

## Photography is all Math

### Depth of Field Calculator:

#### [DOF Calculator](#)

### Magnification Formula:

$$M = F / (u - F)$$

M = magnification

F = focal length

u = object distance to lens

use mm for 105mm case @1000mm object.

$$M = 105 / (1000 - 105) = 0.117$$

use mm for 135mm case @ 750mm object

$$M = 135 / (750 - 135) = 0.22$$

use mm for the 200mm case @1500mm object

$$M = 200 / (1500 - 200) = 0.154$$

## Doubling and Halving



Some of the most common questions I get on the flickr photography forum are related to filter use. I

plan on creating multiple filter tutorials over the winter and will blog and post them to my website. In the meantime, I will briefly touch on using the B+W ND 3.0 10 stop neutral density filter. Using neutral density filters as strong as the B+W 10 stop requires a few steps and a little math. First, the filter is so dark, it is next to impossible to compose an image with the filter in place. Therefore, it is important to compose your frame, focus, and calculate a proper exposure **prior** to adding the 10 stop filter. For the image above, I also was using a Singh-Ray Gold-N-Blue polarizer and a Lee .75 Soft GND (graduated neutral density filter). The polarizer helped create the intense gold and blue tones in the image, and the GND helped reduce the light in the sky to better balance the image's dynamic range. Like I mentioned before, I composed, focused, and fired off some test shots with all my filters attached but without the 10 stop filter. This is where the creative and visual approach I choose for my photography comes in...**and a little math**. Depending on the look I am going for, and how fast the clouds are moving, I may choose to expose a scene between 30 seconds and several minutes. On this day I tried shots between 30 seconds and 2.5 minutes, with around a minute being the length of shutter speed giving me the cloud movement I wanted. Now, onto the math. I typically shoot my landscapes at the base ISO of my camera for quality purposes, in this case ISO 100. I also often start my calculations for shutter speed with my aperture set to give me a good depth of field, typically f16. For this photo, I came up with a shutter speed of 1/4 second. Adding in 10 stops of light reduction, meant that I needed to increase my shutter speed by 10 stops as well. A halving (or doubling) of a shutter speed is one stop of light. Therefore:  $1/4" > 1/2" = 1 \text{ stop}$   $1/2" > 1" = 2 \text{ stops}$   $1" > 2" = 3 \text{ stops}$   $2" > 4" = 4 \text{ stops}$   $4" > 8" = 5 \text{ stops}$   $8" > 15" = 6 \text{ stops}$   $15" > 30" = 7 \text{ stops}$   $30" > 1' = 8 \text{ stops}$   $1' > 2' = 9 \text{ stops}$   $2' > 4' = 10 \text{ stops}$  This would mean a 4 minute exposure would be needed! This is much longer than I wanted to shoot as the clouds would have lost all detail. Not to mention hand holding my GND for that long is tiresome. So what can I do to need less light, and therefore less time for a shorter exposure? First, I changed my camera's ISO to 200. This gave me a full stop back. Now I could shoot for 2 minutes. I also knew that by changing my aperture to allow more light would help.

Aperture settings (f-stops) in full stops.  
1 – 1.4 – 2 – 2.8 – 4 – 5.6 – 8 – 11 – 16 – 22 – 32

From my days of shooting film, my lenses had most of these settings, especially f2.8 - f22. Now, with digital, most cameras can electronically change the aperture in 1/3 stop increments. For example, between f8 and f11, I now have f9 and f10 as options. And between f11 and f16, I now have f13 and f14.

For this image, I opened my aperture to f13, knowing I would retain a good depth of field and gain a 2/3 stop of light (compared to f16) at the same time. Since a full stop (at f11) would have meant shooting at 1 minute even, 2/3 stop (at f13) equates to 40 seconds, or 2/3 of a minute. My calculated shutter speed for ISO 200, f13 and all my filters was 1 minute, 20 seconds by opening my aperture from f16 to f13.

As is often the case, I forgot my stop watch and phone in the car, so I just counted in my head. I was 10 seconds short, but in the end, that is not much of a difference.

By changing both my ISO and aperture to settings within reason for good image quality, I was able to

get a long shutter speed, but not too long. Like I mentioned previously, how long is based on variables that I evaluate in the field.

Posted by Jim Patterson Photography

Remember, the halving and doubling rules apply in the darkroom, as well.

-Mr. Yeager