

RGB-to-CMYK Conversions

How to Maintain Color Control
in Printed Files

By Andrew Rodney

Everyone out there who's had difficulty with output when converting files from RGB to CMYK, raise your hands. I'll bet a number of hands are in the air. Converting RGB to CMYK for final output is a critical step that makes or breaks the quality of a printing job, and it's a demand that more and more clients are making of photographers who shoot with digital cameras or scan their film.

This is both a benefit and a curse. The curse is that it's the photographer who decides how the file conversion will be made and upon whose shoulders rests the responsibility for the quality of the outcome. The benefit is that now the photographer has full control over the

color from inception to the laying of the ink on paper. Wise photographers see this critical step as a new profit center where they can increase their fees for producing images—income that used to be paid to someone else down the production line.

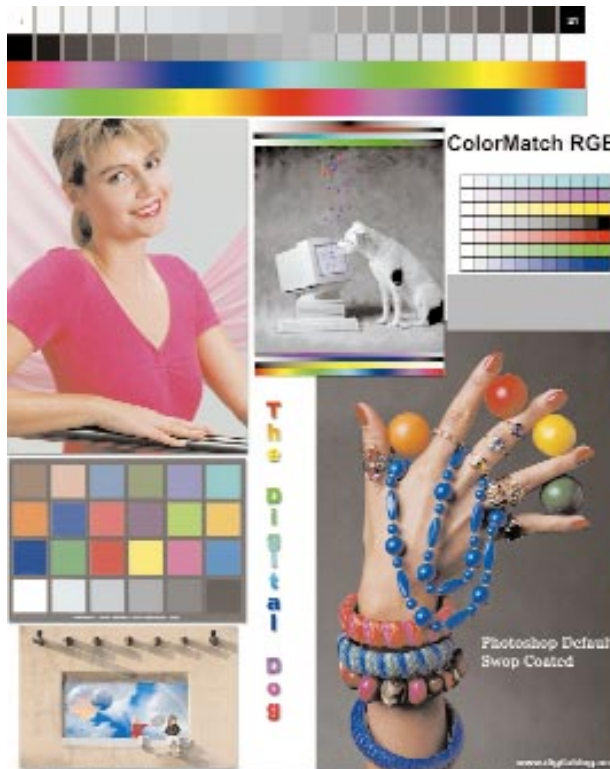
Let's examine some of the options you have for making high-quality conversions, and how you can avoid some of the problems inherent to the process. The first problem with CMYK files (and RGB to a lesser extent) is that CMYK is highly device dependent. You can send a file you converted from RGB to CMYK to a dozen CMYK printers and see a dozen different results in the output. CMYK should be optimized for a specific output—it's not always possible, but we can come close.

The most common application

for RGB-to-CMYK conversions is Adobe Photoshop. You could simply open an RGB file, go to Image>Mode>CMYK, and end up with a separated file. You could do that, if having a sound conversion didn't matter to you. Assuming the default settings in Photoshop are going to produce satisfactory results is like assuming that setting the f/stop on a lens somewhere in the middle will produce an acceptable exposure. First we have to inform Photoshop how we wish to accomplish the conversion.

In today's desktop workflow, users want to scan once, then use the digital image file many times; therefore, it's appropriate to archive an RGB file and simply convert to CMYK whenever necessary for each kind of printing requirement.

Photoshop 5.0 has at least two ways in which we can inform the application how we want to produce a conversion, but we must begin by knowing the condition of the printed output. This critical information comes from the printer. It's important to know the linescreen at which the job will print and the condition of the press or (in most cases) the proofing system—information not often readily available. The print shop might tell you, "We print to SWOP [Specifications for Web Offset Printing] standards," which is hardly specific enough. This generic information is like saying all E-6 films are the same because of the processing method. SWOP tells us just a little bit about the supposed method of printing. For example, SWOP specifies line screens of 133 lpi. If you print 150 lpi, it's not SWOP. Yet it's done and it can be made just as consistent and predictable as 133 lpi.



Contract Proofs

Many clients expect to receive a "MatchPrint" from the printer prior to the printing of their jobs. (I prefer to use the generic term "contract proof" because MatchPrint is a specific product from Imation/3M—your printer might use Fuji ColorArt, Kodak Approval, Kodak Contract, and so on.) It's important to have a conversation with the people providing your film and contract proofs. Ideally you will optimize your conversion from RGB to CMYK for this very proof. It's called a contract proof because it's a contractual agreement between you or your client and the people printing the job. With print jobs that involve making the separated film negatives (black-and-white negatives for all four colors) that will be used to burn the plate for the press, the contract proof will be made with the actual film, and both client and printer will accept the proof as a representation of the pages that will come off the press.

Filmless proofing and printing systems such as Kodak Approval are also used for direct-to-press jobs, and the contractual concept is the same. When clients are satisfied with the contract proof, they sign-off on the proof and the film (or digital file) and the contract proof will go to the printer. The pressman will control the press to the best of his ability to produce a printed page that matches the contract proof. Usually the client comes in for a "press check" to compare the prints coming off the press to the contract proof, under controlled lighting. At this point, the client should be able to approve the output from the

press, and the entire job will be run. As you can see, the contract proof is a critical element against which you should strive to optimize your conversions. Ask your suppliers which proofing system they will be using so you can tailor your conversions to it.

Armed with knowledge about the press conditions—or better yet, the contract proof—it's time to optimize your conversions for this process. Photoshop offers a few ways to do this, depending on your budget and your determination to produce the best possible output. Ideally, you will make custom conversions for your output needs. But when that's not possible, you can aim for providing CMYK conversions that are at least close to the true conditions under which they will be reproduced.

Photoshop has three main methods of setting a conversion: Built-in (also called the "Classic Engine"), ICC, which uses ICC profiles, and Tables. Tables is really just a means of loading the older style separation tables into Photoshop. Also, when a table

or separation setting is loaded, this interface allows the user to save ICC profiles reflecting the current settings when the user clicks on the Save button. The Built-In mode is what most users are familiar with.

Notice in Figure 1 that the top of the dialog box allows you to select the ink options, which I prefer to call the "ink model." This is supposed to describe the color of the inks you are using. It's set to SWOP Coated here, but you can achieve a variety

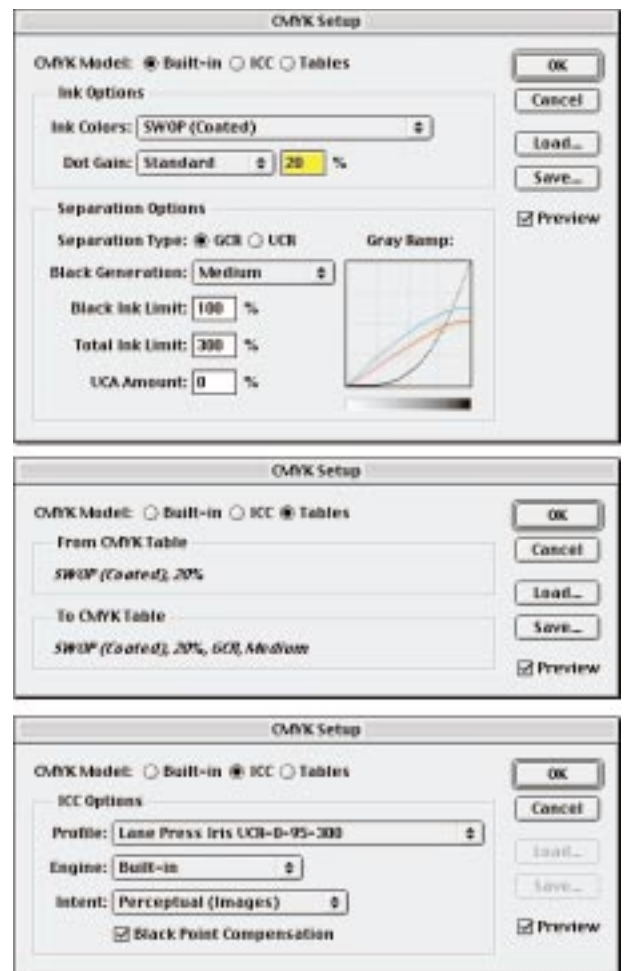


Figure 1. The three dialog boxes for CMYK Setup: Classic (called Built-in), ICC, and Tables. The Save button in the Tables dialog box allows the setting to be saved as an ICC profile.

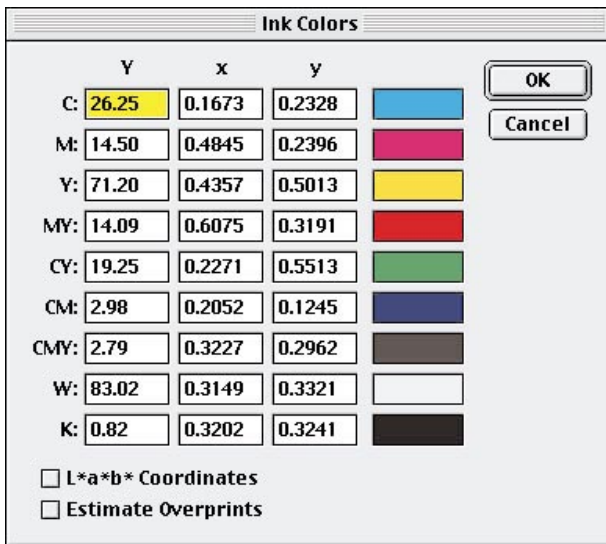


Figure 2. The Ink Colors dialog opens when you click on the Custom menu option in the Built-in CMYK Setup. You can enter the values for the various inks once they have been measured. Do not pick Estimate Overprints.

of results when you use different conversions called SWOP. You will also have control over dot gain and other ways of controlling the black generation of the conversion (the black channel, which will create the black plate). Now's the time to talk to the printer so you can enter the correct settings for these options.

The various ink models built into Photoshop are really intended for press conditions. There are no models that mimic a contract proof, although if the press and contract proof match, you could certainly pick one of these models. Picking one of these ink models and perhaps tweaking the settings for dot gain and other settings (such as total ink limit) will get you in the ballpark—but keep in mind that these settings are vital to the outcome of the printed piece. Being off just a wee bit with dot gain can make or break a job.

You will also notice that in the classic engine, you have a pop-up

menu called “Custom.” The corresponding dialog box seems rather overwhelming and frightening, as seen in Figure 2. However, there is one way in which you could create a custom ink model for use in Photoshop. You have to run an actual test for the printer, then measure the output with a spectrophotometer or colorimeter, evaluating eight colors, plus the substrate. You will need a hardware device and software that will produce either CIE xyY or CIE Lab values, such as the X-Rite Digital Swatchbook or ColorTron II and the supplied software, ColorShop, which in Version 2.6 has a ready-to-print and measure target.

Lacking this target, simply output the nine colors and make a file yourself. Use Photoshop to specify the colors in CMYK (for example, 100C/0M/0Y/0K for pure cyan) and load that color into

a rectangular selection of your file that's large enough to measure. To get exact dot gain values for each ink, specify each ink color in the following percentages: 2, 4, 6, 8, 10, 20, 30, 40, 50, 60, 70, 80, and 90%. You should end up with a total of 61 patches to measure (nine for solid colors plus paper white, plus 13 dot gain patches for each ink).

After printing the test file, measure each solid color and the white of the paper stock, and enter the values in the appropriate fields. ColorShop 2.6 has all the tools to do this easily and correctly. In the Dot Gain popup menu, select Curves. Enter the values in each field.

This method works best for making a custom ink set for the press that the job will be printed

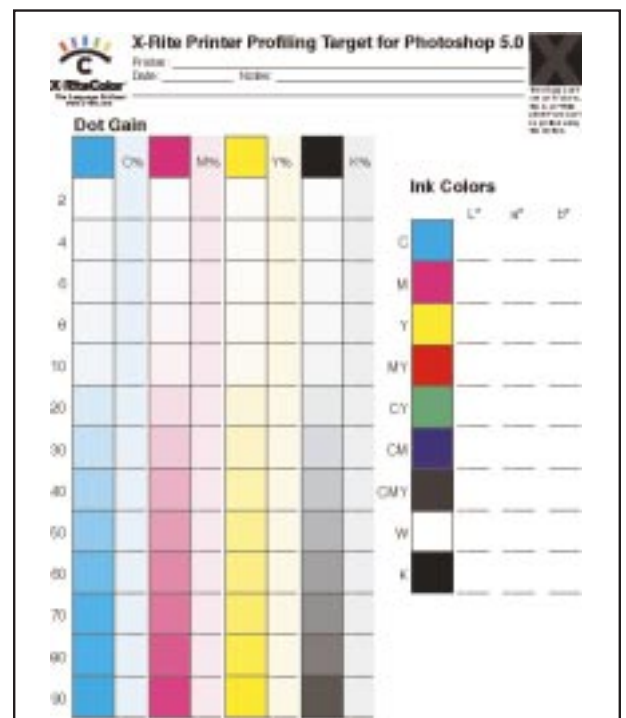


Figure 3. This ColorShop 2.6 target can be output and then measured using one of the ColorShop hardware products to provide the numeric values to be entered in the Custom Ink dialog box (Figure 2).

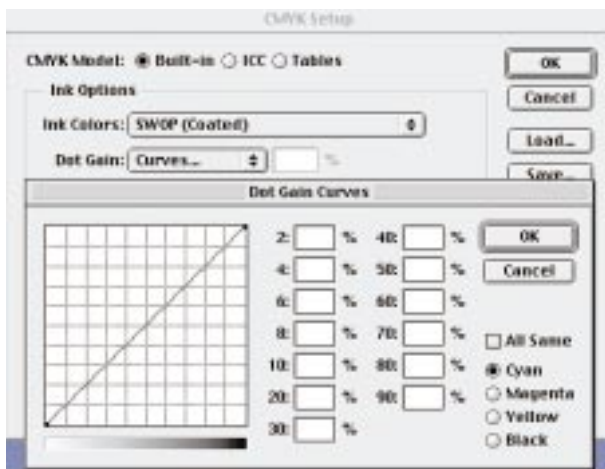


Figure 4. You can save this custom ink model as an ICC profile. For most users, profiling the press isn't a viable option, so use this technique for profiling the contract proof.

on. According to Adobe, however, the Built-in method works with offset lithography and toner-based devices as well as ink-jets. You can also use this technique for contract proofing devices. Best bet: Actually run the patches on the press (if your printer is willing) on the same stock with the same inks you intend to use. That still leaves total ink limit and other black generation issues to work out, but this technique brings you much closer than using a standard ink model.

ICC Profiles

Now let's talk about the real power of conversions. Photoshop 5.0 allows users to create or use existing ICC profiles for making mode changes. You can make your own or you can look for existing profiles that correctly describe the conditions of the printer, press, or contract proof. There are some very good profiles floating around the Web that were created for contract proofing devices (visit www.chromix.com/default.shtml). The Radius/Miro line of displays

ships with a group of excellent profiles for such proofing devices as 3M MatchPrint, Fuji ColorArt and several flavors of SWOP. In addition, printers and service bureaus may have ICC profiles on hand that you can use to make your conversions. And finally, you can use a spectrophotometer and software to

make your own ICC profile (or use the method described above to measure the 61 patches and establish an ICC profile). For a roundup of software packages that can make ICC profiles, see *PEI* October 1999.

If you have the capability to make your own profiles, it's likely you'll want to profile the contract proofing device. This means sending the shop a file with a few hundred color patches that will be read into a software package to generate a profile. When that is accomplished and the profile is loaded in the ICC section of the CMYK Set-Up, all you need to do is to make a standard mode change and the file will be converted using the profile.

Whatever method you use to create a custom conversion, I recommend sending a test to the same shop with a mix of images, just to confirm the soundness of the conversions. Most software profiling packages will allow the conversion to be tweaked with respect to total ink limits and other

black generation parameters—again, it never hurts to contact the printer. Dot gain problems should be accounted for in the proofing system, if the contract proof is sufficiently dialed into the final print process. When no information is provided, your safest move for coated stock is to keep the total ink limit between 300 and 340 percent; a light to medium black generation usually works well. Remember that in profiling and converting for contract proofs, the goal is to produce film or files (if direct to press) with sufficient latitude for the pressman to adjust the press to the desired output and match the proof. Short of profiling the press—a very difficult job—the aim point is the contract proof.

Photoshop, CMYK, & WYSIWYG

Computer displays are RGB devices, so how on earth do we view CMYK files? It's all in the recipe for CMYK to RGB conversions onscreen. Photoshop cannot produce an accurate preview of CMYK unless it's informed about the condition of the display and the output device. With this information, Photoshop can do an on-the-fly conversion from CMYK to RGB, just to preview your files. If you expect a CMYK file to display properly, you must make a profile of your display and a profile of the CMYK conversion method loaded in Photoshop (if you are not using ICC profiles, you need to load the correct separation table).

To see how the output profile alters the display, simply convert a file from RGB to CMYK, then go into the CMYK Set-Up and pick a

GretagMacbeth ProfileMaker Professional 3.0

In my roundup of ICC profiling software packages (*PEI* October 1999), I had yet to review ProfileMaker Professional from GretagMacbeth. I've since had the opportunity to test the newest version. The various modules of ProfileMaker Professional 3.0 can be purchased as a package or separately. I used ProfileMaker, the product that creates ICC profiles, to profile the contract proofing system used at The Lane Press in Vermont, where *PEI* magazine is printed. Because the magazine is produced direct-to-press, sans film color separations, the company uses an IRIS proofer for the contract proof.

For my profile, I simply output a TIFF file from ProfileMaker with 875 color patches and e-mailed it to The Lane Press for output on the IRIS. Proof in hand, I used the X-Rite DTP-41UV/T to measure the patches in ProfileMaker. The software is quite easy to use and has an especially beautiful interface.

Lane provided specific press requirements, such as total ink limit and other black-generation data, which I then entered in ProfileMaker. The application has several really nice features. For example, with the Measure tool, you can save the measured data to a separate file to use for

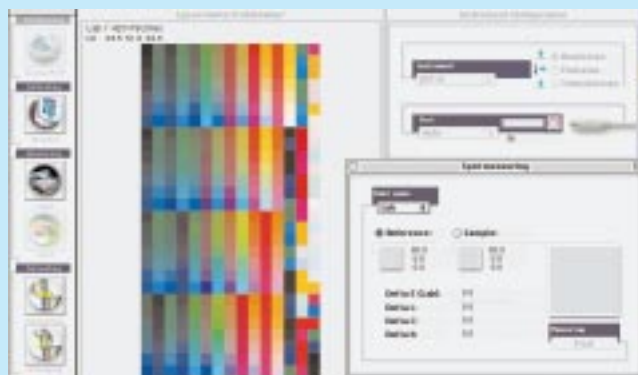


Figure 5. The ProfileMaker Measure tool interface in ProfileMaker 3.0. The buttons on the left are other functions, such as profile averaging and comparing profiles.

diagnostics or for updating the data in the future. There's also a feature for sending a small patch sample to a printer or output device, then updating the profile for device drifting, without re-measuring hundreds of patches. The Pro package also contains the ProfileMaker module, which profiles for scanners, monitors, digital cameras, and output devices, and the ProfileEditor, an easy-to-use module for

altering existing profiles, which I find very useful. With this module, you can tune a profile using any image you wish for a visual guide, and alter lightness, contrast, and saturation, as well as display the gamut of profiles.

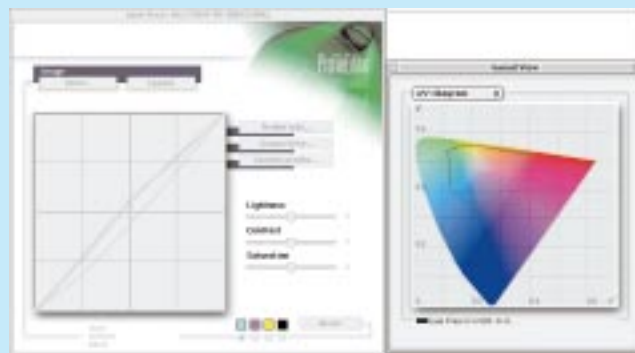


Figure 6. The ProfileEditor interface has an especially nice feature, the Gamut View, which displays the color gamut of the output device on the CIE charts, such as profile averaging and comparing profiles.

The only tool missing is one for tuning selective color, an operation I often use in profile tuning. With the ColorPicker module, you can specify spot and process colors to output devices using ICC profiles, then use the profiles to generate specific recipes for Pantone colors for any device you've profiled. The BatchMatcher module allows you to create hot folders for applying profiles to images, and to process TIFF, JPEG, ScitexCT, and PNG files, with support for EPS and Postscript files. The package also includes the booklet "Postscriptum on Color Management," an excellent and beautifully illustrated introduction to color management, plus a 4x5 transmissive target and a 5x7 reflective IT8 target for profiling scanners.

I also used ProfileMaker to profile my Epson 1200 printer for RGB output on a new matte paper from Epson. The quality of the output was excellent, thanks to the profile. Neutrals were beautifully gray balanced, tonal range was dead-on, and color and saturation were superb. It appears that ProfileMaker is adept with RGB as well as CMYK devices. The only negative comment I can make is that the software, like nearly all the CMS products I've tested, requires a Dongle—a necessary but annoying device. List price for ProfileMaker 3.0, \$3,500.

different CMYK profile or table. The file itself will not change but the preview will, because Photoshop now has a different method for converting CMYK back to RGB for the screen. For a proper preview, it's important to ensure that whatever method was used to convert RGB to CMYK is specified in the Photoshop CMYK Set-Up.

By embedding an ICC profile in saved files, users can be informed when their files are out of sync with Photoshop. In the Profile Set-Up, you should set Preferences to Ask When Opening. Then when you open a copy of Photoshop that has 3M MatchPrint loaded in the CMYK Set-Up, you will get a Profile Mismatch warning when you open a CMYK file that was separated in SWOP Coated CMYK and embedded as such. At this point, it's far better to simply change the CMYK Set-Up to match the file you are attempting to open than to convert the file! Simply click Don't Convert and change the CMYK Set-Up to SWOP Coated to make Photoshop match the file; the preview will update correctly.

Once you have a good profile or separation table for your CMYK output, you should preview the results before making the actual conversion. In Photoshop, select "CMYK Preview" in the View menu to bring up a soft proof. Since you are still working in a wider gamut RGB file, you could do some tweaking prior to the actual conversion. If you have a good profile of your display and a good profile of the output device, the soft proof should be accurate. Although there are significant differences between the appearance of the translucent display and the final reflective printed piece, you should get an excellent idea of how the

colors will appear after conversion. If you do edit the RGB file while looking at it with the CMYK preview, save that RGB version apart from the original RGB file. You've optimized or edited the file for the intended output and these edits may not be appropriate if later on you need to re-separate the file into CMYK using a different profile.

When the file looks like you want it to, doing a mode change from RGB to CMYK will actually alter the data and convert the file, without changing the preview at all.

To illustrate how different conversions can affect the output, I've converted some RGB images using several different methods. First I used the default settings in Photoshop (SWOP Coated)—a

conversion using the "classic engine." In the second test, I used the Radius SWOP Coated ICC profile, and in the third, the Radius 3M MatchPrint ICC Profile. Finally, I made a custom ICC profile using ProfileMaker 3.0 for GretagMacbeth (see sidebar). This topic is a complex process that cannot be properly addressed here, so I highly recommend the book *Real World Photoshop 5.0*, by David Blatner and Bruce Fraser (Peachpit Press).

[Editor's note: *Real World Photoshop 5.0* is a 1999 PEI Cool? Award winner.]

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