G7™ Method for Flexographic Press Calibration

Michael Bayard*, Xiaoying Rong*, Malcolm Keif*

Keywords

GRACoL, G7, calibration, flexography, color reproduction

Abstract

The purpose of this study is to apply the G7 method for calibration on a four-color flexographic press. G7 controls and calibrates a press using colorimetric values rather than tone value increase. Two press runs were completed to calibrate a flexographic press. The first press run provided data for creating a control curve called Neutral Print Density Curve (NPDC) for the press run with a specific combination of inks and substrate. The printed P2P target was used to build the RIP curve and cutback the digital file. The calibrated plates then ran for the second time to check the efficiency of calibration. By applying the NPDC curve, the second press run produced better neutral colors visually.

Introduction

GRACoL (General Requirement for Applications in Commercial Offset Lithography) has been widely accepted as printing guidelines in the industry. This method was developed using the lithographic printing process. It describes how to approach a consistent color reproduction by printing on standard substrates with standard ink sets. In the previous versions of the guidelines, printing quality was controlled by color density and TVI (tone value increase). The current version of GRACoL results in a closer visual match between the proof and the output on press. Gray balance is determined by combining 50% cyan, 39% or 40% magenta and yellow. Based on different substrates, this combination changes slightly.

*New York University

*Graphic Communication Department, California Polytechnic State University, San Luis Obispo, CA 93405
email:xrong@calpoly.edu

SID (solid ink density) and TVI (tone value increase), used for controlling gray balance, vary from substrate to substrate because SID and TVI are device dependent parameters. This control requires different SID and TVI aim values for different substrates. In GRACoL7 (2007), NPDC (Neutral Print Density Curve), highlight, mid-tone and shadow control points are introduced. The gray balance is determined by reaching a*=0 and b*=-2 in an L*a*b* color space. NPDC curve is used to replace TVI control. G7™ is based on GRACoL 7 specifications. The "G" refers to calibrating gray values. The "7" refers to the seven primary colors values defined in the ISO 12647-2 printing standard: Cyan, Magenta, Yellow, Black, Red, Green and Blue. The G7 method can be used to calibrate a press and proofer, which eliminates much of the work normally done by ICC color management.

The G7 (2007) combination of cyan, magenta and yellow for gray is achieved by using substrates and inks defined in ISO 12647-2 (2004). Flexography use different ink sets which is defined in ISO 12647-6 (2006). Printing sequence and drying mechanism are different than offset printing. By focusing on gray balance control, G7 is possible to calibrate any printing process including flexography.

This study focused on the validation and efficiency of G7 method in calibrating a flexo press. By following the guidelines of G7, the quality of gray and color reproduction was evaluated.

Experimental

Test Target

A test target was built following G7 guidelines (Figure 1). This target includes a P2P target, a gray stripe of 50% black, a gray balance stripe of 50% cyan, 40% magenta and 40% yellow, G7 color bar, and two test images.

Materials

DuPont Cyrel® DFM digital plates with shore A 65 degree and EskoGrphics Cyrel Digital Imager (CDI) were used for platemaking. The plates were made at 150 lpi using circular dot shape. Screen angles were set as cyan at 8º, magenta at 38º, yellow at 83º and black at 68º. The plates were produced at 68ºF. Plates were mounted using 3M 1015 mounting tape, a medium compressible tape.

MACtac Kromekote, a gloss-coated pressure-sensitive label stock, was used to print. The colorimetric values of this label stock is L* 95.05, a* 1.11, b* -1.58.

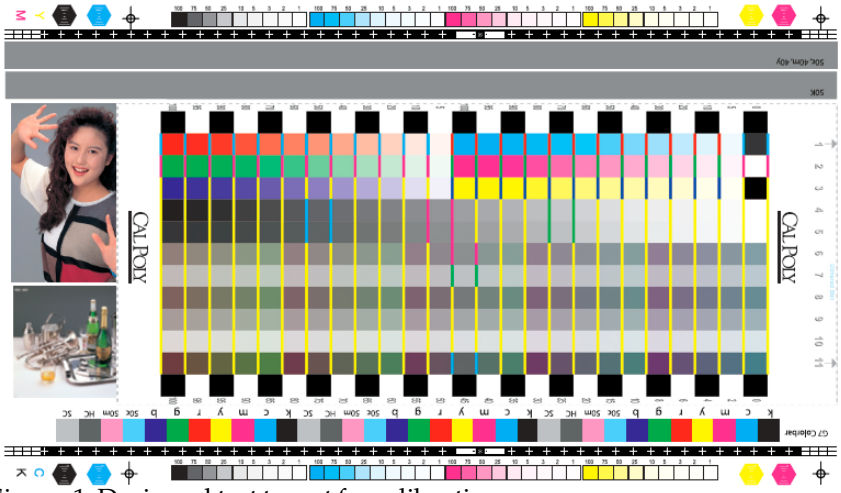

Figure 1: Designed test target for calibration.

Water-based flexo inks from Water Ink Technologies, Inc. were used. The process color inks were custom-made to meet the colorimetric requirements in ISO 2846-5 (2005). Extender from the same supplier was obtained to extend the ink as necessary.

Apparatus

A Mark Andy 2200 7 inch flexo press was utilized for all press runs. The press was set to manufacturer's specification. Color sequence was yellow, cyan, magenta and black. Press was run at 100 feet per minute. Ink viscosity, ink pH, press speed and other press settings were kept consistent throughout the first and second press run.

Results and Discussions

The first set of plates were made without any curve adjustment except a bumb-curve – used to compensate for exposure in the highlights. CIELAB values for the solids of process colors on paper were measured by an X-Rite 500 series spectrodensitometer at illuminant D50 and 2° observer. Solids of process colors were adjusted to follow ISO 12647-6:2006(E) standards with delta E_{ab} less that 5. The following table listed the average delta E_{ab} for solids of process colors (Table 1) during the first press run.

The gray patches on the test target printed with un-calibrated plates showed a visual hue shift or cast. The colorimetric values of the gray balance stripe were a* 0.90 and b* 15.42.

	Black	Cyan	Magenta	Yellow
Average delta E_{ab}	3.23	5.46	4.65	6.33

Table 1: Delta E_{ab} for solids of process colors.

The P2P target printed with un-calibrated plates was measured by a SpectroScan. The data were used to create NPDC curves, which were applied later in making the plates for second press run. IDEALink™ Curve software was used to create the NPDC curves (Figure 2 and Figure 3). NPDC curves were applied to calibrate the RIP. The second set of plates were made with NPDC RIP curves applied. The platemaking process was the same as the first set of plates.

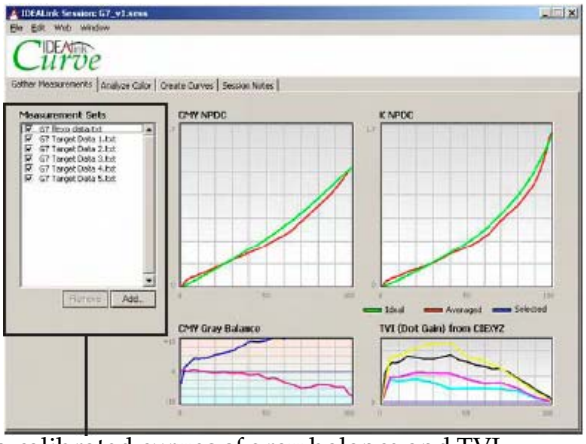

Figure 2: Un-calibrated curves of gray balance and TVI.

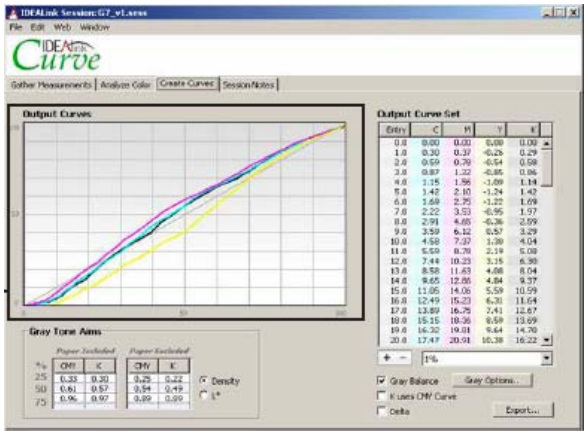

Figure 3: Gray balance correction created by IDEALink™ Curve.

The calibrated plates were mounted and printed at the same conditions as the un-calibrated plates. During the second press run, delta E_{ab} values for solids of process colors were around 6.

The test target printed with calibrated plates showed significant improvements in gray balance, although the color shift can still be detected visually. The colorimetric values of gray balance stripe from the second press run were a* 0.81 and b* -6.77.

There were some press parameters that limited the repeatability. The Mark Andy 2200 flexo press tested does not have automated impression adjustment. There is no ink viscosity control system on press. Impression pressure was adjusted manually. Even though there was no press setting change after the first press run, there were some difficulties in achieving the same colorimetric values for solids of process color. Due to the limitation of environment control, ink viscosity changed slightly, resulting in the need to use extender to dilute the inks.

G7 uses neutral density (ND) combined with highlight range (HR), shadow contrast (SC) and highlight contrast (HC) to control tone reproduction. Prior to G7, this used to be controlled with TVI (tone value increase) alone. To simplify the quality control, ND, HR, HC and SC integrate the effects of density control and TVI control. The colorimetric values of solid process colors from the first and second press runs were controlled within the tolerance. These colorimetric values are directly related to solid ink density (SID). HR, HC and SC are directly related to TVI. Without precise impression pressure control, achieving consistent TVI is difficult. This also leads to inconsistent gray reproduction.

NPDC curves created by IDEALink™ Curve software were based on ISO 12647-2 ink set. The flexo ink set defined in ISO 12647-6 is slightly different than the offset inks. Although the G7 method is based on colorimetric values rather than solid ink density, the NPDC curve is adjusted by densities of gray at different tone values. The difference in colorants may create the color shifts in gray correction in flexo printing. During the first press run, dots smaller than 10% showed a decrease in size on the press sheet. IDEALink™ Curve may also have limits in creating curves with data that appears to have dot sharpening instead of dot gain.

Conclusions

The G7 method introduces a new philosophy for press calibration and control. This method controls the press with colorimetric values to achieve a better visual match. Theoretically, it can be applied to any color reproduction regardless of printing methods. With the results from the flexo press calibration, the G7 method demonstrated its ability in

calibrating a printing press other than offset printing. The significant improvement in gray balance proved that colorimetric control could achieve a better visual match.

The G7 method was developed from offset printing using standard inks and paper defined in ISO 2846-1 (1997). The difference in ink colorants may result in different densities at different tone values when printed with flexo inks. Using the curved created by offset data, the calibration may not be as precise as for offset printing.

The G7 method requires a highly stable and repeatable process. Without automated press adjustments and ink viscosity and pH control, the consistency of flexo printing is challenging. Colorimetric values of solid process colors may change when ink viscosity and pH change during printing. Densities of halftone printing may change when impression pressure is not consistent from one press run to another.

More tests need to be done to study the efficiency of the G7 method to print processes with different ink colorants other than those for offset inks.

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