

Controls that affect exposure

We will spend a lot of time learning about three underlying controls on your camera, each of which both effects how bright or dark your images are. In addition, each of these controls has other effects on the images you make. Quite a bit of the technology in your camera is dedicated to the job of giving you different ways to set these three controls with some degree of automation, but before we get to that automation, we need to understand the underlying concepts of **shutter speed**, **aperture** and **ISO**.

Many, perhaps even most, practiced photographers set ISO intentionally, and then also specify either a shutter speed or an aperture but not both, and then hand off the problem of determining a good value for the third parameter to the camera, with the assumption that the camera will try and adjust it so that the result isn't too light or too dark. We'll talk about this strategy more soon, but it strikes a nice balance between the limitations of setting all three independently ("manual mode") and leaving every decision to the camera ("automatic", "program", or "green zone.")

Control	What it does	Primary effects	Side effects
Shutter speed	Determines how long the camera opens the shutter allowing light to fall into the sensor.	Longer periods of time result (all other things being equal) in a brighter image.	Longer shutter speeds may result in blur , from the camera moving, the subject moving, or both.
Aperture / f-stop	Determines how big an opening, within a lens, light is allowed through when the shutter is open. Small numbers (like f/4) are big openings, Large numbers (like f/16) are small openings. Yes, this is confusing.	Smaller openings result (all other things being equal) in a darker image, wider ones a brighter image.	Smaller openings result (all other things being equal) in more depth-of-field , wider openings result in less depth of field. (Depth of field is also affected a lot by focal length.)
ISO	Determines how sensitive the image sensor is set to be.	Larger numbers result (all things being equal) in a brighter image, smaller ones in a darker image.	Beyond a certain point, which depends on your camera sensor, higher ISO values will result in more noise (the digital equivalent of film grain) in your image.

Notes: How fast a shutter speed you need to avoid **camera shake** depends mostly on your focal length, a telephoto lens will show shake more easily, and you will need a proportionately faster shutter speed to handle it. A good rule of thumb is "1 over the focal length", which sounds suspiciously like math, but is pretty easy. If you are using a 100mm lens, you want 1/100 second or faster, if you are using a 25mm lens, you may be able to get a sharp handheld image at 1/25.

Depth of field describes to what extent that objects closer than and further than the object you actually focused on are also in acceptable focus. A narrower aperture (a higher f-number) gives you more of this “depth in focus”. How much you get, however, also depends a lot on the focal length of your lens. It is very hard or impossible to get very selective focus out of a wide-angle lens, and it is similarly very hard or even impossible to get a very deep depth-of-field out of a telephoto lens.

You can often find many ways to get the same brightness (“equivalent exposures”) in an image, increasing the brightness from one setting and making an offsetting change to another setting. The images will still differ, however, in depth-of-field, any shutter-speed related blur, and noise.

Understanding Shutter Speed

What is a shutter, and what is “shutter speed”? The shutter in your camera is a mechanical device that blocks light from getting to the camera’s sensor from the outside world. Most of the time, that shutter is closed. When you tell your camera to make an image, it opens the shutter for a period of time, that amount of time is the “shutter speed”, and you will want to learn how to control the shutter speed of your camera in order to make great images.

How does shutter speed affect my images? The simplest answer is that the longer the shutter is open, the brighter your image is, *all other things being equal*. If you want to use a longer and longer shutter speed without making your image brighter, you will have to compensate for this by adjusting other settings (such as aperture, ISO), or by somehow changing the scene lighting.

While the shutter is open, light will come into the camera through the lens, be focused onto the camera’s sensor or film, and an image will be made. If the image changes while the shutter is open, for example, if an object is substantially moving in the scene, you will see that object blur in the resulting photograph. We often refer to this as “motion blur.”

You can get blur from camera motion as well, because, as is the case with “motion blur”, the image coming through the lens may be changing substantially during the period of time the shutter open. To combat this, you either need to make sure your camera is perfectly still (perhaps using a tripod), or you will need a “fast enough” shutter speed to make sure that the image isn’t changing substantially during the time the shutter is open.

Of course, you may wish to embrace camera motion and the blur that comes with it as a creative alternative.

How does my camera display shutter speed? Many (most?) cameras use a slightly odd way of expressing the time the shutter is open. A single number, such as 10, doesn’t refer to ten seconds, but instead refers to 1/10 of a second. 100 refers to 1/100 of a second, and so on.

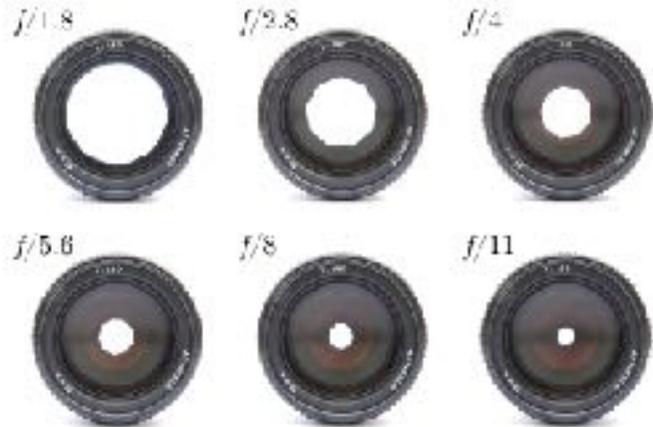
For whole seconds, the camera will usually display a pair of tick marks after the number. 10 seconds would look like 10”, rather than 10.

What sorts of shutter speeds can I use? Most SLRs directly provide a range from as much as 30 seconds to as little as 1/4000 or 1/8000 of a second.

Understanding Aperture

What is an aperture, and what is an aperture setting or f/stop? Your lens contains a mechanical device that contains an iris, similar to those in the diagram below. Your camera is capable of setting this iris to allow a larger or smaller hole (or aperture). The terms “aperture setting” or “f/stop” refer to a measure of how big that hole is. Bigger numbers represent smaller holes.

How does an aperture setting affect my images? In part, the wider the iris is open, the brighter your image is, *all other things being equal*. If you want to use a different aperture without making your image brighter or darker, you will need to adjust other settings, such as ISO or shutter speed, in order to create an equally bright image.



However, the other effect is perhaps even more important. Aperture settings control what we call “depth of field”. Depth of field refers to how much of a scene can be in focus at any one time. A broad landscape image in which everything from the near foreground to the distant horizon is in focus is said to have a deep “depth of field.” A simple portrait head shot with the eyes and head in focus but the background in soft blur is said to have a shallow “depth of field.”

All other things being equal, a wider aperture (a bigger hole in the iris) creates a shallower depth of field, a narrower aperture (a small hole in the iris) creates a wider depth of field.

How does my camera display f/stop settings? Generally with a small number in the range between 1.0 and 32, and will just show that number. Larger numbers refer to smaller holes, smaller numbers refer to larger holes in the iris. This is generally considered a bit confusing.

In writing, we usually write the number with *f/* before it. For example, *f/2.8*.

Camera lenses vary in what range of apertures they can provide. Usually the lens is named in part by the widest aperture (smallest f-number) the lens can provide. The smallest aperture (largest f-number) is usually either 22 or 32. For example, my 24-70/2.8 lens can provide f-stops anywhere from *f/2.8* to *f/22*, the *f/2.8* at the end of the designation refers to the fact that the widest aperture the lens can create is *f/2.8*.

Understanding ISO

What is my camera's ISO? ISO refers to the sensitivity of the sensor in your camera to light. The larger the number, the less light the sensor requires to create an equally bright image, *all other things being equal*.

These numbers are equivalent to what we call **film speed**, or ASA, when talking about film. So "Kodak 100" would have had a film speed of 100, and would be as sensitive to light as a digital camera sensor of ISO 100.

Your camera will also have an "**auto ISO**" mode, which attempts, based on some guesswork, an ISO that will work well for your image. This setting can work very well for candid snapshots, but you may want to exercise more control over ISO for images you intend to eventually print, and particularly those you intend to print at a large scale.

How does the ISO setting affect my image? First, as I noted above, the higher the ISO setting, the brighter the image will be, *all other things being equal*.

However, there is another effect to be aware of. For larger ISO values, where the camera is trying to make an image with less and less light, you'll start to see "noise" in your image. It's not a bad approximation to think of this noise as digital film grain. How big an effect this is depends a great deal on your specific camera, and of course, how much of a problem noise is may depend a great deal on whether you plan to use the image for a thumbnail image on the web, or a poster-sized print for your wall. Still, you may need to look VERY carefully to see much of a difference between ISOs of (say) 100, 200, 400, and 800, and in fact, you may not see any difference that you care about, depending on how you plan to use the image.

Differences may only become detectable at higher numbers.

Experimenting with your camera's higher ISOs is an important part of learning how to get the most out of your camera in difficult lighting situations. The more you can increase your ISO and get a great result, the more flexibility you will have to make photographs in low light.

How does my camera display ISO settings? Usually as a number, starting with 100 and including larger values. 100, 200, 400, 800, 1600, 3200 and 6400 are common settings, your camera may include a slightly wider or narrower range of ISO values than this, and will very probably include intermediate values as well.