datacolor

Spyder5 eBook

Color management can be easy

Compact quick facts for photographers and videographers

Foreword

What is color management?

You are likely familiar with color management if you've spent time behind a camera, or if you have invested a fair bit of your time in photography and videography. We often unconsciously perceive the absence of color management in everyday life. For example, we have all taken pictures, ordered prints and suddenly realized that they have a flaw, like a green cast. "That's not what it looked like when I took the picture!" is the most common reaction. Nobody wants skin tones that remind them of zombies; not in the private sector, and certainly not in a professional environment, such as portrait and wedding photography.

Color Management is technology which minimizes color inaccuracies.

How does the color discrepancy between perception and prints arise?

To understand color management, you first need to take a closer look at the properties of light. White light consists of all of the colors of the visible spectrum. As the composition of colors changes, the color temperature changes. For instance, there are more red component parts in the evening sun than in the midday sun, where the colors have a much more balanced ratio. That means a white sheet of paper should have a reddish or neutral look at times, but that is not always the case.

What about people? The retina of the eye, which is quite comparable with the sensor of a camera, perceives these color differences and redirects these signals to the brain. The brain analyzes this data and completes a white balance based on previous sensory experience. As a result, the sheet of paper mentioned above would then appear white. This phenomenon is called color constancy.

People also perceive colors at different brightness. Our brains perceive an image that isn't what exists in purely physical terms. This explains the green-tinged photo: it was probably taken in fluorescent light, and technical devices do not have the "brain power" to counteract this phenomenon.

Color management will solve this issue

To a certain extent, color management attempts to simulate the brain and corrects the raw data coming from the sensor in order to match the feeling of human perception more closely. Color management can do even more than just that. While a human being represents a closed system (more or less), where everything is finely tuned, this is not the case with modern technology. We combine input devices (camera, smartphone, etc.) and output devices (monitors, printers, etc.), without considering that each device has a wide range of capabilities to capture or play back colors. Different papers also have their own reflection properties when they're printed. All devices must be compatible with each other to prevent any unpleasant surprises. This is why color management is necessary to achieve color consistency across devices and outputs.

This eBook provides compact and practice-oriented information to answer the question, "What do I have to keep in mind to smoothly coordinate all the equipment in my workflow?"

1 Understanding digital color

The basics of color management

- Which color measuring instruments you need for color management
- How the digital color world ticks
- Why you should work with RAW data

Contents

Color management using colorimeters

Why use color management equipment?

High-quality color management that is time and cost-efficient is almost impossible to achieve without color management equipment. Anyone who has ever set up their printer for fine art prints and has ended up using an entire ink cartridge on high-quality paper for mere test prints will have plenty to say about this. The concept of color management involves coordinating systems so that once taken, the image on the output side (monitor, printer or other output medium) appears as close to the original as possible. This also includes deliberate changes made to image content. In other words, photographic processing needs to be reproduced on the output side as it was carried out on the monitor. Why? Depending on the make and model, digital cameras have different color characteristics that can be corrected using a color calibration tool. What's more, lenses can also introduce color traits, while low-quality lenses even create clearly visible color casts and light falloffs. These can be almost impossible to modify.

We can, however, influence the appearance of the digital image on the display. Without settings, we also see an interpretation of the image that may not be representative of its true colors. This is determined by the electronic components of the display and its age. It gets trickier when it comes to printing images on paper. When we convert the light colors, which have determined the process so far, into printing inks, it can cause distortions.

The competence of the eye is not enough

In short, we are moving between physical worlds of color. We can work with several devices, which each individually interpret the colors for us. If you rely solely on the expertise of the naked eye and make adjustments according to your vision, you will very quickly reach your limits. Every additional device included in a color workflow will heighten the complexity. To add to this, color deviations don't behave in a linear fashion, but vary according to color saturation level and the nature of the colors themselves.

INTERESTING ONLINE FINDS

This article gives a good overview on how human vision works

More Info >

Finally, it is important to keep in mind the color constancy phenomenon. You'll notice how fast your eye compensates color casts, when you change the color profile on your monitor. Regardless of whether the colors are right or wrong, our brain hides slight color casts within minutes. This phenomenon is called color constancy. This is similar to situations in which we quickly become accustomed to the brightness or darkness of our surroundings.

Sample representation of color temperatures: An image with a daylight quality (6500 K), in neon tube and incandescent lighting.

INTERESTING ONLINE FINDS

The subject of color, our perception of it and its various interactions with our total health is covered within this article

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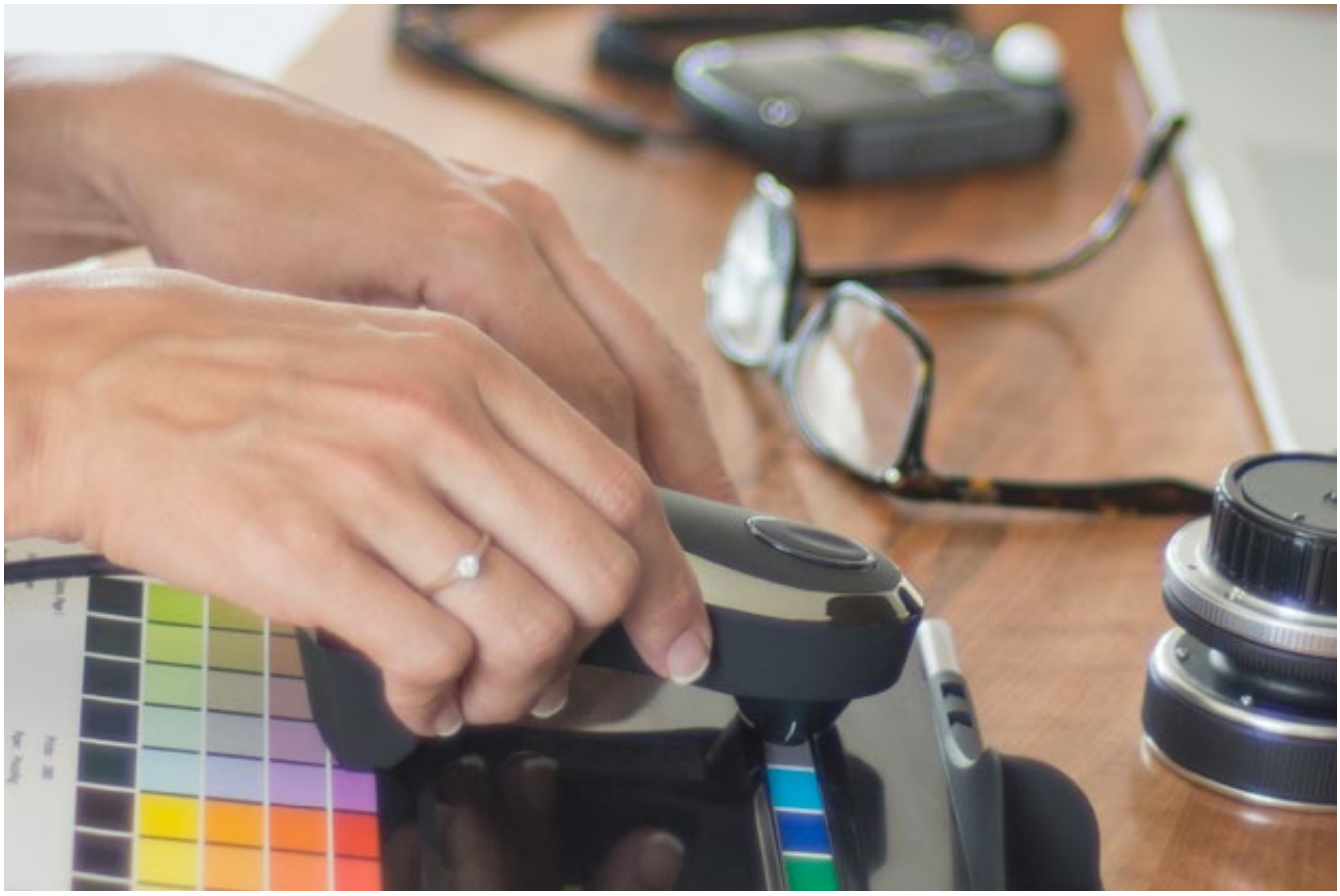
Additional benefits of hardware-based color management

Some lab professionals – especially in the realm of black and white photography – might manage to color match a monitor and printer without any measuring devices. Yet even viewing digital data on another workstation or outputting images on a different printer will produce unpredictable results. The resulting image usually won't resemble the one the photographer intended to create.

Money spent on test prints would be better invested in an affordable monitor calibration device that applies an internationally-standardized color language using color management, rather than a closed system. The lab tech would also have the option to give his or her data to a print service provider afterwards. This wouldn't be possible if they kept to their old workflow, because the settings are very specific and aren't standards-compliant.



The calibration tool for inks in action: SpyderPRINT compares the printed colors with the reference colors, recognizes color differences and compensates for deviations.

TIP

It is wiser to leave the measurement of colors to devices designed for this purpose. These are – in contrast to the eye – objective and, nowadays, there are reliable devices available for an affordable price.

More Info >

What kind of equipment is necessary for color management?

You need two different devices for color management: a calibration device for the light colors of the monitor, and a profiling device for the material colors of the prints. Depending on the manufacturer, the devices are designed either for CMYK offset printing or the RGB workflow. For an explanation about the differences between CMYK and RGB, see the section “Color models” on page 13.

Spyder5 measures the colors on the display surface, compares these with reference values and calibrates brightness before creating an ICC profile.

INFO

Videographers too, will enjoy the benefits: with the Spyder5ELITE you can analyze more than just the quality of the monitor. Even special calibration targets for videographers are easy to achieve. An interactive help window makes it easy to use for beginners.

More Info >

What are ICC profiles for?

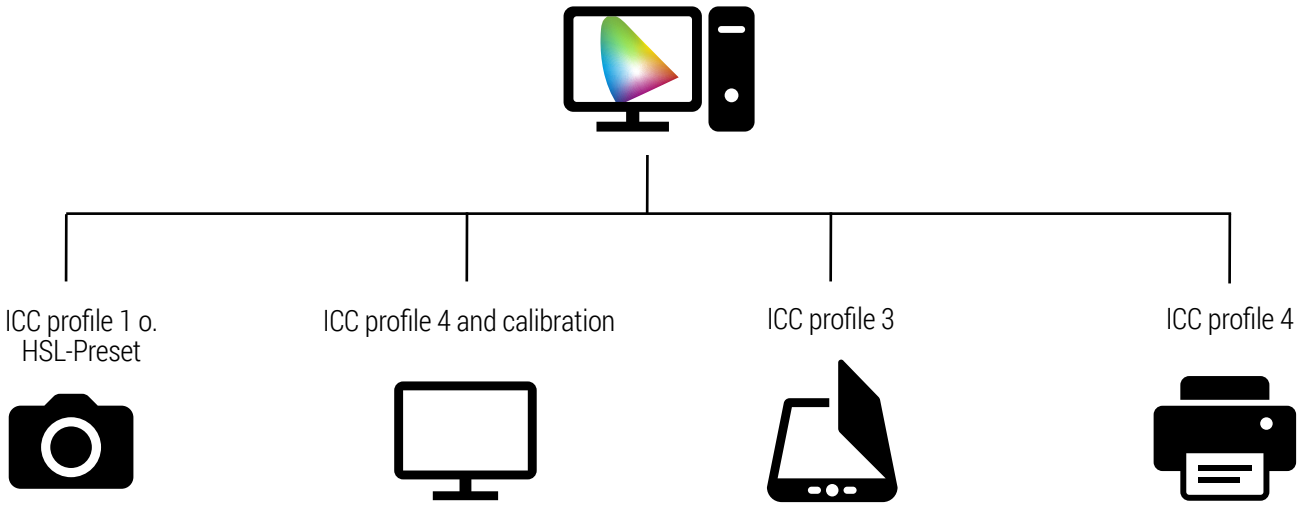
An ICC profile (also called color profile) is a device-independent standardized data set that describes the color space of a color input or color playback device, such as a monitor or a printer. Standardization is necessary for using an open system to create a basis upon which any corrections that need to be made can be carried out using the color management system.

Without ICC profiling, different displays will reproduce the same image in different ways.

But it's not merely the description of the color space alone:

"An ICC profile is (...) used to describe the properties of a device
for capturing and playing back color
to allow for compensation of errors during color reproduction."

This definition by Andreas Kunert (from: Color management in digital photography, Bonn 2004) illustrates the principle of the ICC-based color workflow.
This color workflow works as follows:



For all connected capture and playback devices (i.e. cameras, scanners, monitors and printers or projectors) - individual ICC-profiles have to be generated. Alternatively, with capturing devices, so called HSL-presets can be used.

The color management system now carries out corrections based on the common framework. For example, an image may need to be transferred from one color space to another, like from a monitor screen to a printed image. In this case, so-called gamut mapping is carried out, where the colors of the larger monitor or camera color space are conveyed to the smaller printer color space. The process itself is called rendering intent, and there are different ways of doing this.

INFO

The ICC standard has now reached version 4.3. You will find more information on the Internet at **www.color.org.**

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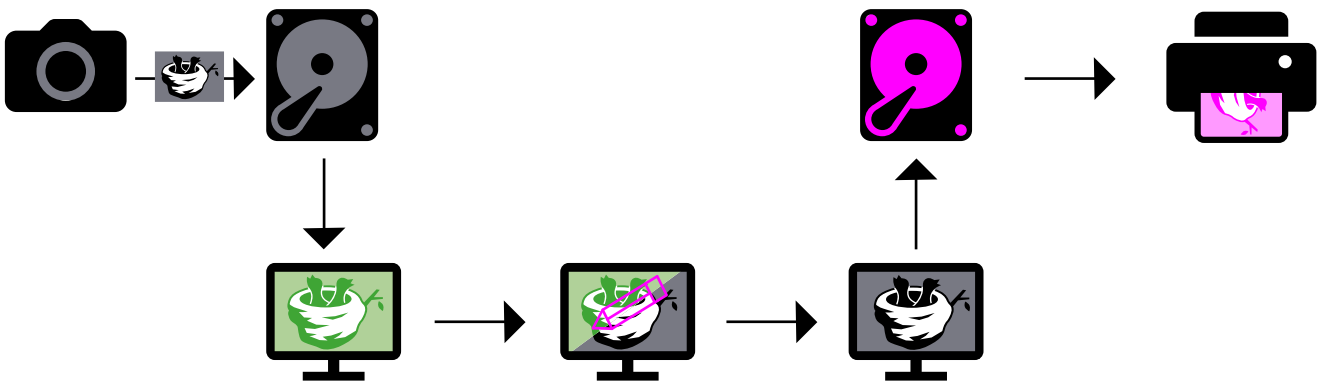


Error chain in a non-calibrated system: A black and white image is corrected in an image processing program on a non-calibrated, green-tinged monitor using its complementary color magenta. Once saved, the previously correct image file that was represented incorrectly on the monitor would now contain flawed corrective values. The result would be images with a magenta cast on the output side.

Why regular profiling is necessary

Unfortunately it is not enough to profile every device once and to then use it in any situation.

- **Digital cameras** must be matched with profiles in different lighting situations and workflows.
- **Monitors** shift out of alignment over the course of time. Here, a regular profiling is necessary, to ensure that the color temperature is constant and the color channels remain coordinated.
- **Printers** are subject to continual wear and tear which changes their physical characteristics. For instance the print head jets on each ink channel stretch depending on usage. The printable color space (gamut) is, however, chiefly dependent on the paper and type of ink used. This makes it necessary to set printer profiles for every paper/ink combination.

Framework

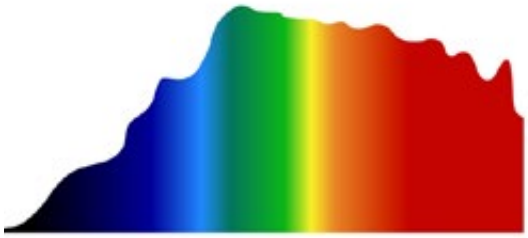
Improving the technical quality of image color profiles

Important: Don't be alarmed by possible deviations in the perceived look of your images while working with color profiles. The aim of working with profiles is to reproduce colors exactly as they appear in the source file to improve the quality of a shot. For example, a super-saturated color display on a monitor can cause an image to suddenly seem to lose its color luminosity, or contrast can be sacrificed in favor of enhanced detail.

Why is this so? Anyone who has ever compared different computer monitors or televisions in a showroom will know that these devices compete wildly with each other for the best in brightness, color saturation and contrast. Reproducing an image as realistically as possible is far down the list of priorities. Any photographer will know that contrast grabs people's attention - including the attention of shoppers. Added to this are age-related changes that affect screens, such as brightness (luminance).

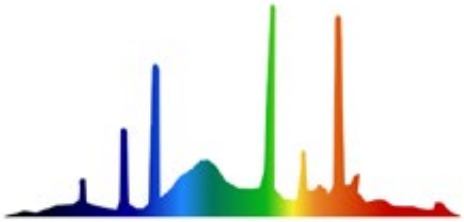
When these are calibrated and therefore improved to a standardized representation using a color management system, they then exhibit the actual colors from the image file. From this point on, the user can not only objectively assess the actual colors, but also the true brightness of an image, and make creative changes where necessary.

Likewise, printers also need correcting due to their physically restricted color space. With cameras, there is yet another significant aspect: ambient light. Things get more complicated here as attention needs to be paid not only to a white point but to a whole spectrum of light that can vary in its composition.

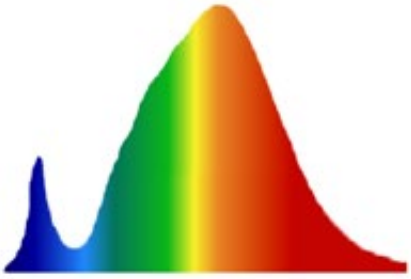


Daylight

Lightbulb



Fluorescent lamp

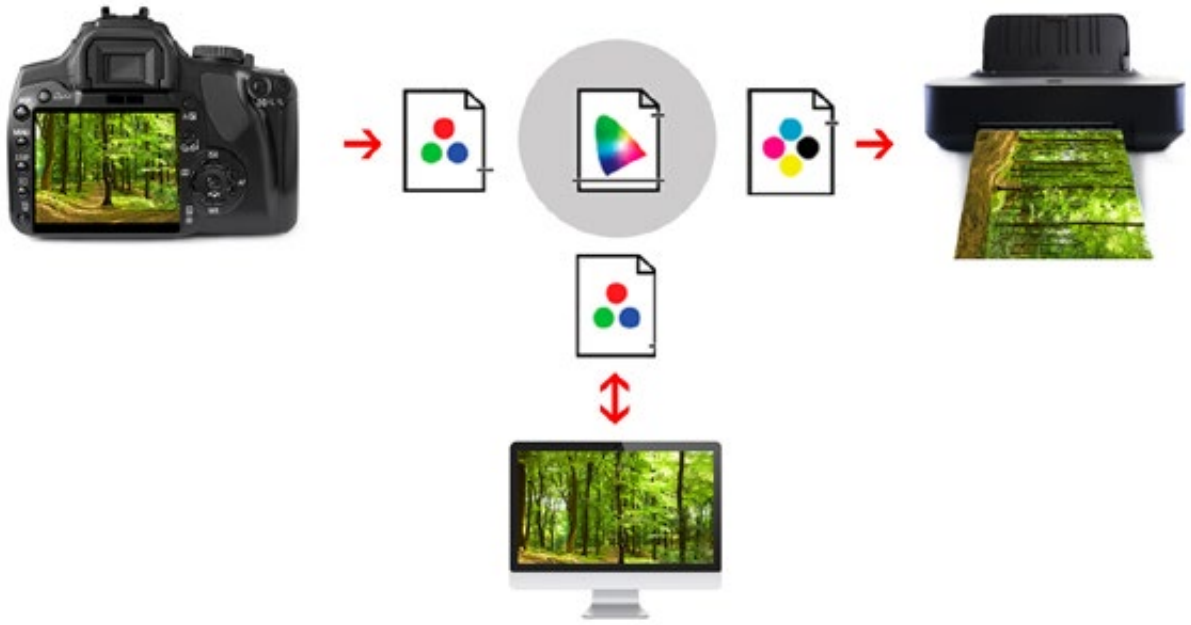


white LED

Light sources have a whole range of spectral compositions and, as a result, different color characteristics.

How to master the color perils of everyday life?

In practice, there are other disruptive factors. These come about, on the one hand, due to the automatic, in-camera editing of the capture and, on the other hand, due to manual image editing on the computer by the photographer. That's why, when photographing in JPEG format, you need custom profiles for the various camera settings and specifications for the handling of color profiles when opening the data on the computer. If you work with RAW photos, a fine-grained RAW workflow is added.



The aim of working with ICC profiles is to get the same color results on different output devices. Depending on the devices included in a workflow, the colors displayed are always defined by the smallest color space in the workflow.

EXPERT KNOWLEDGE

How ICC profiles came about

The acronym ICC refers to the "International Color Consortium," a kind of round table dealing with digital color hardware and software manufacturers. Starting point of the consortium was an invitation from Forschungsgesellschaft Druck e.V. (FOGRA) in 1992, at which they wanted to shape the future of color communication in open computer systems.

There had already been color management problems and solutions. The use of "open systems," (i.e., scanners, computers, monitors or printers that were not coordinated and from different manufacturers) was new in print media production, however. Before DTP conquered prepress, in other words, at the beginning of the digital age in the 80s, you worked with closed systems whose components were all supplied by a single manufacturer. These systems were not only expensive, but also inflexible. Sometimes they did not even offer external data communication. The first ICC standard was published in 1993. The device-independent description of color reproduction behavior for different components was foward-looking.

ICC in practice

What should be considered?

There are many issues and challenges in the world of digital color: which profile best suited, to what purpose? Problems start, when some people set their measured monitor profile as the RGB working space in Photoshop. The immediate astonishment that the color management problems have not been resolved, but—on the contrary—have been made even worse, is all the greater.

Basically, one should differentiate three areas of color management before the practical use of ICC profiles: **color model, color space** and **color profile.**

Color model

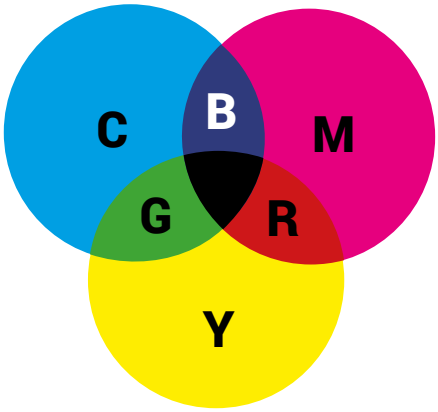
First, you need to be clear on which color models you're dealing with when working with images:

- Cameras and monitors operate clearly according to the **RGB model**, in which the color spectrum is made up of the light colors red, green, and blue according to the additive color model.
- When the images are then brought to paper, the situation is not so clear.

  A) The subtractive CMY color model, along with the additional color black (CMYK), are used in offset printing. Black is added as a fourth color for a range of reasons, including that the model has its pitfalls in practice and also that 100% mixes of cyan, magenta and yellow do not result in 100% black.

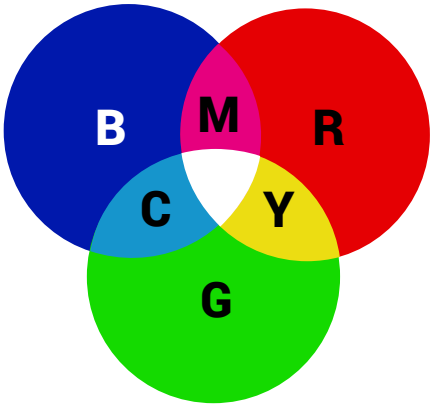
  B) In the photo laboratory, however, a color exposure is made onto light-sensitive photographic paper according to the rules of the additive color model.

C) Inkjet printers, on the other hand, are a hybrid. Although they work according to the subtractive color model with material colors, the process is not standardized. Because some printers work with four colors, others with six, others with eight, and some even with eleven colors: there is no mandatory standard. The image data for the output is therefore not prepared using the individual color model of the printer, but with the RGB color model. A printer communicates in RGB, and only during the last step between the printer driver and printer automatically converts to CMYK. This class is designated as an RGB printer even if it prints using CMYK colors. Because we are primarily looking at the needs of photographers in this series of articles, we can leave offset printing for now and focus on the color workflow.



● Cyan ● Magenta ● Yellow

Cyan/magenta/yellow (CMY) are subtractive colors. They are the complementary colors to the additive colors of red/green/blue (RGB). All three colors combined together filter out all wavelengths of the visible spectrum, theoretically resulting in black. The principle of subtractive colors can be found everywhere in nature. A red cherry, for example, filters out all of the wavelength ranges of the visible spectrum apart from red - meaning that the cherry will appear to be just red. This circumstance is adopted in the case of material colors, using CMY as the base colors. In doing so, many colors in the visible spectrum can be created depending on the mixing ratio of the three subtractive base colors.



● Red ● Green ● Blue

The additive color model rests on the base colors red, green and blue. By using these colors alone, the majority of colors in the visible spectrum can be created (depending on the weighting). All three colors with the same weighting and maximum intensity will, in theory, make white.

INTERESTING ONLINE FINDS

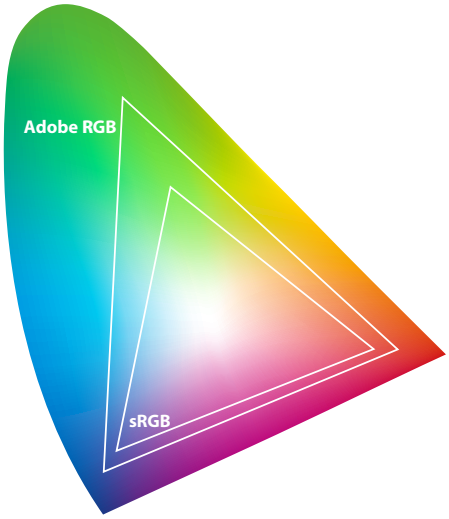
Adobe explains why color models are used in order to classify and qualify colors

More Info ›

Color space

It's important to note that the RGB color model includes most colors visible to the human eye. Cameras, monitors, inkjet printers and exposure devices can never show all the colors of the visible color spectrum, only a snippet. An RGB working space is specified in Photoshop and this defines that the focus should be on a specific part of the whole RGB model. There are as many color spaces available as are installed in the operating system. For photographic purposes, only two color spaces are basically of interest: **"sRGB"** and **"Adobe RGB (1998)."** What's more, new color spaces like the eciRGBv2 (also LStar RGB) are finding their way into photography.

- The factory settings on entry-level digital cameras often only include the „sRGB" color space. You will choose "sRGB", for instance, as the owner of a simple digital camera that offers no color space options. Anyone who processes their images on the computer, but later prints them themselves has them developed by a cheap photo lab and/or uploads them to the internet, is best served with a workflow in the **"sRGB"** color space.
- Owners of high-quality cameras can choose if they want to take their pictures in the (slightly smaller) "sRGB" color space or in "AdobeRGB (1998)" If they opt for **"AdobeRGB (1998)"** should they choose this color space as a "working space" in Photoshop. The basic rule is: when choosing your working space in Photoshop, orient yourself on the source color space of the input device. Anyone who works primarily as an image editor and deals a lot with foreign data, will also choose "AdobeRGB (1998)" as their working space.



TIP

Data not supplied in "AdobeRGB (1998)" should not automatically be converted into the working color space upon opening, but initially left in their original color space. The conversion should be done using the "Convert to Profile..." dialog in the Photoshop Edit menu.

The AdobeRGB (1998) and sRGB color space and their position within the CIE color space: this corresponds to the color perception or the visible perception of most people and was determined empirically.

Color profile

The third area of color management is individual color profiles. These have the task of balancing the characteristic display problems of an input or output device, so that it is compatible in the workflow with the binding color space standards.

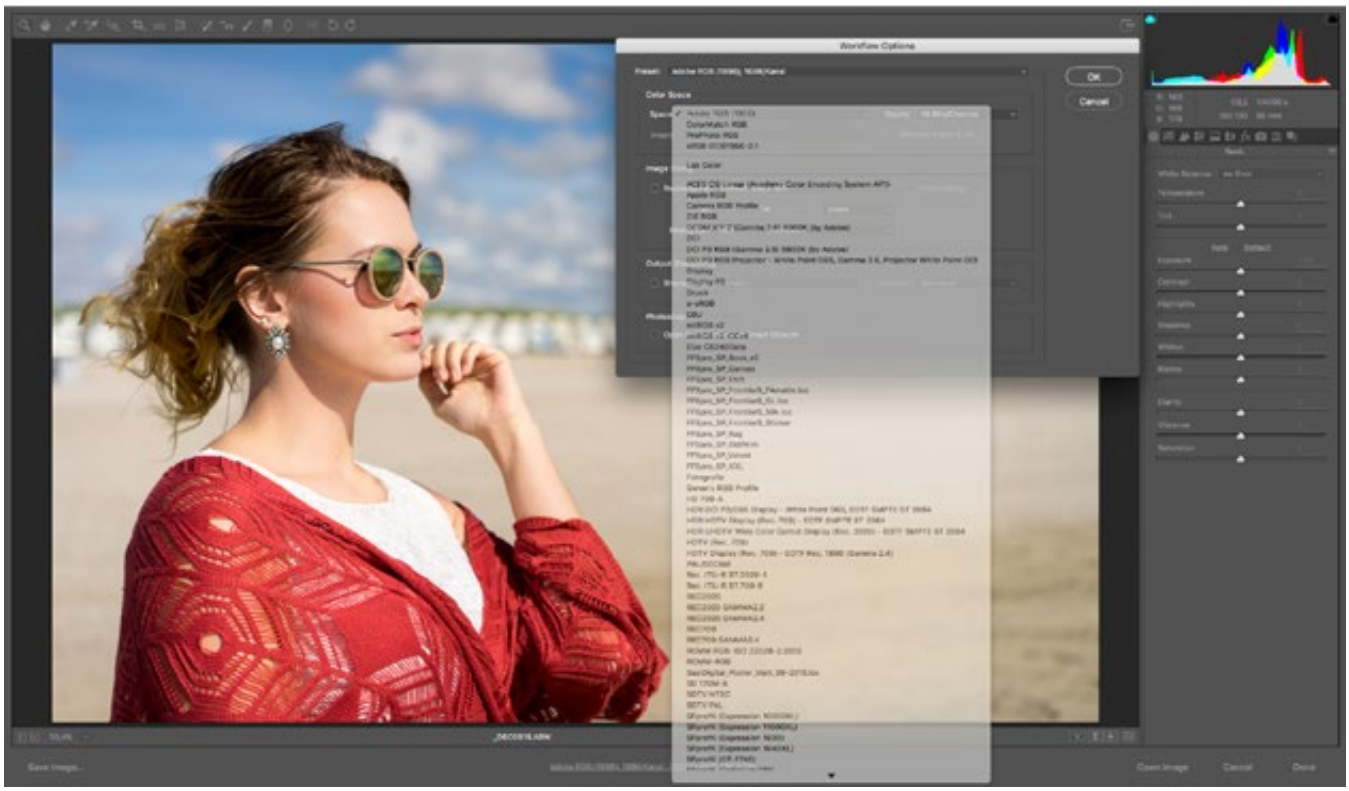
EXAMPLE

A monitor profile is a combination of correction curves for the RGB channels as well as correction values for the white point. The color management of the operating system and the application provides the respective necessary correction for the corresponding target color. These color profiles are embedded in the operating system and are managed by it. To benefit from these corrections, the individual programs access the system interface.

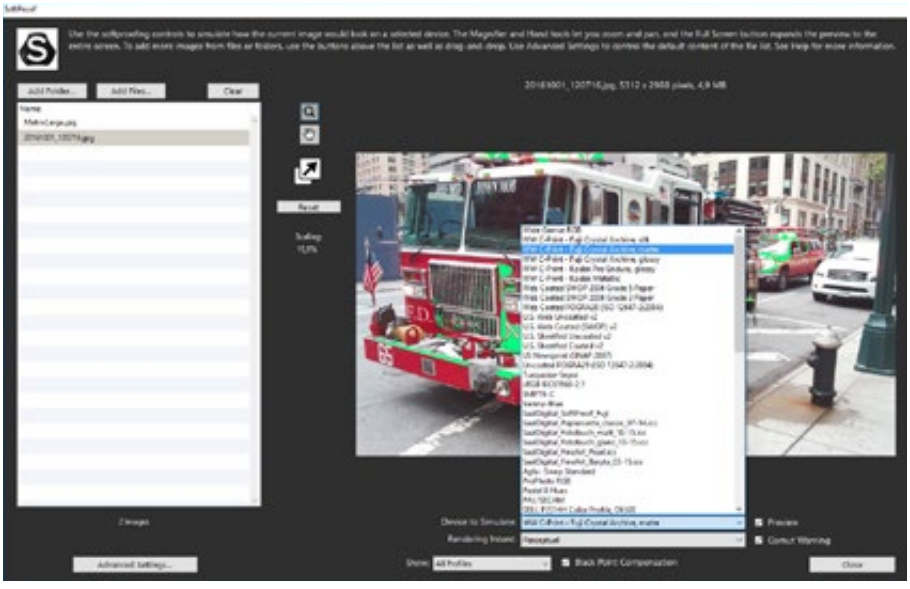
As mentioned, inkjet printers use material colors, as opposed to data for offset printing, so their data is left in the RGB color space. Multiple profiles are drawn up for these printers – one for each combination of printer and inserted paper. Those who do not, or do not exclusively, work with original inks, must make corresponding profiles for each printer, ink and paper combination. These profiles are managed by the system. When it transmits the RGB data to the printer driver, the system corrects this profile in order to optimize the color separation, which is then used by the printer driver for up to eleven colors.

TIP

Programs like Adobe Photoshop and Lightroom, as well as the Datacolor software upgrade Spyder5+, use printer color profiles in their soft proof feature and show a preview of the print colors on the screen.



For photos that are taken in RAW mode, it doesn't matter what color profile is set on the camera. The allocation of this profile takes place only after developing the image in the RAW converter.



Spyder5+ soft proof with activated color gamut warning. This indicates which colors from the original file are not included in the color space of each printer color space (printer gamut).

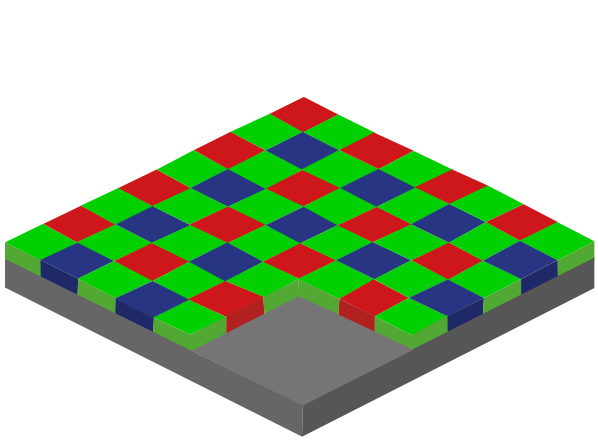
Photos in RAW format

Why you should consider working with RAW data

INFO

Raw data or RAW files are a group of data formats that are recorded onto the storage medium with practically no processing.

RAW data is produced mostly on the basis of the Bayer pattern, which resembles a three-color checkerboard. Each CMOS sensor pixel features either a green, blue or red filter. The ratio here is typically 2:1:1. The structure (Bayer pattern) thereby simulates the color perception of the human eye.



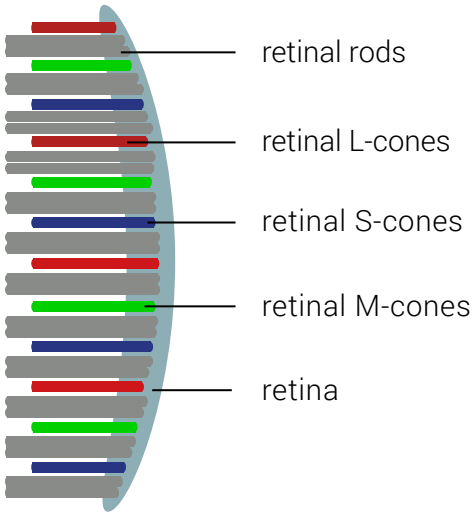


Diagram of a sensor as well as the retina of a human eye: The analogy between the CMOS sensor and retina is easy to spot. Both ultimately use the same „technology," the same color model.

INTERESTING ONLINE FINDS

Should you be shooting in RAW? Read why Digital Photography School thinks you should

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Some photographers are still skeptical about working with RAW format and frequently pose arguments like:

- RAW data are larger than JPEGs, so fewer pictures fit on the memory card
- To use RAW formats, you must install additional software from the camera manufacturer onto the computer
- At first glance, RAW images often seem less sharp and unbalanced, compared to the automatically corrected images in JPEG format.

But many of these problems have solutions. For instance, a 32-gigabyte memory cards costs approximately $21 today, so space should no longer be considered a significant issue.

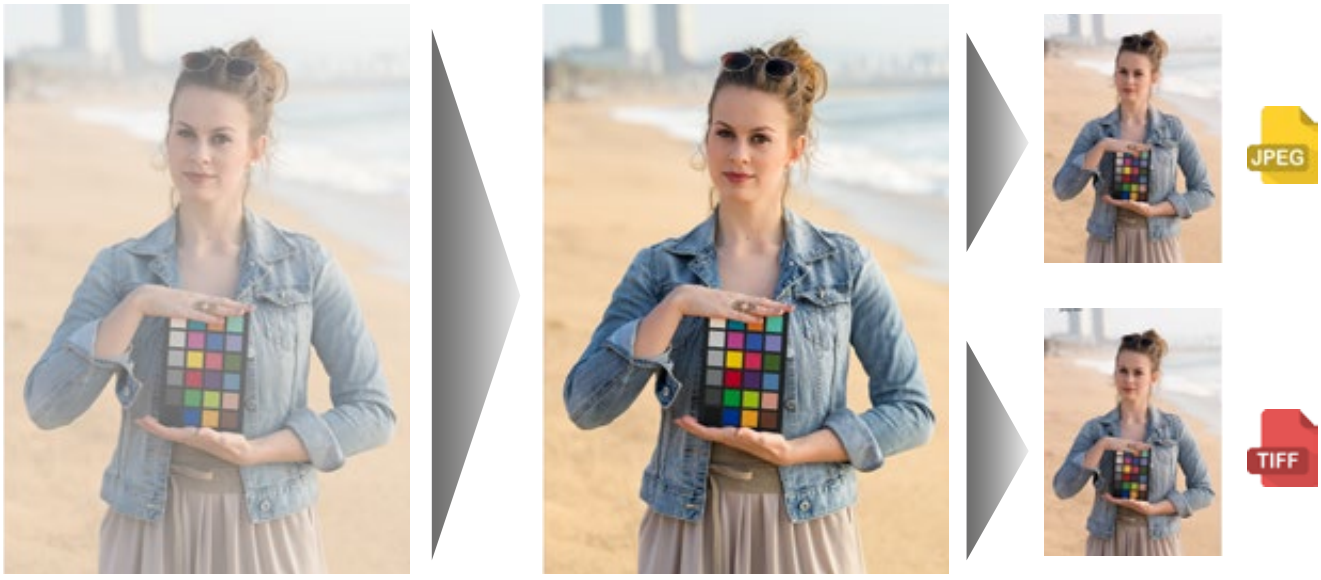
Current versions of Photoshop, as well as the sister applications Photoshop Elements and Photoshop Lightroom, support RAW files from almost all camera models. There are, of course, also special programs from the manufacturer and very powerful, work-flow-oriented RAW converters like Capture One®, DxO® OpticsPro® or AfterShot Pro®. And contrary to first appearances, you get better pictures with the RAW data, even though you have to invest more work. For this reason, photographers are increasingly interested in using "digital negatives."

"The discussion about whether you shoot better in RAW or JPEG, comes up repeatedly in the Photography Network/Nikon Community. We can see here that approximately 70% of our users are basically using the RAW format. Anyone who wants to get the most of his pictures, puts just as much emphasis on color management and calibration of monitor and camera as on the complete control of the individual image data processing steps provided by the RAW format. Arguments like "needs a lot of storage space" are obsolete in today's world. And if time is a factor, e.g., to meet a deadline, most of our users choose the option that most cameras offer of saving RAW and JPEG at the same time. The benefits of the 12 to 16 bit color depth and greater exposure latitude in RAW shots compensate the bitter pill of time consuming processing work for the majority of our users."

(Klaus Harms, editor of the Photography Network/Nikon Community)

The properties of RAW data

RAW, Optimized image before target conversion, JPEG, TIFF



RAW | Optimized image before target conversion | Output file formats

Beginning with a RAW format, which can seem more or less luminous depending on the image compared to an output format such as JPEG, this image is optimized either on the camera itself or subsequently using a RAW converter before it is then converted into the required output format.

What you should know about TIFFs, JPEGs and RAWS

To output an image in exchange formats such as JPEG or TIFF, the camera makes multiple correction calculations with its internal image processing after the actual capture. The results are then converted to the target format.

- **TIFF** (Tagged Image File Format): This format has its origins in the pre-press stage. It supports elements like the CMYK color space, and is able to save layers and offers lossless compression (LZW, ZIP). When converting into TIFF format, the 12/16 or 32-bit color resolution can be converted into the 8-bit color space. It can also be set as a standard format alongside PDF and EPS for the lossless storage of image data.
- **JPEG** (Joint Photographic Expert Group): JPEG compression is a compression method which, depending on the compression rate, can result in more or less lossless data compression right through to visible data loss in the event of higher data compression. However, this is not typically of any consequence in the case of lower compression, thus outweighing the benefits of a smaller file in most cases. Nevertheless, this format is not recommended for anyone processing images, since every time an image is subsequently opened, processed and saved the compression algorithm and accompanying loss of quality is again applied. JPEG is also available in different color depths.

- **RAW:** Although the images are captured with the same camera, RAW photos provide more image detail than JPEG or TIFF files. RAW images contain all the information recorded by the image sensor during the capture. RAWs are barely reprocessed in the camera. In comparison with a TIFF, they require relatively little storage space, because the information is stored according to the Bayer pattern of only one channel and not all three color channels. Thus a RAW file from a 20 megapixel CMOS chip takes up about 20 to 24 megabytes of memory compared to the 60 megabytes of a later 8-bit TIFF (or 120 megabytes for a 16-bit file). All additional values, such as white balance, color correction or contrast enhancement, are stored only in text format (EXIF information). With other capture systems without CMOS technology—such as the SuperCCDs from Fuji or the Fuveon chips, which are used in the Sigma DSLRs—the memory footprint of RAW photos is less favorable.

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SLR Lounge sheds some light on the merits of shooting RAW vs. JPEG

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Correction calculations made by the camera for JPEGs and TIFFs

In the first step, the proper color temperature is applied to the image using a white balance curve. In the next step, the software compensates for the lack of sharpness caused by the CMOS technology. It arises because a greyscale chip equipped with filters provides the color information during the image capture. This trick requires that 66 percent of the image information must subsequently be interpolated. This and the use of so-called low-pass filters lead to blurry contrast edges that need to be sharpened. In the last step, the camera computes “crisp” photos: to make the images more appealing to the viewer, it amplifies the contrast and increases the saturation. The worse the electronic and optical camera components are, the more post-work the camera software has to do.

From the image to the workflow

How RAW files make work easier

Undoubtedly, there is one **key benefit of RAW files:** When converting a RAW photo, the photographer can subsequently adjust almost all recording parameters. Of course the basic physical conditions, such as the lighting situation, focal length, aperture or shutter speed settings, cannot be changed. There are correction options that go far beyond what was formerly manipulated in the laboratory. The photographer no longer has to go into the darkroom. Instead, they sit in a darkened room at a “light box” (i.e. a monitor) and “develop” different versions of a photograph with the aid of easy-to-use sliders. In principle, of course, this also applies for the other image formats.

The RAW workflow of photo professionals: from exposure to output

In addition we also have another application in a manner similar to the image sequence shown under “Properties of RAW,” and have extended the workflow to include printing. In addition to image optimization, many RAW converters have gained a variety of filters. Therefore, the boundaries between photo retouching and composing are becoming ever more blurred. If the work involves layers (e.g. text or color settings) or complex skin retouching, as is required in beauty photography, an image processing program such as Photoshop is most likely the best choice.

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The RAW workflow of photo professionals

From exposure to output

1. Exposure in RAW format, without image optimization in RAW converter. RAW files usually appear less luminous.

The RAW workflow of photo professionals

From exposure to output

2a. Image optimized in RAW converter

The RAW workflow of photo professionals

From exposure to output

2b. Alternatively: Composing in Photoshop (subtle vignetting to support a more dramatic effect) preferably using an uncompressed target format.

The RAW workflow of photo professionals

From exposure to output

3a. Conversion into a JPEG target format at a high compression rate with clearly visible posterization (also known as banding)

The RAW workflow of photo professionals

From exposure to output

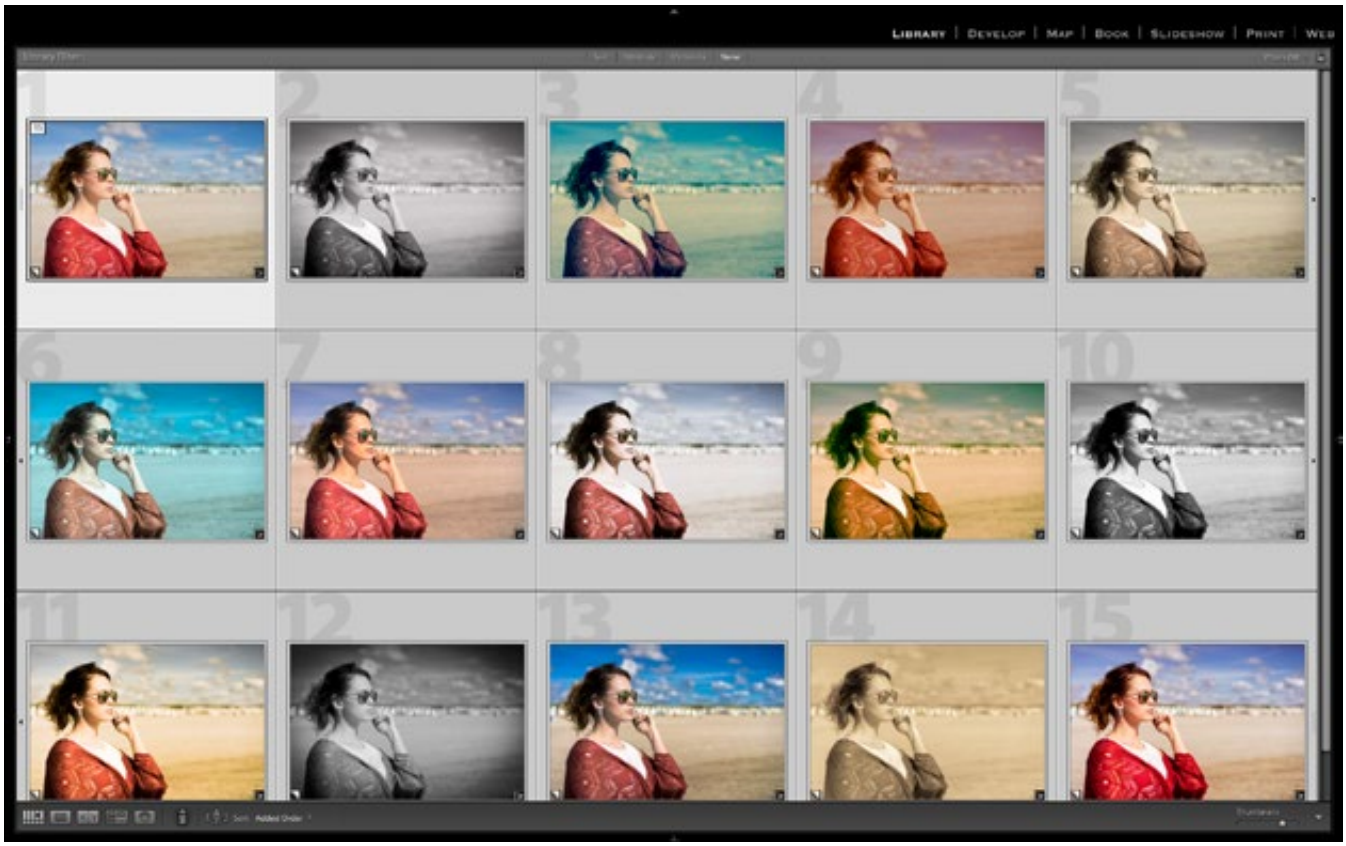
3b. Image optimized for printing. Clearly visible. The colors now appear less luminous due to the transfer of the larger camera color space to the printer color space.

RAWs offer old-school photographers **some pleasant secondary aspects:**

- The RAW format cannot be overwritten. Parameter settings can be changed, but the setting changes do not affect the underlying picture information — apart from in terms of the visual representation. This property stops the RAW file from being inadvertently changed, reduced or "compressed to death."
- You can make various "prints" from the original—just like when using film. Thus, image versions are created depending on the intended use: for the output in the lab, the photo printer, on the Internet, for offset printing or further processing in Photoshop.
- Some RAW converters, such as the programs Capture One and Lightroom, combine this "photo development" with an image management system that radically simplifies the management of the prints. The results can be read in a single operation from the camera or from a memory card, renamed, cropped and labeled according to IPTC conventions. Also you can convert them into different target formats, scale, tune the resolution and color depth for output, add ICC color space information, sort them directly into subdirectories and/or add a watermark. All of this works with single pictures as well as in batch mode.

INFO

Since the CS4 version, Photoshop in combination with the file manager Adobe Bridge cover almost the same functionality as Capture One and Lightroom.



Working with camera RAW formats brings not only benefits in image quality, you can also create multiple versions of a photo—like here in Lightroom 6—from an image without significant disk requirements. However, these “virtual copies” are saved in the respective Lightroom catalog and not in the RAW properties of the image.

Benefits for photographers

How photographers benefit from working with RAW data

Photographers with a high-volume of images can benefit from these workflows in several ways:

- They retain maximum control over the manner that their image is tuned. This is much like a specialist laboratory in which one works with a very capable lab assistant—only without any loss of time and communication problems.
- With special functions, you can also reduce color noise, compensate for chromatic aberration, or remove lens vignetting.
- The shots from a job can be converted into different TIFF versions with just a few clicks.
- And if you want to create JPEG previews at the same time for your customers, you can send them directly via e-mail or upload onto a website.
- There is also the option to save conversion profiles for use on similar capture subjects. Such profiles are useful, for example, for studio photographers. They ensure uniformly warm skin tones in portrait series or optimize the color of top table structures that are always created in similar lighting conditions.
- There is another advantage for photographers who are interested in pure image optimization: they can tune their photos via a clearly laid out and functional interface without having to become a Photoshop expert. In Photoshop's Camera Raw and other RAW converters you will find all essential settings to control the tonal values, the focus and the colors of the images accurately and quickly.

TIP

The RAW workflow can be precisely tailored to your individual needs. This is no problem if you invest a little time in getting to know the technology and are open to experimenting.

Benefits for graphic designers

How RAW technology improves work in the creative field

Creative image editors shift the creative aspect from the capture to the post-production process. This means they photograph individual items for later composite images rather than designed scenes. As the quality of output images is not as important for them as for the photographer, JPEG photos are often used working material. After all, they have the technical know-how to push the detail weaknesses of a picture far into the background with just a few clicks. As they spend much more time with the processing of individual images or illustrations, a time-saving workflow is not so important for them. What they need first and foremost is a well tagged image database so that they can quickly find montage elements. The working files are then simply managed in a project folder at system level. Creative photographers, therefore, do not benefit as much from the advantages of RAW technology as the optimization-oriented photographers, although working with RAW data does have some advantages for them:

- The most fundamental of these is the superior quality. When comparing two normally exposed and unmodified recordings there may be little difference to be seen: but as soon as you start to adjust the image with the gradation curve you are confronted with “artifacts” that come from the JPEG compression. During compositing, montage items almost nearly always need to be adjusted in terms of color and light, thus the increased adaptability that RAW images offer is significant.

- Application areas that offer functions in the range of image optimization and creative image editing are very useful. RAW converters are well suited, for the black and white conversion of color images. Also, color corrections that relate to the whole image are often easier to control than with the normal tools of electronic image processing. Anyone who works with the o subtly manipulate the mood of the images with artificial edge shading.

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Problem areas

What can be tricky when working with RAW data

RAW is not in a consistent format, but rather it is a generic name. It has nothing to do with the Photoshop RAW format. Since the beginning of RAW photography, almost every camera manufacturer has developed its own individual “RAW dialect,” which may be different depending on the camera model.

If you work with the current version of Photoshop or Lightroom, you will receive support for most current and older cameras’ RAW formats automatically.
The above-mentioned “RAW dialects” do not create problems anymore with the general compatibility of today’s image editing programs.

DNG (digital negative)

Alternative format for proprietary standards

INFO

Digital negative (extension: **DNG**) refers to a RAW data format developed by Adobe for files generated by digital cameras. This open archive format aims to clear up linguistic confusion regarding the proprietary file formats of individual camera manufacturers and gradually establish a uniform standard that all manufacturers can resort to.

RAW data can be converted to the DNG standard using Adobe's free DNG Converter and then opened in Photoshop, without the need for the latest version of the image processing software.

At present, each camera manufacturer is still developing its own format, which can sometimes even differ from camera to camera. As a result, the approach involving a uniform standard is a good one. In practice, however, manufacturers have indeed implemented the DNG format but have not done it in full. This means that proprietary formats may be (albeit not necessarily) beneficial, compared to the DNG format. Caution should also be exercised when converting proprietary file formats into the DNG format, as to whether all file information is actually transferred. It is ultimately a very delicate area with conflicting viewpoints. As a result, it is not possible to avoid testing the workflow and committing to the system. All of the formats contain more or less the same information and metadata.

In 2003, the Photoshop RAW plug-in made it possible for the first time to edit many popular RAW formats in a fast, comfortable, and option-rich interface. Nowadays, RAW plug-ins have long been part of the scope of service of Photoshop and Lightroom or other RAW converters with regular updates for new camera models.

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PhotoUp provides an interesting comparison of the various file formats that can be used

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Glossary

AdobeRGB (1998):
The AdobeRGB color space was specified by Adobe in 1998. The objective was to create a color space from which the CMYK color space of a color printer could be adapted to the RGB color space of a monitor. It is larger than the sRGB color space.

Bayer filter:
Photo sensor named after its inventor Bryce E. Bayer. The sensor is overlaid with green, blue and red filters, which are in a ratio of 50% green, 25% blue and 25% red. In this way, it approximates the sensitivity of the human eye, in which green accounts for the greatest share of the perception of brightness.

Border shadowing:
See objective vignetting

CCFL display:
This is a first generation flat screen. CCFL stands for Cold Cathode Fluorescent Lamp. In contrast to today's monitors, which are illuminated with LEDs, the CCFL displays produce light using neon tubes.

Cd/Candela:
Candela is the SI unit of the SI basic variable of luminosity.

CEPS tools:
CEPS stands for Color Electronic Page Setting. In photography, this involves photo retouching or photo editing with the aid of image editing programs such as Adobe Photoshop or Adobe Lightroom.

CIE-xy color space:
The CIE standard valence system has been defined by the International Commission on Illumination (Commission internationale de léclairage). It is the link between human perception and physical causes.

CMOS technology:
CMOS stands for Complementary Metal Oxide Semiconductor. This involves semi-conductor technology, which has become widespread in photo sensors, etc. CMOS sensors are primarily characterized by low power consumption and short switching times.

Color balance:
The color balance determines the ratio of the colors to each other. For example, if the colors in a recorded image are not reproduced as they are in the original, the colors are not in balance.

Color fidelity:
Color fidelity is the measure of the deviation or the similarity of colors during recording and output. Color management systems are normally used to achieve maximum color fidelity.

Color fringes:
Color fringes, also called chromatic aberrations, occur in images because of deviations of optical lenses. Because the individual wavelengths of the visible spectrum in a lens are refracted differently, each wavelength range has its own focal point. In practice, this leads to color fringes, which are particularly visible on the contours and edges of an image. This error can be corrected using additional lenses, which are attuned to the respective wavelengths.

Color homogeneity:
The color homogeneity describes the color consistency or the color deviations from a set point over an area, e.g. the surface of a display. In the case of poor color homogeneity, the same color value is reproduced differently on the surface of the display. For example, this could cause a green tint on the upper right and a red tint on the bottom left corner.

Color noise:
Color noise, or image noise, describes the deterioration of image quality due to structures, which themselves do not carry any image information. The impacted image sections deviate from the actual image information in terms of color and brightness, and are especially visible in dark areas of the image in which the signal-to-noise ratio is very low.

Color separation:
In the prepress stage, this means the conversion of the colors of a wide variety of image datasets, mostly to the CMYK color model. The colors are separated into the print colors cyan, magenta, yellow and black.

Color space:
A color space is a defined range of colors. The best-known color spaces from the RGB color model are sRGB and AdobeRGB (1998), as well as the CMYK color model, Euroscale Coated v2, Fogra39 and ISO Coated v2.

Color temperature:
The color temperature describes the light mood and is specified in Kelvin. A cooler light mood (bluish) prevails, for example, more in a cloudy sky, than in sunshine (yellowish).

Contrast:
Contrast is the ratio of the brightest to the darkest area of an image.

Contrast balance:
Is the ratio of the brightest and darkest areas and is defined from where the light is being drawn.

Cross-effect:
The cross-effect originally came from analogue photography, in which a slide film was combined with a negative development process or a negative film with a reverse development. The colors are artificial and the contrasts are higher. This effect is often used for artistic styling and is imitated today by digital techniques.

Contrast ratio:
See contrast

DLP projector:
DLP stands for Digital Light Processing and it is a technology developed by Texas Instruments where the image is created by an array of micro mirrors within the optical path. A special feature is that the red, green and blue pixels are not generated simultaneously (as in LCD projectors), but by quick alternate flashing through a rotating color filter wheel.

Glossary

ECI RGB:
The ECI (European Color Initiative) RGB is a standardized RGB color space, which covers a large part of the printing processes, as well as all currently known display technologies. Thus, it is a color space that is designed especially for the needs of the graphic arts and prepress.

eciRGBv2:
Further development of ECI RGB. It has been optimized in terms of the visual equidistance, as is known from the CIE-L a*b* color space. This results in a minimization of banding and clipping errors, as with the L-Star color space. The ECI recommends using the color space as early as data creation, for example when converting RAW data or 16-bit material to 8-bit color depth.

EXIF information:
The Exchangeable Image File Format (EXIF) is a standard format for saving metadata in digital images. EXIF information can be, among other things, a camera model, shutter speed, ISO value, aperture or date and is written in the header of the image file.

Fine Art Printer:
There is no uniform definition for the term Fine Art Printing. All Fine Art printers attempt to create an image which most closely resembles a one-of-a-kind or work of art, in terms of its properties, selected image, and post-editing, and in the use of the best photographic materials.

Gamma:
In relation to a monitor, gamma refers to the modulation of an input signal to a desired output signal. In practice, this means that a low-contrast image is obtained by correction of the output signal to contrast.

Gamut:
Is the description of the color range which can be reproduced by a technology or a technical device.

Grey balance:
"Achromatic" colors are the grey shades that lie between white and black. These are produced by equal proportions of the respective primary colors such as cyan, magenta and yellow (CMY) in the print or red, green, blue (RGB) in self-luminaires. If the primary colors change to equal proportions, a grey may become brighter or darker, but remains neutral grey. If the color components are no longer in the same proportion, one can immediately perceive a grey tint and that gray balance is no longer maintained.

High-Key image:
In high-key photography bright tones, few contrasts and soft light lend style to an image.

ICC profile:
An ICC profile describes the color space of input and output devices such as printers, scanners, digital cameras or monitors and refers to the reference values.

IPTC conventions:
IPTC is the acronym for International Press Telecommunications Council. As per the IPTC convention, metadata are saved to the header of an image file for improved classification. They contain such things as parameters such as file format, file size, filename, height and width in pixels of a file, date recorded and the description of the contents.

Kelvin:
Kelvin is an SI unit of temperature measurement. It is also used for measuring the color temperature.

L*a*b* color space:
Is a device-independent color space and describes all perceivable colors equally, so that color deviations can be described by a Delta E.

LCD:
This refers to Liquid Crystal Display. The liquid crystals regulate the light impermeability per color channel. LED monitors are also LC displays, but irradiate the color filters from the rear with LEDs instead of fluorescent tubes.

LCD projectors:
The white light of the projector lamp is split into 3 basic colors by a prism and then sent through 3 LC displays, which control the image information per color channel. Subsequently, the image is put together by another prism. LCD projectors are characterized by a smaller contrast range, but can reproduce the colors very differently.

Low-pass filter:
With image files, so-called Moiré effects may occur instead of very fine recurring structures, which are at the limit of the sensor's resolution. These small, colored structures have a specific pattern, but are not part of the image information. Low-pass filters are used to prevent these phenomena.

L-Star RGB:
A modern color space, which combines the advantages of a higher color resolving power of the human visual sense of the CIE-LAB color space with the usual RGB color spaces like AdobeRGB and ECI-RGB. Banding and color tipper errors are reduced to a minimum when viewed on a display and in printing.

Luminance:
The luminance describes the brightness of image points

Luminance homogeneity:
Describes uniformity of brightness for a defined area. A poor luminance homogeneity of a monitor can be seen as vignetting, although all image areas must be equally bright.

Look Up table:
IT term. Look Up table (also called LUT) are tables in which application-specific values are stored which are used in a program routine.

Glossary

LUT:
See Look Up table

Luv color space:
A color space that is calculated from the CIE-XY system, similar to the L*a*b* color space. This system is mainly used for the evaluation of light sources or monitors.

LED backlight:
This refers to a flat radiator that consists of many light emitting diodes and is used for the background lighting of an LED display.

Low-Key image:
In contrast to high-key photography, low-key photography uses little light as a stylistic device. Light is used consciously to accentuate highlight contours and the few details that are important for the image. Many sections of the image often remain in the dark. This lends a certain amount of drama to this type of image, a familiar sight in theatrical or stage photography.

Objective vignetting:
Vignetting refers to the shadowing of the image to its borders, which can be highlighted by components of the objective, such as lens mounts, and by filters or lens hoods. The effect itself is originally unwanted, but it is also used as a stylistic device.

Offset printing:
Is a printing method, in which the pressure roller does not directly contact the printed product, but the printing is transferred indirectly by a rubber roll. This is the most common method for printing books, newspapers and packaging.

OSD:
Stands for On Screen Display and describes an input menu window of a monitor, which is shown on the display

Primary colors:
Primary colors are the basic colors that compose secondary colors. Thus, the colors that a monitor can display are composed of the colors red, green and blue. The same applies to cyan/magenta/yellow, by means of which all colors which can be displayed by the process are mixed in printing.

Polarization layer:
A polarization layer, as used in LE and LC displays, ensures that light is polarized, which means only the fractions that oscillate in a plane are transmitted. This is the prerequisite for the option of regulating the light quantity per pixel with LCs.

Reflection idiosyncrasies:
Printing paper and photo paper have a large number of surface properties. The bandwidth ranges from matte and glossy to a wide variety of textures and materials. Every surface and every material have very specific characteristics, with regard to how they absorb and reflect light. These must be taken into consideration when setting up a color workflow.

Rendering Intent:
The way in which the colors must be converted from one color model into another.

Softproof:
In a softproof, the colors on a monitor are simulated as they will appear on the selected output material. Also know as ink color simulation.

sRGB:
Standard RGB is also a color space developed by Hewlett-Packard and Microsoft. It is widespread, but smaller than the AdobeRGB (1998) color space.

THM file:
THM files are miniature view video files, which are used to create a thumbnail image (miniature image) of the video file for improved orientation.

Tonal value:
The tonal value describes the measure of tone scales. For example, a digital camera with 8 bits per color channel has a tonal value reduction of 28 = 256 steps per color channel.

White balance:
In the case of a white balance, a camera should be set to the color temperature of the recorded scene to keep the color balance neutral. This is also done by the human eye, which evaluates colors in a largely neutral manner.

White luminance:
White luminance is the maximum brightness of a white point that can be displayed by a monitor.

White point:
The white point defines the white of a monitor with full control.

Wide gamut:
Gamut is the displayable color space of a monitor. Wide gamut features a device class that is characterized by a very large color space that is close to AdobeRGB (1998) or even slightly more. Monitors with wide gamut are typically used in image editing.

Workflow:
A workflow in photography includes all devices and technologies, which are used in the processing of the final image. A typical workflow includes a digital camera, image editing software, display units/monitors, and printers.

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Color management can be easy

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