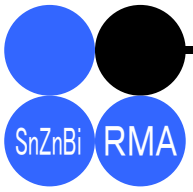
ISHIKAWA

Lead-free Solder paste

EVASOL Z2-7920-JF



Technical material

Test terms

A. Special feature

This product used the lead free solder which has the low melting point.
It is the RMA type lead free solder paste that could be soldering at lower temperature than the other lead free solder.
It can reduce the temperature than the general Sn-Ag-Cu series solder paste, so the electric chips is reduced a heat stress at soldering.

1. A comparative test of reflow profile

B. Basic characteristic

1. Solder powder shape and surface condition test
2. Solder powder grain size distribution measurement test
3. Halogen content test
4. Silver-chromate paper test
5. Copper mirror test
6. Water solution resistance
7. Solder ball test
8. Copper plate corrosion test
9. Slump-in-printing and heating test
10. Fluidity characteristic test
11. Printability of solder paste
12. Tackiness test
13. Spreading ratio
14. Wetting effect and de-wetting test
15. Insulation resistance test
16. Voltage-applied moisture resistance test（Migration test）
17. Characteristics at the continuous printing
18. Strength of joint
19. Storage test

The table of characteristics

Test items		Characteristic	Test terms
Alloy composition（%）		Sn :Balance, Zn:8.0, Bi:3.0	Allowable impurity level is based on JIS Z 3282 class-A
Solidus temperature（℃）		187	D S C (Differencial Scanning Calorimetry)
Liquidus temperature（℃）		197	
Powder grain size（μm）		45～25	JIS Z 8801
Flux contents（mass %）		11.5	JIS Z 3197 8.1.2
Halide content （mass %）		0.02	JIS Z 3197 8.1.4.2.1
Copper mirror test		No corrosion	JIS Z 3197 8.4.2
Copper plate corrosion test		No corrosion	JIS Z 3197 8.4.1
Insulation resistance test（Ω）		1.4×10^{10}	JIS Z 3197 8.5.3 JIS type, 85℃-85RH%,168hr DC100V in the chamber
Voltage-applied moisture resistance test	Insulation resistance（Ω）	2.2×10^{10}	JIS Z 3197 8.5.4 JIS type, 85℃-85%RH applied DC48V,1000hr, DC100V in the chamber
	Migration test	Passed	
Water solution resistance （Ωm）		847	JIS Z 3197 8.1.1
Dryness test		Passed	JIS Z 3197 8.5.1
Spreading ratio （%）		78.0	JIS Z 3197 8.3.1.1
Viscosity(Pa･s)		189	Malcom PCU-2 10rpm, 3minutes ,25℃
Thixotropy index		0.50	Calculation
Tackiness test	Initial (N)	1.42	IPC-SP-819
	After 24hr(N)	1.18	
Slump-in-printing	Pattern Ⅰ	0.2	JIS Z 3284 append.7
	Pattern Ⅱ	0.2	
Slump-in-heating	Pattern Ⅰ	0.3	JIS Z 3284 append.8
	Pattern Ⅱ	0.3	
Printability		It has no irregular cases by continuous printing.	JIS Z 3284 append.5

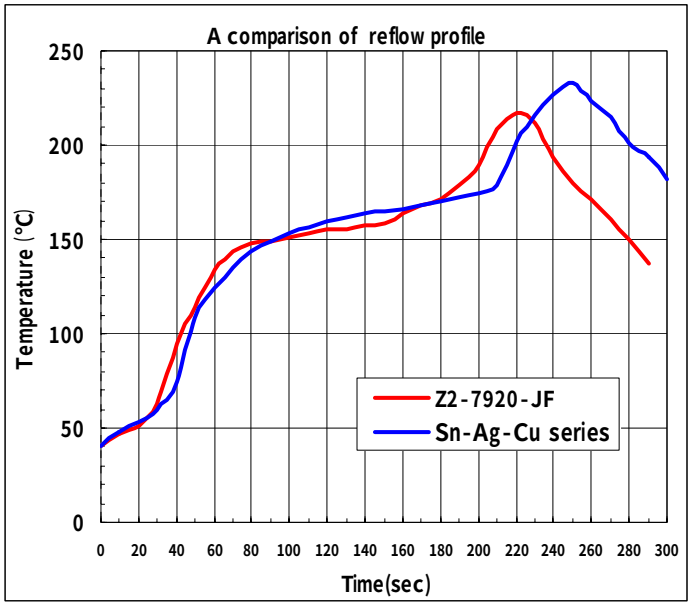
A. Special feature

1. A comparative test of reflow profile

Test method

We observed the wettability at 0.5mm pitch QFP on the evaluation board, as the condition is below.

It reduces the peak temperature about 15℃ lower, and the reflow time about 30sec.shorter than the general Sn-Ag-Cu series solder paste. Also, Sn-Ag-Cu series solder paste has testes at the same reflow profile

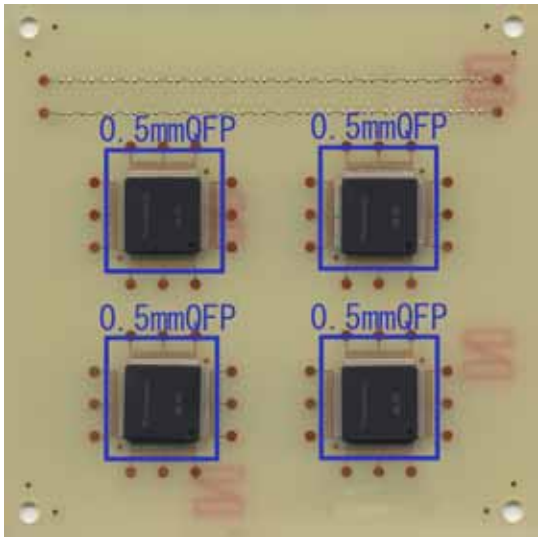


The evaluation board

Material：FR-4

Size：100×100×1.0mm

Mask thickness：0.15mm



Evaluated pattern：0.5㎜ pitch QFP

・Printing condition

Machine：TPM110(SANYO)

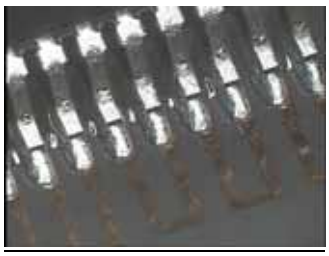
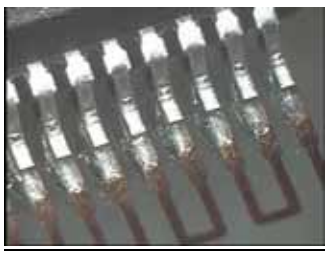
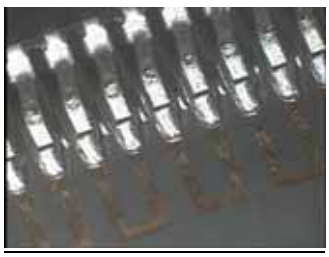
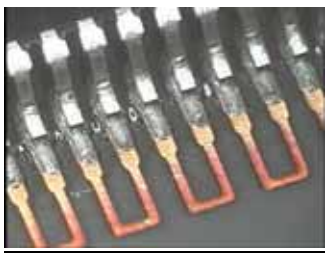
Squeeze：Urethane squeeze

Speed：30mm/s

Mask leaving speed：0.5mm/s

Temperature：25℃

Test result：

Z2-7920-JF	Sn-Ag-Cu series
	
	
	

B. Basic characteristic

1. Solder powder shape and surface condition test

Test method:

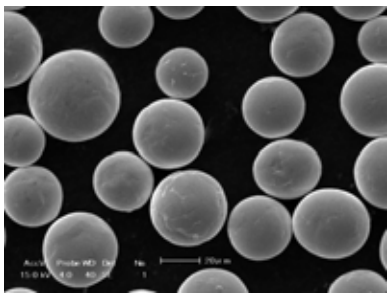
It is observed by scanning electron microscope. (SEM)

Model：SEDX（SSX-550：by SHIMAZU）

Standard:

It has not an irregular powder.

Test result:

SEM	
Result	**Sphere**

2. Solder powder grain size distribution measurement test

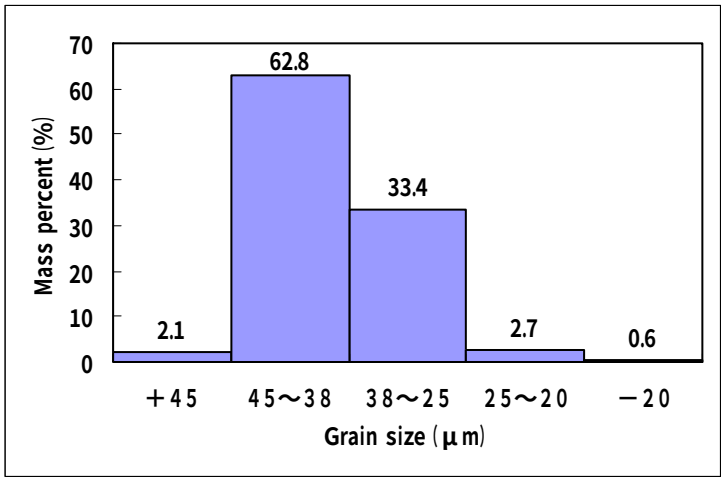
Test method

This test method is defined by JIS Z 3284 Annex 1. Measure the solder powder by using a sonic shifter for 30min.Obtain the respective weights of the powder groups whose grain size is over, within and under the acceptable range of nominal grain size distribution, and indicate the measured values as the mass% for the sample.

Standard:

It consists of more than 45μm(3%), 25～20 μm(under 3%), less than 20μm(under 1%).

Test result:



3. Halogen content test

Test method

This test is defined by JIS Z 3197 8.1.4.2.1.

Weigh 0.5±0.1g of flux at the accuracy of 0.001g and put it into a 300ml beaker.

Add 200ml of 2-propanol and stir it at normal temperature to make test solution.

Putting an electrode into the beaker, place the beaker on a magnetic stirrer.

Stir strongly, and titrate with silver nitrate standard solution.

Standard:

Halide content shall be less than 0.04（%）.

Test result:

Halide content (%)	**0.02**

4. Silver-chromate test

Test method

This test method is defined by JIS Z 3197 8.1.4.2.3. On a silver chromate test paper, place one drop of the specimen and at once drop of chlorine reference solution.

At this time the distance between the two Drops shall be 20mm or more. Leave the paper for 15 sec. and remove the flux on it with 2-propanol and dry it.

Discoloring to white or off-white means the existence of halide in the flux.

Standard:

It is not the white color refer to standard paper.

Test result:

	Z2-7920-JF	Standard(Refer)
Sample		
Result	**Passed**	

5. Copper mirror test

Test method:

This test method is defined by JIS Z 3197 8.4.2. Place the copper mirror test piece facing the mirror upward on a horizontal plane. Drop 0.05ml of specimen on the face. Quickly drop 0.05ml of reference resin at the spot of 35mm away. Put the test piece in the thermoregulator kept at 25±2℃, relative humidity 50±5% , within 5 min. after dropping, and leave them for 24hr. After 24hr. take out the test piece and remove the flux with 2-propanol, and dry it.

Standard:

It is not the corrosion refer to standard.

Test result:

	Z2-7920-JF	WW Rosin(Refer)
Sample		
Result	**No corrosion**	

6. Water solution resistance test

Test method:

This test method is defined by JIS Z 3197 8.1.1.

Measure the resistivity of purified water with an electric conductivity meter.

Put the flux containing the solid portion equivalent to 0.05±0.005g into a beaker with 50ml of purified water.

Cover the beaker with a watch glass.

The beaker capped with a watch glass shall be heated on a hot plate and be boiled 60sec.

Then, it shall be cooled in running water and be placed in a test tank kept at 20±2ºC.

After heat is balanced, the resistivity of it shall be measured with an electric conductivity meter.

Test result:

	Resistivity (Ωm)	Aveage(Ωm)
Sample 1	785	**847**
Sample 2	880	
Sample 3	876	

7. Solder ball test

Test method:

This test method is defined by JIS Z 3284 Appendix 11. Place the metal mask(6.5mm in Diameter and 0.2mm in thickness) on the Alumina substrate（50×50×0.3㎜）, print the solder paste. Heat and dissolve one of two test pieces under the condition.

Condition a　Within 1Hr. after printing.

Condition b　After being left for 24hr.

Humidity:60±20%

Temperature:25±2℃

The solder paste melted within for 5 sec. and leave it to be cooled until the test specimen is solidified.

The solidified solder shall be observed by Using magnifier.

Test result:

	Condition a	Condition b
Sample		
結果	**Degree 2**	**Degree 2**

8. Copper plate corrosion test

Test method:

This test method is defined by JIS Z 3284 appendix 4 .2 pieces of copper plate with the size of 50 x 50 x 0.5mm shall be bent at right angles at 5mm from the both edges and other 2 pieces at 6mm from the both edges, and called plates A and B respectively. Solder paste shall be printed on the copper plate B by using the metal mask, and four circular solder pastes of 6.5mm in diameter and of 0.2mm in thickness shall be made. Put the copper plate A as a cap to be a test piece. Put plate A as a cap on plate B on which solder paste is not applied.(It shall be taken as a blank test piece.)Place the test piece on the surface of soldering bath regulated at 235±2ºC and heat the piece. After fusing of solder, leave it for 5s, and then take the piece out from the bath horizontally and cool it down for 15min.Leave the test piece and the blank piece in the thermoregulator adjusted at the temperature 40±2ºC and the relative humidity 95%. After 96h, take out them from the thermo-

regulator and inspect the corrosion.
Compare with the reference(blank) piece.

Standard:

No corrosion.

Test result:

	Copper A	Copper B
Initial		
96Hr (Before cleanning)		
96Hr (After cleanning)		
Result	**No corrosion**	**No corrosion**

9. Slump-in-printing and heating test

Test method:

This test method is defined by JIS Z 3284 appendix 7 and 8.

The stencil for slump evaluating test has two pattern holes. ((I)3.0×0.7mm and (II)3.0×1.5mm)　It has the interval of holes from 0.2mm to 1.2mm by each 0.1mm.

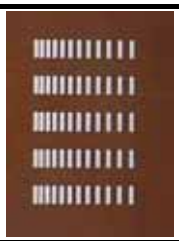
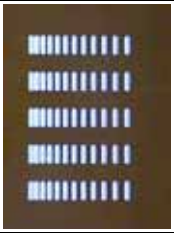
The test condition is as follows;

Condition a: Keep the test plate at the room temperature for 1hr.

Condition b: Heat the printed test plate for 1hr.at 150℃.

Measure and record the minimum interval where no printed solder pastes are integrated out of 5 rows of patterns of two kinds.

Test result:

	Patter I	Pattern II
Condition a		
Result	**0.2**	**0.2**
	Patter I	Pattern II
Condition b		
Result	**0.3**	**0.3**

（Unit：㎜）

10. Fluidity characteristic test

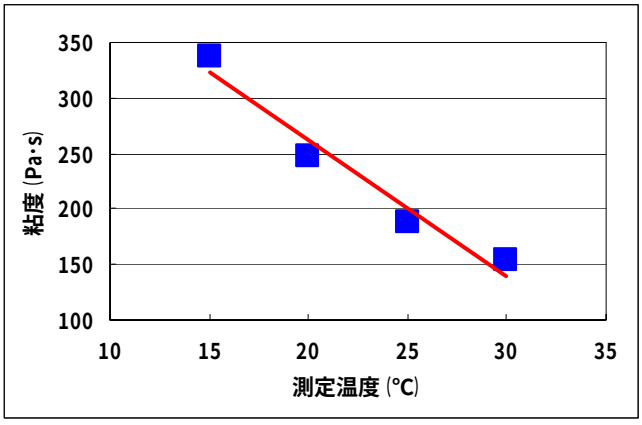
Test method:

This test method is defined by JIS Z 3284 appendix 6 .Leave the solder paste for 2 or 3hr. at room temperature and 25℃, and after stirring it 1 or 2 min. by spatula. Measure the viscosity　at 15,20,25,and 30℃ by Malcom.

Test result:

Rotation	Time	Viscosity (Pa･s)			
		15℃	20℃	25℃	30℃
3rpm	6min	**581.8**	**469.8**	**388.8**	**341.4**
10rpm	3min	**337.8**	**246.1**	**198.7**	**152.4**
30rpm	3min	**225.6**	**159.4**	**123.2**	**86.8**
10rpm	1min	**330.3**	**244.8**	**193.8**	**150.5**

	15℃	20℃	25℃	30℃
Viscosity(Pa・s)	**336.7**	**248.0**	**188.7**	**153.2**
Thixotropy index	**0.41**	**0.47**	**0.50**	**0.60**
Non recoverability(%)	**2.22**	**0.53**	**2.47**	**1.25**



11. Printability of solder paste

Test method

Measure the viscosity by PCU-203 Malcom, after the continuous printing test

Rolling condition:

Printing machine: TPM110（SANYO）

Printing pressure: 40N

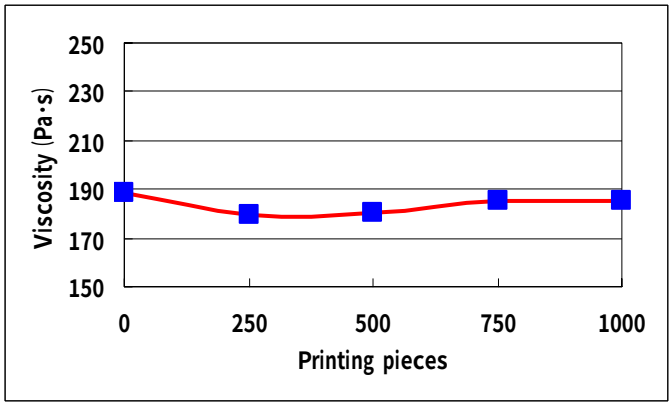
Printing speed：35 ㎜/s

Temperature：25℃

Test time:：6hr.

Test result:

Printing pieces	Initial	250	500	750	1000
Viscosity (Pa・s)	188.7	179.3	180.7	185.0	185.0
Thixotropy index	0.50	0.50	0.50	0.50	0.51
Non recoverability (%)	2.47	2.62	2.34	1.99	1.61



12. Tackiness test

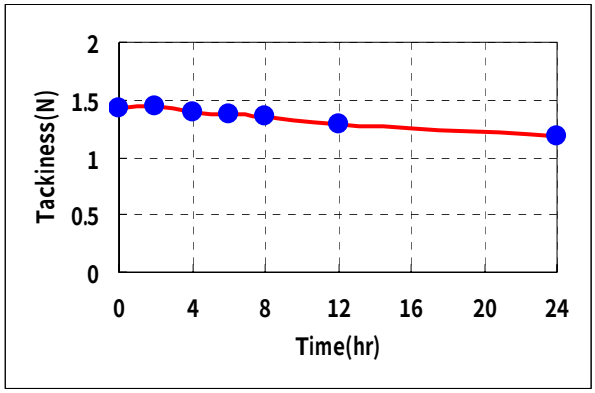
Test method

This test method is defined by JIS Z 3284 appendix 9. The solder paste is printed on the glass plate by using the metal mask, and four circular solder pastes of 6.5mm in diameter and of 0.2mm in thickness shall be made. The test specimen shall be placed under the probe. The probe shall be lowered into the printed paste at the speed of 2.0mm/s, and pressurized at the specified pressure of 50±5g. After pressurization, the probe is pulled upward out of the solder paste at the speed of 10mm/s within 0.2s, and the maximum load required for the separation is recorded. The measured values shall be averaged, and the tackiness strength shall be calculated from these load values.

Test result:

Time（hr）	0	2	4	6	8	12	24
Tackiness(N)	1.42	1.44	1.39	1.37	1.35	1.28	1.18

（The average of n＝5）



13. Spreading ratio

Test method

This test method is defined by JIS Z 3197 8.3.1.1. The one side of the copper plate with the size of 50 x 50 x 0.5mm shall be polished by polishing paper with dropping alcohol and cleaned with alcohol. Put this plate into a dryer set at 150±3ºC for 1h to produce oxidized plate. Apply the solder paste to the copper plate with a metal mask which has 2.5mm thickness and a hole of 6mm diameter, and use it as a test piece. 5 test pieces shall be prepared. Flux residue shall be removed by suitable solvent. The height of the spread solder by fusing shall be measured by a micrometer. Using this value, the spreading ratio shall be calculated from the formula shown below. This procedure shall be carried out on the 5test pieces and the mean value shall be obtained as the spreading ratio of the specimen.

$$S = \frac{D - H}{D} \times 100$$

where,

S: spreading ratio(%)

H: height of the spread solder(mm)

D: diameter of the solder when it is assumed to be a sphere(mm)

$D = 1.24V^{1/3}$

(V: mass / density of tested solder)

Test result:

	Spreading ratio（%）	Average（%）
Sample 1	78.2	**78.0**
Sample 2	78.3	
Sample 3	77.5	

14. Wetting effect and de-wetting test

Test method:

This test method is defined by JIS Z 3284 appendix 10. Dip one side of the copper, nickel and the 42 alloy plate with the size of 50 x 50 x 0.5mm in 2-propanol and polish with polishing paper. Take test substrate horizontally out of the solder bath 5s after the solder is melted. Cool the substrate in the horizontal position until the solder is settled. The degree of spread shall be classified.

Test result

In the air

Degree 2
In N_2 atmosphere

Degree 2

15. Insulation resistance test

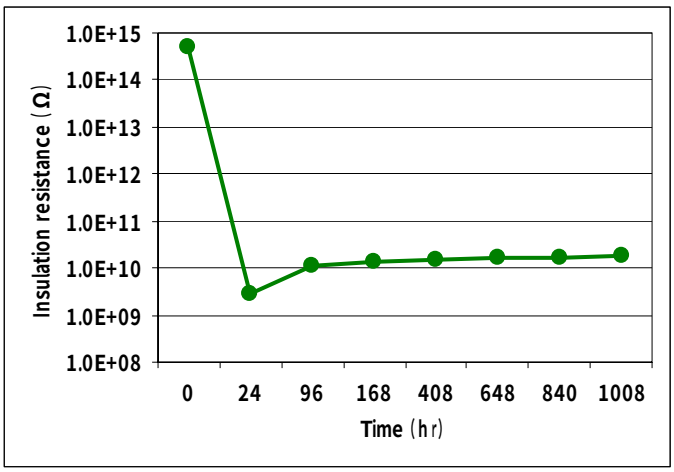
Test method

This test method is defined by JIS Z 3284 appendix 3. 3 test pieces shall be prepared. The insulation resistance between the terminals shall be measured at the test voltage of DC 100V by using an insulation resistance tester before test piece is placed in a thermo-hygrostat. The test piece shall be placed in a thermohygrostat kept at the temperature 85ºC and the relative humidity 85%. The insulation resistance shall be measured at DC 100V in the thermohygrostat at the time of 24h, 96h, 168h, 408h, 648h,840h, 1008h, after the test piece is placed in it. The test shall be carried out for 3 test pieces, and the geometric mean of the respective measurements shall be calculated.

Test result:

	Initial	24hr	96hr	168hr
Sample 1	4.8×10^{14}	2.4×10^{9}	9.3×10^{9}	1.1×10^{10}
Sample 2	5.6×10^{14}	3.8×10^{9}	1.6×10^{10}	2.3×10^{10}
Sample 3	4.7×10^{14}	2.2×10^{9}	9.1×10^{9}	1.1×10^{10}
Average	**5.0×10^{14}**	**2.7×10^{9}**	**1.1×10^{10}**	**1.4×10^{10}**
	408hr	648hr	840hr	1008hr
Sample 1	1.5×10^{10}	1.5×10^{10}	1.4×10^{10}	1.6×10^{10}
Sample 2	1.6×10^{10}	1.9×10^{10}	1.8×10^{10}	2.0×10^{10}
Sample 3	1.4×10^{10}	1.5×10^{10}	1.9×10^{10}	2.1×10^{10}
Average	**1.5×10^{10}**	**1.6×10^{10}**	**1.7×10^{10}**	**1.9×10^{10}**

(Unit : Ω)



16. Voltage-applied moisture resistance test (Migration test)

Test method

This test method is defined by JIS Z 3197 8.5.4. The test piece shall be placed in a thermohygrostat kept at the temperature 85ºC and the relative humidity 85%, and apply the voltage DC 48V between the electrodes.

The insulation resistance shall be measured at DC 100V in the thermohygrostat at the time of 24h, 96h, 168h, 408h, 648h, 840h, 1008h, after the test piece is placed in it.

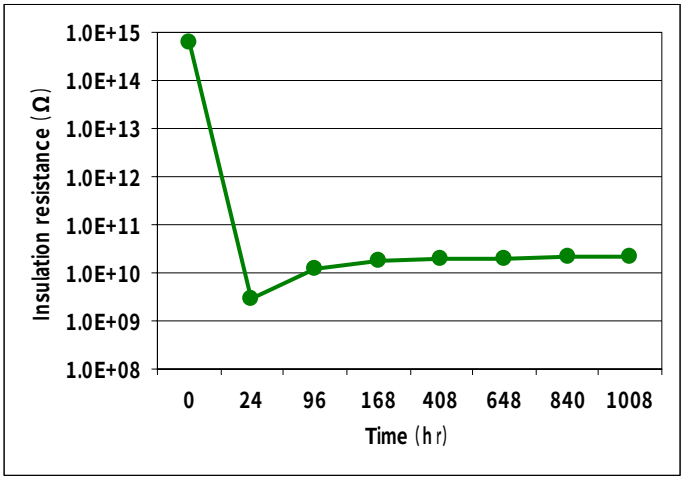
Take the test piece out of the thermohygrost at 1008h after the test piece is placed in it, and check for the migration by using a magnifier. The test shall be carried out for 3 test pieces.

Test result:

No migration.

	Initial	24hr	96hr	168hr
Sample 1	8.6×10^{14}	3.9×10^{9}	1.4×10^{10}	2.2×10^{10}
Sample 2	4.0×10^{14}	2.4×10^{9}	9.5×10^{9}	1.6×10^{10}
Sample 3	7.0×10^{14}	2.6×10^{9}	1.3×10^{10}	1.7×10^{10}
Average	**6.2×10^{14}**	**2.9×10^{9}**	**1.2×10^{10}**	**1.8×10^{10}**
	408hr	648hr	840hr	1008hr
Sample 1	1.9×10^{10}	2.2×10^{10}	2.0×10^{10}	1.6×10^{10}
Sample 2	1.6×10^{10}	1.4×10^{10}	1.8×10^{10}	2.7×10^{10}
Sample 3	2.3×10^{10}	2.5×10^{10}	2.7×10^{10}	2.4×10^{10}
Average	**1.9×10^{10}**	**2.0×10^{10}**	**2.1×10^{10}**	**2.2×10^{10}**

(Unit : Ω)



17. Characteristics at the printing

Test method

The solder paste is printing on the metal mask. It is printing on the evaluation board at initial, 250, 500,750 and 1000, and after mounting QFP and reflow.

Evaluate the printability and wettablity. below board.

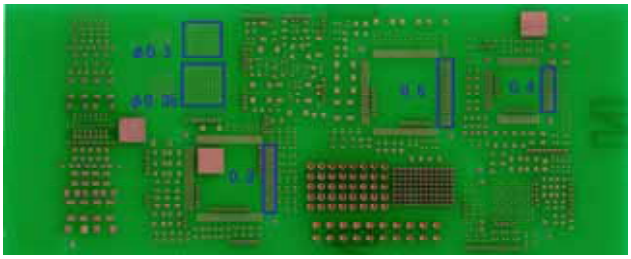
・Printing evaluation board

The material board：FR-4

Size：50×120×1.0mm

The thickness of mask：0.12mm

Printing evaluation board



Printing evaluation：0.3 ㎜ pitch QFP
0.4 ㎜ pitch QFP
0.5 ㎜ pitch QFP
φ0.35 circle dot
φ0.30 circle dot

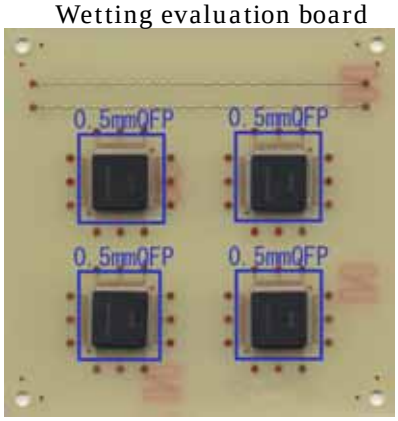
・Wetting evaluation board

The material of board：FR-4

Size：100×100×1.0mm

Thickness：0.15mm

Wetting evaluation board



Wetting evaluation:0.5 ㎜ pitch QFP

・Printing condition

Printing machine：TPM110(SANYO)

Squeeze：Urethane squeeze

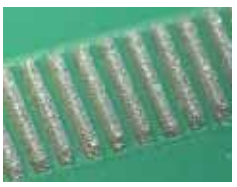
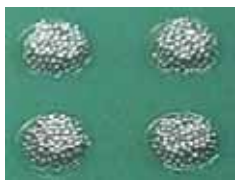
Speed：30mm/s

Mask leaving speed：0.5mm/s

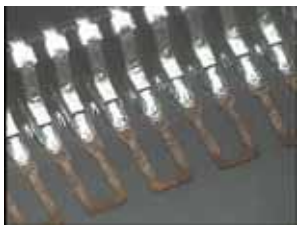
Temperature：25℃

Test result:

Printing test

	QFP			Circle dot	
	0.3 ㎜	0.4 ㎜	0.5 ㎜	φ0.35	φ0.30
Initial					
250					
500					
750					
1000					

Wetting test:

Initial		250		500	
750		1000			

18. Strength of joint

Test method

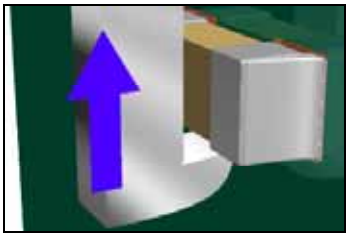
Measure the strength of joint at 3216 chip by the joint of three types land (solder plate, Cu land, Ni-Au plate)

After leave at condition① and condition② for 1000hr. measure the each strength of joint after 250, 500 and 1000hr.

Refer to below figure.

Condition①：－40℃(30min)～80℃(30min) by heat-cycle test

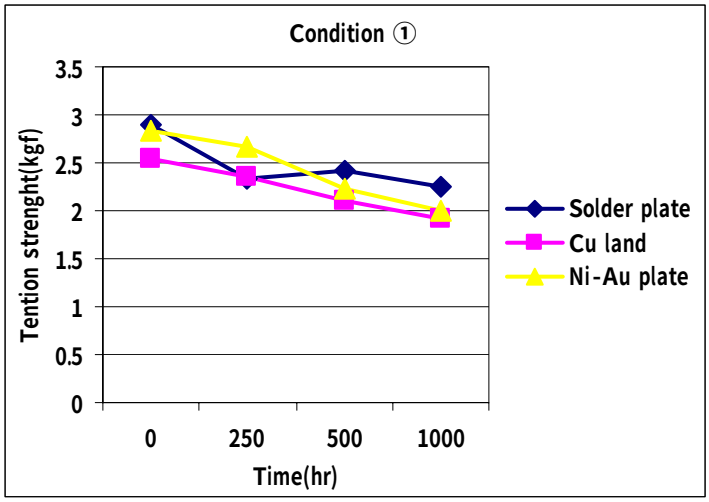
Condition②：Temperature 85℃ Relative humidity 85%

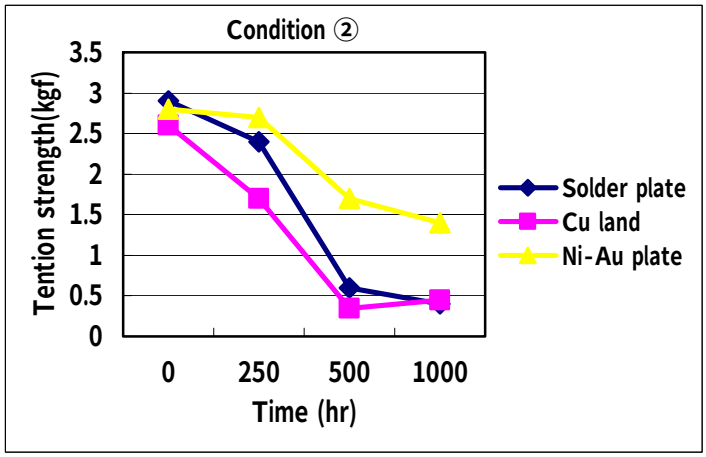


Test result:

	Land or plate	Condition①	Condition②
Initial	Solder plate	**2.90**	**2.90**
	Cu land	**2.55**	**2.55**
	Ni-Au plate	**2.84**	**2.84**
250h	Solder plate	**2.34**	**0.61**
	Cu land	**2.36**	**0.30**
	Ni-Au plate	**2.66**	**1.69**
500h	Solder plate	**2.42**	**2.35**
	Cu land	**2.11**	**1.67**
	Ni-Au plate	**2.22**	**2.77**
1000h	Solder plate	**2.24**	**0.31**
	Cu land	**1.91**	**0.34**
	Ni-Au plate	**2.00**	**1.37**

（Unit：kgf）





19. Storage test

Test method:

It measures the fluidity characteristic of solder paste after it stored in the refrigerator (5～10℃).

Test result:

	Viscosity(Pa・s) /Thixotropy index
Initial	**199 / 0.47**
After 1 month	**190 / 0.49**
After 2 months	**186 / 0.50**
After 3 months	**196 / 0.55**