Color management: At last we're on the road to reliable color

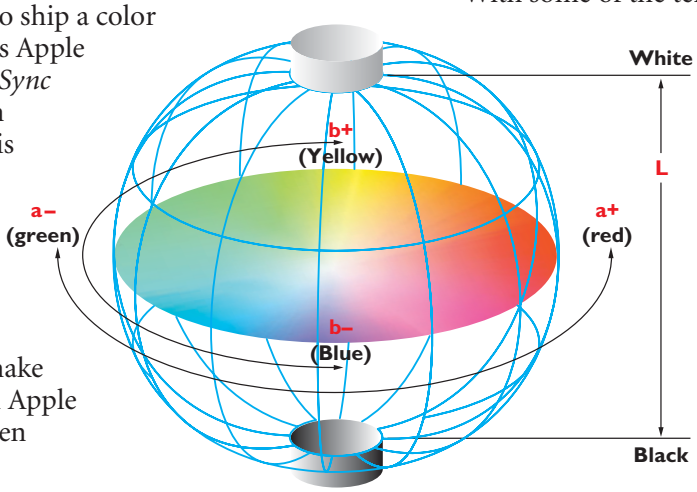
by Brian P. Lawler

Color management has been available for almost ten years. In that decade, we have heard marketing claims from vendors claiming the process is as easy as pushing a button: Click, and… Voilá!

Push button color is still not here, but color management is, and it really works. An industry group called the International Color Consortium (ICC) was formed in 1992 to discuss on a plan for color management, and a method for its implementation.

The first company to ship a color management engine was Apple Computer, whose *ColorSync* software hit the street in April 1993. The engine is the computer software that makes color conversions using ICC-compliant color profiles.

Many software products exist now to make color management with Apple ColorSync possible – even pleasant.



The color space used by color management systems is called CIELab. Its mathematical premise is that any color in the visible (or printable) spectrum can be described within its confines without mathematical damage. Converting in and out of CIELab color is reasonably easy for color management systems.

Begin at the beginning

First let's define a few terms before getting too deep in this color management material:

Profile:

This is a software component which describes the color performance of a certain device. It is possible to make profiles for scanners, monitors, proof printers, printing presses, and film recorders. The color profile is used by the color management software to make a color change from one color gamut to another.

Color Space

Another international group, called the CIE, has worked for a good part of the past century to define color as a scientifically-reliable measurement system. Various CIE color definitions exist: RGB – red-green-blue; Lab – Luminance a/b; xyY – spectral data; XYZ – spectral data, HSB – Hue, Saturation, Brightness; HSV – Hue, Saturation, Value. It's an alphabet soup for color scientists!

Each of these color spaces represents a set of mathematical values in an *imaginary* three-dimensional space where color can be plotted by mathematicians. The purposes are many, but the simplest allows the location and conversion of color between one device and another without causing too much (or any) damage.

CMM (Color Management Method)

A mathematical system for conversion of one color space to another for the purpose of converting – or separating – colors for any reason.

With some of the terminology in our grasp, let's see what makes color management tick:

Monitor profiling

Let's begin with the computer monitor. Many people have never attempted to calibrate their monitor, and some believe that the monitor is not a reliable color viewing device. In practice, monitor calibration and profiling is one of the easiest steps of color management, and once accomplished, the monitor can be a trusted part of the color work flow – within reason.

The method is to use a calibrating device such as the X-Rite *DTP-92 Monitor Optimizer.* This instrument is attached to the face of the monitor with a suction cup while profiling software projects colors on the monitor in rapid succession. The DTP92 reads the colors it sees with four filtered photosensitive cells, and sends their color values down the cable and back to the computer.

The driving software knows what color is *supposed* to be on the monitor. The instrument reads the color that is *actually* being projected onto the monitor. The software then builds a profile that corrects for the differences that exist between the *intended* and the *resulting* image.

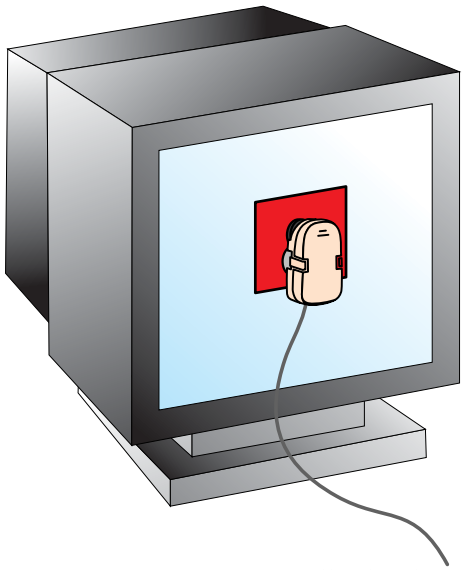
This profile then becomes a *corrective filter* for all color destined for this particular monitor. The profile actually changes the colors requested by a computer application to colors that are more correct on-screen.

After the profiling and calibration are accomplished, colors on the monitor are much more accurate with respect to requested color.

If you see a greenish color cast in an image on a calibrated monitor, you can be certain that it's in the image. If you remove that cast, you can be confident that it will be removed from the printed image. An alternative to using an instrument is to use one of several software profiling tools on the market. These tools show colors on the monitor and allow you to make subjective decisions that ultimately result in a profile. The resulting profiles are surprisingly good. The only problem is that visual tools cannot be used with consistency. It's hard for us humans to see the same color twice the same, or to make a similar profile on more than one monitor.

Scanner profiling

To profile a scanner, you need scanner profiling software and a standard scanner target (these targets ship with the software). The most common target is the Kodak IT-8 (also called Q-60) color transparency or color print target (There is no target for color negative films).

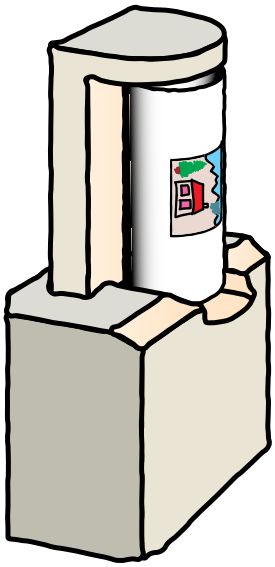


Monitor calibration instruments are affixed to the monitor, where they read the colors projected on the monitor to build a profile that identifies the strengths and weaknesses of the individual monitor. There are also some surprisingly good software monitor profilers that allow for a profile to be made without any instrument.

The target is scanned with scanner controls set to neutral points (this is often a challenge) and then saved to disk with no changes in a TIFF file format.

The scanner profiling software is run. It will ask for the TIFF scan of the target image. You open the image, and identify the corners of the target so that it fits the format of the profiling software.

The profiling software then compares the scan with *known values* for the color squares on the IT-8 target. The software then builds a profile that will adjust subsequent scans for color correctness.



Many printing firms blanch at the idea that a scanner can scan without the operator intervening on each and every image.

In some cases this is true; a scanner will not work with just a profile to drive it for color correctness. But, in most cases the profile makes scanning more accurate and more efficient.

Scanner operators may be dismayed at this, because it means that their livelihood is threatened by a "push button" technology. The truth is that the skills and knowledge of the scanner operator are still critically important in high-quality work. The scanner operator's skills will be needed at the monitor, and less on the scanner itself.

In work done by Time-Warner's *People* magazine, the production people shifted from a traditional CMYK scanning scenario using Hell 3700 drum scanners to an RGB workflow using the same scanners and Apple *ColorSync* production techniques.

Scans are made in RGB without any color correction done on the scanner. *People's* success rate on first proofs from the scanner rose dramatically. The magazine is now converting to an all-RGB, all-ColorSync work flow, and the initial productivity studies show it's working nicely. *People's* counterpart magazines *Time, Fortune,* and *In-Style* will be converting to the same ColorSync work flow during 1999 and 2000.

Proof printer profiling

To profile a proof printer or a printing press, you use a specially-generated target that is created by profiling software.

Examples of this target vary between software products, but most have hundreds of color patches that represent the potential spectrum of colors printable on a four-color device.

To build a printer profile, you print the target, measure the hundreds of squares with a spectrophotometer, then let the software build a profile that corrects for the differences between the *intended* color and the *actual* color.

Some proof printers are very accurate for color while others wander (this is particularly true of dye-sublimation printers). If your proofer's color wanders, you'll never get perfectly accurate or consistent proof prints.

Other proofing technologies, like many of the new ink-jet printers, are extraordinarily consistent and will result in proofs that are quite reliable.

Profiling the press

Each printing process and press technology has a slightly different spin when it comes to printing color on paper (or other substrates).

The combination of press, paper and ink creates a unique situation that can be measured and profiled.

The process is the same as with a proof printer, but requires that the press run a sample of the color patches and make that sample available to the profiling software.

Some instruments, like the X-Rite DTP-41 and other similar instruments automate the process of measuring the test patch panels. The DTP-41 reads strips of color patches, which requires the operator to feed the device, but it's very fast – the entire test panel can be read in a matter of minutes.

The X-Rite DTP-41 auto scanning spectrophotometer can shorten the time needed to read the hundreds of patches produced when profiling a printing machine.

GretagMacbeth makes a fully-automated instrument called *Spectrolino* (when it is hand-held) and *Spectroscan* (when it is attached to its automated table). The Spectroscan makes the process of reading hundreds – or thousands – of test patches completely automatic.

Gretag-MacBeth's SpectroScan instrument is a fully-automated spectrophotometer that can read hundreds of measurements (or thousands) without human intervention. What a blessing to have a machine do the tedious work! The SpectroLino instrument comes off to become a hand-held tool for reflective work or monitor calibration.

The press sheet used to measure the color patches must be run to standard densities, and the quality must be top-notch. With this press color data in hand, we can build a profile for the press using these spectral instruments and appropriate profiling software.

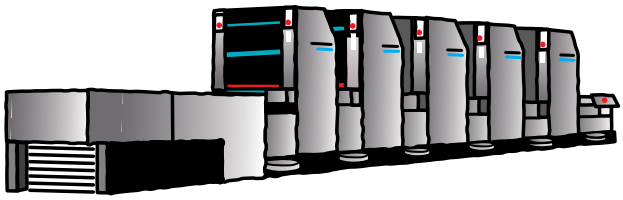
The product, again, is a color profile that describes the color performance of the press/paper/ink combination printed.

What about dot gain?

Color management is a *complete* picture. It measures dot gain or loss, density problems (though ink-starved plates may be outside its jurisdiction), and all color quality issues in one set of measurements. *Everything* on that press sheet is considered when the profile is made – even the color of the paper.

Putting color management to work

We now know that we can build a profile for every device in the production work flow – scanning, prepress, and press. But the profiles are not a solution in themselves. For a complete solution, we must *apply* the profiles to images.



Printing presses running up to eight colors can be profiled by ICC color management software. The resulting profiles make conversion of color for these machines more accurate, and better-tuned to the capabilities of the press-paper-ink combination.

Software using color management right now includes the most popular graphic arts applications: Adobe *PageMaker 7.0,* Adobe *InDesign 2.0, QuarkXPress 4.11,* Adobe *Illustrator,* Macromedia *FreeHand*, and Adobe *Photoshop* (from version 5.02).

Image databases like Canto *Cumulus* also support color management, allowing clients of stock agencies and others to make a "soft proof" of an image by applying a press profile to the image on-screen in Cumulus.

The monitor is then changed to display color the way the printing press does.

Making money with color management

There is a lot of money to be made using color management! The greatest profit opportunities are in reducing the costs of prepress and press make-ready. When prepress proofs are more reliable, and

when the press is able to match the proof more readily, then costs on the highest cost-per-hour machines in your facility are reduced.

Press checks are faster, production printing is acceptable more often, and the whole facility runs better.

Some of the printers using color management are reporting incredible savings in prepress and press make-ready. One printer in the Dallas area claims to be able to get one more job on-press per eight-hour shift. In his two-shift operation that adds up to 888 jobs per year in normal production without adding a single minute of overtime to the costs of production. Compared to the previous methods of production, this is essentially 888 jobs printed *as net profit.*

When electronic proofs are reliable, fewer proofing passes (and associated materials) are consumed to make a job ready for printing. With photomechanical proofs are made, these savings are quite extraordinary.

In one web printing operation I converted to color management, we were able to reduce the number of proof cycles on photomechanical proof materials from an average of four down to one (replacing them with ink-jet proofs costing only ten percent as much). The cost of the ink-jet machine (about $80,000 at the time) was absorbed in the savings of only eight months of production!

Color management requires a commitment

This color management process requires one key ingredient that cannot be ignored: time. In order to benefit from the value that color management brings to the printing trade we must invest time in measuring and testing each device in the process.

Color management is workable for any company – large or small. It requires a commitment to quality and consistency. It requires management buy-in, and it requires that all the workers rally-round the process and give it the time and effort it needs to succeed.

You will need profiling software, and a measurement instrument called a spectrophotometer.

The total investment can be as great as $50,000, but when you do the math, it's easy to see how easily this investment can pay-off. Customers are starting to ask for color management in printing, and they are coming to expect you to provide a color-managed process.

By working to provide color profiles of your proofing machines (and perhaps your presses) to your customers, you can extend the value of color management to those who do business with you, and make it possible for them to preview how printing will appear when it is printed on your equipment.

Surprises will slowly vanish as our industry adopts color management, and the process of proofing and press make-ready will become more routine, and less troublesome in the color-managed future.

■ This is one of a series of essays I have written on issues relating to computers and the graphic arts industry. Other subjects include: dot gain, scanning, black and white from color, Photo CD, several on Web page design and good netizenship.

Brian P. Lawler
Graphic Arts Consultant
6045 Madbury Court
San Luis Obispo, California 93401
Fax: 805 544-8445
Phone: 805 544-8814
e-mail: brian@thelawlers.com
Web: www.thelawlers.com