

## The Balance between ISO, Aperture and Shutter Speed

This article discusses the issues in selecting the ISO rating, the aperture and shutter speeds used in the camera setup and how to balance them.

### ISO

Increasing the sensitivity of the chip increases the noise in the image. The ISO 100 setting has minimal noise. The ISO 200 setting is very usable with only slightly more noise than ISO 100. The ISO 400 setting has noticeable but not obnoxious noise and the ISO 800 setting has significant noise. Much of the effects of noise can be reduced in post processing and downsizing the image eliminates most of it. With the exception of the ISO 800 the effects of noise can usually be ignored since most of our images are downsized for use.

### Aperture

Inherent in microphotography is a very small depth of field. It is a truism in photography that having a smaller aperture increases depth of field so it seems logical that small apertures are desired. The situation is not quite that simple. Decreasing the aperture lengthens the shutter speed, which increases the vibration problem. Secondly a very small aperture can lead to vignetting. Plus the depth of field is so small in microphotography that increasing it doesn't make a dramatic difference in the image. The solution to the depth of field problem is to admit it is there and understand that the critical part, the emphasis point of the image, must be in focus. This required very careful focusing and is a learned skill. Making the aperture small does not increase the depth of field enough to eliminate the need for accurate.

### Shutter Speed

Vibration is the main reason microscope images are degraded. It is very difficult to get the scope and the patient absolutely quiet. The higher the shutter speed the less the problem with vibration so a high shutter speed is the main goal. This is also the reason a remote shutter release is mandatory for microphotography.

### Priorities

The highest priority is a high shutter speed. Something around 1/1000 of a second would be ideal. Every effort should be made to get the speed to 1/250 of a second.

Decreasing the aperture one *f*-stop will improve resolution of the lens and marginally increase the depth of field. While desirable this should not be done at the expense of a decreased shutter speed.

Reducing the ISO rating is the last thing to consider and should not be set below ISO 400 unless the above two criteria can be met.

It is possible, but not likely, with some scope and light sources to get very high shutter speeds which approaches limit of the camera. The accuracy of the image can be affected if the camera wants to set the shutter speed higher than it is capable of doing.

An ideal camera setting series would be to have the ISO at 100, the lens at one or two f-stops below wide open and the shutter speed at one level below maximum. For a variety of reasons, this is not likely to occur with most scopes. If it isn't possible, first increase the ISO to 400. Next, if you can leave the lens one stop below wide open without adversely effecting the shutter do so, other wise open the lens all the way. If at that point that camera shutter speed is below 1/250 of a second set the ISO to 800 if possible and accept the noise in the image.

Typically most scope/camera combinations will end up with an ISO setting of 400, the lens wide open and reasonable shutter speed. The use of the best-picture mode in the Coolpix series of camera will give some relief to the vibration problem and is probably worth one shutter speed improvement. A remote release is mandatory. If the shutter speed is on the order of 1/1000 of a second the scope can be "hand held" which increase the ease of focusing and framing.

### **The maximum ISO settings for the following cameras are:**

Nikon Coolpix 775,880,885,950,990	= ISO 400
Nikon Coolpix 995 and 5000	= ISO 800
Olympus 3040 and 4040	= ISO 400
Canon G2	= ISO 400

### **The maximum shutter speed for the following cameras are:**

Nikon Coolpix 775,880,885,950,990	= 1/1000 of a second
Nikon Coolpix 995 and 5000	= 1/2000
Olympus 3040 and 4040	= 1/800
Canon G2	= varies with <i>f</i> -stop is 1/500@ <i>f</i> 2.5

### **The maximum lens opening at full optical telephoto are:**

Nikon Coolpix 775 and 885	= <i>f</i> 4.9
Nikon Coolpix 880	= <i>f</i> 4.2
Nikon Coolpix 950,990 and 995	= <i>f</i> 4.0
Nikon Coolpix 5000	= <i>f</i> 4.8
Olympus 3040 and 4040	= <i>f</i> 2.6
Canon G2	= <i>f</i> .2.5

Note; the Coolpix 995 has a 4x optical zoom, which allows for more telephoto than the other Coolpix cameras. Unlike the other Coolpix cameras it does not have to be at maximum zoom to eliminate vignetting. If the 995 is set at the same telephoto setting as the maximum for the 950/990 the *f* stop is the same as those camera at *f*4.0. If it is zoomed to its maximum optical zoom then the *f* stop opening reduces to *f*5.1