

CAMERA, LENSES AND ATTACHMENTS

Cropped Sensors - These are the smallest of the sensor sizes and include most compact, point and shoot cameras as well as many entry-level or “prosumer” digital SLR’s.

Full Frame Sensors - These are the class of digital SLR’s that feature a sensor that is same size as the traditional 35mm film frame.

Medium Format - These cameras are represented by those cameras which utilize a sensor that is larger than 35 mm, and smaller than 4x5 inches.

Large Format - These cameras capture images with film or a digital sensor that are 4 inches by 5 inches or larger.

CMOS sensors are used in most of today’s full frame and cropped frame digital cameras. Traditionally, they are of lower quality, lower resolution and lower sensitivity than CCD’s, however, technical advances have improved them greatly. They are generally used to help keep the costs of the camera down and they have great battery life.

CCD sensors tend to be used in higher end medium format and large format cameras and video cameras that focus on high-quality images with lots of pixels and excellent light sensitivity.

Pixels - Digital images are made up of tiny points known as “pixels”. The word “pixels” comes from combining the words “**P**ICTURE **E**LEMENT.”

Resolution - The resolution of any digital image is defined by the number of pixels per inch.

Megapixel - one million pixels.

Photosites - tiny light cavities on the camera sensor which gather photon during the exposure.

Bit - a single unit of digital information which can be represented as either a “0” or a “1”.

Byte - eight bits 2^8 ($2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2 \times 2$) creates 256 values, so in the realm of digital imaging, 8 bits can generate 256 tonal values. Sixteen bits generates 65,536 tonal values.

Bit Depth - (bits per pixel) is the precision to which a pixel can specify color. For example, a sensor that records at 8-bit values for Red, 8 bits for Green and 8 bits for Blue (RGB) means there are 256 possible values for each of the Red, Green and Blue channels. When you multiply that out, ($256 \times 256 \times 256$) the sensor is capable of creating

16,777,216 color values at 8-bit depth. A camera that records three colors at 8 bits each, generates a 24-bit image.

JPG - render color at 8 bits per color. This means when you use your camera in JPG mode, your camera processes the file with 16.7 million colors.

In **RAW** format, DSLR cameras usually capture in 12 or 14 bits for each color. This dramatically increases the number of colors (billions) that the camera can capture. A camera capturing a 12-bit RAW file captures 68.7 **billion** colors - far out performing the JPG capture. RAW capture provides the photographer much more latitude for color adjustments compared to JPG capture.

Increasing the bit depth also increases the size of the digital file. Resolution and bit depth determine the total file size.

Dynamic Range - the camera's ability to record the darkest values and the lightest values with detail. The dynamic range is the ratio between the lightest (highest) and darkest (lowest) values. (lightest values/darkest values)

Focal length - the distance between the principle plane of the lens to the focal plane (sensor plane) when focused at infinity.

Focal Plane - The plane at which light rays passing through a principle plane are focused to a single point, or "focal point".

Prime - "fixed" lenses having a single focal length. Common prime lenses include: 28mm, 50mm, 85mm, 135mm, 200mm and 500mm. Prime lenses tend to be sharper and often have larger aperture openings than zoom lenses.

Normal lens - a lens that records a scene with a field of view that is similar to the way the eyes see a scene. There is little or no magnification or expansion of the image. The focal length of the normal lens is approximately the same millimeters as the diagonal measurement of the sensor in millimeters.

Wide-angle lens - Any lens with a focal length smaller than the normal lens for that particular format is considered to be "wide-angle". This type of lens records a "wider expanse" than the normal lens. For cameras with full frame sensors, common wide-angle lenses include 35mm, 28mm, 24mm, 14mm.

Telephoto Lens - Lenses larger than the normal lens are considered to be telephoto lens as they begin to magnify the image compared to what is seen with the naked eye. Common telephotos are 85mm, 135mm, 200mm and 500mm.

Zoom lens - Zoom lenses cover a range of focal lengths. They combine a minimum and a maximum focal length and provide all of the focal lengths in between.

Macro Lens – specialty lens that is optically optimized to handle extremely close focusing distances and can take sharp, highly detailed images of smaller subjects.

Teleconverters - double or triple the focal length of a lens. With a 2x converter, a 50mm lens becomes a 100mm. With a 3x converter, a 50mm becomes a 150mm. A 2X converters reduces your effective f-stop by two stops. A 3X converter reduces the effective f-stop by three stops. They also tend to reduce the contrast and sharpness of your images.

Lens Shade - a collar or hood at the front of a lens that keeps unwanted light from striking the lens and causing image flare.

Angle of View - how much of a scene is recorded at a given focal length (field of view)

Perspective - The apparent distance, size and depth of objects within a two-dimensional image. Also, the relationships of the foreground and background to the subject.

Compression - the perception of elements in the foreground and background appearing closer in relation to the subject.

Convergence – exaggerated distortion of a subject such as a building appearing wider at the bottom and narrower at the top caused by tilting the camera upward.

Tilt-shift lens. – Specialty lenses which help to correct the “convergence effect” when tilting the camera to photograph tall buildings and other objects. This lens can be **shifted** upwards while leaving the camera, and therefore the sensor plane, parallel with the subject.

Depth of field - the area in a photograph that will be in acceptable focus. Depth of field determines the relative sharpness or lack of sharpness in the background (and the foreground) in relation to the subject.

Hyperfocal distance - the closest distance of focus in which a lens will keep objects at infinity, acceptably sharp.

Multiplication factor - used to express this telephoto effect of using a lens on a cropped sensor. For example, a multiplication factor of 1.6 means a 200mm lens on a camera with a cropped sensor will have the angle of view of a 320mm lens. .
($1.6 \times 200 = 320$)

ISO – the setting that controls the sensor's sensitivity to light..

Manual mode – camera setting in which the photographer determines the exposure by selecting the F-stop and shutter speed and ISO settings based on the desired image capture.

Program (P) – camera setting in which the decision of f-stop and shutter speed selections are totally selected by the camera.

Aperture Priority (A) (Av) – camera setting in which the photographer selects the aperture and the ISO setting, but the corresponding shutter speed is selected by the camera.

Shutter Speed Priority (Tv) (S) – camera setting in which the photographer selects the shutter speed and the ISO and the camera selects the corresponding f-stop.

White Balance - This control on the camera is used to correct the color casts that come with photographing in various types of lighting conditions.

Mirror Lock-up - This control locks the mirror “up” so that it does not move during an exposure. This is helpful for long exposures where vibration of the moving mirror can cause the image to be less sharp.

Quality - a menu function that controls the file type (s) and size that will be used to record images. These may include: RAW, JPG Small, JPG Medium, JPG Large, TIF and RAW+JPG options.

Format - The menu function is the preferred method to prepare a memory card for use after all of the previous images have been safely copied and backed up onto your computer.

Monopod - a camera support utilizing a single post (leg) to take the weight of the camera off the photographer’s hands and arms during the exposure.

Image Stabilization or Vibration Reduction

These systems help to provide a sharper image when using slower shutter speeds where the image might appear blurry if the camera was hand-held and IS or VR was not used.

White Balance Target – calibration standard used in conjunction with the camera’s “Custom White Balance” settings to set for color correction under that particular light source.

Calibration Target - a variety of color swatches that are photographed in the same lighting conditions as the subject. Once the target is photographed, it can be opened with software that is programmed to read the known value of each of those swatches and automatically adjusts each of the subsequent images from those same lighting conditions.

Calibration Disc - a custom white balance device mounted onto the lens and used with the camera’s custom white balance settings.

Color Temperature - white balance measured with settings bases on the Kelvin color temperature scale.

Lossy – describes an image file that discards much of the original data for the image when the file is saved and compressed.

Lossless - describes files that do not suffer data loss when the file is accessed and then saved.

RAW – a data file which contains unprocessed information captured by the sensor. This data includes image metadata as well as pixel data.

JPG - a compressed image file. A JPG is a LOSSY file as much of the original data for the image is discarded and lost when the file is compressed into a smaller size. JPGs do not allow for preservation of individual layers and must be flattened upon saving.

JPGs are often the file type that is used for uploading images to a lab for printing. The compressed file is small enough to upload and download over the internet while still having enough data to create printed images. They are also commonly used as the file type for websites.

TIFF

A TIFF file can be Lossy or lossless, compressed or uncompressed. It is frequently used for graphics and photographs as it can preserve layers upon saving for later editing and does not suffer from image artifacts if not compressed when saved. TIFF files are often provided for high quality 4-color printing.

PSD

A PSD file is a Photoshop Document file. It is an uncompressed, lossless file used primarily for image editing as they can be saved to preserve all layers and other image editing features. This is helpful when reopening the file as it retains the editing which can be continued at any time.

DNG

The Digital Negative is a universal format which retains all metadata within the file instead of separate sidecar files. Since RAW formats change frequently, the DNG format is constant and will remain constant and will be accessible for the long term.

EXPOSURE AND METERS

Ambient Light - The available light existing in an indoor or outdoor setting that is not caused by any illumination supplied by the photographer

18% Grey – The middle grey result used to calibrate a hand-held or in-camera meter.

Incident Meter - measures the amount of ambient light falling **ON** a subject or scene.

Reflective Meter – measures the amount of ambient light reflecting from a subject or scene.

Spot Meter – measures a drastically narrowed down angle of coverage to render the exposure result. Some spot meters will narrow the coverage to a 1° or 2° angle of view.

Panning - technique used to record a moving subject with a slow shutter speed by following the path of the moving subject with the camera as it passes across the field of view while keeping the subject within the viewfinder.

Exposure Compensation – a camera control used during Program, Aperture Priority or Shutter Speed Priority modes to override the camera's choice of exposure and reduce or increase the exposure settings by up to two or three stops and in 1/2 or 1/3 stop increments.

Histograms - a graphic representation of the 256 tonal values captured by the sensor from a given exposure. The horizontal graph represents the pixel's numerical value from "0" (black) on the left to "255" (white) on the right.

LIGHTING

Catchlight: The points of light created by the light source that appears in the subject's eyes.

High Key: Refers to an image that is created using mostly light tones and bright backgrounds.

Low Key: Refers to an image that is created using mostly dark tones and dark backgrounds.

Hard Light - is described as harsh lighting from a small light source (relative to the subject) which produces strong and distinct shadows. Smaller light sources tend to create specular highlights and harder transitions between highlight and shadow.

Soft Light - or diffused light sources are generally soft because they are larger in size and often used at close distances to the subject. Larger light sources tend to create diffused highlights and softer transitions between highlight and shadow.

Flat Lighting

Lighting that strikes the subject from the front or that does not rake across the subject to bring out texture and detail is said to be "flat".

Broad vs Short - With the face turned at a 45° angle from the camera, the view of the face is divided by the nose and the camera sees more of one side of the face and less of the other side. The wider side is referred to as the "**broad**" side and the narrow side is called the "**short**" side. In the definition of Broad Lighting and Short Lighting, the delineating factor is determined by which side of the face the main light strikes first.

Broad Lighting – With the face turned at a 45° angle from the camera, the main light illuminates the widest side of the face turned toward the camera

Short Lighting - With the face turned at a 45° angle from the camera, the main light is placed on the same side as the narrowest side of the face.

Accent/Kicker Light: This specialty light defines and sculpts the subject by adding a strong highlight on the subject to add interest, create form or separation.

Add an orange, color correcting gel to the flash which changes the "daylight" color balance of the flash to an equivalent "tungsten" value and **set the camera white balance to "Tungsten" (roughly 3200K)**. CTO (color to Orange)

Either cover the entire window with an orange color correction gel and set the camera white balance to 3200K or use blue (CTB - Color to Blue) color correction gels over the supplemental hot lighting and set the camera white balance to 5500K.

Sunny 16 Rule

Lighting Pattern / Starting Exposure

Sunny / F16 @ 1/ISO
Partly Cloudy / F11 @ 1/ISO
Overcast / F8 @ 1/ISO
Heavy Overcast / F5.6 @ 1/ISO

Flash Sync - The fastest shutter speed that can be used and still coordinate the timing of the flash with the shutter in the camera. The flash sync is determined by the manufacturer and model of the camera being used.

Here are the ratio settings for powering down a portable strobe:

1/1 = Full Power output of the flash
1/2 power reduces the output by 1 stop
1/4 power reduces the output by 2 stops
1/8 power reduces the output by 3 stops
1/16 power reduces the output by 4 stops
1/32 power reduces the output by 5 stops
1/64 power reduces the output by 6 stops
1/128 power reduces the output by 7 stops

Dragging the Shutter – When using a portable or studio strobe, this technique uses shutter speeds slower than the camera’s sync speed to record some of the ambient light along with the flash exposure.

Visible light spectrum - The very small section of the electromagnetic radiation spectrum which is visible to the human eye. Visible light has varying wavelengths which determine how we see its color.

White light – Light containing all of the wavelengths within the visible light spectrum. Visible light has varying wavelengths which determine how we see its color.

- Passing white light through a prism separates the light waves across the visible spectrum - simply put, a rainbow of color.

ROY G. BIV.

This mnemonic device helps us remember the order in which these light rays manifest themselves when white light is passed through the prism: Red, Orange, Yellow, Green, Blue, Indigo and Violet.

Color temperature - describe the color values throughout the visible spectrum with a numeric value based on the Kelvin Color Temperature Scale. Simply put, color has a numerical value than can be expressed in “degrees Kelvin” or K°. Remember, 5500K represents daylight (white light).

Angle of Incidence = Angle of Reflectance

This principle recognizes the path that light reflects at the same angle it originates. Think of it as traveling the path of a tennis ball when thrown against a wall. Throw it straight, it comes right back at you. Throw it at a 45° angle and it will “reflect” off the wall (subject) at the same angle, but away from the source.

The Inverse Square Law

This law of physics states that “the intensity of the light on a subject is inversely proportional to the square of the distance of the subject from the light source.” In simple terms, this law tells us if we take a given distance of a light source from a subject and double that distance, we will lose two stops of exposure. Conversely, if we cut that distance in half, we will increase two stops of exposure.

Color Correction Filters

While DSLR’s have built-in white balance controls, color correction filters still have a place in modern photography. For our discussion, we will look at a couple of the most common CC filters.

- **FLD or FLW** - These filters are used to correct the color cast of two common fluorescent light sources. The FLD is used for “daylight” balanced fluorescent tubes and the FLW is for “warm” light balanced fluorescent tubes. Both filters help reduce the green overtones that are often present with fluorescent lighting.
- **80A or 80B** - These dark blue filters are used to balance tungsten lighting to daylight. This removes the yellowish cast that is present when the image is captured unfiltered. The 80A is for lights with a color temperature of 3200K and the 80B is for 3400K photo flood lights.
- **81A, 81B and 81C** - These filters are in a class of “warming” filters which may be used to offset bluish overtones often present with overcast lighting or portable flash.

Gels, Grid and Cookies

Gels are acetate sheets of various colors that can be placed over the light source to effectively change the color of the light.

Grids are used in front of a light source to control the direction of light and reduce stray light from falling on areas where it is not wanted.

“Cookies” are used over a light source, primarily a spotlight source, to project patterns or add designs or interest onto the scene.

Composition and Design

Additive Colors - Photographers concern themselves with the color wheel for the RGB color space because Red, Green and Blue are the three **additive colors** of white light.

Secondary Colors

In an RGB color space, the secondary colors are Cyan, Magenta and Yellow. These colors are created when equal amounts of the neighboring colors are blended.

Cyan, magenta and yellow are the three **subtractive** colors used to create the primary colors of pigments used in the printing process.

Tertiary color - created by mixing either: one primary color with one secondary color, or one primary color with two secondary colors

Photographers also deal with **printing images**. Photographic processes that involve applying inks to paper do not achieve color by mixing light - they achieve color through mixing pigments or dyes.

Hues are made up of the twelve colors named on the color wheel. In a reflective light environment (RGB), they include the three primary colors (red, green, blue), the three secondary colors (cyan, magenta, yellow) and the six tertiary colors (orange, chartreuse, spring green, azure, violet, rose).

Tints are created by adding white to any hue on the color wheel.

Shades are created by adding black to any hue on the color wheel.

Tones are created by adding both black and white to any hue on the color wheel.

Saturation of Color - The relative brightness of the color.

Aspect Ratios - The proportional relationship of the height and width of an image.

Positive Space - The area that is occupied by the subject.

Negative Space - The area that is not occupied by the subject.

DIGITAL POST-PRODUCTION

Gamut - The range of colors that can be seen, captured or reproduced by any device.

RGB

The RGB color model uses additive color mixing of red, green and blue to produce color.

sRGB

“Standard RGB” is the most common color space for capture devices such as digital cameras, video cameras and computer monitors. The sRGB is the smallest of the RGB spaces. It is the primary color space for images viewed on the web.

Adobe RGB 1998

This color space was designed (by Adobe) to expand the gamut of colors achievable on CMYK printers, but by using only RGB primary colors. The Adobe RGB 1998 space is somewhat larger than the sRGB gamut.

Pro Photo RGB

The largest of the RGB color spaces providing the widest range of colors. Many of the colors in this space are not printable by some printers.

CMYK

This “subtractive” color space is used in printing images with inks and dyes onto paper. The process utilizes cyan, magenta, yellow and black to produce its color gamut. Its color space is even smaller than the RGB color spaces.

IMAGE CAPTURE, AND OUTPUT

Printing and Reproduction

Printing presses and most digital and inkjet printers use the CMYK color space to print an image onto the paper. Because photographers view images in an RGB environment on a computer screen, images will need to be converted to CMYK before the images are printed. This can be done by the photographer, but it may be best to leave this conversion to the printer since they are the most knowledgeable about their own printing process.

When images are printed on inkjet printers, the conversion from the RGB color space of the file takes place in the printers’ ICC profiles. These profiles translate the colors that are seen on the monitor and embedded into the file into a CMYK color space for printing.

PPI vs. DPI

Pixels per Inch (PPI) defines the resolution of a digital file and how it is viewed on a computer monitor. Images with higher pixels per inch provide better detail.

Where PPI describes the **digital resolution** of a file, DPI describes the **printed resolution** of an image.

Calibration is the process of setting up a monitor to ensuring you are seeing an accurate rendition of the colors within your images on your computer screen. This also helps to increase the likelihood that the images you receive from the lab will look like you anticipated.

The principle is that calibrated monitors should all render the exact same appearance of an image across all monitors. Quite simply, you want the lab to see an image on their monitor exactly the way you see it on your monitor.

Monitor calibration is a two-step process which includes calibration and profiling.

Monitor calibration is done by setting a monitor to a set of standards which have known values for settings such as:

- brightness · contrast
- white point · black point
- Gamma - how quickly shades change from black to white
- luminance - the amount of light emitted from the monitor

Monitor calibration should be done at least monthly to maintain accurate settings.

Profiling

Color Profiling is a process in which your monitor is set to translate the digital values in a file into a standardized set of colors. Because every monitor has its own characteristics in how it can display color from a numerical color value, a perfect translation of color from a file across all monitors is not possible. In profiling a monitor, a “Monitor Profile” is created and embedded into the digital file to enable a color-managed software, such as Photoshop and LightRoom, to make suitable translations of color of that file from one device to the next.

ICC Profiles

In the same way that monitors differ in translating the numerical value of color, so do printers. It is disappointing to see an image that appears beautifully on the computer screen look terrible as it comes off the printer. An ICC profile is used to standardize the values of color between a printer and a monitor so that the two closely match up.

Moiré

This nuisance of unwanted “false” patterns sometimes occurs during capture of clothing or even natural patterns. The “wavy” pattern seen in the bride’s veil at right is an example of **Moiré**. This can sometimes be corrected in post production, but can also be avoided with an anti-alias filter at the time of capture.

Chromatic Aberration

This distortion occurs because the lens design is unable to focus the wavelengths of all the colors to the same convergence point. Chromatic aberration manifests itself as "fringes" of color along the edges that separate dark and bright values of the image. Corrective measures to reduce chromatic aberration include using smaller lens openings rather than large lens openings. There are also adjustments that can be made to files that are captured in RAW mode and processed through RAW conversion software such as Adobe Camera RAW or Lightroom.

Barrel Distortion - A lens aberration or defect that causes straight lines to bow outward, away from the center of the image.

Interpolation – a process in which software increases a file size by adding pixels and estimates their tonal value based on surrounding pixels. This process allows a lab to print larger images from files that might otherwise be too small.

RAID Array - These systems utilize multiple hard drives which store the data on two separate hard drives simultaneously. This process is called, mirroring and provides added security of having data on two drives in the event one of them fails.