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**Environmental testing: Tests —
Test: Test methods for solderability
of surface mounting devices (SMD)
by wetting balance using lead-free
solder paste**

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Foreword

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|---|----------------------|--|
| 1 | Title of invention | MEASURING DEVICE FOR SOLDERING PERFORMANCE OF CREAM SOLDER |
| | Date of registration | February 2, 2001 (Registration number)
Patent No. 3153884 |
| 2 | Title of invention | METHOD AND DEVICE FOR TESTING SOLDERABILITY AND MICROCRUCIBLE FOR TESTING |
| | Date of registration | December 5, 2003 (Registration number)
Patent No. 3498100 |
| 3 | Title of invention | SOLDERABILITY TEST DEVICE |
| | Date of registration | May 14, 2004 (Registration number)
Patent No. 3552061 |
| 4 | Title of invention | MEASURING METHOD FOR PASTE CHARACTERISTICS AND PASTE CHARACTERISTIC MEASURING INSTRUMENT |
| | Date of registration | April 25, 1997 (Registration number)
Patent No. 2630712 |
| 5 | Title of invention | HIGH-TEMPERATURE SOLDER |
| | Date of registration | January 28, 2000 (Registration number)
Patent No. 3027441 |

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Environmental testing: Tests — Test: Test methods for solderability of surface mounting devices (SMD) by wetting balance using lead-free solder paste

1 Scope This Japanese Industrial Standard specifies the methods for testing the solderability of the metal terminal or the electrode of the surface mounting devices (hereinafter referred to as “SMD”) mounted on a printed wiring board by wetting balance using lead-free solder paste (hereinafter referred to as “solder paste”).

2 Normative references The following standards contain provisions which, through reference in this text, constitute provisions of this Standard. If the indication of the year of coming into effect or the year of publication is given to these referred standards, only the edition of the indicated year constitutes the provision of this Standard but the revision and amendment made thereafter do not apply. The normative references without the indication of the year of coming into effect or the year of publication apply only to the most recent edition (including amendments).

JIS C 5602 *Glossary of passive components for electronic equipment*

JIS C 60068-1:1993 *Environmental testing Part 1: General and guidance*

JIS C 60068-2-20:1996 *Basic environmental testing procedures Part 2: Tests. Test T: Soldering*

JIS C 60068-2-54:1996 *Environmental testing Part 2: tests. Test Ta: Soldering. Solderability testing by the wetting balance method*

JIS C 60068-2-58:2002 *Environmental testing—Part 2: Tests—Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices*

JIS H 3100 *Copper and copper alloy sheets, plates and strips*

JIS K 0061 *Test methods for density and relative density of chemical products*

JIS K 0064 *Test methods for melting point and melting range of chemical products*

JIS K 0066 *Test methods for distillation of chemical products*

JIS K 0067 *Test methods for loss and residue of chemical products*

JIS K 0068 *Test methods for water content of chemical products*

JIS K 0070 *Test methods for acid value, saponification value, ester value, iodine value, hydroxyl value and unsaponifiable matter of chemical products*

JIS K 0114 *General rules for gas chromatographic analysis*

JIS K 5902 *Colophonium*

JIS Z 3197 *Testing methods for soldering fluxes*

JIS Z 3284:1994 *Solder paste*

IEC 61190-1-3:2002 *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*

3 Definitions For the purpose of this Standard, the definitions given in **JIS C 60068-1**, **JIS C 60068-2-20**, **JIS C 60068-2-54**, **JIS C 60068-2-58**, and **JIS C 5602** and the following definitions apply.

- a) **solder wettability** properties of the metal terminal or the electrode surface of SMD to easily get wet within molten solder
- b) **solder paste** a mixture of solder powder and pasty flux
Lead-free solder paste is a generic term for the solder paste using the solder which does not contain lead.
- c) **wetting balance** a method for testing solder wettability of a specimen by measuring the time variation of the acting force received when the specimen is dipped in a molten solder
- d) **start point of heating** the time when the temperature raising by heating is started for a solder paste coated on a test jig plate
- e) **zero line** a line obtained by extending the measuring instrument (force sensor) indication value in the time base direction when a specimen is separated from solder and kept in equilibrium after completion of measurement

4 Outline of test

4.1 Outline Dip a specimen in the solder paste coated on a test jig plate, and heat the solder paste. At this time, detect the resultant force of the buoyant force and the surface tension (hereinafter referred to as “acting force”) which the specimen receives by the melting of solder paste as the wetting force by a force sensor, and continuously record or display it on a recorder through a signal converter as a function of time. The evaluation of wettability shall be based on the relative comparison of the specimen with another specimen of the same shape and dimension.

4.2 Test method For the test method, there are the following two methods.

- a) **Profile method** This method is the test method for evaluating the solderability by measuring the solder wettability of a specimen when the solder paste is melted by the temperature profile near actual reflow soldering conditions using a heating apparatus.
- b) **Rapid heating method** This method is the test method for evaluating the solderability by measuring the solder wettability of a specimen when the solder paste is melted for a short time by rapid heating using a heating apparatus.

5 Solder paste The solder paste used by this test shall be as given in table 1. The detailed requirements of flux for solder paste shall be as specified in Annex 1 table 1.

Table 1 Solder paste

Alloy composition	Flux division	Particle-size-distribution symbol	Nominal metal content	Viscosity
Sn96.5 Ag3.0Cu0.5	1a2N/II	S-4	Mass fraction 88 %	170 Pa · s ± 50 Pa · s

Remarks 1 Solder powder shall be globular in shape.

- 2 For the notation of alloy composition of solder powder, **5.2** of **IEC 61190-1-3** was referred to.
- 3 Flux division shall be as given in table 4 of **JIS Z 3284**.
- 4 Particle-size-distribution symbol shall be as given in table 2 of **JIS Z 3284**.
- 5 The measuring method of viscosity shall be as given in Annex 6 of **JIS Z 3284**.

6 Pretreatment conditions When the pretreatment specification is not specified in the product specification, the specimen shall be “as received” condition, and care shall be taken so that it is free from soil due to touch with fingers or others. When the pretreatment specification is given in the product specification, the oil and fat content may be removed by dipping the specimen in a neutral organic solvent at room temperature. However, any cleaning method other than this method shall not be applied. The specimen may be dried in the air before the test.

When the application of accelerated aging is specified in the product specification, the accelerated aging of the specimen may be performed before the test. For the accelerated aging, any one of the methods specified in **4.5.1** of **JIS C 60068-2-20** shall be applied.

7 In the case of profile method

7.1 Test apparatus The test apparatus used for the profile method for raising temperature by profile shall consist of a measurement system, a heat system and an up-and-down system, and the example shall be shown in figure 1. The detailed requirements of the test apparatus shall be as given in Annex 2.

- a) The measurement system shall consist of a force sensor capable of measuring the perpendicular force which acts on the specimen, a signal conversion section and a record section.
- b) The heat system shall consist of a heat section capable of controlling the temperature profile specified in **7.4.1**.
- c) The up-and-down system shall consist of an up-and-down section capable of controlling the up-and-down condition specified in **7.4.3**.

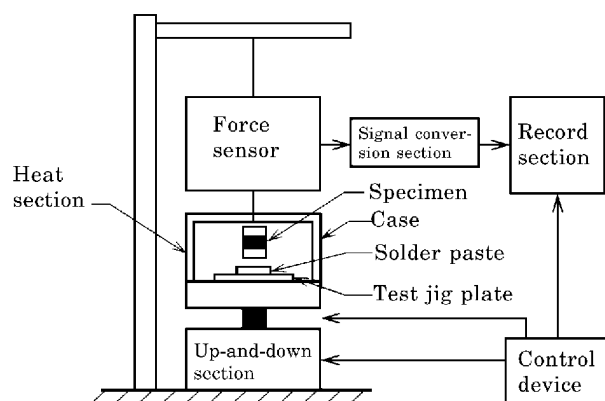


Figure 1 Example of construction of test apparatus used for profile method

7.2 Test jig plate The specification of a test jig plate shall be as given in table 2.

Table 2 Specification of test jig plate for profile method

Item	Specification of test jig plate
Material	Deoxidized copper phosphate (JIS H 3100 C1201P)
Shape	Square-shaped plate
Dimension	15 mm to 35 mm per side
Thickness	0.3 mm $\pm$ 0.03 mm
Warp	± 0.05 mm (for a long side in the case of a rectangle)

7.3 Preconditioning

7.3.1 Preparation of solder paste The solder paste to be used shall have been stored in a dark and cool place at 10 °C or less in a sealed container. The procedure in the case of use for the test shall be as follows.

- Confirm that the solder paste is within an expiration date.
- Take out the solder paste from the dark and cool place, and allow it to stand until it becomes room temperature.
- Open the cover of the container and confirm that there are no clear deterioration and segregation.
- Stir sufficiently until the surface of solder paste and the internal colour tone become uniform.
- After taking out the required quantity, store the solder paste remained in the container in a dark and cool place at 10 °C or less again. However, dispose of the remaining solder paste taken out.

7.3.2 Preparation of test jig plate Use the test jig plate which was stored in a sealed container after cleaning by acid cleaning treatment or was cleaned by acid cleaning treatment before the test. When using the stored test jig plate by opening the sealed container, use the test jig plate taken out within the day when the test is performed. Exchange the test jig plate for every test.

7.3.3 Preparation of specimen holder Clean the specimen holder with a neutral organic solvent for every measurement since it is contaminated by the upward wetting of a flux contained in a solder paste. At this time, the ultrasonic cleaning should be used concurrently. However, this cleaning may be omitted when the degree of contamination is slight and there is little possibility of any doubts arising in a judgement.

7.4 Test condition

7.4.1 Test temperature The test temperature shall be the temperature of a test jig plate. The relation between the test temperature of a test jig plate and the time (hereinafter referred to as “temperature profile”) shall be as shown in figure 2.

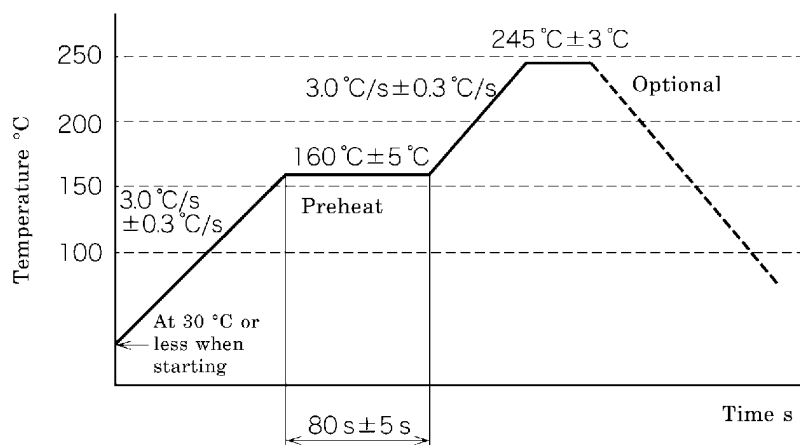
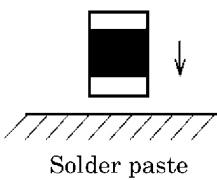


Figure 2 Temperature profile in profile method

7.4.2 Amount of feed of solder paste and dipping condition in solder paste The amount of feed of solder paste and the dipping condition in solder paste should be in accordance with the specified values in table 3.

Table 3 Recommended test condition for profile method

Unit: mm

Type and dimension of parts		Amount of feed of solder paste		Dipping depth	Dipping angle and direction
		Coating diameter	Coating thickness		
C ⁽¹⁾	1005 ⁽²⁾	ϕ 3	0.20	0.05	Horizontal Square SMD 
	1608 ⁽²⁾				
R ⁽¹⁾	1005 ⁽²⁾				
	1608 ⁽²⁾				
C ⁽¹⁾	2012 ⁽²⁾	ϕ 5	0.30		
	3216 ⁽²⁾				
R ⁽¹⁾	2012 ⁽²⁾				
	3216 ⁽²⁾				

Notes ⁽¹⁾ The part notation C indicates a ceramic capacitor, and R indicates a fixed resistor.

⁽²⁾ For example, a part dimension of 1 005 indicates 1.0 mm in length × 0.5 mm in width.

Remarks 1 For the amount of feed of solder paste, the test condition is divided according to the type of parts.

2 The parts which are not specified in table 3 shall be as agreed between the parties concerned with delivery.

3 The amount of feed of solder paste and the dipping depth specified are the target values.

7.4.3 Up-and-down condition of test apparatus The up-and-down conditions of the test apparatus shall be as follows.

- In order to separate the cohesive force from the wetting force of solder paste in **f)** of 7.5, the time when the specimen is detached from the solder paste once during heating shall be 0.5 s before the force is expected to become zero. In 0.5 s after that, the specimen shall be returned to the same location, and it shall be re-dipped in the solder paste.
- The detaching speed of the specimen during heating and the re-dipping speed shall be 5 mm/s ± 0.5 mm/s.
- The time until the specimen is detached after it is re-dipped in the solder paste shall be 10 s ± 0.5 s.
- The downward speed when the specimen is detached from the solder paste at the time of completion of test shall be not less than 3 mm/s.