

Basic Photoshop Color Management – An Overview

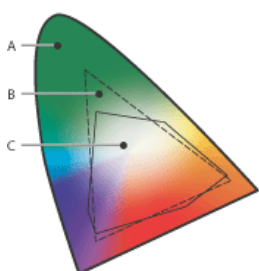
What is Color Management?: a process to identify the actual color of a pixel from its data value within an image file

Why Color Manage?: to predict how colors seen on a monitor will appear on a print or on a different monitor

What Color Management will not do: duplicate exactly all colors seen on a display onto a print

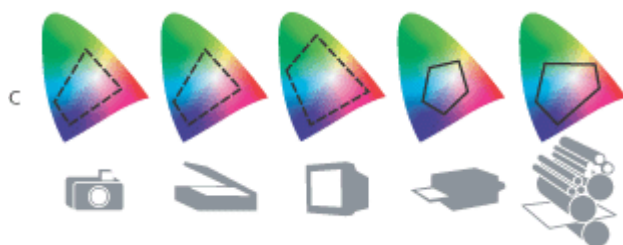
Several important definitions:

- **Color Model:** a method to describe the visible spectrum of color
 - **Device-independent Color Model:** LAB – a fixed color space related to how humans perceive color
 - **Device-dependent Color Models:** RGB (display), CMYK (printer), HSB – can have many color spaces depending upon the device it is associated with
- **Color Space:** a variant of a Color Model that assigns color data values to specific colors
 - **LAB Color Model:** LAB Color Space (LAB Model and LAB Space are the same)
 - **RGB Color Model:** sRGB, Adobe RGB, etc. (note: R200/G200/B200 may be a data point defined in each color space but it represents different colors in different color spaces)
- **Gamut:** the range of colors contained within a color space



The gamut of various color spaces:

- A: LAB Color Model contains all visible colors
- B: RGB Color Model
- C: CMYK Color Model (note that certain CMYK colors are not found in RGB)



The typical gamuts of various devices compared to LAB (left to right):

- Camera Color Space
- Scanner Color Space
- Display Color Space
- Ink Jet Printer Color Space
- Printing Press Color Space

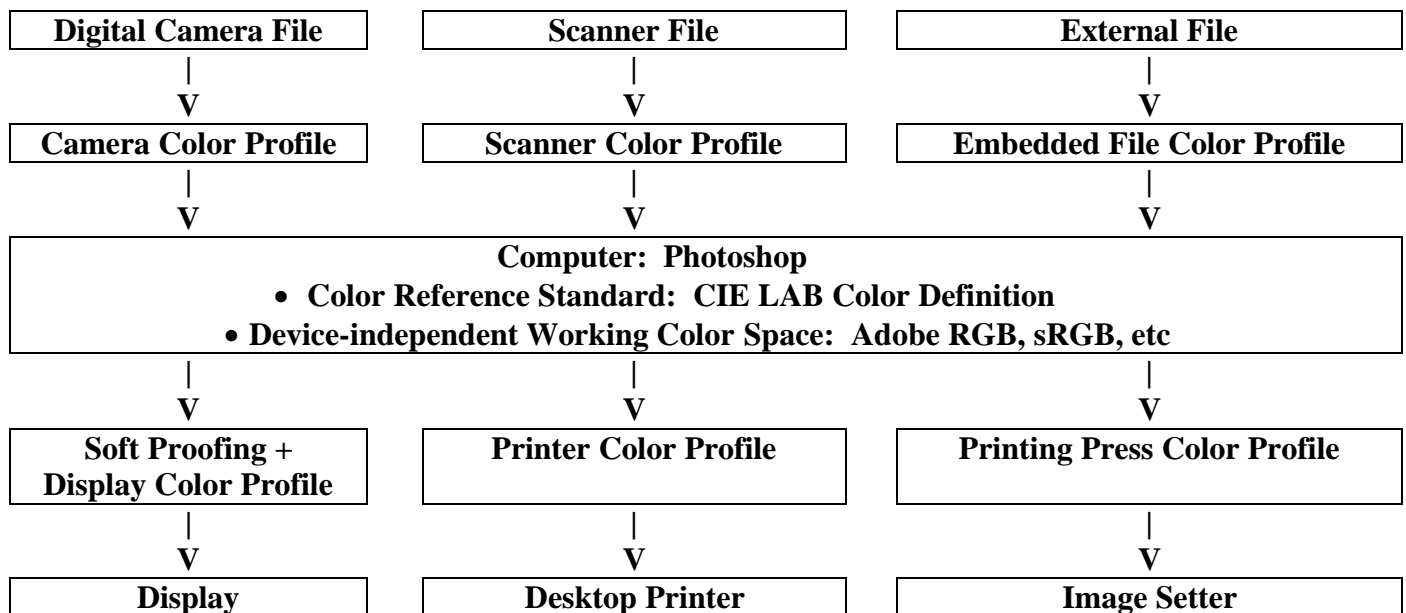
- **Color Profile:** a mathematical definition of a color space (e.g., Epson 2200/Matte paper color profile); color profiles may be calculated or obtained from manufacturers
- **Rendering Intents:** the method used to convert color data from one color space into another color space, especially when a source color is not found in the target color space
 - **Perceptual:** source colors are scaled to fit within the target color space; colors may be modified but the relationship between colors remains unchanged – best for photographic images with many out-of-gamut colors

- **Relative:** source colors within the target color space are not changed; source colors outside of the target color space are mapped to their nearest in-gamut color, usually with less saturation and a lighter color – best for photographic images with few out-of-gamut colors
- **Absolute:** source colors within the target color space are not changed; source colors outside of the target color space are mapped to their nearest in-gamut color - the color white may not be mapped correctly; not too useful
- **Saturation:** convert colors attempting to maintain maximum color saturation – best for business graphics and charts; not for photos

How about a real-world example: R255/G0/B0 is red. On a monitor, R255/G0/B0 produces the maximum red that the monitor can produce. On a print, R255/G0/B0 is the maximum red that the printer can produce, which is very different from the red displayed on a monitor. In this specific example, R247/G3/B0 might be the proper monitor value to produce the maximum red of this printer.

What can be done?: create a standard, an ICC Color Profile, for representing specific colors, the CIE LAB definition, and use this standard to modify image data to produce expected colors.

How do I do this?: for each device in the photographic process, assign an ICC Color Profile and convert all external image data into and out of this standardized definition of color.



Example: Digital Camera to Printer Workflow

1. The user opens an image file from a digital camera in Photoshop, notices that the camera did not assign a color profile, and assigns the Adobe RGB Color Profile (the image file data is not modified)
2. Photoshop uses the Display Color Profile to modify the Adobe RGB color data as it is sent to the display (the original image file data is not modified).
3. Photoshop uses the Printer Color Profile to modify the Adobe RGB color data as it is sent to the printer (the original image file data is still not modified)

Result: Although different data is being sent to the monitor and the printer, the resulting colors should be the same (at least in theory)

How do I change an image file's Color Profile?

- Image > Mode > Assign Profile: image data is not modified but displayed colors may change, the options are:
 - Don't Color Manage: discard the file's color profile (i.e., file is now "untagged")
 - Working Profile: assign the Working Color Profile (e.g., Adobe RGB)
 - Profile: assign a specific color profile
 - Preview: check to see if the colors change when Assign Profile is used
- Image > Mode > Convert to Profile: image data is modified in an attempt to retain original colors
 - Profile, Engine, Intent: specify how the image data is to be modified

This doesn't sound too hard, what's the big problem?: getting accurate color profiles is difficult. Let's look at specific color profiles.

Working Color Profile: the device-independent color profile use by Photoshop; all input data is converted to the Working Color Profile and all output data is converted from the Working Color Profile

- Adobe RGB has a wider gamut than sRGB and is thus a more general purpose solution
- sRGB may still work well especially if the input file is sRGB

Digital Camera's Color Profile: check the user's manual; many cameras do not specify a color profile in the data

- If a color profile is not specified, assume sRGB
- If a color profile is specified, use that profile
- If multiple color profiles are available in a camera, use the profile with the largest color space (Adobe RGB has a wider color space than sRGB)

External File's Color Profile: a color profile encoded within the file

- If a color profile is encoded within the file, leave as it or convert to the Working Color Profile
- If a color profile is not available, assign the Working Color Profile – this may not be accurate but it's the best you can do
- If a color profile is not available and you don't assign the Working Color Profile, the image is displayed as if the Working Color Profile was assigned but be careful using the file on another computer as the colors may be totally different

Display's Color Profile: calibrate the monitor to get a color profile

- Have surroundings painted gray and try to have uniform daylight-balanced ambient lighting
- Set CRT to 6500°K, degauss, and let warm up for at least 30 minutes; set Gamma = 2.2 for PC or Mac
- If you have profiling hardware, use it to create a display color profile; consider the GretagMacbeth Eye-One Display color management system (about \$250)
- If not, use the Adobe Gamma (PC) or ColorSync Monitor Calibrator (Mac) software to create a display color profile (and hope for the best)
- For a CRT, profile weekly, or at least monthly
- For a LCD, profile every 6 months

Printer Color Profile: you need a profile for each printer and paper combination

- If you have profiling hardware, use it to create a printer color profile; consider the GretagMachbeth Eye-One Photo color management system (expensive)
- If not, consider a system where you print a template, mail the print to a calibration company, and install the profile they send back to you
- If not, use the generic color profile provided by the printer's manufacturer
- If this is not available, see if the printer driver can fine-tune the printer's output

Besides color profiles, what else do I have to be concerned about?: ah, glad you asked

- **Out of Gamut Colors:** it may not be possible to convert colors seen on the display into colors produced by your printer
 1. Edit > Preferences > Transparency & Gamut > Gamut Warning: set out-of-gamut color
 2. View > Proof Setup > select the printer's color profile
 3. View > Gamut Warning: out-of-gamut colors are displayed in the out-of-gamut color
 - To reduce the number of colors out of gamut, try adding a Hue/Sat Adjustment layer and reduce the image's saturation
- **Editing Environment:** the color of your room lighting and even the color of your walls and surroundings can effect your perception of color
 - Keep shades drawn to avoid the continuing color change from the outdoors
 - Use daylight lighting about 5000°K
 - Have neutral-colored walls and no brightly colored objects near the work area
 - Set your desktop color to a neutral gray

Can't you just tell me how to set up Photoshop?: well no, this topic is more complex than this discussion can cover but let's offer a starting point

- **Edit > Color Settings (PC) or Photoshop > Color Settings (Mac)**
 - Settings > Custom >
 - Working Spaces > RGB: Adobe RGB (1998)
 - Color Management Policies > RGB: Convert to Working RGB or Preserve Embedded Profiles
 - Profile Mismatches: check both to allow you to be informed of the color space conversion
 - Missing Profiles: check to allow you to decide about the conversion
 - Conversion Options: Adobe (ACE)
 - Intent: Perceptual (for most photographs)
 - Use Black Point Compensation: set
- **File > Print with Preview**
 - Select Show More Options > Color Management
 - Source Space: Document
 - Print Space: Printer/Paper Color Profile (if available – be sure the printer driver is not also managing color) or Printer Color Management (if no printer color profile is available)
 - Intent: Perceptual or Relative Colorimetric
 - Use Black Point Compensation: set

What is Soft Proofing?: a procedure to have Photoshop modify the image data sent to the display so that the displayed image's color simulates the color that would appear on a different output device.

Example: using a PC, see how the image will look when viewed on a Mac

1. View > Proof Setup > Mac RGB
2. View > Proof Colors

Example: see how the image will look when printed on your printer

1. View > Proof Setup > [your printer/paper color profile]
2. View > Proof Colors

Example: see how your image will look when printed at Costco in Goleta

1. Install printer/paper color profile from www.drycreekphoto.com
2. View > Proof Setup > [your printer/paper color profile]
3. View > Proof Colors

Note: be sure to reset Proof Colors when done

How do I really learn Color Management?:

- Book: Real World Color Management
- Take the one-day class from Derrick Bruce, Agave Studio, 805-963-4066 (note: Derrick can also perform color calibration of your display and printer/paper combinations)

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