

# Engineering Manual

# LOCTITE GC 10 Solder Paste

**Suitable for use with:** Standard SAC Alloys

**LOCTITE**<sup>®</sup>

GC 10 – The Game Changer



Excellence is our Passion

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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

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# Introduction

## Basic Solder Paste Properties

Flux Description	GC 10
Alloy	SAC305
Henkel Powder Size	Type 4
Powder Size range, $\mu\text{m}$	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

<b>Product Attribute</b>	<b>Process Benefit</b>
Halogen Free	<ul style="list-style-type: none"><li>• No added halogen</li><li>• Measured &lt;900ppm chlorine and bromine and &lt;1,500ppm total by oxygen (O<sub>2</sub>) bomb test</li></ul>
Halide Free	<ul style="list-style-type: none"><li>• Flux classification ROL0 in accordance to J-STD-004B</li></ul>
Application	<ul style="list-style-type: none"><li>• Designed for printing and pin-in-paste</li><li>• Excellent wetting to a broad range of metallisations, even through long hot soak profiles in an air atmosphere</li><li>• Compatible with existing halogen free solutions</li><li>• Suitable for medium to large board assemblies</li><li>• Designed for long 12 month shelf-life stability without impact to printing or reflow</li></ul>

# Introduction

## GC 10 Features & Benefits

Product Attribute	Process Benefit
Technology Printing Advantages	<ul style="list-style-type: none"><li>• Wide process window for printing and minimal slump</li><li>• Fine pitch abandon time of up to 2 hours; work life &gt; 16 hours</li><li>• Fine pitch capability and reduction in solder bridging</li><li>• Suited for high throughput production, where yield consistency on print deposits is key</li><li>• Improved paste transfer efficiency</li><li>• Allows on line paste utilisation protocols to be re-written</li></ul>
Technology Reflow Advantages	<ul style="list-style-type: none"><li>• Optimised for long hot soak reflow processes</li><li>• Very shiny Pb-free solder joints over wide range of reflow</li><li>• Excellent fine pitch coalescence</li><li>• Excellent humidity resistance</li><li>• Excellent solderability on challenging surface finishes (ENIG, Copper OSP, CuNiZn and Imm Ag)</li></ul>
Low Voiding	<ul style="list-style-type: none"><li>• Low void levels increases solder joint reliability</li><li>• New chemistries allow pursuit of class 3 void levels in accordance to IPC7095B on industry surface finishes: ENIG, Copper OSP, CuNiZn and Imm Ag</li><li>• Low voiding in CSP</li></ul>
Residues	<ul style="list-style-type: none"><li>• Clear, transparent and colourless</li><li>• Pin testable after 5x reflows</li></ul>



# Contents

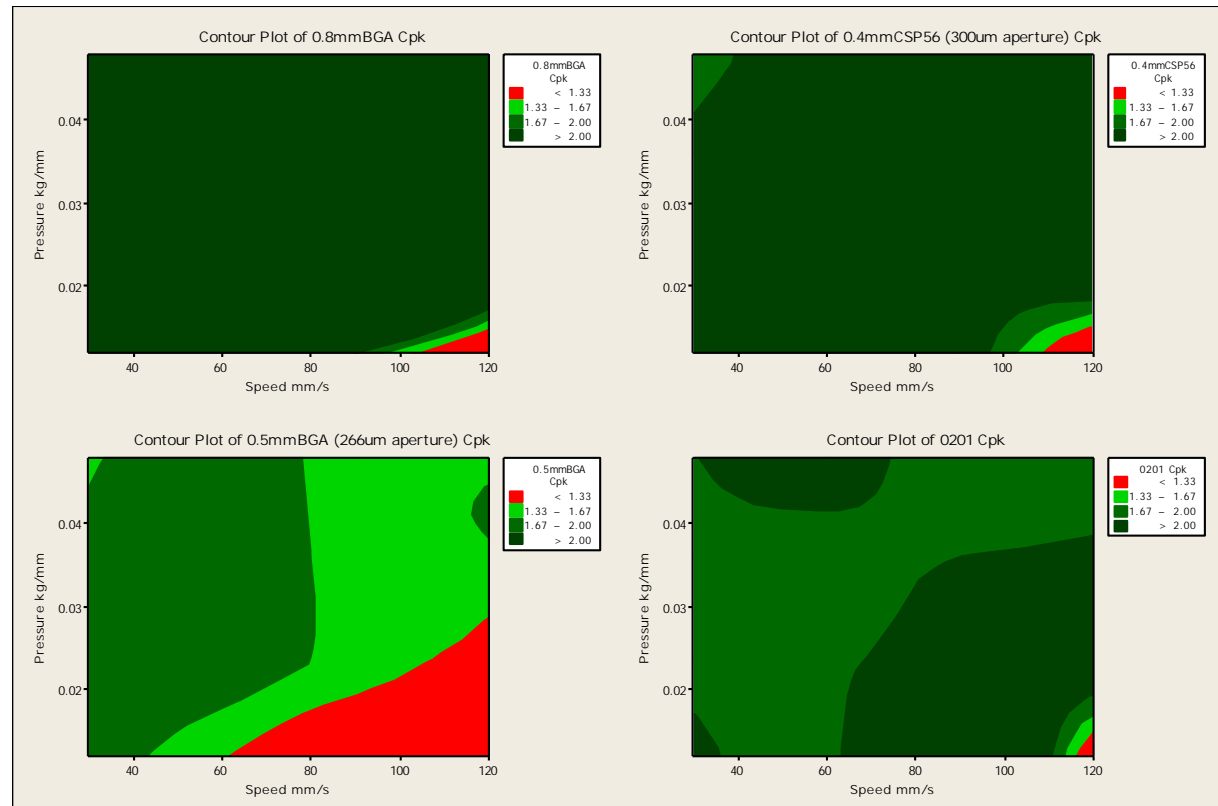
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# Operating Parameters

## Print Process Window

### (LOCTITE GC 10 SAC305 T4 885V)

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



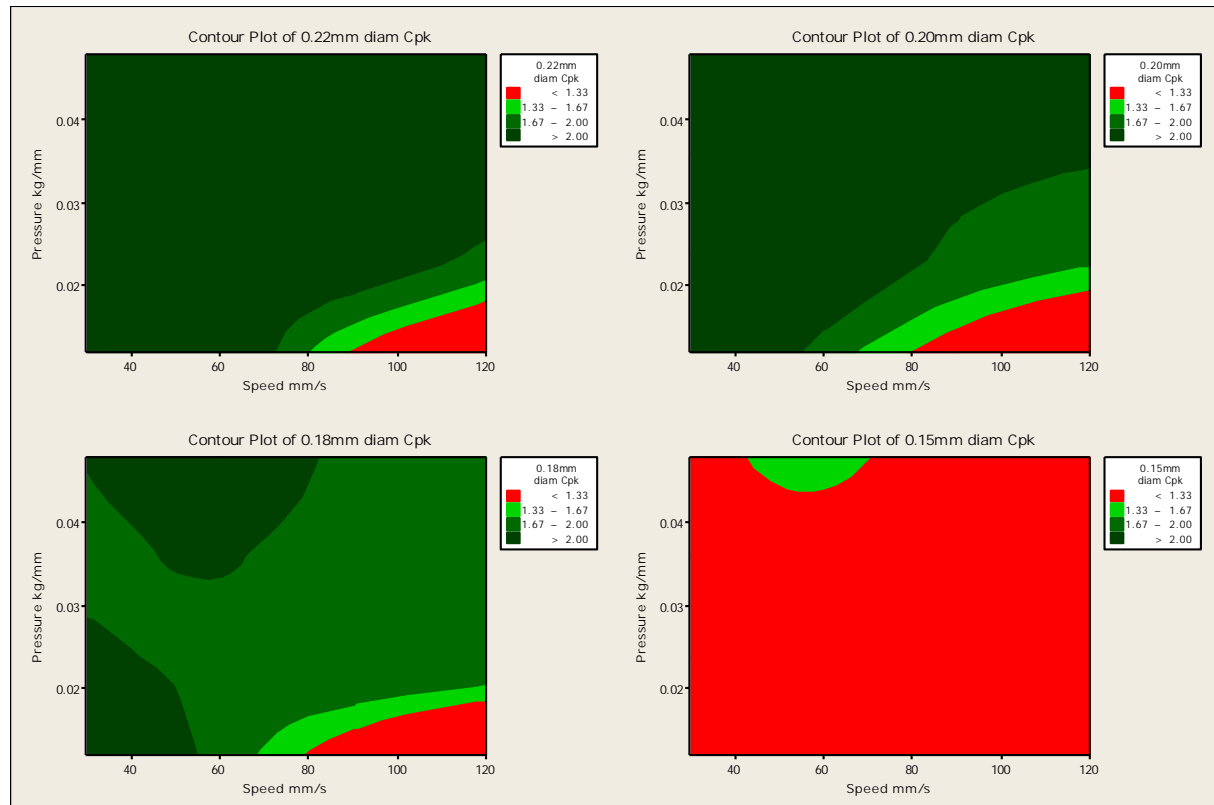
0.8mm, 0.5mm & 0.4mm round apertures, 0201 (100µm stencil)

# 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



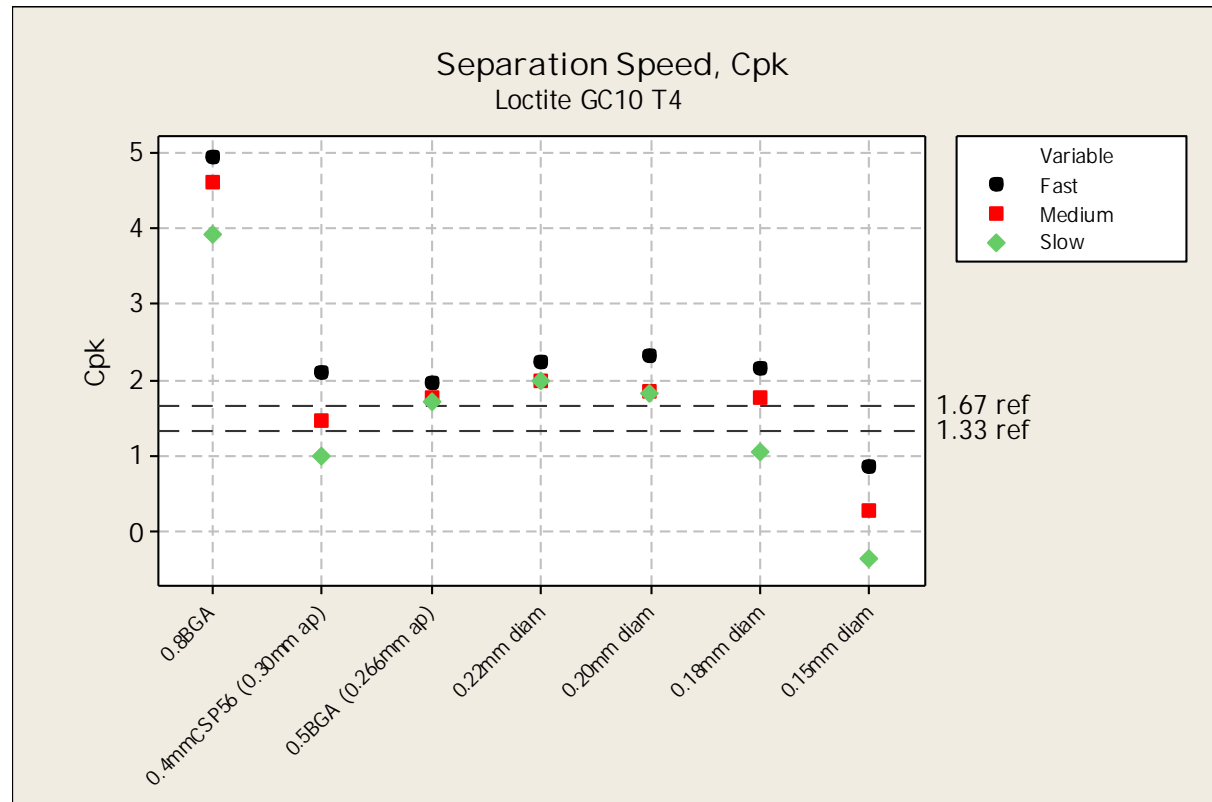
0.22mm – 0.15mm round apertures, (100µm stencil)

# 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.

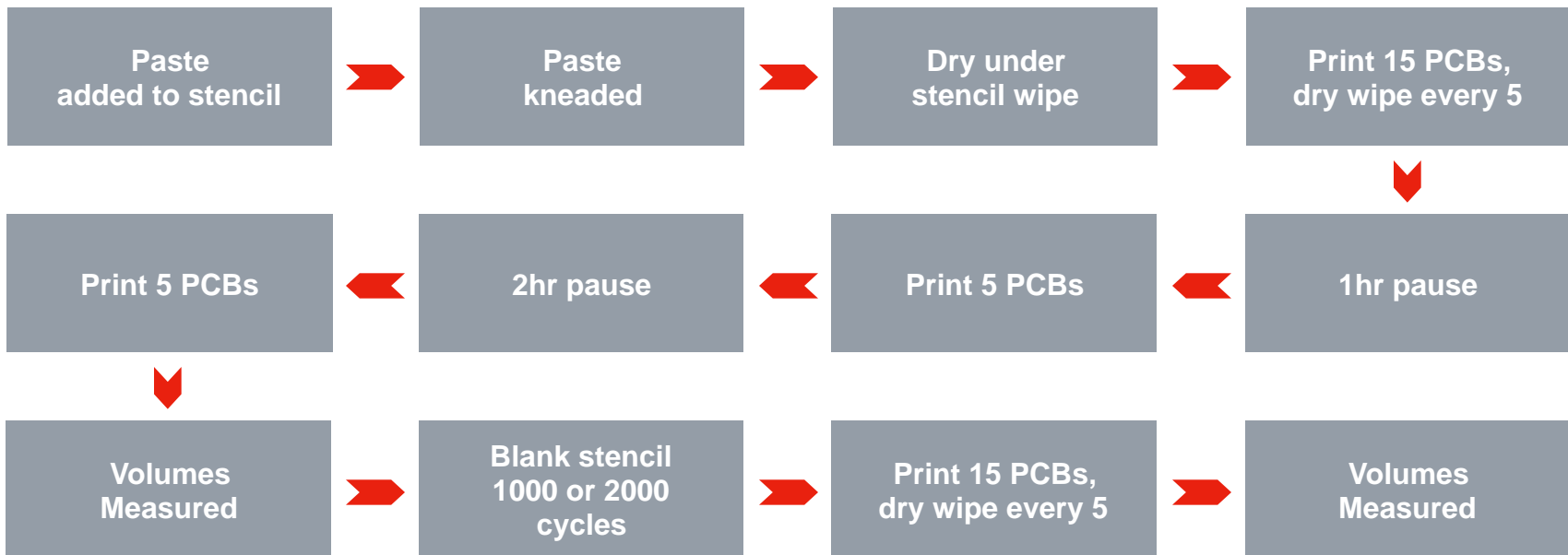


0.8mm BGA – 0.15mm round apertures, (100 $\mu$ m stencil) 100 $\mu$ m stencil thickness, 60mm/s

# 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



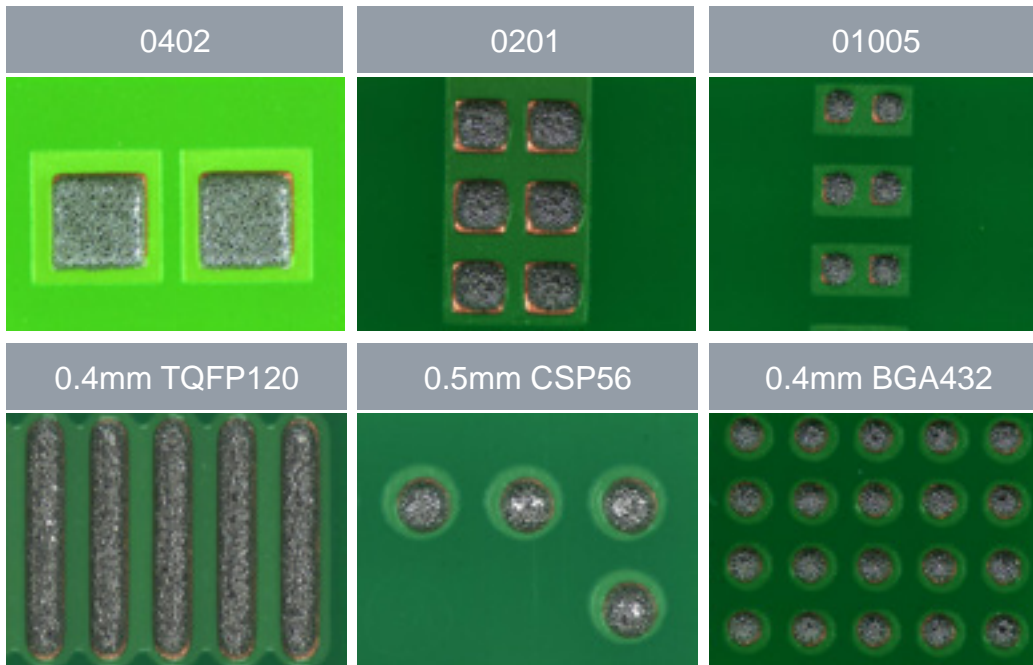
- Printing
- DEK Europa
- Stainless steel, laser cut
- 100µm thickness
- Vacuum tooling

- 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

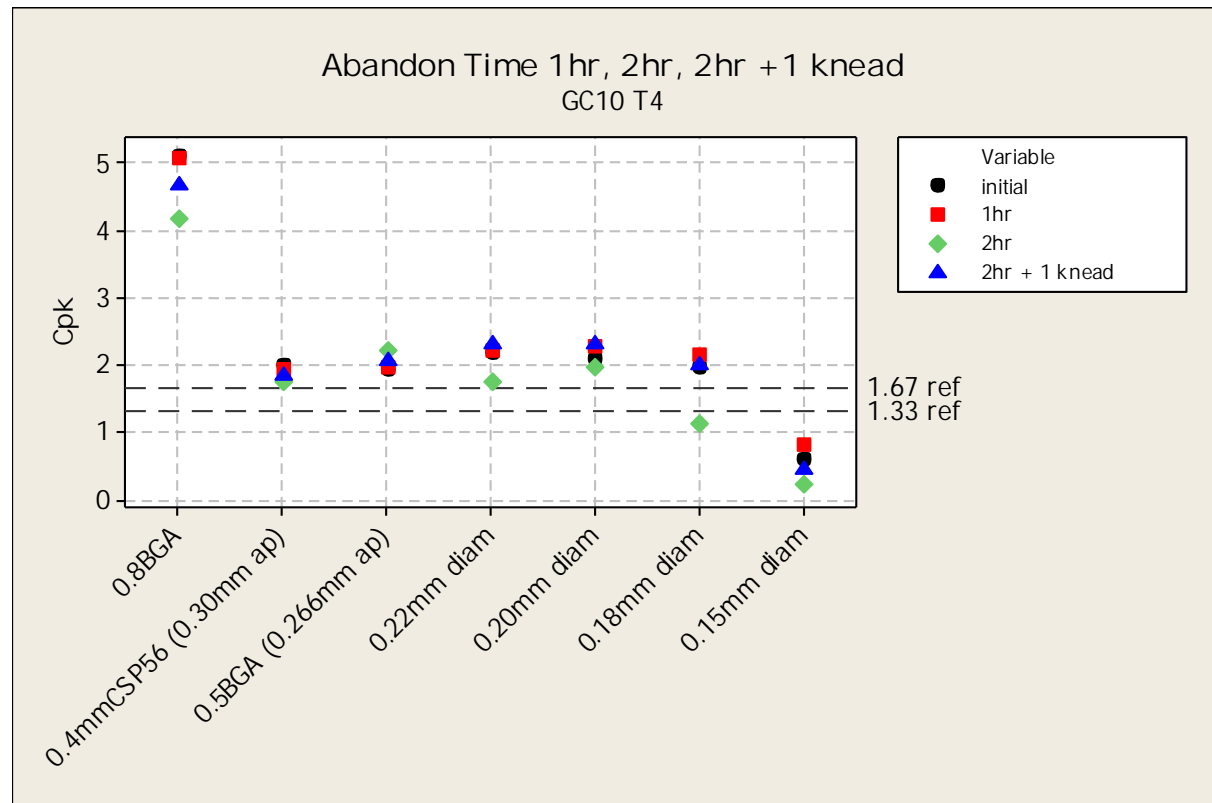


# Operating Parameters

## – 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)

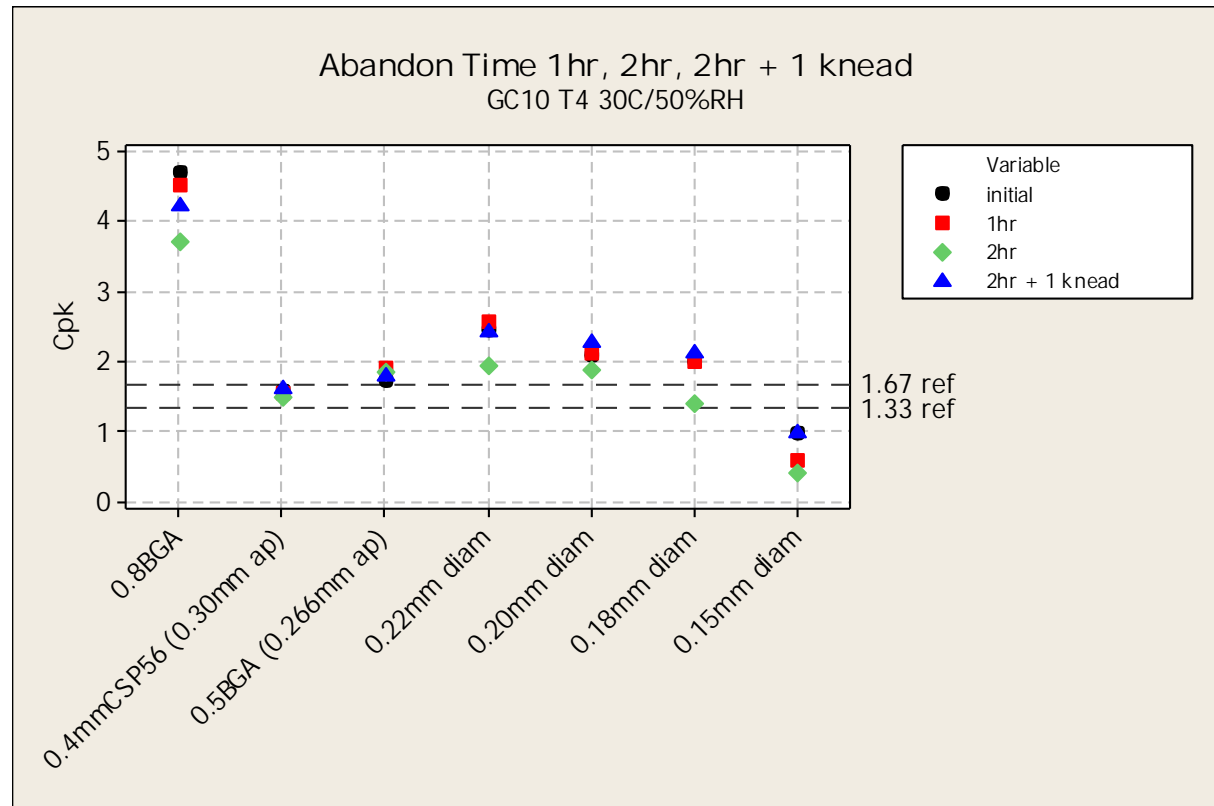
100µm stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 8kg

# 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

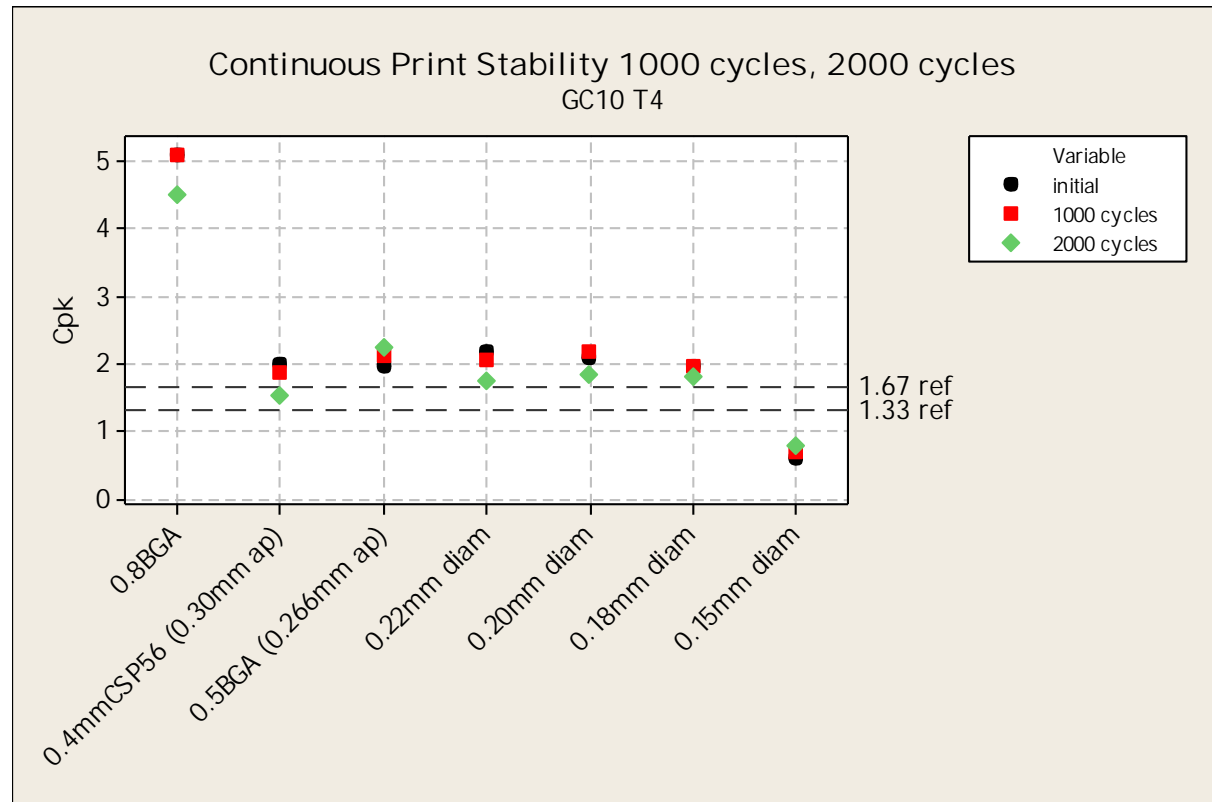


# Operating Parameters

## – Continuous Print Stability

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

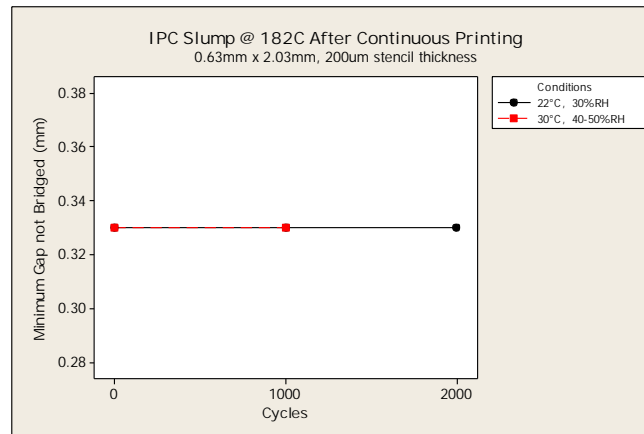
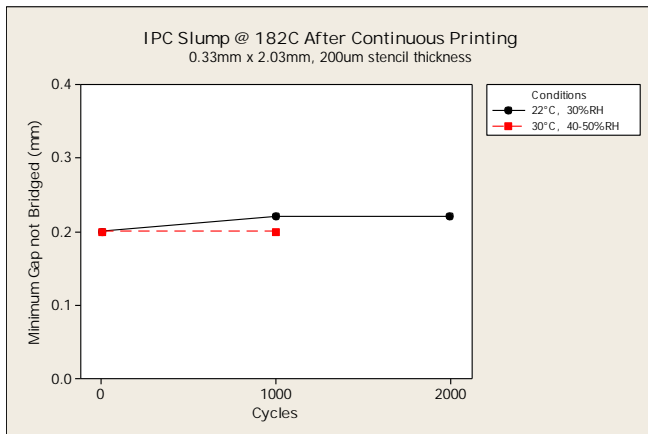
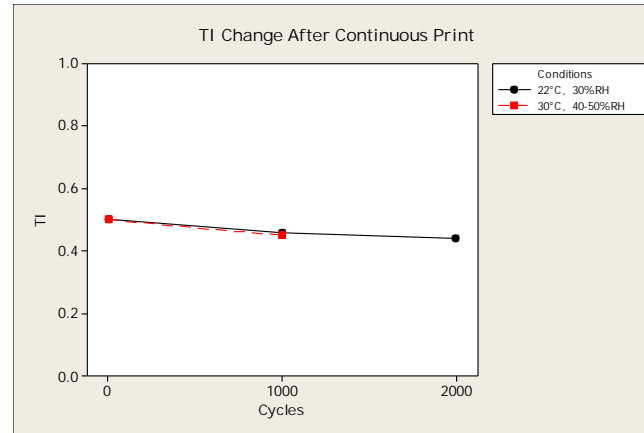
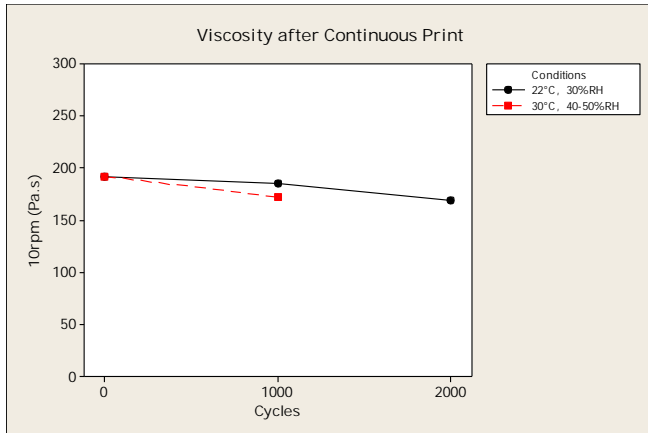
- No impact on print performance after 4 hours (1000 cycles) and 8 hours (2000 cycles) printing



0.8mm BGA – 0.15mm round apertures, (100µm stencil)  
 100µm stencil thickness, 60mm/s, Fast separation, 250mm squeegee, 8kg

# Operating Parameters

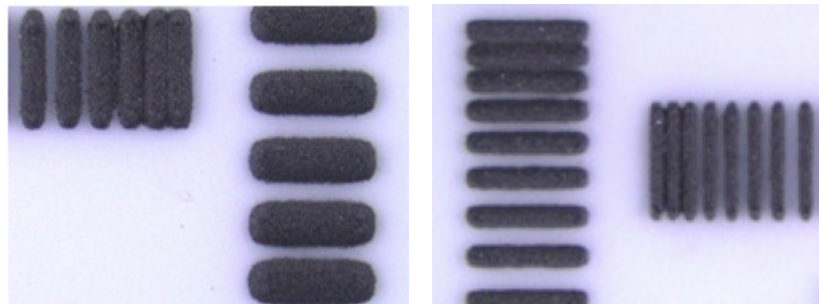
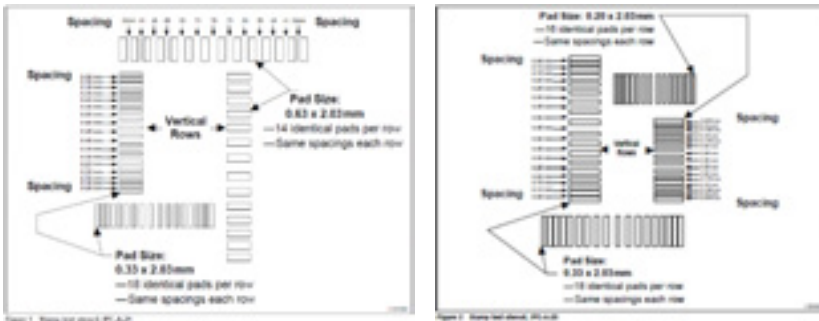
## Paste Properties After Continuous Printing



# 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

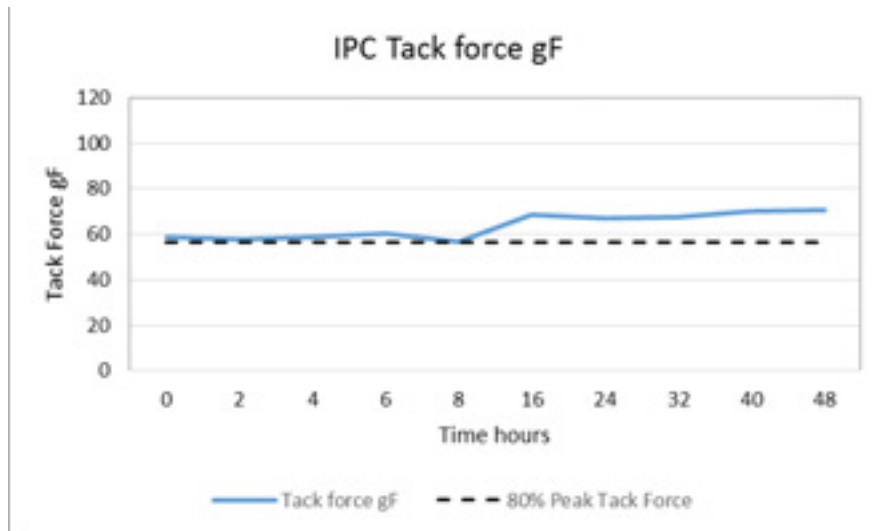
A20  
100µm

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
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

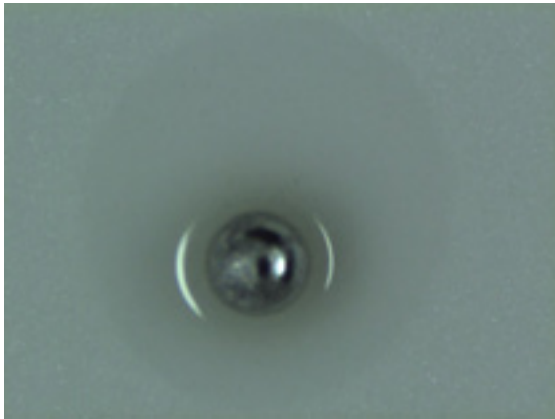
Preload	300g
Preload time	5 secs
Retraction Speed	2.5mm/sec
Deposit diameter	5.1mm
Deposit height	0.25mm

# Operating Parameters

## Solder Balling

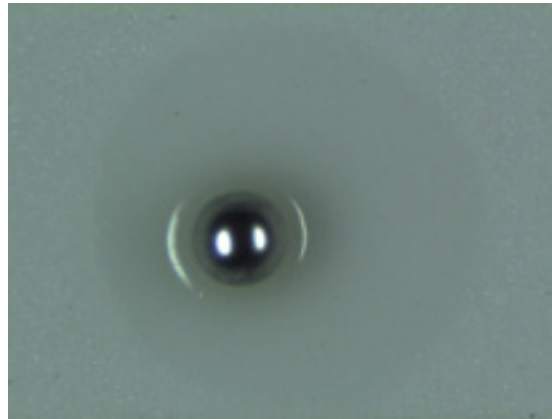
- Solder balling performance as been assessed in accordance with an extended version of IPC-TM-650 2.4.4.3
- Clear and colourless residues observed post-reflow

**Initial**



Preferred Pass

**24hrs 25°C 50% RH**

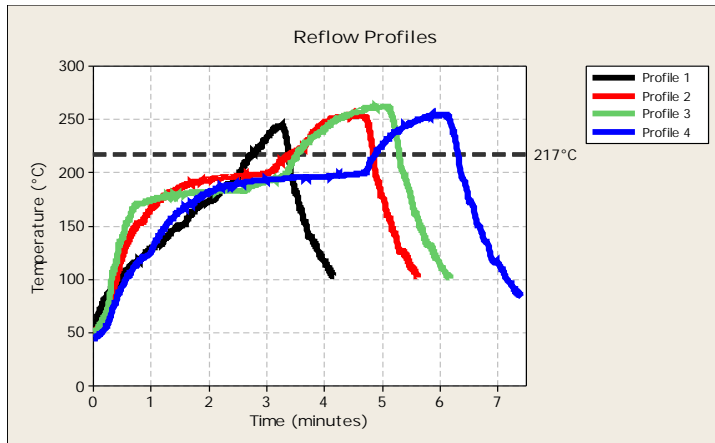


Preferred Pass

# Operating Parameters

## Reflow Process Window (Air)

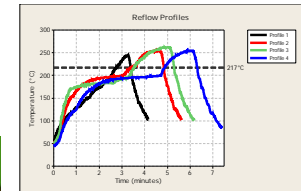
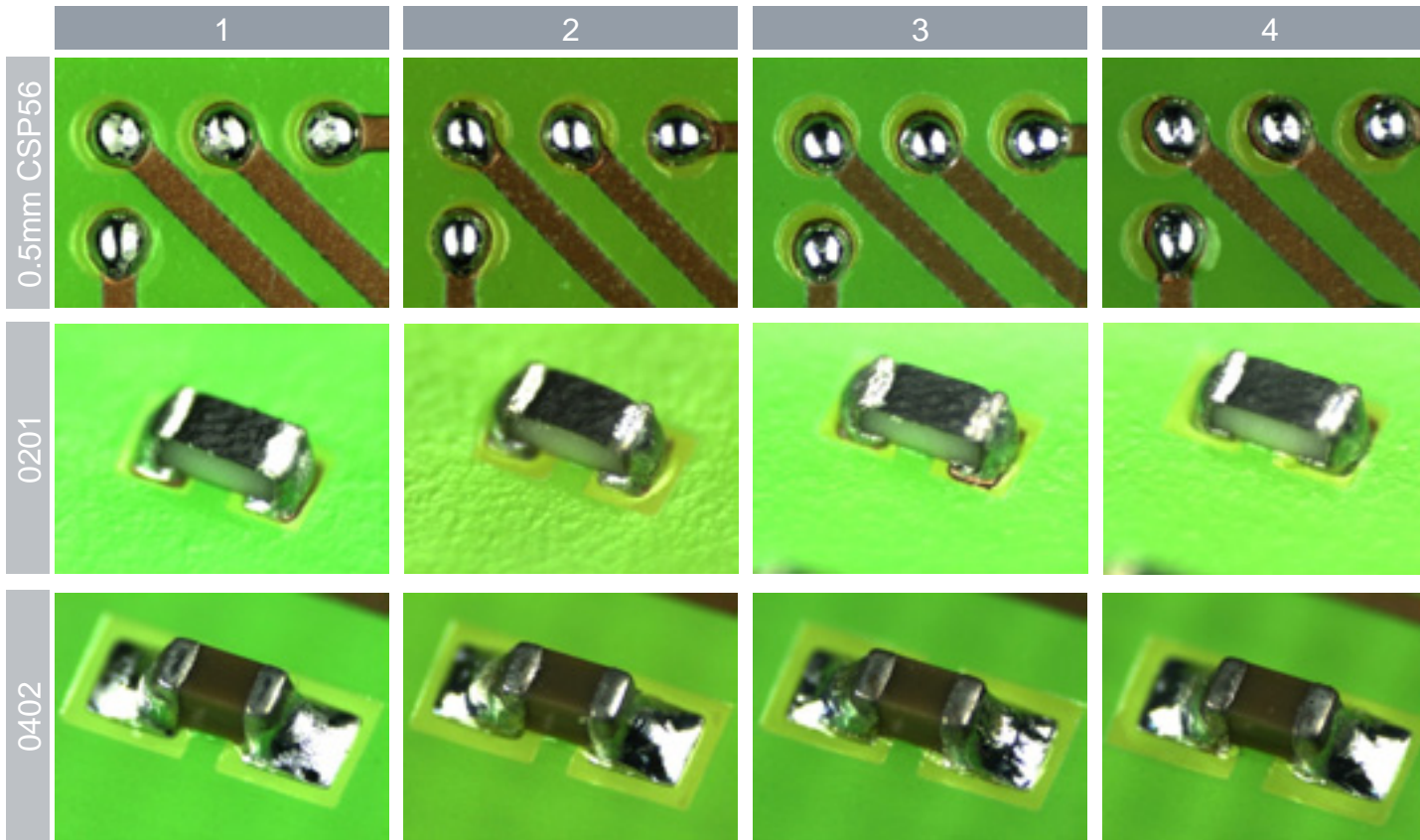
- LOCTITE GC 10 solder paste offers halogen containing reflow performance in a truly halogen free formulation
- GC 10 shows excellent coalescence onto a range of PCB and component finishes especially during long-hot profiles
- There is no single profile that works for all applications and each process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

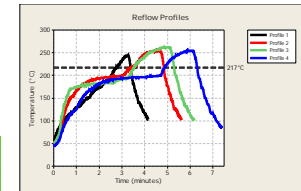
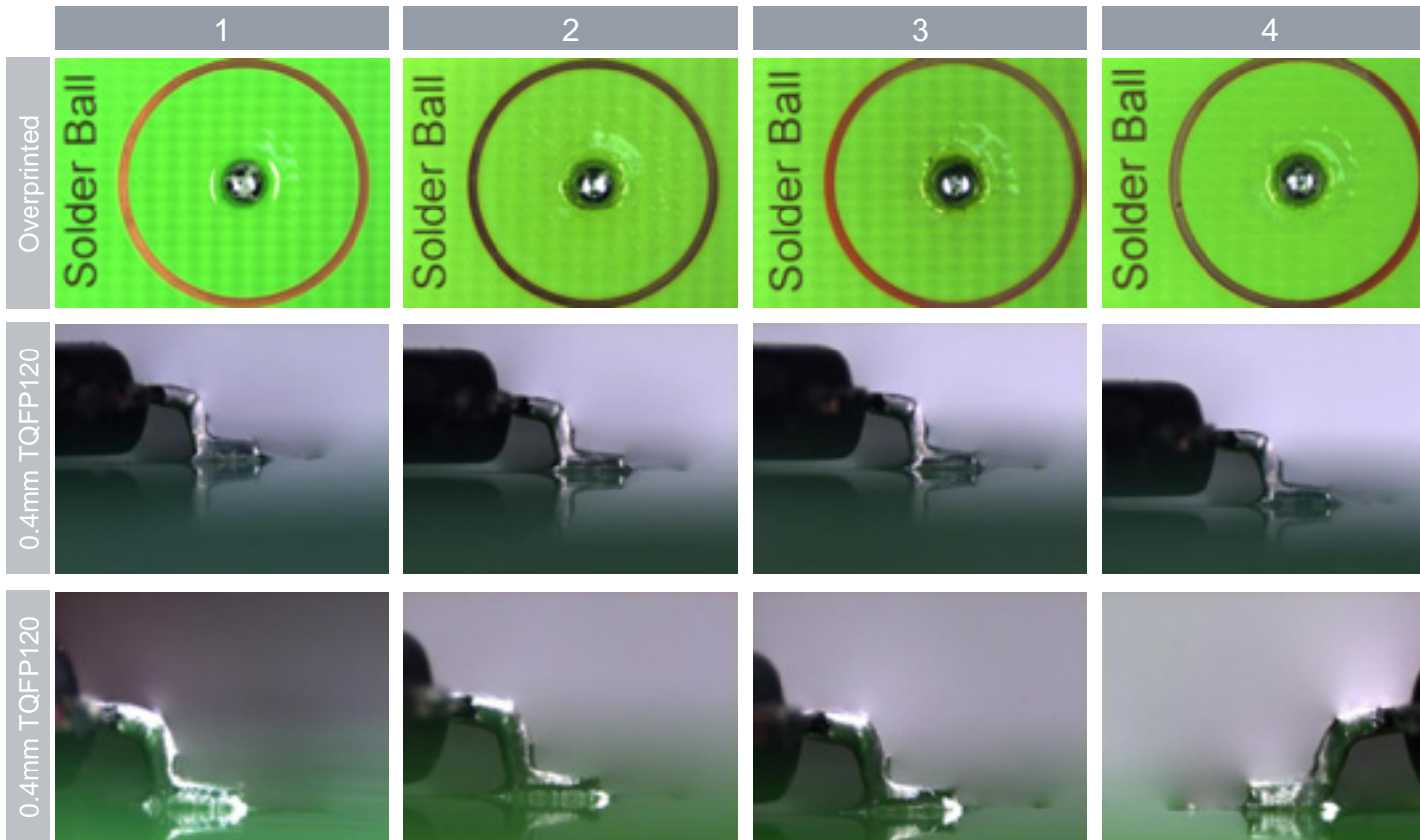
# Operating Parameters (Reflow)

## Reflow Profile



# Operating Parameters (Reflow)

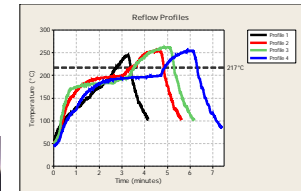
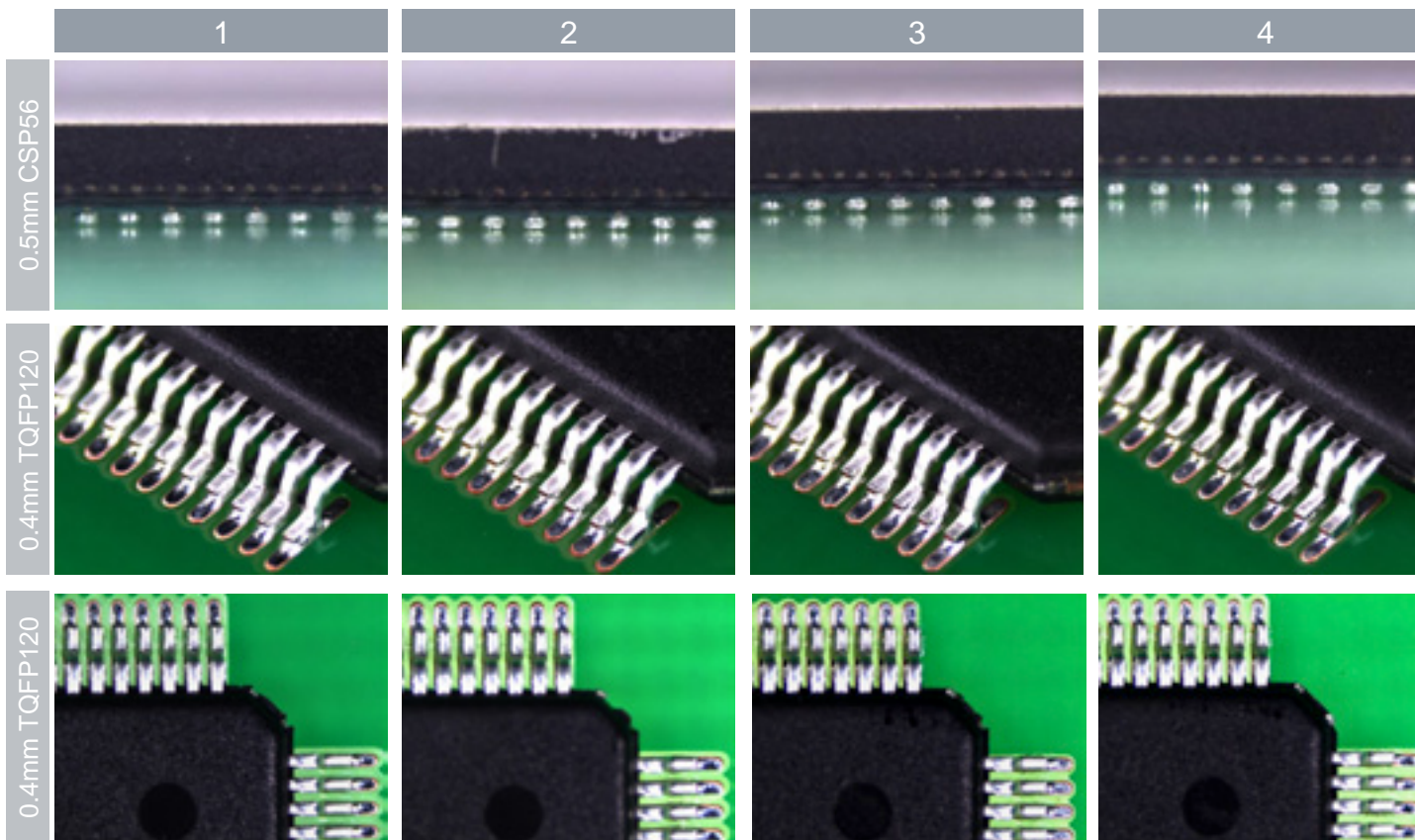
## Reflow Profile





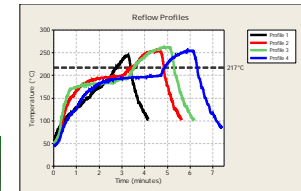
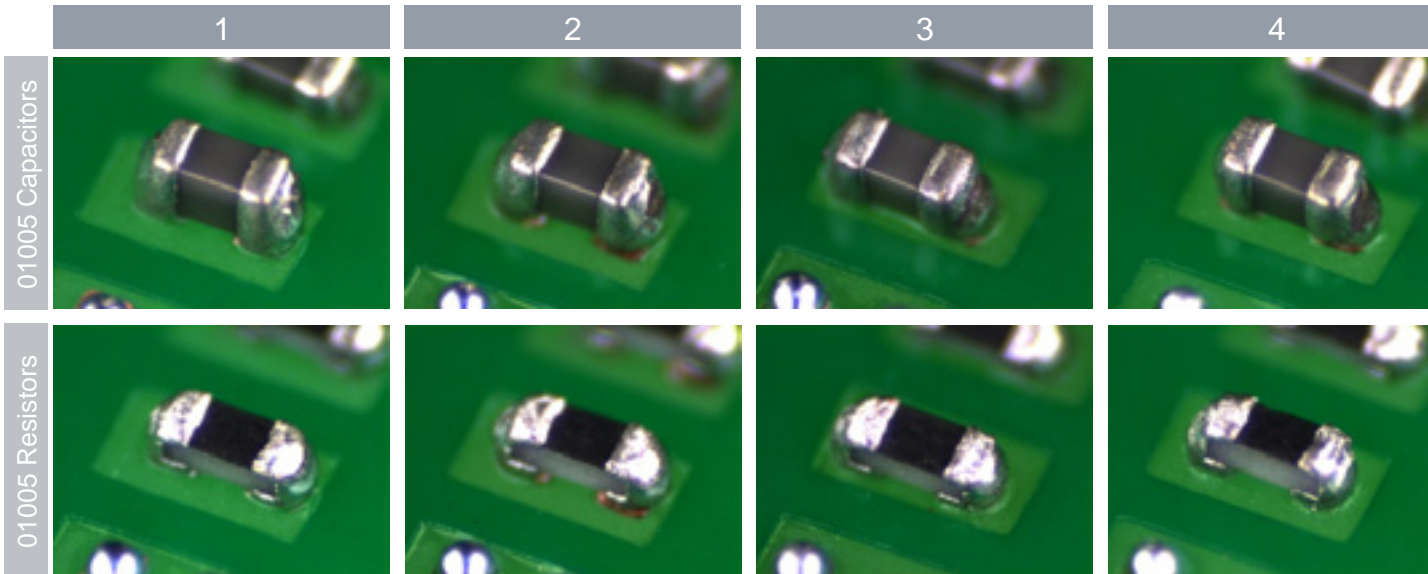
# Operating Parameters (Reflow)

## Reflow Profile



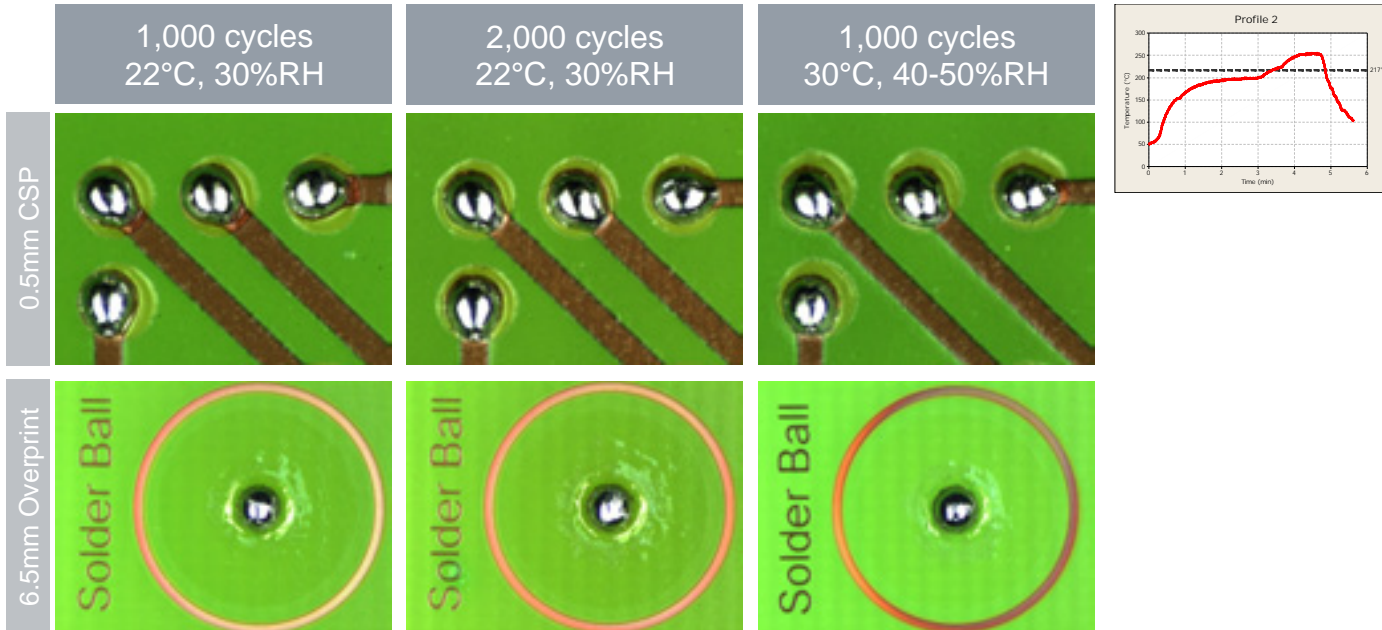
# Operating Parameters (Reflow)

## Reflow Profile



# Operating Parameters (Reflow)

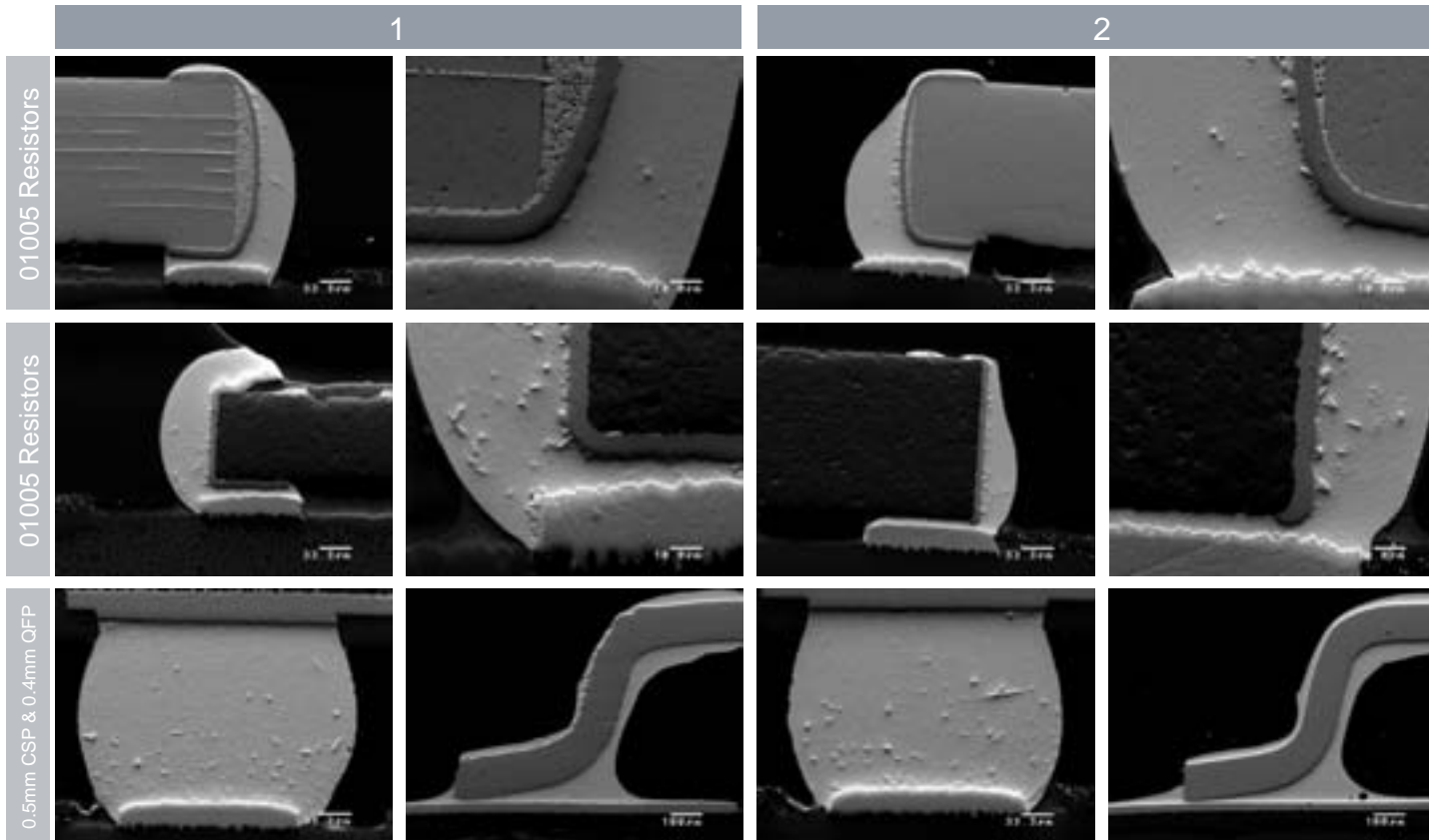
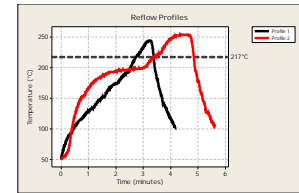
## Paste Properties After Continuous Printing



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

# Operating Parameters (Reflow – GC10)

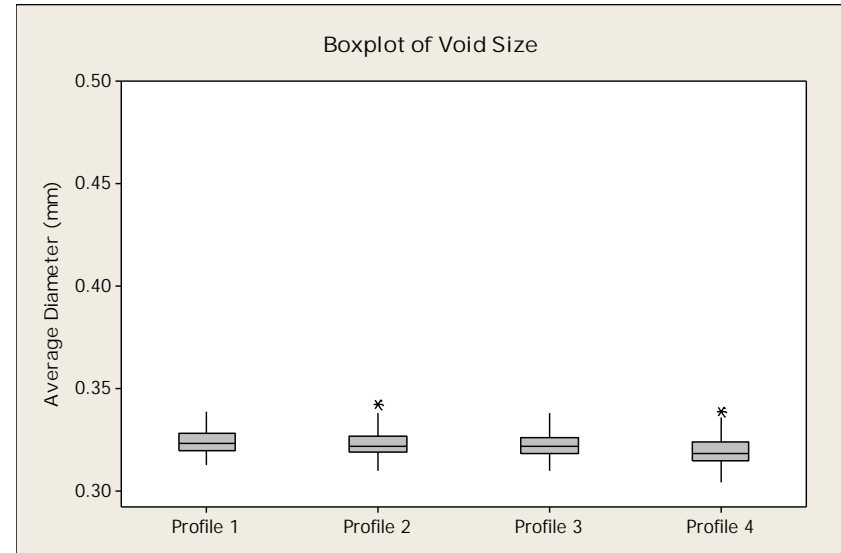
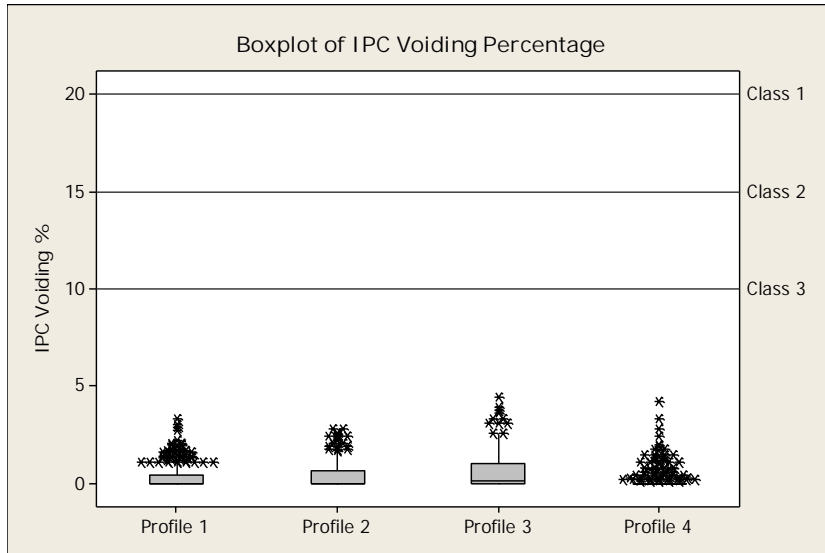
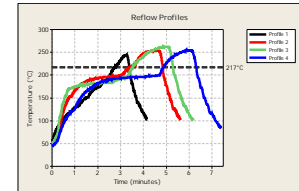
## Reflow Profile



# Operating Parameters

## Voiding

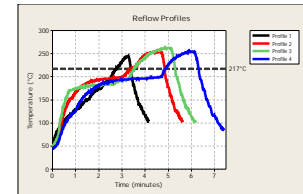
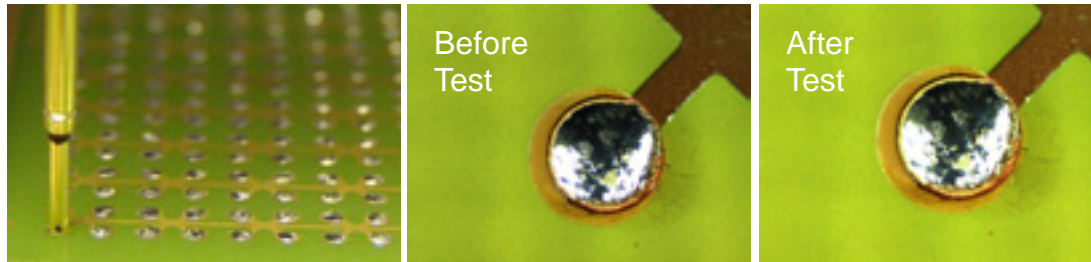
- Void performance assessed using 4 different reflow profiles
- GC 10 shows low levels of voiding over a range of profiles
- Void Percentage analysed in accordance with IPC7095B



**GC 10 meets IPC7095B class 3**

# Operating Parameters

## Pin Testing



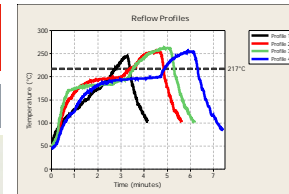
Board	
Stencil	100µm
Pads	500 pads per board, 2 boards tested
Probe	0.9mm 4 point plain crown light spring probe 100g spring force
Profiles	4 reflow profiles
No. of reflow	1, 2, 3 & 4 passes through oven
Atmosphere	Air & 1000ppm O <sub>2</sub>
Time after reflow	1 day, 1 week

# 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%

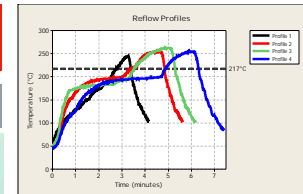


# Operating Parameters

## 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%

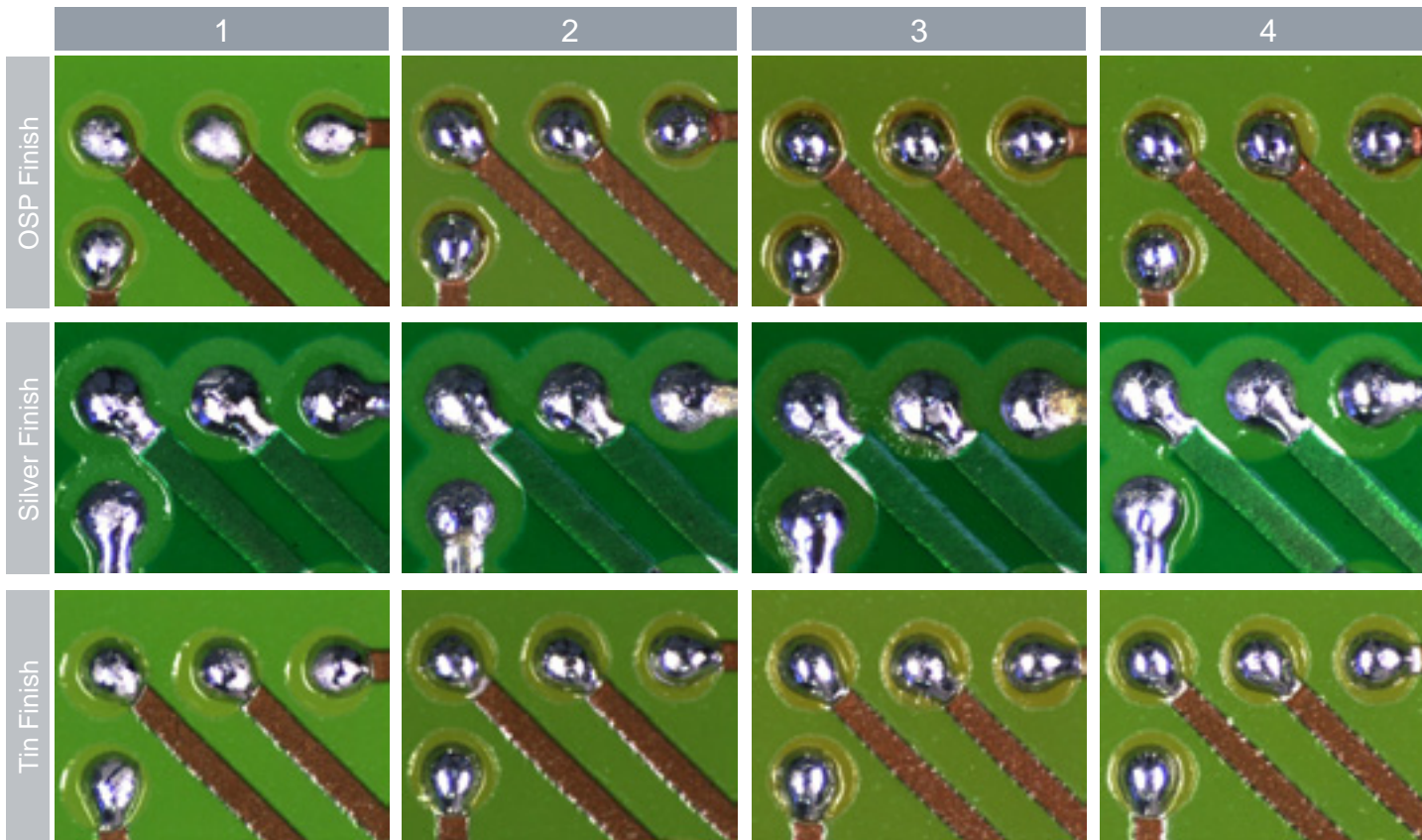
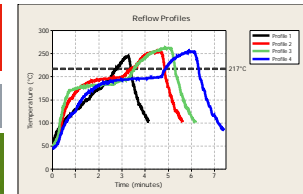




# Operating Parameters

## Surface Finish

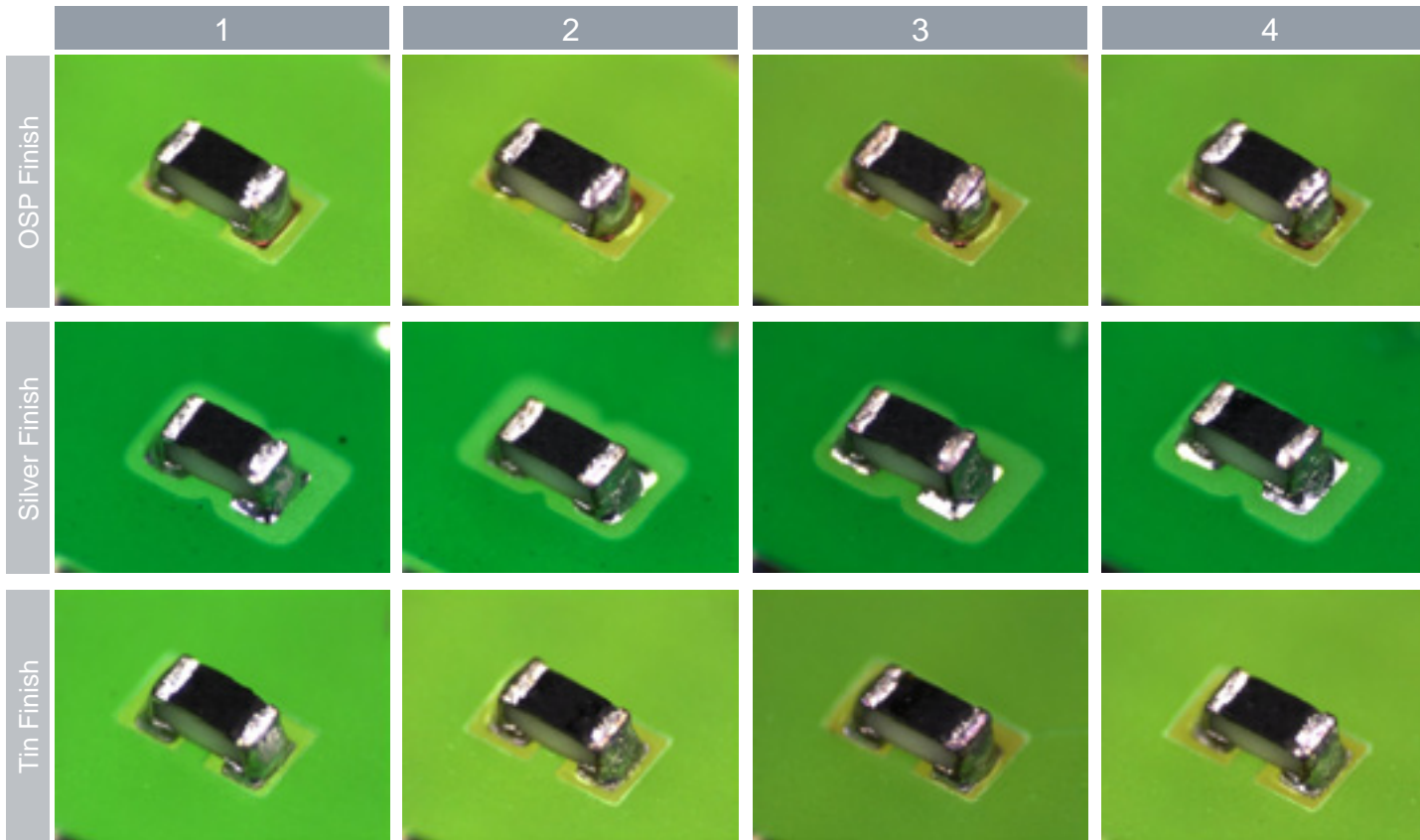
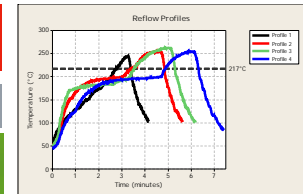
Reflow Profile (0.5mm CSP56)



# Operating Parameters

## Surface Finish

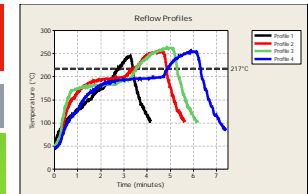
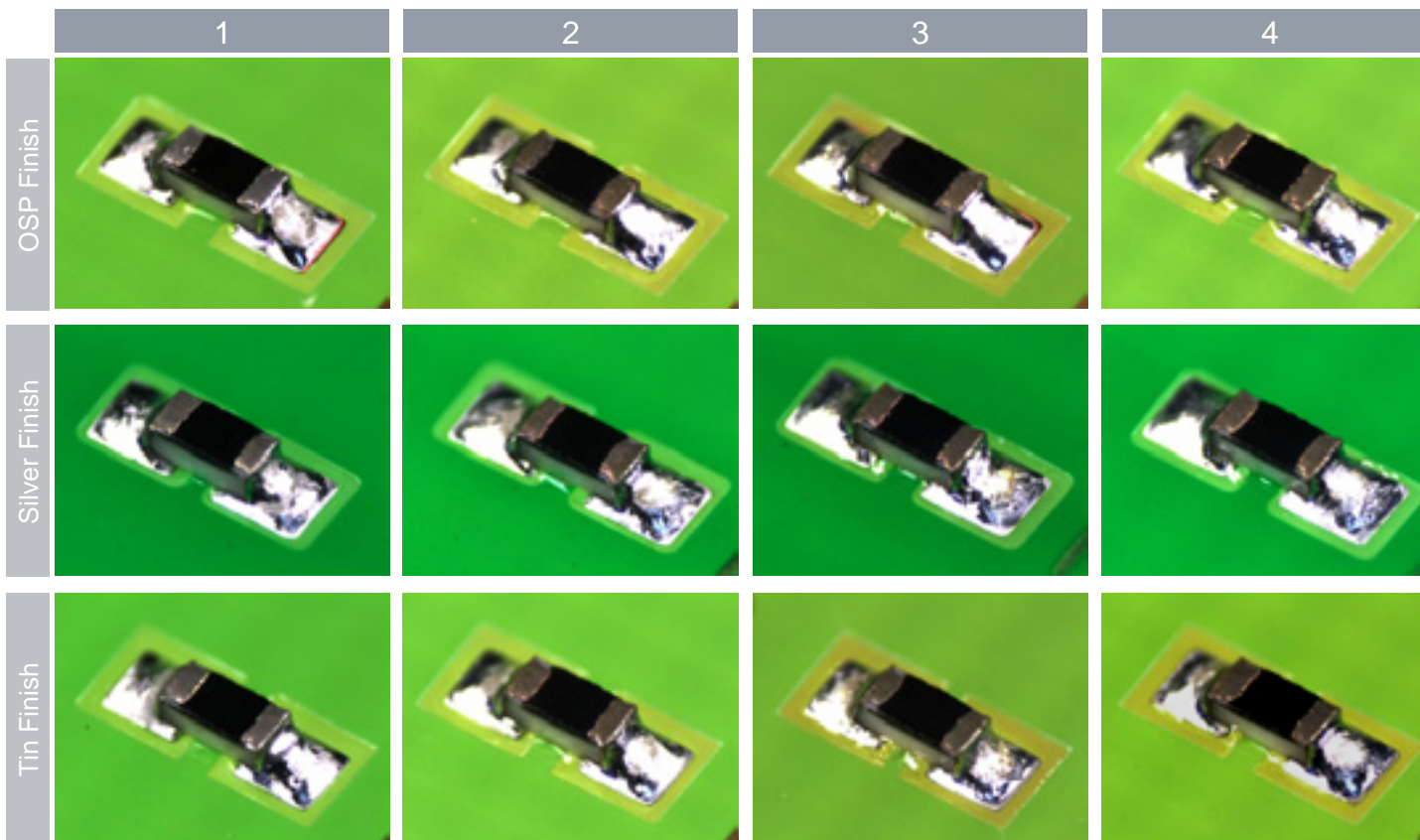
Reflow Profile (0201)



# Operating Parameters

## Surface Finish

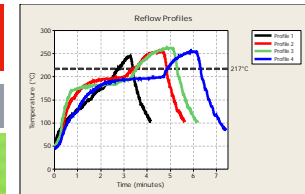
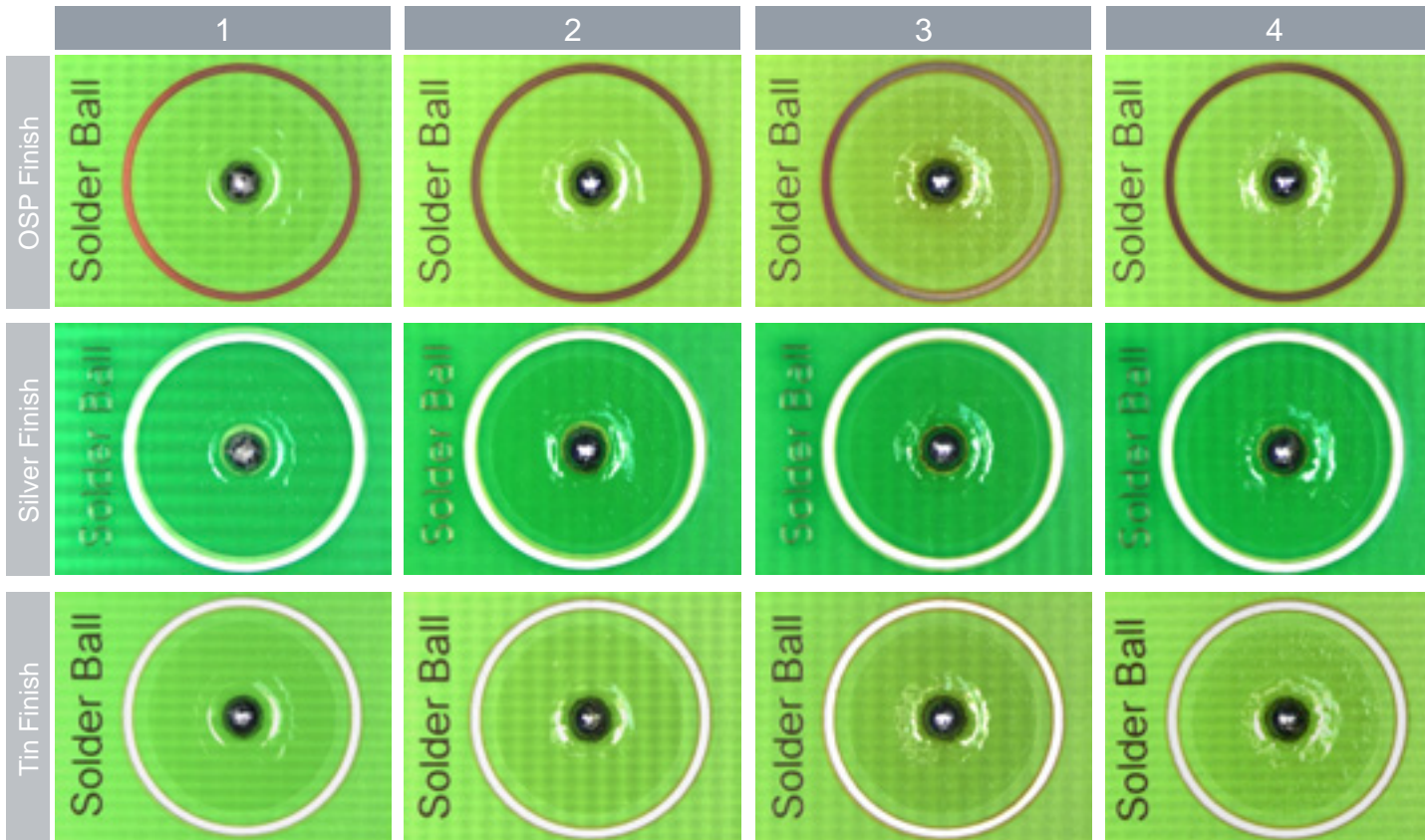
Reflow Profile (0402)



# Operating Parameters

## Surface Finish

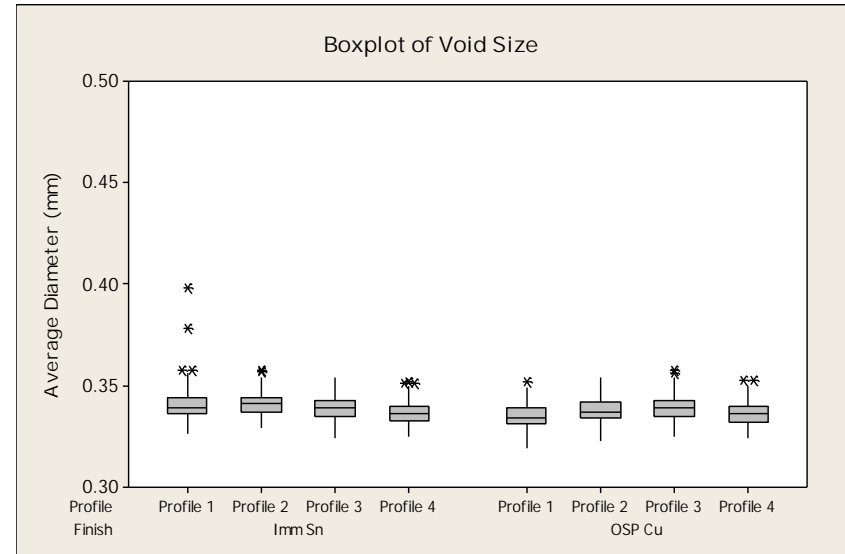
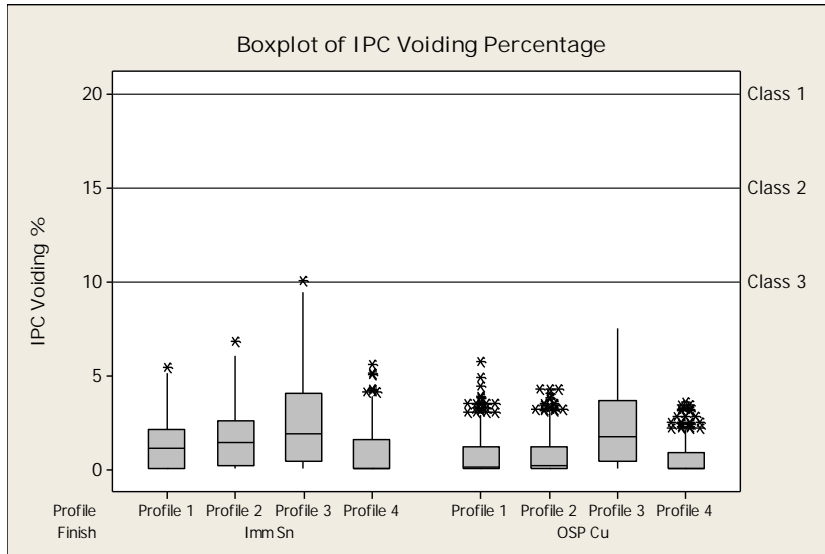
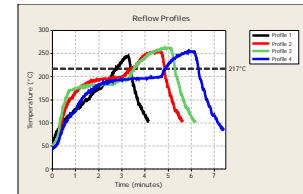
Reflow Profile (6.5mm overprint)



# 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**

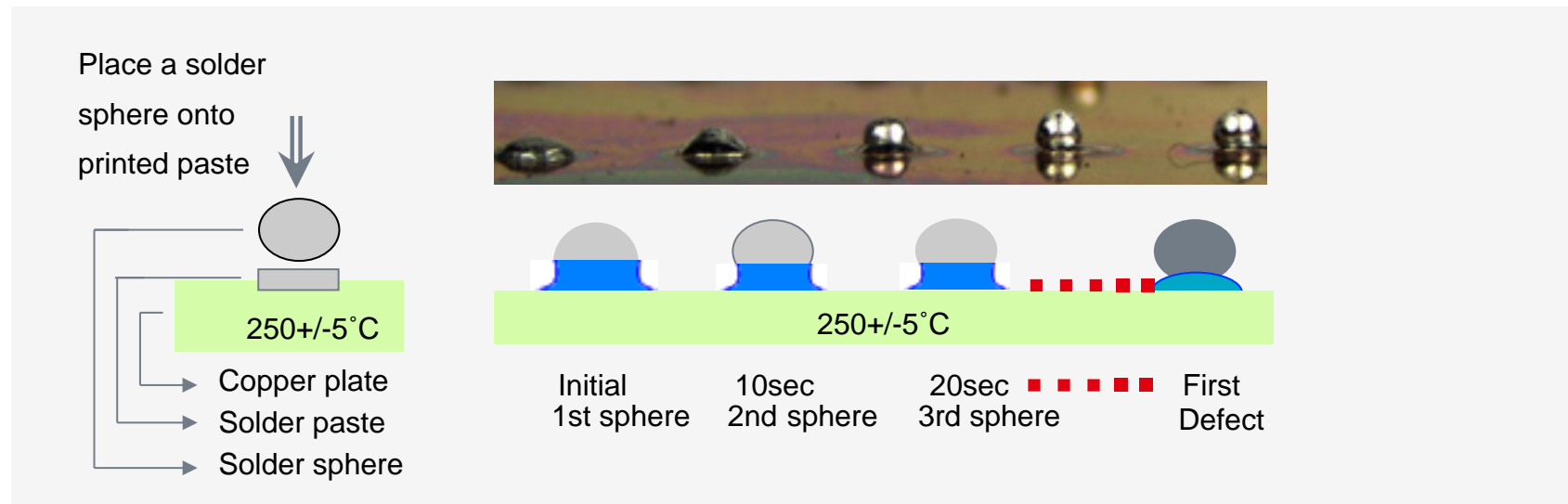
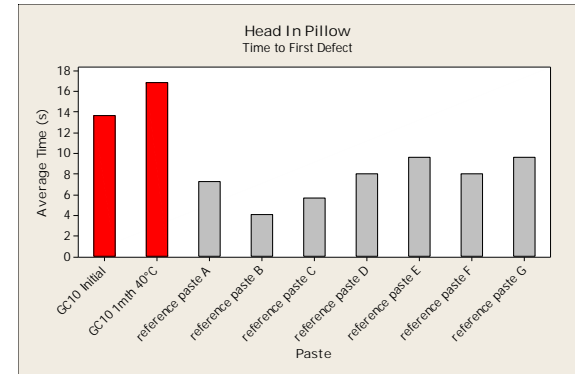
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# Reliability and Specification Testing

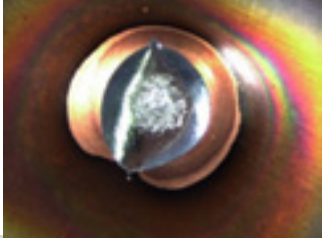
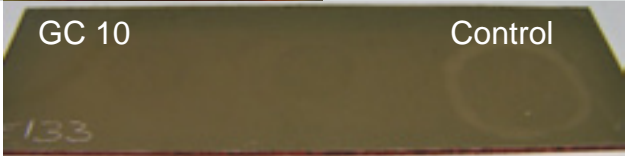
## Head- in Pillow Test

- Print solder paste on a Cu plate, 0402 pad, stencil thickness 125 $\mu$ 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	
	Cu Corrosion	Pass	
ANSI/ J-STD-004B	Cu Mirror	Pass	
	Halogen	Pass	(no added halogen)
	Surface Insulation Resistance	Pass	$6.0 \times 10^{11}$ Ohms after 7days
	Electromigration	Pass	$5.0 \times 10^{10}$ Ohms after 21days

**GC 10 J-STD-004B classification ROL0**



# Reliability and Specification Testing

## 3<sup>rd</sup> 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



**SGS**

**Test Report** No. : CE0914JA1482 Date : 2014/10/14 Page 2 of 4

HENKEL CORPORATION  
1400 JAMBOREE ROAD, IRVINE, CALIFORNIA, 92606 U.S.A.

**Test Results**

PART NAME No.1 : YELLOW PASTE

Test Item(s)	Unit	Method	MDL	Result No.1
<b>Halogen</b>				
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.

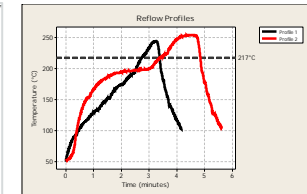
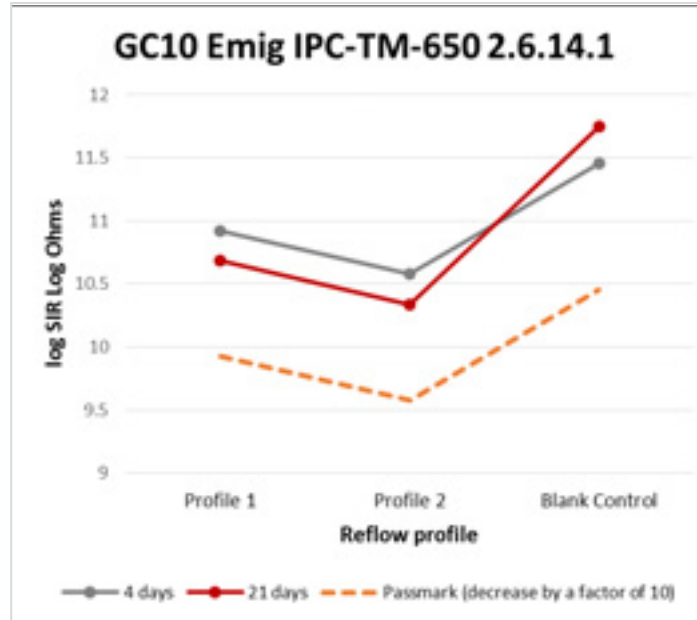
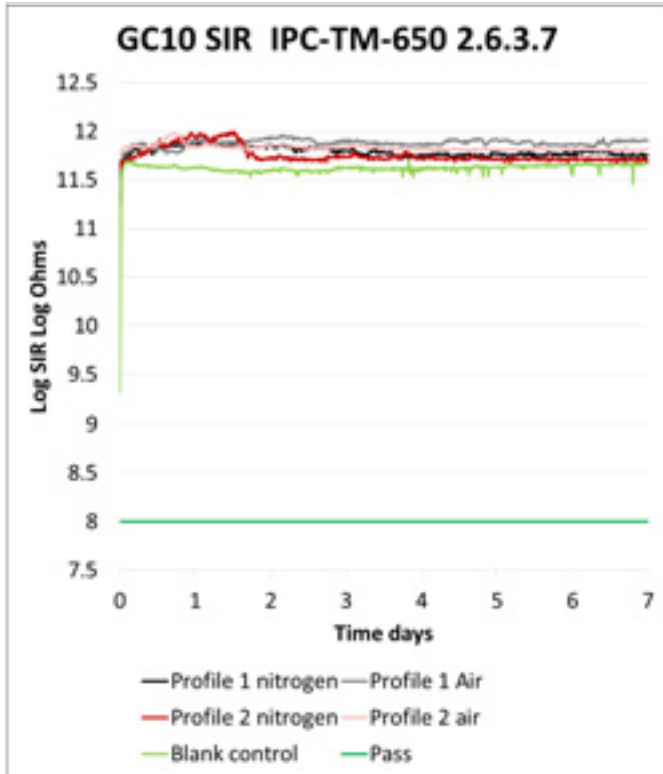
**Note :**

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



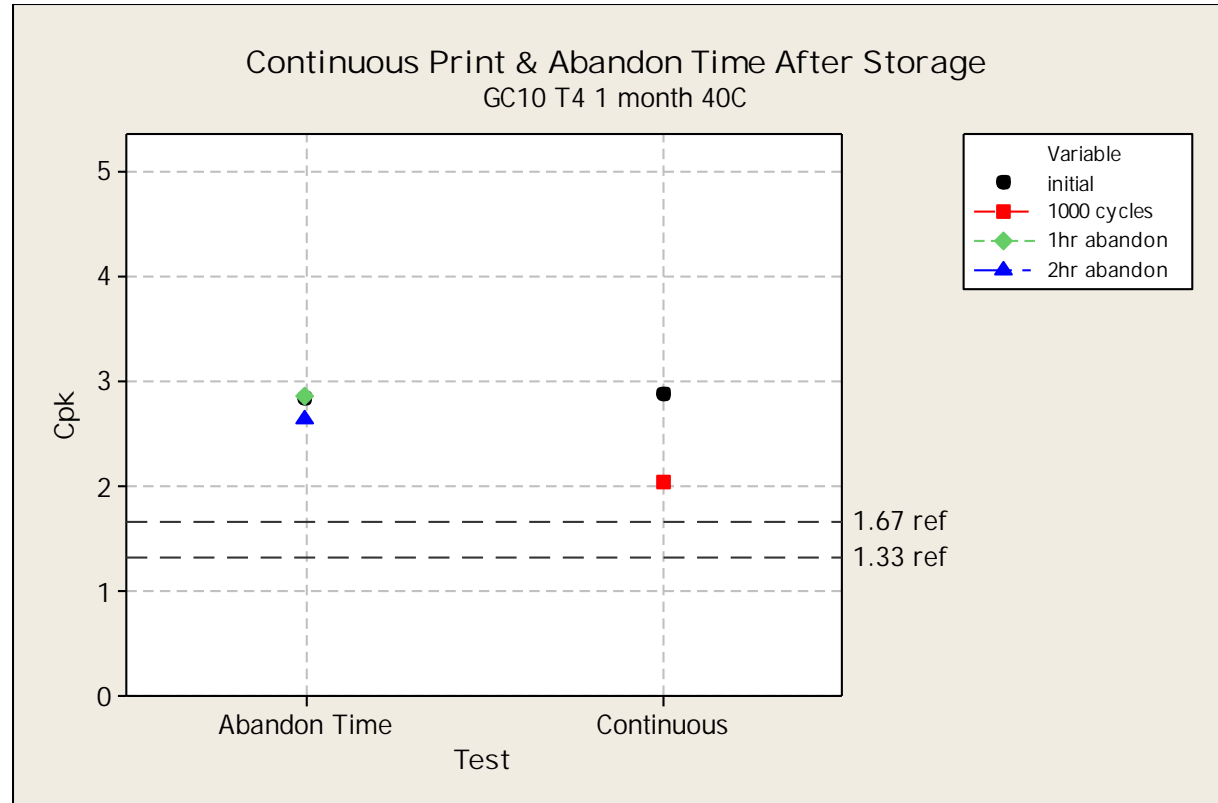
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1. Performance Summary
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4. Reliability and Specification Testing
- 5. Operating Parameters: Storage**
  - Printing & Reflow Performance
6. Product Summary

# 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

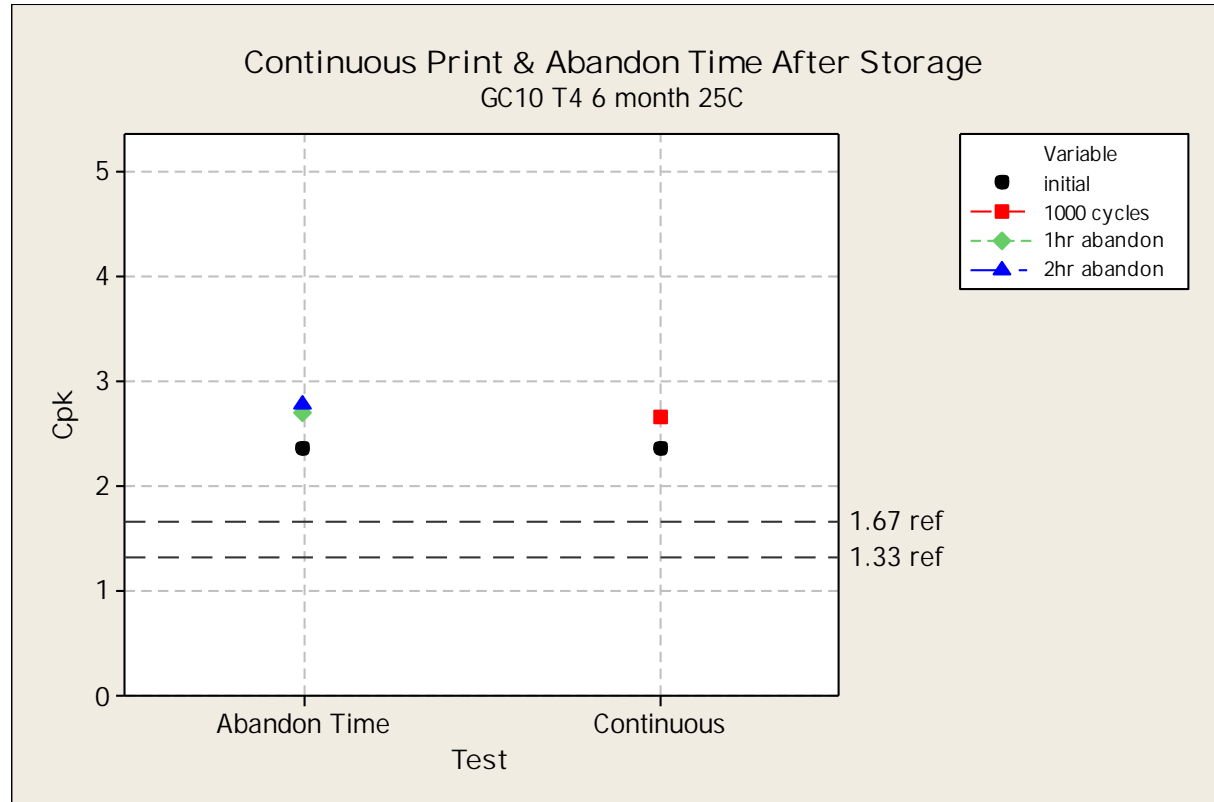


0.4mm BGA ,100µm stencil thickness, 60mm/s, Fast separation,  
250mm squeegee, 8kg

# 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

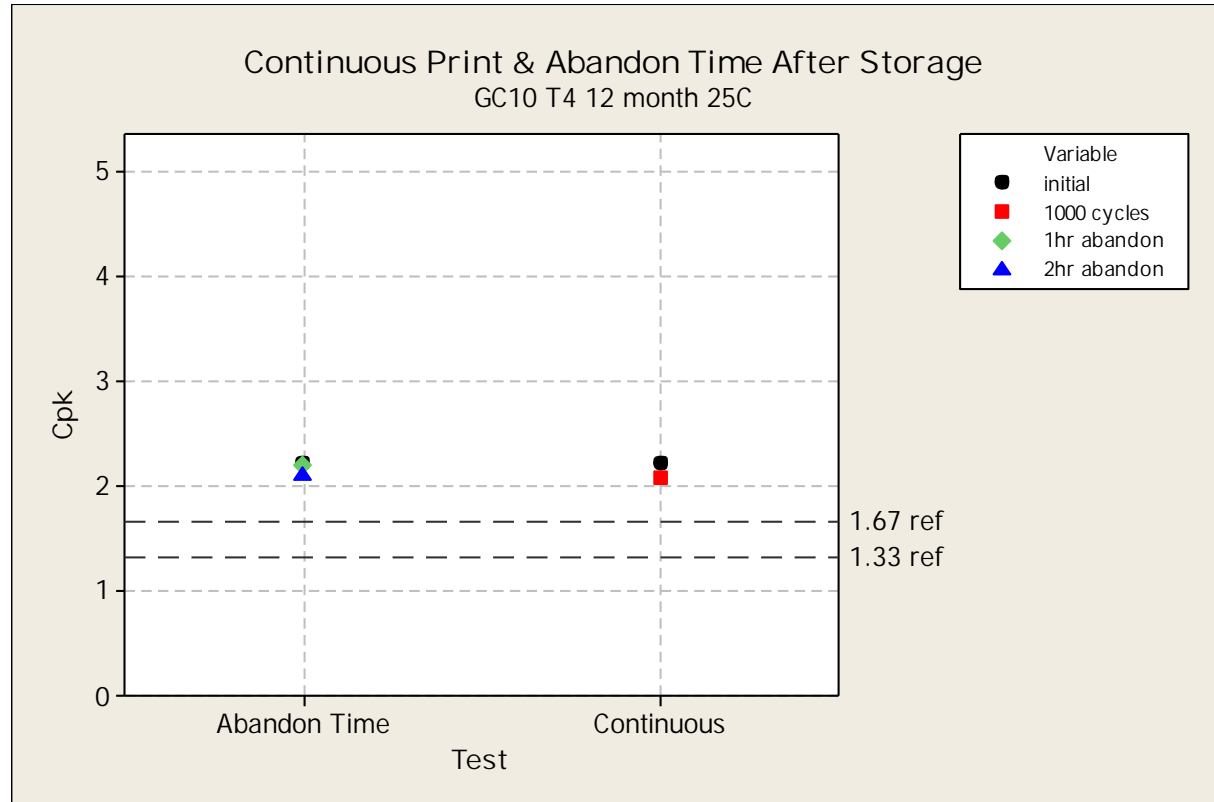


0.4mm BGA ,100µm stencil thickness, 60mm/s, Fast separation,  
250mm squeegee, 8kg

# 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

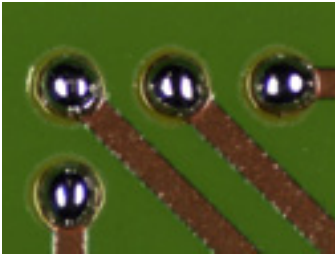
After Paste storage

Initial

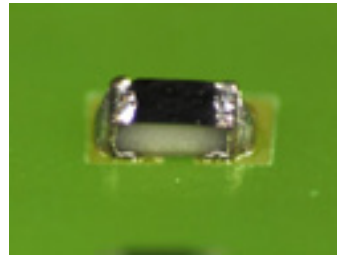
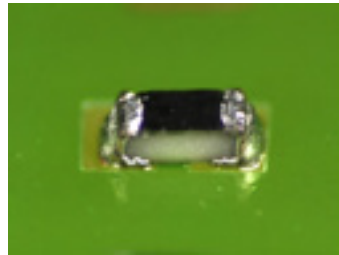
1m 40°C

6m 25°C

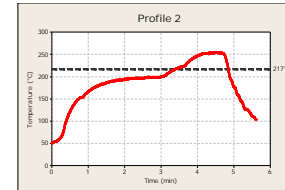
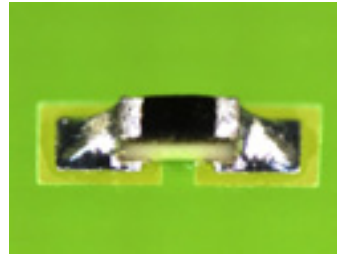
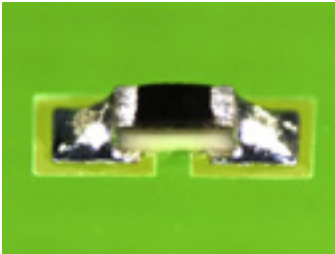
0.5mm CSP



0201

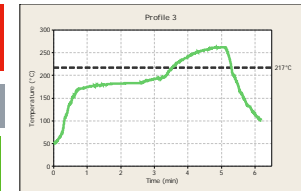
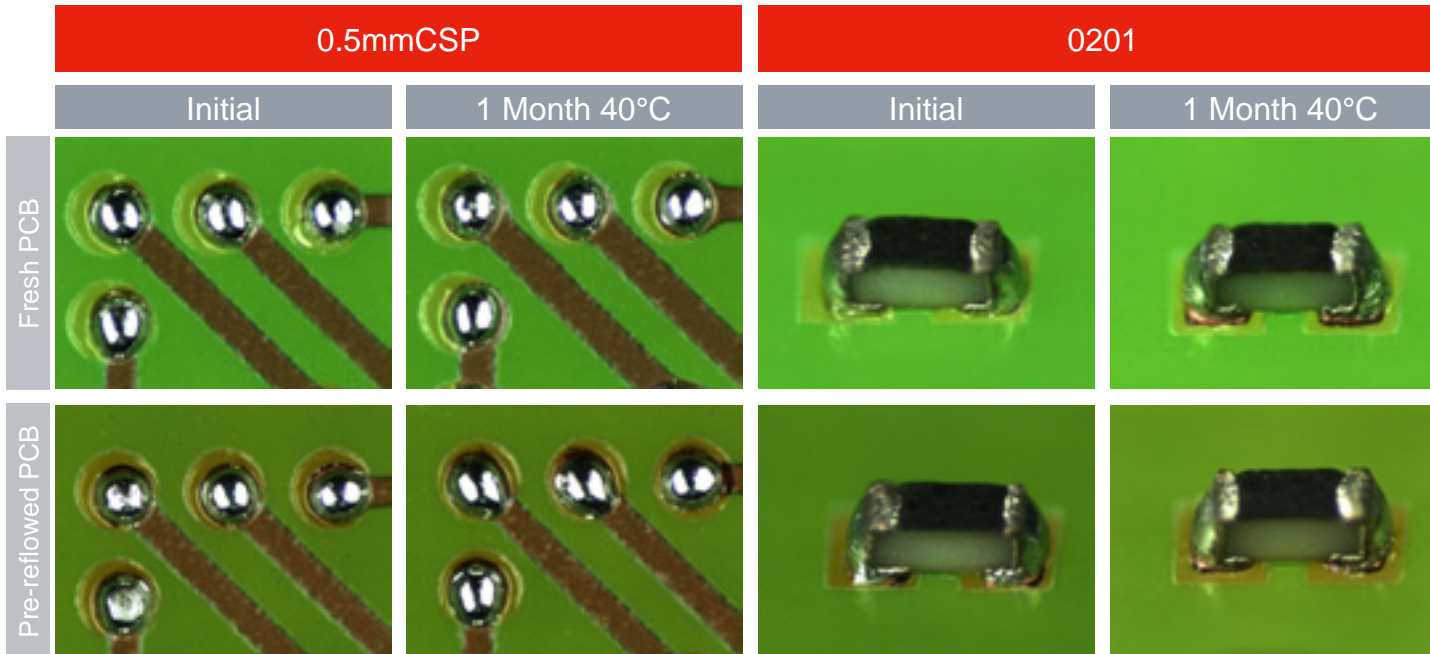


0402



# Operating Parameters: Storage

## After storage and 2<sup>nd</sup> side/pre-reflow





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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

# Thank you!



**LOCTITE**<sup>®</sup>



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