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(JWES)

**Test methods for lead-free solders—
Part 4 : Methods for solderability
test by a wetting balance method
and a contact angle method**

ICS 25.160.50

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Foreword

This translation has been made based on the original Japanese Industrial Standard established by the Minister of Economy, Trade and Industry through deliberations at the Japanese Industrial Standards Committee according to the proposal of establishing a Japanese Industrial Standard from The Japan Welding Engineering Society (JWES), with a draft of Industrial Standard based on the provision of Article 12 Clause 1 of the Industrial Standardization Law.

Soldering is called HANDAZUKE (Japanese), a technique to be used for mounting electronic and electrical machinery and apparatus, communication equipment and the like and its use field is wide and expectation for high reliability of the connection is large.

Though there are standards inside and outside Japan as well as International Standards like IEC or ISO, this Standard uses results of "standardization of test methods and the like necessary for solder connection corresponding to the reduction of an environmental load" based on the research and development by contract of New Energy and Industrial Technology Development Organization.

This Standard concerns the methods for solderability test (wetting balance method and a contact angle method) of lead-free solders which are environmentally friendly and is positioned as a standard for considering environment.

Being in conformance with this Standard may come under the use of the following patent rights:

- ① Denomination of invention Patent: Plane direction detecting appliance
Date of registration of the invention: August 16, 2002
- ② Denomination of invention Patent: Plane direction detecting appliance
Date of decision of grant a patent: October 22, 2002
- ③ Denomination of invention Patent: Contact angle measuring appliance
Date of decision of grant a patent: September 3, 2002

Besides, this description does not affect to any extent the validity, the scope and the like of the above patent rights.

The holders of these patent rights give guarantee to the Japanese Industrial Standards Committee with respect to his willingness to permit anyone to exercise the relevant patent right under the nondiscriminatory and reasonable conditions. In this regard, however holders of other industrial properties related to this Standard are subject to permit their inventions' exercises in exactly same condition above mentioned.

Attention is drawn to the possibility that some parts of this Standard may conflict with a patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have technical properties. The relevant Minister and the Japanese Industrial Standards Committee are not responsible for identifying the patent right, application for a patent after opening to the public, utility model right or application for registration of utility model after opening to the public which have the said technical properties.

JIS Z 3198 includes the following 7 parts with the general title *Test methods for lead-free solders*

Part 1 : Methods for measuring of melting temperature ranges

Part 2 : Methods for testing of mechanical characteristics—tensile test

Part 3 : Methods for spread test

Part 4 : Methods for solderability test by a wetting balance method and a contact angle method

Part 5 : Methods for tensile tests and shear tests on solder joints

Part 6 : Methods for 45° pull test of solder joints on QFP lead

Part 7 : Methods for shear strength of solder joints on chip components

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Test methods for lead-free solders— Part 4 : Methods for solderability test by a wetting balance method and a contact angle method

Introduction This Japanese Industrial Standard specifies the methods for solderability test by a wetting balance method and a contact angle method of a lead-free solder which are based on occupational results by contract of New Energy and Industrial Technology Department Organization concerning “the standardization of test methods and the like necessary for solder connection corresponding to the reduction of an environmental load” carried out in 2000 and 2001.

1 Scope This Standard specifies the methods for solderability test of a wetting balance method and a contact angle method of lead-free solder to be used principally for wiring connection, parts connection and the like of electrical machinery and apparatus, electronic apparatus, communication equipment and the like.

2 Normative references The following standards contain provisions which, through reference in this Standard, constitute provisions of this Standard. The most recent editions of the standards (including amendments) indicated below shall be applied.

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

JIS H 3260 *Copper and copper alloy wires*

JIS K 5902 *Colophonium*

JIS K 8034 *Acetone*

JIS K 8180 *Hydrochloric acid*

JIS K 8839 *2-Propanol*

JIS Z 3001 *Welding terms*

JIS Z 3282 *Soft solders—Chemical compositions and forms*

3 Definitions For the purposes of this Standard, the definitions given in **JIS Z 3001** and the following definitions apply:

- a) **lead-free solder** It is the generic term of “a tin based solder” not containing lead as an alloy component. It is “a solder not containing lead” for a use corresponding to that of “a tin-lead based solder”, which is used for mounting an electrical, electronic, communication equipment and the like.
- b) **wetting force** It is a value obtained by adding a buoyance to an action force when a metal piece is dipped vertically into a molten solder. It is also called a bonding strength.
- c) **contact angle** It is an angle made by a tangent drawn from a point contacting a solid surface of a solder liquid drop to a liquid surface and the solid surface, or an angle made by a tangent direction of a meniscus (a curved surface of a liquid) and a vertical axis when a metal piece is dipped vertically into the molten solder.

- d) **solder bath (HANDA YOKU)** It is a solder tank filled with molten solder having a mechanism capable of being held at a specific temperature by heating and melting the solder.

4 Test method

4.1 Outline of test For the test method, the following two methods are specified, in which the solderability of lead-free solder being tested is evaluated by being compared with that of a standard solder by using a specified test piece and a standard flux.

- (1) **Method A (Wetting balance method)** A method for measuring a wetting time and a wetting force of the solder being tested.
- (2) **Method B (Contact angle method)** A method for measuring the contact angle at the tip of a fillet of the solder being tested.
 - a) Fill a lead-free solder as the test object or a standard solder for comparison into a solder tank and heat it at a specific test temperature to provide a solder bath.
 - b) Attach a test piece to the holder and hang it on the tester (see Fig. 1).
 - c) Raise the tester or lower the test piece so that the test piece comes in contact with the molten solder surface of the solder bath and the test piece is dipped to a specific depth.
 - d) For method A, detect the action force operating on the test piece from the point of dipping the test piece to pulling it out and display it by recording continuously as a function of time on the recorder through a signal converter.
 - e) For test method B, measure the contact angle of the solder wetted on the test piece from the point of dipping the test piece to pulling it out and display it by recording.

4.2 Reagent and material The reagent and material shall be as follows:

- a) **Deionized water**
- b) **Acetone** is specified in **JIS K 8034**.
- c) **2-Propanol** is specified in **JIS K 8839**.
- d) **Acid cleaning liquid** is provided by diluting 5 g (35 %) of hydrochloric acid specified in **JIS K 8180** with 95 g of deionized water. (1.75 %)
- e) **Standard flux A⁽¹⁾** (nonactive rosin flux) is provided by dissolving 25 g $\pm$ 0.1 g of rosin specified as class 2 in **JIS K 5902** in 75 g $\pm$ 0.1 g of 2-propanol specified in **JIS K 8839**.
- f) **Standard flux B⁽¹⁾** (halogen activated rosin flux) Add 75 g $\pm$ 0.1 g of 2-propanol specified in **JIS K 8839** to 25 g $\pm$ 0.1 g of rosin and heat. Thereafter, add 0.39 g $\pm$ 0.01 g of diethylamine hydrochloride⁽²⁾ and dissolve by stirring quietly. After cooling, weigh and add 2-propanol of the evaporated content. This flux contains 0.5 % of the chlorine amount for every content of rosin. Put the standard flux into a hermetically sealed container and preserve by avoiding light, heat and extreme low temperatures.