

Light Transmission and Eye Relief

Scopes don't gather light, as most people think, although the term "light gathering ability" has become accepted jargon. Scopes *transmit* available light through the lenses to your eye, always losing a bit in the process. The best a scope can hope to offer in light transmission is about a theoretical 98%, which only the very finest (read expensive) scopes can hope to approach. Anything above 95% is considered great, and most scopes are around 90%, give or take a bit. You have to take light transmission figures with a grain of salt. Manufacturers measure light transmission differently, sometimes for specific wavelengths to boost their numbers.

The more magnification you have, the less light you get to your eyepiece. The larger the objective lens, the more you get through your eyepiece.

Aged eyes may dilate to only about four millimeters. Younger eyes may open up to seven millimeters and even more. An exit pupil much larger than your eye can use is wasted. Like drinking out of a fire hose.

The small circle of light that appears in the eyepiece when you hold a scope at arm's length is called an *exit pupil*. Here's an interesting experiment to help explain it. Take a variable scope, put it at its lowest power, and hold it at arms length. See the circle of light in the ocular lens? That is the exit pupil. The diameter of it in millimeters is the exit pupil size. Now turn the scope up to its highest power and try it again. See how much smaller it gets? Imagine if you are using this scope during poor lighting conditions as common in hunting situations, like dawn or dusk. How small and dark will that exit pupil be? How well do you think you'll be able to see through that tiny circle of light?

A formula for exit pupil is as follows: Divide the objective lens size in millimeters by the magnification. Example: if your 3-9X40 scope is set at 3X, 40 divided by 3 equals 13.3 millimeters, which is large enough for almost all low light applications. If your scope is set at 9X, 40 divided by 9 equals 4.44 millimeters. The difference in available light from the larger exit pupil is significant.

The larger the exit pupil, the less critical the position of your head in relation to the scope is, also. The distance that your eye must be to the ocular lens to get a full, clear picture is called *eye relief*. Lower powered scopes will have a larger range of distance available for a full view. Higher powered scopes are sometimes very critical in relation to the centering of your eye through the middle of the tube, and the distance your eye must be from the ocular lens. Sometimes there is only a half inch closer or farther you may be to see the whole available view.

The largest eye relief currently available for a standard riflescope is about four inches. Four inches is great, and offers enough room for the gun to recoil and not hit your face, if you do your job correctly. Most standard riflescopes have between three and three and a half inches. Higher recoiling guns including slug guns require lots of eye relief to prevent "scope eye" or the cut that some people get from the ocular lens of the scope coming back under recoil and cutting a semicircular gash above the shooter's eye. Shotgun, muzzleloader, and dangerous game scopes sometimes have 5 or 6 inches of eye relief to prevent scope eye, but often at the expense of field of view.

IER (Intermediate Eye Relief) scopes, also known as "Scout scopes" are mounted in front of the receiver of a long gun and require around 9-12 inches of eye relief. LER (Long Eye Relief) scopes, also known as "Pistol scopes" used on handguns may have around 16-20 inches of eye relief.

When mounting a scope, it should be at its highest power, and in a position that your head and neck are comfortable. Your head should be positioned on the stock in the position you will be shooting the most. For instance, if you sight in a gun while shooting off a bench rest, your head tends to sneak up on the stock a bit. If this gun is then used for snap shooting for deer in the woods, your eye relief might not be optimal, nor might your sight picture. Always mount your scope so you don't have to move your head for optimal field of view. Move the scope to your eye, not your eye to the scope