Sight-in Your .22 LR Rifle At 75 Yards!

By Allen Schuh

A great many .22 LR rifles are purchased every year. The .22 LR is the most popular caliber in history, because it is inexpensive, light weight, relatively quiet, low recoil, accurate and perfect for small game hunting, plinking and target shooting. For beginners, it is a great introduction to the world of shooting.

.22 rifle prices range from a few hundred to thousands of dollars. Some folks shoot at paper targets exclusively. Others are hunters. These are two different worlds of shooting. A 15 pound competition rifle with a super light trigger pull might be perfect for its intended application, but in the field it would be cumbersome, to say the least. For squirrel hunting, a six pound rifle with a three pound trigger pull would be far more appropriate.

Competition shooters and others shooting exclusively at rifle ranges should sight-in their rifles for the known target distance. In this respect, they have it easy.

Hunters and casual plinkers will be shooting at targets at various distances, from close to the muzzle to, perhaps, 100 yards, so they need to take maximum advantage of the trajectory of the .22 LR cartridge. Sometimes they will be shooting at rabbits or other running animals, where the range is rapidly changing. This article is intended for the hunter and plinker who will be shooting at unknown (variable) ranges.

Most .22 rifles come with inexpensive iron sights, but the vast majority are quickly fitted with telescopic sights. Most come with grooves in the top of the receiver to accommodate "tip-off" type rings that make scope mounting very simple. For the small game hunter, the problem is to zero the scope so the rifle is suitable for as many shooting distances as possible with the type of ammunition he or she intends to use.

Some shooters think the riflescope is more important than the rifle itself and will spend more money on it. You can't hit what you can't see. However, a large, high magnification scope is not the best choice for a .22 hunting rifle. Since the small game hunter and plinker will not be shooting beyond 100 yards, due to trajectory and killing power considerations, a fixed 4x or low power variable magnification riflescope is all that is desirable. For example, my .22 rifle is a Ruger 10/22 with four power scope.

There are many potential variables to consider when shooting. I kept a list at one time. I think it exceeded two dozen variables of internal and external ballistics. I was looking at temperature, humidity, altitude, barrel length, wind velocity, wind direction, barrel elevation or depression in degrees, and many others. I even included the Coriolis Effect. For that you had to know your latitude, both for the range where you zeroed and where you were hunting.

I studied different ammunition. I kept track of six different bullet manufacturers and compared by nose shape and muzzle velocity (MV). That became boring and very tedious. Eventually, I threw it all away and just focused on barometric pressure (altitude related), nose shape (drag coefficient) and speed out the muzzle as input variables. Out to 100 yards I did not even consider wind direction and velocity.

As you might have guessed, my group were about the same for all six brands of the different ammunitions at 25 yards. The catch was for me to shoot the rifle consistently. Consistency is very important, no matter what you are shooting.

A fixed power scope has the advantage of always being the same. The variable scope, for example a 2.5-7x rimfire model, might be set at 7x zeroing, but 4x in the field to take advantage of the lower magnification's greater field of view. There is a point, especially for the hunter, where enough is enough and field of view is usually more important than magnification at .22 LR ranges. A reasonable balance between these two conflicting requirements is necessary when choosing a riflescope.

With a suitable scope properly mounted to your rifle (be sure the scope is tightly attached), the next step is Bore Sighting. If your rifle does not allow bore sighting the old fashioned way (by literally looking through the barrel), an optical or laser bore sighter can be used. If you don't have either, your local gun shop should be able to help you. After bore sighting, it is time to visit the rifle range to actually sight-in your rifle from a bench rest.

With a new rifle, a new scope and ammunition I have never used before, I put my first target at 10 yards. I want to be sure I am on the paper before I do anything else. I use an NRA B-8 target attached to a wood frame about 4 feet off the ground. It is straight and level down range from my shooting position. In the literature it says that shooting up or down at angles up to 15 degrees won't make any appreciable difference. Just realize we are shooting straight and level at the range and we will generalize to a straight and level target in the field.

For the actual zeroing, I move to 25 yards. I shoot five shot groups and adjust the windage and elevation of the riflescope until the center of the final groups is in the "X" ring (the center of the bull's eye).

Try several different brands of ammunition and different loads to see what you rifle shoots most accurately. For the small game hunter, High Velocity ammo using 36-38 grain, copper plated, hollow point bullets at a catalog muzzle velocity between 1250-1330 fps is a good choice. Such loads are available from CCI (Mini-Mag), Federal (Game-Shok), Remington (Golden Bullet), Winchester (Super-X) and others. Avoid budget and promotional ammunition (Lightning, Thunderbolt, American Eagle, etc.), as it is usually less consistent than the good stuff.

Once you are zeroed at 25 yards, what happens if you move to 50, 75, or 100 yards? Let's look at the theory first. The ballistic charts available on the web, and there are at least half a dozen, will suggest the ballistic trajectory if you input the data. I will give you a spoiler alert, the different published ballistic computation algorithms do not all give the same answer on every problem. They might for 25 yards,

but not for 500 yards. You won't shoot a .22 LR at 500 yards, but I am saying there are differences in how the calculations are done.

All ballistic calculations for .22 LR that I checked suggest the best zero is at 75 yards if you sight-in to minimize the variation from the line of sight as the bullet moves down range (sight-in for maximum point blank range). The trick of this calculation is that the bullet leaves the barrel below the line of sight of the scope. Usually, the center line of the rifle barrel is about 1.5 inches below the center line of the line of sight of a low mounted hunting scope.

The bullet is affected by gravity the minute it leaves the barrel, so the procedure is to raise the barrel at the muzzle just enough, compared to the line of sight, that the bullet is fired slightly upward. The bullet will then cross the line of sight (going up) somewhere down range. It is then above the line of sight. As air resistance slows the bullet and gravity pulls it down, it again crosses the line of sight, this time going downward. This second crossing, the bullet going back down through the line of sight, is the distance at which a rifle is said to be zeroed.

The shape of the bullet trajectory is technically called a parabola, but it is slightly skewed at the far end, as the effect of air drag accumulates. The point of sighting-in is to have the bullet impact the target exactly at that second intersection of the line of sight.

Here is a simple table that shows the results of using a ballistic calculator. This is the trajectory in inches for a typical .22 LR 40 grain, round nose bullet at 1255 fps MV when zeroed at different ranges.

Zero range	Muzzle	25 yards	50 yards	75 yards	100 yards
25 yds	-1.5	+/-0	-0.06	-1.89	-5.59
50 yds	-1.5	-0.01	+/-0	-1.80	-5.47
75 yds	-1.5	+0.59	+1.19	+/-0	-3.10
100yds	-1.5	+1.38	+2.76	+2.33	+/-0

A few comments are in order. All calculations start with -1.5 inches, because this is the difference between the center line of the bore of the rifle barrel and the center line of the scope (the line of sight). When zeroing a rifle for hunting small game animals, due to the small size of their kill zone, it is reasonable and customary to allow the

bullet no more than +/- 1.5 inches deviation from the line of sight. +/- 1.5 inches thus defines the maximum point blank range (MPBR) of a .22 LR hunting rifle.

The table shows that with a rifle zeroed at 25 yards, all points further down range are going to be below the line of sight. A zero at 50 yards is better than 25, but still fails to take best advantage of the bullets trajectory. Conversely, a 100 yard zero means, with a dead-on hold, the bullet's maximum mid-range rise will cause misses by shooting over when shooting at typical small game targets, such as the head of a squirrel.

With a 75 yard zero, the amount of error is less than the other choices. The bullet does not drop 1.5 inches below the line of sight until it reaches something like 85-90 yards. It is as though a tube with a three inch diameter extended from the rifle barrel to at least 85 yards and the bullet never moved outside of that envelop. For statistical fan it should be noted that if you square the deviations along the entire bullet path, not just at these benchmarks, the sum of the squares will be lowest for the 75 yard zero.

As a general rule, beyond the 90 yard mark the bullet's trajectory drops so steeply that one should pass on shots beyond that range. While the numbers in this example may not be exact for your rifle and ammunition at your altitude, they are representative of what I have gotten from many tests.

Interestingly, 75 yards is the distance Jack O'Conner, the Dean of American gun writers, suggested decades ago for zeroing a scoped .22 LR hunting rifle. As usual, O'Connor had done his homework and was correct. See you at the range.