ABOUT RIFLE SCOPES

Functioning of Rifle Scopes

Rifle scopes work on the principle of magnifying an image (target) and by placing that and the shot’s eye on the same optical plane. Since magnification works by bending light rays via a number of lenses within the scope, the higher the power of magnification, the longer the scope. In other words, low powered rifle scopes are shorter and contain smaller lenses.

The similarities that all riflescopes share include a reticular or crosshair, a dot, a post or similar markings to help align the device with the target. A reticle or crosshair is a shape, usually a "+" shape, superimposed on an image (target) to aid with the alignment of the device. Some reticles use dots to mark the center of field of view or a post or similar markings to help view and centre the image through the scope. Rifle scopes also work to eliminate the problems associated with open sights, and allow for precise shooting.

Anatomy & Terminology of Rifle Scopes

A rifle scopes contains two tubes, one within the other. The inner tubes refracts light for magnification purposes, while the outer tube protects the inner tube and provides a mount for the three of the parts found in rifle scopes. All riflescopes contain about the same ten or so parts. These parts include:

**Eye Piece:** Attaches to the eye-bell and holds the ocular lens.

**Ocular Lens:** The lens nearest to your eye.

**Eye Bell:** Houses the eye piece and gets attached to the tube.

**Eye Relief:** Refers to the distance between your eye and the ocular lens when you see the full field of view. The larger the eye relief the better the riflescope.

**Power Ring:** Allows you to rotate and change the magnification on the scope.

**Windage Adjustment:** Changes the aiming point of the scope on the horizontal plane (left/right).

**Elevation Adjustment:** Shifts your aiming point along the vertical plane (higher/lower).

**Tube:** Provides a mount for the eye piece, eye-bell and objective bell.

**Objective Bell:** Encases the objective lens and the tube gets attached to it.

**Objective lens:** Collect the light that enters the scope. The higher the magnification the larger the diameter of the objective lens.

**Adjustable Objective Lens (AO):** Fixes the parallax error by adjusting the objective lens. A parallax error is caused in a medium to high powered microscope, when the scope's "eye" is not focused at the right distance.

**Side Focus (SF):** Side parallax adjustment knob for fixing parallax errors.
Quality

The quality of your rifle scope can have a huge effect on whether or not your hunt is successful. The quality of the rifle scope can be more important than the quality of the rifle itself. It is definitely worth spending more to ensure your rifle's scope is rugged and lightweight with good quality optics.

Magnification

The best rifle scopes do not necessarily need to magnify too much. Most rifle scopes are equipped with lines to give you a range estimate to assist in adjusting for the perspective distortion. Choose a rifle scope with good cross-hair guides. These are the guidelines you see when you look through the rifle scope. Choose a magnification that is right for your hunt.

Reticles

Telescopic sights come with a variety of different reticles, ranging from the traditional crosshairs to complex reticles designed to allow the shooter to estimate accurately the range to a target, to compensate for the bullet drop, and to compensate for the windage required due to crosswinds. A user can estimate the range to objects of known size, the size of objects at known distances, and even roughly compensate for both bullet drop and wind drifts at known ranges with a reticle-equipped scope.

For example, with a typical duplex 16 Minute of Angle (MOA) reticle on a fixed power scope, the distance from post to post (that is, between the heavy lines of the reticle spanning the center of the scope picture) is approximately 32 inches (81.3 cm) at 200 yards (183 m), or, equivalently, approximately 16 inches (40.65 cm) from the center to any post at 200 yards. If a target of a known diameter of 16 inches fills just half of the total post-to-post distance (i.e. filling from scope center to post), then the distance to target is approximately 200 yards (183 m). With a target of a diameter of 16 inches that fills the entire sight picture from post to post, the range is approximately 100 yards. Other ranges can be similarly estimated accurately in an analog fashion for known target sizes through proportionality calculations. Holdover, for estimating vertical point of aim offset required for bullet drop compensation on level terrain, and horizontal windage offset (for estimating side to side point of aim offsets required for wind effect corrections) can similarly be compensated for through using approximations based on the wind speed (from observing flags or other objects) by a trained user through using the reticle marks. The less-commonly used holdunder, used for shooting on sloping terrain, can even be estimated by an appropriately-skilled user with a reticle-equipped scope, once the slope of the terrain and the slant range to target are both known.

There are two main types of reticles:

- Wire reticles
- Etched reticles

Wire reticles are the oldest type of reticles and are made out of metal wire. They are mounted in an optically appropriate position in the telescopic sight's tube. Etched reticles are images of the desired reticle layout that are etched on an optic element. This optical element (lens) with the etched reticle is then mounted in the telescopic sights tube as an integrated part of the optics chain of the sight. When backlit through the ocular a wire reticle will reflect incoming light and not present a fully opaque (black) reticule with high-contrast. An etched reticle will stay fully opaque (black) if backlit. Etched reticles are by most considered to be a more refined solution and offer greater reticle lay out flexibility. Because of this some manufacturers can provide client designed custom reticles on special order. In the more expensive and high end contemporary telescopic sights
etched reticles dominate the market. In cheaper telescopic sights wire reticles are still often mounted to avoid a rather specialized and costly production step.

Mil-dot reticles:

If the helmeted head of a man (≈ 0.25 m tall) fits between the fourth bar and the horizontal line, the man is at approximately 100 meters distance. When the upper part of the body of a man (≈ 1 m tall) fits under the first line, he stands at approximately 400 meters distance.

Modern military and law enforcement reticles are generally designed for (stadiametric) rangefinding purposes. Perhaps the most flexible ranging reticle is the "Mil-dot" reticle, which consists of duplex crosshairs with small dots at milliradian (Mil) intervals in the field of view. A milliradian equates to 3.43774677078493 MOA, that is, approximately 21.6 inches at 600 yards; each MOA equates to 1.0471975511966 inch at 100 yards, often rounded to 1 inch at 100 yards for fast mental calculations.

Users who use the metric system are better off with a Mil-dot reticle, since they do not have to hassle with the unnecessary complications of a non metric system of measurement during mental calculations. Also the Mil-dot measurements and ranging calculations are always exact in the metric system.

A trained user can relatively accurately measure the range to objects of known size, the size of objects at known distances, and compensate for both bullet drop and wind drifts at known ranges with a Mil-dot reticle-equipped scope.

Above left is what a Netherlands Army sniper sees through his 3-12x50 PM II telescopic sight. The Mil-dots can be seen on the cross hairs. By means of a mathematical formula - (width or height of the target/ number of mil of dots) x 1000 = distance - the user can measure the range to a target. An object of 1 meter tall or wide is exactly 1 Mil tall or wide at 1000 meters distance. If the user sees an object of 1.8 m tall for example as three mil dots tall through the riflescope the object is at 600 m distance - (1.8 / 3) x 1000 = 600.

The four horizontal bars over the horizontal line are also intended for (quick) ranging purposes.
Reticle focal plane

Above is the typical internal construction of a scope with its reticle in the First Focal Plane.

The reticle may be located at the First(front) Focal Plane (FFP) or Second(rear) Focal Plane (SFP) of the telescopic sight. On fixed power telescopic sights there is no significant difference, but on variable power telescopic sights the front plane reticle remains at a constant size compared to the target, while rear plane reticles remain a constant size to the user as the target image grows and shrinks. Front focal plane reticles are slightly more durable, but most American users prefer that the reticle remains constant as the image changes size, so nearly all modern American variable power telescopic sights are rear focal plane designs. European high end optics manufacturers often leave the customer the choice between a FFP or SFP mounted reticle.

Variable power telescopic sights with front focal plane reticles have no problems with point of impact shifts. Variable power telescopic sights with rear focal plane reticles can have slight point of impact shifts through their magnification range caused by the positioning of the reticle in the mechanical zoom mechanism in the rear part of the telescopic sight. Normally these impact shifts are insignificant but make accuracy oriented users, that wish to use their telescopic sight trouble-free at several magnification levels, often opt for front focal plane reticles. Around the year 2005 Zeiss was the first high end European telescopic sight manufacturer who brought out variable magnification military grade telescopic sight models with rear focal plane mounted reticles. They get around impermissible impact shifts for these sights by laboriously hand adjusting every military grade telescopic sight.

Reticle illumination

Either type of reticle can be illuminated for use in low-light or daytime conditions. With any illuminated low-light reticle, it is essential that its brightness can be adjusted. A reticle that is too bright will cause glare in the operator’s eye, interfering with his ability to see in low-light conditions. This is because the pupil of the human eye closes quickly upon receiving any source of light. Most illuminated reticles provide adjustable brightness settings to adjust the reticle precisely to the ambient light.
Illumination is usually provided by a battery powered LED, though other electric light sources can be used. The light is projected forward through the scope, and reflects off the back surface of the reticle. Red is the most common colour used, as it least impedes the shooter’s night vision. This illumination method can be used to provide both daytime and low-light conditions reticle illumination.

Radioactive isotopes can also be used as a light source, to provide an illuminated reticule for low-light condition aiming. In sights like the SUSAT or Elcan C79 Optical Sight tritium-illuminated reticles are used for low-light condition aiming. Other manufacturers use tritium in their optics. The (radioactive) tritium light source has to be replaced every 8–12 years, since it gradually loses its brightness due to radioactive decay.

With fiber optics ambient (day)light can be collected and directed to an illuminated daytime reticle. Fiber optics reticles automatically interact with the ambient light level that dictates the brightness of the reticle. Certain manufacturers use fiber optics combined with other low-light conditions illumination methods in their telescopic sights.

**Parallax compensation**

Parallax problems result from the image from the objective not being coincident with the reticle. If the image is not coplanar with the reticle (that is the image of the objective is either in front of or behind the reticle), then putting your eye at different points behind the ocular causes the reticle crosshairs to appear to be at different points on the target. This optical effect causes parallax induced aiming errors that can make a telescopic sight user miss a small target at a distance for which the telescopic sight was not parallax adjusted.

To eliminate parallax induced aiming errors, telescopic sights can be equipped with a parallax compensation mechanism which basically consists of a movable optical element that enables the optical system to project the picture of objects at varying distances and the reticle crosshairs pictures together in exactly the same optical plane. There are two main methods to achieve this.

- By making the objective lens of the telescopic sight adjustable so the telescopic sight can compensate parallax errors. These models are often called AO or A/O models, for adjustable objective.
- By making an internal lens in the internal optical groups mounted somewhere in front of the reticle plane adjustable so the telescopic sight can compensate parallax errors. This method is technically more complicated to build, but generally more liked by parallax adjustable telescopic sight users—unlike AO models, which are read from the top, the sidewheel’s setting can be read with minimal movement of the head. These models are often called side focus or sidewheel models.

Most telescopic sights lack parallax compensation because they can perform very acceptably without this refinement. Telescopic sights manufacturers adjust these scopes at a distance that best suits their intended usage. Typical standard factory parallax adjustment distances for hunting telescopic sights are 100 yd or 100 m to make them suited for hunting shots that rarely exceed 300 yd/m. Some target and military style telescopic sights without parallax compensation may be adjusted to be parallax free at ranges up to 300 yd/m to make them better suited for aiming at longer ranges. Scopes for rimfires, shotguns, and muzzleloaders will have shorter parallax settings, commonly 50 yd/m for rimfire scopes and 100 yd/m for shotguns and muzzleloaders. Scopes for airguns are very often found with adjustable parallax, usually in the form of an adjustable objective, or AO. These may adjust down as far as 3 yards (2.74 m).

The reason why scopes intended for short range use are often equipped with parallax compensation is that at short range (and at high magnification) parallax errors become more
noticeable. A typical scope objective has a focal length of 100 mm. An optical ideal 10× scope in this example has been perfectly parallax corrected at 1000 m and functions flawlessly at that distance. If the same scope is used at 100 m the target-picture would be projected \((1000 \text{ m} / 100 \text{ m}) / 100 \text{ mm} = 0.1 \text{ mm}\) behind the reticle plane. At 10× magnification the error would be \(10 \times 0.1 \text{ mm} = 1 \text{ mm}\) at the ocular. If the same scope was used at 10 m the target-picture would be \((1000 \text{ m} / 10 \text{ m}) / 100 \text{ mm} = 1 \text{ mm}\) projected behind the reticle plane. When magnified ten times the error would be 10 mm at the ocular.

**Bullet Drop Compensation**

Bullet Drop Compensation (BDC) (sometimes referred to as ballistic elevation) is a feature available on some rifle scopes. The feature compensates for the effect of gravity on the bullet at given distances (referred to as "bullet drop"). The feature must be tuned for the particular ballistic trajectory of a particular combination of rifle and cartridge at a predefined air density. Inevitable BDC induced errors will occur if the environmental and meteorological circumstances deviate from the circumstances the BDC was calibrated for. Marksmen can be trained to compensate for these errors.

**Adjustment controls**

![The adjustment controls of a telescopic sight with an elevation adjustment knob featuring a zero-stop and second revolution indicator.](image)

A telescopic sight can have several adjustment controls.

- Focusing control at the ocular end of the sight - meant to obtain a sharp picture of the object and reticle.

- Elevation or vertical adjustment control of the reticle.
  - Zero-stop elevation controls can be set to prevent inadvertently dialing the adjustment knob "below" the primary zero (usually 100 meters or 100 yards for long-range scopes), or at least prevent dialing more than a couple adjustment clicks below zero. This feature is also useful on long-range scopes because it allows the shooter to physically verify the elevation knob is dialed all the way down avoiding confusion regarding the elevation status on two- or multi-revolution elevation knobs.

- Windage or horizontal adjustment control of the reticle.
• Magnification control - meant to change the magnification by turning a ring that is generally marked with several magnification power levels.

• Illumination adjustment control of the reticule - meant to regulate the brightness level of the lit parts of the reticles crosshairs.

• Parallax compensation control.

Most contemporary telescopic sights offer the first three adjustment controls. The other three are found on telescopic sights that offer a variable magnification, an illuminated reticle and/or parallax compensation. A rather common problem with the elevation and windage adjustment controls is that once smooth working adjustment turrets ‘get stuck’ over the years. This is generally caused by long time lack of movement in the lubricated turret mechanisms.

Older telescopic sights often did not offer windage and elevation adjustments in the scope, but rather used adjustable mounts to provide adjustment. Some modern mounts also allow for adjustment, but it is generally intended to supplement the scope adjustments. For example, some situations require fairly extreme elevation adjustments, such as very short range shooting common with airguns, or very long range shooting, where the bullet drop becomes very significant. In this case, rather than adjusting the scope to the extremes of its elevation adjustment, the scope mount can be adjusted. This allows the scope to operate near the center of its adjustment range. Some companies offer adjustable bases, while others offer bases with a given amount of elevation built in. The adjustable bases are more flexible, but the fixed bases are more durable, as adjustable bases may loosen and shift under recoil.

Accessories

Scrome LTE J10 F1 with a lens hood mounted at the ocular and a flip-open cover at the objective.

Typical accessories for telescopic sights are:

• Lens hoods for mounting on the objective and/or ocular to reduce/eliminate image quality impairing stray light.

• Lens hoods that extend the full length of a gun barrel to improve image quality by blocking out shot strings induced mirage (“heat waves” or aberrations resulting from a hot gun barrel).

• Covers to protect the objective and/or ocular external lens surface against foul weather and damage. There are slide-over, bikini and flip-open type covers without or with transparent covering material.

• Optical filters like Grey, Yellow and Polarising filters to optimize image quality in various lighting conditions.
• Kill Flash or honeycomb filters to eliminate light reflections from the objective that could compromise a sniper.

• Eye-safe laser filters to protect operators against being wounded/blinded by laser light sources. These filters are often an internal part in the assembly of lens elements.

• Transit and protection pouches and cases.

Integrated laser rangefinder

Riflescopes with integrated laser rangefinders for the civilian market, was available on the market since 1997. This provides the hunter with a rifle scope and range finder in one instrument, mounted on the rifle.

Ballistic support devices

An integrated ballistic computer/riflescope system known as BORS has been developed by the Barrett Firearms Company and became commercially available around 2007. The BORS module is in essence an electronic Bullet Drop Compensation (BDC) sensor/calculator package intended for long-range sniping out to 2500 m (2734 yd) for some telescopic sights. To establish the appropriate elevation setting the shooter needs to enter the ammunition type into the BORS (using touch pads on the BORS console) determine the range (either mechanically or through a laser rangefinder) and crank the elevation knob on the scope until the proper range appears in the BORS display. The BORS automatically determines the air density, as well as the cant or tilt in the rifle itself, and incorporates these environmental factors into its elevation calculations.

The SAM (Shooter-supporting Attachment Module) measures and provides aiming and ballistic relevant data and displays this to the user in the ocular of the Zeiss 6-24x72 telescopic sight it is developed for. The SAM has different sensors integrated (temperature, air pressure, shooting angle) and calculates the actual ballistic compensation. All indications are displayed in the ocular. It memorizes up to 4 different ballistics and 4 different firing tables. So it is possible to use 1 SAM with 4 total different weapons without an additional adjustment.

CCD and LCD technology

A totally different approach has been applied in the ELCAN DigitalHunter Digital Rifle Scope series which combines CCD and LCD technology with electronic ballistics compensation, automatic video capture, 4 field selectable reticles and customizable reticles. In 2008 a DigitalHunter DayNight Riflescope that uses infra red light captured by the CCD to enhance low light capabilities became available. It is also possible to attach infra red light sources to use this telescopic sight as an active night sight in total darkness. Some jurisdictions however forbid or limit to use of night vision devices for civilian or gun aiming use.

Mounting
Colt Python Silhouette, with 8-inch barrel, factory scope, and case — 500 made in 1981 by the Colt Custom Gun Shop.

As very few firearms come with built-in telescopic sights (military designs such as the Steyr AUG, SAR 21 and the H&K G36 being exceptions) mounting a scope to a firearm requires additional equipment. Equipment is available to mount scopes on most production firearms. A typical scope mounting system consists of two parts, the scope base and the scope rings. By picking the appropriate combination of scope base to fit the firearm and scope rings to fit the scope, a wide range of scopes may be mounted to most firearms. With the appropriate combination of adjustable scope bases and scope rings it is also possible to mount several telescopic sights on the same gun to make the gun more versatile. However, it is important to take into consideration whether or not a gun is particularly hard to mount. If it is or if a gun is intended for long-range shooting, it could be that the amount of vertical adjustment range is smaller than required. This can be solved with the help of a vertically canted base or canted rings. Typical cant angles offered by mounting components manufacturers are 20 and 30 MOA. It is always wise to buy telescopic sights that provide a decent adjustment range, preferably at least 60 MOA or more.

Lapping of Scope Rings

It is critical to ensure that good quality precision rings are used and that they are lapped. In short it means that the rings are “machined” with a lapping tool in order to align rifle, rings and scope. Even the best scope can be damaged or de-accuratised by rings not aligned.

Scope bases

The base is attached to the rifle, usually with screws, and is often designed to have a low profile, and to allow use of the iron sights if the scope is not present. Some manufacturers provide integral bases on many of their firearms; an example of such a firearm is the Ruger Super Redhawk revolver. The most commonly encountered mounting systems are the 3/8 inch (9.5 mm) and the 11 mm dovetail mounts (sometimes called tip-off mounts), commonly found on rimfires and air guns, the Weaver type base and the STANAG 2324 (MIL-STD-1913 "Picatinny rail") base. Ruger uses a proprietary scope base system, though adapters are available to convert the Ruger bases into Weaver type bases. Scope base and mounting systems are also manufactured in Europe. Specialized manufacturers like Ernst Apel GmbH offer an elaborate program of mounting solutions for many different guns. Many European gun manufacturers also developed and offer proprietary scope base systems for their guns, for example Sako has tapered dovetails and Tikka uses 16mm dovetail.

Scope rings

In addition to needing the right type of connector to attach to the desired base, scope rings must be used to hold the scope to the mount. The rings must be of the proper size to fit the scope; common sizes are 3/4 inch (19.05 mm), 22 mm, 1 inch (25.4 mm), 26 mm, 30 mm and 34 mm. Red dot sights commonly are found in larger sizes, such as 40 mm, and these often use ringless mounting systems designed to fit dovetail or Weaver type bases. Rings are also available in a variety of heights and materials. Ring height is chosen to place the scope high enough to clear the firearm, and at a height comfortable for the shooter.

Scope mounting rails

European telescopic sight manufacturers often offer the option to have mounting rails underneath the riflescope to provide for mounting solutions that do not use scope rings or a single scope ring around the objective of the scope. These rails are an integral part of the scope body and can not
be removed. The mounting rail permits the riflescope to be securely and tension-free mounted at the preferred height and correct distance from the shooter’s eye and on different guns.

There are several mounting rail systems offered:

- Standard prism
- Zeiss ZM/VM, also used by DOCTER
- Swarovski Optik SR
- Schmidt & Bender Convex

The traditional standard prism mounting rail system requires to have the scope rail drilled from the side for fixture screws. The more recent propriety systems mainly offer aesthetic advantages for people who have problems with redundant drill holes in sight in case the riflescope is used on different guns. To avoid drilling the scope rail, the propriety rail mounting systems have special shape connections machined in the inside of the rail. These shape connections prevent ever showing any exterior damage from mounting work on the rifle scope. The propriety rail systems use matching slide-in mount fasteners to connect the riflescope to the gun. Some propriety rails also offer the possibility to tilt the scope up to 1° to the left or right.

**Rail interface systems**

![Telescopic sight fitted with scope rings on a Picatinny/MIL-STD-1913 rail mounted above the receiver of a sniper rifle.](image-url)

For mounting telescopic sights and/or other accessories to guns several rail interface systems are available to provide a standardized mounting platform. Probably the best known rail interface system is the Picatinny rail or STANAG 2324 rail or MIL-STD-1913 rail used by NATO forces and other official and civil users. The name of this interface system comes from the Picatinny Arsenal in New Jersey, where it was originally tested and was used to distinguish it from other rail standards at the time. The Picatinny rail comprises a series of ridges with a T-shaped cross-section interspersed with flat "spacing slots". Telescopic sight mounting rings are mounted either by sliding them on from one end or the other; by means of a "rail-grabber" which is clamped to the rail with bolts, thumbscrews or levers; or onto the slots between the raised sections. Another commercially available rail interface system is the Weaver rail mount from Weaver Optics. The only difference between the Picatinny rail and the Weaver rail is the size of the slots, although many rail-grabber-mounted accessories can be used on either type of rail.
Mounting issues

Scopes for use on light recoiling firearms, such as rimfire guns, can be mounted with a single ring, and this method is not uncommon on handguns, where space is at a premium. Most scopes are mounted with two rings, one in the front half of the scope and one on the back half, which provides additional strength and support. The heaviest recoiling firearms, such as Thompson Center Arms Contender pistols in heavy recoiling calibers, will use three rings for maximum support of the scope. Use of too few rings can result not only in the scope moving under recoil, but also excessive torque on the scope tube as the gun rolls up under recoil.

Scopes on heavy recoiling firearms and spring piston airguns (which have a heavy "reverse recoil" caused by the piston reaching the end of its travel) suffer from a condition called scope creep, where the inertia of the scope holds it still as the firearm recoils under it. Because of this, scope rings must be precisely fitted to the scope, and tightened very consistently to provide maximum hold without putting uneven stress on the body of the scope. Rings that are out of round, misaligned in the bases, or tightened unevenly can warp or crush the body of the scope.

Another problem is mounting a scope on a rifle, such as some lever action designs, where the shell is ejected out the top of the rifle. Usually this results in the scope being offset to one side (to the left for right-handed people, right for left-handed) to allow the shell to clear the scope. Alternately a scout rifle type mount can be used, which places a long eye relief scope forward of the action.

A firearm may not always be able to fit all aiming optics solutions, so it is wise to have a preferred aiming optics solution first reviewed by a professional.

Uses

Telescopic sights have both advantages and disadvantages relative to iron sights. Standard doctrine with iron sights is to focus the eye on the front sight and align it with the resulting blur of the target and the rear sight; most shooters have difficulty doing this, as the eye tends to be drawn to the target, blurring both sights. Gun users over 30 years of age with keen eyesight will find it harder to keep the target, front sight element and rear sight element well enough into focus for aiming purposes as human eyes gradually lose focusing flexibility with rising age. Telescopic sights allow the user to focus on both the crosshair and the target at the same time, as the lenses project the crosshair into the distance (50 m or yd for rimfire scopes, 100 m or yd more for centerfire calibers). This, combined with telescopic magnification, clarifies the target and makes the target stand out against the background. The main disadvantage of magnification is that the area to either side of the target is obscured by the tube of the sight. The higher the magnification, the narrower the field of view in the sight, and the more area that is hidden. Rapid fire target shooters use reflex sights, which have no magnification; this gives them the best field of view while maintaining the single focal plane of a telescopic sight. Telescopic sights are expensive, and require additional training to align. Sight alignment with telescopic sights is a matter of making the field of vision circular to minimize parallax error. For maximum effective light-gathering and brightest image, the exit pupil should equal the diameter of the fully dilated iris of the human eye — about 7 mm, reducing with age.

We trust that the above gave you some background on rifle scopes.

With compliments

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