

# Do you know what ink film thickness is transferred?

*Understanding the volume of ink transferred in the flexo process is simple but not well understood, this article strips away the mystery and simplifies the equation*

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Perhaps the greatest mistake flexo converters make is printing a job and identifying the anilox roll by its »line screen«. A typical comment is, »This job needs an 800 lpi (315 l/cm), or 550 lpi (216 l/cm), or that solid should be printed with a 440 lpi (173 l/cm).« Strangely though a print job has never been printed with a line screen, but rather the »volume« of ink it delivers.

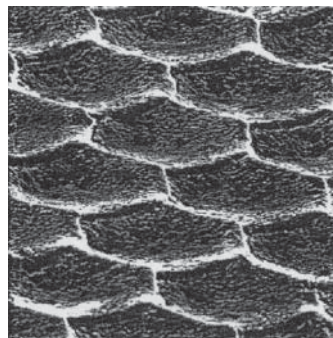
Nevertheless, mistakes are made daily by installing an 800 lpi (315 l/cm) anilox and not getting the colour results achieved the last time the job was run. Consequently, the press doesn't run that job until another, or perhaps several 800 anilox rollers have been tried in order to achieve the same colour required for customer approval. This common mistake cost thousands of dollars in downtime and can easily be prevented by a better understanding of the anilox ink carrying volume.

It's understandable that such terminology is common as line screen is perhaps the one thing most understood about an anilox roll. However, what really achieves the printing result is the »volume numbers« of an anilox surface. An anilox volume is what drives the printed colour and thus is the primary figure management and press crews should concern themselves with – providing an excellent way to reduce downtime.

Ink volume of an anilox roller is calculated as one would figure the cubic square footage in a room. Instead of using cubic square feet as a measure, cubic square microns are used. These cubic square microns are the »space available« (volume) in the cells within one square inch (or square centimetre), on the anilox surface that will contain the ink – ultimately producing the ink film

which is printed. In the same way if the cubic square footage of a room was calculated and its available space filled with ink, this would determine how much ink it would hold through the measure of cubic square footage or cubic square metres.

In the case of an anilox surface volume, things have to be kept on a microscopic level (see *anilox graphic*) This requires the calculation to use microns as the unit of measure, as it is the only thing small enough to use, though metric. A micron is one-millionth of a metre and there are 25.4 microns in one-



Scanning Electron Microscope Shows Harper's Platinum™ cells at 375X.

thousandth of an inch, this is the conventional way to determine the available area in the cells of an anilox that will contain the ink. Thus in one cubic thousandth of an inch, there would be 645.16 cubic microns of space available to hold ink. This is further factored into an area on the anilox using one square inch of surface area, which quickly becomes a very big number. This is then expressed in the billions of cubic microns or in short: BCM's.

BCM's is then the area of cubic »anilox cell space« available for carrying ink within one square inch on an anilox roll. And perhaps more clearly – on an 800 line, hexagon pattern anilox roll, it is the available space, or cubic area available, for

carrying ink within the 736,000 cells that are within one square inch of surface area. This »available space« with a 800 line screen will typically range from 1.6 to 2.2 billion cubic microns (BCM's). Expressed in actual numbers it looks like this: 1,600,000,000 cubic microns.

## Determining anilox volume

Anilox suppliers typically have two ways of determining the available volume available for carrying ink on an anilox roll. The first is the historical method, still used by some, using a microscope. The volume is determined by analyzing the space available in a single cell – or a sampling of cells on the anilox roll. Then assume that the rest of the cells, 222,640 of them in the case of a 440 line screen roll, are basically the same. Needless to say, it can be said that this produces a highly theoretical number – the second method proves this to be so.

The second method was adopted in the 1990's and uses a microscopic mapping modality called interferometric light technology. Interferometer uses a multimode waveguide interferometer, or MWI, whereby a single light beam enters a waveguide formed by two parallel mirrors, where it propagates as a combination of many different modes. Because these modes follow many paths simultaneously to reach their destination, they interfere with each other. This interference pattern can be used to obtain a measurement of the distance travelled. These distances are then captured and placed in a computer model into a microscopic surface topographical map – which in turn is used to calculate the available »space available« that can carry ink on the anilox roll surface.

Through extensive research in the late 1990's, Harper Corporation determined that physical measurement, beginning with an individual (the human factor) determining the microscopic opening, depth and shape of an individual anilox roll cell, was the biggest area of poten-

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tial problems with the historical method. Variations of cell depths in the region of plus or minus 15% could easily be made – depending on the person’s perceptible vision in focusing a microscope.

Compared to the interferometric system, this variation was cut virtually in half – thus meriting a large investment and conversion in manufacturing and quality control technology. Harper reasoned: If Flexography was to be more predictable in colour reproduction, then anilox volumes had to be more predictable. Thus, today, it is the standard operating procedure in setting up the rolls for laser engraving and quality control.

**Anilox volume and colour control**

It is commonly known that the anilox cell volume (or size) drives the ultimate colour achieved on press. This is caused by the anilox cell sizes ability to be changed. This in turn will change the physical ink film thickness transferred – to darken or lighten the colour. But how relative, is colour control versus anilox cell volume? Or perhaps better still, how can an 800 line anilox print a stronger colour than a 600 line anilox – where experience would indicate that the lower the anilox line screen count, the stronger the colour on press.

To better understand how anilox changes the colours seen on press irrespective of cell count, the »anilox volume« is converted into »ink film thickness«. To determine how thick the ink film would be, the »cubic square area« (BCM’s) is converted into ‘actual micron film thickness’ that would result if every cell transferred 100% of its ink. The conversion calculation is: BCM/0.65 = Available ink film thickness. As shown in figure 1, anilox BCM’s converted to available ink film thickness are actually far less than most would imagine – as represented by a 8.0 BCM having slightly less available than 1/2 thousandth of an inch if all is released.

Measured anilox volume in BCM’s	Measured anilox volume in cm³/m²	Calculated ink film thickness »in microns« available	50% transferred to plate	50% transferred to substrate
8.0	12.39	12.3	6.154	3.077
7.0	10.84	10.8	5.385	2.692
6.0	9.29	9.2	4.615	2.308
5.0	7.75	7.7	3.846	1.923
4.0	6.20	6.2	3.077	1.538
3.0	4.65	4.6	2.308	1.154
2.0	3.10	3.1	1.538	0.769

Figure 1: Anilox BCM’s converted to »ink film thickness«.

This answer then produces another question: How much ink is actually transferred from the anilox roll surface to the printing plate, and then to the substrate? Answering this question took years of research. The technical explanation is the subject of the next article in this series. Again, surprisingly the amount is approximately 50% transferred from the anilox surface to the plate and then 50% of the ink on the plate goes onto the substrate.

Therefore, if there are 3.0 BCM’s »available« to carry ink within the cells (or on the surface) of an anilox roll, the resulting film thickness »available« for transfer would be calculated as: 3.0/0.65 = 4.615 microns. In other words, a 3.0 BCM anilox roll has a 4.615 ink film thickness available for transfer. Of this thickness, only 1/2 is transferred at most or just 2.307 microns of ink. Taken to the substrate, it is calculated that only 1/2 is transferred from the plate to the substrate, or an infinitesimal amount of 1.155 microns.

Knowing this, it can be easily seen that a given thickness of red ink will go pink if the anilox cells are filled (dirty) by only 15%. In this case, a 4.615 micron ink film thickness is available, but reduced by 15% would make this 3.9 microns. This difference will create big differences of colour on press, particularly with certain colours.

These facts further illustrate the need for standard cleaning and maintenance of an anilox roll’s surface. Otherwise, it will be the cause of massive downtime, heart ache and a lot frustration in any pressroom. Making a point to educate the operators regarding these small, but

critical colour control numbers can easily save thousands of Dollars (Euros) every year.

To put this information to work in the pressroom, classification of the anilox inventory by volume is the best place to start. Considering the logic that volume or the ink film thickness is actually what is used to print – not line screens on an anilox – adopting some language changes may be in order. To change this in the print shop in the beginning it is suggested that every where an anilox is referenced, that volume figure is added. This should begin with the anilox charts and tags – ending with the customer order records. And if it is not referenced on the latter, it is paramount to downtime reduction that it is done. To go a step further, it is suggested to chart the inventory using volumes and line screen as the second number to simply help identify the roll. If there just isn’t time to do it right, it is well worth the expense of having someone audit the inventory first and then chart, list, identify the colour drivers – to prevent guessing for every job each time it returns to press.

While it is advocated that anilox volume is king in the flexographic colour control equation, line screen is a secondary driver for optimum success in colour reproduction on press. This will be covered in the second article in this series of three – outlining how line screen selection of an anilox roll becomes the stabilizer of the perfect ink film we’re wanting to transfer. ■