Core Shooting Principles

Glen Roberts

Contents

Core Shooting Principles

Core shooting principles, what are they? They are a group of guidelines and skills that form the foundation of accurate shooting. They are things that we do to ensure consistency from shot to shot when zeroing and grouping, cold bore shooting and positional shooting. Each principle when used in unison forms a concept of precision shooting. Marksmanship Principles form a part of these have been around for a long time. Handed down from generation to generation, some have wanted to change them or mould them to their own style of shooting, but what you do with them, they will still always be there.

Marksmanship Principles

These principles were formed way before the use of telescopic sights and bipods, so when you see in a minute exactly what they are, you will understand just how important they still are in the current age of sport shooting. Target shooters engaged in Full Bore match shooting still apply these principles to 100% of their shooting.

The four Marksmanship Principles are;

1. The position and hold must be firm enough to support the rifle.

2. The rifle must point naturally at the target without any physical effort.

3. Sight alignment and aiming must be correct.

4. The shot must be released and followed through without any disturbance to the position.

What do these mean? Well quite simply, holding the rifle not firm enough with cause shots to stray off target and so too will applying too much force to the rifle or “Muscling” it. This of course can be taken several different ways, however the essence of this principle should be taken just how it reads. Well you might say, this only applies to when you are shooting in the prone unsupported position when using an arm sling. No, not quite right. In fact this applies to any shooting position or shooting style. Shooting from a bipod generally usually means that only one hand is actually holding on to the rifle (Pistol Grip). The other hand controls the vertical movement of the rifle by sometimes adjusting a rice bag underneath the rifle butt. This doesn’t mean the position and hold is not firm enough, it means that whatever part of your body that is in contact with the rifle, still holds or supports the rifle firm enough to do the job.

The rifle most definitely in all situations must point naturally at the target without any physical effort. Bending you body, around or adjusting your grip to get the reticle on target is just asking for trouble. Moving your whole body around with the rifle as “One”, ensures the consistent reaction under recoil making smaller groups sizes probable. The Test and Adjust procedure described shortly covers this area.

Sight alignment and aiming really does speak for itself. When using iron sights, the foresight has to align with some part of the rear sight depending on the type used. With telescopic sights, this refers to not only the cross hair or “reticle” being on target, but also means that a correct and consistent cheek weld must be made to cope with parallax error. With the prevalence of multiple range parallax corrected scopes today this cheek weld is not so important.

When the shot is finally released, it must be “Followed Through” without any disturbance to the shooting position. The most important Marksmanship principle and one that plagues rifle shooters for their entire shooting career, is this one. If not completed properly, or completed at all, will lead to very dissatisfying results and usually a miss. What is a follow though? It can be described as *“the shooter’s complete NON REACTION, from the time the trigger is released, until the rifle has completely finished moving from recoil”.* This means your body and mind to absolutely nothing until the rifle has come to rest. Even our more powerful subconscious mind can ruin a good follow through by causing the body to freeze under recoil without us even knowing it.

A common cause of follow through failure is the dreaded flinch. A bad one is very easy to see when a cartridge has not functioned, and we see the persons eyes close and rifle jerk, finished with a trigger

snap. Embarrassing to say the least when these people have just blamed the rifle and everything else but themselves with 25 years of experience under their belts. Another common one is looking over your rifle to see the target. The body actually freezes and prepares to move when the projectile is still in the barrel. Wanting to look at the target without looking though the telescopic sight is human nature, however, in this case it really doesn't achieve anything, especially when shooting at targets at distances far exceeding the capabilities of the human eye.

If I can emphasise anything in this book, it is the importance of follow through. This is by far the most important and perishable skill that forms the foundation of marksmanship.

Test and Adjust

This procedure is completed very quickly and efficiently when getting behind the rifle in preparation to shoot. Whatever angle this may be when shooting prone, sitting, kneeling or standing, it should feel comfortable within reason. The following steps should be followed when testing and adjusting;

1. Adopt the relevant shooting position.

2. Point the rifle at the target without looking through the sighting system first so that when you look through the sight, you are not bumbling around trying to locate it.

3. Acquire the target through the sight and settle on the point of aim (POA).

4. While maintaining the hold. Look away for a second, relax the body and then look back through the sight.

5. If your reticle is not bang on the intended POA then move the whole body until it is and not just the rifle.

You have just completed the Test and Adjust procedure.

Breathing Cycle

A common question by newcomers to the sport of rifle shooting is, How should I breathe? My answer usually is, just breath normally. Follow your natural body function of breathing. The body is most relaxed when half a breath is released.

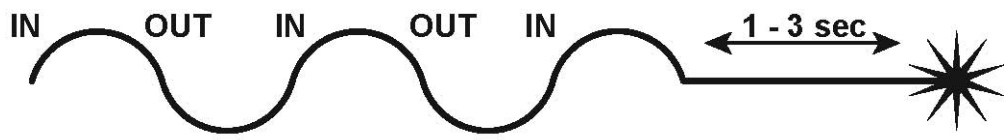

Figure 1.1 Suggested breathing cycle and shot release timing.

Years of practice and instruction has shown that the half out breathing technique as illustrated in Figure 1.1 as the most effective method for shot release when using a rifle. The shot should be released within a three second period to avoid the build up of carbon dioxide on the blood. This build up of CO_2 causes vision impairment and the muscle tension which leads to poor shot release. If this starts to happen, the breathing cycle must be started again.

Grouping and Zeroing

Shooting for a group is a very important task in precision rifle shooting. It forms the basis for ammunition and rifle testing, marksmanship skills and zeroing a rifle scope. A group can be described as *"a series of shots, not less than 3 in number, fired consecutively from the same shooting position".* The group may contain many more shots than 3, but usually around 5 in number as this is what most rifle shooters prefer and measure themselves and their equipment against.

A group containing only 3 shots may not give as accurate data for the mean point of impact (MPI) as a 5 shot group does, however the slight error created by doing this is far over-shadowed by the possible error of MPI shift from the rifle heating up by shot number 4 and 5. A large number of rifles (especially rifles with large capacity cartridges), I have used have a shift in MPI in the vertical plane when firing more than 3 shots. This will be discussed in Chapter 6 in a little more length. Unless you have conducted some form of rifle temperature testing with control methods in place, it is best to stick to 3 shot groups for a few reasons. Three shot groups can generally be fired in a space of time where a lapse of concentration is minimised, ammunition usage remains minimal and most rifles will not start to show the effects temperature increase in the space of time that is normally used to fire a 3 shot group.

Accuracy in a group lies in second place to the precision in a group. Accuracy is really the location of the group and Precision is the size of the group. A very small cluster of shots on a target no matter where on the target it is shows far more promise than a group 3 times the size with the MPI over the bullseye.

A rifle that shoots a small cluster of holes in the target indicating a nice tight group can be "Zeroed" far easier than one that doesn't. The diagram over leaf in Figure 1.2 illustrates the difference between accuracy and precision. The accepted distance for grouping shots is generally 100 yards or 100 metres. This distance provides enough distance to test the shooter and the equipment, whilst not succumbing to any great degree, to the effects of wind.

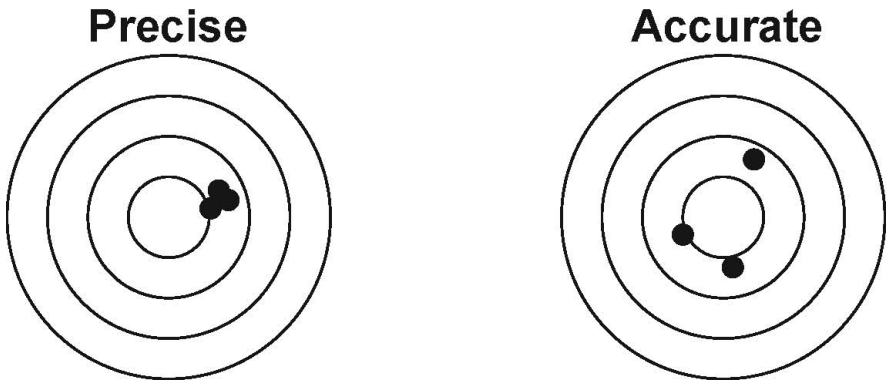

Figure 1.2 A Precise but not accurate group, versus an Accurate group but not Precise. '

Basic Theory of Small Arms Fire (T.O.S.A.F)

Before getting into zeroing a rifle, there are a few points I must cover. The Theory of small arms fire is a description of a number of components to the composition of a small arms trajectory. It generally comes in the form of a labelled illustration and internationally recognised terminology. Some of this terminology will constantly be referred to throughout this book and for good reason. Figure 1.3 below illustrates a common Theory of Small Arms Fire diagram.

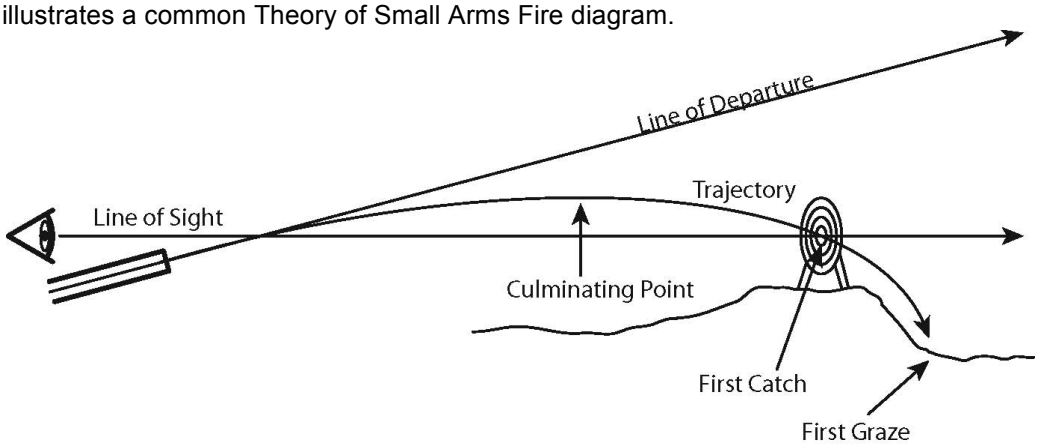

Figure 1.3 Theory of Small Arms Fire Diagram.

Line of Sight - An imaginary straight line from the eye, through the telescopic sight and onto the target.

Line of Departure - An imaginary straight line running down the centre of the bore axis. The initial line the projectile follows until leaving the muzzle.

Trajectory - The curved path the projectile follows as a result of coming under the effect of gravity and air resistance.

Culminating Point - The highest point along the trajectory. Normally between 1/2 and 2/3rd along the trajectory path.

First Catch - The first object the projectile strikes along the trajectory path. Usually the target.

First Graze - The area when the projectile strikes the ground.
Dangerous Space – The distance between the First Catch and the First Graze.

What distance to zero your rifle?

Zeroing your rifle is purely adjusting the relevant sighting system fixed on top so that the projectile crosses the line of sight when the sight is on the target. Basically, where the crosshair is, the bullet should go. Not that simple. As you have seen before the T.O.S.A.F diagram, the projectile in most situations will cross the line of sight twice. It only crosses the line of sight once when the rifle is zeroed at distances between 80 – 100m. After that the projectile will definitely cross the line twice however small the amount.

A rifle can only be zeroed at one distance at a time. However, a common practice for hunters who either do not wish to adjust their telescopic sights on the run or don't know how, hunt with what is called a *"Point Blank Zero"*. This distance is usually greater then 200m to take full advantage of the flatter earlier section of the trajectory. A typical example is where the kill zone of a Deer may be 10 inches in diameter. The Hunter will zero his rifle at a distance where the culminating point of the trajectory will be no larger than 5 inches above the line of sight. He will then ascertain the distance after between the zero distance and the area where the projectile falls to 5 inches below the line of sight. The Zero distance may be 250m. The Point blank zero distance spread may be 150m – 290m. This way, if the Deer appears anywhere between 0 and 290m, all the hunter has to do is aim at the centre of the kill zone and the projectile should, and I say should, land in the kill zone.

The disadvantage of this method is that there is no room for error. Make a shot where the rifle is fired when the crosshair is on the edge of the vital zone and the shot may then land 5 or more inches outside the vital zone. Even though this possibility for error exists, this type of hunting zero is still the best when using telescopic sights with internal (capped) turrets and plain style reticles with no reference marks. Reticles and turrets will be discussed at length in Chapter 5.

If you utilise a telescopic sight with finger adjustable, external turrets, and all precision long range rifle systems should, then your rifle should be zeroed at with the 100 yd or 100m mark. Why?

1. No adjustments have to be made for grouping practice unless the zero is out.

2. If you require a 200, 250 or 300m zero, wind up the required MOA or Milrad from the 100m one, it only take 3 seconds. If you have slipped the turrets back to "0" for the 100m zero (Chapter 5), then returning back to your 100m zero is a synch.

Zeroing your Rifle

The art of getting your rifle to shoot true to the scope is exactly that, an Art. In fact it's really any easy art, not black magic or voodoo like some people describe it. If done correctly with a good scope, it should only take 3 – 5 shots maximum over a 2 minute time period. I have seen frustrated shooters over the years chase their group all over the target and 40 rounds later, still no zero. If your ability to shoot a rifle is consistent, displaying regular tight grouping in the same or similar MPI from different shooting positions you are doing fine.

After a scope has been mounted onto a rifle the chance of it being zeroed at some distance is very slim. The chances of it being zeroed to the distance you want is even less. Rifle scopes are often "Bore Sighted" with either a bore collimator or at the range. I have never seen a rifle successfully zeroed with the use of a bore collimator. The first round may cut an A4 piece of paper at 100 yards but that is really it. I will explain two quick and easy ways to zero your rifle. The first way is a crude bore sight method and the second is the splash method.

Both methods require an A4 piece of paper with a grid reference system copied onto it. This grid reference system must match or be close to the value of 1 or 2 clicks on the turret systems of the scope. For example a Milliradian scope should have a 1cm grid pattern on the paper and an MOA scope should have at the very least, a 1/2 inch grid pattern. The aiming mark should be no larger than a 1/2 inch dot for a 15x magnification scope and 3/4 inch for a 10x magnification scope. Aim small, miss small. This aiming mark should be in the centre of this piece of paper.

Crude Bore sight Method.

1. Remove the bolt from the rifle.
2. Steadying the rifle on a bag or bipod enough so that when the turrets are moved, the rifle will not.
3. Steady the rifle and peer through the barrel so that the 100 yard or metre target appears in the centre of the bore.

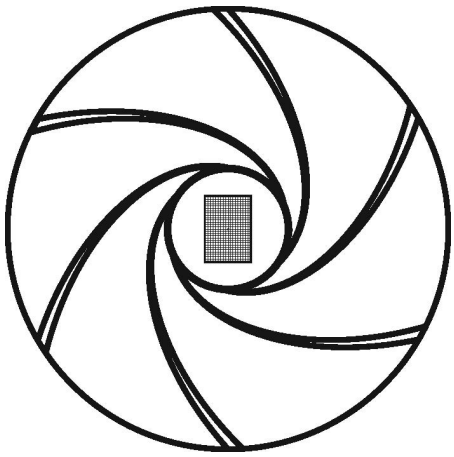

Figure 1.4 A4 Target in centre of Bore axis.

4. The while holding the rifle steady, look through the scope and see where the A4 paper appears in reference to the reticle. If reticle on not on the centre of the paper on or near the aiming mark. The elevation and windage must be adjusted until it does. Just remember, winding the elevation turret up, makes the reticle go down. Winding the windage turret right, makes the reticle move to the left.

So now you have locked your rifle down with the paper appearing in the centre of the bore. Now without moving the rifle you look through the scope and the target grid paper appears left and low. How much? Well you can either count the grid squares to the reticle cross or use the mil reticle if you have one. Now with the target appearing in the centre of the bore, a projectile would land very close to the centre of the paper target if the rifle was fired. If the scope reticle was placed onto the centre of the target the projectile will strike 1.0 Milrad low and 1.0 Milrad to the left it is not aligned with the bore.

So to zero the scope to the bore, the elevation turret should be wound UP this much and the windage turret should be wound to the RIGHT the same amount. Figure 1.5, 1.6 and 1.7 illustrate the target appearing low and left, which requires approximately 1.0 Milrad of adjustment in the vertical plane and 1.0 Milrad of adjustment in the horizontal plane.

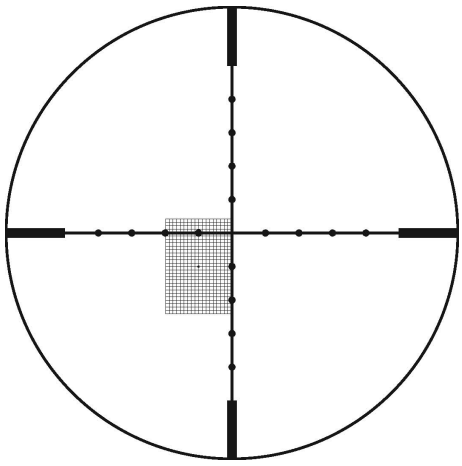

Figure 1.5 Target low and let buy about 1.0 Milrad when bore is aligned with the centre of the target paper.

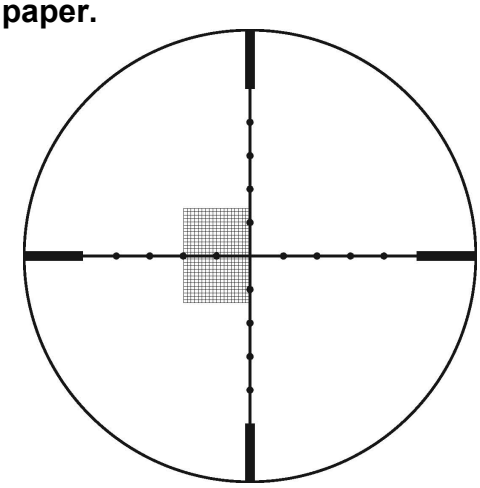

Figure 1.6 The elevation turret has been wound UP 1.0 Milrad or 10 clicks. The reticle moves down to the centre of the target in the horizontal plane.

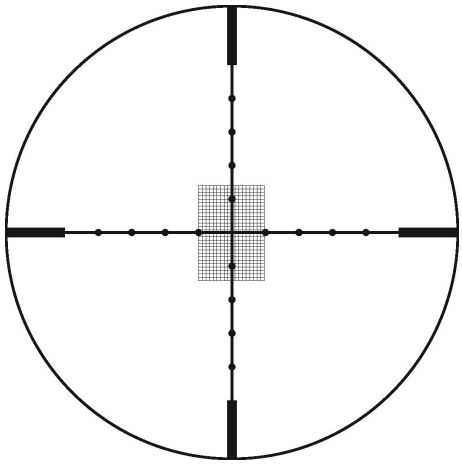

Figure 1.7 The windage turret has been wound RIGHT 1.0 Milrad or 10 clicks. The reticle moves left to the centre of the target in the vertical plane.

Now you are at the stage where if you chambered a cartridge, placed the centre of the reticle onto the centre of the target and fired, the chance of cutting paper somewhere inside the grid system is pretty damn good.

5. You have fired one round. Low and behold, you have a hole in the target 5 grid squares to the right of the aiming mark and 3 squares high. Now you can simply hold the rifle steady while looking through the scope. Having the reticle centred on the aiming mark. Move the windage turret five 0.1 Milrad clicks to the left and watch the reticle move 5 squares to the right. Then moving the elevation turret down three 0.1 Milrad clicks watch the reticle move up three squares until the cross has met the bullet hole in the target. See Figure 1.8.

You have just zeroed your rifle with about a 10mm or 1/2 inch error factor in just 1 round. I say an error factor here because without the use of a gun vice, it is nearly impossible to keep the rifle steady enough while mucking around with the scope turrets. If you fire another round, then a finer adjustment can be made.

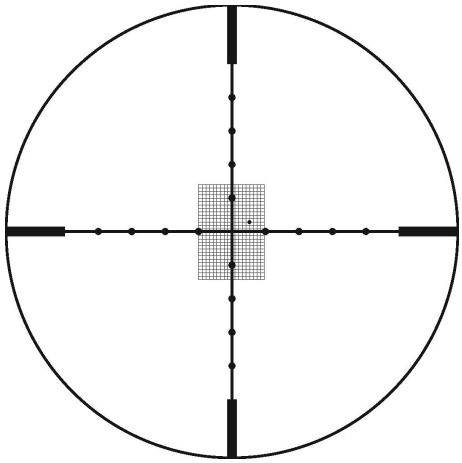

Figure 1.8 Using the grid pattern as well as holding the rifle while turning the windage and elevation drums leads to quicker more accurate one shot zeros.

Splash Method

1. Find and aiming mark that can be seen with the naked eye on the dirt bank behind target at the rifle range. I know it may be up to 30 yards behind the target but the error in trajectory difference here is not big enough to worry about at this stage.
2. Chamber a cartridge, place the reticle cross onto the aiming mark and while holding the rifle firm into the shoulder, lift your head slightly and look at the aiming mark.
3. Fire the rifle and watch for the splash on or near the aiming mark.
4. With the unloaded rifle, aim through the scope and place the reticle onto the aiming mark if it has not been hit.
5. Wind the elevation and windage turrets until the reticle cross meets the splash mark.
6. Repeat step 5 of the bore sighting method and you are on.

See Figure 1.9. over the page.

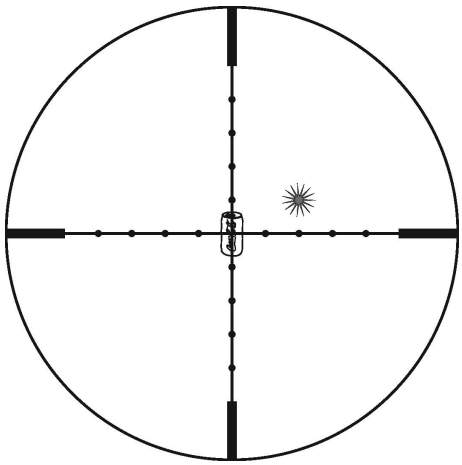

Figure 1.9 Watching the splash near the aiming mark. Aiming mark can be anything so long as it can be seen with the naked eye.

The reason why the aiming mark should be seen with the naked eye is that when firing at dirt or grass background, the splash usually cannot be seen when looking though the scope. Since the time of flight is so quick, when the rifle comes under recoil, even with a .223 Rem cartridge, the image of the splash cannot be seen. Observing to the side with the naked eye makes it possible to see the splash. You may be asking why is it so important to observe the splash when it happens and why not just look for the mark after. Well quite often it is very difficult to actually see this mark the projectile has left. Seeing it happen burns the splash mark into your memory.

These two methods give you options when by yourself at the range. These options are efficient and accurate. I have used them for many years. The only drawback from zeroing your rifle this way is the loss of patience, waiting for others to zero their rifles their own way.

Shooting for Group

The size of the group of shots on a target is the main indicator of one's level of marksmanship skill apart from the inherent precision of the rifle itself. The group size has been and still is, measured from the centre of two projectile holes that are the longest distance apart on the target. Obviously the smaller group you can manage the better. Half inch groups are what you should be aiming for as a good standard.

The question is, how many shots should I fire for group size? The answer is 3. Yes you will most definitely increase the group size, the more rounds you fire. That's the way this works. A half inch, 5 shot group is very good off a bipod in the prone position. Ten shots inside less than half an inch is simply amazing. Three shot groups will definitely give you a good indication as to the accuracy of you and your rifle without burning a hole in your pocket.

Fouling Shots

A fouling shot is one taken from a rifle with a clean barrel. It has been passed on from generation to generation that shooting from a clean bore will make your first shot print in a different area on the target. Well all I can say is that I have fired a hell of a lot of different rifles with extremely precise ammunition over the years with clean bores and I simply have not seen this phenomenon very often. I am not speaking on behalf of the Benchrest community here as they tend to see errors occurring that are usually much smaller than practical shooters purely as a result of the level of precision in their equipment. I know this happens, and as barrels/projectiles/cleaning differ vastly from one shooter to another, some fouling shots move and others don't.

What I am saying is that the combined errors of firing for the first time each day on the range, in different temperatures, with different ammunition, in a slightly different shooting position with winds that vary in strength and direction can lead to shots printing off the rifles zero. I simply have not seen any hard evidence of this fouling shot being different from any others.

Back in 2007 I tested a factor of this with a Remington 700 BDL and an Accuracy International AWP Sniper rifle. The test was ascertain the velocity change though a reliable chronograph, cleaning the rifles after each shot with exactly the same process. The ammunition used was the .308Win Federal 175gn Gold Medal Match and the cleaning product was Hoppes No 9 bore solvent.

10 Rounds Fired consecutively from dirty barrel	5 Rounds fired each time in clean barrel
02-2677	12-2621
03-2651	13-2579
04-2667	14-2611
05-2607	15-2594
06-2593	16-2595
07-2594	-------
08-2613	15-2677 +
09-2588	15-2579 -
10-2609	15-0098 E
11-2596	**15-2613 M**
-------	15-0029 S
10-2677 +	-------
10-2588 -	
10-0089 E	
10-2619 M	
10-0032 S	

Figure 1.10 Ammunition fired through a fouled barrel and a clean barrel on the same rifle (Remington 700).

As seen in Figure 1.10, the change in velocity may or may not be directly related to the state of barrel cleanliness. The variation in the ammunition velocity from one column to the next is well inside the variation within the batch of ammunition.

The question is, how can a projectile print differently if there is no change in velocity? Well it can, but not from a clean or dirty barrel, from the temperature of the rifle itself. This will be explained in depth in Chapter 6 and 7.4. What I will say now is that the phenomenon of a *"Cold Bore Zero"* is real. The zero of your rifle is not a constant. It is a living beast that lives in most rifles which changes with ambient air temperature among other factors. The temperature of the rifle can change in three ways.

1. Change in ambient air temperature.
2. Exposure to cold wind or direct warm sunlight
3. Heat transfer from the chamber from the act of firing the rifle.

A cold bore zero does not mean that the zero was reached on a cold day. It means that rifle was at ambient air temperature when it was zeroed. Firing 10 rounds in quick succession and slipping the turret scales does not amount to a cold bore rifle zero. Waiting 10 – 20 mins and then confirming the next shot dead on, does. After all, it is the first shot that counts in practical rifle shooting and hunting, not really the second and definitely not the third. When a good rifle zero has been obtained at ambient air temperature, this temperature should be recorded.

Zeroing Positions

Please do not expect the same zero when shooting with a bipod compared to shooting over a pack or some form of shooting rest. The rifle reacts in different ways under recoil and will print in different areas on the target. How much? Well this can be up to 1 – 2 inches and 100 yards.

Understand that in a lot of cases, the rifle will print in a different area on the target every time you change your shooting position. The answer to this problem is to find the most precise, useable and comfortable shooting position that you can and zero the rifle in this position. This is usually the prone supported position. In chapter 6, the recoil effects of the rifle will be discussed at length explaining the significance of shooting positions. Shooting positions themselves will be discussed in the next chapter.

Conclusion.

Having a good theoretical knowledge of small arms fire and practical knowledge of marksmanship principles helps the foundation of your rifle shooting. Zeroing a rifle can be very difficult if you cannot group your shots with it. The more precise the rifle, the quicker the zero can be obtained with resulting tighter groups.

Zeroing you rifle does not have to be a hassle. When done properly, sometimes only 2 rounds are needed and not 30. Try to pay more attention to the temperature of your rifle rather than if it is clean or dirty when starting to shoot.

GUIDELINES

1. Always adhere to the four Marksmanship Principles, especially the fourth.

2. Three shot groups are sufficient for most grouping and zeroing applications.

3. Zero at closer distances like 100 yards or metres if you have externally adjustable turrets on your scope. 200 Yard and 300 yard zero's are only a few clicks away.

4. Obtain a "Cold Bore" zero when possible to improve first shot hits.