



## Color Management for Harpers Ferry Center Designers and Cartographers

Version 05.05a

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# 2

## Color Management - Introduction

This is an overview of color management in the Macintosh operating system and in the primary Adobe applications in use at Harpers Ferry Center. Color management can be very complex and this is by no means presented as a comprehensive treatment. It is a guide for you, designer, cartographer, or producer at HFC, to be sure your settings are correct for the task at hand and to provide a basic understanding of what is going on.

The main reason to use color management is predictability. It can make the final color and contrast of a project predictable during the design process. You can soft proof while you work and make color decisions with reasonable confidence. The productivity gains are obvious.

Another reason is that color management can help to squeeze the best possible performance from less than ideal equipment. Color management started by extracting some decent results from some pretty wimpy desktop hardware. Now manufacturers are designing computer equipment and software to take advantage of color management to move quality up several levels. As a result much of the expensive "big iron" that used to exist in prepress facilities, for example, is no longer being made. These savings should also be obvious.

Each device involved (scanner, digital camera, film, monitor, computer software, printer, press) has its own and often serious limitations relative to other devices and to human perception of color. Many devices operate in completely different ways from one another and might use different color models (RGB, LAB, YCC, CMYK, CcMmYKk, or even GCBMOYK); different data types (raster or vector); and different colorants (pigments, dyes, phosphors, filters, prisms). So it is not possible, or even desirable, to manufacture each device so its output visually matches that of all other possible devices. Instead we rely on a computer to interpret the file for the device that is using it and to project how it will look in the final product.

To manage this the computer needs device characterizations—contained in little software tags called profiles—to tell it how each device behaves. For example your monitor is calibrated to bring it into a known linear state—a specific white point of 5000° K, a specific gamma of 2.2, and with neutral grays. Then a series of color patches of known luminance and chromacities are displayed and read by a colorimeter or spectrophotometer. The actual values are compared to the desired values and the difference is the basis of your profile. It tells interested software how your monitor behaves so when the video signal is processed its deficiencies can be compensated for to the extent possible.

There are also profiles for the color printers we use, profiles for scanners, profiles for the processes themselves, and *working space* profiles.

The information presented here is what you need to know for it to work for you.

Shaded boxes contain specific *Do This* information. The first line indicates the path to the relevant settings. The rest is an indication of settings to make. Italicized text inside the box is exactly the text you will see or the selection you should make.

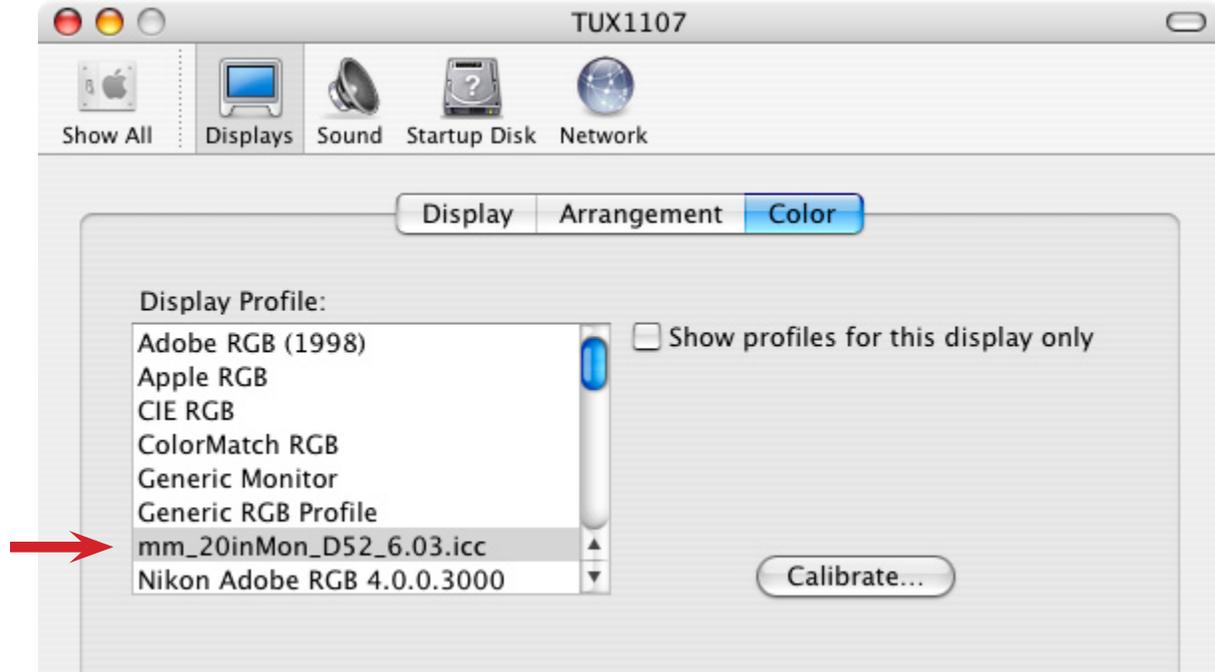
A shaded box will be followed by an illustration of the specific dialog box showing the selections to be made. Key selections are indicated by a red arrow. This in turn is followed by a few comments to provide some explanation for those who want it.

The obligatory disclaimer: Color management is not bullet proof. It does a good job if it is used correctly, consistently, and if the profiles are good ones. We are working with our vendors to either have them fully embrace ICC color management or to provide a target for us to aim for, one they will consistently hit. It will work either way.

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## Mac OS X - Selecting Your Display Profile

- *System Preferences...*  
*Displays / Color / Your custom monitor profile*



I will set this as your default monitor profile when I calibrate and profile your system. Anytime you restart after this point your system should automatically reselect this profile. For identification, I usually name the profile with monitor model name, the color temperature, my initials, and date.

The calibration part of the process involves hardware settings on your monitor (brightness, contrast, color gun settings, resolution) and look-up tables for your video card. **The monitor hardware settings must not be changed or the profile will no longer be valid.** If you get a new computer, replace the video card, or get a new monitor you will need recalibrating and reprofiling.

The length of time a monitor calibration and profile remains valid varies with the type and age of monitor and how long it is on. An LCD monitor will remain stable longer than a CRT. I have spoken with people who recalibrate theirs daily and others who do it weekly. I have found that except for very critical applications once a year is sufficient unless hardware has changed or a visual problem becomes evident. If you think there is a problem with your monitor please let me know.

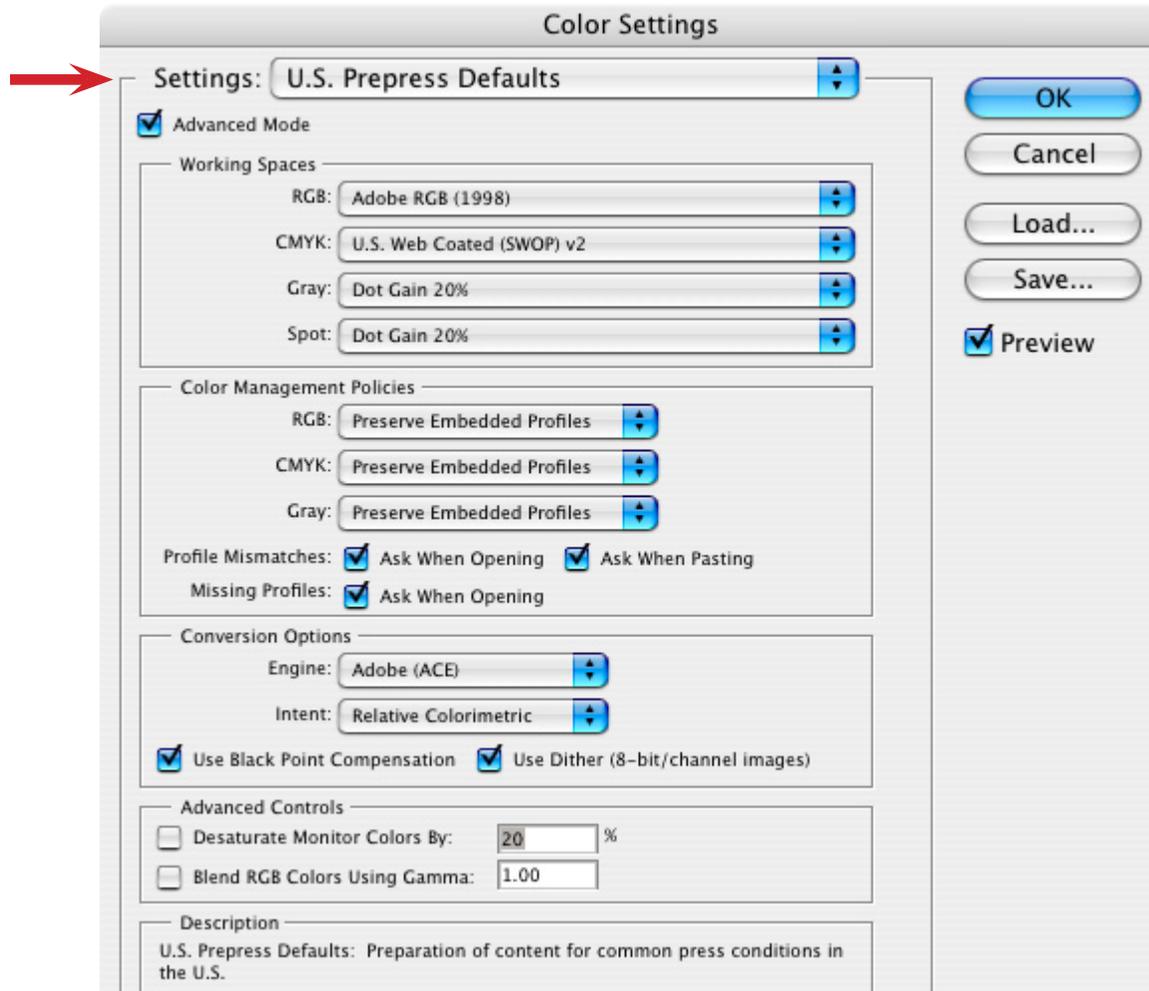
You can expect your profiled monitor to look right and to reasonably match the profiled output only in a controlled environment with D50 lighting. Controlled means very little ambient lighting (from the ceiling and windows), and near neutral surfaces surrounding the viewing space. The actual standards are much more specific but this seems to work.

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## Photoshop v6 through CS1 - Color Settings

**For Publications, Waysides, and Exhibits:**

- *Photoshop / Color Settings...*  
*Settings: US Prepress Defaults* (select from pop-up)



*Color Settings* (US Prepress Defaults) is a group of settings that come predefined in Photoshop and the rest of the Adobe CS Suite. The *Color Settings* for Publications, Waysides, and Exhibits should be the same.

**Note:** If you currently have an ArtLitho profile please dispose of it. (The *ArtLitho* (v2) profile that I created differs little from the *US Web Coated (SWOP) v2* CMYK profile except when you convert an RGB file to CMYK you will get smoother transition into the shadows with the SWOP profile. The original *ArtLitho* profile is much lighter than SWOP and is no longer valid.)

*Color Management Policies* should be left at *Preserve* for all and *Ask* for all per the presets.

*Conversion Options: Relative Colorimetric with Black Point Compensation* (rendering intent) and *Adobe Ace* (CMM) will give the best results. These govern conversions from one profile to another, or one space to another. Dither helps to smooth tone breaks that can be evident when working with 8 bit images, so this should always be on.

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## Photoshop v6 through CS1 - Soft Proofing

Soft proofing (*View / Proof Setup* and *View / Proof Colors*) is critical to the effective use of color management, particularly if you are using an RGB workflow. Soft proof settings define what you see while you edit files. They also come into play when printing. While *Color Settings* are now the same for waysides and publications, soft proof settings are not. Soft proof settings must correspond with how the work will be produced. It is likely that we will eventually have several groups of settings for wayside production to choose from, one set per process.

Soft proofing in the Adobe CS Suite is not completely uniform but is pretty similar from application to application. There are two parts: *View / Proof Setup* and *View / Proof Colors*. Use *Proof Setup* to create one or more sets of preview settings or to select and turn on a set that is not the default. In Photoshop you can name and save these settings. Do this without a file open and they will become the default.

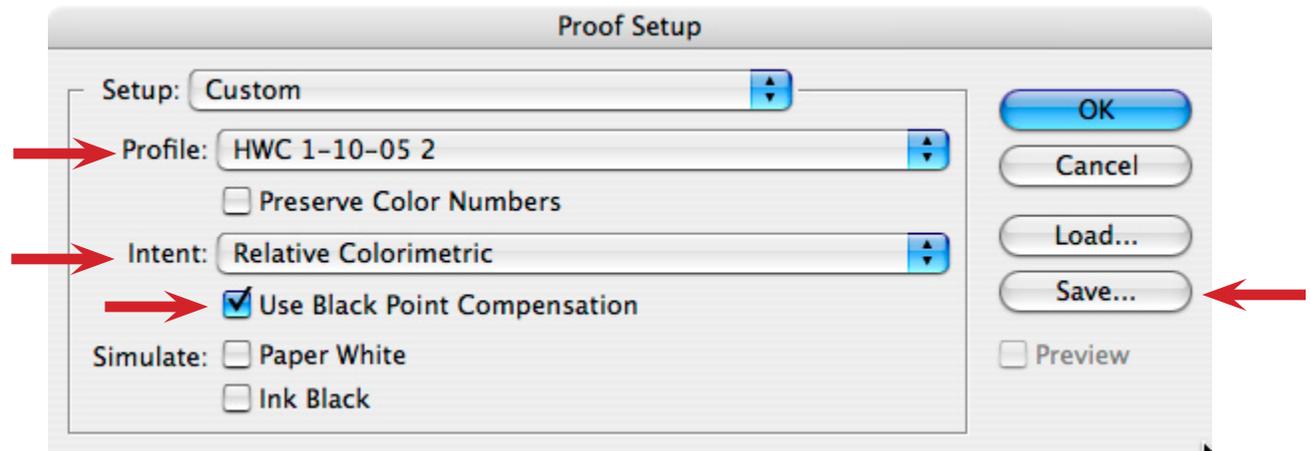
Selecting *Proof Colors* will apply the **default settings**. If nothing is selected as a default, your CMYK working space (as defined in color settings) becomes the default, but you still have to turn it on for each image.

### For Publications - Art Litho

- *View / Proof Setup / Custom...*  
Profile: *US Web Coated (SWOP) v2*  
Intent: *Relative Colorimetric*  
Click: *Use Black Point Compensation*  
nothing else should be checked

### For Waysides - Pannier

- *View / Proof Setup / Custom...*  
Profile: *HWC 1-10-05 2*  
Intent: *Relative Colorimetric*  
Click: *Use Black Point Compensation*  
nothing else should be checked



## Photoshop v6 through CS1 - Turn on soft proofing

- *View / Proof Colors* or *Command Y*

This turns on soft proofing for the image that is in the foreground **using the default proof setup**, so you have to be aware of what the default is.

Or you can turn on soft proofing for any defined setup by selecting the setup name from the *Proof Setup* menu. The custom settings are in the bottom section.

- *View / Proof Setup / Setup:* select your saved and named settings

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You will have to turn soft proofing on for each image and every time you open it. You also have to turn it back on if you convert from 16 bits to 8 bits. It is very easy to forget to do this. In some instances you might not see much of a change but you should get in the habit of using it anyway because as you edit the image you might extend it beyond the gamut of the target color space. This is especially true of RGB files which have can have a much larger color gamut than most output color spaces.

You can have several images with different soft proofing setups open at one time.

## **Photoshop v6 through CS1 - Opening a File with a Profile Mismatch**

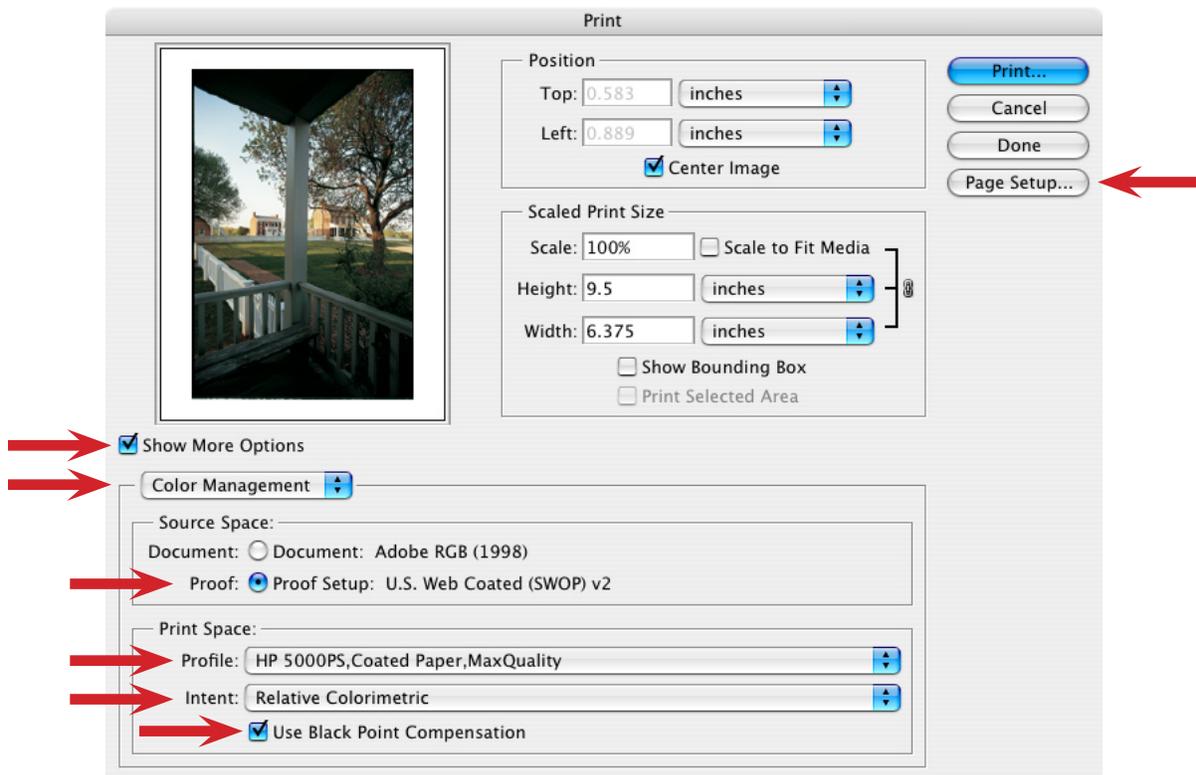
If you open a file that has a profile embedded that is not the same as your working space – *Adobe RGB (1998)* if it is an RGB file, or *US Web Coated (SWOP) v2* if this is a CMYK file – PS will ask you what to do and will present several options. The default option will be **Convert to Working Space** followed by the profile that is your working space for the color model of the file. This is usually what you want.

## **Photoshop v6 through CS1 - Opening a File Without an Embedded Profile**

If you open a file without an embedded profile select the default *Assign Profile* option. This will assign your working space profile.

## Photoshop v6 through CS1 - Printing with Color Management

- **File / Print with Preview...** (or *command + option + P*)
  - Select: *Show More Options*
  - Select: *Color Management*
  - Source Space
    - Proof: *Proof Setup*: (your active soft proof profile name will appear here)
  - Print Space
    - Profile: *Printer / Paper / Ink profile* for the device you are printing to
    - Intent: *Relative Colorimetric*
    - Select: *Use Black Point Compensation*



Be sure to click **Page Setup** to select the printer and orientation. Selecting the profile for the output device does not select the printer.

By selecting **Proof Setup** for your **Source Space** you are telling Photoshop to emulate the final process (off-set printing in this case) to the extent that it can on the device you are printing to. The quality of the device profile plays a large roll in the accuracy of these results. If soft proofing is not turned on this option will not be available.

When you click **Print** in this dialog box you will then get the standard OS print dialog in which you will have to set up everything. Selections in Photoshop do not over ride the OS print settings. Maybe someday.

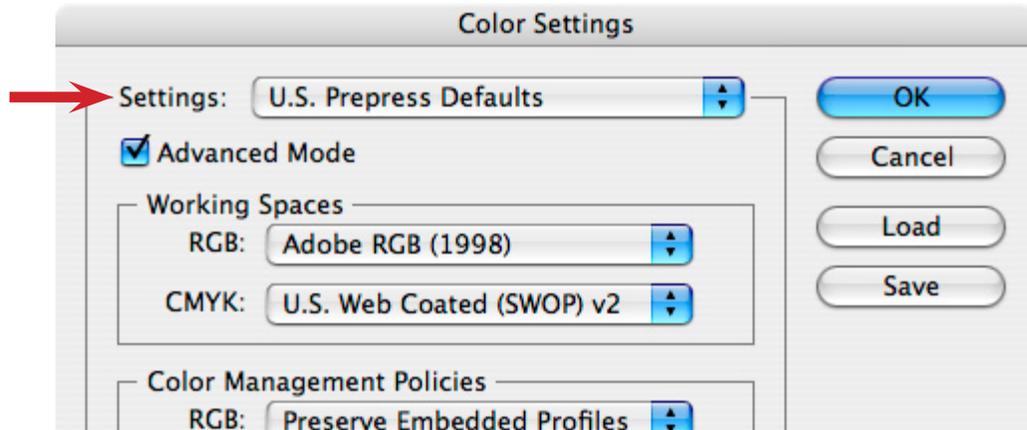
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## Illustrator v10 and CS

The settings dialogs are essentially the same as Photoshop. There are some minor differences and the locations are not the same. The concepts are the same.

### Illustrator v10 & CS - Color Settings

- *Edit / Color Settings...*  
Recommended Settings: *US Prepress Defaults*

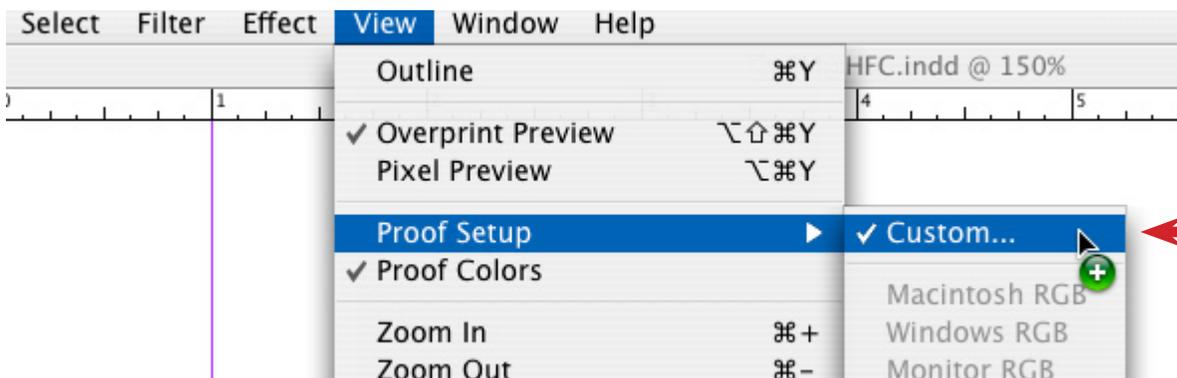


Select *US Prepress Defaults* in the settings menu which will load all the appropriate settings.

The current color settings will determine what profile mismatch messages you get when you open a file. You will get similar questions from Illustrator as you do from Photoshop. You should choose to assign if there is no profile or convert if it is a different profile to the correct profile for the workflow you are working in. If you convert and you have not made a copy of the file specifically for your use, you should do a *Save As...* renaming the file so you do not overwrite the original file after a conversion because it does change the file.

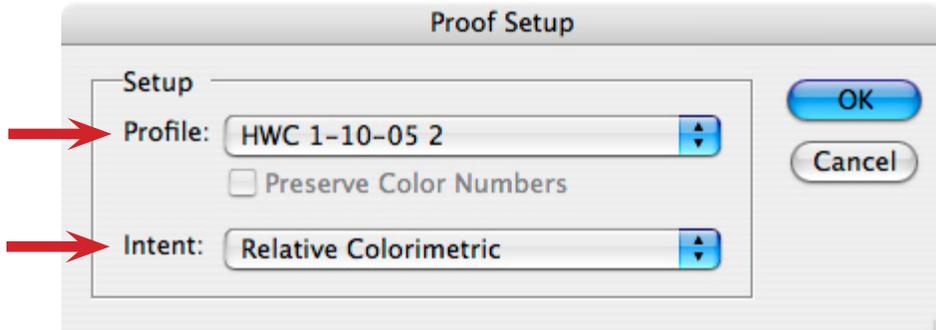
### Illustrator v10 & CS - Soft Proofing

- *View / Proof Setup / Custom...*  
Profile: *US Web Coated (SWOP) v2* if you are working on a publication or  
Profile: *HWC 1- 10-05 2* if you are working on a wayside for fiberglass embedment  
Preserve Color Numbers NOT checked  
Intent: *Relative Colorimetric*



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Soft proofing (*View / Proof Setup* and *View / Proof Colors*) is critical to the effective use of color management, particularly if you are using an RGB workflow. Soft proof settings define what you see while you edit files. Unfortunately they do not come into play when printing from AI. While *Color Settings* are now the same for waysides and publications, soft proof settings are not. Soft proof settings must correspond with how the work will be produced. It is likely that we will eventually have several groups of settings for wayside production to choose from, one set per process.



Unlike Photoshop Illustrator CS does not allow custom proof setups to be saved.

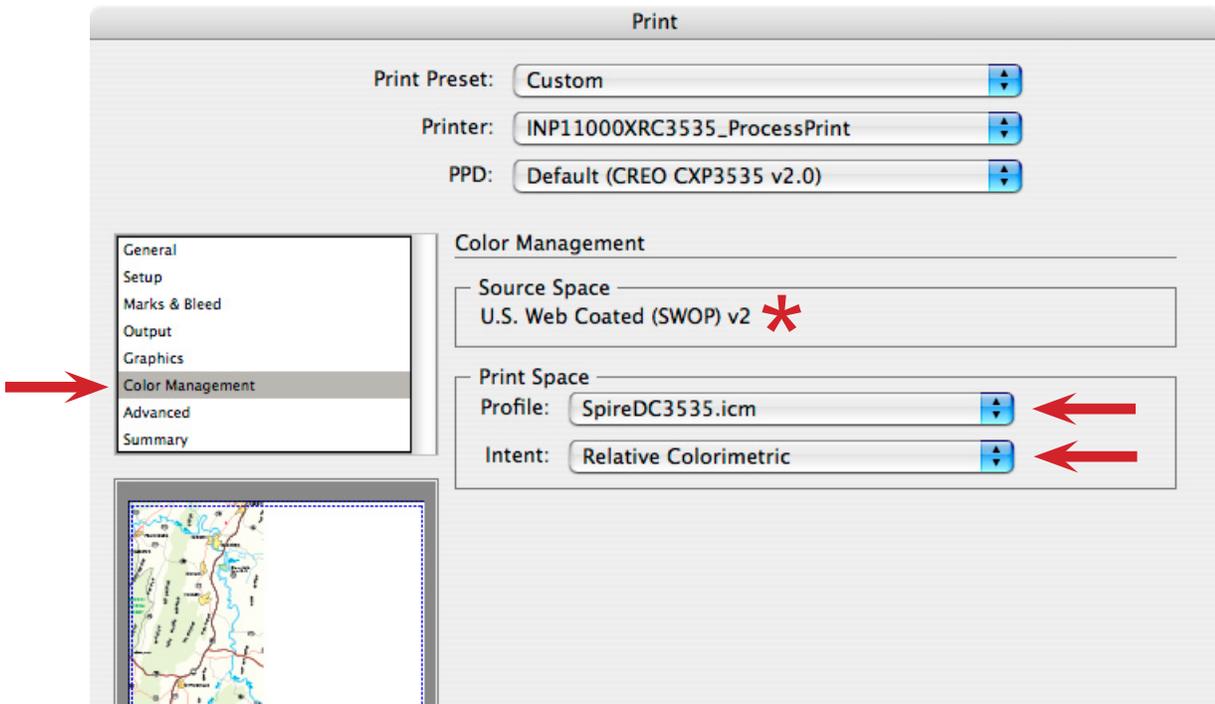
You have to remember to turn soft proofing on for each file you open and each time you open it.

The default preview is based on the current *Color Settings* in Illustrator, so if you work in several different media it is a good idea to open *Proof Setup... Custom* to verify that the correct profile is being used for the soft proof.

## Illustrator v10 & CS - Printing with Color Management

### • File / Print... Color Management

Print Space Profile: the correct profile for the printer you are printing to  
Intent: *Relative Colorimetric*





Unfortunately as of Illustrator CS 1 you can't emulate your final print space like you can in Photoshop and InDesign. The only option for the source space is the color space of the document being printed.

The *Print Space* profile tells the computer about the characteristics of the printer you are currently printing to (color Xerox, Godzilla, CLC 700, etc).

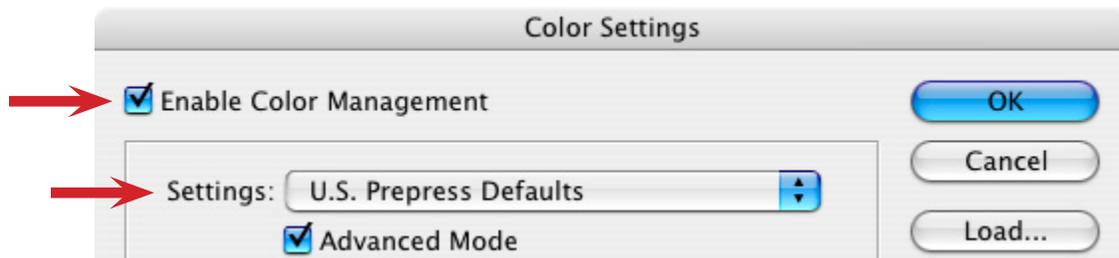
The *Rendering Intent* should be *Relative Colorimetric*. It tells the computer how to adjust the file colors to fit to the color gamut of the printer.

## InDesign CS

The settings and dialogs for InDesign are similar to Photoshop and the concepts are the same. This section will touch on the differences from Photoshop. **Be sure you have saved your graphic files (images and maps) with the appropriate profile embedded. As you place them in the layout the profile will go with them and will be used in the color transforms described below.**

### InDesign CS - Color Settings

- *Edit / Color Settings...*  
Click: *Enable Color Management*  
Settings: *US Prepress Defaults*



Open the *Color Settings* dialog and select your settings without a document open to make them your default for InDesign.

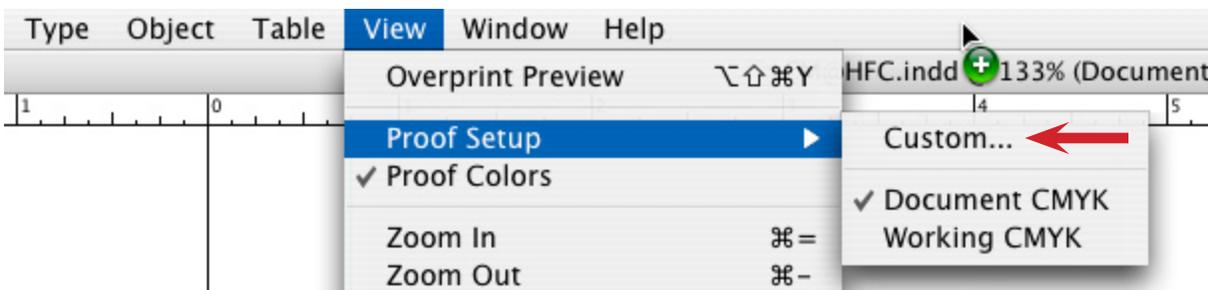
When you create a new document it is automatically assigned your default CMYK profile.

### InDesign CS - Soft Proofing

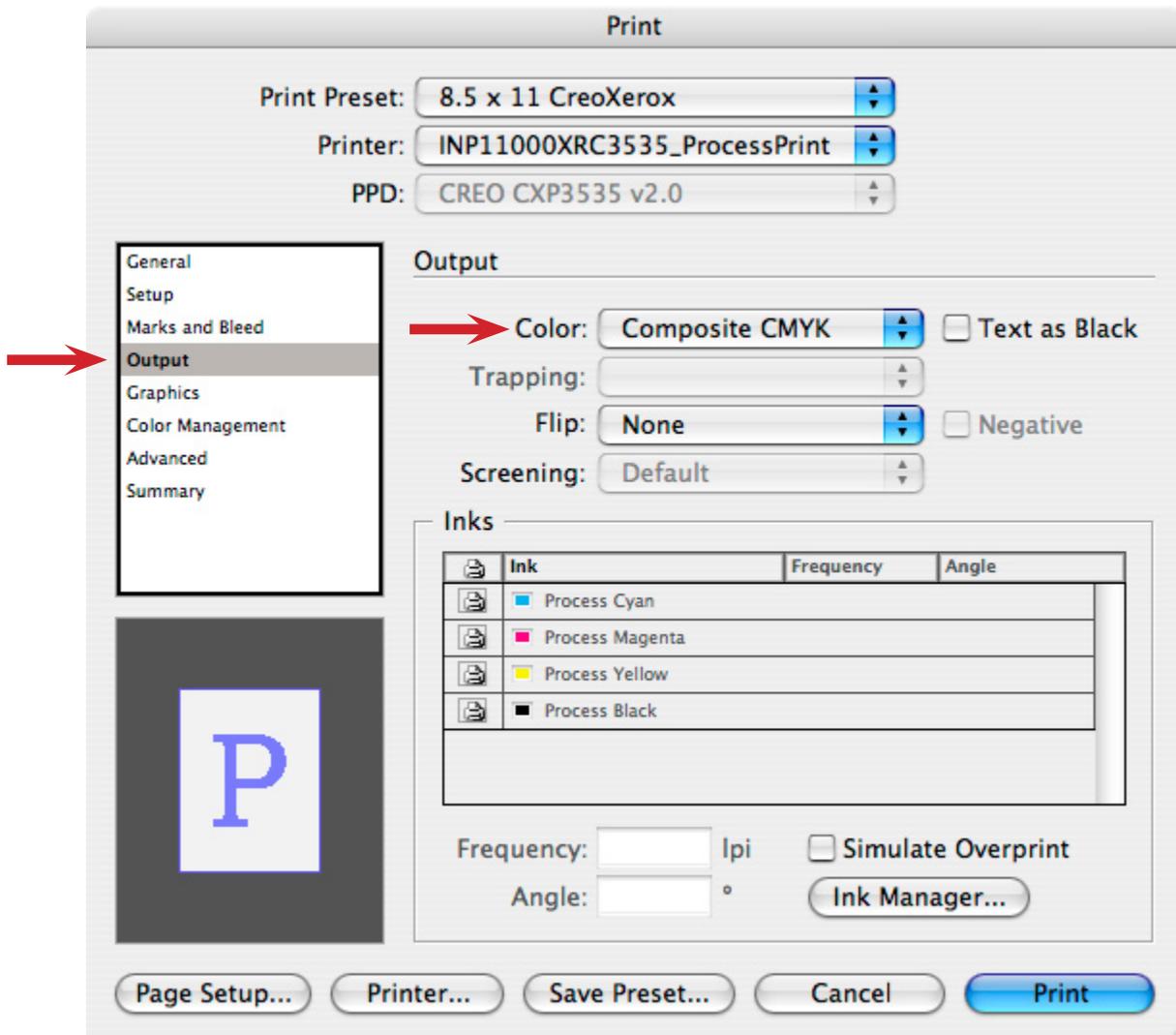
- *View / Proof Setup / Document CMYK* for Publications and *Custom / HWC 1-10-05 2* for Pannier

If you select *Document CMYK* InDesign will use the profile that is embedded in your InDesign layout (your CMYK working space) to create the soft proof. Selecting this option also turns soft proofing on.

For Pannier or anything other than your SWOP working space you must create a custom preview setting selecting the correct profile in the dialog. Unfortunately you can not save it for future use like you can in Photoshop. Let's hope that changes with CS2.



Like Photoshop, you will have to turn soft proofing on for each file every time you open it. It is easy to overlook this. In some cases you might not see much of a change but you should always use it unless you are simply editing text. This also plays a role in printing (see below).



These settings will make InDesign convert all linked RGB graphics to CMYK using the parameters set in *Color Settings*. (This change is only for the file that is sent to print. Your linked graphics will remain RGB.) This is a good thing to do because the Adobe application does the conversion and not the RIP, and because RIPs like CMYK.

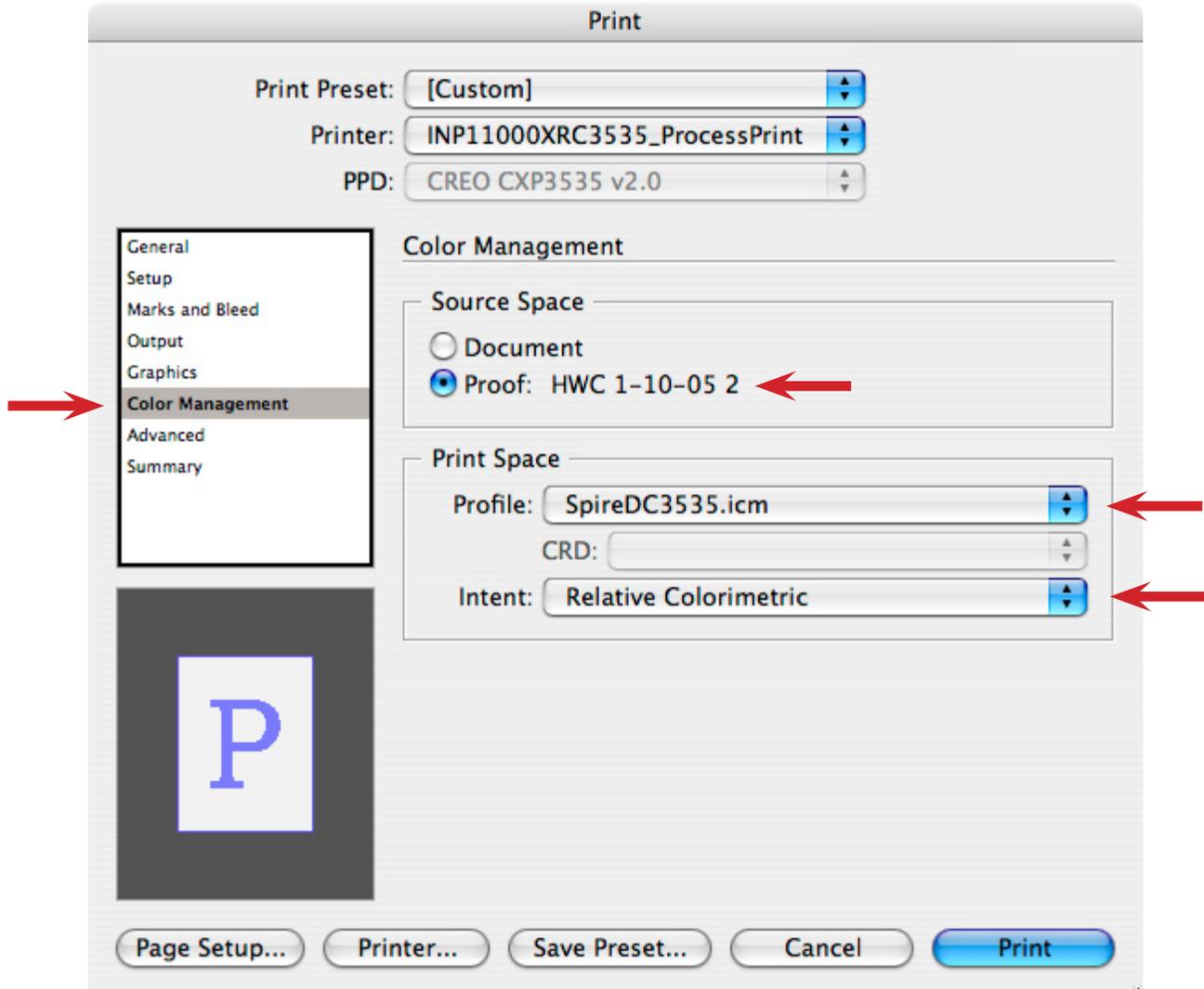
Continued on the next page.

- *Print / Color Management / Source Space*  
*Print Space*

*Proof: HWC 1-10-05 2*

*Profile: the profile for the printer being used*

*Intent: Relative Colorimetric*



The ability to select the soft proof profile as the source space for printing is useful. This effectively allows us to print a soft proof, subject to the quality of the printer and device profiles involved. While this is not perfect and should not be used as a proof, it should be more accurate than not using it. This option is only available if you have soft proofing turned on in the document prior to entering the print settings.

In *Print Space* select the profile for the printer you are printing to, not the profile for the final imaging.

The example illustrated in the print dialog above shows the correct setup for printing a layout that will be going to Pannier (*Source Space / Proof: HWC 1-10-05 2*) that is printing on the Xerox color printer in Waysides (*Print Space / Profile: SpireDC3535.icm*).

## Color Management Policy

We all know that standardized work processes result in reduced errors, increased efficiency, more uniform and higher quality, and more predictable schedules and costs. Color management must become part of the standard work process for us to gain maximum benefit from it. To this point this document has addressed how your workstation and the color management tools that are built into the software should be set. While this is a critical component, a comprehensive color management policy will also focus the use of color management in the overall workflow. It will prescribe when various conversions are to be made, by who, what input profiles, working space profiles, and what output profiles are to be used for each output vendor. In addition it will say how reprints and rehab work will be handled in relation to color management and output conversions.

This is a first attempt to provide a uniform color management policy. The knowledgeable and consistent use of color management by our output vendors is critical to this process, but it is largely uncertain at this time.

- We do have a recent victory with Pannier, the primary fabricator for wayside production. We have won the confidence of Pannier's management about the value of color management and now have an informal written color-managed workflow agreement with them (see following pages).
- The primary contractor for publications, Art Litho, has been moving from a device-dependent color-managed workflow towards a device-independent color-managed workflow with recent hardware and software acquisitions, though they are not completely there at this date. They do, however, present a consistent color "profile" which allows for predictability in work being prepared for their processes, which is the primary goal.

This however is just the beginning. Almost all media production downstream of the Center is now digital, and therefore is already subject to color management. The problem is in knowledgeable implementation, consistency, and coordination with HFC. This has to be addressed one vendor at a time and requires the commitment of the vendor. As we establish that commitment we will document the process and it will become part of a specific policy for each media. Until then here are some things to think about.

There are three basic color management workflows that could be employed. The assumption for all is that RGB image files are acquired. At the most simplistic level they are:

- 1) Image files will be converted from the scanner or camera profile to the working space profile. Image editing will be completed in the RGB working space and an RGB layered working file will be saved for archiving. The file will be flattened and converted to the CMYK output color space to create the final image file that will be placed into the layout. The layout will be created and maintained as a CMYK document.
- 2) Image files will be converted from the scanner or camera profile to the working space profile. Image editing will be completed in the RGB working space and an RGB layered working file will be saved for archiving. The file will be flattened but left as RGB to create an image file that will be placed into the layout. The layout will be created as an RGB document. As a last step before going to production everything is converted to the CMYK output color space.
- 3) This workflow is the same as the previous one except that the conversion to CMYK is not done at HFC. We will rely on the output vendor to convert everything to their CMYK color space. The one established color managed workflow at this time (Pannier 4/19/05, see next page for details) follows this form.

## Pannier Workflow 4/19/05

- NPS/HFC working spaces and embedded profiles will be Adobe RGB (1998) and US Web Coated (SWOP) v2 for RGB and CMYK files respectively. All files submitted to Pannier will have the appropriate one of these two profiles embedded.
- NPS/HFC will submit layout files in Adobe InDesign native file format because of its superior color management capabilities. Color settings for InDesign files sent to Pannier will be US Prepress Defaults.
- Linked files will be TIFF, PDF, PSD, or AI. EPS will be avoided going forward because of its lack of full support for color management.
- Pannier will not edit NPS files without prior consultation with the designer originating the files via the COTR for the project (Larry or Bruce). This is specifically about color editing of images.
- The color settings for NPS/HFC InDesign files at Pannier will be US Prepress Defaults. The important settings in this context are:
  - Enable Color Management
  - Working Spaces:
    - RGB: Adobe RGB (1998)
    - CMYK: US Web Coated (SWOP) v2
  - Conversion Options:
    - Engine: Adobe ACE
    - Intent: Relative Colorimetric
    - Use Black Point Compensation
- Pannier will process the InDesign files by printing to PostScript files.
  - The Output settings will be:
    - Color: Composite CMYK
  - The Color Management settings will be:
    - Printer: PostScript File
    - PPD: Device Independent
    - Source Space: Document
    - Print Space Profile: US Web Coated (SWOP) v2
    - Rendering intent will be defined in the color settings (RelCol with BPC)

*Output of composite CMYK is necessary for conversion from RGB to CMYK with Black Point Compensation. Onyx employs a RIP that is not licensed from Adobe and BPC is an Adobe feature. This does mean another conversion back to RGB, then to the printer CcMmYK color space will occur at the RIP. Normally the employment of multiple conversions like this is to be avoided but in this case the contribution of Black Point Compensation outweighs this concern.*
- Pannier will then convert the PostScript files to PDF via Acrobat Distiller with no change in resolution or compression applied to the raster files, no change in color space or profile, but will convert the fonts to outlines.
 

*The conversion to PDF is necessary due to the inability of the current version Onyx RIP to work fully with InDesign generated PostScript files resulting in no preview on the RIP. The conversion to outlines insures that there will not be a missing font.*
- The files will be Ripped for printing on the HP DesignJet 5500 using the established ink limit and linearity tables, and the profile labeled HWC5500Pannier2005.ICM (directory visible) which has the internal name (application visible) of HWC 1-10-05 2.

## Glossary

This glossary groups words and phrases by relationship, they are not listed alphabetically.

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### Degrees Kelvin

A unit of measure for temperature commonly used in physics where 0° K is absolute zero (-273° Centigrade) and water boils at 373.15° K.

### Color Temperature

In color science this refers to the spectral emission of a black body heated to a specific number of degrees Kelvin. 6504° K is neutral, lower temperatures are red and higher temperatures are blue. The color temperature 5000° K is a component of the D50 standard for graphic arts viewing.

### D50

This is the name of a graphic arts standard for viewing. It includes 5000° Kelvin lighting with a color rendering index (CRI) of 95 or higher (on a 1-100 scale).

### Color Model

A system for conceptualizing and describing color. RGB, CMYK, HSB, CIE, XYZ, and LAB are color models.

### CMYK

A subtractive color model using Cyan, Magenta, Yellow, and Black colorants.

### RGB

An additive color model using Red, Blue, Green colorants.

### Color Gamut

The range of colors that a given environment or device can produce. Chroma, luminance, and saturation are components of color gamut. Out of gamut colors do not exist in the referenced color space.

### Color Space or Working Color Space

Usually a subset of a color model that is intentionally restricted to conform to a specific environment. Typically a working color space will encompass, but be just a little larger than the largest gamut that will be produced from it. If it is significantly larger the conversion to the output color space can suffer from a loss of data and banding can result. sRGB is a good working space for web work because it is a subset of RGB that is restricted to the gamut of a typical monitor; Adobe RGB (1998) is a good working space for reflective media and web because its gamut is based on these needs; ProPhoto RGB is a good working space for photography where inkjet and lightjet imaging devices are employed. sRGB has the smallest and ProPhoto RGB has the largest gamut of these three.

### Soft Proofing

Use of color management on a computer system to allow the computer display to predict how a file will look as a result of the final production.

### Rendering Intent

The selected color rendering intent tells the color engine how to adjust colors when converting from one color space to another with specific attention to out of gamut colors. There are several predefined methods in common use: Relative Colorimetric, Absolute Colorimetric, and Perceptual.

### Absolute Colorimetric

This is a color rendering intent. It is a specific set of rules for the color engine about how to adjust colors when moving between color spaces. Adobe says: *Leaves colors that fall inside the destination gamut unchanged. This intent aims to maintain color accuracy at the expense of preserving relationships between colors. When translating to a smaller gamut, two colors that are distinct in the source space may be mapped to the same color in the destination space.*

**Relative Colorimetric**

This is a color rendering intent. It is a specific set of rules for the color engine about how to adjust colors when moving between color spaces. Adobe says: *This intent is identical to absolute colorimetric, except for the following difference: relative colorimetric compares the white point (extreme highlight) of the source color space to that of the destination color space, and shifts all colors accordingly. The relative colorimetric intent can be more accurate if the image's profile contains correct white point information. This is the default rendering intent used by all predefined color management configurations.*

**Perceptual**

This is a color rendering intent. It is a specific set of rules for the color engine about how to adjust colors when moving between color spaces. Adobe says *This intent aims to preserve the visual relationships between colors in a way that is perceived as natural by the human eye, although the color values themselves may change.*

**Black Point Compensation**

This is associated with perceptual and relative colorimetric rendering intents. When selected, a conversion from one space to another maps the black point of the source space to the black point of the destination space, adjusting to and taking advantage of the contrast of the destination space.

**CMM**

Color Matching Method. The software engine that makes the color transformations for color management. Examples are Adobe Color Engine (ACE) and Apple ColorSync.

**Calibration**

Bringing a device into a known, repeatable, and linear state. A calibration is usually done before a device is characterized and a profile made.

**Characterization**

The process of running color patches of known values on a device for the purpose of creating a profile. The patches are read by a colorimeter or a spectrophotometer, and the resulting data is compared to the known LAB values for each patch. The difference between the known value and the result is referred to as Delta E. This comparison is the basis for the profile.

**Profile**

A profile is a relatively small piece of software that contains the specific color data and tables for a given device or color space. It is used by the color management system to transform the color from one space to another. A profile might be an input profile (scanner, camera), a working space (Adobe RGB 1998, ProPhoto), or an output profile (HWC 1-10-05 2 - Pannier, USWebCoatedSWOP.icc). Monitor profiles are output profiles of sorts.

**ICC**

International Color Consortium. *The International Color Consortium was established in 1993 by eight industry vendors for the purpose of creating, promoting and encouraging the standardization and evolution of an open, vendor-neutral, cross-platform color management system architecture and components. The outcome of this co-operation was the development of the ICC profile specification.* Quoted from the ICC web site.