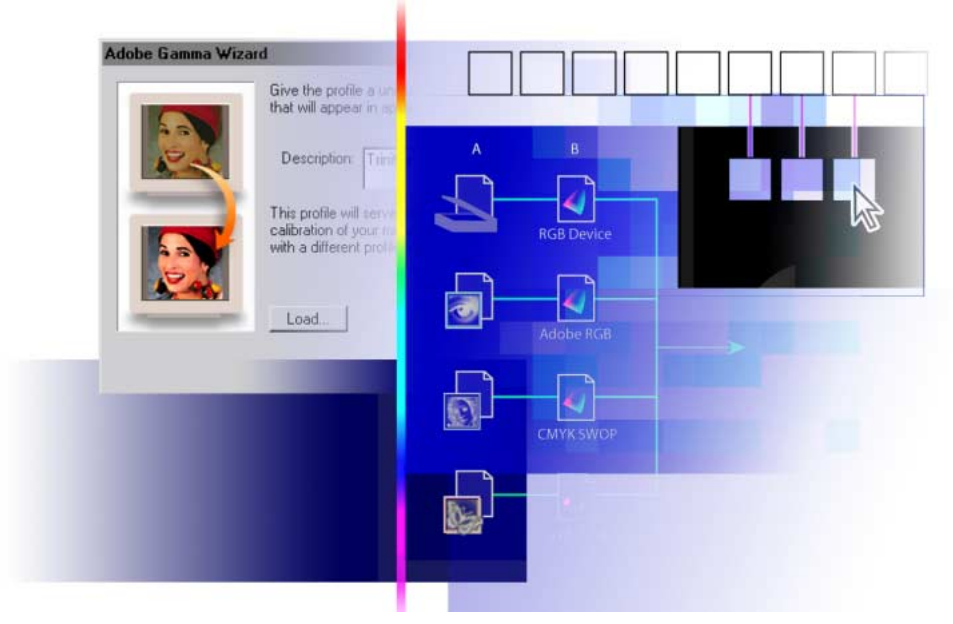
11 Setting Up Your Monitor for Color Management



The most basic requirement for color management is to calibrate your monitor and create an ICC profile for it. Applications that support color management will use your monitor's ICC profile to display color graphics consistently. If you don't have a hardware-based calibration and profiling utility, you can get reasonably accurate results using Adobe Gamma.

In this lesson, you'll learn how to do the following:

- Examine the principles associated with color management.
- Calibrate your monitor using Adobe Gamma.
- Create an ICC profile for your monitor using Adobe Gamma.

This lesson will take about 45 minutes to complete.

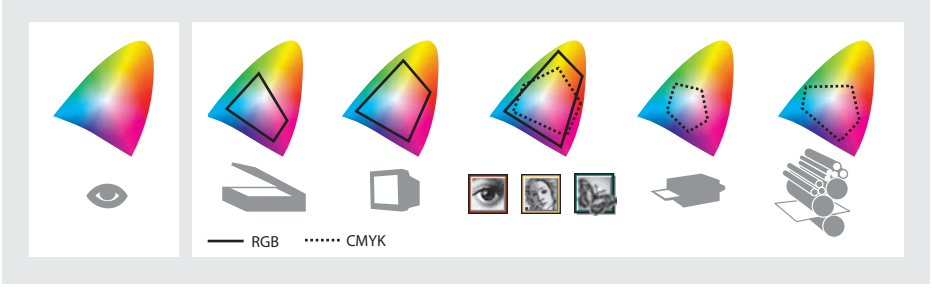
Note: *You can skip this lesson if you have already calibrated your monitor using a hardware-based tool or an ICC-compliant calibration tool such as the Adobe Gamma utility included with Photoshop 5.0 and later, Illustrator® 8.0 and later, and InDesign® 1.0 and later, and if you haven't changed your video card or monitor settings.*

Getting started

In this lesson, you'll learn some basic color management concepts and terminology. In addition, you'll calibrate your monitor to a known color condition, and then create an ICC profile that describes your monitor's specific color characteristics. For information about setting up RGB and CMYK color spaces in Photoshop, see Lesson 12, "Producing and Printing Consistent Color."

Color management: An overview

Although all color gamuts overlap, they don't match exactly, which is why some colors on your monitor can't be reproduced in print. The colors that can't be reproduced in print are called *out-of-gamut* colors, because they are outside the spectrum of printable colors. For example, you can create a large percentage of colors in the visible spectrum using programs such as Photoshop, Illustrator, and InDesign, but you can reproduce only a subset of those colors on a desktop printer. The printer has a smaller *color space* or *gamut* (the range of colors that can be displayed or printed) than the application that created the color.



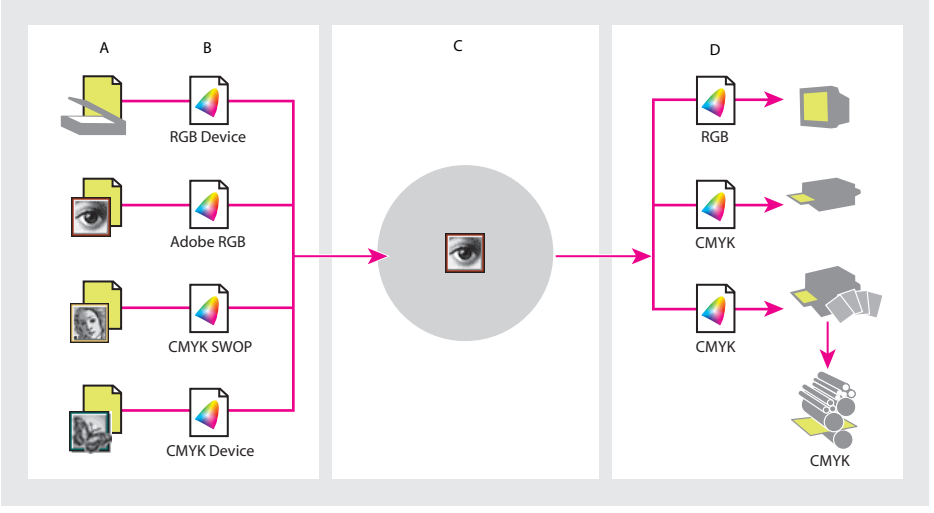
Visible spectrum containing millions of colors (far left) compared with color gamuts of various devices and documents

To compensate for these differences and to ensure the closest match between on-screen colors and printed colors, applications use a color management system (CMS). Using a color management engine, the CMS translates colors from the color space of one device into a device-independent color space, such as CIE (Commission Internationale d'Eclairage) LAB. From the device-independent color space, the CMS fits that color information to another device's color space by a process called *color mapping*, or *gamut mapping*. The CMS makes any adjustments necessary to represent the color consistently among devices.

A CMS uses three components to map colors across devices:

- A device-independent (or reference) color space.
- ICC profiles that define the color characteristics of particular devices and documents.

• A color management engine that translates colors from one device's color space to another according to a *rendering intent*, or translation method.



A. *Scanners and software applications create color documents. Users choose document's working color space.* ***B.*** *ICC source profiles describe document color spaces.* ***C.*** *A color management engine uses ICC source profiles to map document colors to a device-independent color space through supporting applications.* ***D.*** *The color management engine maps document colors from the device-independent color space to output device color spaces using destination profiles.*

About the device-independent color space

To successfully compare gamuts and make adjustments, a color management system must use a reference color space—an objective way of defining color. Most CMSs use the CIE LAB color model, which exists independently of any device and is big enough to reproduce any color visible to the human eye. For this reason, CIE LAB is considered *device-independent*.

About ICC profiles

An *ICC profile* describes how a particular device or standard reproduces color using a cross-platform standard defined by the International Color Consortium (ICC). ICC profiles ensure that images appear correctly in any ICC-compliant applications and on color devices. This is accomplished by embedding the profile information in the original file or assigning the profile in your application.

At a minimum, you must have one *source profile* for the device (scanner or digital camera, for example) or standard (SWOP or Adobe RGB, for example) used to create the color, and one *destination profile* for the device (monitor or contract proofing, for example) or standard (SWOP or TOYO, for example) that you will use to reproduce the color.

About color management engines

Sometimes called the color matching module (CMM), the color management engine interprets ICC profiles. Acting as a translator, the color management engine converts the out-of-gamut colors from the source device to the range of colors that can be produced by the destination device. The color management engine may be included with the CMS or may be a separate part of the operating system.

Translating to a gamut—particularly a smaller gamut—usually involves a compromise, so multiple translation methods are available. For example, a color translation method that preserves correct relationships among colors in a photograph will usually alter the colors in a logo. Color management engines provide a choice of translation methods, known as *rendering intents*, so that you can apply a method appropriate to the intended use of a color graphic. Examples of common rendering intents include *Perceptual (Images)* for preserving color relationships the way the eye does, *Saturation (Graphics)* for preserving vivid colors at the expense of color accuracy, *Relative* and *Absolute Colorimetric* for preserving color accuracy at the expense of color relationships.

Color management resources

You can find additional information on color management on the Web and in print. Here are a few resources:

- On the Adobe Web site (www.adobe.com), search for **color management** or go directly to http://www.adobe.com/support/techguides/color/.
- On the Apple® Web site (www.apple.com), search for **ColorSync**.
- On the LinoColor Web site (www.linocolor.com), open the *Color Manager Manual*.
- On the Agfa Web site (www.agfa.com), search for the publication *The Secrets of Color Management*.

- On the ColorBlind Web site (www.color.com), click Color Resources.
- At your local library or bookstore, look for *GATF Practical Guide to Color Management*, by Richard Adams and Joshua Weisberg (May 1998); ISBN 0883622025.

 For information about setting up color management in Photoshop, see Photoshop 6.0 online Help.

Calibrating and characterizing your monitor using Adobe Gamma

The first requirement for color management is to calibrate your monitor and create an accurate ICC profile for it. Although this doesn't address your entire workflow, at least it ensures that your monitor displays colors as precisely as it can. *Calibration* is the process of setting your monitor, or any device, to known color conditions. *Characterization*, or profiling, is the process of creating an ICC profile that describes the unique color characteristics of your device or standard. Always calibrate your monitor, or any device, before creating a profile for it; otherwise, the profile is only valid for the current state of the device.

Although monitor calibration and characterization are best done with specialized software and hardware, you can get reasonably accurate results with the Adobe Gamma utility included with Photoshop 5.0 and later, Illustrator 8.0 and later, and InDesign 1.0 and later. If you have used other calibration utilities to calibrate and characterize your monitor, such as Apple ColorSync, Adobe Gamma will overwrite those settings.

 *You may find it helpful to have your monitor's user guide convenient while using Adobe Gamma.*

1 If you have the Mac OS Gamma control panel (included with Adobe Photoshop 4.0 and earlier) or the Monitor Setup utility (included with PageMaker 6.0) for Windows, remove it because it is obsolete. Use the latest Adobe Gamma utility instead.

2 Make sure your monitor has been turned on for at least a half hour. This gives it sufficient time to warm up for a more accurate color reading.

3 Make sure your monitor is displaying thousands of colors or more.

4 Set the room lighting to the level you plan to maintain consistently.

5 Remove colorful background patterns on your monitor desktop. Busy or bright patterns surrounding a document interfere with accurate color perception. Set your desktop to display neutral grays only, using RGB values of 128. For more information, see the manual for your operating system.

6 If your monitor has digital controls for choosing the white point of your monitor from a range of preset values, set those controls before starting Adobe Gamma. Later, in Adobe Gamma, you'll set the white point to match your monitor's current setting. Be sure to set the digital controls before you start Adobe Gamma. If you set them after you begin the calibration process in Adobe Gamma, you'll need to begin the process again.

Starting Adobe Gamma

You'll use the Adobe Gamma utility to calibrate and characterize your monitor. The resulting ICC profile uses the calibration settings to precisely describe how your monitor reproduces color. Depending on your workflow scenario, an ICC monitor profile can be either a source or destination profile. In this section, you'll load an existing monitor profile as a starting point for calibrating your monitor.

Note: *Adobe Gamma can characterize, but not calibrate, monitors used with Windows NT®. Its ability to calibrate settings in Windows 98 depends on the video card and video driver software. In such cases, some calibration options documented here may not be available. For example, if you're only characterizing your monitor, you'll choose the default white point and gamma, but not the target calibration settings.*

1 Do one of the following to start Adobe Gamma:

- In Windows, choose Start > Settings > Control Panel, and double-click Adobe Gamma.
- In Mac OS, from the Apple menu choose Control Panels > Adobe Gamma.

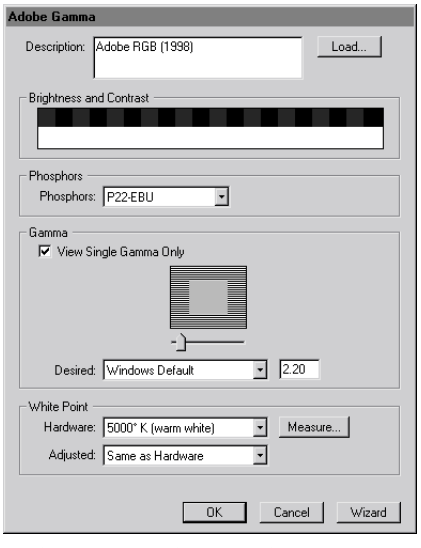
You can use either the control panel or a step-by-step wizard to make all the adjustments necessary for calibrating your monitor. In this lesson, you will use the Adobe Gamma control panel. At any time while working in the Adobe Gamma control panel, you can click the Wizard (Windows) or Assistant (Mac OS) button to switch to the wizard for instructions that guide you through the same settings as in the control panel, one option at a time.

2 Select Control Panel, and click Next.

The next step is to load an ICC monitor profile that describes your monitor. This profile serves as a starting point for the calibration process by supplying some preset values. You'll adjust these values in Adobe Gamma to characterize the profile to match your monitor's particular characteristics.

3 Do one of the following:

- If your monitor is listed in the Description area at the top of the control panel, select it.
- Click the Load button for a list of other available profiles, and then locate and open the monitor ICC profile that most closely matches your monitor. To see an ICC profile's full name at the bottom of the Open Monitor Profile dialog box, select a file. (Windows profile filenames have the .icm extension, which you may not see if the extension display is off.) Make your choice, and click Open.
- Leave the generic Adobe monitor profile selected in the Description area.



Adobe Gamma utility control panel

Setting the optimum brightness and contrast

Now you'll adjust the monitor's overall level and range of display intensity. These controls work just as they do on a television. Adjusting the monitor's brightness and contrast enables the most accurate screen representation for the gamma adjustment that follows.

1 With Adobe Gamma running, set the contrast control on your monitor to its highest setting. (On many monitors, this control is shown next to a contrast icon (◐).)

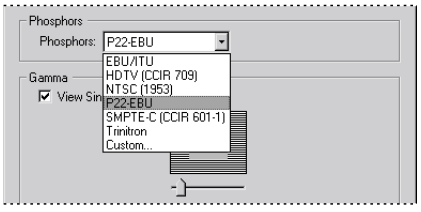
2 Adjust the brightness control on your monitor (located next to a brightness icon (☼) on many monitors) as you watch the alternating pattern of black and gray squares across the top half of the Brightness and Contrast rectangle in Adobe Gamma. Make the gray squares in the top bar as dark as possible without matching the black squares, while keeping the bottom area a bright white. (If you can't see a difference between the black and gray squares while keeping the bottom area white, your monitor's screen phosphors may be fading.)

***A.** Gray squares too light **B.** Gray squares too dark and white area too gray **C.** Gray squares and white area correctly adjusted*

Do not adjust the brightness and contrast controls on your monitor again unless you are about to update the monitor profile. Adjusting the controls invalidates the monitor profile. You can tape the hardware controls in place if necessary.

Selecting phosphor data

The chemical phosphors in your monitor determine the range of colors you see on your screen.



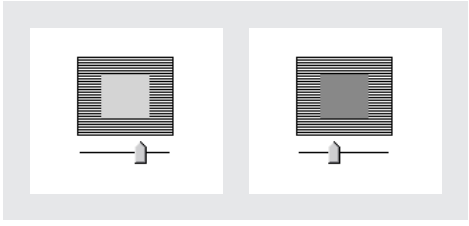
Do one of the following from the Phosphors menu:

- Choose the exact phosphor type used by the monitor you are calibrating. The two most common phosphor types are EBU/ITU and Trinitron.
- If the correct type is not listed but you were provided with chromaticity coordinates with your monitor, choose Custom, and enter the red, green, and blue chromaticity coordinates of the monitor's phosphors.
- If you're not sure which phosphors your monitor uses, see the monitor's documentation; contact the manufacturer; or use a color measuring instrument such as a colorimeter or spectrophotometer to determine them.

Setting the midtones

The gamma setting defines midtone brightness. You can adjust the gamma based on a single combined gamma reading (the View Single Gamma Only option). Or you can individually adjust the midtones for red, green, and blue. The second method produces a more accurate setting, so you will use that method here.

For the Gamma option in the Adobe Gamma utility, deselect the View Single Gamma Only option. Drag the slider under each box until the shape in the center blends in with the background as much as possible. It may help to squint or move back from the monitor.



Single gamma not calibrated (left), and calibrated (right)

Make adjustments carefully and in small increments; imprecise adjustments can result in a color cast not visible until you print.

Selecting a target gamma

You may also have an option for specifying a separate gamma for viewing graphics.

Note: *This option is not available in Windows NT due to its hardware protection shield that prevents Adobe Gamma from communicating with the computer's video card.*

If you have this option, choose one of the following from the Desired menu:

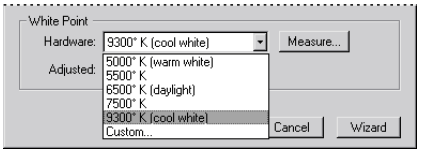
- Windows Default for Windows systems. Leave the setting at 2.2.
- Macintosh Default for Mac OS computers. Leave the setting at 1.8.

Setting the monitor's white point

Now you'll adjust the hardware *white point*, the whitest white that a monitor is capable of displaying. The white point is a measurement of color temperature in Kelvin and determines whether you are using a warm or cool white.

First you'll make sure that the white point setting matches the white point of your monitor. Do one of the following:

- If you know the white point of your monitor in its current state, you can select it from the Hardware menu in the White Point section. If your monitor is new, select 9300 Kelvin, the default white point of most monitors and televisions.



- If you started from a manufacturer's profile for your monitor, you can use the default value. However, the older your monitor, the less likely it is that its white point still matches the manufacturer's profile.
- If your monitor is equipped with digital controls for setting the white point, and you already set those controls before starting Adobe Gamma, make sure the Hardware menu matches your monitor's current setting. Remember, though, that if you adjust these hardware controls at this point in the calibration process, you'll need to start over, beginning with the procedure in "Setting the optimum brightness and contrast" on page 297.
- If you don't know the white point and don't know the appropriate values, you can use the Measure option to visually estimate it. If you choose this option, continue to step 1.

To get a precise value, you need to measure the white point with a desktop colorimeter or spectrophotometer and enter that value directly using the Custom option.

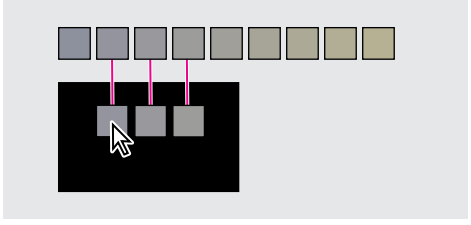
If you were unable to choose a hardware setting as described, try the following experiment:

1 For best results, turn off all lights in the room.

2 Click Measure, and then click OK (Windows) or Next (Mac OS). Three squares appear.

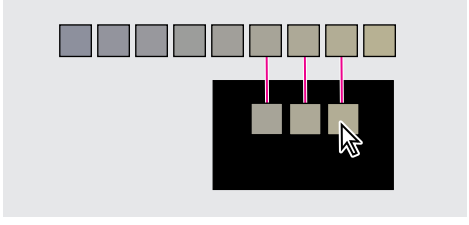
The goal here is to make the center square as neutral gray as possible. You'll train your eyes to see the contrasts between the extreme cooler (blue) white and warmer (yellow) white, and then adjust the colors in the squares to find the most neutral gray between them.

3 Click the left square several times until it disappears, leaving the middle and right squares. Study the contrast between the bluish square on the right and the center square.



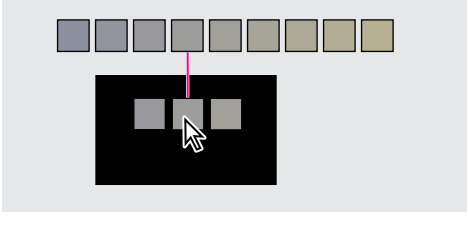
Clicking on the left square will reset all the squares a shade cooler.

4 Click the right square several times until it disappears, and study the contrast between the yellowish square on the left and the center square.



Clicking on the right square will reset all the squares a shade warmer.

5 Click the left or right square until the center square is a neutral gray. When complete, commit the changes by clicking the center square.



For a color illustration of adjusting the white point, see figure 11-1 of the color section.

Setting an adjusted white point

This option, when available, sets a working white point for monitor display, if that value differs from the hardware white point. For example, if your hardware white point is 6500 Kelvin (daylight), but you want to edit an image at 5000 Kelvin (warm white) because that most closely represents the environment in which the image will be viewed, you can set your adjusted white point to 5000 Kelvin. Adobe Gamma will change the monitor display accordingly.

Do one of the following to specify a separate white point for viewing graphics:

- To use the current white point of your monitor, choose Same as Hardware from the Adjusted menu.
- To specify your monitor's white point to a target value other than the Hardware value, choose the gamma setting you want from the Adjusted menu.

Saving the monitor profile

Now that you have adjusted all settings for your monitor, you will save the ICC profile you have created. Applications that support color management will use this monitor profile to display color graphics.

1 In Adobe Gamma, rename the monitor profile by editing the text in the Description text box. (We named the profile My Monitor.) When you name the monitor here, it appears by default when you start Adobe Gamma.

2 Click OK (Windows) or click the Close button (Mac OS). In Mac OS, click Save when prompted.

3 In the Save As dialog box, type the filename again, and save the file in the Color folder (Windows) or the ColorSync Profiles folder (Mac OS).

Adobe Gamma makes the new monitor profile the default. You can use this profile in any application that supports ICC-compliant color management. In Mac OS, the profile information will be supplied to Apple ColorSync as the default monitor setting.

Review questions

1 What does the color management engine do?

2 What is calibration?

3 What is characterization?

4 What are the four main monitor settings you adjust when you run the Adobe Gamma utility, and why do you adjust them?

Review answers

1 The color management engine translates colors from the color space of one device to another device's color space by a process called color mapping.

2 Calibration is the process of setting a device to known color conditions.

3 Characterization, or profiling, is the process of creating an ICC profile that describes the unique color characteristics of a particular device. You should always calibrate a device before creating a profile for it.

4 Using Adobe Gamma, you adjust the brightness and contrast, phosphors (color characteristics), gamma (color contrast), and white point (extreme highlight) of the monitor. You adjust these settings to calibrate your monitor. Adobe Gamma uses those settings to create an ICC monitor profile that defines your monitor's color space for working on graphics.