1,7 - 2,3
5	2,5	2,2 - 2,8
6	3,0	2,7 - 3,3
7	3,5	3,2 - 3,8
8	4,0	3,7 - 4,3
9	4,5	4,2 - 4,8
A	5,0	4,7 - 5,3
B	5,5	5,2 - 5,8
C	6,0	5,7 - 6,3
D	6,5	6,2 - 6,8

3.5 Other characteristics

Standard bar solders are further classified by unit mass. Wire solders are further classified by wire size (outside diameter) and unit mass. Ribbon solders are further classified by thickness, width and unit mass. Powder solders are further classified by powder particle size distribution and unit mass.

4 Terms and definitions

For the purpose of this part of IEC 61190, the terms and definitions given in English only¹⁾ in IEC 60194 and the following apply.

4.1

acceptance tests

tests deemed necessary to determine the acceptability of a product and as agreed to by both purchaser and vendor

[IEC 60194]

4.2

alloy

substance having metallic properties and being composed of two or more chemical elements of which at least one is an elemental metal

4.3

basis metal

metal upon which coatings are deposited, (also referred to as base metal)

[IEC 60194, modified]

4.4

corrosion (chemical/electrolytic)

attack of chemicals, flux, and flux residues on base metals

¹⁾ Certain definitions of IEC 60194 have been translated into French.

4.5

density (phototool)

logarithm of the value of opacity, usually expressed in grams per cubic centimeter

[IEC 60194, modified]

4.6

dewetting

condition that results when molten solder coats a surface and then recedes to leave irregularly shaped mounds of solder that are separated by areas that are covered with a thin film of solder and with the basis metal not exposed

4.7

eutectic (n.)

alloy having the composition indicated by the eutectic point on an equilibrium diagram or an alloy structure of intermixed solid constituents formed by a eutectic reaction

[IEC 60194]

4.8

eutectic (v.)

isothermal reversible reaction in which, on cooling, a liquid solution is converted into two or more intimately mixed solids, with the number of solids formed being the same as the number of components in the system

[IEC 60194]

4.9

flux

chemically and physically active compound that, when heated, promotes the wetting of a base metal surface by molten solder by removing minor surface oxidation and other surface films and by protecting the surfaces from reoxidation during a soldering operation

[IEC 60194 modified]

4.10

flux characterization

series of tests that determines the basic corrosive and conductive properties of fluxes and flux residues

[IEC 60194]

4.11

flux residue

flux-related contaminant that is present on or near the surface of a solder connection

[IEC 60194]

4.12

liquidus

temperature at which a solder alloy changes from a paste form to a liquid form

4.13

non-wetting (solder)

partial adherence of molten solder to a surface that it has contacted and of which the basis metal remains exposed

[IEC 60194]

4.14

solder

metal alloy with a melting temperature that is below 485 °C

NOTE Metal alloy with a melting temperature less than 450 °C is classified as "soft solder".

[IEC 60194, modified]

4.15**solderability**

ability of the surface of a metal to be wetted by molten solder

[IEC 60194]

4.16**solidus**

temperature at which a solder alloy changes from a solid to a paste form

4.17**wetting, solder**

formation of a relatively uniform, smooth, unbroken, and adherent film of solder to a basis metal

[IEC 60194, modified]

5 Requirements**5.1 Materials**

Materials shall be used which permit the solder product to conform to the specified requirements. The use of recovered or recycled materials is encouraged. Recovered or recycled materials must conform to or exceed comparable standards for virgin raw materials.

5.2 Alloys

The solder alloy shall be as specified (see annex B). For purposes of this standard, electronic grade solder alloys are all of the alloys listed in annex B, table B.1, including pure tin (Sn99) and pure indium (In99). The elements listed in annex B, table B.1, for an alloy are considered to be the component elements of that alloy. Only the component elements of an alloy are desirable and all other elements are impurities for that alloy. To the maximum extent feasible and unless otherwise specified, solder alloy metal, including solder powder, shall be a homogeneous mixture of the component elements of the alloy, so that each particle of the metal is the same alloy. Unless otherwise specified, the percentage by mass of impurity elements in alloys which are identified with an A, B, C, or E suffix shall not exceed the following values and the values listed in 5.2.1, 5.2.2, 5.2.3, and 5.2.5 respectively, and the percentage by mass of impurity elements in alloys which are identified with a D suffix shall conform to the requirements in 5.2.4.

Ag: 0,05	Au: 0,05	Cu: 0,08	Ni: 0,01	Sn: 0,25
Al: 0,001	Bi: 0,10	Fe: 0,02	Pb: 0,20	Zn: 0,001
As: 0,03	Cd: 0,002	In: 0,10		

The percentage of each element in an alloy shall be determined by any standard analytical procedure. Wet chemistry shall be used as the referee procedure.

5.2.1 Variation A alloys

In alloys which are identified with an A suffix, the percentage by mass of antimony (Sb) as an impurity element shall not exceed 0,50.

5.2.2 Variation B alloys

In alloys which are identified with a B suffix, the percentage by mass of antimony as an impurity element shall not exceed 0,20.