Taking Contol of Your Camera

CONTROLLING EXPOSURE

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Taking Control of Your Camera

Following the talk I gave in October prior to the practical lighting session, it became evident that many members use their cameras in auto mode and have not had the opportunity, or have struggled to get to grip with, the controls to unleash its creative potential. This talk is intended to be the first of three which I hope will explain some of the common controls which will help you migrate from auto mode – if that is what you want to do!

Although much of what I have to say is a repeat of what Chris Bell went through a couple of seasons ago I will make these notes available as a pdf document that members can download from the clubs website. I hope you find them useful.

Please be aware that I have, for the last 30 years, only used Canon cameras and I hope that that the majority of the terminology is transferable.

Taking Control of Your Camera

The advance in the capabilities of our cameras has been huge over the last decade and it is possible to take acceptable pictures using them in "point and shoot" or program mode. To my mind that defeats the object of spending your hard earned cash to purchase a good quality camera. If you, the photographer, are happy with that it is of course fine, however, a camera is a tool that can enable you to demonstrate your creative skills in your image making. In my mind to do that you need to be able to use the camera to its full potential. The object of these talks is to get you started down that creative road.

Taking Control of Your Camera

There are, in my opinion, three principal areas where you, the photographer, has crucial input into the image making process. These are, composition, focus and exposure control.

- Although the photographer is in complete control of the composition of the image, today's cameras have features that can be used to aid the photographer in this process.
- The camera provides the photographer with features such as focusing modes to achieve the required image sharpness. Whilst different camera types and manufacturers provide variations of these features there are some general rules to follow which can be used to aid the creative process.
- Most cameras can be left to judge the exposure in program mode. Getting the required exposure is, in my opinion, critical to the creative process and seems to be the area where most inexperienced photographers struggle, particularly with the terminology used.

Exposure Control: Exposure Simulation

This talk, the first of three, covers control of exposure.

A practical exercise in selecting camera settings to achieve an acceptable exposure using Canon's online simulator will be given at the end of the talk. I have uploaded the link to the simulator to the clubs Facebook page. If members are not on social media then the link to use to locate the simulator is as follows:

http://canonoutsideofauto.ca/play/

Exposure

The photographer can put the camera in "point and shoot" mode and leave the camera to select settings which will usually achieve an adequate exposure. Your camera may even have "scene" modes such as portrait, landscape, macro and sports which will bias settings to reflect the scene.

To take back creative control the photographer needs to get to grip with the steps involved in achieving the required exposure:

- Metering and metering modes – assessing the brightness of the scene.
- Selecting camera settings necessary in order to achieve the required exposure.
- How to check the exposure after image capture (shutter release).

First we need to acquaint ourselves with the camera settings and the relationship between them.

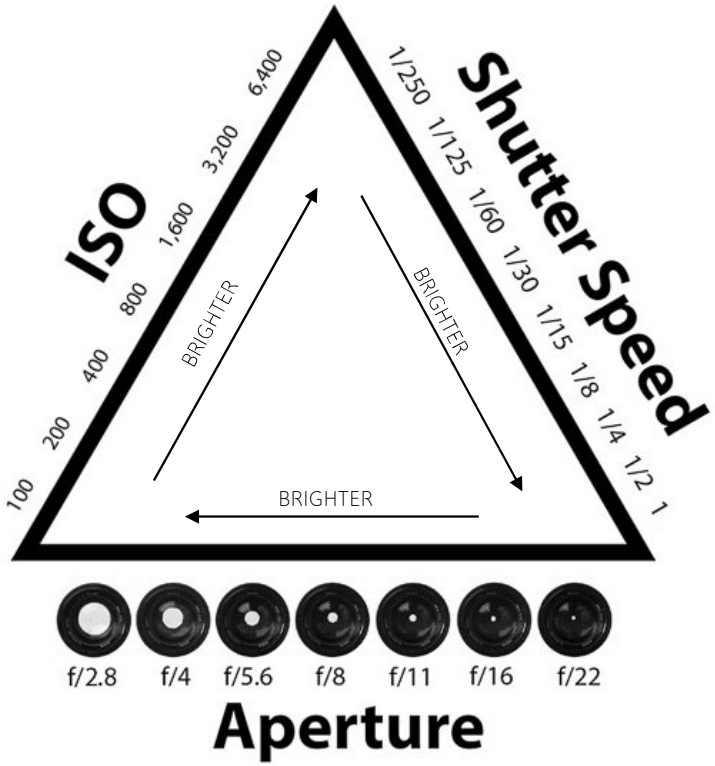
Exposure: Settings

Exposure control ensures that the right quantity of light reaches the camera's sensor to record the image you are making. In my opinion there is no "correct" exposure, only the exposure that the photographer is trying to achieve. There are three variables that control the exposure, these being:

1. ISO
2. Shutter speed
3. Aperture

For any particular scene there will be very many different combinations of these three variables that can be employed to achieve an acceptable exposure. There may however be constraints on one or more of the variables to achieve the image that the photographer requires.

Exposure: Exposure Triangle



The inter relationship between ISO, shutter speed and aperture in achieving the required exposure is represented by the exposure triangle.

The photographer has control over the selection of each of these variables in making the image.

Different genres of photography may put particular emphasis on one of these variables to achieve the required image.

We will now discuss ISO, shutter speed and aperture in detail and get to grips with the concept of exposure values, "EVs", or "stops" of light.

Exposure: Shutter Speed

The shutter speed is simply the time the shutter is open to let light reach the sensor when the image is recorded (when the shutter release is pressed). The longer the shutter is open, the slower the shutter speed, and the more time there will be for light to reach the sensor and the brighter the recorded image.

Shutter speed is given as a fraction, i.e. 1/125s or 1/30s. On your camera this will generally appear as 125 or 30, the larger the number indicating a faster shutter speed and therefore a shorter time the sensor will be exposed to the light passing through the lens.

In changing the shutter speed from 125 to 30 there will be 4 times the amount of light passing through the lens when the shutter release is pressed.

Exposure: ISO

ISO, to those of us familiar with film photography, represents the "speed" of the film being used. The higher the film speed (or ISO) meant that it was more light sensitive and required less exposure time to achieve the required exposure.

With digital cameras the ISO value is best thought of as amplification of the signal output by the sensor, a little like a volume control. Hence with a higher ISO setting the image recorded by the sensor is made brighter.

If two images are taken with the exact same shutter speed and aperture but the ISO is varied from say 100 to 400, the image recorded with ISO 400 will be 4 times brighter than the one taken at ISO 100.

At higher ISO values the images will be increasingly affected by "noise" which will make them look grainy.

Exposure: Aperture

Understanding aperture is probably the most complex aspect relating to the control of exposure despite it being a relatively simple concept. The aperture is the size (area) of the "opening" in the centre of the iris in the camera lens. The larger the aperture the more light that is let through to the sensor when the shutter is released.

The aperture is set by the f stop and will generally be in the range of f2.8 through to f22 on many lenses. Not all lenses will have an f stop as low as f2.8, many will start at between f3.5 and f5.6 while some are made with larger apertures of f1.4 or even f1.0.

The complexity here is that the larger the f stop the smaller the aperture. The f stop values are better defined as f/2.8 through f/22 as this gives a better clue as to what the values mean.

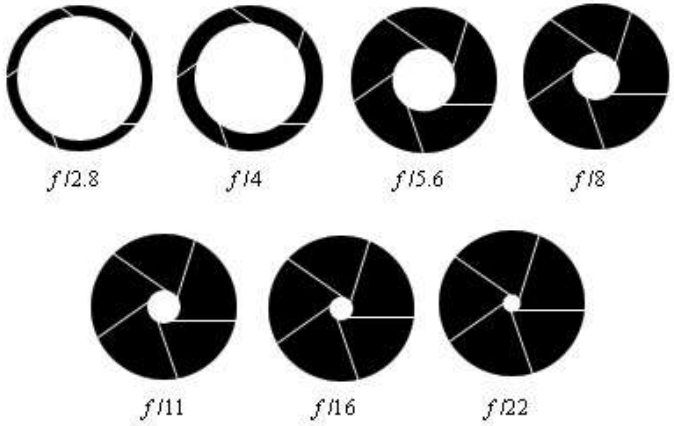
For any f stop the diameter of the aperture is the focal length of the lens divided by the selected f stop number.

Exposure: Aperture (continued)

Although the f stop defines the aperture diameter relative to the focal length of the lens, the size of the aperture is equal to the area of the opening in the iris and is therefore proportional to the square of its diameter (area of a circle = $\pi d^2/4$). Because of this, doubling the diameter of the opening in the iris (from say f/16 to f/8) will increase the aperture by a factor of 4 (and therefore pass 4 times the amount of light whilst the shutter is open).

To assist our understanding we can see this relationship in tabular format in the next slide.

Exposure: Aperture (continued)

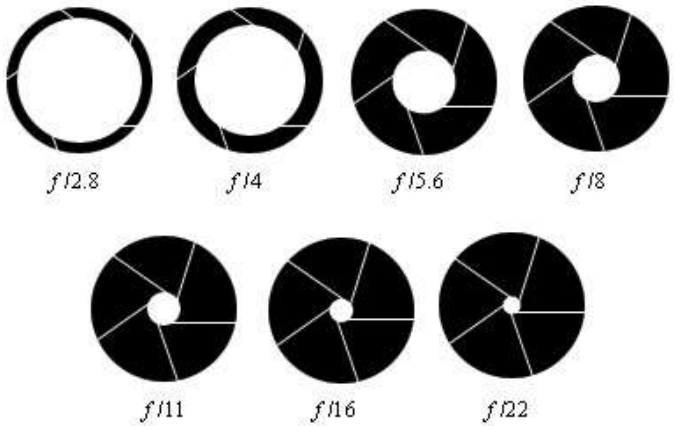


For a lens with a focal length of 100mm the aperture diameters are therefore the focal length divided by the f stop number:

f	Aperture Diameter (mm)	Aperture Area (mm^2)	Aperture Area Ratio f/f22
2.8	100/2.8=35.7	1001.8	64 (1001.8/16.2=61.8)
4.0	100/4=25.0	490.9	32 (490.9/16.2=30.30)
5.6	100/5.6=17.9	250.4	16 (250.4/16.2=15.46)
8	100/8=12.5	122.7	8 (122.7/16.2=7.57)
11	100/11=9.1	64.9	4 (64.9/16.2=4.01)
16	100/16=6.3	30.7	2 (30.7/16.2=1.89)
22	100/22=4.5	16.2	1

Exposure: Aperture (continued)

Going back to our diagram showing apertures and associated f stop values:



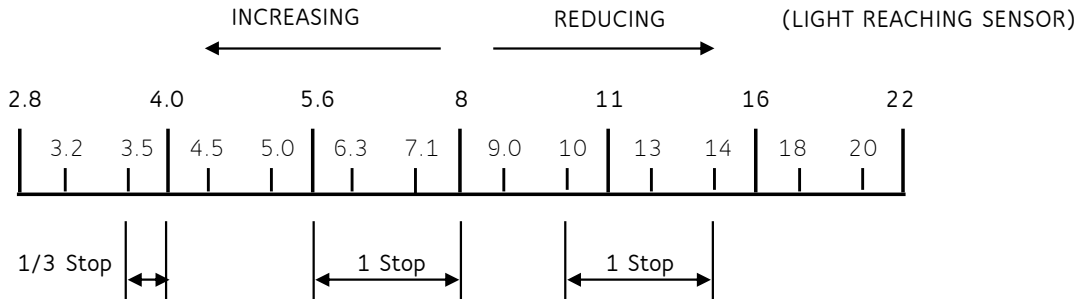
Each of these apertures is half the area of the previous one and will therefore let in half the light of the previous when the shutter is released.

You may hear photographers speaking about exposure in terms of "stops". A stop is simply the halving or doubling of the light reaching the sensor when the shutter is released.

With shutter speed and ISO remaining unchanged and the aperture set at f/5.6, to open up one stop will mean changing the aperture to f/4 and to close down one stop will require changing the aperture to f/8.

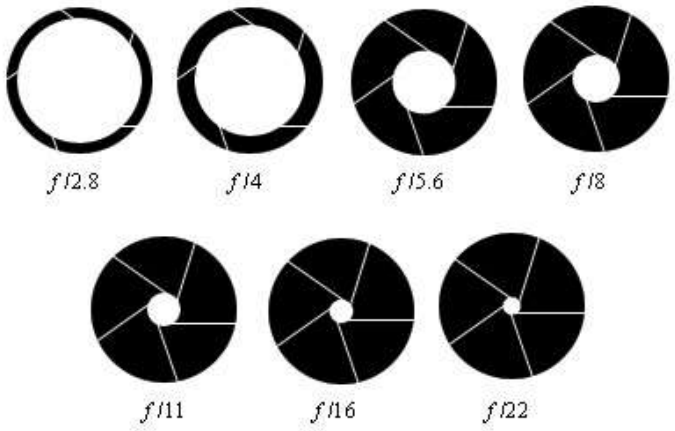
Exposure: Aperture (continued)

This diagram shows that lenses generally also have intermediate apertures for fine control of exposure. Most lenses will have intermediate apertures equal to one third of a stop.



Changing the aperture from f/5.6 to f/8.0 or from f/10 to f/14 will reduce the light reaching the sensor by half but changing it from f/4.0 to f/3.5 will increase the light by one third.

Exposure: Aperture (continued)



We have said that in going from f/2.8 to f/4 or from f/4 to f/5.6 or from f/16 to f/22 the light reaching the sensor is halved. In each case we have reduced the light reaching the sensor by 1 stop.

In reducing the aperture from f/2.8 to f/5.6, i.e. by 2 stops, the light reaching the sensor is reduced by a factor of 4.

In reducing the aperture from f/2.8 to f/22, i.e. by 6 stops, the right reaching the sensor is reduced by a factor of 64.

The reduction factor is 2 raised to the power of the number of stops.

Exposure: Stops

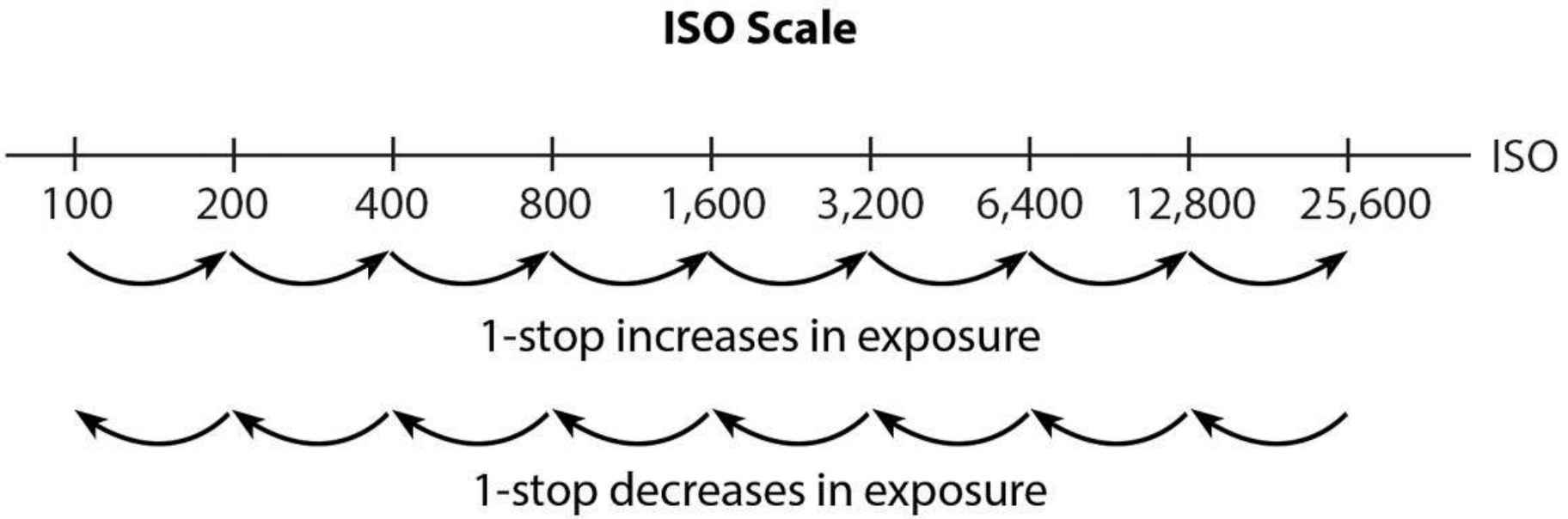
In discussing aperture we have introduced the concept of "stops" of light. Doubling or halving the light reaching the sensor is changing the exposure by a "stop". Whilst we can change the exposure by a stop by opening the aperture (from say f/8 to f/5.6) or closing it down (from say f/8 to f/11) we can also change the shutter speed or ISO to make the same change.

To increase the exposure by a stop we would reduce the shutter speed by a half from say 1/125s to 1/60s. To reduce the exposure by a stop we would change the shutter speed from 1/125s to 1/250s.

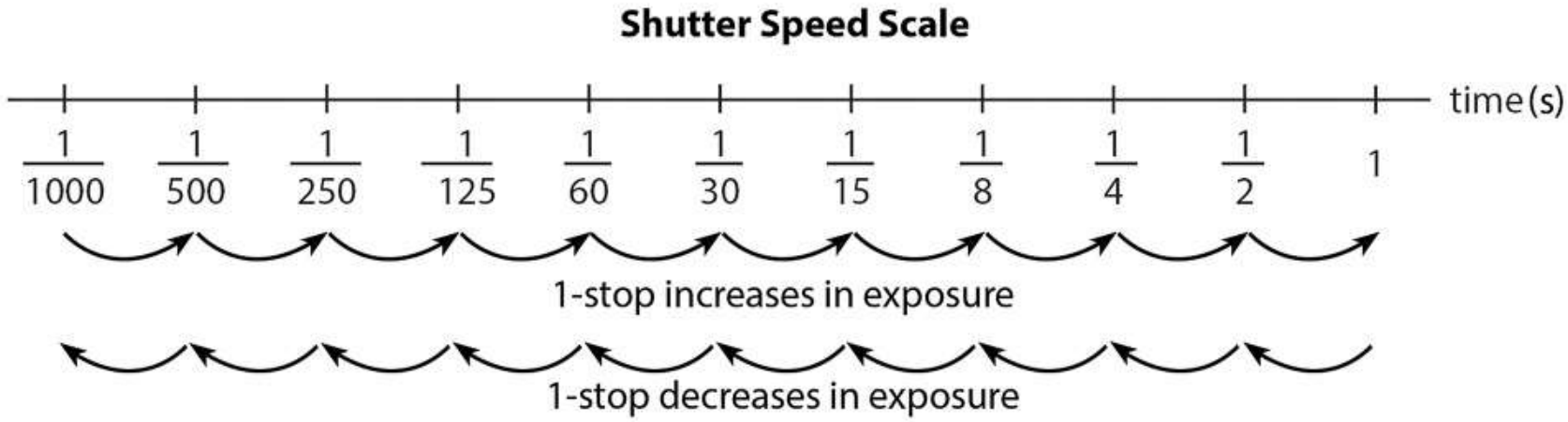
Similarly to increase the exposure by a stop we would change the ISO from 200 to 400 and to reduce the exposure by a stop change the ISO from 200 to 100.

In achieving the required exposure we can see that the aperture, shutter speed and ISO are therefore related as is indicated earlier in the exposure triangle!

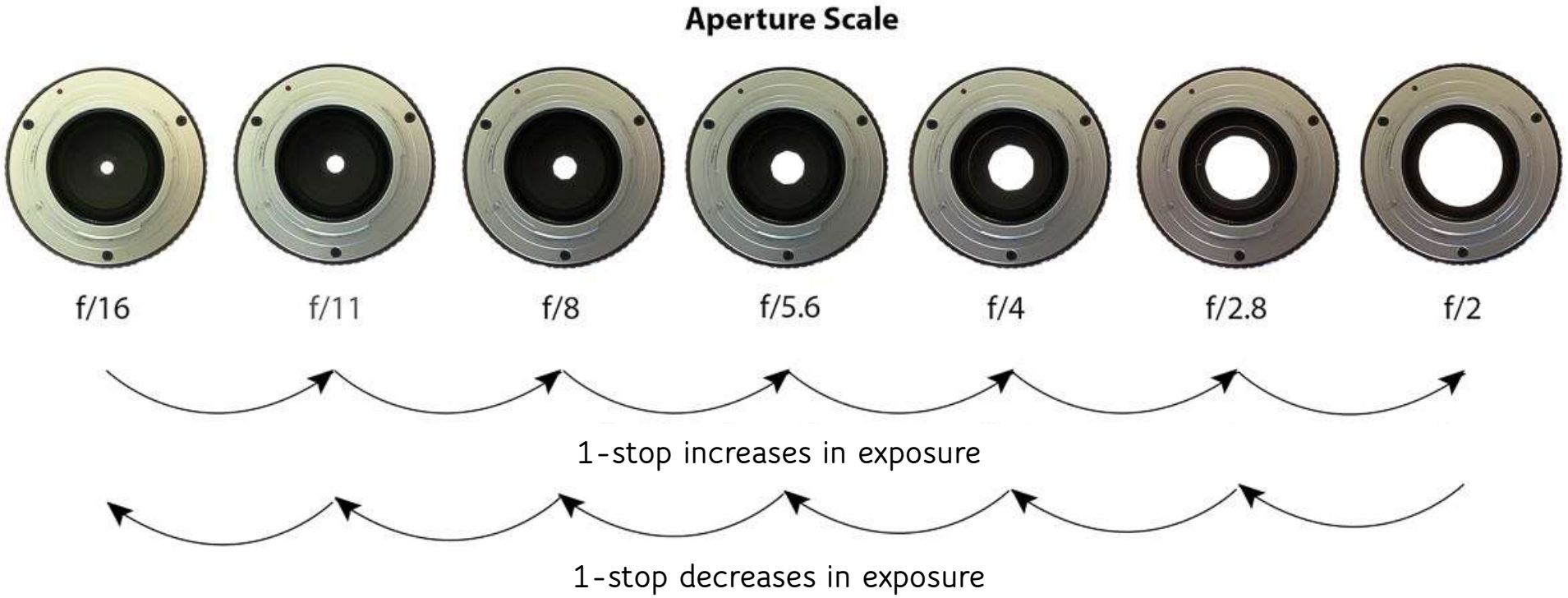
Exposure: ISO & Stops



Exposure: Shutter Speed & Stops



Exposure: Lens Aperture & Stops



Exposure: Metering the Required Exposure Value

Let us consider the process of taking our photograph and assume that we have total control over camera settings, equivalent to the camera being in manual mode, *M*.

The required camera settings will depend on how well the scene is lit, i.e. is it indoors or outside, is it in bright sunlight, in shade or is it at dusk or at sunrise? We therefore have to understand how the camera assists the photographer in deciding what settings to use.

When the shutter release is pressed half way down the camera meters or measures the brightness of the scene through the lens. In doing so it determines an Exposure Value (EV) for the scene in order that the photographer can determine the settings required.

The EV is influenced by the "metering mode" selected by the photographer based on the nature of the scene and the distribution of the brightness in the scene.

The camera does not tell the photographer the magnitude of the EV, we don't need to know it, but does indicate if the settings we choose will, when the shutter is released, enable enough light to reach the sensor to record the scene as it appears.

Exposure: Metering modes

The most common metering modes available to the photographer are:

- Matrix or evaluative metering – general purpose metering mode where the camera adjusts the exposure to suit the whole scene.
- Partial metering – metering based on a small area of the viewfinder at the centre – suitable for backlit subjects.
- Spot metering – metering based on a very small central area.
- Centre weighted metering- metering averaged for the whole scene with the viewfinder centre weighted more heavily.

Exposure: Metering

Once the brightness of the scene has been metered the photographer can ascertain if the camera settings that have been selected will achieve the required exposure. The EV meter will indicate the difference between metered exposure and that which would be achieved using the selected camera settings. This difference is given in EVs which are equal to a "stop" of light.

If the chosen settings would record an image as metered the EV meter will read 0, i.e. no difference between the metered and captured exposure. If the settings would provide an image that is under exposed it will give a -EV reading or a +EV reading if the image would be overexposed. While the meter usually operates over the range of up to +/- 3EVs or stops it will also indicate whether the image would be outside this range, i.e. brighter or darker by more than 3EVs or stops. We now need to adjust each of the camera settings in turn to ensure that the desired exposure is achieved. We will see how this is done using Canon's exposure simulator.

Exposure: Controlling the Exposure

Even though the EV meter told you the settings you selected should give an acceptable exposure, i.e. when the EV meter reading = 0, the distribution of light in the scene we are recording and the metering mode we have selected in camera do not always result in the exposure we wanted or expected.

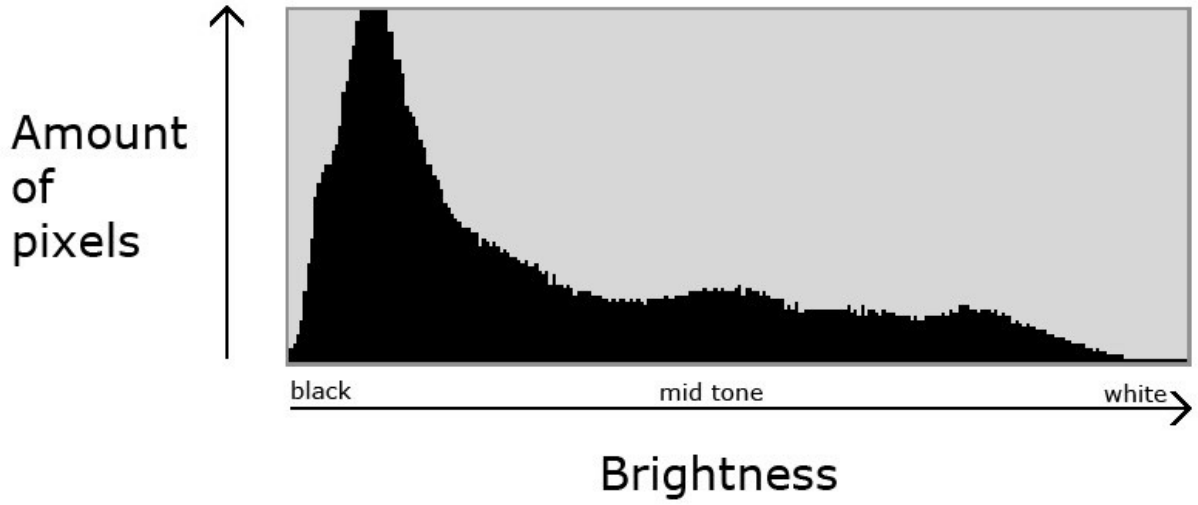
To check the exposure achieved is acceptable then always check the histogram for the recorded image. The histogram shows a graphical representation of the brightness recorded by each pixel and allows you to check that no data (details) have been lost as a consequence of the image being either under or over exposed.

It also allows the photographer to understand the tonal range in the image.

Some cameras will also allow the photographer to show areas of the image that are overexposed (highlights clipped) to blink when played back on the camera screen.

Exposure: Controlling the Exposure (continued)

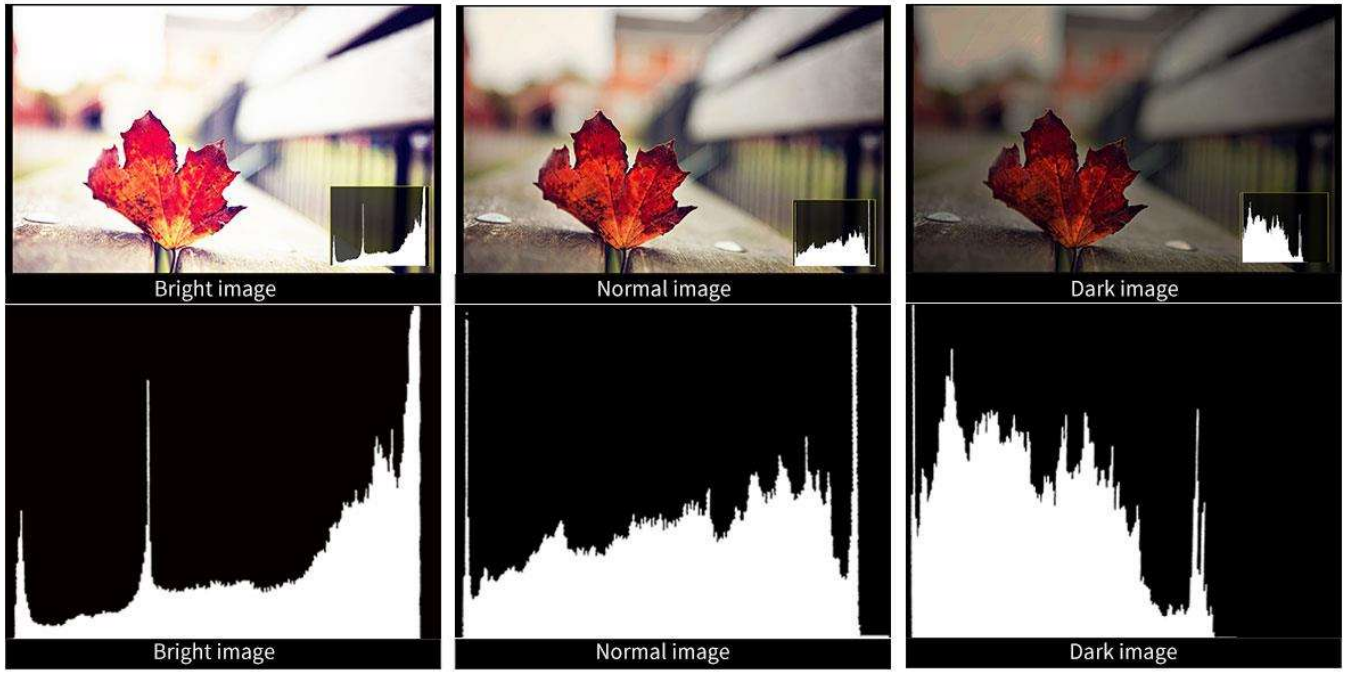
The histogram is simply a graph showing the distribution of the brightness (or luminance) recorded by each of the pixels in the sensor and indicates the tonal range in your image:



This histogram's horizontal axis shows the luminance (brightness) of the image from pure black on the left edge of the graph to pure white on the right edge. The vertical axis indicates the relative quantity of pixels recording the given level of luminance (brightness).

Exposure: Controlling the Exposure (continued)

Exposure: Controlling the Exposure (continued)



Exposure: Controlling the exposure (continued)

These example histograms indicate whether an image is correctly exposed (Normal), or either overexposed (details lost in the highlights – no ink on the paper if printed) or underexposed (detail lost in the shadows – pure black).

There is no such thing as a "correct" histogram but it is important that the photographer makes sure the recorded image is as they intended.

If the histogram indicates that an image is incorrectly exposed then the camera settings can usually be modified and the picture re-taken.

Please be aware that in some cases it may not be possible for the camera to adequately record all of the dynamic range of the scene, i.e. from the brightest highlights to the darkest shadows, due to limitations in the capability of the camera sensor. In these situations the photographer may have to resort to the use of neutral density filters to reduce the dynamic range of the scene or using multiple exposures to effectively increase the dynamic range of the camera.

Exposure: Controlling the Settings

Up until now we have just been considering the interdependence of the camera's different settings and using it in manual mode, M, where the photographer has control of all settings. Different genres of photography have different priorities. In some like landscape photography the depth of field is often of prime importance and for this reason the camera may be used in aperture priority mode, A or Av, in which the photographer sets the aperture and the camera then sets the shutter speed based on the selected ISO value.

In sports photography the shutter speed is the predominant variable and is selected to be fast enough to freeze the motion of the subject and the camera can generally be hand held. In this case it is the camera's shutter priority mode, S or Tv, that is often used. For the selected ISO value the aperture will be selected to achieve the required shutter speed. This can lead to a reduced depth of field as a large aperture may be required to achieve the required shutter speed.

Exposure: Controlling the Settings (Continued)

In aperture priority mode, A or Av, and shutter priority mode, S or Tv, the photographer can also use exposure compensation. Exposure compensation allows the photographer to impose correction on the selected shutter speed, in the case of A or Av mode , and aperture, in the case of S or Tv mode, to achieve a compensation to the metered exposure, usually by up to +/- 3EVs or stops. An exposure compensation of +1EV means that the exposure will be overexposed by 1 EV or stop relative to that which the exposure meter calculates is necessary.

Unfortunately, this cannot be demonstrated in the Canon exposure simulator.

Exposure: Exposure Simulator

The exposure simulator provided by Canon will now be used to demonstrate some of camera settings to control exposure.

This is the first of three talks aimed at helping members take control of their camera. Others talks will be delivered on composition and focusing at some convenient point in the future.