HD Flexo

Quality on Qualified Plates

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1 Our objectives – quality, ease of use and an open system

When we created the HD Flexo product, the objective was to raise the quality of flexo and also to make this easy to achieve. To do this, we chose to base the product on a concept of "screening sets" that are ready to use for specific applications.

We could have found an easier development route for HD Flexo had we restricted it only to a single plate technology. However, Esko Artwork has always seen the openness of our imaging system as a strength, which is much appreciated by our customers. Therefore, we made it a requirement that HD Flexo should work on a wide range of existing plates from multiple manufacturers, as well as being able to take advantage of new plate technologies. This requirement allows our customers to select the most cost effective plates for their needs, and offers the option to migrate smoothly to new plate types as they prove themselves in the market.

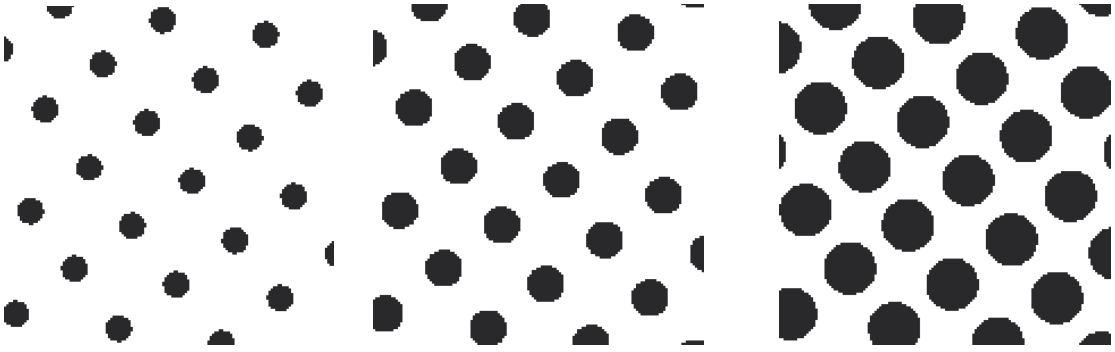
In order to close the quality gap between flexo and other processes we had to increase the smoothness and tonal range of flexo printing. Offset and gravure printing processes have been regarded in the past as higher quality than flexo in large part because they print with a wider tonal range and the images appear smoother to the eye.

To explain further, let's start by looking at what is really meant by tonal range and smoothness of images.

2 Why was flexo considered inferior in the past?

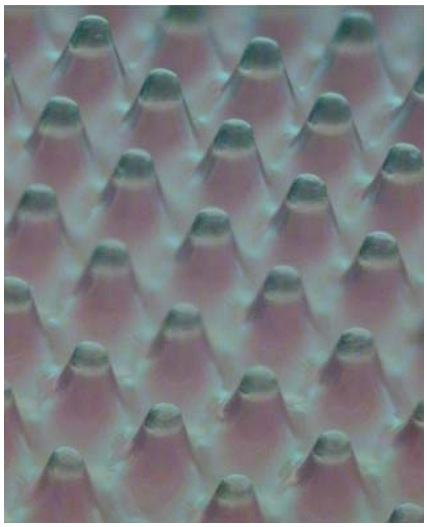
Flexo is a relief printing process, typically using a conventional (also known as amplitude-modulated or AM) screening technique. To produce different gradations of grey or a color, a regular pattern of dots is formed on the plate, determined by the "screen ruling". Screen ruling is normally measured in lines per inch, and determines how fine the pattern is - a higher screen ruling means more dots per inch, making the dots smaller and therefore less visible to the eye. Once the screen ruling increases to 200 lines per inch or more, the dot pattern is so fine that it is invisible to a normal observer at reading distance and the printed image looks for all intents and purposes like a photograph.

With AM screening, the size of the dots is varied according to the darkness of the tone to be reproduced. A tone close to white in the image (a highlight) will use very small dots, a dark tone (a shadow) much larger dots, and an intermediate tone (a midtone) a size in between. This method has been proven in the field over many years, both in flexo and with other printing processes.



10% dots *20% dots* *40% dots*

But because flexo is a relief printing method, a limitation arises. The dots are formed out of the plate material itself - a relatively soft polymer. When the dots become very small, as in highlights at high screen rulings, the polymer they are made of becomes too weak to withstand the pressures of the printing process. The polymer dots bend on the plate and print inconsistently or, even worse, they can fracture off the plate completely, failing to print at all or leaving debris that spoils other areas of the image. Pithily, these small failing dots are known in the trade as "scum dots".



Relief dots formed from plate polymer
(Image courtesy of Tina Mierse, reproflex brandmedia)

3 Out, damned spot!

To avoid the problem of "scum dots" altogether, prepress for flexo has always established a white point, often referred to as a minimum dot (min-dot). At or below the white point in the image, everything is printed as white so that no scum dots will appear. The white point can be measured as a percentage, where 0% refers to the original white of the image you are printing, and 100% refers to black.

Setting the white point at 1% or less means that, for all intents and purposes, the image will be printed exactly as it should be. This is easily achieved, for example, in commercial offset printing and so the quality expectation with offset is that images will be printed very well. In contrast, the usual white point for flexo flexo results in a minimum value on the print between 8% and 15%, which causes considerable detail in the highlights of the image to be discarded. Why would we ever want to discard image detail? It all comes back to screening and those scum dots.

In flexo, the white point has to be high enough to avoid scum dots, but how can we work out what that value should be? In conventional digital flexo, it depends on the size of the smallest screening dot that is strong enough to stand up to the pressure of printing. The smaller the dot, the less polymer it is constructed of, and therefore the weaker it becomes.

Unfortunately for those looking for high quality in flexo, the white point is in direct competition with another measure of quality: image smoothness. Lower screen rulings will result in larger dots, providing more stability to the printing dot. But these low screen rulings result in grainy images that are not smooth, even to the naked eye. In contrast, higher screen rulings with smaller dots produce extremely smooth images. Since the size of the dots depends on the screen ruling, higher rulings (which we want for better image smoothness) need smaller dots, and so the white point will be higher.

10% at 120lpi
70 micron dot

10% at 150lpi
60 micron dot

10% at 200lpi
40 micron dot

In choosing the white point, the prepress provider is caught between two competing facts - a higher ruling will offer smoother images, but will force the use of a higher white point. A lower ruling supports a lower white point, but risks lowering overall quality due to a too-coarse screening pattern.

Other factors influence the choice of white point too. A narrow web press like those used for label printing is "kinder" in its treatment of the dots on a plate and so smaller dots can be used. A wide-web press used to print flexible packaging on OPP film has greater printing pressure and so the dots must be bigger and stronger. Printing on corrugated board, where the surface is very rough requires the most robust (and hence largest) dots. This means that the white point varies depending on the press and the substrate, further complicating and already complicated process.

Generally speaking, the white point will yield a minimum printable tone of at least 10 to 12% in flexible packaging applications. In label printing, conditions are kinder, but even there the requirement to raise screen rulings to 200 lpi in order to give a photorealistic appearance means that the white point cannot be set lower than 10%. There's no doubt that this has a severe impact on the image or design to be printed. The primary negative effects are that highlight detail is lost in photographs, and that packaging designs with smooth gradations or shadows that fade to zero cannot be printed properly. Typically these gradations show a hard edge at the white point, instead of the smooth fade that the designer intended.

The image on the right has 12% white point. It lacks contrast and shows contouring.

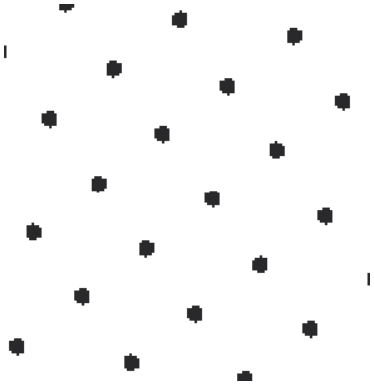
Flexo prepress specialists work hard to mitigate the effect of the high white point on quality reproduction. Images are retouched, tones rebalanced, and designs altered. EskoArtwork and other software suppliers make specialized tools to help with this type of image modification. Despite the power of such tools, and the skill and creativity of their operators, the result may still be a compromise compared with what the designer and brand owner expected. In the end, good reproduction of the image demands a lower white point.

4 Lowering the white point, not raising the white flag

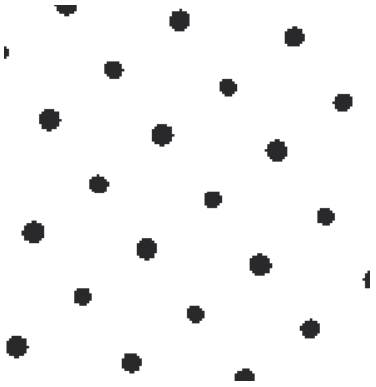
HD Flexo consists of two separate technologies: a piece of hardware (known as HighRes optics) and the screens. HighRes optics enhances the CDI imager so that it can write the plate with a finer "writing pencil" at 4000 pixels per inch, while still keeping the same plate making productivity. The increased resolution (4000 ppi) gives us more than 3 times the number of pixels for shaping screen dots than in standard digital flexo.

Having more pixels in the dot means that it can be formed into a more regular, rounder shape, which on its own supports a lowering of the white point. Dots with a more round shape are stronger on the plate, and so a smaller dot can be used without the risk of it deforming or breaking and so becoming a scum dot. These rounder more regular dots have other advantages – they produce a plate that prints with more consistent color for longer in the print run. For more information on this, see the separate whitepaper "Pixels - size does matter".

While the improvement made by increasing the imaging resolution helps, alone it is not enough - our customers and we expected more, which brings us to the second piece of technology. HD Flexo uses a new screening technique to further reduce the white point. As explained above, the scum dot problem is caused by small fragile dots on the plate. In highlight areas, the screening used in HD Flexo does not continue to reduce the dots' size. Instead, a balanced mixture of larger and smaller dots is used.



Standard Screening: all dots same size



HD Screening: mixture of dot sizes

The larger dots are designed to contain enough polymer to be strong enough to stand up on their own (just like the large dots that are made in standard flexo by establishing the white point). But the HD screening pattern also contains many smaller dots - we would expect them to become scum dots and cause a problem, so why does this not happen with HD Flexo?

The secret is in the balance of small and large neighbor dots. The larger dots act as supporters, bearing the brunt of the forces that occur during flexo printing. The smaller dots are protected from damage by their large dot neighbors so they can still print (delivering a small amount of ink, which is needed to give a lighter tone) but not turn into scum dots.

Thousands of combinations of dot sizing and the quantity of small dots compared to large are of course possible in theory, but which one will give the lowest white point along with avoidance of scum dots? What we have learned during the development of HD Flexo is that we can choose the right combination of dot sizes taking into account the plate polymer material and target printing conditions to achieve a dot balance that produces an excellent result - we deliver this combination as a Screening Set.

5 Qualifying a plate

Drawing on our hundreds of man-years technical experience in flexo plate making and printing, experts from our flexo engineering center at Itzehoe, Germany work along with plate material suppliers to qualify each plate for HD Flexo. High powered microscopes are used to examine dots on the plate in detail, and test prints made in cooperation with lead customers are evaluated:

The result of the evaluations and tests is a tuned set of HD screening dots that best balance the forces occurring on the plate highlight dots. Once this screening set is ready, it is delivered as part of the HD Flexo software and we can consider the plate to be "qualified" for HD Flexo.

The qualification process is carried out for each plate (usually at several plate thicknesses) and also for the different applications for which that plate is normally used - typical applications would be label/narrow web printing, wide-web, folding cartons and corrugated - but this list could be extended to encompass new print applications addressed by flexo. Because each application uses a different type of press and hence different forces during the print process, a different screening set is usually determined during the qualification.

Because plate processing is also important to the formation of the dots, our flexo team also works hand in hand with the plate material suppliers to establish a "plate processing window" of acceptable parameters (such as UV intensity, time) which will give consistent results with HD Flexo. The plate processing information can be obtained from your plate supplier.

Each screen set in HD Flexo contains four different screens. The variation between these screens allows the user of HD Flexo to adapt it to different printing presses or other print conditions. The experience of our

engineers during the qualification process is written down in an "application guide" for each plate type which is embedded in the software - this guide gives advice on optimal use of the screening set.

6 The results

HD Flexo has screening sets for more than 25 plates already available at the time of writing, and qualification continues for both new plate types and existing popular types in the market. We began with qualification for label and flexible packaging applications first because our customers told us that these were the areas where increased quality was most needed, but will extend to other applications in the future. Users of HD Flexo always have the option of adding new screening sets as they become available.

We have been working with all major plate suppliers to the industry and have already been able to qualify a range of popular solvent processed plates, as well as modern but widely used plates such as the DuPont FAST system. HD Flexo integrates with seamless screening, so support for making sleeves with the new FAST-Round system from DuPont is possible. Water-wash plate processing is an emerging technology and one such plate (the DEF from Asahi) is already qualified, with more to follow.

With HD Flexo it has been possible for many users to lower the white point down to 1% in print in label printing, and down 3% in wide format flexible packaging printing. In many cases, it is also possible to increase the ruling while still lowering the white point, giving a further boost in quality. But a full explanation of how that is possible will have to wait until the next whitepaper!

This lower white point means less compromise compared with the original design, enabling converters and printers to deliver higher quality that better satisfies the brand owner. By achieving quality levels that were only possible with offset or gravure in the past, flexo printers can compete in new market segments or can optimize production by using flexo instead of offset if it better suits the economics of the print run.

Traditional Flexo

HD Flexo

Because the white point is higher, less (or even no!) prepress adjustment is done to the original design in order to make it printable, simplifying the production process and reducing the length of the production cycle. Brand owners get packaging with greater shelf presence, an appearance matching the design intent and with a reduced time to market. Happy faces all around the table!

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