

Photography *exposure reference.*

Aperture, shutter speed, and ISO as equivalent stops. The exposure triangle quantified — how to trade depth of field for motion blur for noise, and the EV reference for common scenes.

The chart

STOP	APERTURE (F-NUMBER)	SHUTTER (S)	ISO
-4 (4 stops darker)	f/64	1/4000	ISO 6
-3	f/45	1/2000	ISO 12
-2	f/32	1/1000	ISO 25
-1	f/22	1/500	ISO 50
0 (reference)	f/16	1/250	ISO 100
+1	f/11	1/125	ISO 200
+2	f/8	1/60	ISO 400
+3	f/5.6	1/30	ISO 800
+4	f/4	1/15	ISO 1600
+5	f/2.8	1/8	ISO 3200
+6	f/2	1/4	ISO 6400

STOP	APERTURE (F-NUMBER)	SHUTTER (S)	ISO
+7	f/1.4	1/2	ISO 12800
+8 (4 stops brighter)	f/1	1 s	ISO 25600

How the table works. Each row is one 'stop' brighter than the row above it. Aperture stops are powers of $\sqrt{2}$ (so f/2 → f/2.8 → f/4 is each one stop). Shutter speeds are powers of 2 (1/1000 → 1/500 → 1/250 each one stop). ISO doubles each stop (100 → 200 → 400). A camera at f/8, 1/60, ISO 400 (stop +2) gives the same exposure as f/4, 1/250, ISO 400 (still stop +2 — we made aperture 2 stops brighter and shutter 2 stops darker, netting zero change).

Common applications

SCENE / SITUATION	SUNNY 16 STARTING POINT	NOTES
Bright sunlight (the 'Sunny 16 rule')	f/16, 1/ISO, base ISO	At ISO 100: f/16 at 1/100 (or 1/125)
Bright cloudy	f/11 (1 stop brighter)	Slightly diffused
Overcast	f/8 (2 stops brighter)	Soft, no harsh shadows
Heavy overcast	f/5.6 (3 stops brighter)	Approaching low light
Open shade / sunset shade	f/4 (4 stops brighter)	Indirect light
Indoor (well-lit)	f/2.8 + ISO 800-1600	Or use flash
Indoor (dim restaurant)	f/1.8 + ISO 3200+	Or tripod for slow shutter

SCENE / SITUATION	SUNNY 16 STARTING POINT	NOTES
Night street lights	f/2.8 + ISO 6400 + 1/30	Or tripod, longer exposure
Stars / Milky Way	f/2.8 + ISO 3200 + 15-25s	500-rule: shutter \leq 500/focal length for sharp stars
Frozen action (sports)	f/4-5.6 + 1/1000+	Increase ISO as needed
Motion blur (waterfall)	f/8-16 + 1/4-2s	Need ND filter in bright light
Portrait (blurred background)	f/1.4-2.8	Wide aperture = shallow DoF
Landscape (everything sharp)	f/8-11	Sharpest aperture for most lenses

Common pitfalls

- **The aperture series isn't intuitively linear.** f/2 to f/2.8 looks like a small jump (only 0.8 difference) but is one full stop (2× light). The numbers are powers of $\sqrt{2}$ because aperture diameter scales linearly while light scales with area (diameter²).
- **'Wide open' aperture trades sharpness.** Lenses are usually sharpest at f/5.6 to f/11. Wide-open (f/1.4) has more aberrations; very stopped down (f/22) has diffraction softening. The 'sharpest' aperture is typically 2-3 stops below wide-open.
- **ISO noise depends on sensor size.** Full-frame at ISO 6400 looks better than APS-C at ISO 1600. Modern sensors have made high-ISO usable, but 'usable' depends on the print/output size and noise tolerance.
- **Shutter-speed reciprocal rule for handholding.** Without stabilization, the minimum shutter speed to avoid motion blur is roughly 1/focal length (for 50mm lens, use 1/60 or faster). With image stabilization, 2-4 stops slower may be possible.

- **Depth of field depends on three things.** Aperture (smaller f = shallower DoF), focal length (longer = shallower), and subject distance (closer = shallower). Same aperture at 200mm has much shallower DoF than at 24mm.
- **Sunny 16 is rough but reliable.** In bright sun, set aperture to $f/16$ and shutter to $1/ISO$ (e.g., $1/100$ at ISO 100). Adjust from there. Useful when meters fail or for testing.

Common questions

What's the 'exposure triangle' and why does it matter?

ISO (sensor sensitivity), aperture (lens opening), and shutter speed (light duration) all control how much light reaches the sensor. Doubling any one is +1 stop. Each affects the image differently: ISO adds noise, aperture changes depth-of-field, shutter affects motion blur. Balancing all three for your scene is the entire craft of exposure.

What does 'f/2.8' mean on a lens?

f-number is focal length divided by aperture diameter. A 100 mm lens at $f/2.8$ has an aperture about 36 mm wide. Lower f-numbers = wider aperture = more light. The square root sequence (1.4, 2, 2.8, 4, 5.6, 8) doubles light area at each stop. $f/2.8$ to $f/4$ is one stop less light, but also more depth of field.

Why is my photo blurry at 1/30 second shutter speed?

Two reasons. Camera shake: the rule of thumb is shutter speed $\geq 1/(\text{focal length} \times \text{crop factor})$. At 100 mm full-frame, that means 1/100 or faster handheld. Subject motion: a walking person at 1/30 will smear. Use a faster shutter or a tripod; image stabilization helps with camera shake but not subject motion.

What ISO can I use without ruining the image?

Depends on the sensor. Modern full-frame cameras handle ISO 6400 cleanly; APS-C may show noise above 3200; phone cameras get noisy above 800. Higher ISO doesn't 'add' noise — it amplifies the existing signal-to-noise ratio, making sensor noise more visible. For a critical shot, use the lowest ISO the situation allows.

How do I 'stop down' to f/8 from f/2.8?

Closing the aperture from f/2.8 to f/8 is 3 stops (2.8 → 4 → 5.6 → 8). To maintain the same exposure, you need to compensate with 3 stops more light — either ISO $\times 8$ (e.g. 200 → 1600) or shutter $\times 8$ (e.g. 1/1000 → 1/125). The exposure triangle keeps total light constant when stops trade off.

Sources

- **Aperture standard:** ISO 517 — Photography — Apertures and related properties pertaining to photographic lenses.
- **ISO sensitivity:** ISO 12232 — Photography — Digital still cameras — Determination of exposure index.
- **Shutter speed standard:** Modern series follows ISO 2240 (B&W) and ISO 5800 (color) conventions for sensitometry.
- **Reference principles:** Ansel Adams, *The Camera* (Book 1 of his photography trilogy) — classic reference on the exposure triangle.

Disclaimer. Photographic exposure is creative as well as technical — the 'correct' exposure depends on artistic intent. The reference here is for starting points and understanding the technical relationships, not prescriptive rules.

