Cyan, magenta, yellow and black are all innocent enough, but when you have to make a color space conversion for a client, they can land you in the hot seat.

CMYK: The devil's color space

Imaging author David Blanter once told me, "God created RGB. Man created CMYK. Which would you rather use?"

As more photographers use digital capture, it has become common for their clients to ask for CMYK files optimized for four-color reproduction on a printing press. There are benefits and pitfalls for photographers who undertake the task. If you supply RGB files, you have limited control over the final rendering in print. You risk losing potential profits if you forgo doing the conversion yourself, and provide in-house proofs to simulate the final printing conditions. By far the most dangerous situation is to make incorrect CMYK conversions, which results in poor color reproduction. If you think it gets expensive making multiple test prints on your desktop inkjet, imagine the expense of running a printing press that spits out 5,000 color pages an hour!

In the analog film days, a properly exposed transparency was all a photographer had to supply to the client for output. Someone else in the production chain handled the scanning and conversion from RGB to CMYK. Scanners and digital cameras produce RGB data. A tricky part of this workflow is producing the optimal CMYK values based upon the behavior of the intended press or a matching contract proof. Invariably, this is the key to producing the best quality reproductions from any printing device, even your desktop inkjet. The most effective way to produce such color space conversions is to use ICC device profiles. So, from the perspective of color management, printing to a press or an inkjet involves basically the same steps. The CMYK color space is simply different from what most photographers are used to.

There's a yin-yang relationship with RGB and CMY; they complement each other. Converting the correct amount of red values into cyan values, green into magenta and blue into yellow isn't all that difficult. It's adding black ("K" for key. CMYK's short for cyan, magenta, yellow and black, or "K" so as not to be confused with the "B" in blue.) to the mix that makes it a far more complex, device-dependant color space ***(Figure 1)***.

Black is necessary because the colored inks used on a printing press are impure, and when mixed to full density do not produce black but a muddy brown. The solution is to add black ink to the mix, but it complicates the process. Many different combinations of all four inks can produce the same colors. For example, it is possible to produce grays and many dark colors with differing percentages of CMY and K inks. In addition, the total amount of ink hitting the paper plays a role in how well the press will reproduce the expected colors. (More later on black generation and total ink coverage.) But you can sort this out if a client demands a job delivered output-ready in CMYK.

Simply providing RGB documents is no guarantee that the conversion will be handled properly and the print job will turn out well, so it's advisable to supply a written notice or contract clearly stating that you are not responsible for work conducted on your digital files by those outside your control. Some output devices, including most desktop inkjet printers, are geared for the document to be printed to be in a defined RGB color space. Expecting RGB data, they perform a proprietary color space conversion for the number of inks used in the printing process. For a printing press, CMYK data is almost always the norm. There are a number of press processes that can use additional inks, such as orange and green, to extend the color gamut. This rare and expensive printing technique is sometimes called hexachrome printing, although the term is correct only when referring to Pantone inks and processes ***(Figure 2)***.

How does one convert the RGB data to

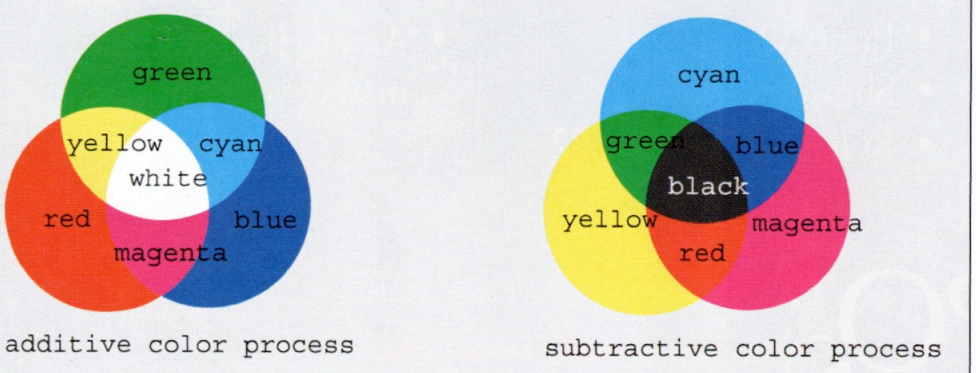

Figure 1. Both the additive and subtractive color models are seen here. RGB or additive colors are based on the mixing of light. CMYK colors are based on removing light from a page by adding colorants.

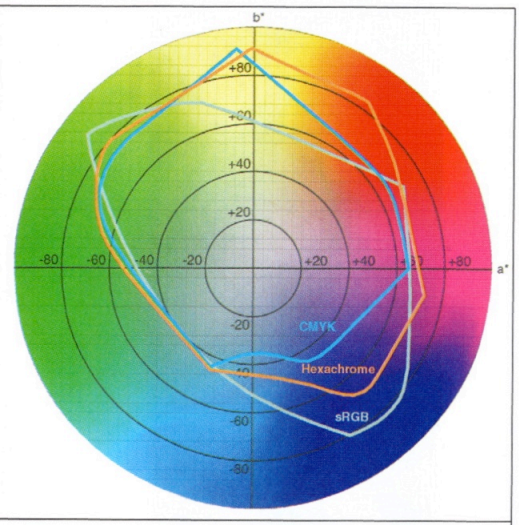

Figure 2. The gamut of hexachrome is greatly extended, thanks to the use of orange and green ink.

CMYK for a four-color process based upon a specific printing press? First, obtain an ICC profile for this printing condition and use it just as you would an RGB printer profile for your inkjet. Set up a soft proof in Photoshop using this profile while viewing the original RGB image. Edit as necessary. Then use the correct profile in the Convert to Profile command and save a copy of the document for the print shop. Who said making color separations is difficult?

If only we lived in a perfect world, we'd have such profiles at our disposal. What about the CMYK ICC profiles that ship with Adobe Photoshop? For example, why not just use the one called U.S. Web Coated (SWOP) v2? Like all printer profiles, it's designed to work with a press performing in a well defined way. Unless we know for certain that the printers are using this process, selecting random print profiles is about as effective as throwing darts blindfolded.

In the photographic world, we have standards for film processing. Your film can be developed by any number of service providers. Process control and calibration are essential in analog and digital color reproduction. This kind of process control is necessary with a printing press or any output device.

Where does that leave SWOP and Photoshop's CMYK profile? SWOP stands for specifications for web offset publications, specs written in the early '70s by an organization of printers to define the ideal behavior of a web press ("web" refers to the giant rolls of paper used in these presses). If hundreds of printing companies using a web press conformed to SWOP standards, every print shop could supply an identical ICC profile to their customers. But many print shops do not conform to those standards. That's why we need custom profiles. Of note, the U.S. Web Coated (SWOP) v2 profile that ships

with Photoshop is built upon a tightly defined SWOP behavior called TR001. The SWOP Committee went to great lengths to set up multiple presses to conform to their published standards, and then printed and measured 938 solid color patches from the press sheets. The averaged measured spectral data of this SWOP behavior is known as SWOP TR001. If a press or, even better, a proofing system conforms to TR001 specifications, the U.S. Web Coated (SWOP) v2 profile will produce superb color separations. The farther the press or proof deviates from this expected behavior, the farther the color reproduction will appear from optimal using this ICC profile.

If you are asked to supply CMYK data for a print job and you know it will be printed on a web press, ask if the press conforms to SWOP. If so, ask if the press conforms to TR001 SWOP. If the answer is yes, you have your profile; use U.S. Web Coated (SWOP) v2 and move on. If the answer is suspiciously vague, you'll probably have to find another profile. Ask the staff at the print shop for such a profile (good luck with that), build your own or have a service build one for you once the client agrees to pay for this service as well as for conversions and possibly proofs.

Another common printing process is sheet-fed. Some organizations have attempted to define standard conditions for printing on sheet-fed presses. The final draft for profiles based on GRACoL (general requirements for application in commercial offset lithography) conditions emerging now are known as CGATS DTR 004 or GRACoL 7.

With printing companies that conform to the standards, there should be few problems in producing excellent CMYK conversions based on well-built ICC profiles. Otherwise, short of having a profile provided by the print vendor, building a custom CMYK profile is the ideal solution. I'll explore how to do this and discuss the options that make this process a bit more complicated than making an RGB profile next month.

For now, if you are asked to supply CMYK files for a print job, you have few viable options if you can't target the ultimate output devices that will be used. My advice is to avoid any color space conversions, provide documents in sRGB to avoid color management confusion from outsiders, and have paperwork that frees you from any issues that may show up on press. ■

Look for Part 2 of "CMYK: The devil's color space" in the next issue.