

Photography basics for Underwater Digital camera systems

By Sun Seeker Diving

There are 3 ways to control natural or ambient light for acceptable exposure:

1. Shutter Speed
2. Aperture
3. ISO

When in **Program** mode, the camera chooses an optimum shutter speed and aperture, which is based solely on the amount of sunlight or ambient light that the camera is measuring. For underwater photographers, this is often not useful, as we use artificial light (strobes) to light a large portion of the foreground and the camera has no way of knowing how powerful the strobe is or how far it is from the subject. The program metering system takes the entire scene into consideration, including the dark shadow area in the foreground that we will be lighting with the strobe. When the camera chooses an exposure based on the dark area in the foreground, it results in a washed out, pale blue photo that is then further over-exposed when the strobe light is added.

Therefore:

It is usually easier to use manual settings for virtually all of our underwater photography. By using manual, we can define what we want for the water background exposure, i.e. do we want a light blue, dark blue or black background and what type of lighting do we want for the foreground - do we want bright light, soft fill etc.... Once we have chosen background exposure, we can then choose the best setting for our strobe exposure.

Shutter speeds: SLR cameras have a wide range of shutter speeds, such as $1/60^{\text{th}}$ or $1/250^{\text{th}}$ of a second, this speed is how long the shutter is open for the exposure. Shutter speeds are varied to help control the proper amount of ambient light reaching the sensor (film) for the exposure. Slower speeds let in more light than faster speeds, for example, $1/60^{\text{th}}$ of a second will let in twice as much as $1/125^{\text{th}}$ of a second. Shutter speeds can be used to help control the amount of subject and camera movement which occurs during exposure. The faster the shutter speed, the less blur from movement will appear in the photo.

As a rule of thumb, use a shutter speed that is at least two times the focal length of the lens being used with a 35mm film format. With digital cameras, such as the Nikon D70 with a 1.5 multiplication for lens focal length, triple the digital number to find your maximum shutter speed. Thus, if you are using a 28-80mm zoom lens, set for the widest 28mm setting, you can get away with using a shutter speed as slow as a $1/90^{\text{th}}$ with a Nikon digital or $1/60^{\text{th}}$ with a Canon CMOS digital, provided you and the subject are not moving at all. The more you and your subject are moving the faster the speed should be. For average work, use at least a $1/180^{\text{th}}$, and for fast moving subjects use a $1/360^{\text{th}}$ if it will synchronize with your strobe.

If you are shooting a strobe exposure in dim light or at night when the ambient light does not affect your exposure, then the shutter speed is not as important. The duration of the exposure will be limited to the duration of the flash. Since the flash fires at a very high speed such as $1/1000^{\text{th}}$ of a second, the action will be frozen by the short duration strobe light even if the shutter speed is relatively long.

If you zoom to a larger focal length, such as 80mm length in our example, the minimum shutter speed becomes $1/250^{\text{th}}$. With many cameras you have little choice but to set your camera for the fastest setting that will synchronize with your strobe.

Synchronization: In your owners manual you need to find the flash synchronization speed. This is the fastest shutter speed that the camera is capable of at the time the flash fires. If the shutter speed is too fast, only part of the image will be exposed when the flash fires and only part of the image will be lit. The slower speeds work fine with the strobe, but you need to know the upper limit, such as Nikon D70 $1/250^{\text{th}}$, D2X $1/250^{\text{th}}$, D100 $1/180^{\text{th}}$. Some Olympus non-SLR digital cameras have the ability to sync at speeds higher than $1/800^{\text{th}}$ of a second, allowing the photographer to reduce ambient light altogether (if that is desired) without having to greatly increase the f-stop. As far as the ambient exposure goes the D70 $1/500^{\text{th}}$ @ ISO 200 is the same as the D2X $1/250$ @ ISO 100 (the minimum ISO setting for each camera).

F-Stops: There is an adjustable opening, called the **aperture**, in the centre of the lens that controls the amount of light passing through the lens to the CCD. The size of the opening is indicated by a system called f-stops, e.g. F45, f32, f22, f16, f11, f8, f5.6, f4, f2,. The higher the number, the smaller the aperture and the less light reaches the CCD (or film) and the lower the number the more light passes through the lens producing a brighter exposure. Each whole f-stop lets twice as much light as the number above it. Digital cameras generally also list the 3rd stop values such as f6.3 and f7.1 between the f5.6 and the f8.

How do they get those weird f-numbers and why do bigger numbers seem to indicate smaller apertures?

The size of the aperture is measured relative to the size of the camera. It is “f” unctio of the size of the camera. The f-number is the number of times the diameter of the opening fits into the distance between the center of the lens and the film or CCD plane. An f8 on a very big camera is much larger than the f8 on a tiny camera, but each f8 produces the same exposure – the large f8 lights a larger piece of film on the bigger camera and the small f8 lights a smaller area on the little camera. The 8 actually stands for $1/8^{\text{th}}$. The width of the aperture is $1/8^{\text{th}}$ of the distance to the film, while the larger f4 is $1/4^{\text{th}}$ of the distance. Thus, the 4 actually represents a bigger number ($1/4^{\text{th}}$) than the 8 ($1/8^{\text{th}}$). All you need to remember is that you stop down to smaller openings to make the photo darker and open up to larger openings to make the photo lighter.

Depth of field: Not only do apertures control the amount of light reaching the CCD, they also affect the amount of blur in front and behind the focused distance. The area in front and behind that looks acceptably sharp in the photograph is called the depth of field, the smaller the aperture the greater the depth of field. Look at your lens owner’s manuals so you can see the depth of field charts and make a simple chart to put on your camera or to help you review the lens characteristics.

ISO: The ISO is automatically set by the camera in Auto/Program mode, or manually by the photographer when in manual mode. The higher the ISO number of the CCD, the more sensitive the CCD is to light. Each time the ISO number is doubled, the CCD needs half as much light for an exposure. So, if you were taking a photo with a shutter speed of $1/125^{\text{th}}$ with an ISO 200, and then you changed to an ISO 100, what shutter speed would now give the correct exposure? ($1/60^{\text{th}}$ allows twice as much light for exposure). But, the higher ISO speed, the more chance there is of introducing noise into the photograph.

ISO, f-stops, and shutter speed are all equally proportional to one another. A camera and lens set for 1/250th at f8 is the same exposure as 1/150th at f5.6, or ISO 200 at f8 is the same exposure as ISO 100 at f5.6, so you see that it really is a balancing act, with a little juggling involved for a well exposed photograph.

Noise: With normal CCD sensors, the amount of electrical charge that is generated in each pixel is proportional to the amount of light it receives. It is this charge that is measured and produces the “output” for each pixel. The amount of noise (random fluctuations in charge) does not vary, but if you try to increase the sensitivity by amplifying smaller charges (i.e. less light) you will increase the proportion of noise. Noise in CCD sensors is very dependant on temperature. Cooling the camera sensor will dramatically lower noise.

Distance: Things look closer and larger underwater. They look closer to you and to your camera lens. Even when using an SLR camera, you must estimate the distance by eye to determine your f-stop for your strobe exposure. Two divers with their arms reaching toward each other and just touching fingertip to fingertip are four measured feet apart, or three apparent feet.

Test your understanding: If the proper exposure for a photo is f5.6 with ISO 50, but you want greater depth of field, what ISO would allow you to use f11? **Answer:** ISO 200. f11 is two stops greater than f5.6. Changing from ISO 50 to 100 would allow you to use f8, one stop higher, doubling again to ISO 200 would allow you to use f11.

Some Basic things you should also know how to do:

- Set camera for manual exposure control
- Adjust metering pattern for centre weighted metering for sunlight
- Adjust shutter speed through housing
- Adjust f-stop through housing
- Hold focus for one part of the photo, move camera position without changing focus and then shoot, while set on “S” (single servo) focus mode, or change your point of focus
- Attach the ports and lens gears
- Read the exposure metering bar in the view finder
- Use focus assist signal in view finder