

TECHGUIDE SERIES:

The Benefits of CIELab for Consistent Color Matching

by Hapet Berberian

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Introduction

A valuable service that a printer can provide for a print buyer is the generation of a reliable visual match between a proof (hard or soft copy) and press output. Greater predictability in proof to press match is often a function of good process control and will contribute to lower costs, faster turnaround, and improved production efficiencies. More importantly, process control can provide consistent quality print production

- from beginning to end of a press run
- from press to press
- from pressman to pressman
- from one press run to subsequent press runs of the same job

A critical set of prerequisites for a device independent reference color space such as CIELab to provide consistent visual matches between output systems includes the following for each color reproduction device.

- compensation for dot gain
- gray balance control
- calibration for solids, midtones, and overprints of colorants
- maintenance of calibration throughout a press run

The focus of this paper is on the value drivers, the process, and the instrumentation used to calibrate and maintain calibration of hard and soft copy color reproduction devices from prepress through production. Special attention is given to spectral measurement devices like the Techkon SpectroDens and SpectroDrive. These spectrophotometers compute and report quantitative control parameter change recommendations to the press

operator to achieve and maintain press calibration. This is accomplished by applying derivatives of CIELab measurements to the G7™ press calibration process.

Process Control and the Importance of a Reference Color Space

Traditionally, densitometers have been the main instrument in the press room to measure and report calibration parameters including solid ink density (SID), tone value increase (TVI) or dot gain, print contrast, and trapping. With the advent of colorimetric specifications for solids, midtones, and overprints, spectrodensitometers have become more widely used for press calibration. CIELab is a reference color space for generating colorimetric values for color bar (control strip) elements on a printed page to be used for calibration by the G7™ process. It is also a reference color space typically used by color management modules (CMM's) and ICC profiles to convert from one device dependent space to another (monitor to proof, monitor to press, proof to press, press to press) to ensure a good visual match between devices. It's the responsibility of a color space to associate absolute color values with corresponding tristimulus values – those that map into the human visual response. To satisfy quantitative needs in human visual perception, the International Commission on Illumination (Commission Internationale de l'Éclairage) defined the 1931 CIE XYZ color space based on the response of photoreceptors in the human eye under well-defined observation geometry.

The Benefits of CIELab in the G7™ Calibration Process

G7™, along with the appropriate data set (aim points) and control strip, uses spectrophotometry and colorimetric data to achieve gray balance on a printing device instead of only measuring and correcting for solid ink density and dot gain. The specific parameters that the G7™ method brings to the world of calibration along with a brief definition of each are the following:

- Neutral Print Density Curve (NPDC) – NPDC is a comparison between the halftone values on a gray scale target and the measured neutral densities.
- Highlight Range (HR) – HR is the density of a mid-tone patch minus the density of the paper.
- Shadow Contrast (SC) – SC is the density of a shadow patch minus the density of the paper.
- Highlight Contrast (HC) – HC is the density of a highlight patch minus the density of the paper.

The main advantage of the G7™ process and the use of gray balance, HR, SC, and HC for production is that there is better control of the visual appearance of neutral tones than by applying more traditional dot gain based methods.

Automated Aids to Attaining Press Aim Characteristics

Certain high-end spectrodensitometers such as the Techkon SpectroDens and SpectroDrive compute and report quantitative control parameter change

recommendations to the press operator to achieve and maintain press calibration. The functionality built into these instruments makes the press operator's job more efficient and easier by eliminating trial and error in deriving neutral print density ink correction curves and adjusting ink densities for press calibration. The results include greater productivity and more accurate color reproduction.

Once the inks and papers chosen for a job have been qualified to meet specs, the remaining parameters for making adjustments to the printing characteristics of an offset press are neutral print density correction curves for both the black printer and the CMY gray scale target and ink film thickness or density. The process steps include

- Burn to a plate and print a P2P target (available for download from www.idealliance.org) with black printer and CMY gray scales
- measure both the black and CMY gray scales
- compare spectral measurements to the prescribed CIELab values via instrument software
- report discrepancies as 4 corrective one-dimensional look-up-table curves (one for each printer). (Figure 1 shows the display screen of the Techkon SpectroDens measurement function called "Print Curve" which generates the 1-D correction curves. The look-up-table curves are applied through the CtP's RIP. The P2P target plate can then be burned again, printed, and measured to confirm press aim requirements.)

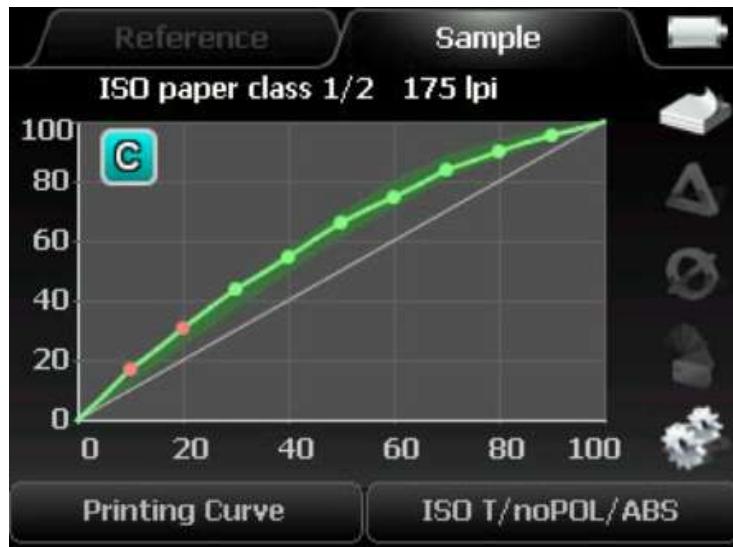


Figure 1 – Techkon SpectroDens in Printing Curve mode

Over time as press and ink conditions drift along with a corresponding drift in press calibration, there will be a need for adjustments to ink density to get back to desired press aim values. In this case, the latest P2P target plate is printed with special attention to the G7™ HR patches, which are the midtone black and midtone CMY neutral. A spectral measurement is made of each patch. A function in the Techkon SpectroDens Connect software called Gray Guide compares the two midtone neutrals to the expected target specifications. If an established Delta E threshold is exceeded, the instrument and

associated software will calculate and report recommended increases or decreases in each of the CMYK ink densities for the purpose of meeting target aims. The resultant improvement in Delta E is also displayed. Figure 2 is the display screen of the SpectroDens in the Gray Guide mode.

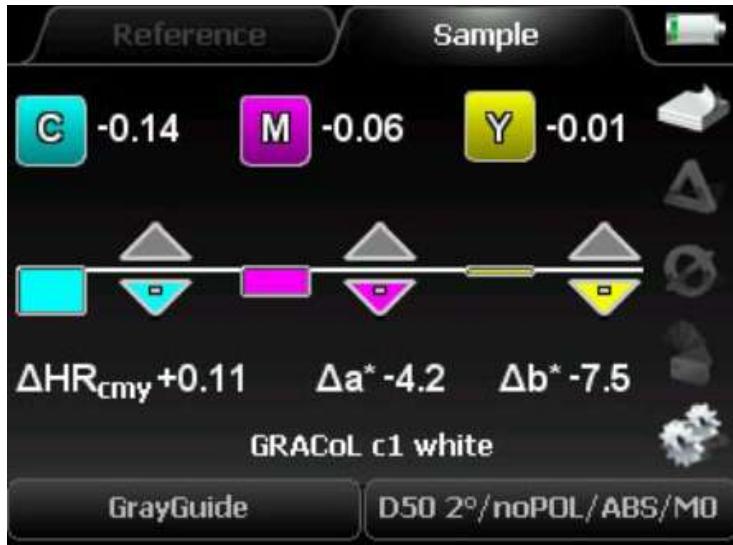


Figure 2 – Techkon SpectroDens in GrayGuide mode

It should be noted that instruments like the Techkon SpectroDens can also be used to measure CIELab values of the inks used in a job to determine if they meet their stated specs or if there is sufficient colorant contamination to make calibration difficult if not impossible. This can be part of the incoming inspection of not only process color inks but also for specially defined spot colors, which have associated CIELab specifications. More specifically, the operator would measure a solid ink draw down and a 50% ink patch to check Delta E when compared to the CIELab spec for each of the given CMY and spot color ink types. Figure 3 is the display screen of the Techkon SpectroDens in Ink Check mode. A comprehensive video tutorial of the Techkon SpectroDens' G7™ functionality can be viewed at <http://www.techkonusa.com/products/g7>.



Figure 3 – Techkon SpectroDens in InkCheck mode

Benefits Provided by CIELab for the G7™ Calibration Process

The following is a summary of the benefits to printers and print buyers of employing the colorimetric properties of CIELab with the G7™ calibration process.

- Simplified press calibration and control by means of a well-defined process
- Shortened make ready times
- Improved match from proof to proof (monitor to digital hardcopy)
- Improved match from proof to press
- Less variability from press to press
- Less variability from operator to operator
- Happier print buyers

By using GRACoL 7, SWOP 2006, SNAP, or FIRST specifications as aim points for a given printing process and using G7™ as the method to achieve the desired aim points, printers can consistently achieve color matching between color reproduction devices.