TC 3-22.19

GRENADE MACHINE GUN
MK 19 MOD 3

MAY 2017

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Washington, DC, 13 January 2020

Grenade Machine Gun MK 19 MOD 3

1. Change TC 3-22.19, 10 May 2017, as follows:

Remove old pages:	**Insert new pages:**
i through vi	i through vi
1-3 through 1-7	1-3 through 1-10
6-11 through 6-14	6-11 through 6-14
8-7 through 8-12	8-7 through 8-13
References-1 through References-2	References-1 through References-2

2. A bar (|) marks new or changed material.

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13 January 2020

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Grenade Machine Gun MK 19 MOD 3

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Preface

Training Circular (TC) 3-22.19 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which TC 3-22.19 is the proponent publication (the authority) are italicized in the text and are marked with an asterisk (*) in the glossary. Terms and definitions for which TC 3-22.19 is the proponent publication are boldfaced in the text. For other definitions shown in the text, the term is italicized and the number of the proponent publication follows the definition.

The principal audience for TC 3-22.19 is all members of the profession of arms. Commanders and staffs of Army headquarters serving as joint task force or multinational headquarters should also refer to applicable joint or multinational doctrine concerning the range of military operations and joint or multinational forces. Trainers and educators throughout the Army will also use this publication.

Commanders, staffs, and subordinates ensure that their decisions and actions comply with applicable United States, international, and in some cases host-nation laws and regulations. Commanders at all levels ensure that their Soldiers operate in accordance with the law of war and the rules of engagement. (See FM 6-27.)

This publication applies to the active Army, the Army National Guard (ARNG)/Army National Guard of the United States (ARNGUS), and the United States Army Reserve (USAR).

Uniforms depicted in this manual were drawn without camouflage for clarity of the illustration.

The proponent of this publication is United States (U.S.) Army Maneuver Center of Excellence (MCOE). The preparing agency is the MCOE, Fort Benning, Georgia. Submit comments or recommend changes by any of the following means, but you must either submit or use the format of DA Form 2028, (*Recommended Changes to Publications and Blank Forms*) to Commander, Maneuver Center of Excellence, Directorate of Training, Doctrine, Doctrine and Collective Training Division, ATTN: ATZB-TDD (TC 3-22.19), 1 Karker Street, Fort Benning, GA 31905-5410; by email to usarmy.benning.mcoe.mbx.doctrine@mail.mil or submit an electronic DA Form 2028.usarmy.benning.mcoe.mbx.doctrine@mail.mil.

Introduction

TC 3-22.19 is comprised of nine chapters and five appendices, and is specifically tailored to the individual Soldier's use of the MK 19 grenade machine gun. This TC is divided into two major parts to provide specific information about the weapon, aiming devices, attachments, followed by sequential chapters on the tactical employment of the weapon system.

TC 3-22.19 is purposely organized in a progressive manner, each chapter or appendix building on the information from the previous section. This organization provides a logical sequence of information which directly supports the Army's training strategy for the weapon at the individual level.

Chapters 1 through 4 of this TC describe the weapon, aiming devices, weapon mounts, and accessories associated with the weapon. General information is provided in the chapters of the manual, with more advanced information placed in appendix A, Ammunition, and appendix B, Machine Gun Theory.

Chapters 5 through 9 provide the employment, stability, aiming, control and movement information. This portion focuses on the Solider skills needed to produce a well-aimed burst. Appendix C of this publication provides common tactical drills that are used in training and combat that directly support tactical engagements. Appendix D provides zeroing information on this weapon. Finally, appendix E of this publication, is provided at a common location in this and future weapons publications to provide a common location for reference for qualification.

TC 3-22.19 does not cover the specific machine gun strategy, ammunition requirements for the training strategy, or range operations. These areas will be covered in separate training circulars.

TC 3-22.19 applies to all Soldiers, regardless of experience or position. This publication is designed specifically for the Soldier's use on the range during training, and as a reference while deployed.

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Chapter 1
Overview

Chapter 1 describes the principles of safe weapons handling, which includes tactical applications and control measures for handling the weapons; surveys the concepts of overmatch relative to the MK 19, and it discusses the terminal ballistic performance of MK 19 cartridges.

Each Soldier must place accurate and effective fires on threat targets with his weapon. To do this, each Soldier must understand the principles of operation, the characteristics of the ammunition, and engagement techniques that are essential to build Soldier proficiency with their weapon. This combination of knowledge and practice, builds and sustains the skills to achieve accurate and precise shots consistently during combat operations (figure 1-1).

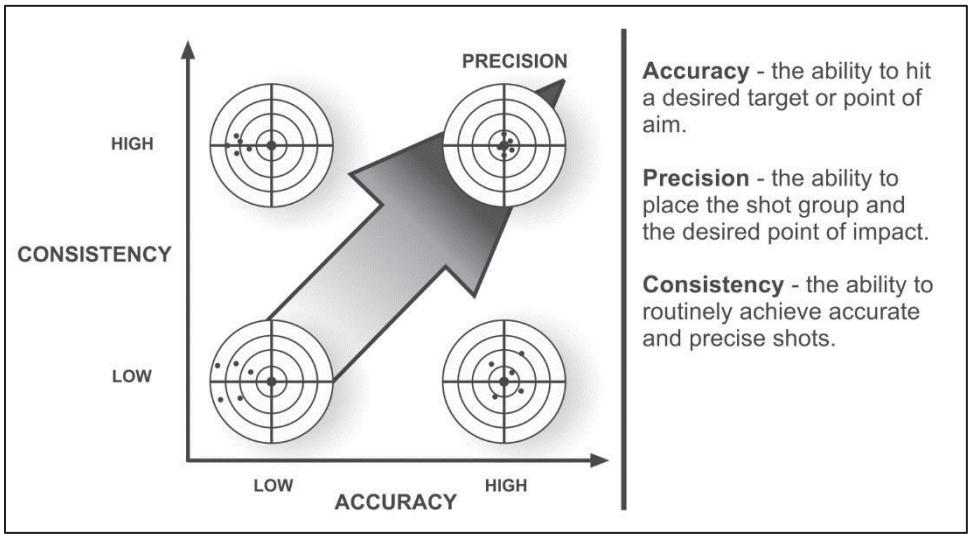


Figure 1-1. Accuracy, precision, and consistency

SAFE WEAPONS HANDLING

1-1. Safe weapons handling procedures are a consistent and standardized way for Soldiers to handle, operate, and employ the weapon safely and effectively. Weapons handling is built on three components: the Soldier, the weapon, and the environment.

- The Soldier must maintain situational understanding of friendly forces, the status of the weapon, and the ability to evaluate the environment to properly handle any weapon. The smart, adaptive, and disciplined Soldier is the primary safety mechanism for all weapons under their control.
- The weapon is the primary tool of the Soldier to defeat threats in combat. The Soldier must know of and how to operate the mechanical safeties built into the weapons they employ, as well as the principles of operation for those weapons.
- The environment is the Soldier's surroundings. The Soldier applies muzzle discipline, understands the nature of the target, and knows what is behind it.

1-2. To safely and effectively handle weapons, Soldiers must apply three weapons handling measures. These support the three factors of safe weapons handling.

- Rules of firearms safety.
- Weapons safety status.
- Weapons control status.

1-3. The weapons handling measures provide redundant safety measures when handling any weapon or weapon system in training and operational environments. A Soldier would have to violate two of the rules of firearms safety or violate a weapon safety status in order to have a negligent discharge.

Note. Unit standard operating procedures (SOPs), range SOPs, or the operational environment may dictate additional safety protocols; however, the rules of firearms safety always apply. If a unit requires Soldiers to violate these safety rules for any reason, such as by requiring Soldiers to use blank rounds or other similar training munitions during training, the unit commander must take appropriate actions to mitigate the risk.

RULES OF FIREARMS SAFETY

1-4. The rules of firearms safety are standard. They apply to any weapon a Soldier may employ. Soldiers must follow these rules at all times, in training and in combat operations, regardless of the type of ammunition.

RULE 1: TREAT EVERY WEAPON AS IF IT IS LOADED

1-5. Any weapon handled by a Soldier must be treated as if it is loaded and prepared to fire. Whether or not a weapon is actually loaded should not affect how the Soldier handles the weapon in any instance.

1-6. Soldiers must take the appropriate actions to ensure the proper weapon status is applied during operations, whether in combat or training.

RULE 2: NEVER POINT THE WEAPON AT ANYTHING YOU DO NOT INTEND TO DESTROY

1-7. Soldiers must be aware of the orientation of their weapon's muzzle and what is in the path of the projectile if the weapon fires. Soldiers must ensure the path between the muzzle and target is clear of friendly forces, noncombatants, or anything the Soldier does not want to strike.

1-8. When this is unavoidable, the Soldier must minimize the amount of time the muzzle is oriented toward people or objects they do not intend to shoot while simultaneously applying the other three rules of firearms safety.

RULE 3: KEEP THUMB(S) OFF THE TRIGGER UNTIL READY TO FIRE

1-9. Soldiers must not place their thumb(s) on the trigger unless they intend to fire the weapon. The Soldier is the most important safety feature on any weapon. Mechanical safety devices are not available on all types of weapons. When mechanical safeties are present, Soldiers must not rely upon them solely for safe operation knowing that mechanical measures may fail.

1-10. Whenever possible, Soldiers should move the weapon to mechanical safe when a target is not present. If the weapon does not have a traditional mechanical safe, the trigger finger acts as the primary safety.

RULE 4: ENSURE POSITIVE IDENTIFICATION OF THE TARGET AND ITS SURROUNDINGS

1-11. The disciplined Soldier can positively identify the target and knows what is in front of and what is beyond it. The Soldier is responsible for all bullets fired from their weapon including the projectile's final destination.

1-12. Application of this rule minimizes the possibility of fratricide, collateral damage, or damage to infrastructure or equipment. It also prepares the Soldier for any follow-on bursts that may be required.

WEAPON SAFETY STATUS

1-13. Weapon safety status (WSS) is a standard code that uses common colors (green, amber, red, and black) to represent the level of readiness for a given weapon. Each color represents a specific series of actions that are applied to a weapon. The colors are used in training and combat to place or maintain a level of safety relevant to the current task or action of a Soldier, small unit, or group.

Note. If the component, assembly, or part described is unclear, refer to the weapon's technical manual (TM 9-1010-230-10) or chapter 2 of this publication.

1-14. Figures 1-2 through 1-5, pages 1-5 through 1-7, describe the standard color code for the MK 19 MOD 3 machine gun weapon safety statuses. The gunner takes actions described in figures 1-2 through 1-5, pages 1-5 through 1-7.

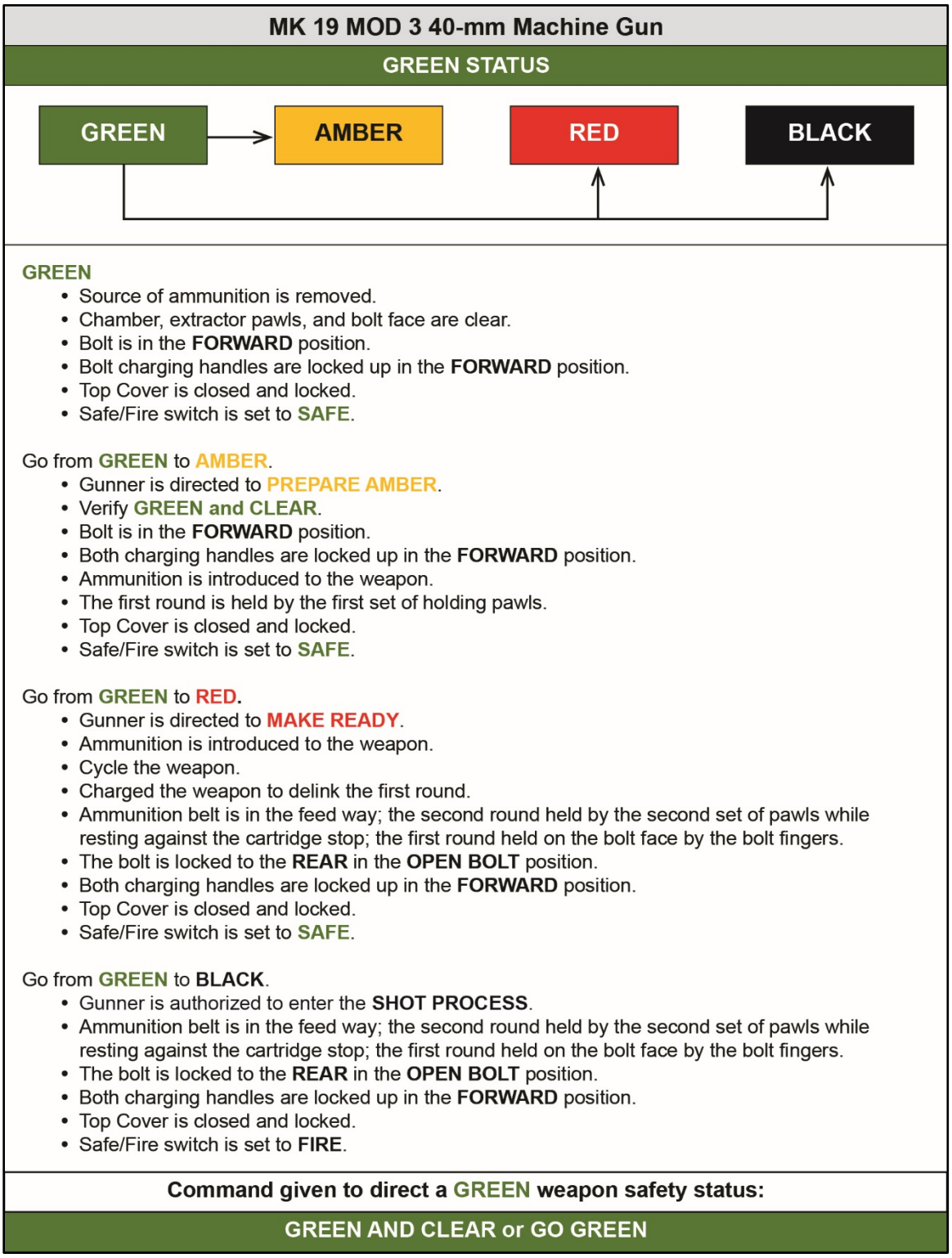
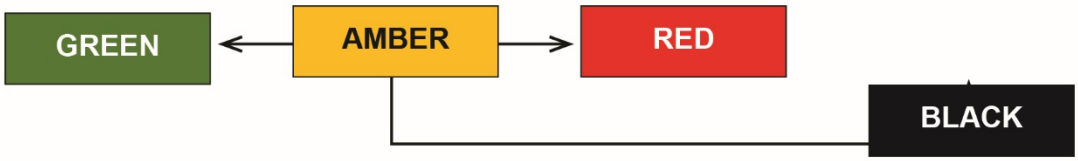


Figure 1-2. Green status

MK 19 MOD 3 40-mm Machine Gun

AMBER STATUS



AMBER

- Gunner is directed to **PREPARE AMBER**.
- Verify **GREEN and CLEAR**.
- Bolt is in the **FORWARD** position.
- Both charging handles are locked up in th **FORWARD** position.
- Ammunition is introduced to the weapon.
- The first round is held by the first set of holding pawls.
- Top Cover is closed and locked.
- Safe/Fire Switch is set to **SAFE**.

Go from **AMBER** to **GREEN**.

- Clear weapon.

Go from **AMBER** to **RED**.

- Gunner is directed to **MAKE READY**.
- Cycle the weapon.
- Charged the weapon to delink the first round.
- Ammunition belt is in the feed way; the second round held by the second set of pawls while resting against the cartridge stop; the first round held on the bolt face by the bolt fingers.
- The bolt is locked to the **REAR** in the **OPEN BOLT** position.
- Both charging handles are locked up in the **FORWARD** position.
- Top Cover is closed and locked.
- Safe/Fire switch is set to **SAFE**.

Go from **AMBER** to **BLACK**.

- Gunner is authorized to enter the **SHOT PROCESS**.
- Ammunition belt is in the feed way; the second round held by the second set of pawls while resting against the cartridge stop; the first round held on the bolt face by the bolt fingers.
- The bolt is locked to the **REAR** in the **OPEN BOLT** position.
- Both charging handles are locked up in the **FORWARD** position.
- Top Cover is closed and locked.
- Safe/Fire switch is set to **FIRE**.

AMBER is a preparatory status and is only used at the discretion of the commander.

Command given to direct an AMBER weapon safety status:

PREPARE AMBER

Figure 1-3. Amber status



Figure 1-4. Red status



Figure 1-5. Black status

WEAPON CONTROL STATUS

1-15. A weapon control status (WCS) is a tactical method of fire control given by a leader that incorporates the tactical situation, rules of engagement for the area of operations, and expected or anticipated enemy contact. The WCS outlines the target identification conditions under which friendly elements may engage a perceived threat with direct fire.

1-16. Table 1-1 provides a description of the standard WCS used during tactical operations, both in training and combat. Table 1-1 describes when the gunner is authorized to engage a threat target once the threat conditions have been met.

Table 1-1. Weapon control status

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.

1-17. A weapon control status and a weapons safety status are both implemented and available to leaders to prevent fratricide and limit collateral damage. These postures or statuses are typically suited to the area of operation or type of mission and should always be clearly outlined to all Soldiers, typically in the operations order (OPORD), warning order (WARNORD), or fragmentary order (FRAGORD).

OVERMATCH

1-18. Overmatch is the effective application of skill, technology, and force to gain and maintain an unfair advantage over any threat. To achieve and maintain this advantage, the Soldier must have the following attributes:

- Smart, the ability to routinely generate understanding through changing conditions.
- Fast, the ability to physically and cognitively outmaneuver adversaries.
- Lethal, deadly in the application of force.
- Precise, consistently accurate in the application of power to ensure delivery of the right effects in time, space, and purpose.

1-19. This requires the Soldier to understand the key elements that build the unfair advantage and exploit them at every opportunity during tactical operations. The components of overmatch are:

- Target detection, acquisition, and identification is the ability of the Soldier to detect and positively identify any suspected target as hostile at greater distances than their adversary. The Soldier must rely upon their training and their ability to leverage the capabilities of optics, thermals, and sensors.
- Engagement range provides the Soldier with weapons, aiming device(s), and ammunition capable of striking and defeating a threat at a greater range than the adversary can detect or engage the friendly force with effective fires.
- Limited visibility gives the Soldier an advantage through technology and techniques, and compounds the adversary's disadvantage during limited visibility conditions.
- Precision provides a weapon and ammunition package that enhances the Soldier's consistent application of shots with a level of precision greater than the adversary's.
- Speed is the weapon, aiming device(s), and accessories a Soldier employs, which must work in unison seamlessly, be intuitive to use, and leverage natural motion and manipulations to facilitate rapid initial and subsequent shots during engagement at close, mid, or extended range.
- Terminal performance ensures that precise bursts delivered at extended ranges provide the highest probability to defeat the threat through exceptional ballistic performance.

1-20. Although not a component of overmatch, exceptional training is critical to create smart, fast, lethal, and precise Soldiers. Training builds proficiency in a progressive, logical, and structured manner and provides Soldiers the skills necessary to achieve overmatch against any adversary. This requires the training

program to provide experience to the Soldier in all the components of overmatch to their fullest extent possible in the shortest amount of time.

TARGET DETECTION, ACQUISITION, AND IDENTIFICATION

1-21. The first component of overmatch at the Soldier level is the ability to detect targets as far away as possible during limited and low visibility conditions. TC 3-22.19 describes the aiming devices for the MK 19 that enhance the Soldier's target detection and acquisition skills. The Soldier must be able to detect, acquire, and identify targets at ranges beyond the maximum effective range of their weapon and ammunition. In addition, this manual also provides key recognition information to build the Soldier's skills in correctly identifying potential targets as friend, foe, or noncombatant (neutral) once detected.

ENGAGEMENT RANGE

1-22. To ensure small unit success, the Soldier requires weapon systems that can effectively engage threats at ranges greater than those of their adversaries. The weapons system creates a standoff distance advantage that allows friendly forces to destroy the target outside the threat's maximum effective range.

1-23. Range overmatch provides a tactical engagement buffer that accommodates the Soldier's time to engage with precision fires. For example, a Soldier that has the capability to effectively engage personnel targets at a range of 500 meters will have range overmatch of 10 to 20 percent over a threat rifleman. That 10 to 20 percent range difference is equivalent to a distance of 40 to 80 meters, which is approximately the distance a maneuvering threat can traverse in 15 to 40 seconds.

1-24. Figure 1-6 shows the battlefield from the Soldier's perspective. With mobile, maneuvering threats, the target acquisition capabilities must compliment the engagement of those threats at the maximum effective range of the weapon, optic, and ammunition.

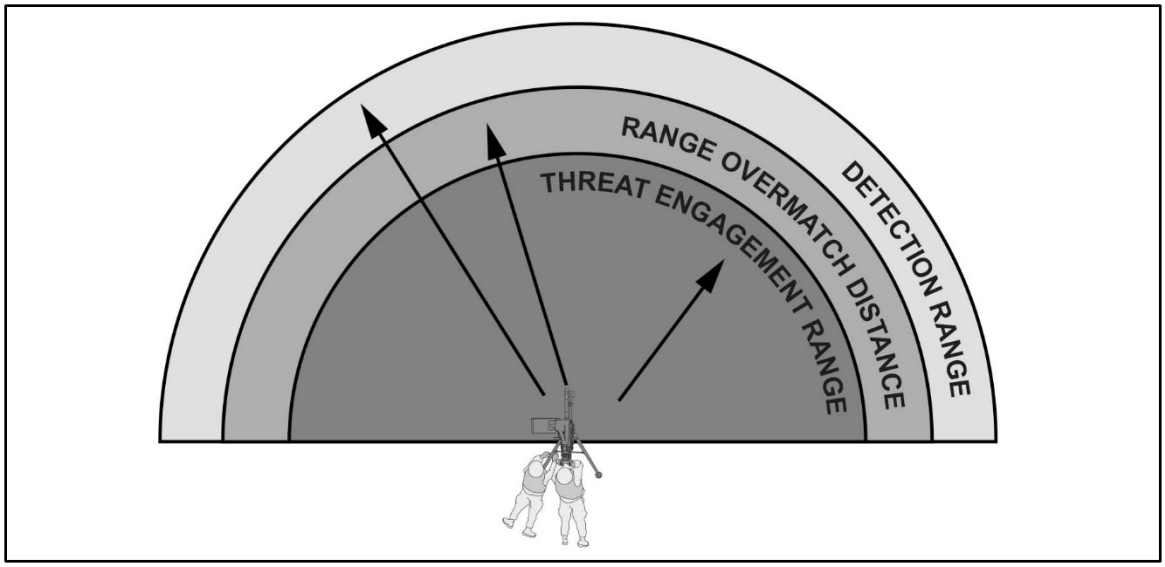


Figure 1-6. Small unit range overmatch

LIMITED VISIBILITY

1-25. Soldiers must be able to detect, acquire, identify, and engage threats in all light conditions. Aiming devices minimize, but do not completely eliminate, the effects of limited visibility.

1-26. Image intensifiers and thermal optics provide a significant overmatch capability, but they also have limitations and disadvantages. A general discussion of their capabilities, particularly what those systems can view within the spectrum of light is provided. Soldiers must understand what can and cannot be seen or viewed when using their assigned equipment. Understanding the advantages and limitations of their

equipment has a direct impact on force protection, fratricide and collateral damage prevention, and maintaining overmatch during tactical operations.

PRECISION

1-27. The MK 19 is designed with a specific level of accuracy out to its maximum effective range of 1500 meters point target and 2212 meters area target. This level of accuracy is more consistent and reliable with magnified aiming devices and superior ammunition. The Soldier must build the skills to use the magnified aiming devices to effectively deliver precision fires during tactical engagements.

SPEED

1-28. The close fight requires rapid manipulations, a balance of speed and accuracy, and very little environmental concerns. Soldiers must move quickly and efficiently through their manipulations of the fire control to maintain the maximum amount of muzzle orientation on the threat through the shot process. The Soldier's second-nature efficiency of movement comes only from regular practice, drills, and repetition.

1-29. The foundation of speed of action is built through understanding the weapon, ammunition, ballistics, and principles of operation of the associated aiming devices. Speed of action is reinforced during drills (appendix C) and the unit training program.

1-30. The goal of training to overmatch is to increase the speed at which the Soldier detects a threat, identifies it as hostile, and executes the shot process with the desired target effect. TC 3-22.19 provides the requisite information in a progressive manner to build and reinforce Soldier understanding, confidence and ability to execute tactical operations with speed and smooth fluidity of motion.

TERMINAL BALLISTIC PERFORMANCE

1-31. Terminal ballistic performance is the actions of a projectile from the time it strikes an object downrange until it comes to rest. The ammunition used with the MK 19 performs exceptionally well out to its maximum effective range and beyond. Appendix A, Ammunition provides information on the various munition types available for training and combat, their capabilities and purpose, and the terminal ballistic performance.

1-32. Soldiers must understand the capabilities of their ammunition, whether designed for training or combat use. An understanding of the ammunition's capabilities creates a respect for the weapon and ammunition, reinforces the precepts of safe weapons handling, and an understanding of the appropriate skills necessary to deliver lethal fires.

1-33. Soldiers that understand the how and why of their weapon system, aiming devices, ammunition, and procedures work or function develops a more comprehensive understanding. Soldiers' level of understanding, coupled with a rigorous training program that builds and strengthens their skills create more proficient Soldiers. The proficiencies and skills displayed during training translate into smart, fast, lethal and precise Soldiers for the small unit during decisive action combat operations.

Chapter 2

Principles of Operation

Chapter 2 provides the general characteristics, description, available components, and principles of operation for the MK 19, 40-mm grenade machine gun, model (mod). It provides a general overview of the mechanics and theory of how weapons operate, key terms and definitions related to their functioning, and the physical relationship between the Soldier, the weapon, and the optics/equipment attached to the weapon.

DESCRIPTION

2-1. The MK 19 is an air-cooled, blowback-operated machine gun with six major assemblies. A disintegrating metallic link belt feeds ammunition from the left. The MK 19 provides automatic weapon suppressive fire for offensive and defensive purposes. The MK 19 can be used effectively against personnel, light armored vehicles, and hovering rotary aircraft. The weapon system is used as a ground gun mounted on the M3 tripod or the M205 lightweight tripod.

2-2. The MK 19 consists of components, assemblies, subassemblies, and individual parts. Soldiers must be familiar with these items and how they interact during operation.

- Components are uniquely identifiable group of fitted parts, pieces, assemblies or subassemblies that are required and necessary to perform a distinctive function in the operation of the weapon. Components are usually removable in one piece and are considered indivisible for a particular purpose or use.
- Assemblies are a group of subassemblies and parts that are fitted to perform specific set of functions during operation, and cannot be used independently for any other purpose.
- Subassemblies are a group of parts that are fitted to perform a specific set of functions during operation. Subassemblies are compartmentalized to complete a single specific task. They may be grouped with other assemblies, subassemblies and parts to create a component.
- Parts are the individual items that perform a function when attached to a subassembly, assembly, or component that serves a specific purpose.

MAJOR COMPONENTS

2-3. The six assemblies in the MK 19 are the bolt and backplate assembly, receiver assembly, feed slide assembly and tray, top cover assembly, feed throat assembly, and sear assembly (see figure 2-1). Table 2-1 shows technical data:

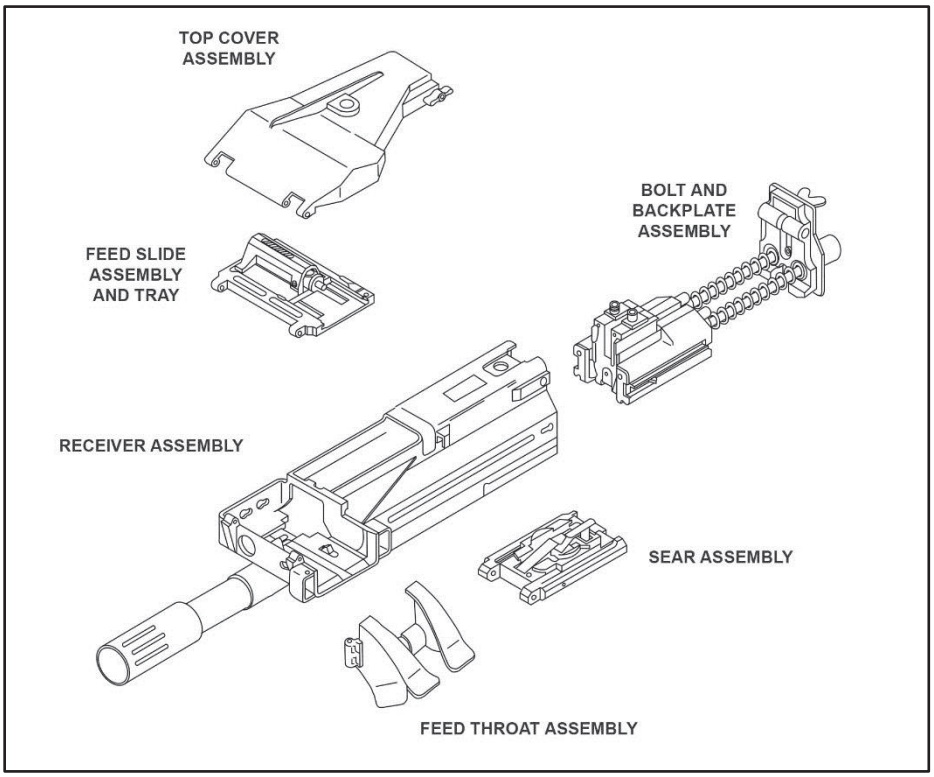


Figure 2-1. Assemblies

BOLT AND BACKPLATE ASSEMBLY

2-4. The bolt fires the round when the sear is depressed by trigger action. The recoil springs drive the bolt forward on the receiver rails. The guide rods hold the springs in position. Trigger and handgrips are located on the backplate assembly.

RECEIVER ASSEMBLY

2-5. The receiver assembly holds the barrel and other parts of the gun. Ammunition is fed into the left side of the receiver through the feed throat assembly. The MK 19's barrel will not overheat, even after prolonged firing.

FEED SLIDE ASSEMBLY AND TRAY

2-6. The feed slide assembly and tray hold the rounds in the feeder and indexes the ammunition into position for delinking.

TOP COVER ASSEMBLY

2-7. The top cover assembly holds the feed slide assembly and tray. It is opened by a latch (left side) to load the weapon or to clean and inspect the feeder area. A blade-type front sight is attached to the top cover assembly.

FEED THROAT ASSEMBLY

2-8. The feed throat assembly allows smooth feeding of 40-mm ammunition. The feed throat assembly attaches to the forward left side of the receiver by two sets of spring-loaded retaining pins. Without a feed throat, machine gun stoppages may occur because of twisted or misaligned rounds.

SEAR ASSEMBLY

2-9. The sear assembly holds the receiver sear. Trigger action releases the sear and allows the bolt to go forward. The safety is attached to the sear assembly.

Table 2-1. Technical data

MK 19 (Mod 3):		
Weight without feed throat	77.6	Pounds
Weight with feed throat	78.0	Pounds
Length	43.1	Inches
Width	14.0	Inches
Height	8.8	Inches
MK 64 (MOD 7) gun cradle:		
Weight	21.0	Pounds
Length	17.5	Inches
Height	9.5	Inches
Tripod (M3) weight: **Tripod (M205) weight:**	44.00 34.00	Pounds Pounds
Gun and cradle:		
Weight without feed throat	98.6	Pounds
Weight with feed throat	99.0	Pounds
Gun, cradle, and tripod:		
Weight without feed throat	142.6	Pounds
Weight with feed throat	143.0	Pounds
Mounts:	**Ammunition:**	
M3 tripod	M430 (HEDP)	
M4 pedestal	M383 (HE)	
M66 ring	M918 (TP)	
HMMWV weapon platform	M922 (dummy)	
M113		
APC commander's cupola		
Remote Weapons Station		
Note. Keep the feed throat attached to the weapon.		
LEGEND: APC: armored personnel carrier HE: high explosive HEDP: high explosive dual purpose HMMWV: high mobility, multipurpose wheeled TP: target practice		

CYCLE OF FUNCTION

2-10. The cycle of function is the mechanical process the weapon follows during operation. The cycle begins when the Soldier manually operates the recoiling groups, which places the first round in the chamber. The cycle of function are:

- Charging.
- Extracting.
- Cocking.
- Firing.
- Recoil.
- Automatic feeding.

2-11. The weapon has six major mechanical functions that occur during its cycle of operation: charging, extracting, cocking, firing, recoil, and automatic feeding. Within each paragraph is a description of the function. (Refer to TM 9-1010-230-23&P for more information☺

CHARGING

2-12. Charging is the process of manually pulling the bolt to the rear by pulling the charging handle assemblies. (See figure 2-2.) The bolt assembly's rearward movement causes the primary drive lever to move to the left. The primary drive lever rotates the adjustable secondary drive lever. The forked end of the secondary drive lever, which rests on the inner feed slide pin, moves the feed slide assembly to the right. The feed pawls on the feed slide assembly move the linked rounds over one place in the ammunition-feed area of the receiver. The leading round is now in line with the bolt face.

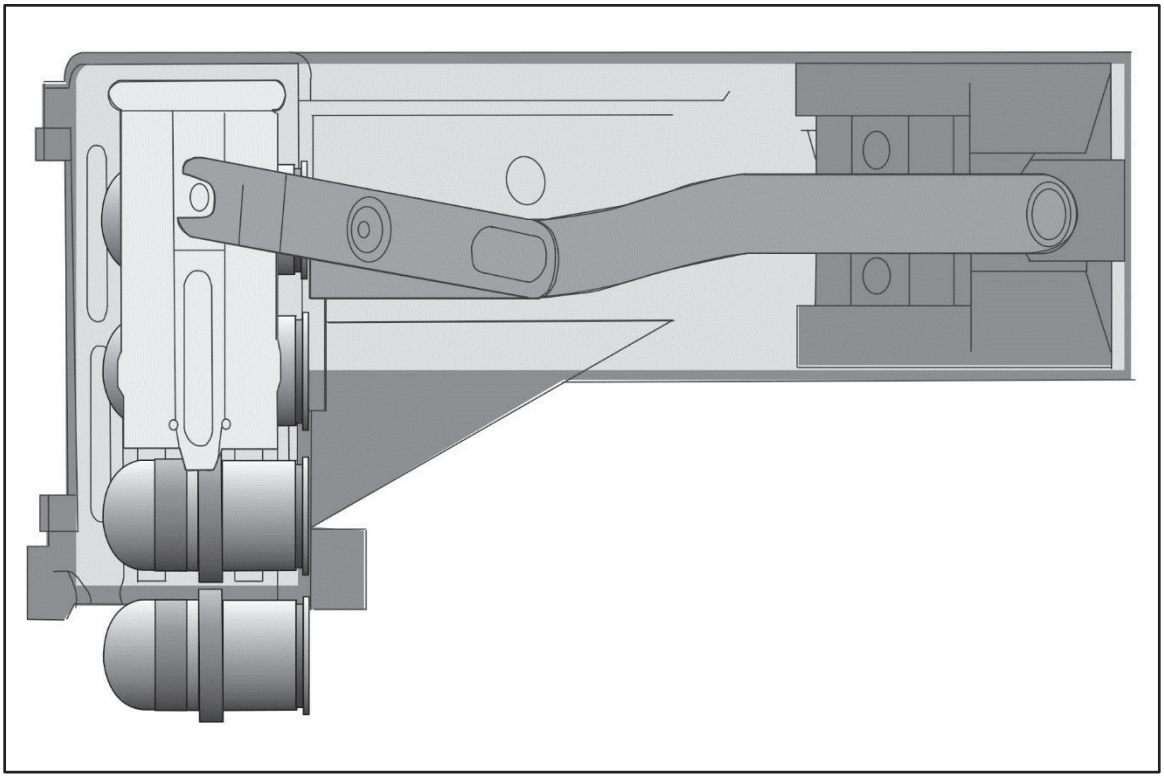


Figure 2-2. Charging

EXTRACTING

2-13. When the operator presses the trigger after charging the gun, the bolt slams forward under spring tension. (See figure 2-3.) The bolt's extractors snap over the cartridge of the leading round. As the operator charges the gun a second time, the link on the second round in the feeder contacts a depression in the receiver forcing the male and female links apart. As the round is pulled rearward by the extractors, the curved edge of the vertical cam assembly forces the round down the face of the bolt, out of the extractors, and into the bolt fingers. When the bolt is fully to the rear, the round is lined up with the chamber. The primer of the round is aligned with the firing pin, ready for firing. The rounds in the ammunition feed area move over one place.

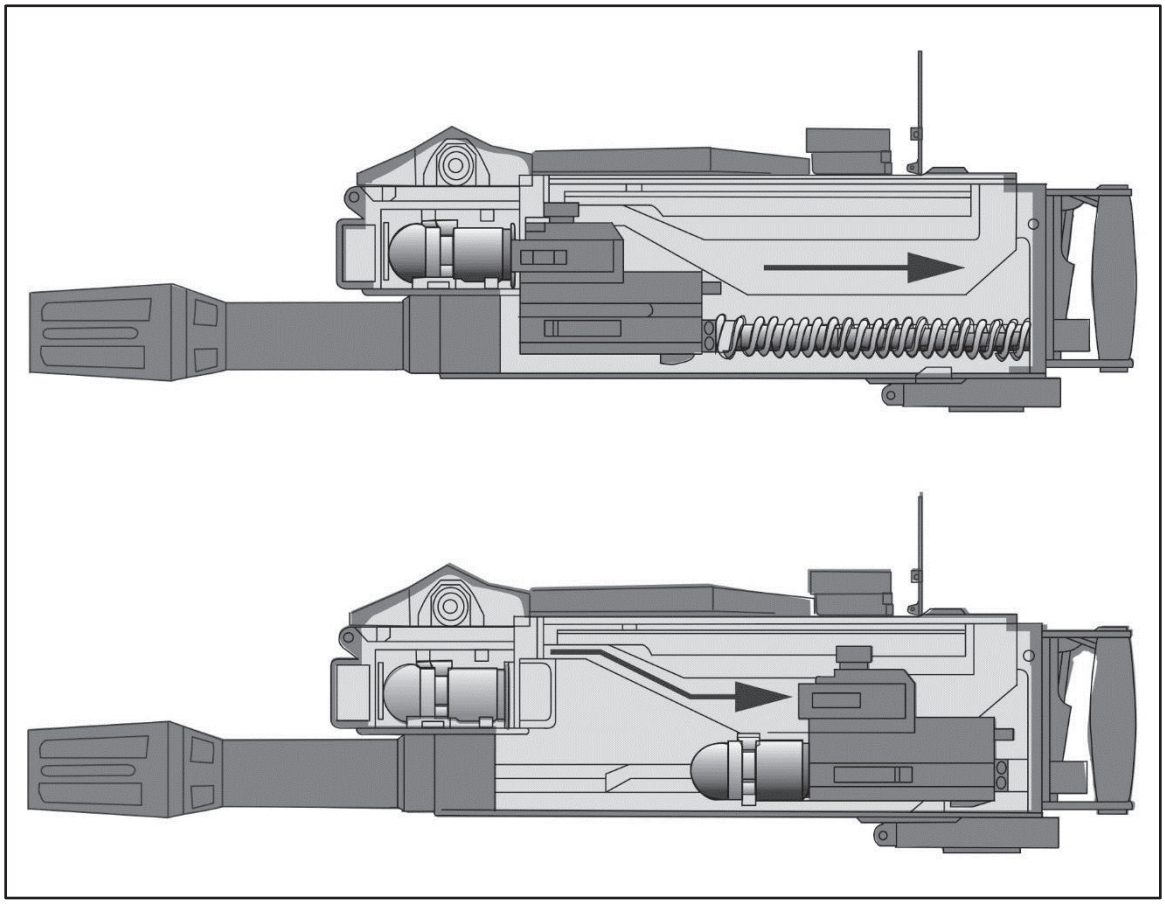


Figure 2-3. Extracting

COCKING

2-14. The rearward movement of the bolt causes the cocking lever to retract the firing pin. (See figure 2-4.) The firing pin is held rearward by the firing pin sear. The firing pin sear and the cocking lever each prevent the gun from firing until the bolt is released forward.

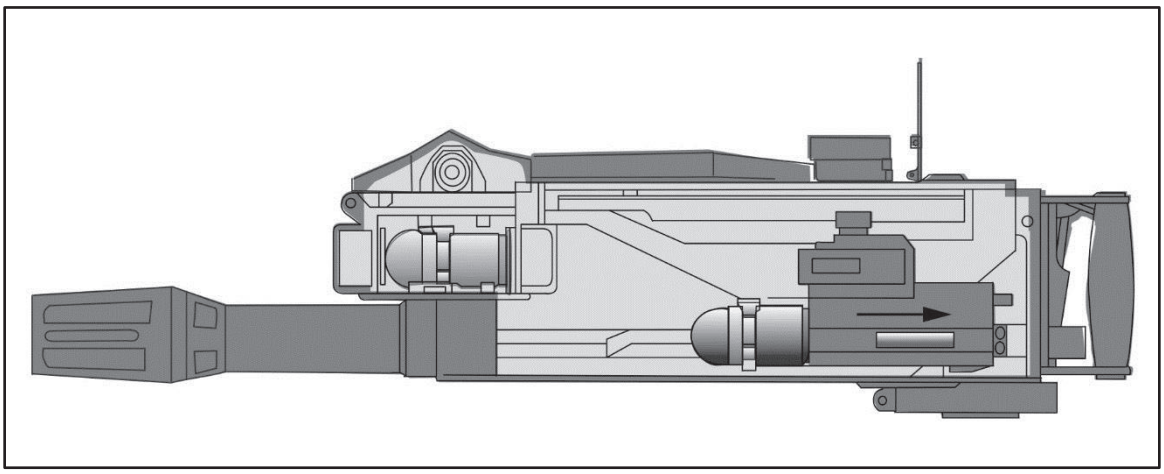


Figure 2-4. Cocking

FIRING

2-15. The releasing of the firing pin detonates the primer. Before the MK 19 Mod 3 will fire—

- The bolt must be to the rear with the firing pin cocked.
- A round must be centered on the face of the bolt by the bolt fingers.
- Both charger handle assemblies must be forward, up, and locked.

Note. If either charger handle assembly is down, the bolt sear will not contact the forward end of the receiver, which is necessary in order for the firing pin to strike the primer, igniting the propellant and firing the round.

- The thumb safety must be on F (fire).

2-16. When the operator presses the trigger, the trigger depresses the operating rod, which depresses the tip of the receiver sear. (See figure 2-5.) The receiver sear disengages the bolt sear. The bolt is released forward under spring tension, with a round in its bolt fingers. When the cocking lever hits the forward end of the left-hand receiver rail slot, it is forced rearward. The bolt sear hits a plate in the bottom of the receiver, pushing the firing pin sear up to release the firing pin. The firing pin is driven forward, under tension by the firing pin spring. The firing pin detonates the primer of the round, igniting the propellant. At the moment of firing, the round, which has a reinforced propellant chamber, is not fully within the barrel's chamber. (The bolt never locks in the weapon.) Thus, the cartridge case protrudes from the chamber, still held by the bolt fingers. The exploding powder then forces the projectile down the bore and out the muzzle of the gun. The bolt is fully forward with a new round in its extractors.

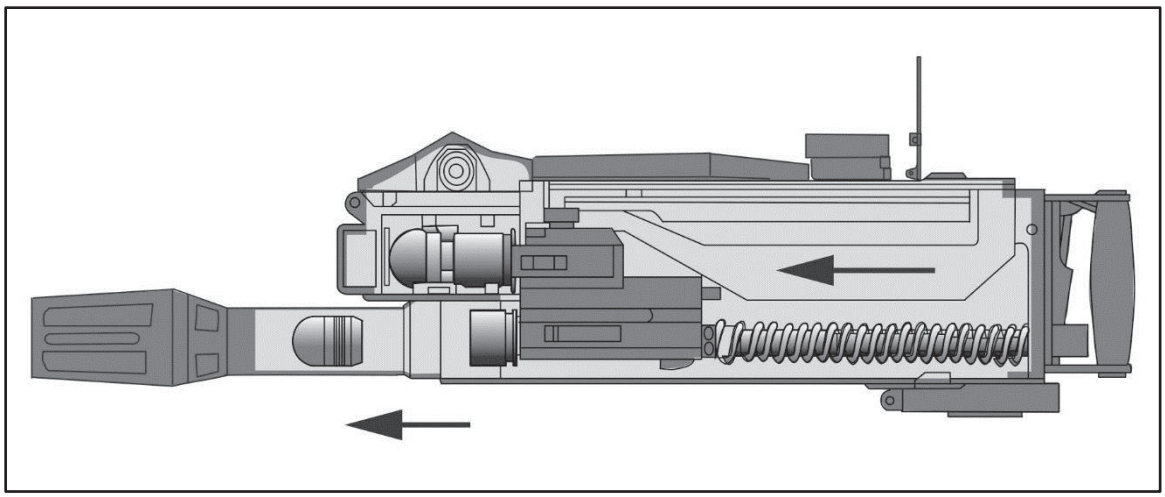


Figure 2-5. Firing

RECOIL AND AUTOMATIC FEEDING

2-17. The gases from the burning powder blow the bolt rearward with a new round in its extractors. (See figure 2-6.) During recoil, several functions happen almost at once. The new round is extracted and is cammed down on top of the spent case by the vertical cam's curved rail. The spent case with its link still attached is forced from the bolt fingers and out the bottom of the gun (ejection). The feed slide assembly pulls the round to the right in the receiver's ammunition-feed area, where a new round is now ready to be delinked and extracted (automatic feeding). During the bolt's rearward travel, the cocking lever is pushed forward, which cocks the firing pin. When the bolt reaches the limit of its rearward travel, the recoil springs are completely compressed. Any over-travel is absorbed by the bolt buffer assembly and receiver buffer bodies thus reducing trunnion load (recoil force) at the gun/mount attaching points.

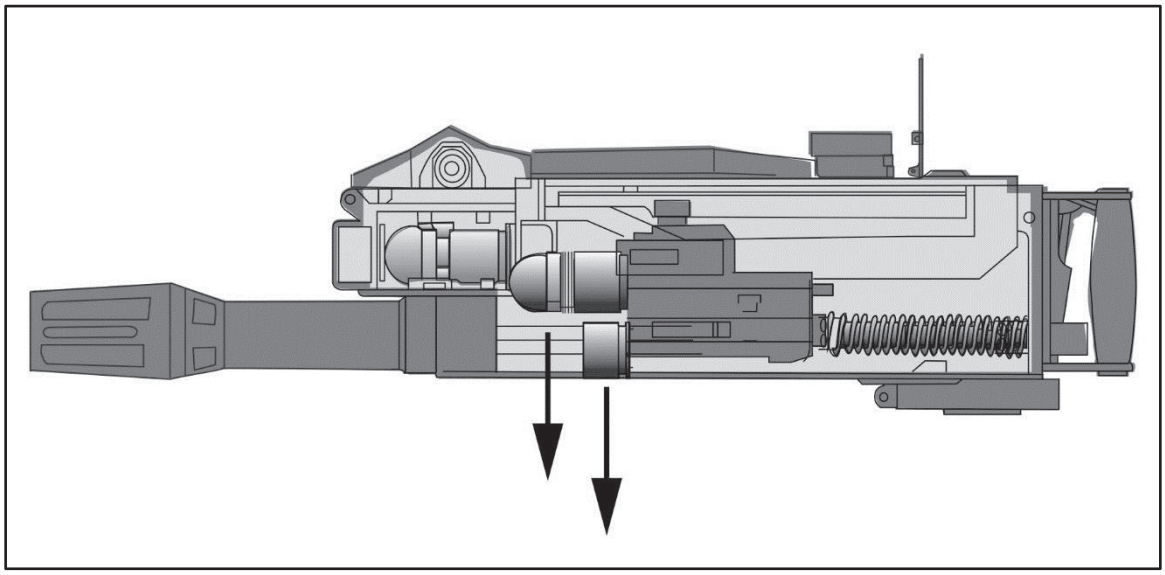


Figure 2-6. Recoil and automatic feeding

COOLING

2-18. Cooling is the process of dissipating heat from the weapon during firing. Although not part of the cycle of function, cooling the weapon during firing is critical to ensure the weapon continues to operate efficiently. Firing a round generates heat and pressure within the chamber and bore, which radiates outward through the metal of the barrel.

2-19. The temperature generated by the burning of propellant powders is greater than 1000 degrees Fahrenheit. Some of the heat produced during firing remains in the chamber, bore, and barrel during firing, endangering the firer.

2-20. How this heat is absorbed by the weapon and dissipated or removed, Air cooling, which is a function of engineering and design, allows the heat absorption by the weapon and the heat's subsequent dissipation and removal. Maximum surface of the barrel and receiver are exposed to permit air cooling. Perforations in the barrel support allow air to circulate around the breach end of the barrel and help in cooling the parts. A heavy barrel retards early overheating.

2-21. Radiation, conduction, and convection cooling are used by the MK 19 to reduce the thermal stress on a weapon.

RADIATIONAL COOLING

2-22. Radiational cooling allows for the dissipation of heat into the surrounding cooler air. This is the least efficient means of cooling, but is common to most small arms weapons.

CONDUCTION COOLING

2-23. Conduction cooling occurs when a heated object is in direct physical contact with a cooler object. Conduction cooling on a weapon usually results from high chamber operating temperatures being transferred into surrounding surfaces such as the barrel and receiver of the weapon. The transfer from the chamber to the cooler metals has the net effect of cooling the chamber. Thermal energy is then carried away by other means, such as radiant cooling, from these newly heated surfaces.

CONVECTION COOLING

2-24. Convection cooling requires the presence of a moving air current. The moving air has greater potential to carry away heat. The perforations in the barrel support are designed to facilitate air movement.

2-25. Soldiers should know how the weapon's cooling methods directly affect their line of sight. Dissipating heat along the length of the barrel can create a mirage effect within the line of sight, which can cause a significant error to the true point of aim when using magnified optics.

Chapter 3

Aiming Devices

Every weapon has a fixed or attached device for aiming. Soldiers must be familiar with the various aiming devices, how they operate, and how to employ them correctly for the best effect. Chapter 3 provides the principles of operation of the most widely available aiming devices, and provides general information concerning their capabilities, function and use.

An aiming device is used to align the Soldier, the weapon, and the target to make an accurate and precise shot. Each aiming device functions in a different manner. To employ the weapon system to its fullest capability, the Soldier must understand how their aiming devices function.

Different types of aiming devices are useful in different settings. The main categories of devices include the iron sight (leaf sight), thermal weapon sight (TWS), and available pointing devices.

FUNCTIONS

3-1. Soldiers use an aiming device to align themselves, the weapon, and the target to make an accurate and precise shot. Each aiming device functions in a different manner. The Soldier must understand how the aiming device functions to employ the weapon system to its fullest capability.

3-2. The following aiming devices are described within this chapter:

- Iron sights. The iron sight represents the mechanical sighting system available on the weapon. The mechanical sighting system consists of the rear aperture and the front sight post
- Thermal. Thermals are electronic sighting systems that provide a view of the field of view based on temperature variations. The numerous variants of thermal optics are grouped into one type, which is the thermal weapon sight (TWS).
- Pointer, illuminator, laser. The pointer, illuminator, laser aiming devices use either a laser beam, flood light, or other light to aim the weapon at the target. The automatic rifle/light machine gun uses four types of pointers, illuminators, and lasers listed below:
  - Infrared aiming light
  - Advanced Target Pointer/Illuminator/Aiming Light (ATPIAL).
  - Dual Beam Aiming Laser–Advanced (DBAL-A2).
  - Illuminator, integrated, small arms (STORM).

UNITS OF ANGULAR MEASUREMENT

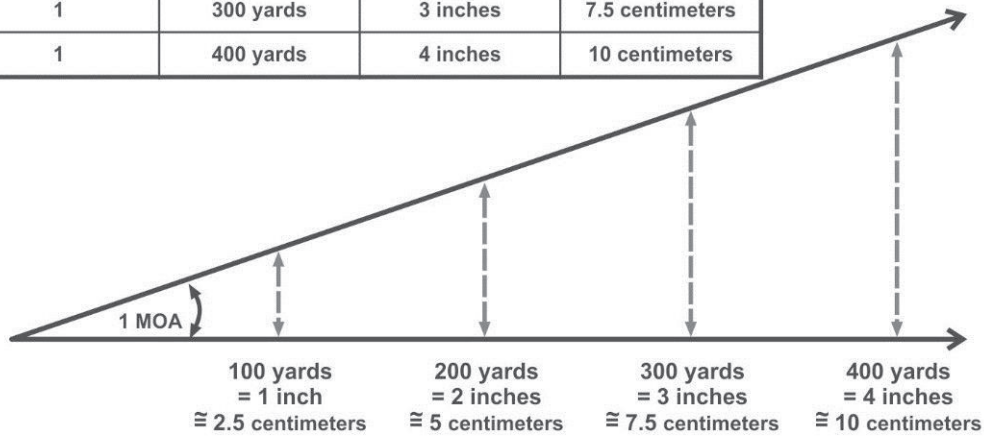
3-3. Two major units of angular measurement the Army uses: milliradians (mils) and minutes of angle (MOA). Mils and MOAs describe a measurement of accuracy when firing a weapon, system, or munition. Mils and MOAs typically include the accuracy of a specific weapon, the performance of ammunition, and the ability of a shooter to fire the weapon.

MINUTE OF ANGLE

3-4. Minute of angle is an angular unit of measurement equal to 1/60 of a degree. (See figure 3-1.) The most common use of MOA is to describe the distance of change required when zeroing a weapon.

3-5. One MOA equals 1.047 inches per 100 yards. For most applications, a Soldier can round this down to 1 inch at 100 yards or 1.1 inches at 100 meters to simplify their arithmetic.

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



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

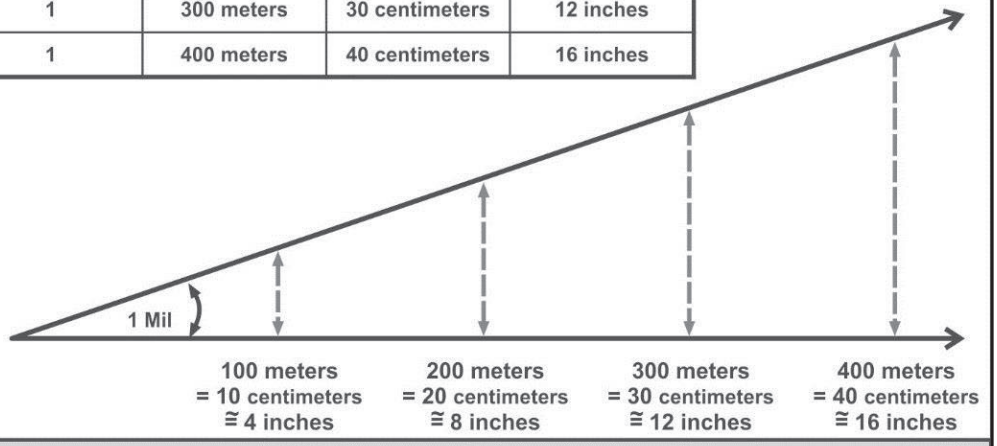
Minute of Angle (MOA) Unit of Measurement	
1. Degree = 60 MOA	3. 360 degrees x 60 MOA = 21,600 MOA
2. Circle = 360 degrees	4. 1 MOA at 100 yards = 1 inch.
Smaller measurements of an MOA are described in fractions (such as 1/2 MOA), not seconds.	

Figure 3-1. Minute of angle example

MIL

3-6. The mil is a common unit of angular measurement that is used in direct fire and indirect fire applications. This mil to degree relationship is used when describing military reticles, ballistic relationships, aiming devices, and on a larger scale, map reading and for indirect fire. (See figure 3-2.)

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



MILS Unit of Measurement	
1. Degree = 17.78 mils	3. 360 degrees x 17.78 mils
2. Circle = 360 degrees	4. 1 mil at 100 meters = 10 centimeters.

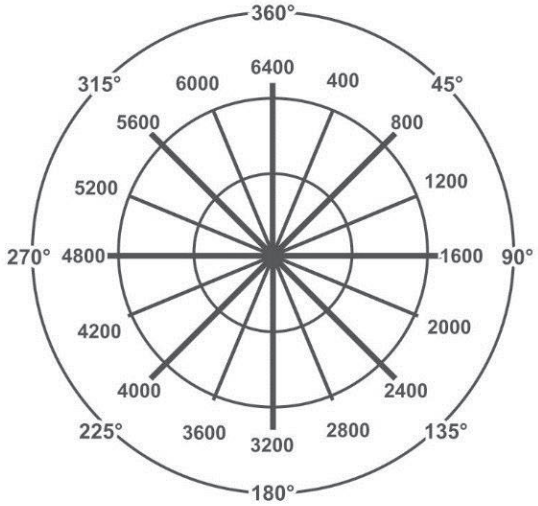


Figure 3-2. Mil example

STADIA RETICLE (STADIAMETRIC RETICLE)

3-7. A reticle is a series of fine lines in the eyepiece of an optic (see figure 3-3) used as a measuring scale with included aiming or alignment points. Reticles use either mils or minute of angle for their unit of measurement.

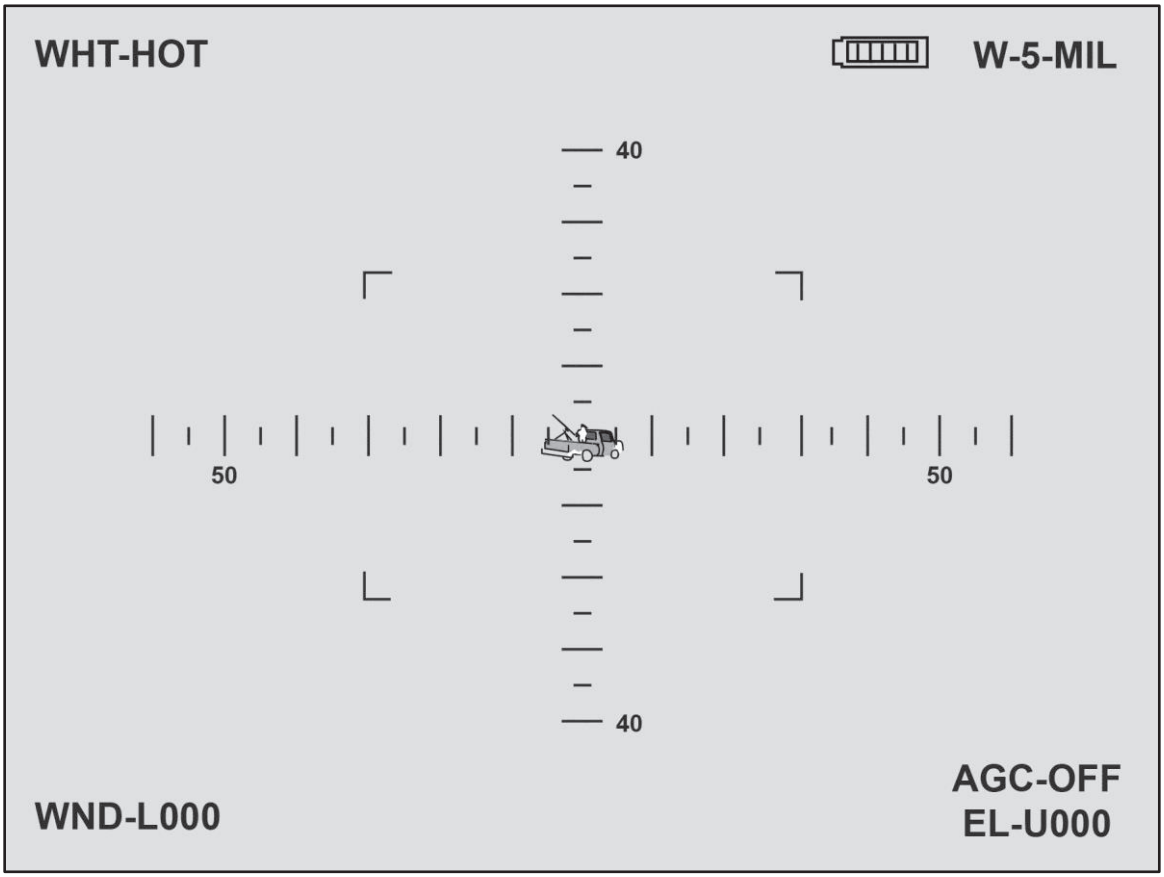


Figure 3-3. Thermal reticle example

3-8. The MK 19 uses only one type of reticle, a stadia reticle, which provides a means of rapidly determining the approximate range to target of a viewed threat, based on the target's standard dimensions.

3-9. The stadia reticle (sometimes referred to as stadiametric or "choke sight") can provide approximate range to target information using width or height of a five-foot man or a 10-foot wide tank using standard threat dimensions. The TWS has two stadia reticles, one vertical and one horizontal (See figure 3-4.)

- Vertical stadia. Soldiers can evaluate the range to target of a standing dismounted threat using the corresponding vertical lines.
- Horizontal stadia. Soldiers can evaluate the range to target of an exposed 10-foot wide tank based on the width of the target using the horizontal lines.

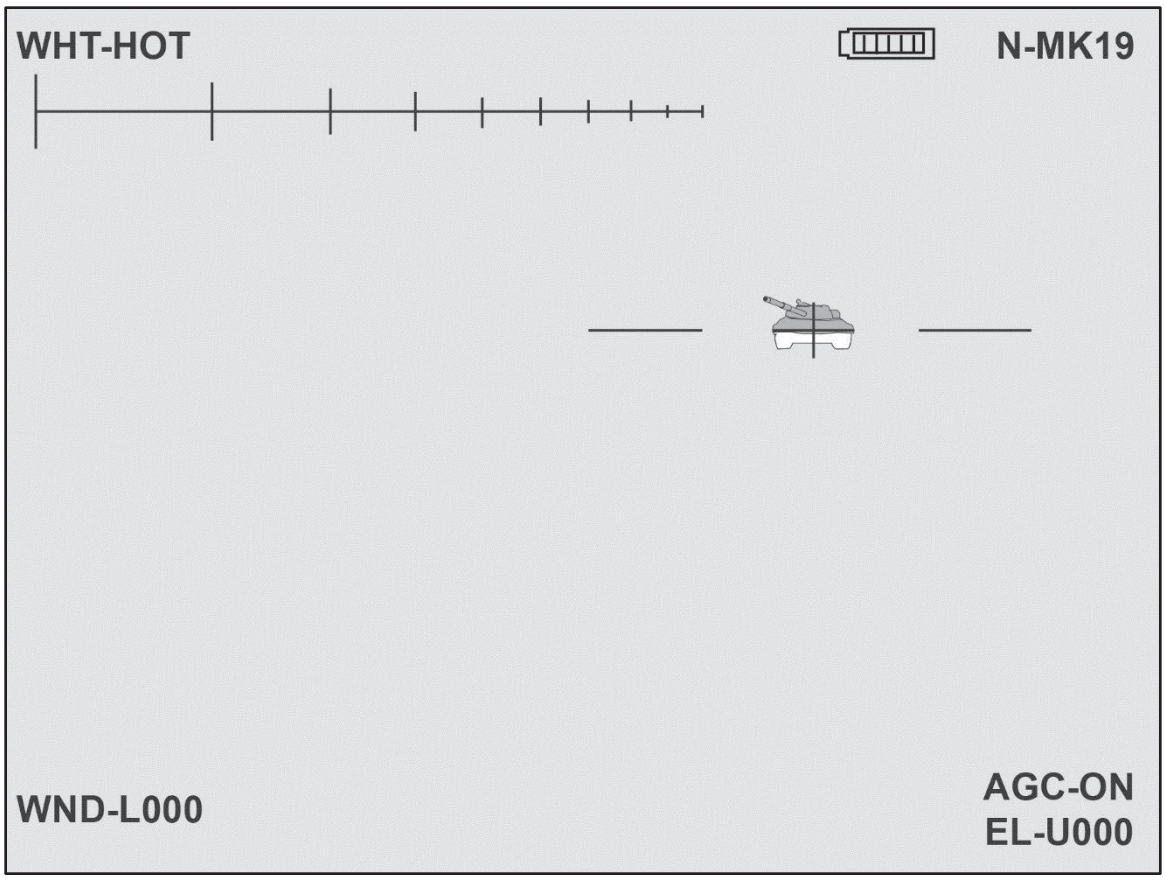


Figure 3-4. Stadia reticle example

ELECTROMAGNETIC SPECTRUM

3-10. A major concern for the planning and use of thermal and other optics to aid in the detection process is understanding how they function, but more appropriately, what they can see. Each device develops a digital representation of the scene or view it is observing based on what frequencies or wavelengths it can detect within the electromagnetic spectrum.

Note. Thermal devices see differences in heat.

THERMAL OPTICS

3-11. This equipment operates in the mid- and far-wavelength of the infrared band, which is the farthest of the infrared wavelengths from visible light. Thermal optics cannot translate (see) visible light. Thermal optics cannot see infrared equipment such as infrared (IR) strobe lights, IR chemical lights, illuminators, or laser pointers. They can only identify emitted radiation in the form of heat. (See figure 3-5 on page 3-7.)

IMAGE INTENSIFIERS

3-12. Image intensifiers (I2), such as night vision devices, use the near area of the infrared spectrum closest to the frequencies of visible light, as well as visible light to create a digital picture of the scene. These systems cannot *see* or detect heat or heat sources.

3-13. These sights generally operate on the principles of convection, conduction, and radiation (mentioned in chapter 2 of this publication). The sight picks up or translates the IR wavelength (or light) that is emitted from a target scene through one of those three methods. Things to be aware of (planning considerations) with these optics are that they have difficulty imaging through the following:

- Rain absorbs the IR emitted by the target, makes it difficult to see.
- Water acts as a mirror and generally reflects IR, providing a false thermal scene.
- Glass acts similar to water, interfering with the sensor's ability to accurately detect emitted radiation behind the glass.

3-14. Situations where IR can see better are the following:

- Smoke will not obscure a target unless the chemical obscurant is extremely hot and dense, or if the target is sitting on top of the smoke source.
- Dust may interfere with the accurate detection of the emitted thermal signature due to dust and debris density between the sensor and the target scene. Dust typically does not obscure the IR signature unless its temperature is similar to the targets.

3-15. Figure 3-5 on page 3-7 shows the areas of the electromagnetic spectrum. It details the various wavelengths within the spectrum where the aiming devices, night vision devices, and equipment operate. It shows where these items can and cannot "see" the others, respectively, within their operating range. Situations where IR can see better are the following:

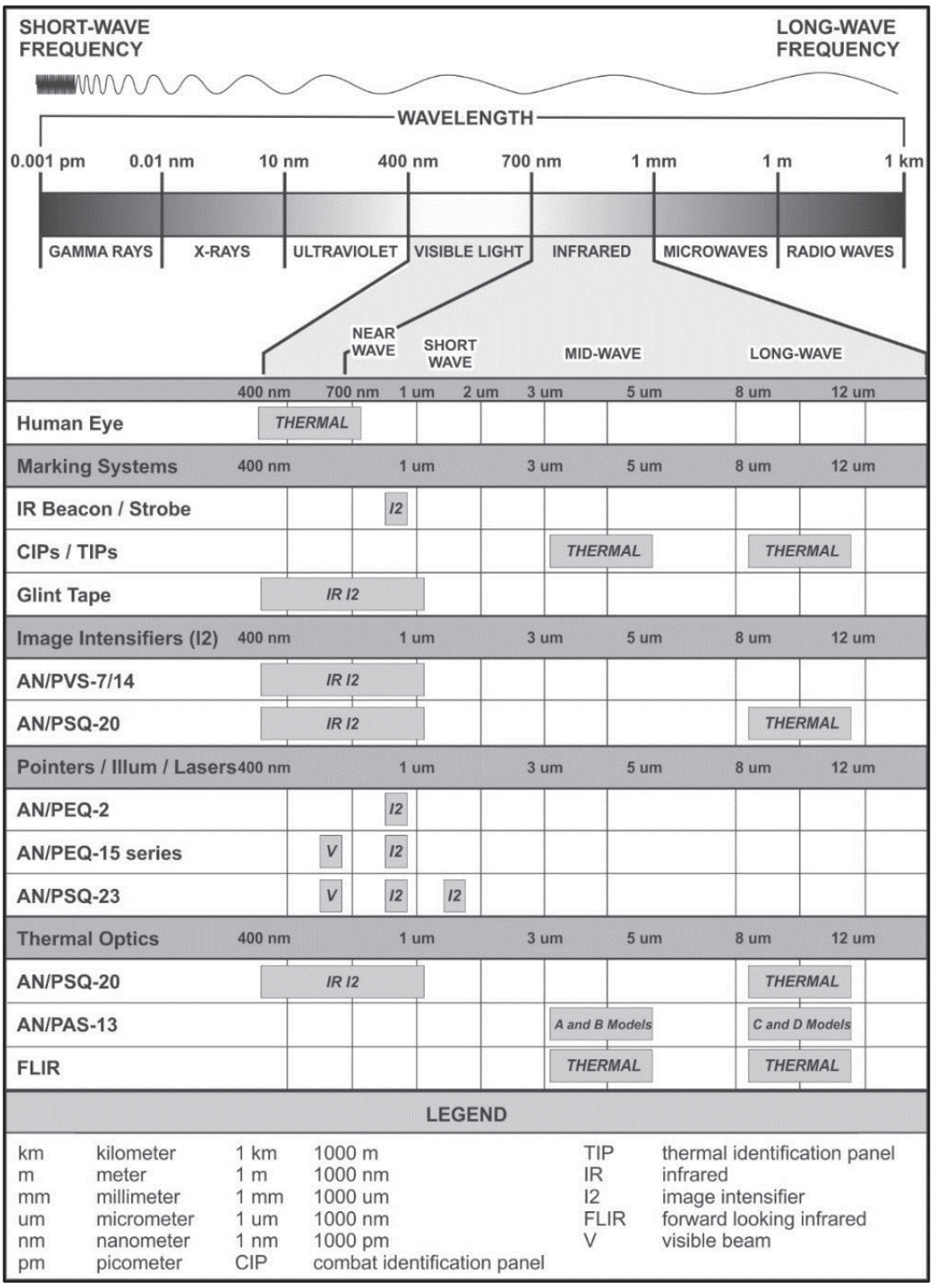


Figure 3-5. Electromagnetic spectrum

IRON SIGHTS

3-16. The MK 19 is the rear sight assembly. (See figure 3-6.) The integrated rear aperture includes adjustments for both azimuth (wind) and elevation (range). Specific instructions for boresighting the rear sight assembly are found in TM 9-1010-230-23&P.

3-17. This assembly is hinged to the rear sight base hinge support on top of the receiver. The rear sight base is held by four socket-head cap screws and is designed to hold the AN/TVS-5 night vision sight. The M2 bracket interfaces between the rear sight and the AN/TVS-5. The scale dial ranges from 300 to 1500 meters. The windage screw permits deflection changes to right or left of center in a 1-mil increments. The front sight is a fixed blade type with cover. (See figure 3-7.)

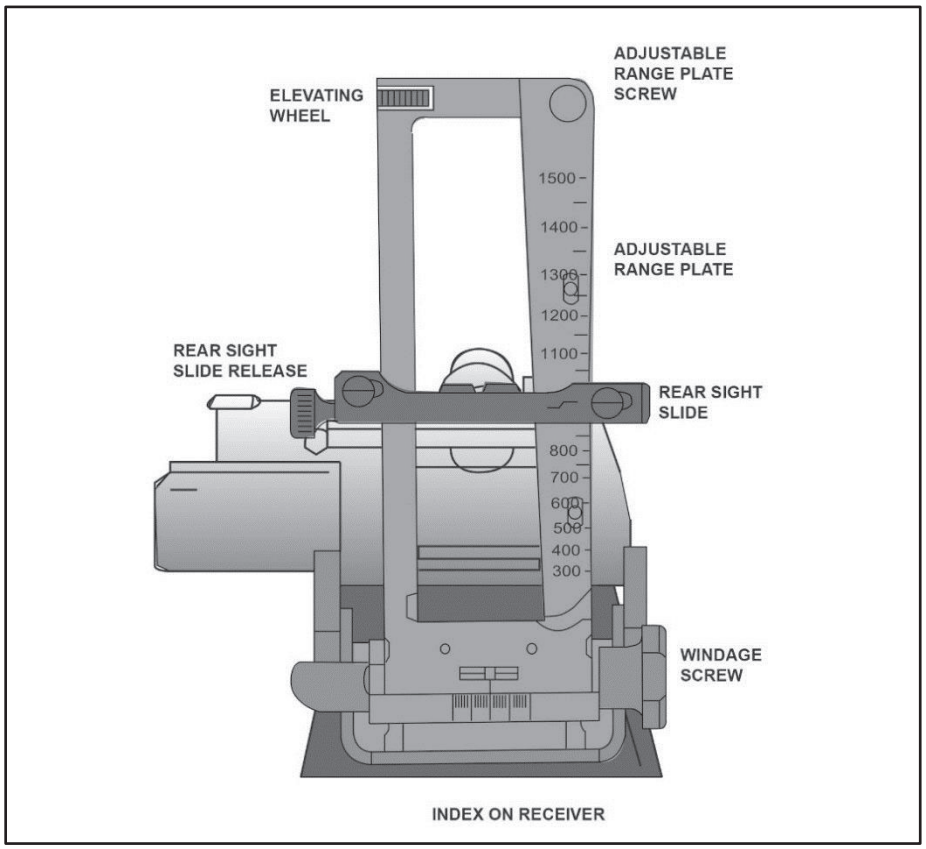


Figure 3-6. Rear sight assembly

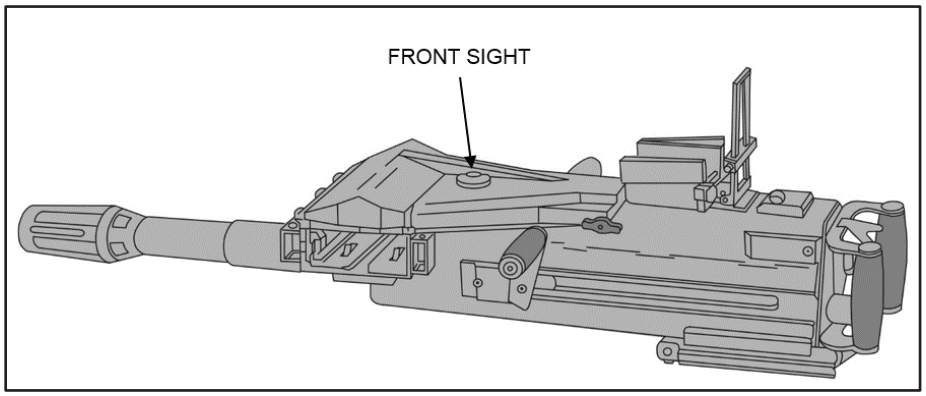


Figure 3-7. Front sight on top cover assembly

THERMAL SIGHT

3-18. Thermal sights are target acquisition and aiming sensors that digitally replicate the field of view based on an estimation of the temperature. They use advanced forward-looking infrared technology that identify the infrared emitted radiation (heat) of a field of view, and translate those temperatures into a gray- or color-scaled image. The TWS is capable of target acquisition under conditions of limited visibility, such as darkness, smoke, fog, dust, and haze, and operates effectively during the day and night.

3-19. The TWS has five functional groups (see figure 3-8):

- Objective lens receives IR light emitting from an object and its surroundings. The objective lens magnifies and projects the IR light.
- Detector assembly senses the IR light and coverts it to a video signal.
- Sensor assembly processes the video for display on the liquid crystal display (LCD) array in the field of view.
- LCD array and eyepiece work together. The LCD array provides the IR image along with the reticle selected. The light from the LCD array is at the eyepiece.
- User controls allow the user to interface with the device to adjust contrast, thermal gain, sensitivity, reticle display, and magnification.

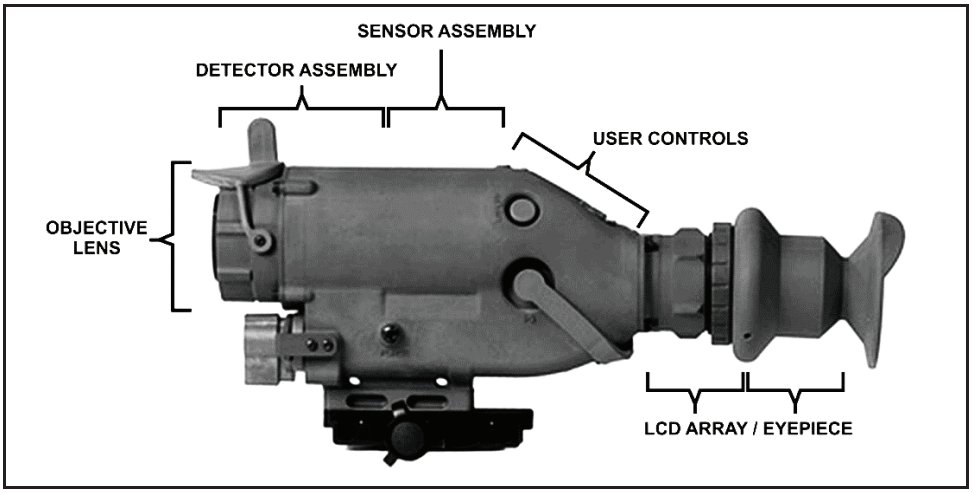


Figure 3-8. Thermal weapon sight example

3-20. A small detector used in thermal sensors or optics to identify IR radiation with wavelengths between 3 and 30 µm (micrometer). The thermal optic calculates and processes the thermal scene into a correlating video image signal based on the temperature identified. These optics can differentiate thermal variations of 1 degree Celsius of the viewable scene. These variations generate a corresponding contrasting gradient that develops a thermal representation on the LCD screen in the eyepiece.

AN/PAS-13 SERIES OF THERMAL WEAPONS SIGHTS

3-21. There are several versions of weapons thermal sights available for use across the force. Soldiers must be familiar with their model and version of the weapon thermal sight. They must know the specific procedures for alignment and operation of their weapon thermal sight. The official model nomenclature identifies the various models and versions as listed below.

- Version 1 (v1) – Light weapons thermal sight (LWTS).
- Version 2 (v2) – Medium weapons thermal sight (MWTS).
- Version 3 (v3) – Heavy weapons thermal sight (HWTS).

3-22. Weapons thermal sights are silent, lightweight, and compact, and have durable battery-powered infrared imaging sensors that operate with low battery consumption. (See figure 3-9 on page 3-10.)



VERSION		
Light Weapon Thermal Sight (LWTS)	**Medium Weapon Thermal Sight (MWTS)**	**Heavy Weapon Thermal Sight (HWTS)**
AN/PAS-13C (v1)	AN/PAS-13C (v2)	AN/PAS-13C (v3)
AN/PAS-13D (v1)	AN/PAS-13D (v2)	AN/PAS-13D (v3)
AN/PAS-13E (v1)	AN/PAS-13E (v2)	AN/PAS-13E (v3)

NOTE: The MWTS does not include the ballistic reticle for the M4- or M16-series weapons.

Figure 3-9. Weapon thermal sights

Advantages

3-23. Military grade thermal weapon sights have the following traits:

- Small and lightweight.
- Real-time imagery. Devices provide real-time video of the thermal scene immediately after power on.
- Low power consumption over time means long battery life.
- Reliable. Long mean time between failures (MTBF).
- Quiet. The lack of a cooling element allows for a very low operating noise level.
- One optic fits on multiple weapons. The adapter rail system (ARS) rail-mounting bracket allows one optic to be used on other weapons.
- The F and G models attach in front of other aiming devices to improve their capabilities and eliminate the zeroing procedures for the device.

Disadvantages

3-24. These devices have limitations that Soldiers should consider, particularly during combat operations. The primary disadvantages are—

- Cannot interpret (see) multispectral infrared. These systems view a specific wavelength for emitted radiation (heat variations), and do not allow viewing of all aiming and marking devices at night.
- Relies on rechargeable batteries and charging stations. Although the batteries are common and have a relatively long battery life, additional equipment is required to charge them. If common nonrechargeable (alkaline) batteries are used, a separate battery adapter is typically required.
- Cannot interpret thermal signatures behind glass or water effectively.
- Cannot always detect friendly marking systems worn by dismounts.

Fields of View

3-25. The thermal sight has wide and narrow fields of view. (See figure 3-10 and figure 3-11.)

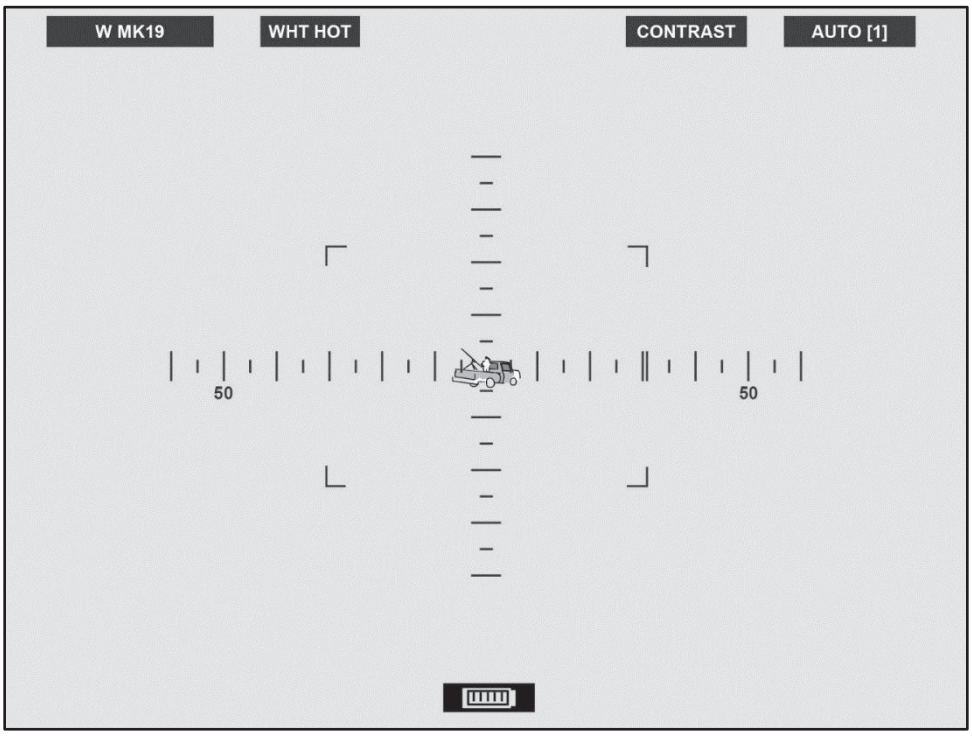


Figure 3-10. AN/PAS-13F, narrow field of view reticle

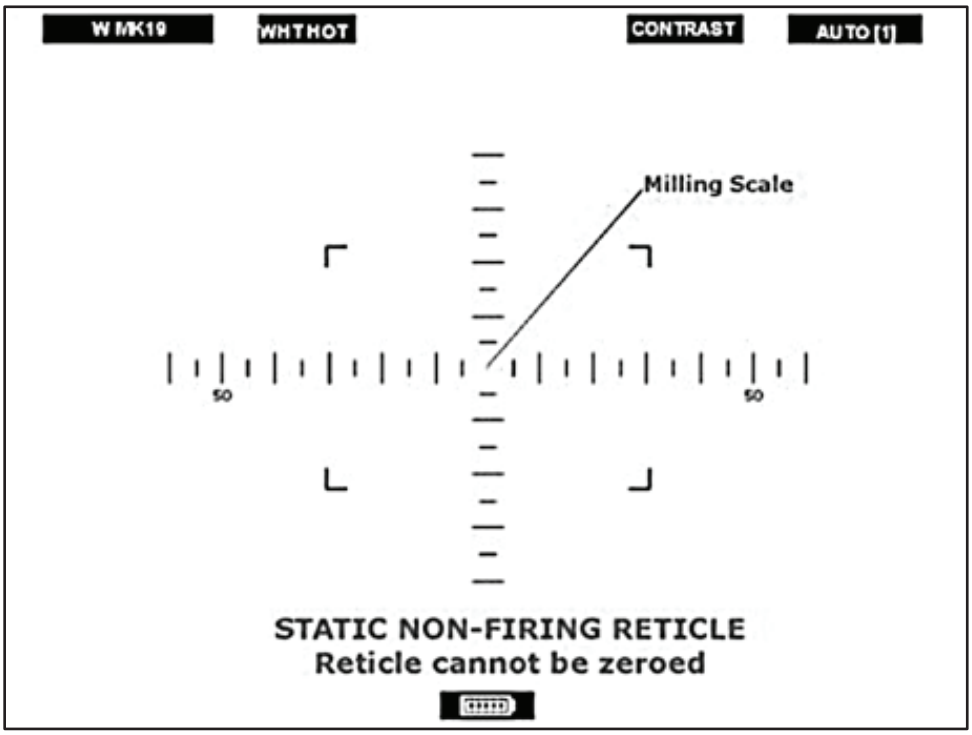


Figure 3-11. AN/PVS-13F, wide field of view reticle

POINTERS, ILLUMINATORS, AND LASERS

3-26. Pointers, illuminators, and laser devices for small arms weapons emit a collimated beam of IR light for precise aiming and a separate IR beam for illumination. These devices operate in one single mode at a time, as selected by the user. The laser is activated by a selector switch on the device or by a remote mechanism installed on the weapon. The basic two modes or functions are pointer and illuminator.

- Pointer. When used as a pointer or aiming device, a small, pin-point beam is emitted from the device. The IR beam provides an infrared visible point when it strikes an object or target. The IR beam operates in the 400 to 800 nanometer wavelength and can only be seen by I2 optics, such as the AN-PVS-7 or -14 night vision devices.
- Illuminator. Typically used to illuminate a close quarters area as an infrared flood light. The illuminator provides a flood-light effect for the Soldier when used in conjunction with I2 night vision devices.

***Note*.** Laser is an acronym for light amplified stimulated emitted radiation, but is predominantly used as a proper noun.

3-27. The devices shown in table 3-1 are the most common laser pointing devices available for use on the MK 19.

Table 3-1. Laser aiming devices for the MK 19

Laser Aiming Device	Device Name	Reference
AN/PEQ-2A	Target Pointer/Illuminator/ Aiming Light (TPIAL)	TM 9-5855-1915-13&P
AN/PEQ-15	Advanced Target Pointer/ Illuminator/Aiming Light (ATPIAL)	TM 9-5855-1914-13&P
AN/PEQ-15A	Dual Beam Aiming Laser – Advanced2 (DBAL-A2)	TM 9-5855-1912-13&P
AN/PSQ-23	Illuminator, Integrated, Small Arms (Storm)	TM 9-5855-1913-13&P

Note. The ATPIAL, DBAL-A2, and Storm have collocated IR and visible aiming lasers. A single set of adjusters move both aiming beams. Although the aiming lasers are collocated, Soldiers should zero the laser they intend to use as their primary pointer to ensure accuracy and consistency during operation.

AN/PEQ-2A TARGET POINTER/ILLUMINATOR AIMING LIGHT (TPIAL)

3-28. AN/PEQ-2A aiming devices are Class IIIB laser devices that emit a collimated beam of IR light for precise aiming and a separate IR beam for illumination of the target or target area. (See figure 3-12.) Both beams can be independently zeroed to the weapon and to each other. The beams can be operated individually or in combination in both high and low power settings.

Note. The IR illuminator is equipped with an adjustable bezel to vary the size of the illumination beam based on the size and distance of the target.

3-29. The aiming devices are used with night observation devices (NODs) and can be used as handheld illuminators/pointers or mounted on the weapon with the included brackets and accessory mounts. In the weapon-mounted mode, the aiming devices can be used to direct fire and to illuminate and designate targets.

3-30. The aiming light is activated by pressing on either the ON/OFF switch lever, or the button on the optional cable switch. Either switch connects power from two AA batteries to an internal electronic circuit which produces the infrared laser. Internal lenses focus the infrared light into a narrow beam. The direction of the beam is

controlled by rotating the mechanical adjusters with click detents. These adjusters are used to zero the aiming light to the weapon.

3-31. Once zeroed to the weapon, the aiming light projects the beam along the line of fire of the weapon. The optical baffle prevents off-axis viewing of the aiming light beam by the enemy.

CAUTION

A safety block is provided for training purposes to limit the operator from selecting high power modes of operation.



TM 9-5855-1915-13&P		
DIMENSIONS		
LENGTH	6.4 in	16.3 cm
WIDTH	2.8 in	7.1 cm
HEIGHT	1.2 in	3 cm
WEIGHT	9.5 oz	269 g

POWER	
BATTERY LIFE	100 hours >32°
	36 hours <32°
POWER SOURCE	2 each AA batteries

MODE OF OPERATION			
MODE	**MARKINGS**	**TGT LASER**	**ILLUM LASER**
O	OFF	OFF	OFF
1	AIM LO	LOW POWER	OFF
2	DUAL LO	LOW POWER	LOW POWER
3	AIM HI	HIGH POWER	OFF
4	DUAL LO/HI	HIGH POWER	LOW POWER
5	DUAL HI	HIGH POWER	HIGH POWER

LASER	**DIVERGENCE**	**WAVELENGTH**
IR BEAM	0.3 mRad	820-850 nm
IR ILLUMINATOR	3.0 mRad	820-850 nm

LEGEND					
cm	centimeters	IR	infrared	oz	ounces
g	grams	mRad	milliradians		
in	inches	nm	nanometers		

Figure 3-12. AN/PEQ-2A (TPIAL)

AN/PEQ-15 ADVANCED TARGET POINTER/ILLUMINATOR/AIMING LIGHT (ATPIAL)

3-32. The AN/PEQ-15 ATPIAL is a multifunctional laser that emits both a visible and IR light for precise weapon aiming and target/area illumination. This ruggedized system can be used as a handheld illuminator/pointer.

- Visible light can be used to boresight the device to a weapon without the need of night vision goggles. A visible red-dot aiming laser can also be selected to provide precise aiming of a weapon during daylight or night operations.
- Infrared laser emits a highly collimated beam of IR light for precise weapon aiming. A separate IR-illuminating laser can be adjusted from a flood light mode to a single point spot-divergence mode.

3-33. The lasers can be used as handheld illuminator pointers, or can be weapon-mounted with included hardware. The co-aligned visible and IR aiming lasers emit through laser ports in the front of the housing. These highly capable aiming lasers allow for accurate nighttime aiming and system boresighting.

3-34. The AN/PEQ-15 has an integrated rail grabber molded into the body to reduce weight and additional mounting hardware. (Refer to TM 9-5855-1914-13&P for more information.)

CAUTION

During force-on-force training, use the AN/PEQ-15 in the low power modes only. You can use high power modes only on live-fire ranges and beyond 220 meters.

3-35. The AN/PEQ-15, ATPIAL's (see figure 3-13) visible aiming laser provides for active target acquisition in low light conditions and close-quarters combat situations, and allows users to zero using the borelight without using NODs. When used in conjunction with NODs, its IR aiming and illumination lasers provide for active, covert target acquisition in low light or complete darkness.

3-36. The ATPIAL visible and IR aiming lasers are co-aligned. A single set of adjusters moves both aiming beams, and the user can boresight/zero using either aiming laser.



TM 9-5855-1914-13&P		
DIMENSIONS		
LENGTH	4.6 in	11.7 cm
WIDTH	2.8 in	7.1 cm
HEIGHT	1.9 in	4.1 cm
WEIGHT	7.5 oz	213 g

POWER	
BATTERY LIFE	>6 hours in DUAL HIGH (DH) mode
POWER SOURCE	1 each DL-123A, 3 volt

MODE OF OPERATION		
POSITION	**MODE**	**REMARKS**
VIS AL	Vis Aiming Laser	Visible Aim Laser ON
O	OFF	Prevents inadvertent laser burst
P	Program	Sets the desired IR pulse rate
AL	AIM LOW	Low power of Aiming Laser
DL	DUAL LOW	Aiming Laser and Illuminator on LOW
AH	AIM HIGH	Aiming Laser set to HIGH
IH	ILLUM HIGH	IR Illuminator set to HIGH
DH	DUAL HIGH	IR Aim and Illuminator set to HIGH

LASER	**DIVERGENCE**	**WAVELENGTH**
IR BEAM	0.5 mRad	820-850 nm
IR ILLUMINATOR	1.0 to 105 mRad	820-850 nm
VISIBLE AIMING	0.5 mRad	605-665 nm

LEGEND					
cm	centimeters	IR	infrared	oz	ounces
g	grams	mRad	milliradians		
in	inches	nm	nanometers		

Figure 3-13. AN/PEQ-15, ATPIAL

AN/PEQ-15A, DUAL BEAM AIMING LASER – ADVANCED 2 (DBAL-A2)

3-37. The AN/PEQ-15A, DBAL-A2 is a multifunctional laser device that emits IR pointing and illumination light, as well as a visible laser for precise weapon aiming and target/area illumination. The visible and IR aiming lasers are co-aligned enabling the visible laser to be used to boresight both aiming lasers to a weapon without the need for night vision devices. This ruggedized system can be used as a handheld illuminator/pointer.

- Visible light can be used to boresight the device to a weapon without the need of night vision goggles. A visible red-dot aiming laser can also be selected to provide precise aiming of a weapon during daylight or night operations.
- Infrared laser emits a tightly focused beam of IR light for precise aiming of the weapon. A separate IR illumination provides supplemental IR illumination of the target or target area. The IR illuminator is equipped with an adjustable bezel to vary the size of the illumination beam on the size and distance to the target (flood to point divergence).

3-38. The lasers can be used as hand-held illuminator pointers, or can be weapon-mounted with included hardware. These highly capable aiming lasers allow for accurate nighttime aiming and system boresighting.

3-39. The AN/PEQ-15A, DBAL-A2 (see figure 3-14) visible aiming laser provides for active target acquisition in low light conditions and close quarters combat situations, and allows users to zero using the borelight without using NODs. When used in conjunction with NODs, its IR aiming and illumination lasers provide for active, covert target acquisition in low light or complete darkness.

3-40. The DBAL-A2 visible and IR aiming lasers are co-aligned. A single set of adjusters moves both aiming beams, and the user can boresight/zero using either aiming laser. The following information is an extract from the equipment's technical manual for Soldier reference.



TM 9-5855-1912-13&P		
DIMENSIONS		
LENGTH	3.5 in	8.7 cm
WIDTH	2.9 in	7.4 cm
HEIGHT	1.9 in	4.8 cm
WEIGHT	8 oz	224 g

POWER	
BATTERY LIFE	>5.5 hours in IR DUAL HIGH mode
POWER SOURCE	1 each DL-123A, 3 volt

MODE OF OPERATION		
POSITION	**MODE**	**REMARKS**
AL	LOW POWER	Low power for aim laser
AH	HIGH POWER	High power for aim laser
VIS A	VIS AIM RED	Aiming or marking laser for daylight
VIS A	VIS AIM GREEN	Aiming or marking laser for daylight

LASER	**DIVERGENCE**	**WAVELENGTH**
IR BEAM	0.3 mRad	840 nm
IR ILLUMINATOR	0.5 to 75 mRad	840 nm
VISIBLE AIM, RED	0.3 mRad	635 nm
VISIBLE AIM, GREEN	0.5 mRad	532 nm

LEGEND					
cm	centimeters	IR	infrared	oz	ounces
g	grams	mRad	milliradians		
in	inches	nm	nanometers		

Figure 3-14. AN/PEQ-15A, DBAL-A2

AN/PSQ-23, ILLUMINATOR, INTEGRATED, SMALL ARMS (STORM)

3-41. The AN/PSQ-23 is a battery-operated laser range finder (LRF) and digital magnetic compass (DMC) with integrated multifunctional lasers. The illuminator, integrated, small arms device is commonly referred to as the STORM laser. The visible and IR aiming lasers are co-aligned enabling the visible laser to be used to boresight both aiming lasers to a weapon without the need for night vision devices. This ruggedized system can be used as a handheld illuminator/pointer.

- Laser range finder provides range to target information from 20 meters to 10,000 meters with an accuracy of +/- 1.5 meters.
- Digital magnetic compass provides azimuth information and limited elevation information to the operator. The azimuth accuracy is +/- 0.5 degrees to +/- 1.5 degrees. The elevation accuracy is +/- 0.2 degrees. The digital magnetic compass can identify bank or slopes up to 45 degrees with an accuracy of +/- 0.2 degrees.
- Visible light provides for active target acquisition in low light and close quarters combat situations without the need for night vision devices. It can be used to boresight the device to a weapon without the need of night vision devices. A visible red-dot aiming laser can also be selected to provide precise aiming of a weapon during daylight or night operations.
- Infrared laser emits a tightly focused beam of IR light for precise aiming of the weapon. A separate IR illumination provides supplemental IR illumination of the target or target area. The IR illuminator is equipped with an adjustable bezel to vary the size of the illumination beam on the size and distance to the target (flood to point divergence).
- Infrared illuminator [STORM] features a separately adjustable IR illuminator with adjustable divergence. It is fixed in the device housing and is set parallel to the rail mount.

Note. The STORM's LRF and DMC may be used in combination to obtain accurate positioning information for targeting purposes and other tactical applications.

3-42. The integrated visible aim laser and illumination lasers provide for active, covert target acquisition in low light or complete darkness when used in conjunction with night vision devices. The STORM also is equipped with a tactical engagement simulation laser allowing it to be used in a laser-based training environment (see figure 3-15).



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 sec to enter menu power

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

LEGEND					
cm	centimeters	IR	infrared	oz	ounces
g	grams	mRad	milliradians		
in	inches	nm	nanometers		

Figure 3-15. AN/PSQ-23, STORM

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Chapter 4

Mountable Equipment

The MK 19 has a wide variety of attachments to increase Soldier lethality, situational awareness, and overmatch. Machine gun tripods and traversing and elevating mechanisms (T&E) provide a stable platform for crew-served weapons and permit a higher degree of accuracy and control for gunners when firing. Gunners can easily extend, collapse, carry and store tripods and mounts, mission, enemy, terrain and weather, troops, time available, and civil considerations (METT-TC)-dependent. The attachments can be applied utilizing the adjustable sight bracket by attaching it to the mounting bracket on the side of the weapon system. Soldiers must understand what the attachments are, how they are correctly positioned, how to align them with the weapon system, and how to integrate them into use to maximize the system's capabilities.

This chapter discusses the M3 and M205 machine gun tripods and machine gun T&E utilized by today's Soldiers. It does not provide all the machine gun tripods and mounts available. For more information regarding these and other machine gun tripods and mounts, refer to the respective TMs listed in the references section of this publication. This chapter also explains how the adjustable sight bracket is used to mount the various attachments. It describes accessories available for mounting onto the MK 19.

M3 MACHINE GUN TRIPOD

4-1. The M3 machine gun tripod is the standard ground system for the MK 19. It has a folding tripod with three telescopic tubular legs connected at the tripod head. Each leg ends in a metal shoe that can be stamped into the ground for greater stability. The two rear legs are joined together by a traversing bar. The traversing bar serves as a support for the traverse and elevating mechanism, which in turn supports the rear of the weapon. The tripod head provides a front support for the weapon that is further supported by the front leg.

COMPONENTS

4-2. The major components of the M3 machine gun tripod (See figure 4-1 on page 4-2) consist of the following:

- The tripod (1) has three telescopic tubular legs connected at the tripod head. A traversing bar joins the two rear legs.
- The pintle (2) provides a means of attaching the M2 Caliber .50 to the tripod. The MK 19 will not utilize the pintle. The MK 19 will utilize the MK 64, Mod 7, gun cradle. The pintle is a standard issue item for the M3 machine gun tripod.
- The T&E mechanism (3) lets a Soldier control manipulation and allows a Soldier to engage predetermined targets. The elevation mechanism allows for traversing, elevating, and locking of T&E to traverse bar.

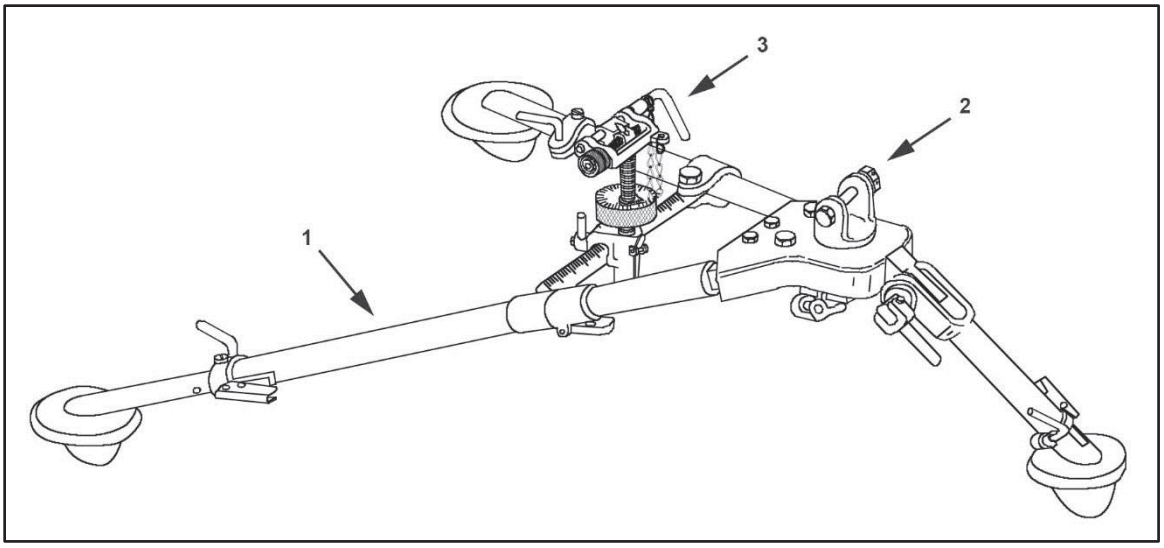


Figure 4-1. M3 tripod, pintle and traversing and elevating mechanism

EQUIPMENT DATA

4-3. Table 4-1 shows the equipment data for the M3 machine gun tripod.

Table 4-1. M3 tripod equipment data

WEIGHT:	M3 tripod	44 pounds (19.98 kilograms)
LENGTH:	Stowed	45.5 inches (116 centimeters)
	Legs extended	76 inches (193 centimeters)
WIDTH:	Stowed	8 inches (20 centimeters)
	Legs extended	61.5 inches (156 centimeters)
HEIGHT:	On hard surface	14 inches (36 centimeters)
	Stowed	7 inches (18 centimeters)
ELEVATION:	Free gun	285 milliradian (16 degrees)
	T&E engaged	100 milliradian (6 degrees)
DEPRESSION:	Free gun	335 milliradian (19 degrees)
	T&E engaged	250 milliradian (14 degrees)
TRAVERSE:	Free gun	6400 milliradian (360 degrees)
	T&E engaged	400 milliradian (22 degrees left or right)
	Traverse hand wheel	25 milliradian (1 degrees left or right)
LEGEND:	T&E traversing and elevating	

EMPLOYMENT

4-4. The M3 machine gun tripod is a folding tripod with three telescopic tubular legs connected at the tripod head. The two rear legs are joined together by a traversing bar. Each leg ends in a metal shoe that can be stamped into the ground for greater stability. The traversing bar is hinged on one side with a sleeve and on the other side with a sleeve latch. The traversing bar serves as a support for the traverse and elevating mechanism, which in turn support the rear of the weapon.

4-5. The T&E mechanism is used to engage pre-selected target areas. The elevation scale shows 250-milliradian depression and 100-milliradian elevation, graduated in one-milliradian increments. The traverse scale shows 400-milliradian traverse to the right or left. The T&E mechanism is clamped in place by a traversing slide lock lever. The head provides a front support for the weapon through a pintle attached to the weapon and tripod.

TRAVERSING AND ELEVATING MECHANISM

4-6. When the T&E mechanism is locked to the traverse bar the traversing hand-wheel should be centered. To make changes in direction (right or left) loosen the traversing lock lever (1) and move the sleeve along the traverse bar (2). (See figure 4-2.) The T&E mechanism traverses 400-milliradian left or right from the zero index.

Note. The traverse bar is graduated in 5-milliradian increments and is numbered every 100-milliradian from the zero index (right or left) up to 400-milliradian.

4-7. Readings are taken off the traverse bar from the left side of the traversing sleeve. To make changes of 25-milliradian or less (right or left) turn the traversing hand wheel (3), the head will appear to move along the traverse screw, moving the weapon right or left. Each click of the traversing hand wheel (3) is 1-milliradian deflection. The traverse screw has 50-milliradian total traverse.

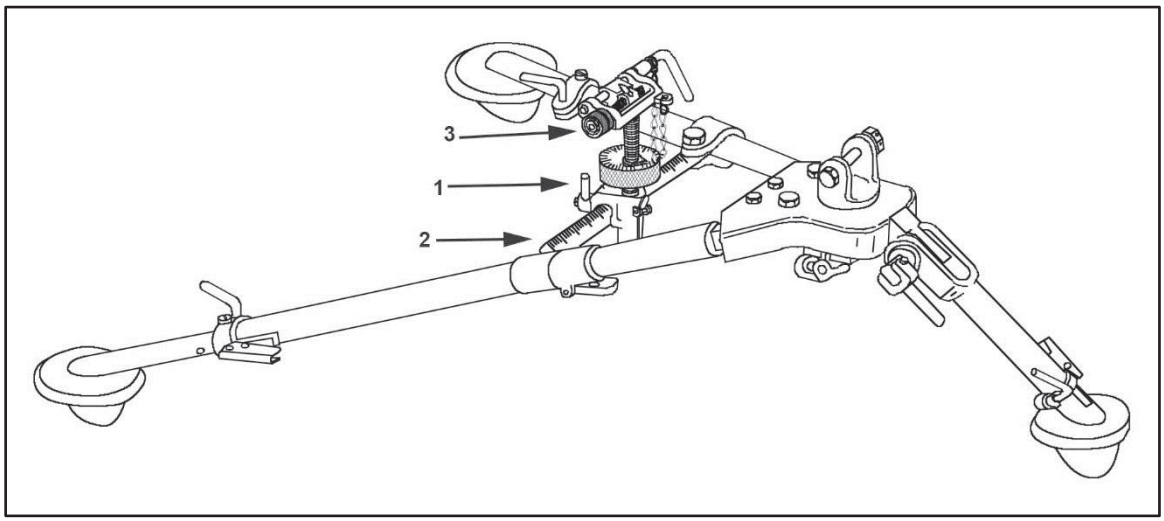


Figure 4-2. T&E mechanism attached to the M3 tripod

4-8. The T&E elevation portion consists of the upper and lower elevating screw and elevating hand-wheel. (See figure 4-3 on page 4-4.) The upper screw has a scale that is graduated in 50-milliradian increments (+ 200-milliradian). The hand-wheel has a dial scale that is graduated in 5-milliradian increments (50-milliradian total). Each click of the hand-wheel indicates 1-milliradian of elevation or depression. Turn the hand-wheel clockwise to depress and counterclockwise to elevate.

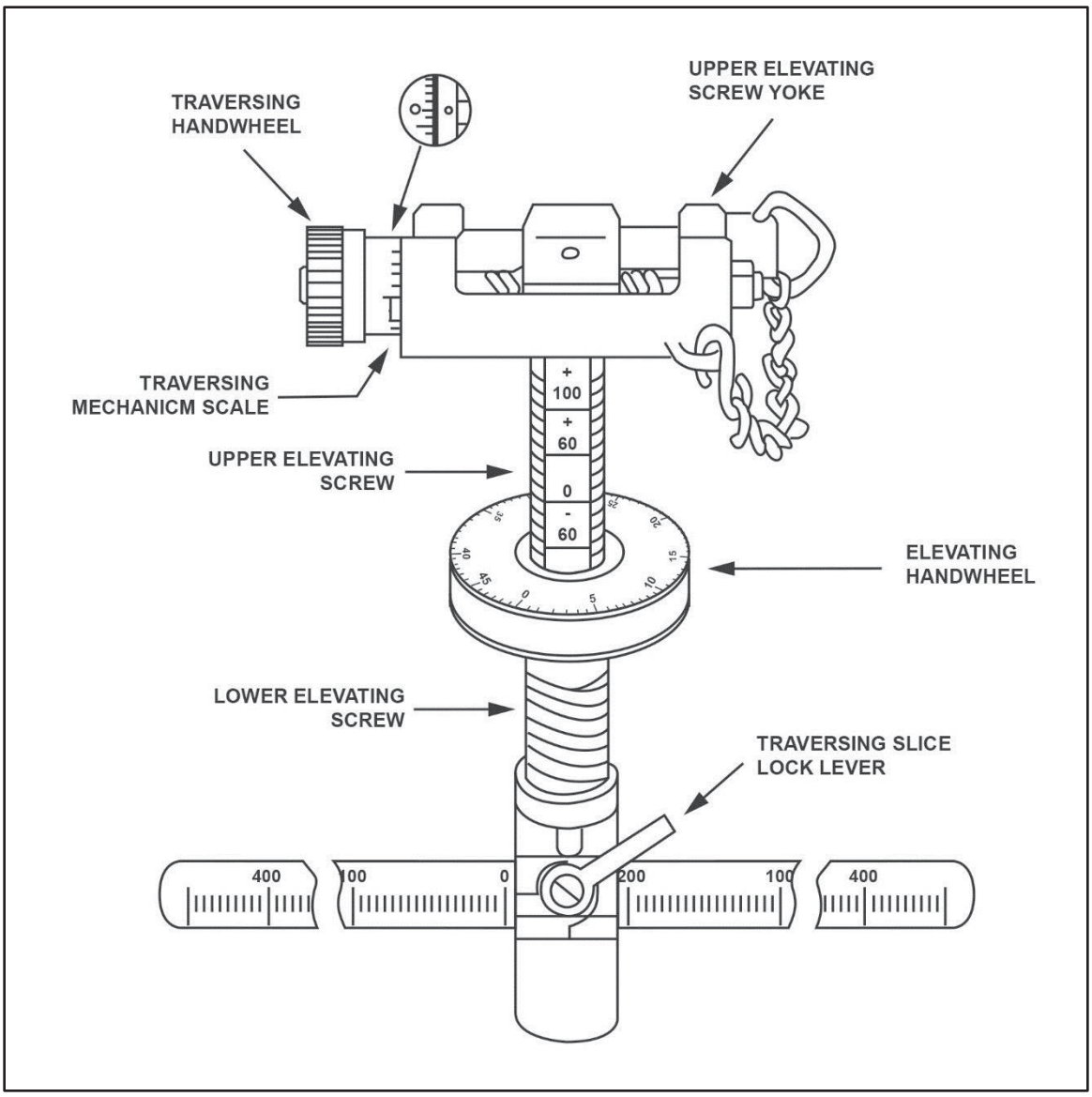


Figure 4-3. T&E mechanism

M205 LIGHTWEIGHT MACHINE GUN TRIPOD

4-9. The M205 is a lightweight tripod for use with the MK 19 and machine guns (with MK93 mount). It has a 10-pound weight savings over the current M3 tripod. It will replace the M3 tripod. The M205 lightweight tripod mount (See figure 4-4.) for the MK 19 is composed of the following:

- Front leg assembly (1).
- Tri-head assembly (2).
- Pintle assembly (3).
- Traverse and elevation assembly (4).
- Right rear leg assembly (5).
- Left rear leg assembly (6).

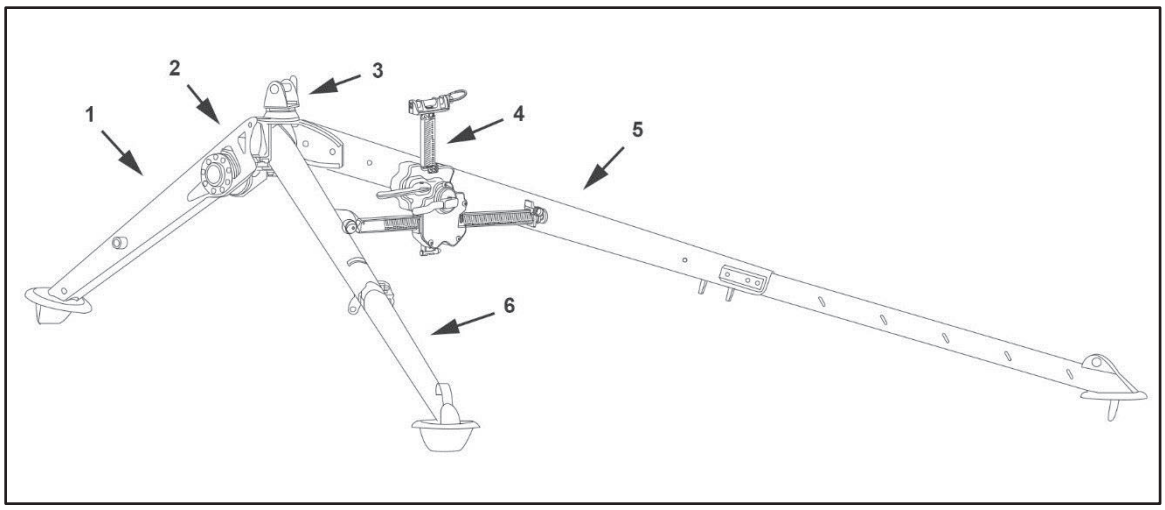


Figure 4-4. M205 lightweight tripod mount, deployed configuration

4-10. The front leg is fully adjustable. The tri-head assembly accepts the M205 pintle assembly, M3 tripod pintle, or the MK93 dual mount. The tri-head assembly includes a cam handle, which adjusts the front leg assembly from stowed to deployed positions.

TRAVERSE AND ELEVATION ASSEMBLY

4-11. T&E assembly permits controlled manipulation in both traverse and elevation by hand force of the user. The T&E assembly allows for bold adjustment throughout the full range and fine adjustment down to 1 milliradian. Figure 4-5 on page 4-6 shows the components of the T&E assembly:

- Elevation handle (1).
- Elevation bracket assembly (2).
- Elevation bar assembly (3).
- Traverse handle (4).
- Traverse stop (5).
- Traverse bar assembly (6).

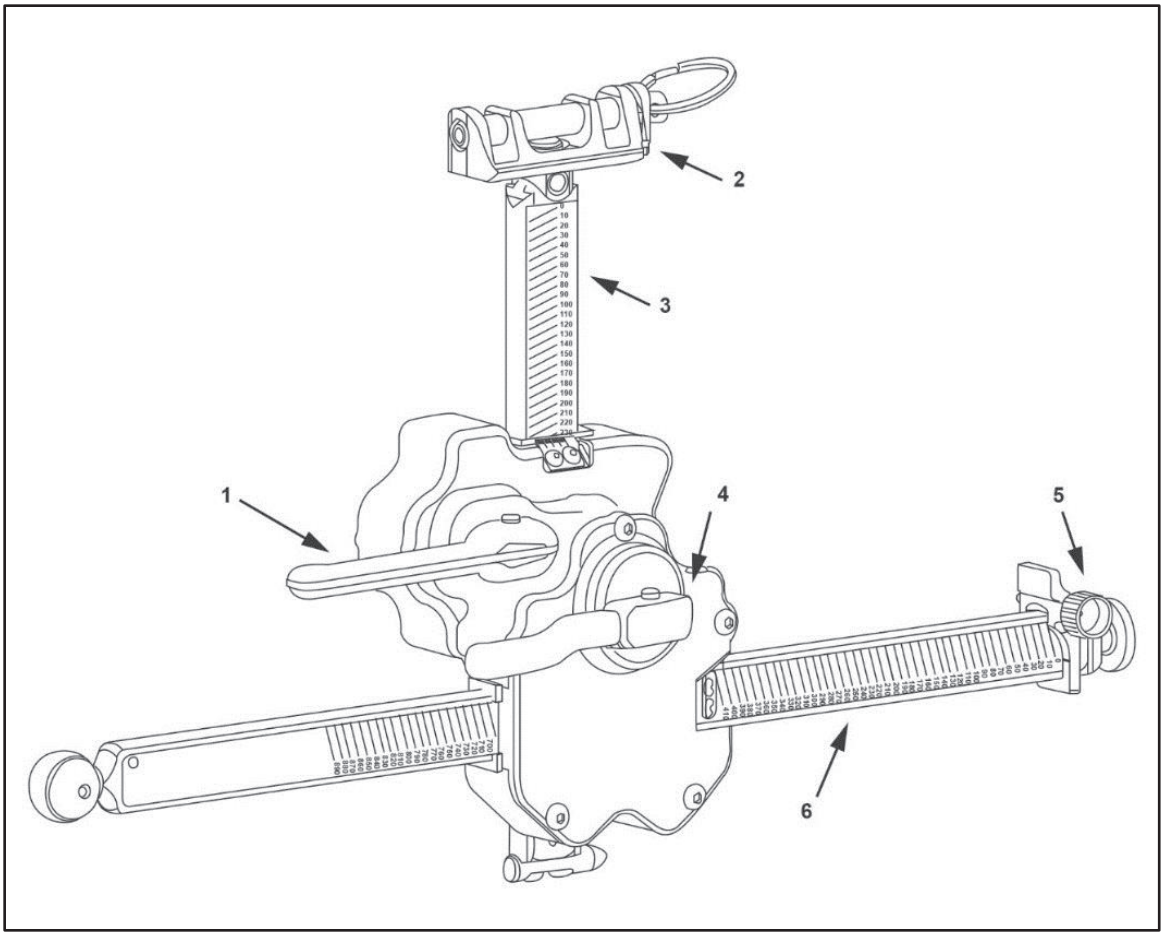


Figure 4-5. M205 T&E assembly components

REAR LEG ASSEMBLY AND EQUIPMENT DATA

4-12. Rear legs are capable of independent extension and retraction without tools. The leg latch will lock at each position to enable deployment of the MK 19 grenade machine gun on varying terrain. Right rear leg has two stowage lugs to secure the elevation bracket in the stowed position. The left rear leg has one stowage lug to secure the elevation bar in a stowed position to secure the T&E assembly to the legs. Table 4-2 shows the equipment data for the M205 lightweight machine gun tripod.

Table 4-2. M205 tripod equipment data

WEIGHT:	M205 tripod	34 pounds (16 kilograms)
LENGTH:	Stowed Deployed (maximum)	46 inches (117 centimeters) 75 inches (191 centimeters)
WIDTH:	Stowed Deployed (maximum)	12 inches (30 centimeters) 69 inches (175 centimeters)
HEIGHT:	Stowed Deployed (maximum)	8 inches (20 centimeters) 25 inches (64 centimeters)
ELEVATION AND DEPRESSION:	Total range	0 to 460 milliradian
TRAVERSE:	Total range	0 to 900 milliradian
Note. Weight includes tripod, pintle assembly, and T&E assembly.		

4-13. The M205 lightweight tripod mount is a lightweight ground mount for use with the MK 19. The M205 lightweight tripod mount is delivered with a unique, lightweight pintle that is also compatible with the M3 tripod pintle, MK93 dual mount, .50 caliber ammunition can, PA 120 and M548 mounting bracket assembly.

4-14. The M205 lightweight tripod mount can be carried, deployed, emplaced, and stowed in its carrying configuration by a single operator without the use of tools. An integrated, permanently-attached traverse and elevation assembly provides infinite fine adjustment and rapid bold adjustment of the point of aim. Traverse and elevation motions can be controlled together or independently and traverse travel can be limited by setting the adjustable traverse limit stop located to the right of the T&E housing.

4-15. The M205 lightweight tripod mount includes an adjustable, fixed-length front leg, and telescoping rear legs. It comes with a new, lightweight pintle that stows on the front leg when not in use. The front leg can be rotated and clamped through a range of more than 180 degrees for stowage, to accommodate uneven terrain, and to set the height of the tripod when deployed. The length of the two rear legs can be independently adjusted to accommodate uneven terrain.

4-16. The T&E assembly provides the rear support point for the weapon and allows the user to control the direction of fire. An adjustable traverse limit stop is incorporated on the traverse bar and located to the right of the T&E housing. The integrated T&E assembly is permanently attached to the left leg. When deployed, T&E assembly is attached to the traverse bar locking lug on the right leg. The weapon is attached to the top of the elevation bar with a retained quick release pin.

4-17. When the M205 lightweight tripod mount is in the stowed configuration, the tripod legs protect the T&E assembly during transport. The lightweight pintle can be securely stowed on the front leg using the integrated quick release pin.

MK 64 MACHINE GUN MOUNT

4-18. Use the MK 64 carriage and cradle assembly to mount the MK 19 to the gun pedestal, stand, ring, or tripod. Attach the ammunition container bracket to the side plate of the cradle. In the center of the cradle is a pintle bushing and lock in which the M2 caliber .50 and M60 guns can be mounted. The front of the MK 19 is mounted on the two forward lugs of the gun cradle; the retainer pin secures the rear of the MK 19. Insert the cradle stow pin to hold the cradle in a horizontal position during travel. (See figure 4-6.)

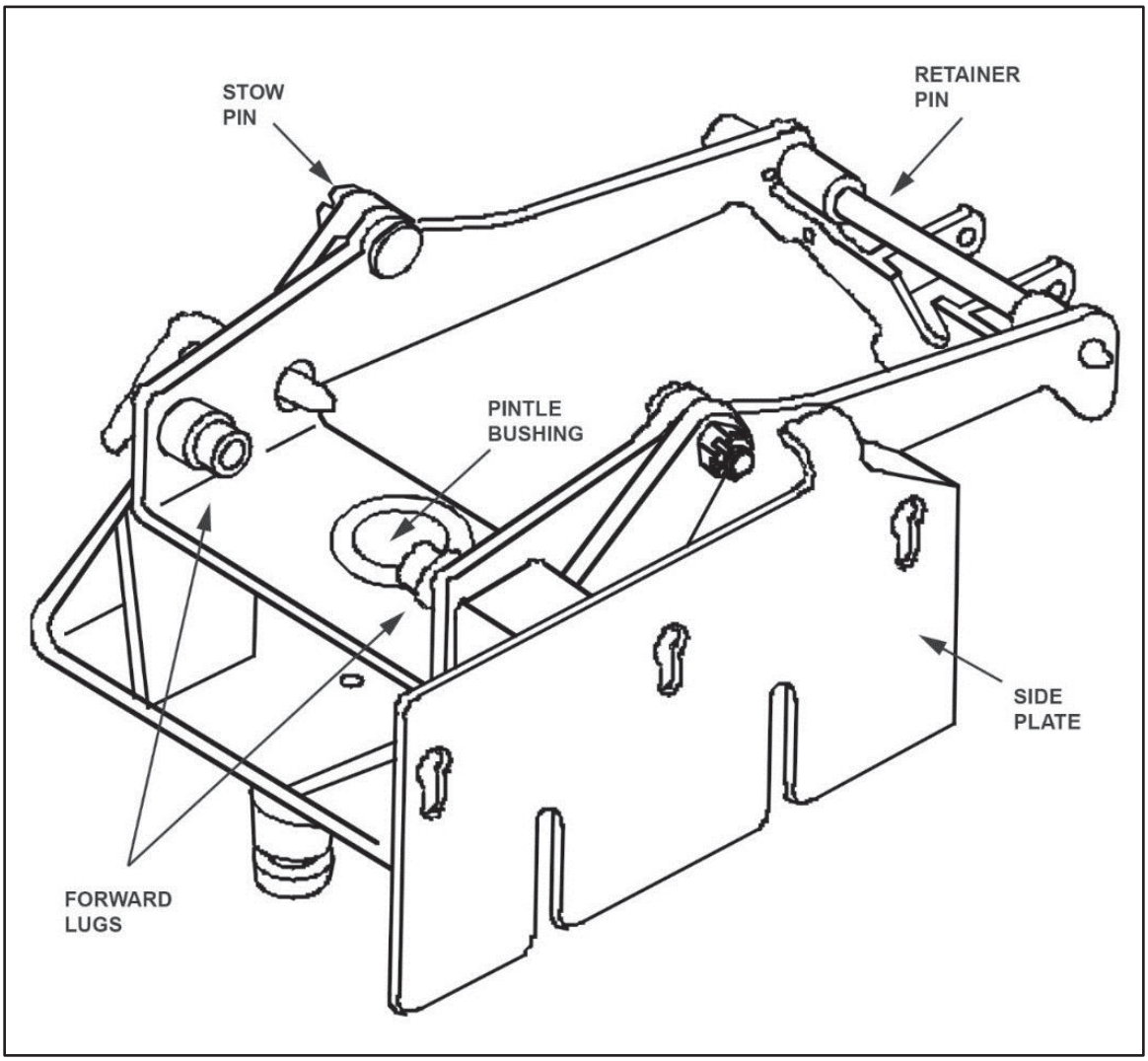


Figure 4-6. MK 64 gun cradle

MK 93 MACHINE GUN MOUNT

4-19. The MK93 Mod 1 and 2 allow the traverse and elevation of an installed weapon. These mounts use a T&E mechanism attached to the universal pintle adapter. (See figure 4-7.) The MK93 Mod 1 and 2 has the capability of mounting both the MK 19 GMG and M2 machine gun without additional adapters. The MK93 carriage and cradle inserts into either the pintle socket of the universal pintle adapter or the brass bushing on the head of the M3 tripod or the M205 lightweight tripod.

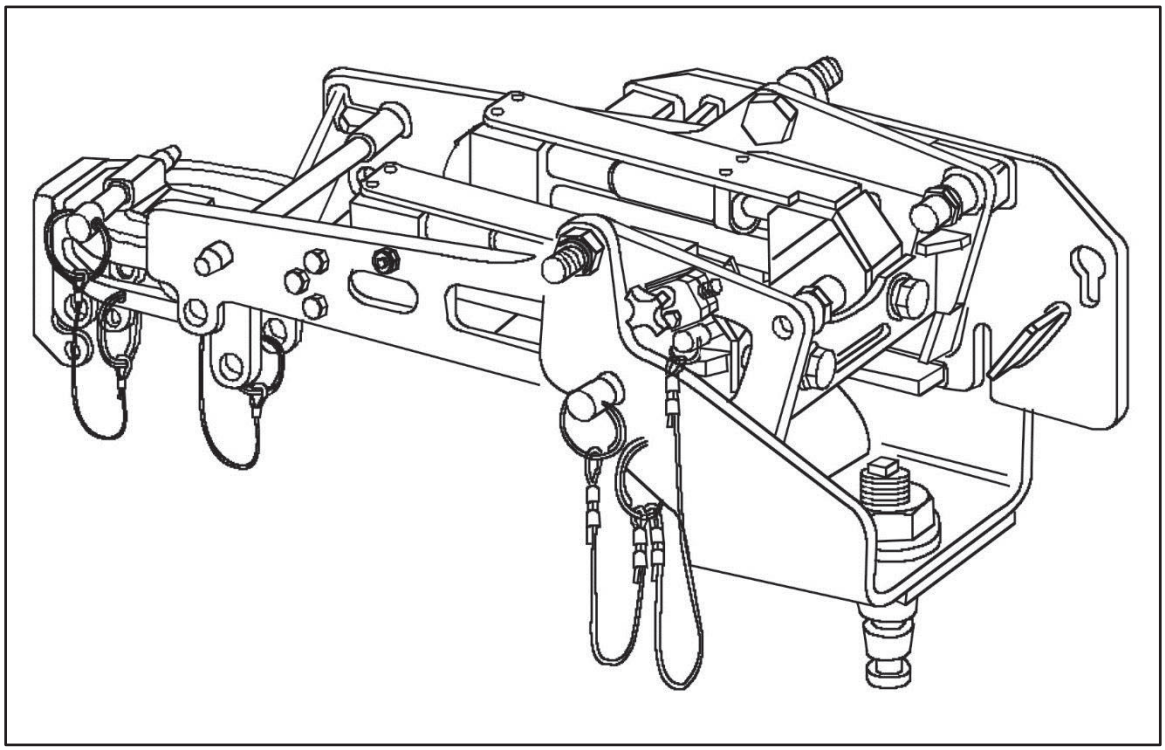


Figure 4-7. MK 93 carriage and cradle assembly

4-20. A Soldier must ensure that the pintle assembly is secured to weapon and fully seated in tripod mount prior to operating the weapon. Failure to secure the weapon could render the operator unable to control the point of aim. Failure to comply may result in serious injury to personnel. It may be necessary to press the pintle latch release to aid in the seating of the MK93 pintle onto the M205 lightweight tripod mount.

ADJUSTABLE SIGHT BRACKET

4-21. The adjustable sight bracket incorporates already existing adapter rail system (ARS) and rail grabbers designed for other weapons in order to mount aiming devices and accessories. The adjustable sight bracket provides a secure mounting point for various accessories that may be mounted on the side of the weapon (See figure 4-8.)

4-22. Soldiers should record the attachment or equipment's serial number (if applicable), the location of the attachment (for example, markings between lugs), and any boresight or alignment settings specific to the equipment at that location.

4-23. Once complete, the Soldier should mark the mounting bracket to identify the tightened position with a permanent marker. Marking the mounting bracket allows for rapid identification of loosening hardware during firing. Soldiers must periodically verify the mounting hardware does not loosen during operation. During zeroing or zero confirmation operations, Soldiers should retighten the mounting hardware after the first five rounds.

4-24. Soldiers must ensure the equipment is firmly affixed to the ARS before tie down is complete. If the attachments are loose, their accuracy and effectiveness will be degraded.

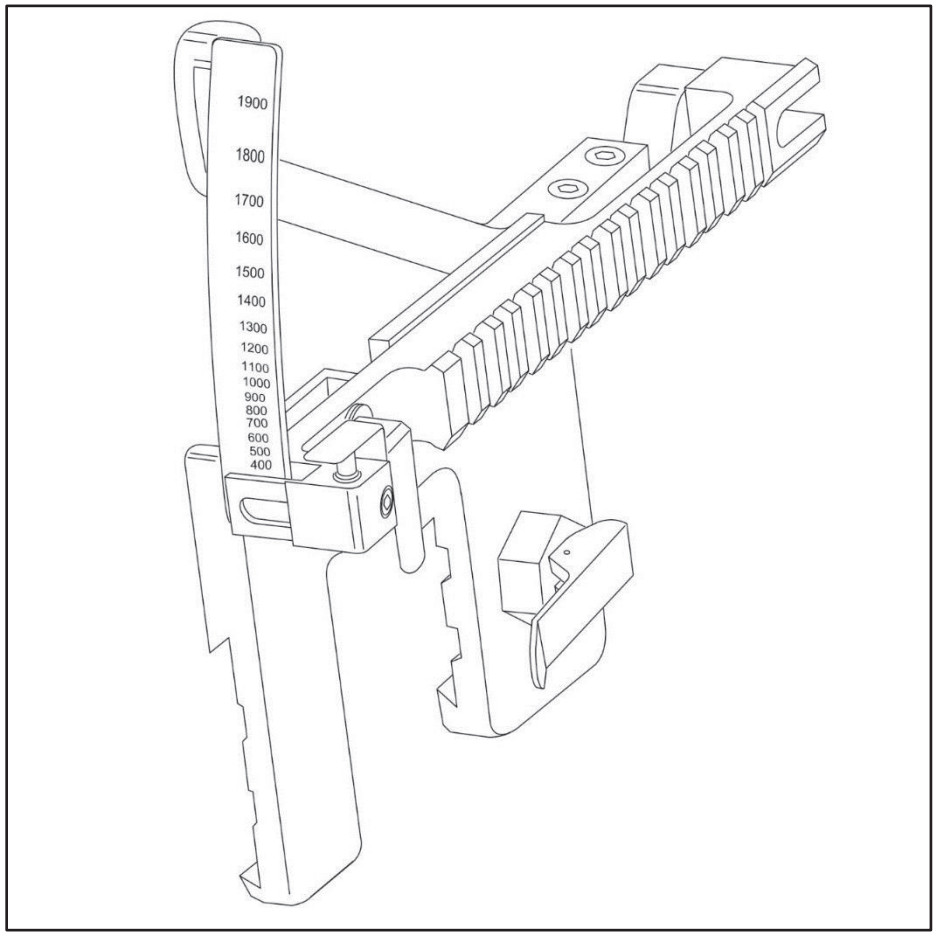


Figure 4-8. Adjustable sight bracket and placement

MOUNTED LIGHTS

4-25. Weapon-mounted lights are commonly issued throughout the Army. The purpose of the weapon mounted lights is to provide illumination and assist in target acquisition and identification during limited visibility operations.

4-26. Most weapon mounted lights provide selection between white light and infrared capabilities. Employment of the weapon mounted light is based upon mission, enemy, terrain and weather, troops and support available, time available, civil considerations (METT-TC) and unit SOP. The weapon mounted lights should be mounted in such a manner that the Soldier can activate and deactivate them efficiently and their placement does not hinder the use of any other attachment or accessory. They must be attached in such a manner as to prevent negligent or unintentional discharge of white light illumination during movement.

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Chapter 5
Employment

Although the machine gun has changed since it first appeared on the battlefield, its role has not. In battle, the mission of machine guns is to deliver fires when and where the leader wants them, both in offense and defense. Machine guns rarely have independent missions. Instead, they provide the unit with the accurate, heavy volume of fire needed to accomplish the mission. This chapter discusses the general-purpose employment of machine guns.

The machine gunner's primary role is to engage the enemy with well-aimed shots. The gunner must acquire the target and perform the shot process. (Refer to ATP 3-21.8 for more information.) Consistently hitting a target with precision is a complex interaction of factors immediately before, during, and after the round fires. These interactions include maintaining postural steadiness, establishing and maintaining the proper aim on the target, stabilizing the weapon while pressing the trigger, and adjusting for environmental and battlefield conditions.

FIRING SITUATIONS

5-1. Every Soldier must adapt to the firing situation, integrate the rules of firearms safety, manipulate the fire control, and instinctively know when, how, and where to shoot. It is directly influenced by the Soldier's ability to hit the target under conditions of extreme stress.

- Interpret and act upon perceptual cues related to the target, front and rear sights, machine gun movement, and body movement.
- Execute minute movements of the hands, elbows, legs, and feet.
- Coordinate gross-motor control of their body positioning with fine-motor control of the hands and digits that are manipulating the trigger and T&E.

5-2. Regardless of the weapon system, the goal of firing a weapon remains constant: well-aimed shots or bursts. To achieve this end state there are two truths. Soldier's must master sight alignment, sight picture, and trigger control, which are defined below:

- Sight alignment. Sight alignment is the relationship between the aiming device and the firer's eye. To achieve proper and effective aim, the focus of the firer's eye needs to be on the front sight post or reticle. The Soldier must maintain sight alignment throughout the aiming process.
- Sight picture. The sight picture is the placement of the aligned sights on the target.
- Trigger control. Trigger control is the skillful manipulation of the trigger that causes the machine gun to fire without disturbing the aim.

SHOT PROCESS

5-3. The shot process is the basic outline of an individual engagement sequence all firers consider during an engagement, regardless of the weapon employed. The shot process formulates all decisions, calculations, and actions that lead to taking the shot. The shot process may be interrupted at any point before the sear disengaging and firing the weapon should the situation change.

5-4. The shot process has three distinct phases:

- Pre-shot
- Shot
- Post-shot

5-5. To achieve consistent, accurate, well-aimed shots, Soldiers must understand and correctly apply the shot process. The sequence of the shot process does not change. However, the application of each element vary based on the conditions of the engagement.

5-6. Each shot that the Soldier takes has a complete shot process. Grouping, for example, is simply moving through the shot process several times in rapid succession.

5-7. The shot process allows the Soldier to focus on one cognitive task at a time. The Soldier must maintain the ability to mentally organize the shot process's tasks and actions into a disciplined mental checklist, and focus their attention on activities which produce the desired outcome: a well-aimed burst.

5-8. The level of attention allocated to each element during the shot process is proportional to the conditions of each individual shot. Table 5-1 provides an example of a shot process.

Table 5-1. Shot process example

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

5-9. Functional elements of the shot process are the linkage between the Soldier, the weapon system, the environment, and the target that directly impact the shot process and ultimately the consistency, accuracy, and precision of the shot. When used appropriately, they build a greater understanding of any engagement.

5-10. The functional elements are interdependent. An accurate shot, regardless of weapon system, requires the Soldier to establish, maintain, and sustain the following elements:

- Stability. The Soldier stabilizes the weapon to provide a consistent base to fire from and maintain through the shot process until the recoil pulse has ceased. This process includes how the Soldier holds the weapon, uses structures or objects to provide stability, and the Soldier's posture on the ground during an engagement.
- Aim. Aim is the continuous process of orienting the weapon correctly, aligning the sights, aligning on the target, and the appropriate lead and elevation (hold) during a target engagement.
- Control. Control entails all the conscious actions of the Soldier before, during, and after the shot process that the Soldier specifically is in control of. The first of which is trigger control. This

includes whether, when, and how to engage. It incorporates the Soldier as a function of safety, as well as the ultimate responsibility of firing the weapon.

- Movement. Movement is the process of the Soldier moving during the engagement process. It includes the Soldier's ability to move laterally, forward, diagonally, and in a retrograde manner while maintaining stabilization, appropriate aim, and control of the weapon. MK 19 gunners are unable to fire the weapon while moving due to its size, however the gun can be moved tactically when not in use.

5-11. These elements define the tactical engagement that require the Soldier to make adjustments to determine appropriate actions, and compensate for external influences on their shot process. When all elements are applied to the fullest extent, Soldiers will be able to rapidly engage targets with the highest level of precision.

5-12. Time, target size, target distance, and the Soldier's skills and capabilities determine the amount of effort required of each of the functional elements to minimize induced errors of the shot.

5-13. Each weapon, tactical situation, and sight system will have preferred techniques for each step in the shot process and within the functional elements to produce precision and accuracy in a timely manner. How fast or slow the gunner progresses through the process is based on target size, target distance, and gunner capability.

5-14. The most complex form of engagement is under combat conditions when the Soldier is moving, the enemy is moving, under limited visibility conditions, or a combination of the three. Soldiers and leaders must continue to refine skills and move training from the simplest shot to the most complex. Applying the functional elements during the shot process builds a firer's speed while maintaining consistency, accuracy, and precision during complex engagements.

Note. Each of the functional elements and the Soldier actions to consider during the shot process are described later in this manual.

TARGET ACQUISITION

5-15. Target acquisition is the ability of a Soldier to rapidly recognize threats to the friendly unit or formation. Target acquisition is a critical Soldier function performed before any shot process begins. Target acquisition includes the Soldier's ability to use all available optics, sensors, and information to detect potential threats as quickly as possible.

5-16. Target acquisition requires the Soldier to apply an acute attention to detail in a continuous process based on the tactical situation. The target acquisition process includes all the actions a Soldier must execute rapidly:

- Detect potential threats (target detection).
- Identify the threat as friend, foe, or noncombatant (target identification).
- Prioritize the threat(s) based on the level of danger they present (target prioritization).

TARGET DETECTION

5-17. Effective target detection requires a series of skills that Soldiers must master. Detection is an active process during combat operations with or without a clear or known threat presence. All engagements are enabled by the Soldier's detection skills, and are built upon three skill sets:

- Scan and search. Scan and search is a rapid sequence of various techniques to identify potential threats. Soldier scanning skills determine potential areas where threats are most likely to appear.
- Acquire. Acquire is a refinement of the initial scan and search, based on irregularities in the environment.
- Locate. Locate is the ability to determine the general location of a threat to engage with accuracy or inform the small unit leader of contact with a potential threat.

Scan and Search

5-18. Scanning and searching is the art of observing an assigned sector. The goal of the scan and search is a deliberate detection of potential threats based on irregularities in the surrounding environment. This includes irregular shapes, colors, heat sources, movement, or actions the Soldier perceives as being "out of place," as compared to the surrounding area. Soldiers use five basic search and scan techniques to detect potential threats in combat situations:

- Rapid scan. Rapid scan is used to detect obvious signs of threat activity quickly. It is usually the first method used, whether on the offense or fighting in the defense.
- Slow scan. Soldiers conduct the more deliberate scan using various optics, aiming devices, or sensors. The slow scan is best conducted in the defense or during slow movement or tactical halts.
- Horizontal scan. Soldiers use horizontal scan when operating in restricted or urban terrain. It is a horizontal sweeping scan that focuses on key areas where potential threats may be over watching their movement or position.
- Vertical scan. The vertical scan is an up-and-down scan in restricted or urban environments to identify potential threats that may be observing the unit from an elevated position.
- Detailed search. Soldiers use a detailed search when no threats are detected using other scanning methods. The detailed search uses aiming devices, thermal weapon systems, magnified optics, or other sensors to slowly and methodically review locations of interest where the Soldier would be positioned if they were the threat. (Where would I be if I were them?)

Acquire

5-19. Target acquisition is the discovery of any object in the operational environment such as personnel, vehicles, equipment, or objects of potential military significance. Target acquisition occurs during target scan and search as a direct result of observation and the detection process.

5-20. During the scan and search, Soldiers are looking for "target signatures," which are signs or evidence of a threat. Tactically, Soldiers will be looking for threat personnel, obstacles or mines (including possible improvised explosive devices [IEDs] and unexploded ordinance [UXO]), vehicles, or anti-tank missile systems. These target signatures can be identified with sight, sound, or smell.

Locate

5-21. Target location is the determination of where a target is in your operational environment in relation to the shooter, small unit, or element. Locating a target or series of targets occurs as a result of the search and acquisition actions of each Soldier in the small unit.

5-22. Once a target is located, the threat location can be rapidly and efficiently communicated to the rest of the unit. Methods used to announce a located target depend on the individual's specific position, graphic control measures for the operation, unit SOP, and time available.

Detection Best Practices

5-23. Threat detection is a critical skill that requires thoughtful application of the sensors, optics, and systems at the Soldier's disposal. Finding potential threats as quickly and effectively as possible provides the maximum amount of time to defeat the threat. Detecting threats is more difficult when operating in a chemical, biological, radiological, nuclear (CBRN) environment. Practice detection skills with personal protective equipment/individual protective equipment and understand the increased constraints and limitations, day and night. Soldiers should be familiar with the following best practices to increase target detection:

- Scan with the unaided eye first, then with a magnified optic.
- Practice using I2 and thermal optics in tandem during limited visibility.
- Understand the difference between I2 and thermal optics; what they can see and what they cannot.

Note. Thermal optics are the preferred sight for target acquisition and engagement, day or night.

- Do not search in the same area as others in the small unit. Overlap, but avoid focusing on the same sector.
- Practice extreme light discipline during limited visibility including infrared light discipline.
- Think as the threat. Search in areas that would be most advantageous from their perspective.

TARGET IDENTIFICATION

5-24. Identifying (or discriminating) a target as friend, foe, or noncombatant (neutral) is the second step in the target acquisition process. The identification process is complicated by the increasing likelihood of having to discriminate between friend/foe and combatant/noncombatant in urban settings or restricted terrain. To mitigate fratricide and unnecessary collateral damage, Soldiers use all of the situational understanding tools available and develop tactics, techniques, and procedures for performing target discrimination.

Classifications

5-25. The Soldier must be able to positively identify the threat into one of three classifications:

- Friend. Any force, U.S. or allied, that is jointly engaged in combat operations with an enemy in a theater of operation.
- Foe. A foe, or enemy combatant, is any individual who has engaged in acts against the U.S. or its coalition partners in violation of the laws and customs of war during an armed conflict.
- Noncombatants. Personnel, organizations, or agencies that are not taking a direct part in hostilities. This includes individuals such as medical personnel, chaplains, United Nations observers, or media representatives or those out of combat such as the wounded or sick. Organizations like the Red Cross or Red Crescent can be classified as noncombatants.

Fratricide Prevention

5-26. Units have other means of designating friendly vehicles from the enemy. Typically, these marking systems are derived from the unit tactical standard operating procedure (TACSOP) or other standardization publications, and applied to the personnel, small units, or vehicles as required:

- Markings. Unit markings are defined within the unit SOP. They distinctly identify a vehicle as friendly in a standardized manner.
- Panels. VS-17 panels provide a bright recognition feature that allows Soldiers to identify friendly vehicles through the day sight during unlimited visibility. Panels do not provide a thermal signature.
- Lighting. Chemical or light emitting diode lights provide a means of marking vehicles at night. However, chemical lights are not visible through a thermal sight. An IR variant is available for use with night vision devices. Lighting systems do not provide for thermal identification during day or limited visibility operations.
- Beacons and strobes. Beacons and strobes are unit-procured, small-scale, compact, battery-operated flashing devices that operate in the near infrared wavelength. They are clearly visibly through night vision optics, but cannot be viewed through thermal optics.

Note. Beacons and strobes generate illumination signals that can only be viewed by I2 optics. The signal cannot be viewed by thermal optics. Leaders and Soldiers are required to be aware of which optic can effectively view these systems when developing their SOPs and when using them in training or combat. Beacons and strobes have the potential to be viewed by enemy elements with night vision capabilities. Units should tailor use of the beacon based on METT-TC.

- Symbols. Unit symbols may be used to mark friendly vehicles. An inverted V, for example, painted on the flanks, rear, and fronts of a vehicle, aid in identifying a target as friendly. These are typically applied in an area of operations and not during training. Symbol marking systems do not provide for thermal identification during day or limited visibility operations.

TARGET PRIORITIZATION

5-27. When faced with multiple targets, the Soldier must prioritize each target and carefully plan his shots to ensure successful target engagement. Mental preparedness and the ability to make split-second decisions are the keys to a successful engagement of multiple targets. The proper mindset will allow the Soldier to react instinctively and control the pace of the battle, rather than *reacting* to the adversary threat.

Threat Levels

5-28. Targets are prioritized into three threat levels—

- Most dangerous. A threat that has the capability to defeat the friendly force and is preparing to do so. These targets must be defeated immediately.
- Dangerous. A threat that has the capability to defeat the friendly force, but is not prepared to do so. These targets are defeated after all most dangerous targets are eliminated.
- Least dangerous. Any threat that does not have the ability to defeat the friendly force, but has the ability to coordinate with other threats that are more prepared. These targets are defeated after all threats of a higher threat level are defeated.

Multiple Targets

5-29. When multiple targets of the same threat level are encountered, the targets are prioritized according to the threat they represent. The standard prioritization of targets establishes the order of engagement. Gunners engage similar threats by the following guide:

- Near before far.
- Frontal before flank.
- Stationary before moving.

5-30. The prioritization of targets provides a control mechanism for the gunner, and facilitates maintaining overmatch over the presented threats. Gunners should be prepared to deviate from the prioritization guide based on the situation, collective fire command, or changes to the target's activities.

Chapter 6
Stability

Stability is the ability of the Soldier to create a stable firing platform for the engagement. The Soldier stabilizes the weapon to provide a consistent base from which to fire from and maintain through the shot process until the recoil impulse has ceased. This process includes how the Soldier uses structures or objects to provide stability, and the Soldier's posture on the ground during an engagement. A stable firing platform is essential during the shot process.

Chapter 6 provides the principles of developing a stable firing platform, describes the interaction between the Soldier, weapon, the surroundings, and the methods to achieve the greatest amount of stability in various positions. It explains how the stability functional element supports the shot process and interacts and integrates the other three elements. Stability provides a window of opportunity to maintain sight alignment and sight picture for the most accurate shot.

SUPPORT

6-1. Stability is provided through four functions: support, muscle relaxation, natural point of aim, and recoil management. These functions provide the Soldier the means to best stabilize their weapon system during the engagement process.

6-2. The placement or arrangement of sandbags, equipment, or structures that directly provide support to the weapon to provide increased stability. This includes the use of a tripod, T&E mechanism, and bone-and-muscle support provided by the gunner to stabilize the machine gun.

6-3. Support can be natural or artificial or a combination of both. Natural support comes from a combination of the gunner's bones and muscles. Artificial support comes from objects outside the gunner's body. The more support a particular position provides, the more stable the weapon.

LEG POSITION

6-4. The position of the legs varies greatly depending on the firing position used. The position may require the legs to support the weight of the Soldier's body, support the firing elbow, or to meet other requirements for the firing position. When standing the body is upright with the legs staggered and knees slightly bent. In the prone, the firer's legs may be spread apart flat on the ground or bent at the knee. In the sitting position, the legs may also serve an intricate part of the firing position.

STANCE AND CENTER OF GRAVITY

6-5. The physical position of a Soldier before, during, and after the shot that relates to the firer's balance and posture. The position/center of gravity does not apply when firing from the prone position. The position/center of gravity specifically relates to the Soldier's ability to maintain the stable firing platform during firing, absorbing the recoil impulses, and the ability to aggressively lean toward the target area during the shot process.

FIRING ELBOW

6-6. The placement of the firing elbow during the shot process. Each firing event presents a unique set of challenges and the gunner must determine how to create the greatest amount of stability necessary to eliminate the threat. Careful consideration should be made when deciding whether to fire with one hand or two. Proper elbow placement provides consistent firing hand grip and support stability while in the standing, sitting, and prone positions. If firing with both hands replicate elbow placement on the non-firing side. Advantages and disadvantages are associated with both techniques.

Advantages of Firing with Both Hands

6-7. Firing with both hands allows the firer more stability, which then provides the following advantages:

- Gunner can provide increased support resulting a smaller arc of movement which allows for in proper sight picture and precise shots/bursts.
- Gunner can ensure body placement is directly behind the weapon resulting in correct sight alignment.
- Recoil management is increased allowing for proper follow through resulting in a tighter shot groups and cones of fire.

Disadvantages of Firing with Both Hands

6-8. Like with any technique, firing with both hands has disadvantages as well. The Soldier should be aware of them so that they can make the best choice for their given situation. The disadvantages are as follows:

- Adjustments require the gunner to move non-firing hand in order to locate azimuth and elevation controls of the T&E mechanism. This results in slower subsequent or supplemental engagements.
- Searching and traversing area targets require the gunner to repeatedly move the non-firing hand.
- Moving targets would need to be engaged with a free gun utilizing the tracking lead method or the gunner would need to employ the trapping method of lead.

Advantages of Firing With One Hand

6-9. Soldiers have the option of firing with one hand. The advantages of using this technique are as follows:

- The non-firing hand is free to make adjustment utilizing the controls of the T&E mechanism allowing for rapid and precise adjustments during subsequent and supplemental engagements.
- Gunner can traverse or track a target area in azimuth in a smooth motion. By pulling out on the traverse lever on the M205 T&E mechanism or loosening the traverse lever on the T&E assembly on the M3 tripod. This allows the gunner to maintain a constant elevation while engaging a linear area target or applying lead.

Disadvantages of Firing With One Hand

6-10. Disadvantages of firing with one hand exist just as they do with two hands. The one hand disadvantages are as follows:

- Gunner is forced to manage recoil and provide stability with one side of the body, which results in larger shot groups and cones of fire.
- Gunner does not have the symmetry provided with two-handed firing as to ensure they are directly behind the weapon, which could lead to sight misalignment.

NONFIRING ELBOW, ONE-HANDED FIRING

6-11. The Soldier's placement of the nonfiring elbow during the shot process supports the hand while manipulating the T&E mechanism in all positions. (See figures 6-1 on page 6-3 and also figure 6-2 on page 6-4.) The nonfiring elbow must be used in conjunction with the firing elbow to stabilize the weapon when being fired in the free gun state. The gunner stabilizes the machine gun while firing the machine gun with two hands by tucking both elbows into the gunner's side while standing, on the inside of the gunners thighs while siting (see figure 6-3 on page 6-5), and by placing both elbows on the ground while in the prone (see figure 6-4 on page 6-6).

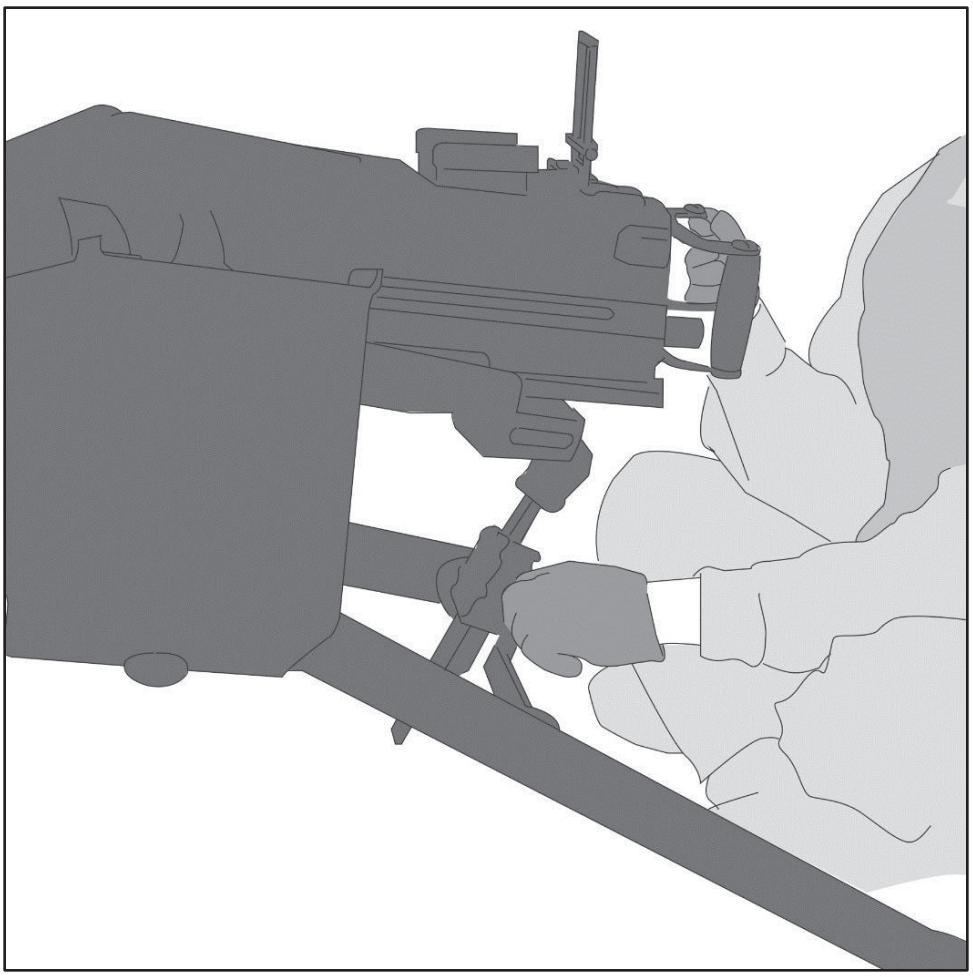


Figure 6-1. Placement of nonfiring hand and elbow manipulating T&E, sitting position

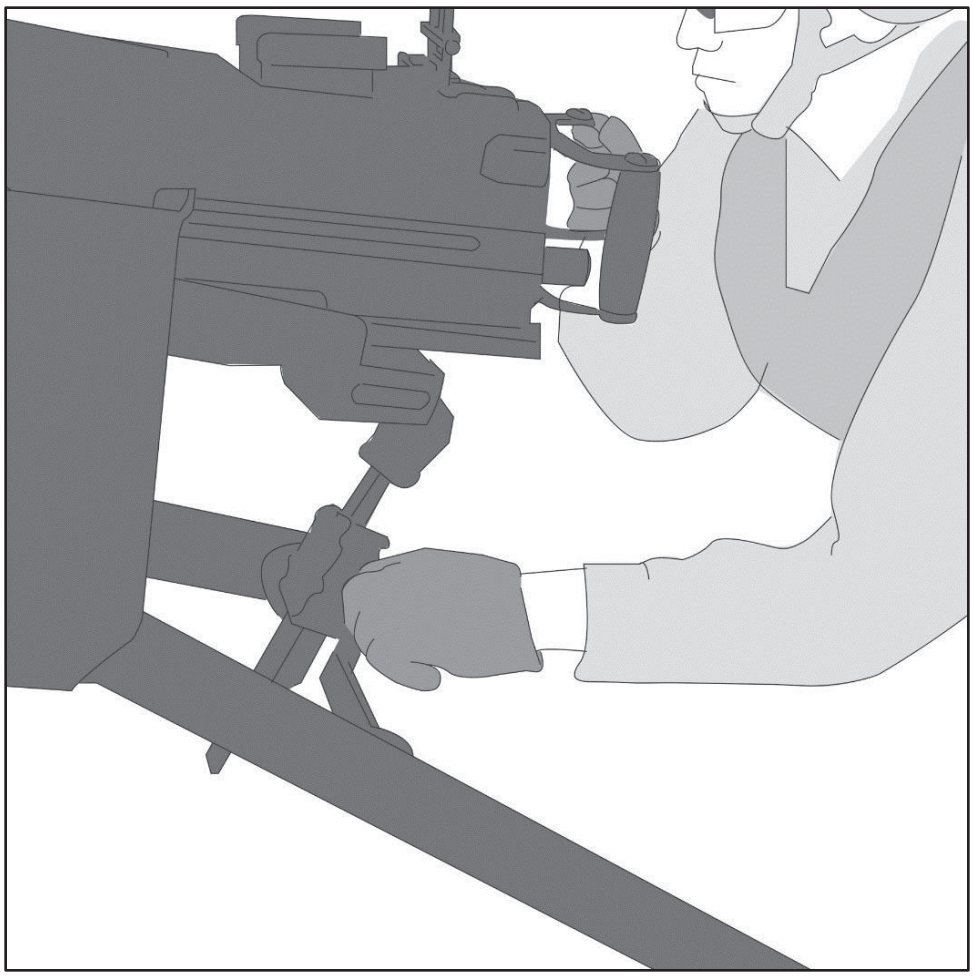


Figure 6-2. Placement of nonfiring hand and elbow manipulating T&E, prone position

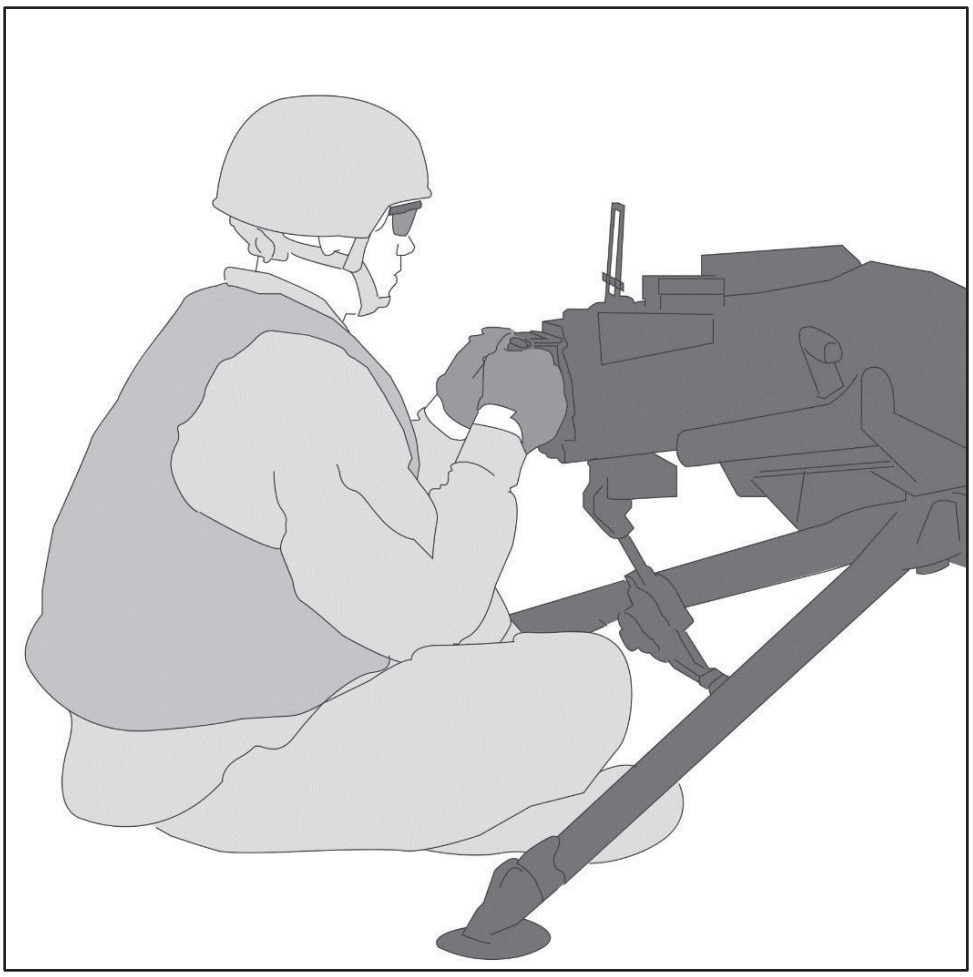


Figure 6-3. Placement of nonfiring elbow and hand, sitting position, firing with both hands

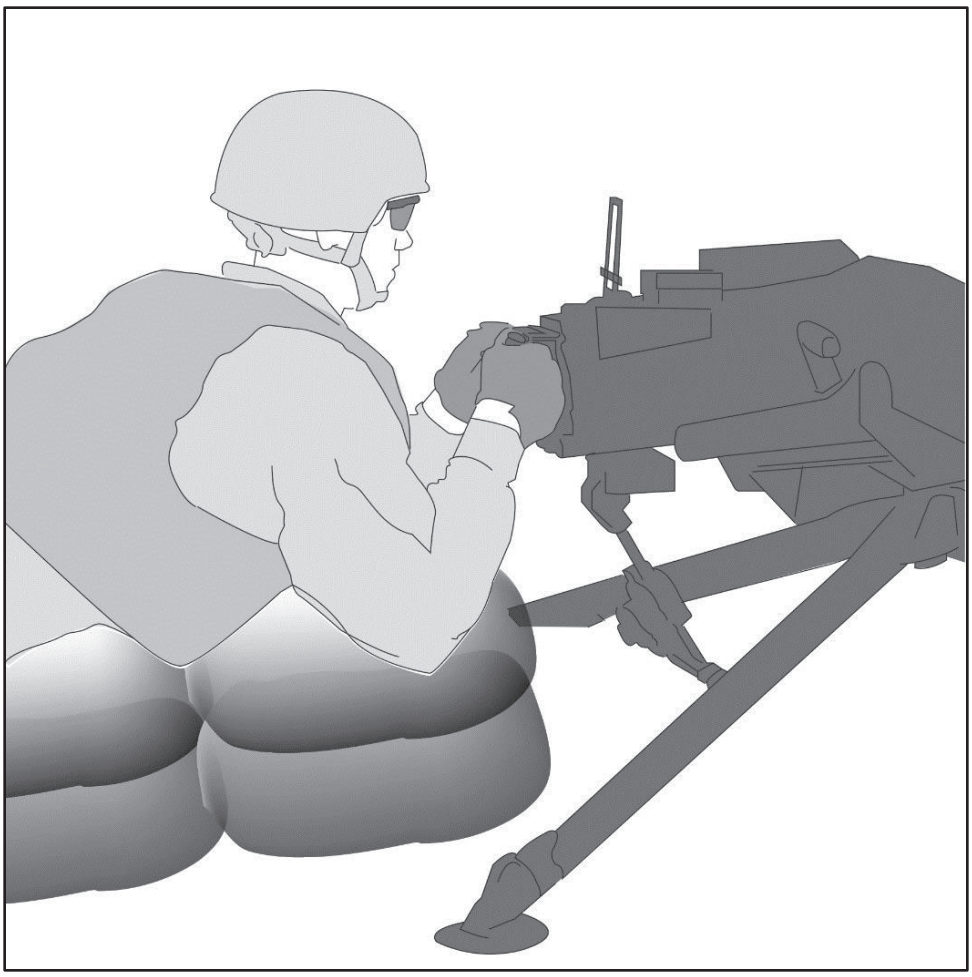


Figure 6-4. Placement of nonfiring elbow and hand, prone position, firing with both hands

Firing Hand

6-12. Proper placement of the firing hand aids in trigger control, recoil management, and stability. A Soldier's hand lightly grasps the spade grip with their thumb in a position to press the trigger. The Soldier places the grip in the 'V' formed between the thumb and index finger. The pressure applied is similar to a firm handshake grip. Different Soldiers have different size hands and lengths of fingers, so there is no set position of the thumb on the trigger. To grip the weapon, the Soldier wraps their fingers around the spade grip.

Nonfiring Hand

6-13. Proper placement of the non-firing hand is based on the firing position and placement of the non-firing elbow to provide the stability of the hand manipulating the T&E mechanism or spade grip if firing with both hands. Placement is adjusted to maximize stability. (See figures 6-1 through 6-4 on pages 6-2 through 6-6.) If possible, the firer should strive to have the non-firing hand provide downward force on the hand wheel of the older style T&E used with the M3 tripod. The pressure provides the necessary force to assist in the management of the wobble area resulting from recoil.

MUSCLE RELAXATION

6-14. Muscle relaxation is the ability of the Soldier to maintain orientation of the weapon appropriately during the shot process while keeping the major muscle groups from straining to maintain the weapon system's position. Relaxed muscles contribute to stability provided by support.

- Strained or fatigued muscles detract from stability.
- As a rule, the more support from the shooter's bones the less he requires from their muscles.
- The more skeletal support, the more stable the position, as bones do not fatigue or strain.
- As a rule, the less muscle support required, the longer the gunner can stay in position.

6-15. Soldiers may have difficulty obtaining optimal muscle relaxation while in the prone position due to differences in body types, operational gear, and fighting positions. To aid in muscle relaxation while in the prone position gunners should use available resources to build their fighting position while still remaining behind available cover. Sand bags, assault packs and built-up earth from around the fighting position can be used to aid in muscle relaxation.

NATURAL POINT OF AIM

6-16. The natural point of aim is the point where the barrel naturally orients when the gunner's muscles are relaxed and support is achieved. The natural point of aim is built upon the following principles:

- The closer the natural point of aim is to the target, the less muscle support required.
- The more stable the position, the more resistant to recoil it is.
- More of the gunner's body on the ground equals a more stable position.
- More of the gunner's body on the ground equals less mobility for the gunner.

6-17. When a Soldier aims at a target, the lack of stability creates a wobble area, where the sights oscillate slightly around and through the point of aim. This condition is especially prevalent while firing the weapon in the free gun state. If the wobble area is larger than the target, the Soldier requires a steadier position or a refinement to their position to decrease the size of his wobble area before and while the trigger is depressed.

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

6-18. To check a gunner's natural point of aim, the Soldier should assume a good steady position and get to the natural pause. Close their eyes, go through one cycle, and then open their eyes on the natural pause. Where the sights are laying at this time, is the natural point of aim for that position. If it is not on their point of aim for their target, they should make small adjustments to their position to get the reticle or front sight post back on their point of aim. The Soldier repeats this process until the natural point of aim is on the point of aim on their target.

RECOIL MANAGEMENT

6-19. Recoil management is the result of a Soldier assuming and maintaining a stable firing position which mitigates the disturbance of one's sight picture during the cycle of function of the weapon.

6-20. The Soldier's firing position manages recoil using support of the weapon system, tripod, T&E mechanism, sand bags, the weight of their body, and the placement of the weapon during the shot process. Proper recoil management allows the sights to rapidly return to the target and allows for faster follow up shots.

SHOOTER–GUN ANGLE

6-21. The shooter gun-angle is the relationship between the gunners' upper body and the direction of the weapon. This angle is typically different from firing position to firing position, and directly relates to the Soldier's ability to control recoil. Significant changes in the shooter-gun angle can result in eye relief changes.

FIELD OF VIEW

6-22. The field of view is the extent that the human eye can see at any given moment. The field of view is based on the Soldier's view without using magnification, optics, or thermal devices. The field of view is what the Soldier sees, and includes the areas where the Soldier can detect potential threats.

STABILIZATION

6-23. The Soldier must stabilize their weapon, while firing from a stationary position. To create a stabilized platform, Soldiers must understand the physical relationship between the weapon system, the tripod, the T&E mechanism, the gunner's body, the ground, and any other objects touching the weapon or gunner's body. The more contact the shooter has to the ground will determine how stable and effective the position is. The situation and tactics will determine the actual position used.

6-24. When a gunner assumes a stable firing position, movement from muscle tension, breathing, and other natural activities within the body will be transferred to the weapon. The gunner must compensate for these.

6-25. Failure to create an effective platform to fire from is termed a stabilization failure. A stabilization failure occurs when a Soldier fails to—

- Control the movement of the barrel during the arc of movement
- Adequately support the weapon system
- Achieve their natural point of aim.

6-26. These failures compound the firing occasion's errors, which directly correlate to the accuracy of the shot taken. To maximize the Soldier's stability during the shot process, they correctly assume various firing positions. As a rule, positions that are lower to the ground provide a higher level of stability. When the center of gravity elevates the level of stability decreases as shown in figure 6-5.

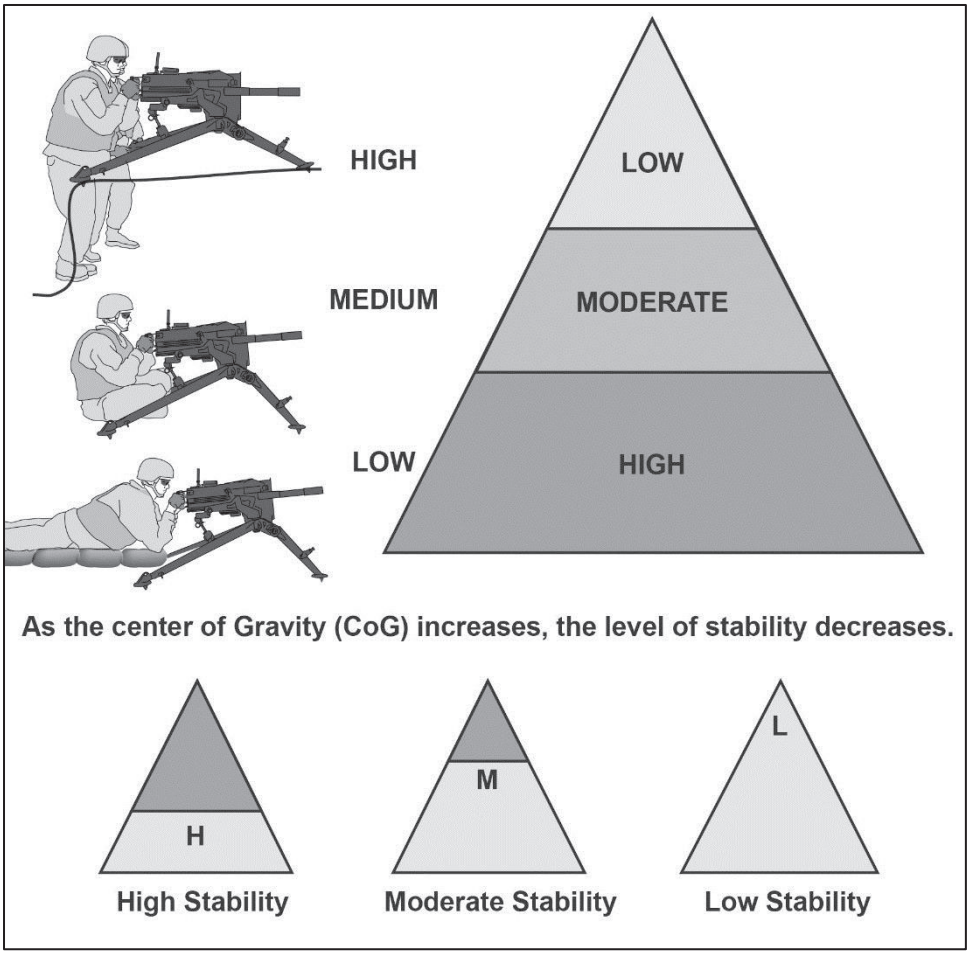


Figure 6-5. Firing position stability example

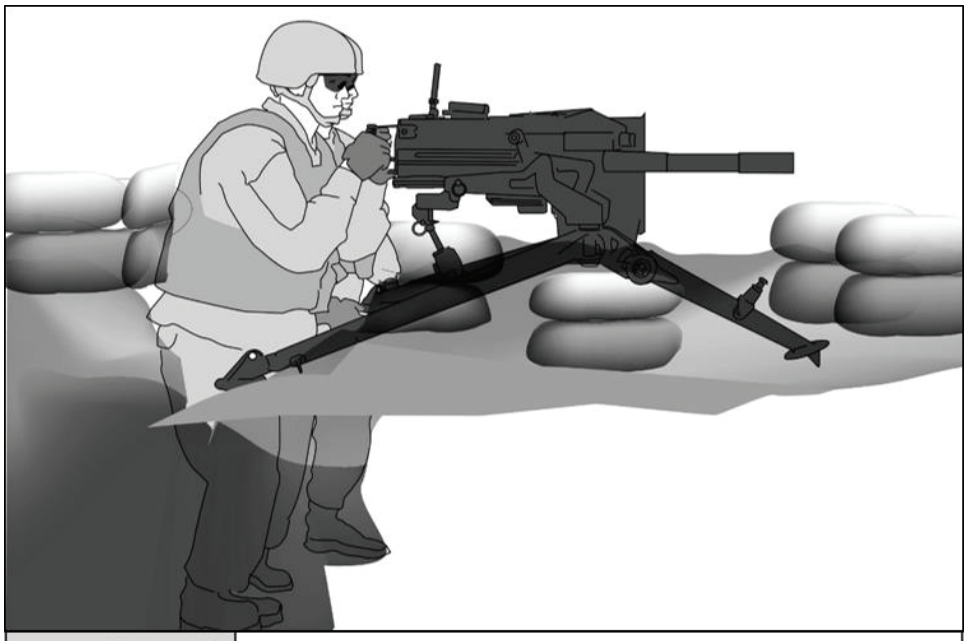
FIRING POSITIONS

6-27. The nature of combat will not always allow time for a Soldier to get into a particular position. Soldiers need to practice firing in a variety of positions. There are 3 firing positions with variations that are common to all Soldiers. The positions are listed highest to lowest. The primary position is listed in bold, with the position variations in italics:

STANDING

6-28. The standing position is used when the gunner is firing from a fighting position. This position is assumed by standing directly behind the gun with the feet spread a comfortable distance apart. This position is the least stable firing positon. However if the gun is connected to the T&E assembly and the tripod is emplaced properly and sand bagged this position can be extremely stable. This position provides the greatest amount of movement for the gunner and allows for rapid sight adjustment, correction of malfunctions, and during loading and unloading procedures.

6-29. The gunner grasps the elevating handwheel of the T&E mechanism with the non-firing hand. The Gunner grasps the spade grip with the firing hand, ensuring that the thumb is in a position to press the trigger. Adjustment of the body is allowed in order to align the firing eye with the sights on the weapon. The upper body should be leaned slightly forward to aid in recoil management. The key focus areas for the standing supported position are applied as described in figure 6-6 on page 6-10.



Support:	Supported
Leg Position:	Standing directly behind the gun with the feet spread a comfortable distance apart.
Stance/ Center of Gravity:	The upper body should be leaned slightly forward to aid in recoil management.
Firing Elbow:	Tucked toward the gunners side.
Non-Firing Elbow:	Rests on the ground while manipulating the T&E or tucked to gunners side during two handed firing.
Firing Hand:	Lightly grasps the spade grip, ensuring that the thumb is in a position to press the trigger.
Non-Firing Hand:	Grasps the elevating handwheel 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.
Shooter-Gun Angle:	Gunner's body is approximately 90 degrees to the gun-target line.

Figure 6-6. Standing example

SEATED

6-30. The seated position can be used when the tripod is set in a high or low position. Gunner's wearing body armor may find it difficult to fire from the seated position if the tripod is too low. The body armor restricts the amount the upper can bend due to the ceramic plates. The tripod should be adjusted to height that provides the gunner with a comfortable natural point of aim.

6-31. The gunner sits directly behind the gun between the legs of the tripod. The gunner may extend legs under, over the tripod, or cross them. Gunners can also place their feet on the rear legs of the tripod. Placement of the legs and feet will change depending on the lateral angle of the target being engaged and the height of the gunner. The gunner then places both elbows on the inside of thighs to get the best support. Gunner grasps the elevating handwheel of the T&E mechanism with the non-firing hand, and lightly grasps the spade grip with firing hand. If firing with two hands the non-firing hand and elbow are positioned in the same manner as the firing hand and elbow. The gunner must ensure that the thumb is in position to press the trigger. The sitting, position provides a broad base of support and places most of the body weight behind the weapon. (See figure 6-7 on page 6-12.) This allows quick shot recovery and recoil impulse absorption.



Support:	Supported
Leg Position:	Gunner may extend their legs under or over the tripod or cross them, depending on physique.
Stance / Center of Gravity:	The upper body should be leaned slightly forward to aid in recoil management.
Firing Elbow:	Inside of thigh to get the best support.
Non-Firing Elbow:	Inside of thigh to get the best support.
Firing Hand:	Lightly grasps the spade grip, ensuring that the thumb is in a position to press the trigger.
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.
Shooter-Gun Angle:	Gunner's body is approximately 45 to 90 degrees to the gun-target line.

Figure 6-7. Sitting, example

6-32. There are four types of sitting positions: open-leg feet over tripod (figure 6-7), crossed-ankle (figure 6-8), open-leg feet on rear tripod legs (figure 6-9), and open-leg with legs under tripod (figure 6-10 on page 6-14). All positions are easy to assume, present a medium silhouette, provide some body contact with the ground, and form a stable firing position. These positions allow easy access to the sights for zeroing.

- Sitting, crossed ankle.
- Sitting, open leg, feet on tripod.
- Sitting, open leg, legs over tripod
- Sitting, open leg, legs under tripod

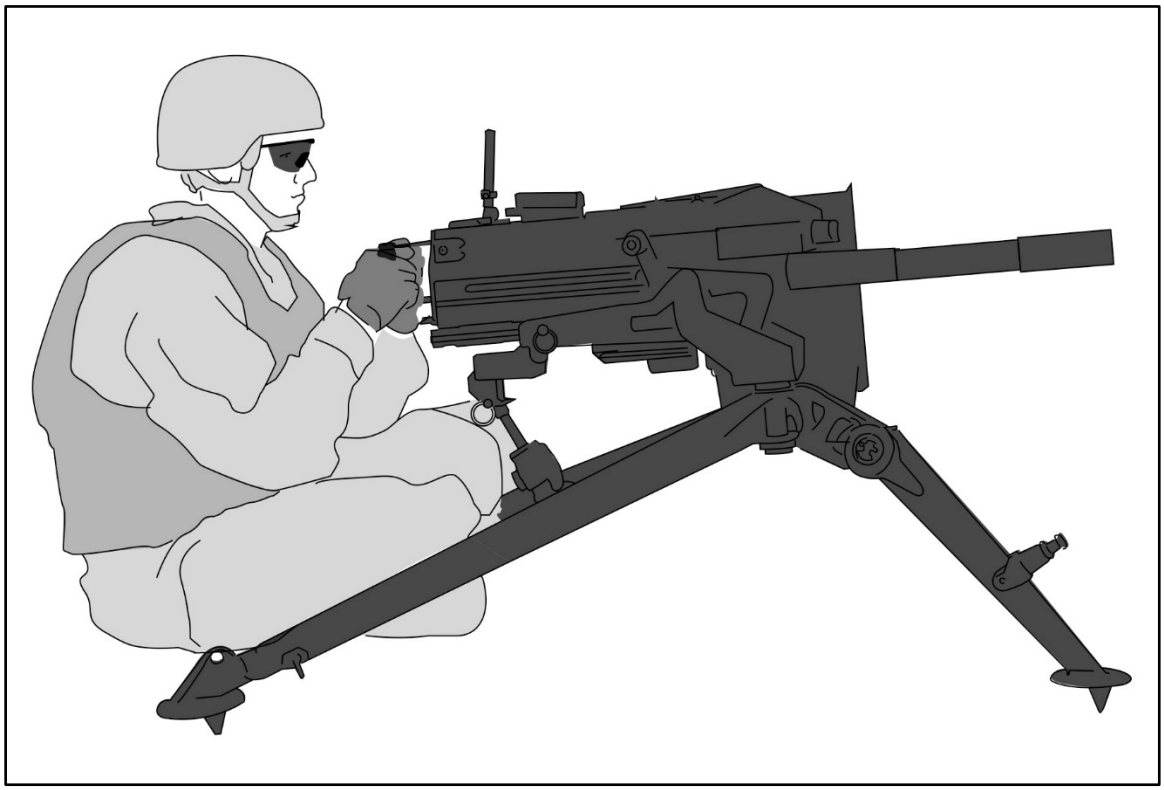


Figure 6-8. Sitting, cross ankle

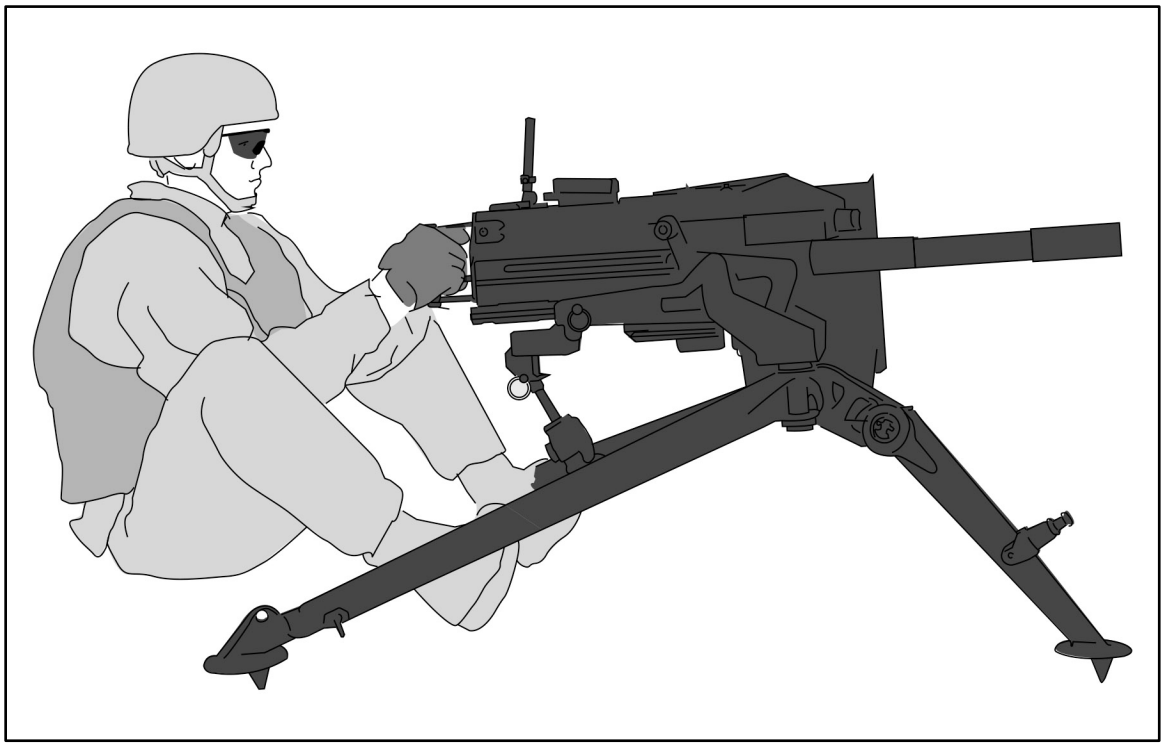


Figure 6-9. Sitting, open legged, feet on tripod

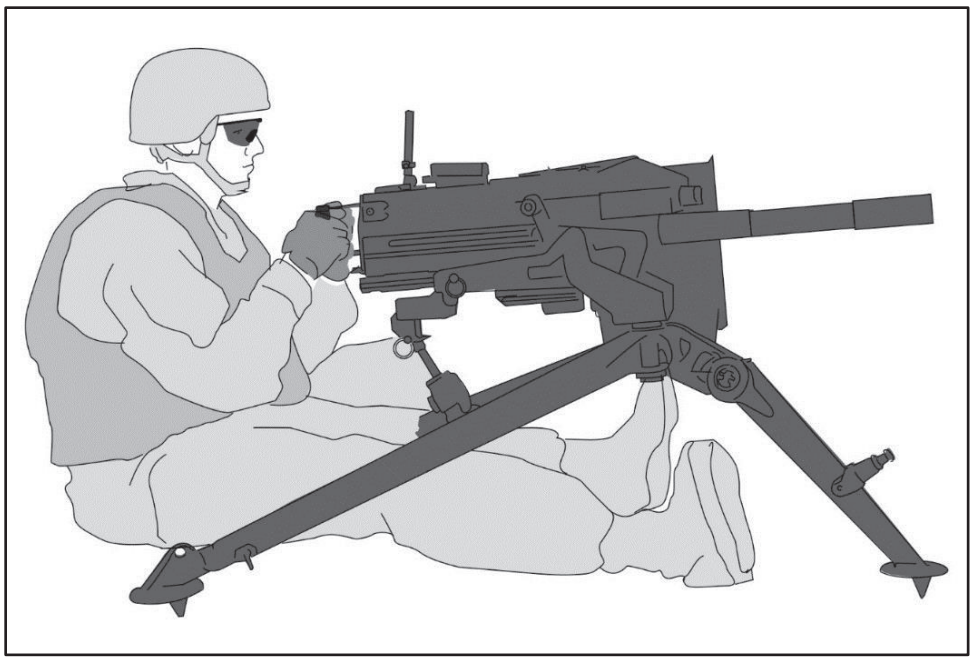
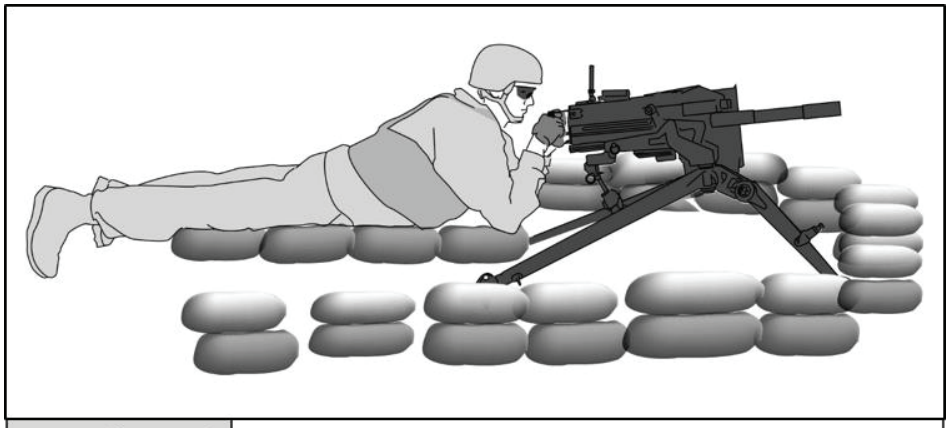


Figure 6-10. Sitting, open legged, legs under tripod

PRONE

6-33. The prone position is used when firing from a tripod that is set in a low position. Gunners may need to supplement this position with artificial support in order to provide sufficient muscle relaxation, stability, and allow the soldier to see through the sights.

6-34. The prone position is assumed by lying on the ground directly behind the gun. The gunner spreads their legs a comfortable distance apart with their toes turned outward. The non-firing elbow rests on the ground, and non-firing hand grasps the elevating handwheel of the T&E mechanism. The firing hand lightly grasps the spade grip with the thumb in a position to press the trigger. The position of the body must be adjusted to position the firing eye in alignment with the sights of the weapon. Soldiers must build a stable, consistent position that focuses on the key areas. (See figure 6-11.)



Support:	Supported
Leg Position:	The gunner spreads his legs a comfortable distance apart with his toes turned outward.
Stance / Center of Gravity:	Prone position maximizes the Soldier's frame against the ground for maximum stability.
Firing Elbow:	Firing elbow rests on the ground.
Non-Firing Elbow:	Non-firing elbow rests on the ground.
Firing Hand:	Lightly grasps the spade grip, ensuring that the thumb is in a position to press the trigger.
Non-Firing Hand:	Grasps the elevating handwheel 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.
Shooter-Gun Angle:	Gunner's is nearly perpendicular to the gun-target line.

Figure 6-11. Prone example

6-35. The prone position is the most stable firing position due to the amount of the Soldier's body in contact with the ground. The majority of the firer's frame is behind the machine gun to assist with recoil management. However, this position limits the gunners' amount of movement when adjusting sights, correcting malfunctions, and during loading and unloading procedures.

6-36. Soldiers must practice the positions dry frequently to establish their natural point of aim for each position, and develop an understanding of the restrictive nature of their equipment during execution. With each dry repetition, the Soldier's ability to change positions rapidly and correctly are developed, translating into efficient movement and consistent stable firing positions.

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Chapter 7
Aim

Aim is the functional element of the shot process. Aim is the continuous process of correctly orienting the weapon, aligning the sights, aligning on the target, and applying the appropriate lead and elevation, throughout a target engagement. Soldiers conduct aiming through pre-shot, shot, and post-shot, to effectively apply lethal fires in a responsible manner with accuracy and precision.

Aim is the application of perfectly aligned sights on a specific part of a target. Sight alignment is the first and most important part of this process.

COMMON ENGAGEMENTS

7-1. The aiming process for engaging stationary targets consists of the following Soldier actions, regardless of the optic, sight, or magnification used by the aiming device:

- Weapon orientation. The direction of the weapon as it is aimed in a stabilized manner.
- Sight alignment. The physical alignment of the aiming device, which includes:
  - Rear sight assembly and the front sight post.
  - Optic reticle.
  - Ballistic reticle (day or thermal).
- Sight picture. The target as viewed through the line of sight.
- Point of aim (POA). The specific location where the line of sight intersects the target.
- Desired point of impact (POI). The desired location of the strike of the round to achieve the desired outcome (incapacitation or lethal strike).

7-2. The aim of the weapon is typically applied to the largest, most lethal area of any target presented. Sights can be placed on target by using battlesight zero, center base of visible mass (CBoVM). The weapon is aimed at the CBoVM in order to maximize the beaten zone as discussed in appendix B. The CBoVM is the initial point of aim on a target of what can be seen by the Soldier. It does not include what the target size is expected or anticipated to be. For example, a target located behind a car exposes the upper portion of the enemy Soldier's body. The CBoVM is in the center bottom of the enemy Soldier's torso, not the estimated location of the center base of the overall target behind the car.

WEAPON ORIENTATION

7-3. The Soldier orients the weapon in the direction of the detected threat. Weapon orientation includes both the horizontal plane (azimuth) and the vertical plane (elevation). Weapon orientation is complete once the sight and threat are in the Soldier's field of view.

7-4. The quickest method of orienting the weapon is by disengaging the T&E mechanism. Disengaging the T&E mechanism allows for increased changes in weapons orientation and increased rate of directional changes. However, this reduces stability and accuracy of the weapon.

7-5. A moderately quick method of laying the weapon for deflection is accomplished by loosening the traverse slide lever on the older style T&E mechanism or by pulling the traverse or elevation levers toward the firer on the M205 tripod T&E. This permits the weapon to move smoothly along the traverse and elevation bar rapidly. This method also has the added benefit of stability provided by the T&E. The gunner can then make refined one milliradian changes in elevation and deflection by utilizing the hand wheel's on the older

T&E or by depressing or elevating the levers on the M205 tripod with T&E. However, this method limits the change in weapons orientation to the limits of the traverse and elevating mechanism and tripod, and takes an increased amount of time to lay the weapon for deflection and elevation.

Note. The older style T&E mechanism does not have a lever that enables a gunner to make rapid adjustments in elevation.

HORIZONTAL WEAPONS ORIENTATION

7-6. Horizontal weapons orientation covers the frontal arc of the Soldier, spanning the area from the left limit of fire, across the Soldier's front, to the area across the right limit of fire. (See figure 7-1.)

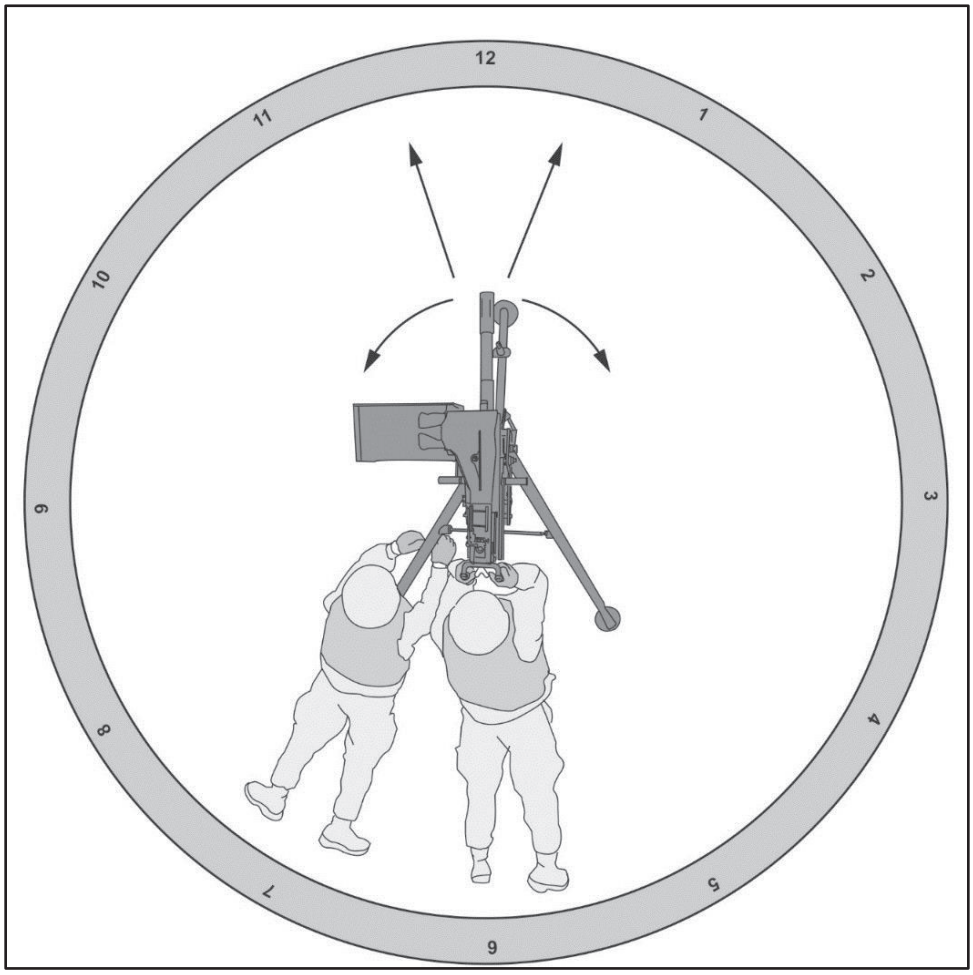


Figure 7-1. Horizontal weapon orientation example

VERTICAL WEAPONS ORIENTATION

7-7. Vertical weapons orientation includes all the aspects of orienting the weapon at a potential or confirmed threat in elevation. This is most commonly applied in restricted, mountainous, or urban terrain where threats present themselves in elevated or depressed firing positions. (See figure 7-2.)

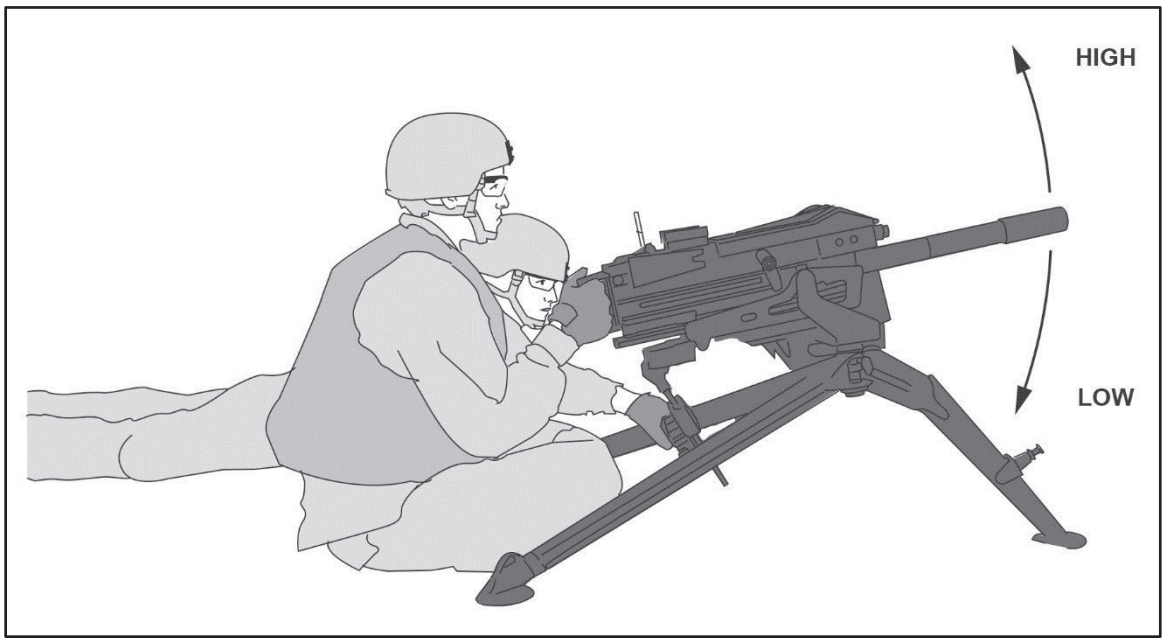


Figure 7-2. Vertical weapons orientation example

SIGHT ALIGNMENT

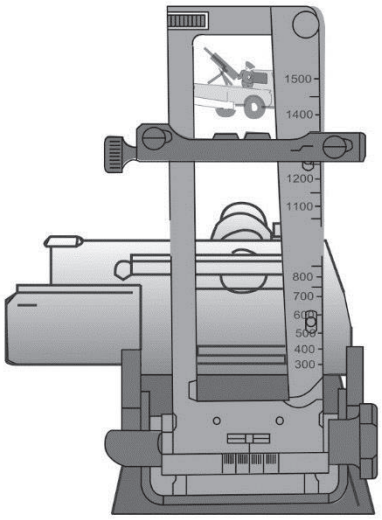
7-8. Sight alignment is the relationship between the aiming device and the firer's eye. The process used by a Soldier depends on the aiming device employed with the weapon.

- Rear sight assembly. When using the rear sight assembly, the relationship is between the front sight post, rear sight aperture, and the firer's eye. The firer aligns the tip of the front sight post in the center of the rear aperture their eye. The gunner must remain cognizant of the position of their head and distance from the rear sight in order to consistently replicate sight alignment. It is recommended that a gunner keep the sights 6-8 inches from their firing eye. The firer will maintain focus on the front sight post, simultaneously centering it in the rear aperture. The gunner must remain directly behind the MK 19 in order to have proper sight alignment.
- Thermal sight. When using a thermal sight, the relationship between the firer's eye, the eyepiece, and the reticle.
- Pointers, illuminators, and lasers. When using pointers, illuminators, and lasers, the relationship between the firer's eye, the night vision device placement and focus, and the laser aiming point on the target.

Note. Small changes matter - 1/1000 inch deviation at the weapon can result in up to an 18 inch deviation at 300 meters.

7-9. The human eye can only focus clearly on one object at a time. To achieve proper and effective aim, the focus of the firer's eye needs to be on the front sight post or reticle. (See figure 7-3 on page 7-4.) The most accurate sight alignment for the shot process is with the firer's eye on the front sight post or reticle.

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.

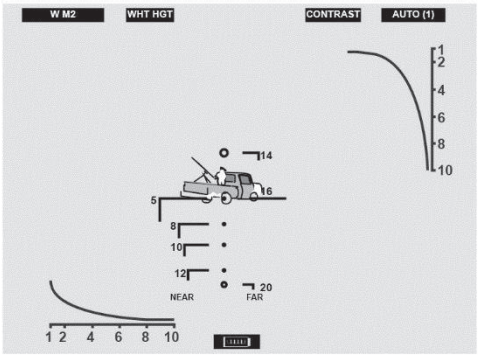


Figure 7-3. Front sight post/reticle aim focus

7-10. The first step in proper sighting is finding a natural, comfortable spot where the gunner is able to see the front sight blade through the rear peep sight. It is important the gunner understands that the spot they choose to sight from must be constant throughout firing. If the firer's head placement changes during the firing process or between shots, the Soldier will experience difficultly achieving accurate shot groups.

SIGHT PICTURE

7-11. The sight picture is the placement of the aligned sights on the target itself. The Soldier must maintain sight alignment throughout the positioning of the sights. This is not the same as sight alignment. The two sight pictures used during the shot process are pre-shot and post-shot. Soldiers must remember the sight pictures of each shot to complete the overall shot process.

- Pre-shot sight picture. Encompasses the original point of aim, sight picture, and any holds for target or environmental conditions.
- Post-shot sight picture. What the Soldier must use as the point of reference for any sight adjustments for any subsequent shot.

POINT OF AIM

7-12. The point on the target that is the continuation of the line created by sight alignment. The point of aim is a point of reference used to calculate any hold the Soldier deems necessary to achieve the desired results of the round's impact. For engagements against stationary targets, with negligible wind, and a weapon with a confirmed zero, the point of aim should be the center base of visible mass (CBoVM) of the target. The point of aim does not include any hold-off or lead changes necessary.

DESIRED POINT OF IMPACT

7-13. The desired point of impact is the location where the Soldier wants the projectile to strike the target. Typically, this is the center of visible mass. At ranges different from the weapon's zero distance, the Soldier's desired point of impact and their point of aim will not align, unless the Soldier changes the range setting on the weapons leaf sight or uses the corresponding range line in the HWTS. If a Soldier does not use the range scale on the leaf sight or adjust utilizing the range lines in the HWTS the Soldier will be required to determine the necessary hold-off to achieve the desired point of impact.

COMMON AIMING ERRORS

7-14. Orienting and aiming a weapon correctly requires practice. Through drills and repetitions, Soldiers build the ability to repeat proper weapons orientation, sight alignment, and sight picture as a function of muscle memory.

7-15. The most common aiming errors include:

- Non-dominant eye use. The Soldier gets the greatest amount of visual input from their dominant eye. Eye dominance varies Soldier to Soldier. Some Soldier's dominant eye will be the opposite of the dominant hand. For example, a Soldier who writes with their right hand and learns to fire right handed might learn that their dominant eye is the left eye. This is called cross-dominant. Soldiers with strong cross-dominant eyes should consider firing using their dominant eye side while firing from their non-dominant hand side. Soldiers can be trained to fire from either side of the weapon, but may not be able to shoot effectively using their non-dominant eye.
- Incorrect zero. Regardless of how well a Soldier aims, if the zero is incorrect, the round will not travel to the desired point of impact without adjustment with subsequent rounds. (See appendix E of this publication.)
- Light conditions. Limited visibility conditions contribute to errors aligning the sight, selecting the correct point of aim, or determining the appropriate hold. Soldiers may offset the effects of low light engagements with image intensifier (I2) optics, use of thermal optics, or the use of laser pointing devices with I2 optics.
- Battlefield obscurants. Smoke, debris, and haze are common conditions on the battlefield that will disrupt the Soldier's ability to correctly align their sights, select the proper point of aim, or determine the correct hold for a specific target.
- Incorrect sight alignment. Soldiers may experience this error when failing to focus on the front sight post or reticle.
- Incorrect sight picture. Typically, an incorrect sight picture occurs when the threat is in a concealed location, is moving, or sufficient winds between the gunner and target exist that are not accounted for during the hold determination process. This failure directly impacts the Soldier's ability to create and sustain the proper sight picture during the shot process.
- Improper range determination. Improper range determination results in an improper hold at ranges greater than the zeroed range for the weapon.

COMPLEX ENGAGEMENTS

7-16. A complex engagement includes any shot that cannot use the CBoVM as the point of aim to ensure a target hit. Complex engagements require a Soldier to apply various points of aim to successfully defeat the threat.

7-17. These engagements have an increased level of difficulty due to environmental, target, or gunner conditions that create a need for the firer to rapidly determine a ballistic solution and apply that solution to the point of aim. Increased engagement difficulty is typically characterized by one or more of the following conditions:

- Target conditions:
  - Range to target.
  - Moving targets.
  - Oblique targets.
  - Evasive targets.
  - Limited exposure targets.
- Environmental conditions:
  - Wind.
  - Limited visibility.
- Gunner conditions:
  - Canted weapon engagements.
  - CBRN operations engagements.

7-18. Each of these firing conditions may require the Soldier to determine an appropriate aim point that is not the CBoVM. This Soldier calculated aim point is called the hold. During any complex engagement, the Soldier serves as the ballistic computer during the shot process. The hold represents a refinement or alteration of the CBoVM point of aim at the target to counteract certain conditions during a complex engagement for—

- Range to target.
- Lead for targets based on their direction and speed of movement.
- Wind speed, direction, and duration between the gunner and the target at ranges greater than 700 meters.
- Greatest lethal zone presented by the target to provide the most probable point of impact to achieve immediate incapacitation.

7-19. The Soldier applies the appropriate aim (hold) based on the firing instances presented. Hold determinations are discussed only for the immediate hold format. Should the gunner require subsequent rounds to defeat the threat the adjusted aim point method of engagement should be used.

7-20. All Soldiers must be familiar with the immediate hold determination methods. They should be naturally applied when the engagement conditions require. These determinations are provided in target-form measurements.

IMMEDIATE HOLD DETERMINATION

7-21. Immediate holds are based on the values of a target form, where the increments shown are sufficient for rapid target hits without ballistic computations. The immediate hold determinations are used for complex target engagements at less than 1500 meters for lightly armored targets and 500 meters for dismounted targets.

7-22. Immediate hold locations for azimuth (wind or lead): The technique of engaging a moving target differs from that of engaging a stationary target. The gun must be aimed ahead of the moving target a sufficient distance to cause the bullet and target to arrive at the aiming point at the same time. The distance is measured in target lengths. One target length as seen by the gunner is one lead. Leads are measured from the center of mass. The lead depends upon range, speed, and direction of movement of the target. To hit the target, the gunner aims at a point ahead of the target equal to the estimated number of leads, maintains the lead by tracking the target (manipulating the gun at the same angular speed as that of the target), and then fires. Fire is adjusted by observation of strike of the round. (See figure 7-4.)

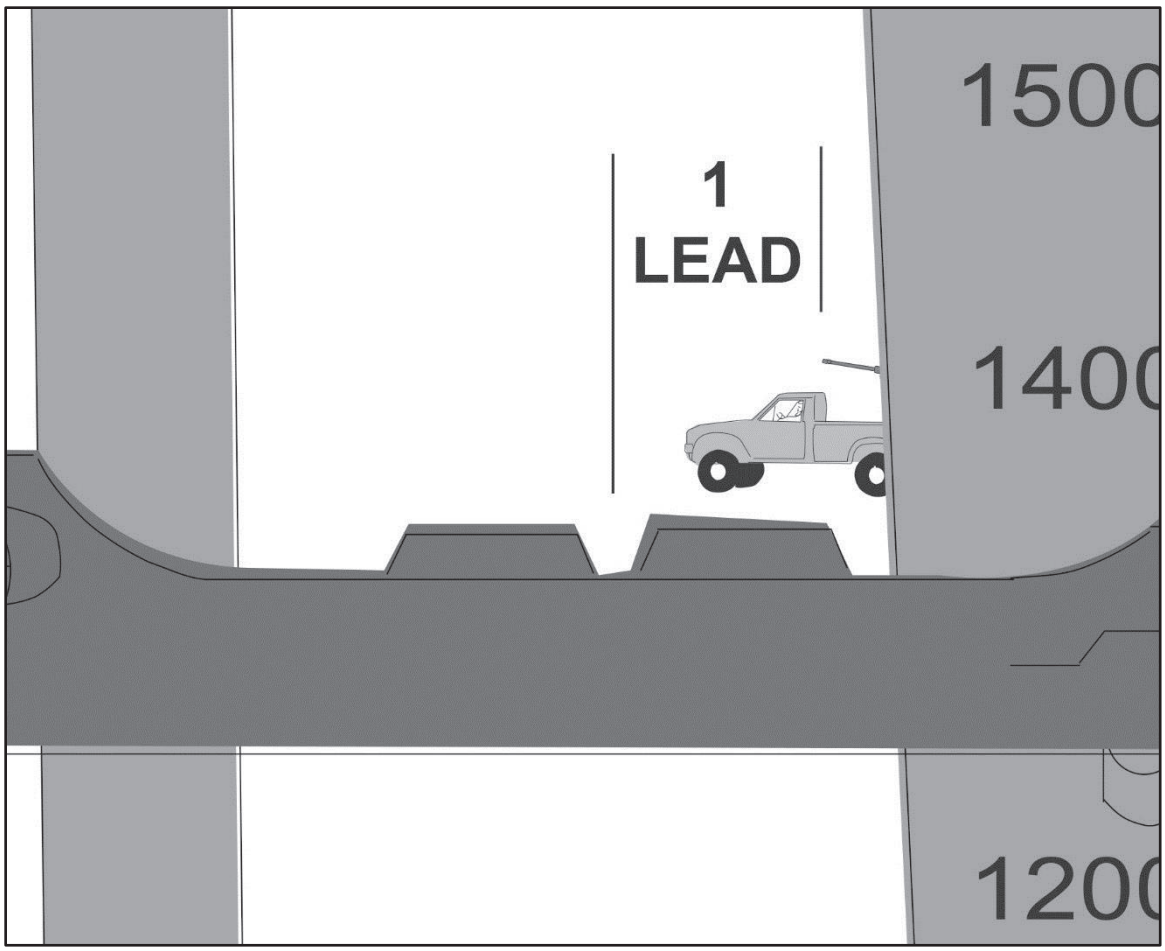


Figure 7-4. Immediate hold locations for windage and lead example

Moving Targets

7-23. Moving targets are those threats that appear to have a consistent pace and direction. Targets on any battlefield do not remain stationary for long periods, particularly once an engagement begins. Soldiers must have the ability to deliver lethal fires at a variety of moving target types and be comfortable and confident in the engagement techniques. There are two methods for defeating moving targets: tracking and trapping.

7-24. Mathematical computation or use of voluminous lead tables to obtain immediate hold locations for elevation (range to target): exact leads on a moving target is impractical in combat. The gunner must correct the lead as conditions change. The angle at which the target is moving also alters the amount of lead taken. If the angle between line of fire and line of travel of the target is less than 45 degrees, the Soldier uses half the lead distance for angles between the line of fire and line of travel that are greater than 45 degrees.

Oblique Targets

7-25. Threats that are moving diagonally toward or away from the gunner are called oblique targets. They offer a unique problem set to gunners where the target may be moving at a steady pace and direction; however, their oblique direction of travel makes them appear to move slower.

7-26. Soldiers should adjust their hold based on the angle of the target's movement from the gun-target line. The following guide will help Soldiers determine the appropriate change to the moving target hold to apply to engage the moving oblique threats. (See figure 7-5 on page 7-8.)

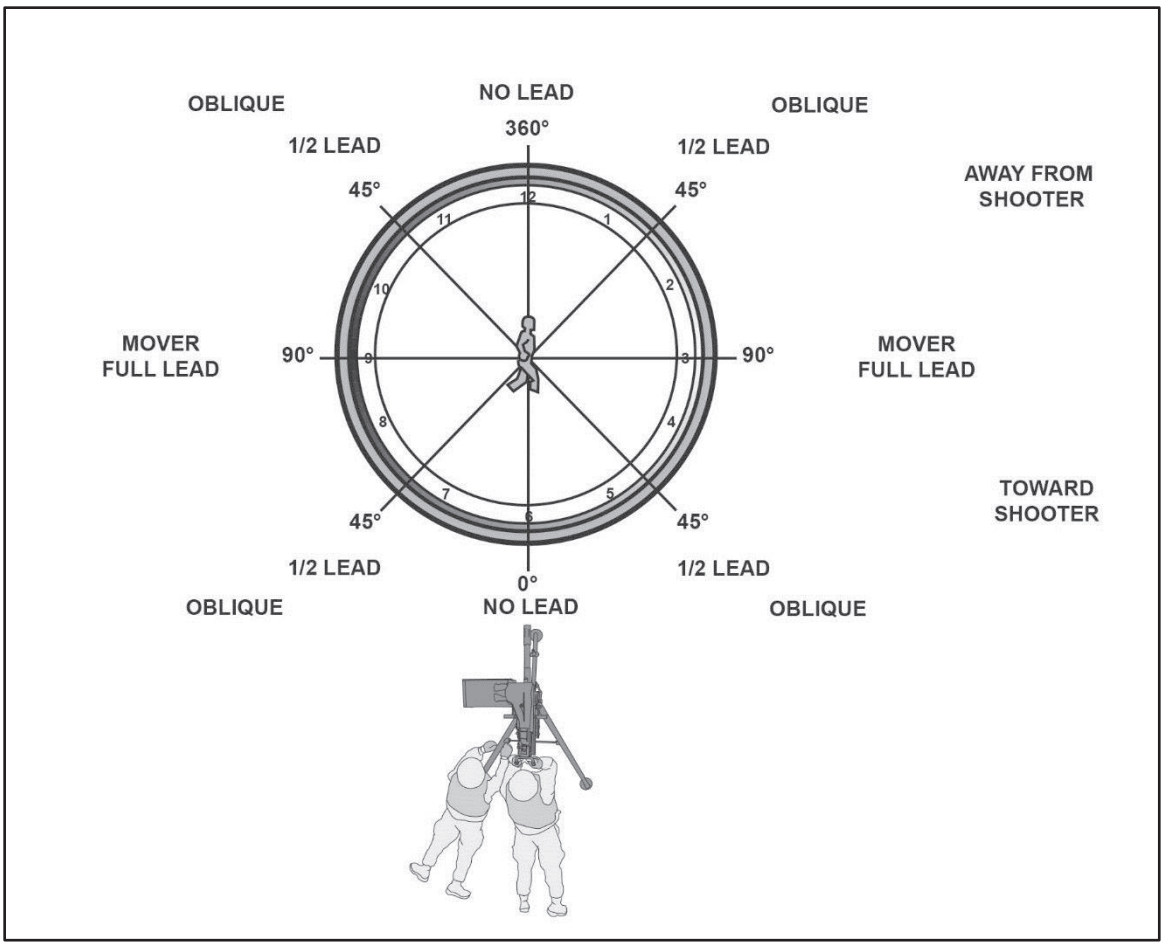


Figure 7-5. Oblique target example

7-27. For targets moving directly toward the gun, the point of aim is placed on the CBoVM. For targets moving directly away from the gun, the point of aim is placed on the center upper edge of the target. Too much lead is better than too little because the target runs into the fire; also, the observation of strike is easier. Intelligent use of the lead table includes immediate application of fire with estimated lead followed by necessary corrections based upon observation of the strike of the round.

TARGET CONDITIONS

7-28. Soldiers must consider several aspects of the target to apply the proper point of aim on the target. The target's posture, or how it is presenting itself to the gunner, consists of—

- Range to target.
- Nature of the target.
- Nature of the terrain (surrounding the target).

RANGE TO TARGET

7-29. Rapidly determining an accurate range to target is critical to the success of the Soldier at mid and extended ranges. There are several range determination methods gunners should be confident in applying to determine the proper hold-off for pending engagements. There are two types of range determination methods, immediate and deliberate.

IMMEDIATE RANGE DETERMINATION

7-30. Immediate methods of range determination afford the gunner the most reliable means of determining the most accurate range to a given target. The immediate methods include—

- Laser range finder.
- Lateral distance
- Firing the gun
- Recognition method.
- 100-meter unit-of-measure method.
- Observation and adjustment of fire

Laser Range Finder

7-31. Equipment like the AN/PSQ-23, STORM have an on-board laser range finder that is accurate to within plus or minus 5 meters. Soldiers with the STORM attached can rapidly determine the most accurate range to target and apply the necessary hold-offs to ensure the highest probability of incapacitation, particularly at extended ranges.

Lateral Distance

7-32. Lateral distance measure is a method that the gunner may use to determine the distance from one target to another from left to right or right to left. When the gun is mounted on the M3 or M205 tripod, width can be measured by aiming on a point and manipulating the traversing handwheel or lever, counting the clicks from one point to another point of aim. Each click equals 1 meter at 1000 meters or one-half meter at 500 meters. This method is accurate but time-consuming.

7-33. The finger measurement method is not a method of range determination; it is a method of measuring the lateral distance (in fingers or mils) between two points. To measure the distance in fingers between a reference point and a target, extend the arm with palm outward, the fingers cupped, and elbow locked. Close one eye, raise the index finger, and sight along its edge, placing the edge of the finger along the flank of the target or reference point. (See figure 7-6 on page 7-10.) The remaining space is then filled in by raising fingers until the space is covered. The measurement is then stated as being one or more fingers or so many mils, depending on the number of fingers used.

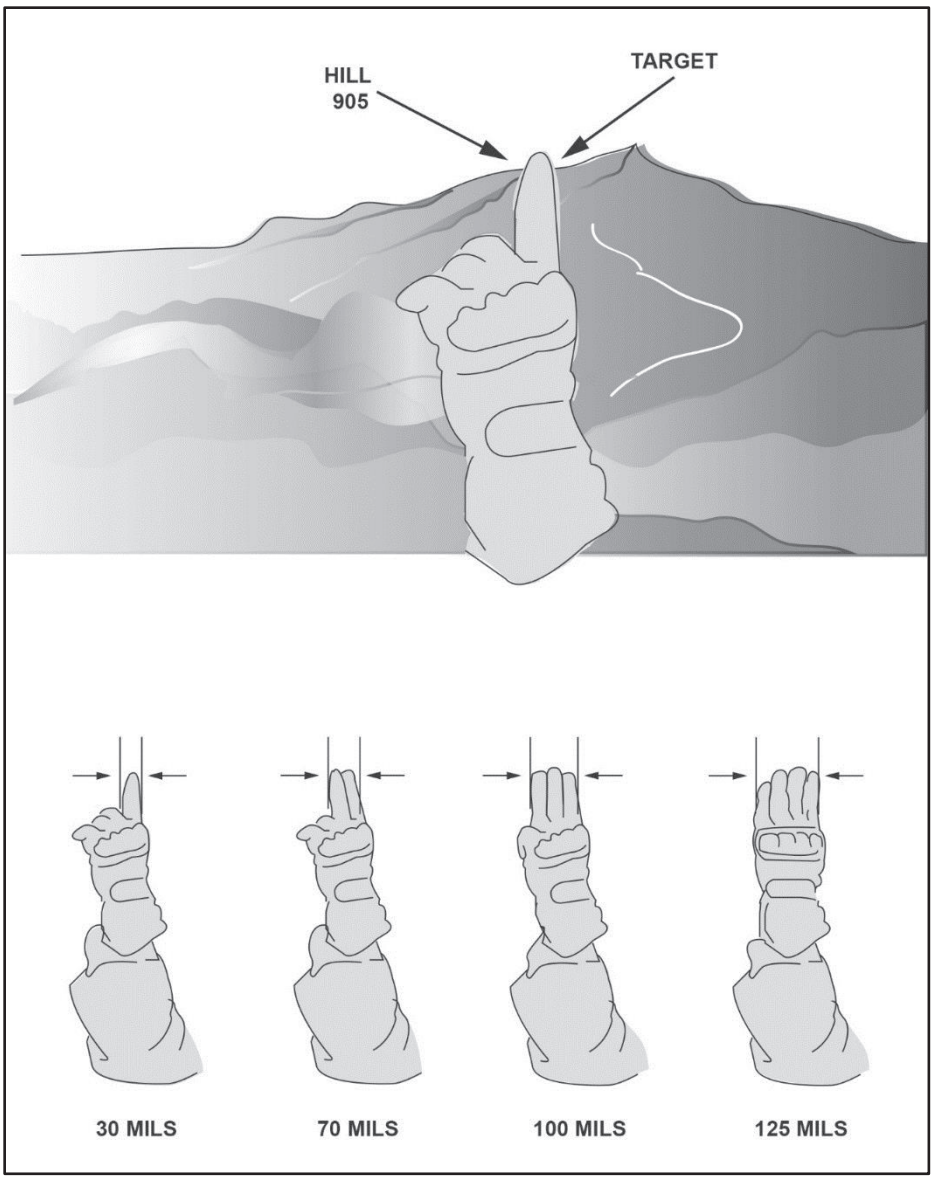


Figure 7-6. Index finger aligned

Firing of the Gun

7-34. Firing the gun is another method of determining range. In this method, the gunner opens fire on the target at the estimated range and moves the center of the beaten zone into the center base of the target by means of the T&E handwheels. The gunner resets the sight so the new line of aim is at the center base of the target and notes the range setting on the rear sight. This range setting may apply only to this gun. When the ground in the vicinity of the target does not permit observation of the strike of the rounds, or when surprise fire on the target is desired, fire is adjusted on a point that offers observation and is known to be the same range as the target. The gunner then lays their gun on the target when ordered. When moving into position occupied by other units, range cards prepared by those units can furnish valuable range information on targets, suspected targets, and various terrain features. When the tactical situation and time permits, range may be determined by pacing off the distance.

Recognition Method

7-35. When observing a target, the amount of detail seen at various ranges gives the gunner a solid indication of the range to target. Gunners should study and remember the appearance of a person when they are standing at 100-meter increments. During training, Soldiers should note the details of size and the characteristics of uniform and equipment for targets at those increments.

7-36. Once Soldiers are familiar and memorize the characteristics of standing threats at 100-meter increments out to 500 meters, they should study the targets in a kneeling and then in the prone position. By comparing the appearance of these positions at known ranges from 100 meters to 500 meters, gunners can establish a series of mental images that will help determine range on unfamiliar terrain. They should also study the appearance of other familiar objects such as weapons and vehicles at different distances. This practice builds muscle memory in how the same objects can appear in different distances (see table 7-1):

Table 7-1. Recognition of dismounted target

Distance	*Level of Detail*
100 meters	The target can be clearly observed in detail, and facial features can be distinguished.
200 meters	The target can be clearly observed, although there is a loss of facial detail. The color of the skin and equipment is still identifiable.
300 meters	The target has a clear body outline, face color usually remains accurate, but remaining details are blurred.
400 meters	The body outline is clear, but remaining detail is blurred.
500 meters	The body shape begins to taper at the ends. The head becomes indistinct from the shoulders.

7-37. With practice, range determination by recognition is quick and accurate; however, this method does not work with passive or thermal sights. The principle of the recognition method is simple. When the gunner sees a target, they can determine the range according to what they recognize. For example, if a target can be recognized as a truck with the unaided eye, it is within 1500 meters; if a target can be recognized as a truck through magnifying optics (such as binoculars), it is within 5000 meters. Table 7-2 gives range estimations for targets as seen with the unaided eye and through magnifying optics (binoculars).

Table 7-2. Recognition method

Range Determination	*Recognition Method*	
Target	Unaided Eye	Magnification 8 power
Tank crew, troops, machine gun, mortar, antitank gun, antitank missile launchers	500 m	2000 m
Tank, personnel carrier, truck (by model)	1000 m	4000 m
Tank, howitzer, personnel carrier, truck	1500 m	5000 m
Armor vehicle, wheel vehicle	2000 m	6000 m
LEGEND: m = meter(s)		

100-Meter Unit-of-Measure Method

7-38. To determine the total distance to the target using the 100-meter unit of measure method, shooters must visualize a distance of 100 meters (generally visualizing the length of a football field) on the ground. Soldiers then estimate how many of these units can fit between the gunner and the target.

7-39. The greatest limitation of the unit of measure method is that its accuracy is directly related to how much of the terrain is visible. This is particularly true at greater ranges. If a target appears at a range of 500 meters or more and only a portion of the ground between the gunner and the target can be seen, it becomes difficult to use the unit of measure method of range estimation with accuracy.

7-40. Proficiency in the unit of measure method requires constant practice. Throughout training, comparisons should be continually made between the range estimated by the gunner and the actual range as determined by pacing or other, more accurate measurement.

Observation and Adjustment of Fire

7-41. The purpose of observation and adjustment of fire practice is to teach the adjustment of fire by observing the strike of the bullets, or by frequent re-laying on the target using sights.

7-42. Observation is used when firing on the 10-meter range because the impact of the round is visible on the target. When firing at greater distances, the strike of the round on the ground may cause dust to rise that is visible to the gunner; however, during wet weather, the strike cannot always be seen.

7-43. Adjustments on the target can be made using the mil relation; that is, one click of traversing or elevating handwheel moves the strike of the round one-half inch on the target at 10 meters. When firing on field targets, adjustment is made by moving the burst into the target. One click of traverse will move the strike of the round one-half meter at 500 meters, or one meter at 1000 meters. (See figure 7-7.) However, the distance one click of elevation will move the strike of the round depends on the range to the target and the slope of the ground. The gunner determines the number of mils necessary to move the center of the strike into the target, and they manipulate the gun the required number of mils. For example, should the gunner fire on a target at 500 meters and observe the strike 10 meters to the right of the target and short about 50 meters, the gunner traverses the gun to the left 20 clicks (mils) and add one or more clicks (mils), depending on the slope.

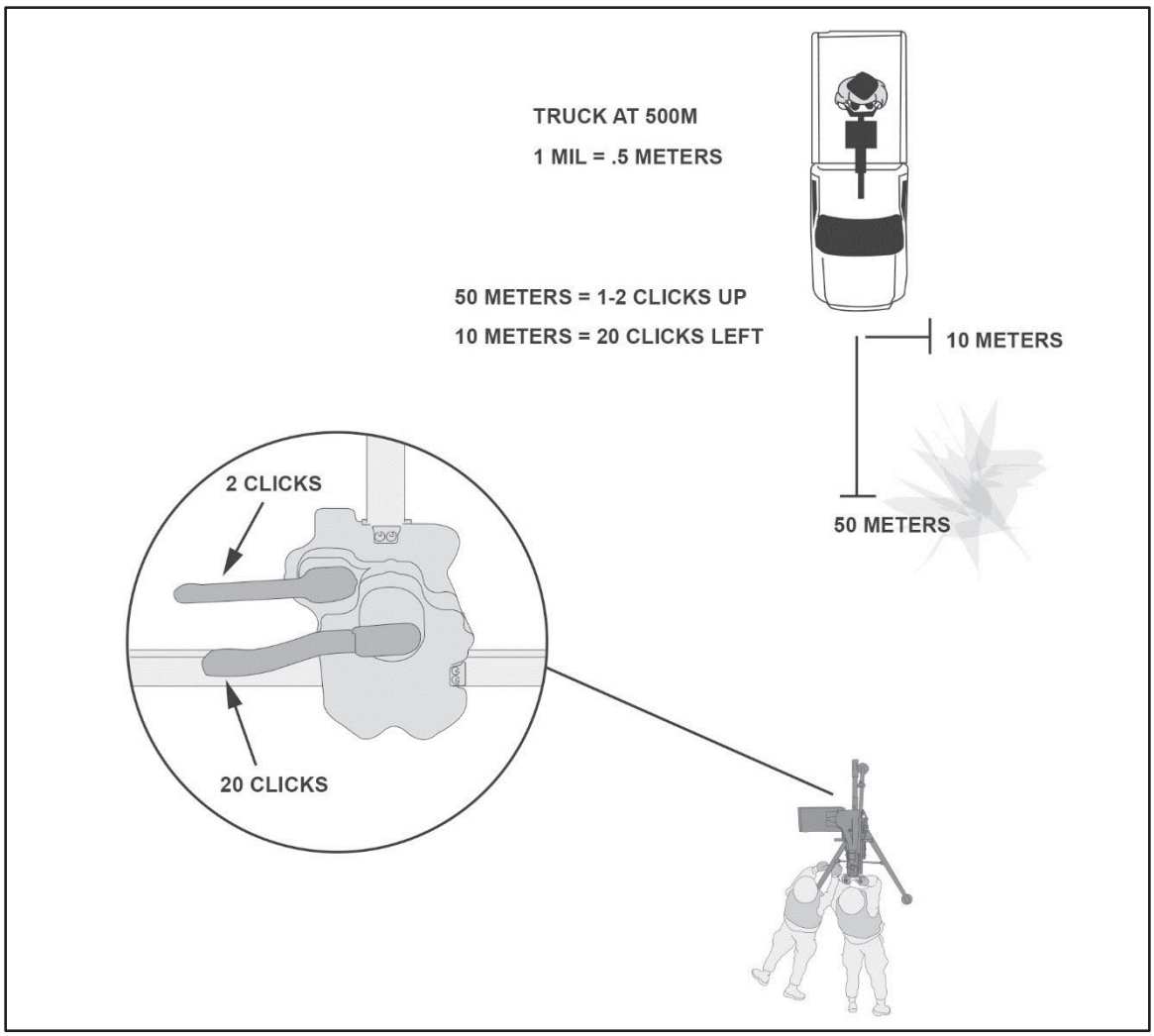


Figure 7-7. Mil relation

7-44. The gunner may use the adjusted aiming point method to adjust the fire. In this method, the gunner must use their sights. The gunner selects an aiming point that will place the next burst on target. For example, when the gunner fires on a target at 500 meters and estimates that the rounds impacted 20 meters short and 10 meters to the right, the gunner rapidly selects an aiming point about 20 meters beyond the target and 10 meters to the left of it and lays on that aiming point and fires. (See figure 7-8.)

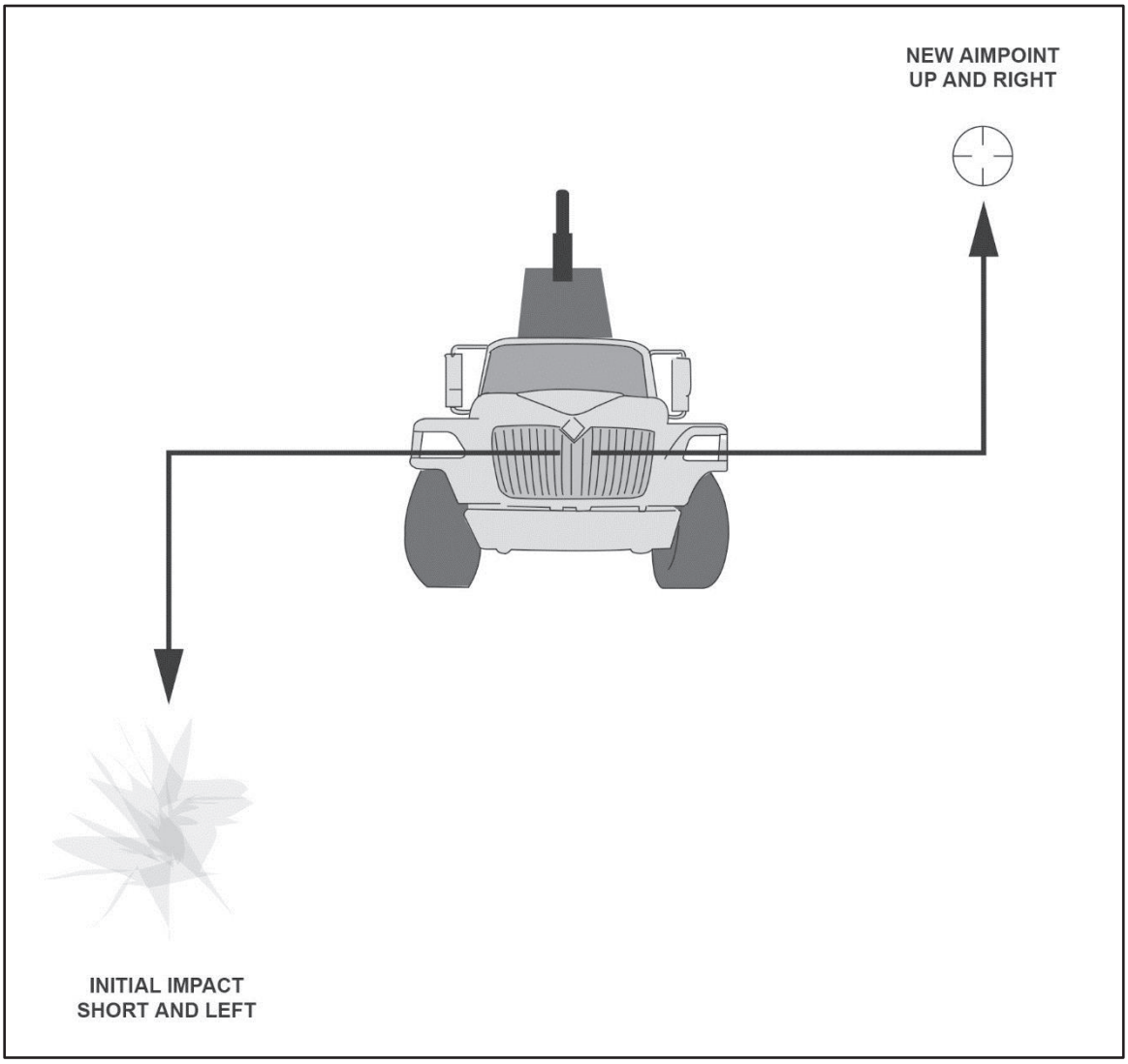


Figure 7-8. Adjusted aiming point method of fire adjustment

ENVIRONMENTAL CONDITIONS

7-45. The environment can complicate the shooter's actions during the shot process with excessive wind or requiring firing during limited visibility conditions. Soldiers must understand the methods to offset or compensate for these firing occasions, and be prepared to apply these skills to the shot process.

WIND

7-46. Wind is the most common variable and has the greatest effect on ballistic trajectories, where it physically pushes the projectile during flight off the desired trajectory. The effects of wind can be compensated for by the gunner provided they understand how wind effects the projectile and the terminal point of impact. The elements of wind effects are—

- The time the projectile is exposed to the wind (range).

- The direction from which the wind is blowing.
- The velocity of the wind on the projectile during flight.

Wind Direction and Value

7-47. Winds from the left blow the projectile to the right, and winds from the right blow the projectile to the left. The amount of the effect depends on the time of (projectile's exposure) the wind speed and direction. To compensate for the wind, the firer must first determine the wind's direction and value.

7-48. The clock system can be used to determine the direction and value of the wind (See figure 7-9). Picture a clock with the firer oriented downrange towards 12 o'clock.

7-49. Once the direction is determined, the value of the wind is determined. The value of the wind is how much effect the wind will have on the projectile. Winds from certain directions have less effect on projectiles. The chart below shows that winds from 2 to 4°o'clock and 8 to 10 o'clock are considered full-value winds and have the most effect on the projectile. Winds from 1, 5, 7, and 11 o'clock are considered half-value winds and have roughly half the effect of a full-value wind. Winds from 6 and 12 o'clock are considered no-value winds and have little or no effect on the projectile.

EXAMPLE

A 10-mph (miles per hour) wind blowing from the 1 o'clock direction would be a half-value wind and has the same effect as a 5 mph, full-value wind on the projectile.

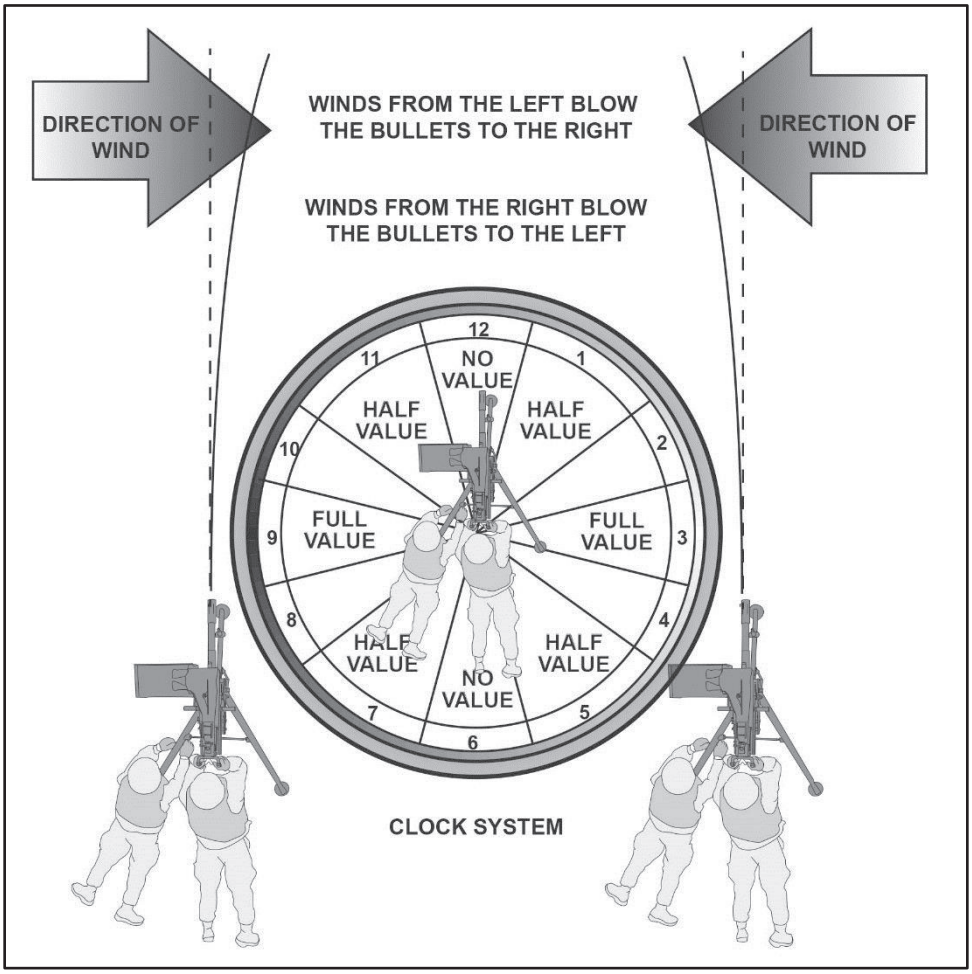


Figure 7-9. Wind value

7-50. The wind pushes the projectile in the direction the wind is blowing. (See figure 7-10.) The amount of effects on the projectile depends on the time of exposure, direction of the wind, and speed of the wind. To compensate for wind the Soldier uses a hold in the direction of the wind (into the wind).

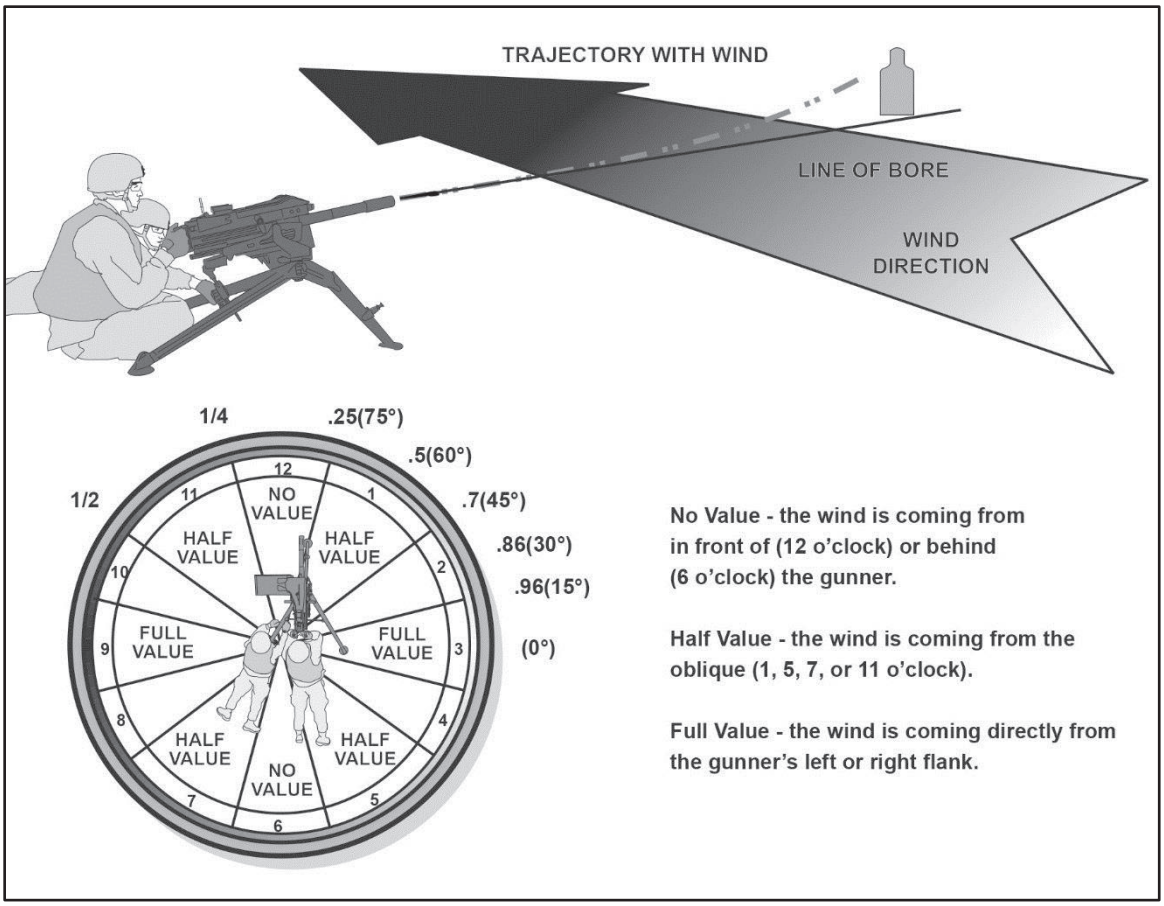


Figure 7-10. Wind effects

Wind Speed

7-51. Wind speeds can vary from the firing line to the target. Wind speed can be determined by taking an average of the winds blowing on the range. The firer's focus should be on the winds between the midrange point and the target. The wind at the one half to two thirds mark have the most effect on the projectile since that is the point where most projectiles have lost a large portion of their velocity and are beginning to destabilize.

7-52. The Soldier can observe the movement of items in the environment downrange to determine the speed. Each environment has different vegetation that reacts differently. Downrange wind indicators include the following:

- 0 to 3 mph. Hardly felt, but smoke drifts.
- 3 to 5 mph. Felt lightly on the face.
- 5 to 8 mph. Keeps leaves in constant movement.
- 8 to 12 mph. Raises dust and loose paper.
- 12 to 15 mph. Causes small trees to sway.

Note. The wind blowing at the Soldier's location may not be the same as the wind blowing on the way to the target.

Wind Estimation

7-53. Soldiers must be comfortable and confident in their ability to judge the effects of the wind to consistently make accurate and precise shots. Soldiers use wind indicators between the Soldier and the target that provide windage information to develop the proper compensation or hold-off. To estimate the effects of the wind on the shot, Soldiers need to determine three windage factors:

- Velocity (speed).
- Direction.
- Value.

Immediate Wind Hold

7-54. Using a hold involves changing the point of aim to compensate for the wind drift. For example, if wind causes the bullet to drift 1/2 form to the left, the aiming point must be moved 1/2 form to the right. Firers must adjust their points of aim into the wind to compensate for its effects. If they miss a distant target and wind is blowing from the right, they should aim to the right for the next shot. Table 7-3 provides information on the effects of constant crosswind at specific ranges that should be applied when using immediate hold for wind.

Table 7-3. Impact shift from constant crosswind

Truck Targets				
	5 mph	10 mph	15 mph	20 mph
500 meters	0.69 meters	1.38 meters	2.08 meters	2.77 meters
1000 meters	3.10 meters	6.20 meters	9.30 meters	12.41 meters
1500 meters	7.83 meters	15.65 meters	23.47 meters	31.28 meters
Dismounted Targets				
	2 mph	3 mph	4 mph	5 mph
100 meters	0.01 meters	0.01 meters	0.02 meters	0.02 meters
200 meters	0.04 meters	0.06 meters	0.08 meters	0.10 meters
300 meters	0.10 meters	0.14 meters	0.19 meters	0.24 meters
400 meters	0.17 meters	0.26 meters	0.34 meters	0.43 meters
500 meters	0.27 meters	0.41 meters	0.55 meters	0.69 meters

7-55. Newly assigned Soldiers should aim at the target's CBoVM for the first shot or burst, and then adjust for wind when they are confident that wind caused the miss. Experienced firers should apply the appropriate hold for the first shot or burst, but should follow the basic rule—when in doubt, aim at the CBoVM.

LIMITED VISIBILITY

7-56. Soldiers must be lethal at night and in limited visibility conditions, as well as during the day. That lethality depends largely on whether Soldier can fire effectively with today's technology: night vision devices, IR aiming devices, and TWSs.

7-57. Limited visibility conditions may limit the viewable size of a threat, or cause targets to be lost after acquisition. In these situations, Soldiers may choose to apply a hold for where a target is expected to be rather than wait for the target to present itself for a more refined reticle lay or sight picture.

7-58. Soldiers may switch between optics, thermals, and pointers to refine their point of aim. To rapidly switch between aiming devices during operations in limited visibility, the Soldier must ensure accurate alignment, boresighting, and zeroing of all associated equipment. Confidence in the equipment is achieved through drills related to changing the aiming device during engagements, executing repetitions with multiple pieces of equipment, and practicing nonstandard engagement techniques using multiple aiming devices in tandem (IR pointer with NVDs, for example).

GUNNER CONDITIONS

7-59. The ability to aim properly while the weapon is canted (tilted to one side or the other), or is fighting in a CBRN environment creates additional difficulties to achieve the appropriate point of aim. These gunner conditions can be mitigated to ensure effective point of aim and target defeat.

CANTED WEAPON

7-60. If the weapon must be tilted (canted) in one direction or another based on the terrain to engage a target, the strike of the bullet will be in the direction of the canted weapon and low. When firing a canted weapon, the elevation becomes the azimuth, and the azimuth becomes the elevation in relation to the aim point.

CLOSE RANGE

7-61. At close range, the effects of cant are specific to the line of sight and the axis of the bore. Soldiers should apply the offset to the target based on the angle of the cant.

EXTENDED RANGE

7-62. The general rule is to apply the aim point in an equal amount in the opposite direction of the cant to ensure the highest probability of hit.

COMPOUND CONDITIONS

7-63. When combining difficult target firing occasion information, Soldiers can apply the rules specific to the situation together to determine the appropriate amount of hold-off to apply.

7-64. The example below shows the application of different moving target directions with varying speed directions. (See figure 7-11.) This is a general example to provide the concept of applying multiple hold-off information to determine complex ballistic solutions for an engagement. This same concept is applied to immediate and deliberate methods of determining hold.

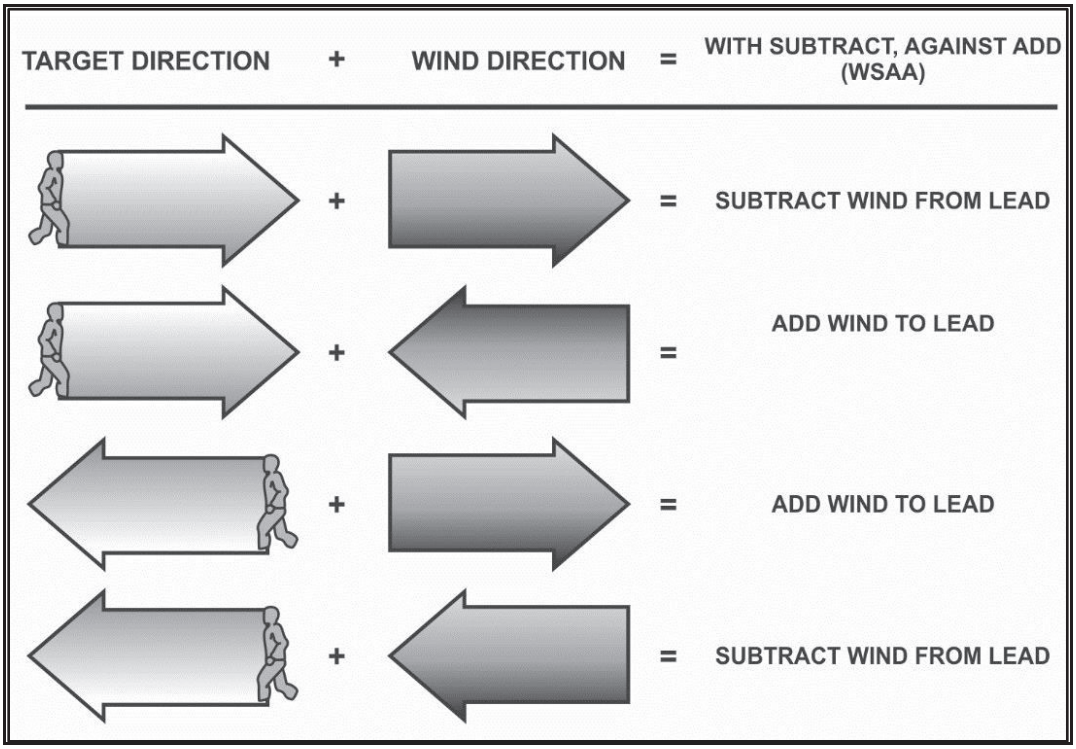


Figure 7-11. Compound wind and lead determination example

Chapter 8
Control

The control element of employment considers all the conscious actions of the Soldier before, during, and after the shot process that the Soldier's specifically in control of. It incorporates the Soldier as a function of safety, as well as the ultimate responsibility of firing the weapon. Proper trigger control, without disturbing the sights, is the most important aspect of control and the most difficult to master.

Combat is the ultimate test of a Soldier's ability to apply the functional elements of the shot process and firing skills. Soldiers must apply the employment skills mastered during training to all combat situations (for example, attack, assault, ambush, or urban operations). Although these tactical situations present problems, the application of the functional elements of the shot process require two additions: changes to the rate of fire and alterations in weapon/target alignment. This chapter discusses the engagement techniques Soldiers must adapt to the continuously changing combat engagements.

ARC OF MOVEMENT

8-1. When firing individual weapons, the Soldier is the weapon's fire control system, ballistic computer, stabilization system, and means of mobility. Control refers to the Soldier's ability to regulate these functions and maintain the discipline to execute the shot process at the appropriate time. Control is extremely important when the machine gun is fired in the free gun state. When the machine gun is fired without the T&E assembly the weapon becomes fully exposed to the arc of movement that would normally will be minimized by the T&E.

8-2. Regardless of how well trained or physically strong a Soldier is, a wobble area (or arc of movement) is present, even when sufficient physical support of the weapon is provided. The arc of movement may be observed as the sights moving in a W shape, vertical (up and down) pulses, circular, or horizontal arcs depending on the individual Soldier, regardless of their proficiency in applying the functional elements. The wobble area or arc of movement is the extent of lateral horizontal and front-to-back variance in the movement that occurs in the sight picture. (See figure 8-1.)

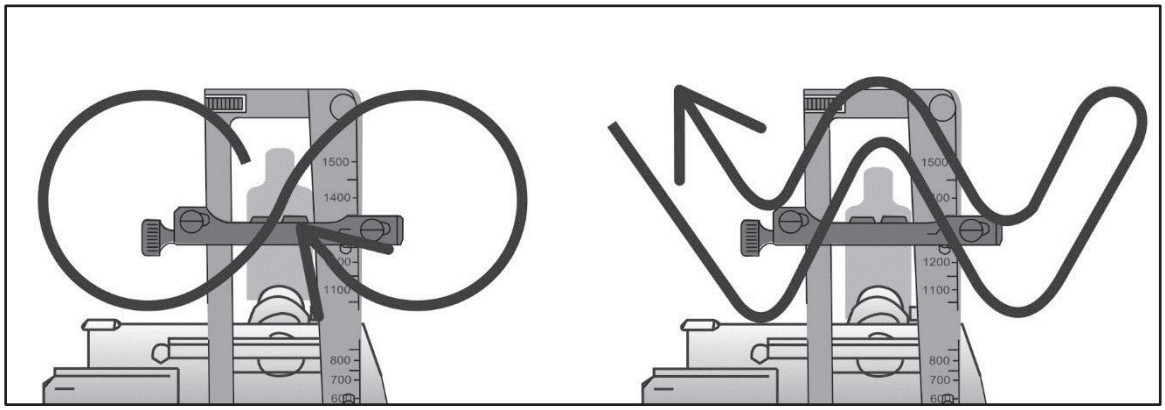


Figure 8-1. Arc of movement example

8-3. The control element consists of several supporting Soldier functions, and include all the actions to minimize the Soldier's induced arc of movement. Executed correctly, it provides for the best engagement window of opportunity to the firer. The Soldier physically maintains positive control of the shot process by managing—

- Trigger control.
- Breathing control.
- Workspace management.
- Calling the shot (firing or shot execution).
- Follow-through.

TRIGGER CONTROL

8-4. Trigger control is the act of firing the weapon while maintaining proper aim and adequate stabilization until the bullet leaves the muzzle. Trigger control and the gunner's position work together to allow the sights to stay on the target long enough for the gunner to fire the weapon and bullet to exit the barrel.

8-5. Stability and trigger control complement each other and are integrated during the shot process. A stable position assists in aiming and reduces unwanted movements during trigger press without inducing unnecessary movement or disturbing the sight picture. A smooth, consistent trigger press, regardless of speed, allows the shot to fire at the Soldier's moment of choosing. When both a solid position and a good trigger press are achieved, any induced shooting errors can be attributed to the aiming process for refinement.

8-6. Smooth trigger control is facilitated by placing the thumb where it naturally lays on the trigger. Natural placement of the thumb on the trigger will allow for the best mechanical advantage when applying forward pressure to the trigger.

8-7. When combined, the elements of trigger control give the Soldier better results:

- Trigger finger placement. The thumb lays naturally on the trigger after achieving proper grip. (See figure 8-2). There is no specified point on the thumb that must be used. It will not be the same for all Soldiers due to different size hands. This allows the Soldier to engage the trigger in the most effective manner.
- Trigger press. The Soldier presses the trigger in a smooth consistent manner adding pressure until the weapon fires. Regardless of the speed at which the Soldier is firing the trigger control will always be smooth.
- Trigger reset. The Soldier must focus on the sights while resetting the trigger.

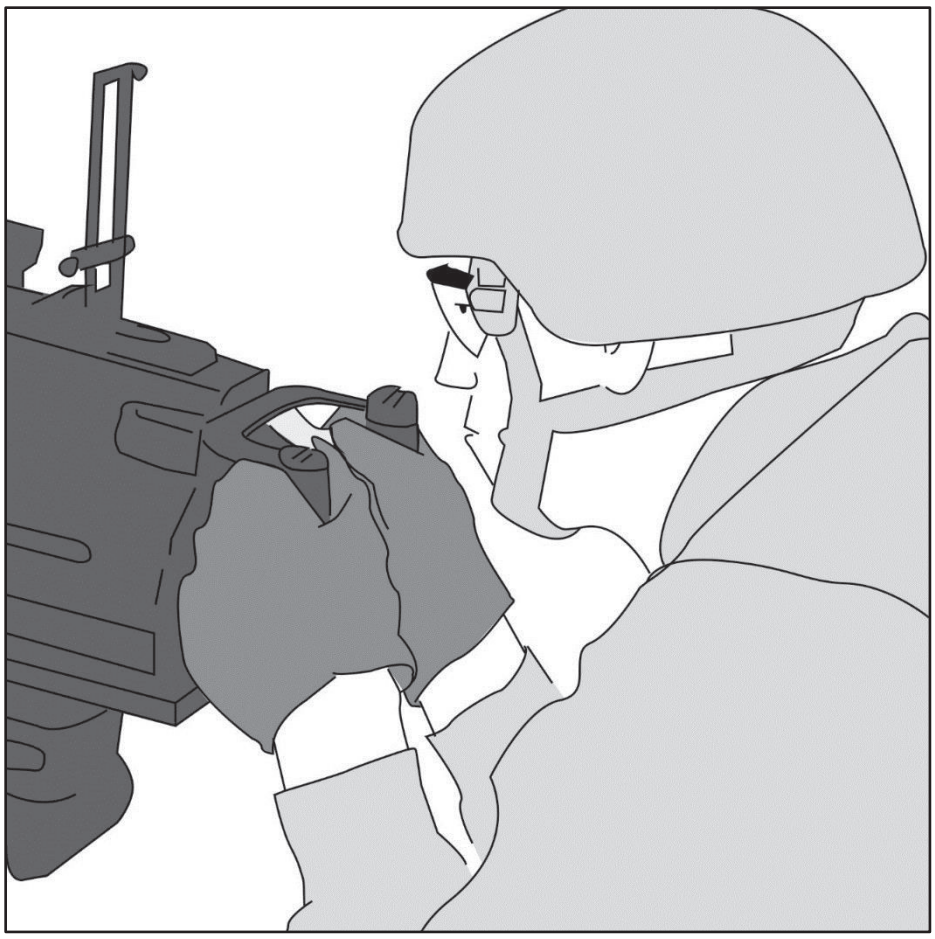


Figure 8-2. Trigger finger placement example

BREATHING CONTROL

8-8. During the shot process, the gunner controls their breathing to reduce the amount of movement of the weapon. During training, the Soldier will learn a method of breathing control that best suits their firing style and preference. Breathing control is the relationship of the respiratory process (free or under stress) and the decision to execute the shot with trigger press.

8-9. Breathing induces unavoidable body movement that contribute to wobble or the arc of movement during the shot process. Soldiers cannot completely eliminate all motion during the shot process, but they can significantly reduce its effects through practice and technique. Firing on the natural pause is a common technique used during grouping and zeroing.

8-10. Vertical dispersion during grouping is most likely not caused by breathing but by failure to maintain proper aiming and trigger control. Refer to appendix E of this publication for proper target analysis techniques.

WORKSPACE MANAGEMENT

8-11. The workspace is a spherical area, 12 to 18 inches in diameter centered on the Soldier's chin and approximately 12 inches in front of their chin. The workspace is where the majority of weapons manipulations take place. (See figure 8-3.)

8-12. Conducting manipulations in the workspace allows the Soldier to keep his eyes oriented towards a threat or his individual sector of fire while conducting critical weapons tasks that require hand and eye coordination. Use of the workspace creates efficiency of motion by minimizing the distance the weapon has to move between the firing position to the workspace and return to the firing position.

8-13. Location of the workspace changes slightly in different firing positions. There are various techniques for using the workspace.

8-14. Workspace management includes the Soldier's ability to perform the following functions:

- Trigger block, to change the weapon's status from safe to fire.
- Charging handles, to smoothly use the charging handles during operation. This includes any corrective actions to overcome malfunctions, loading, unloading, or clearing procedures.
- Feed tray cover, to open the feed tray cover during reloading procedures, clearing procedures, or malfunction corrective actions.
- Chamber check, to verify the status of the weapon's chamber.
- Traverse and elevation mechanism, to prevent impediments in the ability to manipulate the T&E mechanism for side-to-side movement and range adjustment.
- Rear sight assembly, to change the point of aim due to range and windage.



Figure 8-3. Workspace example

CALLING OF THE SHOT

8-15. Knowing precisely where the sights are when the weapon discharges is critical for shot analysis. Errors such as flinching or jerking of the trigger can be seen in the sights before discharge.

8-16. Calling a shot refers to a firer stating exactly where they think a single shot strikes by recalling the sights relationship to the target when the weapon fired. This is normally expressed in clock direction and inches from the desired point of aim.

8-17. The gunner is responsible for the point of impact of every round fired from their weapon. Soldiers must ensure the target area is clear of friendly and neutral actors, in front of and behind the target. Soldiers must also be aware of the environment the target is positioned in, particularly in urban settings—friendly or neutral actors may be present in other areas of a structure that the projectile can pass through.

RATE OF FIRE

8-18. The gunner must determine how to engage the threat with the weapon, on the current shot as well as subsequent shots. Following the direction of the leader, the Soldier controls the rate of fire to deliver consistent, lethal, and precise fires against the threat.

SUSTAINED FIRE

8-19. Sustained rate of fire consists of less than 40 rounds per minute, in bursts of six to nine rounds, fired at 10- to 15-second intervals, which equals out to 4 ½ bursts every minute. Sustained fire is used when the enemy is suppressed and maintains fire superiority. Soldiers should be well-trained in all aspects of sustained rate of fire before attempting any rapid-fire training.

RAPID FIRE

8-20. Rapid rate of fire consists of less than 60 rounds per minute, in bursts of six to nine rounds, fired at 8- to 10-second intervals, which equals about 6 ½ bursts per minute. Once the enemy has been suppressed, machine gunners fire at the sustained rate of fire. Sustained rate of fire conserves ammunition and requires only infrequent barrel changes, but it might not be enough volume of fire to effectively suppress or destroy.

8-21. Rapid fire places an exceptionally high volume of fire on an enemy position. MK 19 gunners normally engage targets at the rapid rate to suppress the enemy quickly. Rapid fire requires much more ammunition than a sustained rate of fire. Rapid fire is when the Soldier is required to provide suppressive fires with accuracy, and the need for precise fires, although desired, is not as important. Rapid fire drastically decreases the probability of hits due to the rapid succession of recoil impulses and the Soldier's inability to maintain proper sight alignment and sight picture on the target.

CYCLIC FIRE

8-22. The cyclic rate of fire represents the maximum amount of ammunition that can be expended by a gun without a break in firing. The cyclic rate of the MK 19 is 325 to 375 rounds per minute.

8-23. Cyclic rate of fire is for emergency use only. Cyclic rate of fire uses ammunition very quickly and also can overheat the weapon system to the point of taking the weapon out of action to allow it to cool down. Cyclic rate of fire should be used only when necessary to gain fire superiority after a surprise attack or ambush. Cyclic rate of fire is the most inaccurate of all rate of fires. It also can cause damage to the weapon system if the weapon is not properly cleaned, cooled down, or lubricated after the engagement.

FOLLOW-THROUGH

8-24. Follow-through is the continued mental and physical application of the functional elements of the shot process after the shot has been fired. The gunner attempts to keep their head in the same position, the firing eye remains open. The thumb holds the trigger forward through recoil and then lets off enough to reset the trigger after a desired burst or single shot. The body position and breathing remain steady.

8-25. Follow-through consists of all actions controlled by the gunner after the bullet leaves the muzzle. Follow-through is required to complete the shot process. Follow through will have a significant impact on the consistency and size of the machine guns cone of fire and beaten zone. These actions are executed in this general sequence:

- Recoil management. Includes the bolt carrier group recoiling completely and returning to battery. The most effective way to manage the recoil of the machine gun is through the use of the T&E, non-firing and firing elbow position and support, proper emplacement of the tripod, and adding additional support to the tripod such as sand bags.
- Recoil recovery. Returning to the same pre-shot position and reacquiring the sight picture. The gunner should have a good sight picture before and after the shot. Due to the MK 19 unique design the gunner does not have a buttstock so as to memorize land marks for sight picture, therefore it is imperative that the gunner focuses on sight alignment by remaining square directly behind the machine gun and distance of the soldiers head to the rear sight.

- Sight picture adjustment. Counteracting the physical changes in the sight picture caused by recoil impulses and returning the sight picture onto the target aiming point. The condition and material the tripod is emplaced upon will affect the point of aim after each shot or burst. The point of aim may need to be adjusted until the tripod can be further braced. For example if the tripod is emplaced in sandy or loose soil, the shoes of the tripod continue to dig downward, and move in the opposite direction where the machine gun is fired.
- Engagement assessment. Once the sight picture returns to the original point of aim, the firer confirms the strike of the round, assesses the target's state, and immediately selects one of the following courses of action:
  - Subsequent engagement. The target requires additional (subsequent) rounds to achieve the desired target effect. The gunner starts the pre-shot process over utilizing the adjusted aim point method based upon the observed impact of the rounds.
  - Supplemental engagement. The gunner determines the desired target effect is achieved and another target may require servicing. The gunner starts the pre-shot process.
  - Sector check. All threats have been adequately serviced to the desired effect. The gunner then checks his sector of responsibility for additional threats as the tactical situation dictates. The unit's SOP will dictate any vocal announcements required during the post-shot sequence.
  - Correction of malfunction. If the firer determines during the follow-through that the weapon failed during one of the phases of the cycle of function, they make the appropriate announcement to their team and immediately execute corrective action.

MALFUNCTIONS

8-26. When any weapon fails to complete any phase of the cycle of function correctly, a malfunction has occurred. When a malfunction occurs, the Soldier's priority remains to defeat the target as quickly as possible. The malfunction, Soldier capability, and secondary weapon capability determine if, when, and how to transition to a secondary weapon system.

SECONDARY WEAPON

8-27. The Soldier controls which actions must be taken to ensure the target is defeated as quickly as possible based on secondary weapon availability and capability, and the level of threat presented by the range to target and its capability.

- Secondary weapon can defeat the threat. Soldier transitions to secondary weapon for the engagement. If no secondary weapon is available, announce their status to the small team, and move to a covered position to correct the malfunction.
- Secondary weapon cannot defeat the threat. Soldiers quickly move to a covered position, announce their status to the small team, and execute corrective action.
- Soldier has no secondary weapon. Soldiers quickly move to a covered position, announce their status to the small team, and execute corrective action.

CORRECTIVE ACTION

8-28. The end state of any corrective action is a properly functioning weapon. Typically, the phase where the malfunction occurred within the cycle of function identifies the general problem that must be corrected. From a practical, combat perspective, malfunctions are recognized by their symptoms. Although some symptoms do not specifically identify a single point of failure, they provide the best indication on which corrective action to apply.

8-29. To overcome the malfunction, the Soldier must first avoid over analyzing the issue. The Soldier must train to execute corrective actions immediately without hesitation or investigation during combat conditions.

8-30. No single corrective action solution will resolve all or every malfunction. Soldiers need to understand what failed to occur, as well as any specific sounds or actions of the weapon in order to apply the appropriate correction measures. The two general types of corrective action follow:

- Immediate action is the simple, rapid actions to correct basic disruptions in the cycle of function. The gunner takes immediate action when after pressing the trigger, the firing pin clicks but the weapon fails to fire.
- Remedial action is a skilled technique applied to a specific problem or issue with the weapon when taking immediate action cannot correct the problem. Soldiers take remedial action when the cycle of function is interrupted. For example, when the Soldier squeezes the trigger and either has little resistance during the squeeze (mush) or the trigger cannot be squeezed causing an interruption in the cycle of function.

8-31. Although no single solution will resolve every malfunction, understanding what failed to occur, and knowing the weapon's specific sounds and actions, helps in determining the appropriate correction measures. Immediate action can correct basic failures in the cycle of function.

RULES FOR CORRECTING A MALFUNCTION

8-32. To clear a malfunction, the Soldier must apply three rules:

- Apply Rule No. 1. Soldiers must remain coherent of their weapon and continue to treat their weapon as if it is loaded when correcting malfunctions.
- Apply Rule No. 2. Soldiers must ensure the weapon's orientation is appropriate for the tactical situation and not flag other friendly forces when correcting malfunctions.
- Apply Rule No. 3. Take the thumb off the trigger.
- Treat the symptom. Each problem has specific symptoms. React to what these symptoms tell you to quickly correct the malfunction.
- Maintain focus on threat. The Soldier must keep their head and eyes focused downrange at the threat, not on the weapon. If the initial corrective action fails to correct the malfunction, the Soldier must move quickly to the most likely corrective action.
- Check the weapon. Once the malfunction is clear and the threat is eliminated, deliberately check the weapon for any potential issues when in a covered position or for any factors that may have caused the malfunction, and correct them all.

PERFORM IMMEDIATE ACTION

8-33. The Soldier performs immediate action after pressing the trigger, the bolt slams forward, but the weapon fails to fire. The gunner must apply these simple, rapid actions to correct or identify the obstruction in the cycle of function:

- When the bolt slams forward but does not fire, announce, "MISFIRE".
- Hold the weapon on target as the gunner waits 10 seconds.
- Pull bolt to the rear.
- Catch live round as it ejects.
- Push charging handles forward and up.
- Put gun on S (SAFE) and check for bore obstruction.
- If bore is clear, move safety to F (FIRE) and attempt to fire.
- If nothing happens, put gun on S (SAFE) and wait 10 seconds.
- Pull bolt to the rear.
- Catch live round as it ejects.
- Open the top cover and clear the ammunition.
- Check bore for obstruction.
- Begin remedial action.

WARNING

- **Do not relink or fire ammunition that has been cycled through the weapon. Failure to comply may result in injury to personnel or damage to equipment.]**
- **Use only ammunition authorized for use with the MK 19 machine gun.**
- **Keep ammunition dry, clean, and away from direct heat.**
- **Do not drop, strike, or destroy ammunition by mechanical means.**
- **The MK 19 machine gun weighs 77.6 lbs (35.2 kg). A two-Soldier lift is required for the MK 19 machine gun and each fully loaded M548 ammunition container.**
- **Do not approach or handle a 'dud' (a fired round which fails to explode on impact). The dud could explode any time after firing, causing injury or death.**
- **All personnel within 1,107 feet (310 meters) of impact MUST wear a helmet and body armor. All personnel within 66 feet (20 meters) shall also wear eye protection and single hearing protection. Sleeves shall be rolled down and gloves worn.**

Note: The preferred method for checking the bore is by running the bore obstruction detector from the top of the weapon through the barrel until it protrudes from the muzzle. However, the bore obstruction detector may also be fed from the bottom of the receiver. The bolt must be to the rear to use the bore obstruction detector from the bottom. Instructions and warnings regarding the execution of bore obstruction inspections are located in TM 9-1010-230-10, Work Package 0038.

PERFORM REMEDIAL ACTION

8-34. When immediate action cannot correct the problem, the gunner applies remedial action when the cycle of function is interrupted. TM 9-1010-230-10 provides troubleshooting procedures to correct the following malfunctions or identify faults that require unit-level maintenance:

- Bore obstruction.
- Gun will not shoot.
- Sluggish or erratic firing.
- Runaway gun.
- Gun fires too soon.
- Bolt jammed.
- Short recoil.
- Top cover will not close.

WARNING

- **Before performing any procedure, ensure the weapon is clear of any ammunition. Performing maintenance on a loaded weapon can lead to unexpected firing. Failure to comply may result in injury to personnel or damage to equipment.**
- **Ensure all ammunition and non-essential personnel are at least 213 feet (65 meters) to the rear of the weapon.**
- **If the bolt jams during firing, do not let the bolt slam forward as the cover is opened as this could allow a round to fire.**

COMMON ISSUES

8-35. The following are faults that can be found during the 10-level troubleshooting process, but require 20-level maintenance to order and replace parts or to perform services to restore the weapon to fully mission capable:

Note. Operators must refer to the appropriate TM for their skill level of training and follow all specified instructions. Failure to do so could result in further damage to the equipment.

- Bolt jams during charging or firing. When the bolt doesn't move or easily move inside the receiver, the most likely causes are—
  - Misaligned rounds or links.
  - Damaged or burred secondary drive lever.
  - Deformed lever or missing retaining ring.
  - Burred secondary drive lever, fork, slot, or post pivot.
  - Obstruction on sides of bolt and in T-slot, between bolt and receiver, or between bolt and vertical cam.
  - Bent, burred, or aluminum buildup on vertical cam assembly.
  - Burred primary drive lever.
  - Loose or cracked right-hand and left hand cam followers.
- Gun is difficult to charge. When the Soldier has to use unusual force to charge the weapon, the most likely causes are—
  - Ammunition links not correctly aligned.
  - Burred bolt rails, charger housing rails, or receiver rails.
  - Eroded firing pin cover.
  - Burrs or aluminum buildup on vertical cam assembly.
  - Bent vertical cam.
  - Burred primary drive lever.
  - Loose or cracked right-hand and left hand cam followers.
- Bolt fails to reach sear. When something is preventing the bolt from fully charging and reaching the sear, the most likely causes are—
  - Ammunition links incorrectly aligned.
  - Broken safety lever, safety lever pin, or sear spring.
  - Broken or missing spring washers.
  - Burrs or aluminum buildup on vertical cam assembly.

- Bent vertical cam.
- Loose or cracked right-hand and left hand cam followers.

- Gun will not shoot. When a round is pushed into the chamber after the trigger is pressed, and the firing pin activates (audible click), but the weapon does not fire, the most likely causes are—
  - Misfire.
  - Bad ammunition.
  - Ammunition jammed in feeder.
  - Rounds crooked or not seated firmly.
  - Broken link.
  - Link off rotating band.
  - Female link was not inserted first.
  - Defective feeder or feed slide assembly.
  - Bolt will not pick-up round.
  - Bolt drops round before firing.
  - Receiver rails binding.
  - Bad cocking lever.
  - Functional problem with weapon.
- Rounds will not feed. When rounds will not move onto the face of the bolt, the most likely causes are—
  - Bent, burred, or missing feed throat.
  - Burred feed tray or damaged, weak, or binding feed tray pawl.
  - Feed slide mechanism out of adjustment.
  - Welded pins missing from receiver, link guide burred or galled.
  - Feed pawls burred; binding or weak flat springs.
  - Loose guide rod; loose or missing self-locking head screws.
  - Missing or improperly installed receiver components.
  - Missing crosspins from primary pawl rod or secondary pawl rod.
  - Damaged alignment guide; cracked flat spring; loose flat head screw.
  - Loose or cracked right hand and left hand cam followers.
- Rounds will not extract or eject. Something prevents the expended cartridge from being extracted from the chamber. When, either automatically or manually, the extractor loses its grip on the cartridge case; or when the bolt seizes during rearward movement (during extraction), leaving the cartridge case still fully seated or only partially removed, most likely causes are—
  - Rough or burred firing pin cover.
  - Firing pin will not retract.
  - Incorrect, obstructed, worn, or broken extractors; broken or weak springs.
  - Loose or cracked right hand and left hand cam followers.
  - Obstructed pawl; weak helical spring.
  - Obstructed bolt fingers; broken or weak finger springs.
  - Broken ogive plunger slotted washer.
- Rounds will not fire. If the rounds will not fire, the most likely causes are—
  - Bent, broken, or missing helical compression spring.
  - Defective firing pin, firing pin sear, or springs.
- The weapon fires erratically. If the weapon is not firing correctly in time, the most likely causes are—
  - Dirty bore or chamber.
  - Weak recoil springs or bent guide rods.

- Advanced causes:
- Loose or cracked right hand and left hand cam followers.
- Cracked or broken alignment guide flat spring.
- Non-electrical wire missing or broken on bolt sleeves.
- Broken lock plate.
- Worn adjusting screw or spring plunger.
- Broken or worn helical compression spring; missing or out of position sear buffer components.
- Bolt timing out of adjustment.
- Broken firing pin sear or bolt sear.

- The weapon fires sluggishly. If the weapon is firing slowly, the most likely causes are—
  - Carbon buildup on chrome erosion on bore and chamber.
  - Dry firing pin cover and bolt face.
  - Burred bolt or receiver rails.
  - Weak helical compression springs or broken strands.
  - Broken spring washers; burred tubes or rods.
  - Out of position or missing buffer washers.
  - Bolt timing out of adjustment.
  - Broken recoil pin(s).
  - Burrs or aluminum buildup on vertical cam assembly.
  - Bent vertical cam.
  - Loose or cracked right hand and left hand cam followers.
- The weapon is difficult to fire. If recoil is excessive, the most likely causes are—
  - Bolt buffers contaminated with oil, water, or dust.
  - Broken helical compression spring; out of position or missing buffer components.
  - Loose buffer bodies; broken, out of position, or missing receiver buffer components.
  - Burrs or aluminum buildup on vertical cam assembly.
  - Bent vertical cam.
- The weapon becomes a runaway gun. If the weapon is firing uncontrollably in automatic mode, the most likely causes are—
  - Broken/worn lock plate or loose bolt buffer cap(s).
  - Burrs or aluminum buildup on vertical cam assembly.
  - Bent vertical cam.
  - Broken receiver sear or sear spring.
  - Trigger obstructed in down position.
- The weapon fires prematurely. If the weapon fires before the trigger is engaged, the most likely causes are—
  - Round stuck in barrel
  - Loose or broken bolt sear; broken lock plate or helical compression spring; or damaged or missing buffer components.
  - Broken firing pin, firing pin sear, or springs.
  - Broken or worn two piece cocking lever.
  - Damaged receiver or chamber from premature firing.
  - Full cartridge catch bag.
- The weapon creates deformed cases or rounds. If the weapon's recoil is short or a round is uncontrolled, the most likely causes are—
  - Case or projectile lodged in bore or chamber.

- Broken or worn cocking lever.
- Worn, frozen, loose, or missing right hand or left hand cam followers.
- Loose or missing screws; loose bolt fingers.
- Broken spring washers; burred tubes or rods.
- Loose or missing feed slide assembly components.
- Burrs or aluminum buildup on vertical cam assembly.
- Bent vertical cam.

- The charger handle(s) overrides the bolt. If the charging handle(s) is not in front of the bolt where the Soldier can pull it back to charge, the cause is most likely—
  - Slot in bolt is deformed.
  - Charger handle assembly(s) housing is bent or bowed.
- The weapons' bore is obstructed. If the bore of the weapon prevents the weapon from completing the cycle of function, the cause is most likely—
  - Live round lodged in bore.
  - Spent case lodged in bore.
  - Projectile in receiver, separated from case.
- The top cover will not close. If the cover of the MK 19 fails to close correctly or fails to close easily, the cause is most likely—
  - Improper position of feed slide assembly.
  - Misaligned ammunition.

Note. When malfunctions occur in combat, a Soldier announces, "Stoppage," or another similar term to the small unit. The Soldier quickly moves to a covered location. The Soldier corrects the malfunction as fast as they can. If the threat is too close to the Soldier or other friendly forces, and the Soldier has a secondary weapon, the Soldier switches to it and defeats the target before continuing to correct the malfunction.

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Chapter 9
Movement

The movement functional element is the process of the Soldier moving tactically during the engagement process. The movement functional element includes the Soldier's ability to move laterally, forward, diagonally, and in a retrograde manner. Due to the nature and physical characteristics of the MK 19, it cannot be fired on the move while in a ground-mount role. However, there are several ways to move or reposition the gun without completely taking it out of action.

Proper application of the shot process during movement is vital to combat operations. The most complex engagements involve movement of both Soldier and the adversary. The importance of sight alignment and trigger control are at their highest during movement. The movement of the Soldier degrades stability, the ability to aim, and creates challenges to proper trigger control.

MOVEMENT TECHNIQUES

9-1. Not all combat actions can be engaged in the same manner. Therefore, Soldiers need to know a variety of movement techniques. Each technique varies in its effect on different situations. Choosing the right technique for the right operation could be a critical factor in the outcome of the mission.

RELOCATING OF TRIPOD-MOUNTED GUN

9-2. When the gun is mounted on the tripod, it can be moved for short distances by dragging or by a two- or three-Soldier carry. (In the latter, the Soldiers should move in step to make carrying easier.)

DRAGGING

9-3. The gun is dragged when there is limited cover, or when the situation requires the gun to be moved in this manner. The gunner and assistant gunner drag the mounted gun to the desired position.

THREE-MAN CARRY

9-4. When the barrel is hot, the gunner gets behind the tripod with a trail leg in each hand. With the assistant gunner on the left and the ammunition bearer on the right, each grasps the carrying handle. In addition, the assistant gunner carries the ammunition in their left hand. When the barrel is cool, the ammunition bearer and the assistant gunner each grasp the front leg.

MOVEMENT OF THE GUN TO OTHER MOUNTS

9-5. With the mount prepared to receive the gun, the cradle of the mount is placed in a horizontal position. To move the gun to the mount, the gunner carries the right spade grip in their left hand and a box of ammunition in their right. The assistant gunner grasps the carrying handle with their left hand and a box of ammunition in their right hand. When they get to the mount, the gunner and assistant gunner place their ammunition boxes near the mount. The gunner removes the rear mounting (gun-locking) pin with their right hand. The assistant gunner removes the front mounting (gun-locking) pin with their right hand. They place the gun on the mount. The gunner aligns the holes in the rear mounting lugs of the receiver with the rear-mounting bracket and inserts the rear-mounting pin. The assistant gunner aligns the front mounting hole in the front of the receiver with the front mounting bracket and inserts the front mounting pin.

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Appendix A

Ammunition

Appendix A discusses the characteristics and capabilities of ammunition used in the MK 19, MOD3. General information such as packaging, standard and North Atlantic Treaty Organization (NATO) marking conventions, components, and general principles of operation are also provided. The information within this appendix is MK 19 grenade machine gun ammunition only.

CARTRIDGES

A-1. A medium arms cartridge has a cartridge case, a primer, a quantity of propellant, and a projectile. Figure A-1 shows the structure of an example live MK 19 round. The following terminology describe the general components of grenade machine gun cartridges:

- Cartridge case. The case is a hollow, bichambered aluminum cylinder with an aluminum base plug. The aluminum base plug fits into an open well in the propellant chamber in the cartridge base. This well is called the high pressure chamber.
- Propellant. The propellant (or powder) combusts, providing the energy to push the projectile through the barrel and downrange towards a target.
- Primer. The firing pin strikes the percussion primer, igniting the small explosive charge inside the primer. This in turn ignites the propellant.
- Bullet. The bullet or projectile is the only component that travels to the target.

Note. A dummy cartridge has a cartridge case and projectile, but no primer or propellant. Some dummy cartridges contain inert granular materials to simulate the weight and balance of live cartridges.

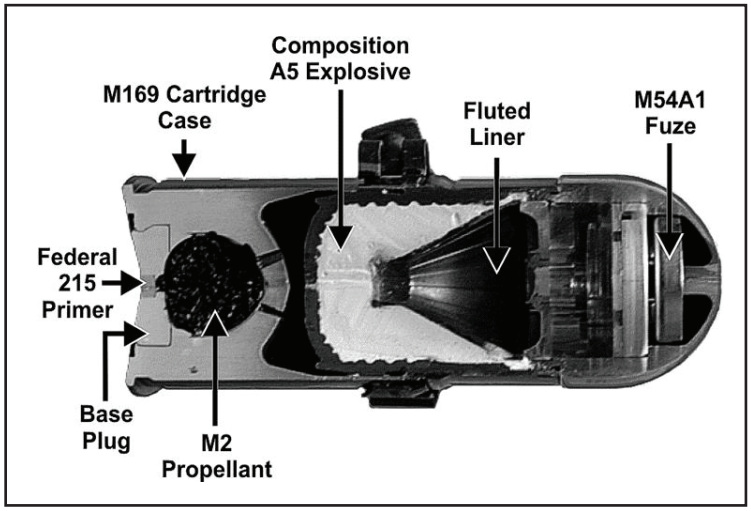


Figure A-1. Example MK 19 round structure

CARTRIDGE CASE

A-2. There are multiple types of 40-mm ammunition used for various purposes. These include high explosive, high explosive dual purpose, canister, practice, and dummy. The MK 19 MOD 3 uses the M169 aluminum bi-chambered cartridge case assembly. These cartridge cases are designed to support center-fire operation. Center-fire cases have a centrally located primer well/pocket in the base of the case, which separates the primer from the propellant in the cartridge case. These cases are designed to withstand pressures generated during firing. 40-mm ammunition has a hollow, bi-chambered aluminum cylinder as a cartridge case (See figure A-2). When the round is fired, the propellant chamber acts as high pressure chamber, and the hollow cavity attached to the projectile acts as a low pressure chamber.

PROPELLANT

A-3. Cartridge cases are loaded with anywhere from 3.8 grams to 4.2 grams (4.64 grams for the M383) of M2 propellant that impart sufficient velocity, within safe pressure, to obtain the required ballistic projectile performance. The propellant (see figure A-3) may be a single cylindrical or multiple perforation, a ball, or a flake design to facilitate rapid burning. Most propellants are coated to assist the control of the combustion rate. A final graphite coating facilitates propellant flow and eliminates static electricity in loading the cartridge.



Figure A-2.
Cartridge case



Figure A-3.
M169 cartridge case with M2 propellant

PRIMER

A-4. Centerfire 40-mm cartridges contain a percussion primer assembly, which consists of a brass or gilding metal cup. The cup contains a pellet of sensitive explosive material secured by a paper disk and a brass anvil.

A-5. The weapon firing pin striking the center of the primer cup base compresses the primer composition between the cup and the anvil. This causes the composition to explode. Holes or vents located in the anvil or closure cup allow the flame to pass through the primer vent, igniting the propellant.

PROJECTILES

A-6. 40-mm grenade projectiles are heavy. They fly slowly, thus have a higher angle trajectory from the barrel to the target than smaller caliber ammunition. MK 19 fires projectiles that are spun out of the barrel and then arc to the point of impact.

EXPLOSIVE PROJECTILES

A-7. Explosive projectiles use the spin to arm the fuse and then explodes upon impact. The delayed arming, or arming distance, can differ between types of rounds.

TRAINING PROJECTILES

A-8. Training projectiles are designed to simulate the loading and firing of other 40-mm explosive type ammunition. These rounds are inert or have a small flash at the point of impact using a delayed arming fuse. Upon impact, the fuse lights a small amount of flash powder to give a signature. Similar to explosive projectiles, the arming distance can differ between types of rounds.

A-9. Inert rounds fire a projectile that does not function upon impact with the target. They do not require a certain number of revolutions upon exiting the barrel to arm, their impact on the target records a hit.

AMMUNITION RECOVERY

A-10. The M918 40-mm target practice cartridge is used in training to simulate the M430A1 HEDP 40-mm cartridge. The projectile is blue with a 1/4-inch brown band behind the ogive. The markings "40-mm M918 TP" are stenciled in black on the projectile body. The annular groove identifies it as a TP round. In addition, the letters "TP" are stamped in three places on the bottom of the projectile body.

A-11. If a sterile area is to be used as a temporary range, M918 projectiles must be recovered. A sterile range is clear of high grass, excess weeds, and other obstacles that could interfere with firing, observation, and recovery in the impact area. Any sterile range is one that does not have a dudded area that can be used for training.

A-12. Recovery of the M918 can be done according to TB 9-1310-251-10 and local range control SOP. The bulletin is supplemental to any and all local installation SOPs and should be integrated into local procedures. Before conducting any recovery operations of the M918, ensure that Soldiers fully understand and follow all local range control SOPs.

HIGH VELOCITY ROUNDS

A-13. The MK 19 uses several types of standard 40-mm ammunition (see table A-1 on page A-4 and figure A-4 on page A-5). Soldiers may only use authorized ammunition manufactured to US and NATO specifications. MK 19 ammunition uses M16A2 links. The following paragraphs describe the types of cartridges commonly used in the MK 19 for training and combat. Some types may have more than one Department of Defense identification code (DODIC).

Note. DODICs are provided for the clarity and ease of the unit's ammunition resource manager.

Table A-1. 40-mm high velocity rounds

	M918	M385A1	M383	M430A1	M1001
GENERAL					
ROUND	**TP**	**TP**	**HE**	**HEDP**	**CANISTER**
Weight Grain	5264.5	5465.1	5310.8	5310.8	5128.7
Length Millimeters Inches	112.100 4.415	112.100 4.415	112.100 4.415	112.100 4.415	109.600 4.314
Color code	Blue with black markings; brown band, blue ogive.	Blue with black markings.	Olive drab with yellow markings; yellow ogive.	Olive drab with yellow markings; yellow ogive.	Olive drab with black markings. White diamonds in brown band.
Chamber pressure Bars PSI	1034 15,000	1034 15,000	1034 15,000	1034 15,000	1034 15,000
Velocity MPS FPS Mach	241.0 790.0 0.7	241.0 790.0 0.7	244.0 795.0 0.71	241.0 790.0 0.7	241.0 790.0 0.7
Kinetic energy Joules Feet/pounds	7028 5176	7405 5454	7293 5307	7115 5240	6772 4988
CASE Dimensions in mm	Center fire 40 x 53	Center fire 40 x 53	Center fire 40 x 53	Center fire 40 x 53	Center fire 40 x 53
PROPELLANT Base Actual	M2 double nitrocellulose, nitroglycerine	M2 double nitrocellulose, nitroglycerine	M2 double nitrocellulose, nitroglycerine	M2 double nitrocellulose, nitroglycerine	M2 double nitrocellulose, nitroglycerine
Weight Grains Ounces	61.728 0.140	61.728 0.140	71.6 0.164	61.728 0.140	61.728 0.140
PRIMER	Percussion	Percussion	Percussion	Percussion	Percussion
DODIC Design	B584 Simulates M430A1 HEDP round in appearance and ballistics.	B576 Used for target practice or for proof-testing weapons.	B571 High explosive impact type round. Produces antipersonnel effects.	B542 High explosive, dual purpose, impact type round.	BA11 Releases flechettes to produce antipersonnel effects out to 100 meters from the muzzle.
Length Millimeters Inches	76.000 2.992	80.500 3.169	70.800 2.786	79.800 3.140	76.300 3.005
Weight Grains Ounces	3734.50 8.54	3935.20 8.99	3780.80 8.64	3780.80 8.64	3598.70 8.23

LEGEND: DODIC Department of Defense identification code; MPS meters per second; FPS feet per second; PSI pounds per square inch; HE high explosive; TP target practice; mm millimeter



M918 Target Practice



M383 High Explosive



M385A1 Target Practice



M430A1 High Explosive Dual Purpose





M922 Dummy M922A1 Dummy



M1001 HVCC Round

EXAMPLE CUTAWAYS



Example Training Projectile



Example High Explosive Projectile

Figure A-4. MK 19 ammunition

DUMMY ROUNDS

A-14. The DODIC B472 dummy (inert and nonfunctional) cartridge (see figure A-4 on page A-5) helps train users to handle ammunition and load the MK 19. These cartridges simulate a loaded round of 40-mm HE ammunition in size, shape, and weight.

M922 DUMMY ROUND

A-15. The M922 is gold tipped with an olive drab casing. This one-piece solid aluminum projectile is crimped to the cartridge case. There are four thru-holes drilled through the cartridge case to the high-pressure chamber for positive identification. The primer hole is filled with RTV sealant.

M922A1 DUMMY ROUND

A-16. The entire M922A1 round is gold in color. There is no separate cartridge case. Four grooves allow easy repositioning of M16A2 link after being cycled through the MK 19. A hole in the base prevents damage to the firing pin.

TARGET PRACTICE ROUNDS

A-17. Target practice rounds simulate the high explosive 40-mm rounds. Target practice rounds are not meant for combat, and they produce minimal effects on targets during test firing or qualification.

M385A1 TARGET PRACTICE ROUND

A-18. The DODIC B576 round (see figure A-4 on page A-5) is used for practice and for proof testing weapons.

A-19. It is a fixed round whose solid, inert aluminum projectile body has a copper rotating band.

A-20. The projectile is crimped to an M169 cartridge case assembly to form a complete cartridge. The M169 cartridge case is an aluminum, bi-chambered case with a small, high pressure chamber and a larger, low pressure chamber. The two chambers are connected by vent holes. The low pressure chamber is the empty space between the projectile and the cartridge case after they are crimped together. The propellant is sealed in the high pressure chamber with an aluminum base plug and a closing cup. A percussion primer is crimped into the center opening in the base plug. Cartridges are linked together to form 32-round belts using the M16A2 loop and coupling.

A-21. The weapon firing pin strikes the percussion primer to ignite the propelling charge. Pressure, generated by the burning propellant in the high pressure chamber, forces the expanding gases through the vent holes into the low pressure chamber, and propels the projectile forward. The rotating band around the projectile engages the rifling in the launcher tube imparting a spin of 12,000 rpm to the projectile. The expanding gases in the low pressure chamber force the projectile through the barrel attaining a muzzle velocity of 241 meters per second. Because it is inert, the projectile does not function upon impact with the target.

M918 TARGET PRACTICE ROUND

A-22. The DODIC B584 (see figure A-4 on page A-5) simulates the M430A1 HEDP cartridge in appearance and ballistics.

Projectile

A-23. The fixed round has a one-piece steel projectile body. Inside the projectile body, an aluminum insert contains a pyrotechnic flash charge chamber. Press-fitted inside this chamber, a plastic container holds about 1 gram of flash charge composition. An aluminum ogive, containing a firing pin plate assembly, a rubber tubing anti-creep spring, and the M550 fuse escapement assembly, is threaded into the projectile body, forming a complete projectile.

Cartridge

A-24. The projectile is crimped to an M169 cartridge case assembly to form a complete cartridge. The M169 cartridge case is an aluminum, bi-chambered case with a small, high pressure chamber and a larger, low pressure chamber. The two chambers are connected by vent holes. The low pressure chamber is the empty space between the projectile and the cartridge case after they are crimped together. The propellant is sealed in the high pressure chamber with an aluminum base plug and a closing cup. A percussion primer is crimped into the center opening in the base plug. Cartridges are linked together to form 32-round belts using the M16A2 loop and coupling. The weapon firing pin strikes the percussion primer igniting the propelling charge. Pressure, generated by the burning propellant in the high pressure chamber, forces the expanding gases through the vent holes into the low pressure chamber, and propels the projectile forward. The rotating band around the projectile engages the rifling in the launcher tube, imparting a spin of 12,000 rpm to the projectile. The expanding gases in the low pressure chamber force the projectile through the barrel attaining a muzzle velocity of 241 meters per second.

A-25. Inside the M550 fuse escapement assembly is the rotor, which contains the M55 detonator and is held out of line with the pyrotechnic flash charge by the setback pin and centrifugal lock. When the projectile is fired, setback force causes the setback pin to move rearward from the fuse rotor. When the projectile attains sufficient spin, the centrifugal lock releases the rotor and arming begins. Arming means the rotor begins rotating toward the center of the projectile to bring the detonator in line with the pyrotechnic flash charge. The rotor gear engages the star wheel and verge, delaying arming of the rotor. After the projectile has traveled 18 to 30 meters from the launch tube, the rotor stops in the armed position and the fuse is armed. Upon impact with the target, the entire M550 fuse escapement assembly in the ogive moves forward. This compresses the cellular foam spring and drives the detonator into the firing pin. In turn, this flashes through the small hole of the insert and ignites the flash powder. Gases generated by the burning powder are concentrated upon the base of the projectile body causing it to rupture and producing a flash, smoke, and a loud report. Rupture begins at the center of the projectile base forming hinged petals.

HIGH EXPLOSIVE ROUNDS

A-26. High explosive (HE) ammunition produces anti-personnel effects and can penetrate steel armor. HE rounds are only used in combat or on a range with a dudded area that only EOD can enter and clear.

M383 High Explosive Round

A-27. DODIC B571 is a fixed, high explosive MK 19 round that produces anti-personnel effects in the target area using a ground burst effect. It has an internally embossed steel projectile body containing a high explosive charge of composition. The M533 point detonating (PD) fuse threads into the loaded body, forming the complete projectile.

A-28. The projectile is crimped to an M169 case, forming a complete cartridge. The M169 case is aluminum and bi-chambered, with a small high pressure chamber and a larger, low pressure chamber. The two chambers are connected by vent holes. The low pressure chamber is the empty space between the projectile and the cartridge case after they are crimped together. The propellant is sealed in the high pressure chamber with an aluminum base plug and a closing cup. A percussion primer is crimped into the center opening in the base plug. Cartridge are linked together to form 32 round belts using the M16A2 loop and coupling.

A-29. The weapon firing pin strikes the percussion primer igniting the propelling charge. Pressure, generated by the burning propellant in the high pressure chamber, forces the expanding gases through the vent holes into the low pressure chamber, and propels the projectile forward. The rotating band around the projectile engages the rifling in the launcher barrel imparting a spin of 12,000 rpm to the projectile. The expanding gases in the low pressure chamber force the projectile through the barrel with a muzzle velocity of 244 meters per second.

A-30. After the projectile leaves the launcher tube, setback forces cause the fuse setback pin, which keeps the rotor out of line with the detonator, to be disengaged from the rotor. The rotor is secured in position by a centrifugal lock which engages the star wheel in the timing mechanism of the fuse assembly. The centrifugal lock releases the star wheel and arming of the fuse begins when the projectile attains sufficient spin. The rotor springs start rotation of the rotor which is sustained by centrifugal force. The escapement assembly

delays arming of the fuse for about 0.07 to 0.16 seconds. The rotor is then locked in the armed position, and the fuse arms at about 18 to 36 meters from the launcher tube.

A-31. Upon grazing or impacting the target, the inertial force from impact causes bracket weights to pivot inward forcing the firing pin into the detonator. At the same time, the detonator detonates the explosive charge causing a blast and fragmentation of the projectile body.

M430A1 High Explosive, Dual Purpose Round

A-32. DODIC B542 (see figure A-4 on page A-5) can penetrate 3 inches of steel armor at 0 degrees angle of obliquity, and produce personnel casualties in the target area.

A-33. This is a fixed round of ammunition with an internally embossed steel projectile body containing a high explosive composition A5 charge and a copper, shaped-charge liner. The M549A1 point-initiating, base-detonating (PIBD) fuse houses an escapement type safe and arm device and an M55 detonator. A spitback charge is crimped to the fuse, and the fuse is threaded into the loaded body, forming the complete projectile.

A-34. The projectile is crimped to an M169 cartridge case assembly to form a complete cartridge. The M169 cartridge case is an aluminum, bi-chambered case with a small, high pressure chamber and a larger, low pressure chamber. The two chambers are connected by vent holes. The low pressure chamber is the empty space between the projectile and the cartridge case after they are crimped together. The propellant is sealed in the high pressure chamber with an aluminum base plug and a closing cup. A percussion primer is crimped into the center opening in the base plug. Cartridges are linked together to form 32 round belts using the M16A2 loop and coupling.

A-35. The weapon firing pin strikes the percussion primer igniting the propelling charge. Pressure, generated by the burning propellant in the high pressure chamber, forces the expanding gases through the vent holes into the low pressure chamber, and propels the projectile forward. The rotating band around the projectile engages the rifling in the launcher tube, imparting a spin of 12,000 rpm to the projectile. The expanding gases in the low pressure chamber force the projectile through the barrel attaining a muzzle velocity of 241 meters per second. Prior to firing, the detonator in the fuse rotor is held out of line by the position of the setback pin against the rotor and gear assembly. Upon firing, setback force frees the pin from the rotor. The spin of the projectile causes the spin locks to disengage from the rotor and gear assembly. The detonator then begins to move toward the armed position under the influence of centrifugal force on the eccentrically located rotor. The movement of the rotor and gear assembly is resisted by an escapement mechanism, providing the required time delay in the arming of the fuse. The detonator reaches the armed position by the time the projectile has traveled a distance of 18 to 40 meters from the launcher. Upon impact with the target, the firing pin is driven into the detonator and initiates it. The effect of the detonator initiates the spitback charge projecting a flyer plate into the main change and initiates it. Detonation of the main charge provides both the armor piercing effect of the shaped charge and fragmentation of the steel body.

M1001 High Velocity Canister Cartridge Round

A-36. There is only one 40-mm high velocity canister cartridge round for the MK 19. This type of round is used only to produce anti-personnel effects on the battlefield. This round should not be used on any lightly armored vehicles.

A-37. The DODIC BA11 high velocity canister cartridge (also known as HVCC or simply as the 40-mm canister cartridge) (see figure A-4) is used against personnel out to 100 meters from the weapon.

A-38. The cartridge is a fixed round of ammunition consisting of a projectile assembly and a cartridge case assembly. The projectile has an aluminum sabot body with 107 steel flechettes, an aluminum nosecap, a pusher cap, valve plate, spring, retaining disk, rubber pad, obturator, and an expulsion charge.

A-39. The projectile is crimped to an M169 cartridge case assembly to form a complete round. The M169 cartridge case is an aluminum, bi-chambered case with a small high pressure chamber and a larger low pressure chamber. The two chambers are connected by vent holes. The low pressure chamber is the empty space between the projectile and the cartridge case after they are crimped together. The propellant is sealed in the high pressure chamber with an aluminum base plug and a closing cup. A percussion primer is crimped

into the center opening in the base plug. Cartridge are linked together to form 32-round belts using the M16A2 loop and coupling.

A-40. The firing pin strikes the percussion primer to ignite the propelling charge. Pressure, generated by the burning propellant in the high pressure chamber, forces the expanding gases through the vent holes into the low pressure chamber, and propels the projectile forward. Propellant gas bleeds into the base of the canister projectile through a hole in the bottom of the sabot body. The force of the gas acting on the valve plate pushes it forward against a spring and opens the plenum chamber. Propelling gas ignites the expulsion charge located in the plenum chamber. The expulsion charge gas pushes the valve plate closed and pushes the pusher cup forward. The pusher cup is loaded with a quantity of 107 flechettes. The forward motion of the pusher cup and the flechettes releases the nose cap. Once the nose cap is released, the pusher cup and flechettes are free to deploy. No parts of the canister projectile are left in the bore of the weapon after firing.

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Appendix B

Machine Gun Theory

Whether organic to the unit or attached, machine guns provide the heavy volume of close and continuous fire needed to achieve fire superiority, machine guns are the Infantry platoon's most effective weapons against a dismounted enemy force. Machine guns can engage enemy targets beyond the capability of individual weapons with controlled and accurate fire. This appendix addresses the capabilities, limitations, and engagement techniques of fire common to machine guns.

COMBAT TECHNIQUES OF FIRE

B-1. Technique of fire is the method of delivering and controlling fire. Each member of the machine gun crew must be trained in standard methods of applying fire, either as a crewmember or a gunner, and must perform their assigned task automatically and effectively. The simplest and most effective technique of delivering fire with the machine gun mounted on its ground or vehicular mount is direct laying—aligning the sights of the gun on the target and firing. At times, techniques of fire other than direct laying are more appropriate and effective. When delivering overhead fire or fire from position defilade, the gunner must use the appropriate technique.

B-2. Before the machine gun can be employed to the best advantage using any firing technique, certain engagement techniques must be understood and applied. These include—

- Characteristics of fire.
- Classes of fire.
- Fire control.
- Target types and methods of engagement.
- Overhead fire.
- Methods of laying the gun.
- Firing from position defilade.
- Machine gun employment, offense and defense.

CHARACTERISTICS OF FIRE

B-3. The gunner's knowledge of their machine gun is not complete until they have a thorough understanding of the action and effect of the projectiles when fired. Characteristics of machine gun fire, include trajectory, cone of fire, and the beaten zone.

TRAJECTORY

B-4. The trajectory is the curved path of the projectile in its flight from the muzzle of the weapon to its impact. The major factors that influence the trajectory are the velocity of the round, gravity, rotation of the round, and resistance of the air. The farther the round travels, the greater the curve of the trajectory. The highest point of the trajectory is called the maximum ordinate. This is a point approximately two-thirds of the distance from the gun to the target. The maximum ordinate increases as the range increases. (See figure B-1.)

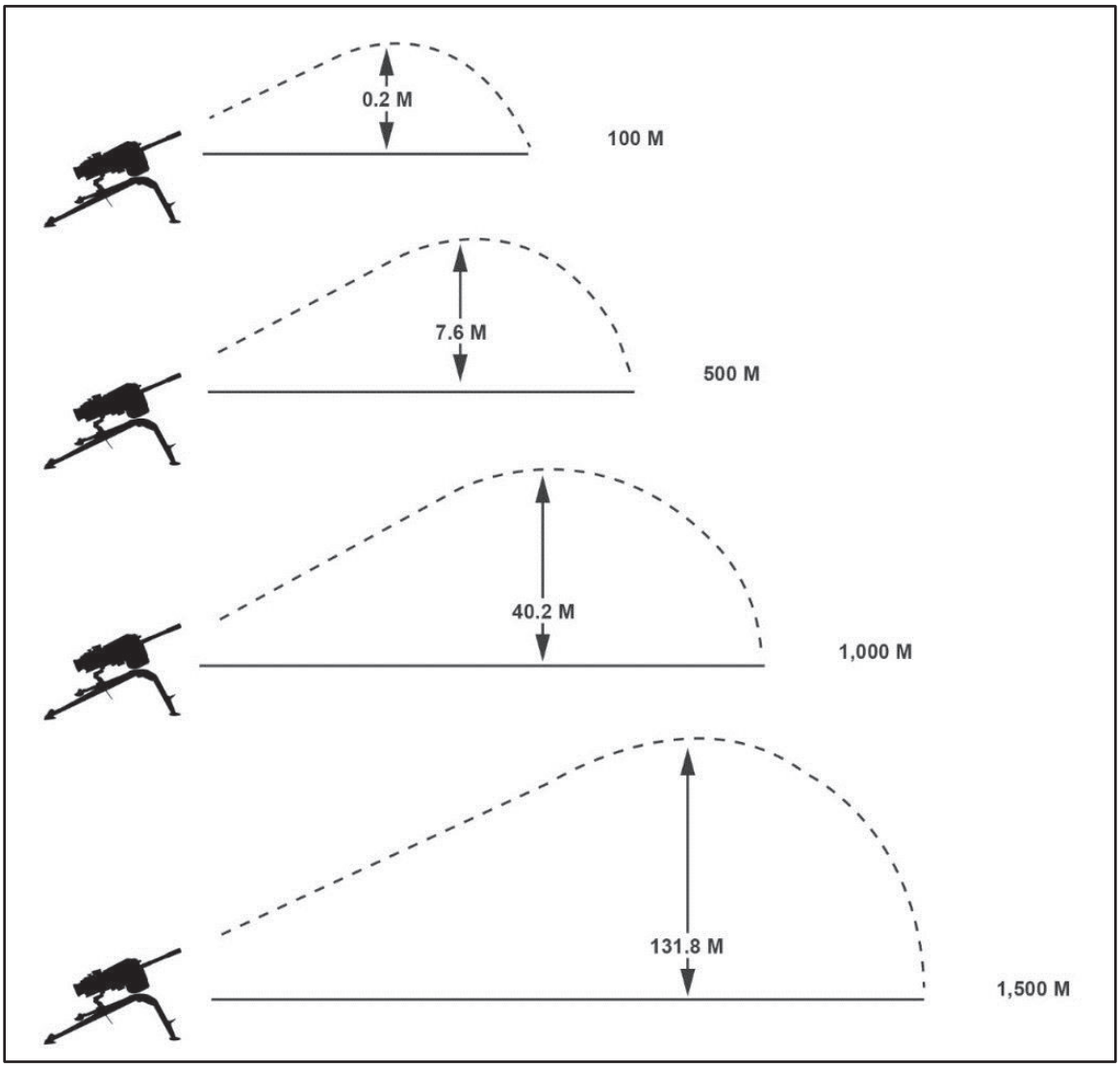


Figure B-1. Maximum ordinates at key ranges

CONE OF FIRE

B-5. When the weapon is fired automatically in bursts, the vibrations of the gun and mount, variations in ammunition, and atmospheric conditions cause the rounds to follow slightly different trajectories. This group of trajectories formed by a single burst is called the cone of fire. (See figure B-2.)

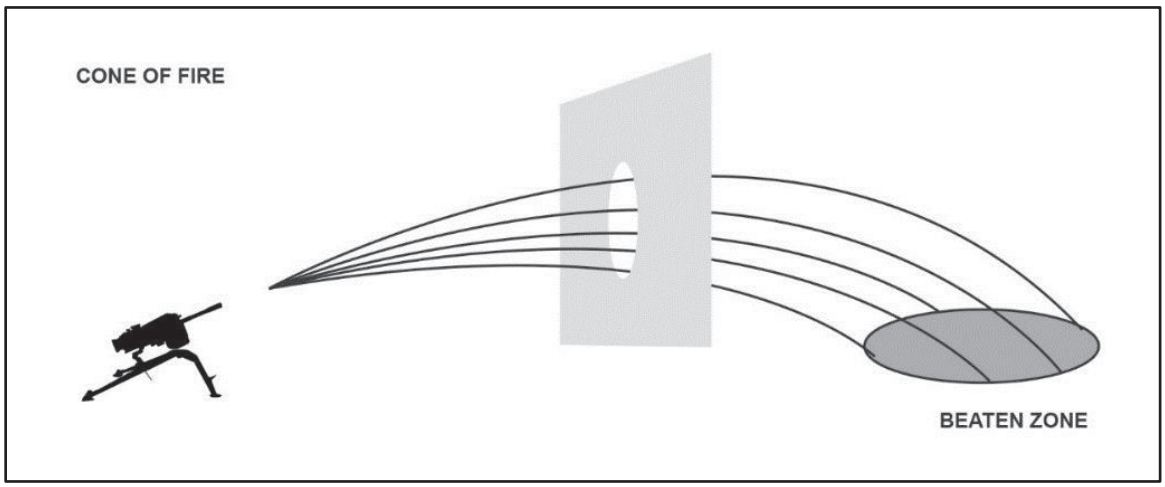


Figure B-2. Cone of fire

BEATEN ZONE

B-6. The beaten zone is an elliptical pattern formed by the cone of fire as it strikes the ground. The beaten zone varies in size due to several factors to include: the weapon, mount, tripod, atmospheric conditions, and stability.

- Effect of range. As the range to the target increases, the beaten zone becomes shorter and wider.
- Effect of terrain. The length of the beaten zone for any given range varies according to the slope of the ground. On rising ground, the beaten zone becomes shorter but remains the same width. On ground that slopes away from the gun, the beaten zone becomes longer but remains the same width.

CLASSES OF FIRE

B-7. Each of the classes of fire have unique uses and benefits. Knowing these enables the Soldier to choose which will work best in a situation. The three classes of fire are as follows:

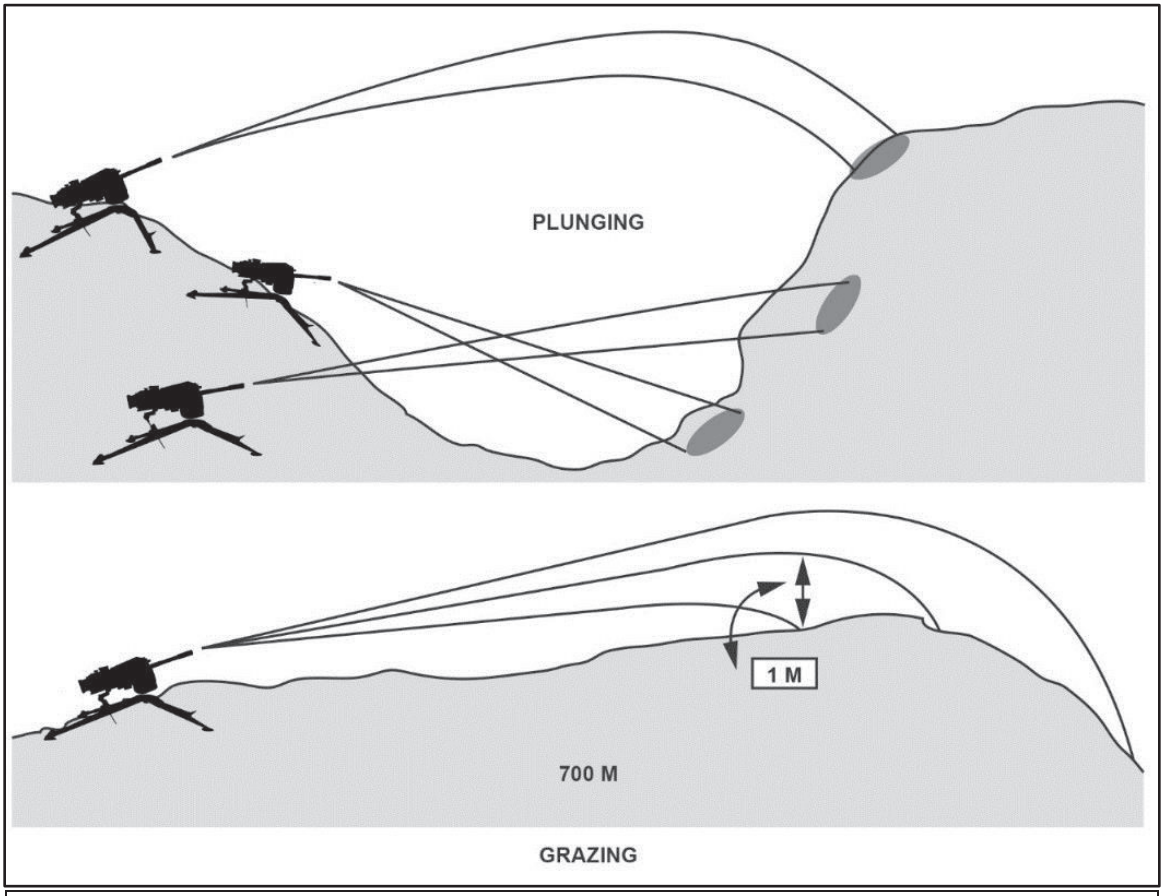
- Respect to the ground
- Respect to the target
- Respect to the gun

Note. Some classes of fire apply only to direct-fire weapons. All of the classes of fire are mentioned here, but the only ones discussed in detail are those that pertain to the indirect fire MK 19.

RESPECT TO THE GROUND

B-8. Class of fire with respect to the ground are shown in figure B-3. Machine gun fire is classified with respect to the ground, the target, and the gun. The classes of fire with respect to the ground are plunging fire and grazing fire.

- Plunging fire. With plunging fire, the angle of fall of the rounds (with reference to the slope of the ground) is such that the danger space is confined to the beaten zone, and the length of the beaten zone is materially shortened. Plunging fire is obtained when firing from high ground to low ground, when firing from low ground to high ground, and when firing at long ranges.
- Grazing fire. Since grazing fire is not practical for use with the MK 19, only plunging fire should be considered for use.



Legend:
m = meters

Figure B-3. Classes of fire with respect to the ground

RESPECT TO THE TARGET

B-9. Class of fire with respect to the target are shown in figure B-4. Classes of fire with respect to the target include frontal, flanking, oblique, and enfilade:

- Frontal. In frontal fire, the long axis of the beaten zone is at a right angle to the long axis of the target.
- Flanking. Flanking fire is delivered against the flank of a target.
- Oblique. In oblique fire, the long axis of the beaten zone is at an angle (but not a right angle) to the long axis of the target.
- Enfilade. With enfilade fire, the long axis of the beaten zone coincides or nearly coincides with the long axis of the target. Enfilade fire is either frontal or flanking. Enfilade fire is the most desirable class of fire with respect to the target because it makes maximum use of the beaten zone.

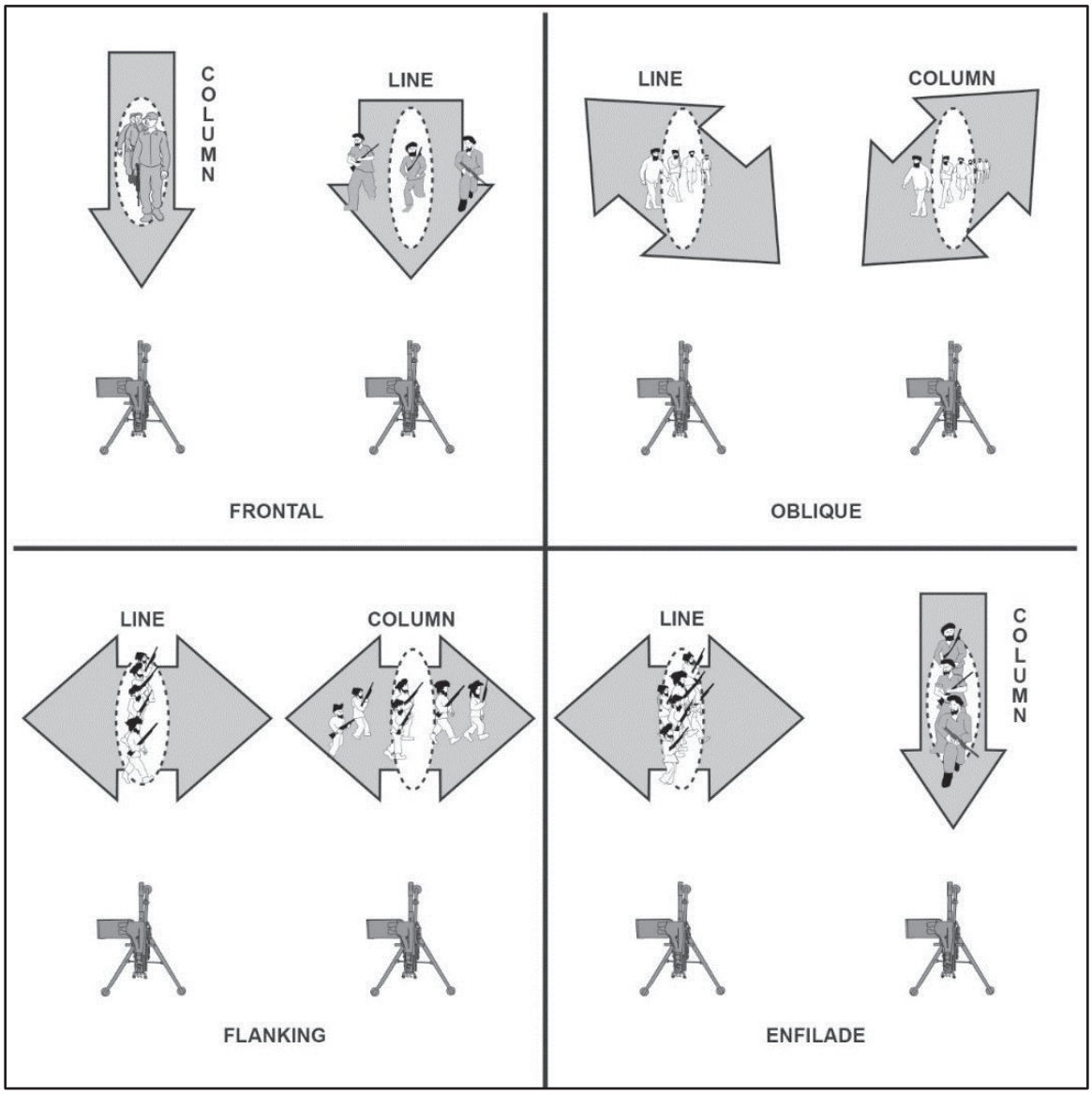


Figure B-4. Classes of fire with respect to the target

RESPECT TO GUN

B-10. Class of fire with respect to the gun are shown in figure B-5. Classes of fire with respect to the gun include fixed and free gun.

- Fixed fire. Fixed fire delivered on a point target with little or no manipulation needed. After the initial burst, the gunners will follow any change or movement of the target without command.
- Traversing fire. Traversing fire is moved from left to right or right to left, with no range change. It may be used against frontal or flanking targets.
- Searching fire. Searching fire is delivered against a deep target or a target that has depth, requiring changes in elevation of the gun. The amount of elevation change depends upon the range and the slope of the ground.
- Traversing and searching fire. Traversing and searching fire is delivered both in width and depth by changes in direction and elevation. It is employed against a target whose long axis is oblique to the direction of the fire.
- Swinging traverse. Swinging traverse employed against targets that require major changes in direction but little or no change in elevation. Targets may be dense, wide, in close formations moving slowly toward or away from the gun, or they may be vehicles or mounted troops moving across the front. The traversing slide lock lever is loosened enough to permit the gunner to swing the gun laterally.
- Free gun. Free gun fire is delivered against moving targets that must be rapidly engaged with fast changes in both direction and elevation. Examples are aerial targets, vehicles, mounted troops, or infantry in relatively close formations moving rapidly toward or away from the gun position. To fire free gun on the M3 tripod mount, remove the T&E mechanism from the receiver and traversing bar and put it down. When firing swinging traverse and free gun, the weapon is normally fired at the cyclic rate of fire, which is in excess of 450 rounds per minute. Free gun fire consumes a lot of ammunition, and does not have a beaten zone because each round seeks its own area of impact.

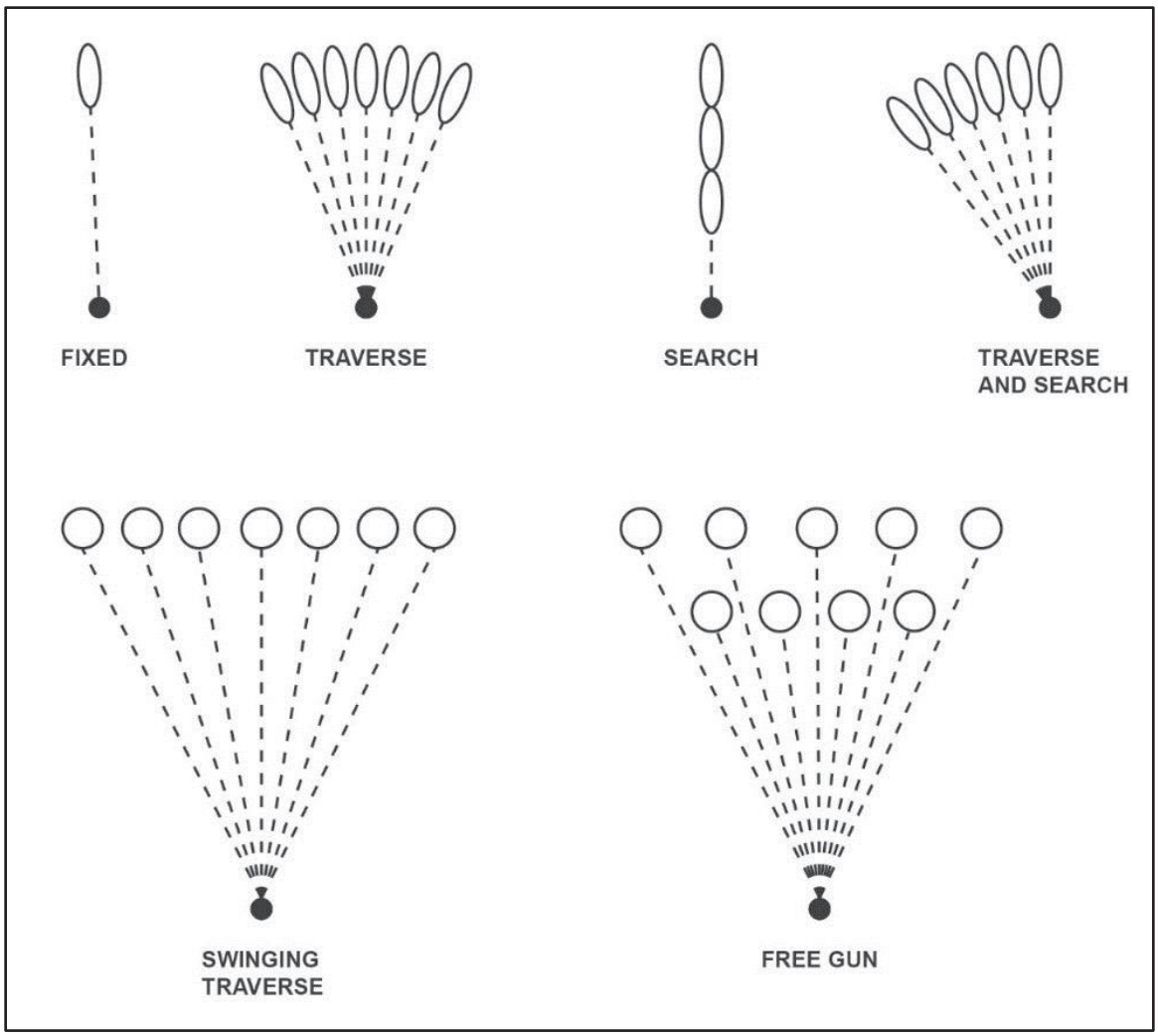


Figure B-5. Classes of fire with respect to the gun

FIRE CONTROL

B-11. Fire control of machine guns includes all operations connected with the preparation and actual application of effective fire on a target. It implies the ability of the leader to open fire at the instant he desires, to adjust the fire of the gun(s) on the target, to regulate the rate of fire, to shift from one target to another, and to cease firing. The ability to exercise proper fire control depends primarily on the discipline and the proper training of the crew. Failure to exercise fire control results in danger to friendly troops, loss of surprise, premature disclosure of positions, application of fire on unimportant targets, loss of time in adjusting fire, and waste of ammunition.

CONTROL METHODS

B-12. The noise of battle limits some methods of controlling machine gun fire. Therefore, the leader must select the method or combination of methods that will best accomplish their purpose. The chain of fire control begins with the leader. The leader is responsible for both the technical and tactical employment of the gun and the training of the crew. The leader is responsible for passing on to the crewmembers all instructions and orders from their next higher leader regarding the situation and mission. The leader assigns sectors of fire and firing positions, designates targets to be engaged, adjusts fire, and ensures effective coverage of the targets.

- Oral control. Oral control is effective unless the leader is too far away from the gun crew(s), or the noise of battle makes it impossible for the gun crew(s) to hear them.
- Hand and arm signals. Using hand and arm signals is an effective method when the gun crew(s) can see the leader. All crewmembers must understand the standard arm-and-hand signals used to control machine gun fire. (Refer to TC 3-21.60 *Visual Signals* for more information).
- Prearranged signals. Prearranged signals are either visual or sound signals such as pyrotechnics or blasts on a whistle. These signals should be included in the units' SOPs and must be clearly understood by all crewmembers.
- Personal contact. In many situations, the leader must move to individual crewmembers to issue orders. This method is used more than any other by small-unit leaders. The leader must use maximum cover and concealment to keep from disclosing the gun crew's position.
- Standing operating procedures. Standard operating procedures are actions to be executed without command, and are developed during the training. Their use eliminates many commands and simplifies fire control. SOPs for certain actions and commands can be developed to make gunners effective. Some examples follow:
  - Observe. The gunners continuously observe their sectors.
  - Fire. Gunners open fire without command on appropriate targets appearing within their sectors.
  - Check. While firing, the gunners periodically check with the leader for instructions.
  - Return fire. The gunners return enemy fire without order, concentrating on enemy automatic weapons.
  - Shift fire. When more dangerous targets appear, gunners shift fire without command.
  - Fire at best rate. When gunners engage a target, they initially fire at the rate necessary to gain and maintain fire superiority.

POINT TARGETS

B-13. Point targets are those with a single aiming point. Enemy bunkers, weapon emplacements, vehicles, small groups of Soldiers, and aerial targets, such as helicopters or descending paratroopers, are examples of point targets. A point target is engaged with fixed fire. If the target moves after the initial burst, the gun crew(s) keeps fire on the target by following its movement with the gun(s).

LINEAR TARGETS

B-14. Targets presented to the machine gunners during combat will, in most cases, consist of enemy soldiers in various formations. This requires distribution and concentration of fire. These targets have width and depth, and the application of machine gun fire is designed to completely cover the area in which the enemy is known or suspected to be. These targets may be easy to see or may be indistinct and difficult to locate.

B-15. When machine gun fire is under direct control of a leader, the leader designates the midpoint and flanks or ends of a target unless they are obvious to the gun crew(s). When a target other than a point target is engaged by two gunners, it is always divided. Each gunner applies their fire to that portion of the target corresponding to their position with relation to the other gun. Normally, each gunner engages one-half of the target; however, gunners must be prepared to engage the entire target if necessary. Gunners continue to fire on the target until it is neutralized or until another signal is received from the leader.

NUMBERED POSITIONS

B-16. The gunner's positions should be numbered so each gunner will know which portion of a target they should engage. It should be emphasized that the positions are numbered—not the guns or gunners. To ensure that gunners react quickly and properly when they detect a target or when a target is designated by the leader, standard methods of applying fire to the various type targets are taught. These methods are the same for ground and vehicular-mounted guns.

Two Guns, Normal Division

B-17. When the target is divided at the midpoint; the right gun engages the right half of the target, and the gun on the left engages the left half of the target. The point of initial lay and adjustment for both guns is at the midpoint of the target. After adjustment on the midpoint, the right gun traverses the right half of the target, to include one aiming point beyond the last visible target flank, and then returns to the midpoint.

B-18. When the target is divided at the midpoint; the right gun engages the right half of the target, and the gun on the left engages the left half of the target. The point of initial lay and adjustment for both guns is at the midpoint of the target. After adjusting on the midpoint, the right gun traverses the right half of the target, to include one aiming point beyond the last visible target flank, and then returns to the midpoint.

Two Guns, Special Division

B-19. If one portion of the target presents a greater threat than another, the target can be divided so fire is concentrated on that portion presenting the greatest threat. The special division of the target is accomplished by a subsequent fire command after firing begins. The gunners initially lay at the midpoint, regardless of the special division to be made, thus precluding confusion.

One Gun

B-20. A single gunner must engage the entire width of a linear target. The point of the initial lay and adjustment is on the midpoint, or that portion of the target presenting the greatest threat. The gunner traverses to either flank and then covers the remainder of the target. (See figure B-6.)

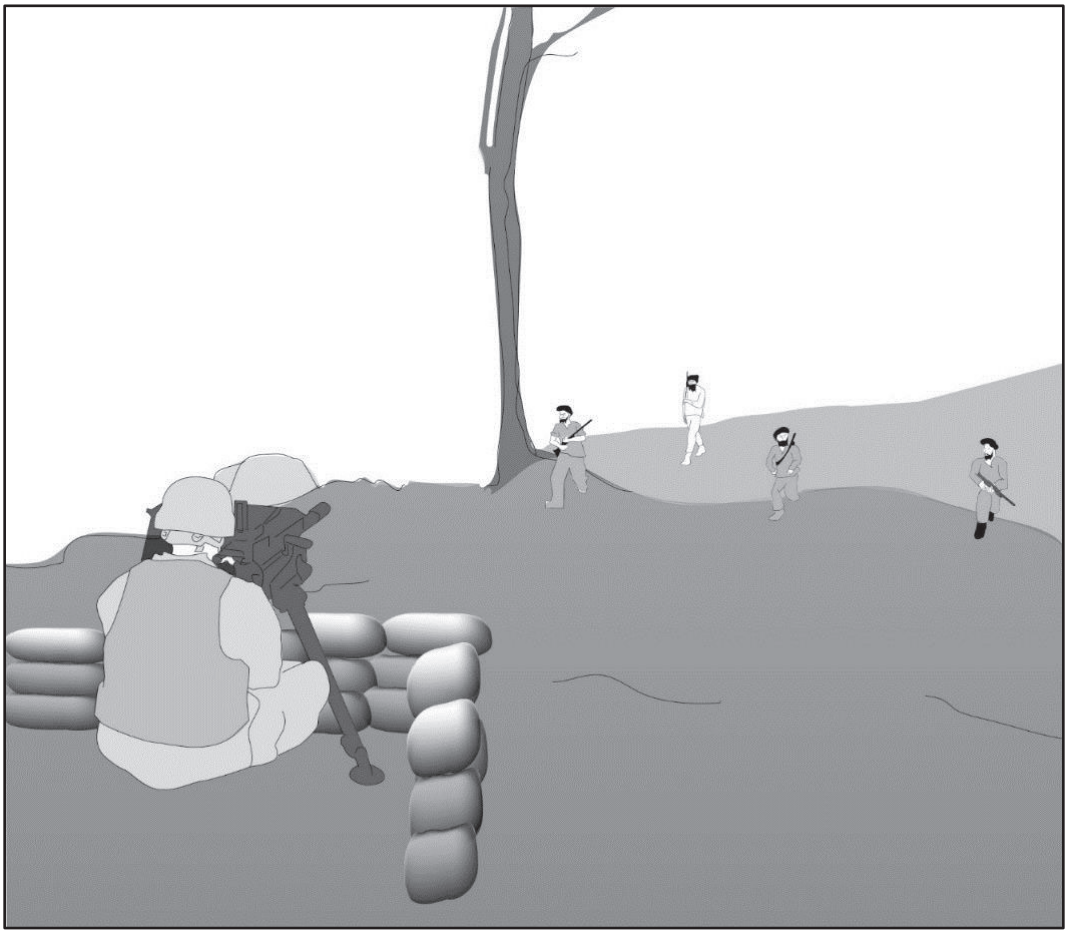


Figure B-6. Linear target and one gun

LINEAR TARGETS WITH DEPTH

B-21. Linear targets with depth are targets that have sufficient width to require traversing fire and depth that cannot be covered by the beaten zone. A combined change in direction and elevation (traversing and searching fire) is required to maintain effective fire on these targets. (See figure B-7.) When range is announced, the range to the midpoint is given.

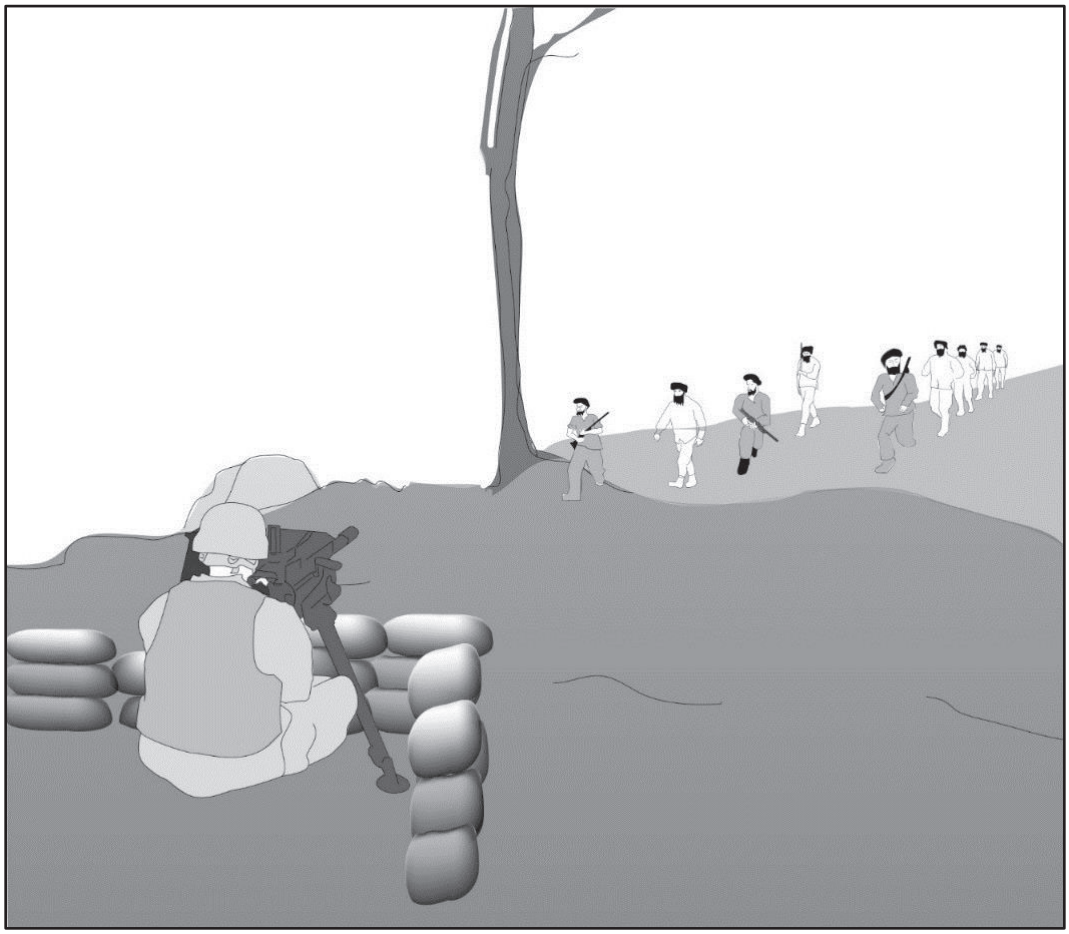


Figure B-7. Linear target with depth

Two Guns

B-22. The method of division, the point of initial lay and adjustment, and the extent of manipulation for both guns are the same as prescribed for linear targets. The gunners, however, apply enough search between each burst to ensure the center of the beaten zone is maintained at the center base of the target. (See figure B-8.)

One Gun

B-23. A single gunner initially lays and adjusts on the midpoint of a linear target with depth unless some other portion of the target presents a greater threat. The gunner traverses and searches to the near flank, then they cover the entire target area. (See figure B-8.)

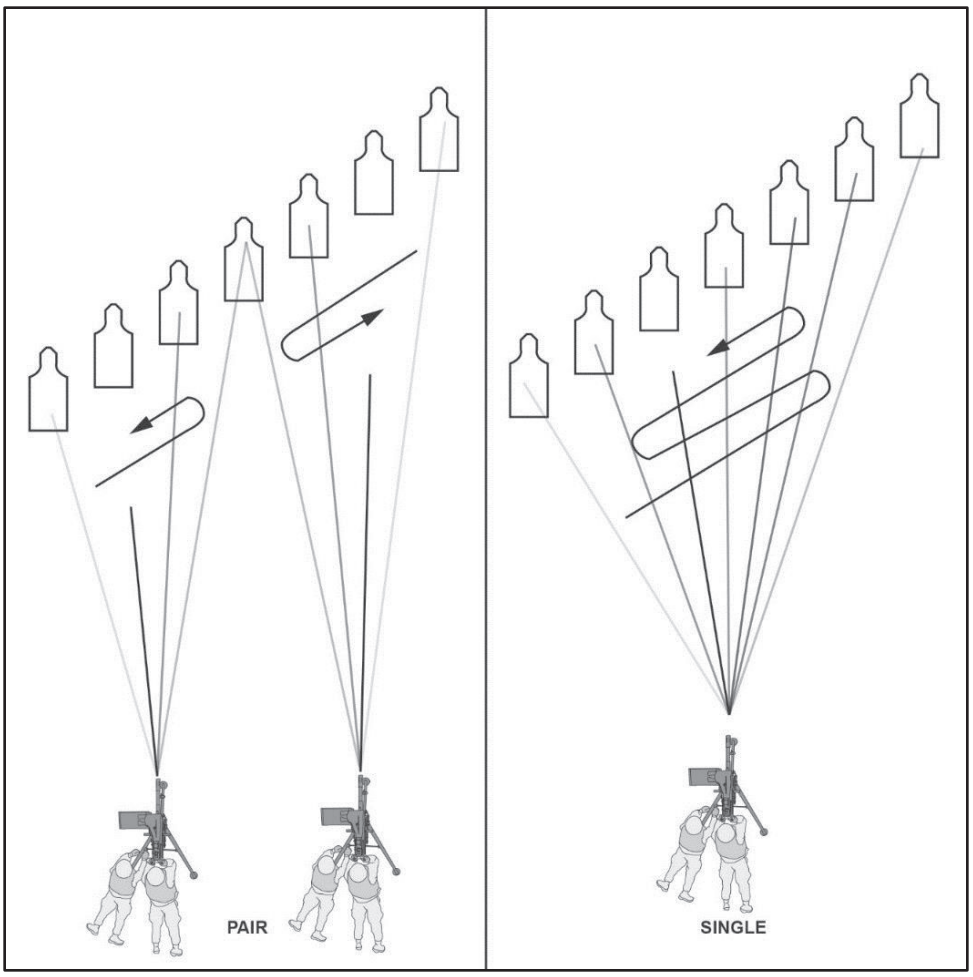


Figure B-8. Engagement of linear targets with depth

DEEP TARGETS

B-24. Deep targets have depth but little width, and can be effectively covered by searching fire (see figure B-9). When the range is announced, it is given to the midpoint of the target.

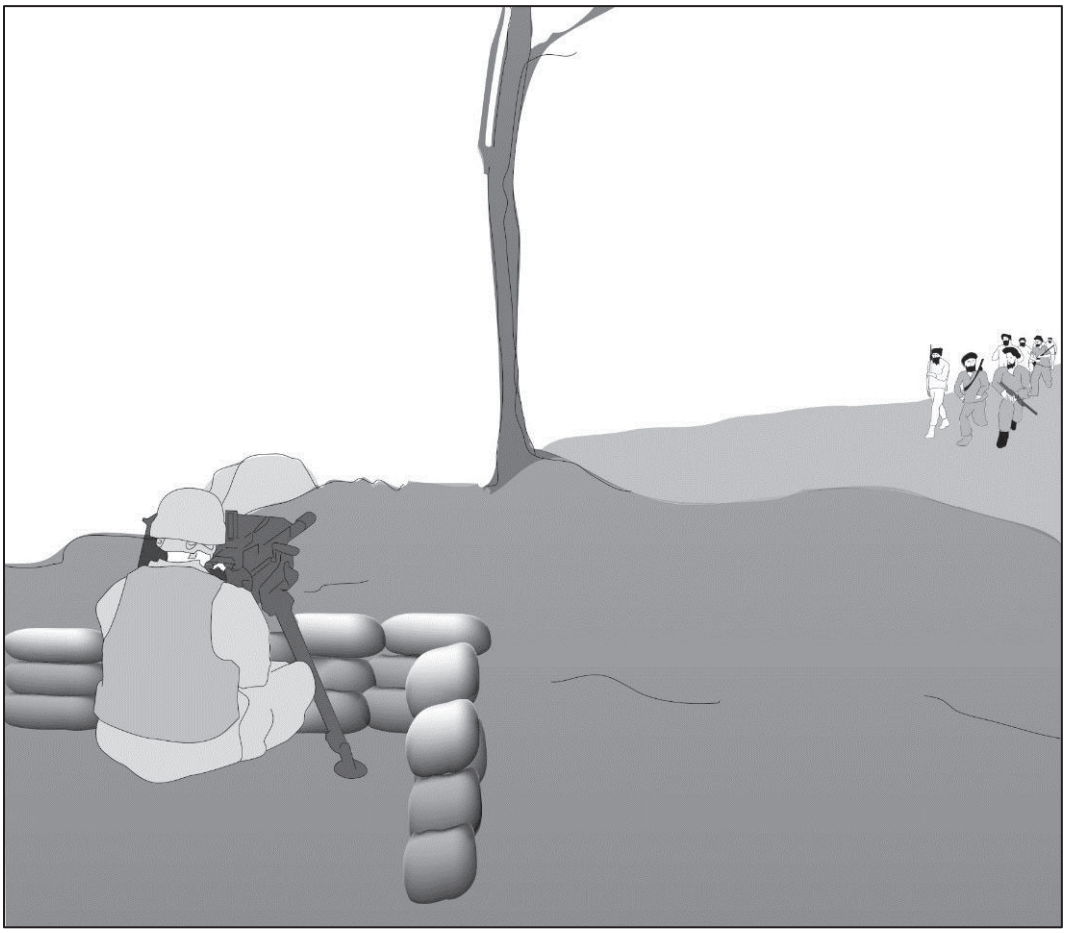


Figure B-9. Deep target

Two Guns

B-25. The point of initial lay of both guns is on the midpoint, which is also the point of division. Since enfilade fire is delivered, the gunners need not adjust on the midpoint of the target, because the long axis of the beaten zone will compensate for missing the midpoint. However, should either gunner's beaten zone lie outside the lateral confines of the target, that gunner must adjust fires into the target area. After the initial bursts, the right gun searches to the near end of the target, and the left gun searches to the far end of the target. Both gunners then reverse their directions of search and return to the midpoint. (See figure B-10.)

One Gun

B-26. A single gunner initially lays and fires at the midpoint of a deep target, unless another portion of the target presents a greater threat. The gunner immediately searches to the near end, then covers the entire target. (See figure B-10.)

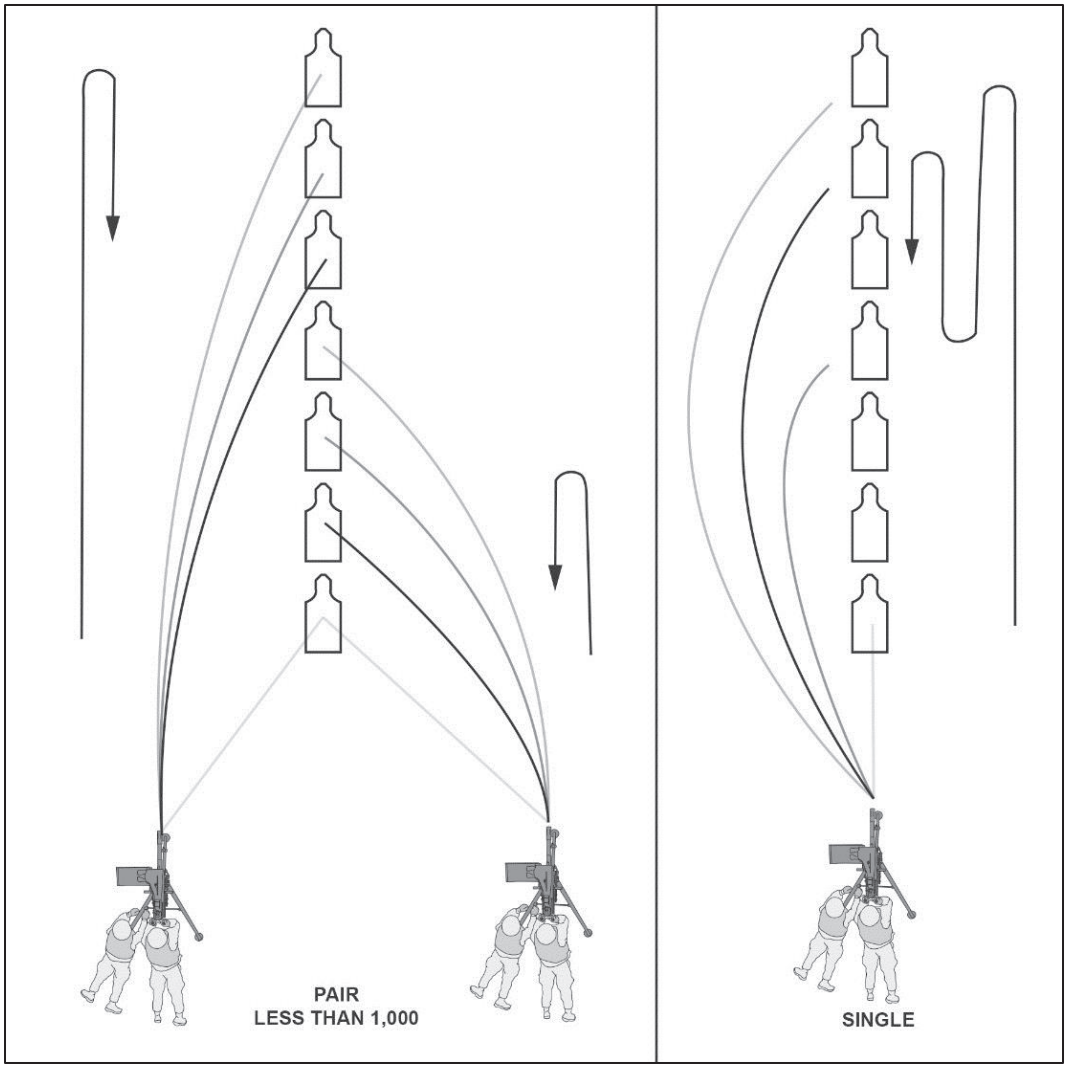


Figure B-10. Engagement of deep targets

AREA TARGETS

B-27. Area targets have considerable width and depth, and they require extensive traversing and searching fires. This type target exists when the enemy is known to be in a certain area, but their exact location is unknown. A hilltop is a typical area target. The leader designates an area target by indicating to the gun crew(s) the width and depth of the target.

Two Guns

B-28. The target is divided at the center of mass; the right gun fires on the right half and the left gun fires on the left half. The point of initial lay and adjustment for both guns is on the center of mass. After adjusting on the center of mass, fire is distributed by determining the size of the beaten zones and applying direction and elevation changes that cause the most effective coverage of the target area. Both guns traverse and search their respective halves to the flanks, then return to the midpoint. (See figure B-11 on page B-14.)

One Gun

B-29. A single gunner engages an area target by laying and adjusting on the center of mass, traversing and searching to either flank, then reversing the direction and traversing and searching to the other flank. (See figure B-11 on page B-14.)

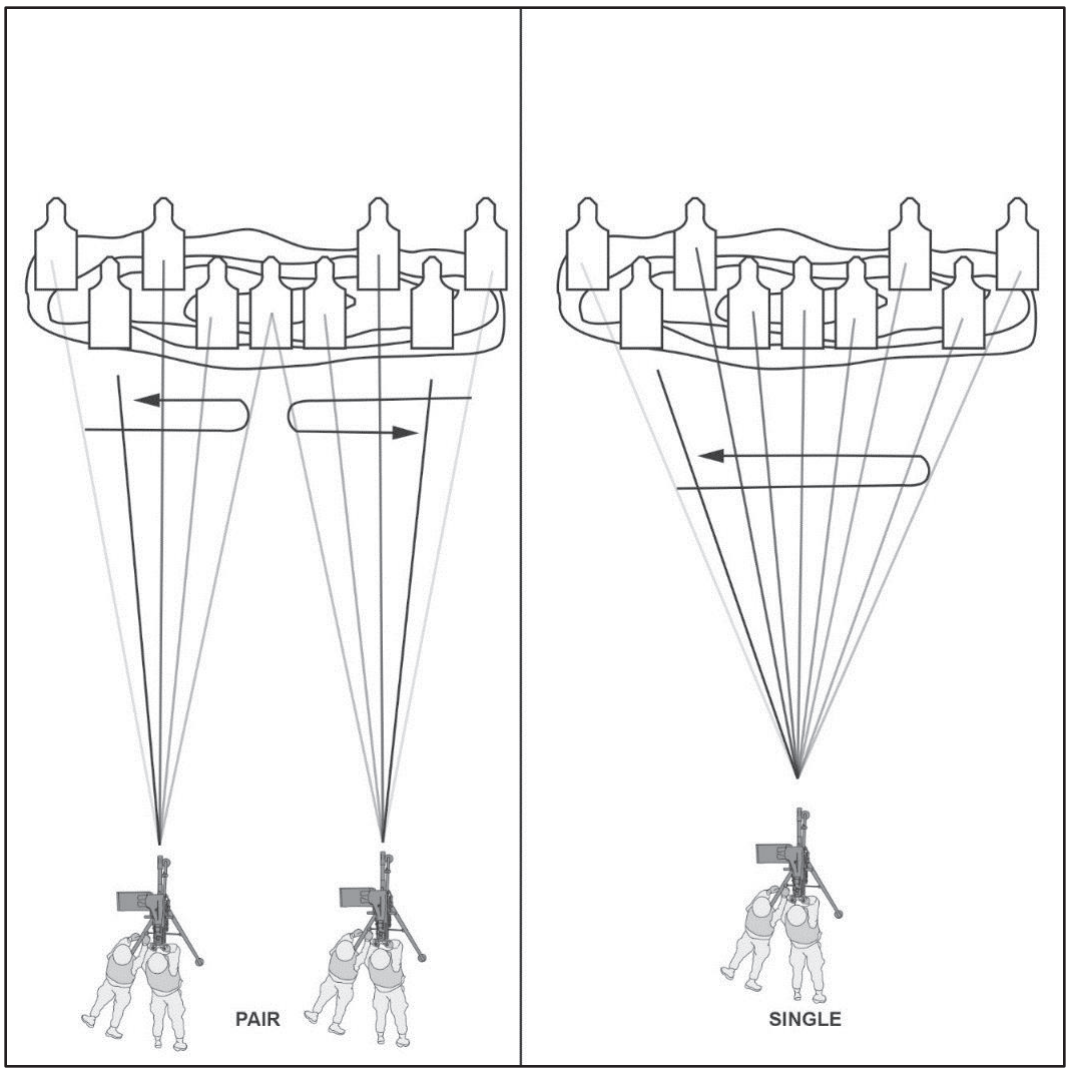


Figure B-11. Engagement of area targets (objective)

Note. After the target is engaged in whatever formation it is in, the configuration of that target will change. The gunner must be trained to compensate for this change and still place effective fire on the target.

OVERHEAD FIRE

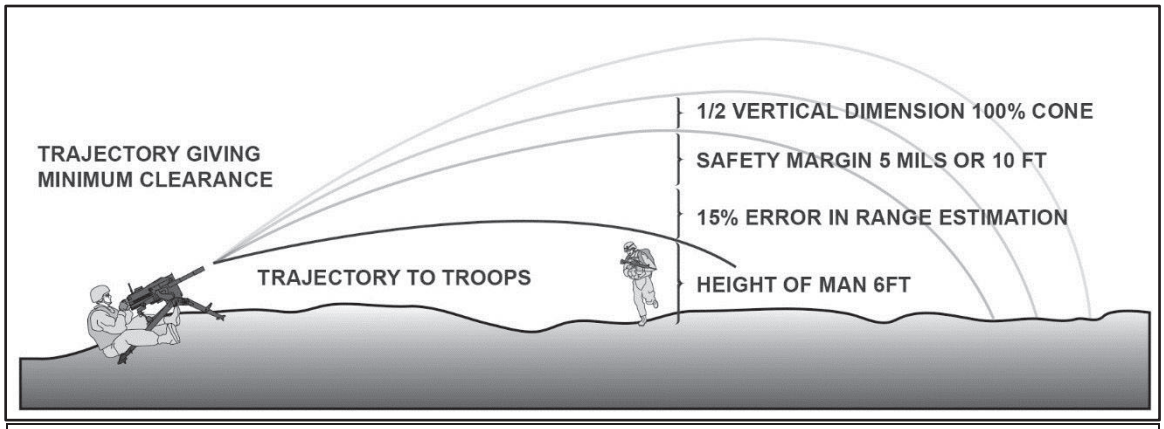
B-30. Overhead fire is fire delivered over the heads of friendly troops. A machine gun on a tripod is capable of delivering this type of fire because of the small and uniform dispersion of the cone of fire. In the attack, the use of overhead fire permits the machine gun to support the advance of rifle units. Sectors of fire allow the trainers to plan safe training while still incorporating the combat realities of overhead fires.

MINIMUM CLEARANCE

B-31. The center of the cone of fire must clear the heads of the friendly troops by a prescribed distance. (See figure B-12.) This distance, known as minimum clearance, is found by adding together the following elements:

- The height of a standing man, taken as six feet or 1.8 meters.
- Half the vertical dimension of the 100-percent cone of fire at the range to the troops.

- A margin of safety equal to the vertical distance, which extends a 5 mil angle at the gun or 3 meters, whichever is greater.
- An additional allowance to compensate for a 15 percent error in range determination.



Legend:
ft= feet
mils = milliradians
% = percent

Figure B-12. Components of minimum clearance

B-32. To obtain this minimum clearance, the gun is elevated so that the center of the cone of fire is raised from the feet of the friendly troops to maintain clearance above their head. This elevation change is known as the safety angle.

B-33. When the gun is fired from the tripod with the required safety angle, the center of impact determines the shortest range at which fire can be delivered over the heads of friendly troops. The range from the gun to the point of strike is called the corresponding range.

B-34. When the ground is level or uniformly sloping between the gun and the target, the corresponding range for the safety angle used is obtained by converting the angle of elevation expressed in mils into range.

CONDITIONS

B-35. Overhead fire is used only when the following conditions have been met:

- When the safety limit has been determined and identified on the ground.
- When the gun mount is firmly seated.
- If possible, when friendly troops have been notified that a MK 19 is about to fire over them.
- When the rate of fire is less than 40 rounds per minute.
- When the gun barrel is in good condition. Those that are not produce excessive muzzle blast.

UNEVEN TERRAIN

B-36. Level or uniformly sloping ground is seldom found in the field, which limits the use of firing tables and corresponding ranges in determining the limit of troop safety. In lieu of firing tables, a rule of thumb has been devised to give the gunner a simple method of checking for troop safety.

B-37. The gunner's rule can be applied when the friendly troops are at least 350 meters in front of the gun position, and the range to the target is 850 meters or less. (See figure B-13 on page B-16.)

- Lay the gun on the target with the correct sight setting to hit the target.
- Without disturbing the lay of the gun, set the rear sight at a range of 1500 meters.
- Look through the sights and notice where the new line of aim strikes the ground. This is the limit of troop safety. When the feet of the friendly troops reach this point, fire must be lifted or shifted.

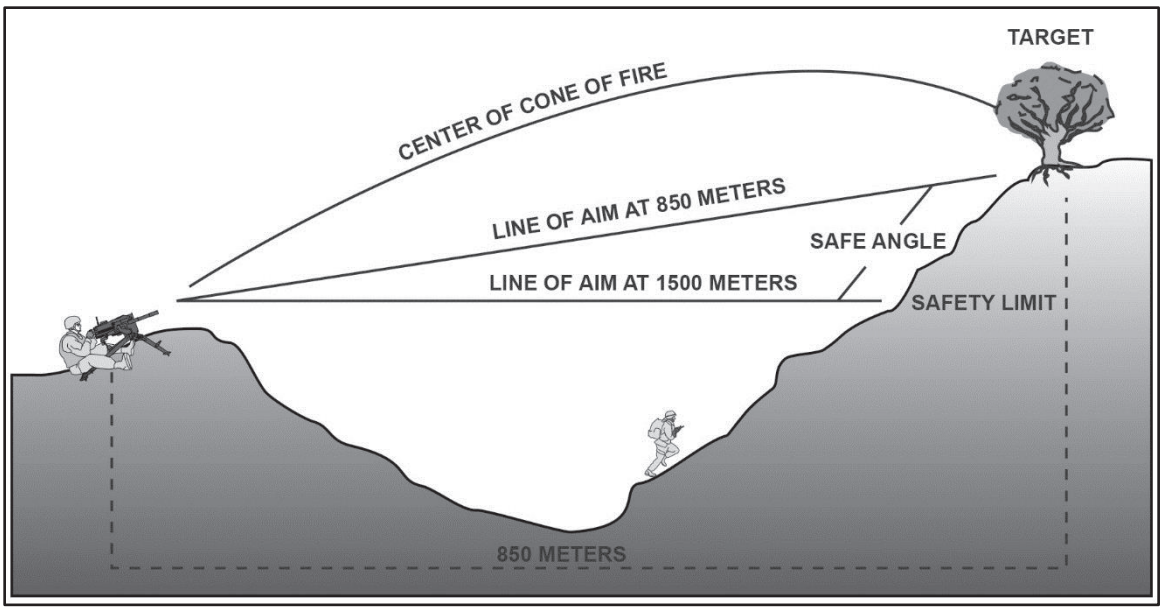


Figure B-13. Application of gunner's rule

RANGE EXCEEDS 850 METERS

B-38. When the range to the target is greater than 850 meters, overhead fire should be delivered only in an emergency and then only out to a range in which the strike of the bullets can be seen by the gunner. In this situation, the leader's rule applies. (See figure B-14.) The platoon or section leader uses the leader's rule only when the target is greater than 850 meters. The rule is as follows:

- Select a point on the ground where it is believed friendly troops can advance with safety.
- Determine the range to this point by the most accurate means available.
- Lay the gun on the target with the correct sight setting to hit the target.
- Without disturbing the lay of the gun, set the rear sight to 1500 meters, or the range to the target plus 500 meters, whichever is greater. Under no conditions should the sight setting be less than 1500 meters.
- Note the point where the new line of aim strikes the ground.
  - If it strikes at the selected point, that point marks the limit of safety.
  - If it strikes short of the selected point, it is safe for troops to advance to the point where the line of aim strikes the ground and to an unknown point beyond. If it is desired to fire after friendly troops advance farther than the point where the line of aim strikes the ground, this farther point is determined by testing new selected points until the line of aim and the selected point coincide.
  - If it clears the selected point, it is safe for the troops to advance to the selected point and to an unknown point beyond. If it is desired to have troops advance beyond the selected point, this farther point must be determined by testing new selected points until the line of aim and the selected point coincide. This point marks the line of safety.

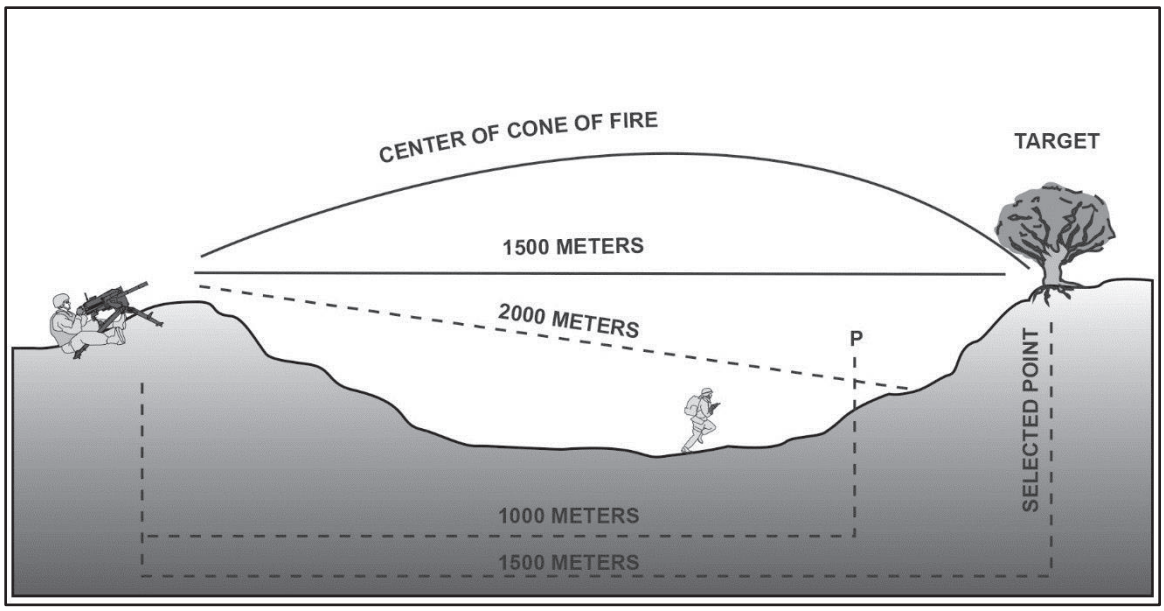


Figure B-14. Application of leader's rule

PRECAUTIONS

B-39. The following safety precautions must be observed in delivering overhead fire:

- Firmly emplace the tripod mount.
- Use depression stops to prevent the muzzle of the gun from accidentally being lowered below the safety limit.
- Do not deliver overhead fire through trees.
- Inform commanders of friendly troops when fire is to be delivered over their heads.
- Ensure that all members of the gun crew(s) are aware of the safety limit.
- Do not deliver overhead fire if the range from the gun to the target is less than 350 meters or more than 850 meters.
- Do not use a barrel that has excessive muzzle blast or is otherwise determined to be badly worn.
- Do not lay machine guns so their fire will cross at any point over the heads of friendly troops.

DEFILADE POSITIONS

B-40. To achieve maximum effectiveness, the machine gun must be employed using the technique of direct lay; however, at times it may be desirable to employ guns from defilade positions.

FULL DEFILADE

B-41. A machine gun is in full defilade when the gun and its crew are hidden from enemy ground observation by a land mass such as the crest of a hill. The position may be on the reverse side of the crest or the forward slope of the next higher ground. (See figure B-15 on page B-18.) The gun must fire up and over the hill. Fire must be observed and adjusted by a crewmember who can observe the target from a position on a flank or to the rear of the gun (on higher ground). A full defilade position allows little opportunity to engage new targets.

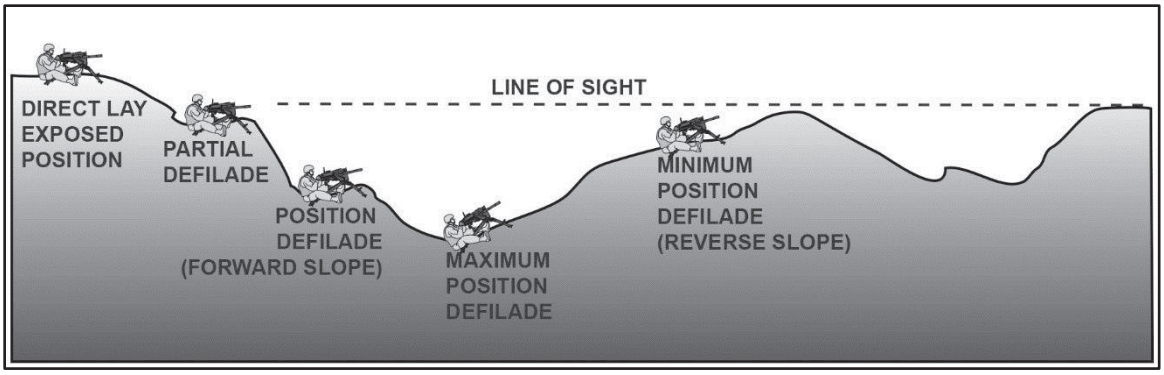


Figure B-15. Minimum and maximum position defilade, partial defilade, and direct lay areas

PARTIAL DEFILADE

B-42. A machine gun is in partial defilade when a mask (usually the crest of a hill) provides the gun and gunner with some protection from enemy direct fire, but the gunner is able to engage the target using direct laying techniques. The gun is far enough up the slope so that the gunner can see the target through the sights but the lower portion of their body and lower portion of the gun are protected by the mask. Partial defilade positions are desirable when a fire mission cannot be accomplished from a full defilade position.

Advantages

B-43. The gun and crew have cover and concealment from direct fire weapons, which partially conceals the MK 19's signatures (smoke and flash). It also gives the crew some freedom of movement near the gun position, and facilitates control and supply.

Disadvantages

B-44. Rapidly moving ground targets are not easily engaged because adjustment of fire must be made through an observer. Targets close to the mask usually cannot be engaged, and it is difficult to secure grazing fire for a final protective line.

POSITION SELECTION

B-45. The fire unit leader selects the location of the gun position. To select a position in partial defilade, the leader moves up the reverse side of the slope until they have the target in view above the mask when sighting at the height of the gunner's eye. To select a position in maximum defilade, the leader estimates the lowest point below the mask at which the gun can still engage the target without danger of hitting the mask.

METHODS OF LAYING THE GUN FOR DEFILADE FIRE

B-46. The essential elements in engagement of a target from a defilade position are direction, elevation, mask clearance, and adjustment of fire.

Direction

B-47. An observer places themselves on the gun-target line in a position from which they can see the gun and the target. The observer aligns the gun approximately by having the gunner shift the mount. The gunner then loosens the traversing slide lock lever and, as directed by the observer, moves the gun right or left until it is aligned on the target; the gunner then clamps it in that position.

B-48. A prominent landmark, visible to the gunner through their sights, is selected as an aiming point. An aiming point on the gun-target line and at an equal or greater range than the target is desirable. However, an aiming point on the mask may be used. If the aiming point is on the gun-target line, the gun is laid on the aiming point and is thereby aligned for direction. If the aiming point is not on the gun-target line, the deflection is measured by binoculars or compass. This measured deflection is laid off with the gun.

Elevation

B-49. An aiming point visible from the gun position is selected (preferably a point at a greater range and at a higher elevation than the target) and the range to the target is determined. The leader, using binoculars, measures the vertical angle in mils from the aiming point to the base of the target. The leader then lays the gun on the aiming point with the sight set to hit the target. The leader directs the gunner to manipulate the gun through the number of mils measured. For example, in figure B-16, the range to the target is 1300 meters.

B-50. The angle read with the binoculars from the aiming point down to the base of the target is 12 mils. The sight is set at 1300 meters, the gun laid on the aiming point, and the muzzle depressed 12 mils. If the aiming point is off the gun-target line, deflection in mils may be taken with the rear sight windage screw knob if it is not more than five mils; otherwise, the deflection must be taken up on the traversing handwheel.

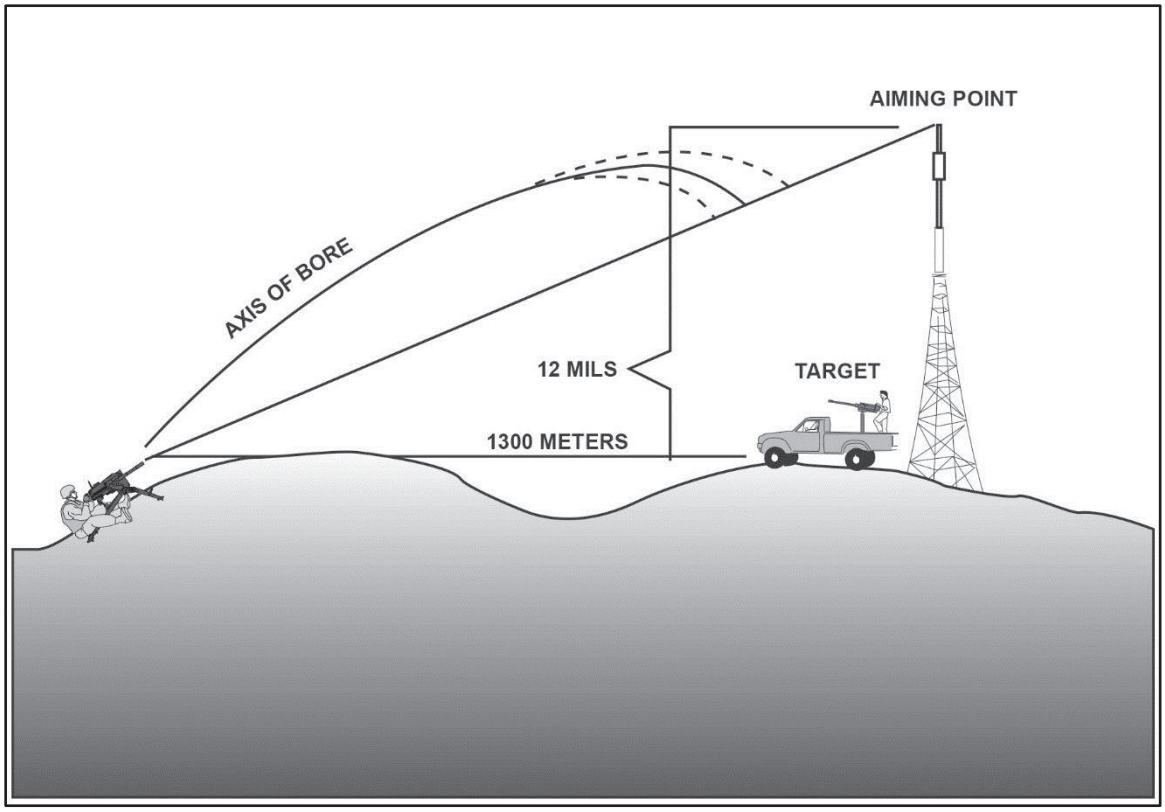


Figure B-16. Aiming point method

Mask Clearance

B-51. After the gun has been laid, determine if the entire cone of fire will clear the mask.

- Visual method. When the range to the mask is not more than 450 meters, mask clearance exists when the axis of the bore is elevated seven mils or more above the gun-mask line. Mask clearance can be checked after the gun has been laid on the target by depressing the muzzle of the gun two mils and sighting along the bottom of the receiver and the barrel support. If this line of sight clears the mask, the clearance exists. Elevate two mils before firing.
- Firing table method. Determine the range to the mask and obtain the corresponding angle of elevation for mask clearance from the firing tables. The range corresponding to the angle of elevation is set on the gun sight. If the line of aim through the sight clears the mask, the clearance exists.

- Adjustment of fire. Under field conditions, even the most practical methods of laying the gun on the target quickly do not always result in the initial burst being on the target. For this reason, adjustment of fire on the target is essential. Creeping fire should be avoided.

FINAL PROTECTIVE FIRE (FPF)

B-52. Final protective fire (FPF) is an immediately available, prearranged barrier of fire to stop enemy movement across defensive lines or areas.

FINAL PROTECTIVE LINE (FPL)

B-53. Final protective line (FPL) are placed on a predetermined line along which grazing fire is placed to stop an enemy assault. This fire is fixed in direction and elevation; however, a few mils of search are employed during firing to compensate for irregularities in the terrain. Final protective fires are always laid in using the extreme left or right of the tripod, causing the T&E mechanism to move to the extreme left or right on the traversing bar. The FPL can be delivered in any visibility conditions. When terrain permits, FPL are assigned to machine guns along the forward line of troops as a part of the FPL of the defending unit. The signal used to call for FPL is normally prescribed in the company operation order. The authority to call for these fires may be delegated to the platoon leader of a forward rifle platoon. Final protective fires are ceased on order.

- Signals. Arm-and-hand signals, voice commands, or pyrotechnic devices may be used in calling for FPFs.
- Rates of fire. When firing FPFs, the rapid rate of fire is used unless it is obvious that a different rate is necessary to accomplish the mission. When engaging other preselected target areas, the rapid rate of fire is used until commanded to cease fire.

APPLICATION OF FIRE

B-54. To be effective, machine gun fire must be distributed over the entire target area. Improper distribution of fire results in gaps that allow the enemy to escape or use weapons against friendly positions without effective opposition.

B-55. The method of applying fire to a target is generally the same for either a single gun or a pair of guns. Direct laying is pointing the gun for direction and elevation so that the sights are aligned directly on the target. Fire is delivered in width, depth, or in a combination of the two. To distribute fire properly, the gunners must know where to aim, how to adjust their fire, and the direction to manipulate the gun. The gunner must aim, fire, and adjust on a certain point of the target. Binoculars may be used by the leader to facilitate fire adjustment.

B-56. The gunner ensures throughout firing that the center of the beaten zone is maintained at the center base of the target for maximum effect from each burst of fire. When this is done, projectiles in the upper half of the cone of fire will pass through the target if it has height, and the projectiles in the lower half of the beaten zone may ricochet into the target. (See figure B-17.)

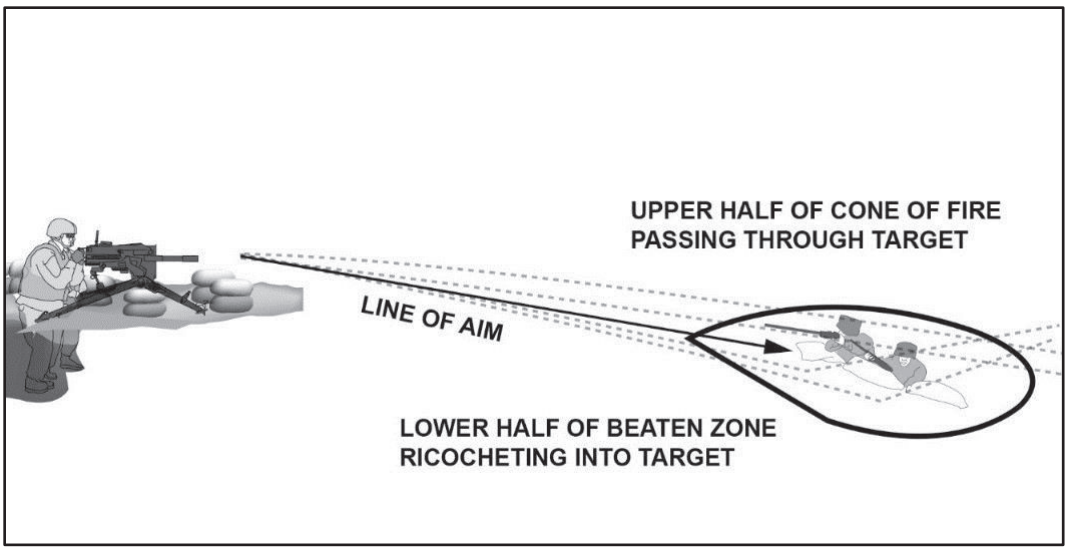


Figure B-17. Line of aim and placement of center of beaten zone on target

B-57. The gunner must move their beaten zone in a certain direction over the target. The direction depends on the type of target and whether the target is engaged with a pair of guns or a single gun. When engaging targets other than point targets with a pair of guns, the targets are divided so that fire is evenly distributed throughout the target area. Fire delivered on point targets or a specific area of other target configurations is called concentrated fire.

Adjustment of Fire

B-58. Machine gun fire is adjusted by observing the strike of the rounds, frequently re-laying the gun, or by a combination of these. Adjustment by observation of fire is the most important element of fire control if it is bold, aggressive, rapid, and continuous throughout the action.

B-59. The gunner is trained to observe and adjust their gun's fire without command. The gunner is trained to anticipate the action of the enemy after the initial burst, and is prepared to shift his fire to cover any change in formation or movement of their target. If the gunner fails to accomplish this, the fire unit leader must promptly correct them by announcing or signaling subsequent fire commands. This responsibility to adjust fire continues through the chains of command.

B-60. The gunner may use the adjusted aiming point method to adjust the fire. In this method the gunner must use their sights. The gunner selects an aiming point that will place the next burst on the target. For example, should the gunner fire on a target at 500 meters and estimate that the strike is 20 meters short and 10 meters to the right of the target, the gunner would rapidly select an aiming point approximately 20 meters beyond the target and 10 meters to the left of the target, lay on that aiming point, and fire.

B-61. When subsequent fire commands are given, the gunner makes the required corrections and continues to engage the target without any further command to fire. If the gun is fired on the tripod mount, subsequent commands are given to make changes in direction, elevation, and the rate of fire. These changes are given orally as SHIFT RIGHT, SHIFT LEFT, ADD, or DROP. (Refer to TC 3-21.60 for arm-and-hand signals.) When making these announced changes, mils may be used to indicate the amount of desired shift; for example, SHIFT RIGHT 5 or SHIFT LEFT 7. When making changes in elevation, mils are not used, as it is normally difficult to determine just how high or low the center of the beaten zone is striking the ground in relation to the target.

B-62. Using the mil relation, traverse the handwheel or elevation handwheel to move the strike of the bullet.

B-63. When firing on field targets, adjust by moving the burst into the target. One click (1 mil) on the traversing handwheel will move the strike one meter at a range of 1,000 meters or 1/2 meter at a range of 500 meters. However, the distance one click (mil) in the elevating handwheel will move the strike depends

on the range to the target and the slope of the ground. The gunner determines the number of mils necessary to move the center of the strike into the target, and he manipulates the gun the required number of mils. This does not require the use of sights. For example, should the gunner fire on a target at 500 meters and observe the strike 10 meters to the right of the target and short about 50 meters, the gunner would traverse the gun to the left 20 clicks (mils) and add one or more clicks (mils), depending on the slope of the ground.

Antiaircraft Gunnery

B-64. The machine gun can provide units with a self-defense capability against hostile low-flying, low-performance aircraft. These guns are employed in the air defense role as part of the unit's local defense. The machine guns are not components of an integrated and coordinated air defense system. Unless otherwise directed, hostile aircraft within range of the gun (about 800 meters maximum effective range) should be engaged. The decision will be made by the commander. Typical targets are surveillance, reconnaissance, and liaison aircraft; troop carriers; helicopters; and drones.

Engagement and Employment

B-65. The mission is to impose maximum attrition upon the attacking enemy such as low-flying, low-performance aircraft. Employment of machine guns used for air defense is guided by the following defense design factors:

B-66. Defense design should produce an equally balanced defense that is effective in all directions, unless a forced route of approach exists.

- Machine guns should be sited so that the maximum number of targets can be engaged, continuous fire can be delivered, and the most likely routes of approach are covered.
- Machine guns used to defend march columns should be interspersed in the convoy, with emphasis on the lead and rear elements (see figure B-18).

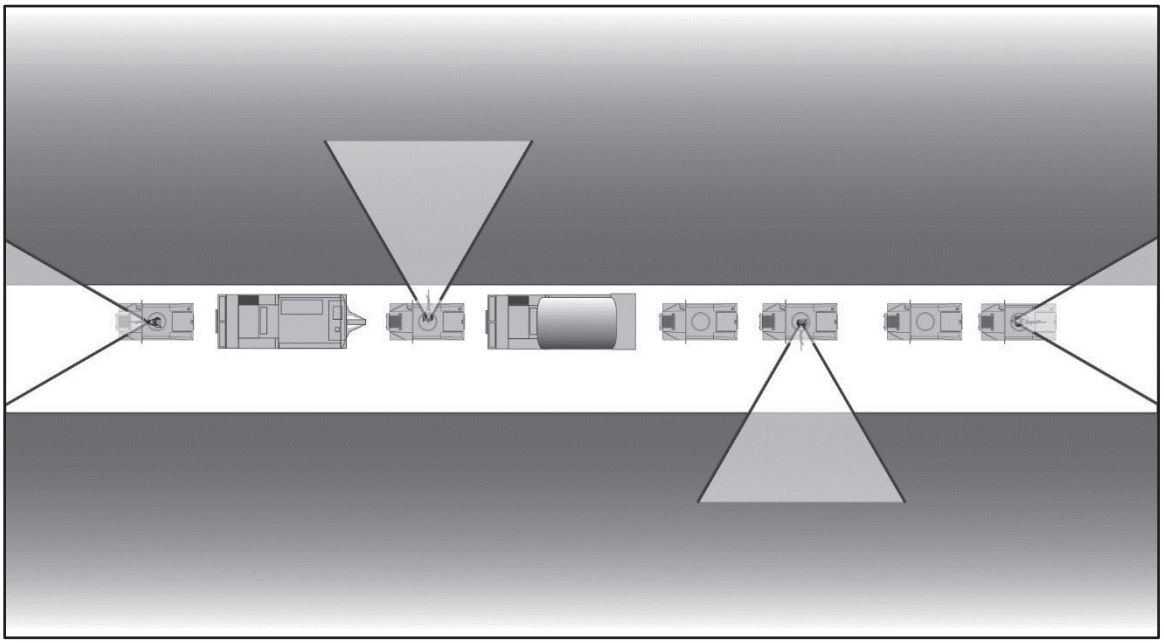


Figure B-18. March column with four machine guns

Target Selection and Engagement Control

B-67. These actions depend upon visual means. The sites selected for the guns must provide maximum observation and unobstructed sectors of fire. Units furnished machine guns in sufficient numbers should site them within mutual support distances of 90 to 360 meters. Each gun is assigned a primary and secondary sector of fire. Weapon crews maintain constant vigilance in their primary sectors of fire, regardless of the sector in which the guns are actually engaged.

AMMUNITION PLANNING

B-68. Leaders must carefully plan the rates of fire to be employed by machine guns as they relate to the mission and amount of ammunition available. The weapons squad leader must understand fully the mission the amount of available ammunition and application of machine gun fire needed to support fully all vital events of the mission. Planning ensures the guns do not run out of ammunition.

B-69. A mounted platoon or squad might have access to enough machine gun ammunition to support the guns throughout its operation. A dismounted platoon or squad with limited resupply capabilities has to plan for only the basic load to be available. In either case, leaders must take into account vital events the guns must support during the mission. They must plan the rate of machine gun fire needed to support the vital events, and amount of ammunition needed for scheduled rates of fire.

B-70. The leader must make an estimate of the total amount of ammunition needed to support all the machine guns. The leader then must adjust the amount of ammunition used for each event to ensure enough ammunition is available for all phases of the operation.

LIMITED VISIBILITY CONDITIONS

B-71. The machine gun is provided with a stable tripod mount, M3, and a traversing and elevating mechanism. By manipulating the T&E mechanism, gun crews can record target data during good visibility and engage the same targets in poor visibility. This section provides guidance on machine gun firing techniques and terms used during limited visibility, which includes darkness, smoke, fog, rain, or snow.

DIFFICULTIES

B-72. Crewmembers encounter difficulties while defending during limited visibility, which preclude the use of many of the daylight techniques of engaging targets. To overcome these difficulties, special techniques must be developed for engaging targets and delivering preplanned fires by the use of range cards.

- During limited visibility, the machine gunner's sector of responsibility cannot be observed in depth; therefore, targets are difficult or impossible to detect.
- Visibility may be so limited that the leader cannot control the fires of their guns by selecting and directing fire on targets as they would during good visibility. Oral commands are not dependable, arm-and-hand signals may not be seen, and personal contact with the gunner is difficult.
- At night, machine gunners have a tendency to fire indiscriminately at noises and suspected enemy locations.

TERMINOLOGY

B-73. The following terms must be familiar to machine gun crews for them to complete their missions in poor visibility:

- Sector of fire. A sector of fire is an area (to be covered by fire) assigned to an individual or unit. Machine guns are normally assigned two sectors of fire, a primary and a secondary sector.
- Final protective line. A final protective line (FPL) is a predetermined line along which grazing fire is placed to stop an enemy assault. The FPL is fixed as to direction and elevation; however, a few mils of search are employed during firing to compensate for irregularities in the terrain. The FPL can be delivered regardless of visibility conditions. The FPL is always the inner limit of the primary sector, which is assigned close to the forward line of troops. When terrain permits, FPLs are assigned to machine guns along the forward line of troops as a part of the final protective fires of the defending unit.
- Principal direction of fire. A principal direction of fire is a priority direction of fire that marks a specific area assigned to a weapon. This area may extend from the gun position to the maximum effective range of the weapon and therefore is not fixed for elevation. Visible targets appearing in the principal direction of fire take priority over targets that may appear elsewhere in the sector. A principal direction of fire may be assigned to cover an area that provides good fields of fire, is a likely avenue of foot approach, or mutually supports an adjacent unit.

- Sector of graze. A sector of graze is a wedge-shaped area formed by assigned sector limits that afford grazing fire (one meter high, maximum) from the muzzle of the weapon to the first major break in the terrain. The sector of graze is fired using swinging traverse in the primary sector of fire. It can be fired in the secondary sector in conjunction with field expedients by freeing the T&E mechanism and using the mount as a pivot. A sector of graze can be delivered regardless of the condition of visibility.
- Area of graze. An area of graze is an area, other than the sector of graze, within a sector of fire that is covered by grazing fire. Grazing fire need not be continuous from the muzzle of the weapon to the area over which grazing fire is desired.

TARGET ENGAGEMENT

B-74. A gunner's ability to detect and identify targets during limited visibility will vary, depending upon the amount of natural and artificial light and the types and numbers of sensors used. Gunners must be trained to fire low initially and adjust up when engaging targets during limited visibility, which helps them overcome the tendency to fire high during these conditions. Enemy automatic weapons and assaulting enemy personnel are of particular concern to machine gunners during limited visibility particularly at night.

B-75. Point targets, such as automatic weapons, may be identified during limited visibility by their muzzle flashes. To effectively engage these targets, fire should be delivered in a heavy volume and adjusted by observing the strike of the round.

B-76. During the final stage of an enemy assault, machine guns normally fire at personnel on a final protective line; they may be assigned a principal direction of fire. Both are considered as final protective fires and should be planned for and coordinated as such. If individual enemy Soldiers are observed near the gun position, they must be neutralized by someone other than the machine gunner (by the other crewmembers or by security forces of the supported unit). The FPFs are fired according to the order or SOP, and the machine gunner is not allowed to stop firing them except according to those orders or SOP.

FIRE CONTROL

B-77. During limited visibility, the leader cannot direct the fires of their guns as effectively as with good visibility. Consequently, initiative is required of the gunners. When targets within their sectors become visible to gunners, they must engage such targets without command and continue to fire until the targets have been neutralized. Gun crews engage targets only when they can identify them, unless otherwise ordered. For example, if one gunner detects a target and engages it, the other gunners observe the area in which fire is being placed. They will add their fire only if they can identify the target or are ordered to place fire in the area.

PREPLANNED FIRES

B-78. In addition to engaging appropriate visible targets, the gunner must be able to deliver preplanned fires during limited visibility. These fires are used to cover target areas of tactical significance (such as routes, avenues of approach, anticipated enemy supporting weapons positions, and probable enemy assault positions) and to establish sectors of graze and final protective lines. For maximum effect in all preplanned target areas, grazing fire should be obtained when possible.

B-79. The machine gunner sets the rear sights at 700 meters; selects a point on the ground, which the gunner determines to be at a range of about 700 meters; and lays, fires, and adjusts on this point. If the gunner cannot obtain 700 meters of grazing fire because of a major break in the ground at a range of less than 700 meters, the gunner places the range to the break on his sight and lays, fires, and adjusts at that point.

- Determining the extent of grazing fire on the final protective line. The extent of grazing fire on the final protective line is determined using the techniques described above. Any intermediate breaks in the terrain along this line that cannot be covered by grazing fire from a gun firing along the line is considered dead space.
- Determining the extent of grazing fire in the sector of graze. The ranges to the extent of grazing fire in a sector of graze are determined by observing the terrain. Normally, the extent of grazing fire within this area will be much less than on an FPL and will form an irregular pattern.

- Determining the amount of grazing fire in an area of graze. The ranges to areas of grazing fire are determined by observing the flight of the ammunition from behind or from the flank of the gun position. The gunner determines the lateral extent of areas of graze by selecting and engaging successive aiming points in the area believed to afford grazing fire, using the same range setting as when determining the range to the extent of grazing fire.

CBRN CONSIDERATIONS

B-80. During this phase of training, the gunner is introduced to firing the machine gun while in MOPP level 4, keeping in mind that engagement of some targets in MOPP is a qualification requirement. Firing weapons is only part of the overall nuclear, biological, chemical training. Soldiers must first be familiar with their equipment, its use, and proper wear before they progress to learning the techniques of MOPP firing. Although there is no different technique required to fire the machine gun, there are certain engagement techniques that may be slightly impaired.

IMMEDIATE ACTION

B-81. Under normal conditions, a gunner should be able to clear a stoppage in two to four seconds; however, under full MOPP, this may take a few seconds longer. Dry-fire practice under these conditions reduces time and streamlines actions. When practicing with the hood, mask and gloves, care must be taken not to snag or damage the gloves or dislodge the hood/mask during movement. Trainers should apply immediate action to a variety of stoppages during dry fire until the gunners are able to instinctively do it without compromising their NBC environment.

TARGET DETECTION

B-82. Techniques and principles of target detection and target acquisition still remain valid during NBC conditions, but considerations must be made for limiting factors imposed by MOPP equipment. For example, vision is limited to what can be seen through the mask's lens or faceplate. Peripheral vision is severely restricted. The lens/faceplate may be scratched or partly fogged, further restricting vision. Gunners requiring corrective lenses must be issued insert lenses before training. Scanning movements may be restricted by the hood and mask. Any of these factors could adversely affect the gunner's ability to quickly and accurately detect targets. Extra skill practice should be conducted.

EFFICIENT PERFORMANCE

B-83. The trainer must keep in mind that although movements are slowed, tasks take longer, and function checks, loading, unloading, and cleaning are affected by MOPP. The gunner must avoid damaging MOPP gear and risk possible exposure to lethal agents. Because of the great difference between no MOPP and MOPP4, gunners must be trained in all aspects of operation and maintenance of the weapon while practicing at the highest MOPP level. Only through repeated training and practice can the Soldier be expected to perform all tasks efficiently.

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Appendix C
Drills

Appendix C describes the various drills for the MK 19, and their purpose. The drill structure is designed to reinforce the most common actions in a logical sequence that all Soldiers need to routinely execute with their assigned equipment during training and combat.

These drills are used during Table III of the integrated weapons training strategy, as well as during routine maintenance, concurrent training, and during deployments. The drills found within this appendix are used to build and maintain skills needed to achieve proficiency and mastery of the weapon, and are to be ingrained into daily use with the weapon. These drills are conducted in all types of environments to include day, night, CBRN, and any other conditions that may be considered unusual.

BUILDING CONFIDENCE

C-1. Each drill is designed to develop confidence in the equipment and Soldier actions during training and combat operations. As they are reinforced through repetition, they become second nature to the Soldier, providing smooth, consistent employment during normal and unusual conditions.

C-2. The drills provided are designed to build the Soldier's proficiency with the following principles:

- Mindset. Ensures Soldiers can perform tasks quickly and effectively under stress.
- Efficiency. Ensure the drills require the least amount of movement or steps to complete correctly. Make every step count.
- Individual tactics. Ensure the drills are directly linked to employment in combat.
- Flexibility. Provide drills that are not rigid in execution. Units may alter the procedural steps depending on their equipment, configuration, or tactical need.

MINDSET

C-3. Continuous combat is inherently stressful. It exhausts Soldiers and causes physiological changes that reduce their ability to perform tasks as quickly or effectively as necessary. The Soldier's ability to function under stress is the key to winning battles, since, without the Soldier, weapons and tactics are useless. Individual and unit military effectiveness depend on the Soldier's ability to think clearly, accurately, quickly, all with initiative, motivation, physical strength, and endurance.

C-4. The impact of physiological changes caused by the stress of combat escalates or de-escalates based on the degree of stimulation, causing Soldiers to attain different levels of awareness as events occur in the continually transitioning operational area around them. Maintaining a tactical mindset involves understanding one's level of awareness and transitioning between the levels of awareness as the situation requires escalation or de-escalation.

Note. Stress can be countered using the principles associated with Soldier resilience and performance enhancement. The Comprehensive Soldier and Family Fitness (CSF2) is designed to increase a Soldier's ability and willingness to perform an assigned task or mission and enhance his performance by assessing and training mental resilience, physical resilience, and performance enhancement techniques and skills. This initiative introduces many resources used to train Soldiers on skills to counter stress. For more information about CSF2, see http://csf2.army.mil/.

EFFICIENCY

C-5. Efficiency is defined as the minimization of time or resources to produce a desired outcome. Efficient movements are naturally faster than movements that contain excessive or wasteful actions.

C-6. By reducing the amount of effort, mental, and/or physical, the movement becomes repeatable and the effect becomes predictable. This allows the Soldier to focus on the tactics while still maintaining the ability to produce accurate and precise fires.

INDIVIDUAL TACTICS

C-7. Individual tactics are actions independent of unit standard operating procedures (SOPs) or situations that maximize the Soldier's chance of survival and victory in a small arms, direct fire battle.

C-8. Examples of individual tactics include use of cover and standoff, or the manipulation of time and space between a Soldier and his enemy.

FLEXIBILITY

C-9. The techniques presented in this publication are not meant to be prescriptive, as multiple techniques can be used to achieve the same goal. In fact, there is no singular "one size fits all" solution to machine gun fire; different types of enemies and scenarios require the use of different techniques.

C-10. However, the techniques presented are efficient and proven techniques for conducting various machine gun-related tasks. Should other techniques be selected, they should meet the following criteria:

- Reliable under conditions of stress.
- Repeatable under conditions of stress.
- Efficiency in motion.
- Develop natural responses through repetition.
- Leverage overmatch capabilities.

Reliability Under Conditions of Stress

C-11. Techniques should be designed for reliability when it counts; during combat. The technique should produce the intended results without fail, under any conditions and while wearing mission-essential equipment. It should also be tested under as high stress conditions as allowed in training.

Repeatability Under Conditions of Stress

C-12. As combat is a stressor, a Soldier's body responds much as it does to any other stressful stimulus; physiological changes begin to occur, igniting a variable scale of controllable and uncontrollable responses based on the degree of stimulation. The technique should support or exploit the body's natural reaction to life-threatening stress.

Efficiency in Motion

C-13. The technique should be designed to create the greatest degree of efficiency of motion. It should contain only necessary movement. Excessive or unnecessary movement in a fighting technique costs time to execute. In a violent encounter, time can mean the difference between life and death.

C-14. Consider the speed at which violent encounters occur; an unarmed person can cover a distance of 20 feet in approximately one second. Efficiency decreases the time necessary to complete a task, which enhances the Soldier's safety.

Development of Natural Responses through Repetition

C-15. When practiced correctly and in sufficient volume, the technique should build reflexive reactions that a Soldier applies in response to a set of conditions. Only with correct practice will a Soldier create the muscle

memory necessary to serve him under conditions of dire stress. The goal is to create automaticity, the ability to perform an action without thinking through the steps associated with the action.

Leverage Overmatch Capabilities

C-16. Engagements can range from 0 to 1800 meters. Fast and efficient movements of the machine gun allow more time to stabilize the weapon, refine the aim, and control the shot required to deliver precise fires. This rapidly moves the unit toward the goal of fire superiority and gains/maintains the initiative. Speed should be developed throughout the training cycle and maintained during operations.

C-17. As distance between the Soldier and a threat decreases, so does the time to engage with well-placed, lethal fires. As distance increases, the Soldier gains time to refine his aim and manipulate the weapon.

CONDUCT DRILLS

C-18. To build the skills necessary to master the functional elements of the shot process, certain tasks are integrated into drills. These drills are designed specifically to capture the routine, critical tasks or actions Soldiers must perform fluently and as a second nature to achieve a high level of proficiency.

C-19. Drills focus on the Soldier's ability to apply specific weapons manipulation techniques to engage a threat correctly, overcome malfunctions of the weapon or system, and execute common tasks smoothly and confidently.

Note. The drill's described below outline the steps for the MK 19 and M205 tripod only. If the unit is conducting this drill with the M3 tripod the steps must be modified according to the respective TM.

WEAPON CHECK

C-20. The weapon check is a visual inspection of the weapon by the Soldier. The weapon check is initiated when first receiving the weapon from the arms room or storage facility. This includes when recovering the weapon when they are secured at a grounded location. Units may add tasks to this drill as necessary. Units may direct Soldiers to execute this drill at any time to support the unit's mission. Upon the command "Weapon Check" the Soldier will perform a weapon check to verify:

- Weapon is clear.
- Weapon serial number.
- Aiming device(s) serial number.
- Attachment points of all aiming devices, equipment, and accessories.
- Functions check.
- Proper location of all attachments on the adaptive rail system.
- Zero information.

EQUIPMENT CHECK

C-21. The equipment check drill is a precombat check (PCC) that ensures weapon and equipment are properly prepared; batteries, attachments secured correctly, weapon system's use not impeded by uniform or personal protective equipment, basic load stowage and accessibility. Upon the command "Equipment Check" the Soldier will verify:

- Batteries.
- Secured correctly.
- Equipment does not interfere with operation of the weapon.
- Basic load of ammunition is stowed properly.
- LSAT, LAW, or grease, molybdenum disulfate (GMD) weapon and extra is ready for use when needed.
- Basic issue items on hand (bore cleaning brush, bore obstruction detector, operators manual, small arms cleaning rod, and round removal tool).

- Tripod, T&E mechanism, MK 64, feed throat,
- Night sights and/or pointer/illuminator/laser are on hand and secure.
- Any additional items that are deemed mission essential may be added.

PLACE WEAPON INTO ACTION

C-22. The place weapon into action drill exercises the Soldier's ability to deploy the weapon into action on demand. This drill increases the team's ability to rapidly emplace the weapon's tripod, mount the weapon, and attach the T&E assembly. The assistant gunner will be responsible for establishing the tripod and assisting in mounting the receiver. The gunner will bring up the receiver and with the help of the ammunition bearer mount the receiver to the tripod. The drill ends after the gunner conducts the safety functions check for preparation for firing. For this drill, the M205 lightweight machine gun tripod is used. Upon the command "Place Weapon Into Action" the team will perform the following steps:

Step 1: Release front leg cam handle (see figure C-1) to unlocked position.



Figure C-1. Release front leg cam handle

Step 2: Place front leg (see figure C-2) in deployed position and lock front leg cam handle.



Figure C-2. Place front leg in the deployed position

Step 3: Position tripod in upright position and pull traverse and elevation (T&E) quick release pin (see figure C-3) on the elevation mounting bracket. Pull the traverse handle to the stowed position to release T&E assembly from right rear leg stowage lugs.



Figure C-3. Remove T&E from mounting bracket

Step 4: Spread rear legs into deployed position (see figure C-4).



Figure C-4. Spread rear tripod legs

Step 5: Pull traverse handle and rotate the handle 180°.

Step 6: Pull or depress traverse handle to slide the T&E assembly towards the center of the traverse bar and remove from left rear leg stowage lug.

Step 7: Locate the traverse bar index notch (see figure C-5), rotate T&E assembly to align the traverse bar index notch with dowel pin (see figure C-5), then engage index notch onto dowel pin as shown in figure C-5.

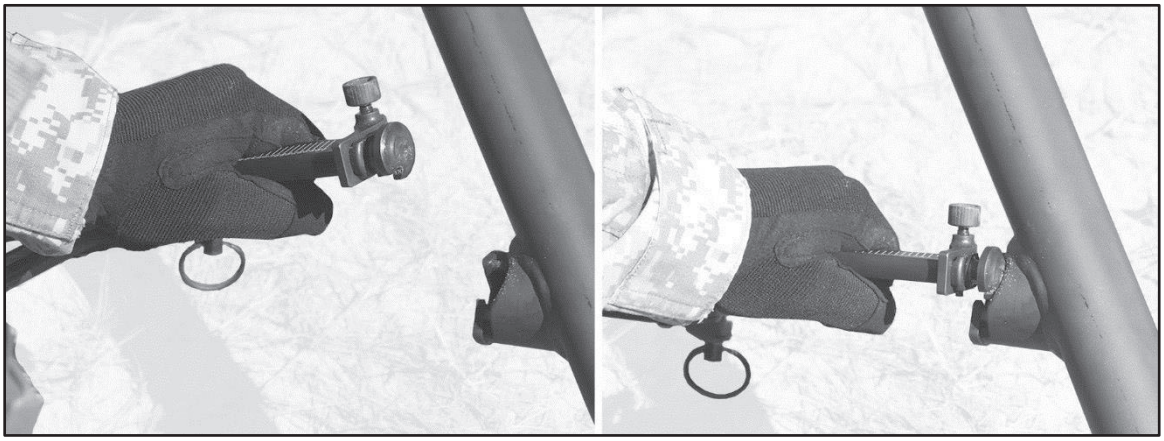


Figure C-5. Align the traverse bar index notch with dowel pin

Step 8: Press down on traverse bar (see figure C-5) while rotating elevation bar (see figure C-6) away from pintle socket until traverse bar drops into place.



Figure C-6. Lock traverse bar

Step 9: Depress right leg latch (see figure C-7 on page C-8), extend right lower leg and slide to desired position, release latch, and pull right lower leg until locked into position. Repeat process for left leg.



Figure C-7. Extend tripod legs

Step 10: Place the MK 64 gun cradle into the tripod. Unlock the tripod pintle lock release cam. Insert the gun cradle's pintle into the tripod pintle bushing.

Step 11: Lock the pintle lock release cam to secure the gun cradle. Check the gun cradle, by pulling up on it slightly, to ensure that it is seated and locked.

Step 12: Ensure that the T&E mechanism is zeroed.

Step 13**:** Remove the stow pin from the gun cradle and align holes in the upper elevating screw yoke of the T&E mechanism with the rear holes in the gun cradle.

Step 14**:** Lock the elevating sleeve mechanism onto the center of the traversing bar. Insert the quick-release pin from the right.

Step 15: Place the MK 19 into the gun cradle. The ammunition bearer will hold the barrel while the gunner holds the control grips. The gun is placed barrel first into the cradle.

Step 16: Align the grooves on the receiver with the lugs in the gun cradle, and slide the receiver forward.

Step 17: Align the sear mounting holes with the gun cradle mounting holes. Secure the rear of the receiver by inserting the retaining pin through the cradle and sear assembly and rotate it until it locks in place. If a safety clip is attached, use it to secure the retaining pin.

Step 18: Attach the feed throat to the MK 19 by squeezing together each set of grip pins. Attach the feed throat to the front left-hand side of the receiver assembly.

Step 19: Align the pins of the feed throat with the pinholes in the receiver. Relax pressure on the spring-loaded grip pins so they will snap into place.

Step 20: Complete functions check to ensure that all parts of the weapon are functioning as a unit.

LOAD

C-23. The load drill is predominantly an administrative load function on demand based safety considerations, and commands from a leader. This drill allows the Soldier to develop reliable loading techniques. During this drill the gunner will remain behind the weapon system and is responsible for the safe operation of the weapon system. The assistant gunner is responsible for positioning the ammunition.

C-24. Before loading, ensure that the feed throat is attached. Upon the command "Load" the Soldier will perform the following steps:

Step 1: Ensure weapon is on Safe and open the feed tray cover. Insert the first round into the feeder with the female link first. Push the round across the secondary feed pawl. To move the feed slide to the left, push the secondary drive lever to the right. Close the cover.

Step 2: Pull retracting charging handle rearward with the palms down while pressing the charging handle locks in. Rotate the handles down and pull them sharply to the rear. Return the charging handles forward to their original upright position, after locking the bolt to the rear.

Step 3: Place the safety switch on fire and press the trigger. The bolt will slam forward and grasp the first round in the bolt extractors.

Step 4: Place weapon on Safe. Repeat step 2. Weapon is now ready to fire with a round on the face of the bolt.

FIGHT DOWN

C-25. This drill builds the Soldier's understanding of how to move effectively and efficiently between firing postures and positions. This drill trains the actions taken to move the weapon system, and adjust the tripod into the lower firing configurations. This drill exposes the gunner to the different firing positions and allows him to remember the settings of the tripod that optimizes a stable firing positon.

C-26. The drill starts at seated, or if a fighting position is available, the standing position. Upon the command "Fight Down", the team executes the announced movement technique and the next lower position announced by the leader. The fight down drill exercises the following positions:

- Standing.
- Sitting.
- Prone.

C-27. Each position should be executed a minimum of three times. To execute this drill with the standing position, the gun needs to be emplaced into a fighting position. Leaders use weapon and T&E manipulation with the fight down drill.

FIGHT UP

C-28. The fight up drill builds the Soldier's understanding of how to move effectively and efficiently between firing postures and positions. This drill trains the actions taken to move the weapon system, and adjust the tripod into the higher firing configurations. This drill exposes the gunner to the different firing positions and allows them to remember the settings of the tripod that optimizes a stable firing positon.

C-29. The fight up drill starts at a prone fighting position and, upon the command "Fight Up", the team executes the announced movement technique and the next higher position announced by the leader. The drill exercises the following positions:

- Prone.
- Sitting.
- Standing.

C-30. Each position should be executed at least three times. In order to execute this drill with the standing position the gun will need to be emplaced into a fighting position. Leaders will use fight up, in conjunction with fight down.

C-31. Leaders may increase the tempo of the drill, increasing the speed the Soldier needs to assume the next directed position. After the minimum three iterations are completed between the fight down drill and the fight up drill, the leader may switch between fight down and fight up at any time, at varying tempos.

RELOAD

C-32. The reload drill is performed from all positions and includes a demonstration of skill under chemical protective conditions. This drill is executed when the Soldier is wearing complete load bearing equipment. It provides exercises to assure fast reliable reloading through repetition at all firing positions or postures.

C-33. To reinforce training as needed, leaders may include other drills while directing this drill. Reload is done the same as load drill. Upon the command "Reload" the Soldier should perform this drill from each of the following positions at least seven times each:

- Standing.
- Sitting.
- Prone.

CLEAR MALFUNCTION

C-34. The clear malfunction drill develops the skills necessary to clear common malfunctions on a grenade machine gun in a rapid manner, while maintaining muzzle and situational awareness. Soldiers should perform clearing a malfunction based on the commands from their leader.

C-35. This drill should be executed five times. Once complete, leaders should incorporate this drill with other drills to ensure the Soldier can execute the tasks at all positions fluently. Upon the command "Clear Malfunction" the Soldier will perform the following steps:

Step 1: Pull the bolt to the rear.

Step 2: Catch the live round as it ejects.

Step 3: Push the charging handles forward and up.

Step 4: Put the gun on Safe and check for any bore obstructions.

Step 5: If there are no obstructions, move the selector switch from safe to fire and attempt to fire.

Step 6: If weapon fails to fire, repeat steps 1 through 4.

Step 7: Open the feed tray cover and clear the ammunition.

Step 8: Check bore for obstructions. Check ammunition for abnormalities, deformities, or problems with the links.

UNLOAD AND SHOW CLEAR

C-36. Unloading is predominantly an administrative unloading function, and allows the Soldier to develop reliable clearing techniques. This drill should be executed in tandem with the load drill.

C-37. Unload the weapon from all fighting positions and while in a chemical protective condition. This drill can be executed without ammunition in the weapon. Leaders may opt to use dummy ammunition. In garrison environments, leaders should use this drill on demand to reinforce the Soldier's skills and attention to detail. Upon the command "Unload and Show Clear" the Soldier performs the following steps:

Step 1: Place the weapon in a safe direction and place the weapon on safe.

Step 2: Open the top cover assembly. If all the ammunition has not been fired, the bolt is to the rear and a round is on the bolt face. If the bolt is forward, lock it to the rear.

Step 3: Take the ammunition from the feed tray by reaching beneath the feed tray and pressing the primary and secondary positioning pawls. While pressing the position pawls, slide the linked rounds out of the MK 19 through the feed throat.

Step 4: Insert a section of the cleaning rod or bayonet through either side of the receiver rail. Place it on top of the live round or cartridge case, as close to the bolt face as possible, and push down. This action forces the round out of the MK 19.

Step 5: Lower and pull both charger handles to the rear. Inspect the chamber and bolt face to ensure that no live rounds are in the weapon. Place the safety switch on fire.

Step 6: Maintain rearward pressure on the charging handle, press the trigger and ease the bolt forward. Place the safety switch on Safe.

SUPPORTING TASKS

C-38. The weapon and T&E manipulation and range card tasks may be performed during drills or when placing the weapon into operation. They are primarily used in defensive operations.

WEAPON AND T&E MANIPULATION

C-39. This series of exercises train how to lay the gun in deflection and elevation, estimate and apply range, and apply the appropriate firing techniques. Soldiers progress through increasingly difficult scenarios utilizing the T&E and the free gun techniques. Soldiers also practice applying range to the rear leaf sight during these drills. Soldiers must demonstrate proficiency in these skills prior to live fire. Leaders should focus on the skills listed below:

- Range determination. Leaders should use the methods discussed in TC 3-20.31-4 and programs such as ROC-V to develop the gunner's skills in acquiring, Identifying, and determining the approximate range to the target. Exercises in this skill will enable the gunner to become proficient in the skills of identifying enemy at various ranges and conditions and applying the appropriate range on the rear leaf sight or AN/PAS-13 HWTS.
- Sight alignment and range setting. Leaders will select and announce point target aiming points and a range. The gunner will manipulate the T&E aligning the sights of the weapon onto the proper aim point and apply the announced range onto the rear leaf sight or AN/PAS-13 HWTS.
- Traverse. The leader will select and announce target aiming points on a horizontal plane and instruct the gunner to engage utilizing flanking fire. Traversing fire is distributed against a wide target requiring successive changes in the direction of the gun. When engaging a wide target requiring traversing fire, the gunner should select successive aiming points throughout the target area. These aiming points should be close enough together to ensure adequate target coverage; however, they need not be so close as to be wasteful of ammunition by concentrating a heavy volume of fire in a small area. Two clicks on the traverse lever or traversing handwheel after each burst ensure coverage. The Soldier must estimate and apply the appropriate range, align the sights, and properly distribute fire.
- Search. The leader will select and announce target aiming points on a vertical plane and instruct the gunner to engage utilizing frontal fire. Searching fire is delivered against a deep target or a target that has depth, requiring changes in elevation of the gun. The amount of elevation change depends upon the range and the slope of the ground. The Soldier must estimate and apply the appropriate range, align the sights, and properly distribute fire.
- Search and traverse. The leader will select and announce target aiming points on an oblique target and instruct the gunner to engage utilizing a combination of the skills previously learned. Traversing and searching fire is delivered both in width and depth by changes in direction and elevation. It is employed against a target whose long axis is oblique to the direction of the fire. The Soldier must estimate and apply the appropriate range, align the sights, and properly distribute fire.
- Pre-planned targets. The leader selects and records various targets/ locations according to the weapons elevation and traverse bar. Without disturbing the lay of the tripod set the T&E back to zero. Have the Soldier assume a good fighting position and then have him apply the appropriate target coordinates onto the T&E. Leaders then verify the readings are correct and continue the exercise. This exercise can also be performed by the Soldier selecting and recording preplanned targets and the leader then verifying.
- Multiple target scenarios and priority of threat. The leader uses visual aids such as mockups, pictures, or targets that represent the three threat levels for enemy targets. After the Soldier has demonstrated the ability to discern most dangerous, dangerous, and least dangerous the leader progresses into multiple target scenarios of targets with different threat levels and targets with the same threat level. The Soldier then announces the threat level of each target and their priority.

RANGE CARD

C-40. A range card is a sketch or diagram of the terrain that a weapon is assigned to cover by fire. It shows possible target areas and terrain features plotted in relation to a firing position. The information on a range card is used for planning and controlling fire, for rapidly detecting and engaging targets, and for orienting replacement personnel or units. DA Form 5517, *Standard Range Card*, should be used to record the information. Follow the procedures outlined in TC 3-21.75 for the automatic weapon range card.

C-41. The range card should be executed each time the weapon system has been established. The leader will verify the information on the range card, and then instruct the gunner and assistant gunner to place the weapon on a series of targets and aim points based upon the elevation and deflection information recorded on the range card.

C-42. Each machine gunner normally prepares range cards for his fighting position. He prepares one for each primary, alternate, and supplementary position designated in the defense and for any static position when enemy contact is possible; for example, a position in an assembly area.

C-43. Each range card contains, as a minimum, the following information:

- The symbol for the weapon covering the sector.
- The azimuth (degrees) and distances (meters) of the firing position from an easily recognizable terrain feature. (This serves as an easy reference to locate the firing position.) If there is no easily recognizable terrain feature, an eight digit grid coordinate may be used.
- The boundaries of the area assigned to be covered by observation and fire.
- Areas where targets are likely to appear (engagement areas) and the range, azimuth, and elevation to them from the firing position.
- Dead space (areas that cannot be observed or covered by fire).
- The direction of magnetic north when the range card is properly oriented.
- Identification data to include unit designation (no higher than company), time and date of preparation, and firing position (primary, alternate, or supplementary).

C-44. The following steps are taken to prepare a range card:

Step 1: Draw the symbol for the machine gun in the lower center of the range card.

Step 2: Show the sector of fire by drawing solid lines from the weapon symbol to the left and right limits. Sketch any easily recognizable terrain features that can be used to identify the sector. In the data section, indicate the magnetic azimuth and the range to the far limits of the sectors of fire.

Note. The left and right limits are labeled 1 and 2, respectively, in the sector sketch and a circle is drawn around each number. The left and right limits should be the first items drawn and labeled in the sector sketch and the data section of the range card. (The azimuth and range are not placed on the solid lines for left or right limit.

Step 3: Place target reference points at the location designated by the platoon leader or unit SOP, and at any other locations where a target is likely to appear. Number each TRP and likely target locations in the sketch section of the range card.

Step 4: Draw a maximum engagement line across the sector of fire for the machine gun. This line shows the maximum range at which a target can be effectively engaged.

Step 5: Show dead space or areas where targets cannot be engaged with direct fire by drawing diagonal lines across the areas and writing the words “DEAD SPACE.”

Step 6: Draw a magnetic north arrow on the range card to orient it with the terrain. Then add identification data—unit designation (no higher than company level), time and date of preparation, and type of position (primary, alternate, or supplementary).

Step 7: Enter the information for the weapon reference point in the remarks block on the range card.

Appendix D

Zeroing

Zeroing a weapon is not a training exercise, nor is it a combat skills event. Zeroing is a maintenance procedure that is accomplished to place the weapon in operation, based on the Soldier's skill, capabilities, tactical scenario, aiming device, and ammunition. Its purpose is to achieve the desired relationship between the line of sight and the trajectory of the round at a known distance. The zeroing process ensures the Soldier, weapon, aiming device, and ammunition are performing as expected at a specific range to target with the least amount of induced errors.

For Soldiers to achieve a high level of accuracy and precision, it is critical they zero their aiming device to their weapon correctly. The Soldier must first achieve a consistent grouping of a series of shots, then align the mean point of impact of that grouping to the appropriate point of aim. Soldiers use the process described in this appendix with their weapon and equipment's technical manuals to complete the zeroing task.

BATTLESIGHT ZERO

D-1. The term battlesight zero means the combination of sight settings and trajectory that greatly reduces or eliminates the need for precise range estimation, further eliminating sight adjustment, holdover or hold-under for the most likely engagements. The battlesight zero is the default sight setting for a weapon, ammunition, and aiming device combination.

D-2. An appropriate battlesight zero allows the firer to accurately engage targets out to a set distance without an adjusted aiming point. For aiming devices that are not designed to be adjusted in combat, or do not have a bullet drop compensator, the selection of the appropriate battlesight zero distance is critical.

ZEROING PROCESS

D-3. A specific process should be followed when zeroing. The process is designed to be time-efficient and will produce the most accurate zero possible.

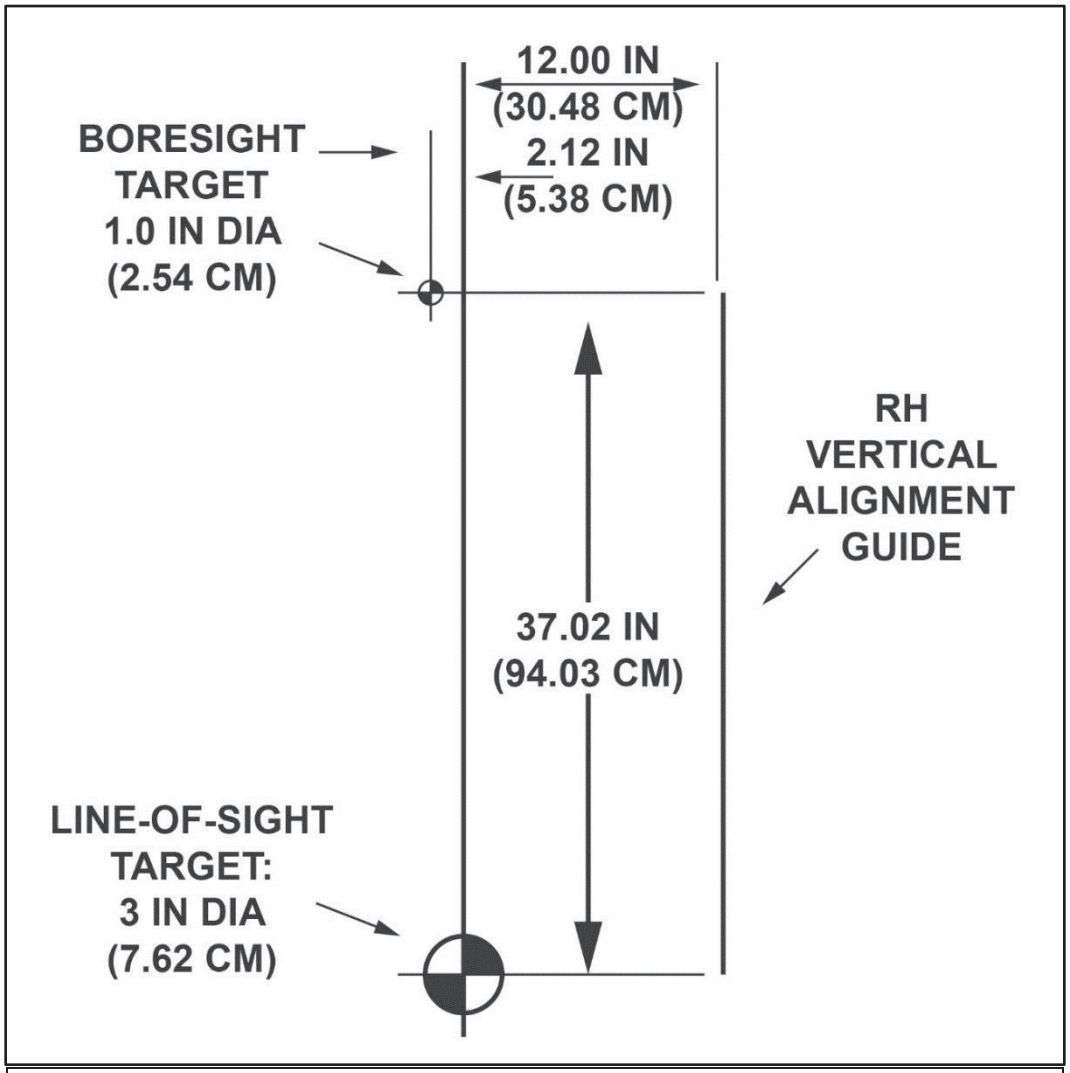
D-4. The zero process includes mechanical zero, laser boresight, and field zero at 400 meters.

Note. Although wind and gravity have the greatest effect on the projectile's trajectory, air density and elevation must also be taken into consideration.

LASER BORESIGHT

D-5. The borelight is an eye-safe laser that is used to boresight iron sights, optics, and aiming lasers. The borelight assists the first shot group hitting the 400-m zeroing target when field zeroing the iron sight, HWTS, AN/PEQ 2A, AN/PEQ-15, and AN/PEQ15A to the weapon. Using the borelight will save range time and require less rounds for the zeroing process. Boresighting is done with a borelight, which is centered in the bore of the weapon, and with an offset target placed 8.41 meters from the muzzle of the weapon (for more information on borelighting refer to TM 9-1010-230-23&P.

D-6. The first step to boresighting the MK 19 is to construct a boresight target for the weapon (See figure D-1). This can be done using a 1 cm standard boresight paper that is blank.



Legend:
cm = centimeters
dia = diameter
in = inches

Figure D-1. Boresight panel

REMOVE FLASH SUPPRESSOR

D-7. Install the weapon in the MK64 carriage and cradle assembly on the M3 tripod or the M205 lightweight tripod ground mount equipped with a T&E mechanism. Ensure stow pin and depression stop are installed before attaching MK64 mount to tripod.

D-8. Position the weapon so the centerline of the barrel is perpendicular to the target and on approximate center of boresight target crosshairs with muzzle end of barrel at 27 feet 7 inches (8.41 m) from the target (See figure D-2).

D-9. Install boresight adapter (6) in the end of the muzzle. Install boresight (5) in the adapter.

D-10. Raise the rear sight on the weapon by pressing the sight lock (7) while rotating the frame assembly (1) upward until it clicks. Turn the windage screw (2) until the windage indicator (3) is aligned with the 0 mark (4) on the windage scale.

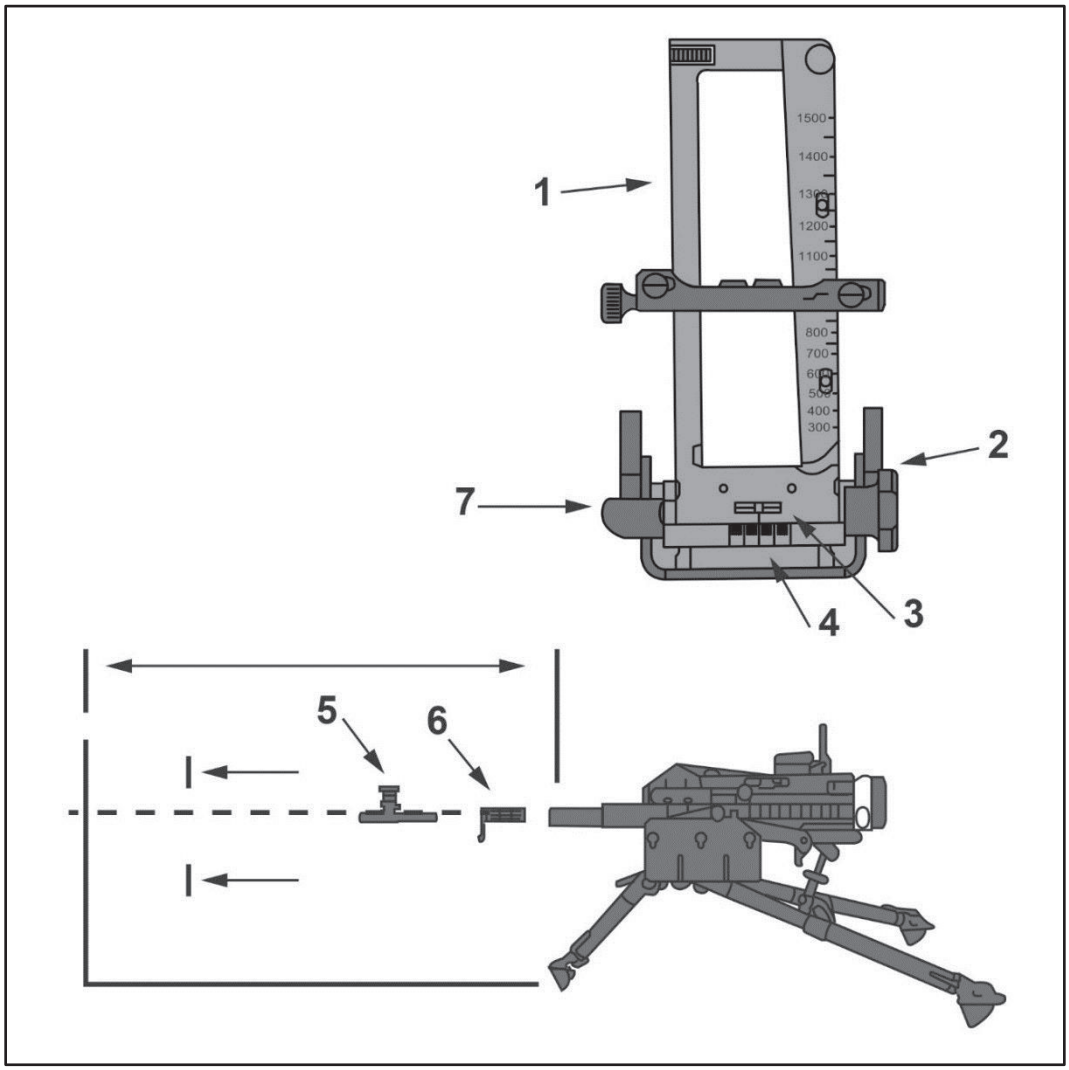


Figure D-2. Boresight weapon setup

D-11. Turn the boresight (See figure D-3 on page D-4) (7) so the eyepiece is out of the way. Stand at arm's length from the rear of the weapon. Sight past the right-hand side of the frame assembly (2). The right-hand side of the frame assembly should be parallel with the vertical alignment guide on the target. If it is not, tilt the target until the frame assembly and vertical alignment guide are parallel.

D-12. With the boresight (6) in the upright position, look through the top of the scope and align the boresight's crosshairs with the boresight crosshairs on the target. Use only the T&E mechanism to move the muzzle into alignment.

D-13. Without disturbing the weapon, slightly unscrew and press in the weapon's retainer plain nut (8). Slide the aperture carrier (9) upward on the scale to the 1000 meter mark.

D-14. Stand at arm's length from the rear of the gun and sight through the sight aperture of the rear sight slide (3) down the front sight blade (7). The center of the line of sight target should be approximately lined up with the top of the front sight blade and the top edge of the notch on the sight aperture.

D-15. Loosen the four socket head cap screws and move the rear sight assembly to align the notch in the windage indicator (5) with the front sight and vertical crosshair on the line of sight target. Tighten the four socket head cap screws and non-electrical wire. If moving the sight does not bring it into alignment, use the elevating wheel (1) and windage screw (4) to bring the sight into alignment with the target.

D-16. If the rear sight assembly is in acceptable alignment, the top edge of the aperture carrier (9) will be aligned with the 1000 meter mark, as shown. If the top edge of the aperture carrier is at the 1000-meter mark continue to verifying alignment. If not, adjust the position of the scale.

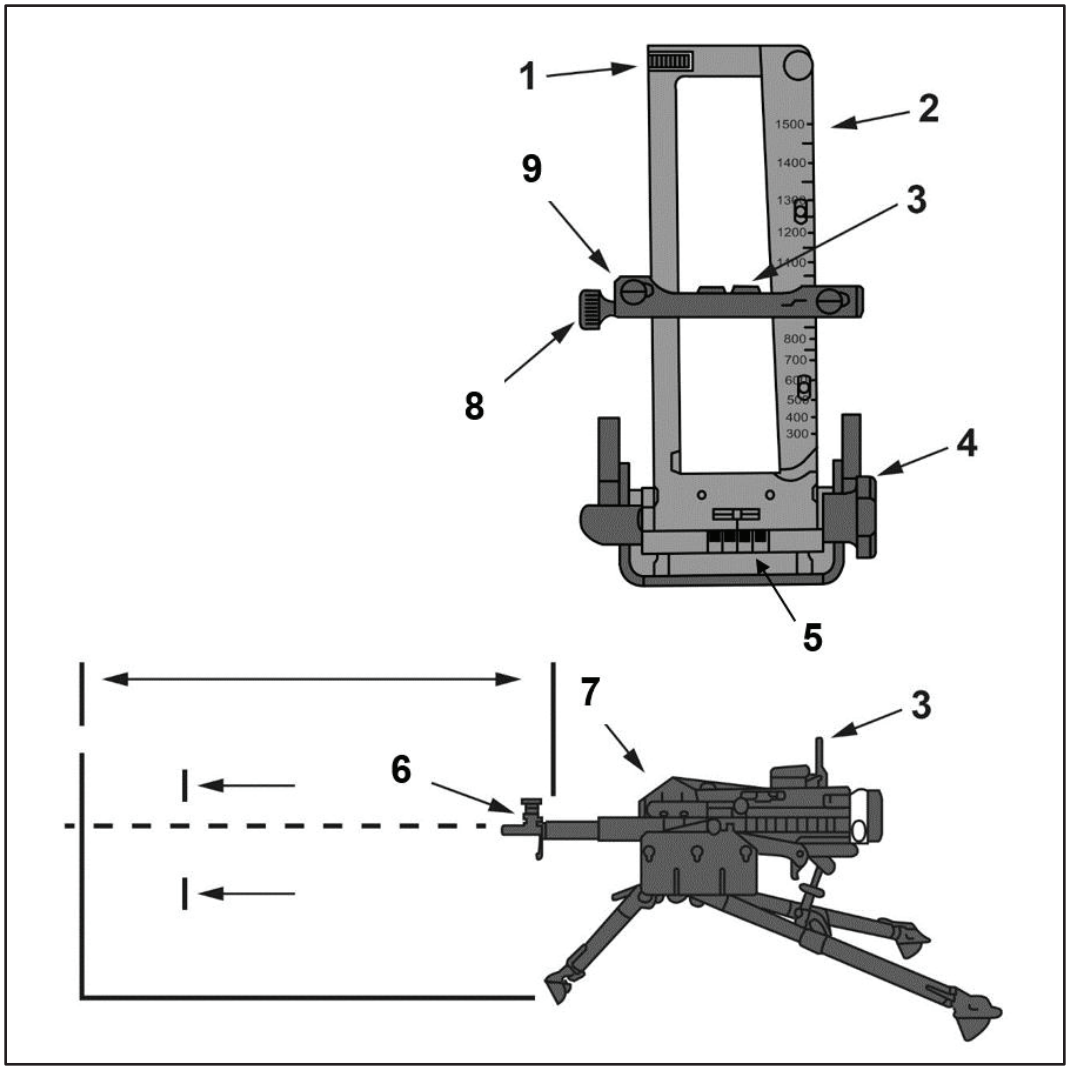


Figure D-3. Boresight weapon sight

ADJUST THE POSITION OF THE SCALE

D-17. If the top edge of the aperture carrier (See figure D-4) (1) was not aligned with the 1000-meter mark, the scale (3) must be physically moved up or down. Do not move the aperture carrier, loosen the scale lock screw (2) at the top of the scale by inserting a punch or key wrench into the holes and turning the screw counterclockwise, until the scale can be moved.

D-18. Carefully slide the scale (3) up or down until the 1000-meter mark is exactly aligned with the top of the aperture carrier (1). Tighten the scale lock screw.

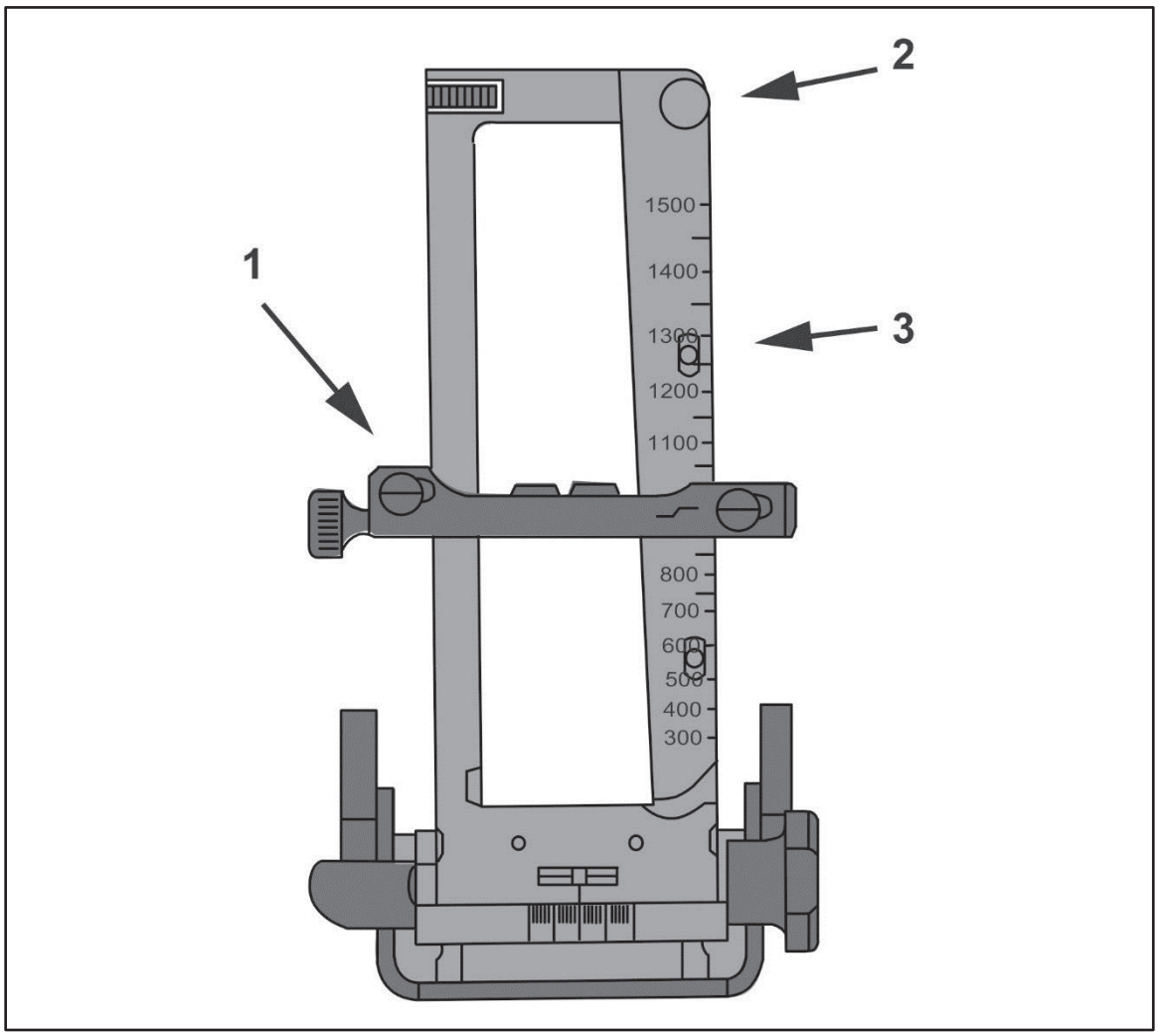


Figure D-4. Adjustment of the position of the scale

VERIFY ALIGNMENT

D-19. Ensure vertical alignment guide on target is parallel with the right-hand side of the frame assembly:

- Ensure intersection of boresight crosshairs is within the 1-inch diameter circle on the target.
- Ensure line of sight is within the 3 inch diameter circle on the target.
- Remove the boresight and 40-mm adapter from the muzzle of the weapon.
- Install flash suppressor on the muzzle.
- Test fire the weapon, if possible.

FIELD ZERO

D-20. When preparing to field zero, make sure the MK 19 is mounted securely on the tripod, make sure the T&E mechanism is working properly, and finally, know the distance to your zero target (400 meters). The only difference in initial sight setting for field zero is range setting on the scale.

D-21. The gunner must also remember that the range scale on the MK 19 is indicated in meters. Therefore, in order to get as close to the target as possible, you may have to convert the yards to the target into meters so you can set the range on the rear sight. Conversion of meters to yards is accomplished by dividing the number of yards by 1.094. For example, 600 yards / 1.094 = 548.45 meters; the gunner would set the range scale to 500 meters.

D-22. All machine guns should be zeroed at actual range. Zeroing procedures are crucial for hitting targets at ranges of 600 meters or more. For the MK 19, it is recommended that zeroing procedures be conducted at a range of 400 meters. The field zero will be recorded, but there are factors on the day that the weapon is fired that can change the zero such as wind and outside temperature. A MK 19 field zero is only good for the day that it is used in current weather conditions. A boresight zero is the only method that should be used to prepare the weapon for field zeroing. This will minimize the amount of rounds that will be fired to obtain a good zero. To field zero the MK 19, a series of steps must be performed. Each will be discussed in detail.

D-23. To establish a proper field zero, each step must be completed carefully by the Soldier.

Step 1: Set the range plate. Loosen the range plate screw. Move the range plate to the midpoint between the two studs. Tighten the range plate screw. Move the rear sight slide to the meter mark that represents the distance to the target. For example, move to the 400-meter mark to zero on a target known to be 400 meters away.

Step 2: Set the windage. Only set the windage knob at the zero index line if the weapon was not boresighted during primary marksmanship instruction.

Step 3: Prepare the T&E mechanism. Align the sights on the base of the target using the T&E mechanism.

Step 4: Fire a single round for assessment. With a good sight picture fire a single round at the center base of the target and observe the location of the strike of the round. If the round strikes the target, fire a three- to five-round burst to confirm zero. If the round misses the target, proceed to adjust the sight.

Step 5: Adjust the sight. If the rounds strike is did not strike the target the gunner must adjust either the elevation knob or the windage knob. The T&E mechanism will only be adjusted to place the sight back on the target after all zero adjustments have been made. Do not only adjust the T&E mechanism for zeroing.

Step 6: Adjust the elevation knob. If the impact of the round is short or over, adjust the elevation knob to acquire correct elevation zero. Locate the strike of the round and adjust the elevation knob to that distance opposite of the strike of the round. For example, if the round impacts 10 mils short, adjust the elevation knob 10 mils up.

Short rounds = clockwise turn

Over rounds = counterclockwise turn

Step 7: Adjust windage knob. If the round strikes to the left or right of the target adjust the windage knob. Locate the strike of the round using the M24 binoculars. Place the target center mass on the reticle. Locate where the strike of the round was. Determine the distance from the target the round impact was in mils. Refer to TM 9-1240-407-13&P for proper use of the M24 binoculars. Turn the windage knob to adjust the aimpoint.

Two clicks = 1 mil

Right adjustment = clockwise turn

Left adjustment = counterclockwise turn

Step 8: Confirm zero. Aim at the center base of the target. Fire a three- to five-round burst at the center base of the target. Observe where the burst strikes. If the burst misses the target then return to adjust the sight. If the burst hits the target, then the MK 19 machine gun is zeroed.

COACHES

D-24. Coaching is the process of having another Soldier observe the firer during the firing process to look for shooting errors that the firer themselves may not consciously know they are making.

TYPES OF COACHES

D-25. Firing a machine gun properly requires the consistent and proper application of the elements of employment. It is about doing the right thing, the same way, every shot. The small arms trainer is also the validation point for any questions during employment training. In most cases, once group training is completed, it will be the firer's responsibility to realize and correct his own firing errors but this process can be made easier through the use of a coach.

D-26. Two types of coaches exist, the experienced coach and the peer coach. Although each should execute coaching the same way, experienced coaches have a more thorough understanding of employment and should have more knowledge and practice in firing than the Soldiers they are coaching. Knowledge and skill does not necessarily come with rank therefore Soldiers serving as experienced coaches should be carefully selected for their demonstrated firing ability and their ability to convey information to firers of varying experience levels.

EXPERIENCED COACHES

D-27. Experienced coaches are generally in short supply throughout the Army and are generally outnumbered by less skilled firers. This lack of experienced coaches usually leads to one experienced coach watching multiple firers dependent upon the table or period of employment being fired. It often helps the experienced coach to make notes of errors they observe in gunners and discuss them after firing that group. It is often difficult for the coach to remember the errors that they observe in each and every firer.

PEER COACHES

D-28. Using a peer coach, although generally not as effective as using an experienced coach, is still a useful technique. The advantage of using a peer coach is two-fold: a peer coach may use their limited knowledge of employment to observe the firer when an experienced coach is not available or is occupied with another firer and can either talk the firer through the shooting errors that they have observed or bring any observed shooting errors to the attention of the experienced coach. The other advantage of using a peer coach is that the peer coach themselves, through the act of coaching, may be able to observe mistakes made by the firer and learn from them before making the mistakes themselves.

Note. Peer coaches can be limited by their level of training.

D-29. Except for aiming, the coach can observe most of the important aspects of the elements of employment. To determine the unobservable errors of shooting the coach and the firer must have an open dialog and there must be a relaxed environment for learning. The firer cannot be hesitant to ask questions of the coach and the coach must not become a stressor during firing. The coach must have the ability to safely move around the firer to properly observe. There is no one ideal coaching position.

STABILIZE

D-30. For the coach to observe how stable the gunner is, they may have to move to different sides of the gunner. To observe the gunner's non-firing elbow (to ensure it makes contact with the ground), the coach should be on the gunner's non-firing side. To observe the cant of the weapon (the sights on the weapon should be pointing towards 12 o'clock position, not 11 or 1 o'clock positions), the coach should watch the relationship of the front sight to the barrel from behind the shooter. The coach should look for all the other aspects of good positions as outlined in chapter 6 of this publication. The coach should also observe the total amount of weapon movement on recoil. A good stable position will have minimal movement under recoil.

AIMING

D-31. Determining the aspects of the firer's aiming (sight picture, sight alignment, point of focus) requires dialogue between the firer and the coach. Often, a shooter will not realize their aiming errors until they

discover them on their own. The only method a coach has to observe aiming errors is to use a locally produced aiming bar to determine where the gunner is aiming on the target, their focus point during firing (which should be the front sight), and where their front sight was at the moment of firing in relation to the rear sight aperture and the point of aim on the target. The calling the shot method should also be used. When calling the shot, the firer calls the point on the target where their sights were located at the moment of firing and matching the point called with the impact locations on the target. Calling the shot helps the firer learn to focus on the front sight during the entire firing process.

D-32. When optics are being used, the gunner can tell the coach where they were holding. This is of particular importance with the heavy weapons thermal sight. Coaches must ensure the corresponding aim point is used when zeroing at range.

CONTROL

D-33. The ideal position to observe trigger press is from the non-firing side because the coach will have a better view of the speed of press, thumb position on the trigger, and grip of firing and non-firing hand. The coach can look from behind the shooter to observe the barrel for lateral movement caused by slack not be taken out of the T&E mechanism during firing.

COACHING FACTORS

D-34. The coach should be focused solely on the gunner during firing and not on what is happening downrange. There is no way for a coach to observe only the bullets impact on target and know what errors the firer made. The coach must watch the gunner during firing to determine errors and use the impacts to confirm their assumptions.

D-35. For a coach to properly observe all aspects of firing they must be able to observe the gunner, safely, from both sides and the back. There is no prescribed coaching position. Coaching requires a relaxed atmosphere with open communication between the firer and the coach.

SHOT GROUP ANALYSIS

D-36. Shot group analysis on field zero means that the gunner pictures how the shot looked when fired while examining the shots at the target location involves the gunner correlating the shots at the target location with the mental image of how the shots looked when fired. An accurate analysis of the shot group cannot be made by merely looking at the location of impact in relation to the target. It is more important to observe the firer than to try to analyze the target. All firing takes place at the weapon. The splash of the rounds are only an indicator of where the barrel was pointed when the machine gun was fired. When coaches are analyzing shots, groups, or bursts, they must question the firer about the shot, group, or burst to make a determination of what caused the placement of the shots.

D-37. For example, if the gunner has a tight group – minus one shot that is well outside of the group, the firer should have observed the outlying shot while firing. The firer would discount this shot when adjusting the elevation or windage. If a coach is analyzing the group, the firer would tell them that they performed poorly on the one shot that is out of the group.

D-38. A novice shooter may benefit from not adjusting their own shot group. When adjusting a shot group, an inexperienced or stressed Soldier may unintentionally make mental corrections. These mental corrections along with the mechanical corrections to their weapon will cause further issues during follow-on shot groups. An experienced Soldier is less likely to adjust their sight placement along with the mechanical changes to the weapon, knowing the zero process is aligning the sights to the location of the impact of the rounds. Having a coach or the employment instructor simply inform the Soldier of mechanical changes needed to the aiming device is an effective way to accomplish this method.

D-39. Observing the gunner must be accomplished before analyzing the target can become effective. Rounds strung vertically do not necessarily mean a breathing issue, nor do rounds strung horizontally absolutely indicate a trigger press problem. Coaches must learn to identify gunners' errors during firing and use the rounds' impacts on target to confirm their observations. Several firing errors can cause certain misplacements of impacts. The coach has to realize that bullets only go where the barrel is pointed, so they have to determine

what happened that caused the Soldier to point the barrel in that direction. Many factors could cause that to occur.

D-40. They key to proper coaching is becoming a shooting detective. The coach needs to observe the gunner, question the gunner, look at the evidence downrange, question the gunner again, make assumptions based upon the evidence available, and then act upon those assumptions. The coach and gunner must have a free and open dialog with each other in a relaxed atmosphere. Remember a Soldier will only shoot as well as the Soldier learns to shoot.

BULLETS DISPERSED LATERALLY ON TARGET

D-41. Bullets displaced in this manner could be caused by a lateral movement of the barrel due to an unstable position. Additional reasons for this could include—

- The gunner may be slightly misaligning the sights to the left and right.
- The gunner may have the sights aligned properly but may have trouble keeping the target itself perfectly centered on the tip of the front sight.
- Gunner may be closing eyes or flinching at the moment of fire.

BULLETS DISPERSED VERTICALLY ON TARGET

D-42. Bullets displaced in a vertical manner could be caused by:

- Gunner may be misaligning the front sight in the rear sight aperture vertically. This may be caused by the gunner watching the target instead of the front sight.
- Gunner may have trouble seeing the target and keeping the tip of the front sight exactly centered vertically on the target. Many gunners find it easier to find the center of a circle than a man-shaped target.
- Gunner may not have good support, which causes them to readjust their position every shot and settle with the sights slightly misaligned.
- Gunner may be closing their eyes or flinching at the moment of fire.
- Gunner may not be pulling the slack out of the T&E during sight alignment or during firing resulting in a less stable position.

LARGE GROUPS

D-43. The most common cause of a large group is the gunner's failure to account for slack in the T&E mechanism. Another cause is looking at the target instead of the front sight. The latter causes the gunner to place the front sight at the center base of the target, without aligning the front sight in the rear sight. A small misalignment between the sights will cause a large displacement of shots downrange.

GOOD GROUPS THAT CHANGE POSITION ON THE TARGET

D-44. When the gunner has good groups but they are located at different positions on the target, there can be a number of reasons. These include:

- May be caused by the gunner properly aligning sights during firing but picking up a different point of aim on the target each time.
- May be caused by the gunner settling into a position with the front sight on target but the sights misaligned. The gunner maintains the incorrect sight picture throughout the group but aligns the sights incorrectly and in a different manner during the next group. Tell the firer to focus on the front sight and have them check natural point of aim before each group.

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Appendix E
Qualification

Four individual gunnery exercises train and qualify MK 19 gunners. The corresponding scorecards are based on the target type and visibility. Each scorecard has two tables, one for practice and one for qualification. The tables have versions for hull or pop-up silhouette engagements and for the type of night vision device used. MK 19s will be mounted on the tripod during qualification.

RANGE SETUP

E-1. Range setup involves targets, ammunition, and fire control. The range is conducted according to local range and unit SOPs. The standards in range setup are discussed for ease of qualification.

TARGETS

E-2. Targets should be within the ranges provided on the table scorecard. Because the gunner has to be able to observe the impact of the round to make adjustments, there should be no dead space within 100 meters of the selected targets. Every target listed in each task is a point target; however, one or two targets between the range of 600 and 900 meters should be changed to an area target. The number of rounds and engagement time are the same for both point and area targets.

E-3. The commander's guidance and the local range configuration should determine the location of the area targets. For area targets, multiple E-type personnel targets may be placed on line or in wedge formations. Multiple personnel targets, indicating area targets, should not be more than five meters apart, and not extend more than 30 meters in width or 20 meters in depth.

E-4. During night firing using hulls as targets, no modification to the target is needed to assist the gunner in identifying the target. If pop-up silhouette targets are used however, a thermal source is needed on each target to enable the gunner to acquire it with the TWS. For gunners only using a laser pointing device, the target can be designated with two chemical lights on targets between 400 meters and 600 meters, and three chemical lights on targets at more than 600 meters. Thermal targets should use thermal blankets to heat the target.

AMMUNITION

E-5. Ammunition is broken down by task. The assistant gunner places each belt in its order of use. The number of rounds authorized for each task will be the number of rounds per belt. For example, if there are 10 engagements, there should be 10 belts of ammunition placed in the order of fire and within reach of the assistant gunner.

E-6. HE rounds cannot be fired at pop-up silhouette targets. Target practice (TP) rounds can be fired at both types of targets. The impact of an HE round is much easier to see than that of the TP round.

FIRE CONTROL

E-7. Controlling and observing a target engagement with the MK 19 is best conducted at a range set up with a firing lane for each firing point. However, each point will not have an individual firing lane, and some ranges must use the same target for more than one lane. The grader must be able to identify which round impact is from which firing point, which is especially true for the 400-meter target.

E-8. To prevent misidentification of round impacts, ensure that only one gunner at a time engages each target. The order in which the targets are engaged can be changed to allow more than one gunner to fire at the same time. Engagement start times also can be staggered so that gunners can engage targets at different ranges at

the same time. This requires a great deal of coordination and communication between the graders and the personnel controlling the range.

QUALIFICATION PREPARATION

E-9. Before the execution of the range, personnel need to be identified as graders. Graders are selected due to their knowledge and experience with the MK 19. They need to be instructed on grading, scoring, and completion of the scorecard.

Grading Procedure

E-10. One grader is required at each firing point.

E-11. During the day, the grader will need a set of binoculars. At night, equipment will vary according to the type of range being used. With an impact range with hull targets, the grader will need an NVD (for example, the AN/PVS-14 and AN/PVS-7B with the 3X magnifier, or the AN/PAS-13) to observe the strike of the round. The same equipment is needed if the pop-up targets fail to provide feedback. The grader also needs the order of engagement and a means to give the gunner the range to that firing point. The grader must be able to identify which target the gunner is about to engage. To do this, the grader can use a completed range card, which includes a diagram of the range with numbered targets and ranges to targets.

E-12. Time starts after the target is exposed and the grader has given the gunner the range to the target. The grader provides all information before the target is exposed. If hull targets are used and exposed at all times, then the time starts after the grader tells the gunner which target to engage and gives the range to the target. Time ends when the time expires, when the target has been successfully engaged, or when the target is no longer exposed.

Scoring Procedure

E-13. Scoring is done on a GO/NO-GO basis for each task within the practice or qualification table.

E-14. Zeroing the gun, the first task in each table, is scored as a GO/NO-GO. Giving a score for the zero emphasizes the importance of a proper zero to effectively engage targets at 600 meters and beyond. However, if the gunner fails to zero within four rounds, they are removed from the line and given additional training before attempting the table again.

E-15. On point target engagements (lightly armored vehicle targets and other similar targets), the gunner receives a GO if they meet or exceed the engagement standard of one or two rounds hitting the target.

E-16. If area targets are included (Infantry squads, rocket-propelled grenade teams, and similar targets.), the gunner receives a GO when at least the number of rounds stated in the engagement standard for that task impact within 10 meters of the area target and thus suppresses it.

E-17. At the end of each table, the scorer adds up the number of GOs and NO-GOs, places that number in the Totals block, and checks the appropriate qualification (expert, sharpshooter, marksman, or unqualified).

Scorecard

E-18. Table I contains the tables for day practice and day qualification for hull targets and Table III contains the tables for day practice and day qualification for pop-up targets. Other than a 30-second difference in the engagement times for each task, the practice and the qualification tables are the same. It is held twice a year, or as often as the commander feels is needed to maintain gunner proficiency.

E-19. The day practice firing exercise allows the gunner to fire on a range engaging hull or pop-up targets to test his skills before qualification firing.

E-20. The qualification live-fire exercise tests skills practiced during day firing exercise. It is scored on time taken and target hits made based on the firing tables.

E-21. During scorecard preparation, the grader selects the correct scorecard (Table I for hull targets or Table III for pop-up targets) and enters the gunner's name, rank, and unit in blocks 1 through 3. The grader also fills in blocks 4 through 7 with the range name, the firing lane, his name, and the date.

E-22. The grader positions themselves so that they can observe both the gunner and the target. Once live fire commences, the grader--

- Observes and informs the gunner of the strike of each round.
- Observes and records a GO or NO GO for each task.
- Sums the GOs and NO GOs in the Totals block, checks the appropriate qualification in block 9, has the gunner sign the scorecard in block 10, and signs the card in block 11 at the end of the practice.
- Repeats the steps above by filling in the appropriate blocks, summing the scores, and assigning the correct qualification during the qualification phase.
- Uses the comment section in either table to enter remarks such as the operation of the gun, condition of the targets, and weather conditions to name a few.

DAY PRACTICE AND QUALIFICATION

E-23. Specific scorecards have been developed for different targets. Gunners will only fire one day practice-qualification and qualification. Units should select the practice and qualification based on the type of targets available.

E-24. Due to the types of targets available for practice and qualification, there are two scorecards for day practice and qualification. Table I (see figure E-1 on page E-4, which shows DA Form 7518, *MK 19 40-mm Grenade Machine Gun, MOD 3 Firing Table I Day Practice and Qualification With Hull Targets Scorecard*) is used when engaging hull-type targets and Table III (see figure E-2 on page E-5, which shows DA Form 7520, *MK 19 40-mm Grenade Machine Gun, MOD 3 Firing Table III Day Practice and Qualification With Pop-up Targets Scorecard*) is used when engaging pop-up silhouette targets.

E-25. Hull-type targets provide height, width, and depth, and give the MK 19 gunner a realistic target. The engagement ranges for practice and qualifications can be set for the full range of the gun and are set at ranges up to 1500 meters.

E-26. Pop-up silhouette targets. Pop-up silhouettes provide a target with width and height but little depth. Due to the high angle at which 40-mm rounds fall at ranges greater than 800 meters, it is difficult to hit this type of target beyond that range. The engagement ranges for practice and qualifications are set at 800 meters or less.

E-27. There is a 30-second difference for the completion of each task between the practice and qualification tables. Practice tables allow 30 additional seconds for each engagement.

MK 19, 40-mm GRENADE MACHINE GUN, MOD 3 FIRING TABLE I DAY PRACTICE AND QUALIFICATION WITH HULL TARGETS SCORECARD
For use of this form, see TC 3-22.19; the proponent agency is TRADOC.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 3012(g)/Executive order 9397
PRINCIPAL PURPOSE: To aid individual training on targets at various ranges.
ROUTINE USES: To evaluate individual proficiency.
DISCLOSURE: Voluntary. However, mass rating and recording require some tracking method.

1a. LAST NAME	1b. FIRST NAME	1c. MI	2. RANK	3. UNIT
SMITH	JOHN	J	SGT	D co 1-23 IN

TABLE I (A). DISMOUNTED AND MOUNTED DAY PRACTICE

4. RANGE	5. LANE	6. GRADER	7. DATE
MPMG	1	SOLDIER, IAM	20170223

TASK	RANGE (Meters)	AMMO	TIME (Minutes)	ENGAGEMENT STANDARDS	GO	NO GO
ZERO	400	4	NA	2 ROUNDS HIT	☒	☐
2	1,100 (+/- 200)	8	2.5	2 ROUNDS HIT	☒	☐
3	1,500 (+/- 200)	10	3.5	2 ROUNDS HIT	☒	☐
4	600 (+/- 100)	6	2	2 ROUNDS HIT	☒	☐
5	800 (+/- 100)	6	2	2 ROUNDS HIT	☒	☐
6	400	4	1.5	2 ROUNDS HIT	☒	☐
MULTIPLE TARGETS						
7	1,100 (+/- 200)	10	4	1 ROUND HIT	☒	☐
8	600 (+/- 100)			1 ROUND HIT	☐	☒
9	800 (+/- 100)	14	4.5	1 ROUND HIT	☒	☐
10	1,500 (+/- 200)			1 ROUND HIT	☒	☐
				TOTALS	9	1

8. COMMENTS

9. NUMBER OF ENGAGEMENTS *(Choose One)*
☐ 10 - EXPERT ☐ 8-7 - MARKSMAN
☒ 9 - SHARPSHOOTER ☐ 6 AND BELOW - UNQUALIFIED

10. GUNNER'S SIGNATURE: J Smith

11. GRADER'S SIGNATURE: I M Soldier

TABLE I (B). DISMOUNTED AND MOUNTED DAY QUALIFICATION

12. RANGE	13. LANE	14. GRADER	15. DATE
MPMG	3	SLAUGHTER, SARGENT	20170223

TASK	RANGE (Meters)	AMMO	TIME (Minutes)	ENGAGEMENT STANDARDS	GO	NO GO
ZERO	400	4	NA	2 ROUNDS HIT	☒	☐
2	1,100 (+/- 200)	8	2	2 ROUNDS HIT	☒	☐
3	1,500 (+/- 200)	10	3	2 ROUNDS HIT	☒	☐
4	600 (+/- 100)	6	1.5	2 ROUNDS HIT	☒	☐
5	800 (+/- 100)	6	1.5	2 ROUNDS HIT	☒	☐
6	400	4	1	2 ROUNDS HIT	☒	☐
MULTIPLE TARGETS						
7	1,100 (+/- 200)	10	3.5	1 ROUND HIT	☒	☐
8	600 (+/- 100)			1 ROUND HIT	☐	☒
9	800 (+/- 100)	14	4	1 ROUND HIT	☒	☐
10	1,500 (+/- 200)			1 ROUND HIT	☒	☐
				TOTALS	9	1

16. COMMENTS

17. NUMBER OF ENGAGEMENTS *(Choose One)*
☐ 10 - EXPERT ☐ 8-7 - MARKSMAN
☒ 9 - SHARPSHOOTER ☐ 6 AND BELOW - UNQUALIFIED

18. GUNNER'S SIGNATURE: J Smith

19. GRADER'S SIGNATURE: S. Slaughter

DA FORM 7518, MAR 2017 APD LC v1.00

SAMPLE

Figure E-1. Completed DA Form 7518, example

MK 19, 40-mm GRENADE MACHINE GUN, MOD 3 FIRING TABLE III DAY PRACTICE AND QUALIFICATION WITH POP-UP TARGETS SCORECARD

For use of this form, see TC 3-22.19; the proponent agency is TRADOC.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 3012(g)/Executive order 9397
PRINCIPAL PURPOSE: To aid individual training on targets at various ranges.
ROUTINE USES: To evaluate individual proficiency.
DISCLOSURE: Voluntary. However, mass rating and recording require some tracking method.

1a. LAST NAME	1b. FIRST NAME	1c. MI	2. RANK	3. UNIT
SMITH	JOHN	J	SGT	D co 1-23 IN

TABLE III (A). DISMOUNTED AND MOUNTED DAY PRACTICE

4. RANGE	5. LANE	6. GRADER	7. DATE
MPMG	1	SOLDIER, IAM	20170223

TASK	RANGE (Meters)	AMMO	TIME (Minutes)	ENGAGEMENT STANDARDS	GO	NO GO
ZERO	400	4	NA	2 ROUNDS HIT	☒	☐
2	600 (+/- 100)	6	2	1 ROUND HIT	☒	☐
3	800 (+/- 100)	8	2.5	1 ROUND HIT	☒	☐
4	400	4	1.5	1 ROUND HIT	☒	☐
MULTIPLE TARGETS						
5	800 (+/- 100)	12	4	1 ROUND HIT	☒	☐
6	400			1 ROUND HIT	☐	☒
7	400	10	3	1 ROUND HIT	☒	☐
8	600 (+/- 100)			1 ROUND HIT	☒	☐
				TOTALS	7	1

8. COMMENTS

9. NUMBER OF ENGAGEMENTS *(Choose One)*
☐ 8 - EXPERT ☐ 6 - MARKSMAN
☒ 7 - SHARPSHOOTER ☐ 5 AND BELOW - UNQUALIFIED

10. GUNNER'S SIGNATURE: J. Smith

11. GRADER'S SIGNATURE: I. M. Soldier

TABLE III (B). DISMOUNTED AND MOUNTED DAY QUALIFICATION

12. RANGE	13. LANE	14. GRADER	15. DATE
MPMG	5	SLAUGHTER, SARGENT	20170223

TASK	RANGE (Meters)	AMMO	TIME (Minutes)	ENGAGEMENT STANDARDS	GO	NO GO
ZERO	400	4	NA	2 ROUNDS HIT	☒	☐
2	600 (+/- 100)	6	1.5	1 ROUND HIT	☒	☐
3	800 (+/- 100)	8	2	1 ROUND HIT	☒	☐
4	400	4	1	1 ROUND HIT	☒	☐
MULTIPLE TARGETS						
5	800 (+/- 100)	12	3.5	1 ROUND HIT	☒	☐
6	400			1 ROUND HIT	☐	☒
7	400	10	2.5	1 ROUND HIT	☒	☐
8	600 (+/- 100)			1 ROUND HIT	☐	☒
				TOTALS	6	2

16. COMMENTS

17. NUMBER OF ENGAGEMENTS *(Choose One)*
☐ 8 - EXPERT ☒ 6 - MARKSMAN
☐ 7 - SHARPSHOOTER ☐ 5 AND BELOW - UNQUALIFIED

18. GUNNER'S SIGNATURE: J. Smith

19. GRADER'S SIGNATURE: S. Slaughter

DA FORM 7520, MAR 2017 APD LC v1.00ES

SAMPLE

Figure E-2. Completed DA Form 7520, example

NIGHT PRACTICE AND QUALIFICATION

E-28. Specific scorecards have been developed for different targets when engaged at night. Gunners will only fire one night practice-qualification and qualification. Units should select the practice and qualification based on the type of night vision devices available and targets available.

E-29. The MK 19 night practice and qualification tables are shown in Scorecards II (see figure E-3 on page E-7, which shows DA Form 7519, *MK 19 40-mm Grenade Machine Gun, MOD 3 Firing Table II Night Practice and Qualification With Hull Targets Scorecard*) and IV (see figure E-4 on page E-8, which shows DA Form 7521, *MK 19 40-mm Grenade Machine Gun, MOD 3 Firing Table IV Night Practice and Qualification With Pop-up Targets Scorecard*). Units with laser aiming devices and any version of the AN/PAS-13 thermal devices and engaging hull-type targets use Scorecard II. Units without a MK 19/sight combination or engaging pop-up silhouettes use Scorecard IV. Gunners do not fire both. Infantry gun crews are required to qualify at night. Other types of units may determine that day qualification is adequate due to their wartime missions.

MK 19, 40-mm GRENADE MACHINE GUN, MOD 3 FIRING TABLE II NIGHT PRACTICE AND QUALIFICATION WITH HULL TARGETS SCORECARD

For use of this form, see TC 3-22.19; the proponent agency is TRADOC.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 3012(g)/Executive order 9397
PRINCIPAL PURPOSE: To aid individual training on targets at various ranges.
ROUTINE USES: To evaluate individual proficiency.
DISCLOSURE: Voluntary. However, mass rating and recording require some tracking method.

NOTE: Use these tables if the targets being used are hulls, and any of the following applies:
AN/PEQ-2A mounted on the TWS mounting bracket.
AN/PAS-13 mounted on the TWS mounting bracket.
AN/TVS-5 with the 3d generation tube mounted on the TWS mounting bracket.

1a. LAST NAME	1b. FIRST NAME	1c. MI	2. RANK	3. UNIT
SMITH	JOHN	J	SGT	D co 1-23 IN

TABLE II (A). DISMOUNTED AND MOUNTED NIGHT PRACTICE

4. RANGE	5. LANE	6. GRADER	7. DATE
MPMG	2	SOLDIER, IAM	20170223

TASK	RANGE (Meters)	AMMO	TIME (Minutes)	ENGAGEMENT STANDARDS	GO	NO GO
ZERO	400	4	NA	2 ROUNDS HIT	☒	☐
2	1,100 (+/- 200)	8	2.5	2 ROUNDS HIT	☒	☐
3	1,500 (+/- 200)	10	3.5	2 ROUNDS HIT	☒	☐
4	600 (+/- 100)	6	2	2 ROUNDS HIT	☐	☒
5	800 (+/- 100)	6	2	2 ROUNDS HIT	☒	☐
6	400	4	1.5	2 ROUNDS HIT	☒	☐
MULTIPLE TARGETS						
7	1,100 (+/- 200)	10	4	1 ROUND HIT	☒	☐
8	600 (+/- 100)			1 ROUND HIT	☐	☒
9	800 (+/- 100)	14	4.5	1 ROUND HIT	☐	☒
10	1,500 (+/- 200)			1 ROUND HIT	☒	☐
				TOTALS	7	3

8. TYPE DEVICE *(Choose One)*	9. NUMBER OF ENGAGEMENTS *(Choose One)*
☐ AN/PEQ-2A ☒ AN/PAS-13 ☐ AN/TVS-5	☐ 10 - EXPERT ☒ 8-7 - MARKSMAN ☐ 9 - SHARPSHOOTER ☐ 6 AND BELOW - UNQUALIFIED

10. GUNNER'S SIGNATURE	11. GRADER'S SIGNATURE
J. Smith	I.M. Soldier

TABLE II (B). DISMOUNTED AND MOUNTED NIGHT QUALIFICATION

12. RANGE	13. LANE	14. GRADER	15. DATE
MPMG	3	SLAUGHTER, SARGENT	20170223

TASK	RANGE (Meters)	AMMO	TIME (Minutes)	ENGAGEMENT STANDARDS	GO	NO GO
ZERO	400	4	NA	2 ROUNDS HIT	☒	☐
2	1,100 (+/- 200)	8	2	2 ROUNDS HIT	☒	☐
3	1,500 (+/- 200)	10	3	2 ROUNDS HIT	☐	☒
4	600 (+/- 100)	6	1.5	2 ROUNDS HIT	☒	☐
5	800 (+/- 100)	6	1.5	2 ROUNDS HIT	☐	☐
6	400	4	1	2 ROUNDS HIT	☒	☐
MULTIPLE TARGETS						
7	1,100 (+/- 200)	10	3.5	1 ROUND HIT	☐	☒
8	600 (+/- 100)			1 ROUND HIT	☒	☐
9	800 (+/- 100)	14	4	1 ROUND HIT	☐	☒
10	1,500 (+/- 200)			1 ROUND HIT	☒	☐
				TOTALS	6	3

16. TYPE DEVICE *(Choose One)*	17. NUMBER OF ENGAGEMENTS *(Choose One)*
☐ AN/PEQ-2A ☒ AN/PAS-13 ☐ AN/TVS-5	☐ 10 - EXPERT ☐ 8-7 - MARKSMAN ☐ 9 - SHARPSHOOTER ☒ 6 AND BELOW - UNQUALIFIED

18. GUNNER'S SIGNATURE	19. GRADER'S SIGNATURE
J. Smith	S. Slaughter

DA FORM 7519, MAR 2017 APD LC v1.00ES

SAMPLE

Figure E-3. Completed DA Form 7519, example

MK 19, 40-mm GRENADE MACHINE GUN, MOD 3 FIRING TABLE IV NIGHT PRACTICE AND QUALIFICATION WITH POP-UP TARGETS SCORECARD
For use of this form, see TC 3-22.19; the proponent agency is TRADOC.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 3012(g)/Executive order 9397
PRINCIPAL PURPOSE: To aid individual training on targets at various ranges.
ROUTINE USES: To evaluate individual proficiency.
DISCLOSURE: Voluntary. However, mass rating and recording require some tracking method.

NOTE: Use this table if you do not have a MK 19/sight combination that applies to Table II, and you are using hull targets OR if targets are pop-up/E type silhouettes.

1a. LAST NAME	1b. FIRST NAME	1c. MI	2. RANK	3. UNIT
SMITH	JOHN	J	SGT	D co 1-23 IN

TABLE IV (A). DISMOUNTED AND MOUNTED NIGHT PRACTICE

4. RANGE	5. LANE	6. GRADER	7. DATE
MPMG	2	SOLDIER, IAM	20170223

TASK	RANGE (Meters)	AMMO	TIME (Minutes)	ENGAGEMENT STANDARDS	GO	NO GO
ZERO	400	4	NA	2 ROUNDS HIT	☒	☐
2	600 (+/- 100)	6	2	2 ROUNDS HIT	☒	☐
3	800 (+/- 100)	6	2	2 ROUNDS HIT	☒	☐
4	400	4	1.5	2 ROUNDS HIT	☒	☐
MULTIPLE TARGETS						
5	800 (+/- 100)	10	3.5	1 ROUND HIT	☐	☒
6	400			1 ROUND HIT	☐	☒
7	400	14	2.5	1 ROUND HIT	☒	☐
8	600 (+/- 100)			1 ROUND HIT	☒	☐
				TOTALS	6	2

8. COMMENTS

9. NUMBER OF ENGAGEMENTS *(Choose One)*
☐ 8 - EXPERT ☒ 6 - MARKSMAN
☐ 7 - SHARPSHOOTER ☐ 5 AND BELOW - UNQUALIFIED

10. GUNNER'S SIGNATURE: J. Smith

11. GRADER'S SIGNATURE: I. M. Soldier

TABLE IV (B). DISMOUNTED AND MOUNTED NIGHT QUALIFICATION

12. RANGE	13. LANE	14. GRADER	15. DATE
MPMG	4	SLAUGHTER, SARGENT	20170223

TASK	RANGE (Meters)	AMMO	TIME (Minutes)	ENGAGEMENT STANDARDS	GO	NO GO
ZERO	400	4	NA	2 ROUNDS HIT	☒	☐
2	600 (+/- 100)	6	1.5	2 ROUNDS HIT	☒	☐
3	800 (+/- 100)	6	1.5	2 ROUNDS HIT	☒	☐
4	400	4	1	2 ROUNDS HIT	☐	☒
MULTIPLE TARGETS						
5	800 (+/- 100)	10	3	1 ROUND HIT	☒	☐
6	400			1 ROUND HIT	☐	☒
7	400	14	2	1 ROUND HIT	☒	☐
8	600 (+/- 100)			1 ROUND HIT	☒	☐
				TOTALS	6	2

16. COMMENTS

17. NUMBER OF ENGAGEMENTS *(Choose One)*
☐ 8 - EXPERT ☒ 6 - MARKSMAN
☐ 7 - SHARPSHOOTER ☐ 5 AND BELOW - UNQUALIFIED

18. GUNNER'S SIGNATURE: J. Smith

19. GRADER'S SIGNATURE: S. Slaughter

DA FORM 7521, MAR 2017 APD LC v1.00ES

SAMPLE

Figure E-4. Completed DA Form 7521, example

Glossary

The glossary lists acronyms and terms with Army or joint definitions. Where Army and joint definitions differ, (Army) precedes the definition. Terms for which this publication is proponent are marked with an asterisk. The proponent manual for other terms is listed in parentheses after the definition.

SECTION I – ACRONYMS AND ABBREVIATIONS

ATPIAL	advanced target pointer illuminator aiming light
CBRN	chemical, biological, radiological, and nuclear
CBoVM	center base of visible mass
DBAL-A2	dual beam aiming laser-advanced2
FPL	final protective line
HWTS	heavy weapon thermal sight
I2	image intensifier
IR	infrared
METT-TC	mission, enemy, terrain and weather, troops and support-time available, and civil considerations
ROE	rules of engagement
SOP	standard operating procedure
STORM	illuminator, integrated, small arms
T&E	traversing and elevating [mechanism]
TC	training circular
TM	technical manual
TWS	thermal weapon sight

SECTION II – TERMS

There are no terms prescribed by this publication.

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References

REQUIRED PUBLICATIONS

ADRP 1-02, Terms and Military Symbols, 16 November 2016.

DOD Dictionary of Military and Associated Terms, November 2019.

RELATED PUBLICATIONS

These documents contain relevant supplemental information.

JOINT PUBLICATIONS

Most joint publications are available online at https://www.dtic.mil/doctrine/doctrine/doctrine.htm.

ARMY PUBLICATIONS

Most Army doctrinal publications and regulations are available at: http://www.apd.army.mil. Military Standards are available online at http://quicksearch.dla.mil.

Technical manuals are available online at https:/www.logsa.army.mil/.

Other publications are available on the Central Army Registry on the Army Training Network, https://atiam.train.army.mil.

ATP 3-21.8, *Infantry Rifle Platoon and Squad*, 12 April 2016.

FM 6-27, *The Commander's Handbook on the Law of Land Warfare*, 7 August 2019.

TB 9-1310-251-10, *Operator's Manual, Range Clearing Procedures for Cartridge 40mm: TP, M918*, 24 February 1995.

TC 3-20.31-4, *Direct Fire Engagement Process (DIDEA)*, 23 July 2015.

TC 3-21.60, *Visual Signals*, 17 March 2017.

TC 3-21.75, *The Warrior Ethos and Soldier Combat Skills*, 13 August 2013.

TM 9-1010-230-10, *Operator's Manual for Machine Gun, 40 mm, MK 19 MOD 3, NSN 1010-01-126-9063 (EIC 4AE)*, *Machine Gun, 40 mm, MK 19 MOD 3, with Sight Bracket, NSN 1010-01490-9697 Machine Gun, 40 MM, MK 19, Upgunned Weapons Station (WGWS), NSN 1010-01-362-6513,* 31 August 2012.

TM 9-1010-230-23&P, *Operator's Manual for Machine Gun, 40mm MK 19 MOD 3, NSN 1010-01-126- 9063 (EIC 4AE)*, 31 August 2012.

TM 9-1240-407-13&P, *Operator and Field Maintenance Manual Including Repair Parts and Special Tools List for Binocular, M24 (NSN 1240-01-430-6944) (LIN: B67839)*, 30 November 2012.

TM 9-5855-1912-13&P, *Operator and Field Maintenance Manual Including Repair Parts and Special Tools List for Dual Beam Aiming Laser-Advanced 2 (DBAL-A2), AN/PEQ-15A (NSN: 5855-01-535- 6166) (NSN: 5855-01-579-0062) (LIN: J03261),* 1 September 2012.

TM 9-5855-1913-13&P, *Operator and Field Maintenance Manual Including Repair Parts and Special Tools List for the Illuminator, Integrated, Small Arms (STORM) AN/PSQ-23*

TAN (NSN: 5855-577- 5946 (4XG) (NSN: 5855-01-535-1905) (EIC: 4XF) (LIN: J68653), 31 August 2012.

TM 9-5855-1914-13&P, *Operator and Field Maintenance Manual Including Repair Parts and Special Tools List for the Advanced Target Pointer Illuminator Aiming Light (ATPIAL) AN/PEQ-15 (NSN 5855-01-534-5931) (NSN 5855-01-577-7174) {TM 10470B-0I/1}*, 10 September 2012.

TM 9-5855-1915-13&P, *Operator and Field Maintenance Manual (Including Repair Parts and Special Tools List) for the Target Pointer Illuminator/Aiming Light (TPIAL) AN/PEQ-2A (NSN: 5855-01- 447-8992) (EIC: N/A) AN/PEQ-2B (5855-01-515-6904) (EIC: N/A) {TM 10470A-0I/1}*, 31 August 2007.

PRESCRIBED FORMS

Unless otherwise indicated, DA forms are available on the Army Publishing Directorate (APD) website: http://www.apd.army.mil.

DA Form 7518, *MK 19 40-mm Grenade Machine Gun, MOD 3 Firing Table I Day Practice and Qualification With Hull Targets Scorecard*

DA Form 7519, *MK 19 40-mm Grenade Machine Gun, MOD 3 Firing Table II Night Practice and Qualification With Hull Targets Scorecard*

DA Form 7520, *MK 19 40-mm Grenade Machine Gun, MOD 3 Firing Table III Day Practice and Qualification With Pop-up Targets Scorecard*

DA Form 7521, MK 19 40-mm Grenade Machine Gun, MOD 3 Firing Table IV Night Practice and Qualification With Pop-up Targets Scorecard

REFERENCED FORMS

Unless otherwise indicated, DA forms are available on the Army Publishing Directorate (APD) website http://www.apd.army.mil.

DA Form 2028, *Recommended Changes to Publications and Blank Forms*.

DA Form 5517, *Standard Range Card*.

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10 May 2017

By Order of the Secretary of the Army:

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