

Day 6: Use Shutter Speed to Keep Your Photos Sharp

Shutter speed is perhaps the most important exposure control for two reasons:

1. It has the greatest range: Most cameras have a range of about 17 stops for the shutter speed in Manual mode (even more if you consider that you can go longer in Bulb mode). Compare that to typical ranges of around 8 stops for ISO and Aperture.
2. It has a huge impact on photos: You can apply a whole range of effects related to sharpness and blur to your photos.

In today's lesson we are going to focus on the sharpness aspect of shutter speed. First, let's cover the basics of this exposure control:

- **Measurement:** Shutter speed is a measure of the *time* that the camera takes to expose the picture. Faster shutter speeds are measured in tiny fractions of a second, while slower shutter speeds are longer, and are sometimes measured in whole seconds.
- **Range:** In Manual mode, most cameras allow shutter speeds as fast as 1/4000th of a second, and as slow as 30 seconds. As a result, as mentioned above, there is a huge range of values available to us when making adjustments to shutter speed.
- **Trade-Off:** Faster shutter speeds reduce the chance of blur ruining your photos due to movement during the exposure process, but they don't allow as much time for light to enter the camera and create an exposure. On the other hand, a slow shutter speed will allow more light into the camera but could result in blur due to movements of the camera or what is in front of the camera.

How Fast Do You Need to Hand Hold?

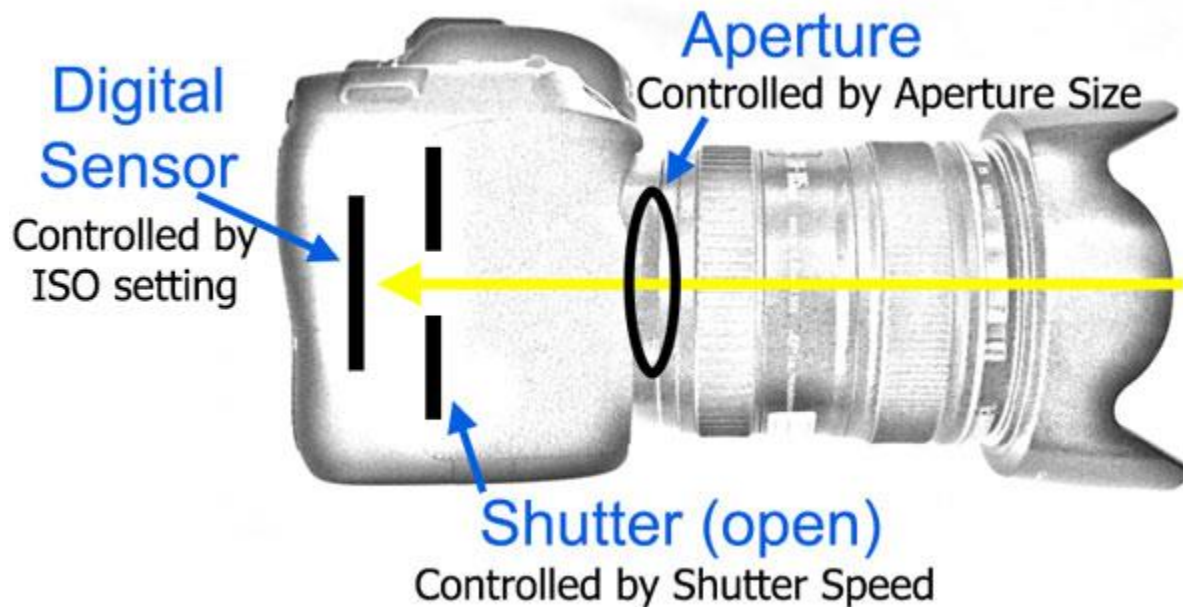
Remember the Reciprocal Rule: your shutter speed should be at least the reciprocal of your focal length (e.g., when using a focal length of 100 mm make sure your shutter speed is 1/100th of a second or faster).

Fast Shutter Speeds for Effect

Using a super-fast shutter speed to capture something in action is referred to as Stopping the Action. You will usually want a shutter speed of 1/500th of a second and faster.

Additional Commentary

At long last, we are to the third and final piece of the exposure triangle: shutter speed. We start, once again, with our diagram showing the three exposure controls:



In a lot of ways, shutter speed is the most important aspect of exposure. It has the broadest range of values to work with of any of the exposure controls. Shutter speed also affects a lot of things other than the actual exposure level, like sharpness and motion blur. These are things you will use all the time, so let's dive in.

How the Shutter Works

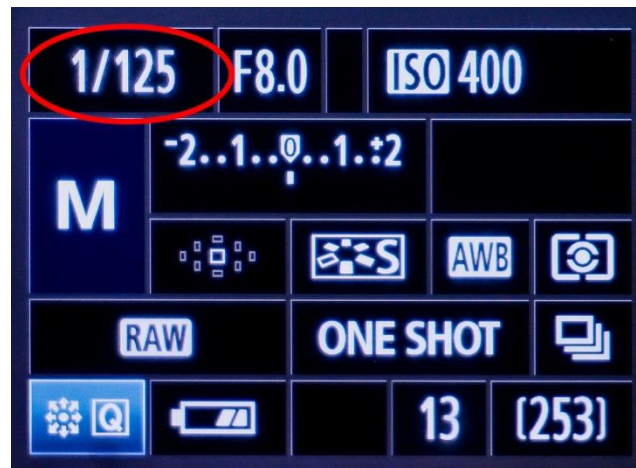
The shutter is the part of the camera that opens up to allow light to reach the camera's digital sensor and take the picture. Most of the time, the shutter is in the closed position, so it blocks light from hitting the sensor. It stays in this closed position until you press the shutter release or shutter button. When you do so, the shutter opens for a length of time needed to expose an image.

Pressing this button is what you think of as "taking the picture." But what you are actually doing is opening the shutter for a defined length of time. In the film days, you would be exposing the film, and in the digital era you are allowing light to reach the digital sensor.

Up to now, you might have thought of the process of your camera taking a picture as being more or less instantaneous. To be sure, it can happen very fast, but that isn't always the case. If you have been shooting in automatic mode, the camera will always try to keep the shutter speed as fast as possible. Therefore, the pictures you have taken to date have been with as fast of a shutter speed as the camera could muster. You won't always want that though.

Measuring Shutter Speeds

Again, shutter speed is a measure of time. That will tell us a lot of about the measurements that we are going to see for setting the shutter speed. Those speeds will generally be set forth as fractions of a second. Sometimes, very long shutter speeds can be whole seconds and those will be set forth as whole numbers. Therefore, when you look on your LCD or in your viewfinder, you will see a fraction or whole number that tells you the shutter speed.

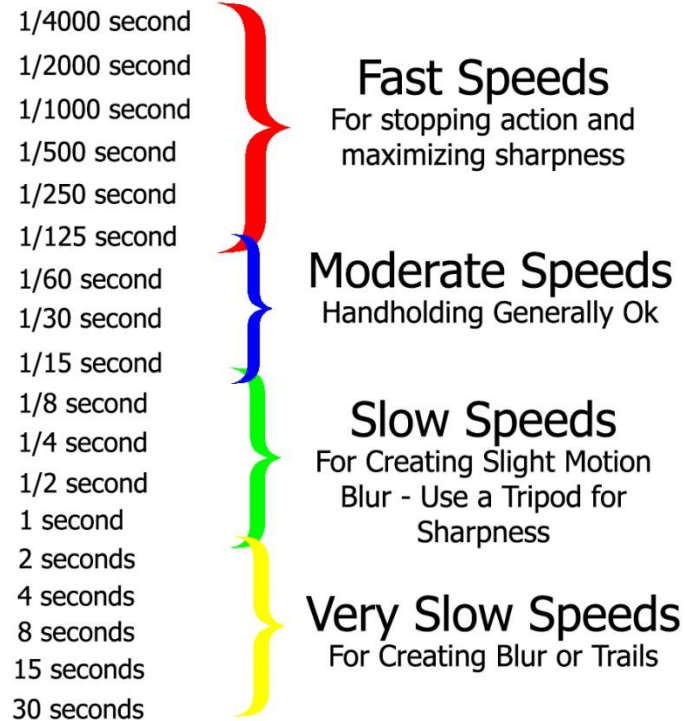


Example of how shutter speed might appear on an LCD display

Shutter speeds can be super-fast. They are often tiny fractions of a second. Most cameras allow you to set your shutter speed as fast as $1/4000^{\text{th}}$ of a second and some go as fast as $1/8000^{\text{th}}$ of a second, although you will rarely use speeds this fast.

On the other side of the spectrum, shutter speeds can be quite slow. In most modes, the longest shutter speed the camera will allow is 30 seconds (you use even longer shutter speeds in a mode called Bulb Mode, and we'll get into that later in the course).

Range of Shutter Speeds (and their uses)



How do you know the length of time you need to dial in as your shutter speed? The length of time the shutter stays open depends on how long it takes the camera to get the light it needs to take a proper exposure. If there is a lot of light available, as on a bright sunny day, only a very short period of time is needed to properly expose the picture. The shutter speed might be something like 1/500 of a second or even faster. On the other hand, if there is not much light available, as at nighttime or indoors, the camera will need to hold the shutter open longer to take the picture. This is usually still a fraction of a second (something between $\frac{1}{4}$ second and $\frac{1}{60}$ second), but can be as long as a second.

The Trade Off

As with our other exposure controls, there is a trade-off when it comes to shutter speed. You've just seen that the longer you hold the shutter open, the more light gets let into the camera. The downside of that is potential blur. That results because holding the shutter open, create a situation where the camera might move during the exposure. Moving the camera during the exposure creates blur.

This isn't a clean trade-off though. In other words, it isn't a simple matter of a balance between a desire for a crisp photo (fast shutter speed) versus letting a lot of light into the photo (slow shutter speed). There are times you will actually *want* motion blur in your pictures. Further, there are ways around the trade-off: namely stabilization. You can use a tripod and if nothing is moving in your picture it will keep the camera still so that you can use as long a shutter speed as you like.

We'll cover the different permutations of this, but for now I just want to introduce you to the trade-off inherent in this exposure control, and make it clear that there is no one single way to do it.

How Fast Is Fast Enough?

Let's talk now about using a shutter speed that is fast enough for your needs. You need to start by understanding this: if you are taking a picture by holding the camera in your hands, you are incapable of holding the camera still for any length of time. We humans are just not capable of holding the camera perfectly still. There always is a certain amount of sway or shake. The consequence to our pictures is called "camera shake."

The way you address this problem is by using a fast shutter speed. You just use a shutter speed that is fast enough that the shake is not noticeable in your pictures. The idea is that if you use a super-fast shutter speed of a tiny fraction of a second, then there will be no movement during that time. But how fast is fast enough?

Unfortunately, there is no single answer covering every situation. The reason there is no single answer is that it depends on your focal length. When you are using a long focal length (i.e., you are zoomed in on something), there is obviously magnification going on. This results in an increase in the effects of camera shake. In other words, the effect of any shake is magnified since you are looking at a magnified image. You can see this for yourself by looking through a lens with a long focal length and trying to keep it perfectly still. Odds are you will see some shake as you try to hold steady.

The Reciprocal Rule

There is, however, a rule you can use to determine the minimum shutter speed you can use and still keep the camera steady. It is called the Reciprocal Rule. The rule is going to seem complicated when I first tell it to you, but then we're going to simplify things greatly, so don't worry. Anyway, the Reciprocal Rule is that the minimum shutter speed should be the reciprocal of your focal length. A reciprocal is a number with a 1 above it.

That seems complicated but it is actually pretty simple in practice. For example, if you are shooting with a 50 mm lens, you can use a shutter speed as slow as 1/50th of a second. The

reciprocal of 50 mm is $1/50$. Get it? If you were to zoom out to 20 mm you should use a shutter speed as slow as $1/20$ th of a second. If you zoomed in to 200 mm, you would need to use a shutter speed of $1/200$ th of a second or faster.

Factors affecting the Reciprocal Rule

Unfortunately for us, there are a few other factors that complicate the Reciprocal Rule for us. The first is that many cameras have what is called a "crop factor." This will change the effective focal length for many cameras and may require that you use a faster shutter speed than the reciprocal of what is on your lens.

Crop Factor

The focal lengths you see on your lens were created for 35 mm cameras. 35 mm cameras were called that because each piece of film was 35 mm wide. In the digital world "full frame" cameras are those with the digital image sensor that is 35 mm wide. So unless you have a full frame camera, there will be a crop factor.

Most cameras have smaller digital image sensors. Many have what are called APS-C sensors, which are about 50% smaller than full frame sensors. Micro Four-Thirds cameras are only half the size of full frame sensors. That means for each, the lens will make things appear closer than they are.

Image Stabilization (IS) or Vibration Reduction (VR)

Conversely, many lenses have emerging technology called "image stabilization" or "vibration reduction." This is specifically designed to reduce or eliminate the camera shake problem that the Reciprocal Rule is designed to help you avoid. Lenses with this feature will typically let you get away with slower shutter speeds than you would otherwise be able to use. How much slower? Usually 2-4 stops, but different lenses have different amounts.

Remember that the Reciprocal Rule provides only a minimum. For an extra guarantee of a crisper picture, use even faster shutter speeds. Where it is paramount, I often double the amount called for in the Reciprocal Rule.

Fast Shutter Speeds for Effect

So far we've talked about the shutter speeds you need to use as a minimum. But that's not the whole story when it comes to talking about shutter speed. Other times you will want to really crank up the shutter speed and capture a split second in time. This is referred to as "stopping the action."



To capture this water in mid-flight, I used a 1/3200 shutter speed. To make that work, even on a bright sunny day, I needed to open up my aperture all the way to f/2.8. (Exposure settings: Shutter speed 1/3200, aperture f/2.8, ISO 200)

This is used commonly in the context of sports, where you want to capture the decisive moment of a play. You want to capture a specific moment in time, you want it sharp, and you don't want any blur in the shot. For this, you need a very fast shutter speed. In general, consider 1/250 a minimum.

Effect on other exposure controls

So how do you get these fast shutter speeds? In other words, if you look at the LCD and the exposure is metered properly but the shutter speed isn't as fast as you want, what do you do? Think back to the prior few lessons and remember how our exposure lettings work together. You can either:

- Set a wider aperture, while remaining mindful that this will get you a shallower depth of field), or
- Set a higher ISO, with the understanding that this might result in more digital noise in the picture.

Or you can do both. Usually, I recommend doing a little of both, but it will depend on what you are trying to accomplish. Don't be shy about raising the ISO though. Remember that you can fix a bit of digital noise later. You cannot fix blur. When in doubt, raise the ISO to get you a faster shutter speed.

A Test: The Moving Camera

I want to stress this point because it is important: shutter speed is probably the most important factor in image sharpness. People always want to blame their lens, or the focus, or something else, but more often than not they used too slow a shutter speed and it caused a tiny bit of blur in the picture.

The first and best way to eliminate this blur is by using a very fast shutter speed. When you do that, the shutter will open and close so fast that even if you are moving, it won't show up on the pictures. You can easily put this to the test yourself. Grab your camera and set it to a fast shutter speed (something like 1/1000 or faster). Open up the aperture really wide and set the ISO really high (you aren't going to keep these anyway). Now wave the camera around in a circle and snap off some pictures.

Take a look at the detail of these pictures on your computer monitor and you will see, despite the fact that you were moving the camera around as much as you could, the details are sharp. Hopefully this shows you what a powerful impact a fast shutter speed has on the sharpness of your pictures.

To look at this from the opposite perspective, you might try hand holding a picture with a 1 second shutter speed and then looking at it on your computer monitor. It will be blurry, no matter how still you tried to be while you took the picture.

Shutter Speed in the Real World: Moving Subjects

As a prelude to today's assignment, let's walk through some examples of using a fast shutter speed in some different contexts. I'm going to show you some different photos I took of my family where I used a fast shutter speed to stop the action. After that, you can take what you've seen here and use it for yourself.

Let's start with this photo of my wife Susan skiing. She is a really good skier, so I wanted to get some action shots. I would race ahead of her and then stop and get out the small camera I kept in my pocket to get shots of her as she went by. Because she was moving really fast, I obviously needed to use a fast shutter speed or the shot would be blurry.



Exposure Settings: Shutter Speed 1/2000; Aperture f/6.1; ISO 200

This was a bright day, made even more bright by the fact that it was snowy. There was a lot of light available. That allowed me some latitude with my exposure settings. Nevertheless, to ensure a fast shutter speed, I still used a wide aperture. I actually meant to use an aperture of f/5.6, but in my rush I inadvertently set it at f/6.1. In addition, although in other contexts a bright day like this would have warranted an ISO of 100, I knocked it up to 200 to ensure a fast shutter speed. The result was a shutter speed of 1/2000th of a second. Despite the fact that Susan was speeding past me, the picture is crisp and she is not blurry.

You don't need to be photographing a racecar, a skier, or something really fast to need a fast shutter speed. I've learned this by having a daughter involved with musical theatre, which can involve a lot of action and dancing. What's worse, this is often done in a low light environment.



Exposure Settings: Shutter Speed 1/500; Aperture f/2.8; ISO 3200

My goal here was to use as fast a shutter speed as possible. To do that, I needed to first pay attention to my other exposure settings. The fast shutter speed was only going to let in a little bit of light, so I needed to set my other two settings for maximum exposure. For my ISO, I wanted to crank it up and get it as high as possible without noise taking over. I used ISO 3200. For the aperture, I wanted it wide open to allow as much light in as possible. That would result in a shallow depth of field, but I actually preferred that here.

Making these first two settings allowed me to use a shutter speed of 1/500th of the second, which is plenty fast. As you can see, I caught her in mid-twirl with no blur.

This same sort of scenario plays out in sports photography all the time. Whether you are photographing professional football or little league, you want a fast shutter speed to stop the action at decisive moments. I have a daughter who was a gymnast, which meant indoor meets (low light) and bursts of action requiring fast shutter speeds.



Exposure Settings: Shutter Speed 1/200; Aperture f/2.8; ISO 3200

As with the prior photo, I start with my other two exposure settings, and make them with an eye toward obtaining a fast shutter speed. The fast shutter speed would severely restrict the amount of light, so I needed to offset that. I started by setting the ISO very high. I put it at ISO 3200, which through prior experience with this camera I knew was the highest I could go without noise becoming a serious issue. I opened up the aperture of the lens all the way to f/2.8 to let as much light in as possible. Again, I knew that would restrict depth of field, but I really didn't care about keeping the background sharp.

These settings only got me to 1/200th of a second. That is pretty fast, but frankly slower than I wanted. As a result, while the picture over sharp overall, you can see a little bit of blur in the feet. There is a place for motion blur, as we'll see in tomorrow's lesson.

Shutter Speed in the Real World: Moving Water

Speaking of tomorrow's lesson, we are going to talk a lot about capturing moving water. Tomorrow we will talk about how to do it with slow shutter speeds, but since today's lesson is all about using fast shutter speeds, let's talk a little bit about how and why you might want to use a fast shutter speed with moving water.

First of all, why use fast shutter speeds with water? To capture a particular moment. One circumstance might be a wave just before it crashes, such as this picture taken on the beach in Destin, Florida:



Exposure Settings: Shutter Speed 1/800; Aperture f/5.6; ISO 100.

You do this the same way as you do other shots with fast shutter speeds, only here it can be a little easier. Because you are shooting outside, there is often plenty of light available. Here I was able to achieve a fast 1/800th of a second shutter speed while using a low ISO and an aperture that is not wide open.

Day 6 Assignment

Stop the Action

Description:

Photograph a person in motion and "stop the action" by using a fast shutter speed. Any sports scene works the best. If you have access to children, photograph them doing something active (swimming, trampoline, or just playing).

Keys to Success:

Be sure to avoid any motion blur by using a fast enough shutter speed

You'll need light - and lots of it!

For best results, take lots of exposures, but avoid "machine gunning" your subject.

Note the aperture and ISO settings you need to use to allow this fast shutter speed.

What are the downsides of using these aperture and ISO settings?

Upon Completion of this Assignment:

You'll be taking crisp, sharp pictures. Fast shutter speeds eliminate both camera shake and motion blur, which are two prime offenders in creating blurry pictures. As a result, fast shutter speeds do more to get you sharp pictures than anything else.