Photo Basics

Most modern cameras include many automatic features allowing the photographer to concentrate on composition and subject matter without needing to think much about good exposure, however there are many variables that should be considered when attempting to capture the desired effect for a specific situation. These variables include among other things focal length, aperture, depth of field, shutter speed and exposure value. An understanding of camera features and how to control them can help to produce a variety of effects and will allow the photographer to modify the impact and quality of the final image.

LENSES

Lens *Focal Length* determines the angle of view that will be included in the image and help to isolate the subject of interest. Fixed focal length, zoom or macro lenses are available in various ranges from wide angle to telephoto. Lens categories are usually based on 35mm film usage. Other formats and digital cameras provide factors which can be used to determine the field of view variations for these formats.

Focal length:	16	20	24	28	35	50	80	120	200	300
	fisheye		*wide angle*			*normal*	*portrait*		*telephoto*	

Fixed lenses are designed for a specific (one) focal length
Zoom lenses provide a range of focal lengths in one lens
Macro lenses are used for close up work and provide up to 1:1 image size/film

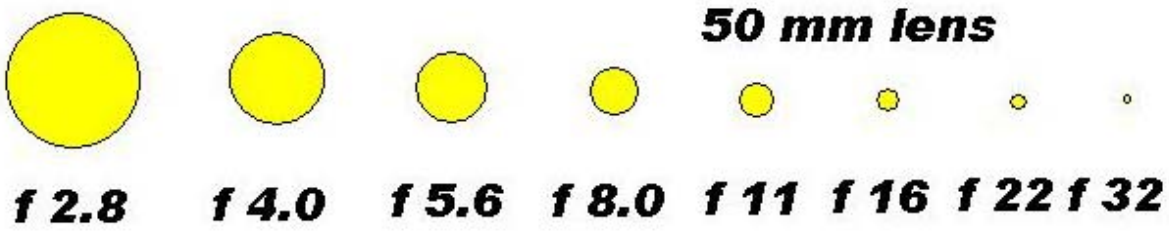
Lenses typically provide for control of the *focal length*, *focus distance* and *aperture size.*

APERTURE

Aperture is the effective opening size in the lens that allows the light from image through to the sensor or film plane. For most cameras this is variable in size to adjust for the proper exposure based on lighting conditions. Aperture diameter is determined as a fraction of the lens focal length (*eg.* f 8 = 1/8 FL) and is expressed in "f" numbers. Larger numbers represent smaller apertures.

Standard "f" =	1	1.4	2	2.8	4	5.6	8	11	16	22	32

For a 50 mm lens, the aperture size is approximately as follows:



Looking at these numbers, each number to the right of its neighbor represents a reduction in area of ½ which allow 50% less light to enter the lens. Likewise each number to the left of its neighbor represents twice the area and allows 2 times the amount of light to enter the lens. These increments are known as a *"stop" or "full stop*." Some lenses provide for fractional stop settings.

SHUTTER SPEED

Shutter speed is the amount of time that the lens is open to permit light to fall on the film or sensor. Shutter speed is measured in fractions or units of seconds and is indicated by the following terminology.

1000	500	250	125	60	30	15	8	4	2	1s	2s …
1/1000	1/500	1/250	1/125	1/60	1/30	1/15	1/8	¼	½	1sec	2sec …

In this series, values to the right of their neighbor represent ½ the speed which will allow twice the amount of light to enter the lens. Values to the left represent twice the speed and will allow ½ the amount of light to enter the lens. Like aperture, each of these increments are known as a *"stop" or "full stop*."

Shutter speed can be an important selection when trying to capture motion or moving subjects or when hand holding the camera. A useful rule for hand holding is to use a shutter speed no slower than the inverse of the lens focal length. For example when using a 200 mm lens, the speed should be at least 1/250 sec or faster, when using a 24mm lens, the speed should be at least 1/30 sec or faster. It is good practice to use a tripod or some other camera support whenever possible. Using a self timer with the tripod can also minimize camera shake at the time of shutter release. Some lenses include image stabilization features.

EXPOSURE VALUE

The amount of light falling on the film or sensor is affected by the two variables aperture and shutter. Various combinations of aperture and shutter speed can

yield the same amount of exposure for the image. *Exposure value* (EV) is a convenient way to represent this fact. EV is determined by the combination of aperture value and shutter speed. An EV = 0 is an exposure time of 1 second at an aperture size of *f* 1.0. For an EV = 12 the following combinations of aperture and film speed represent the same amount of exposure.

Aperture	16	11	8	5.6	4	2.8
Speed	1/15	1/30	1/60	1/125	1/250	1/500

Other values are listed in the following table. Some cameras and photo literature use the EV value in specifications.

Exposure value as a function of aperture setting and shutter speed

		APERTURE VALUE									
SHUTTER SPEED		**1.0**	**1.4**	**2.0**	**2.8**	**4.0**	**5.6**	**8**	**11**	**16**	**22**
	1	0	1	**2**	3	**4**	5	**6**	7	**8**	9
	2	1	**2**	3	**4**	5	**6**	7	**8**	9	**10**
	4	**2**	3	**4**	5	**6**	7	**8**	9	**10**	11
	8	3	**4**	5	**6**	7	**8**	9	**10**	11	**12**
	15	**4**	5	**6**	7	**8**	9	**10**	11	**12**	13
	30	5	**6**	7	**8**	9	**10**	11	**12**	13	**14**
	60	**6**	7	**8**	9	**10**	11	**12**	13	**14**	15
	125	7	**8**	9	**10**	11	**12**	13	**14**	15	**16**
	250	**8**	9	**10**	11	**12**	13	**14**	15	**16**	17
	500	9	**10**	11	**12**	13	**14**	15	**16**	17	18

An increase in EV of one represents a one stop reduction in exposure. A decrease in EV of one represents a one stop increase in exposure. Combinations of shutter speed and aperture with the same EV represent equivalent exposures.

Cameras with *aperture priority* will allow the user to set the desired aperture and the camera metering will automatically adjust the shutter speed to achieve the correct exposure. Cameras with *shutter priority* will allow the user to set the shutter speed and the camera metering will automatically adjust the aperture to achieve the correct exposure. Cameras with *program mode* will automatically select both shutter speed and aperture.

The "*Sunny 16 Rule*" is a handy way to check exposure without a meter. It states that on a full sunny day, if the aperture is set at f 16, the proper shutter speed will be the inverse of the film ISO rating. Example, at f16 on a sunny day, using ISO 100 film, the shutter speed will be 1/125, for ISO 400 film use a shutter speed of 1/500. If it is a hazy sun day try f11 with the same rule. With a heavy overcast

day try f8. These rules are approximate and some adjustment may be needed or bracketing.

EXPOSURE COMPENSATION

Exposure meters in cameras are calibrated to provide a proper exposure when the lighting from a scene is average "*18% gray*". The camera automatic exposure settings will try to make your scene match an average 18% gray for the metered area. Gray cards are available that are useful in determining proper exposure. There are various types of metering systems such as spot, matrix, center weighted, etc. Many scenes require exposure compensation based on unusual lighting conditions. Advanced cameras have exposure compensation features that can be set in ½ or 1/3 stop increments. Plus (+) settings provide *overexposure* and minus (-) settings provide for *underexposure*. Classical situations that may need exposure compensation are:

Snow, beach or reflective water	+ 2/3 to +2 stop (increase exposure)
Very dark or black objects	- 1-1/3 to - 2/3 stop (decrease exposure)
Close up of white or yellow flowers	+ 1/3 to +1-2/3 stop (increase exposure)
Dimly lit night sky	0 to + 2 stop (increase exposure)

Bracketing refers to the practice of taking the same photo at a range of exposure values in order to select the proper exposure once the final image is viewed and is used when there is some question as to the amount of compensation needed.

SENSITIVITY

Film speed affects the exposure needed to record a good image. Film speed is rated by an *ISO number* and typically ranges as follows:

Film ISO rating	25	50	100	200	400	800	1600

Each adjacent value is one stop different in speed than its neighbor and higher numbers are referred to as "fast film" and low numbers as "slow film". EV for a good exposure will increase by one increment for each increase in ISO rating on this chart. Image quality tends to reduce as the film speed increases. Digital cameras also rate their sensor using the ISO scale and some digital cameras can be set to various ISO values. Digital image quality is also reduced as the ISO value increases. ISO 100 is considered a benchmark value.

DEPTH OF FIELD

Depth of field describes the range of distance within the scene that appears in sharp focus in the final image. With aperture and shutter speed as selectable features, there are greater options to affect the depth of field in the final image. This is a useful consideration in many situations. In some cases the photographer want the entire image in focus such as in a broad sweeping scenic photograph. In other cases he may want to isolate a particular subject and have other elements blurred and not distracting such as taking a close up picture of a flower or a bird. In this case he may want to blur the background detail so that it does not compete with the subject. Lens focal length and aperture size have a significant effect on the depth of field as well as focal distance. *Focal Distance* refers to the distance from the camera to that part of the subject where best focus occurs.

Larger focal length lenses and larger apertures tend to result in shallower depth of field while shorter focal lengths and smaller apertures result in longer depth of field. Depth of field can be calculated for a specific set of conditions and will be affected by the lens focal length, the aperture size and the focal distance. There are calculators on the web that can be useful in determining these values. Nothing substitutes for some personal experimentation and practice. Here are a few examples.

Lens FL = 24mm, A = f 16, Focal dist. = 4 feet, DOF = 2 ft to infinity

Lens FL = 200mm, A = f 5.6, Focal dist. = 20 feet, DOF = 19.5 ft to 20.5 ft

Lens FL = 50 mm, A = f8, Focal dist. = 50 feet, DOF = 20.3 ft to infinity

A handy rule estimates that the plane of focus is 1/3 into the depth of field

HYPERFOCAL DISTANCE

The *hyperfocal* distance is a useful number to know and has a value for a specific focal length lens and aperture setting. Focusing at this distance provides for the greatest depth of field for a given focal length lens and aperture size. It is defined as the distance at which to focus to achieve a sharp image (depth of field) from ½ the hyperfocal distance to infinity. As an example. For a 24mm FL lens, with an aperture setting of f 16, the hyperfocal distance is 4 feet. If the camera lens is focused on a point 4 feet away, the image will be in sharp focus from 2 feet to infinity.

Hyperfocal distance is usually of interest for wide angle lenses when the photographer is trying to achieve a long depth of field. The following Table

provides the hyperfocal distances for selected lenses and apertures. Web sites provide calculators that can be used to determine this value for selected lenses.

Hyperfocal distance in feet for selected lens focal lengths

	APERTURE					
LENS FOCAL LENGTH		*f 22*	*f 16*	*f 11*	*f 8*	*f 5.6*
	24 mm	2.9	4.0	5.7	8.0	11.2
	28 mm	3.9	5.5	7.7	10.8	15.3
	35 mm	6.0	8.5	12.0	16.9	23.8
	50 mm	12.2	17.3	24.3	34.3	48.5
	80 mm	31.2	44.0	62.1	87.8	124

Notes: