A Matter of Time

by Malcolm McElvaney

I will be dancing around the simple concept of exposures but trying to use the mechanisms at hand to yield different results. This endeavor is more the intellectual side of me than practical but it is within this challenge of seeing what is possible in a new context that opens up new insights as well. I will begin this journey into the strange working of my mind with the thought that the camera is an over engineered stop watch at its core that happens to take pictures.

A camera is a dark chamber containing the light sensitive medium, a lens to focus light onto to that medium, and a timing device to open or close a shutter to let light in. This simple breakdown of the basics is harder to see now but in the early days of photography the photographer had a large view finder camera and used glass plates sensitized infield. Look up the “wet plate collodion” process to see how easy you actually have it. The lens may or may not have had a shutter and timer builtin but removing and replacing the lens cap worked just as well. The photographer might have been holding a watch to time that exposure and with that gear it was possible to do by hand, now the gear we use controls the process and we set the timer. More likely the computer within even does that for use too but the core concept is the same no matter how invisible it may get.

More about the stop watch

The fastest I can cycle the shutter is 1/4000's of a second and the longest I tell it to stay open is 30 seconds, so a bulb mode allows for the photographer to manually keep the shutter open, as an added option, as long the button in presses down. What are the numbers in between 1/4000 and 30” (seconds) you maybe asking yourself. 1/4000, 1/3200, 1/2500, 1/2000, 1/1600 and so on is an example of the starting values but it is the pattern I want to illustrate here as it makes up the entire range with longer exposures as you get closer to 30”. The exposure setting used determines the overall luminosity of the image captured so if at 1/4000 it was too dark you could go to 1/2000 and double the amount of light allowed into camera and by doing so have raised the exposure by one stop of light. I've lost you if aren't one with your camera like some dedicated photographers so I will break it down for you further.

A stop of light is relative and not fixed to some scale but based on the amount light currently being let in when the shutter is open to capture the image, so double the amount of light you let in and it went up one stop. Half that same light level and you effectively went down one stop. Mathematically this would be multiply by two to go down one stop and divide by two to go up one stop. In the example I went from 1/4000 to 1/2000 and since 1/2000 holds the shutter open twice as long I raised the current light

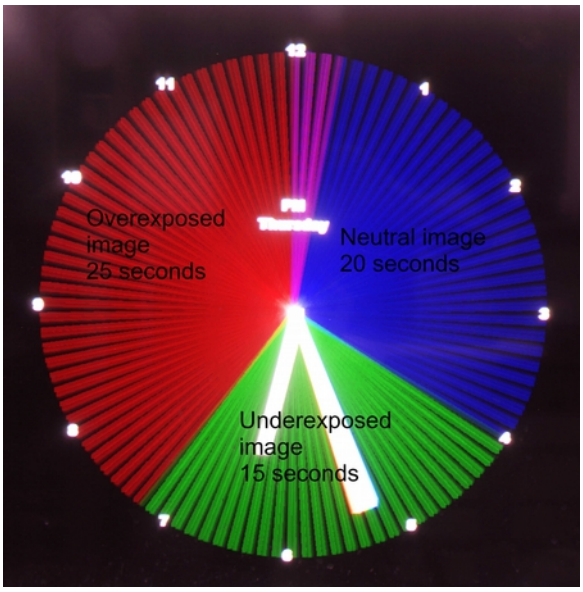
levels by one stop. 1/3200, 1/2500, and 1/1600 are examples of 1/3 stops allowing for more fine tuning options as the entire range is addressable in these 1/3 stop increments.

Drive modes

Standard on most cameras you will find these three modes to take images single exposure, multiple exposures, and a bracketing option. At least on my camera I have 52 unique shutter speeds to select from that a single image can be exposed with or even multiple images taken consecutively at the same shutter rate. More than sufficient for what I need to be a photographer but it isn't at this stage of the photograph I'm stopping so I have a plan in post processing to accomplish as well so extra information in the way of more than image is a must.

Multiple exposures of the same scene is useful to capture motion and chaos and hope one will have captured something useful. Multiple exposures can also be photo stacked in post to create a brighter image based on the darker ones. The method I'm using to capture my sets is a bracketed set that I photo stack and add a few more steps as well in post processing.

Bracketing is not complicated but based on taking extra images that are overexposed and also underexposed to compliment a netrual image taken at the setting specificied. The usuage of this extra information is usually to create High Dynamic Range (HDR) in post processing because the scene had a high level of contrast a single image couldn't capture by itself. The type of bracket taken is expressed as plus or minus a stop range over so many images total. Plus or minus 2 EV 3 take three images – one at the proper exposure (neutral image), one overexposed by two stops, and one underexposed by two stops. There is more detailed information online about this should you want a better idea of how it works.



Proof of concept

What better way to prove the total time of an exposure than an “analog” clock face being photographed. The test was to see if bracketed set taken at .3 stops plus or minus as three images (.3EV3) starting with a neutral image at 20” exposure would actual be 60 seconds in total based on 15 seconds + 20 seconds + 25 seconds of the camera being open via those images being taken in order. The visual proof is presented here.

This example doesn't really show the real goal of what multiple exposures done like this can do but it is interesting to note that because all the images have luminosity values so close to each other the difference in the combining is less visible. Each color really was a distinct capture of the hand moving within that time captured. My goal is to collect a set of images adjacent to the exposure I want via a bracketed set to be photo stacked to achieve a luminosity very close to exposure I needed in the first place. As I said I'm exploring the theoretical as much as the practical but I see value in using this approach, especially artistically. Another photographer saw my inital description of the Adjacent Bracketed Equivalent system and pointed out it looked like “luminosity masking” so maybe looking into that subject might help you understand where I'm going with this as well.

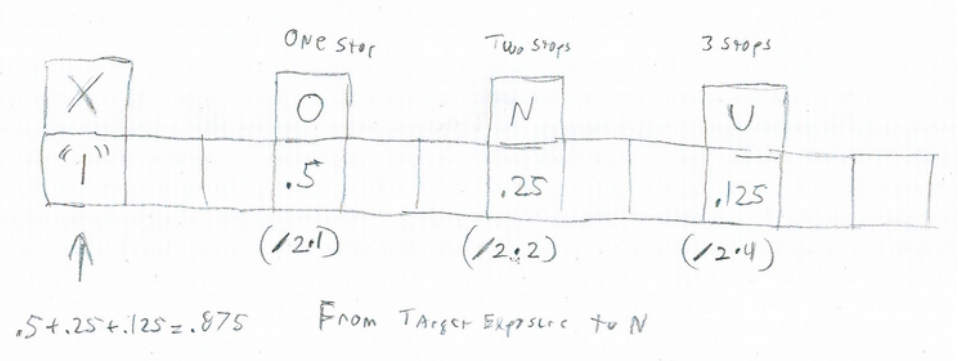
Consider the image on the right taken on a windy day in Fort Davis, TX as it used the earlier way of working out a system for achieving an image like this. At 1/200, F/9, ISO-100 on sunny day the dramatic blur and change of the flags wouldn't have happened but this is a bracketed set I photo stacked as part of my post processing to create it. The numbers will make better sense later but I will try to begin the translation of that I see so clearly.

I took a bracketed set at -2 stops from 1/200 as my target exposure and used 1/800 at plus or minus one stop using three images (1EV3) to have my neutral image at 1/800, underexposed at 1/1600, and the overexposed at 1/400. Because of the wind each image captured the changes differently and it was that artifact of the process in taking them I sought out. On a windy day that which stands still stands out so can be the subject or perhap wind via the moving objects in the scene is what is made visible and becomes the subject. Techniques like this of shifting the exposure used, bracketing, and photo stacking require more effort but allow for results that make the work worth it.

The Adjacent Bracketed Equivalent system

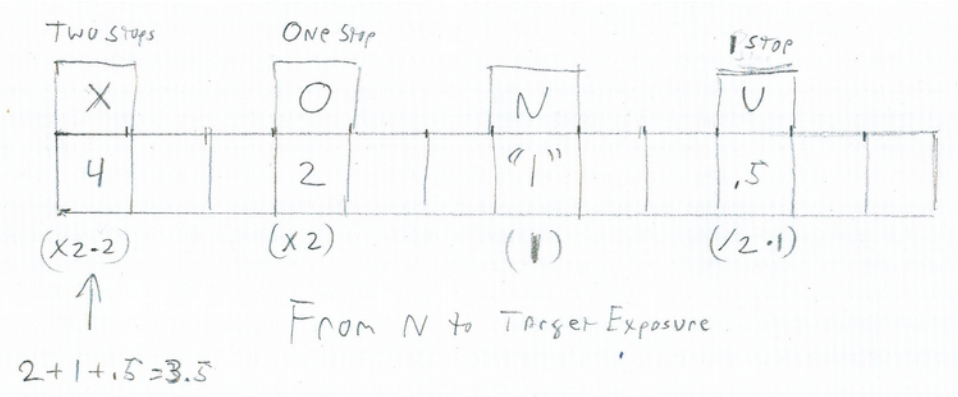
While as out pointed this system may resemble luminosity masking to a larger extent than not, I prefer my nomenclature better as even the abbreviation of ABE is more

unique. It is the technique I want to pass on so use whatever name you like. I'm a visual person so the included illustrations will hopefully help overcome the numbers game that is needed to match up and achieve the similar luminosity after post processing.



Most of the time I see myself working from the target exposure toward the solution I need so I will begin the process from this starting point with a plus or minus 1 EV 3 set. One is in quotes because it is relative so if your setting is 1/500, F/8, ISO-200 or 2", F/4, ISO-1000 it will still be equal to "1" as your starting value. The exposure is brighter than any of the resulting images in the bracketed set so I will stepping down in stops to find my neutral image setting. What can be confusing at around the third stop is it is at times 4 and not 3 but the math works by doubling the previous number, so the 2nd stop at 2 times 2 equals 4 not 3 and the next stop being even darker would be 4 times 2 so 8.

The short cut to avoid the math above is to move to in clicks or steps six moves darker and then take the set either with a tripod or by hand. I just like to know why things work so included the generic example above.

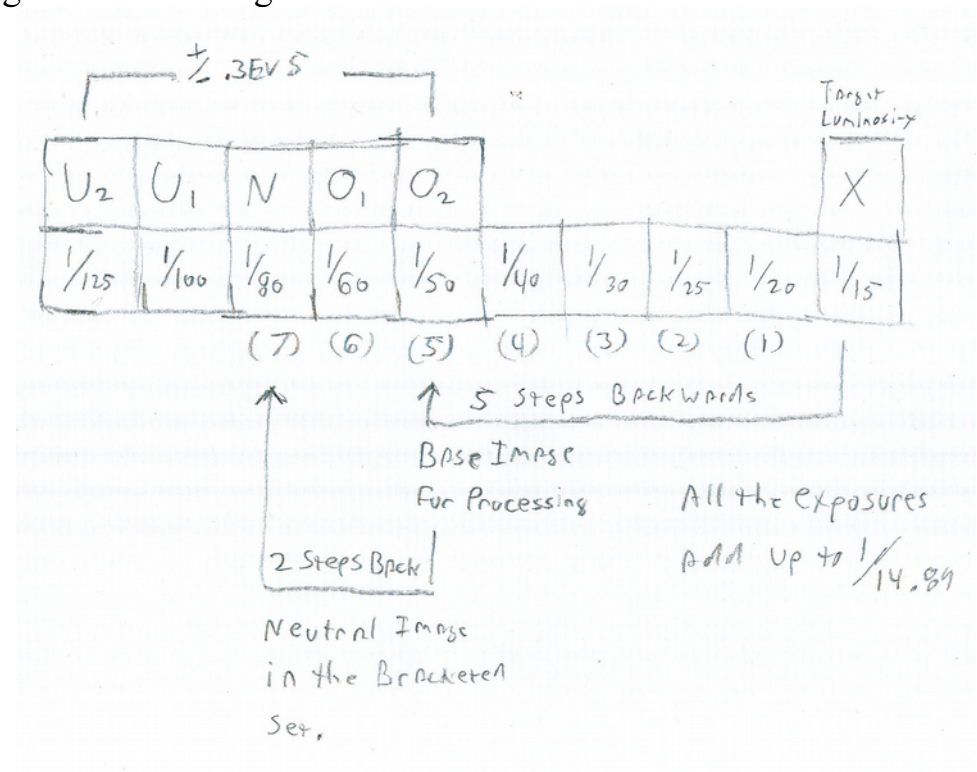


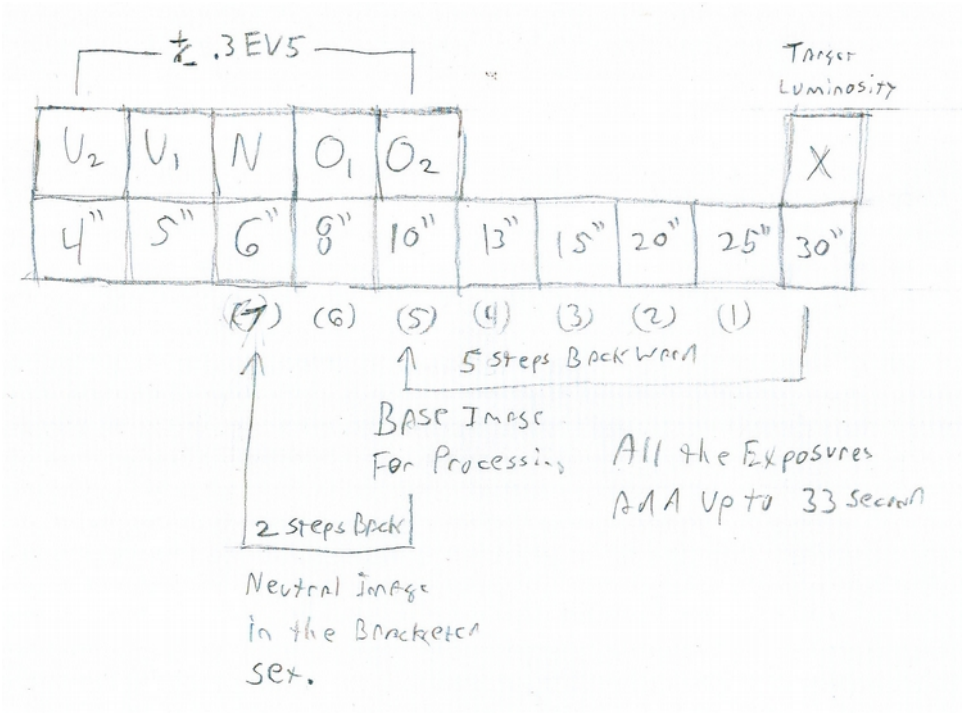
This is the generic model in reverse starting from a neutral image as a starting point, just move up 6 steps brighter and that would be the combined luminosity after post processing approximately.

I started out my exploration into this technique using 1EV3 because it is so predictable and in general works well but I ruled out going beyond one stop; however, the .3 stops has also proved most useful and yields sets with consecutive values adding up to some

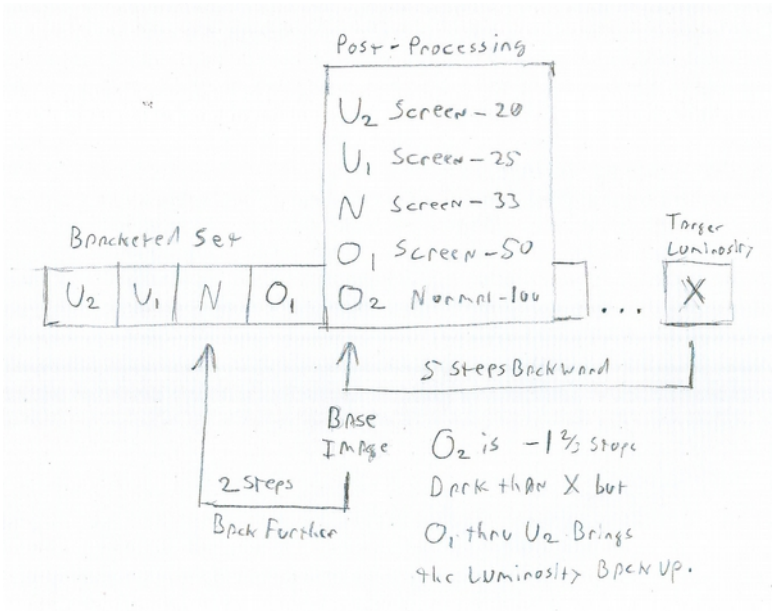
exposures I can't specify directly with the added flexibility of taking 3 or 5 images in total. It is using the .3 stops increments via .3EV3 and .3EV5 I want to cover next but I would be less than complete in covering all my options if the 2EV3 or 3EV3 wasn't mentioned. Because the gaps in the time of exposures taken you can figure the set will take the time of the longest exposure so no fancy tables or special features gained.

The biggest advantage I found was the luminosity of each image is close enough in range to be less obvious overall and in whatever process I may apply that is a big help. The illustrations should speak for themselve but the general rule is 7 steps back to set the neutral image for .3EV5 set and step back 4 steps + 1 step = 5 steps total for a .3EV3 set when setting the neutral image.





I'm still working out the rules here I as go but for subtle transition of movement the . 3EV3 or 5 bracketed sets may be more useful; however, using the full stops of 1EV3 may have more dramatic and obvious changes. The windy Fort Davis day is an example of the more dramatic effect using 1EV3. Due to the nature of the technique I have a level of guest work and luck to deal with so many sets will be taken and this opens up a new option. Provided the images all match and don't have camera shift then look at the images in another set as time between an image on one set and the other may have the visual effect you need. Reality isn't my goal so artistic license is allowed.



Processing the set

The neutral image is the key for taking the bracketed set but in post processing it will be the most overexposed image that is used as the base layer. In the example here O2 and it will be 1 and 2/3rds stops darker than needed. It is a starting point so doesn't matter because in the order of next brightest to the darkest image photo stacking will almost make up for that lost in

luminosity.

My post processing is done in Gimp and while it likely has more advanced features I do love the challenge of using layers and blending modes. I use a basic photo stacking system where the percentage of opacity is based on 1 over the layer number to work the magic.

Layer 5 U2 screen @ 1/5 = 20 percent
Layer 4 U1 screen @ 1/4 = 25 percent
Layer 3 N screen @ 1/3 = 33 percent
Layer 2 O1 screen @ 1/2 = 50 percent
Layer 1 O2 normal @ 1/1 = 100 percent

Overall the basic layering shown above works well but is just a starting point as I get lost in the process and just play. My notation may not make total sense at first but I have an image taken in the sand dunes to show you one possible use of the technique.

This was taken on 02/13/2022 in the Monahans Sandhills State Park with a neutral image at 1/400, F/16, and ISO-100. It wasn't as windy as it looks but artistic license helps show the artist at work creating the sand art. The tables of calculated values will be at the end of this document but I will pull the up entry for the values this image used.

.3EV5 Combinations					
Over by .66	Over by .33	Neutral	Under by .33	Under by .66	1 over X
250	320	400	500	640	75.83

The actual starting exposure was 1/80 and when stepped back 7 “clicks” or steps I landed on 1/400 but the calculated total luminosity would be 1/75.83 versus the 1/80 I started with. The base image I used was the 1/250th image and built up off of this.

Layer 7 – copy visible of lower layers -normal @ 100 percent
I applied a curve with three points set at (113, 51), (186, 107), and (227, 175) to layer 7.
Layer 6 - 2272 (U2) -screen @ 20 percent
Layer 5 - 2273 (U1) - screen @ 25 percent
Layer 4 - 2274 (N) - screen @ 33 percent
Layer 3 - 2275 (O1) - screen @ 50 percent
Layer 2 - 2271 - normal @ 66 percent
2271 was the O2 from a previous set but being at the same intensity allows a good blending at 66% with the contents of the layer below.
Layer 1 - 2276 (O2) - normal @ 100 percent

As you can see the formula, as I like to call it, is not that complex and didn't take long to implement. The hard point was finally going to another set and using that image to blend the wind effect, as the combination with the set used wasn't quite “right”. My approach isn't straight forward some days but within that time used to make the image work I learn in the process. Layers 3 through 6 photo stack onto the newly combined base of layer 1 and 2. Layer 7 is unique to Gimp as I have to create a copy of the layers below to apply the curve to.

Final thoughts

As of this writing I have patterns, tables of data only I would likely fully appreciate, a better sense of how the stops work and ways to connect that to the post processing and the raw input collected; however, in the process of finding ways to use the system verses the normal way what will I learn. It isn't about perfection because adding in multiple exposures when one is more than achievable, especially hand held, creates an image that is unique. Each image attempted is one more clue to something I can note and use, even if unrelated as I use layers and blending modes to work my magic so fragments of ideas do get applied to the next attempt. Maybe the most successful aspect of the system is I tried something new and in the process know more about the tool I take for granted. It works and good results are possible, so as with any technique I will learn when to apply it and how to achieve the image needed in post.

What have you learned from this attempt to explain a system that in my mind makes

sense? The answer will depend but I encourage you to just play and learn the tools you use to see what is possible.

The tables on the following pages have the neutral images values marked in red and the results over 1 second or longer have a grey background. Also these tables were generated on a spreadsheet so .4 seconds is listed as 2.5, .6 seconds listed as 1.5, and .8 seconds is listed as 1.25. So the last entries in tables after 1/2 and between 1 second should make better sense now.

Also worth noting is some of the resulting combination produce an exposure time greater than the 30 second limit. How useful this is in practice I couldn't tell you but it is a possible option to consider.

1EV3 Combinations			
Over by 1	**Neutral**	**Under by 1**	**1 over X**
1000	2000	4000	571.43
800	1600	3200	457.14
640	1250	2500	361.99
500	1000	2000	285.71
400	800	1600	228.57
320	640	1250	182.23
250	500	1000	142.86
200	400	800	114.29
160	320	640	91.43
125	250	500	71.43
100	200	400	57.14
80	160	320	45.71
60	125	250	34.88
50	100	200	28.57
40	80	160	22.86
30	60	125	17.24
25	50	100	14.29
20	40	80	11.43
15	30	60	8.57
13	25	50	7.30
10	20	40	5.71
8	15	30	4.44
6	13	25	3.53
5	10	20	2.86
4	8	15	2.26
3	6	13	1.73
2.5	5	10	1.43
2	4	8	1.14
1.5	3	6	1.17
1.25	2.5	5	1.40
1	2	4	1.75
1.3	1.5	3	2.30
1.6	1.25	2.5	2.80
2	1	2	3.50
2.5	1.3	1.5	4.47
3.2	1.6	1.25	5.60
4	2	1	7.00
5	2.5	1.3	8.80
6	3.2	1.6	10.80
8	4	2	14.00
10	5	2.5	17.50
13	6	3.2	22.20
15	8	4	27.00
20	10	5	35.00
25	13	6	44.00
30	15	8	53.00

.3EV3 Combinations			
Over by .33	**Neutral**	**Under by .33**	**1 over X**
2500	3200	4000	1038.96
2000	2500	3200	824.74
1600	2000	2500	655.74
1250	1600	2000	519.48
1000	1250	1600	412.37
800	1000	1250	327.87
640	800	1000	262.30
500	640	800	207.79
400	500	640	164.95
320	400	500	131.15
250	320	400	103.90
200	250	320	82.47
160	200	250	65.57
125	160	200	51.95
100	125	160	41.24
80	100	125	32.79
60	80	100	25.53
50	60	80	20.34
40	50	60	16.22
30	40	50	12.77
25	30	40	10.17
20	25	30	8.11
15	20	25	6.38
13	15	20	5.17
10	13	15	4.11
8	10	13	3.31
6	8	10	2.55
5	6	8	2.03
4	5	6	1.62
3	4	5	1.28
2.5	3	4	1.02
2	2.5	3	1.23
1.5	2	2.5	1.57
1.25	1.5	2	1.97
1	1.25	1.5	2.47
1.3	1	1.25	3.10
1.6	1.3	1	3.90
2	1.6	1.3	4.90
2.5	2	1.6	6.10
3.2	2.5	2	7.70
4	3.2	2.5	9.70
5	4	3.2	12.20
6	5	4	15.00
8	6	5	19.00
10	8	6	24.00
13	10	8	31.00
15	13	10	38.00
20	15	13	48.00
25	20	15	60
30	25	20	75

.3EV5 Combinations					
Over by .66	**Over by .33**	**Neutral**	**Under by .33**	**Under by .66**	**1 over X**
1600	2000	2500	3200	4000	479.04
1250	1600	2000	2500	3200	379.15
1000	1250	1600	2000	2500	300.75
800	1000	1250	1600	2000	239.52
640	800	1000	1250	1600	190.93
500	640	800	1000	1250	151.23
400	500	640	800	1000	120.30
320	400	500	640	800	95.81
250	320	400	500	640	75.83
200	250	320	400	500	60.15
160	200	250	320	400	47.90
125	160	200	250	320	37.91
100	125	160	200	250	30.08
80	100	125	160	200	23.95
60	80	100	125	160	18.72
50	60	80	100	125	14.89
40	50	60	80	100	11.88
30	40	50	60	80	9.30
25	30	40	50	60	7.41
20	25	30	40	50	5.94
15	20	25	30	40	4.65
13	15	20	25	30	3.75
10	13	15	20	25	3.00
8	10	13	15	20	2.39
6	8	10	13	15	1.87
5	6	8	10	13	1.50
4	5	6	8	10	1.19
3	4	5	6	8	1.08
2.5	3	4	5	6	1.35
2	2.5	3	4	5	1.68
1.5	2	2.5	3	4	2.15
1.25	1.5	2	2.5	3	2.70
1	1.25	1.5	2	2.5	3.37
1.3	1	1.25	1.5	2	4.27
1.6	1.3	1	1.25	1.5	5.37
2	1.6	1.3	1	1.25	6.70
2.5	2	1.6	1.3	1	8.40
3.2	2.5	2	1.6	1.3	10.60
4	3.2	2.5	2	1.6	13.30
5	4	3.2	2.5	2	16.70
6	5	4	3.2	2.5	20.70
8	6	5	4	3.2	26.20
10	8	6	5	4	33.00
13	10	8	6	5	42.00
15	13	10	8	6	52.00
20	15	13	10	8	66.00
25	20	15	13	10	83.00
30	25	20	15	13	103.00