

HOW TO GET ACCURATE EXPOSURES, AND WHY YOU SHOULDN'T ALWAYS TRUST YOUR CAMERA'S METER

*Adrian Stone, lecturer and judge for the East Anglian Federation of Photographic Societies, recently led a successful workshop for photographic beginners at **Pinchbeck Photographic Group**.*

In this article Adrian presents some of the themes introduced in the workshop regarding exposure and the relationships between ISO, aperture and shutter speed.

Try reading this article by dipping into it, a bit at a time. Some parts might make more sense after you've read other sections.

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The light meter in digital SLR cameras is a little less accurate than you might imagine. Its response in low and high light conditions may be less than at the mid-range of light. But the worst characteristic for practical purposes, is that all reflected light meters make one basic assumption. They are calibrated to make the subject look like a middle tone. For example, a black Labrador might look rather grey.

How do you compensate for the fact that your meter is lying? You have to lie to your meter. If you are photographing a light toned subject, such as snow or sand in bright light, you must convince your meter that it is looking at something even lighter than your subject, so that the meter's attempt to make it a middle tone will result in the correct exposure. The same is true for dark objects. You must tell your meter that the object is darker than it really is, so that the meter will produce the correct tone in the photograph.

Another way to get the right exposure from a lying meter is to politely ignore it. Switch from automatic to manual exposure and simply move to the next larger aperture or the next slower shutter speed (for a light object) or to the next smaller aperture or faster shutter speed (for a dark object).

This may have confused you. If that is the case, don't worry about it. The next section will introduce you to exposure values, ISOs, shutter speeds and apertures. It explains the interrelationships between these factors. After you've read the next section, revisit this section again, because the concept is important.

EXPOSURE VALUE, ISO SPEED, SHUTTER SPEEDS, AND APERTURES

Each of the four factors above is represented by a series of numbers.

1. Exposure Value

In most light meters, the photons of light that are reflected from your subject put pressure on a photo-sensitive receptor in your light meter and are converted into electricity. The greater the number of photons, the greater the electricity produced. Internationally accepted standards specify exactly how much light pressure equals a certain EV (exposure value) number. This value is measured by the following number series (for ISO 100 speed):

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21, 22, 23

Although this appears to be a linear progression, each number represents twice as much light as the preceding number. This provides an easily memorized scale to clarify the concept of "absolute value of the amount of light falling on a subject". If you are using a light meter this number is irrelevant, and you can ignore it. You may never see these numbers, because the meter uses them internally to calculate a set of combinations of shutter speeds and apertures.

In order to be useful, this *Exposure Value* number must be converted into an aperture and shutter speed combination that will produce the correct exposure for the ISO you have chosen.

(You may have found this a bit technical. Don't worry, press on and have a look at the next sections, they are probably easier for the beginner to understand, and more important too).

2. ISO Speed:

The ISO speed setting determines the image sensor's sensitivity to light. The sensitivity is measured by a set of standards established by the International Standards Organization (ISO), which is the same as the earlier ASA film standard. In general, the higher the setting the more "noise" is produced, the digital equivalent of the grainy appearance of photos taken with high speed film. The number series for the ISO speed settings are:

25, 50, 100, 200, 400, 800, 1600, 3200

When moving to the right, each number is twice as big as the preceding number, and it represents twice the sensitivity to light. There may be some intermediate steps (such as 64 or 125) on your dial.

So this leaves only two more things to adjust to get the correct exposure; shutter speed and aperture. Shutter speeds and apertures are very important to the appearance of your photograph.

3. Shutter Speed:

The shutter speed determines how long the camera shutter remains open to let light onto the camera's sensor. The number series for shutter speed is:

15, 8, 4, 2, 1, 2, 4, 8, 15, 30, 60, 125, 250, 500, 1000, 2000, 4000, 8000

This looks complicated, but it's actually straightforward. These numbers are whole seconds or fractions of seconds. They aren't expressed on your shutter speed dial or in your viewfinder as fractions to save space. They should read like this:

15, 8, 4, 2, 1, 1/2, 1/4, 1/8, 1/15, 1/30, 1/60, 1/125, 1/250, 1/500, 1/1000, 1/2000, 1/4000, 1/8000

Again, each number moving to the right is half the value of the preceding number, and represents half as much light as the preceding number. There is an important rule regarding shutter speeds:

If your shutter speed is slower than the reciprocal of the focal length of your lens, you need a tripod.

If you are using a 200 mm lens, your shutter speed must exceed 1/200 second (i.e. 1/250 or faster). If not, you should use a tripod. If your subject is moving, double this shutter speed. If you are moving quickly (as in a boat or plane), triple the shutter speed. If you are doing macro work (.25 magnification or greater), always use a tripod. A tripod will allow you to make photographs with slower ISO speed settings. Slower ISO speeds produce more detail and sharpness in your photographs. A tripod makes you slow down and examine your composition more carefully.

4. Aperture:

Aperture refers to the size of the opening inside the lens that the light must go through to reach the sensor. Aperture is measured in f/stops as indicated in this series:

1, 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32, 45

Like the shutter speed series, each progression represents half as much light (moving to the right) as the preceding number.

What you need to remember is that, within each factor, as you move from one number to the next, the amount of light is either doubled or halved. Some cameras may include numbers between the numbers mentioned above. Those numbers represent half or third stops. For the purpose of what you are learning here, ignore the in-between numbers. Have a look at this table and see what you can learn from it. Don't worry if it looks a bit obscure.

Table displaying equivalent aperture and shutter speeds

f-stops	1.4	2.0	2.8	4.0	5.6	8.0	11.0	16.0	22.0
Equivalent Shutter Speeds	250	125	60	30	15	8	4	2	1S
	500	250	125	60	30	15	8	4	2
	1,000	500	250	125	60	30	15	8	4
	2,000	1,000	500	250	125	60	30	15	8
	4,000	2,000	1,000	500	250	125	60	30	15
	8,000	4,000	2,000	1,000	500	250	125	60	30

This table is easier to understand than it looks. Let's take the top line. If a shutter speed of 1/250th of a second with an aperture of 1.4 is a correct exposure setting for the available light, then every other alternative combination on the top row will also give you a correct exposure. If the scene was lighter by 1 f/stop you could use any combination on the second row, and so on.

How does this work? Well the 'true' intervals¹ between the numbers on your ISO, aperture, and shutter speed scales are similar. Each step, on each scale is the same size. These intervals are called f/stops. So a balanced exposure, i. e. one which is neither too light nor too dark, can be altered without altering its level of brightness. Because if you increase the shutter speed by one stop, and decrease the ISO by one stop, your picture's lightness will not change. You can increase or decrease the ISO, the Shutter Speed or the ISO as long as you compensate by changing one of the other two factors by the same amount. If one change lets more light in, the other must let less light in, to remain balanced. It's a bit like a see saw. Two children weighing the same can balance the seesaw in a range of positions.

Example: 1/125 at f5.6 is equivalent to 1/60 at f 8.0

PUTTING THIS INTO PRACTICE: SWITCH YOUR CAMERA TO MANUAL!

Your digital SLR camera's meter is far more accurate than the built in meters 20 years ago. Modern digital SLR cameras have a choice of modes, including spot, centre-weighted and matrix. Spot metering is tricky. You need to select a very small area and the exposure will be entirely based on that small area. It's easy to get it wrong. Centre-weighted is more useful. It measures the light in all areas of the image, but gives places greater emphasis on the centre of the frame. This fits with family snapshots where the subject is in the centre. Matrix metering is a newer and an 'intelligent' development. The software in your camera compares your image with a massive database of images taken previously to find the most appropriate setting. Most photographers use this mode nearly all the time. However more

¹ As mentioned before, your camera will have some intermediate steps, for instance a shutter speed of 1/160 of a second. You can only use the actual f/stop based intervals on the ISO, shutter speed and aperture scales presented above to balance exposures accurately. You need to keep handy a copy of the 3 scales.

creative images, and those with extremes of contrast, back lighting and long exposures can be problematic. This is where an understanding of what your camera is actually doing is very helpful.

Digital SLRs set on automatic program mode will give the average photographer a better chance of getting properly exposed pictures while shooting average subjects in average light, and without a tripod to steady the camera. This works well for family pictures and many urban subjects. Automatic focus and exposure (especially TTL flash) are extremely useful for some specialized types of photography, such as sports or photojournalism.

Nature photography is a different matter. Many of your subjects will not have "average" tonality. Most of your subjects will not be located in "average" light. However, the most important reasons for putting your camera on manual while photographing natural subjects are:

- 1) There are times when you will want to stop motion, i.e. a flower in a breeze. Or you may want to exaggerate the effect of motion, such as when photographing flowing water. You need to decide how you want motion represented; this is controlled by varying the shutter speed. Faster shutter speeds stop action better than slower speeds (1/1000 second will stop most motion, while 1/8 second will blur even slow moving subjects).
- 2) Sometimes you will want everything in focus, such as a foreground flower AND a distant mountain. Sometimes you will want the flower to be in focus while keeping a busy background softly out of focus. When you make this type of decision, you are considering DEPTH OF FIELD (the distance in front and behind of the subject that is acceptably in focus). The aperture controls the depth of the image that is acceptably in focus (f/32 keeps more of the subject in focus than f/2).

EXPOSURE CHARTS

Take a look at Exposure Value Chart A overleaf. The left column of the chart contains the Exposure Value (EV) numbers. The right column of the chart contains some lighting situations that equate to EV numbers. The chart ranges from EV -6 to EV 23. This represents a range of light from below reflected starlight to the brightness of the sun.

Notice that most day lit subjects fall within a narrow range from EV 11 to EV 15. It is a good idea to memorize the characteristics of these daylight Exposure Value factors. Pick a favourite lighting situation, note the EV and turn to Chart B.

Exposure Value Chart A

<u>EV</u>	<u>TYPE OF LIGHTING SITUATION</u>
-6	Night, away from city lights, subject under starlight only.
-5	Night, away from city lights, subject under crescent moon.
-4	Night, away from city lights, subject under half moon. Meteors (during showers, with time exposure).
-3	Night, away from city lights, subject under full moon.
-2	Night, away from city lights, snows cape under full moon.
-1	Subjects lit by dim ambient artificial light.
0	Subjects lit by dim ambient artificial light.
1	Distant view of lighted skyline.
2	Lightning (with time exposure). Total eclipse of moon.
3	Fireworks (with time exposure).
4	Candle lit close-ups. Christmas lights, floodlit buildings, fountains, and monuments. Subjects under bright street lamps.
5	Night home interiors, average light. School or church auditoriums. Subjects lit by campfires or bonfires.
6	Brightly lit home interiors at night. Fairs, amusement parks.
7	Bottom of rainforest canopy. Brightly lighted night-time streets. Indoor sports. Stage shows, circuses.
8	Las Vegas or Times Square at night. Store windows. Campfires, bonfires, burning buildings. Ice shows, football, baseball etc. at night. Interiors with bright florescent lights.
9	Landscapes, city skylines 10 minutes after sunset. Neon lights, spotlighted subjects.
10	Landscapes and skylines immediately after sunset. Crescent moon (long lens).
11	Sunsets. Subjects in open shade.
12	Half moon (long lens). Subject in heavy overcast.
13	Gibbous moon (long lens). Subjects in cloudy-bright light (no shadows).
14	Full moon (long lens). Subjects in weak, hazy sun.
15	Subjects in bright or hazy sun (Sunny f/16 rule).
16	Subjects in bright daylight on sand or snow.

Chart B shows how Exposure Value, ISO speed, aperture and shutter speed are related.

On the left side of this chart, along the top row, are the ISO speed numbers. Pick the ISO speed you use most often. Starting with that speed, move down the column until you reach the EV number that you chose from Chart A. Now move to the right along the row until you cross the double line. To the right of the double line is a row of shutter speeds. As I mentioned, a fast shutter speed stops motion, while a slow shutter speed enhances the effect of motion. Choose an appropriate shutter speed for your subject. Now, move straight up the column to the top row to find the aperture (f/stop) for use with the shutter speed. Enter your chosen shutter speed on your camera and set your lens to your chosen f/stop. It's easy.

Exposure Value Chart B

	<u>ISO SPEED</u>								<u>APERTURE OF LENS (f/STOP)</u>										
	ISO 25	ISO 50	ISO 100	ISO 200	ISO 400	ISO 800	ISO 1600	ISO 3200	f/1.4	f/2.0	f/2.8	f/4	f/5.6	f/8	f/11	f/16	f/22		f/32
E	1	0	-1	-2	-3	-4	-5	-6	4 sec	8 sec	15 sec	30 sec	1 min	2 min	4 min	8 min	16 min	32 min	S
V	2	1	0	-1	-2	-3	-4	-5	2 sec	4 sec	8 sec	15 sec	30 sec	1 min	2 min	4 min	8 min	16 min	H
	3	2	1	0	-1	-2	-3	-4	1 sec	2 sec	4 sec	8 sec	15 sec	30 sec	1 min	2 min	4 min	8 min	U
N	4	3	2	1	0	-1	-2	-3	1/2 sec	1 sec	2 sec	4 sec	8 sec	15 sec	30 sec	1 min	2 min	4 min	T
U	5	4	3	2	1	0	-1	-2	1/4 sec	1/2 sec	1 sec	2 sec	4 sec	8 sec	15 sec	30 sec	1 min	2 min	T
M	6	5	4	3	2	1	0	-1	1/8 sec	1/4 sec	1/2 sec	1 sec	2 sec	4 sec	8 sec	15 sec	30 sec	1 min	E
B	7	6	5	4	3	2	1	0	1/15 sec	1/8 sec	1/4 sec	1/2 sec	1 sec	2 sec	4 sec	8 sec	15 sec	30 sec	R
E	8	7	6	5	4	3	2	1	1/30 sec	1/15 sec	1/8 sec	1/4 sec	1/2 sec	1 sec	2 sec	4 sec	8 sec	15 sec	
R	9	8	7	6	5	4	3	2	1/60 sec	1/30 sec	1/15 sec	1/8 sec	1/4 sec	1/2 sec	1 sec	2 sec	4 sec	8 sec	S
S	10	9	8	7	6	5	4	3	1/125 sec	1/60 sec	1/30 sec	1/15 sec	1/8 sec	1/4 sec	1/2 sec	1 sec	2 sec	4 sec	P
	11	10	9	8	7	6	5	4	1/250 sec	1/125 sec	1/60 sec	1/30 sec	1/15 sec	1/8 sec	1/4 sec	1/2 sec	1 sec	2 sec	E
	12	11	10	9	8	7	6	5	1/500 sec	1/250 sec	1/125 sec	1/60 sec	1/30 sec	1/15 sec	1/8 sec	1/4 sec	1/2 sec	1 sec	E
	13	12	11	10	9	8	7	6	1/1000 sec	1/500 sec	1/250 sec	1/125 sec	1/60 sec	1/30 sec	1/15 sec	1/8 sec	1/4 sec	1/2 sec	D
	14	13	12	11	10	9	8	7	1/2000 sec	1/1000 sec	1/500 sec	1/250 sec	1/125 sec	1/60 sec	1/30 sec	1/15 sec	1/8 sec	1/4 sec	S
	15	14	13	12	11	10	9	8	1/4000 sec	1/2000 sec	1/1000 sec	1/500 sec	1/250 sec	1/125 sec	1/60 sec	1/30 sec	1/15 sec	1/8 sec	
	16	15	14	13	12	11	10	9	1/8000 sec	1/4000 sec	1/2000 sec	1/1000 sec	1/500 sec	1/250 sec	1/125 sec	1/60 sec	1/30 sec	1/15 sec	

GUIDELINES AND TECHNIQUES

Using your Camera in Manual Mode: Set the ISO first by considering the amount of light available. This won't change much if you continue shooting in the same location. Too high an ISO and you risk the image becoming 'grainy', too low and you won't have the full range of effects you can get by using high shutter speeds and small apertures. Then decide whether your shutter speed or your aperture is more important to you in achieving your desired image. For instance, if the shutter speed is more important then set that first, then change the aperture to achieve a balanced exposure, and vice versa.

Sunny f/16 Anchor Point: On a bright day (EV 15) the correct exposure for any subject is f/16 at a shutter speed nearest to the reciprocal of the ISO, i.e. if the ISO is 100, then choose a shutter speed of 1/125, etc.

Doubling Rule: Within any exposure factor (Exposure Value, ISO speed, aperture, shutter speed) each step is double (or half of) the preceding step.

Camera Shake Rules: If your shutter speed is slower than the reciprocal of the focal length of your lens (i.e. slower than 1/200 sec. with a 200 mm lens), you need to increase your ISO to prevent camera shake. Alternatively you can use a tripod. If your subject is moving, double this shutter speed, (i.e. a minimum of 1/400 sec. with a 200mm lens). If you are moving (such as in a boat or plane) triple the shutter speed. If you are doing macro work (.25 magnification or greater), or photographing with a format larger than 35mm, use a tripod. Don't be fooled by a zoom lens. When using an 80mm-200mm zoom lens, ignore the 80mm figure even if you are using it at the 80mm setting. Your calculation for avoiding camera shake will always be based on the largest focal length of the lens.

ISO Speed Settings: As you increase the ISO speed, problems with noise and a lack of sharpness will increase. It is worthwhile setting your camera on a tripod and taking some test images of a sheet of newspaper print on a door. Have a look at the sharpness and noise at the extreme ISO settings to determine what you think would be acceptable. This will vary with different lenses. Photo manipulation software (e.g. Photoshop) will allow you to reduce the grainy effect, but your image will appear softer. Find a midway point between acceptable levels of noise and a reasonably crisp image.

Apparent Subject Motion: Increasing the shutter speed will reduce the sense of motion. Decreasing the shutter speed will increase the sense of motion. Panning your camera will help you to keep your moving subject sharp and your background blurred.

Depth of Field (i.e. the distance in front and behind the subject that is acceptably in focus): Increasing the aperture (a lower f/stop number) will decrease the depth of field. Decreasing the aperture (higher f/stop #) will increase the depth of field.

Bracketing: Sometimes it makes sense to hedge your bets on your exposure, for instance in tricky lighting situations. In these circumstances taking multiple shots using slightly different exposure settings gives you more chance of getting it right. A typical approach might be taking one shot as your meter suggests, the second shot at minus one f/stop, and the third shot plus one f/stop. You can do this manually. Your camera may also have a facility for automating this process. Have a look. You may be thinking it's not worth worrying about because you can alter the apparent exposure on your computer. This is true, but alterations like this will reduce the number of pixels in your image, and if overused it can degrade the quality of your photograph.

Hyperfocal Distance. This technique is used to ensure as much of your image as possible is in focus when you can't use a small aperture. View your image in the viewfinder as a 2 dimensional, upright picture. Then focus your lens 1/3rd up from the bottom of the image.

TRICKY LIGHT SITUATIONS

Front Lighting: Follow the directions given in this document.

Side Lighting: Expose for front lighting, as described. Bracket in ½ stop increments to 1 ½ stops overexposed. No need to bracket on the underexposure side. Or use a reflecting surface to bounce light into the shadows. With a light subject your first exposure of your bracketing sequence should be your best. With a darker subject your last exposure should be correct. Try the fill in flash feature of your camera's built in flash unit if it has one. Used with care it can significantly enhance your image by balancing the light levels.

Back Lighting: Where possible, shoot your subject in front of a dark background. Use EV 12 as your starting point (there are 3 stops difference between sun and shade) and bracket in ½ stop increments 1 ½ stops to the underexposure side (no need to bracket to the over exposure side -- EV12 takes care of it for you). A good option is to shoot a silhouette, or use fill in flash (see above). This lighting situation occurs with backlit fog on a lake with fishermen in a boat. In this case, start with EV 15 and bracket in ½ stop increments to 3 stops on the under exposure side. Your backlit photography will be better if you use a long lens with a lens shade. Make sure your lens is scrupulously clean. If you are shooting people increase your exposure by ½ to 1 stop.

The Ultimate Backlight -- Sunrises & Sunsets: When the sun is in your shot, go for silhouettes. Begin with EV 15 and bracket in full stops to four stops under.

Night Shots: Many successful 'night' shots are taken at dusk, when the remaining light in the sky offsets the impact of artificial light (if present). Successful night shots can be taken under a full moon when the moon is at least 45 degrees above the horizon (90 degrees is overhead). Choose a clear night and try F4 on a 200mm lens set for 30 seconds. You can use a slower shutter speed but your image will start to blur the stars, due to the earth's rotation. Very long exposures produce star trails, bright lines in the sky. An ideal lens would be 28mm. It captures a lot of the sky without distortion at the edges of your image. As with all wide angle shots, make sure you have a strong feature somewhere in the foreground.

Shoot the Moon With a Long Lens: Use EV14. Bracket in ½ stop increments to 1 stop over and 1 stop under.

Shooting in Woods or Where There Are A Lot of Shadows: Shoot when the sky is overcast at EV12 or 13.

Fast Moving Subjects -- Sports, Etc.: Pick a vantage point that lets you shoot with front light, if possible. Utilize a dark background if available. Use a telephoto lens and a tripod if you can. Use Chart B to select an ISO that will allow you to use a shutter speed twice the reciprocal of your focal length (i.e. a 300mm lens at 1/500 sec). Alternatively, if you want a sharp subject and a blurred background, pan your camera.

Shooting from an Airplane or Boat: Use Chart B to find a film speed that will let you shoot at 3 times the reciprocal of the focal length (i.e. 1/1000 sec for a 300mm lens).