Stencil Technology and Guidelines

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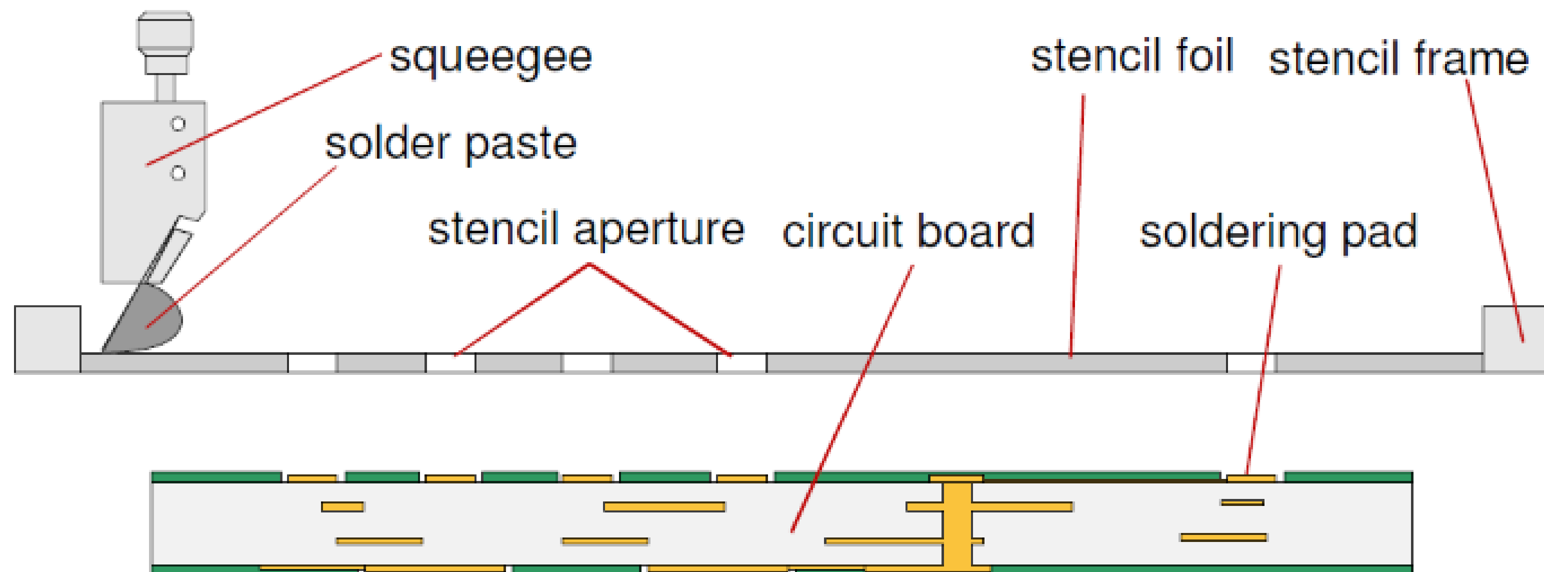
V3.0

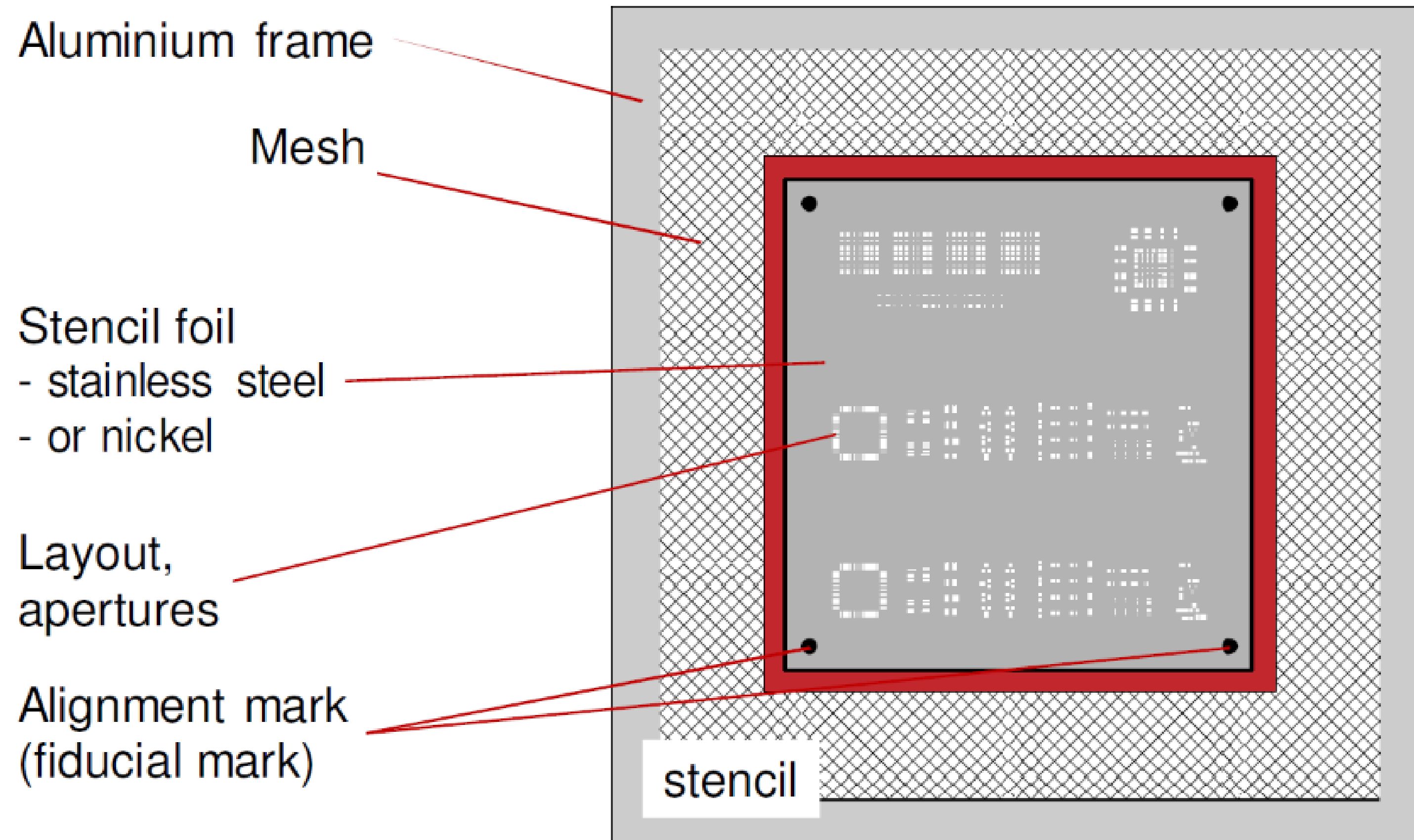
STENCIL PRINTING

A stencil is used to apply solder paste is a thin, 50–200 µm thick metal foil, on which apertures are formed according to the solder pads on the printed circuit board. Stencil printing provides a fast, mass solder paste deposition process; relatively inexpensive, and recommended for mass production.



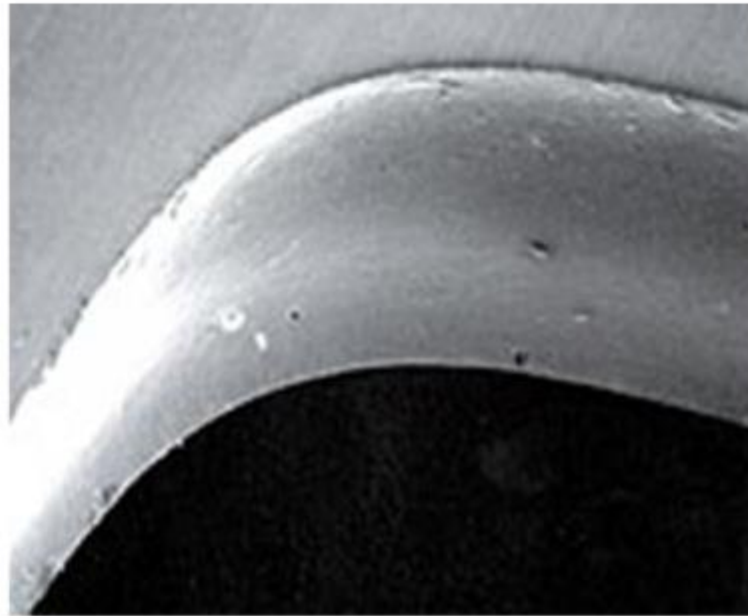
How a stencil is constructed.

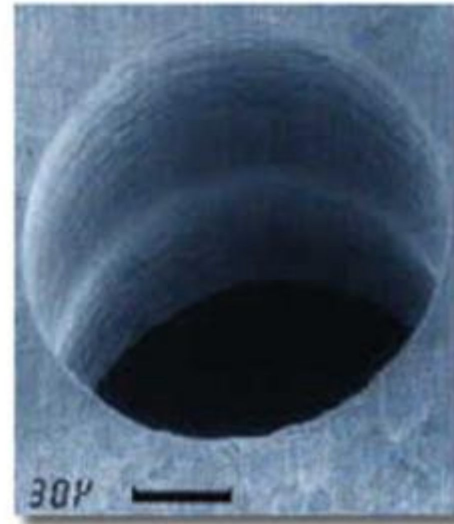
The stencil foil is tensioned and fixed to the frame by mesh.
The tension of stencil foil is around ~ 30 N

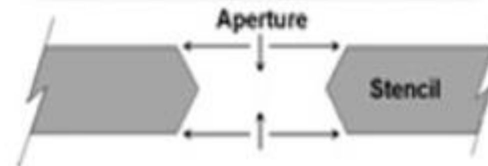


CHEMICALLY ETCHED STENCILS

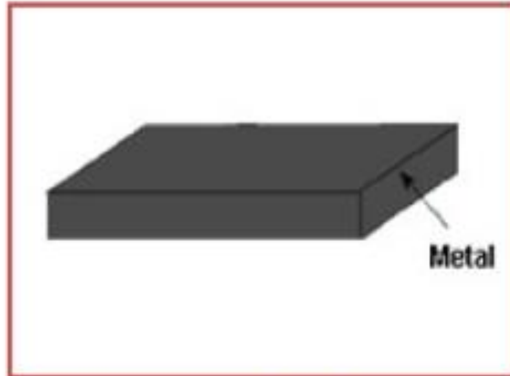
- Subtractive technology
- Trapezoidal shape opening, material: stainless
- Not used as often today because of advancement in laser technology







STEPS OF CHEMICAL ETCHING



Chemically cleaned surface

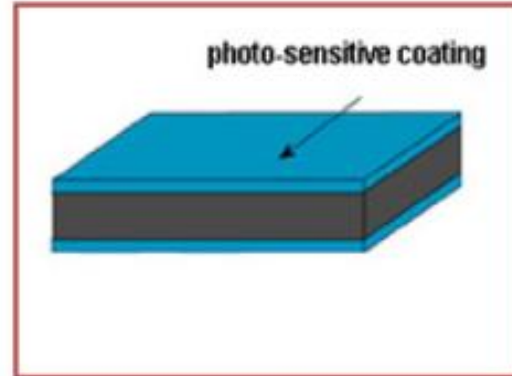
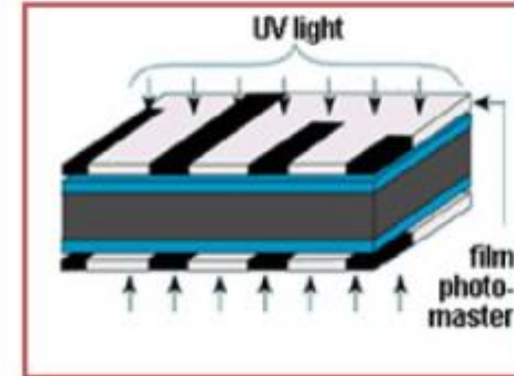
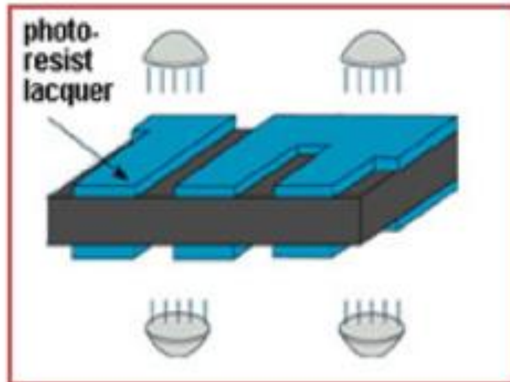


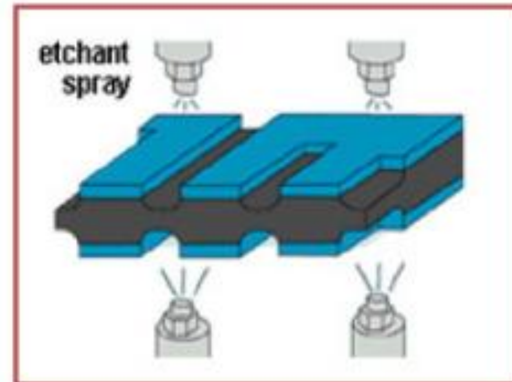
Photo sensitive coating applied to top and bottom



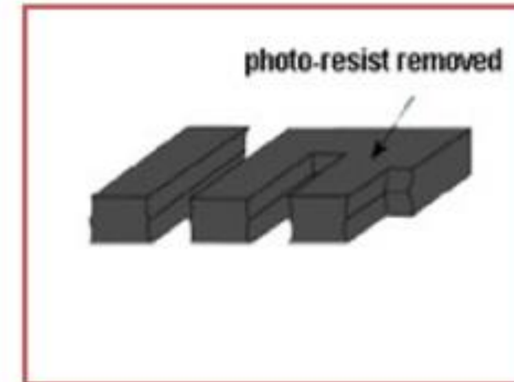
Developing photo-resist



Rinsing off photo-resist



Etching of metal

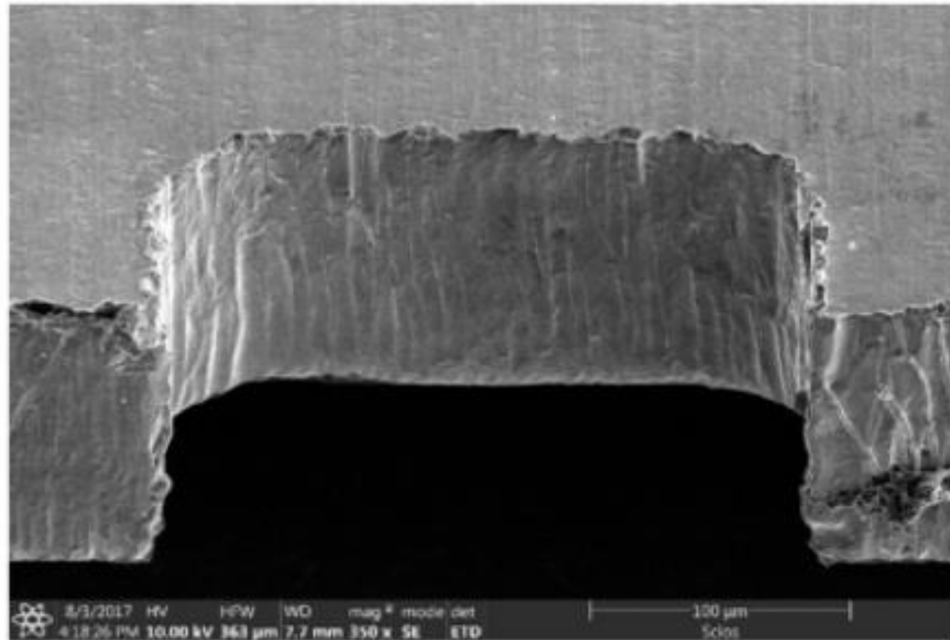


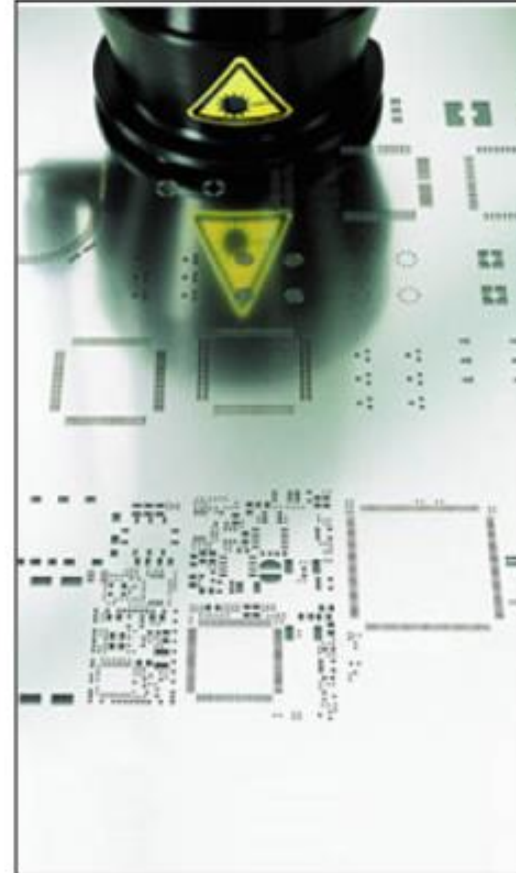
Complete etched product

LASERCUT STENCILS

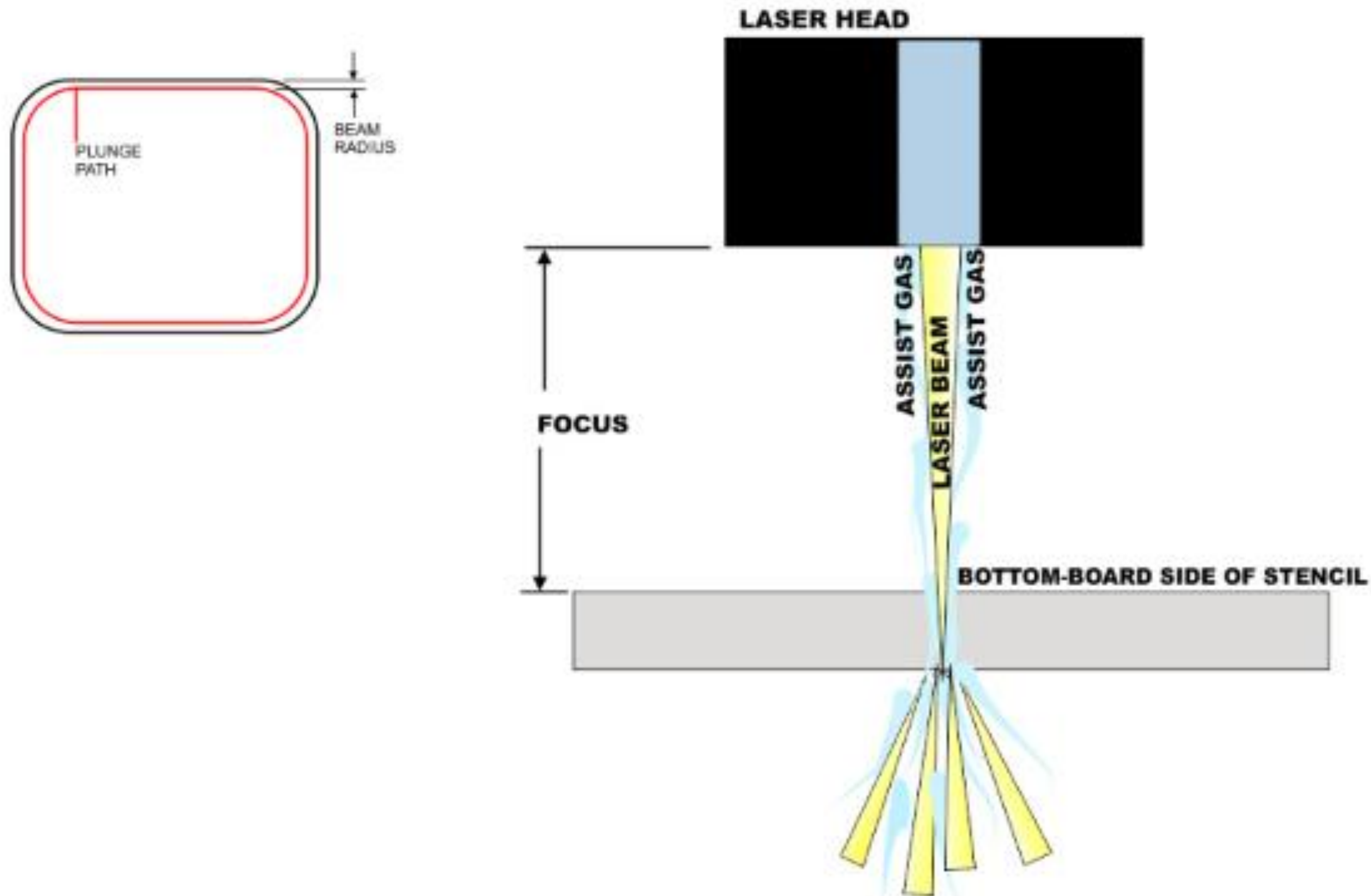
- Subtractive technology
- Very little Trapezoid
- Material: nickel or stainless steel
- Appropriate for pitch size: >0.4 mm.

Aperture Sidewall Images

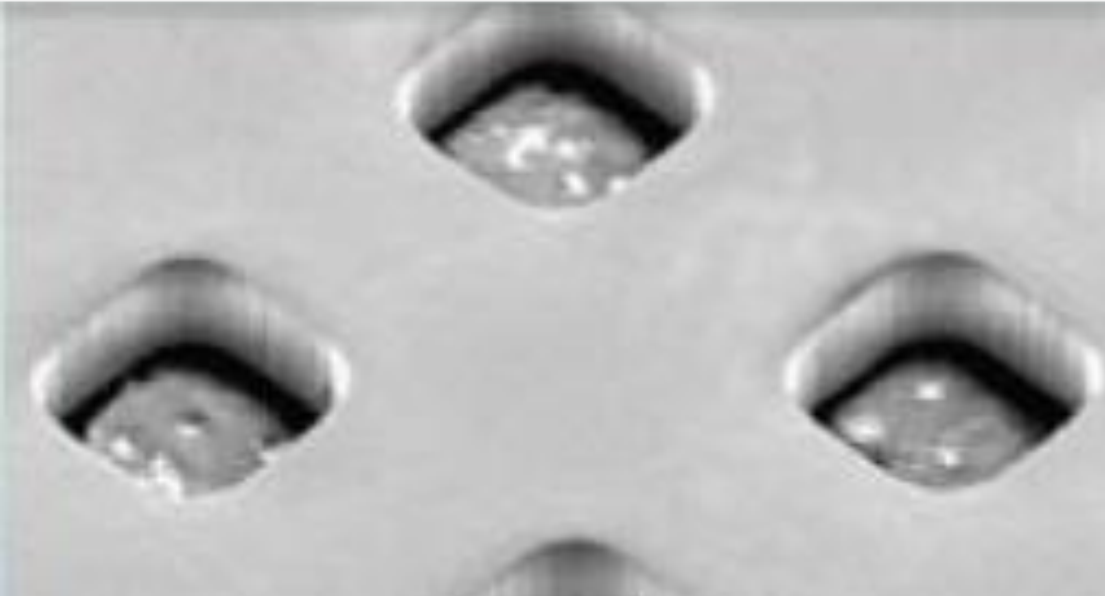


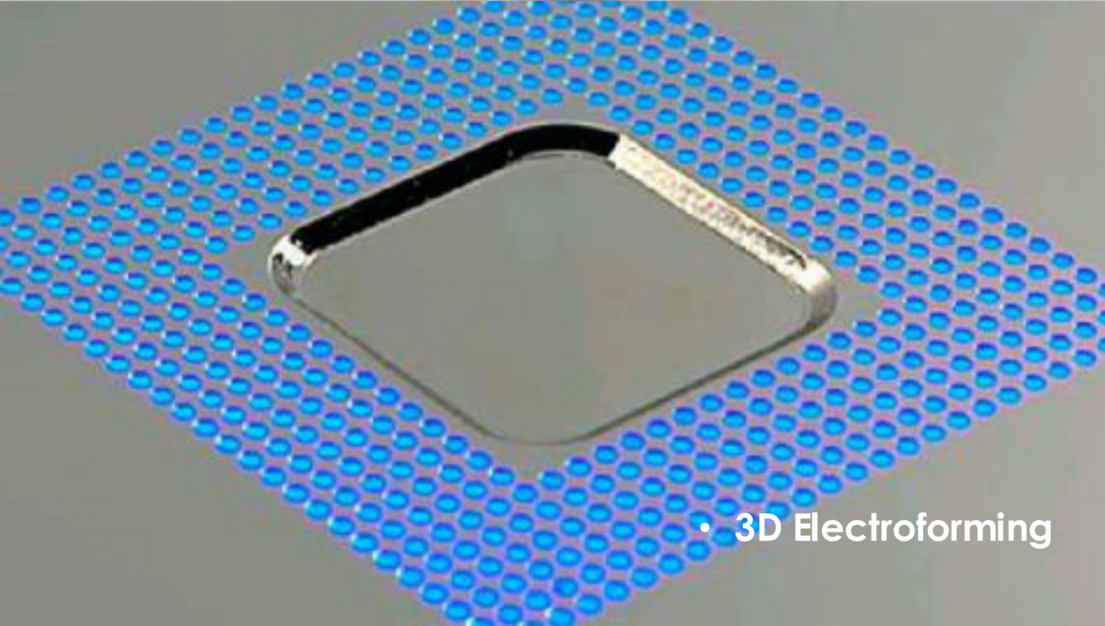


Understanding the Laser Cut Process



Electro formed Stencils





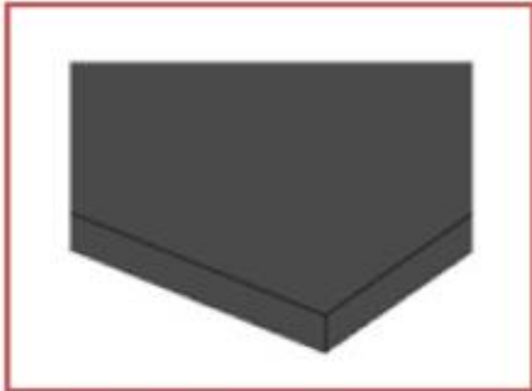
What are electro formed stencils?

- Grown atom by atom, the Electroform can be manufactured to custom thicknesses in increments of .0001
- The hardness of the electroform stencil results in longer stencil life
- Electroform stencils require less under side wiping resulting in increased production
- Electroform stencils ship within 24-48 hours after customer approval

3D Electroforming

- A single thickness Electroform stencil that is created with a raised relief pocket positioned over the protrusion on the print surface. The same application can be used for printing in cavities (reservoir printing). Requires a custom squeegee blade with slits aligned to the pockets.

ELECTROFORMED STENCILS



Metal substrate, cleaned and degreased

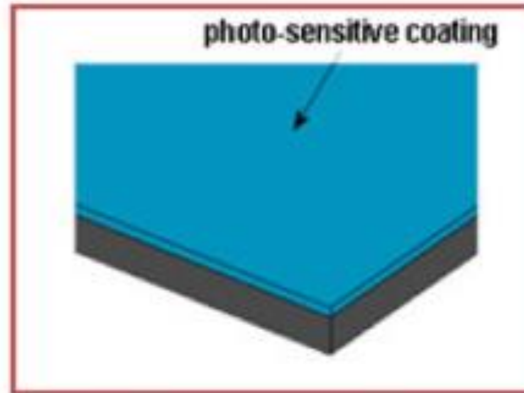
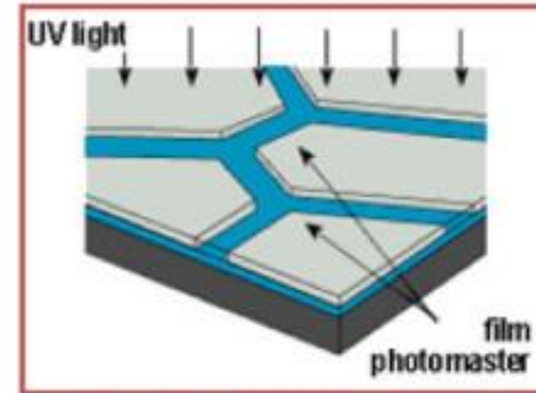
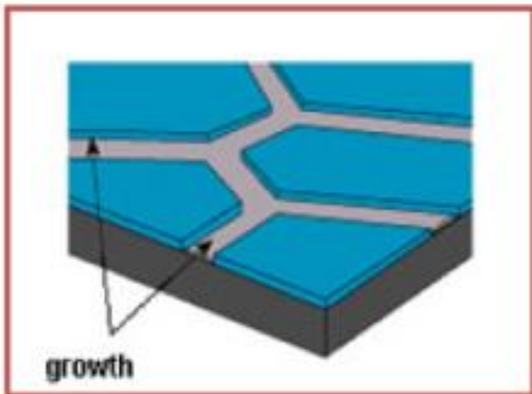


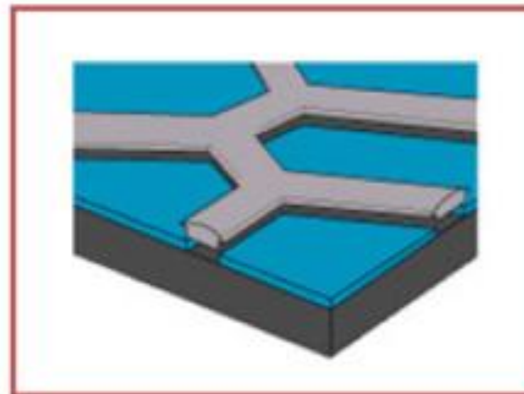
Photo-sensitive coating applied



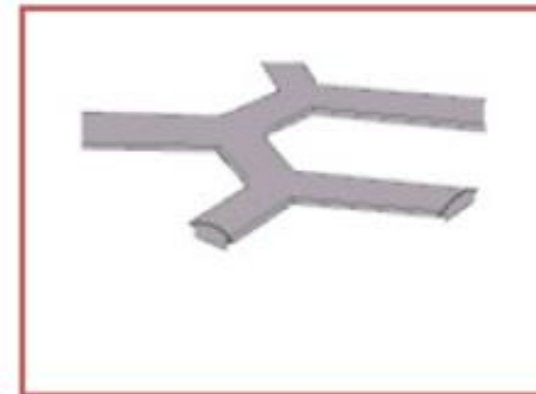
Developing and rinsing off solved photo-resist



Electro deposition of metal



Separation of stencil



Complete stencil

Print differences

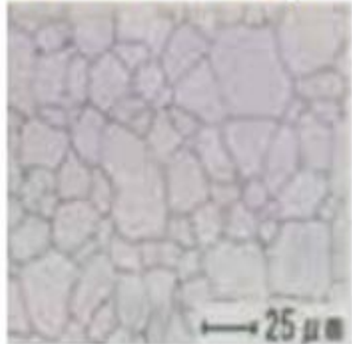
Chemical Etch

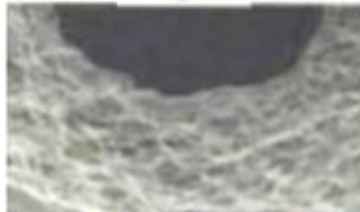
Laser Cut

Electroformed

Stencil Materials

Standard Microstructure
301/304 SS
Grain size 15-30µm





3,000X 5 µm

FG Microstructure
Modified 301SS
Grain size 1-2 µm

3,000X 5 µm

PHD : PHD is the name of this product, not an acronym)

- Grain size is 5-7 microns
- PHD base material is 304 with proprietary rolling method
- This method reduces the relief tension of the material
- The relief tension eliminates the canning/potato chip effect on BGA's or highly populated boards
- The small grain size creates a smoother aperture wall when cutting and increases paste deposit
- Material thickness tolerance plus/minus 2% material thickness
- Material than most stencil vendors use currently.

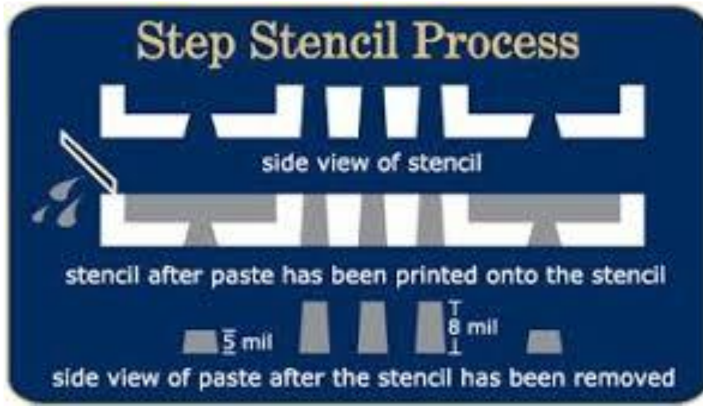
FG

- Grain size is 1-2 microns
- FG stands for Fine Grain
- FG base material is 301 with proprietary rolling method
- This method reduces the relief tension of the material
- The relief tension eliminates the canning/potato chip effect on BGA's or highly populated boards
- The small grain size creates a smoother aperture wall when cutting and increases paste deposit
- Material thickness tolerance plus/minus 2% material thickness Ideal for stencils with miniature apertures

Nickel Blanks

- Grain size Nano microns
- Grown blanks using Electroform process
- Control thicknesses allows for increments of .1 mil therefore sheet thicknesses can be 3, 3.1, 3.2 up-to 7 mil
- Durable
- Material thickness tolerance plus/minus 5% material thickness

Step Stencils



What is a Step / Multilevel stencil?

- A Step Stencil is a stencil with various material thicknesses.

Recessed stencil

- This is where you take away the metal from the contact side of the stencil.
  Some called Relief etch/ Under etch stencils.

Step down stencil

- This is where you reduce the metal thickness from the squeegee side of the stencil.

Step up stencil

- This is where you increased the metal thickness from the squeegee side of the stencil.

Mono-Layer coatings

- Wipe on coating

Permanent coatings:

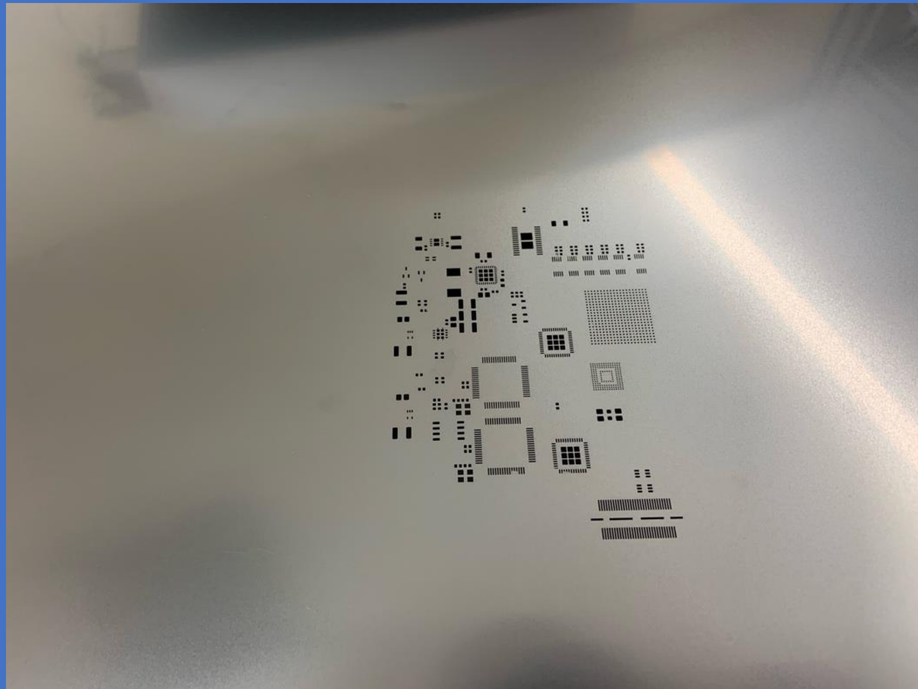
- Ceramic coatings
- Silica Nano Coating
- Vapor Deposition Coating

Silica Nano Coating

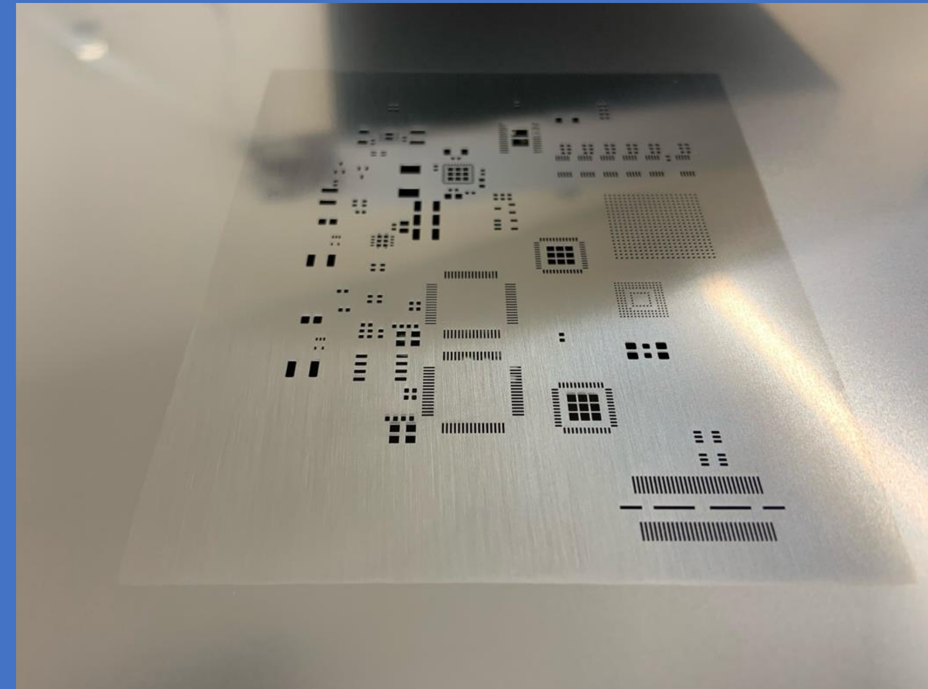
- Reduced bridging
- Reduced Underside cleaning
- Increased transfer efficiency
- Consistent deposits
- Thermally cured in 5 minutes
- Ready same day
- Very thin coating, 2-3 microns
- Improved Yield
- Reduced Rework
- Increase ROI
- Low Surface Energy
- Hydrophobic, Oleophobic & Fluxophobic
- Durability

Advanced prep surface treatment

Untreated Stencil



Treated Stencil



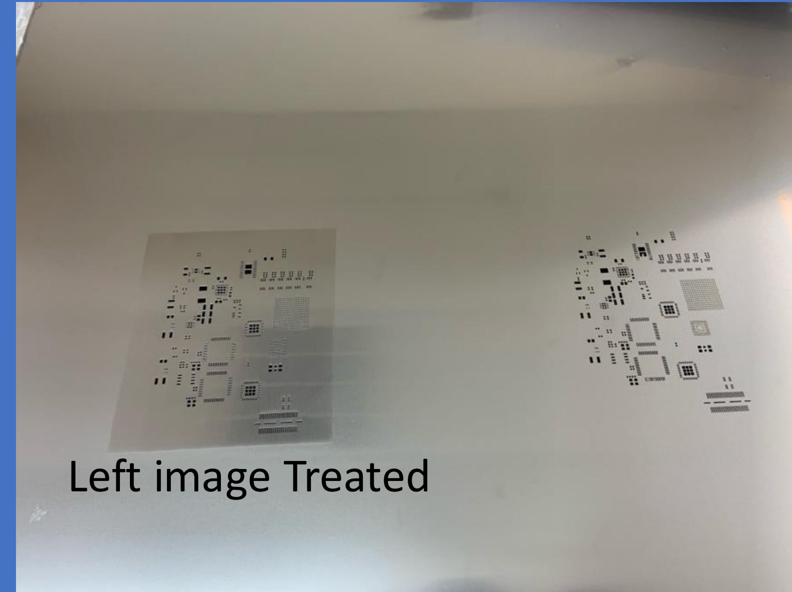
Advanced prep surface treatment

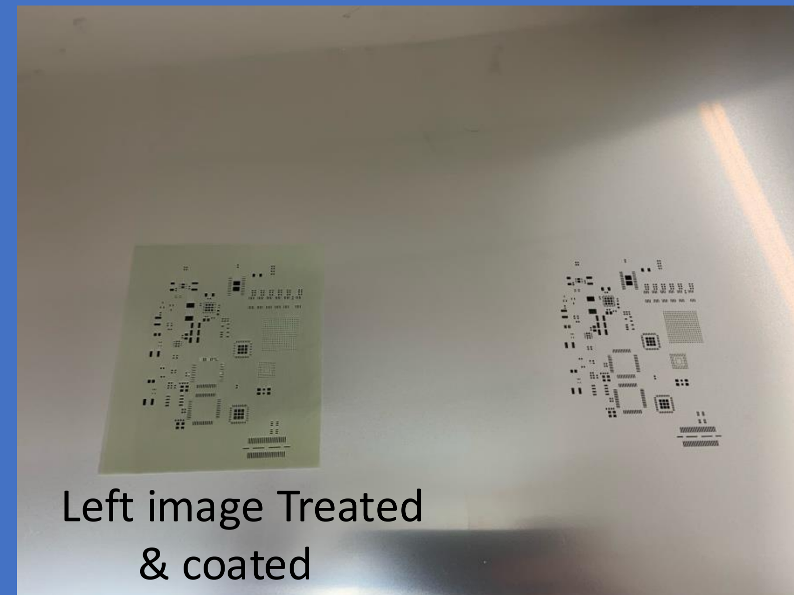
Slags / Surface debris

Un-treated Stencil

Treated Stencil

Advanced surface preparation
and aperture treatment leads to
better adhesion, and a smooth finish
within the surface of the aperture
walls.



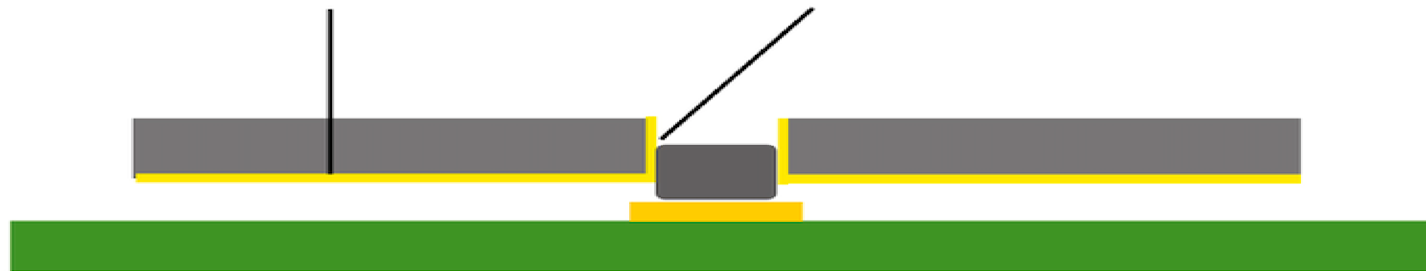


Benefits of Silica coating

Coating is cured and ready to use/clean in 5 mins

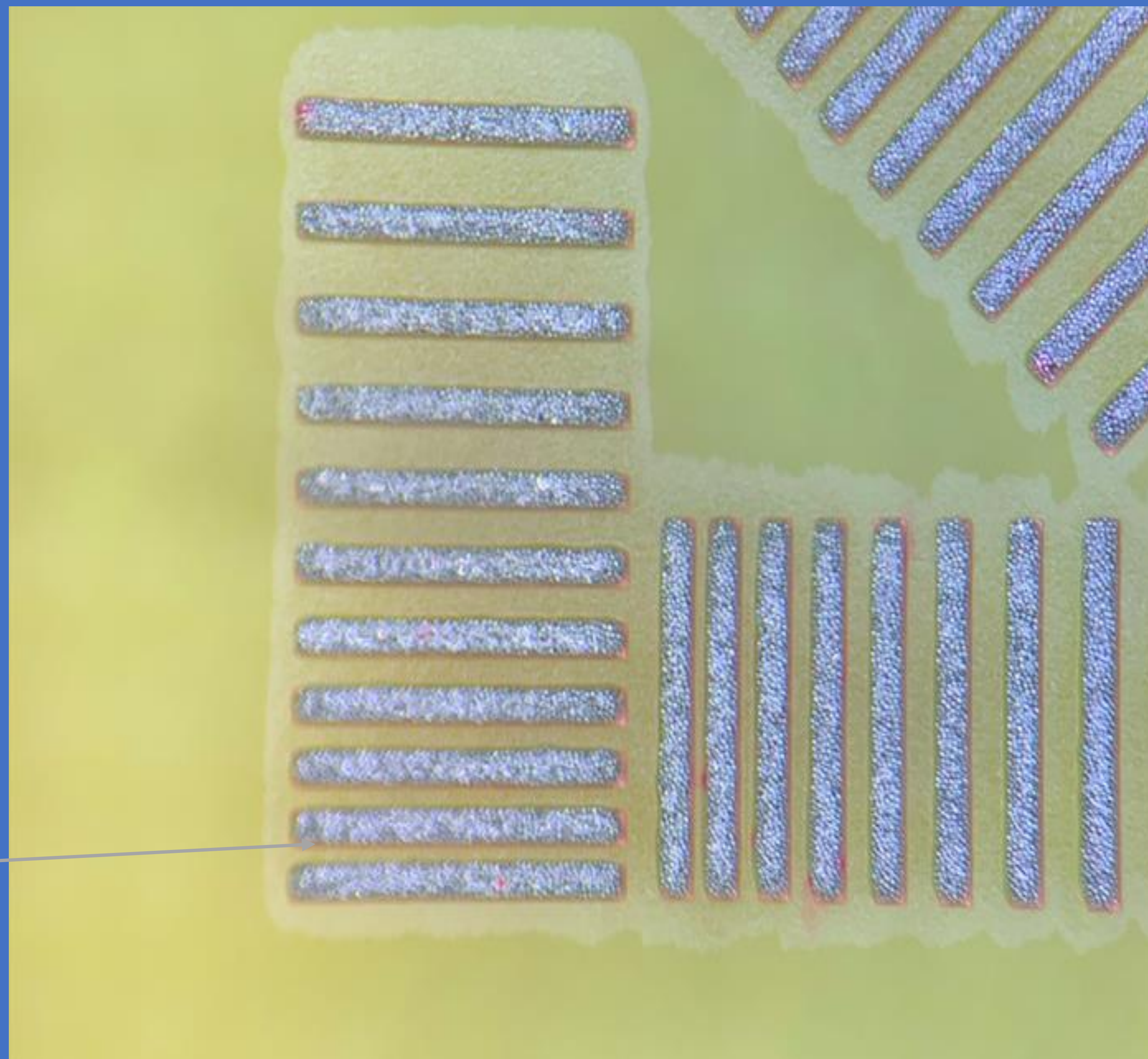
Chemical resistance of just about every cleaner on the market 4ph - 11ph

Coating is very thin and does not interrupt aperture size.



Reduced bridging

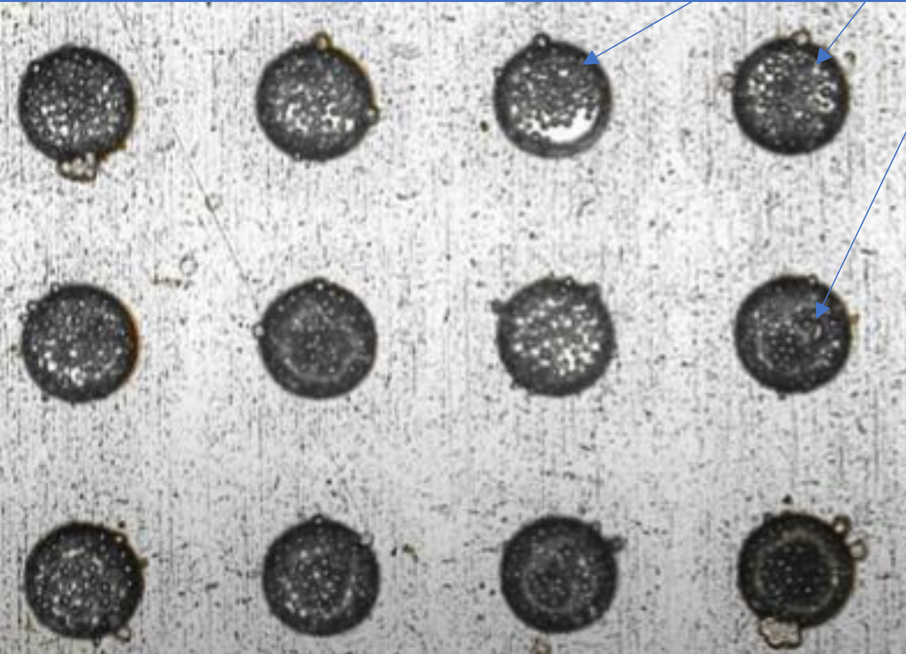
2 MIL SPACING



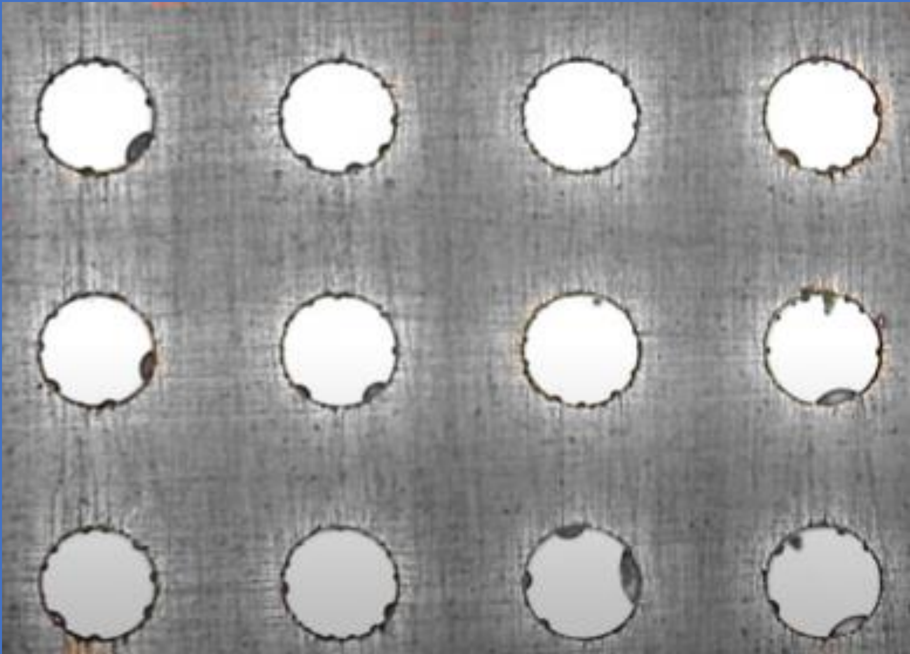
Reduced cleaning

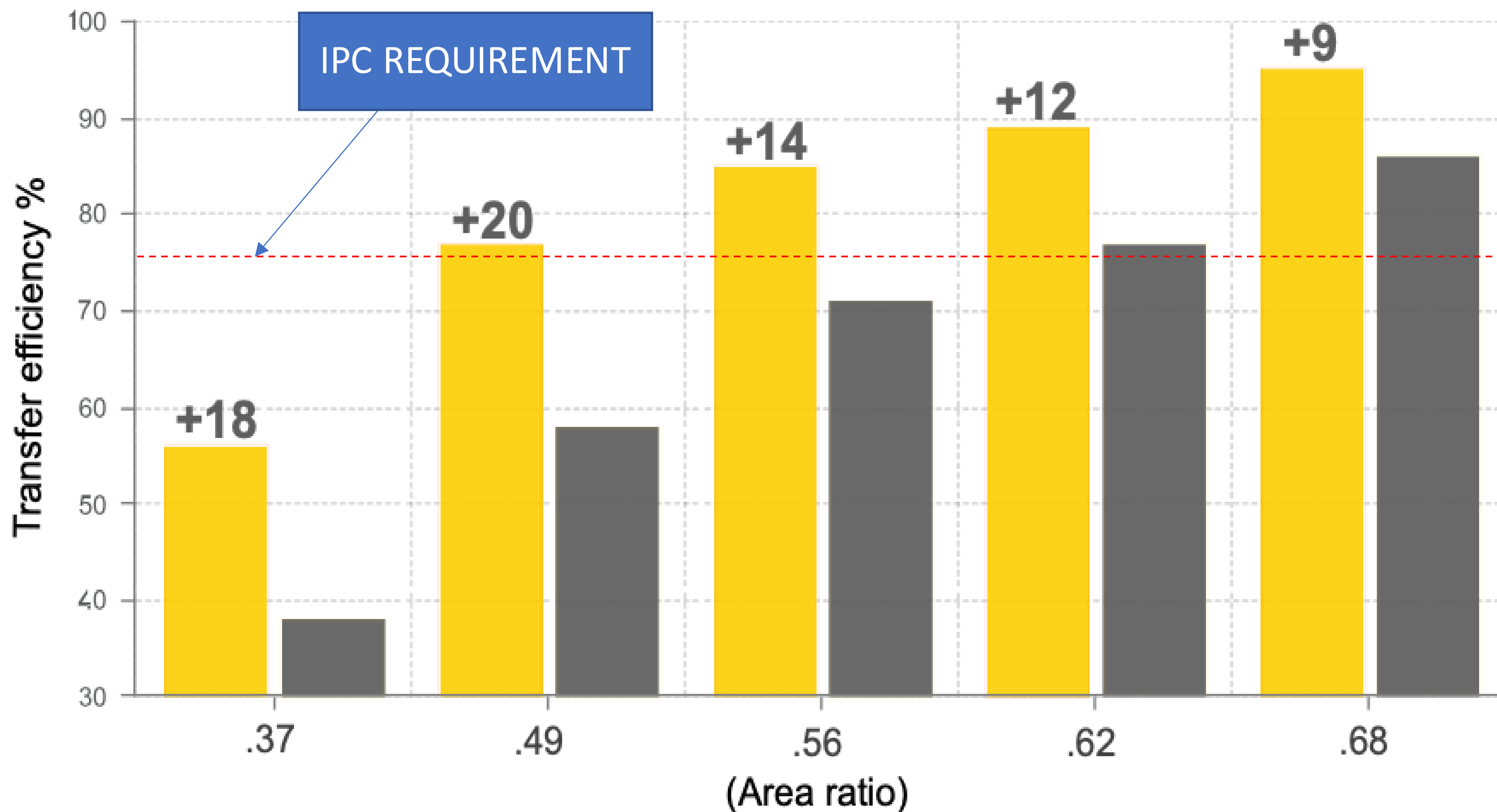
Clogged Apertures

Untreated, uncoated
6 mil Apertures



Treated and Silica coated
6 mil Apertures





Coated with A|N

4mil phd stencil coated with Advanced Nano by Stentech using type 4 solder paste.

Uncoated Stencil

Uncoated 4mil phd stencil using type 4 solder paste.

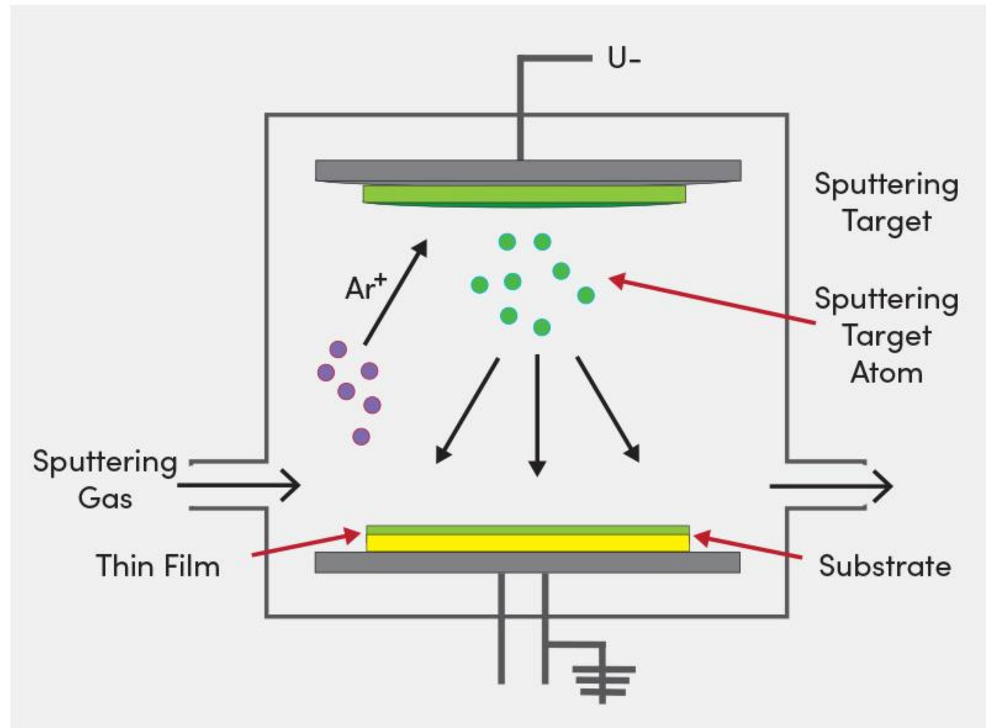
Parameters:

- Squeegee pressure: 3N/cm
- Squeegee angle: 60 degrees
- Squeegee speed: 30mm/s
- Stencil thickness: 4mil PHD
- Paste: Type 4 / No clean

Equipment's:

- Printer: DEK Horizon
- Inspection: KOH YOUNG
- Laser: Tannlin T11

- 300% reduction in cleaning cycles
- 98% First Pass Yield
- 67% Increase in production efficiency
- 32% increase in transfer efficiency on Micro BGA Component
- 20% reduction in solder paste usage
- 18% Increase in units produced per hour
- 15% Reduction in consumables
- 13% Reduction in identified defects
- Reduced Scrap Rate to de minimis



In the StenTech BluPrint™ PVD process, the wafer is exposed to one or more volatile precursors, which react and/or decompose on the substrate surface to produce the desired deposit.

This process is called Ion Beam Deposition (IBD) and involves rotating "Targets" or "Precursors," made from special materials, inside a chamber with stencils for coating. When heat and vacuum are applied, the materials undergo oxidation, vaporize, and then redeposit onto the stencil foil. These vapor-deposited materials form layers of color and coatings, resulting in a unique hydrophobic and oleophobic coating.

Area Ratio Paste Report

What is shown in the area paste report?

- Aperture dimensions
- Area violations
- Paste Volume

PASTE LAYER REPORT

Units:		Mils
Area Ratio Limit:		
Aspect Ratio Limit:		1.5
Thickness:		4
Totals:	Volume:	29767031
	Quantity:	7106

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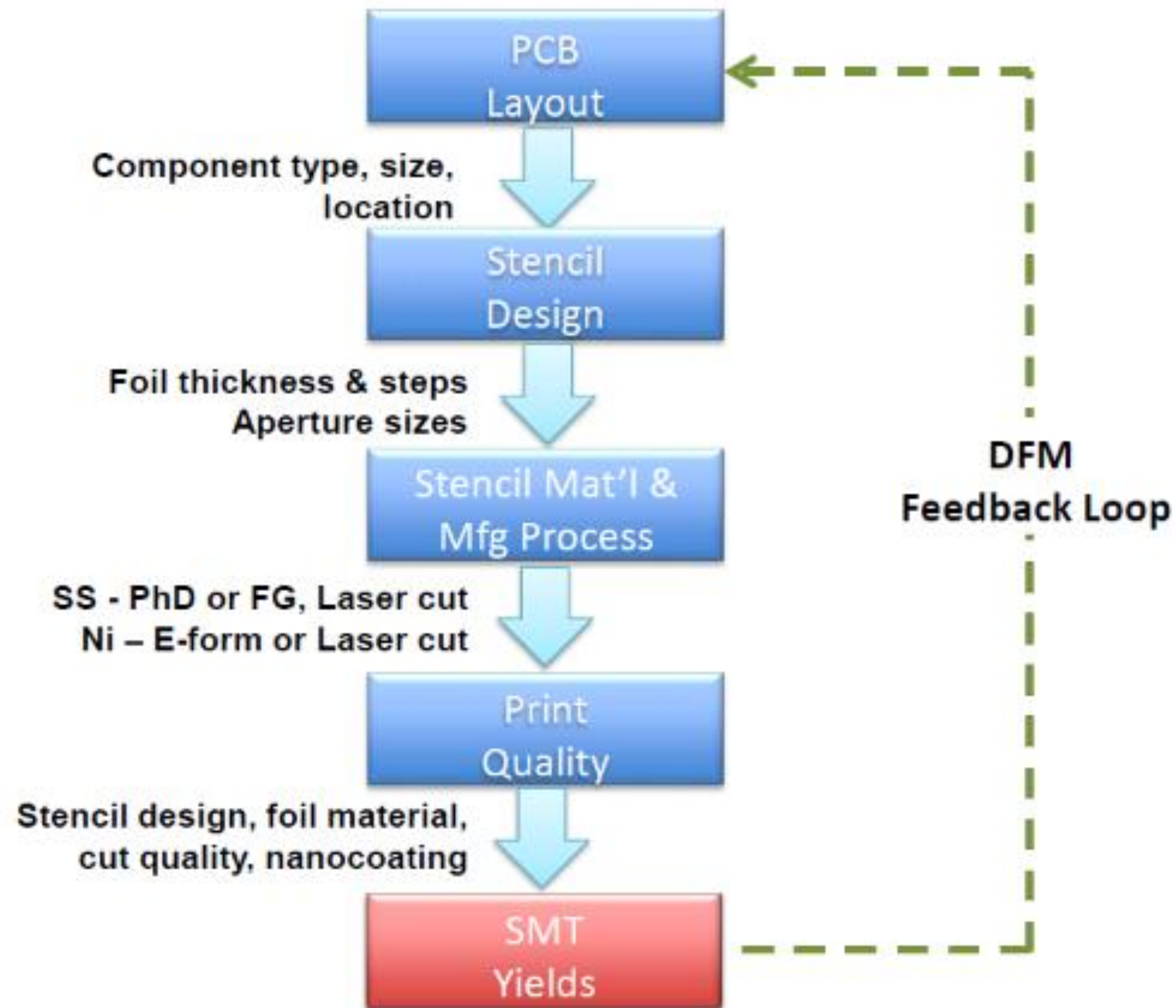
DCode	Shape	Thickness	X-Size	Y-Size	Pitch	Volume	AreaRatio	AspectRatio	Pass
D587	Round	4.00	8.000	8.000		201.062	0.500	2.000	No
D587	Round	4.00	8.000	8.000		201.062	0.500	2.000	No
D587	Round	4.00	8.000	8.000		201.062	0.500	2.000	No
D723	Rectangle	4.00	27.600	7.000	15.700	772.800	0.698	1.750	Yes
D592	Oblong	4.00	27.598	7.000	15.700	730.694	0.723	1.750	Yes
D593	Oblong	4.00	7.000	27.598	15.700	730.694	0.723	1.750	Yes
D537	Rectangle	4.00	19.690	9.000	19.600	708.846	0.772	2.250	Yes
D539	Rectangle	4.00	19.690	9.000	19.600	708.846	0.772	2.250	Yes
D536	Rectangle	4.00	19.690	9.000	19.600	708.846	0.772	2.250	Yes
D582	Rectangle	4.00	19.700	9.000	19.600	709.200	0.772	2.250	Yes
D709	Rectangle	4.00	19.700	9.000	19.600	709.200	0.772	2.250	Yes
D582	Rectangle	4.00	19.700	9.000	19.700	709.200	0.772	2.250	Yes

PCB Layout Drives Stencil Print Process



Optimal Print Accuracy

Summary (1)

- PCB layout heavily influences stencil design
  - Power components and shields require heavy paste deposits
  - QFNs and other small packages require small, precise paste deposits
  - Many tradeoffs with foil thickness, aperture size, steps, overprints, preforms, etc
- Design analysis software speeds and error-proofs calculations
  - Calculates Area Ratio & Transfer Efficiency
  - Predicts deposit volumes

Optimal Print Accuracy

Summary (2)

- Laser cutting technology is better than ever
  - Machines must be tuned for good cut quality
- Alloy
  - 4 years in a row, FG has beaten every other candidate in print performance
  - Smaller grain size, smoother walls, better release, more consistent stepping
  - New SS shows excellent performance and lots of promise
- Nanocoating
  - Lowers the stencil's surface energy so it repels solder paste flux instead of attracting it
  - Improves print yields, print definition and volume repeatability

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