alpha

CE Analytics

Lead Free Process Capability Validation Report

Date: January 19, 2006

Submitted By: Joel Butler
Laritech, Inc.
330 Zachary Street #108
Moorpark, CA 93021

Investigator: Mike Trosky

Approved By: Ron Bulwith

Cookson Electronics

Request: Conduct a Level I Pb-Free Process Capability Validation. The validation will include a stereoscopic visual inspection of the 6 ENIG finished Pb-Free assemblies submitted for analysis. A microscopic examination of 4 cross-sectioned solder connections will also be performed. The 4 solder connections to be cross-sectioned are to be from an ENIG finished PCB from the following components:

- QFP 256
- PLCC 68
- BGA 256
- Chip Resistor (0603)

The microstructural integrity of the cross-sectioned solder connections will be assessed, and the solder connection attributes will be classified in accordance with IPC Standards (Revision D/ February 2005/ Supersedes Revision C January 2000 Standard). If all of the IPC Specifications are met, the capability of the Pb-Free Process used to produce the ENIG finished PCB's will be validated.

Investigation Details: All of the PCB's were macroscopically examined with the aid of a stereo-microscope. No solder connection anomalies were observed. There were no cracked, fractured or disturbed solder connections. Also, no dewetting, non-wetting or incompletely reflowed connections were observed.

The aforementioned components with the solder connections to be cross-sectioned were carefully cut-out from the selected assembly. The parts were solvent cleaned in an ultrasonic bath for approximately 15 minutes. The parts were then rinsed with methanol and thoroughly dried. Photomacrographs of the connections to be cross-sectioned were captured. The parts were then potted in mounting compound, cured and metallographically prepared for cross-sectional examination.

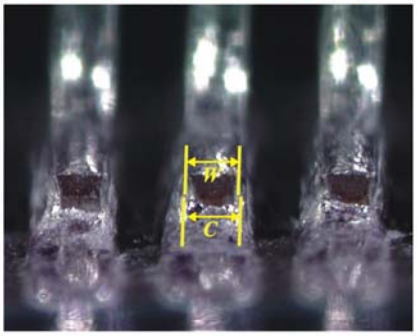
The following pages contain photomacrographs, photomicrographs and tables classifying each of the solder connection attributes. The following pages are detailed illustrations of the observations derived from the visual and microscopic examination conducted on the solder connections on the PCB's submitted for analysis.

Gull Wing Lead (QFP 256) - ENIG Finished PCB

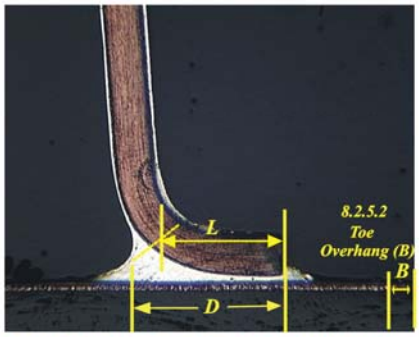
Feature		Dim.	Class 1	Class 2	Class 3	Classification
Maximum Side Overhang		A	50% (W) or 0.5 mm [0.02 in], whichever is less; Note 1		25% (W) or 0.5 mm [0.02 in], whichever is less; Note 1	Class 3
Maximum Toe Overhang		B	Note 1			Class 3
Minimum End Joint Width		C	50% (W)		75% (W)	Class 3
Minimum Side Joint Length	When (L) is > 3 (W)	D	(W) or 0.5 mm [0.02 in], whichever is less	3 (W) or 75% (L), whichever is longer		Class 3
	When (L) is < 3 (W)			100% (L)		
Maximum Heel Fillet Height		E	Note 4			Class 3
Minimum Heel Fillet Height		F	Note 3	(G) + 50% (T) Note 5	(G) + (T) Note 5	Class 3
Solder Thickness		G	Note 3			Class 3
Formed Foot Length		L	Note 2			—
Lead Thickness		T	Note 2			—
Lead Width		W	Note 2			—

Note 1 Does not violate minimum electrical clearance.
Note 2 Unspecified dimension, determined by design.
Note 3 Wetting is evident.
Note 4 See 8.2.5.5
Note 5 In case of a toe-down lead configuration, the minimum heel fillet height (F) extends at least to the mid-point of the outside lead bend.

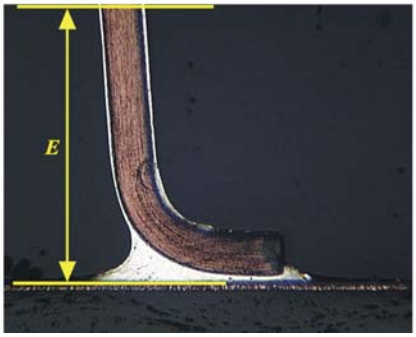
8.2.5.1 Gull Wing Lead Side Overhang



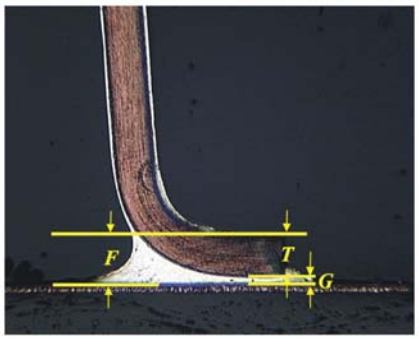
8.2.5.4 Gull Wing Lead Side Joint Length



8.2.5.5 Gull Wing Lead Maximum Heel Fillet Height

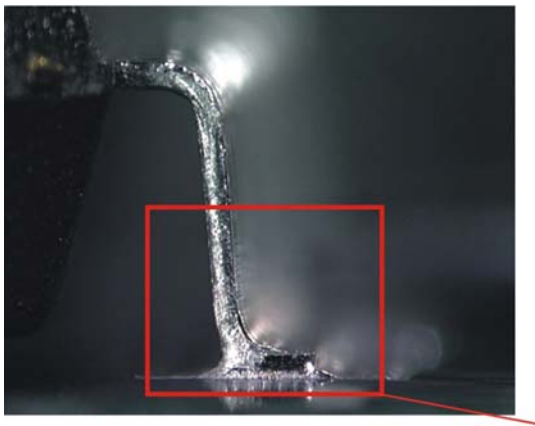


8.2.5.6 Gull Wing Lead Minimum Heel Fillet Height

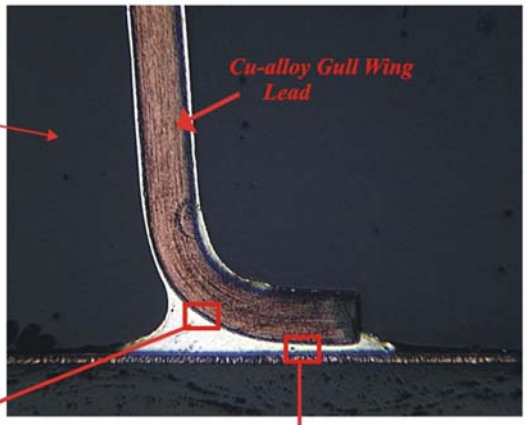


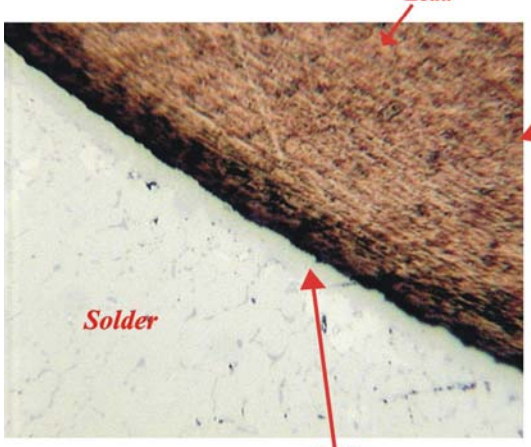
Cookson Electronics

Gull Wing Lead (QFP 256) - ENIG Finished PCB

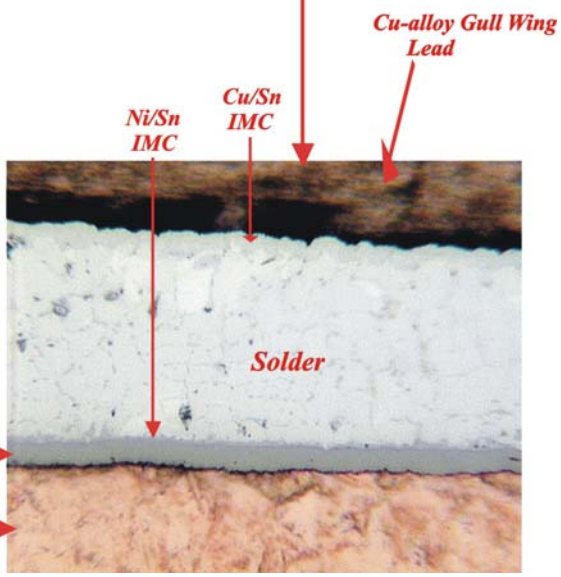


The photomicrograph (below) reveals a good Cu/Sn intermetallic compound (IMC) reaction layer between the solder and the Cu Gull Wing lead.





The photomicrograph (right) reveals a good Ni/Sn intermetallic compound (IMC) reaction layer between the solder and the Ni plating on the board.

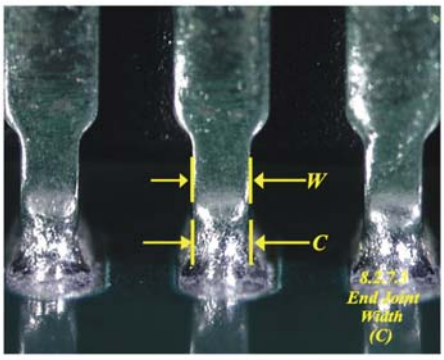


J-Lead (PLCC 68) - ENIG Finished PCB

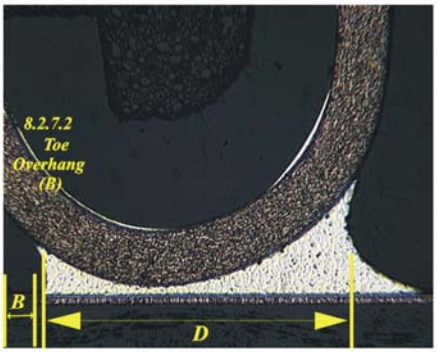
Feature	Dim.	Class 1	Class 2	Class 3	Classification
Maximum Side Overhang	*A*	*50%(W)Note 1*		*25%(W)Note 1*	*Class 3*
Maximum Toe Overhang	*B*	*Note 1,2*			*Class 3*
Minimum End Joint Width	*C*	*50%(W)*		*75%(W)*	*Class 3*
Minimum Side Joint Length	*D*	*Note 3*	*150%(W)*		*Class 3*
Maximum Fillet Height	*E*	*Note 4*			*Class 3*
Minimum Heel Fillet Height	*F*	*G+50%(T)*		*G+T*	*Class 3*
Solder Thickness	*G*	*Note 3*			*Class 3*
Lead Thickness	*T*	*Note 2*			
Lead Width	*W*	*Note 2*			

Note 1 Does not violate minimum electrical clearance.
Note 2 Unspecified dimension, determined by design.
Note 3 Wetting is evident.
Note 4 Solder does not touch pachage body.

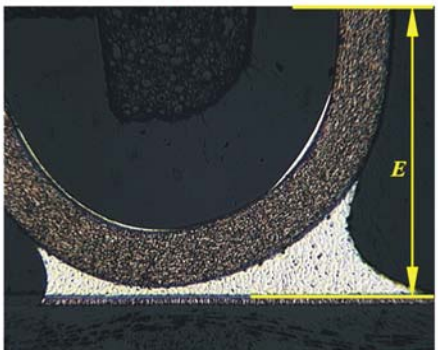
8.2.7.1 J-Lead, Side Overhang



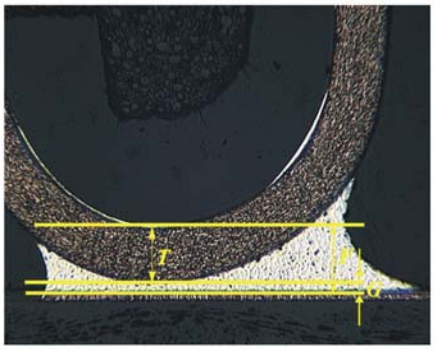
8.2.7.4 J-Lead, Side Joint Length



8.2.7.5 J-Lead, Maximum Fillet Height

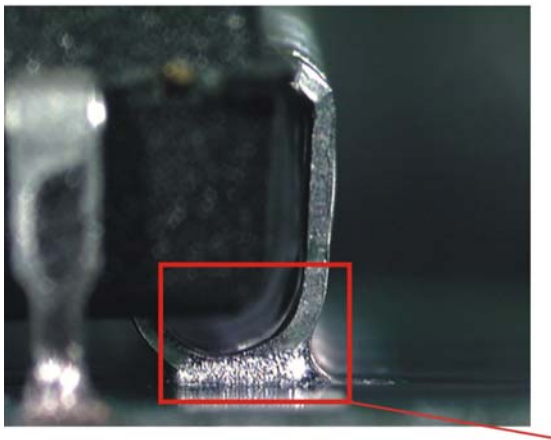


8.2.7.6 J-Lead, Heel Fillet Height

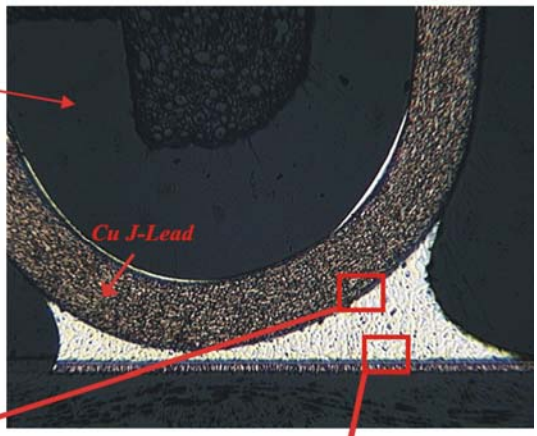


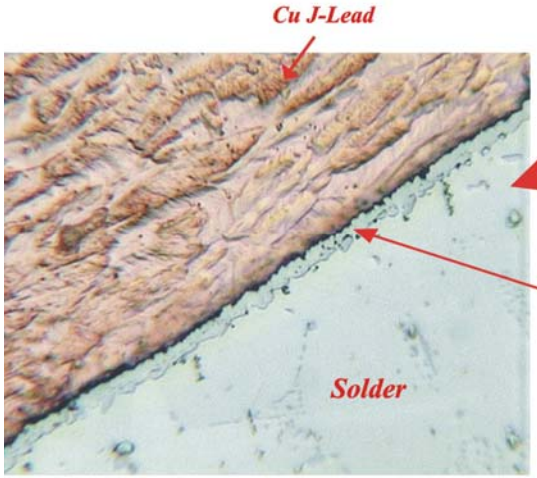
Cookson Electronics

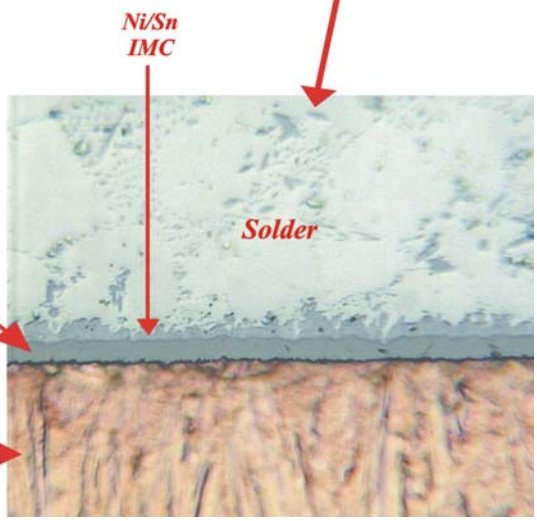
J-Lead (PLCC 68) - ENIG Finished PCB



The photomicrograph (below) reveals a good Cu/Sn intermetallic compound (IMC) reaction layer between the solder and the Cu J-Lead.







The photomicrograph (right) reveals a good Ni/Sn intermetallic compound (IMC) reaction layer between the solder and the Ni plating on the board.

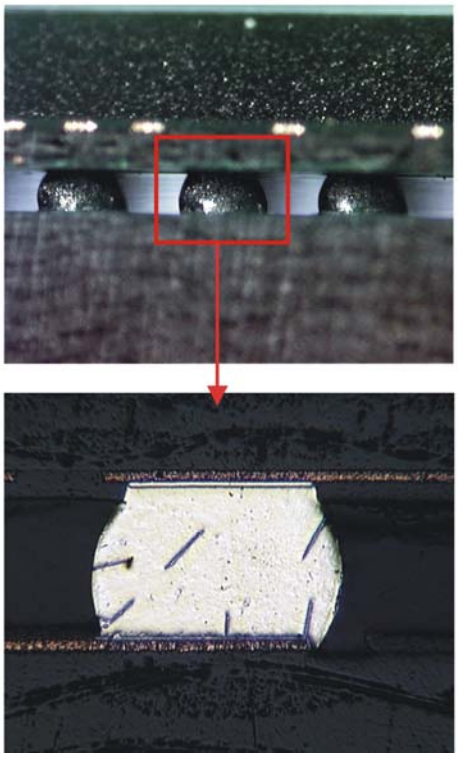
Cookson Electronics

Surface Mount Area Array (BGA 256) - ENIG Finished PCB

Feature	Clause	Class 1,2,3	Classification
Alignment	*8.2.12.1*	*Solder ball offset does not violate minimum electrical clearance*	*Pass*
Solder Ball Spacing	*8.2.12.2*	*Solder ball offset does not violate minimum electrical clearance*	*Pass*
Solder Connection	*8.2.12.3*	No solder bridging; BGA solder balls contact and wet to the land forming a continuous elliptical round or pillar connection	*Pass*
Voids	*8.2.12.4*	*25% or less voiding in a ball x-ray image area.* [1,2]	*Pass*
Under-fill or Staking Material	*8.2.12.5*	*Required underfill or staking material is present and completely cured*	*Pass*

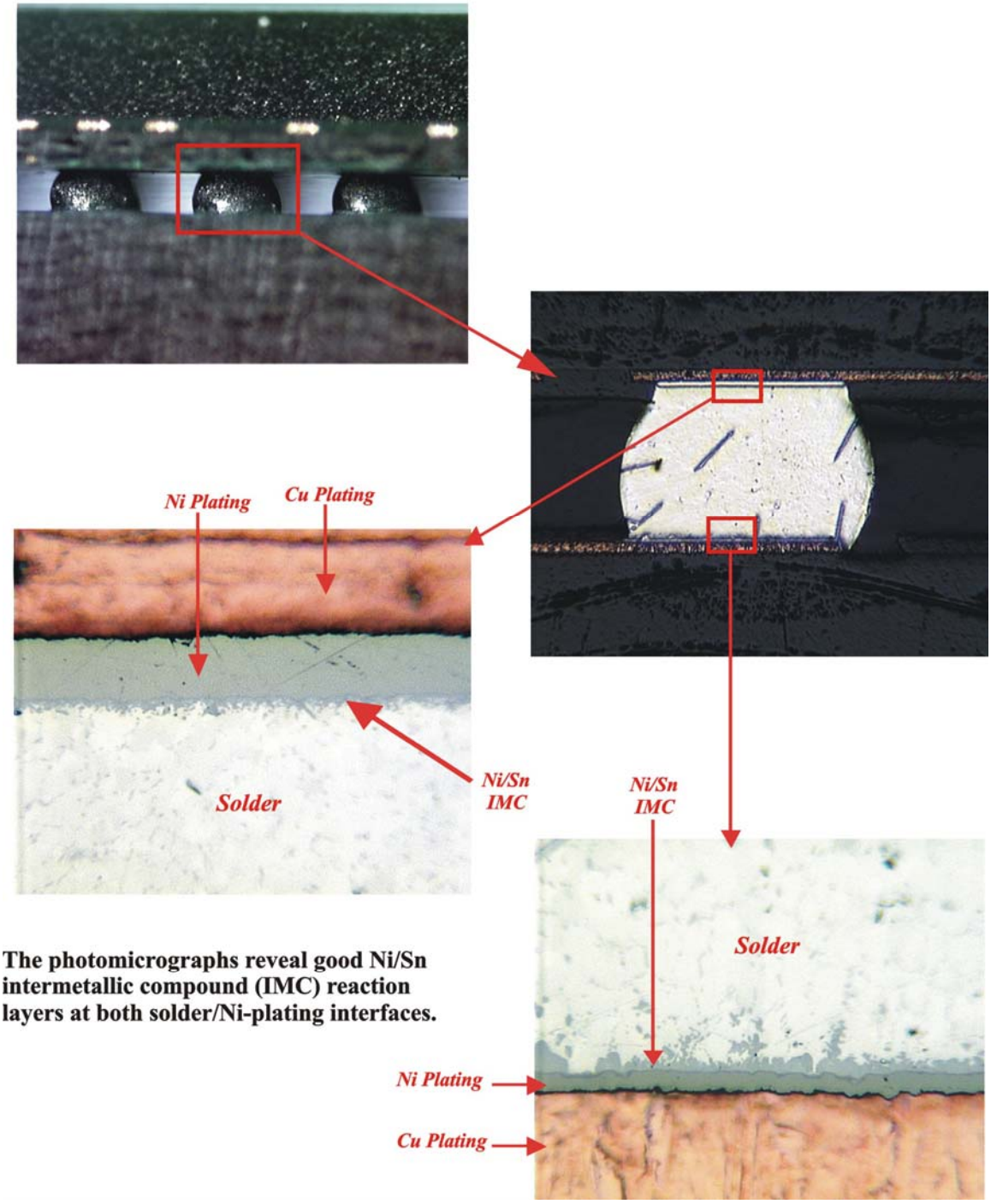
Note 1 Design induced voids, e.g. microvia in land, are excluded from this criteria. In such cases acceptance criteria will need to be established between the manufacturer and user.

Note 2 Manufacturers may use test or analysis to develop alternative acceptance criteria for voiding that consider the end-use environment.



1) Sixteen ball sites were investigated, and four connections contained voids. However, the voids did not interfere with the integrity of the connections.
2) Sixteen ball sites were investigated, and each exhibited a similar ball diameter.
3) The registration of the balls was straight with no overhang.
4) No solder balls were observed.

Surface Mount Area Array (BGA 256) - ENIG Finished PCB



The photomicrographs reveal good Ni/Sn intermetallic compound (IMC) reaction layers at both solder/Ni-plating interfaces.

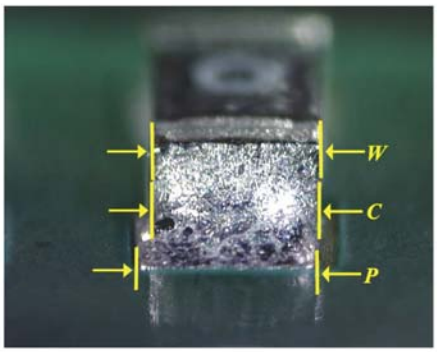
0603 Chip Component - ENIG Finished PCB

Feature	Dim.	Class 1	Class 2	Class 3	Classification
Maximum Side Overhang	*A*	*50%(W)Note 1*		*25%(W)Note 1*	*Class 3*
End Overhang	*B*	*Not permitted*			*Class 3*
Minimum End Joint Width, Note 5	*C*	*50%(W) or 50%P, whichever is less*		*75%(W) or 75%P, whichever is less*	*Class 3*
Minimum Side Joint Length	*D*	*Note 3*			*Class 3*
Maximum Fillet Height	*E*	*Note 4*			*Class 3*
Minimum Fillet Height	*F*	*Wetting is evident on the vertical surfaces(s) of the component termination.*		*G+25%H or G+0.5 mm [0.02 in], whichever is less.*	*Class 3*
Solder Thickness	*G*	*Note 3*			*Class 3*
Termination Height	*H*	*Note 2*			—
Minimum End Overlap	*J*	*Required*			*Class 3*
Width of Land	*P*	*Note 2*			—
Termination Width	*W*	*Note 2*			—

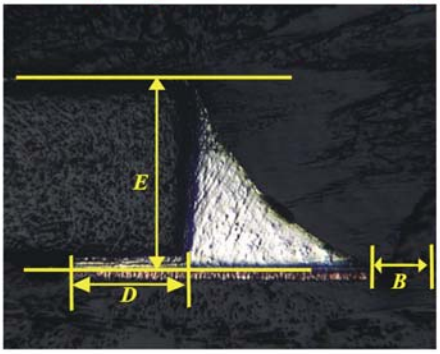
Note 1 Does not violate minimum electrical clearance.
Note 3 Wetting is evident.
Note 5 (C) is measured from the narrowest point of the solder fillet

Note 2 Unspecified dimension, determined by design.
Note 4 The maximum fillet may overhang the land and/or extend onto the top of the end cap metallization: however, the solder does not extend further onto the top of the component body

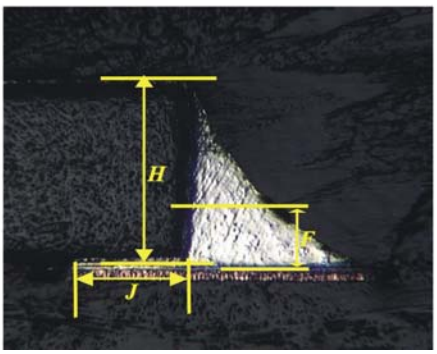
8.2.2.3 Chip Component End Joint Width



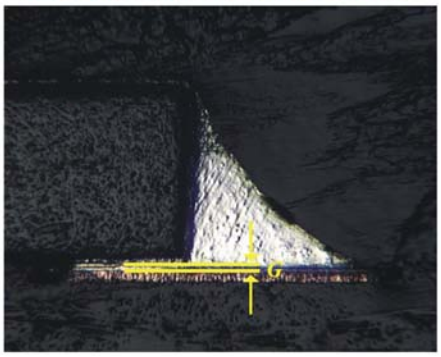
8.2.2.5 Chip Component Maximum Fillet Height



8.2.2.6 Chip Component Minimum Fillet Height

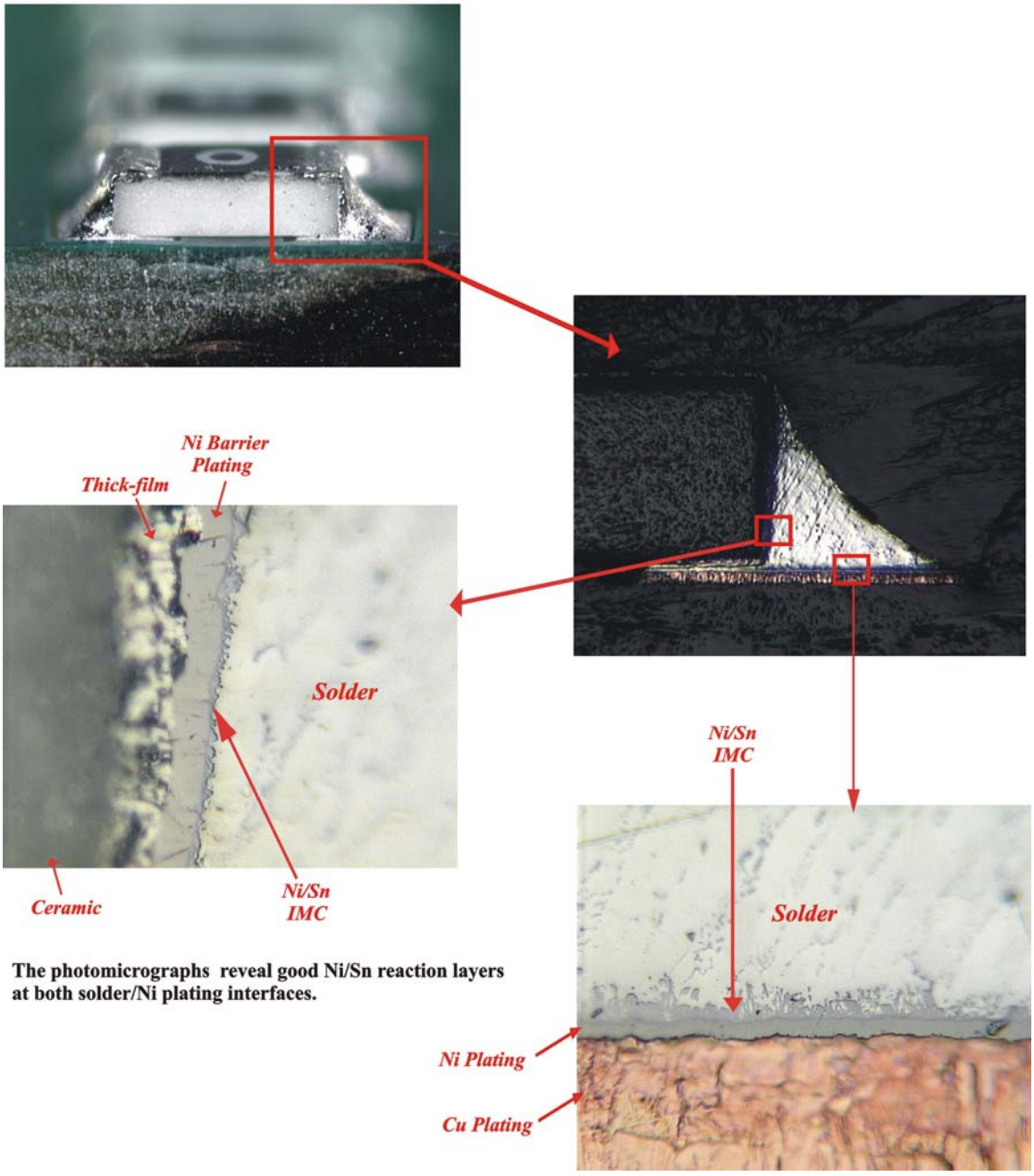


8.2.2.7 Chip Component Solder Thickness



Cookson Electronics

0603 Chip Component - ENIG Finished PCB



The photomicrographs reveal good Ni/Sn reaction layers at both solder/Ni plating interfaces.

IPC-A-610D Acceptability of Electronic Assemblies

Gull Wing Lead (QFP 256) (ENIG Finished PCB)	**Met all general requirements of IPC Standards for surface mount components.**	***PASS***
J-Lead (PLCC 68) (ENIG Finished PCB)	**Met all general requirements of IPC Standards for surface mount components.**	***PASS***
Ball Grid Array (BGA 256) (ENIG Finished PCB)	**Met all general requirements of IPC Standards for surface mount components.**	***PASS***
Chip Component (0603 Chip) (ENIG Finished PCB)	**Met all general requirements of IPC Standards for surface mount components.**	***PASS***

Note: Please refer to the table for each component connection type for specific attribute classification.

Conclusion: The various components examined macroscopically, as well as microscopically, revealed they all met the general requirements of IPC Standards for surface mount soldered components. Refer to the appropriate tables to locate the specific class rating for each of the solder connection attributes. The good mechanical integrity of the solder connections examined reflects the utilization of components and PCB's with good solderability, good solder paste performance and a well profiled Pb-Free surface mount soldering operation.

Mike Trosky
01/19/06