

Long-range Shooting in Millennium's End

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In Millennium's End, there is often a proliferation of long-range shooting. Characters armed with high-powered rifles, often Barrett M82s, fitted with high magnification scopes, frequently make headshots at extreme ranges. While these types of shots are very much within the realm of possibility, they should come only after careful preparation and a fair amount of time. Snap shots at a kilometer just are not possible. Below are some of the factors that should be taken into consideration prior to long range shooting. With proper preparation by the character, they should result in few additional dice rolls.

Knowledge of the Weapon

Any character, planning on long range shooting, should have spent hours on the range recording the ballistic performance of the particular rifle/scope/ammunition combination before taking the weapon on assignment. On the rare occasion when the character has to operate with a weapon they are not intimately familiar with, the following should be done:

- If the scope is not zeroed to the weapon there is no real chance to hit. Either say the round hits only on a roll of 01 or assign a -250 to the normal chance to hit.
- As long as the scope is zeroed to the weapon there is a chance the character will be familiar with have some grasp of the ballistic performance. Have the character make a Military Science/Hardware roll. Assign a bonus of +10 if the character is familiar with the caliber and a +10 if the character is familiar with the make/model of weapon. If the roll is missed, the chance "to hit" will drop by 2 for every point the roll was missed by.

Note: Familiar means the character has owned a weapon of the type and performed ballistic testing.

True Range

After ballistic information the most important thing for the shooter to know is the range to the target. With a .50-caliber rifle, to have any chance of hitting a 1m target at 1000m you have to know the range within 98m. For a headshot, you need to know the actual range within 15m plus or minus. This is a tight margin. There are a couple of methods for range determination.

- Mechanical ranging consists of using a laser rangefinder or theodolite. As long as they are not damaged and the rangefinder is of fine enough resolution there should be no need for any type of roll.
- Using the scope for mil relation or Mil Dot ranging requires extreme precision by the character. A Perception roll should be made with a -10 to the target number. If the roll is missed, the chance "to hit" will drop by 2 for every point the roll was missed by.
- Rough evaluation using the 100-meter unit of measure, coarse triangulation, or map contour comparison is the least accurate means of range determination. This would require a Navigation/Land roll with a -20 to the target number. If the roll is missed, the chance "to hit" will drop by 2 for every point the roll was missed by.

Slant Range

In all likelihood the character will be firing at a target that is above or below the shooting position. In either case, if the shooter fires at the true range the bullet is going to impact above the point of aim. So after calculating the true range it is necessary to find the slant range. A slant angle of 22-degrees is going to decrease the range to target by almost 8%. True Range is

still important because that is the distance if *air* the bullet will be traveling through and is used for determining environmental effects. Slant range can be determined by the following means.

- A GPS or theodolite can be used for accurate measurements without requiring any skill rolls.
- With a protractor, piece of string, section of straw and scientific calculator (+20 modifier) you can get a close value. Math skill roll. If the roll is missed, the chance “to hit” will drop by 1 for every two points the roll was missed by.
- The final method is with a map showing elevation contour lines and a scientific calculator. This requires Navigation/Land and Math skill rolls. If either, or both, of the rolls are missed, the chance “to hit” will drop by one for every two points the roll was missed by.

Wind

Wind is going to deflect the bullets course at long ranges. Period. You can measure it and adjust for it, but it will impact the flight. Adjusting for it will be covered below in Meteorology, but the simple fact is the wind will make it harder to hit your target. At ranges under 50% weapon effective drop the wind speed one category.

- Calm (under 5 MPH), no modifier
- Light wind (5-10 MPH), assign a –10 “to hit”
- Wind (10-20 MPH), assign a –25 “to hit”
- Strong wind (over 25 MPH), assign a –60 “to hit”
- Gusty wind, assign an additional “to hit” penalty of 1d10 x 2 (-2 to –20)

Note: The above modifiers assume a wind blowing 90 degrees to flight of bullet. Adjust for other directions.

Meteorology

Temperature, barometric pressure, and wind speed and direction all dramatically affect the bullets flight to target. The general rules for pressure and temperature is, if they are up, bring your sights down; if they are down, bring your sights up. For wind the character needs the speed and direction at the firing location and target.

- The only accurate way to gather this information is with a handheld weather station.
- A Meteorology skill roll can be to determine barometric pressure. If the roll is missed, the chance “to hit” will drop by 2 for every point the roll was missed by. Without Meteorology skill there is no way to figure barometric pressure so assign a flat –50 “to hit”.
- A Meteorology or Perception (-10 to Perception) skill roll can be made to determine temperature. If the roll is missed, the chance “to hit” will drop by 1 for every point the roll was missed by.
- A Meteorology or Perception (-10 to Perception) skill roll can be made to determine wind speed and direction. If the roll is missed, the chance “to hit” will drop by 1 for every point the roll was missed by.
- A perception skill roll can be made to determine wind speed and direction. Apply a –10 and any penalties associated with the optical sight. If the roll is missed, the chance “to hit” will drop by 1 for every point the roll was missed by.

Bracing

Even the slightest muzzle movement can throw the bullet off target. At short ranges this distance is insignificant, at 25m a 1 MOA “twitch” (depending on barrel length, a 1 MOA muzzle

movement is going to be somewhere well under 1mm) will move the point of impact 6mm. At long ranges this movement becomes very significant. At 1000m, that same “twitch” will move the impact point 29cm, or enough to miss most human size targets. Bracing and perfect body position (good body position is assumed in the basic “to hit” numbers) become very important to insuring the shot goes where aimed.

At ranges under 500m, where muzzle movements under 1 MOA are not likely to change the point of impact in game terms, there is no modifiers to normal “to hit” procedures. At ranges of 500-999m there is a -10 “to hit”, -20 “to hit” at 1000-2000m, and -50 “to hit” beyond 2000m. These modifiers assume that the weapon is braced (against a solid surface, by a sling or best of all a bipod). If the weapon is braced, the bracing bonuses will partially offset these penalties. If the weapon is not braced, the penalties should be doubled.

Flight Time

At long distances it is going to take time for the bullet to reach the target. This is especially true for the slow moving .50-caliber round which takes 1.6 seconds to reach 1000m. The easiest (and fairly accurate) way to account for this is to double Target Movement penalties when the range to target exceeds the bullets muzzle velocity in meters per second. This only really comes into play with the .50-caliber (850m/s), .300 Winchester Magnum (950m/s) and .338 Lapua (925m/s). For longer ranges triple the modifier when range is 1.5x muzzle velocity and quadruple when double muzzle velocity.

Finding the Target

Before a character can make the shot, or even begin aiming, he has to find the target. This does not sound too hard, but high-powered scopes have very small fields-of-view. The Leopold 24-power Bench Rest-D scope, for example, has a field of view, at 1000 meters, of only 16.5 meters. This is where the Perception penalty for different optical sights comes in (if not using the optional rules for optical sights you are going to have to wing it). A failed roll means you have not located the target in the scope. Each additional turn of searching provides a +5 cumulative bonus (+10 if getting directions from a spotter with eyes on the target). Modifiers for targets smaller or larger than human size would be appropriate, along with modifiers for concealed targets (either from camouflage or environmental effects such as heat shimmer, fog, etc.)

Time

So how long does this entire process take? A single operator setting up at the FFP (Final Firing Position) is going to need at least fifteen minutes preparation to get off an accurate shot. With a spotter one-half to a third could cut from the time.