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Interesting Customer Questions

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Topics of Customer Questions

- Gold plating vs Gold Flash
- Gull Wing Toe Fillet requirements
- Class 3 rework
- Tempered leads, what are they?

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Gold Plating vs Gold Flash

Question: J-STD-001 section 4.5.1 requires gold removal for through-hole component leads with gold thickness more than 2.54micrometer.

- On the data sheet of the connector, it indicates Gold Flash Overall for contact plating.
  - Nowhere does the data sheet document the gold thickness.
  - How do we determine this?
  - What is the difference between gold plating and gold flash?

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Gold Plating vs Gold Flash

- If you do a search on the web for HOW THICK IS A GOLD FLASH PLATING you will come up with the following web sites, plus many more.
- I've put them on the next slide for you.

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Gold Plating vs Gold Flash

- http://www.dfrsolutions.com/wp-content/uploads/2012/06/Understanding-the-Risk-of-Gold-Flash.pdf
- http://www.te.com/documentation/whitepapers/pdf/aurulrep.pdf
- http://www.smtnet.com/Forums/index.cfm?fuseaction=view_thread&Thread_ID=16481
- http://www.contechresearch.com/pdf/gold_reflect.doc

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Gold Plating vs Gold Flash

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The bottom line for thickness is:

- Gold flash is less than 10 micro inches
- Gold plating is more than 25 micro inches which is what is called out in the 001 document.

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End Joint Width and Toe Fillet

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End Joint Width and Toe Fillet

Initial question:

- I ran into a little bit of confusion regarding what is the requirement for a toe fillet?

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This is the 610 table for the Flat Gull Wing Component and Leads

Table 8-5 Dimensional Criteria – Flat Gull Wing Leads

Feature		Dim.	Class 1	Class 2	Class 3
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
Maximum Toe Overhang		B	Note 1	Not permitted when (L) is less than 3 (W), Note 1	
Minimum End Joint Width		C	50% (W)		75% (W)
Minimum Side Joint Length	when (L) is ≥3 (W)	D	1 (W) or 0.5 mm [0.02 in], whichever is less	3 (W) or 75% (L), whichever is longer	
	when (L) is <3 (W)			100% (L)	
Maximum Heel Fillet Height		E	Note 4		
Minimum Heel Fillet Height	(T) ≤0.4 mm [0.015 in]	F	Note 3	(G) + (T), Note 5	(G) + (T), Note 5
	(T) >0.4 mm [0.015 in]	F		(G) + 50% (T), Note 5	
Solder Thickness		G	Note 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, or variable in size as determined by design. When lead forming is required, see 7.1.
Note 3. Wetting is evident.
Note 4. Solder does not touch package body or end seal, see 8.2.1.
Note 5. In the 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.

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End Joint Width and Toe Fillet

The second question was from IPC-A-610, Figure 8-89 and the flow of information regarding the placement and soldering of the component.

Figure 8-89 of the IPC gives a requirement for the End Joint Width of the Gull Wing but then on pages following that figure the IPC illustrates an allowance for Toe Overhang and it goes on to state that there is no minimum toe fillet requirement other than "evidence of a fillet" but the placement of this statement seems to talk about the heel fillet height as well as solder thickness.

8.3.5.3 Flat Gull Wing Leads – Minimum End Joint Width (C) (cont.)

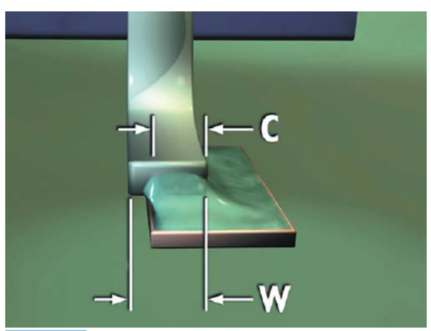

Figure 8-89

Acceptable – Class 3

- Minimum end joint width (C) is 75% lead width (W).

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Third follow on question was:

How can I justify the lack of a toe fillet if my customer points to this figure 8-89 for a condition where there is no toe fillet?

The Figure 8-89 is an illustration, depicting end joint width "C" . Although it shows wetting on the end of the lead, we have to keep the paragraph 1.2 Purpose in mind, and it states **"… In the case of a discrepancy, the description or written criteria always takes precedence over the illustrations."**

Although the pictures or illustration may show wetting on the end of the lead, the written word in the specification states in section 8.3 SMT Connections, page 8-7, paragraph 5, **"… Components with surfaces and /or termination ends or sides that are not wettable by design are exempt for solder wetting requirements in those areas. Solder fillet wetting to the sides or ends of the leads is not required unless specifically stated."**

So the final answer is: The illustration figure 8-89 is there to point out the 50 or 75% of the lead width, to makes is easier to visualize what that looks like when looking at the illustration, but it is not necessary for the end of the leads to be soldered.

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How can I justify the lack of a toe fillet if my customer points to this figure for a condition where there is no toe fillet?

- The final answer to the customer is to have them reference the particular component table to review all the soldering and placement requirement for that particular component.
- However, the important parameter for gull wing solder joints is the heel fillet.

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Class 3 Rework

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Class 3 Rework

Question: Can you tell me is class III allowed have solder joints reworked to make them acceptable?

For example we had some units returned due to incomplete re-flow of solder paste. We re flowed the components and now the solder joints are acceptable.

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From J-STD-001, 1.5.1 Hardware Defects and Process

Indicators it states:

- A defect is a condition that may affect the form, fit, or function of the item in its end use environment, or other risk factors as identified by the Manufacturer, see 1.8.5.
- Defects **shall [D1D2D3]** be identified, documented, and dispositioned by the Manufacturer based on the design, service, and customer requirements.
- Disposition is the determination of how defects are to be treated, and include, but are not limited to, rework, scrap, use as-is, or repair.

Extrapolated from IPC/J-STD-001

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J-STD-001
13.1 Rework

- This is the act of reprocessing in a manner that assures full compliance to applicable drawings/specification.
- Hardware defects **shall [N1N2D3]** be documented before rework.
- Rework for Classes 1 or 2 should and for Class 3 **shall [N1N2D3]** be documented.
- The second application of a soldering iron during a hand soldering operation on a single connection is not considered rework.

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J-STD-001
13.1 Rework

Section continues:

- Proper soldering technique, including limiting the time on the connection and the amount of heat applied, is critical in preventing delamination or other damage to the assembly. Control of hand soldering **shall [N1N2D3]** include operator training, process controls, and management. See 1.10 personnel proficiency.

- Rework **shall [D1D2D3]** meet all applicable requirements of this standard.

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Class 3 Rework

- ANSWER: Yes it is acceptable to reflow those solder joint to bring them into compliance to the requirements of Class 3 Products.
- I know of no place within the IPC documentation where it mentions Class 3 products cannot be resoldered or repaired, i.e., component removal and replacement is an accepted process for all classes of products.

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Tempered leads, What are they?

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Tempered leads, what are they?

- Most component leads are made of a copper alloy or just plain copper. Some are made with Kovar or Alloy 42 which is a hardened material and is very stiff with very little ductility.
- Some pins are made of phosphorous or beryllium copper and these are very hard and should not be clinched.
- So the bottom line and in very simple terms a tempered lead is made of a very hard metal. These pins are sometimes found on connectors and press pins.

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Tempered leads, what are they?

- **Kovar®**
- Composed of iron, nickel and cobalt, Kovar®[1] has thermal expansion characteristics similar to hard glass, making it an excellent choice for glass-to-metal hermetic seals. Kovar® is widely used in the electronics industry.
- **Alloy 52**
- Alloy 52 is a nickel-iron alloy with a thermal expansion rate similar to soft glasses and ceramics. Typical applications include voltage regulators, conductors, and glass-to-metal hermetic seals.

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Cracked Capacitors

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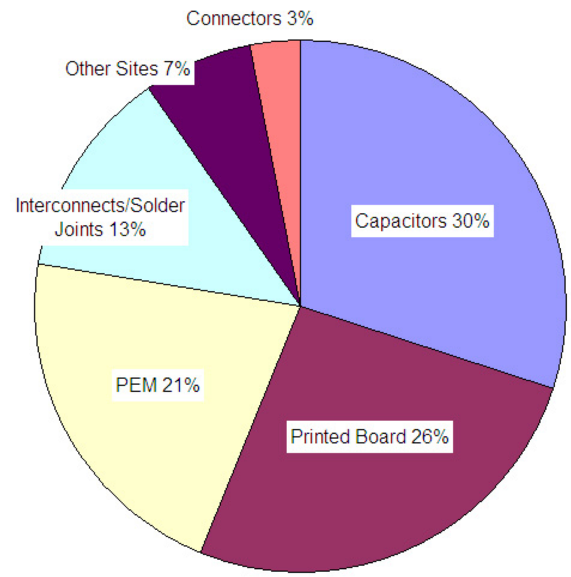
Survey Results of Failure Analysis[1]

- Majority of failures were related to either:
  - Capacitors
  - Printed Circuit Boards



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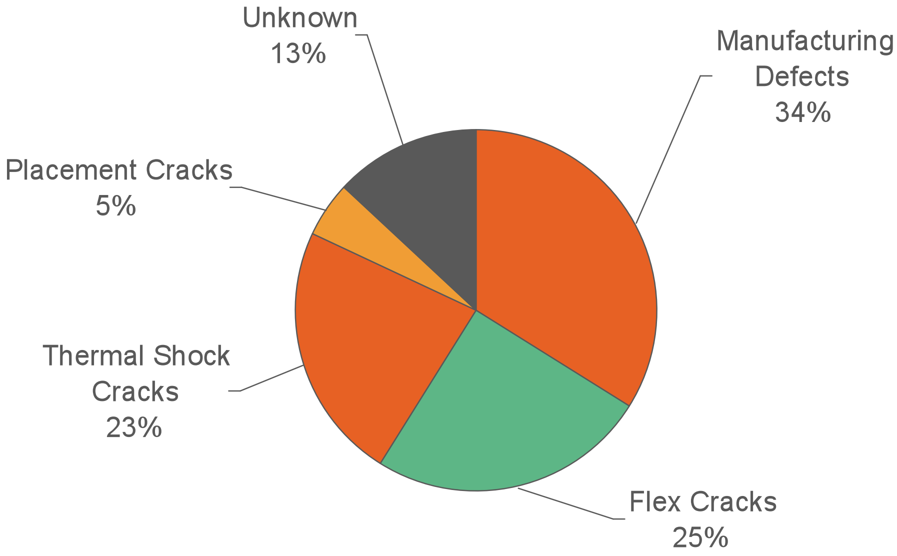
Types of Capacitor Failures



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Induced Crack Defects

The major causes of Capacitor cracking are:

- Thermal mismatch between capacitor and the board
- Handling
- Bending
- Marking Laser
- Assembly design

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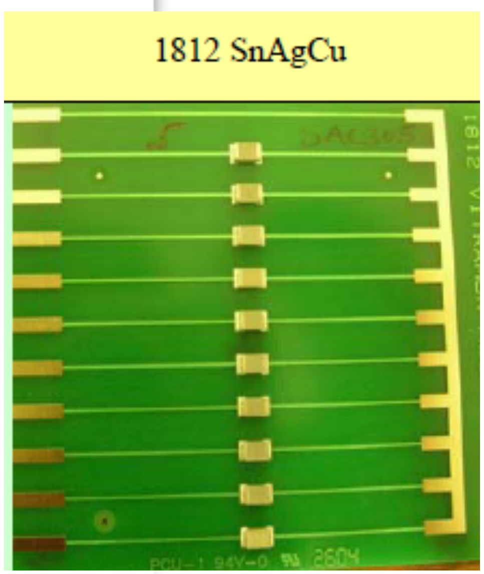
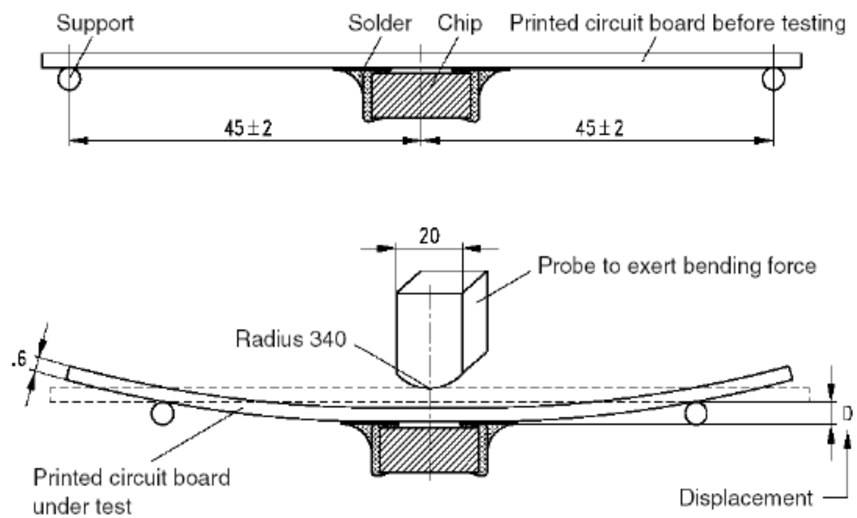
Flex Testing[1]



Test Samples



Industry Standard Capacitor Bend Test

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SnAgCu Flex Crack Examples[1]

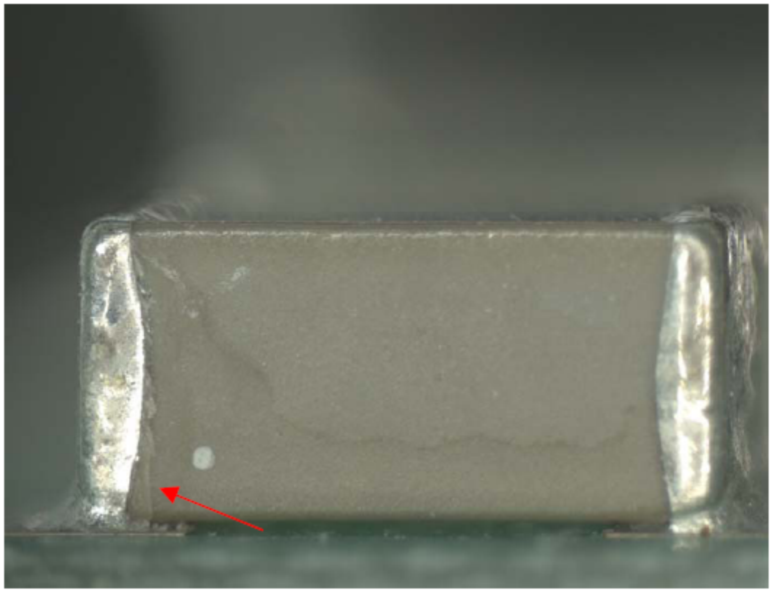

Figure 7: Optical micrograph of a 1812 capacitor attached with SnAgCu solder, flex cracks are identified with the red arrows

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SnAgCu Flex Crack Examples[1]

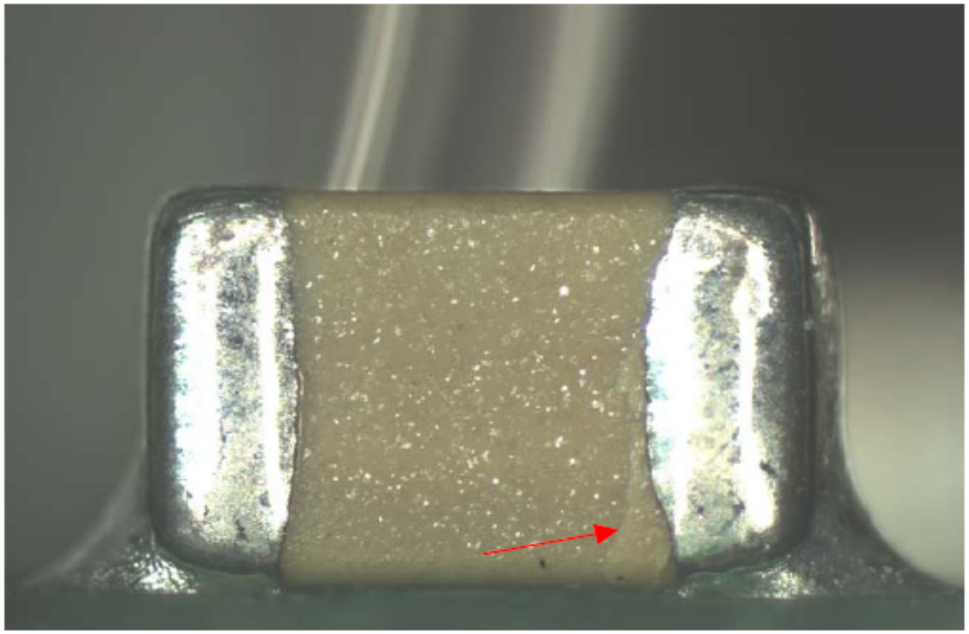

Figure 9: Optical micrograph of a 0805 capacitor attached with SnAgCu solder, flex cracks are identified with the red arrows

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SnAgCu & SnPb Comparison[1]

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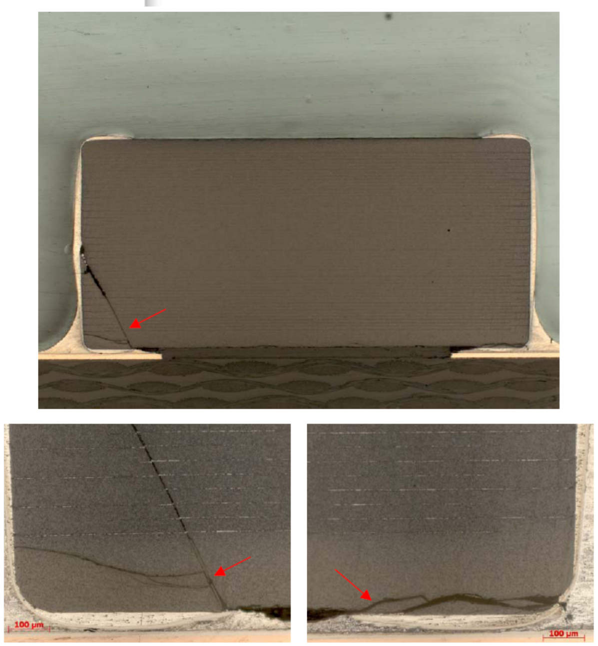

Figure 10: Optical micrograph of a cross-sectioned 1812 capacitor attached with SnAgCu solder, flex cracks are identified with the red arrows

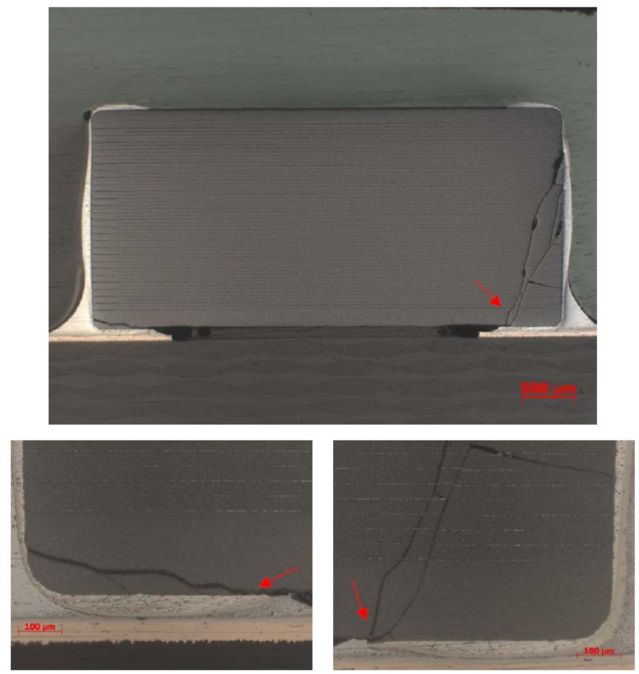

Figure 11: Optical micrograph of a cross-sectioned 1812 capacitor attached with SnPb solder, flex cracks are identified with the red arrows

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Thermal Damage

As quoted by John Maxwell of AVX Corp.

"When processing temperatures exceed the glass transition temperature, Tg, of epoxy resins, the CTE can increase as much as an order of magnitude over room temperature values further increasing stress"

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Thermal Crack

- Components terminations heat up quicker than the ceramic body, exerting forces which crack the ceramic when thermal shock is too quick

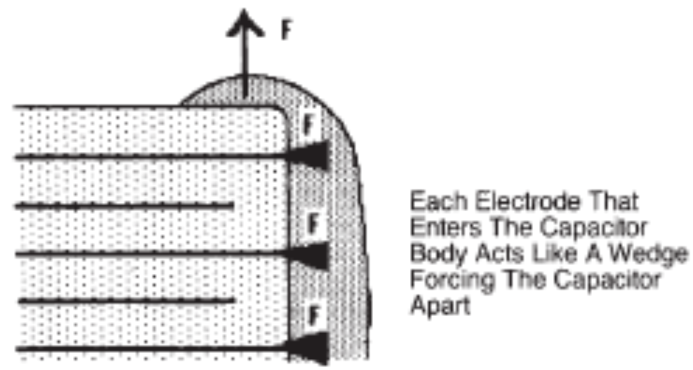

Figure 3. Temperature Forces that Stress an MLC's Structure

AVX Technical Information, "Surface Mount Soldering Techniques and Thermal Shock in Multilayer Ceramic Capacitors" by John Maxwell

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Thermal Crack Review

- Wave solder has the highest heat transfer rate and creates the most shock.
- Vapor phase uses latent heat of vaporization, less thermal shock
- Surface Mount reflow, least amount of thermal shock.

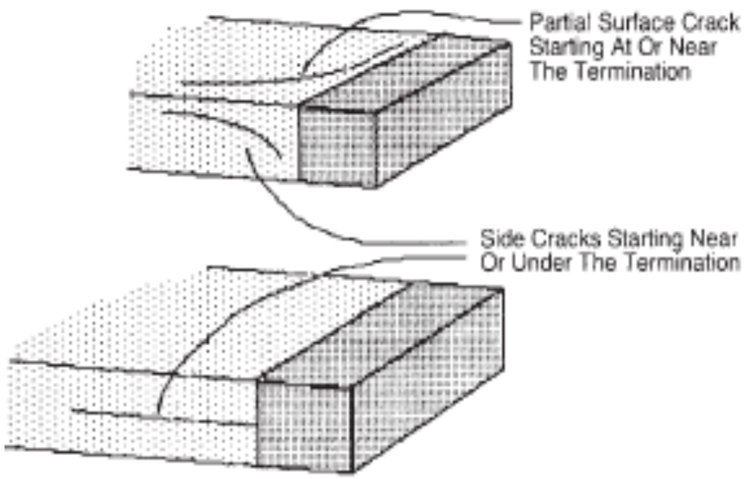

Figure 5. Extreme Thermal Shock Cracks in MLCs

AVX Technical Information, "Surface Mount Soldering Techniques and Thermal Shock in Multilayer Ceramic Capacitors" by John Maxwell

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Thermal Defects

- Thermal cracks manifest themselves by micro cracks around the termination and ceramic body.
- Micro cracks have a tendency to propagate along isothermal lines, where there is maximum stress between both component and the board.

AVX Technical Information, “Surface Mount Soldering Techniques and Thermal Shock in Multilayer Ceramic Capacitors" by John Maxwell

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Thermal Defects

- Maximum shear occurs along these lines during the thermal excursion of the solder reflow or soldering process.

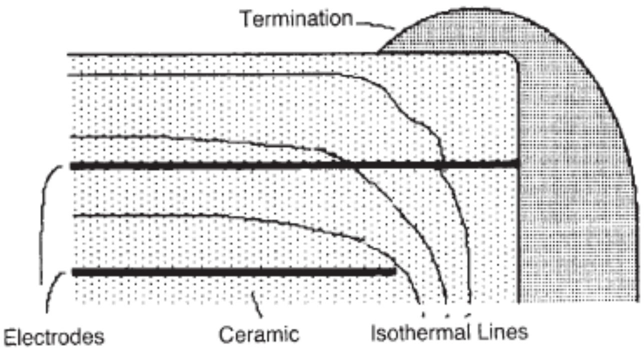

Figure 7. Isothermal Line Shortly After Exposure to Solder Temperatures

AVX Technical Information, "Surface Mount Soldering Techniques and Thermal Shock in Multilayer Ceramic Capacitors" by John Maxwell

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Thermal Crack

- Micro cracks start at the ceramic / termination interface

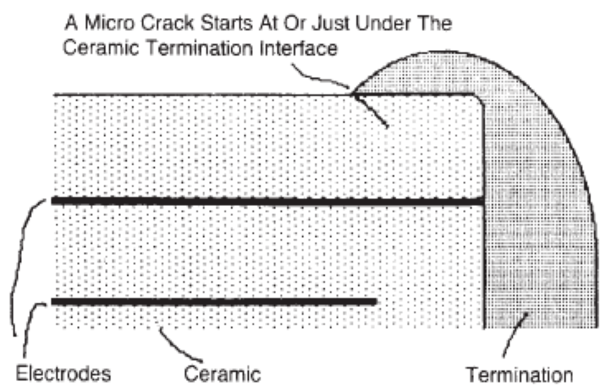

Figure 8. A Micro Crack at the Termination Ceramic Interface

AVX Technical Information, "Surface Mount Soldering Techniques and Thermal Shock in Multilayer Ceramic Capacitors" by John Maxwell

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Thermal Crack

- Watch the thermal ramp up when soldering capacitor
- Try other heat methods than solder irons, due to temperature shock
- Try the use of localized hot gases

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Thank You
Any Questions?

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