Rocky Mountain Reflections Photography, Inc.

DEPTH-OF-FIELD HYPERFOCAL DISTANCE

This is a discussion on:

1. Depth-of-field.

2. Determining the appropriate f-stop and distance to focus at to achieve sharpness throughout an image.

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NATURE RMRP PHOTOGRAPHY

Depth-of-field – Refers to how much of an image in terms of distance is sharp and appears in focus.

When a lens is focused, it is focused at one distance,

but

there is a range of distances in the image that also appear in focus.

This range of distance is known as depth-of-field and is dependent on the size of the **aperture** selected.

With smaller apertures more of the foreground, mid-ground and background will appear in focus creating greater depth-of-field.

Conversely, with larger apertures less distance within the image will appear in focus creating shallow depth-of-field.

Small aperture; F/22

Large aperture; F/2.8

Now we'll have a quick review of how photographers determined depth-of-field settings in the past

This will aid in understanding what's happening now.

In the old days, a hyperfocal scale was printed on all fixed focal length lenses. The scale was matched to the focal length of the lens; different focal lengths had different looking scales.

24mm lens (fixed focal length lens)

Here the aperture is set to f/22 and the brown of the number “22” corresponds to the brown hash marks on the lens.

The range of distance between the hash marks will appear sharp.

By setting the aperture to f/22 and focusing the lens at 3 feet, it achieves maximum depth-of-field of about 1.6 feet to infinity.

Here the aperture is set to f/11 and the lens is focused in such a way as to achieve the maximum depth-of-field.

Focused at 6 feet, resulting in depth-of-field from 3 feet to infinity.

Does the focal distance always need to be set to achieve maximum depth-of-field?

No, here the lens is set to f/11, but is focused at infinity resulting in a depth-of-field of 5 feet to infinity.

Currently, this lens set to f/22 and focused for maximum depth-of-field.

If we change the aperture from f/22 to f/11, and do not refocus, what is the range of distance that will appear sharp?

About 2 feet to 6 feet.

Do modern lenses still have the hyperfocal scales printed on them?

No.

Because most lenses are zoom lenses, they don't have them.

Even many modern fixed focal length lenses no longer have the scales.

Do photographers still need some type of reference material to help determine the depth-of-field properties of their lenses?

Yes.

So, how can a photographer determine what is the appropriate

aperture

&

proper distance to set the focus

to achieve the required depth-of-field?

Well, in the field, once we've composed a photograph, we'll need to know two variables:

1. What **focal length** the lens is set to.

2. What is the **range of distance** in the scene that needs to be sharp.

Why?

Because, these are the two variables needed in the calculation to obtain the appropriate depth-of-field.

Determine 1st Variable

Here the focal length is set to 70mm (top center green circle).

The focal length range of the lens below is 28 - 70mm (bottom left green circle).

Look at your lens, discover it's focal length range and how to read what focal length is selected.

Determine 2nd Variable - Range of Distance

Estimate or measure the distance from the sensor plane of the camera to the closest item in the scene that needs to be sharp.

Also, estimate the distance to the farthest item that needs to be sharp. Often this distance is infinity (∞). This is not “actual infinity”, but a point at which the lens can no longer distinguish the difference in distance. The wider the focal length, the closer “infinity” will be to the camera.

Then we consult a Hyperfocal Chart (Maximum Depth-of-Field)

Where there is a column of focal lengths on the left and a row of aperture choices across the top.

	f/8	
28mm	**16.1ft**	**8.1ft - ∞**
	Focus at this distance.	Resulting depth-of-field.

The left sub column (below the aperture) is the distance to focus at.

The right sub column (below the aperture) is the range of distance that will appear in focus.

Hyperfocal Chart for 35mm Cameras
With 1.5 Lens Multiplication Factor (LMF)

	f/8		f/11		f/16		f/22	
12mm	3ft	1.5ft - ∞	2.1ft	1.1ft - ∞	1.5ft	0.75ft - ∞	1.1ft	0.6ft - ∞
18mm	6.6ft	3.3ft - ∞	4.8ft	2.4ft - ∞	3.3ft	1.7ft - ∞	2.4ft	1.2ft - ∞
24mm	11.8ft	5.9ft - ∞	8.6ft	4.3ft - ∞	5.9ft	3ft - ∞	4.3ft	2.2ft - ∞
28mm	16.1ft	8.1ft - ∞	11.7ft	5.9ft - ∞	8ft	4ft - ∞	5.8ft	2.9ft - ∞
35mm	25.1ft	12.6ft - ∞	18.3ft	9.2ft - ∞	12.6ft	6.3ft - ∞	9.1ft	4.6ft - ∞
50mm	53.2ft	25.7ft - ∞	37.3ft	18.7ft - ∞	25.6ft	12.8ft - ∞	18.6ft	9.3ft - ∞
70mm	101ft	50.3ft - ∞	73.1ft	36.6ft - ∞	50.2ft	25.1ft - ∞	36.5ft	18.3ft - ∞
100mm	205ft	103ft - ∞	149ft	75.6ft - ∞	103ft	51.3ft - ∞	74.6ft	37.3ft - ∞
150mm	461ft	231ft - ∞	336ft	168 - ∞	231ft	115ft - ∞	168ft	84ft - ∞
200mm	820ft	410ft - ∞	597ft	298ft - ∞	410ft	205ft - ∞	298ft	149ft - ∞

The left sub column (under aperture) is the distance to focus at. The right sub column (under aperture) is the range that will appear in focus. ∞ = infinity.

For Example:

In this scene the rocks in the bottom right (foreground) are 6 feet away. Focal length of the lens is 28mm.

1. What aperture will give the depth-of-field required to make the entire image sharp?

2. What distance does the lens need to be focused at to achieve the maximum depth-of-field for the selected aperture?

Well, by consulting the chart on page 19 it seems that choosing f/11 and setting the focus distance to 11.7 feet would create the proper depth-of-field.

And, it might, but who can measure any of the distances involved accurately and precisely when in the field? I can't.

So, If possible, I recommend always choosing one aperture smaller, than the first one that works.

In this case, I think the best aperture to choose is f/16 and setting the focus distance between 8 and 11 feet is appropriate.

How does one set the focus distance?

Answer: Our lesson "Landscape Focus Settings" will show how to properly set up the camera and a procedure for focusing.

With most landscape images it is desirable to have as much of the image as sharp as possible.

Since we often have a close foreground and distant background, small apertures are usually required to achieve sharpness throughout the image.

Are small apertures always the best choice?

No, not always.

Sometimes it's too dark or windy to use the smallest apertures.

Additionally, apertures f/8 & f/11 usually yield the sharpest images for most lenses.

So if the foreground elements are not too close and f/8 or f/11 will yield adequate depth-of-field, then select f/8 or f/11 for a sharper image.

Example of when to choose f/8 or f/11.

In this image the focal length of the lens was about 200 mm and the rocks were over 1000 feet away from the camera.

Focus At	near - ∞	f/8		f/11		f/16		f/22	
200mm		820ft	410ft - ∞	597ft	298ft - ∞	410ft	205ft - ∞	298ft	149ft - ∞

When the lens is focused on the foreground rocks, 1000 feet away, any aperture will yield enough depth-of-field.

So choosing f/8 or f/11 will result in the sharpest image possible.

Should a photographer always use the hyperfocal charts to set the focus distance for maximum depth-of-field?

No, only when the scene requires maximum depth-of-field.

Ok, so how does a photographer know at what distance to focus the lens if the maximum depth-of-field is not required.

Probably the easiest way is by using an app on a tablet or smart phone, there are many free ones available.

Additional Thoughts

1. With smaller apertures (f/16, f/22…) diffraction becomes a factor, reducing over all sharpness. However, I believe the softness from diffraction is usually more acceptable than the blurriness caused by not capturing enough depth-of-field.

2. The math used to calculate hyperfocal charts and phone apps are based upon someone’s opinion about what constitutes sharpness.

What is truly sharp? The charts on my website and many phone apps may give settings where prints at 24” x 36” and larger showing softness at distances predicted to be sharp.

One Apple app called “TRUE DoF.” Is a bit pickier and takes diffraction as a result of small apertures into account. I use the free “INTRO” version. I believe other “pickier” apps are also available.

Review Image Sharpness in Camera

Nothing is worse than spending a lot of time and money taking photos only to discover, at home, when it's too late, that an image is not quite as sharp as it could be.

With today's digital cameras, it's easy to review for sharpness in the field. Now, if softness is discovered, there is opportunity to make an adjustment and re photograph the scene.

To Check Sharpness

1. Replay the image.

2. Zoom all the way in (this is over magnification, the image may seem blurry).

3. Use the zoom out tool to zoom out two movements. One should now be viewing the image pixel to pixel; 100% view.

4. Now, move around the image checking for sharpness in the foreground and background.

5. If the sharpness is not acceptable, reevaluate and adjust the depth-of-field settings, then take another photograph.

Some cameras have an indicator that let the photographer know when the view is 100%.