Senju Metal Industry Co., Ltd.
Senju Manufacturing (Europe) Ltd.

ECO SOLDER®

High-Reliability Halogen Free Low Silver Lead-Free Solder Paste

M40-LS720HF

Manufacturer	European Manufacturing Facility
Senju Metal Industry Co.,Ltd.	Senju Manufacturing (Europe) Ltd.
23 Senju Hashido-cho, Adachi-Ku, Tokyo, Japan Phone: +81-33888-5156 Fax: +81-33870-3032	Unit 5, The Gateway Centre, Coronation Road, Cressex Business Park, High Wycombe, Bucks HP12 3SU England Phone:+44 (0) -1494-526000 Fax: +44 (0) -1494-526100

M40-LS720-HF

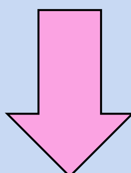
Description

Senju Ecosolder® M40 is a Low Sliver lead-free solder paste, which has been formulated as the new generation of solder pastes to save soldering cost strongly desired in the SMT market.

Sometimes both negative properties of low silver solder, such as deterioration of thermal fatigue property and rising of melting temperature have obstructed the introduction of these solder pastes into the SMT production.
However, the **Senju Ecosolder® M40** Low Silver lead-free solder paste has conquered these obstructions by optimizing the solder alloy composition.
This solder paste also stands in good comparison with the previous SAC305 (Senju M705) solder paste in all soldering parameters.

Previous obstructions to introduce low silver solder paste

- ✓ Rising of Melting Temperature
- ✓ Deterioration of Joint Strength in Thermal cycle



Optimizing alloy composition
Development exclusive flux

Main Features & Benefits

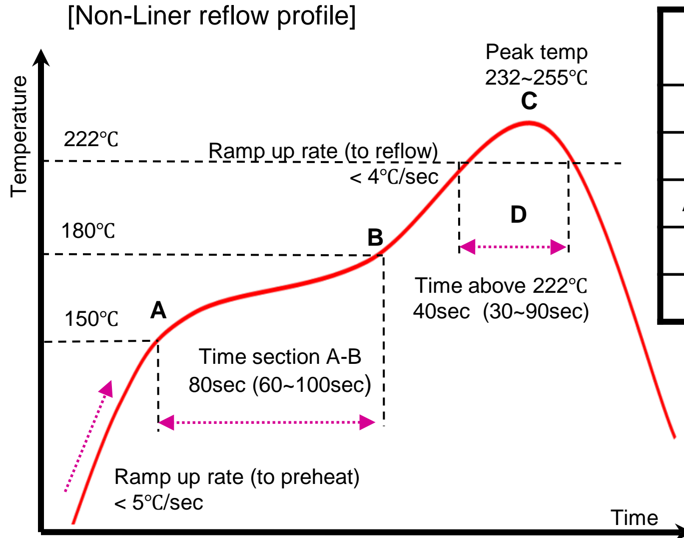
- Cost saving
- Same Solderbility & Quality as SAC305 solder paste
- Same or higher reliability of solder joint as SAC305 solder pastes
- Reduced Head & Pillow and Tombstoning attributes
- High Yield in AOI, ICT process and excellent flux cosmetics after reflow

M40-LS720HF characteristics

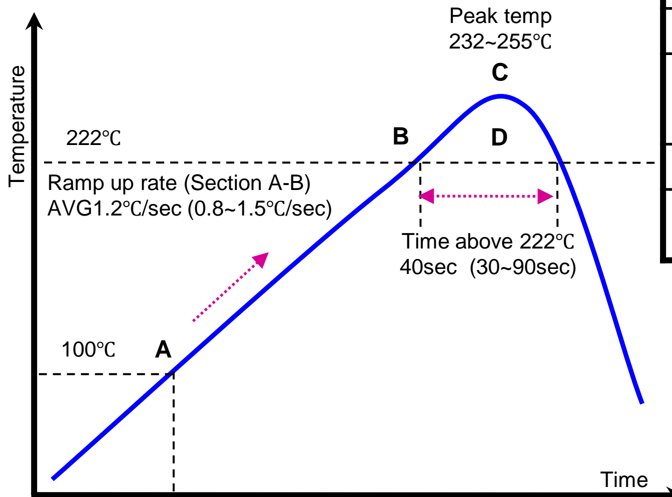
Items	M40-LS720HF		Test method /Remarks
Solder Powder			
Alloy Composition	Sn,Ag-1.0,Cu-0.7,Bi,In		---
Melting Temperature	211 ~ 222 C		DSC
Powder Shape	Spherical		SEM
Powder size/distribution	Type 4 25 ~ 36um	Type 3 25-45 um	SEM & Laser method
FLUX			
Type	RO		J-STD-004
Activity	L0		J-STD-004
Halide	0.0%/Flux		Titration method
Halogen Content	<500 ppm		EN 14582
Surface Insulation Resistance (85C85%RH,168hr)	Over 1.0E+9		ISO 9445-1 & 94554-1
Electrochemical Migration (85C85%RH Bias DC45V, 1000hr)	Over 1.0E+9 No migration		ISO 9445-1 & 94554-1
AG Chromate Test	PASS		ISO 9455
Fluoride Test	PASS		ISO 9455
Copper Mirror Test	PASS		ISO 9455
Solder Paste			
Viscosity	190 Pa.s ±20		ISO 9445-1 & 94554-1
Thixotropic Index	0.6		ISO 9445-1 & 94554-1
Flux Content	12%		ISO 9455
Slump	Cold < 0.2mm, hot < 0.3mm		ISO 9445-1 & 94554-1
Tackiness	1.1N		ISO 9445-1 & 94554-1
Tackiness Time	Over 24h/1.0N		ISO 9445-1 & 94554-1
Spreading	79%		ISO 9455
Wetting and dewetting	Rank 1-2		ISO 9445-1 & 94554-1
Solder balls	Rank 1-2		ISO 9445-1 & 94554-1
Copper plate corrosion test	PASS		ISO 9455
Validity (unopened, keep at 0 ~ 10˚C)	6 months		---

Recommended Reflow Temperature Profiles M40-LS720-HF

M40 solder paste is formulated for using in AIR reflow process. But we also recommend using Nitrogen reflow to obtain higher soldering quality and stability.



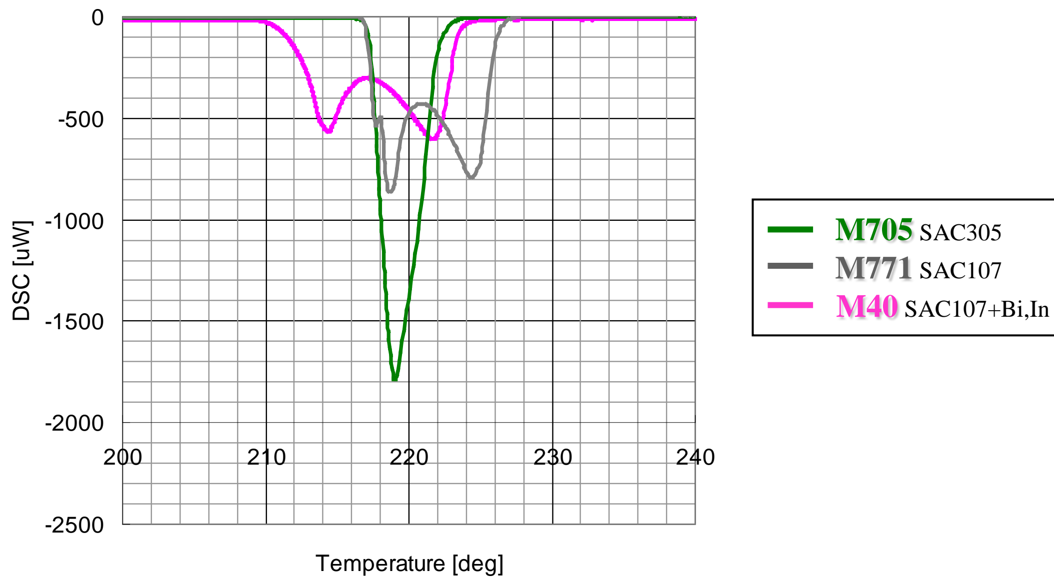
Point		Lower limit	Recommended Points	Upper Limit
A	Soak zone start	140℃	150℃	160℃
B	Soak zone end	160℃	180℃	200℃
A-B	A-B section time	60sec	80sec	100sec
C	Peak temperature	232℃	240℃	255℃
D	Time above 222℃	30sec	40sec	90sec



Point		Lower limit	Recommended Points	Upper Limit
A	Soak zone start	―――	100℃	―――
B	Soak zone end	―――	222℃	―――
A-B	A-B section time	80sec	100sec	150sec
	Ramp up rate	0.8℃/s	1.2℃/s	1.5℃/s
C	Peak temperature	232℃	240℃	255℃
D	Time above 222℃	30sec	40sec	90sec

Melting Temperature and Behavior

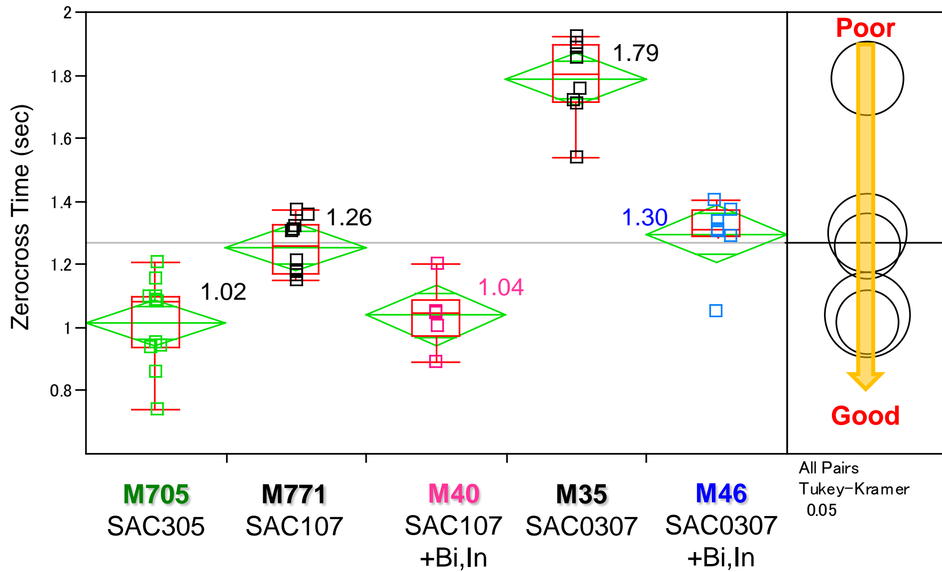
M40 vs SAC305 and typical 1% silver alloy



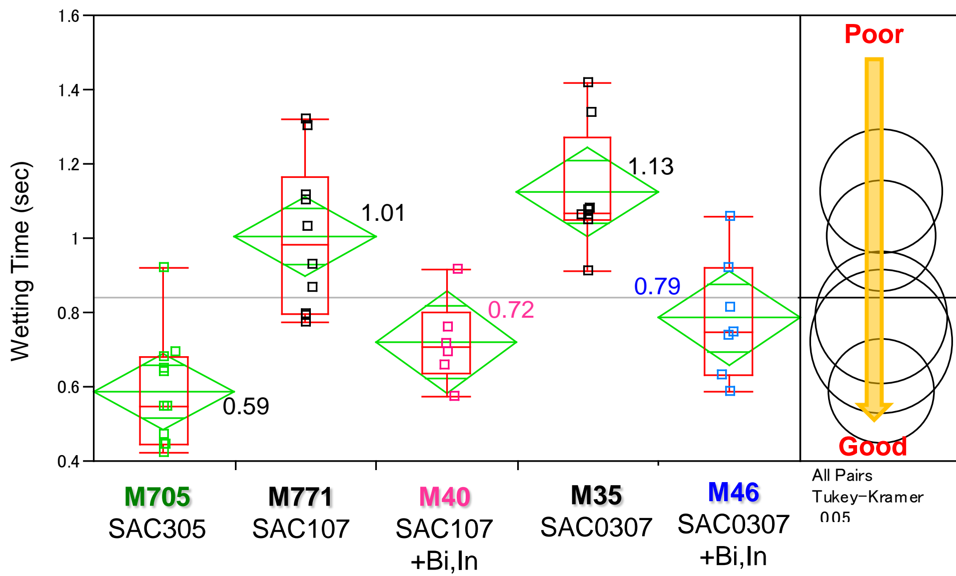
Alloy No.	Alloy composition	Melting Temp (deg C)			Comments
		Solidus	Peak	Liquidus	
M40	Sn-1.0Ag-0.7Cu -Bi,In	211	1st: 215 2nd: 222	222	Typical twin peak Completely melt at around 222deg.C

Wetting properties (Wetting Balance test)

Test result: Zerocross time



Test result: Wetting time

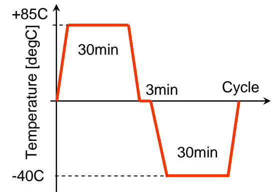


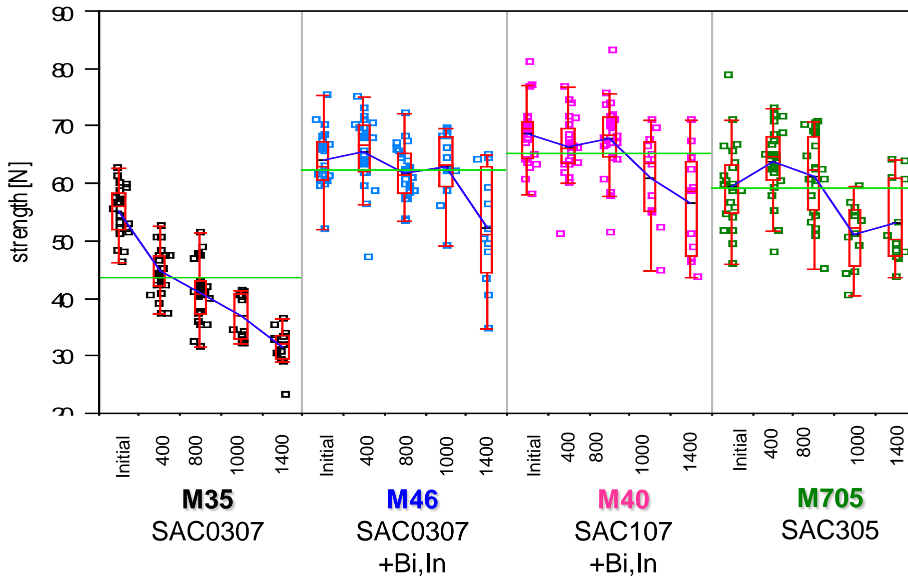
Alloy No.	Alloy composition	Comments
M40	Sn-1.0Ag-0.7Cu-Bi,In	Almost same wetting properties (Zerocross & Wetting time) as compared to SAC305

Reliability of Soldering Joint in TC

[TCT condition: -40～+85℃ Keep time: 30min]

PCB: 2 layers
Surface finish: CU+OSP
Device: 3216 Chip Resistor

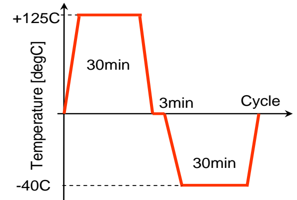


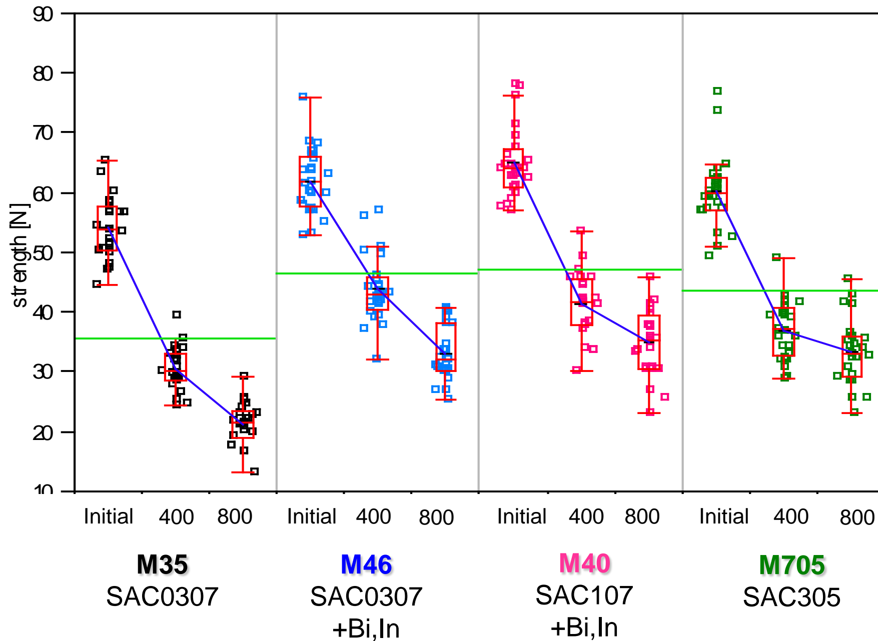


M35	**M46**	**M40**	**M705**
SAC0307	SAC0307 +Bi,In	SAC107 +Bi,In	SAC305

[TCT condition: -40～+125℃ Keep time: 30min]

PCB: 6 layers
Surface finish: Cu + OSP
Device: 3216 Chip Resistor



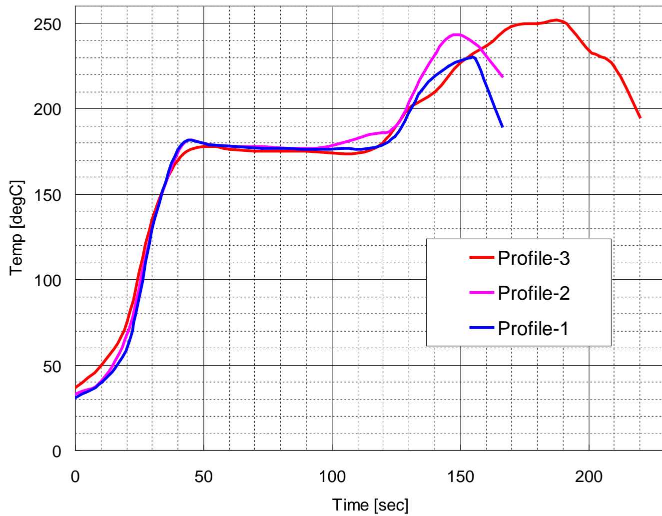


M35	**M46**	**M40**	**M705**
SAC0307	SAC0307 +Bi,In	SAC107 +Bi,In	SAC305

Alloy No.	Alloy composition	Comments
M40	Sn-1.0Ag-0.7Cu-Bi,In	Same or more high reliability of solder joint as SAC305 solder paste

Impact of Joint Strength by Reflow Peak Temperature and Time

Test condition



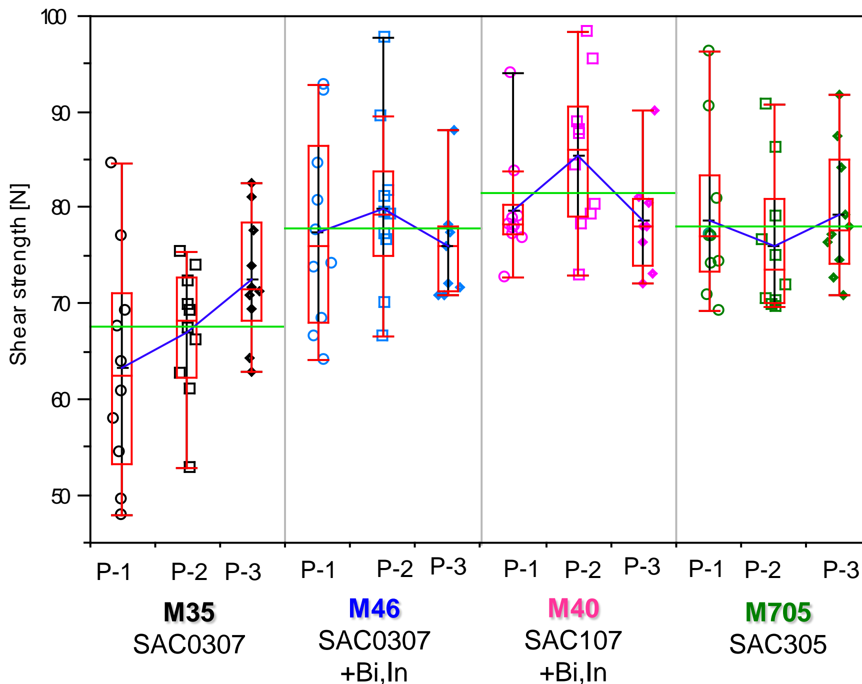
Test reflow profile:
3 profile with different peak temp & time

Profile	1	2	3
Peak Temp [degC]	230	242	251
Time above 220degC [sec]	18	31	66
Time above 227degC [sec]	6	25	57

Measurement strength

3216Chip resistor (Sn plating)
Shear tester : STR-1000
Test speed: 6.0mm/min
Clearance: 10um

Shear strength of 3216resistor



Alloy No.	Comments
M40	Stable & high shear strength regardless of any profiles same as M705 (SAC305).

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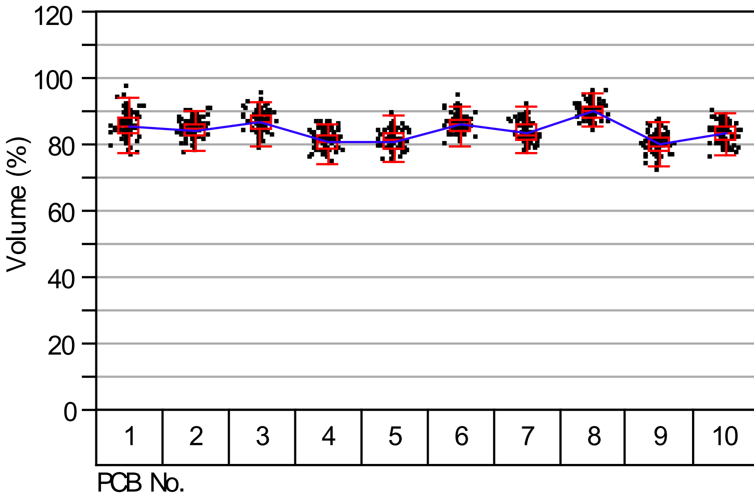
Solder Paste Printing Performance

Printing properties

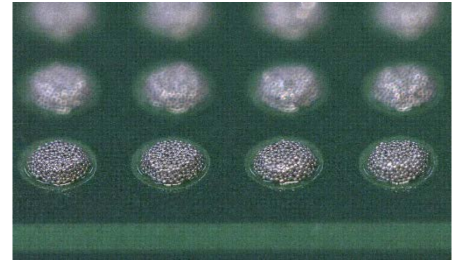
Test condition:

Stencil:	SUS Laser cut / 120umt		
Squeegee:	Metal	Angle:	60°
Speed:	40mm/s	Pressure:	0.25N/mm
Environment:	25℃50%RH	Separation speed: 5.0mm/s(Fixed mode)	

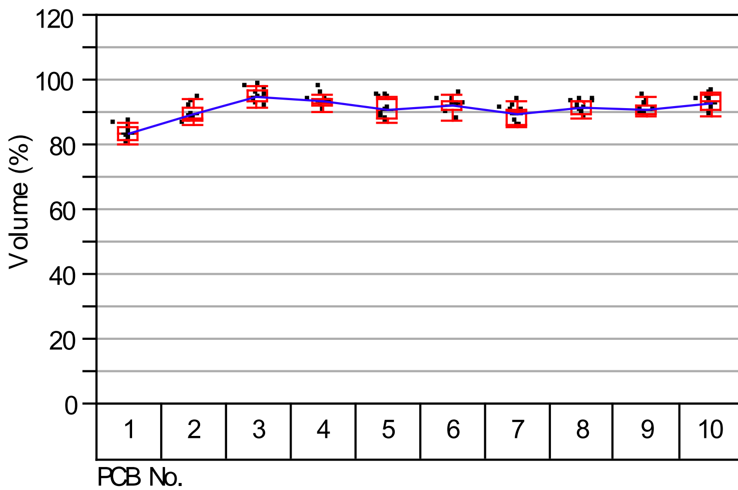
[0.3mm Circle pattern]



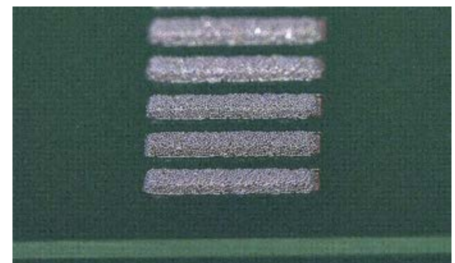
0.3mm Circle pattern (10th sheet)



[0.4mmPitch 0.2mm Width Slit]



0.4mm Pitch Slit (10th sheet)



Recommended printing Conditions

Item	Recommended procedure	Capable
Printer types	Open squeegee model	Enclosed squeegee system
Squeegee blade	Metal	Urethane, Plastic
Squeegee angle	60˚	45 ~ 60˚
Printing speed	30 ~ 50mm/s	20 ~ 100mm/s
Printing pressure	0.20 ~ 0.30N/mm	Adjust not to leave paste on stencil
Separation speed	1.0 ~ 5.0mm/s	< 10mm/s
Paste rolling diameter	10 ~ 15mm	―――
Temperature & Humidity	22 ~ 28℃ 30 ~ 70%RH	―――

Recommended Storage and Handling

Item	Recommended procedure	Remark
Storage	6month at refrigerated 0 ~ 10℃	Without unsealing condition
Warm-up prior to use	At least 2 hour leaving at ambient working temp	Do not use forced heating methods. Actual paste temp should be verified
Capable storage period at room temperature prior to use	1 week	Without unsealing condition below 25deg.C
Working environment	Temperature: 22 ~ 28℃ Related humidity: 30 ~ 70%RH	―――
Capable working time in continuous printing	24 hours	Do not mix worked paste with unused paste
Capable abandon time in printing process	1 hour	―――
Capable idle time before placement after print	8 hours	―――
Capable idle time before reflow after print	8 hours	―――
Re-storage of remaining paste in container (unused portion)	0 ~ 10℃	Allowed to re-storage 1time in validity with putting the lid on firmly.