

## PCB Failure Analysis Techniques

**Christopher Hunt**  
9th November 2011



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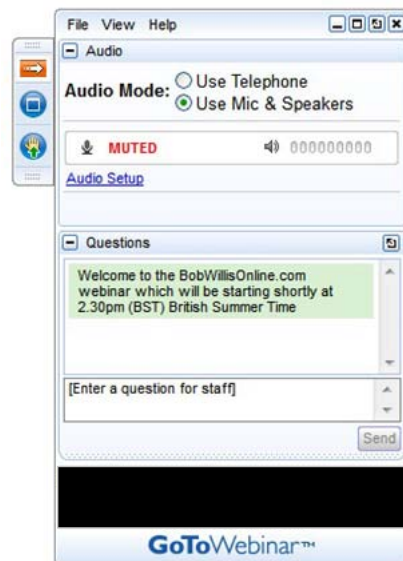
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## PCB Failure Analysis Techniques

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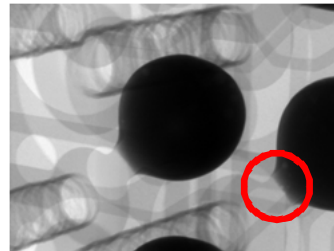


### Failure Analysis Requirements

- Information on the failure mode and location
- Examples of failed assembly
- Example of the bare board, same batch
- Listing of assembly process and materials used
  - Solder alloy used and reflow time above liquidus
- Contact details for additional information
- Where were the products produced?
- Order for the investigation work

## Optical & X-Ray Examination

- Optical inspection of joints
- Corner joints see most stress
- Look for joint consistency
- Look for good wetting optically and with x-ray
- Measure ball size on the four corners and the centre area
- Compare with known good PCB



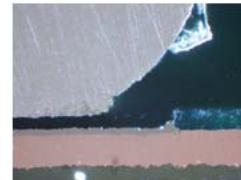
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## Microsection Samples

- Secure the BGA before cutting
- Corner joints see most stress
- Look for good intermetallic
- Check the nickel/gold plating thickness with reference PCB
- Check pad size to design files
- Compare results with known good PCB assembly sections



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## Examination of Bare Board Samples

- Optical inspection of pads for consistent gold coverage and nickel surface topography
- Reference to IPC 4552
- Check for surface contamination like solder mask residues
- Compare surface with know good boards or inspection criteria



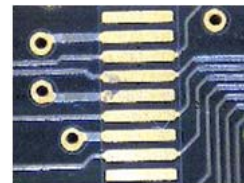
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## XRF Measurements of Samples

- Measure the plating thickness on multiple pads on the bare board
- Measure any non soldered pads on the board under examination
- Compare with known good PCB
- Compare results with customer, supplier specification and the IPC



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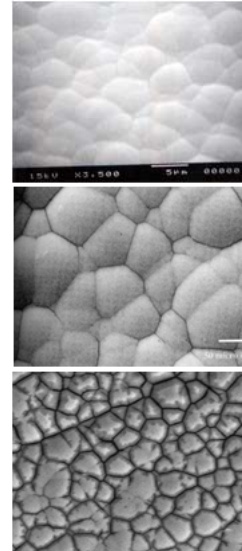
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## Scanning Electron Microscope SEM

- Examine failed and reference sample under SEM
- Compare the surface of the nickel with reference samples from chemistry supplier
- Look for nickel boundary condition
- Look for significant reduction in solderable area
- Conduct surface analysis on the failed sample and reference good board



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## Low or High Speed Shear Testing

- Measure the shear force on sample balls reflowed on reference board and from known good board under the same reflow conditions
- Compare the pad/ball failed surface after shear testing to see consistent failure mode
- Pad interface failures can be examined under optical or SEM



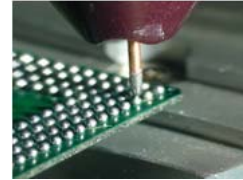
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## Hot Pull Testing

- DAGE Hot pull force measurement can simulate the reflow process on reference board from the same batch with results from known good board
- Pad or solder joint interface failure can be analysed optically or under SEM after testing
- Example of pad/substrate separation
- Example of solder/nickel separation



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| <b>Solder Alloy Option:</b>        | <input type="text" value="Any Soldering Alloy Option"/> | AND |
| <b>Defect Category:</b>            | <input type="text" value="Any Defect Category"/>        | AND |
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**Title Defect Category Assembly Soldering Process Image**

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**Soldering Defects Database**

**Title:** PLCC Solder Joints

**Description:** These two joints have soldered on the front face of the pins which would normally be easily seen during inspection at low magnification but the joints have not formed under the body of the part.

**Probable Cause:** This is probably due to solderability problems with the printed board and are not related to the lead-free process.

**Number of Defects:** 2


**Solder Alloy Options:** Lead-free

**Defect Category:** Assembly/soldering

**Defect Location:** Process

**Product Volume:** Medium (10 to 50 per week)

**Product Application:** Telecommunications

**PLCC component terminations:** 

**Soldering Processes:** Examine the solderability of the printed circuit boards prior to assembly or consider how the solderability has been degraded during the assembly process.

**Possible Solution:** See Good Practice Guide to 66 on Solderability Testing produced by NPL. For details contact Ling Zou email ling.zou@npl.co.uk Telephone 0208 943 6045

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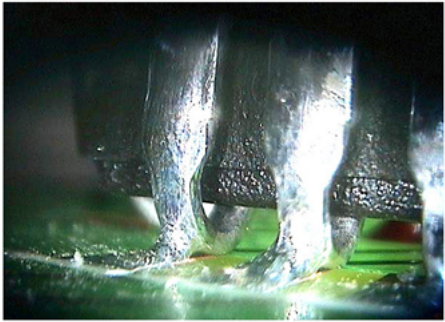
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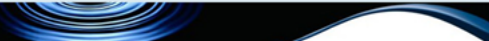
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### National Physical Laboratory Industry Defects Database

Name (\*)

Company (\*)

E-mail (\*)

Failure title

Upload Image

Failure Category -Select a failure category-

Description:

Probable cause:

Solder alloy: -Select a solder alloy-

Soldering Process -Select a soldering process-

Failure location -Select Failure Location-

Number of failures found:

Volume of this product: -Select Product Volume-

Product Application -Select Product Application-


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