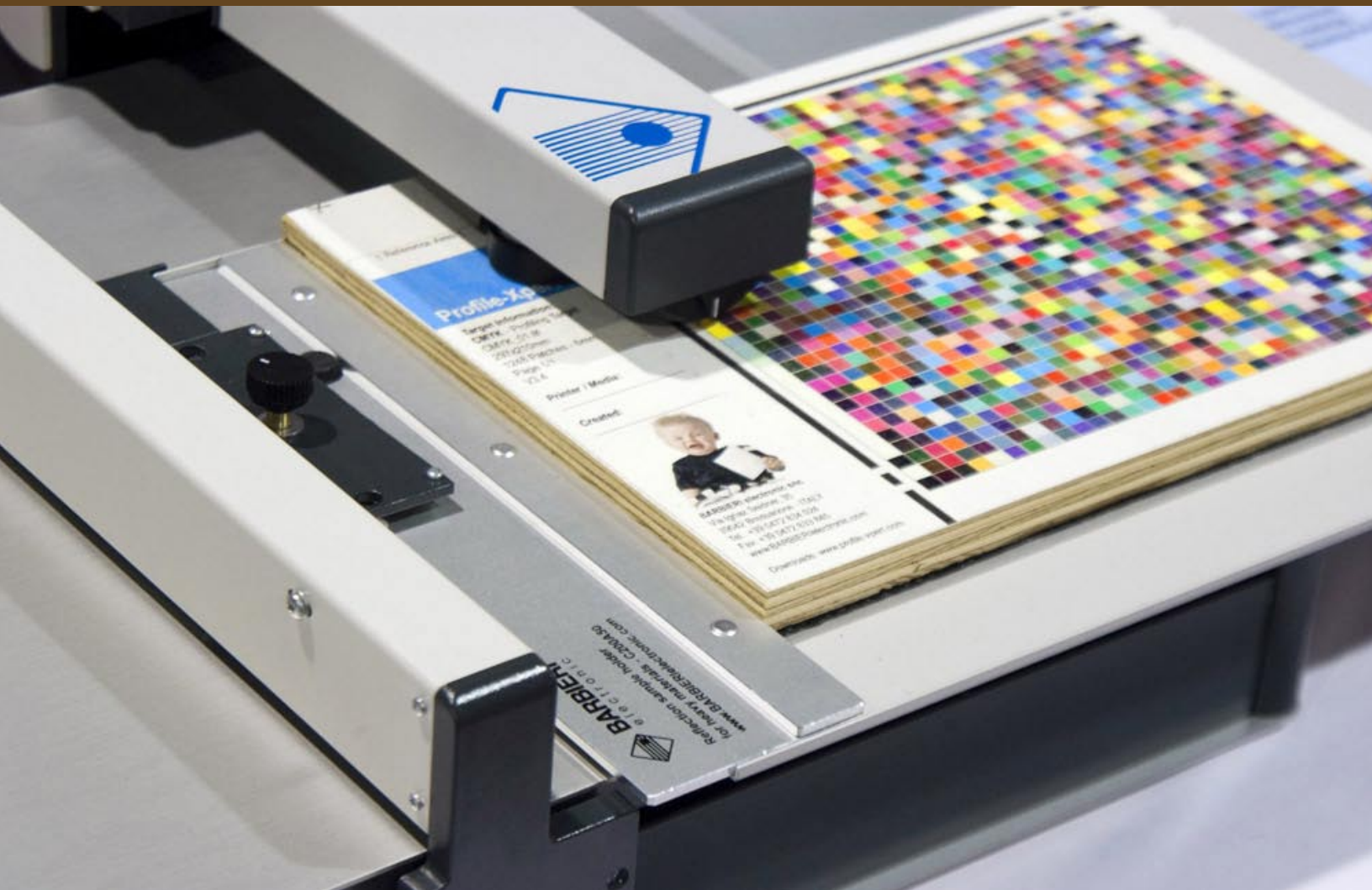


Glossary of terms on Color Management & ICC Color Profiles



**for wide format printers,
digital cameras, and scanners**



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Introduction

Our goal is that this glossary is to assist printshop owners, managers, and printer operators, as well as students of graphic design, photography, and printing. This glossary should also be informative for photographers, artists, giclee ateliers, and printing shops of all kinds, especially signage.

FLAAR has separate glossaries on digital photography, on wide-format inkjet substrates and media, on UV-cured flatbed printers, and is preparing a glossary on wide-format inkjet printers for textiles. These can be obtained from various web sites in the extensive network of FLAAR sites including www.wide-format-printers.NET.

A major focus of FLAAR is in archaeological research and museum displays. To reproduce the color of an ancient mural or artifact is what has led me into color management. In other words this glossary began as my own quest to learn how to handle colors so that my exhibit photographs represented the colors of the original paintings or sculptures. I felt it would be helpful to others to have the results of my years of research teaching myself about the basics of color management. I still have a long way to go, but this FLAAR Report is a good introduction to color management jargon.

Most good books on color management have a short glossary, but tend not to have an extensive one and rarely illustrated no matter how long or short. Then there are dozens of glossaries on the Internet. Several of these simply copy from the others. Most of these are not illustrated. So our intent was to gradually build up a corpus of at least basic illustrations. Since all software is copyright, we can't do screen captures as illustrations until we have staff and time to go through the endless paperwork to obtain permission. So the initial illustrations are mainly for hardware. The other limitation on illustrations is the cost of preparing them. Thus we appreciate the help of research sponsorship from corporations.

Because so many of the glossaries on the Internet copy from each other, our goal was to work in a manner to avoid plagiarism of the glossaries which already existed. You see too many plagiarized glossaries on the Internet already.

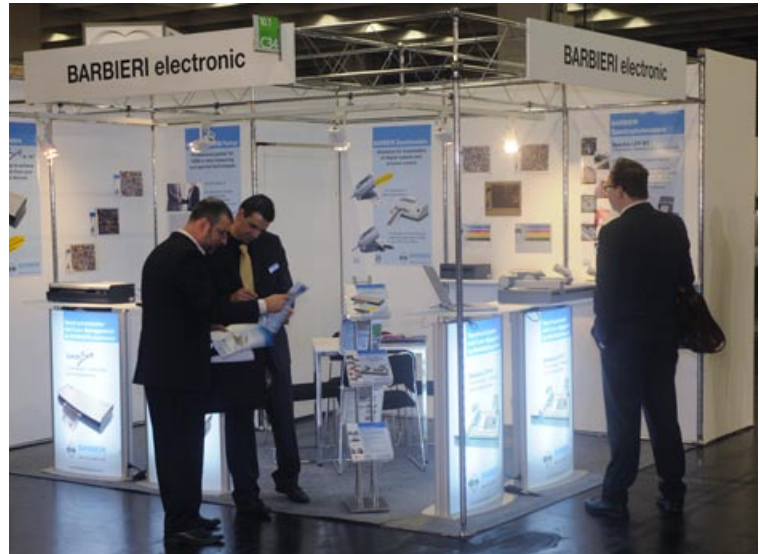
The best way to avoid plagiarizing another work is not to look at it when you are writing your own. So my portion of the following glossary was built up term by term by a long learning process which included attending IMI conferences, trade shows around the world, as well as reading books and articles on color management. To edit some difficult terms then we went back to the books, articles and on the Internet to understand the nuances of a term. Obviously some terms are so basic and standard that there is no way to define it without the definition being similar to everyone else: you would define a hand as having fingers and a thumb.

Earlier versions of this glossary were assigned to students to assist in organizing. Stephanie Madeya did a capable job during her period of co-op internship. Paul Huhtala undertook later revisions. Because of the costs of maintaining the research institute at the university, the resulting bibliography had a nominal fee. Of course most people preferred a free glossary on the Internet rather than paying, even if the Internet glossaries lacked illustrations.

But the university ran out of funding by 2007, so FLAAR returned to St Louis in May 2008, which is where we were located before moving to Ohio. During 2008 I decided to bring this glossary up to date by further improvements. The goal was to make this new FLAAR glossary on color management available at no cost (so there would be less incentive to seek other Internet bibliographies). To make any report free to the worldwide readership of FLAAR web sites implies a sponsor to provide funding, and we thank BARBIERI electronic, a leading color management company in Europe for providing funds to expand and improve this glossary and to make it available to our readers at no cost.

This glossary is essential for the newbie and intermediate user, as well as for any new employee. The terms contained within are related to aspects of color management, including basic information pertaining to color theory as well as information directed more towards the color management workflow.

The present version (October 2008, updated November 2008 and again in May 2009) is a major update over previous years, but this will be further updated about once every year.



BARBIERI electronic booth at Photokina 08

Glossary

18% gray has long been used as a standard reference in gray balance for photography. The gray patch under the yellow patch is the closest on the Macbeth ColorChecker to 18% gray it has Lab values of 52.0.0.

4-color process, a printing process that utilizes four colors of ink, Cyan, Magenta, Yellow, and Black, to reproduce colors.

5000° K, standard color temperature for viewing colors (in a viewing booth) in the United States.



Macbeth ColorChecker

6-color can mean either a printing process that utilizes Cyan, light cyan, Magenta, light magenta, Yellow, and Black to reproduce colors or can mean CMYK plus Orange and Green. Light colors are not really separate colors, they are separate ink lines that help in transitions. In comparison, 6-color process color can produce more colors than 4-color process, due to the two additional inks. But for billboards and banners, or any signage viewed at a distance, four colors are plenty. Four color images are lower cost to print because you use less ink. Wide-format inkjet

printers exist with eight colors and with up to 12 ink lines. However few RIP software or color management software can handle more than six colors. See also **Hexachrome**.

A

Absolute Colorimetric is one of four **rendering intents**. The goal of the Absolute Colorimetric intent is to clip those colors which don't fit into the target device gamut, but all colors which fit both the gamuts remain the same. "Target device" usually means a printer. Alternative rendering intents are **Relative Colorimetric**, **Perceptual**, and **Saturation**. Which one to choose depends on whether you are dealing with pie charts, or photographs or logos (which depend on accurate matching of spot colors). For logos one of the colorimetric options is best. (Andrew Rodney, "ColorSync and ICC"). For example, If your image is primarily spot colors, you will tend to prefer absolute colorimetric. This rendering intent functions by taking colors that are outside the output device gamut and shifting or pulling them into the gamut. See also **clipping**.

absolute color reference systems are three-dimensional color models based on hue, saturation, and lightness. The early versions of these systems were presented in the form of color charts. The Munsell color charts would be one well known absolute color reference system. Europeans, especially in German speaking countries, may know the **DIN** system better. For those for whom a numerical system of color nomenclature and reference is too rigid and mathematical, there are also **verbal color designations**.

achromatic color, color lacking hue, meaning that it either totally reflects or absorbs light. Examples of achromatic color include white and black. See also **chromatic color**.

additive color model is demonstrated by the mixture of colored lights to form all colors. Experiments have demonstrated that with varying percentages of Red, Blue, and Green light you can form most other colors. Also known as additive primary colors. If you take any two additive primaries and combine them, you get one of the subtractive primary colors (C, M or Y). An example of additive color is the color produced by your computer monitor or digital projector. 100% of Red, Blue, and Green forms white. 0% of RGB is black. See also **subtractive color model**.

additive primaries, also known as the additive primaries of red, green, and blue. These colors are the base of the additive color model. Your monitor displays in RGB and scanners scan in RGB. Although your inkjet printer reproduces color in CMYK, cyan, magenta, yellow, and black, most large-format printer firmware prefers to receive files in RGB. When working in Adobe PhotoShop, do not convert files into CMYK and then return them back to RGB. Converting a file from RGB to CMYK clips part of the color gamut. Let your RIP or printer driver make that conversion for you. See also **subtractive primaries**.

Adobe Gamma, a function to calibrate monitors provided by Adobe Systems.

Adobe RGB 1998, sometimes written as Adobe RGB. Released in 1998, Adobe RGB 1998 requires the use of a monitor profile and then in theory, images will display identically on any monitor that is using the same profile. Most professional graphic designers prefer Adobe RGB

1998 as their working color space. See also **sRGB** and **Colormatch RGB**.

algorithm, a mathematical equation to transform aspects of an image from one state to another. An algorithm may be used to transform a color from RGB through LAB to CMYK.

B

banding are horizontal lines on a print. Banding is an undesirable effect of all sizes and shapes of inkjet printers, both piezo and thermal. Banding may be present only across one color (usually a solid black or solid cyan). Or banding may be continuously across the entire range of colors. Banding is a result of the path of the printhead across the media. There may be lines or absence of image within the bands.

At trade shows circa 2000-2003 the printer that showed banding defects the most were Roland printers, though if you take the last dozen trade shows, at least one printer of every brand has been banding at least once. Encad has the best record of seldom banding (reputedly because it sprays so much ink out of its Lexmark heads that the ink obliterates any banding tracks).

Nowadays (since the last several years) the Roland is for signage and not really made for giclee or photo printing any more. The newer Mutoh printers have software that allows the user to correct for banding from media advancement (Intelligent Interweaving from Mutoh). Roland and other companies have copied this concept, either by license or by creating their own method of gradient masking. In general, banding today (2009) is less a problem that it was five years ago. You should not accept banding from your printer. A banding is a defect. In most cases it can be overcome when the end-user understands what kind of banding is involved, and how to resolve the problem.

For more intimate details on banding see the FLAAR Report on “Piezo vs Thermal: Pros and Cons, Fact vs. Fiction.”

Banding is called many other things, such as streaking, but it is not a streak, it is a continuous horizontal defect.

- Banding on inkjet is more complex than a different kind of banding on desktop office laser printers; several kinds of banding may occur in wide format inkjet output.

Printers that use UV-cured ink have an additional kind of banding called “bi-directional banding.” This defect, also called curing banding or the lawnmower effect, is described in FLAAR Reports on UV printers. See also **chromatic banding**.

base linearization, see **linearization**, **re-linearization**, **calibration**.

basIColor is a German color management company. Their software is considered excellent. Their motto is “the basIColors of color management.” Website is www.basIColor.de. I have, however, not yet had the opportunity to receive and thereby not the opportunity to test their products in person.

black is the absence of any color because the object has absorbed all color and hence reflects none back to the observer. In theory black results when you combine all three primary subtractive colors. But the actual inks or paints are not pure enough and the end result would be a muddy dark brown. Hence in printing you need pure black colorant to produce your black type and other desired blacks. In the abbreviation CMYK, Cyan, Magenta, Yellow, black, the K is thought to come from the old fashioned printer's term as the key color. See also "**rich black**"

black point is the darkest part of your scene where you still wish to be able to see details, such as within a dark shadow. If it were pure black there would be nothing to see. See also, **white point**.

black point adjustment (Green p. 133) is the process of adjusting the shadow areas of an image to enhance image detail, the opposite of white point adjustment. Adding black to the shadow areas of the image will make this adjustment. See also **white point adjustment**.

black point compensation is the adjustment of black points between different color spaces, which allows for the darkest darks of an image to remain unchanged.



Calibration strips for printer self-calibration. Taken From HP 5000

blooming (in a digital photography) tends to occur on areas of high brightness when the information (from the electrical charge) for one area spills over into adjacent areas.

blue, one of the three additive primary colors, otherwise known as B of the RGB acronym.

brighteners are chemicals added to the surface layers of inkjet media to make them whiter than white. To counteract this unnatural brightness, a **spectrophotometer** may need a UV filter to make unbiased readings. See also **inkjet receptor layer**.

brightness is the **lightness** or darkness of the emission of light. The sun is bright. Brightness is the measure of the intensity of light in a color from bright to dim. Brightness is also dependant on the amount of color that is reflected from a surface.

bronzing is an undesired effect resulting from coincidental reflections primarily from pigmented ink and especially on glossy media, mostly noticeable from large areas of ink and especially black. See also **gloss differential**.

C

calibration (standardizing) vs **characterization** (describing). Calibration returns the device to a known state by checking the state you find it in, then adjusting it to a preferred state which

is a known state. You calibrate first, then characterize it. Initial calibration of an output device begins with **linearization** of that device. Fraser describes all this in terms a lay person can actually understand (2003:114). . See also **linearization**, **characterization**, **monitor calibration**, and **printer calibration**.

calibration bars, sometimes referred to as calibration colors or **target** or **swatch**. These bars are printed in either grayscale or color and can be measured by a color measurement instrument to determine if the color of the printed output is accurate.

canned profile is a pre-developed ICC profile that are made by printer, media, and ink manufacturers, or by a commercial profiling company. These profiles can produce varying results, as the conditions at the facility where the profiles were created may be much different from the conditions within your facility. Plus, their printers, the age of their printheads, all affect their profiles. Your printheads may be different. Indeed photographers have told me that even with two of “the same” printer models, a canned profile will result in one color on one printer and slightly different nuances of color on the “same” printer model next to it (in the same temperature, humidity and on the same media). Therefore It is recommended avoiding canned profiles and that custom profiles be developed.

The reason that printer manufactures so eagerly provide you with canned ICC profiles is so that you use their canned profiles and thereby their ink and their own branded media. But if you know how to do your own ICC color profiles, then you can do select media that is less expensive. See also **custom profile**, **color profile** and **ICC color profile**.

capture, in digital imaging jargon means to take a picture or do a scan, to “capture” the digital image with a capture device.

CCD, charge coupled device, the imaging sensor of many digital cameras (except those that use a CMOS sensor).

channel, specific color areas of an image. Examples of channels are red, green, or blue for RGB and cyan, magenta, yellow, and black for CMYK.

characterization means profiling a device; profiling means you describe it colormetrically using color measuring tools. You calibrate the device first, then characterize it. The best definition of characterization I have seen in the process of reading countless books as background research is by Fraser et al. 2003:114: “profiling, which is often called characterization, is the process by which we record a device’s behavior into a profile. It doesn’t change the device’s behavior; it just records how this device makes color and what colors it can (and cannot) reproduce.”

The ICC profile contains device specific information (in numerical form) to help create consistent output results. Characterization is done after calibration of the output device and requires the use of color measurement instrument and third-party color management software.

chroma is **saturation**, the quality of a color that is the combination of hue and brightness. White, black, and gray have no chroma. Adobe Technical Guides. Glossary of Color manage-

ment Terms. Chroma is elsewhere defined as “deviation from gray.” (Raja Balasubramanian et al. The Industrial Physicist, p. 20).

chromatic banding results when the sequence of colors being printed with the carriage going from left to right is a different sequence of colors when the printhead carriage is going the other direction. This has to do with the sequence of the printheads. If each ink color has only one printhead, then it may be first color down with the carriage moving to the left and last color down when the carriage is moving back the opposite direction. The final color (of the mixture of CMYK) will vary slightly depending on the sequence of color laydown. One way to avoid chromatic banding is to have two printheads for each color and mirror their positions. In this way the sequence of color is the same no matter what direction the carriage is moving.

chromaticity coordinates, based upon the CIE xy Chromaticity Diagram. Chromaticity coordinates describe the redness greenness and yellowness blueness of a color, otherwise known as hue description of the color.

chromatic color, color that has hue, meaning that it reflects light to create different colors. Examples of chromatic color include red, green, blue, yellow, etc. See also **achromatic color**.

chromaticity, description of the redness greenness and yellowness blueness of a color, otherwise known as hue description of the color. Also abbreviated as C*.

CIE, French for Commission Internationale de l’Eclairage, otherwise known as the International Commission of Illumination. They are credited with the creation of the CIE Lab color space.

CIE Lab, also written **CIE L*a*b*** (see also LAB). “L” stands for lightness, “A” stands for the color location between magenta and green, “B” stands for the color location between yellow and blue. Paraphrased from Print Publishing (p. 456). In jargon it is really called LAB (also written Lab). It is not an acronym but is spelled and usually thought of as one anyway. Lab is a device independent color space. The intent is to have a color description that is based on the way we humans view color with our own eyes.

CIE LUV, color space also known as CIE L*u*v* or CIELUV.

CIE standard illuminates, CIE data pertaining to different light sources as viewed by a CIE standard observer.

CIE standard observer, observer that represents a human with the sense of normal color vision.

CIE tristimulus values, reference amount needed to match color stimulus.

CIE xy chromaticity values, chromaticity coordinate values that describe the redness greenness and yellowness blueness of a color.

clipped, occurs when colors that are outside the output device gamut are shifted to be capable of being reproduced by an output device. See also **Absolute Colorimetric**, one of the four rendering intents.

CLUT, also known as color look-up table.

CMD, Color Measurement Device (Onyx, p. 5).

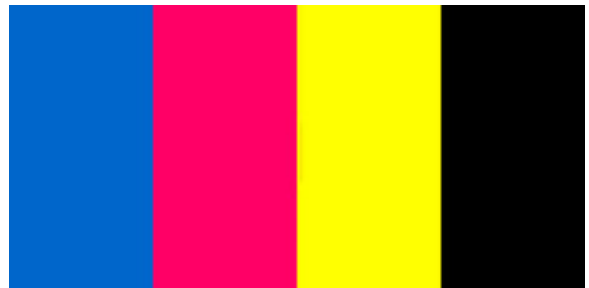
CMC, also known as color management committee.

CMS, otherwise known as color management system. The CMS is used to translate color gamut information from one device to another device, while retaining accurate color information.

CMM, otherwise known as color matching method. The part of the CMS that is responsible for the color gamut translation function between the device and the profile.

CMY, cyan, magenta, and yellow. Otherwise known as the subtractive primary colors.

CMYK stands for Cyan, Magenta, Yellow, and black or Key color (based on traditions in printing from the previous century). Otherwise referred to as the subtractive primary colors. The colors that are used in the inkjet printing process. Note: “B” is not used for black since it could be confused with process Blue.



CMYK color. When overprinted, it can produce full color. Also Know as 4-color process inks

color (brightness, colorfulness and hue) color requires an observer, an object, and a light source.

color adaptation is the known propensity of the human eye to recognize certain colors as standardized even when under a differing light they have a color cast. Thus a white sheet of paper is interpreted by the brain as white even when moved from tungsten (yellow) light to bluish fluorescent lighting.

colorants, additives (pigments or dye) used to create color for inks used in the printing process.

color balance is an even **grayscale**. Your color balance is “off” when your gray looks pink or your sky looks purple. Color balance is not corrected by color management whatsoever. Color management would merely tell the output device how to properly reproduce the color imbalance in the original image. To correct the color balance you need to do a white balance (or gray balance), either before you take the photograph, or afterwards in Adobe Photoshop or iCorrect from Pictographics.

color by the numbers. You can represent RGB (or CMYK) by numbers 0 through 255, or by

percentages, 0-100%. You can find the colors and see their numbers on the 0-255 scale in the color picker of Adobe Photoshop.

color cast, the visually noticeable tint in red, blue, green or an off-gray. Gray does not have a color cast. Color cast can be removed from an image by the manipulation of the image color channels. See **gray balance**.

color configuration, data specific to an ink set and media that is sent to the printer along with a job to produce accurate color.

color conversion, changing from one color model to another. For example the RGB to CMYK conversion that is performed by the RIP software when printing to an ink jet printer.

color correction, the process of altering an image so that it displays realistic color. Color correction can be done in a variety of different methods, including color balancing and manipulation of color curves. To color correct an image, Adobe Photoshop or other similar manipulation programs are needed.

color curves, tool that can be utilized in the color correction process of an image. Color curves can be adjusted as one, or they can be adjusted as specific channels.

color designation system, see **Munsell** and **verbal color designation**

color gamut, the range of colors that can be reproduced within a color space.

colorimeter is an instrument which seeks to measure color in the same manner as the human eye. "A device that measures luminosity of colors" (A&W GATF p. 41) in a manner similar to that of the human eye. "better at measuring color differences than individual colors" (Brues). A spectrophotometer is more accurate because it can handle a wider spectrum. You tend to use a colorimeter to measure a monitor and a spectrophotometer to measure a printed test patch (Monaco by X-Rite: p. 22)

color key, a sample print that is used for a customer proof to display what the final job prints will look like in terms of color. See also **proof**.

Colormatch RGB, a working color space which is the standard for prepress imaging. See also **Adobe RGB 1998** and **sRGB**.

colorimetric rendering results in clipping out of gamut colors. Then all the colors in the original are brought into the gamut the output device can handle. Use colorimetric rendering if you have spot colors; do not use colorimetric rendering with most photographs. There are two kinds of colorimetric rendering intends: **Relative Colorimetric** and **Absolute Colorimetric**. See also **perceptual rendering**.

color management, the process of reproducing accurate color from device to device. Color management is not at all the same as color correction or color balancing (**gray balance** or

white balance). Color management does not correct poor color, it only manages image colors from input to output devices. Color correction (color balance) is intended to adjust poor color. Color management is intended to take color from RGB color space, transfer it to an intermediate color space, Lab or similar, and finally to CMYK for either offset or inkjet printing.

color matching, basis for the science of what is referred to as color management. Color matching is the process of producing accurate and consistent color from device to device. There are many functions, such as the development of an ICC profile and choice of the correct rendering intent, which are crucial for accurate and reliable color matching.

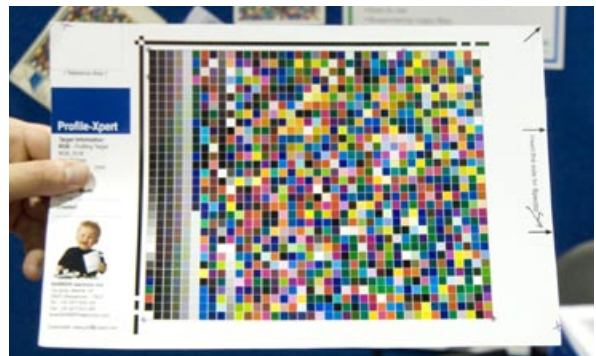
color model, this term is utilized differently by various authors. Most specialists consider **additive color** and **subtractive color** as color models; **colorimetric rendering**, **perceptual rendering** can be assumed under color models. Fraser calls **RGB**, **CMYK**, and **CIE Lab** color models. Yet others call those **color spaces**. Either definition shows the important fact that color models are classified into various categories to be represented and differentiated between one another.

color profile, otherwise referred to as ICC color profiles. Color profiles can and should be generated for both input and output devices. These profiles play an important role in color matching, since they contain device specific information pertaining to a devices ability to reproduce color. Color profiles are created by manufactures of output and input devices, but it is recommended that custom profiles be generated, because they will reflect the specific of your work environment. See also **custom profile**, **canned profile** and **ICC color profile**.

color reference systems is a color system in which colors can be identified by name and the true color can be looked up in color reference documentation provided by the manufacturer. Examples of color reference systems are Pantone, Toyo, and Truematch. See **absolute color reference systems**.



The X-rite and DTP70 are some of the color instruments used in building a color profile.



BARBIERI Spectro Swing RT, used for building a color profile (in this picture for transparent backlit media).

color spaces include **RGB**, **CMYK**, **CIE L*a*b***. (Caponigro 21-35; Ciaglia pp. 94-95; see also the X-Rite booklet and the Agfa booklet) Fraser calls the color space the three-dimensional representation of a color model (www.creativepro.com/story/feature/11132.html). The term color space is utilized differently by various authors. Some consider the term to define RGB, CMYK, and Lab. Others consider the term to define all of the colors that a color model is capable of producing.

color separations, individual printout of colors used in an image. If an image is four colors, there will be four separate prints, if the image is two color, there will be two separate prints and so on.

color sequence, the sequence in which colors can be viewed from the visible spectrum.

color shift is an unwanted change in color. Color shift can be caused by using an incorrect rendering intent or using the wrong color model when sending a job to an output device.

ColorSync was Apple's system color management extension that was the predecessor to the ICC profile system that is the current industry standard. ColorSync existed before the ICC color profiles that we use today. Apple was one of the founding members of the ICC. A good description of a ColorSync workflow is available from Roy Bohnen and Sean O'Leary, pp. 54-57 and elsewhere in their booklet.

color temperature is measured in degrees Kelvin. Color temperature is based on an idealized black radiant body which, as heated, starts out glowing red and as the heat rises turns to blue white. A technical definition is available from from hundreds of different web sites.

color viewing booth is a hooded booth with the hood intending to keep other light from falling on the subject whose color is being studied. In the US, a viewing booth uses light which tries to simulate natural light at 5000K unless you wish a different color temperature. In Europe a different color temperature is preferred. Several companies are best known for making color viewing booths; the one I know best is Just Normlicht.

color wheel, a method of showing colors and their position next to each other.

complementary color, a color that is the exact opposite of another. Complimentary colors can be easily determined by locating the primary color on a color wheel and finding the color that is directly opposite. For example, the complimentary color to red is green and the complimentary color to blue is yellow. Combining complementary colors produced gray.



Just Normlicht Color Viewing booth at GraphExpo 2004

composite file, opposite of color separation. All colors in the image file are reproduced together as opposed to individually.

cones, color sensitive light receptors that are located in the retina of the human eye. The cone is the opposite of the rod, which is also located in the retina of the human eye, in that it is responsive to high light source brightness. See also **rods**.

contrast is the relationship between darks and lights in an image. A color management system usually wants to know the darkest and lightest areas of an image.

cool color, a color that has a hue related to blue colors on the color wheel. The opposite of a cool color is a warm color. See also **warm color**.

correction, color correction is what you do with Adobe Photoshop, Pictographics iCorrect, and comparable software. This is not calibration nor characterization. Two good books on color correction are by Dan Margulis and another by Michael Kieran.

CMM = Color Matching Module, “will interpret the information contained within a device profile and carry out the instructions on the way the color gamut of each device should be treated.”

Cyan is also called **process blue**; one of the three primary subtractive colors. Also known as C in the CMYK acronym.

custom profile, the opposite of a canned profile. Custom profiles are developed in house and reflect the specifics of the particular work environment such as temperature, humidity, age of materials, etc. Custom profiles help to ensure consistent color reproduction from device to device. If you are doing commercial production printing you will eventually wish custom profiles. The reason you want a custom profile is that it is accomplished in your shop with your room temperature and humidity. See also **color profile** and **canned profile** and **ICC color profile**.

D

D50, otherwise known as 5000° K. This is the industry standard for viewing color for accuracy and consistency.

D65, otherwise known as 6500° K. This is the calibration standard for monitors.

Delta E is how to pronounce ΔE ; a standard for measuring difference in color. The smallest difference in color a normal (healthy) person with healthy eyes can distinguish.

densitometer, a device that measures the density of colors. Densitometers work by measuring the amount of light that is reflected to the eye (light which is not absorbed) and assigning that amount a value based upon absorption factors of white light. A densitometer could be considered a color tool but is not intended to measure color, but rather relative density. A densitometer enables you to read pixel values directly from the screen. Print Publishing (p. 344). Barbieri

has been manufacturing densitometers since 1983 (for photography, where quality counts). See also **colorimeter**, **spectrophotometer**.

density is the ability of a surface to absorb a source of light. Light colors have low density; dark colors have high density because not much light is reflected off them.

density range, value difference between the lowest density level and the highest density level of an object.

device, informally described a device is hardware, such as a monitor, printer, scanner, or digital camera. See also **drift** (device drift).

device dependent is a color whose gamut is dependent on the type and even the specific device within that type. So two printers (or monitors, or scanners), even if the same make and model, can exhibit differences in color reproduction.

device independent, a color space whose appearance does not change with every device which displays it.

diffuse highlight, the lightest part of an image for which you wish to see visible detail still preserved. see also **highlight** and **specular highlight**.

differential gloss, see **gloss differential**

DIN. Wikipedia says this really means Deutsche Institute fuer Normung, but 100% of the people that I ask say it means Deutsche Industrienorm (German industrial standard(s). This organization sets standards (norms) for German industry.

dot pitch, differential distance between phosphors or dots contained within a monitor. Monitors with a lower dot pit are considered to be of better quality, because of their ability to create a better display. See also **phosphor**.

drift, as in, device drift. A printer's output will "drift" as the printheads become worn out, as the temperature and humidity change. In this case you will occasionally wish to re-linearize the device to compensate for the drift.

dye, colorant used in the printing process.

dye sublimation, is a chemical process whereby heat is applied to an inked surface. The heat turns the ink (so no more individual droplets). The result is continuous tone. Dye sublimation works best on polyester. The color of the printed material before heat is applied is not the color you achieve



Klieverik GTC 3400 for Dye Sublimation

dynamic range, the range of measurable density values, usually used for the range a scanner can detect.

E

edit a profile, in effect means you take the profile and tweak it yourself. In other words, you use subjective impressions to tweak what is supposed to be a scientifically valid objective profile. Once you realize you may have to, or desire to, tweak a profile, this sort of ridicules the entire ICC profiling process. Now you see why some printshops simply skip color profiling all together and tweak from the beginning (and skip even trying to apply profiles. Downside of not using ICC profiles or color management workflow is that only your current printer operator can replicate a desired result. If the operator is sick, or retires, or jumps to another job elsewhere, you have no way to replicate what he or she was doing. But if you have a color management workflow, any new employee can come in and repeat what was being done by anyone else.

embedded profile, an ICC profile that is attached to a file, which can be used by other applications.

F

flat color, color that is solid and contains no blends or gradations.

fluorescing, the process of light absorption and reflection, which produces bright colors. Reflection may produce a different hue than absorption.

FOGRA, a non-profit research institute in Munich, Germany dedicated to setting standards in offset printing. FOGRA is now realizing that offset printing is being gradually replaced in some aspects by inkjet presses. At a recent FOGRA event (autumn 2008), FLAAR was one of several presenters on the wide-format UV-cured inkjet aspects of the changes that are coming into the offset printing world.

four color black is a black made of K plus CMY. See also **rich black**.



Dr. Nicholas Hellmuth lecturing at FOGRA 2008

G

GCR, Gray Component Replacement. This process replaces portions of the CMY ink with black ink throughout the image including highly saturated areas, as opposed to UCR (Under Color Removal) which removes CMY primarily in shadow areas which are supposed to be neutral anyway. Check to make sure that a large dose of GCR has now lowered the gloss, contrast,

and saturation of the end result. (Field 1999:175; 218). Advantages include the ability to print cleaner with brighter colors, disadvantages include loss of shadow detail.

gamut, the range of colors which can be achieved by the device. see **color gamut**.

gamut compression, compression of the color gamut based upon the amount of colors that the output can realistically reproduce. Rendering intent also plays a large role in gamut compression, due to the gamut mapping that is completed.

gamut mapping is necessary when moving color from one device to another when their respective device specific color gamut differs. The gamut mapping is what is undertaken to arrange the transformation with as little change as possible. One Adobe author uses the word gamut mapping in a manner that I would interpret as synonymous with **rendering intent**.



Black tonal scale used for measuring gamma.

gamut simulation, simulation of the color gamut available for one device on another. This mimics available device colors, so it is good for creating proofs.

generic profiles are the **canned profiles** that you get with the inkjet printer hardware, software, inks, or media. Unfortunately, your printhead wear, the temperature and humidity of their printer won't be the same as your own printer or environment. If you are serious about color matching you will prefer to work with **custom profiles**. Generic profiles may also be called stock profiles or canned profiles.

gloss, a form of surface finish, a quality which reflects light. Pigmented inks may suffer from differential gloss defect. Some glossy surfaces may be too reflective, but this is a matter of personal preference. Gloss may be enhanced by lamination. See also **matte** and **satín**.

gloss differential. Pigmented inks may suffer from differential gloss defects because some inks are more glossy than others. You see the difference when some pure dark surfaces look muddy in comparison to other colors near them. Some glossy surfaces may be too reflective and others look nice; this is a matter of personal preference. Gloss may be enhanced by lamination. Gloss differential may also be eliminated or minimized by lamination. See also **matte**, **luster**, **satín** finishes.

grain, 1 The direction in which the fibers run in paper. Grain, 2: the ditty pattern of inkjet drops. grain, 3, grain of film as seen in a photographic print. The higher the ISO the more grain. Digital equivalent of grain is noise.

gray is the absence of any color cast. Gray is neutral. Whether light gray or dark gray or anything in between; gray is gray.

gray balance, the process of removing colorcast tint from a color. Gray balance is needed when C, M and Y are not in proper proportions and all colors make a shift towards the colorcast tone and may happen at several stages of production.

gray levels range (the number of) levels between the lightest and darkest parts of the scale.

grayscale: a grayscale image in digital jargon means a black and white image. Grayscale is not normally intended to mean a scale of gray.

green, one of the three additive primary colors, otherwise known as G of the RGB acronym.

greyscale, in printhead jargon, has nothing to do with the color gray, white, or black or any color. A greyscale head is contrasted with a normal binary head. This technology gets complex fast and is best left to a printer or printhead glossary. The Xaar website and IMI conference PowerPoint presentations explain what a greyscale printhead is.



Dr. Nicholas Hellmuth at XAAR facilities inspecting the XAAR Printheads

H

halftones, the series of dots that comprise a continuous tone image.

hard proofing, image is printed to show what the final output will look like in terms of color and quality. At this point, changes can be made if necessary. This method may extend the time of the production process, but can alleviate costly mistakes. Hard proofing is the direct opposite of soft proofing. See also **soft proofing**.

Hexachrome inks, a trademark name for a special 8-color ink set. Hexachrome inks were popular with offset printing but were not successful at all in the world of inkjet. Roland tried to offer Hexachrome inks circa 2002-2003 but there was not much interest among sign printing companies (uses too much ink, so raises cost; and most clients are not willing to pay for the difference because they barely notice the improvement). Encad offered their own version of an 8-color ink set, but called it Octachrome since Hexachrome is a trademark. Octachrome was not very popular. ColorSpan had more success with an 11-ink and 12-ink system but the Roland d'Vinci attempt with 12 colors was not very successful (in part because there was not enough fine art media at the full width of that Roland printer, in part because there was not a large enough market demand to create a really good 12-ink color set, and in part because Epson did not want to encourage people to think that any printer but Epson could produce giclee).

High-Fidelity (Hi-Fi) Color, color that is reproduced using more than colors than four, usually six or more. See also **Hexachrome**, **4-color process** and **6-color process**.

highlight, highlight area, the lightest part of the photograph, which will tend to be burned out (**specular highlight**). In a digital photograph you want the white point to have detail, so you can see the texture or substance which is white. Otherwise you get just pure white highlight with no detail (the detail is “burned out”). Highlight may be synonymous with **white point** and specular highlight (more a term for digital photography). See also **black point**.

HSB display (Green p. 29), available via Macintosh color-picker. Stands for **H**ue, **S**aturation, and **B**rightness. A color model that measures color in these terms. You can access an HSB display on your Macintosh color picker.

HSL, a three-dimensional color model that stands for **H**ue, **S**aturation, and **L**ightness. A few older color management software or scanner software still allows you to manipulate the color balance in HSL. Photoshop does Hue and Saturation. Check out Dan Margulis’s book on Adobe Photoshop. See also **LAB**.

hue is represented by the name of a color. For example, blue, green, and yellow. The human eye determines color through hue, **chroma**, and **brightness**.

HutchColor HCT, a scanner target from Don Hutcheson made specifically for scanners. I have, however, not yet had the opportunity to receive and thereby not the opportunity to test their products in person.

I

ICC, International Color Consortium. Their web site is www.color.org. Established in 1998 by eight leading companies in the field of printing and computers, with the intent of creating cross-platform color management system standards. Adobe, Agfa-Gevaert, Kodak, and computer and software companies such as Microsoft were founding members. FOGRA was an honorary initial member.

ICC color profile identifies the components of the original color by a numerical designation and tells the output device how to recreate in the new gamut a color as close to the original as possible. A profile is a code, or map, or designation. You can see the actual codes in your software if you wish. The purpose of an ICC profile is to convert color between two devices. ICC profiles are embedded into the document for transfer to the printer.

.icc, Macintosh platform file extension for the ICC profile. Windows applications use the file extension .icm.

ICC profiles – generating, individual device profiles are recommended and may be generated with the use of specialized profile making software and color management equipment.

ICC profiles – editing, generally done with the use of profile making software. Recommended for only those that have skills and experience in color editing.

ICM, Windows PC version of ICC. Macintosh applications use the file extension .icc.

ink limit is working out at which point the total of CMYK inks on top of each other is too much ink (not this much is needed). You set your ink limit before you do your ICC profile. You can save a lot of money by using less ink if you have a good RIP software (such as Wasatch or Caldera and others) and learn how to use this RIP software and color management workflow to set your ink limit. In some cases you can pay for the color management tools from the amount of ink that you no longer waste.

inkjet receptor layer is the coating (layer) whose chemicals interact with the ink. The inkjet receptor layer is on top of the base material (which may be paper or synthetic material). If the chemicals in the inkjet receptor layer include artificial brighteners you need to be aware of this when doing ICC profiles. You may need to use a filter to handle the artificial brighteners. When you are printing with UV-cured ink, and full-strength solvent ink, the materials on which you print usually do not need an inkjet receptor layer.

input, the image that goes into a printer (the output device). **Output** is the hard copy which comes out of any printer. Hence a digital camera or scanner produces input for an inkjet or laser printer output.

input device usually implies a digital camera or a scanner.

Intent, meaning color rendering intent: **absolute colorimetric**, **relative colorimetric**, **perceptual**, **saturation** are the four color rendering intents. In lay persons terms, intent means do you want natural color (perceptual) or noticeable colors for image on signage (saturation).

IT8 target. An accepted industry standard target image for calibrating scanners. However for color balance for digital cameras, or as any kind of reference for digital photography, the standard is the (Gretag) **Macbeth ColorChecker** (ironically not the version that was available during roughly 2002-2004). Don't leave any of these test charts exposed to sunlight.

J

Just Normlicht is a German company that makes viewing booths.

K

Kelvin, otherwise known as °K and is the standard for measuring color temperature degrees.

Kodak gray card, for decades this letter-sized cardboard was the basic standard for creating a gray balance for traditional photography. Kodak also offered a smaller glossy grayscale patch sheet. Today to varying degrees most Kodak reference cards have been replaced by those of GretagMacbeth, judged as more appropriate for digital values rather than offset printed values. The primary remaining advantage of the Kodak gray card is that it is larger than the gray square on the Macbeth ColorChecker.

L

Lab is a way to describe color that is device independent (could be considered a safe haven for how to measure and describe colors). Lab is not an acronym; it can also be written $L^*a^*b^*$ or CIE $L^*a^*b^*$. The best book for understanding working with Lab in Adobe Photoshop is by Dan Margulis. As an aside, if you move your file from RGB to Lab, it is not fatal to return it to RGB, but never try to then take your CMYK and turn it back into an RGB file. This is because once the file is in CMYK its gamut has been clipped, so it won't be the same when it is returned to LAB.

LCH, color model based upon the properties of luminance, chroma, and hue, which is an adaptation of the Lab color model. This model is different in that hue angle works in conjunction with the color wheel to determine the color hue.

light is the visible part of the spectrum (visible to humans). **Color** requires light, an object on which the light falls, and an observer.

lightness or value is part of how color is perceived or described by people (and I would guess perceived by some other animals). Lightness is on a scale from light to dark; 0% lightness represents black; 100% lightness represents white. The other two components of human perception of color are **chroma** (saturation) and **hue** (what a lay person would call the common name of the color). Lightness is one of the dimensions of the HSL color model. See also **brightness**.

linearization; the purpose of linearization is to adjust a device (in our instance, an output device, namely a wide-format inkjet printer) to take advantage of its full color gamut and **dynamic range**. The first printout of color patches will show the current state; correction will result in a more even pattern stretched out to the maximum possible for that device. Fraser et al. shows a good before and after (his fig. 5-3, p. 121).

Linearization may best be accomplished through your RIP software, assuming yours handles linearization well. ColorSpan printers can accomplish linearization on-board from their own software and a measuring device built into the printer itself. Today (since autumn 2006), the HP Z-series printers with an onboard i1 spectrophotometer and software system can handle linearization within the printer's own system.

linearization target is a set of four rows of colors: Cyan, Magenta, Yellow, and grayscale (black). The first patch is pure white, then more and more ink is added in 10% increments until the final patch is 100% of that color. This is an idealized density series. You should be able to see the difference in colors as 10% more ink is added at every stage. But in the real world, this ideal is not found until you calibrate your printer. So you first print out the linearization target. Then you notice which patch is the darkest. This needs to be "moved" to the 11th position by telling the software which position the target is in initially. Because if fully cyan is in the 8th position, you are wasting 10% of ink in the 9th position and 20% of ink in the 10th position. So your software resets the ink, when you print out the next linearization target, maximum Cyan should now be at the end. You do the same for the grayscale and for Magenta and Yellow. You have now linearized the density stages of your printer in today's temperature, humidity, ink, on this media. Some linearization targets are more than 11 levels; some are 21 levels.

luminance may be considered a synonym for brightness. The definition was originally based on a video signal, now used as part of the HSL manner of showing colors. Best to check out the books on color management or books on Adobe Photoshop, especially by Dan Margulis.

luminosity is the range from black to white in a CIE L*a*b* color space, relating to the amount of light reflected from an object to create color.

luminous color, color that is produced via the reflection from an object that is illuminated, meaning that light is produced from the object reflection. See also **self-luminance color**.

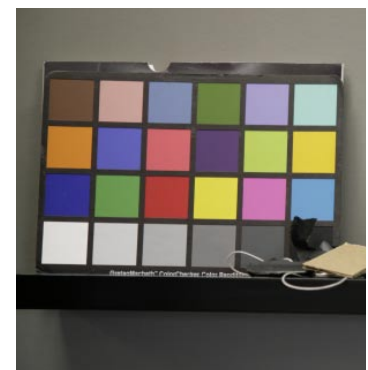
luster a kind of surface appearance to inkjet materials, especially for fine art or photographs. There are slight variations and nuances in how each inkjet media company calls the surface finish on their printable materials. Satin, gloss, glossy, or pearl, silk finish, are among many options. Some luster surface finishes may offer with less gloss contrast, or **bronzing**.

LUT, otherwise known as a LookUp Table, which is an index of CIE Lab values corresponding with RGB and CMYK values used by a device. An ICC color profile is essentially a lookup table for moving a file from RGB (which is what the camera or scanner produces) into CMYK (which is what the RIP or printer driver create from the RGB file to send to the printer, most of which print with CMYK). The lookup table is prepared in LAB values. So the image goes from RGB to LAB and from LAB to CMYK.

The printers that are the exception (that print in RGB, not in CMYK) are the Durst Lambda, Océ LightJet and other similar technologies that print with LED-related lights on photo-sensitive paper (in other words, these LED-related light printers are not inkjet).

M

Macbeth ColorChecker is cardboard, letter sized, with 24 squares of matte colors. Although Gretag bought Macbeth already several years ago, the ColorChecker is still known by the original name, Macbeth. The ColorChecker DC (digital camera) has not been as successful in becoming a standard. Since about 2006 Gretag-Macbeth belongs to X-Rite. Try to wear gloves when you handle a Macbeth ColorChecker, especially after eating a meal or if your hands are wet.



Macbeth ColorChecker

magenta, one of the three primary subtractive colors, Also known as M in the CMYK acronym.

matte, media surface finish that is considered no gloss, low gloss, or flat. See also **luster** and **satin**.

media, any material (such as paper, canvas, etc) that is covered with a coating of chemicals to assist the inkjet laydown of inks is called media. The coating is called an **inkjet receptor layer**.

metamerism is the effect when two colors which match under one light source (such as lighting inside a store) no longer match when you take them to view under another light (such as outside in sunlight). In inkjet printing metamerism is most talked about relative to Epson's pigmented inks, especially in the models 7500 and 9500. Some people have suggested that Yellow is a color that causes problems with metamerism in Epson inks. Since about 2005 the metamerism in recent Epson inks is not as terrible as was metamerism circa 2001-2003. In other words, don't buy most old Epson printers. Metamerism is described in helpful detail by Fraser et al. 2003:25-32.

monitor profile, ICC profile of the working monitor space. This is the first step in the process of color management to reproduce accurate and consistent colors so that what is seen on the screen, is seen on the print.



OPTIX MONACO, Monitor Calibration



The ECI 2002 CMYK target (Foreground) and resulting prints



Binuscan calibration system from Photokina four to six years ago.

monochrome, otherwise known as black and white printing.

Munsell (color) system. One of the most influential color-modeling systems was devised by Albert Henry Munsell, an American artist. Munsell desired to create a “rational way to describe color” that would use clear decimal notation instead of a lot of color names that he considered “foolish” and “misleading.” He was probably referring to the **Ridgway color system**, popular especially after 1912. The Munsell system, which he began in 1898 with the creation of his color sphere, or tree, saw its full expression with his publication, *A Color Notation*, in 1905. This work has been reprinted several times and is still a standard for colorimetry (the measuring of color).

N

named color, a color with a registered name, rather than a numerical classification. A named color would be Pantone color. I am guessing that Munsell would be another.

nanometer, measurement for the wavelength of light.

neutral, a gray with no color cast. White or black are also neutral. They have no hue.

neutral color, a color with no color cast or improper hue. The colors in an image are considered neutral when the gray is itself perfectly neutral, namely that R, G, and B values are identical numbers. It makes no difference if the gray is light or dark; all that counts is that the gray is neutral. Once the gray in a scene is neutral, all other colors are also considered neutral. Unfortunately, many photographers (sometimes including myself) are too much in a hurry to gray balance their photographs during the actual photography. But at least you need to be sure to include something gray in the first photographs of the session so that the photos at least can be color balanced in software after the shoot.



Neutral Image

O

opacity, density of color shade, ranging from transparent to opaque.

optical density is the measure of the blackness of a printed image. Optical density is also referred to as Black absorbs 100% of the light; white absorbs 0% of the light.

output tends to mean hard copy (something printed on a material, usually paper, substrate, or media), but in reality is anything which shows the image, hence a monitor or printer. Output is the image; **output device** is the hardware, such as printer. See also **input**.

output device would be a printer, to output **hard copy**, see also **input device**.

P

palette, the full range colors that are available for use by a particular device.

Pantone is a company specializing in producing color standards primarily for printing with traditional presses such as offset presses. As printing has become more digital and more with inkjet machines, Pantone has done its best to become relevant also to this new technology (but is only successful to a limited degree). But Pantone is still the standard reference for many logo colors (especially in the US). X-Rite bought Pantone by 2008, after previously buying GretagMacbeth.

Pantone matching system (PMS), see **color reference scale**.

patch; each square or rectangle of color reference samples on a **targent** is called a patch. Usually used in the plural, color patches.

PCS, profile connection space, a device-independent color space used by a color management module, CMM, for translating colors from one device's gamut to another. The CMM translates colors from the source color space defined by an ICC device profile to the PCS, and then to the destination color space using a second ICC profile. The PCS is selected by the CMM so it is not visible to users (the www.Adobe.com web site provides more details).

percent, some traditional color specialists do **color by the numbers** (white being 0% RGB; black being 100% of RGB, Red being ***, Blue ***, Green ***). Others do color by percent, white being 0% Cyan, 0% Magenta, 0% Yellow. Black would be 100% C, M, and Y.

perceptual rendering, one of the four rendering intents. Perceptual rendering is recommended for photographic reproduction. Choosing this rendering intent, converts all colors into a realistic available color space, including out of gamut color, to the same degree, which preserves relative color relationships. The other color rendering intents are **Saturation**, **Absolute Colorimetric**, and **Relative Colorimetric**.

pigment, colorant used in the inks for printing. Ink pigments last longer in the sun than do dye molecules that are used in dye inks.

Photoshop, means Adobe PhotoShop, a software program for editing photographic images.

PMS stands for **Pantone matching system**.

Profile Mechanic is a color management product of a company named Digital Light & Color, Jonathan Sachs.

printer profile, ICC profile of the printer and its ability to reproduce color in terms of inks and media used. The printer file works in conjunction with the monitor profile to produce accurate color reproductions in terms of WYSIWYG. See also **ICC profile**, **monitor profile**, and **WYSIWYG**.

profile connecting space is the standardized color space used for reference.

profiling, the process of obtaining a mathematical description (**profile**) of a device as in profiling a monitor, doing an **ICC color profile** of a particular ink-media combination. However before you “profile a device” you first have to **calibrate** that device.

process colors are colors whose components are Cyan, Magenta, and Yellow. Black is added to achieve better results. CMYK are used in the inkjet printing process. See also **spot colors**, **Pantone colors** and **primary colors**.

proof is a sample on paper or on the monitor (soft proof) of a print job to show what it will look like when printed on the main press. Since it is very expensive to turn on the press for a single sample, a hard proof has traditionally been made by a more economical printing machine. Today proofs are increasingly done with an inkjet printer, usually Epson or Hewlett-Packard, although other brands are also capable. A contract proof is the proof signed by the client as what he/she will accept in the final printed work. Sometimes referred to as a proofprint or a pressmatch.

Q

R

RCS, otherwise known as reference color space. RCS is a representation of colors in a device-independent color space.

red, one of the three additive primary colors, otherwise known as R of the RGB acronym.

Relative Colorimetric adjusts all colors relative to the white point of the target gamut. Out of gamut colors are moved to the nearest color which the target gamut can reproduce. The other three rendering intents are **Perpetual**, **Saturation**, and **Absolute Colorimetric**.

Relative Colorimetric, one of the four rendering intents. Choosing this rendering intent, adjusts all colors relative to the white point of the target gamut. Out of gamut colors are moved to the nearest color that the target gamut is capable of reproducing, which is a color shift.

re-linearization, to measure and compensate for changes in a device caused by usage, temperature, humidity, etc. When an output device has drifted from its base linearization by natural change over time, it is probably the moment to undertake a relinearization (see also, **base linearization** and/or **linearization**)

rendering intent are options for transforming (converting) colors of one **gamut** into another more restricted color gamut. Since you can't have all the original colors in the target gamut, something has to be sacrificed. Each of the four different rendering intents sacrifices something different to achieve a desired effect in the new gamut. The four rendering intents are **Relative Colorimetric**, **Absolute Colorimetric**, **Perceptual**, and **Saturation**. These rendering intents are nicely described and pictured in comparative color images by Fraser et al. 2003:88-92.

Perceptual (for photographs)

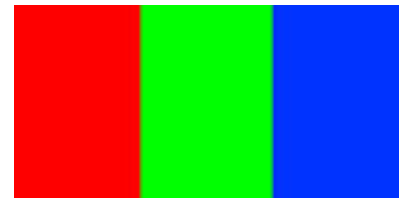
Saturated (for signage, to get saturated colors)

Relative Colorimetric (for specific colors that you need to reproduce exactly such as a logo color)

“**rich black**” is 100% K with varying amounts of Cyan, Magenta, and Yellow.

Ridgway color nomenclature system. Ridgway was an ornithologist who worked with color nomenclatures. But already in 1913 there was critique of the capricious manner of naming colors which was common in Ridgway’s day (William Leon Dawson, A Practical System of Color Designation. A Partial Critique of Ridgway’s “Color Standards and Nomenclature”). The Ridgway naming system (and others of that era) are typical of what **Munsell** reacted against to form a more rigidly repeatable standardized color reference system. The Munsell system is still used today, indeed as an archaeologist the Munsell color system is what we use to designate the colors of ancient murals, painted vases, etc. As a humorous footnote, the Ridgway book cost \$8 but registered postage cost 20 cents, so you can estimate that \$8 was a huge sum in that day (1912). His first foray into color nomenclature had been almost three decades earlier (1886), “Nomenclature of Colors for Naturalists.”

RGB, stands for **R**ed, **G**reen, and **B**lue color. These are the additive primary colors. RGB images use these three colors to reproduce up to 16.7 million colors on-screen. RGB is the standard color model for output displays such as monitors and projectors. RGB images are three channel images, so they contain 24 (8 x 3) bits per pixel.



RGB Color. Colors are added via light to make color. Has a much larger color gamut than CMYK

rods, less sensitive light receptors that are located in the retina of the human eye. It is opposite of the cone, which is also located in the retina of the human eye, in that it is not responsive to high light source brightness. See also **cone**.

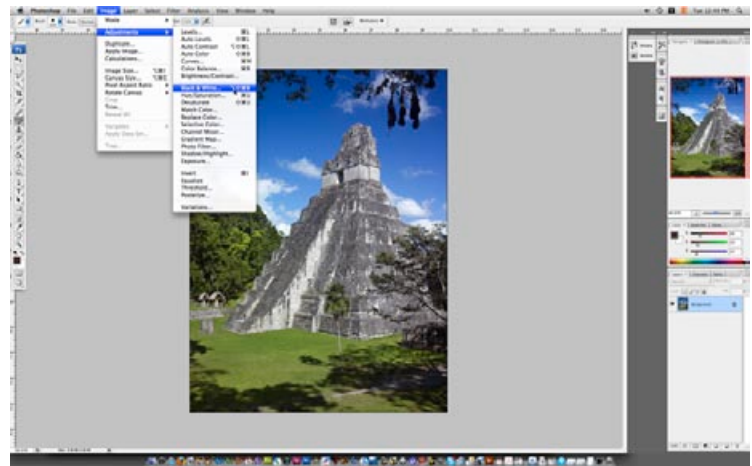
S

satin finish media surface finish that is reflective, but not highly reflective. Satin media can be thought of as in between glossy media and matte media. See also **glossy**, **luster**, **matte**.

saturation The measurement of the intensity of a color. When an image is set to 0% saturation it loses all color information, it becomes grayscale. When an image is set to 100% saturation the colors become the greatest intensity possible; vividness is highly saturated, dullness is less saturated. A lay person’s description of saturation might be how strong the color was. Covering a color with a glossy surface, such as lamination, will increase the perceived saturation. See also **lightness** and **chroma**.

scanner profile, ICC profile of the scanner in relation to the values of color that it is able to capture. The scanner profile differs from the monitor and printer profiles in that it is considered to be an input profile. See also **monitor profile** and **printer profile**.

secondary colors, the colors formed by combining two **primary colors**. Secondary additive colors are cyan, magenta, and yellow; secondary subtractive colors are red, blue, and green.



self-luminous color, color that is produced via an object that is considered to be self-luminous, meaning that the light that produces colors is directed from within, not reflected from the exterior. See also **luminance color**.

soft proofing, the image of the eventual output is seen only on a computer monitor. Soft proofing may also be done in an on-line environment, via a web-based system. Naturally this implies that the monitor has received appropriate calibration. This method of proofing is proving to be very valuable in time restricted and repeat jobs. See also **hard proofing**.

spectrophotometer is an instrument that measures diverse characteristics of light that is either reflected from or transmitted through a surface.

A spectrophotometer can calibrate monitors as well as output devices (a printer for example). For some measurements (such as of monitors) you could use either a spectrophotometer or a colorimeter. For linearization you could use a spectrophotometer or a densitometer. But you can't use either a colorimeter or densitometer for measuring some features of the color management workflow that requires a spectrophotometer. So if you intend to add professional color management workflow to your printshop you will need a good spectrophotometer. Be sure to select one that can read both reflective (normal) and transmissive (transparent) materials. Transmissive materials would include acrylic and other substrates used for backlit applications.



BARBIERI spectrophotometer Spectro LFP at SGIA 2008



BARBIERI spectrophotometer Spectro LFP at SGIA 2008



BARBIERI spectrophotometer Spectro Swing R at Photokina 2008

specular highlight is the area of pure white with no detail; reflection of light on a glossy surface would be a specular highlight. This is “printed” as pure white paper. The other highlight, which still preserves detail, is either just the **highlight**, or the **diffuse highlight** for those more inclined to technical jargon.

spot colors are special colors blended by the ink company that would be difficult to obtain using CMYK in your inkjet printer. It is not also easy to create logo colors with **process colors**. So spot colors are especially pertinent for printing logo colors to help with brand recognition. In rare cases you can obtain spot color inks by special order for your inkjet printer manufacturer. You might also consider fluorescent inks or metallic inks as spot colors, but these are rarely used in inkjet printers

sRGB was an attempt by Hewlett-Packard and Microsoft to make color choices easy for the lowest common denominator, namely colors on the Internet. sRGB came to the foreground with Adobe Photoshop version 5. Professionals were aghast that such a low gamut color space was favored. The next version of Adobe Photoshop made it easier to select Adobe RGB or other professional quality. See also **Adobe RGB 1998** and **Colormatch RGB**.

step wedge, the series of tones in steps of rising or falling density, in the grayscale charts available commercially or which your color management software prints as a test for **linearization**.

sublimation, output method that produces photo realistic color prints

subtractive color model, see **subtractive primary color model**.

subtractive primaries, cyan, magenta, and yellow are the subtractive primary colors. Cyan subtracts red, magenta subtracts green, and yellow subtracts blue. See also **additive primaries**.

subtractive primary color model is used to explain printing inks. With subtractive color the surface absorbs certain wavelengths and reflects others. Your eye receives the reflected wavelengths. Your rods and cones interpret that as a specific color. Cyan, Magenta, and Yellow are the subtractive primary colors. Red, Blue, Green are the **additive** colors. All books on color theory picture and explain all this fully.

swatch (for color management) is what I call a **target**.

swatch book, a book of samples, often of materials; often shows different versions of one material (such as different colors, or colors on coated and also on uncoated media).

T

tag, the ICC color profile consists of numerical information that tags the designated system.

tagged means that the embedded profile is put into the file so that it interacts with the file whenever necessary.

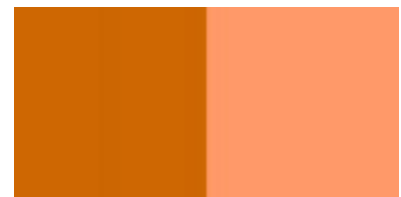
target, in color management jargon this is the printed file with all the squares of colors (the “patches”). You will first print the target file with your printer; then cut it out and stick it into the **spectrophotometer** to be read. A synonym for target in this sense would be **swatch**. There are also standard reference targets which you buy already printed, such as the **IT8 Reflective 5x7 target**.

TIFF is short for Tagged Image File Format for digital images, abbreviated .tif. If you are doing professional digital photography, you should save your working images in .tif format instead of .jpg.

tint, a color that has been reduced in its opacity.

tonal gradation Adjustment of the red, green and blue channels. Print Publishing (p. 461)

tonal range, the difference between the lightest light and the darkest dark, otherwise known as the highlights and shadows of an image.



Example of a orange tint.

tone curves, see **gamma curves**.

total ink coverage of CMYK would be 400%. But that means so much ink is jetted onto the paper that it takes a long time to dry. Plus you are wasting ink. So you need to set the % of each ink so that the total is not excessive.

transform is a color transformation to change a color from the color of one device to color available on another device. Uses a source profile through the transform to compare with a destination profile. A transform is sort of like a translation from one language to another language.

transmissive reading, for taking readings of such as backlit film. X-Rite had a model T for this, DTP41/T. But if you have a lot of backlit or other transparent materials to profile, you might consider one of the BARBIERI spectrophotometers.

tristimulus data would include RGB and CMY. These are dependent on viewing conditions and other factors, as opposed to **spectral data** which is a measured reading with a color tool such as a **spectrophotometer**.

true color, otherwise known as 24-bit color.

U

UCR, Under Cover Removal, obviously removes something, in this case removes some of the CMY and replaces them with K (black). This results in lower printing costs since colored ink costs more than black ink (on traditional offset presses at least). The removal of the colors is

especially for unsaturated areas which are supposed to be neutral anyway. Removal of colors also keeps the inkjet paper from swelling up due to excess water (from all the ink). Inkjet media has limits on how much water(ink) it can handle. UCR is explained and pictured in all good books and descriptions of conventional printing and color management, such as by Bohnen and O'Leary p. 19-24). See also **GCR**, Gray Component Replacement which adds black ink everywhere, not just in shadow areas.

UV filter, such as in for handling papers with artificial brighteners (which fluoresce).

V

value, the numerical sequence given to a color or density range for interpretation.

verbal color designation, such as red, orange, brown. There is no internationally accepted system of culturally valid color designations though black, white, and red would be the closest. For example, the Mayan languages tend to bunch blue and green together as *yax*. As a result the National Bureau of Standards and the ISCC (Inter-Society Color Council worked on a solution. Their suggested verbal color designations are presented in a book by Kelly and Judd (1955). I recommend this book for anyone that needs to designate or describe color with words understandable to more intelligent mortals. Obviously the Munsell system, Lab, and all the others have their validity also.

viewing booth, a booth with special lighting of a known standard, in the United States 5000° K. A viewing booth usually sits on a table, but larger ones may be freestanding. Just Normlicht is one of several companies that market viewing booths.

visual spectrum, the part of the spectrum that is visible to the human eye. The colors of the visible spectrum include red, orange, yellow, green, blue, indigo, and violet.

W

warm color, a color that has a hue related to red colors on the **color wheel**. The opposite of a warm color is a cool color. See also **cool color**.

Web safe colors are all in RGB since computer monitors work with light, so the colors produced by your monitor are **additive** primaries, Red, Green, and Blue.

The Web safe color palette contains a maximum of 256 colors. The number is limited due to old viewing capabilities of monitors and since has not changed.

white is the result of mixing 100% Red, 100% Blue, and 100% Green, the three **additive primaries**. see also **black**.

white point (for photographers), is the area of the photograph where you still want to see detail in the brightest whites. The white point will tend to be in the **highlights**. Most good software nowadays will find the white point for you, and allow you to see it on the monitor. You may need to do **white point adjustment** (Green p. 132), synonymous with **setting white point**, usually via a **histogram** See also **black point**.

white point (for color management), setting the white point during monitor calibration. The idea is to have the white point of your monitor at your preferred setting, 5000 degrees Kelvin for North American traditional preference, or 6500 K for European standards.

workflow means what steps you go through from beginning to end of any process. In wide-format inkjet printing a basic workflow would be input through output and then finishing. Input means digital capture (digital camera or scanning), through working the file in Adobe Photoshop and other imaging software; feeding the image through RIP software, printing, cutting, and top coating or lamination if that is part of your process. A strictly color management workflow means starting with gray balance (during input), profiling the monitor, linearization through the RIP software and then handling the color tools and their ICC profiling software. Proofing in a **viewing booth** would be another step in the color management workflow.



Color Management Workflow

working space, literally, the space in which you work your image. Working usually means editing which implies improving the image in Adobe Photoshop. RGB and CMYK may be considered working spaces. A working space should be a device independent color space www.rgbnet.co.uk Grayscale and Spot are the other working spaces besides RGB and CMYK. Working space for Internet pages and low-level electronic publications tends to mean sRGB. But for professional photography and significant printing jobs, it's best to use **Adobe RGB**.

WYSIWYG, the acronym used for the phrase "what you see is what you get," which is the bases of color management. The problem is that what you see on the monitor is not always what you get on the print.

X

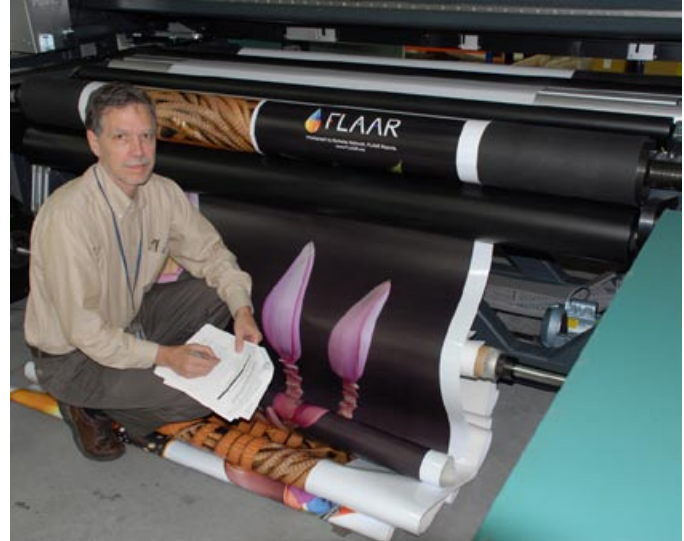
X-Rite is a manufacturer of entry-level color management hardware. X-Rite bought first Monaco color management software and then X-Rite bought GretagMacbeth and then Pantone. Currently BARBIERI electronic is one of the few remaining independent color management companies that develop and manufacturer spectrophotometers for inkjet printing output. It is essential in any field of endeavor to have competition, and not a monopoly. Competition encourages innovation and keeps prices fair to the end-user.

Y

YCC color space, used in the ill-fated Kodak Photo CD system. My least favorite color system because it is based on interpolation after Kodak has stripped away much of the color information.

Avoid Kodak Photo CD images whenever possible. I call it the “yuck” color space. Kodak has fared poorly with most digital imaging technologies except for making CCD sensors. However their main competitor there, Dalsa, also makes excellent CCD sensors.

yellow, one of the three subtractive primary colors. In inkjet printing you get light Cyan and light Magenta and sometimes light black, but you rarely get light Yellow. That is because a light tone of yellow is no appreciable help; yellow is already relatively light. So trying to offer a printer with light Yellow ink simply takes up an entire ink channel without producing much benefit. NUR, and thus now HP Scitex, is one of the few printers that consistently offers light Yellow. So far no one has been able to conjure up a significant benefit of this extra ink channel and the printheads that it occupies.



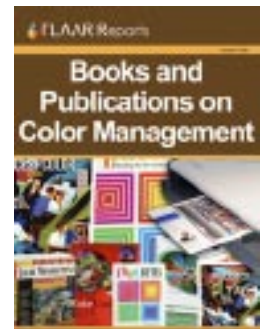
Dr. Nicholas Hellmuth inspecting NUR Tempo print samples

Z

Resources on Color Management

FLAAR has a complete (separate) book review report specifically on books which cover color management. That set of book reviews is part of the FLAAR Reports.

Adobe
Apple
Digital Light & Color
HutchColor LLC



Other Glossaries

<http://apsprinting.com/glossary.html>

Not a single PDF but html; so you have to click on each letter of the alphabet.

Articles on Color Management

FLAAR has a complete (separate) book review report specifically on books which cover color management. That set of book reviews is part of the FLAAR Reports.

Bourgoin, Michael

Introduction to Color Management Systems.

Eads, A.

2002. Why it's time to make time for color management. The Big Picture magazine, Jan/Feb 2002, pp. 48-57.

Howard, C.E.

2002. Profiling color management progress. Electronic Publishing, Feb. 2002, pp. 29-31.

Griffin, Jay

2002. Color Management and Software Issues for Successful Digital Textile Printing. 6th Annual Digital Printing of Textiles Conference, IMI, Oct 2002, Palm Springs, California.

ICC

2001. ICC Color Management. International Color Consortium, PowerPoint presentation.

O'Quinn, D.

2000. Print publishing: A Hayden shop manual. Indianapolis, Hayden Publishing.

Powers-Jones, S.

2002. Color Management 101. Digital Output, March 2002, pp. 24-27.

The Digital Graphics, The Big Picture Magazine and Digital Output are the three main trade magazines for wide format inkjet printing. They have something on color management at least once a year. Even when they are infomercials, at least you can see what is available. In Germany the leading trade magazine is SIP.

There is not really a magazine specifically on scanning or scanners. Magazines on digital photography sometimes have articles on color management. Try Digital Capture magazine.

A good book on color management is, "Real World Color Management," Peachpit Press (all their books are great). Authors are Bruce Fraser, Chris Murphy, and Fred Bunting. Buy this book immediately. Just be sure you set aside a rainy weekend to actually read it, and then additional time to practice with the tools and software.

Other sources of glossaries specifically on color management:
Adams, Richard M, II and Joshua B. WEISBERG

1998. The GATF Practical Guide to Color Management. GATFPRESS, Pittsburgh.

Field, Gary G.

1999. Color and its Reproduction. GATFPRESS, Pittsburgh.

Fraser, Bruce, Murphy, Chris, and Fred Bunting

2003. Real World Color Management. Peachpit Press, Berkeley.

An excellent book which describes everything. Nice long descriptions, with plenty of illustrations and examples. Some chapters are veritable glossaries in themselves. However this is not a practical guide for the lost soul who just needs to know how to do linearization and custom profiles to get his/her colors right in the final inkjet print. 533 pages are simply too much for the average mortal. I have considerable interest in learning color management, but I fell by the wayside after about 350 pages. Not that the book is bad, but that it explains too much detail about everything under the sun related to color management. In the process it neglects to walk the lost soul through what they have to do out in the print shop, starting at a print with an angry artist demanding to know why their inspirational colors in the original oil painting did not reproduce in the inkjet (giclee) print.

Johnson, H.

2003. Mastering digital printing. Muska & Lipman, Cincinnati.

Kelly, Kenneth L, and Deane B. Judd

1955. The ISCC-NBS Method of Designating Colors and a Dictionary of Color Names. National Bureau of Standards Circular 553, U.S. Dept. of Commerce, Washington, D.C.

Kornerup, A., and J.H. Wanscher,

1967. *Methuen Handbook of Colour*. Second edition. Methuen Co., London. 243 pp and 30 two-page color plates.

Ridgway, Robert,

1912. *Color Standards and Color Nomenclature*. Washington, D.C., published by the author. 43 pp and 53 color pls.

Other Crucial Sources

Operating Manual, SpectroSwing, Automatic Reflection/Transmission Spectrophotometer, Edition 11/08.

Operating Manual, Spectro LFP RT, Automatic Reflection/Transmission Spectrophotometer, Edition 05/08.

Operating Manual, Profile-Xpert Gateway, BARBIERI Spectrophotometer Measuring Software Version 2.42 for Microsoft Windows, Edition 04/08.

MonacoProfiler User Guide, April 2002 (this happens to be the version we have in stock, if a more recent version becomes available, we will update).

Significant Resources with Multiple White Papers

www.color.org/whitepapers.xalter

www.colormangement.com/technical_resources/articles_and_white_papers/introductory_articles_and_presentations (unfortunately most date to 2005; nothing recent).

Sources and Resources on the Internet

These were some of the web sites that I used in 2003 and for other early editions of this glossary. But now I have updated this glossary to 2009.

<http://www.barbierielectronic.com/>

www.color.org

Web site of the International Color Consortium, ICC, Filled with potential information.

www.colorcube.com/articles/theory/glossary.htm

Great information on color terms such as hue and chromaticity, albeit short, the illustrations (in color) make it fully understandable. Be sure to visit their other links, such as “Color Models” to find a “Color Model Museum.” Great site, wish it kept going on and on.

www.colorremedies.com/articles.html

Has articles on

- Managing Color in Photoshop 6
- Top 10 Color Management Pros/Cons
- The Intro Series (to ColorSync and ICC-based color management)

www.colorsavvy.com/

Commercial web site for their products; has one page of helpful information, a definite must read)

www.colorsavvy.com/Products/Learn/Calibration.htm

“Overview of Calibration”.

www.computer-darkroom.com/

Ian Lyons on scanning, Photoshop, color management, and more).

www.creativepro.com/story/feature/11132.html?origin=story

Fraser.

www.creativepro.com/story/feature/14331.html

Part of an excellent article by Bruce Fraser on color management from monitor onwards)

www.dcs.napier.ac.uk/~mm/COL_G/CG_HTML/05/0501.HTM

<http://desktoppub.about.com/cs/colorcalibration/>

Lists about ten sources on ICC color profiles, color management, for desktop publishing; I would bet that many of these links go to sites and pages filled with useful information on color management.)

<http://desktoppub.about.com/cs/iccprofiles/>

Links for tons of stuff on ICC color profiles)

www.lexjet.com/lexjet/color_mgt_tools.asp

Helpful info from a helpful wide format inkjet media company)

www.lexjet.com/lexjet/photoshop_6.asp

This page lists all the articles within the LexJet site on color management and related topics including resolution.

www.matrixcolor.com/color/links.htm

Links to color management.

www.picto.com

A commercial site for Pictographics.

www.pmel.org/Color-Glossary.htm

"Color Glossary." No illustrations.

www.poynton.com/PDFs/Sun_Color_Mgmt.pdf

Has some helpful definitions.

www.sapdesignguild.org/resources/glossary_color/index1.html

This nice glossary has color illustrations, which help the beginner and intermediate reader.

www.tasi.ac.uk/advice/creating/targets.html

Color and resolution targets; lens resolution, not pixel resolution.

<http://tigger.uic.edu/~hilbert/Glossary.html>

"A Glossary of Color Science," by Alex Byrne and David Hilbert, from "Readings on Color, Vol. 2: The Science of Color," MIT Press, 1997.

First issued June 2003, updated October 2003, May 2004, January 2007, October 2008. November 2008

Most recently updated May 2009 for FESPA

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These photographs explain why FLAAR is interested in color management. Our research projects on cacao work on understanding the different species, which species are indigenous to Guatemala (Central America) and which are introduced from South America. For our zoology projects, there are several species of iguana; these are babies and are obviously a green species, but zoologists appreciate seeing accurate colors. The iguana is pictured in 7th century Maya art. Hence we appreciate the patient training of our staff by companies that make color management hardware, software, or who provide assistance in learning about ICC color profiling workflow. BARBIERI electronic is providing support to our current initiative in providing information on color management to our readers.

For archaeological photography the color of an artifact is important to reproduce for museum exhibit signage (Photography by FLAAR Mesoamerica courtesy of Fundation La Ruta Maya).

SmartStuff Inc. is the master distributor in USA for BARBIERI electronic color management tools. By coincidence SmartStuff Inc. is in the same city as FLAAR USA office is located, so we know all the folks at SmartStuff. Key person is Don Bobenhouse.

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