



International Electronics Manufacturing Initiative

Lead Free Wave Soldering Initiative

Chair: Denis Barbini, Ph.D., Vitronics Soltec

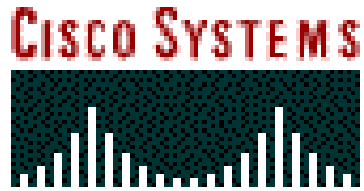
Co-chair: Paul Wang Ph.D., Microsoft Corp.

Project Justification

- The focus of the first two NEMI lead free assembly projects focussed on assembly, reliability, and rework of lead free joints. All participants in these two groups identified thru-hole assembly as a gap in the respective project scopes. This project aims to fill in this gap by addressing the lead free wave soldering issue on two levels: process and board level.

Project Objectives

- Phase I will aim to understand and characterize process-related challenges and material impact based on a low cost, representative test vehicle. The purpose of characterizing the lead free wave process in Phase I is to optimize process parameters for Phase II where solder joint performance will be evaluated based on a specific, optimized lead free wave soldering process.
- Phase II encompasses the development of the GTLO test vehicle which is characterized by a complex network of components assembled upon varying board construction complexity. The purpose of the GTLO assembly will be to characterize joint performance.



- Cookson Test Vehicle design “Skate”.

Board Specification

- 64 mil
- 93 mil
- 135 mil
- CuOSP
- HASL

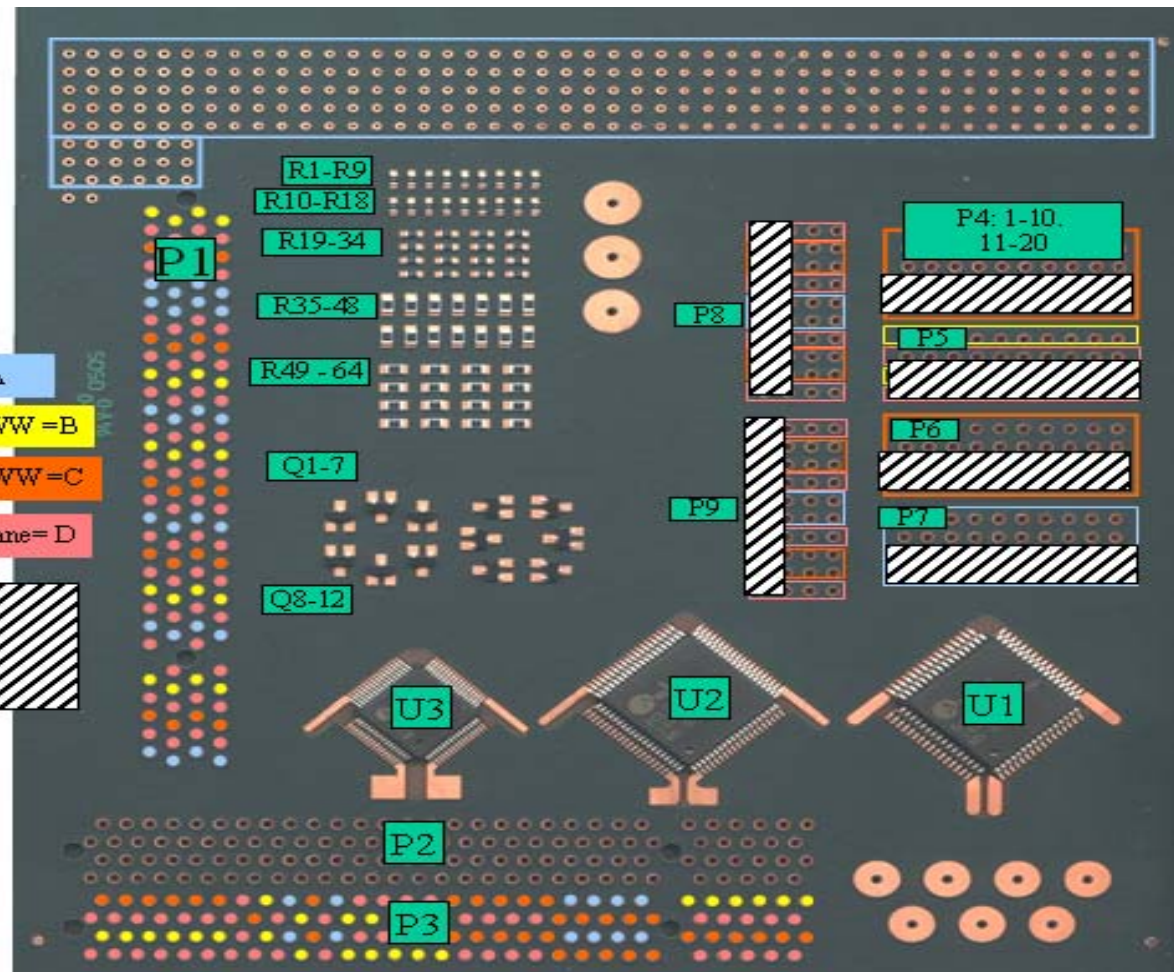
Alloys

- SAC 305
- SACx
- Sn100C
- SnPb



Components

- QFP's, SOT, Passives
- PCI, Berg Stick






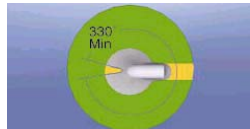
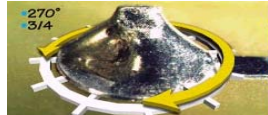

- Designed an experiment to investigate the impact of various materials and process parameters on joint formation with specific focus on thru-hole penetration.
- Experiment was executed in March 2005 at Vitronics Soltec.

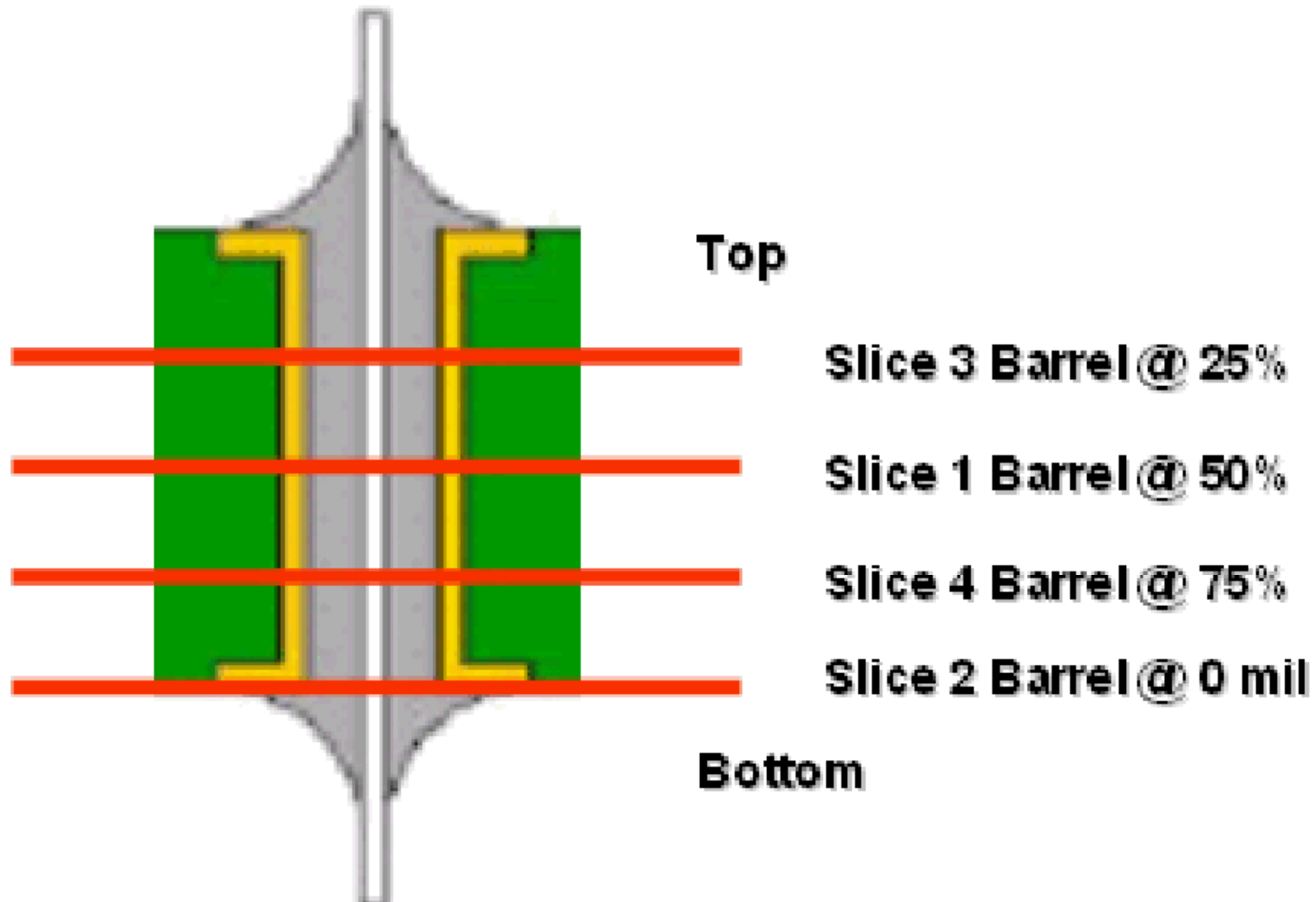
Std Order	Atmosphere	Belt speed	Preheat Temp	Flux Quantity	Flux Type	Chip Wave	Solder Temp	PCB thickness
1	N2	3	100	1 low	VOC Free	on	255	0.062
2	N2	3	110	2 med	Alcohol	off	265	0.094
3	N2	2	130	3 high	WS	on	275	0.135
4	N2	3.5	90	1 low	Alcohol	off	275	0.135
5	N2	4.5	110	2 med	WS	on	255	0.062
6	N2	4.5	130	3 high	VOC Free	on	265	0.094
7	N2	5	100	2 med	VOC Free	on	265	0.135
8	N2	6	110	3 high	Alcohol	on	275	0.062
9	N2	6	130	1 low	WS	off	255	0.094
10	Air	3	90	3 high	WS	off	265	0.062
11	Air	3	115	1 low	VOC Free	on	275	0.094
12	Air	2	130	2 med	Alcohol	on	255	0.135
13	Air	4.5	90	2 med	WS	on	275	0.094
14	Air	3.5	115	3 high	VOC Free	off	255	0.135
15	Air	4.5	130	1 low	Alcohol	on	265	0.062
16	Air	6	90	3 high	Alcohol	on	255	0.094
17	Air	5	110	1 low	WS	on	265	0.135
18	Air	6	130	2 med	VOC Free	off	275	0.062

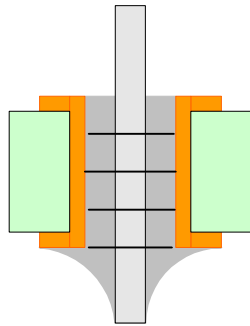
Score	End Joint Width, min	Fillet Height, min	Fillet Height, max
0 = Perfect	As wide as lesser of terminal/land width	Fillet height = solder thickness +75% terminal height. Wetted.	Fillet height = solder thickness +75% terminal height. Wetted.
			0.5 Ref. sample ->
1 = Good	75 - 100% of terminal/land width	Solder thickness + 25-50% term. height. Wetted.	solder height +100% of terminal height.
			1.5 Ref. sample ->
2 = Fair	50% of terminal/land width	solder thickness + 25% terminal height. Wetted.	fillet overhangs land or top of terminal but not on comp body
			2.5 Limit sample ->

3 = NG marginal	25-50% of terminal/land width	solder thick +slightly <25% terminal height. Poorly wetted.	fillet barely extends onto component body.
			3.5 Ref sample ->
4 = Bad	<25% of terminal/land width	solder thick + far <25% of term ht.	fillet clearly extends on component body
			4.5 Ref sample ->
5 = Horrible	no connecting joint	no connecting fillet	fillet far extends on and above component body

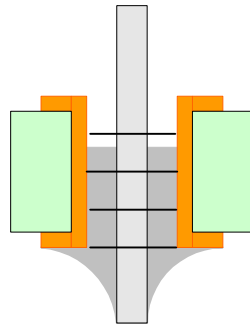
- **Criteria per IPC-A610-C chapter 6 Solder Acceptability Requirements (MFG Eng Solder Best Practices website).**

Score	Fillet shape	Circumferential Wetting	Land cover %	Solder Balls in 2cm area
0 = Perfect	Concave, <math><90^\circ</math> cont. angle, wetted	360 * circum.	100% cover	none
				
1 = Good	Concave, 45 - 75* wetted	330 - 360* cricum.	90-100% cover	diam <math><.005\text{''}</math> / 1-3 per area
				
2 = Fair	barely concave, 75 - 90*	270 - 330* circum.	75-90% cover	diam <math>.005 < d < .010\text{''}</math> / 3-6 per area
				

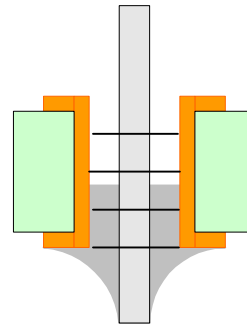




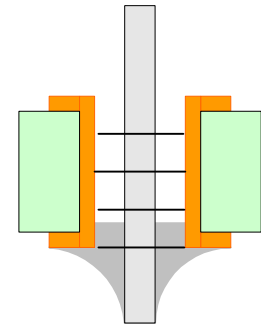
No defect



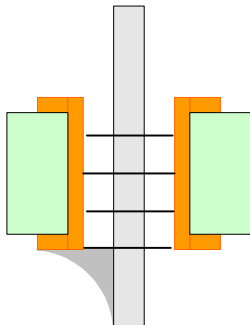
Defect
S3-25%



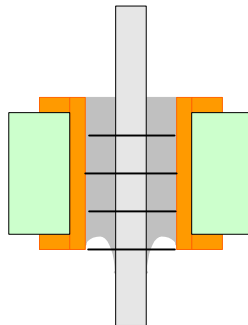
Defect
S3-25%
S1-50%



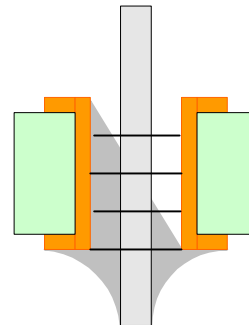
Defect
S3-25%
S1-50%
S4-75%



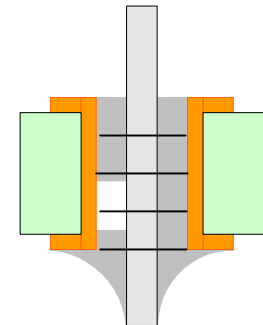
Defect
All Slices



Defect
S2-0%



Defect
S3-25%
S1-50%
S4-75%



Defect
S4-75%
Void

