How to Make an ICC Profile for the UV Innovations UV Target

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26 October 2015
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Invented and patented by UV Innovations, produced and distributed by Image Science Associates, the UV Target provides color and neutral references which can be used to correct digital images as they appear to the photographer. The target consists of four sets of patches, two sets on each side. Each set consists of three gray patches, and one each of red, green and blue. When illuminated by visible light the patches appear gray. When illuminated by UV light, they fluoresce. Each set fluoresces with a different intensity, with each set marked as low, medium, high and ultra. Depending on the amount of UV illumination, the photograph can select the appropriate set to not over-saturate the camera's sensor. For high UV illumination the low set should suffice, for low illumination the ultra set might be appropriate.

The appropriate target set can be used to color correct the image. While this can be accomplished with manual adjustments, it would be much more convenient to use modern color management to automatically correct the images. The necessary item being an ICC color management profile.

Making an ICC Profile

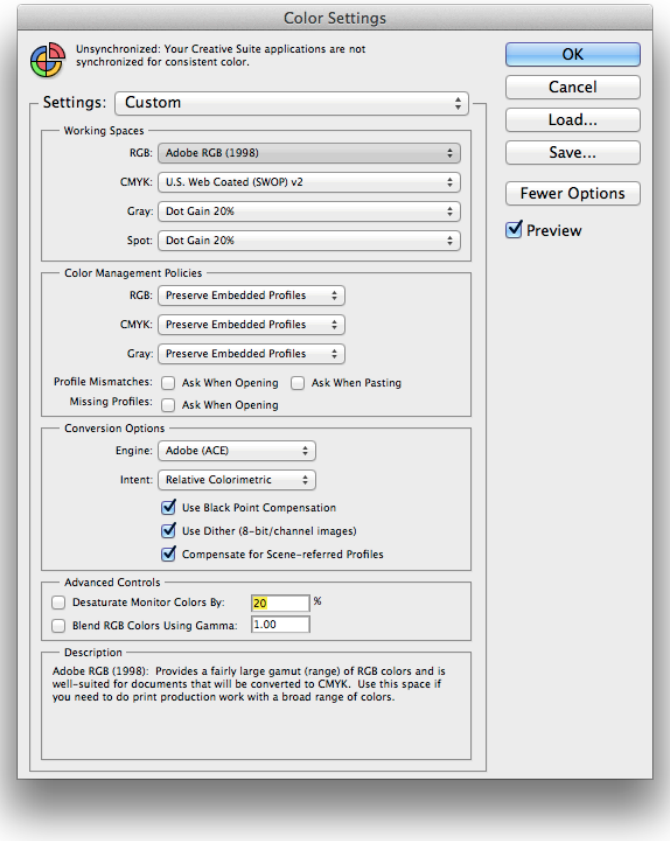
A very interesting feature of the UV Target is that the materials used fluoresce in the visible but are excited by UV light, not visible light. This is just like a CRT television set, where phosphors were excited by electrons, not visible light.

To profile a monitor, either a CRT or the more modern LCD, there are two ways to do this. One is to attach a colorimeter or spectrometer to the display's surface, then read a series of color patches to create a table for converting colors to accurately display on the screen. The patches include the red, green, and blue primaries, mixes of these primaries and mixes with white. The purpose is to create a three-dimensional table of RGB values and their measured standard values and the tonal responses for controlling the intensity of the colors. This method requires measuring many patches, sometimes several hundred.

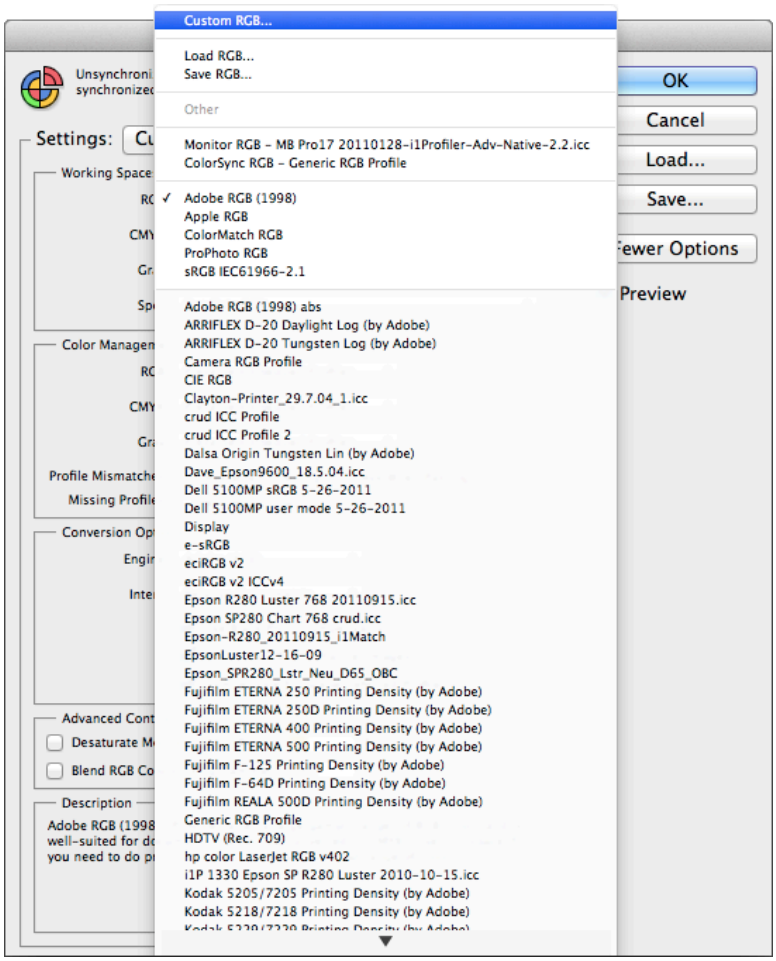
The second method for profiling a monitor is to measure only the red, green and blue primaries. In combination with the white point and a value for controlling the tonal response (aka the gamma value), a matrix can be calculated for converting colors for display on the monitor or for converting monitor colors to standard values. This method has the advantage of requiring only four patches be measured. Only three patches (red, green and blue) need be measured if the white point arbitrarily assigned.

The matrix method is simple enough that for many years Adobe has been providing a tool to create a matrix profile in their Photoshop® image editing program. To get to this tool within Photoshop, go to the "Edit/Color Settings..." menu item.

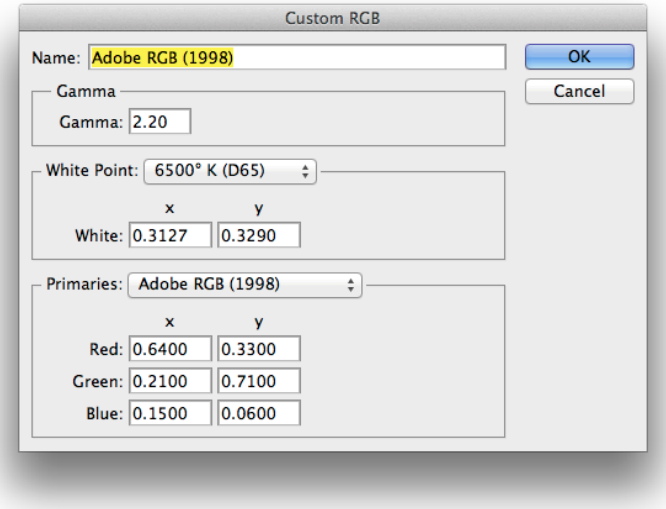
When the Color Settings window opens, make sure the bottom button in the upper-right corner is labeled “Fewer Options”. If it is labeled “More Options”, then click it to reveal the Advanced Controls. This must be done to activate the “Custom RGB” setting in the Working Spaces RGB popup menu.



In the “Working Spaces” area, click on the “RGB:” popup menu, then select “Custom RGB...” from the menu. It is found at the top of the profile list.



This will produce the Custom RGB editor window. In addition to the name for the profile, this window needs five items to define the RGB profile: the Gamma, White Point, and the chromaticity coordinates for the Red, Green and Blue primaries.



Before we can begin entering values, it is necessary to make an assumption and take some measurements.

The first two values, Gamma and White Point, will govern the tone of the image and the neutrality, respectively. For a gamma value enter “2.2”. This value is the one used by sRGB and Adobe RGB, both found in widespread use so this seems like a good starting point.

We do not have a white patch to measure on the UV Target, but again we can make use of the same one used in sRGB and Adobe RGB, which is “6500° K (D65)”. Select this value from the White Point popup menu.

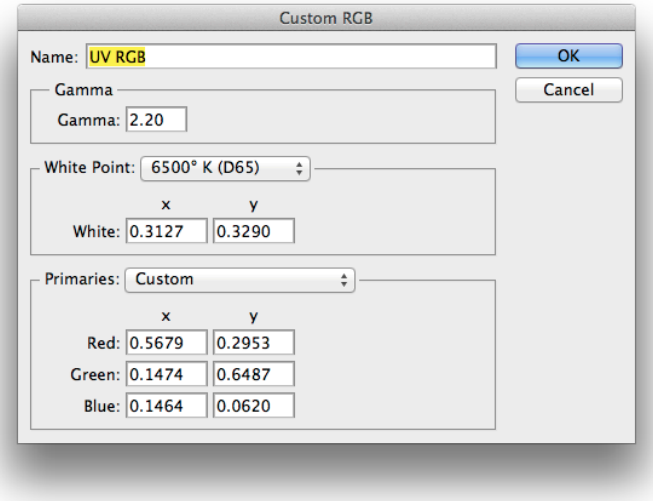
The Primaries are a bit more difficult to determine. Because the red, green and blue patches do not fluoresce until illuminated with UV light, then a UV illuminated spectrometer is needed to get these values.

Since UV illuminated spectrometers are highly uncommon, the primary values are shown below in Table 1. These values were obtained from a special UV illumination/ spectrometer device manufactured by the author for Image Science Associates. Enter the values shown in Table 1. The values were measured with this custom device and calculated with SpectraShop™, a spectral program created by the author.

Table 1.

Primary	x	y
Red	0.5679	0.2953
Green	0.1474	0.6487
Blue	0.1464	0.0620

The window should look something like this when all the values have been entered.



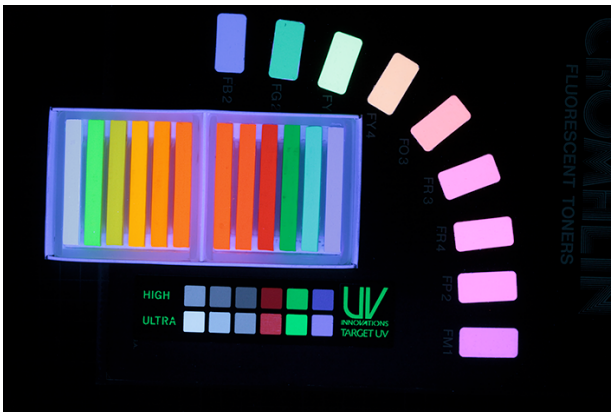
Make sure you have selected a unique name for your profile. Here we have given it the name “UV RGB”. Then click “OK” to close the window.

Click the OK button in the Color Settings window to enter the profile into the list. This will also make your profile the current working space. You can then assign this profile to your images.

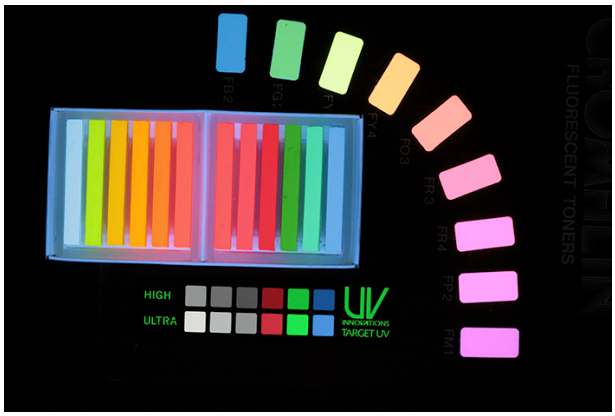
Using the Profile

When using this profile with UV fluorescence images, the first step is to neutral balance the image.

Once the image is neutral balanced, attach the profile to the image to adjust the colors.



A. Image as shot. Notice the blue cast to the neutral patches in the target.



B. Image neutral balanced to the middle High neutral patch. The blue cast has been eliminated as shown by the neutral patches.

The UV profile has been attached to the neutral balanced image. Notice that the contrast has been reduced to a more natural appearance without affecting the neutral balance.

Further Explorations

In making this profile several assumptions were made. The first was that a D65 white point provided an adequate perceptual white point. This was a reasoned guess but further experimentation is needed to determine if this holds true for a large body of images.

Another assumption was with the gamma value of 2.2 used in making the profile. Trials of different gamma values may produce a value which will better match the tonal range of the images.

With the UV Target it is now possible to have an aid for both neutral balancing UV induced visible fluorescence images. The described method for making an ICC color management profile allows these images to be treated like visible light color images in color managed imaging applications.