Preliminary Marksmanship Instruction and Evaluation

Heavy Machine Gun - M2 Series

TC 3-22.50

U.S. Army Reserve Marksmanship Program

www.usar.army.mil/ARM ArmyReserveMarksman.info

Safe Weapons Handling

Rules of Firearms Safety

Standardized for any weapon a Soldier may employ

- Rule 1: Treat every weapon as if it is loaded
- Rule 2: Never point the weapon at anything you do not intend to destroy
- Rule 3: Keep thumb straight and off the trigger until ready to fire
- Rule 4: Ensure positive identification of the target and its surroundings

Safe Weapons Handling

Weapon Safety Status

Standard code using common colors to represent level of readiness. Represents specific series of actions applied.

- Green: Trigger block Safe (if available), bolt latch on single-shot, bolt back, open top cover, remove ammunition, chamber/T-slot empty.
- Amber: Trigger block Safe (if available), single-shot or automatic, ammo in place, bolt forward, chamber empty.
- Red: Trigger block Safe, single or auto, ammo in place, M2 charged twice, bolt forward, round in chamber.
- Black: Red plus block on Fire, thumb positioned to fire, awaiting command to engage. Follow ROE and/or SOP.

Safe Weapons Handling

Weapons Control Status

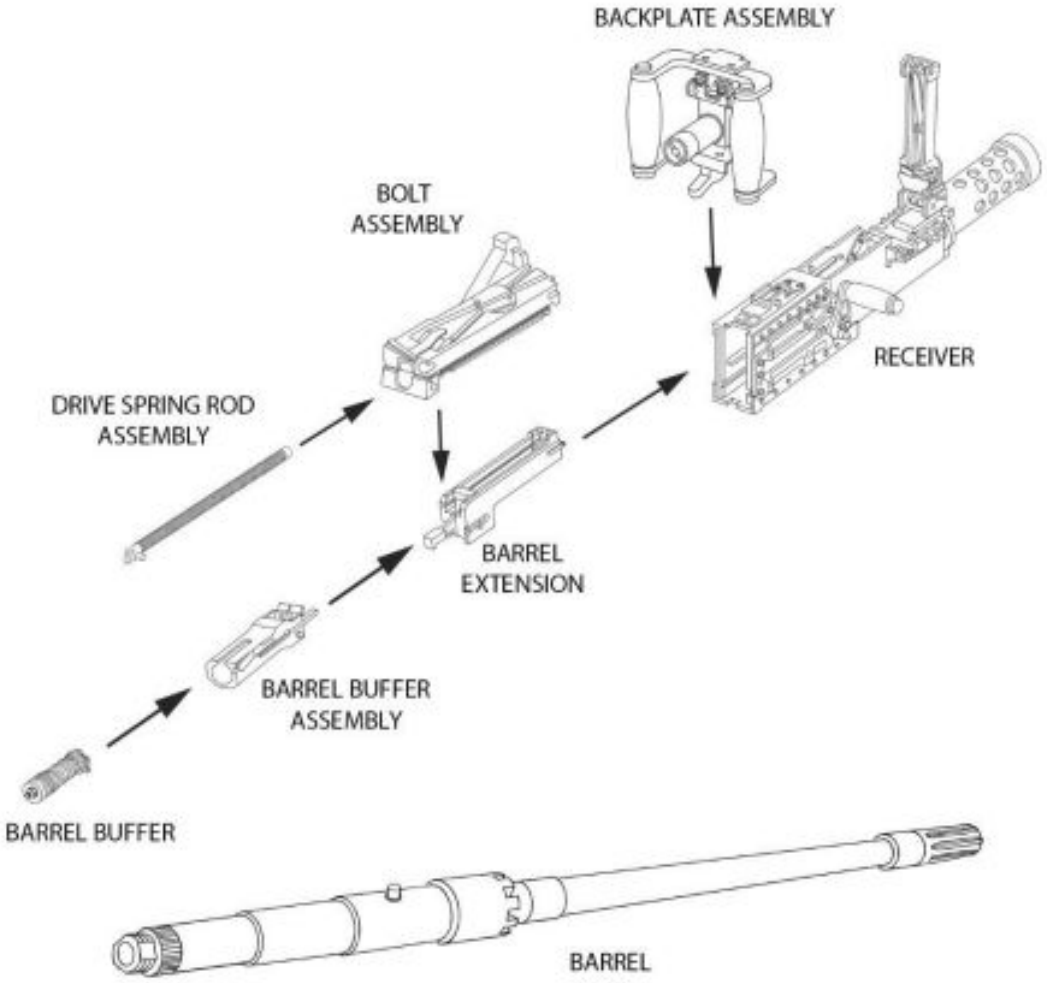
Tactical method of fire control given by a leader incorporating the situation, ROE, and anticipated enemy contact.

- Weapons Hold: Engage only if engaged or ordered to engage.
- Weapons Tight: Engage only if target is positively identified as enemy.
- Weapons Free: Engage targets not positively identified as friendly.

Principles of Operation

Major Components

The M2 is a belt-fed, recoil-operated, air-cooled, crew-served machine gun. M2A1 has fixed headspace and timing.



Principles of Operation

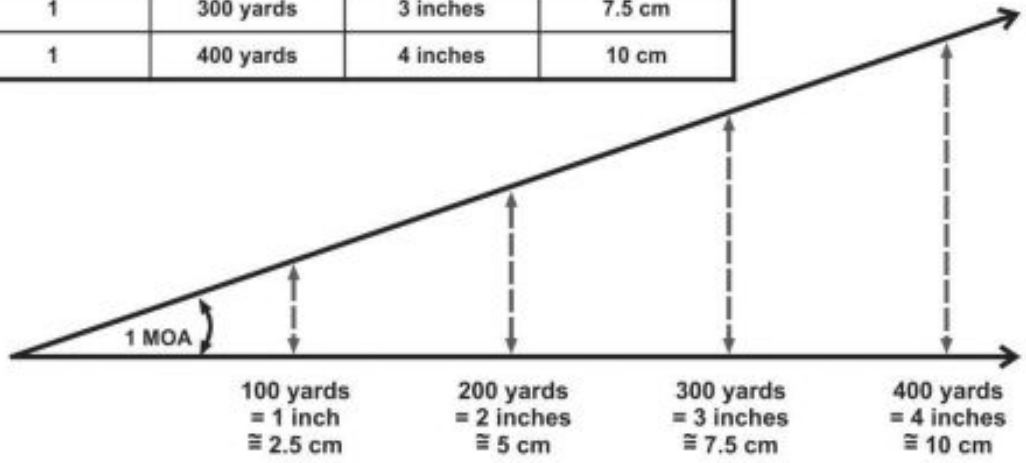
Technical Data

Weight of gun (approximate)	84 pounds (38.10 kilograms)
Weight of barrel	26 pounds (11.79 kilograms)
Length of gun (M2A1)	67 inches (172.10 centimeters)
Length of gun	65 inches (165.43 centimeters)
Length of barrel with flash suppressor (M2A1)	47 inches (119.38 centimeters)
Length of barrel	45 inches (114.30 centimeters)
Length of rifling (approximate)	41.88 inches (106.38 centimeters)
Number of lands and grooves	Eight
Twist, right hand	One turn in 15 inches (38.10 centimeters)
Feed	Link belt
Operation	Recoil
Cooling	Air
Muzzle velocity (approximate)	3,050 feet per second (929.64 meters per second)
Maximum range (approximate)	7,400 yards (6,767 meters)
Maximum effective range (approximate)	2,000 yards (1,829 meters)
Head space (M2)	Manually set and checked
Head space (M2A1)	Fixed

Aiming Devices

Units of Angular Measurement - MOA

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).	

Aiming Devices

Units of Angular Measurement - MOA

Rifle shooting is often measured in Minutes of Angle

60 Minutes of Angle per degree

21,600 Minutes of Angle per circle/revolution

1 MoA at 300 yards = π inches

Simplify this by rounding off:

100 yards: 1 MoA ≈ 1 inch (1.0471)

200 yards: 1 MoA ≈ 2 inches (2.0943)

300 yards: 1 MoA ≈ 3 inches (3.14159)

1000 yards: 1 MoA ≈ 10 inches(10.471)

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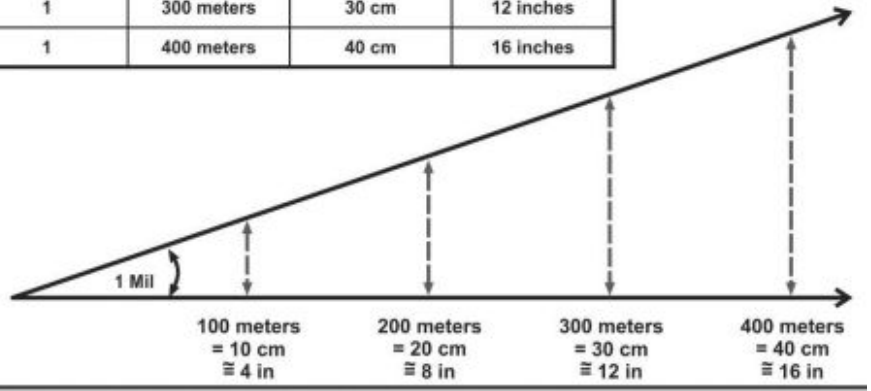
Aiming Devices

Units of Angular Measurement - Mils (milliradians)

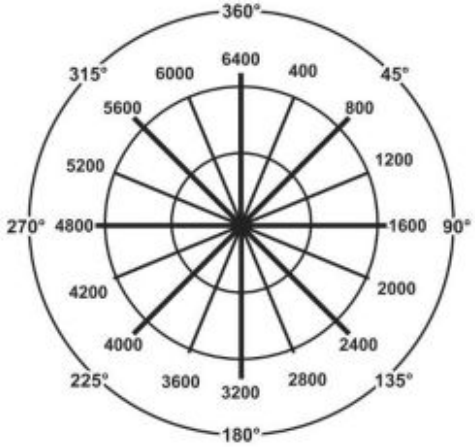
The mil is a common unit of angular measurement that is used in direct fire and indirect fire applications.

Check Technical Manual for your sight to know adjustments

Mil	At Distance	Equals	
1	100 meters	10 cm	4 inches
1	200 meters	20 cm	8 inches
1	300 meters	30 cm	12 inches
1	400 meters	40 cm	16 inches



MILS Unit of Measurement	
There are 360 degrees in a circle.	There are 17.78 mils in a degree.
There are 6400 mils in a circle	1 mil at 100 meters = 10 cm.



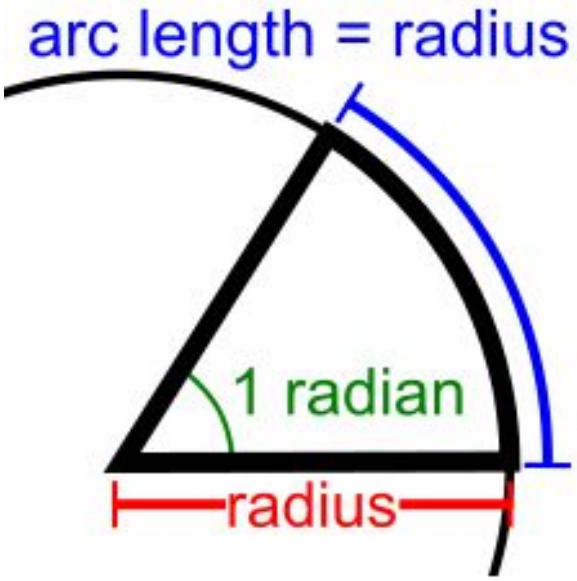
Aiming Devices

Units of Angular Measurement - Mils

Gunnery is often measured in Mils, increasingly popular for precision rifle

Mil (mrad) is short for milliradian

A circle (360 degrees) is 2 π radians



Aiming Devices

Units of Angular Measurement - Mils

"Milli-" prefix is 1/1000

Shortened to Mil, mil, or mrad

2000π milliradians = 2π radians

360 degrees = 6.283 radians = 6283 mils

1 Mil = 3.43 MoA (≈ 3.5 MoA ≈≈ 4 MoA)

Aiming Devices

Units of Angular Measurement - Mils

6283 mils are the true unit of angular measurement

1 mil subtends 1/1000 of the distance (radius)

Telescopic sight manufacturers using rangefinding reticles (e.g., mil dots) use this

There is NO difference between Army and Marine mils

6400 mils in NATO countries (“artillery mils”)

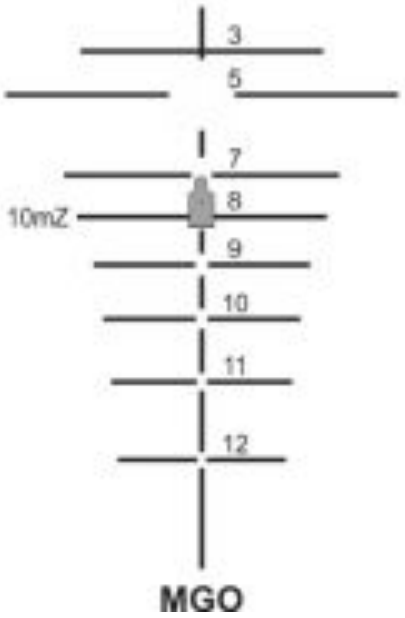
6000 mils in the former Soviet Union and Finland

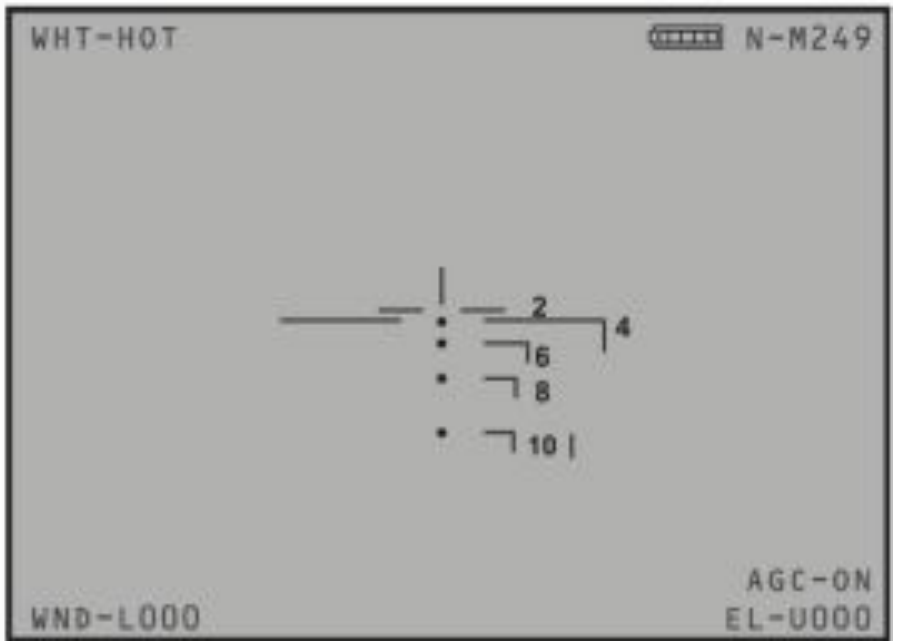
6300 mils in Sweden (streck, or “line")

Aiming Devices

Ballistic Reticles

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

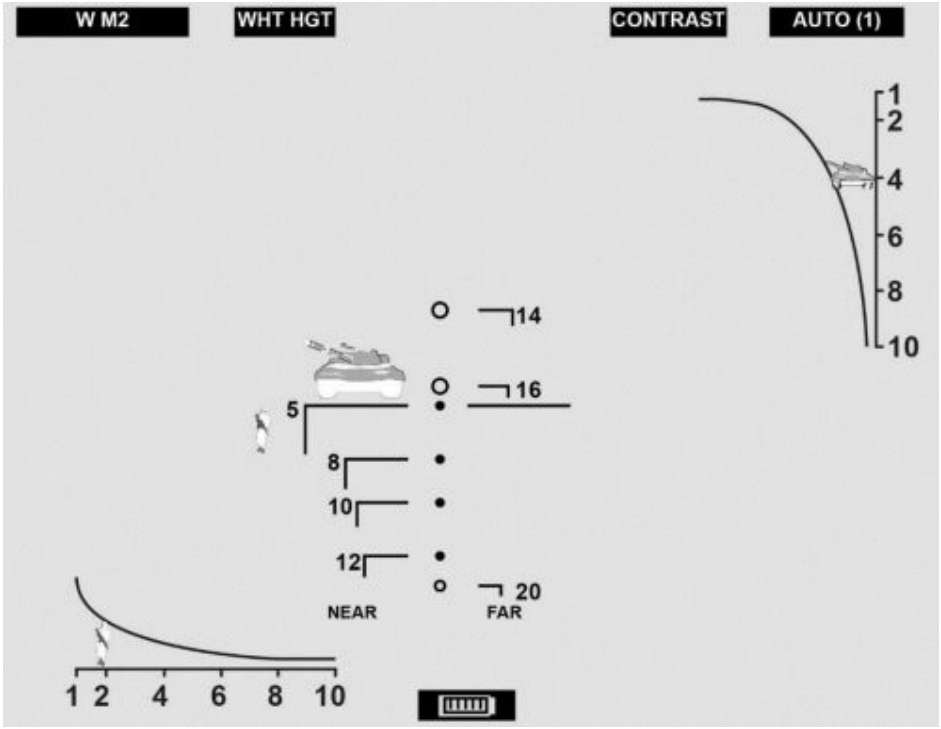




Aiming Devices

Stadia Reticles

Vertical and horizontal lines reflect size of vehicles, personnel, etc. at distance.
Placed next to a series of aim points (dots here) for different ranges.



Aiming Devices

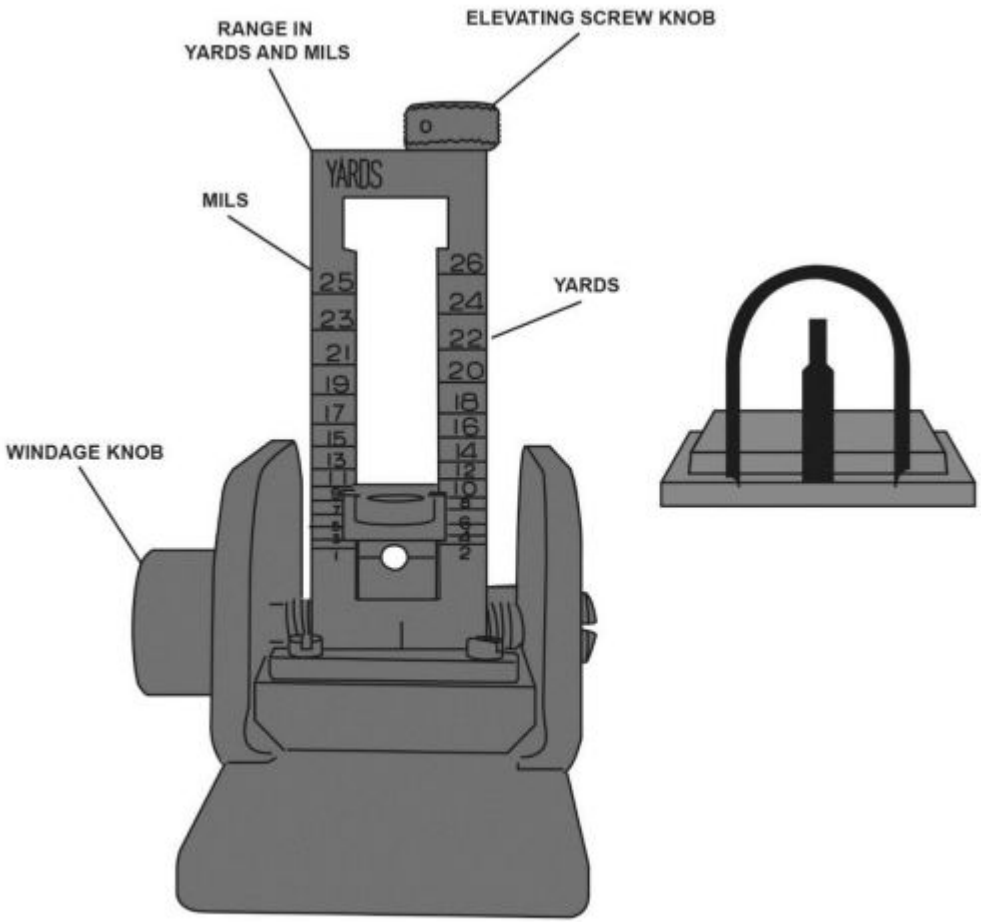
Iron Sights

Rear sight adjusts elevation and windage/azimuth

- Elevation: 100-2600 yards, 0-62 mils 1 click ~ 1 mil
- Windage: 1 click ~ 1 mil
- POI same direction as sight

- Yards-meters: ~10% (multiplier of 1.094) 600 meters x 1.094 = 656.4 or 650 yards

1,000 yards ~ 10m zero



Mountable Equipment

Tripods: M3

Critical for gunnery (not just marksmanship.) Stable, repeatable adjustments along left/right (traverse) and up/down (search) axis.

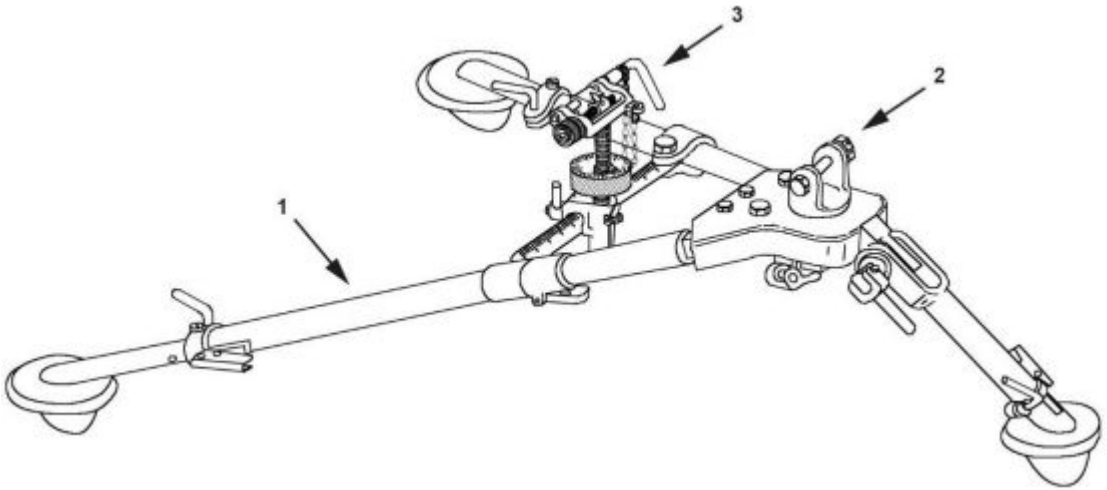
Traverse & Elevation

Search: 250 mil depression, 100 mil elevation

Traverse: 100 mil on T&E

Traverse Bar: 450 mils left, 425 mils right

1 mil clicks



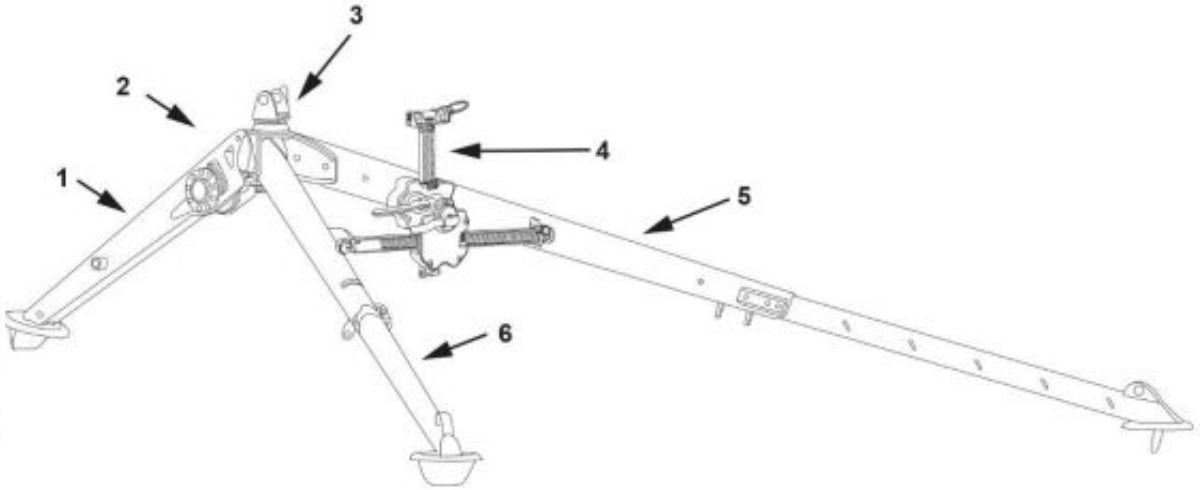
Mountable Equipment

Tripods: M205

Critical for gunnery (not just marksmanship.) Stable, repeatable adjustments along left/right (traverse) and up/down (search) axis. Integrated T&E

Traverse & Elevation

- Search: 0-460 mils total
- Traverse: 0-900 mils
- 4-5 mils push/release



WEIGHT:	*M205 tripod*	34 pounds(15 kilograms)
LENGTH:	*Stowed*	46 inches (117 centimeters)
	Deployed (maximum)	75 inches (191 centimeters)
WIDTH:	*Stowed*	12 inches (30 centimeters)
	Deployed (maximum)	69 inches (175 centimeters)
HEIGHT:	*Stowed*	8 inches (20 centimeters)
	Deployed (maximum)	25 inches (64 centimeters)
ELEVATION AND DEPRESSION	*Total range*	0 to 460 milliradians
TRAVERSE:	*Total range*	0 to 900 milliradians

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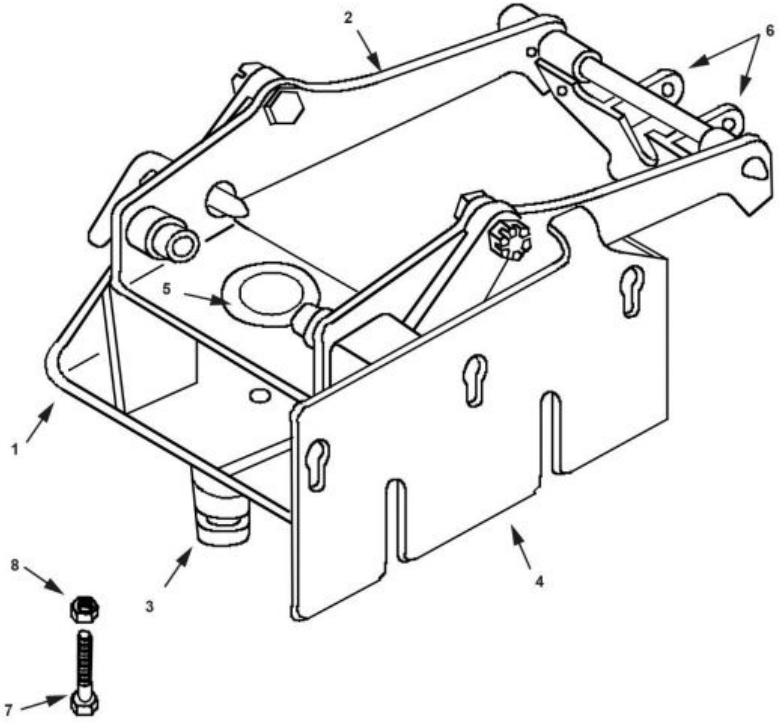
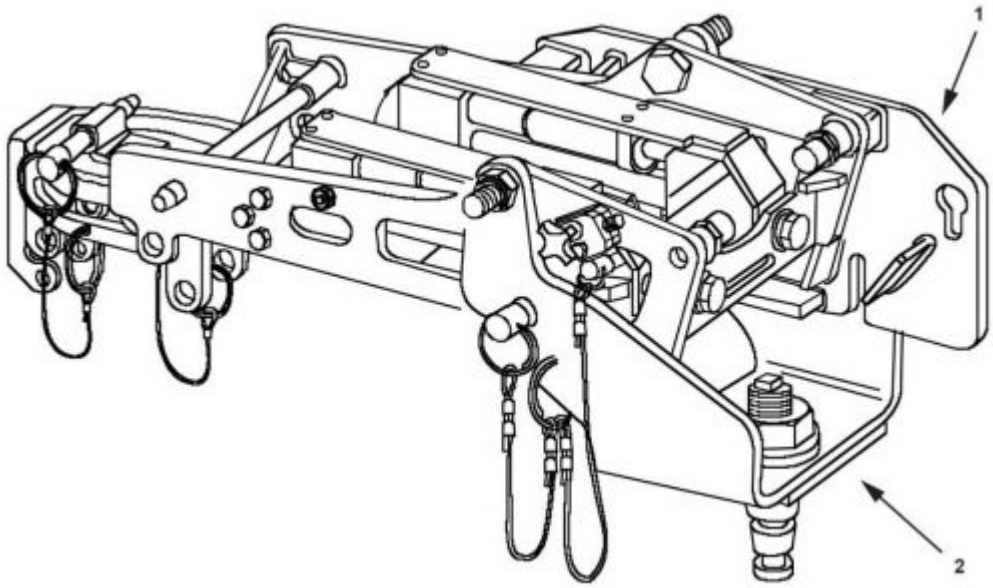
Mountable Equipment

Mount: Mk64 and Mk93





Employment

Shot Process

The object is to fire an Accurate Initial Burst, adjust fire, and develop speed.

- Pre-shot
- Shot
- Post-shot

Pre-shot	Position
	Natural Point of Aim
	Sight Alignment / Picture
	Hold
Shot	Refine Aim
	Breathing Control
	Trigger Control
Post-shot	Follow-through
	Recoil management
	Call the Shot
	Evaluate

Employment

Functional Elements

The object is to fire an Accurate Initial Burst, adjust fire, and develop speed.

- **Stability**: Provide a consistent base to fire from and maintain through the Shot Process until the recoil pulse has ceased. Includes hold/position.
- **Aim**: Continuous process of orienting the weapon, aligning the sights, using appropriate lead and elevation during engagement.
- **Control**: All conscious actions before, during, and after the Shot Process. Trigger control is of primary importance, along with whether, when, and how to engage. Incorporates the Soldier as a function of safety and responsibility.
- **Movement**: The process of moving during the engagement process. Into and out of position, moving laterally, forward, diagonally, and in a retrograde manner while maintaining stabilization, appropriate aim, and control

Employment

Functional Elements

Firing with Both Hands

- More support, center directly behind the weapon, recoil easier to manage
- Adjusting requires moving nonfiring hand for search/traverse, can't track moving targets as well free gun.

Firing with One Hand

- Nonfiring hand rapidly adjust T&E, pull/loosen traverse lever to maintain constant elevation while tracking linear area target
- Must manage recoil and provide stability with one side of the body

Employment

Stability

The object is to fire an Accurate Initial Burst, adjust fire, and develop speed

- **Support**: Use support (tripod/bipod) and bone structure primarily.
- **Muscle relaxation**: Use good positioning (cheek weld, body straight behind line of recoil, etc.) to enhance support.
- **Natural Point of Aim**: Where barrel naturally orients when position is solid, muscles relaxed and support is achieved. Should be **on target**.
- **Recoil management**: Maintain stable firing position and followthrough the recoil pulse to mitigate movement during the cycle of function,

Note. The steadier the position, the smaller the wobble area. The smaller the wobble area, the more precise the burst.

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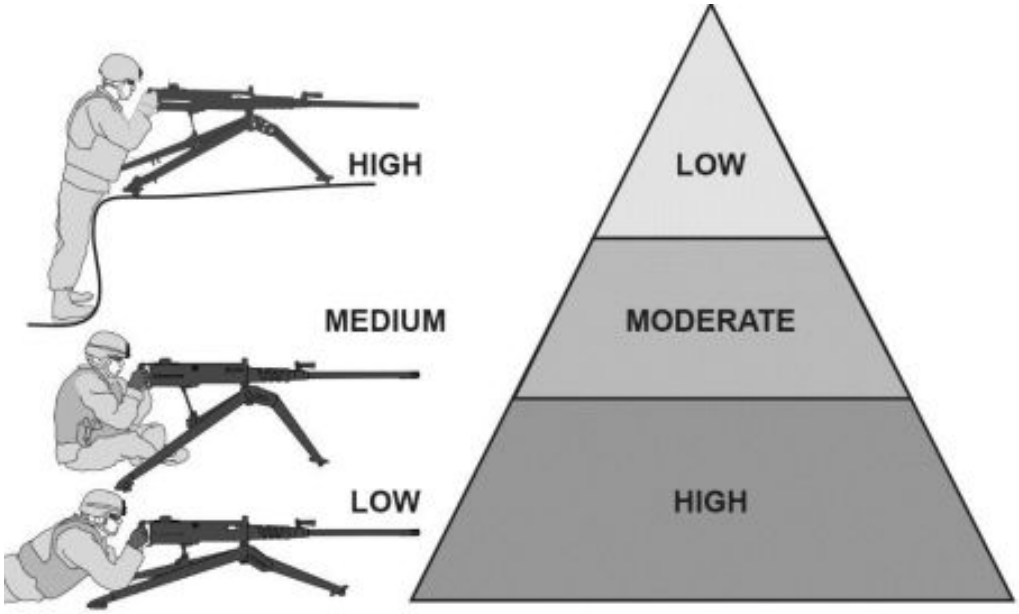
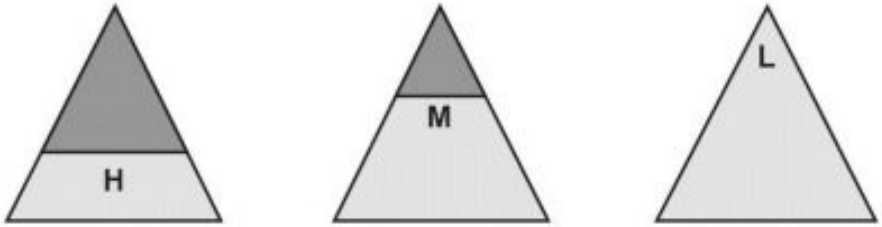
Employment



As the center of Gravity (CoG) increases, the level of stability decreases.



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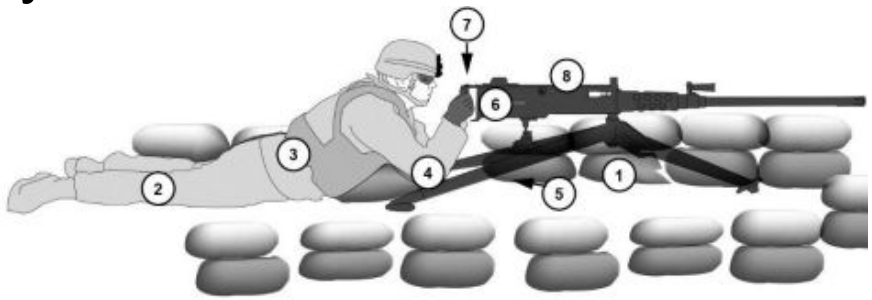
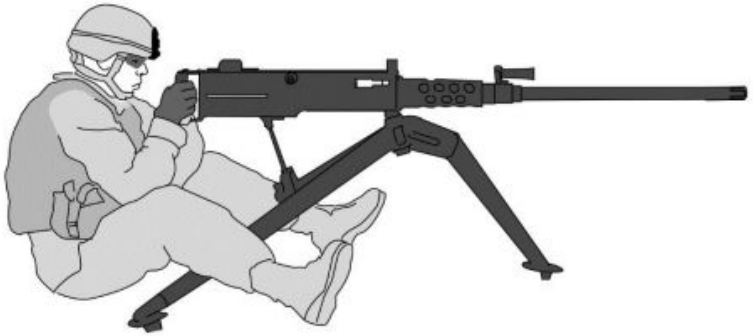
Employment

Firing Positions

A position is good *ONLY* if it consistently produces a tight Cone of Fire!





1	SUPPORT:	SUPPORTED.
2	LEG POSITION:	THE GUNNER SPREADS HIS LEGS A COMFORTABLE DISTANCE APART WITH HIS TOES TURNED OUTWARD.
3	STANCE/CENTER OF GRAVITY:	PRONE POSITION MAXIMIZES THE SOLDIER'S FRAME AGAINST THE GROUND FOR MAXIMUM STABILITY.
4	FIRING ELBOW:	FIRING ELBOW RESTS ON THE GROUND.
5	NON-FIRING ELBOW:	NON-FIRING ELBOW RESTS ON THE GROUND.
6	FIRING HAND:	LIGHTLY GRASPS THE SPADE GRIP, ENSURING THAT THE THUMB IS IN A POSITION TO PRESS THE TRIGGER.
7	NON-FIRING HAND:	GRASPS THE ELEVATING HAND WHEEL OF THE T&E MECHANISM. IF FIRING WITH BOTH HANDS, THE NON-FIRING HAND REPLICATES THE FIRING HAND BY GRASPING THE SPADE GRIP, ENSURING THAT THE THUMB IS IN A POSITION TO PRESS THE TRIGGER.
8	SHOOTER-GUN ANGLE:	GUNNER'S BODY IS NEARLY PERPENDICULAR TO THE GUN-TARGET LINE.

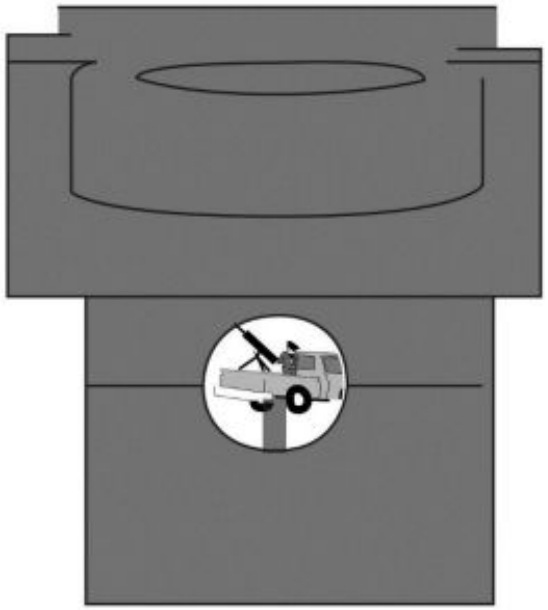
Employment

Aim

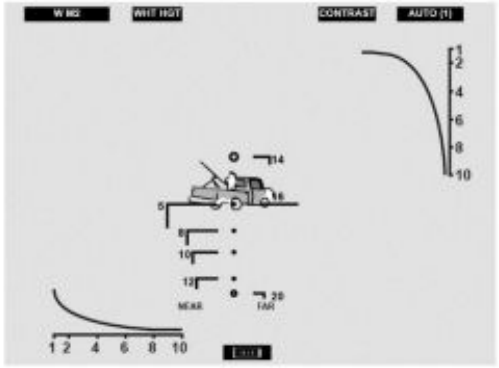
Sight Alignment: Relationship between the aiming device and the firer's eye. Maintain by using **consistent head placement**.

- **Iron sight**. Relationship of front sight, rear sight, and firer's eye. Maintain by keeping focus on the top of the front sight.
- **Optics/Thermal**. Relationship between the reticle and the firer's eye. Maintain by ensuring full, centered field of view (no shadow in magnified optics)
- **Pointers/Illuminators/Lasers**. Relationship between the firer's eye, the night vision device placement and focus, and the laser aiming point on the target.

FOCUS ON THE FRONT SIGHT POST, NOT THE TARGET ITSELF.



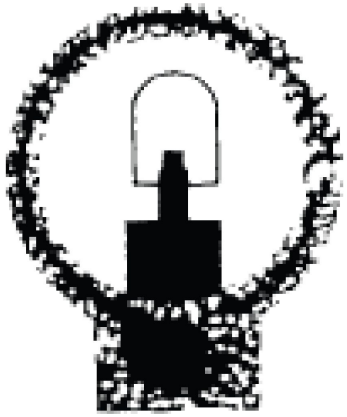
THERE IS NO DIFFERENCE IN FOCAL VIEWING WHEN USING THERMAL OPTICS. ALIGN THE RETICLE AT THE DESIRED POINT OF AIM.

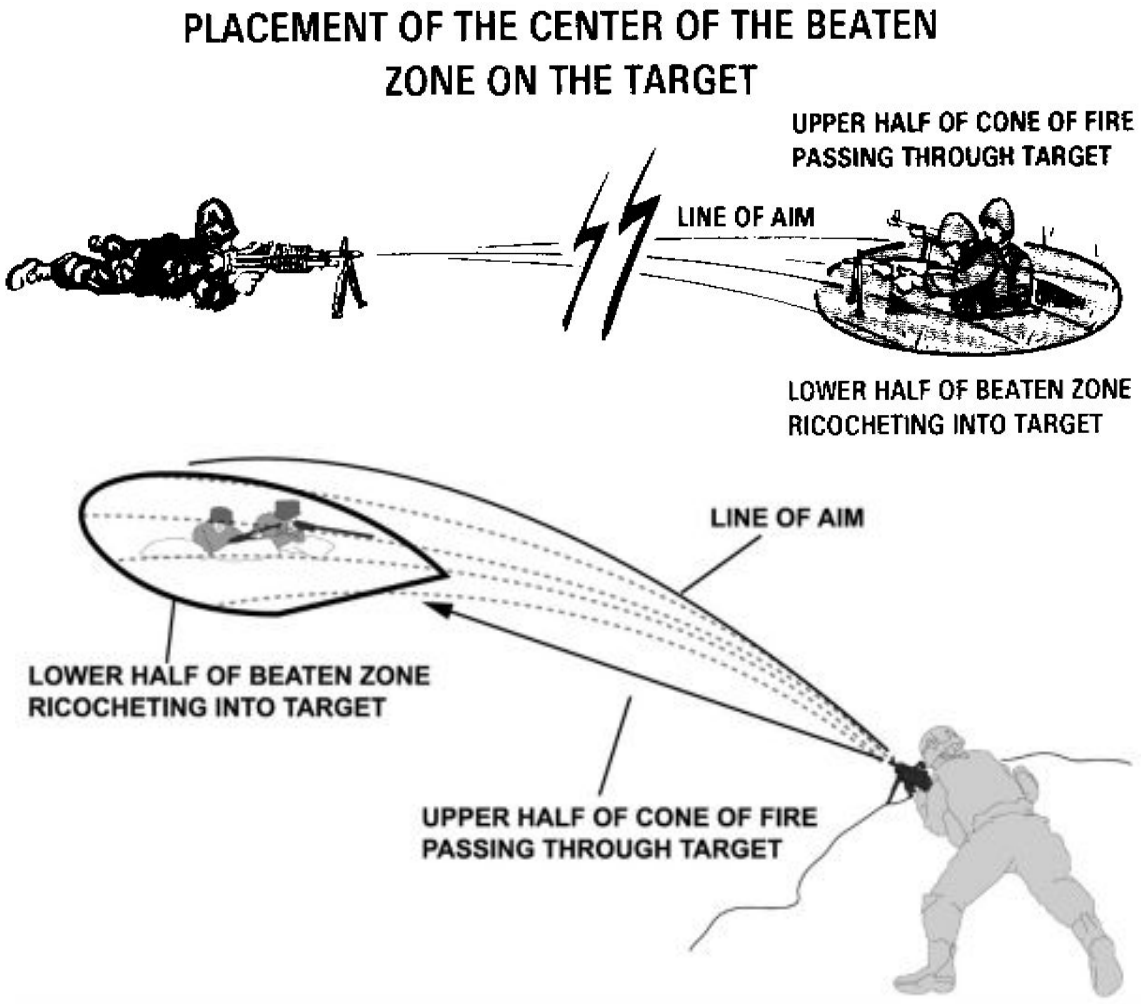


Employment

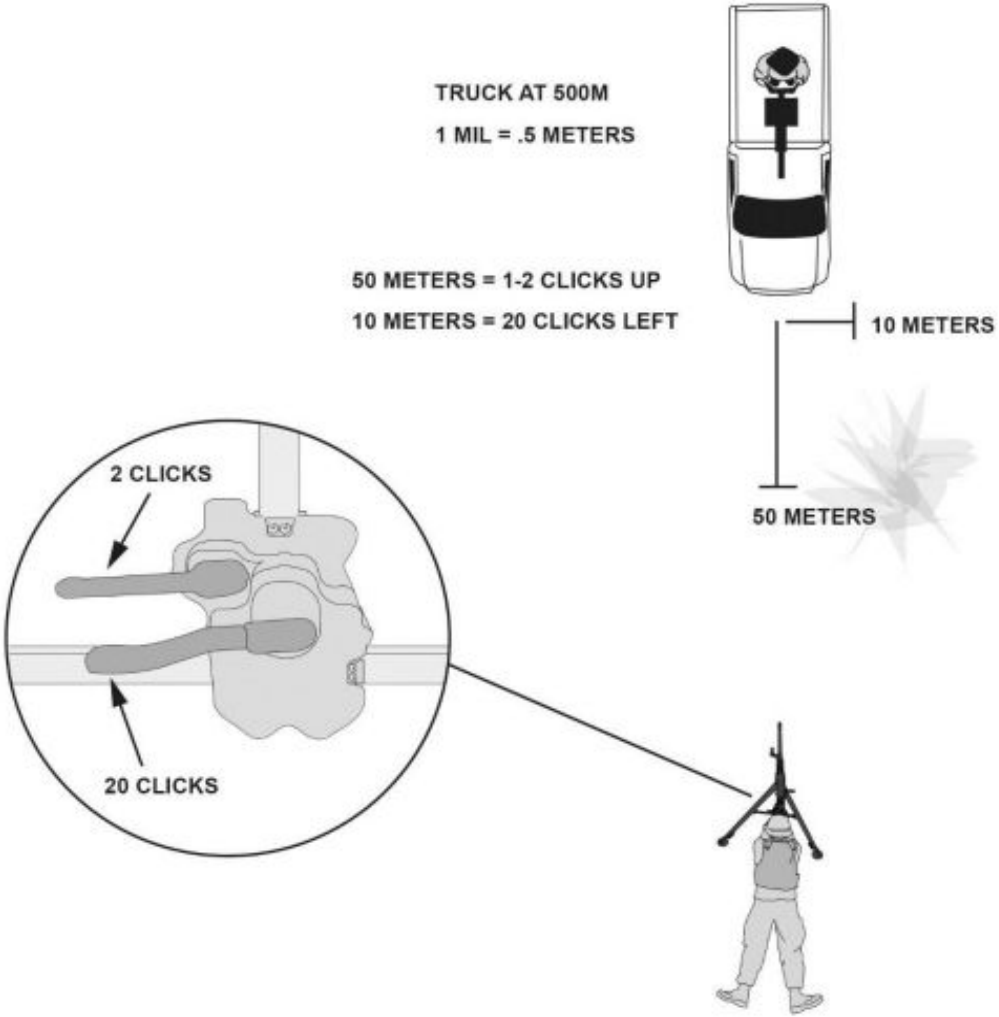
Center Base Aimpoint

- Used to place Beaten Zone correctly on targets with depth
- **NOT** because "the gun climbs in recoil"
- Gun climbing in recoil = poor position and bad shooting





Employment


TRUCK AT 500M
1 MIL = .5 METERS
50 METERS = 1-2 CLICKS UP
10 METERS = 20 CLICKS LEFT
10 METERS
50 METERS
2 CLICKS
20 CLICKS

Employment

Control

- All conscious actions before, during, and after the shot process
- Includes safety and decision to shoot (when/if based on ROE)
- Proper trigger control without disturbing the sights is a critical aspect of Control and the most difficult to master
- Shot anticipation (flinch, pre-ignition push) disrupts Control
- Reducing or eliminating shot anticipation with good trigger control is often most effective way to improve shooting results

Employment

Control

- Thumb placement lays naturally across the trigger after achieving proper grip. No specified point must be used
- Trigger squeeze/press. Push in a smooth, consistent manner. Add steady pressure until the weapon fires.
- Trigger reset. Retain sight focus while resetting the trigger
- Left hand controls T&E

Employment

Control: Rate of Fire

- **Single Shot:** 12-15 rounds/minute. Point targets to 1500 meters.
- **Sustained**: Less than 40 rounds/minute, 6-9 round bursts, 10-15 second intervals, barrel change daily or if damaged. **Normal use**.
- **Rapid Fire**: More than 40 rounds/minute, 6-9 round bursts, 5-10 second intervals, barrel change regularly (every hour or so, or if damaged.)
- **Cyclic Fire**: 450-600 rounds/minute, continuous bursts, barrel change every 200 rounds. Useful for suppression **only if** accurately directed. Learn and use Sustained and Rapid first.
- **Suppressive Fire**: Fires that degrades the performance of an enemy force below the level needed to fulfill its mission. Must either hit directly or land close enough to convince the enemy fires ***could*** have hit.
    - Volume does NOT equal suppressive fire unless directly accurately enough that it ***could*** hit on purpose

Employment

Control

- **Follow-through**: Continued mental and physical application of the shot process' functional elements
  - Firer's head stays in put behind sights, the firing eye remains open, and the trigger thumb holds the trigger down through recoil (semi-auto and fixed ammunition drill)

- **Calling The Shot**: State where you think the shot/burst went based on where the sights were when the shot/burst was released
  - Call is expressed in clock direction and amount from point of aim
  - Peer coach/Assistant Gunner verifies actual location
  - Poor/inconsistent shot call is a poor application of Control

Drills

Drill structure is standardized for all weapons to reinforce common actions

A: Weapon Check-Condition Green, serial numbers, function check

B: Equipment Check/PCC

C: Place Weapon Into Action

D: Headspace/Timing (M2 HB only)

E: Load and Barrel Change

F: Fight Down. Start in the standing/offhand position and assume the kneeling, sitting, and prone (or variations) in order.

G: Fight Up. Start prone and assume positions up to standing in order.

H: Reload. Completely reload from ammunition stored in load bearing equipment.

J: Clear Malfunction. Reduce the most common malfunctions.

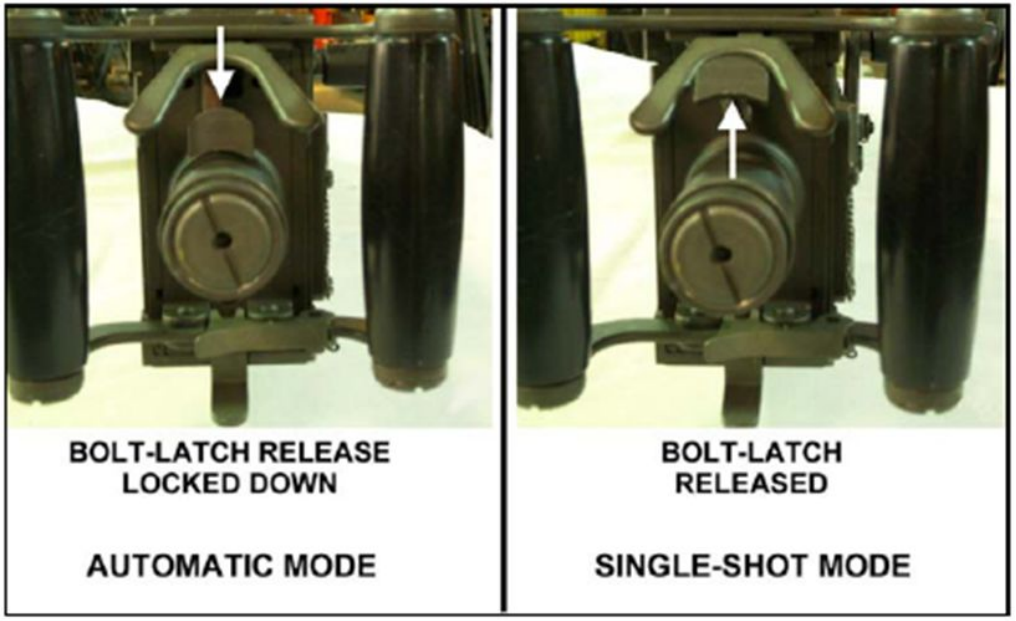
K: Unload/Show Clear

L: Weapon and T&E Manipulation

M: Range Card

Drill A: Weapon/Function Check

Go to Condition Green



- Bolt forward, close top cover, single-shot mode
- On Safe (if available) so trigger is blocked.
- Pull cocking handle, bolt remains rearward.
- Press bolt latch, ride bolt forward
- Press trigger, weapon fires (click)
- Automatic mode, pull cocking handle, bolt continues forward
- Press trigger, weapons fires (click)
- Use linked dummy ammo to check stripping, locking, loading, unlocking, extracting and ejecting.

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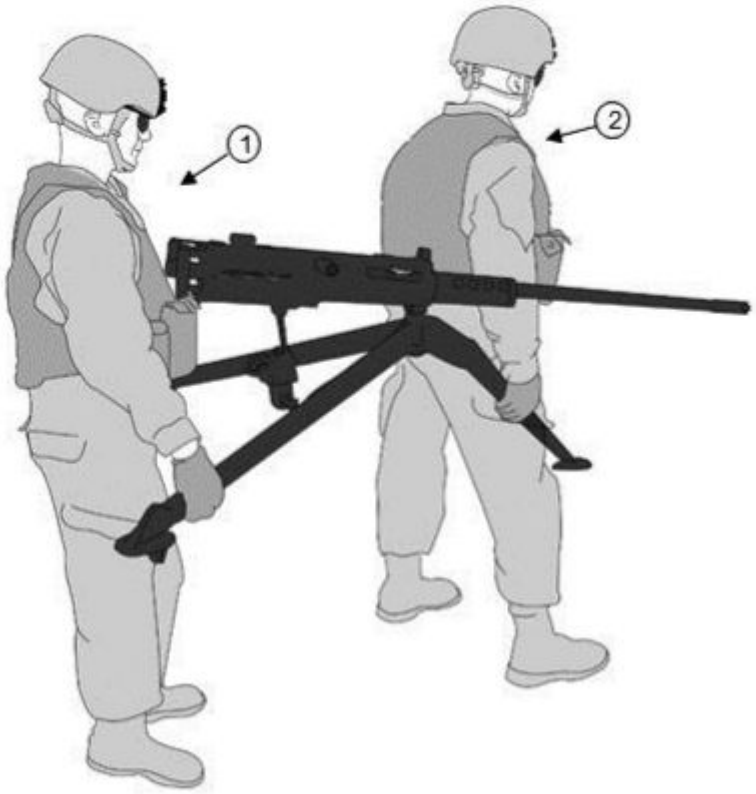
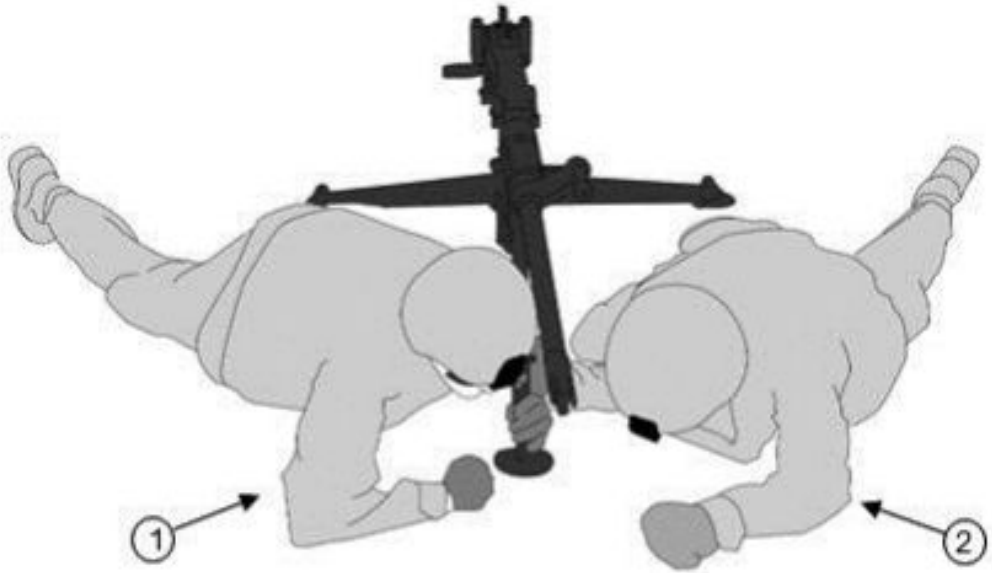
Drill C: Place Weapon Into Action

- Deploy tripod
- Set traverse bar and pintle
- Mount gun to pintle and T&E

Drill C: Place Weapon Into Action

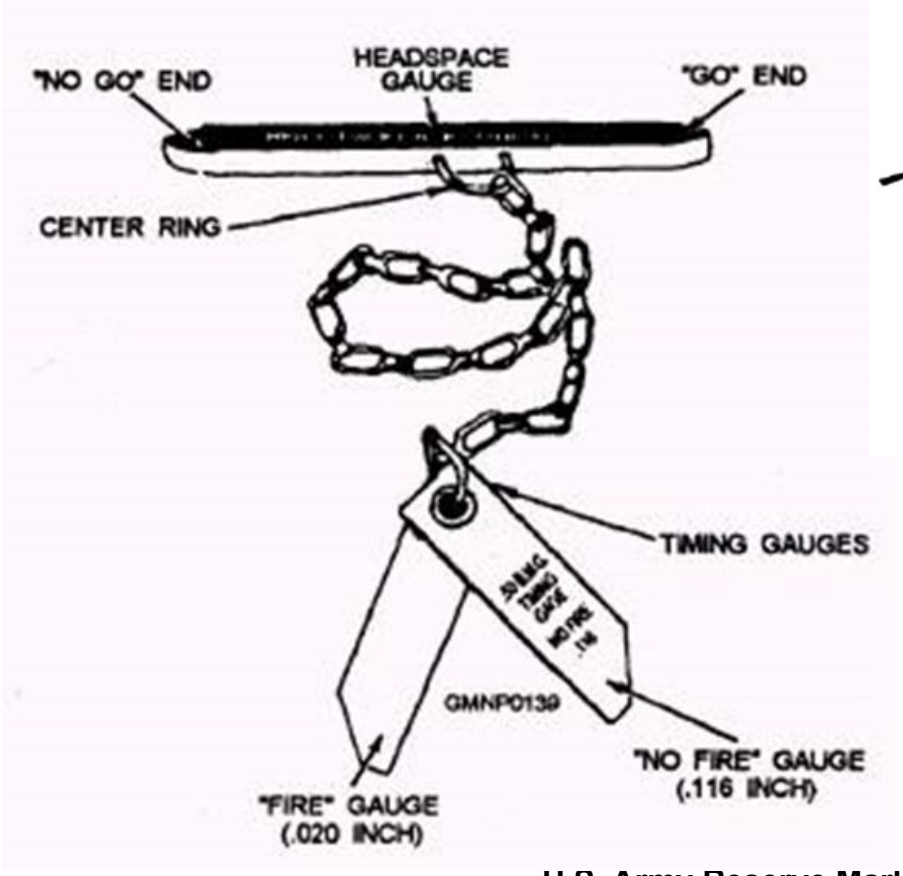


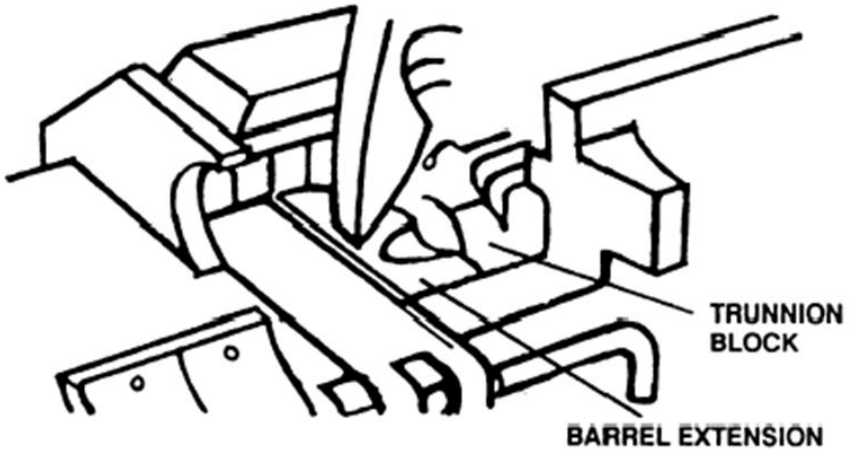


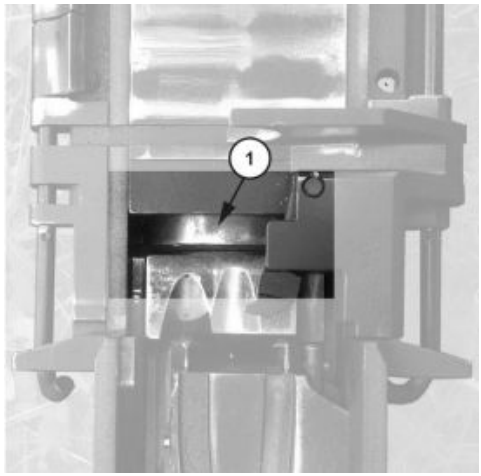
- Be careful of a hot barrel

Drill D: Headspace and Timing

- Headspace: Distance between bolt face and shoulder surface in chamber



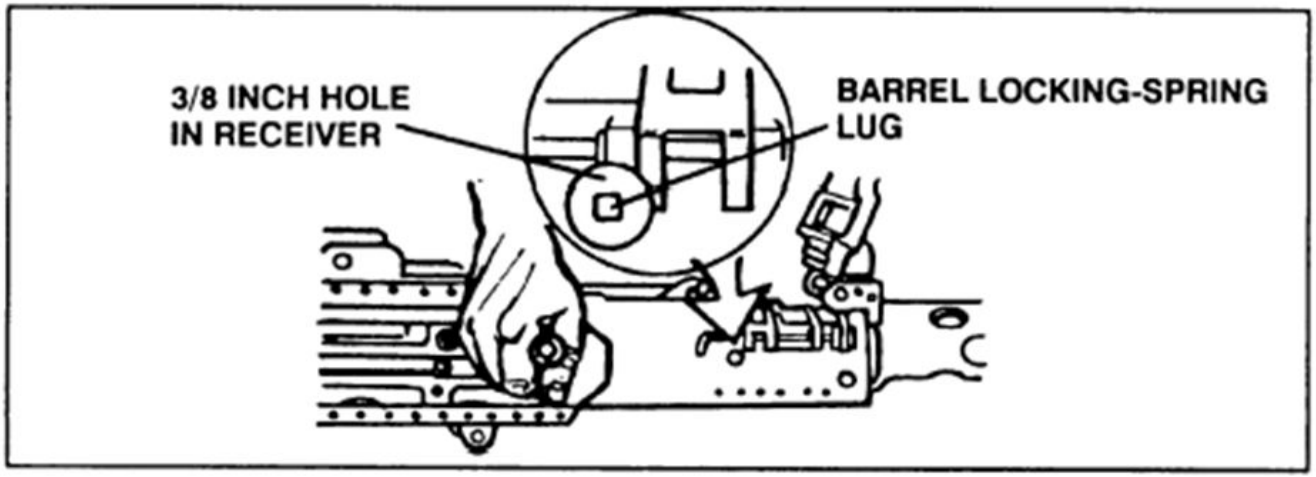




Drill D: Headspace and Timing

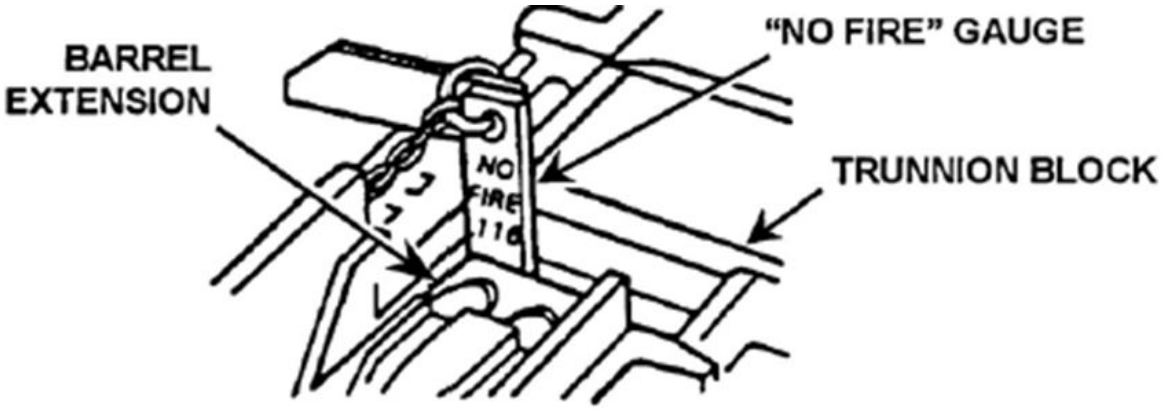
Headspace: M2 HB only

1. Condition Green
2. Pull bolt back to witness spring lug
3. Screw in barrel, back out two clicks
4. Weapon (firing pin) cocked
5. With slack out with cocking handle, Go gauge should fit between bolt and barrel, No Go gauge should not. If Go gauge does not fit, screw out barrel in one click increments until it fits.



Drill D: Headspace and Timing

- Timing: Gun adjustment so firing occurs when recoiling parts are in position



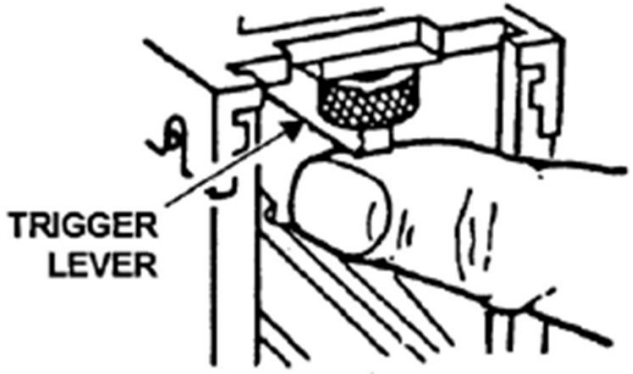
Drill D: Headspace and Timing

Timing: M2 HB only

1. Condition Green
2. Cock weapon, place on Fire (if available)
3. Insert No Fire gauge (thick) between barrel extension and trunnion block
4. Push trigger, should not fire
5. Insert Fire gauge (thin) between barrel extension and trunnion block
6. Push trigger, should fire

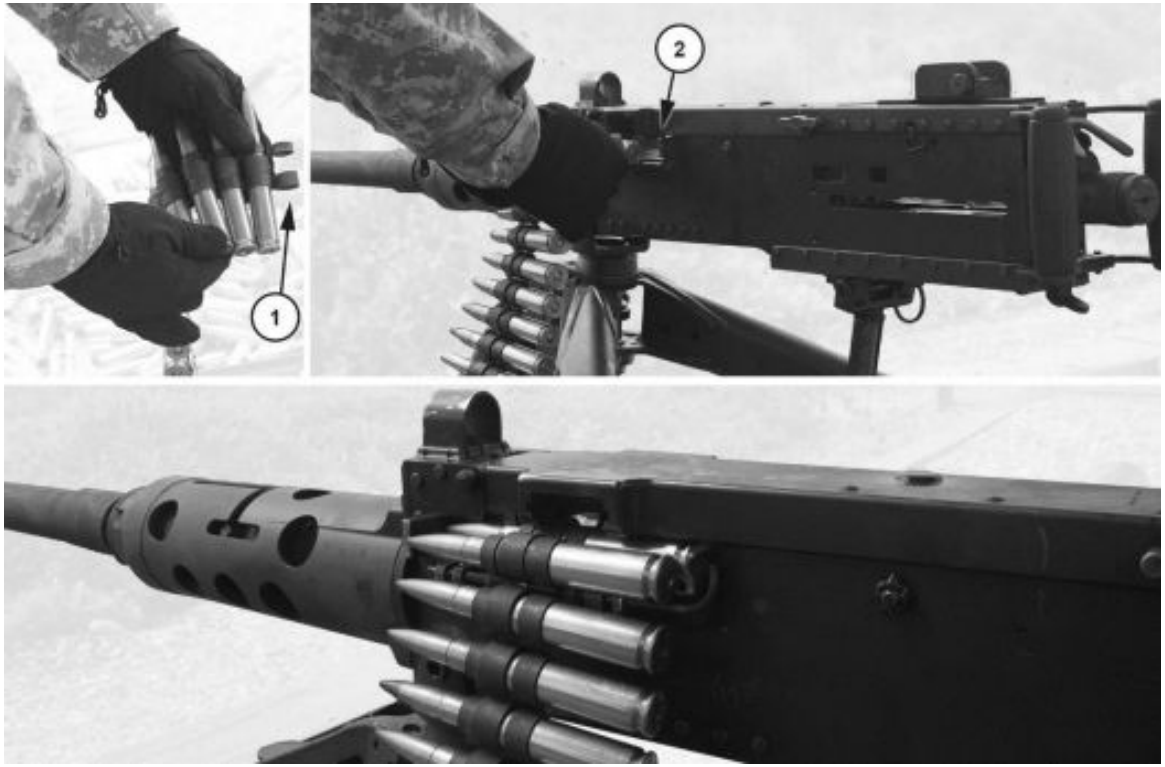
Adjust Timing Nut:

1. Cock weapon, remove backplate assembly, screw timing nut down (to the left)
2. With Fire gauge in place, press up on trigger lever
3. Click timing nut up one, retry
4. When weapon fires, go up two more clicks
5. Reinstall backplate, retest



Drill E: Load and Barrel Change

- Cover closed
- Insert double loop end of link
- Push first cartridge past belt-holding pawls



Amber

- Pull cocking handle once, on Safe

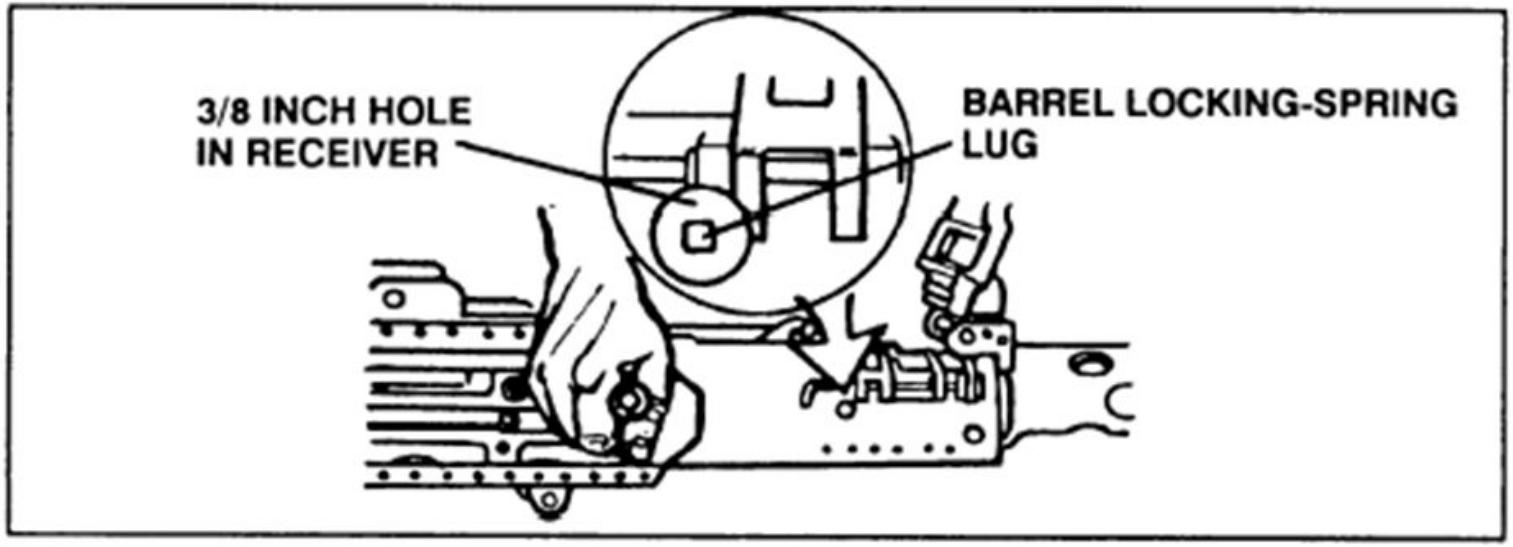
Red

- Pull cocking handle twice, on Safe

Drill E: Load and Barrel Change

M2 HB

1. Remove ammunition
2. Retract bolt to reveal spring lug
3. Unscrew barrel. Use barrel handle and heat glove
4. Install new barrel
5. Check Headspace
6. Reload



Preliminary Marksmanship Instruction and Evaluation

Heavy Machine Gun - M2 Series

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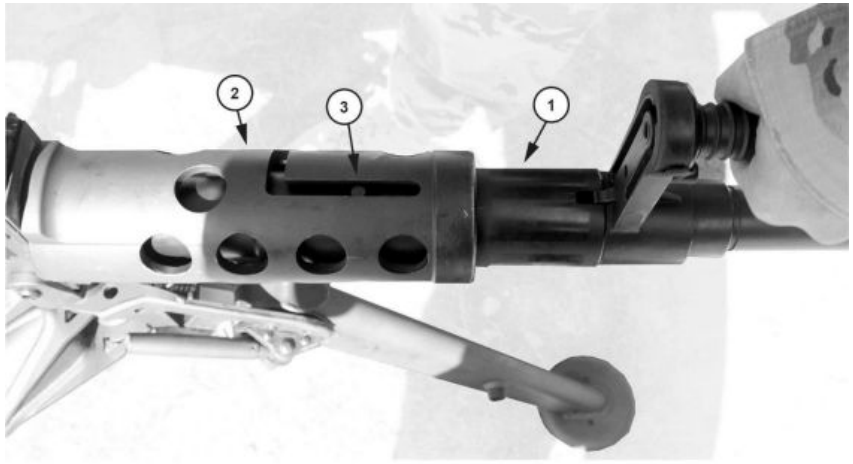
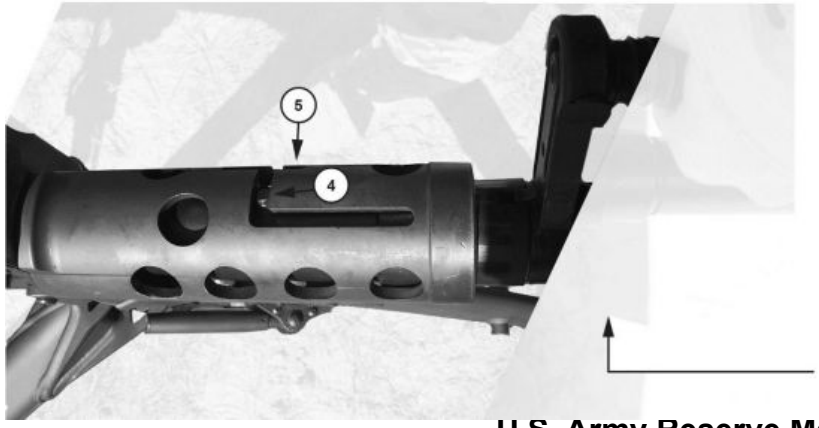
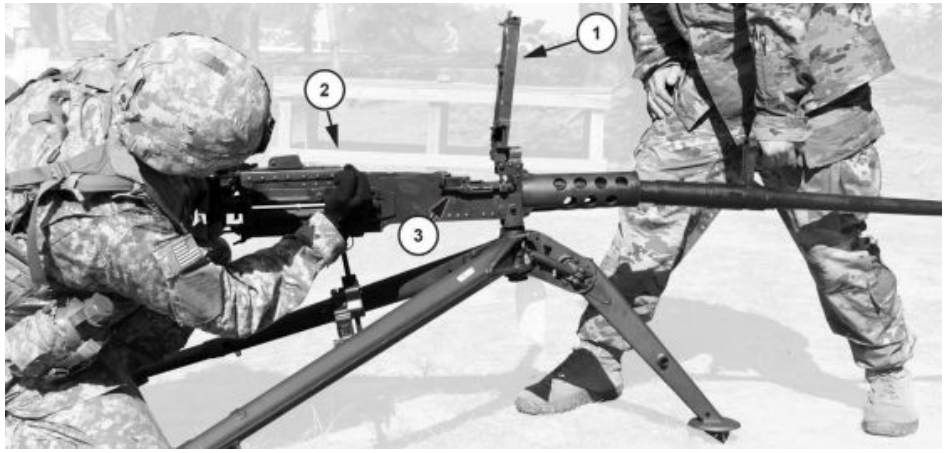
Drill E: Load and Barrel Change

M2A1







1. Remove ammunition
2. Retract bolt to reveal spring lug
3. Rotate barrel with handle, move alignment pin along slot and out
4. Install new barrel with alignment pin aligned with top slot
5. Rotate barrel, alignment pin in slot
6. Release bolt and reload

Drill J: Clear Malfunctions

Any failure of the weapon to complete normal cycle of function. Correct by:

- Use secondary weapon (if available and appropriate)
- Apply Corrective Action
  - **Immediate action**. Simple, rapid action to correct basic disruptions
  - Commonly fix simple failures to fire, especially ammunition related
    - **Pull** and lock the cocking handle to the rear
    - **Observe** ejection port and belt for ejection and advance
    - **Attempt** to fire.
    - If no fire and hot gun (100 rounds/minute), put in single shot mode.
  - **Remedial action**. Skilled/thorough response to specific problem or issue that simple Immediate action cannot correct
  - Typically requires unload/show clear to correct
  - Hot gun (100 rounds/minute): Place in single shot mode, lock bolt back

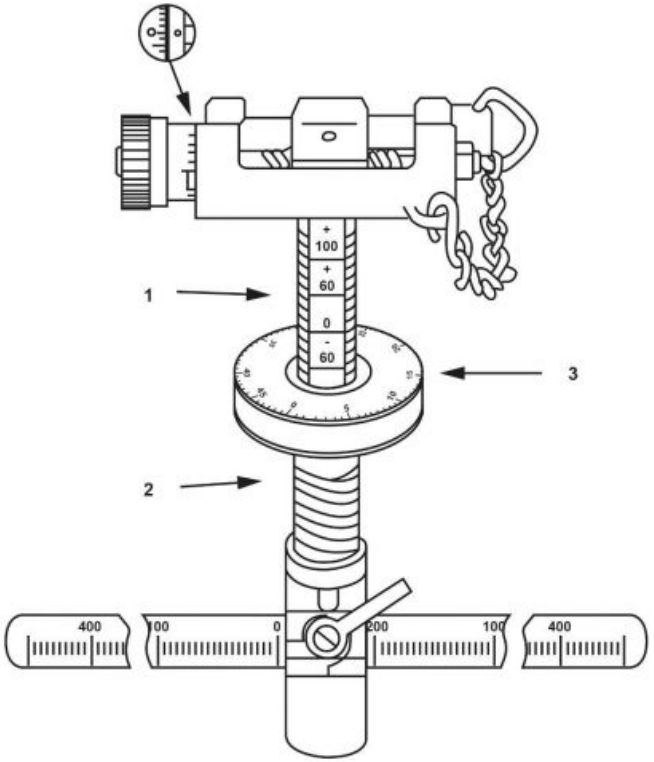
No single corrective can resolve all malfunctions.

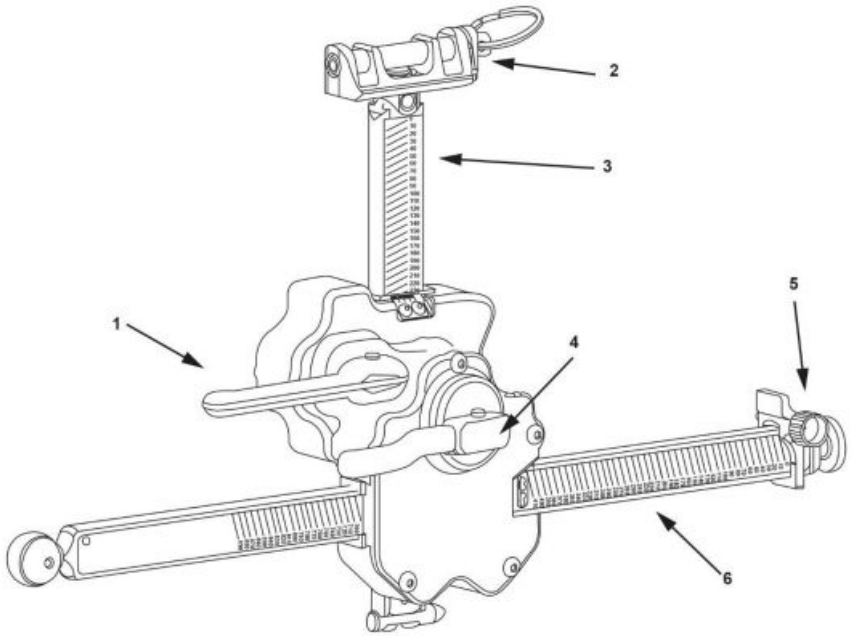
Drill K: Unload/Show Clear

1. Place on Safe (M2A1)
2. Single-shot mode
3. Open top cover, remove ammunition belt
4. Pull bolt rearward, locking bolt back
5. Check space between bolt assembly and chamber. Confirm all ammo and links are out
6. Weapon is now Green

Drill L: Weapon and T&E Manipulation

- Practice traversing and searching between target and along target areas.
- Need large swings (move to different objective) and controlled increments (~4-5 mils) search and traverse for even, overlapping coverage





Drill M: Range Card

- Weapon symbol, azimuth (degrees), distances (meters) to terrain features
- Area covered, likely engagement areas (range, azimuth, elevation)
- Dead space, magnetic north, unit (company), time/date, primary, alternate, supplementary positions

1. Machine gun symbol, sector of fire (left,right), azimuth, far limits ranges
2. Terrain features in Data Section, left and right limits labeled 1 and 2
3. Target reference points designated by platoon leader or unit SOP. Track likely avenues of approach
4. Draw maximum engagement line (range) and any dead space
5. Indicate position type (primary, alternate, or supplementary)
6. Enter the information for the weapon reference point in the remarks block on the range card.

Preliminary Marksmanship Instruction and Evaluation

Heavy Machine Gun - M2 Series

TC 3-22.50

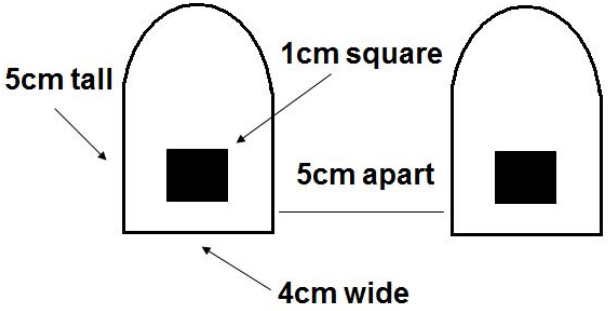
Zeroing

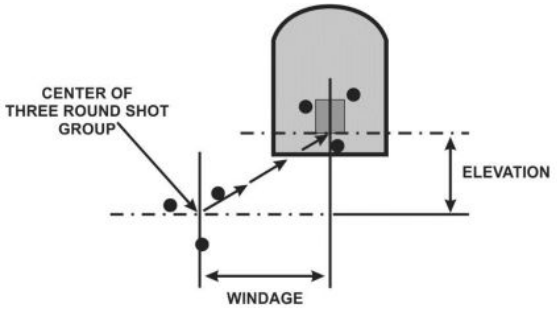
Iron sight:

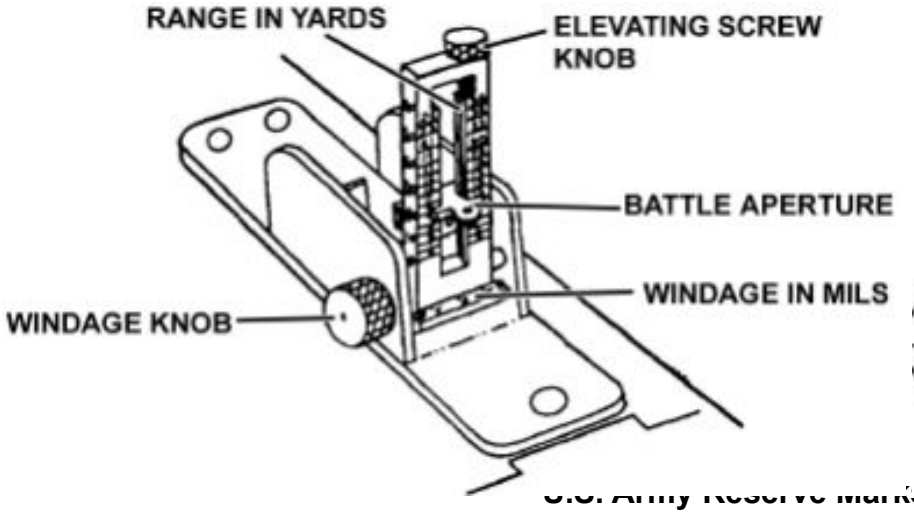
- 1000 yards (10 meters)
- Fixed battle sight aperture: 750 yards

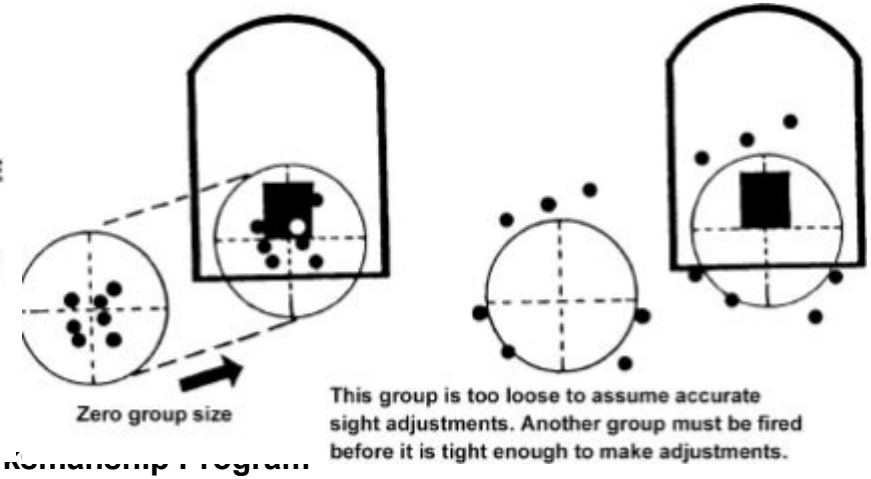
10 meters: 1 cm = 1 mil

Always use Peer Coaches!









Preliminary Marksmanship Instruction and Evaluation

Heavy Machine Gun - M2 Series

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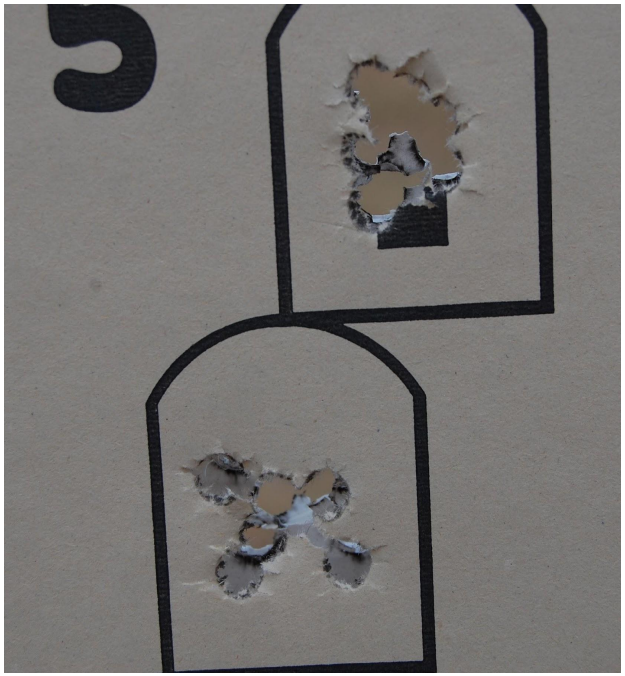
Zeroing

1. Start with single-shot mode
   - Center groups with center base hold
   - Single round zeros need confirmation

2. Continue zeroing with bursts
   - Load using **exact** number of rounds
   - Hold trigger and let gun empty out
   - Follow-through!
   - Start with three rounds, then seven

3. Groups and bursts should be 2-4 mils and centered in target as pictured
   - Continue until this is achieved



Preliminary Marksmanship Instruction and Evaluation

Heavy Machine Gun - M2 Series

TC 3-22.50

Practice: 10 Meters

Task 1	Twelve single rounds
Task 2	Two 7-round belts
Task 3	One 35-round belt
Task 4	One 56-round belt

Objectives:

Accurate Initial Burst, Adjust Fire, Develop Speed

Task 1&2:

Use more ammo as available to facilitate learning and training

Task 3&4:

Only shoot **ONE** burst per target area/paster.

10-METER PRACTICE FIRE
(Prone or Fighting Position)

Task	Time	Rounds	Type	Target	Type Fire
1	No limit	12	Ball	Pasters A1 and A2	12 single rd (zero).
2	No limit	14	Ball	Pasters A3 and A4	Controlled bursts: 5- to 7-rd bursts
3	No limit	35	Ball	Pasters A5 thru A6	Traverse and search: area targets in-depth. 5- to 7-rd bursts
4	No limit	56	Ball	Pasters A7 thru A8	Traverse and search: linear targets with depth. 5- to 7-rd bursts

Note. The gunner fires pasters on section A and the assistant gunner on section B.

TC 3-20.40 Training and Qualification, Individual and Crew Served Weapons, 7-119

"Qualification requires gunners to practice trigger control and requires the firer to fire **ONE** five to seven round burst at each specified point target or series of targets in the area target sequences. Gunners are authorized to fire **only ONE** five to seven round burst at each paster."

Preliminary Marksmanship Instruction and Evaluation

Heavy Machine Gun - M2 Series

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Qualification: Transition

Objectives:

Accurate Initial Burst, Adjust Fire, Develop Speed

Qualification:

Firers may only shoot **TWO** bursts per target.

Engagement	Time (Minutes)	Rounds	Target	Range	Type Fire
Zero	No limit	14	Double E	500	Fixed, single shot, three round shot groups (field zero)
2	1.5	14	Double E	1100	Fixed, 5- to 7-round burst
3	1.5	14	Double E	1500	Fixed, 5- to 7-round burst
4	1.5	14	Double E	600	Fixed, 5- to 7-round burst
5	1.5	14	Double E	800	Fixed, CBRN, 5- to 7-round burst
6	1.5	14	Single E	400	Fixed, CBRN, 5- to 7-round burst
7	2.5	28	Double E Double E	1100 600	Fixed, 5- to 7-round burst
8	2.5	28	Double E Double E	800 1500	Fixed, 5- to 7-round burst

- Fire a burst, adjust fire (if missed) and re-engage ONCE
- Remaining ammo is NOT used or alibi granted.
- Go for hitting target in engagement with first or second burst
- 6 Go pass, 9 max
- DA Form 7449

Note: Enforcement of only one burst per target area/paster (10 meter) and two bursts per target (transition) is NOT a change to the Qualification. The Training Circulars have finally explicitly stated what the standard always was supposed to be. **You've been cheating**!