TC-1905022A(G)
STC0049P_3.0E

ECO SOLDER® PASTE

M705-ULT369 Series Technical Report

Senju Metal Industry Co.,Ltd.
Solder Technical Center

SMIC confidential

SMIC

Content

Product Characteristics

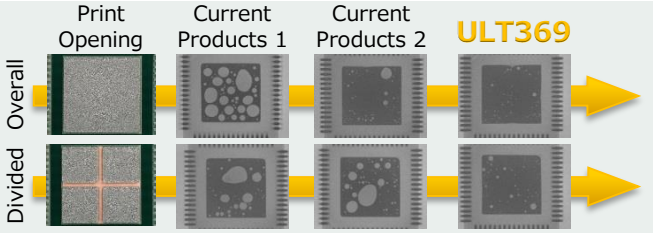
Next Generation Solder Paste

M705-ULT369 Series

Newly designed to be state-of-the-art. More user-friendly, achieving a high workability.

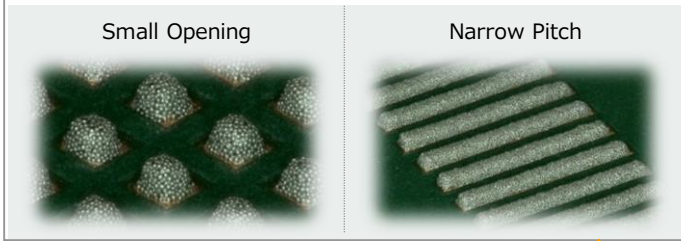
Low Void

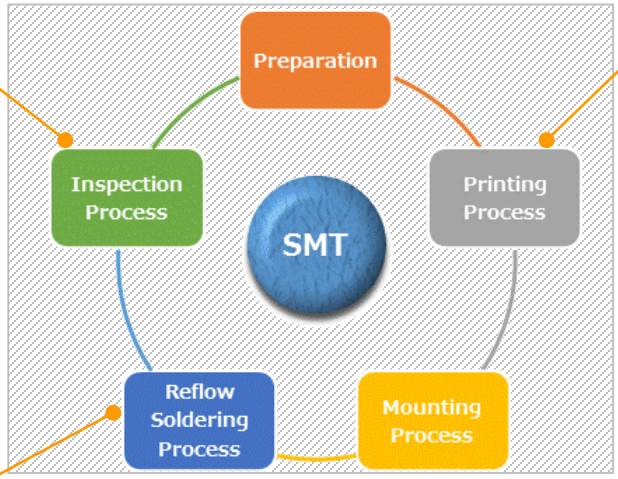
The trend to high-capacity and high-speed communication puts heat radiation into focus.
In this connection, voiding became an important character in terms of soldering. ULT369 has a high flowability. Voids are easily discharged from solder. Even in case of subdivided pattern, ULT369 is able to decrease the voiding.



High Printability

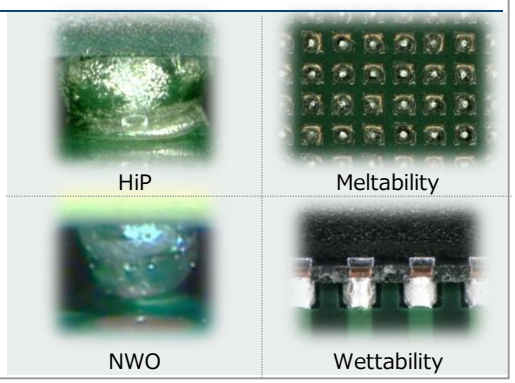
ULT369 has a high printability. Especially the filling/releasing ability is increased. This contributes to the printability at small openings and narrow pitches. ULT369 has an excellent temporal stability to achieve high productivity.





High reflowability

・Electric parts become smaller and smaller, and require thus a smaller solder powder size. Smaller solder powder oxidizes easily, affecting the solderability. ULT369 can keep its solderability with high heat resistance.
・BGA Packages become thinner and thinner, bending more easily. This can cause HiP (Head in Pillow) and NWO (Non-wet Open) issues. ULT369 overcomes those problems with its outstanding wettability.
・Its high wettability can help soldering difficult places like QFN edges.

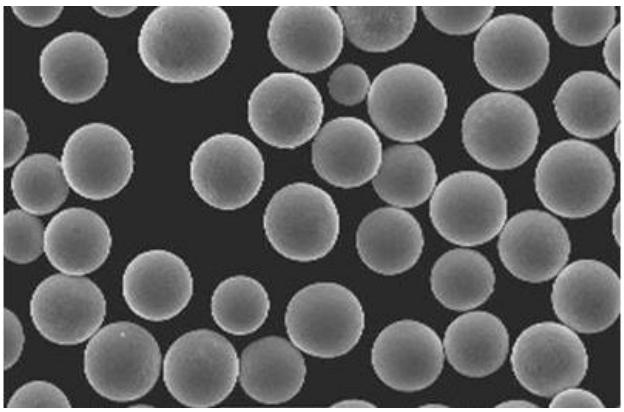


2-1. Alloy Characteristic

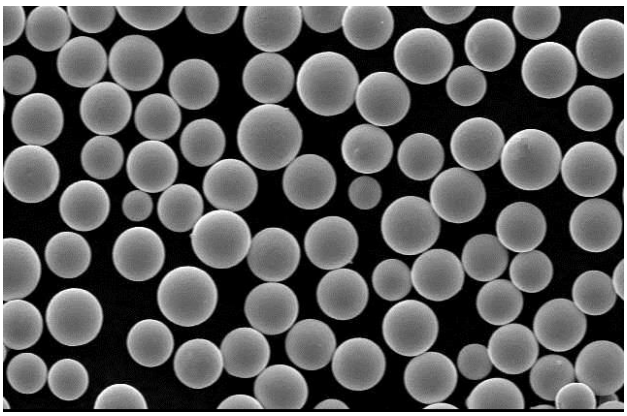
Alloy Name		M705
Alloy Composition (%)		Sn-Ag3.0-Cu0.5
Specific Gravity		7.4
Melting Temp. (℃)	Solidus	217
	Liquidus	220
Tensile Strength (MPa)		53.3
Elongation (%)		56
Young's Module (GPa)		46.9
0.2 Yield Point (MPa)		39.4
CTE (ppm/ C)		21.7
Vickers Hardness (Hv)		17.9

2-2. SEM Image

Type4（20-38μm）

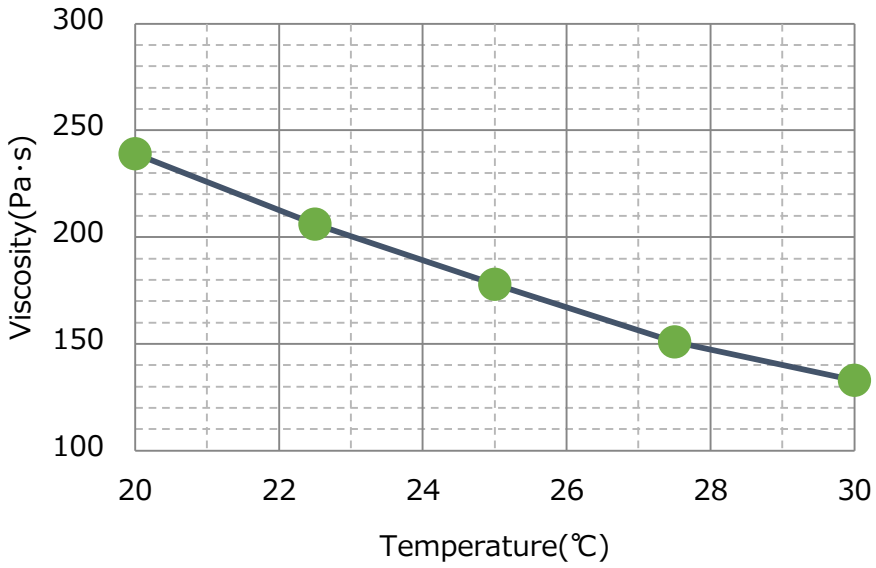


Type5（15-25μm）



Almost no surface oxidation, spherical lead-free powder is used in all ECO-solder paste products from SMIC.

3-1. Fluid Characteristic at Temperature

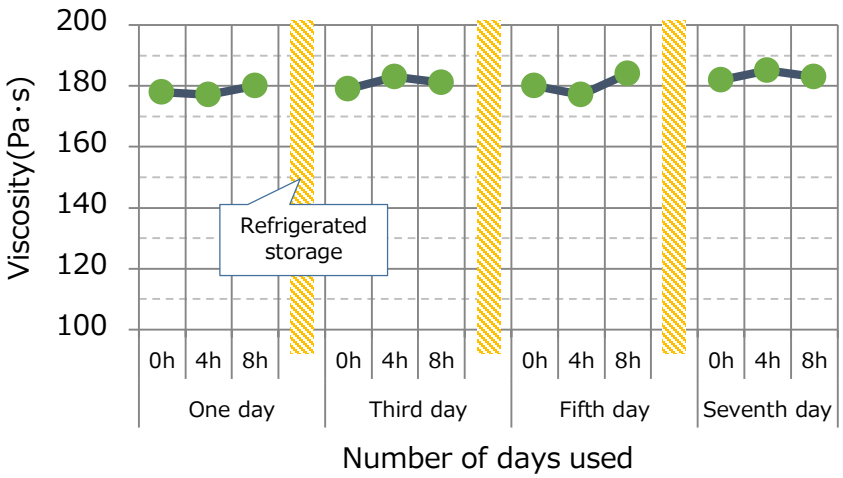


Solder paste characteristics change corresponding to temperature. There is a tendency for viscosity to become lower (softer) at high temperature. Slumping and/or spreading in the printing stage and solder ball or bridging in reflow stage may potentially occur if the paste has lower viscosity. Conversely, sticking to squeegee and/or clogging to stencil aperture may occur if viscosity is higher. Therefore, suitable environmental conditions are preferred for this paste's use. 25+/-3℃ temperature is usually recommended for this product.

3-2. Viscosity Change by Continuous Printing

Printing Tact:	30sec/sheet	Environment:	25℃50%RH
Viscosity measurement:	PCU-205(Malcom)		

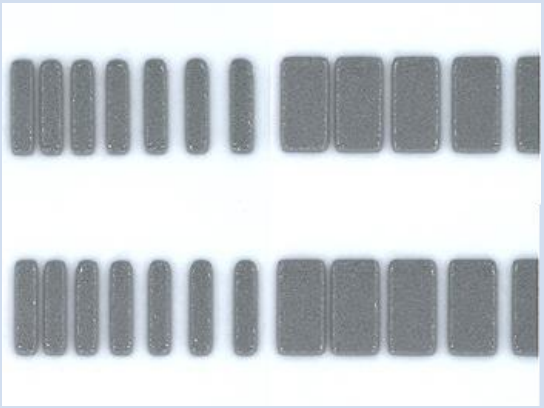
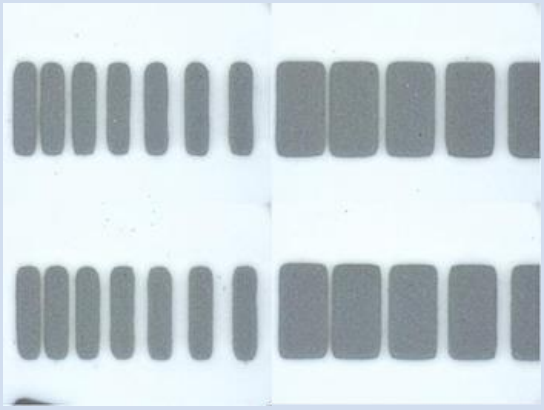
Test cycle



This product is excellent in continuous printing, contributing thus to waste reduction.

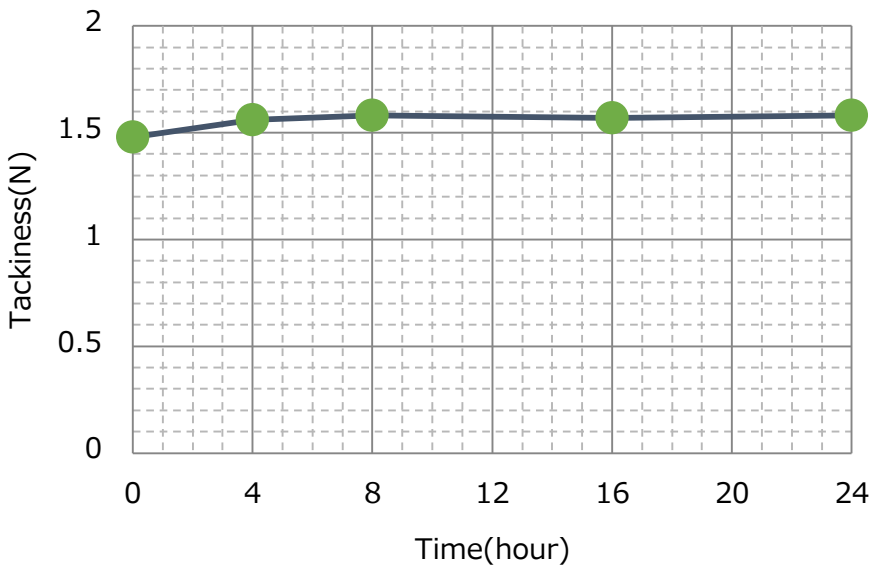
3-3. Slump Test

Reference:	JIS Z 3284	Stencil Thickness:	0.2mm
Heating Condition:	150℃3min (Chamber)		

Cold Slump	Hot Slump
	
Result: Under 0.2mm	Result: Under 0.2mm

3-4. Tackiness Test

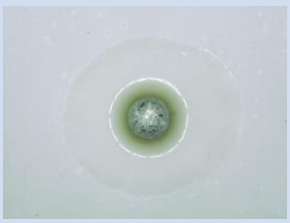
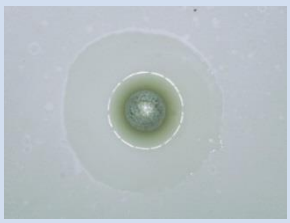
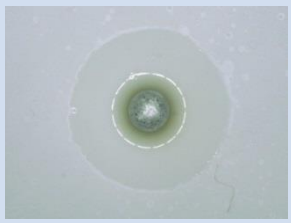
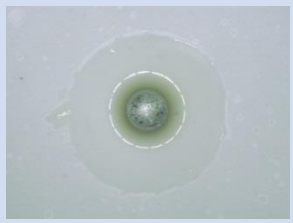
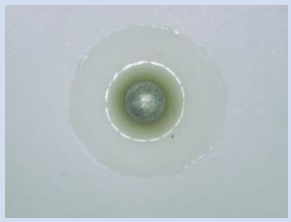
Reference:	JIS Z 3284	Stencil Thickness:	0.2mm
Environment:	25℃50%RH		



Also after 24hours the paste keeps a tackiness of more than 1.0N.

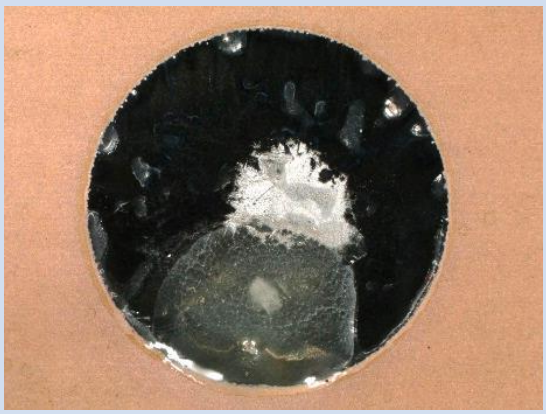
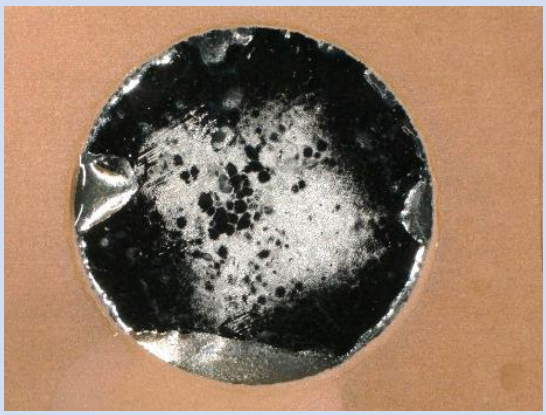
3-5. Solder Ball Test

Reference:	JIS Z 3284	Stencil Thickness:	0.2mm
Environment:	25℃50%RH, 30℃90%RH	Heating Condition:	270℃ (Solder Bath)

	Initial	2hours	6hours	24hours
25℃50%RH				
	Result: rank1	Result: rank1	Result: rank1	Result: rank1
30℃90%RH				
	Result: rank1	Result: rank1	Result: rank1	Result: rank2

3-6. Wetting Effect and De-wetting Test

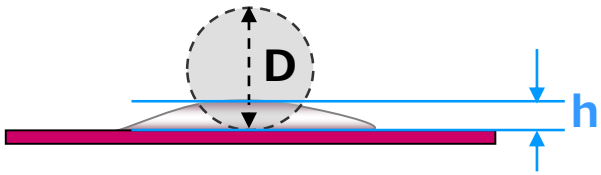
Reference:	JIS Z 3284	Stencil Thickness	0.2mm
Heating Condition:	270℃(Solder Bath)		

Result-1	Result-2
	

Result: Rank 2
(Wetting the copper coupon without de-wetting)

3-7. Solder Expansion Test

Reference:	JIS Z 3197	Heating Condition:	270℃(Solder Bath)
Solder Specific Gravity:	7.39		

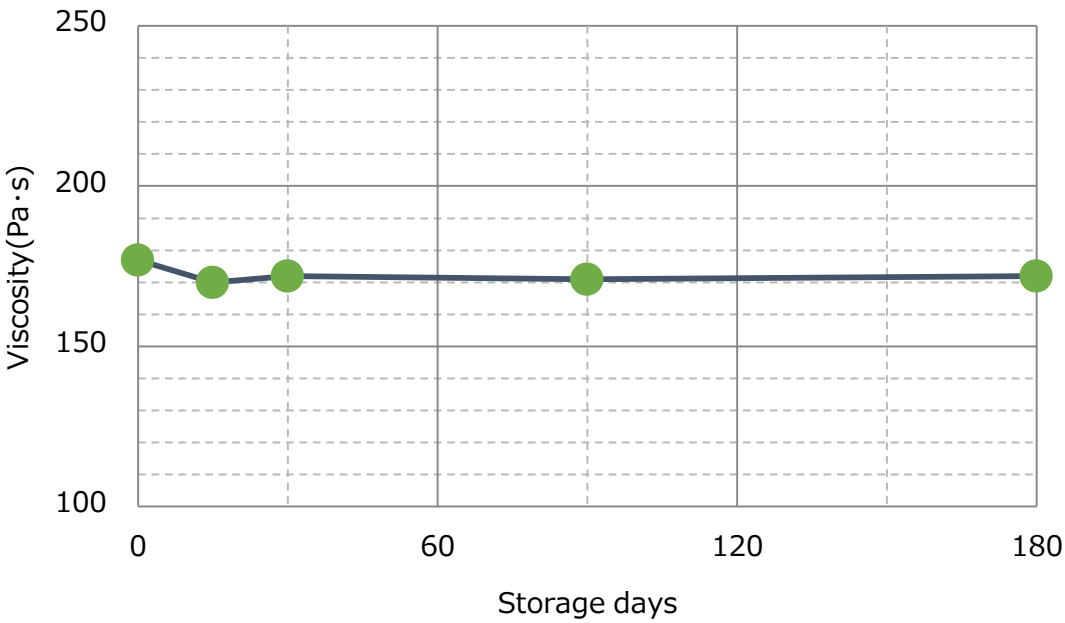


Expansion ratio(%)
= (D − h) / D x 100

N	Paste Weight (g)	Solder Weight (g)	Solder volume (mm3)	Solder thickness (mm)	Expansion ratio (%)	Mean (%)
1	303.0	268.2	36.2	0.947	**76.93**	**77.07**
2	309.0	273.5	37.0	0.852	**79.38**	
3	303.7	268.8	36.3	1.052	**74.40**	
4	296.5	262.4	35.5	0.952	**76.64**	
5	292.6	259.0	35.0	0.893	**77.99**	

3-8. Pot Life

Environment:	Keep at 0-10℃	Viscosity Measurement:	PCU-205(Malcom)

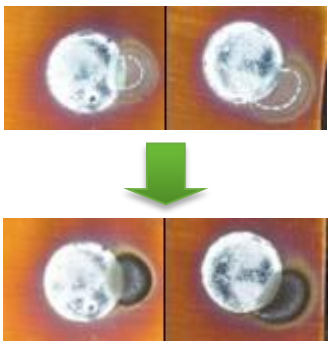


The product is stable and can keep its characteristics over a long period of time.

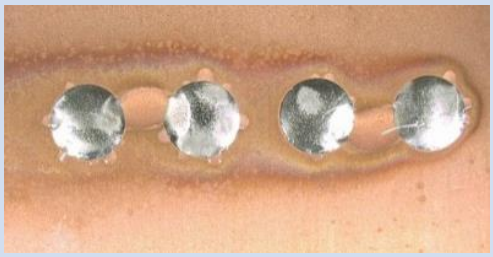
4-1. Cu Plate Corrosion Test

Reference:	JIS Z 3197	Environment:	40℃90%RH
Test Time:	72hours		

NG sample



Flux Residue Color Change to White and Green

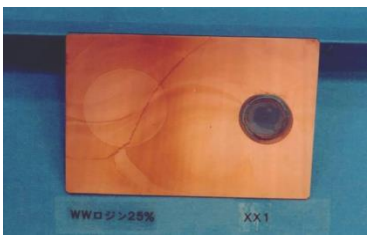
Initial	After 72hours
	

Result: PASS(No change of residue color)

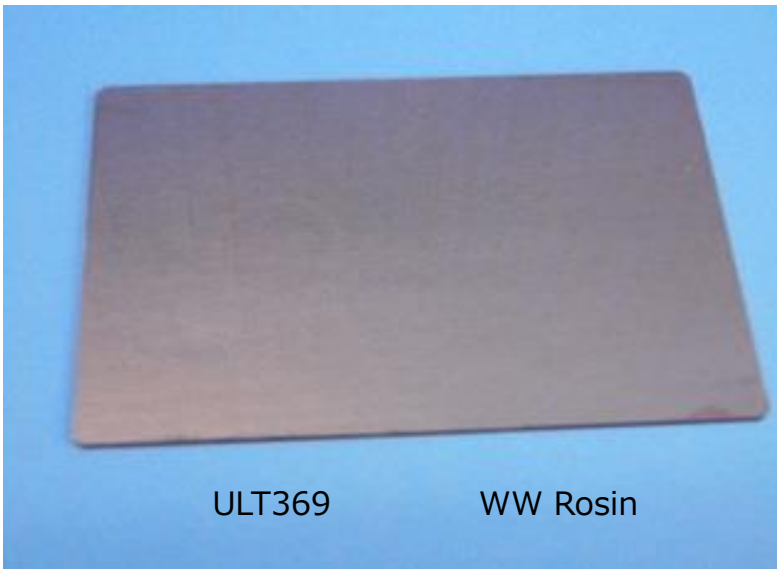
4-2. Cu Mirror Corrosion Test

Reference:	JIS Z 3197	Environment:	25℃50%RH
Test Time:	24hours		

NG Sample



Right Side Mirror Break Through

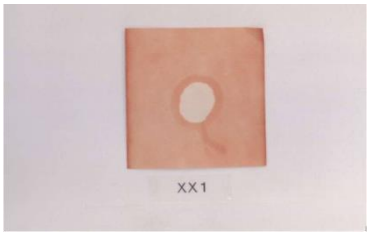


Result: PASS(No evidence of mirror breakthrough)

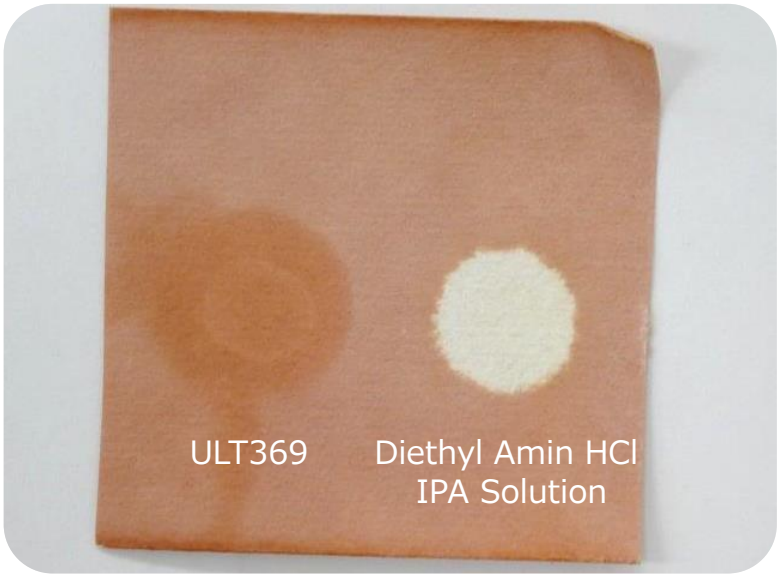
4-3. Silver Chromate Paper Test

Reference:	JIS Z 3197	Standard solution:	Diethyl Amine HCl IPA Solution

NG Sample



Color Change to white or off-white

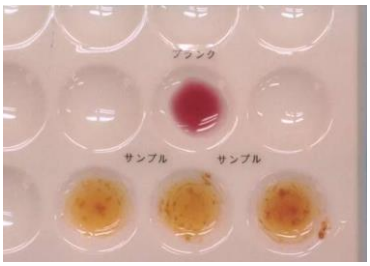


Result: Pass(No evidence of color change)

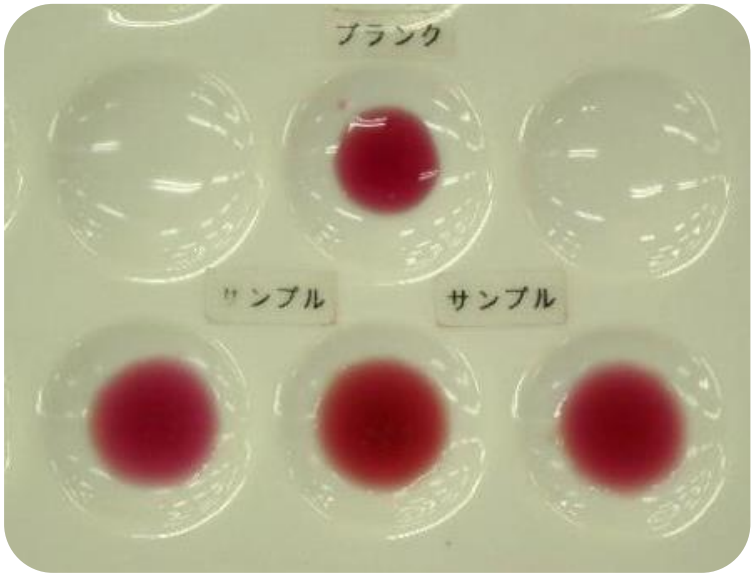
4-4. Fluoride Content Test

Reference:	JIS Z 3197

NG Sample



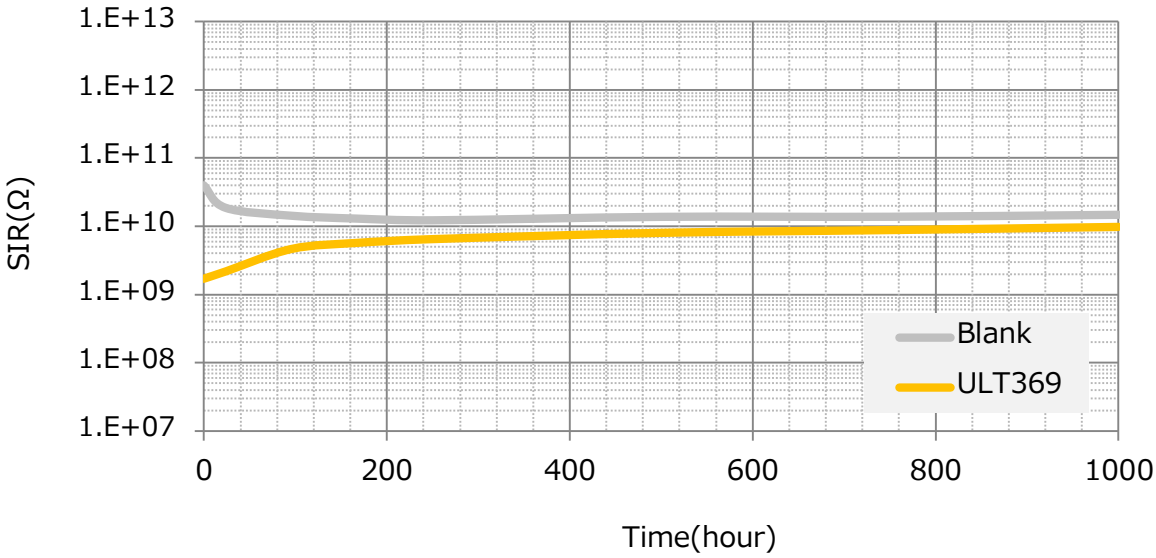
Color Change to Yellow



Result: Pass(No evidence of color change)

4-5. SIR Test and ECM Test

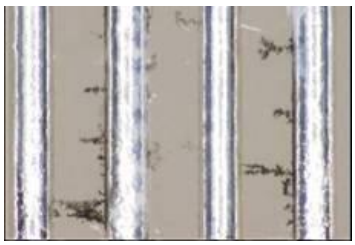
Reference:	JIS Z 3197	Environment:	85℃85%RH
Measure Voltage:	DV100V	Applied Voltage:	DC45V



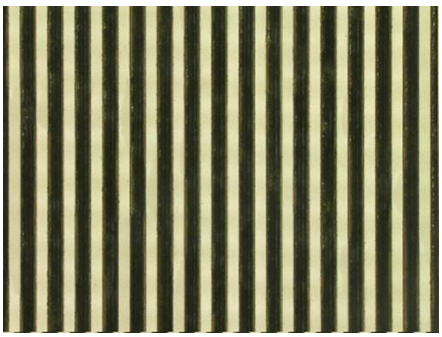
Blank								
	Time(hour)							
No.	0	24	96	168	250	500	750	1000
1	3.98E+09	1.34E+10	1.16E+10	1.09E+10	9.87E+09	1.12E+10	1.17E+10	1.25E+10
2	7.66E+10	2.40E+10	1.70E+10	1.49E+10	1.45E+10	1.62E+10	1.58E+10	1.69E+10
3	4.03E+10	1.87E+10	1.43E+10	1.29E+10	1.22E+10	1.37E+10	1.38E+10	1.47E+10
Average	4.03E+10	1.87E+10	1.43E+10	1.29E+10	1.22E+10	1.37E+10	1.38E+10	1.47E+10

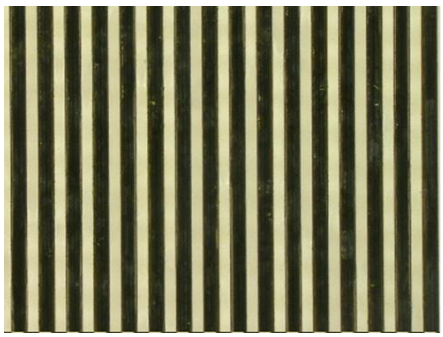
ULT369								
	Time(hour)							
No.	0	24	96	168	250	500	750	1000
1	2.01E+09	2.60E+09	5.13E+09	6.12E+09	6.97E+09	7.75E+09	8.84E+09	1.01E+10
2	1.38E+09	1.97E+09	4.01E+09	4.95E+09	5.65E+09	7.69E+09	8.48E+09	9.31E+09
3	1.73E+09	1.98E+09	4.80E+09	6.03E+09	6.76E+09	8.51E+09	8.96E+09	9.86E+09
Average	1.71E+09	2.18E+09	4.65E+09	5.70E+09	6.46E+09	7.98E+09	8.76E+09	9.75E+09

NG Sample



Growth of Migration





Result: PASS(No migration)

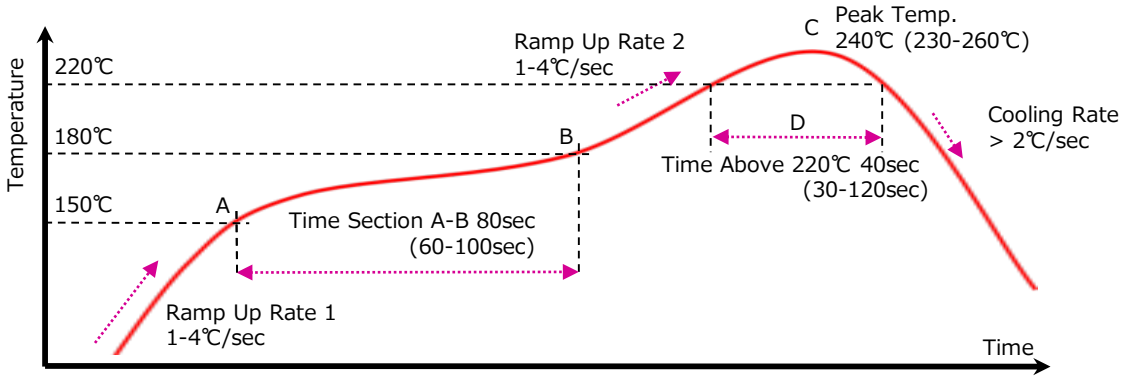
Handling

Item	Recommended	Remarks
Storage Condition	Keep at 0-10℃	Unopened
Warm-up Prior to Use	Min. 1hour at Room Temp.	Do Not Open When Still Cold
Storage at Room Temperature Prior to Use	Max. 3 days	At 30℃ or Lower
Stirring Condition Before Processing	30-60sec by Hand Mixing or Automatic Mixing	In Case of Jars
Operating Environment	22-28℃、30-70%RH	- - -
Stencil Life for Continuous Printing	Up to 24hours	- - -
Abandon Time by Printing Process	Up to 1hour	- - -
Idle Time After Printing	Up to 8hours	- - -
Idle Time After Mounting Components	Up to 8hours	- - -
Re-storage of Remaining Solder Paste in Container	at 0-10℃	Only Once

Recommended Printing Process

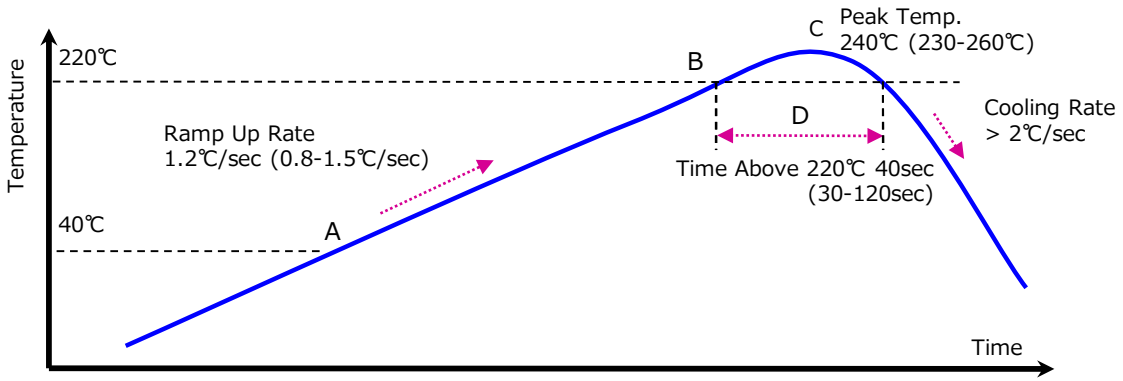
Category	Recommended	Capable
Printer Type	Open Squeegee Model	Enclosed Squeegee System
Squeegee Blade	Metal	Urethane, Plastic
Squeegee Angle	60°	45-60°
Print Speed	30-50mm/sec	20-100mm/sec
Print Pressure	0.20-0.30N/mm	Adjust not to Leave Paste on Stencil
Separation Speed	1.0-5.0 mm/sec	< 10mm/sec
Paste Rolling Height	10-20mm	- - -
Operating Environment	22-28℃、30-70%RH	- - -

Soak Reflow Profile * It can be used with Air condition.



Category		Lower Limit	Recommend	Upper Limit
-A	Ramp Up Rate 1	1℃/sec	**2℃/sec**	4℃/sec
A	Soak Zone Start Temp.	140℃	**150℃**	160℃
B	Soak Zone End Temp.	160℃	**180℃**	200℃
A-B	A-B Section Time	60sec	**80sec**	100sec
B-C	Ramp Up Rate 2	1℃/sec	**2℃/sec**	4℃/sec
C	Peak Temp.	230℃	**240℃**	260℃
D	Time above 220℃	30sec	**40sec**	120sec
	Cooling Rate	2℃/sec	**- - -**	- - -

Ramp Reflow Profile * It can be used with Air condition.



Category		Lower Limit	Recommend	Upper Limit
A	Ramp Start Temp.	- - -	**40℃**	- - -
B	Ramp End Temp.	- - -	**220℃**	- - -
A-B	A-B Section Time (Ramp Up Rate)	120sec (1.5℃/sec)	**150sec (1.2℃/sec)**	220sec (0.8℃/sec)
C	Peak Temp.	230℃	**240℃**	260℃
D	Time Above 220℃	30sec	**40sec**	120sec
	Cooling Rate	2℃/sec	**- - -**	- - -

Items	M705-ULT369		Test Method
	Type4	Type5	
Solder Powder			
Alloy Composition	Sn-3.0Ag-0.5Cu		- - -
Melting Temperature	217-220℃		DSC
Powder Shape	Spherical		SEM
Particle Size	20-38μm	15-25μm	SEM, Screen Method
Solder Paste			
Flux Classification	ROL0		J-STD-004B
Halogen Content	Less than 500ppm		EN 14582
Halide Content	0.02% or less		JIS Z 3197
Cu Plate Corrosion Test	Pass		JIS Z 3197
Cu Mirror Corrosion Test	Pass		JIS Z 3197
Surface Insulation Resistance Test	Over 1.0E+12Ω		JIS Z 3197 (40℃/90%RH, 168hours)
Electro Chemical Migration Test	Over 1.0E+9Ω No Migration		JIS Z 3197 (85℃/85%RH, 1000hours)
Flux Content	11.5%	11.7%	JIS Z 3197
Viscosity	180 Pa･s		JIS Z 3284
Thixotropic Index	0.60		JIS Z 3284
Slump Test	Cold 0.2mm/Hot 0.2mm		JIS Z 3284
Tackiness Test	Over 1.0N within 24hours		JIS Z 3284
Solder Ball Test	Rank 1-2		JIS Z 3284
Validity	6 months		Unopened, Keep at 0-10℃

※The values in this table are for reference.