MSR2 reticle – Battle Proven

"Practicality, versatility and accuracy within the footprint of modern sniper rifles systems"

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Prefix

The original MSR concept was released in 2009. The idea for the reticle was born from the needs of long-range field shooters. These principles are also valid and carry over to many sport shooters and hunters - those who appreciate and need practical usable precision, in any situation and all conditions.

The original designers consisted various types of experienced professionals; active and retired military, Law Enforcement Officers and competitive long-range shooters. Many members of the design team were also passionate hunters at the same time, so the MSR design functionality was considered from various perspectives.

After many successful years from that original release, MSR2 features are updated and optimized to match or exceed even the most demanding modern needs. Since its original inception there have been many advances, and changes within the precision rifle shooting world. Scope magnification ratios have increased just to mention one - as well as the general knowledge level among advanced scoped rifle users.

The original designing key points were a clean overall look with dedicated areas for precise but simple multitasking. Each MSR2 reticle area can also be used in various ways too, as explained in this manual.

MSR2 has new features, yet with further development of original design features, all carefully benchmarked and fine-tuned for the most optimized usability. Dozens of test combinations were used in the development phase, some incorporated into final prototype scopes for further evaluation and final analysis. Countless individual aspects had to be considered in design, especially line or object weight balancing which is always difficult with any reticle. This was a particularly sensitive issue with MSR2 where optimization had to be balanced uniquely for various types of use, and design had to truly perform through wide magnification range, features that we believe MSR2 does better than any other reticle.

All in all – MSR philosophy opens up the possibility of getting the full potential from your premium riflescope whether it is: shooting, viewing, observing or spotting. Near, far or extremely long ranges. Daytime or dusk, with or without image intensifiers. MSR2 offers clear system for less experienced shooters- but still offers much more as skills accumulate.

MSR2 functionality starts from the very lowest 3x magnifications, scaling up to the very highest magnifications on the market - 45x included. It covers the widest spectrum of practical precision shooting: MIL/LEO users, professionals, precision shooting enthusiasts and hunters too globally. We are proudly convinced it does it better than any other reticle on market. MSR has been used up to 4000m /4400yd shots successfully – and can be used beyond this distance too.

The MSR reticle is milliradian/ 6283 mil circle based, and is always located in the first focal plane. All dimensions are valid with all magnifications and distances. Turret clicks always match the reticle – 10 clicks of 0.1mrad shift the impact amount the matching distance between the 1mrad deviation base-hashmarks - at any distance and with any magnification. Simple, precise and efficient.

Note: *MSR and MSR2 dimensions are always fine-tuned according to scope specifications and magnification range. There can also be some design difference variations between scope manufacturers. Check your scope manufacturer for detailed specification sheet.*

Manual ver 1.4.1

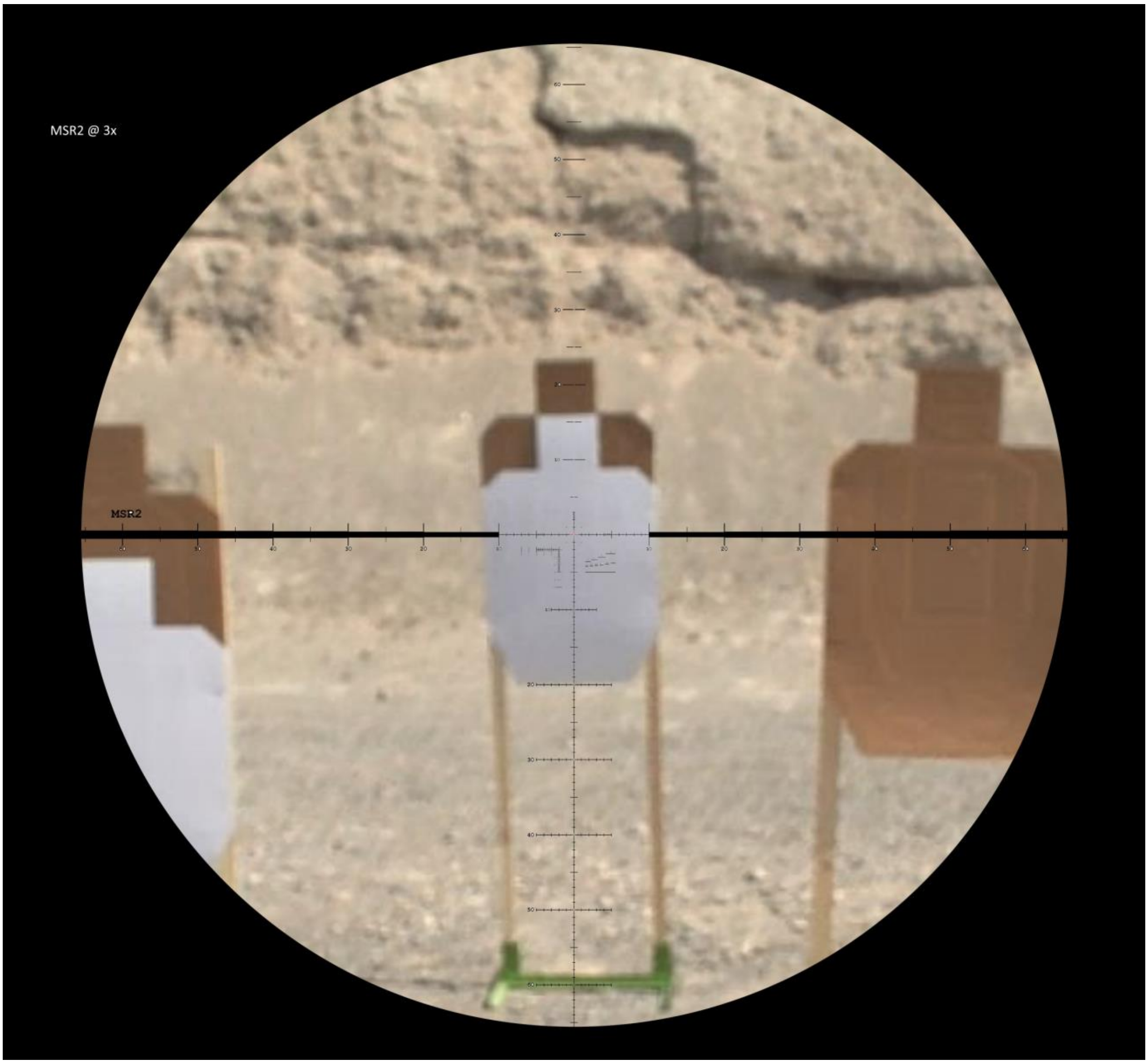
MSR2 usage in different magnifications

Low magnifications, very close-range shooting

The reticle can be used at very low magnification for spotting and general observing, whilst still be used for very close range and rapid aiming situations where a wide field of view is needed. **(**Picture 1**)**

The upper half of the view has been kept very clean, for minimal interference to both close and far shooting. Heavy hairline bars are scaled for both area spotting and rapid aiming reference use – including stepped numbers for full ten milliradian increments.

This is a desired feature for team communication and area observing- MIL FO (forward observation) type of use included, very similar in the way that classic army binoculars with rough mrad/mil scale reticle work. **(**Picture 2**)**



*Picture 1. **Rapid low magnification aiming** – app. 50m simulated distance / 3x magnification*

Wide field of view, area observing / team communication

Picture 2, example:

"Reference point: left blue building by the river, go 45mrad left, 10mrad down. Observe wood line"

Tip: The wide field of view reticle dimensions can be very usable in the urban environment as well. For instance, in mass events, or when pinpointing certain building among hundreds of buildings with very similar look.

Picture 2. ***Wide field-of-view****: Area observing / team communication example*

ELR target engagement, MSR2 elements as turret extension

Low magnification with very large field of view offers the possibility to extend shooting ranges significantly. The light hairline is stepped to heavier weight on the lower part of the reticle – offering visible aiming references in the lowest magnifications as well. Most riflescopes designed for military use offer approximately max. 25mrad (=mils) of elevation turret travel and 5mrads of windage turret travel to each direction.

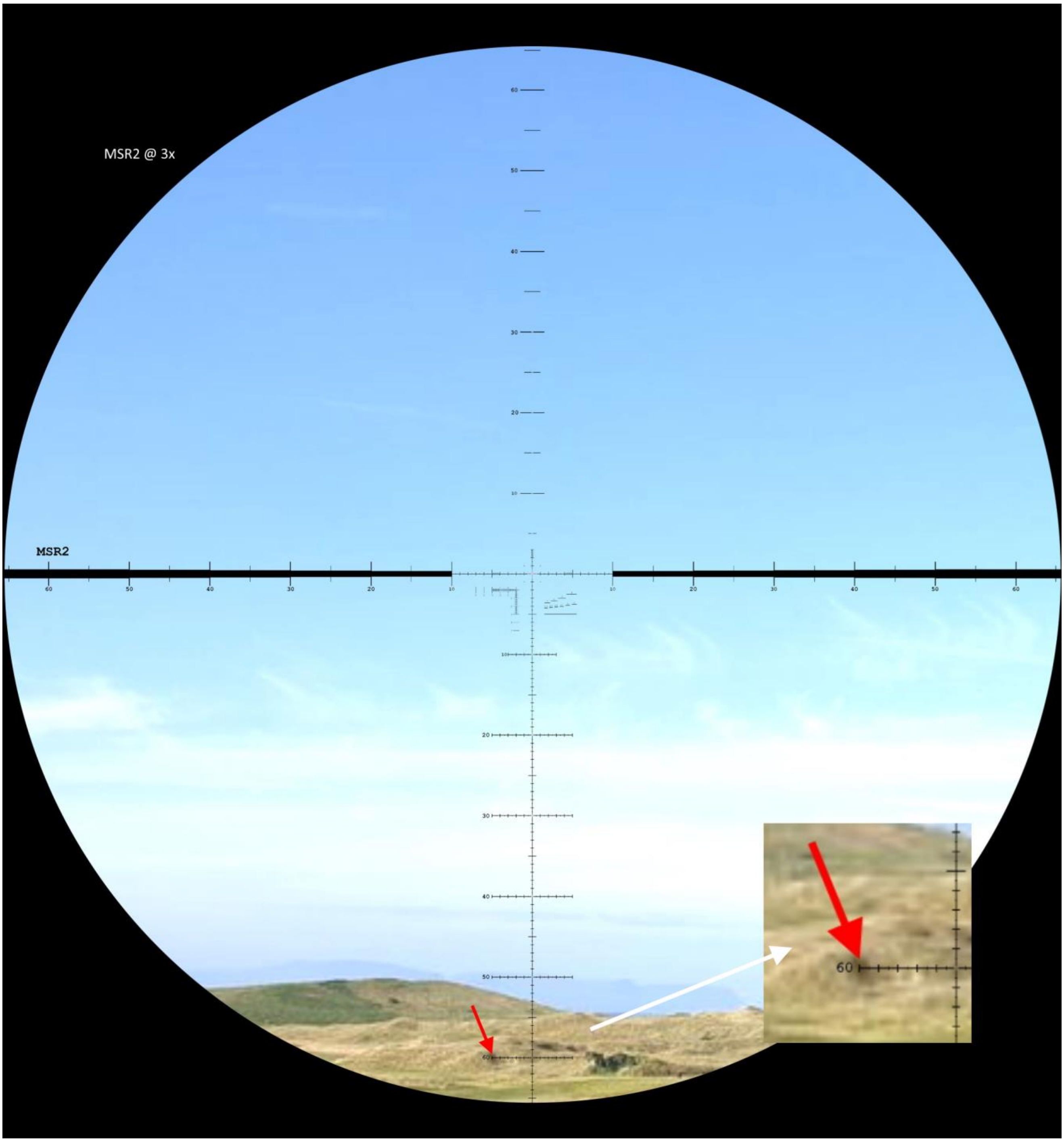
By combining the turrets and reticle, +90mrad of elevation and +8mrad of windage compensations are easy to achieve:

ELR example, based on true ballistic data: *(Picture 3)*

338 Lapua Magnum user is shooting 300gr Lapua Scenar bullets. In typical Northern European summer close to sea level, 80,6 mrad or 806pcs of 0.1mrad elevation clicks are needed for 3000 meters (3281yd) distance if rifle is zeroed at 100m. Effective average sidewind is 6.5m/s (13mph), so the needed total windage correction is 9.2mrad or 92 clicks. In this example, the user would bottom both turrets much closer than required range elevation is. Typically, max. 25mrad elevation turret travel is sufficient for little over 1700m / 1860yd only- and even the 25mrad available adjustment travel requires optimized forward cant on scope mount or rifle mount rail.

Solution: The user decreases magnification until he sees a sufficient amount of hold-over marks in lower part of light hairline. In this case, bottom horizontal secondary aiming line: 60mrad low from reticle center where rifle is normally zeroed. As required the total adjustment is 80,6mrad, the remaining 20,6mrad (80.6-60=20.6) is adjusted from the turret: 206 clicks up. Windage compensation is done a similar way: The Ballistic computer solution is 9.2mrad. User aims full 5mrad against wind from reticle, and adds remaining 4.2mrads (9.2-5=4.2) from windage turret for perfectly matched aiming point.

Note: Using low magnifications is not optimal for precise aiming- but most objects can be seen from very far with relatively low magnifications too - > working aiming reference for engagement with reasonable accuracy.

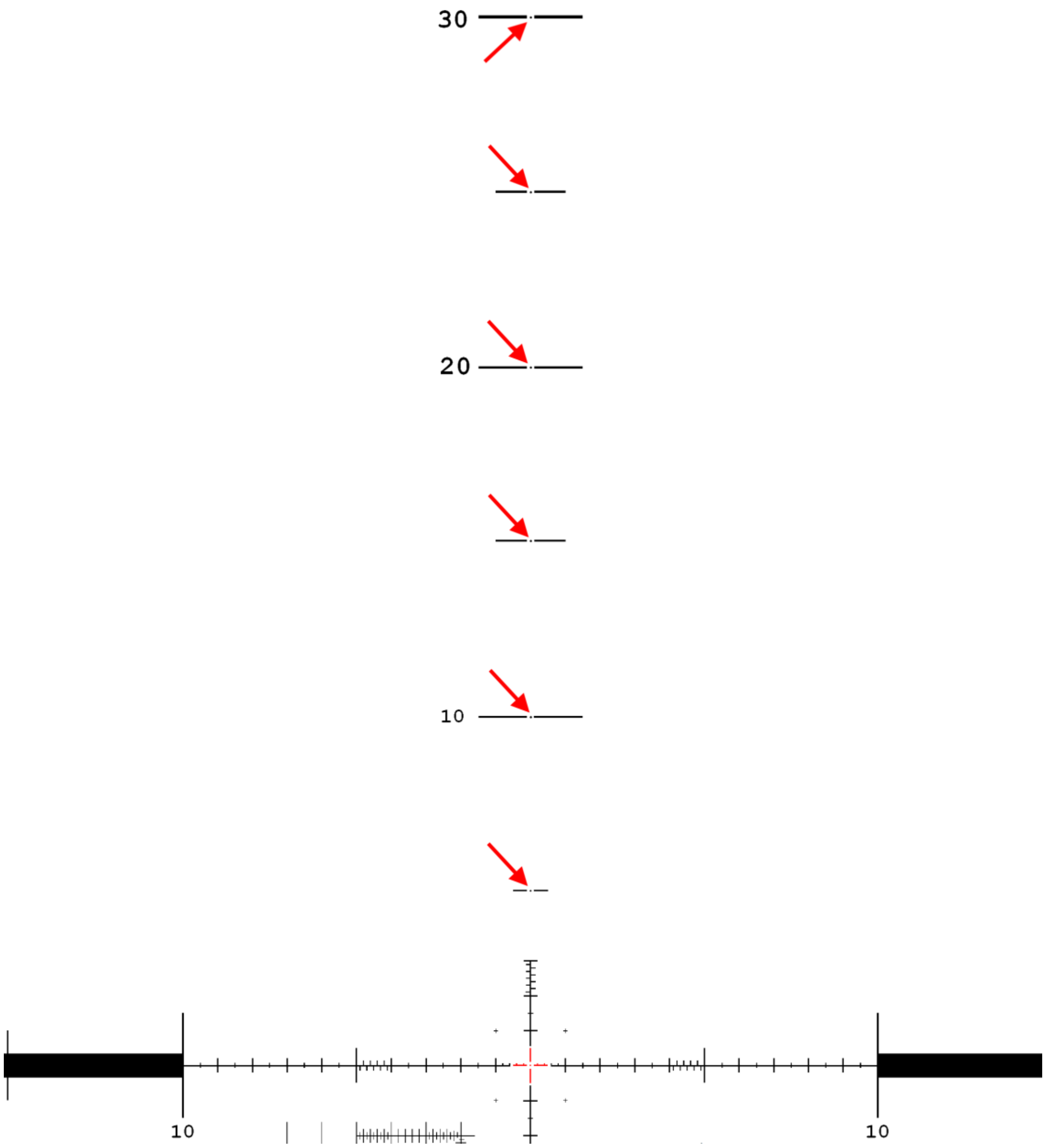


Picture 3. ***3000 meter/3281yd ELR target engagement*** *with 100m zeroed riflescope: 806 clicks (80.6mrad) equivalent elevation aiming point.*

Zeroing rifle on upper half or reticle for additional ELR hold-over

Picture 4). MSR2 “spotting hashmarks” directly above the center are dual-use dot-hashmarks up to 30 mrad mark. The dots can be used as secondary aiming reference mark in extremely long-range shooting purposes where very large amount of elevation adjustment is needed.

Scopes with steeply canted +60MOA or +100MOA mounts can be zeroed with these dots for any distance, releasing more usable hold-over room for extreme ranges: Zeroing to “30” (30 mrad) up dot-hashmark releases instantly more usable shooting elevation than most military scope turret can offer as total.



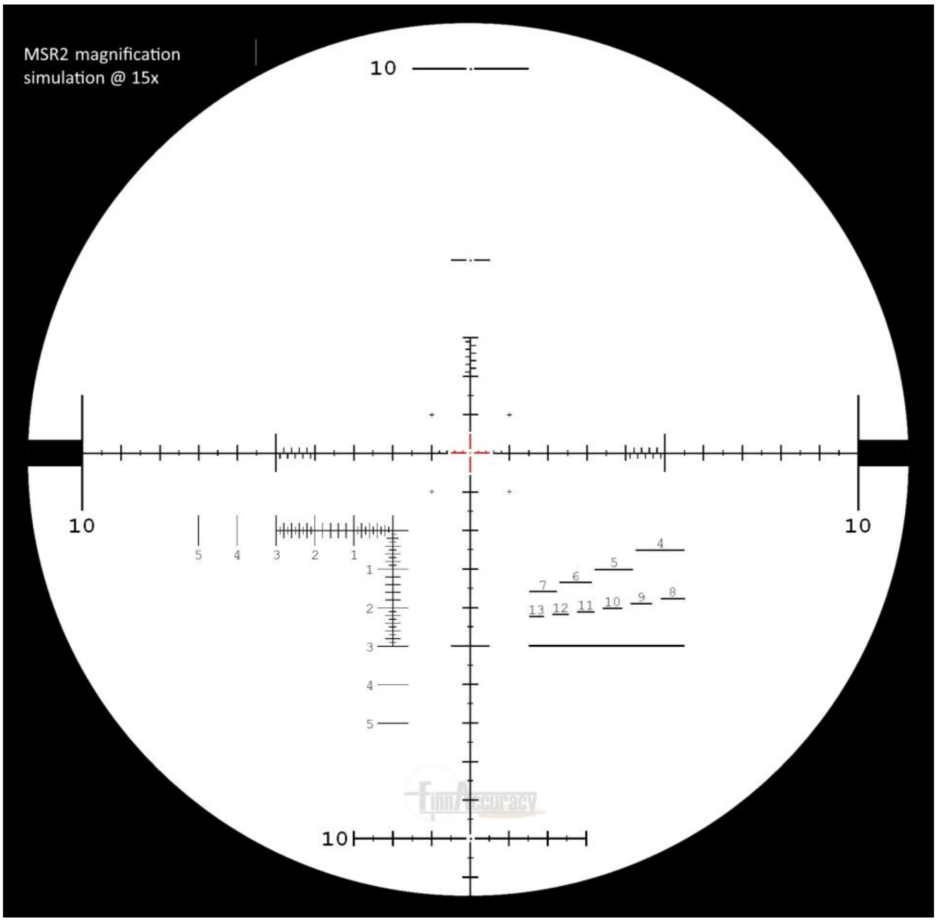
*Picture 4, **ELR / ULR use** - alternative zeroing reference dots with steeply canted riflescopes*

Midrange magnifications 10…15x

15x magnification offer traditional 1/0.5mrad deviation feel for any precision shooting where reasonably large field of view and simple, clear classic look is needed, where heavy mirage or moving targets are encountered, for instance. The stadiametric 400m-1300m instant and “fail-safe” ranging scale becomes most usable starting from this power range. The Finest 0.1mrad deviation “L” – scale is kept as close to center of the scope as possible, as the best image quality is always in the center area of FOV (Field of View). Precision is crucial if “L” is used as the only ranging method- in a situation where active transmitting laser fails or cannot be used due to environmental reasons. Or, in a situation where passive ranging method is the only safe way to determine target distance.

10…15x magnification is often a good balance between FOV/observing and precision aiming, depending on the target and situation. The Upper half of MSR2 field of view is kept clean for a minimal interference general observing: whenever the user needs to observe instead of purely aiming just before shot, all that is required is to aim rifle slightly lower relatively to the observed target.

Several additional aiming references for ELR/ULR are also available due to relatively large FOV. Horizontal and secondary aiming line, 10mrad down from center, is visible at 15x. This can be used as an easy turret adjustment extender equaling 10mrad or 100 clicks as elevation and 3mrad / 30 clicks horizontal / windage. Offering +2000m/+2200yd instant shooting distances for 338 Lapua Magnum user with almost any military-purpose built riflescope, while still using normal 100m/100yd turret zero distance.



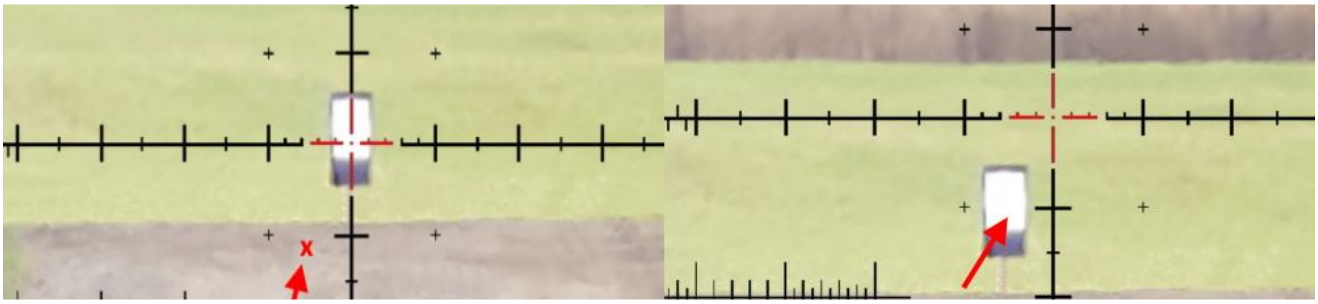
*Picture 5. **Typical field of view** on 15x magnification*

Practical aiming and shooting

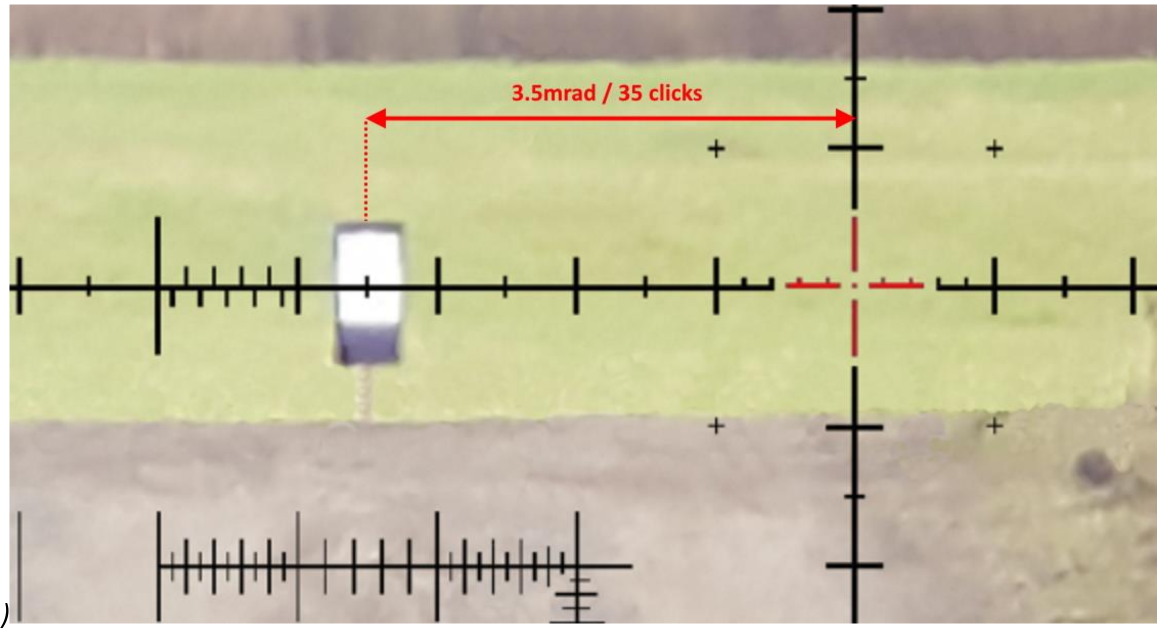
Most precise way for any long-range shot is to calculate ballistics with known and verified projectile Cd values or ballistic coefficient (BC). Most significant environmental variables should always be taken into account: wind, air pressure, air temperature and humidity. All modern ballistic applications, can compensate these and give instant turret setting solution.

Turret adjustments for each shot is always most accurate way. Using reticle center with first shot is also fast and safe way to re-aim secondary shot after first shot miss: original aiming reference is dominating view, infallible part of reticle in any situation. Second shot can be aimed relatively to this point with very small risk of user error – when in rush, stress or poor visibility.

Alternative method with good precision and reasonable clarity, is to adjust elevation from turret according to firing solution (pre-calculated tables or ballistic application), and use horizontal hairline hashmarks for hold-off (wind or moving target lead) aiming points.



*Picture 6. **Instant 2nd shot correction:** Both turrets set to reticle center, 800m/875yd target. First round miss, splash marked with "X". Instant second shot to same wind conditions with corrected aiming point. "+" marks offer good correction reference. 1m/s (2mph) wind estimation error causes 0.5mrad (5 clicks) error at 800m example distance. (Real life ballistic example: Lapua 308 Scenar-L 175gr)*



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*Picture 7. **Windage hold-off aiming:** Distance 800m, effective 90deg sidewind from right to left 7m/s (14mph). Elevation adjusted with turret: 76 clicks up. Windage turret set on zero. 35 clicks wind deflection compensated with hold-off aiming. (Real-life ballistics example, 308 Win / .30cal Lapua 175gr Scenar-L)*

MSR2 reticle elements

Quick ranging bars

Rapid ranging brackets are pre-calculated for 0.5m (50cm = 19.7”) wide and 1m (100cm = 39.7”) tall target size. Line weight, is heavy for best clarity and visibility needed during mirage and twilight.

0.5m width matches typical shoulder width, but is also close to many commonly used paper targets. 1m height is typical average dimension for groin to top-of head height. Many mil-reticles use total human height as reference, but this is problematic as vegetation, terrain or even mirage often hides lower parts of objects being ranged.

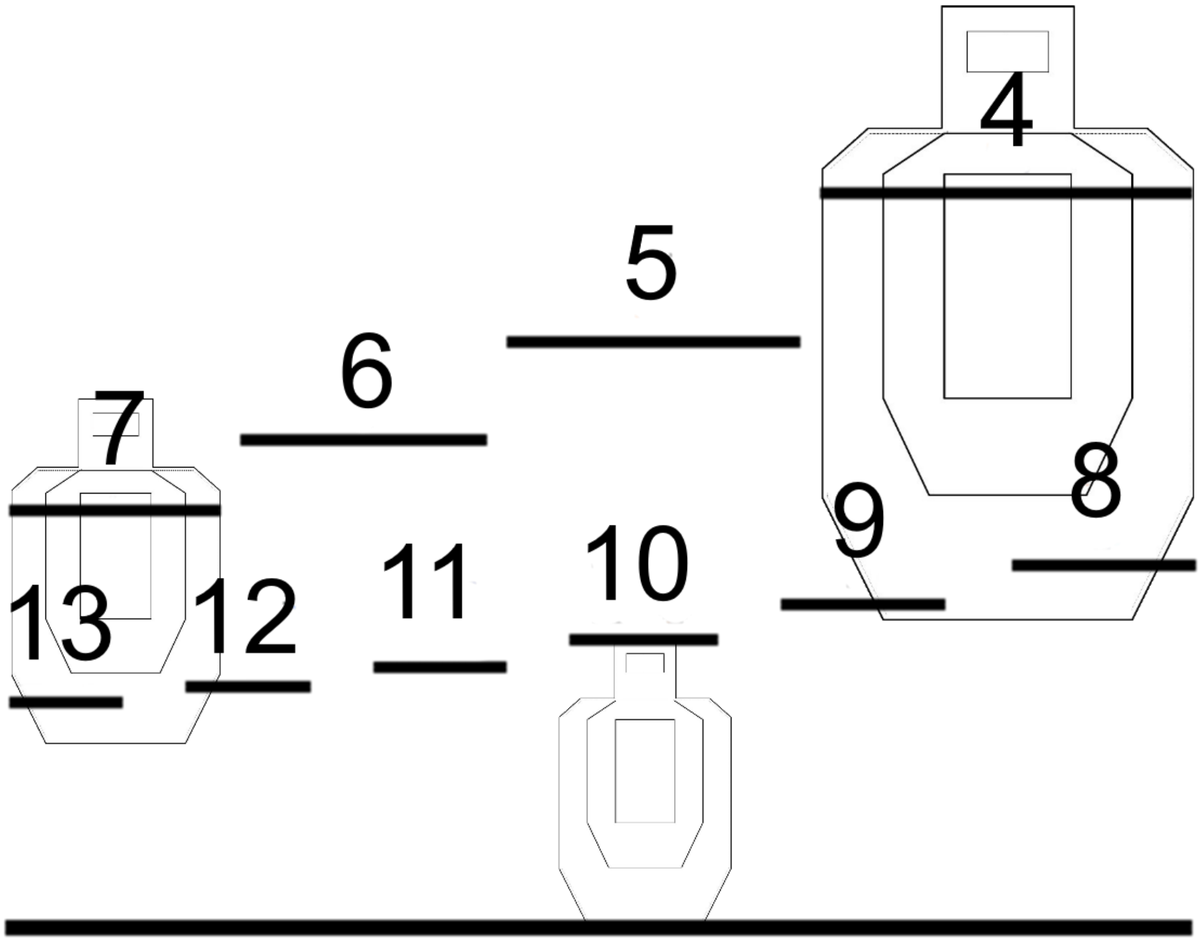
Tip 1*, picture 8*

Ranging bars can be easily used with double/half sized dimensions by multiplying or dividing the measured range by 2. If the true target width is 25cm (9.85”) instead of the reticle calibrated 50cm, object appears to be twice as far as it actually is: therefore if a 25cm wide object matches perfectly to 4 (400m) ranging bar width, the true range is actually 200m. Ranging bar can also be scaled to any smaller or larger target with easy memorization rules: If the known target width is even 20” or 50.8cm, all ranging results are repeatedly 1.6% smaller than the actual distances are.

Tip 2*, picture 8:*

Actual target width is 45cm. (17.7”) This is 5cm (2”) less than bracket pre-calculated width 50cm. Percentual size difference is 10%. (50-45=10%), (19.7-17.7=10%)
45cm wide target is measured with stadiametric bracket normally. Matching range bracket is “7”, equaling 700m distance:
As actual target size is known to be 10% smaller than bracket pre-calculated size is, range is corrected by simply subtracting -10% from bracket distance number. Actual range to 45cm wide target is therefore 700m – 10% = 630m (700 - 70m = 630m).

This way stadiametric scale brackets can be used for any size target ranging with relatively easy memorized way. All user has to do is to find out the actual reference target size difference vs the nominal 50cm (width) or 1m (height) value. Then use this percentage difference as simple correction factor with range bracket distance number.



Picture 8, quick ranging brackets

Note: Pre-calculated ranges based on true average human body dimensions - mismatching IPSC target for illustrational purposes only.

Precision milling with fine “inverted L” scale

Angular size ranging, or “milling”, can be a surprisingly precise ranging method up to 1000m, and even beyond. Repeatable and reliable measuring results require training and optimized reticle. Reticle “milling” is often considered to be only usable when a laser is not available- but still has its undisputed benefits: Passive and therefore undetectable. Lasers can be very sensitive to fog, mist, rain dust and snow. Cold environment reduces battery life dramatically.

False laser readings are common with reflecting objects/vegetation aligned with or around target, or surrounding near to laser beam path. When measuring trough distant wood line opening, for instance.

Traditional milling can also be useful in situations where laser max range is exceeded – to very far with larger objects, as long as object true size is known or estimated correctly. Reliable ranging can be especially challenging with monocular-type lasers where the missing depth-of-field does not reveal that other objects may cause increased risk of false reflection. The risk of false reading also increases with longer ranges, as any laser beam size increases proportionally with measuring distance.

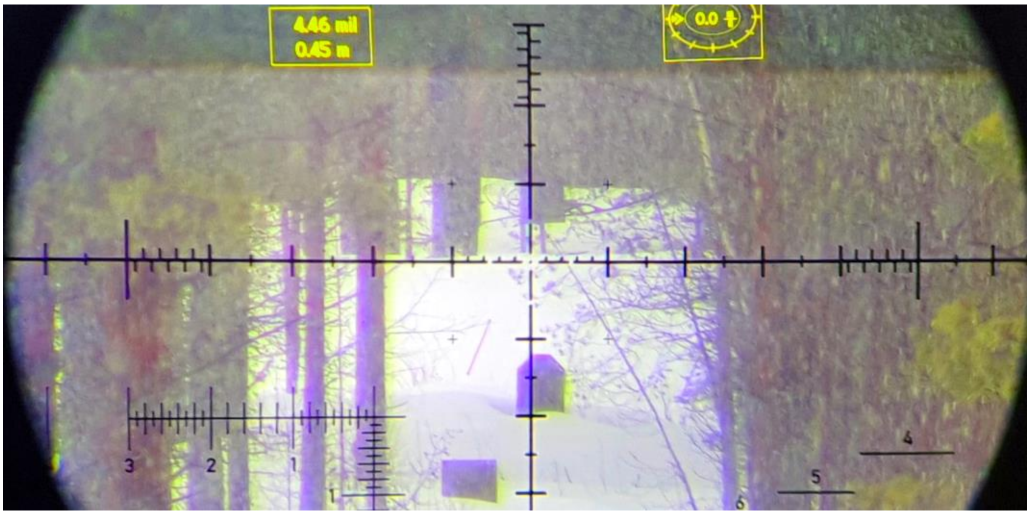
“L” scale is thinnest measuring part of MSR and MSR2 (0.02mrad line weight), balanced for best daylight precision. Besides getting used to it with the various size objects at known distances, always use as large reference/target object as possible for mathematically smallest ranging error.

Object true size in millimeters / Measured object size in milliradians = Object distance in meters

(Object true size in inches / Measured object size in milliradians) * 27.78 = Object distance in Yards

If inches are used as target size but distance is preferred as meters, use 25.4 instead of 27.78

Precise milling requires rather complex calculation where number is divided by decimal number. Some modern computer sights offer shortcut by calculating and showing angular size of pre-set sized object automatically, according to distance that is set on ballistic computer



Picture 9 ***. 45cm (0.45m) wide target mrad size shown on FOV upper left box****. Computer range was set at 100m distance with elevation turret = pre-calculated angular size is 4.46mrad.*
28x magnification view - target top on 1.25mrad down from center, between 1 and 0.5mrad hashmark. Distance to target 1.5mrad low from center is 721m/788yd.

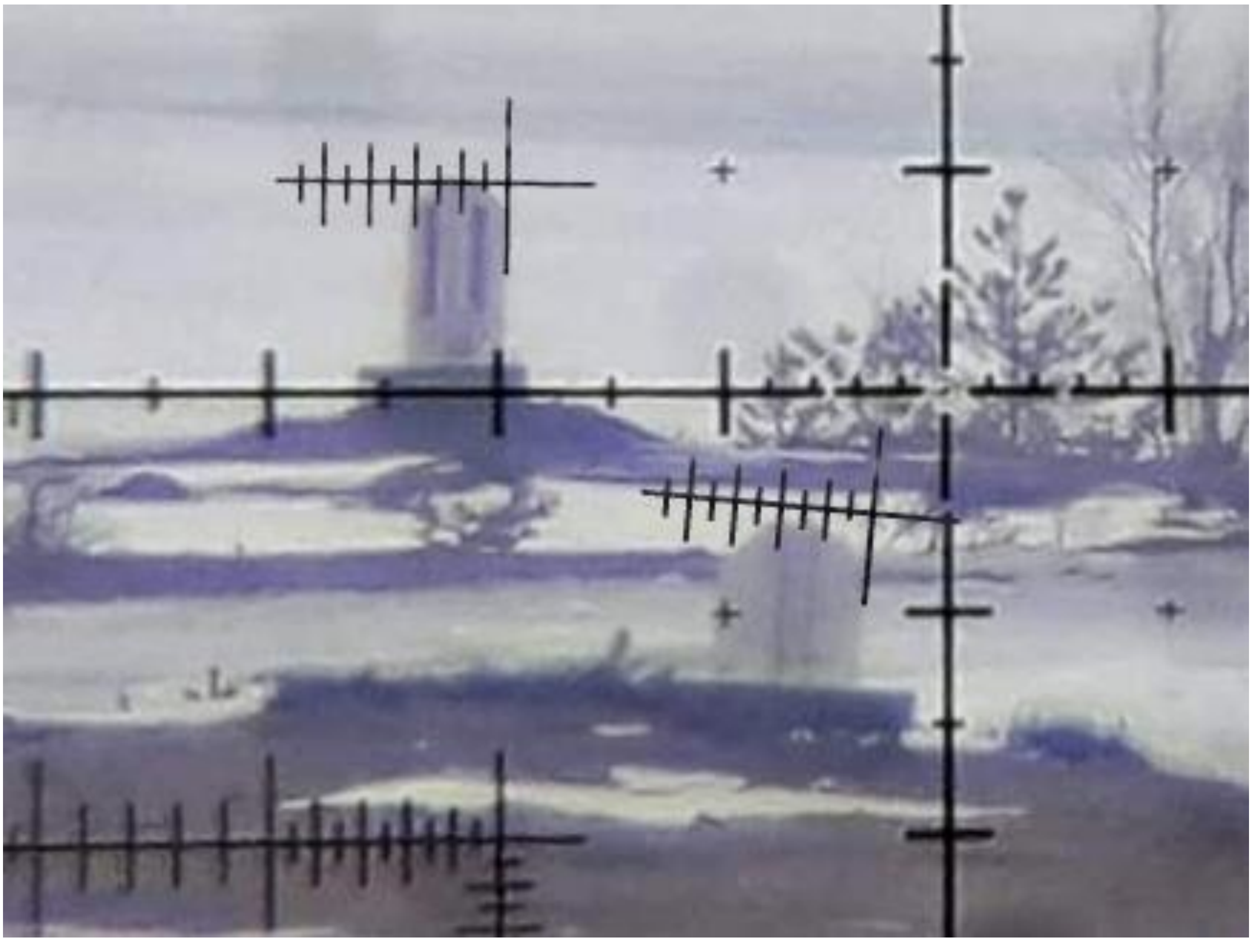
Measuring in practice

Example: *Picture 9 ,* Simulated L-scale parts to equal true reticle sharpness. Aluminum target plates in view, true width is 45cm/17.7”. Example target in view is located 2.25mrad Left, 0.5 Up from reticle center.

Ranging procedure: L- scale has both 0.2mrad and 0.1mrad deviation hashmarks. Where possible, use the corner closest to the reticle center for the best optical performance. Note: If the target is wider than the fine 0.1mrad hashmark portion of the scale, align the target edge against the next full milliradian hash-line. With this method, all objects sized between 0 and 5mrad can be measured, vertically or horizontally.

Example target angular width is slightly more than even 0.4mrad hashmark is -but clearly less than half-way (0.45mrad) to next 0.5mrad line is. Therefore, the observed target width appears to be 0.41-0.42mrad. Averaging it to 0.415mrad equals a distance of 1084m / 1185yd. (450mm/0.415mrad = 1084m). Lasered true distance to this particular target was 1080m.

Practical first round hit probability and ranging error: In real life arctic environment, without access to ballistic computer, user would most likely use rounded distance to closest full 10 meters: drop equaling 1080m from dope chart. Target visible height is roughly 90cm or 35". 338 Lapua / 300 Scenar OTM drops about 30cm/12" for each 10meter range step at 1100m distance, so available error budget for ranging in this case is about +/- 15m. If true distance to target would be 1085m, turret or aiming point set between 1070m and 1100m would produce solid hit with theoretical perfectly shooting rifle.



*Picture 9. **L-scale precision milling**. Simulated scale parts aligned with targets*

Main hairline milling hashmarks

MSR2 has additional measuring hashmarks in both horizontal and vertical direction. Main hairline is with heavier weight that ultra-fine L-scale, so it is more usable in twilight.

Each side of hairline offer 0.2mrad deviation hashmarks. Opposite sides of hairline have even and odd decimals, offering 0.1mrad measuring precision. As in the image below- odd 0.1 / 0.3…0.9mrad hashmarks below hairline, 0.2, 0.4…0.8mrad hashmarks above hairline. Vertical hairline has identical steps – odd mrad decimals on left side, even decimals on right side, respectively.

Tip: Over 1mrad sized objects can be measured by keeping next closest full milliradian mark as reference, aligned with opposite side of observed object in FOV.

Picture 10. Simulated twilight view, house +1000m.

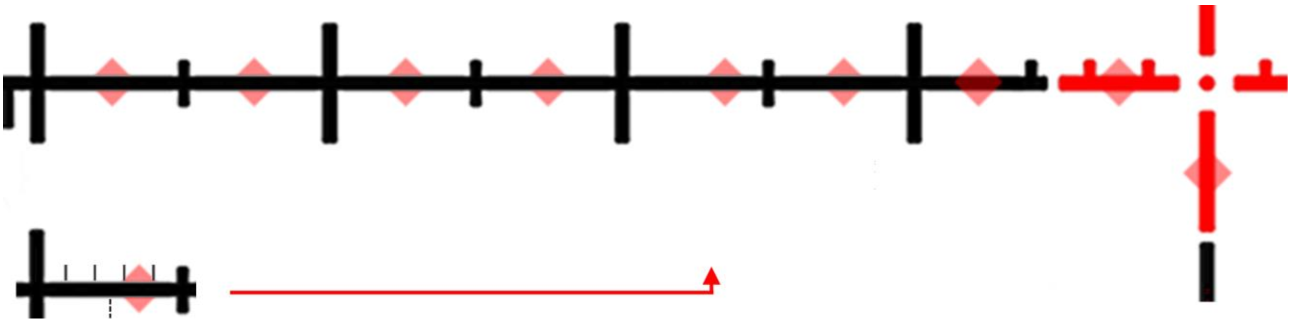
From 15…20x power and above, the smaller center area details for long range precision become visible for best usability. The center cross has added hashmarks, as well as very fine surrounding multi-purpose alignment crosses whilst still keeping the clean and simple overall feel without any unnecessary distraction.

Main hairline hashmark system

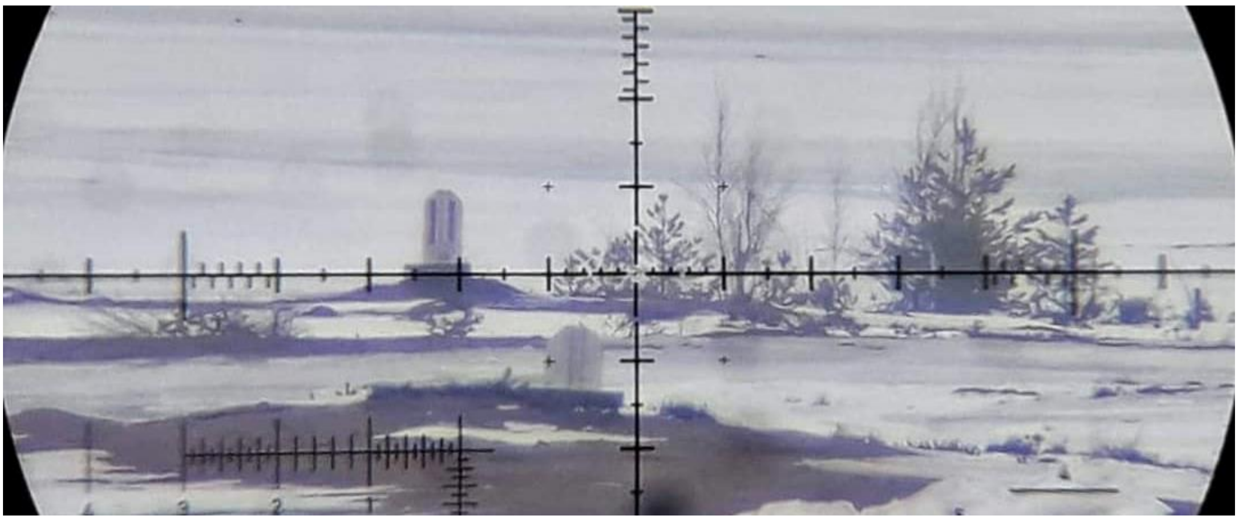
MSR and MSR2 hairline hashmark-system is balanced for practical precision: when in rush, tired or in high-stress situations, it is very easy to get lost with dense-stepped hashmarks or complicated geometric forms such as 0.2 or finer deviation lines can be. On the other hand, based on testing with several reticle prototypes and concepts, human eye is extremely good recognizing symmetric and asymmetric forms, also splitting space into even-sized measures - instinctively. In other words, simple look can be both fast and precise same time. This is due to fundamental nature of vision; geometric recognizing and processing is done by inferior temporal cortex in base of human brain.

Each 1mrad deviation base-hashmark has smaller, carefully balanced 0.5mrad hashmark between them. User can count and locate full milliradian steps very fast with any part of hairline. General “feel” is uncluttered, very much same than with original simple dot-mildot: full milliradian steps are easy to count and locate instantly.

As soon as desired full milliradian step hashmark is located and eye concentrates on certain point of hairline, finer 0.5mrad lines become clearly visible. If finer than 0.5mrad aiming reference is needed, eye will split empty space between 0.5mrad hashmark and full 1mrad mark precisely in half – offering instant 0.25mrad reference point with less than 1/2 click practical error - without any further thinking or calculations.



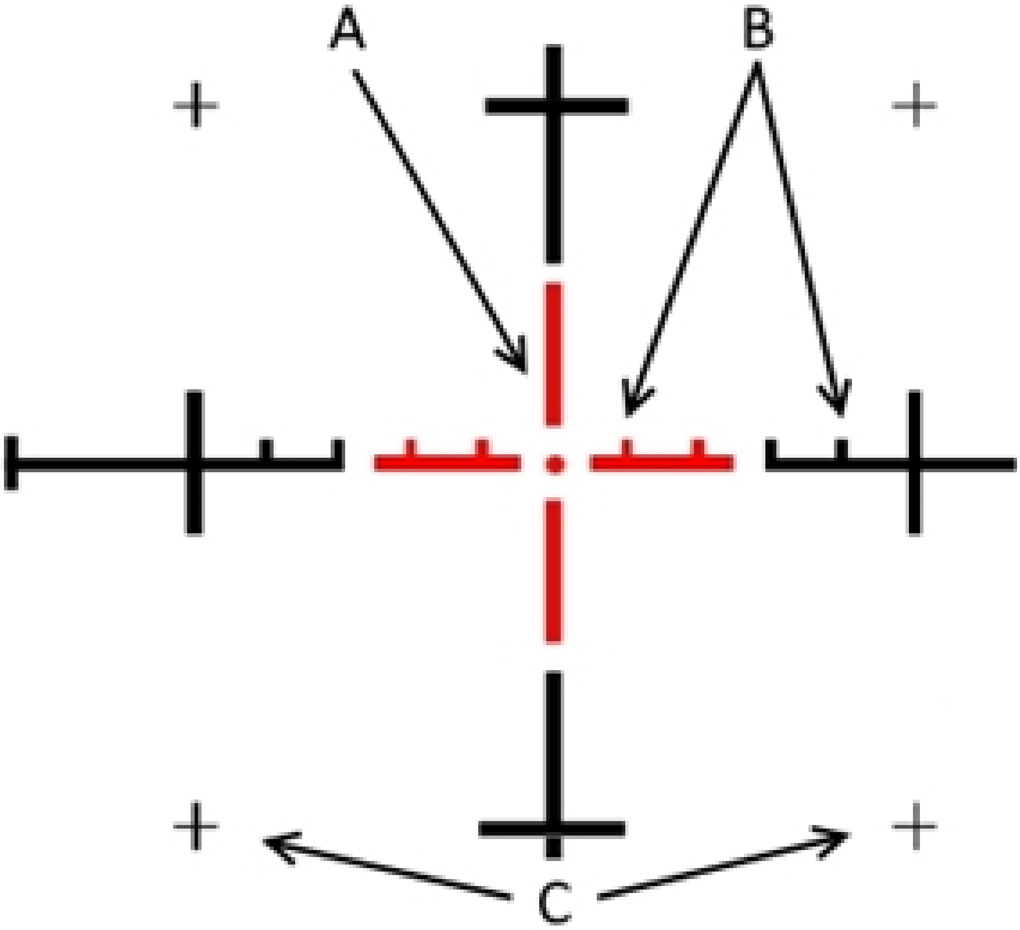
*Picture 11**.** Clear, uncluttered and fast 1mrad / 0.5mrad hashmark step – red ghost squares splitting 0.5mrad spaces evenly = precise 0.25mrad deviation aiming points.* ***One of the red “ghost targets” set*** *exactly 0.1mrad (1 turret click), off from 0.25mrad half-point: eye catches asymmetry immediately.*



Picture 12. ***25x high magnification view****. Image slightly unfocused. Furthest target 0.5mrad up, 2.2mrad left from center*

MSR2 center area

- **A)** The compact 1x1mrad center illuminated area for minimal interference to twilight performance. The center 0.5mrad lines in each direction can also be illuminated for daytime use, to emphasize it for dimensional reference. The center cross illuminated area can also be used as simple memorized ranging scale as with original MSR.
- **B)** 0.2mrad deviation hashmarks in center area vertical line - kept compact for maximum center area clarity. Hashmarks still clearly visible starting at mid- magnification ratios
- **C)** Additional very fine "+" marks around center cross offer three different functions:
    - C1. Alignment references for near-hit impacts – precise and instant shot correction in situations where target surrounding does not offer any distinguishable reference points
    - C2. Clean, ultra-fine aiming reference by shifting zero 10+10 clicks with turrets to any direction from center.
    - C3. Improvised position shooting. In typical centerfire rifle, 90-degree canted zero will shift to these reference marks if turrets are kept at 100m/100yd zero.
      See: Shooting with canted rifle



Picture 11. Typical MSR2 reticle center area. Red color is illuminated part

Center area, high magnification use

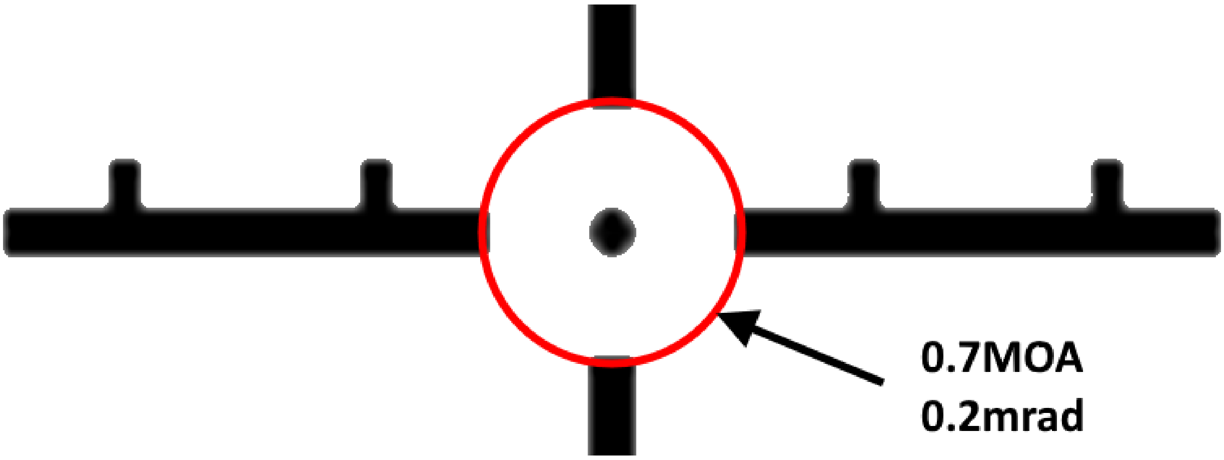
Highest magnifications limit field of view and reticle usage to the center area. The illuminated center cross has 0.2mrad deviation hashmarks in the horizontal axis. These marks were kept light to keep the center area as clean as possible while still offering functionality with new aiming references in case of need to fast 2nd shot.

The reticle 0.04mrad hairline thickness in 5-25x or larger scope class can be considered to be slightly on the heavy side, but is done so to keep hairline usable in mid to high magnification in all conditions. Heavy mirage included. Incorporation of a center aiming dot enables aiming at even the smallest and most distant target, dot diameter equaling approximately half size of .308 bullet hole at 100m distance. +25x magnifications offer most precise target angular size measurement, as well as best possible view to target if mirage is not limiting factor.

Tip: Surrounding empty space around center dot is with 0.2mrad /0.7 MOA diameter, giving prediction of constant average point-of-impact feedback to user within reasonable shooting distances.

POI feedback might also be useful when shot is taken through tight loophole, starting from relatively close distances. Typical 5-25x class scope with 50m/yd closest parallax/side focus setting offers somewhat usable image quality already few meters away, and is reasonably good already at approximately 15m/yd distance.

Note: True, repeatable 0.7MOA average accuracy requires precision rifle and premium ammunition.



Picture 12, MSR2 center dot and the 0.7MOA diameter space for impact area prediction.

1x1mrad illuminated center cross, memorized quick ranging

Range estimation method can be used when illumination is needed and/or target needs to be kept on center while fine-tuning true range for precise shot.

Note: Ranges based on true average human body dimensions, mismatching IPSC target for illustrational purposes only. In typical situations, “L” -scale or quick ranging bars are recommended due to larger reference dimensions and better ranging accuracy.

Top left: Half center-cross width, eye to eye = 150m

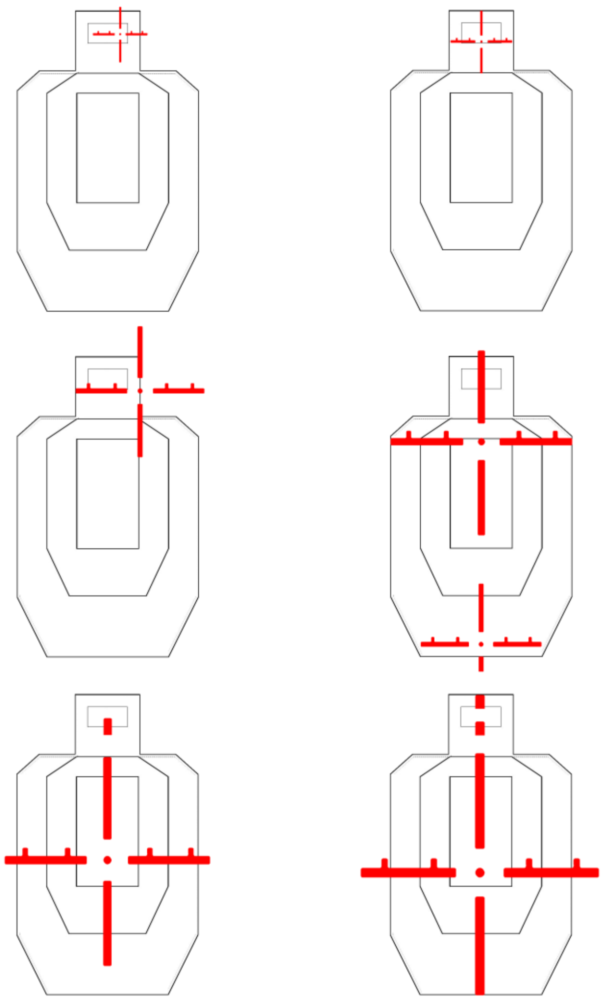
Top right: Full reticle height, chin to top of head = 250m. Helmet or hat, add 50m.

Center left: Half-center head width: 300m

Center right: Waist width = 400m, shoulder width 500m

Bottom left: Beltline to chin = 600m, beltline to eye level = 700m

Bottom right: Groin to chin = 800m, groin to eye level = 900m, groin to top of head = 1000m



Picture 13, Center cross memorized ranging

Shooting with canted rifle

In some situations, it may be beneficial to use rifle from steep right or left cant. Small "+" marks around MSR2 center area can be used various ways, with canted rifle too.

When typical precision rifle scope installation heights vs bore are in use, both elevation and windage zero shifts from 100m to app. 130m if proper aiming mark is used. In another words – canted rifle impact shift at zero range is not significant – while turrets are still kept at same zero as in normal 100m (or yd) shooting.

If rifle is shot 90 deg on its right side, 125...135m impact point will be on upper right "+" mark. As range extends and rifle is still kept on its right (or left side), user can easily use horizontal (now vertical) hairline hashmarks as stepped hold-over reference. POI difference to true 100m/100yd zero is typically not more than 1 turret click or 0.1mrad.

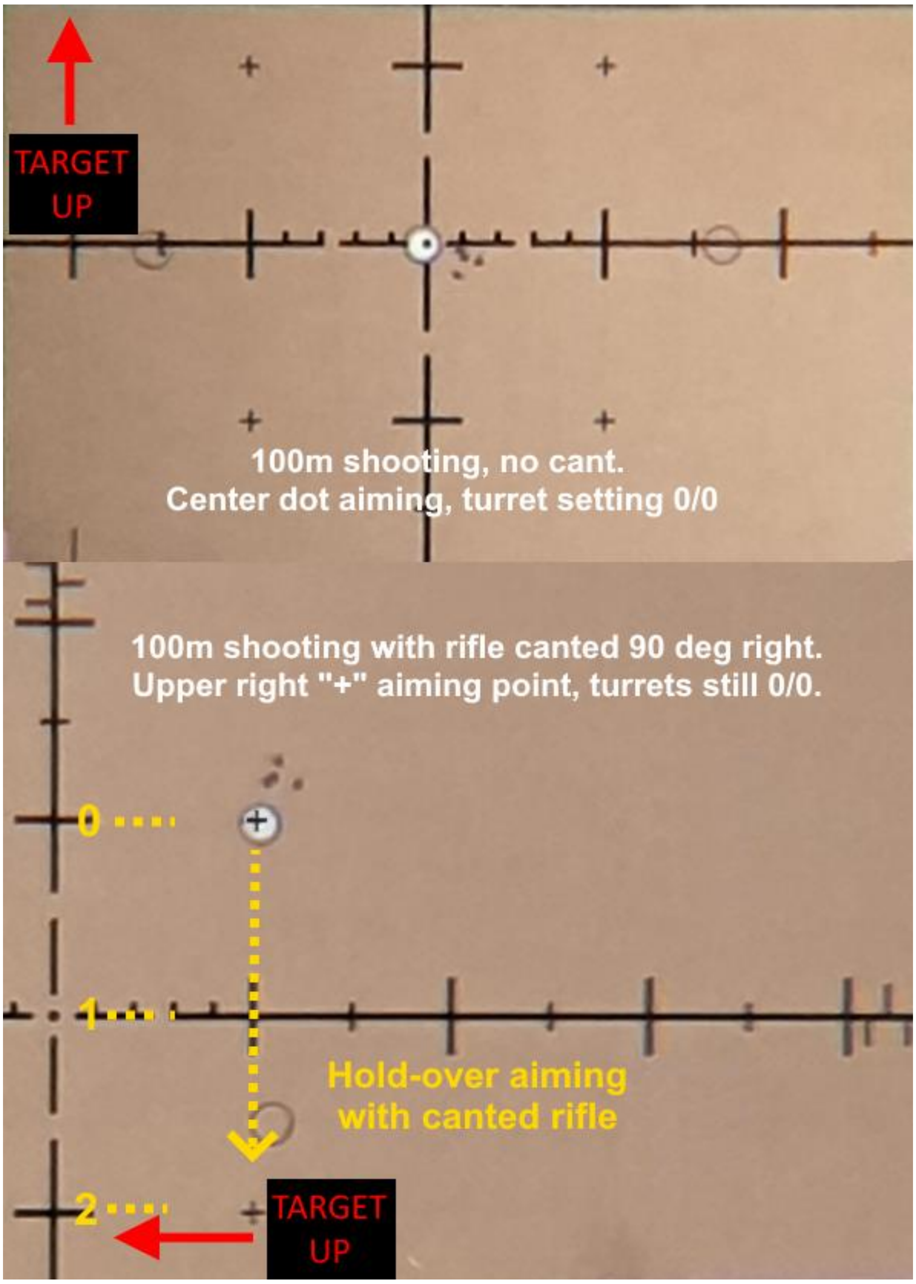
Picture 14 Rifle canted 90 degrees to right

Example- normal shooting vs 90deg right cant shooting

100m impact shifts to upper right “+” when rifle is canted right, upper left “+” when canted left.

Visible app. 0.75MOA 2+2 shot group was shot with both canted and vertically positioned rifle, by changing aiming point on reticle between shots. Turret adjustments was not done, turrets were kept at 0 elevation and 0 windage.

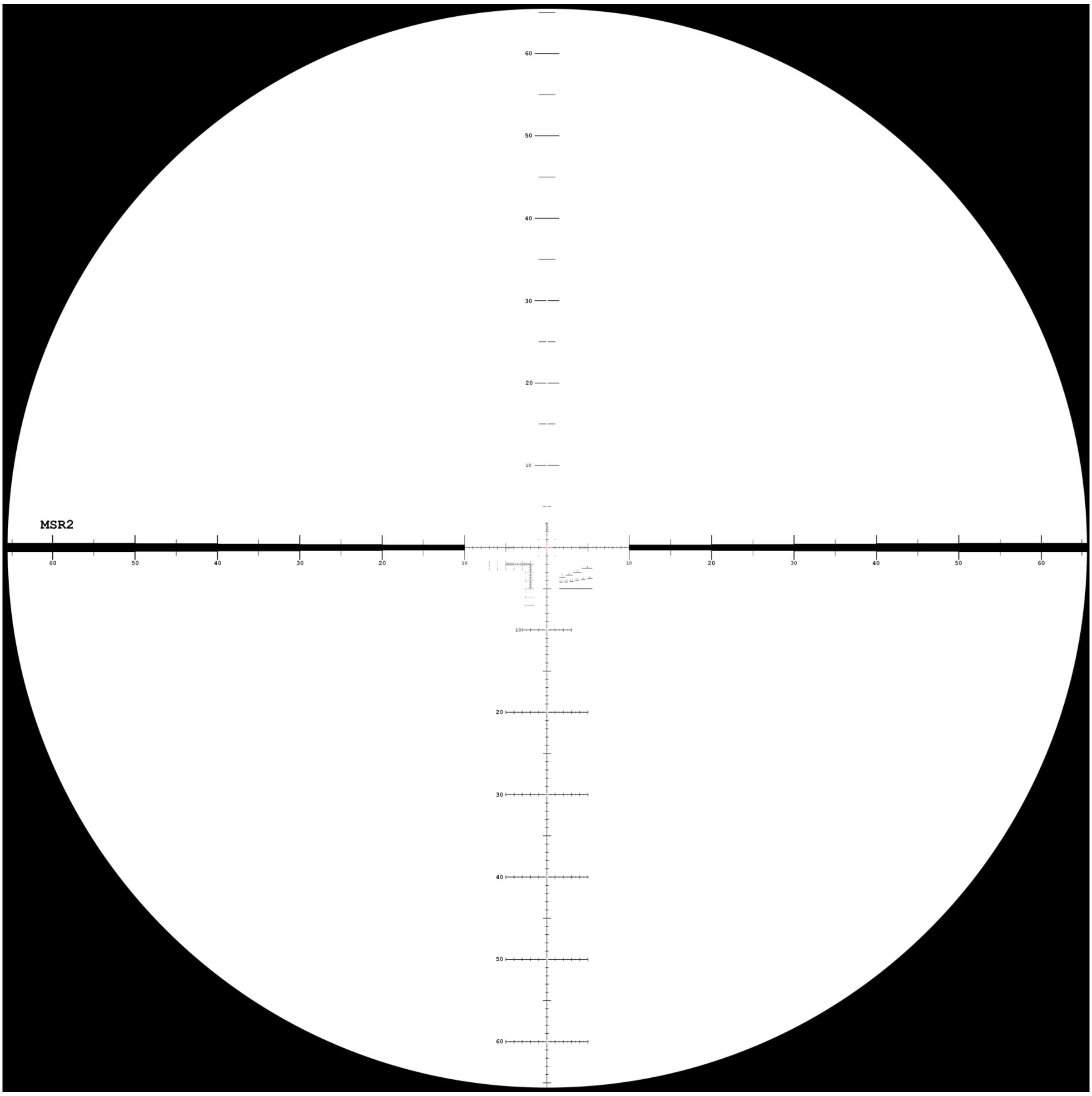
Tip: If target is further than zero range and canted rifle must be used for shot, hold-over aiming points for bullet drop compensation are easy to align with vertical (normally horizontal) hairline hash marks. Both turrets should be kept on zero.



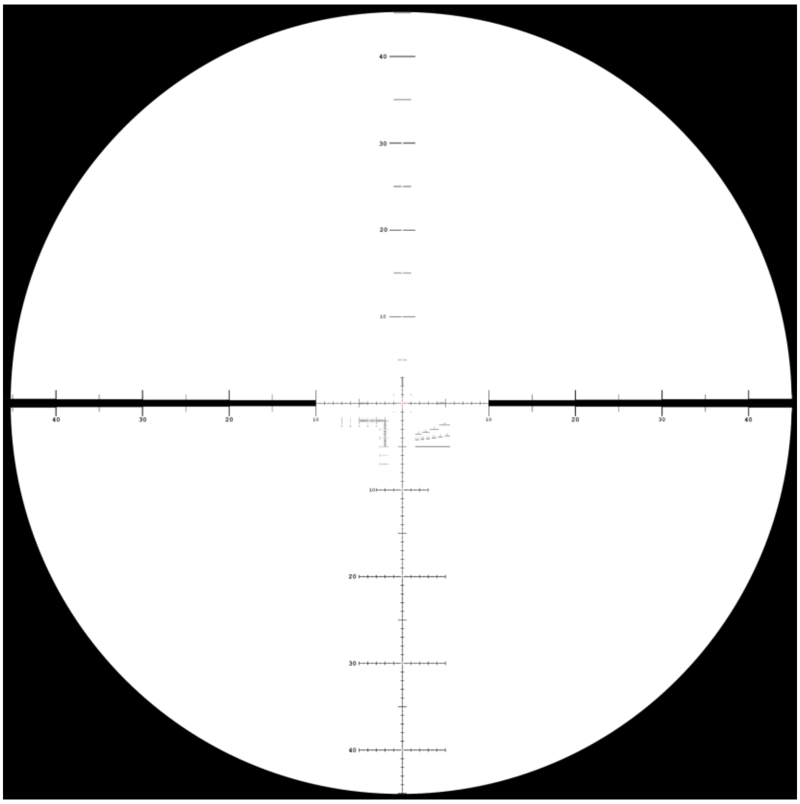
Picture 15
Upper half of target picture: *Rifle oriented normally, target direction up*
Lower half of target picture: *Rifle canted 90 degrees right, camera canted 90 degrees with scope.*

MSR2 simulated view with various magnifications

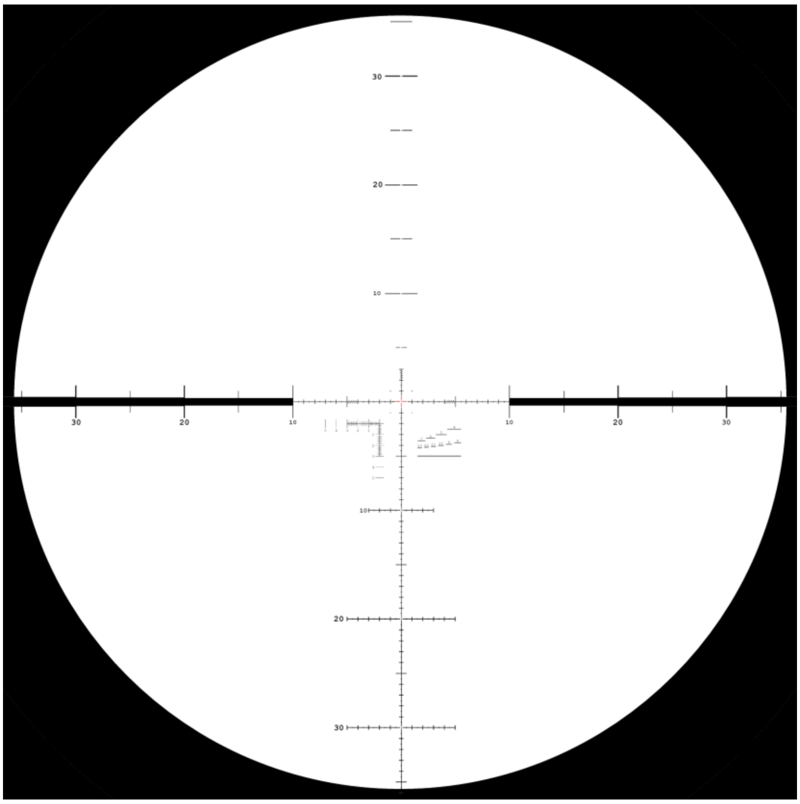
Note: Actual field of view may vary, due to riflescope specifications differences between manufacturers.



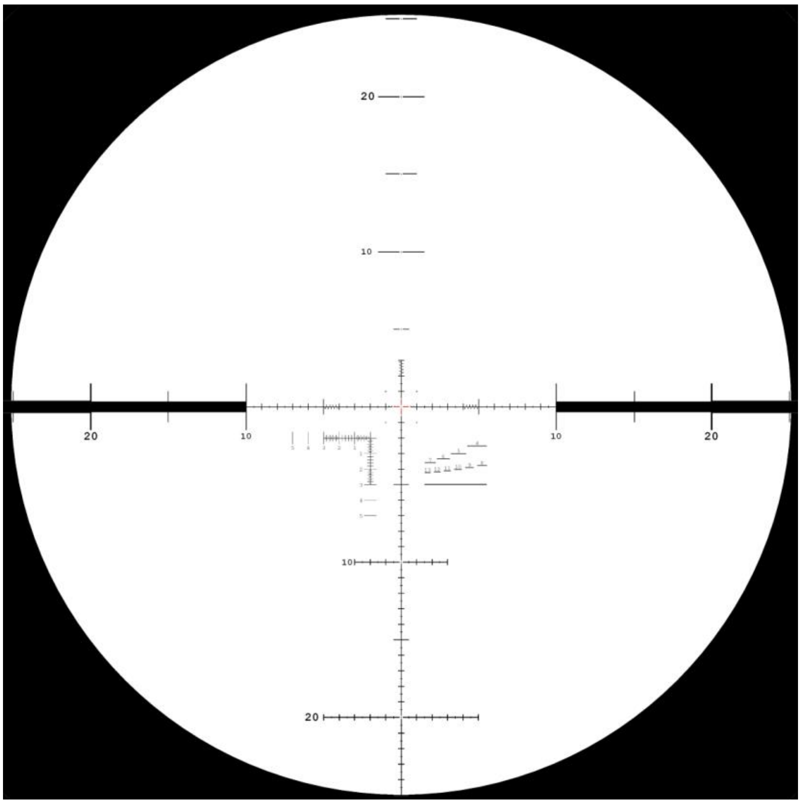
Picture 16 MSR2, typical view at 3x magnification



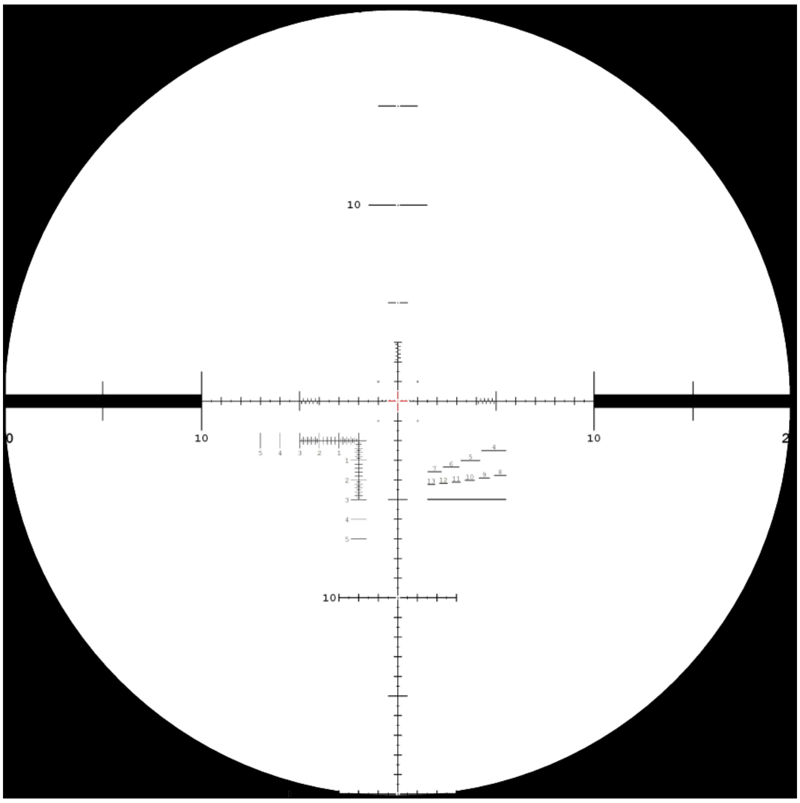
Picture 17 MSR2, typical view at 4x magnification



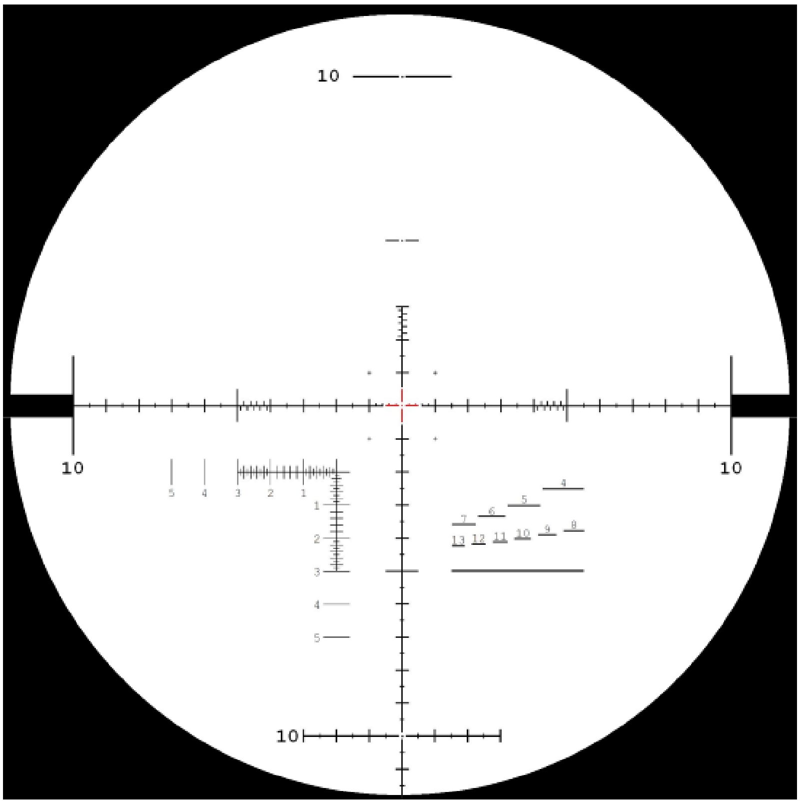
Picture 18 MSR2, typical view at 5x magnification



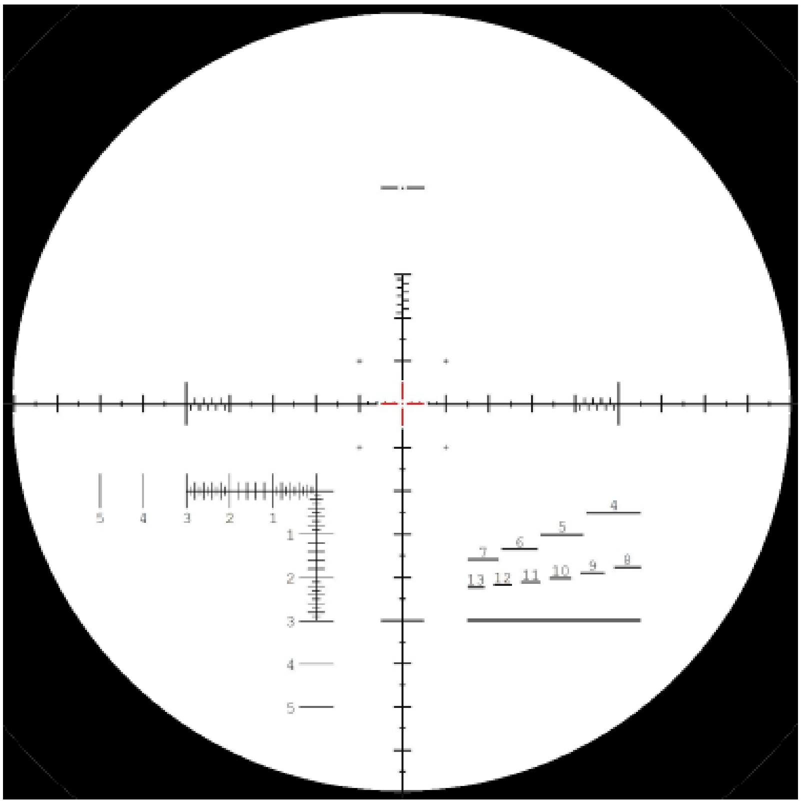
Picture 19 MSR2, typical view at 8x magnification



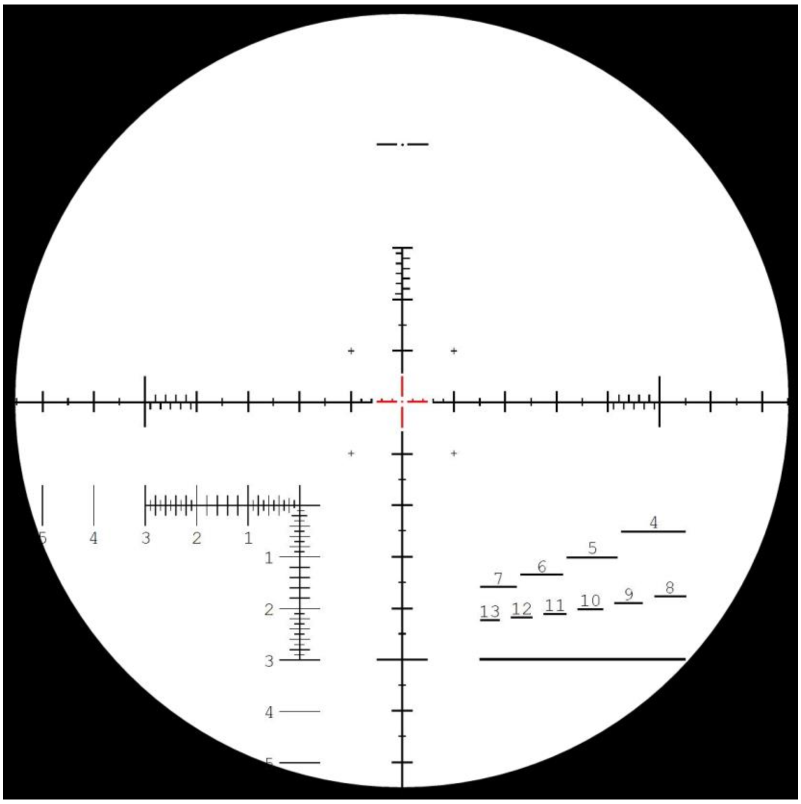
Picture 20 MSR2, typical view at 12x magnification



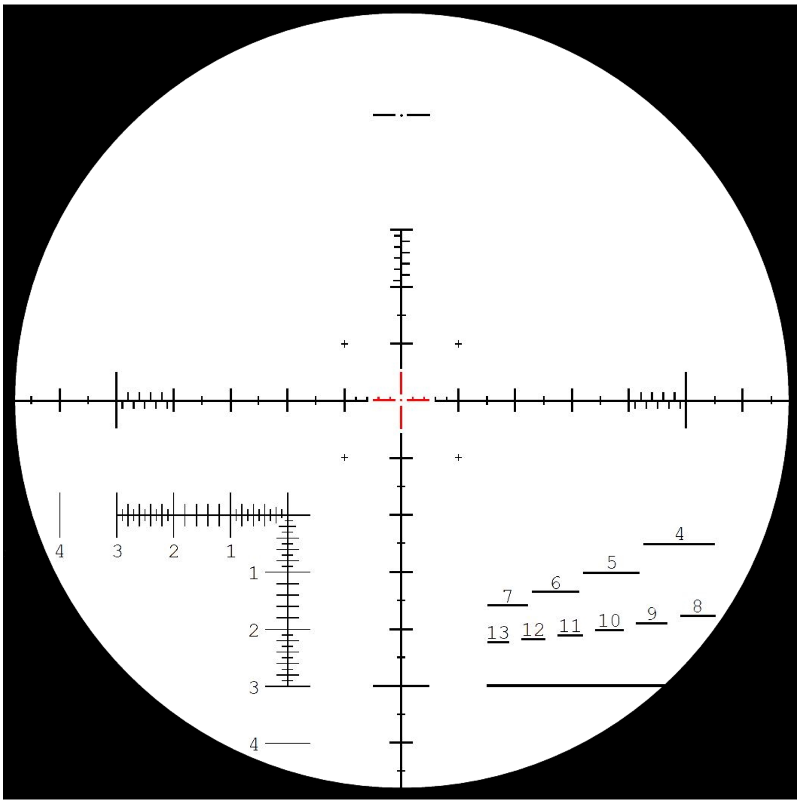
Picture 21 MSR2, typical view at 15x magnification



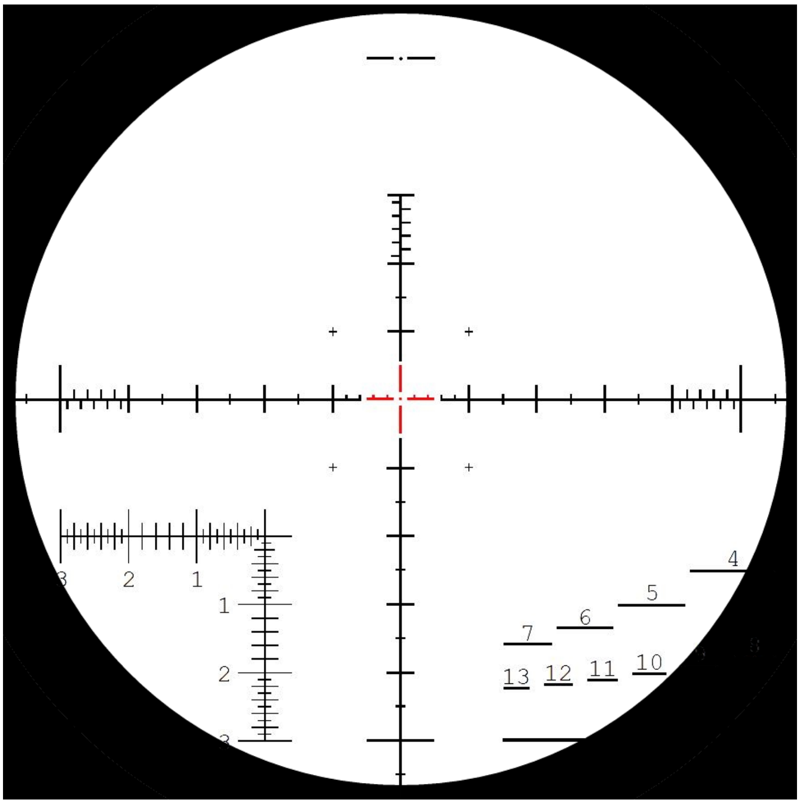
Picture 22 MSR2, typical view at 20x magnification



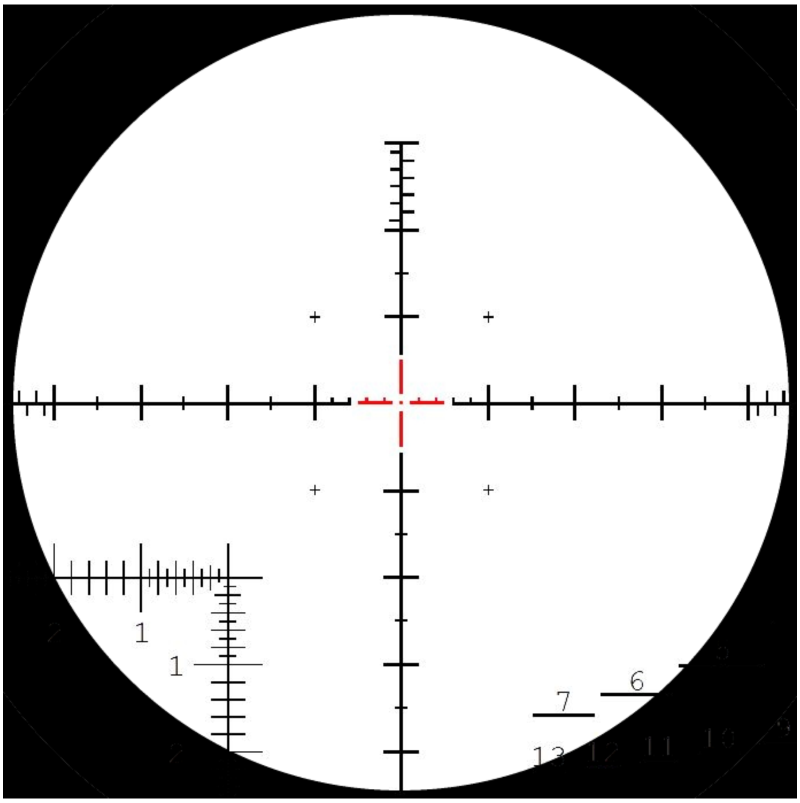
Picture 23 MSR2, typical view at 25x magnification



Picture 24 MSR2, typical view at 27x..28x magnification



Picture 25 MSR2, typical view at 35x magnification



Picture 26 MSR2, typical view at 45x magnification

Dimensions

All dimensions in milliradians unless otherwise mentioned.

Small differences between scope manufacturers may occur. Check model – specific dimensions from scope manufacturer.