MARKSMAN'S HANDBOOK

Guide to becoming a SOAR marksman

J. Cole

Contents

INTRODUCTION

Hello and welcome to the SOAR marksman's handbook, this handbook will teach you the basics of all you need to know to set up your shot, and successfully neutralize every target. This guide was written on experience and all content is subject to amendment. In no way is this guide a replacement for practice but is to be considered during practice.

This Guide was written to

- Bridge the gap between Basic Rifleman knowledge to Advanced Marksman knowledge
- Help the reader find their stride in what at the time of writing this is very barren in terms of complete, correct and accurate guides
- Help those with Marksman knowledge in Arma refresh their Knowledge
- To be used in conjunction with SOAR marksman training

I hope you will find this guide of some use in helping you become an effective and accurate marksman that can be relied on by your team

Best of luck and welcome

- J. Cole

Choosing your weapon

Choosing your weapon can be the difference between being an effective marksman and essentially being useless. It's important to remember that you are a marksman who can fill a sniper roll if needed, not a sniper filling a marksman roll, which often means you will be fighting within 500 metres, not 2000.

This handbook was written to help you be proficient at any range so it is appropriate to choose the appropriate weapon, which comes to personal preference.

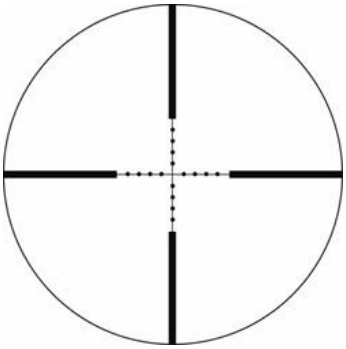
It's not always necessary to pick anti-material rifles, don't forget that typical rifles such as m16 variants can prove to be~~~ more than sufficient due to their ability to fire in quick succession, versatility and reliability including sharing ammo with squad-mates.

That being said, Larger Calibre rounds will typically have a higher muzzle velocity and in turn more range and stopping power.

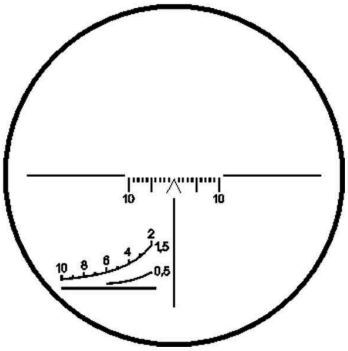
Choosing the correct rifle and ammunition will be the difference between an effective marksman and a benchwarmer.

Scope Variants

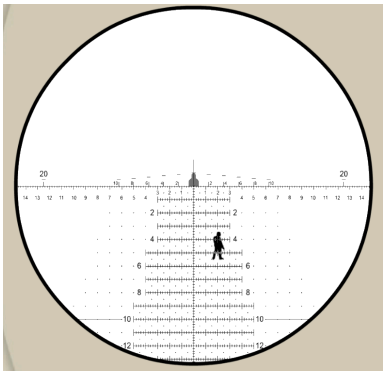
This guide will be based off of the LRPS and MIL dot system, however there are many types of scopes. This section will serve to familiarize you with different scope types and marking meanings



Mil dot system



POSP system

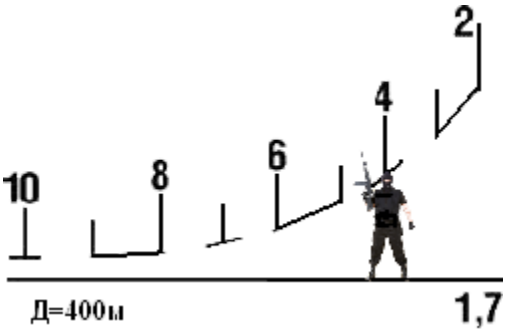


Horus Vision system

MIL Dot System

The MIL Dot system is an extremely simple yet extremely effective method in ranging, adjusting and engaging targets (all will be covered later) each of those dots on the reticle are called **MIL dots**, this is extremely important to remember for later on.

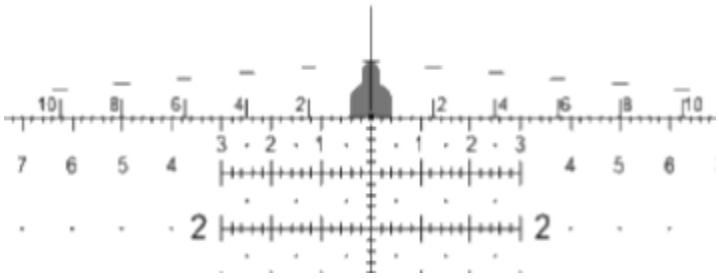
POSP System



the POSP system includes a straightforward ranging solution, for example

we can see, a 1.7 meter target fits in between the 4 and the base line, indicating that the target is 400 meters away.

Horus Vision System

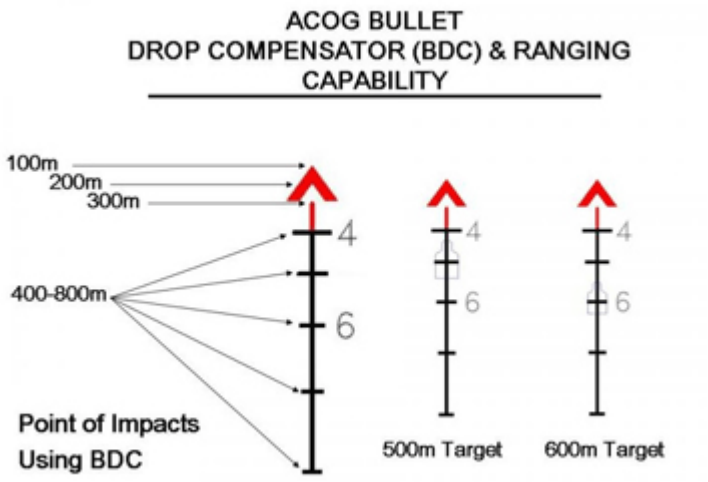


The Horus vision in my opinion is the best scope variant out there, not only can you range the target using the indicators on the top of the X crosshair (in this case 100m), you can adjust for windage and easily track your shot offset using the christmas tree like MIL setup to easily compensate for a missed shot

ACOG reticle

The ACOG is an extremely powerful tool if known how to use correctly, the lines in the x direction are designed to indicate shoulder width at that range x100 and the height at which you must hold the reticle to compensate for bullet drop at that range.

For example



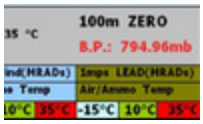
Note that acog sights come in two versions for 5.56 and 7.62 ammunitions and the correct type must be used, (a 5.56 ACOG will not operate properly on a 7.62 rifle) to accurately predict bullet drop (ammo type will typically be displayed in the scope).

Finding Your Default Zero

Imagine how great a markman Stevie wonder would be..

If you don't find your default zero you're essentially shooting blind, it doesn't matter how precise your calculations are, if you don't set your default zero you will miss.

All of the equipment you will use relies on something called a zeroing, a zeroing is essentially the range you are shooting to. Since bullets follow an arc as they travel it is important to compensate for that arc. A zero adjusted to 100m will miss at 1000m the same way a 1000m zero will miss at 100m. If you are zeroed to 100 it means you've setup your scope to be accurate at 100m. If you've zeroed to 1000m it means your scope is adjusted to be accurate at 1000m. All of the equipment we will use expects you to set your default zeroing to 100m.



(example of the range card requiring a 100m Zero)

Unfortunately there is no easy way to find your 100m zero so we must find it manually

Step 1) Load the SOARBCT2 Map and choose the marksman role in the loading screen

Step 2) Head to the zeroing range and place a pop-up target (scroll menu) on one of the pink markers down range

Step 3) Head back to the firing line and stand on the equivalent pink marker.

Step 4) shoot the target and adjust your scope until the bullet is impacting where you're aiming (default keys to adjust scope are PG up and PG down for Y adjustments, ctrl+PG up/down for X adjustments)

Step 5) use self interact and select Equipment>Set Default Zero

Your default zero is now set, it is highly encouraged to take note of the weapon, scope, and scope adjustment required to zero to 100m so that you do not need to go to the zero range every time you want to use that weapon.

Equipment Checklist

- Rifle/ammo
- Kestrel (long range only)
- AtragMX (long range only)
- Vector Rangefinder
- SSWT kit (optional)
- Range Card

Equipment Overview

Kestrel

Just like in real life, arma not only has day and night cycles, but weather cycles.

Weather cycles and weather in general play a huge part in marksmanship as they will affect things such as Temperature (powder burn rate will change the speed of the bullet) Humidity (resistance the bullet encounters) and many other aspects, therefore it is important to account for these variables when adjusting for a long range shot.

The Kestrel is an invaluable device as it is the only piece of equipment capable of telling you the current weather forecast. In combination with the AtragMX these two devices are what will make you hit your targets at longer ranges.

However the Kestrel is not the end all be all of weather tracking and does not take into account things like wind deflection. The Kestrel can only tell you the weather of the position where it is being used and not what the weather is downrange (for example wind will be stronger at the top of a mountain than at the bottom) so it is important to use common sense along with these pieces of equipment which will only come from practice and experience.

AtragMX

The AtragMX is the singular most important device you can bring second only to your rifle itself. The AtragMX is a ballistics calculator meaning after you input some variables it will calculate the exact adjustments you must input into your scope to zero into almost any range

However powerful the AtragMX is, it must be used in conjunction with other instruments.

The AtragMX is not capable of determining weather and requires the user to use the Kestrel or a Rough approximation of weather reading to input the variable that is weather. The AtragMX is capable of finding a range using known variables (height of target and height in mils) however it is recommended to bring along a range finder, specifically the Vector which will automatically input the range to a ranged target

Vector Rangefinder

If you are playing the role of a spotter the Vector Rangefinder trumps the importance of your rifle tenfold

The Vector Rangefinder is an instrument use to find, but not limited to, the exact range and elevation to a target and will be one of the most used pieces of equipment in a marksman's arsenal. It is recommended you read the Vector manual to find and familiarize yourself with the many functions which include the ability to find the exact range, elevation and bearing of a position from not only your position but a separately tagged location

(Being able to tell a squad where a target is without being in the same location as that squad)

SSWT Kit

The SSWT kit is a tripod to be used when a suitable surface cannot be found to rest your weapon on. It is always very important to keep your weapon as stable as possible not only to hit your target but to avoid any potential collateral damage. It is operated through the self interact menu under Equipment

Range Card

The Range Card is an extremely important Piece of the puzzle that is marksmanship. It is the only tool that will tell you the muzzle velocity at different temperatures which is used to input into the AtragMX as one of its required variables.

The Range Card (although made obsolete by the AtragMX) is also capable of delivering approximate scope adjustments to zero into all ranges up to your weapons maximum effective range

In the event where a scope adjustment is required to be made immediately (such as an unexpected target at an unexpected range) it is recommended to use the Range Card to quickly zero in on that target and simply use compensation to adjust to any needed changes.

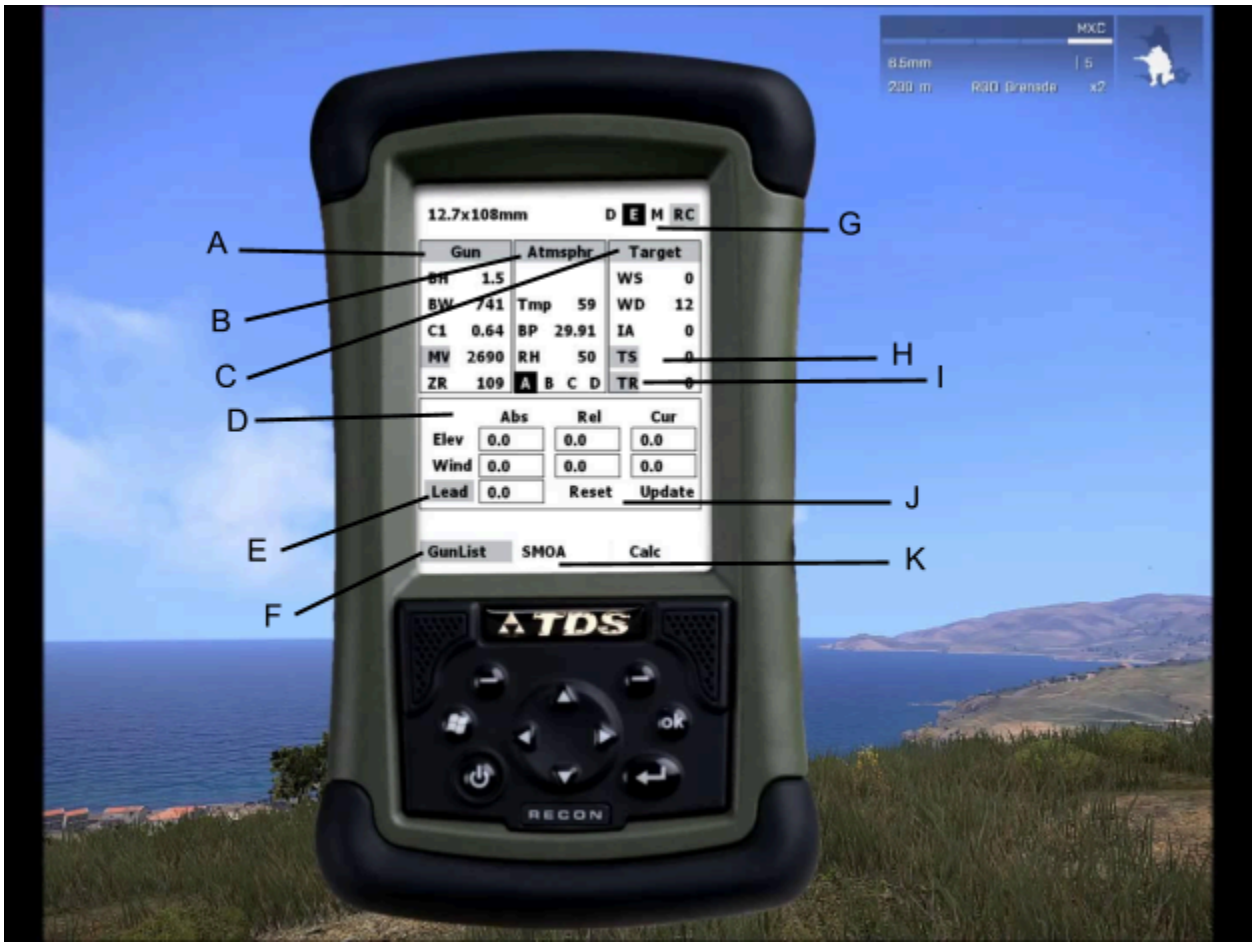
How to Use

Now that you know what each piece of equipment does, it's time to learn how to use them

This Run through of equipment use assumes you have access to the AtragMX, Vector Range Finder, Kestrel, Range Card, and an ACE compatible scope.

For a manual run through that only requires the Range card and Ace scope (for reasons such as role play) Refer to how to manually Calculate a Shot

Everything you do will revolve around the AtragMX so it is important to first become familiar with the AtragMX. The AtragMX is based off of a real life ballistics calculator which you can find the manual to here and here



AtragMX

Here is an image of the AtragMx, it is accessed by self interacting and under Equipment>AtragMX. While it may look intimidating at first it is easily learned and an invaluable asset. The Atrag has the option to save up to 4 presets denoted by the A,B,C and D letters under Atmsphr which will allow you to range four separate instances to cut down on time inputting values. All boxes that are grey are clickable and bring up a new menu relating to whatever was clicked

A) This will bring up a list of Variables relating to the gun. Most of these are imputed for you after selecting your calibre in “Gunlist” (F)
B) This is your atmosphere (a.k.a weather) tab. Select this to input the variables found in the Kestrel such as temperature, barometric pressure etc.

C) This is your Target tab, this is where you will input things like range, elevation, bearing, Target speed, wind speed and wind direction etc.
D) This is your adjustment box. It will tell you the adjustments you need to make to your scope in order to hit whatever target you choose. Going along the top you have Abs (absolute) Rel (Relative) and Cur (Current). These boxes will tell you what adjustments you need to make, for example if I need to adjust my scope up one the Absolute value is +1. The relative is +1 (because it is relative to our previous scope adjustment of 0) and Current (Which would be 0 Until we adjusted our scope up one and hit Update)

Now if we needed to adjust to something from +1 to +3 they would read

Absolute: +3 Relative: +2 (relative to our last setting of +1) and Current: +1

These Values can be positive or negative depending on which direction you need to adjust your scope, + indicating down, and - indicating up

Going along the side you have Elev (Elevation), Wind and Lead

Elevation will indicate your Y coordinate correction (up or down)

Wind will indicate your X coordinate Correction (Left and Right)

Its is important to remember in the case of the X coordinate that - indicates left and + indicates right

Hitting Reset will reset your Relative value as if you were back zeroed to 0,0

Hitting Update will update all numbers with new corrections needed to be made in regards to any new info you input

E) This is the Mode button, it can be changed between Lead and Wind2, Lead will adjust your scope to a preset lead under “Target Speed”. Wind2 will adjust your scope to a secondary wind speed that was preset under Wind speed (2) under the target tab.

Arma features sudden occasional sudden gusts of wind so this setting can be used to quickly adjust for **expected** changes in wind speed.

F) This is the gunlist, it will have all the default guns from arma preset for you. Just choose whatever calibre you’re firing and it will input all the variables in the “gun” tab except Muzzle Velocity (remember you must find the temperature and the corresponding

MV in the Range card)

G) This lets you switch between units such as imperial and metric. Highly suggested to keep it on Metric

H) Target speed (used for moving targets)

I) Target range

J) Reset and Update options mentioned in D)

K) Measurement units, clicking this will cycle through different scope measuring units such as MILs (Radians) TMOA (True Minute of Angle) SMOA (Shooters Minute of Angle) and Clicks. Keep this setting on Mils as this is what we will be using.

Vector Rangefinder

The Vector Rangefinder is located under binoculars and will be equipped the same way you equip binoculars (B). As previously mentioned Ace has their very own Vector manual which has all the instructions to operate the Vector Rangefinder. The Vector Rangefinder and the AtragMX actually will exchange information automatically so if you range a target (tab+r) It will automatically fill in all variables under “target” except for wind speed (which we will use the Kestrel to find) and direction

Kestrel

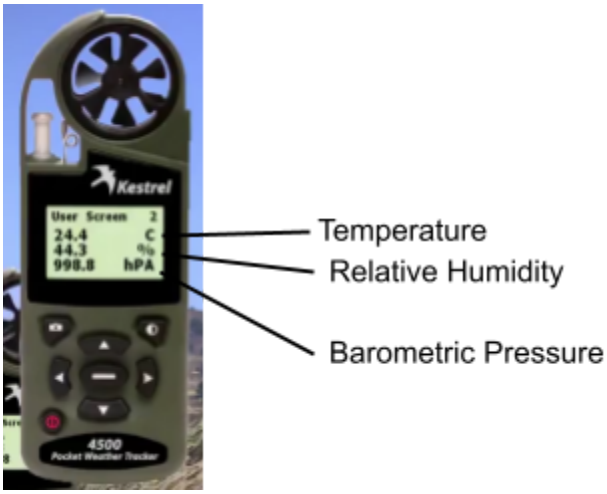
The Kestrel can be located through self interact>Equipment>Kestrel with two options allowing you to view the Kestrel while still being able to interact with things outside of the Kestrel (Like the Atrag) and an option to interact with the Kestrel itself

Since weather is dynamic and always changing it is important to check the weather often to ensure that your Atrag Calculations are still correct. Something that will come with experience is determining if wind is relevant in your shot, sure you might be at the top of a mountain where the wind is 5mps but what if your target is at a lower elevation being shielded by the wind by that very same mountain? An inexperienced marksman would compensate for that nonexistent wind and miss by one or two feet to the side, therefore it

is important to take common sense into account and know when certain variables are required.

If you looked through the AtragMX under atmosphere you would see that there are three variables. Those variables can be found by using the up and down arrows on the kestrel interface to swap through pages of information

First locate that Barometric pressure, Temperature and Relative humidity on the kestrel and input those values into the Atrag under “atmsphr”



Next is finding the wind speed and direction.

Pressing shift-K will bring up a rough wind speed direction and speed (arrow representing the direction the wind is blowing and the white dots representing the wind speed, each dot = 1mps) on the top left side of your screen

Note that a large circle instead of an arrow indicates that there is no wind or that the wind is being blocked by something (a rock, mountain) so it's important to find open ground before you take your wind measurement

Now face the wind head on (so the arrow is pointing down) and flip through your kestrel until you find a page called wind SPD

(image of the kestrel in wind speed setting and the arrow indicating wind direction)

Make sure that the wind is not being blocked by something such as a rock, vehicle etc.

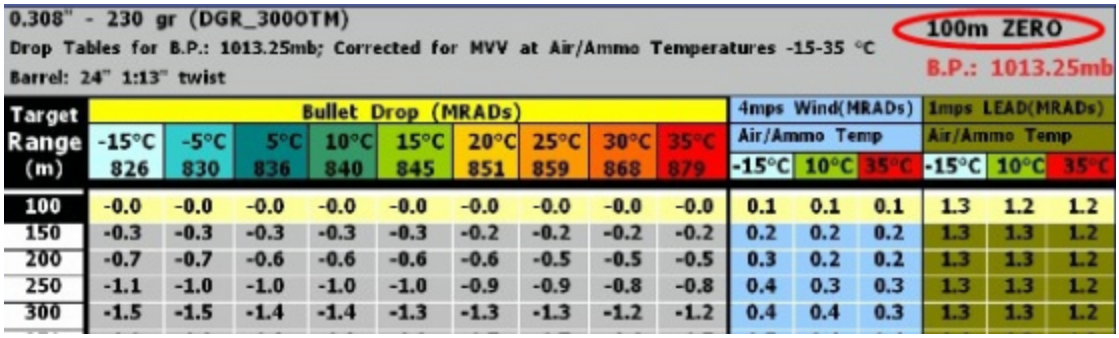
Input the wind speed under “target” in your AtragMX. Do not input the wind direction yet.

Now face your target (notice how the direction of the arrow will change if your target is not in the same direction as the wind) and input the direction in hours

Examples, left to right. 12 o’clock, 3 o’clock, 9 o'clock, 10 o’clock

Input the direction into your Atrag under “target>wind direction”.

Range Card



0.308" - 230 gr (DGR_300OTM)
Drop Tables for B.P.: 1013.25mb; Corrected for MVV at Air/Ammo Temperatures -15-35 °C
Barrel: 24" 1:13" twist

100m ZERO
B.P.: 1013.25mb

Target Range (m)	Bullet Drop (MRADs)									4mps Wind(MRADs) Air/Ammo Temp			1mps LEAD(MRADs) Air/Ammo Temp		
	-15°C 826	-5°C 830	5°C 836	10°C 840	15°C 845	20°C 851	25°C 859	30°C 868	35°C 879	-15°C	10°C	35°C	-15°C	10°C	35°C
100	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	0.1	0.1	1.3	1.2	1.2
150	-0.3	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2	0.2	0.2	0.2	1.3	1.3	1.2
200	-0.7	-0.7	-0.6	-0.6	-0.6	-0.6	-0.5	-0.5	-0.5	0.3	0.2	0.2	1.3	1.3	1.2
250	-1.1	-1.0	-1.0	-1.0	-1.0	-0.9	-0.9	-0.8	-0.8	0.4	0.3	0.3	1.3	1.3	1.2
300	-1.5	-1.5	-1.4	-1.4	-1.3	-1.3	-1.3	-1.2	-1.2	0.4	0.4	0.3	1.3	1.3	1.2

To equip your range card navigate to self interact>Equipment>Range Card

An automatically generated range card will appear for whatever weapon you have equipped.

Under the label “Bullet Drop (MRADs) you will see temperatures in celsius followed by the muzzle velocity at that temperature. Notice how the lower the temperature the lower the muzzle velocity, lower muzzle velocity = more bullet drop. This is where you will get the muzzle velocity to input into your AtragMX (don't use the default muzzle velocity) (im saying muzzle velocity too much)

Again remember that this is all based on a 100m zero so it is incredibly important to set you zeroing to 100 before any of this!

Gun Lists

Chances are you'll eventually want to use a gun imported VIA a mod that does not exist in vanilla ArmA. If so you're in luck! It is possible to dive into the Mod's cfg files and locate the required information. It is also possible to save the new gun as a custom preset

" open A3 Config Viewer and navigate towards the classname of bullet (CfgBullets) you'll be using, and the weapon (cfgWeapons), too. All values are stored in there afaik and I've been able to achieve very satisfactionary results for HLC AWM by reading them out straight outta configs. If there's an array of values (e.g. {800, 900}) it usually refers to two variants of the weapon using this bullet - short and long AWM (suppressed and unsuppressed one)." -LurkingButterlord (https://www.reddit.com/r/arma/comments/3vxr4f/bullet_properties_while_sniping_with_ace/)

Taking your shot

It is now time to take the shot, and the first step of taking your shot is… Not taking your shot

First we want to quickly insure that we have completed this checklist (read above for how to complete each item)

- ✓ Ranged target using Vector and made sure it is recorded in the AtragMX
- ✓ Correctly found your weapon scope's default 100m zero using the method detailed above and set it as the zeroing using self interact
- ✓ Input atmospheric information using the Kestrel into the AtragMX
- ✓ Input correct weapon calibre using gunlist on the AtragMX
- ✓ Found correct muzzle velocity from range card into the AtragMX
- ✓ Found wind direction using Shift+K and input direction using hours into AtragMX
- ✓ Found wind speed using the Kestrel and Input that data into the AtragMX

After all that go ahead and hit Update on your AtragMX and use PG up and PG down to adjust your scope in the Y direction (elev) and Ctrl-PG up and ctrl-PG down to adjust in the X direction (wind) Note that even with no wind you will need to compensate horizontally due to the Magnus effect (caused by rifling in the barrel)

Congratulations you may now take your shot

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Congrats, You probably missed if you shot at a 1500< range. (Hopefully you didn't miss)

Why Did I Miss?

If shooting at long ranges, chances are your first shot will not hit so it's important to know what corrective actions to take to make sure your next shot will hit.

Reasons you missed could have included

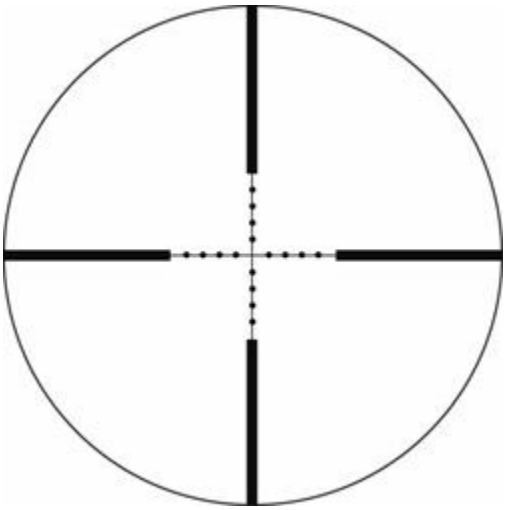
- The Weather changed since you measured it
- The Muzzle velocity you input was not exactly correct
- The zeroing you set was not exactly correct
- Wind was different downrange than it was at the place you took the shot

It's important to know that any small error in your shot calculation will amplify itself the further the range. **This is why practice and experience are both necessary**

How do I make sure my next shot hits?

There are a number of corrections you can make to insure your next shot hits such as going back and double checking all your inputs but we need to be quick! Your target is running away!

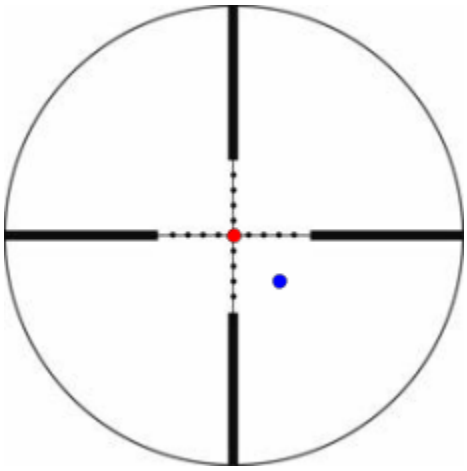
Lets take a look down your scope and see if there's anything that can help us



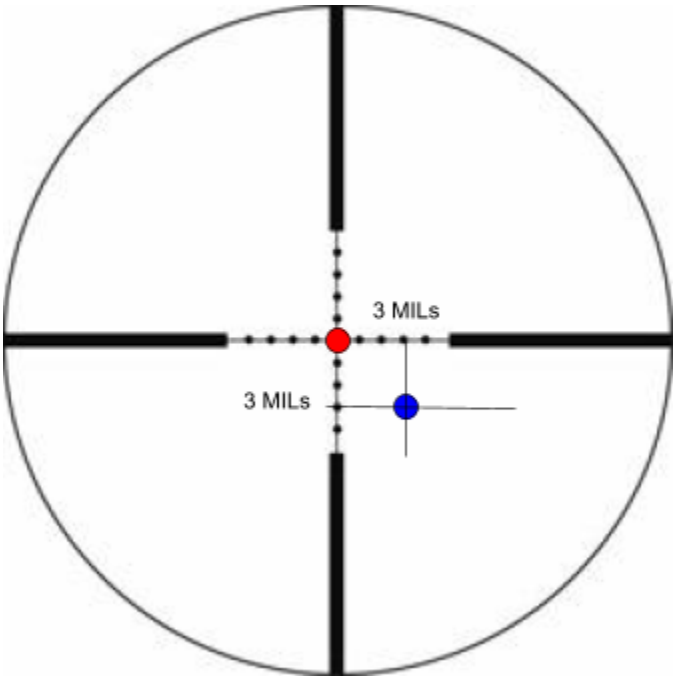
Chances are your scope looks something like this, ever wonder what those dots are there for? Those are called MIL dots. Do you remember how we set our AtragMX to MILs?

Thats right! When you input your MIL results from your Atrag into your scope, thats what you were adjusting. If I set my Vertical MIL offset to +1 than I will shoot 1 mil above where I was aiming before.

So how can we use this to correct our shot? Well let's find out

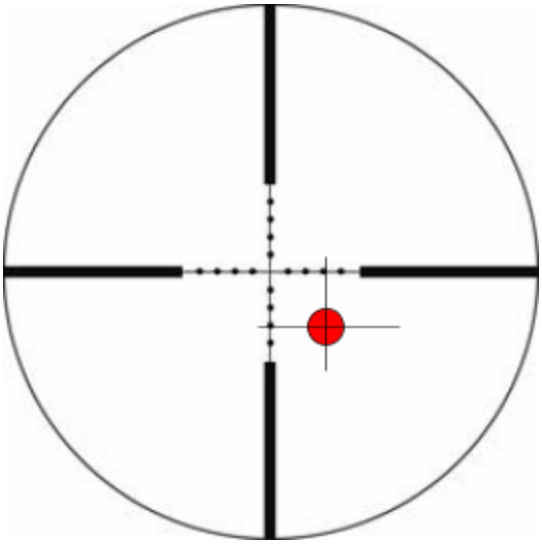


Let's pretend the red dot is our target and the blue dot is where our bullet hit. (we can tell where it hit because we saw the dust cloud from the impact) Well let's count how many MILs our scope is off by



So we're off by three MILs in both the X and Y coordinate, knowing this we can simply use PG up and PG down to correct by three MILs to the left and three MILs up

So we have two choices now, re-calibrate the scope knowing the corrections we must make, or we could take advantage of the MILs and simply compensate as so

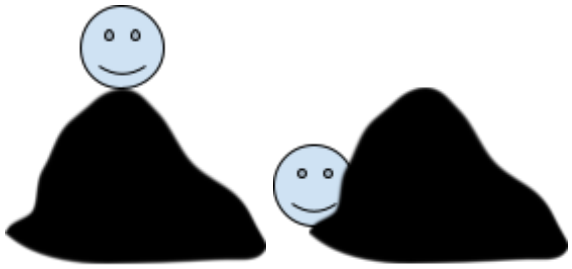


If possible after doing all your calculations take a practice shot to get your zeroing perfect

Concealment

(PvP Specific)

The goal of concealment isn't to look like a bush, it's to look like nothing. What's the best way to not look like a person? Easy, dont look like a person. You can wear as much camouflage as you want. If you're standing on top of a mountain you're still going to look like a person but made out of leaves. Your number one goal should be to break up your silhouette



Out of those to images, which would be easier at a significant distance to identify? What if we take very basic camo and lighting into effect?

Now which is easier to identify? Is the left image any less easy to distinguish from a rock? Is the right image any less easy to distinguish?

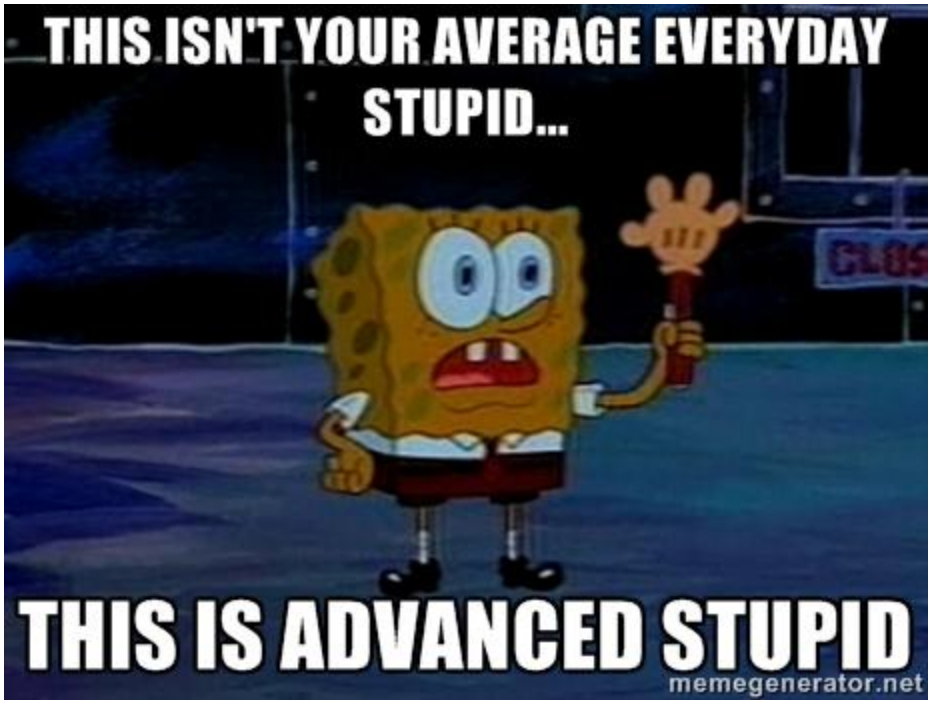
Onto camouflage, Remember your goal isn't to look like a bush, it's to look like nothing. What's one of the first things that pops into mind when you think about camouflaged clothing? I would be willing to bet "ghillie suit", although they can be extremely effective they're not always the best choice.

Take this picture for example, notice how the uniform on the far left and far right would be the most effective for this environment, do you see any piles of leaves in the picture besides the guy in the middle? Remember your goal is to look like nothing, not a totally inconspicuous pile of leaves.

In the event your environment is appropriate, yes, conceal your silhouette by wearing a ghillie suit.

Secondly be aware that the human eye has an evolutionary attraction to movement so the less movement you can make the better.

Diving Deeper



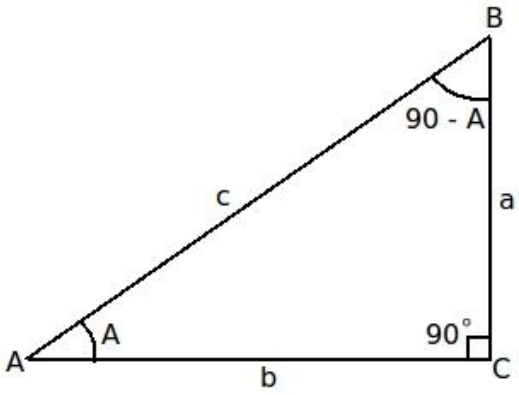
From this point you should know everything you need to know to start to dip your feet in marksmanship.

Following this point I will begin to address *advanced* advanced marksmanship and should only be practiced and attempted after basic advanced marksmanship is fully understood

See you soon and good luck!

True Ballistic Range

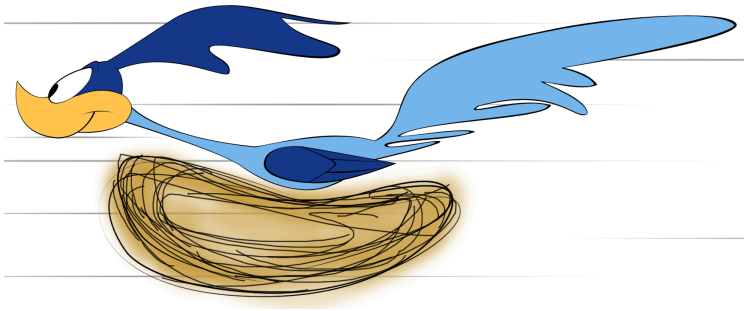
So you've just zeroed in your target and input all your calculations and still missed the shot, whats up? Unless you are shooting at a target that is at the exact same elevation as you you were shooting up or down an incline. Since gravity always acts Perpendicular to the earth, the effect gravity will have on the accuracy of your shot will change. To account for this on the Vector Rangefinder simply tap r and then hold r in quick succession (tap, press and hold) to display the range that gravity will effect the bullet, this must be input manually and will increase the accuracy of your shots on elevations.



Say you're standing at point B up on a hill and want to shoot a target at point A. If using your Vector with the normal tab+r measurement you would get a range of c

The true ballistic range that would give you a more accurate reading would actually be distance b and is therefor the one you must manually input into your AtragMX to take an accurate shot on an incline. From this point on this is the ranging method we will use for all calculations.

Moving Targets

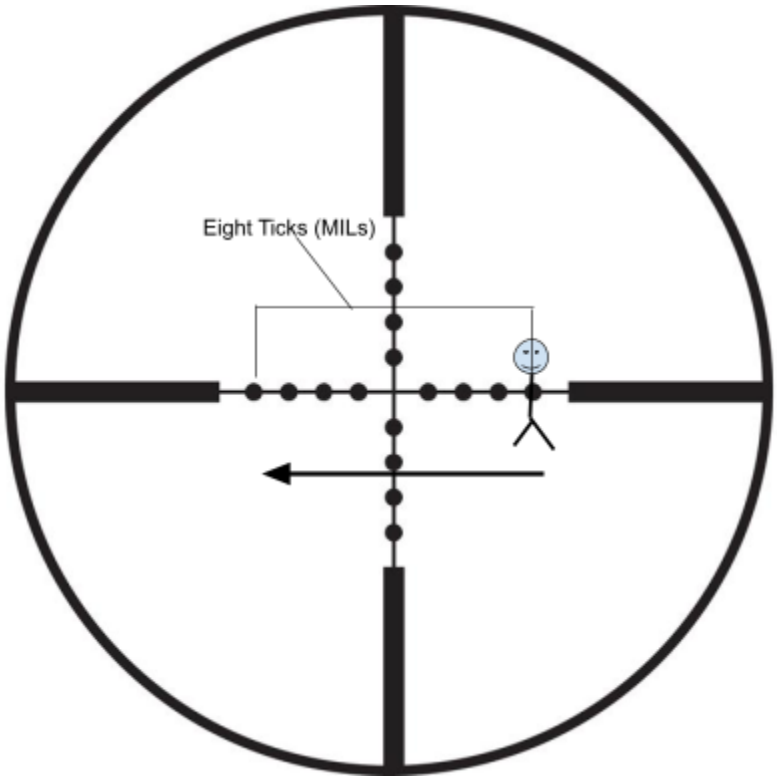


One of the more challenging shots to hit is that of the moving target.

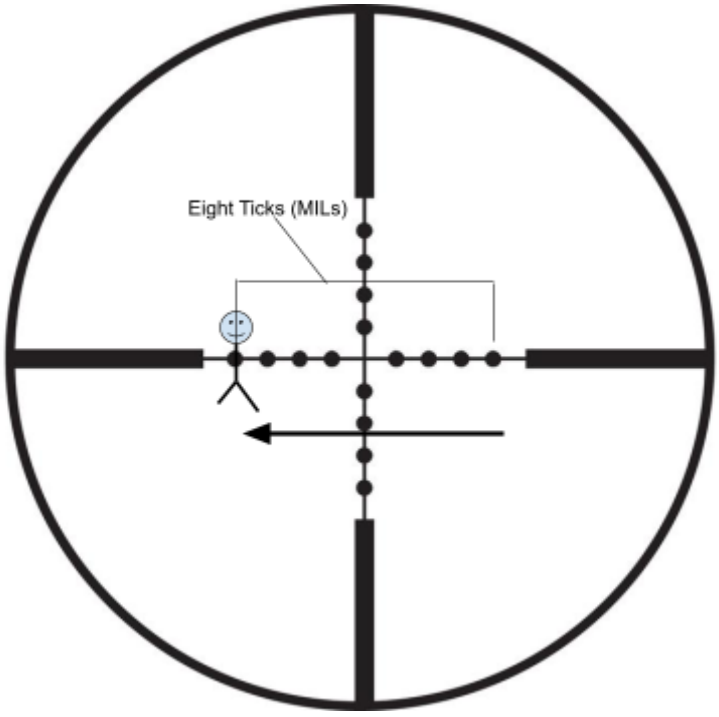
This guide is intended to help you hit a patrolling guard with your first shot, not a sporadically moving target.

To begin pull out your AtragMX and click “TS” under target, you will be presented with several variables including a timer designed to help you track the speed of a target.
To begin input the range of the target by using your range finder or the AtragMX manual rangefinder, Next enter the number of ticks you will be measuring for, this will be in MILs (remember those MIL dots on your scope from earlier). It is important to know that the more MILs you use to measure the more accurate your reading will be

For example we have a target moving to the left, lets find his speed.



As soon as bobby here hits the centre of that far right MIL dot we hit start on the timer



And once he exits the middle of the far left MIL we stop the timer

Keep in mind this whole time you must keep your weapon entirely still and steady for your measurement to be precise

Once you hit stop on the timer the estimated speed will be displayed to you. Now you need to set the direction the target was headed which is done under “Target” click that and you will notice a “>” sign next to your target speed, click this arrow to indicate the direction your target was travelling. Next you can access the needed adjustment to hit that target by setting the mode in the adjustments tab to Lead instead of Wnd2. Simply adjust your scope, aim at the middle of your target and when he comes back to the same area you measured his speed and direction from pull the trigger

How to Hit Sporadically Moving Targets

Pray

How to Manually Calculate a Shot

Oh dear it's happened, the apocalypse has come and your Zeus/Game Master has decided you will be roleplaying as a sniper after some catastrophic event that leaves you without your rangefinder, AtragMX, Kestrel and any hope of hitting your target at long ranges. It’s all over for you… Or is it.

As it turns out not all hope is lost and while those instruments make it *significantly* easier and make you *significantly* more reliable and accurate it's still possible to hit a target at longer ranges with your first shot.

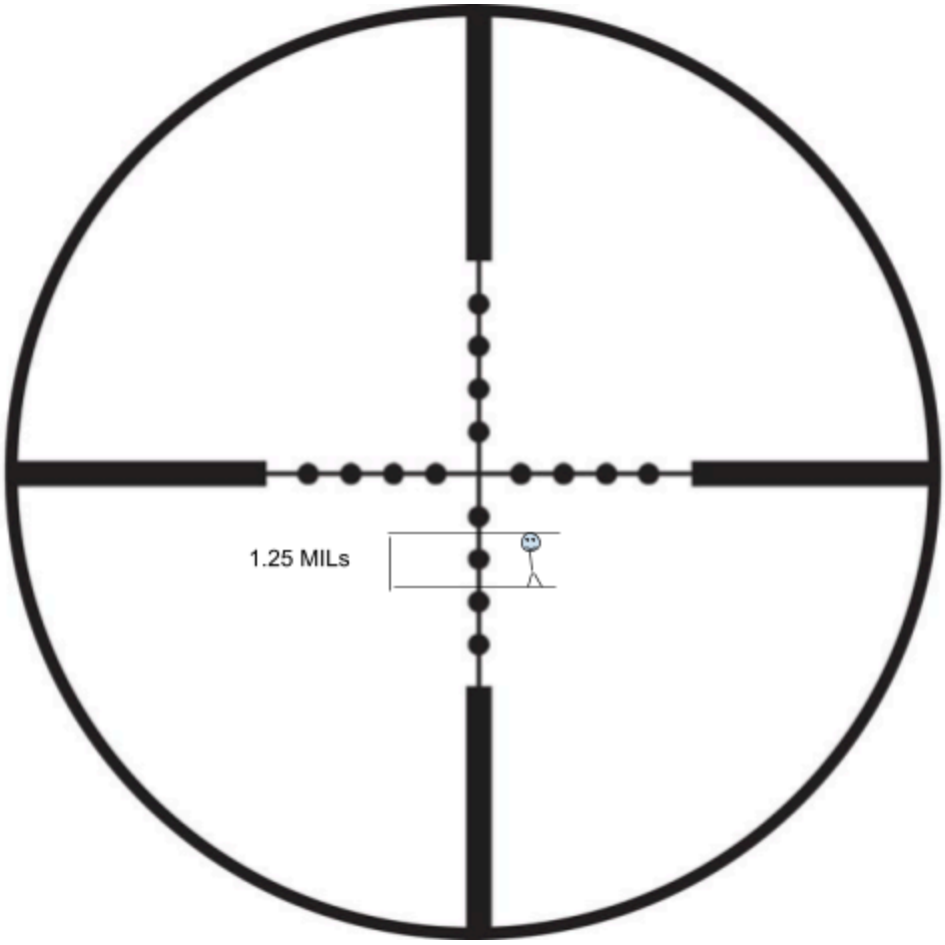
While it requires a bit more math and memorization it is entirely possible to hit your target with nothing but your scope and a range card.

A simple equation to remember is

Target size (in meters) x 1000 / Mils read = meters to target

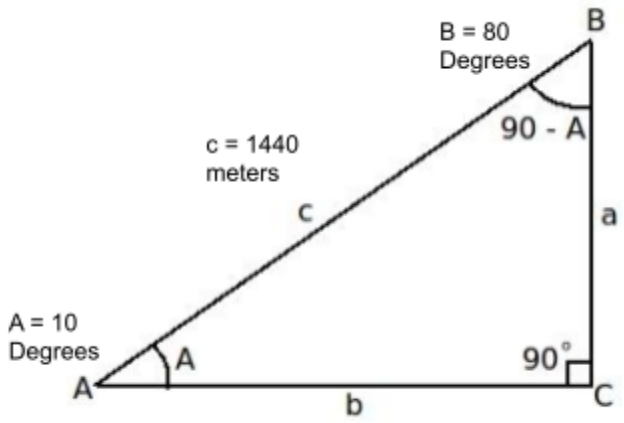
Memorizing this equation and that the average human height is 1.8 meters means you can get the approximate range to any human target (or any target you can guess/know the height of)

Let's see an example of a target on an incline of 10 degrees.



1.8 x 1000 / 1.25 = 1440 meters to target

Next we would want to find our angle of inclination for our true ballistic range crtl-shift-k will bring up an angle degree indicator, knowing these variables we can find our true ballistic range

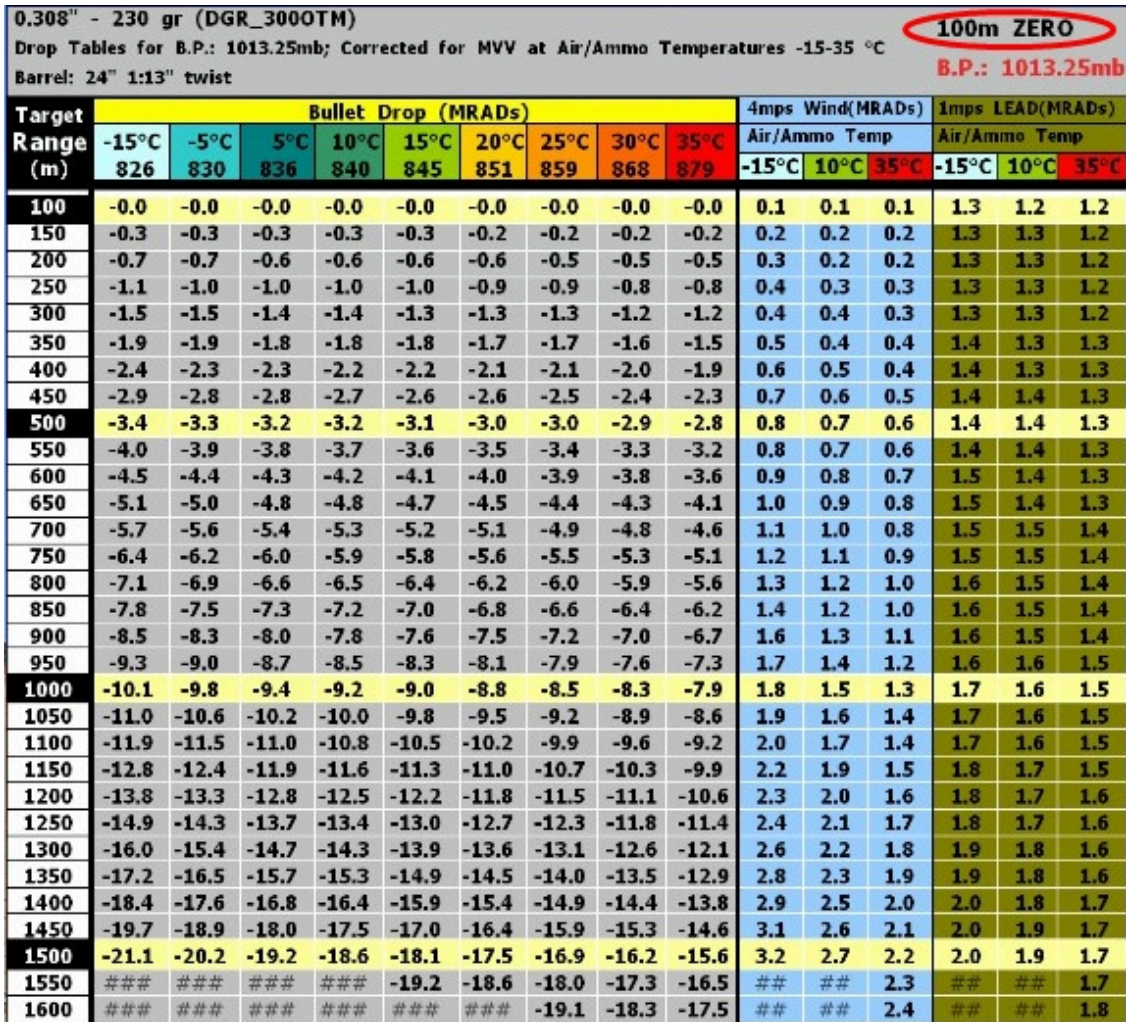


Knowing SOACAHTOA we can find the length of b

CAH = (Cos10) b/1440, b = 1418m

Our new range to consider is 1418m

Now lets check our range card



0.308" - 230 gr (DGR_300OTM)
Drop Tables for B.P.: 1013.25mb; Corrected for MVV at Air/Ammo Temperatures -15-35 °C
Barrel: 24" 1:13" twist

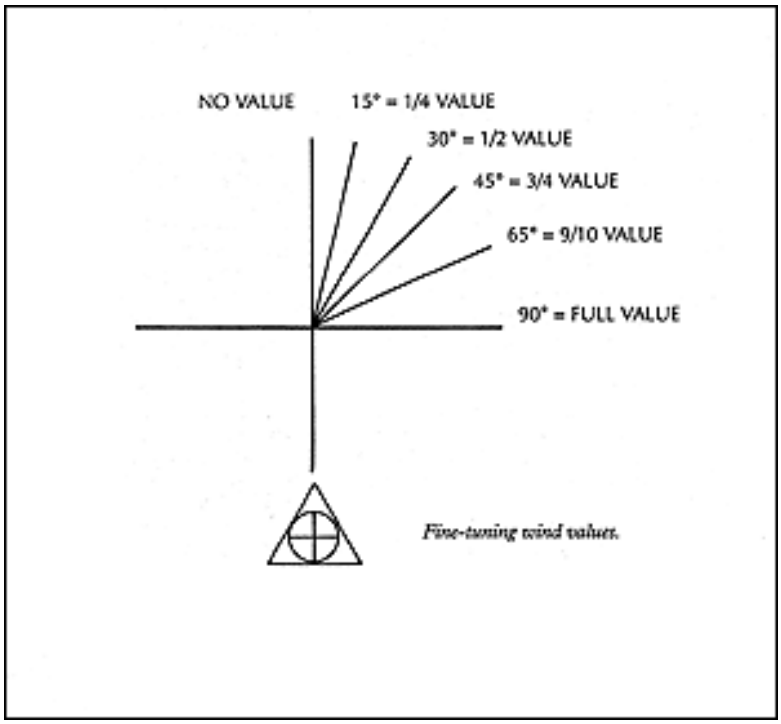
100m ZERO
B.P.: 1013.25mb

Target Range (m)	Bullet Drop (MRADs)									4mps Wind(MRADs) Air/Ammo Temp			1mps LEAD(MRADs) Air/Ammo Temp		
	-15°C 826	-5°C 830	5°C 836	10°C 840	15°C 845	20°C 851	25°C 859	30°C 868	35°C 879	-15°C	10°C	35°C	-15°C	10°C	35°C
100	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	-0.0	0.1	0.1	0.1	1.3	1.2	1.2
150	-0.3	-0.3	-0.3	-0.3	-0.3	-0.2	-0.2	-0.2	-0.2	0.2	0.2	0.2	1.3	1.3	1.2
200	-0.7	-0.7	-0.6	-0.6	-0.6	-0.6	-0.5	-0.5	-0.5	0.3	0.2	0.2	1.3	1.3	1.2
250	-1.1	-1.0	-1.0	-1.0	-1.0	-0.9	-0.9	-0.8	-0.8	0.4	0.3	0.3	1.3	1.3	1.2
300	-1.5	-1.5	-1.4	-1.4	-1.3	-1.3	-1.3	-1.2	-1.2	0.4	0.4	0.3	1.3	1.3	1.2
350	-1.9	-1.9	-1.8	-1.8	-1.8	-1.7	-1.7	-1.6	-1.5	0.5	0.4	0.4	1.4	1.3	1.3
400	-2.4	-2.3	-2.3	-2.2	-2.2	-2.1	-2.1	-2.0	-1.9	0.6	0.5	0.4	1.4	1.3	1.3
450	-2.9	-2.8	-2.8	-2.7	-2.6	-2.6	-2.5	-2.4	-2.3	0.7	0.6	0.5	1.4	1.4	1.3
500	-3.4	-3.3	-3.2	-3.2	-3.1	-3.0	-3.0	-2.9	-2.8	0.8	0.7	0.6	1.4	1.4	1.3
550	-4.0	-3.9	-3.8	-3.7	-3.6	-3.5	-3.4	-3.3	-3.2	0.8	0.7	0.6	1.4	1.4	1.3
600	-4.5	-4.4	-4.3	-4.2	-4.1	-4.0	-3.9	-3.8	-3.6	0.9	0.8	0.7	1.5	1.4	1.3
650	-5.1	-5.0	-4.8	-4.8	-4.7	-4.5	-4.4	-4.3	-4.1	1.0	0.9	0.8	1.5	1.4	1.3
700	-5.7	-5.6	-5.4	-5.3	-5.2	-5.1	-4.9	-4.8	-4.6	1.1	1.0	0.8	1.5	1.5	1.4
750	-6.4	-6.2	-6.0	-5.9	-5.8	-5.6	-5.5	-5.3	-5.1	1.2	1.1	0.9	1.5	1.5	1.4
800	-7.1	-6.9	-6.6	-6.5	-6.4	-6.2	-6.0	-5.9	-5.6	1.3	1.2	1.0	1.6	1.5	1.4
850	-7.8	-7.5	-7.3	-7.2	-7.0	-6.8	-6.6	-6.4	-6.2	1.4	1.2	1.0	1.6	1.5	1.4
900	-8.5	-8.3	-8.0	-7.8	-7.6	-7.5	-7.2	-7.0	-6.7	1.6	1.3	1.1	1.6	1.5	1.4
950	-9.3	-9.0	-8.7	-8.5	-8.3	-8.1	-7.9	-7.6	-7.3	1.7	1.4	1.2	1.6	1.6	1.5
1000	-10.1	-9.8	-9.4	-9.2	-9.0	-8.8	-8.5	-8.3	-7.9	1.8	1.5	1.3	1.7	1.6	1.5
1050	-11.0	-10.6	-10.2	-10.0	-9.8	-9.5	-9.2	-8.9	-8.6	1.9	1.6	1.4	1.7	1.6	1.5
1100	-11.9	-11.5	-11.0	-10.8	-10.5	-10.2	-9.9	-9.6	-9.2	2.0	1.7	1.4	1.7	1.6	1.5
1150	-12.8	-12.4	-11.9	-11.6	-11.3	-11.0	-10.7	-10.3	-9.9	2.2	1.9	1.5	1.8	1.7	1.5
1200	-13.8	-13.3	-12.8	-12.5	-12.2	-11.8	-11.5	-11.1	-10.6	2.3	2.0	1.6	1.8	1.7	1.6
1250	-14.9	-14.3	-13.7	-13.4	-13.0	-12.7	-12.3	-11.8	-11.4	2.4	2.1	1.7	1.8	1.7	1.6
1300	-16.0	-15.4	-14.7	-14.3	-13.9	-13.6	-13.1	-12.6	-12.1	2.6	2.2	1.8	1.9	1.8	1.6
1350	-17.2	-16.5	-15.7	-15.3	-14.9	-14.5	-14.0	-13.5	-12.9	2.8	2.3	1.9	1.9	1.8	1.6
1400	-18.4	-17.6	-16.8	-16.4	-15.9	-15.4	-14.9	-14.4	-13.8	2.9	2.5	2.0	2.0	1.8	1.7
1450	-19.7	-18.9	-18.0	-17.5	-17.0	-16.4	-15.9	-15.3	-14.6	3.1	2.6	2.1	2.0	1.9	1.7
1500	-21.1	-20.2	-19.2	-18.6	-18.1	-17.5	-16.9	-16.2	-15.6	3.2	2.7	2.2	2.0	1.9	1.7
1550	###	###	###	###	-19.2	-18.6	-18.0	-17.3	-16.5	##	##	2.3	##	##	1.7
1600	###	###	###	###	###	###	-19.1	-18.3	-17.5	##	##	2.4	##	##	1.8

And adjust our scope to 1400m which at 10 celsius would be -16.4 vertically and 0 horizontally (with no wind)

<u>Remember this is still reliant on your custom set 100m zero as detailed earlier</u>

If there was wind to be factored into the shot (Shift+k) first measure it with the Dots as mentioned in the Kestrel overview/how to use, next consider the value of the wind relative to the direction you're facing to the target. Here is a simple chart to help us.



For example we're facing a target to the east with a 2m/s wind at our 7 o'clock. We can divide the 4m/s reference on our range card by two to see our 2m/s value, then take one quarter of that number (because we're taking the ½ value stated by the image) and we're left with a MIL correction of -0.6,

Manual Moving targets (a.k.a you thought **THAT** was a lot of math?)

First lets memorize some basic movement speeds. The average human will move at the following speeds

Walking: ~ 1.4m/s

Running: ~ 6.7m/s

We'll use the same 1440m example as the last lesson

We are shooting a .308 at 840m/s which means our time of flight is 1.714 seconds until the bullet impacts the target

Now we convert to imperial because it's what the MIL system uses and use the following formula

Time of flight (sec) x Speed of target (fps) = Lead from center-mass in feet

1.7 x 4.6 = 7.8

So we must aim 7.8 feet in front of the target, but what is that in MILs?

(Lead in feet X 12) - 6__

(Range in yards x .01) X 3.5 = Lead in mils

So ((7.8 x 12) - 6)/ ((1574.803 x .01) x 3.5) = 1.6 MIL lead on the target

If we wanted to add that calculation to the windage we found in the previous example and our target was walking from right to left we would adjust for the two Mil adjustments and add them together. Finally we would be left with a 1.9 Mil horizontal adjustment to the Left. Keep in mind that due to the Coriolis and Eotvos effect bullets fired in the northern hemisphere will hit slightly to the right and vice-versa, and bullets travelling to the east will hit slightly high and vice versa

Obviously your chances of hitting your target are pretty miniscule at that range without any exact measurements but it is your best shot at hitting the shot

Coriolis Effect

An important factor to take into account when making long range shots that is indeed included in ACE ballistics is the Coriolis effect. The Coriolis effect will affect shots travelling along a northern or southern trajectory. It is caused by the conservation of momentum of the west or east rotation speed at the time of firing.

Because the earth is a spinning globe, the equator of the globe is travelling faster than the poles, so if you shoot a bullet facing north from the equator the bullet will drift to the right at the same speed as the equator, so since land closer to the poles is moving slower, the bullet will drift to the right.

Shots in the northern hemisphere will drift to the right,

Shots in the southern hemisphere will drift to the left.

(more drift the more you're aiming at the poles)

Eötvös Effect

The Eötvös effect is another factor to take into consideration. The rotation of the Earth generates a centrifugal force, the same that pushes you to the side when you make a sharp turn with your car. This force acts perpendicular to the Earth rotatory axis, adding or subtracting to the gravity force. When an object flies eastward, in the same direction of Earth's rotation, centrifugal force acts opposite of gravity, pushing it away from the Earth's surface. If the object flies westward, in the opposite direction of the Earth rotation, the centrifugal force is not as powerful and pushes the object toward the ground concurrently to gravity force. Thus, bullets fired to the east always fly a little higher, and, conversely, bullets fired to the west always travel somewhat low.

Knowing what hemisphere you're located in as well as the direction of your shot to properly compensate for both Coriolis and Eotvos effects is something that will come with experience, each individual map will have separate location data found online.

Conclusion

In conclusion you should now know how to be an effective and accurate marksman under any conditions. Remember you are a marksman now able to fill a sniper's roll, not the other way around.

You should now know,

- How to range a target.
- How to adjust for atmospheric conditions.
- How to adjust for changes in wind.
- How to take corrective action.
- How to remain hidden.
- How to calculate advanced ballistic range.
- How to hit moving targets.
- How to manually calculate a shot including stationary and moving.
- The effects the Coriolis and Eotvos effects will have at longer ranges.

I hope this guide has helped you to familiarize yourself and understand the aspects of advanced marksmanship using ACE advanced ballistics. The goal of this guide was to cover as many subjects as possible in one location, this is a living document and is subject to amendment or alteration by instructors based off of specific needs. Feel free to contact me at Cole.ryan@hotmail.com if you have any questions or recommendations for things I could add to this guide as i'm hoping this can be used as a central "hub" for information regarding anything relating to marksmanship and ACE ballistics. I am in no way a professional marksman so some of the information in this guide may not be 100% accurate, if you notice any errors please contact me so I may fix them.

Things that may be added in the future if requested

- Demonstrations
- Advanced runthrough of different Scope Variants
- Anything you can think of that will positively benefit this guide

Further Reading and Sources

Mil Dot user guide

Mil Dot user guide(2)

AtragMX guide

Vector Guide

Scope Variations and their uses