ECO+PLUS® series
Lead Free SOLUTIONS you can TRUST

PAT. PEND.

Anti-Erosion Flux Cored Wire Solder

S03X7Ca-56M

■ Features

1) Greatly extends the life of the soldering iron tip.
2) Very fast and complete wetting.
3) Minimized solder/flux spattering.
4) No tailing or spiking and clean take away of soldering iron.
5) Compatible with various other solder alloys.

■ Specifications

Application			Hand, robot soldering
Product			**S03X7Ca-56M**
Alloy	Composition (%)		Sn0.7Cu0.3Ag0.03Co+ α
	Specific gravity		7.3
	Melting point (℃)		217 - 227
	Tensile stength (N/mm^2)		35
	Elongation (%)		36
Product	Flux content (wt%)		2.8 - 3.6
	Halide content (wt%)		0.12
	Surface insulation resistance	85℃ × 85%RH × 168Hr Out of oven	$> 2 \times 10^{12}$
		85℃ × 85%RH × 168Hr in oven	$> 1 \times 10^{9}$
	Aqueous solution resistivity *1 (Ω cm)		> 500
	Flux type *2		ROL1
	Copper plate corrosion *3		Passed
	Solder spread factor (%)		80
	Diameter (mm)		0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 1.0, 1.2, 1.6
	Shelf life (room temp.)		3 years

1. Aqueous solution resistivity ..... In accordance with MIL specifications.
2. Flux type ..... In accordance with ANSI/J-STD-004
3. Copper plate corrosion ..... In accordance with JIS.

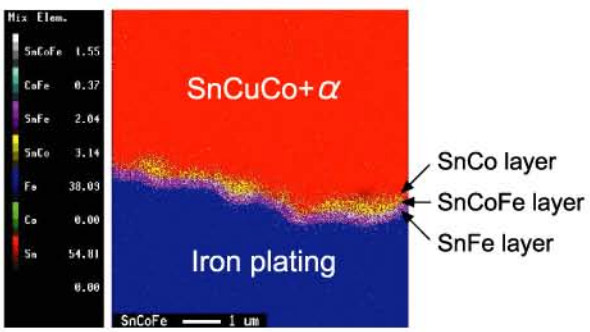
■ Anti-erosion effect

The normal alloy composition of the lead free rosin flux cored solder wires, is now dominated by SnAg3.0Cu0.5 (SAC305), resulting in a much higher Tin content compared to Tin/Lead wires. Whilst soldering, Tin enters the crevices or gaps between the crystal structures of the plating surface (normally Nickel and Iron) of the soldering tip, dissolves and erodes the Copper in the center, and the Copper is drawn out from the soldering tip.
Consequently, the Copper in the center of the soldering tip becomes thinner, and when external pressure is exerted, the plating surface becomes deformed and damaged.

As a corrective measure against such erosion of the soldering bit, simply thickening the tip plating (around 500 μm) may be one option, though it cannot be the complete solution due to the properties and crystal structures of the metals used. Furthermore it has been found that the iron content of the plating surface is also considerably eroded by the high tin content of normal lead free alloys, thus further enhancing the risk and rate or erosion of the copper beneath it.
In the case of S03X7Ca-56M, intermetallic compounds are formed over the plating surface during soldering in the same way as with the normal tin lead solders.
Uniquely S03X7Ca-56M forms a 3 layer barrier over the iron tip and restricts the erosion of the Iron content of the plating surface and thus further protects the copper bulk of the soldering tip.

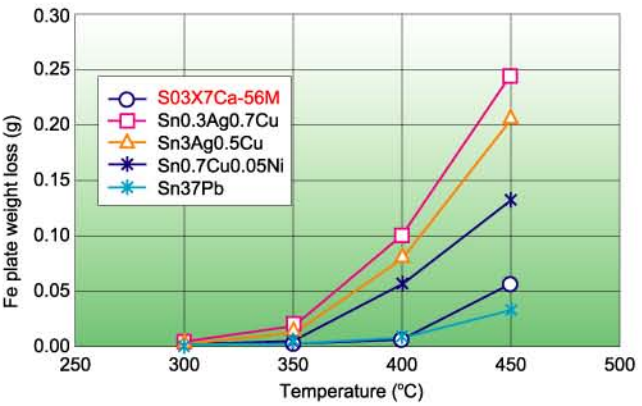
► Restriction Mechanism of Iron erosion

Cobalt melts into the metallic compounds, SnCu or SnFe, to be formed at the interface of the solder and Iron coating of the soldering tip, and restricts the diffusion of Iron into the solder.



► Iron erosion test

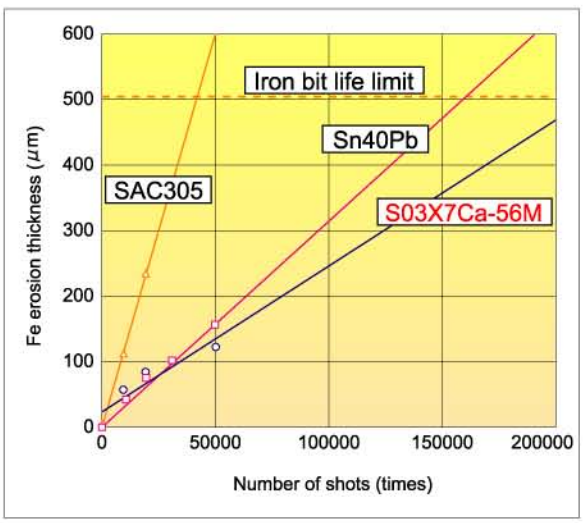
Test specimen: 25 × 70 × 2.2mmt, iron plate (SPC)
Test procedure: Dip iron plate 15mm into solder alloy and agitate at 30 rpm for 1 hour to measure the weight loss.

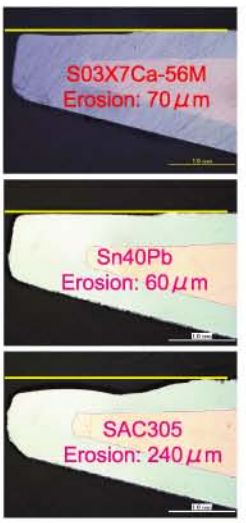


► Anti-Fe erosion test

By using an automatic soldering iron robot, the anti-Iron erosion property of Sn40Pb, SAC305 and S03X7Ca-56M alloys was conducted as shown below. At the 20,000th contact, erosion of the soldering tip using S03X7Ca-56M wire was only 25% of that in comparison to SAC305 alloy (see below pictures).

Test conditions
- Fe coating thickness: 500 micron
- Iron bit temp.: 390°C
- Wire diameter: 0.8mm
- Feed amount: 5mm/shot
- Soldering robot: Japan Unix





*Specifications are subject to change.

KOKI COMPANY LIMITED
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2008.2.8

Solder wire: applicable for REACH compliance

Eco+PLUS series
Lead Free SOLUTIONS you can TRUST

S3X-70M

- Quick wetting through components with large thermal mass such as connectors
- Remarkable wetting performance to nickel and brass leads
- Realizes low flux spitting and bridging in slide-soldering
- No REACH restricted SVHC substances contained

◆ Wetting performance

Test method

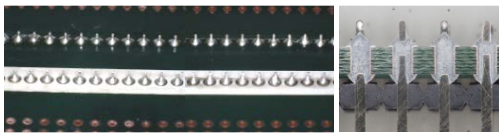
Heat a SAC305 alloy ring with solid flux added on the solder bath at 300ºC for 5 sec.

Solder spreads quickly even on Brass and Nickel.

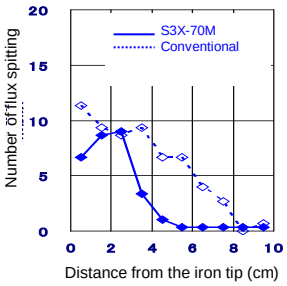
Test method

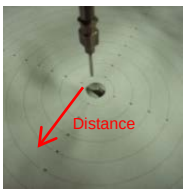
Conduct a drag soldering to 21 pins at one time (Iron tip temp. = 370ºC)

No bridges are seen maximum at 10mm/sec.



◆ Low flux spitting





Iron tip temp.: 380ºC

◆ Product specifications

Product	S3X-70M
Alloy composition (%)	Sn 3.0Ag 0.5Cu
Melting point (ºC)	217-219
Flux content (%)	3.0
Halide content (%)	0.09
Diameter of wire (mm)	0.3, 0.4, 0.5, 0.6, 0.8, 1.0, 1.2, 1.6

*Specifications are subject to change.

◆ Hand soldering products line-up

■ Flux cored solder wire

S01X7Ca-70M	Anti-erosion low Ag alloy (Sn0.1Ag0.7CuCo+α)
S03X7Ca-70M	Anti-erosion low Ag alloy (Sn0.1Ag0.7CuCo+α)
SB6N-70M	High reliability, crack free alloy

■ Tacky flux

TF-M880R	For repairing BGA/CSP, halogen free
TF-MP1	For PoP soldering

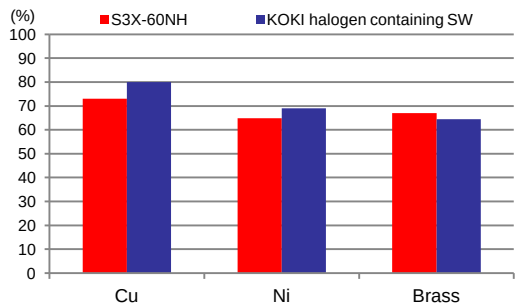
Halogen free type solder wire

S3X-60NH

- Halogen free (Cl, Br ≦ 900ppm / Cl + Br ≦ 1500ppm)
- Secures equivalent wetting performance to conventional halogen containing product

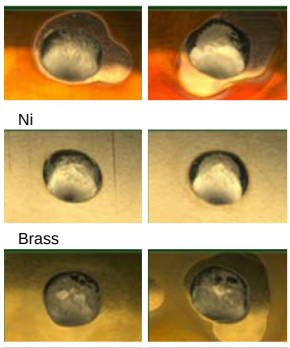
◆ Wetting performance

Solder spread ratio



S3X-60NH secures almost equivalent or even better wetting performance to KOKI halogen containing solder wire with Cu, Ni and Brass.

S3X-60NH



◆ Product specifications

Product	S3X-60NH
Alloy composition (%)	Sn 3.0Ag 0.5Cu
Melting point (ºC)	217 – 219
Flux content (%)	3.0
Halide content (%)	0.0
Diameter of wire (mm)	0.3, 0.4, 0.5, 0.6, 0.8, 1.0, 1.2, 1.6

*Specifications are subject to change.

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Lead Free Cost Saving Ideas

Koki Wire Benefits

When you switch from eutectic solder wire to lead free, the rule of thumb for solder tip usage is that you will use twice as many solder tips. We have seen some companies who also hit over 4 times the amount! Many factors affect this "rule of thumb" such as:

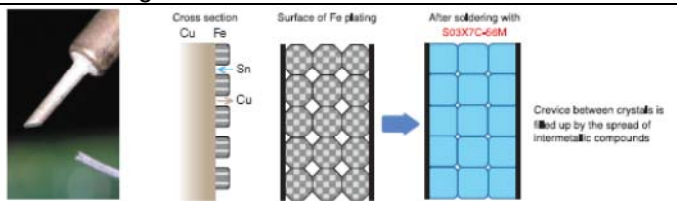
- Operator training
- Fluxes used
- Alloys used
- Temperatures
- Soldering tip types & manufacturer

The reason for this "rule of thumb" is due to a very simple factor that the solder tip plating is no long protected by the lead anymore allowing the SAC alloy to enter the tip and literally eat the tip from the inside out.

This means that if your company purchased $20,000 worth of tips, you are now using at least $40,000 worth of tips to do the same job.

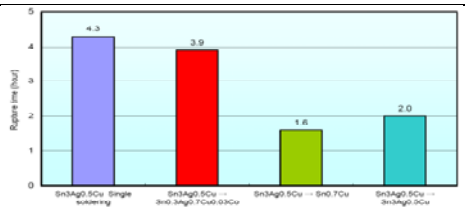
If this paper were to be 100%, where is 0.03%?

Koki wire maintains solder tip life by adding 0.03% cobalt. The cobalt replaces what the lead use to do and also aids somewhat in wetting.



What about solder joint strength?

Pull test results show that a SAC305 joint reworked with Koki is almost as strong as the original and is almost DOUBLE that of SAC305 reworked with SAC305



What are some of the common issues or defects seen?

We have tabulated some of the wires we have tested using a very simple test of flowing lead free solder wire from one side of a penny on a copper coupon to the other to observe their performance characteristics.

	Koki Solution	***Brands Encountered***			
		A	B	C	D
Wetting or wicking	Excellent	Very Good	Fair	Poor	Poor
Fillet	Excellent	OK	Poor	OK	Poor
Flux charring or dark residues	None	None	Some	Some	None
Spiking or flagging of the joint	None	Yes	Yes	Yes	Yes
Solder tip usage is double or more	No	Yes	Yes	Yes	Yes
Flux splatter	Minor - None	Average	High	High	High
Green Residue on Copper?	No	Yes	No	No	No
Flowed around test?	Yes	Yes	No	No	No
0.032" (.8mm) DIA Cost per 500 gram spool (*estimated) CDN (Price Mar 2013)	$42.20				
Solder tip usage is double or more	No	Yes	Yes	Yes	Yes

Bottom Line

Koki wire will not only save you money but will improve your lead free assembly quality.

40 hours use with Koki | 16 hours use with SAC wire | 32 hours use with SAC wire

Smart SMT
Equipment & Solutions for Electronic Assembly

ECO+PLUS® series
Lead free SOLUTIONS you can TRUST

www.ko-ki.co.jp

#50017E
2012.12.27

Koki no clean LEAD FREE flux cored solder wire

Contents

REACH compliant

70M series

Product information

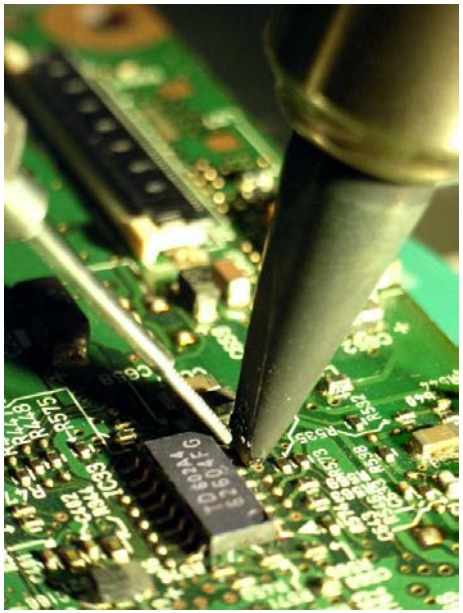
LINE-UP

S01X7Ca - 70M

S03X7Ca - 70M

SB6N - 70M

S3X - 70M



This product information contains product performance assessed strictly according to our own test procedures and may not be compatible with results at end-users.

Product Features

Contents

- Free of the regulated substances listed in JIG-101 (rev.3), which has been quoted in REACH, RoHS, etc.
- Drastically reduces iron tip erosion (S01X7Ca/S03X7Ca/S3XCa) with added Co forming barrier layers
- SB6N contains 6% indium, highly resistant to severe temperature environments
- Excellent wetting to lead frame components
- No tailing or spiking and a clean take away of the soldering iron
- Minimized fume and flux sputtering

Specifications

Contents

Items		S01X7Ca	S03X7Ca	SB6N	S3X
Alloy	Composition (%)	Sn 0.1Ag 0.7Cu 0.03Co + α	Sn 0.3Ag 0.7Cu 0.03Co + α	Sn 3.5Ag 0.5Bi 6.0In	Sn 3.0Ag 0.5Cu
	Melting point (ºC)	217 - 227	217 - 227	202 - 210	217 -219
Flux content (%) *		3.2 ± 0.3			
Dryness *		Pass			
Halide content (%)*		0.09 ± 0.03			
Copper plate corrosion *		Pass			
Copper mirror corrosion *		Pass			
Aqueous solution resistivity test (Ωm) *		≥ 800			
SIR (Ω) * [85 °C,85%RH,168Hrs outside chamber]		≥ 1×10^{13}			
Voltage applied migration (Ω, visual check) *	[40 ºC,90%RH,DC50V,1000Hrs inside chamber]	≥ 1×10^{12} No migration observed			
	[85ºC,85%RH,DC50V,1000Hrs inside chamber]	≥ 1×10^{10} No migration observed			
Flux sputtering [350ºC,30 shots, in total]		≤ 30 pc.	≤ 30 pc.	≤ 45 pc.	≤ 35 pc.
Iron tip erosion [400ºC 10,000shots, rate of decrease]		≤ 14%	≤ 17%	≤ 27%	≤ 51%
Shelf life		3 years			

* Data based on S3X-70M.
Refer to each item herein for detailed test method.

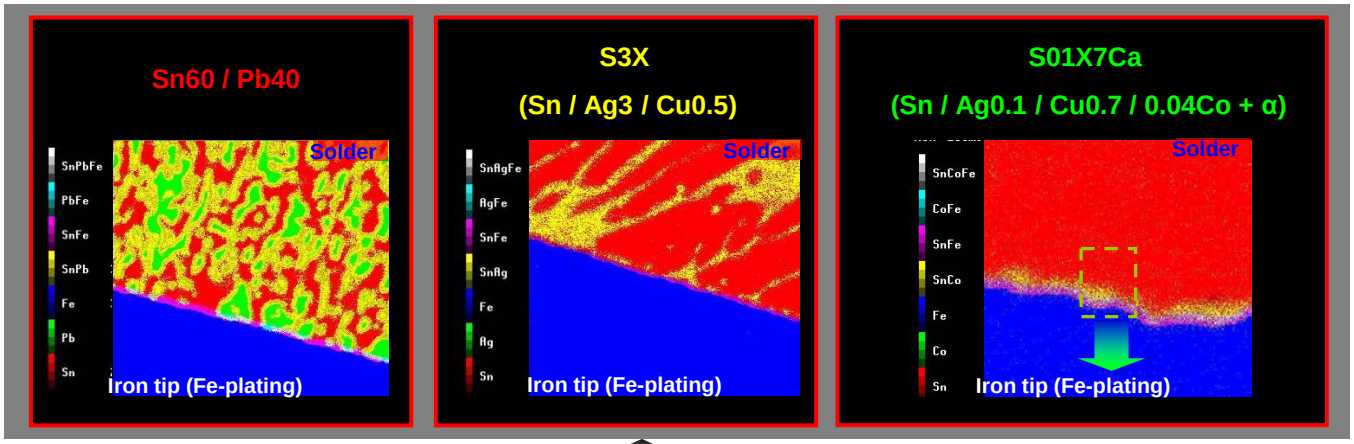
Product code

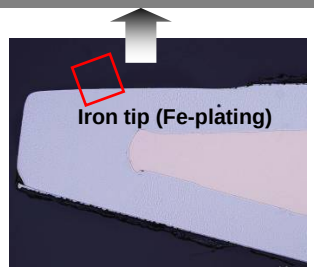
S01X7Ca – 70 M

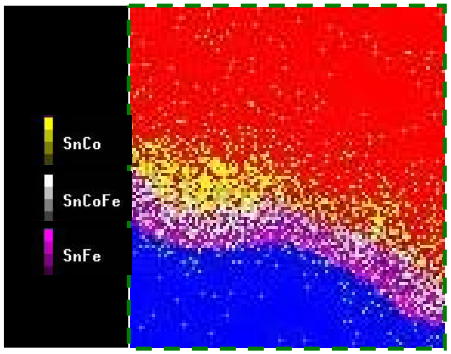
- S01X7Ca: Alloy composition
- 70: Flux number
- M: Flux type

Alloy composition (%)	**S01X7Ca**	: Sn 0.1Ag 0.7Cu 0.03Co + α
	S03X7Ca	: Sn 0.3Ag 0.7Cu 0.03Co + α
	SB6N	: Sn 3.5Ag 0.5Bi 6.0In
	S3X	: Sn 3.0Ag 0.5Cu
Flux type	**M**	: Low halide or halogen free
Flux number	Solid used	

Mechanism of preventing tip erosion - S01X7Ca / S03X7Ca alloys



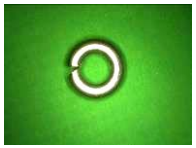


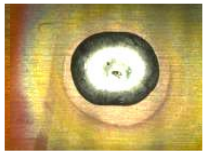
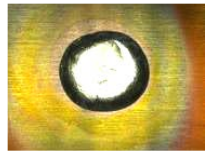
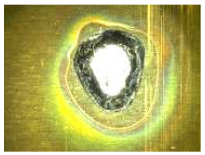
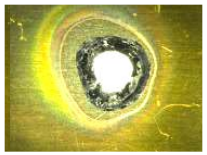
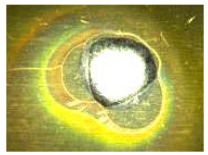
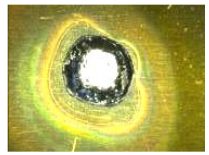


When using Sn60/Pb40 solder, tip erosion is minor, as Pb in the interface forms Pb-Fe compound, preventing Sn-Fe from dispersing Fe into the solder. Whereas in lead free solders such as S3X (SAC305), tip erosion is noticeable because Fe gets dispersed constantly into the solder. Having Co as its constituent, S01X7Ca ad S03X7Ca alleviate tip erosion, with Co replacing Fe in Sn-Fe, and forming barrier layers of Sn-Fe, Sn-Co-Fe, and Sn-Co between Fe plating and the solder.

Solder spread factor

・Test method: In-house method
・Test piece: Copper, brass, nickel piece (surface delipidated)
・Wire diameter: 0.8mm （outer diameter of the ring: 1.6mm）*as shown
・Melting conditions: Keep 5 sec. after melting over solder bath of 300ºC

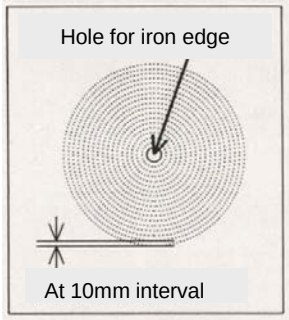


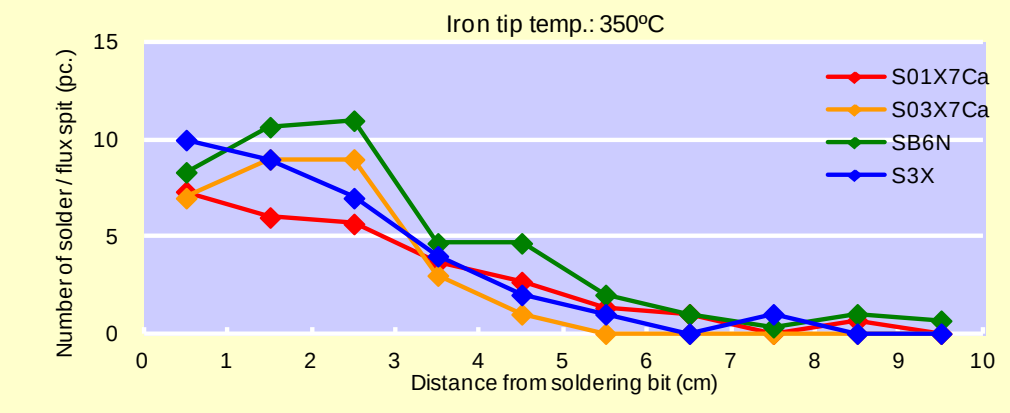
Base	S01X7Ca	S03X7Ca	SB6N	S3X
Cu				
Brass				
Ni				

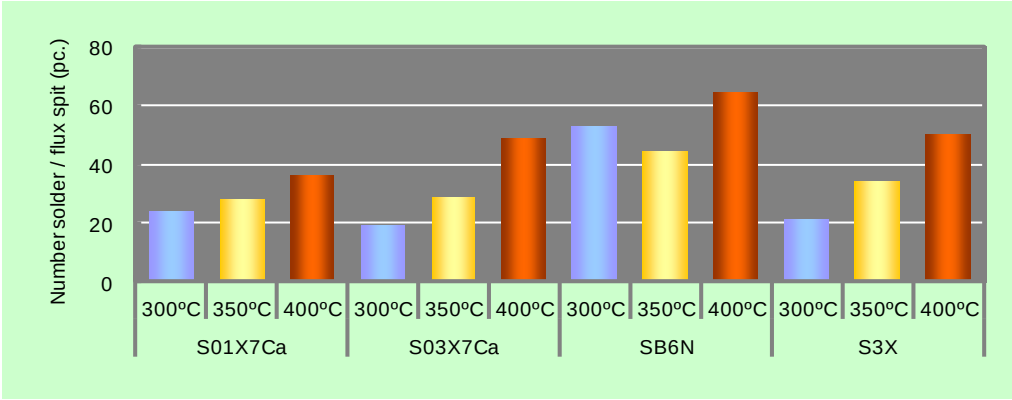
Alloy composition does not seem to affect solder spread factor.

Solder / Flux spitting

・Test method : In-house test method
・Solder iron temperature: 300・350・400ºC
・Solder wire diameter: 0.8mm
・Feeding speed: 10mm/2sec（interval = 8 sec.）
・Feeding amount: 30 shots

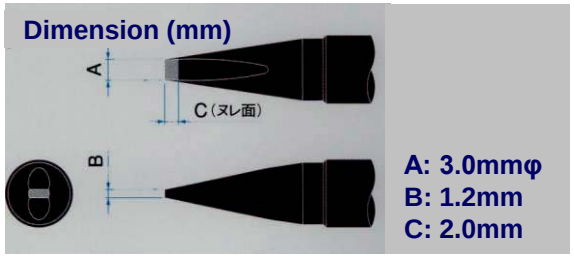




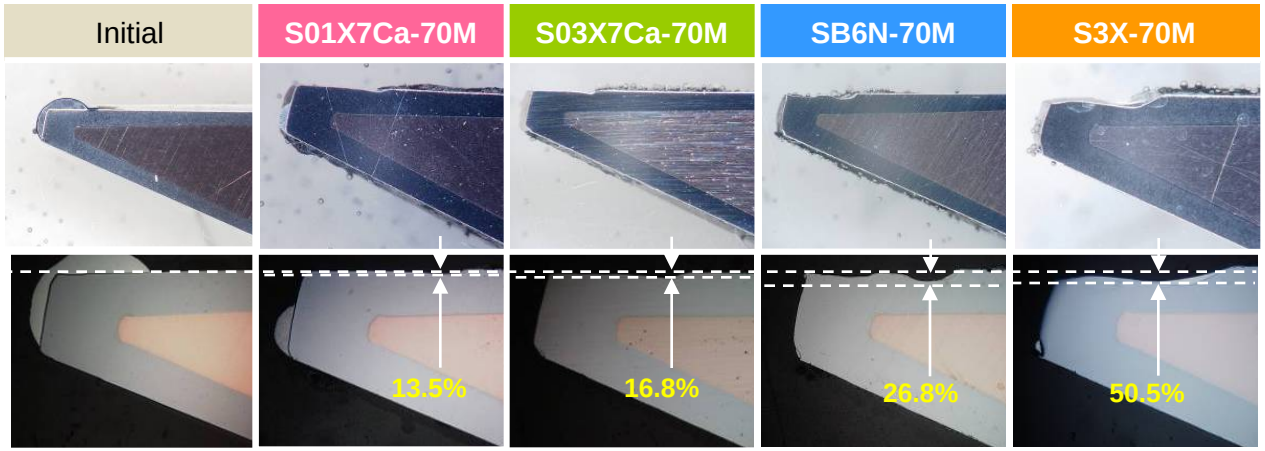


Iron tip erosion

- Test equipment : UNIX-412R
- Iron tip temp.: 400ºC (Iron tip : P3DR)
- Solder wire diameter: 0.8mm
- Feeding speed: 5.0mm/shot, feeding tact=1.0mm/sec
- Number of feeding: 10,000 shots



Iron tip configuration



Compared to SAC305 (S3X), a standard lead free solder alloy, S01X7Ca / S03X7Ca / S3XCa significantly extend the life of the iron tip, by having Co as its constituent. The less the Ag content, the longer the life of the iron tip tends to be.

Other properties

Contents

Item	Result	Method
Dryness of flux residue	Pass	JIS Z 3197
Halide content	0.0912 (%)	JIS Z 3197
Aqueous solution resistivity	940 (ohm.m)	JIS Z 3197
Copper mirror corrosion	Pass	JIS Z 3197
Copper plate corrosion	Pass	IPC-JSTD-004
SIR	2.96×10^{10} (ohm)	85ºC,85%RH,168hrs.
Voltage applied SIR	4.2×10^{10} (ohm)	85ºC,85%RH,1000hrs,DC50V
	1.29×10^{13} (ohm)	40ºC,90%RH,1000hrs,DC50V

Handling guide

1. Recommended solder iron temperature: 330 – 380ºC

May require adjustment according to solder wire diameter, specific heat capacity of component, and the feeder. Cautions should be taken not to set it too high as it could hinder heat conduction due to carbonization of the flux.

2. Shelf life: 3 years from the date of production

The flux shall retain the activation level during the warranty period as it does not soften below 70ºC. However, keep away from heat and moisture, and store in a place where temperature change is moderate throughout the year to prevent the solder surface from oxidation.

* How to read a lot number

ex. **Lot No. 12 09 100 72**

- 72 → Production number of flux
- 100 → Production number of solder alloy
- 09 → Month of production (September)
- 12 → Last two digits of calendar year of production (2011)

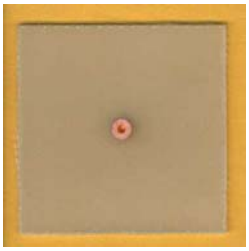
Creep Strength Testing of Mixing Lead Free Alloys

1. Purpose

This test is to verify the creep strength of the solder joint which is soldered with Sn3Ag0.5Cu and re-soldered by another alloy including Sn0.3Ag0.7Cu0.03Co, thus simulating the rework of a joint.

2. Test conditions

2-1 Test PCB



- Size: 30 x30x1.6t mm FR-4
- Through hole: 1.1mm dia.
- Copper land size: 3.0mm dia.
- Lead wire : 0.8mm dia. Sn plated

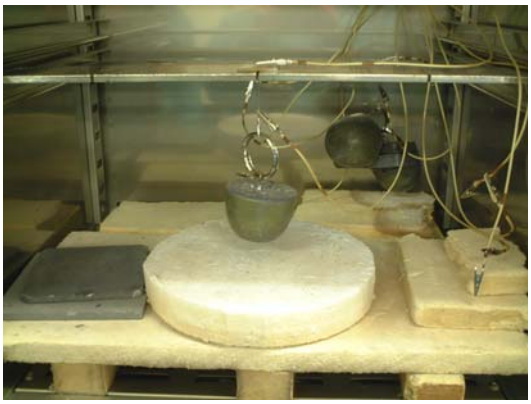
2-2 Soldering condition

Insert lead wire Sn plated into through hole of test PCB and apply flux on it. Pre-heat the soldering side at around 100~110°C, then solder it by wave soldering for the first operation.
In the second soldering operation, pre-heating was eliminated after the application of flux.
See table below for more details regarding the soldering conditions.

Test No	1st soldering			2nd soldering		
	Alloy composition	Solder Temperature	Dip time	Alloy composition	Solder temperature	Dip time
Sample 1	Sn3Ag0.5Cu	255	10sec	–		
Sample 2				Sn0.3Ag0.7Cu0.03Co	265°C	3sec
Sample 3				Sn0.7Cu	265°C	3sec
Sample 4				Sn3Ag0.5Cu	255°C	3sec

2-3 Creep test conditions

Place the test PCB on the table and put it into the thermogygrostat.
Once the test PCB has reached the set temperature, attach the weight to each lead wire and measure the elapsed time for the joint to rupture.



Test temperature	Test load
175°C	3 kg

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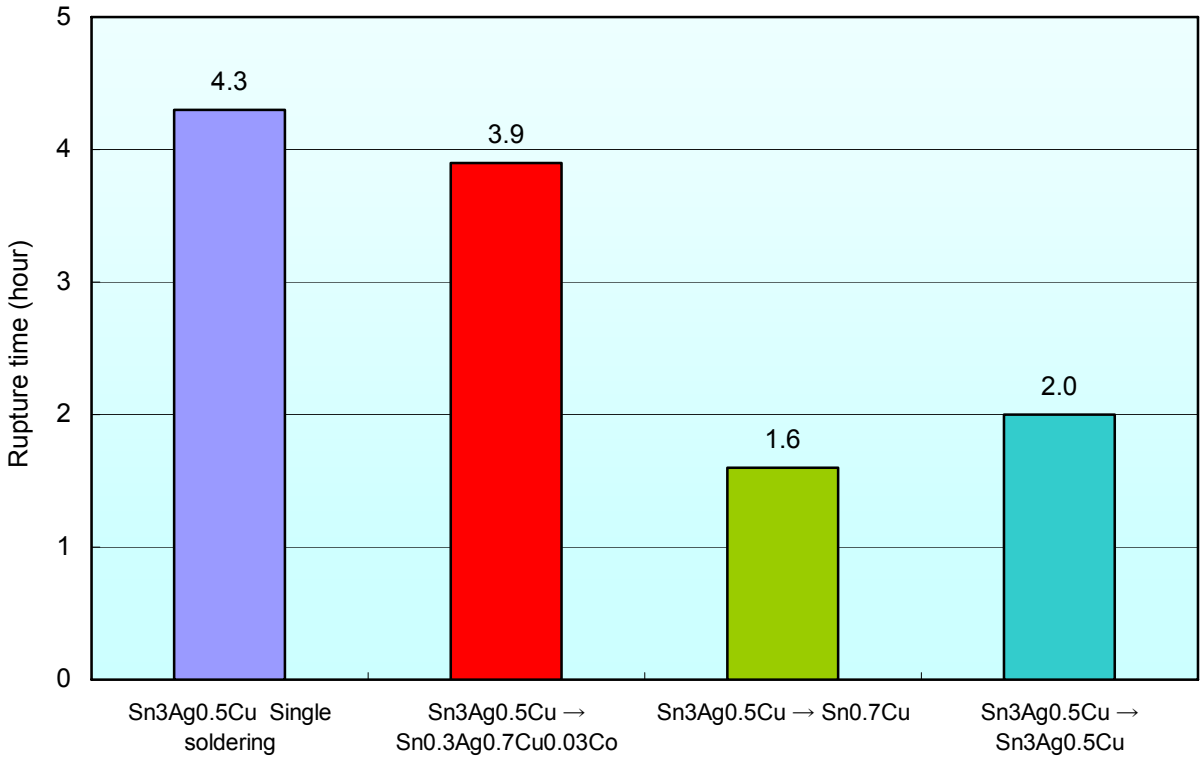
3. Test result

The test results are shown in the following chart and graph.

Sample No.	Flow soldering process	Rupture time (hour)				
		(n=1)	(n=2)	(n=3)	(n=4)	Average
1	Sn3Ag0.5Cu (single soldering)	3.8	4.5	4.8	3.9	**4.3**
2	Sn3Ag0.5Cu → Sn0.3Ag0.7Cu0.03Co	3.6	4.2	4.9	2.8	**3.9**
3	Sn3Ag0.5Cu → Sn0.7Cu	1.3	1.4	2.4	1.4	**1.6**
4	Sn3Ag0.5Cu → Sn3Ag0.5Cu	2.4	1.7	2.3	1.6	**2.0**



► The results above, show that in each case that after the 2nd soldering operation, regardless of the additional alloy used, rupture of the joint in comparison with the single soldered Sn3Ag0.5Cu was quicker. But the joint soldered with Sn0.3Ag0.7Cu0.03Co indicated highest creep strength (longest time before rupture) of any of the alloys tested, even when secondary soldered with Sn3Ag0.5Cu from which the original joint was formed.

Koki Company Limited
Soldering Technology Div.
2005.5.26

ECO+PLUS® series
Lead Free SOLUTIONS you can TRUST

PAT. PEND.

Anti-Erosion Flux Cored Wire Solder

S03X7Ca-56M

■ Features

1) Greatly extends the life of the soldering iron tip.
2) Very fast and complete wetting.
3) Minimized solder/flux spattering.
4) No tailing or spiking and clean take away of soldering iron.
5) Compatible with various other solder alloys.

■ Specifications

Application			Hand, robot soldering
Product			**S03X7Ca-56M**
Alloy	Composition (%)		Sn0.7Cu0.3Ag0.03Co+ α
	Specific gravity		7.3
	Melting point (℃)		217 - 227
	Tensile stength (N/mm^2)		35
	Elongation (%)		36
Product	Flux content (wt%)		2.8 - 3.6
	Halide content (wt%)		0.12
	Surface insulation resistance	85℃ × 85%RH × 168Hr Out of oven	$> 2 \times 10^{12}$
		85℃ × 85%RH × 168Hr in oven	$> 1 \times 10^{9}$
	Aqueous solution resistivity *1 (Ω cm)		> 500
	Flux type *2		ROL1
	Copper plate corrosion *3		Passed
	Solder spread factor (%)		80
	Diameter (mm)		0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 1.0, 1.2, 1.6
	Shelf life (room temp.)		3 years

1. Aqueous solution resistivity ..... In accordance with MIL specifications.
2. Flux type ..... In accordance with ANSI/J-STD-004
3. Copper plate corrosion ..... In accordance with JIS.

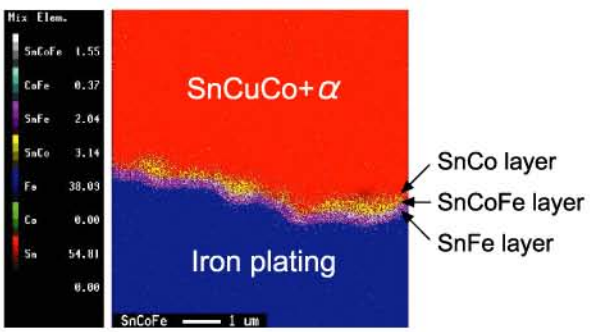
■ Anti-erosion effect

The normal alloy composition of the lead free rosin flux cored solder wires, is now dominated by SnAg3.0Cu0.5 (SAC305), resulting in a much higher Tin content compared to Tin/Lead wires. Whilst soldering, Tin enters the crevices or gaps between the crystal structures of the plating surface (normally Nickel and Iron) of the soldering tip, dissolves and erodes the Copper in the center, and the Copper is drawn out from the soldering tip.
Consequently, the Copper in the center of the soldering tip becomes thinner, and when external pressure is exerted, the plating surface becomes deformed and damaged.

As a corrective measure against such erosion of the soldering bit, simply thickening the tip plating (around 500 μm) may be one option, though it cannot be the complete solution due to the properties and crystal structures of the metals used. Furthermore it has been found that the iron content of the plating surface is also considerably eroded by the high tin content of normal lead free alloys, thus further enhancing the risk and rate or erosion of the copper beneath it.
In the case of S03X7Ca-56M, intermetallic compounds are formed over the plating surface during soldering in the same way as with the normal tin lead solders.
Uniquely S03X7Ca-56M forms a 3 layer barrier over the iron tip and restricts the erosion of the Iron content of the plating surface and thus further protects the copper bulk of the soldering tip.

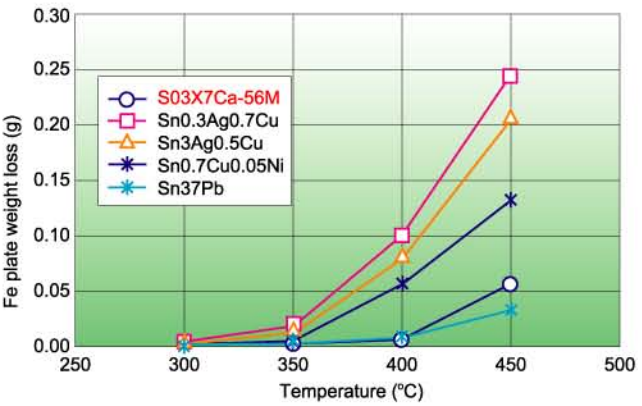
► Restriction Mechanism of Iron erosion

Cobalt melts into the metallic compounds, SnCu or SnFe, to be formed at the interface of the solder and Iron coating of the soldering tip, and restricts the diffusion of Iron into the solder.



► Iron erosion test

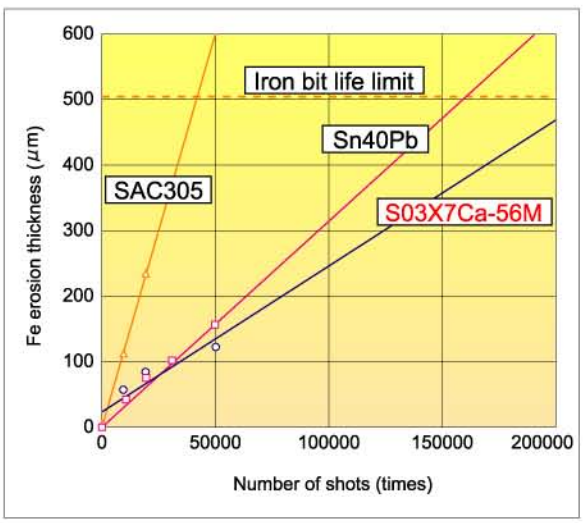
Test specimen: 25 × 70 × 2.2mmt, iron plate (SPC)
Test procedure: Dip iron plate 15mm into solder alloy and agitate at 30 rpm for 1 hour to measure the weight loss.

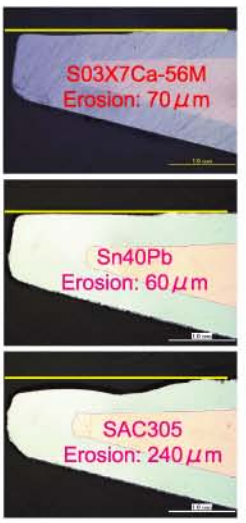


► Anti-Fe erosion test

By using an automatic soldering iron robot, the anti-Iron erosion property of Sn40Pb, SAC305 and S03X7Ca-56M alloys was conducted as shown below. At the 20,000th contact, erosion of the soldering tip using S03X7Ca-56M wire was only 25% of that in comparison to SAC305 alloy (see below pictures).

Test conditions
- Fe coating thickness: 500 micron
- Iron bit temp.: 390°C
- Wire diameter: 0.8mm
- Feed amount: 5mm/shot
- Soldering robot: Japan Unix





*Specifications are subject to change.

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2008.2.8

Solder wire: applicable for REACH compliance

Eco+PLUS series
Lead Free SOLUTIONS you can TRUST

S3X-70M

- Quick wetting through components with large thermal mass such as connectors
- Remarkable wetting performance to nickel and brass leads
- Realizes low flux spitting and bridging in slide-soldering
- No REACH restricted SVHC substances contained

◆ Wetting performance

Test method

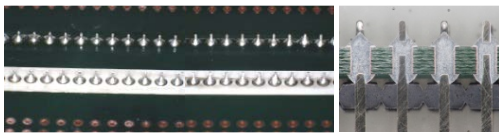
Heat a SAC305 alloy ring with solid flux added on the solder bath at 300ºC for 5 sec.

Solder spreads quickly even on Brass and Nickel.

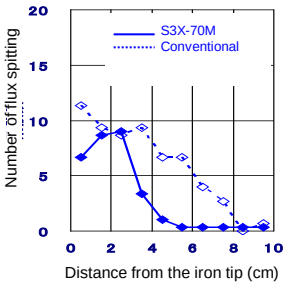
Test method

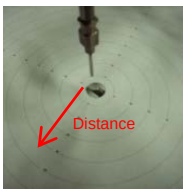
Conduct a drag soldering to 21 pins at one time (Iron tip temp. = 370ºC)

No bridges are seen maximum at 10mm/sec.



◆ Low flux spitting





Iron tip temp.: 380ºC

◆ Product specifications

Product	S3X-70M
Alloy composition (%)	Sn 3.0Ag 0.5Cu
Melting point (ºC)	217-219
Flux content (%)	3.0
Halide content (%)	0.09
Diameter of wire (mm)	0.3, 0.4, 0.5, 0.6, 0.8, 1.0, 1.2, 1.6

*Specifications are subject to change.

◆ Hand soldering products line-up

■ Flux cored solder wire

S01X7Ca-70M	Anti-erosion low Ag alloy (Sn0.1Ag0.7CuCo+α)
S03X7Ca-70M	Anti-erosion low Ag alloy (Sn0.1Ag0.7CuCo+α)
SB6N-70M	High reliability, crack free alloy

■ Tacky flux

TF-M880R	For repairing BGA/CSP, halogen free
TF-MP1	For PoP soldering

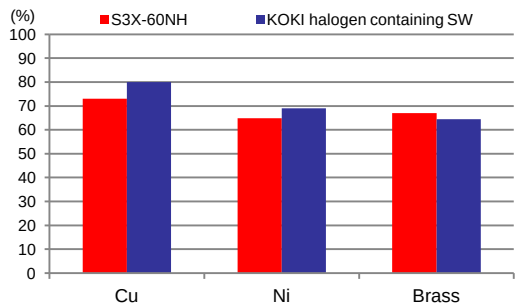
Halogen free type solder wire

S3X-60NH

- Halogen free (Cl, Br ≦ 900ppm / Cl + Br ≦ 1500ppm)
- Secures equivalent wetting performance to conventional halogen containing product

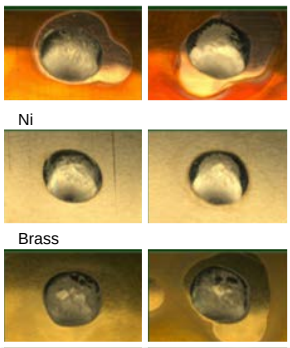
◆ Wetting performance

Solder spread ratio



S3X-60NH secures almost equivalent or even better wetting performance to KOKI halogen containing solder wire with Cu, Ni and Brass.

S3X-60NH



◆ Product specifications

Product	S3X-60NH
Alloy composition (%)	Sn 3.0Ag 0.5Cu
Melting point (ºC)	217 – 219
Flux content (%)	3.0
Halide content (%)	0.0
Diameter of wire (mm)	0.3, 0.4, 0.5, 0.6, 0.8, 1.0, 1.2, 1.6

*Specifications are subject to change.

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Lead free SOLUTIONS you can TRUST

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#50017E
2012.12.27

Koki no clean LEAD FREE flux cored solder wire

Contents

REACH compliant

70M series

Product information

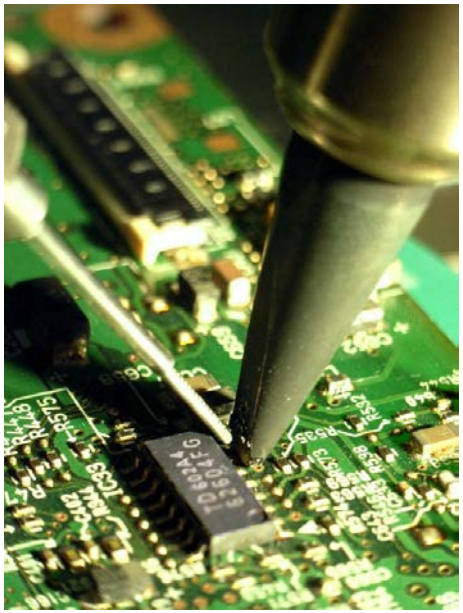
LINE-UP

S01X7Ca - 70M

S03X7Ca - 70M

SB6N - 70M

S3X - 70M



This product information contains product performance assessed strictly according to our own test procedures and may not be compatible with results at end-users.

Product Features

Contents

- Free of the regulated substances listed in JIG-101 (rev.3), which has been quoted in REACH, RoHS, etc.
- Drastically reduces iron tip erosion (S01X7Ca/S03X7Ca/S3XCa) with added Co forming barrier layers
- SB6N contains 6% indium, highly resistant to severe temperature environments
- Excellent wetting to lead frame components
- No tailing or spiking and a clean take away of the soldering iron
- Minimized fume and flux sputtering

Specifications

Contents

Items		S01X7Ca	S03X7Ca	SB6N	S3X
Alloy	Composition (%)	Sn 0.1Ag 0.7Cu 0.03Co + α	Sn 0.3Ag 0.7Cu 0.03Co + α	Sn 3.5Ag 0.5Bi 6.0In	Sn 3.0Ag 0.5Cu
	Melting point (ºC)	217 - 227	217 - 227	202 - 210	217 -219
Flux content (%) *		3.2 ± 0.3			
Dryness *		Pass			
Halide content (%)*		0.09 ± 0.03			
Copper plate corrosion *		Pass			
Copper mirror corrosion *		Pass			
Aqueous solution resistivity test (Ωm) *		≥ 800			
SIR (Ω) * [85 °C,85%RH,168Hrs outside chamber]		≥ 1×10^{13}			
Voltage applied migration (Ω, visual check) *	[40 ºC,90%RH,DC50V,1000Hrs inside chamber]	≥ 1×10^{12} No migration observed			
	[85ºC,85%RH,DC50V,1000Hrs inside chamber]	≥ 1×10^{10} No migration observed			
Flux sputtering [350ºC,30 shots, in total]		≤ 30 pc.	≤ 30 pc.	≤ 45 pc.	≤ 35 pc.
Iron tip erosion [400ºC 10,000shots, rate of decrease]		≤ 14%	≤ 17%	≤ 27%	≤ 51%
Shelf life		3 years			

* Data based on S3X-70M.
Refer to each item herein for detailed test method.

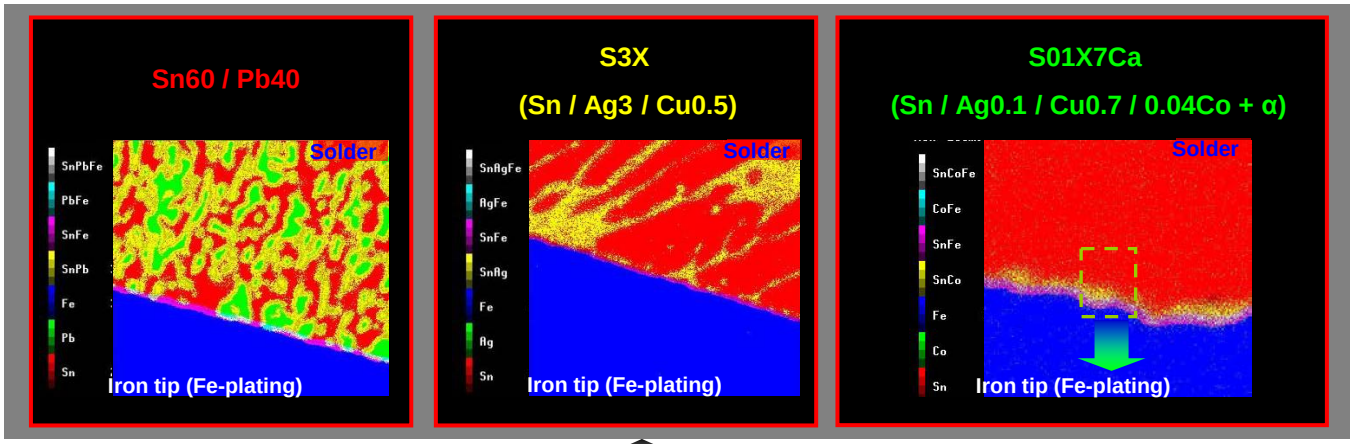
Product code

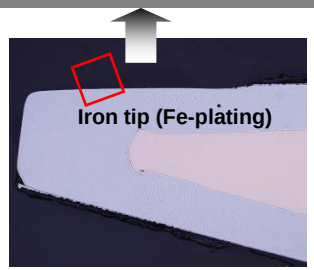
S01X7Ca – 70 M

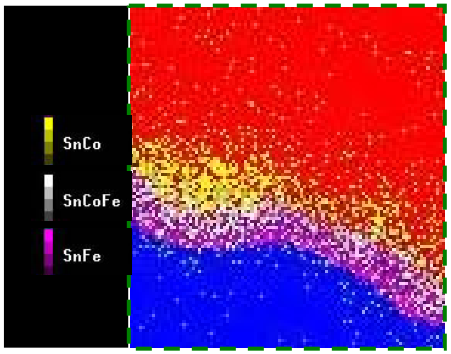
- S01X7Ca: Alloy composition
- 70: Flux number
- M: Flux type

Alloy composition (%)	**S01X7Ca**	: Sn 0.1Ag 0.7Cu 0.03Co + α
	S03X7Ca	: Sn 0.3Ag 0.7Cu 0.03Co + α
	SB6N	: Sn 3.5Ag 0.5Bi 6.0In
	S3X	: Sn 3.0Ag 0.5Cu
Flux type	**M**	: Low halide or halogen free
Flux number	Solid used	

Mechanism of preventing tip erosion - S01X7Ca / S03X7Ca alloys



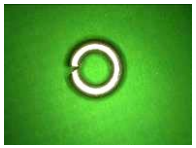


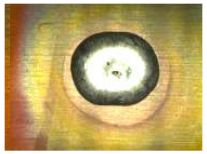
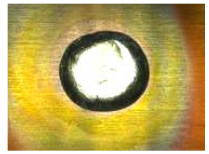
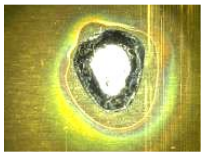
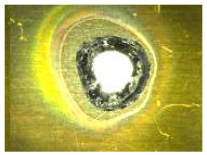
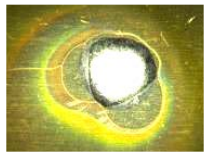
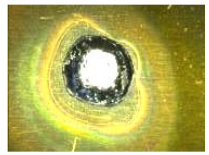


When using Sn60/Pb40 solder, tip erosion is minor, as Pb in the interface forms Pb-Fe compound, preventing Sn-Fe from dispersing Fe into the solder. Whereas in lead free solders such as S3X (SAC305), tip erosion is noticeable because Fe gets dispersed constantly into the solder. Having Co as its constituent, S01X7Ca ad S03X7Ca alleviate tip erosion, with Co replacing Fe in Sn-Fe, and forming barrier layers of Sn-Fe, Sn-Co-Fe, and Sn-Co between Fe plating and the solder.

Solder spread factor

・Test method: In-house method
・Test piece: Copper, brass, nickel piece (surface delipidated)
・Wire diameter: 0.8mm （outer diameter of the ring: 1.6mm）*as shown
・Melting conditions: Keep 5 sec. after melting over solder bath of 300ºC

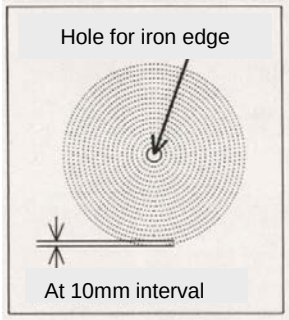


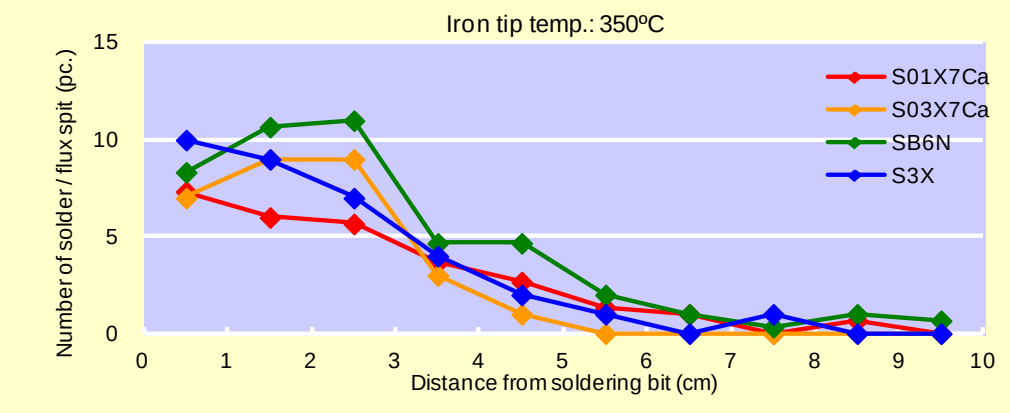
Base	S01X7Ca	S03X7Ca	SB6N	S3X
Cu				
Brass				
Ni				

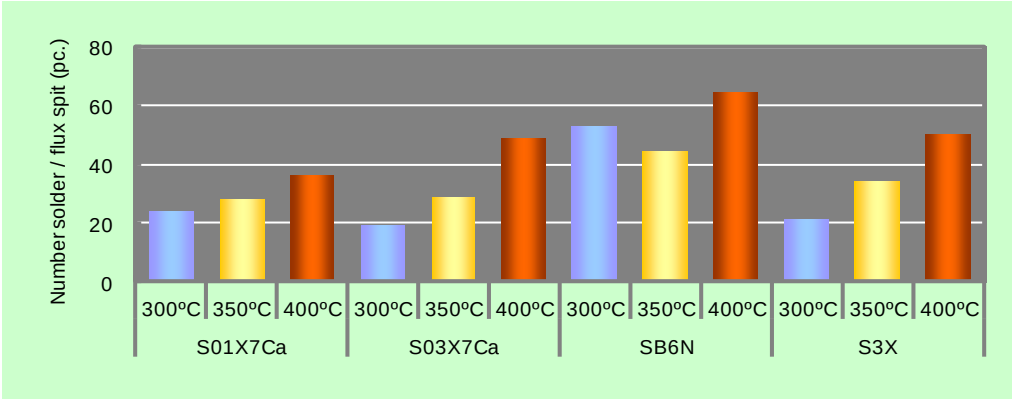
Alloy composition does not seem to affect solder spread factor.

Solder / Flux spitting

・Test method : In-house test method
・Solder iron temperature: 300・350・400ºC
・Solder wire diameter: 0.8mm
・Feeding speed: 10mm/2sec（interval = 8 sec.）
・Feeding amount: 30 shots

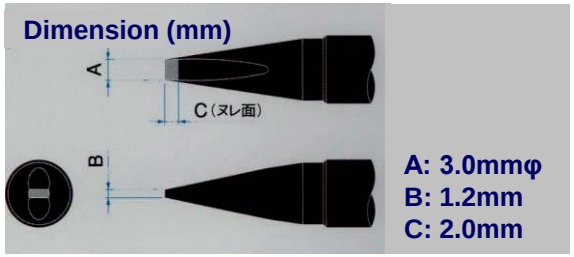




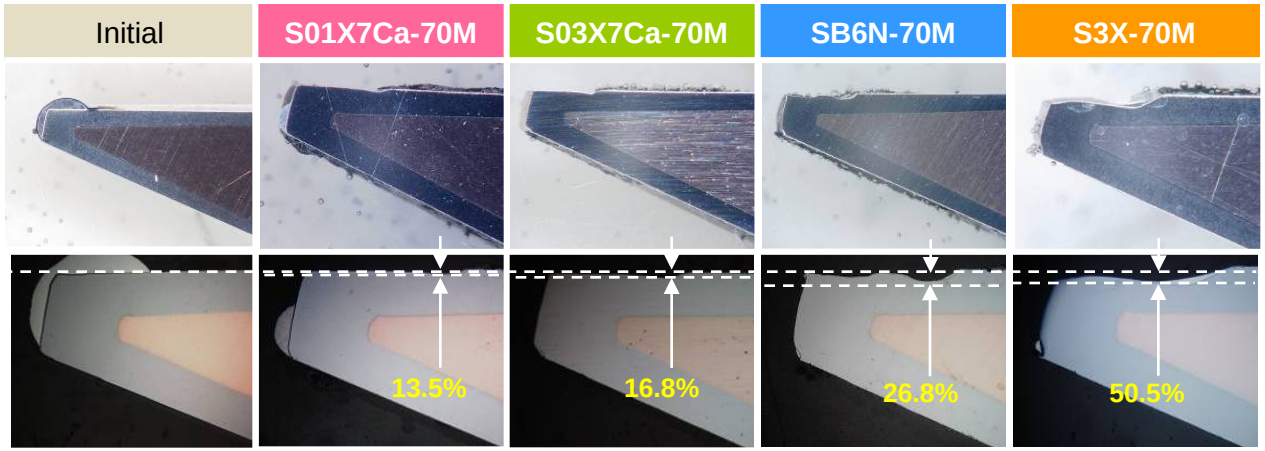


Iron tip erosion

- Test equipment : UNIX-412R
- Iron tip temp.: 400ºC (Iron tip : P3DR)
- Solder wire diameter: 0.8mm
- Feeding speed: 5.0mm/shot, feeding tact=1.0mm/sec
- Number of feeding: 10,000 shots



Iron tip configuration



Compared to SAC305 (S3X), a standard lead free solder alloy, S01X7Ca / S03X7Ca / S3XCa significantly extend the life of the iron tip, by having Co as its constituent. The less the Ag content, the longer the life of the iron tip tends to be.

Other properties

Contents

Item	Result	Method
Dryness of flux residue	Pass	JIS Z 3197
Halide content	0.0912 (%)	JIS Z 3197
Aqueous solution resistivity	940 (ohm.m)	JIS Z 3197
Copper mirror corrosion	Pass	JIS Z 3197
Copper plate corrosion	Pass	IPC-JSTD-004
SIR	2.96×10^{10} (ohm)	85ºC,85%RH,168hrs.
Voltage applied SIR	4.2×10^{10} (ohm)	85ºC,85%RH,1000hrs,DC50V
	1.29×10^{13} (ohm)	40ºC,90%RH,1000hrs,DC50V

Handling guide

1. Recommended solder iron temperature: 330 – 380ºC

May require adjustment according to solder wire diameter, specific heat capacity of component, and the feeder. Cautions should be taken not to set it too high as it could hinder heat conduction due to carbonization of the flux.

2. Shelf life: 3 years from the date of production

The flux shall retain the activation level during the warranty period as it does not soften below 70ºC. However, keep away from heat and moisture, and store in a place where temperature change is moderate throughout the year to prevent the solder surface from oxidation.

* How to read a lot number

ex. **Lot No. 12 09 100 72**

- 72 → Production number of flux
- 100 → Production number of solder alloy
- 09 → Month of production (September)
- 12 → Last two digits of calendar year of production (2011)

Lead Free Solder Wire

Report #SPA-45063
Soldering Technology Div.
May 1, 2008

Compatibility between S03X7Ca-56M and SN100C

ECO+PLUS series
Lead Free SOLUTIONS you can TRUST

KOKI
Challenging New Technologies

Objective and Test method

Objective

This is to verify the compatibility between Koki lead free solder wire S03X7Ca-56M and SN100C solder for wave soldering, assuming that the joint wave soldered with SN100C is repaired by the wire solder S03X7Ca-56M.

- S03X7Ca-56M (Sn0.7Cu0.3Ag0.03Co+α)
- SN100C

Test applied is the creep strength test.

Test method

Solder a test board for the creep strength test with SN100C for 10sec. and solder it again with S03X7Ca-56M for 3sec. to obtain the test sample.
For comparison, prepare the test boards soldered only one time and two times with SN100C respectively.

Test conditions

Test board

・Test board: 30 x 30 x 1.6mmt FR-4
・Through hole dia.: 1.1mm
・Cu pad dia: 3.0mm
・Lead wire: 0.8mm dia. Cu wire with Sn plating
・Squeegee pressure: 50 → 60N

Test board

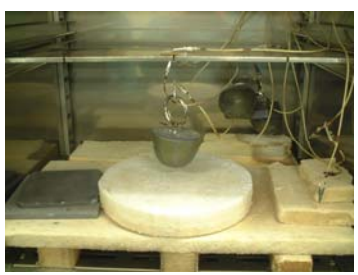
Soldering conditions

Insert the solder wire into the through hole. Pre-heat it at 100-110ºC and solder with the below conditions.

Sample No.	1st soldering			2nd soldering		
	Solder	Solder temp.	Dip time	Solder	Solder temp.	Dip time
#1	SN100C	260ºC	10sec.	--		
#2	SN100C	260ºC	10sec.	SN100C	260ºC	10sec.
#3	SN100C	260ºC	10sec.	S03X7Ca-56M	260ºC	10sec.

Creep strength test conditions

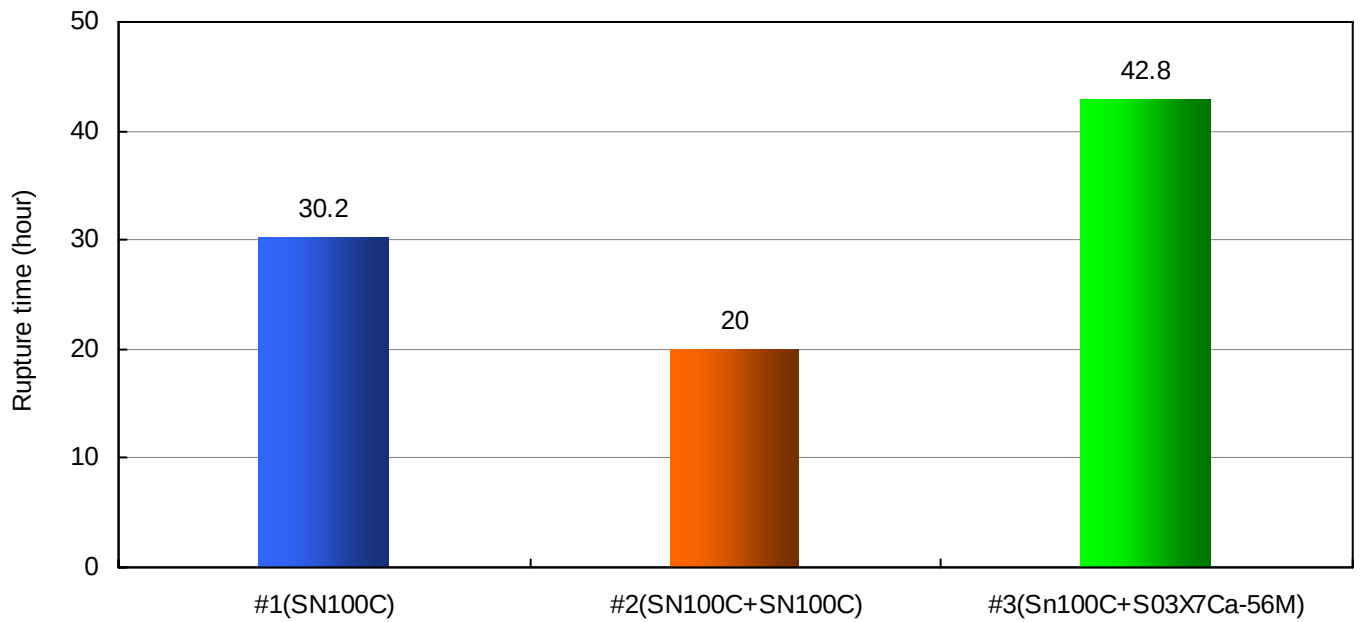
・Temperature: 150ºC
・Load: 3kg



Creep strength test

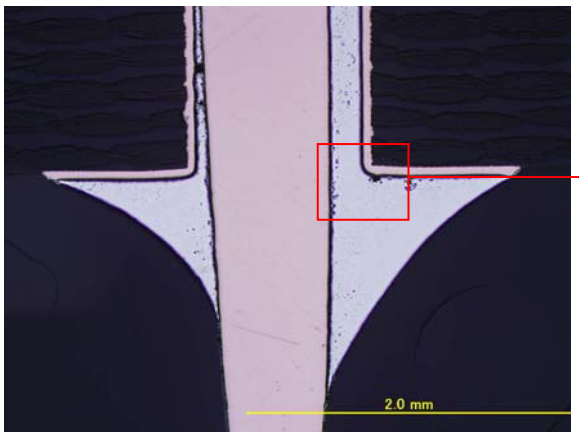
Test result

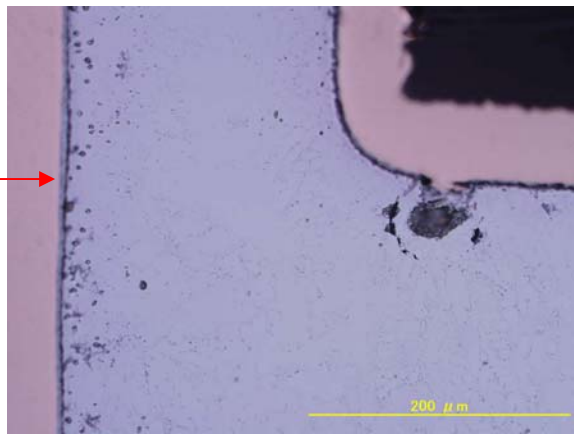
Sample No.	1st soldering		Creep strength(rupture) time (hour)				
	1st soldering	2nd soldering	n=1	n=2	n=3	n=4	Ave.
#1	SN100C	--	39.3	21.4	21.0	39.0	**30.2**
#2	SN100C	SN100C	12.6	23.3	30.6	13.3	**20.0**
#3	SN100C	S03X7Ca-56M	38.0	47.1	31.6	54.6	**42.8**



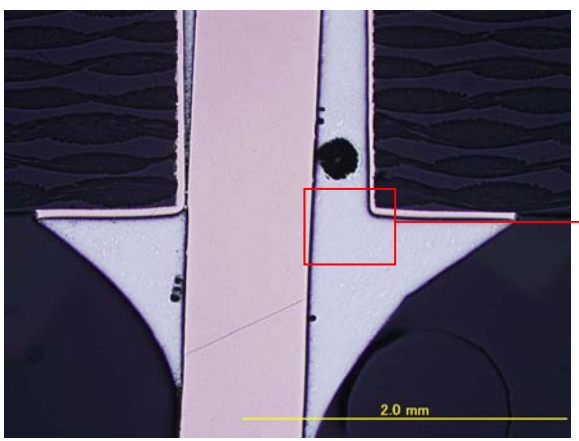
Test result

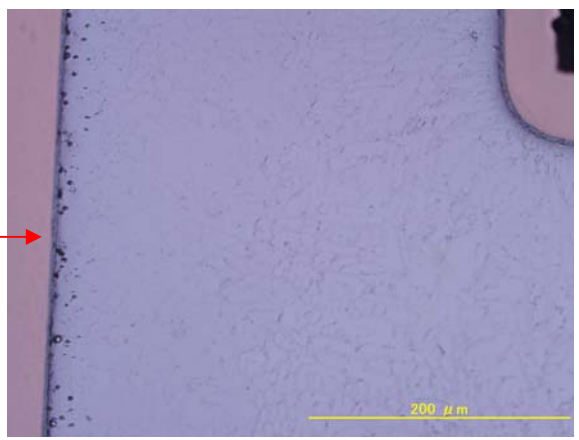
#1 SN100C





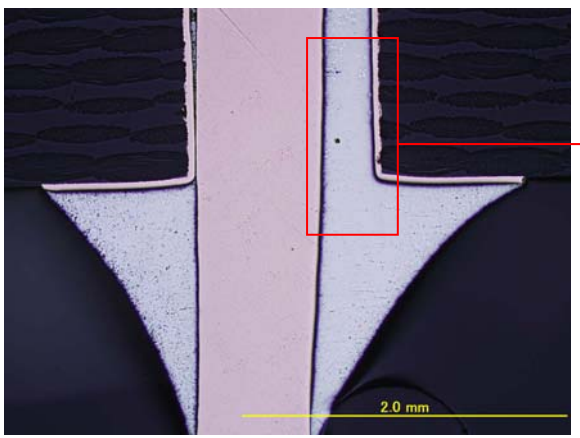
#2 SN100C+SN100C

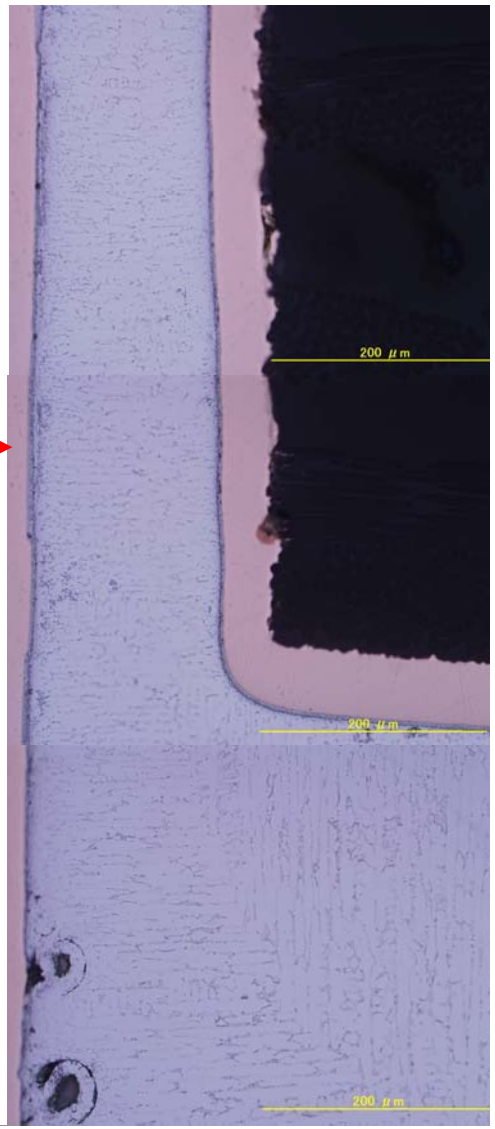




Test result

#2 SN100C+S03X7Ca-56M





Summary

1. Creep strength test

The combination of SN100C+S03X7Ca-56M resulted in the longest rupture time.

This is because of property of the alloy composition of S03X7Ca-56M, which originally has higher creep rupture time.

SN100C+SN100C resulted in the shortest rupture time shall be because the solder around the lead wire re-melted at the 2nd soldering and caused inconsistent crystalline structure in the joint, which lead to weakening of the joint strength.

2. Cross-section

SN100C+S03X7Ca-56M combination shows no discernible defects at around more or less the boundary between the two alloys.

As the conclusion, S03X7Ca-56M is compatible with SN100C in terms of joint reliability or even makes the joint more reliable.