Parting Is Such Simple Sorrow

New Plate Exposure Technology May Change the Rules of Flexo Color Separation

Mark Samworth

A cynical flexo printer once told me, "We use the flexographic printing process because we have to, not because we want to." He went on to explain that with the substrates he printed on, the inks he was required to use, and the economic necessity to print roll to roll with variable repeat and inline die cutting, he simply could not do the work with any other process.

He reflected that, while flexo has limitations, his company has learned to use tools, techniques and science (much of which was learned through FTA) to overcome those limitations. As a result, he stated, "The 4-color process we print via flexo is every bit as good as 4-color process printed offset." One has only to view the FTA Excellence in Flexography Award winners on display every year at Forum to confirm his point.

Then, almost as an afterthought, he added, "But we sure do spend a lot of time and money manually retouching each separation to achieve those results."

Indeed, the next breakthroughs in flexo color separation are as much about simplicity and productivity as about quality.

"FLEXO-IZING" THE COLOR SEPARATION

The process of manually retouching each separation to enable it to print cleanly on press is sometimes called "flexo-izing" the separation. There are many techniques for "flexo-izing" a color separation, but they all, in some way, are an attempt to cover up the large amount of highlight dot gain in the print process, the hard edge that becomes visible if you drop the highlight dot, or the scum that results when interspersed areas of dropouts and min dots create partial or isolated dots on plate.

Figure 1 attempts to simulate full-range vignette scales printed offset (top) and flexo (bottom). As seen, these scales are identical from

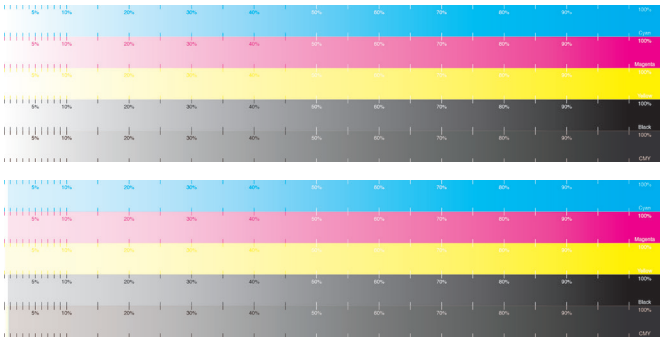


Figure 1: The scales above were printed on an offset press (this issue of this magazine); the scales below simulate flexo highlight gain.
All artwork courtesy of Mark Samworth

about 25 percent to 100 percent, but because of highlight dot gain, the flexo scale is much darker in the highlight areas.

Additionally, a hard edge can be seen at the very beginning of the flexo vignettes. While a zero percent dot on plate will always print as a zero percent dot on press, the smallest "holdable" dot on plate (say 0.5 percent) will often print to 15 percent or higher on press. This dramatic change from zero percent to 15 percent is known as the "flexo highlight break." It can ruin the appearance of process color images, as well as gradients and drop shadows, on the flexo-printed job.

The most common technique for "flexo-izing" a separation is to create an extreme skeleton black. The logic behind this approach is that the hard edge is more objectionable than a dark highlight. The strategy is to set cyan, magenta and yellow to have no dropout at all, then—to avoid a 4-color highlight—set black to have extreme dropouts. As a normal black plate will have hard edges (the top pair of images in *Figure 2*), the trick is to use separation settings and manual retouching to "hide" the black hard edge in darker areas of the image (the bottom pair of images in *Figure 2*).

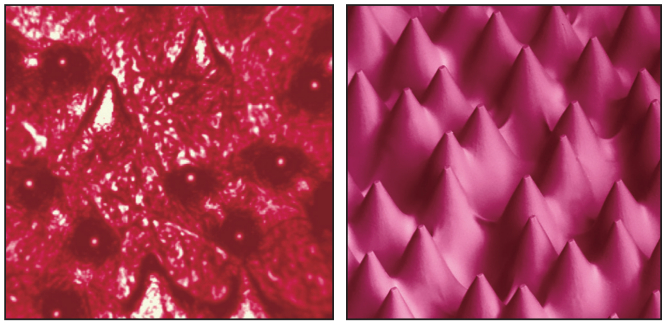
Figure 2: These images attempt to simulate flexo print. Typical "offset" black separation (above); extreme "flexo" skeleton black separation (below)

This technique eliminates the visually objectionable hard edge, but compromises detail and results in dark highlights and desaturated colors associated with holding dots through the entire range of cyan, magenta and yellow.

In order for flexo color separation to advance in terms of both quality and simplicity, we must be able to print color separations that have dropouts everywhere—with the confidence they will print cleanly on press with no highlight break. We need to move beyond manual retouching of dropout areas and into automated separation based on profile conversion. This can, and is, being done today. There are numerous tools to assist in this advancement. The two big tools are: moving source LED (MS LED) plate exposure and minimalist HD hybrid screening.

MS LED PLATE EXPOSURE

While legacy bank light plate exposure technology allows for the optimization of main and back exposure time, MS LED plate exposure technology enables the optimization of intensity (technically "irradiance") and time and allows the option to deliver energy in many short bursts (fast moving source with many passes) or a fewer number of long bursts (slow moving source with fewer passes). Add to this the ability to control irradiance—a parameter that is fixed in bank light exposure units—and to separately optimize main and back exposure, and we have the potential to advance flexo plate quality to a whole new level.



While these images are not an exact comparison (a top view image of a bank light plate on the left; an angled view image of an MS LED-exposed plate on the right), they do show the ability of MS LED exposure to hold small and isolated dots with extreme shoulder support.

The benefits of MS LED exposure technology have been the subject of magazine articles, conference presentations and industry awards. Since this article is focused on color separation, we will examine what many people believe to be MS LED exposure's single biggest benefit: the ability to hold small and isolated dots on a flexo plate.

This, in turn, allows the very best type of hybrid screening to be used: minimalist HD hybrid. It is the minimalist hybrid screen on a high-end flexo plate—potentially combined with two other tools to be discussed—that allows for the complete disregard of dropouts in flexo color separations. It also eliminates the flexo highlight break in drop shadows and gradients.

To be sure, with the recent introduction of premium "flat top" plates, the quality of plates exposed on bank light units has also dramatically improved. These plates—which feature a flat top dot built into the plate—truly make the flexo process "easier." But while the ability of bank light exposure to hold small, isolated dots is better than ever, MS LED has still proven to hold the smallest and most isolated dots across a range of plate materials.

PRINTED PROOF

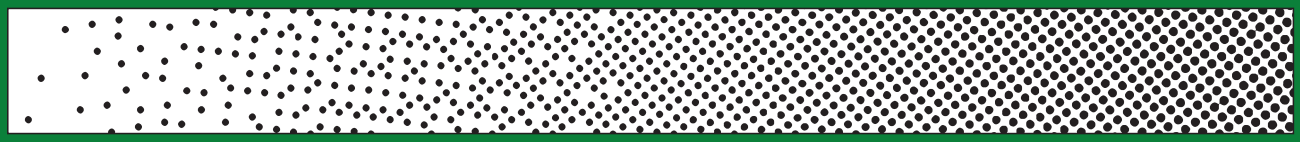
The 2017 FLEXO Magazine Cover Project—showcased in the October issue last month—featured a cover spread printed flexo and digital to showcase the 2017 FTA Technical Innovation Award winners. The outside spread was printed on a hybrid press (the FLEXO masthead

A BRIEF, OVERSIMPLIFIED HISTORY OF HYBRID SCREENING

Hybrid screening was introduced to the flexo industry in the late 1990s and has been run on millions of flexo production jobs ever since. It is the basis of today's HD flexo screens. The goal of hybrid screening is to eliminate the flexo highlight break and provide lighter highlights. The images below illustrate an admittedly oversimplified history of hybrid screening.

The extreme "dot holding" characteristics of MS LED plate exposure technology are forcing our industry to re-think screening. Observing plates alone might lead one to conclude the original AM dot be revived. While it's true MS LED-exposed plates can hold AM dots down into tenths of a percent, it's also true such dots often produce a hard edge on the printed sheet. The screen proving to show the best results over the broadest range of conditions might be called a "minimalist" HD hybrid screen (the last image on this page). The ability of MS LED-exposed plates to hold small and isolated dots enables "just enough" hybrid screening to eliminate the highlight break while limiting its range, so as not to produce "grainy" images.

The AM Screen: MS LED plate exposure technology can hold AM dots well below 1 percent, but such dots will gain on press and may create a hard edge on the printed sheet. As such, even the best plate exposure technology can benefit from hybrid screening.



Dot Deletion: A hybrid screen can be created by deleting dots from an AM screen. Such screens can fade to zero, however the human eye can see the "hole" near the transition point. Hybrid screens with large dots and a long range may also appear "grainy" to the eye.

Dot Deletion with Repositioning: Repositioning some of the dots hides the holes from the human eye. Such screens have been successful; however, the isolated dots in the extreme highlights tend to cause problems with normal bank light plate exposure technology.

Support Dot Hybrid Screen: Mixing small "support" dots with larger "print" dots eliminates the effects of isolated dots. Such screens have been very successful with round top dot flexo plates, but require extreme expertise to optimize on plate and on press.

Minimalist HD Hybrid Screen: MS LED plate exposure technology enables very small and isolated dots to be held on the plate. This allows the use of the minimum amount of the simplest type of hybrid screening—dot deletion with slight repositioning.

The outside and inside spreads of the 2017 FLEXO Magazine Cover Project

was printed flexo, while the rest of the spread was printed digital); the inside spread was printed entirely flexo. As such, there were two full pages—an Esko ad and a Flint Group ad—in which to showcase the ability to print "non flexo-ized" CMYK separations. This is a true test of the ability to print separations with dropouts "everywhere" containing isolated dots throughout every color in every image.

The image of the dancers in the Flint Group advertisement shows MS LED-exposed plates can enable offset separations to be printed flexo—without a single alteration for the flexo process. The Flint Group marketing department submitted the image as a JPEG RGB file embedded in a PDF with the understanding that, once approved, they would convert to CMYK, "flexo-ize" the separation, then re-submit. As might be expected of an offset JPEG image, a prepress image quality check for dropouts, isolated dots and scum immediately raised red flags. However, the cover project team saw this as a chance to show off flexo's capabilities and specifically asked Flint to keep the image "as is." The only treatment to the image was conversion from Adobe RGB to GRACoL2013 CMYK (also known as CRPC-6) as an automated process in creating the PDF.

QC check tools (like Esko's Adobe Photoshop plug-in, Viewer) enable the ability to see dropouts and isolated dots that may cause scum. The extreme scum and isolated dots on this image (the Flint Group ad from the 2017 FLEXO Magazine Cover Project) were intentionally kept in the separation to show the ability of MS LED plates to print isolated dots cleanly.

ISOLATED DOTS WITH NO SIGN OF SCUM!

The close-ups on the next page are photomicrographs of Flint Group's ad that ran on the inside back cover of last month's FLEXO. It was printed flexo using MS LED-exposed plates. To see the real print samples, grab a copy of October's FLEXO and break out your loupe.

You will notice a "shadow" of small and isolated dots around the entire "dancers" image. This is the result of JPEG "noise" being screened, held on plate and printed. Such noise is particularly pronounced around silhouette images and is one of the reasons image files should never be saved in the JPEG format.

But for this demonstration, there could hardly be a better or more challenging image. What better way to showcase flexo technology than to print an image full of dropouts, scum and isolated dots, and achieve a clean printed result in press? The proof is in the print.

COLOR CONVERSION & GCR

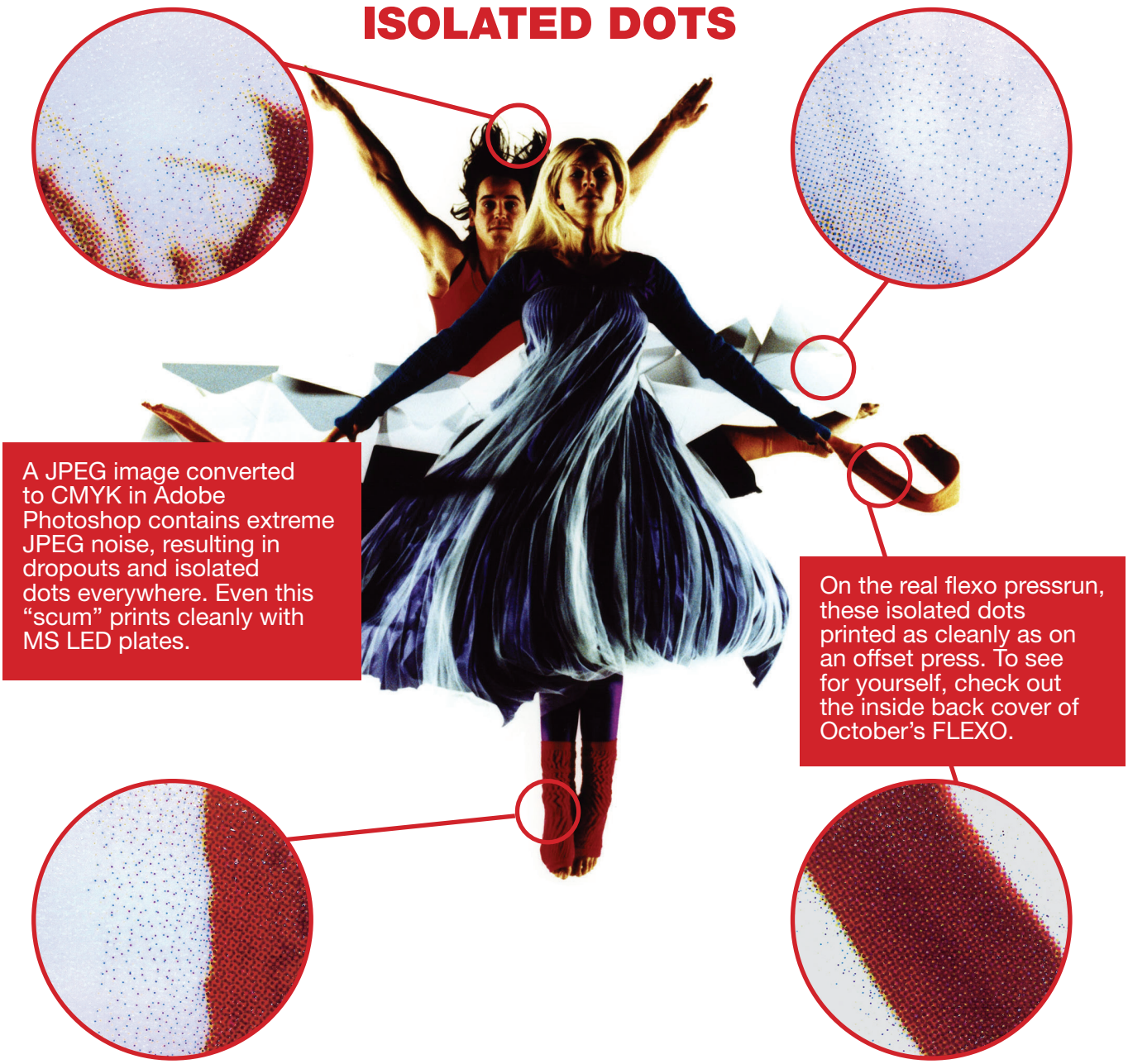
The Esko advertisement from that issue reveals an even closer look at the future of flexo color separation. No special treatment was performed to "flexo-ize" this image; instead, it was "blindly" converted from Adobe RGB to GRACoL2013 CMYK in Adobe Photoshop. Then—just to show off—we took one additional step that almost no flexo printer would have performed in the past, but which the cover project team believed most flexo printers will routinely perform at some point in the future: We converted this image to 100 percent Gray Component Replacement (GCR). Hence, an image that in the "old days" would have had dropouts only in black now has dropouts everywhere, in every color (cyan, magenta, yellow and black).

GCR images reduce ink consumption, but more importantly, have extreme stability on press. Even the best flexo and offset printers have trouble printing a 50-C, 40-C, 40-Y as a consistent, neutral gray. Why fight it when it can be convert to a stable 5-C, 4-M, 4-Y, 52-K?

ELIMINATING PARTIAL DOTS THROUGH ADVANCED RIP TECHNOLOGY

As part of the 2017 FLEXO Magazine Cover Project, we've proven that with the right conditions (a key one being an MS LED-exposed plate) you can print images with extreme amounts of scum and still achieve a clean printed result.

But does that mean you should? Two new RIP tools offer automated workflow-based approaches to ensure partial dots and small image noise artifacts don't make it into the final plate. The first is a RIP setting called "re-sampling." It's well understood the conflict between image resolution (typically around 300 dpi) and CTP device resolution (exactly 4,000 dpi for high-resolution flexo) can create partial dots



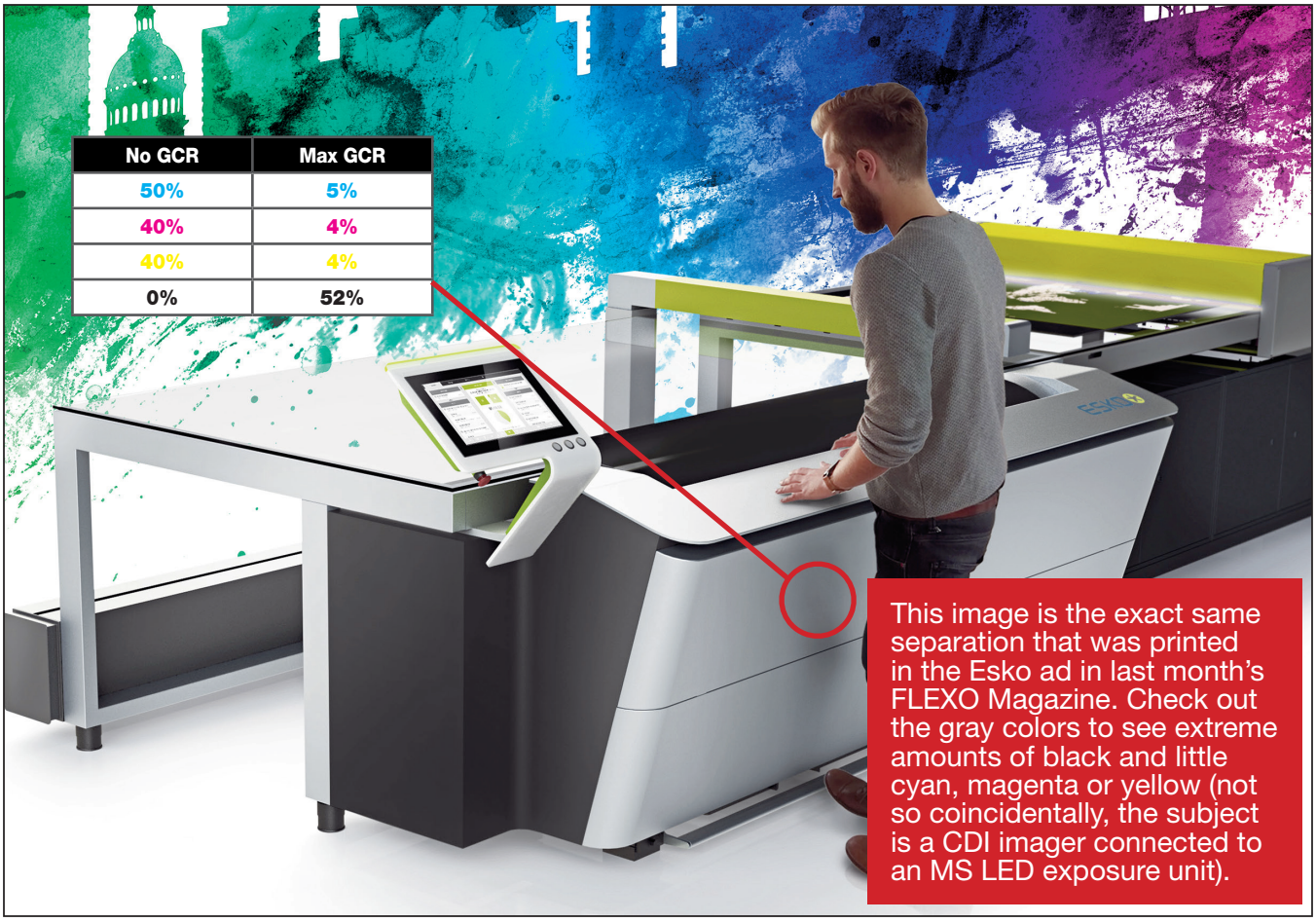
that are smaller than the minimum desired dot size in your screen (see *Screen 1* on page 33). Setting the re-sampling control to "output resolution" instructs the RIP to internally increase the resolution of all images to 4,000 dpi.

The result is an elimination of about 80 percent of the partial dots—as well as an increase in the smoothness and roundness of all dots in the image (see *Screen 2* on page 33). But even after this—depending upon the specific image—a few partial dots may still remain. A second post-RIP control called "clean highlights" allows the user to set a minimum dot size (set at 16 pixels in *Screen 3*). The automated task then cleans all dots below this size on the screened file.

MS LED & COLOR SEPARATION QUALITY

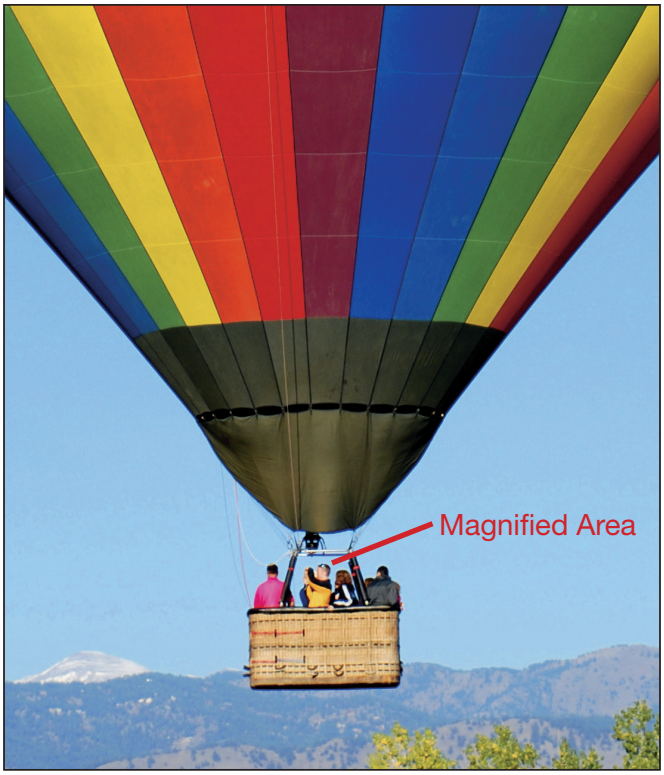
MS LED plate exposure technology promises to change the rules of flexo color separation. Specifically, the ability to hold small and

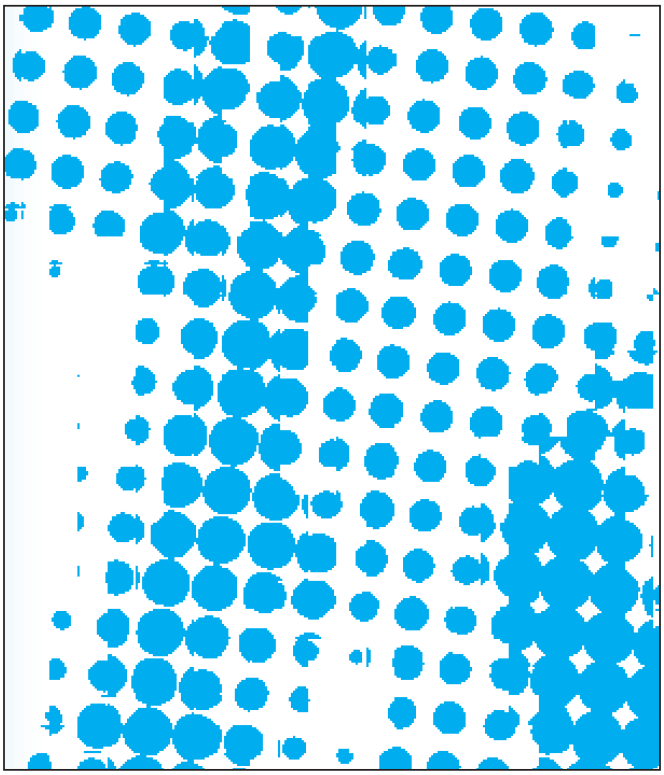
The above sequence of separations shows a typical "low GCR" separation (the top row of images) and a very "high GCR" separation (the bottom row of images). The high GCR separation was used for the October 2017 FLEXO cover, resulting in perfect neutral grays, extreme stability on press and ink savings. The fact that high GCR separations contain dropouts and isolated dots in all channels is not an issue with MS LED-exposed plates.



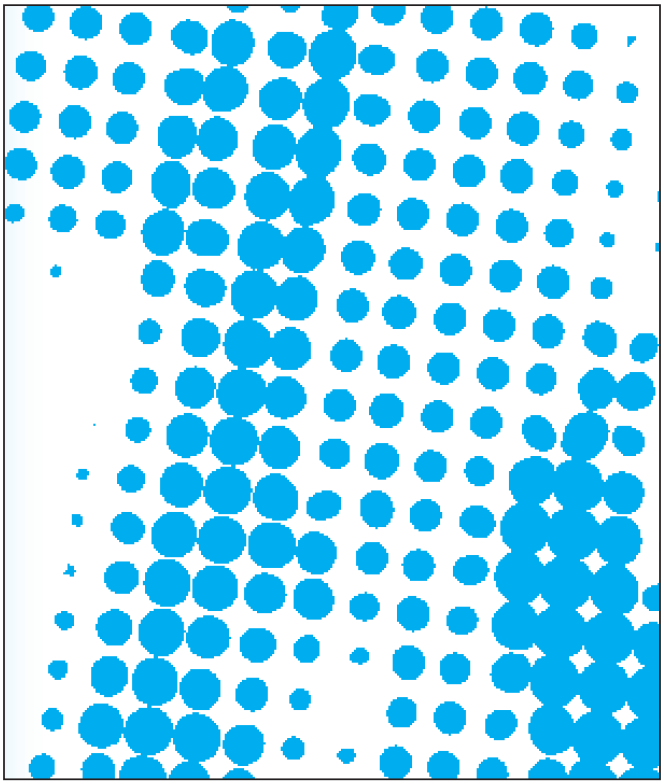
No GCR	Max GCR
50%	5%
40%	4%
40%	4%
0%	52%

This image is the exact same separation that was printed in the Esko ad in last month's FLEXO Magazine. Check out the gray colors to see extreme amounts of black and little cyan, magenta or yellow (not so coincidentally, the subject is a CDI imager connected to an MS LED exposure unit).

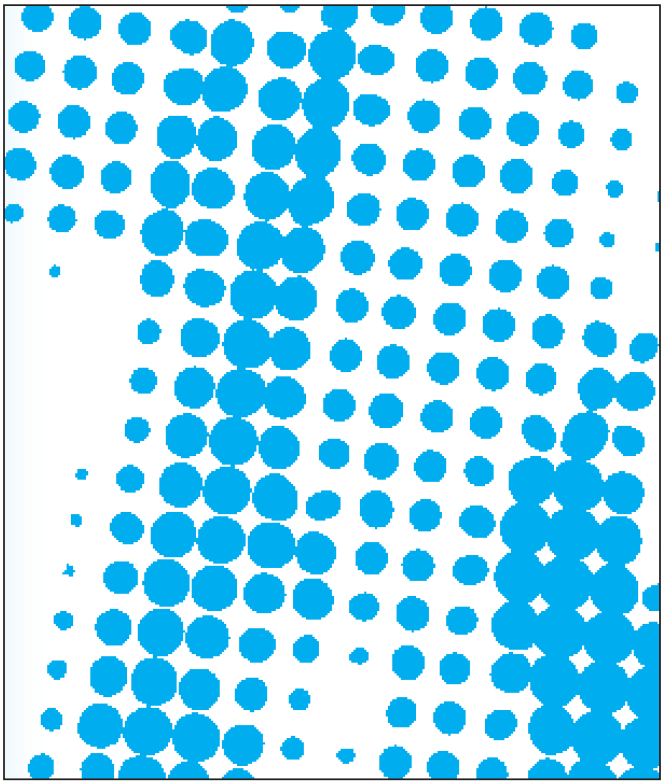




SCREEN 1 (No Re-Sampling)



SCREEN 2 (Full Re-Sampling)



SCREEN 3 (Full Re-Sampling with Partial Dot Removal)

New RIP technology enables fully automated solutions for eliminating partial dots. The only isolated dots remaining are those of the hybrid screen. *Screen 1* contains no re-sampling, *Screen 2* uses full re-sampling and *Screen 3* uses full re-sampling with partial dot removal.

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isolated dots with extreme consistency within large plates and between plates enables the total disregard for dropouts in flexo CMYK separations.

This, in turn, increases simplicity. A separation is now just a simple profile conversion from RGB to CMYK. It also increases quality. A mathematical profile conversion produces higher quality than manual image editing based on human judgment. All of this opens the door to high GCR color separation where dropouts are present everywhere, in every color (cyan, magenta, yellow and black).

Comparing MS LED to bank light exposure using the "flexo-ized" separation of the past will likely show a small to medium increase in quality for MS LED. However, such a comparison fails to show the total values of MS LED plate exposure technology. Comparing new style color separations—profile conversion separations with high GCR and dropouts everywhere—will show a night-and-day difference. It's truly the ability of MS LED plate exposure to enable better color separation and screening techniques that makes it the obvious technology of the future.

And in the future, any serious comparison between the future of flexo and digital must conclude that a movement to eliminate spot colors and replace them with 7-color process is critical to flexo's future. As digital technology is new, it's all based on the process color model (4-color to 7-color), not a spot color model. With 7-color process flexo, every element of a job—images, solid spot colors, gradients, drop shadows—is converted to 7-color process. Hence, there are dropouts everywhere in a converted 7-color job.

Whether your goal is to compete with digital or to run flexo side-by-side with digital and achieve a color match (as we did in the 2017 FLEXO Magazine Cover Project), MS LED-exposed plates make the expanded gamut dream more obtainable for flexo, while increasing quality and stability. ■

About the Author: *Mark Samworth began his career with DuPont, where he held numerous positions in the areas of flexographic plates and electronic imaging. Mark joined Esko in 1997 and is currently focused on consulting in screening, calibration, G7, color management and expanded gamut. He holds 11 patents in digital imaging, including Flexo-Cal, Hybrid Screening, Plate Cell Patterning, Concentric Screening, Equinox expanded gamut technology and PressSync. He has authored numerous articles in the industry's major trade publications and presented many papers at the industry's major trade forums. In May of 2011, Mark was inducted as the 49th member of the FTA Flexo Hall of Fame. Mark received his B.S. from RIT and his MBA from the University of Delaware. He lives in Wilmington, DE.*

Technologies discussed in this article include the Esko XPS plate exposure unit, a winner of the 2017 FTA Technical Innovation Award and a part of the 2017 FLEXO Magazine Cover Project. The XPS is a very specific type of LED plate exposure unit, which is referred to as a moving source LED (MS LED) unit in this article. Based on Esko patented technology, it features advanced LED lighting on a moving source for increased exposure uniformity and to allow for the optimization of variables which, until now, has been unavailable. To learn more about Esko's products, visit www.esko.com.