

# Choosing the right anilox-roll engraving for the application

By Alan Rogers, technical account manager, Harper Corp. of America

## Abstract

In today's high-tech world of flexographic printing and coating, it is vital that printers not only understand their anilox-roll specifications, i.e., line screen (cells per inch) and volume (BCM), but they must also understand their anilox engravings and cell geometry to maximize anilox efficiencies. It has been said many times that the anilox is the heart of the flexographic-printing process, however, the engraving and cell shape is what makes this heart beat. Line screen provides definition and volume provides color and density, but the engraving geometry is vital information to know to maximize print-transfer properties.

Recent advancements in laser technology have allowed many anilox-roll companies to experiment in different cell shapes and engravings and to come up with new ideas on ink transfer. Printers may be confused by the various engraving technologies available. Numerous surface geometries have come to market in the last few years, among them Channeled Technology, Irregular Hexagon Technology and even Random Engraving Technology. In addition to cell shapes, there is also the question of engraving angle. Other than random patterns, anilox-cell angles include the 60-deg hex pattern, 30-deg hex pattern, 45-deg quad pattern, 45-deg trihelical and new 70-deg angles. Printers must ask, "What is the most beneficial engraving for my application?" and "What geometry provides the consistency to meet customers' demands and hit print targets?"

## 60-deg hexagonal pattern

Although numerous engravings have been introduced lately, the 60-deg hex continues to be the staple of the industry and the workhorse of anilox-roll engravings. Looking closely at the 60-deg hex reveals how it is a clone of the honeycomb geometry created by honeybees (see Figure 1). The highly complex, well-planned

engineering and storage system of the honeycomb has fascinated scholars and scientists for centuries. More than 2,000 years ago, Greek scholars marveled at the "geometrical forethought" of the honeycombs, which were crafted in the exact measurement needed to efficiently store honey. There is no wasted space; this is the reason for the 60-deg hexagon engraving for anilox rolls. By comparing the area enclosed by these regular shapes, it is possible to see why the hexagon is the most efficient.

The 60-deg hexagonal pattern allows for more cells to be compacted in an area and provides the most efficient use of volume. There is no wasted space as compared to a circular shape. If the circular pattern was used for engraving, the wasted spaces would be void of ink and create print problems.

By adjusting the engraving laser, different cell angles are created in conjunction with a horizontal line across the face of the roll. Contrary to popular belief, the laser beam does not create an individual cell. Engraving a ceramic-coated anilox roll is a precise science, creating thousands of cells by moving ceramic using multiple beams to create cell walls that eventually form the cells as shown in Figure 1.

Engineers will confirm that a 60-deg hexagonal structure also provides maximum strength. Mathematician Thomas C. Hales of the University of Michigan proved mathematically that the hexagonal grid represents the best way to divide a surface into regions or sections of equal area with the least total perimeter.

continued on page 38 ►

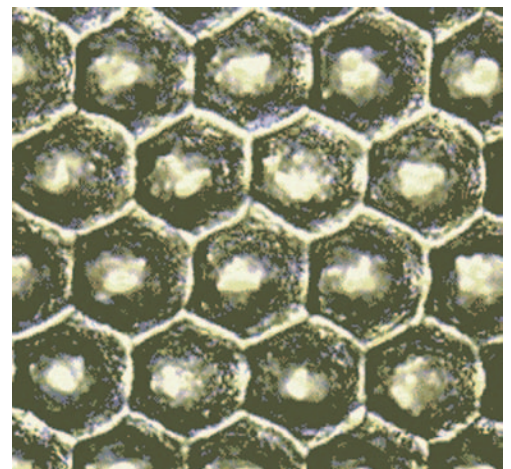
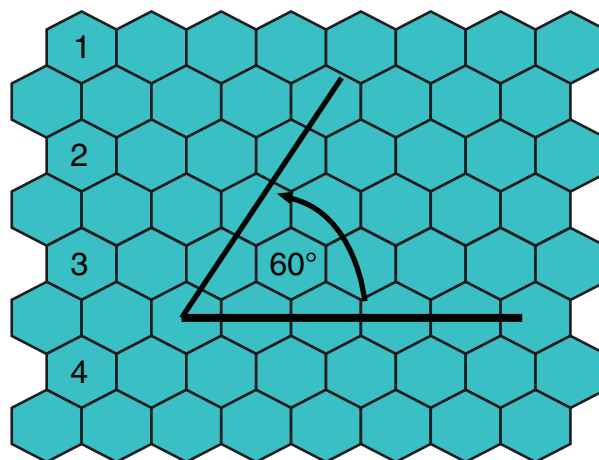
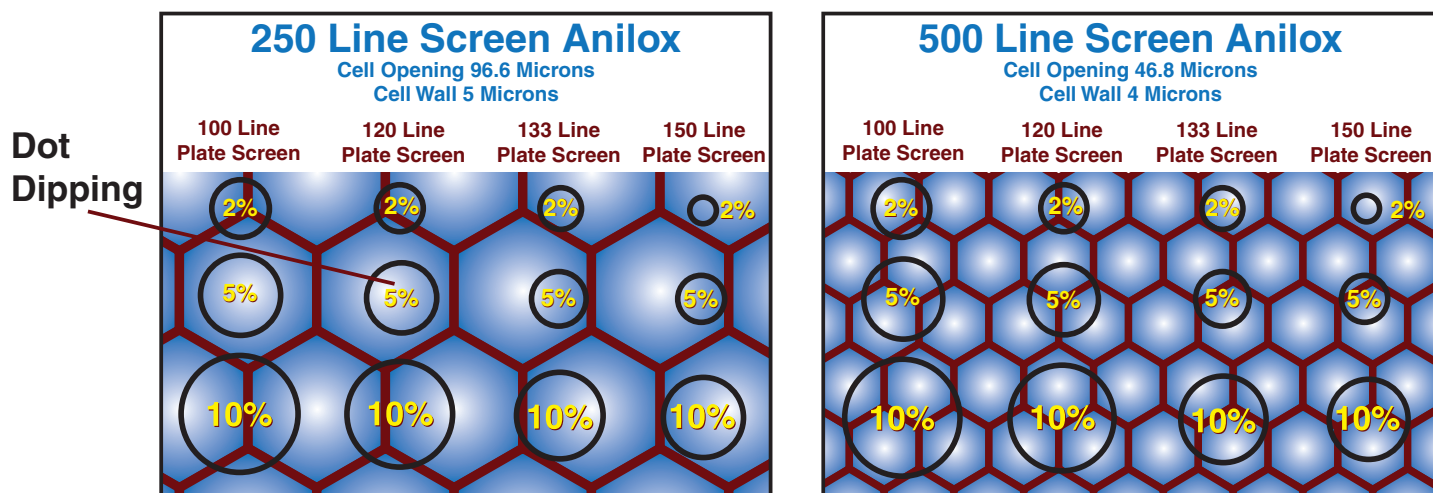


FIGURE 1. 60-deg hexagon anilox engraving

◀ continued from page 37



**FIGURE 2.** Line-screen aniloxes that fit the plate screen allow the dot to sit atop the post areas of the uniform hexagons.

Today, since its introduction by this firm in 1989, the 60-deg hex pattern is the world standard for flexographic printing. It provides the following benefits over other alternative engravings:

1. The cells can be nested more tightly together, allowing approximately 15 percent more cells in a given area.
2. The post areas are minimized due to the placement of the cells during laser engraving.
3. The cells can be shallower while still releasing the same amount of ink because more cells fit into a sq-in. area.
4. The 60-deg pattern is most easily reproducible from a manufacturing standpoint; therefore, there is greater consistency from roll to roll.

The cells per inch provide definition, whereas volume provides color and density. Therefore, using an anilox roll with more cells per inch will provide greater detail and definition, especially in the highlight areas. By using the 60-deg hexagonal engraving, the efficiency of this particular geometry allows for thinner ink films, resulting in sharper graphics and better tone distribution. The 60-deg hexagonal engraving is ideal for printing process-color, screens/vignettes or combination work.

In addition to the above-mentioned benefits, the 60-deg hex pattern provides better dot support when printing screens and dots. The dot on the printing plate must not be smaller than the cell opening on the anilox. If that occurs, the diameter of the dot on the plate will be smaller than the diameter of the cell opening. This leads to excess ink on the dots, resulting in dot bridging or dirty printing. The 60-deg hex pattern provides excellent dot support via the uniformity of the hexagonal engraving across the face of the roll. When using the recommended line-screen anilox for the plate screen, the dot sits atop the post areas of the uniform hexagons (see Figure 2). The area where the hexagon shapes meet form the support required to maintain the integrity of the dot. This allow for cleaner print and better dot stability. If this

were a channeled engraving or an elongated cell, the dot may not sit atop a post area and cause dirty print.

The technology employed in today's lasers allow for deeper engravings in the higher line screens of the 60-deg hex family of engravings. This is important to combination printing and vignettes as printers now have the ability to print a very dense solid and screen on the same plate.

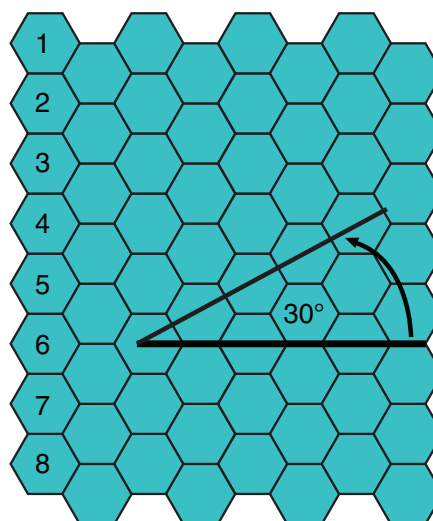
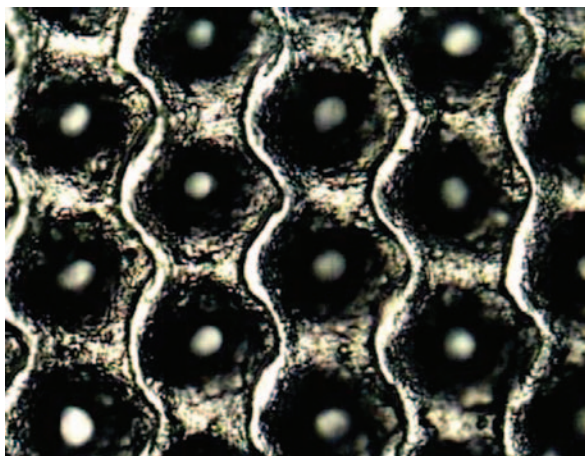
### 30-deg hexagonal channel pattern: Opaque white and coatings

The 30-deg hex pattern (see Figure 3) and the 45-deg diamond pattern are more commonly used in coatings, laminations and specialty-printing applications due to their geometry and engraving angle. For example, the 30-deg hex pattern is usually a channeled engraving, which is created by nesting rows of staggered cells within a circumferentially connected channel. By removing a small part of the top and middle cell walls, a channeling effect is created that enhances the laydown of the ink or coating by helping to prevent the trapping of air that does not allow the cell to be filled properly. The result is a more uniform ink film to plates. The lack of vertical walls in the engraving means there is no interruption to the ink film, thus, resulting in an ink film that achieves opacity through uniformity rather than ink volume. This helps reduce pinholing and can create higher-opacity readings. The same holds true for coatings. Coatings are used for protection and pinholes can provide the opening for liquids to penetrate and render the coating protection useless. By channeling the coating, pinholes are reduced, providing better protection for the product.

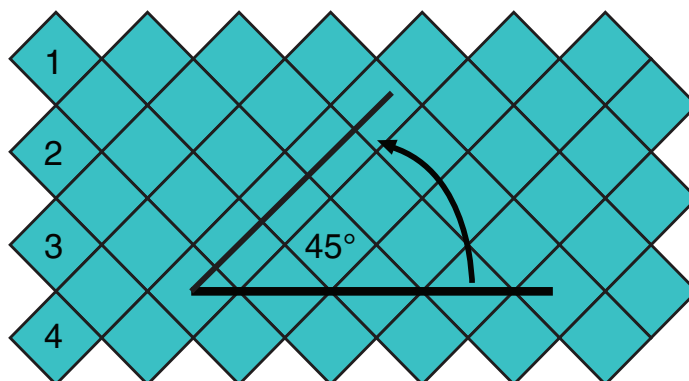
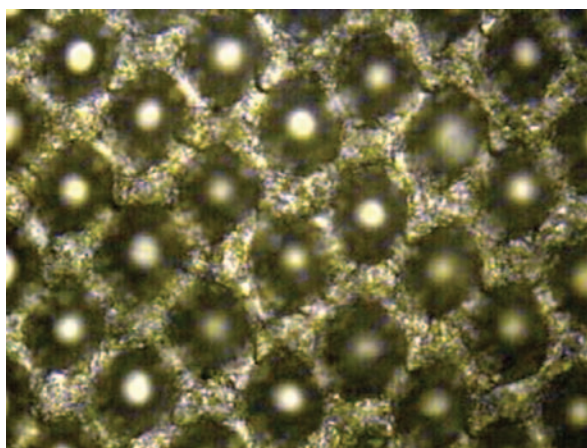
### 45-deg quad and trihelical pattern: Adhesives

The nesting of 45-deg cells naturally joins four walls together, creating large post areas (see Figures 4 and 5). The large post areas are why the 60-deg hex, at its introduction, quickly pushed flexographic printing to a new level. The 45-deg quad is still

◀ continued from page 38



**FIGURE 3.** 30-deg hexagon channeled engraving



**FIGURE 4.** 45-deg quad engraved pattern

useful in heavier film thickness where the coating will level out and hide the post areas, or where, with coatings and adhesives, the post areas do not affect ultimate coating performance. However, it must be noted that with advances in engraving technology, the 30/60 hexagonal pattern is now available in higher volumes than ever before. With smaller posts, shallower depths can be engraved, which allows for easier cleaning.

The 45-deg quad and trihelical channel engravings still have application for heavy coatings, laminations and adhesives where the possibility of seeing the engraving pattern in the printing makes no difference. Being a channel, the trihelical engraving does not have individual cells, so higher volumes are achievable. However, this may cause doctor-blade issues or, as stated earlier, visible lines, but it is great at releasing air returning to the chamber.

## Alternative geometries

As mentioned earlier, the latest laser technology has increased

the R&D of alternative engravings. Recent developments have been achieved in weave or new channeled engravings that differ from the 30-deg that transfer ink via channels or canals — and not cells. There have been software developments that allow for non-uniformity in hexagonal shapes. The result is a combination of hexagonal cells and elongated cells. These channeled canals and elongated engravings will continue to be marketed; however, it is not clear what role they will play. The initial consensus is they will be more suited for solid ink laydown, opaque whites and specialty coatings. However, further research will determine if they are consistent enough for combination printing, process printing and vignettes.

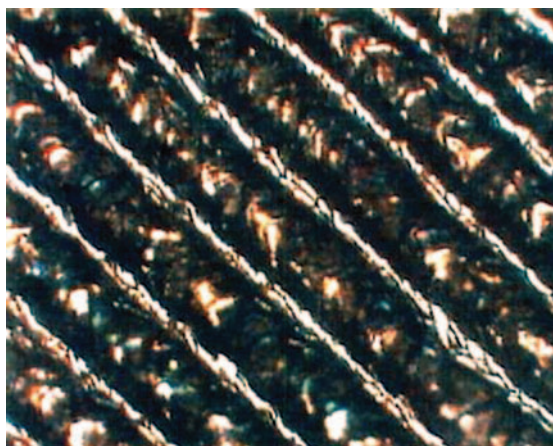
R&D into alternative engravings has never ceased, and with increases in press speeds, ink pigments and graphic features such as tactile printing, some new engravings are available. There have been developments in channel engravings to a variety of shapes from weaves to non-traditional angles, and channels with flat bottoms or with partially developed cells. These shapes



have come about from software developments to the use of imaging software originally not intended for ceramic-coated anilox engraving. The result is a combination of distorted hexagonal cells. These channeled canals and distorted engravings seem to have a niche application when coupled with specialty inks and plate combinations. There is a challenge to the engravers to process these engravings with the same consistency as is available with the 60-deg hex from roll to roll and order to order. However, further research will determine if they are consistent enough for combination printing, process printing and vignettes — and not just as niche problem-solvers.

## Conclusion

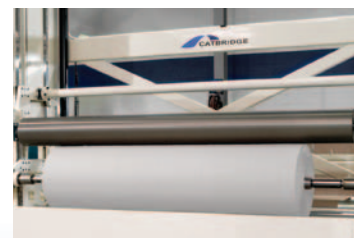
The 60-deg hexagonal pattern continues to be the anilox-roll engraving of choice and is by far the most consistent and repeatable engraving. Numerous scientists and mathematicians



**FIGURE 5.** 45-deg trihelical engraved pattern

have proven its efficiencies. Real-world industrial experience has proven that the 60-deg hex is the most repeatable engraving for anilox manufacturers, and from a printing standpoint, consistency and repeatability is what printers and end-user customers want to achieve — run after run. ■

*Alan Rogers, technical account manager for Harper Corp. of America (Charlotte, NC), graduated from Georgia Tech with a B.S. in Industrial Management and has been working in the flexographic-printing industry for more than 18 years. He began his career in flexo as a sales representative for a water-based ink company and eventually held the positions of regional and national sales manager. Alan currently serves wide-web accounts throughout the southeastern US. He can be reached at 800-438-3111, [www.harperimage.com](http://www.harperimage.com)*



## Innovative, cost-saving slitter rewinders

More efficiency, less downtime, less waste



Catbridge designs and builds innovative slitter rewinders that maximize productivity. Our unique technologies and smart designs improve quality, reduce waste, and significantly increase run times. We incorporate features such as patented knife placement systems, automatic cutoff and transfer, automatic loading and discharge systems, advanced tension and recipe control, and remote support. To further optimize performance, we tailor all of our equipment to your exact needs. To learn more, visit [www.catbridge.com](http://www.catbridge.com) or call us at 973-808-0029.

Standard or custom – we build solutions: slitter rewinders • unwinds • knife systems • perforators • coaters & laminators

Catbridge Machinery • 222 New Road, Parsippany, NJ 07054 USA • Tel 973-808-0029 • [www.catbridge.com](http://www.catbridge.com)