Abstract
Considering all the continued advancements in the flexographic-printing industry — press, inks, plates and aniloxes, the anilox is still the heart of the flexographic process.

Most consumer packaging companies and print-buying customers now require specific print targets for their products — density, dot-gain percentage and/or Delta E color tolerances. The push for more consistency, higher-quality graphics and faster turnaround of products continues. Thankfully, there are numerous methodologies available for quantifying the print process regardless if it is measuring density, dot gain, near-neutral density or using G7 standards. By using a tried-and-true scientific approach to select your anilox inventory — banded-roll trials — you can correlate anilox specifications directly to any print targets and tolerances.

Every anilox roll manufactured by this firm is measured and engraved using an EDV™ Echotopography™ (Interferometric) Digital Volume measurement system. This approach has dramatically improved print consistency by assuring a quantifiable, manufactured ink-delivery engraving and has narrowed the window for achieving print tolerances, resulting in a high level of quality products. With today’s Interferometric technology, printers have the ability to use a measurable, quantifiable approach for the selection of anilox-engraving specification that correlates directly to print targets and tolerances. Printers can use the Interferometric measurements supplied with each anilox roll to document anilox specifications, digital microscopes to measure the polymer and spectrodensitometers to measure print targets and tolerances (see Figure 1). Printers that do not have or use print targets need to choose one. Without targets, you have nothing to measure; without a quantifiable process you have a high degree of variability and inconsistency. A good source for print targets is the FIRST 4.0 manual.

Banded-roll print trials will result in tight controls for the print process starting from the heart of flexography — the anilox roll, and then scientifically correlating directly to print targets and tolerances. This quantifiable approach is effective regardless if you are doing banded-roll trials for process printing, line/solids, combination printing or for coatings. Coatings require specific
coatweights to work successfully, that as with normal printing, correlates directly to the anilox-roll specifications.

**Measurement methodology**

Process printing enables a high quality of graphic reproduction, almost photographic. When printing, there must be print targets and tolerances for the entire process, including ink formulation and viscosity, plate thickness and dot consistency, stickyback choice and press condition — impression settings, production speed — to consistently achieve production goals. It is also important to define the measuring methodology. Are you measuring density, dot gain, gray balance or Delta values? How are you measuring these values? Are you using a white tile for a backing or an Opacity Leneta Board? Are you using a viewing booth, and what are the parameters of the measuring device? Defining measuring methodology is vital to conducting a successful print trial and achieving consistent results.

**One-to-one testing**

In today’s flexo industry, numerous engravings are being introduced as “new.” A word of caution: Conduct comparative one-to-one testing. “New” does not necessarily mean better. Over the last several years, our firm’s technical team has conducted countless banded-roll trials and tested all available anilox engravings. No engraving has surpassed the performance of XLT-60 deg Hexagonal cell engraving when the test is structured with a one-to-one comparison of equal volumes. This is due to the high precision of the hexagonal structure and the fact that the hexagonal shape allows for 15-percent more cells in a given area.

The 60 deg Hexagonal engraving covers 80+ percent of most printers’ needs. This type of engraving offers the highest degree of consistency and repeatability for matching print tolerances from job to job and press to press tied directly to print tolerances for coatings, density and color.

For example, Figure 2 shows the results of one of the many print trials conducted. This banded-roll trial involved comparing the Extra Large 70 deg Hex, compared to Long-Cell Engravings, compared to the XLT-60 deg Hex. It was conducted using process Cyan UV ink with digital polymer imaged at 175 lpi, printed on a mid-web press and using an anilox specification for all three different cell shapes engraved to 1,000 cpi (or equivalent), 1.8 bcm, +/- .1bcm.

The print trials conducted compared digital-polymer plates imaged at 150-, 175- and 200-lpi with all three engravings. For the 150-lpi plate, dot gains were a little lower — all within 2 to

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Banded anilox rolls allow testing of all print variables for daily print production and are also the best way of testing new engraving technologies side-by-side with your current anilox specification. When conducting any print trial, including a banded-roll trial, it is imperative to have benchmarks against which results are compared. This is especially critical when comparing current anilox specification to “new” engravings. It is easy to claim that a “new” engraving technology outperforms another when the older roll is worn or plugged. Additionally, when comparing any change in the print process, use visual as well as measurable targets to decide if the change is truly better.
3 percent of each other; solid ink density, like the dot gain, was similar and within +/-0.03 density. For the 200-lpi print trials, the solid ink density was within +/-0.03 density and the dot gain was overall a little higher, but all within 3 percent of each other (see Figure 3).

**Channeled engravings**

Today, the flexo industry is abuzz regarding a variety of channeled engravings promoted as “new.” Variations of channeled engravings are and have been available for quite some time. Some of these are tri-helical engravings — 45, 75 and 89 deg; weave engravings; hourglass or quad-type engravings and other types. If you are interested in using any new engraving, take the time and conduct print trials to determine specific results. Channel engravings are more applicable to solids, coatings or specialty inks, such as fluorescents and metallics. Again, a quantifiable approach should be your avenue to determine the results when comparing “new” engravings to current anilox-roll inventory.

An example would be a line/solid, narrow-web print trial comparing XLT-60 deg Hexagonal engraving to channel engravings — 89 deg and weave channel. This test involved an opacity print trial that tested white ink in a wide-web format for surface print. The protocol used medium-durometer stickyback and a hard-durometer plate with solvent-based white surface-print ink. Ink viscosity was maintained around 22 secs, and

The substrate was 2.0-mil clear film. An XLT-60 deg Hex was compared to 30-deg Channel to the weave channel with engraving specifications around 9.0 bcm (see Figure 4).

The press was run at 1,000 fpm (305 mpm). Samples were evaluated from the start of the print trial, mid-way through and at the end of the press run, visually against a backlighted table and by measuring the opacity of the different engravings. Measuring methodology used: \( L \)-value of the spectrodensitometer measured against the black area of a Leneta Opacity Board. Visually, it was difficult to discern a difference between the three different engravings. Measurements were taken using the spectrodensitometer with the black area of a Leneta board as a backing. Average Opacity readings are shown in Figure 5.

**Print-trial guidelines**

Several points should be kept in mind when conducting any print trial. 1) It is critical to define the variables you seek and always compare them to a known target or standard. 2) Always have measurable print targets. There is no value to conducting a test comparing a new engraving to an old engraving, if you have no way of measuring the results. 3) Always use clean aniloxes. Dirty anilox rolls will dramatically skew the print results.

The following are potential challenges to consider when testing with new engravings:

- Hitting your measurable print targets
Conduct comparative one-to-one testing. ‘New’ does not necessarily mean better.

- Print patterns due to moiré
- Too much color due to excessive volume
- Plugging of screens used with vignettes
- Plugging of minimum dots due to too much flowing ink
- Consistency of anilox engravings. This is by far the greatest factor when thinking about converting to a different engraving technology, especially when attempting to use the same specifications on multiple presses.

Selection of anilox specifications should be based on desired print targets which, in turn, should be established for every aspect of your print needs — process, line/solid, whites and coatings. Anilox specs should be defined and tracked throughout their use to determine when they no longer achieve print targets.

The length of wear for an anilox roll will differ depending on frequency of use, speed of the press and type of ink. For example, a press running at 1,500 fpm (457 mpm) will clearly wear out aniloxes faster than one running at 900 fpm (274 mpm). This is especially true for aniloxes that are used for process printing. The engraving specifications for process printing continue changing to higher engravings. In flexible packaging, anilox specifications typically had ranged from 800 to 900 cpi; today that engraving specification is changing to 900 to 1,100 cpi. By tracking your print targets, and having frequent anilox-inventory audits, you will know at what point the anilox specification will no longer hit the required print targets.

Conclusion

Much is changing in today’s flexographic-printing industry that continues to result in higher-quality printed products. Aniloxes have been and still are the heart of the flexo process; they are what enable printers to consistently achieve defined print targets. Therefore, regardless of the type of anilox engraving used, it is critical to know your anilox specifications, the condition of the anilox inventory and at what point the aniloxes no longer hit targets. By knowing which anilox specifications match required print targets and tolerances, and tracking roll-wear history, you will be able to maintain a high level of print consistency and profitability.

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