

What is the Aperture?

When taking a photograph, there are really only three controls that matter on a camera: focus, shutter speed and aperture. Focus is reasonably obvious; you can quickly spot when a picture is out of focus. Likewise shutter speed is easy to understand since it is measured in fractions of a second. However aperture is a mystery to most people, because it is usually explained using technical jargon and its effects are not immediately obvious.

The aperture is literally that – a hole through which light passes after it enters the lens. The size of this hole can be altered, allowing a greater or smaller amount of light to pass through.



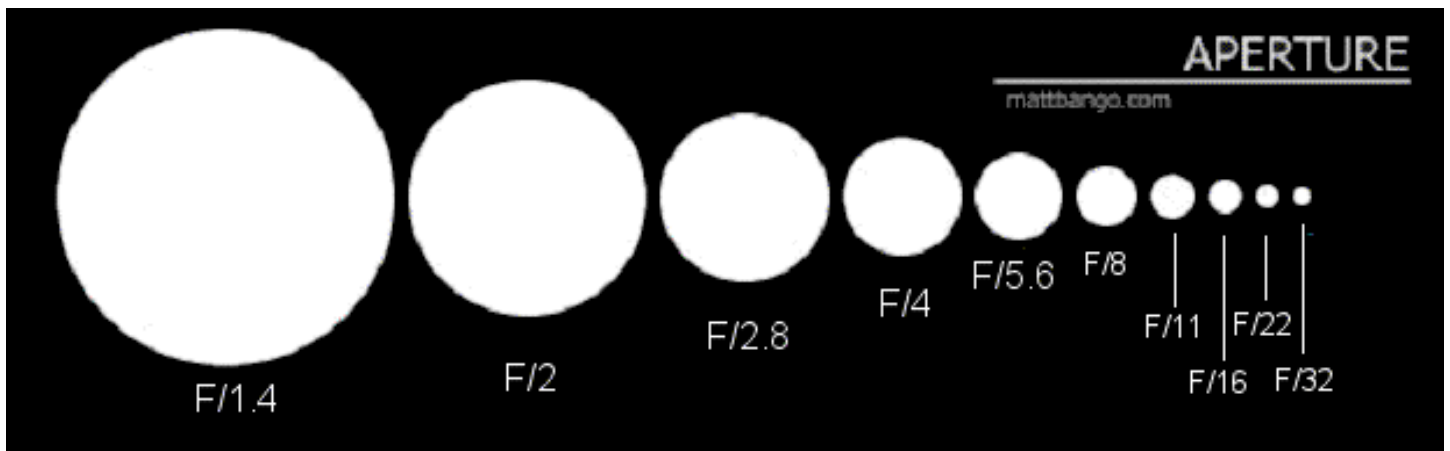
Wide aperture: a Pentax f1.7 50mm lens set at f2.8



Narrow aperture: a Pentax f1.7 50mm lens set at f16

Aperture is used in conjunction with shutter speed to control exposure. However it is also the primary means of controlling something called **depth of field**.

This is where a lot of people get confused. Aperture is measured in increments called f-stops. The smaller the f-stop number, the larger the aperture is open (meaning more light can come in). A f-stop of $f/1.8$ will let in a large amount of light as opposed to an f-stop of $f/22$ which decreases the amount of light let into the camera. This can easily be seen in the image below, showing the different sized openings at different f-stop numbers.



The range of the aperture is determined by the lens itself. You can see the f-stop numbers printed on the lens. For example, my Canon 35-135 mm lens has "F4 - 5.6" printed on the lens. This means at 35mm the F-stop allowing in the most light (smallest f-number) is $F/4$. While at 135mm the F-stop allowing in the most light (smallest f-number) is 5.6. In this example, zooming in allows less light to pass through compared to shooting the same scene at the widest possible angle on the lens. There are certain situations where you would want to use a smaller f-stop vs. a larger f-stop.

Depth of Field

When a lens focuses on a subject at a distance, all subjects at that distance are sharply focused. Subjects that are not at the same distance are out of focus and theoretically are not sharp. However, since human eyes cannot distinguish very small degree of unsharpness, some subjects that are in front of and behind the sharply focused subjects can still appear sharp. The zone of acceptable sharpness is referred to as the **depth of field**. Thus, increasing the depth of field increases the sharpness of an image. We can use smaller apertures for increasing the depth of field.

The following shows an example. The lens focuses at the middle between the 3 inch and 4 inch marks. Thus, the 3 inch and 4 inch marks are sharp in all images. The 5 inch mark is not very sharp at F3.2, and is improved as the lens closes down to F3.6. Then, it becomes sharp in all subsequent images. The 6 inch and 7 inch marks are not sharp until F5.0 and F6.4, respectively. The 8 inch mark becomes reasonably sharp when the lens closes down to F8.0. The 9 inch and 10 inch marks are not sharp in all images; but, they become sharper as the lens closes down. For the foreground, the 2 inch mark is acceptable at F3.2 and becomes "focused" at F4.0. The 1 inch mark is not sharp until F5.6, and the lead of the ruler becomes reasonably sharp at F7.1. As you can see, the range of sharpness (*i.e.*, depth of field) gets larger as the aperture gets smaller. Therefore, use a smaller aperture if a greater depth of field is needed.



F3.2



F3.6



F4.0



F4.5



F5.0



F5.6



F6.4



F7.1



F8.0



F9.0

Note, the larger the f-stop number (smaller opening for light) the greater the depth of field.

Examples of Depth of Field

Photo One — Small Depth of Field

In this photograph I focused on the quarter in the very front. This is where the plane of focus is located.

The mat underneath the quarter is also in focus.

The aperture is set to f5.6 (large opening for lots of light) so there is a small depth of field.

Both quarters in the background are completely out of focus.



Photo Two — Large Depth of Field

Same photo, same angle. Only one thing has changed — the aperture.

The aperture is now set to f32 (very small opening for light), and the depth of field has increased.

All three quarters are in focus, even though my plane of focus is still on the quarter in the front.



Photo Three — Portrait with Limited Depth of Field

This photo is another example of a small depth of field.

While the dog's face is in focus, the background is blurry, so that it is not distracting.

The aperture for this photograph was set to f6.7.



Photo Four — Landscape Large Depth of Field

Everything from the rocks in the foreground to the mountain in the background is in focus.

Using a high aperture number (smaller opening for light) ensures that everything within the depth of field is in focus.

In this case, the aperture was set to f22.





Narrow depth of field (left) helps you emphasize the flowers



Large depth of field (right) shows the overall landscape



Narrow depth of field on this tiger blurs the background to emphasize your subject.

Common Photographic Mistakes With Depth of Field

Does this sound familiar? You take a great shot of your best friend standing in front of the Washington Monument. You get home, get the photo developed and lo and behold! The Washington Monument is growing out of your friend's head. How did this happen?

PROBLEM: Too much depth of field.

Even though the camera was focused on your friend's face, the depth of field was so great that the monument also wound up in perfect focus.

SOLUTION: Set your camera to a small f-stop (f4.5) and keep the depth of field shallow. Your friend's face will be in focus, and everything behind him or her will be softly out of focus.

Here's another one: you're visiting Yellowstone for the first time. You get to Old Faithful and set yourself up to get a great photograph. When the geyser erupts, you get the shot of a lifetime. But when you get home, it turns out that your camera was focused in front of the geyser, leaving the star of your photo looking blurry. You've probably guessed why.

PROBLEM: Too little depth of field.

The plane of focus was in front of Old Faithful, and since the geyser did not fall within the depth of field, it is out of focus.

SOLUTION: Set your camera to a large f-stop (f16) and increase the depth of field.