

# A game of millimeters

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The next time you swing by the camera shop, take a closer look at those digital cameras on display. Notice the numbers that are tattooed on them. You'll see numbers expressing millimeter lengths (such as 50mm), others as ratios (such as 1:2.8), and some preceded by the letter f (f2.8-8), just like those of the digicam's analog-camera neighbors on the shelf. It makes perfect sense to use equivalent numbers for analog and digital cameras, especially for those longtime photo experts who already understand these digits. But for those of you who find the varying values to be cryptic and confusing, we'll take a closer look at how these numbers describe the capability of any given lens.

## Coming into focus

To help produce the correct exposure and to regulate the depth of field (the zone in which everything is in sharp focus), camera lenses have an irislike diaphragm inside. To let in more light, the diaphragm opens up, and when less light is needed, it "stops down." Each setting is precisely calculated and assigned a specific number, which is printed on the lens as either a ratio (1:2.8, for instance) or an f-stop (such as f2.8). Both markings mean the same thing; they describe the particular amount of light that will fall on the CCD. It's somewhat counterintuitive, but the smaller the number, the more light passes through the lens. To distinguish this scale from the other lens measurement (focal length, which we'll discuss a little later), lens designers from as far back as the 1870s have been using a small letter f, which is short for factor or factorable. Eventually these measurements became known as f-stops. The most common f-stops, which are progressively larger numbers (meaning smaller openings), are f1.0, f1.2, f1.4, f2, f2.8, f4.0, f5.6, f8, f11, f16, f22, f32, and f45. As you move down the scale from f1.0 to f45, each of these most common f-stops lets in precisely half the amount light as the previous one. Of course, there's no reason why there can't be numbers in between, such as f2.5 or f6.3, but those settings wouldn't necessarily be exactly half (or double) the next regular f-stop.

A lens that can open up to f1.0 will let you shoot better available-light photos in low-light conditions. However, the larger the opening, the more limited the depth of field. So if you want objects from the foreground all the way out to the horizon to be in perfect focus, you'll have to use a lens stopped down to f8 or f11. But to keep the same amount of light coming into the camera, you must reduce the shutter speed. That's when you must change the camera from the automatic point-and-shoot mode to manual or aperture priority mode and select the best f-stop/shutter speed combination to give you the depth of field you want.

## Focal lengths

The other universal measurement found on every lens is the focal length, or the distance from the center of the lens to the CCD when the lens is focused at infinity. Translated into English, this number tells you how much subject area your lens can capture in a shot and is most commonly expressed in millimeters (mm) rather than inches. So, for instance, a 35mm lens, because it's a short focal length, allows you to see a much wider area in front of your camera. Digicams with a fixed-focal-length lens have a single number, such as 55mm or 135mm. But when referring to a zoom lens with a variable focal length, the number is usually written as a range from the smallest to the largest focal length--35-200mm, for example. Variable-focal-length lenses usually mark their f-stops as two numbers--one for when the center of the lens is physically closer to the CCD and the other for when the lens is further away and therefore lets in less light.

And here's where the equivalency comes in. If you're used to operating a 35mm single lens reflex (SLR) camera with interchangeable lenses, you know that 50mm would be your normal lens, and that you'd use 35mm for wide angles and 135mm for telephoto, and so on. Those millimeter amounts describe how far the surface of the lens is from a single frame of 35mm film, one frame of which usually measures 1 by 1.5 inches.

In comparison, the size of a typical digital camera CCD is about 0.33 by 0.5 inches--much smaller than the measurement of a 35mm frame. A 50mm lens that gives normal coverage for a 35mm camera will show a narrower field of view on a digital camera and is about equivalent to what you would see when looking through a 300mm lens on the film camera. In other words, to produce the same normal coverage as a 35mm camera, a digital camera needs only a 12mm lens. And 6mm will give about the same wide-angle coverage as a 38mm lens on a 35mm camera.

If none of us had ever used a 35mm film camera and lens, we wouldn't need any conversions or equivalencies to understand how their lens measurements relate to digital camera focal lengths. However, most photographers are used to thinking in terms of 35mm lenses. In the same way, if most Americans didn't grow up learning everything in inches and feet, we wouldn't have to struggle so to understand the metric system. And that is why digital-camera manufacturers often print both the true focal lengths of the lens on their cameras and the 35mm equivalencies.