



Inspection of Hidden Solder Connections

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Inspection of Hidden Solder Connections



- Introduction
- “Hidden” Solder Joint Types and Resulting Inspection Challenges
- Traditional Inspection Methods
- New Inspection Methods Available
- Conclusion



Inspection of Hidden Solder Connections



Introduction

- The assembly process determines joint integrity, not inspection!!!!!!
- PWB solder joint miniaturization
- New inspection challenges
- Traditional inspection methods may not be sufficient for solder joint assessment
- What are the inspection alternatives???? What is the latest and greatest available????



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“Hidden” Solder Joint Types and Resulting Inspection Challenges

- What’s a hidden solder joint?
- Surface mount components
 - All types of BGA (Micro BGA, PBGA, CBGA, CCGA)
 - J-leads
 - CSP
- Densely populated through hole components
 - Backplane connectors



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Traditional Inspection Methods (Industry Standards)

- Microscope inspection

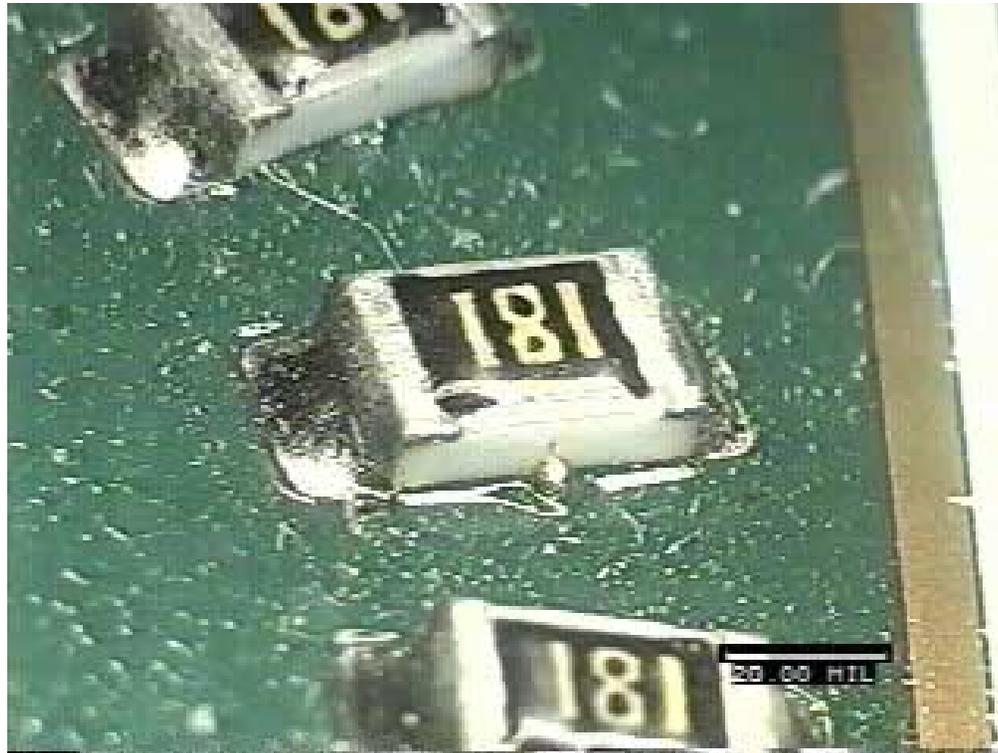
Pros

- Partial view of solder joint parallel to PWB edges

Cons

- Extensive board handling increasing the possibility for damage
- Results are subjective
- Unable to view multiple rows of joints and unable to view between component gaps

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Traditional Inspection Methods (Industry Standards)

- Cross sectional analysis

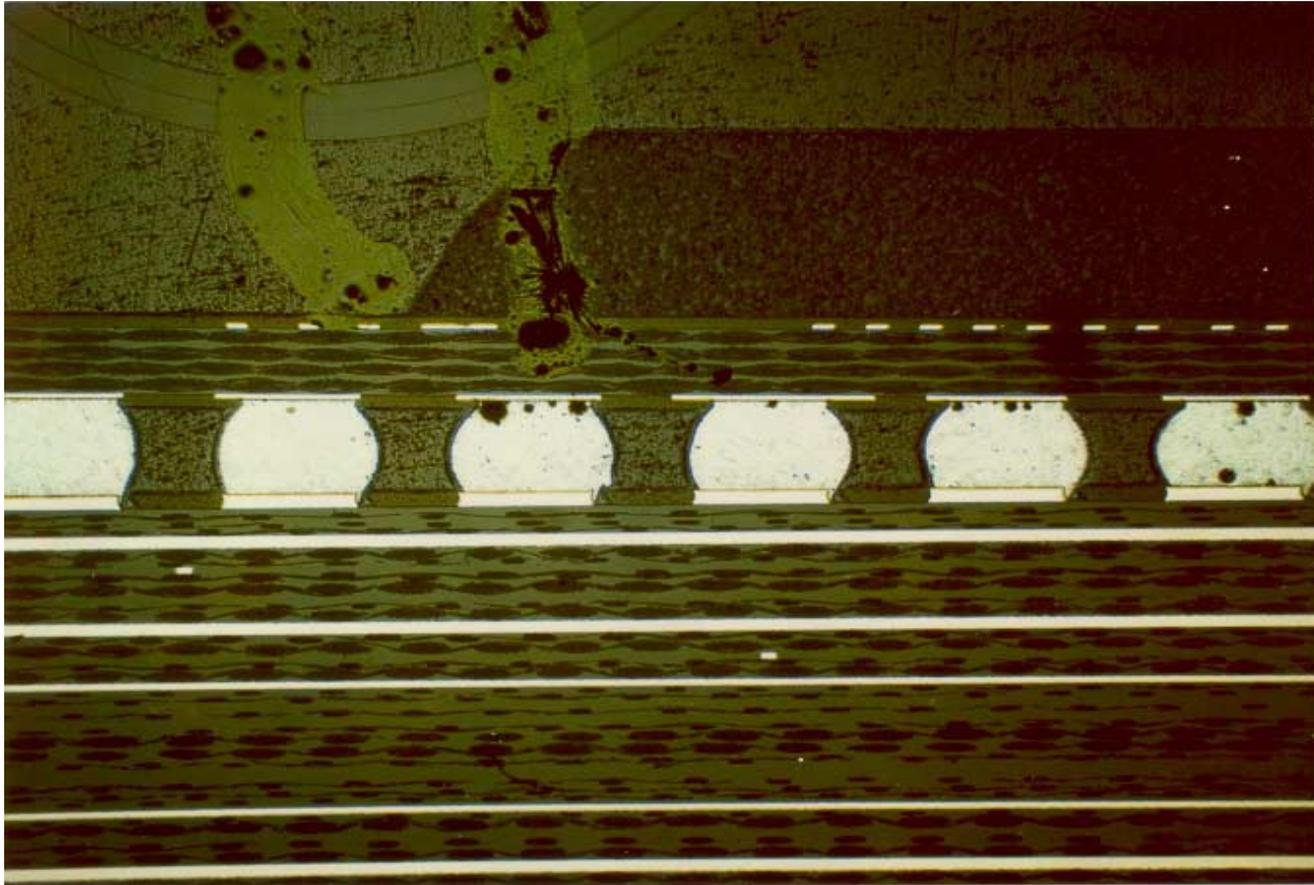
Pros

- Able to view solder joint integrity, presence of cracks and microstructure condition can be determined
- Ability to view multiple rows through additional sections
- Z-axis or planar views possible

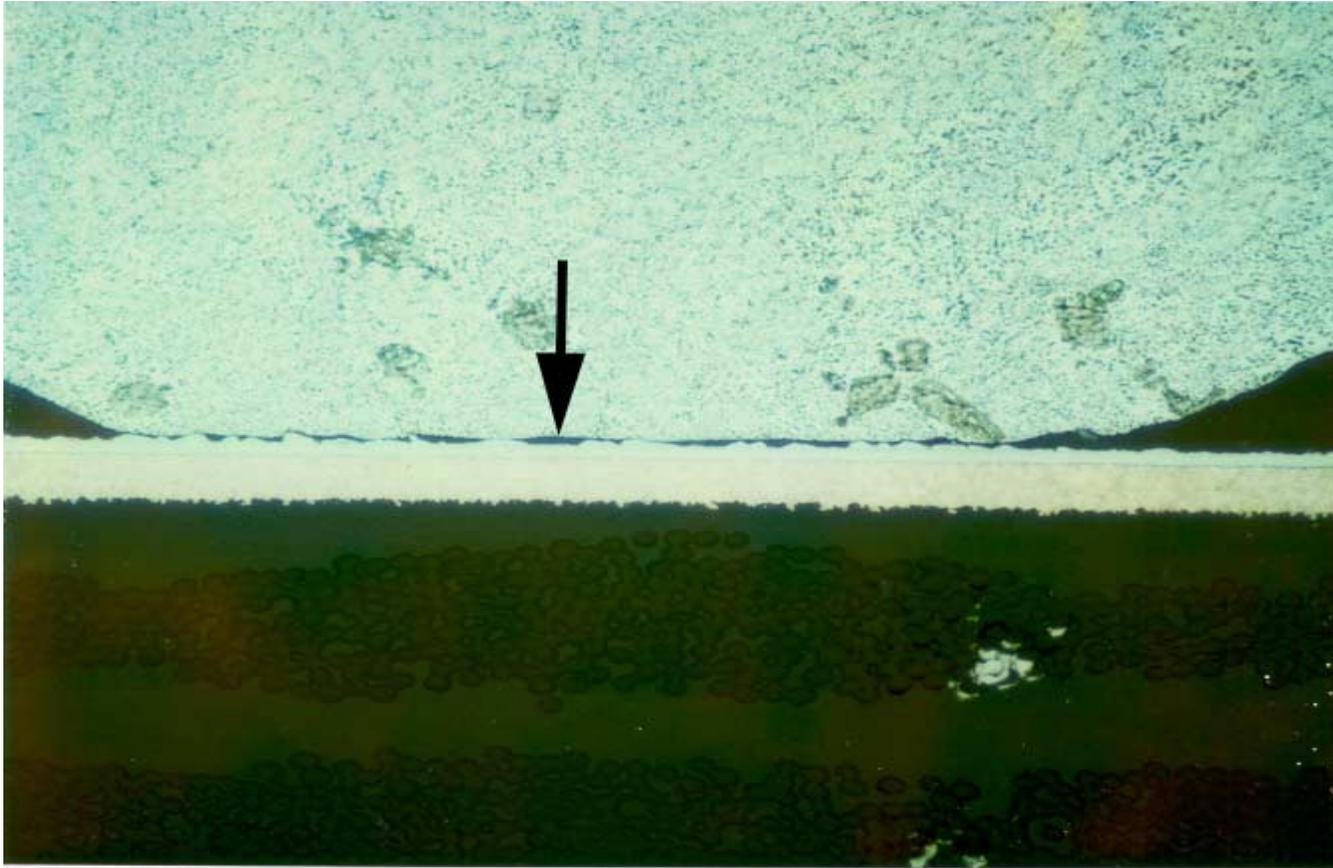
Cons

- Destructive test, not practical for process inspection
- Labor intensive
- Two dimensional aspect only

Traditional Cross Section Inspection Of BGA Joints



Traditional Cross Section Inspection Of a BGA Joint





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Traditional Inspection Methods (Industry Standards)

- Electrical testing

Pros

- 100% assembly verification
- Simple, pass or fail (either it works or it doesn't)

Cons

- Does not reflect certain anomalous solder joint conditions (i.e. cold joints, partial cracks, voiding, etc.)
- Solder joint contamination may be overlooked



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Traditional Inspection Methods (Industry Standards)

- X-ray inspection

Pros

- Provides an internal view all solder joints in a non-destructive fashion

Cons

- 1:1 ratio of x direction views (tilt views are possible)
- Difficult to assess solder joints of a fully populated PWB, many obstructions could be present
- Film interpretation = labor intensive
- Unable to distinguish cold joints, fine cracks, flux contamination, etc.



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New Inspection Methods Available

- 90° prism assisted microscope inspection

Pros

- Easy to use and systems are relatively inexpensive at 25 to 30K
- Minimizes PWB handling
- Can view one full side of periphery BGA solder joints. Able to view for BGA solder joint cracks
- Able to inspect between components with gaps as tight as 35 mils and component height gaps as small as 2 mils.
- Ability to view multiple BGA rows or J-leads to view solder joint profiles
- Able to detect the presence of non-metallic contamination such as flux



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New Inspection Methods Available

- 90° prism assisted microscope inspection

Cons

- Labor intensive
- Subjective and requires interpretation
- 100% inspection not possible

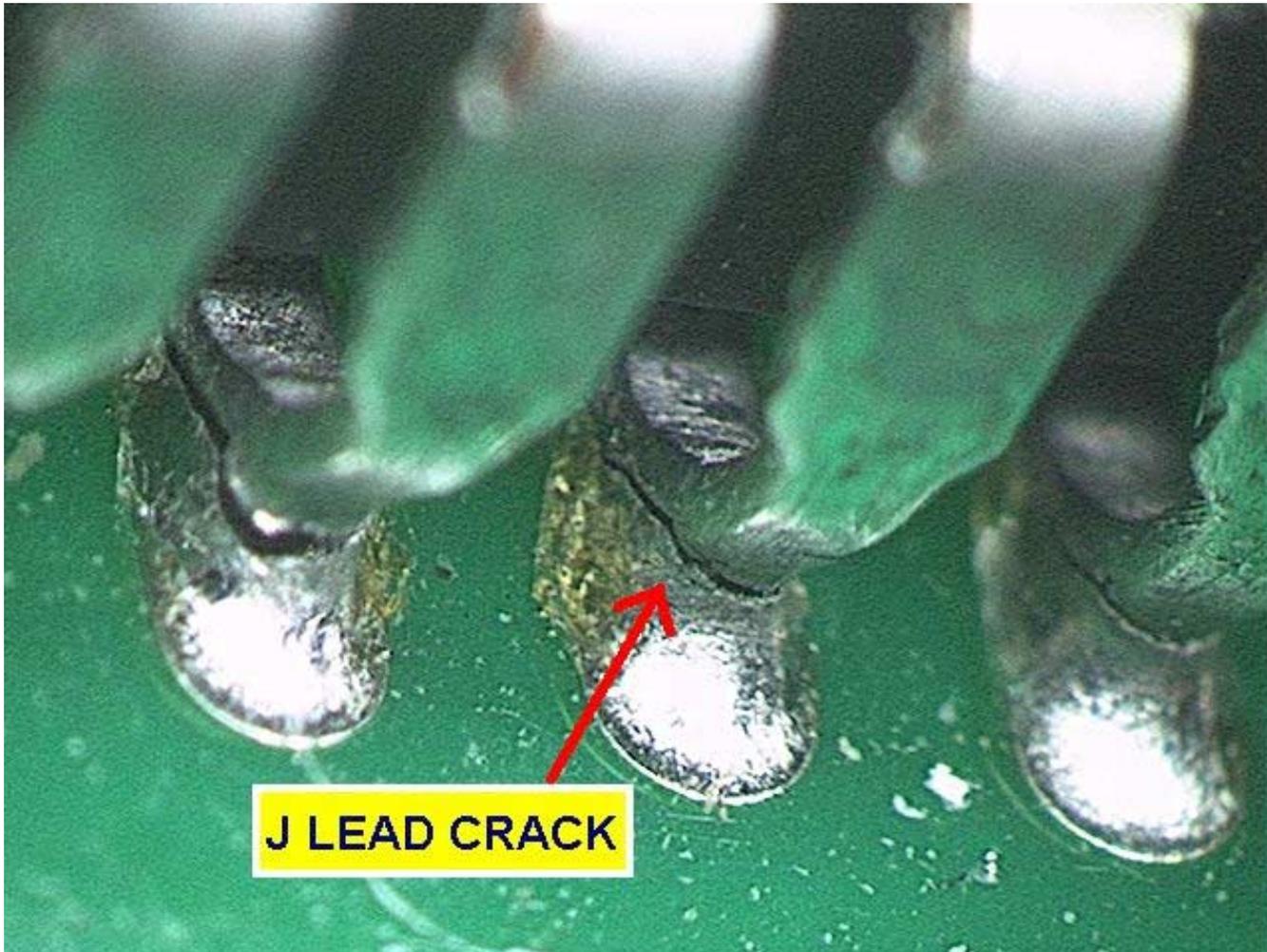
90° Microscope Visual Inspection Of BGA Joint



90° Microscope Visual Inspection of BGA 3rd Row



90° Microscope Visual Inspection of J-Leads





Inspection of Hidden Solder Connections



New Inspection Methods Available

- Real time microfocus x-ray and integrated BGA inspection software

Pros

- Relatively easy to use
- Real time x-ray views observable on a monitor. Can manipulate sample during the inspection process
- Can view solder joints in great detail, resolution as great as 0.0001 inches and magnifications can range from 1x to 1300x
- Image analysis software program that can eliminate operator judgement with simple pass or fail criteria



Inspection of Hidden Solder Connections



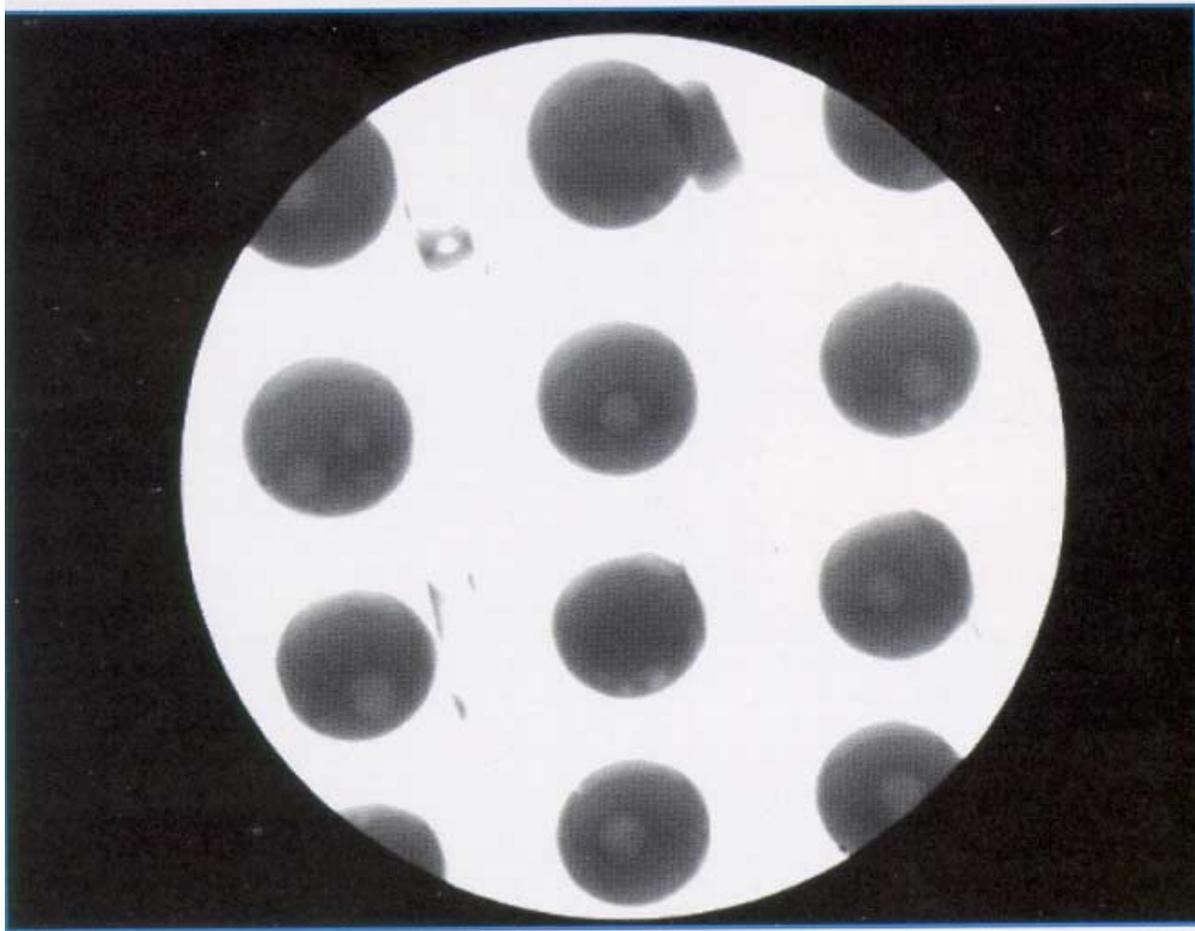
New Inspection Methods Available

- Real time microfocus x-ray and integrated BGA inspection software

Cons

- Labor intensive and not practical for 100% inspection if components obstruct BGA analysis system
- BGA analysis system only useful if the x-ray detector is parallel to the PWB. PWB tilt renders the program useless
- Unable to detect non-metallic contamination such as flux

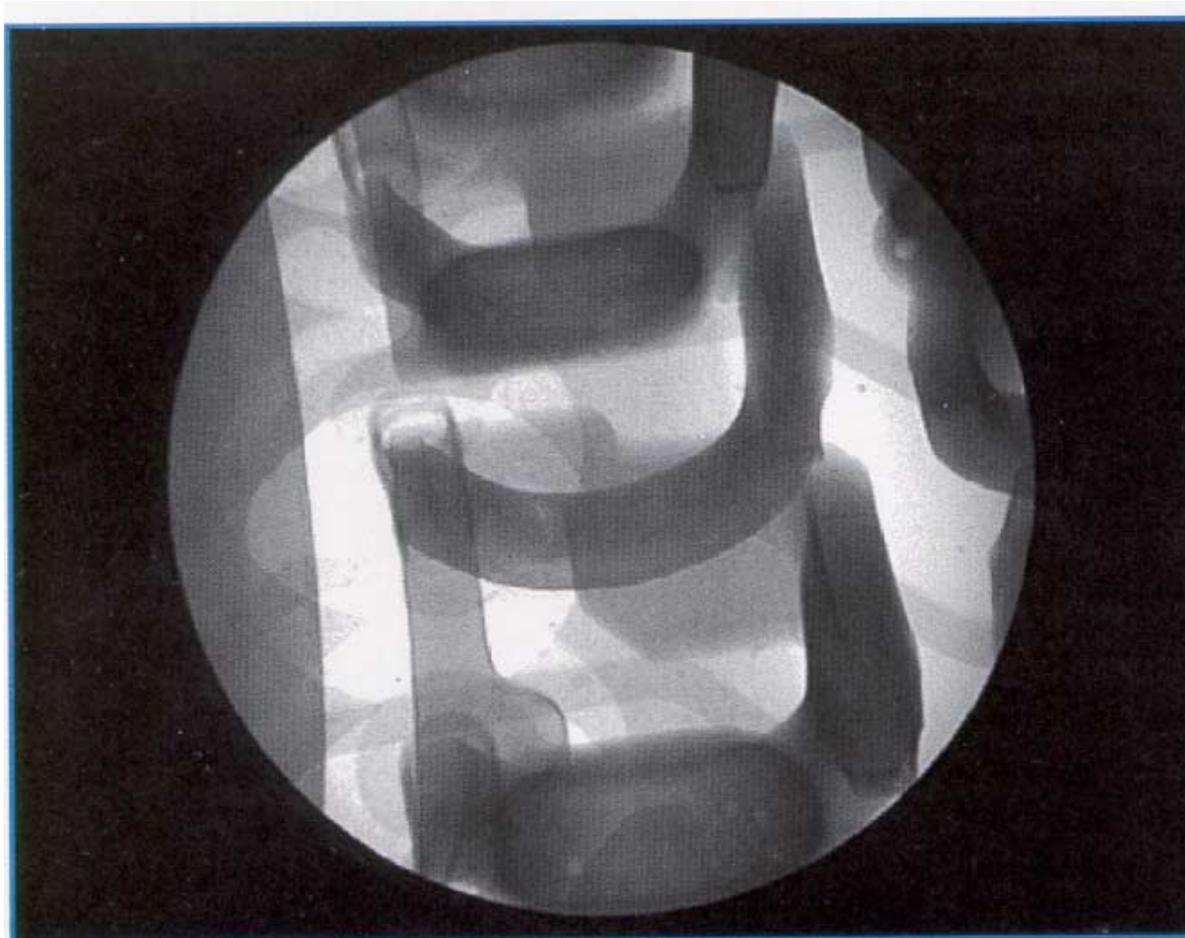
Real Time Microfocus X-ray Inspection



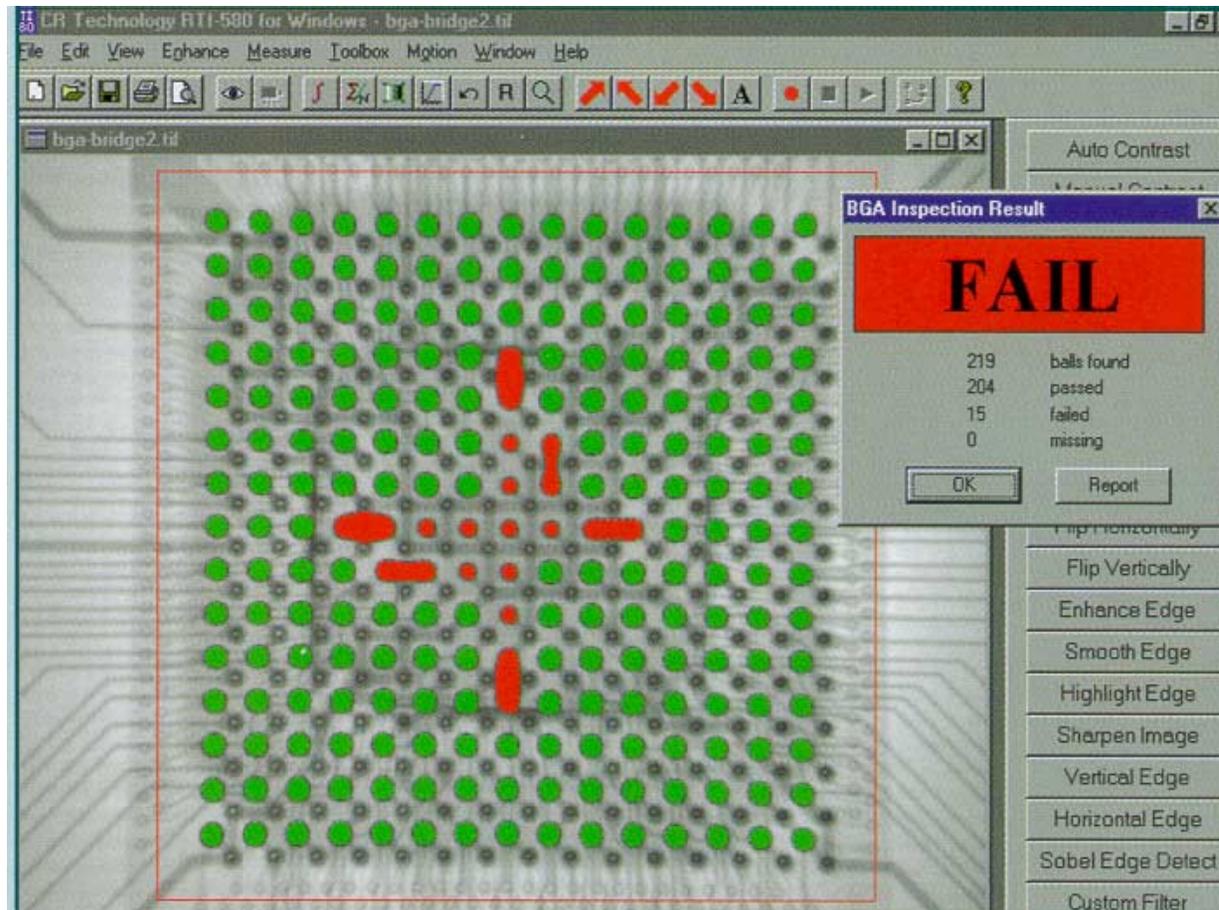
Real Time Microfocus X-ray Inspection



Real Time Microfocus X-ray Inspection



Real Time Microfocus X-ray with BGA Inspection Software



New Inspection Methods Available

- X-ray laminography

Pros

- Views solder joints in unobstructed planar (z-axis) sections or “slices”
- 100% inspection
- Pass/fail criteria can be established prior to inspection and interpretation is not required
- Three dimensional solder joint digital reconstruction can be determined for solder volume and characteristics
- Inspection process is fast. HP claim of over 10Ksolder joints PWB top and bottom side in less than 10 minutes

New Inspection Methods Available

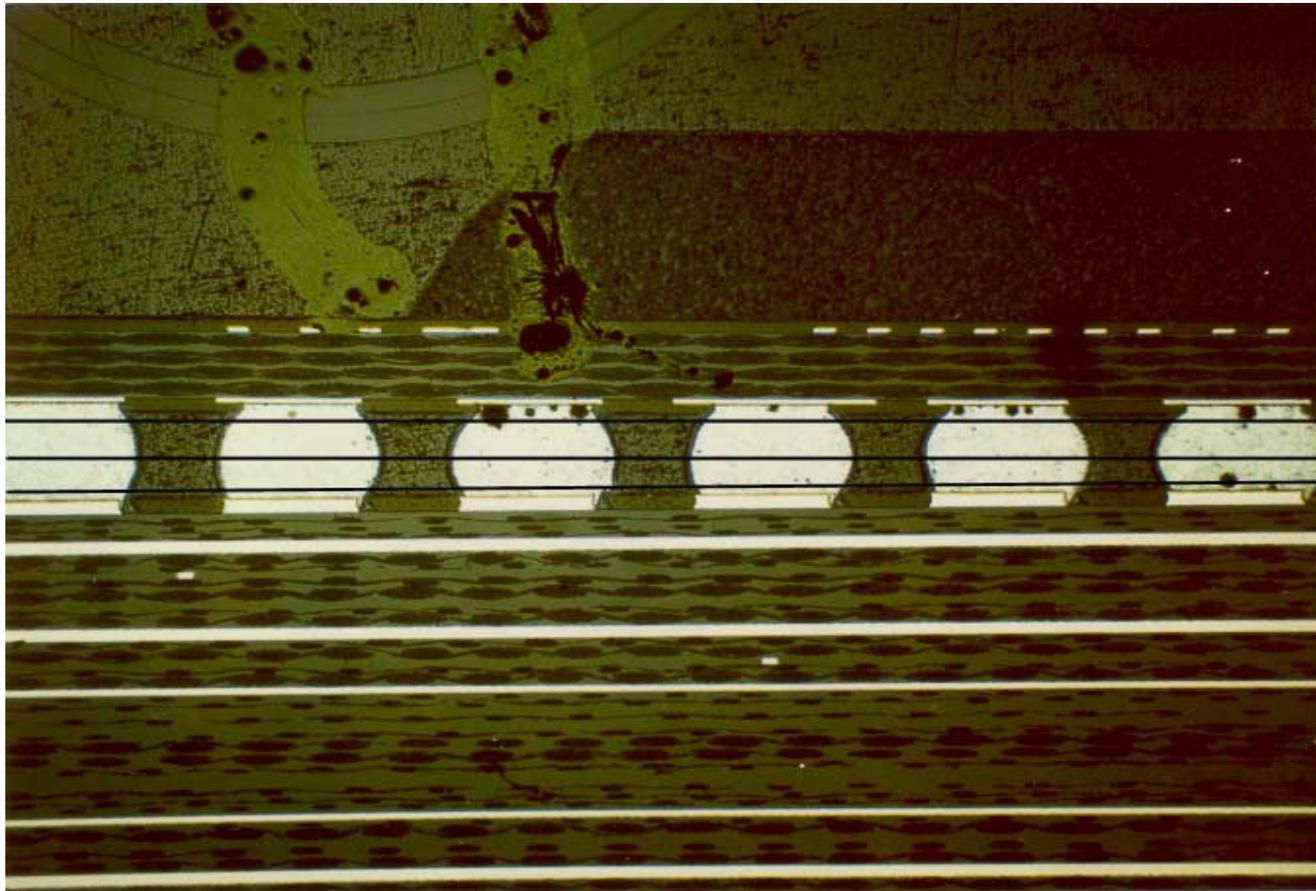
- X-ray laminography

Cons

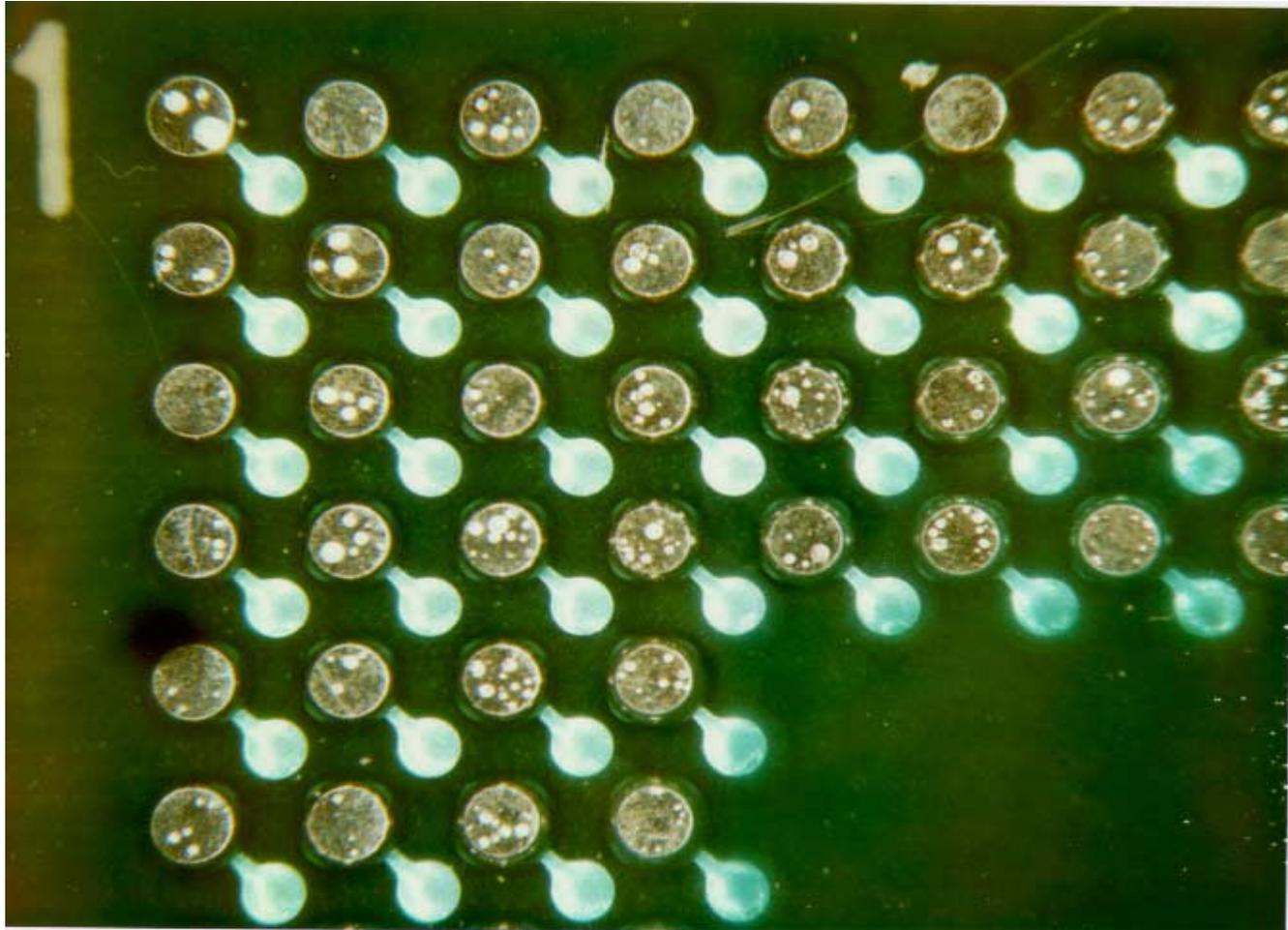
- Initially very labor intensive with programming. 5-7 days of skilled labor for PWB Gerber (graphics) data interface
- Resolution of images is poor
- Slice size are between 4 to 6 mils, therefore joint cracking could not be detected
- Expensive purchase, ~540K. Alternative, service is offered at ~2K a day
- Too much information produced

Inspection of Hidden Solder Connections

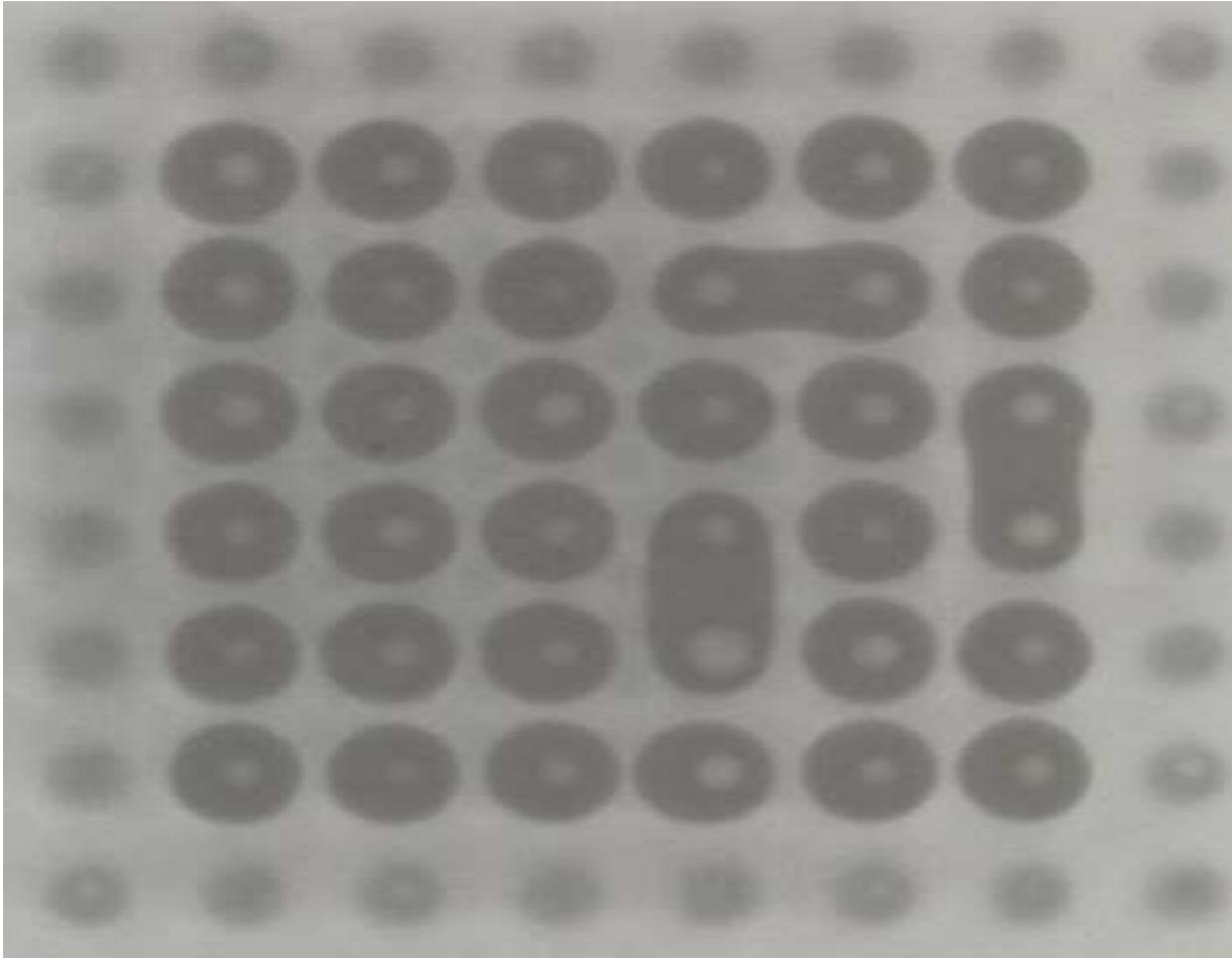
X-ray Laminography Inspection Will Show a Planar “Slice” View of BGA Solder Joints



X-ray Laminography Inspection Will Show a Planar “Slice” View of BGA Solder Joints



X-ray Laminography Inspection Showing a Planar “Slice” View of BGA Solder Joints



Conclusion

- Process control is of the utmost importance!
- Visual and real time x-ray examinations should not be used for 100% inspection to verify process control
- 90° inspection, cross section, and real time x-ray should be used for qualification and failure analysis purposes
- X-ray laminography can be used for 100% inspection. Is the initial cost worth the volumes of data?
- Combination of 100% electrical and lot sampling inspection - appropriate method to be determined by the customer