ECO+PLUS® series
Lead free SOLUTIONS you can TRUST

Halogen Free

# *Anti-Pillow Defect* Lead Free Solder Paste

# S3X48-M500

**PREVENTS** the occurrence of **HIDDEN PILLOW DEFECT** (Head in Pillow) and ensures the highest quality of solder joints.

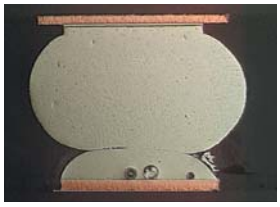
Drastically **REDUCES VOIDING** especially with large contact area components, such as power transistors, LGAs0and QFNs, and is particularly well suited to automotive applications.

Significant **REDUCTION** of **HALOGEN** from the flux formulation helps to prevent environmental pollution.

## 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 when complete solder merging between the bumps and solder does not occur, and is referred to as "hidden pillow defect" or "head in pillow" under certain conditions.

The solder paste **S3X48-M500** has been specifically developed to solve this difficult technical problem, not only for bumped components such as BGAs, but also exhibits excellent wetting with all other types of components.



Pillow defect

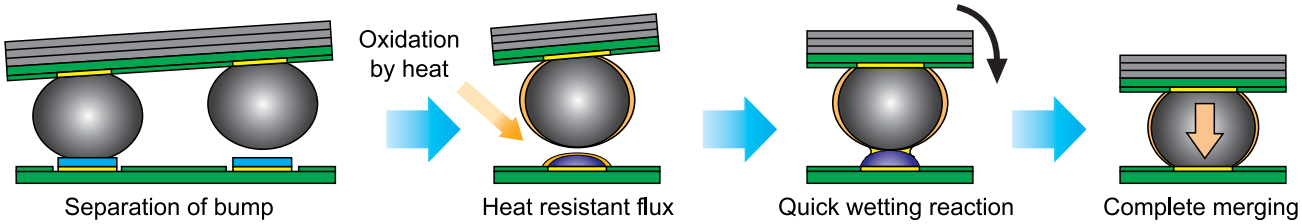
## Mechanism of occurrence of Pillow Defect

For various reasons, such as package warpage and co-planarity, inconsistent bump size, insufficient solder deposit, distortion of package during reflow etc., will induce the solder bump to be separated from the solder paste before the solder melts and wets to it. In such cases where the solder bump separates from the solder paste, during heating in the reflow oven, an 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 too 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 fully merging together.

It seems difficult to completely prevent the separation of the bumps from the solder paste, so it is critical 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. Furthermore it is necessary 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 -**



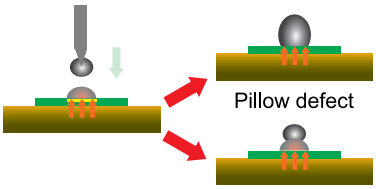
## Anti-Pillow defect

Significant enhancements in the heat resistance of the flux and wetting reaction speed have succeeded in reducing the occurrence of hidden pillow defect.
**S3X48-M500** assures robust wetting action to BGA bumps even with intentional extra oxidation.

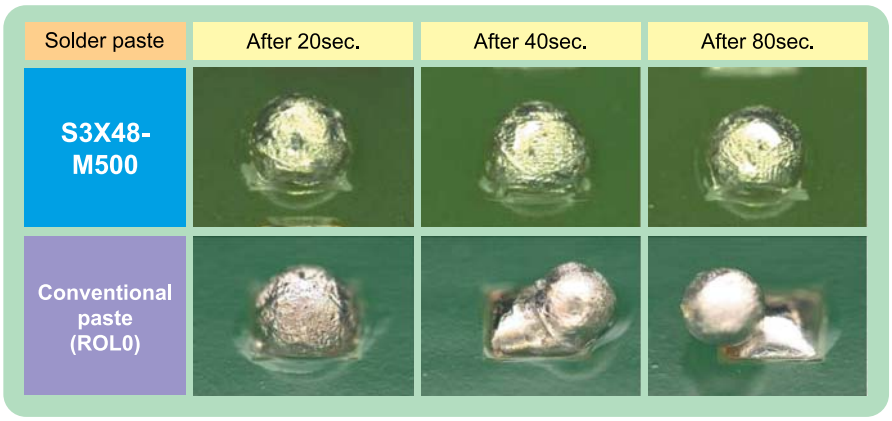
### ► Retention of flux activation

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

- Stencil : 0.12mm thickness, 100% stencil 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.

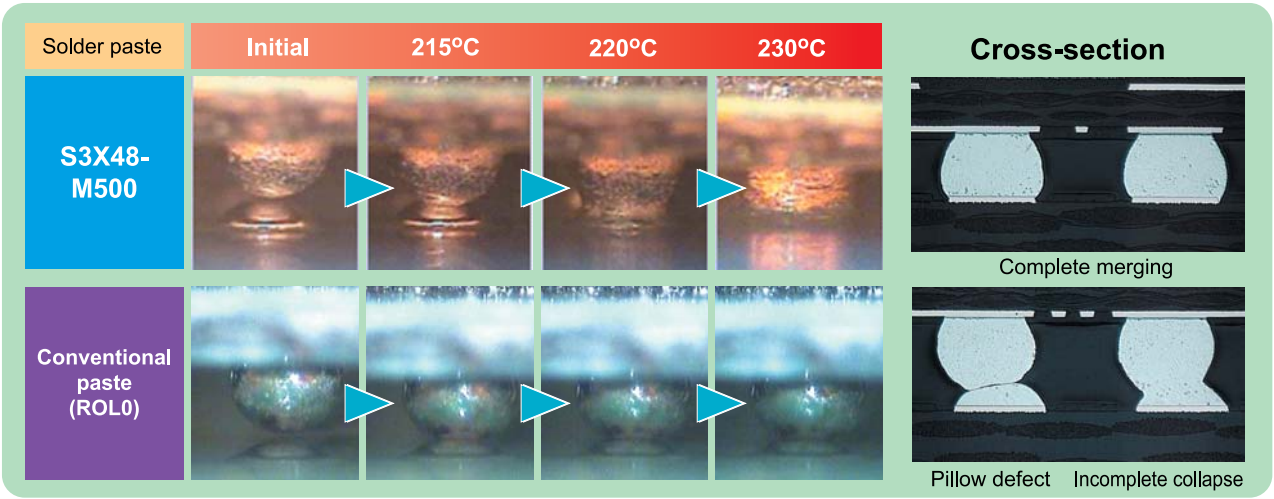



Drop solder ball every 10 sec. after the solder paste has melted to see heat durability of flux.




### ► 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 180°C x 100sec.
- Procedure: 1. Reflow solder paste without BGA.
  2. Place BGA on post-reflowed solder.
  3. Reflow it.
- Surface treatment : OSP
- Stencil aperture : 100% aperture opening to pad
- Reflow Atmosphere : Air




New formula **S3X48-M500** 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 ensure joint quality.

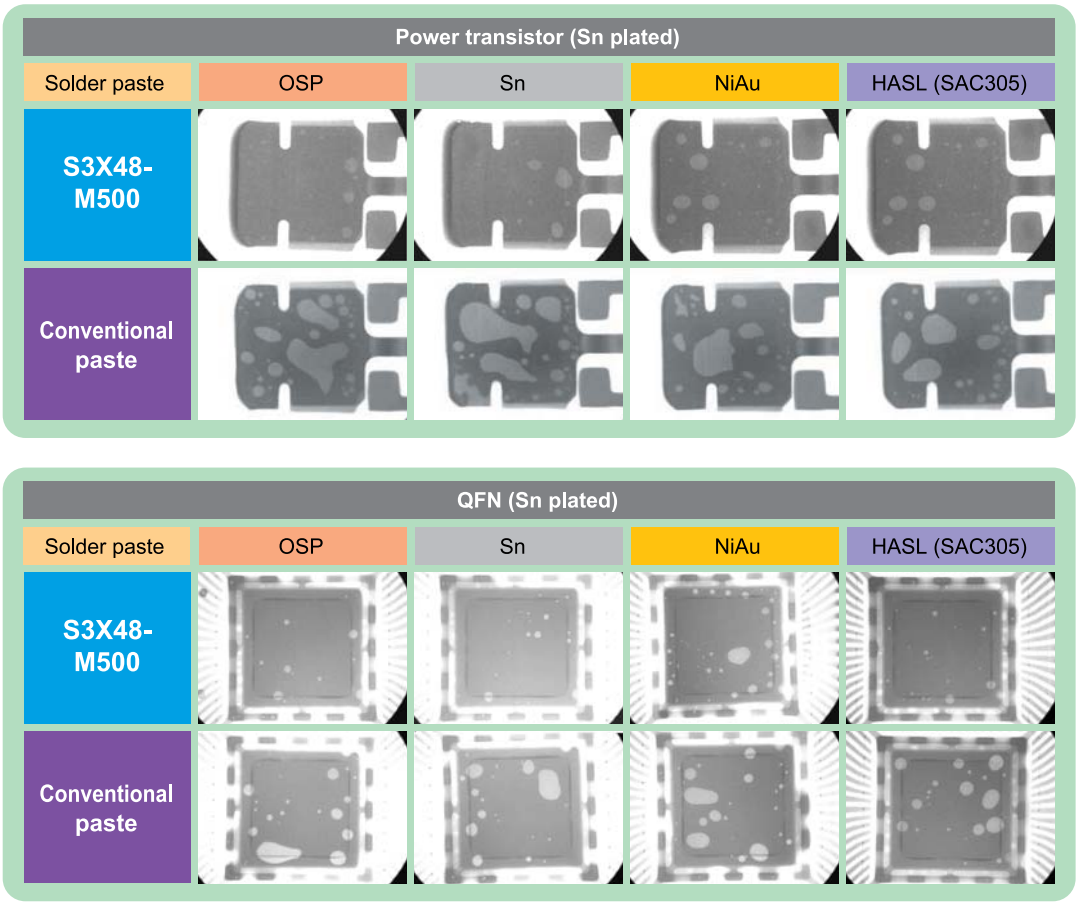
**S3X48-M500** succeeded in securing a drastic reduction of pillow defects.

## Low voiding

### ► Voiding behavior with different surface finish

A variety of optimizations to the flux formulation combined with a newly adopted activator system and much lower boiling point materials have succeeded to remove flux gases from the solder joint. This dynamic evacuation is swift and highly effective regardless of the types of surface finish and components used in the assembly.

- Material : Glass epoxy FR-4
- Surface treatment : OSP, NiAu, Sn, HASL(SAC305)
- Stencil thickness : 0.12mm (laser cut) / 100% aperture opening to pad
- Components : Power transistor, QFN, (both 100% Sn plated)
- Atmosphere : Air




## Halogen Free

### ► Background of development

Recent increasing consciousness about ecology on a global scale has started considerations for the restriction of certain elements within soldering materials used within the electronics industry.

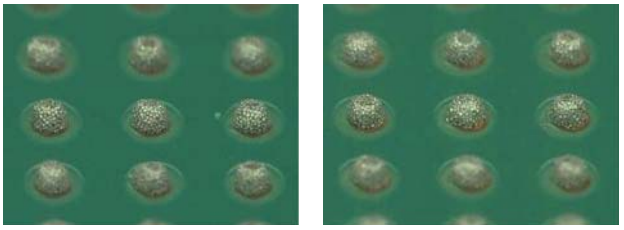
Ever since it's been reported that dioxins can be generated when specific kinds of halide are combusted, there have been moves afoot to eliminate halogens from soldering materials, such as solder pastes and wave soldering fluxes.

Koki's research and development team have been working on this "halogen free" issue for many years and provided various products already. **S3X48-M500** is the latest and fully developed product as a true "halogen free" solder paste meeting the below Halogen Free criteria.

| Substance | Permissible limit (by weight) | Actual halogen content (Analysis results by outside lab) |
|---|---|---|
| Chlorine (Cl) | ≤ 900 ppm (0.09%) | ND |
| Bromine (Br) | ≤ 900 ppm (0.09%) | 103 ppm |
| Total concentration of Cl+Br | ≤ 1500 ppm (0.15%) | 103 ppm |

Test method: EN14582: 2007

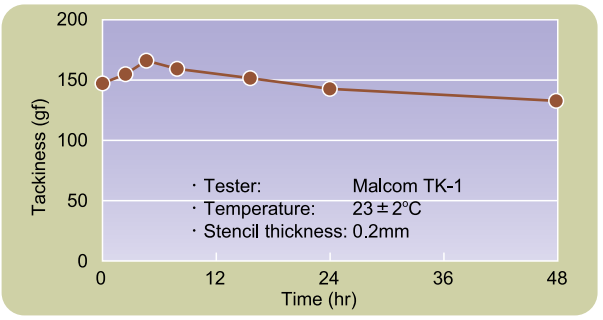
## Stencil idle time



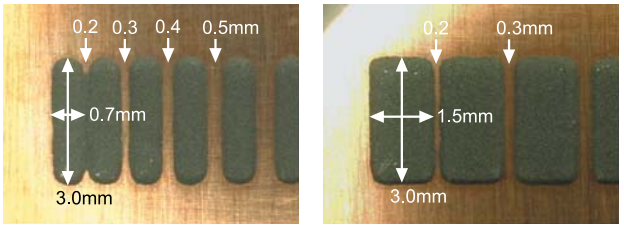
1st print (no idle time)　1st print after 60min idle time

0.3mm dia. OSP pattern

## Tack time

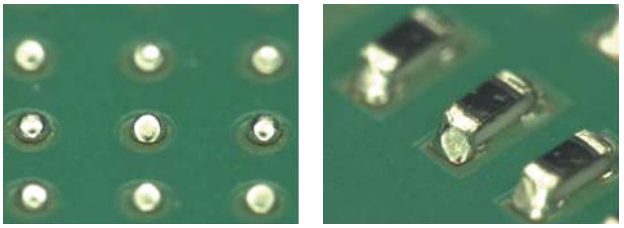



## Heat slump




*Heating condition : ..... 180°C for 5 min. by JiS Z 3284

## Solder wetting



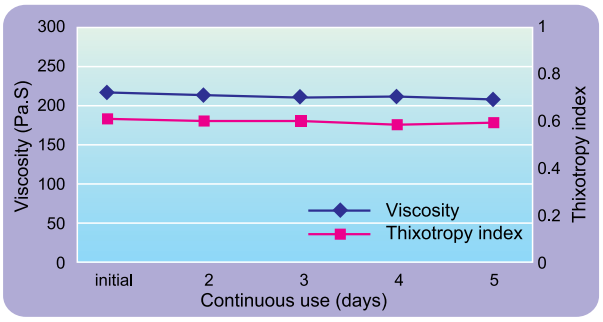
03mm dia. CSP pattern (OSP)　0603 chip (100Sn)

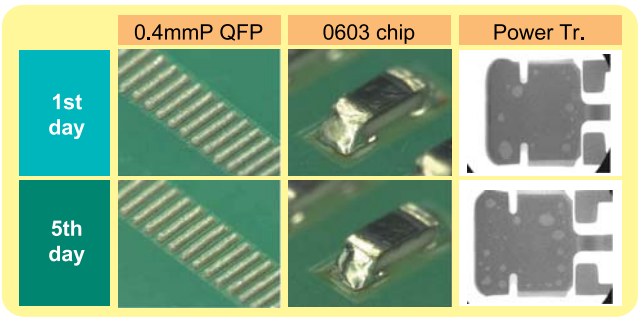
OSP board

## Durability (repeated use)

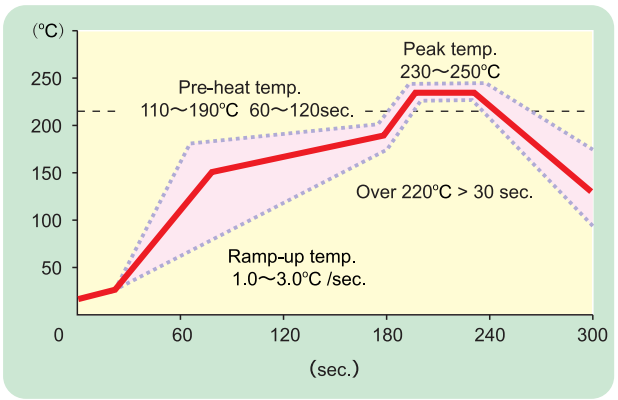
Test design enables a solder paste to be monitored under repeated use. **S3X48-M500** indicated consistent quality and performance over the period of 5 days of repeated use without any quality degradation.

· Rolling condition: 30mm/sec. x 300mm stroke, squeegee length 250mm
· Procedure: Vscosity/Ti checkí→Put 500g of fresh paste on stencilí→Continuous rolling for 8hours/Check printability, wetting & voidingí→Keep it in refrigerator over nightí→Dispose of 250g add 250g of fresh pasteí→Viscosity/Ti checkí→Continue rolling for 8hours/check rest of featuresí→Repeat this for 4 days




## Recommended reflow profile




## Specifications

| | | |
|---|---|---|
| | Application | Printing - Stencil |
| | Products | S3X48-M500 |
| Alloy | Composition (%) | Sn96.5, Ag3.0, Cu0.5 |
| Alloy | Melting point (°C) | 217 - 219 |
| Alloy | Particle size (μm) | 20 - 45 |
| Flux | Halide content (%) | 0.0 |
| Flux | Flux type* | ROL0 |
| Product | Flux content (%) | 11.5 |
| Product | Viscosity (Pa.S) | 220 |
| Product | Copper mirror* | Pass |
| Product | Quantitative halide content(%)* | < 0.05 |
| Product | SIR* | Pass |
| Product | Tack time | > 48 hours |
| Product | Shelf life (below 10°C) | 6 months |
| Product | Optional powder(μm) | 20 - 38; *S3X58-M500* |

*ANSI/J-STD-004A (IPC-TM-650)

*Specifications are subject to change*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