TC 3-22.240

MEDIUM MACHINE GUN

APRIL 2017

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Medium Machine Gun

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Preface

Training Circular (TC) 3-22.240 uses joint terms where applicable. Selected joint and Army terms and definitions appear in both the glossary and the text. Terms for which TC 3-22.240 is the proponent publication (the authority) are marked with an asterisk (*) in the glossary. Definitions for which TC 3-22.240 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 3-22.240 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 27-10.)

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 TC 3-22.240 is the United States Army Maneuver Center of Excellence. The preparing agency is the Maneuver Center of Excellence, Fort Benning, Georgia. Send comments and recommendations on DA Form 2028 (Recommended Changes to Publications and Blank Forms) to Commander, Maneuver Center of Excellence, Directorate of Training and Doctrine, Doctrine and Collective Training Division, ATTN: ATZB-TDD (TC 3-22.249), 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.

Introduction

Training Circular (TC) 3-22.240 is comprised of nine chapters and six appendices, and is specifically tailored to the individual Soldier's use of the M240-series medium machine gun (MMG). It provides specific information about the weapon, aiming devices, attachments, followed by sequential chapters on the tactical employment of the weapon system.

TC 3-22.240 is organized in a progressive manner, each chapter or appendix builds 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 describe the weapon, aiming devices, mountable equipment, 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, Ballistics.

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

TC 2-22.240 does not cover the specific machine gun strategy, ammunition requirements for the training strategy, or range operations. Separate training circulars cover those areas.

TC 3-22.240 applies to all Soldiers, regardless of experience or position. TC 3-22.240 is designed specifically for the Soldier's use on the range during training, and as a reference while deployed.

Chapter 1
Overview

Chapter 1 describes the principles of proper weapons handling, tactical applications and control measures for handling the weapon. An overview of the concepts of overmatch as it pertains to a Soldier's individual weapon system is also discussed in this chapter.

Each Soldier is responsible for placing accurate and effective fires on threat targets with their individual weapon. To do this each Soldier must understand the functional elements of the shot process, the principles of operation of the weapon, the characteristics and description of ballistics and ammunition, and the various engagement techniques essential to building the Soldier's proficiency with their weapon system. The combination of knowledge and practice, builds and sustains the skills to achieve accurate and precise shots consistently during combat operations. (See figure 1-1).

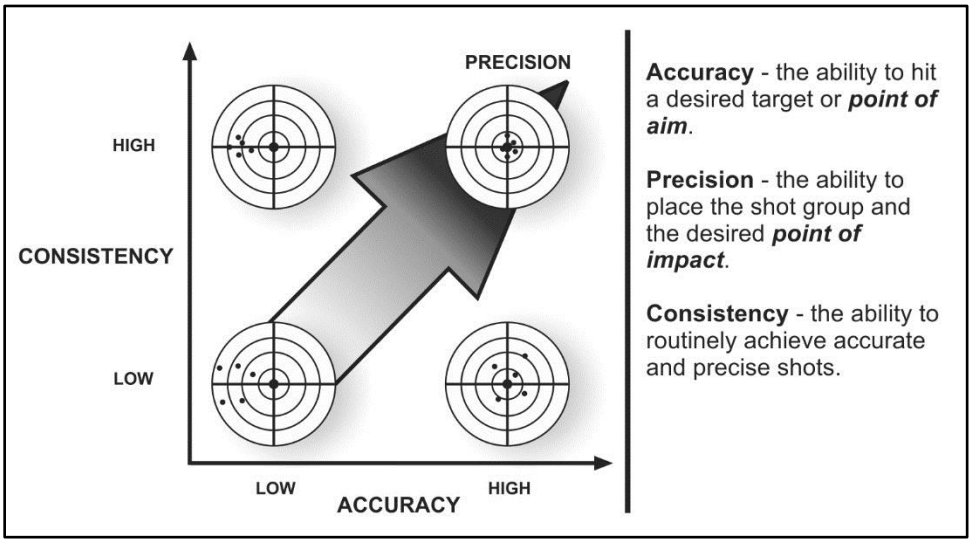


Figure 1-1. Employment skills

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, which are discussed below:

- 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 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 must be aware of muzzle discipline, the nature of the target, and what is behind it.

1-2. Soldiers must be cognitively aware of three distinct weapons handling measures, listed below, to safely and effectively handle weapons:

- The rules of firearms safety.
- Weapons safety status.
- Weapons control status.

1-3. The weapon handlings measures directly support the components of safe weapons handling. The weapons handling measures are designed to provide redundant safety measures when handling any weapon or weapon system, not just automatic rifles or light machine guns.

1-4. This redundancy allows for multiple fail-safe measures to provide the maximum level of safety in both 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 are always applied. If a unit requires Soldiers to violate these safety rules for any reason, such as for the use of blank rounds or other similar training munitions during training, the unit commander must take appropriate risk mitigation actions.

RULES OF FIREARMS SAFETY

1-5. The rules of firearms safety are standardized for any weapon a Soldier may employ. Soldiers must adhere to these precepts during training and combat operations, regardless of the type of ammunition employed, except as noted above.

RULE 1: TREAT EVERY WEAPON AS IF IT IS LOADED

1-6. Any weapon must be treated as if it is loaded and prepared to fire. Whether or not a weapon is loaded should not affect how a Soldier handles the weapon in any instance.

1-7. 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

1-8. 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.

1-9. 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 FINGER STRAIGHT AND OFF THE TRIGGER UNTIL READY TO FIRE

1-10. Soldiers must not place their fingers 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, a Soldier must not rely upon them solely for safe operation knowing that mechanical measures may fail.

1-11. Whenever possible, a Soldier 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

1-12. 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.

1-13. Application of this rule minimizes the possibility of fratricide, collateral damage, or damage to infrastructure or equipment. It also prepares the Soldier to re-engage the target when required.

WEAPON SAFETY STATUS

1-14. Weapon safety status 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. The following WSS are used for all M240-series weapons:

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

GREEN

1-15. The bolt is locked forward and the fire/safe selector switch is on fire (F). The feed tray and cover assembly are closed.

Note. The command given to direct a GREEN safety status is GREEN AND CLEAR or GO GREEN.

AMBER

1-16. The M240-series machine gun ***does not have*** an amber status. Units are not authorized to place the weapon into any form of amber status.

Note. Weapons that fire from the open bolt do not allow the safety to be engaged when the bolt is forward. For more information see weapon's technical manual (TM).

WARNING

Units are NOT authorized to employ the HALF-LOAD except aviation units that are employing door mounted systems on an Army aircraft

RED

1-17. The color red signifies that the machine gun ammunition is loaded on to the feed tray, bolt is open and locked to the rear, and the fire/safe selector switch is on SAFE.

Note. The command given to direct a RED safety status is MAKE READY.

BLACK

1-18. The color black signifies that the machine gun ammunition is loaded onto the feed tray, the bolt is locked to the rear, the selector switch is set to fire, and the Soldier's finger is on the trigger ready to engage.

Note. The command given to direct a BLACK safety status is driven by the unit's SOP, rules of engagement (ROE), or the command, FIRE.

1-19. Table 1-1 shows the WSS for the M240-series weapons.

Table 1-1. Weapons safety status for M240 series MMG

STATUS	GREEN	AMBER	RED	BLACK
Function	**CLEAR**	**N/A**	**READY, SAFE**	**READY, FIRE**
Commands	**GREEN AND CLEAR**	**N/A**	**MAKE READY**	**SOP/ ROE/ FIRE**
Ammunition	None	N/A	On feed tray	On feed tray
Bolt	Forward	N/A	Open and locked to rear	Open and locked to rear
Chamber	Empty	N/A	Empty	Empty
Safety	Fire	N/A	Safe	Fire
Trigger	OFF	N/A	OFF	ON

Note. The M240-series machine gun does NOT have an amber status. Units are not authorized to place the weapon into form of amber status. It emphasizes the importance of Safety First.

WARNING

Only aviation units employing door mounted systems on Army aircraft are authorized to employ the half-load procedures. Refer to TM 9-1005-313-10.

WEAPONS CONTROL STATUS

1-20. A weapons control status 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 weapons control status outlines the target identification conditions under which friendly elements may engage a perceived threat with direct fire.

1-21. Table 1-2 provides a description of the standard weapons control status used during tactical operations, both in training and combat. The table describes when the firer is authorized to engage a threat target once the threat conditions have been met.

Table 1-2. Weapons 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.

1-22. A weapons 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

1-23. Overmatch is the Soldier applying their learned skills, employing their equipment, leveraging technology, and applying the proper force to create an unfair fight in the Soldier's favor. To achieve and maintain overmatch against any threat, this publication focuses on providing information that develops the Soldier's direct fire engagement skills using 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**, c**onsistently accurate in the application of power to ensure delivery of the right effects in time, space, and purpose.

1-24. 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 his adversary. The Soldier must rely upon their training and their ability to leverage the capabilities of their optics, thermals, and sensors.
- Engagement range provides the Soldier with weapons, aiming devices, 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 provides the Soldier an advantage through technology and techniques, and compound their adversary's disadvantages during limited visibility conditions.
- Precision provides a weapon and ammunition package that enhances the Soldier's consistent application of burst with a level of precision greater than the adversary's.
- Speed is the weapon, aiming devices, and accessories a Soldier employs must seamlessly work in unison, be intuitive to use, and leverage natural motion and manipulations to facilitate rapid initial and subsequent burst during an engagement at close quarters, mid-, and extended ranges.
- Terminal ballistic performance ensures that precise burst delivered at extended ranges provide the highest probability to defeat the threat through exceptional ballistic performance.

1-25. 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

1-26. 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 3-22.240 describes the aiming devices for the M240-series MMG 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 provides key recognition information to build the Soldier's skills in correctly identifying potential targets as friend, foe, or noncombatant (neutral) once detected. (For more information about target acquisition, refer to chapter 5 of this publication.)

ENGAGEMENT RANGE

1-27. To ensure small-unit success, the Soldier requires weapon systems that can effectively engage threats at ranges greater than those of their adversaries. This creates a standoff distance advantage that allows friendly forces to destroy the target outside the threat's maximum effective range.

1-28. 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 has a range overmatch of 10 to 20 percent over an identified threat. 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.

1-29. Figure 1-2 portrays the battlefield from the Soldier's perspective. With mobile, maneuvering threats, the target acquisition capabilities must complement the engagement of those threats at the maximum effective range of the weapon, optic, and ammunition.

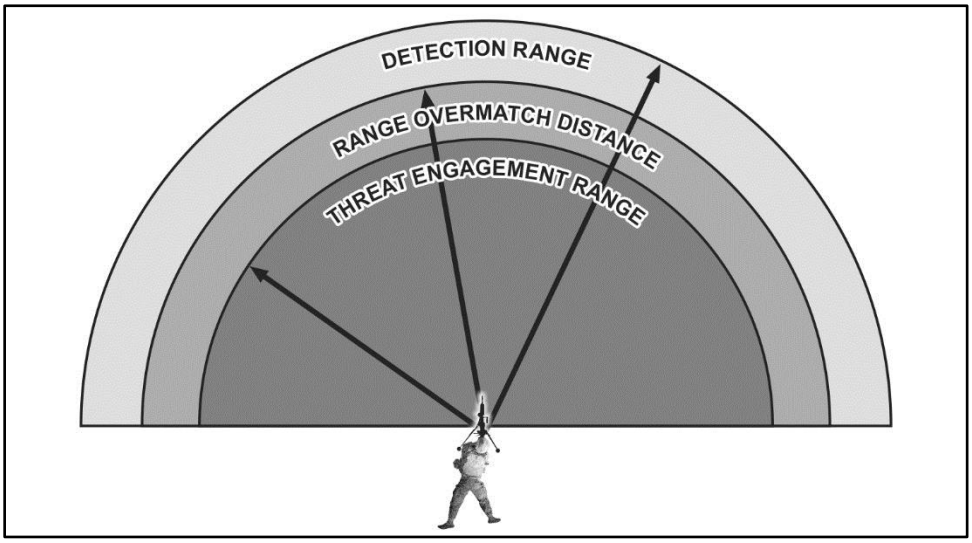


Figure 1-2. Small unit range overmatch

LIMITED VISIBILITY

1-30. Soldiers must be able to detect, acquire, identify, and engage threats in all light conditions, regardless of the tactical situation. Aiming devices are provided that minimize the effects of limited visibility (but not completely) to ensure Soldiers can engage threats in all light conditions.

1-31. 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 in chapter 3. Soldiers must understand what can be seen or viewed and what cannot 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

1-32. The Army M240 is designed with a specific level of accuracy at its maximum effective range. Magnified aiming devices and superior ammunition assures his level of accuracy is consistent and reliable.

The Soldier must build the skills to use the magnified aiming devices effectively to deliver precision fires during tactical engagements.

SPEED

1-33. 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 process to maintain the maximum amount of muzzle orientation on the threat through the shot process. This second-nature efficiency of movement only comes from regular practice, drills, and repetition.

1-34. 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 D) of this publication, and the training program of the unit.

1-35. 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 3-22.240 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

1-36. 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 machine gun performs exceptionally well out to its maximum effective range and beyond. Appendix A, Ammunition, and Appendix B, Ballistics, provide information on the various munition types available for training and combat, their capabilities and purpose, and the service (combat) round's terminal ballistic performance.

1-37. 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 creates an understanding of the appropriate skills necessary to deliver lethal fires.

1-38. Soldiers who understand "how and why" their weapon system, aiming devices, ammunition, and procedures work or function develop a more comprehensive understanding. Soldiers' level of understanding, coupled with a rigorous training program that builds and strengthens their skills creates more proficient Soldiers. The proficiencies and skills the Soldiers display during training translate into smart, fast, lethal and precise Soldiers for the small unit during decisive action combat operations.

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Chapter 2

Principles of Operation

Chapter 2 provides the general characteristics, description, major components, and principles of operation for the M240-series medium machine gun (MMG). Chapter 2 provides a general overview of the mechanics and theory of how the weapon operates, and the key terms and definitions related to their functioning.

DESCRIPTION

2-1. The M240 is a gas-operated, belt-fed, air-cooled, fully automatic weapon that fires from the open-bolt position. The weapon system has a standardized mounting surface for various optics, pointers, illuminators, and equipment, to secure those items with common mounting and adjustment hardware.

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

- Components are a 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 fitted parts that perform a specific set of functions during operation. Subassemblies are compartmentalized to complete a 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 MMG consists of eight major components: the barrel assembly, buffer assembly, bolt and operating rod assembly, driving spring rod assembly, trigger housing assembly, cover assembly, feed tray, and receiver assembly. These components are described below including their associated assemblies, subassemblies, and parts.

2-4. The machine gun shown in figure 2-1 on page 2-2, consists of the following components, assemblies, and parts:

- The barrel assembly houses the cartridge for firing and directs projectile.
- The buttstock/buffer assembly absorbs recoil for bolt and operating rod assembly at the end of recoil movement. The spade grip assembly initiates firing for the M240D/M240E1/M240H models.
- The driving spring rod assembly provides energy for returning bolt and operating rod assembly to firing position.
- The bolt and operating rod assembly provide feeding, stripping, chambering, firing, extraction, and ejection of cartridges using the projectile propelling gases for power. There are two different operating rods that are not interchangeable.
- The trigger housing assembly controls the firing of the machine gun. There are different triggers that are not interchangeable.

- The cover assembly feeds linked belt, positions and holds cartridges in position for stripping, feeding and chambering. Cover has integral sight mounting rail for current/future accessories (all models except M240C). There are different cover assemblies that are not interchangeable.
- The feed tray serves as a guide for positioning cartridges to assist in chambering
- The receiver assembly serves as a support of all major components. The receiver houses action of weapon, and controls functioning of weapon through a series of cam ways. It has a forward integral mounting rail for current/future accessories (M240B/M240L/M240H).

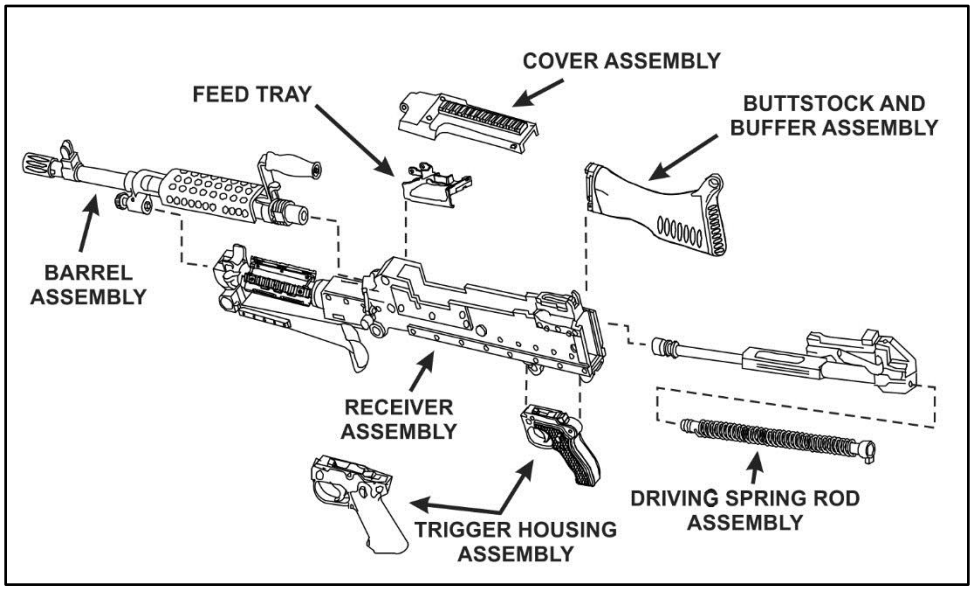


Figure 2-1. M240 major components

2-5. Additional information on the characteristics and components of the MMG can be found in TM 9-1005-313-10. Soldiers will use the TM for preventive maintenance checks and services (PMCS), and operation under normal conditions, as well as more detailed information on the principles of operation.

2-6. Each variant of the MMG has subtle capabilities differences. The primary differences are shown in table 2-1, and are specific to each variant

Table 2-1. Technical data for the M240 series MMG

MEDIUM MACHINE GUN	***WEIGHT***
M240/M240C	10.34 kilograms/22.8 pounds
M240B	12.29 kilograms/27.1 pounds
M240D	10.39 kilograms/22.9 pounds
M240E1	11.66 kilograms/25.7 pounds
M240H	11.70 kilograms/25.8 pounds
M240L	10.12 kilograms/22.3 pounds
M240N	10.93 Kilograms/24.1 pounds
RATE OF FIRE	***ROUNDS PER MINUTE***
Sustained	100 rounds per minute (four to five seconds between bursts). Change barrel every 10 minutes.
Rapid	200 rounds per minute (two to three seconds between bursts). Change barrel every two minutes.
Cyclic	650 to 950 rounds per minute. Not intended to fire at 950 rounds per minute. This will cause accelerated wear/damage to the barrel and rest of weapon. 550 to 650 rounds per minute – M240B/M240L/M240N with hydraulic buffer.
RANGE	***METERS***
Maximum range	3725 meters.
Maximum effective area	1800 meters with M122A1 tripod or M192 tripod (M240B/M240L).
Maximum effective point	800 meters M122A1 tripod or M192 tripod (M240B/M240L).
Tracer burnout	Approximately 900 meters.

MODELS

2-7. The theory of operations for all M240-series MMGs is relatively the same, but there are some slight differences between each model. All M240-series MMGs (see figures 2-2a and 2-2b on pages 2-4 and 2-5) have the following properties:

- All models recoil with gas-assist boost. Three gas settings help maintain a consistent rate of fire (with the exception of M240B/M240H).
- The firing pin is part of bolt and operating rod assembly, and cannot strike the primer until the bolt is fully locked.
- Fires from open bolt position prevent the explosion of a cartridge (cook-off) after prolonged firing.

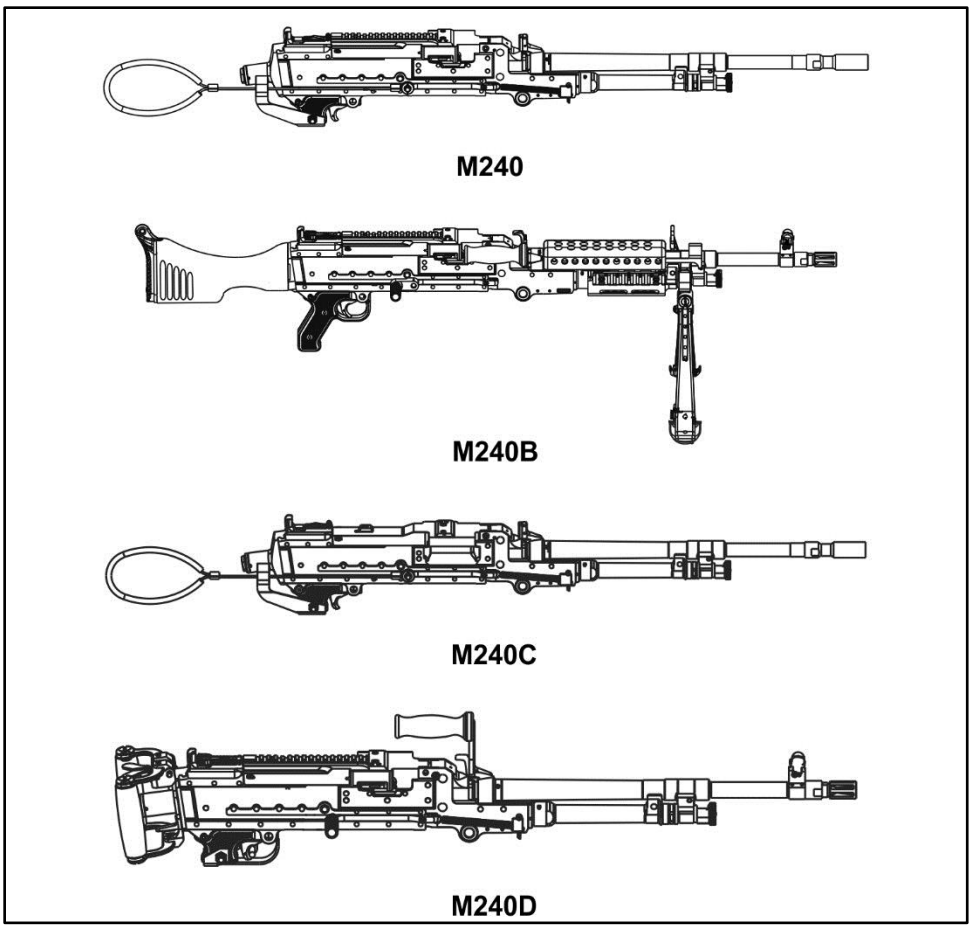


Figure 2-2. M240 variants

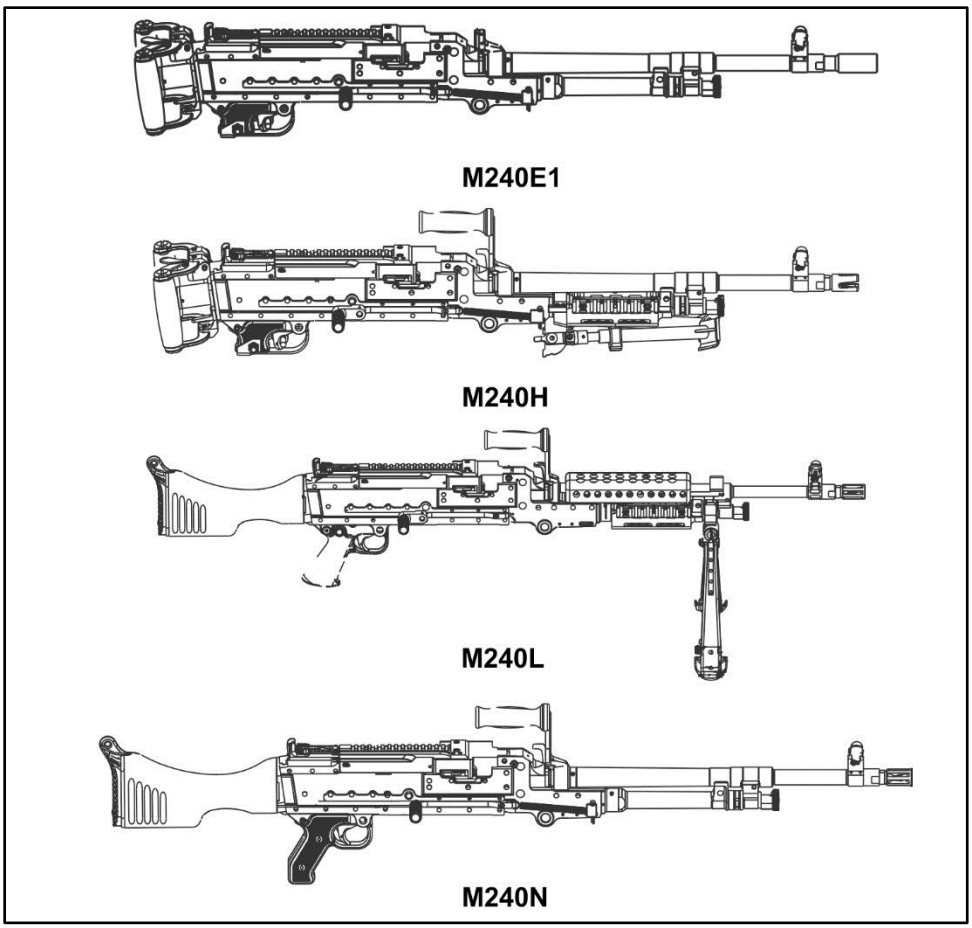


Figure 2-2 (continued). M240 variants

MOUNTED ON A COAXIAL MOUNT (M240/M240C)

2-8. The M240/M240C model is designed as a coaxial machine gun for tanks and 7.62-mm fire power on light armored vehicles. It has the following properties:

- Fires parallel to turret main gun.
- No sights on barrel.
- Can be fired manually or electrically.
- Fired manually from turret ring mount (M240 with optical top cover).

GROUND-MOUNTED (M240B/M240L)

2-9. The M240B/M240L model is designed as a tripod-mounted or bipod-supported MMG for use by ground forces and has the following properties:

- Mounted on tripod (M122A1/M192).
- Ground supported with integral bipod assembly.
- Has front and rear sights on machine gun and barrel.
- Optical accessory top cover and forward rail system.

MOUNTED ON EXTERIOR PINTLE LOCATION (M240D/M240H) (AVIATION) AND (M240E1)

2-10. M240D/M240H is designed as a pintle-mounted window or door gun for use in rotary aircraft. The M240E1 is designed with front and rear sights and a spade-grip trigger device and is pintle-mounted on light armored vehicles. The MMGs have the following properties:

- Mounted in pintle socket.
- Front and rear sights on machine gun.
- Optical accessory top cover.
- Forward rail system (M240H).

MOUNTED ON SPECIAL PURPOSE MOUNTS (M240N)

2-11. The M240N is designed with front and rear sights and is configured for mounting on watercraft. It has the following properties:

- Authorized use of right hand feed cover assembly, and tray as authorized additional list (AAL) to primary configuration.
- Front and rear sights on machine gun and barrel.
- Primary U.S. Navy small boat gun.
- Optical accessory top cover.

CYCLE OF FUNCTION

2-12. The cycle of function is the mechanical process a weapon follows during operation. The information provided below is specific to the cycle of function as it pertains specifically to the 240-series MMG.

2-13. The eight-step cycle of function begins when the gunner places the first round of the belt in the feed tray groove and the trigger is pressed. The sear is pulled down by the trigger, disengaging it from the sear notch on the bottom of the operating rod, and initiating forward movement of the operating group under the force of the expanding drive spring. It ends when the gunner releases the trigger and the sear again engages. The phases of the cycle of function in order are-

- Feeding.
- Chambering.
- Locking.
- Firing.
- Unlocking.
- Extracting.
- Ejecting.
- Cocking.

FEEDING

2-14. The bolt assembly roller moves the feed lever side to side, which in turn moves the feed pawls. The forward movement of the bolt forces the outer pawls to the right, fully feeding the round. The inner pawl rides over the round and settles behind it. The rearward movement forces the inner pawl to the right, fully feeding the round. This, in turn, pushes the link of a fired round out of the side of the gun. (See figure 2-3.)

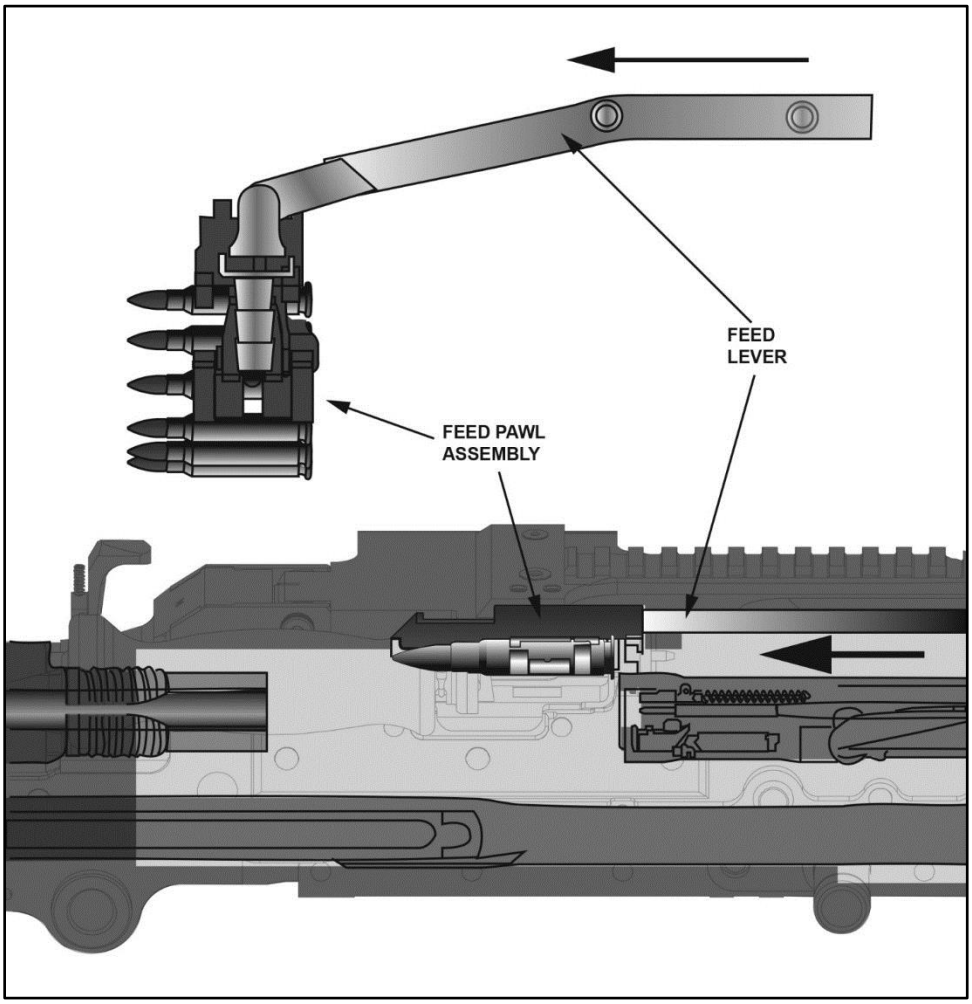


Figure 2-3. Feeding

CHAMBERING

2-15. As the bolt travels forward, the feed horn strikes the base of the round, and the bolt strips the round from the belt link. The chambering ramp angles downward, and, along with the spring tension of the cartridge guide pawl, forces the round toward the chamber. The cartridge guide pawl also holds back the belt link. When the round seats fully in the chamber, the extractor snaps over the extractor rim of the cartridge, and the ejector depresses. (See figure 2-4.)

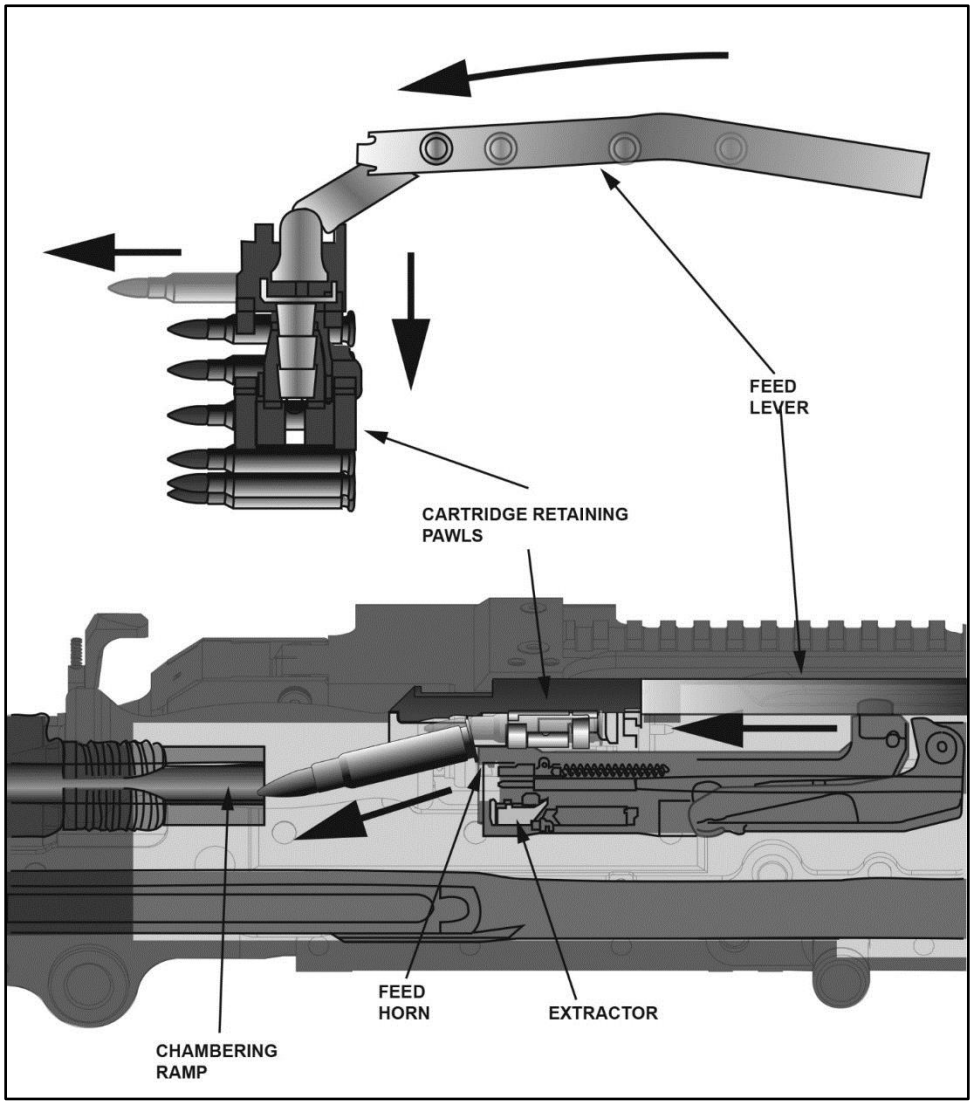


Figure 2-4. Chambering

LOCKING

2-16. During chambering, as soon as the piston begins to move, the firing pin is withdrawn into the bolt block. The breech remains locked during the primary movement. The bolt enters the barrel breech as the driving spring drives the operating rod forward, and as the locking lever, which the bolt is riding on, swings forward, pushing the bolt forward and locking it to the barrel breech. Although the term, locking, is used here, in the M240-series, the bolt and barrel do not physically interlock. This way, the barrel can be removed when the bolt is forward. (See figure 2-5.)

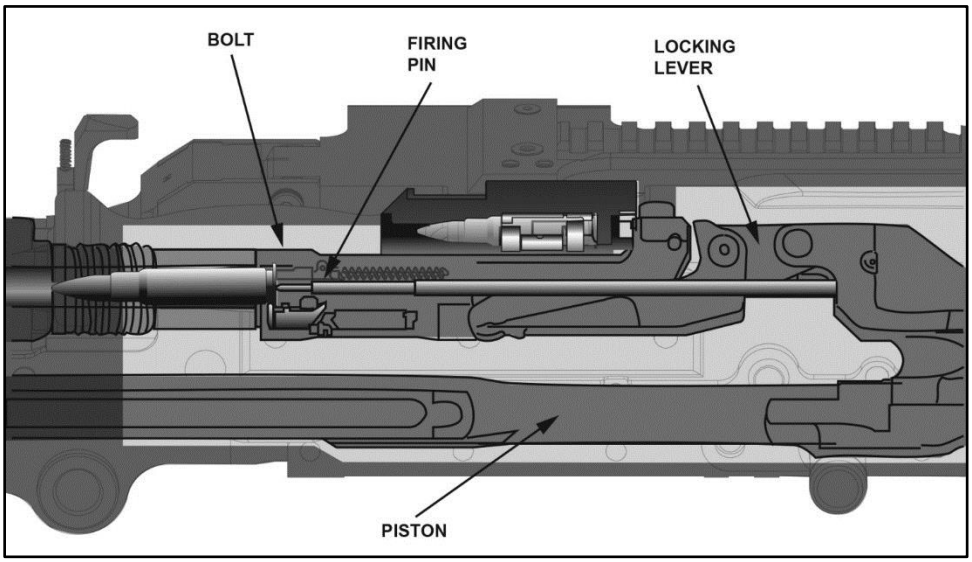


Figure 2-5. Locking

FIRING

2-17. After the bolt reaches its locked position, the operating rod moves forward independent of the bolt. The final forward movement of the piston extension drives the firing pin through the bolt assembly onto the cartridge primer and fires the round. At this point, the working parts are fully forward. (See figure 2-6.)

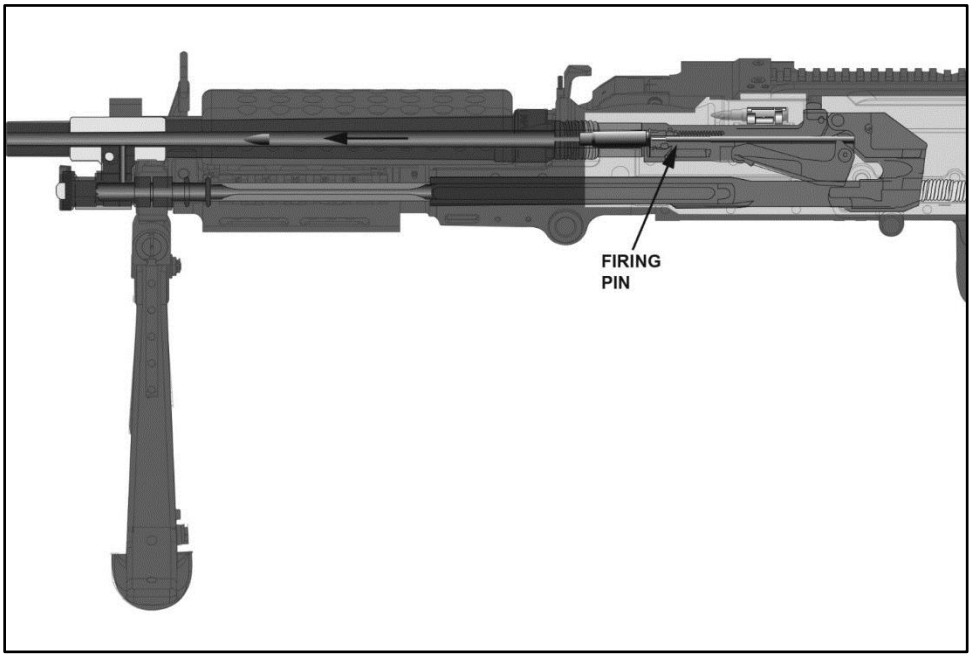


Figure 2-6. Firing

UNLOCKING

2-18. When the gunner fires a round, some of the gasses pass through the gas plug regulator into the gas cylinder. The rapidly expanding gases enter the hollow end cap of the gas piston and force the operating assembly to the rear. This powers the last four steps in the cycle of function. During the primary movement of the operating rod assembly, it moves independent of the bolt for a short distance. At this point, the locking lever begins to swing toward the rear, carrying the bolt with it into its unlocked position, and clearing the barrel breech. (See figure 2-7.)

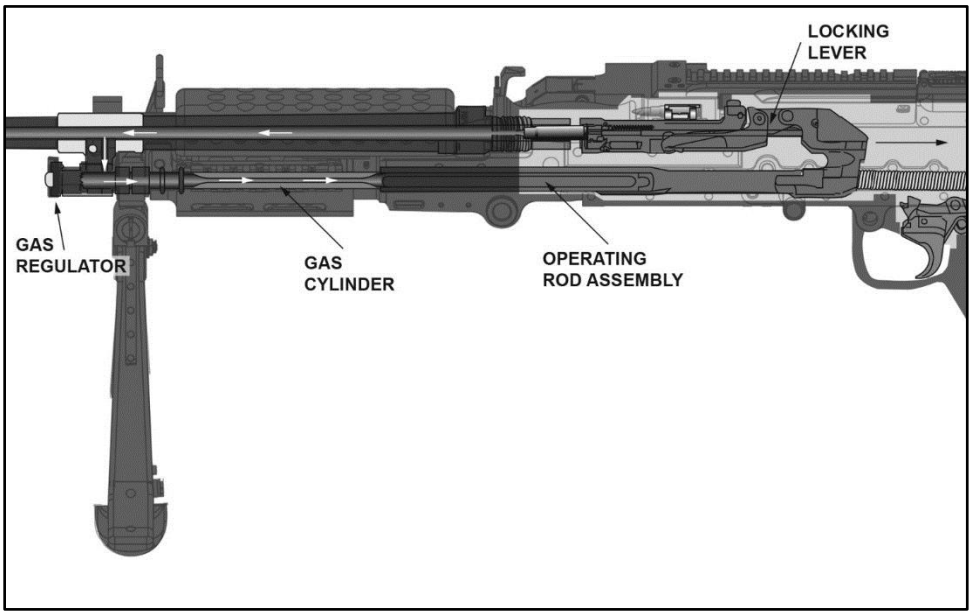


Figure 2-7. Unlocking

EXTRACTING

2-19. When the breech is fully unlocked and the bolt assembly starts its rearward movement, the extractor withdraws the empty case from the chamber. (See figure 2-8).

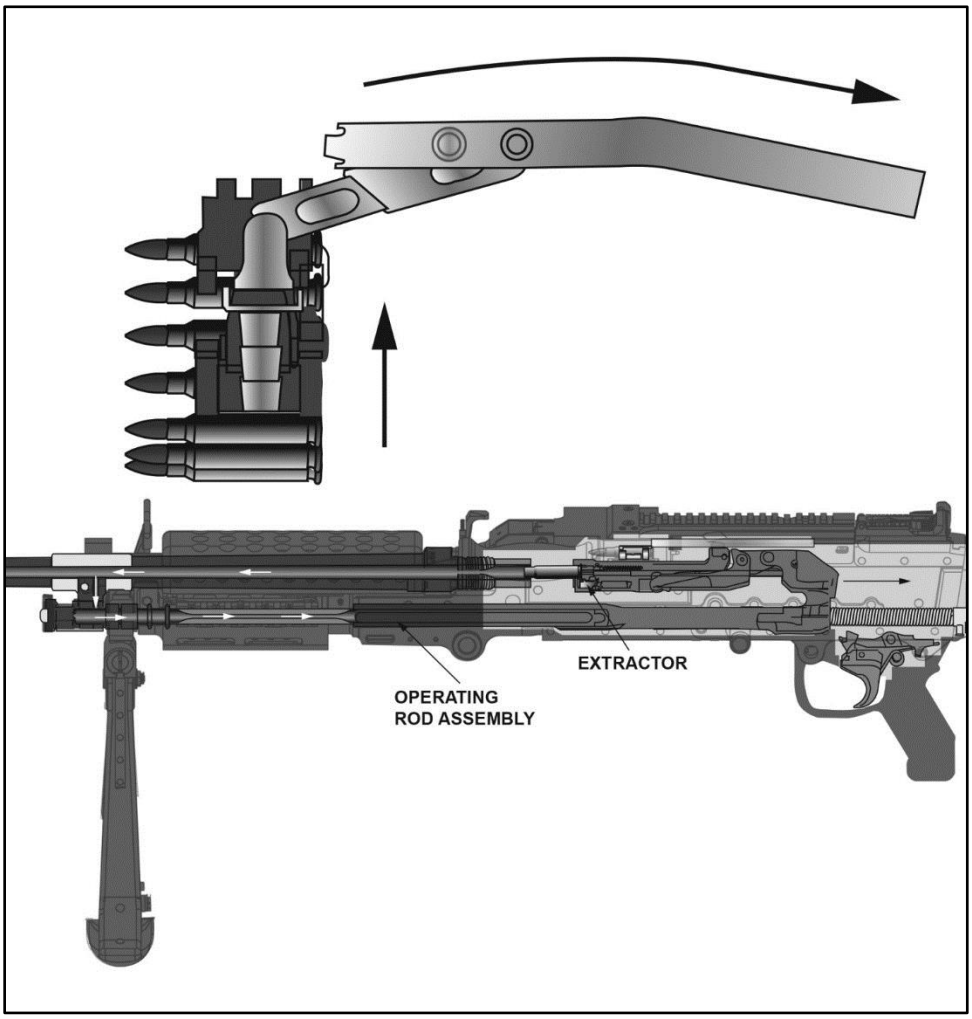


Figure 2-8. Extracting

EJECTING

2-20. As the cartridge case is withdrawn from the chamber, the ejector pushes from the top, and the extractor pulls from the bottom. The casing falls down from the face of the bolt as soon as it reaches the cartridge-ejection port. The empty belt links are forced out the link ejection port as the bolt's rearward movement causes the next round to be positioned in the tray groove. (See figure 2-9.)

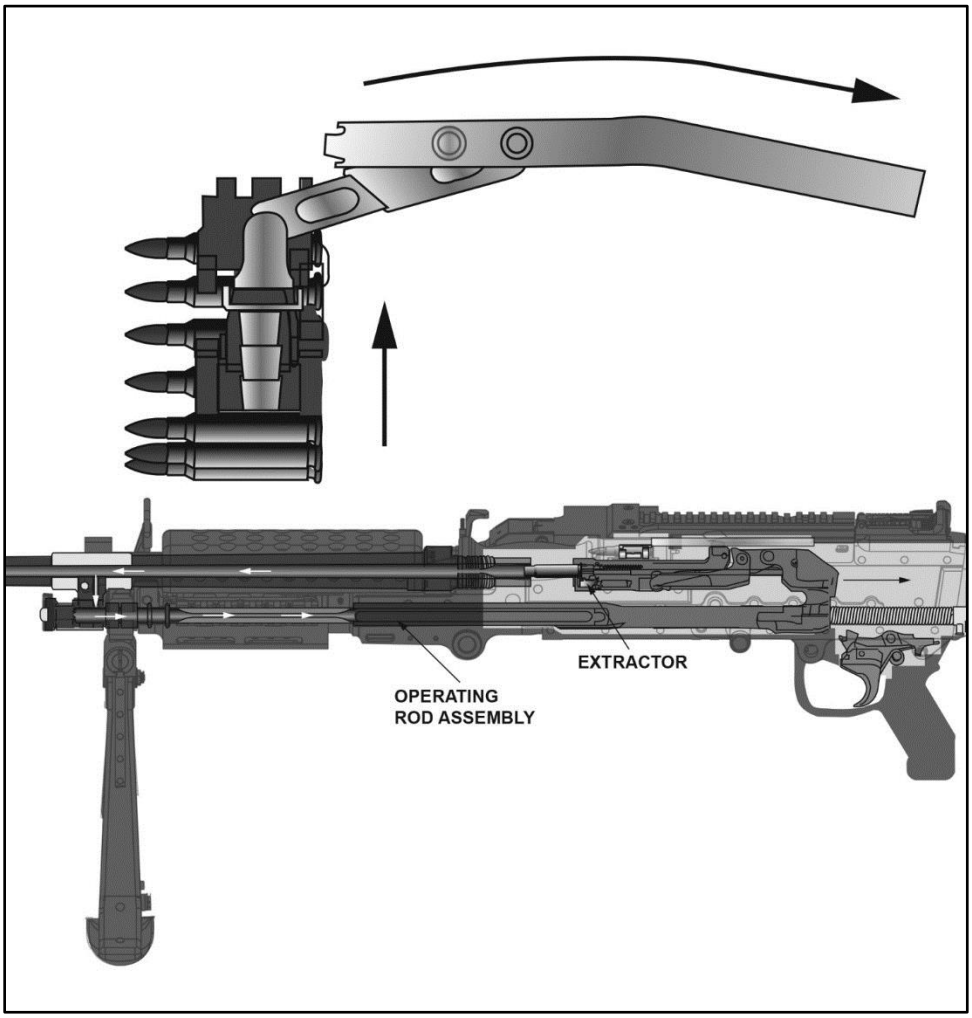


Figure 2-9. Ejecting

COCKING

2-21. As the working parts continue toward the rear, the return spring compresses and the gunner maintains their trigger squeeze. The gas regulator adjustment makes sufficient gas available, which causes the working parts to rebound off the buffer; continuing the cycle of feeding and firing continues. When the gunner releases the trigger, the sear remains down, but the tripping lever rises. As the working parts come to the rear, the end of the piston rod extension hits the tripping lever, which, in turn, allows the sear to rise and engage the sear notch, which holds the working parts to the rear.

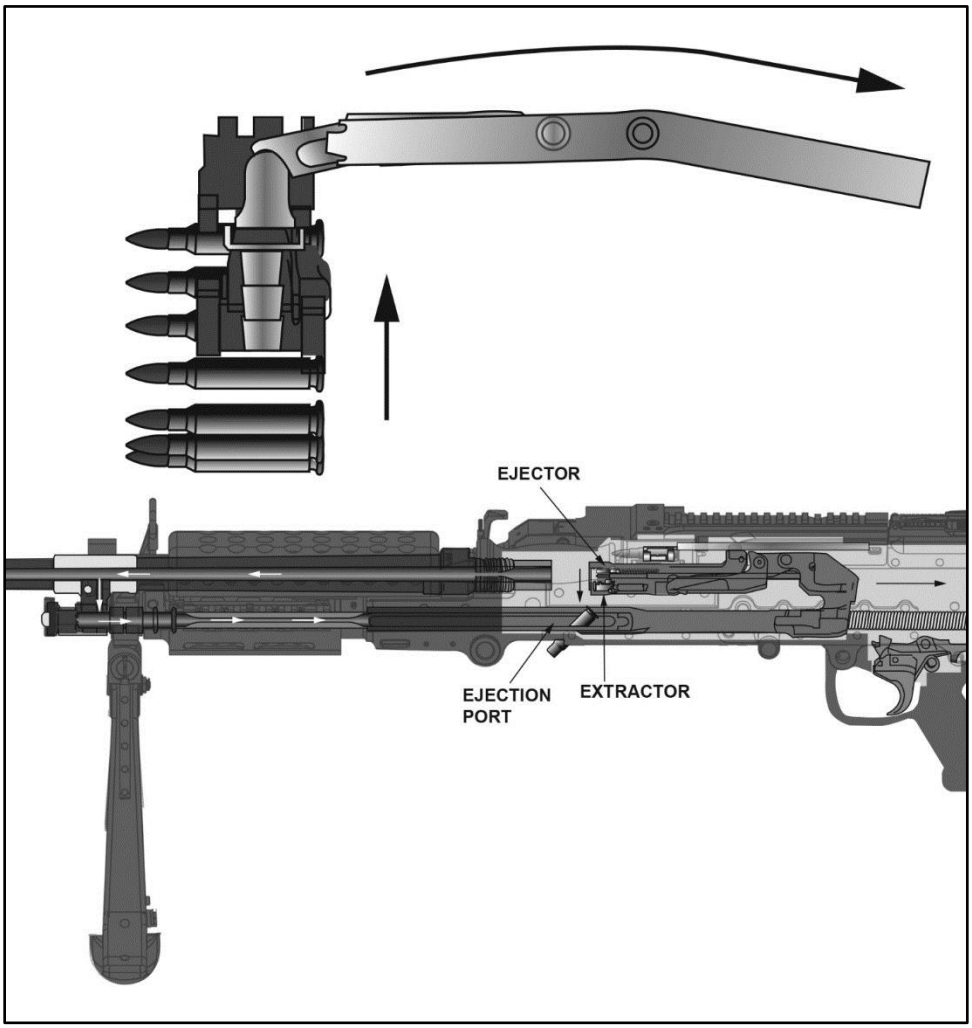


Figure 2-10. Cocking

COOLING

2-22. Cooling is the process of dissipating heat from the weapon during firing. Although not part of the cycle of functioning, 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.

2-23. Burning propellant powders raises the temperature of the weapon to over one thousand degrees Fahrenheit. Some of the heat produced during firing is retained in the chamber, bore, and barrel during firing and poses a significant hazard to the firer. How the weapon absorbs the heat and dissipates or removes the

heat is a function of engineering and design. The M240 weapon system must have a means to radiate the heat outward, away from the barrel, to allow continuous firing.

2-24. There are three methods to reduce the thermal stress on a weapon. The M240 series of weapons uses all three of these methods to varying degrees to cool the chamber, bore, and barrel to facilitate continuous operation. These three methods of cooling are radiation, conduction, and convection.

RADIATION

2-25. Radiation cooling allows for the dissipation of heat into the surrounding cooler air. Radiation cooling is the least efficient means of cooling, but is common to most small arms weapons and machine guns.

CONDUCTION

2-26. Conduction cooling occurs when a heated object is in direct physical contact with a cooler object. Conduction cooling on a weapon usually results when high chamber operating temperatures transfer 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

2-27. Convection cooling requires the presence of a moving air current. The moving air has greater potential to carry away heat. The hand guards and adaptive rail system are designed to facilitate air movement. The heat shield reflects heat energy away from the hand guard and back towards the barrel. The net effect is an updraft that brings the cooler air in from the bottom. The process establishes a convection cycle as heated air is continually replaced by cooler air.

Note. Weapons that fire from the open bolt position have distinct advantages. The heated cartridge case is extracted and expelled immediately from the weapon as the bolt moves to the rear removing the heat source. The barrel is open at both ends when the bolt remains locked to the rear allowing for faster cooling of the barrel due to air circulation. The system does not place a round into the hot chamber except when actually firing. This reduces the potential for a cookoff. A cookoff is a round that spontaneously ignites due to residual heat in the chamber.

2-28. Soldiers should be aware of the principles of the weapon's cooling methods direct effects on their line of sight when viewing a target through an aiming device. 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.

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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 is used to align themselves, 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.

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

- Iron**.** Iron represent the various types of mechanical sighting systems available on the weapon. The mechanical sighting system for the M240 consists of the rear aperture and front sight post.
- Optics**.** The optics aiming devices are predominantly for day firing, with limited night capability. This section covers the optics associated with weapon.
- Thermal**.** Thermals are electronic sighting systems that provide a view of the field of view (FOV) 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**.** These aiming devices use either a laser beam, flood light, or other light to aim the weapon at the target. There are three types of pointers, illuminators, and lasers used by the M240:
  - Advanced Target Pointer Illuminator Aiming Light (ATPIAL).
  - Dual Beam Aiming Laser–Advanced (DBAL-A2).
  - Illuminator, Integrated, Small Arms (STORM).

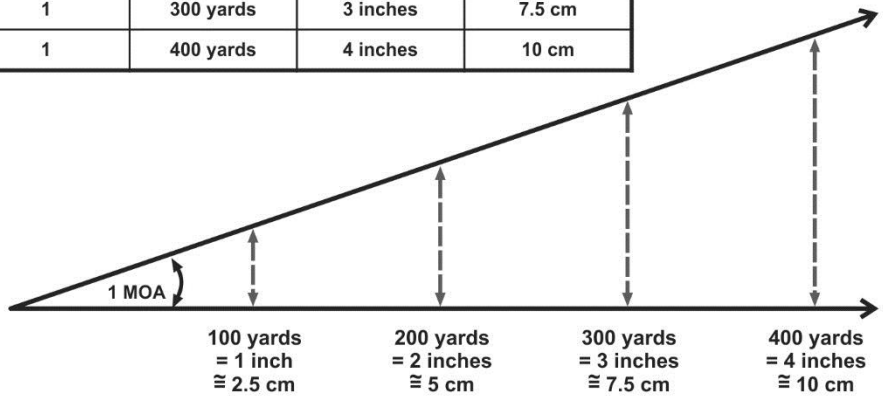
UNITS OF ANGULAR MEASUREMENT

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 the firer as it relates to firing the weapon.

MINUTE OF ANGLE

3-4. A MOA is an angular unit of measurement equal to 1/60th of a degree (see figure 3 1 on page 3-2). The most common use of MOA is when describing the distance of change required when zeroing a weapon. One MOA equals 1.047 inches per 100 yards. For most applications, a Soldier can round this 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 cm
1	200 yards	2 inches	5 cm
1	300 yards	3 inches	7.5 cm
1	400 yards	4 inches	10 cm



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

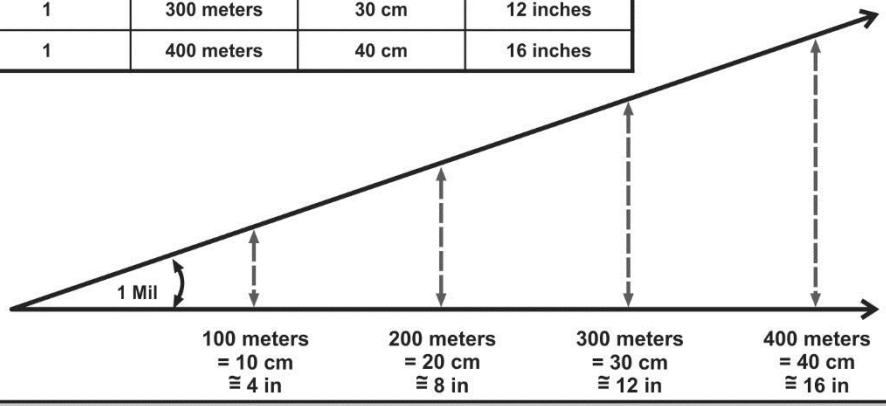
MINUTE OF ANGLE (MOA) Unit of Measeurement	
There are 360 degrees in a circle.	There are 60 MOA in a degree.
There are 21,600 MOA in a circle.	1 MOA at 100 yards ≈ 1 inch.
Smaller measurements of an MOA are described in fractions, not seconds (i.e., 1/2 MOA).	

Figure 3-1. Minute of angle example

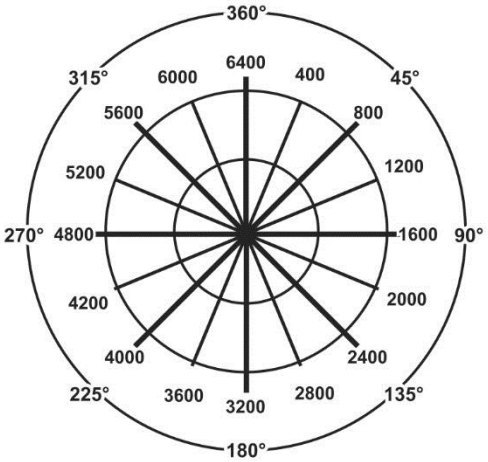
MILS

3-5. The mil is a common unit of angular measurement that is used in direct fire and indirect fire applications. (See figure 3-2).

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



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



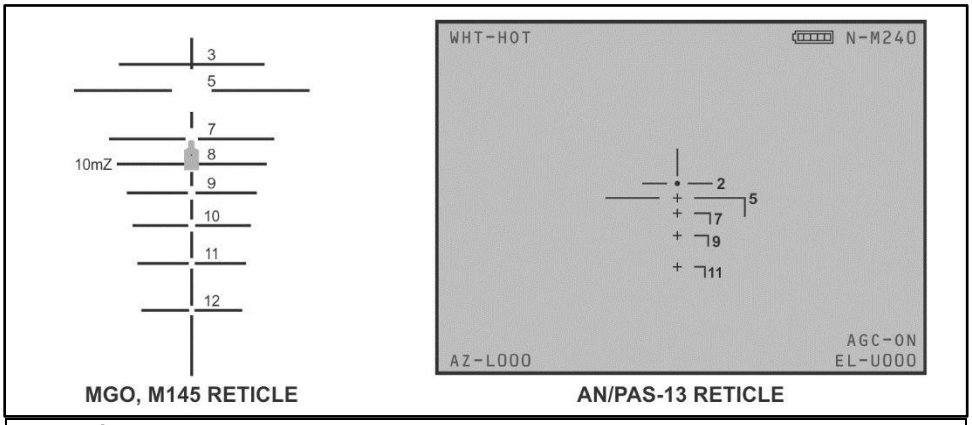
Legend:
cm= centimeters
in= inches

Figure 3-2. Mil example

3-6. Soldiers use the mil to degree relationship to describe military reticles, ballistic relationships, aiming devices, and on a larger-scale map reading and indirect fire.

BALLISTIC RETICLE

3-7. A ballistic reticle is a series of fine lines in the eyepiece of an optic, such as an MGO or TWS used as a measuring scale with included aiming or alignment points. Reticles use either mils or MOA for their unit of measurement. (See figure 3-3).

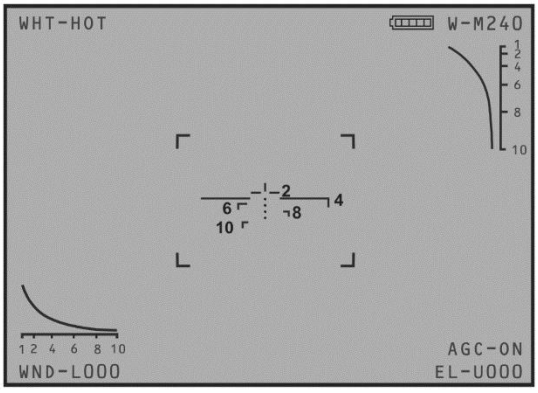


Legend:
AZ= azimuth
EL= elevation
mZ= meter zero

Figure 3-3. Machine gun optic reticle/thermal reticle examples

STADIA RETICLE (STADIAMETRIC RETICLE)

3-8. Commonly used in the thermal weapon sight (TWS), a stadia reticle provides a means of rapidly determining the approximate range to target of a viewed threat, based on its standard dimensions. The stadia reticle (sometimes referred to as stadiametric or choke sight) can provide approximate range to target information using width or height of a viewed dismounted target using standard threat dimensions (see figure 3-4).



Legend:
AZ= azimuth
EL= elevation
mZ= meter zero

Figure 3-4. Stadia reticle example

Note. This reticle refers to the AN/PAS 13B(V2); for specifics on your particular TWS refer to the appropriate TM.

3-9. The M240 reticle has two stadia reticles (see figure 3-5 and figure 3-6) within the thermal weapons sight—vertical and horizontal as described below:

- Vertical stadia. The vertical line of the range gauge reflects the height of a five-foot man at the specified range.
- Horizontal stadia. The horizontal line of the range gauge reflects the width of a 10-foot tank at the specified range.

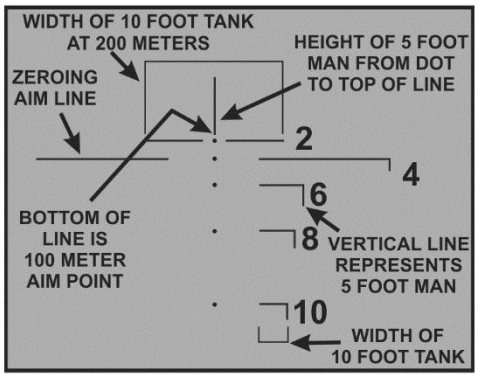


Figure 3-5. Thermal weapons sight, narrow field of view reticle, example

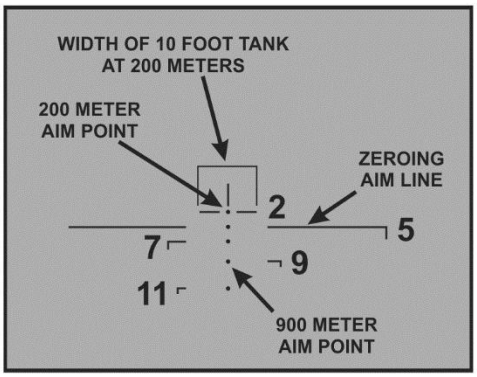


Figure 3-6. Thermal weapons sight, wide field of view reticle, example

ELECTROMAGNETIC SPECTRUM

3-10. Soldiers must understand how thermal and other optics aid in the detection process, but more appropriately what each device 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. Thermal devices see differences in heat.

- Thermal optics 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 3-7, page 3-7).
- Image intensifiers (I2) equipment, 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.

3-11. Generally, these sights 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.

3-12. Limitations of these optics include 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.

3-13. Situations where IR can see better than thermal sights 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 target's signature.

3-14. Figure 3-7 depicts the areas of the electromagnetic spectrum. The figure details the various wavelengths within the spectrum where the aiming devices, night vision devices, and equipment operate. Figure 3-7 illustrates where these items can and cannot see the others, respectively, within their operating range.

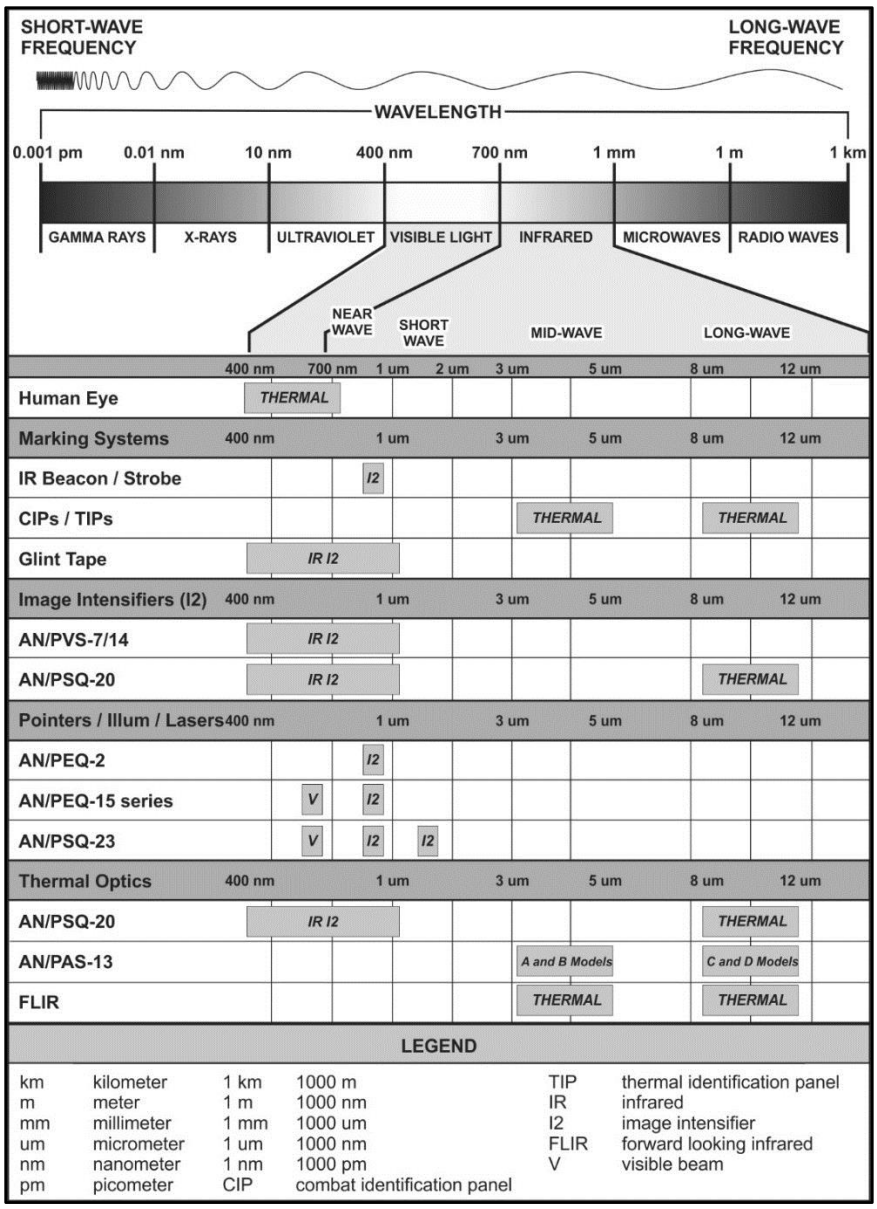


Figure 3-7. Electromagnetic spectrum

OPTICS

3-15. Optics are sighting aids for the MMG that provide enhanced aim point reticles. The optics may include magnified fields of view. Optics are specific to day operations, although they may be used during limited visibility or night operations. They do not have any method of enhancing low light conditions.

3-16. Optics enhance the Soldier's ability to engage targets accurately and at extended ranges. The available optic for mounting on the MMG weapon system are:

- Iron sight.
- M145 straight telescope. (Refer to TM 9-1240-415-13&P for the technical data, proper mounting and zeroing this equipment.)

IRON SIGHT

3-17. The M240 series MMG iron sight consists of a rear sight assembly that is securely mounted on the receiver assembly and an adjustable front sight post that is mounted on the barrel assembly. (Refer to TM 9-1005-313-10 for specifics on which variant of the M240 MMG has the front sight assembly mounted.)

3-18. The front sight aperture includes adjustments for both azimuth (wind) and elevation. Specific instructions for zeroing these aiming devices are found in the respective weapon's TM.

3-19. The iron sight uses the adjustable front sight post to create the proper aim. Soldiers use the front sight post centered in the rear aperture. The information in figure 3-8 and figure 3-9 is extracted from the weapon's TM.

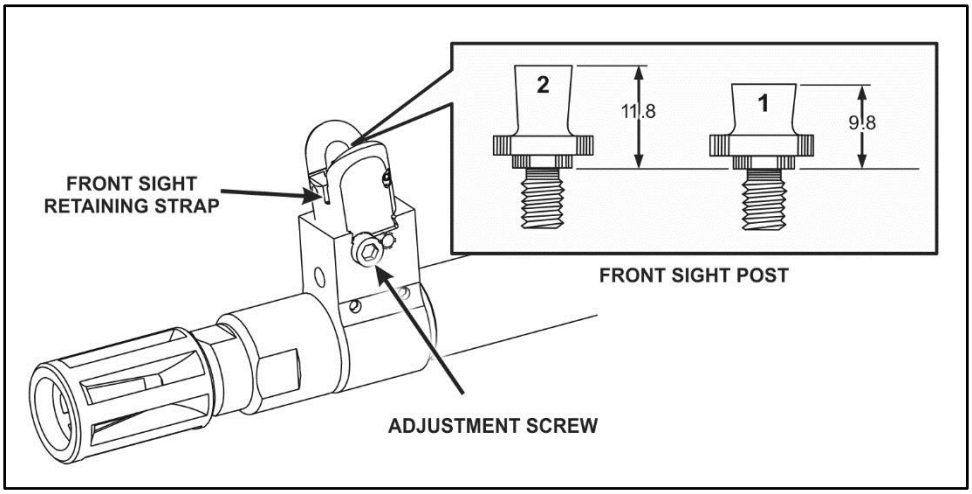


Figure 3-8. Example of front sight assembly

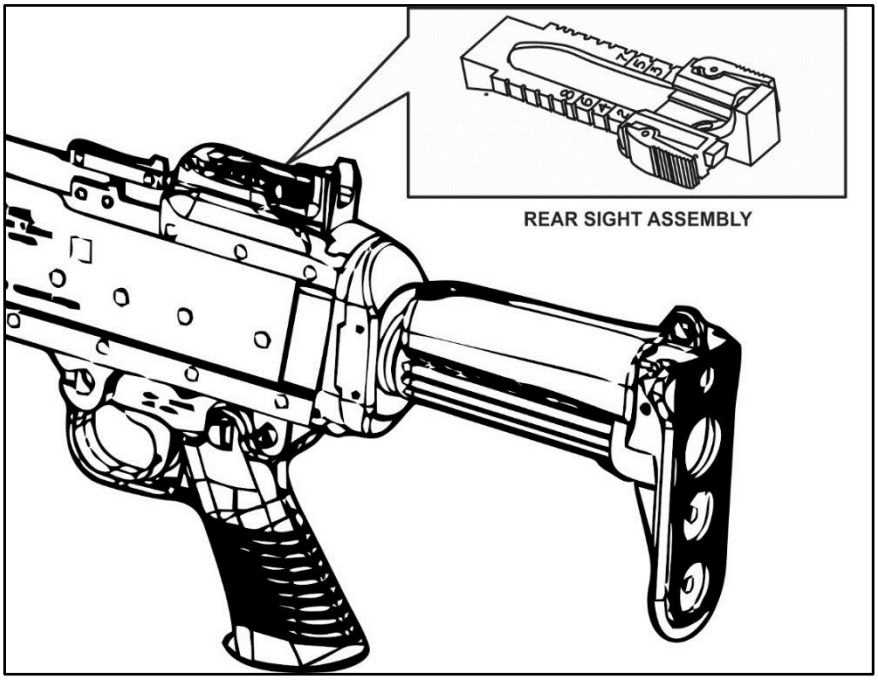


Figure 3-9. Example of rear sight assembly

3-20. Aiming devices mounted to the weapon system should be placed in a specific location on the weapon to maximize their capabilities. Table 3-1 provides the preferred mounting locations of the most common attachments.

Table 3-1. Optics and lasers weapons integration

ACCESSORY	*Technical Manual*
M145 machine gun optic (MGO)	TM 9-1240-415-13&P
AN/PAS-13B/C/D(V)2 medium weapon thermal sight (MWTS)	TM 11-5855-312-10
AN/PEQ-2A laser pointer/illuminator	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-beamed aiming laser—advanced (DBAL-A^2)	TM 9-5855-1914-13&P

MACHINE GUN OPTIC, M145

3-21. The M145 machine gun optic (MGO) is a telescopic sight. The telescope magnifies targets by 3.4 times. The telescope shows the strike of the round more clearly and allows more accurate shooting. In low light conditions, looking through the sight without the laser filter allows for more accurate target detection than with the naked eye. The lens cover protects the lens when the gunner transports or stores the sight. An O-ring keeps moisture out of the battery.

3-22. The M145 straight telescope must remain matched with the same weapon and attached at the same slot in the rail system. Otherwise it must be rezeroed. If the MGO must be removed for storage, Soldiers must record the serial number and the rail slot to retain zero.

Note. The weapon must be rezeroed if the MGO is not returned to the same rail slot on the adaptive rail system.

Advantages

3-23. The telescope has an 8.2-mm diameter exit pupil, which provides excellent vision in low light levels, and also allows for rapid target acquisition. The adjustment on brightness allow the Soldier to have the desired brightness from full daylight to blackout conditions.

3-24. The zeroing adjustment increments in both windage and elevation are 2.5 mm at 10 meters for each detent (click of movement) and five inches (127 mm) at 500 meters.

3-25. The stadia reticle pattern has a built-in trajectory compensation from 300 meters to 1200 meters.

Disadvantages

3-26. The telescope has an eye relief of approximately three inches (70 mm). If the eye relief is not correct, the image size is reduced.

3-27. The optic's ocular view is limited when engaging targets in close quarters engagements.

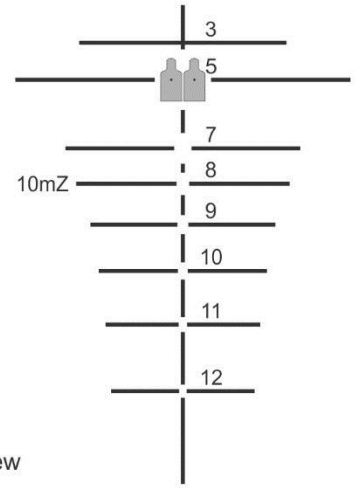
3-28. Figure 3-10 on page 3-10 illustrates the M145 straight telescopic sight.



M145 STRAIGHT TELESCOPE		
DIMENSIONS		
LENGTH	7.0 in	17.8 cm
BATTERY LIFE	175 hours average (New Battery)	
WEIGHT	24 oz	681 g

FUNCTION	SINGLE CLICK	
	10 METERS	500 METERS
ZERO WINDAGE	2.5 mm	5 inches
ZERO ELEVATION	2.5 mm	5 inches

RETICLE



NOTE: 500 m reticle view

LEGEND

cm	centimeters	in	inches	mZ	meter zero
g	grams	mm	millimeters	oz	ounces

Figure 3-10. M145 reticle, example

THERMAL SIGHTS

3-29. Thermal sights are target acquisition and aiming sensors that digitally replicate the field of view (FOV) based on an estimation of the temperature. They use advanced forward-looking infrared (FLIR) technology that identify the infrared emitted radiation (heat) of an FOV, 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. The TWS operates effectively during the day and night.

3-30. The TWS is composed of five functional groups: (See figure 3-11.)

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

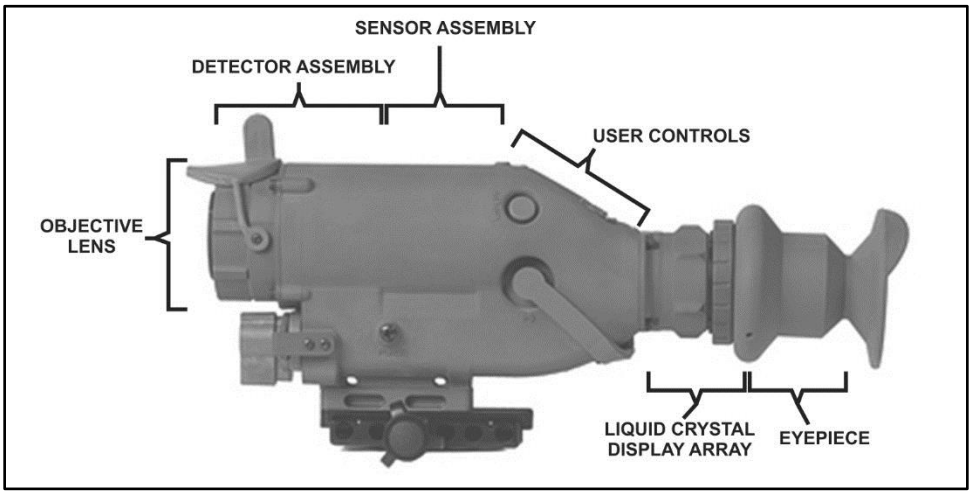


Figure 3-11. Thermal sight weapon example

3-31. A small detector used in thermal sensors or optics to identify IR radiation with wavelengths between 3 and 30 um (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 WEAPON THERMAL SIGHTS

3-32. There are several versions of weapons thermal sights available for use. Soldiers must be familiar with their specific model and version of their assigned weapons thermal sight, and be knowledgeable on the specific procedures for alignment and operation. The various models and versions are identified in their official model nomenclature:

- Version 1 (v1) – Light Weapons Thermal Sight (LWTS).
- Version 2 (v2) – Medium Weapons Thermal Sight (MWTS).
- Version 3 (v3) – Heavy Weapons Thermal Sight (HWTS).

3-33. Weapons thermal sights are silent, lightweight, and compact, and have durable battery-powered infrared imaging sensors that operate with low battery consumption. (See figure 3-12 on page 3-12.)



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)
AN/PAS-13F (v1)	AN/PAS-13F (v2)	AN/PAS-13F (v3)
AN/PAS-13G (v1)	AN/PAS-13G (v2)	AN/PAS-13G (v3)

Figure 3-12. Weapon thermal sights by version

ADVANTAGES

3-34. Military grade weapon thermal weapon sights are designed with the following advantages:

- Small and lightweight.
- Real-time imagery. Devices provide real-time video of the thermal scene immediately after power on.
- Long-lasting battery life. Low power consumption over time.
- Reliable. Long mean time between failures (MTBF).
- Quiet. The lack of a cooling element allows for a low operating noise level.
- One optic fits on multiple weapons. The use of the ARS rail mounting bracket allows for the same 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

3-35. These devices have limitations that Soldiers should take into consideration, 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.
- Reliance 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 non-rechargeable (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.

3-36. Thermal sight has a wide field of view and a narrow field of view (see figures 3-11 and 3-12).

POINTERS, ILLUMINATORS, LASERS

3-37. 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. 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.

3-38. The following devices (see table 3-2) are the most common laser pointing devices available for use on the M240-series MMG.

Table 3-2. Laser aiming devices for the M240 series

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

Note. The ATPIAL and DBAL-A2 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)

3-39. The AN/PEQ-2A aiming device is a Class IIIB laser devices that emit a collimated beam of infrared light for precise aiming and a separate infrared beam for illumination of the target or target area (see figure 3-12, page 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 infrared illuminator is equipped with an adjustable bezel to vary the size of the illumination beam based on the size and distance to the target.

3-40. The aiming devices are used with night observation devices. Soldiers can use the devices as handheld illuminators or pointers or they can mount the devices on the weapon with the included brackets and accessory mounts. In the weapon-mounted mode, the aiming devices can be used for direct fire and to illuminate and designate targets.

3-41. Pressing on either the ON/OFF switch lever or the button on the optional cable switch activates the aiming light. 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. Rotating the mechanical adjusters with click detents controls the direction of the beam. The adjusters zero the aiming light to the weapon.

CAUTION

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

3-42. The information in figure 3-13 can be found in the equipment's technical manual for Soldier reference.



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 3-13. AN/PEQ-2A

AB/PEQ-15 ADVANCED TARGET POINTER, ILLUMINATOR, AIMING LIGHT

3-43. The AN/PEQ-15 ATPIAL is a multifunctional laser that emits both a visible and infrared light for precise weapon aiming and target and area illumination. Soldiers can use the ruggedized system as a handheld illuminator or pointer or they can mount to weapons equipped with an M4- or M5- ARS (Military Standard [MIL STD] 1913).

- 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.

3-44. 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.

3-45. 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

The AN/PEQ-15 can be used during force-on-force training in the low power modes only. High power modes can be used on live-fire ranges exceeding 220 meters only.

3-46. The AN/PEQ-15, ATPIAL's (see figure 3-14 on page 3-16) visible aiming laser provides for active target acquisition in low light conditions and close-quarters combat situations. The aiming laser allows users to zero using the borelight without using night optical devices. When used in conjunction with night observation devices, its infrared aiming and illumination lasers provide for active, covert target acquisition in low light or complete darkness.

3-47. The ATPIAL visible and infrared aiming lasers are co-aligned. A single set of adjusters moves both aiming beams, and the user can boresight or zero using either aiming laser. The following information is an extract from the equipment's TM for Soldier reference.



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 3-14. AN/PEQ-15, ATPIAL

AN/PEQ-15A, DUAL BEAM AIMING LASER— ADVANCED 2

3-48. The AN/PEQ-15A DBAL-A2 is a multifunctional laser device that emits infrared pointing and illumination light, as well as a visible laser for precise weapon aiming and target and area illumination. The visible and infrared 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 or can be mounted to weapons equipped with an adapter rail system (MIL-STD-1913).

- 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).

3-49. 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.

3-50. The AN/PEQ-15A, DBAL-A2 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 night vision devices. When used in conjunction with night vision devises, its infrared aiming and illumination lasers provide for active, covert target acquisition in low light or complete darkness.

3-51. The DBAL-A2 visible and infrared aiming lasers are co-aligned. A single set of adjusters moves both aiming beams, and the user can boresight or zero using either aiming laser. The following information is an extract from the equipment's technical manual for Soldier reference (see figure 3-15, page 3-18).



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

Chapter 4

Mountable Equipment

The M240-series medium machine gun have a wide variety of attachments to increase Soldier lethality, situational awareness, and overmatch. The attachments can be applied in various locations on the weapon system. Soldiers must understand what the attachments are, how to position them correctly, how to align them with the weapon system, and how to integrate them to maximize the system's capabilities.

Chapter 4 explains how to mount the various attachments onto the adaptive rail system. It describes the weapons, aiming devices, and accessories available for mounting, and includes general information on the proper mounting location as well as their capabilities.

ADAPTIVE RAIL SYSTEM

4-1. The adaptive rail system (ARS) on the cover assembly and the accessory rail kit on receiver assembly of the M240B (NSN 1005-01-487-8049) are designed to mount aiming devices and accessories.

4-2. The ARS provides a secure mounting point for various accessories that may be mounted on the weapon's top, left, and right. Each rail groove has an incremental number identifying the slot location, starting from the rear of the weapon.

4-3. 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.

4-4. 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.

4-5. 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 are degraded.

MOUNTABLE ACCESSORIES

4-6. Mountable accessories are items that may be attached to a weapon but are not required for operation. Mountable accessories assist with stabilizing the weapon or provide white-light illumination for specific tactical operations.

4-7. These devices are authorized as needed by the small unit. Some mountable accessories are aftermarket (commercial-off-the-shelf, or COTS) items that use the ARS for semi-permanent attachment.

COLLAPSIBLE BUTTSTOCK

4-8. The collapsible buttstock kit (NSN 1005-01-576-4661) (see figure 4-1) provides the firer a number of comfort positions depending on the individual's body composition. The collapsible buttstock is adjustable from 10.125 inches to seven inches in five increments, each approximately .75 inches apart.

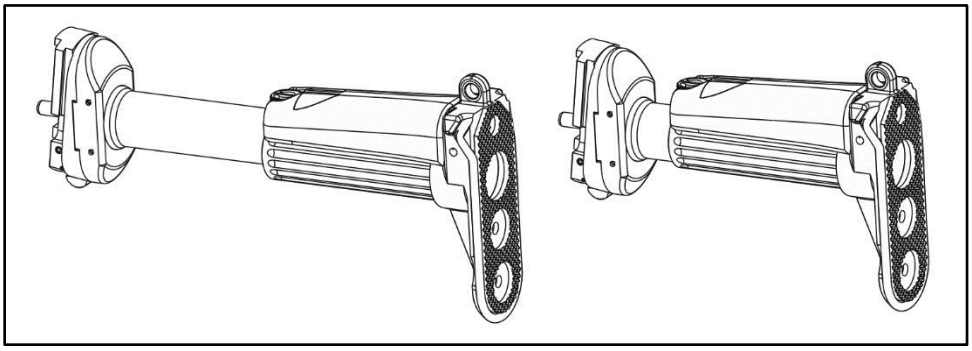


Figure 4-1. Collapsible buttstock

ADJUSTABLE BIPOD

4-9. The M240B adjustable bipod kit (NSN 1005-01-586-8837) (see figure 4-2) is highly adjustable and enhances stability within the battle space environment. It is secured by the front sling swivel foregrip of the weapon. It can be used in combination with a sand sock or other buttstock support to provide an extremely stable firing platform.

4-10. The bipod provides additional support which facilitates acquisition of muscle relaxation and natural point of aim. The use of bipods in barricade shooting can increase the Soldier's efficiency and probability of a first-round hit while engaging targets.

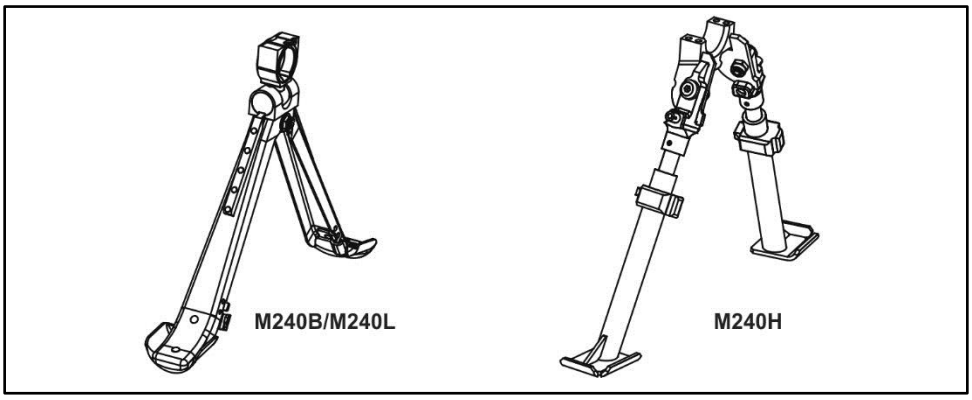


Figure 4-2. Adjustable bipod

TRIPOD

4-11. The tripod (see figure 4-3) provides stability along the left-to-right and fore-and-aft coordinate axis of motion. The tripod is provides a stable weapon support system for use in ground mounting applications of various weapon systems. Tripods have the disadvantage of being heavy and bulky although when used in firing mode they have enough stability to be used with large firearms. The tripod permits the firer to rest the weapon on the ground and thus the gun feels lighter to the firer and accuracy is increased. (Refer to TM 9-1005-344-10 for more information.)

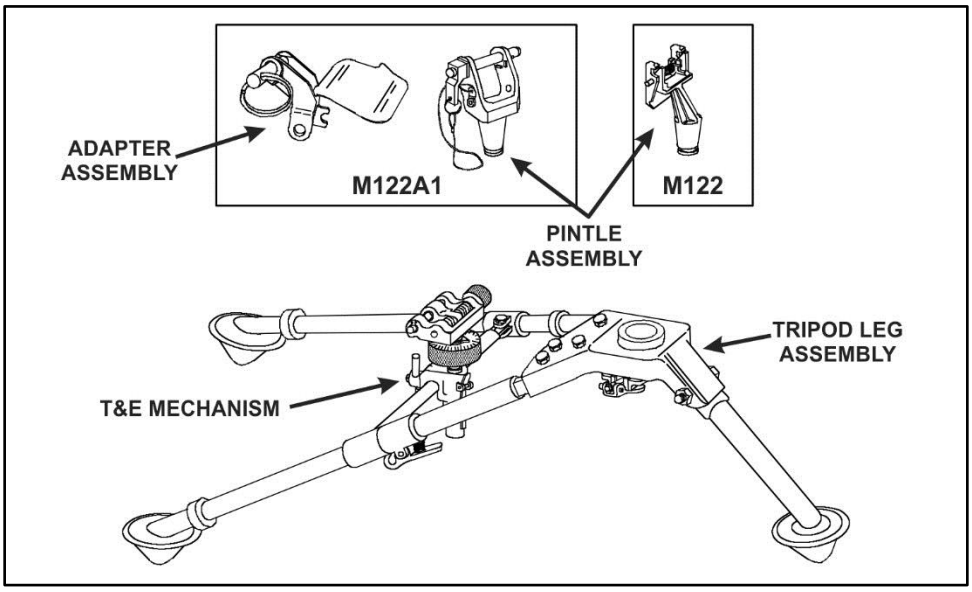


Figure 4-3. M122 and M122A1 tripod

4-12. Both the M122 and M122A1 tripods have three tubular folding legs connected at the head assembly. The head assembly provides a support base for the machine gun through a pintle attached to the weapon and tripod.

4-13. Each leg end has a metal shoe that can be stamped into the ground, for stability. The rear legs are joined together by the traversing bar assembly. The traversing bar assembly is hinged on one side; with an adjustable sleeve and sleeve latch on the other. This allows the tripod to collapse into a closed position for carrying and storage; or to lock in an open position for use. The traversing bar serves as a rear support for the traversing and elevating mechanism (T&E), which in turn supports the rear of the machine gun.

4-14. When in the M122A1 configuration the T&E has an adapter assembly attached, to deflect ejected cartridge cases from the M240B machine gun. The T&E mechanism is used to engage pre-selected target areas. Direction and elevation readings can be obtained from the traversing bar and the T&E mechanism. A scale shows approximately 250-mil depression and 100-mil elevation, graduated in 5 mil increments. In traverse it is numbered every 100- mils from 0 (center) to 450-mils (left) and 425-mils (right). Graduation movements of the hand wheel are synchronized to the upper elevating screw.

4-15. The M192 machine gun ground mount is a system with an integrated traversing and elevation mechanism (T&E) (see figure 4-4 on page 4-4). The traverse bar and mounting bracket assembly serves as rear support for the T&E, which in turn supports the rear of the M240B machine gun. The scale range is 0 to approximately 530 mils in elevation with 1 mil readability. The traverse bar is joined to the frame assembly by two shoulder bolts, and the elevation bar fits into a quick release socket on the bottom of the mounting bracket assembly. The traverse scale range is 0 to approximately 900 mils in one-mil increments. (Refer to TM 9-1005-344-10 for further information.)

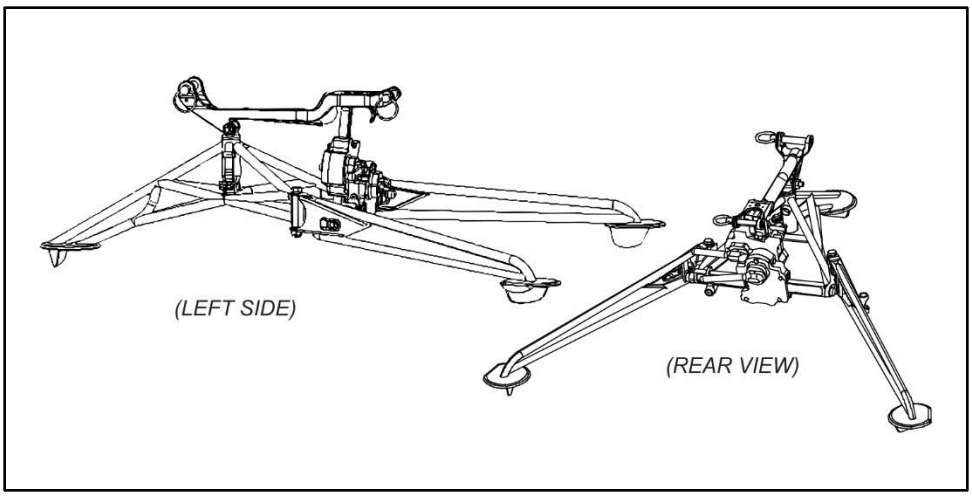


Figure 4-4. M192 tripod

4-16. The T&E is locked to the traversing bar by the traversing lever. The T&E is properly mounted when the traversing lever is to the rear and the traversing hand wheel is on the left. Refer to TM 9-1005-344-10 for further information.

Chapter 5

Employment

The machine gunner's primary role is to engage the enemy with well-aimed bursts. The machine gunner is the subject matter expert for employment of the medium machine gun, and advises the rifle squad leader of the best way to employ the medium machine gun (MMG). (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 rounds are fired. The interactions include maintaining postural steadiness, establishing and maintaining the proper aim on the target, stabilization of 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. The Soldier's ability to hit the target under conditions of extreme stress rely upon the following:

- Interpret and act upon perceptual cues related to the target, front and rear sights, rifle movement, and body movement.
- Execute minute movements of the hands, elbows, legs, feet, and cheek.
- Coordinate gross motor control of their body positioning with fine motor control of the trigger finger.

5-2. The Soldier's goal when shooting is to fire well-aimed bursts, regardless of the weapon system. The Soldier must properly point the weapon (sight alignment and sight picture), and fire the weapon without disturbing the aim. Soldiers must master sight alignment, sight picture, and trigger control.

- 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. The shot process has three distinct phases:

- Pre-shot.
- Shot.
- Post-shot.

5-4. Soldiers must understand and correctly apply the shot process to achieve consistent, accurate, well-aimed shots. The sequence of the shot process does not change, however, the application of each element vary based on the conditions of the engagement. Every shot that the Soldier fires has a complete shot

process. Grouping, for example, is simply moving through the shot process several times in rapid succession.

5-5. 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.

5-6. 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

FUNCTIONAL ELEMENTS OF THE SHOT PROCESS

5-7. 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. The functional elements are interdependent. An accurate shot, regardless of weapon system, requires the Soldier to establish, maintain, and sustain all of the four functional elements defined below:

- 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.

5-8. The functional 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. Soldiers can rapidly engage targets when all the functional elements are applied.

5-9. The shooter must consider the functional elements of time, target size, target distance, and their own skills and capabilities to minimize induced errors of the shot.

5-10. 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 firer progresses through the process is based on target size, target distance, and firer's capability.

5-11. The most complex form of shooting is under combat conditions when the Soldier and the enemy is moving under limited visibility conditions. Soldiers and leaders must refine their skills continuously and move training from the simplest engagement 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. Each of the functional elements and the Soldier's actions to consider during the shot process are described later in this manual.

TARGET ACQUISITION

5-12. Target acquisition is the ability of a Soldier to rapidly recognize threats to the friendly unit or formation. It is a critical Soldier function before any shot process begins. It includes the Soldier's ability to use all available optics, sensors, and information to detect potential threats as quickly as possible.

5-13. 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, which are—

- 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

5-14. Soldiers must master a series of skills to perform effective target detection. Detection is an active process during combat operations with or without a clear or known threat presence. The Soldier's detection skills enable all engagements and are built upon the following 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 Soldier's ability to determine the general location of a threat and to engage with accuracy or to inform the small-unit leader of contact with a potential threat.

Scan and Search

5-15. 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. Environment irregularities include irregular shapes, colors, heat sources, movement, or actions the Soldier perceives as being out of place as compared to the surrounding area

5-16. Soldiers use the following 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 if no threats are detected during the rapid scan. 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. A horizontal scan 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

5-17. 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.

5-18. During the scan and search, Soldiers are looking for target signatures, which are signs or evidence of a threat. Tactically, Soldiers look for threat personnel and obstacles (including explosive hazards [EH] such as mines, unexploded ordinance [UXO] and improvised explosive devices [IEDs]), vehicles, or anti-tank missile systems. These target signatures can be identified by sight, sound, or smell.

Locate

5-19. Target location is the determination of where a target is in your operational environment in relation to the firer, 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.

5-20. 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 Practice

5-21. 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. 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 can't. (Refer to chapter 4 of this publication.)
- Thermal optics are the preferred sight for target acquisition and engagement, day or night.
- Don't search in the same area as others in the small unit. Overlap, but do not focus on the same sector.
- Practice extreme light discipline during limited visibility including IR light discipline.
- Think as the threat. Search in areas that would be most advantageous from their perspective.
- Detecting threats is exponentially more difficult when operating in a chemical, biological, radiological, nuclear (CBRN) environment. Practice detection skills with personal protective equipment (PPE)/individual protective equipment (IPE) and understand the constraints and limitations, day and night.

TARGET IDENTIFICATION

5-22. 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

5-23. The Soldier must be able to positively identify the threat as one of the following three classifications:

- Friend. Any force, U.S. or allied, that is jointly engaged in combat operations against an enemy of the U.S. in a theater of operation.

- Foe (enemy combatant). Any individual who has engaged 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. Noncombatants include individuals such as medical personnel, chaplains, United Nations observers, media representatives, or those out of combat such as the wounded or sick. The Red Cross or Red Crescent are examples of organizations classified as noncombatants.

Fratricide Prevention

5-24. 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 mission, enemy, terrain and weather, troops and support available, time available, civil considerations (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

5-25. The Soldier must prioritize each target and carefully plan his burst to ensure successful target engagement when faced with multiple targets. The keys to a successful engagement of multiple targets are the Soldier's mental preparedness and the ability to make split-second decisions. The proper mindset allows the Soldier to react instinctively and control the pace of the battle rather than reacting to the adversary threat.

Threat Levels

5-26. 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 cannot defeat the friendly force, but can coordinate with other threats that are more prepared. Least dangerous targets are defeated after all threats of a higher threat level are defeated.

Multiple Targets

5-27. 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. Firers engage similar threats by the following guide:

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

5-28. The prioritization of targets provides a control mechanism for the firer, and facilitates maintaining overmatch over the presented threats. Firers should be prepared 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 holds the weapon, 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, whether the Soldier is stationary or moving.

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. Chapter 6 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 burst.

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 receiver assembly of the weapon to provide increased stability. The shooter stabilizes the medium machine gun using a bipod or tripod along with their bone and muscle support to provide additional stability to the weapon.

6-3. Support can be natural or artificial or a combination of both. Natural support comes from a combination of the firer's bones and muscles. Artificial support comes from objects outside the firer's body. The more support a particular position provides, the more stable the weapon. Principles of firing positions are described in the following paragraphs.

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 unsupported, 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 Soldier must place their firing elbow properly during the shot process. Proper elbow placement provides consistent firing hand grip while standing, sitting, or kneeling and provides support stability in the prone position.

NONFIRING ELBOW

6-7. The Soldier's placement of the nonfiring elbow during the shot process supports the machine gun in the all positions. The nonfiring elbow must be used with the firing elbow to stabilize the weapon when firing.

FIRING HAND

6-8. Proper placement of the firing hand aids in trigger control. The Soldier places the pistol 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 length of fingers, so there is no set position of the finger on the trigger. To grip the weapon, the Soldier places the back strap of the weapon's pistol grip high in the web of their firing side hand between the thumb and index (trigger) finger. The Soldier's trigger finger is indexed on the lower receiver, well outside of the trigger guard. The Soldier grasps the pistol grip with their remaining fingers ensuring there is no gap between their middle finger and the trigger guard.

NONFIRING HAND

6-9. Proper placement of the nonfiring hand is based on the firing position and placement of the nonfiring elbow to provide the stability of the weapon. Placement is adjusted during supported and unsupported firing to maximize stability.

6-10. The placement of the nonfiring hand varies if the firer is manipulating the traverse and elevating mechanism (T&E). The ideal positon of the nonfiring hand provides additional support to stabilize the MMG by grasping the stock weld and applying additional pressure during the shot process. The nonfiring hand can be used as reference point when applying the firer's head to the stock of the weapon.

BUTT STOCK

6-11. Correct placement of the butt stock in the firing shoulder aids in achieving a solid stock weld. Side-to-side placement varies depending on equipment worn while firing. The butt stock is placed high enough in the shoulder to allow for an upright head position.

6-12. The vertical placement of the butt stock varies from firing position to firing position. A general guideline to follow is: the higher the position from the ground, the higher the butt stock will be in the shoulder.

STOCK WELD

6-13. Stock weld is the placement of the firer's head on the stock of the weapon. Correct stock weld is critical to sight alignment. The firer rests the full weight of their head on the stock. The head position is as upright as possible to give the best vision through the aiming device. It allows for scanning additional targets not seen through the aiming device.

6-14. When establishing the stock weld, a Soldier brings the stock up to their head, not their head down to the stock. The firer's head remain in the same location on the stock while firing, but the location may change when positions are changed. The bony portion of the cheek placed on the stock is the basic starting point. Soldiers adapt to their facial structure to find the optimal placement that allows for both sight alignment and repetitive placement.

6-15. Figure 6-1 shows the differences in head placement, which effects sight alignment. The firer on the right is NOT resting the full weight of their head on the stock. The picture on the left shows the skin of the firer's head being pushed down by the full weight of their head. This technique can be observed and corrected quickly by a peer coach.

Note. Soldiers' bodies vary with the amount of flesh and the bone structure of the face. Firers who apply downward force simply to achieve the appearance in the correct (left) image in figure 6-1 will not have relaxation and will not have a repeatable placement. The goal is to have alignment with consistent placement.

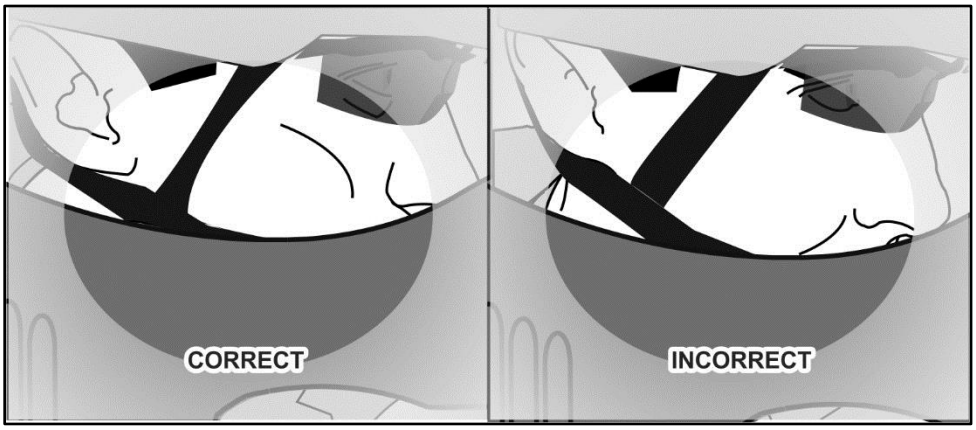


Figure 6-1. Stock weld

MUSCLE RELAXATION

6-16. 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 firer's bones the less he requires from his 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 firer can stay in position.

NATURAL POINT OF AIM

6-17. The natural point of aim is the point where the barrel naturally orients when the firer'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 firer's body on the ground equals a more stable position.
- More of the firer's body on the ground equals less mobility for the firer.

6-18. 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. 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 trigger squeeze.

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

6-19. To check a firer's natural point of aim, the Soldier should assume a good steady position and get to the natural pause. Soldier's should 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 the 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 the target.

RECOIL MANAGEMENT

6-20. 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.

6-21. The Soldier's firing position manages recoil using support of the weapon system, 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 bursts.

SHOOTER-GUN ANGLE

6-22. The shooter-gun angle is the relationship between the shooters 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 firer-gun angle can result in eye relief and stock weld changes.

Note. Units with a mix of left- and right-handed shooters can take advantage of each Soldier's natural carry positions, by placing left-handed shooters on the right flanks, and right-handed shooters on the left flanks. The Soldier's natural carry alignment places the muzzle away from the core element and outward toward potential threats, and reduces the challenges of firing when moving laterally.

FIELD OF VIEW

6-23. The field of view (FOV) is the extent that the human eye can see at any given moment. The FOV is based on the Soldier's view without using magnification, optics, or thermal devices. The FOV is what the Soldier sees, and includes the areas where the Soldier can detect potential threats.

CARRY POSITIONS

6-24. There are three primary carry positions. These positions may be directed by the leader, or assumed by the Soldier based on the tactical situation. The primary positions are—

- Safe hang.
- Low ready.
- Ready.

SAFE HANG

6-25. The safe hang is used when no immediate threat is present and the hands are not necessary (see figure 6-2). In the safe hang carry, the weapon is slung, the Soldier has gripped the machine gun's pistol grip, and muzzle awareness is enforced. The weapon status is GREEN.

6-26. In the safe hang position, the Soldier can move in any direction while simultaneously maintaining his muzzle oriented at the ground by using his firing hand. This carry provides control of the weapon, flexibility in movement, and positive control of the weapon's fire controls.

Carry Position:	Safe Hang
When Used:	No immediate threat is likely or present. Used to maintain positive control of the weapon, the fire controls, and weapon orientaion during movement.
Command:	ASSUME SAFE HANG
Advantages:	Provides some Soldier mobility while maintaining positive control of the weapon and weapon orientation.
Disadvantages:	Reduced use of hands.



Figure 6-2. Safe hang example

LOW READY

6-27. The low ready (see figure 6-3) is used when a greater degree of muzzle control and readiness to respond to threats or weapon retention is necessary (such as crowded environments). In the collapsed low ready, the weapon is unslung, the firing hand is secured on the machine gun's pistol grip, and the nonfiring hand is placed on the hand guards or vertical fore grip. The weapon status is RED.

6-28. The Soldier sustains Rule 3, keeping the finger off the trigger until ready to engage when transitioning to the ready position.

6-29. This carry allows a Soldier to navigate crowded or restrictive environments while simultaneously minimizing or eliminating his muzzle covering (flagging) by maintaining positive control of the muzzle orientation.

Carry Position:	Low Ready
When Used:	A greater degree of muzzle control and readiness is required. Used in restricted or crowded environments, urban terrain, or when positive control of weapon orientation is required.
Command:	ASSUME LOW READY
Advantages:	Provides some Soldier mobility while maintaining positive control of the weapon and weapon orientation. Increased readiness.
Disadvantages:	Use of hands limited.

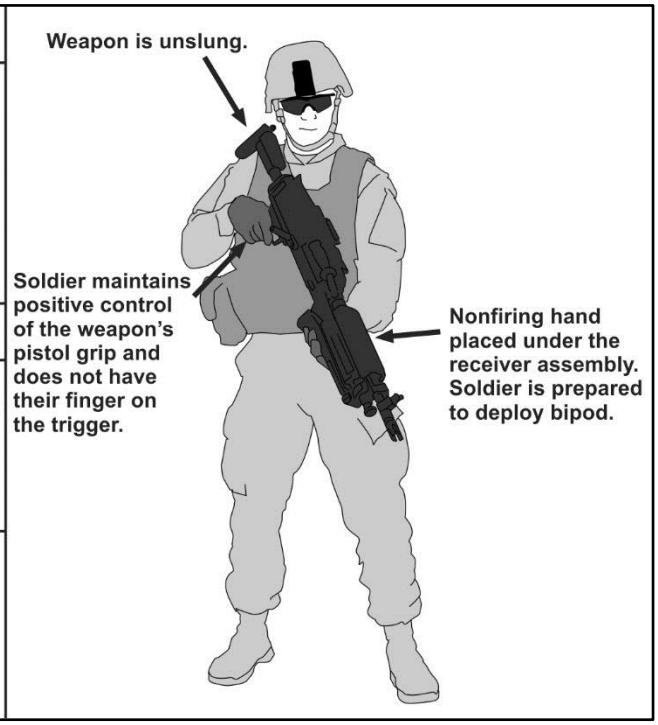


Figure 6-3. Low ready example

READY

6-30. The ready is used when enemy contact is imminent (see figure 6-4). This carry is used when the Soldier is preparing or prepared to engage a threat.

6-31. In the ready, the weapon is unslung, the Soldier has established a supported fighting position and is prepared to engage the threat. The weapon status is RED.

6-32. The Soldier sustains Rule 3 and Rule 4, keeping the finger off the trigger until ready to engage.

Carry Position:	Ready
When Used:	Contact with threats is imminent, the orientation of the muzzle is in the most probable target location, and the Soldier is prepared to engage.
Command:	MAKE READY
Advantages:	The highest level of readiness to engage a threat or threats. Rapid transition from target acquisition to engagement.
Disadvantages:	Reduced awareness laterally and to the rear. Requires the Soldier to maintain situational awareness laterally while actively acquiring targets.

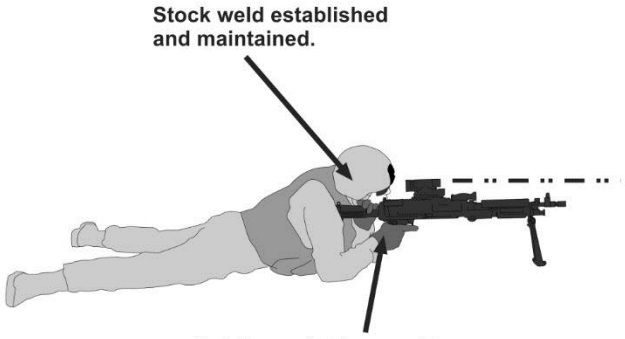


Figure 6-4. Ready position

STABILIZATION

6-33. The Soldier must stabilize his weapon when firing from a stationary position. To create a stabilized platform, a Soldier must understand the physical relationship between the weapon system, the firer's body, the ground, and any other objects touching the weapon or firer's body. The more contact the firer has to the ground will determine how stable and effective the position is. The situation and tactics will determine the actual position used.

6-34. When a firer assumes a stable firing position, movement from muscle tension, breathing, and other natural activities within the body are transferred to the weapon and must be compensated for by the firer.

6-35. Failing 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 (AM).
- Adequately support the weapon system.
- Achieve their natural point of aim.

6-36. 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 when stationary, or offset the induced errors with other firing skills during tactical movement.

FIRING POSITIONS

6-37. The nature of combat does not always allow time for a Soldier to get into a particular position. Soldiers need to practice firing in a variety of positions, including appropriate variations. The primary positions described below are highest to lowest. The position variations are subbullets of the primary positions in the list below:

- Standing.
  - Standing, unsupported.
  - Standing, supported.
- Kneeling. The kneeling position is common and useful in most combat situations. The kneeling position can be supported or unsupported.
  - Kneeling, unsupported.
  - Kneeling, supported.
- Prone. The prone position is the most stable firing position due to the amount of the Soldier's body is in contact with the ground. The majority of the firer's frame is behind the machine gun to assist with recoil management.
  - Prone, bipod-supported.
  - Prone, tripod-supported.

6-38. 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.

6-39. Each of these firing positions is described using in a standard format using the terms defined earlier.

STANDING, UNSUPPORTED

6-40. This position should be used when no cover is available and immediate cover is required. The Soldier, based on situation, may have to fire on the move to establish or acquire a better fighting position. This position also can be used for closer targets or when time is not available to assume a steadier position such as short range employment. The upper body should be leaned slightly forward to aid in recoil management. The key focus areas for the standing supported position are described in figure 6-5:

1 Support:	Unsupported
2 Leg Position:	Standing, firm, feet shoulder-width apart.
3 Stance / Center of Gravity:	Aggressive lean forward toward the target.
4 Firing Elbow:	Tucked toward the shooter's side with the emphasis on the stability of the weapon.
5 Nonfiring Elbow:	Slightly outward.
6 Firing Hand:	Grasping pistol grip, finger off the trigger until ready to fire.
7 Nonfiring Hand:	Extended forward, placed underneath the receiver assembly with the bipod extended.
8 Buttstock	Tucked underneath the arm.
9 Firer-Gun Angle:	The body is approximately 45 degrees to the gun-target line.

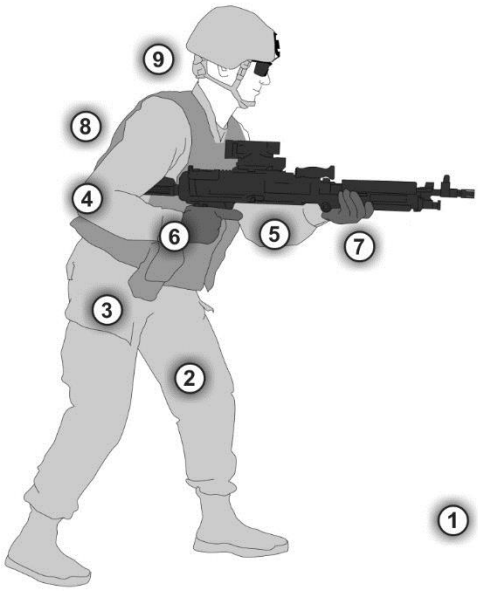


Figure 6-5. Standing, unsupported example

STANDING, SUPPORTED

6-41. Soldier should ensure that the handguard of the weapon and not the barrel is in contact with the artificial support. Barrels in direct contact with artificial support result in erratic shots. The standing supported position uses artificial support to steady the position (see figure 6-6.) Forward pressure should be applied by the rear leg and upper body to aid in recoil management. The key focus area for the standing supported position are applied in the following ways:

- Nonfiring hand. The nonfiring hand holds the hand guards firmly to provide additional support to stabilize the machine gun if needed. Hand positioning varies depending on the type of support used.
- Bipod/tripod. The use of the bipod or tripod can be utilized if the situation and/or supporting structure being used permits it.

1 Support:	Weapon is supported using a structure, bipod, or equipment.
2 Leg Position:	Standing, firm, feet shoulder-width apart.
3 Stance / Center of Gravity:	Aggressive lean forward toward the target.
4 Firing Elbow:	Tucked toward the shooter's side.
5 Nonfiring Elbow:	Extended to provide nonfiring hand support.
6 Firing Hand:	Grasping pistol grip, finger off the trigger until ready to fire.
7 Nonfiring Hand:	Firm grasp of the stock weld.
8 Buttstock	Highest point of shoulder to absorb recoil impulse.
9 Stock Weld:	Firm stock weld.
10 Firer-Gun Angle:	The body is approximately 45 degrees to the gun-target line.

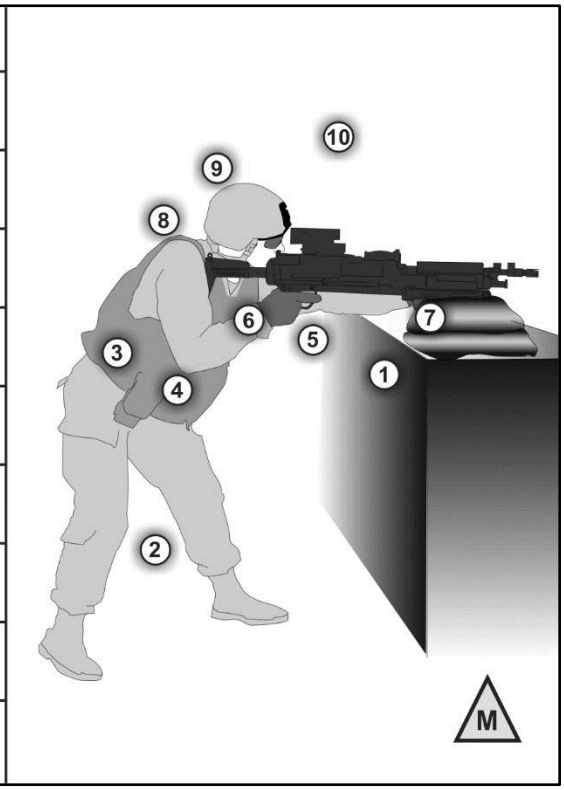


Figure 6-6. Standing, supported example

KNEELING, UNSUPPORTED

6-42. The kneeling unsupported position does not use artificial support. Figure 6-7 shows the optimum unsupported kneeling position. The firer should be leaning slightly forward into the position to allow for recoil management and quicker follow-up shots. The primary goal of this firing position is to establish the smallest wobble area possible. Key focus areas for kneeling, unsupported are:

- Nonfiring elbow. Place the nonfiring elbow directly underneath the machine gun as much as possible. The elbow should be placed either in front of or behind the kneecap. Placing the elbow directly on the kneecap causes it to roll and increases the wobble area.
- Leg position. The nonfiring leg should be bent about 90 degrees at the knee and be directly under the machine gun. The firing-side leg should be perpendicular to the nonfiring leg. The firer may rest their body weight on the heel. Some firers lack the flexibility to do this and may have a gap between their buttocks and the heel.
- Aggressive (stretch) kneeling. All weight on nonfiring foot, thigh to calf, upper body leaning forward, nonfiring triceps on nonfiring knee, firing leg stretched behind for support. This position is highly effective for rapid fire and movement.

1 Support:	Unsupported - Soldier uses non-firing knee when possible.
2 Leg Position:	Firing knee on the ground, foot under seat. Nonfiring leg bent approximately 90 degrees and under weapon.
3 Stance / Center of Gravity:	Slight lean in to the target area. All weight on nonfiring foot, thigh to calf.
4 Firing Elbow:	Tucked toward the shooter's side.
5 Nonfiring Elbow:	Tricep on the nonfiring knee for self-support. Elbow underneath rifle. Elbow NOT ON KNEE.
6 Firing Hand:	Grasping pistol grip, finger off the trigger until ready to fire.
7 Nonfiring Hand:	Firm grasp underneath the receiver and prepared to deploy bipod.
8 Buttstock	Mid to high point of shoulder to absorb recoil impulse.
9 Stock Weld:	Firm stock weld.
10 Firer-Gun Angle:	The body is approximately 30 degrees to the gun-target line.

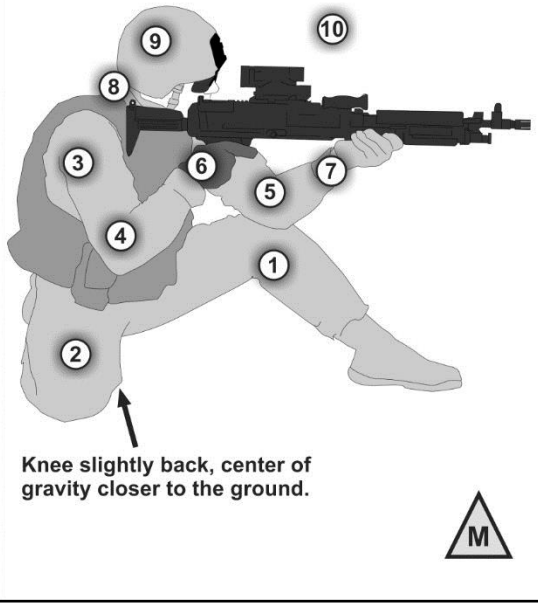


Figure 6-7. Kneeling, unsupported example

KNEELING, SUPPORTED

6-43. The kneeling supported position uses artificial support to steady the position (see figure 6-8). Contact by the nonfiring hand and elbow with the artificial support is the primary difference between the kneeling supported and unsupported positions since it assists in the stability of the weapon. Body contact is good, but the barrel of the machine gun must not touch the artificial support. Forward pressure is applied to aid in recoil management. The key focus areas for the kneeling supported position are applied in the following ways:

- Nonfiring hand. The nonfiring hand holds the hand guards firmly and is also pushed against the artificial support. Hand positioning will vary depending on the type of support used.
- Nonfiring elbow. The nonfiring elbow and forearm may be used to assist with the weapon's stability by pushing against the artificial support. The contact of the nonfiring elbow and forearm with the structure varies depending on the support used and the angle to the target.
- Bipod/tripod. The use of the bipod or tripod can be utilized if the situation and/or the supporting structure being used permits it.

1 Support:	Supported using available structure, bipod or equipment
2 Leg Position:	Nonfiring knee on the ground, foot under seat. Firing leg bent approximately 90 degrees outward.
3 Stance / Center of Gravity:	Slight lean toward target area. All weight on firing foot and pressure on the artificial support.
4 Firing Elbow:	Tucked toward the shooter's side, pressed against the inside of the firing thigh.
5 Nonfiring Elbow:	Extended. May be pushed against the artificial support for stability.
6 Firing Hand:	Grasping pistol grip, finger off the trigger until ready to fire.
7 Nonfiring Hand:	Firm grasp on the stock weld.
8 Buttstock	Mid to high point of shoulder to absorb recoil impulse.
9 Stock Weld:	Firm stock weld.
10 Firer-Gun Angle:	The body is nearly in-line with the gun-target line.

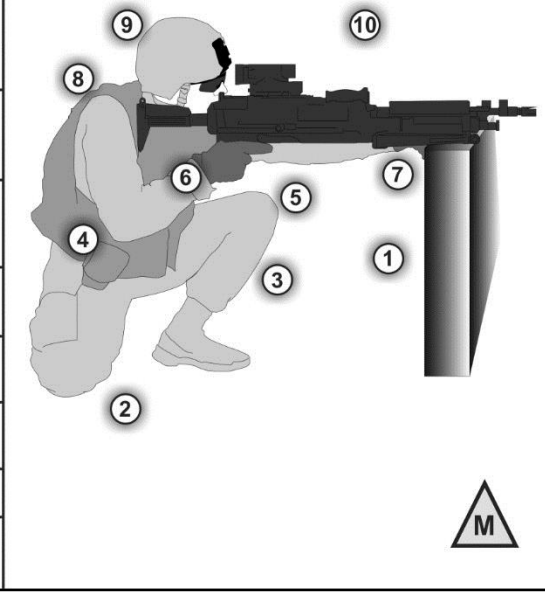


Figure 6-8. Kneeling, supported example

PRONE, BIPOD-SUPPORTED

6-44. The prone supported position allows for the use of support, such as sandbags (see figure 6-9). Soldiers must build a stable, consistent position that focuses on the following key areas:

- Firing hand. The firer should have a firm handshake grip on the pistol grip and place their finger on the trigger where it naturally falls.
- Nonfiring hand. The nonfiring hand is placed to maximize control the weapon and where it is comfortable on the artificial support.
- Leg position. The firer's legs may be either spread with heels as flat as possible on ground or the firing side leg may be bent at the knee to relieve pressure on the stomach.
- Artificial support. The artificial support should be at a height that allows for stability without interfering with the other elements of the position.

1 Support:	Supported with bipod.
2 Leg Position:	Spread with heels flat against the ground or the firing side leg bent at the knee to relieve pressure.
3 Stance / Center of Gravity:	Prone position maximizes the Soldier's frame against the ground for maximum stability.
4 Firing Elbow:	Used to provide stability to the weapon.
5 Nonfiring Elbow:	Used to provide stability to the weapon.
6 Firing Hand:	Grasping pistol grip, finger off the trigger until ready to fire.
7 Nonfiring Hand:	Firm grasp of the stock weld.
8 Buttstock	Mid-point of shoulder to absorb recoil impulse.
9 Stock Weld:	Firm stock weld.
10 Firer-Gun Angle:	The body is nearly in-line with the gun-target line.

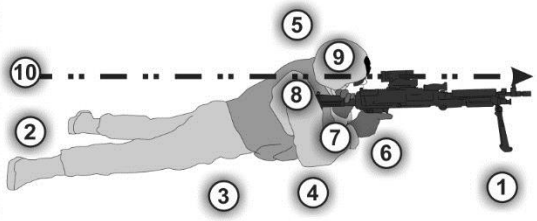


Figure 6-9. Prone, bipod-supported example

PRONE, TRIPOD-SUPPORTED

6-45. The prone supported position allows for the use of support, such as sandbags (see figure 6-10). Soldiers must build a stable, consistent position that focuses on the following key areas:

- Firing hand. The firer should have a firm handshake grip on the pistol grip and place their finger on the trigger where it naturally falls.
- Nonfiring hand. The nonfiring hand is placed to maximize control the weapon and where it is comfortable on the artificial support.
- Leg position. The firer's legs may be either spread with heels as flat as possible on ground or the firing side leg may be bent at the knee to relieve pressure on the stomach.
- Artificial support. The artificial support should be at a height that allows for stability without interfering with the other elements of the position.

Note: The assistant gunner assumes a prone position along the left side of the gunner to load ammunition and observe.

1 Support:	Supported with tripod.
2 Leg Position:	Spread with heels flat against the ground or the firing side leg bent at the knee to relieve pressure.
3 Stance / Center of Gravity:	Prone position maximizes the Soldier's frame against the ground for maximum stability.
4 Firing Elbow:	Used to provide stability to the weapon.
5 Nonfiring Elbow:	Used to provide stability to the weapon.
6 Firing Hand:	Grasping pistol grip, finger off the trigger until ready to fire.
7 Nonfiring Hand:	Firm grasp of the stock weld. Non-firing hand can be used to manipulate the T&E.
8 Buttstock	Mid-point of shoulder to absorb recoil impulse.
9 Stock Weld:	Firm stock weld.
10 Firer-Gun Angle:	The body is nearly in-line with the gun-target line.

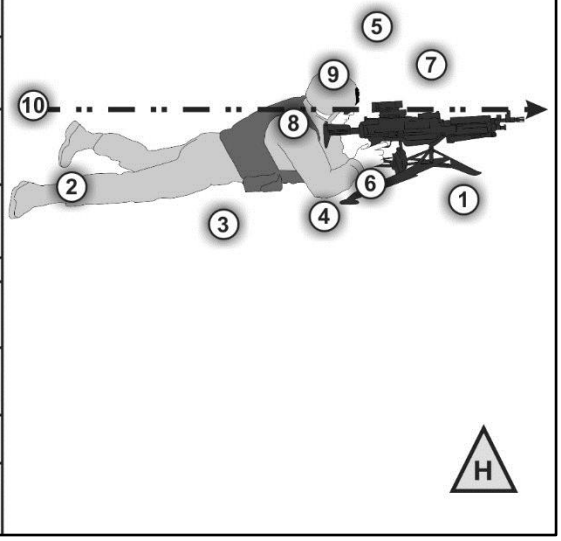


Figure 6-10. Tripod, steady position, example

Chapter 7
Aim

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

Aiming 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 consist 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 held in a stabilized manner.
- Sight alignment. The physical alignment of the aiming device:
  - Front and rear sight assembly.
  - Optic reticle.
  - Ballistic reticle (day or thermal).
- Sight picture. The target as viewed through the line of sight.
- Point of aim. The specific location where the line of sight intersects the target.
- Desired point of impact. The desired location of the strike of the round to achieve the desired outcome (incapacitation or lethal strike).

7-2. Typically, Soldiers apply the aim to the largest, most lethal area of any target presented. Soldiers use battlesight zero (BZ), center of visible mass (CoVM). The center of visible mass is the initial point of aim on a target of what can be seen by the Soldier. The CoVM does not include what the target size is expected or anticipated to be. For example, a target located behind a car exposes its head. The CoVM is in the center of the head, not the estimated location of the center 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 FOV.

HORIZONTAL WEAPONS ORIENTATION

7-4. Horizontal weapons orientation covers the frontal arc of the Soldier, spanning the area from the left shoulder, across the Soldier's front, to the area across the right shoulder (see figure 7-1).

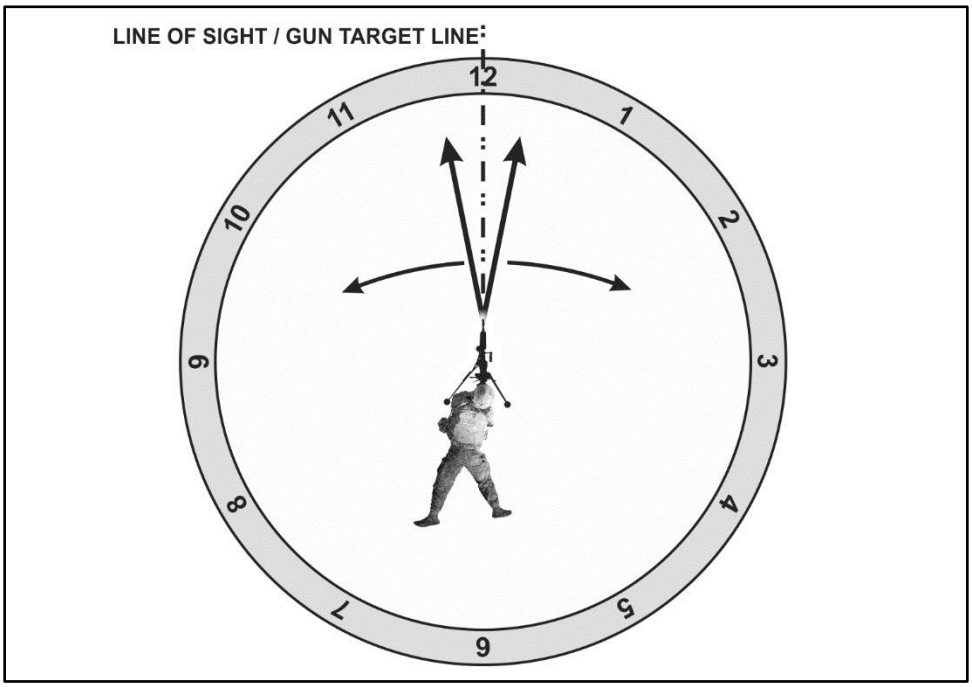


Figure 7-1. Horizontal weapons orientation example

VERTICAL WEAPONS ORIENTATION

7-5. Vertical weapons orientation includes all the aspects of orienting the weapon at a potential or confirmed threat in elevation. This is most applied in restricted, mountainous, or urban terrain where threats present themselves in elevated or depressed firing positions (see figure 7-2).

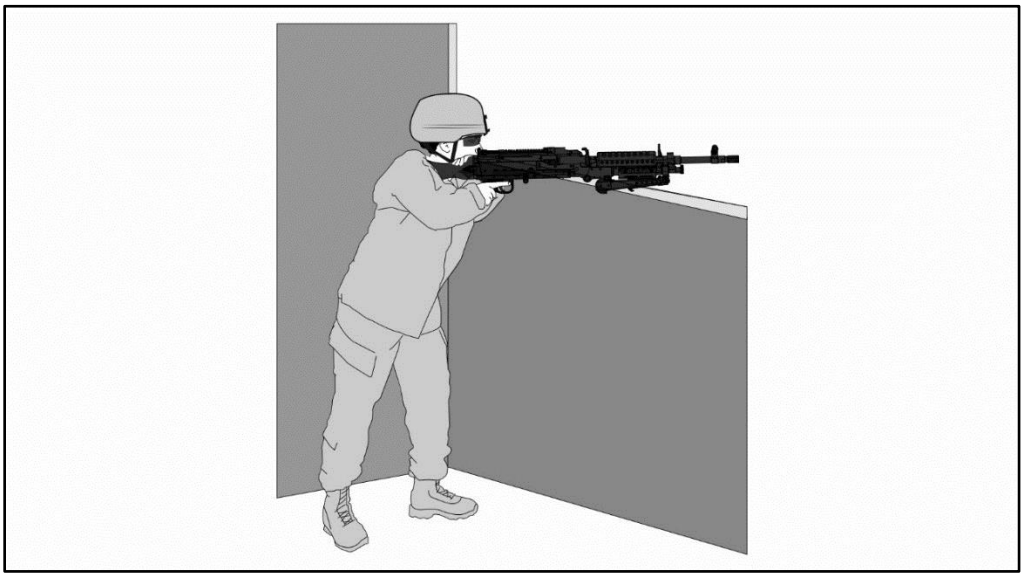


Figure 7-2. Vertical weapons orientation example

SIGHT ALIGNMENT

7-6. 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.

- Iron sight. The relationship between the front sight assembly, rear sight assembly, and the firer's eye. The firer aligns the tip of the front sight post in the center of the rear aperture and their eye. The firer maintains focus on the front sight post, simultaneously centering it in the rear aperture.
- Optics. The relationship between the reticle and the firer's eye and includes the appropriate eye relief, or distance of the Soldier's eye from the optic itself. Ensure a full centered FOV is achieved with no shadow on magnified optics
- Thermal. The relationship between the firer's eye, the eyepiece, and the reticle.
- Pointers/Illuminators/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 of an inch deviation at the weapon can result in up to an 18-inch deviation at 300 meters.

7-7. 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). The most accurate sight alignment for the shot process is with the firer's eye on the front sight post or reticle.

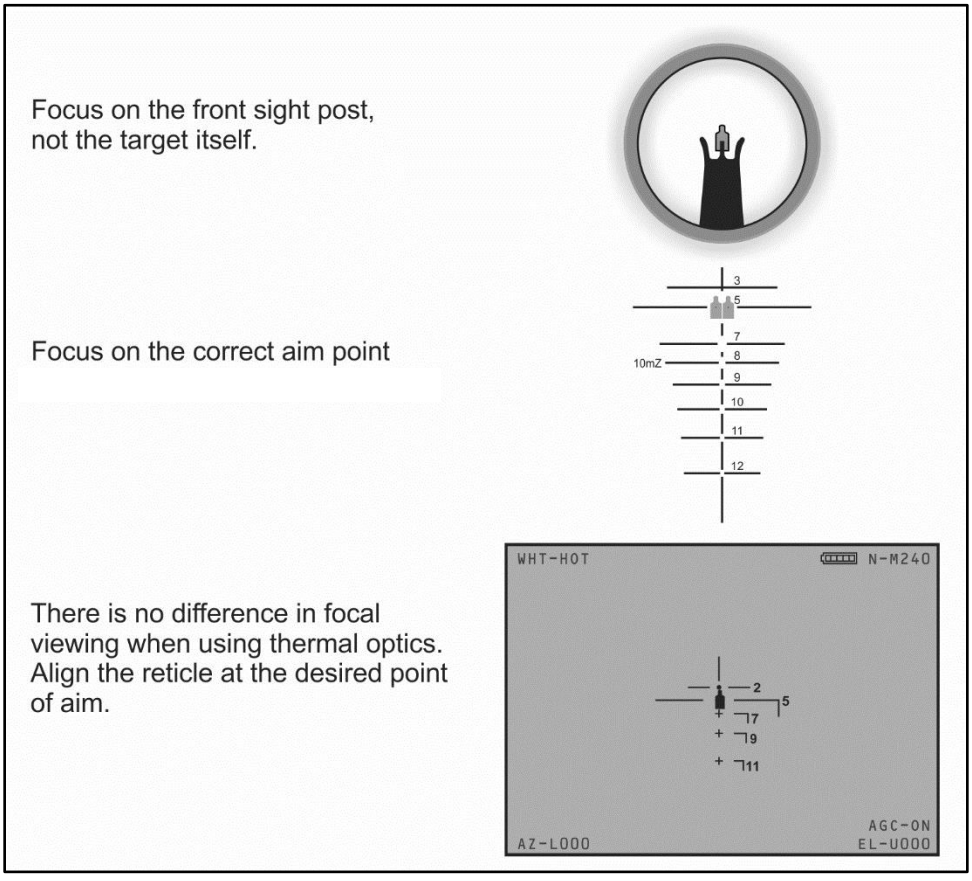


Figure 7-3. Front sight post/reticle aim focus examples

7-8. Firers rest the full weight of their heads on the stock to achieve consistent sight alignment. The firers allow their dominant eye to look through the center of the aiming or sighting device. If the firer's head

placement is subjected to change during the firing process or between bursts, the Soldier will experience difficultly achieving accurate shot groups.

SIGHT PICTURE

7-9. 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. Sight picture is not the same as sight alignment.

7-10. There are two sight pictures used during the shot process; pre-shot and post-shot. Soldiers must remember the sight pictures of the 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

7-11. 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. The point of aim should be the target's CoVM for engagements against stationary targets under 400 meters with negligible wind, and a weapon that has a 400-meter confirmed zero. The point of aim does not include any hold off or lead changes.

DESIRED POINT OF IMPACT

7-12. The desired point of impact is the location where the Soldier wants the projectile to strike the target. Typically, this is the CoVM. At any range different than the weapon's zero distance, the Soldier's desired point of impact and their point of aim will not align. Therefore, the Soldier must determine the hold off necessary to achieve the desired point of impact.

COMMON AIMING ERRORS

7-13. Orienting and aiming a weapon correctly is a practiced skill. Through drills and repetitions, Soldiers build the ability to repeat proper weapons orientation, sight alignment, and sight picture as a function of muscle memory.

7-14. The most common aiming errors include:

- Nondominant 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 his right hand and learns to shoot right-handed might learn that his 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 nondominant 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. (Refer to 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 incorrect sight alignment 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 firer and target exist that are not accounted for during the hold determination process. The 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

7-15. A complex engagement includes any shot that cannot use the CoVM 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.

7-16. Complex engagements have an increased level of difficulty due to environmental, target, or shooter conditions that create a need for the firer to rapidly determine a ballistic solution and apply that solution to the point of aim. One or more of the conditions listed below characterizes increased engagement difficulty:

- Target conditions:
  - Range to target.
  - Moving targets.
  - Oblique targets.
  - Evasive targets.
  - Limited exposure targets.
- Environmental conditions:
  - Wind.
  - Angled firing.
  - Limited visibility.
- Firer conditions:
  - Moving firing position.
  - Canted weapon engagements.
  - Chemical, biological, radiological, nuclear (CBRN) operations engagements.

7-17. Each of these firing conditions may require the Soldier to determine an appropriate aim point that is not the CoVM. 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 CoVM 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.
- Counterrotation lead required when the Soldier is moving in the opposite direction of the moving target.
- Wind speed, direction, and duration between the firer and the target at ranges greater than 300 meters.
- Greatest lethal zone presented by the target to provide the most probable point of impact to achieve immediate incapacitation.

7-18. The Soldier applies the appropriate aim (hold) based on the firing instances presented. Hold determinations are discussed in two formats, immediate and deliberate. All Soldiers must be familiar with the immediate hold determination methods. Soldiers should apply hold determination methods naturally when the engagement conditions require them. The determinations are provided in target form measurements based on a standard E-type silhouette dimension approximately 20-inches wide by 40-inches tall.

IMMEDIATE HOLD DETERMINATION

7-19. 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 not as accurate as

the deliberate method, and are used for complex target engagements at less than 500 meters. Figure 7-4 illustrates immediate hold locations for azimuth (wind or lead).

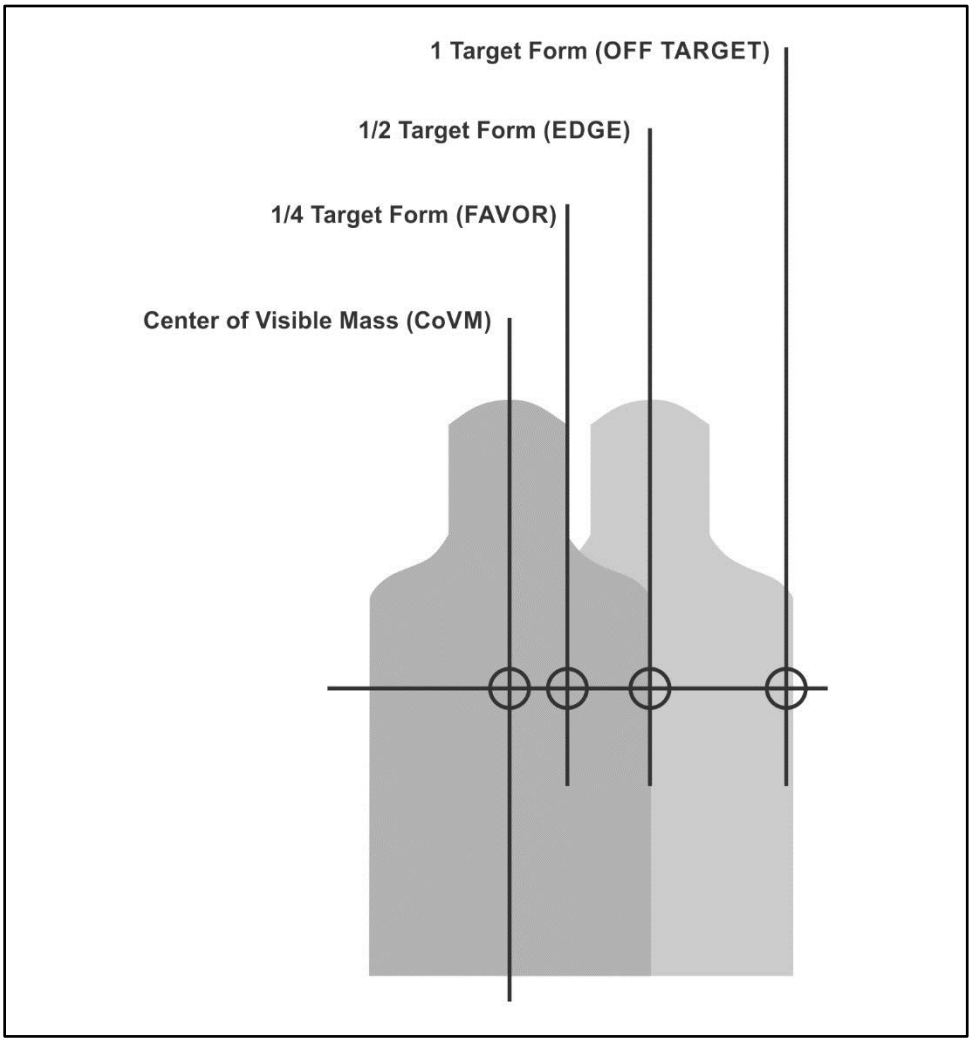


Figure 7-4. Immediate hold locations for windage and lead examples

TARGET CONDITIONS

7-20. 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 firer, consists of—

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

RANGE TO TARGET

7-21. 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 that the firer 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

7-22. Immediate methods of range determination afford the firer the most reliable means of determining the most accurate range to a given target. The immediate methods include—

- Close quarters engagements.
- Laser range finder.
- Front sight post method.
- Recognition method.
- 100-meter unit-of-measure method.

Close Quarters Engagements

7-23. Short-range engagements are probable in close terrain (such as urban or jungle) with engagement ranges typically less than 50 meters. Soldiers must be confident in their equipment, zero, and capabilities to defeat the threats encountered.

7-24. Employment skills include swift presentation and application of the shot process (such as quick acquisition of sight picture) to maintain overmatch. At close ranges, perfect sight alignment is not as critical to the accurate engagement of targets. The weapon is presented rapidly and the shot group is fired with the front sight post placed roughly center mass on the desired target area. The front sight post must be in the rear sight aperture.

Laser Range Finder

7-25. Equipment like the AN/PSQ-23, STORM have an on-board laser range finder that is accurate to within +/- 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.

Front Post Sight Method

7-26. The area of the target that is covered by the front sight post of the weapon can be used to estimate range to the target. By comparing the appearance of the front sight post on a target at known distances, the firers can establish a mental reference point for determining range at unknown distances. Because the apparent size of the target changes as the distance to the target changes, the amount of the target that is covered by the front sight post will vary depending upon its range. In addition, the firer's eye relief and perception of the front sight post also affect the amount of the target that is visible.

Recognition Method

7-27. When observing a target, the amount of detail seen at various ranges gives the firer a solid indication of the range to target. Firers 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.

7-28. Once Soldiers are familiar with and memorize the characteristics of standing threats at 100-meter increments out to 500 meters, they should study the targets in a kneeling position and then in the prone position. Shooters can establish a series of mental images that can help them determine range on unfamiliar terrain by comparing the appearance of positions at known ranges from 100 meters to 500 meters. Soldiers should study the appearance of other familiar objects such as weapons and vehicles, also. The list below is a general description of what the target looks like at various ranges:

- 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.

100-Meter Unit of Measure Method

7-29. To determine the total distance to the target using the 100-meter unit of measure method, firers 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 firer and the target.

7-30. Accuracy's relation to visible terrain is the greatest limitation of the unit of measure method. 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 firer and the target can be seen. This lack of visibility makes it difficult to use the unit of measure method of range estimation with accuracy.

7-31. Proficiency in the unit of measure method requires constant practice. Throughout training, comparisons should be continually made between the range estimated by the firer and the actual range as determined by pacing or other more accurate measurement.

MOVING TARGETS

7-32. Moving targets are those threats that appear to have a consistent pace and direction. Targets on any battlefield will not remain stationary for long periods. 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.

Tracking Techniques

7-33. The gunner aims at a point ahead of the target equal to the estimated number of leads, maintains this lead by tracking the target (manipulates the weapon at the same angular speed as that of the target), and then fires. Tracking places the gunner in position for a second burst if the first one misses.

Trapping Techniques

7-34. The gunner establishes an aiming point forward of the target and along the target path. He pulls the trigger as the target reaches the appropriate point in regard to lead.

HOLD FOR MOVING TARGETS

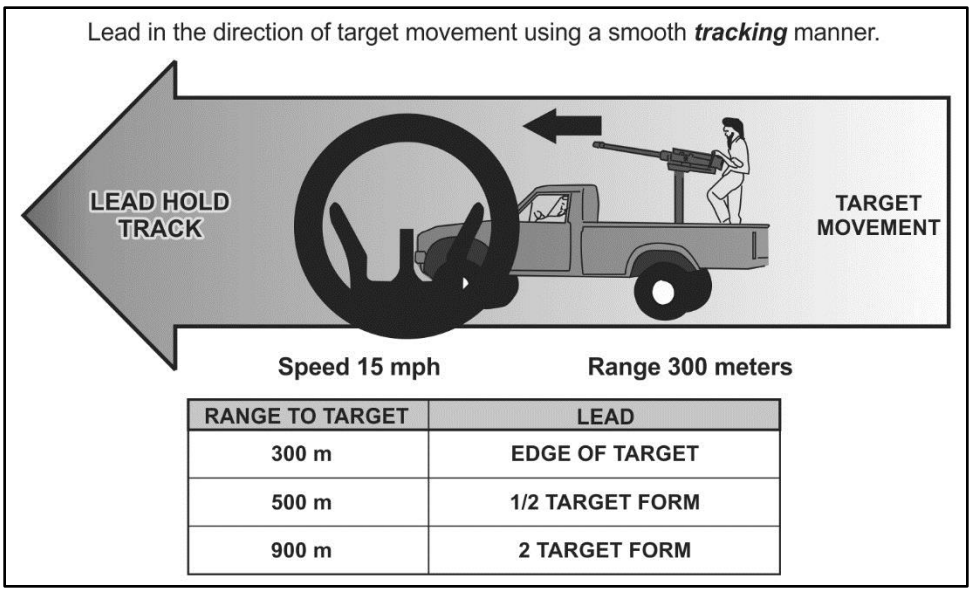
7-35. The immediate hold for moving targets includes an estimation of the speed of the moving target and an estimation of the range to that target.

7-36. To hit a moving target, the machine gun must be aimed far enough ahead of the target to cause the bullet and target to arrive at the same point at the same time. This distance is measured in target lengths. One target length as seen by the gunner is one lead.

7-37. Leads are measured from the center of mass. Figure 7-5 gives the amount of lead needed to hit a target moving at right angles, to the gunner, and at speeds and ranges indicated.

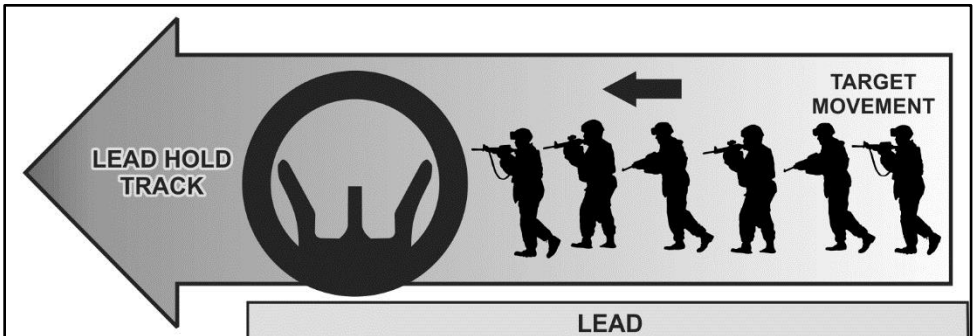
7-38. The gunner makes adjustments as conditions change. If target speed is 7 1/2 miles per hour (mph), the amount of lead is half that shown on the table in figure 7-6; at 30 mph, double that shown. The angle at which the target moves also changes the lead. If the target is moving on an oblique angle, only half the lead is required.

7-39. For a target moving directly at the gunner, the aiming point is below the center base of the target depending on range and slope of the ground. For a target moving directly away from a gunner, the aiming point is above the center base of the target (see figure 7-7 on page 7-10). Too much lead is better than too little because the target moves into the beaten zone, and observation of the strike of the rounds is easier relative to the target.



RANGE TO TARGET	LEAD
300 m	EDGE OF TARGET
500 m	1/2 TARGET FORM
900 m	2 TARGET FORM

Figure 7-5. Lead example for moving truck using 7.62-mm, M80, Ball



	LEAD		
RANGE (M)	3 MPH	5 MPH	10 MPH
100 m	EDGE	EDGE	2 TARGET FORM
200 m	1/2 TARGET FORM	1/2 TARGET FORM	3 TARGET FORM
300 m	1 TARGET FORM	3 TARGET FORM	6 TARGET FORM
400 m	2 TARGET FORM	4 TARGET FORM	8.TARGET FORM
500 m	3 TARGET FORM	5 TARGET FORM	11 TARGET FORM
600 m	4 TARGET FORM	7 TARGET FORM	
700 m	5 TARGET FORM	9 TARGET FORM	
800 m	6 TARGET FORM	11 TARGET FORM	
900 m	8 TARGET FORM	13 TARGET FORM	

Figure 7-6. Lead example for moving troops using 7.62-mm, M80, Ball

OBLIQUE TARGETS

7-40. Threats that are moving diagonally toward or away from the firer are called oblique targets. They offer a unique problem set to the firers where the target may be moving at a steady pace and direction; however, their oblique direction of travel makes them appear to move slower.

7-41. 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 7-7).

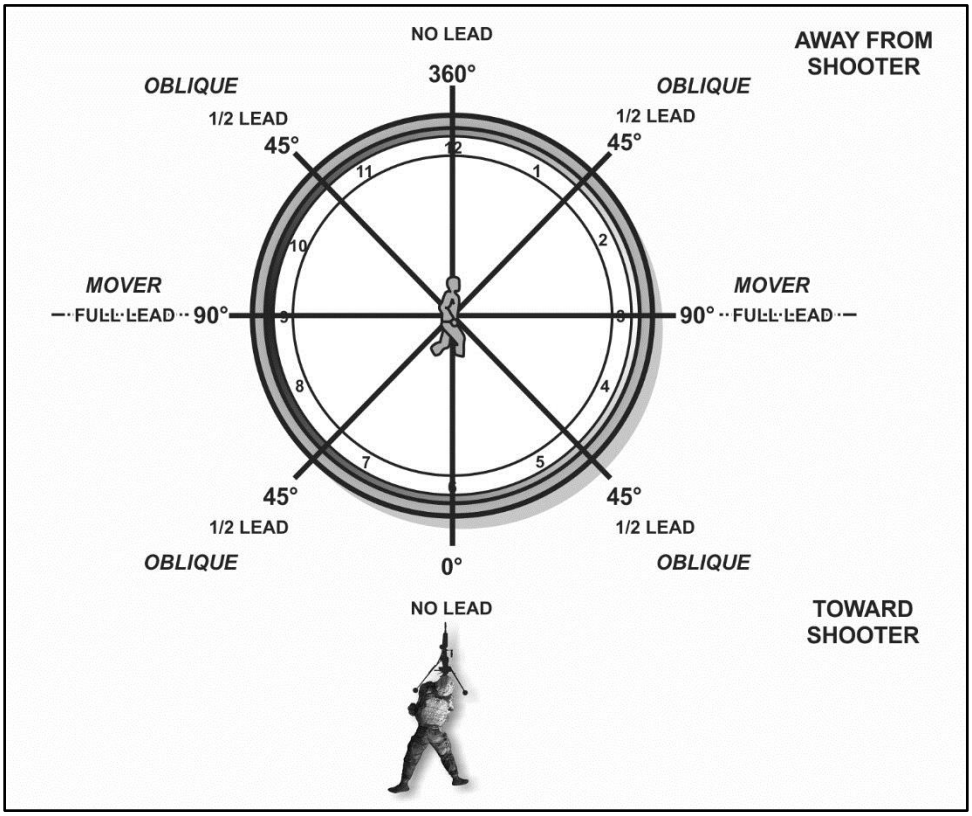


Figure 7-7. Oblique target example

ENVIRONMENTAL CONDITIONS

7-42. The environment can complicate the firer's actions during the shot process with excessive wind or requiring angled firing 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. This includes when multiple complex conditions compound the ballistic solution during the firing occasion.

WIND

7-43. Wind deflection is the most influential element in exterior ballistics. Wind does not push the projectile causing the actual deflection. The bullet's tip is influenced in the direction of the wind slightly, resulting in a gradual drift of the bullet in the direction of the wind. The effects of wind can be compensated for by the firer 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

7-44. 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.

7-45. The clock system can be used to determine the direction and value of the wind. (See figure 7-8.) Picture a clock with the firer oriented downrange towards 12 o'clock.

7-46. Once the direction is determined, the value of the wind is next. The value of the wind is how much effect the wind has 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 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.

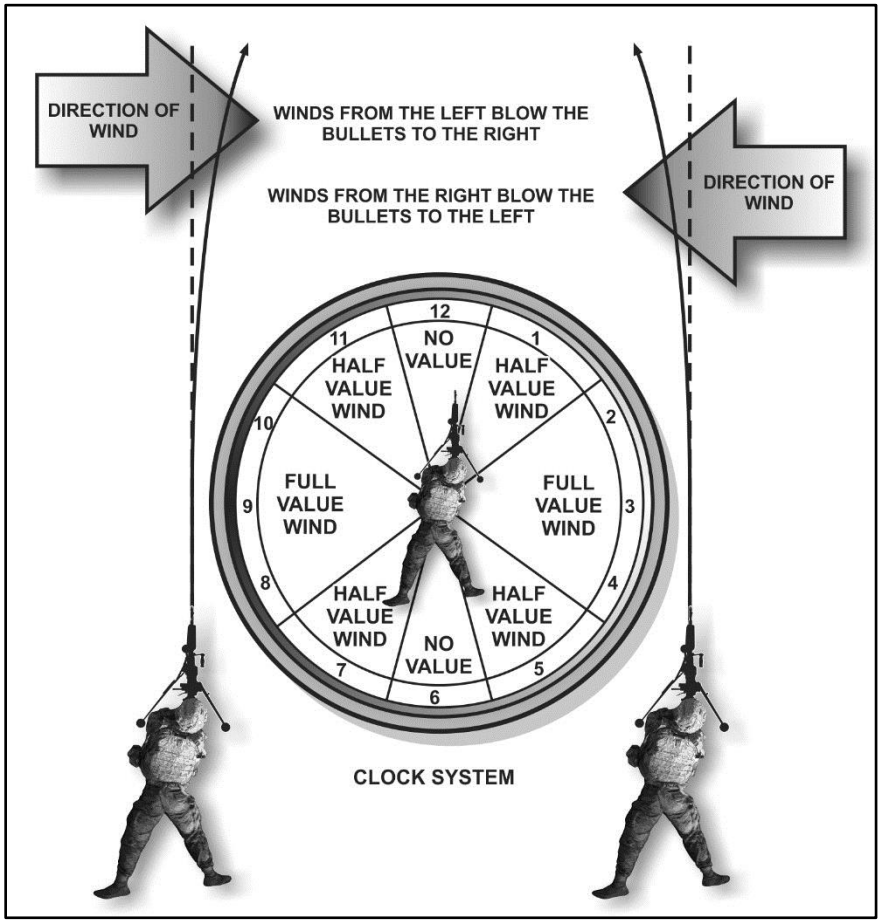


Figure 7-8. Wind value

7-47. The wind pushes the projectile in the direction the wind is blowing (see figure 7-9). 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).

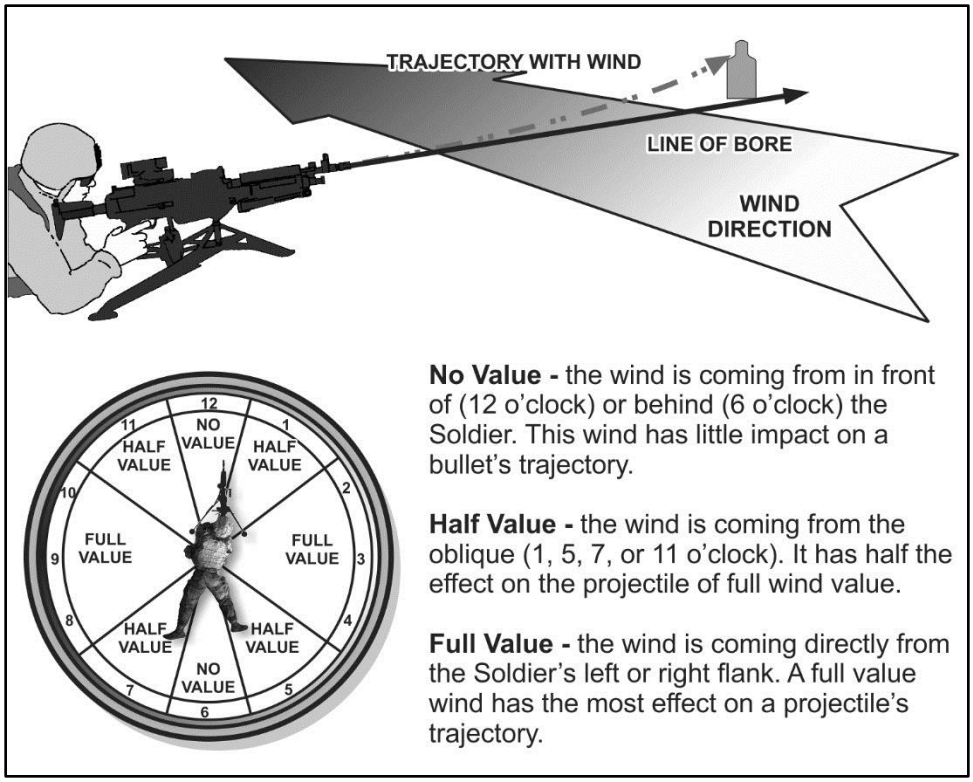


Figure 7-9. Wind effects

Wind Speed

7-48. Wind speeds can vary from the firing line to the target. An average of the winds blowing on the range determines the wind speed. 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 has the most effect on the projectile since that is the point where most projectiles lose a large portion of their velocity and are beginning to destabilize.

7-49. The wind speed blowing at the Soldier's location may not be the same as the wind speed blowing on the way to the target. The Soldier can observe the movement of items in the environment downrange to determine the wind 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.

Wind Estimation

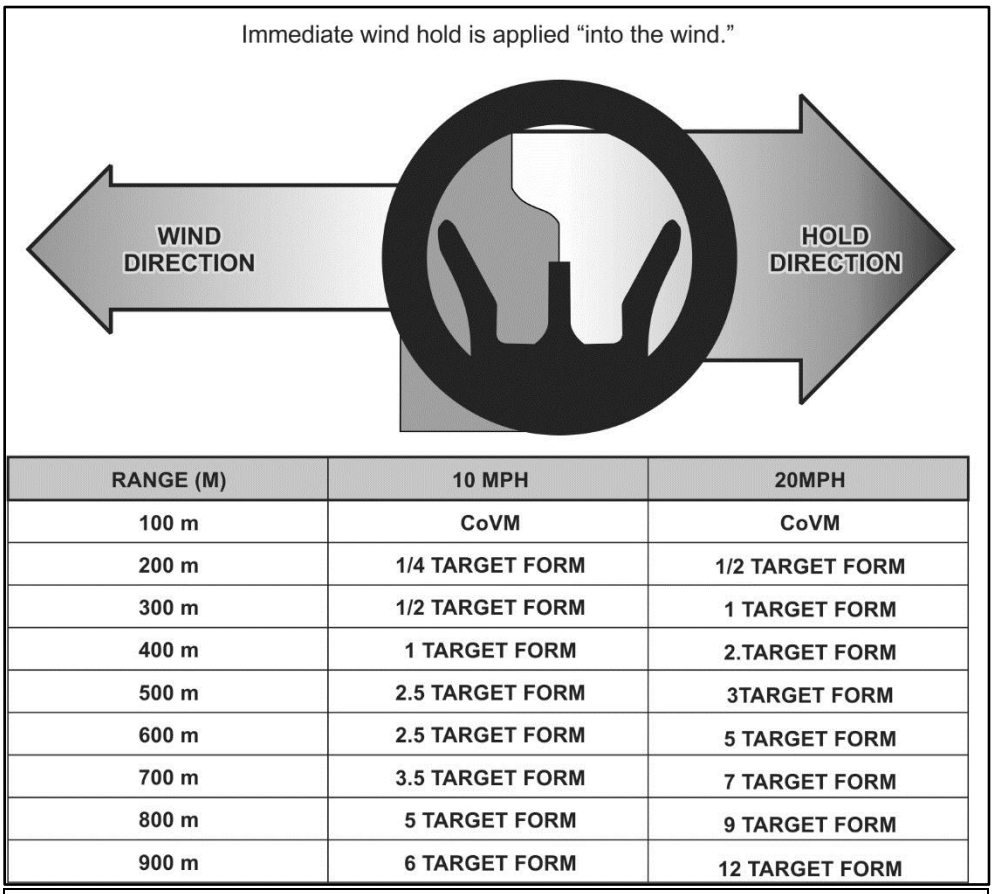
7-50. Soldiers must be comfortable and confident in their ability to judge the effects of the wind to consistently make accurate and precise shots. Soldiers use wind indicators between themselves and the target that provide windage information to develop the proper compensation or hold off. To estimate the effects of the wind on the shot, Soldiers need to determine the three windage factors below.

- Velocity (speed).

- Direction.
- Value.

Immediate Wind Hold

7-51. 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. (See figure 7-10.)



RANGE (M)	10 MPH	20MPH
100 m	CoVM	CoVM
200 m	1/4 TARGET FORM	1/2 TARGET FORM
300 m	1/2 TARGET FORM	1 TARGET FORM
400 m	1 TARGET FORM	2.TARGET FORM
500 m	2.5 TARGET FORM	3TARGET FORM
600 m	2.5 TARGET FORM	5 TARGET FORM
700 m	3.5 TARGET FORM	7 TARGET FORM
800 m	5 TARGET FORM	9 TARGET FORM
900 m	6 TARGET FORM	12 TARGET FORM

Legend:
m= meters
MPH= miles per hour

Figure 7-10. Wind hold example for the 7.62-mm, M80, ball

7-52. 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. A guide for the initial adjustment is to split the front sight post on the edge of the target facing the wind.

7-53. Newly assigned Soldiers should aim at the target's CoVM for the first shot, 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, but should follow the basic rule—when in doubt, aim at the center of mass.

LIMITED VISIBILITY

7-54. 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 such as night vision devices, IR aiming devices, and TWSs.

7-55. 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.

7-56. 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. Soldiers achieve onfidence in the equipment 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 night vision devices, for example).

GUNNER CONDITIONS

7-57. The ability to aim properly while the firer is moving, has the weapon canted (tilted to one side or the other), or is fighting in a chemical, biological, radiological, nuclear (CBRN) environment creates additional difficulties to achieve the appropriate point of aim. Shooters can mitigate their conditions to ensure effective point of aim and target defeat.

TACTICAL MOVEMENT

7-58. A Soldier moving tactically in any direction and attempting to engage a target may require an increase or decrease in the lead applied to a target. The following rules apply:

- A Soldier is moving in the same direction as the target, or the target is stationary, the Soldier must apply counter-lead to offset his forward movement. The counter-lead (or counterrotation) is based upon the range to target, the speed of the Soldier, and the speed of the target. Typically, this movement negates the need for any lead hold-off.
- The Soldier applies twice the amount of lead, when moving in the opposite direction of the threat.

CANTED WEAPON

7-59. If the weapon must be tilted (canted) in one direction or another to engage a target, the strike of the bullet is 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

7-60. 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

7-61. 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

7-62. 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.

7-63. The example below shows the application of different moving target directions with varying speed directions. Figure 7-11 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.

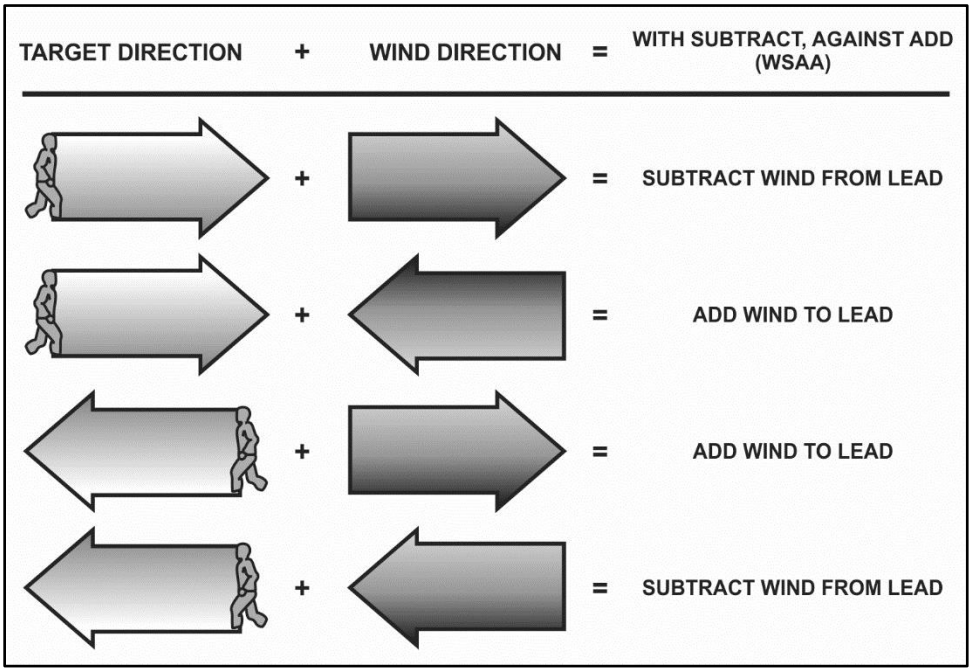


Figure 7-11. Compound wind and lead determination example

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Chapter 8

Control

The control element of employment considers all the conscious actions of the Soldier before, during, and after the shot process. The control process incorporates the Soldier as a function of safety, as well as giving them 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 and target alignment. Chapter 8 discusses the engagement techniques to which Soldiers must adapt to and the continuously changing combat engagements.

ARC OF MOVEMENT

8-1. When firing, the Soldier is the weapon's fire control system, ballistic computer, stabilization system, and mobilization system. Control refers to the Soldier's ability to regulate these functions and maintain the discipline to execute the shot process at the appropriate time.

8-2. Regardless of how well-trained or physically strong a Soldier is, a wobble area (or arc of movement) is present, even when the Soldier provides sufficient physical support of the weapon. The arc of movement may be observed as the sights moving in a W shape, a circular shape, vertical (up and down) pulses, 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 lateral, horizontal, and front-to-back variance in the movement that occurs in the sight picture (see figure 8-1).

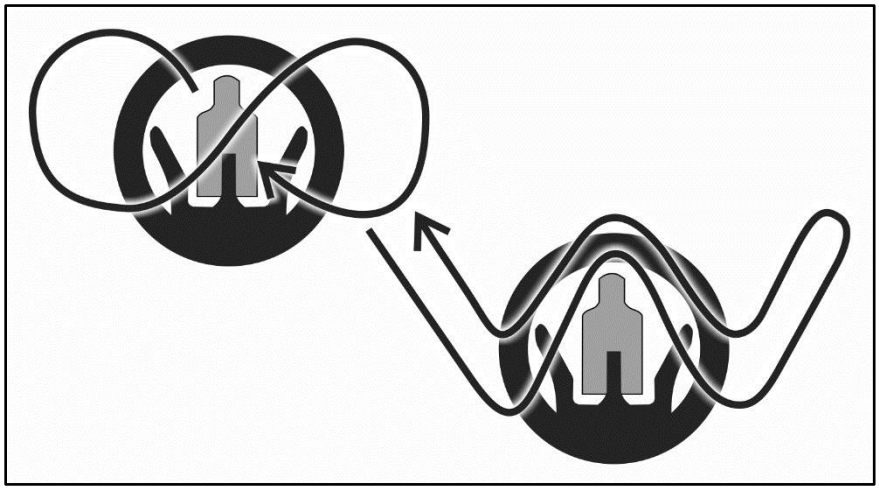


Figure 8-1. Arc of movement example

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.
- Calling the shot (firing or shot execution).
- Follow-through.

TRIGGER CONTROL

8-4. Trigger control is firing the weapon while maintaining proper aim and adequate stabilization until the bullet leaves the muzzle. Trigger control and the firer's position work together to allow the sights to stay on the target long enough for the firer 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 squeeze without inducing unnecessary movement or disturbing the sight picture. A smooth, consistent trigger squeeze, regardless of speed, allows the shot group to fire at the Soldier's moment of choosing. When both a solid position and a good trigger squeeze are achieved, any induced shooting errors can be attributed to the aiming process for refinement.

8-6. Placing the finger where it naturally lays facilitates smooth trigger control. Natural placement of the finger on the trigger allows for the best mechanical advantage when applying rearward pressure to the trigger. (See figure 8-2.)

- Trigger finger placement**.** The trigger finger lays naturally across the trigger after achieving proper grip. There is no specified point on the trigger finger that must be used. It is not the same for all Soldiers due to different size hands.
- Trigger squeeze**.** The Soldier pulls 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 is always smooth.
- Trigger reset. The Soldier must retain focus on the sights while resetting the trigger.

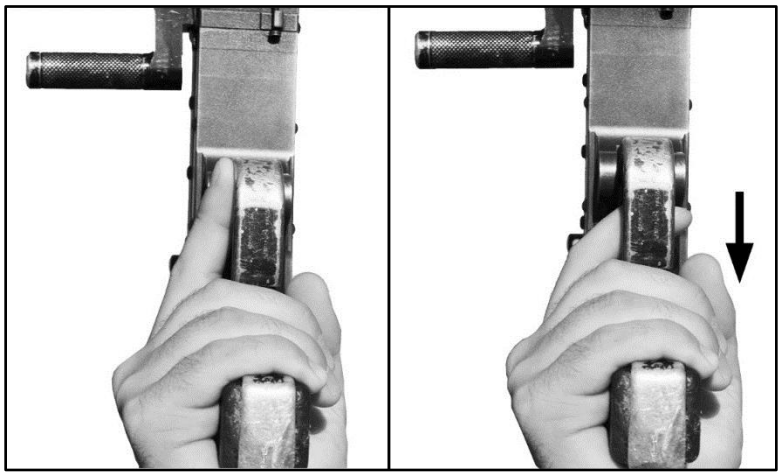


Figure 8-2. Natural trigger finger placement

BREATHING CONTROL

8-7. During the shot process, the firer controls their breathing to reduce the amount of movement of the weapon. During training, the Soldier learns a method of breathing control that best suits their shooting 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 squeeze.

8-8. 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.

8-9. Failure to maintain proper aiming and trigger control, rather than breathing, is the likely cause of vertical dispersion during grouping. Refer to appendix E of this publication for proper target analysis techniques.

WORKSPACE MANAGEMENT

8-10. 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.)

8-11. Conducting manipulations in the workspace allows the Soldier to keep their eyes oriented towards a threat or their 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.

8-12. Location of the workspace changes slightly in different firing positions. There are various techniques to use the workspace. Some examples are leaving the butt stock in the shoulder, tucking the buttstock under the armpit for added control of the weapon, or placing the buttstock in the crook of the elbow.

8-13. Workspace management includes the Soldier's ability to perform the following functions:

- Selector switch, to change the weapon's status from safe to fire from any position.
- Trigger housing assembly, to control the firing of the machine gun.
- Charging handle, to smoothly use the charging handle during operation, including any corrective actions to overcome malfunctions, loading, unloading, or clearing procedures.
- Feed tray, to serve as a guide for positioning cartridges to assist in chambering.
- Cover assembly, to feed linked belt and holds cartridges in position for stripping, feeding, and chambering.
- Cover assembly latches, to ensure cover assembly is locked.

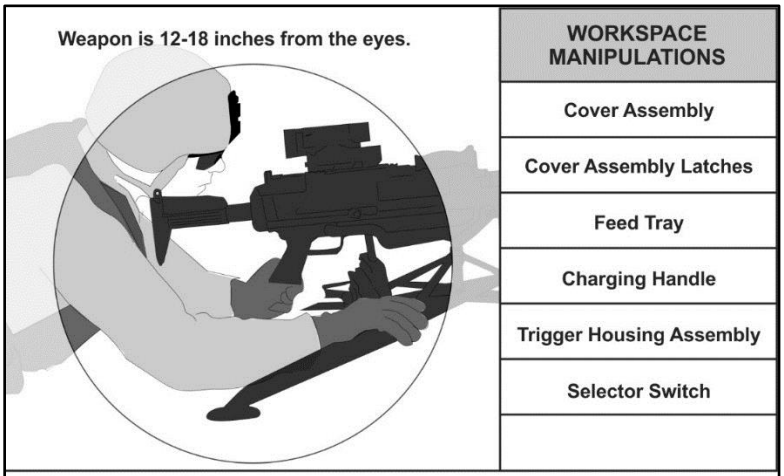


Figure 8-3. Workspace example

CALLING THE SHOT

8-14. 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.

8-15. Calling a shot refers to a firer stating exactly where they think the initial burst strikes by recalling the sights' relationship to the target when the weapon fired. Normally, calling a shot is expressed in clock direction and inches from the desired point of aim.

8-16. The firer is responsible for the point of impact of every round fired from their weapon. Therefore, the Soldier must ensure the target area is clear of friendly and neutral actors, in front of and behind the target. A Soldier also must 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

8-17. The firer must determine how to engage the threat with the weapon, on the current burst as well as subsequent bursts. Following the direction of the team leader, the Soldier controls the rate of fire to deliver consistent, lethal, and precise fires against the threat.

8-18. Automatic 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. Automatic fires drastically decrease the probability of hit due to the rapid succession of recoil impulses and the Soldier's inability to maintain proper sight alignment and sight picture on the target.

FOLLOW-THROUGH

8-19. Follow-through is the continued mental and physical application of the shot process' functional elements after the shot has been fired. The firer's head stays in contact with the stock, the firing eye remains open, and the trigger finger holds the trigger back through recoil. The firer then lets off the trigger, allowing the operating rod assembly to engage the sear to prevent it from firing, and the Soldier's body position and breathing remain steady.

8-20. Follow-through consists of all actions controlled by the firer after the rounds leaves the muzzle. Firers must complete the shot process with follow-through. The follow-through actions are executed in a general sequence as follows:

- Recoil management. Includes the bolt and operating rod assembly recoiling completely and returning to the locked back position.
- Recoil recovery**.** Returning to the same pre-shot position and reacquiring the sight picture. The firer should have a good sight picture before and after the shot.
- Trigger/sear reset. When the gunner releases the trigger, the trigger tripping lever pops up and raises the sear. As the operating rod assembly come to the rear, the sear holds the operating rod assembly back.
- 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.
- Engagement assessment**.** Once the sight picture returns to the original point of aim, the firer confirms the strike of the rounds, assesses the target's state, and immediately selects one of the following courses of action:
  - Subsequent engagement**.** The target requires additional (subsequent) burst to achieve the desired target effect. The firer starts the pre-shot process.
  - Supplemental engagement**.** The firer determines the desired target effect is achieved and another target may require servicing. The firer starts the pre-shot process.
  - Sector check**.** All threats have been adequately serviced to the desired effect. The firer checks their sector of responsibility for additional threats as the tactical situation dictates. The unit's SOP dictates any vocal announcements required during the post-shot sequence.

- Correct 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

8-21. A malfunction occurs when any weapon fails to complete any phase of the cycle of function correctly. 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

8-22. 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. The list below describes the general use of secondary weapons.

- Secondary weapon can defeat the threat. Soldier transitions to secondary weapon for the engagement. If no secondary weapon is available, Soldier announces their status to the small team, and moves 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.
- No secondary weapon. Soldiers quickly move to a covered position, announce their status to the small team, and execute corrective action.

CORRECTIVE ACTION

8-23. A properly functioning weapon is the end state of any of corrective action. Typically, the phase in which the malfunction occurred within the cycle of function identifies the general problem. 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.

8-24. To overcome the malfunction, the Soldier must first avoid overanalyzing the issue. The Soldier must train to execute corrective actions immediately without hesitation or investigation during combat conditions. There are two general types of corrective action:

- Immediate action is the simple, rapid actions or motions the Soldier takes to correct basic disruptions in the weapon's cycle of function. The Soldier takes immediate action when a malfunction occurs, for example, when the trigger is squeezed and the piston assembly moves forward with the firing pin resulting in an audible click.
- 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

8-25. No single corrective action solution can resolve all or every malfunction. Soldiers need to understand what failed to occur as well as any specific sounds or actions of the weapon to apply the appropriate correction measures.

8-26. Defective ammunition or improper operation by the gunner is not considered a malfunction. Sluggish operation and uncontrolled fire are the most common malfunctions. If cleaning and lubricating the weapon fail to fix the problem, the gunner turns it in to the unit armorer. Table 8-1 on page 8-6 identifies malfunctions, their probable causes, and the corrective actions.

Table 8-1. Correcting malfunctions on the M240 series

MALFUNCTIONS	*PROBABLE CAUSES*	*CORRECTIVE ACTIONS*
Sluggish operation on gas regulator	Carbon build-up	Clean gas regulator.
Uncontrolled fire (runaway gun)	Broken or stuck trigger. Stuck sear. Broken or damaged sear spring.	Replace trigger. Replace sear. Replace sear spring.
Failure to feed	Insufficient gas pressure. Improper lubrication. Defective links or ammunition Ammunition belt installed wrong. Damaged or weak feed pawls and springs or feed lever obstruction in receiver. Damaged or weak feed pawls. Defective links or ammunition. Ammunition belt installed wrong.	Clean gas port, inserts, and gas plug.
Failure to chamber.	Ruptured cartridge case. Damaged drive-spring rod assembly. Damaged gas plug or collar (cracks or burrs). Built-up carbon on gas plug or collar, gas cylinder, or piston; or dirty chamber.	Remove in accordance with TM 9-1005-313-10. Replace drive-spring rod assembly. Replace gas plug/collar. Remove carbon and clean in accordance with TM 9-1005-313-10.
Failure to extract.	Broken extractor or spring. Chipped or broken extractor. Defective extractor plunger. Insufficient gas pressure.	Replace. Replace. Replace. Clean and lubricate as required.
Failure to lock.	Dirty chamber. Dirty receiver or lack of lubrication. Insufficient gas pressure.	Clean in accordance with TM 9-1005-313-10. Clean and lubricate in accordance with TM 9-1005-313-10. Clean gas regulator.
Failure to fire.	Faulty ammunition. Broken or damaged firing pin or defective trigger. Insufficient gas pressure.	Replace Replace or send to direct support maintenance. Clean gas port, inserts, and gas plug.

Table 8-1. Correcting malfunctions on the M240 series (continued)

MALFUNCTIONS	*PROBABLE CAUSES*	*CORRECTIVE ACTIONS*
Failure to cock.	Broken sear. Worn operating rod sear notch. Broken, defective, or missing sear plunger and or spring.	Send to direct support maintenance. Send to direct support maintenance. Send to direct support maintenance.
Short to recoil.	N/A	Clean gas port and operating rod tube. Lubricate as required. Replace operating rod spring. See runaway gun (Malfunctions).

RULES FOR CORRECTING A MALFUNCTION

8-27. To clear a malfunction, the Soldier must—

- 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 trigger finger off the trigger and keep it straight along the lower receiver placed outside of the trigger guard.
- Do not attempt to place the weapon on safe (unless otherwise noted). Most stoppages do not allow the weapon to be placed on safe because the sear has been released or the weapon is out of battery. Attempting to place the weapon on SAFE wastes time and potentially damages the weapon.
- Treat the symptom. Each problem has its own specific symptoms. Soldiers can quickly correct the malfunction if they react to what the weapon is telling them.
- Maintain focus on the threat. The Soldier must keep their head and eyes looking downrange at the threat, not at the weapon. If the initial corrective action fails to correct the malfunction, the Soldier must quickly move to the next most probable corrective action.
- Look last. Do not look and analyze the weapon to determine the cause of the malfunction. Execute the drill that has the highest probability of correcting the malfunction.
- Check the weapon. Once the malfunction is clear and the threat is eliminated, deliberately check the weapon when in a covered location for any potential issues or contributing factors causing the malfunction and correct them.

PERFORM IMMEDIATE ACTION

8-28. The Soldier should perform immediate action instinctively to reduce a malfunction without seeking the cause. For example, the firer conducts immediate action when a misfire or cookoff occurs. The gunner keeps the weapon on his shoulder while performing immediate action procedures. If the weapon stops firing, they take the following immediate actions—

- A misfire is the failure of a chambered round to fire. Such failure can be due to an ammunition defect or faulty firing mechanism.
- A cook off is the firing of a round due to the heat of a hot barrel and not to the firing mechanism. Cook offs can be avoided by applying immediate action within 10 seconds of a failure to fire.
- An effective memory aid is POPP, which stands for pull, observe, push, and press:
  - Pull and lock the cocking handle to the rear:
  - Observe the ejection port to see if a cartridge case, belt link, or round ejects. Ensure that the bolt remains to the rear to prevent double feeding if a round or cartridge case is not ejected. If a cartridge case, belt link, or round ejects

- Push the cocking handle to its forward position, take aim on the target.
- Press the trigger. If the weapon does not fire, take remedial action. If a cartridge case, belt link, or round fails to eject, take remedial action.

PERFORM REMEDIAL ACTION

8-29. Remedial action is any action taken to determine the cause of a malfunction and to restore the weapon to an operational condition. Do this only if immediate action fails to fix the problem.

8-30. Remedial action requires the Soldier to quickly identify one of four issues and apply a specific technique to correct the malfunction. Remedial action is required to correct the following types of malfunctions or symptoms:

Cold Weapon

8-31. When a malfunction occurs with a cold weapon and immediate action has failed, the gunner must—

- Pull the cocking handle to the rear, locking the bolt. Return the cocking handle and place the safety to SAFE.
- Place the weapon on the ground or away from your face and open the cover. Perform the four point safety check. Reload and continue to fire.
- If the weapon fails to fire, clear the weapon inspect it and the ammunition.

CAUTION

When applying immediate or remedial action on a cold gun, check to see if any part of the round (ranging from the tip of the bullet to the rim) is in the chamber. Remove the ammunition from the feed tray only, then close the cover and try to fire. If the weapon fires, reload and continue firing. If it does not fire, then clear the weapon and inspect the weapon and ammunition.

Hot Weapon

8-32. If the malfunction occurs with a hot weapon (200 rounds or more in two minutes or combat situation), the gunner moves the safety to SAFE, waits five seconds. During training, the Soldier lets the weapon cool for 15 minutes, and uses the same procedures as outlined for cold weapon procedures.

Note. METT-TC and outside temperature ultimately determines how long a weapon barrel may be allowed to cool off.

DANGER

Never open the cover assembly on a hot weapon. An open cover cookoff could damage the weapon and more importantly, could result in serious injury.

Jammed Cocking Handle

8-33. If the gunner cannot pull the cocking handle to the rear by hand (the bolt might be fully forward and locked, or only partially forward), the gunner must—

- Try again to pull the cocking handle by hand do not over force, it can damage the weapon.
- If the weapon is hot enough to cause a cookoff, move all Soldiers a safe distance from the weapon and keep away for 15 minutes.

- After the weapon has cooled, pull the cocking handle to the rear. Keep rearward pressure on the cocking handle until you remove the drive-spring rod assembly. Open the cover and disassemble the weapon. (Have assistant gunner assist you.)
- Removes the round or fired cartridge. Uses cleaning rod or ruptured cartridge extractor if necessary.

Note. In a training situation, after completing the remedial action procedures, do not fire the weapon until an ordnance specialist has inspected it. In a combat situation, after you have corrected the malfunction, change the barrel and try to fire. If the weapon fails to function properly, send it to the unit armorer.

Stuck Barrel

8-34. Not properly cleaning the gas cylinder or the gas regulator plug often results in a stuck barrel. During training or range firing, clear, disassemble, and clean the M240-series MMG immediately. In combat, clean it as soon as possible if METT-TC permits.

8-35. Although there are other types of malfunctions or disruptions to the cycle of function, those listed above are the most common. Any other malfunction will require additional time to determine the true point of failure and an appropriate remedy.

Note. When malfunctions occur in combat, the Soldier must announce, "STOPPAGE," or a similar term to their small unit, quickly move to a covered location, and correct the malfunction as rapidly as possible. If the threat is too close to the Soldier or friendly forces, and the Soldier has a secondary weapon, the Soldier should immediately transition to the secondary weapon to defeat the threat prior to correcting 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 while maintaining stabilization, appropriate aim, and control of the weapon.

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 Solider degrades stability, the ability to aim, and creates challenges to proper trigger control.

MOVEMENT TECHNIQUES

9-1. The Soldier uses vertical and horizontal tactical movements. Each tactical movement requires specific considerations to maintain and adequately apply the other functional elements during the shot process.

9-2. Soldiers use vertical movements to change their firing posture or negotiate terrain or obstacles while actively seeking, orienting on, or engaging threats. Vertical movements include actions taken to—

- Change between any of the primary firing positions; standing, kneeling, or prone.
- Negotiate stairwells in urban environments.
- Travel across inclined or descending surfaces, obstacles, or terrain.

9-3. Soldiers use horizontal movements to negotiate the battlefield while actively seeking, orienting on, or engaging threats. Soldiers use one or all four of the horizontal movement techniques listed below to maintain weapon orientation on the threat—

- Forward**.** Movement in a direction directly toward the adversary.
- Retrograde**.** Movement rearward, in a direction away from the threat while maintaining weapon orientation on the threat.
- Lateral right or left**.** Lateral, diagonal, forward, or retrograde movement to the right or left.
- Turning left, right, or about**.** Actions taken by the Soldier to change the weapon orientation left/right or to the rear, followed by the Soldier's direction of travel turning to the same orientation.

FORWARD MOVEMENT

9-4. Forward movement is continuous progress toward the adversary or route of march. Forward movement is the most basic form of movement during an engagement.

9-5. During forward movement, Soldiers should—

- Roll the foot heel to toe to best provide a stable firing platform.
- Ensure their feet fall closely in line during movement. This straight-line movement reduces the arc of movement and visible bouncing of the sight picture.
- Keep their hips as stationary as possible. Use the upper body as a turret, twisting at the waist, maintaining proper platform with the upper body.
- Ensure that when shooting while moving, they are very close to their natural walking gait and come directly from the position obtained while stationary.

- Keep the weapon at the low ready position. Always maintain awareness of the surroundings, both to the left and right, at all times during movement.
- Maintain an aggressive position.
- Keep the muzzle of the weapon facing down range toward the expected or detected threat.

RETROGRADE MOVEMENT

9-6. Retrograde movement is where the orientation of the weapon remains to the Soldier's front while the Soldier methodically moves rearward.

9-7. During retrograde movement, Soldiers should—

- Take only one or two steps to open the distance or reposition the feet.
- Place the feet in a toe-to-heel manner and drop the center body mass by consciously bending the knees, using a reverse combat glide.
- Maintain situational awareness of team members, debris, and terrain.
- Use the knees as a shock absorber to steady the body movement to maintain the stability of the upper body, stabilizing the weapon's sight(s) on the target.
- Ensure all movement is smooth and steady to maintain stability.
- Bend forward at the waist to put as much mass as possible behind the weapon for recoil management.
- Keep the weapon at the low ready position and muzzle oriented downrange toward the expected or detected threat. Always maintain awareness of the surroundings at all times during movement.
- Keep the hips as stationary as possible. Use the upper body as a turret, twisting at the waist, maintaining proper platform with the upper body.

LATERAL MOVEMENT

9-8. Lateral movement is where the Soldier maintains orientation downrange with the weapon on the low ready at the expected or detected threat while moving to the left or right. In the most extreme cases, the target is offset 90 degrees or more from the direction of movement.

9-9. During lateral movement, Soldiers should—

- Place their feet heel to toe and drop their center mass by consciously bending the knees.
- Use the knees as a shock absorber to steady the body movement to maintain the stability of the upper body.
- Ensure all movement is smooth and steady to maintain stability.
- Bend forward at the waist to put as much mass as possible behind the weapon for recoil management.
- Roll the foot, heel to toe, as you place the foot on the ground and lift it up again to provide for the smoothest motion possible.
- Keep the weapon at the low ready position. Do not aim on the target until ready to engage.
- Maintain awareness of the surroundings, to the left and right, at all times during movement.
- Trigger control when moving is based on the wobble area. The Soldier shoots when the sights are most stable, not based on foot position.
- Keep the muzzle of the weapon facing down range toward the threat.
- When moving, the placement of the feet should be heel to toe.
- Do not overstep or cross the feet, because this can decrease the Soldier's balance and center of gravity.
- Keep the hips as stationary as possible. Use the upper body as a turret, twisting at the waist, maintaining proper platform with the upper body.

Note. Engaging adversaries to the firing side while moving laterally is difficult. The twist required to achieve a full 90-degree offset requires proper, repetitive training. The basic concept of movement must be maintained, from foot placement to platform.

Twisting at the waist does not allow the weapon to be brought to a full 90 degrees off the direction of travel, especially with nonadjustable buttstocks. The Soldier must drop the nonfiring shoulder and roll the upper body toward the nonfiring side. Rolling the upper body toward the nonfiring side causes the weapon and upper body to cant at approximately a 45-degree angle, relieving some tension in the abdominal region, allowing the Soldier to gain a few more degrees of offset.

TURNING MOVEMENT

9-10. Soldiers use the turning movement to engage widely dispersed targets in the oblique and on the flanks. Turning skills are just as valuable in a rapidly changing combat environment as firing on the move (such as lateral movement) skills and should be used with the alert carry only.

9-11. Which direction the Soldier is turning or which side is the Soldier's strong side is unimportant. The Soldier must maintain the weapon at an exaggerated low-alert carry for the duration of the turn.

9-12. Soldiers must maintain muzzle awareness at all times. Soldiers ensure that the muzzle does not begin to come up on target until their body is completely turned toward the threat.

9-13. When executing a turn to either side, Soldiers will—

- Look first. Turn head to the direction of the turn first.
- Weapon follows the eyes**.** The Soldier moves the weapon smoothly to where the eyes go.
- Follow with the body**.** The body begins movement with the movement of the weapon. Soldiers finish the body movement smoothly to maintain the best possible stability for the weapon.
- Maintain situational awareness**.** Soldiers must be completely aware of the surrounding terrain, particularly for tripping hazards. When necessary, Soldiers should visually check their surroundings during the turning action and return their vision to the target area as quickly as possible.

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Appendix A

Ammunition

Appendix A discusses the characteristics and capabilities of the different ammunition available for the M240-series medium machine gun (MMG). Appendix A includes general ammunition information such as packaging, standard and North Atlantic Treaty Organization (NATO) marking conventions, the components of ammunition, and general principles of operation. The information within this appendix is 7.62 mm for the M240-series weapons only.

SMALL ARMS AMMUNITION CARTRIDGES

A-1. Ammunition for use in medium machine guns is described as a cartridge. A small arms cartridge (see figure A-1) is an assembly consisting of a cartridge case, a primer, a quantity of propellant, and a bullet. The following terminology describes the general components of machine gun cartridges:

- Cartridge case**.** The cartridge case is a brass, rimless, center-fire case that provides a means to hold the other components of the cartridge.
- Propellant**.** The propellant (or powder) provides the energy to propel the projectile through the barrel and downrange towards a target through combustion.
- Primer**.** The primer is a small explosive charge that provides an ignition source for the propellant.
- Bullet**.** The bullet or projectile is the only component that travels to the target.

Note. Dummy cartridges are composed of a cartridge case and bullet, with no primer or propellant. Some dummy cartridges contain inert granular materials to simulate the weight and balance of live cartridges.

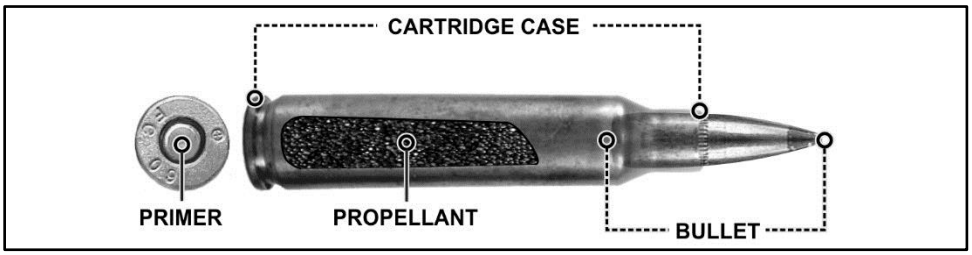


Figure A-1. Machine gun cartridge

CARTRIDGE CASE

A-2. Ball, tracer, armor-piercing, blank, special ball long range (LR), dummy, and short-range training ammunition (SRTA) are types of bullets used for various purposes.

A-3. The cartridge case is made of steel, aluminum, or a brass combination (70 percent copper and 30 percent zinc) for military use. The 7.62-mm cartridge case is a rimless cartridge case with an extraction groove (shown in figure A-2 on page A-2). These cartridge cases are designed to support center-fire operation.

A-4. 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 and are used for most small arms.

A-5. All 7.62-mm ammunition uses the rimless cartridge case. A rimless cartridge is where the rim diameter is the same as the case body, and uses an extractor groove to facilitate the cycle of functioning. This design allows for the stacking of multiple cartridges in a magazine.

A-6. The cartridge case expands tightly to the chamber walls, providing rear obturation to contain the burning propellant when the round is fired.

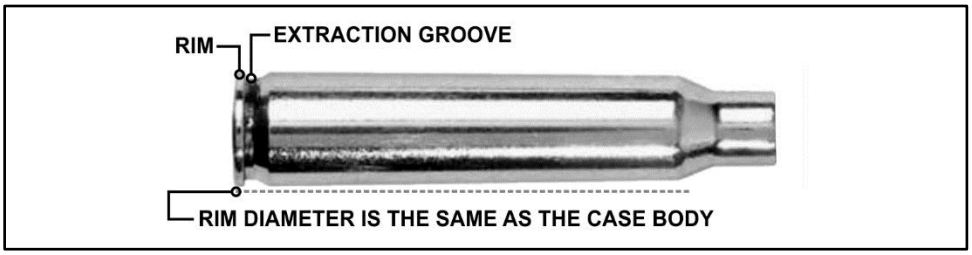


Figure A-2. Cartridge case

PROPELLANT

A-7. Cartridges are loaded with various propellant weights that impart sufficient velocity, within safe pressure, to obtain the required ballistic projectile performance. The propellants are either a single-base (nitrocellulose) or double-base (nitrocellulose and nitroglycerine) composition.

A-8. 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.

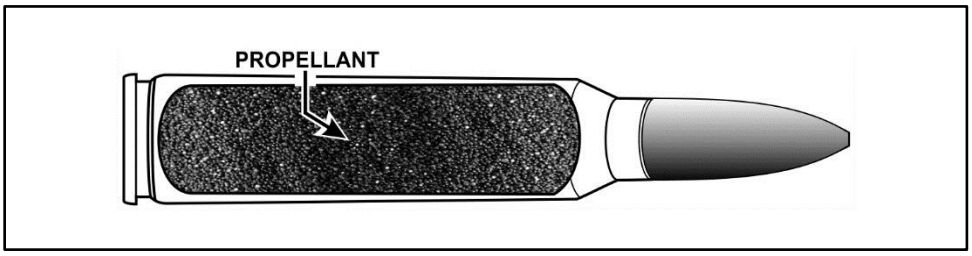


Figure A-3. Propellant

PRIMER

A-9. Center-fire, small arms cartridges contain a percussion primer assembly. The assembly has a brass or gilding metal cup (see figure A-4). The cup contains a pellet of sensitive explosive material secured by a paper disk and a brass anvil.

A-10. The weapon firing pin striking the center of the primer cup base compresses the primer composition between the cup and the anvil, causing 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.

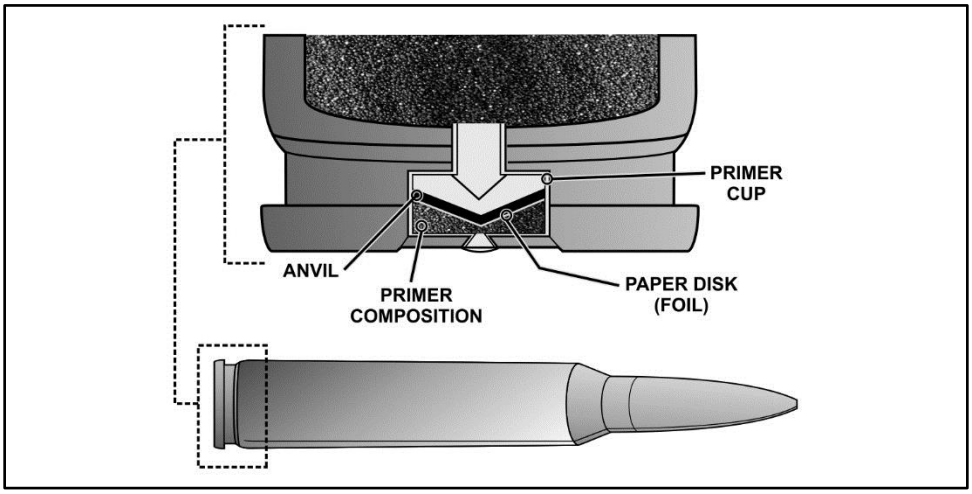


Figure A-4. Example of primer in detail

BULLET

A-11. The bullet is a cylindrically shaped lead or alloy projectile that engages with the rifling of the barrel. The bullets used today are either lead (lead alloy), or assemblies of a jacket and a lead or steel core penetrator. The lead used in lead-alloy bullets is combined with tin, antimony or both for bullet hardness. The alloying reduces barrel leading and helps prevent the bullet from striping (jumping) the rifling during firing.

A-12. Soldiers use jacketed bullets (see figure A-5) to obtain high velocities. Jacketed bullets are better suited for semiautomatic and automatic weapons. A bullet jacket may be either gilding metal, gilding metal-clad steel, or copper plated steel. In addition to a lead or steel core, they may contain other components or chemicals that provide a terminal ballistic characteristic for the bullet type.

A-13. Some projectiles may be manufactured from plastic, wax, or plastic binder and metal powder, two or more metal powders, or various combinations based on the cartridge's use.

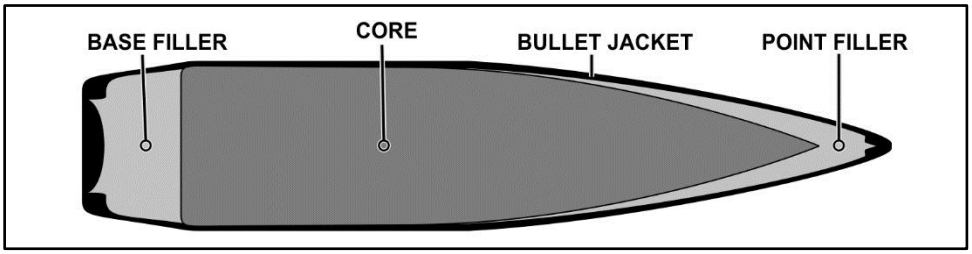


Figure A-5. Bullet example, armor-piercing cartridge

SMALL ARMS AMMUNITION TYPES

A-14. Soldiers use several types of small arms ammunition for the M240-series weapons for training and combat. Each of these ammunition types provides a different capability and has specific characteristics. The

most common types of ammunition for the automatic rifle and light machine gun are described in the following paragraphs.

BALL

A-15. The ball cartridge (see figure A-6) is intended for use in automatic rifles and light machine guns against personnel and unarmored targets. The bullet, as designed for general purpose combat and training requirements, normally consists of a metal jacket and a lead slug.

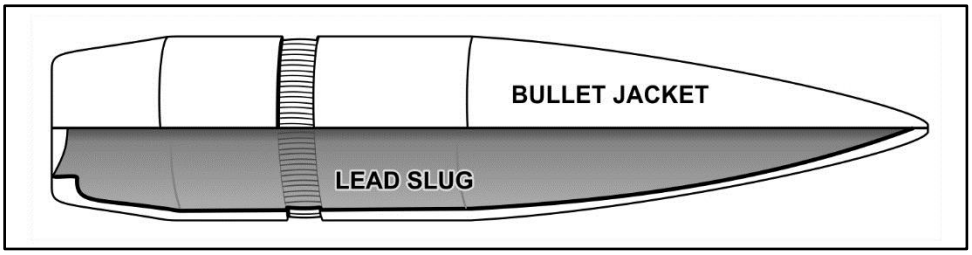


Figure A-6. Ball cartridge

TRACER

A-16. A tracer round (known as a TCR or T) contains a pyrotechnic composition in the base of the bullet to permit visible observation of the bullet's in-flight path or trajectory and point of impact. (See figure A-7) The propellant ignites the pyrotechnic composition when the round is fired, emitting a bright flame visible by the firer. Tracer rounds may be used to pinpoint enemy targets, to ignite flammable materials, and for signaling purposes.

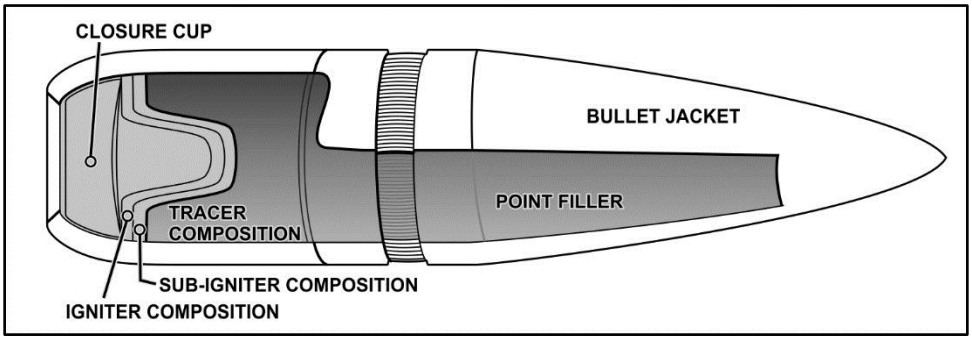


Figure A-7. Ball with tracer cartridge

ARMOR PIERCING

A-17. The armor-piercing cartridge (see figure A-8) is intended for use against personnel and light armored and unarmored targets, concrete shelters, and similar bullet-resistant targets. The bullet is made of a metal jacket and a hardened steel-alloy core. In addition, it may have a lead base filler and a lead point filler.

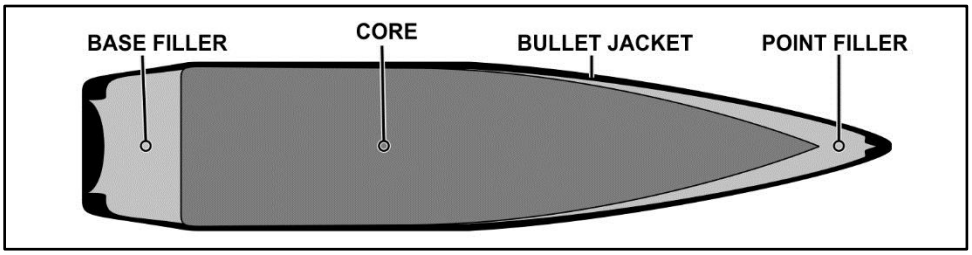


Figure A-8. Armor-piercing cartridge

BLANK

A-18. The absence of a bullet or projectile distinguishes a blank cartridge (see figure A-9). Soldiers use a blank cartridge to simulate fire, in training maneuvers, and for ceremonial purposes. The rounds consist of a roll crimp (knurl) or cannelure on the body of the case, which holds a paper wad in place instead of a projectile. Newer cartridges have rosette crimp (7 petals) and an identification knurl on the cartridge case.

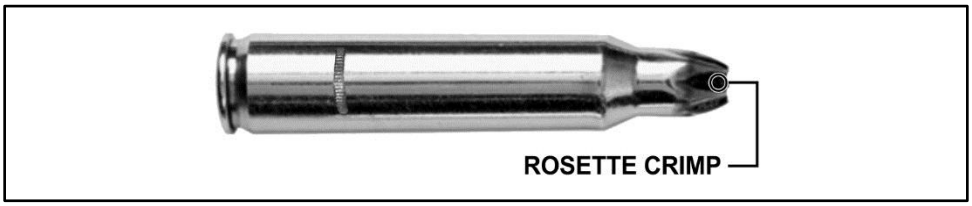


Figure A-9. Blank cartridge

DUMMY

A-19. Soldiers use the dummy cartridge (see figure A-10) for loading weapons and simulated firing practice to detect errors in employment skills when firing weapons. The round is completely inert and consists only of an empty cartridge case and ball bullet. Soldiers identify cartridges by the holes through the side of the case or the longitudinal corrugations in the case and by the empty primer pocket.

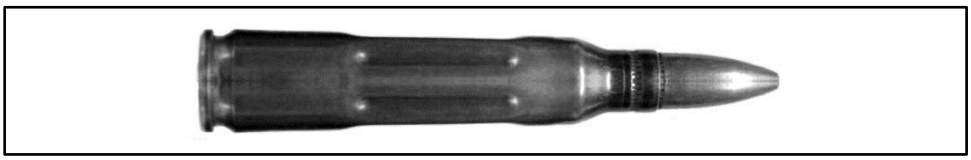


Figure A-10. Dummy cartridge

COLORS, MARKINGS AND SYMBOLS

A-20. Small arms ammunition is identifiable by color coding specification per type and intended use. Table A-1 on page A-6 describes the general color codes for all types of 7.62-mm ammunition. (Refer to TM 9-1300-200 and MIL-STD-709D for more information.)

A-21. Markings stenciled or stamped on munitions or their containers include all information needed for complete identification.

A-22. Packaging and containers for small arms ammunition are clearly marked with standard NATO symbols identifying the contents of the package by type of ammunition, primary use, and packaging information. The most common NATO symbols are described according to STANAG (see table A-1, page A-6).

A-23. Small arms ammunition (less than 20 millimeters) is not color-coded under MIL STD 709D. Marking standards for small arms ammunition are outlined in TM 9-1305-201-20&P and TM 9-1300-200. These publications describe the color coding system for small arms projectiles. The bullet tips are painted a distinctive color so the user can identify them quickly.

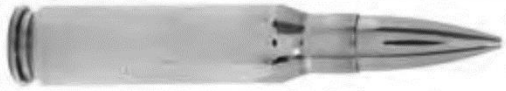
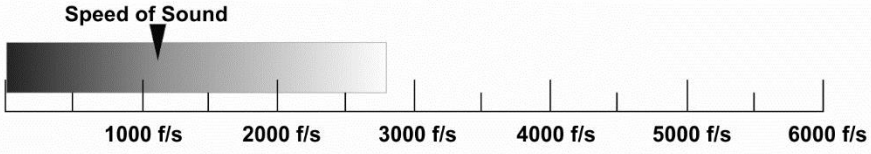
Table A-1. Small arms color coding and packaging markings

Ammunition Type	Color Coding	Package Marking
Ball	No Color or Green (M855)	
Tracer (TCR or T)	Orange Tip	
Armor Piercing (AP)	Black Tip	
Short Range Training Ammunition (STRA)	Blue	
Blank (BLK)	Cringed or Capped End	
Close Combat Mission Capabilities Kit (CCMCK) Dummy	Black Cartridge and Tip, or Perforated Cartridge	None
Special Markings	**Color Code**	**Package Marking**
NATO Standard		
Interchangeable - suitable for use in similar caliber NATO weapons		
Bandoleers - ammunition is packaged in bandoleers		
Clipped - ammunition is packaged in clips for use with a speed loader		

7-62 MM AMMUNITION

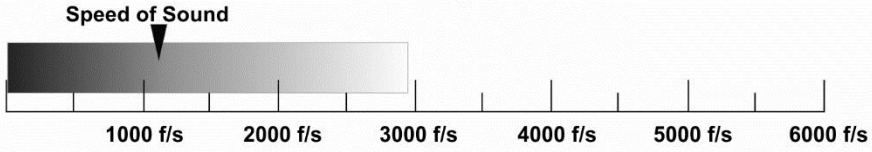
A-24. Tables A-2 through A-10 on pages A-7 through A-15, provide a brief description of the nine different types of commonly used 7.62-mm ammunition for training and combat. Some types of 7.62-mm ammunition have more than one applicable Department of Defense Identification Code (DODIC); those identifications codes provide clarity and ease for the unit's ammunition resource manager.

Table A-2. 7.62 mm, M80, ball

Cartridge, 7.62 mm, M80, Ball			
DODIC	A166		
Model:	M80		
Type:	Ball		
Weight:	392 gr		
Length:	2.8 in	71.1 mm	
Color Code:		Plain Tip	
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 51.181 mm
Propellant			
Type:	WC844	Double Base	Nitrocellulouse,
Weight:	46 gr	0.11 oz	Nitroglycerine
Primer			
Type:	Center Fire, Percussion		
Bullet			
Type:	Armor Piercing		
Design:	The cartridge is identified by a plain bullet tip.		
Weight:	8.2 gr	0.289 oz	
Length:	28.956 mm	1.14 in	
Tracer:	None		
Characteristics			
Chamber Pressure:	3447 bars	50000 psi	
Velocity:	838 m/sec	2750 ft/sec	2.44 mach
Kinetic Energy (Ek)	3390 J	2502 FtLbsF	
Velocity to Speed of Sound			
			
Special Features			
The cartridge is used in machine guns for firing over the heads of troops being trained in field exercises. Stringent production control and screening of ammunition lots ensure the safety of personnel operating immediately below the trajectory of the fired bullets.			

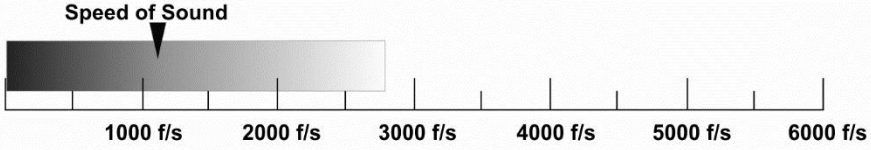
Legend:
FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

Table A-3. 7.62 mm, M80A1, ball

Cartridge, 7.62 mm, M80A1, Ball			
DODIC	AB79	AB80	AB81
Model:	M80A1		
Type:	Ball		
Weight:	355.68 gr		
Length:	2.8 in	71.1 mm	
Color Code:		Tarnished Bronze Tip	
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 51.181 mm
Propellant			
Type:	SMP842	Double Base	Nitrocellulouse,
Weight:	44.62 gr	0.102 oz	Nitroglycerine
Primer			
Type:	Center Fire, Percussion		
Bullet			
Type:	Ball		
Design:	The cartridge is identified by a tarnished bronze bullet tip.		
Weight:	8.2 gr	0.289 oz	
Length:	30.1498 mm	1.187 in	
Tracer:	None		
Characteristics			
Chamber Pressure:	3930 bars	57000 psi	
Velocity:	892 m/sec	2925 ft/sec	2.6 mach
Kinetic Energy (Ek)	3350 J	2469 FtLbsF	
Velocity to Speed of Sound			
			
Special Features			
The cartridge is intended for use against personnel and unarmored targets. When the percussion primer is struck, the propellant is ignited. The propelling gases ignite the tracer and expel the projectile toward a target.			

Legend:
FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

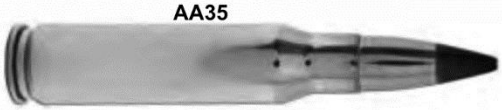
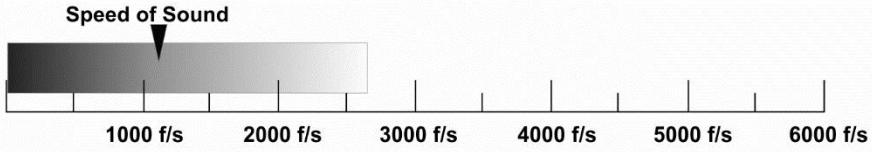
Table A-4. 7.62 mm, M62, tracer

Cartridge, 7.62 mm, M62, Tracer			
DODIC	A124		
Model:	M62		
Type:	Tracer		
Weight:	383 gr		
Length:	2.8 in	71.1 mm	
Color Code:		Orange Tip	
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 51.181 mm
Propellant			
Type:	WC846	Double Base	Nitrocellulouse,
Weight:	46 gr	0.105 oz	Nitroglycerine
Primer			
Type:	Center Fire, Percussion		
Bullet			
Type:	Tracer		
Design:	The cartridge is identified by a orange bullet tip.		
Weight:	8.2 gr	0.289 oz	
Length:	34.29 mm	1.35 in	
Tracer:	R284		
Characteristics			
Chamber Pressure:	3447 bars	50000 psi	
Velocity:	838 m/sec	2750 ft/sec	2.44 mach
Kinetic Energy (Ek)	3231 J	2385 FtLbsF	
Velocity to Speed of Sound			
			
Special Features			
The tracer is intended to permit visible observation of the bullet's in-flight path or trajectory to the point of impact.			

Legend:

FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

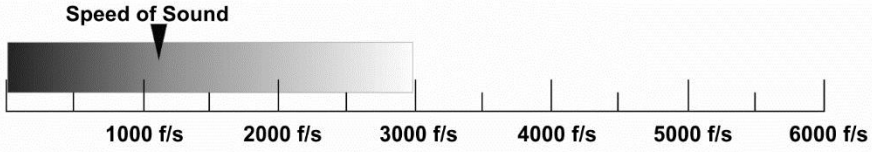
Table A-5. 7.62 mm, M276, dim tracer

Cartridge, 7.62 mm, M276, Dim Tracer			
DODIC	A163	AA35	
Model:	M276		
Type:	Dim Tracer		
Weight:	24.8 gr		
Length:	2.8 in	71.12 mm	
Color Code:		Lavender Tip	
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 51.181 mm
Propellant			
Type:	WCR846	Double Base	Nitrocellulouse,
Weight:	2.79 gr	0.01 oz	Nitroglycerine
Primer			
Type:	Center Fire, Percussion		
Bullet			
Type:	Armor Piercing		
Design:	The cartridge is identified by a lavender bullet tip and a knurling on the projectile.		
Weight:	8.2 gr	0.289 oz	
Length:	34.29 mm	1.35 in	
Tracer:	R440		
Characteristics			
Chamber Pressure:	3930 bars	57000 psi	
Velocity:	814 m/sec	2670 ft/sec	2.37 mach
Kinetic Energy (Ek)	207 J	152 FtLbsF	
Velocity to Speed of Sound			
			
Special Features			
The combat dim tracer cartridge is used for low light engagements where a tracer round is desirable, but when a standard traced round can be traced back to the shooter. For use when Night Vision Goggles (NVG) are available, the burning trace compound is invisible to the naked eye. When the percussion primer is struck, the propellant is ignited. The propelling gases ignite the tracer and expel the illuminated projectile towards a target.			

Legend:

FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

Table A-6. 7.62 mm, M993, armor-piercing

Cartridge, 7.62 mm, M993, Armor Piercing			
DODIC	AA03	AA04	
Model:	M993		
Type:	Armor Piercing		
Weight:	23.5 gr		
Length:	2.8in	71.12 mm	
Color Code:		Black Tip	
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 51.181 mm
Propellant			
Type:	WC844	Double Base	Nitrocellulouse,
Weight:	2.92 gr	0.01 oz	Nitroglycerine
Primer			
Type:	Center Fire, Percussion		
Bullet			
Type:	Armor Piercing		
Design:	Armor piercing cartridge. The cartridge is identified by a black stripe circling the tip of the projectile.		
Weight:	8.2 gr	0.289 oz	
Length:	26.499 mm	1.0433 in	
Tracer:	None		
Characteristics			
Chamber Pressure:	3800 bars	55115 psi	
Velocity:	909.82 m/sec	2985 ft/sec	2.65 mach
Kinetic Energy (Ek)	220 J	162 FtLbsF	
Velocity to Speed of Sound			
			
Special Features			
The cartridge provides an enhanced armor penetrating capacity for use in standard 7.62 mm weapons.			

Legend:

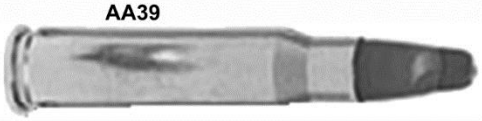
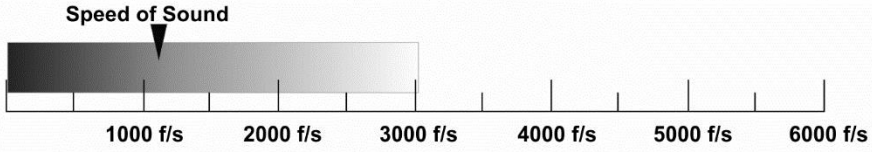
FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

Table A-7. 7.62 mm, short-range training ammunition

Cartridge, 7.62 mm, M973, Training, Short Range			
DODIC	AA37	AA39	
Model:	M973		
Type:	Training, Short Range		
Weight:	19.4 gr		
Length:	2.625 in	66.675 mm	
Color Code:		Blue Tip	
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 51.181 mm
Propellant			
Type:	WC-749	Double Base	Nitrocellulouse, Nitroglycerine
Weight:	3.02 gr	0.01 oz	
Primer			
Type:	Center Fire, Percussion		
Bullet			
Type:	Training, Short Range, plastic projectile		
Design:	Brass case with a blue plastic projectile.		
Weight:	3.68-4.81 gr	0.13 - 0.17 oz	
Length:	24.4856 mm	0.964 in	
Tracer:	None		
Characteristics			
Chamber Pressure:	2094 bars	30372 psi	
Velocity:	831.8 m/sec	2729 ft/sec	2.43 mach
Kinetic Energy (Ek)	84 J	62 FtLbsF	
Velocity to Speed of Sound			
Speed of Sound	1000 f/s	2000 f/s	3000 f/s 4000 f/s 5000 f/s 6000 f/s
Special Features			
The cartridge is for training in local and urban training areas where range restrictions preclude the use of full range standard service ammunition.			

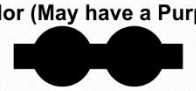
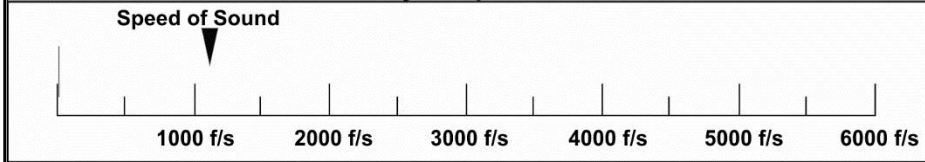
Legend:
FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

Table A-8. 7.62 mm, M974, short-range training ammunition

Cartridge, 7.62 mm, M974, Training, Short Range			
DODIC	AA37	AA39	
Model:	M973		
Type:	Training, Short Range		
Weight:	19 gr		
Length:	2.625 in	66.675 mm	
Color Code:		Red Tip	
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 51.181 mm
Propellant			
Type:	CMR 100	Double Base	Nitrocellulouse,
Weight:	3.02 gr	0.0069 oz	Nitroglycerine
Primer			
Type:	Center Fire, Percussion		
Bullet			
Type:	Training, Short Range, plastic projectile		
Design:	Brass case with a blue plastic projectile with red tip.		
Weight:	3.68-4.81 gr		
Length:	24.4856 mm		
Tracer:	Tracer Mix SRT-04		
Characteristics			
Chamber Pressure:	2049 bars	29712 psi	
Velocity:	922.8 m/sec	3027.6 ft/sec	2.69 mach
Kinetic Energy (Ek)	103 J	76 FtLbsF	
Velocity to Speed of Sound			
			
Special Features			
The cartridge is for training in local and urban training areas where range restrictions preclude the use of full range standard service ammunition.			

Legend:
FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

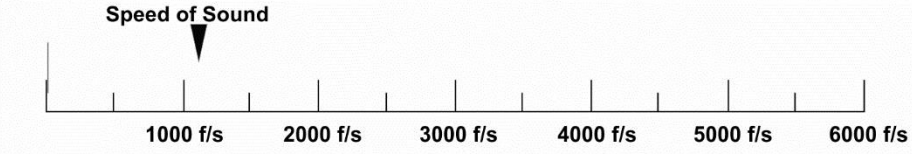
Table A-9. 7.62 mm, M82, blank

Cartridge, 7.62 mm, M82, Blank			
DODIC	A110	A111	A112
Model:	M82		
Type:	Blank		
Weight:	235 gr		
Length:	2.62 in	66.55 mm	
Color Code:		No Color (May have a Purple Tip)	
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 66.04 mm
Propellant			
Type:	WC818	Double Base	Nitrocellulouse,
Weight:	0.939 gr	0.939 oz	Nitroglycerine
Primer			
Type:	Center Fire, Percussion		
Bullet			
Type:	Blank		
Design:	The cartridge is identified by its double tapered neck and absence of a bullet.a		
Weight:	N/A		
Length:	N/A		
Tracer:	None		
Characteristics			
Chamber Pressure:	0 bars	0 psi	
Velocity:	0 m/sec	0 ft/sec	0 mach
Kinetic Energy (Ek)	0 J	0 FtLbsF	
Velocity to Speed of Sound			
			
Special Features			
When the percussion primer is struck, the propellant is ignited. The propelling gases are used to cycle the weapon using an appropriately installed Blank Firing Adapter to create back pressure..			

Legend:

FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

Table A-10. 7.62 mm, M63A1, dummy, training

Cartridge, 7.62 mm, M63A1, Dummy, Training			
DODIC	AB47		
Model:	M63A1		
Type:	Dummy, Training		
Weight:	0 gr		
Length:	2.8 in	71.12 mm	
Color Code:	Both bullet and casing being metallic nickel color		
Markings:			
Case			
Type:	Center Fire	Description:	7.62 x 66.04 mm
Propellant			
Type:	N/A		
Weight:	N/A		
Primer			
Type:	N/A		
Bullet			
Type:	N/A		
Design:	Tactically, the cartridge is identified by 6 longitudinal corrugations (flutings) in the cartridge case and there is no primer.		
Weight:	N/A		
Length:	N/A		
Tracer:	None		
Characteristics			
Chamber Pressure:	0 bars	0 psi	
Velocity:	0 m/sec	0 ft/sec	0 mach
Kinetic Energy (Ek)	0 J	0 FtLbsF	
Velocity to Speed of Sound			
			
Special Features			
Tactically, the cartridge is identified by 6 longitudinal corrugation (flutings) in the cartridge case and there is no primer. Visually, the cartridge is identified by both bullet and casing being a metallic nickel color. The cartridge is used for practice in loading the 7.62 mm weapons, for simulated firing to detect flinching of personnel when firing, and for inspection and testing the weapon mechanisms.			

Legend:

FTLbsF= feet pounds of force
ft/sec= feet per second
f/s= feet per second
gr= grain
in= inches
J= joules
mm= millimeters
m/sec= meters per second
oz= ounces
psi= pounds per square inch

M13 OPEN-LOOP LINK

A-25. Ammunition for use in machine guns is issued in metallic link belts. Link belts are made of units of cartridges and links. Each link has two loops fitted around a single cartridges and one loop fitted around adjacent cartridge. Each cartridge in a metallic link belt has two links attached to it, except the end cartridges. Cartridge links are made of steel which is processed to prevent rusting. They are manufactured and tested to assure satisfactory ammunition feed and functioning under all service conditions,

A-26. The 7.62-mm, M13 disintegrating links (see figure A-11) are manufactured with partially open loops and have a positioning finger on one side which snaps into extractor grooves of cartridge to retain cartridge in proper feed alignment. This link design permits a portion of bolt to ride through link loop openings and push cartridges forward and out of the link into the chamber for firing.

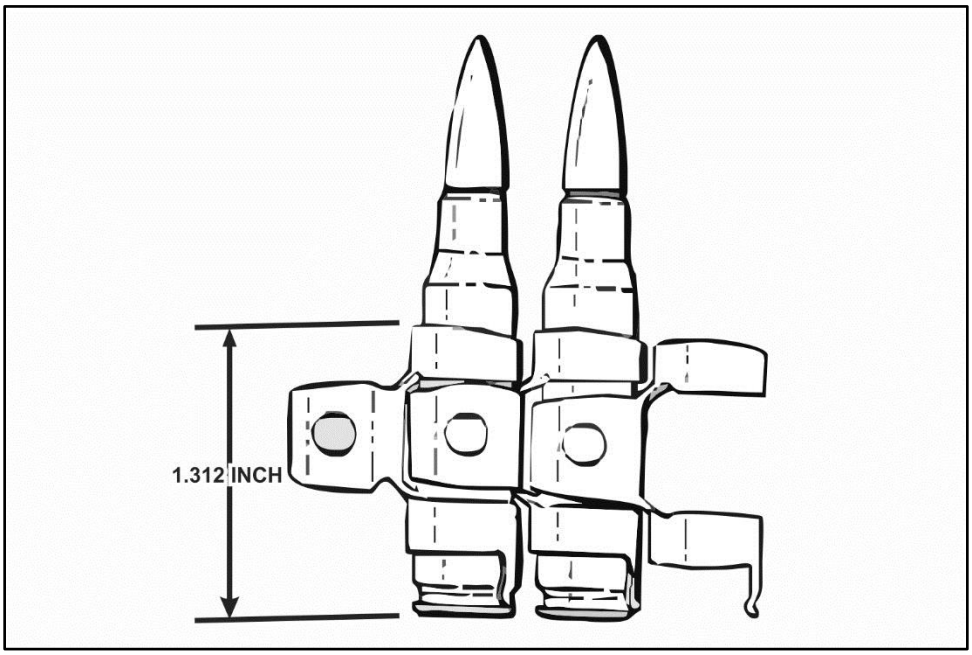


Figure A-11. 7.62-ammunition with M13 disintegrating link

Appendix B

Ballistics

Ballistics is the science of the processes that occur from the time a firearm is fired to the time when the bullet impacts its target. Soldiers must be familiar with the principles of ballistics to understand how the projectiles function, perform during flight, and the actions of the bullet when it strikes the intended target. The profession of arms requires Soldiers to understand their weapons, how they operate, their functioning, and their employment.

BALLISTIC CATEGORIES

B-1. The flight path of a bullet includes three stages: the travel down the barrel, the path through the air to the target, and the actions the bullet takes upon impact with the target. These stages are defined in separate categories of ballistics: internal, external, and terminal ballistics.

INTERNAL BALLISTICS

B-2. Internal ballistics is the study of the propulsion of a projectile. Internal ballistics begin from the time the firing pin strikes the primer to the time the bullet leaves the muzzle. Once the primer is struck the priming charge ignites the propellant. The expanding gases caused by the burning propellant create pressures which push the bullet down the barrel. The bullet engages the lands and grooves (rifling) imparting a spin on the bullet that facilitates stabilization of the projectile during flight. Internal ballistics ends at shot exit, where the bullet leaves the muzzle. (See figure B-1 on page B-2.)

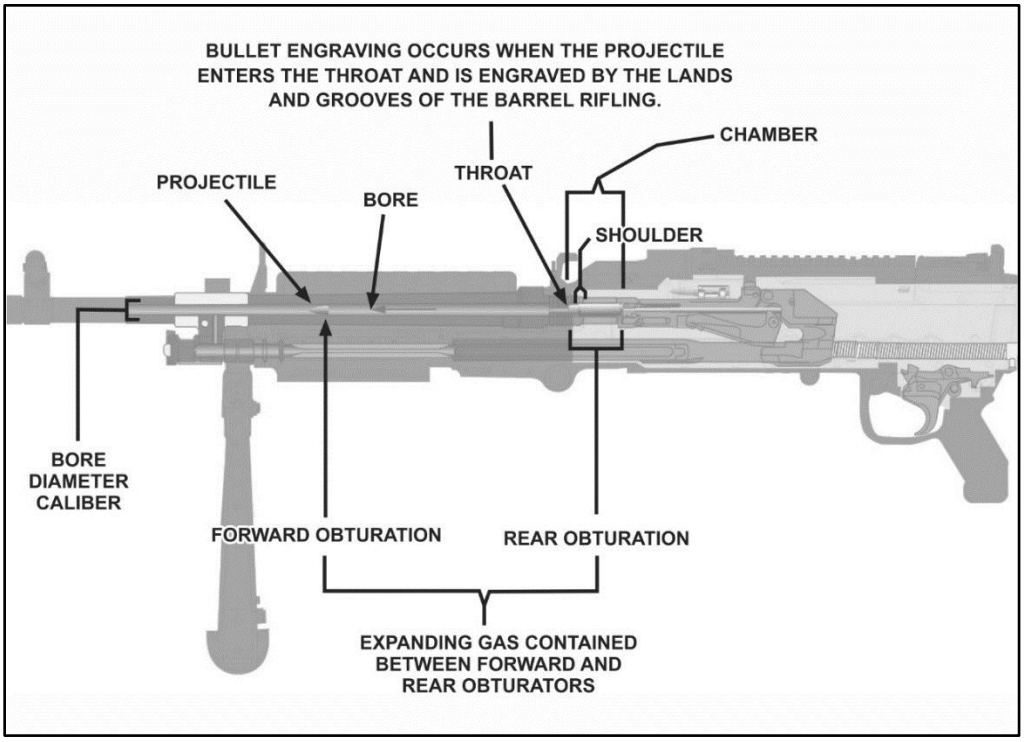


Figure B-1. Internal ballistics terms

B-3. Several key terms are used when discussing the physical actions of internal ballistics —

- Bore**.** The interior portion of the barrel forward of the chamber.
- Chamber**.** The part of the barrel that accepts the ammunition for firing.
- Grain (gr)**.** A unit of measurement of either a bullet or a projectile. There are 7000 grains in a pound, or 437.5 grains per ounce.
- Pressure**.** The force developed by the expanding gasses generated by the combustion (burning) of the propellant. Pressure is measure in pounds per square inch (psi).
- Shoulder**.** The area of the chamber that contains the shoulder, forcing the cartridge and projectile into the entrance of the bore at the throat of the barrel.
- Muzzle**.** The end of the barrel.
- Throat**.** The entrance to the barrel from the chamber. Where the projectile is introduced to the lands and grooves within the barrel.

EXTERNAL BALLISTICS

B-4. External ballistics is the study of the physical actions and effects of gravity, drag, and wind along the projectile's flight to the target. Exterior ballistics includes only those general physical actions that cause the greatest change to the flight of a projectile. (See figure B-2.) External ballistics begins at shot exit and continues through the moment the projectile strikes the target.

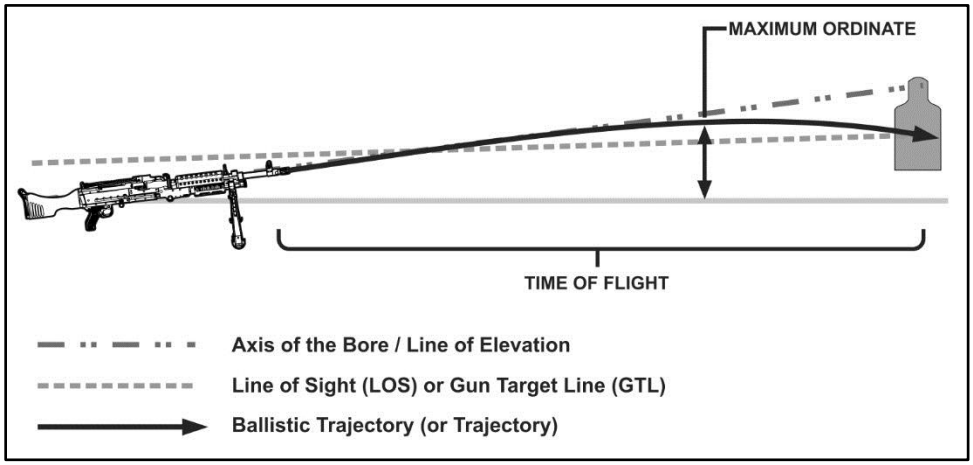


Figure B-2. External ballistics terms

B-5. Soldiers use the following terms and definitions to describe the actions or reactions of the projectile during flight. This terminology below is standard when dealing with any weapon or weapon system, regardless of caliber. (See figure B-3.)

- Axis of the bore (line of bore)**.** The line passing through the center of the bore or barrel.
- Line of sight (LOS) or gun target line**.** A straight line between the sights or optics and the target. The LOS is never the same as the axis of the bore. The LOS is what the Soldier sees through the sights and can be illustrated by drawing an imaginary line from the firer's eye through the rear and front sights out to infinity. The LOS is synonymous with the gun target line when viewing the relationship of the sights to a target.
- Line of elevation (LE)**.** The angle from the ground to the axis of the bore.
- Ballistic trajectory**.** The path of a projectile when influenced only by external forces, such as gravity and atmospheric friction.
- Maximum ordinate**.** The maximum height the projectile travels above the line of sight on its path to the point of impact.
- Time of flight**.** The time taken for a specific projectile to reach a given distance after firing.

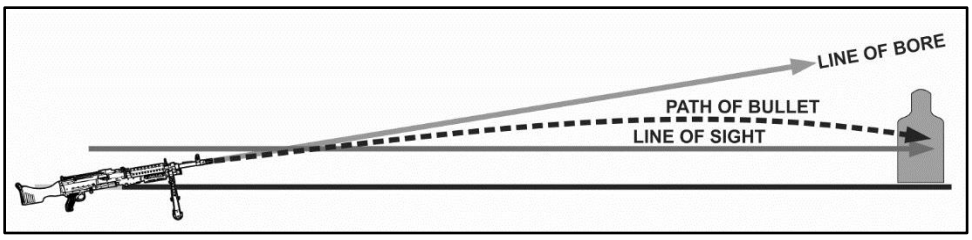


Figure B-3. Trajectory

- Jump**.** Vertical jump in an upward and rearward direction caused by recoil. Typically, it is the angle, measured in mils, between the line of departure and the line of elevation.
- Line of departure (LD**).** The line the projectile is on at shot exit.
- Muzzle**.** The end of the barrel.
- Muzzle velocity or velocity**.** The velocity of the projectile measured at shot exit. Muzzle velocity decreases over time due to air resistance. For small arms ammunition, velocity (V) is represented in feet per second.
- Twist rate**.** The rotation of the projectile within the barrel of a rifled weapon based on the distance to complete one revolution. The twist rate relates to the ability to gyroscopically spin-stabilize a projectile on rifled barrels, improving its aerodynamic stability and accuracy. The twist rate of the M240 series MMG is a right-hand, one revolution in every 12 inches of barrel length (or R 1:12 inches).
- Shot exit**.** The moment the projectile clears the muzzle of the barrel, when the barrel no longer supports the bullet.
- Oscillation**.** The movement of the projectile in a circular pattern around its axis during flight.
- Drift**.** The lateral movement of a projectile during its flight caused by its rotation or spin.
- Yaw**.** A deviation from stable flight by oscillation. Cross wind or destabilization when the projectile enters or exits a transonic stage can cause yaw.
- Grain (gr)**.** A unit of measurement of either a bullet or a propellant charge. There are 7000 grains in a pound, or 437.5 grains per ounce.
- Pressure**.** The force the expanding gases generate from the combustion (burning) of the propellant. For small arms, pressure is measured in pounds per square inch (psi).
- Gravity**.** The constant pressure of the earth on a projectile at a rate of about 9.8 meters per second squared, regardless of the projectile's weight, shape or velocity. Commonly referred to as bullet drop, gravity causes the projectile to drop from the line of departure. Soldiers must understand the effects of gravity on the projectile when zeroing as well as how it applies to determining the appropriate hold-off at ranges beyond the zero distance.
- Drag (air resistance)**.** The friction that slows the projectile down while moving through the air. Drag begins immediately upon the projectile exiting the barrel (shot exit). Drag slows the projectile's velocity over time, and is most pronounced at extended ranges. Each round has a ballistic coefficient that is a measurement of the projectile's ability to minimize the effects of air resistance (drag) during flight.
- Trajectory**.** The path of flight that the projectile takes upon shot exit over time. For the purposes of this manual, the trajectory ends at the point of impact.
- Wind**.** Wind has the greatest variable effect on ballistic trajectories. The effects of wind on a projectile are most noticeable in three key areas between half and two-thirds the distance to the target:
  - Time (T)**.** The amount of time the projectile is exposed to the wind along the trajectory. The greater the range to target, the greater time the projectile is exposed to the wind's effects.
  - Direction**.** The direction of the wind in relation to the axis of the bore. The relation compensates for direction of the projectile's drift.

- Velocity (V)**.**The speed of the wind during the projectile's trajectory to the target. Variables in the overall wind velocity affecting a change to the ballistic trajectory include sustained rate of the wind and gust spikes in velocity.

TERMINAL BALLISTICS

B-6. Terminal ballistics is the science of the actions of a projectile from the time it strikes an object until it comes to rest (called terminal rest). This includes the terminal effects that take place against the target.

- Kinetic energy (KE)**.** A unit of measurement of the delivered force of a projectile. Kinetic energy is the delivered energy that a projectile possesses due to its mass and velocity at the time of impact. Kinetic energy is directly related to the penetration capability of a projectile against the target.
- Penetration**.** The ability or act of a projectile to enter a target's mass based on its delivered kinetic energy. When a projectile strikes a target, the level of penetration into the target is termed the impact depth. The impact depth is the distance from the point of impact to the moment the projectile stops at its terminal resting place. Ultimately, the projectile stops when it has transferred its momentum to an equal mass of the medium (or arresting medium).

B-7. Against any target, penetration is the most important terminal ballistic consideration. Soldiers must be aware of the penetration capabilities of their ammunition against their target, and the most probable results of the terminal ballistics.

B-8. The 7.62-mm projectile's purpose is to focus the largest amount of momentum (energy) on the smallest possible area of the target to achieve the greatest penetration. They are designed to resist deformation on impact to enter the target's mass. The steel tip of the penetrator allows for reduced deformation through light skin armor or body armor, and the heavier steel penetrator allows for increased soft tissue damage.

ACTIONS AFTER THE TRIGGER SQUEEZE

B-9. Once the trigger is squeezed, the ballistic action begins. Although not all ammunition and weapons operate in the same manner, the following list describes the general events that occur on the M240-series MMG when the trigger is squeezed.

- The sear, which is located in the trigger assembly, is holding the operating rod assembly back. Pulling the trigger lowers the sear allowing the operating rod assembly to move forward.
- The bolt strips the first round as it moves forward.
- The cartridge guides the round forward and prevents the forward movement of the link.
- The bolt assembly roller moves feed lever and the feed pawls begin feeding next round.
- The bolt feeds a round into barrel and chambers that round, then the breech face of the bolt will sit firmly against the barrel.
- The operational rod forces the locking lever down locking it against the recoil shoulder.
- The firing pin moves through the bolt and strikes the primer.
- The firing pin is pushed forward, striking the cartridge percussion primer assembly.
- The primer is crushed, pushing the primer composition through the paper disk, and on to the anvil, detonating the primer composition.
- The burning primer composition is focused evenly through the primer cup vent hole, igniting the propellant.
- The propellant burns evenly within the cartridge case.
- The cartridge case wall expands from the pressure of the burning propellant, firmly locking the case to the chamber walls.
- The expanded cartridge case, held firmly in place by the chamber walls and the face of the bolt, provides rear obturation, keeping the burning propellant and created expanding gasses in front of the cartridge case.
- The projectile is forced by the expanding gasses firmly into the lands and grooves at the throat of the bore, causing engraving.
- Engraving causes the scoring of the softer outer jacket of the projectile with the lands and grooves of the bore. This allows the projectile to spin at the twist rate of the lands and grooves, and provides

a forward obturation seal. The forward obturation keeps the expanding gasses behind the projectile in order to push it down the length of the barrel.

- As the propellant continues to burn, the gasses created continue to seek the path of least resistance. As the cartridge case is firmly seated and the projectile is moveable, the gas continues to exert its force on the projectile.
- As the end of the projectile leaves the muzzle, it is no longer supported by the barrel itself. Shot exit occurs.
- Upon shot exit, most of the expanding and burning gasses move outward and around the projectile, causing the muzzle flash.
- At shot exit, the projectile achieves its maximum muzzle velocity. From shot exit until the projectile impacts an object, the projectile loses velocity at a steady rate due to air resistance.
- As the round travels along its trajectory, the bullet drops consistently by the effects of gravity.
- As the actual line of departure is an elevated angle from the line of sight, the projectile appears to rise and then descend. This rise and fall of the projectile is the trajectory.
- The round achieves the highest point of its trajectory typically more than halfway to the target, depending on the range to target. The high point is called the round's maximum ordinate or max ord.
- From the max ord, the projectile descends into the target.
- The round strikes the target at the point of impact, which, depending on the firing event, may or may not be the desired point of impact, and is seldom the point of aim.
- Once the projectile strikes a target or object, it delivers its kinetic energy (force) at the point of impact.

TERMINAL BALLISTICS BEGIN

B-10. Once terminal ballistics begin, no bullets follow the same path or function. Generally speaking, the projectile penetrates objects where the delivered energy (mass times velocity squared, divided by 2) is greater than the mass, density, and area of the target at the point of the delivered force. There are other contributing factors, such as the angle of attack, yaw, oscillation, and other physical considerations that are not included in this ballistic discussion.

STRUCTURE PENETRATION

B-11. The machine gun's direct-fire projectiles are primarily designed to strike a target with a velocity high enough to achieve penetration. These kinetic energy projectiles use high velocity and mass (momentum) to penetrate their target.

B-12. The machine gun's kinetic energy direct-fire projectiles include ball, tracer, and armor piercing rounds. Armor-piercing and armor-piercing incendiary rounds are designed to penetrate armor plate and other types of homogeneous steel. Armor piercing projectiles have a special jacket encasing a hard core or penetrating rod which is designed to penetrate when fired with high accuracy at an angle very close to the perpendicular of the target. Incendiary projectiles are used principally to penetrate a target and ignite its contents. The ball and tracer projectile penetrates soft targets on impact at a high velocity. The penetration depends directly on the projectile's velocity, weight, and angle at which it hits.

B-13. The penetration of the 7.62-mm round is best at 600 meters, but most urban targets are closer. The typical minimum effective penetration range for the 7.62-mm round is 200 meters. At 50 meters, the 7.62-mm ball round cannot reliably penetrate a single layer of well-packed sandbags. At 200 meters, it can penetrate a single sandbag layer but not a double layer. The armor-piercing round does only slightly better against sandbags. It cannot penetrate a double layer but can penetrate up to 10 inches at 600 meters.

B-14. An MMG is difficult to hold steady enough to repeatedly hit the same point on a wall. The dust created by the bullet strikes also makes precise aiming difficult. For this reason, firing from a tripod is usually more effective than without, especially if sandbags are used to steady the weapon. Short bursts of three to five rounds fired in a U-shaped pattern are best.

B-15. Breaching cinder block presents a problem for MMGs. Rounds easily penetrate the hollow portions of the cinder block but leave a net-like structure of the solid portions. Substantial amounts of ammunition are

required to destroy this net. However, a crowbar or axe can remove this web and allow entry through the breach hole.

B-16. Typically, small-arms weapons, except for shotguns, have limited breaching value. Most 5.56-mm, 7.62-mm, or .50-caliber weapons produce ricochets and require numerous rounds to create a successful breach. As such, these weapons are not recommended for breaching.

SOFT TISSUE PENETRATION

B-17. A gunshot wound, or ballistic trauma, is a form of physical damage sustained from the entry of a projectile. The degree of tissue disruption caused by a projectile is related to the size of the cavities the projectile creates as it passes through the target's tissue. When striking a personnel target, there are two types of cavities created by the projectile: permanent and temporary wound cavities.

Permanent Wound Cavity

B-18. The permanent cavity refers specifically to the physical hole left in the tissues of soft targets by the pass-through of a projectile. It is the total volume of tissue crushed or destroyed along the path of the projectile within the soft target.

B-19. Depending on the soft tissue composition and density, the tissues are either elastic or rigid. Elastic organs stretch when penetrated, leaving a smaller wound cavity. Organs that contain dense tissue, water, or blood are rigid, and can shatter from the force of the projectile. When a rigid organ shatters from a penetrating bullet, it causes massive blood loss within a larger permanent wound cavity. Although typically fatal, striking these organs may not immediately incapacitate the target.

Temporary Wound Cavity

B-20. The temporary wound cavity is an area that surrounds the permanent wound cavity. It is created by soft, elastic tissues as the projectile passes through the tissue at greater than 2000 feet per second. The tissue around the permanent cavity is propelled outward (stretched) in an almost explosive manner from the path of the bullet. This forms a temporary recess or cavity 10 to 12 times the bullet's diameter.

B-21. Tissue such as muscle, some organs, and blood vessels are elastic and can be stretched by the temporary cavity with little or no damage and have a tendency to absorb the projectile's energy. The temporary cavity created slowly reduces in size over time, although typically not returning completely to the original position or location.

Note. Projectiles that do not exceed 2000 feet per second velocity on impact do not provide sufficient force to cause a temporary cavity capable of incapacitating a threat.

B-22. The extent of the cavitation (the bullet's creation of the permanent and temporary cavities) is related to the characteristics of the projectile:

- Kinetic energy (KE)**.** The delivered mass at a given velocity. Higher delivered kinetic energy produces greater penetration and tissue damage.
- Yaw**.** Any yaw at the point of impact increases the projectiles surface area that strikes the target, decreasing kinetic energy, but increasing the penetration and cavity size.
- Deformation**.** The physical changes of the projectile's original shape and design due to the impact of the target. Deformation increases the projectile's surface area and the size of the cavity created after penetration.
- Fragmentation**.** The fracturing of a projectile into multiple pieces or subprojectiles. The multiple paths of the fragmented subprojectiles are unpredictable in size, velocity, and direction. The bullet jacket, and for some types of projectiles, the lead core, fracture creating small, jagged, sharp edged pieces that are propelled outward with the temporary cavity. Fragments can sever tissue and causing large explosive-type damage to the body. Bone fragments caused by the bullet's strike can have the same effect.
- Tumbling**.** Tumbling is the inadvertent end-over-end rotation of the projectile. As a projectile tumbles as it strikes the target, the bullet travels through the tissues with a larger diameter.

Tumbling causes a more severe permanent cavity as it passes through the soft tissue. A tumbling projectile can change direction erratically within the body due to its velocity and tendency to strike dense material with a larger surface area.

B-23. Once inside the target, the projectile's purpose is to destroy soft tissues with fragmentation. The ball ammunition is designed to not flatten or expand on impact, which would decrease velocity and delivered energy.

Incapacitation

B-24. Incapacitation with direct fire is the act of ballistically depriving a target of the ability, strength, or capability to continue its tactical mission. To assist in achieving the highest probability of incapacitation with a single shot, the projectile is designed with the ability to tumble, ricochet, or fragment after impact.

B-25. The projectile or its fragments then must hit a vital, blood-bearing organ or the central nervous system to effectively incapacitate the threat. The projectile's limited fragmentation potential after entry maximizes the soft tissue damage and increases the potential for rapid incapacitation.

Lethal Zones

B-26. The Soldier's primary point of aim at any target by default is center of visible mass, which allows for a tolerance that includes the greatest margin of error with the highest probability of a first-round hit. The combat conditions may require more precise fires at partially exposed targets or targets that require immediate incapacitation.

B-27. Ideally, the point of aim is anywhere within a primary switch area. This point maximizes the possibility of striking major organs and vessels, rendering a clean, one-shot kill (see figure B-4.)

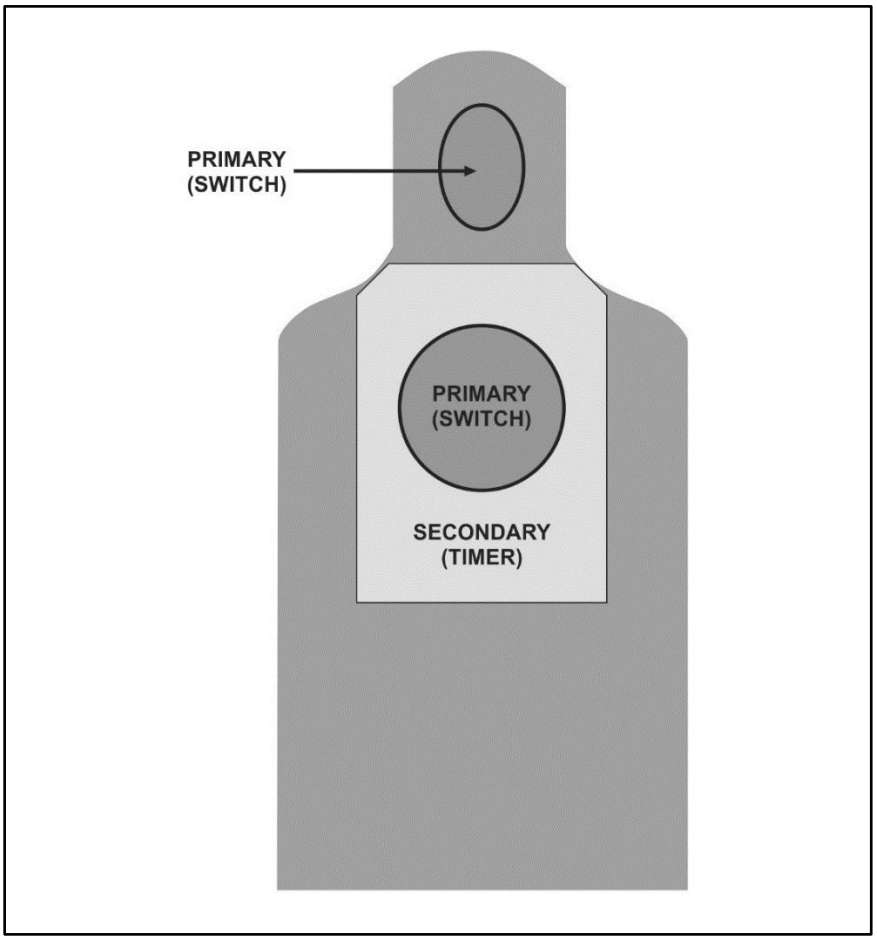


Figure B-4. Lethal zone example

B-28. Shots to the head should be weighed with caution. The head is the most frequently moved body part and is the most difficult to hit with precision. Soldiers should consider shots to other exposed body parts, such as the pelvic area.

B-29. Shots to the pelvic area are used when the target is not completely visible or when the target is wearing body armor that prevents the Soldier from engaging the primary zone. This area is rich in large blood vessels and a shot here has a good possibility of impeding enemy movement by destroying the pelvis or hitting the lower spine.

- Circuitry shots (switches).
- Hydraulic shots (timers).

Circuitry Shots (Switches)

B-30. Circuitry shots, or switches, are strikes to a target that deliver its immediate incapacitation. Immediate incapacitation is the sudden physical or mental inability to initiate or complete any physical task. To

accomplish this, the central nervous system must be destroyed by hitting the brain or spinal column. All bodily functions and voluntary actions cease when the brain is destroyed and if the spinal column is broken, all functions cease below the break.

Hydraulic Shots (Timer)

B-31. Hydraulic shots, or timers, are impacts on a target where immediate incapacitation is not guaranteed. These types of ballistic trauma are termed timers because after the bullet strikes, the damage caused requires time for the threat to have sufficient blood loss to render them incapacitated. Hydraulic shots, although ultimately lethal, allow for the threat to function in a reduced capacity for a period of time.

B-32. For hydraulic shots to eliminate the threat, they must cause a 40 percent loss of blood within the circulatory system. If the shots do not disrupt that flow at a rapid pace, the target can continue their mission. Once two liters of blood are lost, the target transitions into hypovolemic shock and becomes incapacitated.

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Appendix C

Machine Gun Theory

Appendix C illustrates the characteristics of machine gun fire, the types of enemy targets Soldiers engage, and how to apply machine gun fire on those enemy targets.

CHARACTERISTICS OF FIRE

C-1. The gunner's or leader's knowledge of the machine gun is not complete until they learn about the action and effect of the projectiles when fired. The following definitions help the leader, gunner, and assistant gunner understand characteristics of fire of the platoon's weapon's squad machine guns.

LINE OF SIGHT

C-2. Line of sight (LOS) is an imaginary line drawn from the firer's eyes through the sights to the point of aim.

BURST OF FIRE

C-3. A burst of fire is a number of successive rounds fired with the same elevation and point of aim when the trigger is held to the rear. The number of rounds in a burst varies depending on the type of fire employed.

TRAJECTORY

C-4. Trajectory is the curved path of the projectile in its flight from the muzzle of the weapon to its impact. The major factors influencing trajectory are the velocity of the round, gravity, rotation of the round, and air resistance. As the range to the target increases, so does the curve of trajectory. (See figure C-1.)

MAXIMUM ORDINATE

C-5. Maximum ordinate is the highest point above the LOS the trajectory reaches between the muzzle of the weapon and base of target. It always occurs at a point about two-thirds of the distance from weapon to target and increases with range. Like trajectory, maximum ordinate increases as the range increases. (See figure C-1.)

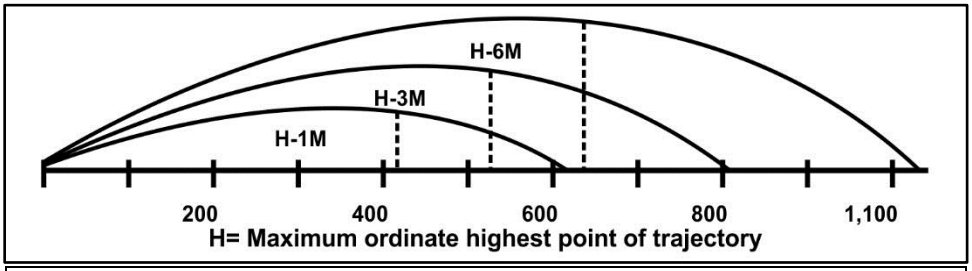


Figure C-1. Trajectory and maximum ordinate

CONE OF FIRE

C-6. The cone of fire is the pattern formed by the different trajectories in each burst as they travel downrange. Vibration of the weapon and variations in ammunition and atmospheric conditions all contribute to the trajectories making up the cone of fire. (See figure C-2, page C-2.)

BEATEN ZONE

C-7. The beaten zone is the elliptical pattern formed when the rounds within the cone of fire strike the ground or target. The size and shape of the beaten zone changes as a function of the range to the target and to the slope of the target, but is normally oval or cigar shaped. The density of the rounds decreases toward the edges. Gunners and automatic riflemen should engage targets to take maximum advantage of the beaten zone. The simplest way of engaging targets to take maximum advantage of the beaten zone is to aim at the center base of the target. Most rounds will not fall over the target, and falling short creates ricochets into the target. (See figure C-2)

Effective Beaten Zone

C-8. Due to dispersion, only part of the beaten zone in which 85 percent of the rounds fall is considered the effective beaten zone.

Effect of Range on the Beaten Zone

C-9. As the range to the target increases, the beaten zone becomes shorter and wider. Conversely, as the range to the target decreases, the beaten zone becomes longer and narrower.

Effect of Slope on the Beaten Zone

C-10. The length of the beaten zone for given ranges varies according to the slope of the ground. On rising ground, the beaten zone becomes shorter but remains the same width. On ground sloping away from the gun, the beaten zone becomes longer but remains the same width.

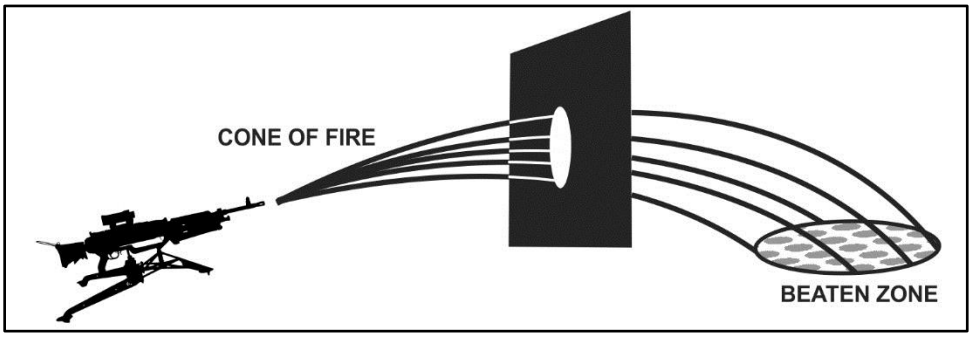


Figure C-2. Cone of fire and beaten zone

DANGER SPACE

C-11. The danger space is the space between the muzzle of the weapon and the target where the trajectory does not rise above 1.8 meters (the average height of a standing Soldier) including the beaten zone. Gunners should consider the danger space of weapons when planning overhead fires.

CLASSIFICATION OF AUTOMATIC WEAPONS FIRE

C-12. The U.S. Army classifies automatic weapons fires with respect to the ground, target, and weapon.

FIRES WITH RESPECT TO THE GROUND

C-13. The Army classifies fires with respect to the ground, which includes grazing and plunging fire. Dead space is the folds or depressions in the ground that prevent a target from being engaged from a fixed position.

Grazing Fires

C-14. Automatic weapons achieve grazing fire when the center of the cone of fire does not rise more than one meter above the ground. Soldiers employ grazing fire in the final protective line in the defense. Grazing fire is possible only when the terrain is level or sloping uniformly. Dead space encountered along the final protective line must be covered by indirect fire, such as from an M203/M320. When firing over level or uniformly sloping terrain, the M240 series and the M249 can attain a maximum of 600 meters of grazing fire. The M2/M2A1 can attain a maximum of 700 meters.

Plunging Fires

C-15. Plunging fire occurs when there is little or no danger space from the muzzle of the weapon to the beaten zone. Plunging fires happen when Soldiers fire weapons at long range, when they fire from high ground to low ground, when they fire into abruptly rising ground, or when they fire across uneven terrain, which results in a loss of grazing fire at points along the trajectory. (See figure C-3.)

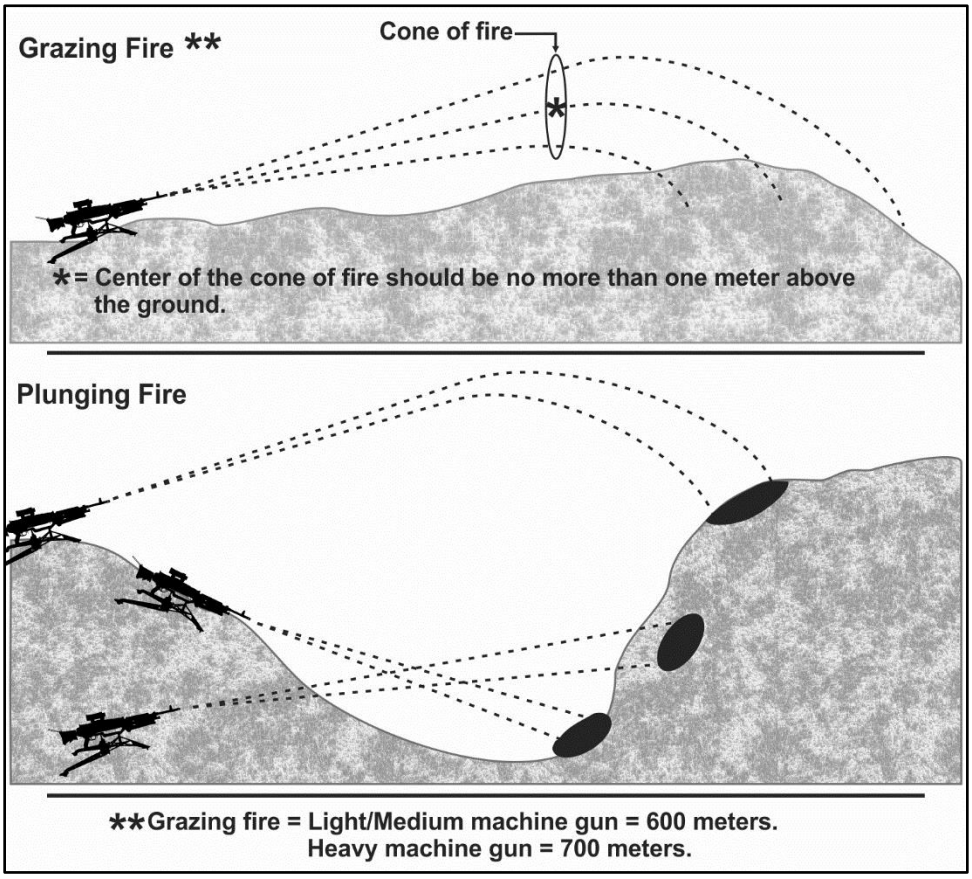


Figure C-3. Classes of fire with respect to the ground

FIRES WITH RESPECT TO THE TARGET

C-16. Classification of fires with respect to the target include enfilade, frontal, flanking, and oblique fire. (See figures C-4, C-5, and C-6, pages C-5 and C-6). Normally, the enemy presents these three types of targets to gun teams. Gun teams must engage as these targets as they are presented by the enemy. For example, if the enemy presents its flank to the gun crew as it moves past their position from the left or right, the gun team will have no choice but to employ flanking fire on the enemy.

C-17. Leaders and gunners should strive at all times to position their gun teams where they can best take advantage of the machine gun's beaten zone with respect to an enemy target. Channeling the enemy by use of terrain or obstacles so they approach a friendly machine gun position from the front in a column formation

is one example. In this situation, Soldiers would employ enfilade fire on the enemy column. The effects of the machine gun's beaten zone would be much greater than if it engaged enemy column from the flank.

Enfilade Fire

C-18. Enfilade fire occurs when the long axis of the beaten zone coincides or nearly coincides with the long axis of the target. It can be frontal fire on an enemy column formation or flanking fire on an enemy line formation. This is the most desirable class of fire with respect to the target because it makes maximum use of the beaten zone. Leaders and gunners always should strive to position the guns to the extent possible engaging enemy targets with enfilade fire. (See figure C-4 and figure C-6.)

Frontal Fire

C-19. Frontal fire occurs when the long axis of the beaten zone is at a right angle to the front of the target. This type of fire is highly desirable when engaging a column formation. It then becomes enfilade fire as the beaten zone coincides with the long axis of the target. (See figures C-4 on and figure C-5 on page C-6.) Frontal fire is not as desirable when engaging a line formation because the majority of the beaten zone normally falls below or after the enemy target.

Flanking Fire

C-20. Flanking fire is delivered directly against the flank of the target. Flanking fire is highly desirable when engaging an enemy line formation. It then becomes enfilade fire as the beaten zone will coincide with the long axis of the target. (See figure C-5 and figure C-6 on page C-6.) Flanking fire against an enemy column formation is least desirable because the majority of the beaten zone normally falls before or after the enemy target.

Oblique Fire

C-21. Gunners and automatic riflemen achieve oblique fire when the long axis of the beaten zone is at an angle other than a right angle to the front of the target. (See figure C-4 and figure C-6 on page C-6.)

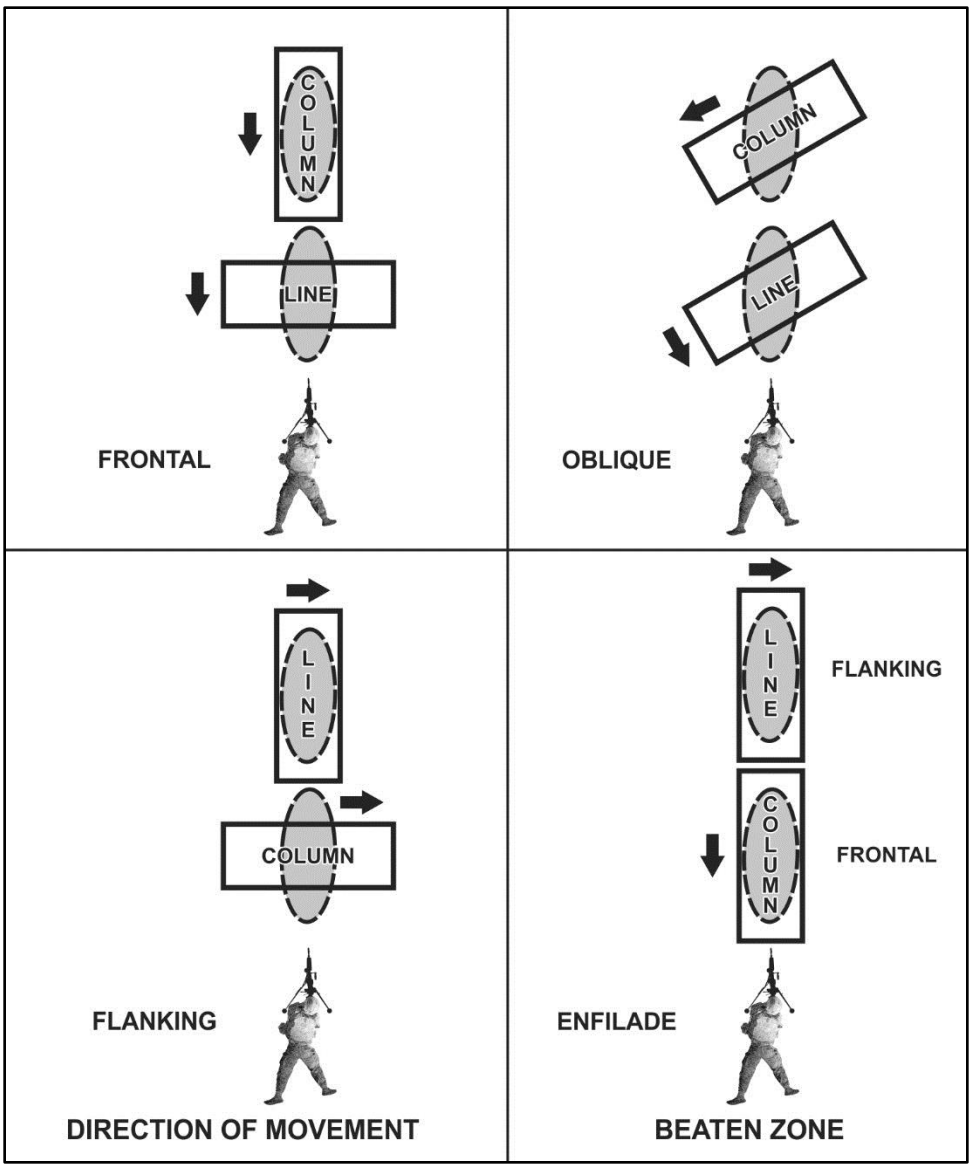


Figure C-4. Classes of fire with respect to the target

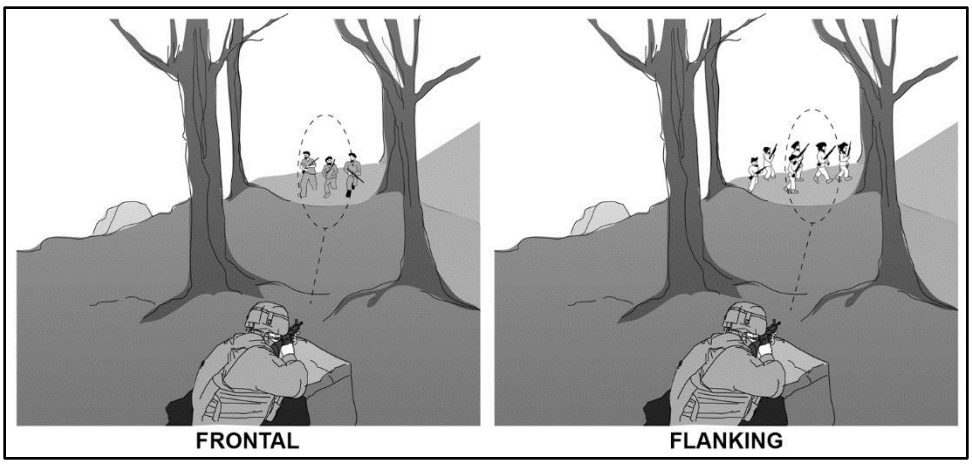


Figure C-5. Frontal fire and flanking fire

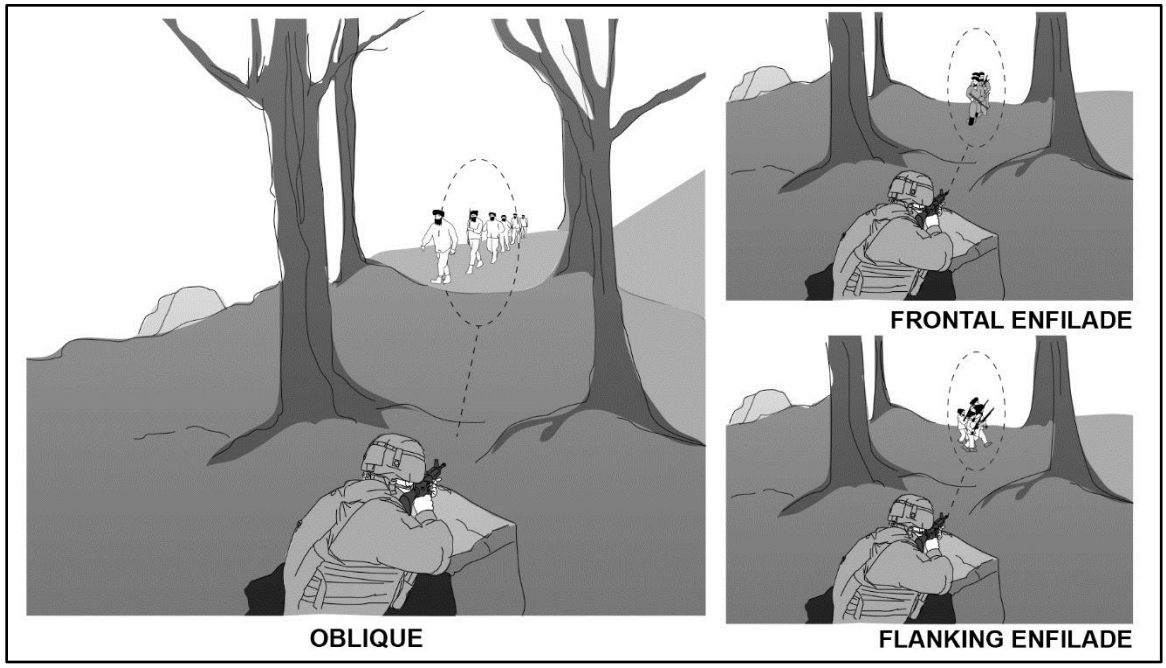


Figure C-6. Oblique fire and enfilade fire

FIRES WITH RESPECT TO THE MACHINE GUN

C-22. Classification of fires with respect to the weapon include fixed, traversing, searching, traversing and searching, swinging traverse, and free gun fires. (See figure C-7 on page C-8.)

Fixed Fire

C-23. Gunners deliver fixed fire against a stationary point target when the depth and width of the beaten zone covers the target with little or no manipulation needed. After the initial burst, the gunners follow changes or movement of the target without command.

Traversing Fire

C-24. Traversing disperses fires in width by successive changes in direction, but not elevation. Gunners deliver traversing fire against a wide target with minimal depth. When engaging a wide target requiring

traversing fire, the gunner selects successive aiming points throughout the target area. These aiming points should be close enough together to ensure adequate target coverage. However, the aiming points do not need to be so close wasting ammunition by concentrating a heavy volume of fire in a small area.

Searching Fire

C-25. Searching distributes fires in-depth by successive changes in elevation. Gunners employ searching fire against a deep target or a target having depth and minimal width, requiring changes in only the elevation of the gun. The amount of elevation change depends upon the range and slope of the ground.

Traversing and Searching Fire

C-26. The traversing and searching class of fire is a combination of successive changes in direction and elevation resulting in the distribution of fires both in width and depth. Gunners employ traversing and searching fire against a target whose long axis is oblique to the direction of fire.

Swinging Traverse

C-27. Gunners employ swinging traverse fire against targets requiring 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 vehicles or mounted troops moving across the front. If tripod mounted, the traversing slide lock lever is loosened enough to permit the gunner to swing the gun laterally. When firing swinging traverse, the weapon normally is fired at the cyclic rate of fire. Swinging traverse consumes an enormous amount of ammunition and does not have a beaten zone because each round seeks its own area of impact.

Free Gun

C-28. Gunners deliver free gun fire against moving targets rapidly engaging 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. When firing free gun, the weapon normally is fired at the cyclic rate of fire. Free gun fire consumes an enormous amount of ammunition and does not have a beaten zone because each round seeks its own area of impact.

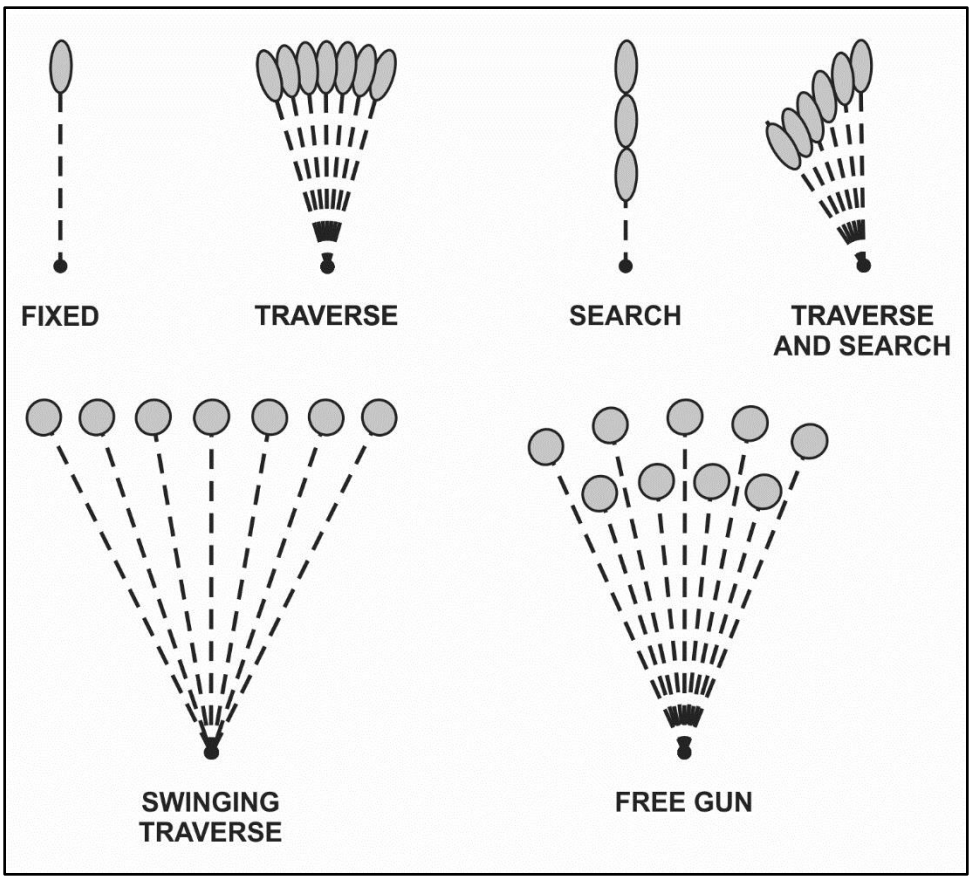


Figure C-7. Classes of fire with respect to the gun

APPLICATION OF FIRE

C-29. Application of fire consists of the methods the gunner uses to cover an enemy target area. The weapons squad leader and gunners must be able to recognize the different types of targets they may find in combat before they can train applications of fire methods. The squad leaders and gunners must know how to distribute and concentrate their fire, and how to maintain the proper rate of fire. Normally, the gunner is exposed to two types of targets in the squad or platoon area of operation: enemy soldiers and supporting automatic weapons. Leaders must ensure targets have priority and are engaged immediately.

C-30. Gunners must distribute machine gun fire over the entire target area. Improper distribution of fire results in gaps that allow the enemy to escape or use their weapons against friendly positions without opposition.

C-31. The method of applying fire to a target is generally the same for either a single gun or a pair of guns. Direct lay is pointing the gun for direction and elevation so 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, gunners must know where to aim, how to adjust their fire, and 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.

SIGHT PICTURE

C-32. The sight picture is the placement of the aligned sights on the target. The gunner uses the machine gun optic to apply the appropriate range and lead. The gunner aims with the intent of placing the cone of fire centered on the base of target, which takes full advantage of the cone of fire and the beaten zone.

BEATEN ZONE

C-33. The gunner ensures throughout his firing 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 pass through the target if it has height, and projectiles in the lower half of the beaten zone may ricochet into the target. (See figure C-8.)

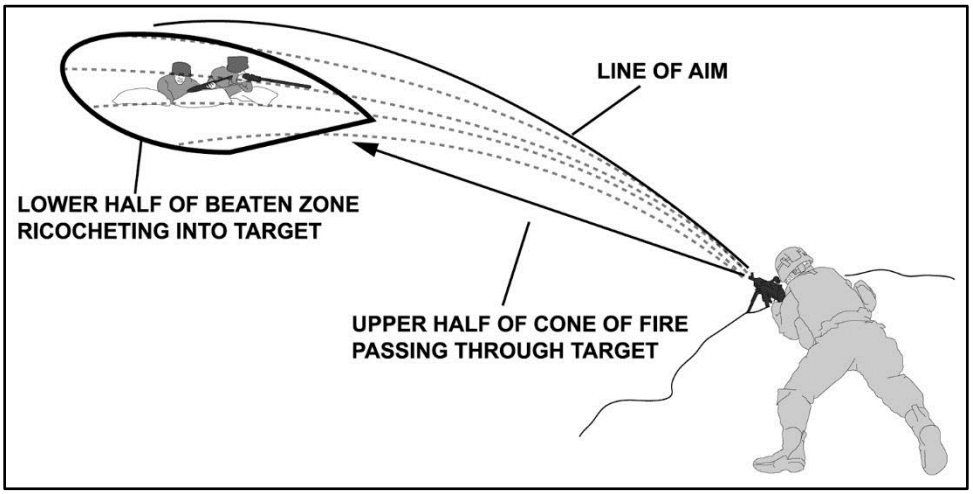


Figure C-8. Line of aim and placement of center of beaten zone on target

C-34. The gunner must move his 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 fire is distributed evenly throughout the target area. Fire delivered on point targets or a specific area of other target configurations is called concentrated fire.

TARGET ENGAGEMENT BY TYPES OF TARGETS

C-35. Gunners engage targets throughout their respective sectors. They must know how to engage all types of targets, either individually or with other gunners.

C-36. Gunners' targets in combat are normally enemy troops in various formations or displacements, which require distribution and concentration of fire. These targets often have both width, depth, and 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. The size of the target, stated in terms of the number of aiming points required to engage it completely, determines its type.

C-37. When a single gunner is assigned targets he is responsible for covering the entire target. When a pair of gunners engage an enemy target, each gunner normally is responsible for covering one half of the target. The gunners must be prepared to engage the entire target should the other gun go down.

C-38. 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 or leader. Typical targets are surveillance, reconnaissance, and liaison aircraft; troop carriers; helicopters; and drones.

ENGAGEMENT AND EMPLOYMENT

C-39. 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 defensive design factors:

- Defensive design should produce an equally balanced defense in all directions, unless a forced route of approach exists.
- Machine guns should be sited so the maximum number of targets can be engaged, continuous fire can be delivered, and likely routes of approach are covered.

TARGET SELECTION AND ENGAGEMENT CONTROL

C-40. These actions depend upon visual means. The sites selected for 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 actually are engaged.

DISTRIBUTION, CONCENTRATION, AND RATE OF FIRE

C-41. The size and nature of the enemy target determines how machine gun fire is applied. Automatic weapons fire in one of three rates: rapid, sustained, or cyclic. The rates of fire for each machine gun are shown in table C-1 on page C-20. The situation normally dictates the rate used, but the availability of ammunition and need for barrel changes play important roles as well. The rate of fire must be controlled to cover the target adequately, but not waste ammunition or destroy the barrel.

DISTRIBUTED AND CONCENTRATED FIRE

C-42. Distributed fire is delivered in width and depth such as at an enemy formation. Concentrated fire is delivered at a point target such as an automatic weapon or an enemy fighting position.

RAPID FIRE

C-43. Rapid rate of fire places an exceptionally high volume of fire on an enemy position. Machine gunners normally engage targets at the rapid rate to suppress the enemy quickly and quickly gain fire superiority. Rapid fire requires more ammunition than sustained fire and requires frequent barrel changes.

SUSTAINED FIRE

C-44. Once the enemy has been suppressed and fire superiority gained, machine gunners fire at the sustained rate. Sustained fire conserves ammunition and requires only infrequent barrel changes, but it might not be enough volume of fire to suppress or destroy.

CYCLIC RATE OF FIRE

C-45. To fire the cyclic rate, the gunner holds the trigger to the rear while the assistant gunner feeds ammunition into the weapon. This normally is used only to engage aerial targets in self-defense or to fire the final protective fires in the defense to protect the perimeter. This produces the highest volume of fire the machine gun can fire, but can permanently damage the machine gun and barrel and should be used only in case of emergency.

TARGET ENGAGEMENT DURING LIMITED VISIBILITY

C-46. Gunners have difficulty detecting and identifying targets during limited visibility. The leader's ability to control the fires of his weapons also is reduced; therefore, he may instruct the gunners to fire without command when targets present themselves.

C-47. Gunners should engage targets only when they can identify the targets, unless ordered to do otherwise. For example, if one gunner detects a target and engages it, the other gunner observes the area fired upon and adds his fire only if he can identify the target or if ordered to fire.

C-48. Gunners should use tracer ammunition if it helps a gunner engage targets during limited visibility. However, it is important to note in certain circumstances the enemy will have an easy time identifying the

machine gun's position if the gunner uses tracer ammunition. Gunners need to balance the need to engage targets with the need to keep the guns safe before deciding to employ tracers. If firing unaided, gunners must be trained to fire low at first and adjust upward, doing so overcomes the tendency to fire high.

C-49. When two or more gunners are engaging linear targets, linear targets with depth, or deep targets, they do not engage these targets as they would when visibility is good. With limited visibility, the center and flanks of these targets may not be defined clearly. Therefore, each gunner observes his tracers and covers what he believes to be the entire target.

TECHNIQUES

C-50. Techniques of fire include assault fire; overhead fire; and fire from a defilade position. Only automatic rifles use assault fire.

Assault Fire

C-51. Automatic riflemen use assault fire when in close combat. Assault fire involves firing without the aid of sights using the shoulder position. From this position, automatic riflemen adjust their fire by observing the tracer and impact of the bullets on the target area. Additional considerations for automatic riflemen using assault fire include:

- Maintaining alignment with the rest of the assault element.
- Reloading rapidly.
- Aiming low and adjusting the aim upward toward the target.
- Distributing fires across the objective when not engaging enemy automatic weapons.

Overhead Fire

C-52. Gunners can use overhead fire when there is sufficient low ground between the machine gun and target area of the maneuver friendly forces. 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. Gunners must accurately estimate range to the target and establish a safety limit imaginary line parallel to the target where fire would cause casualties to friendly Soldiers. Gun crews and leaders must be aware of this safety limit. Leaders must designate signals for lifting or shifting fires. Gunners should not attempt overhead fires if the terrain is level or slopes uniformly, if the barrel is badly worn, or if visibility is poor.

GUNNER'S RULE

C-53. The gunner's rule can be applied when the friendly troops are at least 350 meters in front of the gun position and range to the target is 850 meters or less. (See figure C-9, page C-12.) The rule follows:

- 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 1600 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.

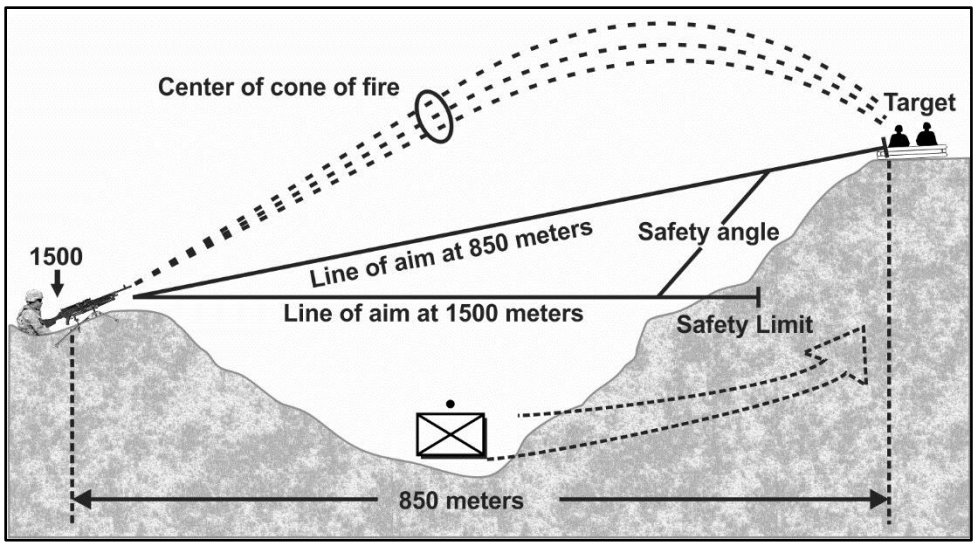


Figure C-9. Application of gunner's rule

LEADER'S RULE

C-54. When the range to the target is greater than 850 meters, overhead fire should be delivered only in an emergency. Even then, fire should extend only to a range at which the tracers or strike of the bullets can be seen by the gunner. In this situation the leader's rule applies. (See figure C-10.) The platoon or section leader uses the leader's rule only when the target is greater than 850 meters. The rule 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 1600 meters or the range to the target plus 500 meters, whichever is the greater of the two ranges. Under no conditions should the sight setting be less than 1500 meters.
- 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 fire is called for 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 selected point coincide.
  - If it clears the selected point, it is safe for troops to advance to the selected point and to an unknown point beyond. If it is advantageous 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 selected point coincide. This point marks the line of safety.

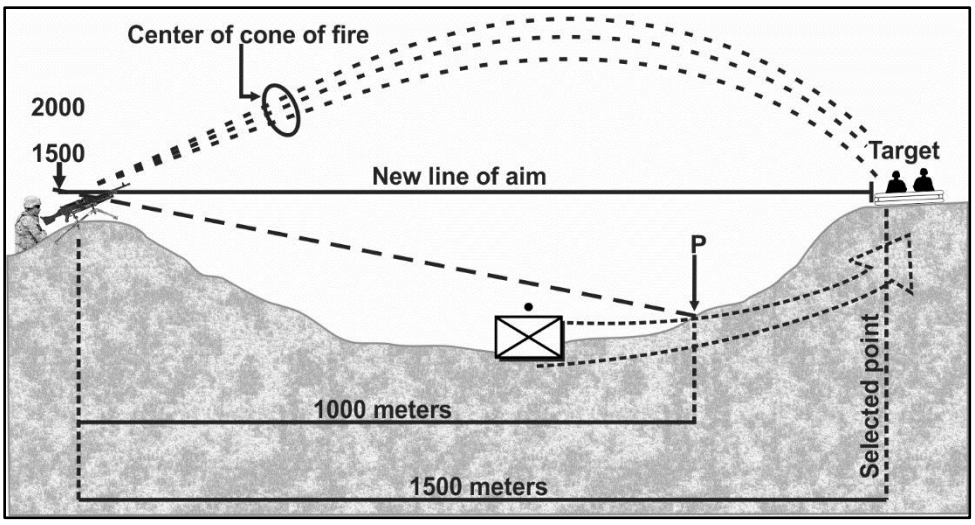


Figure C-10. Application of leader's rule

FIRE FROM A DEFILADE POSITION

C-55. Defilade positions protect gunners from frontal or enfilading fires (see figure C-11). Cover and concealment may not provide the gunner with a view of some or all of the target area. In this instance, some other member of the platoon or squad must observe the impact of the rounds and communicate adjustments to the gunner (see figure C-12). Gunners and leaders must consider the complexity of laying on the target. They also must consider the gunner's inability to make rapid adjustments to engage moving targets, the ease with which targets are masked, and the difficulty in achieving grazing fires for a fire protective line.

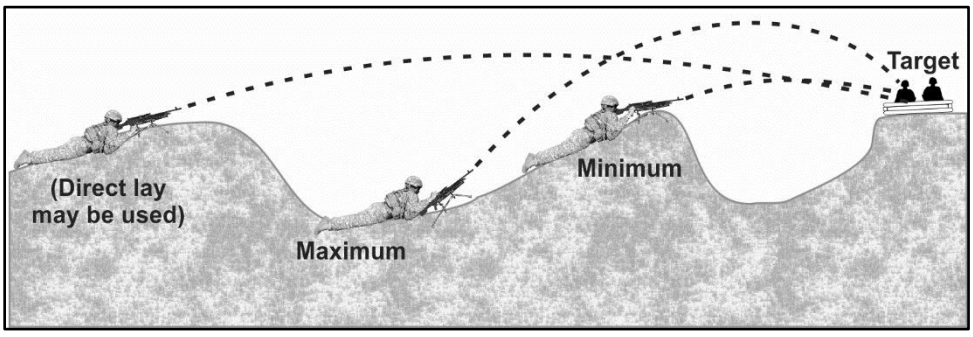


Figure C-11. Defilade positions

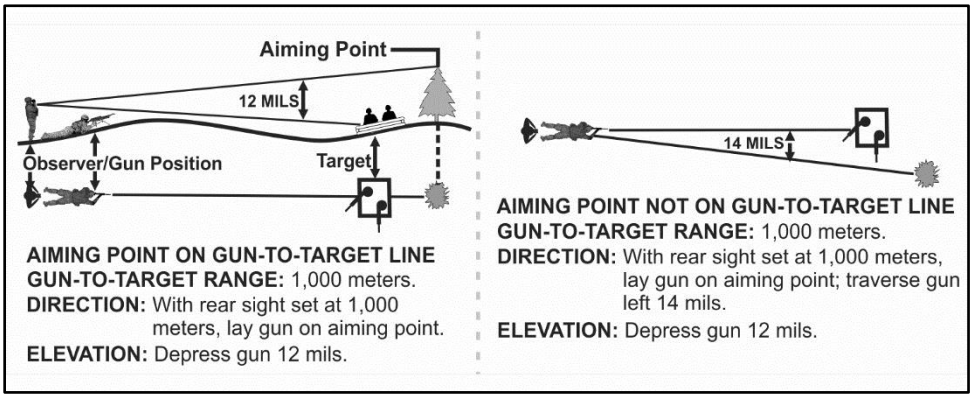


Figure C-12. Observer adjusting fire

PREDETERMINED FIRES

C-56. Predetermined fires organize the battlefield for gunners. Predetermined fires allow the leader and gunner to select potential target areas with tactical significance or target areas where the gunner will most likely engage the enemy. The target areas include dismounted enemy avenues of approach, likely positions for automatic weapons, and probable enemy assault positions. The gunners use sectors of fire, final protective fire, or a principal direction of fire and selected target areas. The gunner's preparation maximizes the machine gun's effectiveness during clear as well as limited visibility. Preparation enhances fire control by reducing the time required to identify targets, determine range, and manipulate the weapon onto the target. Abbreviated fire commands and previously recorded data enable the gunner to aim or adjust fire on the target quickly and accurately. Gunners should fire on selected targets in daylight whenever practical to confirm data. The range card identifies the targets and provides a record of firing data. DA Form 5517, *Standard Range Card*, provides a record of firing data and aids defensive fire planning.

TERMINOLOGY

C-57. Gunners need to know several terms associated with predetermined fire. The most common terms are defined in the following paragraphs.

Sector of Fire

C-58. A sector of fire is an area to be covered by fire assigned to an individual, a weapon, or a unit. Gunners normally are assigned a primary and a secondary sector of fire.

Final Protective Fire (FPF)

C-59. 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)

C-60. A final protective line (FPL) is a predetermined line along which grazing fire is placed to stop an enemy assault. If a final protective line is assigned, the machine gun is sighted along it except when other targets are being engaged. A final protective line becomes the machine gun's part of the unit's FPFs. A final protective line is fixed in direction and elevation. However, a small shift must be employed to prevent the enemy from crawling under the final protective line and to compensate for irregularities in the terrain or the sinking of the tripod legs into soft soil during firing. Fire must be delivered during all conditions of visibility.

C-61. A good FPL covers the maximum area with grazing fire. Grazing fire can be obtained over various types of terrain out to a maximum of 600 meters. To obtain the maximum extent of grazing fire over level or uniformly sloping terrain, the gunner sets the rear sight at 600 meters. The gunner selects a point on the ground they estimate to be 600 meters from the machine gun; then aims, fires, and adjusts on that point. The gunner searches (downward) by lowering the muzzle of the weapon to prevent enemy soldiers from crawling under grazing fire.

Principal Direction of Fire (PDF)

C-62. A principal direction of fire (PDF) is assigned to a gunner to cover an area having good fields of fire or has a likely dismounted avenue of approach. It also provides mutual support to an adjacent unit. Machine guns are sited using the PDF if an FPL has not been assigned. If a PDF is assigned and other targets are not being engaged, machine guns remain on the PDF. A PDF has the following characteristics:

- It is used only if a FPL is not assigned; it then becomes the machine gun's part of the unit's final protective fires.
- When the target has width, direction is determined by aiming on one edge of the target area and noting the amount of traverse necessary to cover the entire target.
- The gunner is responsible for the entire wedge-shaped area from the muzzle of the weapon to the target, but elevation may be fixed for a priority portion of the target.

Dead Space and Grazing Fire

C-63. The extent of grazing fire and dead space may be determined in two ways. In the preferred method, the machine gun is adjusted for elevation and direction. A squad member then walks along the FPL while the gunner aims through the sights. In places where the Soldier's waist (midsection) falls below the gunner's point of aim, dead space exists. Arm-and-hand signals must be used to control the Soldier who is walking and to obtain an accurate account of the dead space and its location. Another method is to observe the flight of tracer ammunition from a position behind and to the flank of the weapon.

Primary Sector of Fire

C-64. The primary sector of fire is assigned to the gun team to cover the most likely avenue of enemy approach from all types of defensive positions.

Secondary Sector of Fire

C-65. The secondary sector of fire is assigned to the gun team to cover the second most likely avenue of enemy approach. It is fired from the same gun position as the primary sector of fire.

Field Expedient Techniques

C-66. When laying the machine gun for predetermined targets, the gunner can use field expedients as a means of engaging targets when other sources are not available.

Base Stake Technique

C-67. A base stake is used to define sector limits and may provide the lay of the FPL or predetermined targets along a primary or secondary sector limit. This technique is effective in all visibility conditions. The gunner uses the following steps:

- Lays the gun for direction along one sector limit to define sector limits and by emplaces a stake along the outer edge of the folded bipod legs. Rotates the legs slightly on the receiver, so the gunner takes up the play. Uses the same procedure for placing a stake along the opposite sector limit.
- Lays the machine gun along the FPL by moving the muzzle of the machine gun to a sector limit. Adjusts for elevation by driving a stake into the ground so the top of the stake is under the gas cylinder extension. This allows a few mils of depression to cover irregularities in the terrain.
- Lays the machine gun to engage other targets within a sector limit. Done in a primary sector by using the procedure described previously, except he keeps the elevation fixed.

Notched Stake or Tree-Crotch Technique

C-68. The gunner uses the notched-stake or tree-crotch technique with the bipod mount to engage predetermined targets within a sector or to define sector limits. This technique is effective during all conditions of visibility and requires little additional materiel. The gunner uses the following steps:

- Drives either a notched stake or tree crotch into the ground where selected targets are anticipated. Places the stock of the machine gun in the nest of the stake or crotch and adjusts the weapon to hit the selected targets and to define his sector limits.
- Digs shallow, curved trenches or grooves of the bipod feet. (These trenches allow for rotation of the bipod feet as the gunner moves the stock from one crotch or stake to another.)

Horizontal Log or Board Technique

C-69. This technique is used with the bipod or tripod mount to mark sector limits and engage wide targets. It is good for all visibility conditions and is best suited for flat, level terrain. The gunner uses the following steps.

Bipod-Mounted Machine Gun

C-70. Using a bipod-mounted machine gun, the gunner places a log or board beneath the stock of the weapon so the stock can slide across it freely. He digs shallow, curved trenches or grooves for the bipod feet to allow rotation of the feet as he moves the stock along the log or board. (The gunner may mark the sector limits by notching or placing stops on the log or board. The gunner uses the bipod firing position and grip.)

Tripod-Mounted Machine Gun

C-71. Using a tripod-mounted machine gun, the gunner places a log or boards beneath the barrel, positioning it so the barrel, when resting on the log or board, is at the proper elevation to obtain grazing fire. When appropriate, he marks the sector limits as described of the bipod in the preceding paragraph. (This technique is used only if a T&E mechanism is not available.)

FIRE CONTROL

C-72. Fire control includes the planning, preparing, and applying fire on a target actions of the leader and Soldiers. The leader selects and designates targets. The leader also designates the midpoint and flanks or ends of a target, unless they are obvious to the gunner. The gunner fires at the instant desired, then adjusts fire, regulates the rate of fire, shifts from one target to another, and ceases fire. When firing, the gunner should continue to fire until the target is neutralized or until signaled to do otherwise by the leader.

C-73. Predetermined targets, including the FPL or PDF, are engaged on order or by SOP. The signal for calling these fires normally is stated in the defensive order. Control these predetermined targets by using arm-and-hand signals, voice commands, or pyrotechnic devices. Gunners fire the FPL or PDF at the sustained rate of fire unless the situation calls for a higher rate. When engaging other predetermined targets, the sustained rate of fire also is used unless a different rate is ordered.

METHODS OF FIRE CONTROL

C-74. The noise and confusion of battle may limit the use of some of these methods. Therefore, the leader must select a method or combination of methods to accomplish the mission.

Oral

C-75. The oral fire control method can be effective, but sometimes the leader may be too far away from the gunner, or the noise of the battle may make it impossible for the gunner to hear. The primary means of the oral fire control method is the issuance of a fire command.

Arm-and-Hand Signals

C-76. Arm-and-hand signals are an effective fire control method when the gunner can see the leader. All gunners must know the standard arm-and-hand signals. The leader gets the gunner's attention and points to the target. When the gunner returns the READY signal, the leader commands, “FIRE.”

Prearranged Signals

C-77. Prearranged signals are either visual or sound signals such as casualty-producing devices (rifle or Claymore), pyrotechnics, whistle blasts, or tracers. These signals should be included in SOPs. If the leader wants to shift fire at a certain time, the leader gives a prearranged signal such as obscurants or pyrotechnics. Upon seeing the signal, the gunner shifts fire to a prearranged point.

Personal Contact

C-78. In many situations, the leader must issue orders directly to individual Soldiers. Personal contact is used more than other methods by Infantry leaders. The leader must use maximum cover and concealment to keep from disclosing the position or himself.

Range Cards

C-79. When using the range card method of fire control, the leader must ensure all range cards are current and accurate. Once this is accomplished, the leader may designate certain targets for certain weapons with the use of limiting stakes or with fire commands. The leader also should designate no-fire zones or restricted fire areas to others. The vital factor in this method of fire control is gunners must be well-disciplined and pay attention to detail.

Standard Operating Procedures

C-80. Standard operating procedures (SOPs) are actions to be executed without command and developed during the training of the squads. Their use eliminates many commands and simplifies the leader's fire control. Standard operating procedures, or certain actions and commands, can be developed to make gunners effective. Some examples follow:

- Observation**.** 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**.** Gunners shift their fires without command when more dangerous targets appear.
- Rate of fire**.** When gunners engage a target, they initially fire at the rate necessary to gain and maintain fire superiority.

SECURITY

C-81. Security includes all command measures to protect against surprise, observation, and annoyance by the enemy. The principal security measures against ground forces include employment of security patrols and detachments covering the front flanks and rear of the unit's most vulnerable areas. The composition and strength of these detachments depends on the size of the main body, its mission, and nature of the opposition expected. The presence of machine guns with security detachments augments their firepower to delay, attack, and defend, by virtue of inherent firepower.

C-82. The potential of air and ground attacks on the unit demands every possible precaution for maximum security while on the move. Where this situation exists, the machine gun crew must be thoroughly trained in the hasty delivery of antiaircraft fire and of counterfire against enemy ground forces. The distribution of the machine guns in the formation is critical. The machine gun crew is constantly on the alert, particularly at halts, ready to deliver fire as soon as possible. If the leader expects a halt to exceed a brief period, they carefully choose machine gun positions to avoid unduly tiring the machine gun crew. If the leader expects the halt to extend for a long period, they can have the machine gun crew take-up positions to support the unit. The crew covers the direction from which they expect enemy activity as well as the direction from which the unit came. The leader selects positions permitting the delivery of fire in the most probable direction of enemy attack, such as valleys, draws, ridges, and spurs. Leaders choose positions offering obstructed fire from potential enemy locations.

MACHINE GUNS IN THE OFFENSE

C-83. Offensive missions result from the employment of fire and movement. Each is essential and greatly depends upon the other. Without the support of covering fires, maneuvering in the presence of enemy fire can result in disastrous losses. Covering fires, especially providing fire superiority, allow maneuvering in the offense. However, fire superiority alone rarely wins battles. The primary objective of the offense is to advance, occupy, and hold the enemy position.

MACHINE GUN AS A BASE OF FIRE

C-84. Machine gun fire from a support-by-fire position must be the minimum possible to keep the enemy from returning fire. Ammunition must be conserved so the guns do not run out of ammunition.

C-85. The weapons squad leader positions and controls the fires of all machine guns in the element. Machine gun targets include essential enemy weapons or groups of enemy targets either on the objective or attempting to reinforce or counterattack. In terms of engagement ranges, medium machine guns in the base-of-fire element may find themselves firing at targets within a range of 800 meters. The nature of the terrain, desire to achieve some standoff, and mission, enemy, terrain and weather, troops and support available, time available, civil considerations (known as METT-TC) prompts the leader to the correct tactical positioning of the base-of-fire element.

C-86. The machine gun delivers an accurate, high-volume rate of lethal fire on fairly large areas in a brief time. When accurately placed on the enemy position, machine gun fires secure the essential element of fire superiority for the duration of the firing. Troops advancing in the attack should take full advantage of this period to maneuver to a favorable position from where they can facilitate the last push against the enemy. In addition to creating enemy casualties, machine gun fire destroys the enemy's confidence and neutralizes their ability to engage the friendly maneuver element.

C-87. The base-of-fire element employs distinct phases of rates of fire :

- Initial heavy volume (rapid rate) to gain fire superiority.
- Slower rate to conserve ammunition (sustained rate) while still preventing return fire as the assault moves forward.
- Increased rate as the assault nears the objective.
- Lift and shift to targets of opportunity.

C-88. All vocal commands from the leaders to change the rates of fire are accompanied simultaneously by arm-and-hand signals.

C-89. Machine guns in the support by fire role should be set in and assigned a primary and alternate sector of fire as well as a primary and alternate position.

C-90. Machine guns are suppressive fire weapons used to suppress known and suspected enemy positions. Therefore, gunners cannot be allowed to empty all their ammunition into one bunker simply because it’s all they can identify at the time.

C-91. The support-by-fire position, not the assault element, is responsible for ensuring there is no masking of fires. The assault element might have to mask the support-by-fire line because it has no choice on how to move. The support-by-fire gunner’s job is to shift fires continually, or move gun teams or the weapons squad to support the assault and prevent masking.

C-92. The leader shifts and shuts down the weapon squad gun teams one at a time, not all at once. M203/M320 and mortar or other indirect fire can be used to suppress the enemy while the machine guns are moved to positions where they can fire.

C-93. Leaders must take into account the surface danger zones of the machine guns when planning and executing the lift and or shift of the support-by-fire guns. The effectiveness of the enemy on the objective plays a large role in how much risk leaders should take with respect to the lifting or shifting of fires.

C-94. Once the assault element masks the support-by-fire line, leaders shift or left fires to prevent enemy withdrawal or reinforcement.

MACHINE GUN WITH MANEUVER ELEMENT

C-95. Under certain terrain conditions, and for proper control, machine guns may join the maneuver or assault unit. When this is the case, they are assigned a cover fire zone or sector.

C-96. The machine guns seldom accompany the maneuver element. The gun’s primary mission is to provide covering fire. The machine guns are employed only with the maneuver element when the area or zone of action assigned to the assault, platoon, squad or company is too narrow to permit proper control of the guns. The machine guns are moved with the unit then and readied to employ on order from the leader and in the direction needing the supporting fire.

C-97. When machine guns move with the element undertaking the assault, the maneuver element brings the machine guns to provide additional firepower. The weapons are fired from a bipod, in an assault mode, from

the hip, or from the underarm position. They target enemy automatic weapons anywhere on the unit's objective. Once the enemy's automatic weapons have been destroyed (if any), the gunners distribute their fire over their assigned zone or sector. In terms of engagement ranges, the machine gun in the assault engages within 300 meters of its target and frequently at point-blank ranges.

C-98. Where the area or zone of action is too wide to allow proper coverage by the platoon's or weapons squad organic medium machine guns, the platoon or squads can be assigned additional MMGs or personnel from within the company. This may permit the platoon or squads to accomplish its assigned mission. The MMGs are assigned a zone or a sector to cover and move with the maneuver element.

MACHINE GUNS IN THE OFFENSE

C-99. In the offense the platoon leader has the option to establish his base-of-fire element with one or two machine guns, the M249 light machine gun, or a combination of the weapons. The platoon sergeant or weapons squad leader may position this element and control its fires when the platoon scheme of maneuver is to conduct the assault with the Infantry squads. The M240-series machine gun, when placed on a tripod, provides stability and accuracy at greater ranges than the bipod, but it takes more time to maneuver the machine gun should the need arise. The machine gunners target essential enemy weapons until the assault element masks their fires. They also can be used to suppress the enemy's ability to return accurate fire, or to hamper the maneuver of the enemy's assault element. They fix the enemy in position and isolate him by cutting off his avenues of reinforcement. They then shift their fires to the flank opposite the one being assaulted and continue to target automatic weapons providing enemy support, and engage enemy counterattack. M240-series fires also can be used to cover the gap created between the forward element of the friendly assaulting force and terrain covered by indirect fires when the indirect fires are lifted and shifted. On signal, the machine gunners and base-of-fire element displace to join the assault element on the objective.

MACHINE GUNS IN THE DEFENSE

C-100. The platoon's defense centers on its machine guns. The platoon leader sites the rifle squad to protect the machine guns against the assault of a dismounted enemy formation. The machine gun provides the necessary range and volume of fire to cover the squad's front in the defense.

C-101. The primary requirement of a suitable machine gun position in the defense is its effectiveness in accomplishing specific missions. The position should be accessible and afford cover and concealment. Machine guns are sited to protect the front, flanks, and rear of occupied portions of defensive positions, and to be mutually supporting. Attacking troops usually seek easily-traveled ground providing cover from fire. Every machine gun should have three positions: primary, alternate, and supplementary. Each of these positions should be chosen by the leader to ensure his sector is covered and machine guns are protected on their flanks.

C-102. The leader sites the machine gun to cover the entire sector or to overlap sectors with the other machine guns. The engagement range may extend from more than 1000 meters where the enemy begins his assault to point-blank range. Machine gun targets include enemy automatic weapons and command and control elements.

C-103. Machine gun fire is distributed in width and depth in a defensive position. The leader can use machine guns to subject the enemy to increasingly devastating fire from the initial phases of his attack, and to neutralize partial successes the enemy might attain by delivering intense fires in support of counterattacks. The machine gun's tremendous firepower enables the unit to hold ground. The machine gun's firepower is what makes it the backbone or framework of the defense.

M240-SERIES MEDIUM MACHINE GUNS IN THE DEFENSE

C-104. In the defense, the MMG provides sustained direct fires covering the most likely or most dangerous enemy dismounted avenues of approach. It protects friendly units against the enemy's dismounted close assault. The platoon leader positions the machine guns to concentrate fires in locations where they can inflict the most damage to the enemy. The leader also places them where they can take advantage of grazing enfilade fires, stand-off or maximum engagement range, and best observation of the target area. Machine guns provide overlapping and interlocking fires with adjacent units and cover tactical and protective obstacles with

traversing or searching fires. When FPFs are called for, machine guns place a barrier of fixed, direct fire across the platoon or squad front. Leaders position machine guns to—

- Concentrate fires where they want to kill the enemy.
- Fire across the platoon and squad front
- Cover obstacles by direct fire.
- Tie in with adjacent units.

AMMUNITION PLANNING

C-105. Leaders must carefully plan the machine guns' rates of fire 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.

C-106. 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.

C-107. The leader must make an estimate of the total amount of ammunition needed to support all the machine guns. He then must adjust the amount of ammunition used for each event to ensure enough ammunition is available for all phases of the operation. Examples of planning rates of fire and ammunition requirements for a platoon's or weapons squad's machine guns in the attack follow.

KNOW RATE OF FIRE

C-108. Leaders must know the length of time their guns will be firing and their guns' rate of fire to ensure they have enough ammunition to complete the mission. Leaders must calculate the number of rounds needed to support every machine gun throughout all phases of the operation. Ammunition must be allocated for each vital event and to support movement with suppressive fire. As part of an example of the planning needed to use M240-series in support-by-fire roles, the rate of fire of the M240-series are listed in table C-1.

Table C-1. M240-series rate of fire

SUSTAINED	100 rounds per minute Fired in 6- to 9-round bursts 4-5 seconds between bursts (Barrel change every 10 minutes.)
RAPID	200 rounds per minute Fired in 10- to 12-round bursts 2-3 seconds between bursts (Barrel change every two minutes.)
CYCLIC	650-950 rounds per minute Continuous burst (Barrel change every minute.)

Appendix D

Drills

Appendix D describes the various drills for the medium machine 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

D-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.

D-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

D-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.

D-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 awareness levels as events occur in the continually transitioning operational area around them. Maintaining a tactical mindset involves understanding one's awareness level and transitioning between the awareness levels 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

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

D-6. By reducing the amount of effort, mental and physical, the movement becomes repeatable and the effect becomes predictable. Thus, the Soldier can focus on tactics while still producing accurate and precise fires.

INDIVIDUAL TACTICS

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

D-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

D-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. 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.

RELIABLE UNDER CONDITIONS OF STRESS

D-10. 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. Techniques should be tested under stress conditions that are as high stress as training allows.

REPEATABLE UNDER CONDITIONS OF STRESS

D-11. As combat is a stressor, a Soldier's body responds to combat stress 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. Techniques should support or exploit the body's natural reaction to life-threatening stress.

EFFICIENCY IN MOTION

D-12. 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.

D-13. 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.

DEVELOP NATURAL RESPONSES THROUGH REPETITION

D-14. The technique should build reflexive reactions that a Soldier applies in response to a set of conditions, when practiced correctly and in sufficient volume. Only with correct practice will a Soldier create the muscle

memory necessary to serve them 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

D-15. Machine gun engagements can occur at various distances. Fast and efficient presentation of the machine gun allows 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 and maintains the initiative. Speed should be developed throughout the training cycle and maintained during operations.

D-16. As distance between the Soldier and a threat decreases, so does the time to engage with well-placed lethal fires. As distance increase, the Soldier gains time to refine his aim and conduct manipulations.

CONDUCT DRILLS

D-17. Certain tasks are integrated into drills to build the skills necessary to master the functional elements of the shot process. 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.

D-18. 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.

WEAPON CHECK

D-19. The weapon check is a visual inspection of the weapon by the Soldier. A weapon check includes, at a minimum, the following verifications:

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

D-20. Soldiers initiate a weapon check when they first receive the weapon from the arms room or storage facility. Soldiers perform a weapon check when recovering the weapon at a secured grounded location or guard point, also.

D-21. 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.

SLING AND UNSLING

D-22. This drill exercises the Soldier's ability to change the location of the weapon on demand. The drill reinforces their ability to maintain situational and muzzle awareness during rapid changes of the weapon's sling posture. This drill provides a fitment check between the weapon, the Soldier's load bearing equipment, and the Soldier's ability to move between positions while maintaining effective use of the weapon. When conducting this drill, Soldiers should:

- Verify the proper adjustment to the sling.
- Rotate the torso left and right to ensure the sling does not hang up on any equipment.
- Ensure the weapon does not interfere with tactical movement.

EQUIPMENT CHECK

D-23. This drill is pre-combat check (PCC), which ensures the Soldier prepares their aiming devices, equipment, and accessories. The Soldier ensures the following:

- Accessories have batteries.
- Equipment is secured correctly.
- Equipment does not interfere with tactical movement.
- Basic load of ammunitions are stowed properly.

LOAD

D-24. This drill is predominantly an administrative loading function. The drill load allows the Soldier to develop reliable loading techniques.

CARRY

D-25. This drill consists of a series of three specific methods of carrying the weapon by a Soldier. These three methods are closely linked with range operations in the training environment, but are specifically tailored to combat operations. This drill demonstrates the Soldier's proficiency moving between:

- Safe hang.
- Low ready.
- Ready.

D-26. A leader will announce the appropriate carry term to initiate the drill. Each carry method should be executed in a random order a minimum of three times.

FIGHT DOWN

D-27. The fight down drill builds the Soldier's understanding of how to move effectively and efficiently between firing postures. This drill starts at a standing position, and, on command, the Soldier executes the next lower position or the announced position by the leader. The fight down drill exercises the following positions:

- Standing.
- Prone bipod-supported
- Prone tripod-supported

D-28. Each position should be executed a minimum of five times. Leaders will use fight down drill in conjunction with the fight up drill.

FIGHT UP

D-29. The fight up drill builds the Soldier's timing and speed while moving from various positions during operations. This drill starts in the position previously designated by the fight down drill, and, on command, the Soldier executes the next higher position or the announced position by the leader. The fight up drill exercises the following positions:

- Prone tripod-supported
- Prone bipod-supported
- Standing.

D-30. Each position should be executed a minimum of five times. Leaders will use fight up drill, in conjunction with fight down drill.

D-31. Leaders may increase the tempo of the drill, increasing the speed the Soldier needs to assume the next directed position. After the minimum five 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.

GO-TO-PRONE

D-32. The go-to-prone drill develops the Soldier's agility when rapidly transitioning from a standing or kneeling position to a prone bipod-supported firing position. Standard time should be less than three seconds.

D-33. Leaders announce the starting position for the Soldier to assume. Once the Soldier has correctly executed the start position to standard, the leader will announce, "GO TO PRONE." This drill should be conducted a minimum of five times stationary and five times while walking.

D-34. Leaders should not provide preparatory commands to the drill, and should direct the Soldier to go to prone when it is unexpected or at irregular intervals. Leaders may choose to include a tactical rush with the execution of this drill.

RELOAD AND BARREL CHANGE

D-35. Leaders execute the tactical reload and barrel change drill when the gun team is wearing complete load bearing equipment. Reload provides exercises to assure fast reliable reloading through repetition at all firing positions or postures. Leaders will incorporate the barrel change drill every third iteration to improve proficiency.

D-36. The Soldier should perform reload and barrel change from each of the following positions a minimum of three times each:

- Prone bipod-supported
- Prone tripod-supported

D-37. Leaders may include other drills while directing this drill to the Soldier to reinforce the training as necessary.

CLEAR MALFUNCTION

D-38. This drill is designed help Soldiers practice clearing the most common malfunctions on the 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 as discussed in chapter 8 of this publication using the POPP acronym.

D-39. Clear malfunction 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.

UNLOAD AND SHOW CLEAR

D-40. Unload and show clear is predominantly an administrative unloading function, and allows the Soldier to develop reliable clearing techniques. This drill should be executed in tandem with load drill.

D-41. This drill can be executed without ammunition in the weapon. Leaders may opt to use dummy ammunition or spent cartridge cases as desired. In garrison environments, Leaders should use this drill on demand, particularly prior to entering buildings or vehicles to reinforce the Soldier's skills and attention to detail.

MOUNT TO TRIPOD

D-42. Leaders execute the mount to tripod drill when the Soldier is wearing complete load-bearing equipment. This drill provides exercises to assure a fast and reliable means to mount the light machine gun through repetition.

D-43. Leaders should execute this drill five times. Once complete, leaders should incorporate this drill with other drills to ensure the Soldier can execute the task quickly and efficiently under any circumstance.

MANIPULATE TRAVERSE AND ELEVATION MECHANISM

D-44. The manipulate traverse and elevation (T&E) mechanism drill develops the Soldier's ability to quickly shift from one target to another. The Soldier trains to use the traversing handwheel, the traversing slide lock, and the elevating handwheel.

D-45. Leaders use a basic machine gun target placed 10 meters away. Leaders announce the starting position for the Soldier to assume. The Soldier executes the start position to standard with the sights lined up correctly on the target. The leader announces a fire command directing the Soldier to switch through various targets using the T&E mechanism. Leaders conduct the drill until the Soldier can manipulate through the targets quickly and efficiently while maintaining proper sights on the target without looking at the T&E mechanism.

D-46. Leaders should not provide preparatory commands to the drill, and should direct the Soldier to go to the next target when it is unexpected or at irregular intervals. Leaders may choose to include another drill with the execution of this drill.

Appendix E

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. Zeroing achieves 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.

Soldiers must zero their weapon to achieve a high level of accuracy and precision aiming. The Soldier must first achieve a consistent grouping of a series of bursts, 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 TMs to complete the zeroing task. Appendix E covers the zeroing process for the iron sights and the M145 straight telescope.

BATTLESIGHT ZERO

E-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, the ammunition, and the aiming device combination.

E-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

E-1. A specific process should be followed when zeroing. The process is time-efficient and produces the most accurate zero possible. The zero process includes a 10-meter laser borelight and zero and field zero (battlesight zero).

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

TEN METER LASER BORELIGHT AND ZERO

E-2. Ten-meter zero (mechanical zero) is the standardized starting point for the M240-series medium machine gun. The gunner places the range scale on a range of 500 meters on the rear sight. The gunner gets the front sight post blade approximately centered for both elevation and windage. The gunner identifies what number blade is on the weapon for elevation. (See figure E-1 on page E-2.)

NUMBER 1 BLADE (LOW 9.8 MM)

E-3. Unlock the retaining strap and unscrew (counterclockwise) until the base of the blade is flush with the front sight protector surface, then make one full turn (counterclockwise). This should put the base of the blade past the base of the protector. Screw in (clockwise), counting the number of turns it takes until it stops,

making sure the blade is on line with the barrel. If needed, back off until the blade is on line. Unscrew (counterclockwise) half the number of turns. This brings the blade to about the center.

NUMBER 2 BLADE (HIGH 11.8 MM)

E-4. Unlock the retaining strap and unscrew (counterclockwise) until the base of the blade is flush with the front sight protector surface. Screw in (clockwise), counting the number of turns it takes until it stops, making sure the blade is on line with the barrel. If needed, back off until the blade is on line. Unscrew (counterclockwise) half the number of turns. This brings the blade to about the center. Assume the prone position and sight on the target. Adjust windage by ensuring that the front sight protector is centered left and right on its base.

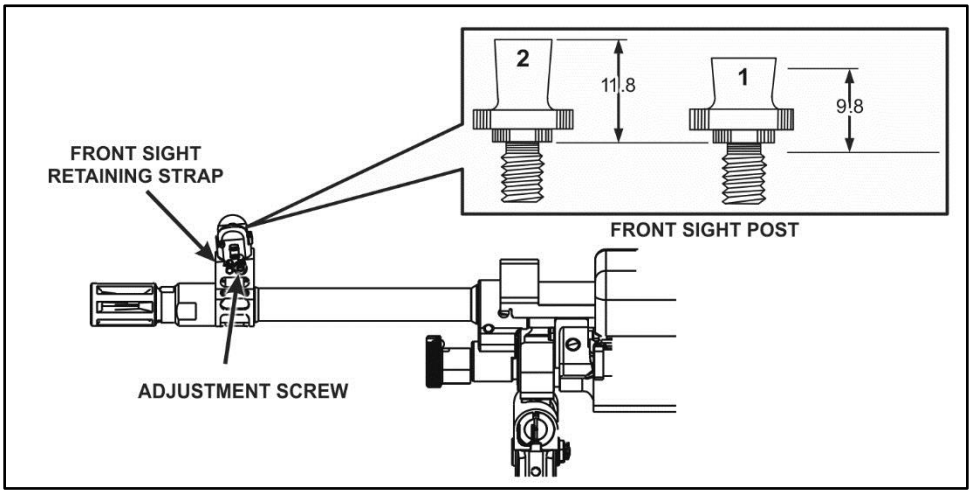


Figure E-1. Number 1 and 2 blades

THREE-ROUND SHOT GROUP

E-5. The gunner fires three single rounds loaded individually at the center base of the aiming points on the basic machine gun marksmanship target. The gunner fires the three rounds without making any adjustments to the sights. The shot group must be in a four-centimeter circle or smaller to establish the center of the group relative to the center base of the aiming paster.

Grid Square Overlay/Marksmanship Target

E-6. For a more accurate adjustment, the gunner moves downrange and places the grid square overlay over pasters 1 and 2. The gunner ensures that he aligns the overlay with the pasters and squares.

- Counts the number of squares needed to move the shot group to the aiming paster.
- Upon completion, returns to the firing line to apply corrections to the weapon. (Figure E-2 shows a zero group size where adjustments may be made, and a group that is too loose to adjust.) If a group is too loose, the gunner checks their position and group.

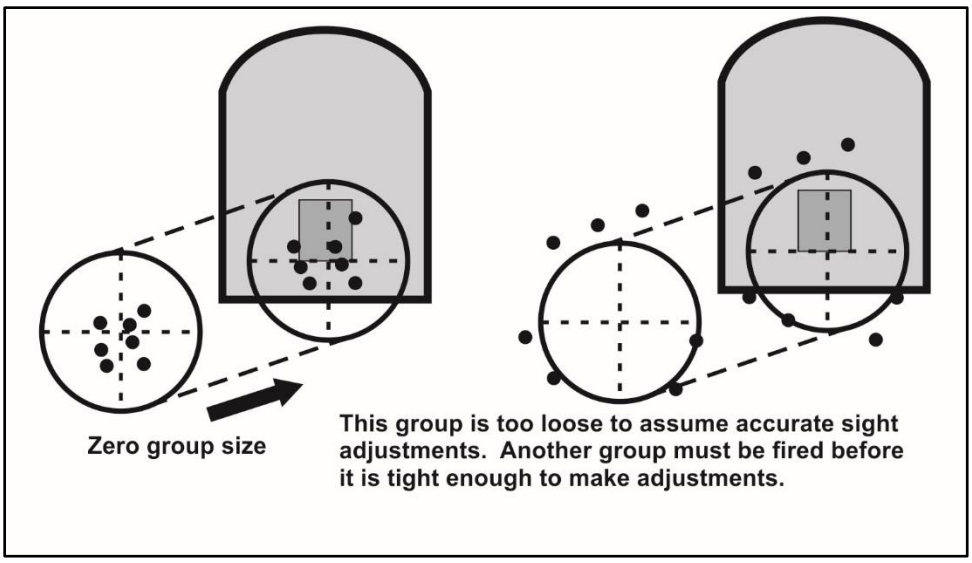


Figure E-2. Size of zero group example

Elevation Correction

E-7. If the shot group is above or below the point of aim, the gunner must use the front sight-adjusting tool (NSN 1005-01-458-7004) to adjust the front sight posts. Unlock front sight retaining strap and rotate it up. If shot group is above the point of aim, rotate sight post counterclockwise. If shot group is below the point of aim, rotate sight post clockwise. Rotating the front sight post counterclockwise brings the point of impact down on the target. Rotating front sight post clockwise brings the point of impact up on the target. Table E-1 on page E-4 provides an elevation correction chart.

E-8. At a range of 10 meters, one-half turn of front sight post blade moves the point of impact by five millimeters or .5 centimeters. One full turn of front sight post blade moves point of impact by one centimeter.

Note. If the required correction cannot be obtained with the installed front sight blade, you may need to install the other blade.

E-9. The maximum unscrewed position of either blade is where the base of the blade is flush with the front sight protector surface. If the center of the shot group is still above the point of aim with the No. 1 blade unscrewed to the maximum position, remove it and install a No. 2 blade. Start with the No. 2 blade at a flush position, two full turns (clockwise) should approximate the same position as the No. 1 blade.

E-10. If the center of the shot group is still below the point of aim with the No. 2 blade screwed all the way in (clockwise), remove it and install a No. 1 blade. Starting with the No. 1 blade screwed clockwise, two full turns (counter-clockwise) should approximate the same position as the No. 2 blade.

Note. If the center of the shot group cannot be brought to the point of aim after trying both sight blades, the spare barrel (BII) should be used and a new barrel assembly acquired. If neither barrel assembly can be adjusted, the weapon should be coded and turned in through normal channels.

Table E-1. Elevation correction chart

At This Range	*One Full Turn Moves Strike Up Or Down Centimeters or Inches*
100 meters	10.8 4.25
200 meters	21.6 8.50
300 meters	32.4 12.75
400 meters	43.2 17.00
500 meters	54.0 21.25
600 meters	64.8 25.50
700 meters	75.6 29.75
800 meters	86.4 34.00
900 meters	97.2 38.25

Windage Correction

E-11. At a range of 10 meters, one complete rotation of the adjusting screws will move point of impact 8 millimeters or .8 centimeters. As you turn the adjusting screws, you should detect eight clicks per revolution. Each click should be 1 millimeter or .1 centimeter. If not, have the armorer repair it.

E-12. If the center of the shot group is to the left of the point of aim, move the front sight protector to the left. To move the front sight protector to the left, first unscrew the screw on the left side (looking from the rear of the weapon) of the sight protector more than the number of turns needed for the sight correction. Then screw in the right side of the front sight protector the desires number of turns. Finally screw in the left side of the sight protector fully home.

E-13. If the center of the shot group is to the right of the point of aim, move the front sight protector to the right. To move the front sight protector to the right, first turn the hex adjusting screw on the right counter-clockwise to loosen it the desired amount. Then turn the hex adjusting screw on the left side clockwise the same number of turns to tighten.

E-14. The front sight windage adjusting procedure is the combination of creating slack on one side, and then taking up that slack from the opposite side. Always clamp the front sight protector assembly between the heads of the two opposing screws. Remember, each time you loosen or back off one screw, you must turn the opposite screw exactly the same amount. Check for play in the front sight assembly by lightly clamping it between finger and thumb and attempting to move sight assembly laterally. If you feel no play, the windage adjustment is completed. Carefully check both screws for looseness. (See table E-2.)

Table E-2. Windage correction chart

At This Range	*One Full Turn Moves Strike Up Or Down Centimeters or Inches*
100 meters	8.0 3.15
200 meters	16.0 6.30
300 meters	24.0 9.45
400 meters	32.0 12.60
500 meters	40.0 15.75
600 meters	48.0 18.90
700 meters	56.0 22.00
800 meters	64.0 25.20
900 meters	72.0 28.35

Confirmation

E-15. The gunner fires another three-shot group (loaded singly) after making his corrections for windage and elevation. If the center of the group is still off the aiming point, he adjusts further until the group centers on the point of aim.

Recording of Zero

E-16. The gunner can refrain from recording the 10-meter zero, because it applies only to firing at the 10-meter basic machine gun target

FIELD ZERO

E-17. A gunner must know how to zero the machine gun at a known distance. The gunner should select a known distance target between 300 and 700 meters. As the range increases, determining the location of the center of the beaten zone relative to the target becomes more difficult. Therefore, to simplify adjustment of fire, the 500-meter target should be used.

SETTING OF THE SIGHTS

E-18. The gunner uses the same procedures as for 10-meter zeroing except that they place the rear sight on the range to the target. The recommended range is 500 meters.

BURST

E-19. The gunner assumes a stable position and fires a burst (6 to 9 rounds at the center base of the target). They observe where each burst strikes.

CORRECTION FOR ELEVATION

E-20. If the center of the beaten zone is higher or lower than the target, the gunner corrects for elevation. Because determining this is difficult, they rely on trial and error to gain the experience to make reliable estimates. They correct for elevation the same as he did for 10-meter zeroing. (Refer to table E-1.)

CORRECTION FOR WINDAGE

E-21. If the center of the beaten zone is to the left or right of the target, the gunner corrects for windage. (Refer to table E-2 on page E-4.)

CONFIRMATION

E-22. After correcting for elevation and windage, the gunner fires a confirming burst. If they miss the target, they repeat the procedures.

RECORDING OF ZERO

E-23. On confirming a zero, for both windage and elevation, the gunner records how many clicks (and the direction) that they moved the sight from its original settings.

LASER BORELIGHT

E-24. This section provides the 10-meter target offsets for the M240 machine gun mounted with iron sight, optics, MILES, or aiming lasers. A blank reproducible 10-meter target offset (DA Form 7476, *10-Meter Boresight Offset Target*) is provided along with a table and an example of every weapon configuration in figure E-4 on page E-7 and figure E-5 on page E-8.

10-METER TARGET OFFSET

E-25. To mark the proper 10-meter target offset, the gunner must do the following:

- Find the correct template for your weapon configuration.

- Count the number of squares starting from center of the bore light circle on the offset to the desired point of aim. Each template also provides a number formula for the proper offset, for example, (L2.0, U2.4): Starting from the center of the bore light circle (0.0, 0.0) move LEFT 2 squares and UP 2.4 squares.
- Place the appropriate symbol or mark (see figure E-3).

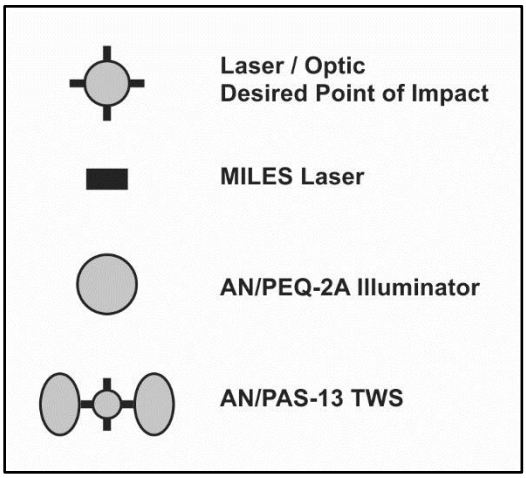
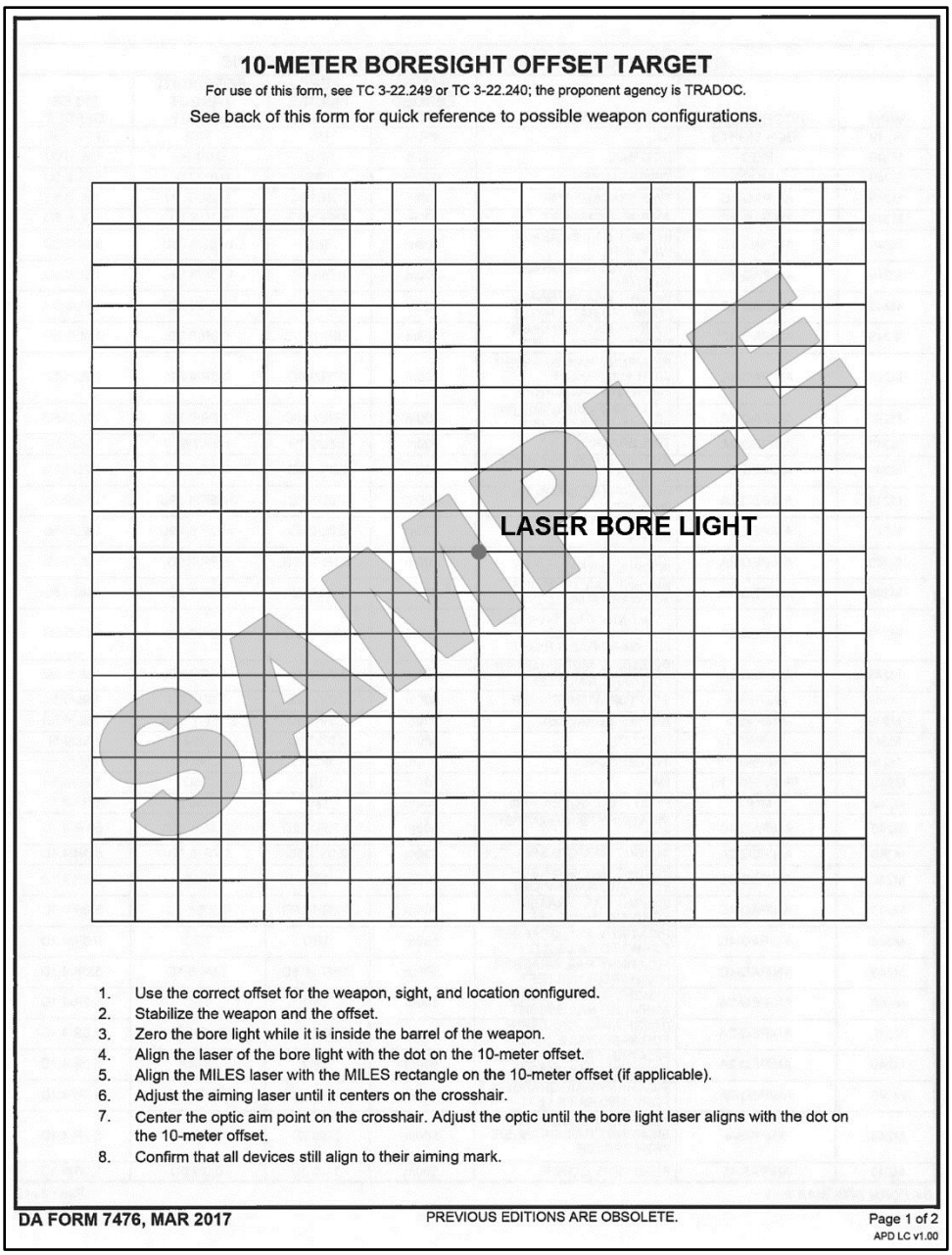


Figure E-3. 10-meter target offset symbols



10-METER BORESIGHT OFFSET TARGET

For use of this form, see TC 3-22.249 or TC 3-22.240; the proponent agency is TRADOC.

See back of this form for quick reference to possible weapon configurations.

LASER BORE LIGHT

SAMPLE

1. Use the correct offset for the weapon, sight, and location configured.
2. Stabilize the weapon and the offset.
3. Zero the bore light while it is inside the barrel of the weapon.
4. Align the laser of the bore light with the dot on the 10-meter offset.
5. Align the MILES laser with the MILES rectangle on the 10-meter offset (if applicable).
6. Adjust the aiming laser until it centers on the crosshair.
7. Center the optic aim point on the crosshair. Adjust the optic until the bore light laser aligns with the dot on the 10-meter offset.
8. Confirm that all devices still align to their aiming mark.

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Figure E-4. Example DA Form 7476 front



QUICK REFERENCE - POSSIBLE WEAPON CONFIGURATIONS

WPN	ACCESSORY	MOUNT	RANGE ZEROED TO	ZERO TARGET OFFSET	BORESIGHT TARGET OFFSET	MILES OFFSET
M249	IRON SIGHTS	NA	400m	NA	TBD	1.9L/0.5U
M249	MGO	IFTC RAIL	400m	TBD	0.0/7.9U	1.9L/0.5U
M249	MGO	TWS BRACKET	400m	TBD	0.0/2.15U	1.9L/0.5U
M249	AN/PAQ-4C	TWS BRACKET TOP	400m	0.5R/1.5U	1.85L/7.7U	1.9L/0.5U
M249	AN/PAQ-4C	AN/PVS-4 BRACKET	400m	2.5R/1.5D	4.1L/6.1U	1.9L/0.5U
M249	AN/PAQ-4C	INSIGHT RAIL GRABBER WITH IFTC	400m	TBD	1.75L/4.69U	1.9L/0.5U
M249	AN/PAQ-4C	PICATINNY RAIL GRABBER WITH IFTC	400m	1.75R/0.0	1.75L/5.39U	1.9L/0.5U
M249	AN/PAQ-4C	INSIGHT RAIL GRABBER FORWARD RAILS RIGHT	400m	5.9R/9.6D	5.9R/4.0D	1.9L/0.5U
M249	AN/PAQ-4C	INSIGHT RAIL GRABBER FORWARD RAILS LEFT	400m	6.0R/13.3D	6.0R/8.3D	1.9L/0.5U
M249	AN/PAQ-4C	PICATINNY RAIL GRABBER WITH ALL SPACER FORWARD RAILS RIGHT	400m	7.7R/9.6D	7.7R/4.0D	1.9L/0.5U
M249	AN/PAQ-4C	PICATINNY RAIL GRABBER FORWARD RAILS LEFT	400m	7.6R/13.3D	7.6R/8.3D	1.9L/0.5U
M249	AN/PEQ-2A	TWS BRACKET TOP	400m	1.8L/2.7D	1.8R/7.95U	1.9L/0.5U
M249	AN/PEQ-2A	AN/PVS-4 BRACKET WITH SPACER	400m	5.0R/4.0D	0.45L/6.5U	1.9L/0.5U
M249	AN/PEQ-2A	INSIGHT RAIL GRABBER WITH IFTC	400m	2.0L/1.5U	1.95R/4.79U	1.9L/0.5U
M249	AN/PEQ-2A	PICATINNY RAIL GRABBER WITH IFTC	400m	2.0L/0.5D	1.95R/6.49U	1.9L/0.5U
M249	AN/PEQ-2A	INSIGHT RAIL GRABBER FORWARD RAILS RIGHT	400m	6.1R/13.2D	6.1R/7.6D	1.9L/0.5U
M249	AN/PEQ-2A	INSIGHT RAIL GRABBER FORWARD RAILS LEFT	400m	6.0R/9.4D	6.0R/4.4D	1.9L/0.5U
M249	AN/PEQ-2A	PICATINNY RAIL GRABBER WITH ALL SPACER FORWARD RAILS RIGHT	400m	7.8R/13.2D	7.8R/7.6D	1.9L/0.5U
M249	AN/PEQ-2A	PICATINNY RAIL GRABBER FORWARD RAILS LEFT	400m	7.6R/9.4D	7.6R/4.4D	1.9L/0.5U
M249	AN/PVS-4	IFTC TOP WITH SPACER	400m	0.0/4.3D	0.0/10.0U	1.9L/0.5U
M249	AN/PVS-4	AN/PVS-4 BRACKET	400m	2.5R/4.9D	2.25L/11.25U	1.9L/0.5U
M249	AN/PAS-13	IFTC TOP	400m	0.0/2.75D	0.0/8.6U	1.9L/0.5U
M249	AN/PAS-13	TWS BRACKET	400m	0.0/5.5D	0.0/10.05U	1.9L/0.5U
M240	IRON SIGHTS	NA	500m	TBD	TBD	1.9L/0.5U
M240	MGO	FEED TRAY COVER RAIL	500m	NA	0.0/0.0	5.0R/4.1D
M240	AN/PAQ-4C	PICATINNY RAIL GRABBER TOP	500m	1.75R/2.2D	1.5L/3.5U	5.0R/4.1D
M240	AN/PEQ-2A	INSIGHT RAIL GRABBER TOP	500m	2.0R/1.5D	1.7R/3.71U	5.0R/4.1D
M240	AN/PAQ-4C	INSIGHT RAIL GRABBER FORWARD RAILS RIGHT	500m	TBD	TBD	5.0R/4.1D
M240	AN/PAQ-4C	INSIGHT RAIL GRABBER FORWARD RAILS LEFT	500m	6.2R/16.8D	6.2R/8.1D	5.0R/4.1D
M240	AN/PAQ-4C	PICATINNY RAIL GRABBER FORWARD RAILS RIGHT	500m	TBD	TBD	5.0R/4.1D
M240	AN/PAQ-4C	PICATINNY RAIL GRABBER FORWARD RAILS LEFT	500m	7.9R/16.8D	7.9R/8.1D	5.0R/4.1D
M240	AN/PEQ-2A	INSIGHT RAIL GRABBER FORWARD RAILS RIGHT	500m	TBD	TBD	5.0R/4.1D
M240	AN/PEQ-2A	INSIGHT RAIL GRABBER FORWARD RAILS LEFT	500m	6.2R/12.8D	6.2R/4.1D	5.0R/4.1D
M240	AN/PEQ-2A	PICATINNY RAIL GRABBER FORWARD RAILS RIGHT	500m	TBD	TBD	5.0R/4.1D
M240	AN/PEQ-2A	PICATINNY RAIL GRABBER FORWARD RAILS LEFT	500m	7.9R/12.8D	7.9R/4.1D	5.0R/4.1D
M240	AN/PVS-4	FEED TRAY COVER RAIL PICATINNY RAIL GRABBER WITH SPACER	500m	0.0/6.2D	0.0/6.0U	5.0R/4.1D
M240	AN/PAS-13	FEED TRAY COVER	500m	0.0/2.3U	0.0/8.0U	5.0R/4.1D

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SAMPLE

Figure E-5. Quick reference card from back of DA Form 7476

ZERO CONFIRMATION OUT TO 500 METERS

E-26. The most important step in the zeroing process is zero confirmation out to 500 meters. Having a 10-meterm zero does not guarantee a center hit at 500 meters. The only way to rely on a 500-meter hit, is to confirm a 500-meter zero.

E-27. Confirmation can be done on any range where Soldiers can see the impacts of their rounds. Groups should be fired and aiming devices should be adjusted. At a minimum, the confirmation should be done at 500 meters. If rounds are available, groups can be fired at various ranges to show the firers where their impact will be.

E-28. When confirming zero at ranges past 100 meters, the effects of the wind needs to be considered and acted upon, if necessary. If a zero is confirmed at 500 meters on a windy day, and then the weapon is fired at a later date in different wind conditions or no wind at all, the impact changes. (See figure E-6.)

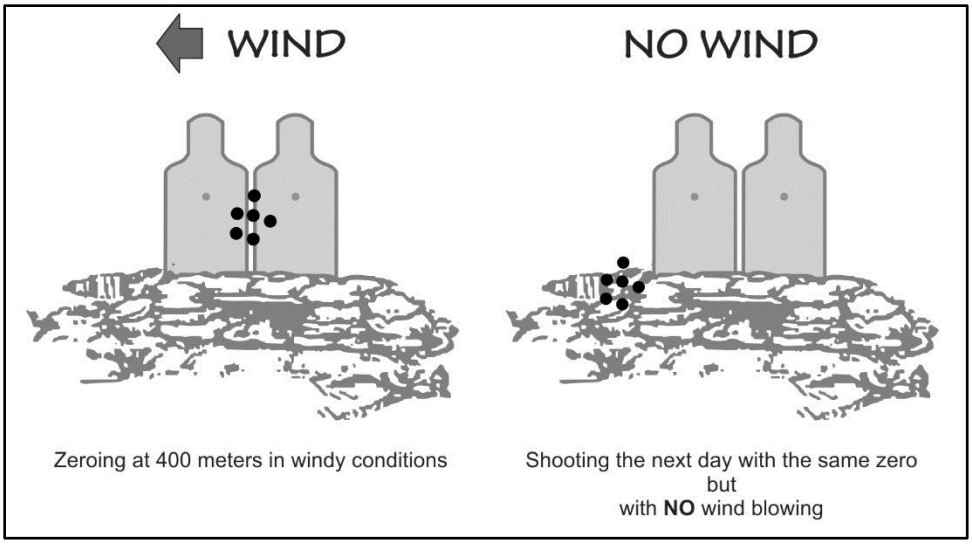


Figure E-6. Wind effects on zero at 500 meters

M145 STRAIGHT TELESCOPE

E-29. The M145 straight telescope (see figure E-7) is a fixed 3.4 power, 28-mm optical sight that has been designed to engage targets accurately out to 1200 meters. The telescope weighs 24 ounces (681 grams) and is extremely rugged for rough field conditions. The telescope has an 8.2-mm diameter exit pupil, which provides excellent vision in low light levels, dawn and dusk, and also allows for rapid target acquisition.

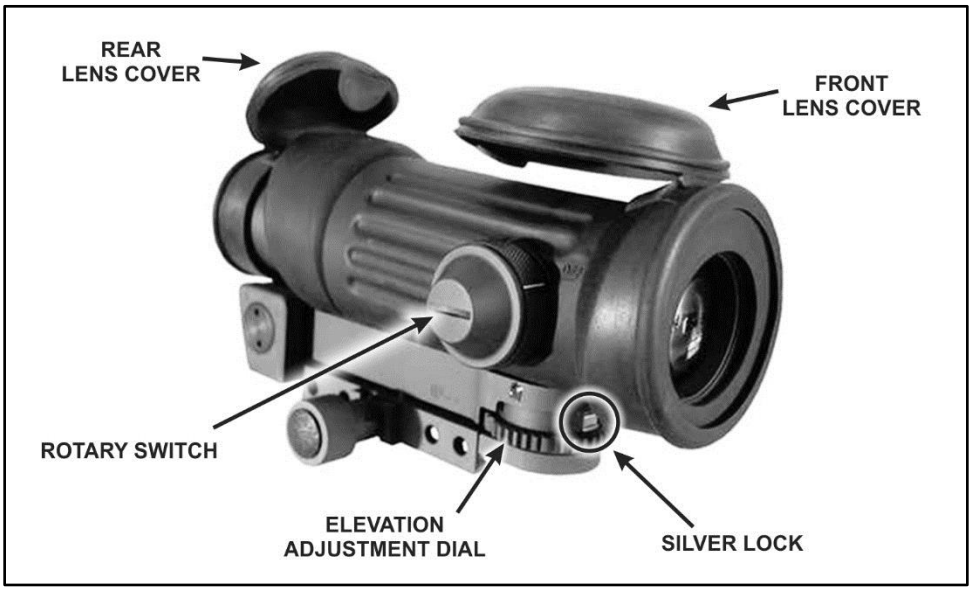


Figure E-7. M145 straight telescope

SET THE M145 TELESCOPE TO MECHANICAL ZERO

1. Adjust the telescope so that the weapon's barrel and optical sighting axis are in approximate alignment. The sighting axis will be approximately two to three inches (51 to 76 millimeters) above the machine

gun barrel and therefore the strike of the bullet at 10 meter range will also be approximately two to three inches (51 to 76 millimeters) low without further zeroing adjustment. (See figures E-8 and E-9.)

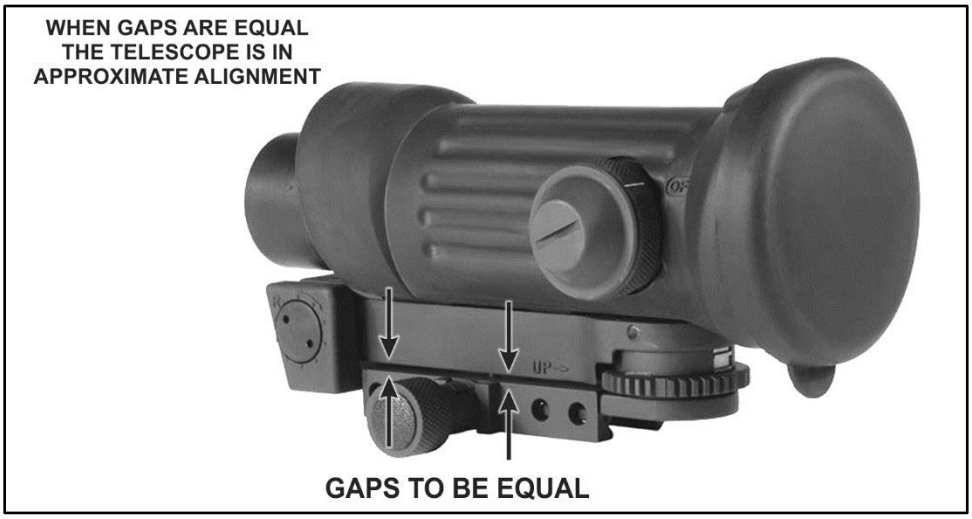


Figure E-8. Mechanical zero

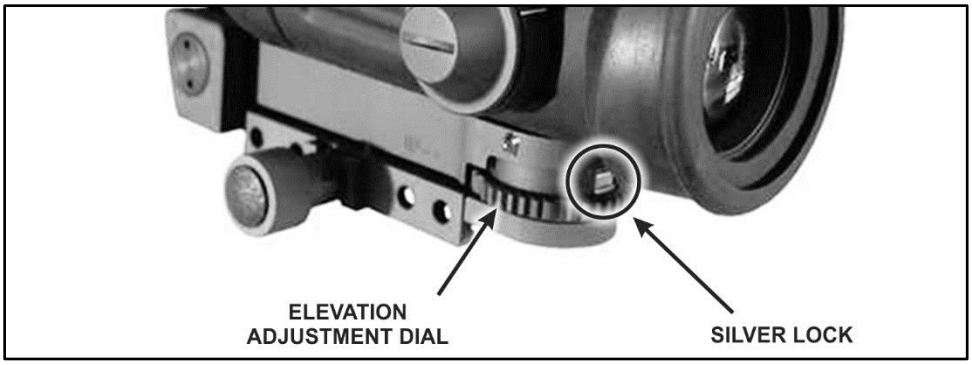


Figure E-9. Elevation adjustment

2. To bring the strike of the bullet up, lift the silver lock (see figure E-10) and rotate the elevation adjustment dial counterclockwise (to the right) approximately one full turn.

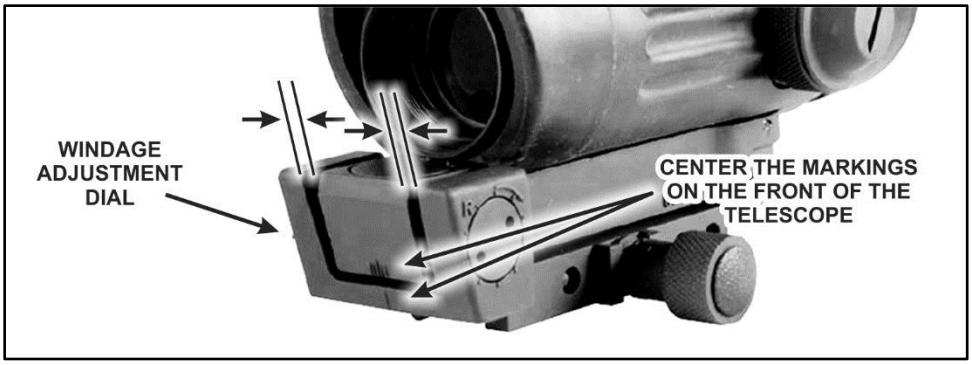


Figure E-10. Windage adjustment

3. Adjust the windage adjustment dial (to center the markings on the front of the telescope (see figure E-11)

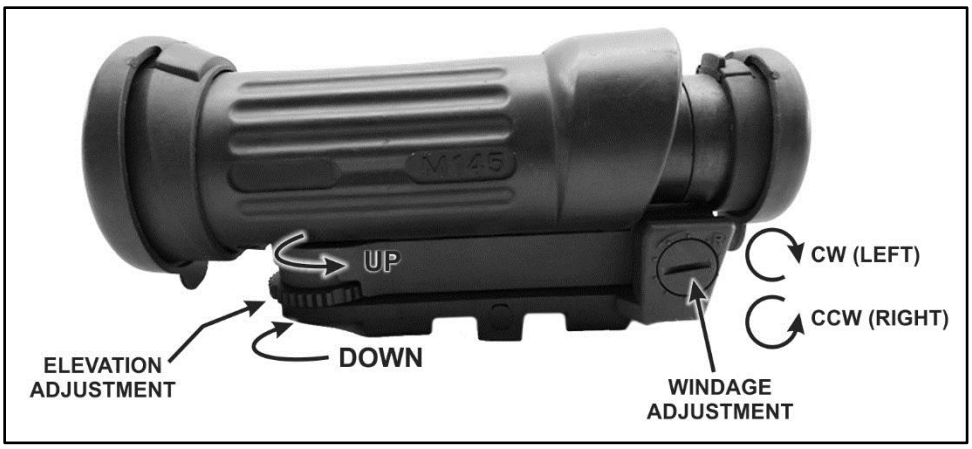


Figure E-11. Point of impact adjustment

Note. Each click of the zeroing adjustment makes a 2.5-millimeter movement of the point of impact at 10 meters.

4. Make the final adjustments as follows (see figure E-12, page E-12):
    a. To move the point of impact to the right, turn windage adjustment dial counterclockwise with the arrow marked on the dial.
    b. To move the point of impact to the left, turn windage adjustment dial clockwise opposite to the arrow.
    c. To move point of impact up, turn elevation adjustment dial counterclockwise (right) in the direction of the arrow and UP marking.
    d. To move the point of impact down, turn elevation adjustment dial clockwise (left) opposite to the arrow.

TEN-METER ZEROING USING THE M145 STRAIGHT TELESCOPE

Notes. In the zeroing process, groups of three single shot rounds are fired at a target. After each three rounds, the center of the group has to be determined.

The 10mZ (800) line is to be used with the M240 machine guns when firing the 10-meter exercise as part one of the qualifying course.

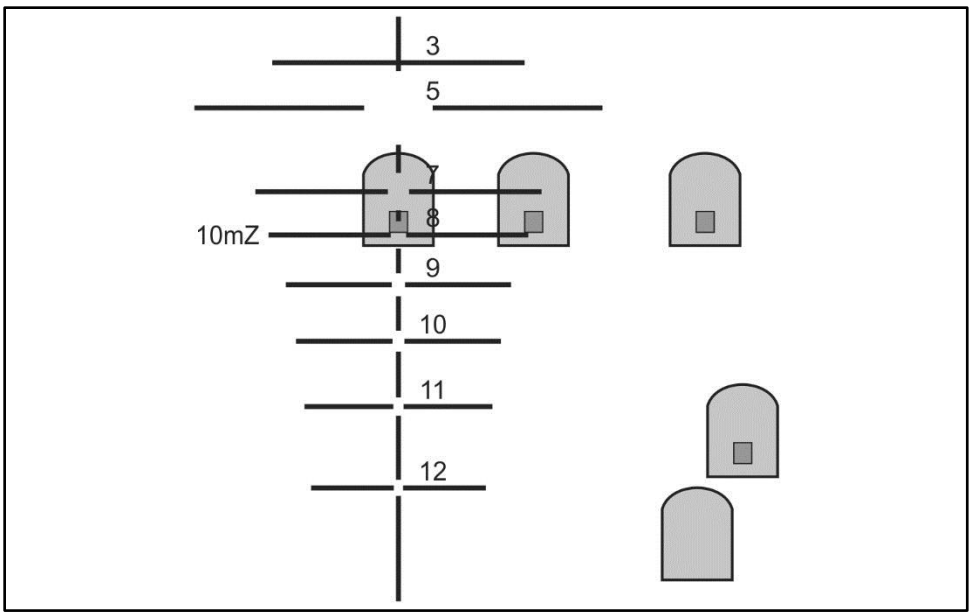


Figure E-12. Target zeroing.

1. Look through the telescope and align the reticle's 10mZ zeroing mark on the center base of the aiming points on the basic machine gun marksmanship target.
2. Fire three single rounds loaded individually without making any telescope adjustments.
3. The three-round shot group (figure E-13) should be within a four-centimeter circle to establish the center of shot group in relation to the center base of the aiming paster.
4. Measure the amount of movement required left or right (windage) and up or down (elevation) (figure E-13) to move the three-round shot group onto the center of the aiming paster.
5. Windage correction: Upon completion, return to the firing line to make corrections to the weapon and re-fire a three-round shot group to confirm zero.
6. Repeat steps 1 through 5 until the strike of the round is coincides with the center of the target. Close the silver lock. (figure E-7, page E-9 and figure E-10, page E-11) down to prevent any further movement of the elevation adjustment dial (figure E-7, page E-9 and figure E-10, page E-11). The telescope is now 10-meter zeroed.

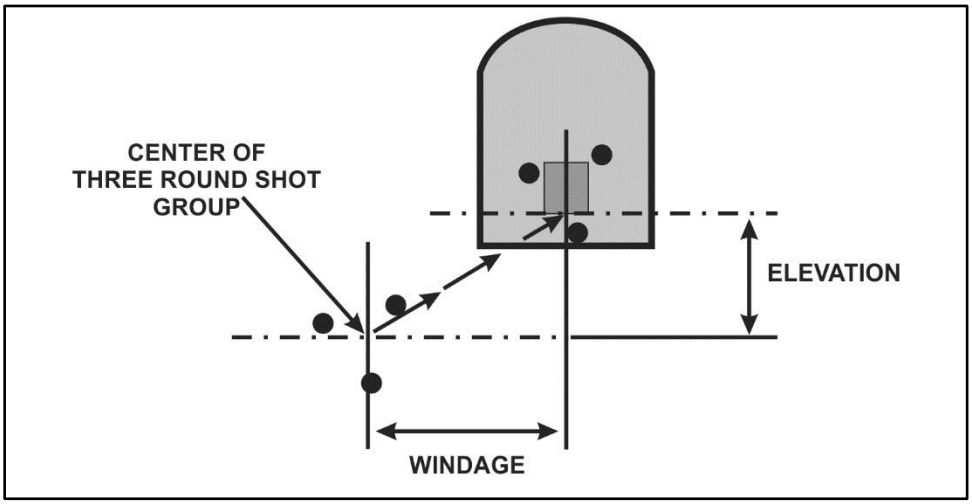
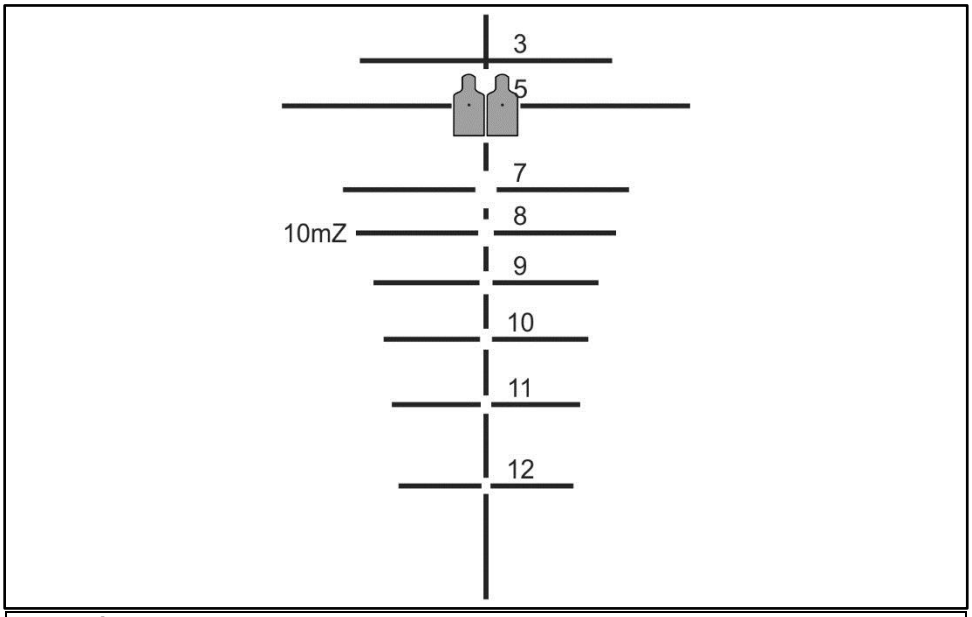


Figure E-13. Shot group

FIELD ZERO AT 500-METER RANGE



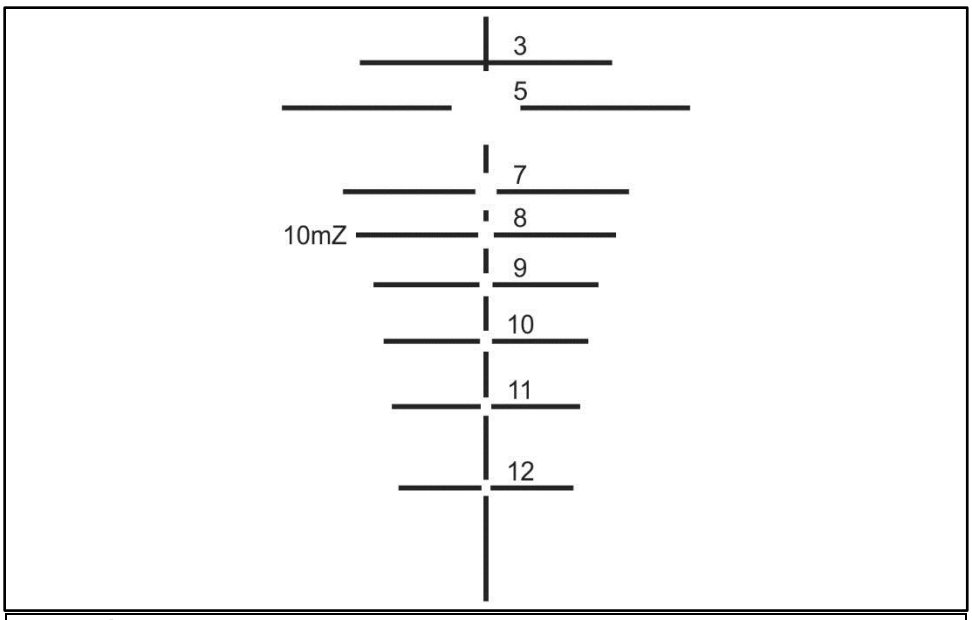
Legend:
mZ= meter zero

Figure E-14. 500-meter reticle view

1. Look through the telescope and align the reticle's 500-meter mark (see figure E-14) on the center of mass of the double "e" silhouette target.
2. When firing a M240 weapon, fire a 6- to 9-round burst.
3. Observe impact of rounds.
4. Determine direction of movement needed for impact (up or down, left or right).
5. Estimate or measure the amount of adjustment required to move the impact of the round to the center of the target (at 500 meters), five inches equal one click of adjustment in both windage and elevation).
6. Repeat steps 1 through 5 until the impact of the round coincides with the center of the target. Close the silver lock down to prevent any further movement of the elevation adjustment dial. The telescope is now zeroed and ready for operational shooting.

M145 STRAIGHT TELESCOPE RETICLE

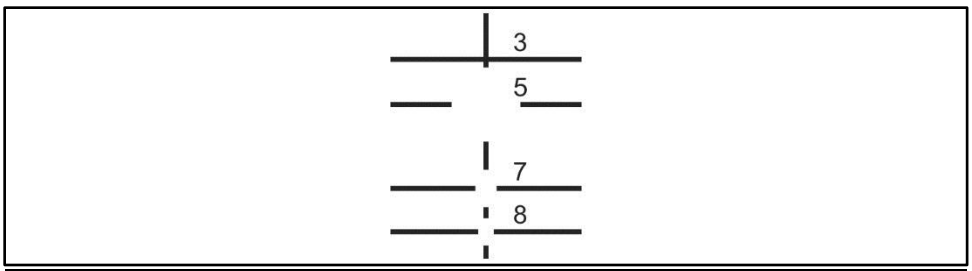
E-30. The vertical gap in the stadia lines is for estimating ranges. The height of gaps in the stadia lines represents a 60-inch (152.4-centimeter) high target at the range noted (5, 7, 8, 9, 10, 11, or 1200 meters). (See figure E-15, page E-14.)



Legend:
mZ= magnetic azimuth

Figure E-15. M145 reticle

E-31. For low light operations, the reticle can be illuminated to show the 300-meter, 500-meter, 700-meter and 800-meter aiming marks. (See figure E-16.)



Legend:
mZ= magnetic azimuth

Figure E-16. Illuminated reticle

Note. Telescope is equipped with a variable intensity light emitting diode (LED) for illumination of the reticle. It has 10 positions: the OFF position and nine positions for different reticle intensity settings.

1. To make reticle illumination adjustments, turn rotary switch (figure E-7, page E-9) clockwise. The intensity of the illumination increases as the switch is turned.
2. Turn rotary switch (figure E-7, page E-9) to OFF position when the telescope is being used during normal daylight or when illumination is not required.

DOWNRANGE FEEDBACK

E-32. Feedback must be included in all live-fire training. Soldiers must have precise knowledge of a bullet strike; feedback is inadequate when bullets from previous firings cannot be identified. To provide accurate feedback, trainers ensure that Soldiers triangulate and clearly mark previous shot groups on a zeroing target or receive a hard copy from the tower on an automated range.

Note. A common misconception is that wearing combat gear causes the zero to change. Adding combat gear to the Soldier's body does not cause the sights or the reticle to move. The straight line between the center of the rear sight aperture and the tip of the front sight post either intersects with the trajectory at the desired point, or it does not. Soldiers should be aware of their own performance, to include a tendency to pull their burst in a certain direction, across various positions, and with or without combat gear. A shift in point of impact in one shooting position may not correspond to a shift in the point of impact from a different shooting position.

E-33. A good zero is necessary to engage targets accurately. Whenever the Soldier deploys or does training in a new location, he should confirm the zero on his weapon if possible, as elevation, barometric pressure, and other factors affect the trajectory of burst. There are multitudes of factors that can affect a zero, and the only sure way to know where the rounds are going, is to fire the weapon.

E-34. The zero on each assigned machine gun will not transfer to another machine gun. Inputting that same settings from one machine gun on to another machine gun does not make it zeroed. This is due to the manufacturing tolerance difference between the weapons.

E-35. It is recommended that Soldiers setup their equipment and dry practice in position with gear on before coming to the range.

E-36. Standard in Training Commission (STRAC) Department of the Army Pamphlet (DA PAM) 350-38 allocates ammunition to conduct zeroing procedures using three-shot groups. The preferred method is to use a five-shot grouping, allowing the firer to more accurately analyze their shot group. Figure E-17 shows similar three-shot and five-shot groups with one shot on the right edge of the group. If all the shots were taken into account in the three-shot group, the firer would probably adjust their zero from the right edge of the four-cm circle. It is possible that the shot on the right was a poor shot and should not be counted in the group. The five-shot group on right is in the same place as the one on the left with the exception of the one shot out to the right. With four out of five shots in a tight group, the wide shot can be discounted and little or no change to the windage is necessary.

E-37. Part of the grouping (see figure E-17) and zeroing process is the marking and analysis of shot groups.

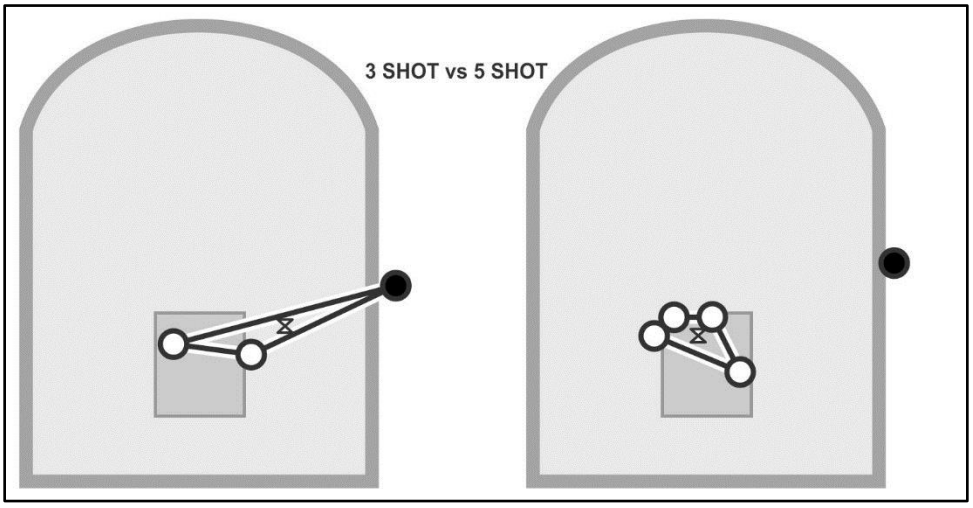


Figure E-17. Grouping

MARKING THE SHOT GROUP

E-38. If possible, shot groups should be marked using different colored markers so the firer can track their progress. Figure E-18 on page E-16 shows a technique for marking shot groups on a zero target. This technique allows the firer and coach to track their progress throughout the grouping and zeroing phase.

E-39. All sight adjustments are from the center of the group, called the mean point of impact (MPI), and not from the location of a single shot. When using five-shot group, a single shot that is outside of the rest of the group should not be counted in the group for sight adjustment purposes.

Note. This figure depicts the color variations in shades of gray.

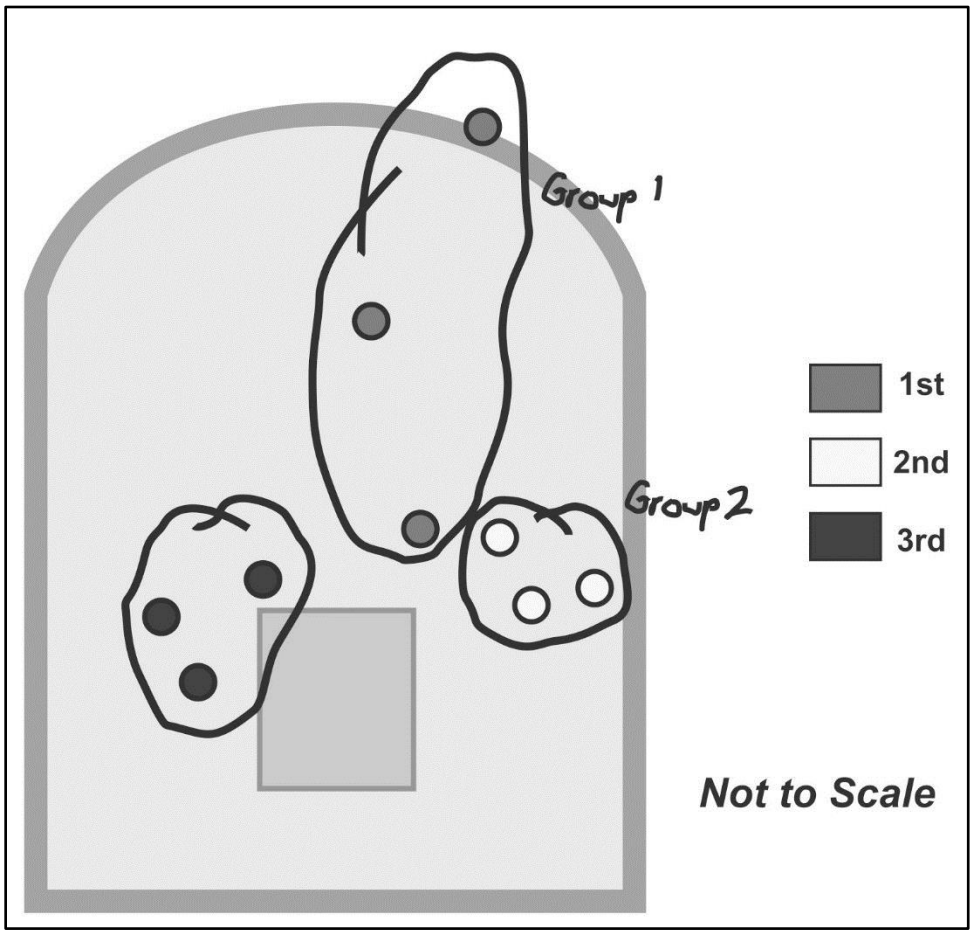


Figure E-18. Marking shot groups

E-40. The firer shoots and marks their first shot group with a colored marker. The color of the first group is noted by placing a line with that marker next to the 1 on the right side of the zero target. Groups are fired and marked until they are consistently in the same location.

E-41. Each sight adjustment is annotated in the same color as the group that was just fired.

COACHING

E-42. 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

E-43. Firing the 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 burst. 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 their own firing errors but this process can be made easier through the use of a coach.

E-44. 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

E-45. 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 observed and discuss them after firing that group. It is often difficult for the coach to remember the errors observed in each and every firer.

Peer Coaches

E-46. Using a peer coach, although generally not as effective as using an experienced coach, is still a very 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. Many people grasp instruction more deeply when they are coaching others than when they are simply told to do something.

Note. Peer coaches can be limited by their level of training.

E-47. 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. The following section discusses the elements of shooting and how best to observe them as a coach.

STABILIZE

E-48. For the coach to observe how stable the firer is, they may have to move to different sides of the firer. To observe the firer's non-firing elbow (to ensure it makes contact with the ground), the coach will need to be on the firer'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 needs to watch the relationship of the front sight to the barrel from behind the firer. 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

E-49. 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 firer will not realize their aiming errors until they discover them on their own. Without the use of a sighting device, the coach must rely on drawings and discussions to determine where the firer 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 technique of having the firer call their shots should also be used. This technique involves calling the point on the target where the 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.

E-50. When optics are being used, the firer can tell the coach where they were holding. This is of particular importance with the MGO. Coaches must ensure the 800-meter aim point is used when zeroing at 10 meters.

CONTROL

E-51. The ideal position to observe trigger squeeze is from the non-firing side because the coach has a better view of the speed of pull, finger position on the trigger, and release or pressure on the trigger after firing. The coach can look from behind the firer to observe the barrel for lateral movement caused by slapping the trigger during firing.

COACHING FACTORS

E-52. All firing happens at the weapon. This means that the coach should be focused solely on the firer during firing and not on what is happening down range.

E-53. 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 firer during firing to determine errors and use the impacts to confirm their assumptions.

E-54. For a coach to properly observe all aspects of firing they must be able to observe the firer safely, from both sides and the back. There is no prescribed coaching position.

E-55. Coaching requires a relaxed atmosphere with open communication between the firer and the coach.

SHOT GROUP ANALYSIS

E-56. Shot group analysis involves the firer correlating the shots on paper 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 holes in the paper. It is more important to observe the firer than to try and analyze the target. All firing takes place at the weapon, and the holes in the paper are only an indicator of where the barrel was pointed when the weapon was fired. When coaches are analyzing groups, they must question the firer about the group to make a determination of what caused the placement of the shots.

E-57. For example, if the firer 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 marking their group. (See figure E-19 and figure E-20.) 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.

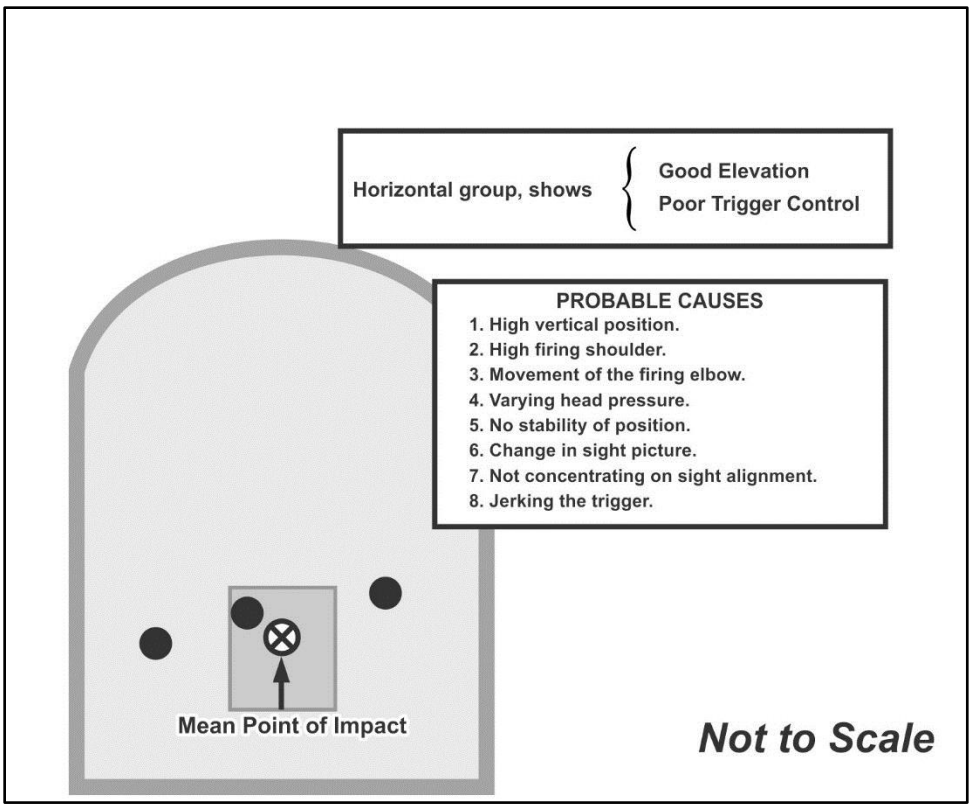


Figure E-19. Horizontal diagnostic shots

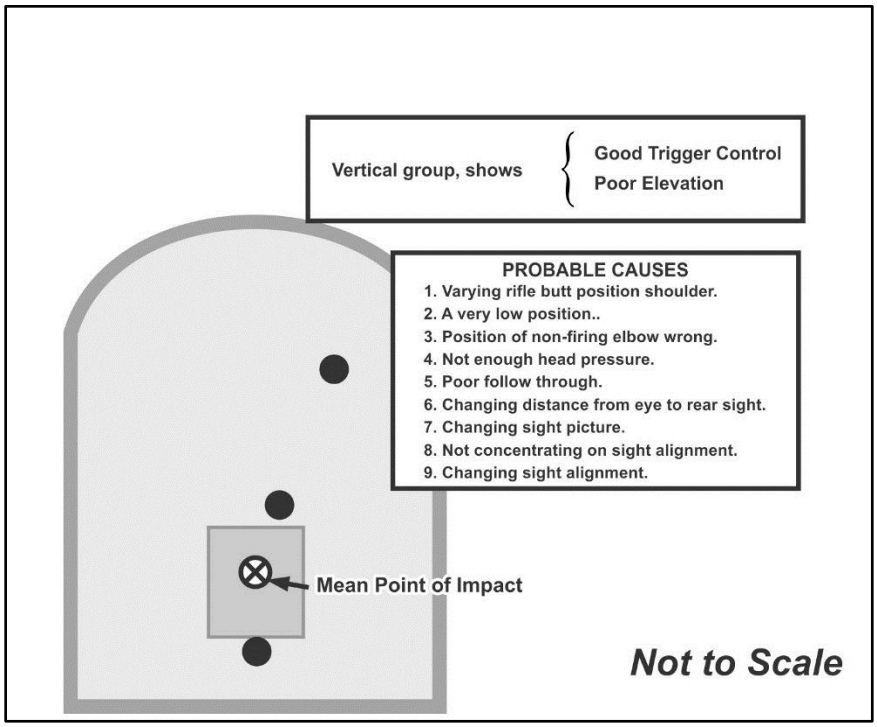


Figure E-20. Vertical diagnostic shots

E-58. Novice firers may benefit from not marking their own shot group. When marking 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. The experienced Soldier is less likely to make adjustments to 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.

E-59. Observing the firer must be accomplished before analyzing the target can become effective. Bullets strung vertically do not necessarily mean a breathing issue, nor do bullets strung horizontally absolutely indicate a trigger squeeze problem. Coaches must learn to identify firer's errors during firing and use the bullet impacts on target to confirm their observations. There are often several firing errors that can be the cause of 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 barrel to be pointed in those directions, and those causes can be many.

E-60. They key to proper coaching is becoming a shooting detective. The coach needs to observe the firer, question the firer, look at the evidence downrange, question the firer again, make assumptions based upon the evidence available, and then act upon his assumptions. The coach and firer must have a free and open dialog with each other in a relaxed atmosphere. Remember if a Soldier learns to shoot poorly they will only be capable of shooting poorly.

DISPLACEMENT OF SHOTS WITHIN A SHOT GROUP (FLYERS)

E-61. The capability of the weapon to shoot groups varies dependent on the number of rounds fired through the barrel over its lifetime. The average expected group size is in a four-centimeter circle or smaller at 10 meters; some weapon may shoot slightly larger than this. If a firer is firing groups larger than a normal group size, the next step should be to have a known skilled firer attempt to fire and group with the original firer's weapon. If a proven skilled firer is able group off of the normal size it is most likely an issue with the original firer. If, however, the skilled firer cannot fire within the accepted group size there may be something wrong with the gun or barrel.

E-62. When looking at groups where there are one to two shots away from the group body (one shot away for a three round group, one or two shots away for a five-round group), the coach must look objectively at the overall consistency of group placement. A bad shot or group might not indicate a poor grasp of the elements; every firer will have an occasional bad shot, and some may even have an occasional bad group. Coaches need to use their experience and determine whether or not the firer had a bad shot, a bad group, or doesn't have a clear grasp of the elements and take the necessary steps to get the firer to the end-state. The coach may have the firer shoot again and ignore the bad group or bad shot, instead hoping that the new group matches up with the previous shot groups or the coach may need to pull the firer off the line and cover the basic elements. Contrary to popular belief, having a firer shoot over and over again in one sitting, until the firer "get it right" is not a highly effective technique.

BULLETS DISPERSED LATERALLY ON TARGET

E-63. Bullets displaced in this manner could be caused by a lateral movement of the barrel due to an unnatural placement of the trigger finger on the trigger. Reasons for this could include—

- The firer may be misaligning the sights to the left and right slightly.
- The firer may have the sights aligned properly but may have trouble keeping the target itself perfectly centered on the tip of the front sight.
- The firer may be closing their eyes at the moment of firing or flinching.

BULLETS DISPERSED VERTICALLY ON TARGET

E-64. Bullets displaced in a vertical manner could be caused by the following:

- Firer may be misaligning the front sight in the rear sight aperture vertically. It may be caused by the firer watching the target instead of the front sight.

- Firer may have trouble seeing the target and keeping the tip of the front sight exactly centered vertically on the target. Coach may consider using a larger target or a non-standard aiming point. Many firers find it easier to find the center of a circle than a man-shaped target.
- Firer may not have a good support, which causes the firer to readjust their position during every shot and may settle with the sights slightly misaligned.
- Firer may be flinching or closing their eyes at the moment of firing.
- Firer may be breathing while firing the weapon. (This is not normally the case, most firers instinctively hold their breath just before the moment of firing.)

LARGE GROUPS

E-65. Large groups are most commonly caused by the firer looking at the target instead of the front sight. This causes the firer to place the front sight in the center of the target without regard for its location in the rear sight aperture. A small misalignment of the sights results in a large misplacement of shots downrange. Most shooters do not fire when their properly aligned sights are pointed all over the target, so a large group is most likely not a point of aim issue.

GOOD GROUPS THAT CHANGE POSITIONS ON THE TARGET

E-66. When the firer has good groups but they are located at different positions on the target, there can be a number of reasons. These include the following:

- The firer may be properly aligning sights during shooting but picking up a different point of aim on the target each time.
- The firer may be settling into a position with the front sight on target but the sights misaligned. The firer 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 check natural point of aim before each group.

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Appendix F
Qualification

Appendix F assists trainers with preparing and conducting machine gun marksmanship training. Marksmanship begins with proficiency achievement in nonfiring individual skills and ends with collective proficiency in firing under demanding conditions.

OBJECTIVES

F-1. The objective of machine gun marksmanship training is to produce gunners who can fire an accurate initial burst, adjust fire, and develop speed. Each of these functions are described in the paragraphs below.

FIRE AN ACCURATE INITIAL BURST

F-2. Obtaining an accurate initial burst of fire on the target is essential to good marksmanship. The gunner estimates the range to the target, sets the sights, and applies marksmanship skills while engaging targets to achieve an accurate initial burst of fire.

ADJUST FIRE

F-3. The assistant gunner must observe the strike of the rounds when the initial burst is fired. If the gunner misses the target, then they manipulate the T&E mechanism until they hit the target. The assistant gunner must be proficient in observing the strike of rounds and in observing and using tracers. The assistant gunner's proficiency helps the gunner relay the machine gun back on target.

DEVELOP SPEED

F-4. Speed is essential to good marksmanship also. Practicing dry-fire and live-fire exercises increases the gunner's speed. Speed develops through extensive training that combines other skills when delivering fire. However, speed is less important than accuracy.

BASIC MACHINE GUN TARGET

F-5. The basic machine gun target (FSN 6920-078-5128 and NSN 6920-00-078-5123) is used for the 10-meter firing exercise (see figure F-1, page F-2). The following explanation of the target, including the size of the aiming pasters and scoring spaces, aids in zeroing the machine guns and facilitates control during the 10-meter firing exercises. The target has four sections lettered A, B, C, and D. Each section has four point targets numbered 1, 2, 3, and 4; and two sets of area targets numbered 5 through 6 and 7 through 8. Each space is four centimeters wide and five centimeters high. The black aiming paster within the numbered scoring spaces is one-centimeter square. The target is used to score two gunners. One gunner uses sections A and B and the other C and D.

POINT TARGETS

F-6. Point targets on the basic machine gun target are pasters 1 through 4 of sections A, B, C, and D. Firing at point targets exposes the gunner to zeroing techniques and controlled-burst fire techniques. Targets 1 through 4 can also be used for qualification.

AREA TARGETS

F-7. Area targets on the basic machine gun target consist of pasters 5 through 6, and 7 through 8 of sections A, B, C, and D. Target group 5 through 6 provides the gunner with targets in depth and allows him to use a series of aiming points to disburse fire across the target by using the T&E mechanism. Target group 7 through

8 provides the gunner with linear targets with depth. This series of targets uses a series of aiming points to disburse fire across the target and in depth by using the T&E mechanism.

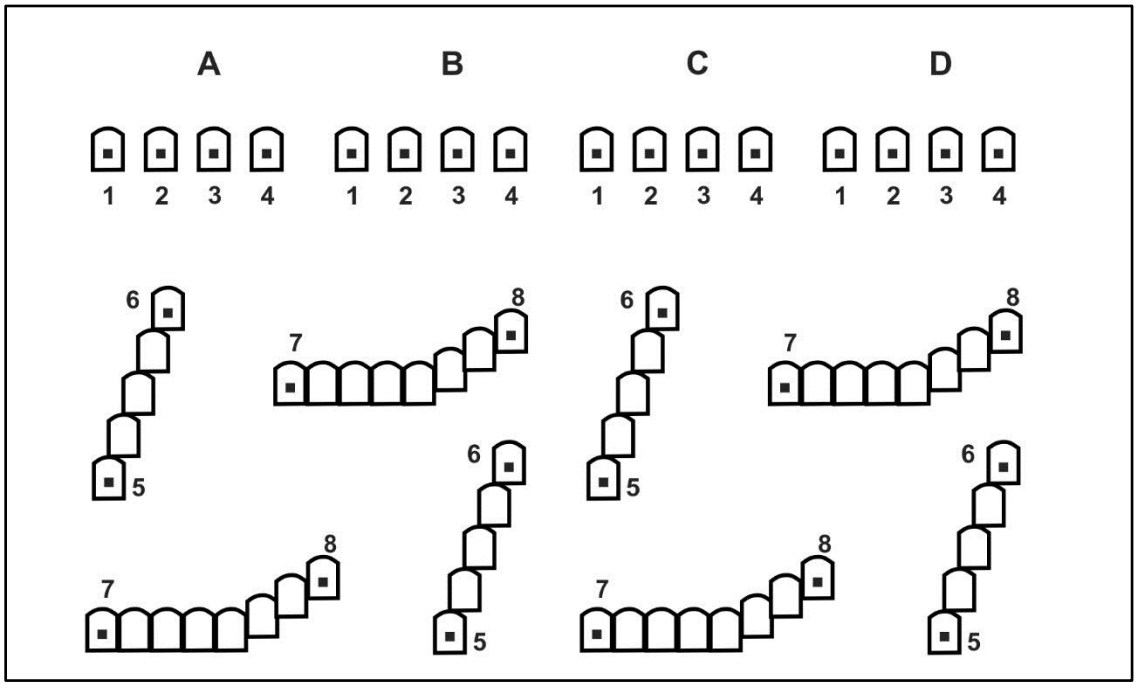


Figure F-1. Basic machine gun target

TEN-METER FIRE

F-8. The 10-meter firing exercise trains the gunner to apply the functional elements of the shot process of machine gun marksmanship in live-fire exercises. It familiarizes the Soldier with the weapon's characteristics, noise, and recoil. It also instills in the Soldier confidence in his weapon. Each gunner learns to zero his machine gun, conduct crew drill, fire controlled-bursts at point targets, and use traverse and search techniques on area targets. Ten-meter firing is conducted on a 10-meter or multipurpose range with the basic machine gun target. The gunner fires with the machine gun on the tripod, from both prone and fighting positions. Ten-meter firing exercises allow practice and part of record qualification. Therefore, all 10-meter firing exercises are recorded and scored. This way, the gunner has an assessment of his performance. Ten-meter fire is conducted using Firing Table I (table F-1,).

Table F-1. Firing Table 1, all weapons, basic (10-meter) fire

TASK	TIME	ROUNDS		TARGET	TYPE FIRE
		QTY	TYPE		
1	No Limit	12	Ball/tracer	Pasters A1 and A2	1 to 2 single rounds (zero)
2	No Limit	6	4:1	Pasters A3 and A4	5- to 7-round burst each paster
3	No Limit	15	4:1	Pasters A5 through A6	5- to 7-round burst each paster, traverse and search
4	No Limit	24	4:1	Pasters A7 through A8	5- to 7-round burst each paster
5[a]	45	12	4:1	Pasters B1 through B4	5- to 7-round burst each paster
6[a]	30	24	4:1	Pasters B7 through B8	5- to 7-round burst each paster

Notes. The gunner fires pasters on sections A and B and the assistant gunner fires on sections C and D.

[a]Qualification task.

TASK 1: ZERO, TRIPOD

F-9. The gunner fires single shots to determine his weapon's zero for 10 meters. This task reinforces the dry-fire experience and allows the gunner to practice loading, while providing the tightest, most accurate shot group he can (A1 and A2 in figure F-1, page F-2).

TASK 2: CONTROLLED-BURST FIRE, TRIPOD

F-10. Task 2 exposes the gunner to automatic fire and the action of the weapon and at the same time introduces trigger control (A3 though A4 on figure F-1, page F-2). Using point targets, the gunner fires a burst of 5 to 7 rounds.

TASK 3: TRAVERSE AND SEARCH FIRE

F-11. Task 3 requires the gunner to make position changes or manipulate the T&E mechanism to engage linear targets with depth, to use controlled-burst fire, and to use a series of aiming points to disburse fire across the target (A5 and A6 on figure F-1, page F-2).

TASK 4: TRAVERSE AND SEARCH FIRE

F-12. Task 4 requires the gunner to make body position changes or manipulate the T&E mechanism to engage area targets in depth, to use controlled-burst fire, and to use a series of aiming points to disburse fire across the target, while wearing a protective mask and gloves (A7 and A8 on figure F-1, page F-2.)

TASK 5: TRAVERSE AND SEARCH FIRE, QUALIFICATION

F-13. Task 5 requires the gunner to engage area targets with width and depth while changing position or manipulating the T&E mechanism during timed conditions (B7 and B8 on figure F-1, page F-2).

TASK 6: TRAVERSE AND SEARCH FIRE, QUALIFICATION

F-14. Task 6 requires the gunner to make position changes or manipulate the T&E mechanism to engage area targets in depth during timed conditions (B5 and B6 on figure F-1, page F-2).

ASSISTANT GUNNER: TEN-METER PRACTICE AND QUALIFICATION

F-15. After the gunner finishes firing, he and the assistant gunner swap positions. The assistant gunner then fires the same tasks in the 10-meter practice and qualification tables, but he fires at the pasters on sections C and D on figure F-1, page F-2.

TEN-METER CONDUCT OF FIRE

F-16. The gunners are instructed on the objectives of firing from the tripod-supported prone or fighting positions. They also learn the fire commands used on the basic range. They learn about the basic machine gun marksmanship target, and how the target is analyzed and scored. The assistant helps the gunner during prefire checks and zeroing. The assistant gunner also relays signals to the tower operator, checks the gunner's position, and provides any other assistance allowed. No assistant gunner is available during qualification fire. The six tasks are fired as follows:

TASK 1: ZERO, TRIPOD

F-17. The gunner should zero his weapon in nine rounds. The gunner should use the other three rounds to confirm the zero. If the gunner cannot zero in 12 rounds, the gunner leaves the firing line and attends remedial training.

- The tower operator commands, MACHINE GUN TO BE MOUNTED HERE (weapon squad leaders indicate the firing points on the 10-meter line), FRONT (weapon squad leader points to the 10-meter targets), ACTION.
- At the command, ACTION, the machine gun crew places the machine gun into action (tripod mode).
- The gunner prepares the rear sight for zeroing and checks the front sight.
- The gunner assumes a good tripod position.
- The tower operator instructs the gunner to prepare a single round.
- The gunner and assistant gunner repeat each element of the following fire command:
  - FIRE MISSION. The gunner loads and moves the safety to "F."
  - FRONT. The gunner focuses on the target or target area.
  - PASTERS A1 and A2. The gunner locates the target.
  - FIVE HUNDRED. The gunner adjusts sights and acquires the sight picture.
  - FIXED, ONE ROUN. The gunner is given the method of fire.
  - COMMENCE FIRING. The gunner fires on command from tower operator, but when ready.
- The gunner loads one round, obtains the proper sight picture, and signals "thumbs up" to the assistant gunner.
- The assistant gunner relays the ready signal to the tower operator.
- The tower operator commands, COMMENCE FIRING.
- When ready, the gunner engages paster A1 with three single shots.
- The gunner moves downrange to observe, mark, and triangulate the shot group. The gunner adjusts as needed.
- The gunner repeats steps 3 through 10 until they have zeroed or fired 12 rounds. If they have not zeroed after 12 rounds, they are removed from the firing line for retraining. Once they zero, they fire the remaining rounds at paster A2 to confirm the zero.

TASK 2: TRIPOD, CONTROLLED-BURST, TRAVERSE

F-18. The tower operator instructs the gunner to prepare a 28-round belt.

- The gunner and assistant gunner repeat each element of the following fire command:
  - FIRE MISSION
  - FRONT
  - PASTERS A3 AND A4
  - FIVE HUNDRED
  - FIXED, FIVE TO SEVEN-ROUND BURST
  - AT MY COMMAND
- The gunner acquires the proper sight picture and signals "thumbs up" to the assistant gunner.
- The assistant gunner relays the ready signal to the tower operator.
- The tower operator commands, FIRE.

- The gunner engages pasters A3 and A4, firing a 5- to 7-round burst at each paster, using traverse.

TASK 3: TRIPOD, CONTROLLED-BURST FIRE, TRAVERSE AND SEARCH

F-19. The tower operator instructs the gunner to prepare a 35-round belt.

- The gunner and assistant gunner repeat each element of the following fire command:
  - FIRE MISSION
  - FRONT
  - PASTERS A5 AND A6
  - FIVE HUNDRED
  - TRAVERSE AND SEARCH, FIVE- TO SEVEN-ROUND BURST
  - AT MY COMMAND
- The gunner acquires the proper sight picture and signals "thumbs up" to the assistant gunner.
- The assistant gunner relays the ready signal to the tower operator.
- The tower operator commands FIRE.
- The gunner engages pasters A5 and A4, firing a 5- to 7-round burst at each paster, using traverse and search technique.

TASK 4: TRIPOD, CONTROLLED-BURST FIRE, TRAVERSE AND SEARCH

F-20. The tower operator instructs the gunner to prepare a 56-round belt.

- The gunner and assistant gunner repeat each element of the following fire command:
  - FIRE MISSION
  - FRONT
  - PASTERS A7 AND A8
  - FIVE HUNDRED
  - TRAVERSE AND SEARCH, FIVE TO SEVEN-ROUND BURST
  - AT MY COMMAND
- The gunner acquires the proper sight picture and signals "thumbs up" to the assistant gunner.
- The assistant gunner relays the ready signal to the tower operator.
- The tower operator commands FIRE.
- The gunner engages pasters A7 and A8, firing a 5- to 7-round burst at each paster, using traverse and search technique.
- The gunner and assistant gunner move downrange to observe and analyze the targets

TASK 5: TRIPOD, QUALIFICATION, TRAVERSE AND SEARCH FIRE

F-21. The tower operator instructs the gunner to prepare a 56-round belt.

- The gunner and assistant gunner repeat each element of the following fire command:
  - FIRE MISSION
  - FRONT
  - PASTERS B7 AND B8
  - FIVE HUNDRED
  - TRAVERSE AND SEARCH, FIVE- TO SEVEN-ROUND BURST
  - AT MY COMMAND
- The gunner acquires the proper sight picture and signals "thumbs up" to the assistant gunner.
- The assistant gunner relays the ready signal to the tower operator.
- The tower operator commands FIRE.
- The gunner engages pasters B7 and B8, firing a 5- to 7-round burst at each paster, using traverse and search technique. The gunner has 45 seconds to engage as many pasters as they can during the time allowed.

TASK 6: TRIPOD, QUALIFICATION, TRAVERSE AND SEARCH FIRE

F-22. On completion of all firing, the firing line is cleared and the trainers or safeties move downrange and score the targets. Someone besides the firer scores their target.

- The tower operator instructs the assistant gunner to prepare a 35-round belt.
- The gunner and assistant gunner repeat each element of the following fire command:
  - FIRE MISSION
  - FRONT
  - PASTERS B5 AND B6
  - FIVE HUNDRED
  - TRAVERSE AND SEARCH, FIVE- TO SEVEN-ROUND BURST
  - AT MY COMMAND
- The gunner acquires the proper sight picture and signals "Thumbs up" to the assistant gunner.
- The assistant gunner relays the ready signal to the tower operator.
- The tower operator commands FIRE.
- The gunner engages pasters B5 and B6, firing a 5- to 7-round burst at each. They use traverse and search. They have 30 seconds to engage as many pasters as they can.
- When the gunner and assistant gunner return from downrange, the tower operator commands OUT OF ACTION.
- The machine gun crew then takes the machine gun out of action (tripod mode).

Gunner Notes: Throughout the firing exercise, perform the appropriate tasks during each element of the fire command. Use the number of rounds fired instead of the rate for the METHOD OF FIRE. This improves control. However, omitting the rate specifies RAPID fire, which is undesirable for these tasks.

If you zero in nine rounds, then use the other three to confirm the zero. If you cannot zero in 12 rounds, leave the firing line and go through remedial training.

WARNING

BOLT POSITION

In tactical situations, where noise discipline is critical to mission success, carry the M240B with the bolt locked to the rear. Only trained gun crews may load the M240B, and then only on command.

TEN-METER QUALIFICATION FIRE

F-23. The first phase of qualification has the gunner firing tasks 2 through 4 of Firing Table I for practice, and tasks 5 and 6 of Firing Table I for record. Before firing, all Soldiers must be familiar with the tasks, the time allowed, the ammunition allowances, the procedures to follow in the event of a stoppage, and the penalties imposed.

TIME AND AMMUNITION

F-24. Each gunner completes zeroing before record fire. They receive individual fire commands for each task. They must fire Task 5 in 45 seconds, and Task 6 in 30 seconds.

STOPPAGES

F-25. After correcting for elevation and windage, the gunner fires a confirming burst. If they miss the target, they repeat the procedures.

- If a stoppage occurs that the gunner cannot reduce by immediate action, then they raise their hand and awaits assistance.
- Once they reduce the stoppage, the gunner completes firing, beginning with the next task.
- If gunner error causes a stoppage, additional time is disallowed. They receive whatever score they had earned before the stoppage occurred.
- If the machine gun must be replaced, the gunner must zero it and fire the exercise again.
- Gunners who fail to fire a task or fail to do so in the time allowed due to malfunctions have another option: They can finish the exercise in an alibi run after all other gunners complete firing. They need only fire the tasks they failed to hit due to the malfunction.

PENALTIES

F-26. Five points are deducted from the score of any gunner who fails to stop firing at the command or signal to cease fire. If a gunner fires at the wrong target or exercise, they lose the points for those rounds. A gunner whose target was fired upon by another gunner is permitted to refire the exercise.

SCORING

F-27. On the 10-meter target, the trainer counts all scoring pasters in sections B and D (B/D5 to B/D6, and B/D7 to B/D8). They award one point for each round that impacts within the scoring space. The most points they can give the gunner for each paster is seven points for the M240B. Rounds that touch the line on the paster are considered hits. Someone besides the gunner scores the gunner's target. During qualification fire, the gunner must earn at least 63 points on Firing Table I on any of the weapons.

Sections B/D5 to B/D6

F-28. When firing B/D5 though B/D6, the gunner engages five scoring pasters with 35 rounds (M240B). They can earn up to 35 points for either the M240B.

Sections B/D7 to B/D8

F-29. When firing pasters B/D7 through B/D8, the gunner engages eight scoring pasters with 56 rounds (M240B). They can earn up to 56 points for the M240B.

POSITION

F-30. For practice and qualification, the gunner will use either a tripod-supported prone or tripod-supported fighting position.

FIRERS

F-31. The gunner and the assistant gunner both fire Table I.

TRANSITION FIRE

F-32. Transition fire provides the gunner with the experience he needs to progress from 10-meter fire to field fire at various types of targets at longer ranges. In a timed scenario, the gunner experiences and learns the characteristics of fire, field zeroing, range determination, and engagement of targets. They use the adjusted aiming-point method of fire adjustment. Transition fire occurs on a machine gun transition range or the multipurpose range complex (MPRC). Exercises are fired with the tripod prone or fighting position. However, the commander may direct that transition fire be conducted from the bipod prone or fighting position. Each gunner and assistant gunner fires transition fire twice once for practice and, once for qualification. They fire the field zero (Task 1) only once during the practice phase. Transition fire is scored during both practice and qualification to provide feedback to the gunner. Firing Table II has eight tasks (See table F-2, page F-8).

Table F-2. Firing Table II, all weapons, tripod transition fire

TASK	TIME	ROUNDS		TARGET	RANGE	TYPE FIRE
		QTY	TYPE			
1	No Limit	28	4:1[b]		500	Fixed, 5- to 7-round burst (field zero)
2[a]	10	14	4:1[b]	Single E	400	Fixed, 5- to 7-round burst
3[a]	15	14	4:1[b]	Double E	500	Fixed, 5- to 7-round burst
4[a]	20	14	4:1[b]	Double E	600	Fixed, 5- to 7-round burst
5[a]	30	14	4:1[b]	Double E	800	Fixed and area, 5- to 7-round burst
6[a]	30	28	4:1[b]	Single E Double E	400 600	Fixed, 5- to 7-round burst
7[a]	45	28	4:1[b]	Double E Double E	700 800	Fixed and area, 5- to 7-round burst
8[a]	45	42	4:1[b]	Single E Double E Double E	400 500 600	Fixed, 5- to 7-round burst

Notes. The unit commander determines the position.

[a]Qualification task.

[b]Ball-to-tracer ratio (mix), that is, four ball rounds are loaded for every tracer round loaded.

RANGE FACILITIES

F-33. The transition range has several firing lanes. Each lane is 10 meters wide at the firing line and 100 meters wide at a range of 800 meters. Ideally, each lane has a fighting position with an adjacent prone firing position.

TARGETS

F-34. Cardboard (NSN 6920-00-795-1806) and plastic (NSN 6920-00-071-4780) E-type silhouette targets are used. Both single and double are needed for qualification. The double E-type silhouette represents an enemy automatic weapon, which for the gunner is a priority target (figure F-2). The targets are at various ranges that the gunner might engage. All targets are plainly visible from the firing positions. Electrical targets are desirable.

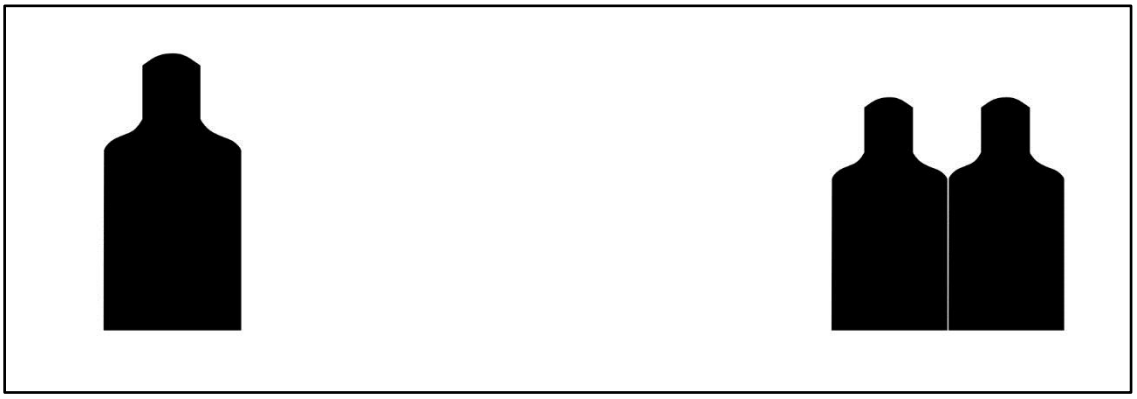


Figure F-2. Single and double E-type silhouette targets

STOPPAGE

F-35. Firing Table I criteria are used.

PENALTIES

F-36. Firing Table I criteria are used.

SCORES

F-37. Ten points are given for each target hit, whether hit on the first or second burst. The total possible points is 110. The gunner must hit at least seven targets (70 points) out of 11 exposures to qualify. Trainers use DA Form 85, *Scorecard for M249 and M240 Machine Guns*, to record scores. (See figure F-2.) The form may be downloaded at https://www.apd.army.mil.

FIRING POSITION

F-38. Transition fire should be fired from the tripod, but the commander may specify that the gunner should fire it from the bipod. The gunner and assistant gunner both fire Table II.

TRANSITION CONDUCT OF FIRE WITH TRIPOD

F-39. The unit is organized in firing orders based on range constraints. Each firing order has a gunner and an assistant gunner. The assistant gunner helps the gunner during prefire checks and zeroing. He also relays signals to the tower operator, checks the gunner's position, and helps with target detection and adjustments during qualification. The gunner uses the bipod-supported prone or fighting position. He fires the eight tasks as follows:

TASK 1: FIELD ZERO, 500-METER, DOUBLE E-TYPE SILHOUETTE

F-40. The tower operator commands, MACHINE GUN TO BE MOUNTED HERE (weapon squad leader's pointing to the firing points on the transition line), FRONT (weapon squad leader's pointing to the targets), ACTION.

- At the command ACTION, the machine gun crew places the machine gun into action (tripod mode).
- The gunner prepares the rear sight for field zeroing, and then they check the front sight blade. They set the range to the zero target on the range scale. The preferred range is 500 meters.
- The gunner assumes a good position.
- The tower operator tells the assistant gunner to prepare a 28-round belt.
- The gunner and assistant gunner repeat each element of the fire command exactly.
  - FIRE MISSION
  - FRONT
  - TARGETS, TROOPS IN THE OPEN
  - FIVE HUNDRED
  - FIXED, FIVE- TO SEVEN-ROUND BURST
  - AT MY COMMAND
- The gunner loads one 28-round belt of ammunition, gets the proper sight picture, and signals "thumbs up" to the assistant gunner.
- The assistant gunner relays the ready signal to the tower operator.
- The tower operator commands FIRE.
- When ready, the gunner fires a 5- to 7-round burst at the target.
- The gunner observes the beaten zone. If the rounds miss the target, they adjust windage and elevation.
- After adjusting, the gunner repeats steps 10 through 11 with the remaining rounds until the rounds impact on the target. They record their zero.

TASK 2: 400-METER, SINGLE E-TYPE SILHOUETTE

F-41. The tower operator tells the gunner to load one 154-round belt.

- When the fire command is given, the gunner and assistant gunner repeat each element. For tasks 2 through 8, it is only given once.
  - FIRE MISSION
  - FRONT
  - TARGET, TROOPS IN THE OPEN
  - ONE HUNDRED TO EIGHT HUNDRED METERS
  - FIXED, FIVE- TO SEVEN-ROUND BURST
  - AT MY COMMAND
- The gunner signals "thumbs up" to the assistant gunner.
- The assistant gunner signals ready to the tower operator.
- The tower operator commands FIRE.
- The gunner scans the sector.
- A 400-meter, single E-type target is exposed for 10 seconds.
- The gunner determines the range, places the proper setting on the rear sight, assumes the proper position, obtains the correct sight alignment and sight picture, and fires a 5- to 7-round burst.
- If the gunner fails to hit the target, they fire another 5- to 7-round burst. To adjust fire, they use the adjusted aiming point method.

TASK 3: 500-METER, DOUBLE E-TYPE SILHOUETTE

F-42. The gunner and assistant gunner continue to scan the sector.

- A 500-meter, double E-type target is exposed for 15 seconds.
- The gunner determines the range, places the proper setting on the rear sight, assumes the proper position, obtains the correct sight alignment and sight picture, and fires a 5- to 7-round burst.
- If the gunner fails to hit the target, he fires another 5- to 7-round burst. To adjust fire, they use the adjusted aiming point method.

TASK 4: 600-METER, DOUBLE E-TYPE SILHOUETTE

F-43. The gunner and assistant gunner continue to scan the sector.

- A 600-meter, double E-type target is exposed for 20 seconds.
- The gunner determines the range, places the proper setting on the rear sight, assumes the proper position, obtains the correct sight alignment and sight picture, and fires a 5- to 7-round burst.
- If the gunner fails to hit the target, he fires another 5- to 7-round burst. To adjust fire, they use the adjusted aiming point method.

TASK 5: 800-METER DOUBLE E-TYPE SILHOUETTE

F-44. The gunner and assistant gunner continue to scan the sector.

- An 800-meter, double E-type target is exposed for 30 seconds.
- The gunner determines the range, places the proper setting on the rear sight, assumes the proper position, obtains the correct sight alignment and sight picture, and fires a 5- to 7-round burst.
- If the gunner fails to hit the target, they fire another 5- to 7-round burst using the adjusted-aiming-point method of fire adjustment.

TASK 6: 400-METER, SINGLE AND 600-METER, DOUBLE E-TYPE SILHOUETTES

F-45. The gunner and assistant gunner continue to scan the sector.

- A 400-meter single E-type target and a 600-meter double E-type target are exposed for 30 seconds.
- The gunner determines the range, places the proper setting on the rear sight, assumes the proper position, obtains the correct sight alignment and sight picture, and fires a 5- to 7-round burst at each target.

- If the gunner fails to hit the target, they fire another 5- to 7-round burst at each target using the adjusted-aiming-point method of fire adjustment.

TASK 7: 700- AND 800-METER, DOUBLE E-TYPE SILHOUETTES

F-46. The gunner and assistant gunner continue to scan the sector.

- A 700-meter and an 800-meter double E-type targets are exposed for 45 seconds.
- The gunner determines the range, places the proper setting on the rear sight, assumes the proper position, obtains correct sight alignment and sight picture, and fires a 5- to 7-round burst at each target.
- If the gunner fails to hit the target, they fire another 7-round burst at each target using the adjusted-aiming-point method of fire adjustment.

TASK 8: 400-METER, SINGLE AND 500- AND 600-METER DOUBLE E-TYPE SILHOUETTES

F-47. The gunner and assistant gunner continue to scan the sector.

- The 400-meter single E-type silhouettes, and 500- and 600-meter double E-type silhouettes are exposed for 45 seconds.
- The gunner determines the range, places the proper setting on the rear sight, assumes the proper position, obtains correct sight alignment and sight picture, and fires a 5- to 7-round burst at each target.
- If the gunner fails to hit the target, they fire another 5- to 7-round burst at each target using the adjusted-aiming-point method of fire adjustment.

TRANSITION FIRE, LIMITED VISIBILITY

F-48. Night or limited visibility firing requires the Soldier to apply the shot process while using nightsights. This training instills confidence in the machine gunner. Each Soldier learns how to engage targets using a nightsight. The Soldier learns to mount the sight, boresight the weapon at 10-meters, and zero the vision devices (Use the appropriate TM for that device.) at 10-meters using a 25-meter (M16A2) zero target. Finally, the Soldier learns to detect and engage a series of undetermined targets at various ranges with the aided vision device. Night firing exercises can be conducted during daylight with an assigned night thermal / vision device when the daylight cover is used. These exercises are for instructional, practice and qualification purposes. One point is given for each target hit, whether hit on the first or second burst. The total possible points are 11. Conduct of fire is identical to that in Firing Table II, except for target ranges and exposure times. Stoppage criteria from Firing Table II also are used. Firing Table III (table F-3, page F-12) provides ammunition requirements.

SCORING

F-49. Rather than points, the gunner receives only a hit or a miss when they hit the target on the first or second hit. They must hit 6 out of 11 targets to qualify. The gunner must have qualified on both the 10-meter and transition in order to advance to this step. The scorer can record the number of hits on DA Form 85-R. It may be downloaded at Army Knowledge Online (https://www.apd.army.mil).

CONDITIONS

F-50. Firing Table III (table F-3, page F-12) is used for engaging targets out to 400 meters in ideal moonlight or daylight. In the absence of ambient light, commanders may use field-expedient means to identify targets.

Note. When ambient light is too low to engage targets at extended ranges, the commander may lower the ranges by 100 meters.

Table F-3. Firing Table III, all weapons, transition fire, limited visibility

TASK	TIME	ROUNDS		TARGET	RANGE	TYPE FIRE
		QTY	TYPE			
1	No Limit	6	4:1[b]	25-meter zero	10	6 single rounds
2	No Limit	15	4:1[b]	25-meter zero	10	18 single rounds
3	No Limit	28	4:1[b]	Double E	500	28 single rounds
4[a]	10	14	4:1[b]	Single E	200	14 single rounds
5[a]	10	14	4:1[b]	Single E	400	Fixed and area, 5- to 7-round burst
6[a]	10	14	4:1[b]	Single E	100	Fixed, 5- to 7-round burst
7[a]	15	14	4:1[b]	Single E	300	Fixed, 5- to 7-round burst
8[a]	25	28	4:1[b]	Single E Single E	200 400	Fixed, 5- to 7-round burst Fixed, 5- to 7-round burst
9[a]	25	28	4:1[b]	Single E Single E	100 300	Fixed, 5- to 7-round burst Fixed, 5- to 7-round burst
10[a]	30	42	4:1[b]	Single E Single E Single E	100 200 400	Fixed, 5- to 7-round burst Fixed, 5- to 7-round burst Fixed, 5- to 7-round burst

Notes. Unit commander determines position.

[a]Qualification task.

[b]Ball-to-tracer ratio (mix), that is, four ball rounds are loaded for every tracer round loaded.

TARGETS

F-51. Firers use single and double E-type silhouettes.

FIRING POSITION

F-52. For the limited visibility transition firing table, the firers use the tripod, unless the commander directs that they use the bipod.

FIRERS

F-53. Both the gunner and assistant gunner fire the limited visibility transition table.

THERMAL / NIGHT VISION DEVICE ZEROING PROCEDURES

F-54. Use the appropriate TM for installing and zeroing your device.

QUALIFICATION STANDARDS

F-55. Qualification with the M240B machine gun requires the achievement of minimum standards for 10-meter and transition day firing tables (see appendix D). For ammunition allocation refer to DA PAM 350-38.

FIRING TABLE I

F-56. Allow one point for each round that impacts within the scoring space, up to a maximum of seven points for each space. The firer must score between 63 and 91 points to qualify.

FIRING TABLE II

F-57. For each hit, place an "X" in the HIT column. For a miss, place an "O" in the MISS column. Allow 10 points for each target hit, whether the firer hits it with the first or second burst. The firer must score between 70 and 110 points to qualify.

FIRING TABLE III

F-58. For each hit, place an "X" in the HIT column; for each miss, place an "O" in the MISS column. The firer must score between 6 and 11 hits to qualify.

ALL TABLES

F-59. The firer must earn a total (combined) score (all firing tables added together) for each weapon as follows, and as shown in table F-4: The ammunition requirements for all firing tables are shown in table F-5.

Table F-4. Machine gunner ratings

QUALIFICATION	*POINTS*
EXPERT	186-212
GUNNER 1ST CLASS	157 to 185
GUNNER 2ND CLASS	139 to 156
UNQUALIFIED	0 to 126

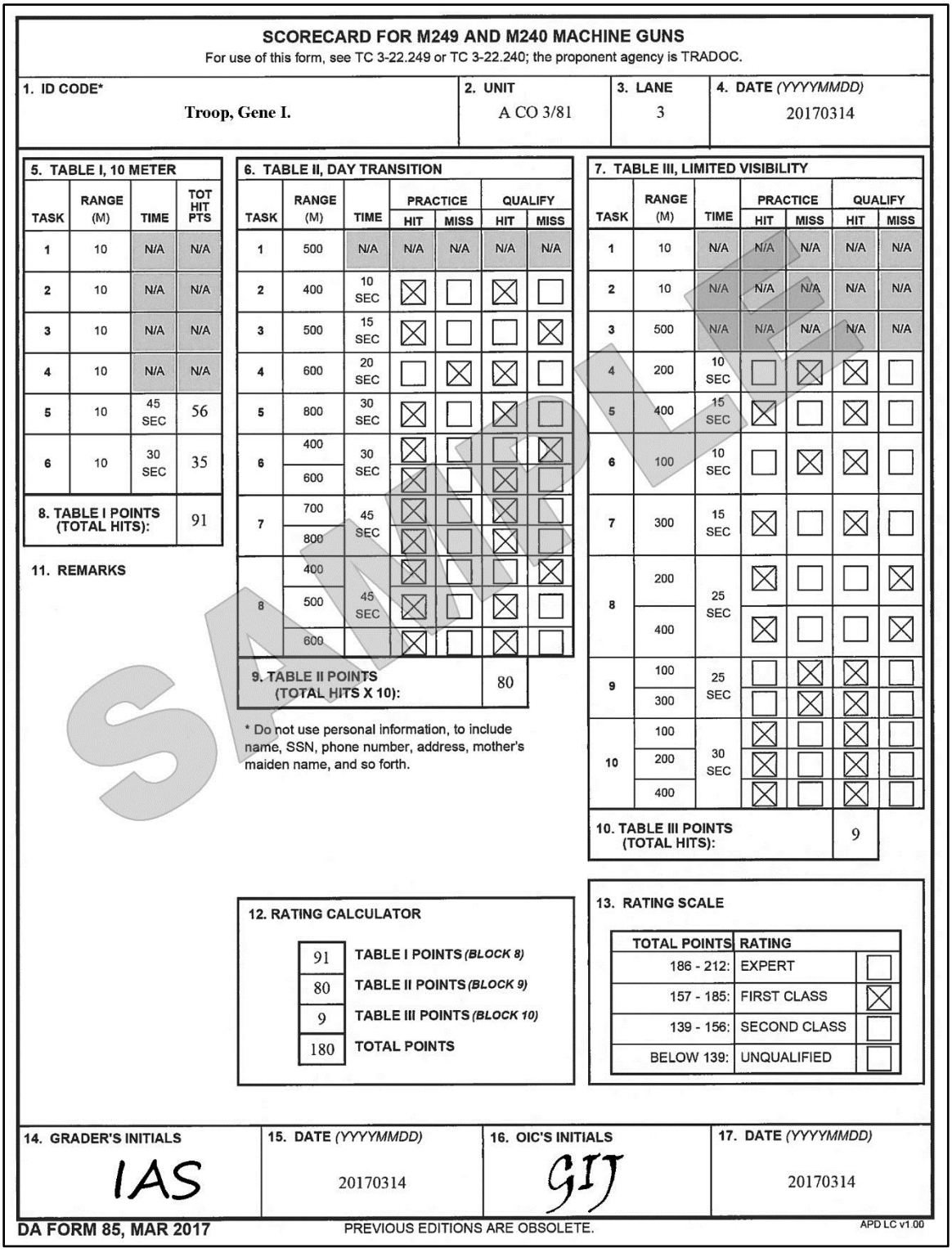
Table F-5. Ammunition requirements, all weapons, machine gun role

FIRING TABLE	*ROUNDS (ALL WEAPONS)*	
	QTY	*TYPE*
Table I, Practice	131	Ball
Table I, Record	91	X4:1
Table II, Practice	182	X4:1
Table II, Record	154	X4:1
Table III, Practice	52	X4:1
Table III, Record	154	X4:1

SCORECARD

F-60. The trainer uses DA Form 85-R to record the gunner's performance on the qualification range. A blank form is provided at the back of this book for reproduction on 8 1/2 by 11 inch paper, or it can be downloaded from the U.S. Army e-forms website, https://www.apd.army.mil. Table F-5 shows ammunition requirements by table. DA Pam 350-38 provides STRAC ammunition requirements. Figure F-3 on page F-14 shows an example completed DA Form 85-R. Complete this form as follows (Blocks 1 through 4, 11, and 14 through 17 are self-explanatory):

- Block 5--Table I, 10 Meter. Task 5 has eight target spaces; Task 6 has five. The firer may impact up to seven rounds per target space, so he can earn 56 points (8 x 7) for Task 5 and 35 points (5 x 7) for Task 6, for a maximum of 91 points for Table I.
- Block 6--Table II, Day Transition. Mark each qualifying hit with an X, whether the firer hits the target on the first or second burst.
- Block 7--Table III, Limited Visibility. Mark each qualifying hit with an X whether the firer hits the target on the first or second burst.
- Block 8--Table I Points. Enter the sum of the points earned in Tasks 5 and 6.
- Block 9--Table II Points. Enter total qualifying hits multiplied by 10.
- Block 10--Table III Points. Enter total qualifying hits (no multiplication factor).
- Block 12. Enter the total from each table, and then add them to obtain TOTAL POINTS.
- Block 13. Using the TOTAL POINTS in Block 12, determine the firer's RATING.



SCORECARD FOR M249 AND M240 MACHINE GUNS

For use of this form, see TC 3-22.249 or TC 3-22.240; the proponent agency is TRADOC.

1. ID CODE*	2. UNIT	3. LANE	4. DATE (YYYYMMDD)
Troop, Gene I.	A CO 3/81	3	20170314

5. TABLE I, 10 METER

TASK	RANGE (M)	TIME	TOT HIT PTS
1	10	N/A	N/A
2	10	N/A	N/A
3	10	N/A	N/A
4	10	N/A	N/A
5	10	45 SEC	56
6	10	30 SEC	35

8. TABLE I POINTS (TOTAL HITS): 91

6. TABLE II, DAY TRANSITION

TASK	RANGE (M)	TIME	PRACTICE HIT	PRACTICE MISS	QUALIFY HIT	QUALIFY MISS
1	500	N/A	N/A	N/A	N/A	N/A
2	400	10 SEC	X		X	
3	500	15 SEC	X			X
4	600	20 SEC		X	X	
5	800	30 SEC	X		X	
6	400	30 SEC	X			X
	600		X		X	
7	700	45 SEC	X		X	
	800		X		X	
8	400	45 SEC	X			X
	500		X		X	
	600		X		X	

9. TABLE II POINTS (TOTAL HITS X 10): 80

7. TABLE III, LIMITED VISIBILITY

TASK	RANGE (M)	TIME	PRACTICE HIT	PRACTICE MISS	QUALIFY HIT	QUALIFY MISS
1	10	N/A	N/A	N/A	N/A	N/A
2	10	N/A	N/A	N/A	N/A	N/A
3	500	N/A	N/A	N/A	N/A	N/A
4	200	10 SEC		X	X	
5	400	15 SEC	X		X	
6	100	10 SEC		X	X	
7	300	15 SEC	X		X	
8	200	25 SEC	X			X
	400		X			X
9	100	25 SEC		X	X	
	300			X	X	
10	100	30 SEC	X		X	
	200		X		X	
	400		X		X	

10. TABLE III POINTS (TOTAL HITS): 9

11. REMARKS

* Do not use personal information, to include name, SSN, phone number, address, mother's maiden name, and so forth.

12. RATING CALCULATOR

91	TABLE I POINTS *(BLOCK 8)*
80	TABLE II POINTS *(BLOCK 9)*
9	TABLE III POINTS *(BLOCK 10)*
180	TOTAL POINTS

13. RATING SCALE

TOTAL POINTS	RATING	
186 - 212:	EXPERT	
157 - 185:	FIRST CLASS	X
139 - 156:	SECOND CLASS	
BELOW 139:	UNQUALIFIED	

14. GRADER'S INITIALS	15. DATE (YYYYMMDD)	16. OIC'S INITIALS	17. DATE (YYYYMMDD)
IAS	20170314	GIJ	20170314

DA FORM 85, MAR 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.00

SAMPLE

Figure F-3. Example completed DA Form 85-R

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 TC 3-22.XX is the 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
CoVM	center of visible mass
DBAL-A2	dual beam aiming laser-advanced2
FOV	field of view
I2	image intensifier
IR	infrared
LCD	liquid crystal display
LOS	line of sight
METT-TC	mission, enemy, terrain and weather, troops and support-time available, and civil considerations
MOA	minute of angle
NATO	North Atlantic Treaty Organization
NSN	national stock number
SOP	standard operating procedure
TC	training circular
TM	technical manual
TWS	thermal weapon sight

SECTION II – TERMS

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TC 3-22.240

28 April 2017

By Order of the Secretary of the Army:

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General, United States Army
Chief of Staff

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