

LENS AND SHUTTER

LENS: DESCRIBED IN TWO WAYS

1. FOCAL LENGTH
2. RELATIVE APERTURE or SPEED

1. FOCAL LENGTH

The "normal" focal length lens for a camera is roughly equal in length to the length of the diagonal of the camera's negative size. The focal length of a lens is usually measured in millimeters (though it may be measured in inches or centimeters) and this information is normally engraved on the lens mount. The focal length determines the scale of the image on the negative: **the longer the focal length, the larger the image.**

The standard focal length for a 35mm lens is 50mm. A short or wide angle lens would be 35mm or shorter whereas a long lens would be 85mm or longer. A zoom lens permits the use of a range of focal lengths, for example from 28 - 70 mm.

2. RELATIVE APERTURE or SPEED

The relative aperture is the measure of the light transmission of a lens. The larger the diameter of a lens in proportion to its focal length: the larger is its "relative aperture"; the more light it admits to the film; and the higher is its "speed."

The relative aperture of a lens cannot be measured directly since it is **a function of two factors: 1. lens diameter, and 2. focal length.**

It is expressed in the form of a ratio: **relative aperture equals approximately the focal length divided by the diameter of the front surface of the lens.**

Relative aperture = focal length DIVIDED BY diameter of front surface of lens.

Relative aperture is expressed in f- numbers and may be written in several ways. For example a lens with a relative aperture of f2.8 may be encribed on the lens as f. 2.8 or as f/2.8 or as 1:2.8.



Many inexpensive zoom lenses have a relative aperture of f4 or f5.6, which limits their use in low light--as in this example, a 24-70mm zoom with a 3.3-4.5 relative aperture.

Therefore, on the lens you will find two sets of numbers. One is the focal length of the lens and the other is the relative aperture (speed) of the lens.

The higher the speed of a lens, the lower is its f-number.



This 24mm prime lens has a relative aperture of 2.8.

LENS DIAPHRAGM AND APERTURE:

Lenses are provided with built-in diaphragms by which the amount of light passing through the lens may be controlled. The largest opening of the diaphragm is equivalent to the relative aperture of the lens.

The aperture is the size of the opening of the diaphragm at any given f-stop. The closing down or stopping down of the diaphragm is done by a system of F-numbers calibrated in such a way that each consecutive F-number requires twice the exposure time of the preceding larger diaphragm opening.

The American F-number system is as follows:

F: 1, 1.4, 2, 2.8, 4, 5.6, 8, 11, 16, 22, 32, 45, 64

Most camera lenses do not have the full scale of openings but encompass only a portion of it.

Reading the F-stops above from left to right, f.1 would be the largest opening, one stop down would be f1.4 which would close the diaphragm down to allow only half as much light to enter the lens, f2 would cut the amount of light in half again, etc. Conversely, reading the above system from the larger F-stop numbers toward the smaller (right to left) each F-stop would double the amount of light allowed to enter the lens.

In the F-system, THE LARGER THE OPENING, THE SMALLER THE NUMBER.

standard lens aperture settings

The F-stops listed above must be committed to memory.

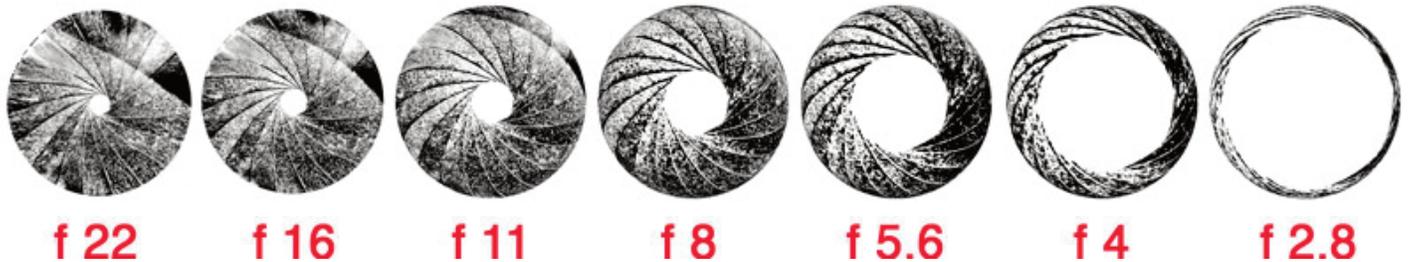
Automatic cameras permit the selection of intermediate SHUTTER SPEED and APERTURE settings. Manual cameras only permit the selection of intermediate APERTURE settings.

THE SHUTTER:

The shutter regulates the length of time that the light is admitted through the lens to the film. There are two basic types of shutters: 1) between the lens shutter, and 2) focal plane shutter.

The focal plane shutter is built into the camera body. The focal plane shutter allows faster shutter speeds but is less accurate in timing. As its name implies, the between the lens shutter is built into the camera lens. Although more accurate than the focal plane shutter, the between the lens shutter is more expensive because each lens, in the context of working with cameras using interchangeable lenses, requires its own shutter mechanism.

The between the lens shutter is usually found in the twin lens reflex (TLR) type camera and view-type or large format cameras. The focal plane type is usually found in a single lens reflex 35mm camera. Great care should be taken when pressing the shutter release button. Blurred or unsharp photographs are very often caused by pushing the button instead of squeezing it, resulting in camera shake or movement.



Shutter speeds on manual cameras are fairly standard and read as follows:

1 2 4 8 15 30 60 125 250 500 1000

Automatic cameras permit the selection of intermediate shutter speed and aperture settings. Although these "intermediary" speed settings can be used on an automatic camera, attempts to set an "in-between" shutter speed on a manual shutter should be avoided.

An electronic camera displays shutter speed and aperture while a manual camera has a dial to set the ISO and shutter speed.



Shutter speeds are in seconds or fractions of seconds. On the shutter speed scale the "1" stands for 1 second and the remainder are fractions of a second. For example: 125 is 1/125th of a second.



Each shutter speed in the above system reading from left to right reduces the length of time the light is allowed to strike the film by one half. Conversely, reading from right to left the length of time is doubled from one number to the next.

SUMMARY: The f-number and the shutter speed systems halve or double the amount of light reaching the film moving from number to number. One system accomplishes this by regulation of the size of the aperture (f-stop), the other by the length of the time of exposure. Thus, the two systems are inherently compatible and can be used together or give a wide choice to f-stop/shutter speed combinations. The photographer selects the desired combination of f-stop/speed to stop or blur motion, or to give increased or decreased depth of field.

APERTURE AND SHUTTER-SPEED COMBINATIONS YIELDING THE SAME EXPOSURE:

SHUTTER SPEED: 1/125 1/60 1/30 1/15 1/8 1/4 1/2

F-STOP **F/2.8 F/4 F/5.6 F/8 F/11 F/16 F/22**

FOCUSSING AND DEPTH OF FIELD

Focusing: Focusing means to adjust the lens-to-film distance to produce a sharp image of the subject being photographed. A common fault in photographing is insufficient care in focusing, resulting in unsharp photographs or images that lack visual coherence.

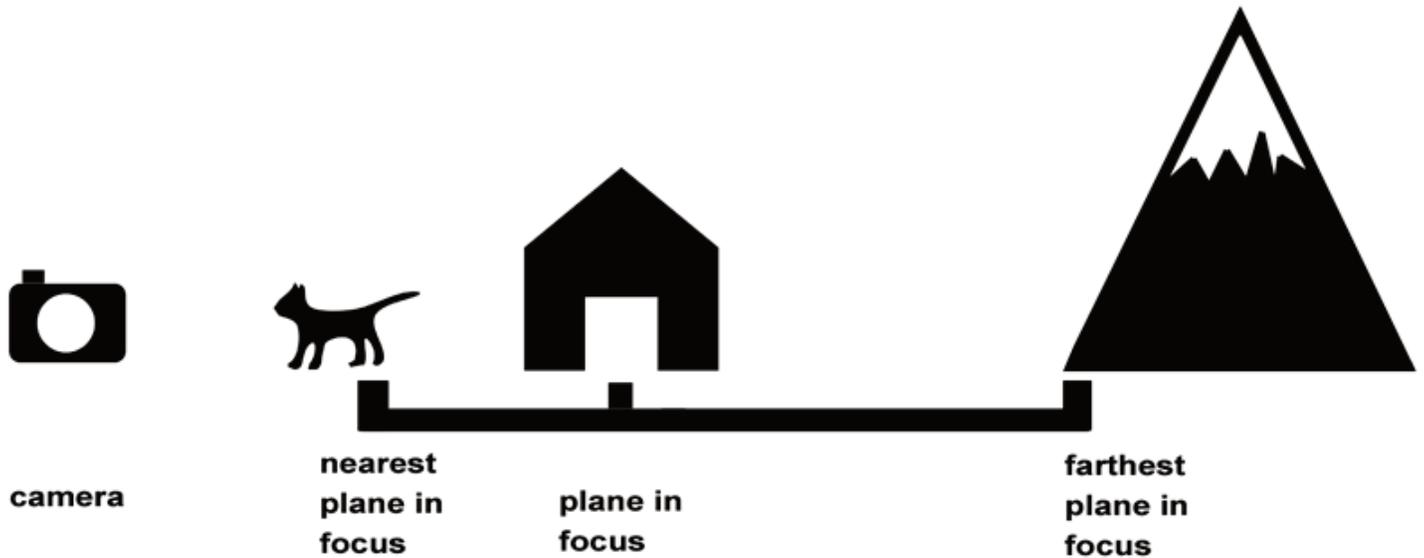
Electronic cameras provide various options for the selection of the plane of focus: standard manual focus, standard autofocus, focus tracking (for moving subjects), and focus lock.

(see image at right)



When using focus lock, the shutter release button can be lightly pressed in order to focus on a subject plane that appears in the viewfinder. This technique permits the selection of a particular plane of focus, accompanied by its corresponding depth of field. While continuing to gently depress the shutter, the photographer can then reframe the image. The plane of focus is locked and applied to the new composition when the shutter release is fully depressed. The final exposure permits the use of autofocus while allowing for more control over the determination of the plane of focus and the resulting depth of field. On an electronic camera the focussing modes (autofocus, manual focus, tracking) can be set usually near the lens itself, on the front of the camera.

depth of field



Depth of field: Depth of field is the distance between the nearest and the farthest planes (or objects) in acceptable focus when the camera is focused on a plane (or object).

The smaller the diaphragm or aperture opening, the greater is the depth of field.

To intentionally create shallow depth of field, use a wide lens aperture.

The distance from the plane or object focused on to the nearest object in acceptable focus is always less than the distance from the object or plane focused on to the farthest plane or object in the acceptable focus.

The closer to the object focused on, the more shallow the total depth of field: conversely, the farther away the object focused on, the greater the total depth of field.



The contemporary diaphragm is located inside the lens. The diaphragm is comprised of thin metal plates overlapping in such a way as to form a circular opening called the aperture. The size of the aperture opening controls the amount of light coming through the lens to the film.

Turning the diaphragm mechanism one way or the other increases or decreases the size of the aperture opening in increments called F-stops. (Each increment is associated with an F-number which is equal to the focal length of the lens divided by the diameter of the aperture opening at the stop. See Relative Aperture.) These F-numbers or stops are calibrated in such a way that going from larger to smaller aperture openings, the turning at each stop, is exactly half the size of the previous one.

When turning the diaphragm mechanism the opposite way, the aperture opening at each stop is twice as large as the one preceding it.

Manual cameras usually have depth of field scales in two parts, one for camera-to-subject distance and one for F-numbers. For any given F-stop, the depth of field will be indicated by the corresponding F-numbers on either side of the center mark.



In diagram (a), the F-number is 2.8. Depth of field is limited or very shallow; the area located from 9 to 11 feet from the camera will be in focus.



In diagram (b), the lens has been stopped down to F11. Depth of field will extend from 8.5 to 20 feet (Notice the yellow lines that correspond with the yellow color used to indicate f11).



In diagram (c), the lens has been stopped down to its smallest aperture opening, F22. Depth of field is extensive, from under 10 feet to infinity. (Notice the orange lines that correspond with the orange color used to indicate f22).

The distance scale window of an autofocus lens, reveals the depth of field.

With the lens focused at 3.5 feet, and an aperture setting of F22, the depth of field would be less than 1 foot to infinity.



When using an aperture of f16 with this focus setting, the depth of field will extend from 2 feet to infinity. The depth of preview button will provide a visual confirmation of the depth of field prior to exposure of the image.

Stopping down the aperture produces a greater zone of sharp focus in both depth directions from the plane in focus (toward and away). Stopping down, or using a smaller aperture, or selecting a higher f-number, also creates proportionally more sharpness in the distance behind the plane of focus than in front of the plane of focus. **Ideally, to obtain extensive depth of field, one should focus about one-third of the way into the subject-depth and stop down until the entire depth is covered sharply.**

Depth of field can be determined by using the depth of field scale (above) or by using the depth of field preview button (available on some manual and automatic cameras.) Photographers also use shallow depth of field intentionally to produce a limited area of sharpness from foreground to background, to place an emphasis on the subject as in portraiture or still life, for example. When photographing a flat wall, no depth of field is required. In this case, the aperture does not need to be stopped down.

SUMMARY:

As aperture openings get smaller, F-numbers get larger, sharpness in depth increases, exposure times increase, ground glass image darkens.

Ample light or a long exposure is required--perhaps with use of a tripod.

As aperture openings get larger, f-numbers get smaller, depth of focus decreases, exposure times decrease and the ground glass image brightens.

Low lighting is usually acceptable.