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IEC 61190-1-3

Edition 2.1 2010-11

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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

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

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IEC 61190-1-3:2007+A1:2010

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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

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~~Cookson Electronics Assembly Materials~~
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~~For Sn88In8Ag3,5Bi,5:~~
~~JP PAT No. 3040929~~
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~~JP PAT No. 3027441~~

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~~Matsushita IMP Building 20F 1-3-7, Shiromi, Chouh-ku, Osaka, 540-6319, Japan~~

~~For Sn92In4Ag3,5Bi,5~~
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The technical content is therefore identical to the base edition and its amendment and has been prepared for user convenience. A vertical line in the margin shows where the base publication has been modified by amendment 1. Additions and deletions are displayed in red, with deletions being struck through.

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

This bilingual version, published in 2008-05, corresponds to the English version.

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The French version of this standard has not been voted upon.

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

A list of all parts in the IEC 61190 series, under the general title *Attachment materials for electronic assembly*, can be found on the IEC website.

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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, powder solders and solder paste, for electronic soldering applications and for “special” electronic grade solders. For the generic specifications of solder alloys and fluxes, see ISO 9453, ISO 9454-1 and ISO 9454-2. This standard is a quality control document and is not intended to relate directly to the material's 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. Examples of special solders include anodes, ingots, preforms, bars with hook and eye ends, multiple-alloy solder powders, etc.

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

IEC 61190-1-1:2002, *Attachment materials for electronic assembly – Part 1-1: Requirements for soldering fluxes for high-quality interconnects in electronics assembly*

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

IEC 61189-5, *Test methods for electrical materials, interconnection structures and assemblies – Part 5: Test methods for printed board assemblies*

IEC 61189-6, *Test methods for electrical materials, interconnection structures and assemblies – Part 6: Test methods for materials used in manufacturing electronic assemblies*

ISO 9001, *Quality management systems – Requirements*

ISO 9453:2006, *Soft solder alloys – Chemical compositions and forms*

ISO-9454-1:1990, *Soft soldering fluxes – Classification and requirements – Part 1: Classification, labelling and packing*

ISO-9454-2:1998, *Soft soldering fluxes – Classification and requirements – Part 2: Performance requirements*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60194, as well as the following apply. Terms marked with an asterisk (*) are taken from IEC 60194 and are reprinted here for convenience.

3.1
acceptance tests *
those tests deemed necessary to determine the acceptability of a product and as agreed to by both purchaser and vendor

3.2
alloy
substance having metallic properties and being composed of two or more chemical elements of which at least one is an elemental metal

3.3
basis metal *
metal upon which coatings are deposited, also referred to as base metal

3.4
corrosion (chemical/electrolytic) *
attack of chemicals, flux, and flux residues on base metals

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3.5
density (phototool) *
mass of a surface per unit volume, usually expressed in grams per cubic centimetre

3.6
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

3.7
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

3.8
eutectic (adj.) *
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

3.9
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

3.10
flux characterization *
series of tests that determines the basic corrosive and conductive properties of fluxes and flux residues

3.11
flux residue *
flux-related contaminant that is present on or near the surface of a solder connection

3.12
liquidus
temperature at which a solder alloy changes from a paste form to a liquid form

3.13
nonwetting (solder) *
partial adherence of molten solder to a surface that it has contacted and where basis metal remains exposed

3.14
lead-free solder
solder alloy the lead content of which is equal to, or less than 0,10 % by mass

3.15
solder *
metal alloy with a melting temperature that is below 450 °C.

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

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3.16
solderability *
ability of a metal to be wetted by molten solder

3.17
solidus
temperature at which a solder alloy changes from a solid to a paste form

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3.18
wetting, solder *
formation of a relatively uniform, smooth, unbroken, and adherent film of solder to a basis metal.

4 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.

4.1 Alloy composition

The solder alloys covered by this standard are the alloys listed in Tables B.1, B.2 and B.3 and include pure tin and pure indium. Each alloy is identified by an alloy name composed of a series of alphanumeric characters. These characters identify the component elements in the alloy by chemical symbol and nominal percentage by mass. They terminate with an arbitrarily assigned alloy variation letter (A, B, C, D). Alloys are also identified by an alloy short name. This is an alphanumeric designation composed of the chemical symbol for the key element in the alloy (see Clause A.4), the nominal percentage of that element in the alloy and the arbitrarily assigned alloy variation letter.

Tables B.1, B.2 and B.3 identify alloy composition, short name and temperature characteristics; Table B.4 cross-references solidus and liquidus temperatures to alloy names and Table B.5 cross-references ISO alloy numbers and designations from ISO 9453 to alloy names.

NOTE The alloy short name can be used as identifier of solder alloy(s) in mounted boards used in electrical and electronic equipment (see Annex C).

4.2 Solder form

Table 1 shows the forms of solder materials covered by this standard listed with their single-letter designating symbols.

Table 1 – Solder materials

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

4.3 Flux type

The flux types used in/on solders covered by this standard are listed in Table 2. The requirements for fluxes are covered by IEC 61190-1-1.

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Table 2 – Flux types and designating symbols

Flux materials of composition [a]	Flux activity levels wt. % 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 (<0,01)	M0	ROM0	1.1.3.W
	Moderate (0,15–2,0)	M1	ROM1	1.1.2.Y, 1.1.2.Z
	High (<0,01)	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 (<0,01)	M0	REM0	1.2.3.W
	Moderate (0,15 – 2,0)	M1	REM1	1.2.2.Y, 1.2.2.Z
	High (<0,01)	H0	REH0	1.2.3.X
	High (>2,0)	H1	REH1	1.2.2.Z
Organic (OR)	Low (<0,01)	L0	ORL0	2.1., 2.2.3.E
	Low (<0,15)	L1	ORL1	-
	Moderate (<0,01)	M0	ORM0	-
	Moderate (0,15 – 2,0)	M1	ORM1	2.1.2, 2.2.2
	High (<0,01)	H0	ORH0	2.2.3.0
	High (>2,0)	H1	ORH1	2.2.2
Inorganic (IN)	Low (<0,01)	L0	INL0	Not applicable (inorganic ISO flux is different)
	Low (<0,15)	L1	INL1	
	Moderate (<0,01)	M0	INM0	
	Moderate (0,15 – 2,0)	M1	INM1	
	High (<0,01)	H0	INH0	
	High (>2,0)	H1	INH1	

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

[b] See 7.1 and 7.2 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.".

[c] 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.

[d] ISO designations are similar to IEC designators with minor differences in characteristics

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4.4 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

Design symbol	Nominal %	Allowable range %	Design symbol	Nominal %	Allowable range %	Design symbol	Nominal %	Allowable range %
0	None		5	2,5	2,2 – 2,8	A	5,0	4,7 – 5,3
1	0,5	0,2 – 0,8	6	3,0	2,7 – 3,3	B	5,5	5,2 – 5,8
2	1,0	0,7 – 1,3	7	3,5	3,2 – 3,8	C	6,0	5,7 – 6,3
3	1,5	1,2 – 1,8	8	4,0	3,7 – 4,3	D	6,5	6,2 – 6,8
4	2,0	1,7 – 2,3	9	4,5	4,2 – 4,8			

4.5 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.

5 Requirements

5.1 Materials

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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 shall conform to or exceed comparable standards for virgin raw materials.

5.2 Alloys

The solder alloy shall be as specified (see Annex B). For the purposes of this standard, electronic grade solder alloys are all those listed in Tables B.1, B.2 and B.3, including pure tin (Sn99) and pure indium (In99). The elements listed in Tables B.1, B.2 and B.3 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 homogenous mixture of the component elements of the alloy, such 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”, or “C” suffix shall not exceed the following values and the values listed in 5.2.1, 5.2.2, and 5.2.3 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: 0,05	Ni: 0,01	Sn: 0,25
Al: 0,001	Bi: 0,10	Fe: 0,02	Pb: 0,10	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.