Flexographic Printing Workflow

PLATE-MAKING CONSISTENCY

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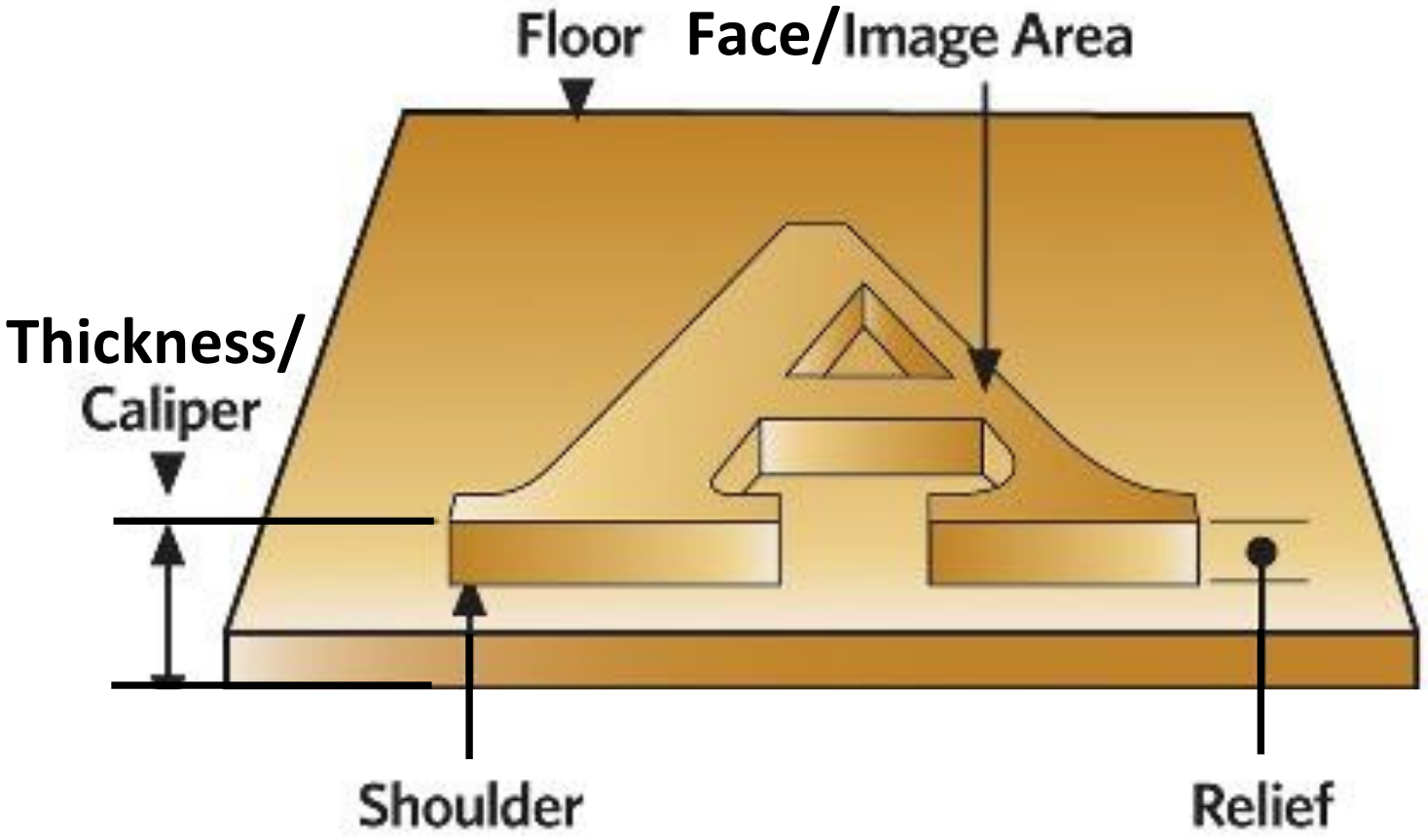
The Purpose Printing Plates

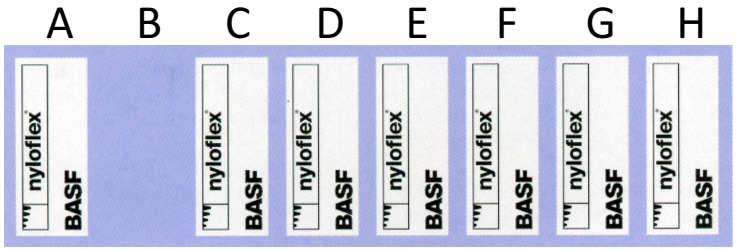
- The Printing plate is the carrier that picks up the ink in the design area and delivers that ink to the substrate.
- Flexographic plates, like letterpress plates, are relief plates with image elements raised above open areas.

Parts of the Photopolymer Plate



Back-exposure Relief Test

Step A remains unexposed for check of wash-out

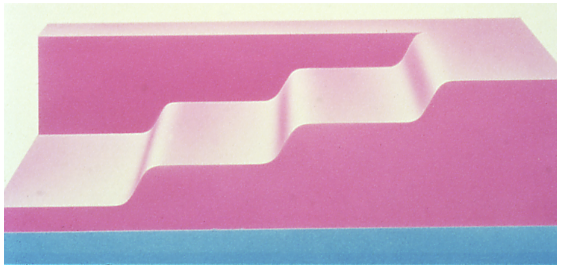


.045 - .112 plates
Time per step:
About 20 seconds

.125 - .250 plates
Time per step:
About 30 seconds

Important:

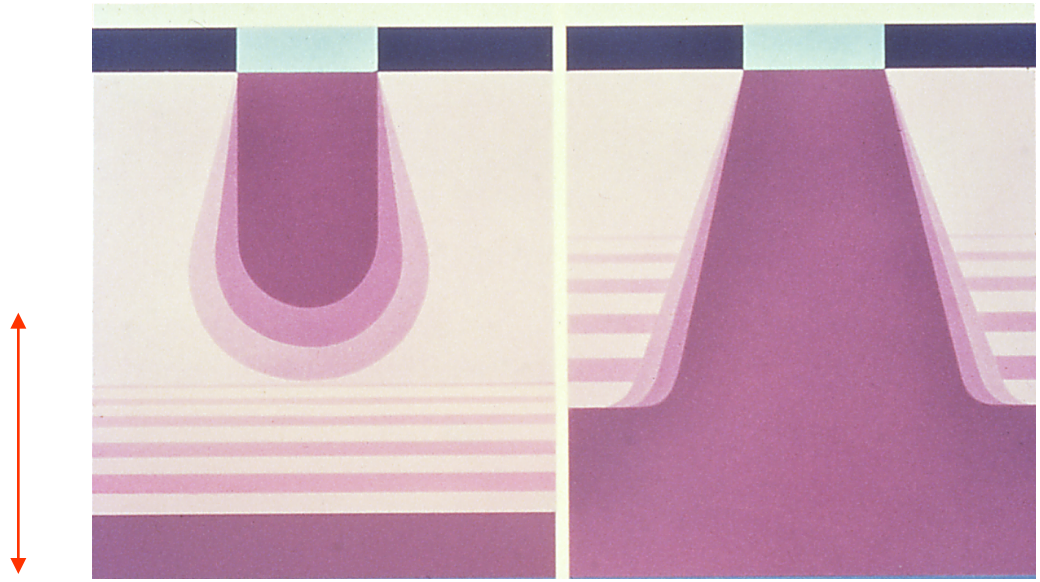
- Test only with warm tubes
- Expose each section individually in order to avoid affects of tube flickering time
- Choose wash-out time so that Step A, with no exposure is completely washed out
- Minimum drying time: 30 minutes



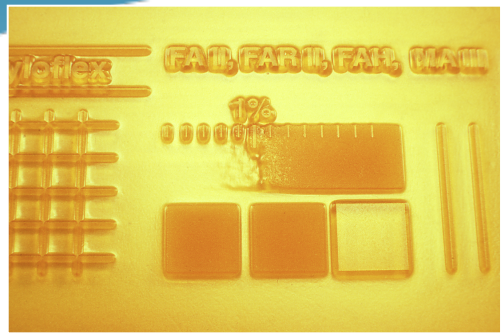
Profile of test plate with different back-exposure times

The Effect of Back-exposure

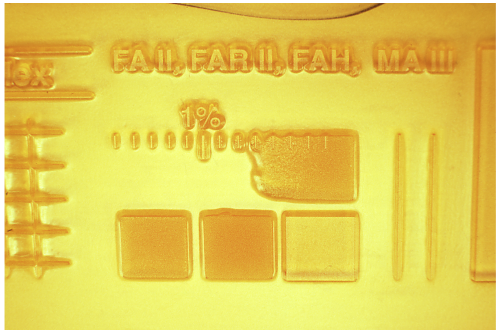
- Back exposure serves to achieve better anchoring of fine images.



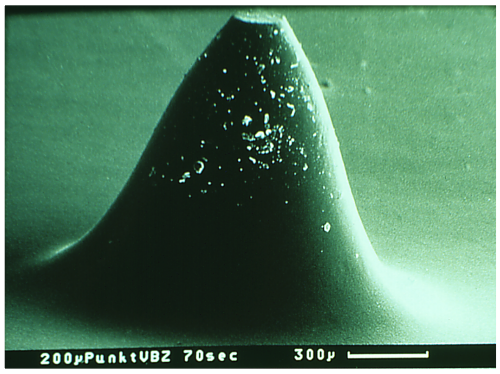
Insufficient and Optimum Back-exposure



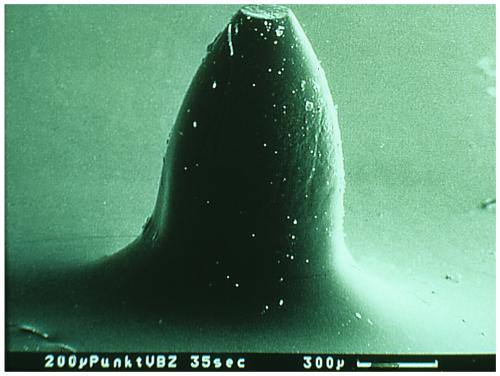
Optimum Back-Exposure



Half Back-Exposure Time



70 sec



35 sec

Face exposure is the same in each case !

Back Exposure QC

- The tools used for back exposure QC
  - Micrometer used to measure the floor, which in turn creates the plate relief.
  - Light meter (UV-A) used to monitor lamp strength and determine test frequency

Making the Analog Polymer Plate

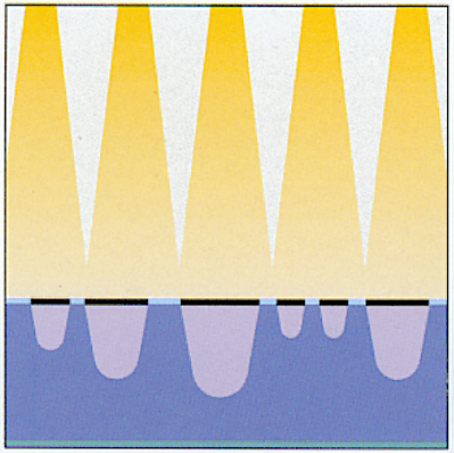
- Before main exposure, inspect film negative for finish, thickness, density, and quality.

Finish – matte

Thickness .005” - .007”

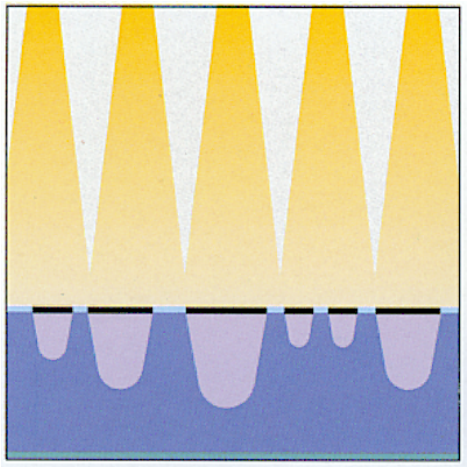
Density – 4.0 matte
Density - .05 clear

Quality - Pinholes



Making the Analog Polymer Plate

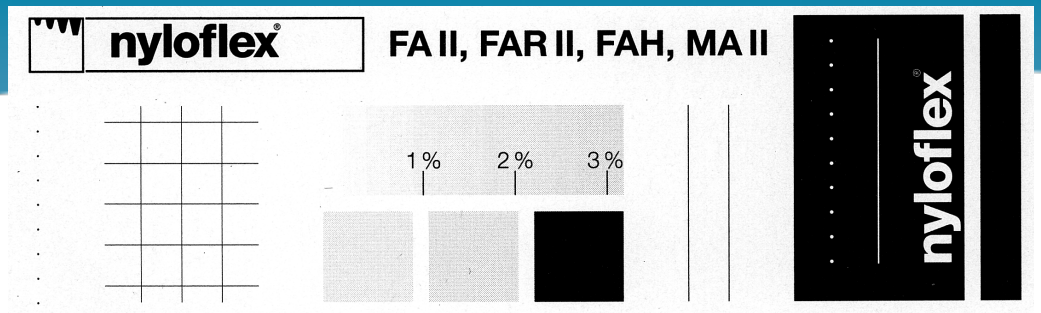
- A main exposure is performed through the top of the plate with UV-A. This establishes the copy on the plate face.

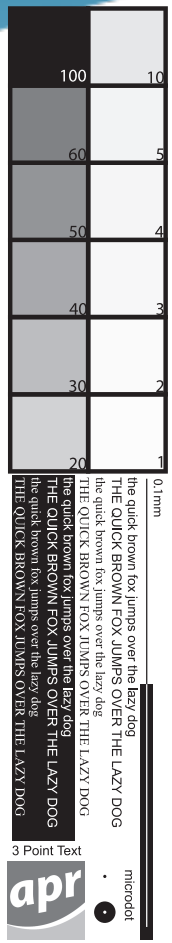


Making the Analog Polymer Plate

A vacuum (kreen) film holds the negative tight against the polymer

Main Exposure Test





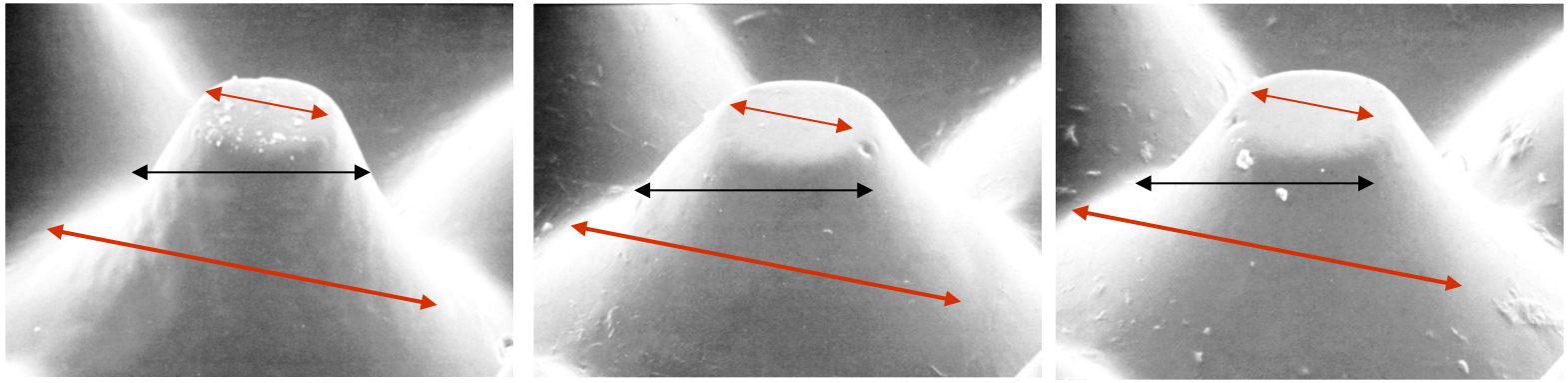
1 2 3 6 7 9

1. Dots of 200 µm dia.
2. Grid of 50 µm lines
3. Field of 150 lpi screen, 2% tonal value
4. Field of 150 lpi screen, 3% tonal value
5. Field of 150 lpi screen, 90% tonal value
6. Lines of 100 µm
7. Reverse dots of 400 µm dia.
8. Reverse line of 200 µm
9. Trench of 2 mm (0.079“) width

Acceptance limits

Effect of Excess Main-exposure

Dot of 10% tonal value, 120 lpi



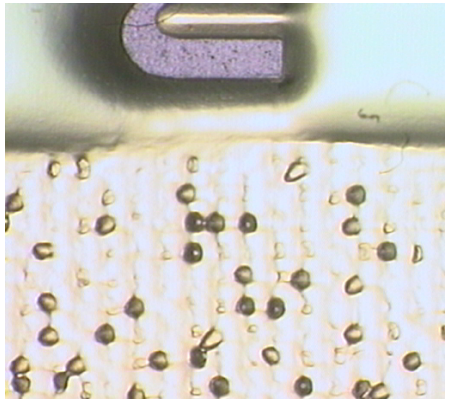
Exposure time 3‘
67.9 µm

Exposure time 13‘
68.1 µm

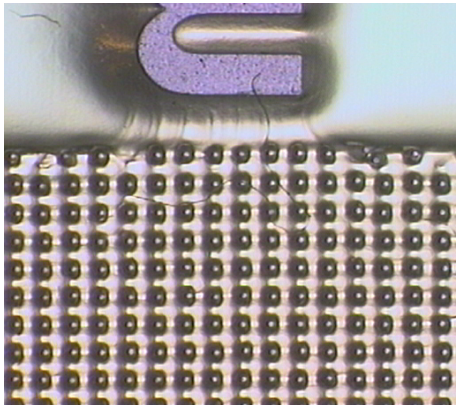
Exposure time 25‘
68.5 µm

The different exposure times will only change the shoulder angle of the relief

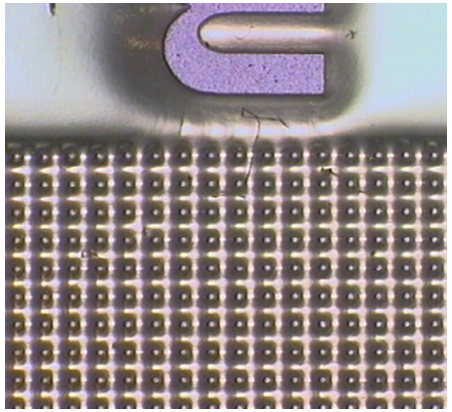
Effect of Main-exposure in Screens



1



2

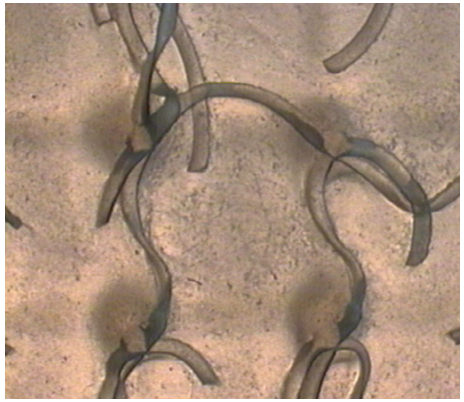


3

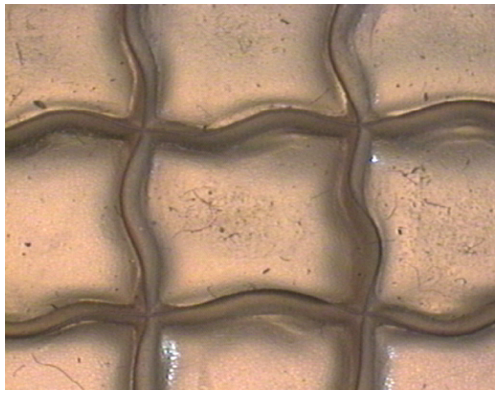
1&2 = under-exposed

3 = exposure time OK, relief is fully developed

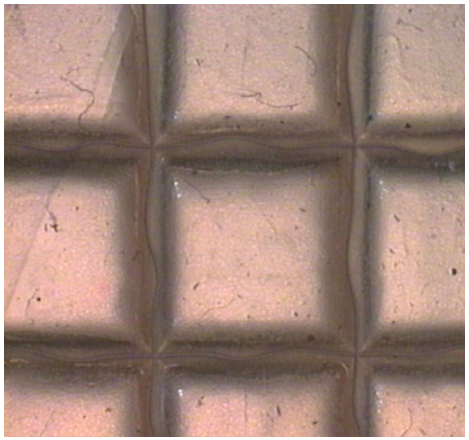
Effect of Main-exposure on Fine Lines



1



2



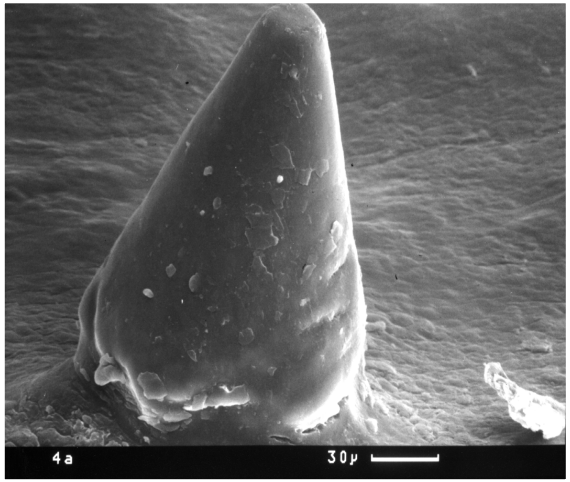
3

1&2 = under-exposed

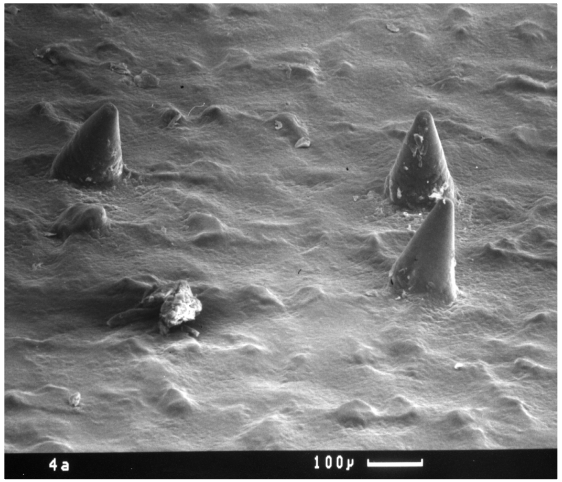
3 = main exposure still needs additional time

Examples of insufficient Back-exposure and Main-exposure

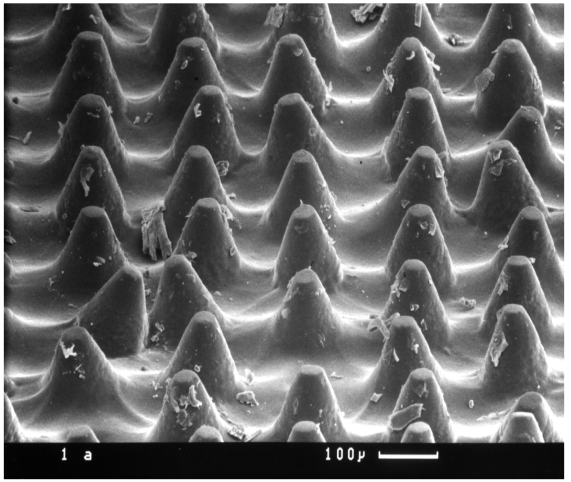
Insufficient anchoring



Washed-off dots



Slanted dots

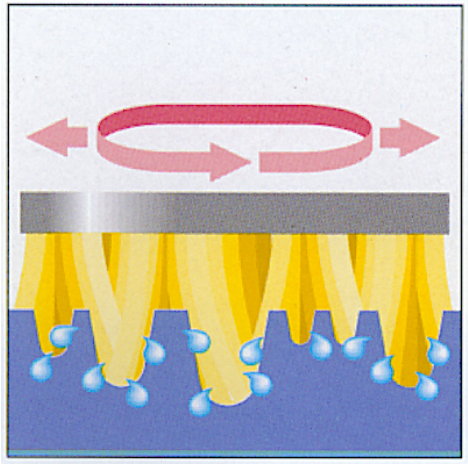


Main Exposure QC

- The tools used for main exposure QC
  - Loupe used to visually inspect plate and dot quality.
  - Plate reader used to measure dot quality, i.e. consistency, dot%, shoulders, etc.

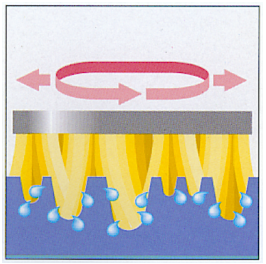
Making the Analog Polymer Plate

- After main exposure, the non-image area must be washed away with H2O, solvent or removed thermally through heat and pressure to create a relief plate with face and floor areas.



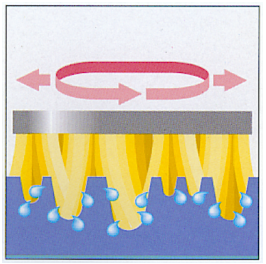
Which Method is the Best?

- Solvent wash systems have always held the highest degree of processing at the highest lpi and min dots.
- Water and thermal are known for quick turn around because they don’t require drying.
- Water wash plates also know for their longevity



Which Method is the Best?

- In the past few years the playing field has leveled
  - Solvent plates drying in as little as 20 min
  - Thermal processing has increased ability to achieve higher lpi and smaller min dots
  - Print quality of water wash plates meets the level of solvent and thermal and is truly the fastest process
  - It comes down to personal preference as strong arguments can be made for each

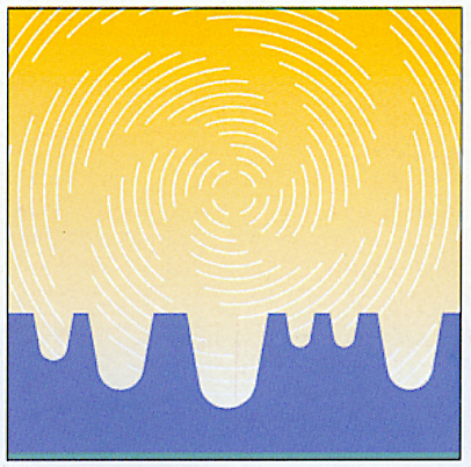


Processing (Washout) QC

- The tool used for plate washout or thermal processing QC
  - Micrometer used to measure the floor material thickness, which in turn creates the plate relief.

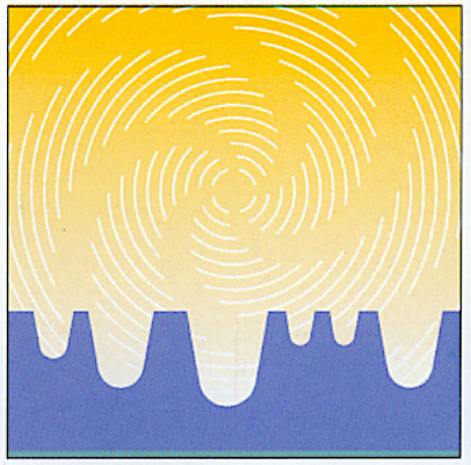
Making the Analog Polymer Plate

- If your plate requires drying to drive out washout solutions from the plate, the plate moves on to the dryer after the washout stage.

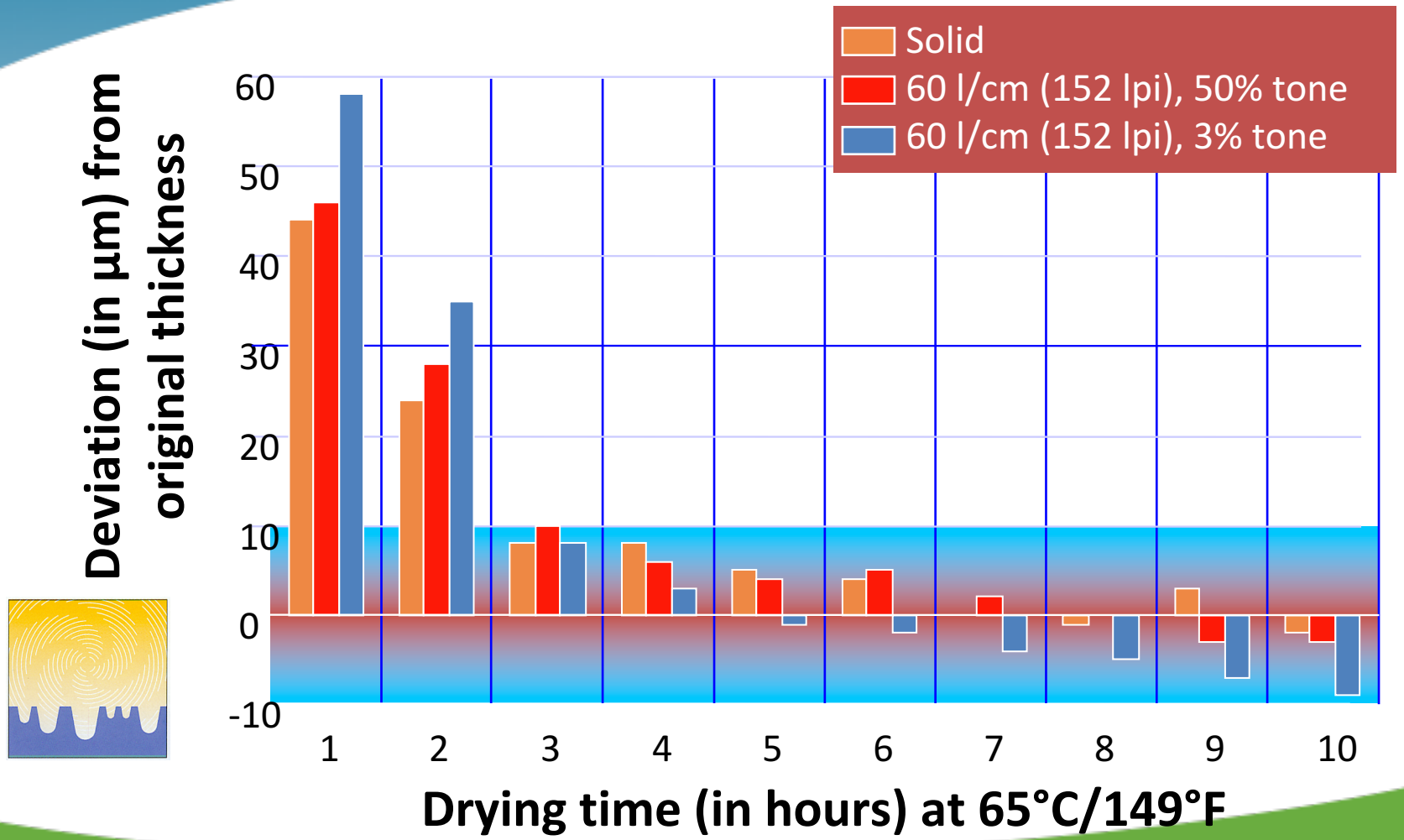


Making the Analog Polymer Plate

- In years past before alternative solvent solutions entered the market is was not uncommon to see dry time exceed 2 hrs. Drying was the bottleneck.
- Plates can now be made within 1 hr, rivaling thermal



Making the Analog Polymer Plate

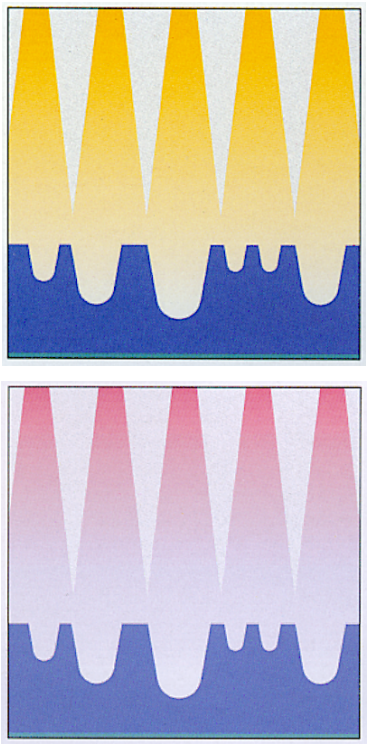


Drying QC

- The tool used for plate drying QC
  - Micrometer used to measure the material thickness. When the material returns to it's original thickness it is dry.

Making the Analog Polymer Plate

- After drying it is best to let the plate rest at room temperature for 10-15 for optimal dimensional stability and fit.
- The plate is then simultaneously post exposed (UV-A) and detacked or light finished (UV-C).



UV-A versus UV-C

Table 1. UV spectrum.

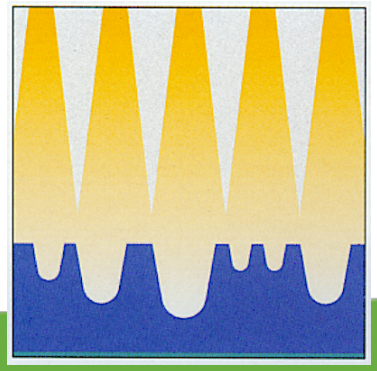
UVR	Level of UVR on Earth	Wavelength	Absorbed by	Biological effects
UVA	95-99%	320-400 nm	Riboflavin, porphyrins, and heme	Photoaging Formation of reactive oxygen and nitrogen species Indirect DNA damage
UVB	1-5%	290-320 nm	DNA in the epidermis	Sunburn Tanning Direct DNA damage
UVC	0%	220-290 nm	Ozone prior to reaching earth	N/A

N/A: not applicable; UV: ultraviolet; UVR: UV radiation.

Image courtesy of International Journal of Clinical Reviews
http://www.remedicajournals.com/International-Journal-of-Clinical-Reviews/BrowseIssues/November-2010/Article-Systemic-Lupus-Erythematosus-Treatment

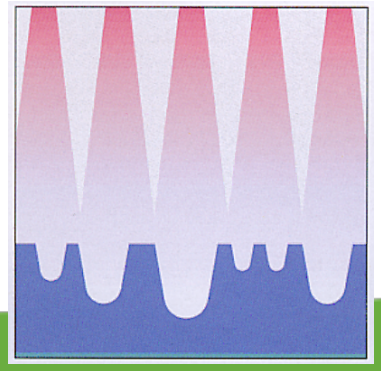
Post Exposure

- Post exposure (UV-A) is a full-surface exposure of the dried plate, without film and vacuum. Post exposure ensures total cross linkage of relief parts only partly polymerized before. Only after sufficient post exposure will the plate reach its final hardness, which affects ink delivery.



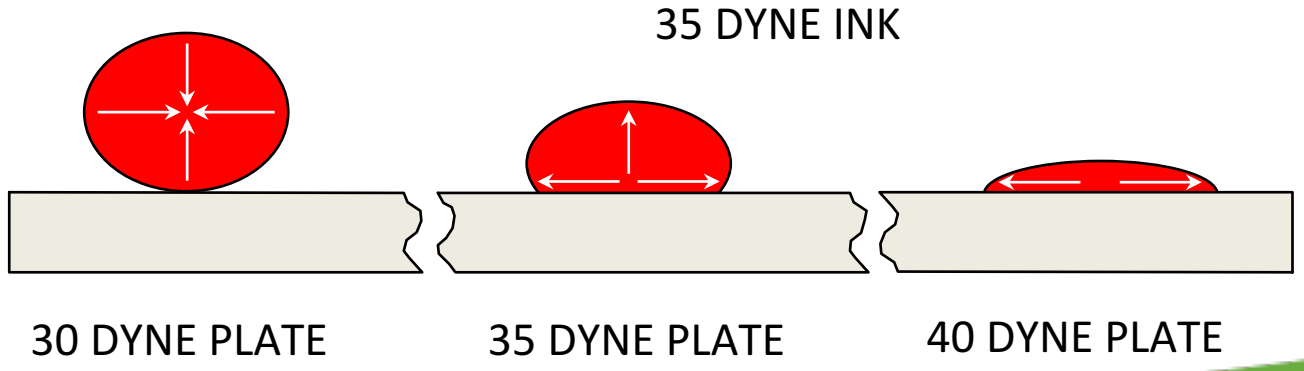
Detack a.k.a. Light Finishing

- Detack, a.k.a. light finishing (UV-C) is a full-surface exposure of the dried plate, without film and vacuum. Detack ensures that all stickiness is removed from the plate that will affect ink delivery and plate longevity.
- Note: UV-C is extremely harmful to the skin and eyes and in always used enclosed with the machine.



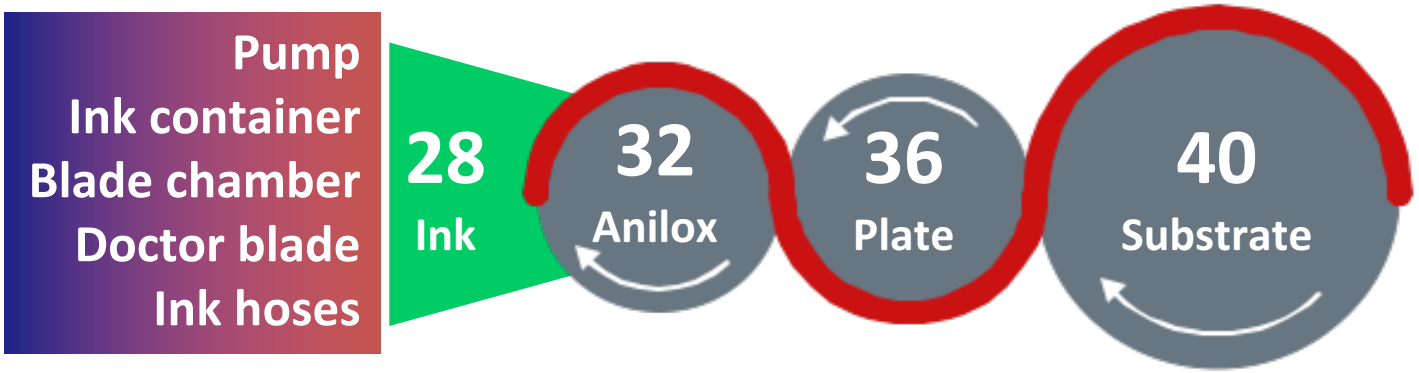
Post Exp / Detack Affect Ink Delivery

- Surface energy is what enables the plate to accept ink from the anilox roll and release the ink t the substrate.
- Dyne level is the numeric measurement of surface energy.
- Surface tension is the force that pulls like particles close together.

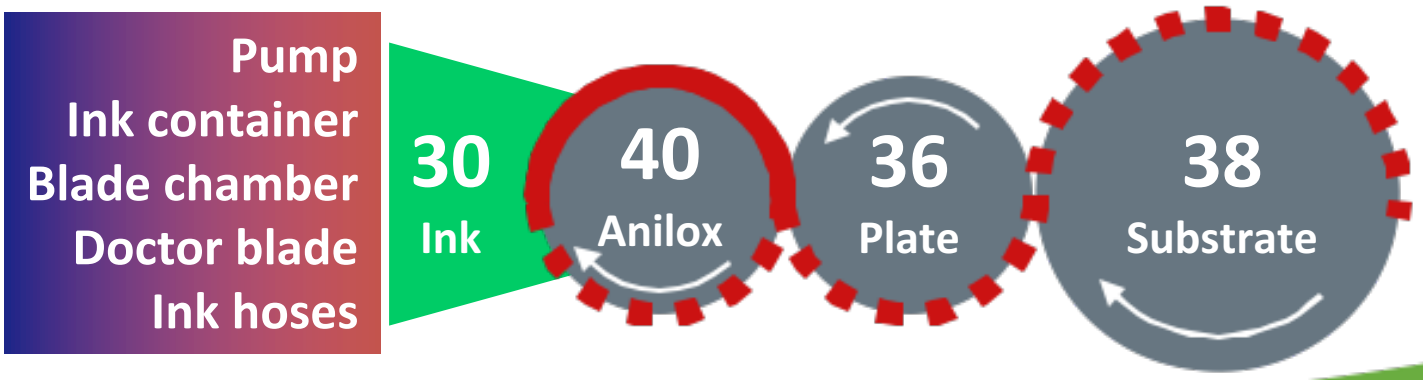


The Effect on Press

Regular increase



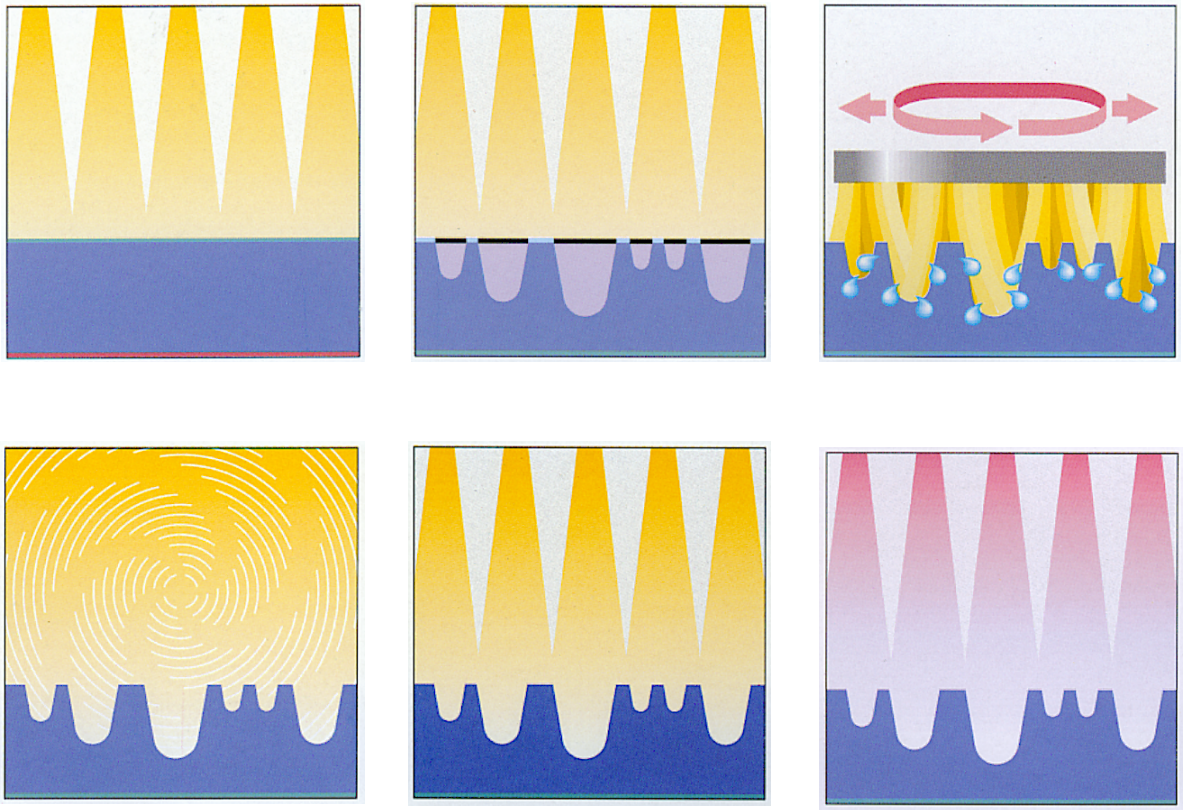
Non-regular increase



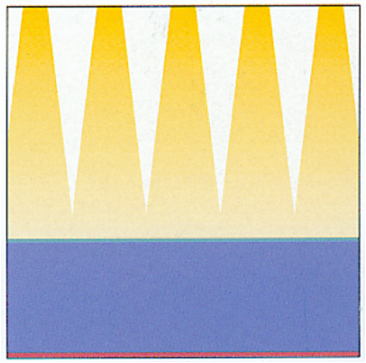
Post Expose and Detack QC

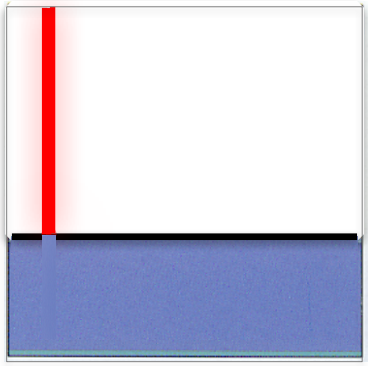
- The tools used for post expose and detack QC
  - UV-A and UV-C used to determine lamp strength and base exposure time.
  - Loupe to inspect for cracking
  - Shore A durometer gage to measure hardness

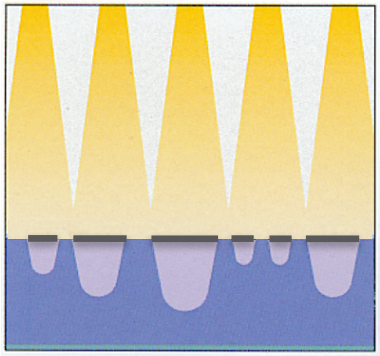
Recap Analog Platemaking

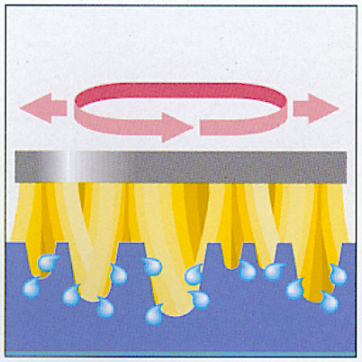


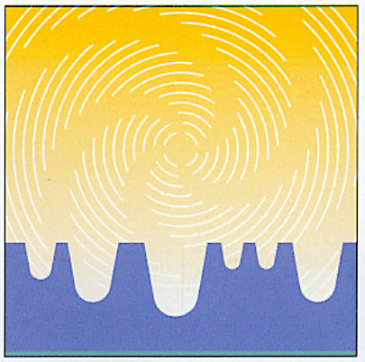
Making the Digital Polymer Plate

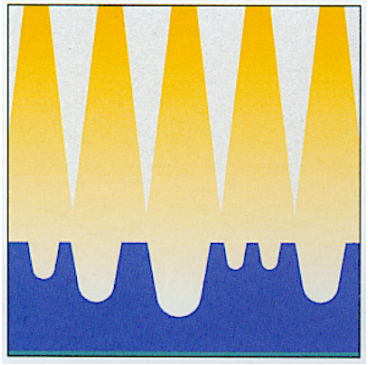


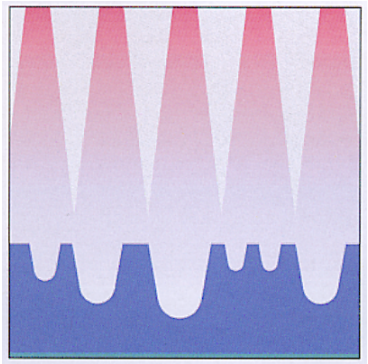




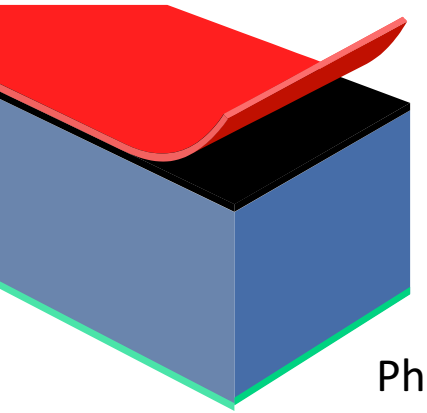






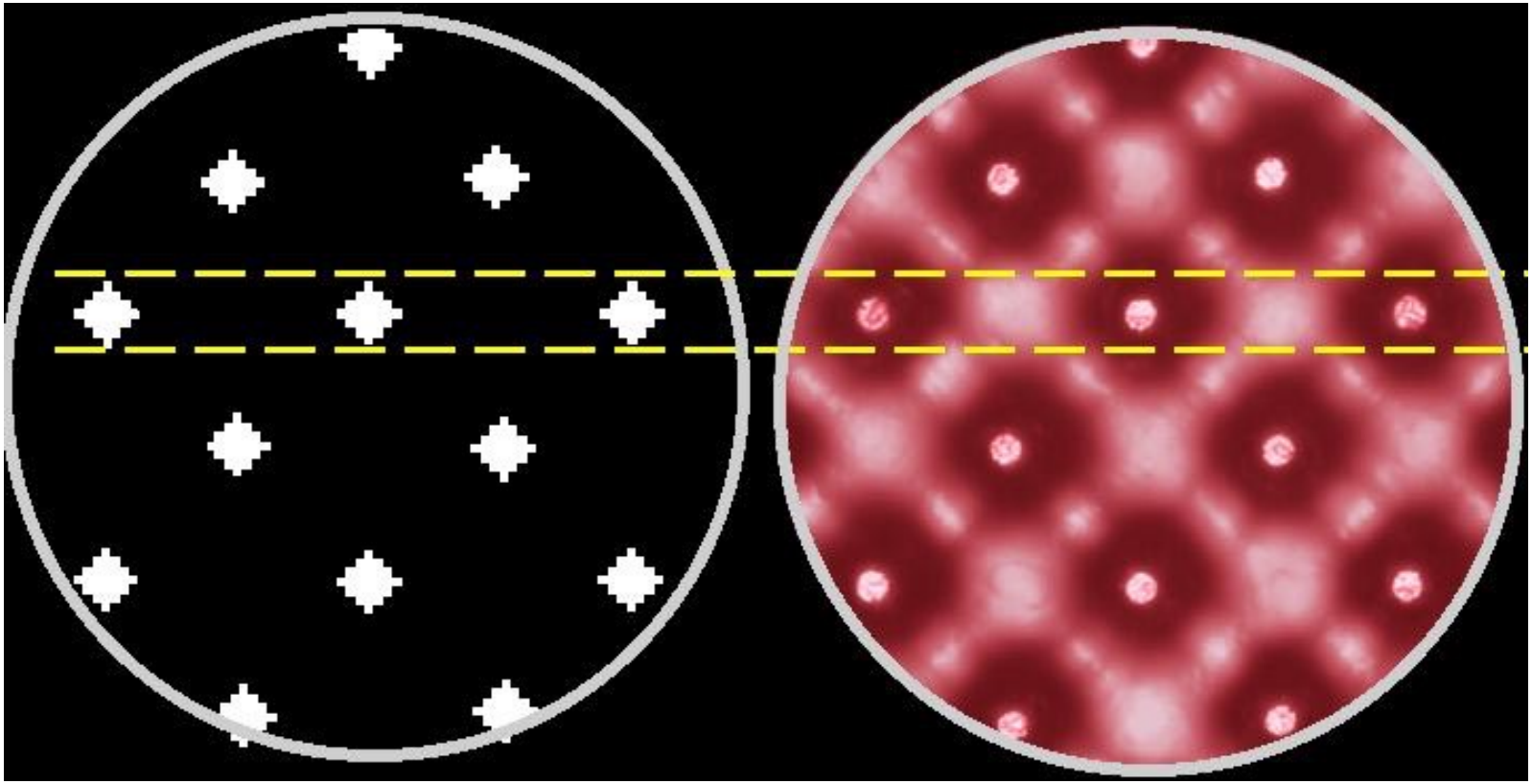


The Difference is the Mask



- Film negatives, are replaced by a black carbon mask that is applied on directly the raw sheet of photopolymer by the manufacturer.
- A laser then ablates (images) away the thin black mask area in all areas that printed copy was required.

Oygen Presence = Dot Sharpening



Mask Dot: 8% **Plate Dot 2%**

Key Concept

- Thin Layer Of Black Carbon Mask On Plate Surface
- Focused Infra-red Laser Beam Burns Away Black Mask To Form Negative Image On Plate Surface
- Exposing The Plate In Open Air Causes Dot Reduction Or Shrinkage Of Dot Diameter – Customers Have To Compensate For This Dot Shrinkage.

Imaging Factors

- Number Of Beams
- Laser Power
- RPM Of Imaging Drum
- Focus
- Mask Density

Optimize Laser Power Setting, RPM Of Drum & Focus According to Plate Gauge And Mask Density

Plate Imaging QC

- The tools used for laser imaging QC
  - B/W Transmission Densitometer used for stain test.
  - 100X Scope for inspection
  - STEP 1
    - Rip a test file containing 3 patches, no smaller than the aperture of your densitometer.
    - 1%, 50%, and 100% patches on the target. LPIs between 133 and 175 work well.
    - NO CURVE APPLIED – Linear only

Plate Imaging QC

- The tools used for laser imaging QC
  - STEP 2
    - Image this target on your plate, in the same place, twice to ensure that the 100% patch is completely free of any carbon mask.
    - This double-ablated patch will be the zero-point for your densitometer. Mark this patch with a zero on the plate to remember that it is the zero-point.

Plate Imaging QC

- The tools used for laser imaging QC
  - STEP 3
    - Image the same target in a new location on the plate, once only. This will be the patch that you'll read to determine the laser ablation status.
  - STEP 4
    - Remove the plate and zero the densitometer on the "zero" marked 100% patch. Read this patch to confirm zero.
  - STEP 5
    - Taking the readings

Plate Imaging QC

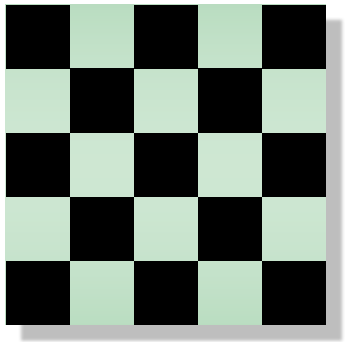
- Stain Test (100% patch): Read the 100% patch on the single-ablated target. The maximum allowed density is 0.06. Anything above this is considered out of spec. After taking this reading, zero the densitometer to this patch before taking the 50% reading.

- Power Test (50% patch): Read the 50% patch after zeroing to 100% stain patch. The reading should be between 0.28 – 0.32. Anything above or below this range may indicate a power setting issue.

- Rough Focus Test (1% patch): This is a simple, rough test to check that your laser is generally in focus. You should be able to see dots in the mask under magnification (100x recommended). If no dots are seen in this patch, it could be a sign of a focus issue or power setting issue.

Plate Imaging QC

- Loupe or Scope is used during a power test using a 50% Euclidean screen test which tells us the correct drum speed that laser device is operating.
  - 1. We want the perfect checkerboard.
  - 2. Overexposed = Drum is too slow or power too high
  - 3. Underexposed = Drum is too fast or power too low



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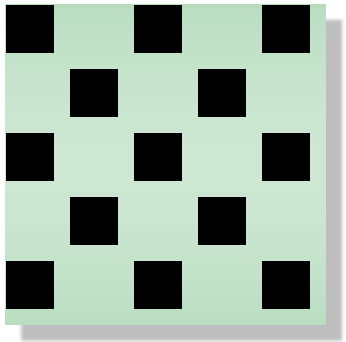

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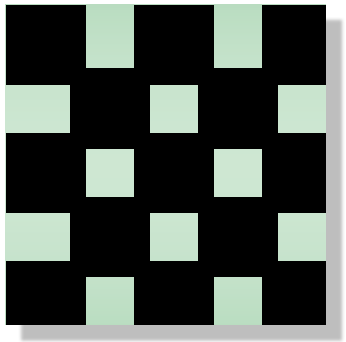
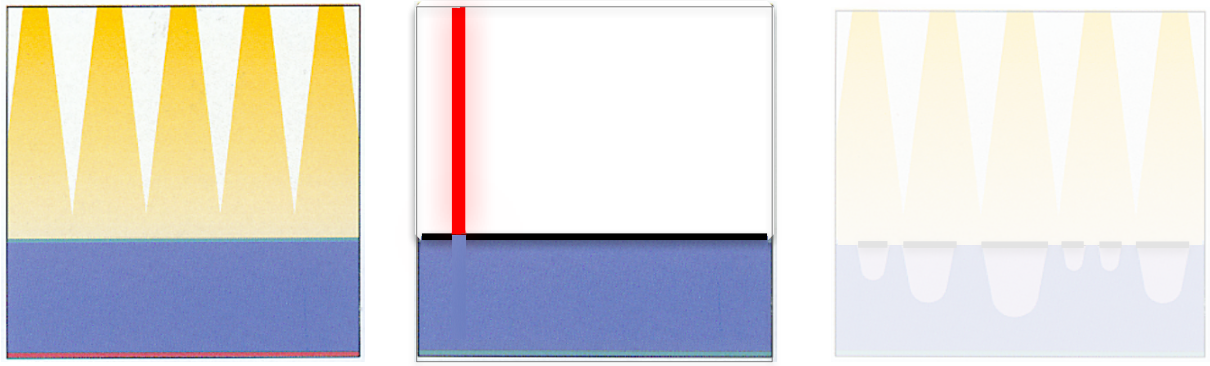


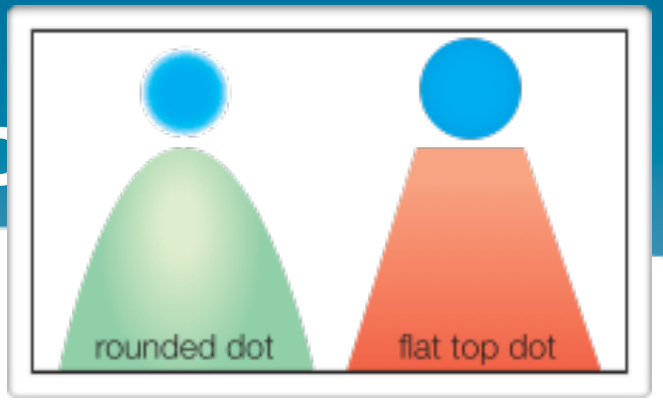
3

Making the Digital Polymer Plate



- The rest of the process is the same as the analog platemaking process.
- The remaining QC processes are also the same.
  - Main differences being the film QC process is replaced with Laser QC process, i.e. focus and stain tests.

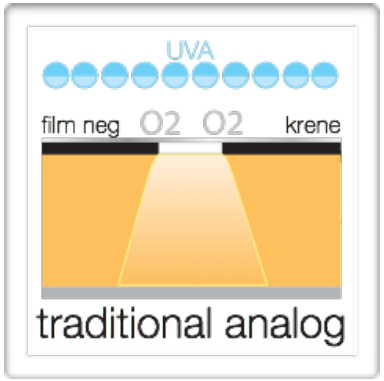
What is Flat To



- Dot with flat, rather than rounded face (surface)

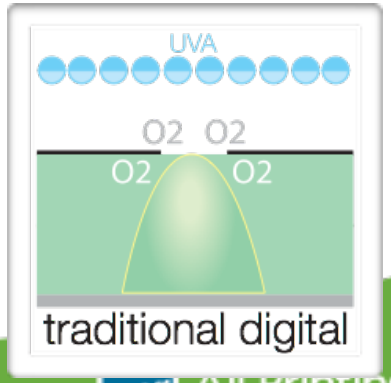
Film → Plate → Expose → Process

Traditional Analog Process

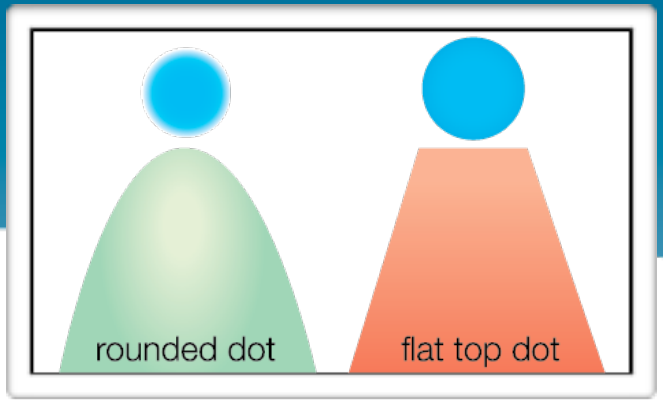


Film → Image → Plate → Expose → Process

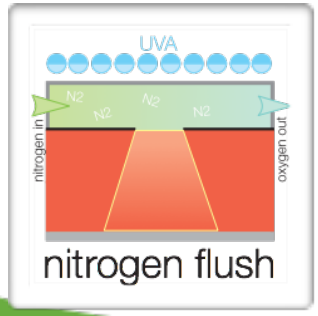
Traditional Digital Process

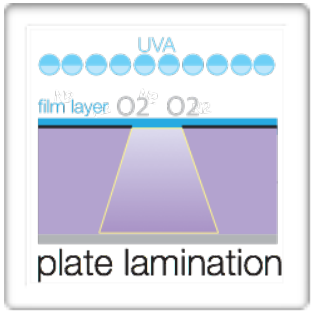


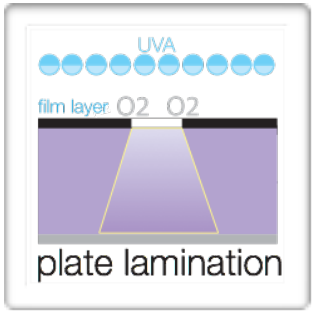
Why Flat Top?

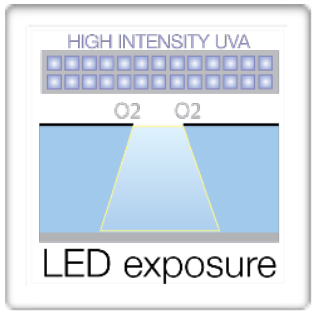


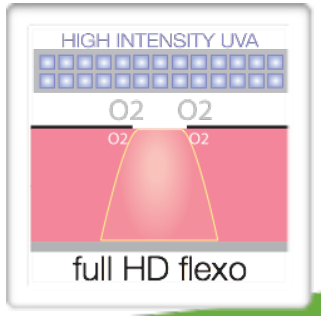
- Improved resistance to over-impression
- Improved resistance to plate wear
- More stable HL dot structure
- Improved Solid Ink Transfer due to surface screening

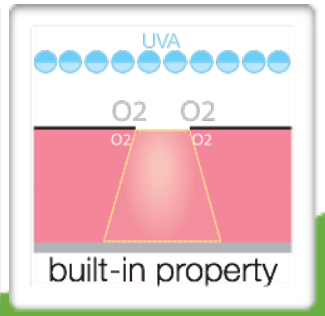






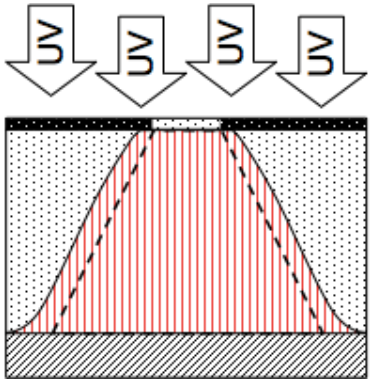


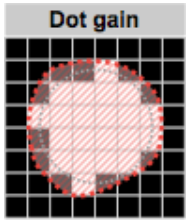


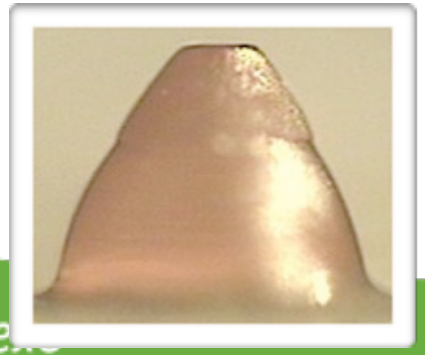


What does it Look like

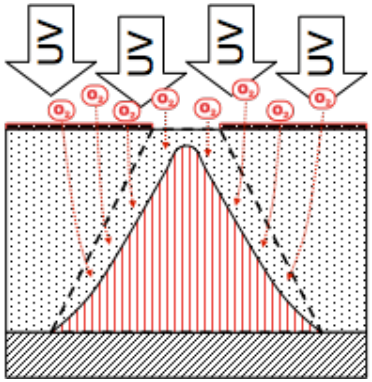
Analogue with Film & UVA

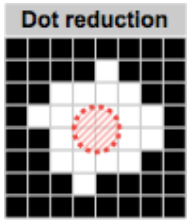


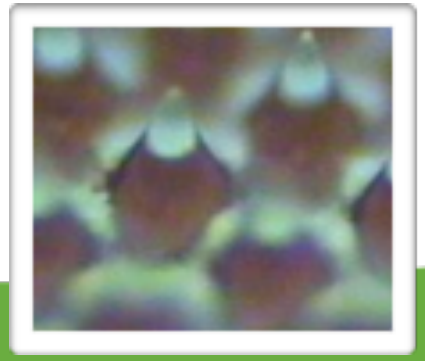




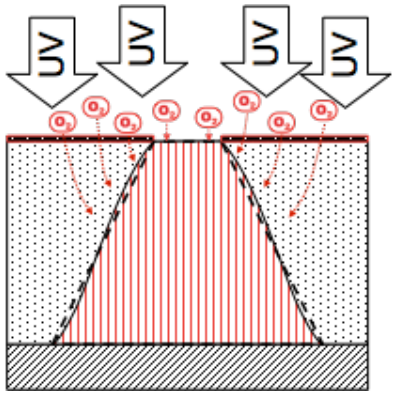
Digital with LAMS & UVA

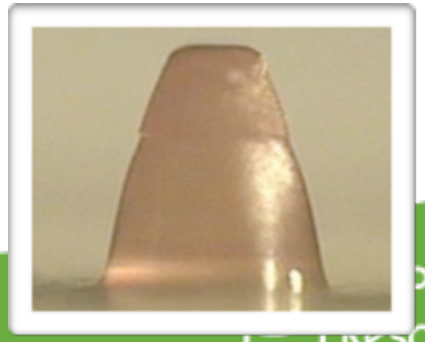






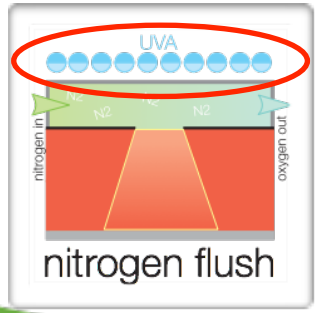
Flat Top

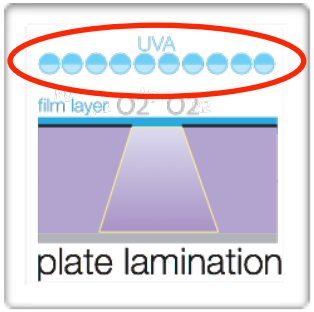


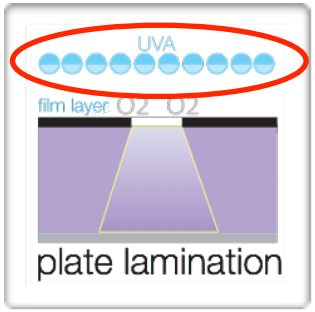


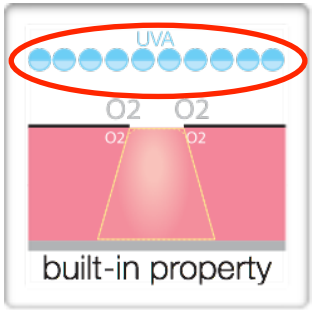
Flat Top Methods

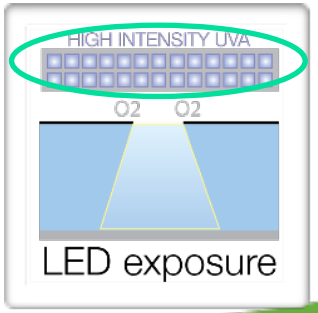
- reduction of oxygen inhibition effect
  - oxygen exclusion
    - inertisation
      - use of auxiliaries: inert gas (nitrogen)
        - inert gas consumption
    - oxygen barrier
      - use of auxiliaries: film consumption
        - additional processing steps
      - built-in barrier property
  - acceleration of polymerization speed
    - high intensity UV exposure
      - hi-intensity UV LED + conventional UV bulb in exposure bed
      - hi-intensity UV LED exposure in platesetter



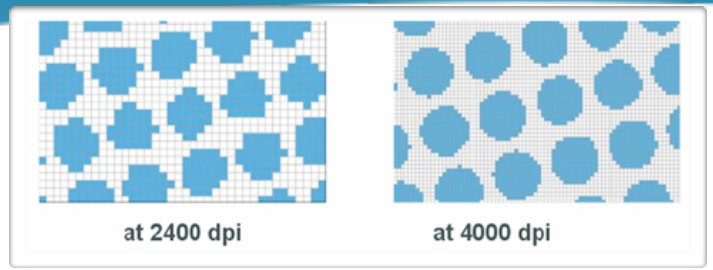






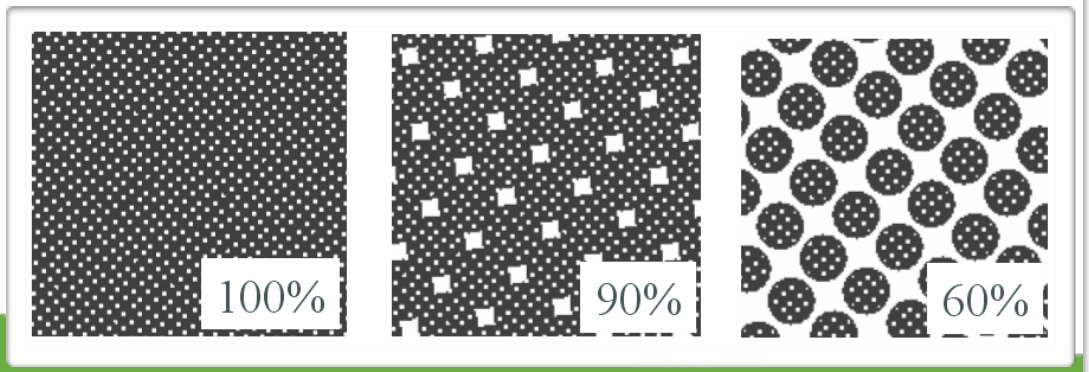


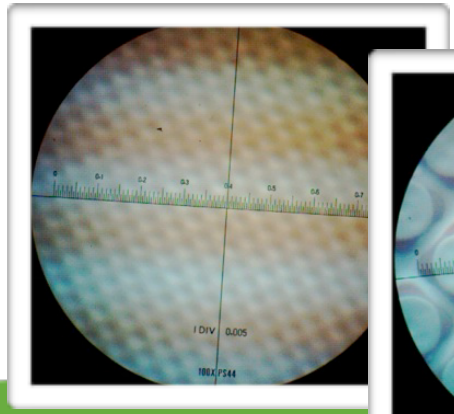
Why HD Flexo?

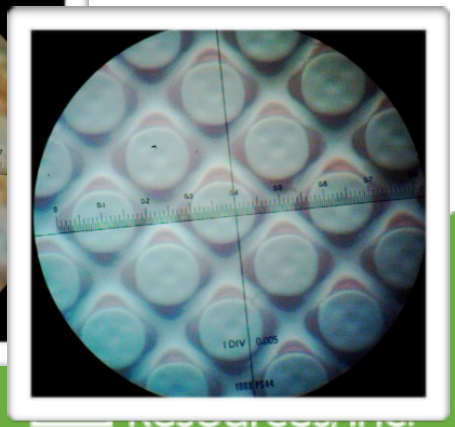


- Hi-Res Output
- Improved gradations - smaller HL dots and hybrid screening solutions

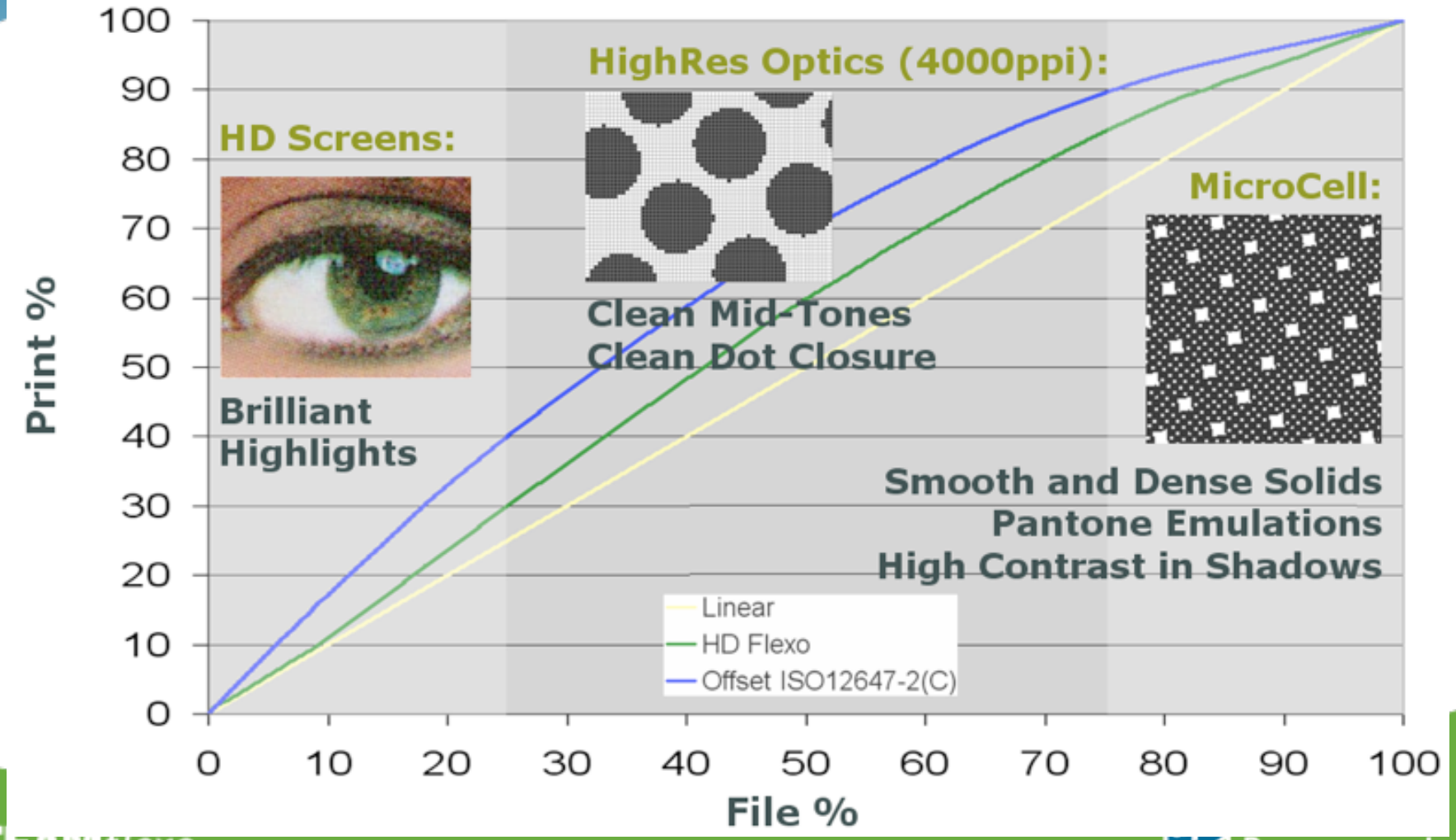
- Improved solids - solid screening into midtones



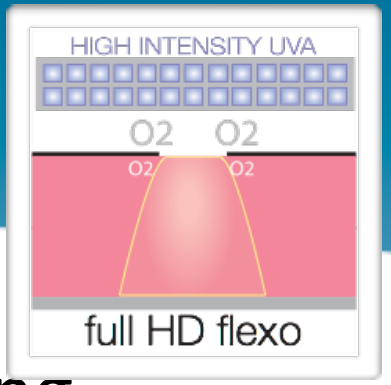




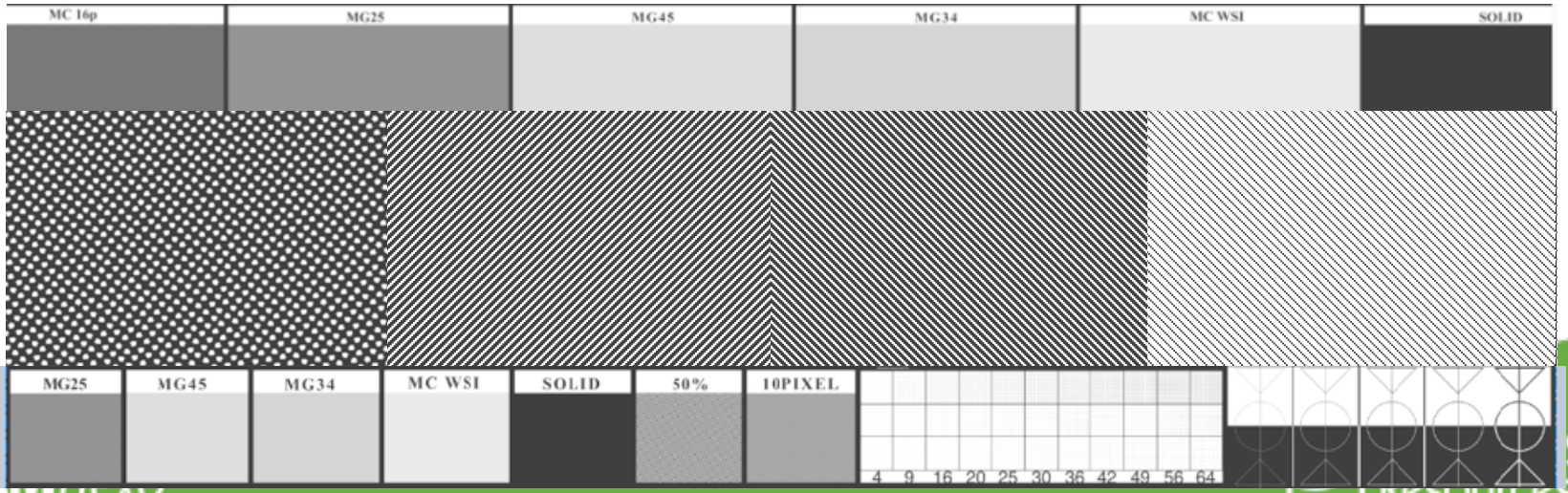
HD & Full HD Flexo



Pixel+ & Full HD Flexo

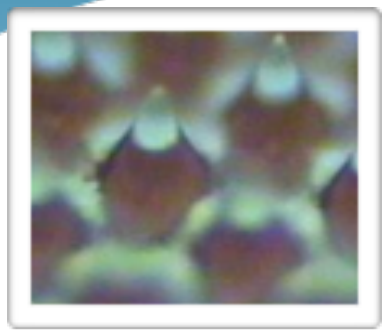


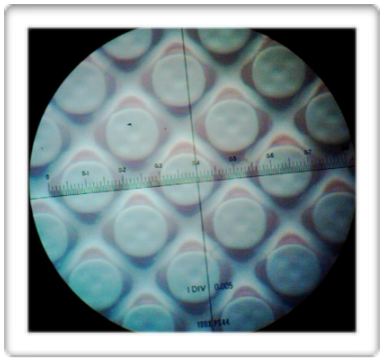
- Pixel+ combines Esko's Full HD Screening Options with a plate vendors flat top dot solution
- Full HD Flexo combines Esko's Full HD Screening Options with In-line LED exposure



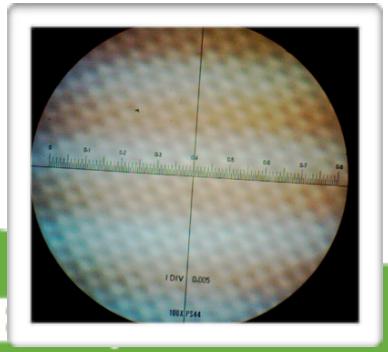
HD vs. Full HD Flexo

Conventional Digital HD Flexo

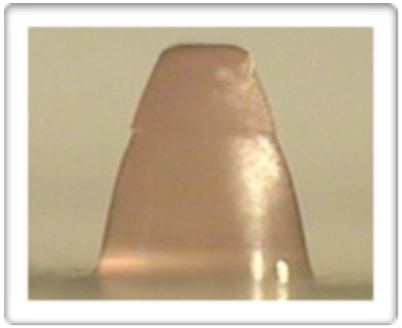


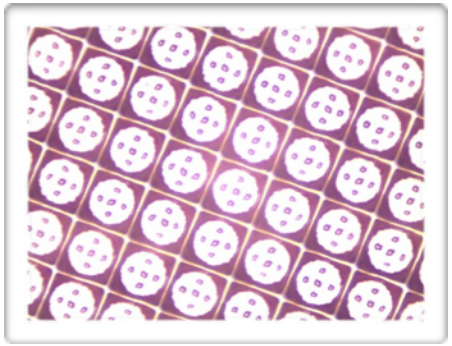


HD Flexo allows screens down into mid-tone dots.

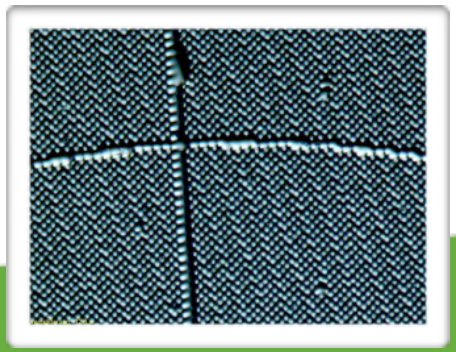


Flat Top Digital Full HD Flexo

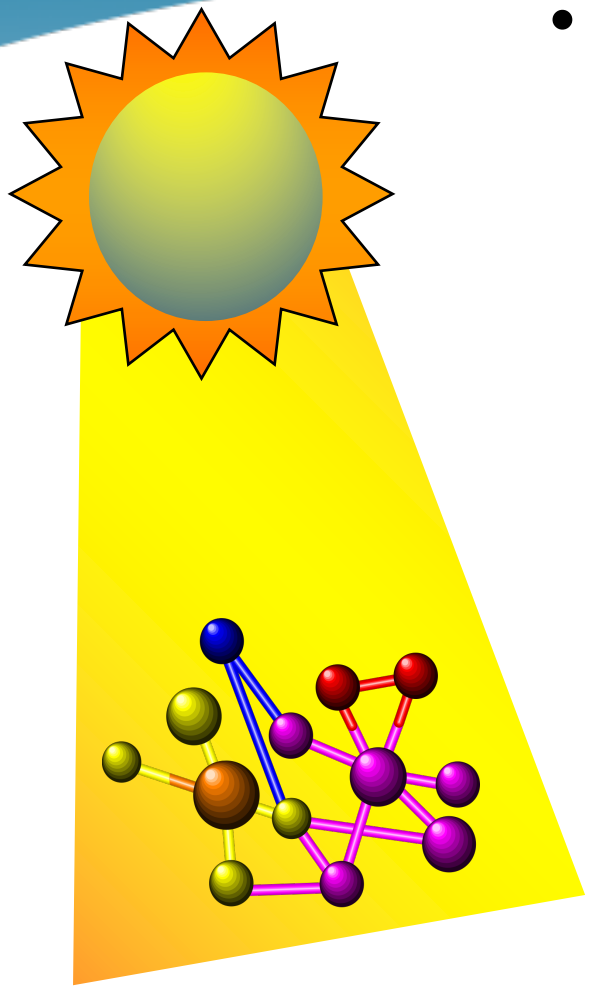




Full HD Flexo allows screens down into quarter-tone dots.



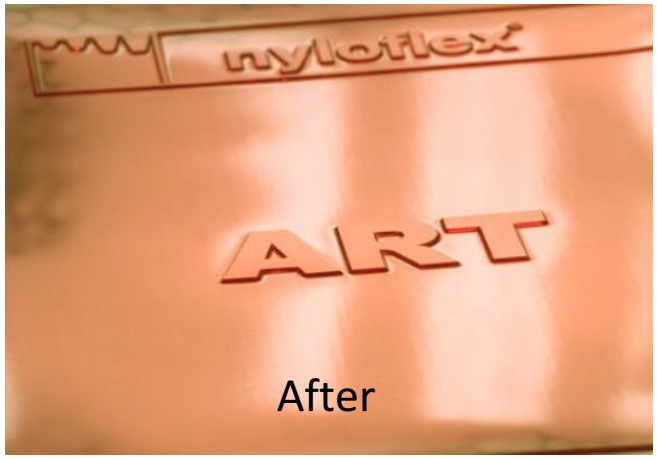
Wrapping up Platemaking



- Finished Plate Care
  - Ozone is a gas created by UV light acting on oxygen and destroys finished plates.
  - Ozone is created by
    - Electric Panels or Motors
    - Corona Treaters
    - Plate Finishing Units
    - Nature

Wrapping up Platemaking

Before



After

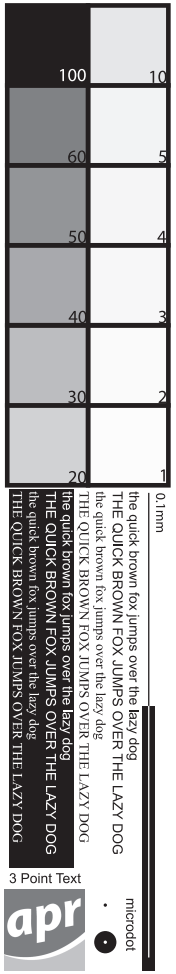
- Ultra Violet Light Damage
  - Visible Signs
    - Plate Hardening
    - Plate Cracking
    - Brittleness
    - Discoloration

Wrapping up Platemaking

- Plate Storage
  - Store plates flat and away from light wrapped in black polyester if mounted
  - Never stack plates on top of each other…
  - Place separator (foam/paper) sheets between plates
  - Do not store plates in areas above 100°F

Summary

Incorporate Process Control Tools and Testing!



Flexographic Printing Workflow

THANK YOU

DAN MUTHIG – D.MUTHIG@TEAMFLEXO.COM