

# Closing the Colour Management Loop

Last June in a small hotel in Leeds, deep in the heart of what was once industrial England, an important but largely unnoticed meeting occurred. It was a special session within a routine meeting of the International Color Consortium (ICC) and it was intended to address paper characterisation for the purposes of colour management. Riveting as this sounds, not, this meeting marked an important turning point for colour management professionals. It addressed a major shortcoming in current colour management practice and in ISO 12647 (see box).

So what, you may ask. Well, the fact that an ISO standard needs revision isn't terribly exciting. However incorporating paper characteristics into print quality control improves print's competitiveness and cost effectiveness, and this is exciting, which is why the meeting attracted such an extraordinarily diverse group of participants. Besides paper manufacturers and colour scientists, the meeting included ink manufacturers, printers, prepress professionals and print buyers from around the world.

The goal was to explore the relationship between CMYK data and the colorimetry of the printed image, aka print characterisation, with a special focus on the importance of the fifth colour, paper. Paper plays a crucial role in colour management because its optical and surface properties determine colour appearance. Understanding how paper properties affect colour management can reduce the need for printers to generate characterisation data and ICC profiles, for each paper and print process combination, helping with quality control and cost containment.

## The Problem

ISO 12647 includes five paper classes categorised according to gamut and covering a wide range of paper types. These categories were defined in 1994 based on prevailing market needs and at a time when paper grades were more clearly differentiated. Today we have extensive overlapping between and within grades, a lack of clear definitions of what paper types really mean, plus a more limited use of some papers such as the slightly yellowish uncoated stocks used previously. There are cultural preferences for different paper shades and the ISO paper classes don't include many grades used in America and elsewhere, so there is no international correlation.

In addition, the set of characteristics measured during paper production and the way in which paper is described by the manufacturer varies substantially from region to region. For print produced at multiple locations around the world this means bespoke colour management and quality control at each print site. This is expensive, time consuming and

### **ISO 12647**

ISO 12647 is the international standard that specifies how colours should be reproduced, including processing and measuring colour, throughout a print media workflow. It includes tolerances for all processes, including different paper types and, as one would expect, it is based on CIE $L^*a^*b^*$ . It uses spectrophotometric measurement of target solid colours rather than density to eliminate differences in ink properties but when it comes to paper, as it currently stands, the standard falls short.

▼ inconvenient, so the ICC, which has made colour management cheaper, quicker and easier, set up this collaborative project with ISO TC130 and other groups such as ECI in Europe and Idealliance in the US to try to find ways of characterising paper.

Digital colour management is based on the use of ICC device profiles and print characterisation data to determine how colour data relates to the printed page. Profiles take into account paper, ink set, screening, ruling and type, plus an array of other factors depending on the workflow and the print application. At the moment it's impossible to come up with accurate characterisations for all possible combinations of print and paper, because the paper characteristics that can be measured are not universal. Paper characteristics all seem to get measured in different ways, and only a few are incorporated into profiles.

Paper properties such as shade, brightness and surface chemistry affect print density and dot gain. Visual properties such as colour, the effect of calendaring (the smoothness of a surface), gloss and surface type also determine colour gamut, opacity and fluorescence. Fluorescence is particularly problematic because of light absorption and re-emission and because it is difficult to ensure consistent UV light content in both measuring instruments and viewing environments. All of these can influence the choice of characterisation data and substrate, and all of them can cause proofing problems. This makes it very difficult for users to know whether a profile that was created for one paper brand can be used successfully with another.

This is why proofing systems need to take into account the mechanical properties of the paper to be used in the final print. Currently there are limited options for this based on the ISO categories, although there are many other factors influencing colour: roughness, stiffness, fibre direction, water content, rub resistance, picking strength, ink-setting, fan-out, ink mileage, coating resistance and colour. A proofing system also needs to reflect a printing system's grey balance, taking all factors into account to produce an accurate proof.

These variables shape a printer's choice of materials and print buyers' budgets. Given the costs involved for large print projects, were this data available, it should ideally be captured in JDF for input into process management systems and cost management. The ICC has therefore been careful to co-ordinate its activities with that of CIP4, the group responsible for JDF.

Matters are further complicated by the fact that characterisations for the five paper types within 12647 don't correlate worldwide for colour repro because the use of optical brighteners is inconsistent. There are also different ways of measuring paper brightness, and the US doesn't follow

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ISO standards at all, preferring the home-grown TAPPI T 452 standard instead. Brighteners make the paper colour (its whiteness) unstable because their characteristics influence a surface's chemical absorption and emission of UV light.

Paper manufacturers use their own different concoctions for making paper, so depending on how they have used optical brighteners, paper whites can go from white to yellow. Brighteners also influence the appearance of inks because of variations in UV absorption. The effect of brighteners can be especially visible in the cyan, whereas magenta and black may block their influence altogether. Yellow's appearance on brightened papers depends on the particular ink transparency, and it can cause false spectrophotometric readings.

On top of all this, although the use of glossing can expand saturated tone gamut, it can also confuse spectrophotometric readers because they do not accurately capture a colour's shininess.

## The Solution

So what's being done? Various groups around the world have recognised the problem and are working to solve it. The German trade association, bvdM, has developed a classification of gravure papers that ECI (European Colour Initiative) has accepted as well. The group is now working on the same concept for offset papers for commercial applications, working with seven international paper manufacturers and hoping to integrate their work with the next edition of ISO 12647.

Any change to ISO 12647 will need to first work out the set of lowest common denominators across paper types in order to define how things deviate from it, so that the papers can be differentiated and classified. Having a standard reference substrate that meets a set of specific criteria is crucial and the suggestion was well received at the meeting in Leeds. According to the paper manufacturers present, it should be possible to develop such a reference including the required characteristics. As one participant said: "You tell us the characteristics you want a paper to have and we will make it".

Work is already underway to determine what those criteria should be, reflecting the full diversity of market needs worldwide. This will provide the basis for a reference substrate for different paper classes, and will include the ink consumption of a given type of paper based on its surface chemistry.

The bvdM's work is an important step towards closer cooperation between the graphics and paper industries. Apart from making it possible to reliably include a paper's colour properties in colour management, it will help us to develop common nomenclatures in measuring tools and

tool characterisation. There is also a need for commonality across media for example between CMYK devices and the added complexity of multi-colour devices such as those from HP and Canon.

Canon is particularly active working with X-Rite to develop a process control system for the Canon Imagepress digital printing devices. X-Rite's Eye-One is becoming a market standard for colour measurement in the graphic arts. The complete Eye-One Process Control system for the Imagepress Q1 server (an EFI Fiery) provides colour management and verification using both LAB and spectral data. It includes profiling tools, device performance evaluation, plus the means of creating a library of spot colours and generating colour recipes for use in applications and in the Canon RIP.

It is the result of a joint initiative between X-Rite and Canon, whereby Canon has exclusivity on specific elements of the technology. Since the initiative was launched late last year, Canon has sold over 500 units throughout Europe. Expected in the spring is automatic correction of a customer's device set-up, should the verification process fail. This is an interesting addition based on iterative profiling techniques to provide device quality control without making it difficult for the user.

This system is a good example of the work being done within the development community to improve colour management. The support for paper types is comprehensive and Canon includes detailed instructions and tools for assessing a device's performance, including media data and reminders of the importance of using the same media type when creating device profiles and measuring performance.

For the print professional struggling to compete in an unstable market this work is a good start. However the work of the ICC and ISO working groups means little at the moment, although it means a great deal for the future. At the very least it underlines the need for better understanding of paper's contribution to colour management and quality control. A paper categorisation working group was formed at the Leeds meeting, with key representation from each region. Led by Dr. Uwe Bertholdt of Fogra, representative paper samples from Europe, Japan, Brazil, Thailand and the USA have been collected and the group has started to measure them. These measurements will be done in Europe, Japan and the USA and an initial report of the group's findings is expected during the next ISO TC 130 meeting in Bangkok at the end of April.

Don't hold your breath just yet, but keep in mind that progress, although it takes time, is being made.

– **Laurel Brunner**

