Quality & Inspection for Lead-free Assembly: New Lead-free Visual Inspection Standards

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1/27/05

Definition: IPC-A-610 Acceptability of Electronic Assemblies

"Pictorial interpretive document indicating various characteristics of the board and/or assembly as appropriate relating to desirable conditions that exceed the minimum acceptable characteristics indicated by the end item performance standard and reflect various out-of-control (process indicator or defect) conditions to assist the shop process evaluators in judging need for corrective action."

IPC/EIA J-STD-001 Requirements for Soldered Electrical and Electronic Assemblies

1.2 Purpose <u>This standard describes materials, methods and acceptance criteria for producing soldered electrical and electronic assemblies.</u> The intent of this document is to rely on process control methodology to ensure consistent quality levels during the manufacture of products. It is not the intent of this standard to exclude any procedure for component placement or for applying flux and solder used to make the electrical connection. The methods used **shall** produce completed solder connections conforming to the acceptability requirements described in this standard.

Status of Standards Today

- IPC-A-610D & J-STD-001D
  - Final Ballot Accepted Jan. 5th
  - Feb. release date: both published and available at the co-located APEX, IPC Printed Circuits Expo, Designer's Summit and Electronic Circuits World Convention
  - Both Handbooks due out shortly after

Status of Standards Today

- IPC-A-610D training status
  - Instructor & CIS (Certified Inspection Specialist) materials scheduled to be completed April 1st
  - Modular certification
- J-STD-001D training status
  - Instructor & CIS materials proposed - July
  - Will include Pb-free practical for instructors (mandatory)
    - chose your own materials
  - May include Pb-free practical in application specialist training if needed
  - Pb-free practical for IPC 7711/21A Rework/Repair

“C” to “D” Changes - Solder

- Lead free acceptance criteria
- Expanded BGA criteria (IPC-7095 for process guidance)
- Expanded SMT
  - Plastic Quad Flat Pack – No Leads (PQFN)
  - D-Pak – Components with Bottom Thermal Plane Terminations

"Soldering Acceptability Requirements"

Visual appearance statement

"The primary difference between the solder connections created with processes using tin-lead alloys and processes using lead free alloys is related to the visual appearance of the solder. This standard provides visual criteria for inspection of both tin-lead and lead-free connections. Figures specific to lead-free connections will be identified with the Pb-free symbol.

Acceptable lead-free and tin-lead connections may exhibit similar appearances but lead free alloys are more likely to have:

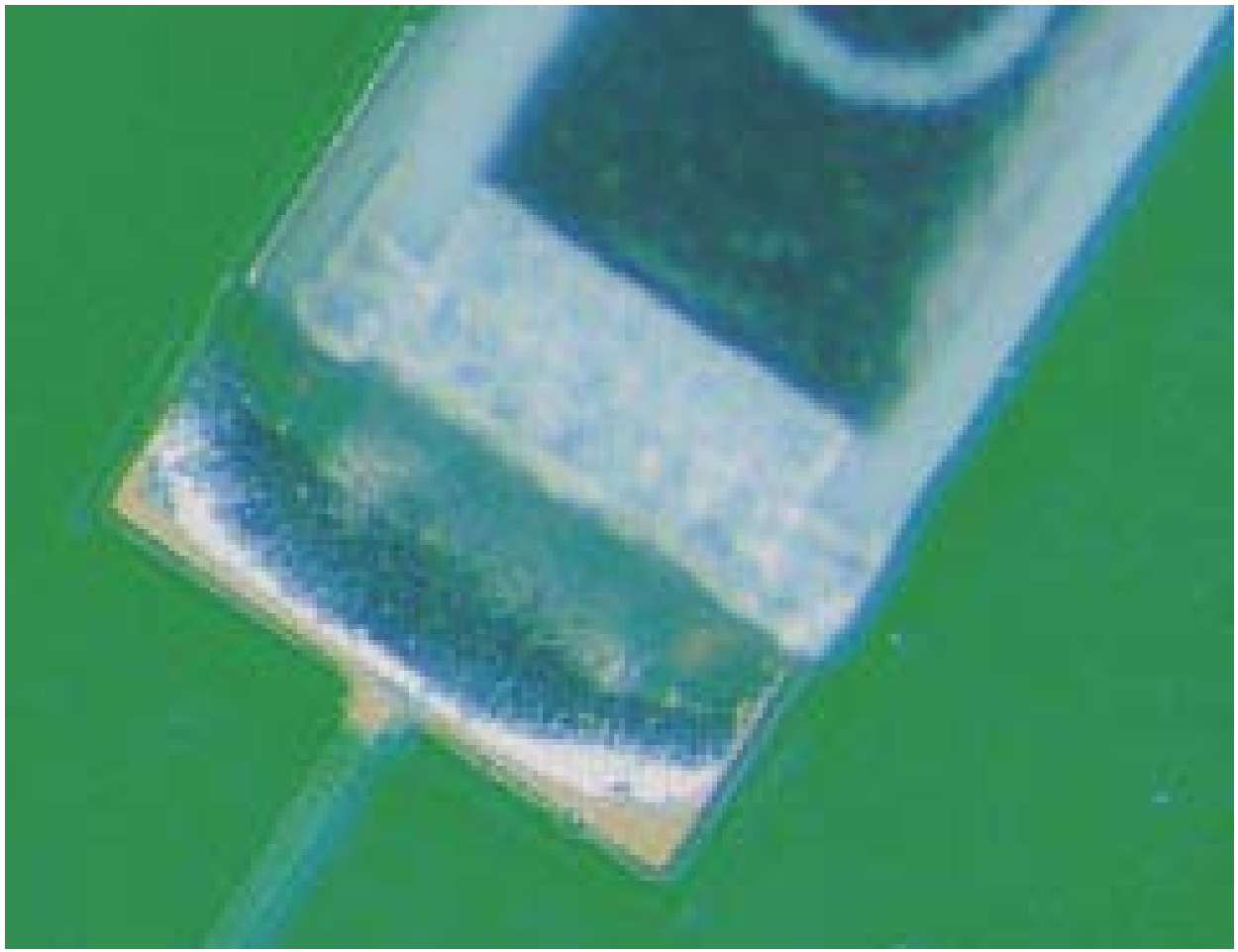
- **Surface roughness (grainy or dull).**
- **Greater wetting contact angles.**

All other solder fillet criteria are the same."

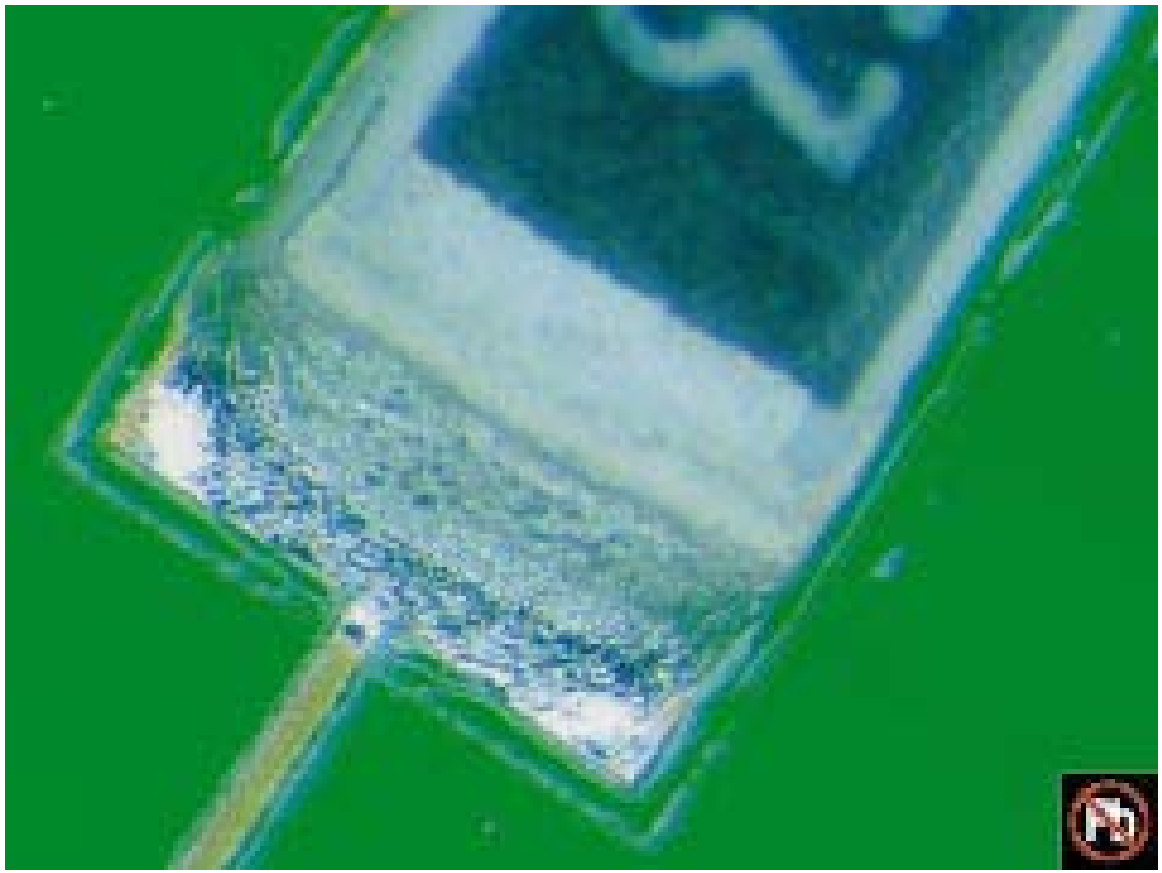
"Soldering Acceptability Requirements"

- J-STD-001D, Appendix E – "Visual Comparisons of SnPb and Lead Free Solder Connections
  - Same as figures in IPC-A-610D

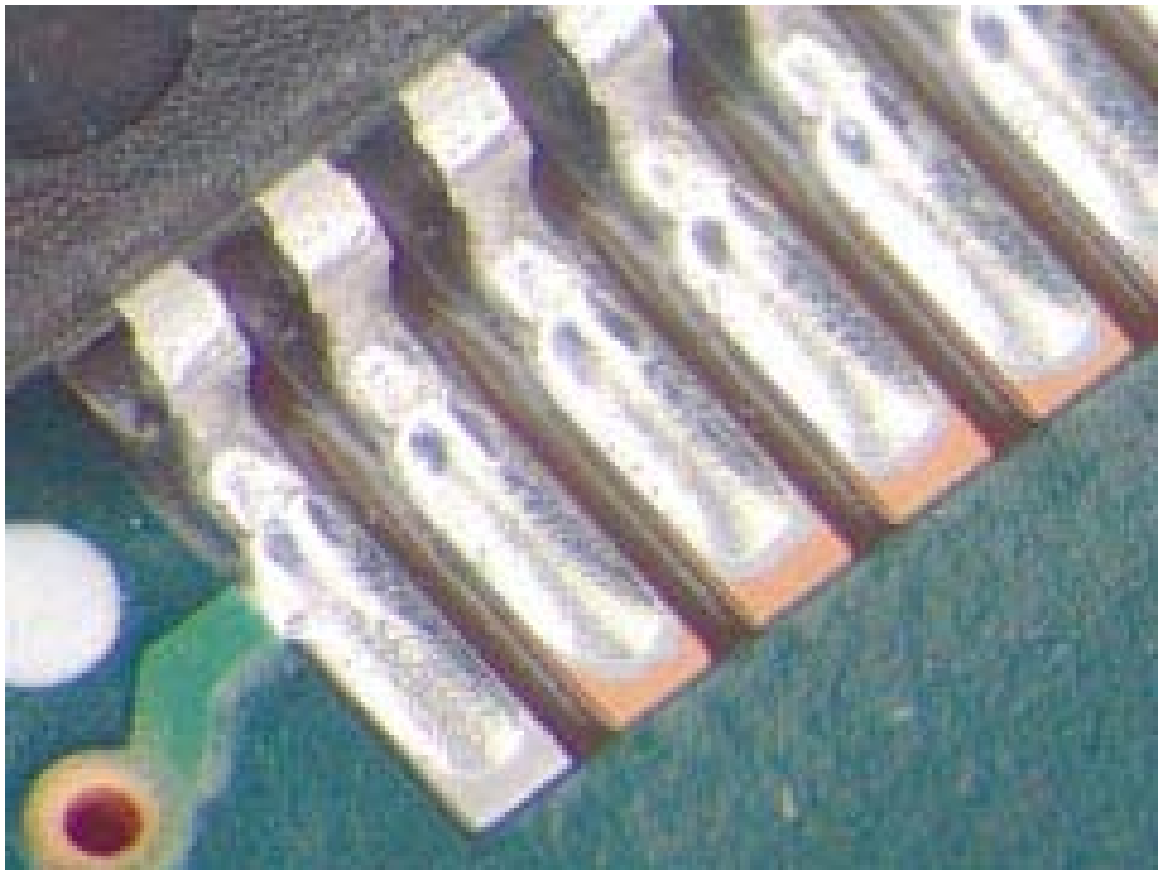
SnPb Solder
No Clean Process



SnAgCu Solder
No Clean Process

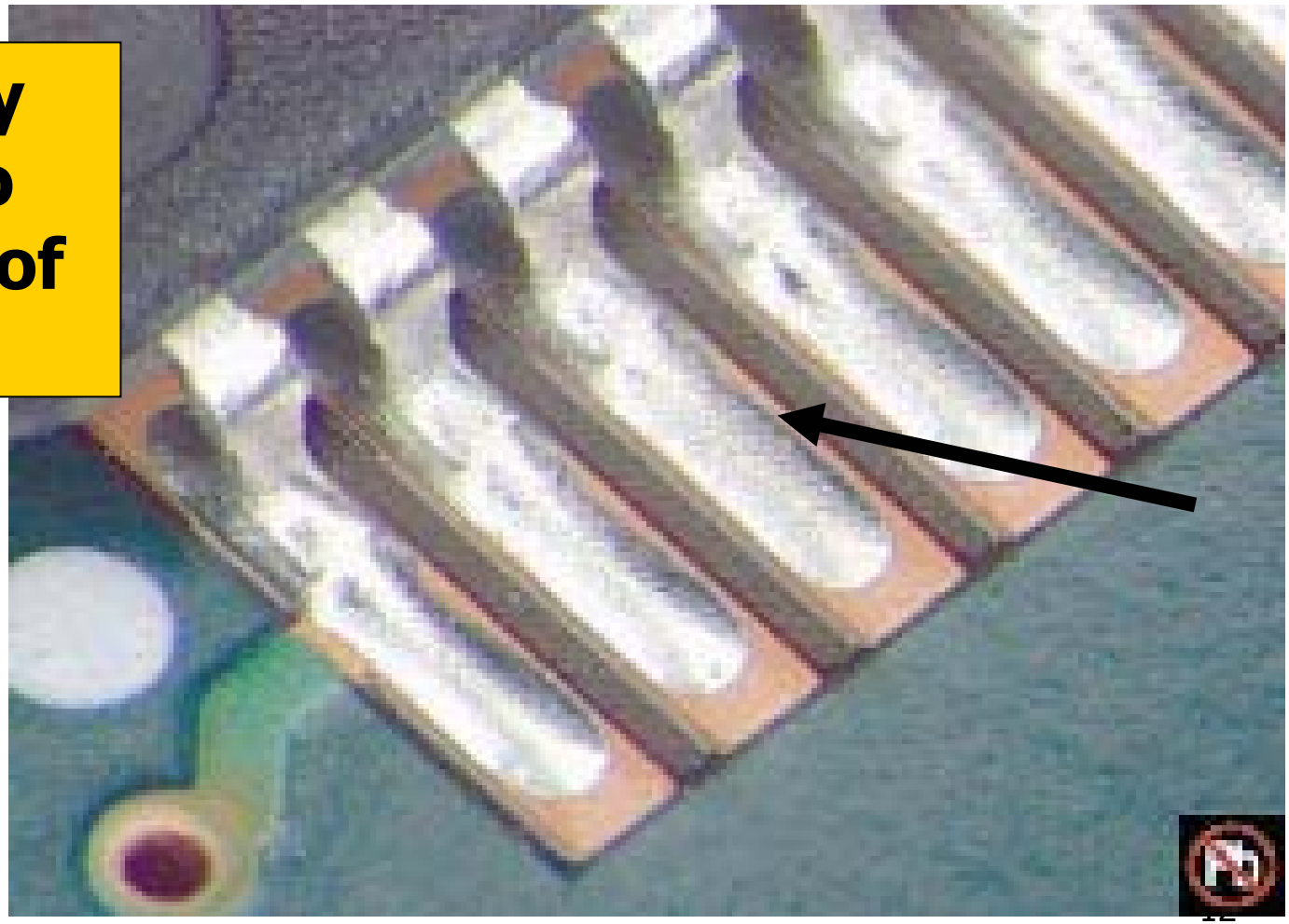


SnPb Solder
Water Soluble Flux



SnAgCu Solder
Water Soluble Flux

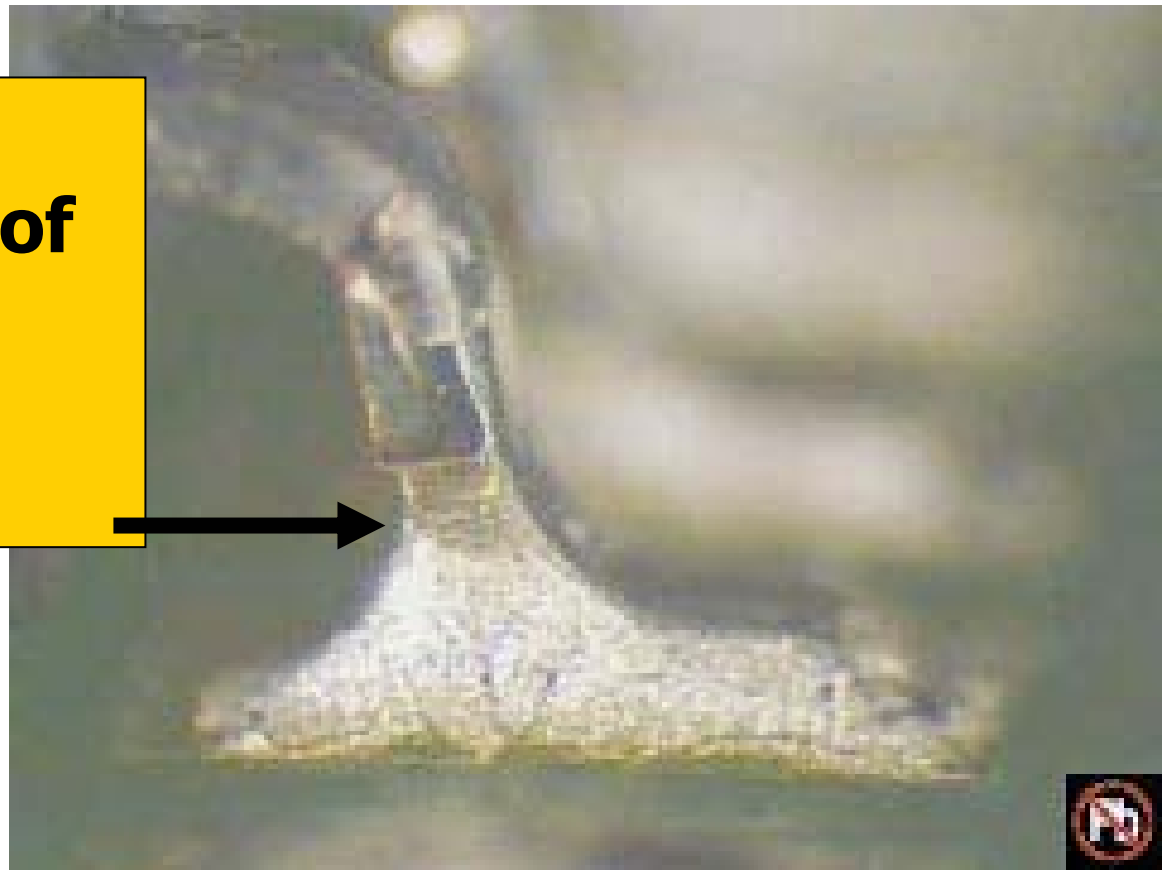
Solder may not flow to the edges of the land.



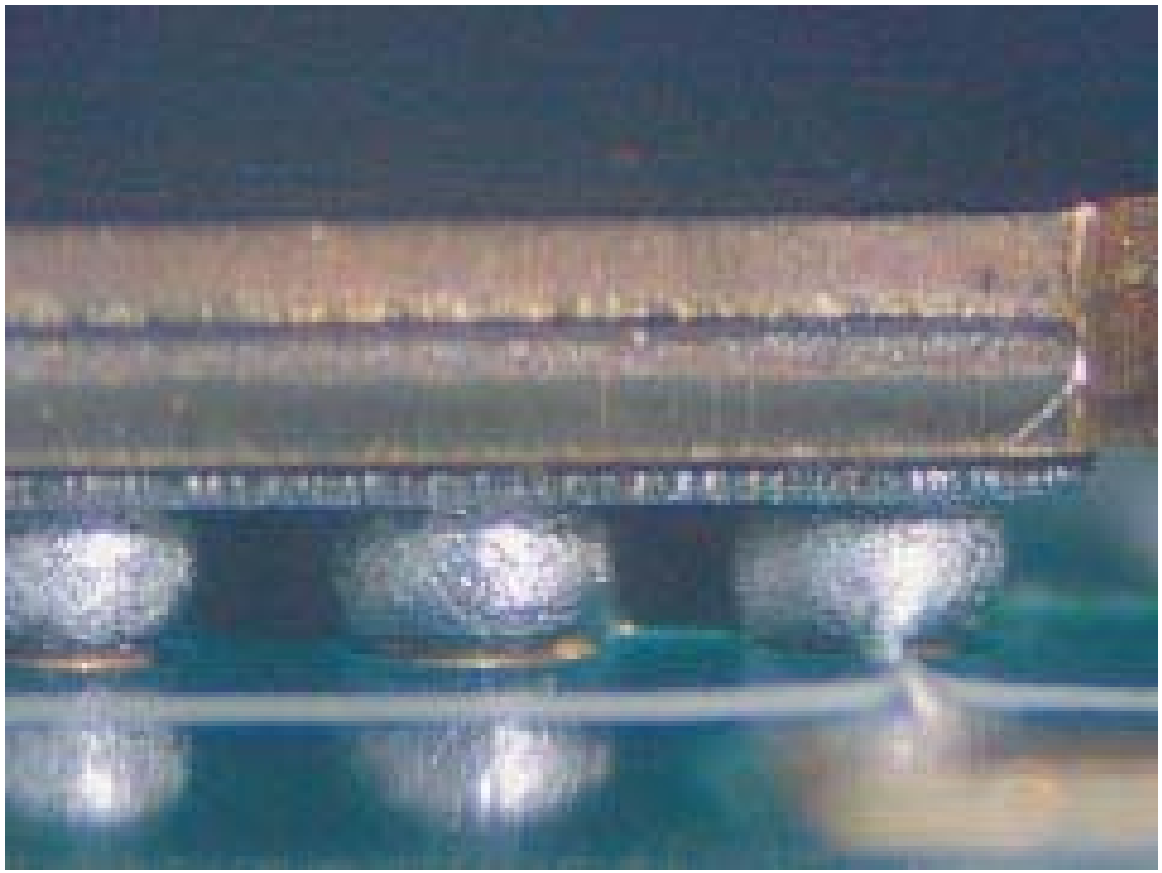
SnPb Solder
No Clean Process

SnAgCu
No Clean Process

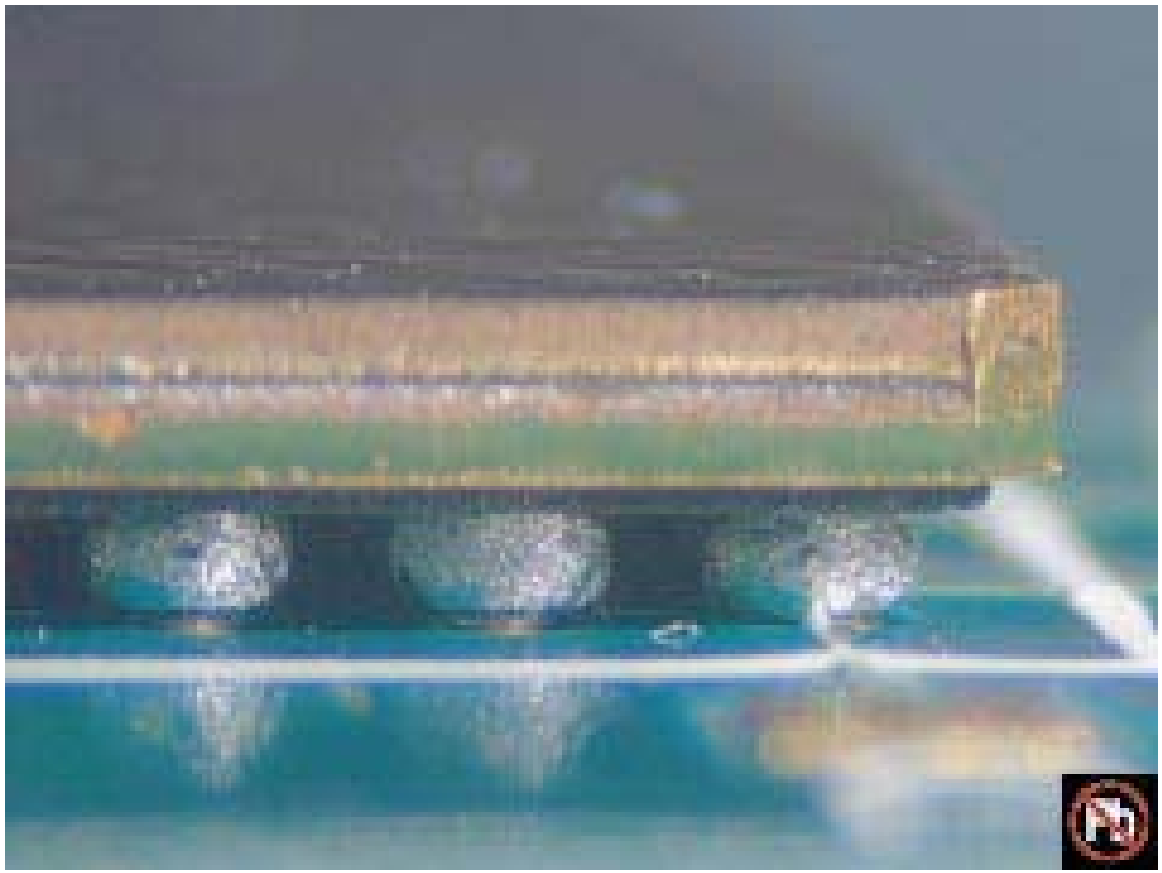
Greater incidence of higher wetting angles.



SnPb Solder
No Clean process



SnAgCu Solder
No Clean Process

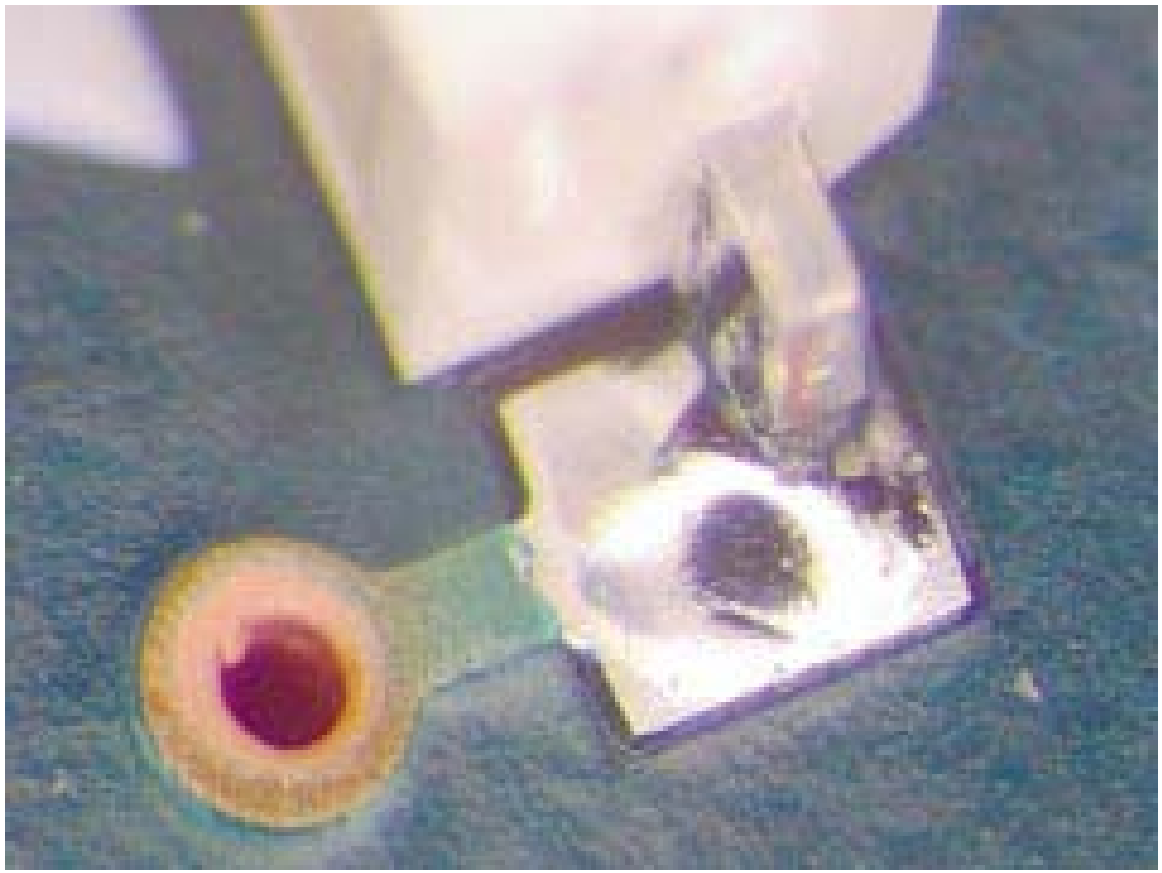


SnPb Solder

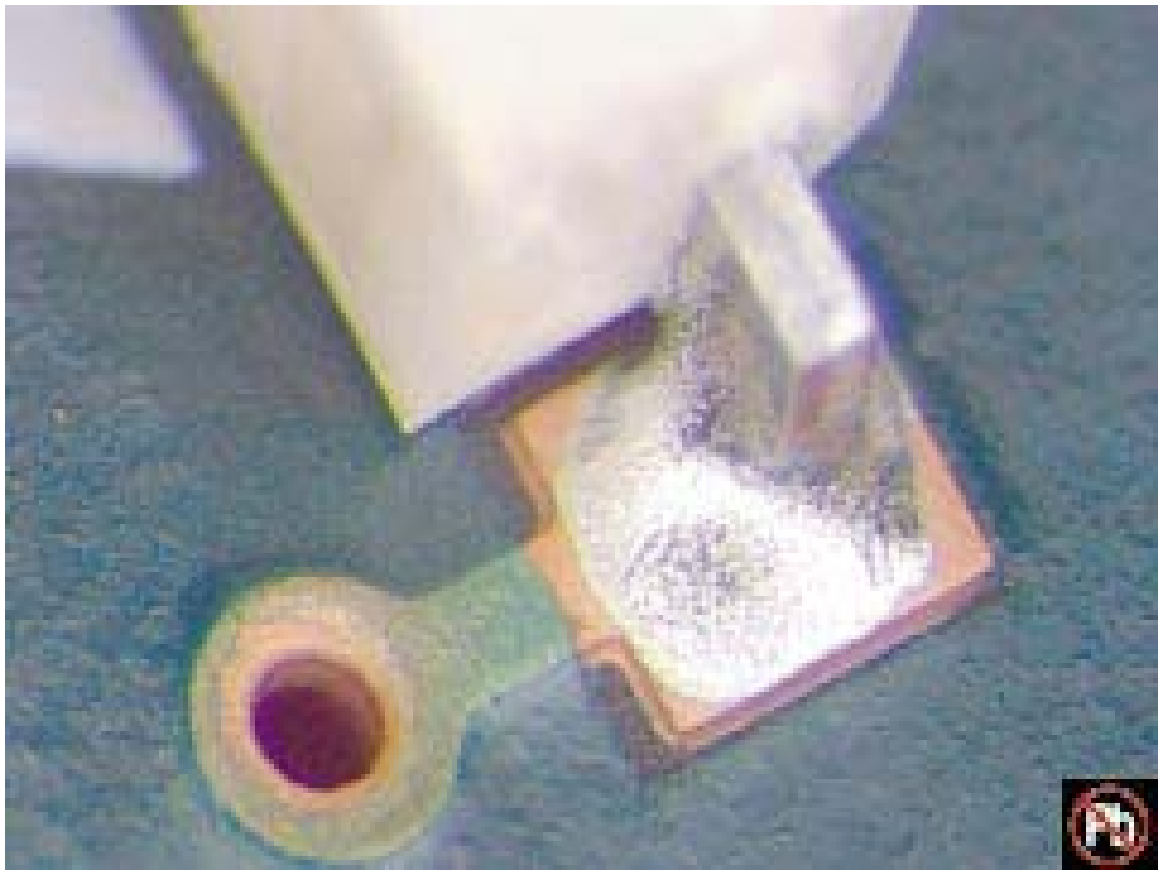
SnAgCu Solder

Surface Roughness (grainy or dull)

SnPb Solder
OSP Finish



SnAgCu Solder
OSP Finish



SnAgCu Solder

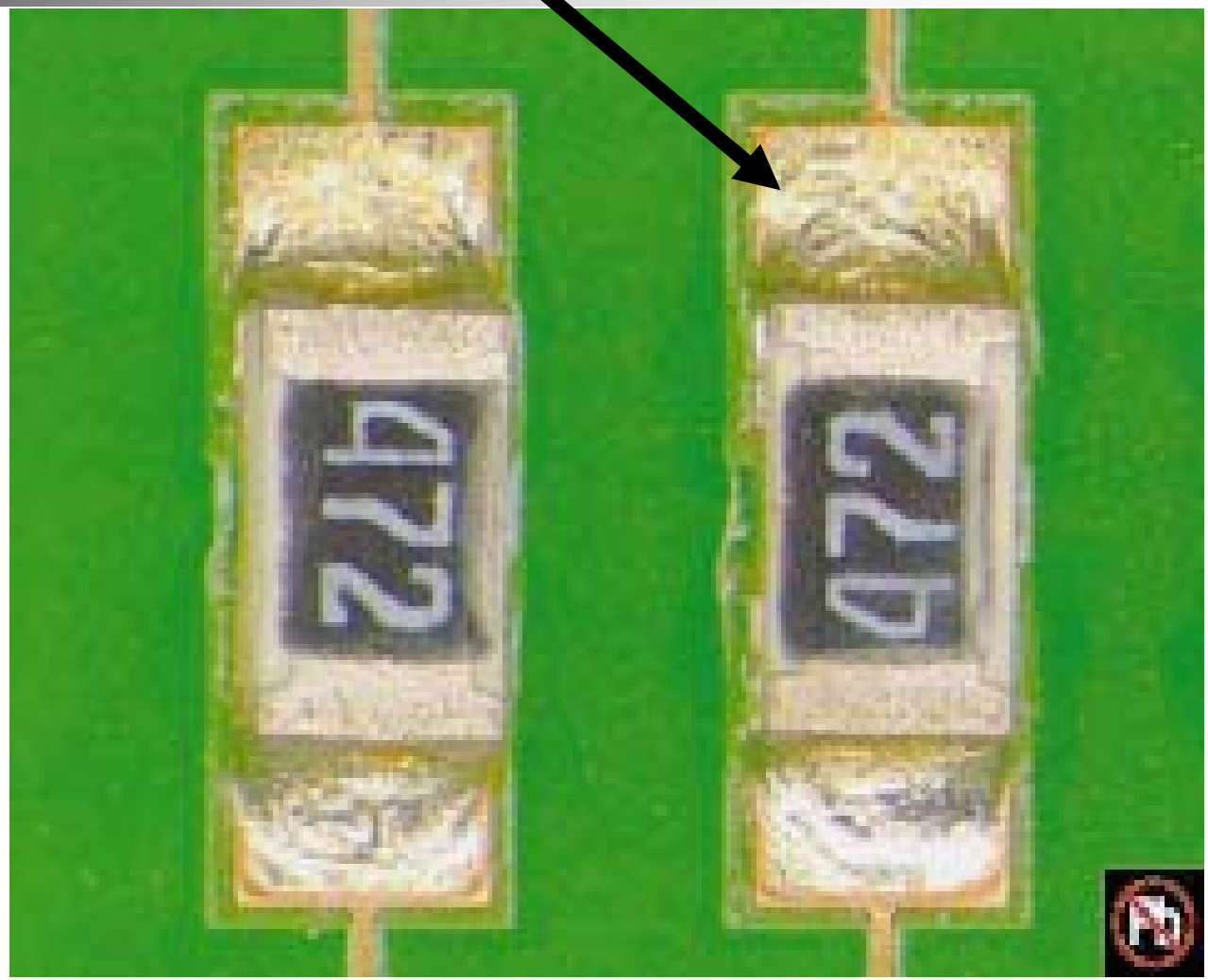
SnAgCu Solder

SnAgCu Solder

SnAgCu Solder

Cooling Lines

Surface appearance with cooling lines is more likely to occur in lead free alloys and is not a disturbed solder condition.



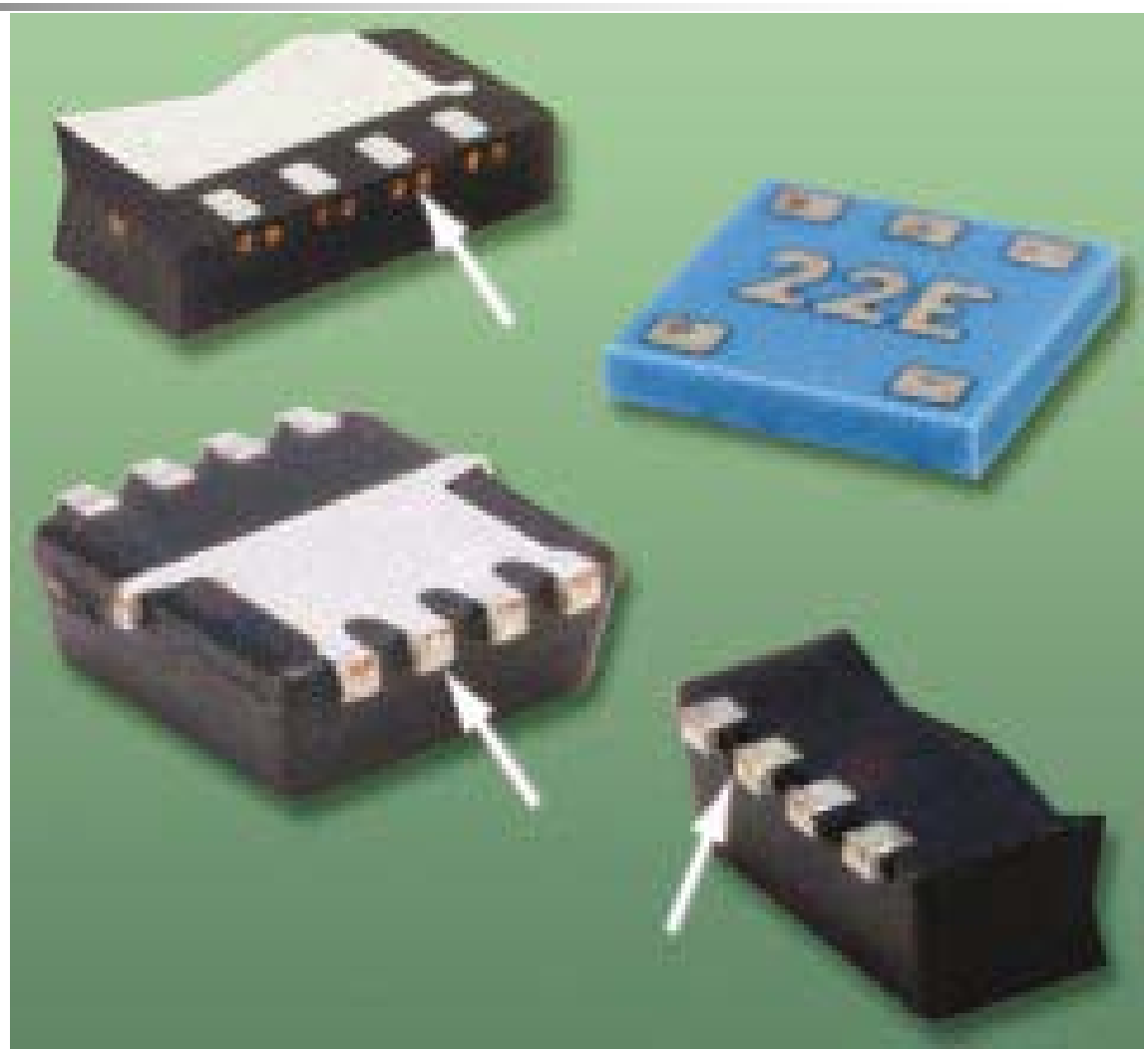
Disturbed Solder

Defect - Class 1,2,3

- **Characterized by stress lines from movement in the connection (SnPb alloy).**

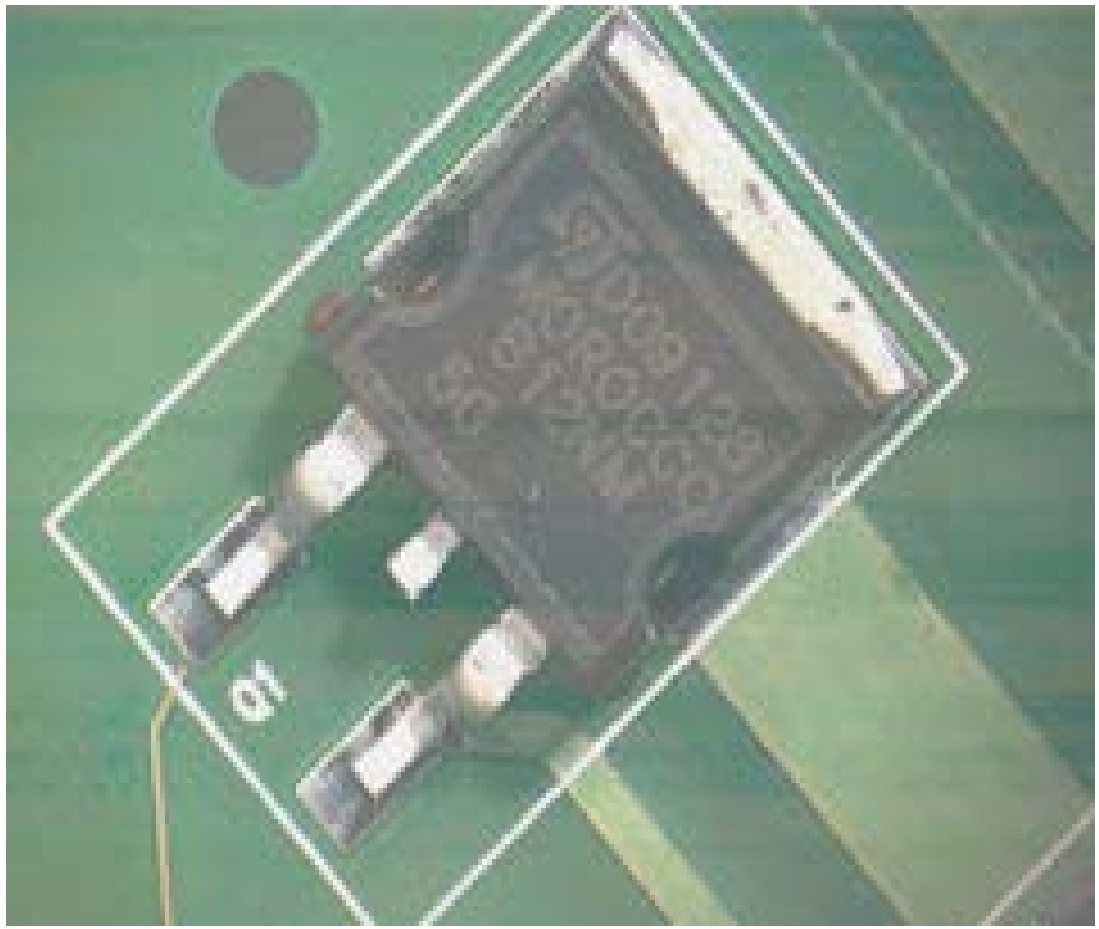
Plastic Quad Flat Pack

There are some package configurations that have no toe exposed or do not have a continuous solderable surface on the exposed toe on the exterior of the package (arrows) and a toe fillet will not form.



D-Pak

Components with Bottom Thermal Plane Terminations



Tin Whisker

No Tin Whisker criteria “because it is not something that occurs during the soldering process - it “could” occur later”.

Jack Crawford of IPC