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INTERNATIONAL STANDARD

NORME INTERNATIONALE

Withdrawn

Attachment materials for electronic assembly – Part 1-2: Requirements for soldering pastes for high-quality interconnects in electronics assembly

Matériaux de fixation pour les assemblages électroniques – Partie 1-2: Exigences relatives aux pâtes à braser pour les interconnexions de haute qualité dans les assemblages de composants électroniques

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

ATTACHMENT MATERIALS FOR ELECTRONIC ASSEMBLY –

Part 1-2: Requirements for soldering pastes for high-quality interconnects in electronics assembly

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International Standard IEC 61190-1-2 has been prepared by IEC technical committee 91: Electronics assembly technology.

This second edition cancels and replaces the first edition, published in 2002, and constitutes a technical revision. The main changes with regard to the first edition concern a definition of lead-free solder alloy and an explanation of solder ball test standards.

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

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

FDIS	Report on voting
91/646/FDIS	91/678/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.

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.

The committee has decided that the contents of this publication will remain unchanged until the maintenance result 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- withdrawn;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
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INTRODUCTION

This part of IEC 61190 defines the characteristics of solder paste through the definitions of properties and specification of test methods and inspection criteria. Materials include solder powder and solder paste flux blended to produce solder paste. Solder powders are classified according to both shape and size distribution of the particles. It is not the intention of this standard to exclude those particle sizes or distributions not specifically listed. For flux properties of solder paste, including classification and testing, see IEC 61190-1-1.

The requirements for solder paste are defined in general terms. In practice, where more stringent requirements are necessary, additional requirements may be defined by mutual agreement between the user and supplier. Users are cautioned to perform tests (beyond the scope of this specification) to determine the acceptability of the solder paste for specific processes.

This standard is intended to be applicable to all types of solder paste used for soldering in general, as well as for soldering in electronics assembly. The solder pastes involved relate to all aspects of application. Generic specifications for soldering pastes are given in ISO 9454-2.

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ATTACHMENT MATERIALS FOR ELECTRONIC ASSEMBLY –

Part 1-2: Requirements for soldering pastes for high-quality interconnects in electronics assembly

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1 Scope

This part of IEC 61190 specifies general requirements for the characterization and testing of solder pastes used to make high-quality electronic interconnections in electronics assembly. This standard serves as a quality control document and is not intended to relate directly to the material's performance in the manufacturing process.

Related information on flux characterization, quality control and procurement documentation for solder flux and flux containing material may be found in IEC 61190-1-1.

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 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*

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 61191-1, *Printed board assemblies – Part 1: Generic specification – Requirements for soldered electrical and electronic assemblies using surface mount and related assembly technologies*

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*

ISO 9000, *Quality management systems – Fundamentals and vocabulary*

ISO 9001, *Quality management systems – Requirements*

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

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

ISO 10012-1, *Quality assurance requirements for measuring equipment – Part 1: Metrological confirmation system for measuring equipment*

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
drying
ambient or heating process to evaporate volatile components from solder paste which may, or may not, result in melting of rosin/resin

3.2
rheology
study of the change in form and the flow of matter, generally characterized by elasticity, viscosity, and plasticity

3.3
lead-free solder
solder alloy which lead content is equal to, or less than 0,10 % by mass

3.4
thinner (paste)
solvent or paste system with, or without, activator which is added to solder paste to replace evaporated solvents, adjust viscosity, or reduce solids content

3.5
viscosity
internal friction of a fluid, caused by molecular attraction, which makes it resist a tendency to flow, expressed in pascal-seconds (Pa s)

4 Standardized description for products

The solder paste product shall be described as outlined in Table 1.

Table 1 – Standardized solder paste description

Alloy designation	Flux classification[a]	Powder size type	Nominal metal content	Viscosity
Designation from IEC 61190-1-3	Classification from IEC 61190-1-1 or ISO 9454-2	Type no. [b]	Weight per cent	Pa s

[a] As defined and determined in IEC 61190-1-1 for low (L), moderate (M), and high (H) activity of the flux residues.

[b] See Table 2.

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5 Test methods

The test methods used in this standard are taken from IEC 61189-5 and IEC 61189-6:

IEC 61189-5, *Test methods for printed board assemblies*

5X04 Solder paste viscosity – t-bar spin spindle method (applicable for 300 Pa s to 1 600 Pa s)

5X05 Solder paste viscosity – t-bar spindle method (applicable at less than 300 Pa s)

5X06 Solder paste viscosity – spiral pump method (for 300 Pa s to 1 600 Pa s)

5X07 Solder paste viscosity – spiral pump method (applicable at less than 300 Pa s)

5X08 Solder paste – slump test

5X09 Solder paste – solder ball test

5X10 Solder paste – tack test

5X11 Solder paste – wetting test

IEC 61189-6, *Test methods for printed board materials*

6X01 Solder powder particle size distribution – screen method

6X02 Solder powder particle size distribution – measuring microscope method

6X03 Solder powder particle size distribution – optical image analyzer method

6X04 Determination of maximum solder powder particle size

6X05 Solder paste metal content by weight

6 Requirements

Except when otherwise specified in the design or assembly drawings, or instructions by the user, the soldering pastes covered by this standard shall conform with the following subclauses.

6.1 Conflict

In the event of conflict between the requirements of this standard and other requirements of the applicable acquisition documents, the precedence in which documents shall govern in descending order is as follows:

a) the applicable acquisition document;

b) the applicable specification sheet/drawing;

c) this standard;

d) applicable normative references.

6.2 Alloy composition

The alloy composition of the solder pastes shall be characterized by the supplier in accordance with the alloy characterization requirements specified in IEC 61190-1-3 and shall be inspected in accordance with the alloy inspection requirements of IEC 61190-1-3. The results of these inspections should be recorded on the report form included in IEC 61190-1-3 and the alloy type shall be recorded on the solder paste report form (see Table A.1).

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

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6.3 Flux characterization and inspection

The fluxes in solder pastes shall be characterized by the supplier in accordance with the flux characterization requirements specified in IEC 61190-1-1 and shall be inspected in accordance with the flux inspection requirements of IEC 61190-1-1. The results of these inspections should be recorded on the report form included in IEC 61190-1-1 and the flux type shall be recorded on the solder paste report form (see Table A.1). If the reflow temperature is unsuitable for inspection, a different reflow temperature should be agreed upon by user and supplier.

6.3.1 Shelf life

If the shelf life of the solder paste has expired, but the paste still meets performance testing, then it may be used. Paste which has been re-qualified can only be used directly after re-qualification.

6.4 Solder powder particle size

6.4.1 Powder size determination

Powder size determination shall be made using this standard. Alternate test procedures may be agreed upon by user and supplier.

6.4.2 Powder size

When tested in accordance with 6.4.2.1, the powder size shall be classified by type as per a standard sieve size or nearest sieve size shown which matches Table 2.

Table 2 – Standard solder powders

Powder size symbol [a]	Percentages of powder by weight				
	None larger than µm	Less than 1% larger than µm	At least 80 % between µm	At least 90 % between µm	Less than 10 % smaller than µm
1	160	150	150-75		20
2	80	75	75-45		20
3	50	45	45-25		20
4	40	38		38-20	20
5	28	25		25-15	15
6	18	15		15-5	5

[a] Basic powder size symbol for each powder size type.

6.4.2.1 Maximum powder size (fineness of grind)

The maximum powder size shall be determined in accordance with IEC 61189-6, Test method 6X04.

6.4.2.2 Solder powder

Powder particle size distribution shall be determined by a suitable test method using IEC 61189-6, Test methods 6X01, 6X02, or 6X03 for minimum particle size, as shown in Table 3.

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Table 3 – Test methods for particle size distribution

Type of weight per cent nominal size	Test methods
1, 2	1, 2, 3, 4
3, 4	2, 3, 4
5, 6	3, 4
[1] Sieve method [2] Microscopic method [3] Optical image analyzer [4] Laser scattering reflectometry	

6.4.3 Solder powder particle shape

6.4.3.1 Powder shape

Solder powder shape shall be spherical with maximum length-to-width ratio of 1:2 when tested in accordance with 6.4.3.1.1. Other shapes shall be acceptable if agreed upon by user and supplier.

6.4.3.1.1 Determination of solder powder particle shape

Solder powder particle shape shall be determined by visual observation of the powder with a binocular microscope at a magnification sufficient to determine the percentage that are spherical or elliptical (length-to-width ratio of less than 1:2). Powder with 90 % of the particles that are spherical shall be classified as spherical; all other powders shall be classified as non-spherical.

Solder powder roundness is determined with a light beam scatter and shall be classified as spherical if the deviation is 1:0 (perfectly spherical) to 1:07. Powders with values above 1:07 shall be classified as non-spherical.

6.5 Metal per cent

The metal content should range from 65 % (by weight) to 96 % (by weight) when tested in accordance with IEC 61189-6, test method 6X05. The metal per cent shall be within ± 1 % of the nominal value specified on the user's purchase order.

6.6 Viscosity

The measured viscosity shall be within ±10 % of the value specified by the user. The measurement and test conditions shall be in accordance with 6.6.1.

6.6.1 Methods of determining viscosity

The methods for determining the viscosity of solder paste in the range of 300 Pa s to 1 600 Pa s shall be in accordance with IEC-61189-5, test method 5X04, or test method 5X06. The method for determining viscosity of solder paste in the range of 50 Pa s to 300 Pa s shall be in accordance with IEC 61189-5, test method 5X05 or test method 5X07.

6.7 Slump and smear test

Unless otherwise specified in the contract or purchase order, slump is assessed using two stencil thicknesses and three land (deposit) sizes in accordance with 6.7.1 and 6.7.2.

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6.7.1 Test with 0,2 mm thick stencil

The 0,63 mm x 2,03 mm lands of the stencil shown in Figure 1 when tested in accordance IEC 61189-5, test method 5X08 at ambient, should show no evidence of bridging between lands when spacing is 0,56 mm or greater. When tested in accordance with IEC 61189-5, test method 5X08 at elevated temperature, the specimen shall show no evidence of bridging between pads when the spacing is 0,63 mm or greater. The 0,33 mm x 2,03 mm lands of the stencil shown in the Figure 1 pattern, when tested in IEC 61189-5, test method 5X08 at ambient, shall show no evidence of bridging at spacing of 0,25 mm or greater; and when tested as per IEC 61189-5, test method 5X08 at elevated temperature, they shall show no evidence of bridging at spacing of 0,30 mm or greater.

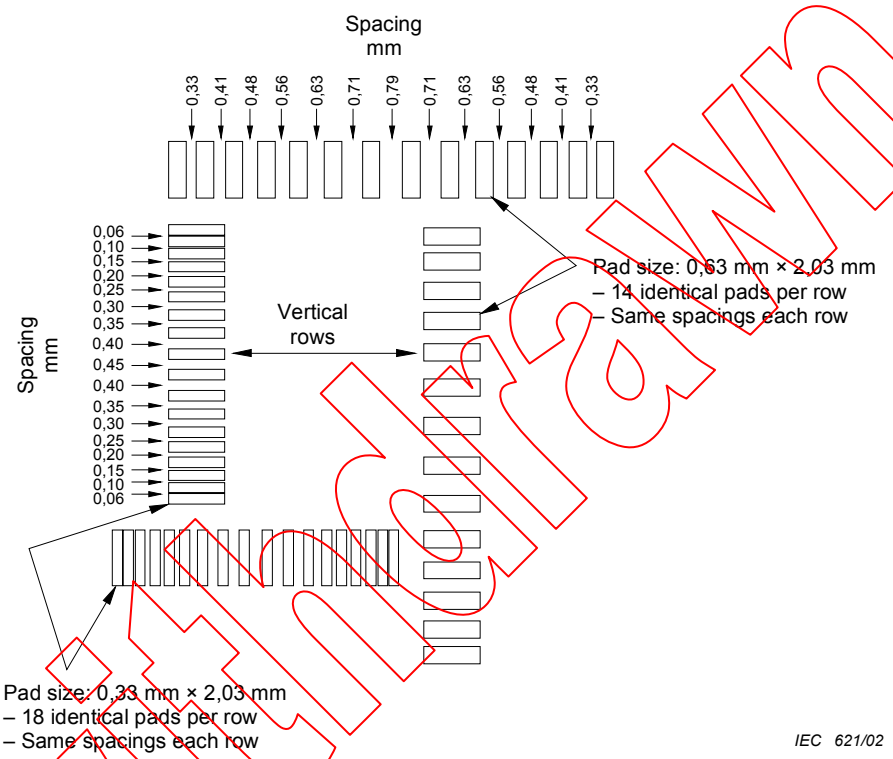

Figure 1 – Slump test stencil thickness, 0,20 mm

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6.7.2 Test with 0,1 mm thick stencil

The 0,33 mm x 2,03 mm lands of the stencil shown in Figure 2, when tested in accordance IEC 61189-5, test method 5X08 at ambient, should show no evidence of bridging at spacing of 0,25 mm or greater. When tested as per IEC 61189-5, test method 5X08 at elevated temperature, the lands shall show no evidence of bridging at spacing of 0,30 mm or greater.

The 0,2 mm x 2,03 mm lands of the stencil shown in Figure 2, when tested in accordance with IEC 61189-5, test method 5X08 at ambient, shall show no bridging at spacing of 0,175 mm or greater. When tested in accordance with IEC 61189-5, test method 5X08 at elevated temperature, the lands shall show no evidence of bridging at spacing of 0,20 mm or greater.

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