Process Control for the Flexographic Pressroom

By Brian Ashe, X-Rite Inc.

How do we define good printing? Some may describe it as printing that is repeatable and predictable or printing that meets or exceeds customer expectations. Most would agree that the best printing is printing that is *profitable*. These notions are not mutually exclusive and good use of process control is a means to help you achieve both goals.

Statistical process control (SPC) can be applied to color control in the flexographic pressroom. To use SPC, the printing process must be monitored and upper/lower limits established to keep the process in compliance with a set of standards. The ultimate goal is to continually narrow these control limits to reduce the range of possible variation. If you are uncertain what the upper and lower control limits of your printing process should be, FIRST (Flexographic Image Reproduction Specifications and Tolerances) is a great place to start (see FLEXO Magazine October 2008).

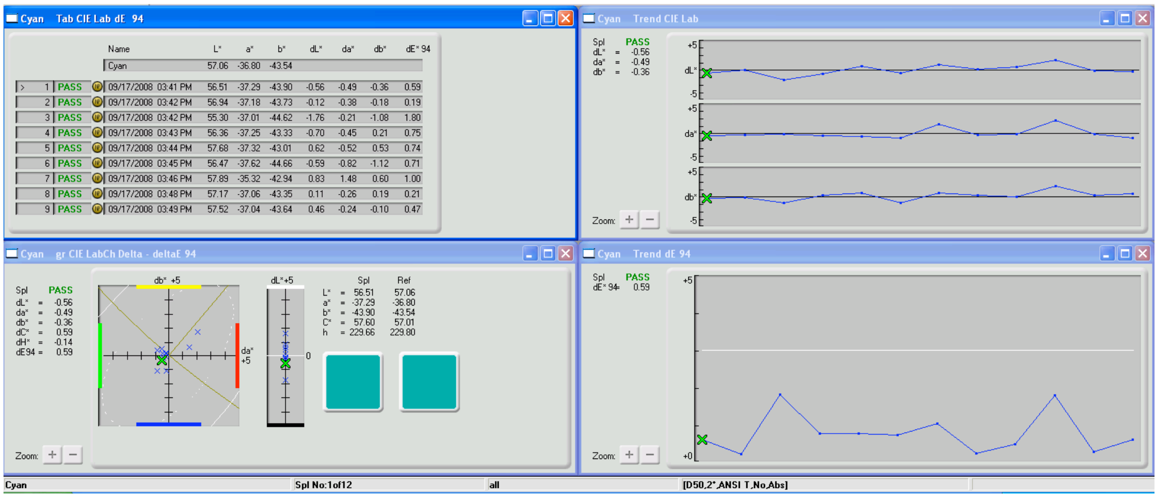
Prepress calibration can bring the printing process to a predictable and repeatable state for flexography. Characterization (color management and use of ICC profiling) captures and documents this calibration. Process control monitors and keeps the process on track through routine data collection. Depending on the process measured, this could be as simple as a tally sheet, or as sophisticated as in-line color measurement on press. Data collection and interpretation is required to achieve success using SPC. An ICC profile is useless without process control - when a press is not stable and predictable, it is impractical to bother with characterization. Process control implies continuous review and improvement. To achieve the desired quality results, you can't just measure once.

When I was a Quality Manager for a printing company implementing a SPC program, one of the main challenges was to get the operators to read and understand the data they were collecting during press runs. Using a scanning spectrophotometer, we were tracking average variations in density. The numbers were generally falling into a range 3, 4, 5, or 6 points, which reminded me of golf scores. I set up a 72-hole (72 colors of density variation measurements) golf tournament with the competition between two presses and three shifts. The winning crew would get the company tickets for a Red Sox game. The operators started to read the job reports and wrote down the density variation for each color as their "score". I realized the idea was working when I started to get questions from the crew like, "How many Mulligans do we get?" (they got one per 18 colors – after all this wasn't the USGA!). The end result was that the press operators started to really pay attention to the reports generated during press runs. They recognized when a run was “above or below par”, and even better, had a quantifiable way to gauge if steps they took improved their “score”.

If it is important enough to measure, it should be important enough to display. There are few things in this world so useless as a bunch of numbers written in a notebook and shoved into a drawer, never to see the light of day. Display the data collected. Let the operators take pride and ownership in it. You can incorporate such displayed charts into plant tours for customers: “here is an example of our SPC program we use to help assure quality to our customers, etc.” It is important for the people collecting the data to understand what they are looking at and why. I once had a person checking the density of film coming out of a processor and plotting it on a chart on the wall. While I was on vacation the pH went out of control. The density plummeted and the operator continued making the marks on the chart until he ran out of room (scale) and continued to diligently make marks off the chart and onto the wall! I now laugh when I think back on this story, but the real lesson I learned was that the fault was really mine. I never established upper and lower control limits or put in place an action plan of how to react when these limits were reached.

There are several ways to apply SPC in the flexographic pressroom:
Monitor press runs. It is possible today to read in-line roll-to-roll. Some camera based systems designed for registration can be applied in this way. Multi channel densitometric systems read the widest range of colors and give the press operator continuous real time feedback.
Monitor incoming raw materials (e.g. ink) for consistency and accuracy prior to using them on press.
Monitor plates. With the advent of Direct-to-Plate computer technology it is no longer possible to read film. Measure your plates with camera-based systems to confirm dot accuracy and consistent dot structure.

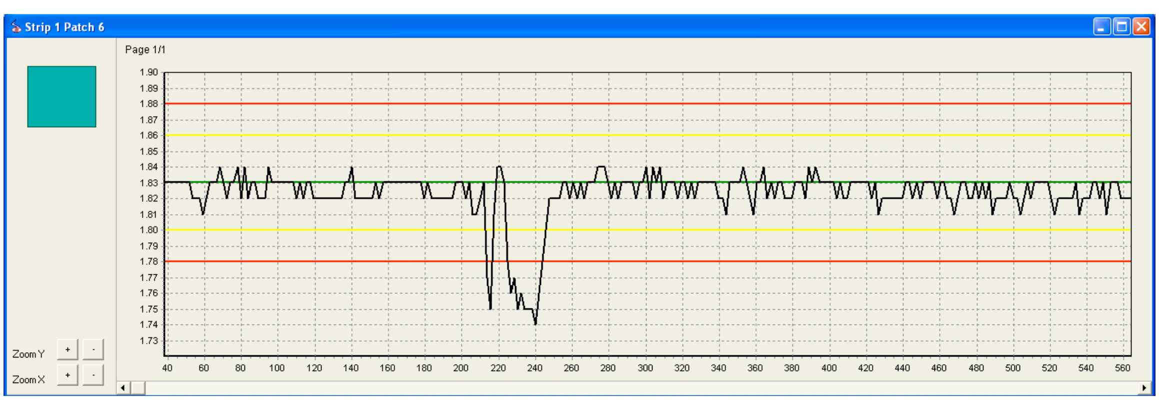
Monitoring incoming raw materials
A good place to start using SPC is monitoring your incoming raw materials (for instance ink). Set up a system whereby the incoming ink can be checked. I had an ink supplier provide drawdowns with large volumes of ink. The drawdowns were created using agreed upon densities (or anilox roller) and a target L*a*b* value. Upper and lower limits of acceptability were agreed upon. A QC person used a spectrophotometer to check the drawdowns of the incoming ink; a pass/fail (go or no go) check was used. Values were recorded and plotted over time. (see chart below)



The end result was that I never had a shipment of ink fail. Because the ink supplier knew the ink was being checked methodically at our end, they made sure they checked it themselves before sending it to us. This way, I had pushed a potential quality problem upstream to the supplier. In the end it worked out well for both of us: the ink supplier had a grateful printer, loyal to their brand and confident in its quality. As a printer we were always confident in the quality of the ink so when problems arose on press, we could usually eliminate the ink as a potential source of the problem and could quickly troubleshoot other areas as the possible source of problems.

Process Control on Press Runs

Pioneers of SPC, Edward Deming and Joseph Juran, teach us that you can not inspect quality into a process. This concept can be applied to press runs. You can't look through the completed job for "good" samples to show the buyer. Measuring samples at specific intervals (time or amount of work run) is a place to start, but it is far better to give press operators continuous real time feedback rather than trying to inspect the finished run for good quality samples. The chart below shows a press run with good process control (with a few out of tolerance occurrences).

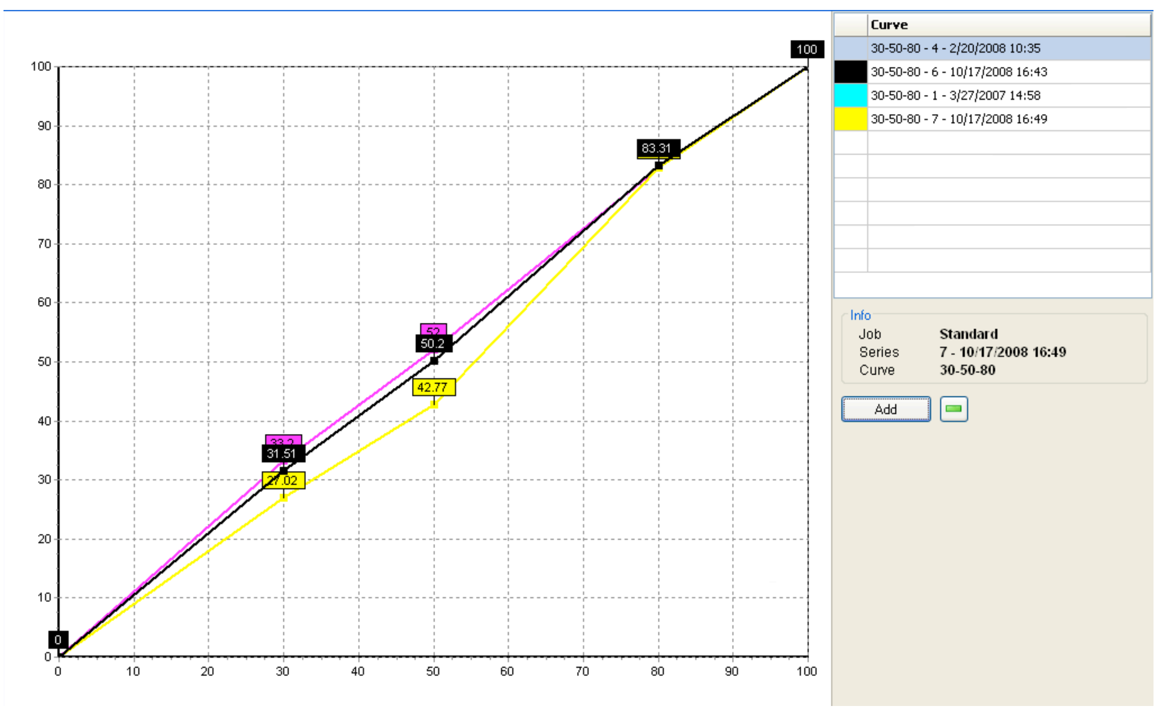


The yellow lines represent a caution warning and the red lines are out of tolerance. All processes will show some variation (above and below the target green line). In this case the density of the color shows good consistency, and since the color is monitored constantly, the operator gets immediate feedback on changing conditions and can react accordingly to bring the process back under control. Since you know exactly when it fell out of tolerance you can mark the portion of the job that should not be used. This report can also serve to protect the printer. If a piece with color variation ends up on the desk of the person paying for the job, the run report can be used to show the variable piece is not indicative of the vast majority of the job.

Another advantage of SPC on press can be seen during setup or make-ready. Rather than run to the subjective judgment of a press operator, run to an objective target or industry standard (such as FIRST) and measure variation from that industry standard. Dramatic reductions in setup time (and variation from operator to operator) can be documented using such techniques.

Monitor Plates

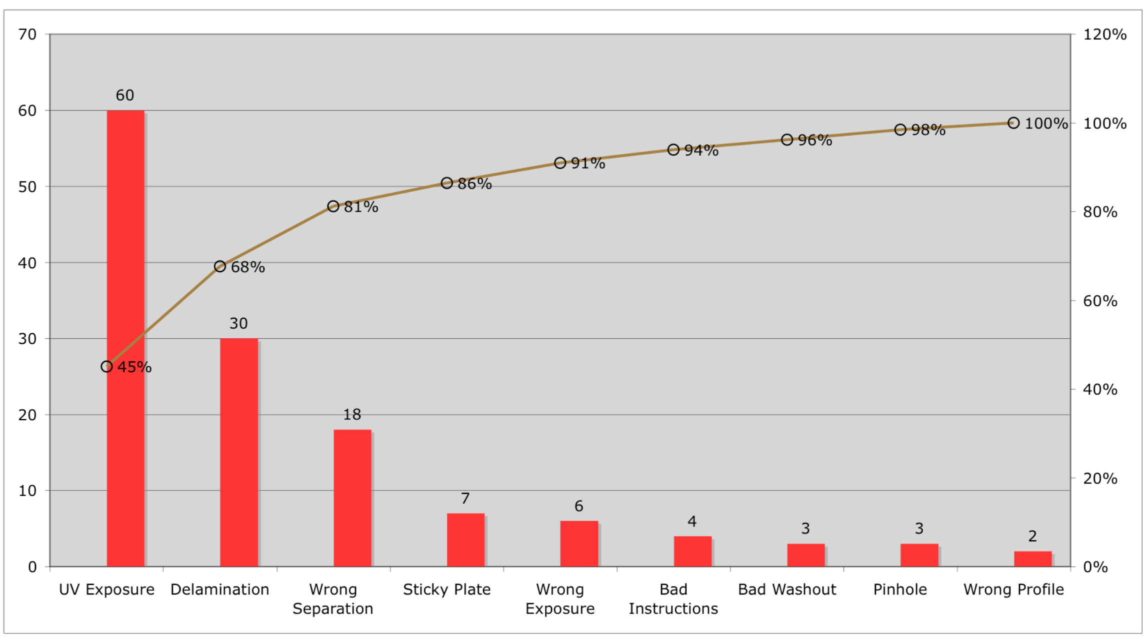
The arrival of direct-to-plate technology means traditional transmission densitometers for reading film have been supplanted by camera based plate-reading systems. The goal is still the same: check the plate for consistent dot structure and size. This process also lends itself to SPC since readings can be plotted, compared and monitored over time.



In the example above the yellow curve should get your attention. Something has changed (sharpened) the dot size at the quartertone and halftone. This plate could cause a potential problem when it gets on press. Better to catch the problem before it gets to the pressroom. I have heard people say: "What a bother it is to check plates and I just do not have to time to check them all." It takes a minute or so to check each plate, and you will most likely find 95% (hopefully more) of the plates are fine. The cost of just one bad plate getting on press more than outweighs the time spent checking them. Bad plates can cost thousands in lost productivity on press, from trouble matching colors to spoiled work. Once during a quality audit by Ray Price from GATF, he asked me if we checked every plate. I responded "most of them" and he told me "well, if you can show me an unimportant plate you are making, then I guess that is one you do not have to check". I took his advice to heart and plate problems discovered on press plummeted.

Pareto Principle

The Pareto Principle (also known as the 80-20 rule or law of the significant few and trivial many) can be applied to many processes in the print shop, and its key tool is the Pareto chart. The chart below describes reasons for plate makeovers plotted over time.



An interesting exercise is to ask the crew responsible for plate making what are the main reasons for plate makeovers and to list them in order of what is the biggest problem. Keep track over time and plot the collected data like the Pareto chart above. The crew will be surprised by what the actual data shows. Many times the reason thought of as the biggest problem is not so at all. The "significant few" will make up 80% of your problem and the "trivial many" account for only 20% of the problem. Pareto Analysis acts as an accurate guide to what problems should be worked on first to affect the greatest return.

Remember SPC is not a panacea. It will not make your printing problems go away. It is a yardstick to measure where you are today and help you determine if you are improving. The term continuous improvement means just that: you continuously monitor your manufacturing process, looking to make gains, reduce spoilage and improve consistency. You cannot know if you are improving if you have nothing to compare it against. So put that initial stake in the ground and measure your way to more accurate and profitable printing.

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About the author:

Brian Ashe brings 25 years of experience to the field of color management and applies his expertise in color reproduction across a variety of industries including graphic arts, packaging, textiles, plastics and inks. Working with a client base as diverse the Metropolitan Museum of Art, Procter & Gamble, NASA's Jet Propulsion Laboratory and Dreamworks, Brian teaches clients about setting standards, communicating color, and process control. Brian is a regular speaker at a variety of color conferences such as Clemson University, FFTA, GATF, and a guest lecturer at RIT and Parsons School of Design. Brian's background in Quality Assurance, ISO certification and print production gives him a unique perspective on customer needs.

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