Position Paper
On Proposed Revisions to ISO 12647-2:2004
A Move to Colorimetry and Matching a Reference Printing Standard

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Position Statement

Technical advances have changed the way printers calibrate their processes. It's now common practice to set up proofing systems to match standard reference data sets, such as FOGRA39 and GRACoL 2006. Then, platemaking and ink levels are adjusted so that presswork matches these proofs. Plates are now made using CtP, which permits use of tone curves to control the tonal characteristics of presswork. These changes in technology and practice suggest revisions to ISO 12647-2 and possibly other members of the ISO 12647 family. The changes proposed here center on obtaining a consistent visual appearance for printing across various processes, substrates, etcetera. Specifications that do not serve this goal should not be included in the standard.

Background

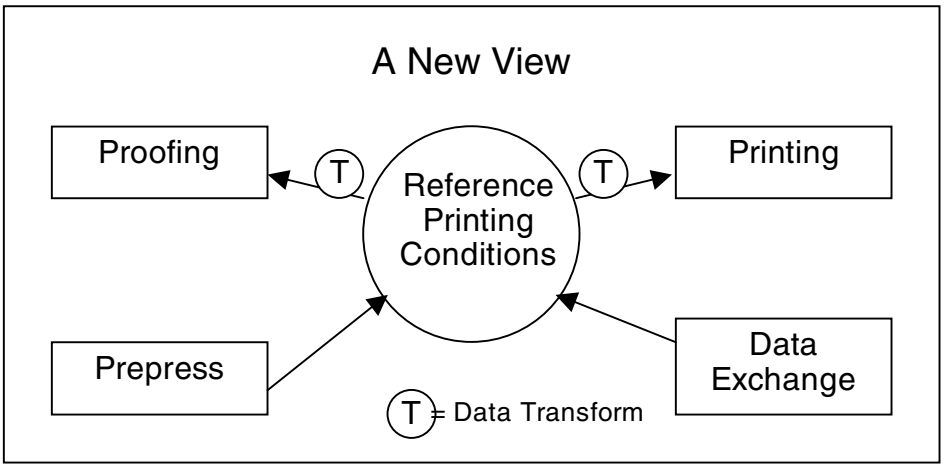
Before CtP, plates were made from linearized film, which was the input to the printing process. There were positive and negative working plates, which had different tonal characteristics. Paper type and screening also affected tonal characteristics. Since there was no reliable way to control TVI on press, print standards could only specify what was typical for various combinations of these parameters.

Today, CtP has replaced film-based platemaking. This changes the scope of the process. Data is now the input to the process, rather than film. With CtP, "tone reproduction curves" may be used to control the tonal characteristics of the process. This allows us to discard the undesirable practice of specifying varying tonal characteristics for combinations of positive/negative legacy, screen ruling, and so on. By specifying a single tonal characteristic for all circumstances, we will “assure, in principle, a good visual match” (ISO 12647-2:2004) between processes that conform to the standard.

The adoption of digital proofing paralleled the end of film. Initially, halftone dot proofs were used to simulate analog proofing. Now, these dot proofs are largely replaced by color-managed ink jet proofs. Ink jet printers and proofing software have improved steadily. We can now

produce highly accurate proofs based on "characterization data sets." It is common practice to set up these systems to simulate standard data sets, such as FOGRA39 and GRACoL 2006.

These developments make practical the idea of "Virtual CMYK" data sets, first proposed by David McDowell in 1999. (McDowell, 1999) He pointed out that a few data sets (5 or 6) are sufficient to describe the color gamuts of all common printing processes. If these data sets, and ICC profiles made from them, are used to prepare image files, file interchange, proofing and printing are greatly simplified. The following diagram illustrates the "Virtual CMYK" concept.



D. McDowell, 1999

Files are prepared by designers and prepress technicians according to "reference printing conditions" of the intended printing process. Proofing is done with a color transform that matches the proofing device to these conditions. These two parts of the "Virtual CMYK" idea are already widely adopted. For instance, in Europe it's common to use ECI's "ISO Coated v2" ICC profile for commercial sheet-fed offset on high-grade coated paper. Proofing devices are set up to match this profile, or its basis, the FOGRA39 data set. The printer must then match these proofs on press. The data transform shown in the diagram could be implemented using simple tone reproduction curves, or device-link profiles, when a more complex transform is needed.

Clearly, these reference data sets are inextricably linked to the printing process. The “virtual CMYK” data sets should be derived from actual printing, as defined by the standard. Printers should be able to replicate this printing from information contained in the standard, preferably with a simple transform using tone curves. Furthermore, we should obtain the same visual appearance, regardless of the substrate, screening method, coatings, and so on. Because ISO 12647-2 uses a single ink set, it is relatively easy to obtain visual matching across substrates.

Proposed Changes and Improvements to ISO 12647 (details in following section)

- Change the scope of the standard to include CtP platemaking, with data as input.

- Eliminate all references to film, with the possible exception of "film-based analogs to CtP".

- Eliminate all references to positive/negative platemaking, screen rulings, and so on.

- Eliminate all reference to density, except for process control. Use colorimetry exclusively to define the color of the process.

- Use media relative colorimetry to allow for variation in the color of paper stock, as in ICC profiles.

- Eliminate all references to TVI, and the graphical curves depicting TVI.

- Specify the tonal ramps using a simple math model, based on the additional parameters of highlight and shadow contrast.

- Add the isometric ramp to the individual process color ramps, so that gray balance of the process is defined by the standard.

- Determine new target values for the different paper types that produce a visual appearance match.

- Make clear that the standard only specifies the end result. Implementation is left to the user. (meaning that the various methodologies are all allowed, so long as they achieve the specified results).

Detailed Explanation of Proposed Changes and Improvements

- *Change the scope of the standard to include CtP platemaking, with data as input.*

CtP is almost universally adopted among printers that would make use of standards. The existing standard states that film is the input, and uses measurements of film as the input metric. Although it would be possible to use plate measurements as the input metric, it is far more practical to use the CtP input data. This data is much easier to obtain than plate measurements, but more importantly, allows us to make use of "tone reproduction curves" to control the tonal characteristics of the overall process. These things are obvious, but still need to be articulated in the standard.

- *Eliminate all references to film, with the possible exception of "film-based analogs to CtP."*

Printers who would make use of standards no longer use film. In addition to changing the scope of the standard to include CtP, we must remove all references to film, and make appropriate changes in wording. Once this is done, we could add a simple reference to film-based processes, as a courtesy to anyone still using them.

- *Eliminate all references to positive/negative platemaking, screen rulings, and so on.*

With the ability to control tonal characteristics through CtP tone curves, there is no longer any reason to make distinctions for positive/negative platemaking, screen ruling, screening types, and so on. With current CtP production methods, the printed tone can be any desired value. It is ironic that these distinctions in the current standard could very well be the cause of color variations, which that standard is supposed to minimize. Removing these things, and the regional variations they allow, will result in a single unified standard for the entire world.

- *Eliminate all reference to density, except for process control. Use colorimetry exclusively to define color values of the process.*

The current standard uses colorimetry to specify the solid ink colors. But tonal characteristics are based on TVI, which is computed from density. Yes, there's a footnote in ISO 12647-1 suggesting the use of XYZ values as a substitute when density is not available. Still, density is currently the preferred measure. We propose to eliminate the use of density in the standard, except for process control, where it is still appropriate. This will help to unify the print standard with the reference data sets derived from it.

- *Use media relative colorimetry to accommodate variation in the color of paper stock, as in ICC profiles.*

Paper is a variable in printing. There are an infinite variety of paper colors, and we should allow for that in the standard. A simple solution is to use media relative colorimetry. This is the approach used in ICC profiles. An ICC printer profile contains a media white point tag, and a relative colorimetric tag. These are combined to produce absolute colorimetric values. In this manner, normative values in the standard could be easily adapted to any paper white-point. The math for media relative colorimetry is contained in the recently issued ISO 15076-1:2005 standard.

- *Eliminate all references to TVI, the graphical curves depicting TVI, and the tables referencing these curves.*

The final tonality of the printed ISO standard is defined in terms of density-based calculations of tone value increase (TVI). Graphs of the TVI for the individual CMYK tone scales are the published aims. This is limiting on a number of levels. Again, density and not colorimetry is used to calculate the graphs. Density, by its nature, does not define color. Using TVI is misleading to the user, because it implies a fixed linear TR on the plate. With current CtP production methods, the printed tone can be any desired value.

- *Specify tonal ramps using a simple math model, using the additional parameters of highlight and shadow contrast.*

To replace TVI, we suggest using the "cubic Hermite spline."
See http://en.wikipedia.org/wiki/Cubic_Hermite_spline

The current standard already specifies the color of each ramp at the endpoints. By adding highlight and shadow contrast, we can model full colorimetric tone curves to a high degree of accuracy. We've tested this model using the FOGRA39, GRACoL 2006, and SWOP 2006 data sets. The L*a*b* values are accurate to an average , ΔE ab of about 0.3. It is a very simple solution that builds on the existing standard. (Birkett and Spontelli, 2005)

- *Add the isometric ramp to the individual process color ramps, so that gray balance of the process is clearly defined.*

Gray balance is not a normative specification is the existing standard. It is an informative annex. To obtain reasonable consistency of appearance from the standard, we must add some additional information to describe the gray scale behavior. We propose specifying a fifth ramp containing equal amounts of cyan, magenta and yellow. We call this the "isometric ramp." This ramp can be modeled in exactly the same way as the process color ramps. (Birkett and Spontelli, 2004)

The other way of specifying gray balance is to define the set of cyan, magenta and yellow values that produce gray, along with the tonal value obtained. This specification is called a "neutral print density curve" or NPDC. In practice, these two approached produce nearly identical results. The advantages of the "isometric ramp" are that is can be directly measured, the target values are already contained in our reference data sets, and it uses very same math as the process colors. An elegant solution, we believe.

- *Determine new target values for the different paper types to produce a uniform visual appearance.*

The current standard contains color values for five different paper types. This is similar to the "Virtual CMYK" data sets described by David McDowell. (McDowell, 1999)
We propose that the parameters for these paper types by further refined to produce consistent visual appearance. This will improve the interchangeability of files. For example, we could print the very same file on coated and uncoated stock, and obtain a reasonable match.

- *Make clear that the standard only specifies the end result. Implementation is left to the user. (meaning that the various methodologies are all allowed, as long as the specified results are achieved)*

At the ISO TC 130 meeting in April 2006, the G7 methodology was presented and proposed as an ISO technical report. That caused a great deal of controversy and discord in the standards community. We believe the role of standards should be limited to specifying the intended result, along with allowable tolerances. It should be left to the users to develop the methodologies they need to obtain the specified results. That will defuse the contention that exists, and leave the way open to continual improvement of the various methodologies.

It should be recognized that specialized software would be required to implement the standard we are proposing. Pencil-and-paper methodologies are not readily workable for colorimetric process optimization. Software developers will quickly fill the need, as the new standard is written.

References

McDowell, David Q. (1999 March/April). Reference Printing Conditions: What Are They & Why Are TheyImportant? *The Prepress Bulletin*, 42-44.

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