IMPROVING ELECTRONICS ASSEMBLY PROCESS THROUGH ORGANIC-METAL FINAL FINISH

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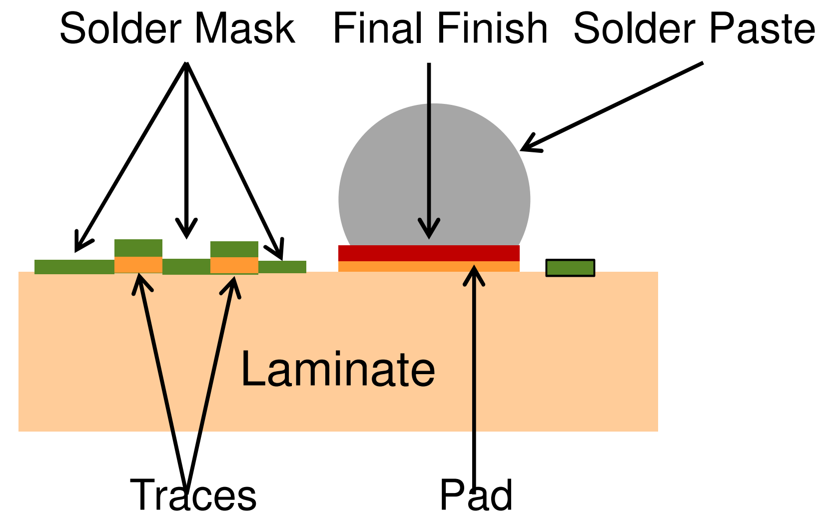
- Introduction
- Objective
- Experimental
- Results & Analysis
- Summary & Conclusions

- Compare and contrast Organic Metal (OM) final finish with OSP through a series of statistically designed experiments.
- Make conclusion based on experimental results.

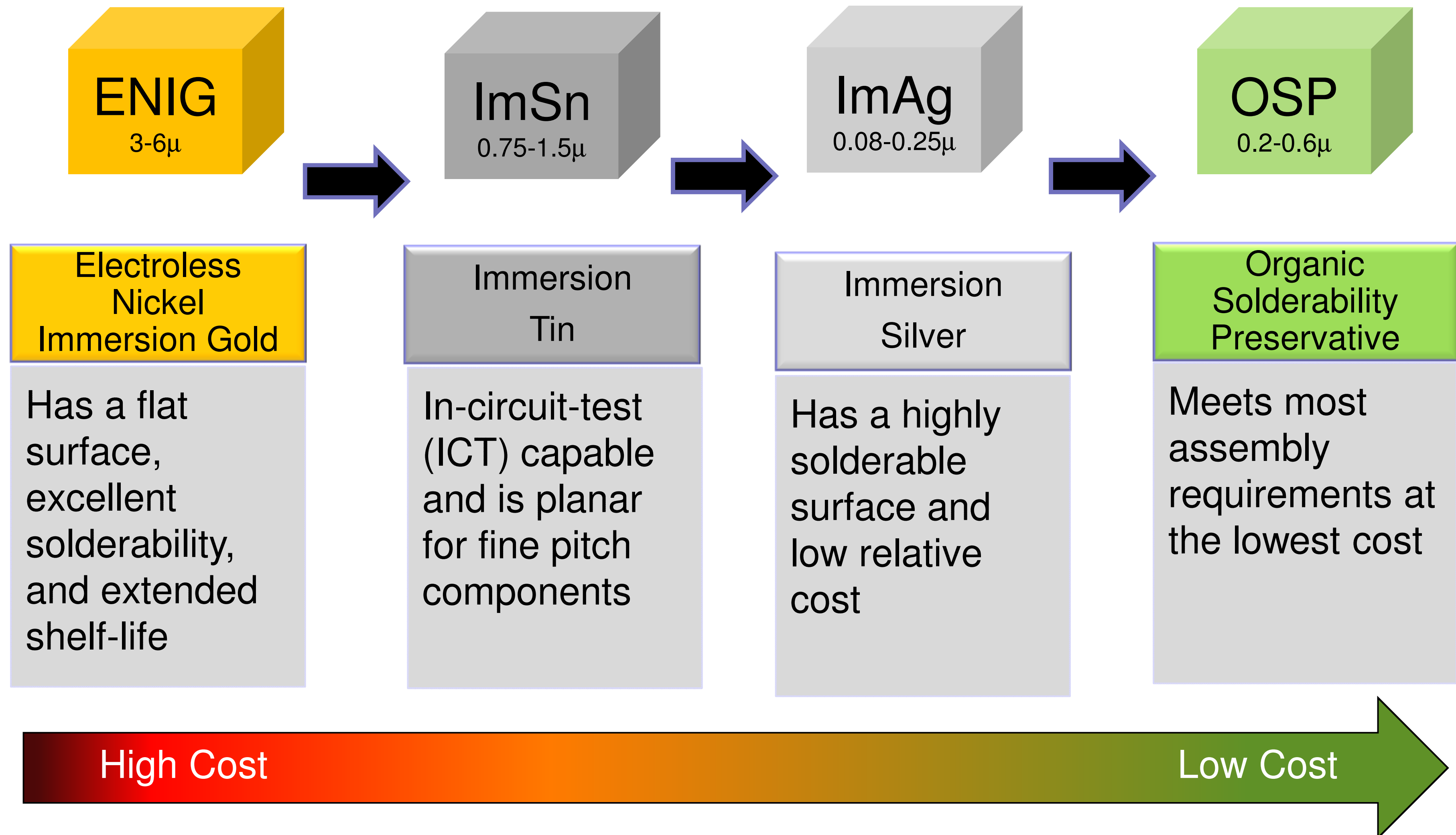
Introduction

What is final finish?

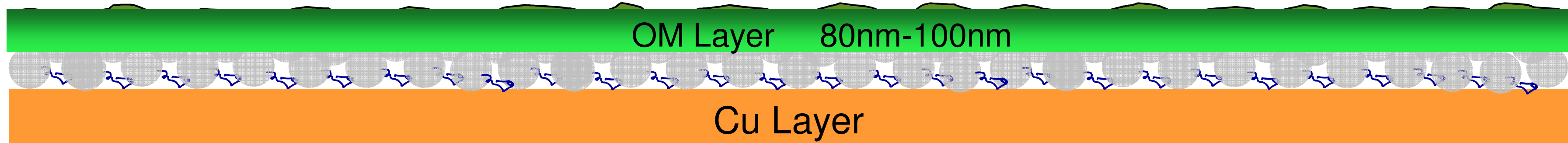
- Final Finish may be viewed as a “coating”
  - Located at the outermost layer of a PCB
  - It protects the PCB surface copper until it’s assembled
  - It dissolves into the solder paste upon reflow or wave soldering



Most Common Alternate Final Finish



Organic Metal (OM) Finish



Based on Nanotechnology

↓

A complex between organic metal and silver

↓

Solderability comparable to metallic finishes

↓

ICT testable

↓

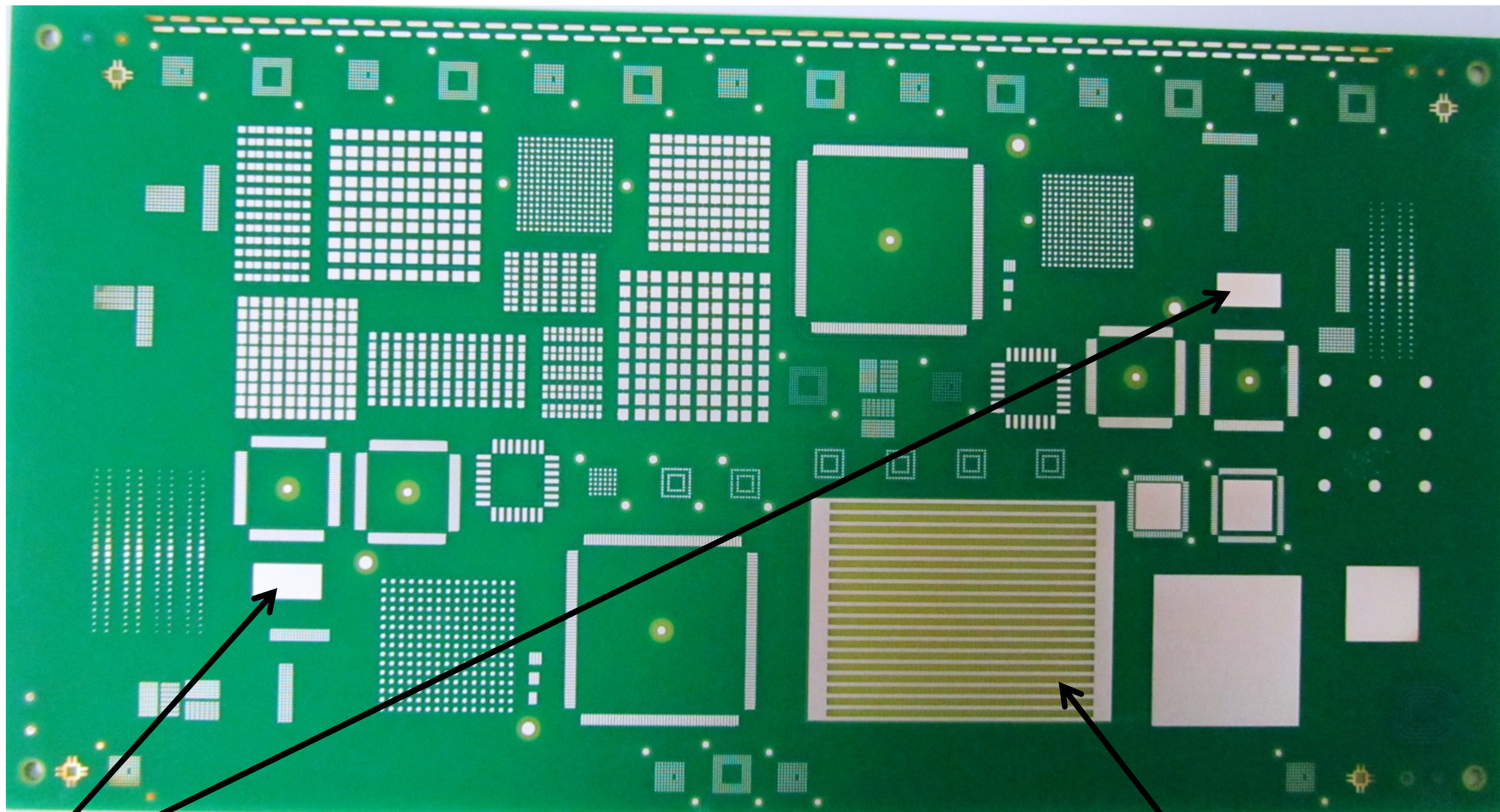
$$$Low Cost$$$

Experimental Approach

Understand the interaction between different final finishes with assembly process parameters

- Reflow process capability
  - Measure solder spread/wettability
- Through Hole Fill Capability
  - Performance after multiple reflow cycle
- In-Circuit-Testing (ICT)
  - Contact resistance with different probes

Reflow Process Capability TV



Large pad wetting features

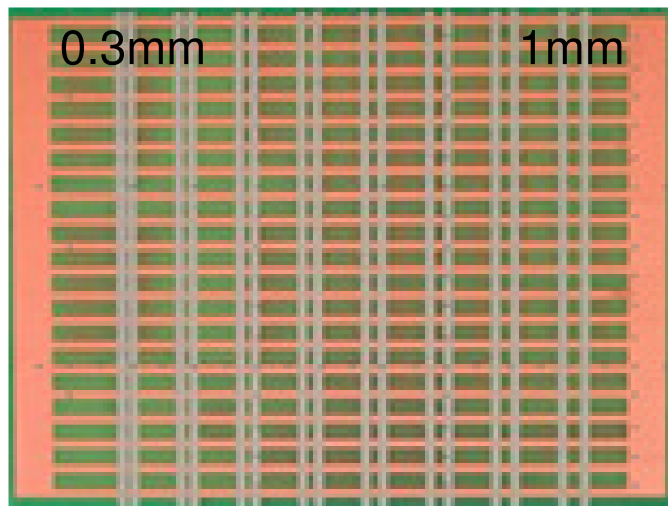
Cross print test feature

Reflow Process Capability Test

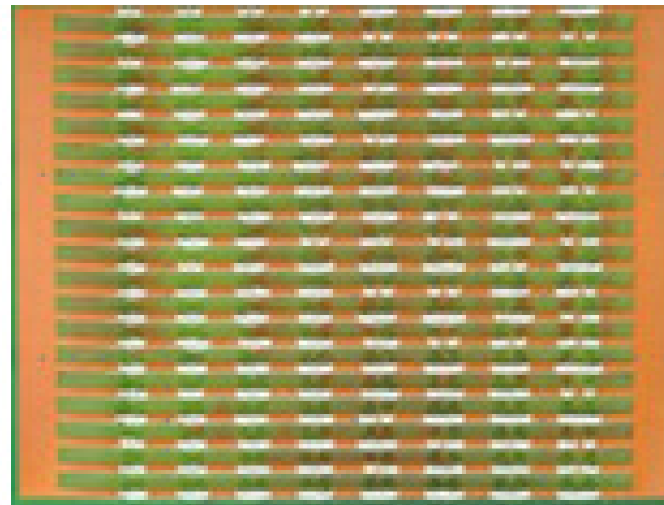
- A 2k DOE was run with the following factors and responses:
  - DOE factors:
    - Paste: CVP 390 & CVP 520
    - Final Finish: OSP & OM
    - Reflow environment: N2 & Air
    - Reflow condition: 0 & 2x reflow
    - Soak time: 60s & 120s
  - DOE responses:
    - Cross print spread
    - Large pad spread

Cross Print Spread Test

- Simulate fine-pitch component
- Bridging will occur upon reflow
- Higher the bridging count, better the wetting ability of the finish
- Indicates wetting characteristics of the final finish & influence solder joint reliability



Before reflow



After reflow

Reflow Process Capability-Results

DOE Analysis

Analysis of Variance for % Of Solder Bridge

Source	DF	SS	MS	F	P
Solder Paste	1	1026.00	1026.00	0.010	0.929
Surface Finish Type	2	203145.75	101572.88	12.783	0.018
Reflow Environment	4	31784.86	7946.22	0.437	0.779
Reflow Precondition	8	145586.91	18198.36	2.162	0.036
Gap Size	112	942790.23	8417.77	30.338	0.000
Soak Time	128	35515.63	277.47	2.909	0.000
Error	768	73256.25	95.39		
Total	1023	1.43311E+06			

Significant factors indicated by “p” value

Finish type

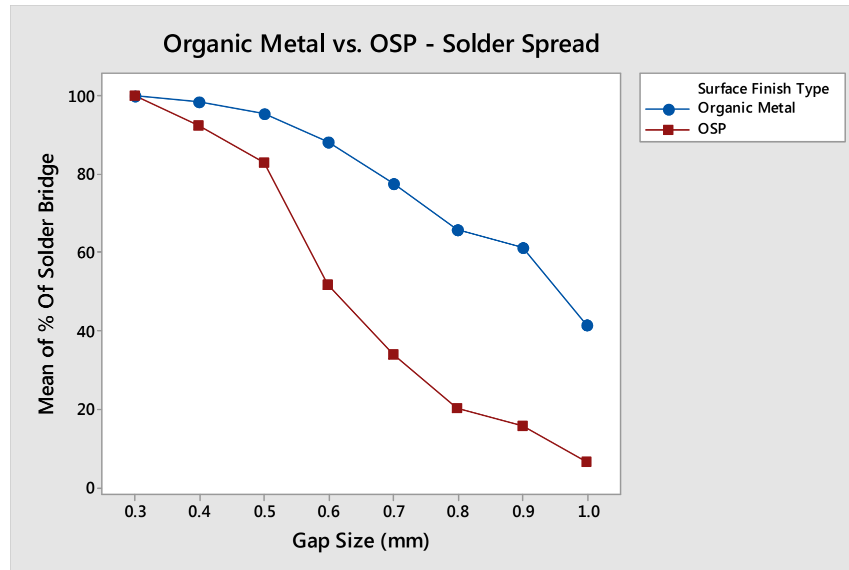
Precondition

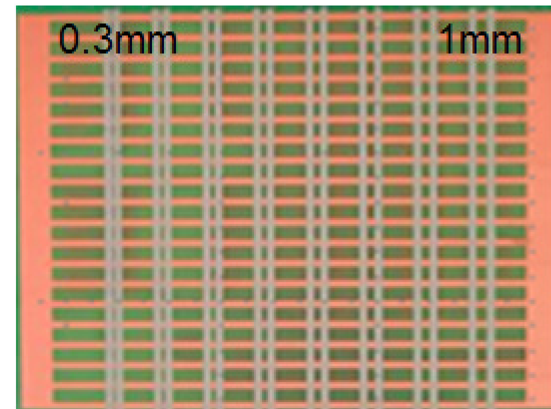
Gap size

Soak time

Reflow Process Capability-Results

Cross Print Solder Spread



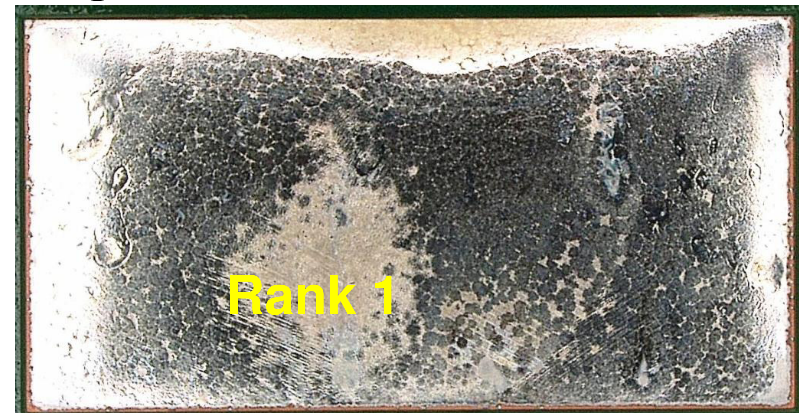


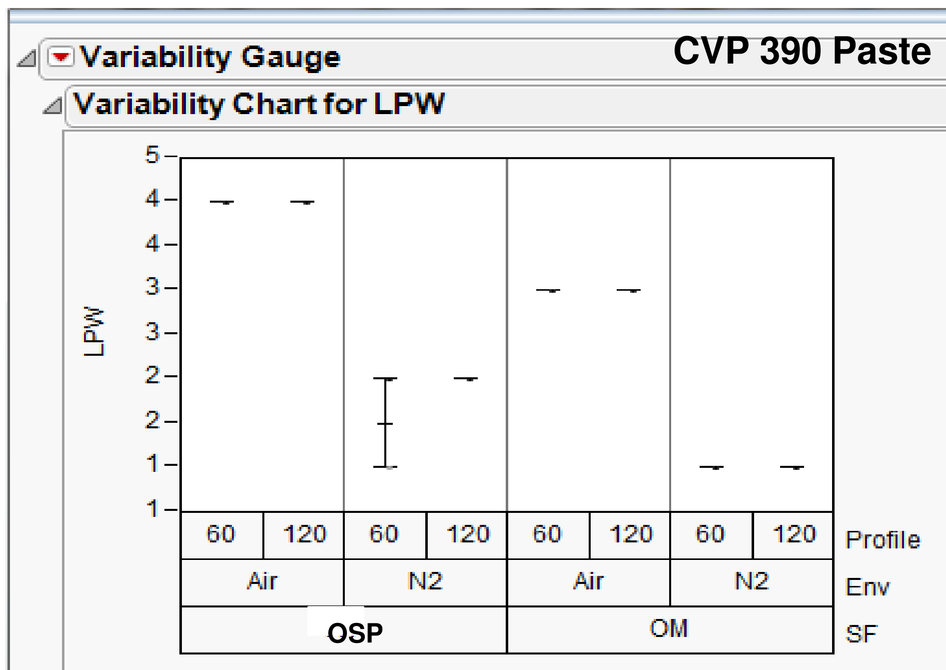
Surface finish type comparison

- Key indicator of surface finish performance
- OM outperformed OSP
- Provides greater process window

Reflow Process Capability

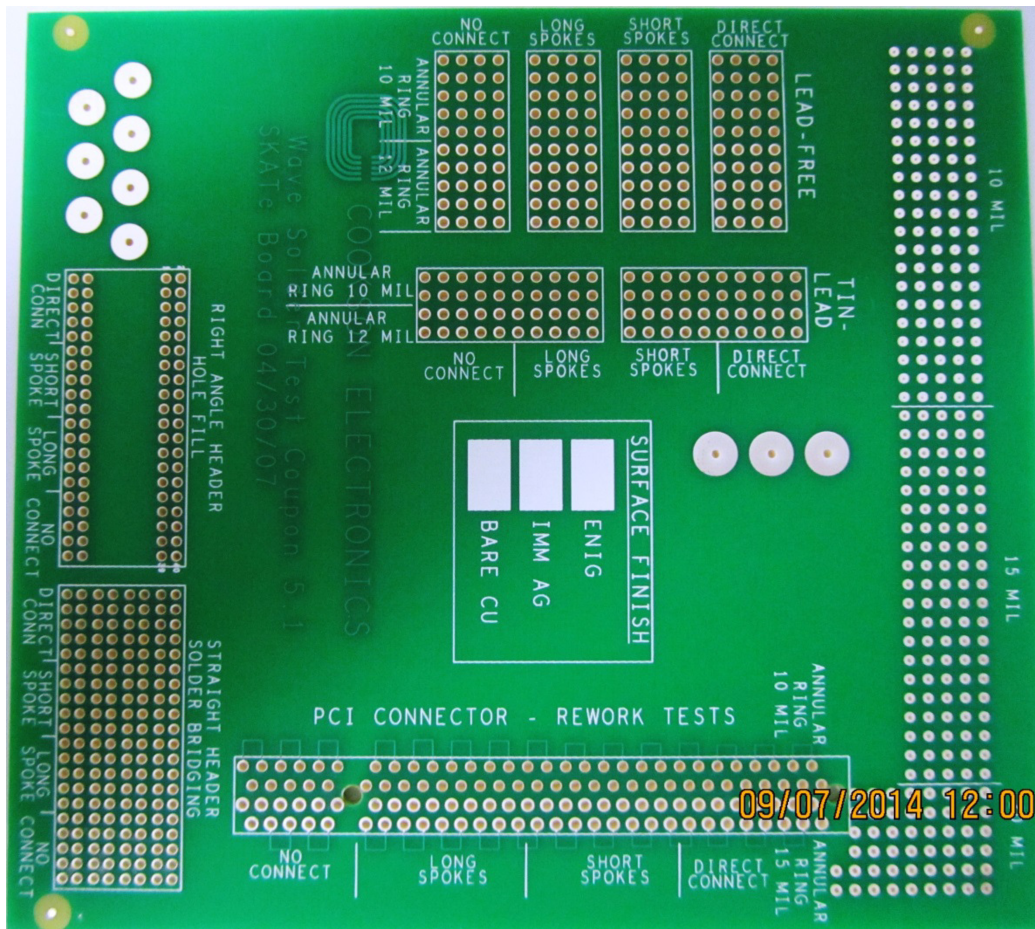
Large Pad Wetting Result





Ranking	Description	Unit
1	Preferred	90-100%
2	Acceptable	80-90%
3	Unacceptable	60-80%
4	Bad	<60%

Through-hole Fill TV

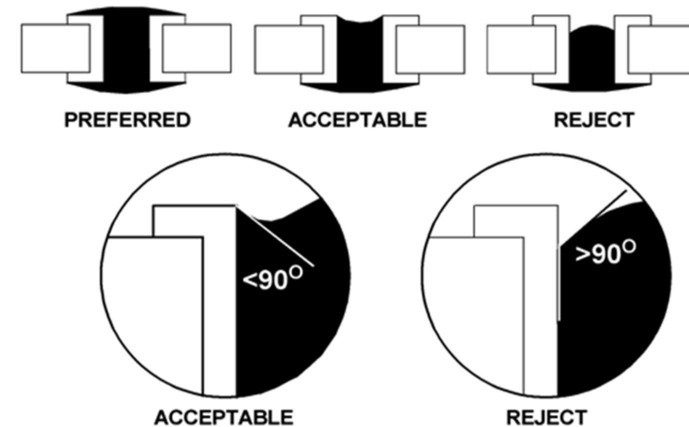


- Board thickness
  - 0.093”
- Hole size
  - 10 mil
  - 15 mil
  - 20 mil
  - 40 mil

- Last step in the assembly process
- Board experienced multiple reflow

Through-hole Fill Test

Flux type	EF-2210
	EF-6850
	NR-205
Surface finish	OM
	OSP
Contact time	5 sec
	7 sec
Hold time	2 hrs
	72 hrs
Precondition	0 reflow
	2 reflow

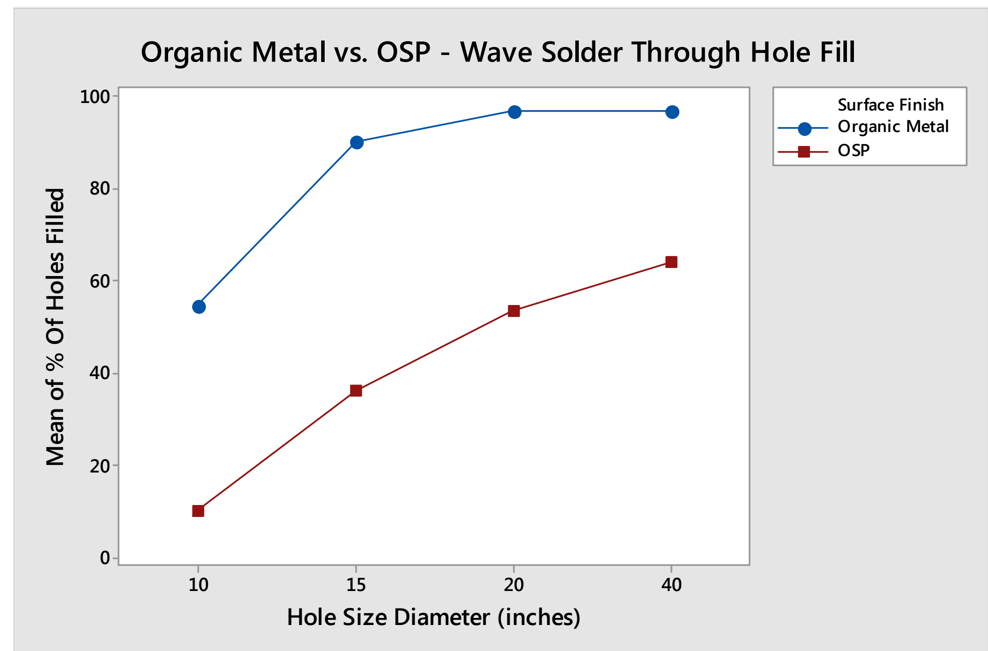


- Measure number of holes filled
- Using IPC J-STD-003A standard

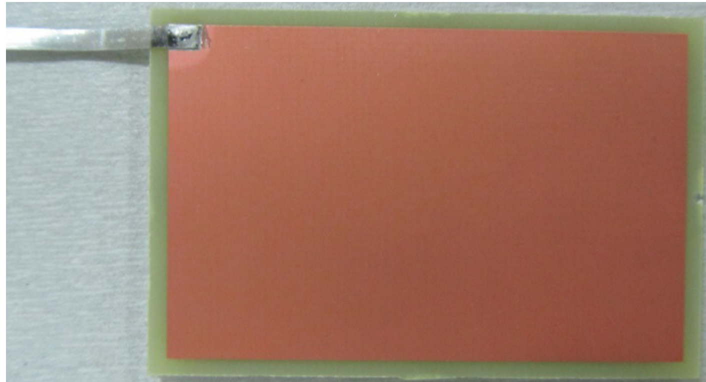
Through-hole Fill Results

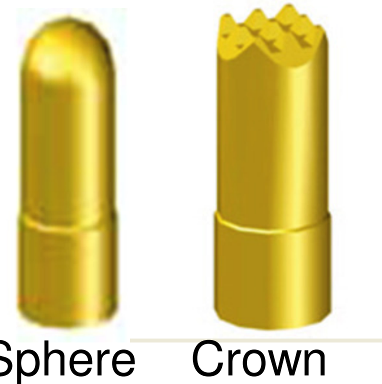
Source	DF	SS	MS	F	P
Surface Finish	1	400757.04	400757.09	271.298	0.004
Contact Time	2	2954.36	1477.18	0.829	0.500
Hold Time	4	7123.92	1780.98	0.064	0.991
Pre Reflow Condition	8	221750.77	27718.85	5.596	0.000
Hole Size	48	237751.59	4953.16	3.047	0.000
Flux	128	208084.72	1625.66	10.716	0.000
Error	576	87385.02	151.71		
Total	767	1.16581E+06			

- "p" value indicates surface finish is significant
- Organic metal shows higher hole fill regardless of the hole size
- Provides larger process window



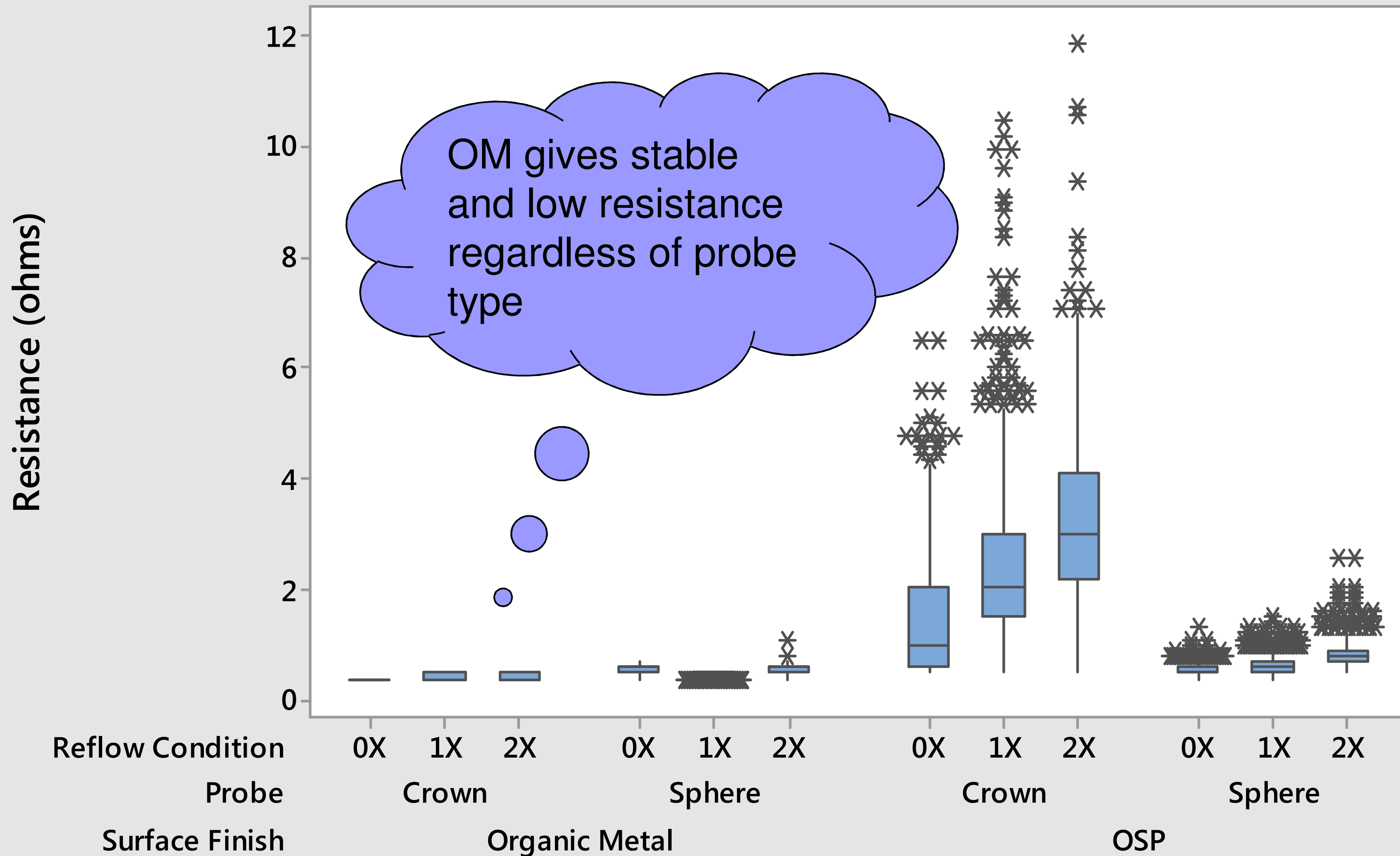
In-Circuit-Test





- Test Vehicle
  - 30mm x 50mm copper clad
  - Coated with desired final finish
- Test Probes
  - 500 data points are collected using labview
  - Resistance is recorded in Omhs
  - Flying probe method was simulated

In-Circuit-Test Results



Summary

- A series of statistically designed experiments were carried out to compare OSP performance with OM
- Based on this study we can say OM has many advantages over OSP
  - Better wetting characteristic leading to greater solderability
  - Better visual characteristic
  - Wider process window
  - Better ICT performance leading to elimination of false positive
- ICT performance makes OM final finish a highly desired finish as compare to OSP
- Lower cost point make OM highly desired over other metal finish without compromising performance

- PCB final finish has significant effect on the reliability, process yield, and ultimately, cost
- Choice of final finish depends on many factors
- When a visible and conductive finish is desirable, OM provides a low cost alternative to metal finish

I like to acknowledge my co-authors, John Fudala and Sathiya Narayanan for their relentless support in in preparing this presentation. Without their support, this paper and presentation would not have happened.