SCREEN PRINTING MASTERCLASS #1

"Basic Mesh and Screen Terminologies"

presented by

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NORTH AMERICA BUSINESS MANAGER
ASADA MESH CO., LTD

TECHBLICK 2021

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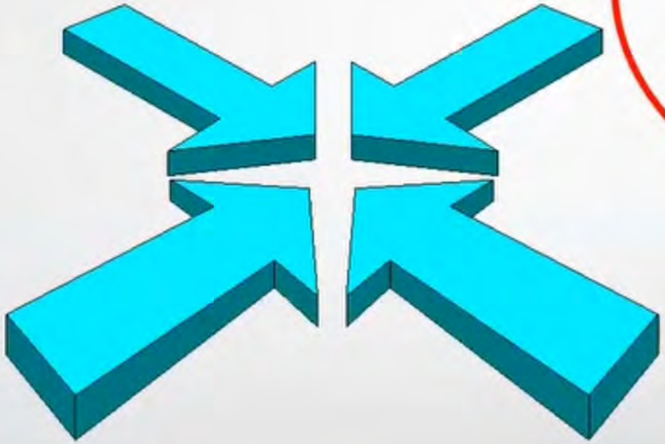
VARIABLES IN SCREEN PRINTING

Ink Composition

- Solids Content
- Viscosity
- Rheology
- Evaporation Rate
- Dispersion / Morphology

Screen

- Mesh Type
- Mesh Count
- Wire Diameter
- % Open Area
- Emulsion Thickness
- Mesh Bias
- Calendering



Printer Setup

- Squeegee
- Down Stop
- Attack Angle
- Squeegee Pressure
- Print Speed
- Snap Off

Environment / Quality

- Room Temperature
- Humidity
- Air Turbulence
- Cleanliness
- Substrate Types
- Shelf Life (Ink & Screens)

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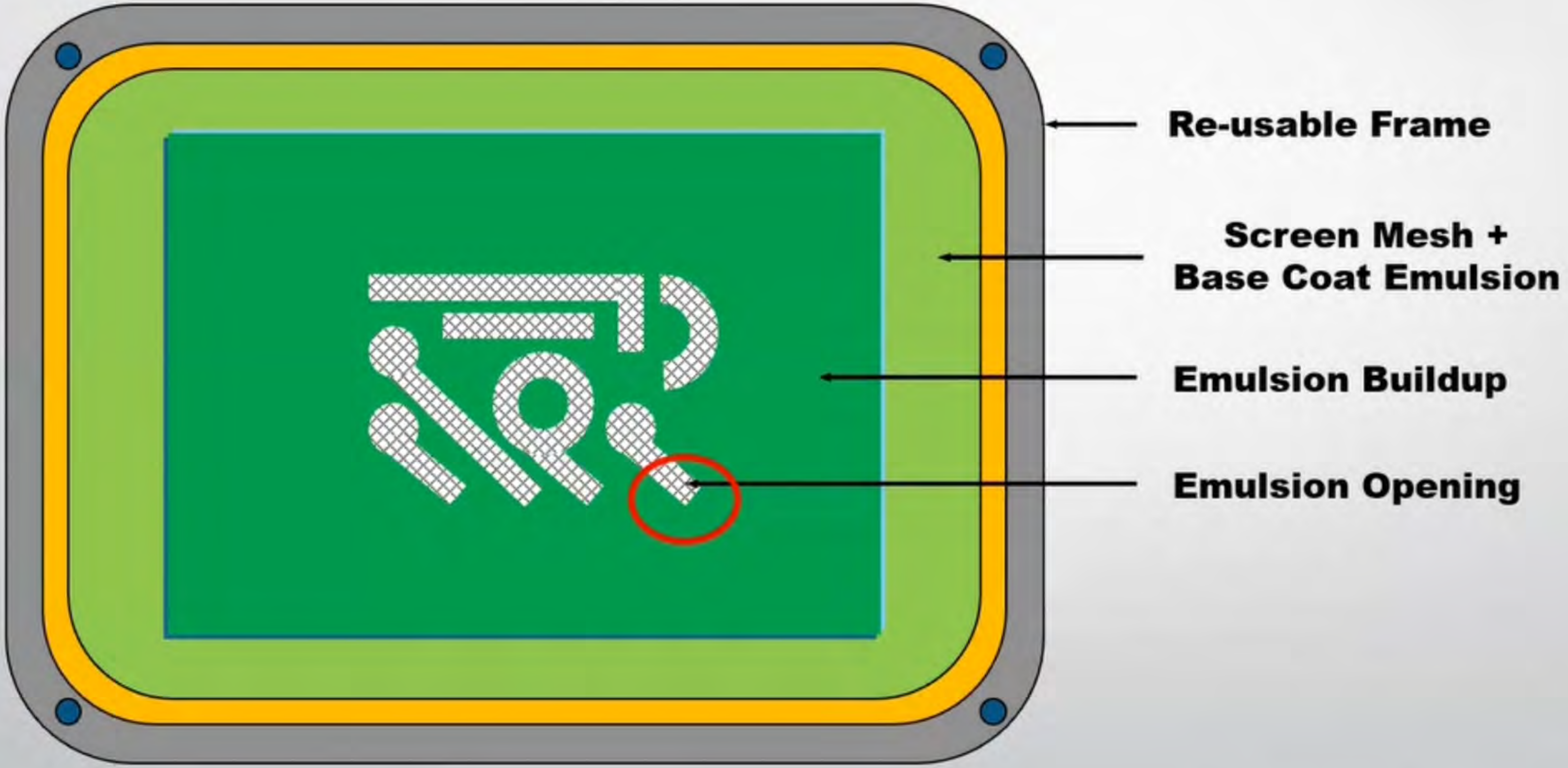
SCREEN TOOL



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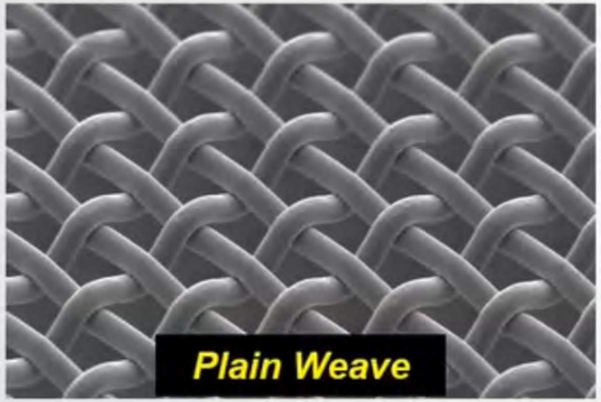
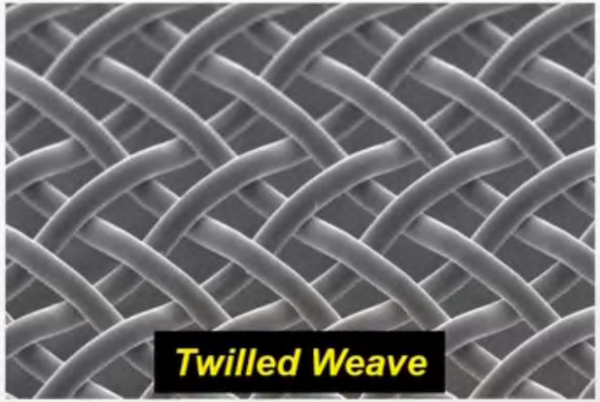
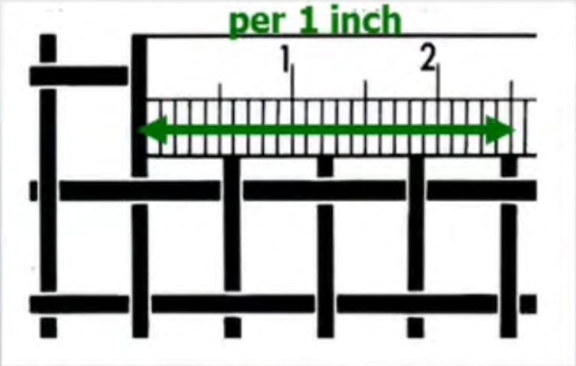
MESH TECHNOLOGY

Mesh Type is how we define the weaving of the mesh; it can be Plain Weave or Twilled Weave; Plain Weave shows 1 wire over and 1 wire under whereas Twilled Weave shows 2 wires under and 1 wire over.





Mesh Count is the number of wires per linear inch/cm in a screen mesh.



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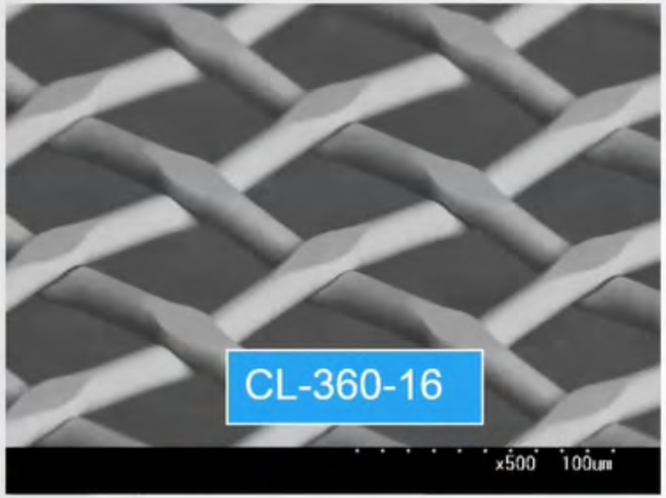
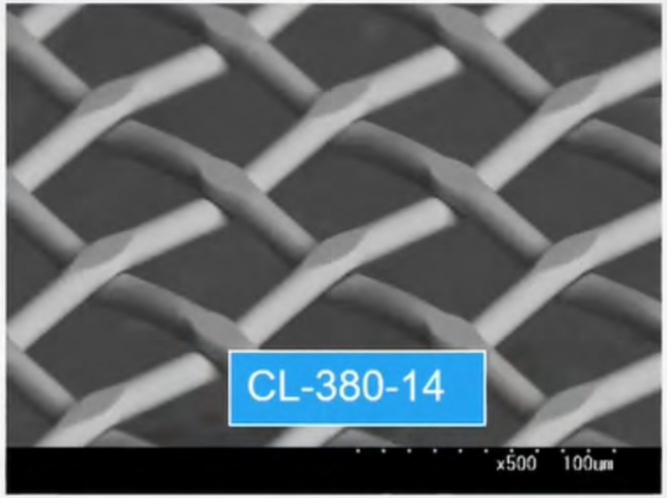
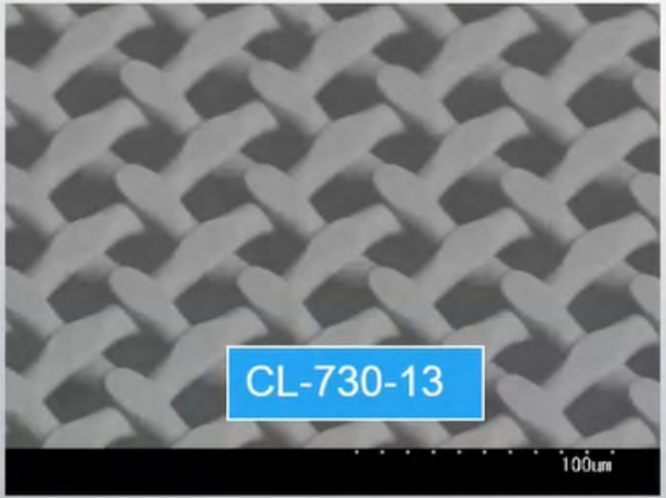
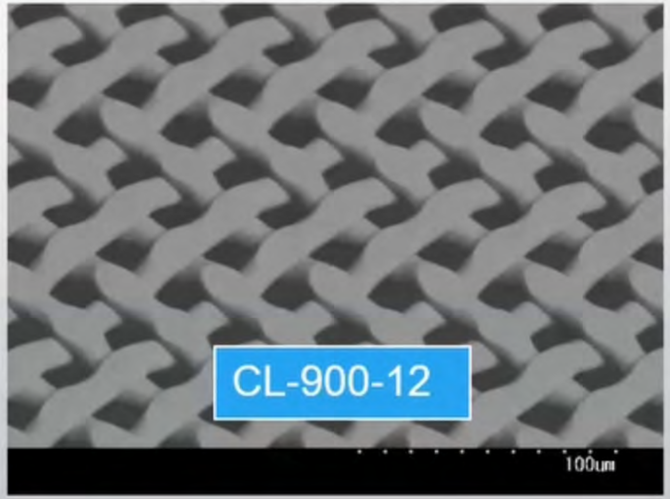
SAMPLES OF MESH COUNTS









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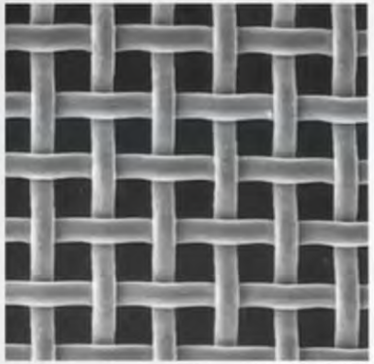
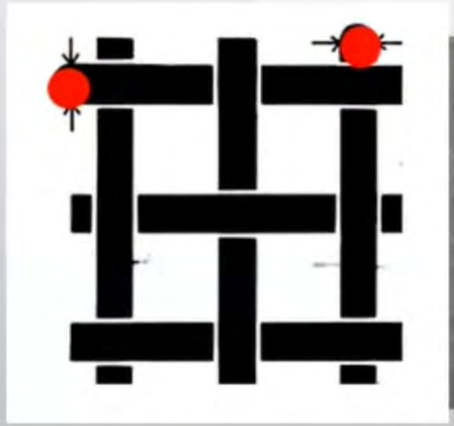
Mesh Angle or Mesh Bias is the orientation of wire mesh relative to the screen frame; typical angles are 0°, 22.5°, 30°, 45° and 60 degrees.

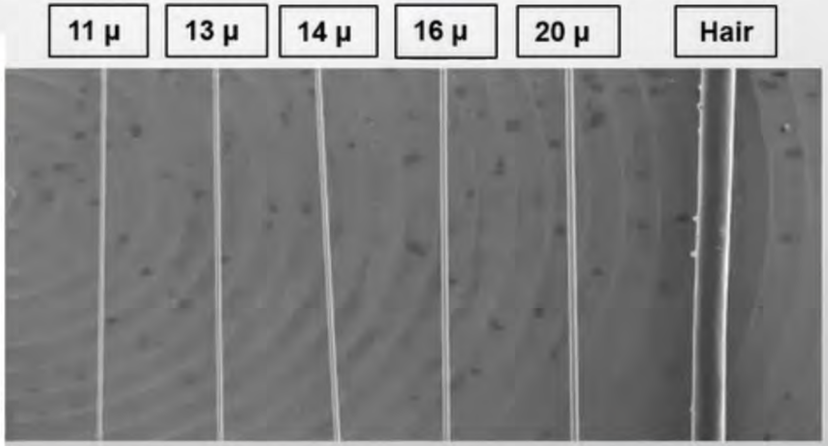
0° Bias



22.5° Bias

Mesh Wire Diameter is the diameter of the wires specified in microns (μ)





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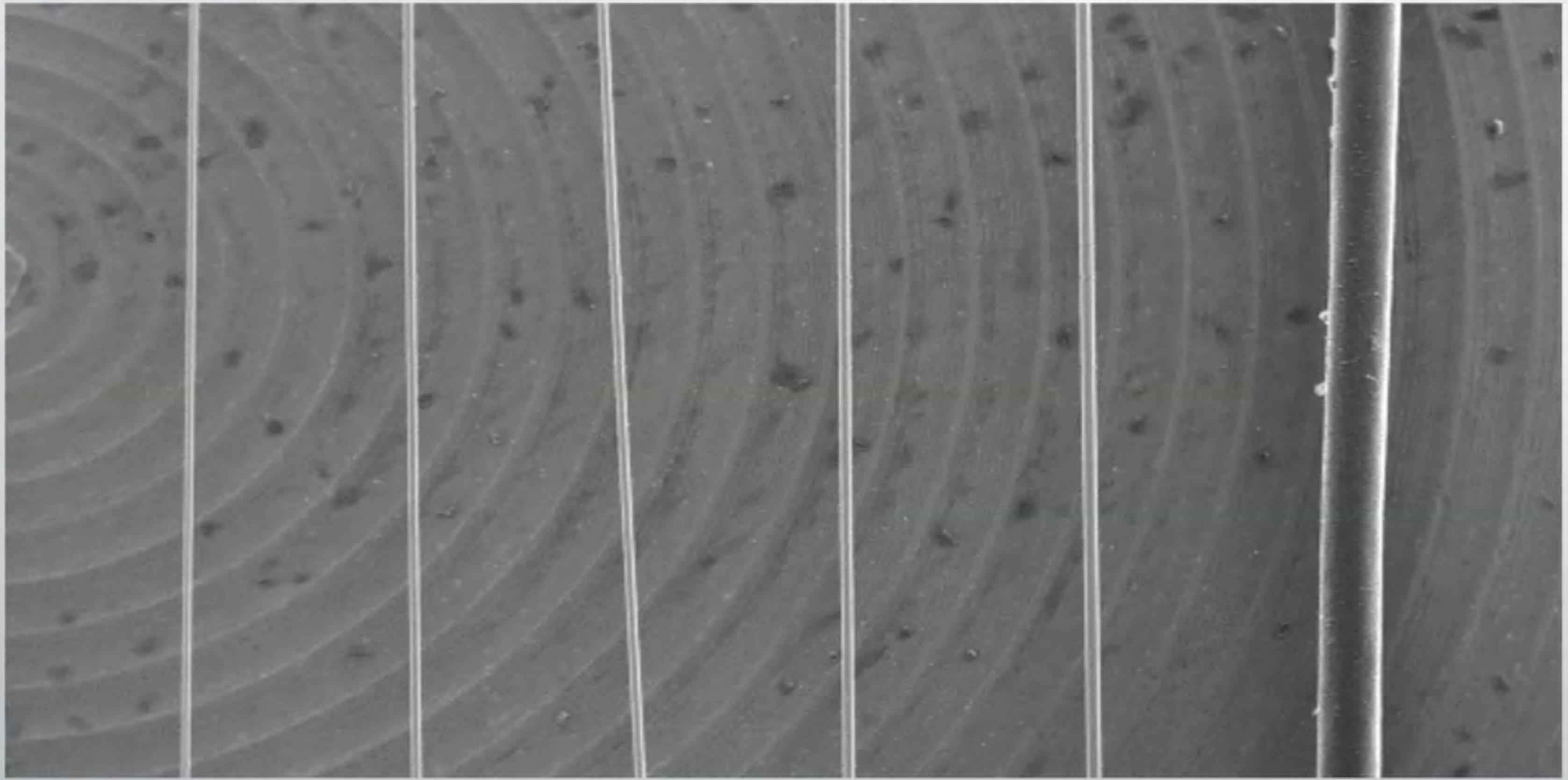
SAMPLES OF WIRE DIAMETERS

0.011㎜ 0.013㎜ 0.014㎜ 0.016㎜ 0.020㎜ HAIR



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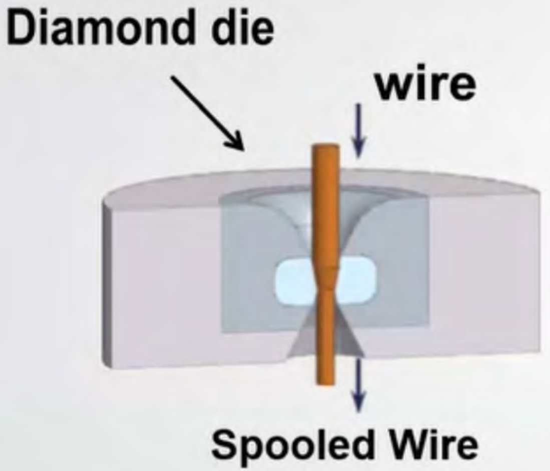
HOW ARE STAINLESS STEEL WIRES MADE?



Human Hair vs 11μ Wire

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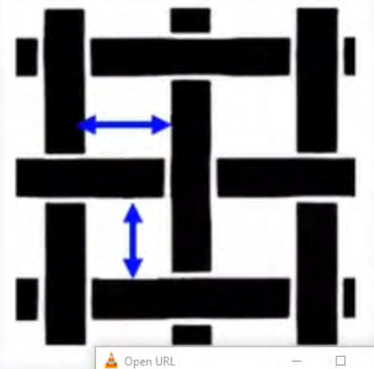
Mesh Opening is the distance between wires going in the same direction.



Open URL

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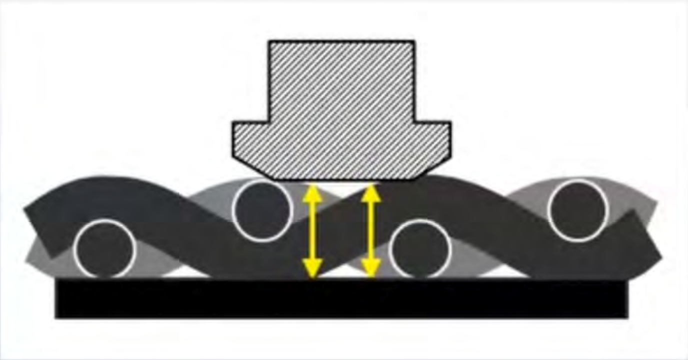
Mesh Thickness is the distance sh ... re below; it is the thickness of the woven mesh.



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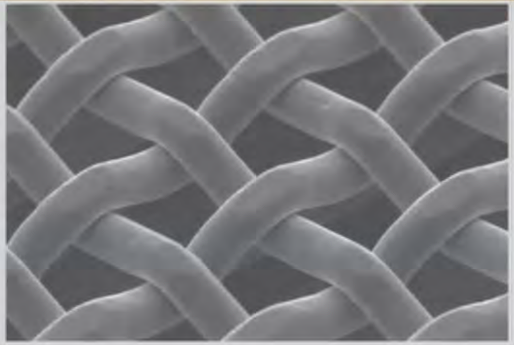
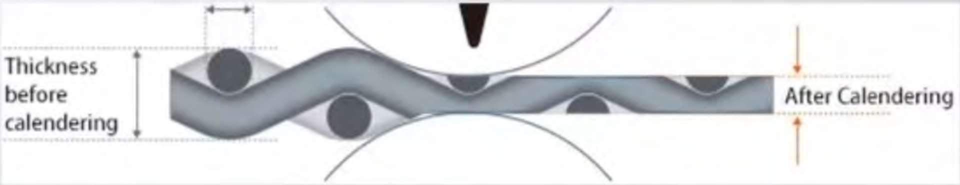
CALENDERING

"Calendering is the process used to flatten the knuckles of the mesh. It helps stabilize the mesh so that less movement of the Warp and Weft wires takes place. You can calendar down to almost 50% of the original thickness; most common is 20%-30%.

BS400/23 N55	BS400/23 CL40
	



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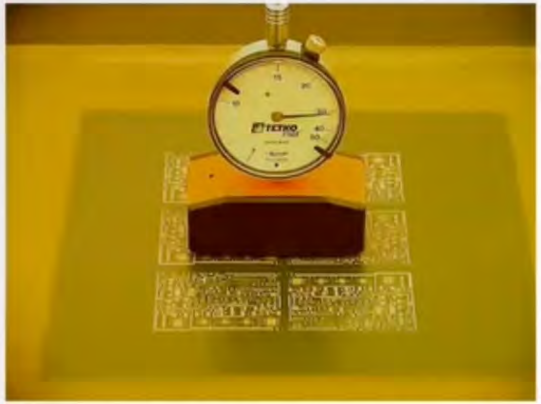
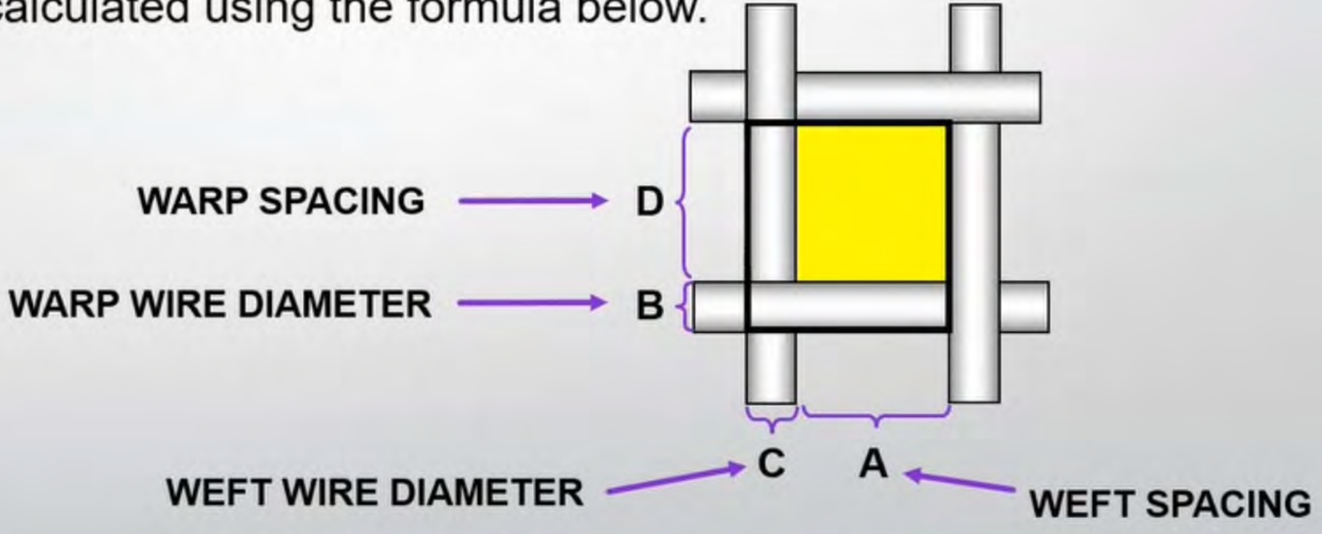
Mesh Tension is defined as the level of tightness in the mesh (Newtons/cm)



Mesh % of Open Area is calculated using the formula below.

$$OA = \frac{C \times D}{(A+C) \times (B+D)} \times 100$$



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CALCULATING % OPENING AREA

B&C　A&D

	SPEC	MESH COUNT	WIRE DIA.	OPENING	OPENING RATE	Normal	Calender			STRENGTH INDEX
Standard	** BS-500/19	500	0.019	0.032	39%	41 ± 2	30 ± 2	25 ± 1	19 ± 1	0.71
	BS-400/23	400	0.023	0.041	41%	55 ± 2	40 ± 2	35 ± 1	26 ± 1	0.83
	BS-400/25	400	0.025	0.039	37%	57 ± 2	49 ± 2	40 ± 1	30 ± 1	0.98
	★ BS-325/28	325	0.028	0.050	41%	62 ± 2	55 ± 2	47 ± 1	40 ± 1	1.00
	BS-325/30	325	0.030	0.048	38%	64 ± 2	60 ± 2	47 ± 2	42 ± 1	1.15
	BS-270/35	270	0.035	0.059	39%	77 ± 2	70 ± 2	58 ± 2	40 ± 2	1.30
	** BS-250/30	250	0.030	0.072	50%	62 ± 2	58 ± 2	50 ± 2	45 ± 2	0.88
	★ BS-250/35	250	0.035	0.067	43%	78 ± 2	64 ± 2	57 ± 2	55 ± 2	1.20
	BS-250/40	250	0.040	0.062	37%	90 ± 3	86 ± 2	72 ± 2	67 ± 2	1.57
	★ BS-200/40	200	0.040	0.087	47%	82 ± 3	77 ± 2	72 ± 2	63 ± 2	1.26

Percentage of Open Area of BS-500-19:

$$^{**}OA = \frac{C \times D}{(A+C) \times (B+D)} \times 100 = \frac{(0.019 \times 0.032)}{(0.032+0.019) \times (0.019+0.032)} = \frac{0.000608}{0.002601} = 39\ \%$$

Percentage of Open Area of BS-250-30:

$$^{**}OA = \frac{C \times D}{(A+C) \times (B+D)} \times 100 = \frac{(0.030 \times 0.072)}{(0.072+0.030) \times (0.030+0.072)} = \frac{0.00216}{0.010404} = 50\ \%$$

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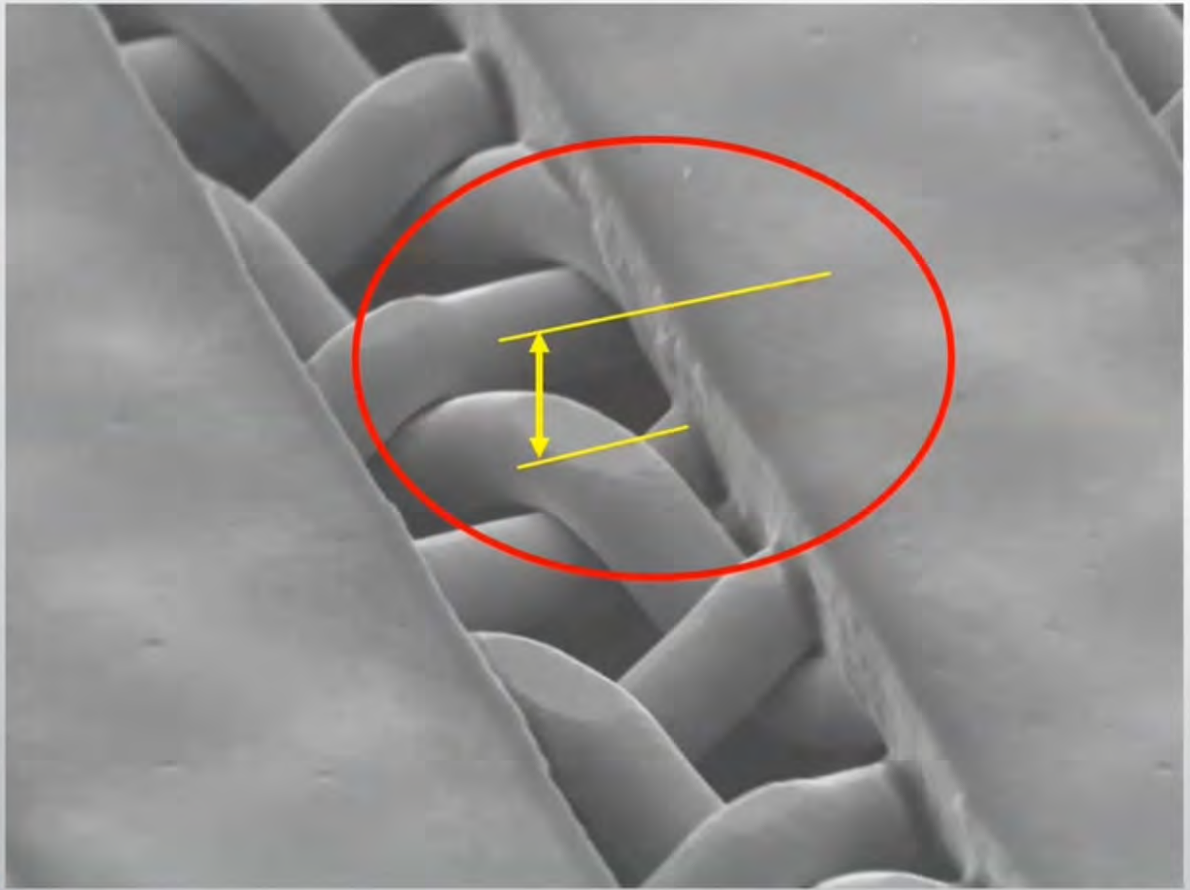
EMULSION OVER MESH (EOM)



- Emulsion over Mesh (EOM) is the Photosensitive layer covering the mesh.
- A photo-tool is placed on top of the emulsion and exposed to UV light.
- Black features where the photopositive was will wash away with water.
- The mesh thickness and the EOM is called the Total Thickness.

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Squeegee is the blade used to move the ink across and through the mesh; it is usually made of urethane materials.

Durometer represents the Hardness of squeegee measured in (Shore A units) and are color coded to distinguish the hardness level.

- **Higher numbers on the scale indicate a greater resistance to indentation and thus harder materials.**
- **Lower numbers indicate less resistance and softer materials.**
- **Standards 60,70,80,90.**

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SQUEEGEE PROFILES

Square or “Diamond-Cut”

- Very common with 4 sides that can be used.
- Sensitive to printer settings (pressure, angle of attack, etc.)
- Used for many applications (small area, fine lines/spaces)

Rectangular

- Less sensitive to variations in parallelism and substrate flatness
- Less sensitive to changes in printer settings (less control over thickness)
- Used mainly for large area graphics, high-speed printing equipment

Dual or Triple “Composite” Durometer

- Rigid or high durometer backing reduces overall squeegee flexibility
- Allows softer durometer material at the very edge to do most of the work
- Used to print large area electronic inks with more precision

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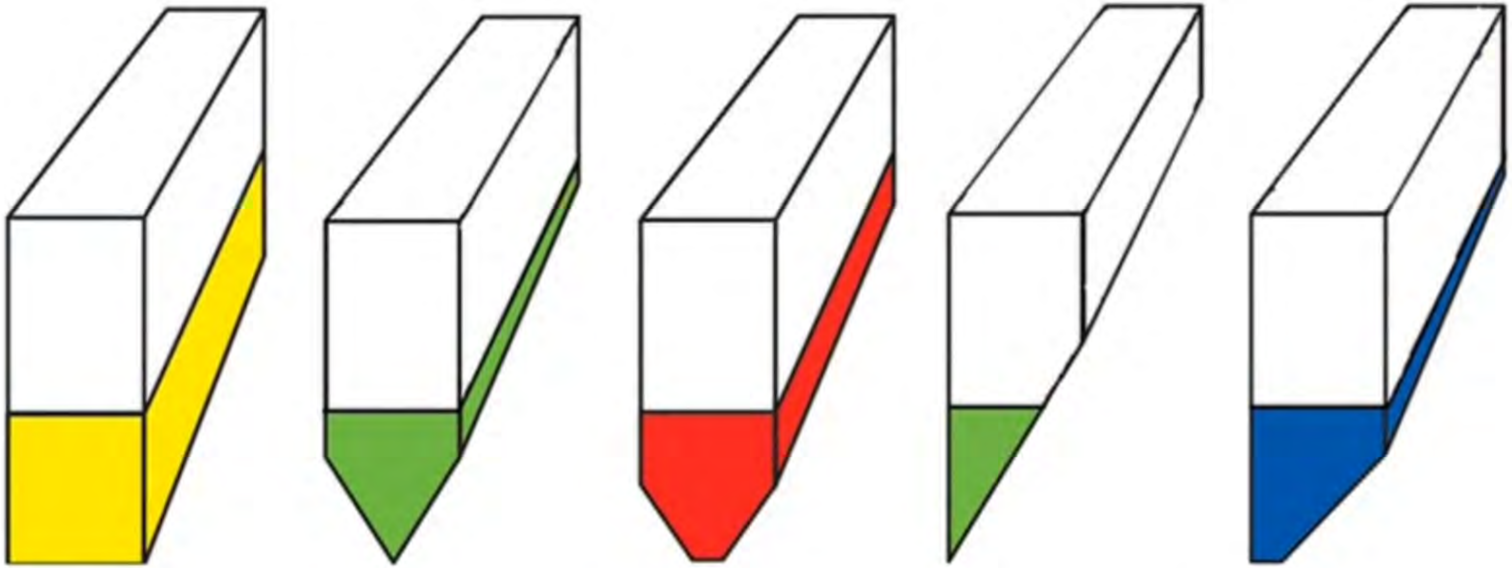
SQUEEGEES PROFILES:



- Squeegee durometer is measured in Shore A units (70, 80 and 90 are most typical)
- Color-coded by different manufacturers
- Higher durometer stay sharper longer + Softer durometer bends more

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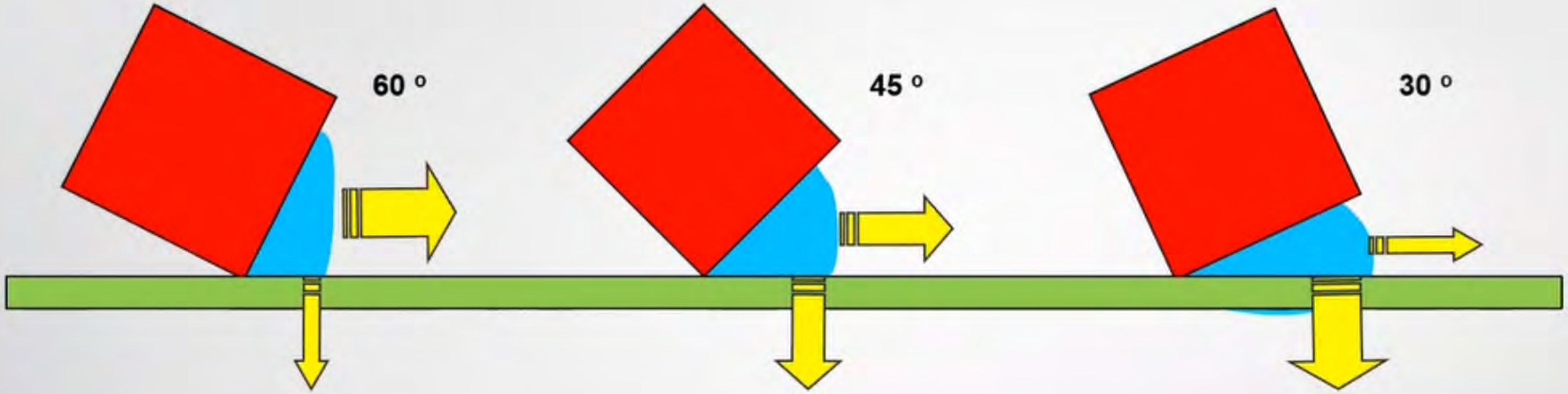
ATTACK ANGLE



- Attack angle affects ink transfer mechanism, mainly at the edge of the squeegee.
- Higher attack angle pushes more ink across the screen than through it.
- Lower attack angle forces more ink through the screen, often ahead of the pattern.
- Greatly affected by squeegee durometer, pressure, speed, & ink viscosity.
- Changing snap-off will change attack angle.

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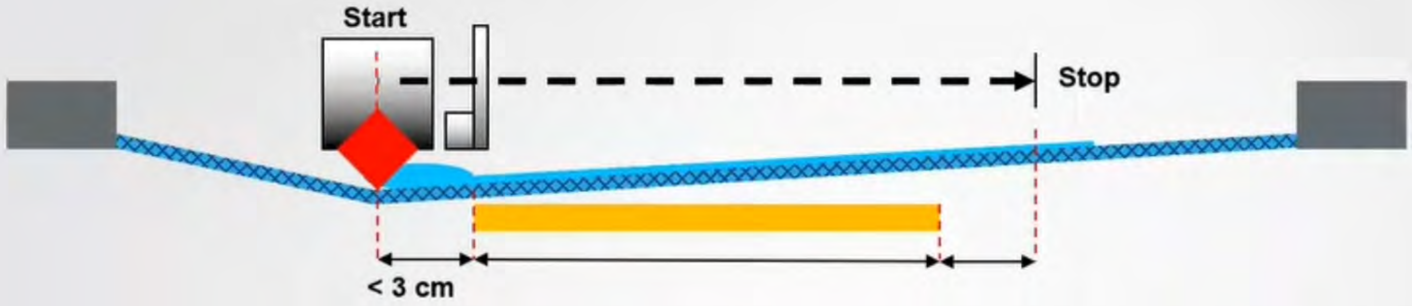
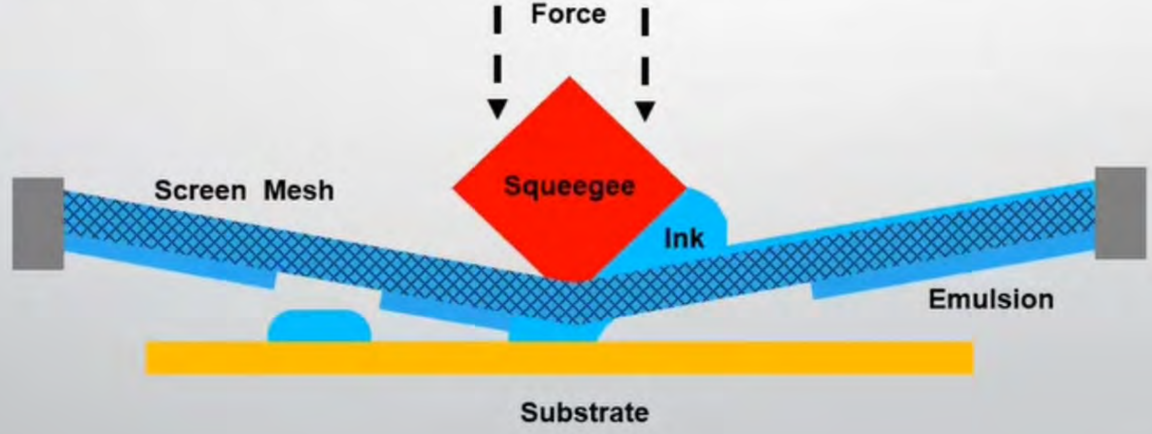
Squeegee Stroke is the squeegee travel distance across screen.



Squeegee Pressure is the force applied by the squeegee onto the screen; it can be Mechanical, Pneumatic or Electrical Driven.



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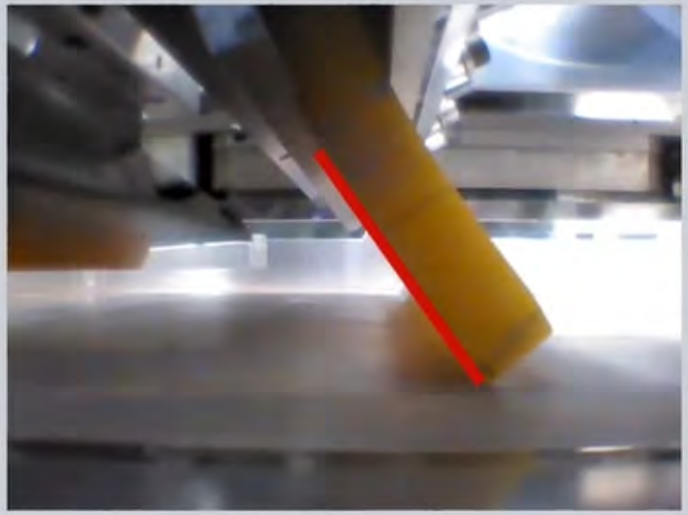
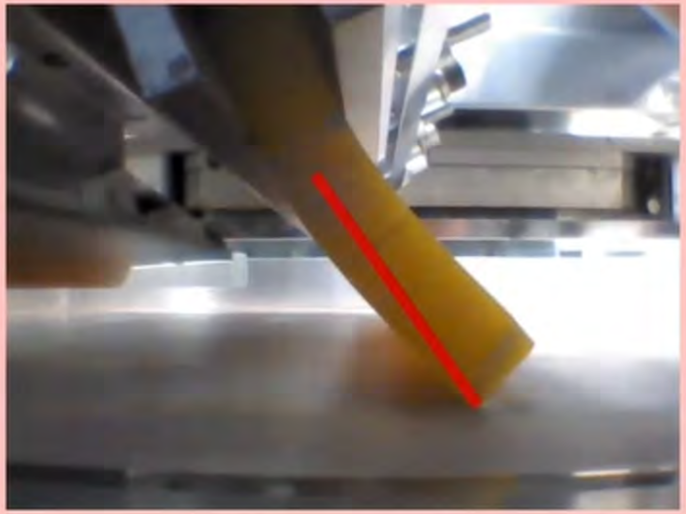
ATTACK ANGLE vs SQUEEGEE PRESSURE

0.3 kg / cm



0.9 kg / cm



- The actual attack angle changes when the pressure increases.
- Squeegee hardness plays a key role in how much the angle changes (the softer the squeegee the more it will bend).

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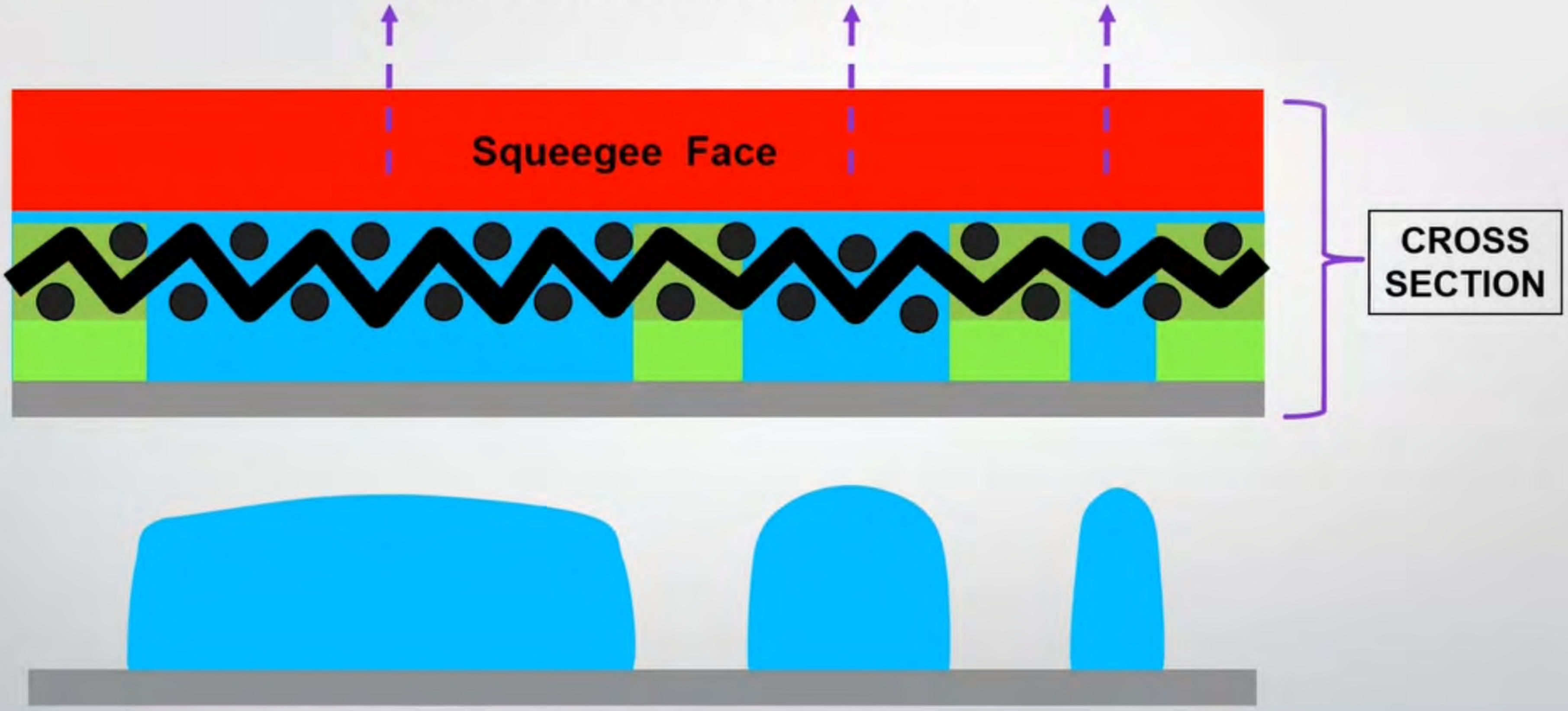
PRESSURE LEVEL EXTRUSION (0.5 lbs/in)



Squeegee "hydroplanes" over viscous ink at very low printing pressures

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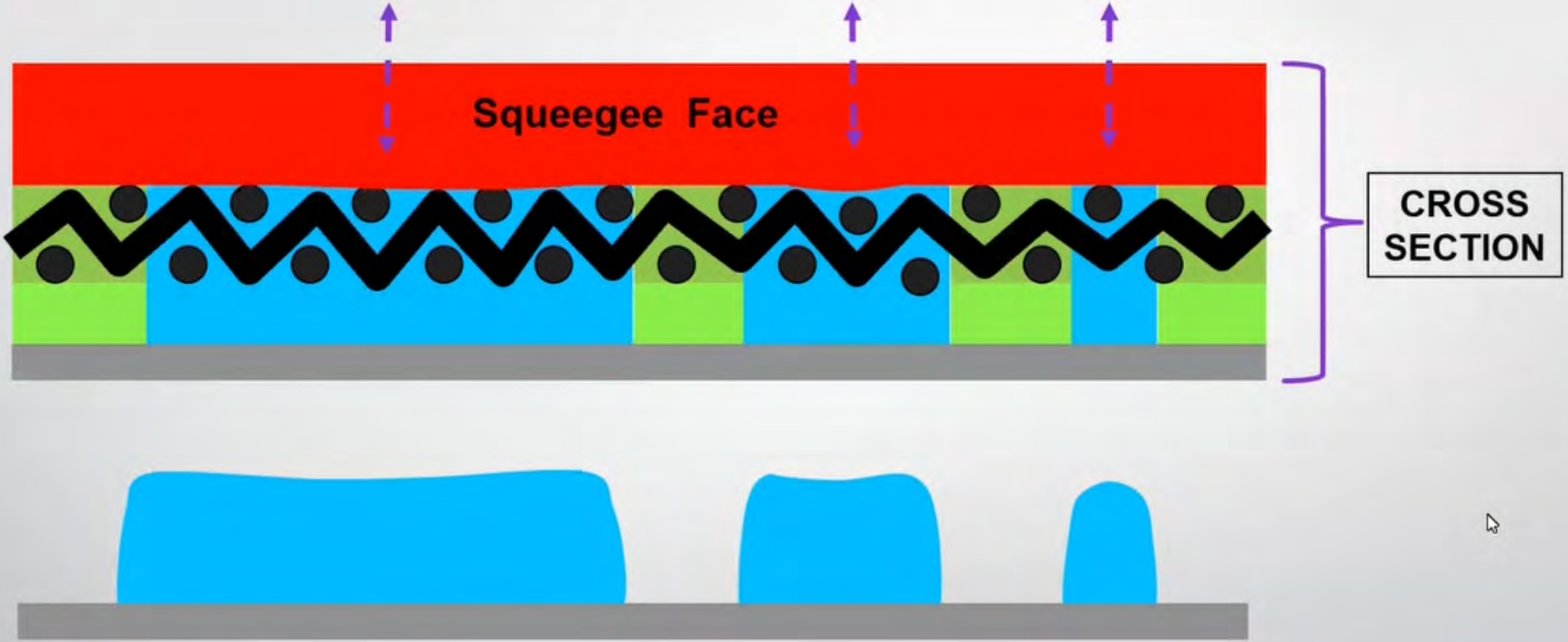
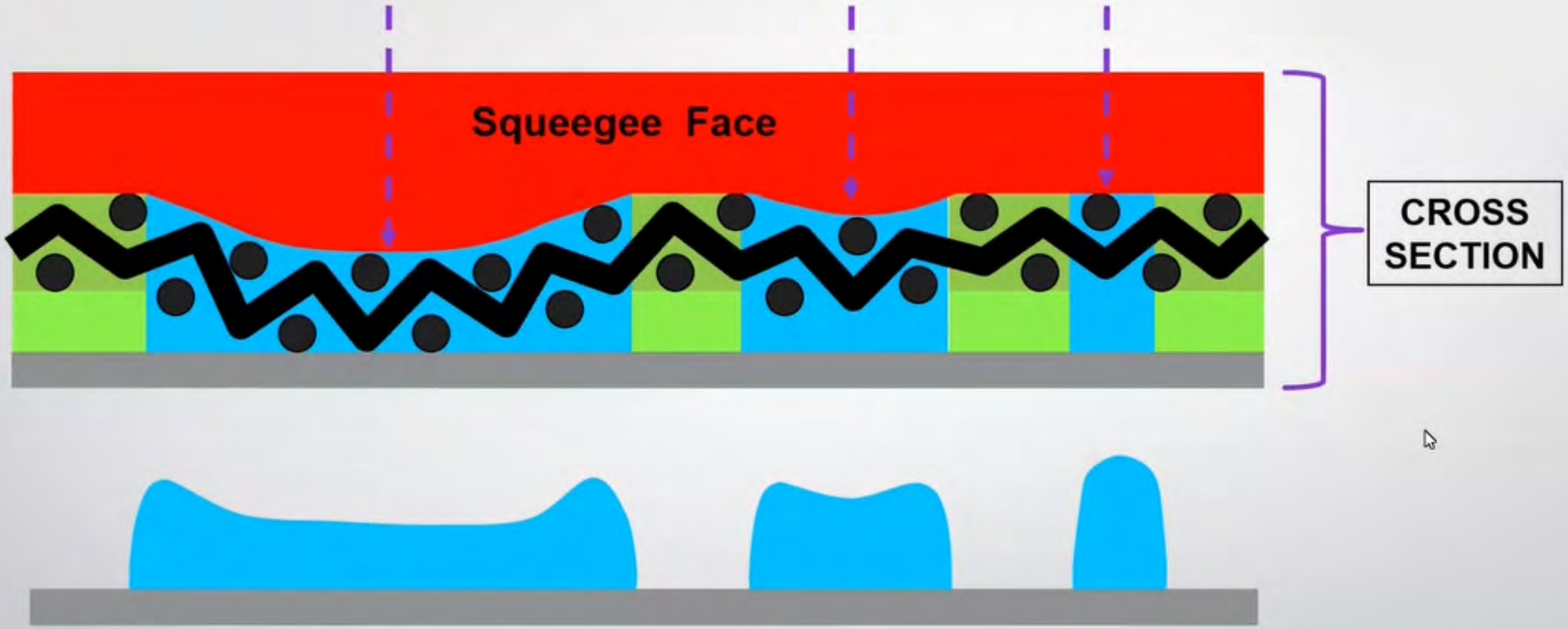
PRESSURE LEVEL SCAVENGING (2 lbs/in)



"Sharp edge of squeegee cuts into open area of mesh to reduce ink deposit"

PRESSURE LEVEL COMPRESSION (8 lbs/in)



"Severe high printing pressure causes the squeegee to enter the emulsion cavities thus removing ink and reducing overall ink deposit"

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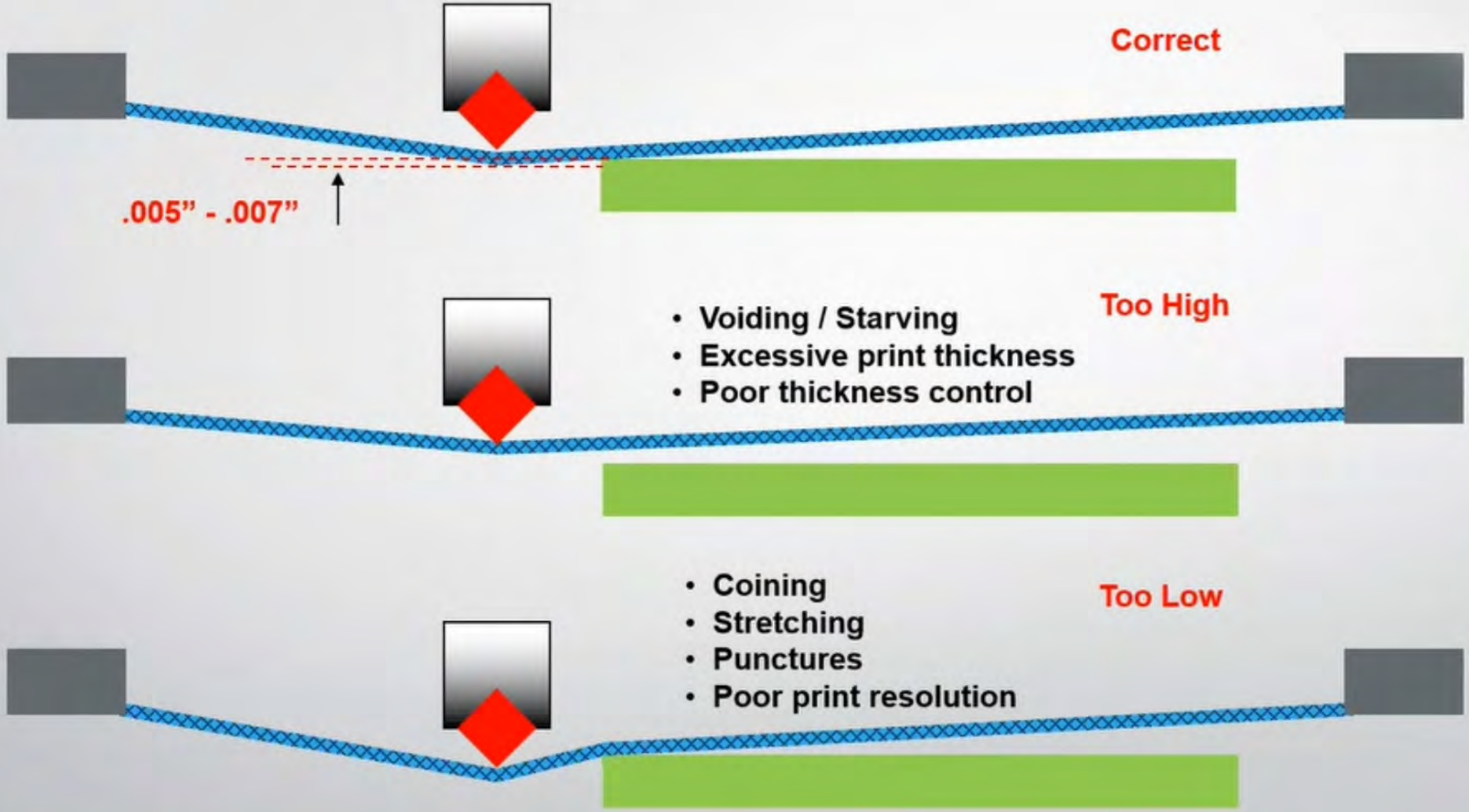
DOWSTOP (Vertical stop position of the squeegee onto the substrate)



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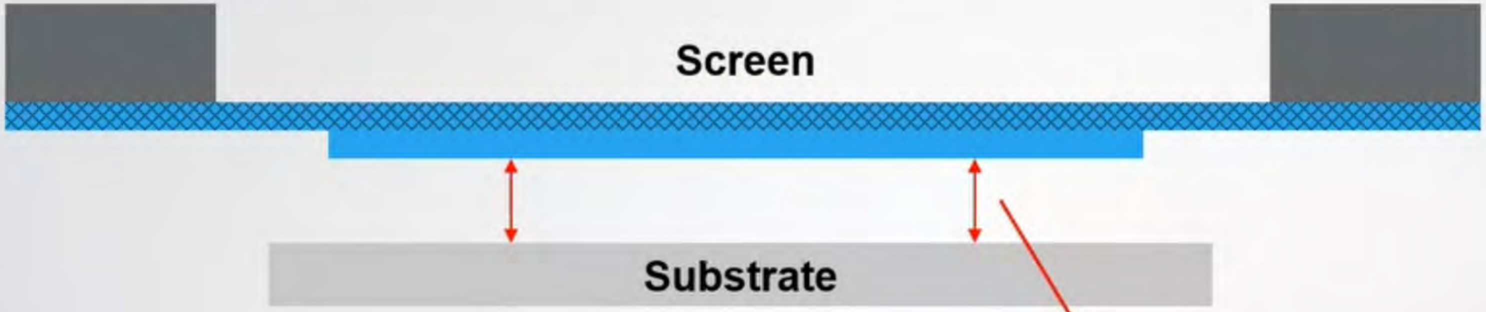
SNAP-OFF DISTANCE



Distance between the bottom of the screen and the substrate. It is calculated using the formula below:

1/300 of the ID of the frame

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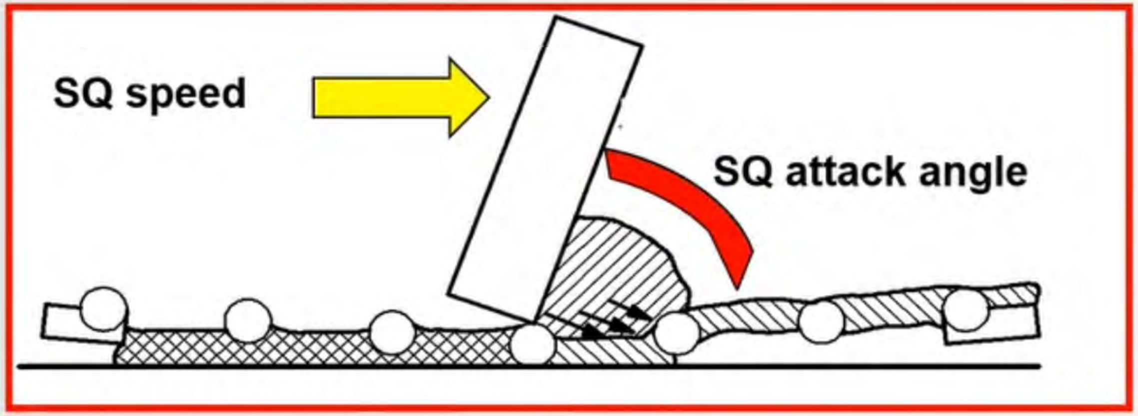
SQUEEGEE SPEED



- Today's typical speeds range between 50mm/sec to 300mm/sec.
- When printing at slow speeds; the emulsion cavity fills up better, hence a thicker deposit.
- When printing at faster speeds; the emulsion cavity fills up partially hence a thinner print.
- Layer thickness also is affected by Squeegee durometer, Pressure and Angle of attack.

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SCREEN PRINTING MASTERCLASS #2

"Selecting the right Screen for your application"

presented by

Fernando Zicarelli
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TECHBLICK 2021

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DETERMINING FACTORS

There are 3 considerations when selecting Screen Tooling; <u>Smallest Feature Size</u>, <u>Desired Print Layer Thickness</u> and <u>Mesh Specs</u> (mesh grade, mesh count, wire diameter, mesh thickness and % of open area).

- **Smallest Feature Size helps us decide the proper mesh count, wire diameter and mesh thickness in order to achieve the customer's design.**
- **Desired Print Layer Thickness.**
- **Mesh Specs help us determine the layer thickness, the feasibility of feature size and the resolution quality.**

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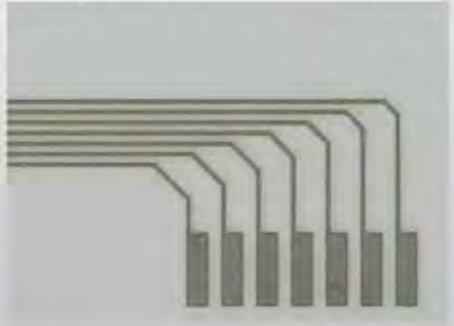
SELECTION WHEN THE PRINTED FEATURE SIZE is 50µ-100µ

When trying to print 50-100 microns feature sizes; the Mesh Count is higher than 290 wires per inch and the Wire Diameter can be 16µ-23µ. The printed layer thickness is the second determining factor in the selection.

Cell Phone Industry

Mesh Grade:	**MS-500**
Mesh Count:	**500**
Wire Diameter:	**19 micron**
Opening:	**32 micron**
% of Opening:	**39%**
Thickness:	**25 microns Cal**

50µm L/S



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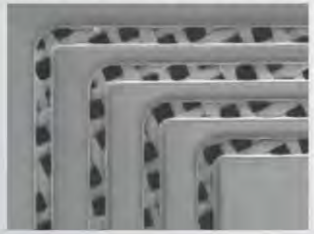
SELECTION WHEN THE PRINTED FEATURE SIZE is 25µ-30µ

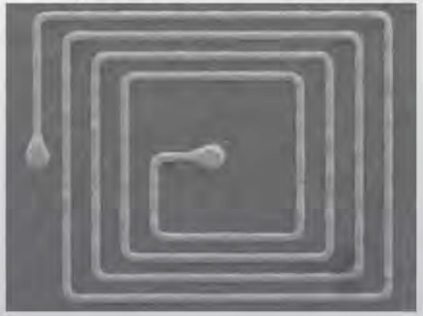
When trying to print 25-30 microns feature sizes; the Mesh Count is usually above 500 wires per inch and the Wire diameter can be 13µ-15µ. The printed layer thickness is the second determining factor in the selection.



LTCC Industry

Mesh Grade:	**MS-640**
Mesh Count:	**640**
Wire Diameter:	**15 micron**
Opening:	**25 micron**
Opening ratio:	**39%**
Thickness	**18 micron Cal**

25µm L/S



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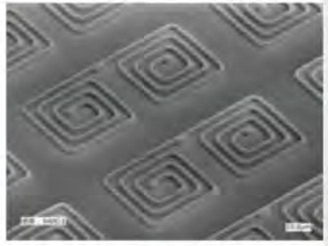
SELECTION WHEN THE PRINTED FEATURE SIZE 15µ-25µ

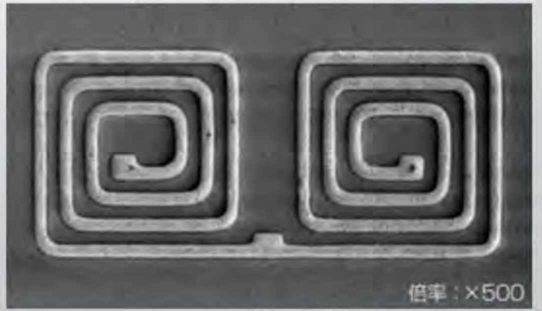
When trying to print 15µ-25µ microns feature sizes; the Mesh Counts recently used have been 500-900 wires per inch and the Wire diameter can be 11µ-13µ. The printed layer thickness is the second determining factor in the selection.



PE Industry – Chip Inductor

Mesh Grade:	**HSR-500**
Mesh Count:	**500**
Wire Diameter:	**13 micron**
Opening:	**38 micron**
Opening ratio:	**55%**
Thickness	**22 micron Cal**

18µm L/S



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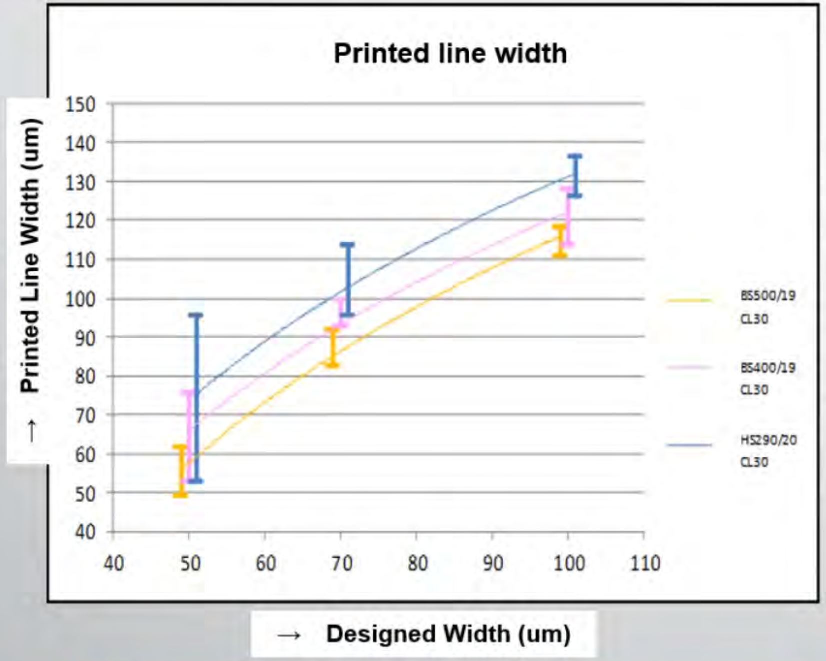
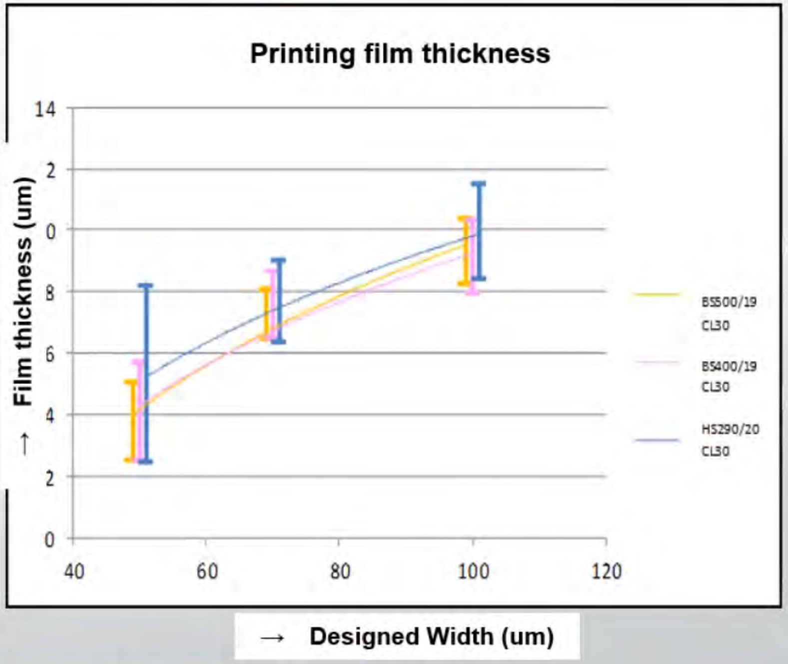
FINE LINE PRINTING vs %OPEN AREA

Mesh	MT (um)	Bias (°)	EOM (um)	Open Area (%)
BS500/19	CL30	22.5	15	40
BS400/19	CL30	22.5	15	50
HS290/20	CL30	22.5	15	60





Distribution of Printed Line Width & Film Thickness
BS500/19 (40%) < BS400/19 (50%) < HS290/20 (60%)

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FINE LINE PRINTING vs %OPEN AREA

Mesh	MT (um)	Bias (°)	EOM (um)	Open Area (%)
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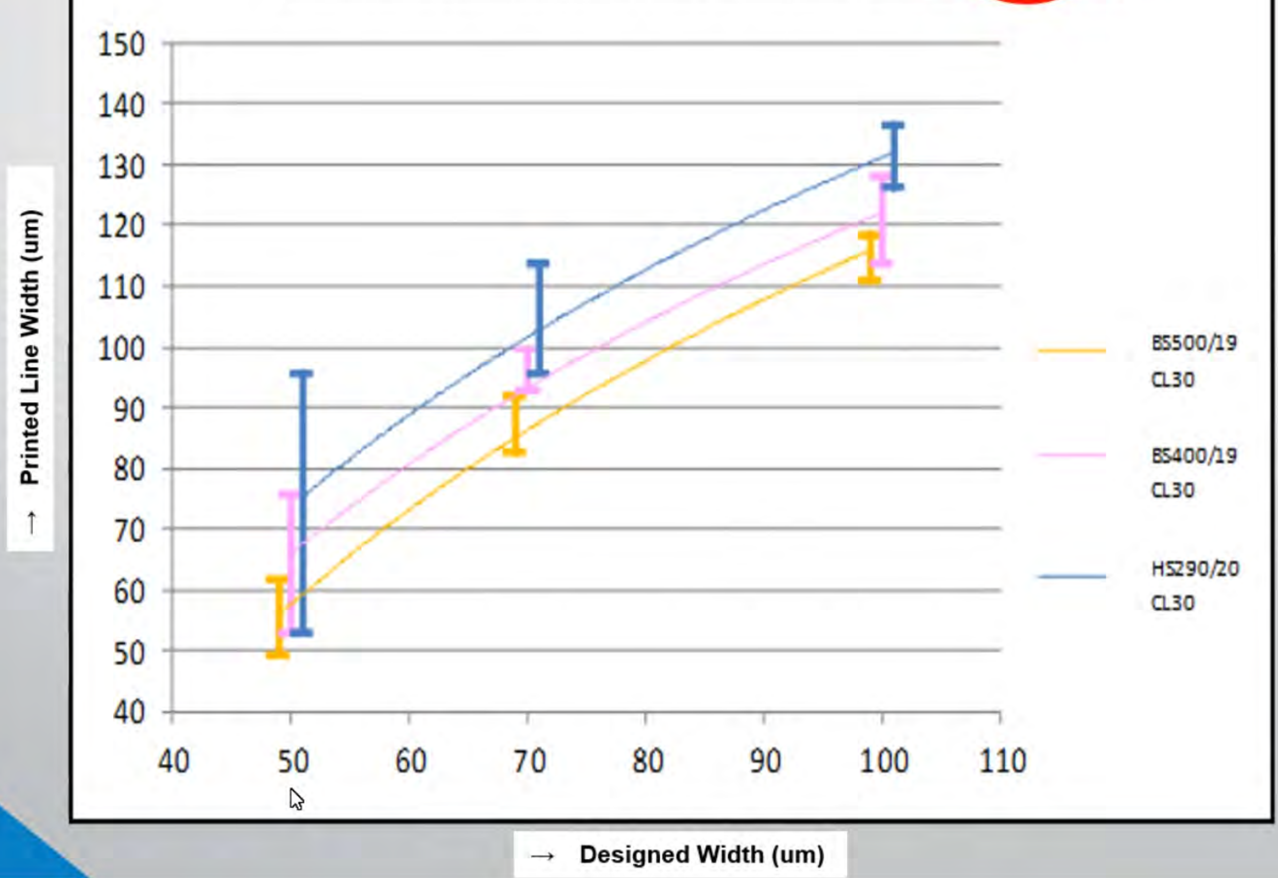

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FINE LINE PRINTING vs %OPEN AREA

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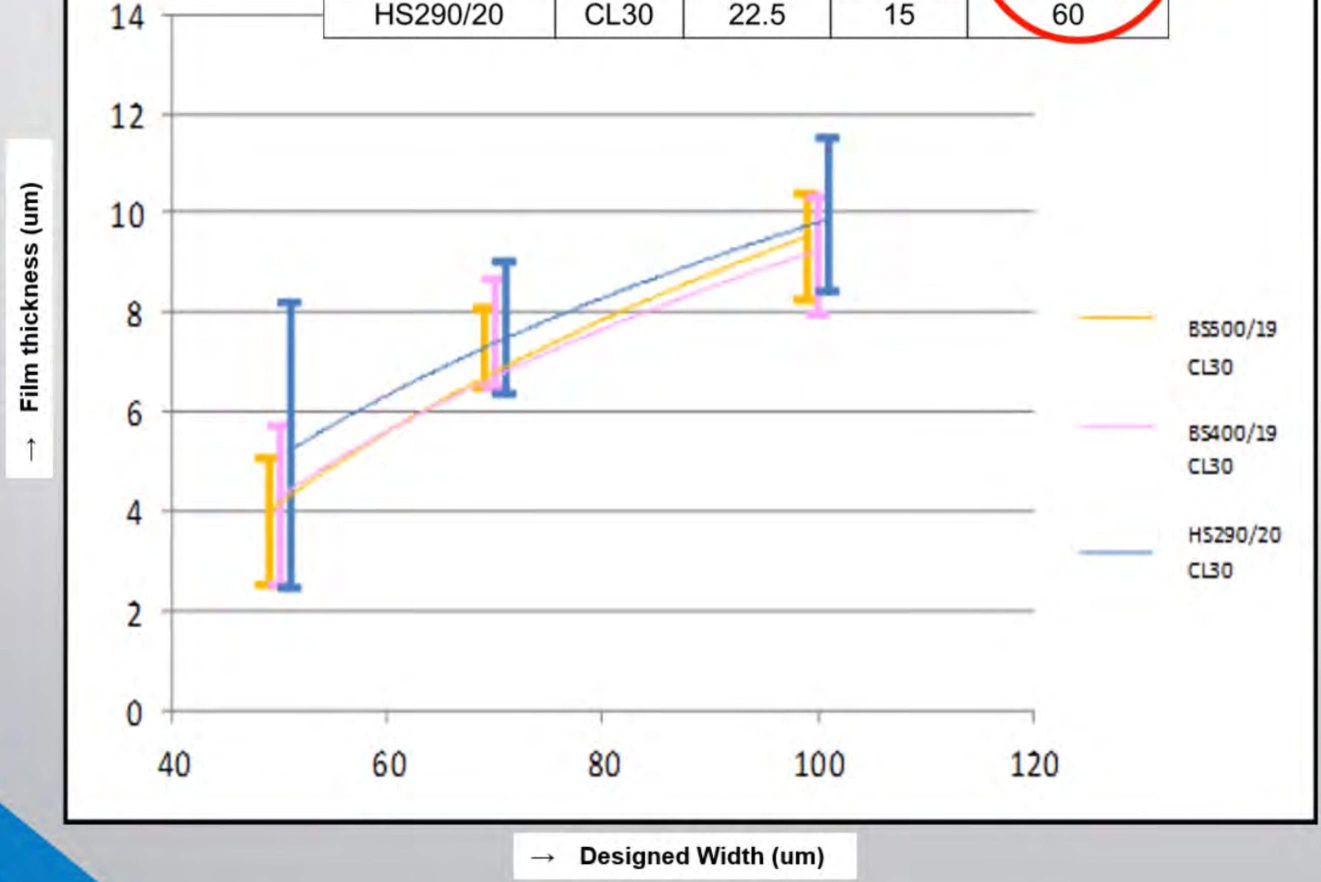

MESH % OPEN AREA SELECTION

	SPEC	MESH COUNT	WIRE DIA.	OPENING	OPENING RATE	Normal	Calender			STRENGTH INDEX
Supermesh	※SHS-T 430/13	430	0.013	0.046	61%	28 ± 3	23 ± 2	21 ± 1	17 ± 1	1.11
	HS-R500/13	500	0.013	0.037	55%	29 ± 3	24 ± 2	21 ± 1	17 ± 1	0.96
	HS-R400/16	400	0.016	0.048	56%	36 ± 3	25 ± 2	21 ± 1	15 ± 1	1.17
	SHS-430/13	430	0.013	0.046	61%	29 ± 3	24 ± 2	21 ± 1	17 ± 1	0.94
	SHS-380/14	380	0.014	0.053	62%	33 ± 3	26 ± 2	20 ± 1	17 ± 1	0.96
	SHS-360/16	360	0.016	0.055	60%	36 ± 3	32 ± 2	21 ± 1	17 ± 1	1.19
	SHS-325/16	325	0.016	0.062	63%	35 ± 3	32 ± 2	20 ± 1	18 ± 1	1.08
	SHS-290/20	290	0.020	0.068	60%	45 ± 3	36 ± 2	30 ± 1	20 ± 1	1.50
	SHS-230/25	230	0.025	0.085	60%	55 ± 3	45 ± 2	35 ± 2	27 ± 1	1.86
	SPEC	MESH COUNT	WIRE DIA.	OPENING	OPENING RATE	Normal	Calender			STRENGTH INDEX
Hardmesh	★ MS-730/13	730	0.013	0.022	40%	28 ± 2	20 ± 1	18 ± 1	15 ± 1	0.63
	★ MS-640/15	640	0.015	0.025	39%	35 ± 2	25 ± 1	21 ± 1	17 ± 1	0.73
	MS-500/16	500	0.016	0.035	47%	36 ± 2	25 ± 1	20 ± 1	15 ± 1	0.65
	★ MS-500/19	500	0.019	0.032	39%	41 ± 2	36 ± 2	25 ± 1	20 ± 1	0.93
	MS-400/19	400	0.019	0.045	49%	42 ± 2	30 ± 2	23 ± 1	18 ± 1	0.74
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	MS-325/28	325	0.028	0.050	41%	58 ± 2	51 ± 2	45 ± 2	39 ± 2	1.30
	★ MS-250/30	250	0.030	0.072	50%	62 ± 2	58 ± 2	50 ± 2	45 ± 2	1.15

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FINE LINE PRINTING vs % OPEN AREA

Photovoltaic

High Open Area mesh can cause **Paste Bleeding** because of the mismatch between screen mesh opening area and the paste. The surface of a printed electrode with **60%** of opening area is very **rough** compared with to a **40%** of opening area mesh.

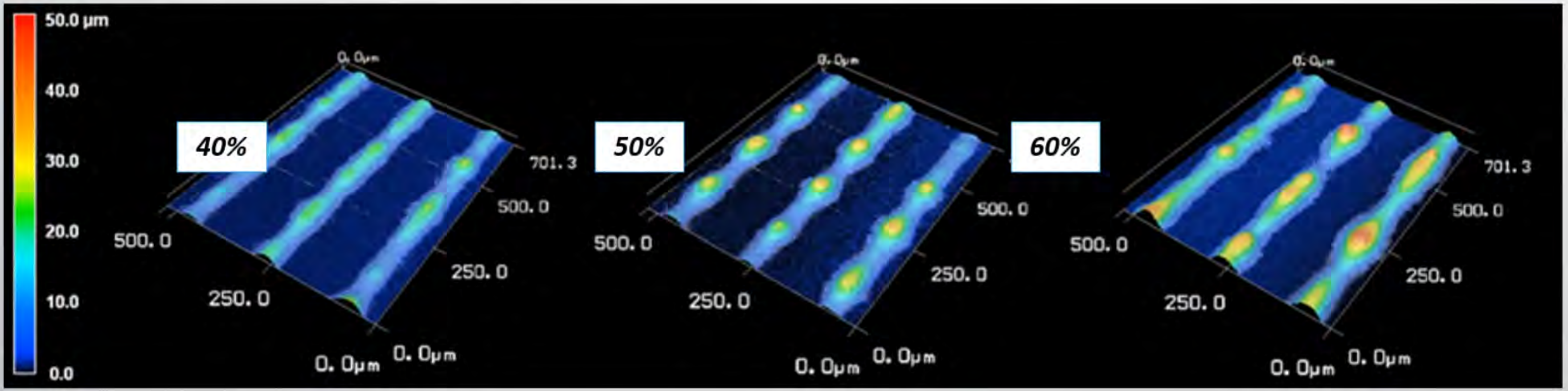

Figure 1. Finger electrode designed 50µm width using mesh screen with 39% opening area (left), 49% (middle) and 60% (right) for paste A.

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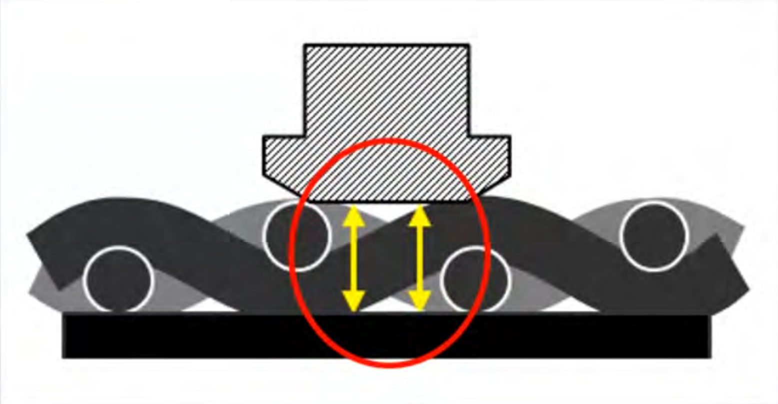
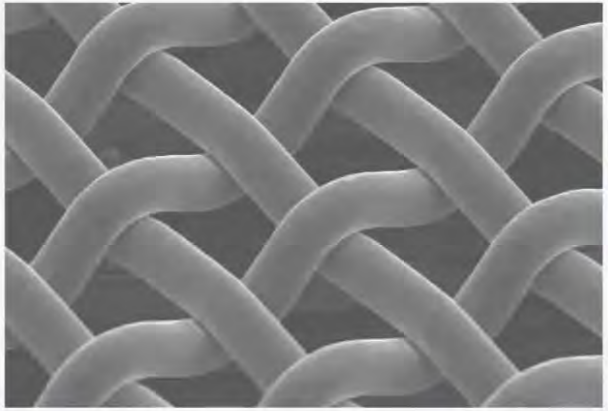
MESH THICKNESS SELECTION





BS400/23
THICKNESS = 55µ

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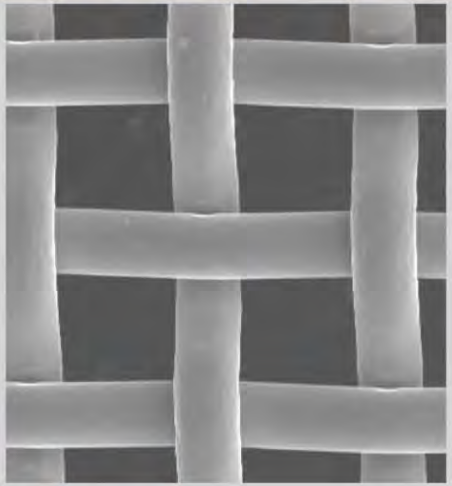
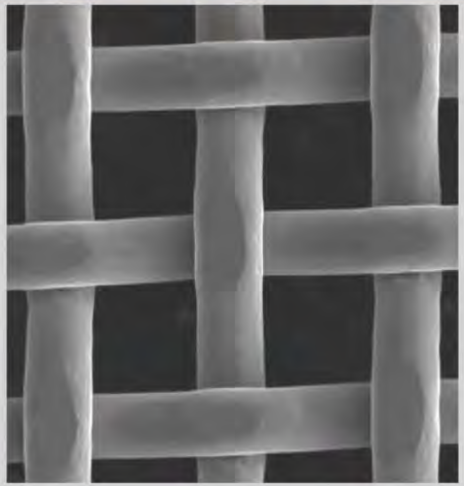
CALENDERING

Calendering is the process used to flatten the knuckles of the mesh which makes the mesh thinner. It also helps stabilize the mesh so that less movement of the Warp and Weft wires takes place. You can calendar down to almost 50% of the original thickness; most common is 20%-30%.

BS400/23 N55	BS400/23 CL40
	

Mesh	Thickness
BS400/23	N55
Cal BS400/23	CL40

MESH THICKNESS SELECTION

	SPEC	MESH COUNT	WIRE DIA.	OPENING	OPENING RATE	Normal	Calender			STRENGTH INDEX
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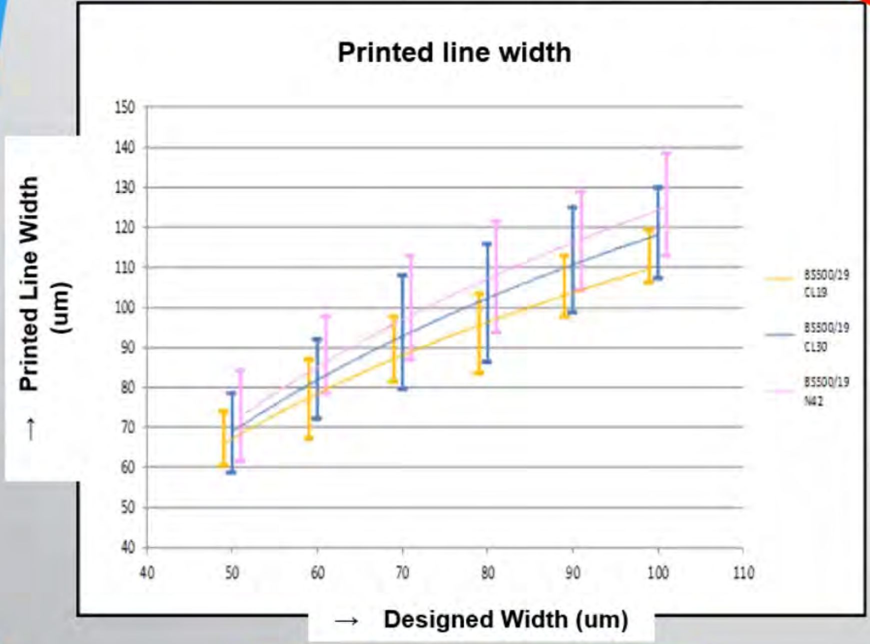
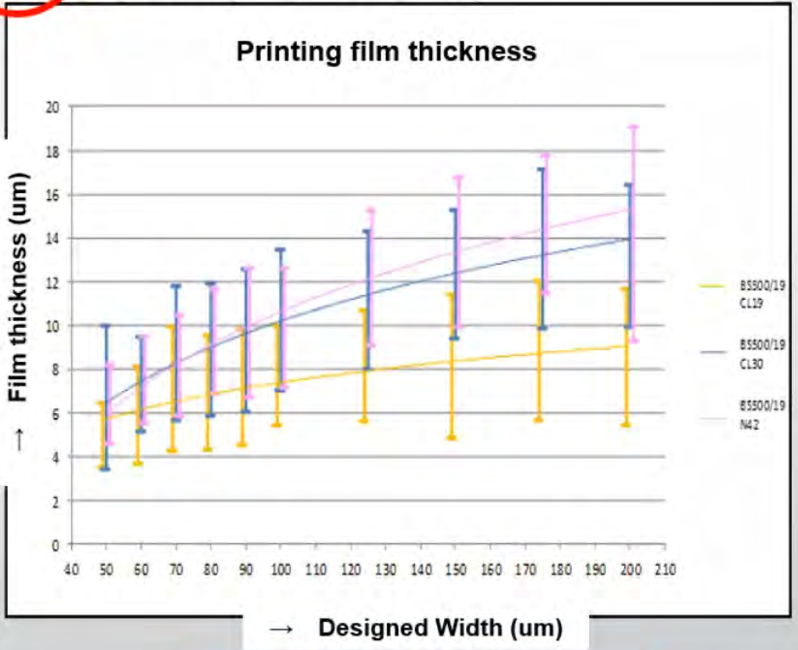
FINE LINE PRINTING vs MESH THICKNESS

Mesh	MT (um)	Bias (°)	EOM (um)
BS500/19	CL19	22.5	15
BS500/19	CL30	22.5	15
BS500/19	N42	22.5	15





Printed line width
CL19 ＜ CL30 ＜ N42

Film thickness
CL19 ＜ CL30 ＜ N42

ASADA MESH CO.,LTD.

CALCULATING THEORETICAL WET PRINT THICKNESS

	SPEC	MESH COUNT	WIRE DIA.	OPENING	OPENING RATE	Normal	Calender			STRENGTH INDEX
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Thickness
55 µm
X
40.7%
=
22.4 µm

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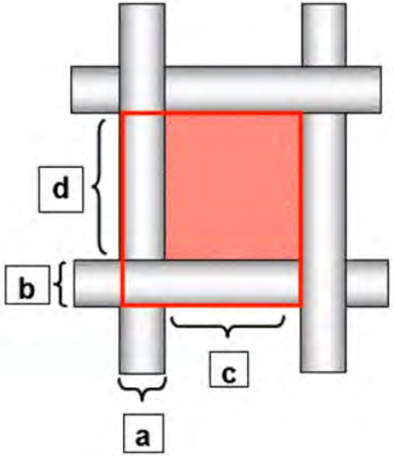
CALCULATING THEORETICAL WET PRINT THICKNESS

Opening Area

a	Warp (mm)	0.023
b	Weft (mm)	0.023
	Mesh Count（wires/inch）	400
	Mesh Count（wires/inch）	400

→

c	Warp Opening (mm)	0.041
d	Warp Opening (mm)	0.041



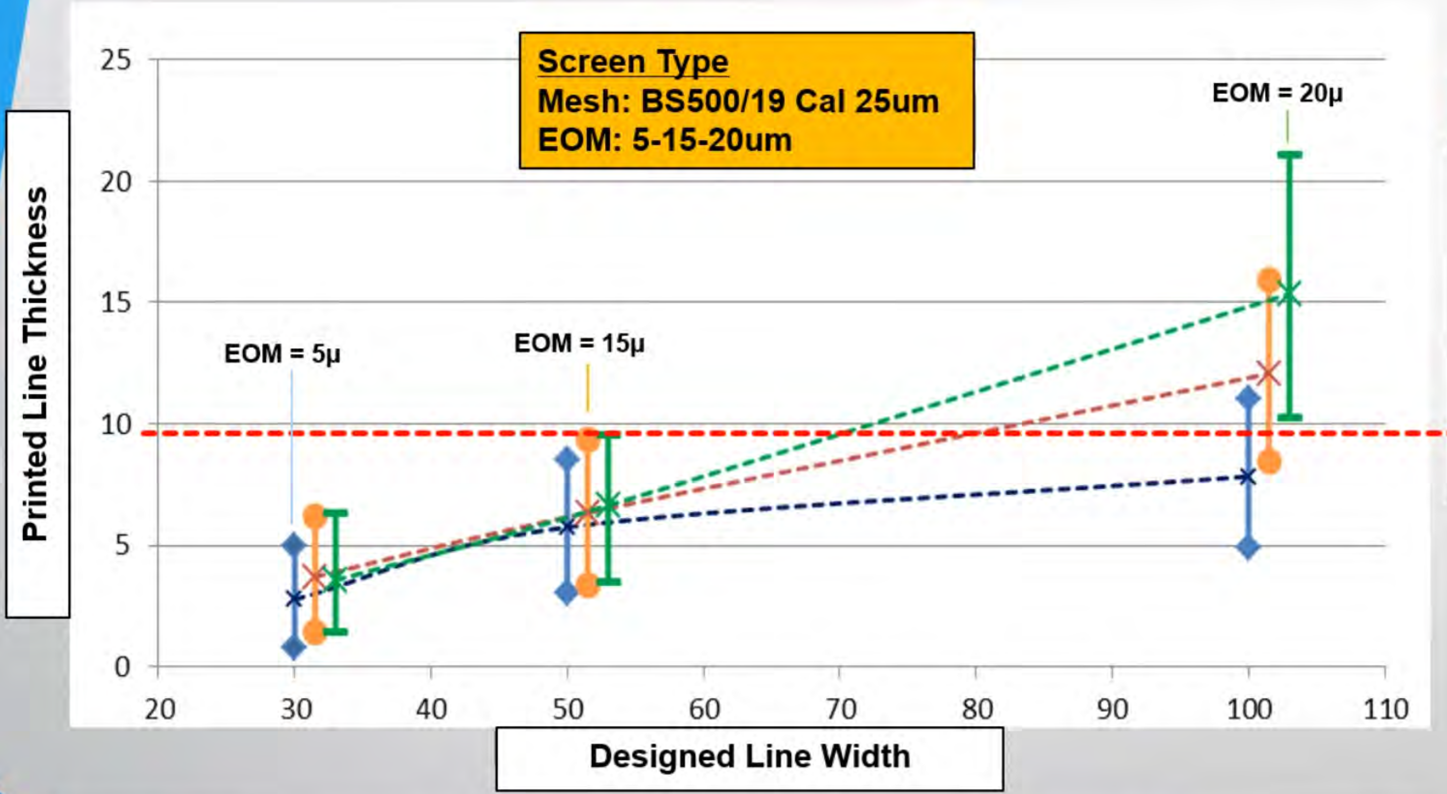
Opening Rate $= \dfrac{c \times d}{(a+c) \times (b+d)} \times 100$

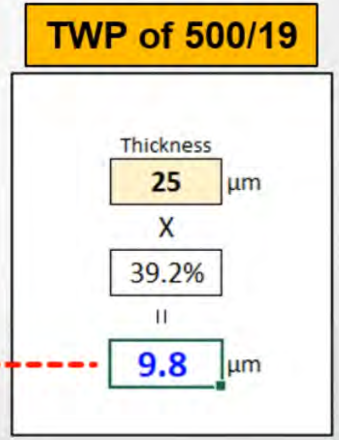
$=$ **40.7%**

Ink Volume

Thickness		Thickness	
55 µm	↔	40 µm	
× 40.7%		× 40.7%	
= 22.4 µm	↔	= 16.3 µm	

EMULSION OVER MESH
vs
PRINT THICKNESS





As we increase EOM, print thickness increases BUT we also observe more Thickness Variability on the Wider Lines.

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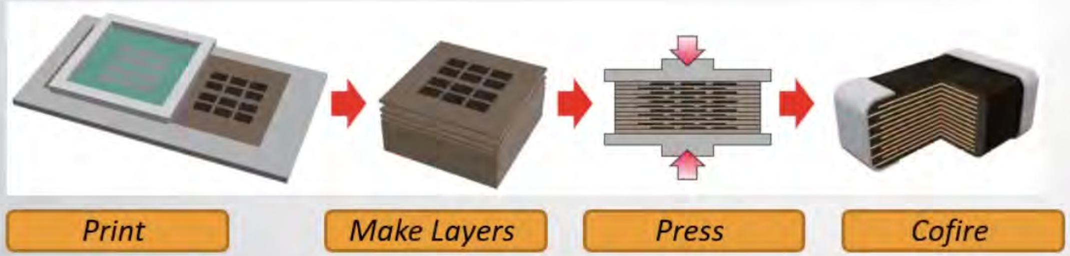
MLCC INDUSTRY WANTS TO PRINT THINNER

MLCC

Industrial demand for thinner inner electrode has increased due to size and capacity. Up to 500 MLCCs of size 0603 (.6mm x .3mm) and 0402 (.4mm x .2mm) can be integrated into a single smartphone.

400 wires per inch are now widely used for MLCC manufacturing process.



0402 = L0.4mm x W0.2mm

Stainless Steel Wire Mesh			*Chip Size*	*Ink Volume (µm)*		
Mesh	*Thickness (µm)*					
400/23	*35*	*40*	*1608*	*14.4*	*16.4*	
500/18	*28*	*25*	*1005 & 0603*	*10.9*	*9.8*	*9.0*
640/15	*21*	*18*	*0402*	*8.2*	*7.0*	
730/13	*15*		*0201*	*6.0*		

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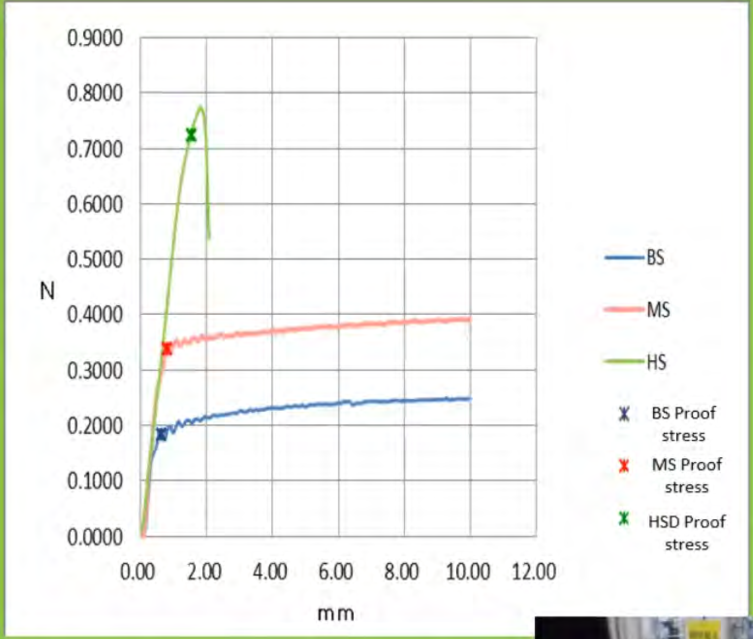
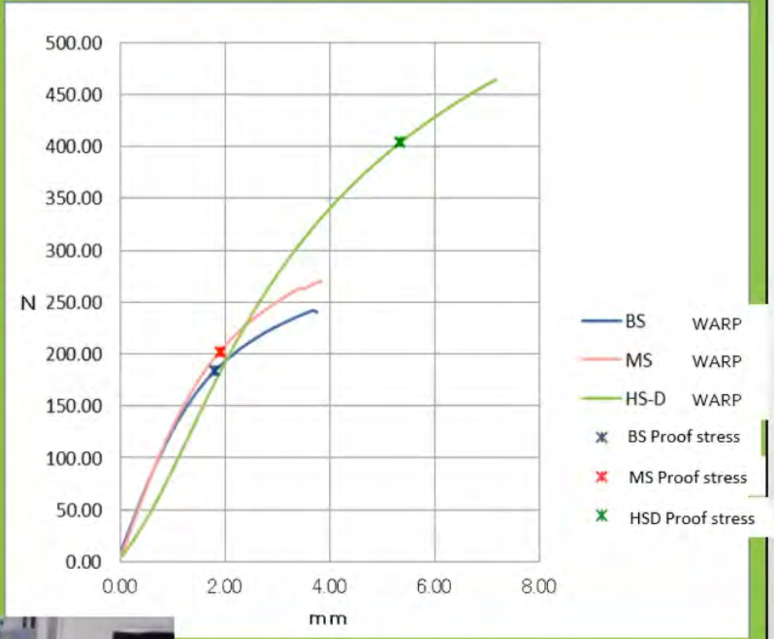
ASADA MESH GRADES

Wire strength	Mesh strength (warp direction)





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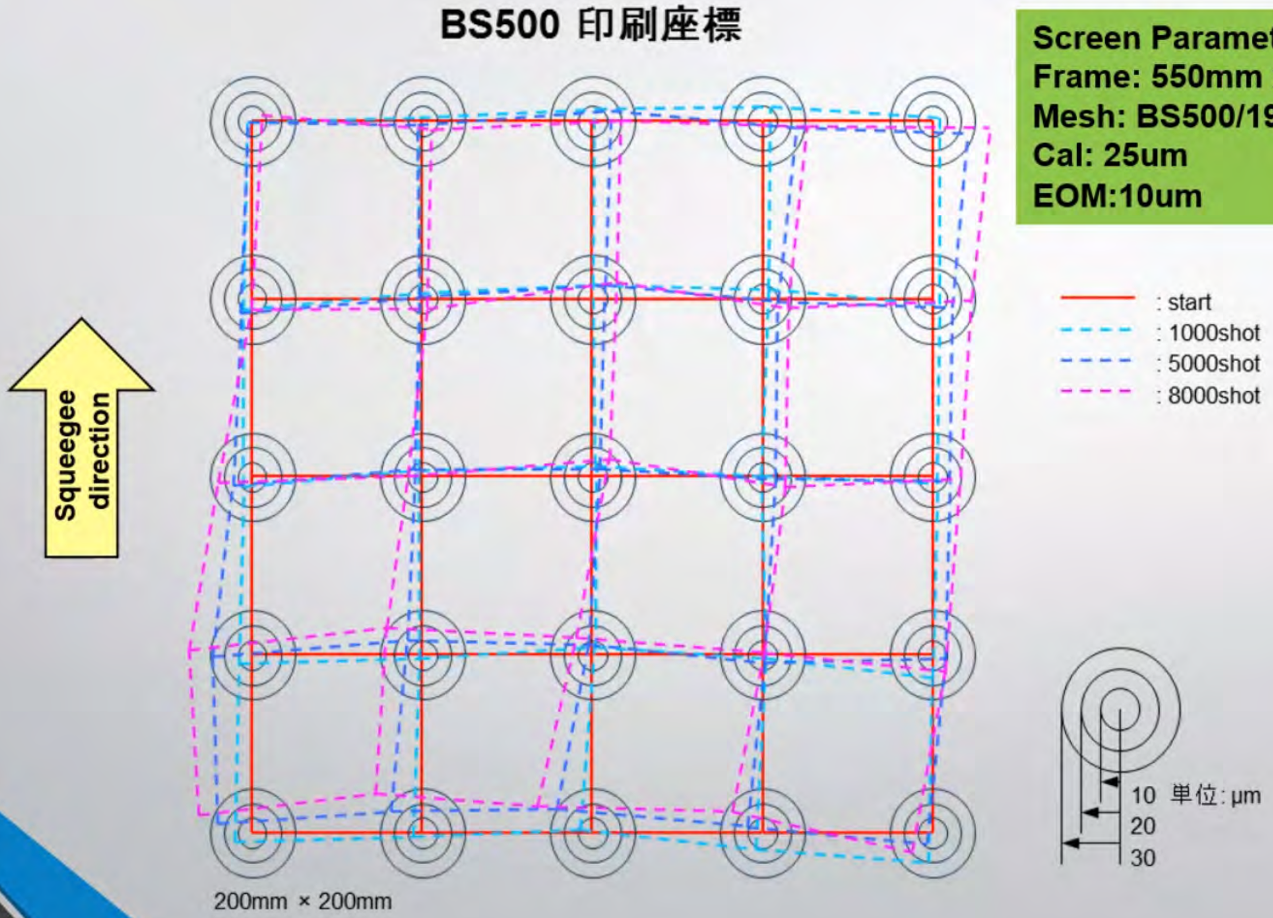
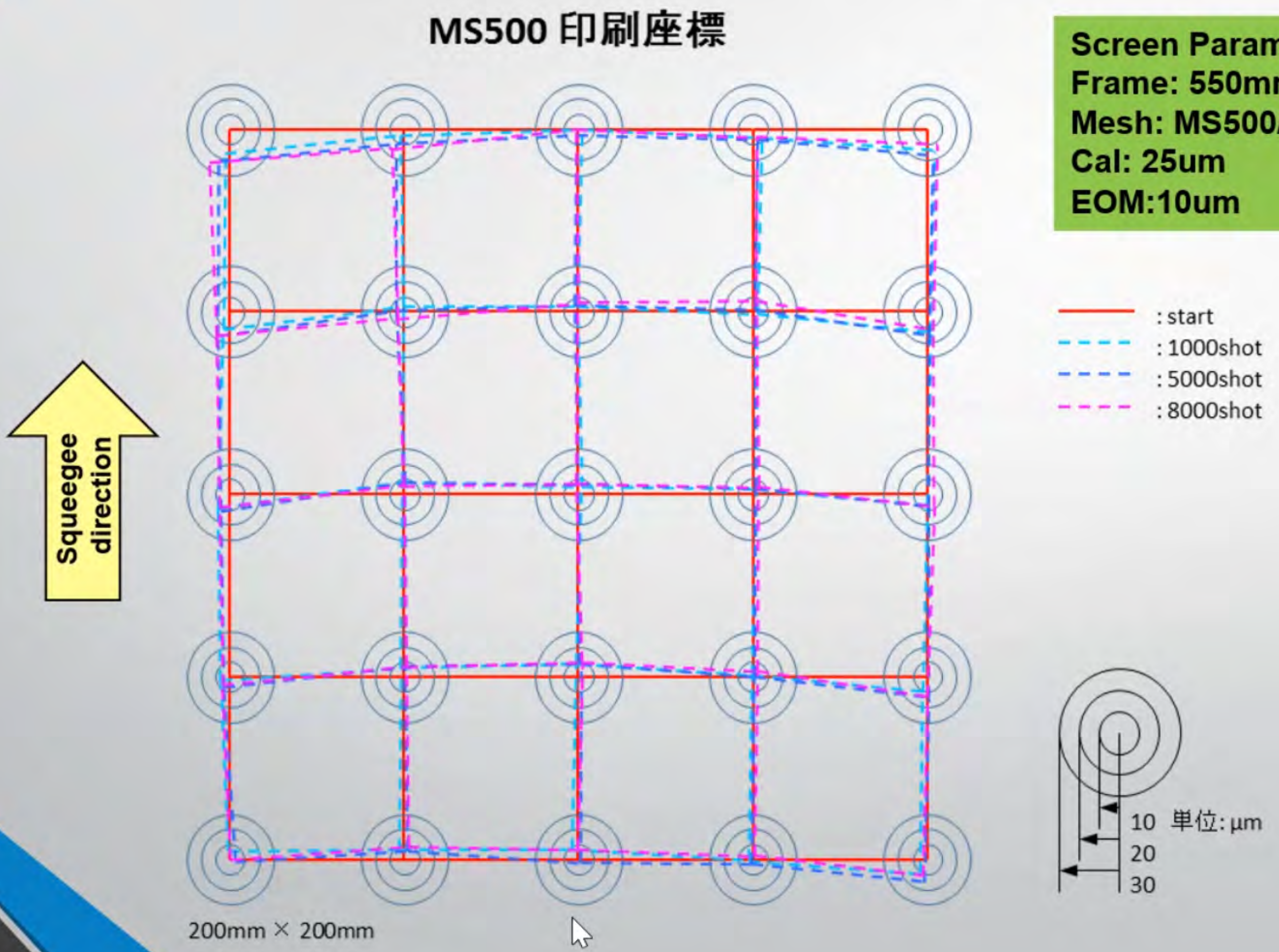
PRINTING with BS Mesh



Screen Parameter:
Frame: 550mm x 550mm
Mesh: BS500/19
Cal: 25um
EOM:10um

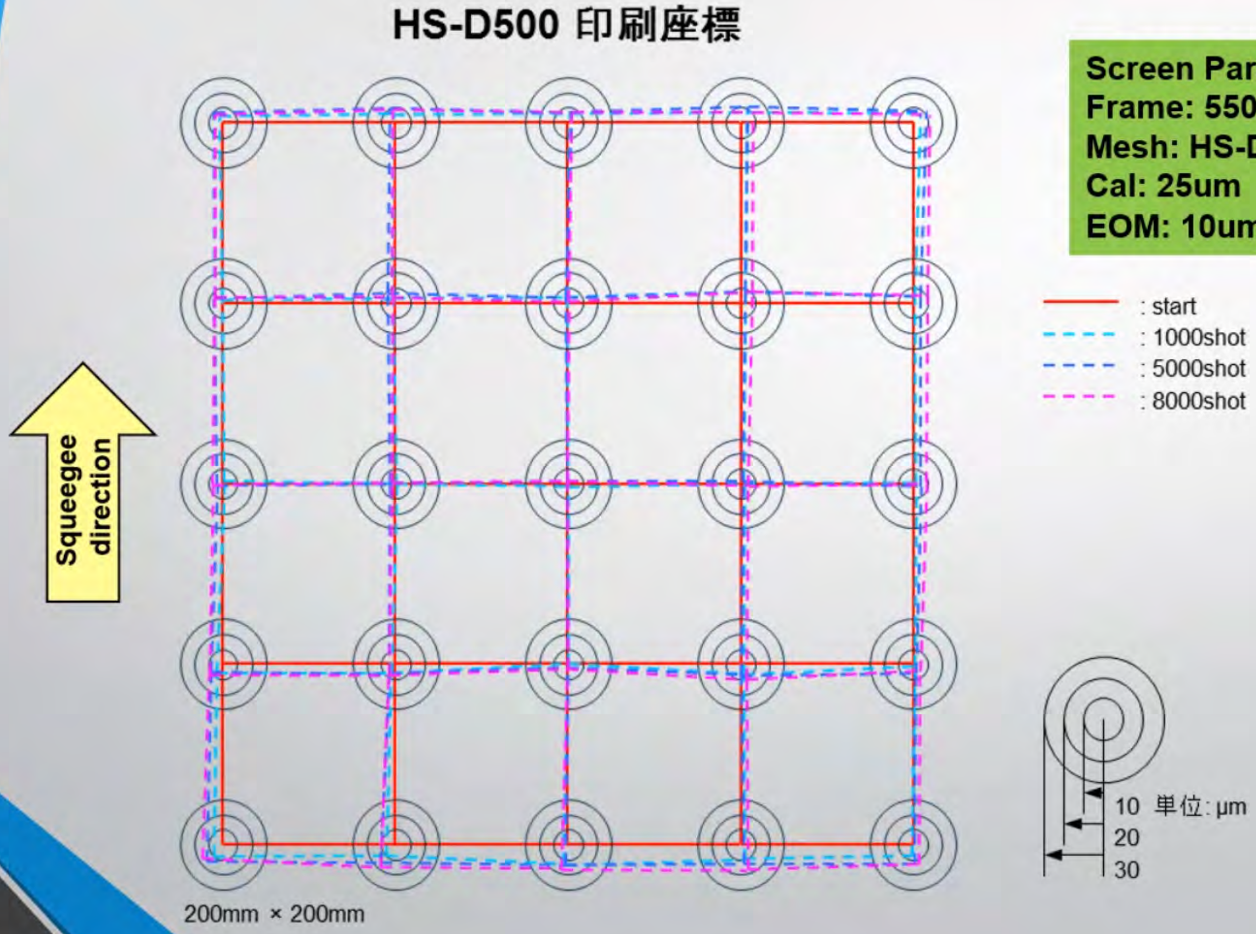
ASADA MESH CO.,LTD.

PRINTING with MS Mesh



Screen Parameter:
Frame: 550mm x 550mm
Mesh: MS500/19
Cal: 25um
EOM:10um

PRINTING with HSD Mesh
(New Generation)

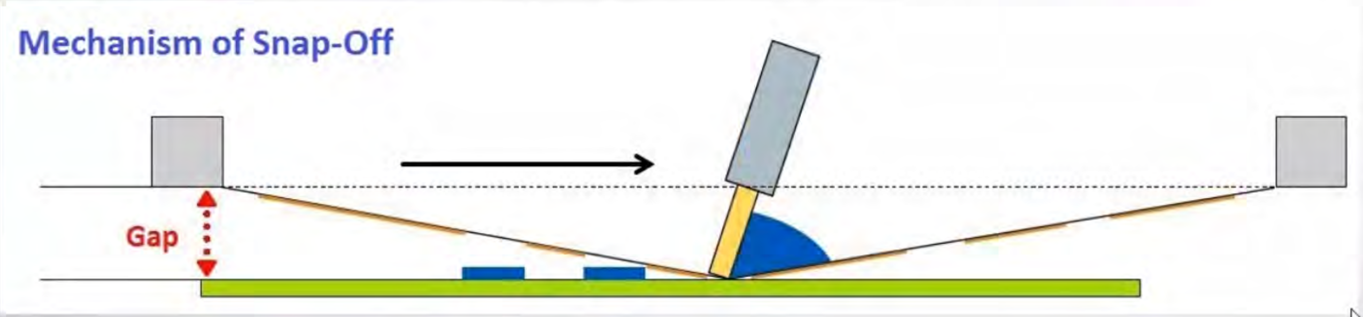


Screen Parameter:
Frame: 550 x 550mm
Mesh: HS-D 500/19
Cal: 25um
EOM: 10um

ASADA MESH CO.,LTD.

Why is Mesh Strength so important?

A Polyurethane Squeegee pushes the Screen Mesh down and it moves an Ink across the openings on the Emulsion. The emulsion openings define the pattern. The Gap between the screen mesh and the substrate is called "Snap-off" and it is one of the most important variables that affects the quality of the printed pattern.



"When the Screen Mesh is stretched repeatedly, the Image location begins to shift and the screen mask has to be replaced. That's the reason why <u>Mesh</u> Strength is very important for High Quality Screen Printing.

ASADA MESH CO.,LTD.

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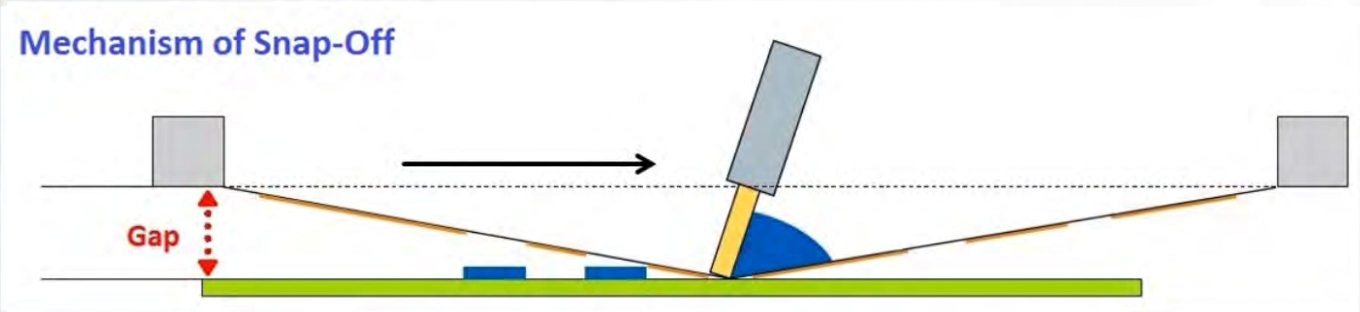

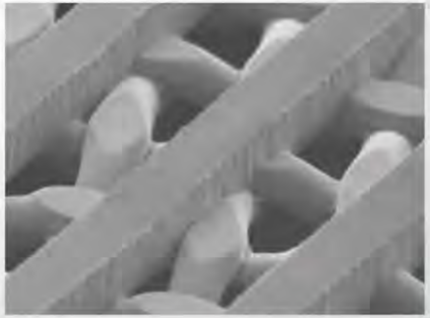

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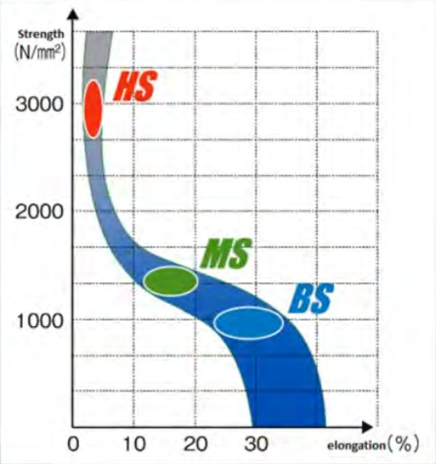
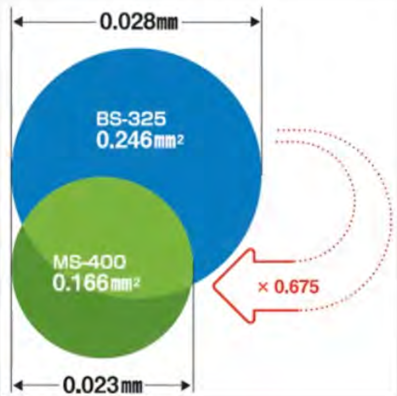
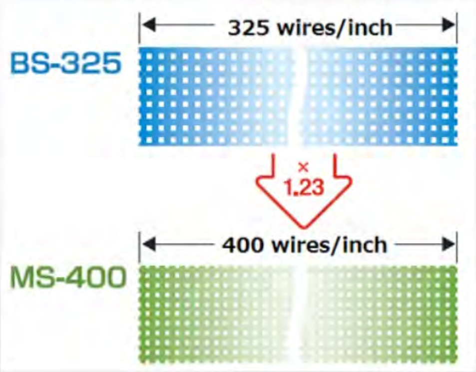
Understanding Index Strength

BS-325/28 has been regarded as the stainless steel mesh mostly used in Mass Production for 40 years. We have set **BS-325/28** strength as a benchmark to compare a Screen Mesh Strength easily. **Index Strength** of any mesh can be calculated from three factors - **Wire Strength**, **Cross-section of wires** and **Mesh count.**

MS-400/23 (400 mesh with 23 micron wires) can be calculated as shown below:







Wire Strength	×	Cross-Section	×	Mesh Count	=	Strength Index
$\left(\frac{1.3}{1.0}\right)=1.3$		$\left(\frac{23}{28}\right)^2=0.675$		$\left(\frac{400}{325}\right)=1.23$		1.08

ASADA MESH CO.,LTD.

Why is Mesh Strength so important?

Supermesh

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Hardmesh

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OBSERVATIONS

- Although Screen Printing has been referred to as an Art; we believe that it is a Science. Understanding how the different parameters interact with each other will ensure a successful result.
- In Screen Printing there are many variables reacting with each other at the same time, BUT there is no single controlling variable, all of them are inter-dependent.
- Try to use our detailed illustrations to help you understand the process itself.

ASADA MESH CO.,LTD.

SCREEN PRINTING MASTERCLASS #3

"Advanced Screen Printing"

presented by

Fernando Zicarelli
NORTH AMERICA BUSINESS MANAGER
ASADA MESH CO., LTD

TECHBLICK 2021

ASADA MESH CO.,LTD.

SUGGESTING TIPS FOR ADVANCED SCREEN PRINTING

1. Squeegee choice (Back supported, 75+ Duro)
2. Attack Angle (45°- 60°)
3. Print Speed (paste dependant)
4. Emulsion RZ (as close to 0μ)
5. Printing Pressure (Scavenging only)
6. Snap Off (1/300th of ID of frame)
7. No distortion HSD Mesh
8. The future of Screen Printing Technology

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SQUEEGEE RECOMMENDED

- Squeegees with durometer values <u>above 75+</u> are used in Advanced Printing for Fine Line applications. Squeegees with new urethane materials with greater resistance to indentation and chemical attack are recommended.








- Squeegees with a rigid back support like Carbon Fiber are used in Advanced Printing for Fine Lines; see below samples from RKS Brand name.


Pictures are courtesy of RKS
Nußbaumweg 31 · 51503 Rösrath · Germany
+49 (0) 2205 94997

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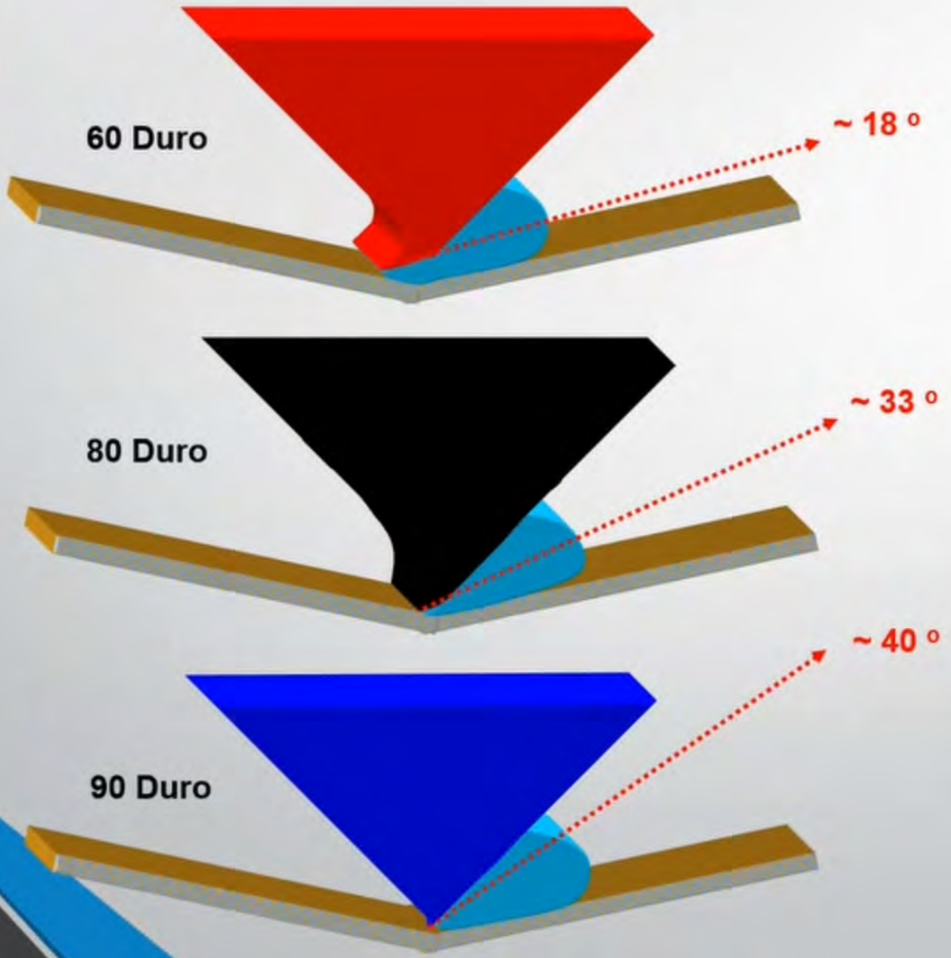
SQUEEGEE DURO vs ATTACK ANGLE



- Durometer is measured in **Shore A units**
- The higher the durometer number the harder the squeegee
- **75-85 is recommended**
- Harder squeegees stay sharp longer
- **Softer squeegees = lower attack angle**

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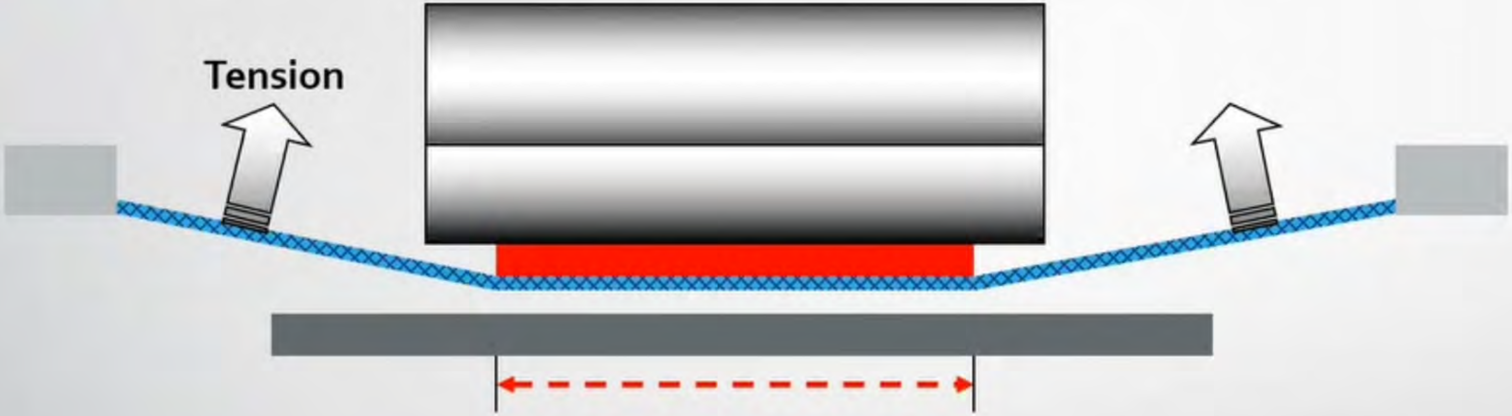
SQUEEGEE SETUP TIPS

- ❖ Use very flat squeegees with sharp edges to obtain good resolution
- ❖ The squeegee printing head must be centered



- ❖ A very flat tool plate must be used to ensure that the squeegee will run parallel to the substrate

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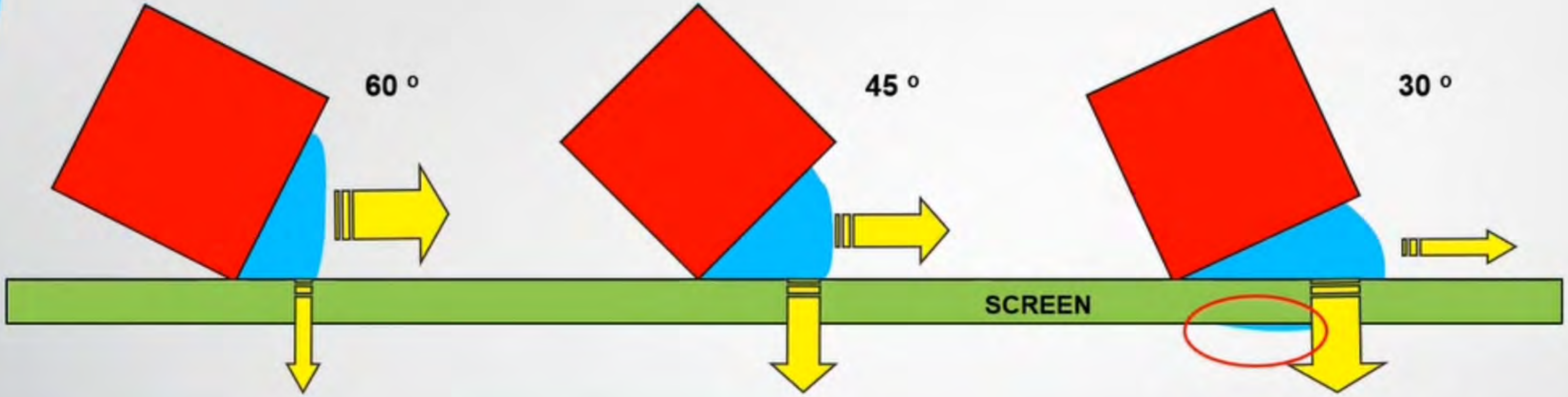
ATTACK ANGLE RECOMMENDATION



- Attack angles of **45° - 60°** yield the best results for Fine Line Printing.
- Higher attack angles push more ink across the screen than through it.
- Lower attack angles force more ink through the screen, often ahead of the pattern.
- Greatly affected by Squeegee durometer, Pressure, Speed, & ink viscosity.
- Changing Snap-off will change the attack angle.

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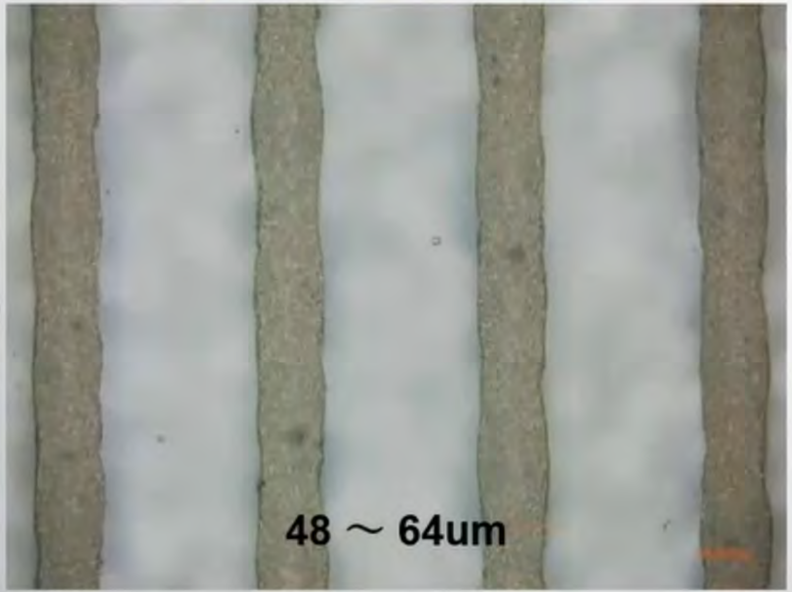
ATTACK ANGLE + PRINTING SPEED

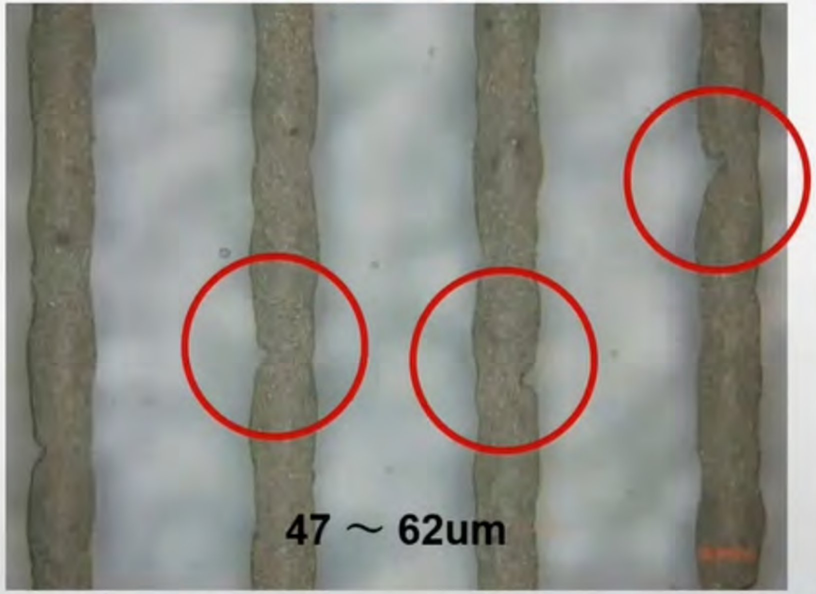
Line design: 50um

50° ATTACK ANGLE



80 mm/sec
PRINTING SPEED

70° ATTACK ANGLE



80 mm/sec
PRINTING SPEED

High attack angles push more ink across the screen than through it which causes paste starvation and poor print quality

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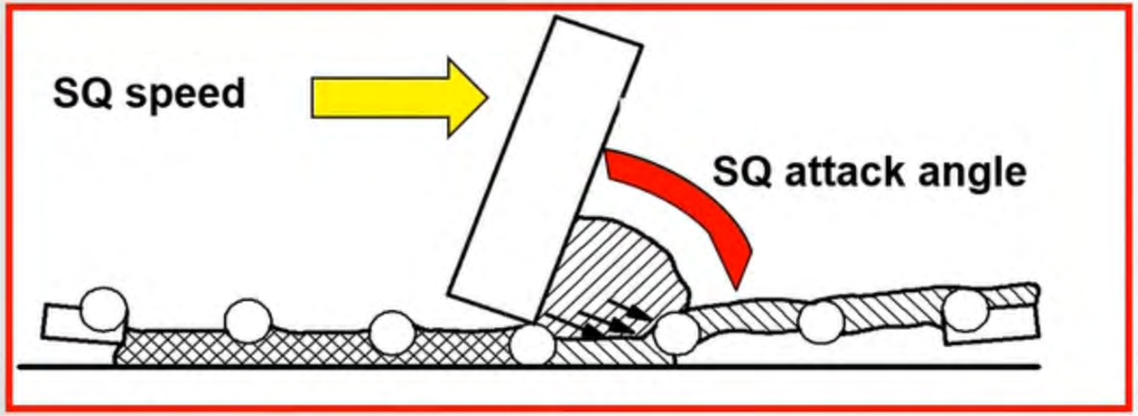
PRINTING SPEED CONSIDERATIONS



- Today's typical speeds range between 50mm/sec to 300mm/sec.
- When printing at slow speeds; the emulsion cavity fills up better, hence a thicker deposit.
- When printing at faster speeds; the emulsion cavity fills up partially hence a thinner print.
- Layer thickness also is affected by Squeegee durometer, Pressure and Angle of attack.

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EXAMPLE OF POOR PASTE RELEASE

If the paste appears behind the squeegee as shown below, the printing result will not be acceptable.

- Incorrect print speed
- Low mesh tension
- Too much ink
- Low Snap-off
- Incorrect mesh specs
- Insufficient squeegee pressure

A = Length of paste behind squeegee not released

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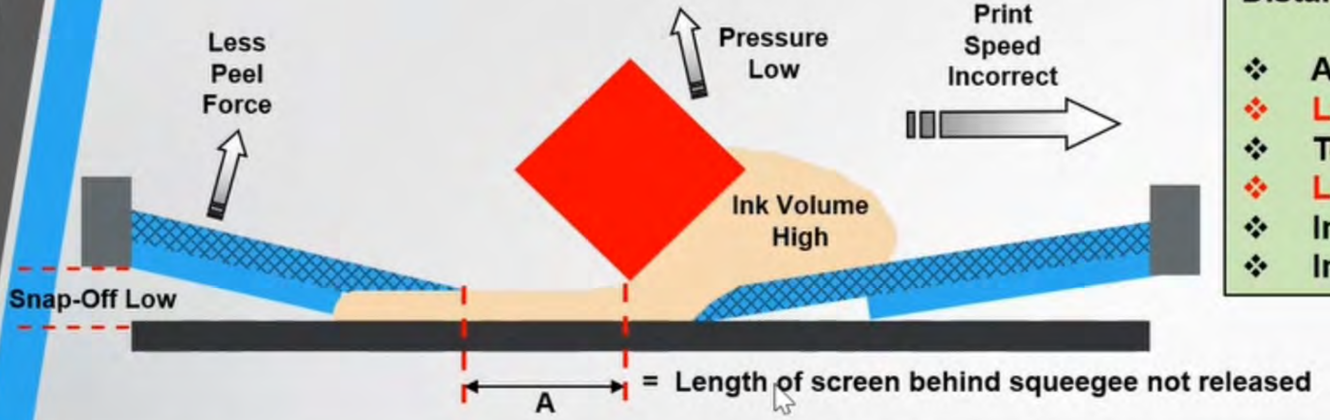
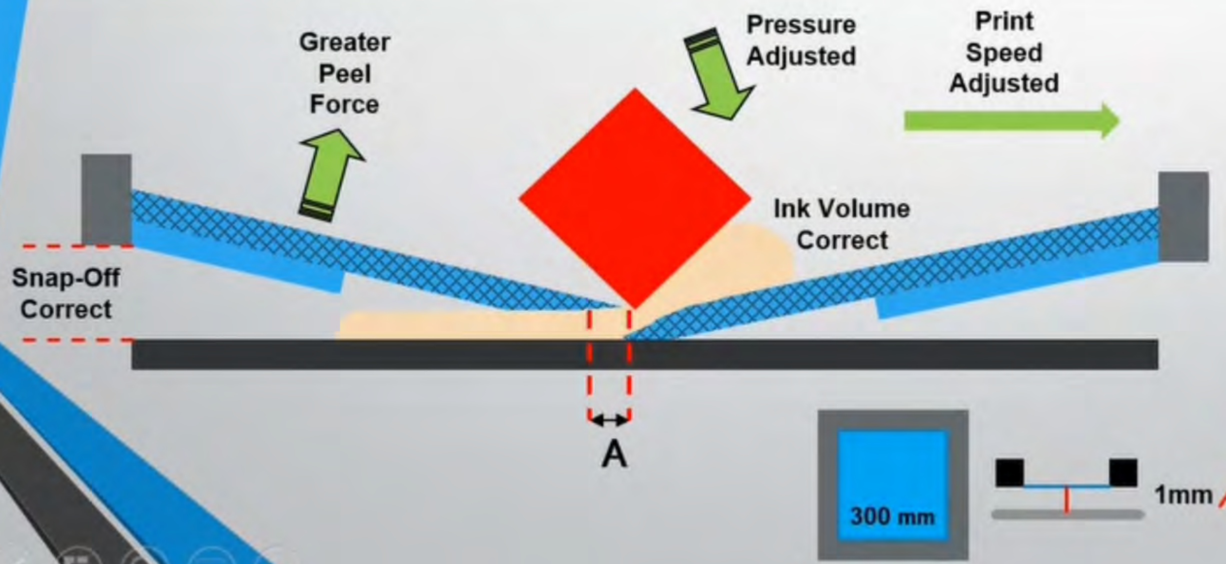
POOR PASTE RELEASE - CAUSES



Distance (A) is affected by:

- An incorrect print speed
- Low mesh tension
- Too much ink
- Low Snap-off
- Incorrect mesh specs
- Insufficient squeegee pressure



Distance (A) can be reduced by:

- Print speed to match viscosity
- Proper screen tension
- Less amount of ink
- Correct Snap-off (1/300th of ID of Frame)
- Proper mesh specs
- Sufficient squeegee pressure

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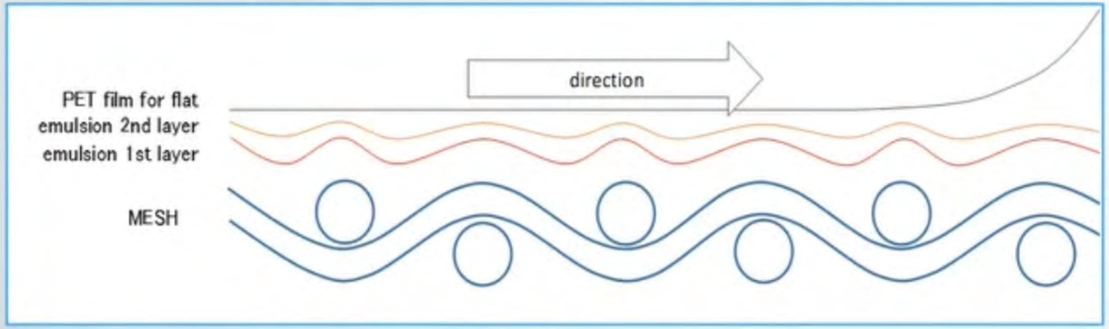
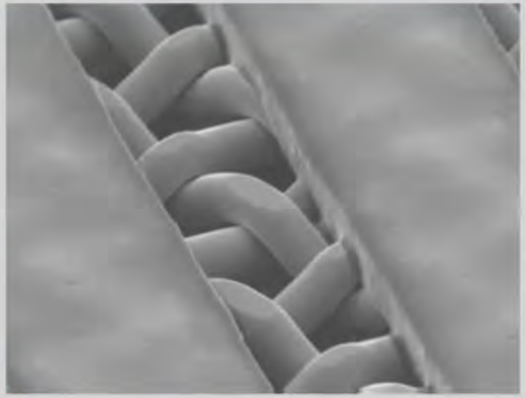
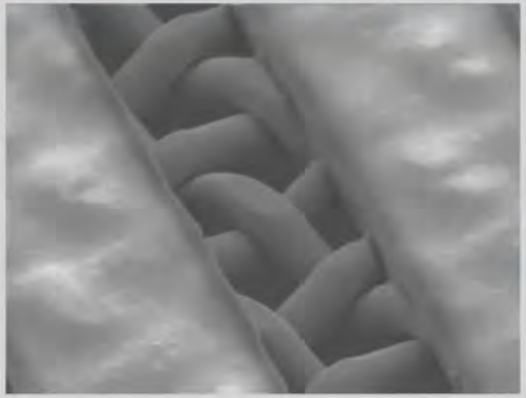
EMULSION RZ VALUE

- Always request an RZ value as close to 0μ as possible.
- By using a PET film (sheet) after a wet emulsion pre-coating, you will achieve a smoother emulsion surface.



w/ Flattening	w/o Flattening
	

BS400/23
Cal = 40
Bias = 22.5°
EOM = 10μ

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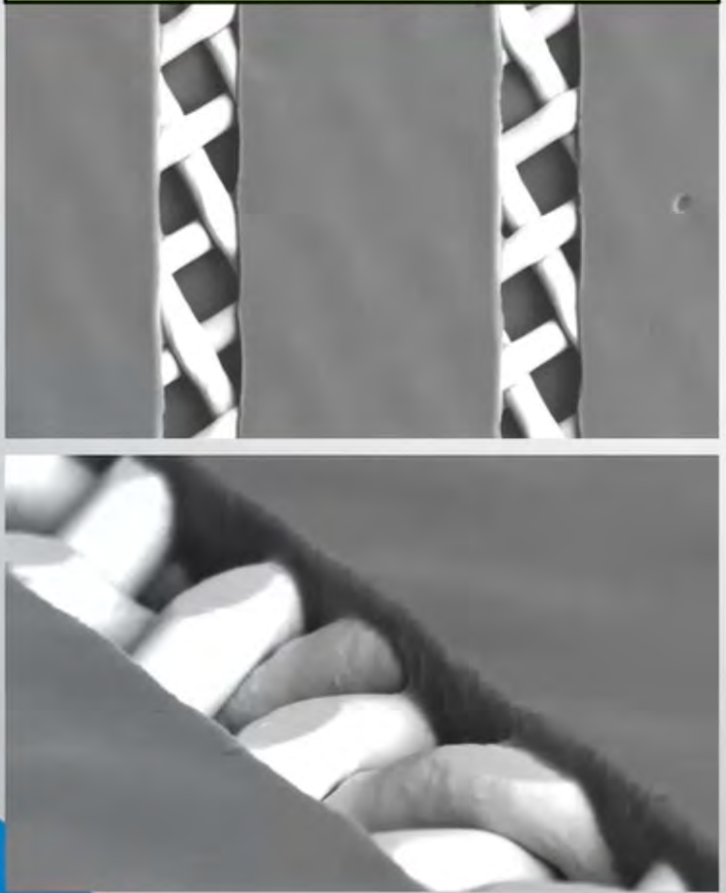
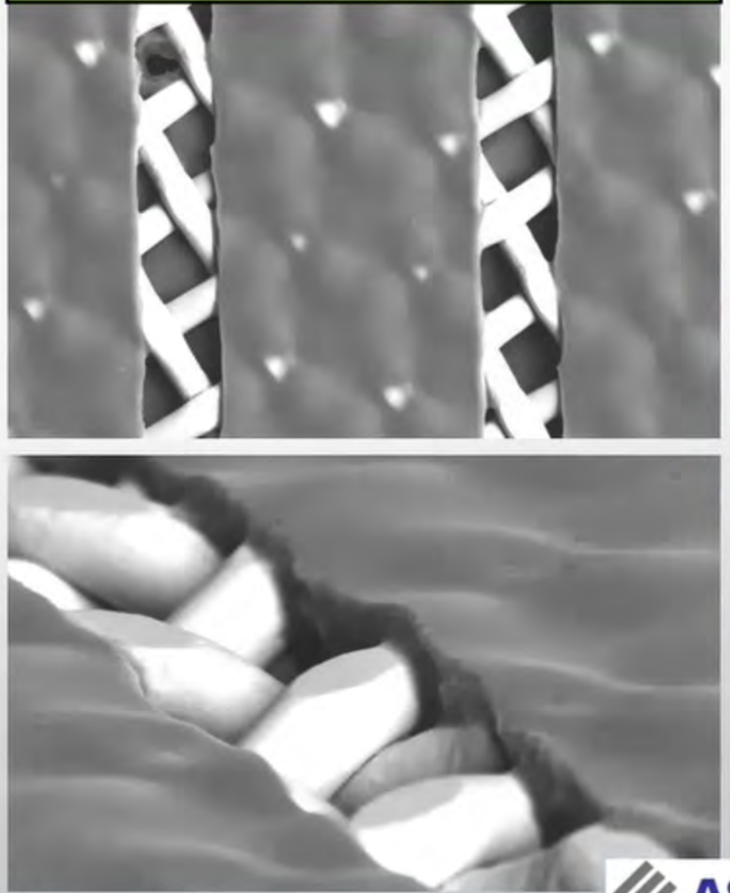
EMULSION RZ VALUE - Sample #1

FLATTENING METHOD APPLIED
GOOD RZ



NO FLATTENING METHOD APPLIED
POOR RZ



BS500/19
Cal = 28µ
Bias = 22.5°
EOM = 5µ

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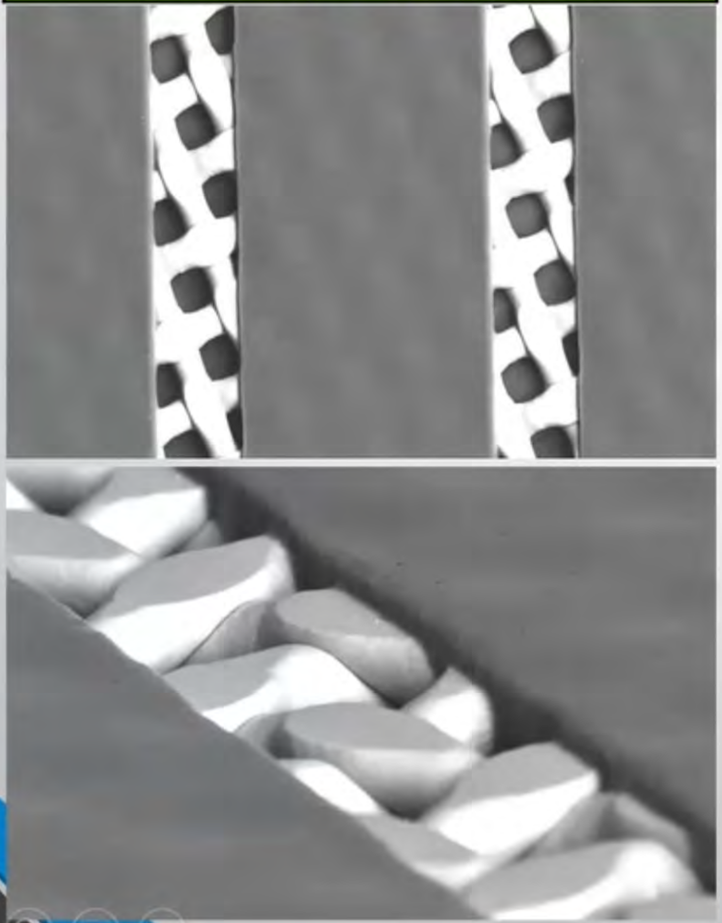
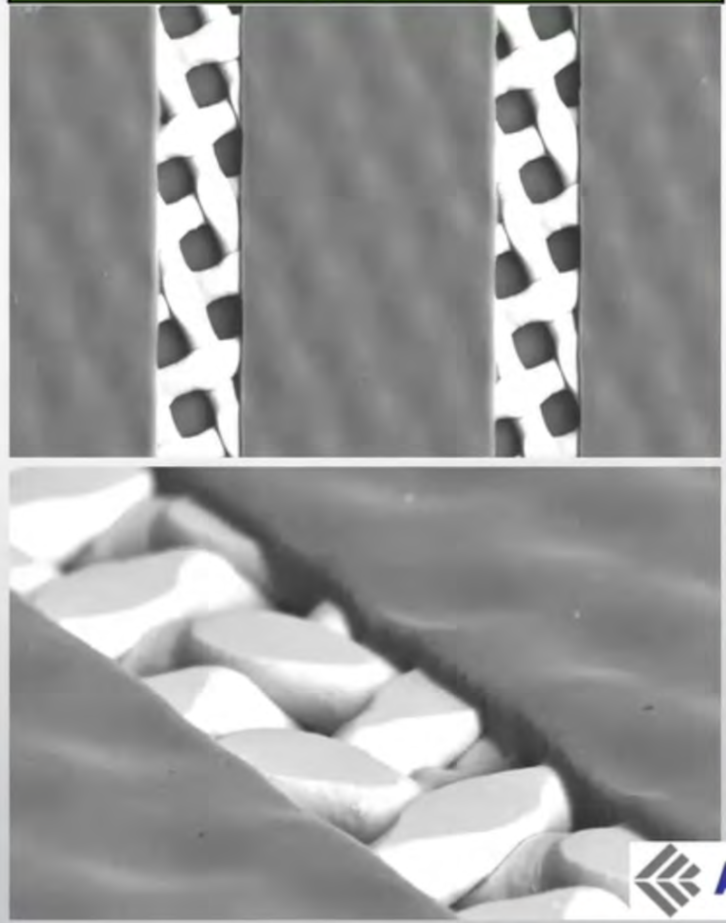
EMULSION RZ VALUE – Sample #2

FLATTENING METHOD APPLIED
GOOD RZ VALUE



NO FLATTENING METHOD APPLIED
POOR RZ VALUE



MS640/15
Cal = 17μ
Bias = 22.5°
EOM = 5μ

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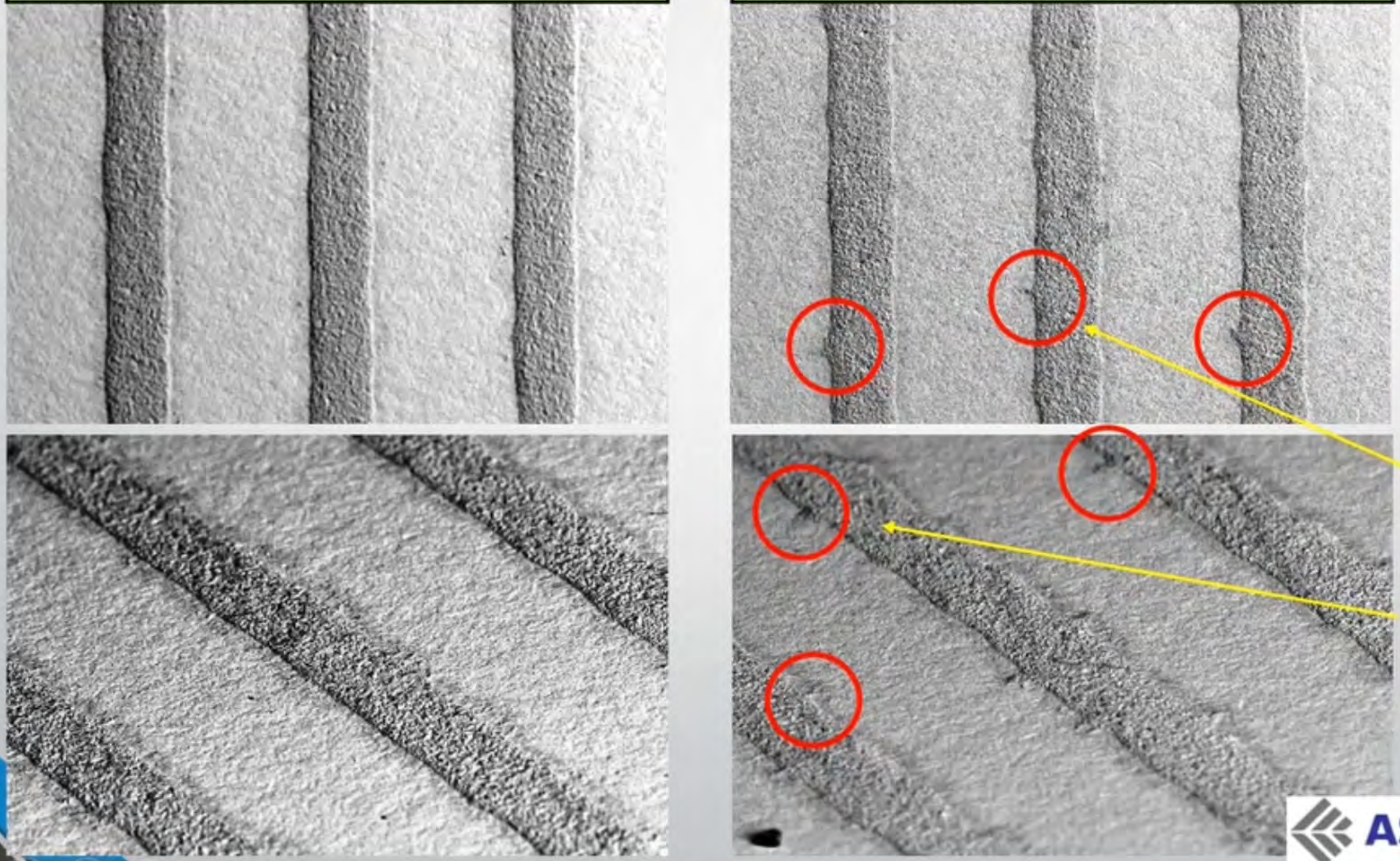
PRINTED RESULTS vs RZ VALUE

FLATTENING METHOD APPLIED
GOOD RZ

NO FLATTENING METHOD APPLIED
POOR RZ



MS640/15
Cal = 17μ
Bias = 22.5
EOM = 5μ

Poor emulsion gasketing allows the paste to escape

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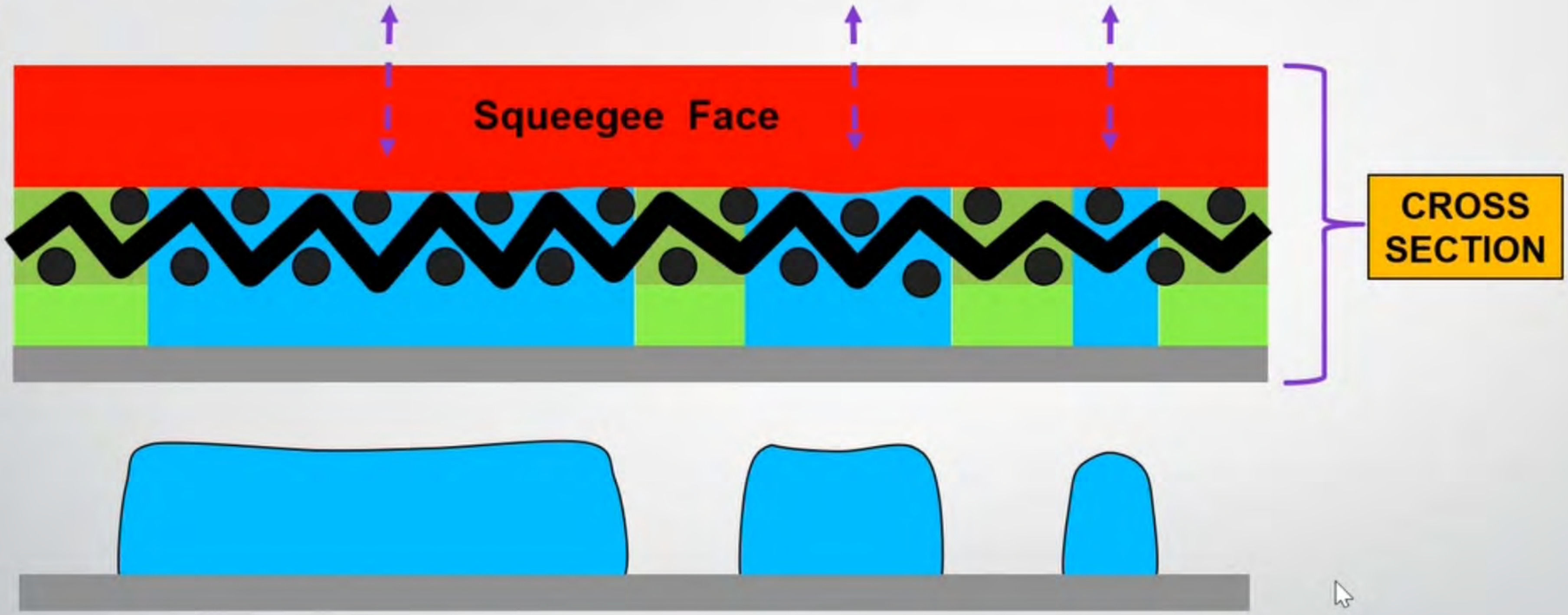
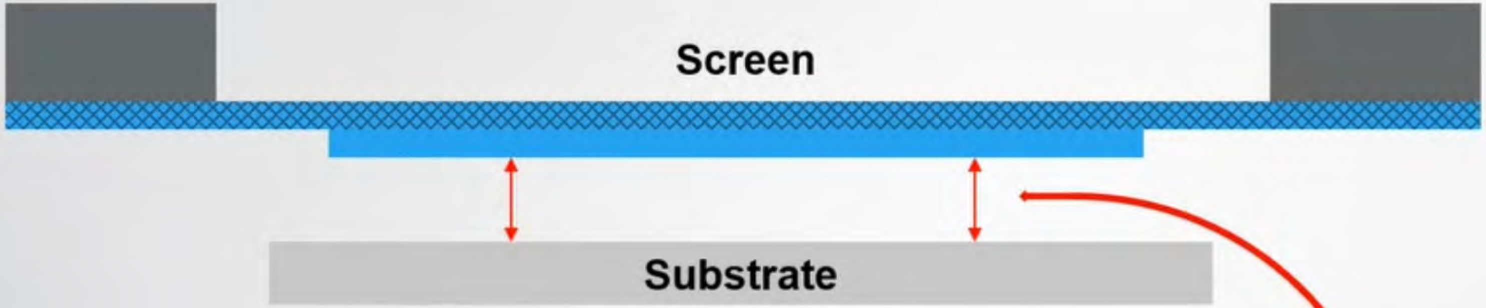
PRINTING PRESSURE LEVEL



The sharp edges of the squeegee penetrate into the open area of mesh and scrap off some material to shape the ink deposit

SNAP-OFF DISTANCE IS IMPORTANT



Distance between the bottom of the screen and the substrate. It is calculated using the formula below:

1/300th of the ID of the frame

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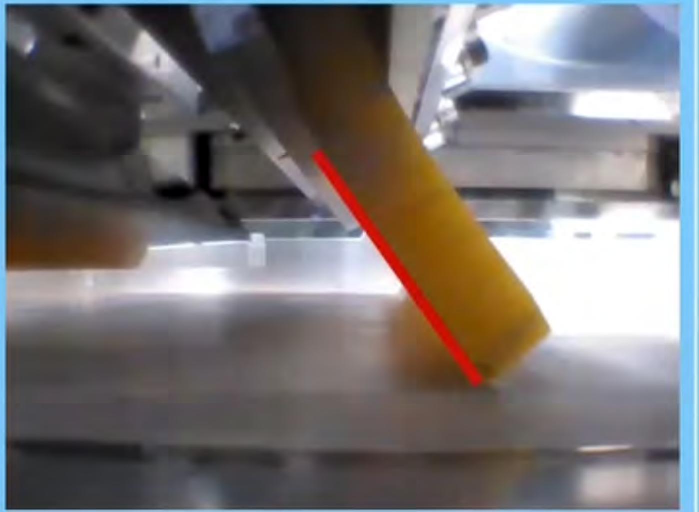
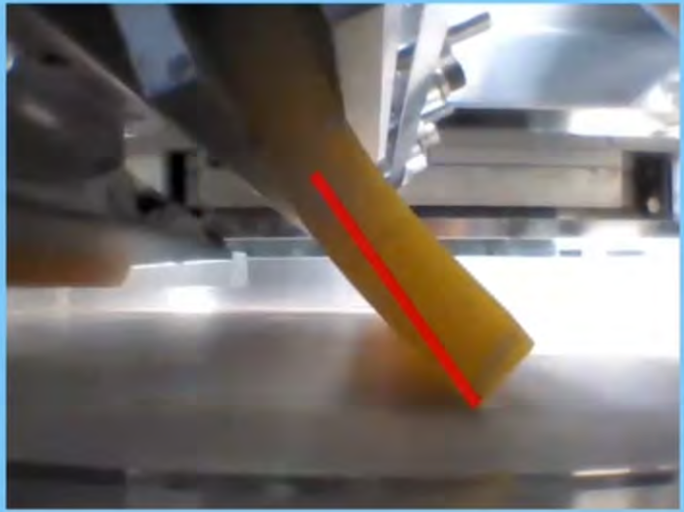
EXAMPLE OF SQUEEGEE PRESSURE

0.3 kg / cm



0.9 kg / cm



- The actual attack angle changes when the pressure increases.
- Squeegee hardness plays a key role in how much the angle changes (the softer the squeegee the more it will bend).

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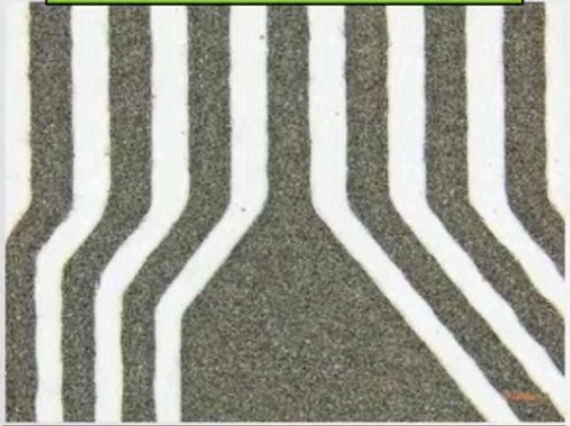
SNAP-OFF DISTANCE - PRINTED RESULTS

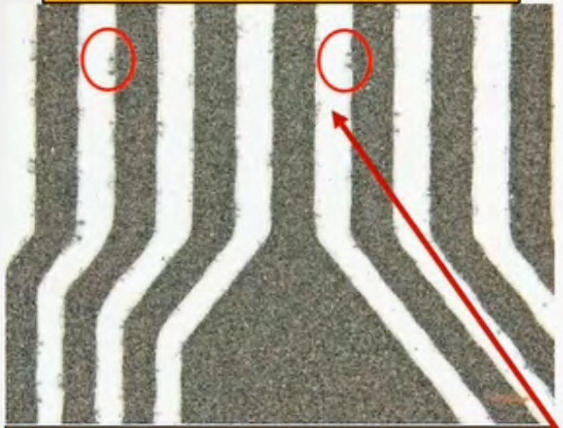
SNAP-OFF = 1.2 mm



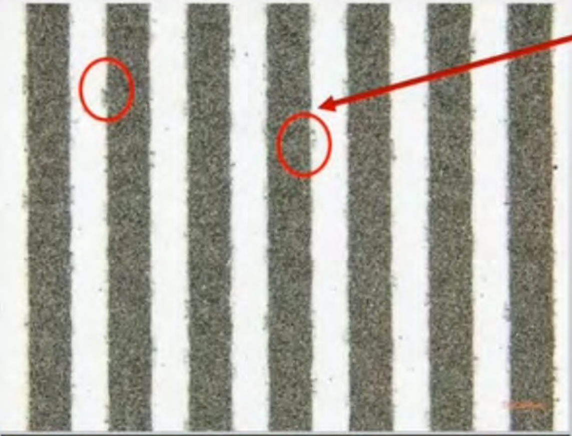
Designed: 75um Actual: 87～89um

Designed: 100um Actual: 108～112um

SNAP-OFF = 0.9 mm



Designed: 75um Actual: 91～106um



Designed: 100um Actual: 108～125um

HS-D500/19
CAL = 25μ
20° B

POOR RESULTS ARE DUE TO INSUFFICIENT SNAP-OFF DISTANCE

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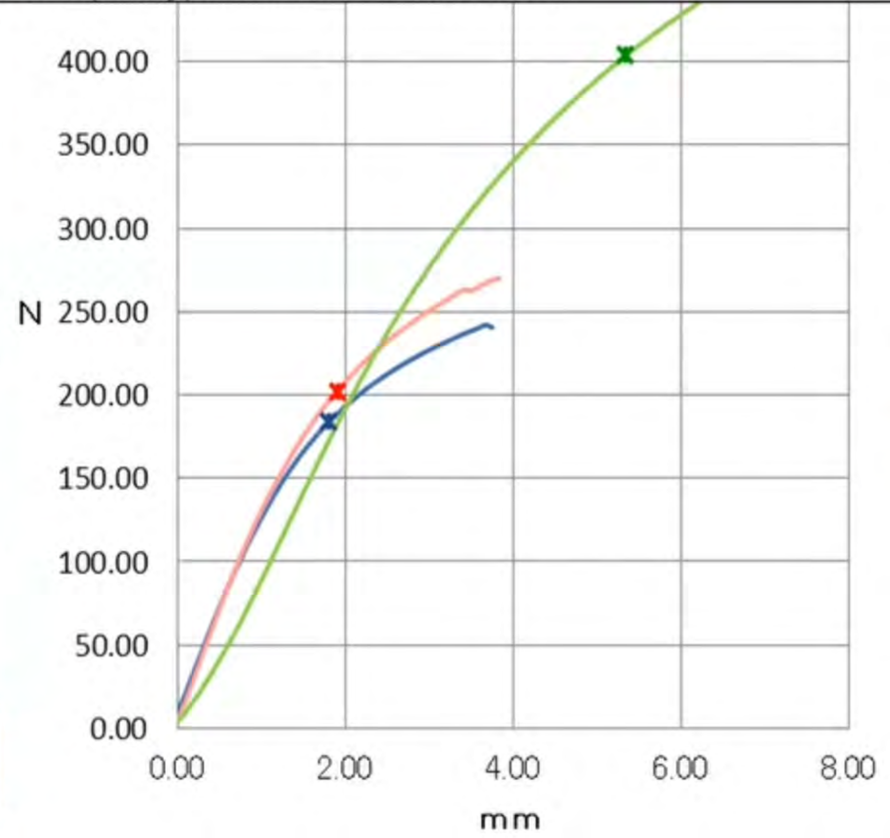
HSD MESH - NO DISTORTION

Supermesh-Type **HS-D** ★★

Ultra-Hard "Non-distortion"
Stainless Steel Woven Wire Cloth

Tensile strength of Supermesh HS-D is over 3 times greater than BS-Standard. Produces more stable and dimensional accurate print plus it has an expected longevity of 2x-3x conventional meshes. Screen printing potential will be further enhanced.



- ❖ **Screens have minimum distortion in either direction even after thousands of prints.**
- ❖ **Screen longevity is 2x-3x times.**
- ❖ **25-30 micron features are possible.**

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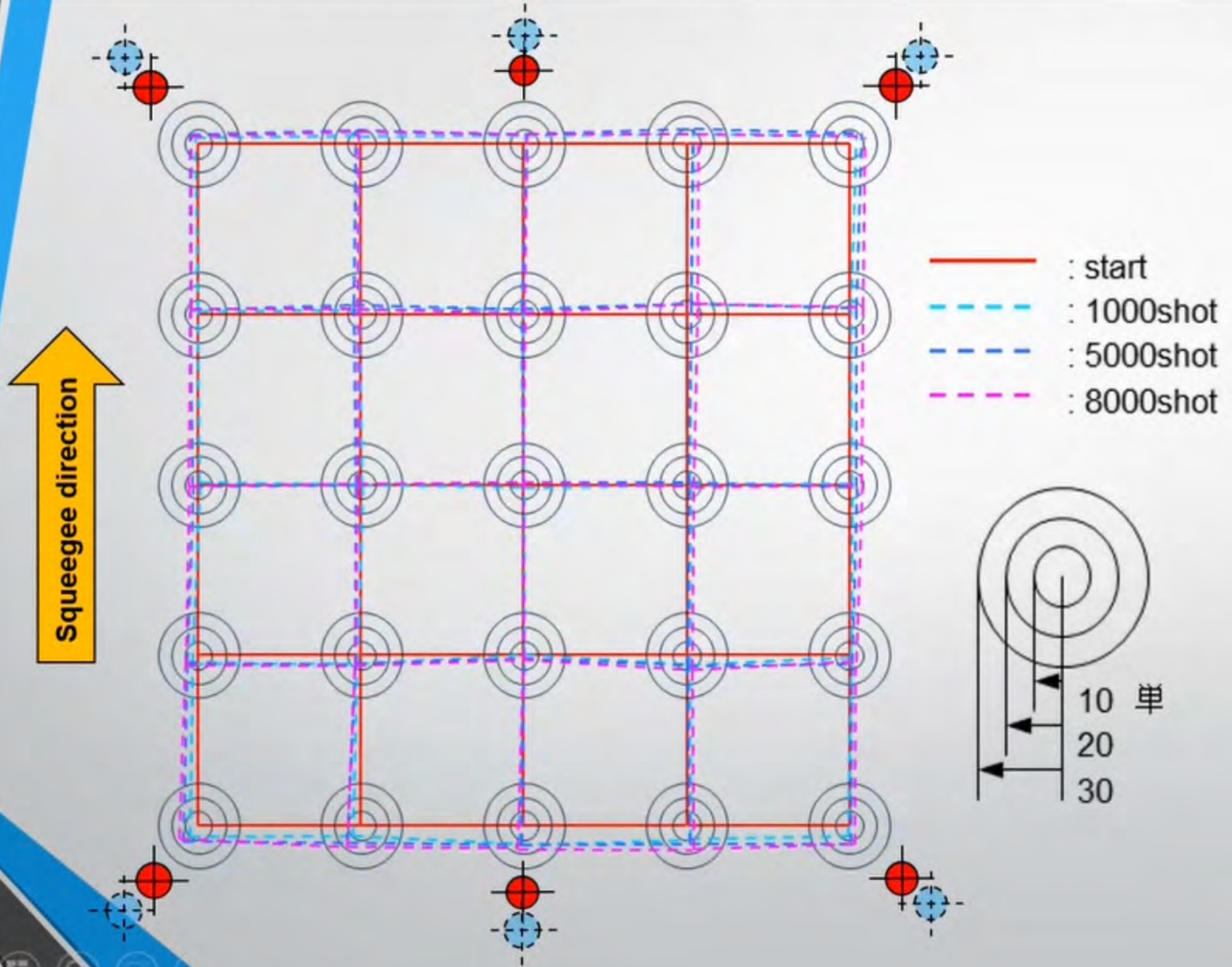
PRINT PATTERN REGISTRATION – HSD MESH



HS-D 500/19
Cal = 25um
EOM = 10um
200mm x 200mm IMAGE

HSD Mesh is recommended to obtain minimum distortion in either direction even if the Snap-off 3x is higher

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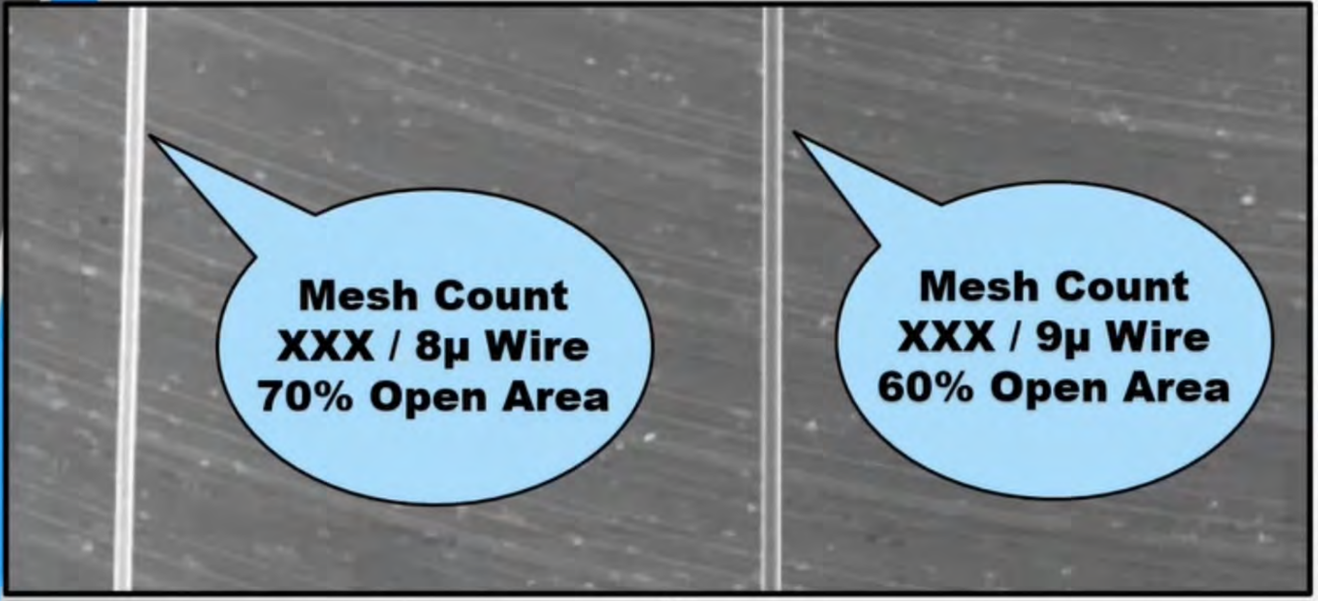
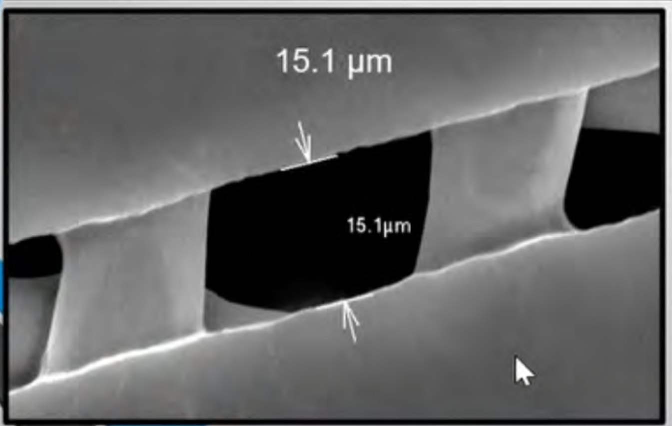
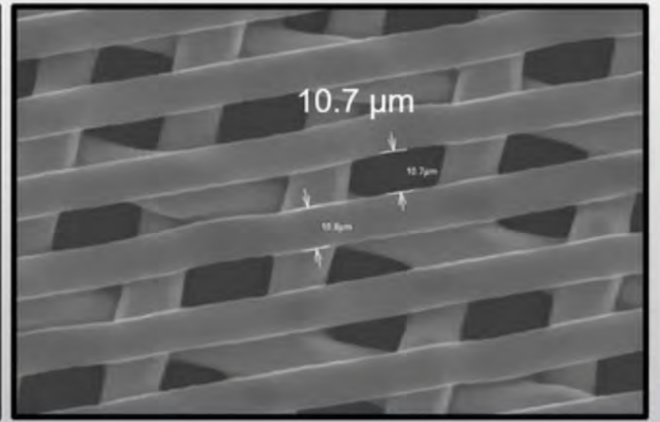
FUTURE OF SCREEN PRINTING TECHNOLOGY



ASADA MESH WILL LAUNCH SUB-10 MICRON DIAMETER WIRES IN THE NEAR FUTURE WHICH WILL ALLOW SCREEN PRINTING TO OBTAIN NARROWER FEATURE SIZES AND TO PRINT VERY THIN LAYERS.





COURTESY OF KIWO US

EMULSION TECHNOLOGY WILL SOON BE ABLE TO IMAGE FEATURE SIZES IN THE SUB-10 MICRON RAGE WHICH WILL ENABLE PRINTING OF NARROWER LINES.

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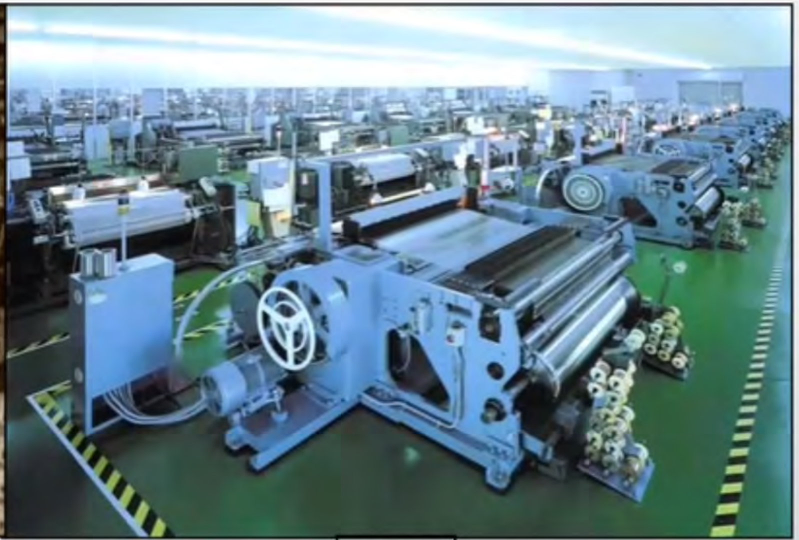
80+ YEARS OF CONSTANT INNOVATION

1940



2021

THANK YOU FOR YOUR ATTENTION !

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