Rifle Scopes 101

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For the past several years I have been training to improve my long range rifle skills. I had a 308 target rifle and duplex hunting scope. The first visit to the range I was able to get 1 hole group at 100 yards. Then I moved back to 200 made the adjustments and shot a ½" group there. I then proceeded to shoot 300,400 and 500 yards; all with respectable groups I thought this was easy and I called it a day.

The next range visit I started at 100 yards again. I was shooting over the target. What the heck is going on I asked myself? I forgot to reset the scope to the 100 yard zero. But wait I don't know the correct setting; there are no numbers on the turret or dial. How many clicks did I turn it? How many revolutions did it go around? I did not write it down. Did I learn some things the hard way?

By the way a scope suitable for 100-200yards that has a duplex reticle and no markings on the turrets won't cut it for long range shooting. Here are a few more things I learned about shooting longer ranges.

The numbers: What do they mean? For example a 4-12x 50 tells us that it is a variable power. The low setting is 4 power magnification and the scope is adjustable up to 12 power magnification. The 50 on the end means the objective lens is 50mm in diameter. This info is well and good but there is more to it. All 4-12x 50 scopes are not created equally.

The diameter of the scope tube is one factor in how much elevation adjustment the scope has. The standard tubes are 1 inch in diameter with 30mm being very popular. There are a few produced with 34mm tubes. Scopes made for long range shooting will normally have a larger tube diameter. The next factor to consider is quality of glass. Good glass helps you see details and transmits light through the scope better. This allows you to make shots at lower light levels. This is important when target identification is critical. Most scopes are clear in the center. The better quality scopes are clear all the way to the edge. It is very hard to judge this in the store. Take the scope outside and look at something with details at a few hundred yards away. You are looking for individual leaves on a tree or the mirage of heat. This is important since we use the mirage to judge wind.

Now let's take a look at the scope adjustments. The first thing to adjust is the reticle focus. This is the ring located at the ocular lens (closest to the eye) and not all scopes have them. Look at the sky or a blank wall that contrast with the reticle. Now turn the ring until the reticle is sharp and clear. You may wish to put a witness mark on the ring and the scope body to insure it stays in the same place. A silver pen works well for this. At the objective end of the scope there may be an adjustment for distance. Newer scopes have this adjustment located on the side of the scope tube near the turrets. One reason to change the focal distance is to read the wind between you and the target or if targets are at two different distances.

Scope magnification is important and more is not always better. The general rule is 1 power for each 100 yards. This works well for shooting large targets but if you use the scope for ranging, target identification or small targets like prairie dogs you can use more magnification.

My long range rifle is set up with a 6.5-20x50. The higher power is used for prone/bench shooting and ranging or target identification. For most ranges under 500 yards the power is turned down. Based on the Guerilla sniper theory this would be too much scope for the average sniper shot. A 3.5-10 would be more acceptable. I used a 2.5-8 scope at the last Guerilla Sniper class and had reliable hits to 800 yards with a 5.56 AR. The targets were steel silhouettes. This was pretty much the limit for this scope, ammo, gun, caliber, and wind combination.

My two partners in the GS class had scopes on the opposite ends of the spectrum. One was a 1-4 with a bullet drop compensator. The other has a 5-22x50 with a MOA reticle. The price difference was about $1400. The performance differences started showing up big time at 500 yards, at 800yards. The 4x scope was wasting ammo. The 22 power was making consistent hits. Too much magnification can be a problem when your heart rate is elevated or you are not in the most stable position. Higher power scopes amplify your movement. It is harder to shoot with precision when the scope jumps every time your heart beats.

Another rig I use for hunting is a 3x9x40 mounted on a 20" 308. This gives me great performance to 600 yards which is more than I need where I live and hunt. If I could only have one scope I would get a

4-14 power with a 50mm objective. This would do almost anything a shooter would need up to the 800/1000 yard mark.

When choosing a scope, be aware the reticles come in many different styles and configurations. Reticles are also called crosshairs by many shooters. Many modern scopes don't have traditional crosshairs. In fact some don't cross at all. A small opening in the center is a good thing when the width of the crosshair can cover up a small target. There are scopes with dots, triangles or circles in the center. Some are illuminated by fiber optics, tritium, or electronics. These are designed for shooting closer ranges so the eye will focus quickly on the illuminated reticle for a faster shot. They work very well for what they were designed. They are not going to give you the precision that will be required at longer ranges.

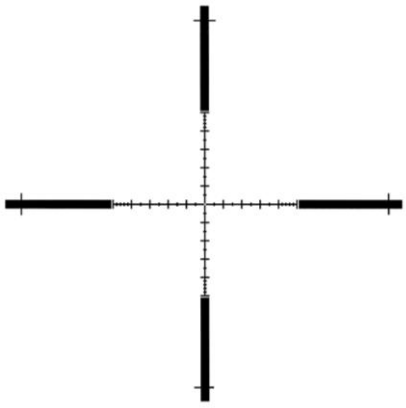
The duplex reticle is very common. It has a thick post and then it narrows near the center where the vertical and horizontal lines cross. These work well when the scope is zeroed for one distance. They only have 3 reference marks for elevation on the vertical line. The first is where the thick post thins down above the center point. The next is the center cross and the point where the line thickens up on the lower post. These work but we are limited to only 3 reference points.

The next choice is a reticle with a bullet drop compensator. These have hash marks or rings below the center cross. These distances are set at the factory for a wide variety of common ammo types. They are not adjustable after the zero is set. They work on large targets but can be difficult on smaller targets or more precise shots. The bullet drop reticles are usually limited to 600 yards.

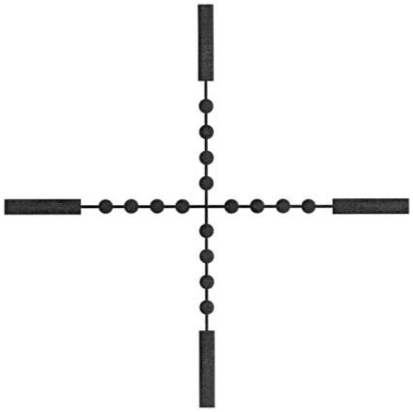
The most flexible are the mil dot type reticles combined with fully adjustable target turrets. Mil-dots were designed by the military to aide in holding over and in ranging the distance to targets. A mil is based off the circular measurement in degrees, minutes etc. One mil at 100 yards is approx. 3.6inches, at 400 yards it is 4x3.6= 14.4inches. The best thing about mil dots is you now can zero your rifle and have 10 or more reference points on both the vertical and horizontal lines. If you dial in the correct elevation and miss the shot a quick follow up shot can be made by holding off using the mil-dots. They make wind corrections and moving target shooting easier since the reference points are there.

Mil-dots were originally designed for artillery at longer ranges than rifles are normally used. If the devastation of the round is measured by meters, missing by a few inches is not so important. In rifle shooting missing by a few inches is still a miss.

There are 3 types of mil-dot scopes. The first model has 4 round dots on the thin reticle lines. The USMC version changed the round dots to ovals to better judge smaller targets. One commercial version now has hash marks at every mil-dot location and a short hash mark at every half mil location. This is the one I prefer because it makes ranging targets easier.



Tactical Milling Reticle



Standard Mil-Dot Reticle

The newest version from Leupold is called a TMR and the mil-dots are 10 sections wide and tall with a section on the outer ends that is divided into 0.2 mils. This really helps when ranging small or distant targets. The best of both worlds is an illuminated TMR reticle.

There are a few scopes that apply the theory of mil-dots, but change the increments from Mil radian to minute of angle. Under this method the hash marks are 2 moa apart. What's the difference? A MOA reticle increment at 100 yards is 2" and 8"at 400yards. The math for the moa scopes is easier since we use a factor of 2 instead of 3.6. The only down side to the scope with MOA reticles is cost. It seems to add a couple of hundred dollars to the cost of the scope.

The turrets are the next thing to examine. Things to look for here include the type of adjustments needed. If the turrets don't have numbers to tell you how many clicks you have made or how many revolutions you have made to get to a specific distance it will be hard to return to zero. The scopes that use a coin to adjust the turrets are normally not going to work for this application. You need the target turrets that are finger adjustable and have a positive click when adjustments are made. The lower quality scopes have plastic gears in the turrets while better quality scopes have metal gears for positive adjustments.

Now look closely at the numbers on the turrets. The adjustments can vary according to manufacture and type of scope. For distance shooting a ¼" adjustment at 100 yards is the most you want. The reason is simple. That ¼" adjust at 100 yards is a 2" at 800 yards. If the scope has 1" adjustments, that translates into 8" at 800 yards. Some scopes now come with 1/8" or 1/10" adjustments for long range shooting. The amount of elevation you will need to shoot at longer ranges will play a role in the scope purchase.

I recently went out to shoot over 1000 yards with a 50 bmg and a few other rifles. At 1150 yards the scope ran out of adjustment. I noticed the scope only had 12 MOA adjustment per revolution of the turret. One of the other guns had 16 MOA adjustment per revolution. We needed the extra elevation on the 50 bmg.

This thought brings us to bases and rings. One way to help an elevation problem is to use a scope base that has elevation built into it. The most common is a 20 moa base. And remember the size of the scope tube dictates the size of the rings. A 30mm scope will not fit in 1" rings. The objective lens size and the height of the scope base are also a factor in choosing rings. Too low and the objective lens cover will hit the barrel. Too high and you can't get a good stable cheek weld.

The most common are the 1913 military style. These allow for more adjustment of the rings than most others. I have had good results with the one piece ring and bases. This type of set up eliminates a set of screws between the ring and base. Some of the one piece models allow extra room over the ejection port. This allows for easier single round loading of a bolt gun. I would recommend that the rings have at least four screws holding them on. The models with 1 thumb screw are not as secure and will ruin your day if they become loose or fall off. This is why you torque the screws with a torque wrench and check them regularly.

Eye relief of the scope is important. It is normally 1-3 inches. Before you torque the scope down check the eye relief in standing and prone positions since this may change your head position depending on your body type.

Now that eye relief is set put the rifle in a level position. Sandbags or a padded vise will work; get the action level. Then level the scope to the action. Even a little cant will make scope adjustments harder at distances. Now tighten it down per the manufacturer's directions using a torque wrench.

Now bore sight the rifle before going to the range. This can be done with several bore sight tools or with a vice and an open bolt. Just clamp the gun in a padded vice and point it at a distant object. If you can do it at 100yards the results will be better. Once the bore is aligned on target adjust the scope to the same object. It is possible to do this at 25 yards and get you on a large target. The first method is more precise.

Before leaving for the range you will need to be sure you have a ballistic chart either from the ammunition company or an online ballistic calculator. I like the one at www.Biggameinfo.com. And, have a notepad to make notes of all the conditions and factors in obtaining your zero. Snipers call this a data book and it is extremely valuable.

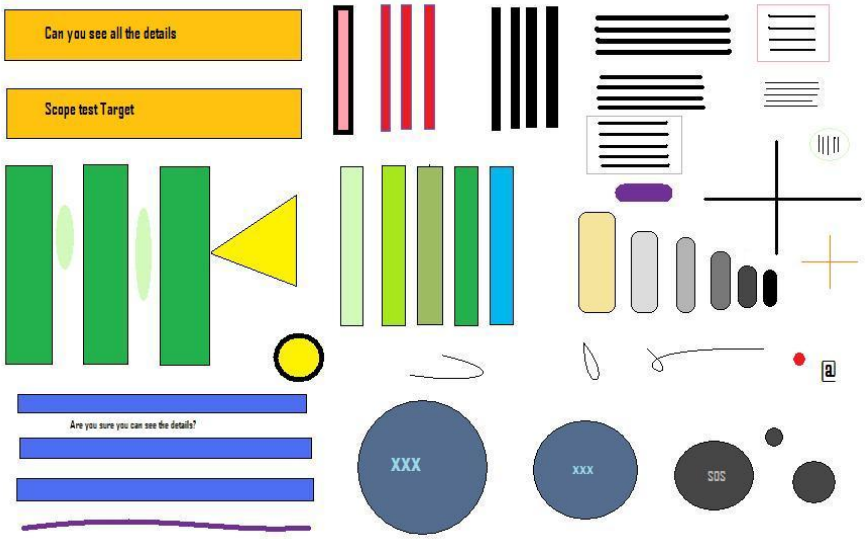
After you zero your rifle you are ready for a few tests. Draw a vertical line on a blank target about 24" long. Use a level to make sure it is completely vertical. Put an orange target dot in the center and fire a 3

shot group at 100 yards move the elevation turret up 48 clinks or 12 inches. Fire a 3 shot group. Return to zero and fire a 3 shot group.

Are all 3 groups on the line? Now do the same drill but go down 12 inches. Still on the line? If the top group is right of the line and the bottom is left of the line the scope is canted in the mount.

The next check is for the scope adjustments. Return to zero. Fire a 3 shot group and move the turret to put 6 inches left in the scope. Fire a 3 shot group. Next add 6" of elevation and fire a group. Now adjust the scope 6" to the right and shoot. Then 6" down and fire a group. The last group should be on the first group.

Too check the clarity of the scope put out a detailed drawing at 100 yards. See if you can determine the fine lines and colors or read the words. You can get special scope targets. Or, you can make your own. Here is an example



Another informative drill is to draw 2 parallel lines on a blank sheet of paper at 7.2 inches apart then observe them through a mil-dot scope at 100 yards and 200 yards, this will verify the accuracy of the spacing of the mil-dots. There are cheap scopes that have dots on the reticle that are not calibrated to the Mil-dot standard.

Check the owner's manual for the scope to see if the scope must be set on the highest power for ranging. Front focal plane scopes do not since they are accurate at any power setting.

As you look into the different types of scopes it does not take long to realize that a good quality scope can cost as much or more than the gun. As an experiment I took a low end Remington 700 SPS 308 and installed a Leupold MK4 scope. I fed it match grade ammo. I have made good hits out to 800 yards with it.

Many guns made in America will perform better and more consistently than the shooter. If you use a quality scope and good ammo you can get the results you desire. If the gun scope ammo combination will only maintain a 2inch group at 100 yards the shooter will have problems at 800 yards when that same group now becomes 16 inches. Not to mention the factors of wind, temperature and humidity on the flight of the bullet.

The old saying "buy once cry once" applies here. Buy a good scope and you will keep it for life. It should have a lifetime warranty anyway.

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