

INTERNATIONAL PRINTING STANDARDS, A VALUE-ADDED PROPOSITION*

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ABSTRACT

The twin issues of quality and productivity have surfaced as key factors for business survival and competitiveness in the printing and publishing industries. In the past, successful printers received films, made plates, and achieved print-to-proof match by craftsmanship. By investing in wider and faster presses, they achieved productivity at the same time. Today, successful printers received editorial content and ads in the form of digital files from around the world. They adjusted their computer-to-plate (CTP) operations and printed at faster speed to numerical specifications. In this new paradigm, it is not uncommon to hear terms like ISO, PSO, CGATS, GRACoL, G7, and ICC, creeping into the dialogue. But what do these mean and how will they impact print production operations? That is the rest of the story.

1. INTRODUCTION

This is a story about international printing standards, i.e., how the business strategy of publishing and printing has changed in the U.S. and Europe in the past 20 to 30 years. The business of publishing and printing, like any industry, is made up of the supply-side and the demand-side. The demand-side has needs and wants. The supply-side does its best to meet these needs while making a profit by seeking workflow solutions to achieve both quality and productivity.

If we agree that color is a critical indicator of print quality, then we should look at how 'print-to-proof' match was achieved using film-based proofs by printers in the past, and how

technology automation, such as the introduction of computer-to-plate (CTP) demands a new approach to digital color proofing by adopting printing standards and color management.

In the past, successful printers in the U.S. received separation films and film-based color proofs. They used craftsmanship to adjust inking on press to achieve print-to-proof match. By investing in high-speed presses, they achieved productivity at the same time. Today, successful printers receive editorial content and ads in the form of digital files. They adjust their CTP operations, and print at faster speed to 'numbers' that match color-managed proofs. So, the question is "Why change?"

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More than 20 years ago, film was used to make color proofs. Presses were adjusted to match the appearance of color proofs. Thus, prepress proofs set color expectations and color management responsibility in the hands of pressmen. When separation film was replaced by CTP in the 1990s, it created a void in color proofing because color-proofing technology requires the use of film.

1.1 ISSUES AND CHALLENGES

To fix the void, a number of questions must be answered. The first question is, “What are the applicable printing standards?” or “What color should *my_Press* print to?” The second question is, “How do I print to specifications?” or “What procedures should I use to achieve printing aim points?” The third question is, “Where do printing standards come from?” or “Who develops printing standards?” The fourth question is, “If I’m able to conform to printing specifications, how do I tell my customer or market my capability to the world?” These questions are all matters of interest to us all.

2. WHAT ARE THE APPLICABLE PRINTING STANDARDS?

Standards address common needs by defining parameters that are quantifiable, practical, and achievable. When we talk about international printing standard, we generally mean ISO 12647. ISO 12647 with a cumbersome title of *Graphic technology – Process control for the production of half-tone colour separations, proof and production prints* is a series of printing standards developed by ISO/TC130. As an example, ISO 12647-2 (2 refers to Part 2) specifies aim points for offset printing. Table 1 shows colorimetric aim points for type 1 gloss-coated paper of a number of color patches (ISO 12647-2, 2004).

In addition to the colorimetric aim points, ISO 12647-2 also specifies aim points for tonal

value increase (TVI) of CMYK ramps. Table 2 shows tonal value of input digital dot (1st column) vs. tonal value of KCMY print dot for offset printing on type 1 gloss-coated paper.

Table 1. Colorimetric aim points for offset printing – PT1 (coated paper).

Color	ISO 12647-2				
	L*	a*	b*	C*	h
K	16	0	0	0	-
C	55	-37	-50	62	233
M	48	74	-3	74	358
Y	89	-5	93	93	93
M+Y	47	68	48	83	35
C+Y	50	-68	25	72	160
C+M	24	17	-46	49	290
C+M+Y	23	0	0	0	-
Paper	95	0	-2	2	270

Table 2. TVI aim points for offset printing – PT1 (coated paper).

TV Input	ISO - Tone Value (BVDM 2006)			
	K	C	M	Y
0	0	0	0	0
5	8	7	7	7
10	15.6	14	14	14
15	23.1	20.9	20.9	20.9
20	30.2	27.6	27.6	27.6
25	37.1	34.3	34.3	34.3
30	43.7	40.7	40.7	40.7
40	56	53	53	53
50	67	64.3	64.3	64.3
60	76.6	74.5	74.5	74.5
70	84.9	83.4	83.4	83.4
75	88.4	87.3	87.3	87.3
80	91.5	90.7	90.7	90.7
85	94.3	93.7	93.7	93.7
90	96.6	96.3	96.3	96.3
95	98.5	98.4	98.4	98.4
100	100	100	100	100

Establishing a color-managed workflow not only depends on ISO 12647-2 for printing aim points, but also on other ISO standards, e.g., ISO 2846-1 for colorimetric conformance of ink sets for four-color printing, ISO 13655 for colorimetric computation for graphic arts images, ISO 13656 for application of colorimetry to process control, etc.

3. HOW DO I PRINT TO SPECIFICATIONS?

A printing standard, such as ISO 12647-2, covers aim points and tolerances of critical printing parameters. But, what is not covered in the standard? In this case, ISO 12647-2 does not specify what hardware and software tools to use, e.g., color control patches, color measurement instrument, data analysis software. It does not dictate how to achieve the conformance either. This is where different groups of people become innovative and this has also been a source of debate for some and confusion for others.

Fortunately, ISO/TC130 adopted a Technical Specification, TS 10128, that describes three methods to digitally match a printing system to reference characterization data. These three methods assume that the device to be corrected is repeatable and the corrections can be applied via (a) TVI adjustment, (b) gray balance adjustment, and (c) device link adjustment (ISO/TS 10128, 2009). Let's take a look at how each method works.

3.1 TVI ADJUSTMENT

The TVI adjustment takes place channel by channel at the CTP stage by leaving image data alone. So, it is a device calibration technique involving two press runs with the following procedures: (a) begin with correct inks and paper per ISO 2846; (b) print with linear plates to achieve a range of ink film thicknesses; (c) verify the conformance of single solids and overprint solids per ISO 12647-2; (d) measure CMYK ramps and derived four one-dimensional TVI correction curves. (Figure 1 is an example of the cyan ramps of the standard and *my_Press* and how the TVI adjustment curve is derived); (e) apply TVI adjustments at CTP when making curved plates; (f) print with the curved plates under repeatable printing conditions; and (g) verify TVI conformance.

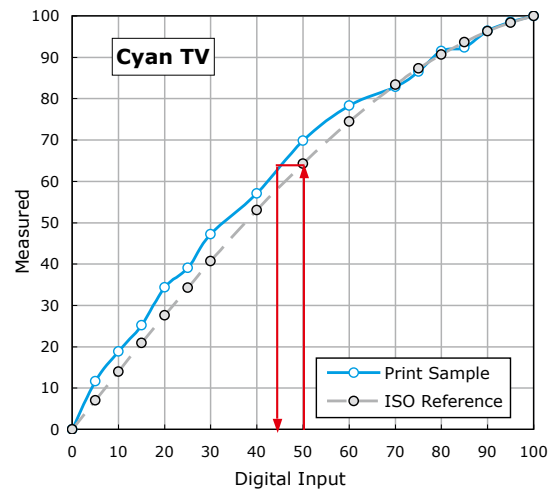


Figure 1. Derivation of one-dimensional TVI correction curve.

3.2 GRAY BALANCE ADJUSTMENT

The gray balance adjustment is a variation of the TVI adjustment described earlier. To understand how the method works, we'll define *gray balance* and *gray balance curve* first.

Gray balance refers to CMY overprint that appears neutral or gray under a specific printing condition, e.g., the overprint of 50C/40M/40Y appears neutral under a repeatable printing condition. *Gray balance curve* is the relationship between the CMY dot areas and their corresponding neutrals, expressed as darkness or (100 minus L^*), for the entire tonal scale. Figure 2 shows two gray balance curves of two printing conditions. Assuming that C1, M1, and Y1 produce a neutral under the reference printing condition and the same neutral is printed with C2, M2, Y2 under *my_Press* printing condition, a point in the gray balance correction curves can be derived by mapping between (C1 and C2), (M1 and M2), and (Y1 and Y2). The process of data mapping needs to be repeated for as many neutrals as needed to cover the entire tonal scale.

The L^*C^* plot of C1/M1/Y1, printed by *my_Press*, helps verify if the gray balance adjustment

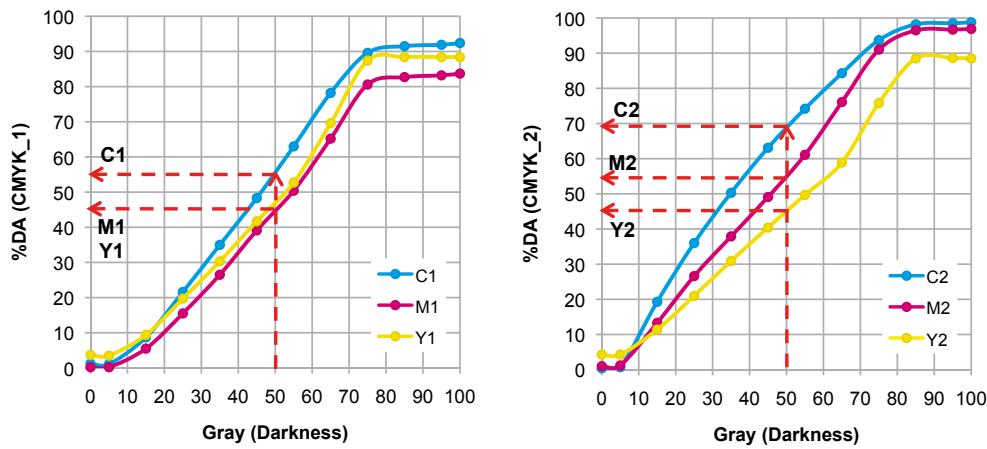


Figure 2. Derivation of one-dimensional gray balance correction curve.

is implemented correctly (Figure 3). The ‘Before’ curve (solid line) shows the result of printing C1/M1/Y1 with linear plates; these patches show colorcast or higher C^* at various L^* levels. The ‘After’ curve (dash line) shows the result of printing C2/M2/Y2 with gray balance adjusted plates. The adjusted CMY neutral dot areas now appear neutral as indicated by lowered C^* value.

3.3 DEVICE LINK ADJUSTMENT

Device link can be used to adjust image data for a device that has been calibrated according to Method 3.1 and 3.2. It can also be used to adjust image data while leaving the device calibration alone. In other words, instead of using four transfer curves to reconcile the color difference between the standard printing conditions and *my_Press*, which device link calibration would do, device link uses one 4-dimensional look-up table to convert device values from the reference color space to *my_Press* color space.

A device link is a type of ICC profile. It not only corrects for color differences due to TVI and gray balance between the two printing devices, but it also corrects for color differences due to colorimetric properties of the process inks and ink trapping.

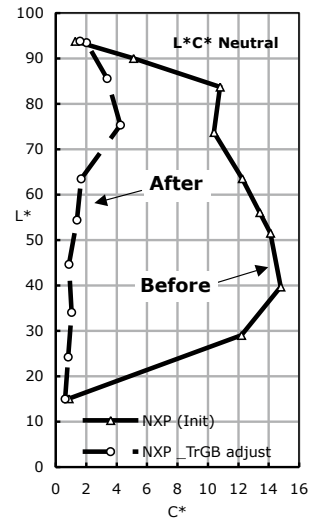


Figure 3. Gray balance verification.

To find out how well the device link method minimizes color difference between the standard and *my_Press*, a distribution of color difference (or ΔE) based on many color patches, e.g., IT8.7/4 or a sub-set of the target, are useful (Chung and Liu, 2008). Figure 4 shows a cumulative relative frequency (CRF) of ΔE between the standard data set and *my_Press* data set. In this case, if the ΔE at the 90% tile is 4 ΔE or less, chances are that there is a good color match between the standard and *my_Press*. If the CRF curve is farther to the right, the color agreement between the standard and *my_Press* will be less.

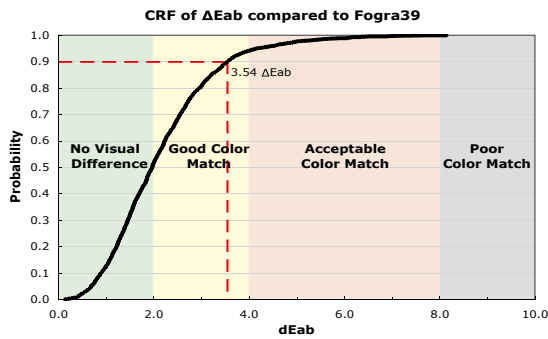


Figure 4. Color difference verification.

If the CRF curve moves to the left, the visual match now improves from ‘good color match’ to ‘no color difference.’ Ultimately, the performance of each of the three methods, i.e., TVI, gray balance, and device link, can be compared quantitatively with the use of the CRF of ΔE assessment method.

4. WHO DEVELOPS PRINTING STANDARDS?

Standards are developed by consensus by printing industry experts at the national and international levels. The standard development process is open, voluntary, and non-governmental. As an example, IDEAlliance is an industry association in the U.S. actively developing and promoting industry standards or best practices, such as G7. CGATS (Committee of Graphic Arts and Technologies Standards) is a national standard committee in the U.S. actively developing and promoting national standards. Likewise, BVDM (The German Printing and Media Industries Federation) is an industry association in Germany; Ugra (Association for the Promotion of Research in the Graphic Arts Industry) is an industry association in Switzerland. All of these associations represent their countries as members of the ISO/TC130 Committee who work together to develop international standards, e.g., ISO 12647.

TC130 was created in the 1960s and was dormant until its reactivation in the 1980s. The

reactivation was prompted by the work of DDES (Digital Data Exchange Standards) that addressed the need to define, store, and move digital data in a meaningful way. DIN, the German Institute for Standardization, agreed to serve as the secretariat. Currently, there are 19 participating members in TC130.

The process of developing international standards goes through a number of document revision stages via face-to-face meetings, email circulations, and balloting before a working draft (WD) can be elevated in status to committee draft (CD), draft international standard (DIS), final draft international standard (FDIS), and finally, international standard (IS).

5. PROCESS CERTIFICATION

Certification refers to the confirmation of certain characteristics of a process. It is the result of an audit process, not self-examination. Certification bodies must be creditable, independent, and unbiased when carrying out process audits.

One may ask, “Why does a printing company need process certification?” There are two points of view to consider. First, print buyers prefer to work with certified printing companies. So, the motivation is the same as why many companies are seeking ISO 9001 and ISO 14001 certification. Second, it is a new strategy for printers to survive and be competitive. To survive is to reduce manufacturing wastes in the plate room and press room. To be competitive is to differentiate your printing quality from the rest of the print suppliers.

There are many printing process certification programs available. The first one is known as the PSO certification. It is accepted practically worldwide and is offered by Fogra and Ugra, based on *Process Standard Offset (PSO)*, a methodology developed by BVDM, based on

ISO 12647-2. Other certifications are available mainly in Europe, e.g., SCGM (NL) and UKAS (UK) certifications also based on ISO 12647. Another certification, offered by IDEAlliance based on G7 methodology in the U.S., is known as the Master Printer Certification.

Regardless which process certification is of interest, here are some general guidelines on what a printer is likely to go through: (a) set up a team for the certification project; (b) review relevant methodology and standards; (c) hire a consultant if the above step is deemed difficult to achieve internally; (d) implement certification requirements; (e) document standard operating procedures (SOP); (f) contact certification body; (g) undergo certification audit which includes a press run that will be measured and analyzed by the certification body; and (h) wait for the evaluation outcome.

6. SUMMARY

We witnessed CTP that improves the print production workflow, printing process control that enables repeatable color, and digital color management that enables predictable color. The convergence of technology advancements pulls the printing industry forward. We also witnessed international printing standards that fulfill the need of specifications in process control. When international printing standards represent print buyer's expectations, they push the printing industry forward. Between technology push and demand pull, the printing industry will be transformed.

The story about international printing standards does not have an end. But one thing is certain, i.e., we will recognize that international printing standards and process certification are new supply-side strategies. Together, they represent a value-added proposition that elevates printing as a first-class manufacturing process in printing and publishing.

7. ACKNOWLEDGMENTS

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