Photography I

Exposure Basics

When a person starts to really get serious about photography, they inevitably want to understand the use of the camera controls more fully. Besides lenses, filters and flash, which will be addressed in other sections, understanding how to use the exposure controls on the camera will be the most important aspect of photography one can seek to understand.

The Perfect Exposure

For any given roll of film, there is a perfect exposure. The film will require a specified amount of light to produce a good image. This will be determined by the speed of the film, listed as an ISO number, 100 / 21° for instance. Once this ISO number is set on the camera (some cameras set it automatically as soon as the film is placed in the camera), the metering system on the camera will help the photographer to determine this perfect exposure. Each camera is different, but we will attempt to demonstrate some of the more common configurations. Before doing this, however, we need to discuss the two basic controls on the camera used to *adjust* the exposure to that truly perfect one.

The Law of Reciprocity

In mathematics, there is a fundamental law, known as the Law of Reciprocity. Simply stated, if there is a mathematical relationship, if one side of an equation is changed, and the other side changed proportionally, the answer for this second equation will be the same as it was for the first. Here is an example:

1/4 x 4/1 = 1 1/2 x 2/1 = 1

The first equation was changed so that the one side of the equation (1/4) was doubled (to become 1/2, we are doubling a fraction). On the other side of the multiplication sign, the number was cut in half (from 4/1 or 4 to 2/1 or 2). The answer to both is still 1.

So how will this help us with camera exposures? Keep this law in mind as we move forward.

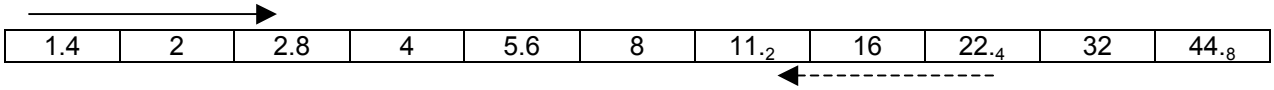
Intensity and Time

There is a mathematical equation for a photographic exposure, and it is fairly simple:

$$E = I \times T$$

or, Exposure equals light Intensity (I) multiplied by a period of Time (T). On a camera, there are two controls, one for light intensity (the aperture setting or the f-stop) and the other for time (the shutter speed). And each control has proportional adjustments that compliment the other. To start, we will discuss the aperture settings.

The camera aperture, also known as the *f-stop* controls the intensity of light coming through the lens. Each camera lens is slightly different, but some common f-stops you will find are as follows:

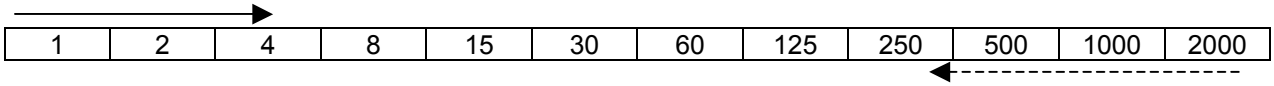


Those f-stops, which end in a decimal, after f-8, will be rounded to the closest whole number. So f-11.2 becomes f-11, 22.4 becomes 22 and 44.8 becomes 45. On most 35mm cameras, the maximum range of f-stops will generally be from 1.4 to 22. For cameras which use larger films, medium format and large format cameras, f-32 and f-45 will be common high f-stops but then the lowest f-stops will be around f-4 or f-5.6.

Each time a change is made in the f-stop, the light coming through the lens is changed. This change is very predictable. If the change is in the direction of the arrow with the solid line (f2.8 to 4, for instance),

each step will reduce the amount of light coming through the lens by ½. In other words, f-4 will let ½ the light through that f 2.8 let through. If the change is made in the direction of the dashed arrow, then each step doubles the amount of light coming through the lens. So when moving from f-11 to f-8, twice the amount of light will come through the lens at f-8 that came through the lens at f-11. Each time a one-step change is made, we say it is a one-stop change. Some lenses have steps in between these steps. These are ½ stop changes and can be used to fine-tune the exposure setting when necessary.

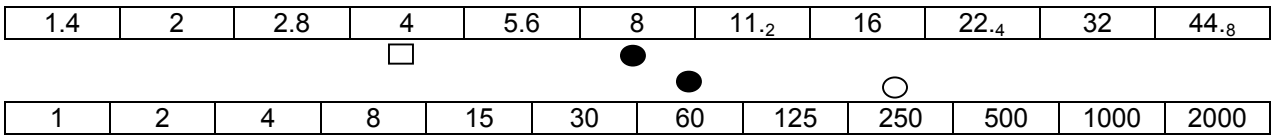
The adjustment for Time on the camera is the shutter speed. On 35mm cameras, most of these shutter speeds are in fractions of a second, so that what is labeled as "60" is actually 1/60th of a second. Common shutter speeds you will find on your camera should be:



Remember, each is a fraction of a second, so 2 is actually ½, 4 is actually ¼, and so on. As the shutter speed is adjusted in the direction of the solid arrow, the time is being reduced by ½. So for a change from ¼ (4) to 1/8 (8), the amount of light hitting the film at 1/8th of a second will be half the amount of light that hit the film at ¼ of a second. If the shutter speed is adjusted in the direction of the dashed arrow, the time is being doubled, so that the amount of light hitting the film at 1/60th of a second is double of that hitting the film at 1/125th of a second. When the two controls (f-stop and shutter speed) are combined, the relationship between the two becomes very useful.

In one-way or another, the light meter in the camera will give the photographer a starting exposure. How this is done will be addressed next. But for now, we'll say the camera indicated we should use 1/60th of a second at f-8. However, for the subject we are shooting, we do not want to use 1/60th of a second. If we are shooting a moving subject, a running horse for instance, a shutter speed of 1/250th of a second will probably be necessary. If we change the shutter speed from 1/60th to 1/250th, we need to compensate for the amount of light we *lost* in changing the shutter speed by adjusting the aperture setting. But how much do we adjust the aperture? This becomes very simple and it comes down to a counting game. Using the scales we did before, we will demonstrate the relationship.

Starting with the base exposure we had before (1/60th at f-8) we first shift the shutter speed to 1/250th:

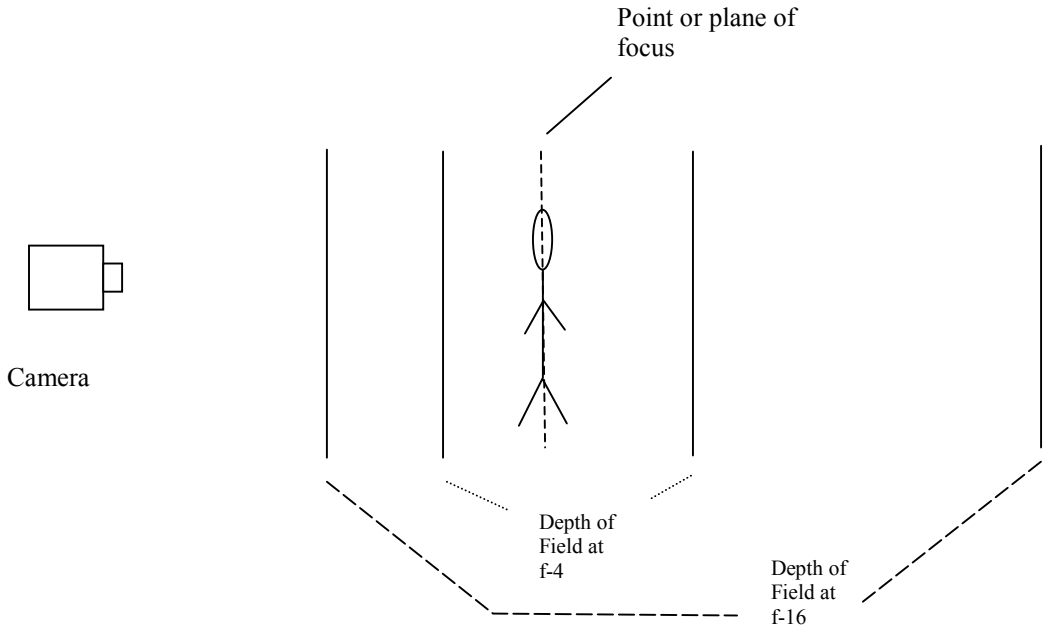


Counting the number of steps we changed, the shutter speed was changed by two steps, or two stops. To get back to a good exposure, the aperture needs to be adjusted in the opposite direction by two stops (represented by the box). Therefore, an exposure of 1/250th of a second at f-4 allows the same amount of light to hit the film that 1/60th of a second at f-8 did.

This first example was for changing the shutter speed for the given subject, but there are times when the photographer needs to change the aperture for a given subject. But the idea is the same. If three stops of light are lost by adjusting the aperture (moving from f-2/8 to f-8 for instance), then to get the light back for the perfect exposure, the shutter speed would need to be adjusted three steps (from 1/125th to 1/15th for instance). To understand why the aperture would need to be changed for a given subject, we need understand the concept of "Depth-of-Field".

Depth of Field

For a given aperture setting with a given lens, once the image has been focused in the camera, there will be a range within the image that will be in focus. For large aperture openings (the small aperture numbers, e.g, f2-8 or f-4) this range will be very small. For the small aperture openings (the large aperture numbers, e.g., f-11 or f-16), this range will be fairly wide. The actual area in focus will not be symmetrical. You will not have one half the range in front of the point of focus and one half behind. The relationship is more like 1/3 in front and 2/3 behind the point of focus. The diagram below illustrates this concept for Depth-of-Field at large and small apertures.

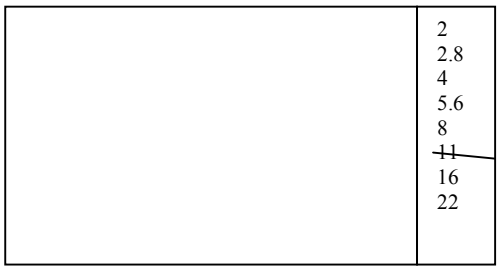


There are a number of reasons to choose the use of one f-stop over another, and it is always because of the need for more or less Depth-of-Field. If the elements of the photograph need to all be in focus, or at least most all in focus, then a high f-number (11, 16 or 22) needs to be used. This is referred to as "stopping down." On the other hand, if the image requires a shallow depth of field, where part of the image will be in focus and the rest not, then a "shallow" Depth-of-Field needs to be used. Why the photographer would want most or the entire image to remain in focus is fairly self-explanatory. But using a shallow Depth-of-Field may need some explanation.

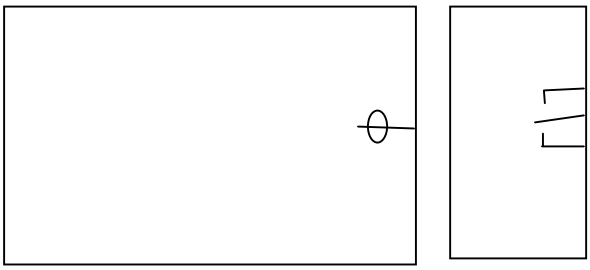
Many times the part of the image behind the actual subject is not pleasing. This area could be a distraction to the actual subject or has too much detail and the image will appear confusing. Knowing that this will occur takes some experience since the actual Depth-of-Field for a given lens opening cannot be determined when looking through the view finder of the camera when the image is being focused. However, when the photographer does not want the background in the image to be in focus, the use of a shallow Depth of Field will be very helpful in eliminating the objectionable detail of the background. As an example, when shooting a flower, it is nice to have the flower in sharp focus, but the background to blur into a soft tapestry of color. It allows the flower to stand out more in the image.

Determining the Base Exposure

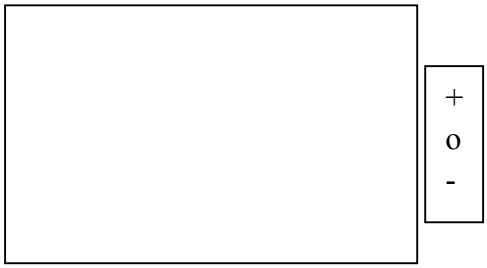
To determine the correct exposure for a given film is a fairly simple process. It will be different for each camera model, but some common examples are presented here. Refer to the diagrams below to see if your camera has a similar system. Otherwise refer to the instruction manual for your camera for more specific information. In all cases, as the aperture and shutter speed are adjusted, the camera will actually tell the photographer that the exposure is correct, or what setting to use to obtain a correct exposure.



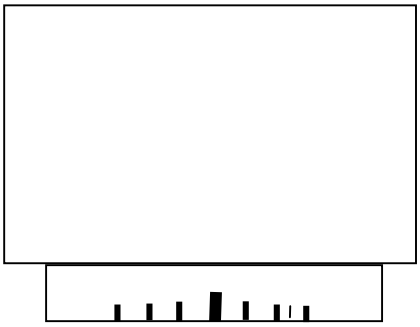
Use f 11 at the shutter speed already chosen. This system can also indicate which shutter speed needs to be used for a given aperture. A final option will be the use of a blinking number. The number that is blinking is the setting that should be used while the solid number usually indicates where the camera is currently set.



As the aperture and shutter speed are adjusted the pointer will move. When the pointer aligns with the circle, the exposure is correct. Instead of a circle, a frame may be used.



When the exposure is correct, the center "o" will light up. It may be green or red in color. If there is too much light or too little light, the "+" or "-" sign will appear. Adjust the camera to light the "o". If the camera has Auto focus, there may also be an additional light, which appears when the image is in focus. Do not confuse these two.



The camera will indicate were the exposure is set relative to the base exposure by the use of a moving pointer. This may be a separate line moving or the blocks being highlighted at the level where the camera is set. Adjust the camera to bring the indicator to the center point of the scale.

Most cameras require the metering system to be turned on before an indication of the exposure can be given. On some models this is a simple on/off switch while on others pushing down a little on the shutter release button will turn on the meter for a period of time. Additionally, each camera has different ways to adjust the shutter speed and aperture. Read the owners manual carefully to determine how this is done.

Whichever exposure system is used, or should a different one be used, the key is to find the base exposure. Once the base exposure is determined, the shutter speed and aperture can be adjusted to give the greatest creative control to the creation of the image. After reading this lesson, work with your camera by pointing at different subjects and finding the base exposure for each scene. Once that exposure is found, adjust the aperture and then the shutter speed to become the familiar with indicators on the camera. Once you have become familiar with each of these, you are well on the way to having total exposure control with your camera.

Film Speed Basics

Each film has been manufactured and tested to obtain a specified sensitivity to light. This is more commonly referred to as "film speed." The systems have changed over the years but have now become standardized. There were originally two separate systems, but with standardization they have actually incorporated both. The system used in the United States was first established by the American Standards Association. The film speed become known as the "ASA" of the film and some photographers still refer to this. In Europe they used a system established by the German standards borad, known as the Deuchland Industrial Norme or "DIN". The two msystems are very different but easily explained. The

current system was established by the International Standards Organization or “ISO”, and newer photographers will refer to the “ISO film speed”, though you will see that they are all incorported in the current system.

The film speed is indicated by a number. The American system will use plain numbers. The European system wil use a number followed by a degree sign (°). The numbers will be different but there is a relationship.

The American system uses a simple multiple system to indicate the doubling of the film speed. With this system, a film speed of 200 is twice as sensitive as a film speed as 100 and a 400 speed film is twice as sensitive as a 200 speed film. This system works nicely when we also consider what is happening with the f-stops and shutter speeds. Just as changing the f-stop or shutter speed one step, or one stop, will cut the light in half or double it, doubling the film speed will require a one stop change to the exposure, using the aperture or shutter speed. Film speeds of 25 to 3000 are currently available with 200 and 400 being the most commonly used.

The European system uses a different set of numbers. A film with an American film speed of 100 will have a European film speed of 21°. Doubling the film speed will now give a number of 24°. Doubling it again will result in a film speed of 27°. This does not seem logical unless you are told the relationship is from a logrythmic scale. This *is* the same relationship that occurs on the camera. Each one stop change in aperture or shutter speed is a logarythmic change, so the system still works very nicely for those who become familiar with it.

The ISO system simply combines the European and American systems. So a film with an American film speed of 100 will have an ISO film speed of 100 / 21°. A 200 speed film will have an ISO number of 200 / 24° and so on. So on your next trip to Europe(or the USA), buying film will be the easiest part of the culture shift!