JOINT

INDUSTRY

STANDARD

Requirements for Soldering Pastes

J Standard 005A

December 2011

Requirements for Soldering Pastes

1.0 SCOPE

1.1 Scope This standard prescribes general requirements for the characterization and testing of solder pastes used to make high quality electronic interconnections. This specification is a quality control document and is not intended to relate directly to the material's performance in the manufacturing process. Solder paste buyers are referred to 6.3 for a listing of requirements information and options which should be addressed when preparing an order for J-STD-005 solder pastes.

1.1.1 Purpose This standard defines the characteristics of solder paste through the definitions of properties and specification of test methods and inspection criteria. The materials include solder powder and solder paste flux blended to produce solder paste. Solder powders are classified as to shape of the particles and size distribution of the particles. It is not the intent of this standard to exclude particle sizes or distributions not specifically listed. The flux properties of the solder paste, including classification and testing, **shall** be based on J-STD-004B. The requirements for solder paste are defined in general terms. In practice, where more stringent requirements are necessary, additional requirements **shall** 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.

2.0 APPLICABLE DOCUMENTS

The following documents of the issue currently in effect, form a part of this specification to the extent specified herein.

2.1 Joint Standards[1]

J-STD-001 Soldering requirements for Electronic Interconnections (Supersedes IPC-S-815)
J-STD-004 Requirements for Soldering Fluxes (Supersedes IPC-SF-818)
J-STD-006 Requirements for Alloys and Solder Products

2.2 International Standards Organization[3]

ISO 9001 Quality Systems − Model for Quality Assurance in Design, Development, Production, Installation and Servicing.

2.3 IPC[1]

IPC-A-20 Fine pitch stencil pattern for Slump.

IPC-A-21 Standard pitch stencil pattern for Slump.

IPC-T-50 Terms and Definitions for Interconnecting and Packaging Electronic Circuits

IPC-TM-650 Test Methods Manual

- **2.2.14.3** Determination of Maximum Solder Powder Particle Size
- **2.2.20** Solder Paste Metal Content by Weight
- **2.4.34** Solder Paste Viscosity—T-Bar Spin Spindle Method (Applicable for 300,000 to 1,600,000 centipoise)
- **2.4.34.1** Solder Paste Viscosity—T-Bar Spindle Method (Applicable at less than 300,000 centipoise)
- **2.4.34.2** Solder Paste Viscosity—Spiral Pump Method (Applicable for 300,000 to 1,600,000 centipoise)
- **2.4.34.3** Solder Paste Viscosity—Spiral Pump Method (Applicable at less than 300,000 centipoise)
- **2.4.35** Solder Paste—Slump Test
- **2.4.43** Solder Paste—Solder Ball Test
- **2.4.44** Solder Paste—Tack Test
- **2.4.45** Solder Paste—Wetting Test

2.4 American Society for Testing Materials[4]

ASTM D-1210 Fineness of Dispersion of Pigment Vehicle Systems

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1. Application for copies should be addressed to the IPC, 3000 Lakeside Drive, Suite 309S, Bannockburn, Illinois 60015-1219
2. Publications are available from Standardization Documents Order Dept., Building 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5090
3. Publications are available from the International Standards Organization 1 Rue de Varembe, Case 56, CH-1211 Geneve 20 Switzerland
4. American Society forTesting Materials, 1916 Race Street, Philadelphia, PA 19103-1187

3.0 REQUIREMENTS

3.1 General Requirements

3.1 .1 Conflict In the event of conflict between the requirements of this specification and other requirements of the applicable

acquisition documents, the precedence in which documents **shall** govern in descending order is as follows:

1. The applicable acquisition document
2. The applicable specification sheet/drawing
3. This standard
4. Applicable referenced documents (see paragraph 2.0)

3.1 .2 Terms and Definitions Definitions applicable to this specification **shall** conform to IPC-T-50, J-STD-001D, J-STD-004B, and as follows. The terms and definitions are in accordance with IPC-T-50.

3.1.2.1 Centipoise* CGS unit of the dynamic measurement of viscosity equal to 1/100 poise. See viscosity.

3.1.2.2 Drying* Ambient or heating process to evaporate volatile components from solder paste which may, or may not, result in melting of rosin/resin.

3.1.2.3 Micron* Equal to 1×10^{-6} meters or 39.4×10^{-6} inches.

3.1.2.4 Rheology* The study of the change in form and the flow of matter, generally characterized by elasticity, viscosity, and plasticity.

3.1.2.5 Thinner (Paste) A solvent or paste system with, or without, activator which is added to solder paste to replace evaporated solvents, adjust viscosity, or reduce solids content.

3.1.2.6 Viscosity* The internal friction of a fluid, caused by molecular attraction, which makes it resist a tendency to flow. Expressed in dyne-seconds per cm^2 (poise) or centipoises.

3.2 Description of Product The description of a solder paste product should identify all applicable characteristics, such as: alloy, flux, powder, metal content, viscosity, unit package size, etc. The description system in Table 1 may be used to concisely describe standard solder paste products and to partially describe non-standard solder paste products. Complete description of non-standard solder paste products usually requires the use of tabular or narrative format, because the number of possible variations in characteristics cannot be easily coded into a concise format.

Table 1 System to Describe Solder Paste Products Description

	Solder Paste Product Characteristic
	Alloy Short name from Appendix A of J-STD-006
	Solder Form[1] - P for all solder paste products
	Flux designator from Table 1 of J-STD-004
	Powder type designation from Table 2
	Metal content in percent by mass (e.g., 91, 92)
	Viscosity (Reference Manufacturer's Product Data Sheet)
	Package unit mass in kilogram (e.g., 0.5, 0.001, 0.010)

Note: [1] The Solder Form code is used to distinguish between various solder forms which use similar description formats.

3.2.1 Alloy Composition The percentage of each element in an alloy **shall** be determined by any standard analytical procedure with sufficient resolution.. Wet chemistry **shall** be used as the reference procedure. The tolerance & impurity levels of the alloy must conform with the current version of J-STD-006. All manufacturer's designed alloy additions AABUS **shall** be identified as a fraction of the weight of the alloy.**3.2.2 Flux Characterization and Inspection** The fluxes in solder pastes **shall** be characterized by the manufacturer in accordance with the flux characterization requirements specified in J-STD-004 and **shall** be inspected in accordance with the flux inspection requirements of J-STD-004. The results of these inspections should be recorded on the report form included in J-STD-004B and the flux type **shall** be recorded on the solder paste report form.

3.3 Solder Powder Particle Size

* See IPC-T-50

3.3.1 Powder Size Determination Powder size determination using laser diffraction or alternate test procedures **shall** be agreed upon by user and supplier (AABUS). Powder size **shall** be by weight %, not population

3.3.2 Powder Size When tested in accordance with paragraph 3.3.2.1, the powder size **shall** be classified by type as per a standard sieve size or nearest sieve size shown which matches Table 2 dimensions. Powder used for testing should be from virgin powder, not extracted from solder paste.

3.3.2.1 Maximum Powder Size (Fineness of Grind) The maximum powder size **shall** be determined with a fineness of grind gauge (Hegmann) type CMA 185, or equivalent, in accordance with ASTM D-1210 or IPC-TM-650, method 2.2.14.3.

3.3.2.2 Solder Powder Powder particle size distribution **shall** be determined by IPC-TM-650, Test Method 2.2.14, Test Method 2.2.14.1, or Test Method 2.2.14.2.

3.3.3 Solder Powder Particle Shape

3.3.3.1 Powder Shape Solder powder shape **shall** be spherical with maximum length-to-width ratio of 1.25 when tested in accordance with paragraphs 3.3.3.1.1 and 3.3.3.1.2. Other shapes **shall** be acceptable if agreed upon by user and supplier (AABUS).

3.3.3.1 .1 Determination of Solder Powder Particle Shape Solder powder particle shape should be spherical and **shall** be determined by AABUS. (Table 2 subgroup will present an alternative)

Table 2 % of Sample by Weight—Nominal Size

Type	Less than 0.5% larger than	10% max between	80% Minimum Between	10% Maximum Less Than
1	160	150-160	75 – 150	75
2	80	75-80	45 – 75	45
3	60	45-60	25 - 45	25
4	50	38-50	20 - 38	20
5	40	25-40	15 - 25	15
6	25	15-25	5 - 15	5
7	15	11-15	2-11	2

3.4 Metal Percent The metal content should be between 65-96% as specified in weight percent when tested in accordance with IPC-TM-650, method 2.2.20. The metal percent **shall** be within +/-1% of the nominal value specified on the user's purchase order.

3.5 Viscosity The measured viscosity **shall** be within +/- 15 of the value specified by the user. The measurement and test conditions **shall** be in accordance with paragraph 3.5.1.

3.5.1 Methods of Determining Viscosity The methods for determining the viscosity of solder paste in the range of 300,000 to 1,600,000 centipoise **shall** be in accordance with IPC-TM-650, method 2.4.34 or method 2.4.34.2. The method for determining viscosity of solder paste in the range of 50,000 to 300,000 centipoise **shall** be in accordance with IPC-TM-650, method 2.4.34.1 or method 2.4.34.3.

3.6 Slump Test Unless otherwise specified in the contract or purchase order, slump is assessed using two stencil thicknesses

and three pad (deposit) sizes in accordance with paragraphs 3.6.1 and 3.6.2. Unless agreed on by supplier and user, ceramic coupons, as specified in TM-650, 2.4.35, shall be used as the test substrates for slump. For purposes of this test a bridge is defined as any location where there are 2 or more solder spheres or particles touching each other and the solder bricks to either side.

3.6.1 Test with 0.2 mm Thick Stencil The 0.63 x 2.03mm pads of IPC-A-21 (see Figure 1) when tested in accordance with paragraph 5.2.1 in IPC-TM-650, method 2.4.35 **shall** show no evidence of bridging between pads when spacing is 0.56 mm or greater. When tested in accordance with paragraph 5.2.2 in IPC-TM-650, method 2.4.35 the specimen **shall** show no evidence of bridging between pads when the spacing is 0.63mm or greater. (For higher melting solders than eutectic tin-lead, e.g. lead free alloys, the sample will be tested at a temperature of 35° C below the melting point when tested as per 5.2.2.) The 0.33 x 2.03 mm pads (Figure 1) of the IPC-A-21 pattern when tested as per paragraph 5.2.1 in IPC-TM-650, method 2.4.35, **shall** show no evidence of bridging at spacing of 0.25 mm or greater and when tested as per paragraph 5.2.2 of IPC-TM650, method 2.4.3 5, **shall** show no evidence of bridging at spacing of 0.30 mm or greater.

3.6.2 Test with 0.1 mm Thick Stencil The 0.33 mm x 2.03 mm pads of IPC-A-20 (see Figure 2) when tested in accordance with paragraph 5.2.1 in IPC-TM-650, method 2.4.3 5 **shall** show no evidence of bridging at spacing of 0.25 mm or greater and when tested as per paragraph 5.2.2 of IPC-TM-650, method 2.4.35, **shall** show no evidence of bridging at spacing at 0.30 mm or greater. (For higher melting solders than eutectic tin-lead, e.g. lead free alloys, the sample will be tested at a temperature of 35° C below the melting point when tested as per 5.2.2.)

The 0.2 mm x 2.03 mm pads (Figure 2) of the IPC-A-20 pattern when tested in accordance with paragraph 5.2.1 in IPC-TM-650, method 2.4.35 **shall** show no bridging at spacing of 0.175 mm or greater and when tested in accordance with paragraph 5.2.2 of IPC-TM-650, method 2.4.35, **shall** show no evidence of bridging at spacing of 0.20 mm or greater.

3.7 Solder Ball Test The solder paste when tested in accordance with the applicable method listed below **shall** meet the requirements specified.

3.7.1 Type 1-4 Powder The solder paste with Type 1 through 4 type powders defined in IPC-TM-650, method 2.4.43, **shall** meet the acceptance criteria presented in Figure 3.

3.7.2 Type 5-6 Powder The solder paste with Type 5 through 6 type powder as defined in IPC-TM-650, method 2.4.43, **shall** meet the acceptance criteria presented in Figure 3.

3.7.3 Type 7 Powder The solder paste with type 7 powders does not require testing.

3.8 Tack Test The solder paste **shall** be tested in accordance with IPC-TM-650, method 2.4.44. Minimum holding force and time **shall** be agreed upon by user and supplier (AABUS).

3.9 Wetting When tested in accordance with IPC-TM-650, method 2.4.45, the solder paste **shall** uniformly wet the copper coupon without evidence of dewetting or non-wetting.

3.10 Labeling The manufacturer **shall** label each container of solder paste with the following:

a. The manufacturer's name and address.
b. The solder paste classification (type designation), and the manufacturer's designation of the solder paste, if different. (See 3.2, Table 1)
c. The net mass of solder paste.
d. The batch number.
e. The date of manufacture.
f. All required health and safety warnings.
g. Additional information **shall** comply with J-STD-609.
h. Expiration date at recommended storage temperatures

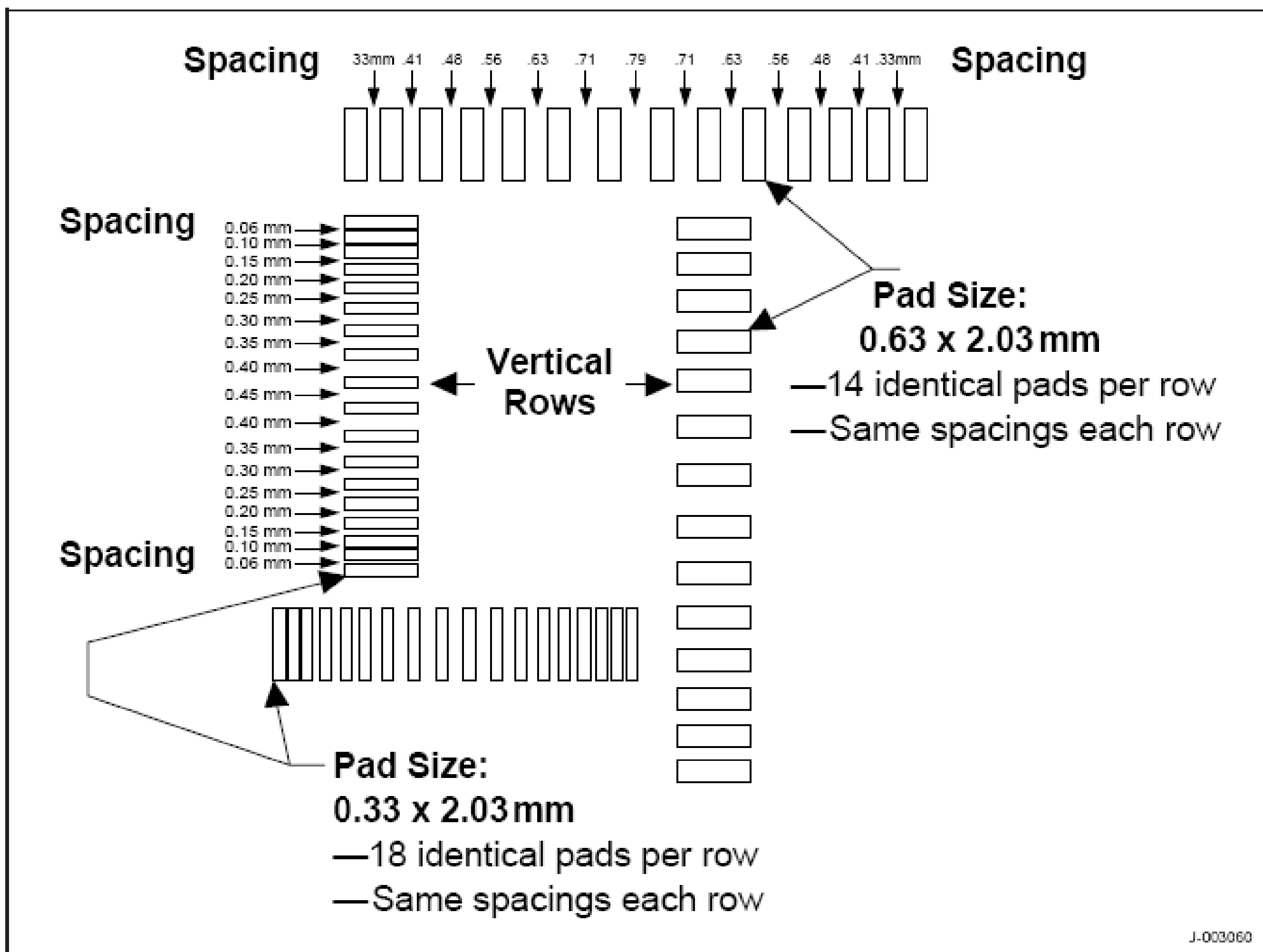


Figure 1 Slump Test Stencil Thickness – 0.20 mm

4.0 QUALITY ASSURANCE PROVISIONS

4.1 Responsibility for Inspection The solder paste manufacturer is responsible for the performance of all inspection specified herein except the performance inspections which are the responsibility of the user. The solder paste manufacturer may use its own or any other facilities suitable for the performance of the inspections specified herein, unless disapproved by the user. It is the responsibility of the supplier to ascertain that all solder products or supplies delivered to the user or submitted for user acceptance conform to the requirements of the contract or purchase order and Section 3, herein. The absence of any inspection requirements **shall** not relieve the supplier of this responsibility. 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.

4.1.1 Responsibility for Compliance Materials covered by this specification **shall** meet all requirements of Section **3.** The inspection(s), excluding the performance inspections defined in this specification, **shall** become a part of the contractor'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.

4.1.1.1 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 ISO 9001 or as otherwise agreed on between user and supplier (AABUS), and **shall** be monitored by the qualifying activity.

4.1.2 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 ISO 10012 Part 1.

4.1.3 Inspection Conditions Unless otherwise specified herein, all inspections **shall** be performed in accordance with the test conditions specified in Section **3** and in test methods listed herein**.**

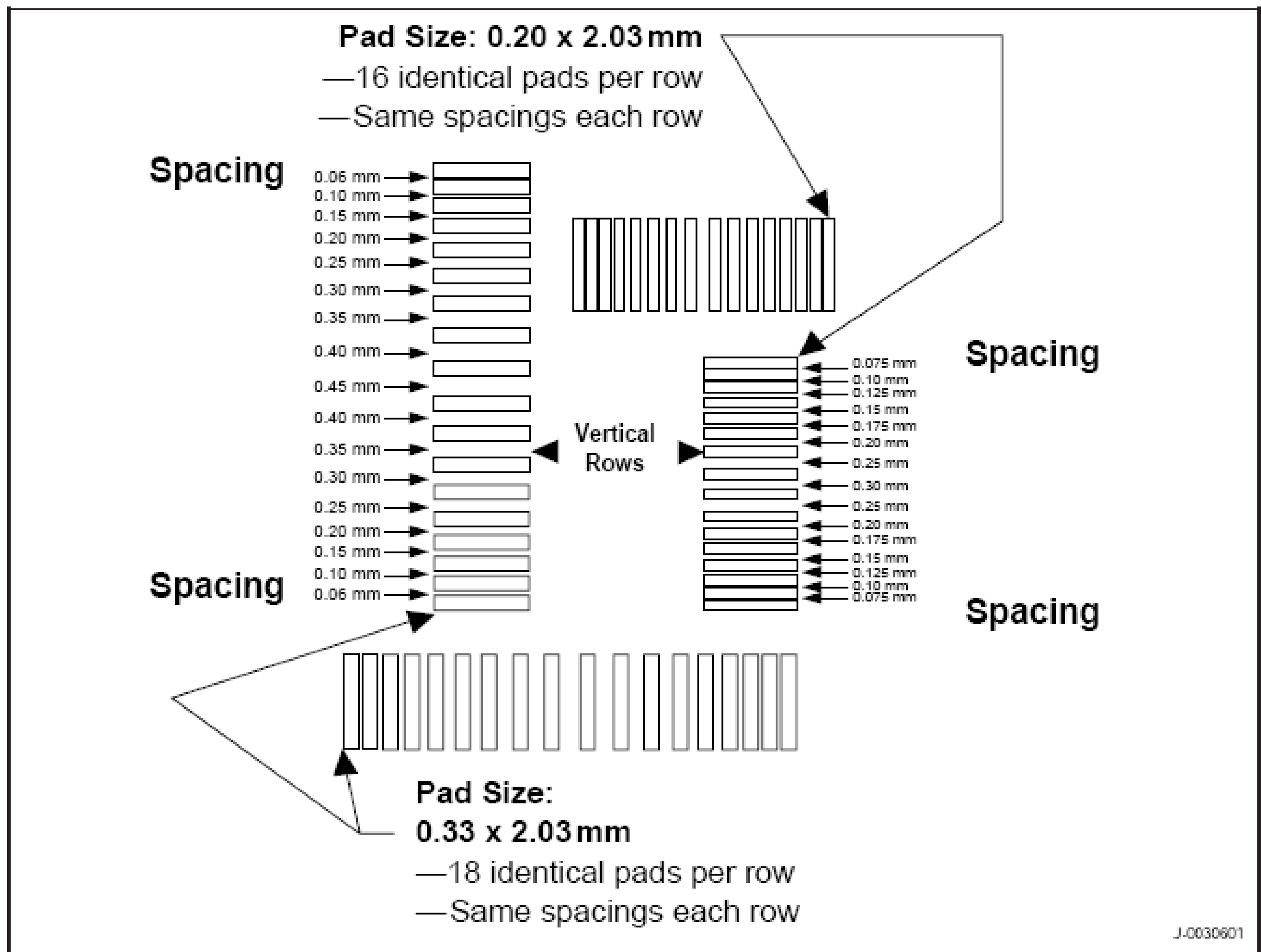


Figure 2 Slump Test Stencil Thickness 0.10 mm

4.2 Classification of Inspections The inspections specified herein are classified as follows:

1. Qualification Inspection **(4.4)**

2. Quality Conformance **(4.5)**

4.3 Inspection Report Form Figure **4** 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.

4.4 Qualification Inspection Qualification inspections **shall** be performed at a laboratory acceptable to the user and inspections **shall** consist of examinations and tests of materials, processes, and products needed to ascertain that a manufacturing facility has the necessary facilities and expertise to make acceptable solder paste. In determining the acceptability of a manufacturing facility as a source for solder paste, users are encouraged to utilize the documented results of product inspections previously performed by the manufacturing facility to the maximum extent possible in lieu of requiring new qualification inspections. Solder paste samples, which have been produced using the materials equipment, processes, and procedures used in production, **shall** be subjected to the qualification inspections specified. The standard qualification inspections for solder paste covered by this standard are listed in Table 3. Unless otherwise specified, the qualification inspections **shall** be conducted using the procedures specified herein.

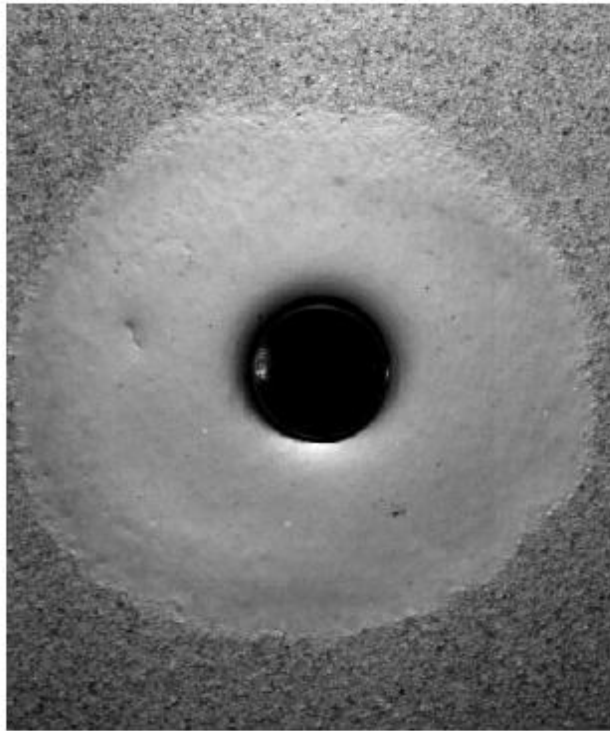
4.4.1 Sample Size A minimum of two 300 to 500 g containers of solder paste **shall** be submitted for qualification inspection.

4.4.2 Inspection Routine The samples **shall** be subjected to the inspections specified in Table 3 and **shall** be performed to verify the ability of a solder paste manufacturer to meet the qualification and/or quality conformance requirements of this standard.

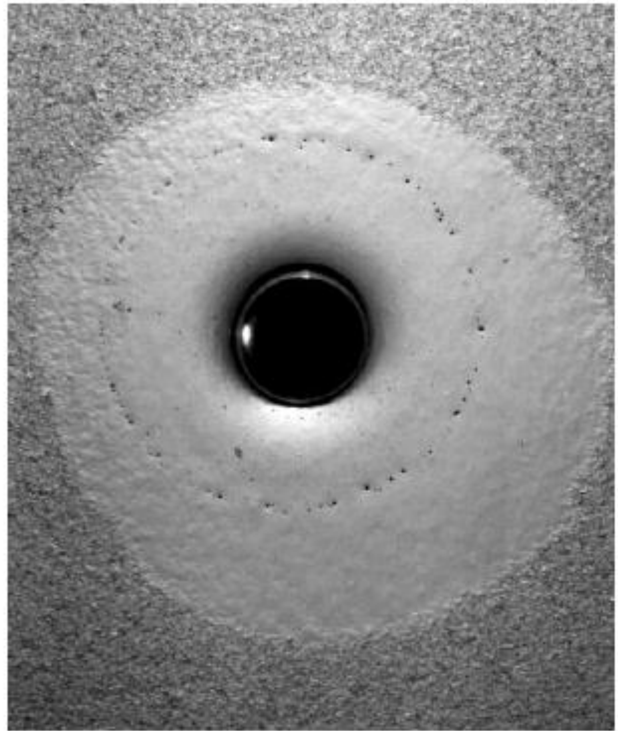
4.5 Quality Conformance The material manufacturer **shall** perform those inspections necessary to ensure that the process is in control and the product is within specification limits.

4.5.1 Sampling Plan Statistical sampling and inspection **shall** be in accordance with an approved quality program. (See 4.1.1.1).

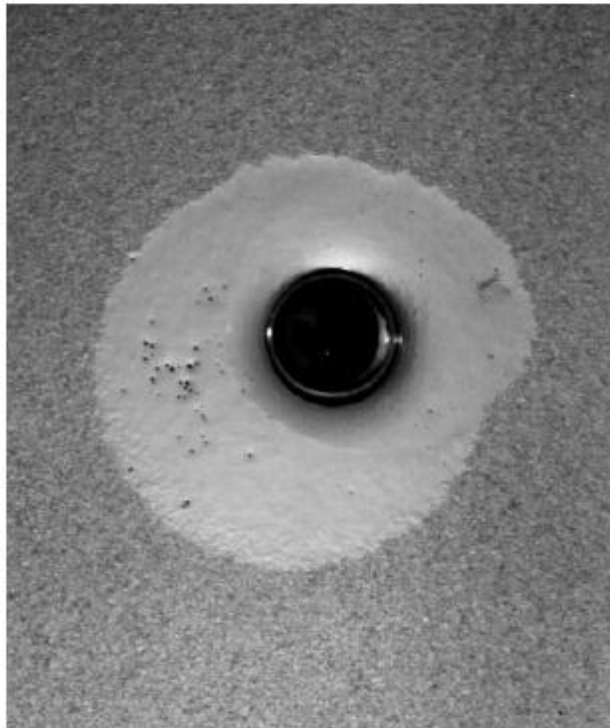
4.5.2 Rejected Lots If an inspection lot is rejected, the supplier may rework it to correct the defects, or screen out the defective units and resubmit for reinspection. Resubmitted lots **shall** be inspected using tightened inspection. Such lots **shall** be separated from new lots, and **shall** be clearly identified as reinspected lots.



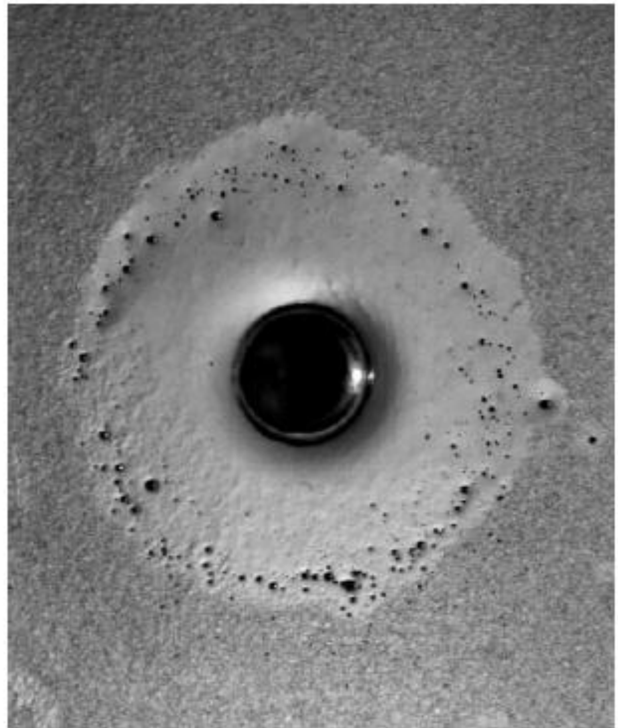
Preferred



Acceptable



Unacceptable; Clusters



Unacceptable

Figure 3 Solder ball test standards

Table 3: Qualification, Quality Conformance and Performance Testing for Solder Paste

Test Method		Reference Paragraph	Qualification	Quality Conformance	User Performance Inspection
Name	IPC-TM-650 or Other Method				
Visual			R		R
Material			R		
Metal Content	2.2.20	3.4	R	R	
Viscosity	2.4.34, 2.4.31.1, 2.4.34.2, 2.4.34.3	3.5	R	R	R
Solder Ball	2.4.43	3.7	R	R	R
Slump	2.4.35	3.6	R	O	R
Alloy Composition	J-STD-006		R	R*	
Flux Designation	J-STD-004		R	R*	
Powder Class	2.2.14, 2.2.14.2, 2.2.14.1, 2.2.14.3	3.3	R	R*	
Maximum Powder Size	2.2.14.3	3.3.2.1	R		
Powder Shape		3.3.3.1	R		
Tack	2.4.44	3.8	R		R
Wetting	2.4.45	3.9	R		R

***Quality conformance testing on the powder and flux which are used in the batch of paste being tested.**

5.0 PREPARATION FOR DELIVERY Preservation packaging, packing and marking for shipment, and identification **shall** be as specified in the contract or purchase order. (See 6.0)

6.0 NOTES

6.1 This document is intended to be applicable to all types of solder paste as used for soldering in general and to soldering in electronics in particular. The solder pastes involved relate to all application types.

6.2 Shelf Life Any use of the material beyond the stated shelf life on the product should be AABUS.

6.3 Acquisition Requirements Acquisition documents should specify the following:

a. Number, revision, title, and date of this standard
b. Alloy designation (see 3.2)
c. Flux type (see 3.2.2)
d. Standard powder size number (see 3.3.2, Tables 2), or size characteristics of non-standard powder
e. Powder shape, if different (see 3.3.3)
f. Metal percent
g. Viscosity (see 3.5)
h. Slump test, if required (see 3.6)
i. Solder ball test, if required (see 3.7)
j. Tack test, if required (see 3.8)
k. Wetting test, if required (see 3.9)
l. Labeling requirements, if different (see 3.10)
m. Qualification and quality conformance inspections (see 4.1)
n. Preservation, packing, packaging, and exterior marking requirements (see 5.0)

Test Report on Solder Paste

(Enter appropriate information in top portion of report and complete report by entering the test results or checkmarks in the appropriate spaces.)

Inspection Purpose:

___ Qualification

___ Shelf-Life Extension

___ Performance

Manufacturer's Identification______________________________

Manufacturer'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 Paragraph	Test Method	User's Actual Requirement	Test Result	P/F (*)	Tested by & Date
Material						
Visual						
Metal Content	3.4	2.2.20				
Viscosity	3.5	2.4.34, 2.4.34.1, 2.4.34.2, 2.4.34.3				
Solder Ball	3.7	2.4.43				
Slump	3.6	2.4.35				
Alloy						
Flux						
Powder Size	3.3	2.2.14, 2.2.14.2, 2.2.14.1, 2.2.14.3				
%in Top Screen						
% in Next Screen						
% in Bottom Screen						
% in Receiver Bottom						
Max. Powder Size	3.3.2.1	2.2.14.3				
Powder Shape	3.3.3.1					
Tack	3.8	2.4.44				
Wetting	3.9	2.4.45				

*P/F = Pass/Fail; enter P if test results are within tolerance of actual requirement; otherwise, enter F.

Figure 4 Solder Paste Inspection Report Form