ECO+PLUS® series
Lead free SOLUTIONS you can TRUST

Anti-Pillow Defect Lead Free Solder Paste

S3X48-M406-3

PREVENTS the occurrence of **HIDDEN PILLOW DEFECT** and ensures the quality of solder joints.

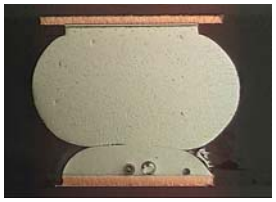
Ensures **OUTSTANDING** continual **PRINTABILITY** with super fine pitch and CSP applications and has long stencil idle time.

Heat **RESISTANT** new flux formula achieves complete solder melting and wetting on micro-components and footprints.

Background of development

Using mobile telephones as a typical example, whilst downsizing of the electronic devices continues, more and more space saving components, such as BGAs and CSPs, are being widely used. It has become a critical issue that solder merging between the bumps and solder does not occur, and is referred to as “hidden pillow defect” under certain conditions.

The solder paste **S3X48-M406-3** has been developed to solve this difficult technical problem, not only for bumped components, such as BGA, but also for chip and leaded components.



Pillow defect

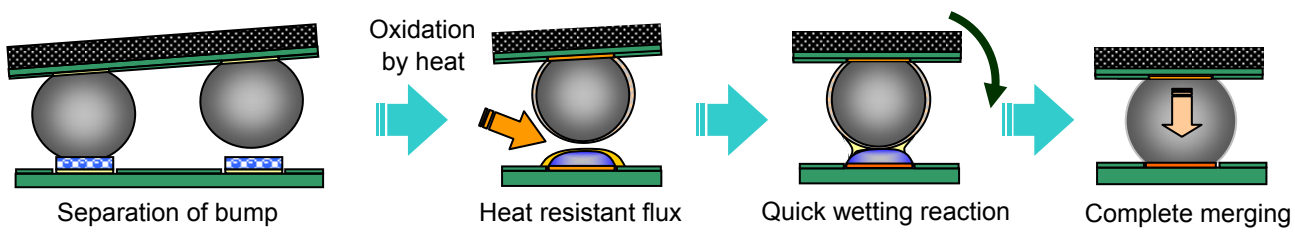
Mechanism of occurrence of Pillow Defect

Due to various reasons, such as warpage of the package, inconsistent bump size, insufficient solder deposit, distortion of package during reflow etc., results in the solder bump being separated from the solder paste before the solder melts and wets to it. In the case of the solder bump being separated from the solder paste and heated in the reflow oven, the adverse effect occurs in two areas. Firstly, the area of the bump surface where it is in contact with the molten solder gets badly oxidized, and secondly, the flux activation of the solder paste will be quickly consumed as the solder melts, thus forming a layer of oxidized flux and solder on the surface.

When the bump descends onto the molten solder due to the weight of the package and wetting forces from the other joints, the oxide film formed on the surface of the molten solder paste and the molten solder bump with almost no flux activation, prohibits them from merging together.

It seems difficult to completely prevent the separation of the bumps from the solder paste, so it is important to develop the solder paste featuring **high heat resistance** characteristics to protect the solder powder and bump from oxidation and sustain the activation strength of the flux for a long time at high temperatures, and furthermore to facilitate **quick wetting reaction speeds** to reduce the exposure time of the solder bump and secure sufficient time for the bump to collapse and merge with the molten solder paste.

- Design concept -

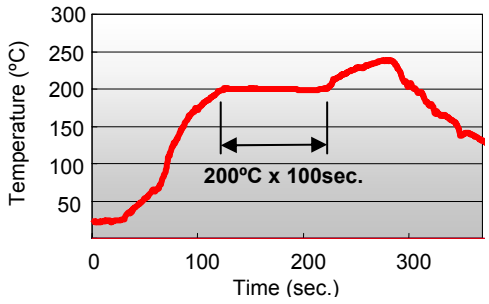


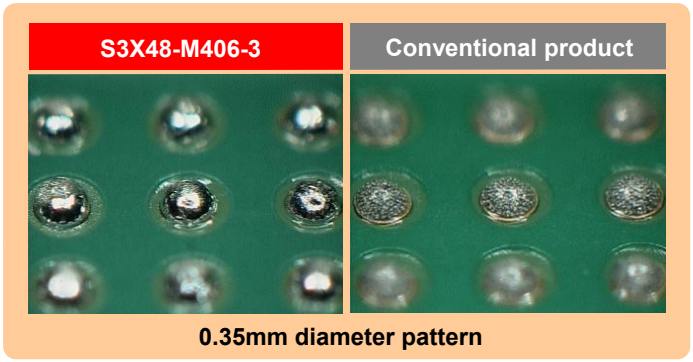
Improvement of heat resistance

A variety of optimizations on the flux formula has been implemented to significantly enhance the heat resistance even at high pre-heat conditions (200°C), such as the selection of anti-oxidant additives and the prevention of flux bleed from the solder deposit to further protect the solder particles.

► Melting of super fine pattern

- Stencil : 0.12mm thickness, 100% aperture to pad
- Pad : 0.35mm dia. BGA pattern
- Reflow profile :

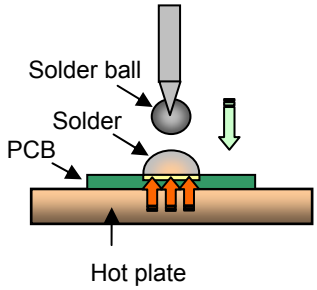


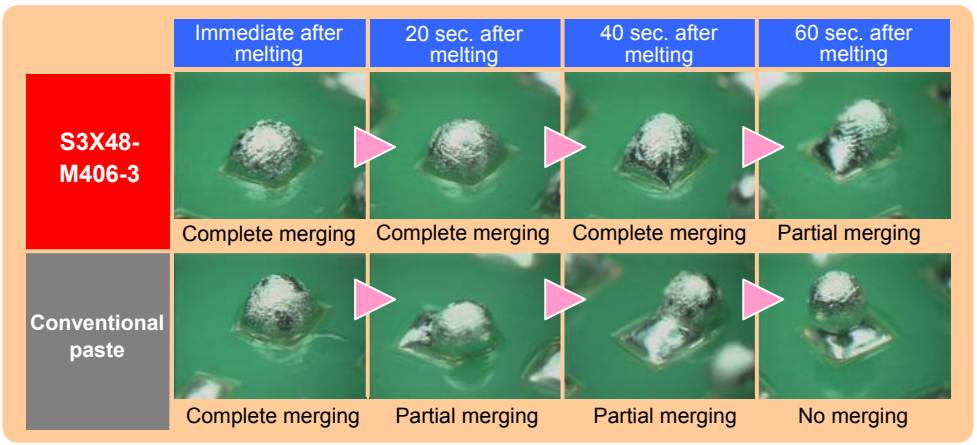


► Retention of flux activation

Observe influence of progressive oxidation of flux/molten solder over retention of flux activation.

- Stencil : 0.12mm thickness, 100% aperture to pad size
- Pad : 0.8 x 0.8mm chip pad
- Solder ball : Sn3Ag0.5Cu, 0.76mm diameter
- Test procedure : Melt solder paste on hot plate and drop solder ball at every 20sec.

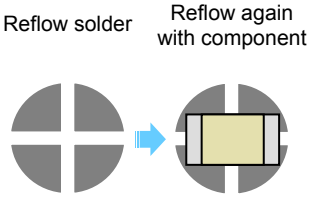


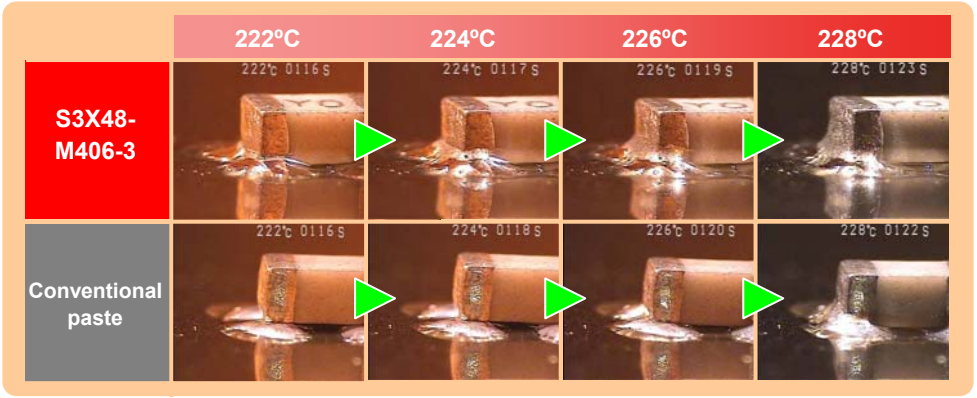


Enhancement of wetting reaction speed

Wetting reaction speed has been enhanced by controlling the flow behavior during the heating process by the adoption of heat resistant flux formulations.
In the wetting test, the chip capacitor was placed on once reflowed solder and reflowed again to simulate the pillow phenomenon. S3X48-M406-3 started to wet to the component at 224°C, whilst the conventional paste started at 228°C. Such a quicker wetting action will help to allow sufficient time for the bump to merge completely with the solder.

- Stencil : 0.12mm thickness,
- Preconditioning of component: 150°C for 3 hours baking



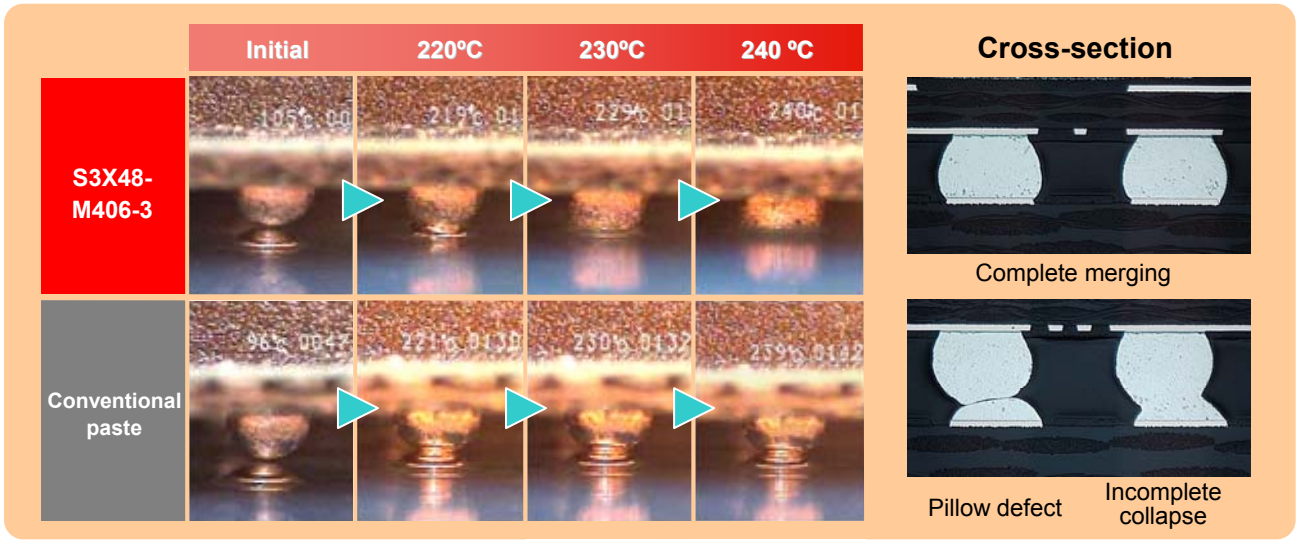


Wetting performance with BGA

Significant enhancements in the heat resistance of the flux and wetting reaction speed have succeeded in reducing the occurrence of hidden pillow defect.
S3X48-M406-3 assures robust wetting action to BGA bumps with intentional extra oxidation.

► Pillow defect test

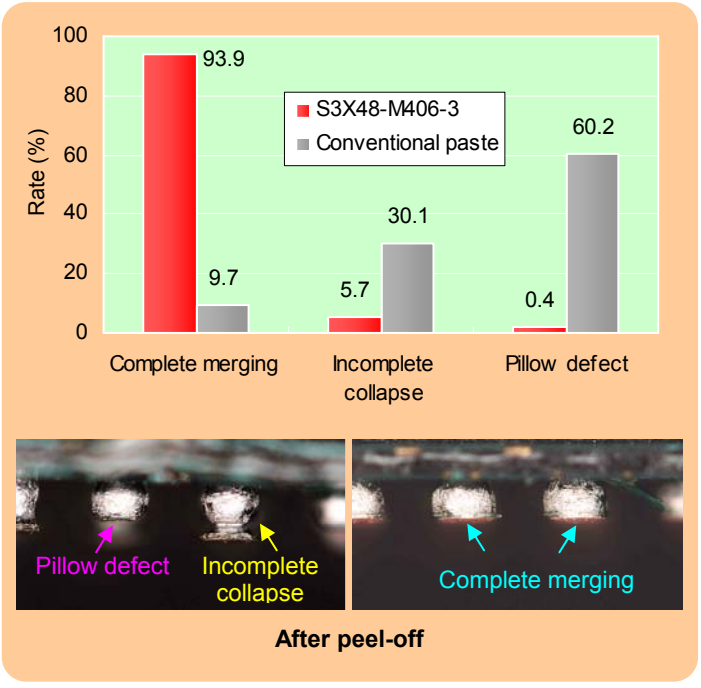
- Material : Glass epoxy FR-4
- Stencil thickness : 0.12mm
- Pad size : 0.5mm
- Component (BGA): SnAgCu, 1.0mm pitch, 196 bumps x 5, pre-conditioned at 180ºC×100sec.
- Procedure: 1. Reflow solder paste without BGA.
  2. Place BGA on pre-reflowed solder.
  3. Reflow it.
- Surface treatment : OSP
- Stencil aperture : 100% aperture opening to pad
- Atmosphere : Air

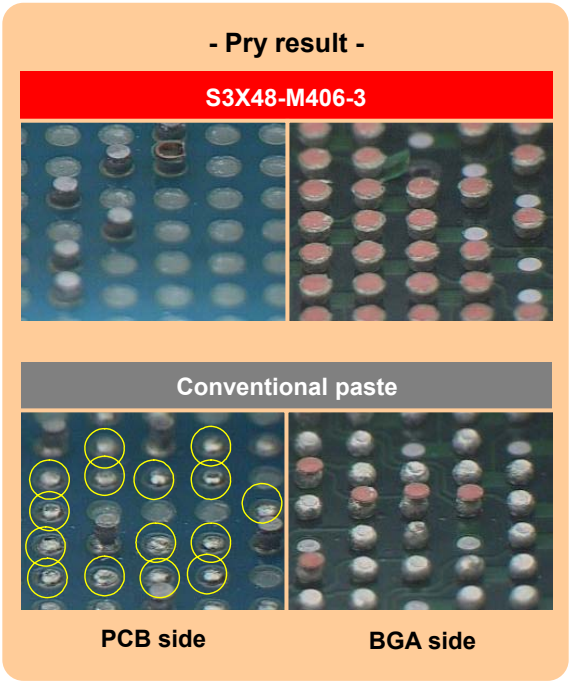


New formula **S3X48-M406-3** wets much faster than the conventional product and immediately breaks the oxide film formed on the surface of both the solder bump and the molten solder and enables quicker wetting and complete collapse of the bump to secure joint quality.

► Observation of pillow defect

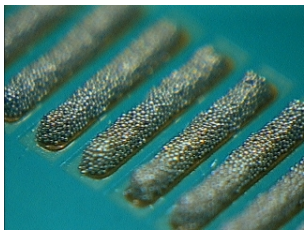
S3X48-M406-3, new heat resistant and enhanced wetting reaction speed formula, exhibited drastic reduction of pillow defects.



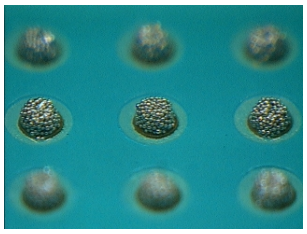


Printability

(Continual print at 40mm/sec., stencil 120μm)

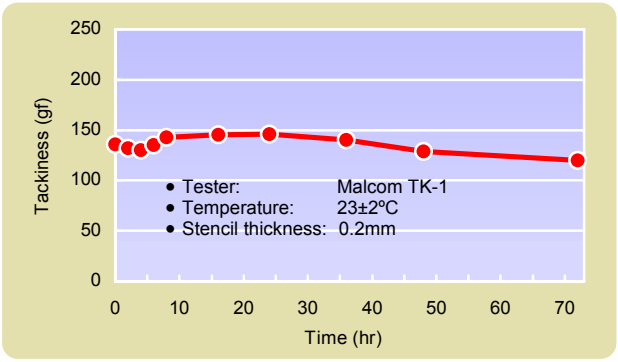


0.4mm pitch
(201st print, parallel)

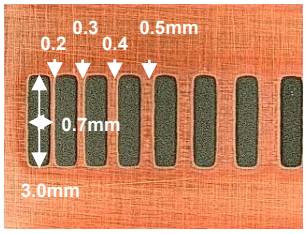


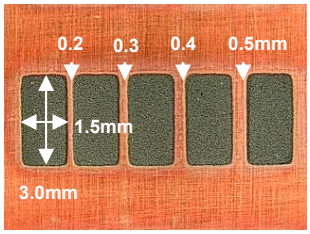
0.3mm diameter
(201st print, parallel)

Tack time



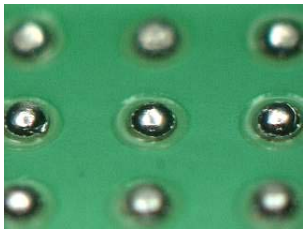
Heat slump

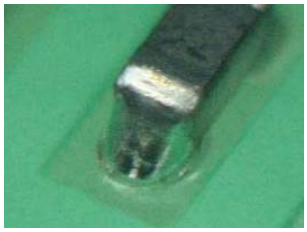




- Heat profile : 180~190°C×120 sec.
- Test method : JIS Z 3284

Solder wetting





03mm dia. CSP pattern
OSP board

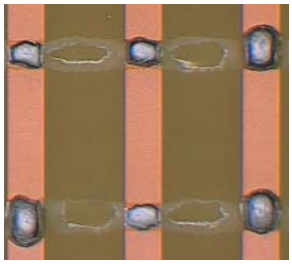
0603 chip (100Sn)

Solder coalescence

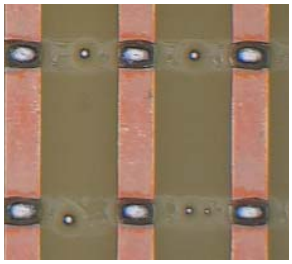
Enhancement of the heat resistance and wetting reaction speed of flux also improves coalescence of solder.

- Stencil : 0.15mm thickness
- Aperture : 0.3mm width
- Track : 0.635mm width, Cu
- Distance : 1.27mm between tracks
  *Comb electrode type 1 by JIS

Reflow

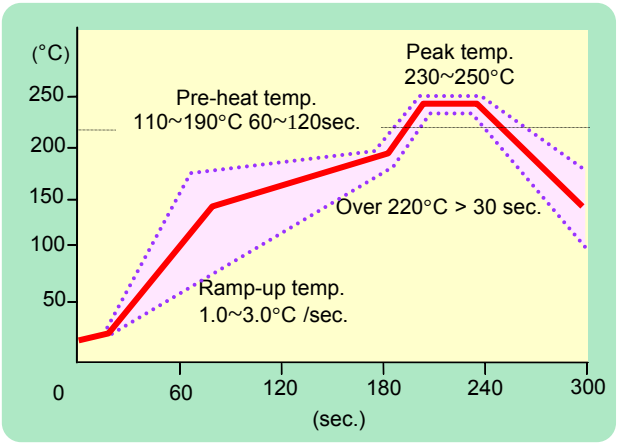


S3X48-M406-3



Conventional paste

Recommended reflow profile



Solder wetting

Application		Printing - Stencil	
Products		S3X48-M406-3	S3X48-M406L-3
Alloy	Composition (%)	Sn96.5, Ag3.0, Cu0.5	
	Particle size (μm)	20 - 45	
Flux	Halide content (%)	0.0	
	Flux type	ROL0	
Product	Flux content (%)	11.5	11.7
	Viscosity (Pa.S)	210	170
	Copper plate corrosion	Passed	
	Solder spread factor (%)	> 85	
	Tack time	> 72 hours	
	Shelf life (below 10°C)	6 months	
	Optional powder size	20 - 38 μm (S3X58-)	

*Specifications are subject to change

08.29.06

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