Depth-of-Field for Smarties - Brief

Robert Stone v2.4 July 2021

This is a 2-page summary of the TL;DR[1] 30-page version. I've removed all the background material; only the final 'lessons' remain. The goal here is to reliably achieve sharpness in depth, the whole image, all the time. Not always needed or desired but crucial in some images. But I have to say, 'Where do I focus so everything is sharp?' seems to be the most frequently asked question on YouTube channels and photography forums. And just as frequently, the answer is a fuzzy 'This is what works for me.' I've seen numerous YouTube videos from very famous photographers who spend hours finding a good composition, then seem to guess what to do!

Here's the 100% guaranteed answer: Use DOF tables! Chances are you are already using your smart phone to preview compositions, and your phone likely has a dedicated, sophisticated camera app and image editor. Just add a Depth-of-Field app! I use the Simple DOF and PhotoPills apps. There are many others. (Printed DOF tables are available but awkward to carry and use. These are discussed in the long version of this eBook.)

As described here, all you need to know from your DOF tables can be gathered in just a few seconds, a far briefer time than, say, mounting and adjusting 120mm square filters.

Both phone and printed tables are generally based on the so called 'Zeiss' formula for 35mm film and fairly small (about 8"x10") prints.[2] This formula uses a circle of confusion (COC) of 0.030 mm for full frame (FX) cameras, and 0.020 mm for APS-C (DX) cameras. Good for small prints; not so good for larger. When an image is displayed larger the COC blur circle becomes more prominent.

So first, set the app to use modern COC choices (0.025 for FX; 0.016 for DX) to overcome the Zeiss formula issue. Both Simple DoF and PhotoPills let you choose a specific camera model, or a specific COC value. The camera model options seem to use the Zeiss formula, so look for the specific COC value shown above.

Depth of Field

These are the four approaches to maximizing DOF that I find on the World Wide Web. You may have come across them already:

Hyperfocal Distance

This is the most commonly recommended focus distance for maximum DOF that includes distant details. At the hyperfocal distance, your near and far objects are at the edges of the sharpness zone.

Double the Hyperfocal Distance

This suggests that you focus the camera at twice the hyperfocal distance. With this focus point, the horizon is well inside the sharpness zone and the near in-focus distance is closer than when the lens is focused at infinity. One photographer I know uses triple the hyperfocal distance if the horizon must be sharp.

Focus at Infinity

This method guarantees good detail in distant objects, mountains, or cityscapes. I actually start with this method.

Double the Distance

This method suggests that you determine the distance to the nearest object that must be in focus, then focus your camera at twice that distance. Surprisingly, actual apertures are never mentioned for this method. There are excellent photographers that teach this method; they always seem to use wide-angle lenses at small apertures. Undoubtedly, their skills reflect years of experience. I cannot recommend this method simply because of the lack of specifics.

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[1] TL;DR – "Too Long; Didn't Read" An editor's notation when writing gets too tedious to continue reading.

[2] If you check Wikipedia for Zeiss formula, you will find the origin of the name is obscure, and unlikely to be related to the Zeiss lens company or its founder.

In Practice

Start with the Focus at Infinity method. With your image composed and exposure set, open your DOF app and set your selected focal length and f/stop. Set the subject distance to infinity. On one of my apps, subject distance only goes to 999 feet, but this value effectively works.

Check your DOF tables for the near in-focus distance. If the near in-focus distance is closer than the nearest part of your subject, you're all done! If necessary, use the second or third method to refocus your lens as suggested. These move the near in-focus distance closer, so may place your near subjects inside the zone of sharpness.

This is how it might work. From my DOF app …

> 24mm lens focused at infinity : FX (full frame) camera : f/11 : COC 0.025 : Hyperfocal distance = 6' 9"

These are the near in-focus distance for each method:

Focal Method	Focus Distance	Near Focus Distance
Focus at Infinity	Infinity	6' 9"
Double Hyperfocal Distance	13' 6"	4' 5.8"
Hyperfocal Distance	6' 9"	3' 4.5"

- When focused on infinity, the near focus is the hyperfocal distance.
- Using the Double Hyperfocal Distance, the near in-focus point gets just over 2' closer.
- The hyperfocal distance only moves the near focus distance about one foot nearer than that.

As you can see, the Near Focus Distance is a key factor in achieving the DOF you need.

- Use 'Focus at Infinity' first.
- Use 'Double the Hyperfocal Distance' if you need a closer near in-focus point.
- Use 'Hyperfocal Distance' only if necessary. Check your LCD display to confirm infinity focus.

The focus at infinity method may get the near in-focus distance surprisingly close and may be all you need! Double the Hyperfocal Distance method gets you amazingly close! This tip may make work in the field a bit easier:

> At 24mm, f/11, full fame camera, the near focus point for the Double Hyperfocal Distance method is *about the same as my tripod height* when set at eye level. That's easy to evaluate!

If your DOF needs to be even closer, make an image using the Double the Hyperfocal Distance method, then refocusing at the Near Focus Distance for that method (~4', 6"). This will get your near focus distance down to 2.3 feet. Then make a second image for a 2-frame stack.[3]

With these values as a foundation, it is easy to anticipate needed adjustments. I chose 24mm for this example as it is considered both the wide end of the 'normal' lens focal lengths, or the beginning of the 'super wide' focal lengths. Shorter focal lengths will have deeper DOF values, so these settings will work! If you do not want to use a DOF app when working, find a few values for your camera and set of lenses. Write them down to carry with you. Examples on the last page.

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[3] See the full version of this document if you need DOF to be even deeper. It has more detail, some material about optics, a closer look at the two smart phone apps mentioned and shows an especially useful tool for determining accurate focus points. It covers focus stacks, too!

Bonus Material

Of course, I still recommend a smart phone app. But tables like these that you can prepare at home will be useful if you do not have a smart phone, or your phone battery fails!

Here are examples for my gear. The first three rows are the widest values for three of my lenses. The others are 'check points' for reference. If you need other focal length, use the values for the next longer focal length value. Create your own table using the 'sweet spot' aperture value for your lenses.

Sample DOF Data : Full Frame : f/8 : COC 0.025 Hyperfocal Distance (HFD) in italic *Red*

Distance in **Feet** & **Inches**

14 mm	Focus	Near Focus
Infinity	∞	*3' 3"*
Double HFD	6' 6"	2' 2"
HFD	*3' 3"*	1' 9"

16 mm	Focus	Near Focus
Infinity	∞	*4' 3"*
Double HFD	8' 6"	2' 10"
HFD	*4' 3"*	2' 1.5"

20 mm	Focus	Near Focus
Infinity	∞	*6' 7.5"*
Double HFD	13' 3"	4' 5"
HFD	*6' 7.5"*	3' 3.75"

24 mm	Focus	Near Focus
Infinity	∞	*9' 6"*
Double HFD	19'	6' 4"
HFD	*9' 6"*	4' 9"

35 mm	Focus	Near Focus
Infinity	∞	*20' 2.5"*
Double HFD	40' 5"	13' 5"
HFD	*20' 2.5"*	10' 1"

50 mm	Focus	Near Focus
Infinity	∞	*41' 2"*
Double HFD	82' 4"	27' 5"
HFD	*41' 2"*	20' 7"

Distance in **Meters**

14 mm	Focus	Near Focus
Infinity	∞	*1*
Double HFD	2	0.66
HFD	*1*	0.5

16 mm	Focus	Near Focus
Infinity	∞	*1.3*
Double HFD	2.6	0.86
HFD	*1.3*	0.57

20 mm	Focus	Near Focus
Infinity	∞	*2*
Double HFD	4	1.3
HFD	*2*	1

24 mm	Focus	Near Focus
Infinity	∞	*2.9*
Double HFD	5.8	1.9
HFD	*2.9*	1.5

35 mm	Focus	Near Focus
Infinity	∞	*6.2*
Double HFD	12.4	4.1
HFD	*6.2*	3.1

50 mm	Focus	Near Focus
Infinity	∞	*12.6*
Double HFD	25	8.3
HFD	*12.6*	6.2