

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**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**

FOREWORD

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

This third edition cancels and replaces the second edition published in 2007. This edition constitutes a technical revision.

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

- a) modification of the solder powder size in Table 2;
- b) addition of the information of "Reflow condition and profile" in Annex B;
- c) addition of a new Annex C.

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

CDV	Report on voting
91/1154A/FDIS	91/1166/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.

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

A list of all parts in the IEC 61190 series, published 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 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

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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

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 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 61190-1-2:2014

IEC 61189-5-3¹, *Test methods for electrical materials, interconnection structures and assemblies – Part 5-3: Test methods for printed board assemblies: Soldering paste*

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*

ISO 9454-2, *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.

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

¹ To be published.

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

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 IEC 61190-1-2:2014	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.				

5 Test methods

The test methods used in this standard are taken from IEC 61189-5-3:

Test methods for electrical materials, interconnection structures and assemblies – Part 5-3: Test methods for printed board assemblies: Soldering paste:

- 5-3X01 Paste flux viscosity – T-Bar spindle method (5X02)²
- 5-3X02 Spread test, liquid or extracted solder flux and solder paste (5X03)²
- 5-3X03 Solder paste viscosity – t-bar spin spindle method (applicable for 300 Pa-s to 1 600 Pa-s) (5X04)²
- 5-3X04 Solder paste viscosity – t-bar spindle method (applicable at less than 300 Pa-s) (5X05)²
- 5-3X05 Solder paste viscosity – spiral pump method (for 300 Pa-s to 1 600 Pa-s) (5X06)²
- 5-3X06 Solder paste viscosity – spiral pump method (applicable at less than 300 Pa-s) (5X07)²
- 5-3X07 Solder paste – slump test (5X08)²

² (5X0x) ; Test number in IEC 61189-5:2006, see Bibliography.

- 5-3X08 Solder paste – solder ball test (5X09) ²
- 5-3X09 Solder paste – tack test (5X10) ²
- 5-3X10 Solder paste – wetting test (5X11) ²
- 5-3X11 Solder powder particle size distribution – screen method (6X01)³
- 5-3X12 Solder powder particle size distribution – measuring microscope method (6X02)³
- 5-3X13 Solder powder particle size distribution – optical image analyzer method (6X03) ³
- 5-3X14 Solder powder particle size distribution – Measuring laser diffraction method (6X04) ³
- 5-3X15 Determination of maximum solder powder particle size (6X05) ³
- 5-3X16 Solder paste metal content by weight (6X06) ²

6 Requirements

6.1 General

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 6.2 to 6.12.

6.2 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; [IEC 61190-1-2:2014](https://standards.iteh.ai/catalog/standards/sist/7000db77-33d9-4b31-a3ed-75588967413/iec-61190-1-2-2014)
- d) applicable normative references; <https://standards.iteh.ai/catalog/standards/sist/7000db77-33d9-4b31-a3ed-75588967413/iec-61190-1-2-2014>

6.3 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.

6.4 Flux characterization and inspection

6.4.1 General

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.

³ (6X0x) ; Test number in IEC 61189-6:2006, see Bibliography.

6.4.2 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.

6.5 Solder powder particle size

6.5.1 Powder size determination

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

6.5.2 Powder size

6.5.2.1 General

When tested in accordance with 6.5.2.2, the powder size shall be classified by type as per a standard sieve size or the nearest sieve size shown which matches the values of Table 2.

Table 2 – Standard solder powders

Type ^a	Less than 0,5 % larger than µm	10 % Maximum between µm	80 % Minimum between µm	10 % Maximum less Than µm
1	160	50 to 160	75 to 150	75
2	80	75 to 80	45 to 75	45
3	60	45 to 60	25 to 45	25
4	50	38 to 50	20 to 38	20
5	40	25 to 40	15 to 25	15
6	25	15 to 25	5 to 15	5
7	15	11 to 15	2 to 11	2

^a Basic powder size symbol for each powder size type.

6.5.2.2 Maximum powder size (fineness of grind)

The maximum powder size shall be determined in accordance with IEC 61189-5-3, Test method 5-3X15 (6X05)².

6.5.2.3 Solder powder

Powder particle size distribution shall be determined by a suitable test method using IEC 61189-5-3, Test methods 5-3X11 (6X01)², 5-3X12 (6X02)², 5-3X13 (6X03)² or 5-3X14(6X04)² for minimum particle size, as shown in Table 3.

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, 7	3, 4
1 Sieve method 2 Microscopic method 3 Optical image analyzer 4 Laser scattering reflectometry ⁴	

6.5.3 Solder powder particle shape

6.5.3.1 Powder shape

Solder powder shape shall be spherical with maximum length-to-width ratio of 1,2 when tested in accordance with 6.5.3.2. Other shapes shall be acceptable if agreed upon by user and supplier.

6.5.3.2 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 2). Alternatively determine the percentage of particles with aspect ratio of 1,2 or less using image analysis. Powder with 90 % of the particles that are spherical shall be classified as spherical; all other powders shall be classified as non-spherical.

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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.

6.6 Metal per cent

The metal content should be range from 65 % (by weight) to 96 % (by weight) when tested in accordance with IEC 61189-5-3, test method 5-3X16(6X06)². The metal per cent shall be within ± 1 % of the nominal value specified on the user's purchase order.

6.7 Viscosity

6.7.1 General

If a measure of viscosity is required it shall be as agreed between user and supplier. The measurement and test conditions shall be in accordance with 6.7.2.

6.7.2 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-61189-5-3, test method 5-3X03, or test method 5-3X05. 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 61189-5-3, test method 5-3X04 or test method 5-3X06.

⁴ See Annex C (informative): Typical comparison of particle size distributions between laser diffraction method and screen method.

6.8 Slump and smear test

6.8.1 General

Unless otherwise specified in the contract or purchase order, slump is assessed using two stencil thicknesses and three land (deposit) sizes in accordance with 6.7.2 and 6.8.3.

6.8.2 Test with 0,2 mm thick stencil

The 0,63 mm × 2,03 mm lands of the stencil shown in Figure 1 when tested in accordance IEC-61189-5-3, test method 5-3X07 at ambient, should show no evidence of bridging between lands when spacing is 0,56 mm or greater. When tested in accordance with IEC-61189-5-3, test method 5-3X07 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 × 2,03 mm lands of the stencil shown in the Figure 1 pattern, when tested in IEC-61189-5-3, test method 5-3X07 at ambient, shall show no evidence of bridging at spacing of 0,25 mm or greater; and when tested as per IEC-61189-5-3, test method 5-3X07 at elevated temperature, they shall show no evidence of bridging at spacing of 0,30 mm or greater.

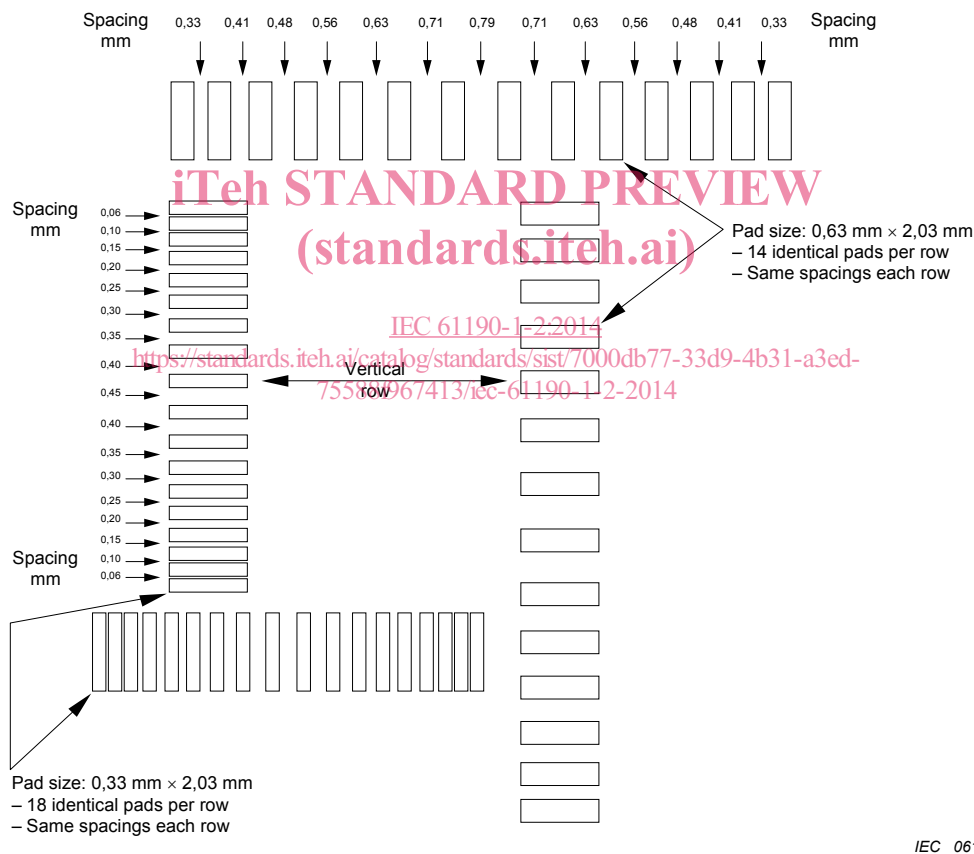


Figure 1 – Slump test stencil thickness, 0,20 mm

6.8.3 Test with 0,1 mm thick stencil

The 0,33 mm × 2,03 mm lands of the stencil shown in Figure 2, when tested in accordance IEC-61189-5-3, test method 5-3X07 at ambient, should show no evidence of bridging at spacing of 0,25 mm or greater. When tested as per IEC-61189-5-3, test method 5-3X07 at elevated temperature, the lands shall show no evidence of bridging at spacing of 0,30 mm or greater.

The 0,2 mm × 2,03 mm lands of the stencil shown in Figure 2, when tested in accordance with IEC-61189-5-3, test method 5-3X07 at ambient, shall show no bridging at spacing of 0,175 mm or greater. When tested in accordance with IEC-61189-5-3, test method 5-3X07 at elevated temperature, the lands shall show no evidence of bridging at spacing of 0,20 mm or greater.

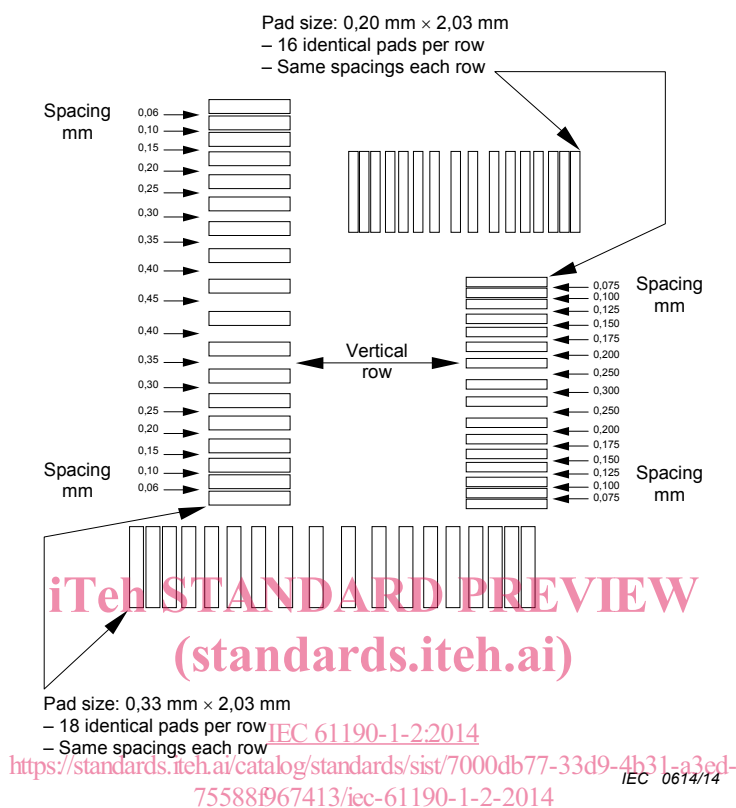


Figure 2 – Slump test stencil thickness, 0,10 mm

6.9 Solder ball test

6.9.1 General

The solder paste, when tested in accordance with the applicable method listed below, shall meet the requirements for random solder particles (solder balls) as specified. If the solder paste is required to reflow in a nitrogen atmosphere, for example in the case of indium (In) containing solder paste, a solder ball test under controlled nitrogen atmosphere should be allowable.

6.9.2 Type 1-4 powder

The solder paste with type 1 through 4 type powder, as defined in IEC-61189-5-3, test method 5-3X08, shall meet the acceptance criteria presented in Figure 3. In addition, individual solder balls of greater than 75 µm shall not form on more than one of the three test patterns used in the evaluation.

6.9.3 Type 5-7 powder

The solder paste with type 5 through 7 type powder as defined in IEC-61189-5-3, test method 5-3X08, shall meet the acceptance criteria presented in Figure 3. If necessary, it is recommended to test in a controlled nitrogen atmosphere. In addition, individual solder balls of greater than 50 µm shall not form on more than one of the three test patterns used in the evaluation. Tests shall be performed while specimen is in a controlled nitrogen atmosphere.