Engineering Manual
LOCTITE GC 10 T4 Solder Paste

Suitable for use with: Standard SAC Alloys

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GC 10: Performance Summary

Flux

- Halogen-free flux: passes IC with pretreatment IPC-TM-650 2.3.34/EN14582
- Halogen-free flux classification: ANSI/J-STD-004 Rev. B for a type ROL0 classification

Paste

- Suitable for fine pitch, high speed printing up to 125mm/s (5”/s)
- Optimized for long hot soak reflow profiles
- Excellent fine pitch coalescence in air & nitrogen atmosphere
- Excellent humidity resistance
- Excellent solderability on challenging surface finishes, including CuNiZn
- Colorless residues for easy post-reflow inspection
- Long 12month shelf-life when stored below 26.5°C

Contents

Introduction

Basic Solder Paste Properties

Flux Description	GC 10
Alloy	SAC305
Henkel Powder Size	Type 4
Powder Size range, μm	38-20
Metal Content, %	88.5
Malcom Viscosity, 10rpm Pa.s	190
TI	0.50
IPC slump @182°C (0.33mm x 2.03mm) first space no bridge	0.20
IPC Solder Balling	preferred

Introduction

GC 10 Features & Benefits

Product Attribute	Process Benefit
Halogen Free	• No added halogen • Measured <900ppm chlorine and bromine and <1,500ppm total by oxygen (O_2) bomb test
Halide Free	• Flux classification ROL0 in accordance to J-STD-004B
Application	• Designed for printing and pin-in-paste • Excellent wetting to a broad range of metallisations, even through long hot soak profiles in an air atmosphere • Compatible with existing halogen free solutions • Suitable for medium to large board assemblies • Designed for long 12 month shelf-life stability without impact to printing or reflow

Introduction

GC 10 Features & Benefits

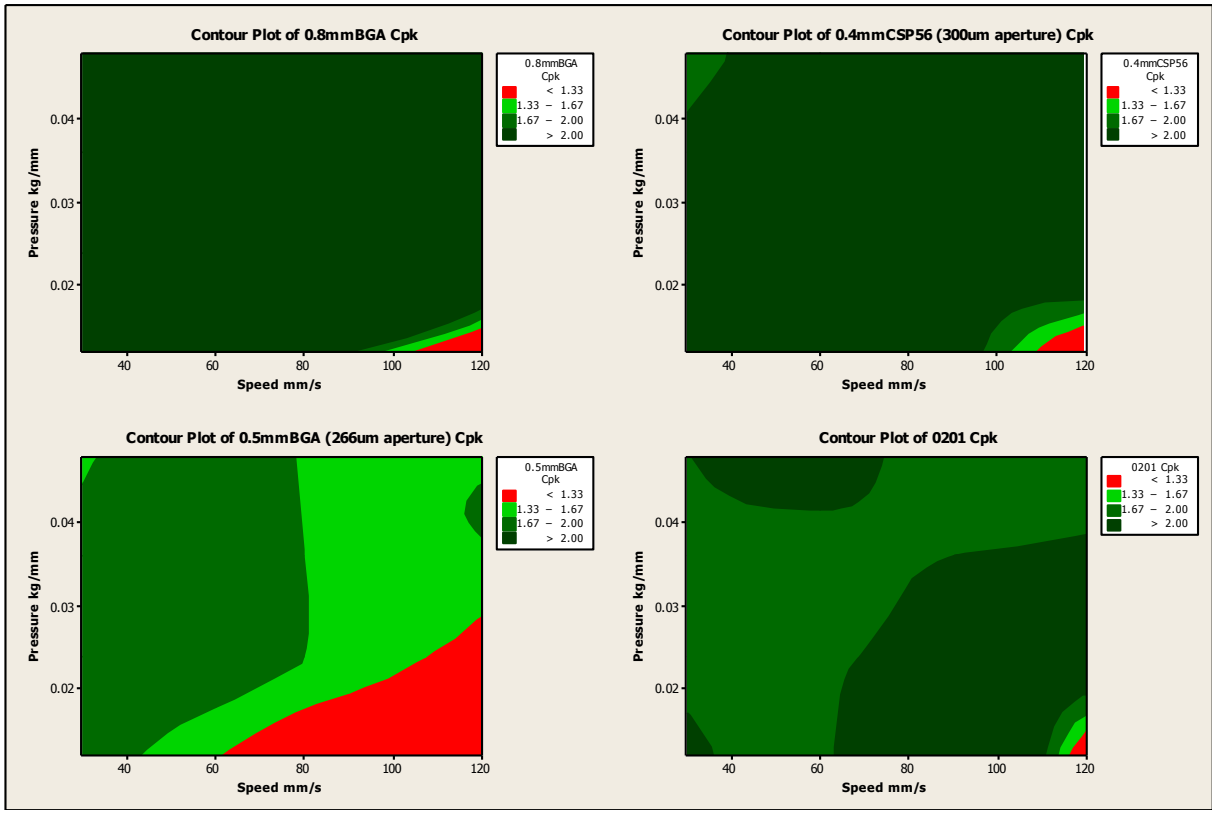
Product Attribute	Process Benefit
Technology Printing Advantages	• Wide process window for printing and minimal slump • Fine pitch abandon time of up to 2 hours; work life > 16 hours • Fine pitch capability and reduction in solder bridging • Suited for high throughput production, where yield consistency on print deposits is key • Improved paste transfer efficiency • Allows on line paste utilisation protocols to be re-written
Technology Reflow Advantages	• Optimised for long hot soak reflow processes • Very shiny Pb-free solder joints over wide range of reflow • Excellent fine pitch coalescence • Excellent humidity resistance • Excellent solderability on challenging surface finishes (ENIG, Copper OSP, CuNiZn and Imm Ag)
Low Voiding	• Low void levels increases solder joint reliability • New chemistries allow pursuit of class 3 void levels in accordance to IPC7095B on industry surface finishes: ENIG, Copper OSP, CuNiZn and Imm Ag • Low voiding in CSP
Residues	• Clear, transparent and colourless • Pin testable after 5x reflows

Contents

Operating Parameters

Print Process Window (LOCTITE GC 10 SAC305 T4 885V)

- Excellent printing in the range 25 – 125mm/s

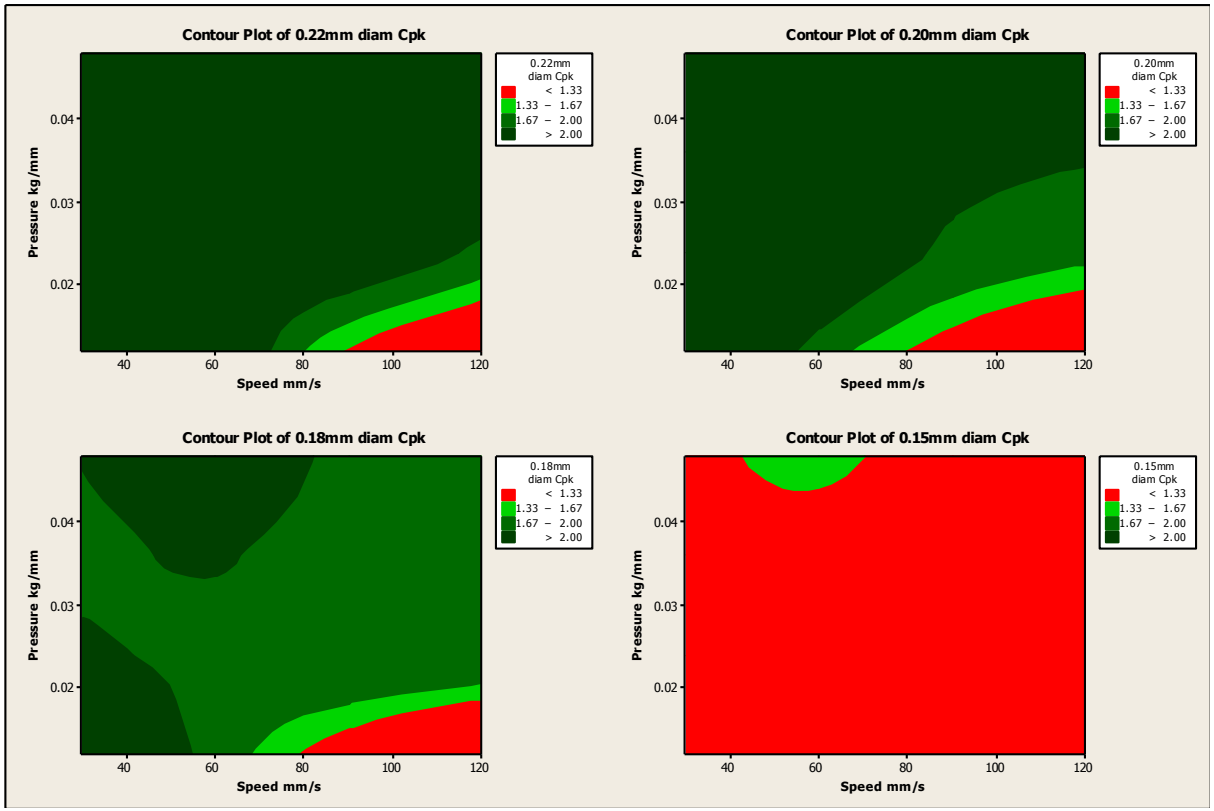


0.8mm, 0.5mm & 0.4mm round apertures, 0201 (100µm stencil)

Operating Parameters

Print Process Window (LOCTITE GC 10 SAC305 T4 885V)

- Excellent printing in the range 25 – 125mm/s, 0.18-0.22mm round apertures

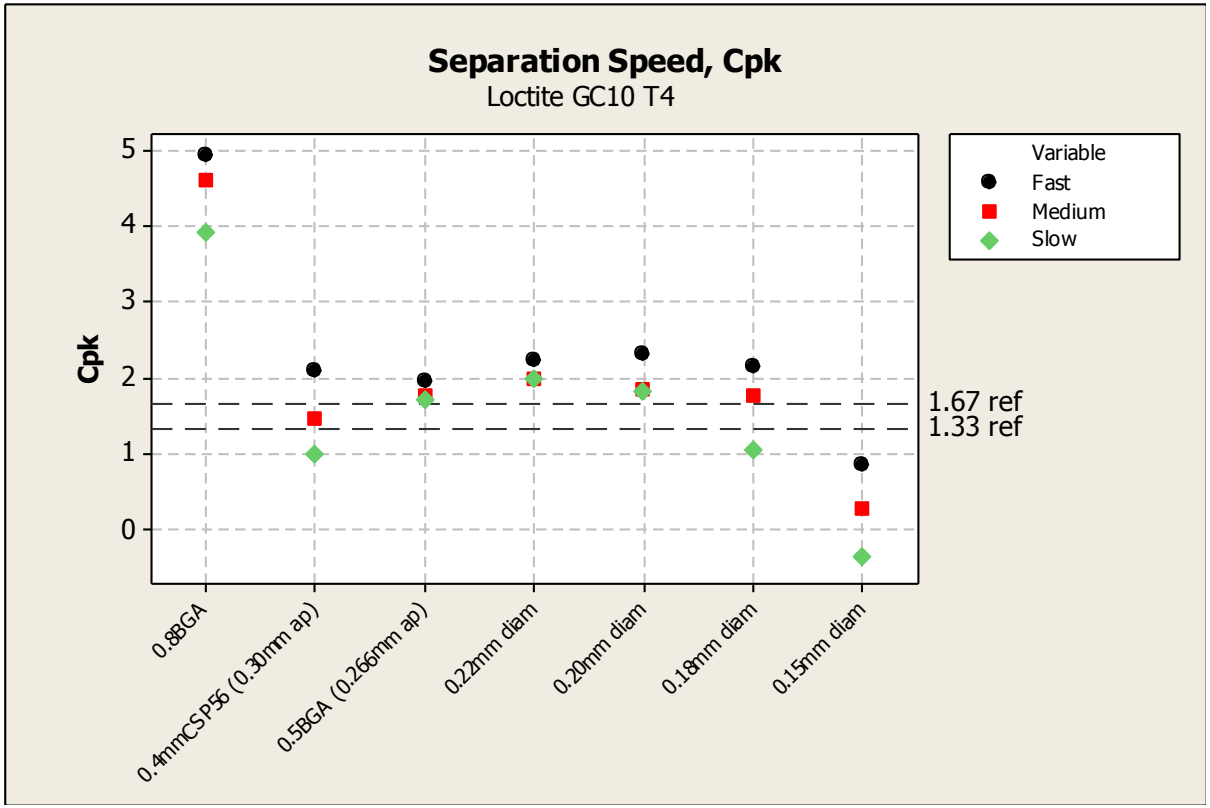


0.22mm – 0.15mm round apertures, (100µm stencil)

Operating Parameters – Separation Speed

Print Process Window (LOCTITE GC 10 SAC305 T4 885V)

- Excellent printing in the range down to 0.18mm round apertures.
- Fast separation speed is preferable.

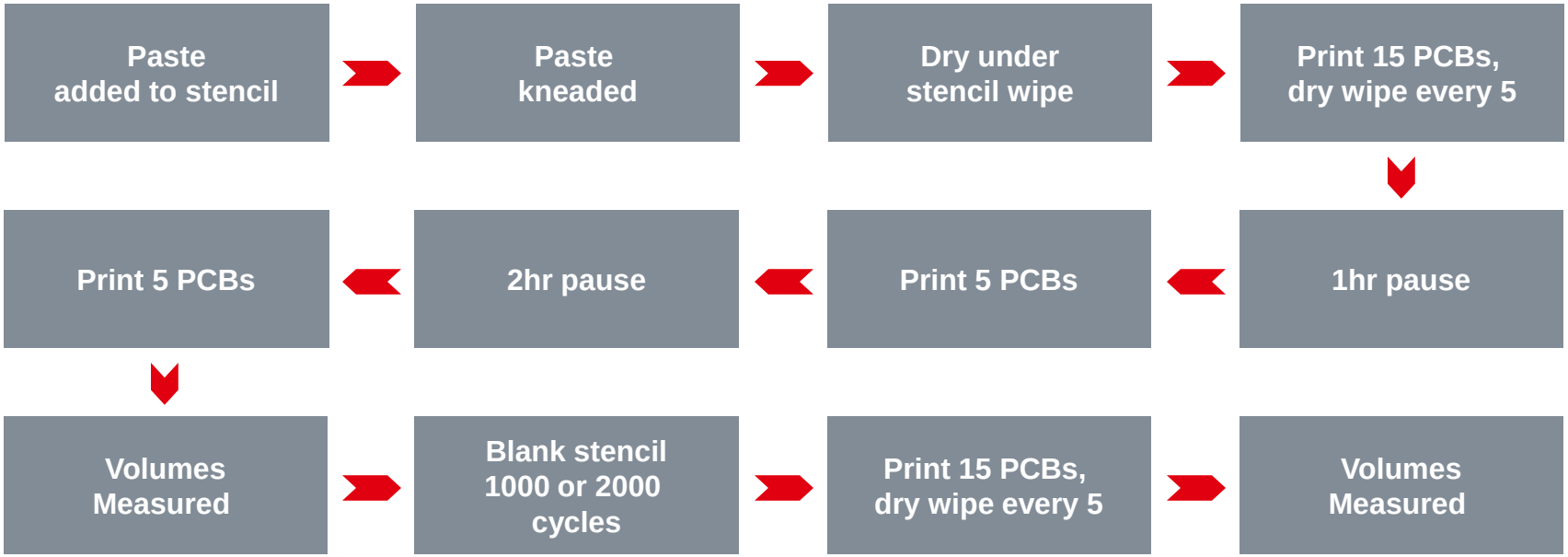


0.8mm BGA – 0.15mm round apertures, (100µm stencil) 100µm stencil thickness, 60mm/s

Operating Parameters

Continuous Print and Abandon Stability Assessment

Henkel Board 0.8mm BGA to 0.15mm diameter circles Process flow for Henkel print test as shown below

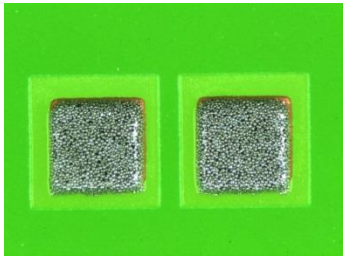
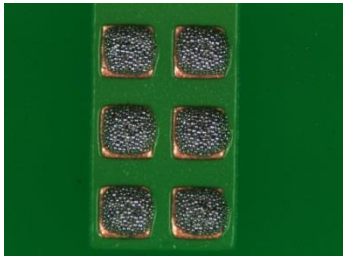
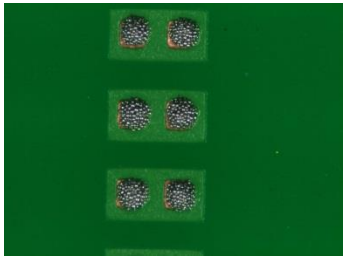
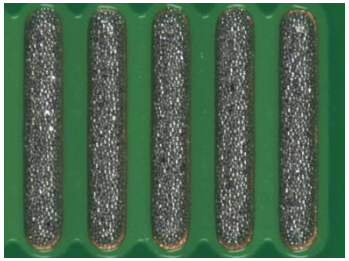
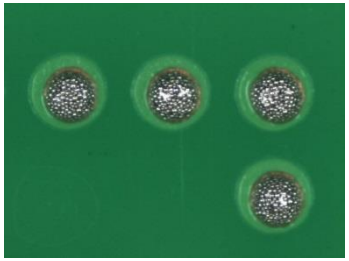
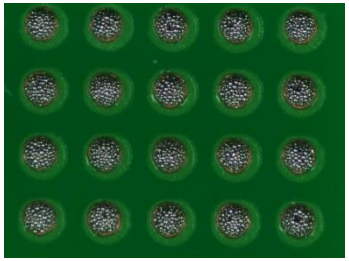


- Printing
- DEK Europa
- Stainless steel, laser cut
- 100µm thickness
- Vacuum tooling

- 250mm, 60° squeegee
- 60mm/s squeegee speed
- 20mm/s separation speed
- Conditions Typical, 22C, 40% RH
- Koh Young KY-8020T volume measurement

Operating Parameters
Printing

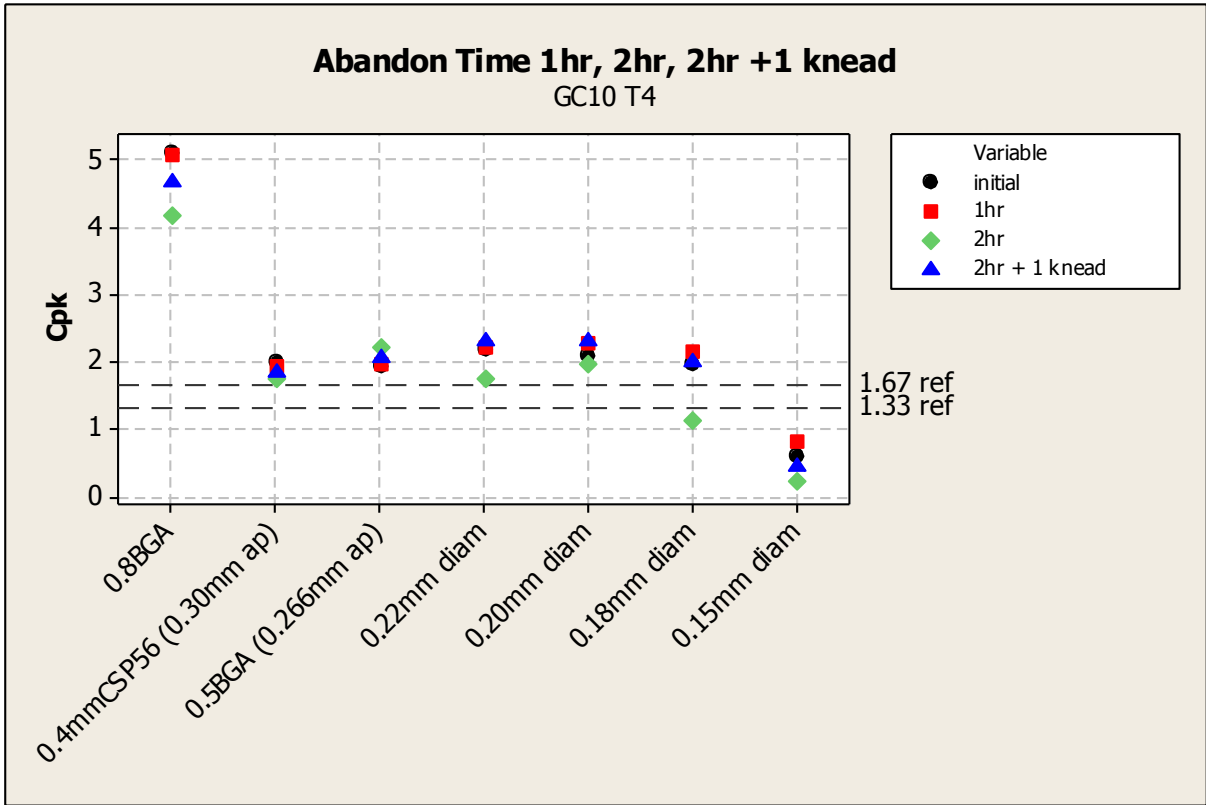
- GC 10 solder pastes show exceptional print quality
- On 0.18mm diameter fine pitch devices only one knead stroke is required after 2hour machine down times
- On coarser pitch deposits it is expected that the first print after abandon can in normal circumstances be perfectly acceptable for production quality

0402	0201	01005
		
0.4mm TQFP120	0.5mm CSP56	0.4mm BGA432
		

Operating Parameters – Abandon Stability 22°C/40%RH

Print Process Window (LOCTITE GC 10 SAC305 T4 885V)

- Excellent printing in the range down to 0.18mm round apertures
- Single knead cycle required after 2hr abandon at 0.18mm round apertures



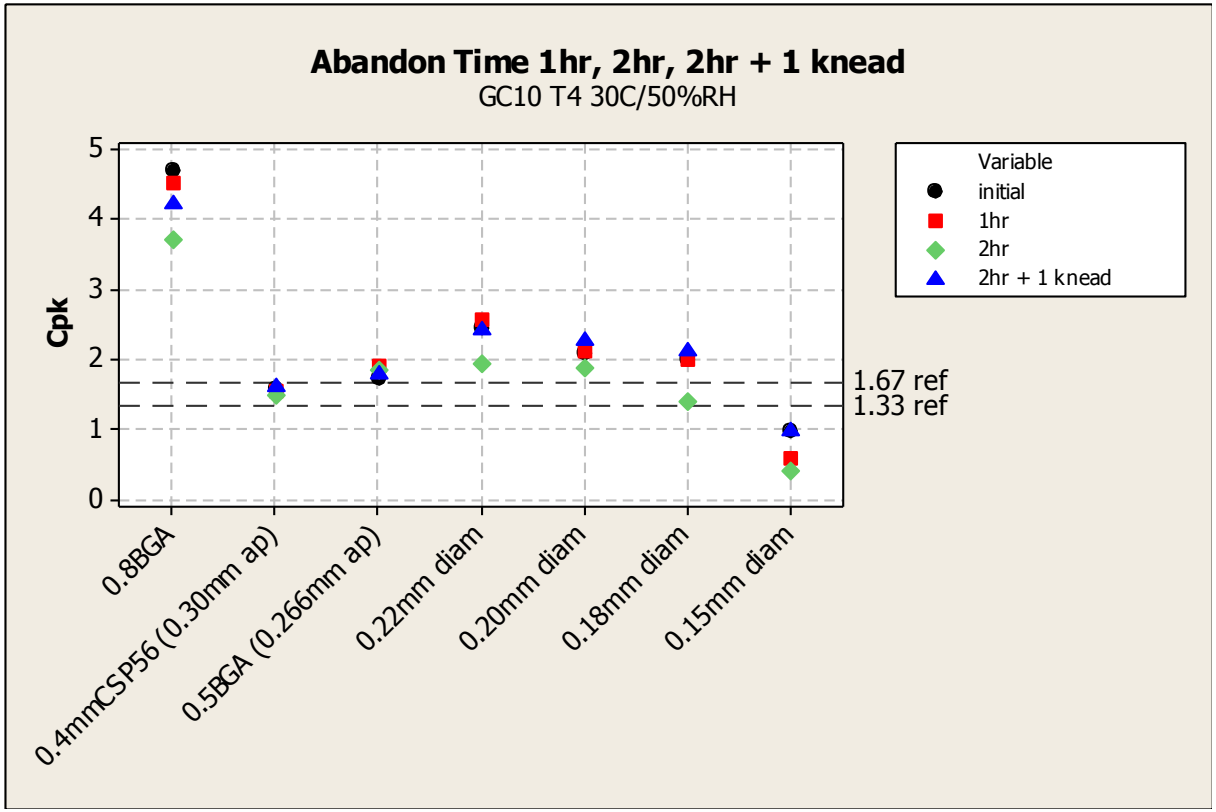
0.8mm BGA – 0.15mm round apertures, (100µm stencil)

100µm stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 8kg

Operating Parameters – Abandon Stability 30°C/50%RH

Print Process Window (LOCTITE GC 10 SAC305 T4 885V)

- Excellent abandon time resistance
- No knead cycle required after 2hrs abandon down to 0.20mm round apertures.
- Single knead stroke required after 2hr abandon at 0.18mm round apertures



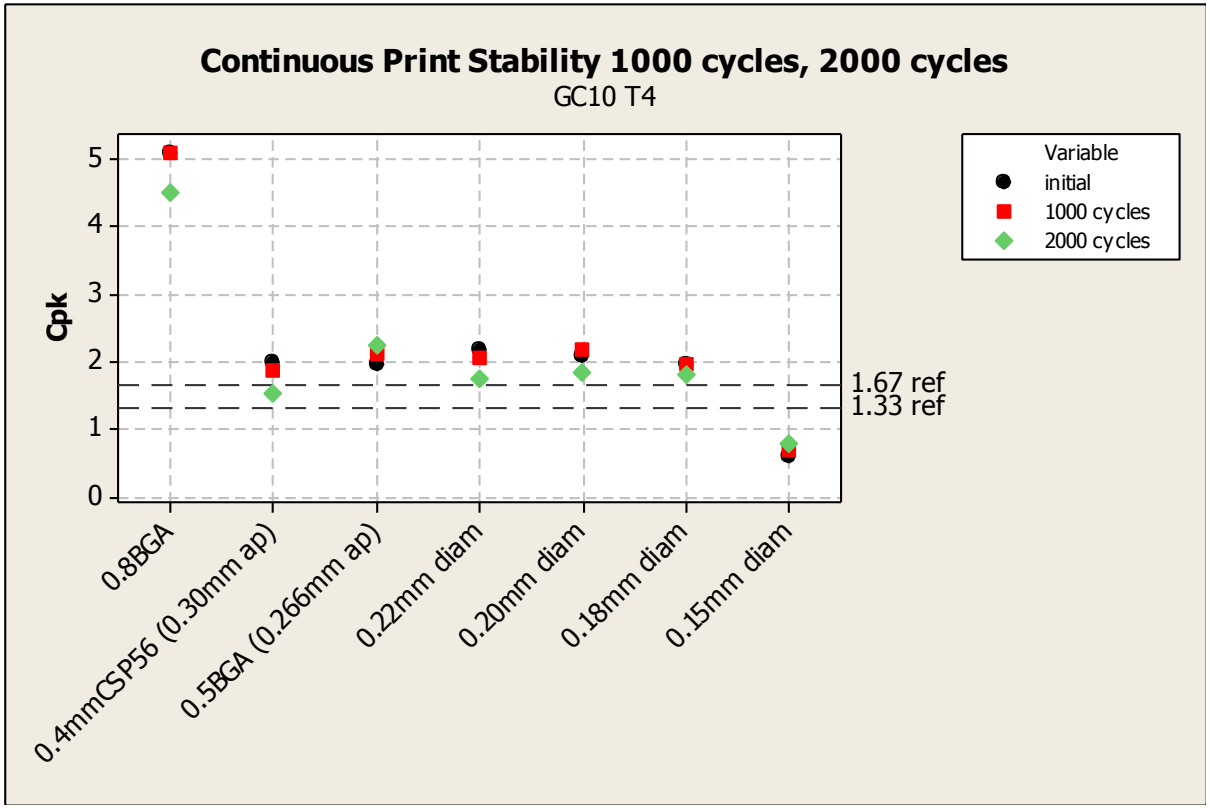
0.8mm BGA – 0.15mm round apertures, (100µm stencil)

100µm stencil thickness,60mm/s, Fast separation, 250mm squeegee, 8kg

Operating Parameters – Continuous Print Stability

Print Process Window (LOCTITE GC 10 SAC305 T4 885V)

- No impact on print performance after 4 hours (1000 cycles) and 8 hours (2000 cycles) printing

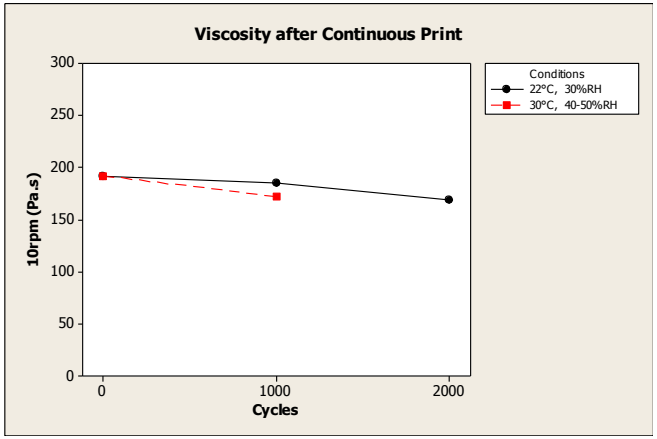


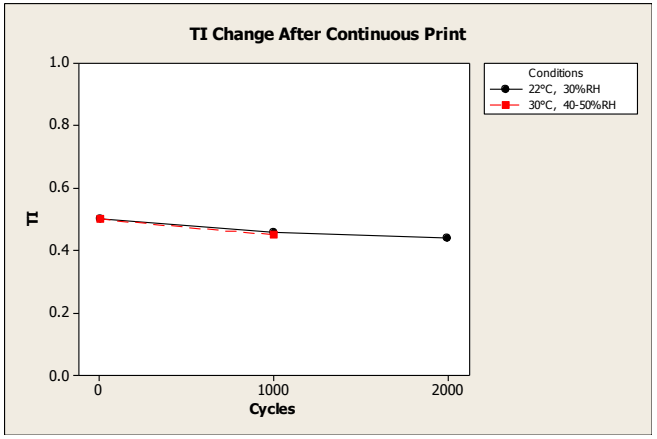
0.8mm BGA – 0.15mm round apertures, (100µm stencil)

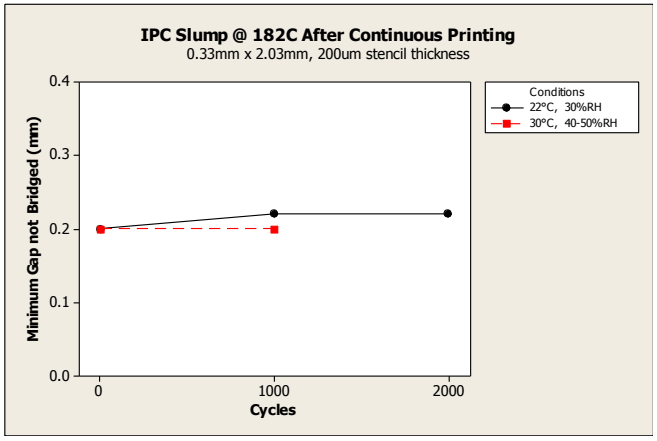
100µm stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 8kg

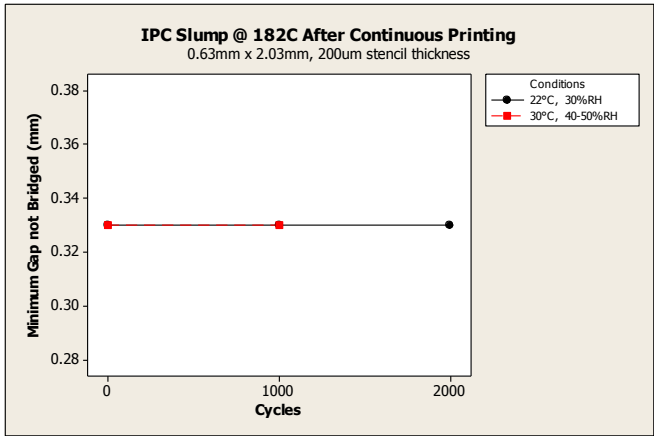
Operating Parameters

Paste Properties After Continuous Printing



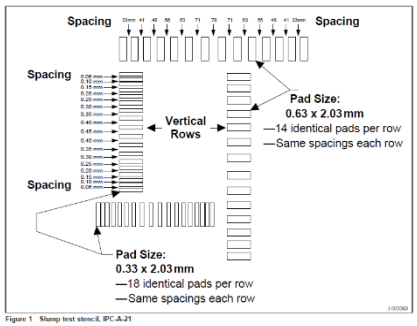


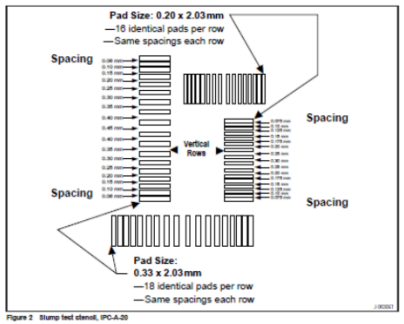


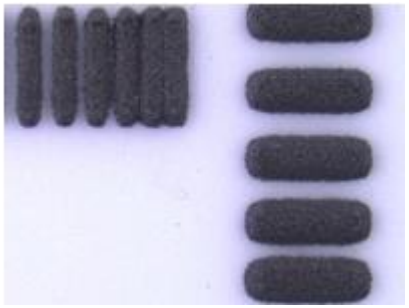


Operating Parameters
Slump

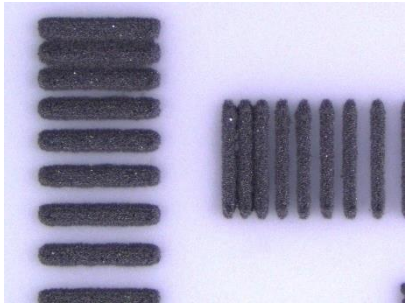
- Slump evaluation was performed in accordance with J-STD-005A, IPC-TM-650 2.4.35
- First spacing with no bridge recorded after 10 minutes at 182°C (35°C below melting point 217°C)







A21
200µm

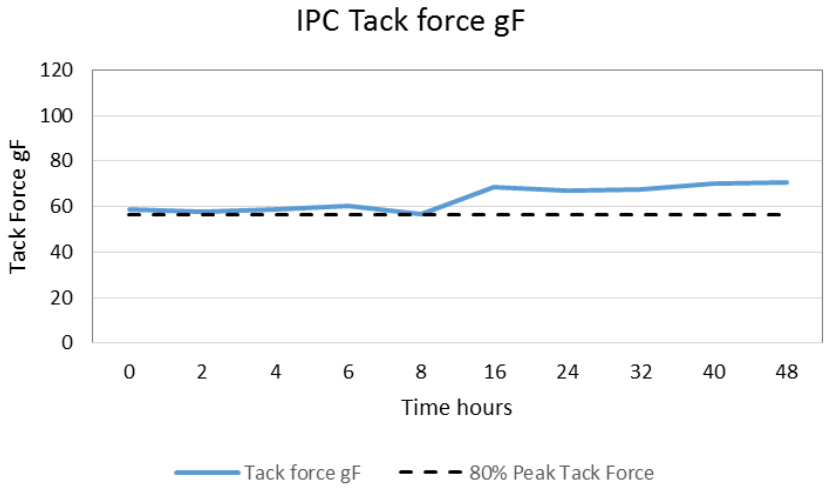


A20
100µm

Stencil Design/ thickness	A 21 200µm		A 20 100µm	
Aperture	0.63 x 2.03mm	0.33 x 2.03mm	0.33 x 2.03mm	0.20 x 2.03mm
Pass mark	0.63mm	0.30mm	0.30mm	0.25mm
GC 10 25°C	0.33mm	0.10mm	0.08mm	0.075mm
GC 10 182°C	0.33mm	0.20mm	0.15mm	0.125mm

Operating Parameters
Tack Force

- Slump Tackiness evaluation was performed in accordance with J-STD-005A, IPC-TM-650 2.4.44
- GC 10 tack-life >48hours



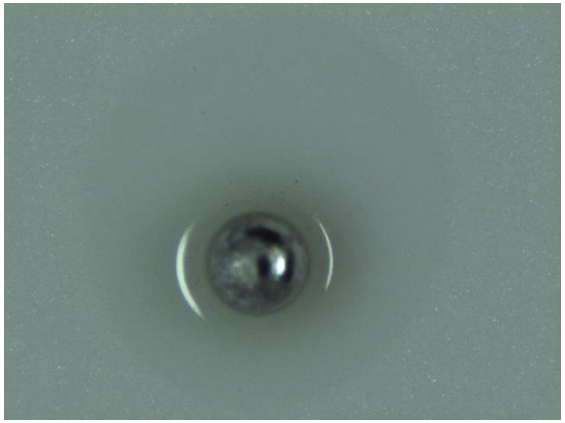
Malcom TK1 Tackiness Tester

Preload	300g
Preload time	5 secs
Retraction Speed	2.5mm/sec
Deposit diameter	5.1mm
Deposit height	0.25mm

Operating Parameters
Solder Balling

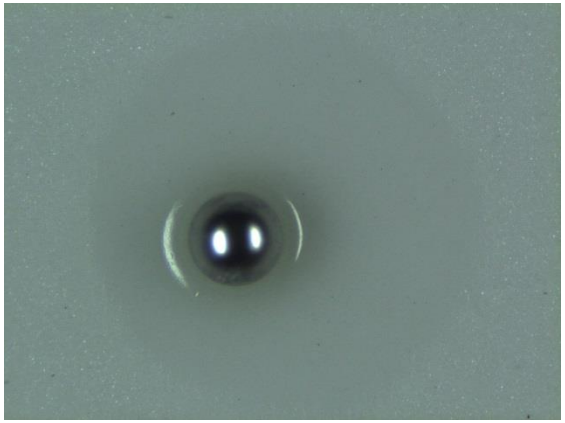
- Solder balling performance as been assessed in accordance with an extended version of IPC-TM-650 2.4.4.3
- Clear and colourless residues observed post-reflow

Initial



Preferred Pass

24hrs 25°C 50% RH

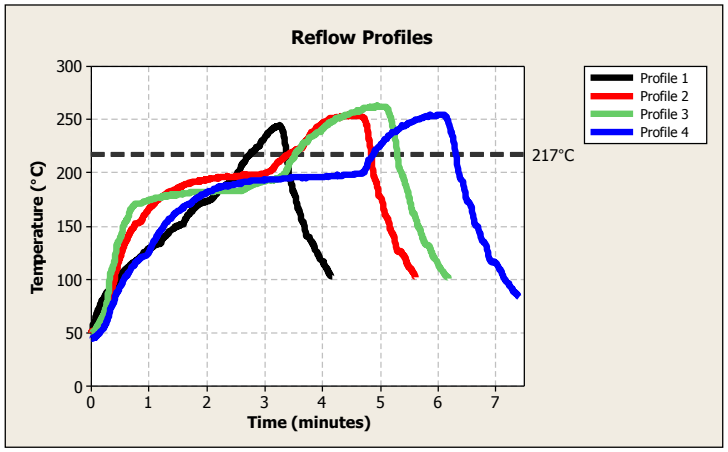


Preferred Pass

Operating Parameters

Reflow Process Window (Air)

- LOCTITE GC 10 solder paste offers halogen containing reflow performance in a truly halogen free formulation
- GC 10 shows excellent coalescence onto a range of PCB and component finishes especially during long-hot profiles
- There is no single profile that works for all applications and each process should be assessed individually, under laboratory conditions the following profiles have been found to give good results
- These process window guidelines are suitable for Type 4 SAC powder



Profile	1	2	3	4
Peak Temp (°C)	244	254	260	255
Time to Peak (min)	3.3	4.5	5.1	6.0
Soak Time (150-200°C) (min)	(No Soak) 1.0	2.35	2.80	3.44
Time above Liquidus (min)	0.62	1.46	1.75	1.45
Time above Liquidus (sec)	37.2	87.6	105.0	87.0

Operating Parameters (Reflow)

	Reflow Profile			
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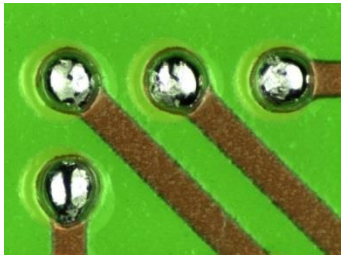
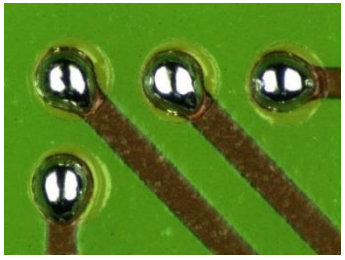
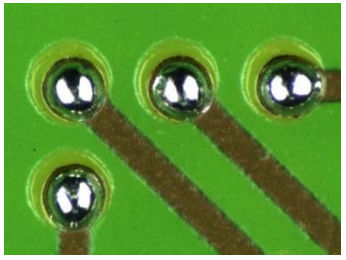
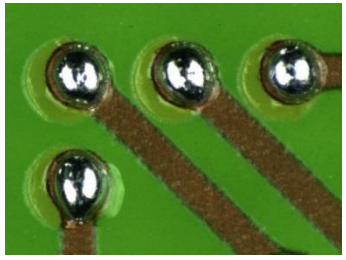
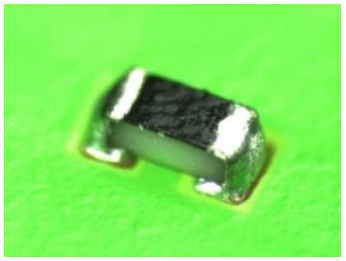
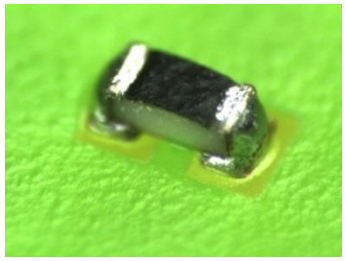
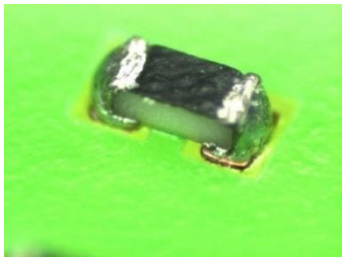
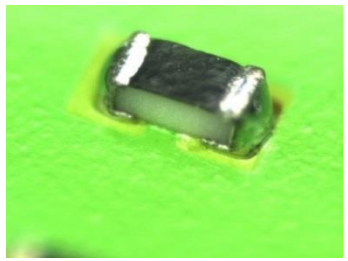
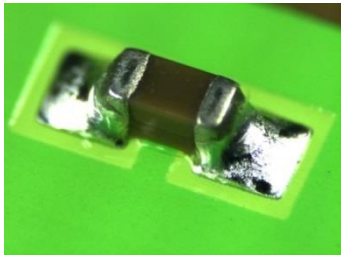
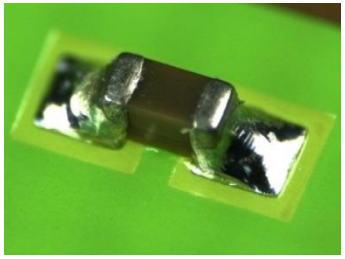
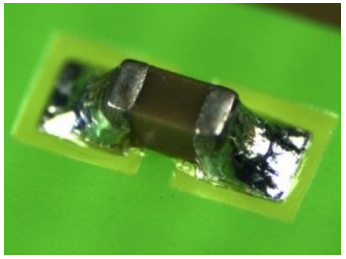
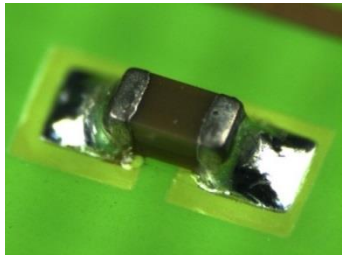
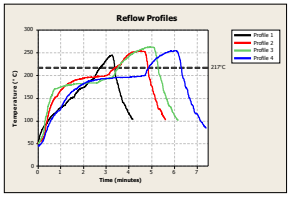
0.5mm CSP56				
0201				
0402				



Operating Parameters (Reflow)

	Reflow Profile			
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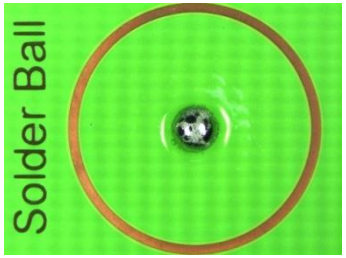
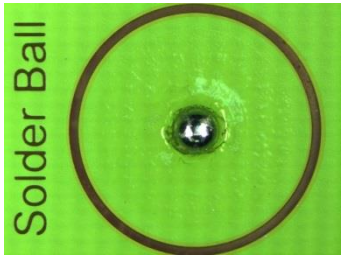
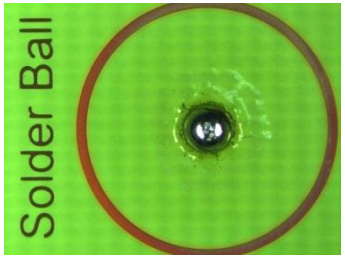
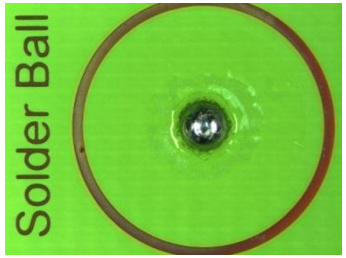
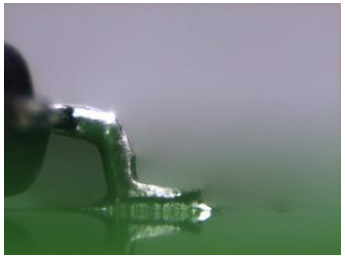
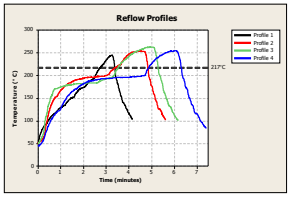
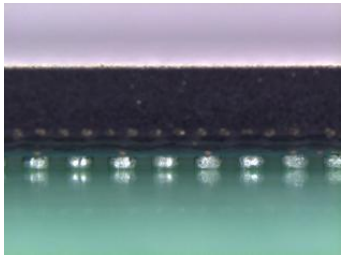
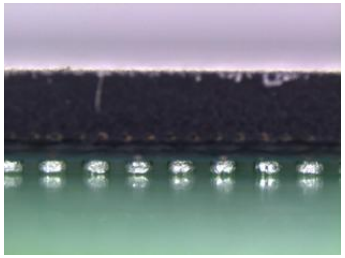
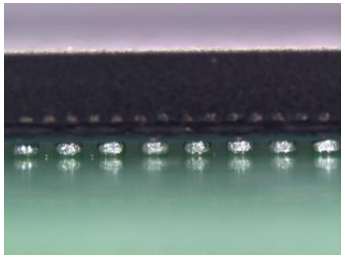
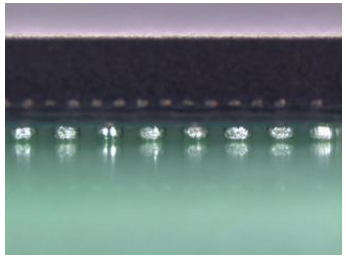
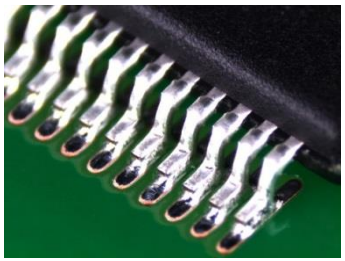
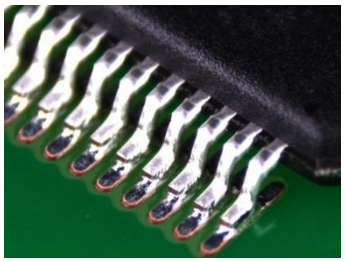
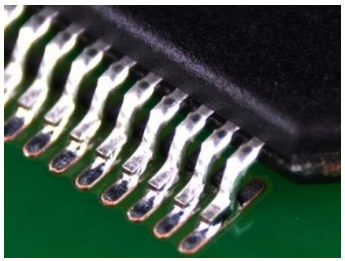
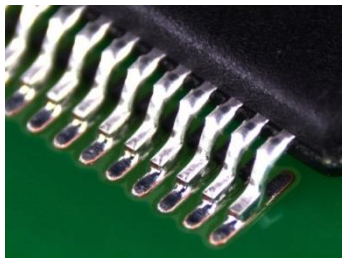
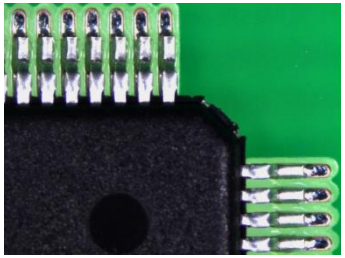
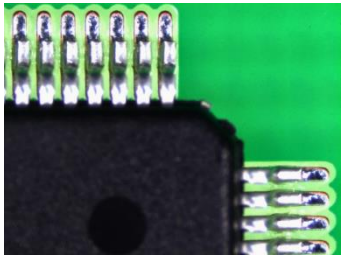
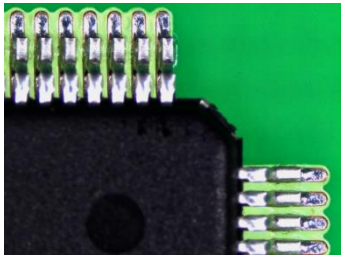
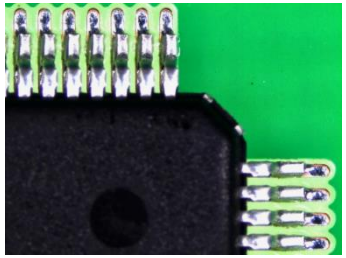
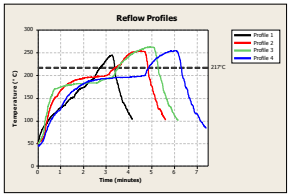
Overprinted				
0.4mm TQFP120				
0.4mm TQFP120				

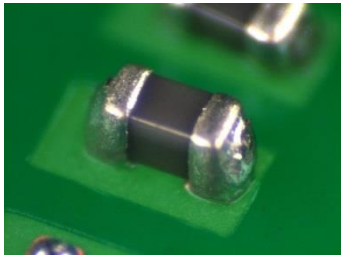
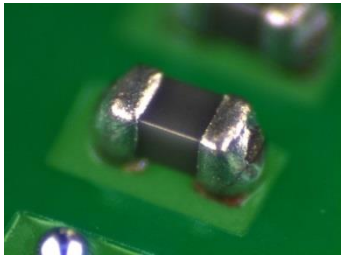
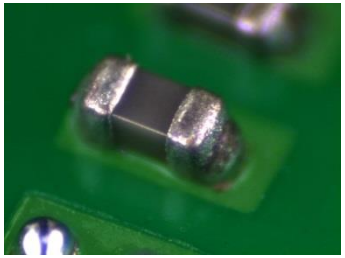
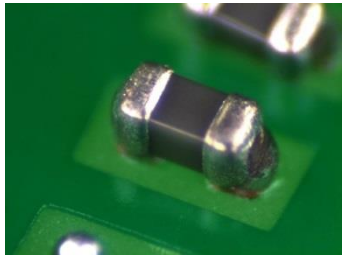
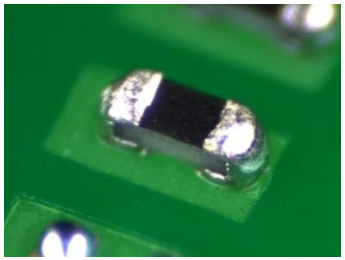
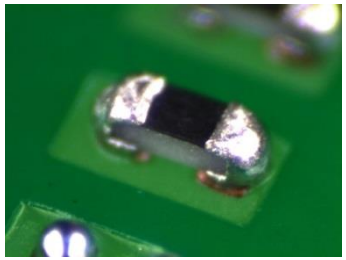
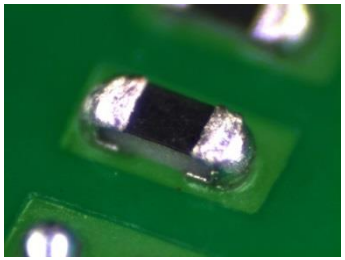
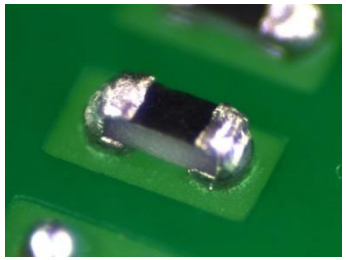


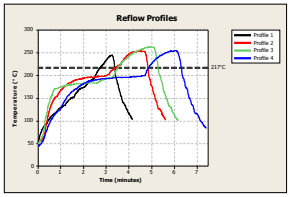
Operating Parameters (Reflow)

	Reflow Profile			
	1	2	3	4
0.5mm CSP56				
0.4mm TQFP120				
0.4mm TQFP120				



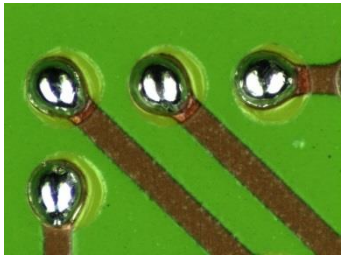
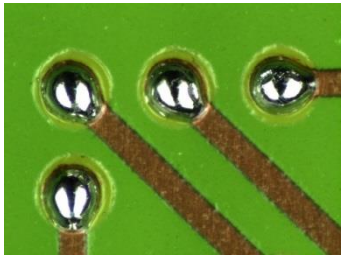
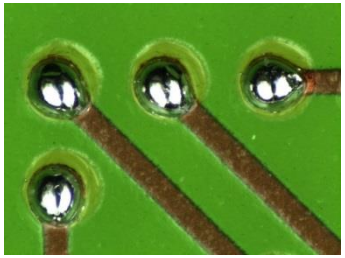
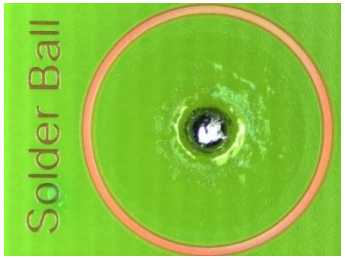
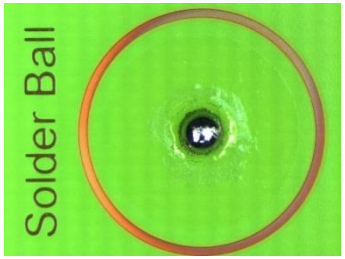
Operating Parameters (Reflow)

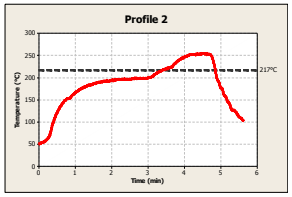
	Reflow Profile			
	1	2	3	4
01005 Capacitors				
01005 Resistors				



Operating Parameters (Reflow)

Paste Properties After Continuous Printing

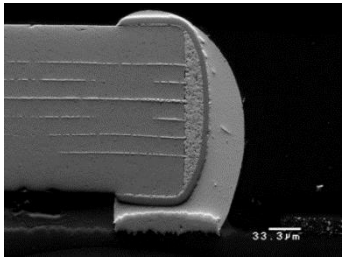
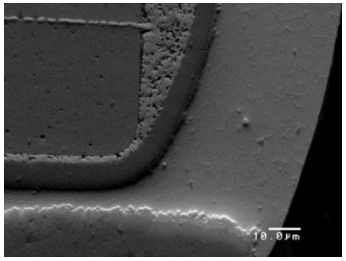
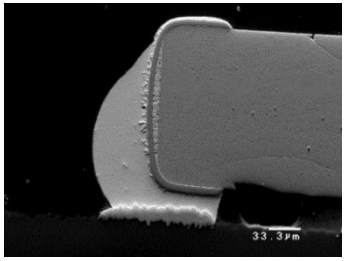
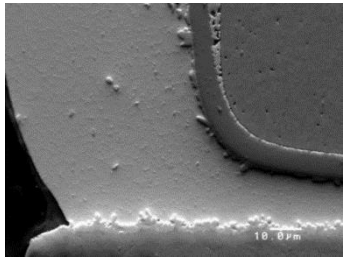
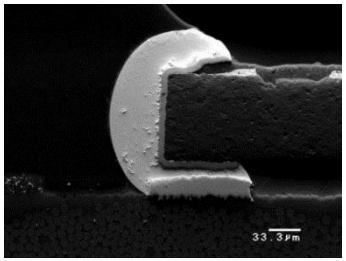
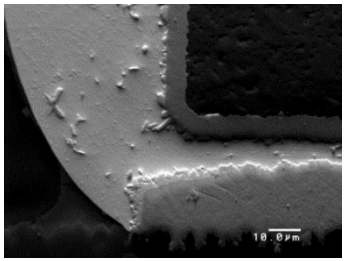
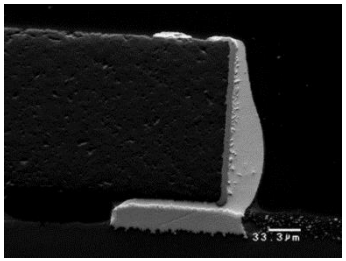
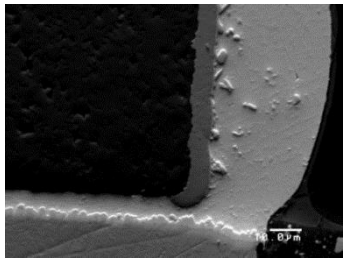
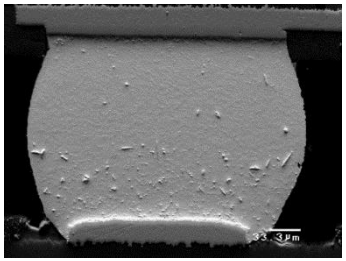
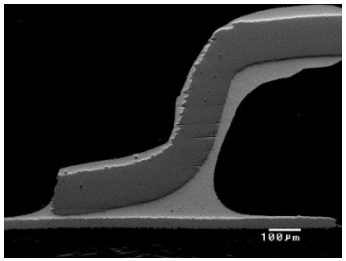
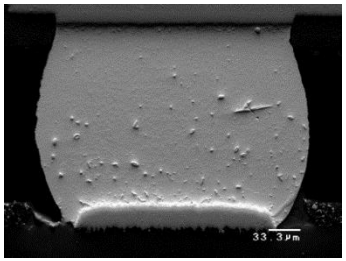
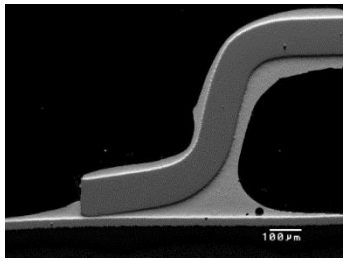
	1,000 cycles 22°C, 30%RH	2,000 cycles 22°C, 30%RH	1,000 cycles 30°C, 40-50%RH
0.5mm CSP			
6.5mm Overprint			

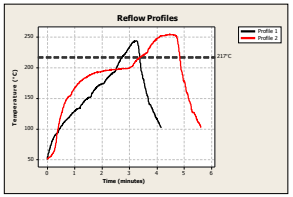


- No change to reflow performance after 8hours printing (2000 print cycles)

Operating Parameters (Reflow – GC10)

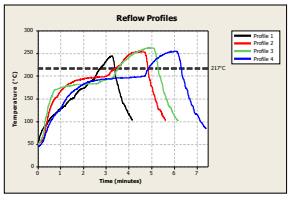
Reflow Profile

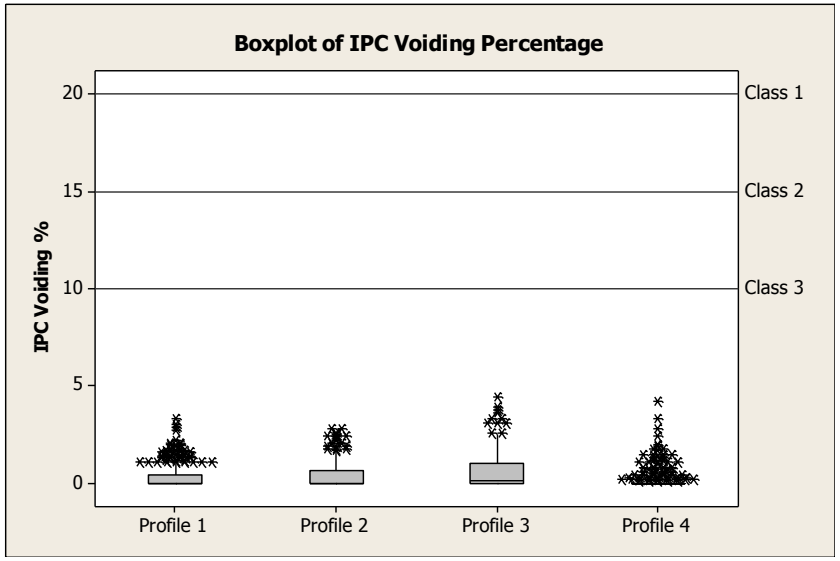
	1	2
01005 Resistors	 	 
01005 Resistors	 	 
0.5mm CSP & 0.4mm QFP	 	 

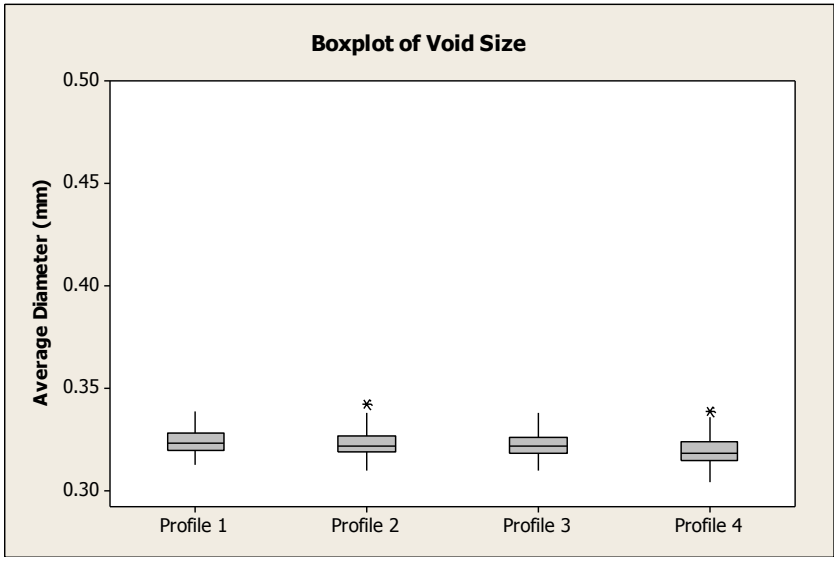


Operating Parameters
Voiding

- Void performance assessed using 4 different reflow profiles
- GC 10 shows low levels of voiding over a range of profiles
- Void Percentage analysed in accordance with IPC7095B



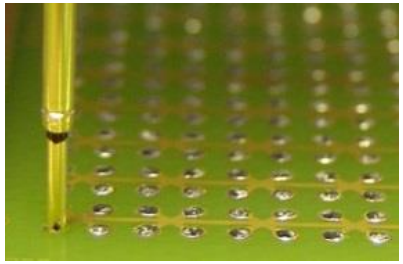
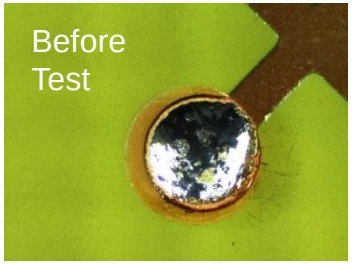
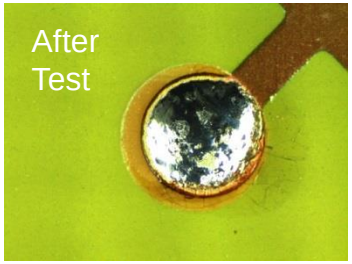


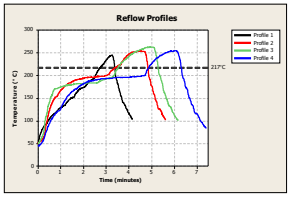


GC 10 meets IPC7095B class 3

Operating Parameters

Pin Testing

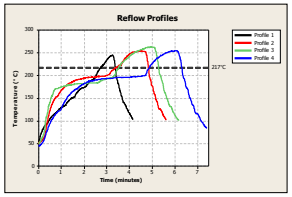
Board	  
Stencil	100μm
Pads	500 pads per board, 2 boards tested
Probe	0.9mm 4 point plain crown light spring probe 100g spring force
Profiles	4 reflow profiles
No. of reflow	1, 2, 3 & 4 passes through oven
Atmosphere	Air & 1000ppm O_2
Time after reflow	1 day, 1 week



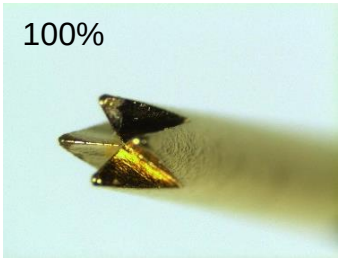
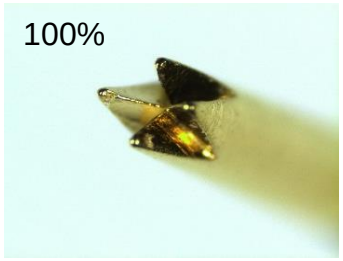
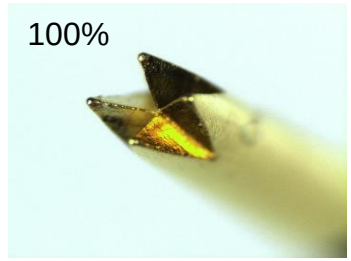
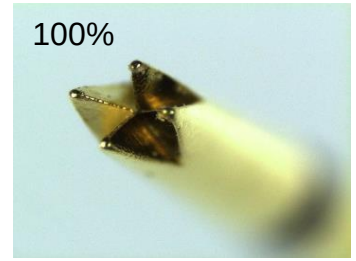
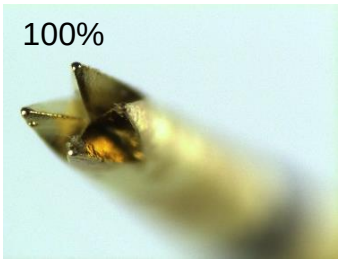
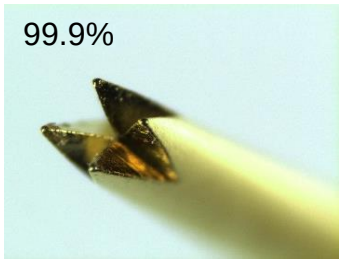
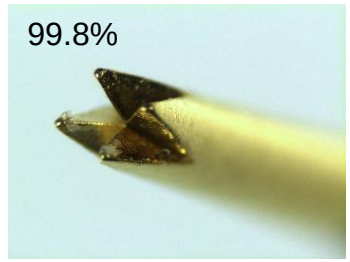
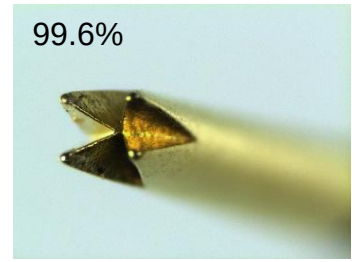
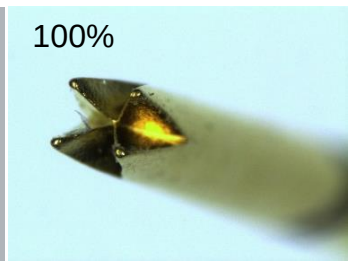
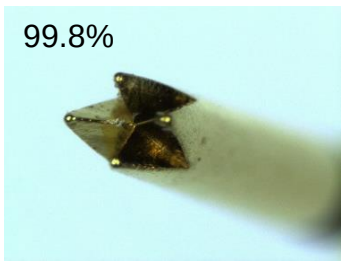
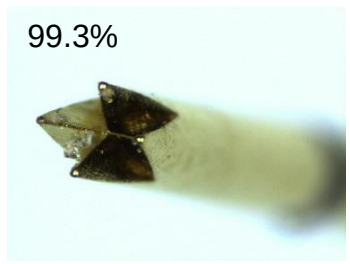
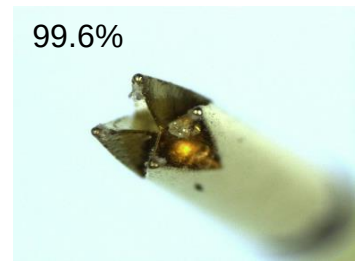
Operating Parameters

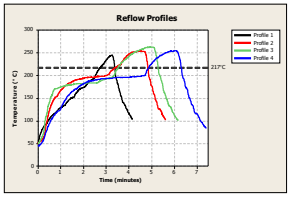
Pin Testing

	Reflow Profile (% after 1000 tests)			
	1	2	3	4
1 reflow	100%	100%	100%	99.5%
2 reflows	100%	100%	99.6%	99.9%
3 reflows	99.9%	100%	100%	98.9%
4 reflows	99.9%	100%	100%	98.5%



Operating Parameters
Pin Testing

	Reflow Profile (% after 1000 tests)			
	1	2	3	4
Reflowed in N2	100% 	100% 	100% 	100% 
1 day after reflow	100% 	99.9% 	99.8% 	99.6% 
1 week after reflow	100% 	99.8% 	99.3% 	99.6% 



Operating Parameters
Surface Finish

Reflow Profile (0.5mm CSP56)

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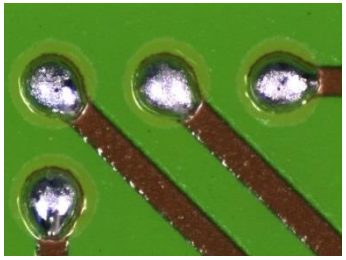
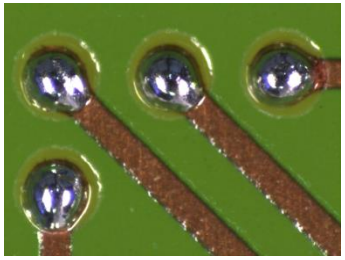
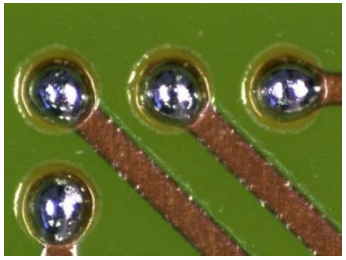
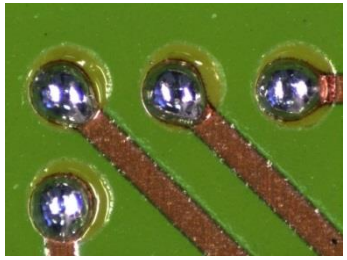
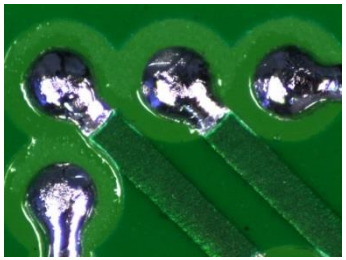
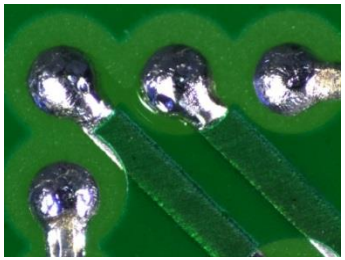
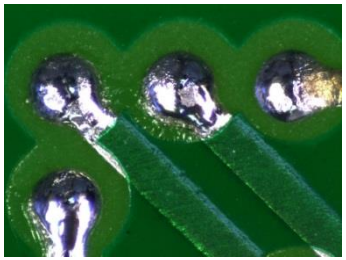
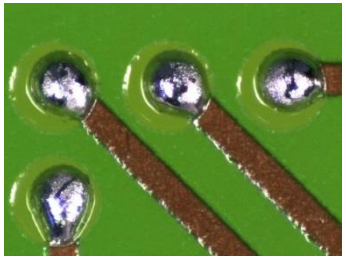
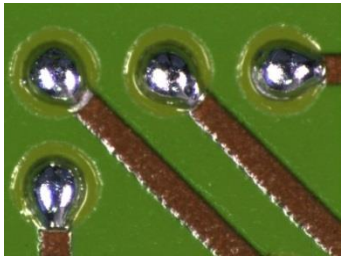
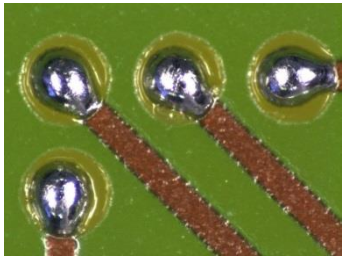
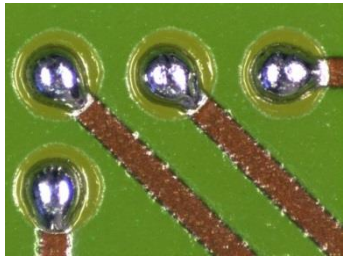
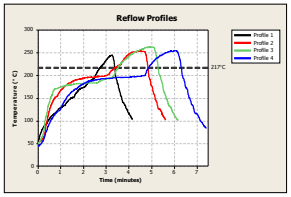
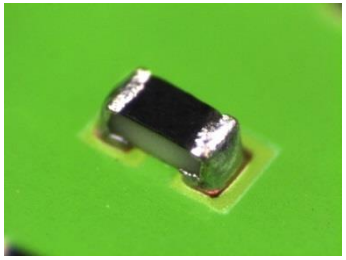
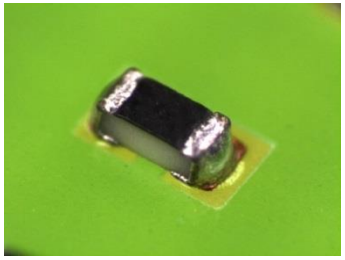
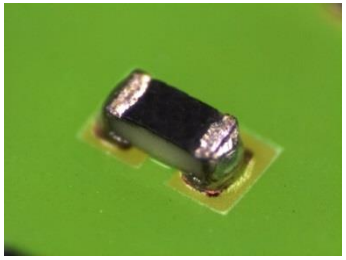
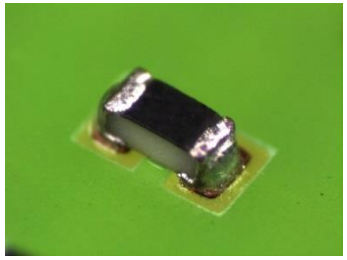
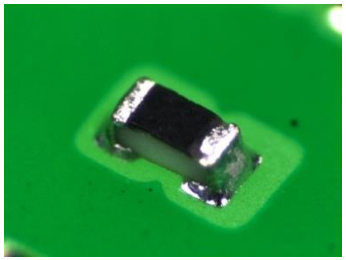
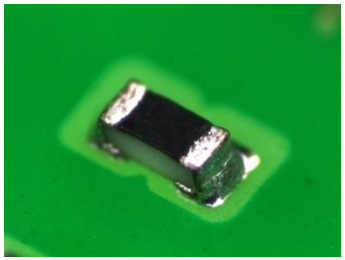
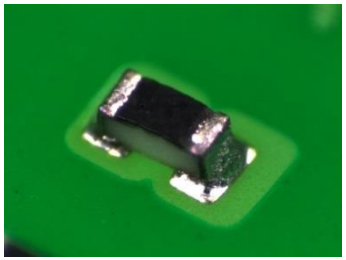
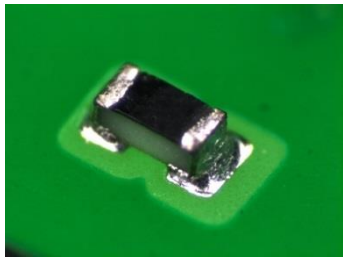
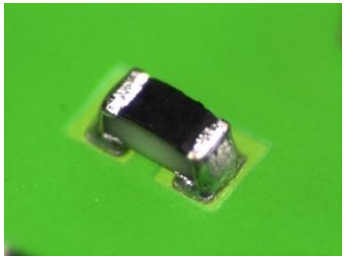
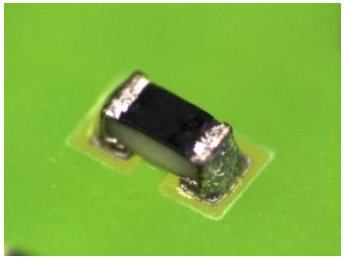
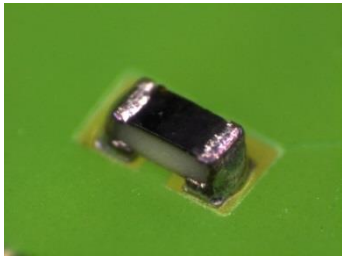
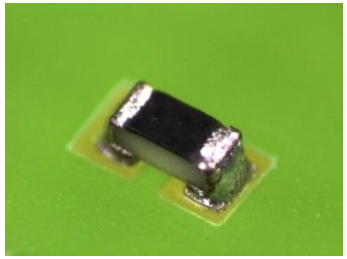
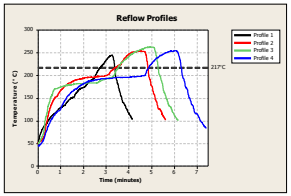
OSP Finish				
Silver Finish				
Tin Finish				

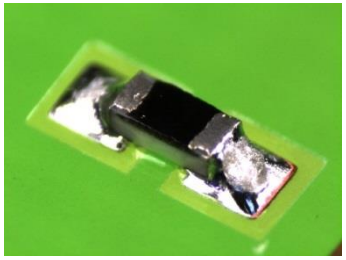
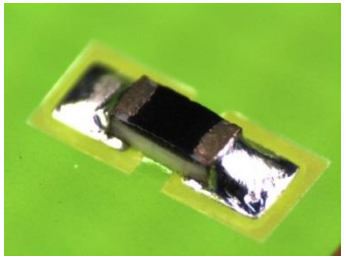
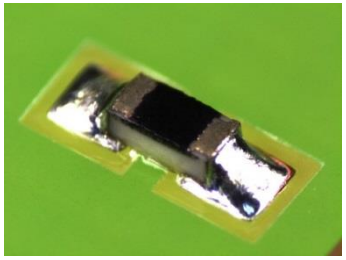
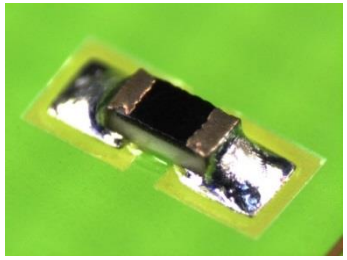
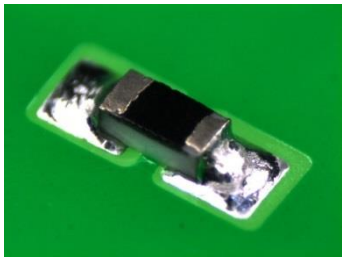
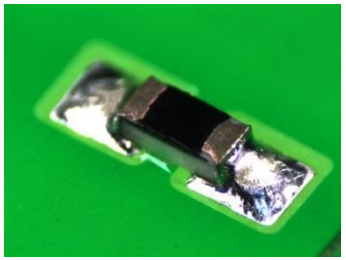
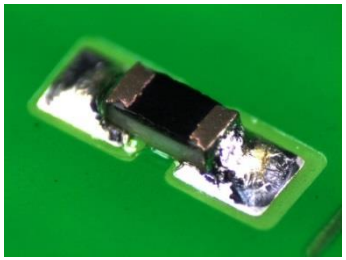
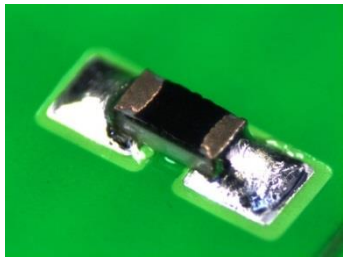
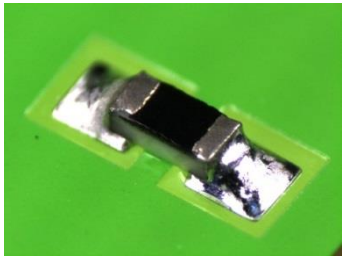
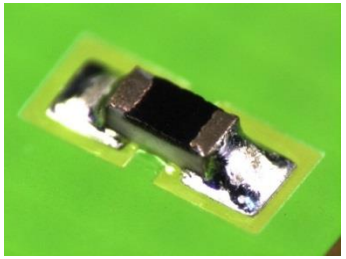
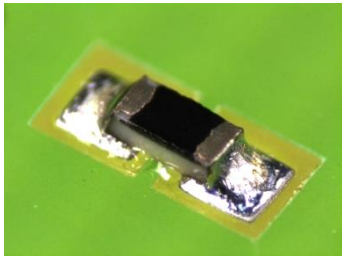
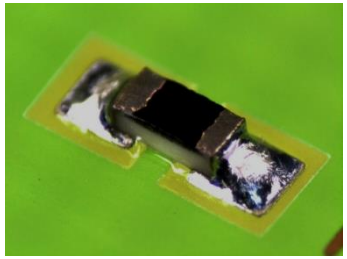


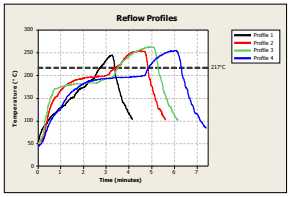
Operating Parameters
Surface Finish

Reflow Profile (0201)	1	2	3	4
OSP Finish				
Silver Finish				
Tin Finish				



Operating Parameters
Surface Finish

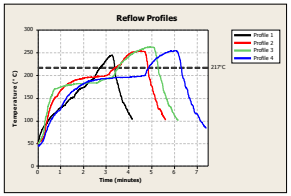
	Reflow Profile (0402)			
	1	2	3	4
OSP Finish				
Silver Finish				
Tin Finish				



Operating Parameters

Surface Finish

Reflow Profile (6.5mm overprint)

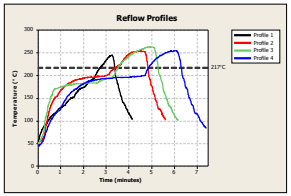


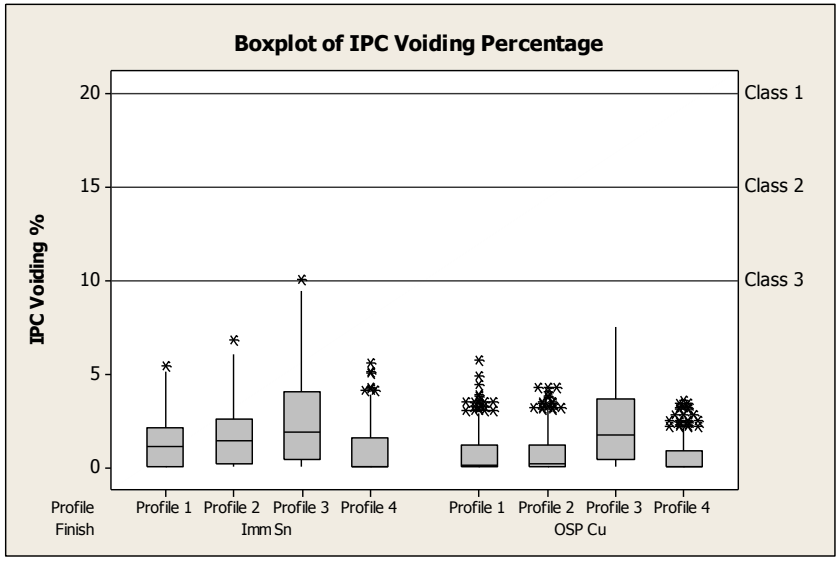
	1	2	3	4
OSP Finish	Solder Ball	Solder Ball	Solder Ball	Solder Ball
Silver Finish	Solder Ball	Solder Ball	Solder Ball	Solder Ball
Tin Finish	Solder Ball	Solder Ball	Solder Ball	Solder Ball

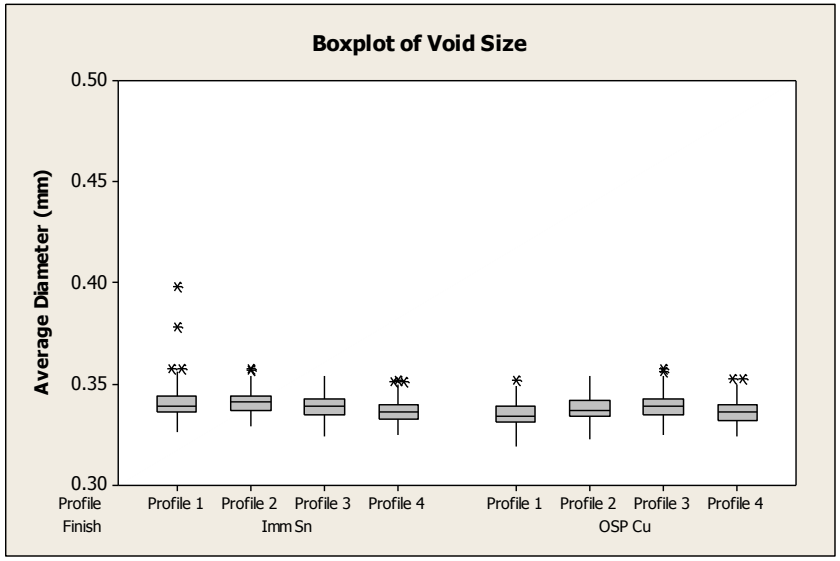
Operating Parameters

Voiding Different Surface Finishes 0.5mm CSP56

- Void performance on OSP Cu and Immersion Sn surface finishes assessed using 4 different reflow profiles







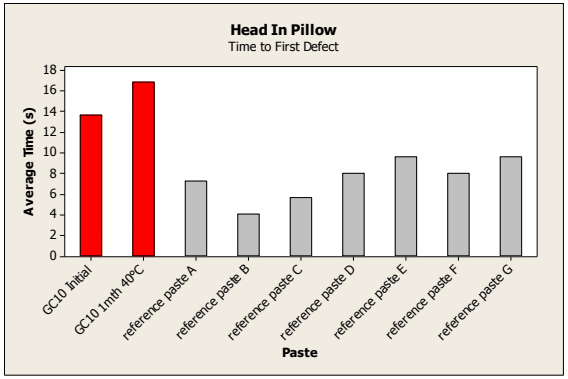
GC 10 meets IPC7095B class 3

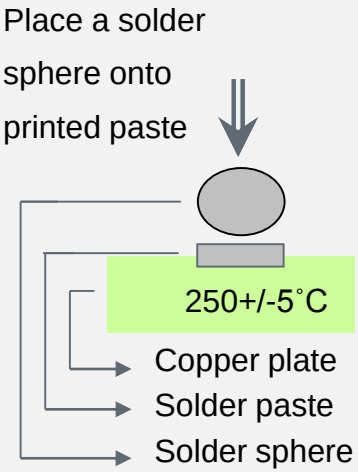
Contents

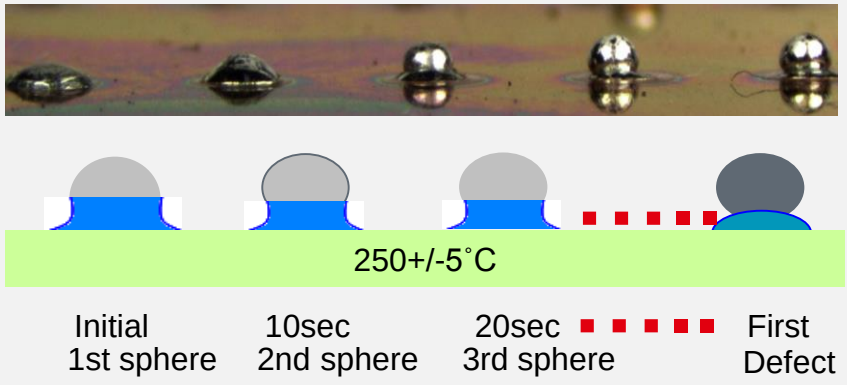
Reliability and Specification Testing

Head- in Pillow Test

- Print solder paste on a Cu plate, 0402 pad, stencil thickness 125□m.
- When the solder paste starts to melt, place a solder sphere (SAC305, 0.76mm diameter) on the printed solder paste
- Place another sphere after 3sec, 6 sec, 9sec… until the solder sphere no-longer coalesces

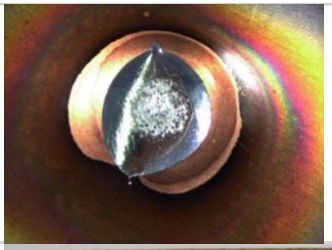






Reliability and Specification Testing

Head- in Pillow Test

Standard	Test	Result	
ANSI/ J-STD-004B	Cu Corrosion	Pass	
	Cu Mirror	Pass	
	Halogen	Pass	(no added halogen)
	Surface Insulation Resistance	Pass	6.0×10^{11} Ohms after 7days
	Electromigration	Pass	5.0×10^{10} Ohms after 21days

GC 10 J-STD-004B classification ROL0

Reliability and Specification Testing

3rd Party Testing

- SGS report for GC 10
- Sample reflowed flux residue
- Reference EN14582/IC Analysis
- To meet halogen free requirements
- Br<900ppm, Cl <900ppm, and combined <1500ppm

- Halogen – Fluorine - ND
- Halogen – Chorine - ND
- Halogen – Bromine – ND
- Halogen – Iodine – ND

SGS

Test Report No. : CE/2014/A1492 Date : 2014/10/14 Page: 2 of 4

HENKEL CORPORATION
14000 JAMBOREE ROAD, IRVINE, CALIFORNIA, 92606 U.S.A.

Test Result(s)

PART NAME No.1 : YELLOW PASTE

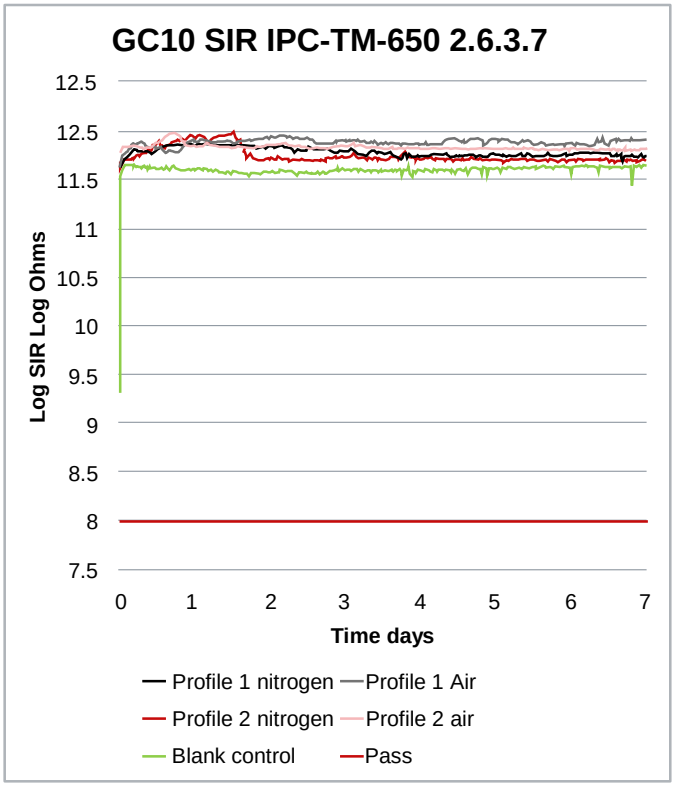
Test Item(s)	Unit	Method	MDL	Result No.1
Halogen				
Halogen-Fluorine (F) (CAS No.: 14762-94-8)	mg/kg	With reference to BS EN 14582:2007. Analysis was performed by IC.	50	n.d.
Halogen-Chlorine (Cl) (CAS No.: 22537-15-1)			50	n.d.
Halogen-Bromine (Br) (CAS No.: 10097-32-2)			50	n.d.
Halogen-Iodine (I) (CAS No.: 14362-44-8)			50	n.d.

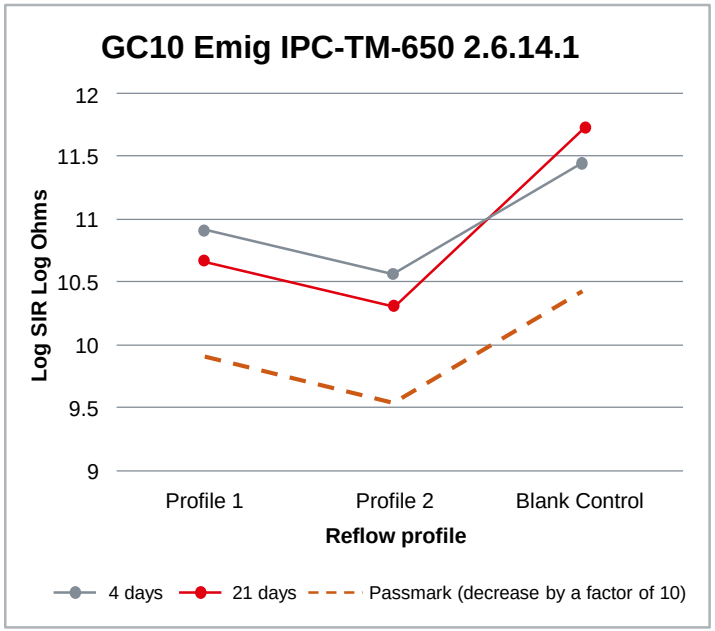
Note :
1. mg/kg = ppm; 0.1wt% = 1000ppm
2. n.d. = Not Detected
3. MDL = Method Detection Limit

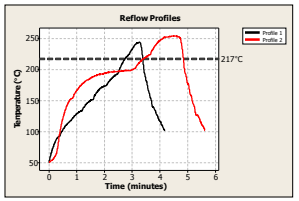
GC 10 has no detectable halogen and is designated as halogen free

Reliability and Specification Testing

IPC J-STD 004B





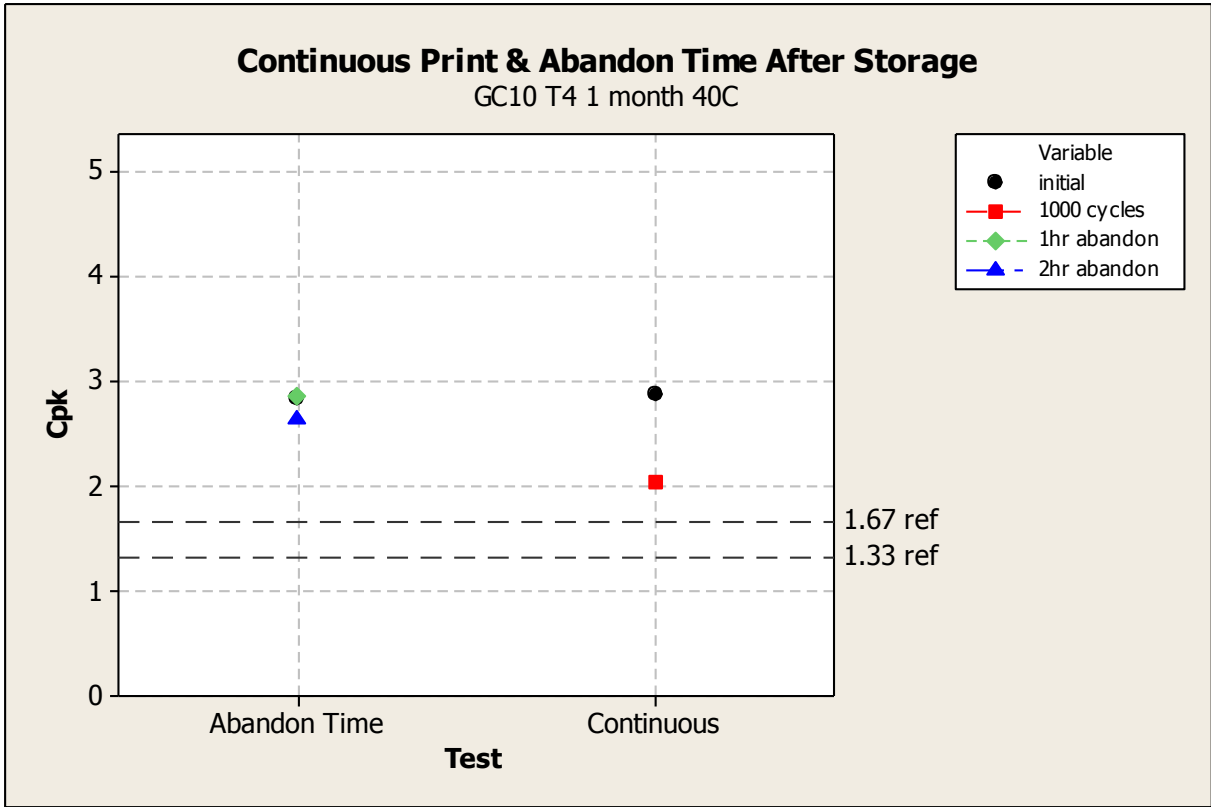


Contents

Operating Parameters: Storage

Printing After Storage 1month 40°C

- Excellent print capability after storage for 1 month @ 40°C
- No knead cycle required after 2hrs abandon down to 0.20mm round apertures

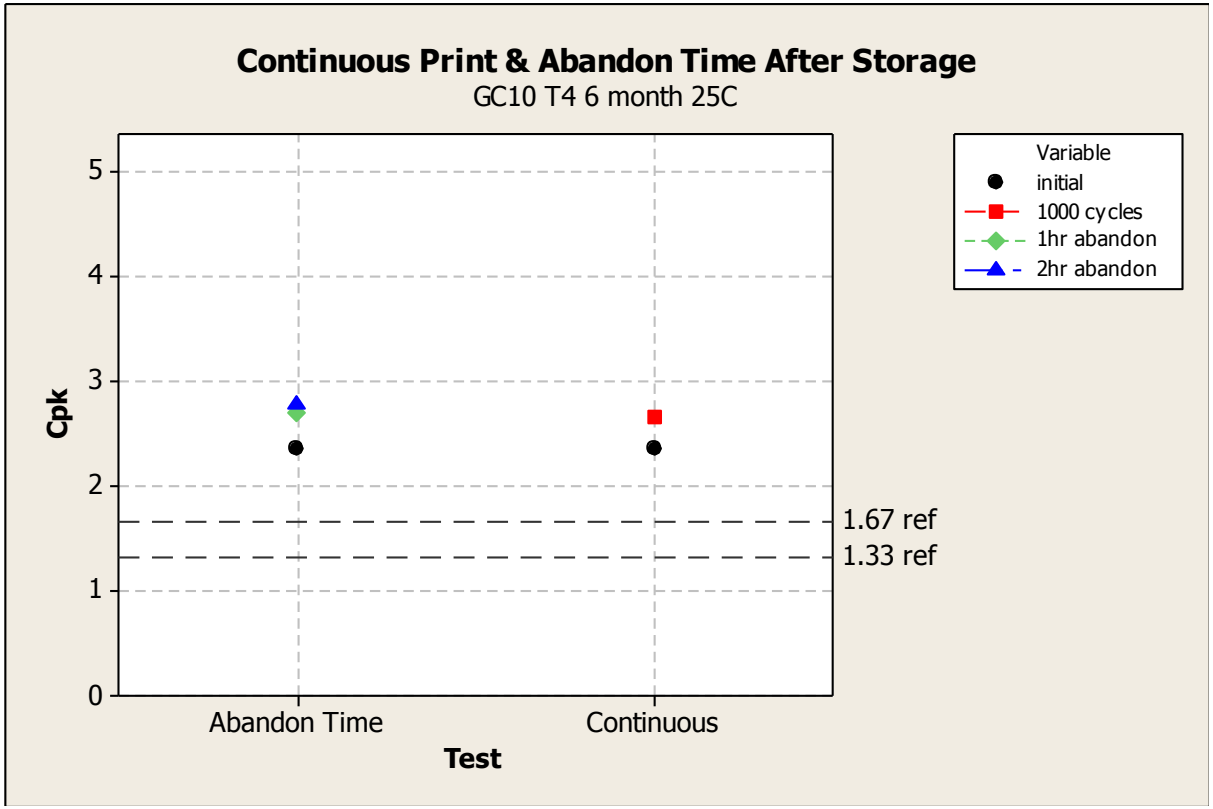


0.4mm BGA ,100µm stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 8kg

Operating Parameters: Storage

Printing After Storage 6months 25°C

- Excellent print capability after storage for 6 months @ 25°C
- No knead cycle required after 2hrs abandon down to 0.20mm round apertures

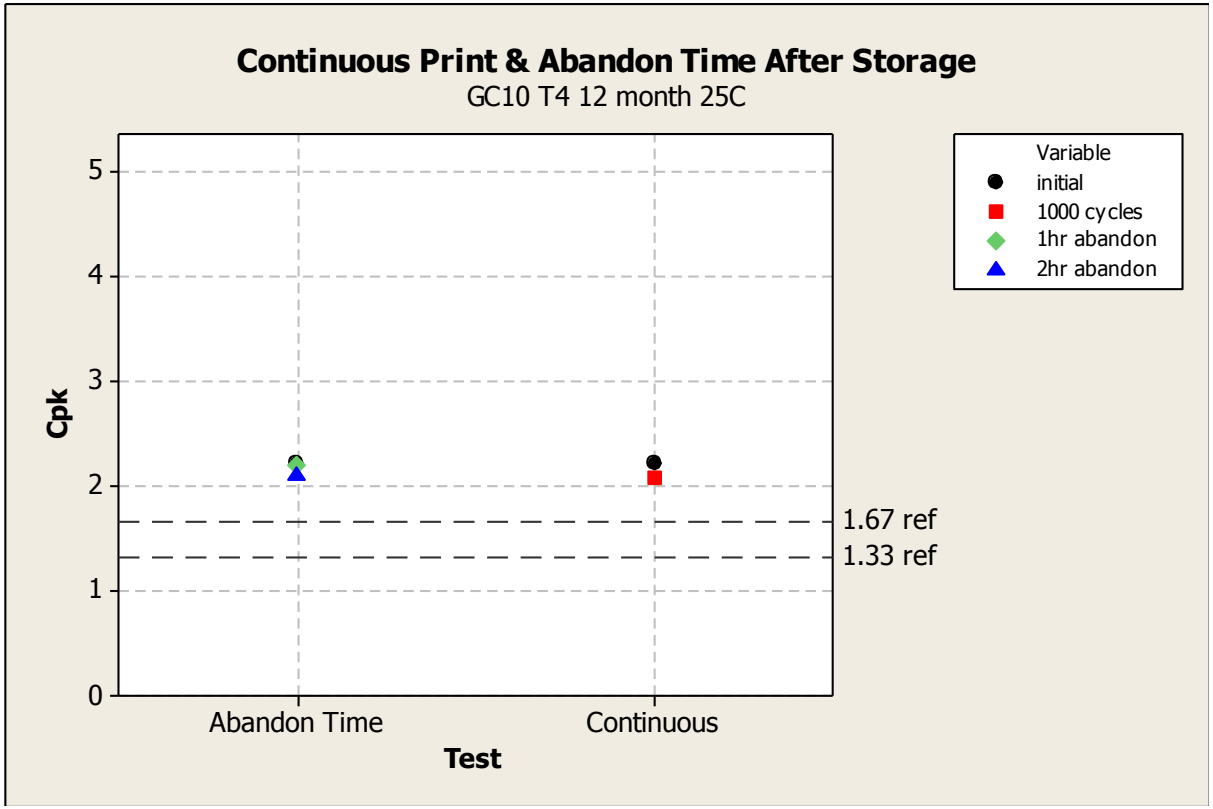


0.4mm BGA ,100µm stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 8kg

Operating Parameters: Storage

Printing After Storage 12months 25°C

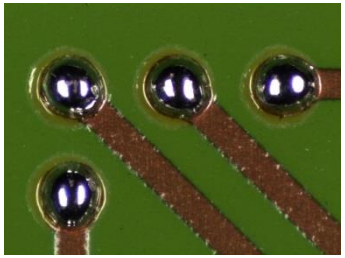
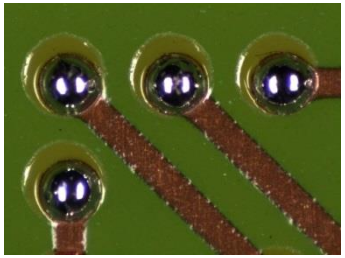
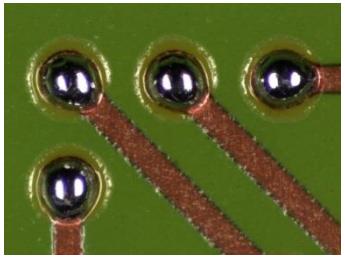
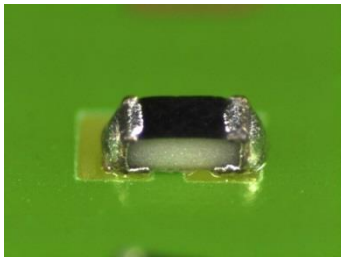
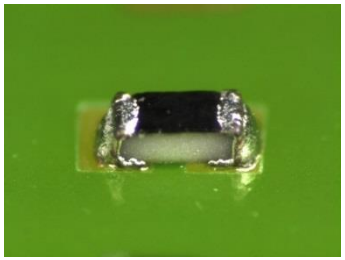
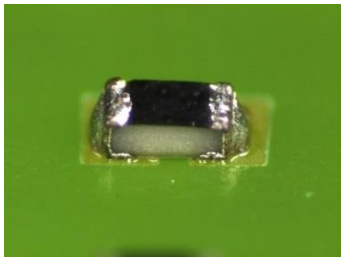
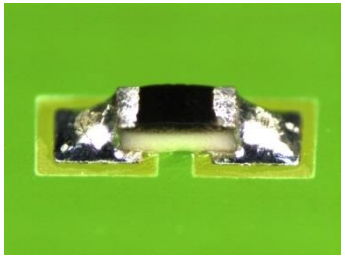
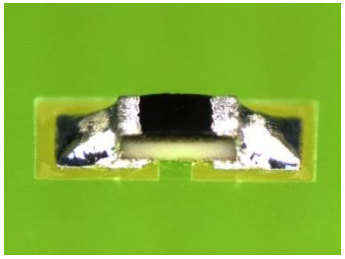
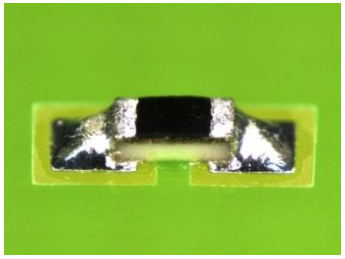
- Excellent print capability after storage for 12 months @ 25°C
- No knead cycle required after 2hrs abandon down to 0.20mm round apertures

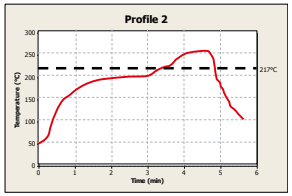


0.4mm BGA ,100µm stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 8kg

Operating Parameters: Storage

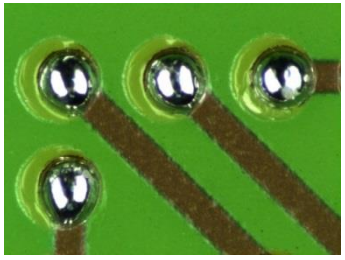
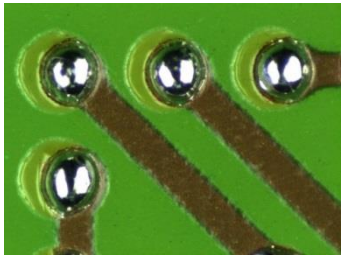
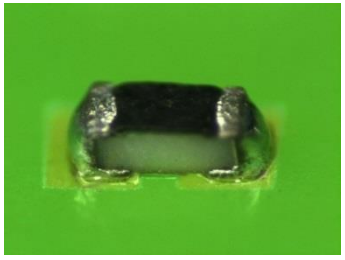
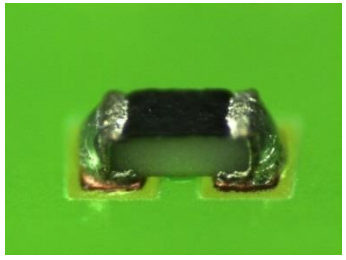
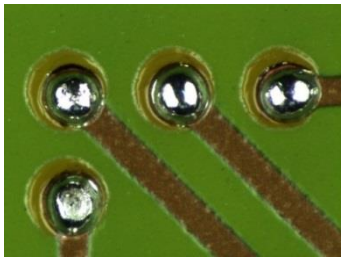
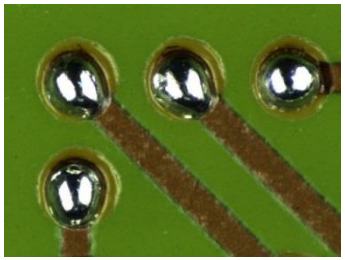
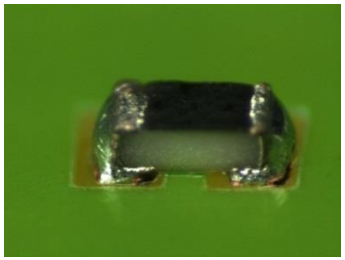
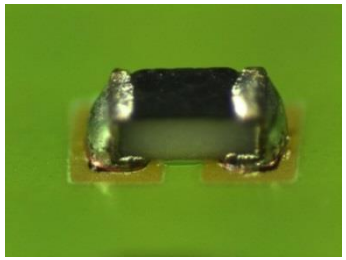
After Paste storage

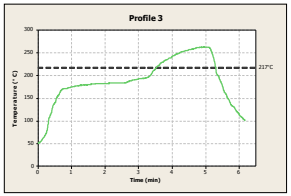
	Initial	1m 40°C	6m 25°C
0.5mm CSP			
0201			
0402			



Operating Parameters: Storage

After storage and 2nd side/pre-reflow

	0.5mmCSP		0201	
	Initial	1 Month 40°C	Initial	1 Month 40°C
Fresh PCB				
Pre-reflowed PCB				



Contents

GC 10: Performance Summary

Flux

- Halogen-free flux: passes IC with pretreatment IPC-TM-650 2.3.34/EN14582
- Halogen-free flux classification: ANSI/J-STD-004 Rev. B for a type ROL0 classification

Paste

- Suitable for fine pitch, high speed printing up to 125mm/s (5”/s)
- Optimized for long hot soak reflow profiles
- Excellent fine pitch coalescence in air & nitrogen atmosphere
- Excellent humidity resistance
- Excellent solderability on challenging surface finishes, including CuNiZn
- Colorless residues for easy post-reflow inspection
- Long 12month shelf-life when stored below 26.5°C

Thank you!

LOCTITE®

Henkel Excellence is our Passion