



The Conceptual

It is important to understand color management conceptually before working with it. The illustration below represents the color management process with an image file and the three basic types of devices that are used with it: an input device, display and printer. The arrows represent color space conversions that occur as we manage color between devices.



Every device interprets color differently. The ICC (International Color Consortium) workflow uses ICC profiles for each of these devices to define their color biases, limitations and gamut.

The input profile, applied to an image coming from a digital camera or scanner, interprets the

color for that device's unique characteristics and yields an image that accurately represents the colors of the original. When an image is displayed on screen, the display's profile is used so that the image's color is displayed as accurately as the display is capable of. In the same manner, a printer's profile is used to make the best print the printer is capable of that matches the actual colors in the image file. Displays and printers are, essentially, both output devices and their profiles are used to convert images to their color spaces.

Independent of device color spaces is the concept of a working space, which is also defined with a profile. The working space is the color space within which all Photoshop retouching work is done and defines the math by which adjustments (like Curves, Hue/Saturation, Blends, etc.) are done.

Every image file should be tagged with the image's working color space. This profile gives meaning to the otherwise arbitrary RGB or CMYK values and allows the image's color to be defined in an absolute manner. The concept that *an image has color that is independent of devices it is used with* is an important one to understand as it is the basis of device independent color management.

Color management is all about maintaining an image's appearance and color integrity as it is used with a variety of devices. Intelligent color space conversions, represented by the arrows in our illustration, are the essence of color management. We've always worked with these different color spaces but now, with ICC Profiles, we have excellent *definitions* of these color spaces and can make far superior color space conversions because of them. The end result is consistent color output that is superior to that of non-color managed output.

Calibrating and Profiling Devices

In order to implement an ICC color managed workflow, one must calibrate and profile each device used in the workflow. Digital cameras and scanners usually come with usable profiles and Photoshop comes with excellent profiles for sheetfed and web presses that allow many users to get away without custom profiles for these devices. However, calibrating and profiling displays and desktop printers (inkjet, laser, dye sublimation) is an absolute must for color management to work.

In order to get your own devices calibrated and profiled you have three choices.

1) Use **'canned' profiles from the manufacturer.** You might as well forget about getting consistent color if you use canned profiles. Every display and printer and printing environment (humidity, altitude...) is different and requires custom profiles for that device or paper/ink/printing environment combination. Apple's Cinema Displays are the exception to this rule. Cinema Displays are consistently manufactured digital devices that work extraordinarily well with the Cinema Display

profile that comes with any Mac. However, if you have one of these you may still want to recalibrate it to match your ambient lighting conditions. Canned printer profiles can be used to get started with color management and you can always upgrade to custom profiles later.

2) **Buy a colorimeter to calibrate your display and utilize remote profiling services for custom printer profiles.** The ColorVision Monitor Spyder with Optical and the Gretag Macbeth Eye-One Display are two excellent colorimeters for under \$300 that can be used for calibrating displays only. Spectrophotometers costing thousands of dollars are required to generate high quality printer profiles. Stay away from profiling packages that utilize a flatbed scanner to generate printer profiles as only a true spectrophotometer can do this well. There are several businesses that can be found on the internet that offer remote profiling services where you print out a test-chart and mail it to them to be read with their spectrophotometer for about \$100 per profile. Keep in mind you will need to profile each

printer/paper/ink combination you use. Be sure to follow the printing instructions carefully as you will be responsible for buying new profiles should the testcharts be printed incorrectly. Be aware that profiles often need editing so you may consider buying profile editing software should you choose this route.

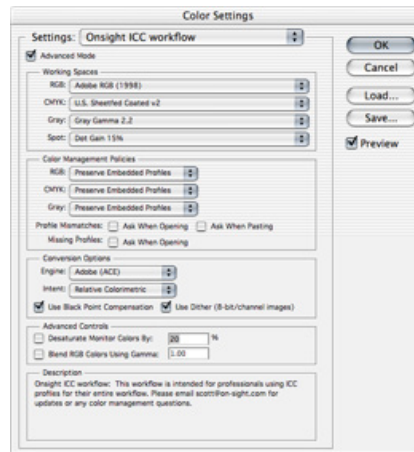
3) **Hire an on-site calibration and profiling service to come to your location and set up your devices using their spectrophotometry equipment and software.** I feel this is an excellent option especially for those needing five or more profiles. For an hourly or daily rate, a color management consultant can quickly calibrate, profile and tweak a large number of devices often for less than what it would cost to utilize a remote profiling service. The consultant is left with the task of buying and maintaining the latest spectrophotometry equipment and can provide one-on-one training and answers to questions while at your location. I started my business, OnSight, in 1999 that does exactly this because I felt it is such an excellent and needed service.

Color Settings

Be sure to set Photoshop's Color Settings appropriately before using images with this workflow. Below are recommended Photoshop color settings for an ICC workflow (you may also download this at www.on-sight.com).

Working spaces: Think of these as default working spaces. You can still open or convert any file into any other space; we are just designating a default here. For the RGB working space use sRGB for images destined for the web and AdobeRGB for everything else. Adobe designed AdobeRGB to be slightly larger than most printing gamuts so it would be an ideal working space for just about any workflow. The whole industry is recognizing the wisdom of this decision and is adopting AdobeRGB as the working space of choice. Choose the CMYK printing method you use most for the default CMYK working space. Gray gamma 2.2 is a good choice for grayscale images since many systems (like Piezography) assume grayscale files come from this color space.

Color Management Policies: "Preserve Embedded Profiles" tells Photoshop to look at each file's profile and open it in that color space. Because it correctly interprets the color



in the file, preserving its true color this option is the best policy for most users. "None" tells Photoshop to ignore any profiles attached to images, assume the default working space and incorrectly interprets the color of files that are in any color space other than the default. "Convert to Working Space" tells Photoshop to look at a file's profile and convert it to the default working space. This might be a good choice if you are a real dictator about having all your files in one color space. I recommend

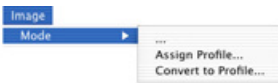
leaving the "Ask When Opening" check boxes unchecked so that your workflow isn't constantly disrupted by annoying "The color space is, blah, blah, blah, what do you want to do?" dialog boxes. You don't need those dialog boxes and can make those color decisions after each file is open.

Conversion Options: I will take a bold step to simplify things and recommend you use Adobe ACE, Relative Colorimetric with Black Point Compensation and Dithering for all color space conversions. In order to keep this techsheet less than 500 pages, I must make some blunt recommendations and save the fun technical discussions for another day.

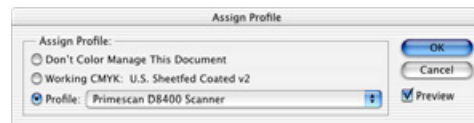
You will also want to look at the color settings for any other applications you work with, including scanner software. If possible, set digital camera and scanner software to work in the same color space you will be using in Photoshop. This will eliminate one color space conversion and simplify your workflow. You can also save your Photoshop color settings as a .csf file and load it into Acrobat, Illustrator, and InDesign so that they manage color in the same way Photoshop does.

Using the ICC Workflow in Photoshop

You are about to become intensely familiar with two of the coolest features in Photoshop that you may not have used before or known they were there: "Assign Profile" and "Convert to Profile." You may want to assign F keys to these features for quicker access to them.

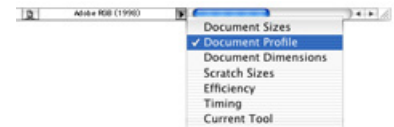


"Assign Profile" allows you to assign a profile to untagged images that aren't yet associated with a profile. If the image is assigned, it's profile will be selected. If the image is untagged it will display "Don't Color Manage this Document" (even though there is no such thing as not color managing in Photoshop). Assigning a profile to an image merely tells the application how to interpret the color in the file, but the photographic information isn't changed at all. The numeric color values for each pixel aren't changed but with the profile these numbers can be interpreted in an objective way. The working space acts as a default color gamut that is assumed when an image is untagged so you won't see any change when assigning the working space to an untagged image. Use Assign Profile to assign input profiles to untagged images, as in the example below where a custom scanner profile is being applied to a fresh scan.

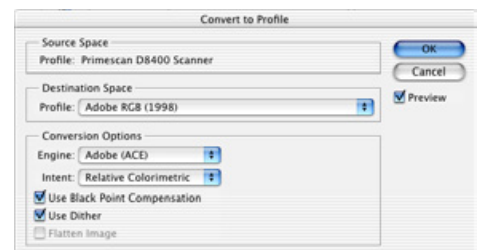


Let me stress the fact that you only need to use Assign Profile for untagged images. If all your image files already have profiles, as in an ideal workflow, then you may never need to use it.

FYI, Adobe's use of the words "tagged, assigned, and embedded" essentially have the same meaning so don't get confused by the lack of consistent terminology. I recommend setting the window's status area to "Document Profile" as illustrated below, so that you can immediately see what profile is tagged with each image.



Once the input profile is applied to an image, the next step is to convert it to the working space using "Convert to Profile." In the example below the newly assigned scan is converted to the working space. Feel free to preview a conversion using any combination of settings and choose what is best for any given image. Again, I recommend you use Adobe ACE, Relative Colorimetric, Black Point Compensation and Dithering anytime you see these options.



Convert to Profile is also an ideal tool for converting RGB files to CMYK. Convert to Profile allows you to designate what CMYK space and separation settings you wish to use all in one place. This eliminates the need to specify the default CMYK working space when converting files the old fashioned way using Image>Mode>CMYK Color. I recommend doing all your CMYK conversions in Convert to Profile and, for that matter, all other color space conversions.

All Photoshop retouching and composition work should be done in this working space and converted to the printing space at the time of printing.

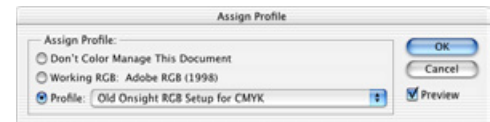
Using Legacy Files

The ICC workflow is fully compatible with files that were previously color managed “the old fashioned way.” The old-fashioned way of managing color was to limit the color gamut of a working space to match that of printing process. Many of us would even tweak primary x and y coordinates to make a custom RGB space that gave us what we thought were great results until we adopted ICC workflows. So, if you have been working with files in this old-fashioned way and were happy with the color you were seeing, you can continue to work with those same files in an ICC workflow without having to rework the color on them.

To maintain color accuracy with untagged legacy files, simply assign the old working space to it. You will need to refer to the previous color settings that were used when that file was worked on. If you know, for example, that you worked on an image in Photoshop 5 with ColorMatchRGB selected as the RGB colorspace in the color settings, then simply assign ColorMatchRGB to that file. In the example below, I’ve saved a previously used custom RGB color space as “Old Onsignt RGB Setup for CMYK” so that I can assign it to my legacy files that were made using that working space.

Once the input profile is applied, you can and probably should convert it to your working

space (most likely AdobeRGB). Be aware that if you are converting any legacy files with adjustment layers, layer effects, or layers using blending modes, converting them to the new working space without flattening will cause these layers to act differently than the way you intended. If you need to maintain legacy master Photoshop files with these layers, then it is probably best to assign its input profile and not convert it. This would be the exception to the rule about converting everything to your working space.



Display Proofing

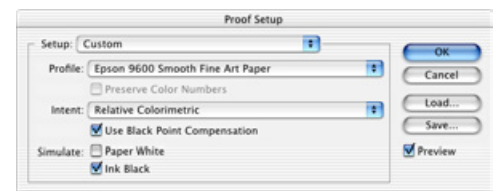
Display proofing (also known as *soft proofing*) can be extremely accurate when properly color managed. In the diagram on the first page, the display and printer are using their profiles to reproduce the colors of the image file as accurately as they are capable. That being said, the display’s larger gamut is usually able to reproduce the image’s actual color more accurately than the printer so that what you see on screen is not what you get when you print. Making the display simulate the way an image will print is where Photoshop’s

Proof Colors feature is used to limit the display’s gamut to that of the printers.

With an image in any color mode, choose Proof Setup to activate display proofing. Proof Setup defines what printing method the display should simulate.



Use Proof Setup’s Custom feature to select any printing process for which you have a profile.



Desktop Printing

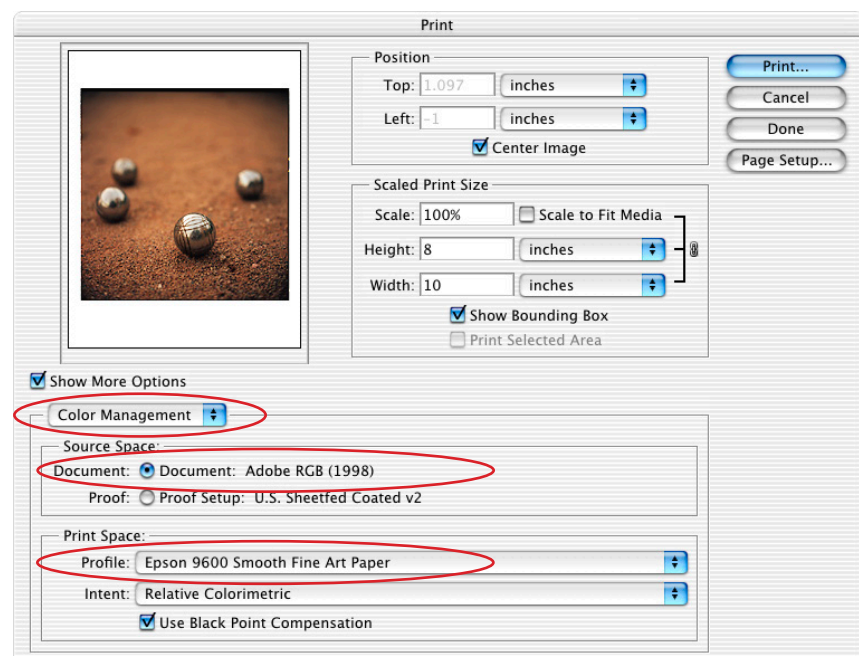
An image file must be converted to the printing space when printing. Sounds easy enough, right? Manufacturer’s printer drivers often cloud this simple path with lots of features like ‘Automatic,’ ‘Color Control’ and ‘Colorsmart.’ Photoshop lets us make the necessary color space conversion while printing, eliminating any need for the manufacturer’s silly printer driver adjustments. Color correction should be done prior to printing, not at the time of printing.

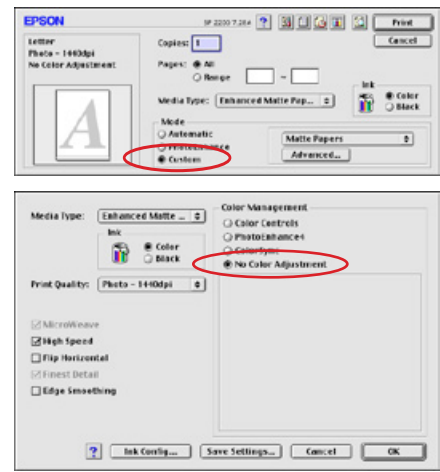
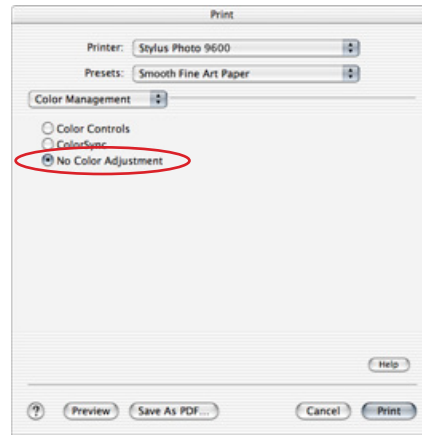
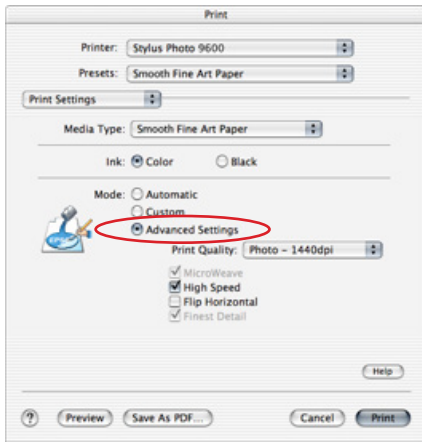
Photoshop 7’s Print With Preview dialog, illustrated below, demonstrates how this conversion takes place. Notice that the document’s input space is selected and the printer’s custom profile is selected as the print space. Since the file will be converted to the printer’s native color space, you may print from a file in any color mode, including CMYK.

At this point the file is ready to print as long as the printer driver doesn’t adjust the color any further. Printer driver settings should be set to the correct media setting (which is basically a total ink limit), paper size and no color adjustment, as illustrated below with Epson’s OS X and OS 9 drivers. You may

choose different media, resolution and High Speed options than you see listed here but you must choose “Advanced Settings” and “No Color Adjustment”. If using the OS X

driver, I suggest saving Presets for media types you use most often and be sure to match this with the printer profile chosen in Print With Preview.



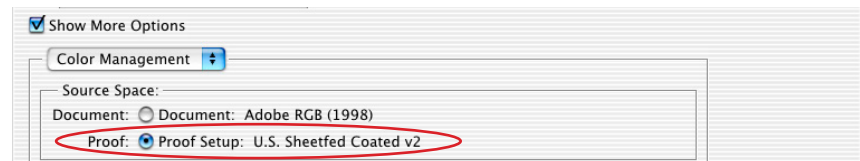


Desktop Printer Proofing

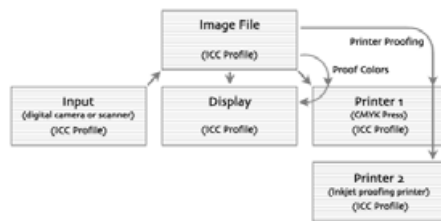
Super accurate press proofs should be left to high-end proofing RIP's like Bestcolor's Screenproof or PerfectProof's ProofMaster. However, Photoshop, Illustrator and InDesign all allow us to make 'pretty darn good' proofs directly from these applications without a RIP.

With an image in any color space, activate Proof Colors with the setup of the printing method you wish to simulate. Print the image using "Proof" as the document space instead of Document and choose your custom printer profile as the print space.

If you would like your proof to simulate the final printing process' paper white, then choose Absolute Colorimetric. This would be the one exception to the rule about using Relative Colorimetric for all color space conversions.



Here's the same color management workflow illustration updated with display and printer proofing features.



Note: Please accept my apologies for not being completely equal and including Windows screen grabs. I have left these out for the sake of keeping this tech sheet within these few pages. Of course, everything in this tech sheet works on any platform and the difference between the interfaces is merely aesthetic.

Thank You! Good luck on your journey with color management! I think you will find it to be an empowering and worthwhile endeavor. Let me know if I can be of assistance – Scott.

About the Author: Scott Martin

With over fifteen years experience with digital imaging technology and a passion for fine art photography, Scott Martin brings a combination of deep knowledge and craft to color management, digital photography, proofing and digital workflow issues. His consulting company, OnSight, assists businesses migrating to fully color-managed workflows utilizing custom ICC profiles throughout their environment and provides photographers, art directors and print shops with in-house high quality proofing solutions that surpass matchprint quality. In addition, he provides one-on-one training covering high-end production techniques designed to attain the highest level of efficiency and image quality. Scott has a degree in Digital Photographic Imaging, is an Adobe Certified Expert, a Texas Photographic Society board member and has worked with some of the best photographers, ad agencies and printers in the industry.



Scott Martin

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