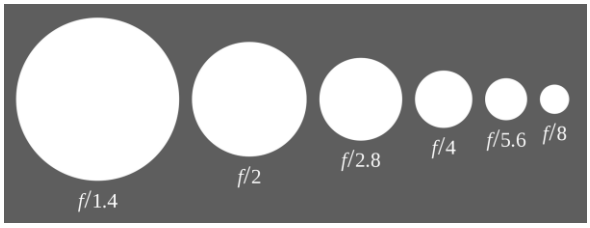
Mysteries of Photography #6: Why is Lens Aperture always “F” Divided by a Number?

You want to buy this lens. It is described, for example, as “Sony F/1.8 55mm”. Why not “Sony F1.8 55mm”?

In addition, when we are actually using our cameras, we most often are using them with the aperture diaphragm “stopped down” to reduce the amount of light reaching the camera sensor and again the aperture is always expressed using the “f/” convention.

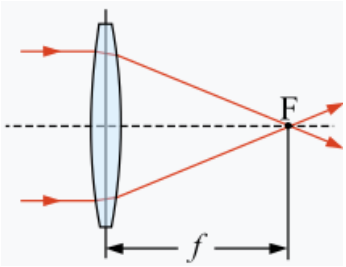
This is the classic illustration of the comparative sizes of the major aperture settings at 1 stop increments.



Note: I don’t think that there is any ironclad rule but the maximum aperture of a lens is usually capital “F” and the aperture when operating your camera expressed using a small “f”.

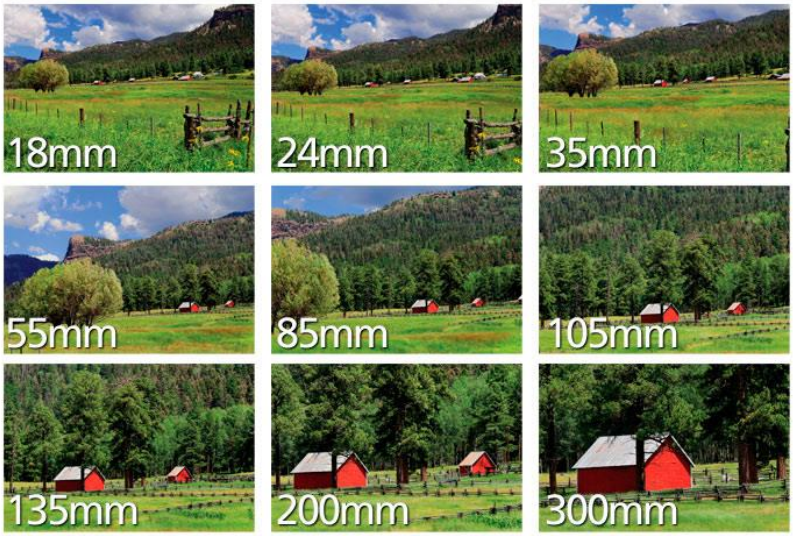
We are not going to worry about stopped down lenses today, just the maximum aperture “F/”.

Whether big “F” or small ”f”, f refers to the intrinsic focal length of the lens. This does not change with the effective aperture and simply means the distance from the lens itself to the point of sharpest focus when the light source is at an infinite distance (light rays striking the lens are all parallel to each other). The sun is an excellent approximation.



The longer the focal length, the smaller the angle of view for any given size of camera sensor.

This is the classic way to illustrate the different fields of view of lenses with different focal lengths:



The longer the focal length the smaller the subject area that will be focused on your camera sensor. This also means that the longer the focal length, the smaller the area light is collected from, and the less light actually reaches your sensor for any given actual physical size of the lens aperture.

(Note: The focal length is determined by the actual physical curvature of the glass in the lens. Different curvatures bend the light rays differently.)

Now let's suppose we have a series of lens with different curvatures so that they focus the sun at 55, 85, 105, 135, 200 and 300mm and further that the actual physical diameter of all of these lenses is the same at 25mm. What happens if we express the maximum apertures of each of these lenses using the stand F/ convention?

Focal Length	Maximum Aperture
55	2.2
85	3.4
105	4.2
135	5.4
200	8
300	12

While with the 55mm focal length lens its maximum aperture is a respectable F/2.2, for 300mm it is a tiny F/12. To get F/2.2 in a 300mm lens would require an effective lens diameter (opening) of 660mm. Hence you can see why you can't readily buy an F/2.2 300mm lens (unless you are a spy agency for a major power). Also it would be too bulky and heavy with that amount of glass up front.

So you can see that the "F/" ("f/") convention is not some weird arbitrary convention. In fact it is a direct way to correct for the different amounts of light collected by the camera sensor when mounted with lenses of different focal lengths.

Because of this system, you can swap your 300mm telephoto lens set at f/4 with your 18mm wide angle set to f/4 and you will get the same exposure levels *without changing any camera settings*.

David Woodcock
9/5/2024