

Socket Performance Over Time and Insertion Count With Pb-Free Applications

2006 Burn-in and Test Socket Workshop
March 12 - 15, 2006



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Johnstech[®]

Agenda

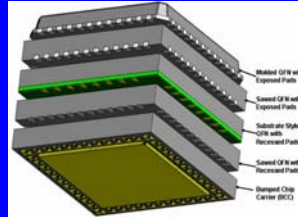
- Package I/O Plating and Composition
- SnPb Performance and Repeatability
- Pb-Free Performance Issues
- Contact Plating and Composition
- Effects of Pb-Free Device Plating
 - Matte Tin
 - NiPdAu
- Device I/O Surface Oxide Penetration and Removal
- Conclusions

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2

Package I/O Plating and Composition

- Type of package
 - Pad vs. Leaded vs. BGA vs. Other
- Device plating effects - Oxide formation
 - Lead-based vs. Lead-free
- Effects of tolerances
- Size of pads and pitch
- Type of device being packaged
 - RF, amplifiers, digital, mixed signal
- Debris generated
 - Sawed vs. Molded vs. Broken



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3

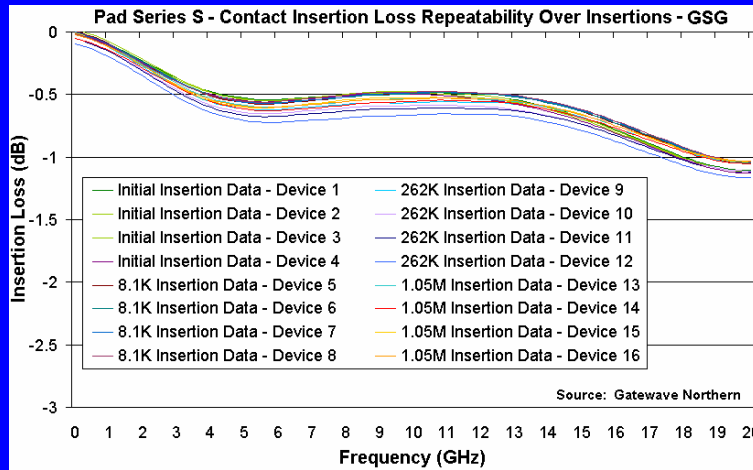
Package I/O Plating and Composition

- Matte Tin (very high percentage of Pad and Leaded packages)
- NiPdAu (small percentage but growing – harder smoother surface)
- SnAgCu (mostly BGA devices – SAC305)
- SnBi (used mostly in Japan)
- Au
- Other Sn based materials
 - SnCu
 - SnAg
 - SnNi

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4

SnPb Performance and Repeatability



NOTE: Same contacts and elastomers were used on the entire test, surrogate devices replaced every 100K insertions

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5

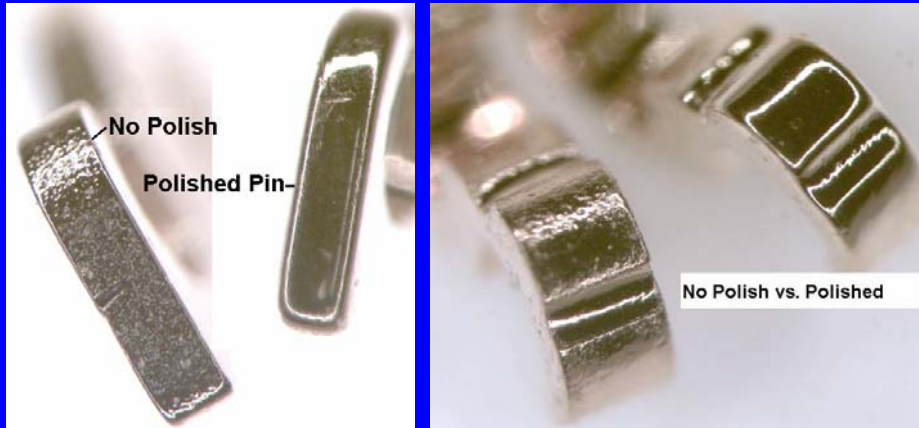
Pb-Free Performance Issues

- More oxidation on leads or pads on Sn
 - More false failures
 - More contact cleaning / maintenance
 - Higher contact forces
- Different companies have different solutions – no standardization yet

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6

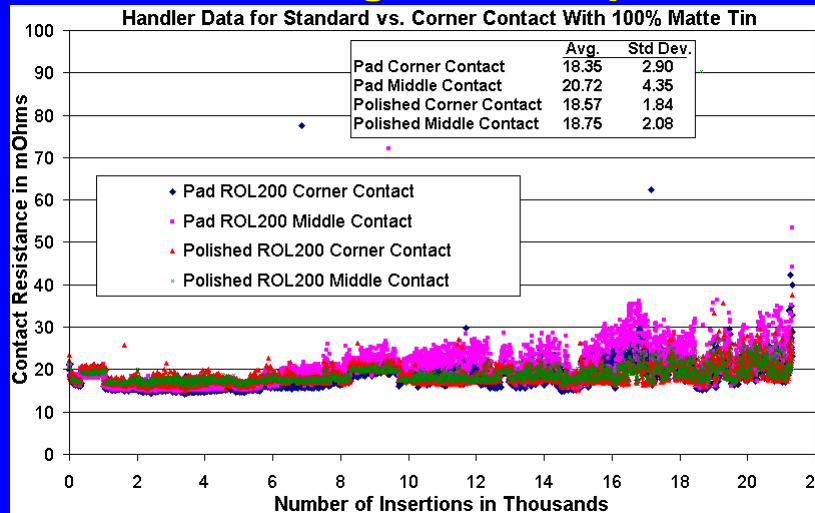
Contact Plating and Composition



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7

Contact Plating and Composition

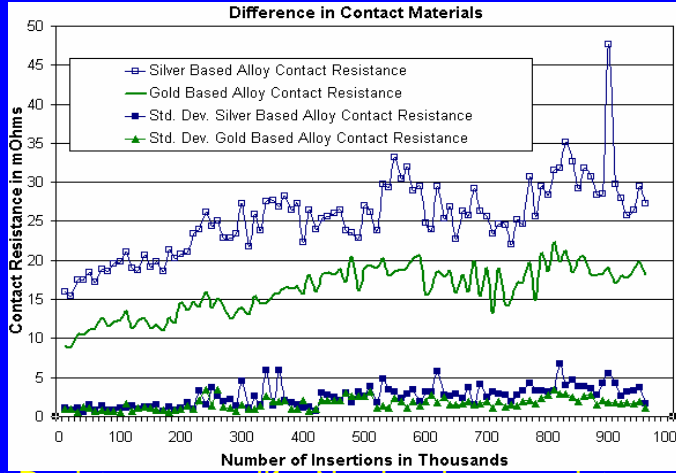


Matte Tin Effect on Contact Location and Smoothness

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8

Contact Plating and Composition



Contact Resistance over life. No cleaning or maintenance with 90/10 solder plating on test vehicle

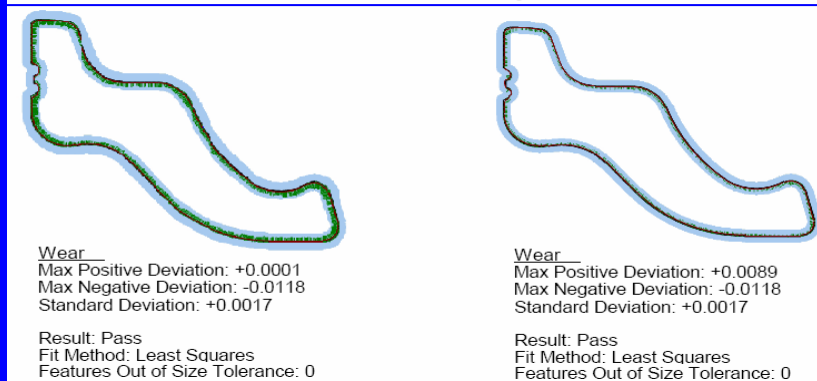
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9

**Effects of Pb-Free Device Plating –
Matte Tin**

SnPb - 1.6 Million insertions Matte Tin - 300K insertions

MeasureFit Report



Contacts not cleaned during test

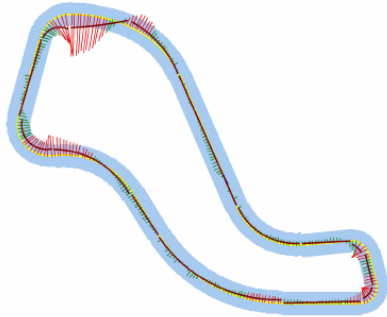
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10

**Effects of Pb-Free Device Plating –
Matte Tin**

Standard ROL100 Contact Profile After 1 Million Insertions

MeasureFit Report
Result: Fail
Max Positive Deviation: +0.0169
Max Negative Deviation: -0.0448
Features Out of Geom. Tolerance: 1
Worst Positive Data Point: 0012/0021
Worst Negative Data Point: 0013/0018
Features Out of Size Tolerance: 0
Standard Deviation: +0.0063
Result: Fail
Fit Method: Calculate Errors



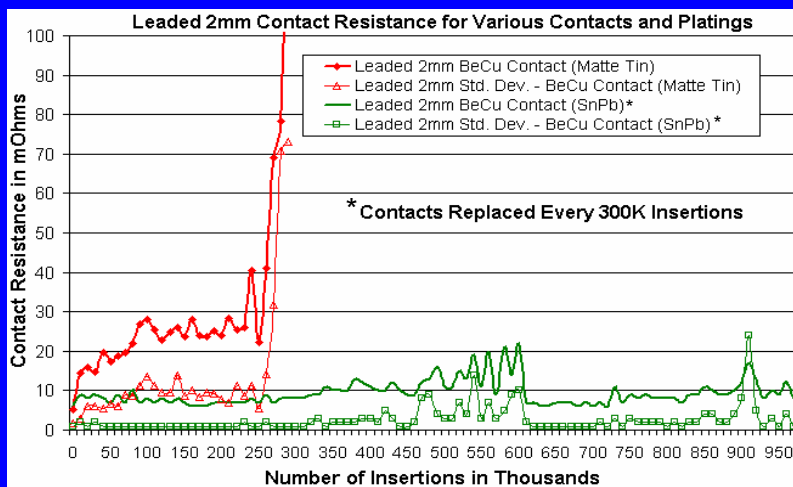
No cleaning performed during test

Feature Label	Nominal	Actual	Upper	Lower	Deviation	Out Tol
Profile	0.0000	0.0214	0.0125	-0.0125	0.0214	0.0089
Profile	0.0000	-0.0378	0.0125	-0.0125		-0.0253

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11

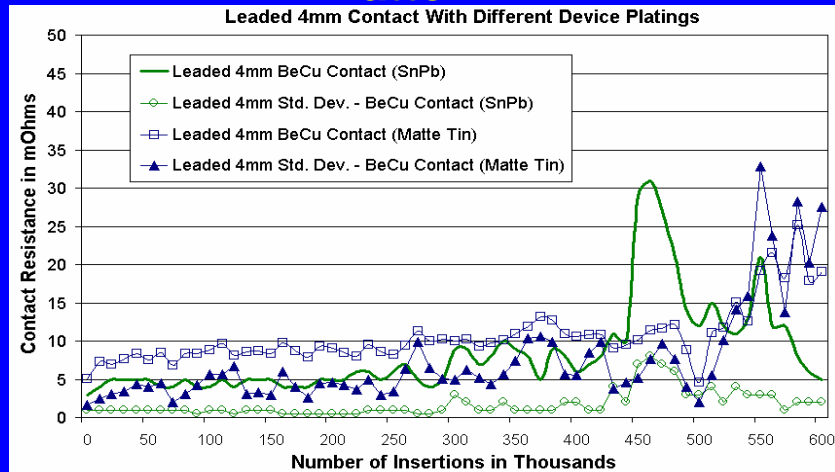
**Effects of Pb-Free Device Plating –
Matte Tin**



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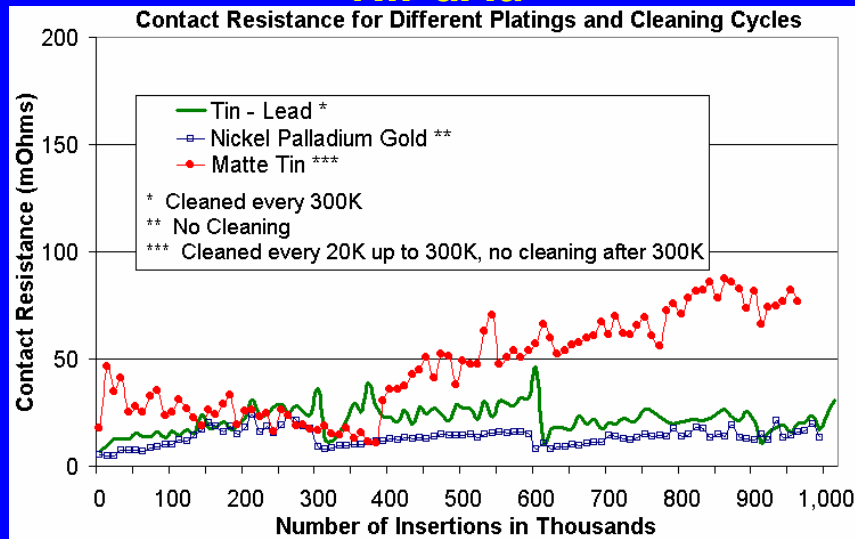
12

**Effects of Pb-Free Device Plating –
Matte Tin**



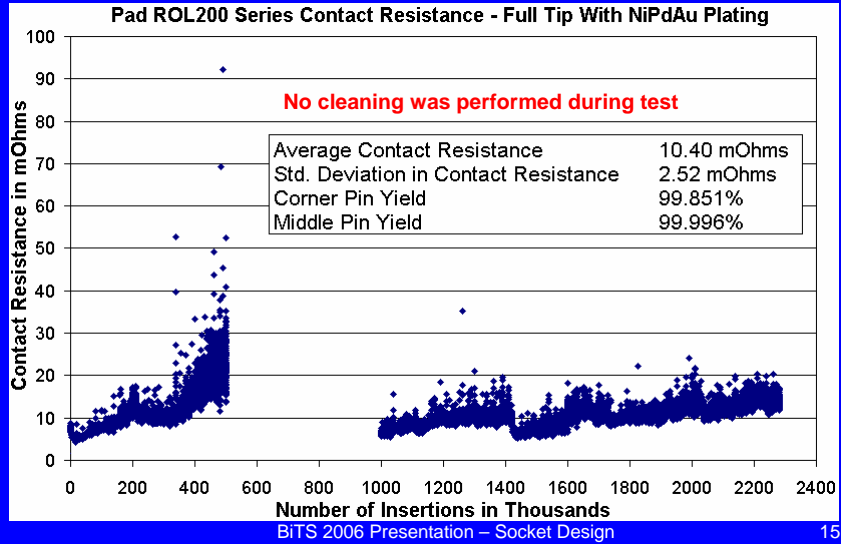
Leaded 4mm Contact Resistance - SnPb vs. Matte Tin Plating
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**Effects of Pb-Free Device Plating –
NiPdAu**

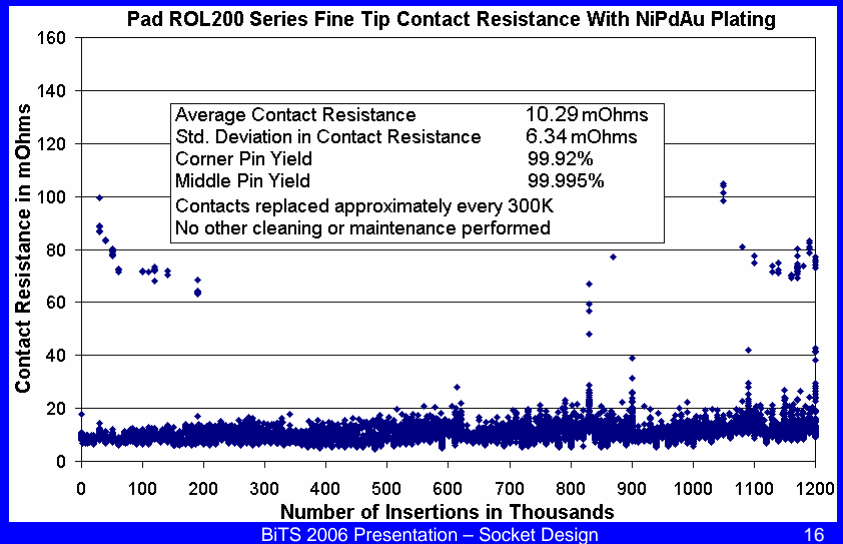


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Effect of Pb-Free Device Plating – NiPdAu

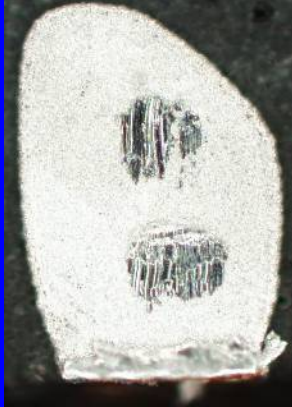


Effects of Pb-Free Device Plating – NiPdAu



Device I/O Surface Oxide Penetration and Removal

SnPb -1 Insertion



SnPb - 10 Insertions



SnPb - 50 Insertions



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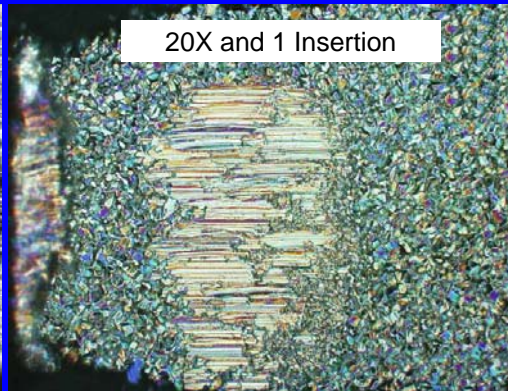
17

Device I/O Surface Oxide Penetration and Removal

SnPb Plating



Matte Tin Plating



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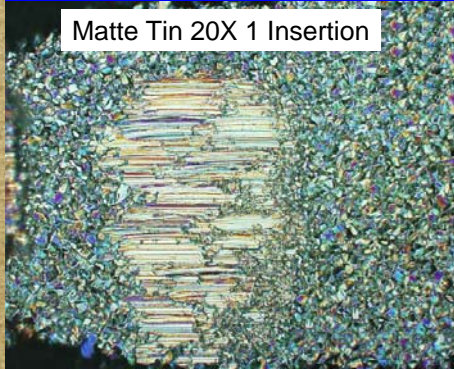
18

Device I/O Surface Oxide Penetration and Removal

NiPdAu 100X 1 Insertion



Matte Tin 20X 1 Insertion

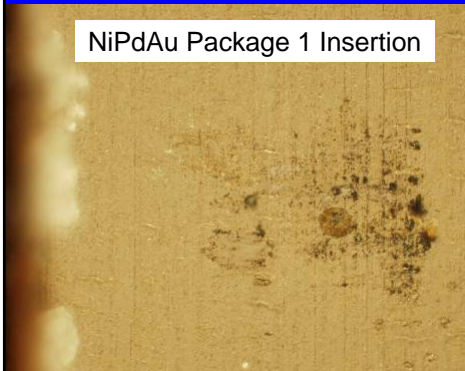


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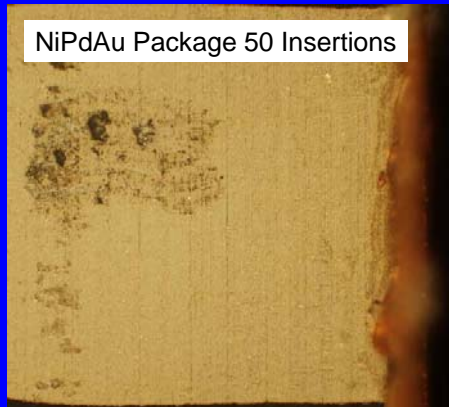
19

Device I/O Surface Oxide Penetration and Removal

NiPdAu Package 1 Insertion



NiPdAu Package 50 Insertions



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20

Conclusions

- There are many Pb-Free platings with each having different benefits
- More plating oxides generally result in more cleaning of contacts to maintain performance
- Matte Tin plating is inexpensive, but because of oxides, results in higher contact resistance and may not be the best choice for resistance sensitive devices
- Harder plating results in lower contact life
- Some Pb-Free platings require more force to break through oxides
- Self cleaning wipe function is critical to long-term Pb-free performance