



What's Coming Down the Tracks for Printing and Stencils?

Presented by:

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Expert Panelists:

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Topics and Format

30-minute presentation on

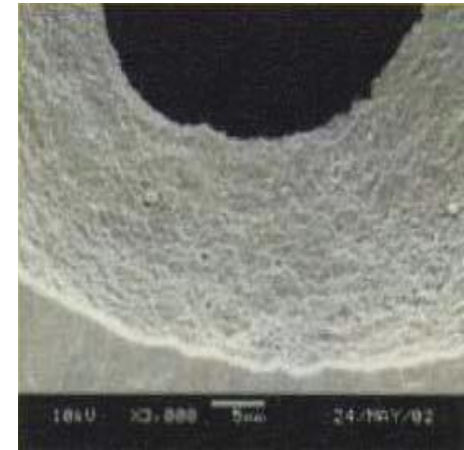
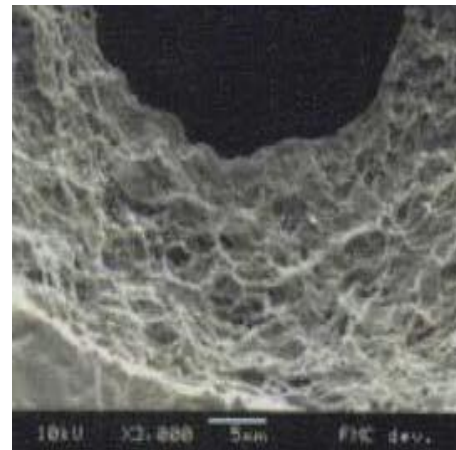
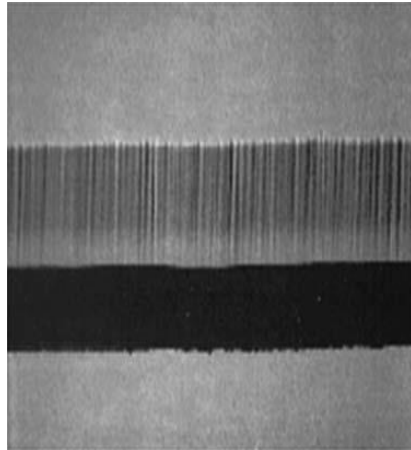
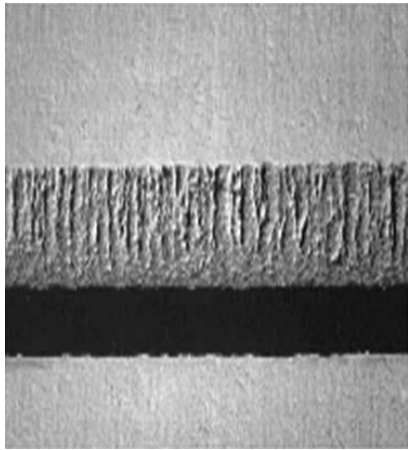
- New foil materials, mesh materials, high tension mounting, and nanocoatings
- New stencil cutting and stepping technologies
- New solder paste flux mediums, room temperature stability, and the trend toward finer solder powder types in response to miniaturization
- New hardware and software upgrades on stencil printing equipment

30-minute round-table discussion

- Submit your questions online
- Direct to any individual or to the group
- Submit at any time during the presentation

Stencil Metal Foil Technology

Metal Foil Technology	Grain Size	Minimum Area Ratio
Datum PhD foil "fine grain"	8-9 micron	0.55
Datum FG foil "ultra-fine grain"	1-2 micron	0.50
Datum Tension FG foil - New in the US	3-4 micron	????

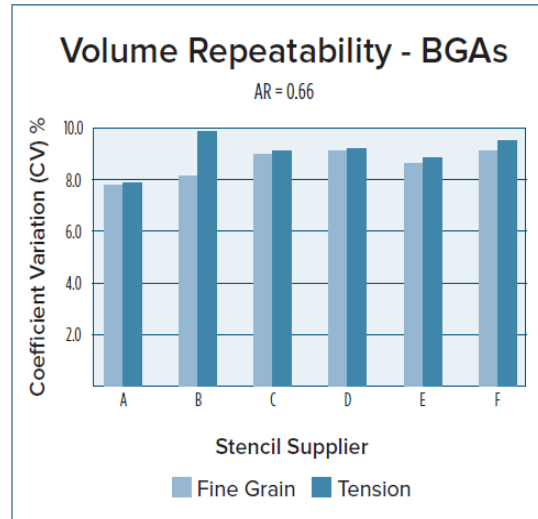
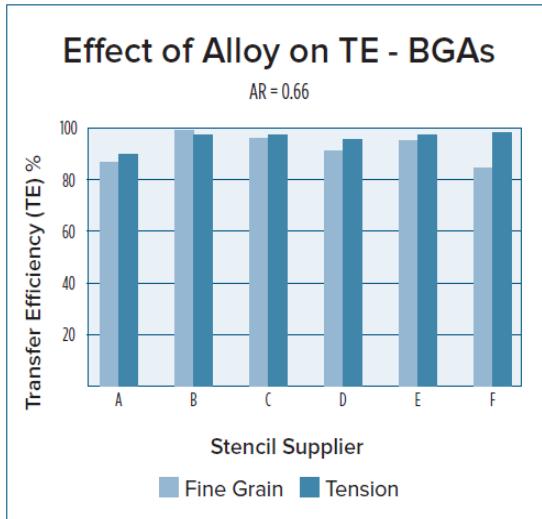


Mill grade steel (500x) Datum PhD (500x)

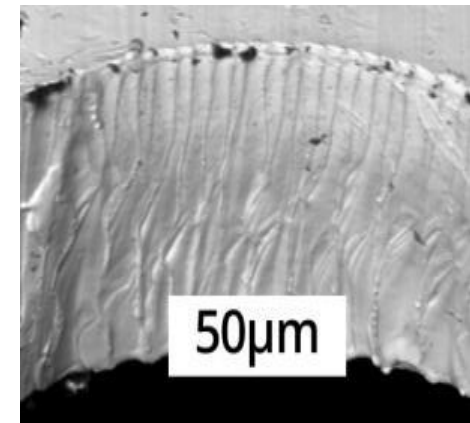
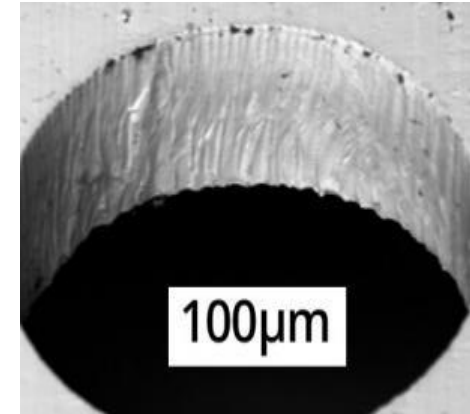
Mill grade steel (1000x)

Datum FG (1000x)

Tension Foil Technology



Datum Tension



- Cuts and prints like original FG, as seen above
- Cost competitive like PhD
- Higher tension mounting gives better snap off, more repeatable print process
- No spec on Fine Grain, beware of less expensive “fine grain” foils that do not cut or print as well as original

High Tension Foils and Frames

- Typical tension – 35-40 N/cm
- “High” tension – 50+ N/cm
- Promise to have less “snap back” and cleaner release
- Need a more rigid frame to carry higher tension without warping
- Needs stronger mesh to carry the tension without ripping
- May need a harder steel to carry higher tension on thin webs, hence the concept behind the Tension alloy



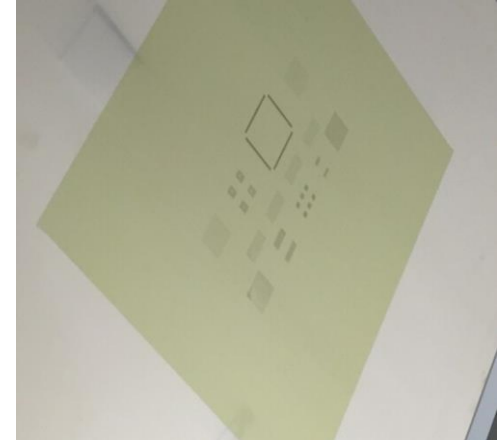
Image source: www.smtstencilsupply.com

For excellent information on mesh and frame quality, see *“A Different Perspective on Solder Paste Printing: Perfecting the Print Process with Practical Solutions”* by Alison Buchholz of Panasonic, SMTAI 2015

Nano Coatings

Attributes	Fluoro-Polymer Coating	Self Assembled Mono Layer Phosphonate (SAMP)
Application	Spray and thermal cure	Wipe on
Thickness	2-4 microns	1-2 nm
Hydro and oleophobic	✓	✓
Reduces frequency of underside cleaning	✓	✓
Abrasion resistant	✓	Wears off
Chemical resistant	✓	Wears off
Solder paste volume	15 – 25% increase in TE	Slight decrease < 5%
Minimum Area Ratio	0.10 lower than foil	Same as foil

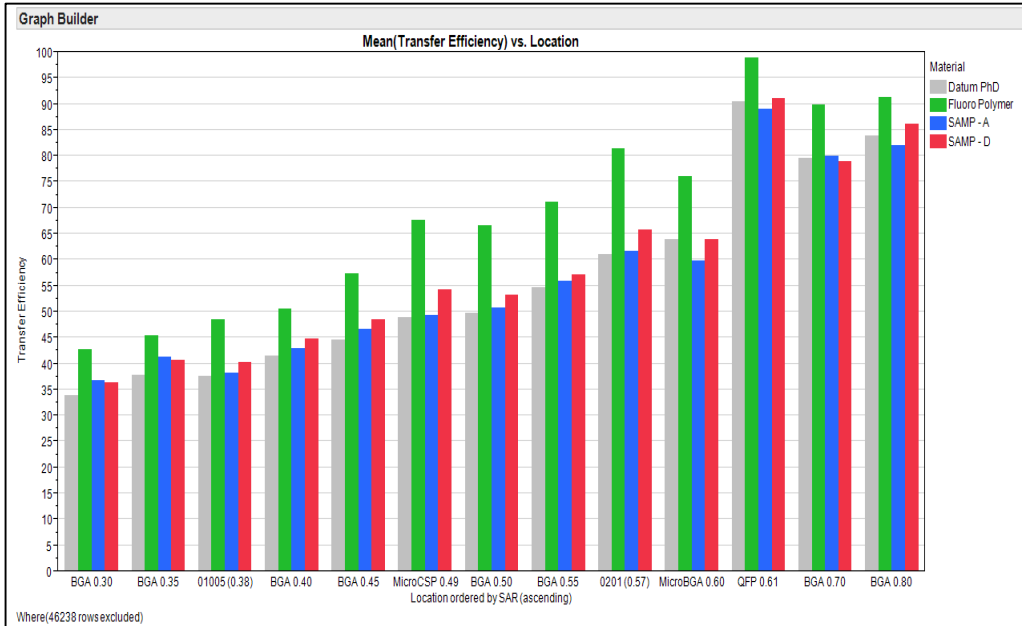
Fluoro-Polymer Coating



SAMP Coating

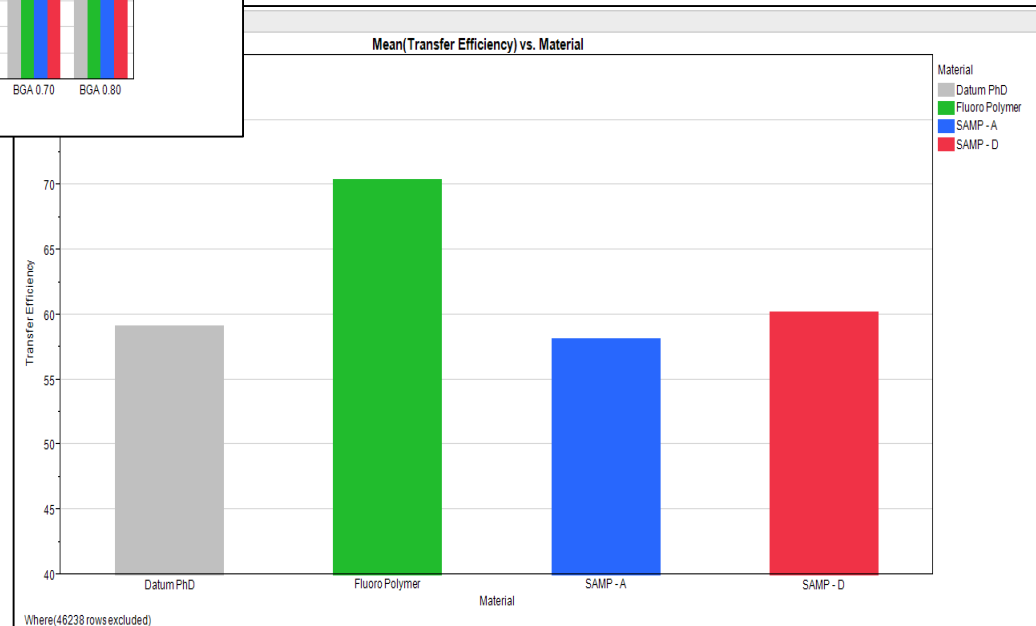


Nano Coatings and Transfer Efficiency



No Clean
SAC305 Type 3
Solder Paste

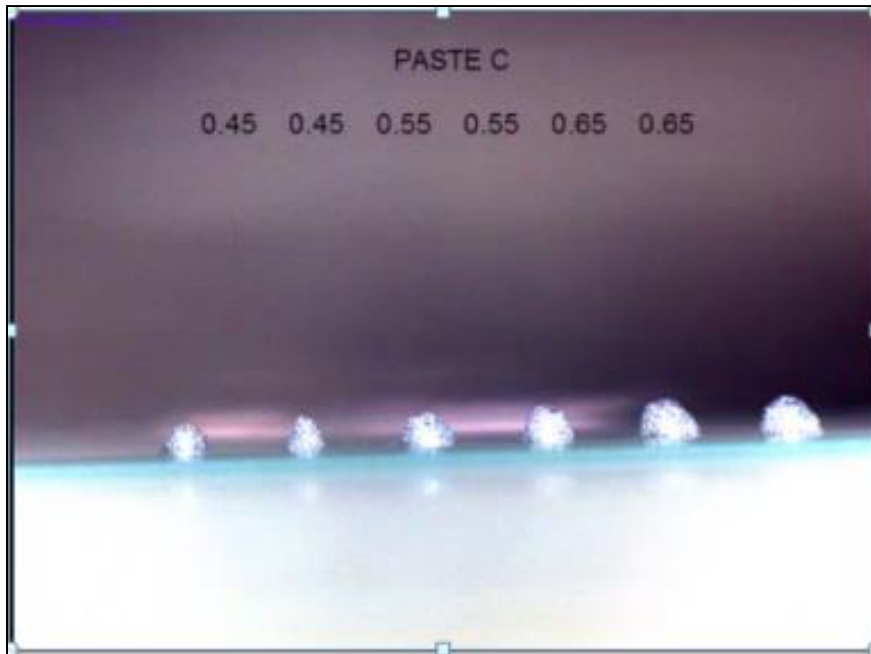
- Uncoated Datum PhD
- Fluoro Polymer
- SAMP - A
- SAMP - D



Nanocoating vs. No Nanocoating

- Nanocoating is always better. **ALWAYS**
- Videos at low ARs

ARs:	0.45	0.50	0.55	0.60	0.65	0.70
Sizes (μm):	180	200	220	240	260	280
Sizes (mil):	7.1	7.9	8.7	9.5	10.2	11.0



Nanocoated



Not Nanocoated

Laser Cutting

- Produces most accurate stencils
- Stencil quality depends on machine quality, age, calibration, maintenance
- Newer cutters have very fine laser beams, on-board optical inspection to make sure the hole is fully cut, on-board aperture measurement for SPC, and remote control for cals, tune-ups or troubleshooting
- Ask your stencil vendor about his cutter – brand, model, calibration and PM history



Image source: www.tannlin.com

Stepping

Stepping is critical in many processes, especially when stencil design calculations are being performed based on aperture volumes and area ratios

- Steps can be chemically etched, milled, or welded prior to laser cutting
- Step Types:
 - **Step Up:** Thickens stencil locally
 - **Step Down:** Thins stencil locally
 - **Top or Bottom side steps,** or both
 - **Multi-level steps:** Accommodate more component variety/needs
 - **Angled steps:** Reduce squeegee damage (also w/encl print heads)
 - **Cavity relief:** For labels or other PCB topographical features
- **Precision steps** are often required for high-density assemblies
- **Milling Machines** are now available to create steps

Laser Cut and Welded Steps

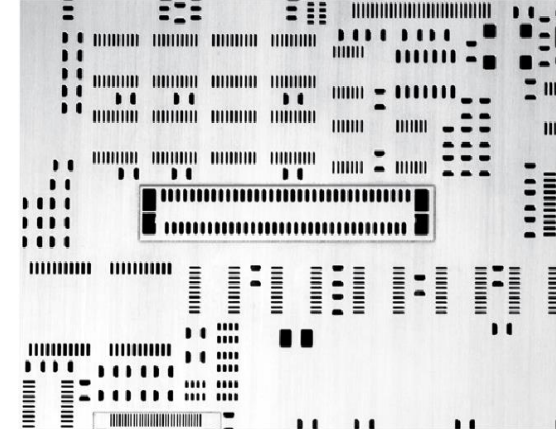
Manufacturing Process:



Laser cut of required size of step area



Welding process of an accurate fitted step in desired thickness



Cutting of apertures in step area and stencil

User Benefits:

- *Exact thickness and surface roughness*
- *Highest precision in stencil step technology*
- *Can step up/down on same stencil and still maintain surface quality*
- *Can create stencils for cavity PCBs*

Formerly only available through LaserJob; now available on Tannlin T11 laser cutters at any shop

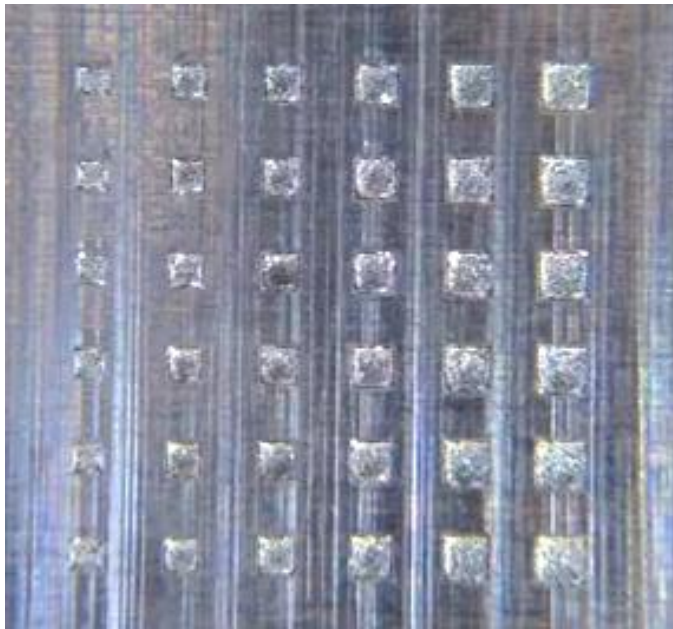
Solder Paste Developments

- New lead-free formulations release really well
- Introduction of room-temp stable pastes
 - Holy Grail for years
 - Within certain temperature parameters (<40°C/104°F)
 - Always tradeoffs in paste properties
- Videos of solder paste release
- T4 powders replacing T3 as new standard. T5?
- No-Clean vs. Water Soluble and why people are choosing to clean no-cleans

Solder Paste Elasticity

Square vs. Circle: What releases better?

ARs:	0.45	0.50	0.55	0.60	0.65	0.70
Sizes (μm):	180	200	220	240	260	280
Sizes (mil):	7.1	7.9	8.7	9.5	10.2	11.0



Uncoated stencil, Paste C

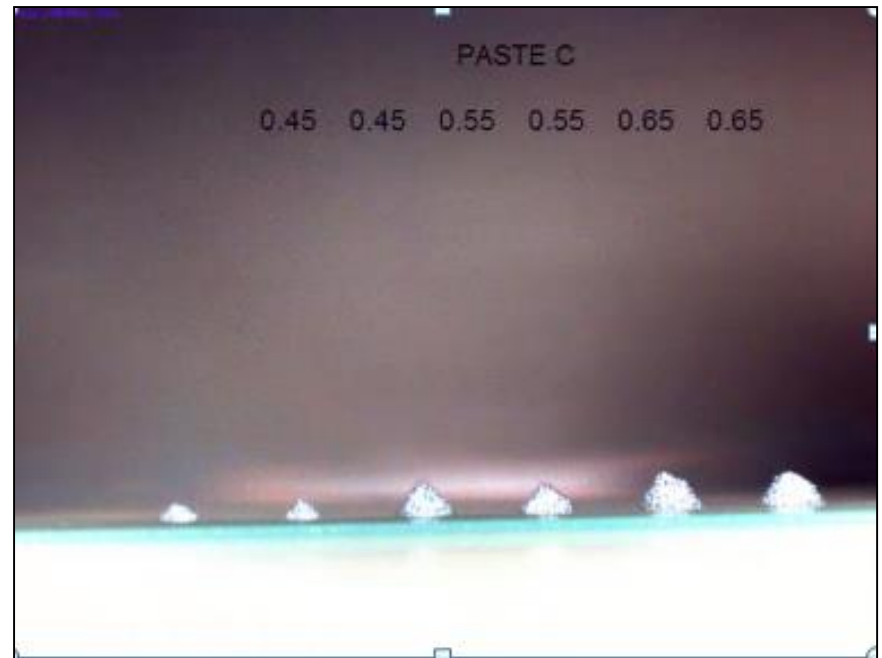
Dirty vs. Clean – Uncoated Stencil

- “Dirty” condition is 4th print without wipe
 - Not an exceptionally long wipe interval
- “Clean” condition is 1st print after solvent wipe
 - 5 prints before wipe to get squeegee in right position

ARs:	0.45	0.50	0.55	0.60	0.65	0.70
Sizes (μm):	180	200	220	240	260	280
Sizes (mil):	7.1	7.9	8.7	9.5	10.2	11.0



Dirty



Clean

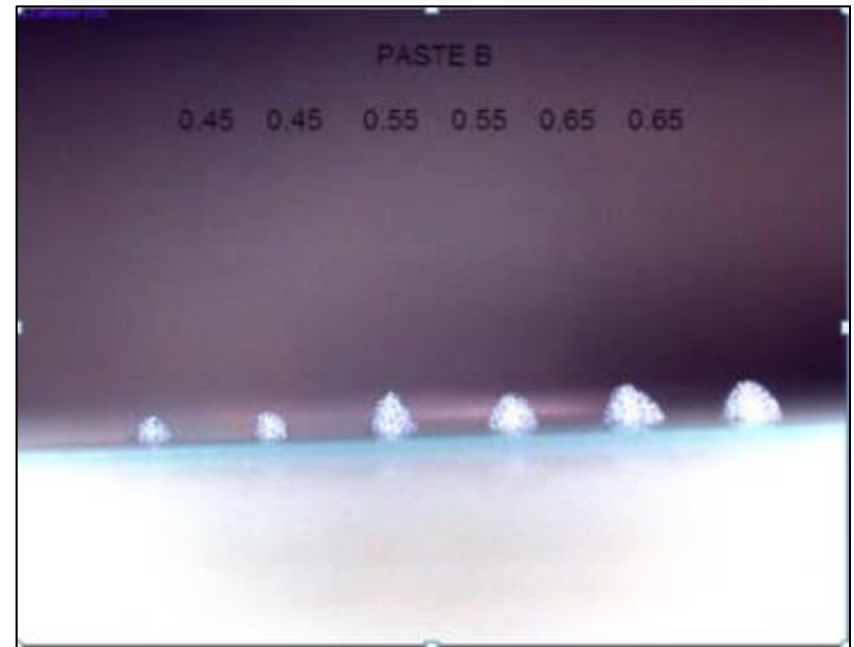
Dirty vs. Clean – Nanocoated Stencil

- Lower ARs
- No discernable difference in release in this comparison

ARs:	0.45	0.50	0.55	0.60	0.65	0.70
Sizes (μm):	180	200	220	240	260	280
Sizes (mil):	7.1	7.9	8.7	9.5	10.2	11.0



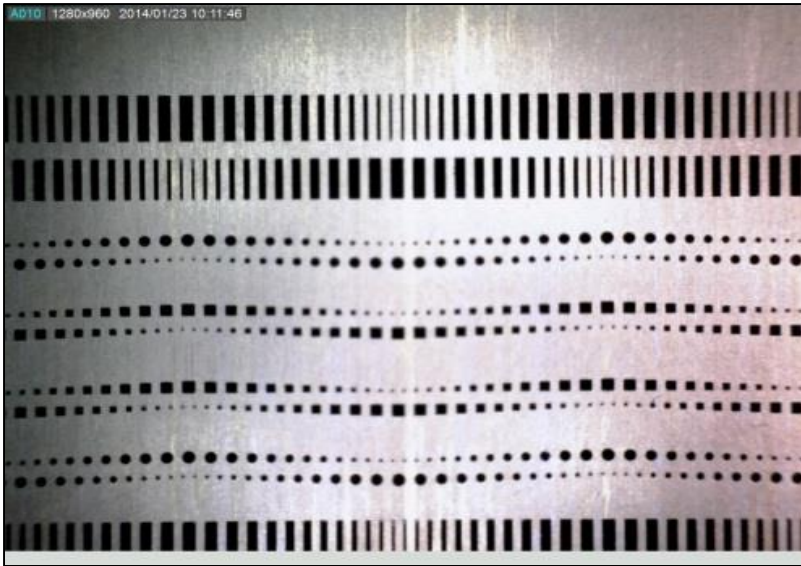
Dirty



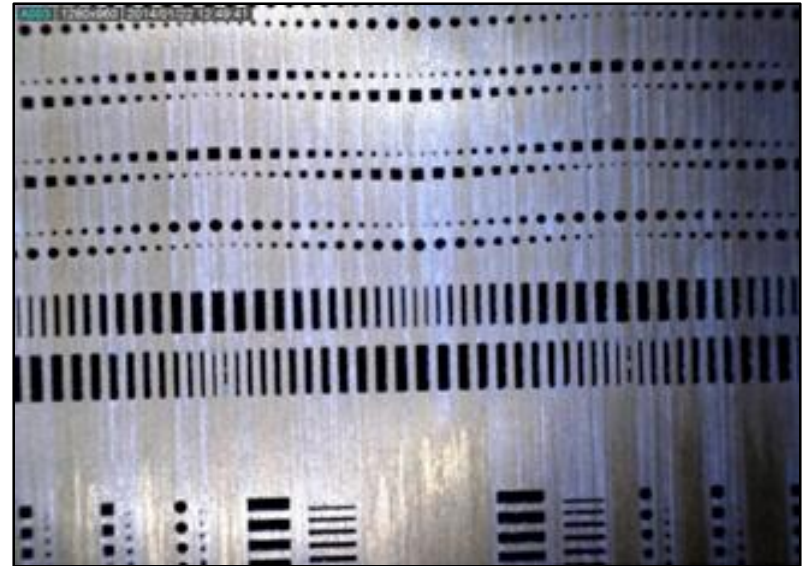
Clean

Solvent vs Dry Wipe on Nanocoated Stencil

Solvent Wipe



Dry Wipe



Tests were performed using wipe-on (SAMP) nanocoating with solder paste treated with UV tracer dye and a black light to show the flux smearing

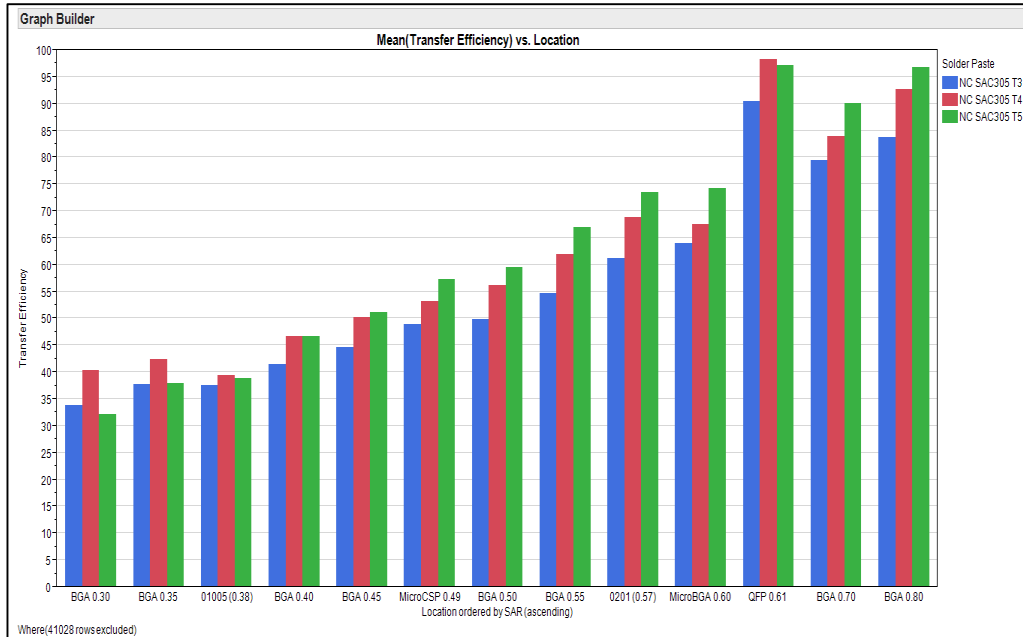
Solder Paste Powder Types – When to Switch?

IPC-7525B 2011-October. Stencil Design Guidelines

3.2.1 Aperture Size. A typical guideline is a minimum of 4 to 5 particles of paste powder across the width of an aperture.

Type	Mesh	Size (μm)	Size (mil)	Min Aperture Size (mil)	AR with 5 mil Stencil
2	-200/+325	45 - 75	1.8 - 3.0	15.0	0.75
3	-325/+500	25 - 45	1.0 - 1.3	9.0	0.45
4	-400/+635	20 - 38	0.8 - 1.5	7.5	0.38
5	-500/+800	15 - 25	0.6 - 1.0	5.0	0.25

Solder Paste Powder Types and TE%

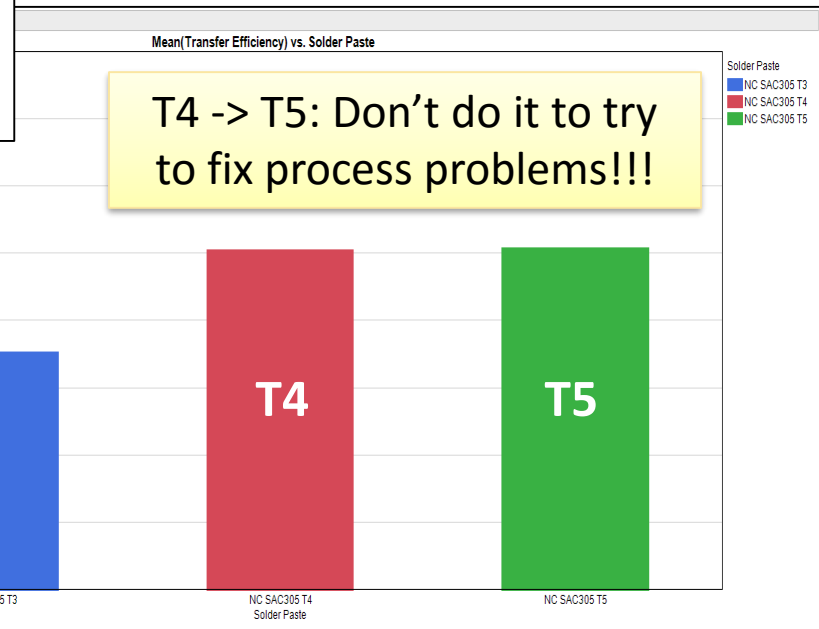


- Uncoated Datum PhD
- No Clean SAC305 Types 3, 4, and 5

NC SAC305 T3

NC SAC305 T4

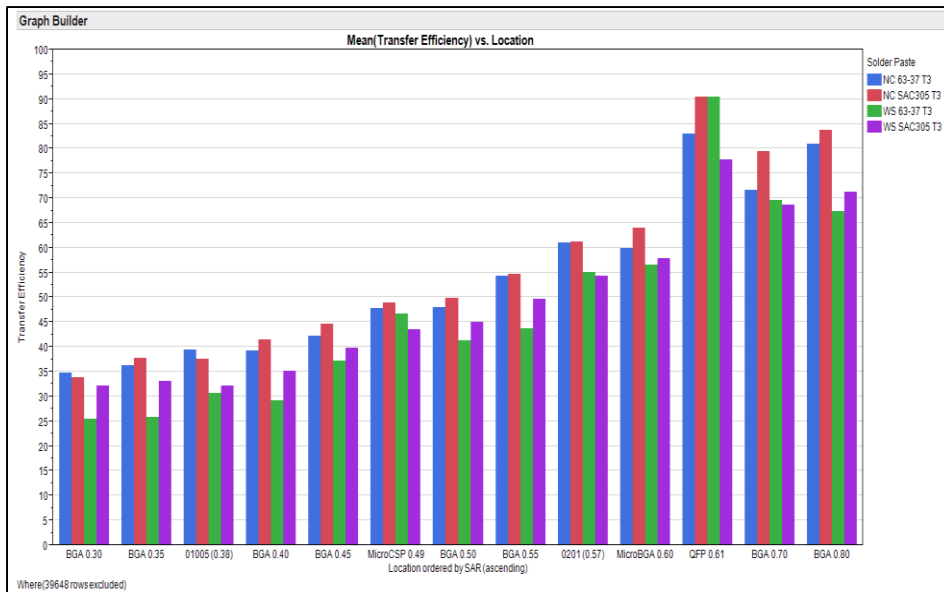
NC SAC305 T5



Printability

- Generally speaking, each generation of solder paste prints better than its predecessor
 - Newer formulations print better than older ones
 - Lead-free pastes are newer formulations than most tin-leads; therefore lead-free products generally print better than tin-lead
- Generally speaking, no-clean pastes are have longer stencil lives and wider process windows than water-soluble
 - There are exceptions to the rule

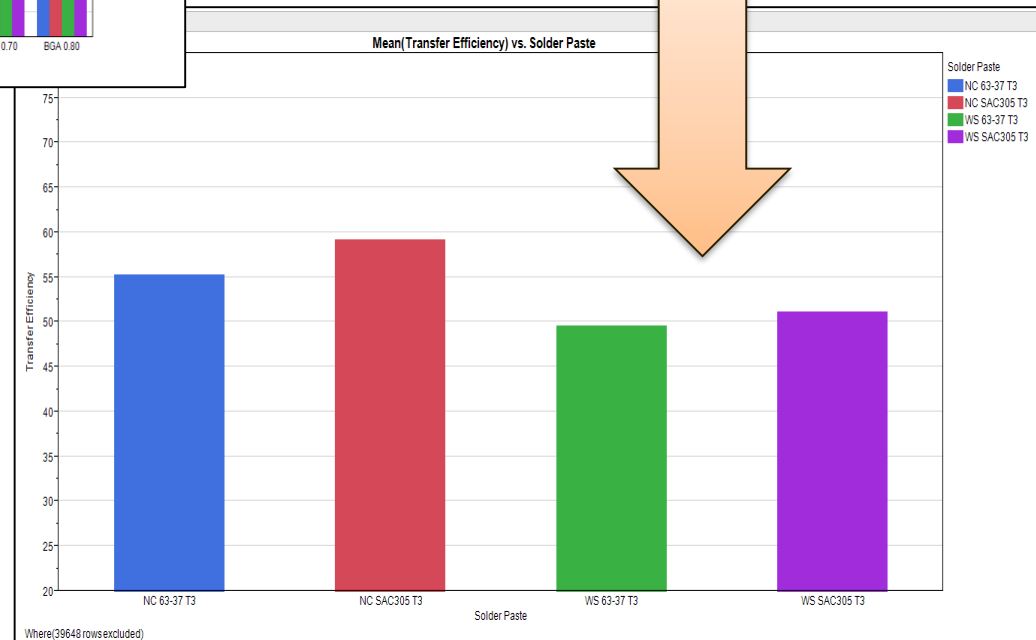
Solder Paste Chemistry and TE%



- Uncoated Datum PhD
- All Type 3 Powder

LF T4 has best process window. Most WS need cleaning chemistry anyway so assemblers are cleaning their no-cleans

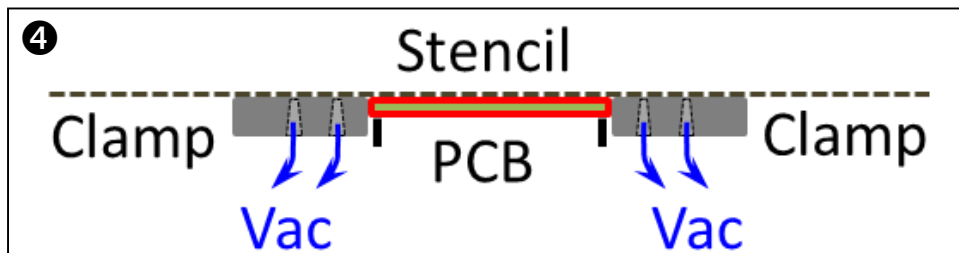
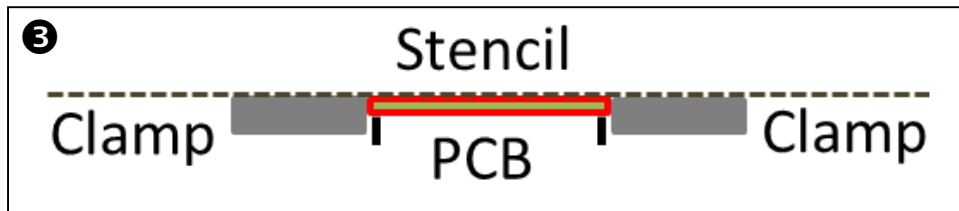
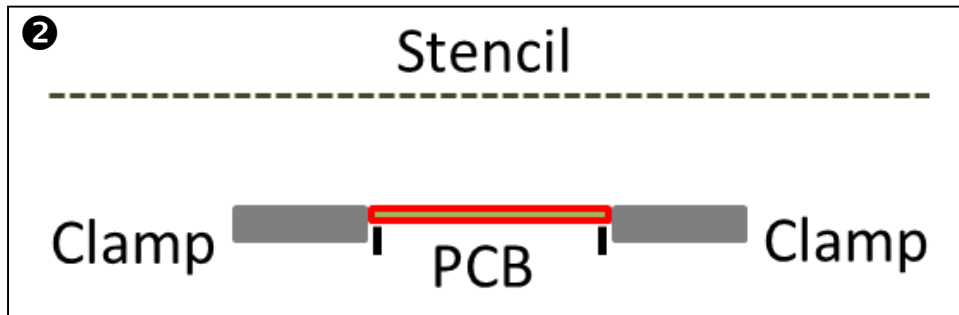
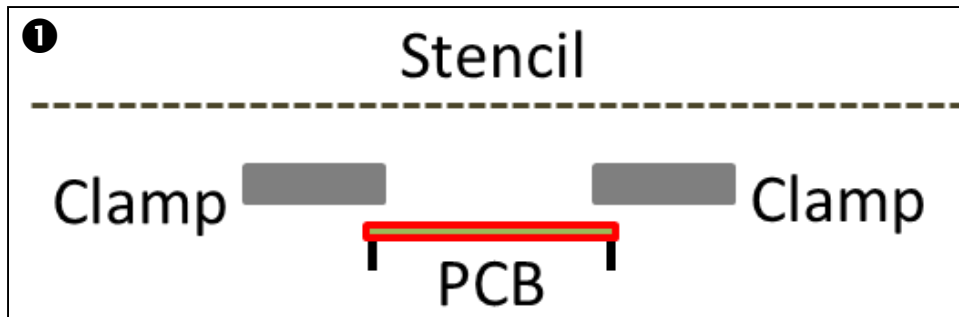
- NC 63-37 T3
- NC SAC305 T3
- WS 63-37 T3
- WS SAC305 T3



Printer Hardware & Software

- Enclosed Print Head improvements
- Meshless mounted stencils
- Compliant Pin tooling is proliferating
- Self-adjusting squeegee deflectors take operator influence out of the process
- Bead height monitor
- Autoset snuggers
- Improved closed-loop feedback from SPI
- New paper more effective and compatible with nanocoatings
- Paste and adhesive dispenser built into printer

Auto Height Adjusting Snugger Clamp



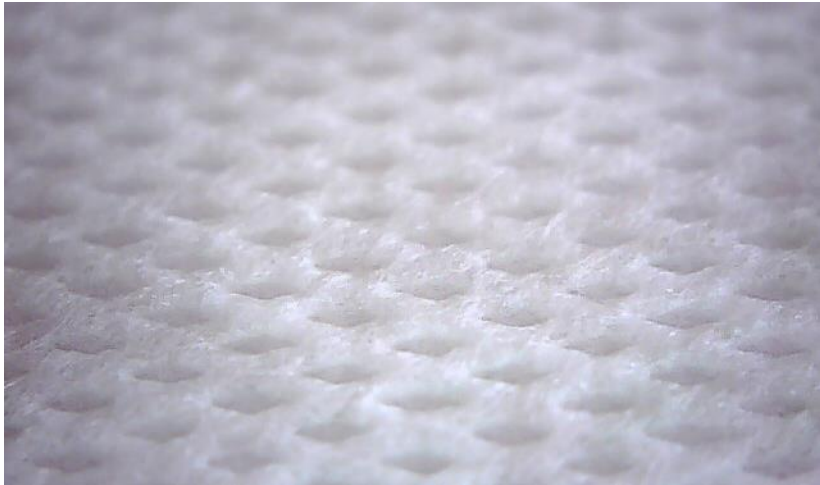
1. PCB loads, clamp measures PCB thickness

2. Clamp retracts to PCB height, pinches PCB sides

3. PCB raised to aligned contact with stencil apertures; **clamp type allows unobstructed printing to PCB edges**

4. **Some systems now include integrated vacuum to improve stencil gasketing**

Consumable Product Developments



- Patterned hydrophilic fabric roll improves paste particle capture
- Low linting, non-abrasive structure
- Excellent for preserving nanocoating finishes

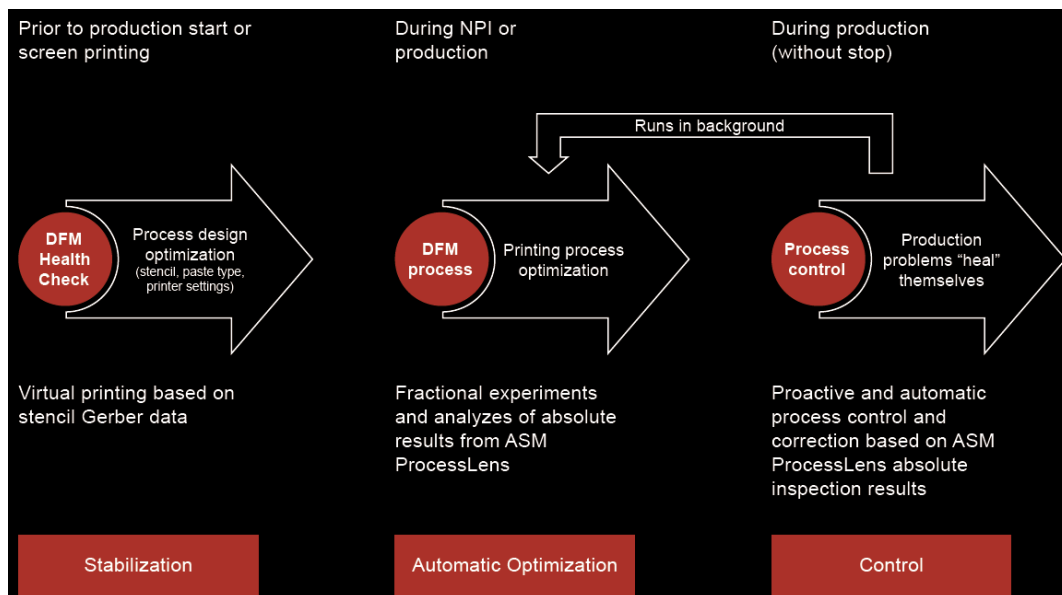


- Quick roll changeover design reduces line down time
- Lateral oscillation during travers
- Programmable high flow vacuum & engineered solvent dispense

Advanced Closed Loop Feedback



- Solder Paste Measurement + Expert System
- Automatic printing machine program optimization
- Self learning capability
- Continuous printing production quality monitoring & machine parameter control
- Intelligent cleaning cycle optimization.



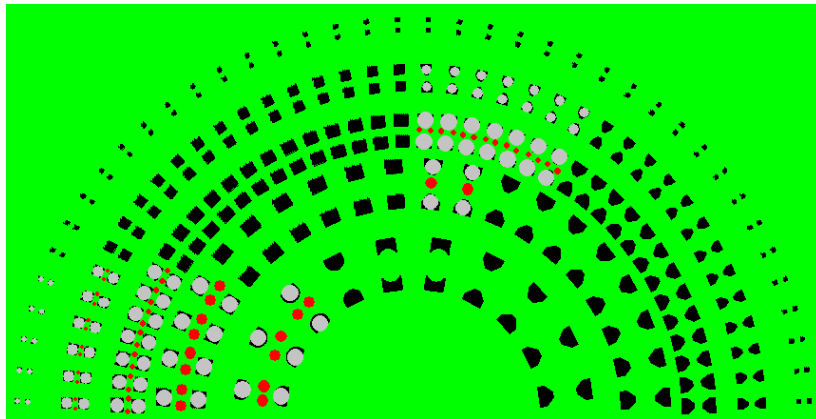
Advanced Dispense Unit

Dispenses Paste and Glue



- Single or Dual Head
- Paste/Adhesive (any dispensable materials)
- Easy Programming

Advanced Dispense Unit



Auto dispense programming
on any rotation

Cleaning & Calibration
station





Questions for Panelists?

Chrys Shea, Shea Engineering Services

Tony Lentz, FCT Companies

Mark Brawley, Speedprint

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