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How to... Control depth of field

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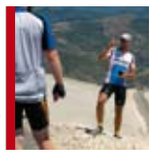
Whole control

Following our Masterclass on shutter speeds last issue, Doug Harman looks at the other key component in exposure control and creative camera use: apertures. Get better pictures by understanding this essential setting

[Main] For this lone sunflower image, a very large aperture of f2 was employed to keep the depth of field as narrow as possible. The aim was to isolate this giant sunflower from the cluttered background and because of the distance from the subject and the fact other foreground plants got in the way, it helped to blur those away as well
Shot details: Olympus E-410 with 35-100mm Zuiko Digital zoom lens at 86mm and f2, 1/3,200sec, ISO 100



Alongside shutter speeds, aperture control – sometimes called f-stop control – is the other key ingredient in creating properly exposed images. Like shutter speeds, apertures offer creative control, which can mean the difference between a stunning shot with correctly placed emphasis or a cluttered image lacking the correct emphasis.

Controlling your camera's apertures provides two crucial reins over how images look. On the simplest level, the aperture helps control the amount of light able to pass through the lens and onto the sensor and, in conjunction with the shutter speed control, helps get a correctly exposed shot.

But the aperture you select also provides key creative control: aperture selection controls depth of field (DoF). That is, it controls the zone of acceptable sharpness in front of and behind your subject.

You can use this effect to remove cluttered or unwanted background detail for, say, a portrait, by having it blur away by using a larger aperture. Or, conversely, ensure that detail from the foreground to the farthest point in a scene is pin sharp, particularly when shooting landscapes, for example.

In all cases, understanding what each aperture or f-stop means to the look of the image and how each f-stop affects the images you create is crucial.

Probably the most important element of aperture control is that it is used to ensure an image is correctly exposed. Use of a large aperture will allow additional light to enter the camera and vice versa. Here, the shutter speed used comes in to play to control how much of that light hits the sensor; the larger the aperture, the faster the shutter speed will need to be for a correct exposure, as more light is getting onto the sensor.

The apertures are denoted on a camera or lens using a series of numbers (usually indicated on the lens or on the camera's LCD or both) and a typical series of apertures would run from around f2.8 to about f22. The lower the f-stop, the 'faster' or 'brighter' the lens is said to be; 'faster' because a

Circle of confusion

Depth of field (the zone or area that is acceptably sharp) does not suddenly switch from sharp to unsharp, but changes gradually. The area immediately in front of and behind the correct focus distance (the point that is properly focused or acceptably sharp) loses sharpness even if you cannot perceive the subtlety of the changes.

Because of the very gradual nature of the transition from the point of acceptable sharpness to being unacceptably sharp, the term 'circle of confusion' is used to describe it. The circle of confusion is the amount a point in a shot needs to become blurred to be perceived as unsharp.

Once this circle of confusion is sufficient to be visible (usually as measured on a standard 10 x 8-inch print viewed at a standard distance of a foot), the region is described as being outside the depth of field and no longer 'acceptably sharp'.

These circles of confusion can be seen; often the term 'bokeh' is used to describe the aesthetic quality of the unsharp areas, where point sources of distant light in a shot are visible as small blurred circles.

[Above] The narrow depth of field in this shot has been achieved by using a long focal length of 150mm and the maximum possible aperture for that focal length. Note how the circles of confusion in the unsharp area of the shot are evident and the 'quality' of the bokeh (defocused area) effect. Processing to remove excessive noise has left some artefacts visible in the enlargement

brighter lens allows faster shutter speeds to be used overall, or 'brighter' because it simply allows more light in than, say, a lens with a less bright maximum aperture of f3.5. But both terms are often used to describe such lenses.

Another benefit of a brighter lens (that's one with a larger maximum aperture) is that they are typically of higher optical quality than lenses with a smaller maximum aperture. But, on the downside, they tend to be much larger and heavier since the glass from which they are made needs to be much bigger.

The creative aspect of aperture control is the manipulation of the zone of sharp focus or DoF around your subject, and how this affects the look of shot. There are three key aspects that change the depth of field: aperture control, the camera to subject distance and changes in the lens focal length.

Aperture priority control is usually indicated on a mode or control dial as an 'A' or 'Av' and allows you to control the aperture size in use while your camera automatically adjusts the shutter speed to provide a properly exposed shot. A larger aperture will force a faster shutter speed – because more light enters the camera – while smaller apertures will force slower shutter speeds.

There's a direct relationship between the aperture and the depth of field in a shot, where the smaller the aperture (a higher f-stop number), the larger the depth of field becomes. Therefore, if you want a large area to be sharp from near to the camera to the far distance, for example, then an aperture such as f16 or f22 needs to be used. This is ideal for landscape work where detail to the farthest extent of a scene is often paramount.

Depending on the light and the sensitivity of the camera (the ISO value selected), you might want – or need – to use a tripod, monopod, or some other form of support to prevent camera shake, since slower shutter speeds will be needed as the aperture is reduced.

[Above] Delicate blur: The aim here was to create emphasis on the centre of the image. The bright lighting meant deep shadow helped eliminate a distracting background and a f5.6 aperture gently controlled the blur for the foreground and background
Shot details: Olympus E-410 with 14-42mm Zuiko Digital zoom lens at 33mm and f5.6, 1/500sec, ISO 100

[Above right bottom] Wide-angle lens and depth of field: In this shot, a wide 17mm focal length has been combined with a relatively large aperture but has still enabled a good depth of field to be maintained
Shot details: Olympus E-410 with 14-42mm Zuiko Digital zoom lens at 17mm and f3.8, 1/100sec, ISO 100

[Above right top] Distant subjects: Shot using a tripod and a 83mm focal length (here, all focal lengths have a x2 multiplier applied, making this a 166mm focal length). It has a zone of 'acceptably sharp' focus running from roughly halfway across the field of lavender to infinity, ensuring the abbey is sharply rendered
Shot details: Olympus E-410 with 40-150mm Zuiko Digital zoom lens at 83mm and f11, 1/60sec, ISO 100

If you want to concentrate a viewer's attention to a particular point in your photo, as with a portrait, for example, where you might want to throw the background out of focus because it is cluttered and distracting, then a larger aperture (smaller f-stop number) needs to be employed. Experimenting with apertures in these situations is your best bet. Here an aperture of f2.8 would be a typical choice (but will depend on the lens's maximum aperture), while for most general picture taking, an f-stop of around f8 or f11 will be typical. These larger apertures provide a good balance between depth of field and exposure control on most cameras, including compacts, offering reasonable shutter speeds for example.

The most noticeable thing about lens focal length and DoF is that a wide-angle lens appears to provide a greater depth of field than a telephoto lens. This effect is actually a facet of the fact you use a longer focal length to get closer (or magnify) the subject of the shot, which flattens perspective. Here the background appears to be larger in relation to the foreground even if it is blurred. Depth of field appears narrower using a DSLR than a digital compact too, because we need to use longer focal lengths to achieve a similar field of view.

If, however, your subject occupies the same amount of space in the frame for both a wide-angle and a telephoto lens – in other words, it has a constant magnification despite the two lenses' differing focal lengths – the total apparent depth of field is, for practical purposes, constant with focal length.

There are caveats and in some cases the depth of field varies slightly; typically, for high magnification focal lengths or when shooting near the hyperfocal distance (when a wide-angle lens may give a greater depth of field than a telephoto lens). To see this you'd need to get much closer with the wide-angle lens or a good degree further away from the subject when using the telephoto lens, which is rarely practical.

Conversely, for high magnifications, say, when shooting macro subjects, the pupil magnification – the symmetry of the entrance pupil (the lens aperture you see when looking into a lens from the front) and the exit pupil (the same opening as seen from rear) – has a bearing. It counteracts the advantages in depth of field afforded by a wider-angle lens and increases them for telephoto and macro lenses.

The last limiting factor is when taking pictures at or near the hyperfocal distance where a wide-angle lens provides a greater depth of field to the rear of your subject and can more readily focus at infinity for a given focal length.

Another aspect of apertures is that the maximum value available to you will depend on the focal length in use. As focal length ▸▸

Hyperfocal distance

This is the distance of the nearest object in a scene that is acceptably sharp when the lens is focused on infinity and can be defined as the focus distance that puts the maximum allowable circle of confusion at infinity.

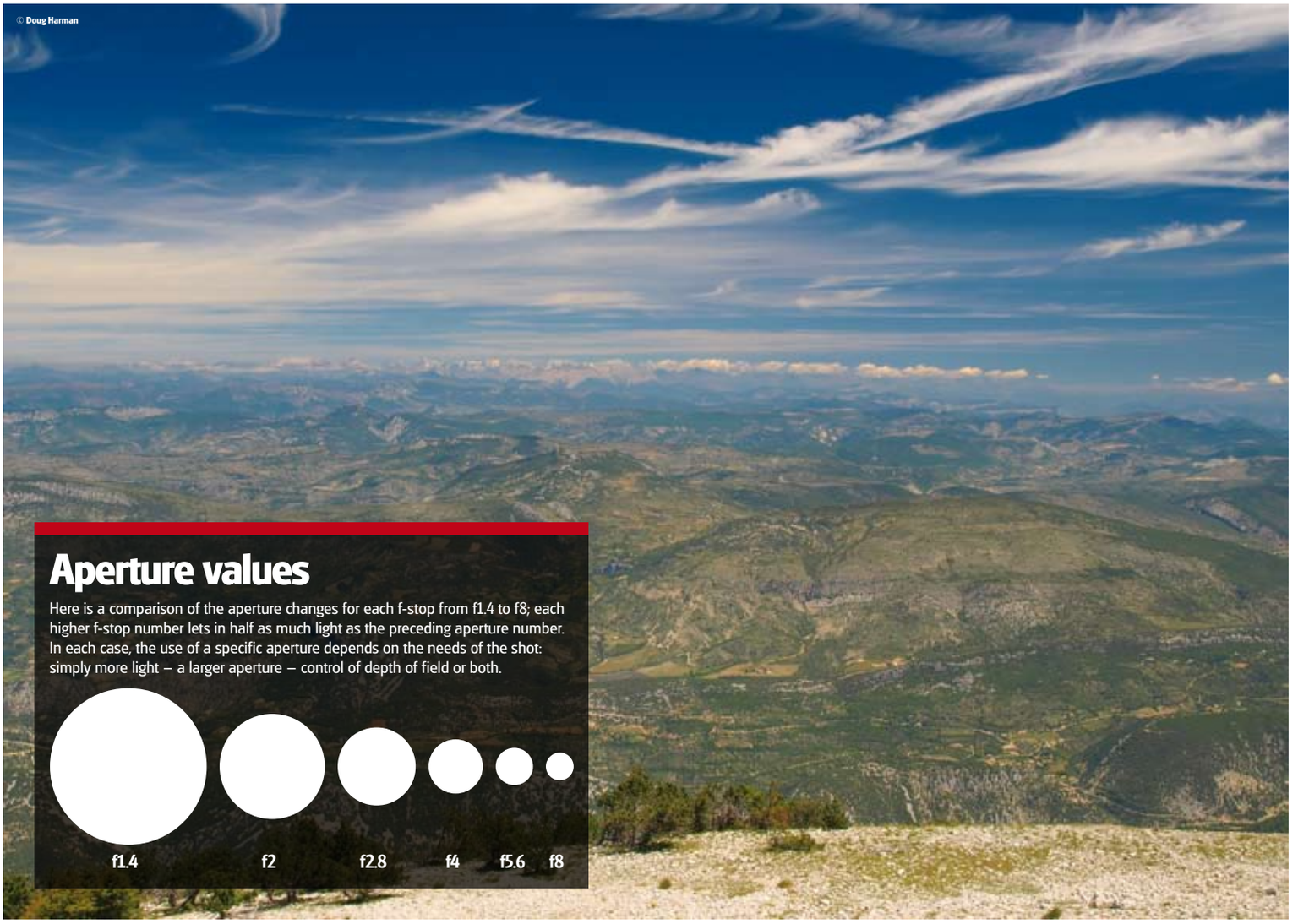
Simply, it means when a lens is focused at the hyperfocal distance (or sometimes hyperfocal point), the effective depth of field will extend from infinity back to a distance halfway between the camera and the hyperfocal point. Importantly, it means you can be confident everything within the scene that you want to be sharp is acceptably sharp.

For instance, simply focusing on infinity might mean a foreground part of the scene you're shooting might be out of focus because the DoF starts beyond its position in the scene. Focusing at the hyperfocal distance ensures maximum sharpness halfway from the camera to the subject and on to infinity, and is ideal for shooting landscapes. However, finding the hyperfocal distance can be a bit problematic.

A fast way to get a reasonable stab at the hyperfocal distance is to focus about one third of the way toward your subject. But this is not ideal, as the hyperfocal distance varies with subject distance, aperture and focal length, and the hyperfocal distance needs to be recalculated for each of these factors.

Check out online distance calculators to get even more information. Point your browsers at: **www.dofmaster.com/dofjs.html** or **www.cambridgeincolour.com/tutorials/hyperfocal-distance.htm**.

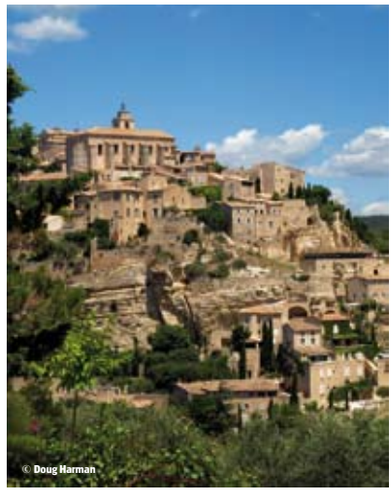
"Depth of field appears narrower using a DSLR than a digital compact, because we need to use longer focal lengths to achieve a similar field of view"



extends, the effective size of the aperture decreases. A typical range of maximum apertures available at each extreme will be something like f2.8 to f5.6.

Apertures can also help control overall image sharpness: every lens has some slight aberrations, so using an optimum aperture setting will have a clear impact on the image's sharpness and image quality.

Aperture extremes, for example, might not get the best from the lens as they prevent the lens from performing at its sharpest; most lenses perform better at apertures inside their extreme values. As a lens is (usually) sharper away from the periphery, apertures that utilise the more central portions of the glass can help get the sharpest performance, but the subject and how you want to capture it often dictate this aspect to you.



[Above] Sharp landscapes: A wide angle was used to encompass the scene, but a small aperture was essential to keep everything sharp
Shot details: Olympus E-410 with 14-42mm Zuiko Digital zoom lens at 18mm and f16, 1/25sec, ISO 100

[Left] Everything sharp: This shot of Gordes, France, includes foreground detail that needed to be kept sharp to 'lead' the eye
Shot details: Olympus E-410 with 14-42mm Zuiko Digital zoom lens at 42mm and f11, 1/60sec, ISO 100

"The size of aperture used affects final image quality; large apertures can introduce vignetting, while small apertures might introduce diffraction"

The size of the aperture used affects final image quality in other ways; large apertures can introduce vignetting, while small apertures might introduce diffraction.

Vignetting (the gradual darkening of corners in a shot) typically occurs when larger apertures are used (or filters such as UV filters are added or an incorrectly fitted lens hood), but using smaller apertures can reduce it. However, diffraction (the way light can be bent or bounced around by something it passes through or around) is affected by the very glass of the lens and can be affected by the iris diaphragm. The mechanical blades that form the iris can create unwanted reflections if the aperture used becomes too small, for example, and, at very small apertures, this introduces unwanted internal reflections.

There's a lot more to aperture control than initially meets the eye, but understanding how it works can really improve your photography. The boxouts over these four pages have additional information that will enhance your learning further. DP