MOD 1 (ZERO THEORY)

Rev 04 FEB 2025
SGT (CA) NYDEN
18th CAV SPT DET, CSG

Table of Contents

Table I, Preliminary Marksmanship Instruction and Evaluation
"Crawl" phase
Instruction to correctly learn Army small arms doctrine.
Gate: Quiz for a Check on Learning

Table II, Preliminary Live-Fire Simulations
Hands-on application of skills
Old School: Shadow Box, Dime/Washer
New School: LMTS, EST, laser simulators, MantisX, SCATT, Noptel, VR
Live Fire can be used as a Table II Preliminary exercise

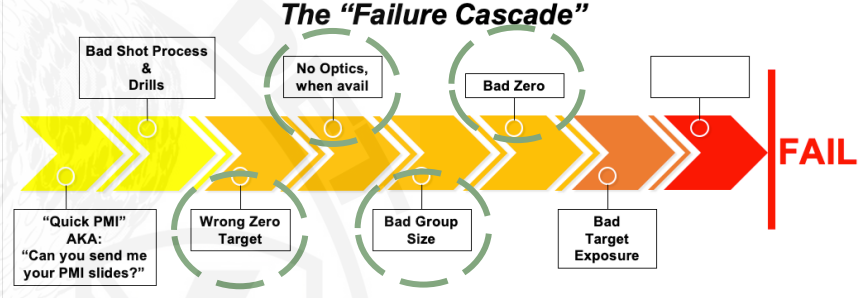
Table III, Drills
Appendix D in Training Circular
Hands-on application of small arms skills that aren't pure shooting.
Get into/out of position, reloading, malfunction clearance, etc.

Table IV, Basic Live Fire
Grouping and Zeroing
By TC 3-20.40, this should be completed with five five-round groups
Table II is where practice and remedial should be done

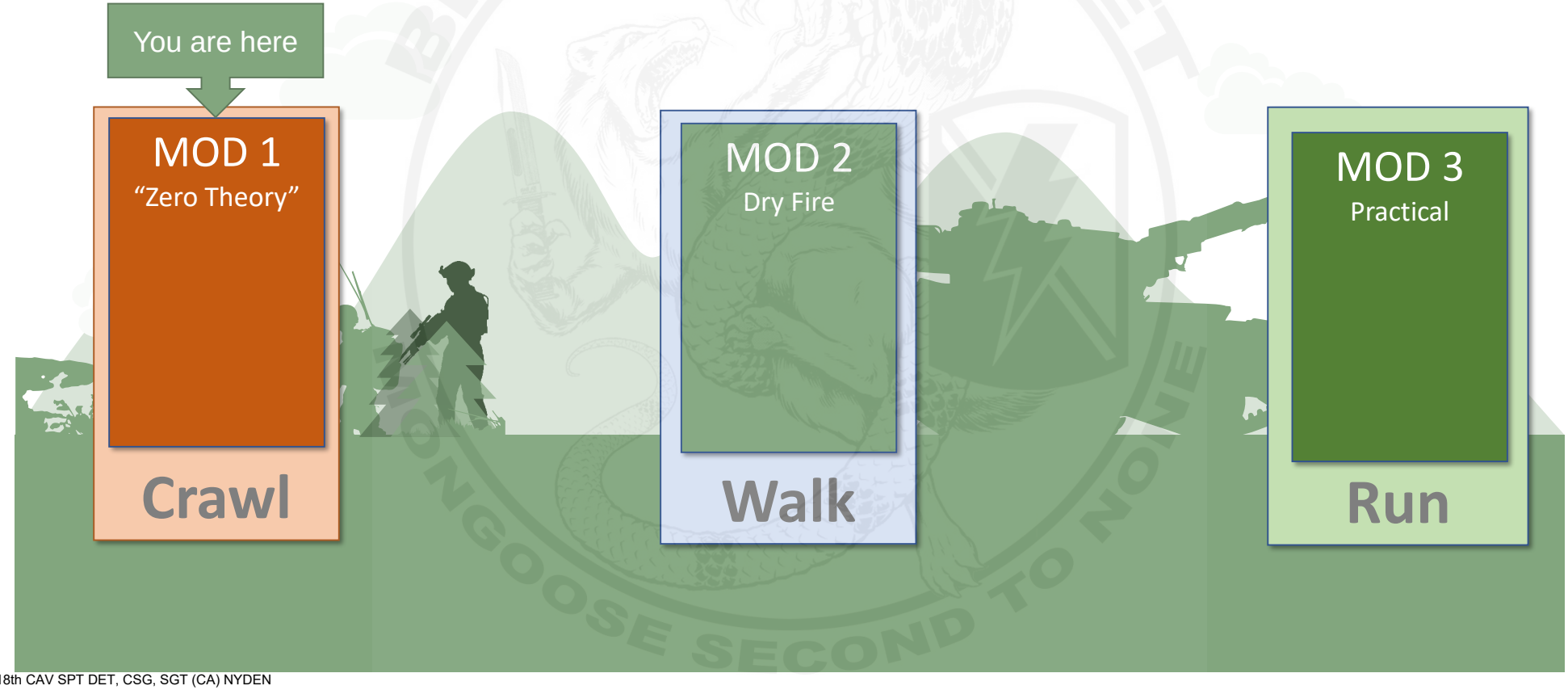
Table V, Practice
Practice is a live fire course reinforcing skills with an increased tempo.
Table V should be as or more difficult than the qualification course

Table VI, Qualification
Only ONE attempt on a qualification for record is allowed
Soldiers and units may shoot as many exercises and Validation courses prior as they like.
Validation/practice can include a full run on the qualification
Gate: Pass qualification with a first-time Go

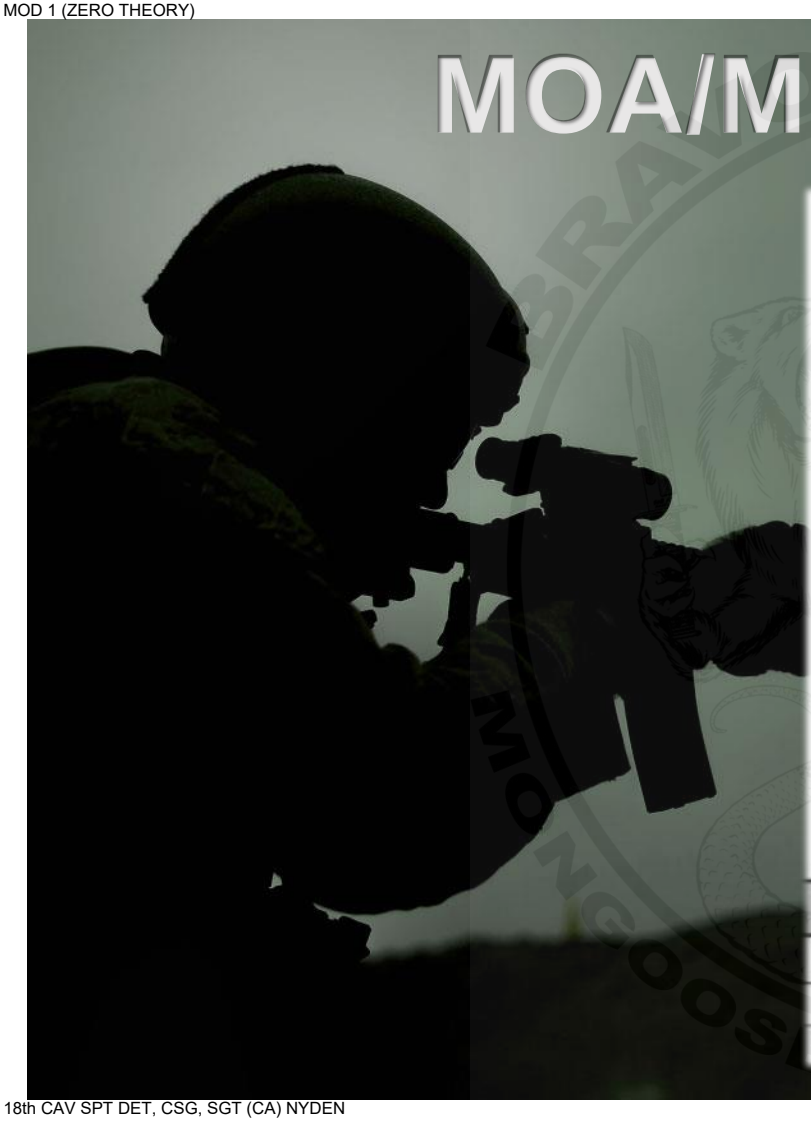
IWQ & Training: Why we Fail and How to Succeed
Problem: Tolerance Stacking



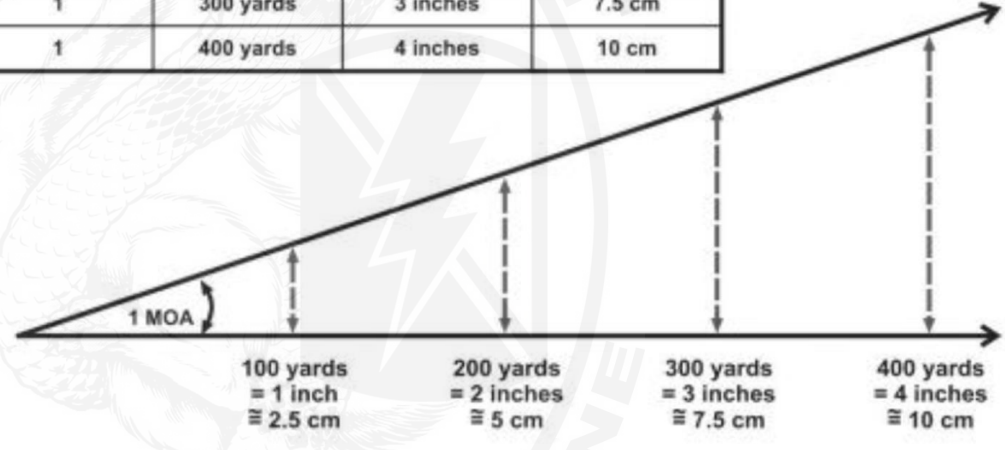
Understanding the Individual Weapons Training Strategy



MOA/Minute of Angle



MOA	At Distance	Equals	
1	100 yards	1 inch	2.5 cm
1	200 yards	2 inches	5 cm
1	300 yards	3 inches	7.5 cm
1	400 yards	4 inches	10 cm

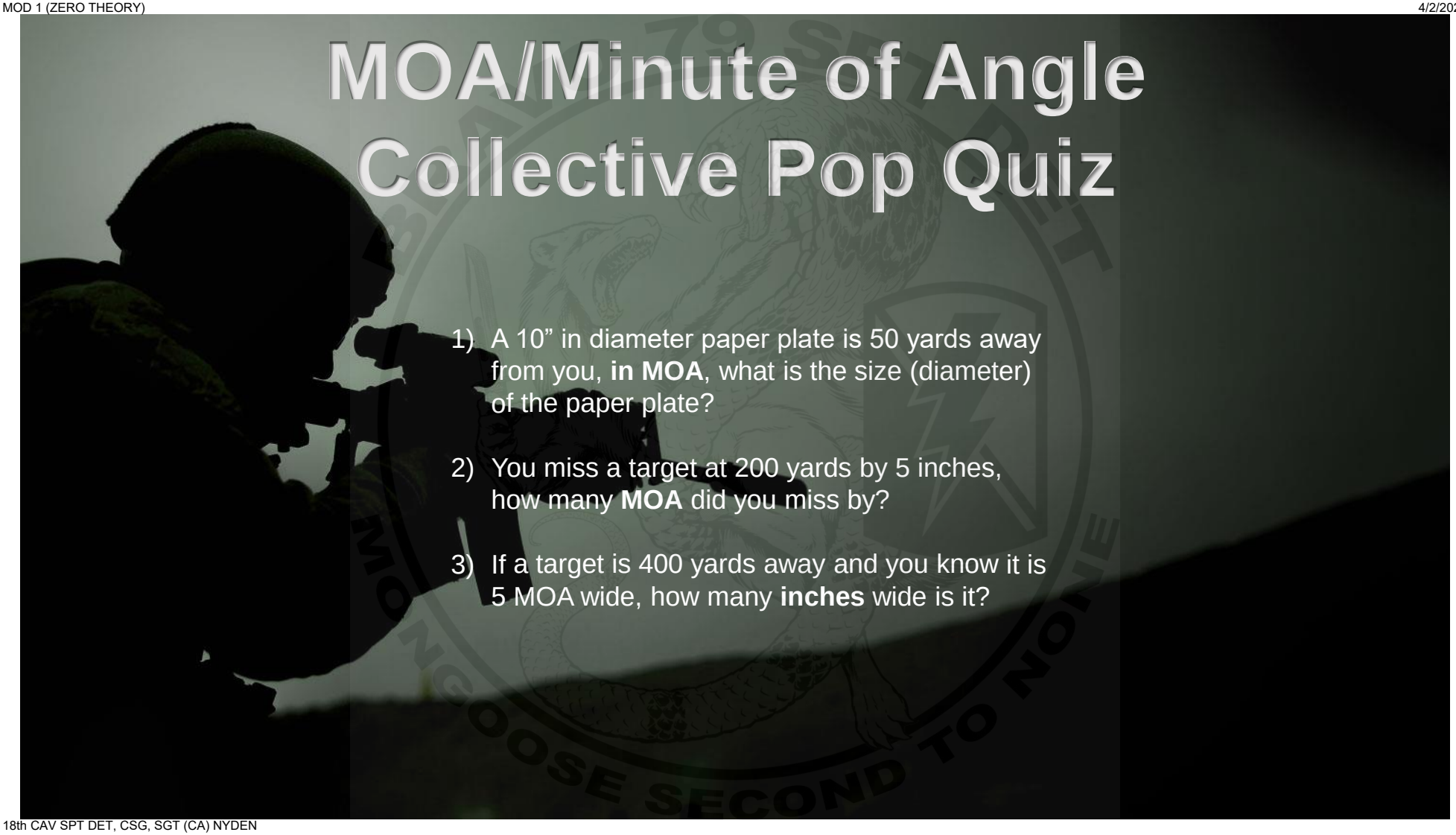


Angle dimension exaggerated for clarity. Examples are not to scale. Centimeter (cm) conversions are approximate.

MINUTE OF ANGLE (MOA) Unit of Measeurement

There are 360 degrees in a circle.	There are 60 MOA in a degree.
There are 21,600 MOA in a circle.	1 MOA at 100 yards ≈ 1 inch.

Smaller measurements of an MOA are described in fractions, not seconds (i.e., 1/2 MOA).

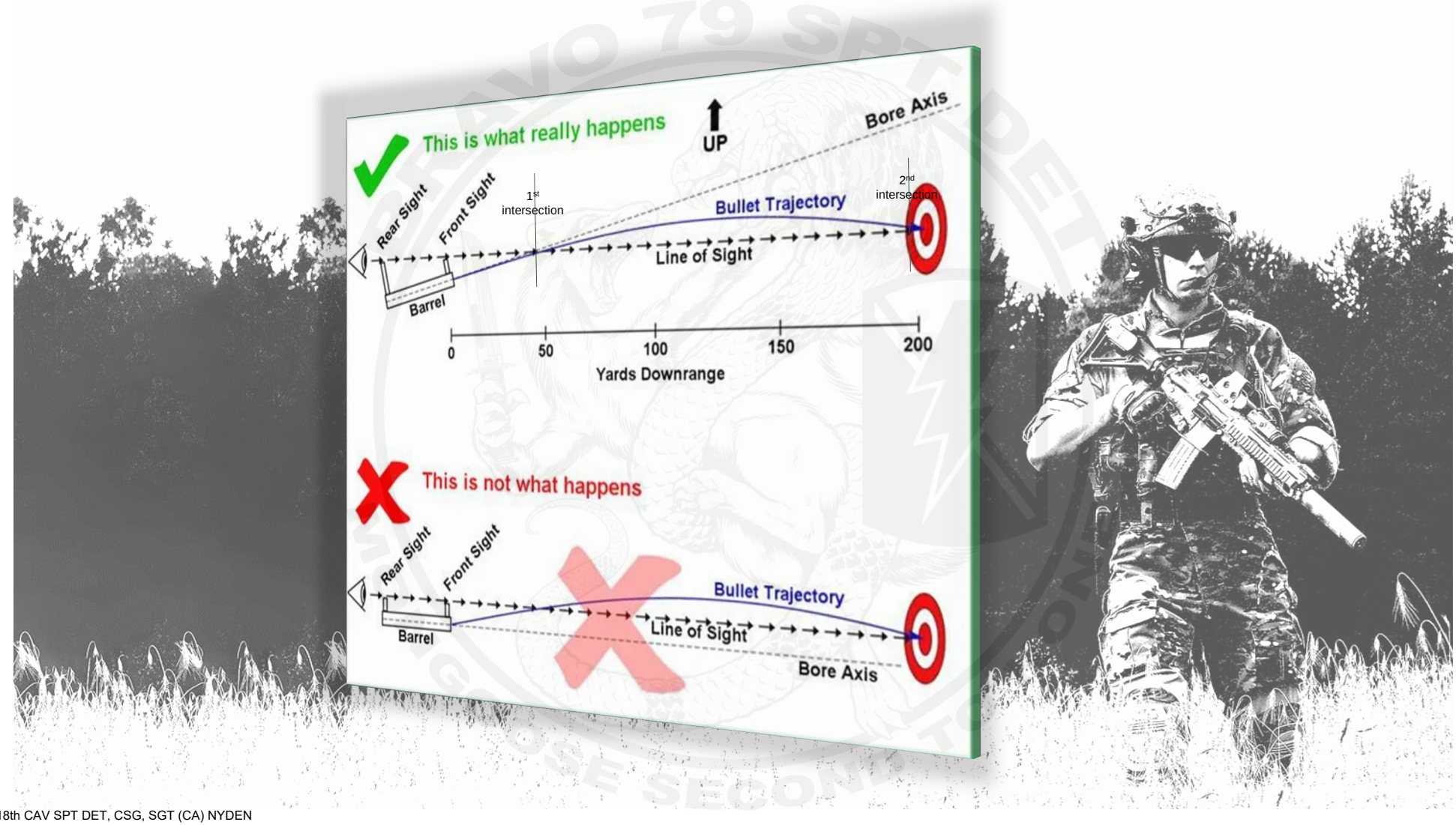


MOA/Minute of Angle Collective Pop Quiz

1) A 10” in diameter paper plate is 50 yards away from you, **in MOA**, what is the size (diameter) of the paper plate?

2) You miss a target at 200 yards by 5 inches, how many **MOA** did you miss by?

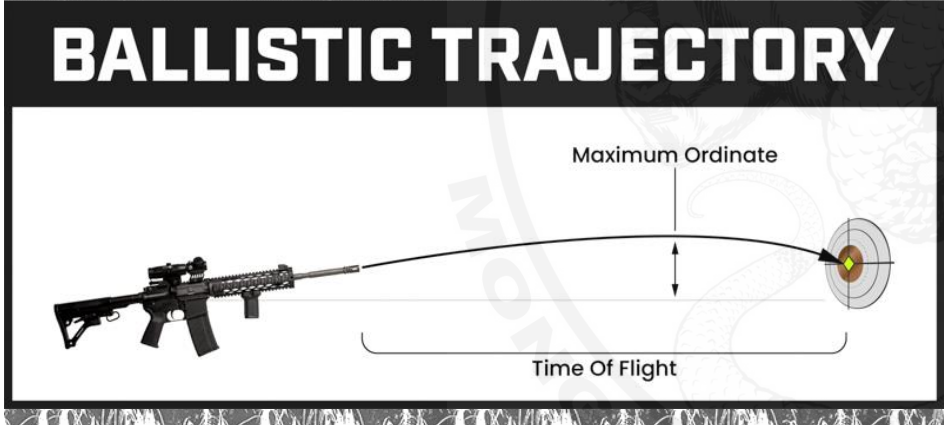
3) If a target is 400 yards away and you know it is 5 MOA wide, how many **inches** wide is it?


This is what really happens
UP
Bore Axis
Rear Sight
Front Sight
1st intersection
2nd intersection
Bullet Trajectory
Line of Sight
Barrel
0
50
100
150
200
Yards Downrange
This is not what happens
Rear Sight
Front Sight
Bullet Trajectory
Line of Sight
Barrel
Bore Axis

Factors affecting bullet flight:

- **Velocity**
- **Ballistic coefficient** (bullet shape and design)
- Barrel harmonics and twist rate
- **Gravity**
- **Wind**
- Air resistance and Drag (see BC)
- Temperature, air density/barometric pressure, humidity
- "Coriolis effect" (earth rotation)
- Earth surface curvature
- Shooting angle

Mastering External Ballistics for Precision Shooting



Maximum Ordinate: This represents the peak of the bullet's curved trajectory—the highest point the bullet reaches above the line of sight. When a bullet is fired, it first rises above the line of sight, achieves the maximum ordinate, and then starts descending towards the target.

Optics & Reticles

Reticle: A series of fine lines or dot(s) in the eyepiece used for aiming at varying distances and measuring for range estimation. Can be MOA or mils.

Backup Iron Sight (BUIS)

Backup Iron Site (BUIS)

3-22. The BUIS is a semi-permanent flip-up sight equipped with a rail-grabbing base. The BUIS provides a backup capability effective out to 600 meters and can be installed on M16A4 rifles and M4-series carbines. (See figure 3-7.)

3-23. The BUIS on the first notch of the integrated rail, nearest to the charging handle. The BUIS remains on the modular weapon system (MWS) unless the carrying handle/sight is installed. The following information is extracted from the weapon's technical manual.

For M4
Zero Elevation – 300 m setting
Zero Windage – White Line

**If your rear sight has two apertures, use the smaller one for zeroing*

FUNCTION	RIFLE	ADJUSTMENTS
ZERO WINDAGE	M16A2	Center rear sight aperture for mechanical zero windage
	M16A4	
	M4	
	M4A1	
ZERO ELEVATION	M16A2	300 meter mark +1 click up for 25 m zeroing Once zeroing is complete, rotate elevation knob -1 click down to apply 300 m zero
	M16A4	
	M4	
	M4A1	
WINDAGE	M16A2	1/2 MOA
	M16A4	1/2 MOA
	M4	1 MOA
	M4A1	1 MOA
ELEVATION (RANGE) FRONT SIGHT POST	M16A2	1 1/2 MOA
	M16A4	1 1/2 MOA
	M4	1 7/8 MOA
	M4A1	1 7/8 MOA

Targets wider than the front sight post are typically closer than 300m

Targets that are covered by the front sight post are typically further than 300m

M68 CCO

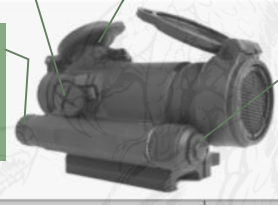
- 2 MOA dot (older versions 4 MOA dot)
- Clicks: 0.5 MOA
- Use both eyes open
- Can be used with front cap on (occluded eye aiming)
- Aimpoint (Sweden) first made in 1975

Windage turret

Elevation turret

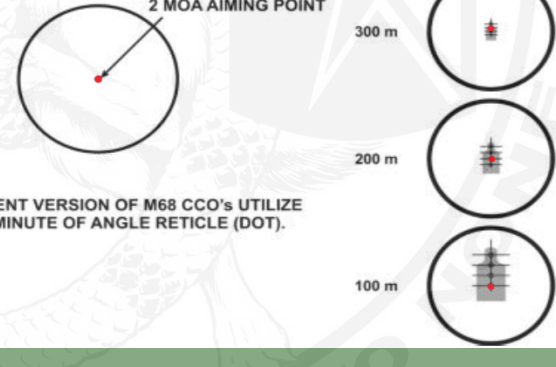
Battery Size AA

Brightness control

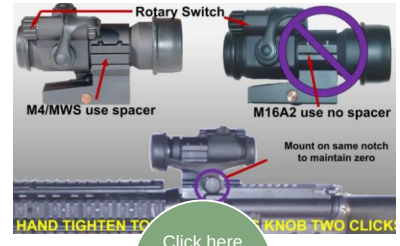


TM 9-1240-413-13&P		
DIMENSIONS		
LENGTH	4.0 in	10 cm
WIDTH	2.3 in	5.8 cm
HEIGHT	2.7 in	6.8 cm
WEIGHT	15.0 oz	425 g

FUNCTION	SINGLE CLICK
ZERO WINDAGE	0.5 MOA
ZERO ELEVATION	0.5 MOA
WINDAGE	0.5 MOA
ELEVATION (RANGE)	0.5 MOA
RETICLE	



CURRENT VERSION OF M68 CCO's UTILIZE A 2 MINUTE OF ANGLE RETICLE (DOT).



Click here for mounting procedures

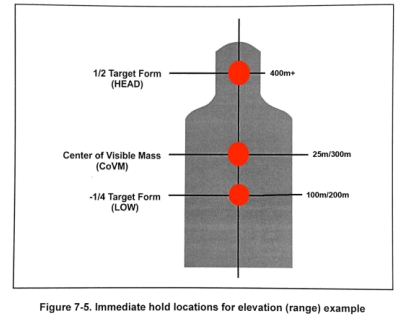
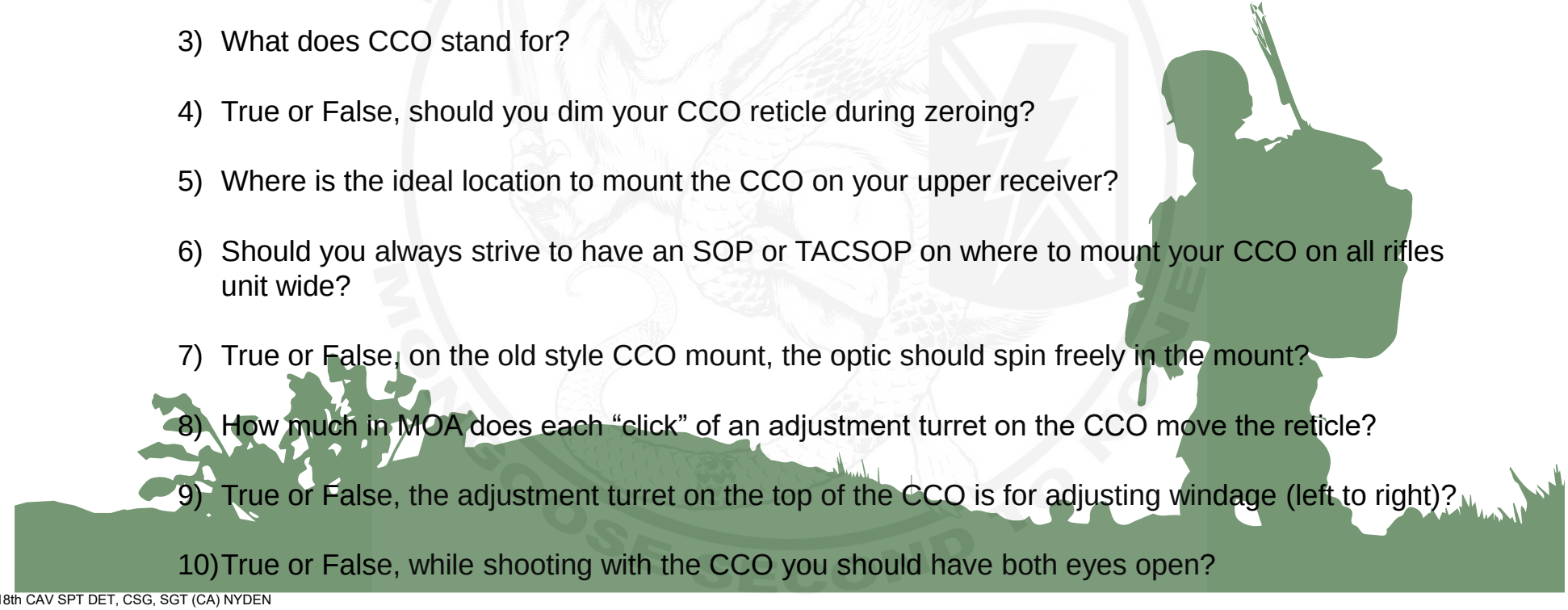


Figure 7-5. Immediate hold locations for elevation (range) example

CCO Collective Pop Quiz

1) What battery does the current model CCO take?
2) What size in MOA is the reticle on the CCO?
3) What does CCO stand for?
4) True or False, should you dim your CCO reticle during zeroing?
5) Where is the ideal location to mount the CCO on your upper receiver?
6) Should you always strive to have an SOP or TACSOP on where to mount your CCO on all rifles unit wide?
7) True or False, on the old style CCO mount, the optic should spin freely in the mount?
8) How much in MOA does each “click” of an adjustment turret on the CCO move the reticle?
9) True or False, the adjustment turret on the top of the CCO is for adjusting windage (left to right)?
10) True or False, while shooting with the CCO you should have both eyes open?



Aiming Devices

Rifle Combat Optic

- ACOG (Advanced Combat Optical Gunsight
- 6 MOA chevron (TA31)
- Fiber optic increases reticle illumination in bright light (cover with tape as needed)
- Tritium illuminates in dark
- Other reticles exist
- Trijicon (Michigan/Sweden) first made in 1981

Windage turret

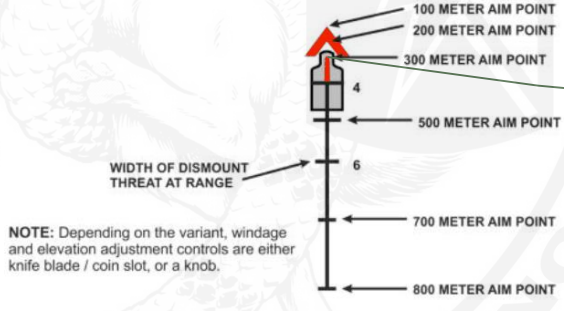
Elevation turret

Fiber optic

Click here for mounting procedures

TM 9-1240-416-13&P		
DIMENSIONS		
LENGTH	4.0 in	10 cm
WIDTH	2.3 in	5.8 cm
HEIGHT	2.7 in	6.8 cm
WEIGHT	15.0 oz	425 g

FUNCTION	SINGLE CLICK	
	BLADE / COIN SLOT	KNOB
ZERO WINDAGE	1/3 MOA	1/2 MOA
ZERO ELEVATION	1/3 MOA	1/2 MOA
WINDAGE	1/3 MOA	1/2 MOA
ELEVATION (RANGE)	1/3 MOA	1/2 MOA
RETICLE		



NOTE: Depending on the variant, windage and elevation adjustment controls are either knife blade / coin slot, or a knob.

If using 25/300 Zero using tip of the line as aiming point

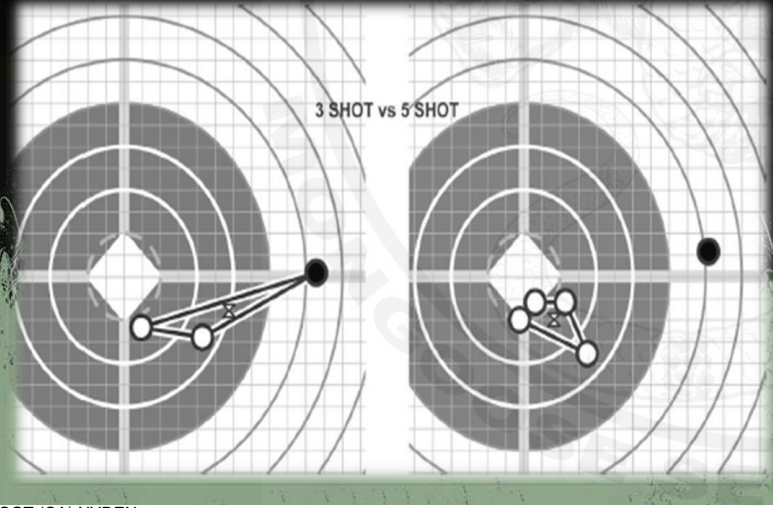
Zeroing Process

- Why do we zero?
  - The zeroing process ensures the Soldier, weapon, aiming device, and ammunition are performing as expected at a specific range to the target with the least amount of induced errors.
- How do we zero?
  - The zero process includes mechanical zero, laser boresight, 25-m grouping and zeroing, and zero confirmation out to 300 meters.
- When is zeroing necessary?
- Tips for zeroing: place targets level with shooter, shoot from ***supported*** prone, take your time, dim your optic reticle! Lubricate all weapons prior to going hot and ensure optics are mounted properly!

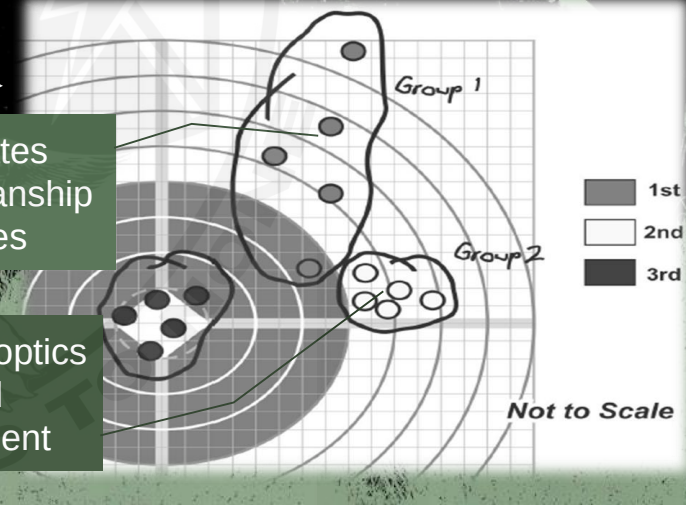
How do we zero?

- The goal of the grouping exercise is for the shooter to fire tight shot groups and consistently place those groups in the same location. Tight, consistently placed shot groups show that the firer is applying proper aiming and smooth trigger control before starting the zeroing process. The firer should not start the zeroing process until they have demonstrated their ability to group well.
- Standard is 8 out of 10 shots are within 4-6 moa sized circle on final zeroing target

Old way →



New way →



Indicates marksmanship issues

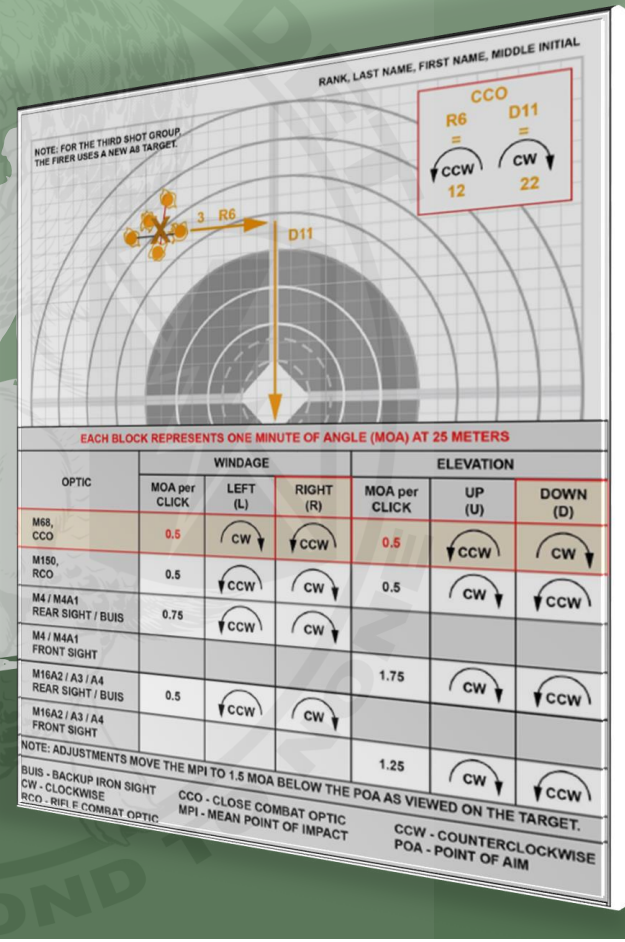
Indicates optics need adjustment

18th CAV SPT DET, CSG, SGT (CA) NYDEN

- Once the firer has shown their ability to accurately group, they should begin adjusting the aiming device to move the groups to the center of the target.
- During the zeroing process, the firer should attempt to center their groups as much as possible.
- Depending on the aiming device used, there may be a zero offset that needs to be used at 25 meters. During the zeroing process it is important that the firer adjusts their groups as close to the offset mark as possible.
- Standard is 8 out of 10 shots are within 4-6 moa circle on final zeroing target.

Zeroing Targets

Using M855A1 Group should be centered around bottom of middle diamond, 1.5MOA from true center



What does a good group and zero look like?

Table IV, Zeroing Standard Template/Example

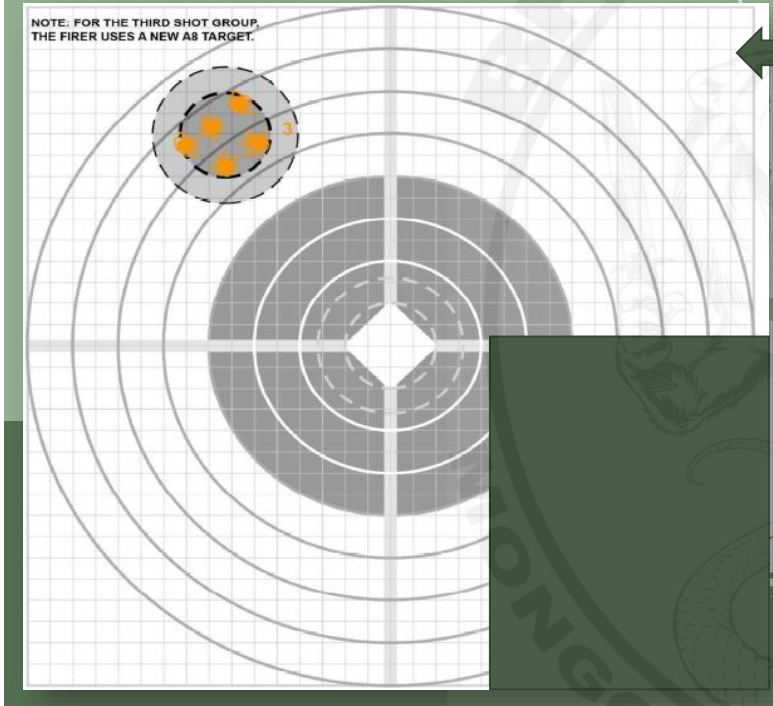
SIGHTING SYSTEM	ELEVATION in MOA	WINDAGE in MOA
CCO	0.5	0.5
M150 RCO/TA-01*	0.5	0.5
M4/M4A1 REAR SIGHT (BUIS)	0	0.75
M4/M4A1 FRONT SIGHT	1.75	0
M16A2/A3/A4 REAR SIGHT (BUIS)	0	0.5
M16A2/A3/A4 FRONT SIGHT	1.25	0

Tools you can use to make zero day easier:

Canebrake 25 meter shot group gauge

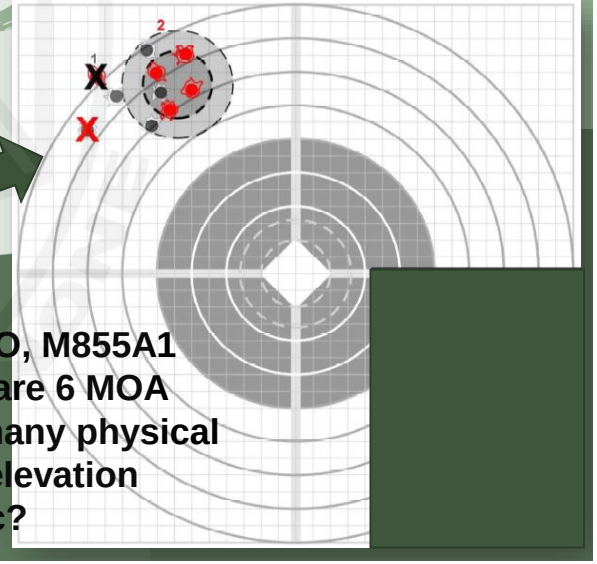
Canebrake 25 meter zero offset tool

Zeroing & Grouping Collective Pop Quiz



Which of the following is TRUE about the this target:

a) Group size is within standard
b) Rifle and optic are zeroed



Given this group, an M4, CCO, M855A1 ammo and the fact that you are 6 MOA left and 13 MOA high, how many physical clicks of both windage and elevation should you adjust your optic?

1. Select all the components of a round of ammo
    a) Primer
    b) Case
    c) Propellant
    d) Bullet

2. True or False, the primer is responsible for igniting the propellant
    a) True b) False

3. Identify the ammo in the following photo

    a) M855
    b) M855A1
    c) M193 ball
    d) M200 blank

4. Approximately how many inches at 100 yards is 1 MOA?
    a) 1”
    b) 0.5”
    c) 2”
    d) 0.25”

5. At 1000 yards, 1 MOA is approximately 8 inches
    a) True
    b) False

6. You shoot a group from 25m that measures 2” in size, what is the size of the group in MOA?
    a) 12 MOA
    b) 6 MOA
    c) 8 MOA
    d) 2 MOA

7. When a bullet initially leaves the barrel, it immediately starts to rise
    a) True b) False

https://forms.office.com/g/GbiBhbgz9S

8. The first intersection in a 300m zero is

a) 50m
b) 36m
c) 100m
d) 25m

9. Max ordinate is the highest peak of a bullets trajectory

a) True b) False

10. The modern CCO takes AAA batteries

a) True b) False

11. The size of the red dot on the CCO is

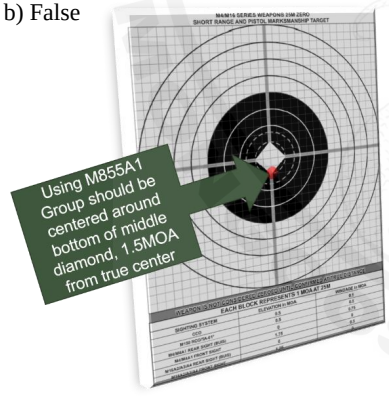
a) 1 MOA
b) 2 MOA
c) 3 MOA
d) 4 MOA

12. You should dim your reticle on your optic when zeroing

a) True b) False

13. Is the following statement in the picture TRUE or FALSE?

a) TRUE b) False



14. True or False, on the old style mount CCO, it should spin freely in it's mounting rings after mounting to the receiver
    a) True b) False

15. What is the ideal position on the upper receiver for the CCO to be mounted?
    a) Front overlapping the barrel/foregrip/handguard
    b) Rear most position
    c) Middle of the receiver
    d) Front most but not overlapping on the barrel/foregrip/handguard section

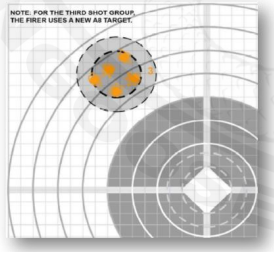
16. What does RCO stand for?
    a) Rebel Counter Optic
    b) Rifle Combat Optic
    c) Really Consistent Optic

17. Which turret is this?

    a) Windage
    b) Elevation
    c) Neither windage or elevation
    d) Both windage and elevation

18. Each click of adjustment on the CCO results in how much of a shift in the reticle?
    a) 0.5 MOA
    b) 1 MOA
    c) 0.25 MOA
    d) 0.1 MOA

19. True or False, this rifle and optic is both grouped to standard ***AND*** zeroed
    a) True b) False



20. Given a CCO and you are 6 MOA left and 13 MOA high, how many clicks of windage and elevation of adjustment is needed?

a) 6 clicks right, 13 clicks down

b) 3 clicks right, 6 clicks down

c) 12 clicks right, 26 clicks down

d) 12 clicks left, 26 clicks up