Since its inception in the early 1990s, flexo printers have employed the 60-degree anilox roller. This proven, reliable roller has been supplied by engravers ever since. If handled with care properly, these anilox rollers can yield many years of production. Based on industry standards, it has been the most useful geometry the industry has to work with. This article will help to explain some suggestions for when it is proper to use an alternative geometry, show some of the aspects of these different geometries, and talk about how to apply these recommendations.

It is important to remember that an application may arise that requires a different geometry, based on unique challenges and/or customer’s requirements. When this happens, the supplier is the best resource for assistance. Suppliers have seen a multitude of requests, problems and solutions and can assist in providing an alternative geometry that might work better.

Because of the sheer number of options, it is important to become familiar with the selection of geometries, as well as what a supplier has to offer. All suppliers offer similar geometries, but some are proprietary. In other words, there are many different types of engravings to choose from.

Let’s start with the existing industry standard for flexographic reproduction.
60-DEGREE HEX

The 60-degree hex (Figure 1 and 2) is the standard for quality graphic printing, line type, solids and coatings. This cell configuration has been standard since its original implementation. When the 60-degree hex was first applied, flexo printers experienced approximately 15 percent better ink transfer. This, in turn, allowed for higher engraving specifications cells per inch, or CPI (line screens). The cell cavity and opening is broader than the previous 45 degree standard, allowing for higher CPI and a much better ink transfer rate. Recent laser upgrades have created a slightly broader cell cavity, which has permitted even higher volumes within an engraving specification. Therefore, higher volumes and higher CPIs have been achieved by approximately 50 percent of users, since that of the original 60-degree engravings of the early 1990s.

This geometry has a consistent reaction to most inks and coatings used in the flexo industry. Water-based, solvent and UV inks react about the same when ink formulas and viscosities are correct. With a 60-degree engraving, higher volumes are being achieved up in the range of 70 billion cubic microns (bcm). The 60-degree geometry can be used for many types of coating and printing applications as well. But, the volume needed may affect dryer requirements. When using narrow web press equipment, it is important to make sure the dryer package can handle the pounds per ream of ink or coating being deposited. Running this, or any geometry, can limit how much volume a specific press can manage.

This geometry is used for all flexo graphic applications, including coatings and laminations up to 40 bcm. If the chemistry of the ink or coating is not compatible with this closed cell design, then it would be prudent to switch to one of the alternate geometries to be discussed here. There are also a couple variations of the hex cell that allow it to expand, which may afford better transfer when testing viscous and tacky coatings. This is especially true for blister packaging and other adhesives, like cold seal and hot melt adhesives. It may be necessary to consider an alternative geometry when using this type of specialty application.

70-DEGREE HEX

The 70-degree geometry (Figure 3 and 4) is slightly more elongated than the 60 degree. This geometry is fairly new to the industry and has not had enough time in the field to show its real worth. But, in preliminary testing with inks or coatings, 70-degree geometry has shown promise for heavy coating applications. Side-by-side testing has shown that, when process printing through the tonal ranges, the numbers coincide with that of the 60-degree anilox. See Figures 4 and 5 for another example of how this geometry compares to the 60-degree cell.

KATRON -ELONGATED HEX

Another new geometry is the elongated hex cell. This cell is similar to the 60-degree cell except extremely elongated. This extension creates thinner walls that may affect overall wear (Figure 5 and 6). Only a few engravers offer this geometry. Cell volumes can be slightly different, depending on where the roller was engraved.

All preliminary tests show that the Katron hex can hold and maintain a process graphic. Tests show that there were acceptable similarities throughout the tonal range. But, the question remains: was there any improvement from the 60-degree hex? After comparing the results, the graphic reproduction of this Katron did not exhibit enough improvement to warrant a complete inventory change.

Further testing is required to determine if the Katron could be used as a coating roller. The volume rating in this cell is approximately double that of a standard 60-degree cell. A banded roller may prove useful to discover any applications that would benefit using a specialty roller.
45-DEGREE QUAD
In the mid-1980s, the main cell geometry that was being engraved in chrome anilox rollers was the 45-degree pyramid or quad cell (Figure 5). When ceramic surfaced laser engraved anilox rollers were first produced, the 45-degree was the first geometric achievement. This cell structure has a four-sided cell with considerably wide walls.

Flexible packaging and the label market went to this geometry as they transitioned from chrome anilox rollers to the ceramic surfaced rollers. This geometry was the cell of choice for the flexo industry for most ceramic surfaces.

30-DEGREE HEX
The 30-degree hex (Figure 10 and 11) has a natural channel created by nature in the orientation of that cell. The channel can be manipulated to some degree. It can help ink to wetout better as it is being transferred from the anilox to plate. Ink type, viscosity and ink rheology can change or affect the way the ink transfers. Experience proves that this geometry works best—with better holdout—on coated papers, films, foils and substrates. When running with uncoated materials, the ink can saturate into the substrate, and if it dries too quickly, a slightly ribbed affect may be seen.

This geometry can and is used to lessen the spitting phenomenon that happens when using UV inks. It will also print adequately with UV inks, thanks to the drying rate of UV inks, which is slower and runs cleaner than most water and solvent systems. The 30-degree engraving needs to be evaluated if being considered for water or solvent systems.

30-DEGREE CHANNEL
This channeled engraving has a few common uses. It was initially popular for UV spitting issues. The channel minimizes some of the pressure that builds up, due to UV ink viscosity behind the doctor blade. The build up can force the blade to bow causing the front edge of the doctor blade to intermittently discharge ink. UV ink spitting is a phenomenon that all printers struggle with and there is no definite cure. This geometry is just one of the components that may help avoid the problem.

When used for printing a standard flexo graphic, it will yield an acceptable result, however, it is not as sharp as the 60 degree geometry. Note Figure 12: the 10 point type at an 8 bcm will print open, but does show some hallowing with the 30-degree channel.

TRIHELICAL CHANNEL: XTR
The trihelical (Figures 13-16) is a constant channel around the anilox roller or sleeve. This geometry comes in three variations: 45-degree, 75-degree and 89-degree. Because it is an open channel, it is speed sensitive. This would be used mainly on high volume coating applications. Certain coatings—due to viscosity or rheology—may be sensitive to misting, which is a very fine mist that gets released from the cell channel while running at an extreme speed. That speed designation may vary due to the ink or coating’s viscosity.

Also, due to the direction and angle of the channel, the 45-degree geometry tends to naturally push inks and coatings to one side of the ink chamber. One possible solution is the 75-degree or 89-degree variation. The 89-degree is almost
ear with the web direction. The 75-degree has a slight angle, much less than the 45-degree variation, making it run much better when using an enclosed doctor blade chamber.

These engravings react totally different at times with all inks and coatings and should be tested well before making any changes in your printing or coating process. Recently, good results have been seen with this at the 75-degree angle using UV inks, as well as water base adhesives. The constant channel recycles inks and coatings out of the channel on each revolution of the roller, thereby allowing the chemistry to run cleaner.

This geometry should be applied when there is drying from the sides of the cell walls. The coating plugging the anilox cell from the sides usually causes this issue. The trihelical lets these coating or inks run cleaner. If there is a struggle with premature plugging, this may be an alternative worth looking into. XTR also works great on in-line adhesive applications for couponing, laminations and any similar application. It may not always apply a defect free finish, so testing is again suggested to see where it can be best used.

This geometry works especially well where the ink or coating has a fast dry rate or with very viscous coatings and adhesives. Abrasive chemistries are also another application for this geometry. I frequently use this in paper-to-paper and paper to film lamination applications. You will see that this has a very specialized range.

CONCLUSION

As printers, we get caught up in CPI – Cells Per Inch (line screen) and forget about volume. CPI, to a degree, will help
improve ink transfer and print clarity. As we all know, if you use a CPI that is too high for the volume being applied, you restrict the amount of ink that you transfer, so we want to use an engraving specification that will comfortably allow the ink to transfer to the substrate when doing coatings.

Engraving specification requirements can change depending on substrate type and application type, like flexo vs. gravure. Uncoated materials with a higher surface tension will pull ink out of the cell much better than a coated paper or film material. Volume is what dictates the amount of ink or coating that is going to get supplied to the substrate, therefore it may be common to use lower cell count on uncoated substrate types to allow ink to wetout thoroughly and provide substantial ink coverage to the uncoated materials.

Choosing the proper depth to opening ratio is key, but using a geometry that may allow the ink or coating to transfer out of the cell more efficiently will be beneficial and this will probably come into play at volumes that are higher than typical flexo graphic volumes. Higher viscosity inks and coatings may struggle as they transfer out of the cell, so an alternative geometry can help these heavier coatings transfer more efficiently.

Lower depth to opening ratios will let coatings transfer better as well. When you combine both of these ways of thinking, you will improve the ink deposit efficiency of the application.

To achieve specific coat weights, it is suggested to conduct banded roller testing. You want to make sure you apply what is needed for the product to pass any requirements, but at the same time, only apply the amount required to meet your customer’s needs. Over specifying the coat weight can lead to excessive cost.

Calculating coat weights or coating thickness should be done to all the geometries discussed here. Pounds per ream, pounds per gallon, transfer percentage and application type (flexo or gravure) should all be calculated when doing coating applications. Banded roll testing is a great alternative for finetuning any coating application.

When the target coat weight is achieved, one will be able to calculate how much coating is being used, as well as develop a window for acceptability for all applications. Even a simple gloss coating should be measured and validated, so you do not waste ink or coatings.

About the Author: Bill Poulson is the technical graphic advisor for Harper Corporation of America. He has been in the flexo industry for more than 30 years and has specialized in coating and multi-web applications. Since August 2011, he has been a FIRST Certified Implementation Specialist and is also an NCCO certified multi-color press operator.