



What is color management?

Part 3: Why you need a working space

One of the first mainstream software applications to fully implement a modern (and usable) color management system was none other than Adobe Photoshop 5.0.

At the time, Adobe introduced a number of new concepts, such as working spaces, display profiles and converting files from colorspace to colorspace. Version 5.0 was a bit rough around the edges and inflexible when it came to color management. Photoshop 6.0 refined these areas and remained quite workable, with little change in its color architecture. Understanding

how Photoshop operates with regard to color management from v6.0 forward is key.

One of the most radical changes in Photoshop was the idea of divorcing the actual display from how we edit our files. In previous articles, I discussed how the colors in digital image files are nothing more than numbers, and how display systems are, without proper calibration and an ICC profile, incredibly unstable. Adobe realized that editing images based on the numbers in a file being sent directly to a display ensured that no two users would see the same numbers the same way. To solve this problem, Adobe had to implement two major changes in Photoshop. First, they had to have a display profile that would inform the application about how each individual user's display system actually reproduced

color (hence, the importance of calibration and profiling the display). The second key became producing standardized colorspace that were ideal for image editing. This is how *working spaces* came about.

Devices that capture color (input colorspace) and devices that output color (output colorspace) don't necessarily provide the best colorspace for editing image files. Moreover, a file that is in a colorspace optimized for an Epson printer will only produce the desired color on that device. If the user wished to print this file on a Fuji Pictography, the color would be wrong. Since most users want to have the flexibility of printing a file on any number of output devices, editing exclusively in an output colorspace is problematic. So for editing images, Adobe came up with

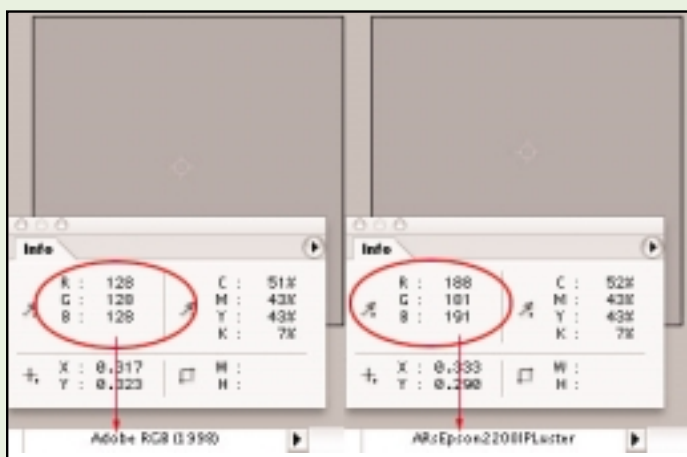


Figure 1. This Adobe RGB 1998 file is a gray patch that reads neutral (128R/128G/128B). After applying a print profile for an Epson Stylus Photo 2200, the values are now 188R/181G/191B. The values are not equal, but these are the numbers necessary to produce a neutral gray on this printer. Notice how the Epson ICC profile produces a new and correct set of values to achieve this neutral color in print.

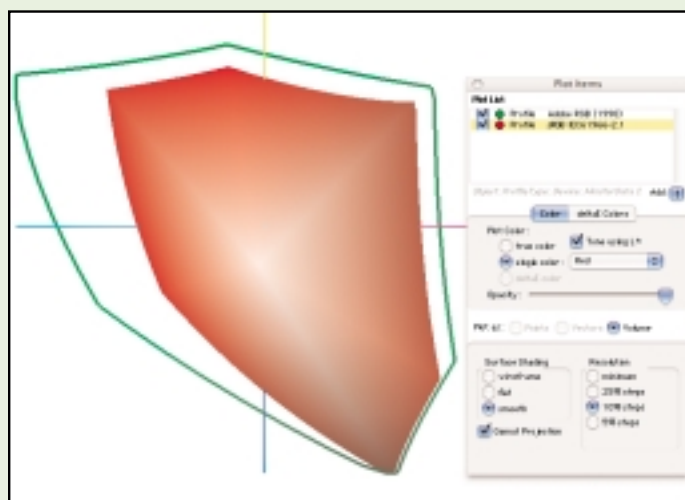


Figure 2. A 2D map of sRGB in Red, and Adobe RGB 1998 (outlined in green) on top of each other. The best way to see all the areas of a color gamut is to view them in 3D, which isn't possible in print. Some utilities, such as ColorThink (www.chromix.com), allow one to view the entire gamut of these spaces in 3D and rotate them to see where they fall in and out of gamut. Nevertheless, even in 2D, one can see how the sRGB working space is smaller and thus contains fewer colors than Adobe RGB 1998.

editing spaces, or the Adobe Working Spaces; e.g., sRGB, Adobe RGB 1998, ColorMatch RGB and so forth.

These colorspaces are not based on any actual devices; rather, they are synthetic colorspaces. A file in an RGB working space has several advantages. First, users can, with an ICC profile, convert that RGB data to any other colorspace they wish, while keeping the original in the working space for any number of further conversions. In addition, in all RGB working spaces, if a file has equal values of red, green and blue, those values will be neutral (e.g., 55R/55G/55B = neutral), as are *any* three equal amounts of RGB. This is not necessarily true with other colorspaces. A CMYK color space is by its very nature an *output* or *print* space, and you cannot depend on any four values to produce a neutral. Each CMYK output space will have a different set of values that can produce a neutral in print. But, when doing actual color corrections, knowing that R=G=B always produces neutral gives you a great deal of control within Photoshop. Using a neutral eyedropper in Levels or Curves, for example, ensures producing a neutral value (Figure 1).

RGB working spaces should be thought of as the digital archives. That is, once a file has been converted into an RGB working space and corrected for best appearance, it can be saved and used for all subsequent conversions for output to any device you might need. A file in a working space can be converted dozens of times for a dozen different print needs.

There's some debate about the "best" working space to edit in, but in reality, there is no such beast. The difference among the Photoshop RGB working spaces essentially boils down to the color gamut of each. Think of the color gamut of a working space as the volume of color it can contain. The sRGB space has a significantly smaller gamut than Adobe RGB 1998 (Figure 2). Ideally, we want to edit images in a working space

that fully contains all the colors our capture devices can produce and all the colors we hope to eventually reproduce.

This might lead you to believe that the working space with the largest gamut is always best, but it's not necessarily so, for two reasons. First, displays have a fixed color gamut, yet there are RGB working spaces with a larger gamut. In such a space, a file could contain colors we can't actually see! While editing the file, you could be adjusting colors that don't appear to be changing onscreen, since these colors fall outside the display's gamut.

Second, the larger the gamut of the RGB working space, the more dangerous it becomes to edit in only 8 bits per color channel, as we have to divide all the colors within just 256 steps. But large gamut editing spaces are appropriate for working in more

than 8-bit color (16-bit color) to avoid banding and posterization. Ideally, you pick a working space that allows the widest gamut of colors you can use today and in the future, while understanding the limitations. While Adobe RGB 1998 should not be considered a standard space, most users find it contains a sufficient gamut for most output needs, while having only a slightly larger gamut than the monitor can display. The sRGB space is also widely used, but the downside is that most capture and output devices are capable of producing a wider gamut than this space contains.

At this point, just keep in mind that we eventually want to bring our image files into an RGB working space for editing and archiving, and from there, use ICC profiles for each and every output device we intend to use. □