Colour Management I

When I started my current business, somebody told me that 20% of your clients give you 80% of your headache. I can confirm this, but when it comes to digital imaging, 80% of my headache comes from adjusting the colours.

Every client wants perfect colours. Of course. You are the expert, but what does that mean 'perfect colour'? Have you ever looked at a file that you optimised to perfection the previous night? My goodness, I can't give *that* to my client ….!

Colour perception is subjective and no amount of colour management expertise will make colour adjustment a straightforward task. But proper colour management will give you a solid base to work on. Next time you tell your client " … but it looked fine on my monitor" you don't need to break out in cold sweat, and you can add with confidence "if the colours are all over the place, the problem must be on **your** side".

Over the next series of articles I want to introduce you to the world of CM (colour management). It will help you to set up a proper colour working environment, tag files and convert between colour spaces and colour modes. You will understand all about calibrating and profiling your monitors and printers.

The Aim of Colour Management

In an ideal world the images on our monitors and our prints will have the exact colours as the objects in front of our lenses. In real life we need to compromise. Monitors can only display a limited range of colours; their colour gamut is restricted. And again, paper with four or even eight different inks cannot reproduce all the colours a monitor can display. Proper CM will get us the best possible compromise.

The second function of CM is to insure uniformity. Every digital camera, scanner, monitor and printer, in short every device standing between the digital and the real world has its own interpretation of colour. CM allows us to do our image editing in an environment which is independent of these external devices.

Thirdly, and this is the most important point, CM will compensate for the different colour interpretations of the various devices. This falls under the umbrella of calibrating and profiling. Every device needs its own 'profile', which acts as a translator for colour interpretation.
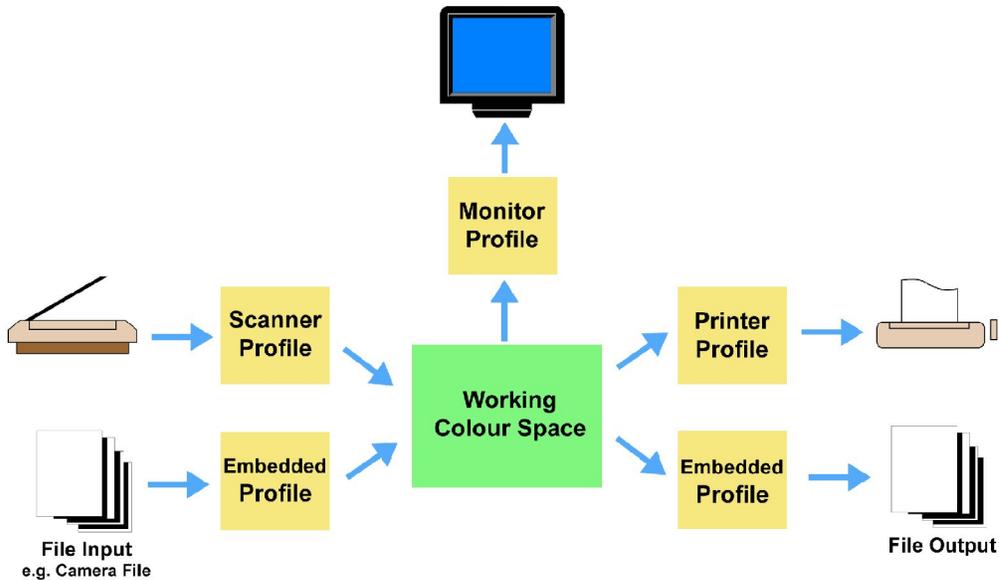
Device-dependent Colour Models

If you scan the image of a fire engine, your scanner may give you an RGB value of (218,49,49). That's how it sees fire engine red. But your monitor might need (224,43,44) to display this colour and your inkjet printer will need yet another set of RGB values, say (217,43,33).

A certain RGB value does not define a particular colour. It is the same with CMYK. We call the **RGB** and **CMYK** colour models device-specific or device-dependent. The actual colour we get from a set of RGB or CMYK values is dependent on the device that's producing the colour.

Device-independent Colour Models

As you might have guessed, a device-independent colour model does not depend on any device to describe colour.

CIE XYZ was the first device-independent colour model to be developed in 1931 by the International Commission on Illumination (called CIE after its French name).

More important for us is the **CIE LAB** colour model (LAB or Lab), which you will find in many image editing programmes. Both of these device-independent colour models (and there are many more) are not based on how we create colour, but on how we perceive colour. The LAB model in particular consists of three channels, the lightness channel 'L' similar to luminosity, and two colour channels, 'a' on the blue-yellow axis and 'b' on the red-green axis.

LAB is the reference colour space for most colour management systems (CMS). Whenever we switch from one colour space into another it is done through LAB.

Why don't we do all our editing in LAB, if it's such a good colour model? Well, there are people who do just that, but for most of us mortals RGB makes more sense. While LAB is based on how we perceive colour, for example it takes into account that the eye is more sensitive to green than to blue, it is difficult to visualise. In fact, you need to worry for your sanity if you can get your head around LAB!

Next time I will expand a bit more on the RGB, CMYK and also the HSB colour models. For now I want to concentrate on the most important first steps in CM: the basic colour setup in Photoshop and monitor calibration.

Colour Settings in Photoshop

The colour settings dialog box is accessed through the Edit menu in the Windows environment or through the Photoshop menu in Mac OS.
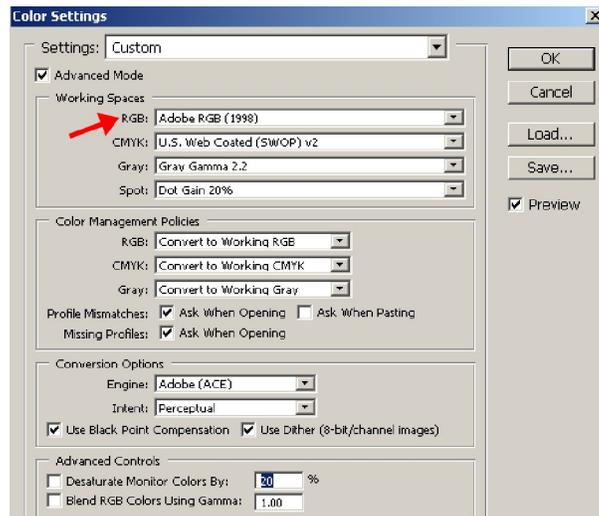
The first group of settings refer to the 'Working Space' profiles. Whereas the scanner, monitor and printer profiles describe the colour behaviour of a specific device, the working space profiles are device-independent. A working space is an abstract colour space describing an ideal environment free from the limitations and inadequacies of any device. It is also 'grey balanced', which means that equal amounts of red, green and blue will produce a neutral grey. This is very important in image editing and we wouldn't get this in any device space.

The dropdown menu for the RGB working space gives us all the profiles that were installed with Photoshop, as well as any monitor, scanner and printer profiles which came with the device drivers. Size is the most important factor when choosing a working space. The working space must be large enough to encompass all the colours your input devices can capture, as well as all the colours your output devices can reproduce.

I don't know why Adobe chooses **sRGB** as default. It is ideal for web graphics and will insure that most browsers will faithfully reproduce your colour images, but it is also the smallest working space. sRGB will guarantee consistent colour across colour managed and non-colour managed apps alike. However, if you want best results from your input devices and printers then you need to select a larger working space.

Adobe RGB (1998) has become something like a prepress default setting. It is larger than sRGB and big enough to contain all the colours of any normal CMYK output. Figure 1 shows an Yxy representation of the sRGB, Adobe 98 and a printer colour space (I have chosen the Epson 4000 Archival Matt paper profile). The differences are even better illustrated in the 3-dimensional Lab diagram (Figure 2). The wireframe represents the sRGB space and the solid block is the printer colour range. For better clarity I left the Adobe 98 profile off, but you can see that the colour range of the printer exceeds the sRGB space in the yellow and the blue region of the spectrum.

ProPhoto RGB is an even larger colour space. It makes only sense in a 16-bit workflow, but it is becoming increasingly popular with many photographers who want to squeeze the last bit of colour information out of their cameras.

We leave the other settings of the Colour Setup at their default settings for now. We'll look at them in another issue. Lets now turn our attention to the monitor.
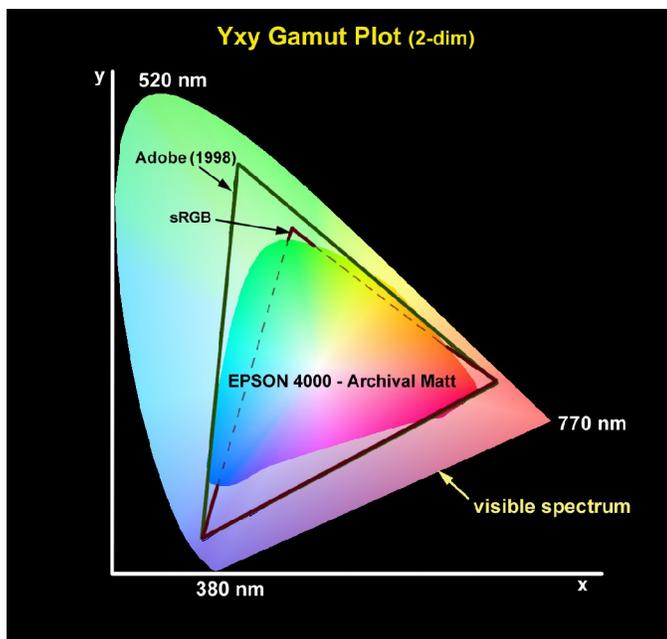
Yxy Gamut Plot – comparing the colour gamut of three colour spaces:
Adobe (1998), sRGB and a printer colour space
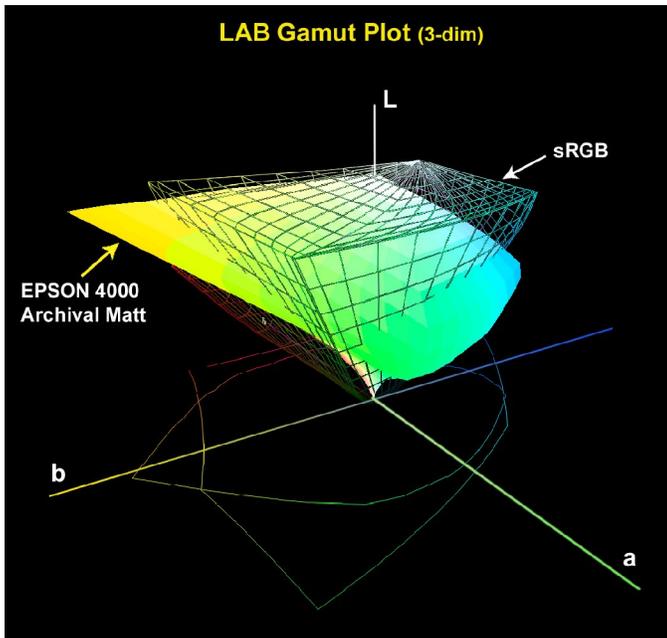
LAB Gamut Plot – showing that the printer colour gamut extends beyond the sRGB colour space

Monitor Calibration

By far the most common problem I have with clients is colour mismatch. The client receives a digital file from a scan or a digital camera capture and notices a colour cast on his or her monitor. Or, a client sends a digital file for printing and is not happy with the colours of the print. Asked if their monitor is calibrated, the invariant answer is "no".

The monitor is the centre of image editing. It provides all the colour feedback on which we base our creative colour decisions. If our colour corrections are to make sense to anybody other than ourselves (including our own desktop printer), then we need to calibrate our monitor.

Today's monitors are better than ever before and the profile that comes with the driver will give you pleasing colours. But there are differences between units of the same model and 'canned' profiles are a compromise. Secondly, monitors age, CRT monitors more than LCD monitors, and their colour characteristics changes over time.

Two concepts pop up here, calibration and profiling, and it is important to understand the difference:

Calibration means sending a target of known colour signals to a device and changing the device's response to get it as close as possible to an optimal point.

Profiling simply records the device's behaviour from a known colour signal. The device's behaviour is recorded into a profile, without changing its behaviour.

Profiling packages usually do both of these jobs so that they are often seen as one. If you don't have a hardware device (a spectrophotometer), a monitor can be calibrated

visually. Under Windows you can find Adobe Gamma in the Control Panel. For Mac users the ColorSync Calibrator utility takes the place of Adobe Gamma. Simply follow the step-by-step procedure, but ensure to do the calibration under the same viewing conditions as used for imaging work. It is recommended to use a white point of 6500K (D65) and a gamma of 2.2.

For professional work I strongly recommend the use a special monitor calibration device. This is a sensor attached to the monitor and software, which cycles through a display of various colours. The colour response is measured and a profile is built.

The most popular packages are:

- Color Vision Spyder
- Gretag Macbeth Eye-One Display
- Monaco OPTIX

Any of these products are excellent and will ensure a consistently accurate display on your monitor. Keep in mind that monitors need recalibrating at least on a monthly basis. There are also service providers which can do this for you.

Next month we are going to look at printer settings and calibration to ensure accurate and consistent colours.