

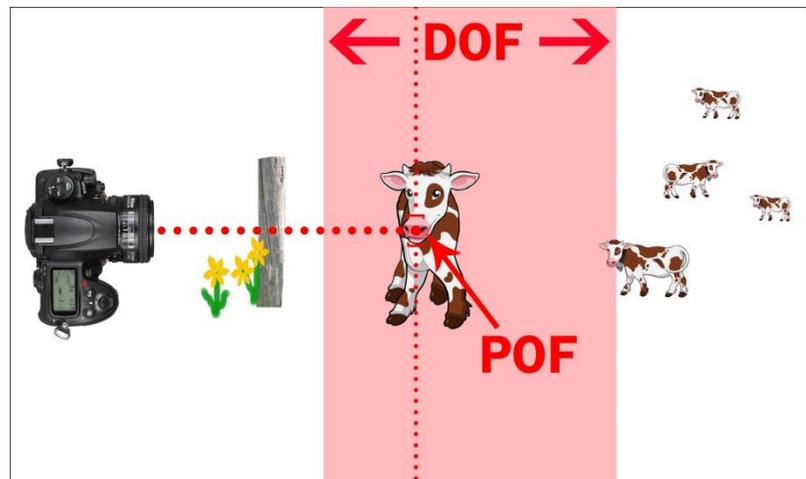
Depth of Field (DOF)

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What Is Depth of Field?

- The range of focus from front to back; the zone of 'acceptable sharpness' in front of and behind the Point of Focus (POF), ranging from 'narrow'/'shallow' to 'deep'/'wide'.
- DOF occurs as a gradual, accelerating transition from tack-sharp at the POF to blurry at the near/far extremes, but the human eye and the camera's resolution cannot distinguish the miniscule differences of focus near the POF, which creates a zone around it that *appears* sharp.
- DOF is *not* synonymous with sharpness: sharpness is partly determined by DOF, but also influenced by motion (of the camera or subject), and by the quality of the lens-camera combination.
- Note: DOF falls approximately 1/3 in front of and 2/3 behind the POF (the proportions vary slightly with lens focal length).



Why is DOF Important?

- DOF determines the appearance of near-to-far sharpness in the resulting image.
- When DOF is used effectively it emphasizes the subject by rendering it sharp, and when used selectively can create a 3-dimensional appearance and eliminate potentially distracting elements in the foreground/background.
- Landscapes: traditionally deep DOF to make the image tack-sharp from foreground to infinity.
- Nature and Portraits: traditionally narrow DOF, using sharpness to emphasize the subject while rendering the background soft.

What Determines Depth of Field?

1) Type of Camera:

- Sensor size/quality determines image resolution and the sensor's ability to detect miniscule difference in sharpness away from the POF.
- The larger and more sensitive the sensor, the *narrower* its natural DOF, so medium-format or full-frame DSLRs have *less* natural DOF than APS, bridge, compact, P&S or phone cameras (so professionals can achieve the limited DOF effects impossible with consumer-grade cameras).

2) Aperture (f-Stop)

- *Aperture*: the opening through which light enters the camera.
- *f-stop*: a measure of aperture = the ratio of lens focal length and aperture diameter.

Aperture Diameter	Lens Focal Length		
	50 mm	100 mm	200 mm
25 mm	$f2$	$f4$	$f8$
12	$f4$	$f8$	$f16$
4.5 mm	$f11$	$f22$	$f44$

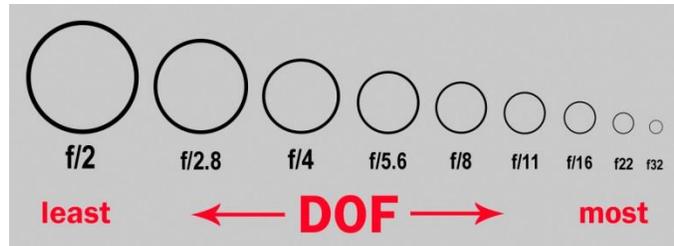
→ **f-stop = Focal length ÷ Aperture diameter**

$$100\text{mm} \div 25\text{mm} = f4$$

$$100\text{mm} \div 4.5\text{mm} = f22$$

→ **The Bottom Line**: wide apertures have small f-numbers ($f2$) and narrow apertures have large f-number ($f22$)

- *DOF and Aperture*: large apertures (small f-numbers) have narrow DOF, and small apertures (large f-numbers) have wide DOF, governed by complex optical laws that determine how precisely directed light rays are as they enter the camera.



- *Diffraction*: extremely narrow apertures ($f16+$) can cause softening by ‘squeezing’ of light rays.
- *Sweet Spot*: most lenses have an optimum aperture for sharpness, typically about 2 stops narrower than the lens’ widest ($f5.6$ for an $f2.8$ lens), and an optimum range of sharpness from there up to about $f11$ depending on the lens quality.
- *Caution re Exposure*: aperture influences amount of light entering camera so, for the given light conditions, as you adjust the f-stop you must also adjust shutter speed and/or ISO to achieve the same exposure.

3) Distance between the Camera and the POF

- *Distance & DOF*: the closer the POF, the narrower the DOF.
- *Physical distance*: moving closer or farther from the focus point.
- *Lens Focal Length*: using a longer or shorter lens to effectively bring the subject closer or farther away by narrowing or widening the angle of view.
- *Caution*: choice of lens focal length and distance from POF will significantly change the positioning of elements in the frame and the visual design of the resulting image.

Rules of Thumb

- *For maximum DOF*: use a wide-angle lens (<50mm), set aperture to $f16$, set POF approximately 1/3 of the way into the frame (= a shortcut for the complicated “hyperfocal distance” measurement).
- *For narrow DOF*: use a longer lens and/or get closer to subject, set wide aperture ($f2.8$ - $f4$), use DOF-preview button to check range of focus, use manual focus to fine-tune positioning of DOF.

Further Reading

www.exposureguide.com/focusing-basics.htm

www.dofmaster.com/articles.html

www.cambridgeincolour.com/tutorials/depth-of-field.htm