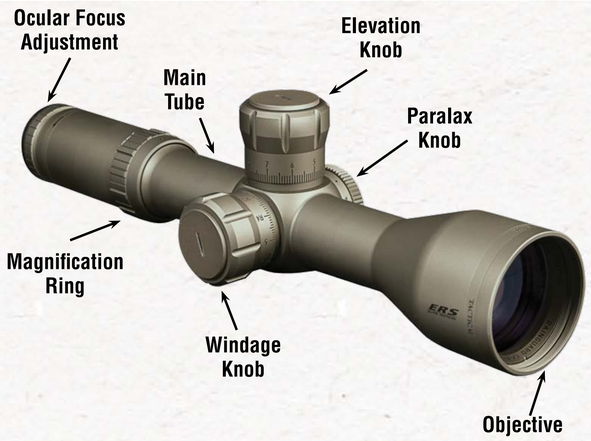
THE MODERN RIFLESCOPE

Shooters have three basic options when it comes to aiming their firearm and hitting their intended target: 1) traditional fixed sights, 2) magnified riflescopes and 3) non-magnified dot-style optics. Each type has its benefits and drawbacks, but perhaps the most popular is the riflescope, or telescopic sight. The modern riflescope is composed of a main tube that houses a set of lenses and a tube-shaped "erector assembly" that houses the reticle and a group of lenses that help control the magnification level of the scope.

Adjustment Controls

Most modern scopes offer multiple adjustment controls. A focus adjustment at the ocular end of the sight allows the shooter to tune in a sharp view of the reticle.

Vertical and horizontal adjustment control of the reticle is provided by the elevation and windage turrets near the middle of the scope. These allow the user to center the reticle at the place where the bullet will strike the target. Magnification control on variable-power scopes allows the shooter to increase the magnification of the scope. Some scopes also provide illumination adjustment controls to light and regulate the brightness level of the reticle. Parallax-compensation is also available on some scopes. It can either be located on a turret knob, or as an adjustment ring on the scopes objective bell.



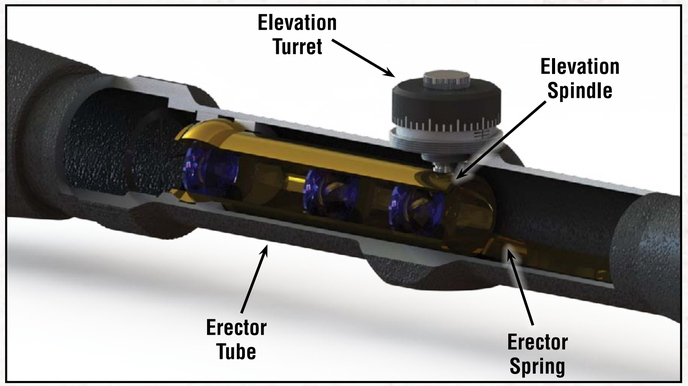
How It Works

MAGNIFICATION

When the shooter turns the magnification ring, a portion of the erector turns along with it. This moves a pair of lenses inside the erector closer or farther from each other. This relationship is what changes the magnification.

ELEVATION AND WINDAGE

The elevation and windage turrets provide a knob or dial that can be turned to change the position of the reticle. Turning this knob or dial adjusts a spindle that pushes the erector assembly, moving the reticle up or down and left or right. The spindle is tied to a click feature that is calibrated to either milliradian or minute of angle. The most common click values are 1/4 MOA and 0.1 mil. The erector spring provides a counterforce, to ensure consistent and reliable adjustment.



Parallax

Parallax is an optical effect created because the objective lens is not at the same plane as the reticle. It creates a small error in the placement of the reticle. To fix this error, a focus lens is used to make the image and the reticle appear as if they are in the same plane.

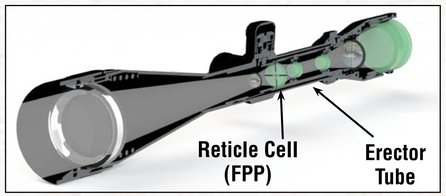
There are three methods for setting the parallax adjustment:
- **Fixed parallax setting**
- **Adjustable objective**
- **Side-focus**

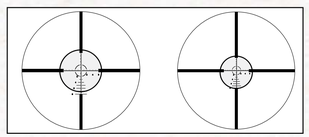
Fixed parallax scopes set the focus lens so the image is parallax free at a certain distance. Adjustable objectives have the focus lens fixed in place, too, but the objective assembly is moved in and out by a ring on the objective bell. Side focus parallax adjustment moves the focus lens instead of the objective.

The Reticle

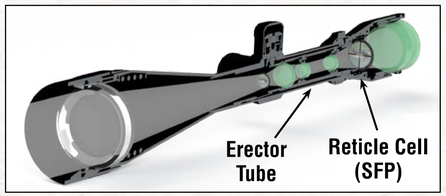
Reticles, or crosshairs, come in a multitude of shapes and styles. Some are simple crosshairs, while others are made up of precisely-spaced dots and hashes. The distance between the dots and hashes is crafted around one of two units of measurement–the milliradian or minute of angle (See MOA vs Mils).

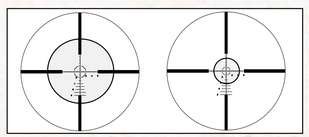
Reticles can be made of wire or etched on a glass surface, and they can be installed in either the first or second focal plane. Second-focal plane reticles are more common because they are less expensive. In these scopes, the target appears to grow larger as the magnification is increased while the reticle appears to stay the same size. The dots and hashes are usually configured for one specific magnification level, usually the highest. In first focal plane scopes, both the target and reticle appear to increase in size as the magnification is increased. This gives the shooters the ability to use their ranging, hold-over and lead calculations through all levels of magnification.





An example of what it is like to look at a target on high power and then a lower power with a first focal plane reticle. Notice how the reticle still covers the same amount of the target despite the magnification change.





An example of what it is like to look at a target on high power and then a lower power with a second focal plane reticle. Even though the target is smaller, the reticle appears to be the same size as on high power.

Both FFP and SFP arrangements have advantages and disadvantages. It's up to the shooter's needs, preferences and budget to find which is best.

Tube Size

The main tube of a scope can be one of several popular sizes. Tubes that are 1-inch in diameter are the most common, followed by 30mm tubes. In tactical, long-range riflescopes, 34mm tubes are also becoming more common. Larger scope tubes are stronger, and usually, heavier. However, the biggest advantage of larger tubes is more internal adjustment travel for long-range shooting.

Terminology

MAGNIFICATION How much closer an object appears that it would with the naked eye

OBJECTIVE The end, or lens, closest to the object you are looking at

OCULAR The end, or lens, closest to your eye

RETICLE The lines or dots used to align your aim on the target

TURRET The projecting knobs on the outside of the scope tube containing the riflescope's windage and elevation controls

COATINGS Riflescopes have thin coatings applied to their lenses that reduce glare and improve light transmission. There are four types of coatings which offer increased levels of performance:

Minimally acceptable: Coated means a coating is applied to at least one lens surface.

Good: Fully-coated lenses have a layer applied to all air-to-glass lens surfaces.

Better: Multi-coated lenses have multiple layers on all lens surfaces.

Best: Fully multi-coated lenses have multiple layer on all air-to-glass lens surfaces.

PURGING This process removes all air and moisture from inside the riflescope and replaces it with either nitrogen or argon gas in order to maintain a crystal clear image in any climate

ZERO The distance at which your bullet will strike precisely where the reticle is centered

EXIT PUPIL A small column of light visible in the ocular lens when a scope is held at arm's length. A larger exit pupil means a brighter image.

EYE RELIEF The distance the eye must be from the ocular lens for a full field of view

FIELD OF VIEW The area visible through scope at a certain distance at a certain magnification. The greater the magnification, the smaller the field of view.

HOLD OVER//UNDER The amount of point of aim change either above or below your target, without adjusting your scope, to adjust for the trajectory of your projectile

What's That Number?

The numbers describing a scope tell you a lot about it. The first number—or set of numbers in variable power scopes—represent the magnification power of the scope. So a 3-9X40mm scope provides magnification from three to nine times that available to the naked eye. The final number in the name is the objective lens diameter. Generally speaking, the larger the objective lens, the more light is allowed to enter the scope to provide a brighter image. A larger objective lens also means the scope must be mounted in higher riflescope rings to prevent contact with the firearm's barrel.

MOA Versus MILS

Riflescopes are calibrated using either minute of angle (MOA) or milliradians. Both are ways of expressing angular measurements.

MOA is based off of the degrees of a circle, and equals 1.0472 inches at 100 yards. For all practical purposes, a MOA is 1 inch at 100 yards, 2 inches at 200 yards, 5 inches at 500 yards and so on. Thus, for every one click on a scope with ¼ MOA click values, the point of aim moves ¼-inch at 100 yards.

Milliradians are based off radians, which are another measurement of rotation around a circle. This is the system used in the mil-dot reticle, and was developed to aid in ranging a target. Scopes 1/10th mil click values are adjusted 1cm at 100 meters or roughly .36 inches at 100 yards with each click. This system is often more useful for ballistic calculations.

Dot Optics

Dot-style optics come in several configurations; including two lenses contained in a short tube, single flat-lens styles and variations in between. These sights are mounted on the firearm like a riflescope. However, instead of using an internal crosshair, they feature an illuminated dot projected onto a piece of glass. This dot appears superimposed over the target, offering an unobstructed view of the animal.

The illuminated dot is visible in low-light situations, making accurate shots possible during the dawn and dusk periods when many game animals emerge from heavy cover.

Most dot sights feature variable intensity, so the brightness of the dot can be adjusted for the available light.

One of the biggest advantages of dot sights is that they offer unlimited eye relief. Scopes and traditional sights require the shooter's eye be properly aligned close to the gun's receiver. Most scopes have eye relief distances of just 2 or 3 inches. However, dot sights work with any eye alignment, near or far. This can be a huge advantage when shooting at moving game, or from a quick, offhand position at an unexpected angle.

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