



Color Management Field Guide

How to install and apply profiles for accurate
color management

Photoshop 7.0 and CS for Macintosh and Windows version

By: Steve Upton and Mike Cummings
Revision 3.0

May 6, 2004

entire contents
© 1999-2004 CHROMiX

CHROMiX
www.chromix.com
techsupport@chromix.com
9594 1st Ave NE, #390
Seattle, WA 98115 USA
206-985-6837 fax: 206-526-8278

Introduction

Welcome to the CHROMiX Color Management Field Guide.

We have supplied basic instructions on how to setup Adobe Photoshop and use profiles for matching and simulation. These instructions are for illustration only. Any other use of profiles is outside the scope of this document and we suggest you obtain additional training and consulting to ensure you are getting maximum benefits of ICC color management. CHROMiX can help in each of these areas. Please call us at 1-866-CHROMiX (247-6649), email techsupport@chromix.com, or visit our website at www.chromix.com for more information regarding our products and services.

The following procedure contains specific examples of converting a scan, matching and simulation using **Mac OS X, Mac OS 9, Windows 2000** and **XP**, and Photoshop 7.0.x or CS.

Please realize that ICC profiles and color management can be applied in many different ways and the techniques differ from workflow to workflow.

Setting Up Your Computer

1. *Get the Software.*
 - Mac** – OS X (10.1 or higher), or OS 9. This should include everything you need with the exception of Photoshop 7 or higher, which we assume you are using.
 - Windows** – The version of ICM included with Windows 2000 or XP should be sufficient. Windows NT does not include ICM and is not generally suggested for color work. Photoshop will run on NT, however monitor calibration may not work as desired.
2. *Calibrate & Profile your Monitor* – Use either the "Monitors and Sound" (**Mac OS 9**) Control Panel, "Adobe Gamma" control panel (Windows), or "Color" under "System Preferences" in **Mac OS X** (please do not use more than one of these) to calibrate and profile your monitor. Any of these methods will do a fair job of setting up your monitor and saving a profile to be used within Photoshop. Please follow the instructions that came with the software for more information. For best results, monitor profiling hardware and software should be used. Your monitor phosphor colors and the desired white point color temperature can only be set accurately with a device reading directly off the glass. For more information, visit our online store www.colorgear.com and refer to the information regarding monitor profiling and calibration.

Installing Profiles

Mac OS X - Your ICC printer profile can be placed in one of two locations: If you want system-wide access to the profile (i.e. all users), it belongs in /Library/ColorSync/Profiles. To find this folder, double-click your hard drive icon, then "Library," "ColorSync," and "Profiles." Drag the profile into this folder.

If you would prefer to make your profiles available only to one user, enter that user's home directory (Choose Go → Home in the Finder), then "Library," "ColorSync," and "Profiles." Drag the profile into this folder.

Mac OS 9 - Your ICC printer profile needs to be in the "ColorSync Profiles" folder in your "System Folder" in order for the MacOS to use it properly. Drag the profile into this folder directly or, if you are using

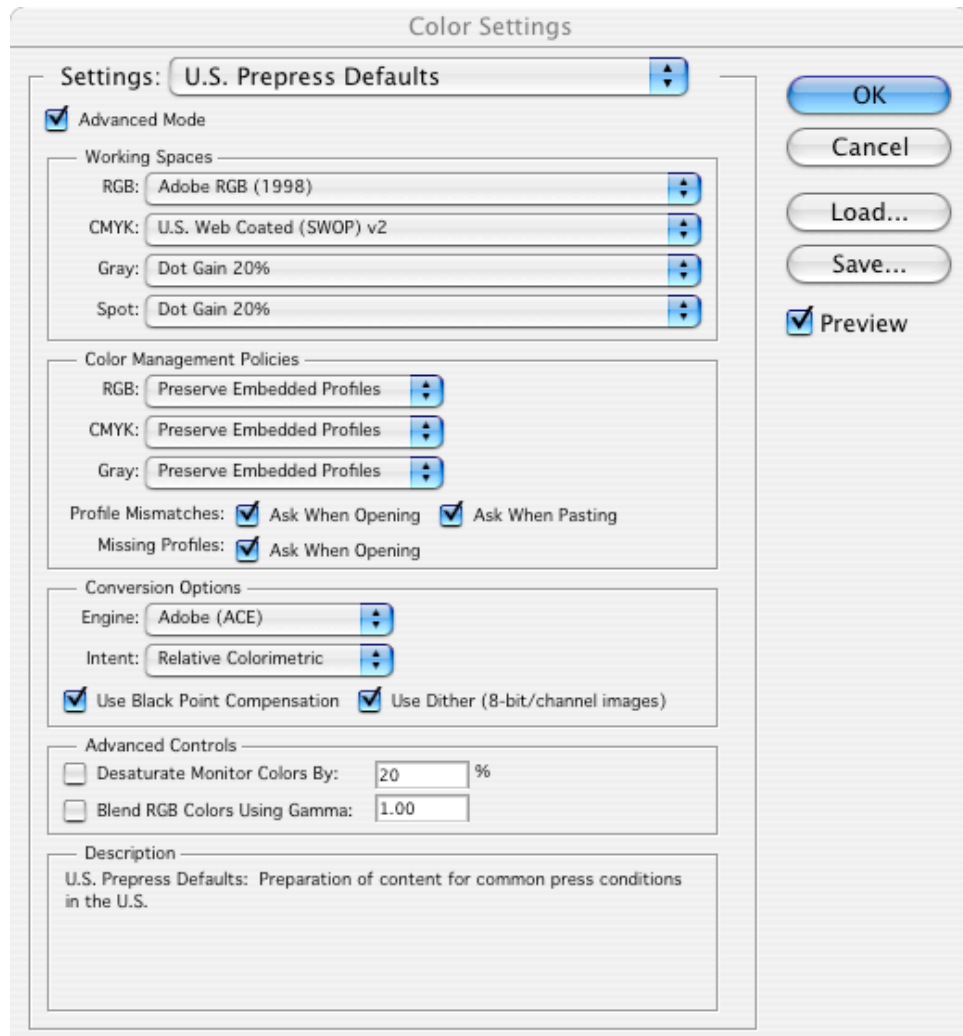
MacOS 8.5 or later, you can simply drag the profile onto the closed "System Folder" icon. The Finder will place the profile in the correct location automatically.

Windows - Your ICC printer profile needs to be in the "\WINDOWS\SYSTEM32\SPOOL\DRIVERS\COLOR\" directory in order for Windows and other applications to use it. The easiest way to achieve this is simply by **right-clicking on the profile and choosing "Install."** If this doesn't work for some reason, you may drag the profile into this folder. At CHROMiX we name all profiles with the ".icc" extension. Windows and most applications recognize this extension but some older applications may not. If your RIP or application does not recognize the profile, try renaming it with the extension ".icm".

Set up Photoshop 7 or CS

Color Settings are found in the "Edit:Color Settings..." menu (**Windows/Mac OS 9**) or the "Photoshop:ColorSettings" menu (**Mac OS X**).

Easy Setup (Recommended): Choose "US Prepress Defaults" from the menu at the top of the Color Settings dialog box. These are good all-around settings for any purpose.



If you prefer to set things up manually, follow these steps:

- 1. Select Advanced Mode**
- 2. Working Spaces**

- a. RGB: Select sRGB if you predominantly concentrate on Web work, otherwise we suggest Adobe RGB (1998) as the best all-around working space. It is big enough to contain most colors you may want to print.
- b. CMYK: Select your final output or proofing profile here. If you do not have a CMYK profile, we suggest “U.S. Web Coated (SWOP) v2”.
- c. Gray: leave as-is
- d. Spot: leave as-is

3. Color Management Policies

- a. RGB: Preserve Embedded Profiles
- b. CMYK: Off (good for press-oriented environments where the destination of CMYK images is known to be one device or printing process. Embedding CMYK profiles in every file created can be space-consuming and is often unnecessary)
- c. Gray: Preserve Embedded Profiles
- d. Profile Mismatches Ask When Opening, Ask When Pasting
- e. Missing Profiles Ask When Opening

4. Conversion Options

- a. Engine: Adobe (ACE) – choose another engine if you also want to perform conversions outside of Adobe products.
- b. Intent: Relative Colorimetric
- c. Use Black Point Compensation
- d. Use Dither

We typically suggest using the “Convert to Profile” command which will override these settings. Other color selection commands do utilize these settings and so they are worth setting up properly.

5. Advanced Controls

- a. Desaturate Monitor Colors By: (leave unchecked)
- b. Blend RGB Colors Using Gamma: (leave unchecked)

Remember that the color settings are defaults, and may be manually overridden at any time. **Note that choosing “Color Management Off” in this dialog does not mean you are not applying color management to your printer!** This is a common misperception.

Problems?

If you are unable to find your printer profile in the list try the following:

- Is your profile for an RGB device? If your device is an RGB device you will not be able to select it in the CMYK setup dialog.
- Did you install your profile as described above? Your profile needs to be properly installed for Photoshop and the operating system to find and use it.
- Opening and closing the Color Settings dialog should refresh the profile list. If not, quitting and relaunching Photoshop may update it.

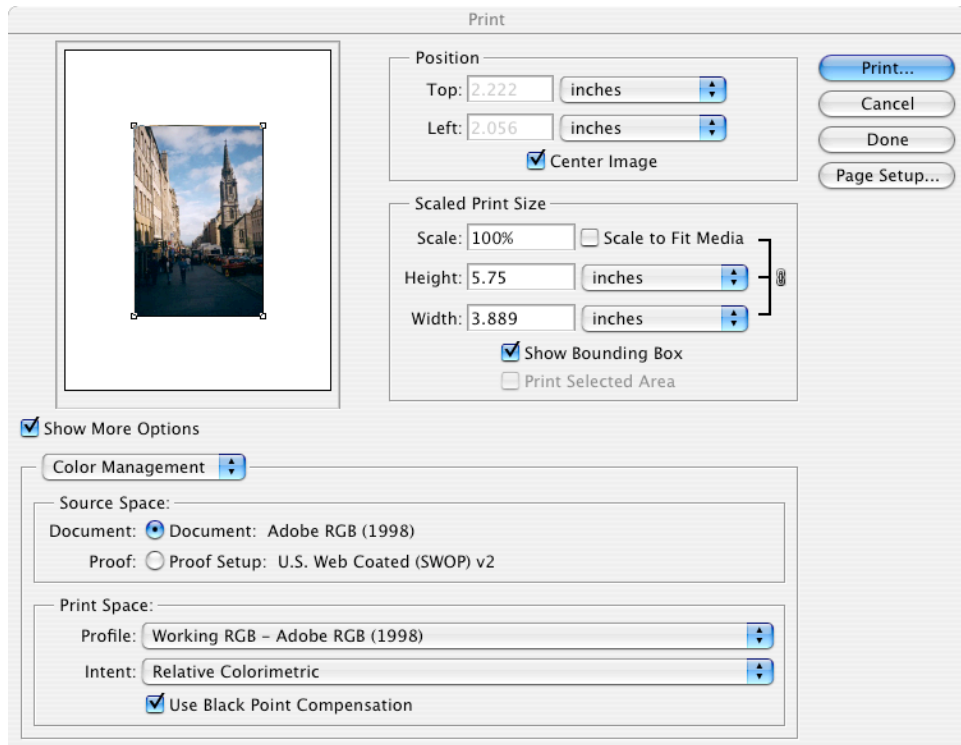
Applying Profiles

Profiles can be used in many ways. When profiles are used to match in this example, the desire is for your printed image to match, as closely as possible, the image on your monitor. Another use for profiles is to simulate another device. Correct application of profiles will allow you to show on your monitor, and on your printer, what an image will look like when printed on a press.

A. Matching Printed Output to Monitor

Use this technique when you want the image on screen to be reproduced as pleasingly as possible on your printer. Due to gamut differences between your image, monitor, and printer, colors on the monitor may not be printable (e.g., saturated blues, greens and reds) and colors not visible on the monitor may appear on the print (often cyans).

1. Open the image in Photoshop
2. Select “File: Print with Preview...”
3. Check “Show More Options
4. Choose “Color Management” from the popup menu
5. Source Space: Document
6. Print Space – Profile: Choose printer profile
7. Print Space – Intent: Perceptual (see note)
8. Print Space – Use Black Point Compensation: checked



9. Click Print

10. After clicking Print, you will have to turn off color management in your print driver, if this has not been done already. On **Windows**, you will be in the print driver's properties window, and under **Mac OS X** you will be in the standard print driver window. Usually there is a setting called "No Color Adjustment," and it's fairly simple to hunt around for it. Since all printer drivers are different, you'll need to consult your printer's user manual if you can't find the setting on your own.

You can also try Relative Colorimetric for the intent for more accurate in-gamut colors. You run the risk of "clipping" out-of-gamut colors though. See "Rendering Intents" later in this guide for more information concerning rendering intents.

Problems?

The printed image does not match the monitor. This is a complicated process and many different settings and other issues could be contributing to the problem:

1. Ensure you have followed all the steps above correctly and in order.

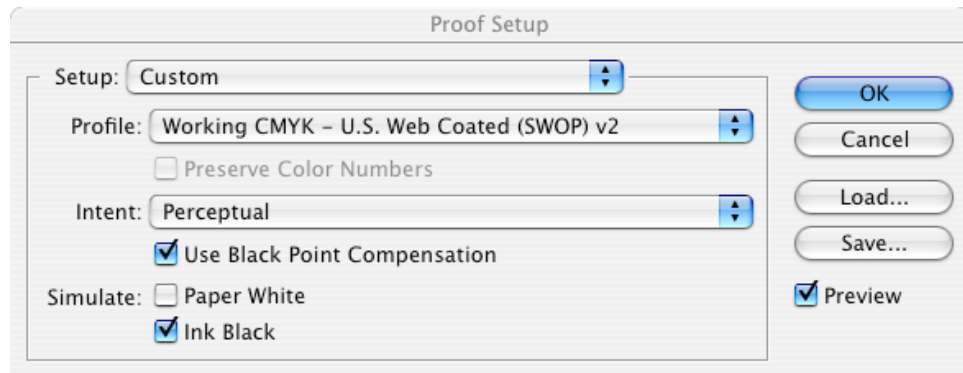
2. Ensure your monitor has been correctly calibrated and profiled as in Setting Up Your Computer above.
3. As your monitor is not “proofing” the printer it may contain colors that cannot be printed. See the simulation section below for more information regarding setting your monitor to simulate your printer.
4. Environmental lighting can have a great effect on the appearance of your printed image relative to the one you see on your monitor. To ensure the most accurate match possible, you should have your monitor calibrated to the D50 standard and the printed image should be viewed under D50 lighting. If you do not have D50 lighting available, you can try D65 (6500) for your monitor and view it in daylight. A simple test to determine if lighting color is causing a problem is to open a window on your monitor with a white background and hold a piece of blank white paper up beside the monitor. If they do not appear the same color then you may have a mismatch between the color temperature of your monitor and that of your ambient lighting.

B. Simulation (Proofing)

This example will simulate a CMYK device, such as a press, on your monitor and your printer.

On Monitor (soft proof)

1. Open the image in Photoshop
2. Choose "View: Proof Setup->Custom..."
3. Profile: Select your press or proofer profile
4. Intent: Perceptual or Relative Colorimetric (See Appendix B for more information on rendering intents)
5. Use Black Point Compensation: checked
6. Simulate: Paper White (unchecked), Ink Black (checked)
7. Click OK



The image on the monitor will be displayed in the gamut of your proofing profile.

You can use a press / proofer profile for this simulation or your printer profile. In both cases Photoshop will display your image as if it had converted through the profile (as in the Matching example above) and then “proofed” back to your monitor.

If the file is already in the color space of the proofer / printer / press and you do not intent to convert the file for printing, then select “Preserve Color Numbers”. Photoshop will then simulate how the image will look when sent to the proofer / printer / press without any further conversions taking place. This is an important distinction.

Experiment with the “Paper White” and “Ink Black” settings to see how the image is affected. Incorrectly measured paper white or black points may produce inaccurate results.

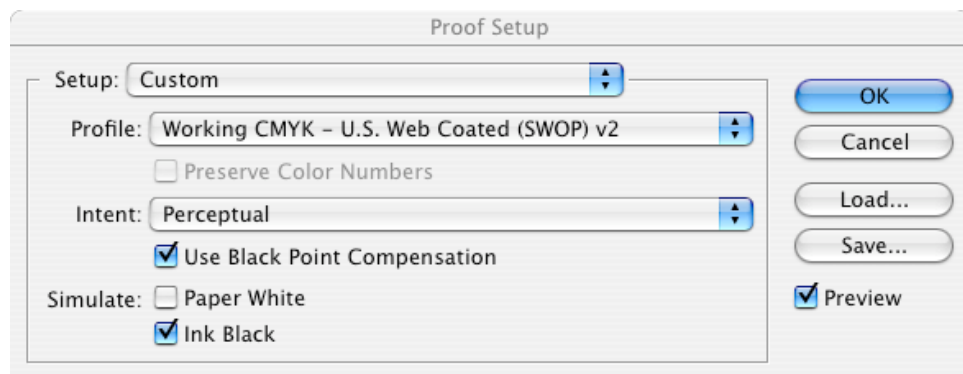
You can click “Save...” to name and save the proofing setup. This setup will then appear at the bottom of the "View: Proof Setup->" menu for use again in the future and also in the printer-proofing technique explained below.

7. Select “View: Proof Colors” to turn off the soft proof feature.

On Printer (hard proof)

(steps 1-6 are repeated from above)

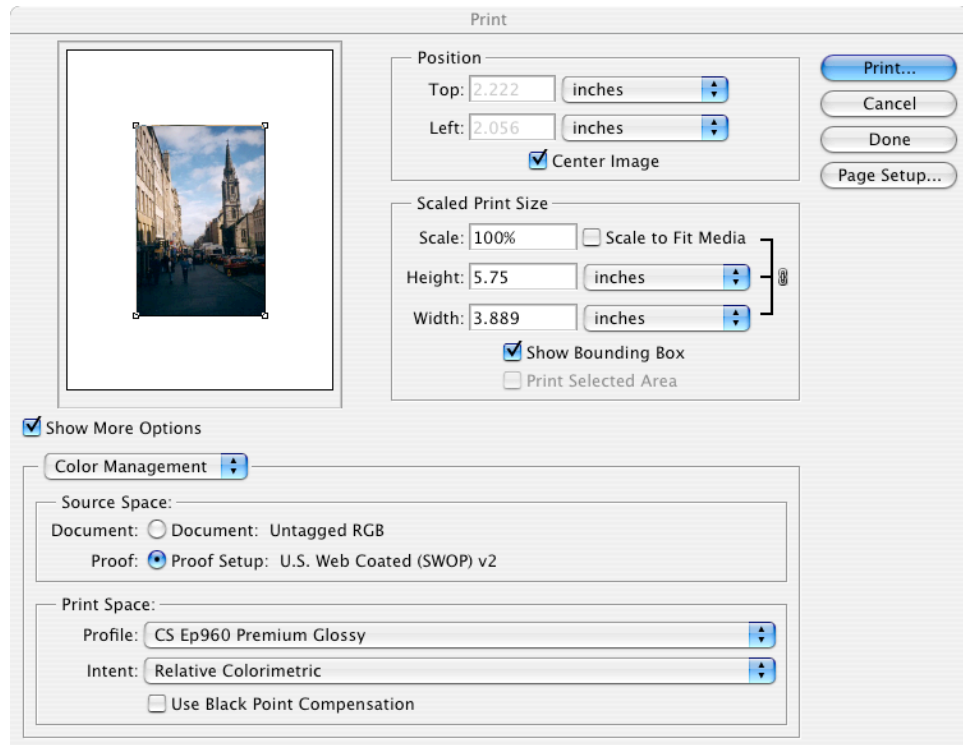
1. Open the image in Photoshop
2. Choose "View: Proof Setup->Custom..."
3. Profile: *Select your press or proofer profile*
4. Intent: Perceptual
5. Use Black Point Compensation: checked
6. Simulate: Paper White (unchecked), Ink Black (checked)



7. Click OK
8. Choose “File: Print with Preview...”
9. Check “Show More Options
10. Choose “Color Management” from the popup menu
11. Source Space: Proof Setup
12. Print Space - Profile: Choose printer profile
13. Print Space – Intent: Absolute or Relative Colorimetric

Note: When you choose Proof Setup in step 11, the rendering intent will default to Absolute Colorimetric. This means the printed image will simulate the gamut and paper color of the proofing profile. If you want to simulate only the gamut and not the paper color, then choose *Relative Colorimetric* for the rendering intent. See Appendix B for more on rendering intents.

14. Print Space – Use Black Point Compensation: unchecked



15. Click Print

16. After clicking Print, you will have to turn off color management in your print driver, if this has not been done already. On Windows, you will be in the print driver's properties window, and under Mac OS X you will be in the standard print driver window. Usually there is a setting called "No Color Adjustment," and it's fairly simple to hunt around for it. Since all printer drivers are different, you'll need to consult your printer's user manual if you can't find the setting on your own.

Photoshop performs a remarkable series of color conversions in this simple printing technique. Say, for example, you want to simulate a Matchprint proof of your RGB image on your inkjet printer. As you print your image with the above settings, Photoshop will convert your RGB

image to Matchprint using the rendering intent chosen in step 4 of the proofing setup. Then Photoshop “proofs” from the Matchprint profile to your printer profile using the rendering intent set in step 9. In this way, Photoshop reduces the colors to those available on the Matchprint, and then faithfully reproduces them on your printer. All without actually affecting your RGB file!

C. Applying a Profile to a Digital Camera or Scanned Image

When an image is scanned into Photoshop using a plug-in, it bypasses Photoshop’s profile-checking function. As a result, raw scanner data is dropped into the current working space and displayed using the working space’s profile. To properly display the image, the scanner or camera profile must be applied using the “Assign Profile...” function.

1. Scan the image using the same settings in place when the scanner profile was built.
2. Select "Image: Mode: Assign Profile..."
3. Select your scanner or digital camera profile from the “Profile:” popup menu.
4. Click OK

Photoshop will assign your profile to the image. It should now display accurately using your monitor profile. Saving the file will embed the assigned profile and enter it into your color-managed workflow.

An important fact to note is that Photoshop does not change the *image RGB or CMYK values* when a profile is assigned. The assigned profile is used when the image is displayed on your monitor and when it is converted for proofing or printing. The Matching and Proofing functions described below, however, may change the RGB or CMYK values in the image.

Legacy and Outside-Source Images

Once you have adopted an ICC-based workflow and color management strategy, you will discover one of the first challenges is dealing with legacy and external images. Any image which has not been part of an ICC workflow and does not have an associated profile is considered a legacy or external image which needs to be properly integrated into your workflow in order to maintain its color fidelity.

The basic strategy is to determine the best approximation of an image's color space and then either convert the image to your current working space or assign the correct profile for later conversion. If the image is in RGB then regardless of how you got it into Photoshop, what you see there will be what you get further along in your workflow (assuming everything else is working properly). For CMYK files, the source profile is often less important than the profile for the proof or the press. The idea is that regardless of where the CMYK was produced, you are probably more concerned with how it will look when sent to press.

Cases:

RGB Images – no profile (Photoshop prior to 5.x and other files)

If the file was created or edited in a version of software that did not use a profile to compensate for your monitor then you can assume it is in your monitor's color space. Use the monitor profile from the computer on which they were created or last edited. Assign the monitor profile to the image. If you have many such images, embedding the monitor profile into the images without conversion will also work. AppleScript (**Mac**) can be a great help in these situations by embedding profiles in entire batches of images. Color Servers will also assign or color-convert batches of images to speed your workflow. The images would then be converted to CMYK for output or your RGB working space farther along in your workflow. Embedding a profile in each file ensures that the file's color data is known and will work correctly in an ICC workflow whenever you may decide to use it.

RGB Images – with profile

As you open the file, Photoshop will note the profile mismatch. In most cases it is best to instruct Photoshop to use the embedded profile. The file can then move through your workflow normally and the profile will be used to convert the image for printing when desired.

CMYK images

Leave them unconverted unless you find conversion is required. Use your press or typical output profile to view them and when proofing as profile. This essentially simulates how the file will appear if sent to that device. If the results are unsatisfactory, then the file may have been separated for a device or printing process quite different than yours. In that case you will want to convert the file to your destination CMYK space. If the file contains a profile, allow the file to convert to your CMYK profile when opening or use “Convert to Profile...” If the file does not have an associated profile then try several different profiles using the “Assign Profile...” dialog with the “Preview” box checked. Most users use Mode->CMYK with default settings when creating CMYK documents. See Appendix C for more information about saving tables from older versions of Photoshop as a profile. Large gamut CMYK space files that you want to convert to small gamut (like ink-jet going to newsprint) may work better if converted to your RGB working space first.

Images "Tweaked" to print correctly

Some images have been messed around with until they look terrible on-screen but print correctly. These orphans of a non-ICC workflow should be considered to be in the printer's color space. If they are not the right file type (RGB images for a CMYK printer) they should be separated using the settings of the old system and then reintegrated using legacy CMYK techniques - see "Extracting Color Tables" for one such technique

Stock Imagery

Most stock agencies that deliver their images in RGB form are now including profiles or making them available through other means. Check profilecentral.com or the stock agency's site for profiles, and then integrate the images into your workflow using the technique described in “RGB Images – with profile” above. If they are CMYK files, treat them as normal CMYK images without profiles as described above.

Outside Scans

- RGB - get the profile for the scanner from the service bureau if you can, then assign the Profile. If you are unable to get a profile, try opening the image and allow Photoshop to assume it is either ColorMatch RGB or Adobe RGB (1998). Experimentation is useful here.

- CMYK - get a profile if you can for the scanner. If not, treat the image as a CMYK Image without a profile as above.

Appendix A - “Uncorrected Settings”

When printing an image that has already been color corrected, it is essential that your program, printer driver, and printer be set up not to perform any automatic color correction.

Printer Driver

If you are using the LaserWriter 8 or Adobe PS printer drivers:

1. In the “Adobe PhotoShop” section of the Print dialog, ensure that “Postscript Color Management” is **unchecked**
2. In the “Color Matching” section, ensure “Print Color:” is set to “Color/Grayscale”
3. In the “Printer Specific Options” section, ensure any color management capabilities specific to your printer or RIP are all turned off.

If you are using other printer drivers or a RIP - refer to the documentation for your software to determine how to disable or bypass any color correction that may be taking place.

Note: If you are using a RIP or other device that allows calibration, (check your documentation to see if your device can be calibrated) ensure that it has been calibrated using a standard procedure. For color laser copiers and many other output devices, regular and correct calibration is *essential* to using profiles that remain valid over time.

To ensure the best results:

1. Print the image using the same settings that were used when the optimization target and the profile target were printed.
2. **Take notes** – enough time may pass between printing the optimization target, profile target, and your profile-corrected images that you could forget the settings you used originally. Consistency is one of the most important aspects of managing your color and that includes using the same procedures and settings each time you print.

Appendix B - Rendering Intents

As your image moves from the color-rich RGB working space out to your printer or press, many of the more saturated colors cannot be reproduced and require conversion. The method by which the conversion takes place differs depending on the content of your image. As a result, software manufacturers have left this setting up to you. The names of these methods, called rendering intents, differ slightly from program to program.

If the total gamut of your image is inside the color space that you are converting to (say Lambda RGB), then the conversion is a fairly straightforward mathematical color transformation. If, however, you have colors in your image which fall outside the gamut of the destination color device (color space), then you need to tell the software which method to use to bring those colors into gamut in the most pleasing way possible. This tends to depend on the image's content.

Bear in mind that these are general suggestions. It doesn't hurt to experiment. In some cases the Saturation or Relative Colorimetric intents give very good results with photographs, for example.

Photographs and other natural continuous-tone images:

Here you should generally use the “**Relative Colorimetric**” (sometimes called “**Logo**”) rendering intent. This will give you the best rendering of in-gamut colors, and with modern large-gamut inkjets this is important. If you find a loss of shadow detail, try “**Perceptual**” (sometimes called “**Photographic**”). In this rendering intent, all the colors in your image might be modified and the software moves them all “inward” (reducing their saturation) in a fashion that tries to preserve the relative differences between the colors. This means that bright red dress has all the subtle red details preserved rather than all turning the same color of red and losing detail. The drawback to using perceptual intent is that it tends to make the image look flat.

Business graphs:

Use the “**Saturation**” (sometimes called “**Graphics**”) rendering intent. This will preserve saturation above other color qualities and will map the out of gamut colors to the very edge of the gamut, making them as saturated as possible for that device. This is good for making sure the red, yellow, blue, etc. in the pie charts are bright and attention grabbing, although they may not be too accurate as far as lightness or hue is

concerned. In some applications, where bright color is more important than accurate color, this intent may work well with photographs, too.

Business Logos or Spot colors:

Use the "**Relative Colorimetric**" rendering intent. This is designed to convert the colors that are in-gamut as accurately as possible (it does not move them at all in terms of saturation, lightness or especially hue) and map the out-of-gamut colors to the closest in-gamut color possible. For instance, if you are using spot colors for a business logo and the color is in-gamut for your target device, it will recreate those colors as closely as possible on the target device (and if you have a good profile, you can get very close).

Proofing (simulating one device on another):

If you are trying to simulate a press on your printer, for instance, use the "**Absolute Colorimetric**" (sometimes called "**Proofing**") rendering intent. This will simulate the white point (paper color) of the final device on your proofing device. To have your photo print the way it will look on newsprint, for instance, use the *perceptual* rendering intent to convert it to the newsprint color space (to maintain the best color renditions you can). Then use the *absolute colorimetric* rendering intent to convert the newsprint colors to your printer's colors. Your printer will actually lay down a light shade where "white" should be, thereby simulating the color of the newsprint paper on your bright white proofing paper.

Special Notes:

1. The mapping in the perceptual rendering intent (all intents actually) is setup at the time the profile is made, NOT when your image is getting converted. So, even if all your colors are in-gamut the perceptual rendering intent may remove saturation from your image (see next note)
2. If you have a continuous-tone image which is entirely in-gamut for your target device, you can use the "Relative Colorimetric" rendering intent to perform the conversion instead of perceptual. This will map the colors as accurately as possible to the destination device, without reducing the image's overall saturation. Use Photoshop's gamut warning feature to see if your image has out of gamut colors.
3. The ICC defined these different intents a little loosely and left the interpretation of them open to the software manufacturers. Each profile contains the information required to perform each type of rendering

intent but they may all do it a little differently. It is worth experimenting between different vendor's profile making packages to see which is pleasing to you.

Appendix C

– Exporting Photoshop 5 Color Spaces

Photoshop 5.x has color spaces that are defined by profiles internally. The RGB working spaces and CMYK tables can be saved out from the program for use elsewhere. This can be handy if you want to convert an image to your working space in scanning software or if you want to use Photoshop's built-in separation tables as a source profile for bringing legacy CMYK images into your workflow.

Saving RGB Working Space Profiles

- Select “File: Color Settings->RGB Setup...”
- Select working space you would like to export for “RGB:”
- Select “Save” and name the resulting and place it in the ColorSync Profiles folder in your System Folder.

Note: Photoshop will need to be quit and re-launched in order to list and use the newly-created profile (or any profile that has been added to the ColorSync Folder when Photoshop was already running).

Saving Photoshop's Built-in separation tables as a CMYK profile

1. Select “File: Color Settings-> CMYK Setup...”
2. Select the “Built-in” radio button for CMYK Model
3. Select the “Tables” radio button for CMYK Model. It is important to perform steps 2 and 3 in order, as Photoshop will then load the Build-in settings into the Table area in a form that can be exported.
4. Select “Save” and name the resulting file “Photoshop Build-in Tables” and place it in the ColorSync Profiles folder in your System Folder.
5. Select the “ICC” radio button for CMYK Model.

Note: Photoshop will need to be quit and re-launched in order to list and use the newly created profile (or any profile that has been added to the ColorSync Folder when Photoshop was already running).