



Reliability and Failure Analyses of CGA/LGA/HDI

by

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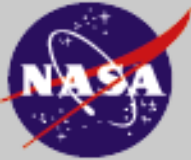
NASA Electronic Parts and Packaging Program (NEPP)

NASA GSFC, June 2014



Outline



- NEPP CGA/LGA/HDI Reliability
 - Key accomplishments
 - 3rd - Final is in progress
 - CGAs and LGAs
- Reliability
 - Thermal: CTE mismatch
 - Mechanical: Mil/Industry
- Failure Analysis Results
 - CGAs /Caps after TC
 - CGA after drop
- Summary




CGA/CGA/HDI Overall Objectives

3rd Report Scope




LGA & CGA

- ✓ Reported pull testing before/after isothermal aging
- ✓ Reported LGA to CGA (two types) assembly and TC data
- Presents assembly of ceramic LGA s (two types) 
- Defines QA indicators by inspection for LGA Assemblies 

CGA

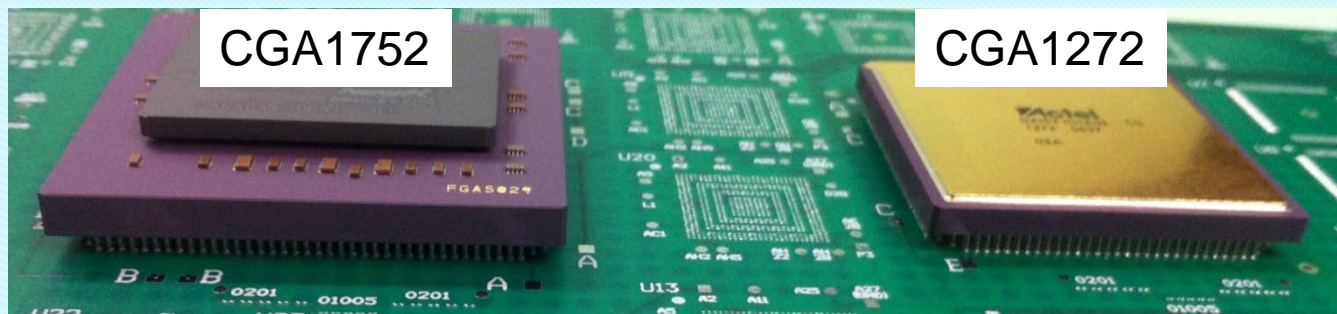
- ✓ Reported package/capacitors reliability evaluation
- ✓ Reported CGA assemblies, QA indicators
- ✓ Reported 200 TC (-55°/100°C or 125°C) of CGA assemblies
- Presents 500 TC results/failure analysis 

CGA/LGA HDI

- Presents new test vehicle with microvia , CGA assembly 
- Presents assembled LGA (ceramic/plastic) on HDI PCB 
- Presents inspection/QA with TC for HDI PCB 
- Reliability functional CGA on HDI is yet to be funded

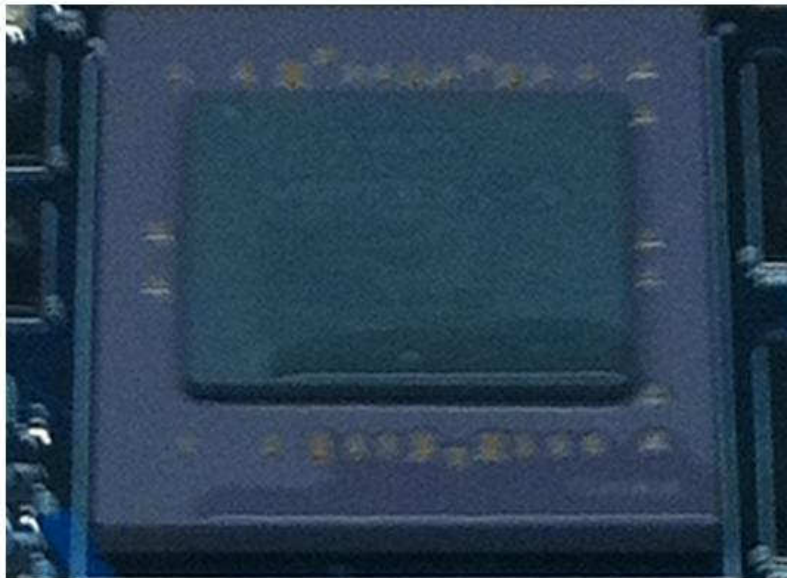
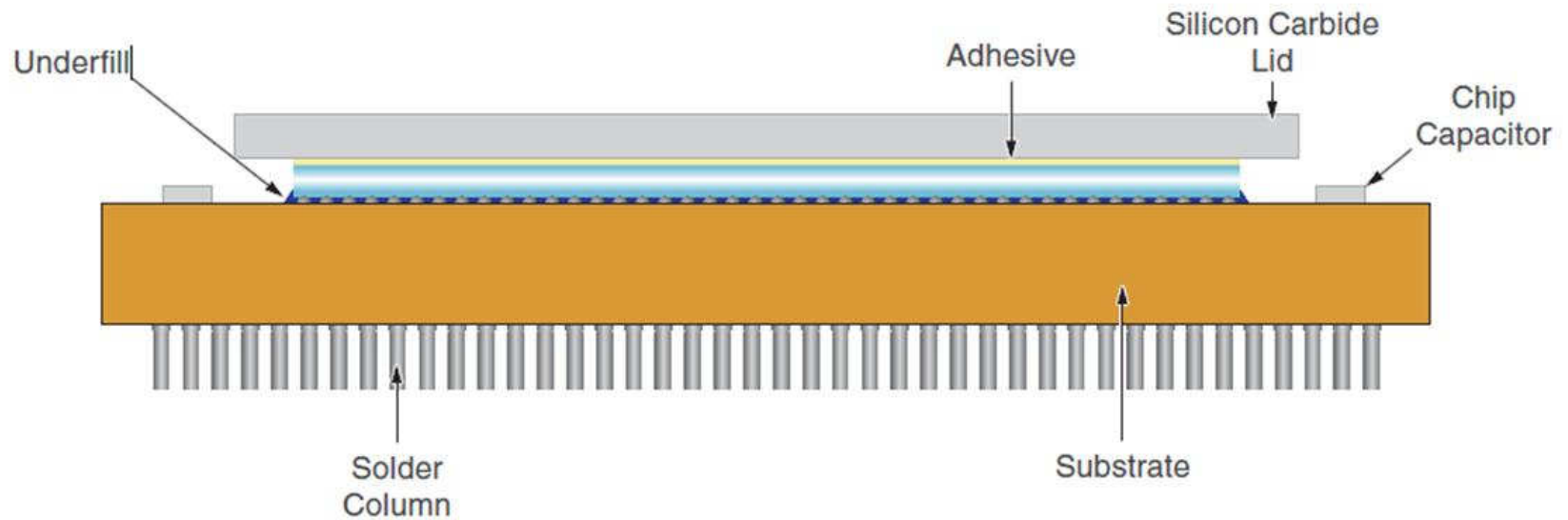


CGA Assemblies



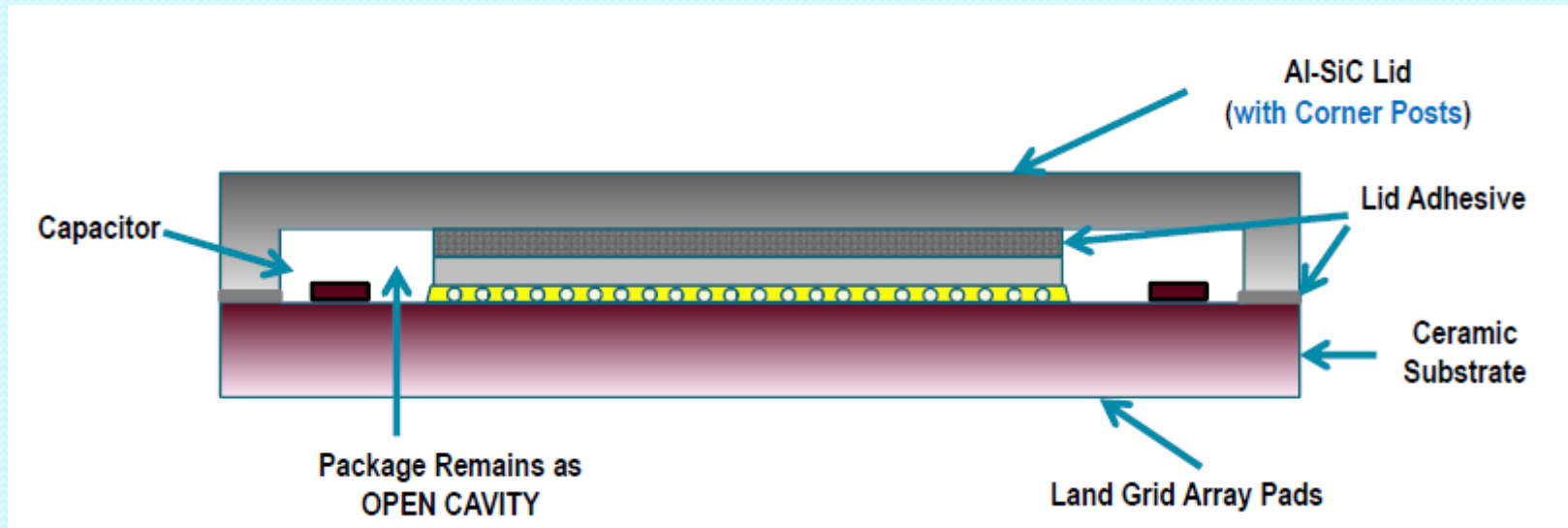


CGA Before Migration to CN (LGA)





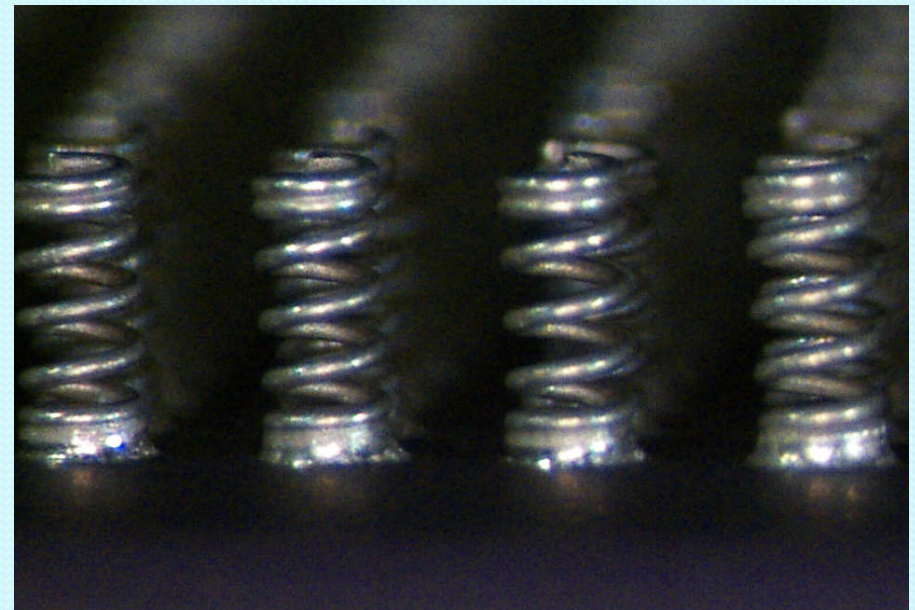
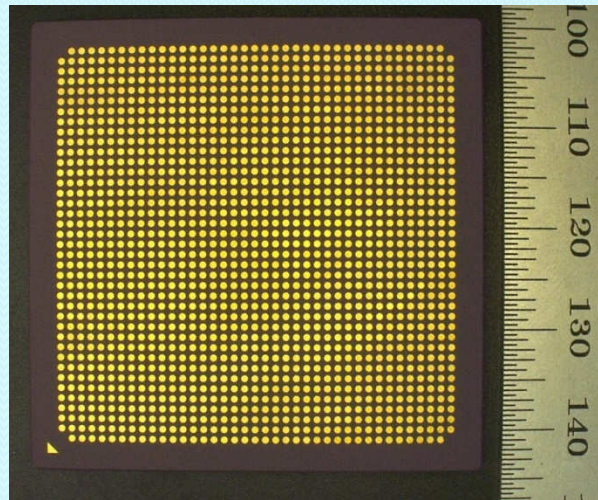
New CN (LGA) Package



- Build facility changed
- CGA to LGA - pad solder coating
- Flip-chip bump now eutectic
- Lid to Al-SiC
- Underfill changed
- Heat sink now covers caps
- Column attachment/Six Sigma

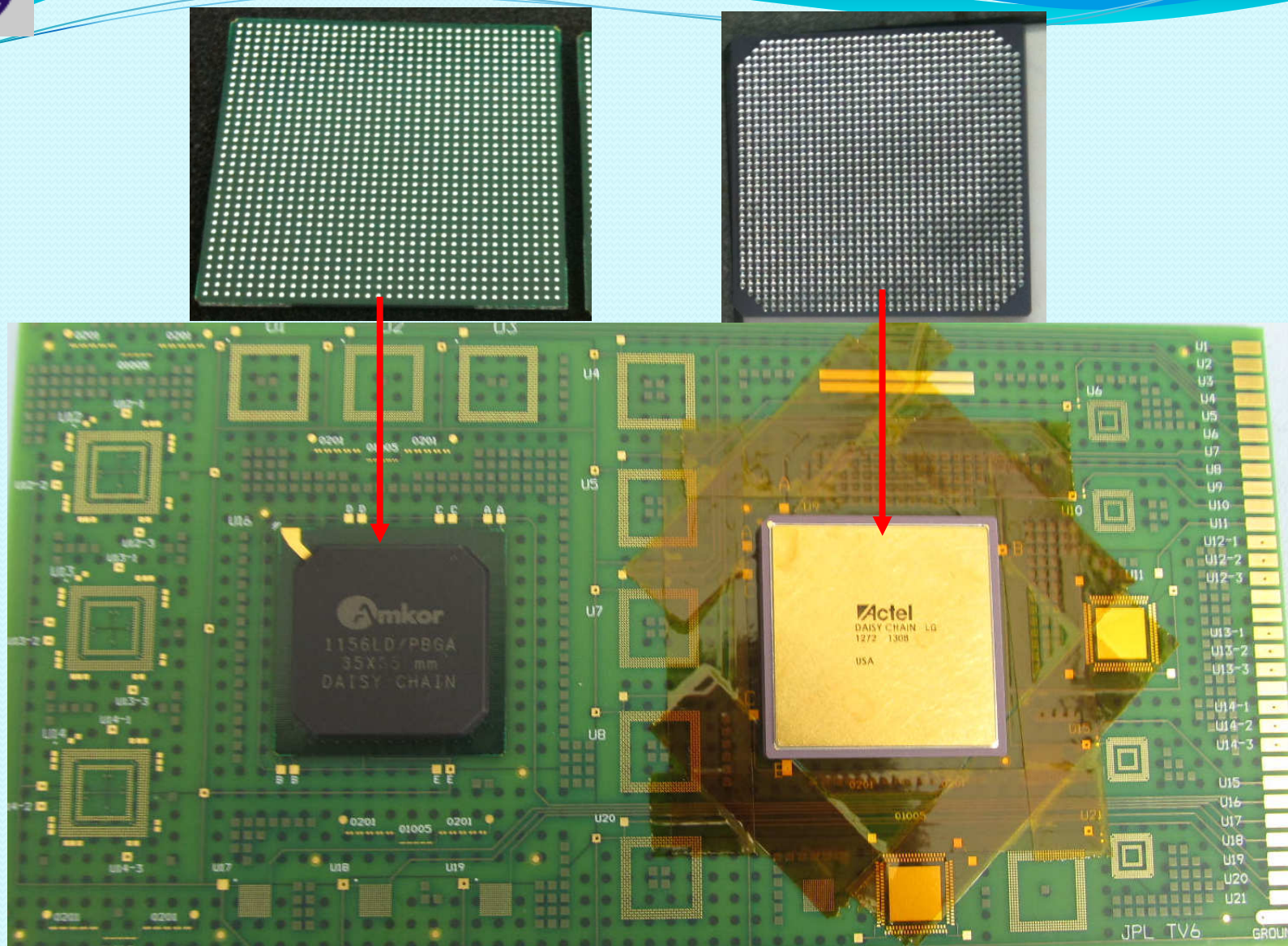


LGA Spiral/Spring Column Attachment



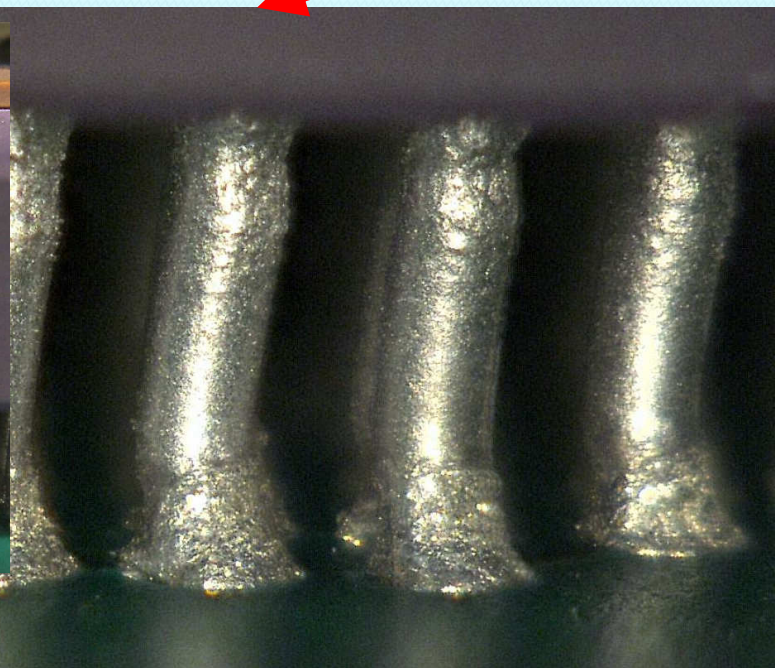
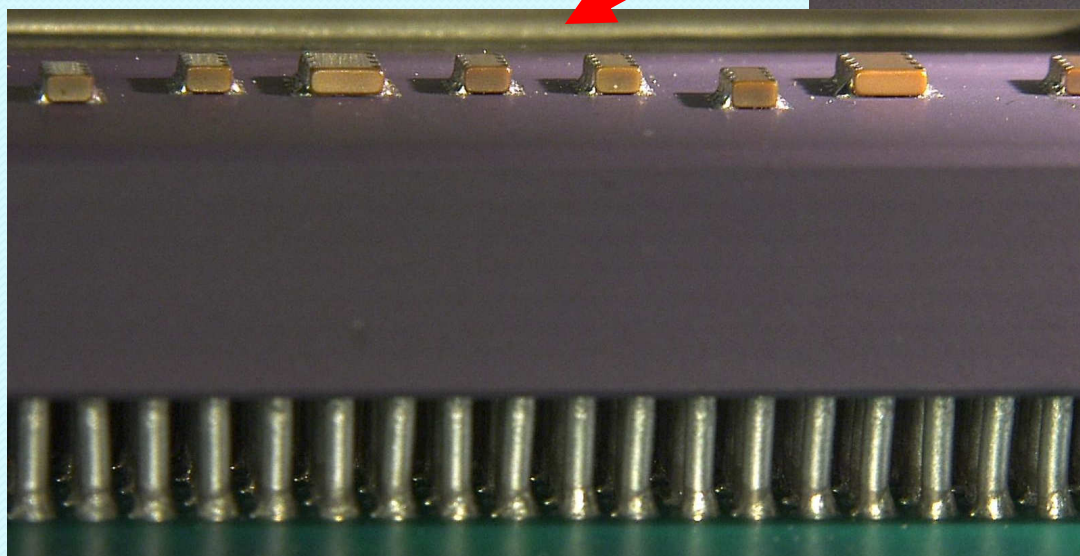
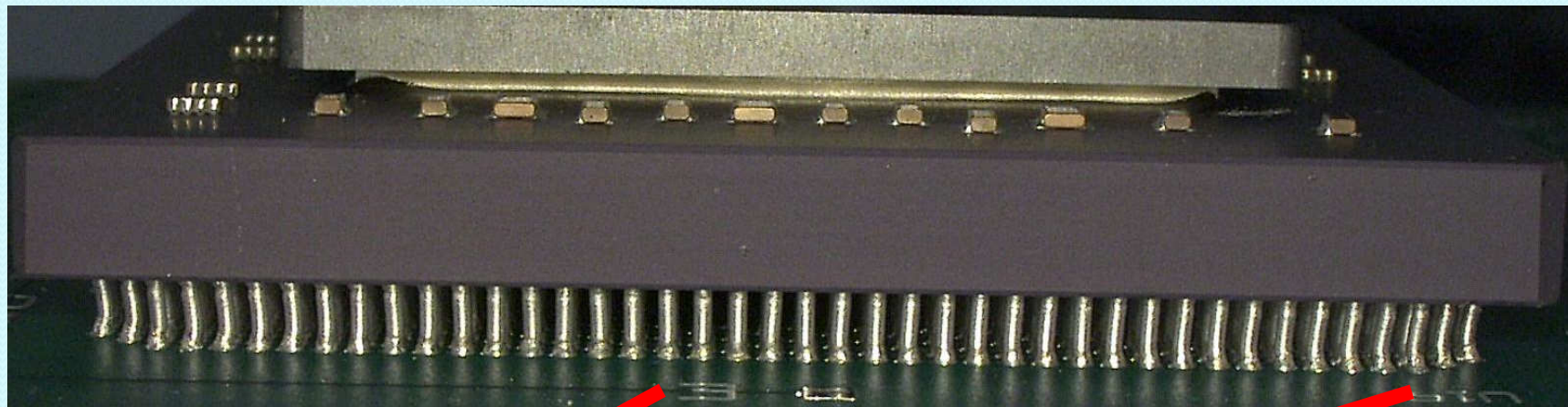


Plastic/Ceramic LGA Direct Attachment



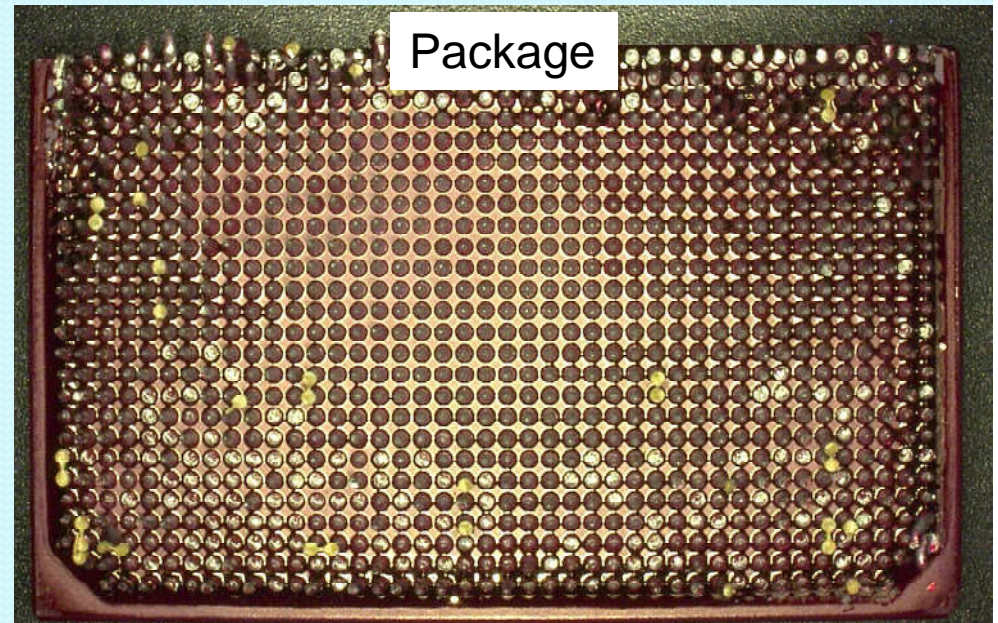
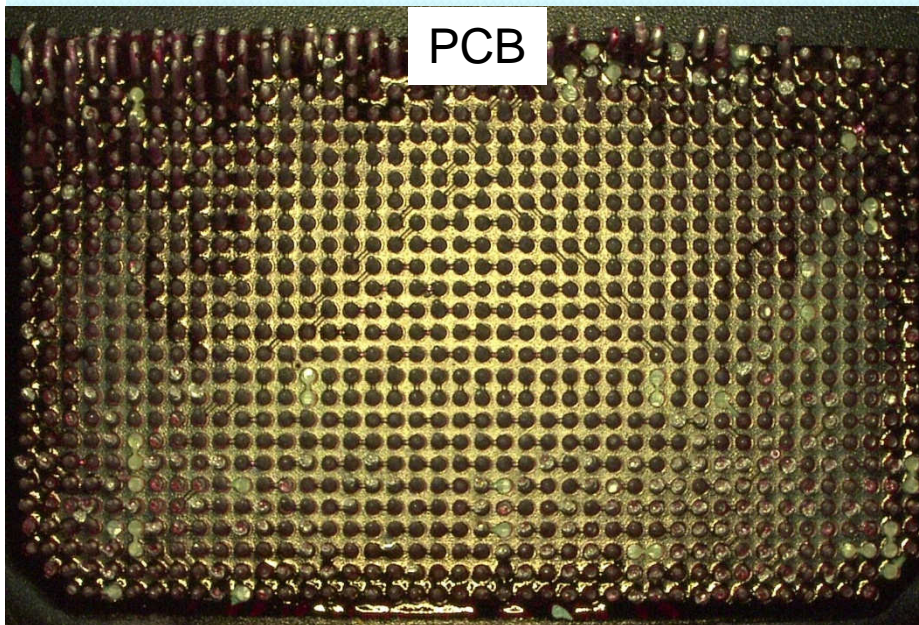
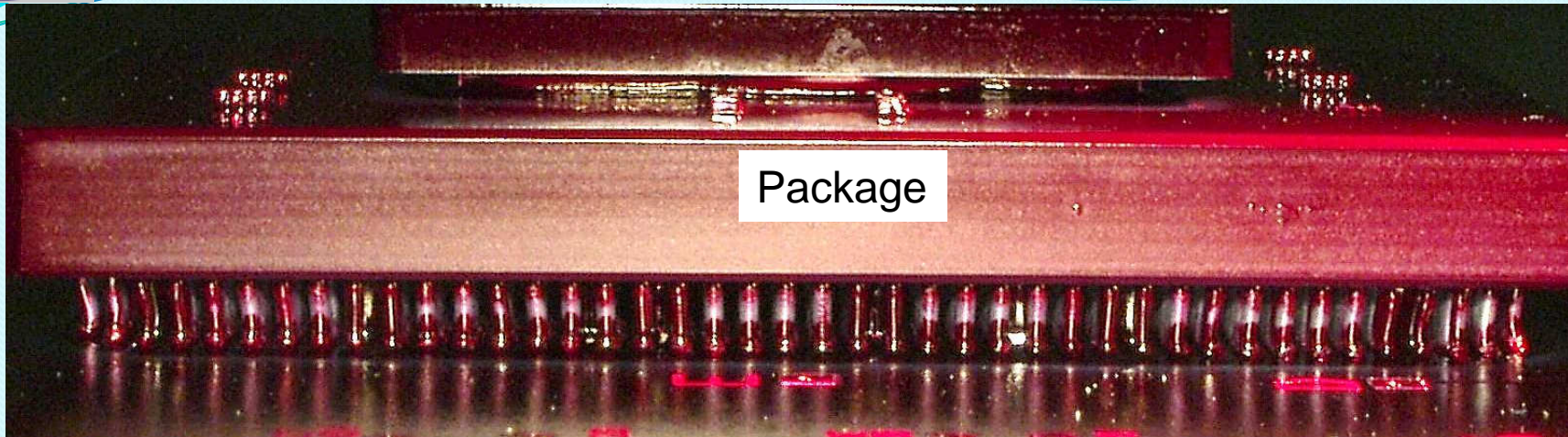


CGA1752 after TC



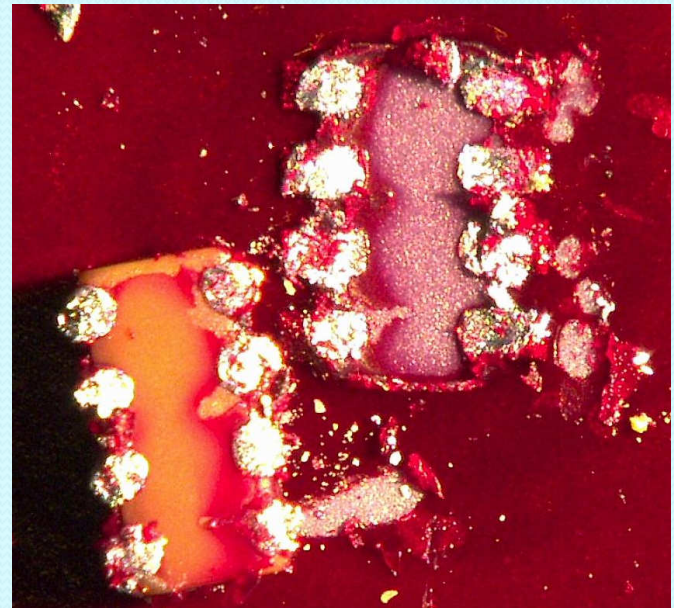
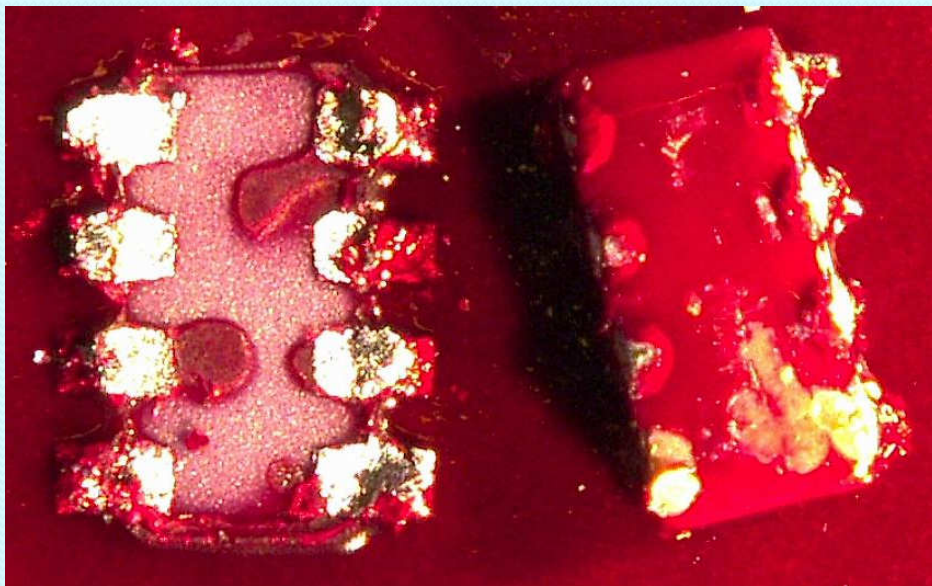
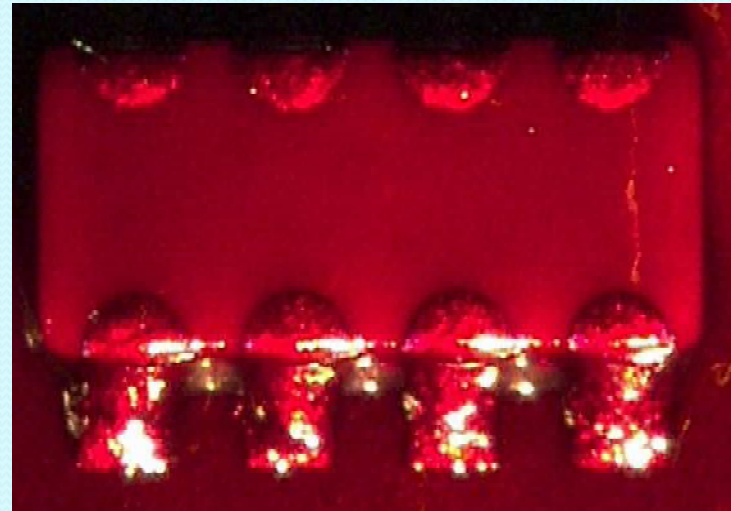
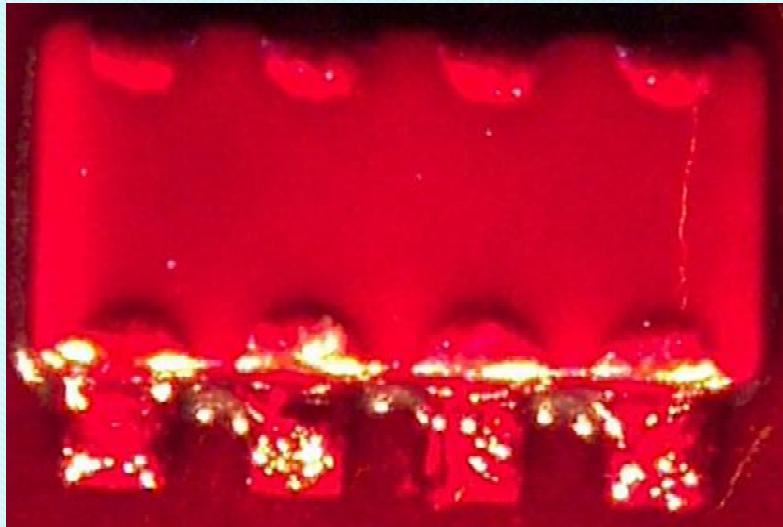


Failure Analysis of CGA



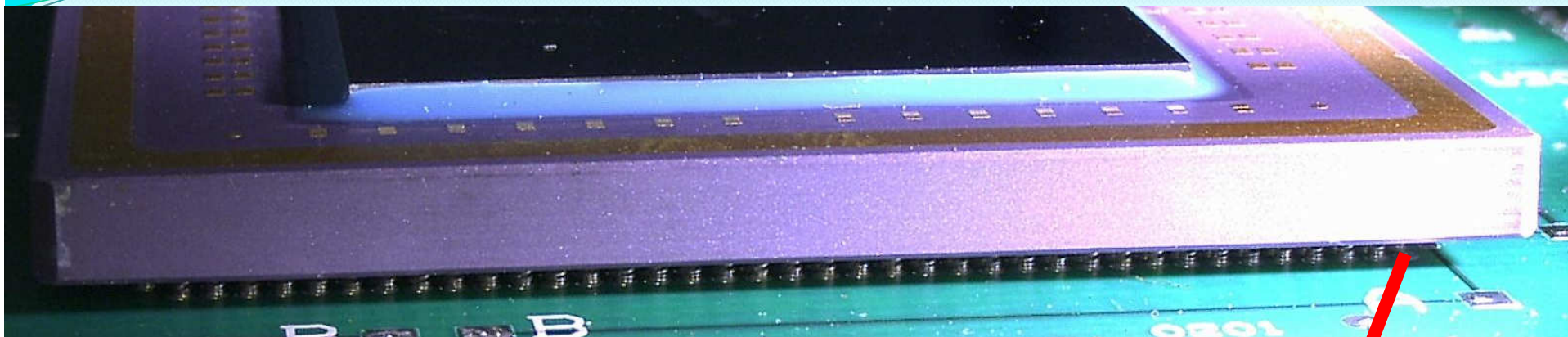


Failure Analysis of Caps



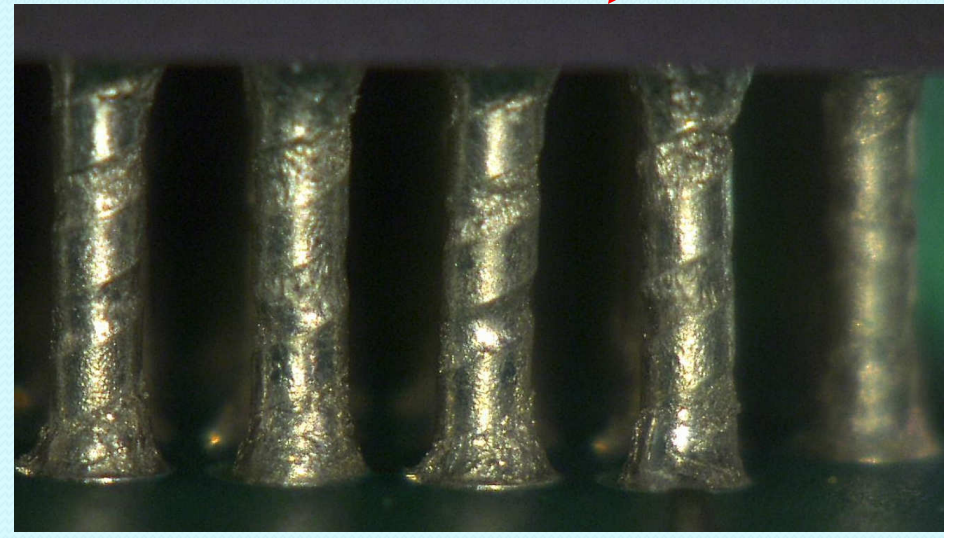
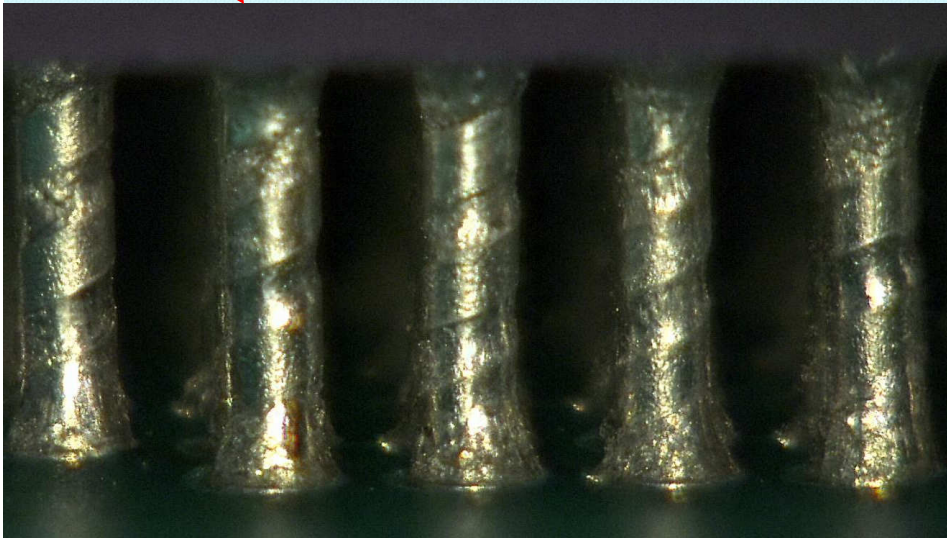
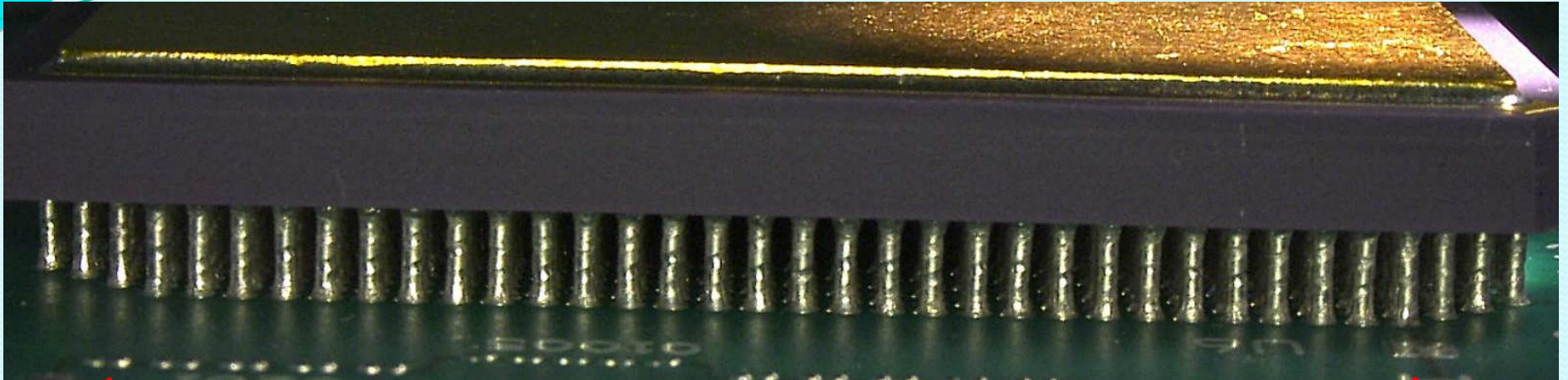


CGA₁₅₁₇/Spr 500TC -55/125°C



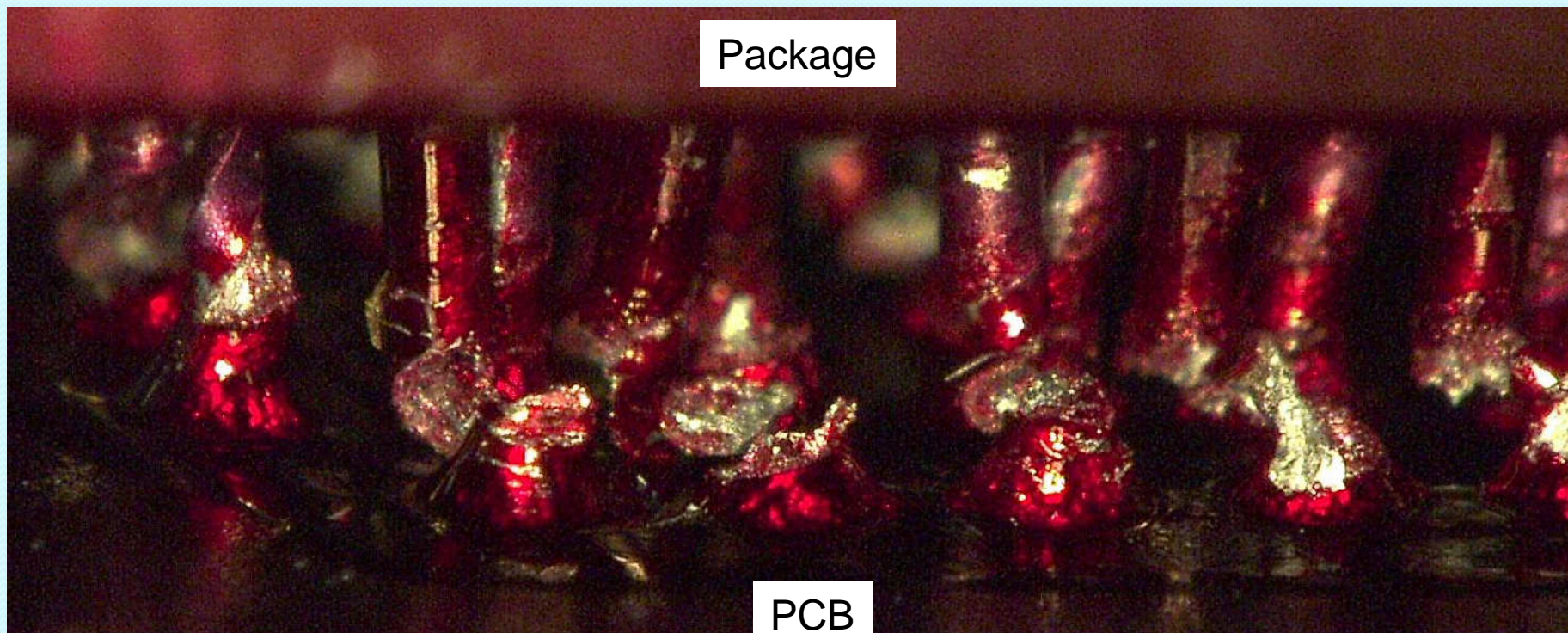
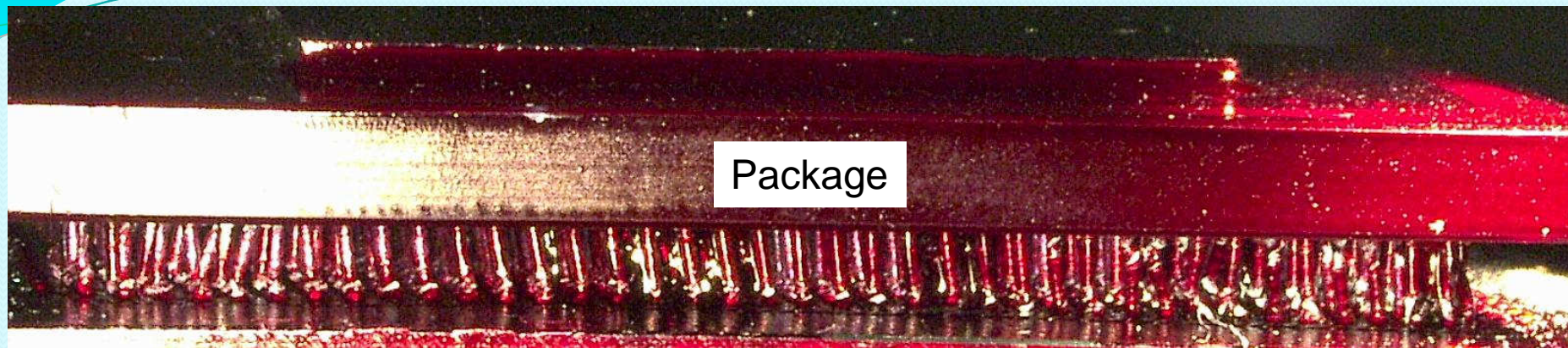


CGA1272 after TC



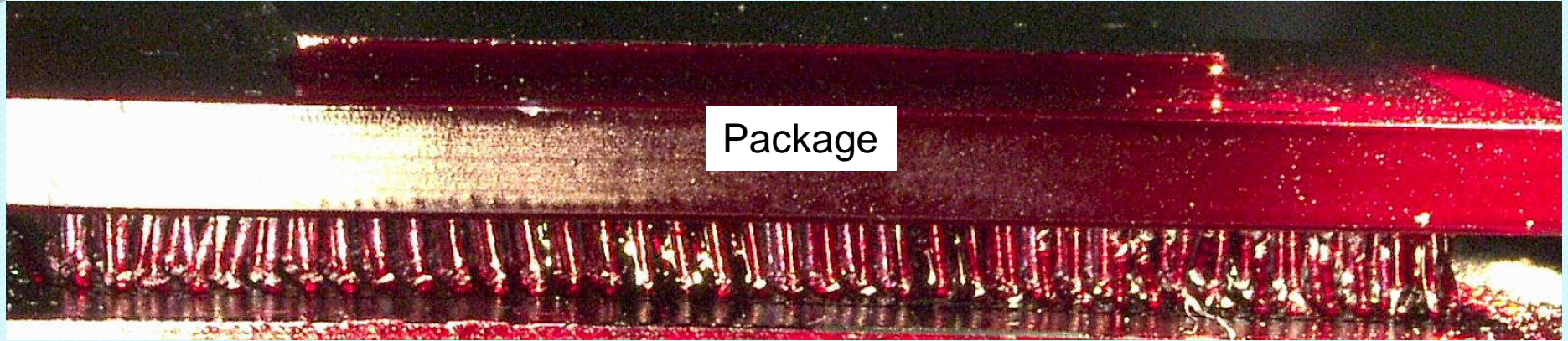


CGA1517 Failure Analysis after TC

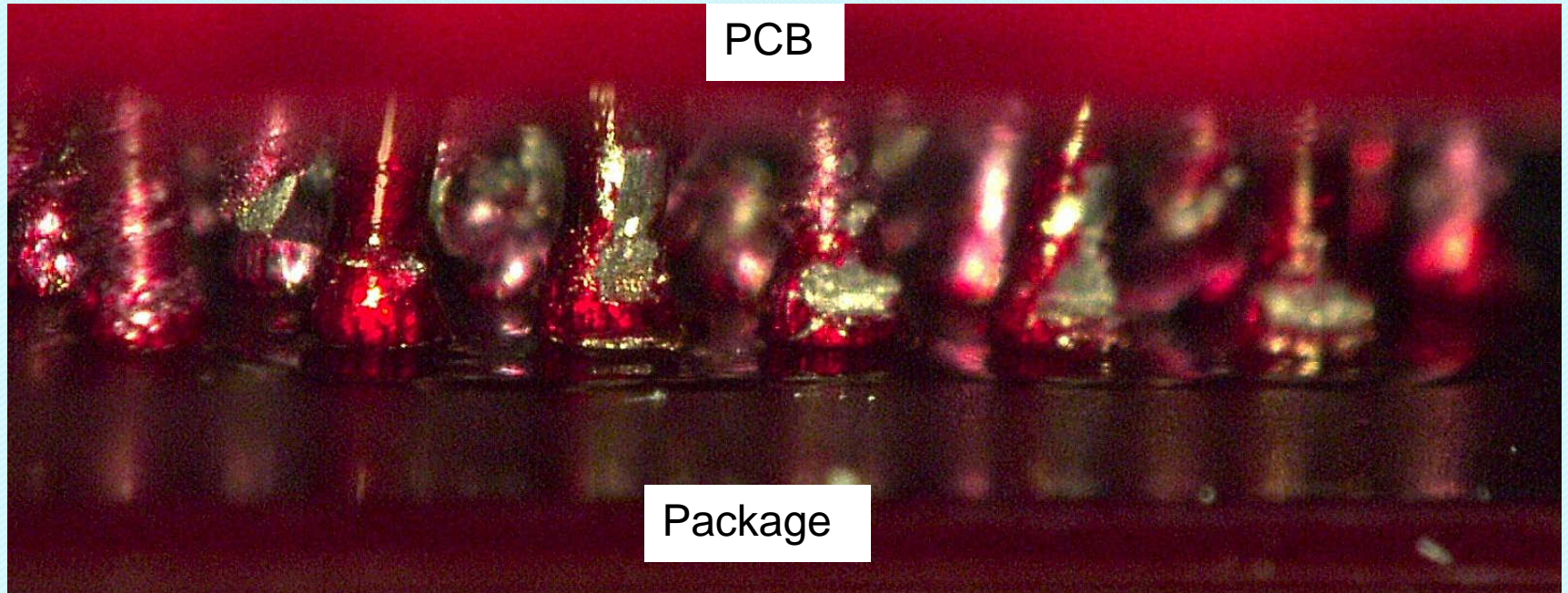




CGA1517 Failure Analysis



Package

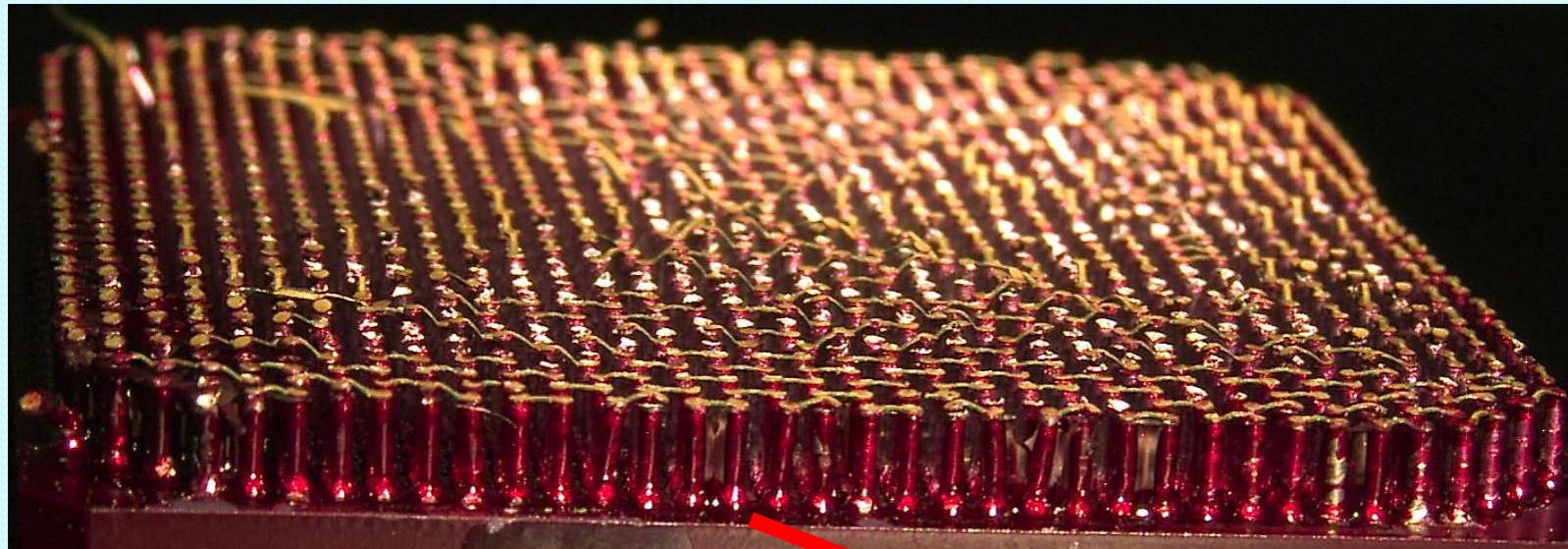


PCB

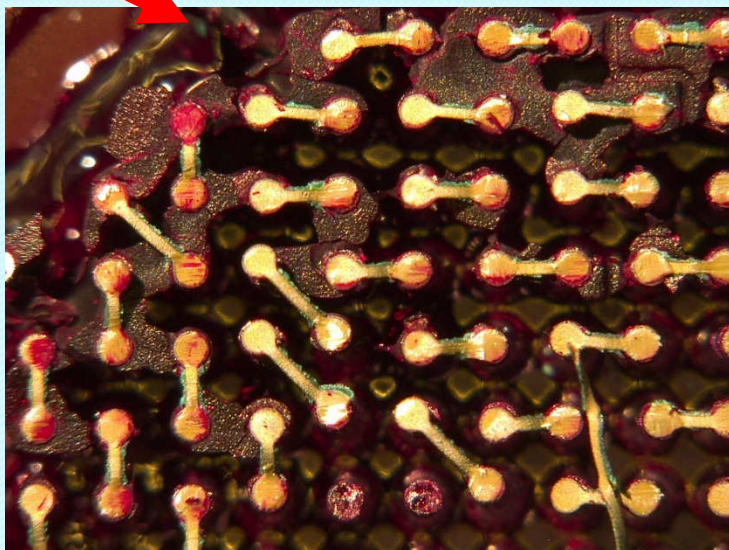
Package



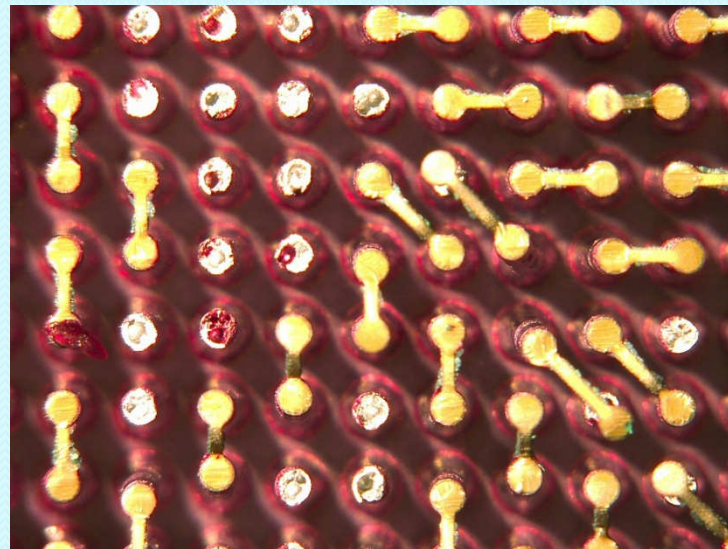
CGA1272/PKG after TC- Small PCB Pad



Corner



Center





Drop Test Condition

Parameter	Setting
Average peak load	485 G
Time period	3 ms
Height of drop	36 inches
Maximum drop cycles	30
Stand-off height	2 inches





Daisy Chain Failures



# of Drops (36 In)	S/N 35 As Assembled		
	A-A Outer	B-B Middle	C-C Inner
1	1.81	2.65	open
2	1.81	2.67	open
3	1.80	2.86	open
4	1.79	2.88	open
5	1.79	2.89	open
6	1.80	2.90	open
7	1.80	2.94	open
8	1.80	2.94	open
9	1.79	2.94	open
10	1.80	2.95	open
11	1.80	2.96	open
12	1.80	2.96	open
13	1.81	2.99	open
14	1.79	2.99	open
15	open	2.99	open
16	open	3.04	open
	Remove for Optical/SEM		



Summary: Assembly

- LGA column attachment
 - Success on using Cu wrap: 1272 & 1517
 - Success on Micro-coil spring: 1517
- Success on Assembly (Vapor Phase)
 - CGAs 1272/1509/1517/1752
 - 90/10 Sn/Pb, Cu wrap, microspring
 - Several variables including PCB pad size
 - Visual inspection
 - X-ray
- Success on Assembly of P-LGA 1156
- Issues on Assembly of C-LGA 1272



Reliability/Failure Analysis

- Reliability TC/Mechanical Results
 - CGAs, 5 different types/2TVs
 - 1st and 2nd report- See NEPP website
 - 3rd report is in progress
 - TC test results 500 cycles (-55/100°C)/500 cycles (-55/125°C)
 - Failure analyses
- Reliability Mechanical
 - Drop test, competing failures
- PCB with HDI (microvia)
 - HDI assembly/optimize process
 - P-LGA and C-LGA assembly and other fine pitch array packages
- Active die, HDI, Reliability
 - Use lessons learned for efficient resource utilization
 - Need funding !



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References

<http://NEPP.nasa.gov>