

Lead free flux-cored solder

Spatter
Prevention



EVASOL

J3-MRK-3

SnAgCu

RMA

Technical data

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Table 1 . Characteristics

Test items		Characteristic	Test method	
Solder alloy	Alloy composition	Sn: Balance Ag:3.0 Cu:0.5	JIS Z 3910	
	Solidus temperature	217°C		
	Liquidus temperature	220		
Flux	The type of flux	RMA		
	Water solution resistance	2960 m	JIS Z 3197 8.1.1	
	Halide content	0.10%	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	
	Silver-chromate paper test	Passed	JIS Z 3197 8.1.4.2.3	
Rosin Flux Cored Solder	Spattering ratio (380 20 mm/sec) 0.8 mm	1.2%	Our company method	
	Flux content	3.0%	JIS Z 3197 8.1.2	
	Spreading ratio (Copper plate)	79%	JIS Z 3197 8.3.1.1	
	Insulation resistance test	Initial	More than 1.0×10^{14}	JIS Z 3197 8.5.3 Condition B (85 ,85%RH)
		After168Hr.	More than 5.0×10^8	
After1008Hr.		More than 5.0×10^8		
Migration test	No migration			

A. Special feature

1 . Spattering test

Test method: (Our company method)

This test method come out by our company method. Assemble the measuring device in accordance with Fig 1. Measure the flux content of resin flux cored solder(F).

Cut the solder at 5m length and weigh the mass of them (W₁).

Prepare aluminum foil of 200mm × 200mm and make a hole of 11mm diameter at the center and measure the mass(X₁). As shown in Fig 1, place the aluminum foil on the top of metal plate of the device and feed about 7mm at 20 mm/sec and feedback 2mm of solder wire at one time, and set the tip of soldering iron keep at each 340 , 360 , 380 , 400 .

At this time solder is recommended to be pushed at right angles to the top.

Measure the remaining resin flux cored solder(W₂).

Measure the aluminum foil on which spattered flux sticks(X₂).

The spattered flux is expressed in mass% and calculated from the below formula.

$$F_s = \frac{(X_2 - X_1)}{(W_1 - W_2) \times F / 100} \times 100$$

- where, Fs : mass of flux spattered (mass%)
 F : flux content of resin flux cored solder(mass%)
 X₁ : mass of aluminum foil(g)
 X₂ : mass of aluminum foil with spattered flux(g)
 W₁ : mass of 5 pieces of resin solder wire (g)
 W₂ : mass of remaining of resin solder wire (g)

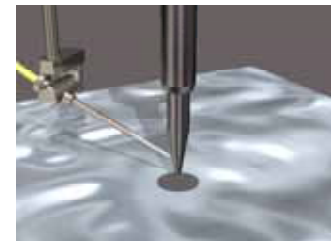


Fig 1. The measuring device

Apparatus:

Soldering iron : made by APOLLO SEIKO LTD. (T T M - 2000)

The chip of iron : 2.4 mm Driver form (T T M - 2016)

Provided machine : made by ISHIKAWA METAL.

Test result:

Table 2. Spattering ratio (Unit:%)

	J 3 - M R K - 3			
	340	360	380	400
0.5 mm	1.7	1.9	2.3	2.5
0.6 mm	1.1	1.4	2.2	2.0
0.8 mm	2.9	1.7	1.2	1.3
1.0 mm	3.0	2.1	2.0	1.8
1.6 mm	-	2.8	2.7	2.3

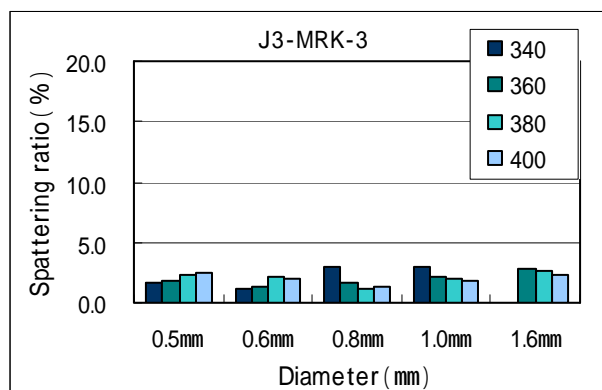


Fig 2. The result of spattering ratio (MRK)

2 . Spreading test

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 $150\pm 3^{\circ}\text{C}$ for 1h to produce oxidized the 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 5 test pieces and the mean value shall be obtained as the spreading ratio of the specimen.

$$S = (D - H) / D \times 100$$

where, $D = 1.24V^{1/3}$ (V: mass / density of tested solder)

S: spreading ratio (%)

H: height of the spread solder (mm)

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

Standard:

The spreading ratio is more than 75%. (Oxidized copper plate)

Test result:

Table 3. Spreading ratio (Unit:%)

Heating time	J 3 - M R K - 3
3 sec.	69.2
5 sec.	76.3
10 sec.	78.2
20 sec.	79.4
30 sec.	79.0

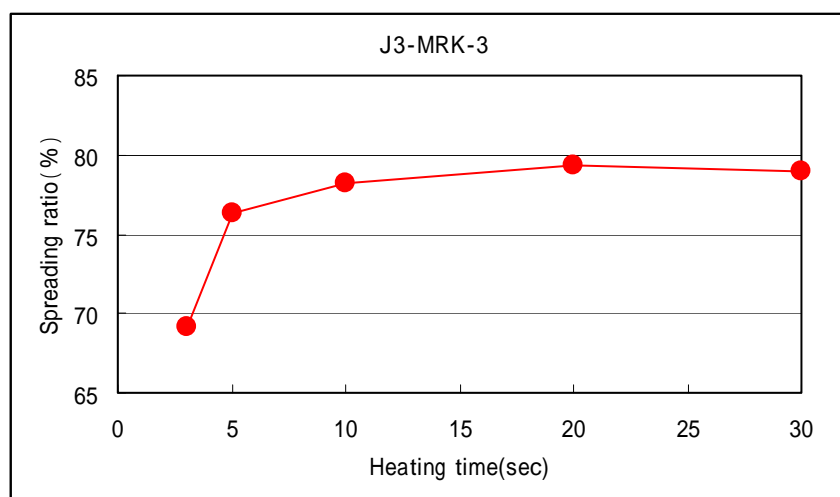


Fig 3. The result of spreading ratio

B. Basic characteristic

1 . Solder alloy

1-1 Alloy composition

Table 4. Alloy composition

Elements	Sn	Pb	Ag	Cu	Bi	Sb	Zn	Fe	Al	As	Cd
Standard(%)	Balance	0.10	3.0±0.15	0.5±0.06	0.10	0.12	0.002	0.02	0.002	0.03	0.002

1-2 Melting point

Table 5. Melting point

Solidus temperature ()	217
Liquidus temperature ()	220

2 . Flux content test

Test method:

This test method is defined by JIS-Z-3197 8.1.2.

Take specimen of 30±2g as W_1 (g), measuring to the nearest 0.001g and take this as W_1 (g). Then add 20ml glycerin and fuse by heating.

When solder and flux are separated completely, leave the beaker to cool down and to solidify.

Next, take out the solidified solder from the beaker and wash it with water, and after immersing it in 2-propanol for about 5min, wash and dry it at room temperature.

Then, measure the accurate mass of it as W_2 (g) and calculate the flux content from the following formula.

$$\text{Flux content (\%)} = (W_1 - W_2) \times 100 / W_1$$

Standard:

Flux content shall be 3.0±0.3 (%).

Test result:

Table 6. Flux content

	J 3 - M R K - 3
Flux content (%)	3.0

3 . Halide 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.

$$H = \frac{3.55 \times M \times f \times V}{m}$$

where H : chlorine content in flux(mass%)

V : volume of silver nitrate solution(ml)

M : density of silver nitrate solution(mol/l)

f : power value of silver nitrate solution

m : mass of specimen(g)

Standard:

Halide content shall be less than 0.14 (%) .

Test result:

Table 7. Halide content

	J 3 - M R K - 3
Halide content (%)	0.10

4 . Silver-chromate paper 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:



Sample	Standard (Reference)	J 3 - M R K - 3
		
Result:		Passed

Fig 4. The result of silver chromate test

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 $50\pm 5\%$, 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:



Sample	WW rosin (Refer)	J 3 - M R K - 3
		
Result		No corrosion

Fig 5. The result of copper mirror test

6 . Copper plate corrosion testTest method:

This test method is defined by JIS-Z-3284 8.4.1 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 $235\pm 2^{\circ}\text{C}$ and heat the piece. After fusing of solder, leave it for 5sec, 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 $40\pm 2^{\circ}\text{C}$ and the relative humidity 9 After 96h, take out them from the thermo-regulator and inspect the corrosion. Compare with the reference(blank) piece .

Standard:

No corrosion.

Test result:

Sample	Initial	After 96 hr. Before cleaning	After 96 hr. After cleaning
J 3 - M R K - 3			
Result		No corrosion	No corrosion

Fig 6. The result of copper plate corrosion test

7 . Water solution resistance

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 $0.10 \pm 0.005g$ 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 $20 \pm 2^\circ C$.

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

Standard:

Water solution resistance shall be more than 1000 $\Omega \cdot m$.

Test result:

Table 8. The result of water solution resistance test

	J 3 - M R K - 3
Water solution resistance ($\Omega \cdot m$)	2980

8 . Insulation resistance test

Test method:

This test method is defined by JIS-Z-3197 8.5.3.

Polish the test substrate (comb-shaped electrode substrate for about 30s in refined water with a soft-hair brush, and rinse it with refined water.

Polish the test substrate for about 30s in isopropyl alcohol by using soft-hair brush, and rinse it in isopropyl alcohol. Dry it in a drier set at $60^\circ C$ for 3h.

The flux test solution shall be adjusted to have precise 25 mass% of solid contents with solvent used at extraction.

Specimen shall be applied evenly to cover the total area on the laps of 3 boards and one is left for reference without applying flux. Dry the boards in a dryer set at (100 ± 3) for 5min.

The pattern side of the 3 boards shall be soldered in the soldering bath at (235 ± 3) for $(3+1)$ sec. to be used as the test pieces.

Confirm that there is no short circuit on the board. If there is any prepare new board and precondition. After it is left to be cooled as it is, the test piece is made.

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 thermohygrostat.

The test piece shall be placed in a thermohygrostat kept at the temperature $85^\circ C$ 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:

Table 9. The measurement of Insulation resistance (J3-MRK-3) [Unit :]

	Initial	24hr	96hr	168hr	408hr	648hr	840hr	1008hr
Sample 1	6.0×10^{14}	2.3×10^{10}	7.2×10^9	7.7×10^9	7.7×10^9	1.2×10^{10}	1.6×10^{10}	1.9×10^{10}
Sample 2	6.0×10^{14}	1.8×10^{10}	8.2×10^9	7.9×10^9	1.3×10^{10}	1.8×10^{10}	2.0×10^{10}	3.1×10^{10}
Sample 3	5.4×10^{14}	1.9×10^{10}	7.7×10^9	7.2×10^9	9.9×10^9	1.6×10^{10}	2.9×10^{10}	2.7×10^{10}
Average	5.8×10^{14}	2.0×10^{10}	7.7×10^9	7.6×10^9	9.9×10^9	1.5×10^{10}	2.1×10^{10}	2.5×10^{10}

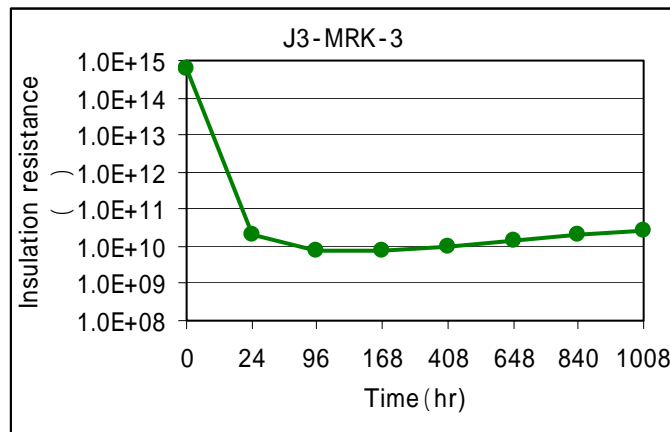


Fig 7. The result of insulation resistance (J3-MRK-3)

9 . Voltage-applied moisture resistance test (Migration test)Test method:

This test method is defined by JIS-Z-3197 8.5.4.

Polish the test substrate (comb-shaped electrode substrate) for about 30s in refined water with a soft-hair brush, and rinse it with refined water.

Polish the test substrate for about 30s in isopropyl alcohol by using soft-hair brush, and rinse it in isopropyl alcohol. Dry it in a drier set at 60°C for 3h.

The flux test solution shall be adjusted to have precise 25 mass% of solid contents with solvent used at extraction.

Specimen shall be applied evenly to cover the total area on the laps of 3 boards and one is lift for reference without applying flux. Dry the boards in a dryer set at (100 ± 3) for 5min.

The pattern side of the 3 boards shall be soldered in the soldering bath at (235 ± 3) for $(3+1)$ sec. to be used as the test pieces.

Confirm that there is no short circuit on the board. If there is any prepare new board and precondition. After it is left to be cooled as it is, the test piece is made.

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 thermohygrostat.

The test piece shall be placed in a thermohygrostat kept at the temperature 85°C 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 thermohygrostat 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:

These products have no migration.

Table 10. The measurement of Insulation resistance (J3-MRK-3)

[Unit :]

	Initial	24hr	96hr	168hr	408hr	648hr	840hr	1008hr
Sample 1	4.8×10^{14}	3.1×10^{10}	8.1×10^9	1.2×10^{10}	1.7×10^{10}	2.4×10^{10}	2.6×10^{10}	2.5×10^{10}
Sample 2	5.6×10^{14}	3.0×10^{10}	9.7×10^9	9.3×10^9	1.3×10^{10}	2.0×10^{10}	3.4×10^{10}	3.2×10^{10}
Sample 3	4.7×10^{14}	3.0×10^{10}	8.9×10^9	9.3×10^9	1.5×10^{10}	2.5×10^{10}	2.8×10^{10}	3.0×10^{10}
Average	5.0×10^{14}	3.0×10^{10}	8.9×10^9	1.0×10^{10}	1.5×10^{10}	2.3×10^{10}	2.9×10^{10}	2.9×10^{10}

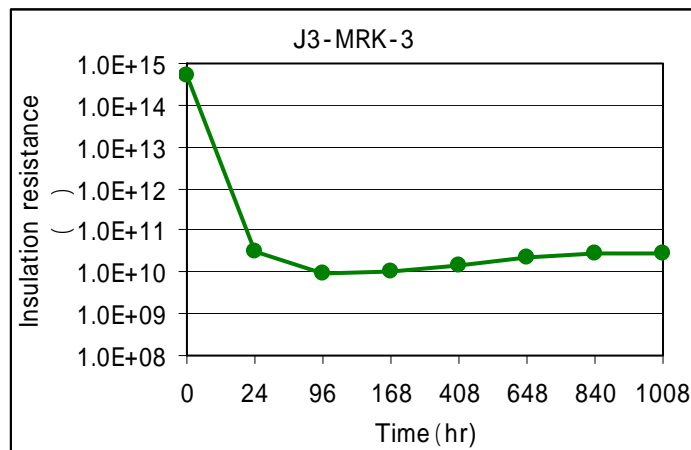


Fig 8. The result of insulation resistance (J3-MRK-3)