BS EN 61190-1-2:2014

BSI Standards Publication

Attachment materials for electronic assembly

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

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National foreword

This British Standard is the UK implementation of EN 61190-1-2:2014. It is identical to IEC 61190-1-2:2014. It supersedes BS EN 61190-1-2:2007 which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee EPL/501, Electronic assembly technology & Printed Electronics.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Attachment materials for electronic assembly - Part 1-2: Requirements for soldering pastes for high-quality interconnects in electronics assembly (IEC 61190-1-2:2014)

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 (CEI 61190-1-2:2014)

Verbindungsmaterialien für Baugruppen der Elektronik - Teil 1-2: Anforderungen an Lotpaste für hochwertige Verbindungen in der Elektronikmontage (IEC 61190-1-2:2014)

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Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Avenue Marnix 17, B-1000 Brussels

Foreword

The text of document 91/1154A/FDIS, future edition 3 of IEC 61190-1-2, prepared by IEC/TC 91 "Electronics assembly technology " was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 61190-1-2:2014.

The following dates are fixed:

• latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2014-12-26
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2017-03-26

This document supersedes EN 61190-1-2:2007.

EN 61190-1-2:2014 includes the following significant technical changes with respect to EN 61190-1-2:2007:

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.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 61190-1-2:2014 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 61189-5:2006	NOTE	Harmonised as EN 61189-5:2006 (not modified).
IEC 61189-6:2006	NOTE	Harmonised as EN 61189-6:2006 (not modified).

Annex ZA
(normative)

Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
IEC 60194	-	Printed board design, manufacture and assembly - Terms and definitions	EN 60194	-
IEC 61189-5-3	-	Test methods for electrical materials, interconnection structures and assemblies - Part 5-3: Test methods for printed board assemblies: Soldering paste	EN 61189-5-3	-
IEC 61190-1-1	-	Attachment materials for electronic assemblies - Part 1-1: Requirements for soldering fluxes	-	-
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	EN 61190-1-3	-
ISO 9454-2	-	Soft soldering fluxes - Classification and requirements - Part 2: Performance requirements	EN ISO 9454-2	-

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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.

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.

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

IEC 61189-5-3 [1], *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]	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;

d) applicable normative references.

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.

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[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	150 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.

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.

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[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.

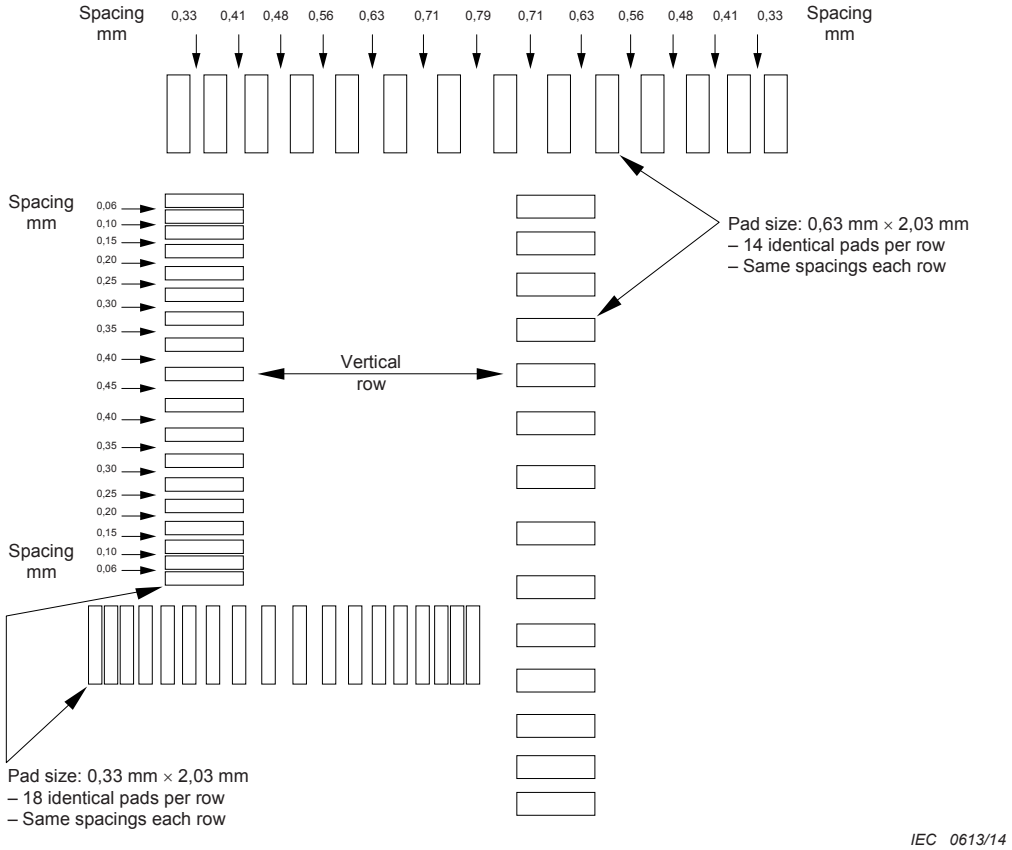


Figure 1 – Slump test stencil thickness, 0,20 mm

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.

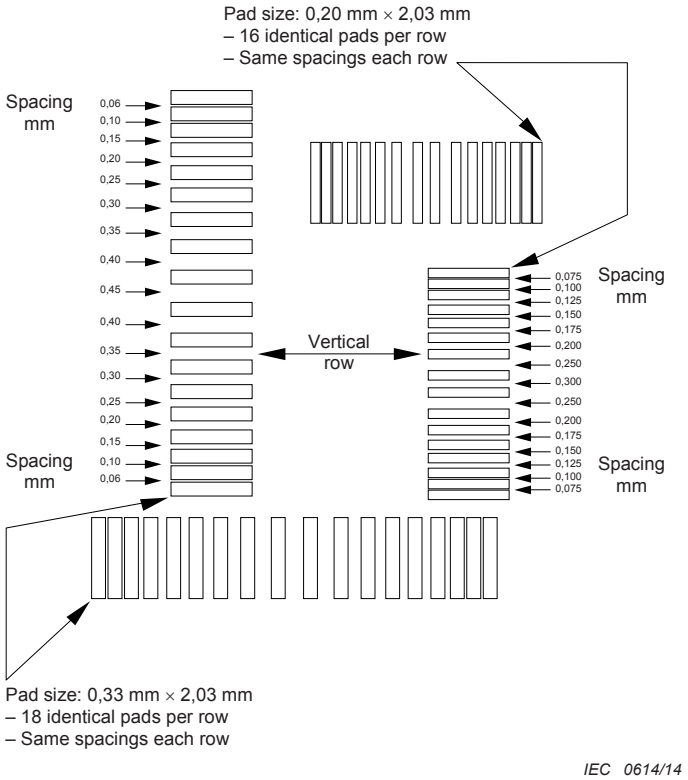


Figure 2 – Slump test stencil thickness, 0,10 mm

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.

6.10 Tack test

The solder paste shall be tested in accordance with IEC-61189-5-3, test method 5-3X09. Minimum holding force and time shall be agreed upon by user and supplier.

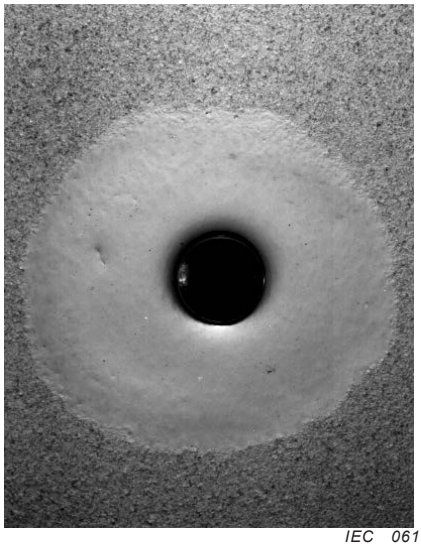
6.11 Wetting

When tested in accordance with IEC-61189-5-3, test method 5-3X10, the solder paste shall uniformly wet the copper lands of the coupon without evidence of dewetting or non-wetting. If the solder paste is required to reflow under a nitrogen atmosphere, for example in case of indium (In) containing solder paste, wetting test under a controlled nitrogen atmosphere should be allowable.

6.12 Labelling

The supplier shall label each container of solder paste with the following:

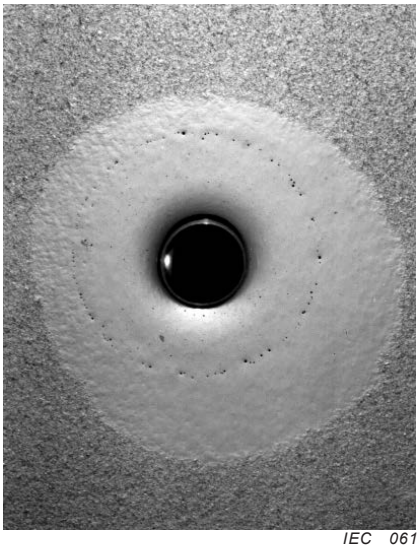
a) the supplier's name and address;
b) the paste classification/designation, for example, designation of alloy name, designation of powder size , flux classification, and supplier's designation of the solder paste, if different;
c) the net mass of solder paste;
d) the batch number;
e) the date of manufacture;
f) expiration date (see Clause 9);
g) all required environment, health and safety warnings;
h) percent metal;
i) information about lead free soldering process if necessary.



IEC 0615/14

The solder paste has melted into a big single solder ball.

a) Category 1 – Preferred (pass)



IEC 0616/14

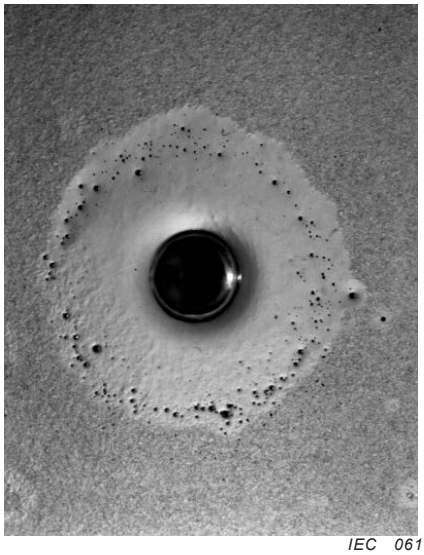
The solder paste has melted into a big solder ball, which must not be surrounded by clustered small solder balls.

b) Category 2 – Acceptable (pass)

IEC 0617/14

The solder paste has melted into a big solder ball, which is surrounded by clustered solder balls.

c) Category 3 – Unacceptable, clusters (reject)



IEC 0618/14

The molten solder paste has not melted completely or has formed many individual solder balls.

d) Category 4 – Unacceptable (reject)

Figure 3 – Solder ball test standards

7 Quality assurance provisions

7.1 Responsibility for inspection

7.1.1 General

The solder paste supplier is responsible for the performance of all inspection specified herein except the performance inspections which are the responsibility of the user. The solder paste

supplier may use its own or any other facilities suitable for the performance of the inspections specified herein, unless disapproved by the user. The user reserves the right to perform any of the inspections set forth in the specification where such inspections are deemed necessary to ensure that supplies and services conform to prescribed requirements.

7.1.2 Responsibility for compliance

7.1.2.1 General

Materials covered by this specification shall meet all requirements of Clause 6. The inspection(s) excluding the performance inspections defined in this specification shall become a part of the supplier's overall inspection system or quality program. The supplier has responsibility of ensuring that all products or supplies submitted to the user for acceptance comply with all requirements of the purchase order contract.

7.1.2.2 Quality assurance program

When required by the user, a quality assurance program for material furnished under this specification shall be established and maintained in accordance with a quality assurance system, or as otherwise agreed on between user and supplier, and shall be monitored by the qualifying activity.

7.1.3 Test equipment and inspection facilities

Test/measuring equipment and inspection facilities, of sufficient accuracy, quality, and quantity to permit performance of the required inspection(s), shall be established and maintained or designated by the supplier. Establishment and maintenance of a calibration system to control the accuracy of the measuring and test equipment shall be in accordance with an agreed-upon quality assurance system.

7.1.4 Inspection conditions

Unless otherwise specified herein, all inspections shall be performed in accordance with the test conditions specified in Clause 6.

7.2 Classification for inspections

The inspections specified herein are classified as follows:

a) qualification inspection (7.4);

b) quality conformance (7.5);

c) performance inspection (9).

7.3 Inspection report form

Table A.1 is a report form suitable, and recommended, for recording the results of solder paste inspections. Where definitive test results are not required or appropriate, successful completion of inspections should be indicated by checkmarks on the solder paste report form.

7.4 Qualification inspection

7.4.1 General

Qualification inspection may be performed at accredited laboratory or a laboratory acceptable to the user on samples produced with equipment and procedures normally used in production.

7.4.2 Sample size

Sample sizes shall be appropriate to the solder paste being inspected and the inspection being performed.

7.4.3 Inspection routine

The sample shall be subjected to the inspections specified in Table 4.

Table 4 – Solder paste qualification inspection

Inspection	IEC 61189-5-3 test method	Qualification
Metal content (6.6)	5-3X16(6X05)[2]	X
Viscosity (6.7.2)	5-3X03, 5-3X04, 5-3X05, 5-3X06	X
Solder ball (6.9.2, 6.9.3)	5-3X08	X
Slump (6.8.2, 6.8.3)	5-3X07	X
Alloy composition (6.3)	Standard analytical procedure	X
Flux characterization (6.4)	IEC 61190-1-1	X
Flux characteristics (6.4)	IEC 61190-1-1	X
Powder size (6.5.2.3)	5-3X11(6X01)[2], 5-3X12(6X02)[2], 5-3X13(6X03)[2], 5-3X14(6X04)[2]	X
Maximum powder size (6.5.2.2)	5-3X15(6X04)[2]	X
Powder shape (6.5.3.2)	Binocular microscope, sufficient magnification	X
Tack (6.10)	5-3X09	X
Wetting (6.11)	5-3X10	X

7.5 Quality conformance

7.5.1 General

The material supplier shall perform those inspections necessary to insure that the process is in control and to insure that the product is within specification limit.

7.5.2 Sampling plan

Statistical sampling and inspection shall be in accordance with an approved quality program. (See 7.1.2).

7.5.3 Rejected lots

If an inspection lot is rejected, the supplier may modify it to correct the defects, or screen out the defective units and resubmit for reinspection. Resubmitted lots shall be subject to tightened inspection. Such lots shall be separate from new lots, and shall be clearly identified as reinspected lots.

8 Preparation for delivery

Preservation packaging, packing and marking for shipment, and identification shall be as specified in the contract or purchase order.

9 Additional information – Performance and shelf life extension inspections

Performance inspections are useful in assessing how well the solder products will perform in a particular application. Table 5 indicates the methodology that the user should employ to verify performance and shelf life extension of solder paste.

Table 5 – User inspection for solder paste prior to use

Inspections	IEC 61189-5-3 test method	Performance	Shelf life extension
Visual		X	X
Viscosity (6.7.2)	5-3X03, 5-3X04, 5-3X05, 5-3X06	X	X
Solder ball (6.9.2, 6.9.3)	5-3X08	X	
Slump (6.8.2, 6.8.3)	5-3X07	X	
Tack (6.10)	5-3X09	X	
Wetting (6.11)	5-3X10	X	

Annex A
(normative)

Test report on solder paste

Table A.1 – Solder paste inspection report form

Enter appropriate/information in top portion of report and complete report by entering the test results or checkmarks in the appropriate spaces. Add the measurements, values, pictures, et al. as an attachment to this report.

Inspection purpose:

_____Qualification

_____Shelf life extension

_____Performance

Supplier's identification_____

Supplier's batch number_____

Date of manufacture _____

Original USE-by date_____

Revised USE-by date_____

Date inspection completed: _____

Overall results: _____Pass_____Fail

Inspection performed by:

_____

Witnessed by:

_____

Inspections	Requirement clause	Test method	User's actual requirement	Test result	P/F *	Tested by and date
Material						
Visual						
Metal content						
Viscosity						
Solder ball						
Slump						
Alloy						
Flux						
Powder size						
% in top screen						
% in bottom screen						
% in receiver bottom						
Max. powder size						
Powder shape						
Tack						
Wetting						
* P/F = pass/fail; enter P if test results are within tolerance of actual requirement; otherwise, enter F.						

Annex B
(informative)

Reflow condition and profile[5]

While a number of factors can cause formation of solder balls, solder beading and splatter during the reflow process, the introduction of no-clean processes in electronic manufacturing has given rise to greater levels of solder balling. Solder balling appears as one or more spheres of solder separated from the main body of the solder connection with a typical diameter of around 0.5 mm or less. The following process evaluations are recommended for improving the process in order to avoid this condition.

Change profile: Change temperature profile to reduce solder balling and beading should be done in accordance with paste manufacture's recommended specification.

Change atmosphere: As solid-content, or activator levels, are reduced, it may become necessary to recommend reflow in atmosphere containing less than the standard 21% oxygen (air).

Preheat: Higher temperatures, and longer times at those temperatures, volatilize activators rapidly. Most organic materials have a measurable vapor pressure over 150 ^{o}C (302,0 ^{o}F). Also, the oxidation of metal surfaces (solder powder and land/component terminations, alike) is increased by longer times at high temperatures. Lowering the preheat temperature and shortening the preheat time allow more paste vehicles to remain liquid into reflow portion of the profile. This tends to reduce the formation of solder balls.

Atmosphere type: Reduced oxygen environments (e.g. a nitrogen atmosphere) can potentially reduce or eliminate certain soldering defects such as solder balling. Nitrogen improves coalescence without increasing paste activation. Additionally, nitrogen offers an added benefit by eliminating reoxidation after the initial surface activation has been completed.

Deposit size: Thicker and wider paste deposits lose activator more slowly than small, thin ones, due to their lower surface area/volume ratio.

If necessary, reference can be made to Appendix A "Mass reflow assembly of 02/01 components", Appendix B "Qualification of Solder beading and Tombstoning in passive Devices using Designed Experiments" and Appendix C "A materials based solution for the Elimination of Tombstones" of the "Guide of solder paste assessment, IPC-HDBK-005".

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5 See IPC-HDBK-005, 8.2.6 Process strategies.

Annex C
(informative)

Typical comparison of particle size distributions between laser diffraction method and screen method[6]

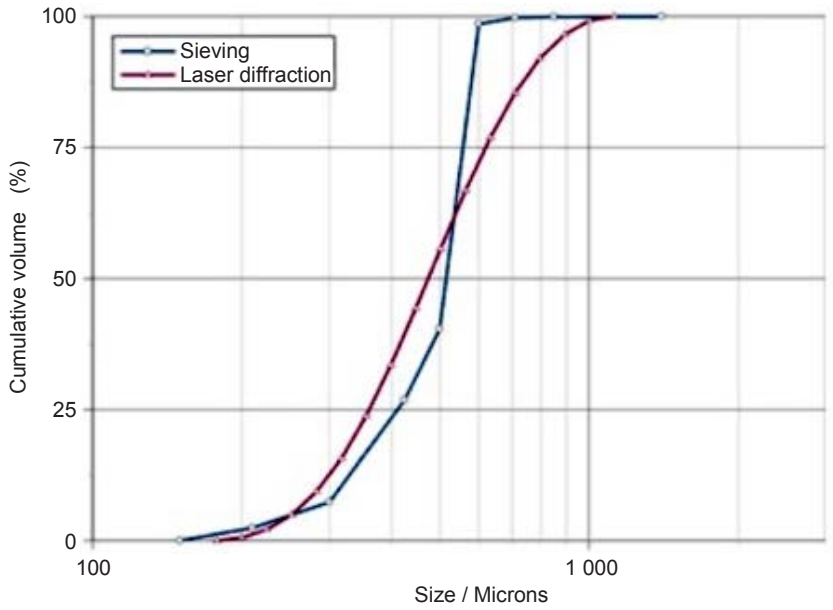
There is an incompatibility between methods such as sieving and image analysis that measure powder size distributions directly, and methods such as laser sizing which measure powder size distributions indirectly and use algorithms to derive powder size distributions from measured data.

Laser sizing methods are attractive because they can analyze relatively large powder samples and give very reproducible results, in contrast to image analysis which can only examine small powder samples and give poorly reproducible results.

Laser sizing methods use algorithms to calculate particle size distributions from scattering data. The algorithms assume smooth wide particle size distributions and do not give reliable (true) powder size distributions when applied to powder size distributions with sharp (sieved) cut-offs. In addition, different machines use different algorithms and give different results. The following Figure C.1 discusses drawbacks of laser sizing.

In order to give a true oversize measurement it is recommended to calibrate sizing powder size distributions against other direct sizing methods such as image analysis.

The following figure is a graph from Malvern Instruments [7] showing different oversize measurements between sieving and laser sizing.



Typical comparison between laser diffraction and sieving showing how the different properties measured by each technique changes the reported size distribution.

IEC 0619/14

Figure C.1 – Typical comparison between laser diffraction and sieving

6 Information from UK on particle size distributions measured by different properties.

7 Reproduced with the permission of Malvern Instruments Ltd.

Bibliography

IEC 61189-5:2006, *Test methods for electrical materials, interconnection structures and assemblies - Part 5: Test methods for printed board assemblies*

IEC 61189-6:2006, *Test methods for electrical materials, interconnection structures and assemblies - Part 6: Test methods for materials used in manufacturing electronic assemblies*

IPC-HDBK-005, *Guide of solder paste assessment*

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