

Education Series: Guide Numbers

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Some time ago I was trying to find information about using my flash on full manual control; the goal being that I would have consistent output from the flash. However, during my research I found it very difficult to come across an easy explanation of how to manually use the flash.

Some would argue (and I would agree) that it would just be easier to meter the flash by remotely triggering it with a set of Pocket Wizards or eBay remote “poverty wizards”. You simply adjust the output of the flash manually and meter it until you get what you want. While that is all well and good, I wanted to learn more about how the flash-to-subject-to-camera-settings worked in the whole scheme of things. That’s where guide numbers come into play.

As photographers, we rely on numbers to get the job done and we know that any single change in those numbers will result in a completely different look to our images. For example, shooting on f/8.0 @ 1/250 @ ISO 100 will give you relatively good depth of field; change those numbers to shoot on f/2.8 @ 1/2000 @ ISO 100 will give you the same exposure with much less depth of field – but those numbers are very tangible and we know that they directly affect what we want our picture to look like. It’s not as straight-forward with guide numbers.

At first, the concept of guide numbers is very confusing. But basically, the guide number itself is just that – a number to guide you to the desired flash output level. Table 1 below is a guide number lookup table for the Nikon SB-800 speedlight; we’ll come back to it later.

Guide number (ISO 100, m/ft)

Flash output level	Zoom-head position (mm)										
	*1	*2	14 ^{*3}	17 ^{*3}	24	28	35	50	70	85	105
M1/1	12.5/41	16/52	17/56	19/62	30/98	32/105	38/125	44/144	50/164	53/174	56/184
M1/2	8.8/29	11.3/37	12/39	13.4/44	21.2/70	22.6/74	26.9/88	31/102	35.4/116	37.5/123	40/131
M1/4	6.3/21	8.0/26	8.5/28	9.5/31	15.0/49	16/52	19/62	22/72	25/82	26.5/87	28/92
M1/8	4.4/14	5.7/19	6.0/20	6.7/22	10.6/35	11.3/37	13.4/44	15.6/51	17.7/58	18.7/61	19.8/65
M1/16	3.1/10	4.0/13	4.3/14	4.8/16	7.5/25	8.0/26	9.5/31	11/36	12.5/41	13.3/44	14/46
M1/32	2.2/7	2.8/9	3.0/10	3.4/11	5.3/17	6.0/20	6.7/22	7.8/26	8.8/29	9.4/31	9.9/32
M1/64	1.6/5	2.0/7	2.1/7	2.4/8	3.7/12	4.0/13	4.8/16	5.5/18	6.3/21	6.6/22	7.0/23
M1/128	1.1/4	1.4/5	1.5/5	1.7/6	2.6/8.5	2.8/9	3.4/11	3.9/13	4.4/14	4.7/15	4.9/16

Table 1: SB-800 GN Lookup Table

ISO	25	50	100	200	400	800	1600
Factors	x0.5	x0.71	x1	x1.4	x2	x2.8	x4

Table 2: ISO Sensitivity Lookup Table

These tables are meaningless without the guide number equation that follows (with derivatives for the mathematically challenged noted by the asterisks *):

$$\text{Guide Number} = (\text{Shooting Distance} * \text{Aperture}) \div \text{ISO Sensitivity}$$

$$* \text{Aperture} = (\text{Guide Number} * \text{ISO Sensitivity}) \div \text{Shooting Distance}$$

$$* \text{Shooting Distance} = (\text{Guide Number} * \text{ISO Sensitivity}) \div \text{Aperture}$$

$$* \text{ISO Sensitivity} = (\text{Shooting Distance} * \text{Aperture}) \div \text{Guide Number}$$

So how does this all work together? That's a good question that relies on a little patience and understanding of the different variables at play. Here they are in no particular order:

Guide Number: the result of your equation used to determine the flash output level on the lookup table.

Aperture: the aperture that you will be using when making the exposure

Shooting Distance: the distance of the FLASH to the subject (not the camera's distance)

ISO Sensitivity: the ISO that you will be using when making the exposure (refer to Table 2 above for different settings).

Important: Please note that shutter speed does NOT play a part in these equations. That's because no shutter can fire as fast as a speedlight, which is usually somewhere around 1/10,000th of a second. Just remember that the shutter speed only controls the ambient light in the exposure.

As I mentioned before, the guide number is just that – a number to guide you to the desired flash output level. So if you're shooting on f/8.0 @ 1/250 @ ISO 100 @ 15 ft (flash-to-subject) then your guide number is... breaking out the calculator... $GN = (15 * 8) \div 1 = 120$. So now you use this number to guide you on the lookup table to the correct flash output. The closest output that I found was the 85mm zoom head position at ½ power level output where the guide number is 123 (the extra 3 doesn't make much of a difference). So there you have it – a guide number example.

But wait, how can you use a table such as this for your non-Nikon flash system? Most manufacturers give you at least one guide number as a reference to create your own lookup tables. Generally speaking, this will be at the midpoint of the zoom-head position such as 35mm or 50mm (depending on how many zoom-head levels you have in the flash). Each change in zoom-head position and each change in power output level is considered a one-stop difference in your exposure. Given the guide number you can calculate the shooting distance that your flash needs to be placed at or the aperture that you need to use. If you dial the flash power up or down then you simply adjust your aperture accordingly (although I'm not too sure how much you need to move the flash if that's the only option you have).

This is not the easiest subject to cover which is perhaps why it's hard to find a simple explanation anywhere. By simply playing with the numbers you can get an idea of what you're supposed to do when using the flash on manual settings without a light meter. While there are other factors to consider (such as light falloff, direction, angle, etc) experimentation is the only way to really prove what's happening. Good luck with your endeavors and I hope this article clears up any questions you had about guide numbers. I'll close with a distance lookup table for the Canon shooters out there using a 580 EX II speedlight at the 50mm zoom head position (GN=138) and at the 105mm zoom head position (GN=190) with an ISO of 100. Enjoy!

POWER LEVEL	APERTURES								
	1.4	2.0	2.8	4.0	5.6	8.0	11.0	16.0	22.0
1	98.6	69.0	49.3	34.5	24.6	17.3	12.5	8.6	6.3
1/2	49.3	34.5	24.6	17.3	12.3	8.6	6.3	4.3	3.1
1/4	24.6	17.3	12.3	8.6	6.2	4.3	3.1	2.2	1.6
1/16	12.3	8.6	6.2	4.3	3.1	2.2	1.6	1.1	0.8
1/32	6.2	4.3	3.1	2.2	1.5	1.1	0.8	0.5	0.4
1/64	3.1	2.2	1.5	1.1	0.8	0.5	0.4	0.3	0.2
1/128	1.5	1.1	0.8	0.5	0.4	0.3	0.2	0.1	0.1
DISTANCE (feet)									

Table 3: Canon 580 EX II Speedlight @ ISO 100, Zoom Head @ 50mm

POWER LEVEL	APERTURES								
	1.4	2.0	2.8	4.0	5.6	8.0	11.0	16.0	22.0
1	135.7	95.0	67.9	47.5	33.9	23.8	17.3	11.9	8.6
1/2	67.9	47.5	33.9	23.8	17.0	11.9	8.6	5.9	4.3
1/4	33.9	23.8	17.0	11.9	8.5	5.9	4.3	3.0	2.2
1/16	17.0	11.9	8.5	5.9	4.2	3.0	2.2	1.5	1.1
1/32	8.5	5.9	4.2	3.0	2.1	1.5	1.1	0.7	0.5
1/64	4.2	3.0	2.1	1.5	1.1	0.7	0.5	0.4	0.3
1/128	2.1	1.5	1.1	0.7	0.5	0.4	0.3	0.2	0.1
DISTANCE (feet)									

Table 4: Canon 580 EX II Speedlight @ ISO 100, Zoom Head @ 105mm

P.S.

Look for the trends in the table and you will see that you get the same distance values across the table using different combinations of apertures and power levels (e.g., f/5.6 @ 1/2 power is the same distance for f/2.8 @ 1/4 power → 12.3 or 17.0 ft, depending on which table you're looking at).