

Engineering Manual

LOCTITE GC 10 T3 Solder Paste

Suitable for use with: Standard SAC Alloys



LOCTITE[®]

GC 10 – The Game Changer



Excellence is our Passion

Contents

1. Performance Summary
2. Introduction: Properties, Features & Benefits
3. Operating Parameters
 - Printing: Process Window
 - Printing: Continuous and Abandon Time Testing
 - Slump Testing
 - Tack-Life Force
 - Reflow Process Window
 - Reflow Performance Testing
 - Voiding Data
4. Reliability and Specification Testing
5. Operating Parameters: Storage
 - Printing & Reflow Performance
6. Product Summary

Contents

1. Performance Summary

2. Introduction: Properties, Features & Benefits

3. Operating Parameters

- Printing: Process Window
- Printing: Continuous and Abandon Time Testing
- Slump Testing
- Tack-Life Force
- Reflow Process Window
- Reflow Performance Testing
- Voiding Data

4. Reliability and Specification Testing

5. Operating Parameters: Storage

- Printing & Reflow Performance

6. Product Summary

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 printing up to 125mm/s (5"/s)
- Optimized for long hot soak reflow profiles
- Excellent coalescence in air & nitrogen atmosphere
- Excellent humidity resistance
- Excellent solderability on challenging surface finishes, including CuNiZn
- Colourless residues for easy post-reflow inspection
- Long 12 month shelf-life when stored below 25°C

Contents

1. Performance Summary
- 2. Introduction: Properties, Features & Benefits**
3. Operating Parameters
 - Printing: Process Window
 - Printing: Continuous and Abandon Time Testing
 - Slump Testing
 - Tack-Life Force
 - Reflow Process Window
 - Reflow Performance Testing
 - Voiding Data
4. Reliability and Specification Testing
5. Operating Parameters: Storage
 - Printing & Reflow Performance
6. Product Summary

Introduction

Basic Solder Paste Properties



Flux Description	GC 10
Alloy	SAC305
Henkel Powder Size	Type 3
Powder Size range, μm	45-25
Metal Content, %	88.5
Malcom Viscosity, 10rpm Pa.s	207
TI	0.50
IPC slump @182°C (0.33mm x 2.03mm) first space no bridge	0.15
IPC Solder Balling	preferred



Introduction

GC 10 Features & Benefits

Product Attribute	Process Benefit
Halogen Free	<ul style="list-style-type: none">• No added halogen• Measured <900ppm chlorine and bromine and <1,500ppm total by oxygen (O₂) bomb test
Halide Free	<ul style="list-style-type: none">• Flux classification ROL0 in accordance to J-STD-004B
Application	<ul style="list-style-type: none">• 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	<ul style="list-style-type: none">• Wide process window for printing and minimal slump• Abandon time of up to 2 hours; work life > 16 hours• Excellent print capability and reduction in print related defects• 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	<ul style="list-style-type: none">• Optimised for long hot soak reflow processes• Very shiny Pb-free solder joints over wide range of reflow• Excellent coalescence• Excellent humidity resistance• Excellent solderability on challenging surface finishes (ENIG, Copper OSP, CuNiZn and Imm Ag)
Low Voiding	<ul style="list-style-type: none">• 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/BGA
Residues	<ul style="list-style-type: none">• Clear, transparent and colourless• Pin testable after 4x reflows

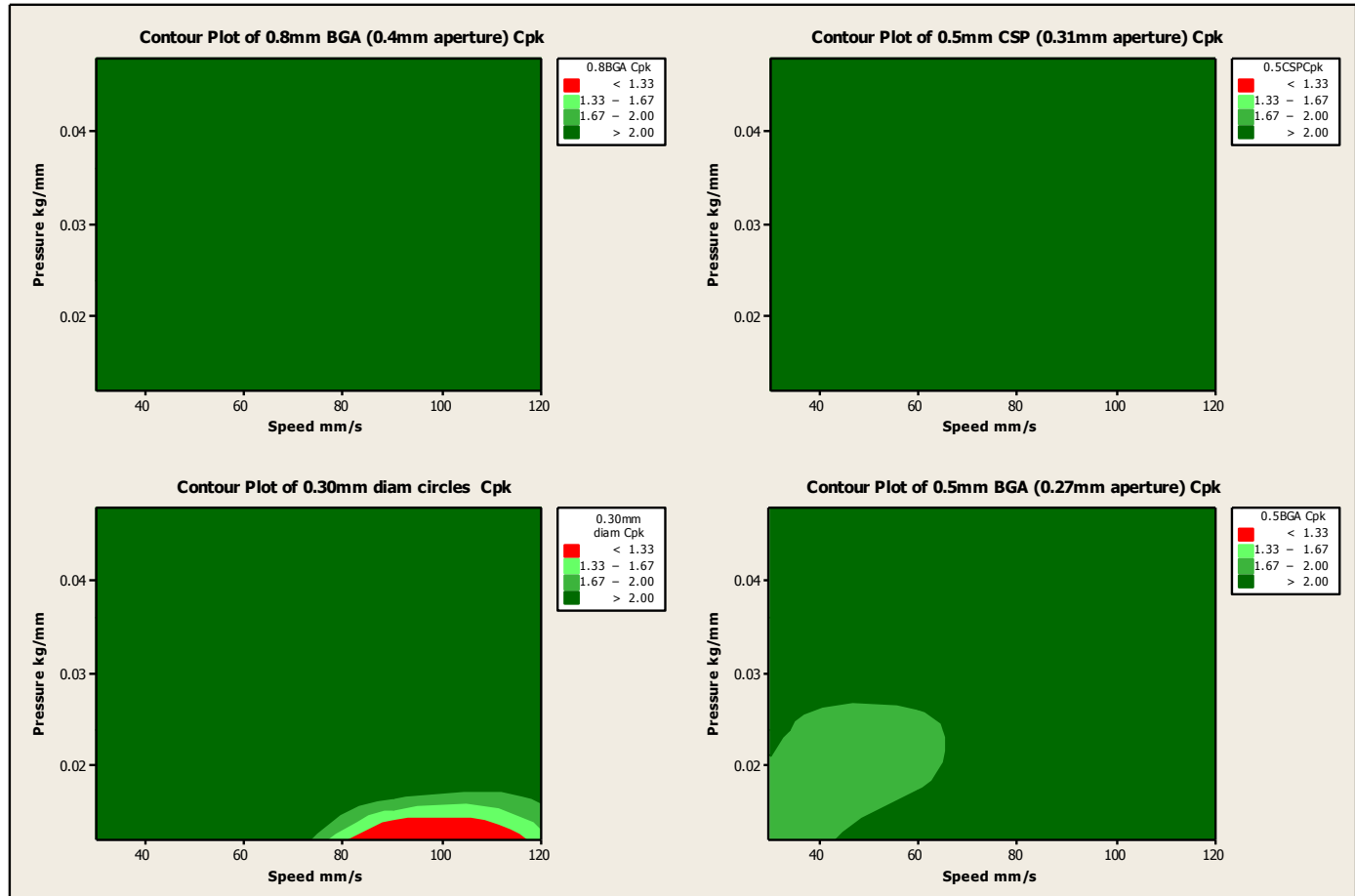
Contents

1. Performance Summary
2. Introduction: Properties, Features & Benefits
- 3. Operating Parameters**
 - Printing: Process Window
 - Printing: Continuous and Abandon Time Testing
 - Slump Testing
 - Tack-Life Force
 - Reflow Process Window
 - Reflow Performance Testing
 - Voiding Data
4. Reliability and Specification Testing
5. Operating Parameters: Storage
 - Printing & Reflow Performance
6. Product Summary

Operating Parameters

Print Process Window (LOCTITE GC 10 SAC305 T3 885V)

- Excellent printing in the range 30 – 120mm/s, 0.4mm to 0.27mm round apertures

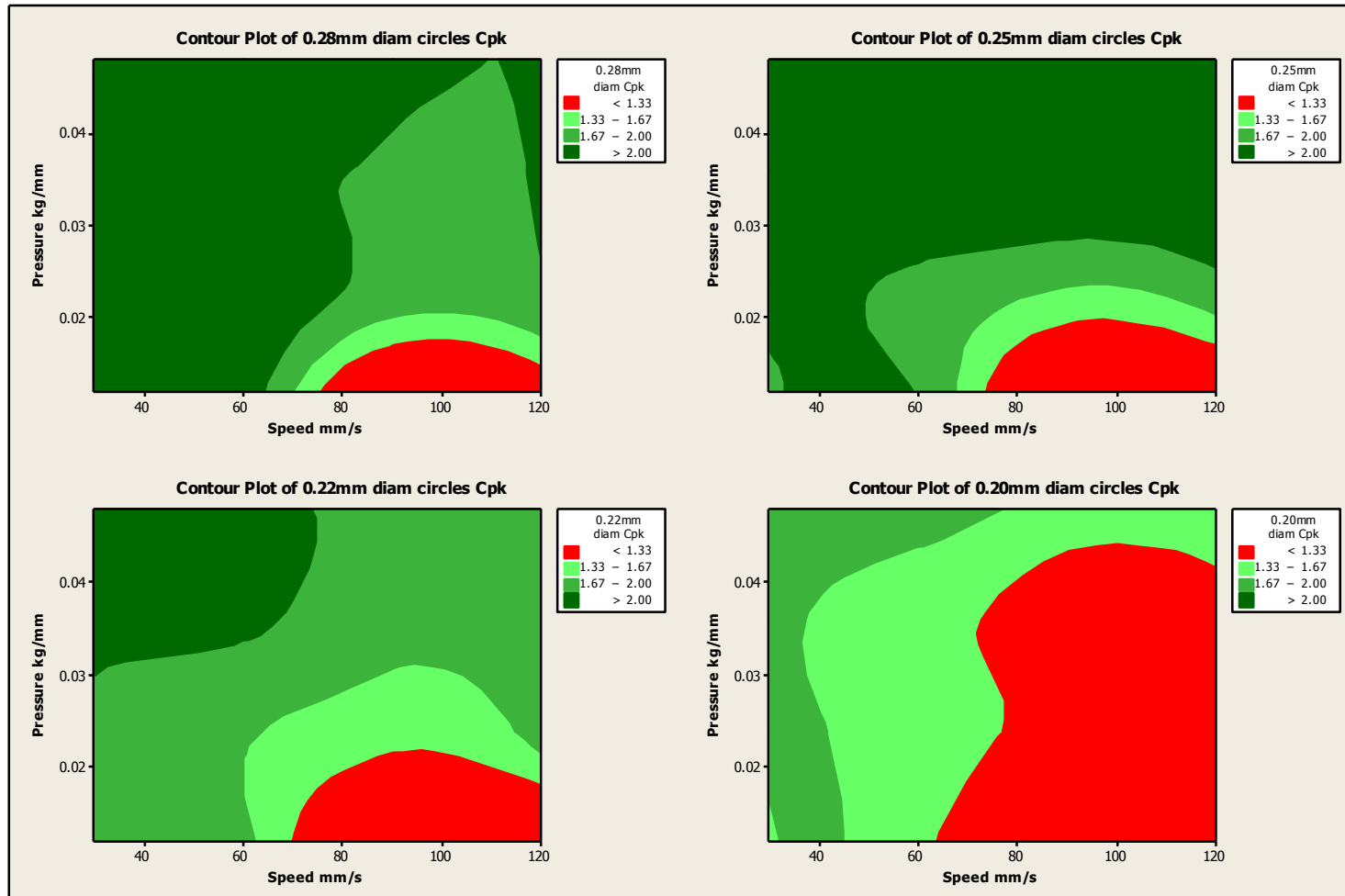


0.8mm, 0.5mm & 0.4mm pitch round apertures, (120µm stencil)

Operating Parameters

Print Process Window (LOCTITE GC 10 SAC305 T3 885V)

- Excellent printing in the range 30 – 120mm/s, 0.28-0.22mm round apertures
- Limited process window with 0.20mm apertures. GC 10 T4 may be required



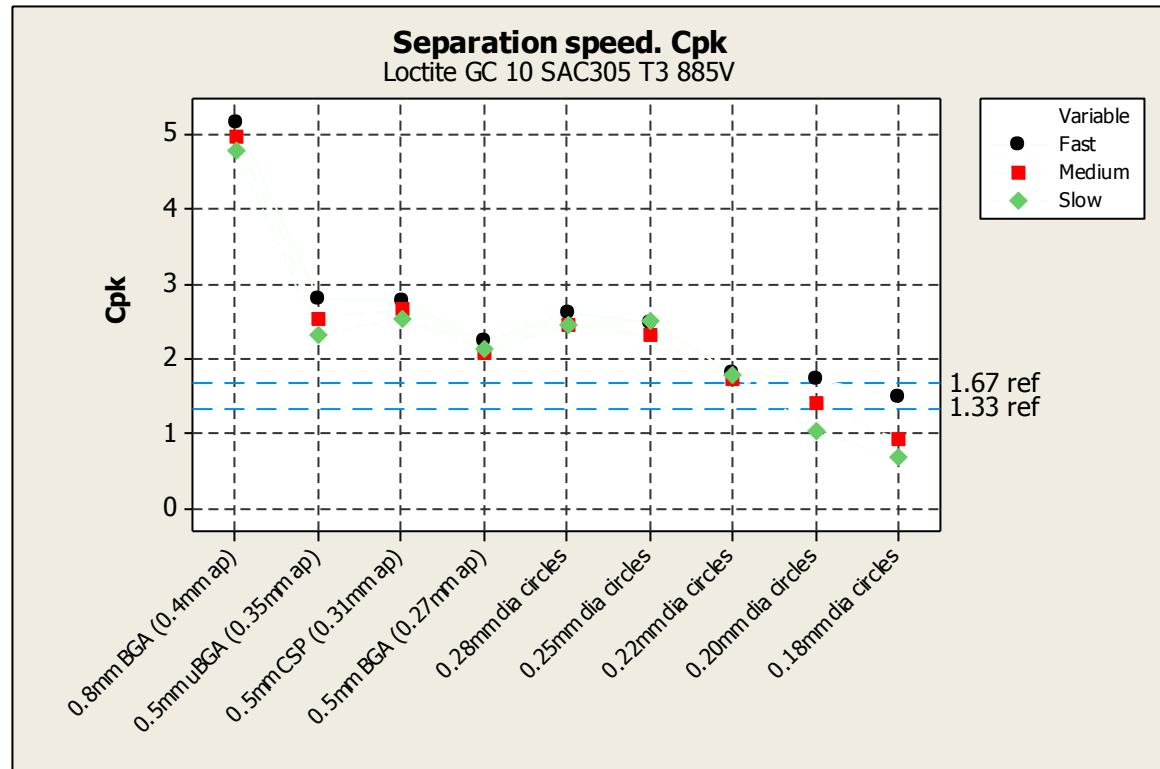
0.28mm – 0.20mm round apertures, (120µm stencil)

Operating Parameters – Separation Speed

Print Process Window

(LOCTITE GC 10 SAC305 T3 885V)

- Excellent printing in the range down to 0.22mm round apertures.
- Fast separation speed is preferable.

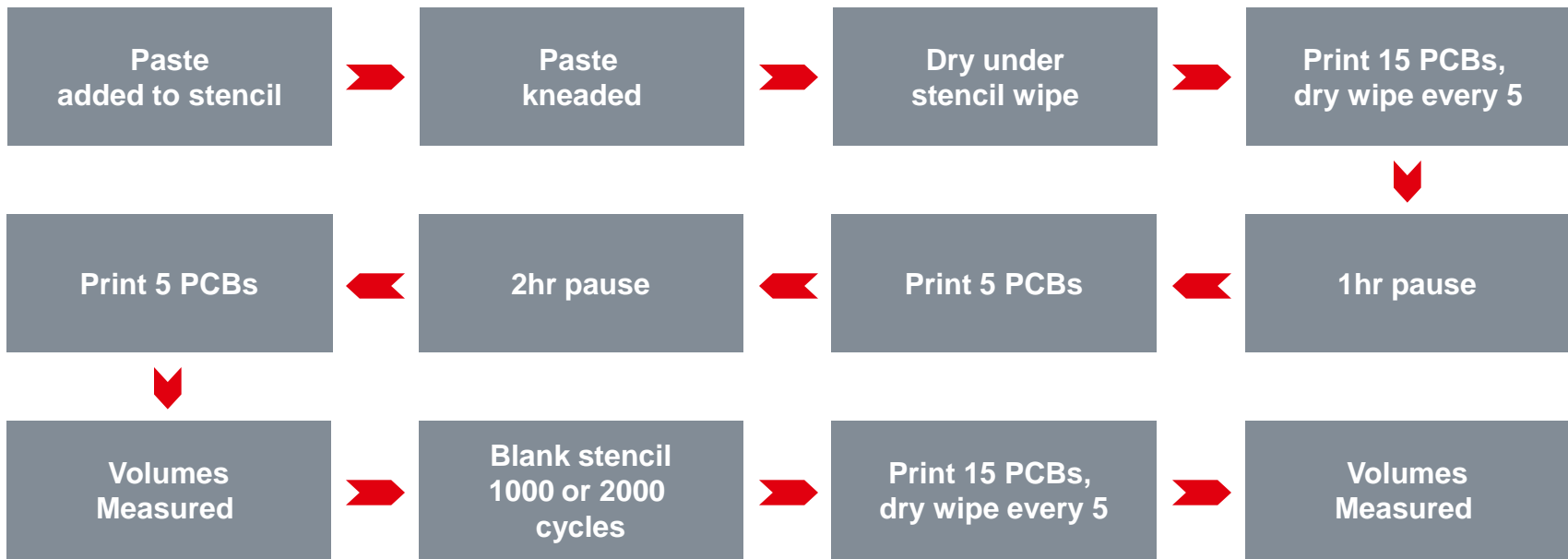


0.8mm BGA – 0.18mm round apertures, 120 μ m stencil thickness, 60mm/s, 10kg

Operating Parameters

Continuous Print and Abandon Stability Assessment

Henkel Board 0.8mm BGA to 0.18mm diameter circles Process flow for Henkel print test as shown below



- Printing
- DEK Europa
- Stainless steel, laser cut
- 120µm thickness
- Vacuum tooling

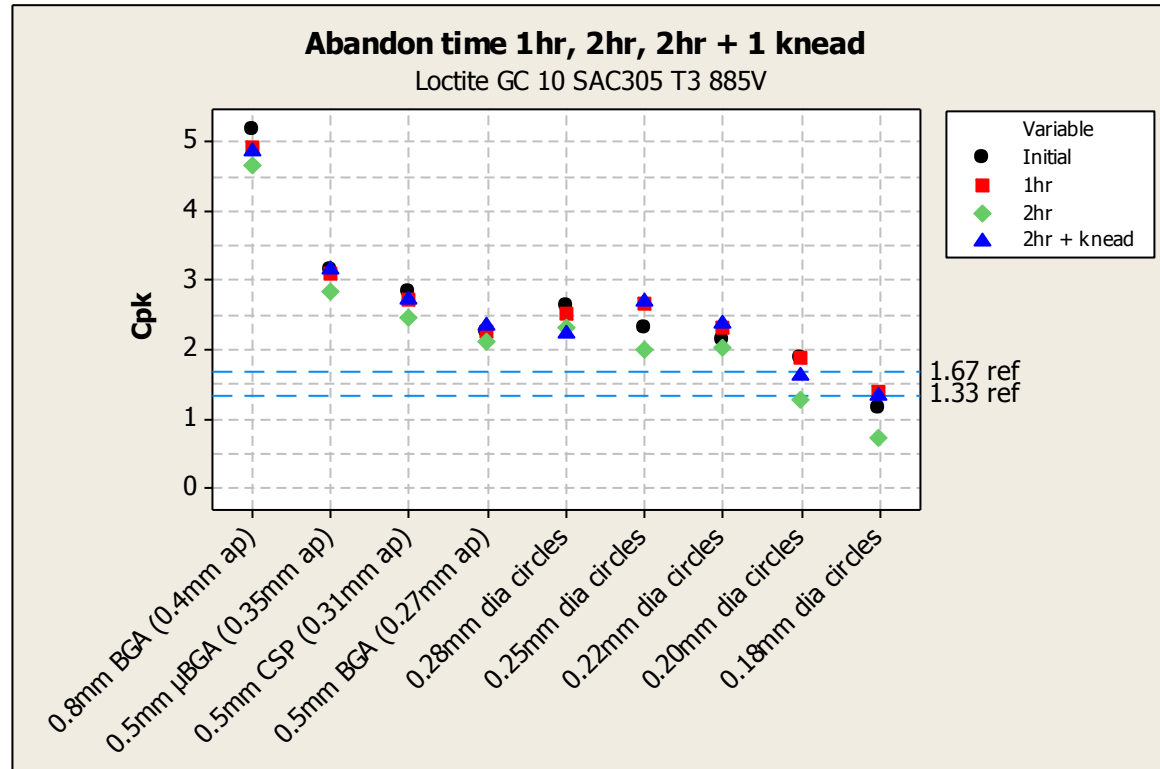
- 250mm, 60° squeegee
- 60mm/s squeegee speed
- Fast separation speed
- Conditions typical, 22C, 40% RH
- Koh Young KY-8020T volume measurement

Operating Parameters

– Abandon Stability 22°C/40%RH

Print Process Window (LOCTITE GC 10 SAC305 T3 885V)

- **Print Capabilities**
- Excellent printing in the range down to 0.22mm round apertures
- Single knead cycle required after 2hr abandon at 0.20mm round apertures



0.8mm BGA – 0.15mm round apertures

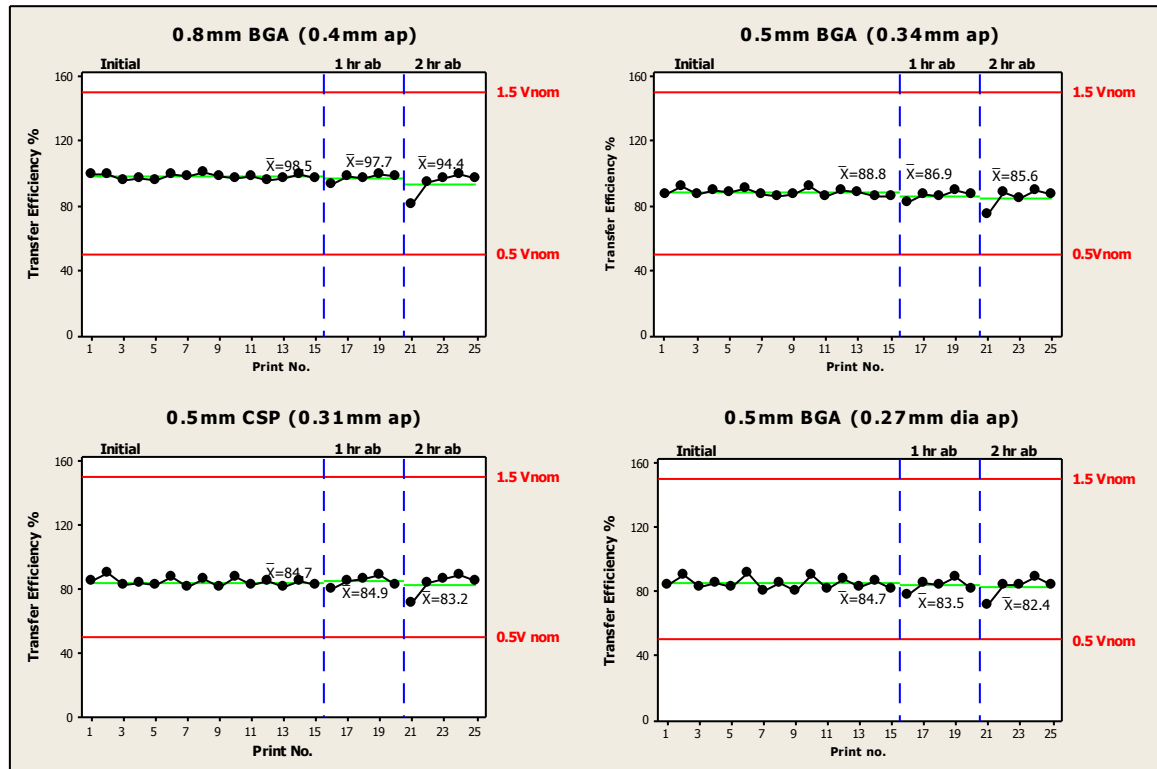
120µm stencil thickness, 60mm/s, fast separation, 250mm squeegee, 10kg

Operating Parameters

– Abandon Stability 22°C/40%RH

Print Process Window (LOCTITE GC 10 SAC305 T3 885V)

- Transfer Efficiencies
- Excellent printing in the range 0.40mm down to 0.27mm round apertures



0.8mm BGA – 0.5mm BGA round apertures

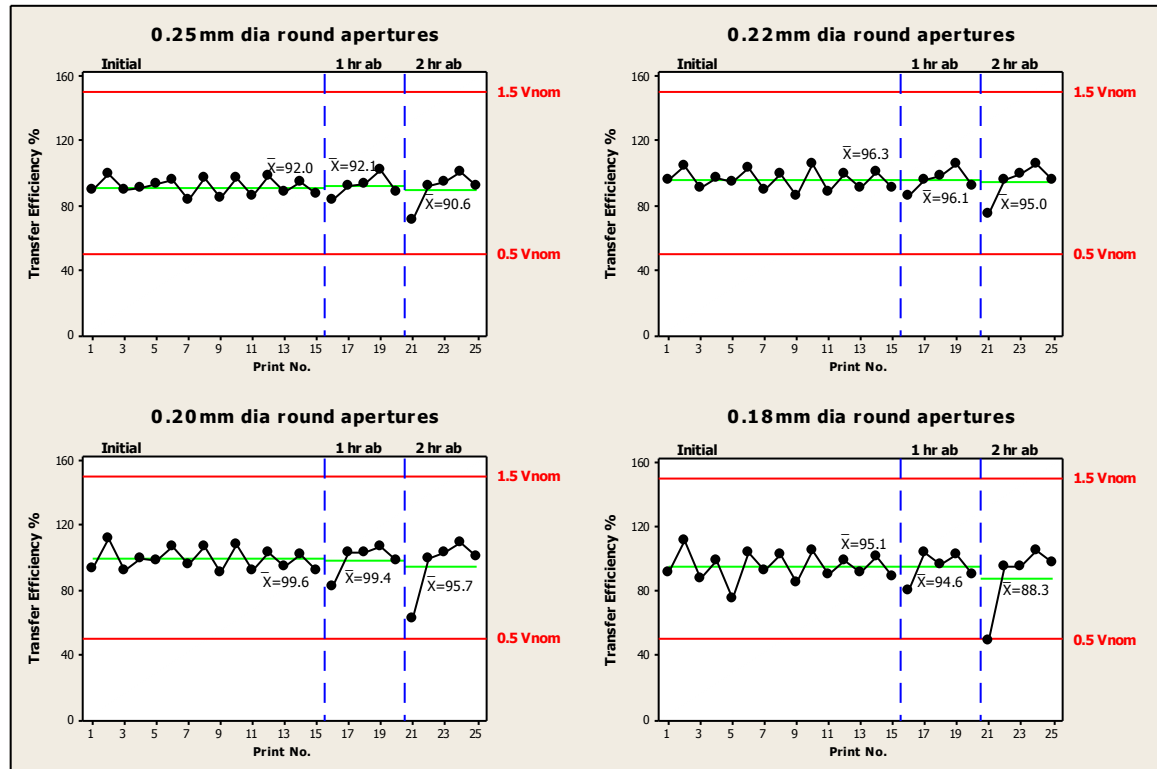
120µm stencil thickness, 60mm/s, fast separation, 250mm squeegee, 10kg

Operating Parameters

– Abandon Stability 22°C/40%RH

Print Process Window (LOCTITE GC 10 SAC305 T3 885V)

- **Transfer Efficiencies**
- Excellent printing in the range down to 0.22mm round apertures
- Single knead cycle for best results after 2hr abandon at 0.20mm round apertures and below



0.28mm – 0.20mm round apertures

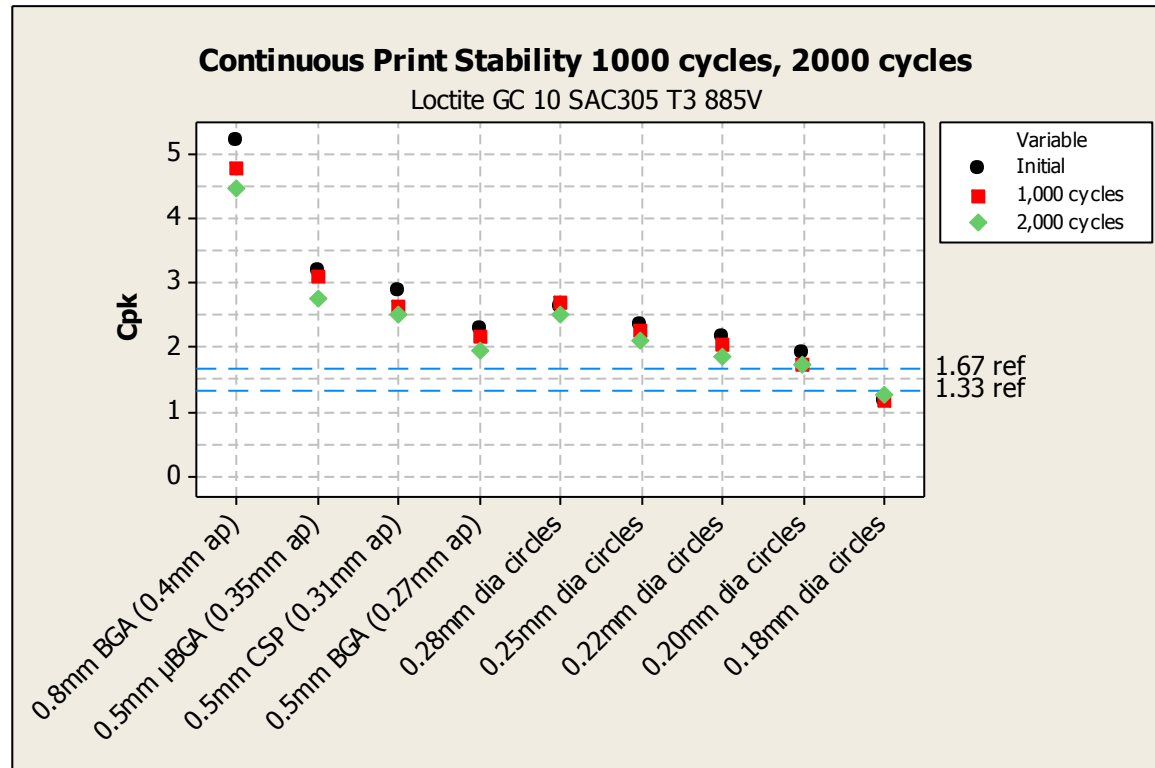
120µm stencil thickness, 60mm/s, fast separation, 250mm squeegee, 10kg

Operating Parameters

– Continuous Print Stability

Print Process Window (LOCTITE GC 10 SAC305 T3 885V)

- **Print Capabilities**
- No impact on print performance after 8 hours (1000 cycles) and 16 hours (2000 cycles) printing



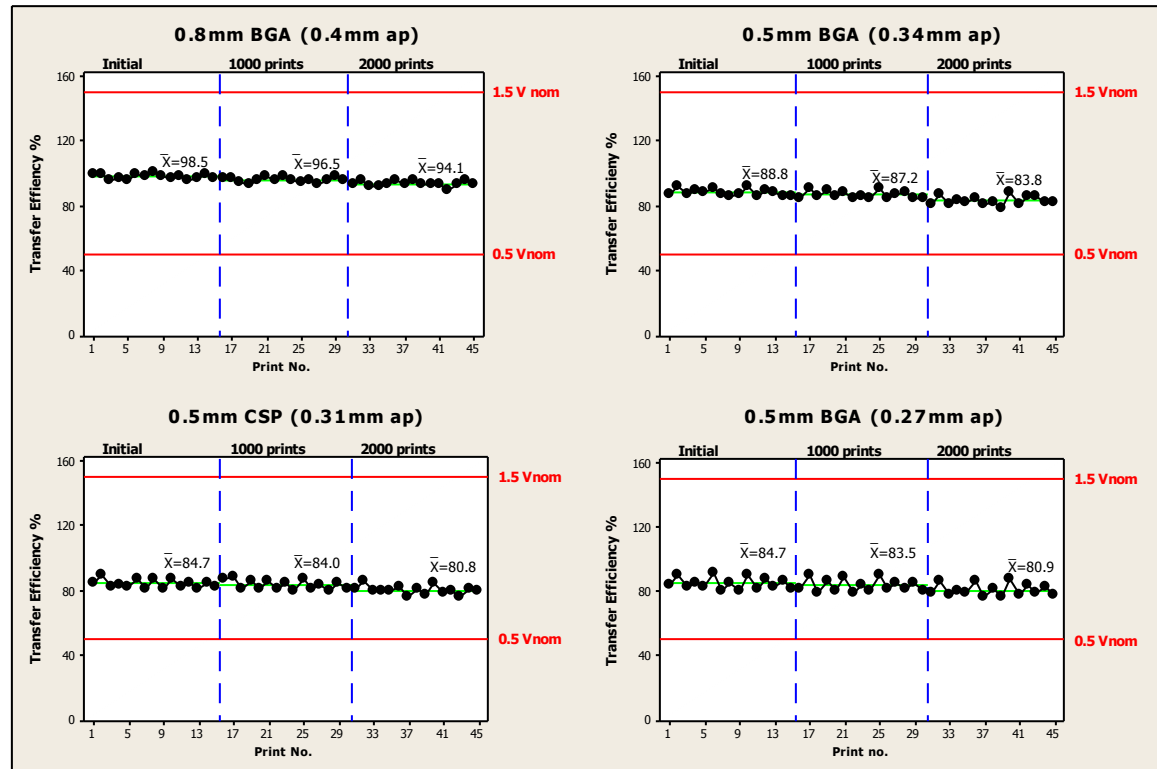
0.8mm BGA – 0.18mm round apertures, 120μm stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 10kg

Operating Parameters

– Continuous Print Stability

Print Process Window (LOCTITE GC 10 SAC305 T3 885V)

- Transfer Efficiencies
- No impact on print performance after 8 hours (1000 cycles) and 16 hours (2000 cycles) printing



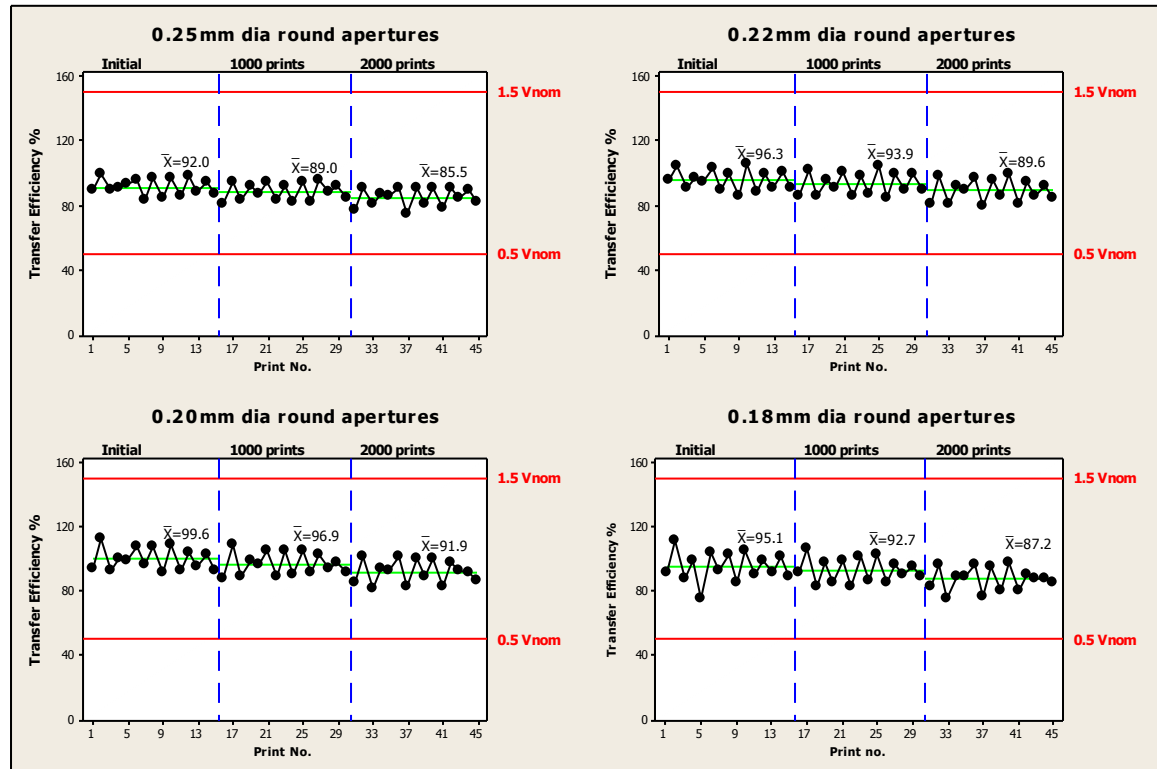
0.8mm BGA – 0.5mm BGA round apertures, 120 μ m stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 10kg

Operating Parameters

– Continuous Print Stability

Print Process Window (LOCTITE GC 10 SAC305 T3 885V)

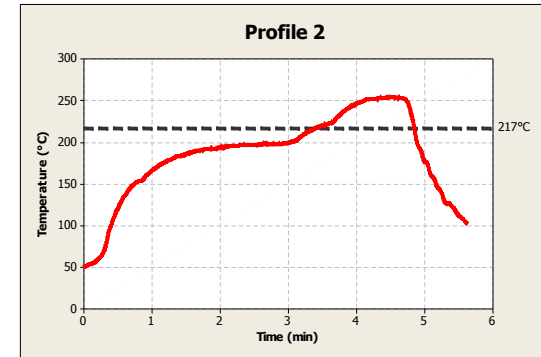
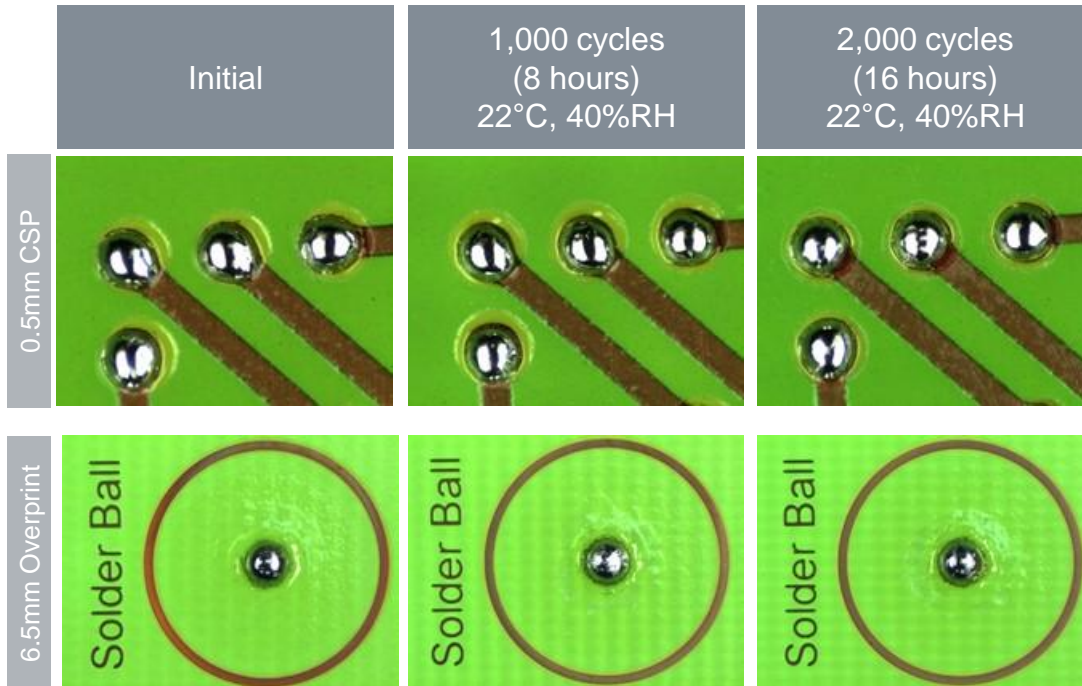
- Transfer Efficiencies
- No impact on print performance after 8 hours (1000 cycles) and 16 hours (2000 cycles) printing



0.28mm– 0.20mm round apertures, 120 μ m stencil thickness,
60mm/s, Fast separation, 250mm squeegee, 10kg

Operating Parameters (Reflow)

Paste Properties After Continuous Printing

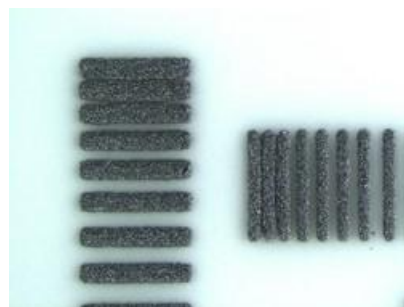
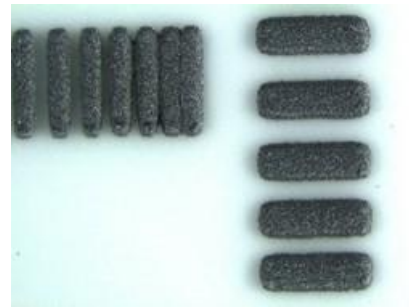
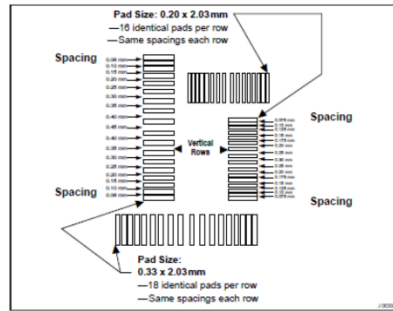
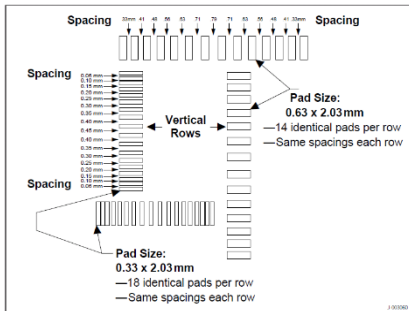


- No change to reflow performance after 16hours printing (2000 print cycles)

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

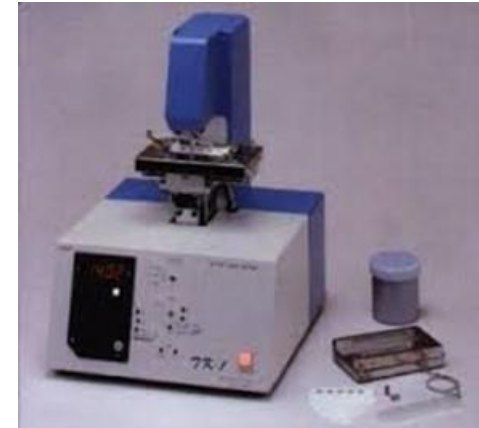
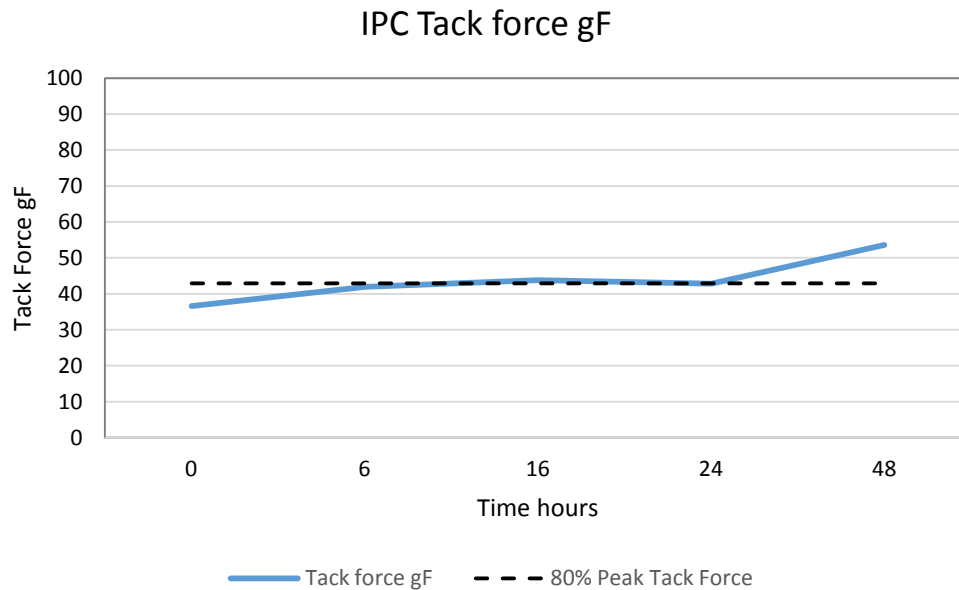
A20
100µm

Stencil Design/ thickness	A 21 200µm		A 20 100µm	
	Aperture	Pass mark	GC 10 25°C	GC 10 182°C
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	0.15mm	0.15mm	0.125mm

Operating Parameters

Tack Force

- Tackiness evaluation was performed in accordance with J-STD-005A, IPC-TM-650 2.4.44
- GC10 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

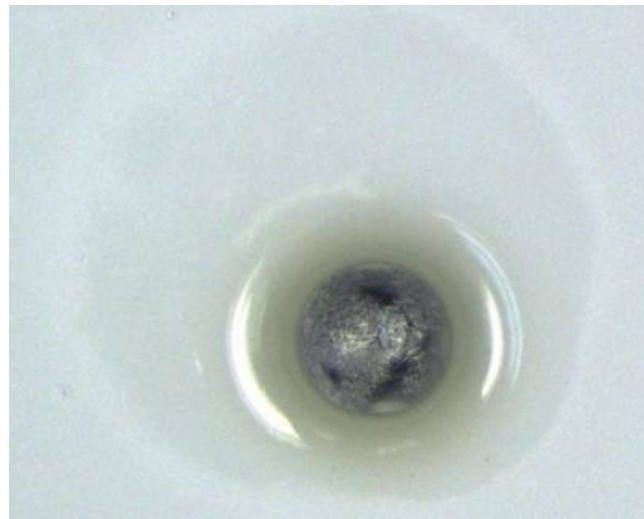
- Solder balling performance as been assessed in accordance with an extended version of IPC-TM-650 2.4.4.3
- Clear and colourless residues observed post-reflow

Initial



Preferred Pass

24hrs 25°C 50% RH

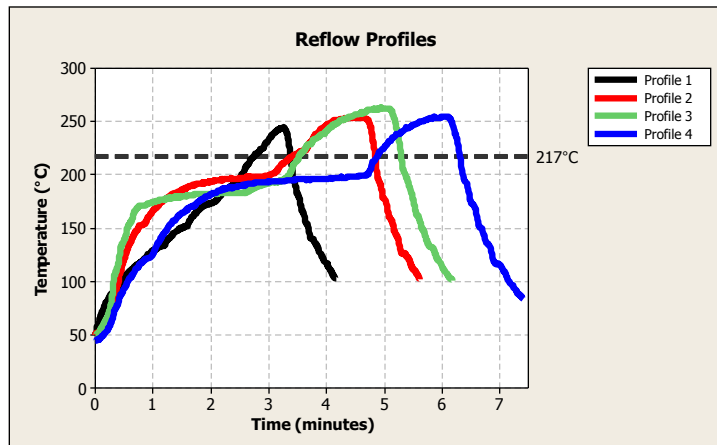


Preferred Pass

Operating Parameters

Reflow Process Window (Air)

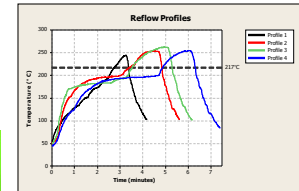
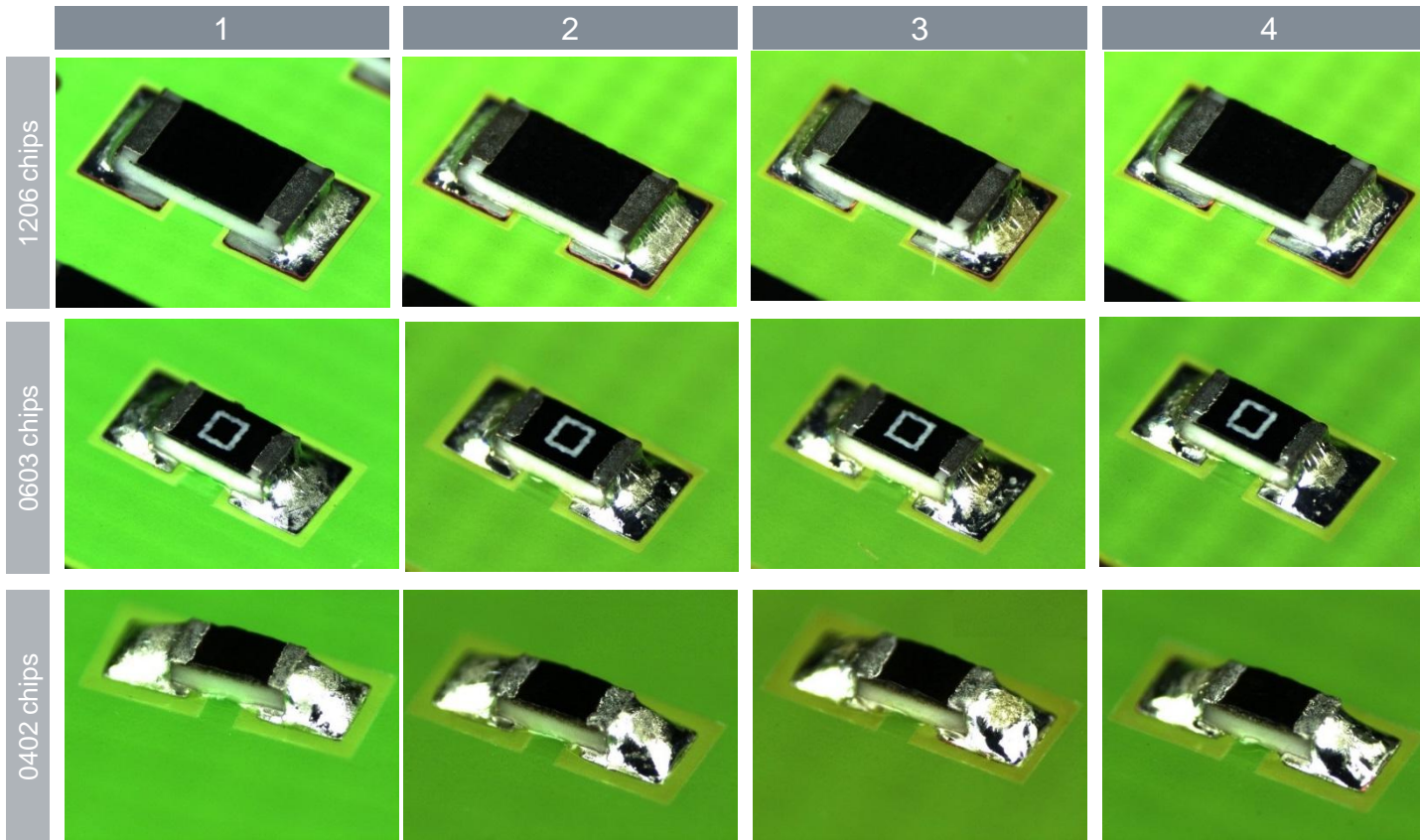
- LOCTITE GC 10 solder paste offers halogen containing reflow performance in a truly halogen free formulation
- GC 10 shows excellent coalescence onto a range of PCB and component finishes especially during long-hot profiles
- There is no single profile that works for all applications and each process 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 3 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)	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

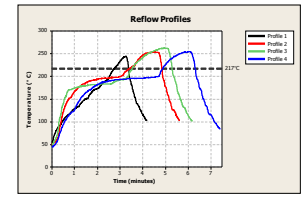
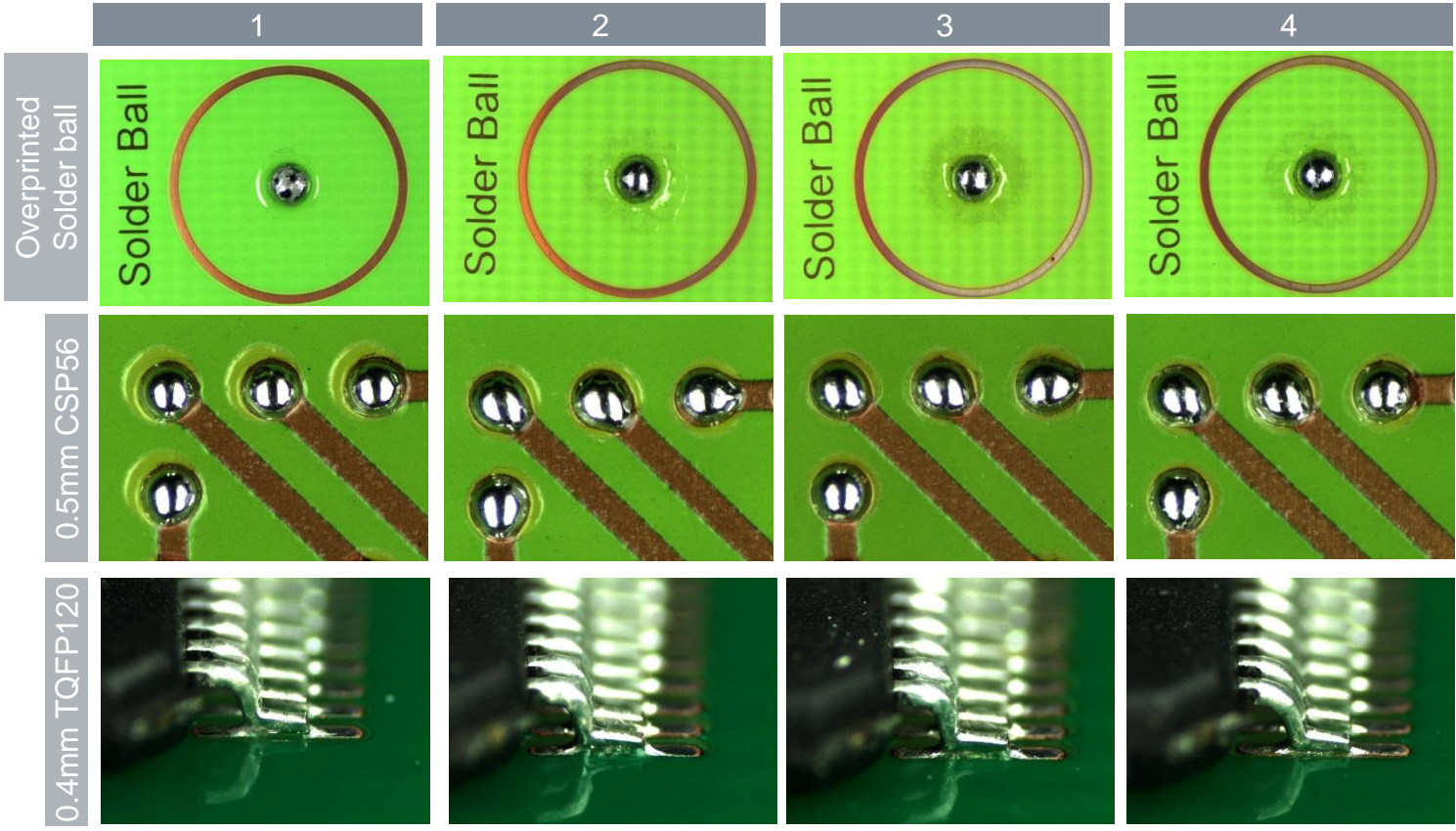
Operating Parameters (Reflow)

Reflow Profile



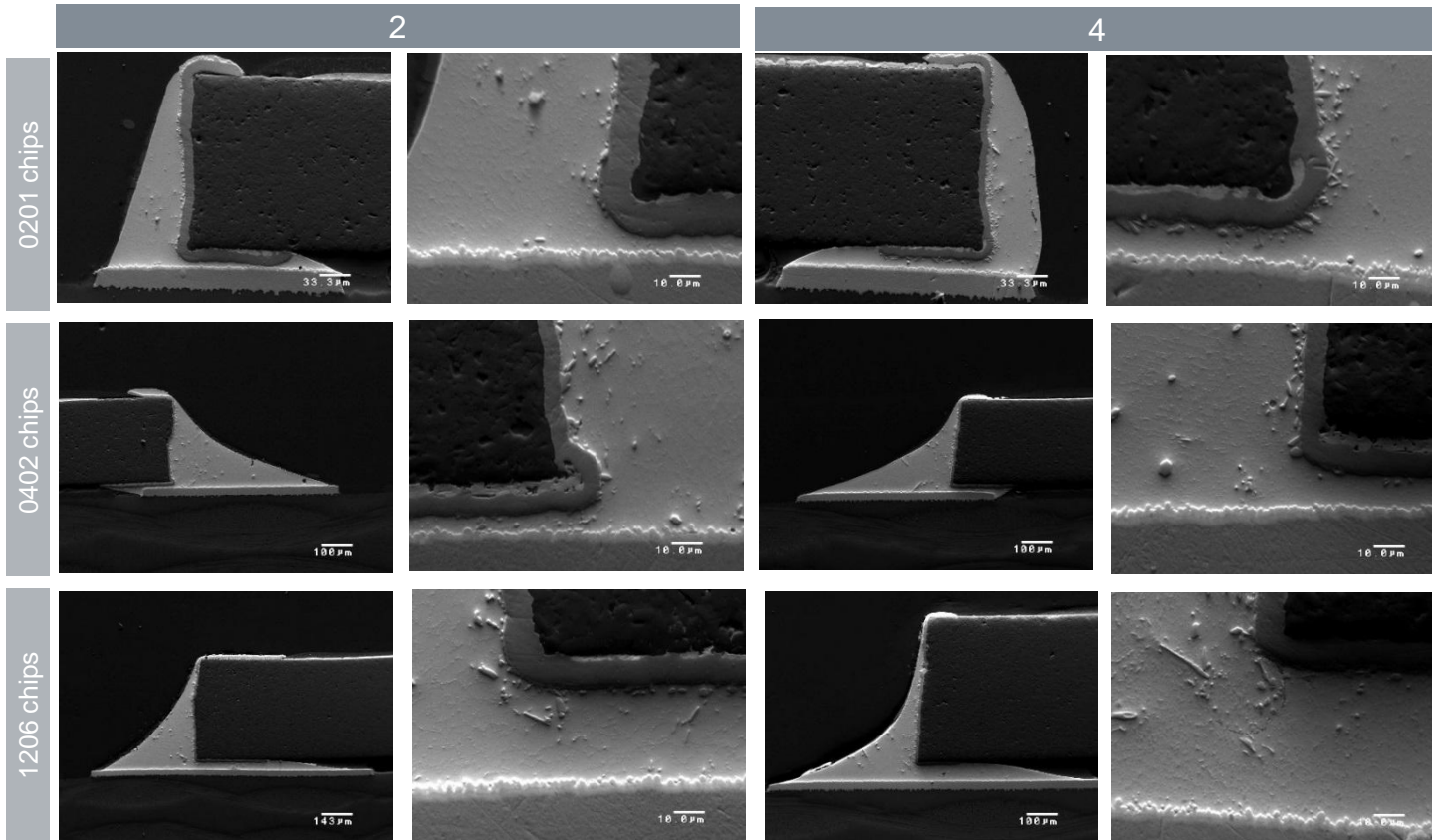
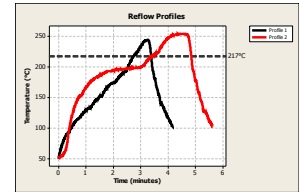
Operating Parameters (Reflow)

Reflow Profile



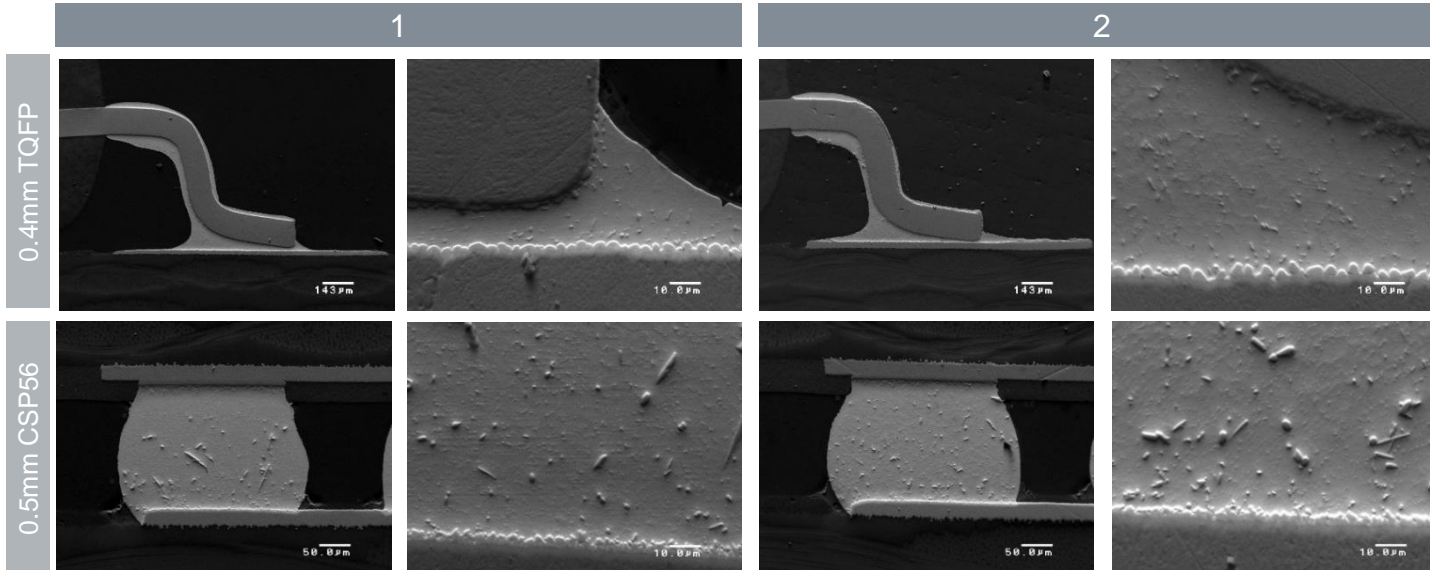
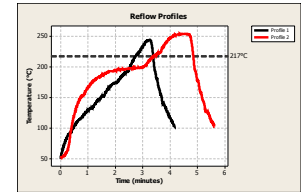
Operating Parameters (Reflow – GC10)

Reflow Profile



Operating Parameters (Reflow – GC10)

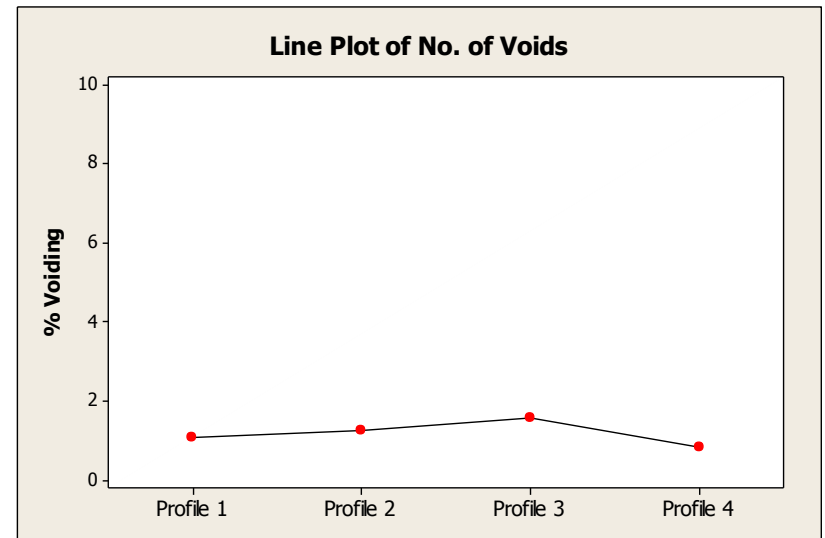
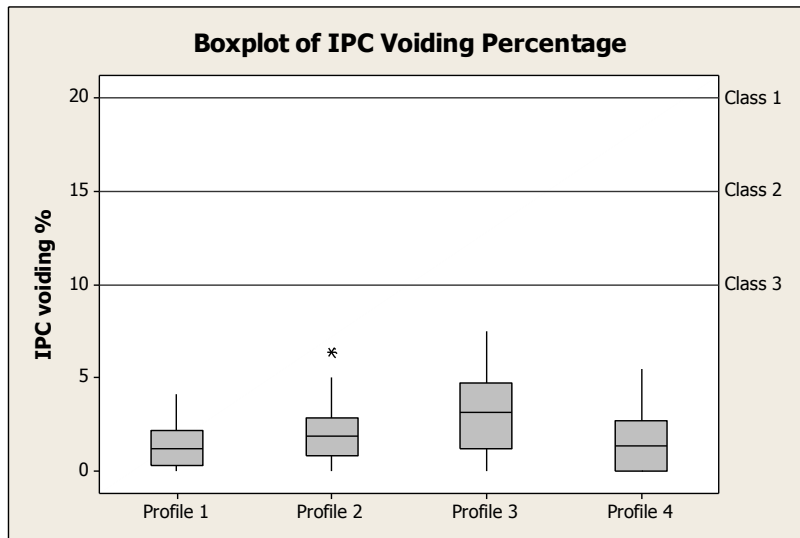
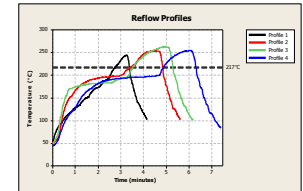
Reflow Profile



Operating Parameters

Voiding

- Void performance assessed using 4 different reflow profiles.
- 0.5mm CSP, 120µm stencil
- With component, 0.5mm CSP, SAC305 balls
- GC 10 shows low levels of voiding over a range of profiles
- Void Percentage analysed in accordance with IPC7095B

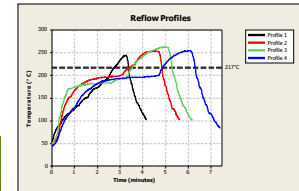
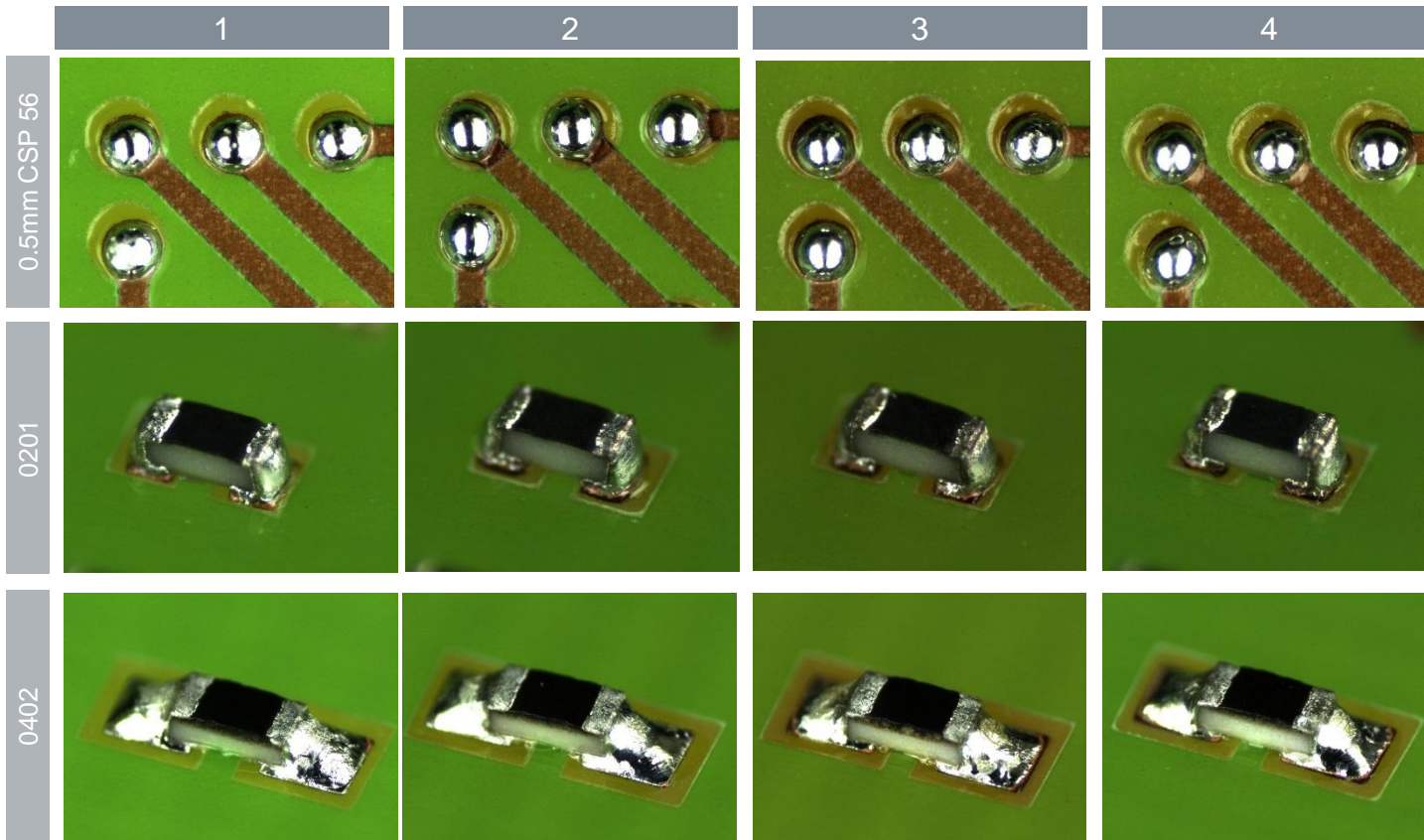


GC 10 meets IPC7095B class 3

Operating Parameters

2nd side reflow

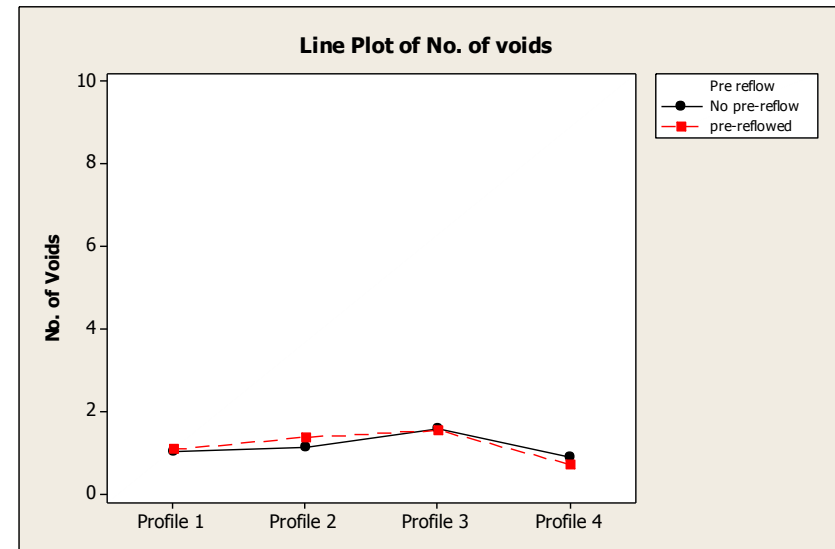
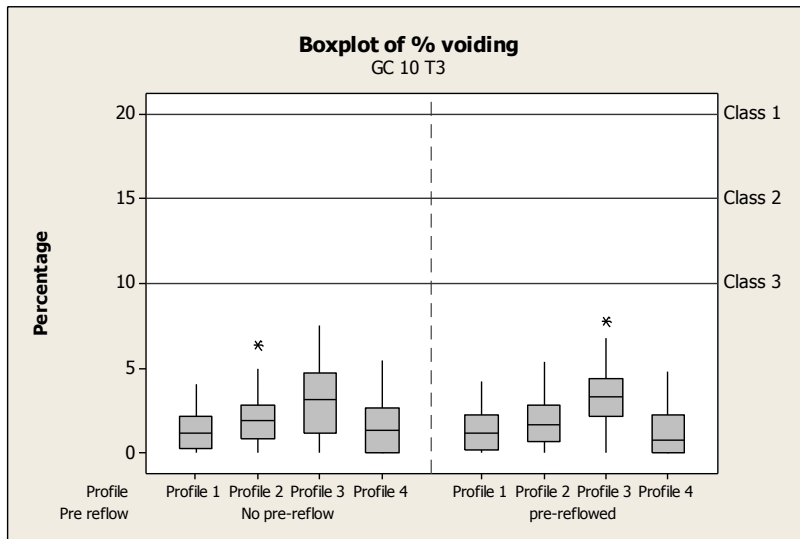
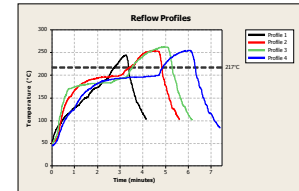
2nd second side reflow profile



Operating Parameters

Voiding after 2nd side reflow

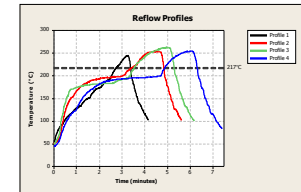
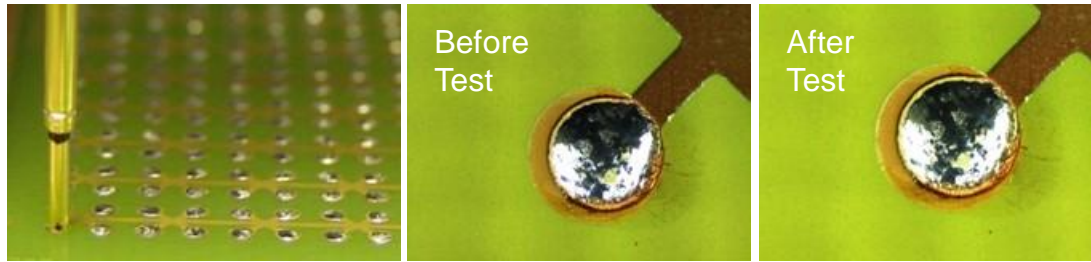
- Void performance assessed using 4 different reflow profiles.
- 0.5mm CSP, 120µm stencil
- With component, 0.5mm CSP, SAC305 balls
- GC 10 shows no deterioration in voiding with pre reflowed boards



GC 10 meets IPC7095B class 3

Operating Parameters

Pin Testing



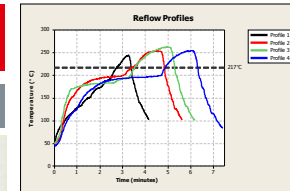
Board	
Stencil	100µm
Pads	500 pads per board, 2 boards tested
Probe	0.9mm 4 point plain crown light spring probe 100g spring force
Profiles	4 reflow profiles
No. of reflow	1, 2, 3 & 4 passes through oven
Atmosphere	Air & 1000ppm O ₂
Time after reflow	1 day, 1 week

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%

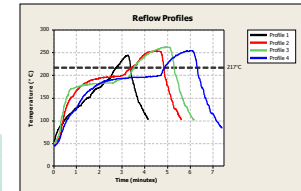


Operating Parameters

Pin Testing

Reflow Profile (% after 1000 tests)

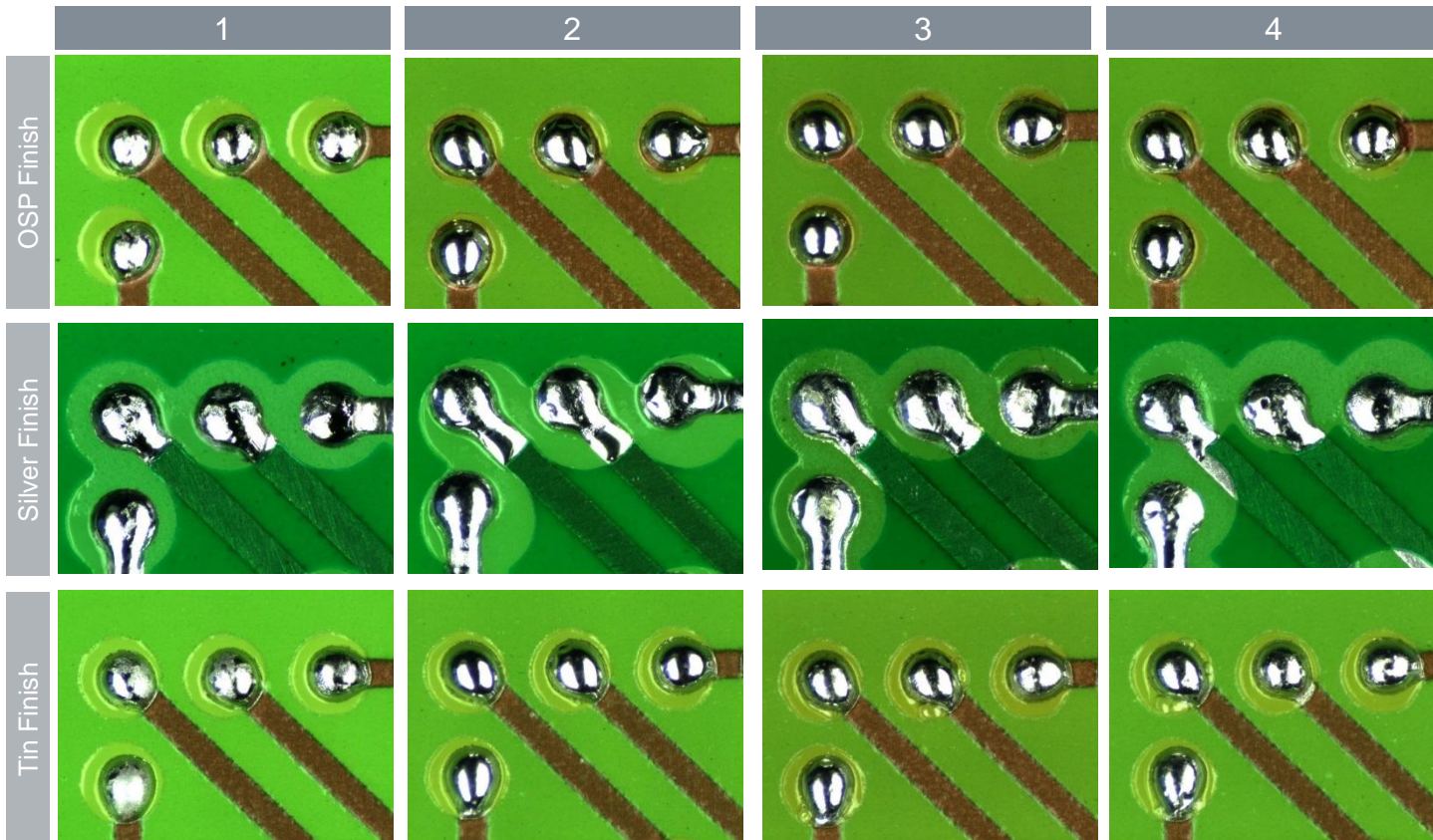
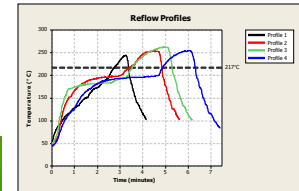
	1	2	3	4
Reflowed in N ₂	100%	100%	100%	100%
1 day after reflow	100%	99.9%	99.8%	99.6%
1 week after reflow	100%	99.8%	99.3%	99.6%



Operating Parameters

Surface Finish

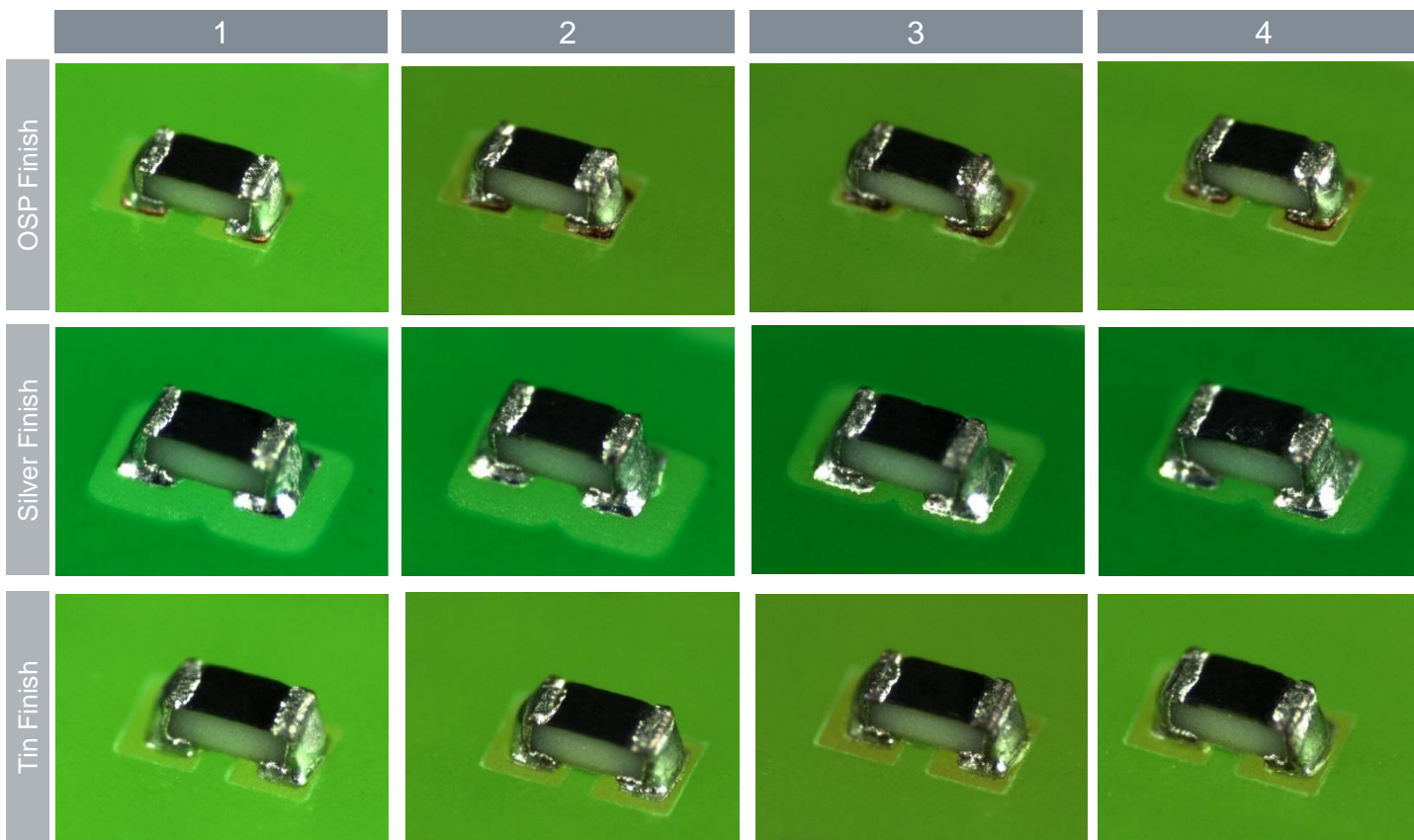
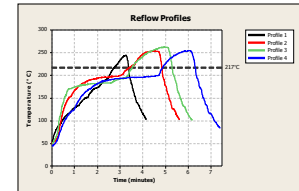
Reflow Profile (0.5mm CSP56)



Operating Parameters

Surface Finish

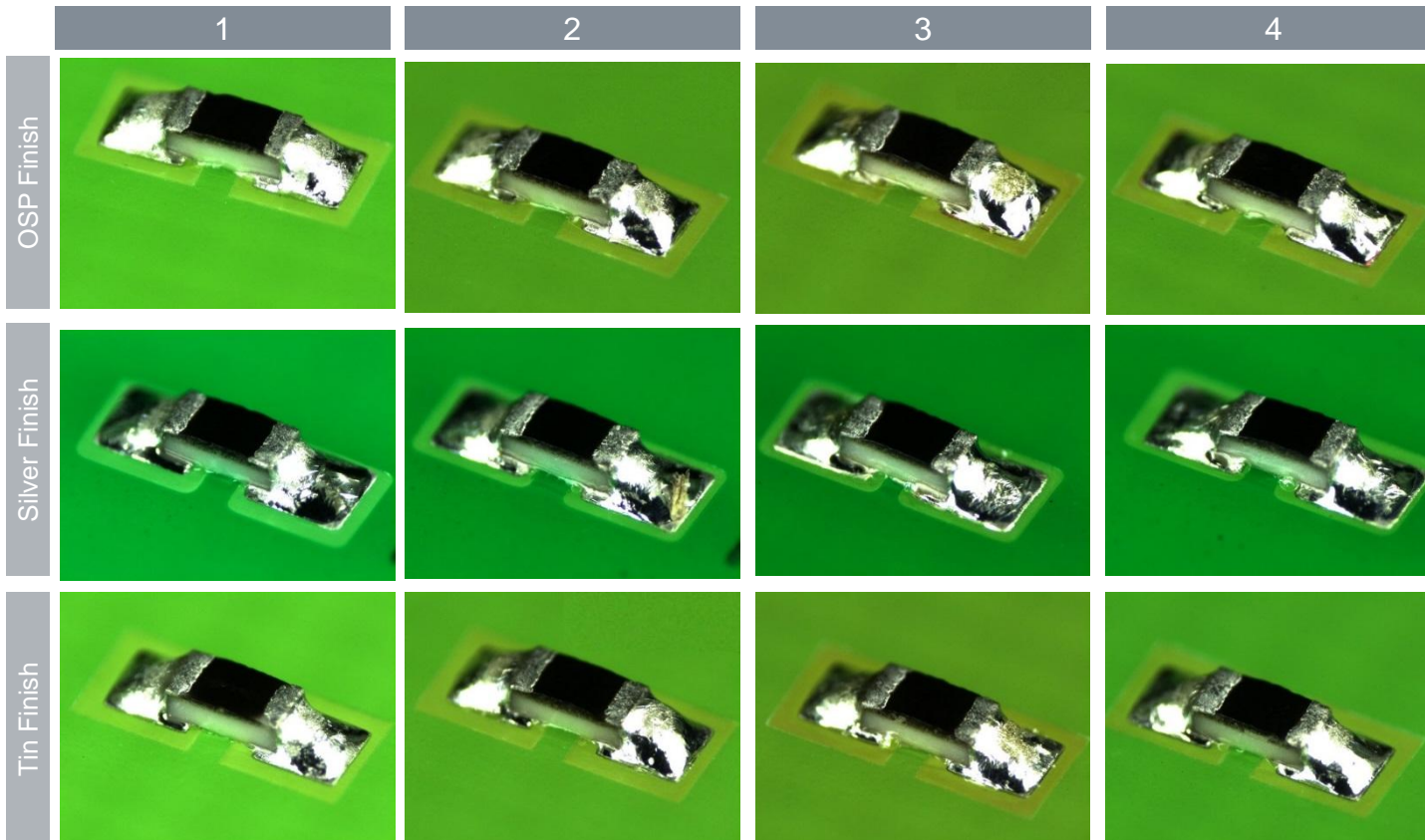
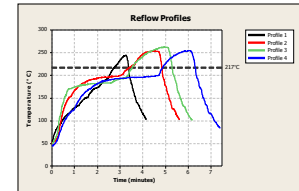
Reflow Profile (0201)



Operating Parameters

Surface Finish

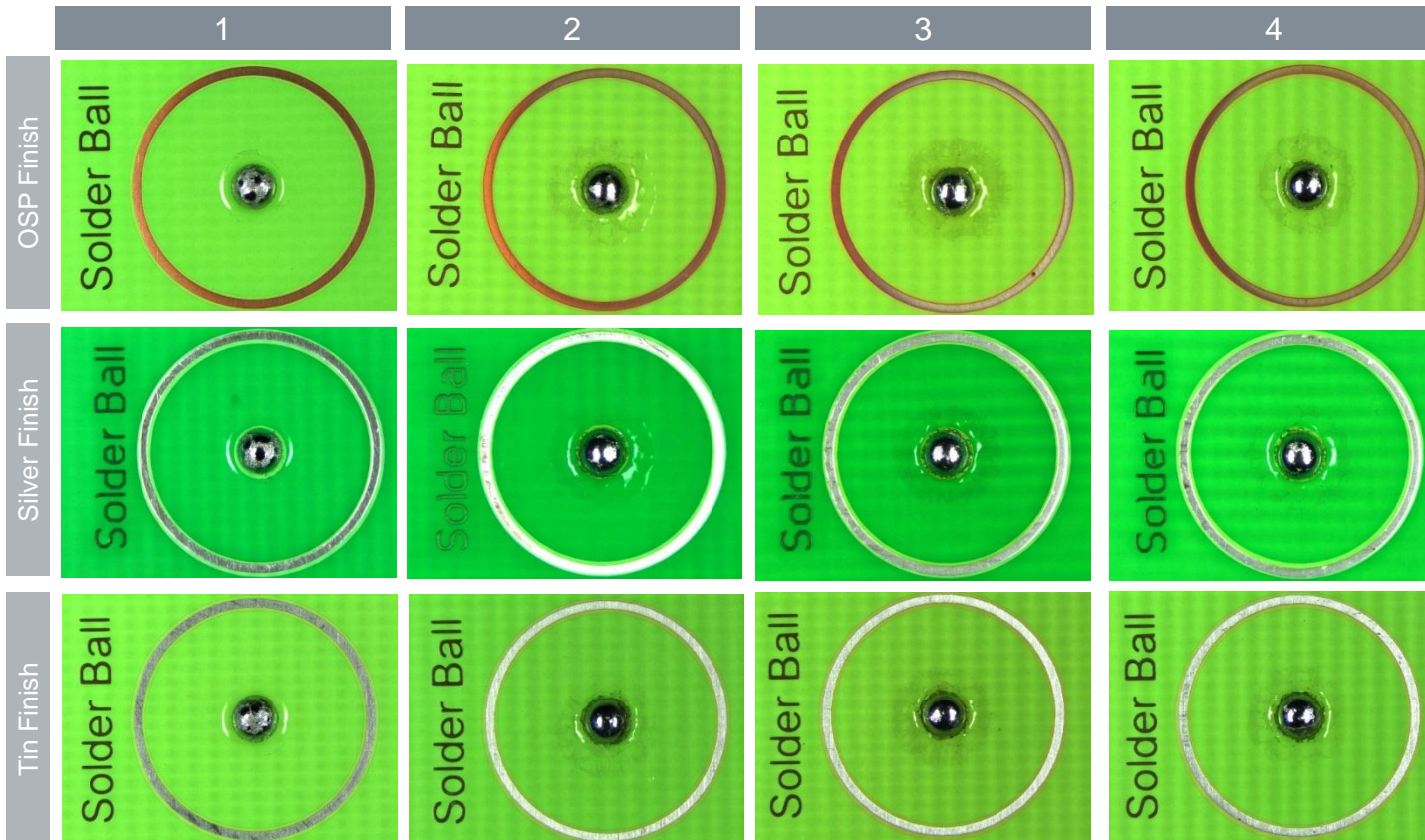
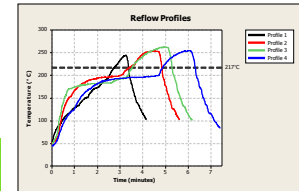
Reflow Profile (0402)



Operating Parameters

Surface Finish

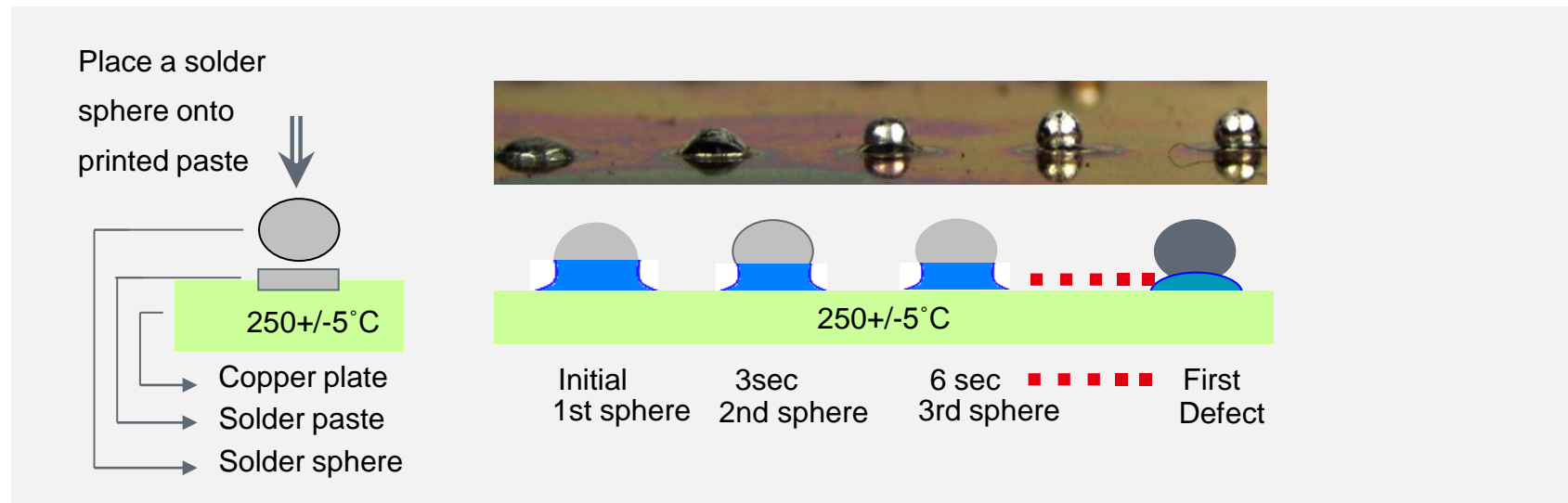
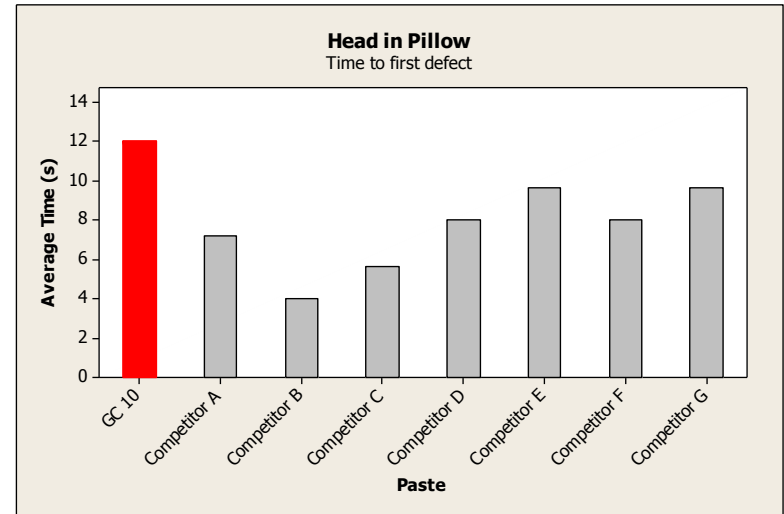
Reflow Profile (6.5mm overprinted solder ball)



Reliability and Specification Testing

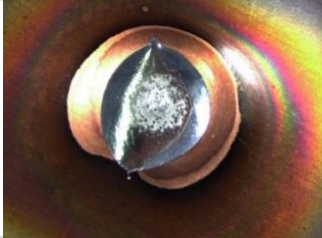

Head in Pillow Test

- Print solder paste on a Cu plate, 0402 pad, stencil thickness 125µm.
- 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
- Flux activity at elevated temperatures – up to 20% longer than industry standard – helping to reduce HiP



Reliability and Specification Testing

J-STD- 004B

Standard	Test	Result	
	Cu Corrosion	Pass	
ANSI/ J-STD-004B	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 – Chlorine - ND
- Halogen – Bromine – ND
- Halogen – Iodine – ND



Test Report

No. : CE/2015/61413

Date : 2015/06/12

Page: 2 of 4

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



Test Result(s)

PART NAME No.1 : GRAY 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)	mg/kg		50	n.d.
Halogen-Bromine (Br) (CAS No.: 10097-32-2)	mg/kg		50	n.d.
Halogen-Iodine (I) (CAS No.: 14362-44-8)	mg/kg		50	n.d.

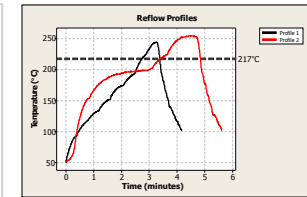
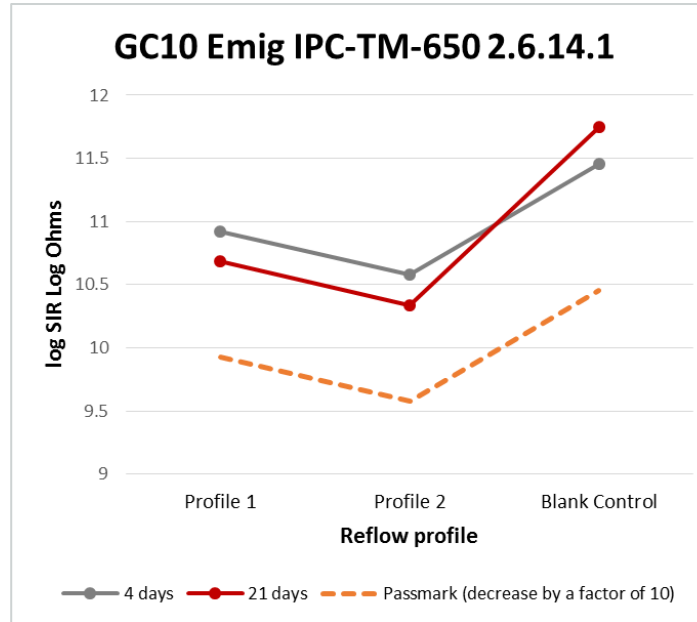
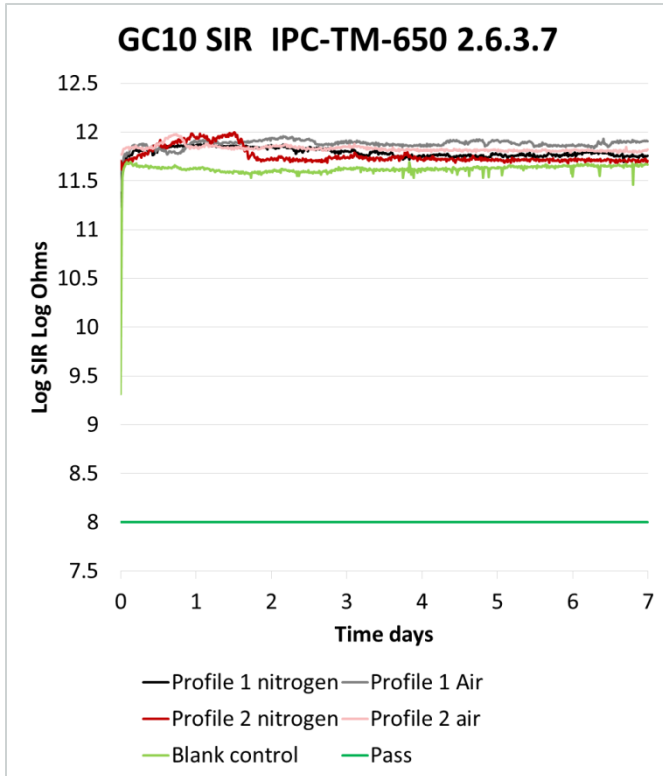
Note :

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



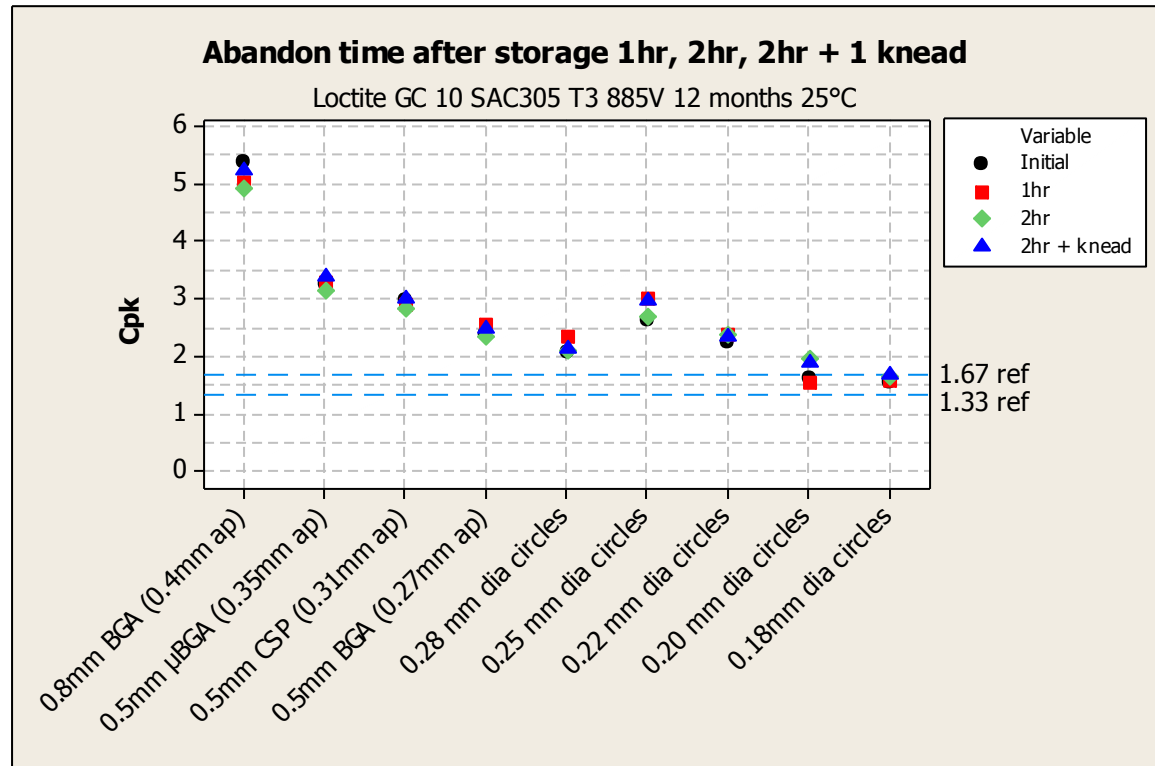
Contents

1. Performance Summary
2. Introduction: Properties, Features & Benefits
3. Operating Parameters
 - Printing: Process Window
 - Printing: Continuous and Abandon Time Testing
 - Slump Testing
 - Tack-Life Force
 - Reflow Process Window
 - Reflow Performance Testing
 - Voiding Data
4. Reliability and Specification Testing
- 5. Operating Parameters: Storage**
 - Printing & Reflow Performance
6. Product Summary

Operating Parameters: Storage

Printing After Storage 12 months 25°C

- **Print Capabilities**
- Excellent print capability after storage for 12 months @ 25°C
- No knead cycle required after 2hrs abandon down to 0.22mm round apertures

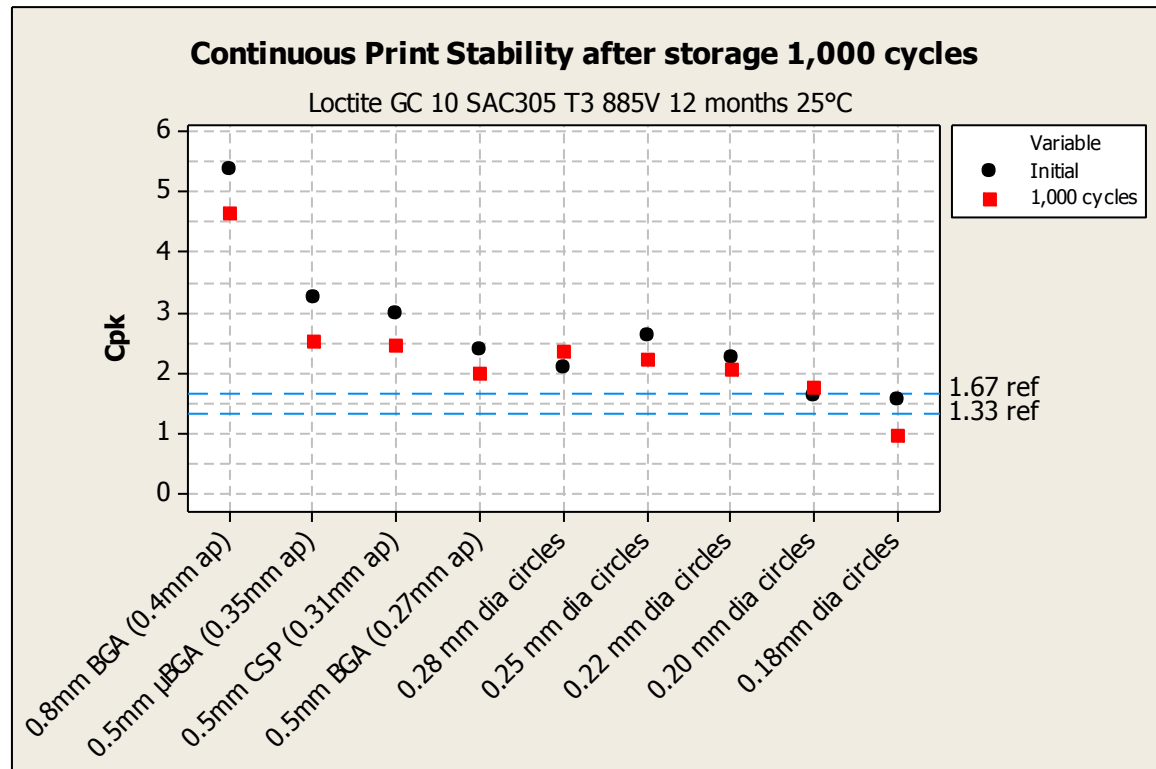


0.8mm BGA – 0.18mm round apertures, 120 μ m stencil thickness, 60mm/s,
Fast separation, 250mm squeegee, 10kg

Operating Parameters: Storage

Printing After Storage 12 months 25°C

- **Print Capabilities**
- Excellent print capability after storage for 12 months @ 25°C
- Excellent print performance after 1000 cycles down to 0.22mm round apertures

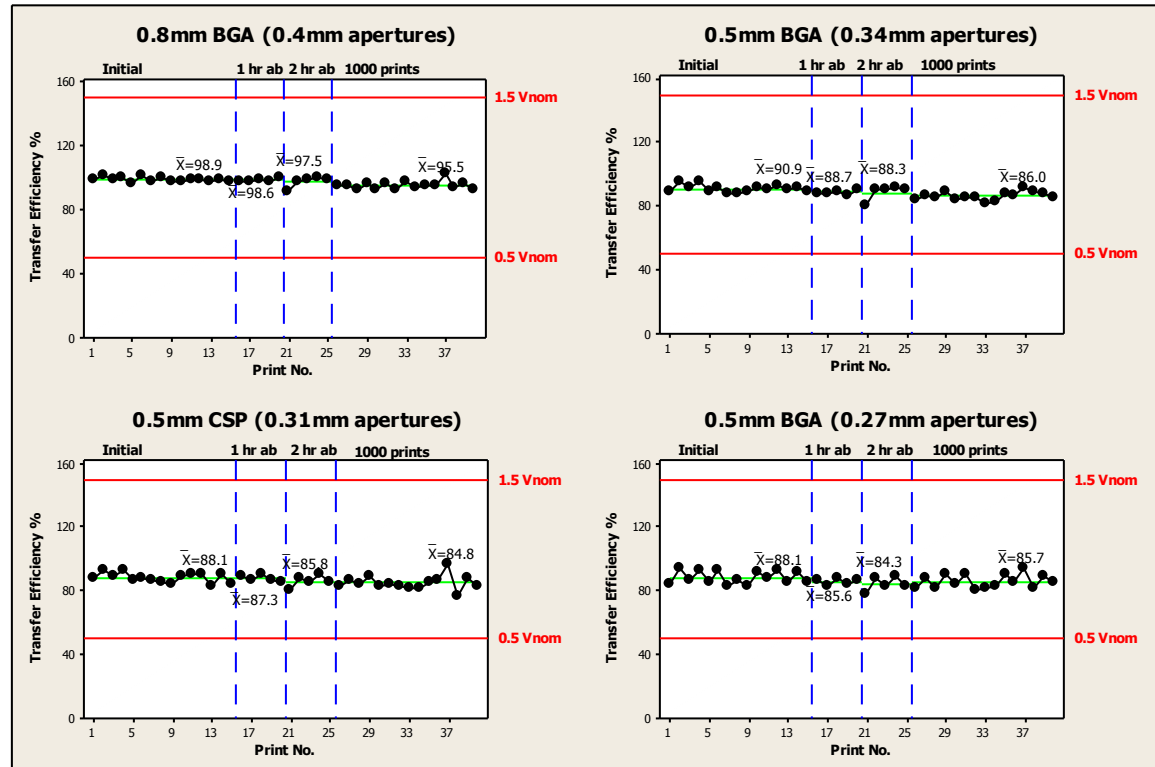


0.8mm BGA – 0.18mm round apertures, 120µm stencil thickness, 60mm/s,
Fast separation, 250mm squeegee, 10kg

Operating Parameters: Storage

Printing After Storage 12 months 25°C

- **Transfer Efficiencies**
- Excellent print capability after storage for 12 months @ 25°C
- No knead cycle required after 2hrs abandon
- Excellent print performance after 1000 cycles

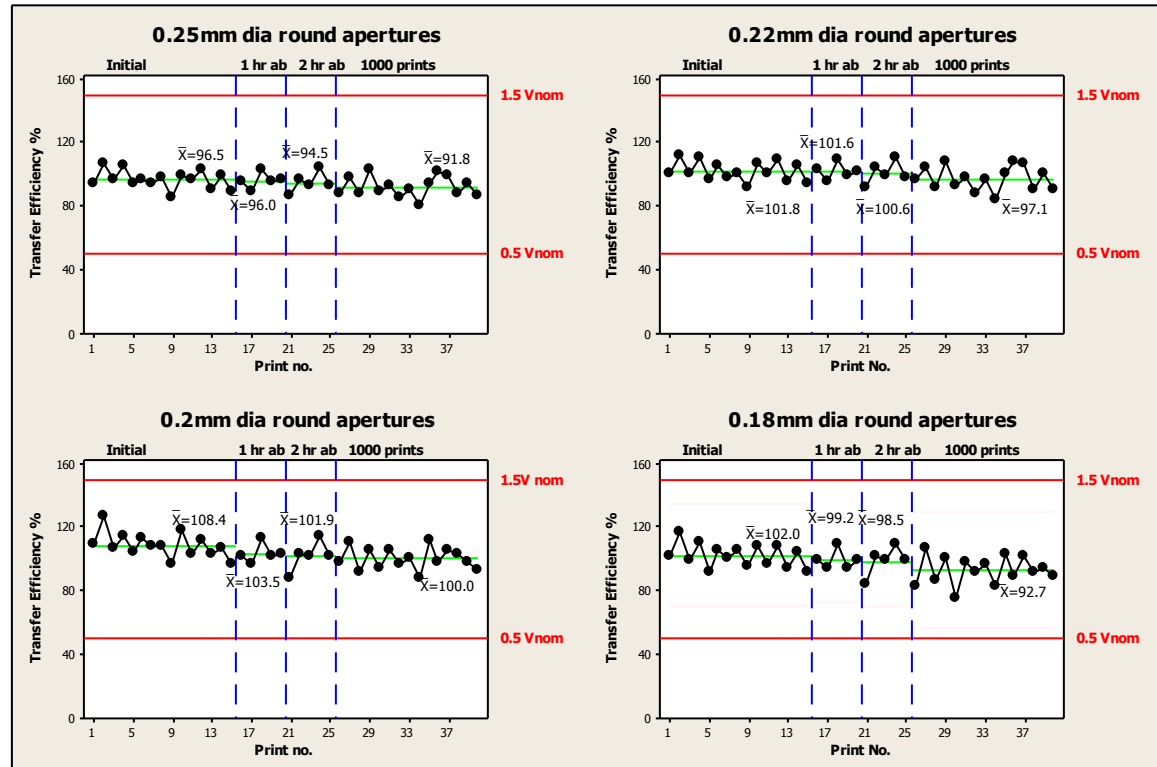


0.8mm BGA – 0.5mm BGA, 120µm stencil thickness, 60mm/s,
Fast separation, 250mm squeegee, 10kg

Operating Parameters: Storage

Printing After Storage 12 months 25°C

- **Transfer Efficiencies**
- Excellent print capability after storage for 12 months @ 25°C
- No knead cycle required after 2hrs abandon
- Excellent print performance after 1000 cycles

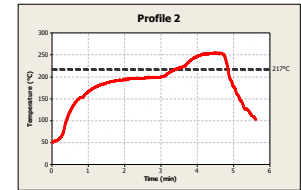
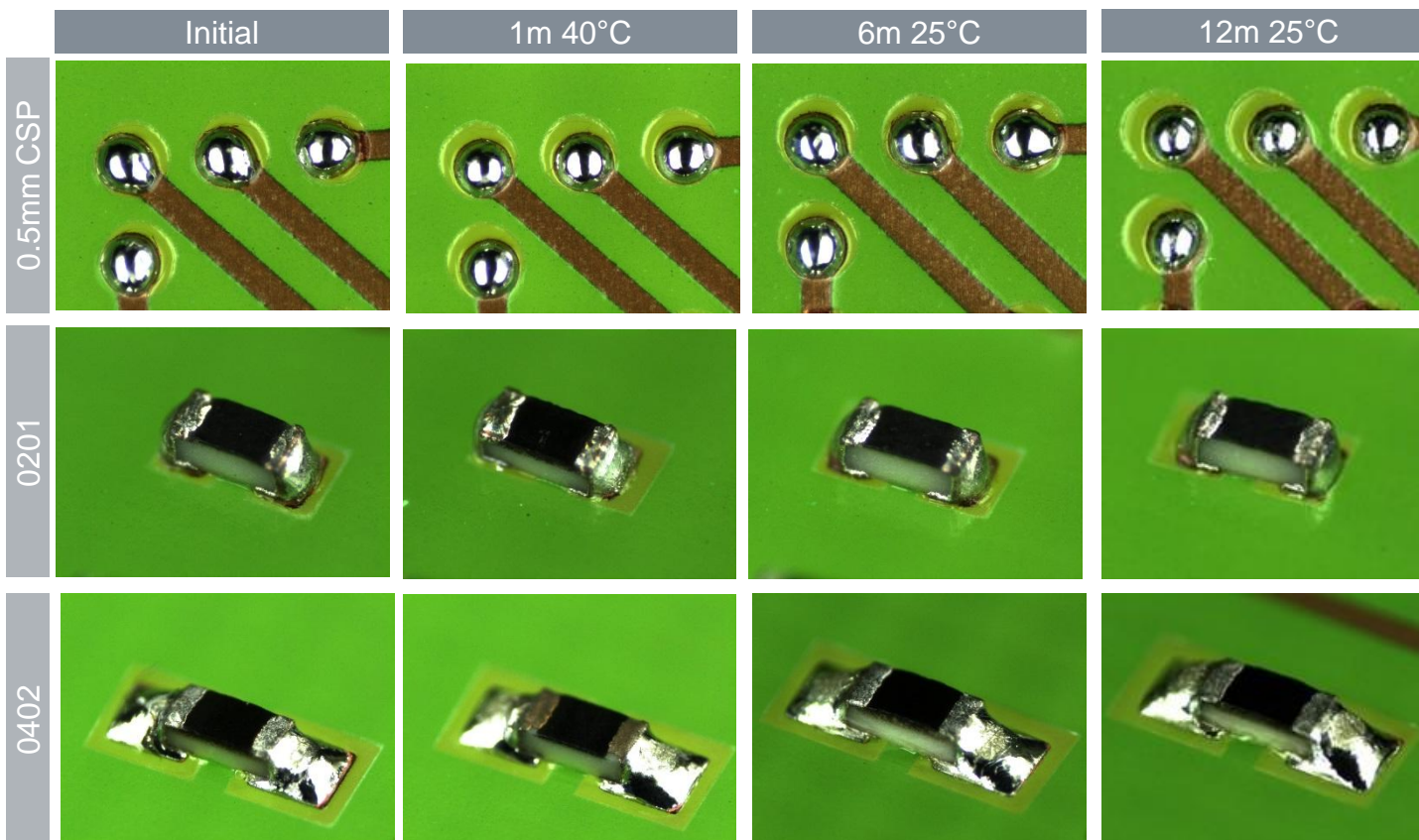


0.25mm – 0.18mm round apertures, 120µm stencil thickness, 60mm/s,
Fast separation, 250mm squeegee, 10kg

Operating Parameters: Storage

Reflow After Storage to 12months 25°C

After Paste storage



Contents

1. Performance Summary
2. Introduction: Properties, Features & Benefits
3. Operating Parameters
 - Printing: Process Window
 - Printing: Continuous and Abandon Time Testing
 - Slump Testing
 - Tack-Life Force
 - Reflow Process Window
 - Reflow Performance Testing
 - Voiding Data
4. Reliability and Specification Testing
5. Operating Parameters: Storage
 - Printing & Reflow Performance
- 6. Product Summary**

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 printing up to 125mm/s (5"/s)
- Optimized for long hot soak reflow profiles
- Excellent coalescence in air & nitrogen atmosphere
- Excellent humidity resistance
- Excellent solderability on challenging surface finishes, including CuNiZn
- Colourless residues for easy post-reflow inspection
- Long 12 month shelf-life when stored below 25°C

Thank you!



LOCTITE[®]



Excellence is our Passion