Reference Printing Conditions

What Are They & Why Are They Important?

by David Q. McDowell, Senior Technical Associate
Eastman Kodak Company

The present evolution in graphic arts technology started in 1979. The arrival of the Scitex Response 300 represented the first generally available technology that allowed us to treat a graphic arts page as a data file that could be electronically manipulated as a complete entity. Prior to this time, electronics and computers had seen use in graphic arts, but only to process data on the fly, without storage and without the ability to edit, change and manipulate complete page images.

Since then, as computer power has increased, we have introduced more and more electronic data technology into the workflow. However, in general, we have not changed the basic approach to the overall graphic arts workflow, only the tools have changed. Data have largely replaced film as the media of exchange between prepress and printing, but we still treat the data as we do film. In general, hard copy proofs are sent together with either data or films so the recipient will understand how the sender interpreted the data. Too often, where the press/paper combination is somewhat different from an intended reference (for example SWOP) we, as an industry, want to tune the proof so it matches the press. We hear time and again that the individual press should drive the process.

A Different Approach

Some of us believe that a different, and better, approach is available—one that will allow us to accommodate the needs of the press, and, in fact, give the printer more freedom and control over the press; one that will simplify the interface between prepress and printing; and one that will allow us all to produce better, more consistent output in a more cost effective method.

The key to this different vision of the future is not a revolutionary new technology, or any new product, but simply the fact that three key influencers have converged at new plateaus. The first of these is the price/performance of both computer power and data storage. Both higher speed and lower cost now allow us to manipulate electronic data in line, once considered prohibitive.

The second, is largely a result of the first, digital data represents the most prevalent workflow today. Certainly when copy-dot scanning is included, any workflow can be all digital. The third is the maturing of color management.

Some Assumptions

In addition to noting these key influencers we have made a couple of assumptions. We believe the key difference between presses, printing processes, or printers is not the solid ink density laid down on a given type of paper, but the intermediate characteristics such as tone value increase (dot gain), trapping, overprint colors, etc. The gamut of the printed color is defined by the color/density of the solids, which in turn are largely determined by the ink holdout ability of the paper involved. For any particular grade of paper, there are some differences between processes but these are small compared to the differences between papers. The intermediate characteristics, which are far more variable between sites and processes, are the factors that largely affect the appearance of an image.

We also believe that if the printer is only given an aim for the solids—the color gamut—and is allowed to determine the best setting for the other conditions for his press, output can be more consistent and more easily achieved and maintained. Today, once a job is on press, the printer must balance his solid ink density and tone value increase to achieve a compromise. Unfortunately, the best operating point for a particular press (the so called “sweet spot” that everyone seems to believe exists) may not match the tone reproduction and color trapping that are required to meet a given printing specification.

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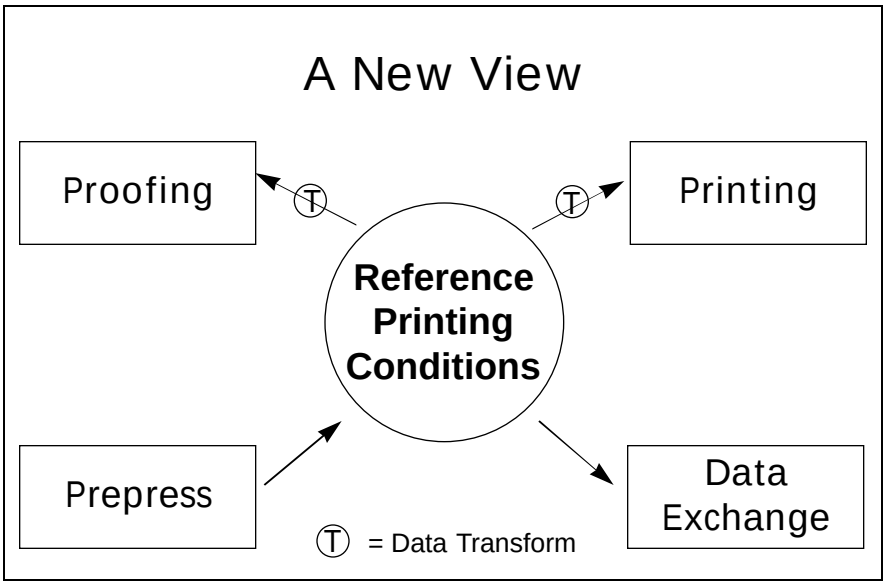
To take advantage of the best printing conditions, and also meet color aims, requires our third assumption.

We believe that, given today's color measurement and color management tools, we can characterize presses and proofing systems. Using this information we can build tools that will manipulate the data provided to accommodate the particular printing conditions available. As long as the gamuts (solids) are held relatively constant, the printed image color will match across different press conditions, or even printing processes.



Reference Printing Conditions

If all of that is true, and we need to evaluate and test those hypotheses, then all we need to do is worry about specifying the gamut to be printed and some arbitrary reference for the in-gamut colors that represents achievable printing. We call this a "reference printing condition."

These reference printing conditions would be the aim for prepress. Proofs would be based on the reference printing condition. The data would be tagged so that the recipient knew the reference conditions, assumed by prepress, and the proper proof could be made at the printer. The color transforms used, in modifying the data before making the plate for the press, would convert between the reference and the actual press performance.

The reference printing condition would be the aim for the relationship between data and color for prepress, for proofing, and for printing. Indeed, the use of specific aims provides the best methodology for carrying out remote proofing. All would be "tuned" to meet a common goal, matched color. Admittedly, this represents a new vision of the electronic workflow and changes some of the relationships and responsibilities.

Is This Really Possible?

Can we really make it happen? We actually have a real life test of this hypotheses that many of us have seen frequently, or maybe even participated in, but never thought of from this perspective. SWOP, in addition to the normal booklet, has been defined colorimetrically in ANSI/CGATS/TR001 (which some refer to as the digital definition of SWOP). Here the relationship between CMYK dot values and the CIELAB values of the printed color are tabulated. Using proofs made to these aims, and the tabulated data from TR001, advertisements in both gravure and offset publications are made to match.

In publications such as *Reader's Digest, National Geographic*, etc., gravure and offset are mixed within the same book maintaining consistent appearance. *TV Guide* has gone even further and mixes gravure and offset in inside-cover cross-over ads which also mix cover and body stock. The color match they achieve is impressive.

Some portions of the printing industry have clearly shown that the basic concept works. The question is, can we apply this approach on a broader basis?

How Many Reference Printing Conditions are Needed?

How many gamuts would we really have to accommodate? As a reference, SWOP tolerances are ±0.07 in density or a range of about 10 chroma units; the difference in chroma between SWOP and SNAP is about 25 units. From this, one could conclude that if SNAP represents a minimum gamut and SWOP the publication gamut then these plus two additional steps in between could accommodate the full range of gamuts up to publication printing. Premium printing would require at least the definition of one and maybe two additional larger gamuts.

This says that five or six reference printing conditions could cover the bulk of data exchange and proofing requirements for commercial, publication, and newsprint work. What a simplification that could offer! It goes without saying that there are many vertically integrated and/or special situations that would require "private reference conditions." These could, and should, be based on the same model and could use the same color management and data manipulation tools.

Our vision—A world in which there are no more than six reference

printing conditions that are used for essentially all prepress, proofing, and printing. These enable better proofing, easier prepress, easier identification of the meaning of data, and new freedom and capabilities for the printer. Color management becomes an inherent part of the process, something that happens automatically and not an operation someone needs to remember to do.

As was pointed out clearly at the Digital Smart Factory Conference, held by the Research and Engineering Council, we must make significant steps in both standardization and digital data control as we move towards a digital manufacturing process. The use of reference printing conditions is simply one step in that direction.

We Can Start Today!

The existence and meaning of the digital definition of SWOP in ANSI CGATS TR001 is one of our most overlooked and under utilized tools as we move forward into the digital world. Already many of the digital proofing vendors are using that data to setup and calibrate their proofing devices. It forms the basis for many of the SWOP Application Data sheets, that each proofing vendor is required to provide if they wish to offer proofing to match SWOP.

Some prepress organizations and printers have already started to test the color matching capability of proofing equipment offerings by their ability to match the numbers in TR001. The more we test the concept using TR001 the better prepared we will be to move on to the wider range of printing conditions envisioned.

Virtual CMYK, An Extra Option

As more and more people ask for the ability to repurpose data for other applications, or worry about limiting the gamut too early in the process, an option that can be considered is virtual CMYK.

Virtual CMYK (yes, we need a better term) is simply defined to be raw data from any source plus the appropriate specific input and specific output profile needed to target the data to the intended reference printing condition. In a color-managed workflow these can always be combined to produce essentially the same CMYK data.

Admittedly, today that ability is dependent on consistency of data processing among CMMs from different vendors. (The CMM is the basic "color manipulation module" that is part of a color management system.) The consistency issue is being addressed by the International Color Consortium (ICC), and recent tests indicate that the compatibility between CMMs is getting better.

Virtual CMYK results in smaller files, preserves the full range of the original data, and also allows the output profile to be switched if the intended use of the data is changed—for example, to a web application. Virtual CMYK data aimed at one of the reference printing conditions could be easily intermixed with actual CMYK data aimed at the same reference printing condition. Simply another option, enabled in part by the reference printing condition concept.

What Are the Standards Organizations Doing?

Within the United States both CGATS and several of the industry trade associations are developing characterization data for various printing conditions. These data will form the basis for the identification and selection of the appropriate data to be used for the five or six reference conditions needed.

Similar work is going on within ISO/TC130. In addition, TC130 has identified a new part of ISO 12647 (*Graphic technology—Process control for the manufacture of halftone colour separations, proof and production prints*) to focus specifically on characterization data for electronic data exchange, i.e., our reference printing conditions.

In the area of virtual CMYK, the ICC is looking at the consistency of CMM performance and is also studying a new graphic arts profile format. This format will combine several transforms into a single profile which will fully enable the exchange of virtual CMYK data.

A Conclusion & A Challenge

We truly have an opportunity to change what has been a gradual evolution of the overall graphic arts workflow into a true revolution. It represents a significant step along the path to a digitally integrated workflow. This can only be a win-win situation for everyone.

The challenge! If you are involved in work that is aimed at publication printing, and should be using SWOP as the reference, ask your proofing, color separation, and color management vendors for tools based on TR001 data. If you are doing color measurements, get a copy of TR001 from NPES[1] and compare your results against the tabulated data. When you do any of the above, provide feedback to the IPA Standards Committee about your experiences so we can learn together. **IPA**

[1]NPES The Association for Suppliers of Printing, Publishing and Converting Technologies serves as secretariat for CGATS and ISO TC 130 activities. Further information is available from the NPES Standards Department at (703)264-7200 or on their web site at www.npes.org.