Contents

Introduction

Color management is required in many areas of the photographic process, from image capture to final print. This guide is intended to assist with each important step along the way.

1) White Balancing for Digital Capture: an essential step for reproducing the desired color of images during shooting.

2) Monitor Calibration: ensures that your monitor is accurately displaying the color of your images and assists with print matching.

3) Soft Proofing: limits the gamut of your images displayed on your monitor to create a closer match to the gamut of the printing process.

4) Color Space & File Management: a necessary step for reproducing colors the way you intended.

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NOTE: The term "gamut" refers to the range of reproducible color which can be displayed, either on your monitor or within a printing or output device.

White Balance for Digital Capture

White balancing is crucial for obtaining consistent, repeatable color in your digital images during capture. Establishing an appropriate white balance setting while shooting can dramatically cut down on the time spent during post production. There are several different ways to white balance images, and the environment/situation plus photographer's preference will determine which method will work best. Before you can understand the process of white balancing, it is important to establish the concept of *color temperature*.

Measured in degrees Kelvin (K), color temperature is a way of qualifying the color of light, and different color temperatures will determine the *color cast*, or predominant hue of your images. Normal daylight measures around 6500 K, and the lower the color temperature, the *warmer* the light tends to be. A sunrise or sunset is approximately 3000 to 4000 K, while candlelight tends to be about 1000 to 2000 K. On the other side of the spectrum, a moderately overcast day is usually between 6500 to 8000 K creating *cooler* light than normal daylight. An overcast day (right before a storm or in deep shade) can have a color temperature of 9000 to 10,000 K.

Various forms of indoor light have different color temperatures as well. Tungsten lighting, produced by many common household light bulbs, is approximately 3000 K. Fluorescent lighting that is commonly found in offices is typically between 4300 and 6000K, and tends to have a green color cast. (There are fluorescent lights available that simulate daylight.) Strobes tend to be a similar color temperature to daylight as well. Because each lighting situation is unique, all of these temperatures are approximations, but this should provide you with an idea of the nature of color temperature in relation to the quality and color cast of light produced.

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So what does all of this have to do with white balances?

The human brain is accustomed to seeing in a color temperature similar to that of daylight, which is considered neutral lighting. If you were to enter a building lit by fluorescent lights after being outside on a sunny day, you probably wouldn't notice much difference in color temperature between the two environments. In reality, there is a substantial difference. You don't usually notice because your brain filters out the color casts in an attempt to reproduce a more neutrally lit environment. This is what occurs when a white balance is performed. The photographer attempts to filter out color casts present in different lighting scenarios to produce an image with neutral lighting.

There are several methods for white balancing a camera, none of which are correct all of the time, and each has its advantages and disadvantages. The sections that follow discuss each of the various methods of white balancing and offer information to help you choose the proper method for white balancing your images.

Auto White Balance

Auto white balance is similar to the auto exposure feature in most cameras. The camera will scan the scene and try to filter out any color casts to produce a neutral image. This method is particularly useful in situations where 100% accurate color is not necessary. It can also be used when the majority of an image is not composed of one color or multiple shades of a particular color, or in situations where the ability to shoot rapidly in any lighting environment is an issue (action photography). Conversely, auto white balance may not produce the best results when the following scenarios arise:

Example 1) When absolute color accuracy is necessary, (as in when shooting for a fashion catalog to correctly reproduce the color of the shirt) auto white balance cannot guarantee accurate colors every time just as auto metering won't always produce the best exposure.

Example 2) Auto white balancing might not produce the best results when an image consists largely of a single color, like this grassy field. The auto white balance mistakes the large amount of green grass as a green color cast and tries to eliminate that hue.

Example 3) For an image of a sunrise or sunset, the photographer may not want to remove the color cast, opting to keep the warm feel. Auto white balancing the image might remove the warmth, making the image look as if it was taken during normal daylight hours.

Preset White Balance

The advantages of using preset white balance function are the same as those of the auto white balance except that scenes with predominantly one color won't fool a preset white balance function. As discussed earlier, certain forms of light fall within a known range of degrees Kelvin. Preset white balancing is designed to compensate for an average color temperature of a known type of lighting condition. For example, an awards ceremony held indoors with fluorescent lighting would be a situation well suited for preset white balancing. If the camera was set to the preset for fluorescent lighting it should filter the scene quite well. There may be instances where the image is not an exact recreation of the scene's color neutrality, however the difference should be fairly insignificant and should not compromise the integrity of the shot. Preset white balancing may not be the best option in situations where absolute color reproduction is necessary or for scenes where the lighting conditions do not match one of the presets offered within the camera's options.

* simulated LCD image ©iStockphoto / Oleg Prikhodko

TIP: Familiarize yourself with your camera's color qualities. Regardless of the manufacturer, all cameras have their own, inherit tendencies when it comes to color cast and image quality. Factors such as sensor type (CMOS vs. CCD), lens filters, age, and make can all contribute to image color casts, and knowing your camera's qualities is the best means of compensating, diminishing, or making the most of them.

Custom White Balance

Custom white balancing is the best option when accurate color reproduction is required, or if the photographer desires the colors in the image to appear as they would if under neutral light. Each camera requires a slightly different procedure to perform a custom white balance, and you should refer to your camera's owner's manual for the procedure. Regardless of the camera, the procedure usually involves photographing a gray or white card under the lighting conditions of the shot. That image is then used to create a custom white balance setting that is applied to the remainder of the images under that lighting condition.

By shooting a gray or white card and allowing the camera filter out any color casts, the photographer ensures accurate color reproduction of his or her scene. Furthermore, the camera won't be fooled by a large amount of a singular color in the shot. Custom white balancing might not be appropriate for scenes where the color temperature is an important part of the shot (i.e. a sunset), or in situations where speed is a factor, as it can be time consuming. This also might not be the best option when lighting conditions are continually changing, hence requiring the photographer to perform a custom white balance every time the lighting shifts. The fashion shoot example on the previous page would be a suitable use for custom white balancing.

TIP: Utilizing a "gray card" can help in the process of setting your white balance. Doubling their usefulness, most gray cards are solid white on their reverse side. We offer our own line of gray cards at Richmond Professional Lab. Please call 800.262.0515 ext. 105 if you would like to purchase a gray card.

©iStockphoto / Jim Pruitt

NOTE: A "raw image file" is one which contains minimally processed data from the image sensor of a digital camera or image scanner (*Wikipedia*). RAW formats differ from each camera manufacturer. Here is a list of RAW file extensions for a number of major camera manufacturers:

- **.dng (Adobe)**
- **.crw** & **.cr2 (Canon)**
- **.erf (Epson)**
- **.raf (Fuji)**
- **.kdc** & **.dcr (Kodak)**
- **.mrw (Minolta)**
- **.nef (Nikon)**
- **.orf (Olympus)**
- **.ptx** & **.pef (Pentax)**
- **.arw** & **.srf (Sony)**
- **.x3f (Sigma)**

Manual White Balance

This option can be time consuming but often rewarding, as it produces the most accurate color reproduction, leaving the photographer with the option to correct for an inaccurate white balance made while shooting. This method requires that all of the images be captured in the RAW format. Whenever possible, it is best to shoot in RAW format because it preserves the most information of any file type. This format also allows more leeway when manipulating the files in post production. **Richmond Professional Lab currently requires that you convert your images to JPEG format prior to sending to the lab. Do not submit RAW files to the lab.**

To begin, photograph an image that contains a neutral object such as a gray card. Then, using a program like Adobe's® RAW conversion software, use the gray balance eyedropper and click on the gray object, creating your neutral gray point. This will remove most of the color cast that might be in the original scene. (If you use a white card in the image, simply use the white balance eyedropper to set your white point.) If done properly, this will produce the most accurate color reproduction. You can then apply those same corrections to the remainder of your images from the shoot. If the lighting conditions changed in the field, you should photograph another image with a gray or white card or other neutral object, then use that image to color balance those shots in the different lighting situations.

Manual white balancing works well in conjunction with a custom white balance. By performing a custom white balance and then photographing a gray or white card, you have created a back up should the custom white balance results be inaccurate. When you review your images from the shoot only to discover that the custom white balance setting was not quite correct, you'll be able to use the image with the gray or white card to save the images from bad color.

Manual white balances are also useful for changing the color temperature of a scene. Perhaps you have an image that was taken on a sunny day with a very neutral cast. However, you would now like to create a "warmer feeling" image than what the original portrays. By manually adjusting the white balance setting, it's easy to create a warmer final image.

White balancing does not necessarily have to produce a neutral image. The process of white balancing is merely intended for the photographer to have control over the color cast of a final image. Manual white balancing can be time consuming, and for this reason it may not always be your best option. However, if absolute color recreation is necessary, this is the best choice.

White Balance Conclusion

There are some lighting situations that may not have an appropriate white balance option. Scenes with mixed light might be impossible to reproduce neutrally without using multiple exposures, each compensating for a different color cast, then piecing the multiple images together in Photoshop or similar program. Additionally there are some situations where the appropriate white balance setting might not produce the desired color temperature. As in most areas of photography, trial and error might be beneficial in understanding exactly which methods work best for each scenario. It is recommended that whenever possible, capture using the RAW file mode, allowing for the most image information to be preserved and a significant margin of error when capturing, then manipulating the image. **Please remember that Richmond Professional Lab currently requires that you convert your images from RAW format to JPEG before submission. We do not accept or print RAW files.**

NOTE: For a more detailed description of manual white balancing with Adobe® Photoshop, please visit adobe.com and check the tutorials section found in "Knowledgebase and Forums" under the support tabs.

Monitor Types: CRT vs. LCD

CRT monitors, characterized by their boxy shape and large footprint, create an image on screen by utilizing a vacuum-sealed glass envelope, known as a cathode ray tube, that accelerates electrons.

LCD monitors are the most common (and usually most affordable) type of "flat panel display", whereby the alignment of particular crystal molecules suspended in a fluid creates an image on screen.

CRT Monitor

LCD Monitor

Quality Monitor Brands

- Eizo
- Apple Cinema Display
- NEC
- Samsung
- MonoPrice

TIP: To reduce glare and minimize the effects of ambient light while performing color-sensitive work, try using a monitor hood.

Quality Monitor Calibrators:
- i1 Display Pro
- ColorEyes Display Pro

TIP: Check your monitor calibration every month to see how well it's holding up. Over time, the monitor's appearance will shift, causing it to lose color accuracy. If your monitor is particularly unstable, you may need to calibrate weekly.

TIP: Profile icons do appear differently in Windows (PC) based systems than on a Mac:

Common Windows/PC profile icon

Common Apple (Mac) profile icon

NOTE: Monitor profiles almost always have the file extension ***.icc*** which refers to the ***International Color Consortium***. Established in 1993, The ICC has played a significant role in establishing the standardization of cross-platform color management. For more on The ICC, visit www.color.org.

What's a Calibrator?

To assist in the process of setting a monitor's color output model to simulate that of what's being printed, a small, electronic device called a monitor calibrator is employed. The calibrator will read and analyze the output of the monitor, providing parameters by which to begin calibration.

What's a Profile?

Imaging output devices (monitors, printers, etc.) have limited and varying ranges to the colors they can produce. A profile is a mathematical model representing the color capabilities of a specific device. When properly installed and utilized, a profile allows the end-user to simulate the capabilities of the intended output device (like a printer) from his or her source device (the monitor).

About Monitor Calibration

Monitor calibration is an important step in achieving repeatable and reliable color. Each monitor reacts differently depending upon make, model, age, video card, and level of use. As such, you may need to try multiple settings before finding what works best for your monitor. It is highly recommended that you use a hardware calibration device for this process to ensure a reproducible, consistent calibration. For a list of high quality monitors and calibration devices, please refer to the previous sections. **Additionally, it is not recommended that you perform color sensitive work on laptops.** Even if you are able to achieve a good calibration, laptops have such a small viewing angle (the range that the monitor accurately displays an image) that it is almost impossible to ensure that you are getting consistent color.

It is extremely difficult, arguably impossible, to achieve a perfect match between your monitor and prints due to the inherent differences between the two. Because monitors are displaying backlit imagery, they will almost never match reflective prints exactly. What's more, monitors' color outputs are in constant states of flux. While they don't necessarily shift enough on a daily basis to require them to be recalibrated, this can account for a minute difference between print and screen. Due to these factors, it is unreasonable to expect a 100% match. Achieving an approximate match between the physical print and the image displayed on the monitor should be acceptable the majority of the time.

Monitor Calibration Procedures

1) Before calibrating, allow LCD monitors to warm up for fifteen minutes and CRTs for thirty minutes.

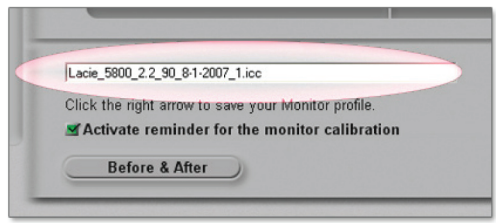
2) Prior to calibrating, reset the monitor's color settings back to their factory defaults from the monitor control menu. If you are unsure how to do this, refer to your owners manual. This is an essential starting point. For LCD calibration, skip any steps that suggest adjusting the contrast and RGB settings initially. Often times these steps are unnecessary for obtaining a desirable result. If various attempts at calibrating the monitor fail, it may be necessary to use these adjustments.

3) Calibration should always occur in an area where your monitor is exposed to minimal ambient light. Using your calibrating device and software, begin with the following settings:

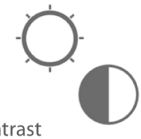
Color Temperature: 6000K
Gamma: 2.2
Luminance: 95cd/m² (for CRTs) or 115 cd/m² (for LCDs)

4) After calibration is complete, open the evaluation JPEG provided with this package (or that you downloaded from richmondprolab.com) in a program that utilizes color management such as Photoshop or Express Digital Darkroom. Compare the image to the evaluation print provided in the package (or that you requested at richmondcprolab.com).

5) Once satisfied with the calibration, use the settings plus any other important information (i.e. date) to name the new profile. Keep track of your monthly calibration results by naming the profiles regularly in this fashion. Example: Lacie_6000K_2.2_115L_11-8-07 (see right).



TIP: You can usually find your Color Temperature, Gamma, and Luminance settings by pressing your monitor's control buttons typically found at the bottom of the unit, just below the screen. Many monitors will have the controls indicated by Brightness and Contrast symbols. Mac users may need to access System Preferences, then select Monitor in order to change these settings. The term gamma refers to a mathematical measurement of the light intensity and it's non-linear reproduction values.



Tips for Adobe® Photoshop Color Management:

NOTE: Some earlier versions of Photoshop may require a different procedure, for which you will need to refer to the Help section of the software.

Soft Proofing

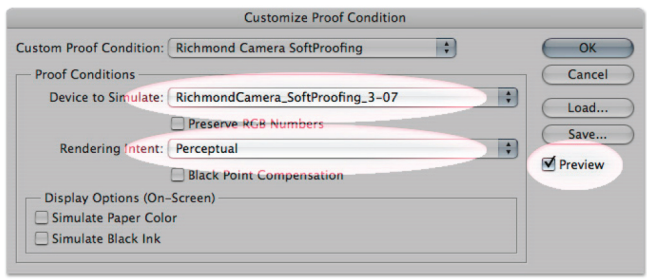
Most monitors are capable of displaying a wider range of colors than printers can reproduce, so it is helpful to enable soft proofing (or *display proofing*) which will limit the monitor's gamut to match the printer's gamut. While it is not necessary to soft proof all images, it is considered advisable when images contain vibrant, highly saturated colors (i.e. flowers) or when choosing colors in a layout program for logos, graphics, borders, etc. Soft proofing will not work on an uncalibrated monitor.

NOTE: For optimum print viewing accuracy, be aware of your lighting

when evaluating the comparison print. Lighting should be "neutral", or without color cast. Daylight balanced light bulbs are okay for home viewing environments, but a viewing station is ideal. Richmond Pro Lab uses and recommends GTI viewing stations.

To enable soft proofing with Richmond Pro Lab's profile, first, install the profile included on the CD in this packet (or that you downloaded from richmondprolab.com). To install on a PC, simply right click on the profile and click on "Install Profile". On a Mac, drag the profile into the folder "Profiles", which can be found in the "Library" folder, and then in the "ColorSync" folder.

Next, in Photoshop select View -> Proof Setup -> Custom. When the "Customize Proof Condition" window appears, select the soft proofing profile provided from the pull down menu next to "Device to Simulate". Set the "Rendering Intent" to "Perceptual" and leave all of the boxes in that window unchecked with the exception of "Preview". You can save this setup so you won't have to redo it every time you soft proof. If your monitor is not properly calibrated then soft proofing will not help. (Unfortunately, Express Digital software does not support soft proofing at this time.)



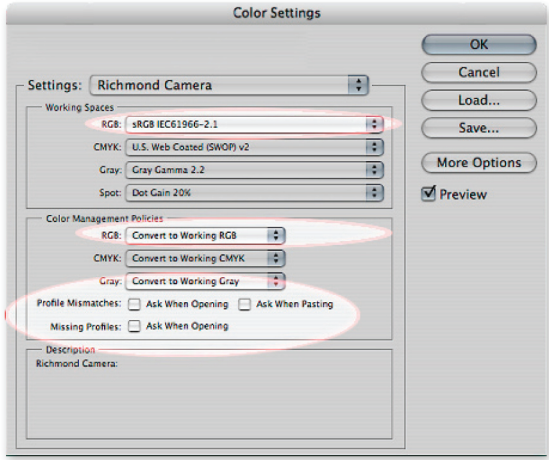
NOTE: Rendering intents are used when converting from a source profile to a destination profile. (Images must first have an embedded profile before converting to another profile; if there is no embedded profile, one must be assigned, preferably the sRGB or Adobe 98 profiles.) Rendering intents manage colors from the source profile that fall outside the gamut of the destination profile. The four intents are as follows:

- **Perceptual**
- **Relative Colorimetric**
- **Absolute Colorimetric**
- **Saturation**

Color Settings

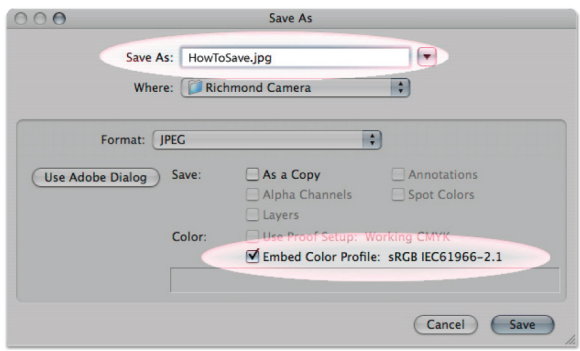
It is possible to set up the color settings in Photoshop to ensure that your images will always be in the appropriate RGB color space. This is important for creating predictable colors in your prints, because when a color space is undefined in your image, one will be assigned automatically, occasionally resulting in unintended color variances in your final image(s). We recommend that you use sRGB or Adobe 1998.

In Photoshop's Color Settings Dialog (Edit -> Color Settings) choose "sRGB" or "Adobe 1998" for the RGB working space, "Convert to Working" for the policies and uncheck the "Profile Mismatches" and "Missing Profiles" checkboxes as pictured if you would like Photoshop to automatically convert to the working space. If you would like to manually convert to the working space, check the boxes and Photoshop will prompt you.



Properly Saving with Profiles

Please make sure to check the "Embed Color Profile" box when saving your JPEGs in the "Save" dialog box. This ensures that your profile stays with your image, and thus results in predictable colors in your prints. **Never embed the *soft proofing profile* when saving. If you do, you will experience compromised quality. Instead, make sure you embed the color space (profile) you have been working in (ie sRGB, Adobe 1998, etc).**



File Management

For best results, we request that files submitted to Richmond Professional Lab be 8-bit sRGB JPEG files. Working with a 16-bit or even a 32-bit file (introduced in Photoshop CS2) is acceptable (in fact, it is advisable), but prior to submission for printing to our lab, please convert your files to an 8-bit JPEG.

Conclusion

Hopefully you have found the information in this guide to be informative and helpful in your pursuit for accurate color reproduction. Whether you are new to color management or a seasoned veteran, the concepts are the same, and while the techniques may change with advancing technology, we believe the quality of your photography should only improve.

As a professional photofinishing lab operating since 1938, Richmond Professional Lab uses Fuji Photographic Paper. A truly archival product, prints produced at Richmond Professional Lab have a lifespan of well-over 100 years.

Richmond Professional Lab is also an Express Digital award-winning lab, recognized for excellence in both workflow and customer service in the photo finishing industry.

REMINDER: The profile you install and use for soft proofing is totally different than the one embedded in your image used for printing accuracy. Never embed the profile you use for soft proofing. Always embed the profile which corresponds to your working color space.

TIP: Check richmondprolab.com regularly for updates, revisions, or other color management information that may not be included in this guide.

This text was produced using knowledge gained from industry experience and resources from the Rochester Institute of Technology. Additional resources include www.luminous-landscape.com, Real World Color Management Second Edition by Bruce Fraser, Chris Murphy, and Fred Bunting, www.chromix.com, www.photocritic.org, www.cambridgeincolour.com, www.brucelindbloom.com, and www.color.org. Special thanks to Scott Martin of On-Sight.

For questions regarding this information, to inquire about purchasing a product mentioned within, to establish a professional account, or if you need assistance with any aspect of your color management and/or your studio's digital workflow, please contact Customer Service.

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