

The word "Article" is written in a white, serif font and is centered within a dark, horizontally-oriented oval shape. The oval has a slight gradient and a soft shadow, giving it a three-dimensional appearance. The background behind the oval is a light, textured surface with faint, overlapping text and graphics.

An article for Photoshop 5 users

# Configuring the Color Management System in Photoshop 5

by Ian Lyons [\(email\)](#)

Prior to the introduction of Photoshop 5 by Adobe®, users of Microsoft® Windows 95/98 had no real knowledge or experience of “Color Management”. Yes, most of us were familiar with the terms ICM and ICC, but in truth we saw very little evidence of its true power and functionality. On the other hand Mac users have had access to a system level color management system for years in the form of “ColorSync”. Even then many of the concepts and procedures introduced by Photoshop 5 have required a different approach from those of previous versions. In truth, and for many, color management is of no great importance, but for photographers and anyone else interested in the accurate reproduction of color in print or on screen, it is one of the most vitally important features introduced by Adobe as part of Photoshop 5.

One of the most often raised issues relating to Photoshop is – “*why don't the printed colors match the colors displayed on screen?*” Epson claim in one of their online support documents that the answer is quite simple - “because monitors and printers use different technologies to create color”. They go on to say - “no monitor will ever match the printed piece of ANY printer due to the fact that the human eye perceives color completely different when looking at color reflecting off paper or projection from color monitors”. However, this is only partially true, by ensuring that Photoshop is correctly configured it is possible to achieve “acceptably” accurate color matched prints with only minimum effort.

This article explains the process of configuring the color management system within Photoshop 5 for those aiming to optimise the RGB workflow required for making prints that come “acceptably” close to matching their on screen image when using inkjet printers from manufacturers such as Canon, Epson and Hewlett Packard.

Obviously, in the limited space available it is not possible to address all the issues pertaining to color management. For those wishing to gain a better understanding of how color management works within Photoshop 5 you should follow this link to Adobes On-line Guidance Documents:-

- <http://www.adobe.com/supportservice/custsupport/TECHGUIDE/PSHOP/main.html>

Further information can also be obtained from **Andrew Rodney's** web site at:-

- <http://www.digitaldog.net/tips.html>

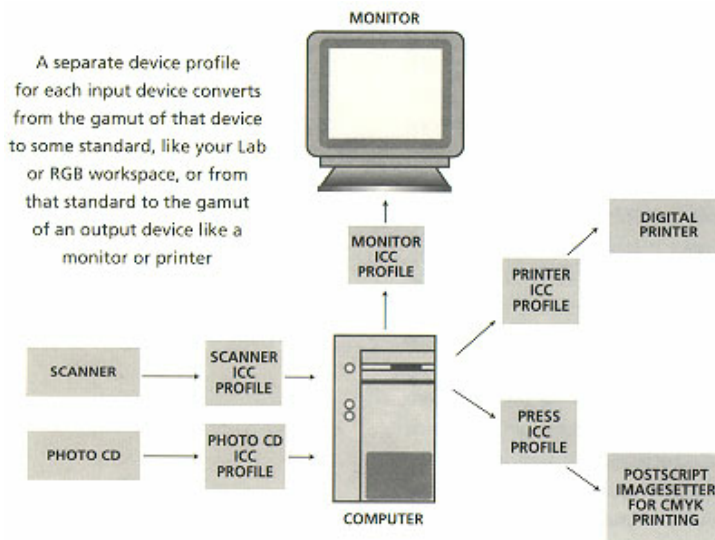
The final section of this article deals with color correction. Although not strictly speaking anything to do with color management, I believe you will find it informative if not entertaining?.

## 2. The Color-managed Workflow

The purpose of a Color Management System (CMS) is to maintain a consistent “appearance” of any given color on different devices (i.e.; scanners, monitors, printers, etc.) throughout our system. In order that we may achieve this it is first necessary for each device to provide Photoshop's Color Matching Engine or Module (CMM) with some information on how color behaves within that device, and this is provided through “Device Profiles”.

A typical “**Color-managed Workflow**” will involve image input via a scanner or Photo CD, being viewed on the monitor, with color correction of images on the computer, and image output to a printer or film recorder. As the image data is passed along the chain - from scanner - to - computer - to - monitor - and printer, color inaccuracies will be introduced. These inaccuracies result primarily from the widely differing color spaces or gamuts of each device. To minimise these inaccuracies we must give the CMS information in the form of device “**Profiles**” that describe the color gamut of each device. Using these profiles the CMS is provided with information that says for example, “this RGB image data is from such and such a scanner, which sees color in this way”, the CMS will then know exactly what color really looks like on that scanner. Likewise for our monitor or printer, again with suitable profiles the CMS will adjust the scanner image data into a form that the monitor or printer can show accurately.

Most devices are supplied with generic or “**Canned**” profiles that describe them pretty well, but for truly accurate colormatching you should seriously consider either getting “**Customised**” profiles for each device done professionally or buying your own profiling software (e.g. Monaco Systems EzColor). For further information on EzColor use the following link <http://www.monacosys.com/>. Remember also that readers of Digital Darkroom can claim a special discount on this software.



It is also worth pointing out that whilst most low cost, consumer based film and flatbed scanner applications are ICC aware they tend to impose sRGB as the “Source” color space. This color space is wholly inappropriate for anybody seriously interested in obtaining high quality prints or film output from within Photoshop, in so far as its color gamut is so severely limited. Nikon and Canon to name but two companies actually recommend that users of Photoshop 5 switch “Off” color management within the scanner application. Some on the other hand allow us to scan and save our images in any “Target” color space we choose, but unfortunately the “Source” color space is generally always “sRGB”. Furthermore, the image is rarely if ever “tagged” with a profile of any description, so the file contains no information relating to the profile upon which it is based.

Clearly there can be no benefit in converting an image from a narrow color gamut to one that is larger, since no new color information can be obtained, and worse still there is no recorded evidence (the “tag”) within the file of the color space conversion having ever taken place. I shall discuss an alternative method (based on specific device profiles) of ensuring the optimum color gamut for scanned images in a later section.

### 3. Monitor Calibration

Having first installed Photoshop 5 on your computer the next task is to make sure your monitor is properly calibrated. If our monitor is not correctly calibrated then we can have no confidence in the on screen colors being a true representation of the image data. Accurately calibrating your monitor is also an essential (if not critical) first step in developing a color-managed workflow. For real accuracy we would normally wish to use a specialist hardware device, but these tend to be expensive. However, Adobe has provided us with an acceptable software solution for this purpose, namely “Adobe Gamma”, although others are available see (<http://www.inkjetmall.com>) for details.

“Adobe Gamma” can be accessed either through the Windows Control Panel Folder or via Photoshop’s Help Menu and selecting “Color Management”.



“Adobe Gamma” is used to calibrate your monitor at “System Level” and thus ensures that unwanted colorcasts associated with your monitor are eliminated. The profile created as part of the calibration process becomes the “default profile” for your monitor and is also available for all other applications that can use ICC profiles. This new “Custom” profile is generally referred to as your “Monitor Space”, and is unique to “your” monitor. It is important to note that:- no matter what software application you are using, the image on screen is

always being viewed in "Monitor Space".

A further point worth considering is your working environment. Calibrating a monitor during daytime and using it later in an artificially lit room is pointless, since your perception of color in natural light is entirely different from that in artificial light. So consider carefully how, where and when you set up your system. A consistent environment is an essential prerequisite for accurate color matching.

You should use a neutral background for the Windows desktop, and all screen savers and power management features should be turned off (and kept "off"). Allow at least 30 minutes after first switching on your monitor before commencing the calibration process.

The following outlines the various steps in calibrating your monitor based upon Adobes' recommended procedure and my own experience.

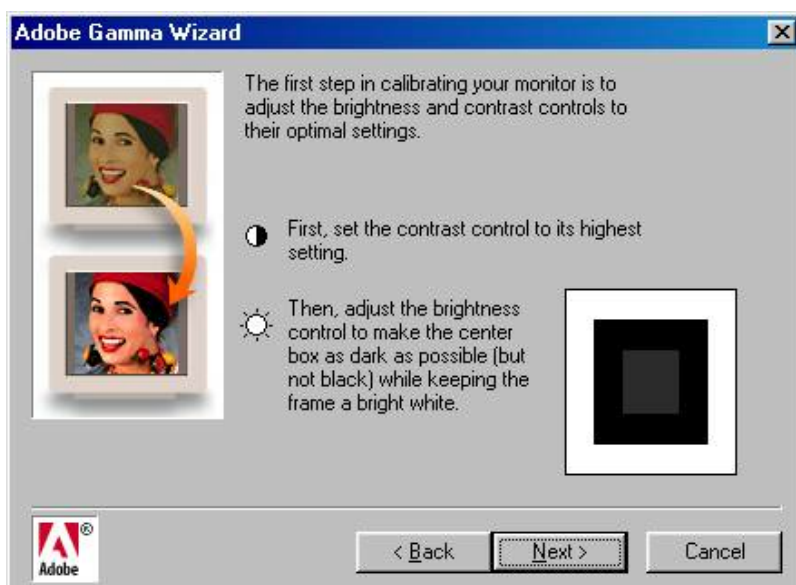
### Step by step monitor calibration using Adobe Gamma

**1** On opening Adobe Gamma I recommend selecting the Step By Step or (Wizard) option. You should then follow the on screen instructions.



**2** Adobe Gamma then tells us the profile upon which the subsequent calibration process will be performed. Normally the profile initially offered is the standard profile supplied with your monitor. We don't have to accept this profile, in fact we can select any monitor profile we want, but realistically it's as good a starting point as any. If you don't have a profile specific to your monitor try the manufacturers Web site or use either "mnp22g21.icm" or "mnebug21.icm", the former is based upon Triniton monitors and the latter upon standard monitors. Although, it is fairly widely accepted that Triniton is probably the better starting point. The amount of adjustment required in the steps that follow will vary, depending upon how far your monitors' actual behaviour deviates from this initial profile.

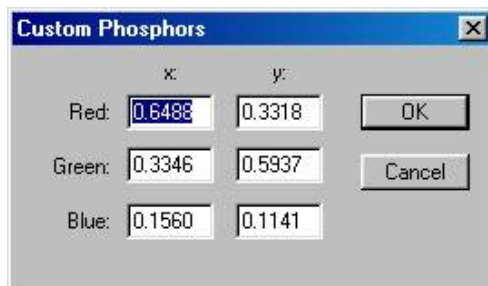
**3** The next step is to adjust the contrast and brightness levels of your monitor.



My recommendation is that the brightness should be adjusted so that the inner square is only just visible. If the on screen image looks a shade dark after this stage don't be too concerned, it will be corrected during the gamma adjustment stage. In

fact, I have found that unless the screen is dim, then the likelihood of over dark prints is increased significantly, so be warned!.

**4** Once the brightness and contrast have been adjusted we move on to the monitor phosphor selection. We can either accept what is offered up in the window or choose "custom" and insert our own values; normally you would need to have obtained the values from the manufacturer.



**5** Next we adjust the gamma slider (I suggest that you stick with the single gamma option initially). When adjusting this slider I recommend that you sit back about 3 feet from the monitor and squint your eyes. When the inner square matches the outer patterned frame, stop. Choose your desired gamma (usually 2.2 for Windows) and then fine tune the gamma slider. If all has gone well your screen should now be reasonably bright, but not to bright. A common misconception is that the gamma must be set to 2.2. Please note that there is no absolute requirement that the gamma be set to this value. If the user prefers to select a gamma value of 1.8 then that is perfectly reasonable choice, it is also the case that many actually prefer to calibrate their monitors to a gamma of 1.8 when CMYK prints are the final output medium. Mac users will generally find 1.8 is the more appropriate choice for their systems since it is apparently the native gamma of Mac monitors.



**6** To set the "Hardware White Point" it is better to use the "Measure" option (ensure that the room lights are off for this adjustment).





For the “Adjusted White Point” it is normally accepted practice to choose “6500K”. As was the case with gamma, it is not essential that we follow conventional wisdom when it comes to setting the White Point of your monitor. I have found a more appropriate choice to be “Same as Hardware”, since this doesn’t actually require the video card to make any color table adjustments (see **Real Word Photoshop 5**).

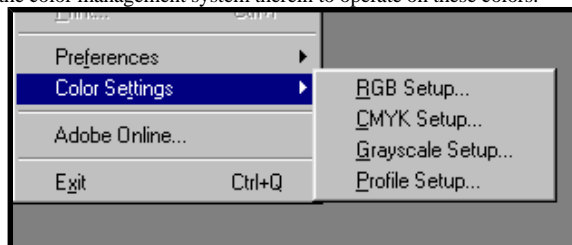


**7** *The final step* of the monitor calibration process is to “save” your new monitor profile. Remember this is now the profile that defines your “Monitor Space” and is used by all your software applications, including your scanner software, whether be it be “Standalone” or a “Twain plug-in”.

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### 4. Color Settings

The previous section concentrated upon how we see color on the monitor and how accurate that representation of color actually is. The "Color Settings" menu option found under the "File" menu is where we effectively tell "Photoshop" what red, green, blue, cyan, magenta and yellow actually look like, and how we want the color management system therein to operate on these colors.

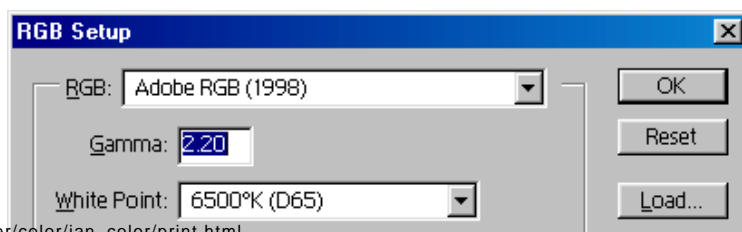


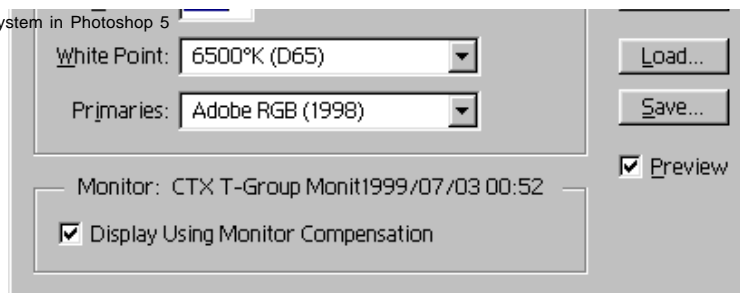
#### (i) RGB Setup

The RGB setup dialog is where we define Photoshop’s RGB "Working Space" or, as it’s also known the "Editing Space". The color space selected here is normally considered "device independent" (i.e. independent of scanner, monitor or printer devices), and allows Photoshop to attach a specific color meaning to our RGB data.

Remember also that unless you specify otherwise the color space (profile) selected by you here is the profile that will be saved with your file (i.e.; "tagged").

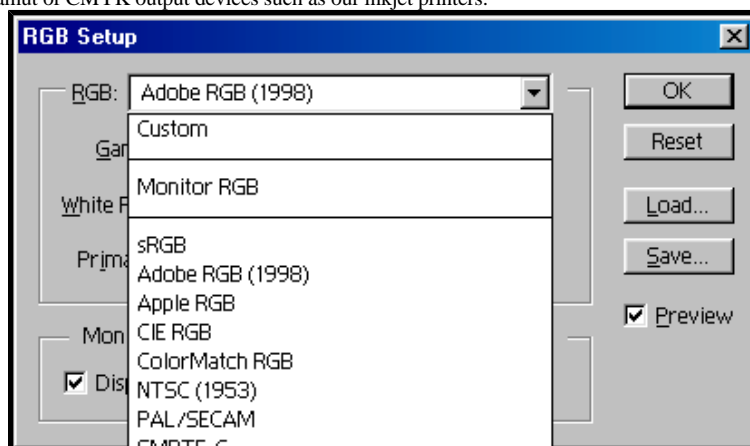
Before we begin selecting our preferred RGB working space I will dispel a commonly held misconception, namely that the gamma and white point selected for the RGB working space must be the same as we have chosen when calibrating our monitor, wrong!!!, simply because the two are not related. There is absolutely no reason why you should keep both compatible.





There are nine "Canned" RGB workspaces supplied as standard with Photoshop 5, each of which is based upon industry standards. There is also the option to select your "monitor space" (i.e. Monitor RGB) or define your own "Customised" RGB workspace.

The selection of Monitor RGB is not recommended since it is not "device independent", but most importantly, monitors cannot display a considerable part of the gamut of CMYK output devices such as our inkjet printers.



Of the nine "canned" RGB color spaces there are only three that are truly useful to most of us printing to inkjet printers, namely:

- Adobe RGB (1998) – based upon a gamma of 2.2 and a White Point of 6500K, which is broadly compatible with daylight in shade. This color space comes very close to encompassing the entire CMYK gamut, although it has some difficulty with greens. Its gamma value of 2.2 ensures adequate separation of shadow detail is maintained.
- ColorMatch RGB – this RGB color space is based upon a gamma of 1.8 and a White Point of 5000K. It is also widely used by Mac users, and has slightly narrower color gamut than Adobe RGB. Its main drawback relates to the gamma value of 1.8, which can cause some posterization problems in shadow areas. That said it is still a perfectly acceptable workspace on either the PC or Mac platforms.
- sRGB – this RGB color space is similar to Adobe RGB above in that it is based upon a gamma of 2.2 and a White Point of 6500K. However, the color gamut of this space is somewhat limited and can only be recommended for use with the 4-color range of inkjet printers from Epson, Canon, HP, etc. It is also widely used for web pages, etc.

With the "Custom" option we can define our own RGB workspace, although this doesn't come highly recommended. That said there is one custom space that has almost become an industry standard, i.e. BruceRGB. The specification for this color space is as follows:-

- White Point = 6500K
- Gamma = 2.2
- Red Primary xy = 0.6400, 0.3300
- Green Primary xy = 0.2800, 0.6500
- Blue Primary xy = 0.1500, 0.0600

This color space has all the advantages of Adobe RGB (1998) but doesn't suffer the problems associated with greens to the same extent. This is the space now highly favoured by users of the 6-color consumer inkjet printers such as those supplied by Epson.

Remember to use the "Save" button after you create this profile (this will ensure that it is retained for future use). You can give the profile any name you like, although I recommend BruceRGB, especially if you propose to share your files with others, since there's a greater chance that they will be able to handle your file without conversion.

The last setting that you can make in the RGB setup dialog is – "Display Using Monitor Compensation". With this feature activated we are instructing Photoshop to carry out an "on-the-fly" conversion of the image data from our selected RGB Workspace to our Monitor space, using the information contained in your customised monitor profile. So now we see why it is so essential that the monitor be calibrated correctly. It should also be noted that this "on-the-fly" conversion does not impact upon, or damage the image data in any way.

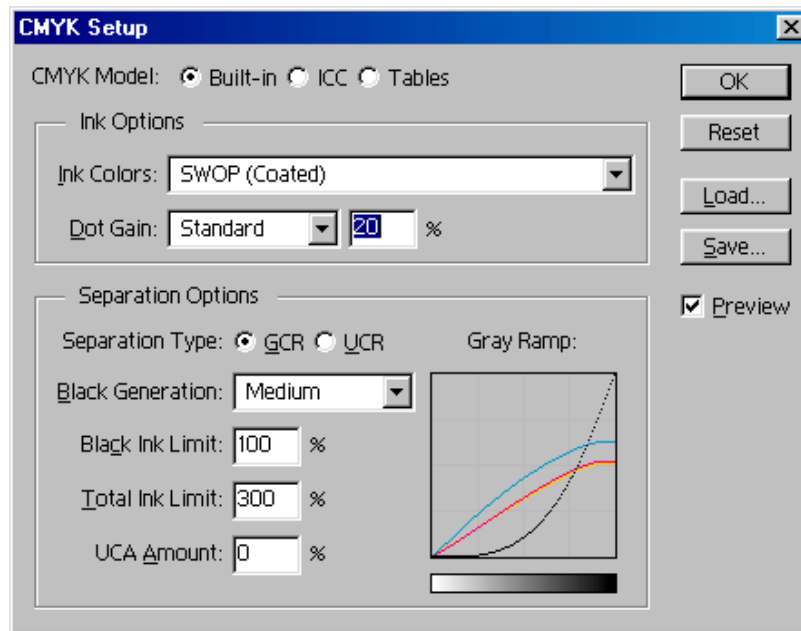
For Photoshop users that share files with others and especially across platforms (PC to MAC and vice versa) the following should be noted:

*"If you open a file that has been color adjusted in a gamma 1.8 workspace into a gamma 2.2 workspace without conversion the resulting on screen image will appear darker and more contrasty than it would have otherwise have done. Conversely, if you originally color corrected a file in a gamma 2.2 workspace and then open it in gamma 1.8 workspace without conversion then the image will appear flat and light."*

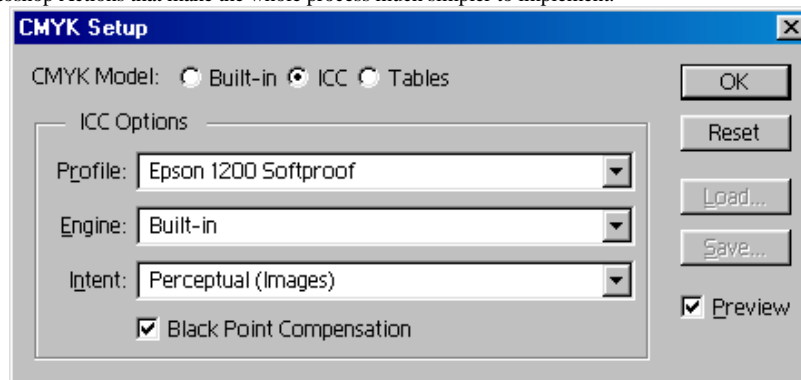
The moral here is that unless you have very good reasons stopping you converting to your own workspace then you should always allow the color space conversion to take place.

## (ii) CMYK Setup

For the most part this dialog is of no interest to those of us who concentrate solely on an RGB workflow. That said there is one "gem" buried within the CMYK settings dialog that anyone using "Custom" printer profiles simply must take heed of, i.e. "soft proofing" your RGB printer. Unfortunately, it doesn't appear to work too well with Epson's new "Unified" printer profiles.



Soft proofing your RGB printer is based upon a very complex procedure developed by Mark Hamburg of Adobe, my thanks to Andrew Rodney for giving us access to the Photoshop Actions that make the whole process much simpler to implement.



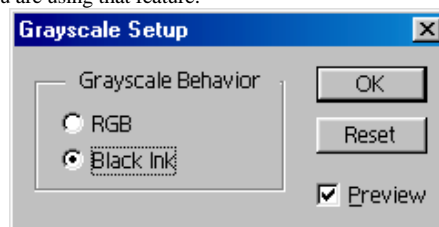
So, rather than try to explain it myself I'll let Andrew Rodney do it for me: -

*"Photoshop 5 has no RGB soft proof (unlike the CMYK Preview/Soft Proof feature). That means that while having a calibrated display is VERY important, you are not looking at your RGB file with an output simulation. There IS a way to trick Photoshop into providing a soft proof for RGB files and you will generally see a much closer screen to print match. This is mostly affecting out of gamut (very saturated) colors. The process of converting an RGB output file into a CMYK profile for soft proofing is long and complex. However, you can find a PDF with the recipe and a Photoshop action on my Web page (<http://www.digitaldog.net/tips.html>) that allows you to load into the CMYK setup, a modified RGB profile for your printer and then use the CMYK preview (Ctrl+Y) to redraw the screen to get a closer match. Of course the quality of all this depends on the quality of the output profile and how well your display really is profiled and calibrated."*

Before you will be able to use these files you will need to expand them from the compressed format that Andrew has saved them in. The files have been saved using Aladdin "Stuffit", a copy of the necessary expansion program Aladdin "Expander" is available for free download from: <http://www.aladdinsys.com>

**(iii) Grayscale Setup**

This dialog allows us to define our grayscale working space by stating whether it is based on RGB neutral values (i.e. equal values of Red, Green and Blue) or simply based on Black ink. If the latter is chosen then the dot gain curves defined in the CMYK dialog are used. Remember to switch "off" RGB soft proofing feature described above if you are using that feature.



If you are using a "Custom" printer profile there is a lot of merit in converting your grayscale images back to RGB before outputting to the printer. Although, it is worth trying both options, and settling one you prefer rather than blindly following convention or even my suggestions.

**(iv) Profile Setup**

I've heard it said that unless you share your image files with other users or have been using an earlier version of Photoshop then the Profile Setup feature is surplus to requirements, nothing could be further from the truth.

The Profile Setup dialog is in fact fundamental to determining how (or even whether) Photoshop acts upon images when they are "opened" or "saved". If you set the various options incorrectly you could potentially destroy an image and never even know that you've done so.

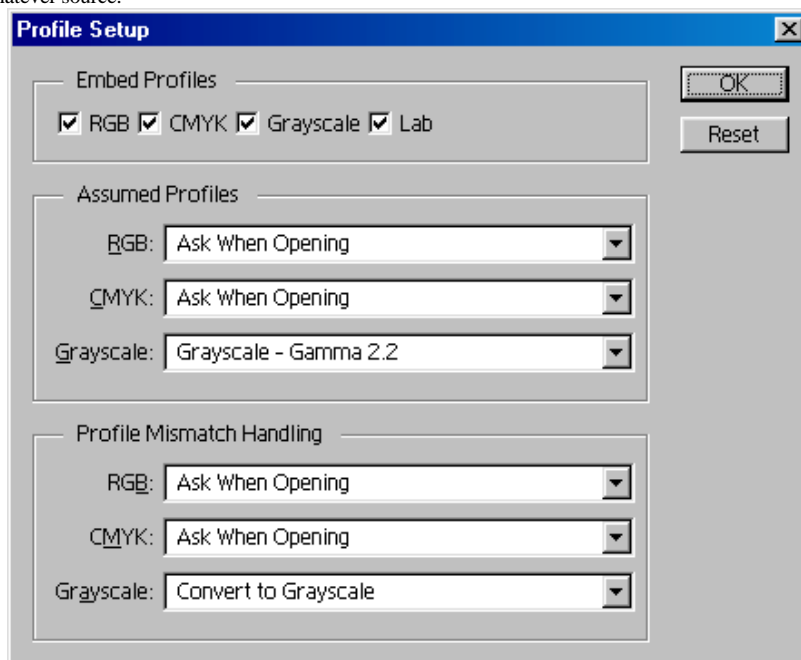
It performs two functions, namely:

- It offers you a method of ensuring that images get converted into your working space, and
- It lets you embed an ICC profile (or "tag") within the file that describes the workspace in which the image was created.

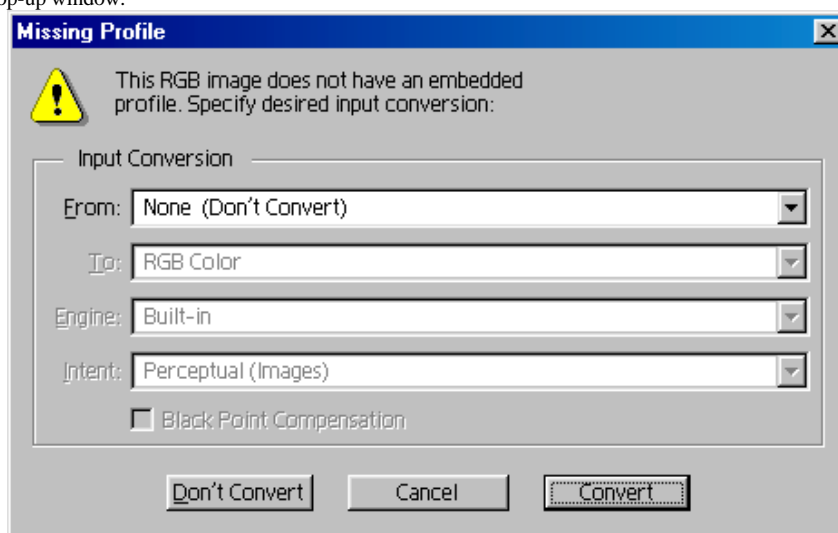
As can be seen from the "screen grab" below, the dialog is separated into three distinct sections, "Embed Profiles", "Assumed Profiles", and "Profile Mismatch Handling".

The Embed profiles section is fairly straightforward in that by checking the boxes we are effectively telling Photoshop to automatically embed our workspace profile within the file when we save the image. By default all the checkboxes are normally "On". It is recommended that you leave this section of the Profile Setup in its default state, the exception being when you open a calibration Test target (typically those used with Device Profiling Packages such as EzColor, etc.). With calibration targets it essential that you don't allow the image to be saved (usually by accident) with your workspace profile, so its better to be safe than sorry, with calibration images make sure "Embed Profiles" is "Off".

The settings you see in the "screen grab" below are generally accepted as the safest choices (although not necessarily the defaults that you will obtain when you first install Photoshop, so please check), and will enable you to avoid virtually all image data damaging scenarios that you may encounter when opening files from whatever source.



The "Assumed Profile" section is where we tell Photoshop how it should deal with images that contain no embedded profile. However, it doesn't actually do very much other than flag up another dialog, unless of course we have set the "Profile Mismatch Handling" section to something other than "Ask When Opening", in which case it will totally ignore the fact that the file has no embedded profile and open it anyway in a color space previously specified by you in the pop-up window.

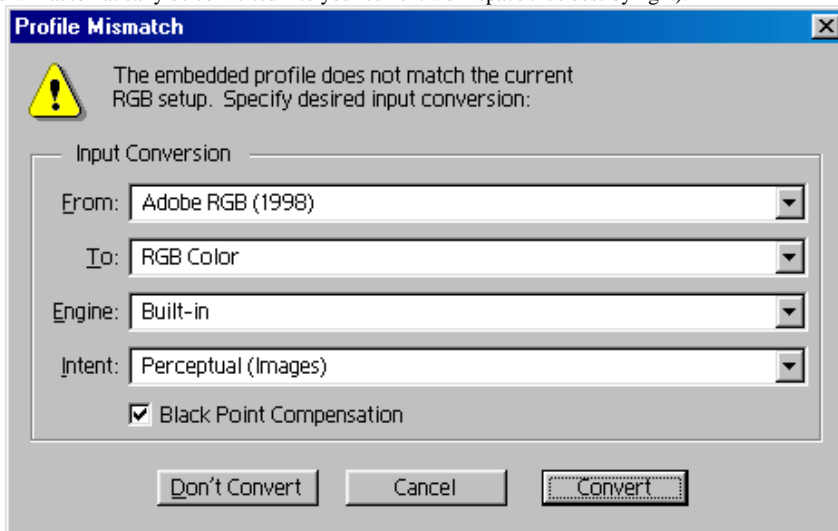


The final section of the profile setup dialog is the "Profile Mismatch Handling" section. Get the settings in this section wrong and, well your image data is very likely to end up in a less than optimal state. For each of the three pop-up windows we have three choices, "Ignore", "Ask When Opening", and "Convert".

Taking each of the options in turn:

- **"Ignore"** – This option simply opens the image in your current RGB, CMYK or Grayscale workspace without any conversion of the image data. At first this may appear to be a perfectly reasonable choice, but note, by not allowing a color space conversion we are in fact changing the "Colorimetric" meaning of the image data thus it will appear on your monitor and print differently from what it would have done on the system in which it was created.
- **"Ask When Opening"** – When you select this option you will be presented with dialog similar to that shown below. If the file contains a profile it will be displayed in the "From" pop-up window. The "To" pop-up window will usually be "RGB", "CMYK", or "Grayscale" depending upon which mode you are currently working.

- o "Convert to ----- C" – This is the most dangerous option in that it allows Photoshop to automatically convert the file you are opening "from" and "to" the color spaces you specified in the "Assumed Profiles" section. For most this is not the best option for very obvious reasons (e.g. a calibration image will automatically be converted into your current work space thus destroying it).

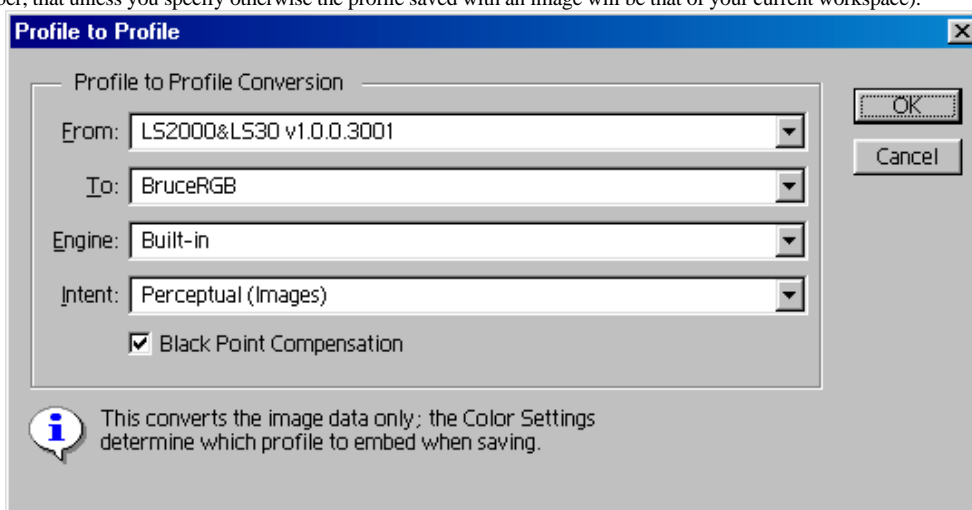


Unless you have very good reason to do otherwise it is recommended that you leave the Engine: at "Built-in", Intent: at "Perceptual Images", and "Black Point Compensation" at "On" at all times.

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### 5. Profile-to-Profile

Although not specifically part of the Color Settings menu, Profile-to-Profile (PtoP) does form an essential part of the color management system, and is found under the Image/Mode menu. Profile-to-Profile is a very powerful tool in that it effectively lets you convert an image between any two color spaces, as and when required. However, there is also a "health Warning" that needs to be considered – "Photoshop does not keep track of any color space conversions undertaken by PtoP", which means that the user could potentially save an image with the wrong color space profile (tag) embedded within it (remember, that unless you specify otherwise the profile saved with an image will be that of your current workspace).



The "From" pop-up is where we select the "Source" color space and the "To" pop-up the "Target" color space.

It is also generally recommended that in Profile-to-Profile mode you specify the specific "To" and "From" color spaces (e.g. From: LS2000Scanner - To: Adobe RGB (98) rather than From: LS2000Scanner - To: RGB), even if Adobe RGB (98) is the color space you have chosen in the RGB setup dialog as your normal workspace.

It is normally best to keep "Black Point Compensation" checked thus ensuring that the black point of the source is mapped to the black point of the target color space.

For a comprehensive explanation on what each of the color management "Engines" and render "Intents" actually do, please refer to Andrew Rodney's Tips page at:

<http://www.digitaldog.net/tips.html>

#### Profile-to-Profile has three main functions:

- o As a time saver, whereby we find, that having opened a file without color space conversion we realise that we should have done so. By using PtoP we can avoid closing the file, shutting down and restarting Photoshop.
- o We can also use it to convert between the native color space of our input devices (e.g. scanners) and our current workspace. I mentioned earlier that some scanner manufacturers (e.g. Nikon LS2000 and LS 30 film scanners) allow you to scan images in the devices native and usually very wide color space. The problem is that Photoshop has no idea what color space the image is in because there is no embedded profile, and worse still no equivalent to "Profile Mismatch" or "Missing Profile" for images imported via Acquire mode (i.e. "Twain" or "Plug-in" modules). So in this situation we must force the color space conversion ourselves.

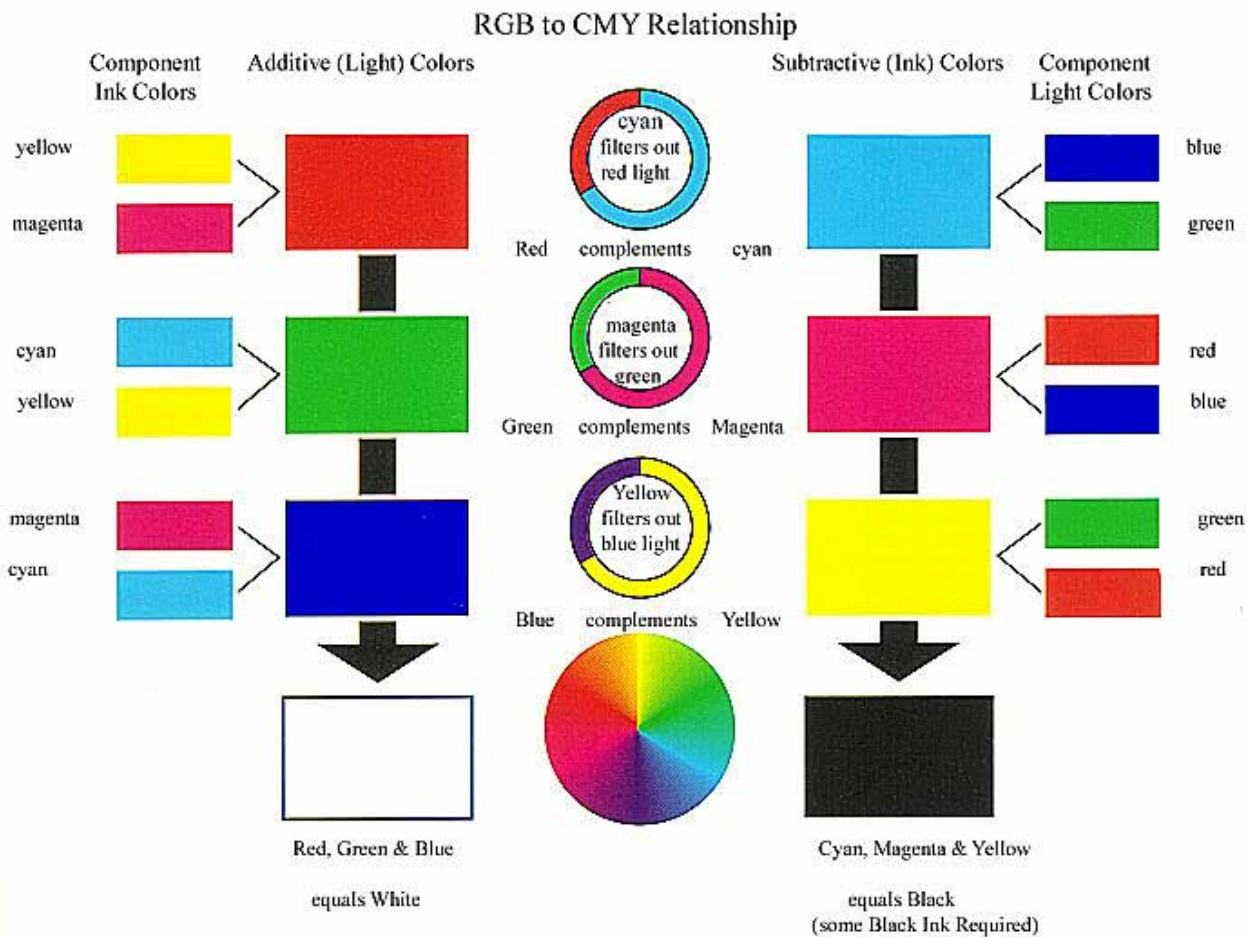
However, you should also note that quite often a PtoP using the devices "Native" or even "Customised" profiles could result in quite dramatic shifts in color, hue and saturation. This usually occurs if you have made color and gamma adjustments within the scanner software. Remember, if you propose to use device profiles within your scanning workflow then you must never make color adjustments within the scanner software. Remember also that, what you see in the scanner Preview window is based on your "monitor space" and bears no resemblance to the actual colors, etc seen by the scanner. So if you carry out your color adjustments within the scanner software I recommend you use your monitor profile in the "From" pop-up window of the PtoP dialog and not the scanner profile, be warned!!

- o The final use of PtoP mode is for preparation of print files for output the RGB printers or film recorders whose drivers do not contain any form of color management or were we chose to switch it off deliberately. A typical example of the latter would be when using "Customised" printer profiles.

**6. Color Wheel and Color Correction**

Again, whilst not strictly speaking part of color management I have decided to include some basic information on the subject of color correction techniques. These are not unique to Photoshop; in fact much of my color theory has been gleaned over a period of twenty years printing Cibachrome prints in a conventional darkroom.

During those years it has never ceased to amaze me, how some supposedly intelligent individuals just came apart (mentally) at the thought of even trying to identify and correct a colorcast. So before I begin here's what I consider to be one of the best presentations of the RGB/CMYK color wheel that I have yet to come across. This diagram has been copied from a book (classified by me as a must have book) entitled Photoshop 5 Artistry, by Barry Haynes and Wendy Crumpler. I know it's a breach of copyright, but just think of the free advert I've just given them .



Remember the significance of both color spaces; RGB is what we see on our monitor and CMYK are the inks used to create the various colors in print.

Before we look at the diagram in use let's deal with another issue that seems to cause confusion – the term "complements". As the diagram shows:-

- o Red is the complement of Cyan, so Cyan filters out Red Light;
- o Green is the complement of Magenta, so Magenta filters out Green Light; and
- o Blue is the complement of Yellow, so Yellow filters out Blue Light

What does this mean?, simple; by reducing "red" we're actually adding "cyan". By increasing "magenta" we're reducing "green", and so on.

So what makes the above version of the color wheel so good? Well just look at the relationships between RGB and CMY and how they are specified.

Most of us (me included J) appear to have some difficulty in specifying a cast in one of the CMY colors but virtually none when it comes to specifying a cast if it's "red", "green" or "blue" biased. So in this context I will let you decide how to interpret the diagram yourself, but remember we all make mistakes, and its only through finding the appropriate correction through trial and error that we will ever learn the true art of color correction. One "Tip" though, it is always preferable to make color adjustments that effect one color rather than two, think about it!

At least with this diagram there's a better chance that we can quickly establish the most appropriate correction. I hope it makes the task of determining the bias of a colorcast all the more easier for you in the future, so please feel free to Print the diagram and pin it to your workroom wall for reference.

When it comes to actual color correction inside Photoshop I think most novices find the "*Variations*" or "*Color Balance*" dialogs to be the easiest to get to grips with. However, they don't really provide you the level of control required to make accurate color adjustments. On many occasions you will find that the color cast in say the shadow region is one color and the cast in the highlight another color. The best option for color correction in that situation is to use the "*Curves*" tool, I know it's a complicated tool to use, but the sooner you learn to use it, the sooner you will produce top flight color corrected images. You may also find some benefits to be in using the "*SelectiveColor*" controls. I have found two books of particular benefit when trying to perfect the art of color correction; i.e.:

- **Real world Photoshop 5**, by David Blatner and Bruce Fraser, and
- **Photoshop 5 Artistry**, by Barry Haynes and Wendy Crumpler

Both books offer a wide range of advice on all things Photoshop and should form a good foundation upon which you can further develop your knowledge in its use.

*Happy Photoshopping*  
*Any corrections or additions are gratefully received*

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