Lesson **4**

Creating Custom Profiles

To get the best results and most predictability from color management, you need to create your own device profiles. While this may seem like a daunting process, it can be relatively easy to do, and the results are well worth the effort. There is a wide range of profiling products on the market; some of these are reasonably priced, easy to use, and able to profile most types of devices.

Profiling products range from standalone products made specifically for a certain type of device, to profiling "suites," such as the GretagMacbeth Eye-One bundle and the X-RiteColor Ensemble, which include a measurement device and software that can profile scanners, cameras, displays, printers, and even projectors.

The choice of profiling package depends on your own criteria: how much it costs, how easy it is to use, what advanced features it includes, and the quality of its results. Some professionals believe that packages that take the Swiss Army knife all-in-one approach don't do as good a job at creating profiles as programs that are dedicated to creating a specific type of profile. In any case, this lesson uses a variety of applications to create device profiles. These are not the only or necessarily the best products available; rather, they represent an assortment of solutions.

Understanding Measurement Devices

To calibrate displays and printers, a measurement device is required. There are a variety of devices on the market, each with different capabilities. Buying a measurement device is a complicated process in itself, and should you prefer to skip the color babble, a decent spectrophotometer such as the GretagMacbeth Eye-One will handle all of your color-management needs. Three basic types of devices are used in graphic arts and publishing, as described below.

- *Densitometer*—A densitometer measures the density of ink on paper (that is, the absorption of light), not color values. A densitometer can tell you how much of a color is on the page, but not what the color is. This is useful for a variety of purposes: to check whether the printing devices are behaving, for example, or to calibrate a device. Densitometers can be found on or near every printing press, but they are not useful for creating device profiles.
- *Colorimeter*—A colorimeter measures the color value of a sample, using color filters, within a specific color space. A colorimeter can determine if two colors are the same; it does not, however, take into account the light under which the samples are measured. Colorimeters are often used to calibrate both LCD and CRT display types.
- *Spectrophotometer*—A spectrophotometer measures the wavelength of light across the entire visible spectrum of colors. This type of measurement is the broadest, and it can easily be translated into a number of values, including those used by colorimeters and densitometers. As it can be used to profile both displays and printers, the spectrophotometer is preferred for device profiling.

These devices typically come in different flavors; some measure one patch of color at a time, while others measure strips in an automated fashion. The automated devices cost more—sometimes much more—but save time and reduce errors. Some devices, such as the GretagMacbeth Eye-One spectrophotometer, can measure single patches but also include an attachment that enables the device to engage a strip-reading mode. Spend some time creating profiles with a device that only measures patch by patch, and you will quickly come to appreciate the value of an automated instrument. In case you were

wondering, the Rolls-Royce of these devices is the GretagMacbeth iCColor spectrophotometer—simply feed a target into the device, wait about 20 seconds, and the measurements are complete, all for about $5,000.

> **NOTE ►** You can use the trial applications on this book's CD to complete the exercises in this lesson even if you don't have a color-measurement device.

Creating Display Profiles

The display is where color professionals spend most of their time viewing color information, and where they evaluate and adjust color data. And it just so happens to be the easiest device to profile. Creating a custom profile for your display will have a dramatic effect and will enable you to use your display as a predictor of your output-device results.

Choosing High-Quality Displays

When investing in a display for high-quality color-managed workflows, one of the primary considerations is whether to choose LCD or CRT technology. Color professionals disagree as to which is better for color reproduction. Flat panels, which are now the only type of display that Apple sells, tend to have more contrast than CRTs, and the viewing angle may affect the appearance of the color data.

Regardless of whether you choose CRT or flat-panel technology, keep in mind that as with most things in life, you get what you pay for. So caveat emptor: "bargain" displays simply don't have the quality or response required for accurate color reproduction.

Ultimately, it's a matter of personal preference. Just be sure that for color management, you use a high-quality display. "High" quality is subjective, but generally it includes a small dot pitch (the distance between the dots onscreen), support for high-resolution modes, and controls for color temperature and geometry.

Displays degrade with age, becoming less bright and less reliable for viewing color data over time. If your display is more than three years old, and you're dissatisfied with its handling of color data, consider a new display.

> **NOTE ►** If you use an LCD (flat panel) monitor, ensure that any measurement device you use is designed for an LCD or includes an LCD adapter. Devices with suction cups can damage LCDs.

Characterization vs. Calibration

When implementing color management, you often encounter the terms *calibration* and *characterization,* which can be confusing, but the difference is really quite simple: *calibration* changes a device to a standard or to a known state, while *characterization* is the process of measuring the characteristics of the device and creating a profile. Most display color-management products do both tasks, so the terms are often used interchangeably. If your profiling product doesn't do both simultaneously, or if you're using different tools for each, just remember to calibrate first, then characterize.

You can calibrate and characterize a display in three ways, which increase in price and quality: using visual calibration, using a display calibrator, and using a calibrated display system. After discussing how each method works, we will create and compare profiles using visual profiling and an external display calibrator.

Visual Calibration

In visual calibration, your eyes are the measurement tool. Although visual calibration does an excellent job of factoring in ambient lighting conditions in the profiling process, this method is very subjective and is more prone to errors and inconsistencies than device-based calibration. If your goal is to create consistency among multiple displays—say, across all the displays in a production shop—or consistency across time, then visual calibration may not be the best solution, as you have no objective reference point.

Apple ships a very effective (and free) visual characterization tool with Mac OS X: the Display Calibrator Assistant. We will use it shortly to both calibrate and characterize your display.

Display Calibrators

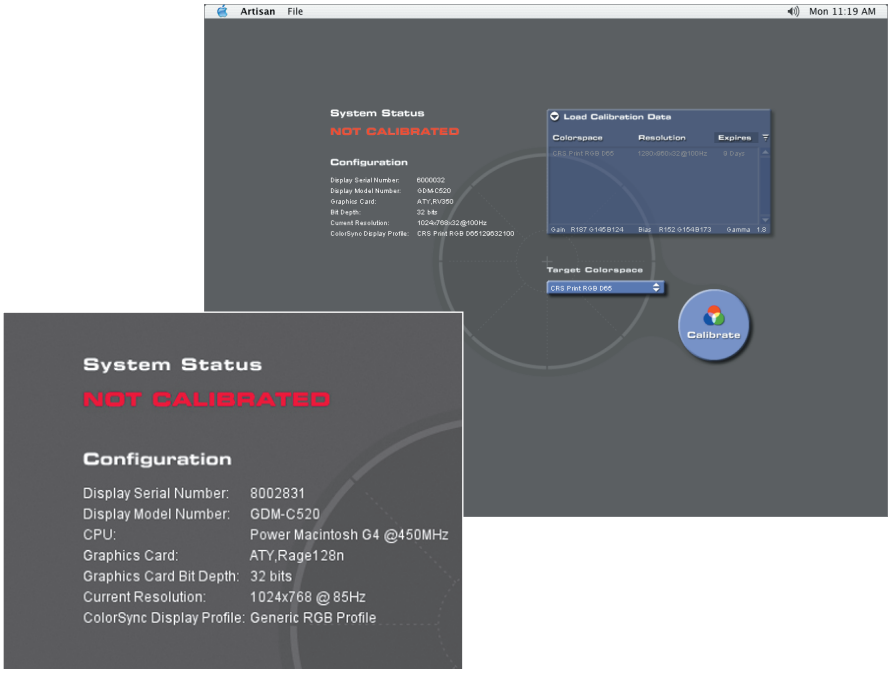
Display calibrators use a measurement device along with software to profile your display. This approach is automated and much less subjective than visual calibration, in which you adjust the controls until the onscreen image appears a certain way. The software flashes a range of colors on the screen, which are measured by the device. The results are compared with the known values of the various colors, and a profile is created that accounts for the particular results of your display. In most cases, a profile created with a display calibrator will be more accurate (and more expensive) than one created using visual calibration.

Calibrated Display Systems

The ultimate solution for a color-accurate display (which also happens to be the most expensive) is a *calibrated display system*. Calibrated display systems typically include a very high-quality monitor, a measurement device, software, and a hood to shield the display from ambient light (a good idea regardless of which type of system you use), all designed to work together. What makes these systems so accurate is the integration of display, software, and calibrator. The software communicates with the display and your graphics card and makes adjustments in the display *automatically*. Calibrated display systems such as the Sony Artisan and the Barco Reference Calibrator V are easy to use and provide better results than visual calibration or third-party display calibrators. With a calibrated display system, there is no guesswork involved, no loss of brightness and gamut. If color is a critical component of your work, and you can afford one of these systems, buy one.

The Sony Artisan is an example of a calibrated display system.

The Sony Artisan software, for example, clearly indicates the calibration status of the display, including the target color space, calibration results (including the date of the last calibration), and display configuration details. If the display is out of calibration, a warning alerts the user at startup as well in the Artisan application.



Preparing to Profile Your Display

We're almost ready to create and compare some display profiles. But first, take a moment to do a few things to increase the accuracy of the profile.

- Let your display warm up. For CRTs, that's a minimum of 30 minutes, preferably one hour. For LCDs, 5 to 10 minutes should suffice.
- Turn off screen savers and energy-saving settings. These can interrupt the process.
- Determine your display's settings: resolution, refresh rate, geometry, and bit depth, and *don't change the settings* (either through the display's front-panel

controls or through the operating system). If you change the settings, you should re-profile the display.

- Set the Desktop to a neutral gray.
- Set the white point to 5000k (D50) or 6500k (D65), if supported by your display. The overall goal is to match the tonal reproduction characteristics of your display to the intended viewing conditions and output.

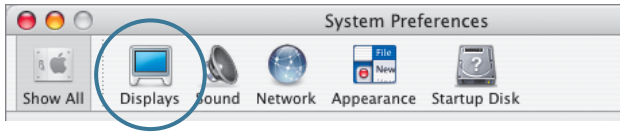
NOTE ► LCDs and laptop displays typically lack controls for white point.

- Clean your display using a product specifically formulated for displays. Most office supply stores carry this type of product.
- Avoid bright light directed at the display. Use a display hood, if available.

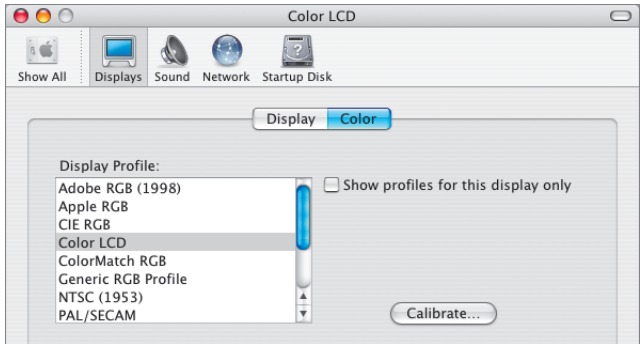
Using Visual Calibration to Create a Display Profile

Let's create a profile for your display using Apple's Display Calibrator Assistant, a visual-profiling tool.

1 Open System Preferences by clicking its icon in the Dock, and then click the Displays icon.



2 Click the Color tab.

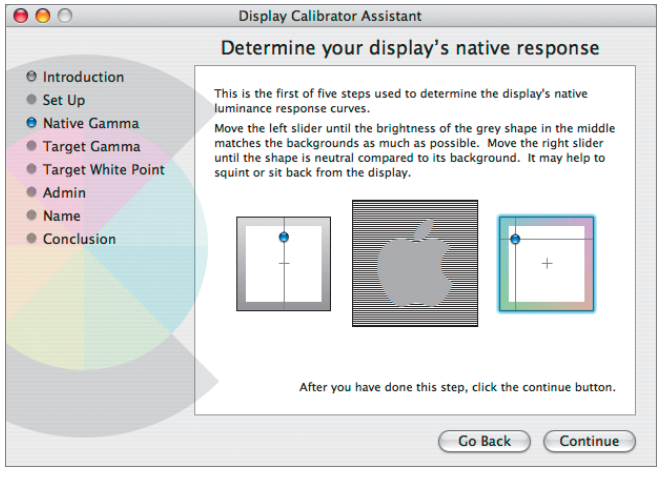


3 Click the Calibrate button, and the Introduction screen appears.

The Introduction screen provides an overview of the Display Calibrator Assistant and the steps required to use it.

4 Make sure the Expert Mode box is checked. Although the Expert Mode is more involved, it gives you more options and produces better results.

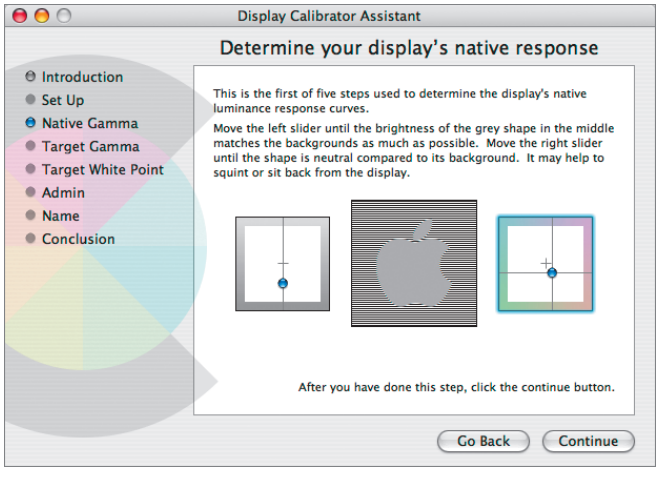
5 Click Continue. The Native Gamma window appears.



This is the first window for a five-step adjustment in the assistant, designed to determine the *luminance* of your display. Luminance is the amount of light emitted by the display.

The assistant uses two sliders to determine luminance. Each slider control has a border that indicates the change made by moving the slider a certain direction. For example, on the brightness box (on the left), moving the slider up increases the brightness; moving it down decreases the brightness. The border of the control is lighter at the top, darker at the bottom. The control on the right, which affects color balance, shows the change in color made by moving the slider toward the direction of a color on the border.

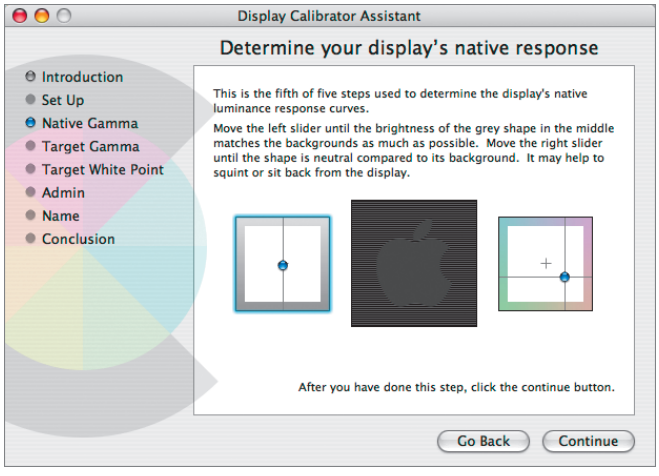
6 Adjust the left slider until the brightness of the Apple icon matches the surrounding boxed background. Move the slider all the way up and all the way down, and then narrow in on the spot that you think achieves the best match. Next, move the right slider until the color of the Apple icon appears most neutral. Again, move the slider around liberally and then home in on the spot that appears to have the least amount of color in the Apple icon.



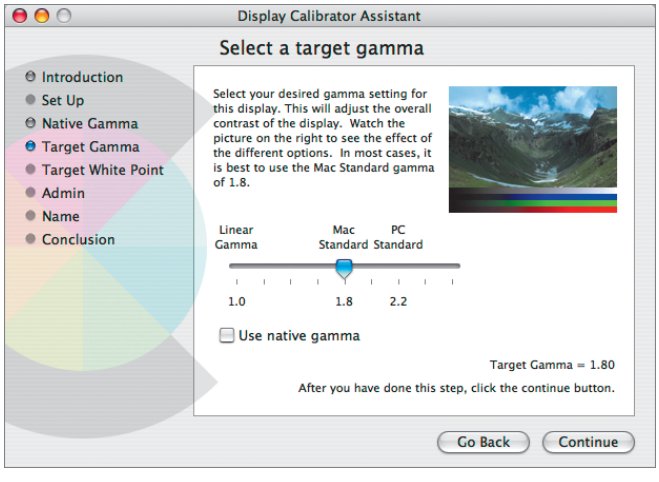
TIP Keep in mind that this is a very subjective process, and there is no right or wrong answer—simply make the best choice you can. As the instructions note, it does help to sit back and squint your eyes a bit.

7 When you are satisfied with the adjustments, click Continue.

8 Repeat steps 6 and 7 four more times as prompted by the assistant, each time further homing in on the luminance of your display as part of the native gamma adjustments.



9 When the Apple icon essentially blends in with its background, click Continue to move to the target gamma adjustment.



Gamma is the ratio of contrast that is displayed. The higher the number, the more contrast you will see.

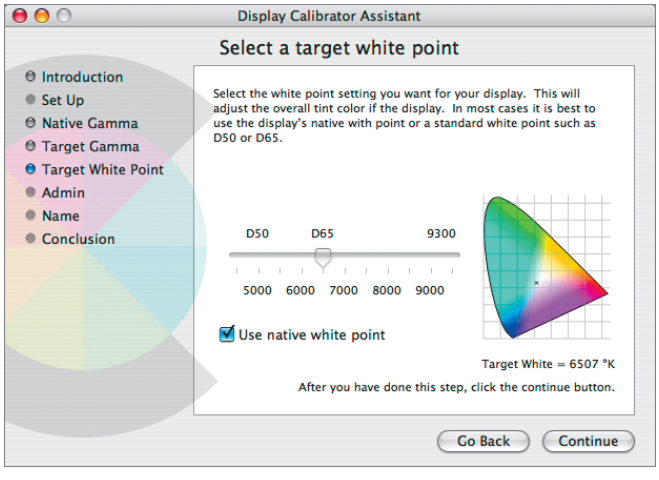
10 Adjust the slider back and forth, watching the changes that occur in the test image, until you see a good balance between highlights and shadows. Use the clouds to examine the changes in the highlights, and the darker parts of the mountains to examine the shadow detail.

At the ideal setting, the tonal gradations in the color bars should be smooth, all the way from bright highlights to deep shadows.

The numbers underneath the slider represent the contrast ratio. Notice that there is a difference between Macintosh and Windows gamma settings. If you are using the Display Calibrator Assistant with the intention of matching displays between the two platforms, consider selecting the same gamma on both systems. You will likely have a better match across the Mac and Windows platforms if you use the PC Standard gamma of 2.2.

TIP If you are unsure about this setting, set the slider at Mac Standard.

11 When you finish, click Continue. The Target White Point adjustment window appears.



White point is the color temperature of the display, measured in kelvins. The higher the white point, the bluer the white will appear; the lower the white point, the redder the white will appear.

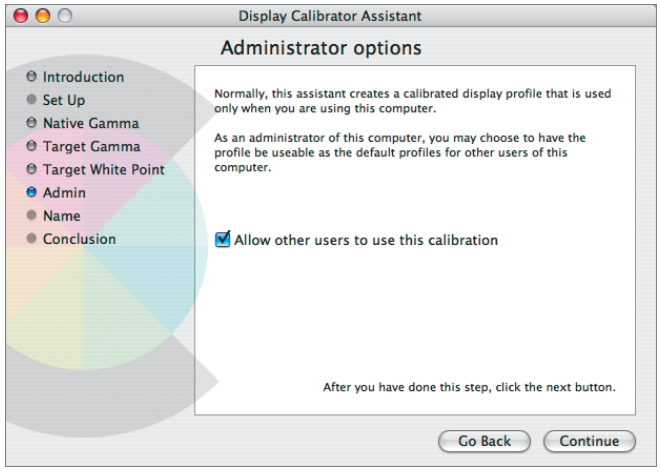
To understand this concept, notice the light at different times of the day. During the morning and evening, when the sun is low on the horizon, the light is warm and rich in color, or about 3500 kelvins. In the middle of the day, when the sun is overhead, the light is cooler, about 6500 kelvins. These temperatures are often noted as D50 (for 5000) or D65 (for 6500).

Most professional proofing systems and color-correct viewing booths used by printers and photographers use D50 lights to simulate daylight. D50 was established as the prepress industry standard, although new standards are emerging based on D65. The challenge with this, however, is that printed materials and photographs will be viewed under many light conditions. It's important to choose a setting that your display can actually reproduce. D50 may also make your display appear dim and yellow. As a result, many users select D65, which results in a much closer match to your output device.

12 Check the "Use native white point" box to use the white point that was determined by the selections you made in the first steps of the process.

NOTE ► Much like the target gamma setting, the white point differs between Macintosh and Windows systems. Macintosh users will see the best results by setting their displays to a D50 white point and a gamma of 1.8. PC users will see the best results by setting their displays to D65 and a gamma of 2.2. The exception to this rule is when both a Macintosh and a PC are used in the same color-managed workflow. In this scenario, the best results will be achieved by using a device calibrator or calibrated display system set to the same white point and gamma on both systems.

13 Click Continue. The Administrator window appears.

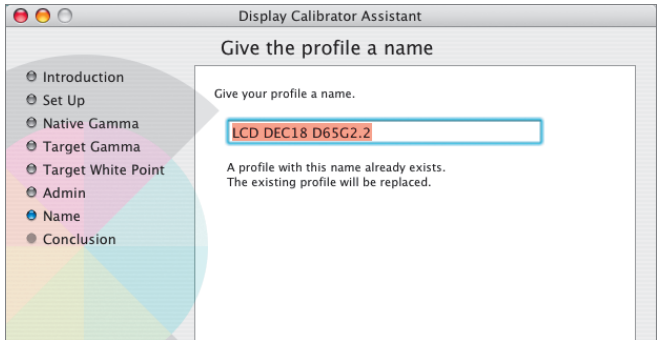


Administrator options, enabled by the Expert Mode box checked in step 4, let you share your profile with other users of the system.

14 Check the "Allow other users to use this calibration" box if you want others to be able to share this profile.

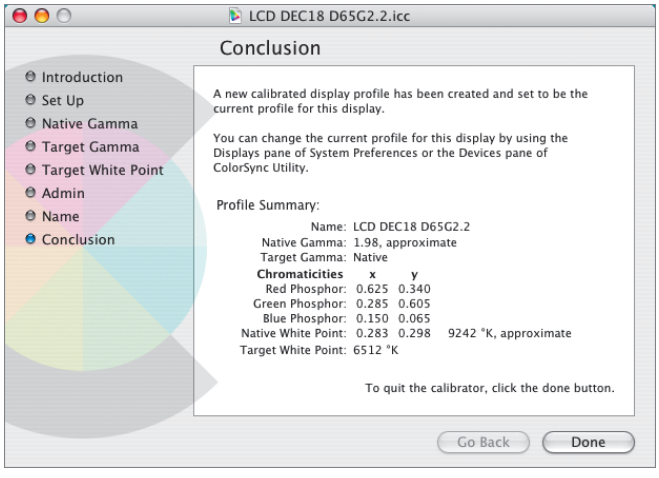
15 Click Continue.

16 In the window that appears, name the profile, giving it a meaningful name that will distinguish this profile from others for the same device. For example, include the device name and its calibration settings.



17 Click Continue.

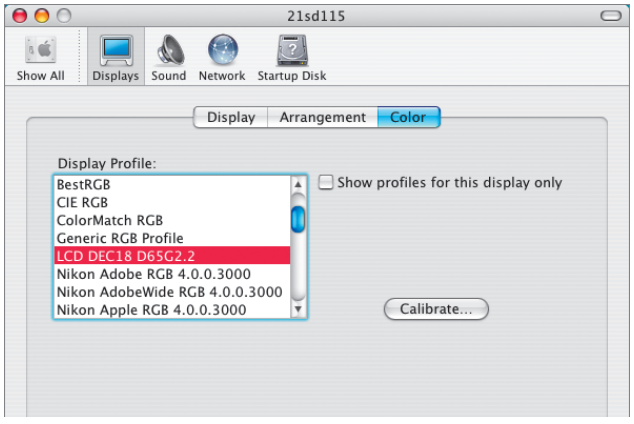
Congratulations! You have just created a custom profile that factors in the unique characteristics of your display, determined by the measurement instrument—your eyes. The Conclusion screen that appears summarizes the relevant details of the profile, which can be useful in comparing these results to generic profiles for the device, an exercise that you'll perform later in this chapter.



Note the difference between Native Gamma and Target Gamma in this window. The profile you just created compensates for the differences between the native and desired gammas.

18 Click Done to close the Display Calibrator Assistant.

The Color tab of the Displays System Preferences window appears, with the profile you just created selected from the Display Profile list. The display profile will be used by applications that support ColorSync to determine which display profile to use.



Using a Calibrator to Create a Display Profile

This exercise uses the GretagMacbeth Eye-One Match to demonstrate how to calibrate and characterize, or profile, a display with a display calibrator. If you don't have a calibrator, or have a different product, you can still follow this exercise to learn the general process.

1 Launch Eye-One Match by double-clicking its icon in the Applications folder of your hard drive. The home screen appears.

The home screen shows the types of devices that the software can profile: displays (also called *monitors*), projectors, scanners, and printers. The Eye-One tool is very easy to use: help is available from every screen, and the interface leaves little room for error.

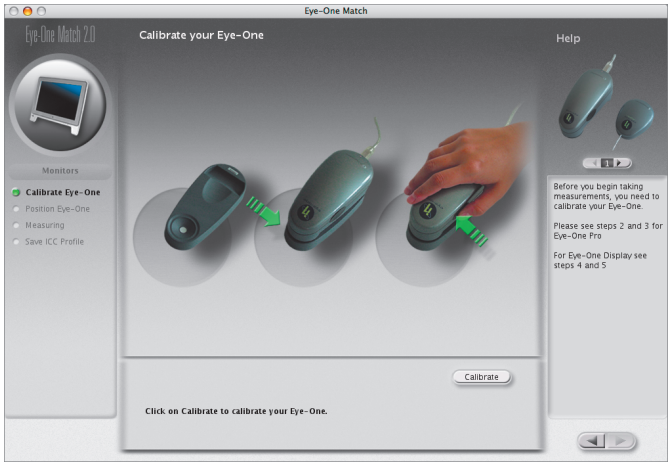
2 Since we are creating a display profile, click the icon that looks like an Apple Cinema Display.

3 Select the Advanced Profiling Mode, which allows you to chose the white point and gamma of your display; we'll do that later in this exercise.

4 Click the right arrow in the lower right of the screen to begin.

The first step in profiling is to calibrate the measurement device.

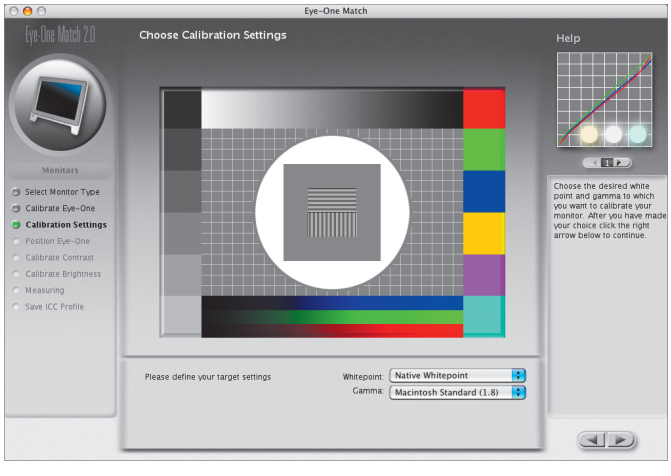
5 Place the Eye-One device on its base, which includes a reference target, and click Calibrate to calibrate the device.



Eye-One compares the results with the known value of the calibration patch and makes any adjustments as needed.

NOTE ► Not all calibrators include this step, particularly devices that calibrate only displays.

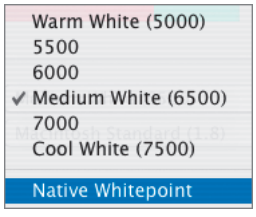
6 Click the right arrow to choose your display calibration settings.



This is where you can choose the white point and gamma of your display.

NOTE ► If your display has the capability to set the white point via the hardware controls, set the display setting before calibrating.

7 Click and hold to view the Whitepoint pop-up menu.



The Whitepoint selection determines the color of the white of the display. The device will measure the actual or native white point of the display, and then the software will adjust the display to achieve the desired white point (or a point as close to it as possible). The higher the number, the cooler (or bluer) the white; the lower the number, the warmer (or redder) the white. The Native Whitepoint setting instructs the software to use the measured white-point value. This is often a good choice for displays that lack the controls to select a white point, particularly LCDs. As noted previously, the typical setting for the Mac is 5000 (also called D50). However, the D50 setting is based on press output; desktop printer users will likely have better results with D65.

8 Experiment with the various settings to see how they change your computer display, and then choose Medium White (6500).

9 Click and hold on the Gamma pop-up menu.

The Gamma selection determines the relationship between light and dark values, similar to contrast.

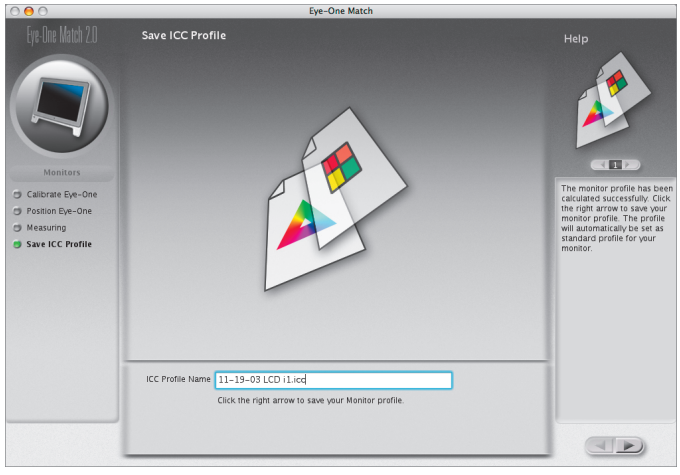
10 Leave the Gamma setting at Macintosh Standard (1.8).

11 Click the right arrow and place the measurement device on the display. As it calibrates and plots the gamut, the software will display and measure a wide range of color values.

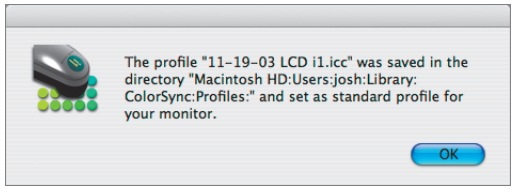
If you use an LCD such as the Apple Cinema Display or a PowerBook, make sure that your calibration device is safe to use on an LCD. The suction cups on devices designed for CRTs can damage the LCD. Most manufacturers have an adapter, or a version that specifically works on LCDs.

Also, if you're using an LCD, be sure to use the appropriate attachment, which usually hangs the device with a counterweight. If you are using a CRT, the attachment will typically have suction cups that will stick to the glass. Once the device is attached, the software first automatically detects where on the screen the sensor is located, and then begins the measurement (some products may require you to manually start the process).

12 When the process is complete, the Save ICC Profile window appears. Save the profile with a name that includes the calibration settings, and then click the right arrow button. In this example, the profile was named with the device name and date.

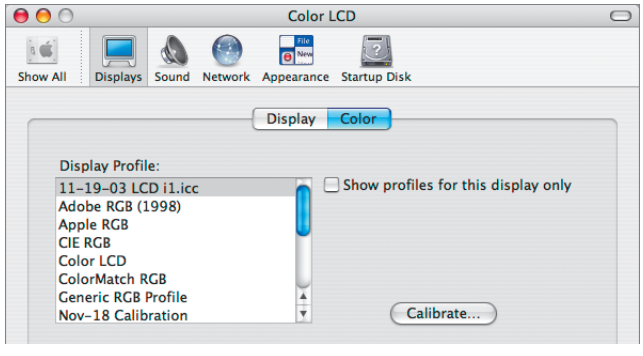


The software indicates that the profile has been saved and that the profile has now been set as the standard profile.



13 Click OK, and close the Eye-One Match application.

14 Open the Displays System Preferences panel, and click the Color tab.



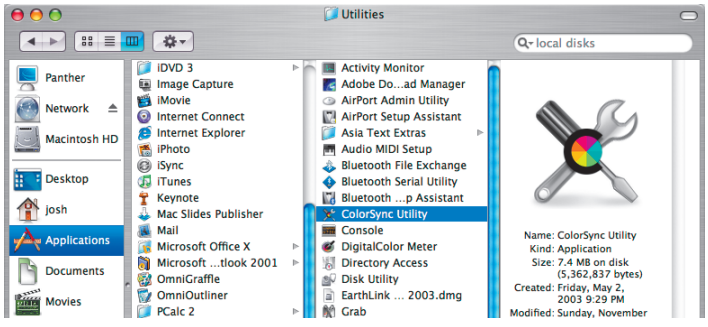
Your new profile is in the Display Profile list and is selected as the default display profile.

NOTE ► If your profiling product does not automatically set the display profile, you will need to change it by selecting the correct profile from the list.

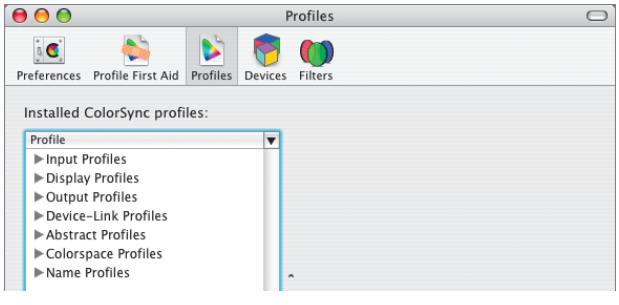
Comparing Display Profiles

Now that you have at least two display profiles—the default profile included with your display and the profile created with the Apple Display Calibrator Assistant—we can compare them. If your display didn't come with a default profile, then use one of the profiles included with ColorSync; this is simply an exercise to illustrate the value of creating a custom profile.

1 Launch the ColorSync Utility inside the Applications > Utilities folder on your hard drive.



2 Click the Profiles icon.

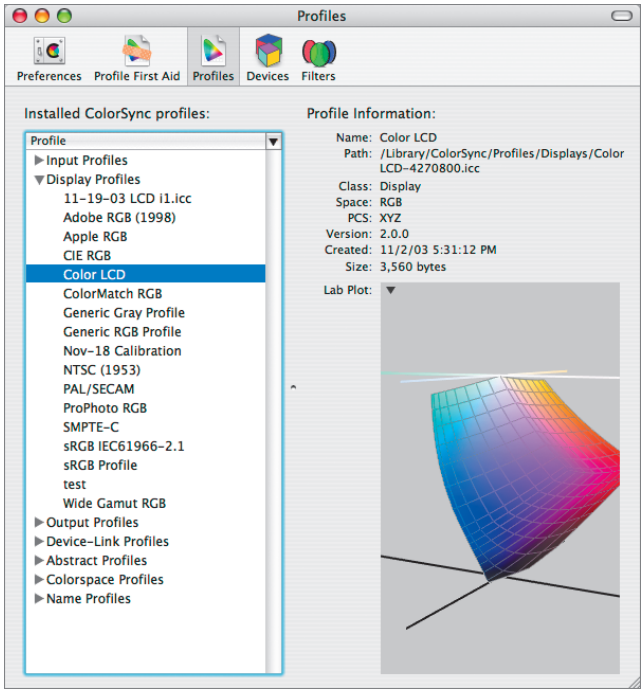


On the left, the utility displays a list of all of the profiles installed on your system, organized by category.

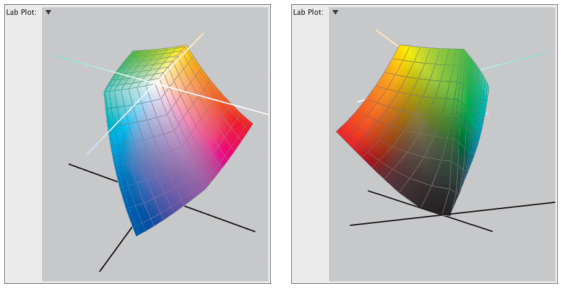
NOTE ► If your list of installed ColorSync profiles appears different from what's shown in the preceding image, click the downward-pointing triangle on the Profile list box and choose "Group by class."

3 Click the triangle next to Display Profiles, and select a display profile, such as Color LCD.

Information about this profile appears on the right. Notice the location, color space, creation date, size, and other information about this profile, including its Lab Plot 3D visual representation.

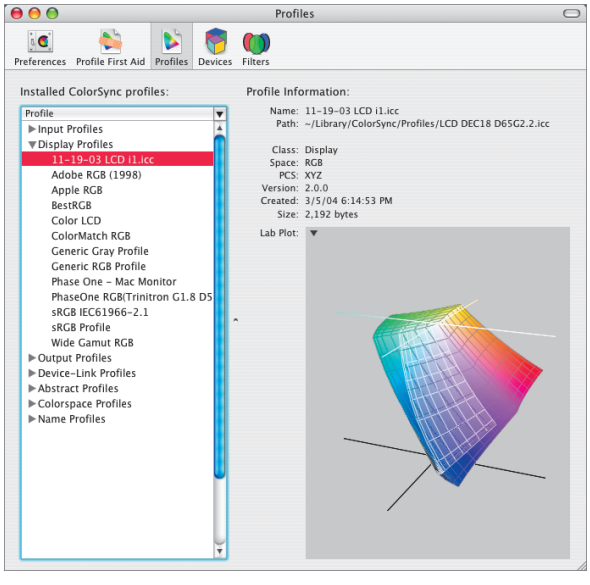


4 Click and drag on the 3D color model to view this profile's color space from multiple angles, then release the mouse.



5 Click the triangle in the Lab Plot area and choose "Hold for comparison" from the pop-up menu.

6 Choose the profile you created with the Apple Display Calibrator Assistant (or one you created with your external display calibrator) from the left-hand list. The ColorSync Utility displays an overlay plot of the two profiles.



The ghosted white outline in the figure is the first, generic profile.

7 Click and drag the cursor over the color model to see how the profiles compare throughout the range of colors displayed by the 3D color model.

Notice whether the color gamut of my custom profile is larger than that of the default profile—meaning that it includes more colors. If the custom profile includes more data, it will be more accurate when used for soft-proofing. In some cases, the differences between two profiles may be very slight, and you will not be able to see any variation in the color model.

You can compare any two profiles with the ColorSync Utility, which is a useful way to visualize the differences between the color gamuts of two devices.

Ensuring Consistency Across Displays

If one of your goals is to have consistency across multiple displays in your workflow, for example in a studio, the simplest way to reduce variability is to use the same make and model of display and the same calibration system at each workstation. If you choose to go with an external display calibrator, you can save money by purchasing one physical device (or a few if you have a lot of systems) and running the software on each monitor. Just be sure to check the manufacturer's policy about software licensing—you may need a license for each computer.

Whichever approach you select to calibrate displays, be sure to use *only that method* to create a profile for each display. Consistency is one of the keys to successful color management.

Keeping Profiles Accurate

A good rule of thumb is to recalibrate your display once a week: calibration is easy, free, and effective. It's also a good idea to recalibrate prior to any important color work—say, a big job.

Creating Digital Camera Profiles

Creating a profile for a digital camera is easy; creating a good profile is another story. With input devices such as scanners, variability over time is low: the light source is fixed, and each scan uses the same source. The challenge with creating camera profiles is that there are a lot of variables—most of which change with each photograph.

Lighting poses the biggest challenge. In the studio, lights have qualities, such as color temperature and luminance, that change over time and with each photo shoot. Simply moving a studio light will change the lighting conditions. In the field, lighting changes by the minute as the sun moves across the sky. And like other devices, each camera has its own subtle characteristics.

As a result, many experts contend that it's only worth the effort to profile digital cameras if you are a studio photographer with highly controlled lighting setups. They believe it's easier, faster, and cheaper to bring digital photographs into a color-managed workflow using generic and working-space profiles.

Indeed, profiles cannot compensate for all variability and are not meant to eliminate the need for image editing. Even for digital cameras, however, profiles can reduce the amount of time needed to color edit an image by as much as 85 to 90 percent. If you choose to profile your camera, the trick is to determine which solution works best for you. Following are the three most common options for profiling cameras.

1 Use a working space instead of a camera profile.

   The simplest option is to convert your images to a working-space profile when you edit it. If your display is calibrated and you are consistent with your workflow, you will be able to use soft-proofing (camera workflow and soft-proofing of images are covered in detail in Lessons 5 and 6) to predict what the image will look like in print.

   Certain cameras, particularly digital single-lens reflex models, enable you to select the working-space profile for the camera. Once an image is taken, an in-camera process converts the image from the camera's native color space (usually a generic profile for that model of camera) to the selected working

space and embeds that profile in the image. This option is typically limited to one or two working-space profiles, such as AdobeRGB or sRGB.

The Nikon D100 digital single-lens reflex camera has three Color Mode options: AdobeRGB, which converts the image to the same working space used in Photoshop, and two sRGB profiles.

In conjunction with the working-space profiles, it's a good idea to create a custom white balance for each scene being photographed. Additionally, working in RAW format enables greater flexibility during editing.

NOTE ► If you chose to create a custom profile for your camera, disable the use of a working space within the camera to avoid double color management (transforming the image twice), which will produce poor results.

2 Use the camera-profiling feature of your profiling software.

The process is simple: shoot an image of the target in each scene. Before you process the images, create a profile from each shot of the target, and use it as the source profile for the image. The results may vary; most photographers find that the results are flat and lack contrast, or that the profile simply doesn't do the job and doesn't warrant the time required.

3 Use a profiling package designed specifically for digital cameras, such as Integrated Color Corp.'s ColorEyes 20/20.

In the case of ColorEyes 20/20, you only have to create the profile once—regardless of the lighting conditions—for each camera. The trick is to light the target precisely as instructed. While this requires a bit of time and patience, many photographers have found it to be worth the effort—especially for studio photography. There are several key features in this package: a specialized target; an extremely specific process for lighting and photographing the target; use of the camera's gray balance in profile

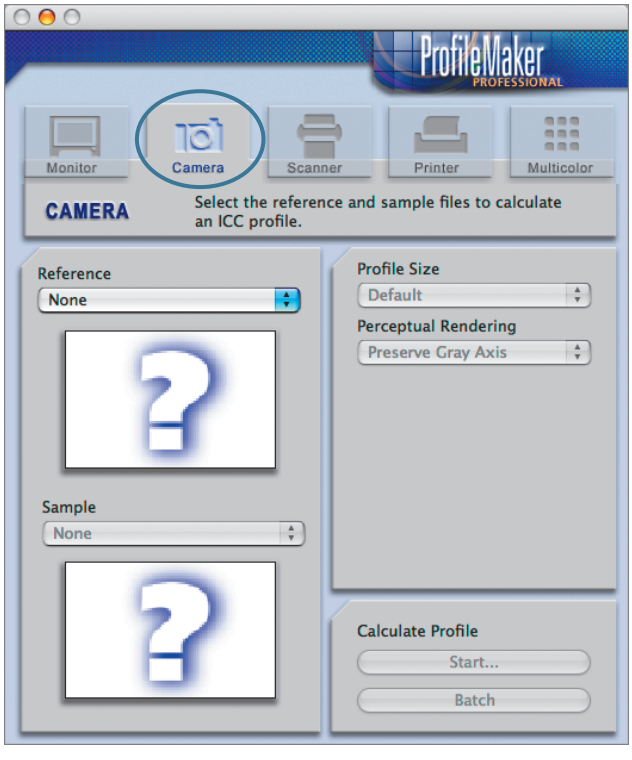
creation; and finally, a profile-generating algorithm specifically designed for digital cameras.

NOTE ► Lessons 5 and 6 go into greater detail about the use of camera profiles and working spaces in Adobe Photoshop.

Creating a Digital Camera Profile, Take One

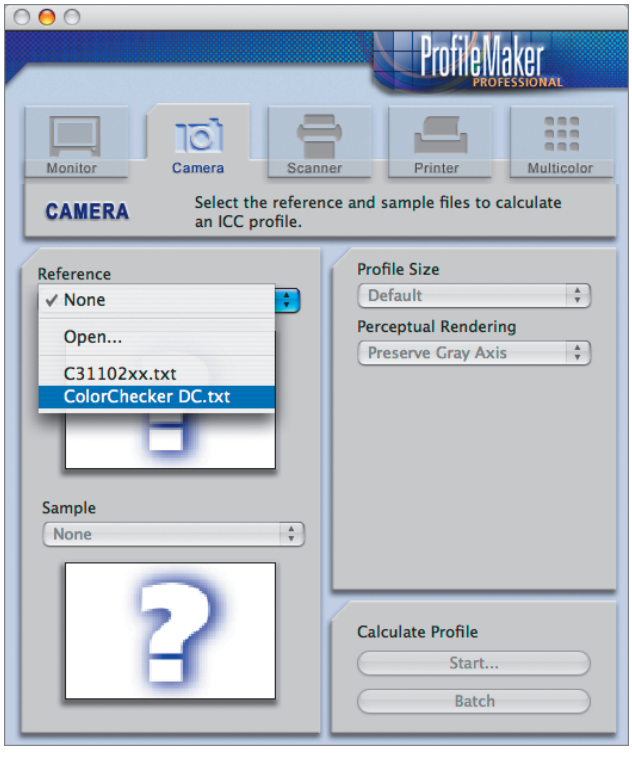
This exercise uses GretagMacbeth's ProfileMaker 4.1 Professional to create a digital camera profile. If you have not already installed the trial version of ProfileMaker Professional from this book's CD, do so now before beginning the exercise.

1 Launch ProfileMaker Professional and select the digital camera module by clicking the Camera icon.



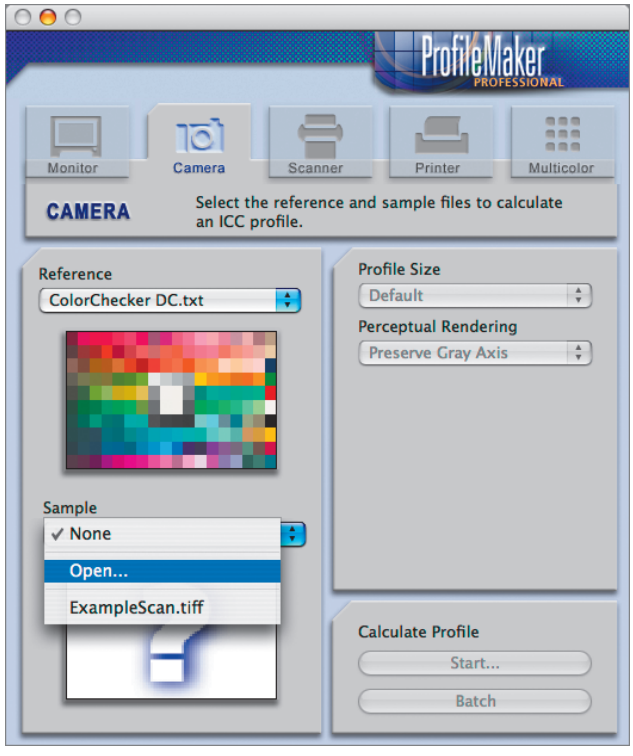
The first step is to select the reference file, which contains the expected measurement data for the target in use. The profiling software will compare the actual data from the photograph of the target to the reference data in order to build the profile.

2 Choose **ColorChecker DC.txt** as your reference target file from the Reference pop-up menu.



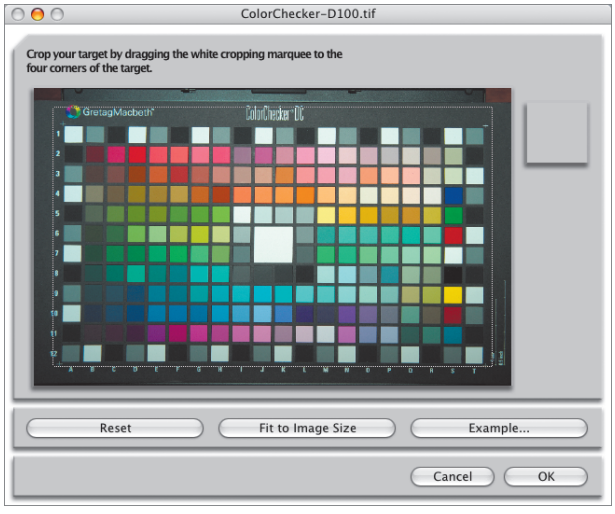
Next, you will select the target image—the actual target data from your camera.

3 Choose Open from the Sample pop-up menu.



4 In the Open dialog that appears, navigate to and select the file **ColorChecker-D100.tif** in the Color Management in Mac OS X Book Files > Lessons > Lesson04 folder on your hard drive. If you have access to a ColorChecker DC or other target, use an actual image from your camera rather than the included sample image.

When you select the image, it opens automatically in another window that allows you to adjust the crop.



5 Crop the target by adjusting the marquee so that the selection includes only the color patch (exclude the grayscale patches that border the target). It's important to crop the image as described so that extraneous data, such as that from the grayscale patches, does not affect the profile creation. Click the Example button to see the exact crop. The Reset button will reset the marquee to the default settings, while the Fit to Image Size button will adjust the image of the target to fit into the crop window.

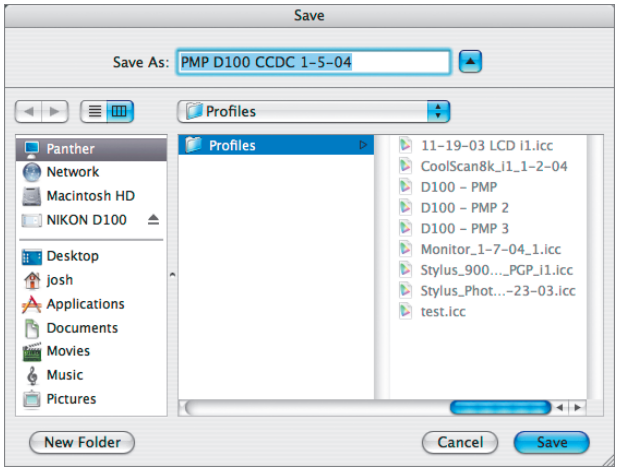
6 When you have adjusted all four corners, click OK to return to the Camera tab of the main interface.

7 Now you're ready to create the profile. Click Start.

ProfileMaker Pro displays a Save dialog and prompts you for a profile name.

NOTE ► The demonstration version of ProfileMaker Professional included on this book's CD will not save the profile. The full version of the application is required to save profiles.

8 Give the profile a meaningful name.



In this example, the profile name is "PMP D100 CCDC 1-5-04." *PMP* indicates that it was created using ProfileMaker Professional; *D100* indicates that the profile is for a Nikon D100 camera; *CCDC* stands for the ColorChecker DC target; and *1-5-04* is the date it was created.

NOTE ► ProfileMaker Professional automatically selects the ColorSync Profiles directory to save the profile. If you use a different camera-profile utility, be sure to store your profile in this directory.

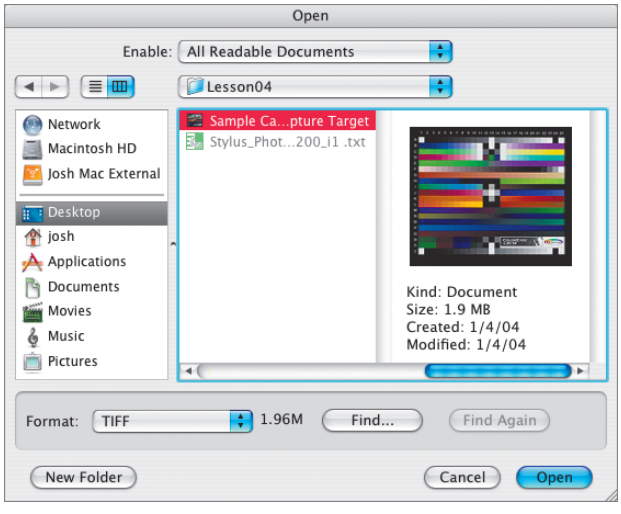
9 Click Save. ProfileMaker Professional generates the profile. Depending on the speed of your Mac, it will take approximately one minute. When finished, ProfileMaker Professional returns to the Camera window. Quit the application when finished.

Creating a Digital Camera Profile, Take Two

The following exercise uses the ColorEyes 20/20 Adobe Photoshop plug-in and a sample target included on this book's CD to create a digital camera profile. If you have not already installed ColorEyes 20/20 from the CD, do so now.

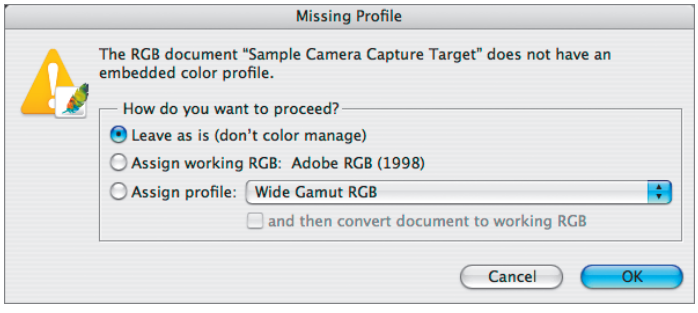
1 Launch Adobe Photoshop and choose File > Open.

2 Navigate to the **Sample Camera Capture Target.tif** file in the Color Management in Mac OS X Book Files > Lessons > Lesson04 folder on your hard drive, and click Open.

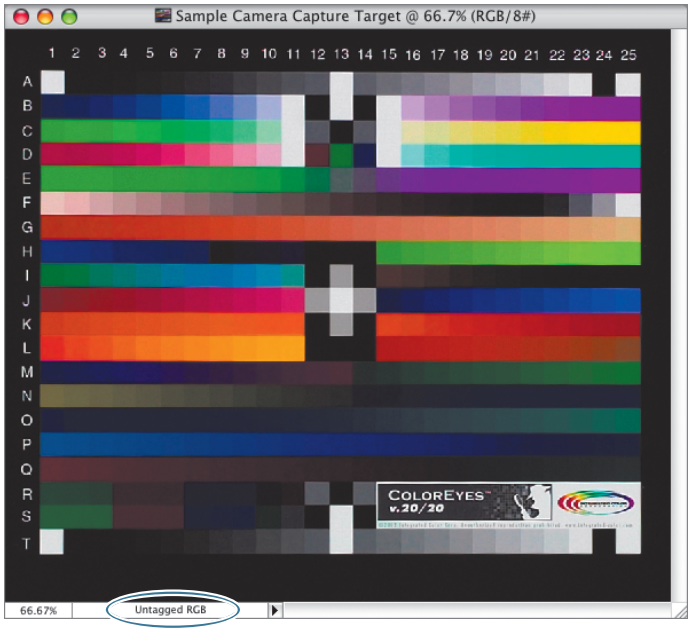


NOTE ► A photograph of the ColorEyes target is included on this book's CD for this exercise. If you have purchased ColorEyes, you can photograph the target yourself as described in the user manual and open that image of the target, instead of the sample file.

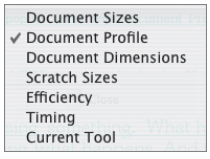
3 If Photoshop displays the Missing Profile alert, select "Leave as is (don't color manage)" and then click OK. This tells Photoshop not to convert the file to a working space, as we don't want to apply any color changes to the target.



4 To ensure that the file has opened correctly, look at the lower-left corner of the image window. The name of the working space should be displayed: Untagged RGB. If it is, skip to step 9.

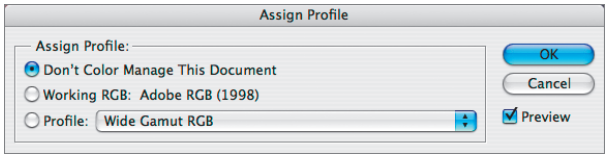


5 If the profile name does not display, or if Photoshop displays an incorrect profile, click the right-pointing arrow and select Document Profile from the pop-up menu.



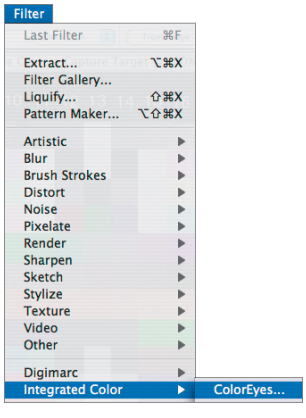
6 If Untagged RGB now appears, skip to step 9. If not, choose Image > Mode > Assign Profile.

7 In the Assign Profile dialog, select the Don't Color Manage This Document option and then click OK.

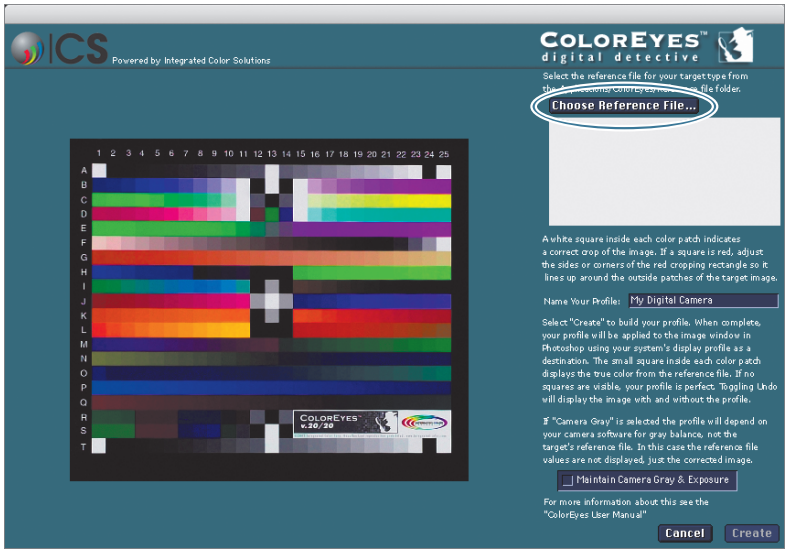


8 Once again, choose Document Profile from the image window's pop-up menu, and Untagged RGB should now display.

9 To launch the ColorEyes plug-in, select Filter > Integrated Color > ColorEyes.



10 To provide ColorEyes with the appropriate reference file for the target image, click the Choose Reference File button in ColorEyes' main window.



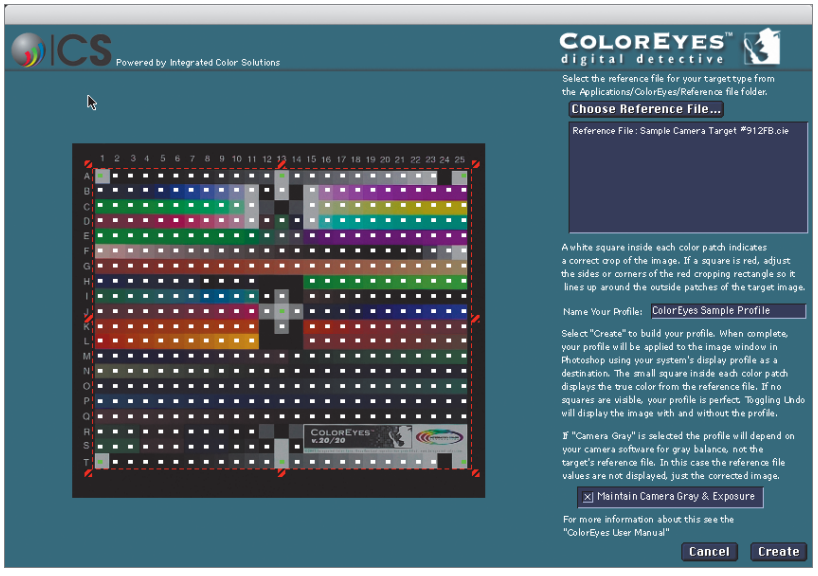
The Choose a File dialog appears, enabling you to choose a reference file.

11 Navigate to the target reference file **Sample Camera Target Reference File.cie**, located in Macintosh HD > Color Management in Mac OS X Book Files > Lessons > Lesson04.

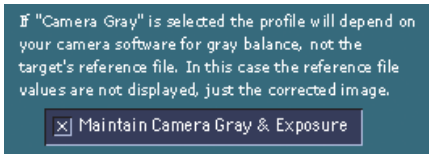
This file contains the known values for the target, which will be compared to the values from the image of the target taken with a digital camera.

12 Click Choose. ColorEyes now displays a grid overlaid on the target image. The grid tells the software where each of the patches are on the target, so that the software can accurately process the data. It's important to properly position the grid.

13 Adjust the corners by dragging the square red handles of the grid until all of the gray corner squares have a green dot.



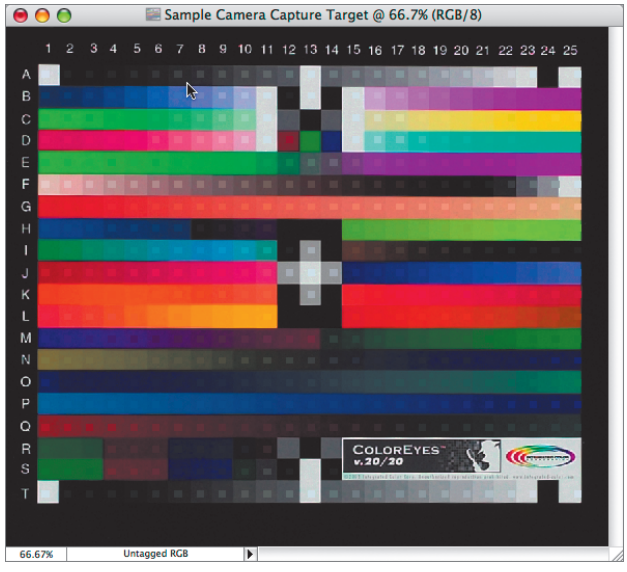
14 Next, check the Maintain Camera Gray & Exposure box in the lower-right area of the ColorEyes window.



This instructs ColorEyes to use the gray balance from the camera, resulting in a profile that will correct hue and saturation values but will leave gray and exposure values untouched.

15 Give your profile an intuitive name in the Name Your Profile box, and then click Create.

ColorEyes processes the data and creates the profile, which is automatically added to the ColorSync profile library, and returns you to Photoshop's main interface.



16 Close the image window or quit Photoshop without saving the file. The target has been modified to illustrate the changes that were made in creating the profile.

These exercises demonstrate two approaches to creating camera profiles; using camera profiles as part of a color-managed workflow will be covered in depth in Lesson 5. Remember, digital cameras are perhaps the most difficult devices to profile. The challenge is to photograph the target properly to create an accurate profile. The benefits of camera profiles will be realized only when a high-quality profile is both created and used in a color-managed workflow. If you are just getting started with color management, you may consider first profiling just your display and printer(s) to establish a color-managed workflow, and then later, if you encounter inconsistencies and unpredictable outcomes with digital images, profile your camera.

Creating Scanner Profiles

Scanner profiles improve the consistency and predictability of your color images and save you time. Creating scanner profiles is easy and straightforward: you scan a target, and the profiling software compares the scan to reference data for that target and generates a profile.

To create a profile for your scanner, you will need profiling software, a target, and the target reference file. Ideally, you want the target to be the same film or paper type as the original you're scanning. For example, if you're scanning a print (also known as a *reflective* image), your target should be reflective; if your image is on transparency or film (also known as a *transmissive* image), your target should be transmissive.

> **NOTE ►** There are no targets for negative film. This is largely due to the challenge of scanning negatives, caused by the orange mask in the negative.

The most common target is the IT8 target—IT8.7/1 for transmissive media, IT8.7/2 for reflective media—although there are others. Whichever target you use, you must have its accompanying reference file, which includes its unique measurement data. The profiling software will compare the data from the scan of the target to the reference file to make the profile.

Some profiling packages allow you to create your own reflective target by printing an image file of the target. The process is straightforward: first you print the target, then measure it to determine the color values, then you scan the target. The software uses your measured values as the reference file.

Preparing to Profile Your Scanner

Here are a few guidelines to keep in mind when scanning the target:

- Clean the target before scanning.
- Crop the target using the crop marks (see the example in the following exercise).

- Select a moderate resolution: 150 dpi will suffice; any more resolution is not necessary and will result in longer processing times. Use 16 bits if supported. A bit depth of 16 bits captures more color data for the profiling software to work with.
- Straighten the scan in Photoshop if necessary. If the scan is not straight, the profiling software will have difficulty finding the patches, resulting in profile errors.
- Don't adjust the resulting scan except to straighten it.
- Don't embed a profile in the resulting scan.

Here are some guidelines for creating good scanner profiles:

- Keep settings consistent: whatever settings you select to create the profile, use them to scan images. If your scanner software can save settings as presets, use this feature to ensure consistency.
- Turn off your scanner's automatic adjustment features. If you can't turn the automatic modes off, you'll have a hard time profiling the scanner.

  NOTE ► You can leave Applied Science Fiction's Digital ICE and GEM features alone—they don't affect color management.

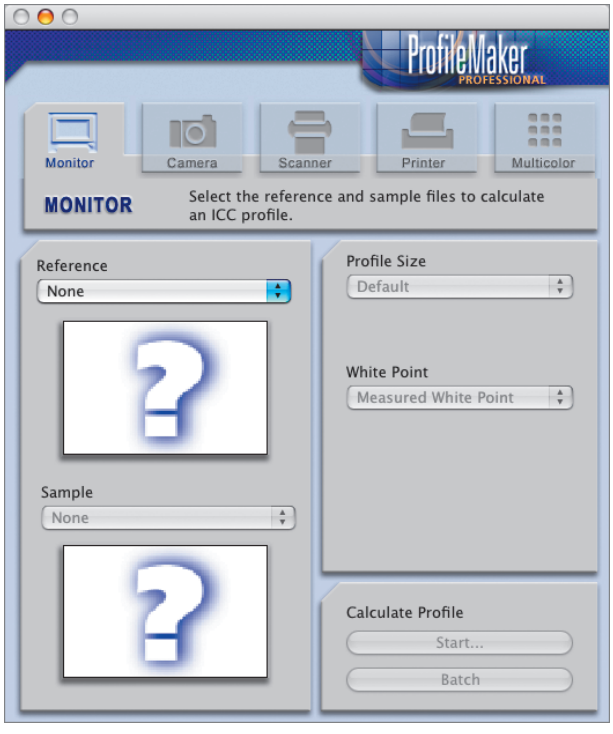
- Turn off sharpening in the scanner, and sharpen in Photoshop.
- The easiest solution is to use the default scanner settings, which are often wide open, and edit in Photoshop.
- With some scanners you can use a display profile for onscreen previews. This improves the accuracy of the onscreen preview because it factors in the unique characteristics of your display—another reason to create a custom display profile!

  TIP If you send your images out to be scanned, ask the service bureau to embed the scanner profile in the saved image. If the service bureau staff will be editing the image for you, insist that they embed the Photoshop working-space profile in the saved file.

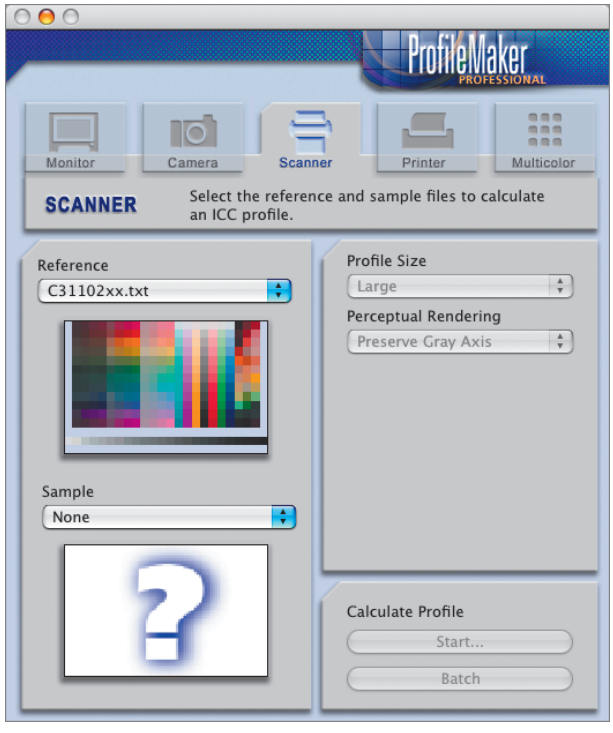
Using a Target to Create a Custom Scanner Profile

For the purpose of this exercise, we'll use GretagMacbeth ProfileMaker Professional and the accompanying sample scanner target. Other profile-creation suites include comparable functionality.

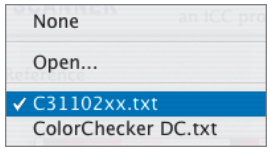
1 Launch ProfileMaker Professional. By default, it opens to the Monitor profiling tab.



2 Click the Scanner button to begin. The Scanner profiling window opens.



3 Choose C31102xx.txt from the Reference pop-up menu.

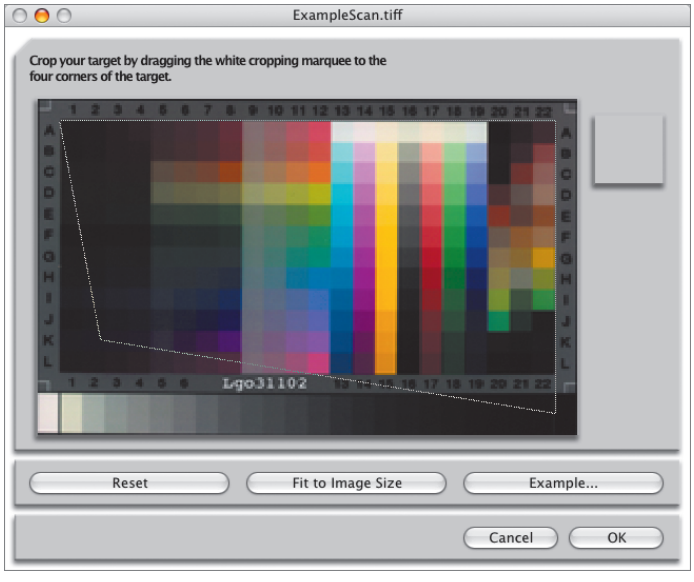


This tells ProfileMaker Professional which reference file to use in the profile creation. The reference file contains the known values for the corresponding target. ProfileMaker Professional provides support for different scanner target files, any of which can be used as long as you have the accompanying reference file. This exercise uses a sample reference file installed with ProfileMaker Professional.

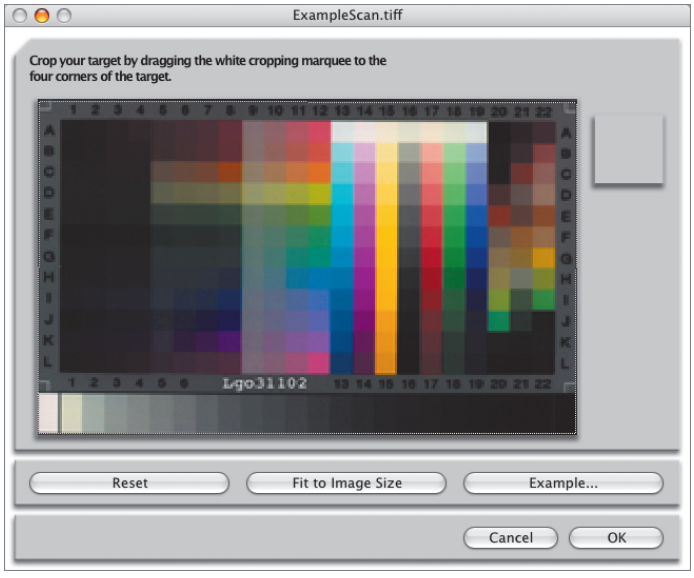
4 Choose ExampleScan.tiff from the Sample pop-up menu.

The Sample selection is used to select the scan of the target. This exercise uses a sample scan installed with ProfileMaker Professional.

Once the scan is selected, a window automatically opens showing the scan of the target.

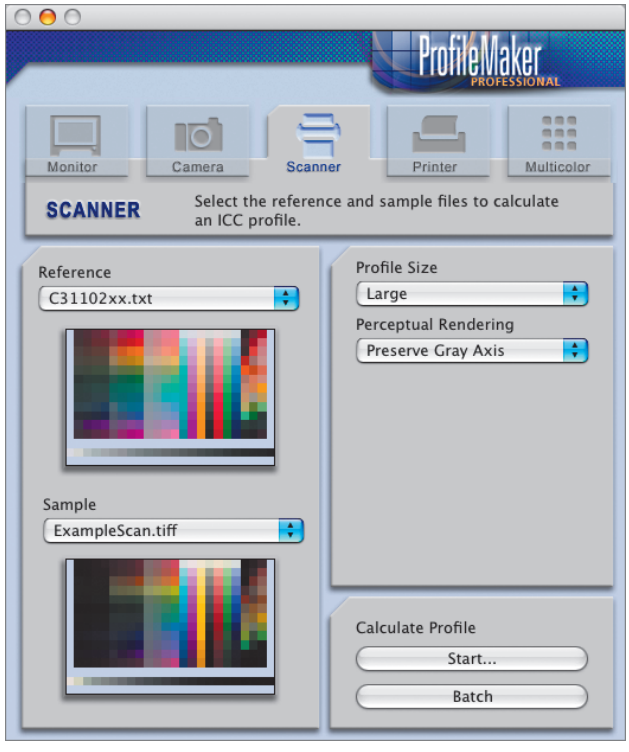


5 Crop the target by adjusting the marquee so that the selection includes only the color patches within the crop marks as well as the grayscale ramp at the bottom, as shown in the following image.



It's important to crop the image as described so that extraneous data does not affect the profile creation. Click the Example button to see the exact crop location. The Reset button will reset the marquee to the default settings, while the Fit to Image Size button will adjust the image of the target to fit into the crop window.

6 Click OK to return to the Scanner tab of the main interface when you have adjusted all four corners. The Reference and Sample files should be selected, as shown in the following image.



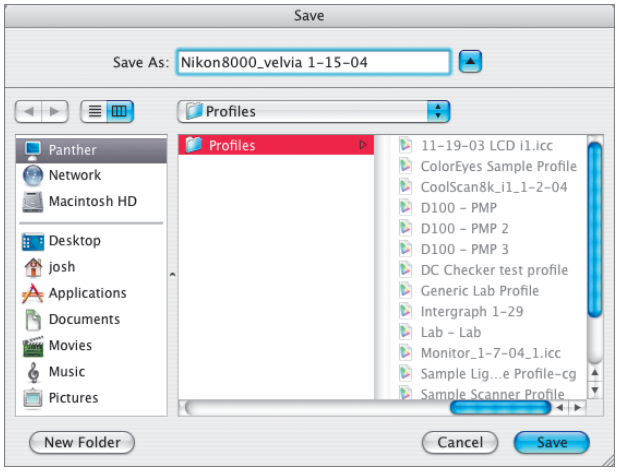
Two additional advanced options are provided: Profile Size and Perceptual Rendering. Profile Size enables you to change the size of the profile created. Large provides the best results in exchange for longer processing times. Select Large; with today's fast computers, there is a trivial difference in processing times between Large and other settings.

Perceptual Rendering factors the media and color characteristics of the device in such a way as to ensure that the human eye will perceive the image in the most faithful reproduction possible of the original. The recommended setting is Preserve Gray Axis.

ProfileMaker Professional is now ready to create the profile.

7 Click Start to create the profile.

8 Save the profile using a meaningful name such as the scanner name, the date the profile was created, and the media type. ProfileMaker Professional automatically selects the Profiles directory to save the profile in.



NOTE ► The trial version of ProfileMaker Professional included on this book's CD does not save profiles.

9 Quit ProfileMaker Professional.

Creating Profiles for Output Devices

Creating a profile for your printer is the ultimate step in creating a color-managed workflow. While it may seem like a daunting task, it's easier than it seems, and it can have a profound impact on the effectiveness of your color management system. Once you have an accurate printer profile, tasks like soft-proofing (simulating your printer on your display) and press-proofing (simulating a press on your printer) become not only possible but also invaluable.

Many printer manufacturers now include high-quality profiles for their devices in the box; some even include profiles for different paper and ink combinations. While these profiles are often quite accurate and will definitely make an improvement, they do not factor in variables such as subtle differences in ink and paper lots, changes that occur as a printer ages, and other environmental factors. They also don't help if you use third-party inks or papers, as even minor variations in paper noticeably affect how color is reproduced. For more accurate color management, creating a custom profile is the way to go.

To create printer profiles, a color-measurement device is used to measure patches printed from your printer. The device is controlled by the profiling software, which generates the profile by comparing the expected values with the actual values.

All profile-creation suites offer the capability to profile printers (many also include a suitable measurement device such as a spectrophotometer or colorimeter) in an easy-to-use package. The more expensive packages typically provide more advanced features (and increased complexity), such as greater control over the algorithm used to generate the profile, the capability to profile presses that use more than four colors, and profile editing (adjusting the profile after it has been created). If you need these types of advanced features, then evaluate packages such as GretagMacbeth ProfileMaker Professional or X-Rite's MonacoProfiler.

Preparing to Profile Your Printer

The fundamental process for creating a printer profile is relatively simple: You just print a target—or a set of color patches, which are typically included with the software—and measure it with a device. The software then generates a profile.

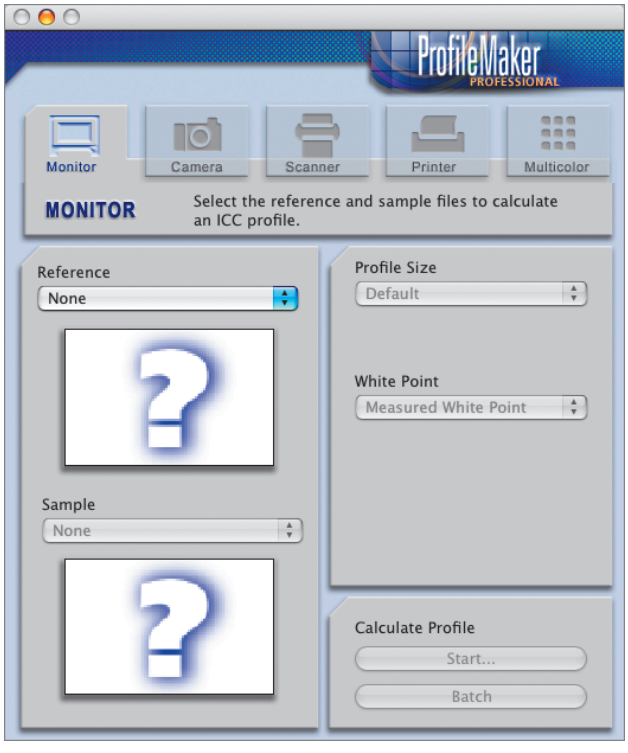
There are some important details to be aware of before starting:

- Determine whether your output device is CMYK or RGB. The profiling software will require you to print a target for one color space or the other. Most desktop printers are RGB, while most printing presses are CMYK. Desktop printers such as the Epson Stylus Photo and Canon photo printers are RGB, even though they use CMYK inks (the printer driver converts everything into RGB). If you're unsure whether your output device operates in CMYK or RGB, contact the manufacturer's technical support or use the exercise in Lesson 3 to find out before you create the profile.
- Calibrate your measurement device. As discussed in the beginning of this lesson, you will need an appropriate measurement device, such as the GretagMacbeth Eye-One Pro or X-Rite DTP41 spectrophotometer. Calibrating the device before profiling ensures that the device is measuring properly.
- Select the appropriate target. Most profiling applications include targets for different printers—at least for RGB and CMYK devices—and are designed to work well with a particular device. However, a number of targets are based on industry standards or are from known color gurus; these targets are often available for download on the Internet. They range in number and diversity of patches, layouts for specific devices, and page sizes. The target included with your software should suffice. If your profiling software supports different targets, try one with more patches to see if more data points improve the quality.
- Print the target properly. It is extremely important to follow the instructions for printing the target (provided with the profile-creation software), as there are specific steps required for printing the target, such as turning off the color management (compared with turning it on for normal printing) and setting the resolution and size.

Creating a Printer Profile

For the purpose of this exercise, we'll use GretagMacbeth ProfileMaker Professional. Other profile-creation suites include comparable functionality.

1 Launch ProfileMaker Professional. By default, it opens to the Monitor profiling tab.



2 Click the Printer button to begin. The Printer profiling window appears.

3 Chose the target reference file i1 RGB 1.5 Ref.txt from the Reference menu. This tells ProfileMaker Professional which target you will use to profile your printer.

ProfileMaker Professional includes a large number of targets and corresponding reference files, which provide support for different instruments, printer types, and target types. There are two important factors in selecting the target. First, determine whether your printer is RGB or CMYK; each supported target is labeled either RGB or CMYK.

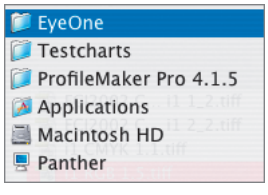
NOTE ► Complete the exercise in Lesson 3 to determine your printer type.

Second, determine which measurement instrument you will use. ProfileMaker Professional includes targets preformatted for different instruments. For example, i1 RGB 1.5 Ref.txt is preformatted for the Eye-One device and for an RGB device, so it is the target we selected for this exercise.

Now that you've selected the target reference file according to the device and printer type, you will open and print the actual target.

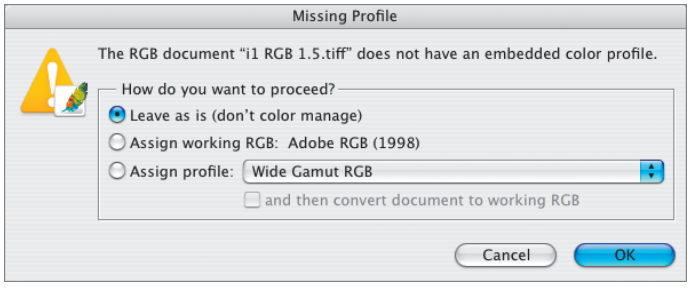
4 Launch Photoshop by double-clicking its application name or icon in the Applications folder of your hard drive, or by clicking it in the Dock.

5 Choose File > Open and navigate to the Applications > ProfileMaker Pro 4.1.5 > Testcharts > EyeOne folder on your hard drive.

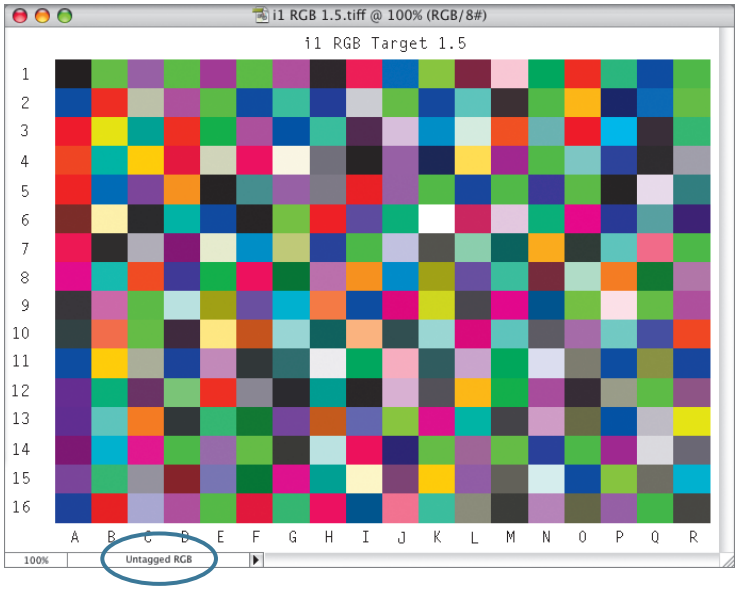


6 Choose the **i1 RGB 1.5.tiff** target and click Open.

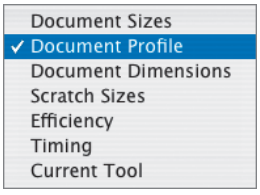
7 If Photoshop presents the Missing Profile dialog, choose "Leave as is (don't color manage)." This tells Photoshop not to convert the file to a working space. Then click OK.



8 Ensure the file has opened correctly by checking the information area in the lower left of the image window. It should read Untagged RGB if you've opened the RGB target, or Untagged CMYK if you've opened the CMYK target. If so, skip to step 13.

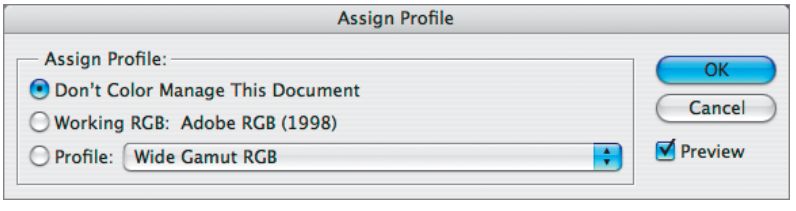


9 If the information area reads differently, choose Document Profile from the pop-up menu.



10 If the pop-up menu says Document Profile but the information area still doesn't say Untagged RGB/CMYK, choose Image > Mode > Assign Profile.

11 In the Assign Profile dialog box, choose Don't Color Manage This Document and click OK.

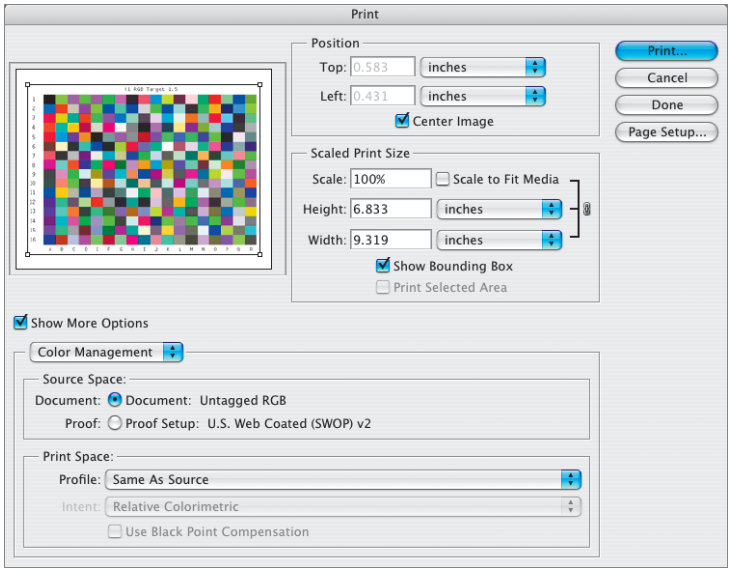


12 Check the information area again, choosing Document Profile from the pop-up menu if necessary, and it should read Untagged RGB or Untagged CMYK.

Now we can print the target.

13 Choose File > Print with Preview.

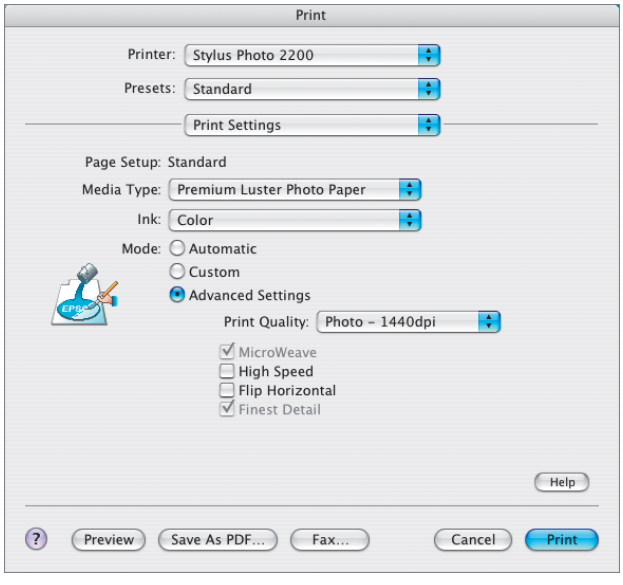
14 In the Print dialog, check the Show More Options box and choose Color Management from the pop-up menu just below it.



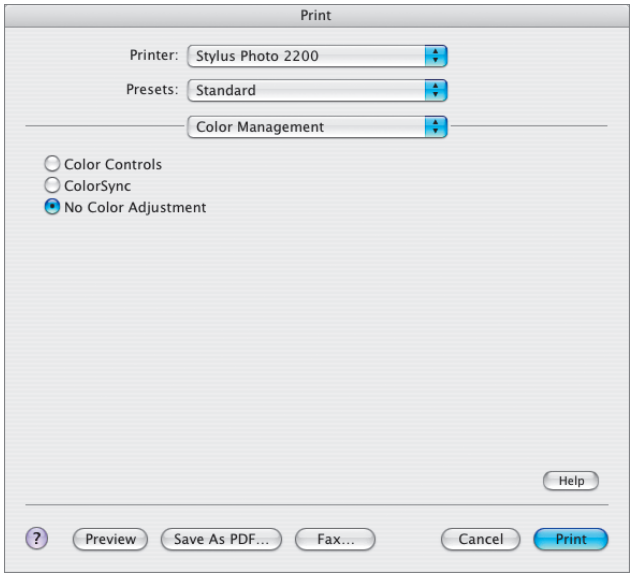
15 Under Source Space, choose Document: Untagged RGB, and under Print Space, choose Same As Source from the Profile pop-up menu. As in previous exercises, we're telling Photoshop not to color manage the file but rather to send it straight to the printer. The goal is to capture the printer's native gamut. Applying any color management will affect the results.

16 Click Print, and in the printer driver dialog that appears, choose your printer from the Printer pop-up menu.

17 Click the Copies & Pages pop-up menu to locate your printer's media settings, and then choose the correct paper for your device. The location of the media option varies with each printer; look for it under a heading such as Print Settings, as shown in the following figure. This is an essential step, as the media option controls the amount of ink the printer will use. If the paper you're using is not listed, either check with the paper manufacturer or choose the closest available setting. If you have the option, disable any automatic settings (such as by selecting Advanced Settings, also shown in the following figure).



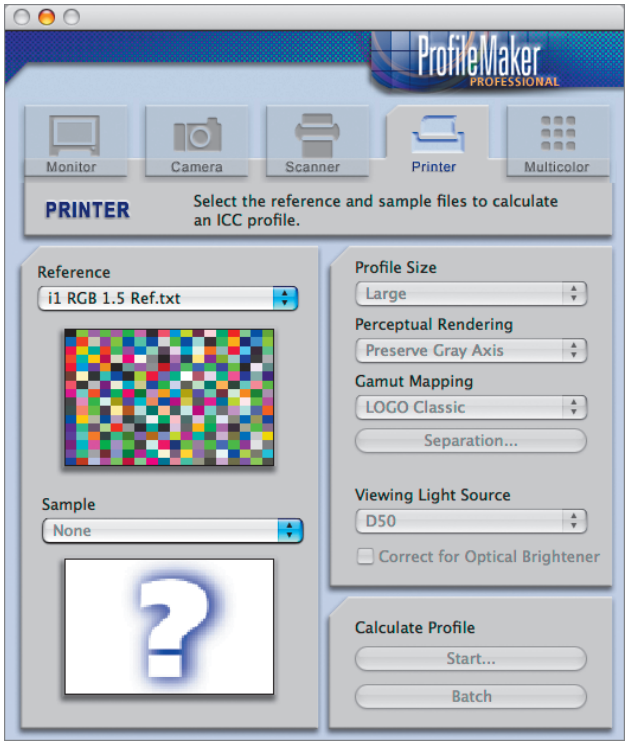
18 Click the Copies & Pages pop-up menu again to locate your printer's color-management options, and *turn them off.* The location of these options varies with each printer; look for them under a heading such as Custom, Advanced, or Color Management. The following image shows the Color Management option in the Epson Stylus Photo 2200 printer driver, with No Color Adjustment selected.



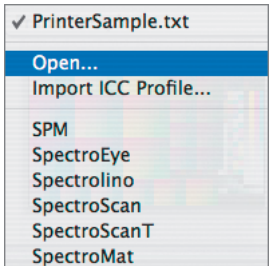
TIP Save these printer settings to use again when printing with the profile. It's important to always print with the same settings—changing the resolution or paper type will affect the results. Save them by choosing Save As from the Presets menu.

19 Click Print to start printing the target.

20 Once you have successfully printed the target, return to ProfileMaker Professional to begin measuring the printed target.

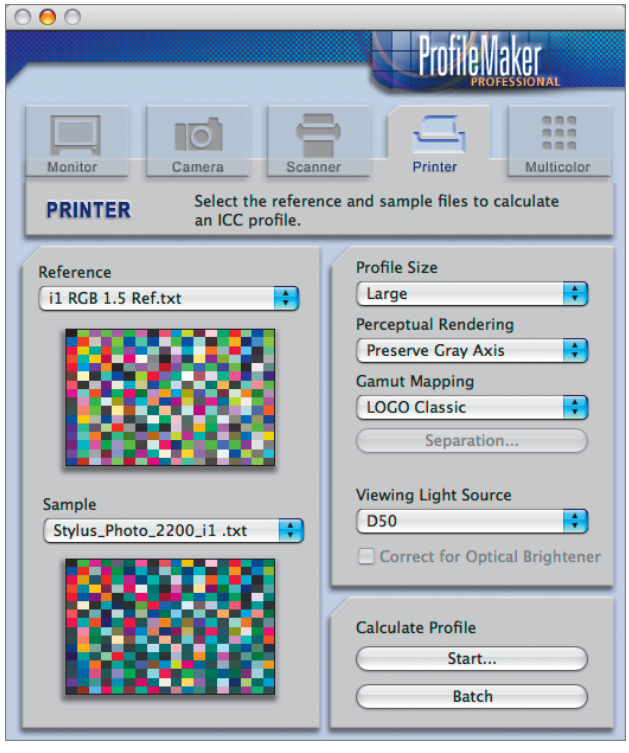


21 Select Open from the Sample menu. Navigate to the Color Management in Mac OS X Book Files > Lessons > Lesson04 folder on your hard drive and select the **Stylus_Photo_2200_i1.txt** file.



This file contains measurement data for the Epson Stylus Photo 2200 with the i1 target. At this stage, you would normally use your instrument to measure the printed target. Instead of selecting a file containing the measurement data, you would select a device from the Sample list. Selecting a device from the list enables ProfileMaker Professional to communicate with the instrument directly.

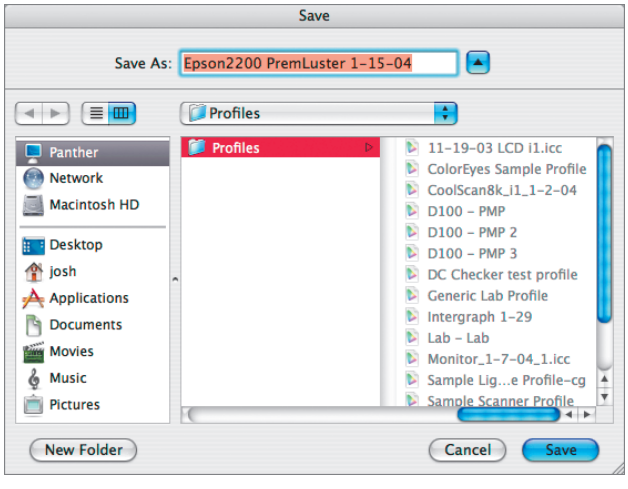
TIP Wait until the target is dry before measuring it.



Several options affect how the profile is created. Profile Size and Perceptual Rendering were discussed in the previous exercise. Gamut Mapping describes how out-of-gamut colors are adjusted so that they are in gamut. ProfileMaker Professional provides two methods: LOGO Classic (which I selected) or LOGO Chroma Plus. Either one is a good choice.

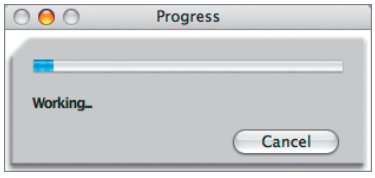
The Viewing Light Source option should be set to the color temperature of the lights under which you will view images. For example, if you have a light box, select the color temperature that corresponds to your light box. If you will use ambient lighting to view images, select D65. The best method to determine the correct setting for Viewing Light Source, aside from using a light booth, is to experiment with different settings and compare the results with the display.

22 Click Start to create the profile. ProfileMaker Professional will prompt you to name the profile. Again, use a meaningful name: for example, the printer name, paper type, and date it was created.



NOTE ► The trial version of ProfileMaker Professional included on this book's CD does not save profiles.

23 Click Save. ProfileMaker Professional will process the data and create the profile. It will take several minutes to create the profile, during which time ProfileMaker Professional displays a progress bar.



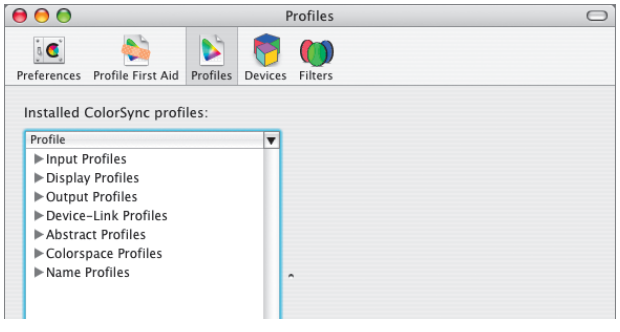
24 When ProfileMaker Professional is finished, choose File > Quit.

Comparing Output Profiles

Once you've created a custom printer profile, you can easily compare it with the generic profile for your printer, similar to the way you compared your display profiles earlier in this lesson. This exercise will show you how to do that, which will illustrate the value of creating a custom profile for your printer.

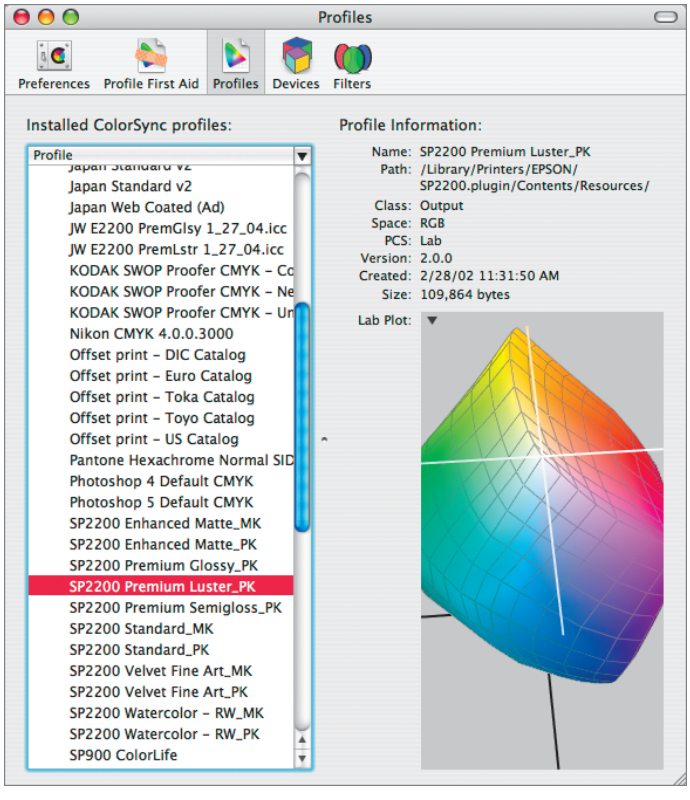
1 Launch the ColorSync Utility inside the Applications > Utilities folder on your hard drive.

2 Click the Profiles icon.



On the left, the utility displays a list of all of the profiles installed on your system, organized by category. If your screen looks different, click the triangle on the Profile list box and select "Group by class" to change the view.

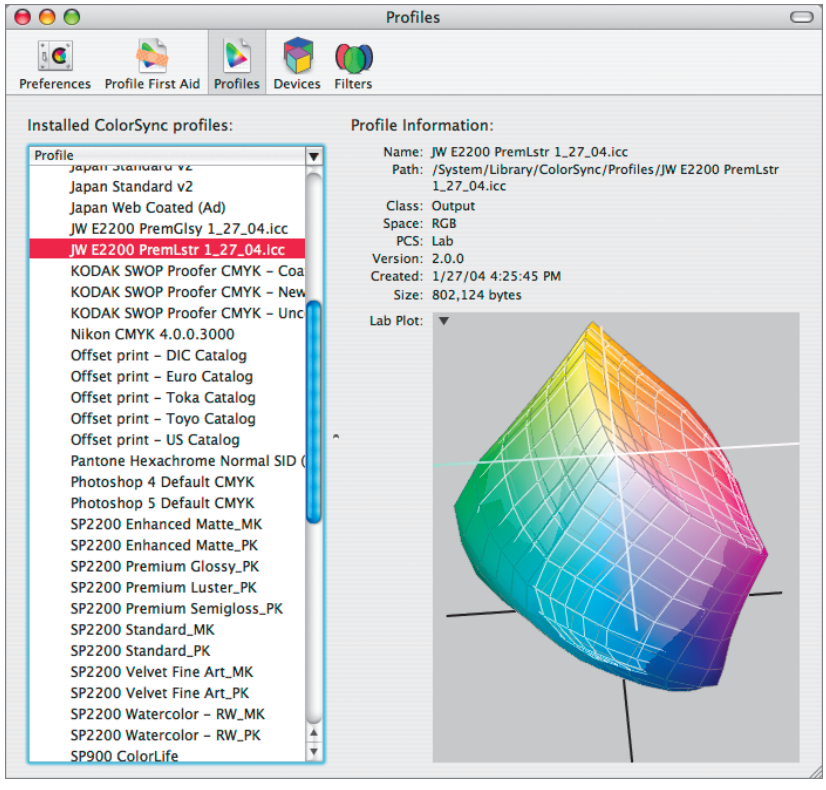
3 Choose a generic profile for your printer from the list, such as SP200 Premium Luster_PK. Information on the selected profile, including a 3D color model, is displayed on the right.



Notice the location, color space, creation date, size, and other information for this profile, including its Lab Plot 3D visual representation.

4 Click the triangle in the Lab Plot area and choose “Hold for comparison” from the pop-up menu.

5 Choose a profile for your printer such as JW E2200 PremLstr 1_27_04 from the left-hand list. The ColorSync Utility displays an overlay plot of the two profiles.



The ghosted white outline is the first profile, the generic Stylus 2200 profile, compared to the profile created for me by Chromix. The areas on the outside of the cube, in color, and the dark section crosscutting the cube are areas where the custom profile contains more data than the generic Epson profile. The custom profile's larger color gamut can be attributed to a number of factors: differences in the ink or paper, a newer printer driver that is affecting the output of the printer, or variables in the profiling device and software.

The custom profile's larger color gamut, however, doesn't ensure that it will yield better, more accurate, or more predictable color output. The only sure way to determine which profile provides the best results is to visually compare the results of each profile both onscreen and in print. Once your system is fully profiled and your applications are set up, print an image using each profile, and then compare the results, both between the profiles and with what you see onscreen (an exercise you'll complete in Lesson 6).

You can also use the preceding exercise to compare other, disparate profiles: your display profile to your printer profile, for example. That will illustrate the differences in the devices, and you will get a much better picture of the differences by running the comparison yourself; the figure in step 5 on the preceding page shows only one angle of the three-dimensional color gamut. As you rotate the color model, you will see areas of color that do not overlap.

Try this exercise with profiles for your devices, as well as standard press profiles such as U.S. Sheetfed Coated v2.

Profiling Printing Presses

With desktop printers, you can control the device and you are typically making a few prints at a time. With a printing press, in contrast, you typically have no control and are making a lot of prints. Due to the expensive nature of printing on press, color becomes even more critical. You can still take advantage of color management if the final destination for your color work is a printing press, but since you will have less control over the process, you will need to work with your printing partner to determine how to best handle color management.

Most printing companies utilize process control to keep their presses printing consistently, often to one of several printing industry standards (based on the specific process, paper type, etc.). The ideal situation is to find a printer that understands color management and has custom ICC profiles to which they keep their press(es) calibrated. Many printers will have instructions for using these profiles in conjunction with their services. Lesson 9 will cover the use of profiles to proof and separate your color documents in more detail.

An important issue to keep in mind with traditional offset printing is that—from the moment you hand your color data to the printer to the time the job comes off the press—getting your document printed introduces several steps, each of which has its own variables that can affect the final color. Your document may be output to color-separation films, which are then used to make the plates for the press. The printer will likely insist that a proof be made (often called a contract proof). Since the printer will agree to match this proof (hence the term *contract proof),* it's important to carefully check the film proofs and make changes based on how they look. The press plates will be made from the same color data as the proof.

Digital presses reduce the variability (and cost) of offset printing by eliminating the need for films and plates. Most digital press operators will still offer a proof, although it will typically be from a desktop printer (such as a high-quality inkjet printer) using profiles that simulate the press. You can also use your desktop printer to simulate the press (a technique covered in Lesson 9). Regardless of the type of press, it's a good idea to give your proof to the printer.

Finally, you'll want to insist on a press check to ensure the prints coming off the press match the contract proof.

If your printer doesn't offer ICC press profiles, you have a few choices:

1. Use standard press profiles (such as SWOP) to proof and separate your images. Then communicate with your printer—let the printer know what type of press profile or standard you used to separate your images. Be sure to use a contract proof. Press profiles are widely available, and applications such as Photoshop typically include several standard press profiles.
2. Find a new printer who offers ICC profiles and keeps its presses well calibrated.
3. Create the press profile yourself, although this is not highly recommended unless you operate your own press. It will be expensive, but if you're doing enough printing with that printer, it can be worth it. The process is essentially the same as the exercises included in this lesson, except the choice of target will be different. You'll want a CMYK target, such as the one included with ProfileMaker Professional.

The most important point in creating or obtaining press profiles is to communicate with your printer about the process.