

Effect of Lead Elimination on Press-fit Interconnects

IEEE HOLM Conference Lead Free Workshop

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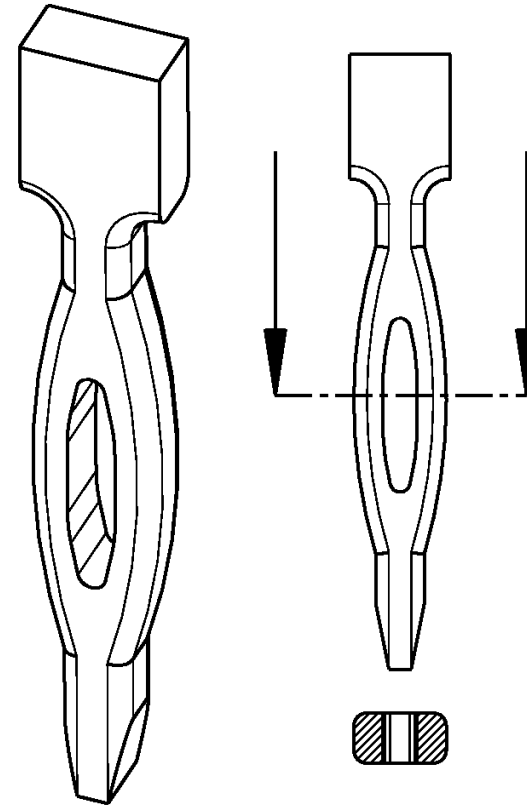
MS 140-09, PO box 3608, Harrisburg, PA 17105

Issues with lead Free Press-fit

- ◆ Insertion force of lead free pins
- ◆ Retention force of lead free pins
- ◆ Impact of lead free boards on
 - Forces
 - Hole tolerances and mean sizes
- ◆ Electrical performance of lead free systems
- ◆ RoHS network exemption (2010) only covers solder
- ◆ Telcordia acceptance of tin
 - GR-78-CORE

Reliability Testing – Press-fit Lead Free

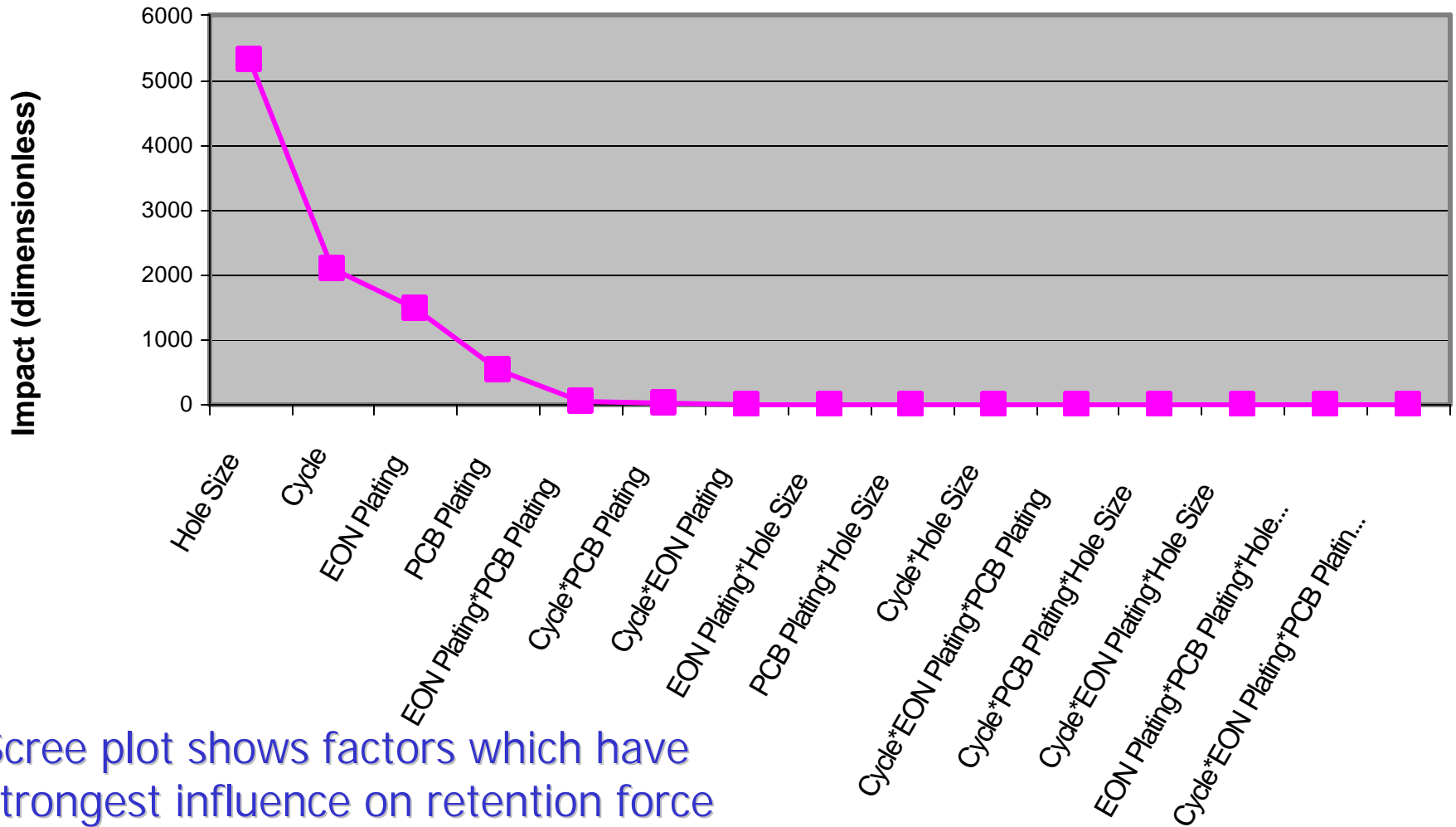
- ◆ Full Factorial DOE
 - Board finish (6)
 - Pin finish (4)
 - Repair cycles (3)
 - Insertion force
 - Withdraw force
 - Hole damage
 - Hole size (7)
 - Three products
 - Single pin testing
 - As per IEC 60352-5
 - ~15,000 tests



Eye of the needle design

0.46 and 0.60 mm nominal hole sizes

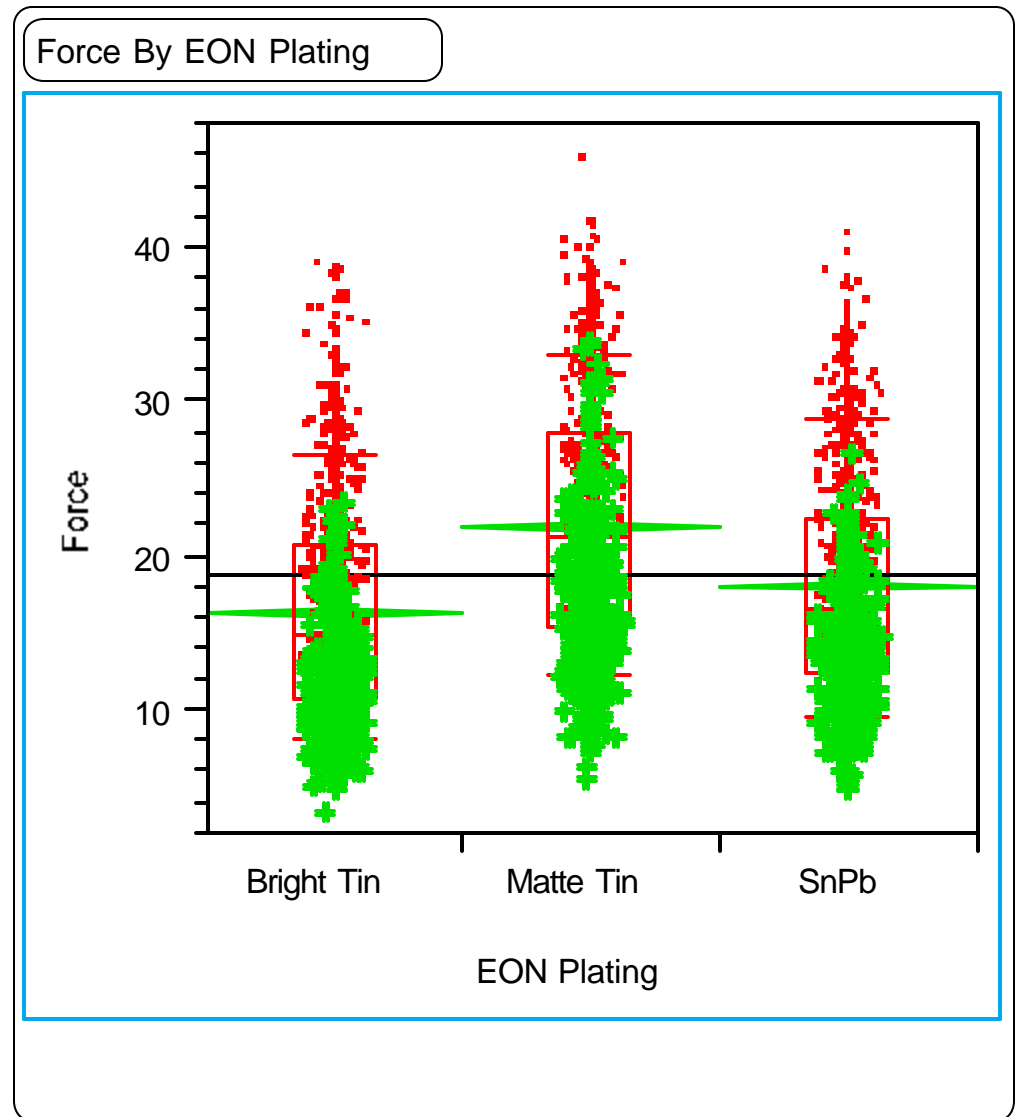
Reliability Testing – Factors of Influence



- ◆ Scree plot shows factors which have strongest influence on retention force
 - Hole size, Cycle
 - EON Plating, PCB plating

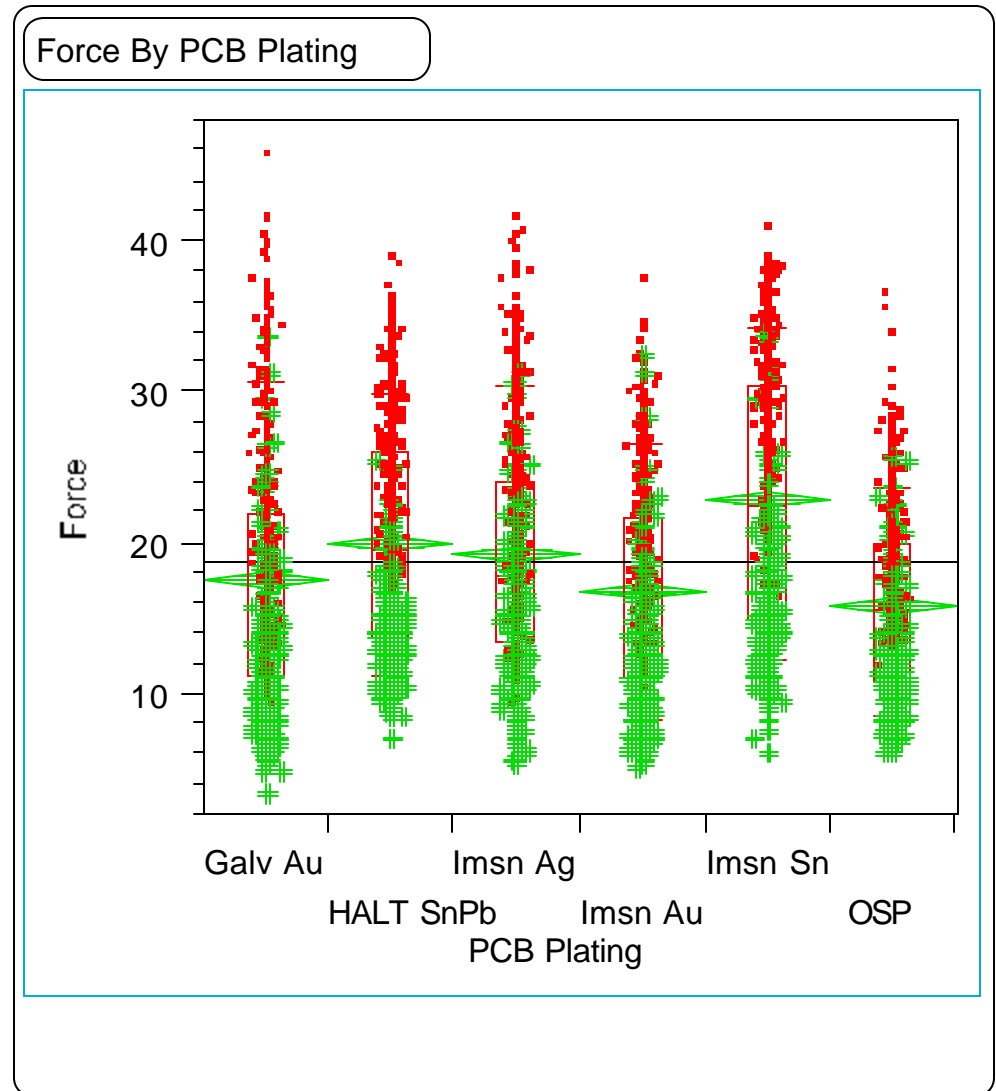
Reliability Testing – Press-fit Lead Free Pins

- ◆ Box plots of withdraw force of two products (red and green data)
- ◆ Ranges are similar for all three materials.
- ◆ Mean shift increase for matte tin finish
- ◆ Bright tin and bright tin/lead are similar
- ◆ All are well above minimum retention of 4 N.



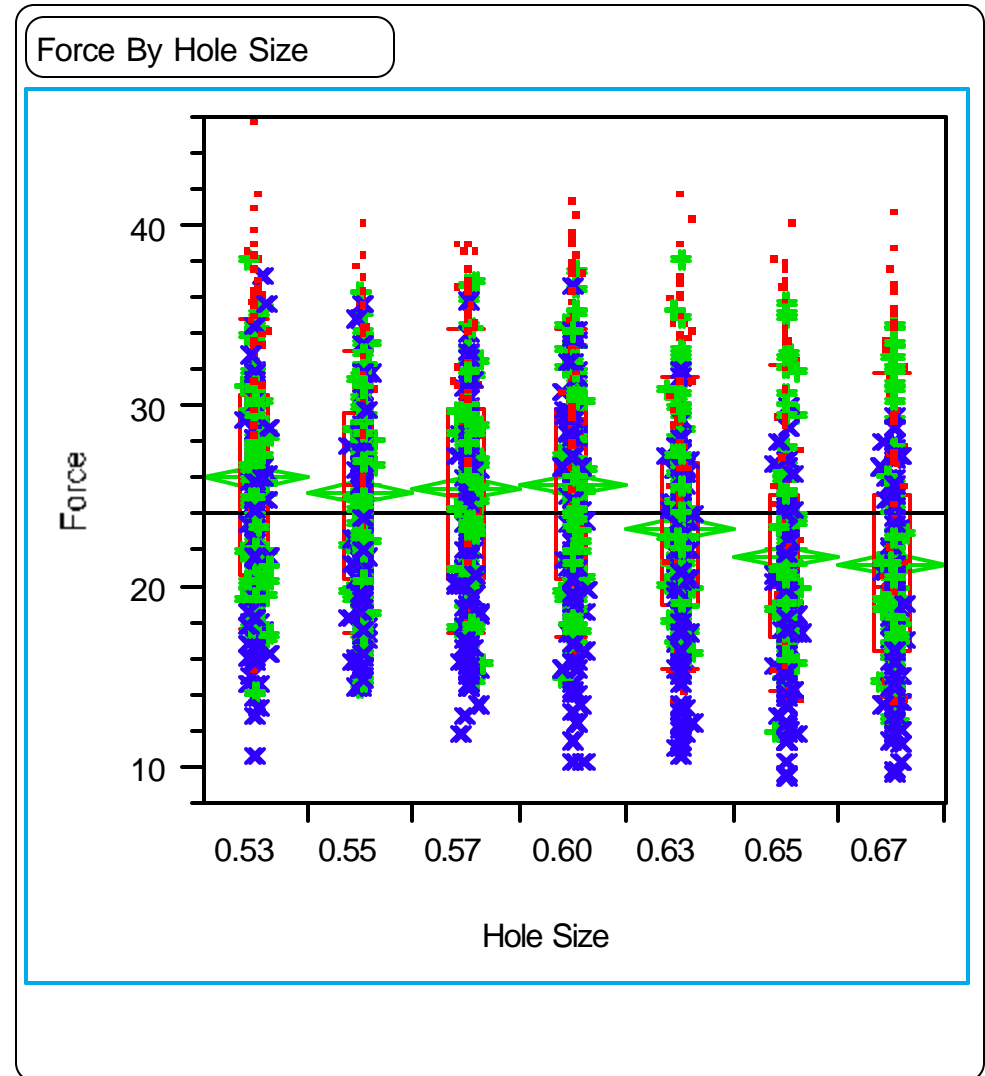
Reliability Testing – Press-fit Lead Free Boards

- ◆ Box plots of withdraw force of two products (red and green data)
- ◆ Ranges are similar for six board finishes
- ◆ Immersion Sn appears to provide highest retention
- ◆ Gold and OSP finishes are slightly lower than Sn/Pb
- ◆ Aligns with expectations from friction measurements (*Corman & Myers*)



Reliability Testing – Press-fit Lead Free Boards

- ◆ Box plots of withdraw force of for one product, three cycles (red=1st, green = 2nd, blue = 3rd)
- ◆ Mean trends down with increasing hole size
- ◆ Extreme hole sizes are beyond specification limits
- ◆ Plots include data from all pin and PCB finishes



Conclusions

- ◆ Press-fit performance in lead free
 - Pins can be converted to lead free in almost all circumstances
 - Bright tin compares more favorably to bright tin/lead
 - Matte tin has higher insertion and withdraw forces
 - Various lead free PCB coatings have proven viable
 - Previous work by Tyco (Ocket *et al**) on other press-fit styles (ActionPin™ and Multispring™) have produced results that agree with these findings
 - Electrical reliability is high for lead free systems*
 - Cross-sections of the press-fit joints show that all combinations meet IEC specification requirements

* Ocket, T., Verhelst, E., "Lead-free Manufacturing: Effects on Press-fit Connections", ICEC Proceedings, Zurich, September 2002.