

Color Management

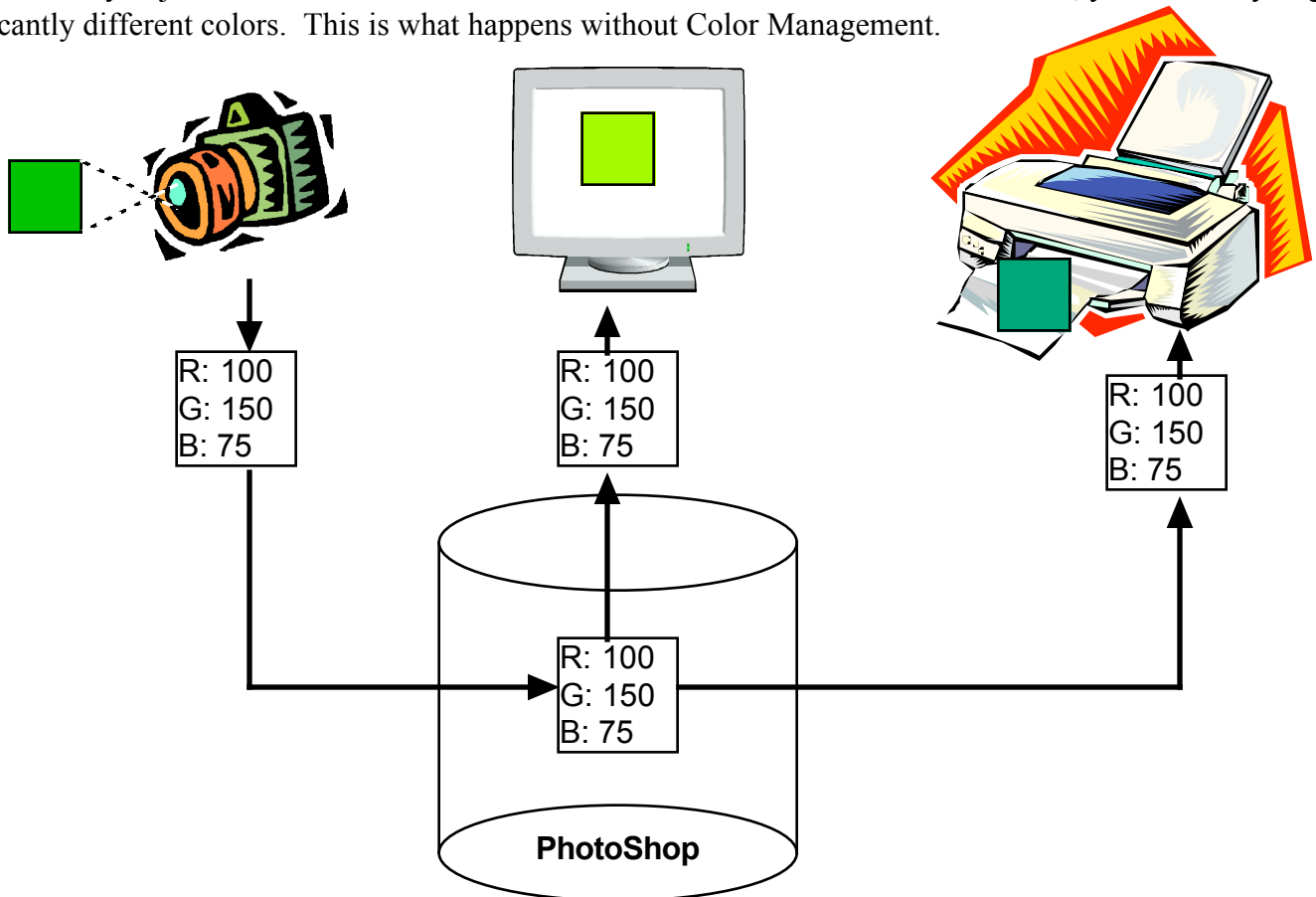
DISG 5/27/04

Various digital cameras, scanners, printers, displays, etc. handle colors differently. Color Management is a system for automatically compensating for these differences in order to produce colors that are acceptably similar across the various devices.

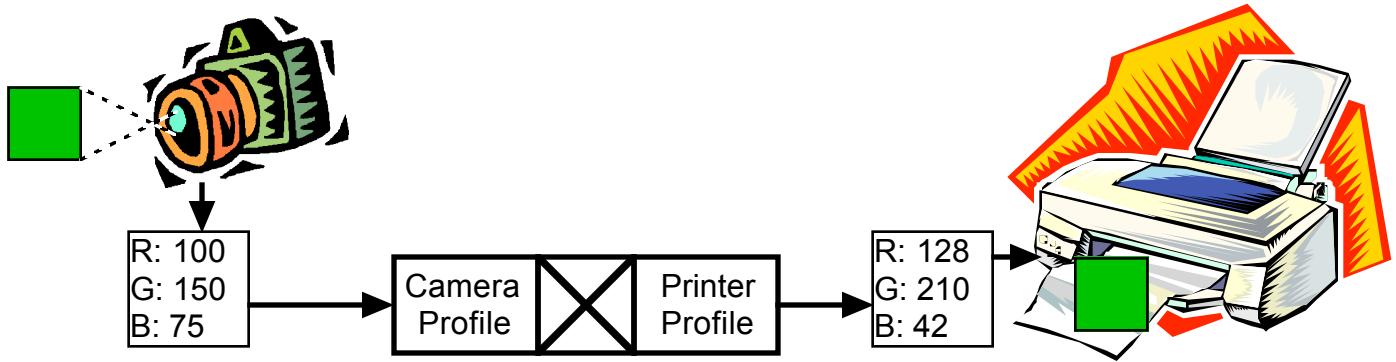


R: 100
G: 150
B: 75

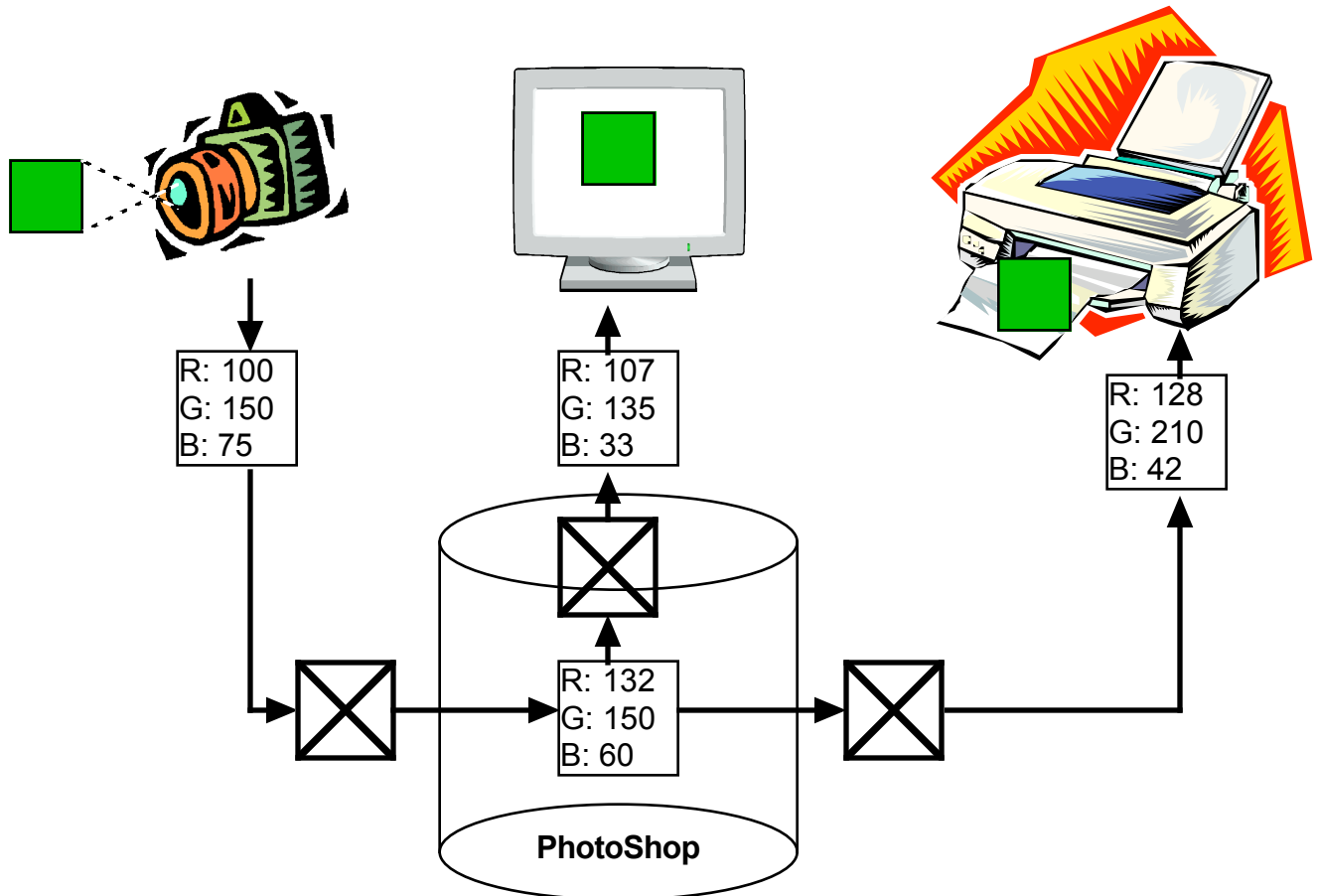
Here's the problem: you have a digital picture, and one of its pixels has Red, Green, and Blue color numbers of R:100, G:150, B:75. What color is that pixel? You might guess that it is greenish color since the Green number is higher than the Red or Blue numbers. But is it a kelly green, a lime green, a mint green, an avocado green, an olive green, or a chartreuse? There is no answer, because the colors can vary so much from one device to another. So if you just take the RGB numbers from one device and feed them into another, you are likely to get significantly different colors. This is what happens without Color Management.



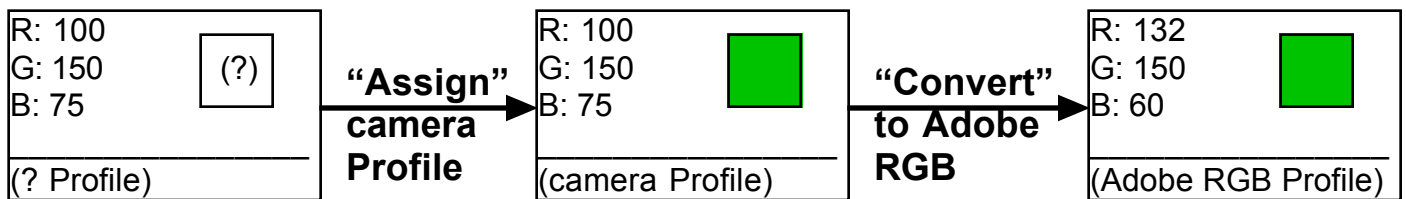
The key to Color Management is something called a “Profile”, which is a description of a particular device. A Profile specifies how color numbers relate to actual shades of color for that particular scanner, printer, etc. If you had Profiles for two different devices, you could do a translation and figure out what color numbers you need to send to the second device in order to produce the same shade of color as the first device.



With Color Management, you can, in theory, translate the color numbers from your camera or scanner into color numbers for your display and printer to achieve consistent color across all these devices. But what color numbers should Photoshop use internally for calculations and storage? You could use the numbers from the camera, or the numbers going to the display, and with appropriate translations all might be well. But for several reasons it is better to translate everything into a neutral common ground called a “Working Space.” The Working Space is defined by a Profile, even though it is not a physical device, just a mathematical construct in your computer. The most commonly used Working Space in Photoshop is called “Adobe RGB 1998.”

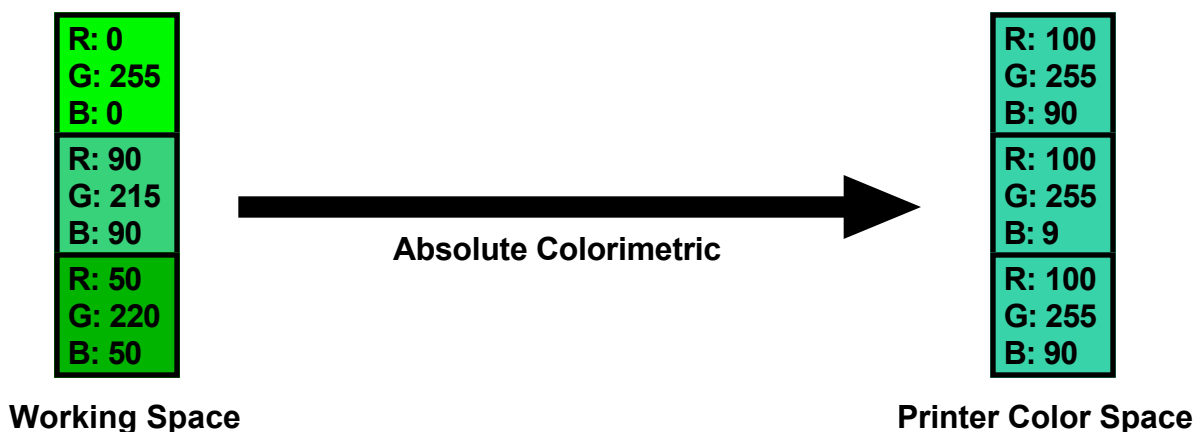


In Photoshop, if Color Management is turned on, the computer makes the translations behind the scenes and the only color numbers you ever need to see are those of the Working Space. But there are two important commands available to you: “Assign” and “Convert.” When you Assign a Profile to a document, it does not change the color numbers, but it tells Photoshop to assume that the color numbers came from a device with that profile. This will enable Photoshop to make the translations to other profiles as necessary. For example, when you bring a document from a digital camera into Photoshop, if it does not have a Profile associated with it (or if it somehow has the wrong Profile associated with it), you could Assign it the camera profile. The “Convert” command translates the color numbers from one profile into another, attempting to keep the actual colors represented the same. For example, you might Convert the document from the camera Profile into the Working Space Profile for further editing. Or you might Convert a document to the sRGB for posting on a website. (The sRGB profile represents an average PC monitor, and is the safest choice for a document to be viewed on an unknown computer monitor without Color Management.)



There is one big problem with translating color numbers from one profile, or “color space”, to another: sometimes the color represented by the numbers in the first color space just can’t be reproduced in the second. For example, your camera may have captured a beautiful bright green color, and with appropriate translation, it may be accurately displayed on your computer screen. But when it is time to print it, your printer may be physically incapable of producing that exact shade of green, no matter what color numbers you send to it. In other words, that color is outside the gamut of the printer. So what is the translator to do? This choice is called the “Rendering Intent.”

The simplest choice of Rendering Intent is called “Absolute Colorimetric.” It just says to match the color exactly if you can, and if not then come as close as possible. This sounds good, but leads to a problem. If significant areas of a picture contain pixels of a variety of shades of color that are all outside the printer’s gamut, then all those pixels may get translated into one color which is the closest the printer can come. Since these pixels all become the same color, you lose any detail or texture in this area of the picture.



“Relative Colorimetric” may be a better choice for photos. It is like Absolute Colorimetric, except that it makes an adjustment for near-white colors. If you look at several kinds of “white” paper together under good light, you will see that there are many shades of “white.” It is often the case that your camera or scanner can distinguish, and your screen can display, several colors that are brighter than the paper in your printer. But since your printer doesn’t contain any white ink or bleach, it cannot possibly render any colors lighter than the blank paper. So the Relative Colorimetric method translates the purest white color (R: 255, G:255, B:255) into the color of the blank paper, and renders all other colors relative to that. This often looks good for photos, but it can have the same problem as Absolute Colorimetric in losing detail and texture in areas outside the printer gamut..

The “Perceptual” Rendering Intent is probably the safest choice for photos. It desaturates all the colors as needed to fit inside the gamut of the printer profile. This helps maintain visibility of the detail and texture in areas outside the printer gamut, but sacrifices maximum color saturation.

There is also one more choice of Rendering Intent, called “Saturation.” It maintains maximum color saturation, even at the expense of getting the hue and brightness wrong. This is not usually a good idea for photos, but might be right for charts and graphs where you want bright, distinct colors, but are not too picky about exactly what those colors are.

Reference

For more in-depth information, read the chapter on “Producing Consistent Color” in the Photoshop CS user manual. It is much clearer than the chapter of the same name in the user manuals of earlier editions of Photoshop.

Where to Get Profiles

You will find several standard profiles, like Adobe RGB 1998 and sRGB, come with Photoshop, and others may come with your computer Operating System. Printer and scanner profiles are often installed when you install the drivers for these devices. You may be able to download additional profiles from the manufacturers’ websites, or a manufacturer may state their equipment conforms to a standard profile like Adobe RGB 1998.

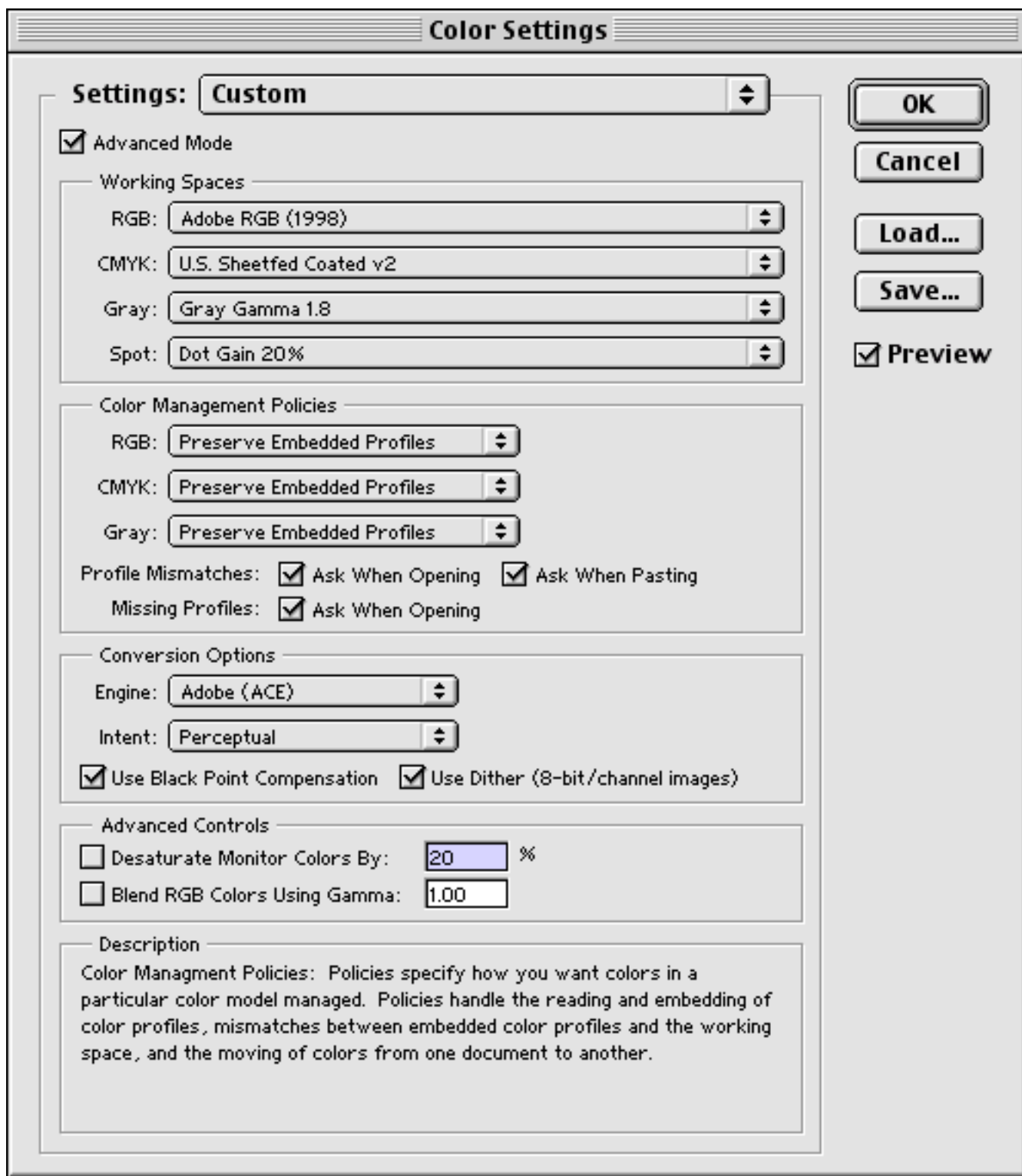
You can run a program like Adobe Gamma (which comes with Photoshop), or similar programs like the Mac Monitor Calibrator, to “calibrate” your monitor. This will create and install a profile for your display.

For greater accuracy, you can invest in special hardware and related software to create profiles for your monitors, scanners, cameras, and printers. These use special light meters to measure the colors of displays and printer outputs, and specially calibrated charts for scanners and cameras. A complete system will run a few hundred dollars, or more. Purists may want to update profiles frequently to compensate for minute changes as equipment ages, or with different batches of paper and ink.

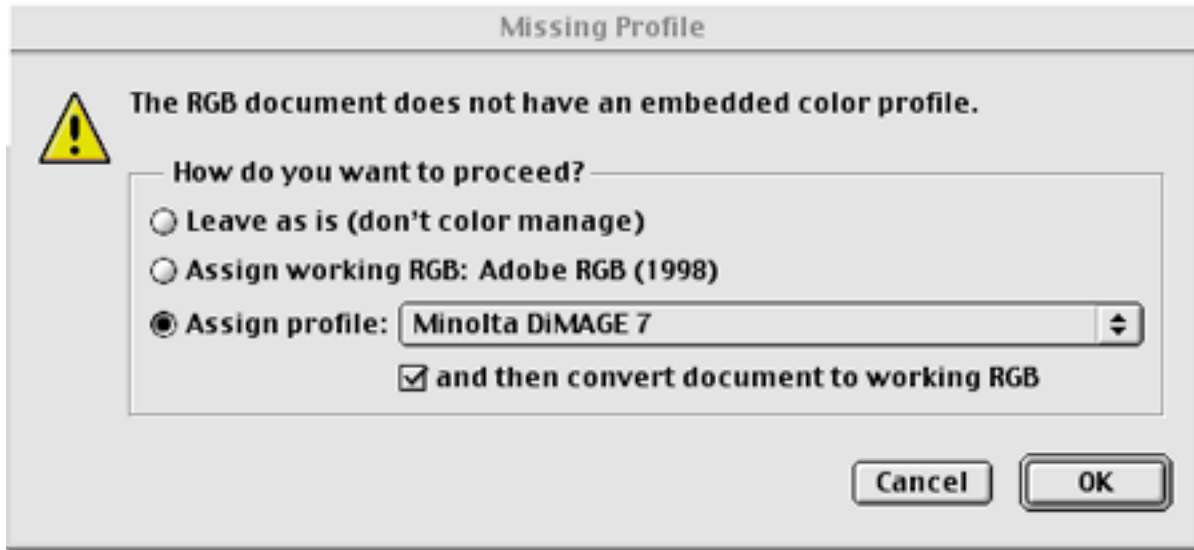
A “Cookbook” Approach to Color Management

1. Run Adobe Gamma (or the Mac Monitor Calibrator if you have a Mac) to calibrate your monitor. Just follow the directions.

2. In Photoshop, open the “Color Settings” dialog box (under the Edit or Photoshop menus) and choose your default settings for Color Management. Choose “Adobe Gamma 1998” as the Working Space, and “Ask When Opening” under Color Management Policies. Choose either Perceptual or Relative Colorimetric as the Intent. You won’t be using the CMYK features, so you can ignore them. For monochrome images, choose Gray Gamme 1.8 if you have a Mac and 2.2 for a PC. If you position the cursor over a menu item, a helpful description of the choice appears in the lower area of the dialog box.



3. When bringing an image into Photoshop for the first time from your digital camera or scanner, Assign it the profile of the camera or scanner, then Convert it to your Working Space.



4. When printing, use either the Print Options or the Print dialog box to choose the printer profile and rendering intent. There may be multiple profiles to choose from depending on the type of paper being used and the dots-per-inch or other printer settings. A typical dialog box is shown below; the details may vary depending on the operating system, the version of Photoshop, and the model of printer.

