

# *Halogen-Free SAC305 Solder Paste*

## *TNA23K Series*

Type4:TLF-204-TNA23K

Type5:TLF-204F-TNA23K



**TAMURA CORPORATION**  
Electronic Chemicals & FA Business Department  
SMT material Development Division



# Agenda

## *TNA23K series Development Concept*

- Superior electronic reliability
- Excellent Meltability at long-profiling condition
- Reduce BGA Head-in-pillow

1. Summary of General characteristics
2. Printability
3. Void (QFN)
4. Solder ball (Chip side ball/Solder Ball between lands)
5. Wetting performance & De-wetting test
6. Through hole reflow
7. Solderball test/Slumping test
8. Insulation resistance test/Voltage applied humidity resistance test
9. Copper corrosion test
10. Recommended Reflow profile

# Feature properties of TLF-204-TNA23K (T4) and TLF-204F-TNA23K (T5)

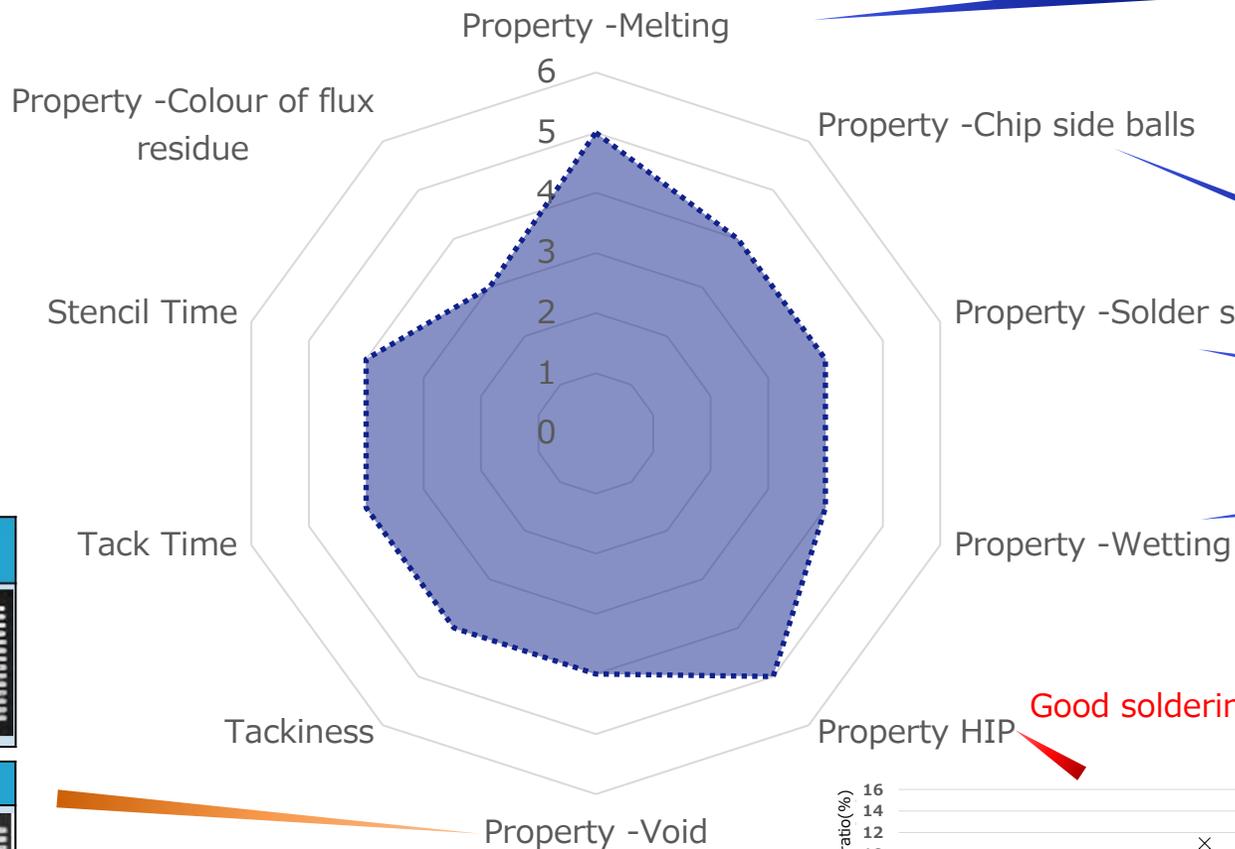
Pin-in-process available



Good soldering for fine patterns  $\Phi 0.22$  (T4)



$\Phi 0.18$  (T5)



0603 mm/0201 mil (T4)



0402 mm/01005 mil (T5)



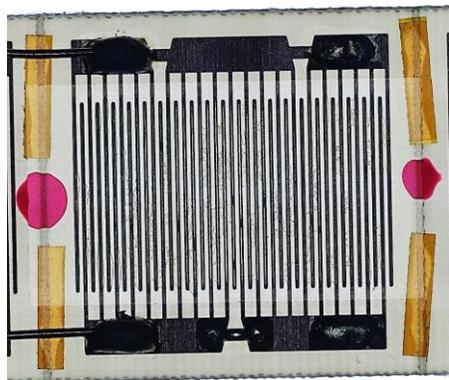
Au plating	Profile A	Profile B
TNA23K		
Cu OSP	Profile A	Profile B
TNA23K		

Less void with wide-range process window

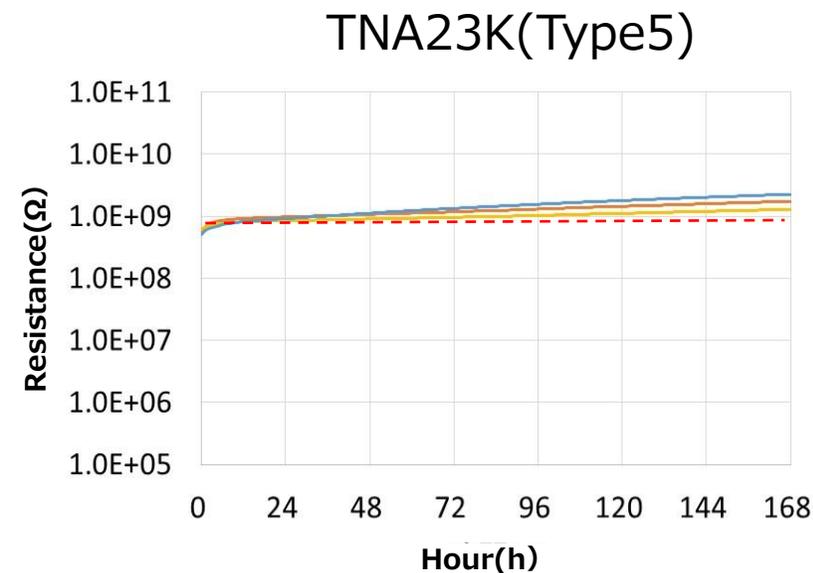
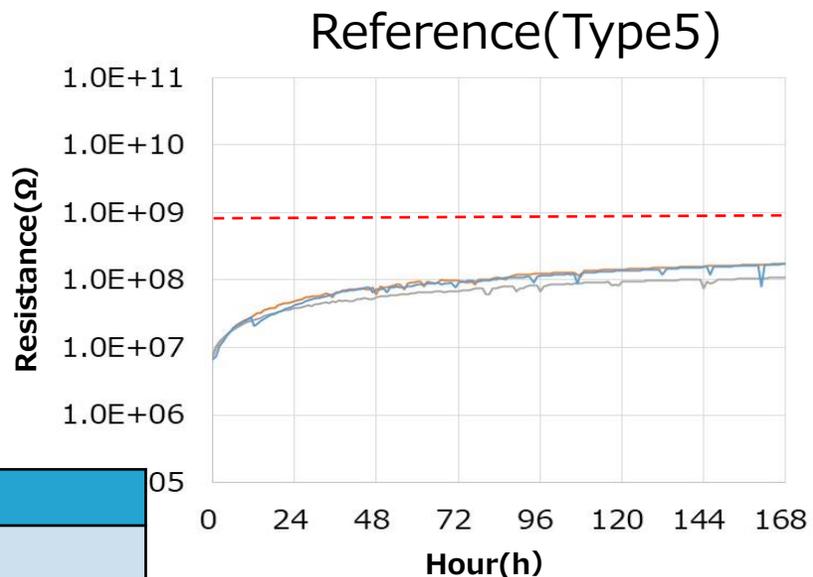


# Development concept① [Superior electronic reliability]

Even under conditions where a cover glass is placed on top of comb shaped substrate and the flux component is not volatilized, it has high electrical reliability.



Comb shaped substrate with cover glass



Test condition	
Substrate	JIS2 くし形electrode substrate
Stencil thickness	0.12mm
Cover glass	18mm×32mm
Environment	40°C90% 168h
Applied voltage	12.5V
Measured voltage	12.5V
Heat condition	Air reflow



**No migration**  
| Photograph of the test specimen after the test under the backlight



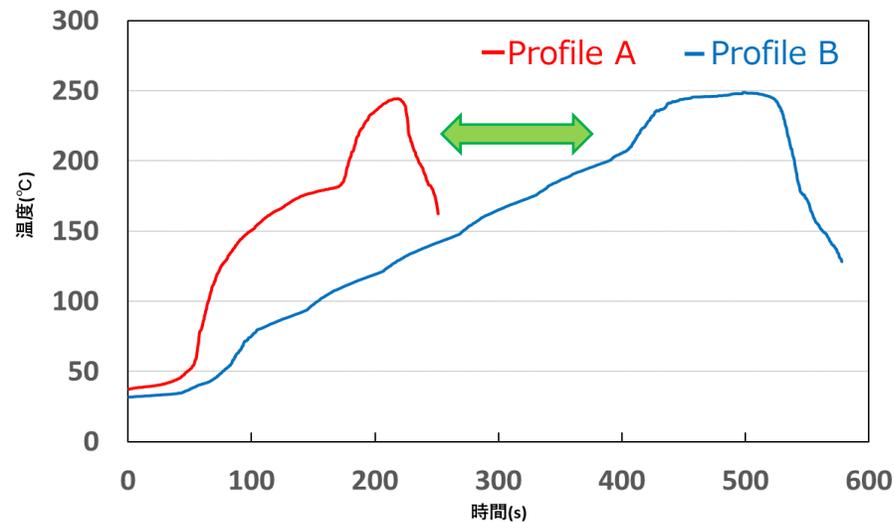
**No migration**  
| Photograph of the test specimen after the test under the backlight

# Development concept②【 Excellent Meltability at long-profiling condition 】

For the flux material, we selected a material that inhibits re-oxidation during pre-heating.  
Achieves excellent meltability in a wide range of reflow profiles under atmospheric conditions.

Test Condition	
Substrate	Tamura test substrate(Cu OSP)
Stencil thickness	Type4:0.12mm
	Type5:0.08mm
Measuring points	Type4:Φ0.22、 24、 0603Chip
	Type5:Φ0.18、 22、 0402Chip
Reflow profile	Profile A・B
Reflow condition	Air

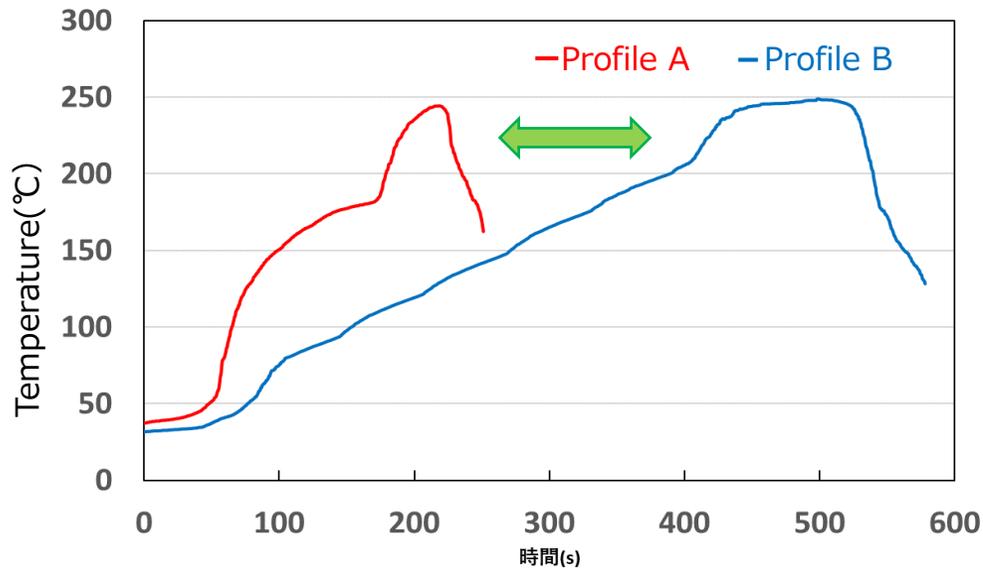
	Profile A	Profile B
TNA23K (Type4)	 Φ0.22 Melted 0603 Melted	 Φ0.24 melted 0603 Melted
Reference (Type4)	 Φ0.22 Melted 0603 Melted	 Φ0.24 Unmelted 0603 Unmelted



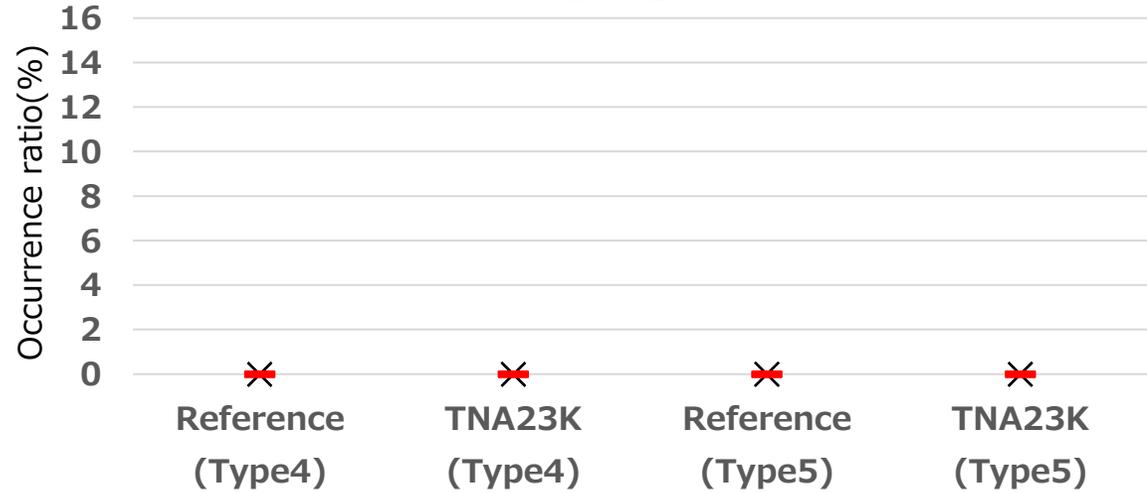
	Profile A	Profile B
TNA23K (Type5)	 Φ0.18 Melted 0402 Melted	 Φ0.22 Melted 0402 Melted
Reference (Type5)	 Φ0.18 Unmelted 0402 Melted	 Φ0.22 Unmelted 0402 Unmelted

# Development concept③ [ Reduce BGA Head-in-pillow ]

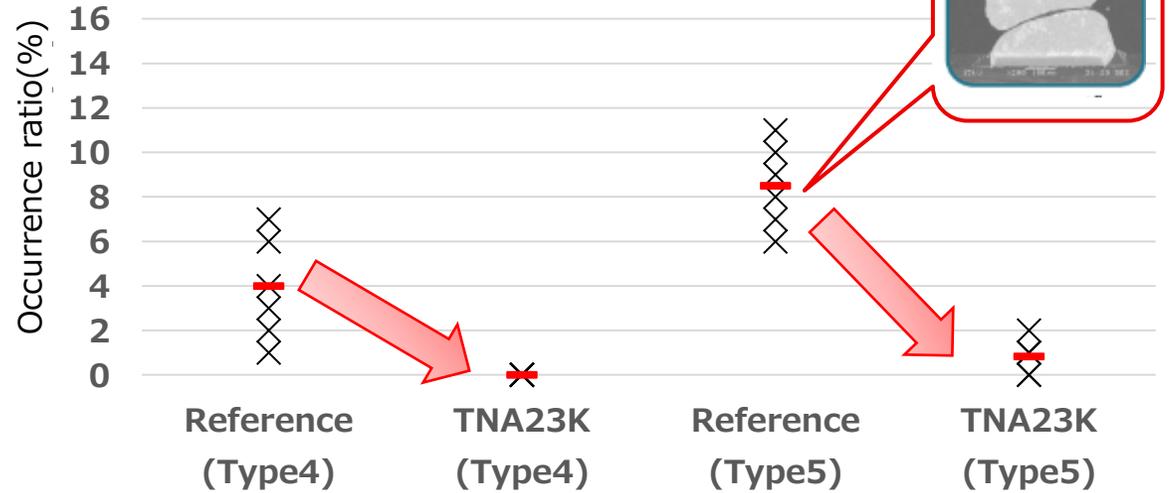
Test Condition	
Substrate	Tamura test substrate(Cu OSP)
Stencil thickness	0.08mm (Opening $\Phi$ 0.27)
Mounted parts	0.5mmPBGA(228pin) 85°C/85% 24hr (n=6)
Reflow profile	Profile A・B
Reflow condition	Air



## Profile A



## Profile B



# 1. General Characteristics

Item	TLF-204-TNA23K	TLF-204F-TNA23K	Test method
Alloy composition	Sn/3.0Ag/0.5Cu		—
Solidus line / Liquidus line	216~220°C		DSC
Solder power size	20-38μm (Type4)	15-25μm (Type5)	Laser diffraction method
Viscosity (Pa·s)	190		JIS Z 3284(2014)
Thixotropy index	0.54		JIS Z 3284(2014)
Flux content (w%)	12.2%	12.3%	JIS Z 3197(2012)
Flux type	ROLO		IPC J-STD-004B
Cl volume in Flux	0.0%		JIS Z 3197(2012) Potentiometric titration
Halogen content in the flux	Bromine(Br)	Less than 900ppm	BS EN 14582
	Chlorine(Cl)	Less than 900ppm	
Isolation resistance test	More than 1.0E+09Ω		JIS Z 3197(2012) 85°C/85%
Voltage applied humidity resistance test	No occurrence of migration		JIS Z 3197(2012) 85°C/85% 1000h
Copper plate corrosion test	No corrosion		IPC TM-650 No2.6.15
Copper mirror corrosion test	No transmission		IPC TM-650 No2.3.32
Solder ball test	Start : Cohesion degree 3/ After 24h : Cohesion degree 3		JIS Z 3284(2014)
Slump	Start : 0.2mm/After heat : 0.3mm		JIS Z 3284(2014)

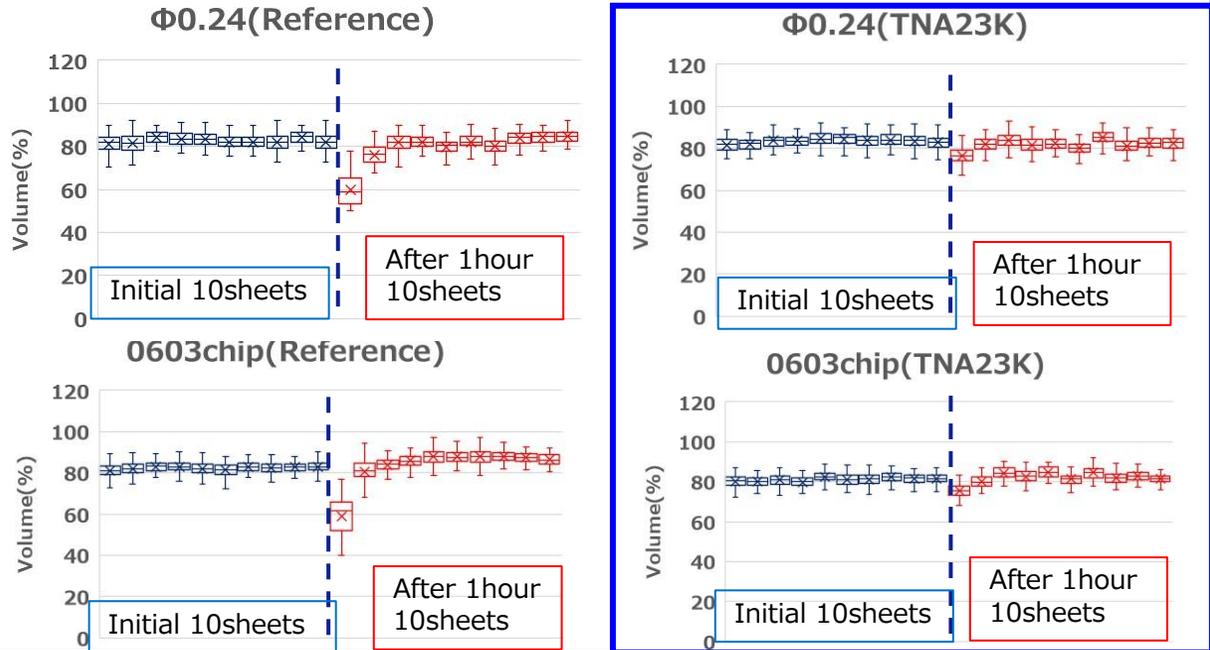
## 2. Printability (Type4)

Apply the solder paste and print 10 sheets continuously

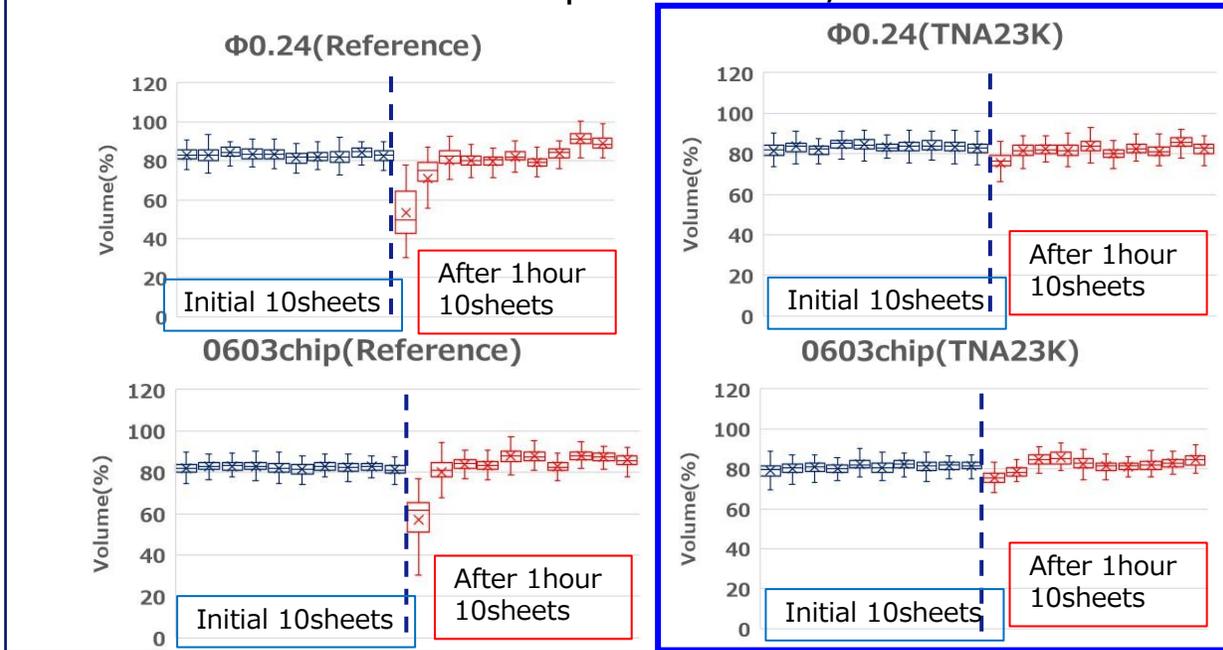
1 hour later

Without cleaning, print 10 sheets continuously.

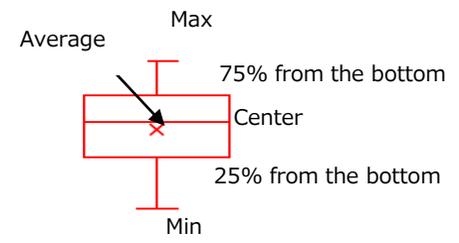
### Print speed 50mm/s



### Print speed 100mm/s



Test condition		
Stencil thickness	Type4	0.12mm
Squeegee Speed	50·100mm/s	
Printing pressure	20×10 <sup>-2</sup> N/mm	
Separation speed	2mm/s	
Observation point	Type4	Φ0.24, 0603(0.35x0.40mm) 100points/1sheet



The printability of TNA23K on Φ0.24/0603 chip is stable even when the printing speed is changed. Even after leaving the paste on the plate for 1h, the printability is stable from the second sheet.

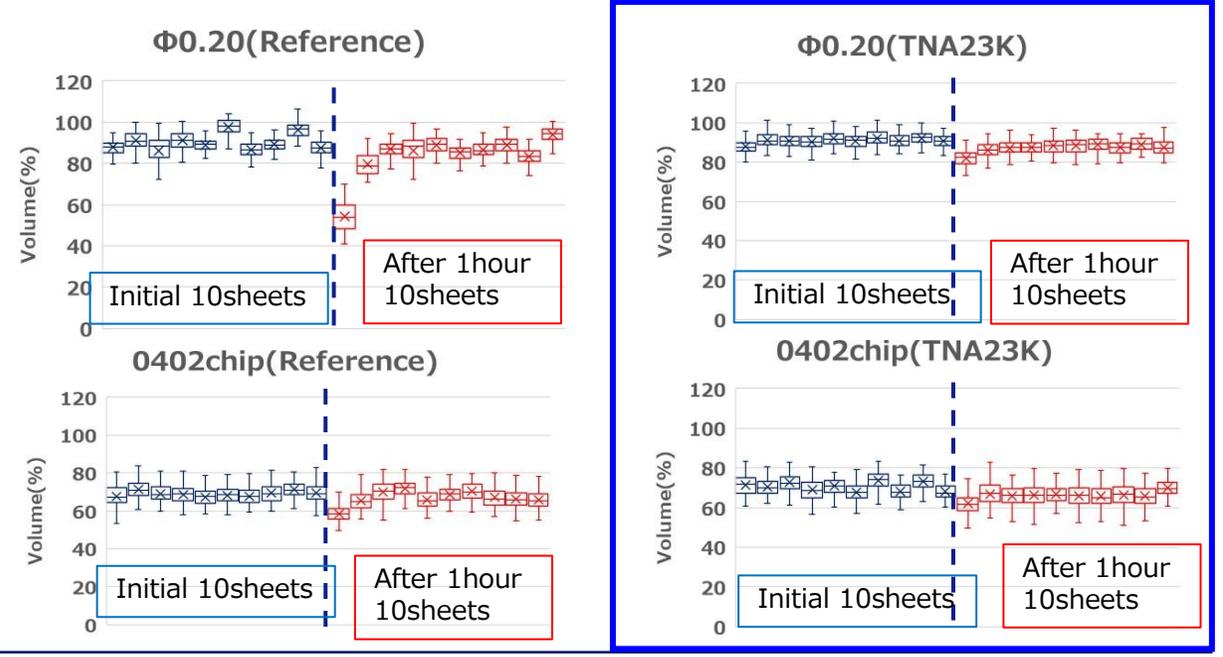
## 2. Printability(Type5)

Apply the solder paste and print 10 sheet continuously

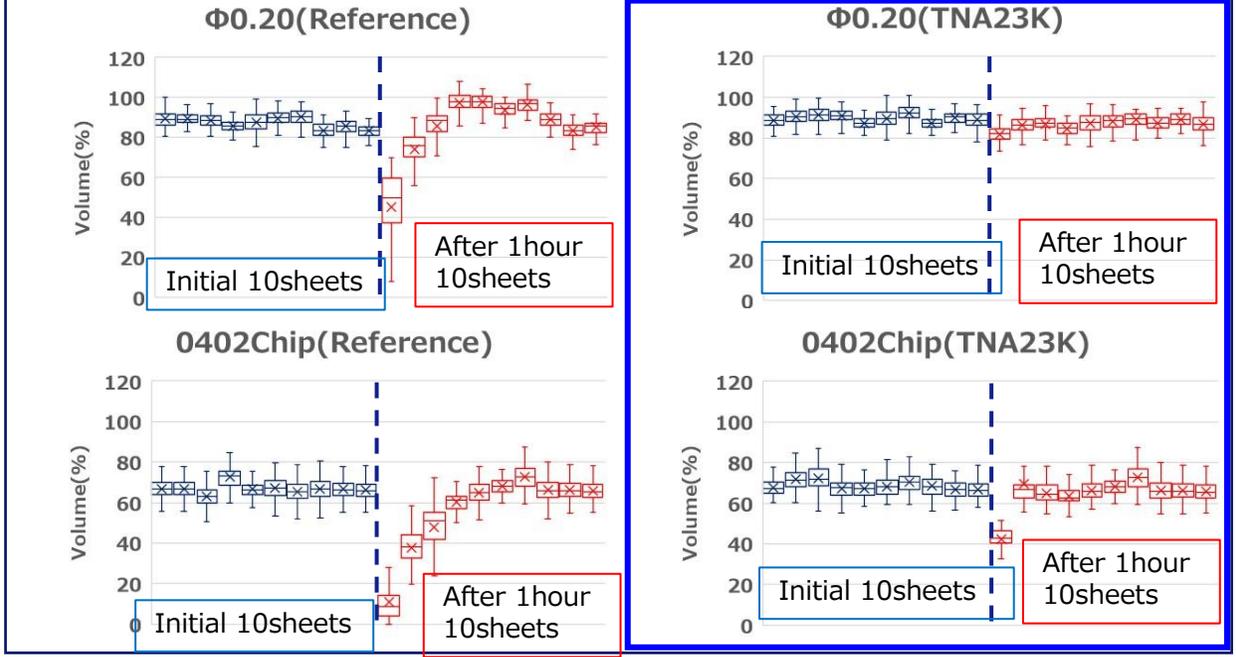
1 hour later

Without cleaning, print 10 sheets continuously.

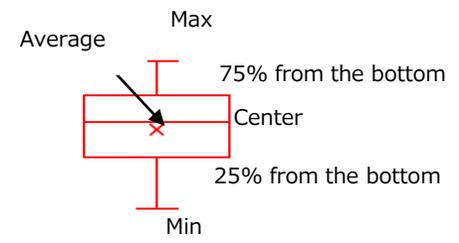
■ Print speed 50mm/s



■ Print speed 100mm/s



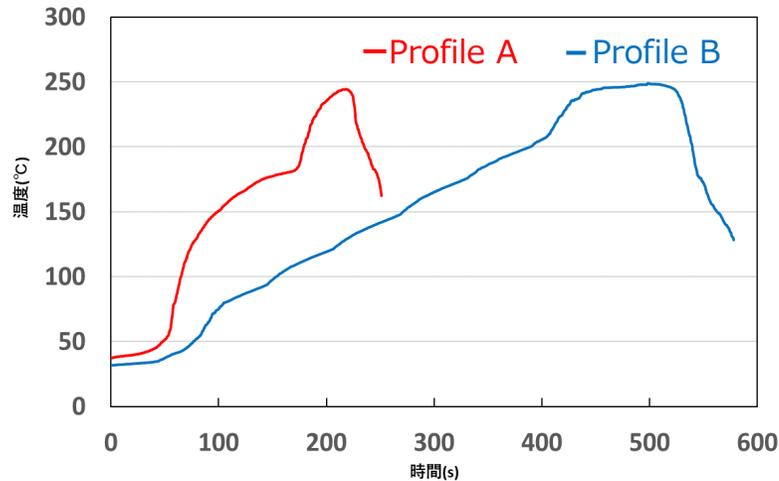
Test condition		
Stencil thickness	Type5	0.08mm
Squeegee Speed	50・100mm/s	
Printing pressure	20×10 <sup>-2</sup> N/mm	
Separation speed	2mm/s	
Observation point	Type5	Φ0.20、0402(0.25x0.2mm) 100points/1sheet



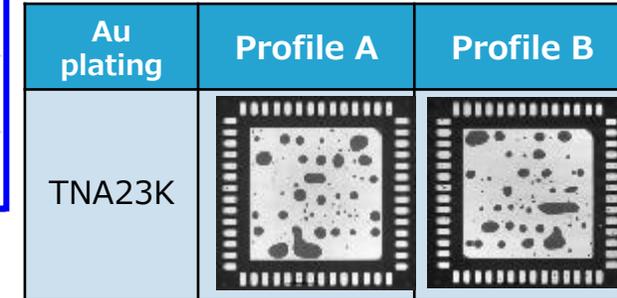
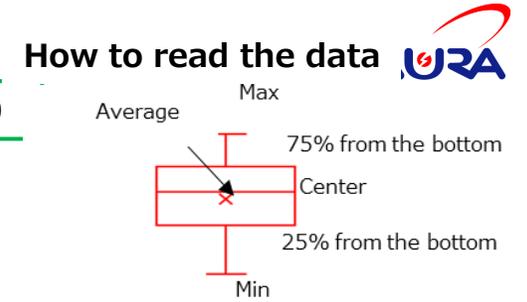
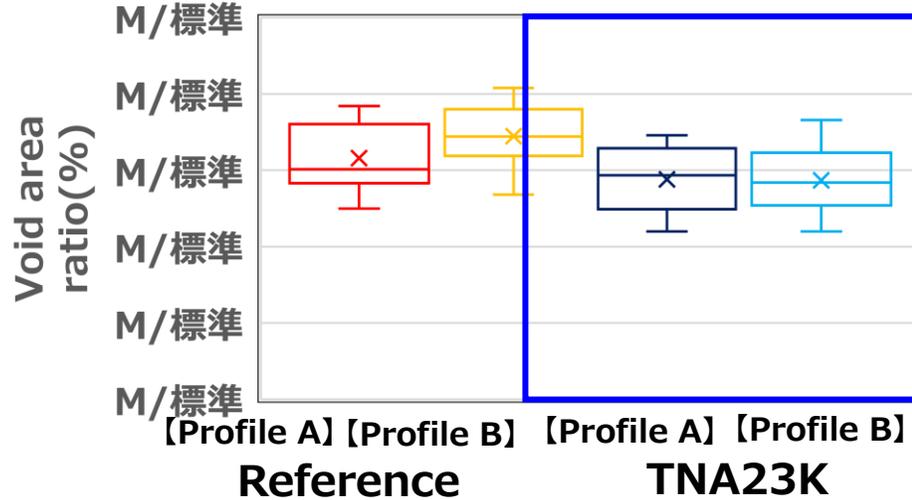
The printability of TNA23K on Φ0.20/0402 chip is stable even after changing the printing speed. Printability of TNA23K on Φ0.20/0402 chip is stable from the second sheet even after leaving the paste on the plate for 1h.

# 3.Void(QFN)Type4

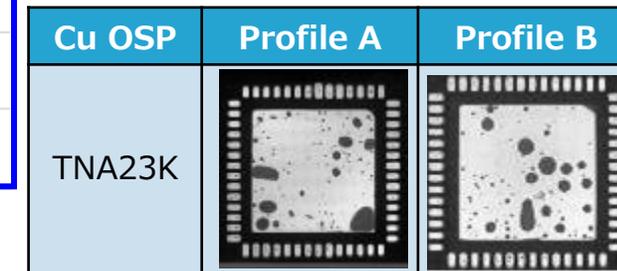
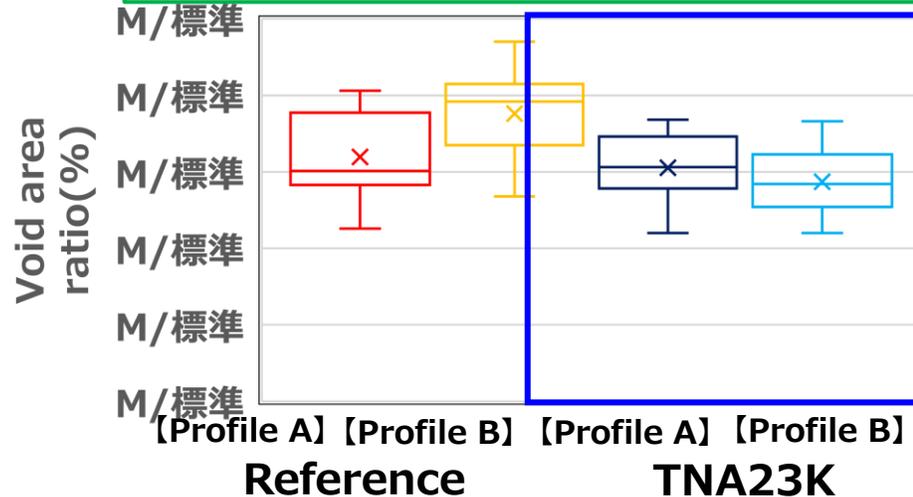
試験条件		
Substrate		Tamura tested substrate (Ni/Au plating・Cu OSP)
Stencil Thickness	Type4	0.12mm
Mounted parts		0.5mmP QFN(Sn・Ni/Au plating) ■:6mm×6mm (n=9)
Reflow profile		Profile A・B
Reflow condition		Air



## Substrate (Ni/Au plating) + Parts (Ni/Au plating)



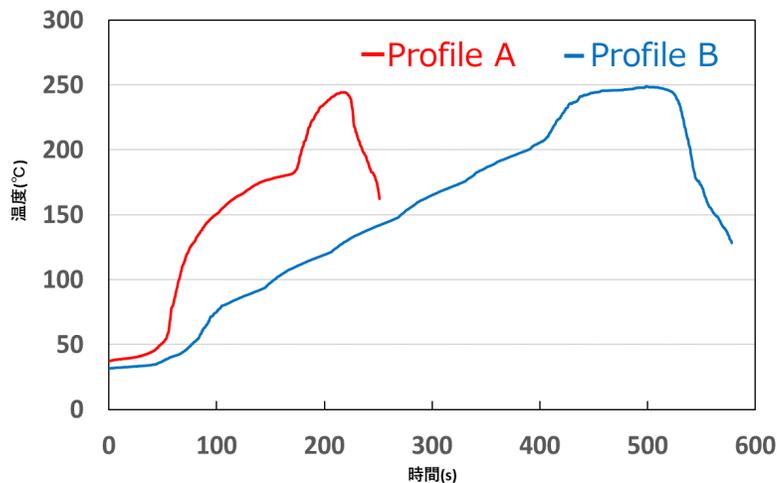
## Substrate (Cu OSP) + Parts (Sn plating)



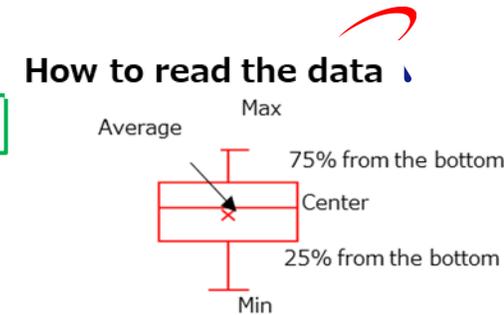
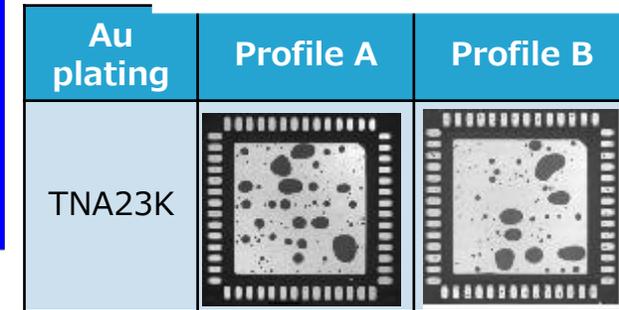
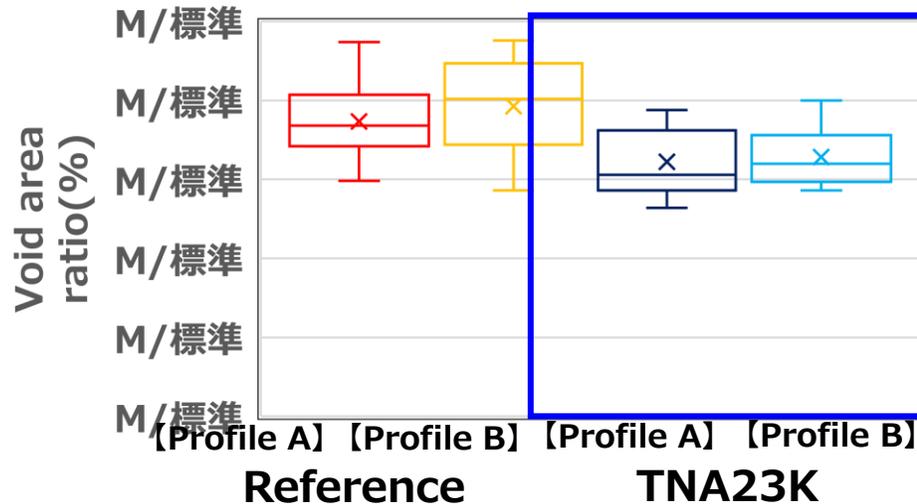
**TNA23K has good void distribution range regardless of the surface treatment of the substrate.**

# 3.Void (QFN) Type5

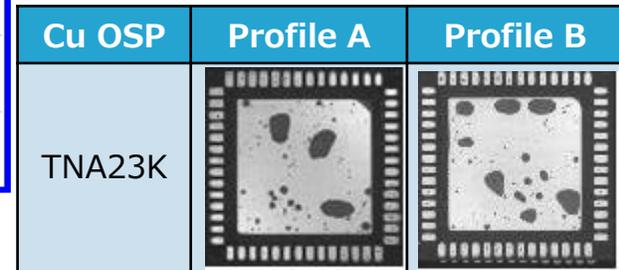
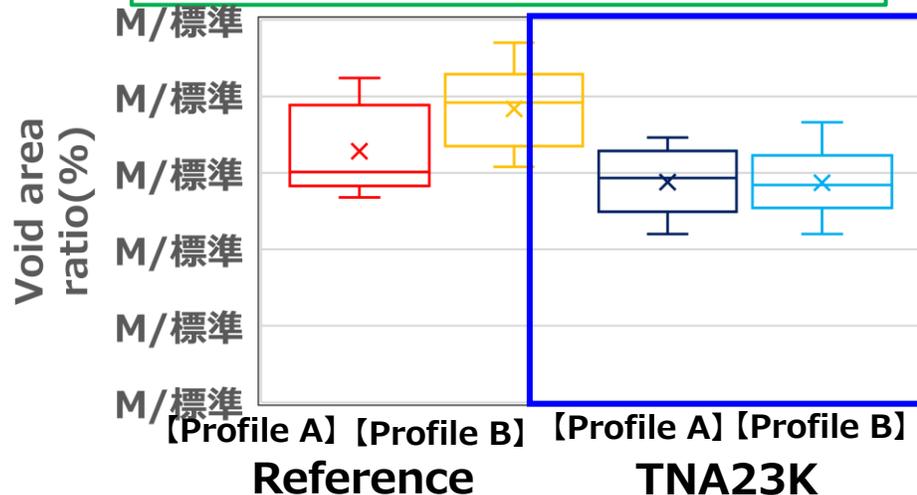
Test Condition		
Substrate		Tamura test substrate (Ni/Au plating·Cu OSP)
Stencil thickness	Type5	0.08mm
Mounted parts		0.5mmP QFN(Sn·Ni/Au plating) ■ :6mm×6mm (n=9)
Reflow profile		Profile A·B
Reflow condition		Air



Substrate (Ni/Au plating) + Parts (Ni/Au plating)

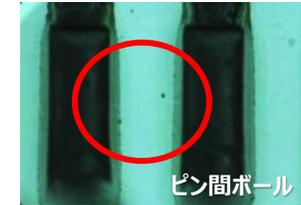
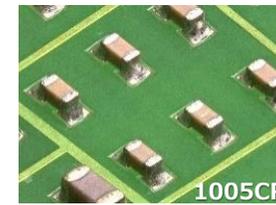
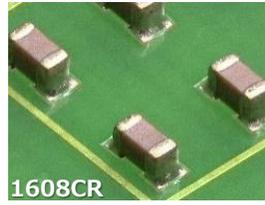


Substrate (Cu OSP) + Parts (Sn plating)

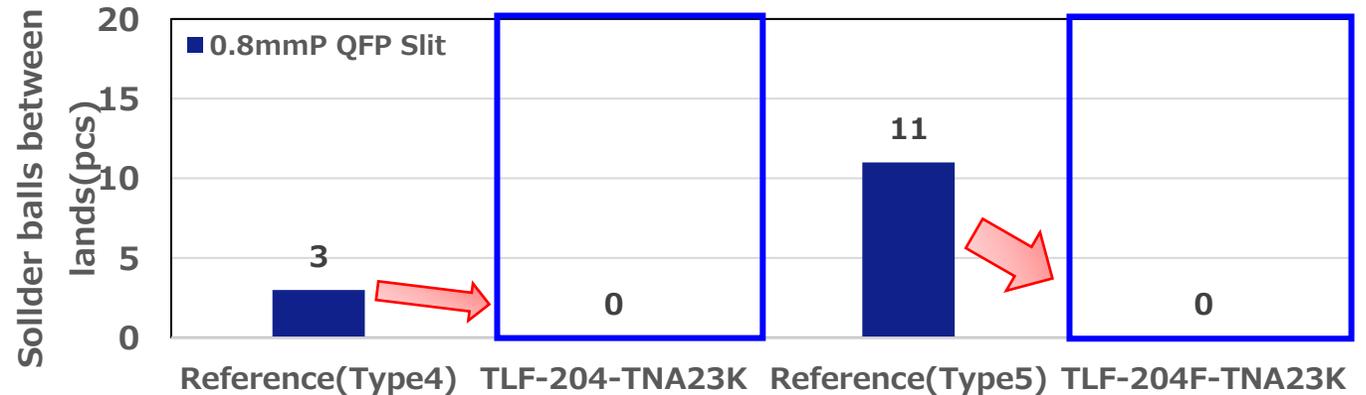
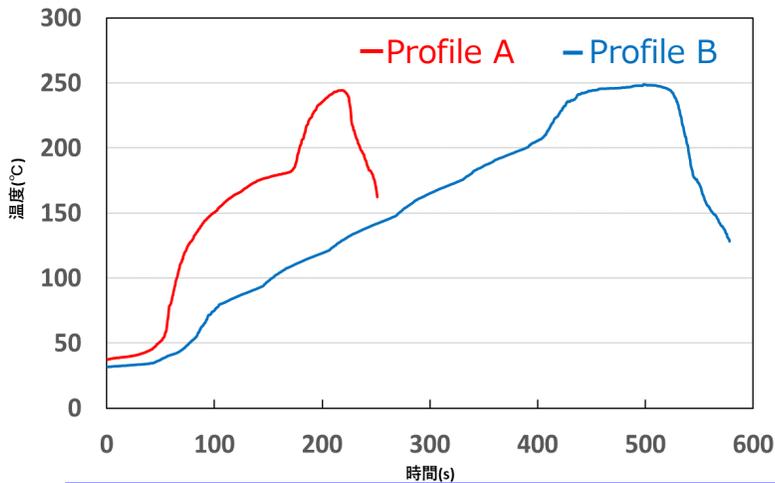
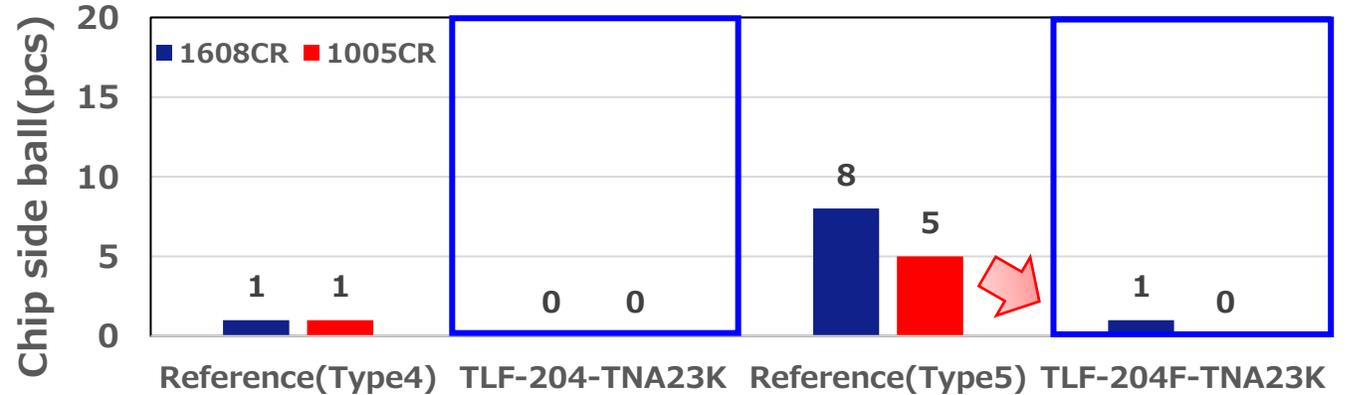


**TNA23K has good void distribution range regardless of the surface treatment of the substrate.**

# 4. Solder ball (Chip side ball/Solder Ball between lands)



Test condition		
Substrate		Tamura test substrate (Cu OSP)
Stencil thickness	Type4	0.12mm
	Type5	0.08mm
Mounted parts		1608chip、1005chip
Reflow profile		Profile B
Reflow condition		Air



**TNA23K can suppress the generation of the balls at the side of the chip and the balls between the lands compared to Reference.**

# 5. Wet effectiveness and De-wetting test

Test condition as per JIS Z 3284-4(2014)	
Test sample	Copper, Copper oxide, Nickel silver, Nickel
Stencil thickness	0.2mm
Reflow profile	Profile A B
Reflow condition	Air

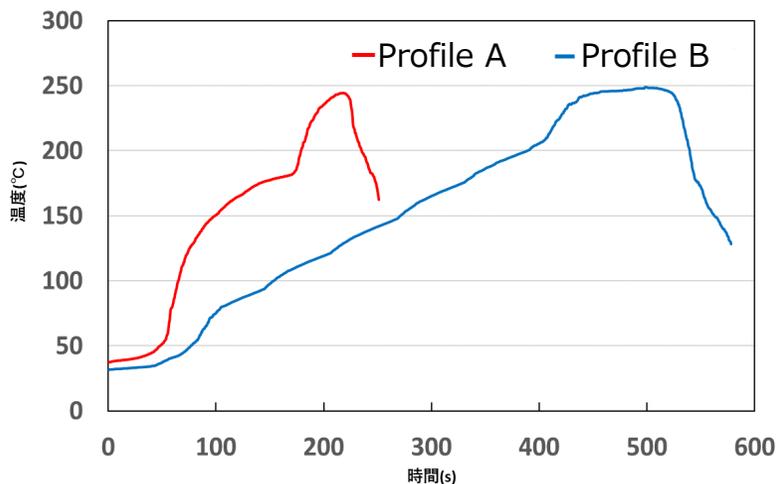


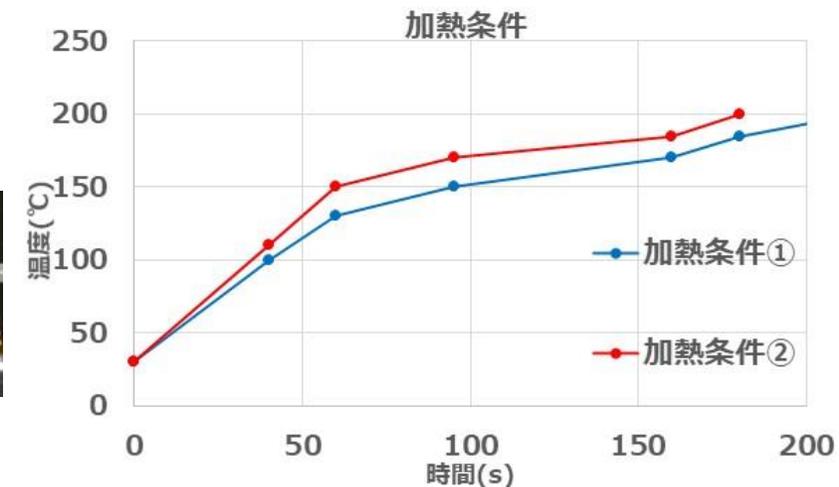
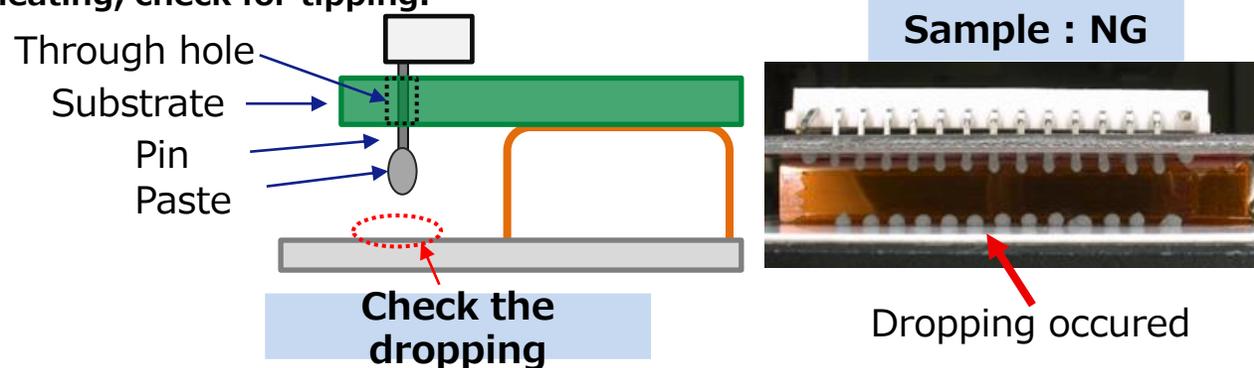
Plate	Copper	Copper oxide	Nickel silver (CuZnNi)	Nickel(Ni)
Reference Type4 (Profile A)				
TNA23K Type4 (Profile A)				
Reference Type4 (Profile B)				
TNA23K Type4 (Profile B)				

**The wetting effect of TNA23K is as good as that of Reference.**

# 6.Through hole reflow

## 【Evaluation method】

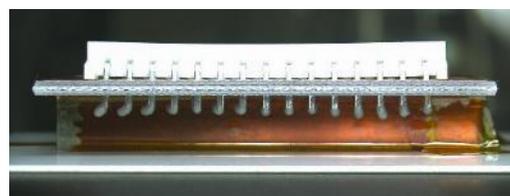
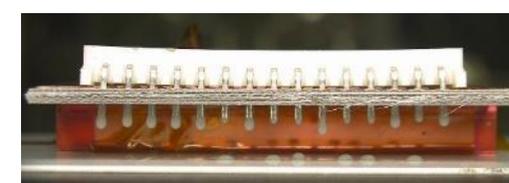
Paste is printed and filled in the through holes, and pins are inserted.  
 Reflow heating of a matchstick substrate under heating conditions (1) and (2).  
 After reflow heating, check for tipping.



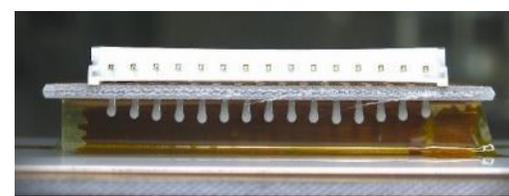
No drooping



Drooping occurred



No drooping



No drooping



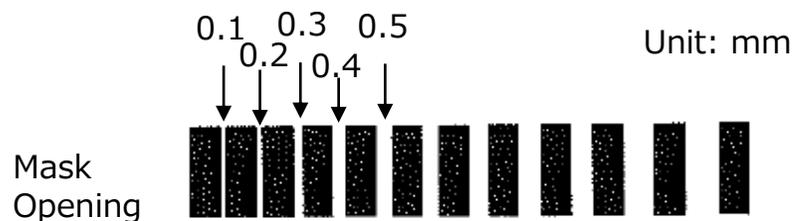
**No drooping and can be used for through-hole reflow.**

# 7. Solder ball test/Slump test

Solder paste ball test	
Test condition	JIS Z 3284-4(2014)
substrate	Ceramic plate
Mask thickness	0.2mm
Environment	25°C/50%

	Start	24h
TNA23K (Type4)	<p>Aggregation 3</p>	<p>Aggregation 3</p>

Slump test	
Test condition	JIS Z 3284-4(2014)
substrate	CCL
Mask thickness	0.2mm



	Start	After heat
TNA23K (Type4)		

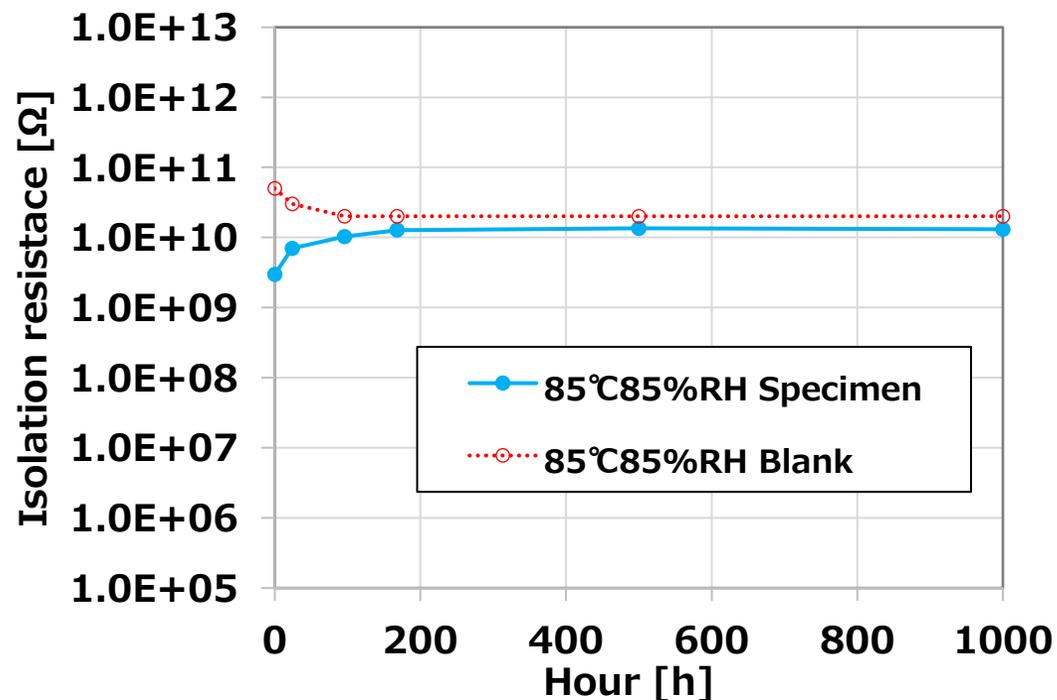
## 8. Isolation resistance/Voltage applied moisture test

**[Test method]**

Test substrate : IPC-B-25A board pattern B

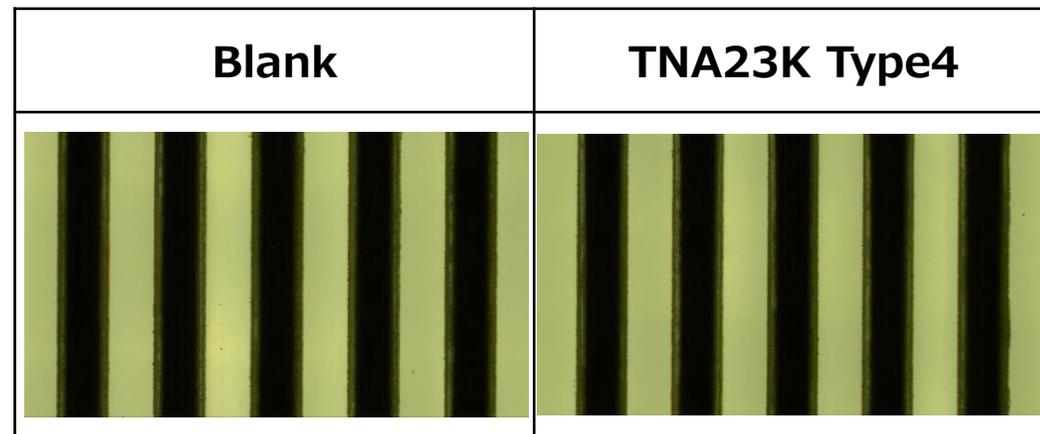
Stencil thickness : 100 $\mu$ m Reflow condition : Air

Environment : 85°C/85% バイアス/Test voltage : 50V/100V



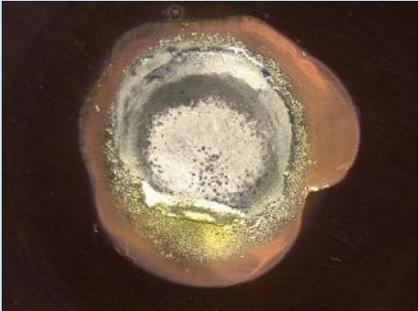
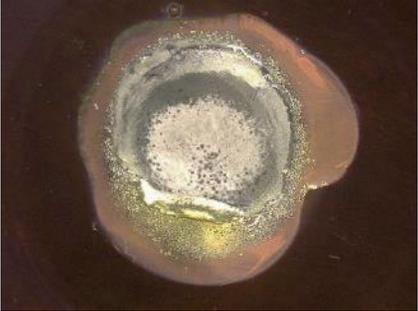
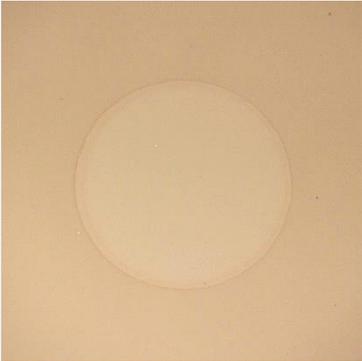
**No reduction of isolation resistance**

85°C85%×1000h



**No migration occurred**

## 9. Copper plate corrosion · Copper mirror corrosion test

		TNA23K(Type4)	
		Before test	40°C93% 240hr
Copper plate (IPC TM-650 2.6.15C)			
Copper mirror (IPC TM-650 2.3.32)			
	No separation		

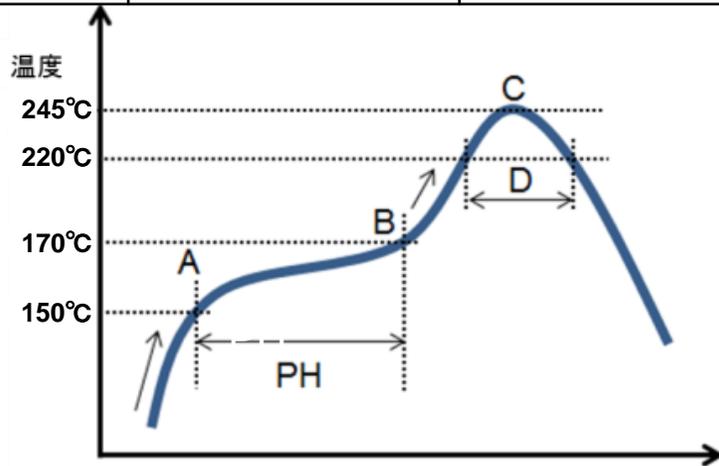
**No corrosion by copper plate corrosion test and No separation by copper mirror test.**

# 10. Recommended Reflow profile

※ The temperature profile varies depending on the components to be mounted, the condition of the board, and the use of the reflow oven, so sufficient verification is necessary.

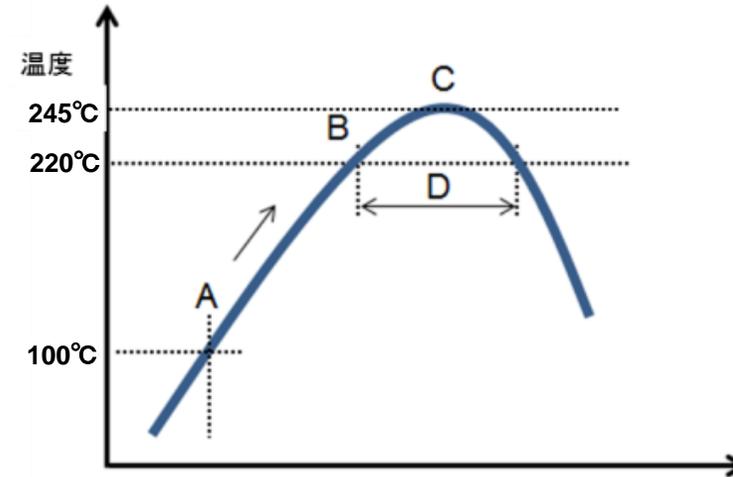


Non-Linear reflow profile		
Area		Recommend condition
—A	Temp rise rate	0.8~3°C/sec
A	Start temp PH	140~160°C
B	End temp PH	170~200°C
PH	PH time	60~150sec
C	Peak temp	235~255°C
D	Melting time	30~120sec



Recommendation when temperature variation is expected to be large due to large substrate or mounted components with large thermal capacity.

Linear type reflow profile		
Area		Recommend condition
A	Start temp PH	100°C
A-B	A-B temp rise rate	0.8~1.5°C/sec
B	End temp PH	220°C
C	Peak temp	235~255°C
D	Melting time	30~120sec



Recommendation when temperature variation in the substrate is assumed to be small.