GTA 07-10-004

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SNIPER QUICK REFERENCE

Ref: TC 3-22.10, Sniper

Proponent: Maneuver Center of Excellence,

Fort Benning, GA

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PREFACE

The purpose of this graphic training aid is to provide snipers with quick access to information to achieve and maintain overmatch against an enemy threat by applying the proper force to create an unfair fight in favor of the sniper. This quick reference encompasses select information about the sniper's weapon system and how to employ that system with efficiency. The sniper rifles included in this graphic training aid are—

- M110 Semi-Automatic Sniper System (SASS).
- M2010 Enhanced Sniper Rifle (ESR).

Milliradian is indicated in all cases where "mil" is used.

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M110 Semi-Automatic Sniper System specifications

M110 Semi-Automatic Sniper System (TM 9-1005-342-10)	
Ammunition	Department of Defense Identification Code-AA11 7.62 millimeters 920 rounds per container
Barrel Length	20 inches
Barrel Rifling	5 grooves, right-hand twist (1 turn in 11 inches)
Muzzle Velocity	2,600 feet per second
Max Effective Range	800 meters or shooter-dependent
Bullet Coefficient G1	.475
Bullet Coefficient G7	.243
Custom Drag Model	175 SMK
Magazine Capacity	10 and 20 round magazines
Combat Weight	15.7 pounds

3.5-10x40 millimeter DOS with Tactical Milling Reticle	
Description	3.5 x 10 power variable optic with a 30-millimeter tube and 40-millimeter objective lens. **NOTE:** When conducting range estimation, the day optical scope (DOS) must be on the highest power setting (10x).
Length	13.5 inches
Weight	1.76 pounds
Field of View	29.9 feet at 100 yards (3.5 x) 11 feet at 100 yards (10x)
Eye Relief	2.5 – 3.5 inches
Elevation Unit	.5 minute of angle (MOA) adjustments
Windage Unit	.5 MOA adjustments

M2010 Enhanced Sniper Rifle and Reticle Specifications

M2010 Enhanced Sniper Rifle (TM 9-1005-438-13&P)	
Ammunition	Department of Defense Identification Code-A191, 300 win mag 480 rounds per container
Barrel Length	24 inches
Barrel Rifling	5-R rifling, right hand twist (1 turn in 10 inches)
Muzzle Velocity	3,000 feet per second
Max Effective Range	1,200 meters or shooter dependent
Bullet Coefficient G1	.523
Bullet Coefficient G7	.267
Custom Drag Model	190 SMK
Magazine Capacity	5-round detachable box magazines
Combat Weight	18.7 pounds

M2010 Enhanced Sniper Rifle Reticle(TM 9-1005-438-13&P)	
Description	Extended range tactical 6.5–20×50millimeter (mm) reticle, M5A2 front focal variable power telescopic sight, featuring a 34 mm tube diameter and a first focal plane grid system reticle.
Length	14.5 inches
Weight	1.375 pounds
Field of View	14.30 feet at 100 yards (6.5x) 5.50 feet at 100 yards (20x)
Eye Relief	4.4 inches at (low) 3.6 inches at (high)
Elevation Unit	.1 milliradian (mil) adjustments
Windage Unit	.1 mil adjustments
NOTE: It is authorized to mount the extended range tactical reticle on M110 SASS	

SETUP SNIPER WEAPON SYSTEM

Setting up a sniper weapon system for an individual shooter is an important process that enables the sniper to employ their sniper weapon system effectively.

Buttstock Adjustments—

(1) Comb height. Adjust the snipers head to be in alignment with the rifle scope. If the comb is not adjusted properly, the sniper will encounter muscle fatigue, ache, and exhaustion.

The sniper should check the comb height in both vertical and lateral positions.

- *Vertical. Provides optimal height without requiring muscular input.*

- *Lateral. Accounts for different head types. Round face head types can adjust the comb away from the face. Narrow face types can pull the comb towards the face.*

(2) Length of pull. Adjust the length of pull to achieve the ability to press the trigger without disrupting the lay of the rifle. The sniper must determine the length of pull in all firing positions. The sniper can check the length of pull by placing the rear of the stock into the nook of their elbow and allowing their trigger finger to naturally lay on the trigger. Improper length of pull can affect bolt cycling operation as well as inconsistent eye relief.

(3) Stock weld. The sniper rests the full weight of the head on the stock. The head position is upright as possible to give the best vison through the aiming device. Snipers must maintain consistency in cheek-to-stock weld when firing. Inconsistent stock weld will lead to aiming errors.

Optic Adjustments—

(**1) Eye relief.** The distance from the last surface of an eyepiece at which the user's eye can obtain a full field of view (FOV). Eye relief changes with magnification. To set up the proper eye relief, the sniper does the following—

1. With the scope as far forward in the mount as possible, hold the rifle in a normal shooting position. Set magnification to highest power.
2. Slowly move the scope to the rear until a FOV is acquired.
3. Without disturbing the optimal eye relief position, rotate the scope until the elevation adjustment turret is at the top of the scope. From the firing position, check to be sure that the vertical line of the reticle aligns with the vertical axis of the firearm. (Use a scope level and confirm with the tall target test, which is covered in this graphic training aid.)
4. Tighten the ring screws evenly and securely. Consult weapon technical manual (TM) for torque guidance.

(2) Reticle focus. The sniper must ensure that the reticle is focused before conducting any live-fire events. To adjust focus, the sniper does the following—

1. The sniper gets behind the rifle and the spotter sets up to their firing side to assist in adjustments.
2. If the eyepiece has a lock ring, grasp the eyepiece and rotate it counterclockwise until the lock is loose.
3. Begin adjustment at the positive side of the eyepiece. The eye focuses faster from the negative side and by starting at full positive. The end result is a more refined reticle.
4. The spotter will block the objective end of the scope with a piece of white paper without blocking the view of the sniper's nondominant eye.

5. The sniper focuses on a downrange object at least 100 meters away with the nonfiring eye, then shifts focus to the firing eye to check the sharpness of the reticle. The spotter adjusts the eyepiece in small increments (+ to -) and continues to rotate the eyepiece until the reticle is sharp.

6. Once complete, retighten the lock ring against the eyepiece and annotate focused point with a paint marker.

(3) To shoot with both eyes open and scan for targets with the nonfiring eye, the sniper must have instant acquisition on the glass when shifting focus back into the scope and onto the reticle. To accomplish this, the sniper needs to set up the ocular focus on the reticle while both eyes are open and focused at a neutral point outside the scope.

(4) If the sniper looks into the scope with their firing eye and provides time for the eye to focus on the reticle, it will. The constant refocusing when going from outside the glass to inside can cause eye fatigue.

(5) **Parallax**. Improper parallax adjustment causes the target image and the reticle to appear to be in two separate places within the scope. This will make the reticle seem to move across the target and will induce errors in milling the target or object. The sniper completes the following steps to eliminate parallax with the side focus adjustment:

1. The reticle must be focused before adjusting parallax.

2. With the rifle in a stable position, look through the scope, concentrating on the center aiming point of the reticle.

3. Move the head slightly up and down and left and right. It is important not to move the rifle while making these head movements as it can cause the appearance of parallax when there is none.

4. The aiming point must remain in the exact same position against the target. If it moves, turn the side focus knob until it becomes stable.

ZEROING

Zeroing a weapon is not a training exercise nor is it a combat skills event. Zeroing is a maintenance procedure to place the weapon in operation, based on the sniper's skill, capabilities, tactical scenario, aiming device, and ammunition. Its purpose is to achieve the desired relationship between the line of sight (LOS) and the trajectory of the round at a known distance. The sniper must first achieve a consistent grouping of a series of shots, then align the mean point of impact (POI) of that grouping to the appropriate point of aim (POA).

(1) To zero the sniper weapon system, snipers must first know the exact range to the zero target. One hundred meters is the preferred zero distance for the M110 and M2010.
(2) Set elevation and windage turret to zero.
(3) Shoot a five-round shot group.
(4) Adjust the mean POI to the appropriate POA.
(5) Continue to shoot a five-round group until the desired effect is achieved.
(6) Slip rings, both elevation and windage. (Refer to TM 9□1005□342□10, TM 9-1005-438-13&P, and TC 3-22.10 for guidance.)
(7) Confirm zero to make sure turrets are slipped correctly.

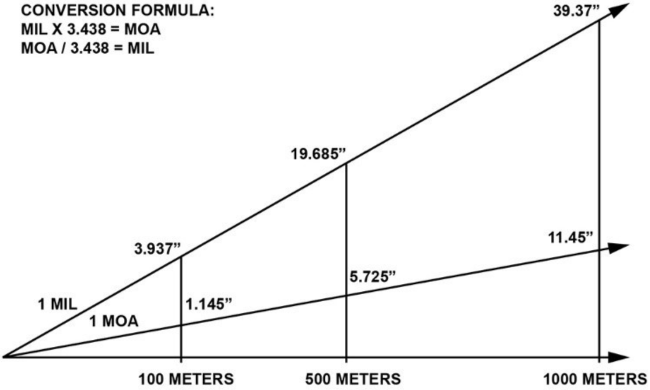
Zero height (elevation) and zero offset (windage) are used when the addition of a suppressor, a change in ammunition, or the addition of night vision optics changes the POI of the zero. These offsets can be programmed into the ballistic program. Make sure to annotate your POI from your POA. Don't take your zero for granted.

MEAN POI AT 100 METERS	***ERROR AT 1,000 METERS***
.1" high or low	1"
.2" high or low	2"
.5" high or low	5"
.7" high or low	7"
Legend: " – inches, POI – point of impact	

MIL AND MOA

1 MIL = 3.438 MOA
1 MOA = 1.145" AT 100 METERS (FIELD USE: 1" EVERY 100 METERS)
1 MOA = 0.291 MIL (FIELD USE: 1 MOA = .3 MIL)
1 MIL = 10 CM AT 100 METERS (1 MIL = 1 METER AT 1000 METERS)
1 INCH = 2.54 CM
1 INCH = .254 MIL AT 100 METERS
.1 MIL MOVES POI 1 CM AT 100 METERS

CONVERSION FORMULA:
MIL X 3.438 = MOA
MOA / 3.438 = MIL



*ANGLE DIMENSIONS EXAGGERATED FOR CLARITY

NOTE: USE RANGE ESTIMATION IN METERS WITH A MIL-BASED SYSTEM AND USE YARDS WITH A MOA-BASED SYSTEM.

LEGEND

"	INCH	CM	CENTIMETERS	MIL	MILLIRADIAN
MOA	MINUTE OF ANGLE	POI	POINT OF IMPACT		

SCOPE CALIBRATION

The sniper needs to verify their scope and determine if the adjustments are accurate. The tall target test is a calibration exercise. The test must be conducted at exactly 100 meters. For anything greater than 1 percent, the sniper should apply a correction factor (CF) as follows:

1. Level target at 100 meters.

2. Visually check horizontal and vertical stadia line alignment with target.

3. Dial 10 milliradians (mils) for elevation.

4. Group while aiming at lowest crosshair on target.

5. Measure vertical distance (in centimeters [cm]) from group to 100 cm line.

    (a) Every 1 cm equals 1 percent elevation error.

    (b) For groups above 100 cm line, subtract from 100.

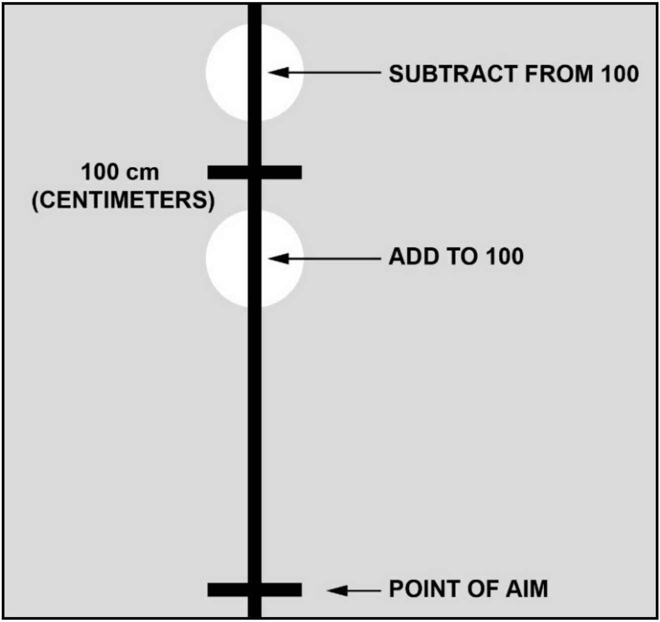
    (c) For groups below 100 cm line, add to 100.

    (d) Answer equals correction factor percentage.

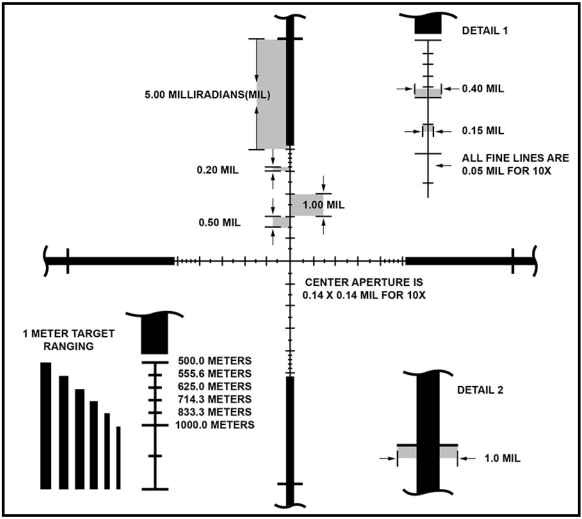
    Example: Group was 2 cm above 100 cm line = 98/ 100 = .98 CF percent. Take the CF and apply it to the elevation hold for true elevation turret value.

6. Measure horizontal distance (in centimeters) from group to vertical stadia line.

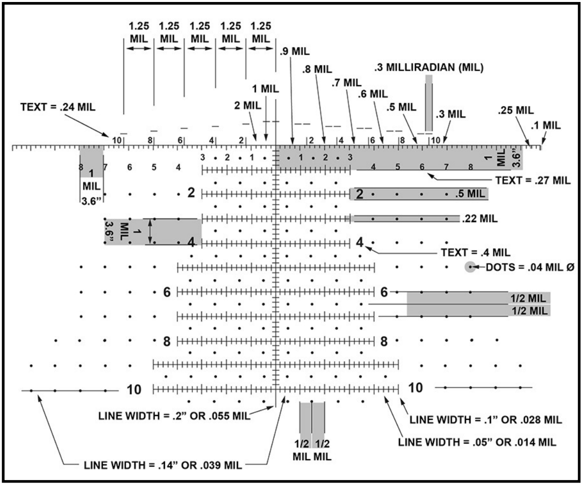
    Every 1 cm equals 0.1 mil (0.348 minute of angle [MOA]) scope cant.


SUBTRACT FROM 100
100 cm
(CENTIMETERS)
ADD TO 100
POINT OF AIM

TACTICAL MILLING RETICLE

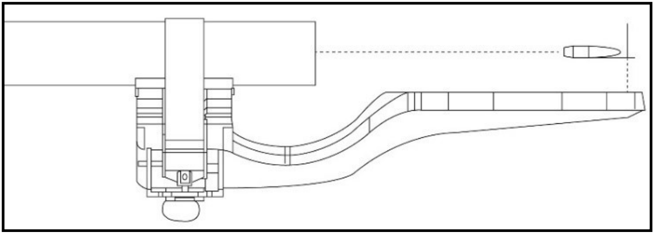


GRID SYSTEM RETICLE



CHRONOGRAPH

Muzzle velocity is one of the most important measurements for a ballistic program. The sniper needs to understand that the muzzle velocity of each shot will be different. The best way for the sniper to take advantage of this is to measure the average and input that number into the ballistic program. When setting up the chronograph, snipers must make sure that the guide rod is directly below the bore for best results. If the chronograph is too low or too far from the bore, the chronograph will give false readings. Refer to chronograph manual for complete setup procedures.



Snipers can use the chronograph to create a muzzle velocity temperature (known as MV□TEMP) table. A minimum of four data points, which are at least 30 degrees apart, will be needed from the current lot of ammunition. It is always best to have data points for the coldest and warmest temperatures in which the sniper will shoot. The following is an example of a MV-TEMP table:

Temperature	***Muzzle Velocity***
30 degrees Fahrenheit (F)	2,550 fps (feet per second)
60 degrees F	2,565 fps
90 degrees F	2,580 fps
120 degrees F	2,620 fps
Note: These numbers are examples.	

BALLISTIC PROGRAM

The basic principle of trajectory modeling is that if the sniper inputs all of the variables correctly into a ballistic program, then that program will return an accurate ballistic solution. The sniper has to be aware of the true value of all the inputs. Possible variables that can account for an error in POI are listed below. The sniper must ensure none of the listed variables are contributing to an observed vertical POI between live-fire data and ballistic program predictions.

Point of Impact Error Checklist
Incorrect muzzle velocity.
Error in zero range.
Error in sight height.
Error in parallax setting.
Inaccurate atmospheric data.
Accounted for aiming error at range.
Uncalibrated turret adjustments.
Unaccounted for wind speed and direction.

Sniper teams will conduct the following steps to confirm trajectory calculations:

1. Dial on predicted dope for 500 meters.
2. Record vertical POA-POI deviation. Must measure impacts to 1/10th of mil.
3. Adjust muzzle velocity, if needed. Should not need to adjust by more than 50 feet per seconds (fps).
4. Dial on predicted elevation (with corrected velocity) for 800 meters (M110) or 1200 meters (M2010)
5. Record vertical POA-POI deviation. Must measure impacts to 1/10th mil.
6. Adjust bullet coefficient (BC) until predicted elevation matches observed elevation. Should not need to adjust by more than 5 or 10 points on BC. Annotate environment and wind conditions.

BUILD GUN: Open the ballistics menu, scroll to and select Manage Guns, then select New Gun.

- To name your gun, scroll up to Gun and press select to open the gun naming screen.
- Use the cursors to create a new name for this gun and bullet combination.

Return to the gun menu and begin inputting values for your gun and bullet combination. Use the tables on page 2 and 3 to assist in building a gun profile.

CAPTURE ENVIRONMENT: To make an environmental capture, turn Update to LIVE, then expose the sensors to ambient air flow. When you select to Update, the ballistic program is reading the environment in real-time and will give real-time data to the ballistic engine. To guard against heat or cold syncing, spin the ballistic program at the end of the lanyard to expose the wire sensor to actual air temperature and then turn off Update to LOCK.

CAPTURE DIRECTION OF FIRE: Measured in degrees or hours from north, this variable can be manually inputted or captured automatically. Capturing direction of fire (known as DoF) – To capture DoF automatically, enter the DoF submenu and select Capture. While pointing the back of the ballistic program towards the target and holding the ballistic program vertical, press the select button.

CAPTURE WIND. The sniper will—

1. Find the wind's general direction.
2. Rotate the wind meter 90 degrees so that the wind is impacting the side (and not the back) of the wind meter, while still being able to see the impeller.

3. Fine-tune the direction until the impeller drastically slows or comes to a complete stop (a complete stop is preferred). If the impeller won't come to a complete stop, find the direction that has the lowest impact on the impeller. When the impeller comes to a complete stop, it is because the crosswind is no longer a factor in the direction the side of the ballistic program is facing. The side of the ballistic program facing the wind depicts the true direction of the wind.

4. Turn the BACK of the ballistic program towards the direction from which the wind is blowing (found in step 3). Then press the capture button and capture wind speed.

5. The wind direction (WD) is relative to the DoF. If you change your DoF, you need to update the inputs for both DoF and WD.

ADDITIONAL VARIABLES: Spin drift results in a horizontal shift in POI caused by the change to the bullet's axis of rotation as it follows the arch of its trajectory. Aerodynamic jump causes a vertical shift in POI due to wind moving perpendicular to the flight of the bullet. Its impact increases when shooting in increased crosswind conditions. The Coriolis effect can cause either a vertical or horizontal shift in POI or a combination of the two depending on the DoF and the rotation of the earth underneath the bullet while in flight.

Always remember to input the correct DoF, wind direction, and wind speed before taking a shot to make sure the ballistic program is giving you accurate elevation and windage holds.

FIELD USE: To use the ballistic program for field use, the sniper will—

1. Select Gun.
2. Update Latitude.
3. Update Environment.
4. Capture Direction of Fire.
5. Capture Wind at Shooters Location.
6. Input Range to Target.
8. Shoot and Assess.

SHOT PROCESS

The shot process is the basic outline of an individual engagement sequence all snipers consider during the engagement, regardless of the weapon system being employed. The shot process formulates all decisions, calculations, and actions that lead to taking the shot.

The shot process allows the sniper to focus on one cognitive task at a time. The functional elements of the shot process are interdependent. An accurate shot, regardless of the weapon system, requires the sniper to establish, maintain, and sustain—

Stability. The sniper stabilizes the weapon to provide a consistent base of fire through the shot process until the recoil pulse has ceased. This process includes how the sniper holds the weapon and uses structures or objects to provide stability. It also includes the sniper's posture on the ground during an engagement.

Aim. The sniper engages in a continuous process of orienting the weapon correctly, aligning the sights, aligning on the target, and the appropriate lead and elevation (holds) during an engagement.

Control. This is all of the conscious actions of the sniper before, during, and after the shot process that the sniper specifically controls. The first action is trigger control. This includes whether, when, and how to engage. Trigger control incorporates the sniper as a function of safety, as well as the ultimate responsibility of firing the weapon.

Movement. This is the process of the sniper moving during the engagement process, the leverage of natural motion, and manipulations to facilitate rapid, initial, and subsequent shots during an engagement sequence.

RANGE ESTIMATION

Three factors that affect range estimation are nature of the target, nature of the terrain, and light conditions.

Factor		*Impact*
Nature of Target	Outline	An object of regular outline (such as a house) appears closer than one of an irregular outline (such as a clump of trees).
	Contrast	A target that contrasts with its background appears to be closer than it actually is.
	Exposure	A partially exposed target appears more distant than it actually is.
Nature of Terrain	Contoured Terrain	Looking across contoured terrain makes a target seem farther away than it actually is.
	Smooth Terrain	Looking across smooth terrain (such as sand, water, or snow) makes a distant target seem nearer than it actually is.
	Downhill	Looking downhill at a target makes it seem farther away than it actually is.
	Uphill	Looking uphill at a target makes it seem nearer than it actually is.
Light Conditions	Sun Behind Observer	A back-lit target seems farther away than it actually is.
	Sun Behind Target	A back-lit target seems farther away than it actually is.

MIL RELATION FORMULA

Estimating Object Range in Meters

$$\frac{\text{estimated height in meters x 1,000}}{\text{size of object in mils}} = \text{estimated range in meters}$$

Estimating Object Height or Width in Inches

To estimate the object height in inches—

(1) Multiply 25.4 by the object size in inches. This will give you the constant.

(2) Measure the object using the reticle in the scope. Be sure to eliminate any parallax before milling of the target.

(3) Divide the constant by the mil reading to get the range in meters.

BACKWARD MANIPULATION METHOD

Familiarity with the mil relation formula is a must. Snipers need to be able to manipulate the formula backwards. To perform the backward manipulation method, divide the range to the object by 25.4 and multiply by the mil reading to receive your answer.

Example: If you have an object that you know is 825 meters from your location with a mil reading of .8, what is the size of the object? Divide the range to the object by 25.4 and multiply by .8: the answer is 26 inches.

Take caution when milling a human target. For better results, use the mil relation formula on solid objects of known sizes (such as, vehicles, building components, weapons).

Example

Difference in range when the target height is 6” shorter than the actual height of the target.

Target estimated at

6’0” = 1.83 meters x 1000 = 1830 / 2.5 mil = 732 meters.

Target actual height

5’6” = 1.67 meters x 1000 = 1676.4 / 2.5 mil = 670.56 meters.

Difference of 62 meters due to a 6” target size error.

If an observer is on the ground and can observe the sniper’s shot, they can assist in relaying corrections using an optic that has a milliradian reticle.

Example. Forward observer is 100 meters from target. Sniper is 2,000 meters from target. FO sees the splash 5 mils left of target. FO can calculate in inches:

5x100/25.4 = 19.7 inches or mils = 19.7 x 25.4/2,000 = .25 mils left.

MOVING TARGET

Engage a Moving Target

Establishing proper leads for engagement of a moving target depends on the variables listed below:

- Projectile time of flight (TOF) based on target range.
- Target speed.
- Target direction of movement.
- Wind speed and direction.

CONVERSIONS

TIME OF FLIGHT (SECONDS) X TARGET SPEED (FOOT PER SECOND) = LEAD IN FEET.

TO CONVERT LEAD IN FEET TO METERS:

LEAD (FEET) X .3048 = LEAD (METERS)

TO CONVERT LEAD IN METERS TO MILLIRADIANS (MILS):

LEAD (METERS X 1000 = LEAD (MILS)

FORMULA WHEN USING MIL-BASED RETICLE

TARGET SPEED IN MILS (1 SECOND) X TIME OF FLIGHT (IN SECONDS) = HOLD.

SNIPER CAN FIND A WORD THAT THEY CAN SAY IN THEIR HEAD, UNDER DURESS, THAT EQUALS ONE SECOND.

Techniques for Engaging a Moving Target

Two techniques are employed to engage moving targets: tracking and ambushing. The terrain, situation, target speed, and proximity of target combined with training and experience dictates which technique to employ.

Target Direction (or Angle) of Movement

There are primarily three types of lead values for hasty application or from which to refine target angle of movement.

- Full lead. Only one arm visible (90 degrees).
- ¾ lead. Only one arm and more than half of the back or chest visible. Recommended lead for an oblique target is .75 of lateral lead.
- No lead. Both arms and full surface area of the chest or back visible. (0 degrees).

Targets Moving With and Against the Wind

- If the target is moving with the wind, subtract the mil hold.
- If the target is moving against the wind, add the mil hold.

Time of Flight

- The time it takes the bullet to reach a given range is called time of flight.
- The amount of lead depends on how fast the target is moving across the range and on the bullet's TOF.

RANGE	***TOF (M110) 2,600 FPS***	***TOF (M2010) 3,000 FPS***
100 m	.131	.113
200 m	.274	.234
300 m	.429	.364
400 m	.598	.504
500 m	.784	.655
600 m	.989	.819
700 m	1.216	.996
800 m	1.467	1.189
900 m	1.748	1.401
1,000 m	2.052	1.632
Note: TOF numbers are for 60° Fahrenheit, 29.92 inHg, 50 percent RH		
Legend: fps – flight per second, inHg – inch of mercury, m – meter, RH – relative humidity, TOF – time of flight		

WIND

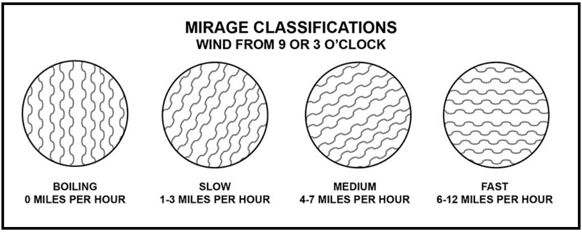
Before a mission, sniper teams need to apply modern methodology to build an appropriate data card for their respective sniper weapon system and ammunition. By preparing a ballistic card with elevation and wind holds, the sniper will have a more accurate means to reference “hard” data.

Forecasting Surface Winds

The sniper can use forecasting tools or visual techniques to help them forecast surface winds. The sniper can use/assess:

- Mirage.
- Micro-level terrain effects.
- Wind scale chart.
- Ballistic program wind meter (covered earlier in ballistic programs, page 15).

Mirage. Sniper team uses their spotting scope to observe mirage. Mirage can be observed mainly on days when the ground and air are different temperatures. The shooter must consider the winds hydrodynamic nature since you will now be looking at wind in another location. Generally, in relatively open terrain, this is a good method for determining wind direction; however, using multiple methods is most accurate.

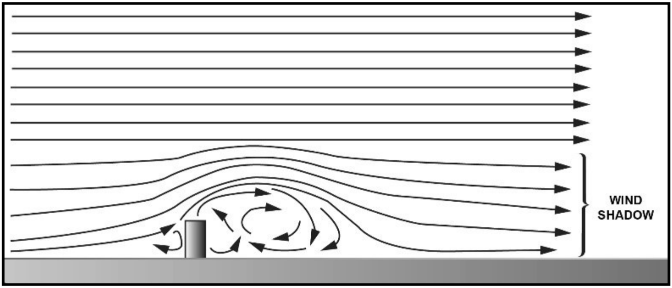


The sniper must then use a wind cosine chart to determine the winds lateral effect on the bullet's flight path. For example, if the sniper finds a 1:30 or 45□degree wind, he would apply a value of .7 to his wind velocity value. If the wind was moving at 4 miles per hour (mph) the lateral component of wind deflection would be 4 mph x .7 = 2.8 mph.

Simplified Wind Cosine Chart

Wind Direction	*Cosine Value*
12:00/0 degrees	0
12:30/15 degrees	0.25
1:00/30 degrees	0.5
1:30/45 degrees	0.7
2:00/60 degrees	0.85
2:30/75 degrees	0.95
3:00/90 degrees	1.0

Terrain Effects. The turbulent area downwind of an obstacle is called its wind shadow. All wind shadows gradually disappear as you get further away from the obstacle. The shadow from a typical tree extends several hundred meters.



Turbulence is caused not only by obstacles, but also by the shape of the ground itself. On the windward, or “front” side of a hill, the air flow compresses and speeds up. The leeward, or “back” side; however, is different. Wind flowing over the crest of the hill separates and causes turbulence that can range from moderate to severe depending on the speed of the wind and the shape of the hill.

The sharp break at the foot of a steep rise causes the wind to form a pocket of stalled and turbulent air. The break at the top causes turbulence to form just like the back side of a hill.

Wind Scale Chart. Snipers can use the Beaufort scale to summarize what they observe and feel. The sniper needs to be aware that not all vegetation acts the same in wind. The best course of action for the sniper is to observe the vegetation in their area of operation and use their ballistic program wind meter to record wind speed and observe how that vegetation is reacting to the corresponding wind speed value.

Beaufort Scale Number	***Wind miles per hour (mph)***	***Common Name***	***Clues on Land***	***Clues on Water***
0	Less than 1	Calm	None	Mirror-like
1	1 to 3	Light air	Smoke drifts	Scale-like ripples
2	4 to 7	Light breeze	Wind felt on face, leaves rustle	Small wavelets, glassy crests
3	8 to 11	Gentle breeze	Leaves, small flags in motion	Few crests begin to break
4	12 to 18	Moderate breeze	Dust swirls, small branches sway	Wave rows lengthen, half of crests break into spilling white wave crests
5	19 to 24	Fresh breeze	Small trees begin to sway	Most waves marked by white horses, some spray
6	25 to 31	Strong breeze	Large branches sway, whistling heard in trees	Extensive spray streaks blows parallel to wind

Making a Wind Call

The sniper must be able to estimate the wind speed and direction. He must also predict how long that wind condition will be stable, if there is going to be a change, and how that change will affect his call. The sniper can break the wind down into three categories:

- Present or not present.
- Stable or unstable.
- Predicable or unpredictable.

For example, the sniper has wind that is:

- Consistent 4 to 5 mph wind from 9 o'clock. The wind is present, stable, and predictable. If the sniper reads the wind correctly, he can assume a high percentage of hits. Primary skill set is READING.
- Gusting on and off from 6 to 10 mph from 9 to 10 o'clock. It is present and unstable, but predictable. If the sniper can predict the changes and read the conditions as they are changing, he can assume a high hit percentage of hits. Primary skill set is PREDICTING AND READING.
- Winds changing directions and with gusts at 5 to 10 mph. It is present, unstable, and unpredictable. The sniper should wait for more stable and predictable conditions or risk a low percentage of hits on target.

The shooter can use a base value system for calculating the effect of wind on the bullets trajectory at distance. This includes constructing a chart for full□value winds and its lateral effect at distance. Using a base 1 mph system can make quick target engagement on targets at different ranges possible with simple calculations and determine the width of your target in mph.

175 SMK at 60 degrees F/29.92 InHg MV = 2,600 fps		***IPSC Target***	
Range to target	1 mph effect of wind (in mils)	18-inch target width (mils)	Target width (mph)
100 m	0.02 mils	4.57	228.5 mph
200 m	0.05 mils	2.29	45.8 mph
300 m	0.07 mils	1.52	21.7 mph
400 m	0.10 mils	1.14	11.4 mph
500 m	0.14 mils	0.91	6.5 mph
600 m	0.17 mils	0.76	4.4 mph
700 m	0.21 mils	0.65	3.0 mph
800 m	0.25 mils	0.57	2.2 mph
900 m	0.30 mils	0.50	1.6 mph
1,000 m	0.35 mils	0.46	1.3 mph
1,100 m	0.40 mils	0.41	1.0 mph
1,200 m	0.44 mils	0.38	.86 mph
Note: **Turn Spin Drift to OFF/LAT to 0**			
TGT mil read (width)/1 mph wind value (mil) = TGT width in mph			
Legend: F—Fahrenheit, fps—feet per second, InHg—inch of mercury, IPSC—International Practical Shooting Confederation, LAT—latitude, m—meter, mils—milliradians, mph—miles per hour, MV—muzzle velocity, TGT—target			

The sniper takes the estimation of wind velocity and applies the lateral value correction as discussed above. This gives the sniper the lateral value of wind in miles per hour. Referring to the above base 1 mph chart, the sniper multiplies the mil value for his target range by the lateral wind velocity. (See example.)

Example

The shooter determines the wind direction is from the 2:00 to the 8:00 and references the cosine chart to determine a 0.85 cosine. The shooter estimates the wind velocity to be 10 mph. The shooter multiplies these together and gets an 8.5 mph crosswind component. The target is at 700 meters so the shooter multiplies 8.5 mph by the 1 mph base wind (0.21 mils) to get 1.78 mils to the right for the hold.

2:00 Wind = 0.85 cosine factor

10 mph x 0.85 = 8.5 mph crosswind component

8.5 mph x 0.21 mils = 1.78 mil hold at 700 meters

Rapid Target Transitioning

The base 1 mph wind system works well for transitioning quickly between targets at various ranges in similar wind conditions. Knowing your wind correction from a previous target engagement can be used to quickly determine an accurate wind hold for a target in similar conditions at any other range if you know the 1 mph effect of wind at that range.

Example

Since we have raw, observed data from the actual impact of our round at 700 meters, we can determine the exact crosswind component that the bullet experienced in flight. Our exact deviation from LOS at 700 meters was 1.9 mils since we achieved a center mass hit while holding 1.9 mils for wind. We divide that by the 1 mph value of 175 SMK at 700 meters (.21) to find that the bullet experienced an overall 9 mph lateral force during flight. We can now use that information to extrapolate wind hold for similar conditions at another range, say 1,000 meters.

We take the known wind velocity (9 mph) and multiply it by the base wind value for the range at our next target (for example, 1,000 meters.) This will give us an accurate wind hold for that range based on verified wind conditions (3.15 mils for wind hold).

Knowing your targets width in miles per hour

Using your 1 mph wind value, you can determine what the width of your target in miles per hours is at that range (such as, how much wind it would take to blow your round off target). You measure your target at 800 meters to be 0.57 mils wide. At 800 meters your 1 mph wind value is 0.25 mils. If you divide your target’s mil reading by your 1 mph wind value you get 2.2 mph. When extracting your 1 mph wind value from your ballistic program, be sure that spin drift is set to OFF and latitude is set to 0. Once 1 mph values are recorded, you can turn spin drift to ON, and set your latitude for your final firing position.

This tells you that it would take 2.2 mph of wind (or error in wind velocity estimation) to blow your round off target if aiming at the upwind side of the target. This means your target at 800 meters is 2.2 mph wide for AA11 (175 SMK) ammunition fired at 2,600 fps. You can calculate this for all ranges to build a chart for use in the field.

SHORT WIND FORMULA

In combat, a sniper can use a rule of thumb formula to calculate a wind call if unable to use a ballistic program or printed data card. The short wind formula is based on the efficiency of a particular bullet (G1 ballistic coefficient scale).

Rv (range value) x W (wind speed in mph)

Step 1: Prior to the mission, find your gun number and once the muzzle velocity (known as MV) is determined:

- Turn off spin drift in Environments.
- Adjust 3 o'clock wind that makes the range of 500 meters become a .5 mil wind deflection. Wind speed 1 will be your GUN WIND #.

Gun Wind Bracket
1. Turn off spin drift.
2. Set range to 500 meters.
3. Adjust wind (3 clock).
4. Adjust wind 1 until .5 mil.
5. Wind bracket is ________.

Step 2: Convert the range to a range value.

Range	***Value***
100 meters	.1
200 meters	.2
300 meters	.3
400 meters	.4
500 meters	.5
600 meters	.7
700 meters	.8
800 meters	.9

Example

The gun wind number is 4. There is an 8-mph crosswind from left to right. Divide 8 by 4 and this would give us 2.

Next, take the range value and multiply it by 2. So, if we were at 500 meters for range, we would take .5 (for 500 meters) x 2 = 1.
Hold LEFT 1 mil to engage the target.

If wind is just short of the multiple, round to the closest multiple. An example would be:

> 15 mph would be Rv x 4 (favor strong side) and a 7 mph would be Rv x 2 (favor light side).

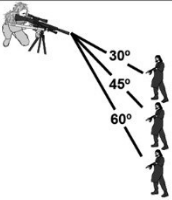
If wind is not full value, apply cosine.

Wind Direction (Clock / Degrees)	***Cosine Value***
12:00/0 degrees	0
12:30/15 degrees	0.25
1:00/30 degrees	0.5
1:30/45 degrees	0.7
2:00/60 degrees	0.85
2:30/75 degrees	0.95
3:00/90 degrees	1.0

ANGLE FIRE

The sniper must account for the change in the strike of the round from a horizontal trajectory.

QUICK HIGH ANGLE FORMULA

	DOWN ANGLE	MOA ADJUSTMENT/ 100 METERS	MIL ADJUSTMENT/ 100 METERS
	30°	-1/2 MOA	0.15 mils
	45°	-1 MOA	0.3 mils
	60°	-2 MOA per 100 meters, then add 1 MOA	0.6 mils per 100 meters, then add 0.3 mils

MINUTE OF ANGLE (MOA) EXAMPLE at 500 meters

DEGREES	RANGE HOLD		ANGLE OFFSET (-)		60 DEGREE OFFSET (+)		HIGH ANGLE HOLD
30°	5.5 MOA	-	2.5 MOA	+		=	3 MOA
45°	5.5 MOA	-	5 MOA	+		=	1/2 MOA
60°	5.5 MOA	-	10 MOA	+	1 MOA	=	-3 1/2 MOA

MILLIRADIANS (MILS) EXAMPLE at 500 meters

DEGREES	RANGE HOLD		ANGLE OFFSET (-)		60 DEGREE OFFSET (+)		HIGH ANGLE HOLD
30°	1.6 mils	-	0.75 mils			=	+0.85 mils
45°	1.6 mils	-	1.5 mils			=	+0.1 mils
60°	1.6 mils	-	3 mils	+	0.3 mils	=	-1.1 mils

60° Rule of Thumb is Range Hold -2 MOA / 0.6 mil + High Angle Hold

ANGLE FIRE (CONTINUED)

Cosine Formula

actual range x cosine = flat ground distance (BDC setting)

The actual range can be determined by a laser rangefinder, mil relation formula, or any other means available. Once the actual range is determined, multiply by the cosine. The solution will provide the flat ground distance (bullet drop compensator [known as BDC] setting). (See next page.)

Compensation Factors for Angle Fire			
Angle	***Cosine***	***Angle***	***Cosine***
1,8	0.99	43	0.73
9,11	0.98	44	0.72
12,14	0.97	45	0.7
15,16	0.96	46	0.69
17,18	0.95	47	0.68
19,20	0.94	48	0.67
21,22	0.93	49	0.65
23	0.92	50	0.64
24,25	0.91	52	0.6
26,27	0.89	55	0.57
28	0.88	57.5	0.53
29	0.87	60	0.5
30,31	0.86	62.5	0.46
32,33	0.84	65	0.42
34,35	0.82	67.5	0.38
36,37	0.8	70	0.34
38,40	0.78	72.5	0.3
41	0.75	75	0.26
42	0.75	77.5	0.215

RAPID TARGET ENGAGEMENT

Rapid target engagement techniques provide the sniper with the ability to effectively and quickly engage targets in an environment where the sniper team does not have the time to conduct standard range estimation procedures. The 12-inch drill is used to flash mil a target from the top of the head to the top of their shoulders. The 20□inch drill is used to flash mil the width of a human.

Milliradian (MIL) Read	***Range (Meters)***	***MIL Hold***
.8	381	2
.7	435	3
.6	508	4
.5	610	5
M110 rifle number is 10		
.8	381	1
.7	435	2
.6	508	3
.5	610	4
M2010 rifle number is 9		

12-Inch Drill

Example

Flash mil a target from the top of the head to the top of the shoulders (12 inches) at .7 mil. Your gun number is 10 (M110). Mil and make 10.

7 + 3 = 10

Hold 3 mils to engage target with M110

RAPID TARGET ENGAGEMENT (CONTINUED)

20-Inch Drill

Milliradian (mil) Read	*Range (meters)*
.9	564
1	508
1.1	462
1.2	423
1.3	391
1.4	363
1.5	339

For M110, Divide mil read by 2 and make 9.

For M2010 Divide mil read by 2 and make 8.

Example

Flash mil the target (20 inches in width) and get 1.2 mils. Make mil read a whole number and divide by two. Now make 9.

12/2 = 6 + 3 = 9

Hold 3 mils to engage target with M110.

MAX POINT BLANK ZERO

Maximum [Max] Point Blank Zero (known as MPBZ) The zero range which allows the sniper to use a single POA at a known size target. The trajectory of the round hits the target at all ranges from the muzzle to where it drops below the target base.

Maximum [Max] Point Blank Range (known as PBR)
The distance to where the round misses at the base of target.

To calculate MPBZ, Select the GUN profile you want to calculate, using your ballistic program.

Example

M110
Muzzle Velocity 2600 FPS
BC: 0.243 (G7)
Bullet Weight: 175 grains
Bullet Diameter: 0.308 inches
Bore Height: 2.70 inches
Target Height is 30.00 inches

Step 1. Change Zero until maximum ordinate (max ordinate) is as close as possible to 15 inches. Remember, max ordinate needs to be half the target size above the LOS. Access Max Ordinate in the Ballistic menu on the ballistic program.

Find the closest zero to within 1 meter with a max ordinate not exceeding 15 inches. For our example, 371 meters, 13.21 inches above LOS.

U

Close Zero: 19 meters
Far Zero: 371 meters
Hold for Far Zero (100 meter zero): 2.2 Mil

Therefore, the MPBZ for a 30.75 inch target is 19 meters/371 meters.

Step 2. Find the distance where the round will drop at the base of the target when aiming center of visible mass (CoVM). This will be the MPBR.

Use Far Zero range and find the DROP. Change unit to inches. Scroll target range until 15.0 U inches is displayed and record MPBR range. For our example, the MPBR is 443 meters.

Step 3. Create a GO/NO-GO range using the target size and mil formula.

Target size in inches x 25.4/range

30 x 25.4/443 = 1.72

Anything milled over 1.72 (vertical) for a 30-inch target, can be engaged with MPBZ dialed on.

Point Blank Zero and Danger Space Card

The point blank zero and danger space card is used to assist the sniper in recording information about their sniper weapon system to maximize the ballistic performance of their weapon when using a single point of aim at a known size target.

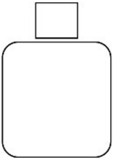
Point blank zero and danger space card

200m Data on Scope		***300m Data on Scope***		***500m Data on Scope***		***Gun Data***	
50m		100m		100m			MV
100		150		200			DM
150		200		300			SP
200		250		400			Temp
250		300		500			Humidity
300		350		600		0	Lat
350		400		700		0	Spin Drift

To obtain deviation in inches,
multiply data changes (mils) x range (100s) x 3.937

Point blank zero and danger space card (cont)

Range	*Hold*	*Mil Variance*	*Inches above LOS*
100m			
200			
300			
400			
500			
600			
700			
Max O			



Hold at base of target

Legend: DM—drag model; lat—latitude; LOS—line of sight; m—meter; Max O—maximum ordinatemil—milliradians; MV—muzzle velocity; SP—station pressure; temp--temperature;

Utilizing a LOS hold at the base of the target (example would be 600-meter data dialed), calculate the bullets location (in inches) relative to LOS every 100 meters. Include maximum ordinate (55 percent of the range).

Example: A sniper preparing to overwatch a ground force wants to simplify the task to affect targets out to a specified range with one elevation hold. Simple math can aid in formulating a single firing solution.

Utilizing the ballistic computer, the sniper compiles data. Based on the mission set, 600 meters would be the longest engagement.

The hold for a 600 meter target: 3.55 mils

The hold for 330 meters (max ordinate): 1.16 mils

These two lines of information show precisely where the bullet is at max ordinate.

3.55 - 1.16 = 2.39 mils

To see if the bullet will stay within the height of a 40-inch target out to the sniper's line of sight hold (3.55 mils, holding at base of target)

2.39 x 3.3 x 3.397 = 26.7"

This shows that holding 3.5 mils at the base of the target out to 600 meters, the round will stay inside the height of a 40-inch target out to 600 meters.

OBSERVING THE SHOT

The sniper depends on the observer for information about the target, environmental conditions, and observation of the shot. Communication between the sniper and observer must be concise to be effective.

The observer does the following:

1. Position themselves in line with the sniper's gun-target line.

2. Check power setting on the spotting scope. Magnification should be between 15 to 20x for optimal observation of trace (known as TRCE) and FOV.

3. Check focal plane. Ensure it is focused between you and the target. To check, turn the focus ring clockwise until the target goes clear then fuzzy. This places your focal plane beyond the target. Now turn the focus ring counterclockwise until the target gets clear and then fuzzy. Now you are in the space between you and the target. Fine tune your desired focal plane based on environmental conditions present.

4. Check for winds by looking for mirage and vegetation movement. Mirage will be easy to see on a bright, sunny day, and difficult to see on an overcast or cloudy day.

5. Trace has three components: rising branch, max ordinate, and falling branch. The arc at max ordinate is easiest to see. Trace will be easy to see on a cloudy or overcast day and difficult to see on a bright sunny day. In the RANGE CARD function of the ballistic meter, observers can scroll to TRCE and it will tell you where trace is at max ordinate in reference to LOS. If the observer sees trace at max ordinate higher or lower than it should be and did not see the impact on or around the target, then the observer knows that the shot impacted over or under the target.

6. Follow the trace on its falling branch into the target. Observers must watch the falling branch of trace and not shift focus to the target for target results.

7. Understand that the focal plane used to detect and formulate a wind call may not coincide with the focal plane used to observe the trace. An observer must be familiar with using the spotting scope and quickly manipulating the focal plane.

8. Make subsequent corrections using: “What’s happening now, what your shooter called on their last shot, and what was your last wind call.”

OBSERVER / SHOOTER DIALOGUE

Observer: Use one of the following methods to indicate the target to the shooter: direct method, reference point method, clock ray method, or a pre-made range card.

FROM BUILDING 4, GO 9 O’CLOCK 10 MILS. ONE MILITARY-AGED MALE, RED SHIRT, BLUE JEANS.

Shooter: Identify one or two distinguishing features at or near the target and relay this information to the observer as a verification that you are looking at the same target as the observer.

ONE MILITARY-AGED MALE, RED SHIRT, BLUE JEANS, STANDING NEXT TO WHITE HILUX TRUCK.

Observer: Once target is confirmed by shooter, tell the shooter to check parallax and mil the target. If using a weapon-mounted laser range finder, you will say: dump dope and laSe. While the shooter is milling or lasing the target, you begin to mil off target height/width to assist in determining range to target.

CHECK PARALLAX AND MIL or DUMP DOPE AND LASE.

Shooter: Mil the height and width of the target. The mil height will give you a more accurate range (it is twice the dimension of the width). Promptly relay mil read to observer.

HEIGHT, 2.0 MILS.

Observer: Once mil is received, immediately develop a firing solution.

Shooter: Begin the pre-shot stage of the shot process: check position, natural POA, sight alignment/picture (parallax), and hold determination. Also ensure a round is loaded into the chamber.

Observer: Relay elevation hold to shooter. (Only apply spin drift if target is 800 meters or greater.)

UP 6.2 MIL. “

Shooter: Repeat observers’ instruction as you hear them. This eliminates confusion and confirms the communication. When you say ready, it means that you have accomplished everything that the observer has directed you to do and your elevation hold is centered in the target.

UP 6.2 MIL, READY.

Observer: Relay a wind call by direction first, then correction.

LEFT 0.5 MIL.

Shooter: Begin the shot phase of the shot process: refine aim (wind call), control your breathing, and begin to break the shot with proper trigger control. Immediately go into the post-shot process: follow-through, recoil management, call your shot, and evaluate and place another round in your chamber.

LEFT 0.5 MIL.

Observer: if your shooter misses the target, you must immediately relay a correction for a follow-on shot based on the trace you see and your shooter’s call.

Knowing the mil height and width of the target allows the observer to easily compensate for a second round hit. For a high or low miss, use up to the full mil height of the target as an elevation correction.

Example: The first shot went through the legs of a 1.3 mil target. The hold was 6.2 mil.

Observer: UP 7.2 MIL.

Shooter: UP 7.2 MIL, READY.

Observer: RELAY A PROMPT WIND CALL: LEFT 0.5 MIL.

Shooter: CONDUCT SHOT PROCESS, CALL YOUR SHOT: LEFT 0.5 MIL.

Knowing the mil width of the target allows the observer to easily compensate for a second round hit. For windage miss, use up to the full mil width of the target as a windage correction.

Observer: UP 6.2 MIL.

Shooter: UP 6.2 MIL, READY.

Example: Observer called 0.5 MIL left for the first shot (target width .65 mil) and missed just off the right side of the target. Add up to, but not over the target mil width to get your wind call.

Observer: LEFT 1.0 MIL.

Shooter: CONDUCT SHOT PROCESS, CALL YOUR SHOT: LEFT 1.0 MIL.

WEAPON MOUNTED LASER RANGE FINDER

The sniper can use a weapon mounted laser range finder to augment the sniper weapon system's effectiveness during the direct fire engagement process.

Both the infrared (IR) and visible aiming lasers of the small tactical optical rifle mounted laser rangefinder (known as STORM) must be collimated to the day optical scope (DOS) to range accurately when pointing with the DOS. Once the DOS has been zeroed to the weapon at 100 meters, do the following at the same range for close alignment:

Measure center of scope to visible laser in inches, convert to mils, and adjust visible laser on target to match offset measured. Visible laser should be within .1 to .3 mils of distant aimpoint.

Example

1.5 inch/3.9 = .4 mil right
2.25 inches/3.9 = .6 mil down

For fine adjustment at long range (800 to 1,000 meters), the sniper will place a reflective target (such as a license plate) at 800 to 1,000 meters, and adjust visible and IR aiming laser on to reflective target for exact alignment.

Always return the DOS to the initial collimation range. If the initial collimation/offset range was 100 meters, always place the DOS at 100 meters for ranging.

You cannot collimate the STORM lasers to a 100-meter DOS zero and change the elevation or windage turret of the DOS, and then lase for range. In this case, all lasing must occur at the 100-meter DOS setting.

When ranging a target, the sniper must make sure the weapon is as steady as possible to ensure that the maximum amount of the laser energy is focused on the target.

TM 9-5855-1913-13&P		
DIMENSIONS		
LENGTH	7.3 in	18.5 cm
WIDTH	3.5 in	9.0 cm
HEIGHT	1.9 in	4.8 cm
WEIGHT	20.8 oz	590 g

POWER	
BATTERY LIFE	>5.5 hours in IR DUAL HIGH mode
POWER SOURCE	2 each DL-123A, 3 volt

MODE OF OPERATION		
POSITION	**MODE**	**REMARKS**
VH	VIS HIGH	Aiming or marking in daylight/indoor
AH	AIM HIGH	IR operates on high power
IH	ILLUM HIGH	IR Illum operates on high power
DH	DUAL HIGH	IR/Illum both operate on high power
BUTTON	**MODE**	**REMARKS**
L	Laser activate	Activates aiming laser
R	Range/Compass	Press/Hold 3 seconds to enter menu power

LASER	DIVERGENCE	WAVELENGTH
IR BEAM	0.5 mil	820-850 nm
IR ILLUMINATOR	1.0 to 100 mil	820-850 nm
VISIBLE AIM, RED	0.5 mil	605-665 nm
LASER RANGE FINDER	1.0 mil	1570 nm

LEGEND					
cm	centimeters	IR	infrared	nm	nanometers
g	grams	L	laser	oz	ounces
in	inches	mil	milliradians	R	range

DETECTION

All direct fire engagements are enabled by the sniper's detection skills. These skills are built upon four core fundamentals described below:

- Scan and search. A rapid sequence of various techniques to identify potential threats.
- Scanning skills. These skills determine potential areas where threats are most likely to appear.
- Acquire. A refinement of the initial scan and search based on irregularities in the environment.
- Locate. The ability to determine the general location to include range to a threat to engage with precision and accuracy.

Detection Challenges

Examples of detection challenges are:

- Peripheral targets (targets on the edge of the FOV).
- Targets that are camouflaged, masked, or appear innocuous.
- Mirage effects caused by high temperatures and heat waves near the ground.
- Small single targets (such as, lone dismount threats).
- Small targets in complex detection environments (urban or jungle).
- Natural and man-made obscurants or surroundings.
- Behavioral or physical deficiencies of the observer (fatigue).

Detection Best Practices

Snipers should be familiar with the following best practices to increase target detection:

- Scan with the unaided eye first, then with magnified optic (escalation of observation).
- Understand the capabilities and limitations of image intensifiers and thermal.
- Apply collective search techniques. Assign sectors amongst team.
- Shield eyes from blinding effects of the sun.

Standard Deviation: If you had a standard deviation (known as SD) of 10 fps for your muzzle velocity, that means 68 percent of your bullets would exit the muzzle within 10 fps of the average velocity. That is + or – 10 fps, so if your average muzzle velocity was 3,000 fps, then you could expect 68 percent of your shots to be between 2,990 and 3,010 fps.

Note: The extreme spread of the above muzzle velocities would be 20 fps because it is always + or – the SD number.

We also know 95 percent of your shots will be within 2 SDs of your average.
That is 2 × 10 fps = 20 fps and + or – that amount. With an SD of 10 fps and an average of 3,000 fps, you could expect 95 percent of your shots to have a muzzle velocity between 2,980 and 3,020 fps. That means you'd have an extreme spread of 40 fps for 95 percent of your shots. Remember, 5 percent of your shots would still fall outside of that range, meaning they'd be below 2,980 fps or above 3,020 fps.

Three Hour Station Pressure Trend: The sniper can use the ballistic meter to monitor changes in air pressure. A change in air pressure leads to a change in wind speeds.

Air Pressure Measurements and Actions

Three-Hour Pressure Decrease	***Altimeter Increase***	***Recommended Acton***
.02 to .04 inches .6 to 1/2 milibars	20 to 40 feet 6 to 12 meters	None, except to continue normal monitoring.
,04 to .06 inches 1.2 to 1.8 millibars	40 to 60 feet 12 to 18 meters	Watch sky carefully for thickening clouds. See if wind is increasing, shifting to east or southeast.
.06 to .08 inches 1.8 to 2.4 millibars	60 to 80 feet 18 to 24 meters	Possible high winds.
,08 inches or more 2.4 millibars or more	80 feet or more	High winds approaching. Reassess position and engagement.

Data Card

The consolidated data card worksheet is used to assist the sniper team in noting pertinent information about their respected sniper weapon system. (See next pgae.)

Data card worksheet

DATA CARD				
WPN StnD		**68 percent (%) shots within ±1**	**95% shots within ±2**	**99.7% shots within ±3 SD**
_____ FPS		______ and _______fps	_____an d	_______ and _______fps
Note: The extreme spread of muzzle velocities would be + or – the SD number				
Legend: diff—difference; fps – feet per second, MV—muzzle velocity; SD – standard deviation, WPN StnD – weapon standard				
Range (meter)	**Predicted (milliradians)**	**Diff ±3SD**	**Actual**	**Gun Data**
m	mil	mil	mil	MV:
m	mil	mil	mil	DM:
m	mil	mil	mil	ZR:
m	mil	mil	mil	GRP SZ:
m	mil	mil	mil	**ENVIRONMENT**
m	mil	mil	mil	TEMP:
m	mil	mil	mil	SP:
m	mil	mil	mil	RH:
m	mil	mil	mil	LAT:
m	mil	mil	mil	**3 HR SP**
m	mil	mil	mil	inHg:
m	mil	mil	mil	St: Stp:
m	mil	mil	mil	Diff: inHg

The second part of the consolidated data card is used to assist the sniper in assessing the effects of wind on a standard size target.

Data card worksheet (cont)

____SMK at ____º F / ______ InHg / MV =______ fps		**Targets**	
Range to Target (meters)	1 mph effect of wind (in mils)	18 Inch Target width (mils)	Target width (mph)
100	mils	4.57	mph
200	mils	2.29	mph
300	mils	1.52	mph
400	mils	1.14	mph
500	mils	0.91	mph
600	mils	0.76	mph
700	mils	0.65	mph
800	mils	0.57	mph
900	mils	0.50	mph
1,000	mils	0.46	mph
1,100	mils	0.41	mph
1,200	mils	0.38	mph
Note: Turn Spin Drift to OFF / LAT to 0			
TGT Mil read (width) / 1 MPH wind value (mil) = TGT width in mph			
Legend: diff – difference, DM – drag model, F – Fahrenheit, fps – feet per second, GRP SZ—group size, InHg – inch of mercury, HR – hour, LAT – lattitude, mil – milliradians, mph – miles per hour, MV – muzzle velocity, RH – relative humidity, SP – station pressure, Stp – station pressure trend,TEMP – temperature,TGT – target, ZR **--**ZERO			

Simplified Wind Cosine Chart

Wind Direction (Clock / Degrees)	Cosine Value
12:00/0 degrees	0
12:30/15 degrees	0.25
1:00/30 degrees	0.5
1:30/45 degrees	0.7
2:00/60 degrees	0.85
2:30/75 degrees	0.95
3:00/90 degrees	1.0

NOTES:

FORMULA QUICK SHEET

UNIT OF MEASUREMENTS
MIL x 3.438 = MOA
MOA/3.438 = MIL
METERS/.9144 = YARDS
YARDS X .9144 = METERS
1 MOA = 1 INCH EVERY 100 METERS (field use)
1 MIL = 4 INCHES EVERY 100 METERS (field use)
1 MOA = 0.3 MIL (field use)
RANGE AND TARGET SIZE ESTIMATION
SOT (in inches) x 25.4 / MIL READ = RANGE (in meters)
R (in meters) x SOT (mils) / 25.4 = SOT (inches)
SOT (inches) x 25.4 / RANGE (in meters) = SOT (in mils)
MOVERS
TGT SPEED IN MIL (1sec) x TOF = MIL HOLD
MILS/SECONDS = MILS PER SECOND
MILS PER SECOND x TOF = MIL HOLD
WIND
TGT MIL READ IN WIDTH/1 MPH WIND IN MIL = TGT WIDTH IN MPH
Rv x W = MIL HOLD
([RANGE METERS X .001] X MILS PER SEC) X 2.237 = SPEED MPH
TRAJECTORY
HOLD FOR TGT – HOLD FOR ½ TGT DISTANCE + 10% = MAX ORD
CLEARANCE REQUIRED = TGT MIL HOLD – OBSTACLE MIL HOLD
115 – ANGLE = COSINE
1061 FPS + TEMP (F) = MACH 1 (SUBSONIC)
MACH 1 x 1.2 = MACH 1.2 (TRANSONIC)
Legend: F – Fahrenheit, fps – feet per second, % - percent, MACH – Mach number, MAX – maximum, MAX ORD – maximum ordinate, MIL – milliradians, mph – miles per hour, MOA – minute of angle, R - range, Rv – range value, sec – second, SOT – size of target, TEMP – temperature, TGT – target, TOF – time of flight, W - wind

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SNIPER QUICK REFERENCE

Ref: TC 3-22.10, Sniper

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