

Absolute Colorimetric Rendering

One of four ways out-of-gamut colours are handled when matching one colour space with another. This reproduces colours exactly, with out-of-gamut colours appearing as near as possible for hue, although lightness and saturation might not be so accurate.

When looking at a white, the eye with considerable help from the brain, is very adaptable and a range of shades will be interpreted as white. This flexibility influences how other colours are seen. Absolute colorimetric rendering will try to reproduce the original white in the target space, which means it will have some colour. With truly white paper around an image, the image will have a cast. The second problem with this intent is that we see colours next to and compared with others and that is how we judge them. If some of these colours are changed (the out-of-gamut colours), the relationship with the in-gamut changes and the result can look strange. This intent is best for proofing devices with much larger gamuts and should be ignored for normal use.

Additive Primary Colors

The three main colours of white light are red, green, and blue.

They combine to form all other colours. One hundred percent of all three colours produces white light; lower percentages produces different colours. Combining 100% of two additive primaries produces a subtractive colour:

red and green = yellow

red and blue = magenta

green and blue = cyan

Bit

A bit is an abbreviation of binary digit and is the smallest measurement of computer data. A bit is a unit of colour information.

A 1 bit pixel has two choices. In the computer binary system, it can be 1 or 0, on or off.

In practice it can be black or white. In simplistic graphic terms, a pixel is like a rod with the colour on the end, so this 1 bit pixel can only represent black or white. An 8 bit pixel has greater pixel depth or bit depth and can contain and display much more colour information.

As each bit has two choices, 8 bits have $2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$ or 256 choices.

16 bit is 2 to the power of 16 (216) which is 65,536 choices.

8 bits make up one byte.

Black

When all light is absorbed by an object or paper, and therefore no light is reflected back, black is the 'colour' which remains. When the three subtractive colours of cyan, magenta and yellow combine they subtract all light and leave black. With printing inks, the combination of CMY do not produce a clean black, so a separate black ink is added.

Blue

One of the three additive primary colours, along with red and green.

Brightness

The amount of light reflection by a colour. The value is measured as a percentage. It is used with Hue and Saturation in HSB.

Byte

A byte is a group of binary digits (8 bits) when they are working as a unit.

Calibration

Calibration is the adjusting of a device, such as a camera, scanner or monitor, to make it meet known standards. Colour temperature, brightness and gamma will be set to particular specifications. Colorimeters and densitometers are used to measure the behaviour of the device; the results are compared to master figures; then the device is adjusted to behave in line with the master standards. The file which accomplishes the adjustments is known as a profile.

CCD

Charge Coupled Device. The silicon chip used as an imaging receptor in some scanners and digital cameras. An electrical charge is applied to one end of the row of pixels. The charge cascades down the row and the data is measured.

Characterization

Making a device behave with profiling software in accordance with known master standards is characterization.

Chroma

The richness or intensity of colour. Soft, pastel colours have low colour chroma/. A ripe red strawberry has high chroma. Chroma makes up part of the Lightness, Chroma, Hue (LCH) colour model. It can be regarded as the same as saturation.

CIE (Commission Internationale de l'Eclairage)

The International Commission on Illumination which set the standards for measuring colour.

CIE XYZ (1931)

A sample of colours based on the colours seen by a 'normal' observer and the human eye. The model has been found to represent accurately the colours that the vast majority of viewers see. They are colours based on human perception. The hypothetical observer is referred to as the CIE Standard Observer.

CIELAB or CIE Lab

The above colours are interpreted mathematically to create CIE LAB. L represents Lightness; A represents red-green; B represents yellow-blue.

CMOS

Complimentary Metal Oxide Semiconductor. An alternative to the CCD as a chip for collecting digital data. They can be cheaper and simpler to make and use less power. However, they can create more digital noise and as each pixel contains amplifiers and selection circuitry as well as a photo diode, there is less area on the pixel to collect data.

CMY

Cyan, magenta and yellow are the subtractive primary colours, sometimes referred to as the secondary colours. There is no white in this system. The absence of all three will leave the white of the paper.

CMYK

Cyan, magenta, yellow and black make up the colour space used for the printing process.

Although CMY mix to give a black, it looks rather murky. Black ink is added to give a richer black.

Color, Colour

Nothing actually has any colour. There are different wavelengths of light which are reflected off objects. The photoreceptors in the retina and the brain interpret these wavelengths as colour. The visible spectrum to humans is white light made up of red, green and blue. Some animals can interpret and see ultra-violet wavelengths which are outside the human range.

Colour Management

A act of matching colour and tones between monitors, scanners and printers. Profiling software will refer the colour behaviour of each device to the LAB standard. The colour and tone information sent to each device will be adjusted to keep to colour and tones consistent across all the devices. The original, the scan, the monitor display, the inkjet print and the offset print will then all match.

Colour Space

The parts of the spectrum used to describe an image. Colour spaces vary in their scope according to the range of colours involved. Examples of colour spaces are: Adobe RGB (1998); sRGB; ColorMatch RGB and CIE LAB.

Colour Temperature

'White' light varies in its colour; sometimes it is reddish (tungsten light or sunsets) with a low colour temperature; sometimes it is blueish (cloudy days or in snow mountains) with a high colour temperature. Light's colour temperature is measured on the Kelvin scale. The scale comes from heating a black body. As it is heated, the body changes colour and the colour relates to the temperature.

Colourants

The materials used to make physical colour, such as inks, dyes, pigments and toners.

Colorimeter

Comparable with a traditional photographic colour meter, but this optical instrument will measure the relative amounts of red, green, and blue light. It can read reflected and transmitted light and can be used to measure colour from monitors and is necessary to calibrate a screen.

ColorSync

The colour management system built into the Macintosh computer system.

Cones

The eye contains receptors which are sensitive to light and which can discriminate between the different wavelengths. The human eye has three types of cone photoreceptors, referred to as L, M and S cones, which react to long, medium and short wavelengths of light. With these cones, the primary colours of red, green and blue are seen. With the help of the brain, this information is interpreted as colour. See Rods.

Compression

The act of reducing the size of a digital file. JPEG is a 'lossy' format which involves throwing away some data where information among the pixels is repeated. High quality compression will show no change in the image. Greater compression will discard more data and ultimately loss of quality will result.

JPEG 2000, Stuffed and Zip are examples of 'loss-less' compression resulting in less compression but no loss of data. The lossless system will remove code which is repeated, for example, in an area of even colour. The area from where code is removed is tagged and when the file is re-opened, the information is replaced, resulting in no loss of data or image quality.

CRT

Cathode ray tube. Used in traditional monitors with red, green and blue sensitive phosphors being struck by an electron beam to create an image.

Curves

Exposure of film to light creates density on that film. With exposure on one axis and density on the other, a graph can be drawn representing the relationship between the two. The line this relationship creates is known as a characteristic curve. Each film has its own characteristic curve; some films producing a curve of high contrast, some of low contrast, some retaining more highlight detail and so on.

Photoshop curves come from this background.

Cyan

One of the three subtractive colors. Cyan absorbs red light, reflecting green and blue, which combine to make yellow.

D50

D50 refers to a colour temperature of 5000 Kelvin. It is used as a standard in parts of the printing industry.

D65 refers to a higher colour temperature of 6500 Kelvin. It is the standard colour temperature setting used on calibrated monitors.

Delta Error, written as delta-E

A measurement of perceived between colours. Delta-E is the smallest colour difference someone with normal vision can detect.

Densitometer

A sensitive instrument that measures the optical density of film and print. Essential in the field of colour management when calibrating equipment and profiling printers.

Density

Materials absorb and reflect light. The darker the material, the more light that material absorbs and the higher is its density. The scale expressing density is logarithmic.

Device-dependent

Some colour spaces are dependent for their appearance on the device displaying them.

A monitor's RGB colour space will be influenced by the physical characteristics of the monitor; so will be a printing press's CMYK colour space.

Destination Profile

The profile that converts one colour space to the target colour space.

Device-independent

A colour space will not be dependent on the physical properties of a piece of equipment. It is based on how the human eye perceives colour, such as LAB colour space.

DNG (Digital Negative)

A camera Raw file cannot be changed. Any settings made on a Raw file image are saved as a separate file known as a 'sidecar' file. DNG is an Adobe format which will save the Raw file and the sidecar file as a combined single file, removing the risk of losing the settings. It will also be smaller than the original Raw file.

Dot Gain

During printing, ink is partially absorbed by the paper, causing the halftone dot to increase in size slightly. The image will appear darker in the mid-tones. It is called 'dot gain' and must be allowed for and controlled in the printing process.

Downsampling

Where groups of adjacent pixels are joined to make one pixel and reduce the resolution of a file. The colour of the new pixel is calculated as an average of the group it replaces.

Dot gain

During printing, ink is partially absorbed by the paper, causing the halftone dot to increase in size slightly. It is called 'dot gain' and must be allowed for and controlled in the process.

dpi

Dots per inch. The resolution printers work at and the resolution of printed images and text.

Dye

Colourants which are soluble in water. Dyes can produce a wide range of colours but have less resistance to fading compared to pigments. Pigments are particles of colour which are not soluble.

Dynamic Range

The range of densities a film can record. Every digital camera or scanner will also have a range of densities it can detect. Light measuring devices, like meters and densitometers will have upper and lower limits of densities they can register. This will be the device's density range.

The highest density is referred to as the D-max; the lowest density is the D-min.

Embedded profile

A profile will describe the colour space of an image. Once a profile is saved with an image, it is said to be embedded.

Error diffusion for photos

The droplets of ink are interweaved by placing drops on the edges of other drops. This smooths the grain by filling in the holes between drops and it creates a larger gamut.

Gamma

The measure of contrast in photographic materials. A graph which plots the relationship between exposure and film density has a straight line portion covering the mid-tone area. Gamma is taken from the gradient of this straight line portion. A high gamma value means a high contrast.

The term has been largely superseded by G-bar which includes some of the toe portion of the curve. Thus some shadow values are included with the mid-tones giving a more relevant description of the film's characteristics. The G-bar is referred to as the Average Gradient or Contrast Index.

Gamut

The range of colours a device such as a monitor or printer can produce. Colour spaces also have their own gamut or range of colours.

Gamut Compression

When the large gamut of one system, such as colour negative film, is converted to fit a smaller gamut, such as a colour print, gamut compression takes place.

GCR

Grey Component Replacement. As well as black ink being used in neutral areas, rather than a mixture of cyan, magenta and yellow, black ink is also used in coloured areas to replace portions of cyan, magenta and yellow. It reduces the amount of ink used and the system can produce richer colours and a better grey balance.

GIF (Graphics Interchange Format)

A file type used for images on the web. Colours are limited to 256, although colours can be reduced if not required. Transparency is also supported. Normally used for more graphic-style images with solid colours.

Gigabyte

One gigabyte is one thousand million bytes. To be more precise, it is 2 to the power of 30 or 1,073,741,824 bytes.

One gigabyte is equivalent to 1000 megabytes.

It refers to the storage capacity or memory of a computer or storage medium.

Halftone

A printed image which is composed of a mesh of ink dots. The dots will be of different colours and the differing sizes of the dots gives the illusion of tones.

Hex (Hexadecimal) value

The number used to identify colours used on the internet and which are referred to as 'web-safe colours'. Each number will have six numbers and letters, such as 66FF33.

Halftone screen

The mesh of dots used to create a halftone image.

HSB

A colour model or system that describes colour with the values of Hue, Saturation, and Brightness. In Photoshop, these values can be seen as one of the sets in the Color Picker.

Hue

The Hue part of the HSB colour model identifies colour by its shade. The value is in degrees measured around a colour circle.

ICC (International Colour Consortium)

A organization of hardware and software suppliers who work to cross-platform standards in the interests of consistent colour communication and exchange.

ICC Profile

A profile is a file that contains information to describe how a device, such as a monitor, scanner, camera or printer, displays colour. It controls how an image is converted between colour spaces and devices. An ICC profile conforms to the ICC standard format. Such profiles are the basis of colour management systems.

Index colour

Indexed colour mode will use a maximum of 256 colours. With this mode, file size is reduced with any change of appearance kept to a minimum. It is particularly useful for the Web and graphics. When a conversion is made, a colour table of the colours used is created. Either the original colour is used in the table or a nearest equivalent colour is simulated.

Intent

See Rendering Intent.

JPEG

A system of compressing digital files developed by the Joint Photographic Experts Group. During the compression, some data is discarded. The more the compression, the smaller will be the file size and image quality gets progressively worse. Every time a JPEG image is manipulated and resaved there is a further loss in quality. Often written as JPG. The file extension will be 'image.jpg'.

JPEG2000

This is another compression method which can produce better results than the standard JPEG. The artifacts found with high compression levels are less pronounced. A JPEG2000 file will not be quite as small as a JPEG but it is lossless which means that data is not thrown away during the compression process.

Kelvin

The Kelvin scale displays the values of colour temperature. The scale starts at absolute zero, which is -273 degrees Celsius. A daylight colour temperature might read 5500K.

Kilobyte

A kilobyte is a measure of computer storage and memory. It comprises 1024 bytes or 2 to the power of 10. This is rounded off to 1000 bytes and will be written as 1KB.

LAB

L represents Lightness; A represents red-green; B represents yellow-blue.

A sample of colours based on the colours seen by a 'normal' observer. The model has been found to represent accurately the colours that the vast majority of viewers see. They are colours based on human perception.

LAB is an abbreviated term for CIE LAB.

LCD

Liquid Crystal Display, the screens used in digital watches and some computer monitors.

Two sheet of polarizing material have a liquid crystal solution between them. When an electric current is passed through the solution, the crystals are aligned, so that light cannot pass through them. Some crystals will let light through and some will not, creating the display.

LCH Colour Model

Comparable to CIELAB or Lab. Lab uses a rectangular model system, while Lightness, Chroma, Hue uses a system of cylindrical coordinates.

LED

Light Emitting Diodes. The standard LCD screen uses a white fluorescent backlight. The latest technology uses red, green and blue LEDs combined to produce a white backlight. This gives a larger colour gamut and larger dynamic range. Also the white point can be adjusted without effecting the colour gamut.

Light

The part of the spectrum which is visible to the human eye. The wavelengths of light range from 380 to 720 nanometres, which is a very small part in the middle of the whole electromagnetic spectrum.

Lightness

The amount of reflected light from a sample. It is used as part of the LAB and LCH colour models.

Ipi

Lines per inch. A measurement of the density of the mesh used for making a halftone print.

Magenta

One of the subtractive colours. Magenta absorbs green light, reflecting red and blue, which combine to make magenta.

Megabyte

One megabyte is one million bytes. To be precise, it is 2 to the power of 20 or 1,048,576 bytes. It will be written as 1MB.

Image sizes are usually measure in megabytes, such as 24MB.

Metamerism

Metamerism is where two objects appear to be the same colour in one light source, but are no longer of matching colour under a second light source.

This is because one of the items is capable of responding to long wave light, for example, to a greater extent than the other.

If the first light source has little long wave light, the objects look the same colour.

If the second light source contains more long wave light, then one of the items will reflect more of the long waves and will look a different colour.

Nanometre

A unit of measurement which is one thousand-millionth of a millimetre. Nanometres are used to measure the wavelengths of visible light.

Optical Density

Usually just referred to as density. Materials absorb and reflect light. The darker the material, the more light that material absorbs and the higher is its density. The scale expressing density is logarithmic and is in Optical Density units.

Out of gamut

Gamut is the range of colours a device such as a printer can produce or display. Any colours that a device cannot produce is out-of-gamut. A print will have a smaller gamut or range of colours than can be seen on a monitor, so many of the subtler tones and shades seen on a monitor will be lost on the print, hence out-of-gamut.

PDF

Portable Document Format. Documents with images, text and formatting can be saved in PDF format. It is a file format which is cross-platform and can be opened on any computer and will look like the original. Documents with images and text to be sent to commercial printing houses are usually best saved in this format. Security can be placed on to a PDF file to restrict access.

Perceptual Rendering

One of four ways out-of-gamut colours are handled when matching one colour space with another. The gamut of the source file is compressed into the target space (the print). It does this by desaturating colour until they fit into the print's gamut. Smooth gradients and the relationships between the colours are maintained and the overall look of the image can be good, although many of the colours may change.

Phosphors

Phosphors are chemical phosphorescent or fluorescent substances. When hit by a beam of electrons, they give out light in proportion to the strength of the beam. Cathode ray tube monitors use three variants to make red, green and blue light.

Photoreceptor

The eye contains photoreceptors in the form of cones and rods. They are structures in sense organs that respond to light and produce a proportionate electrical signal. Sensors in digital scanners and cameras are man-made photoreceptors.

Pigments

Colourants which are insoluble in water. Pigments tend not to produce the range of colours of dyes but are more permanent.

Pidif, pidifing

An acronym for Positive Interface Device Input Facility. A computer jargon term meaning 'to type' or 'typing'.

Pixel

An abbreviation of 'pixel element'. A small piece of digital information with a colour value.

PNG (Portable Network Graphics)

Pronounced 'ping'. A file format used for graphics in the web. It will support millions of colours and transparency, but is best for more solid colours rather than continuous tone.

ppi

Pixels per inch. The resolution of a digital image or digital file.

Primary Colours

The main component colours of white light are red, green and blue. When mixed in equal proportions, they produce white light. Mixed in other proportions they can produce any colour. Red, green and blue are the primary colours. They are also known as additive colours.

For reflective colour, that is print, the opposite colours are used: cyan, magenta and yellow. These are the secondary colours, also referred to as the subtractive colours.

Profile

A file that contains information to describe how a device, such as a monitor, scanner, camera or printer, displays colour. It controls how an image is converted between colour spaces and devices. Profiles are an essential part of a colour management system.

RAW

The original digital file created by a digital camera or scanner. It will then be processed and modified to produce a TIFF or JPEG file.

Relative Colorimetric Rendering

One of the four methods of matching colour spaces. This intent does a white point conversion, which means it adjusts the white of the source to the white of the output and shifts other colours with it. It also clips out-of-gamut colours to the next hue that can be reproduced.

There can still be some sudden gaps and sharp changes.

Rendering Intent

When images are transferred from one colour space to another, some colour will be out-of-gamut. There are four ways of handling this and bringing all colours within range; they are known as Rendering Intents: Perceptual, Saturation, Relative Colorimetric and Absolute Colorimetric.

Resampling

Resampling is changing the size of an image. The number of pixels will change as a result. With resampling down, information and pixels are discarded. With resampling up, new pixels are added. The system is also known as interpolation and there are several methods by which this can be achieved.

Resolution

The sharpness and clarity of an image. The term is used for film images, monitors and printers. Printing is recorded in dots per inch. 300dpi means there will be 300 dots in a line of 1 inch length. Monitor resolution is the number of dots over the whole screen. 1024 x 768 means 1024 dots on 768 lines.

Resolution dependent

An image which is composed of a particular number of pixels, such as bitmap images as created in Photoshop. The quality of the image will depend on its resolution.

Resolution independent

A image which is composed of a mathematical formula, such as vector images created in Illustrator. When such an image is increased in size, a new formula is calculated and quality does not suffer.

RGB

Red, green and blue; the three primary colours of the spectrum which combine to make white light and in different combinations can create all colours.

Rods

Rods are a second type of photoreceptor in the eye and they work in conjunction with the cones. Their function is to work in low light levels on with peripheral vision.

Saturation

Saturation is the richness or intensity of colour. Soft, pastel colours have low colour saturation. A ripe red strawberry has high saturation. Saturation makes up part of the Hue, Saturation, Brightness (HSB) colour model.

Saturation Rendering

One of four ways out-of-gamut colours are handled when matching one colour space with another. This is best for strong graphic primary colours such as bar charts. Colours can shift as they are made to fit into a new gamut but with this sort of subject matter, that is not usually critical. Saturated colours in the original space will still be fully saturated in the target space, although hue and lightness can suffer.

Secondary Colours

For reflective colour, that is print, the colours used are cyan, magenta and yellow, which are the opposites of red, green and blue. Cyan, magenta and yellow are the secondary colours, also referred to as the subtractive colours or subtractive primaries. When all three are mixed they create black; however it is not a strong rich black so black ink is added to the mix for printing.

Spectral Data

Spectral data details the amount of each wavelength in a colour sample. It is usually recorded in 10 nanometre bands. This is the most accurate way to describe colour.

Spectrum

Electromagnetic radiation comes in the form of wavelengths and its total range is known as the spectrum. The range covers gamma rays, X-rays, ultra-violet, visible light, infra-red, radar, microwaves, various radio waves and extremely low frequencies.

The only part of this spectrum which is visible to the human eye is a very small band of colours seen as a rainbow, which combine to make white light.

Spectrophotometer

An instrument for measuring the intensity of light and colour in different parts of the spectrum. It could be measuring transmitted or reflected light.

Subtractive Primaries

For reflective colour, that is print, the colours used are cyan, magenta and yellow, which are the opposites of red, green and blue. Cyan, magenta and yellow are the secondary colours, also referred to as the subtractive colours or subtractive primaries.

When printed on white paper (paper which is reflecting white light), cyan subtracts red light, reflecting blue and green (which make cyan); magenta subtracts green light, reflecting red and blue (which make magenta); yellow subtracts blue light, reflecting red and green (which make yellow).

TAC

Total Area Coverage is the maximum amount of ink of all the CMYK colours applied to an area. The theoretical maximum would be 100% for each colour and 400% in all. Too much ink can cause drying problems and a clogging appearance. The maximum amount of ink actually used will depend on the type of paper and the printing process used.

Tagged

When an image has been saved with a profile of its colour space, it is said to be tagged.

TIFF

Tagged Image File Format. The standard format for pixel images. It will save the image at the highest quality the image can retain.

Tristimulus

The practice of creating or describing colours with three sources with a colour model. The three sources can be RGB, CMY, HSB, LCH or LAB.

TVI

Total Value Increase is also known as 'dot gain'. During printing, ink is partially absorbed by the paper, causing the halftone dot to increase in size slightly. The image will appear darker in the mid-tones. The effect must be allowed for and controlled in the printing process.

UCR

Under-Colour Removal. In printing, where cyan, magenta and yellow are combined to give a

neutral, they are replaced with black ink. The amount of ink can be controlled and ultimately less ink will be used than with a combination of CMY. With UCR, black replaces the grey portion of neutral colours, while with GCR black ink replaces the grey portion of all colours .

Visible Spectrum

The central part of the electromagnetic spectrum which can be seen by the human eye. It covers a range of 380 to 720 nanometres and the colours red, orange, yellow, green, blue, indigo and violet.

Beyond red with longer wavelengths are infra-red, radar, microwaves, various radio waves and extremely low frequencies. Beyond violet with shorter wavelengths are ultra-violet, X-rays and gamma rays.

Web-safe colours

There are 216 colours which will display accurately on all internet browsers and computer systems. These web-safe colours are a limited palette but a fairly reliable one. The 216 colours are identified by a 'hex value' which contains six numbers and letters, such as CC9933.

Working space

The current colour space in which the image is being edited. The image might have been converted from its original colour space to its working space, and the final output space might be different again.

Yellow

One of the three subtractive colours. Yellow absorbs blue light, reflecting red and green, which combine to make yellow.

Zip file

Files and folders can be compressed into a zip file. It reduces the size of the file or folder and makes for more reliable transfer between computers. The zip file has to be decompressed on the receiving computer.