



# M32A1

A GRENADIER PRIMER

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AUGUST 2023



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**M32A1: A Grenadier Primer** would not be possible without the insight and advice of the Marines listed below. Their guidance is the result of hard-won experience in battle and in years of dedicated study:

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 Major Zachary Schwartz, USMC  
 Gunnery Sergeant Robert Selapak, USMC  
 CWO Ryan Snell, Australian Army  
 Gunnery Sergeant Anthony Stea, USMC  
 Gunnery Sergeant Jake Turner, USMC

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*“Private Henry O. Nation for meritorious conduct during an engagement with armed bandits at Santa Rosa, Nicaragua, on January 20, 1929...Private Nation, as a rifle Grenadier, held an advance position and delivered grenades on the enemy machine gun nests. Wounded and weak from the loss of blood, he continued firing until the enemy was in retreat and then pursued him with rifle fire. Private Nation refused to be carried to San Albino and walked over four miles before he could be placed upon a mule for the hospital...”*

— Navy Cross Citation, Private Henry O. Nation, USMC 1929

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**M32A1: A Grenadier Primer**

August, 2023

The Infantry Working Group

[www.infantryworkinggroup.org](http://www.infantryworkinggroup.org)

Grayson Lee, Sean O'Neill and Chad Skaggs

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## Scope

This manual focuses on the M32A1 Grenadier and small-scale techniques for efficient employment.

Direct fire techniques and employment—rifles, rockets, and machine guns—are out of scope.

Supporting arms are out of scope. Fire support plans and fire support planning are out of scope.

M320 Grenadier techniques are out of scope. Supporting relationships between M320 Grenadiers and M32A1 Grenadiers are out of scope and covered in a separate manual.

M32A1 Grenadier firing techniques are in scope.

Characteristics, features, and types of 40mm fire are in scope. 'Theory of 40mm fire'—absent in our manuals—is necessary for efficient employment.

# Characteristics of 40mm Fire

Characteristics of 40mm fire inform employment techniques. Leaders understand characteristics to employ Grenadiers. Grenadiers apply characteristics with firing procedures to accomplish their task.

## 40mm Grenade fire is...

*low-angle, direct fire with a plunging fall of shot in an impact zone. It is used against enemy positions in cover. Multiple ammunition options suppress, illuminate, signal, and obscure.*

### Slow rate

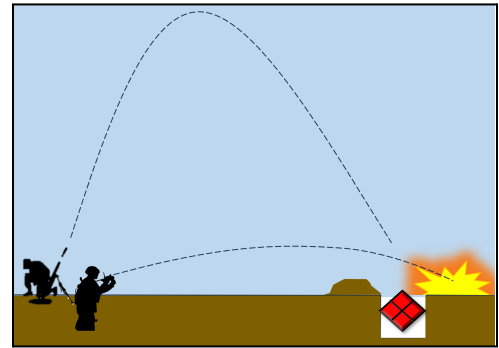
40mm fire is characterized by its slow rate of fire, relative to other infantry weapons.

### Low Angle

40mm grenade fire is low-angle. Though the maximum ordinate increases at longer ranges, 40mm grenade fire is not 'high angle' like infantry mortars.

### Area effect

40mm grenade launchers are not true 'indirect fire' weapons. Its effects behind cover at short range are due mostly to the explosive hazard of the grenade, relative to the enemy, driven by the marksmanship of the grenadier.



*40mm grenade launchers are not high-angle indirect fire weapons.*

### Plunging fall of shot

Gravity's effect on the round, combined with slow muzzle velocity, causes 40mm grenades to plunge. 40mm grenades have little danger space; there is no grazing fire. At closer ranges, gravity has less effect on trajectory—40mm grenades are more direct fire. The effect of gravity at longer ranges—increasing the plunging fall of shot—allows better effects on enemy positions in cover. See [Where to shoot](#).

### Impact Zone

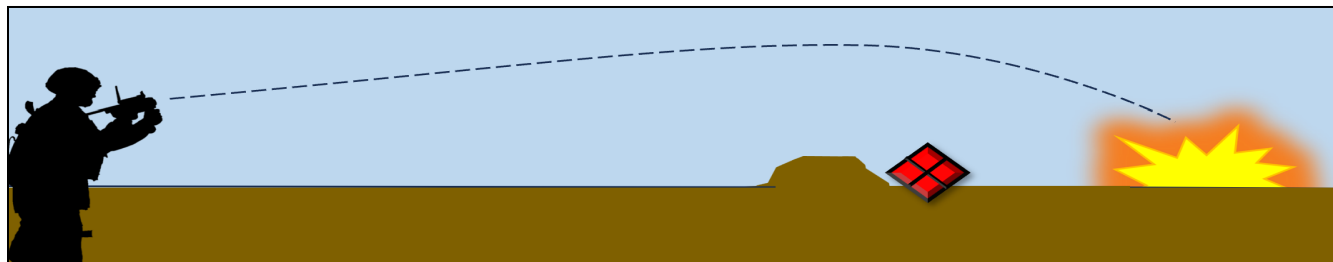
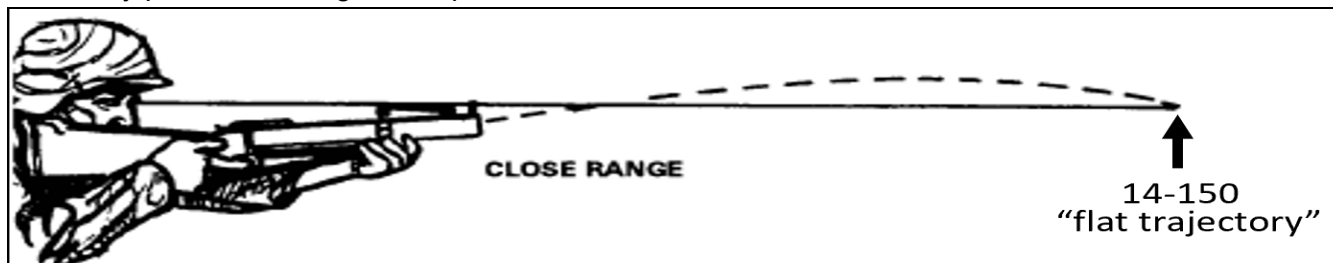
The Grenadier creates an 'impact zone' of area effects with a probability of error relative to their proficiency, training and weapon zero. Grenade launchers have no beaten zone, no cone of fire.



## Ranges

### Close range

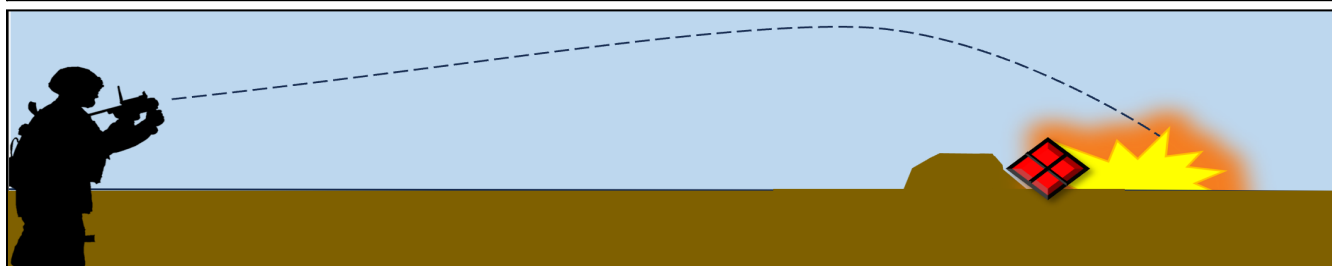
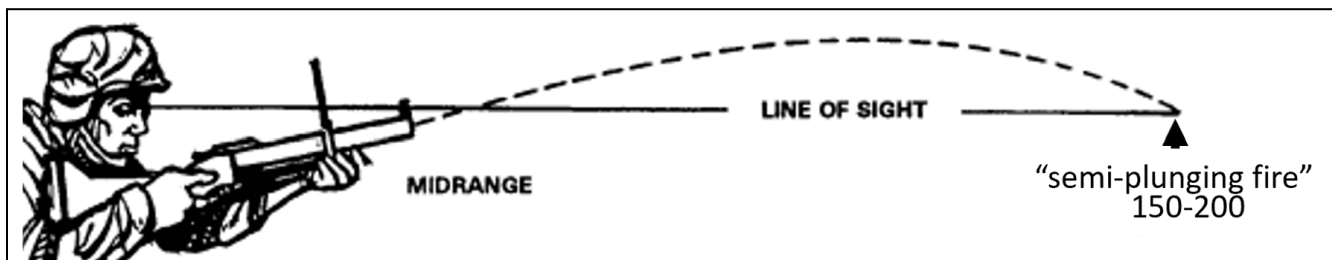
At ranges under 150 meters, 40mm grenade fire is relatively flat and plunging fire is limited. Proximity of the enemy position to the grenade provides effects.



*At close range, the low-angle trajectory typically overshoots targets behind cover. Proximity of the enemy position to the grenade's blast provides effects. USE 40mm grenades at close range in direct-fire role.*

### Midrange

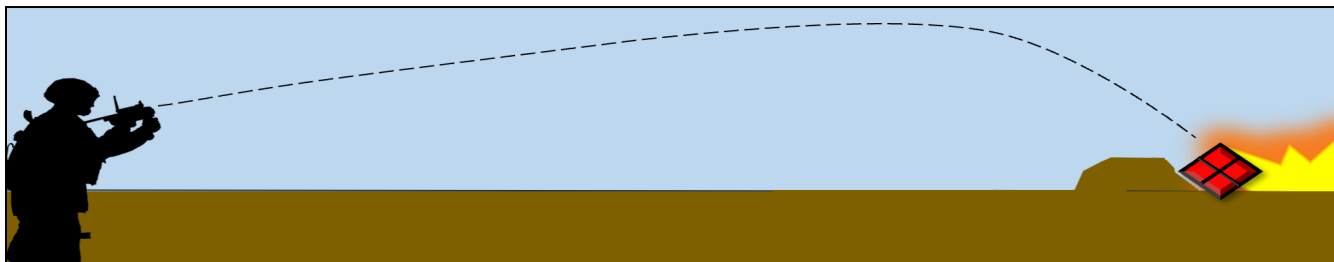
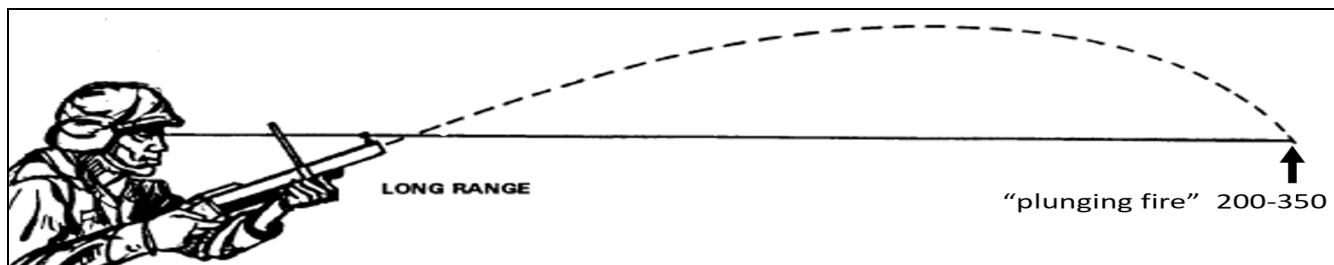
From 150-200 meters, 40mm grenades plunge with a steep enough angle to affect enemy positions in cover.



*At mid-range, 40mm grenades affect enemy positions behind cover. Depending on the impact zone, 40mm grenades may affect some enemy positions in defilade.*

### Long Range

From 200-350 meters, 40mm grenades plunge steep enough to affect enemy positions behind cover, and in dead space. *The greater the range, the greater the fall of shot, and the greater the plunging fire.*



## Types of 40mm Fire

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### Volume

#### Immediate

M32A1 Grenadiers provide fire rapidly on order, on target. Grenadiers respond to all calls for immediate fires from their unit. M32A1 Grenadiers deliver the *most* fire on enemy positions as *quickly* as possible.

#### Duration

M32A1 Grenadiers provide fires over a duration of time. For example, an M32A1 Grenadier may fire one round every twenty seconds before reloading.

### Assignment

Assignment centers on the value provided to the friendly unit. They are agnostic of ammunition type. In offense and defense, assign M32A1 Grenadiers provide two ways:

#### Suppress

A Grenadier's most important function. As squad artillery, they respond to the unit's needs.

Suppression is only as important as the action it supports: forward movement or breaking contact. The time gained from suppression is impossible to quantify—likely a lot shorter than we hope. Do **not** assume the enemy will react as we expect him too.

**suppressive fire**—Fires on or about a weapons system to degrade its performance below the level needed to fulfill its mission objectives, during the conduct of the fire mission.

— *Marine Corps Supplement to the DOD Dictionary of Military and Associated Terms*

### Supplement

Grenadiers supplement other Marines' direct fire. Supplemental fire aids the mission but is not a mission in itself. It is **not** confused with the *support by fire*. Grenadiers respond to other unit's requests.

Targets of opportunity are supplemental. Grenadiers shoot at targets of opportunity in accordance with target precedence and engagement criteria.

Illumination is supplemental.

Signals are supplemental. Signals designate enemy positions or friendly actions. Coupled with a strong unit leader and SOP, signals designate squad sectors, aid the platoon commander in distributing fires, or help units mass fire.

## **Distribution**

Grenadiers use three types of fire:

### **Sheaf**

Grenadiers chose a 40mm spread appropriate to the target description. Grenadiers fire sheafs appropriate to the target. Sheafs create effects economically. Sheafs use casualty-producing measurements.

### **Search**

Grenadiers search a target's axis.

### **Point**

Grenadiers deliver fire on to one target. Many manuals describe 'point fire' in many ways. For the purposes of 40mm fire, *point fire* refers to 40mm effects within acceptable grenade ECR.

## How to Fire a 40mm Sheaf with an M32A1

The M32A1 traverses a target with 40mm grenade fire. The mil-reticle optic, combined with its six round capacity, allow a **well-trained grenadier** to fire 40mm grenades in a predictable pattern. Use Grenadier techniques to suppress enemy positions with width, like a trench.

For example:

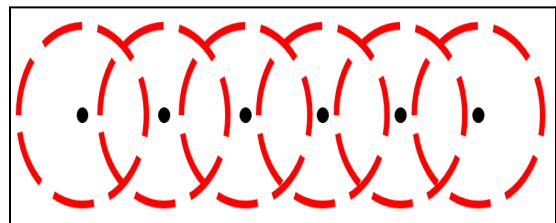
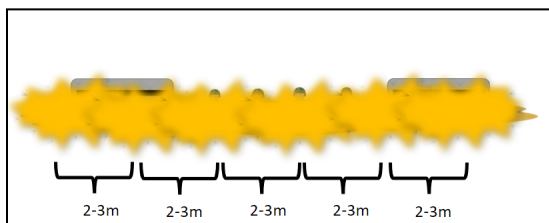
- For infantry units in ambush, an appropriate sheaf affects the length of an enemy column.
- For infantry units in the assault, grenadiers supporting-by-fire shift 40mm sheaf away from the assault element as it closes within hand grenade range.
- In the defense, an appropriate spread complements final protective fires and final protective lines. Squads *plan* and *register* 40mm grenade fire.

The examples below depict an enemy trench. This generic example demonstrates the technique.

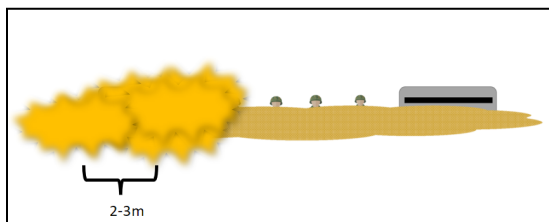
### M32A1 Sheafs

All 40mm sheafs support the assault or the defensive fire plan. Match the sheaf to target composition.

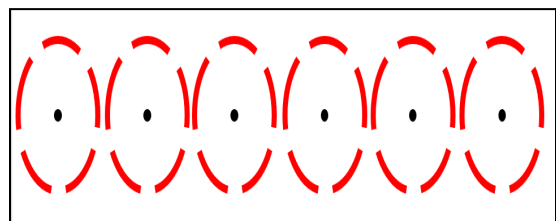
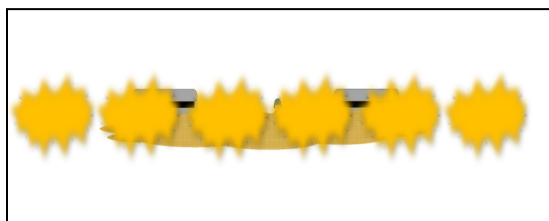
**Standard Sheaf** overlaps the ECR of the 40mm grenade. An M32A1 grenadier covers approximately 15 meters with a standard sheaf.



**Converged Sheaf** concentrates the ECR of 40mm grenades. An M32A1 grenadier covers approximately 5 meters with a converged sheaf.



**Open sheaf** spreads 40mm grenades to the maximum ECR. An M32A1 grenadier covers approximately 30 meters with an open spread.



## Procedure for M32A1 Sheaf

M32 grenadiers fire a lateral spread in five steps. The example below demonstrates an *open* spread.

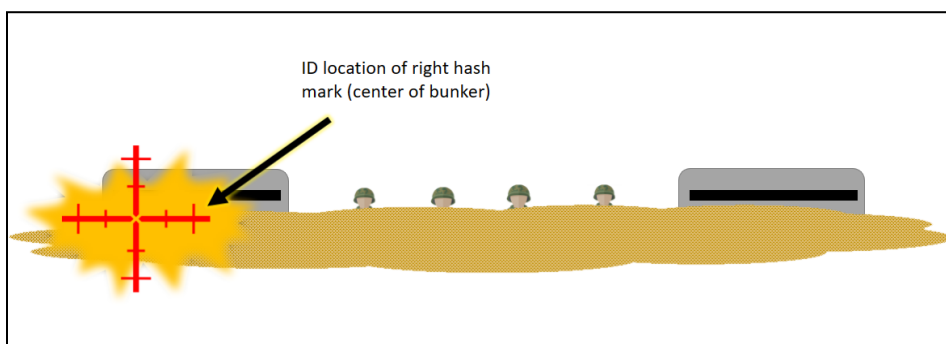
1. Establish range to target.  
Use the mil reticle, range finder or range estimation techniques to establish range to target.  
The M2A1 Optic's constant is 1 stadia line equals 1 meter at 100 meters.

2. Determine aim point and hold.  
Use the center of the optic as the aim point.

Determine the mi-reticle hold. The mil-reticle hold adjusts subsequent impacts for the desired spread. Range-to-target and desired spread determine the mil-reticle hold for predictive fire.

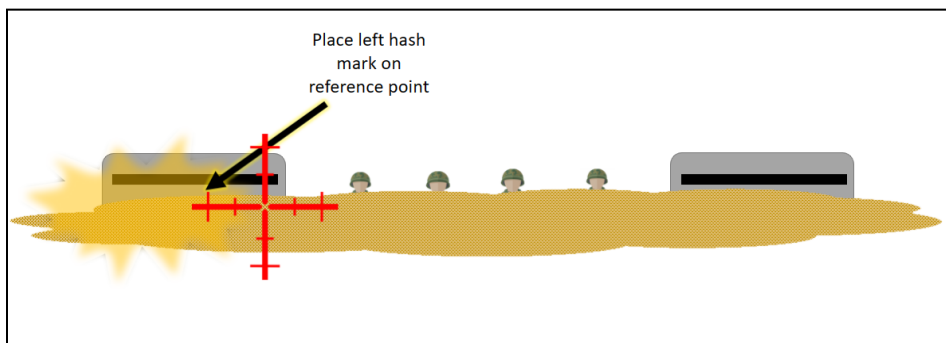
**Use mil-reticle values found in [M32A1 Ranging Estimation](#).**

3. Fire and reference.  
Using the mil-reticle, identify the appropriate reference point. **WATCH** the fall of shot.



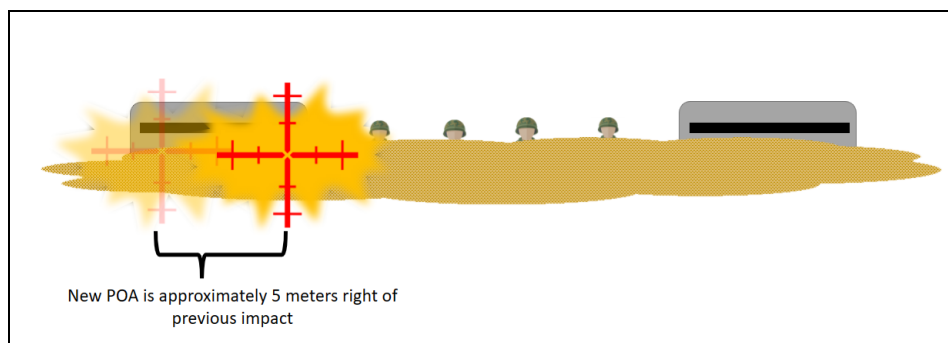
**“Center, Fire.”**

4. Move Hold.  
Acquire the reference point as the new point of aim. AIM from previous impact.

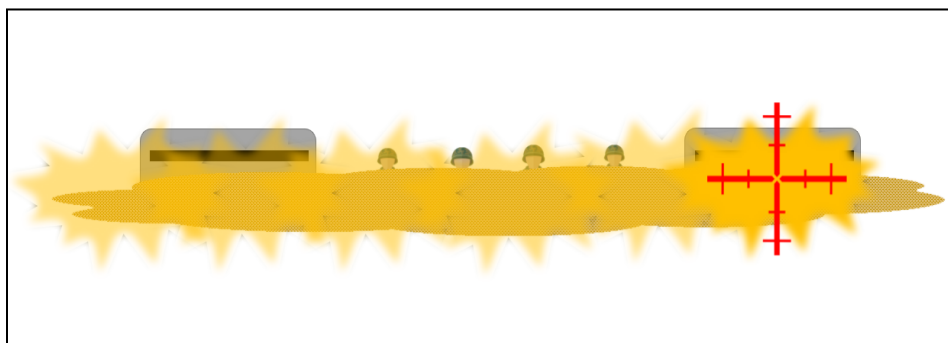


**“Move hold.”**

5. Continue until the effect of the spread is achieved. Use the ditty, “Center-fire. Move-hold.”



“Center, Fire.”



## Standards

**Train** M32A1 Grenadiers to traverse a target in ninety seconds. **Train** M320 grenadiers to cover an M32A1 Grenadier while they reload. *Mass effects*, not *units*. Through manipulation of the optic's range mechanism, M32A1 Grenadiers provide searching fire in a similar manner to a sheaf.

## Range Estimation with the M2A1 Sight

Grenadiers *must* estimate range when the unit leader is not in position to pass a target range, or when a leader's ADDRAC omits *range*.

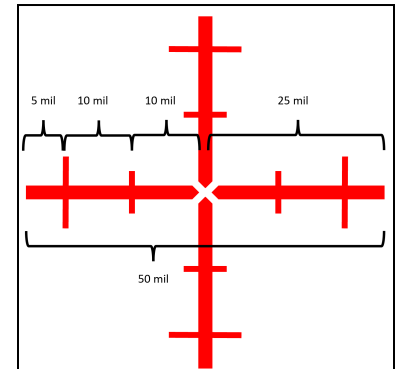
Grenadiers need two things to estimate range: Average measurements and ranging constants.

### Mil-Reticule Pattern

The M2A1 optic is an unmagnified, illuminated optic with a 10-mil reticle pattern.

The thick crosshair bars are 25 mils across and 25 mils high. Stadia lines are 10 mils apart. There is an additional 5-mil distance at the end of each horizontal and vertical crosshairs.

Each crosshair quadrant measures 25 mils. Each vertical or horizontal crosshair measures 50 mils.



### Average Measurements

The average height of a man is just under 2 meters.

The approximate length of a light military utility or reconnaissance vehicle is 6 meters. The approximate width is 2 meters.

Grenadiers need standard reference cards for averages to better range estimate. A reference card may include averages for all types of combat vehicles, doors, and windows.

### Apply the mil-reticle value to a 40mm lateral spread

Grenadiers must know mil-reticle values at different ranges in order to fire a lateral spread appropriate to the target.

Use the examples below, to determine the mil-hold for a *standard*, *open* or *converged* lateral spread. See [M32 Lateral Sheaf](#).

*“The Marine version, designated the M32, was fitted with Picatinny rails and an M2A1 reflex sight with an infrared capability and powered by an AAA battery. The sight allows for rapid range and elevation adjustments, compensates for the projectile’s right-hand drift, and is compatible with night-vision goggles.*

*“The M32s were delivered in October 2005 and underwent extensive, but rushed testing to include combat trials in Iraq beginning in March 2006. It is said that the US Marine Corps contracting officer bestowed the designation ‘M32’ as his unit had been 3d Battalion, 2d Marines.”*

— Gordon L. Rottman *U.S. Grenade Launchers M79, M203 and M320*



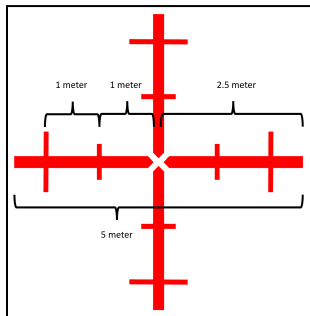
## M2A1 Ranging Constants

To estimate range use constants to measure the unknown range of a target.

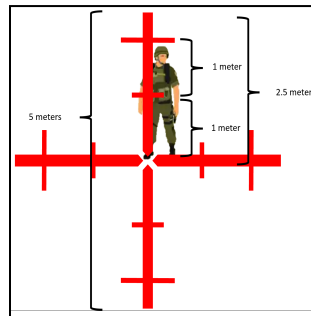
### 100 meter mil-reticle constant

1 stadia line = 1 meter at 100 meters

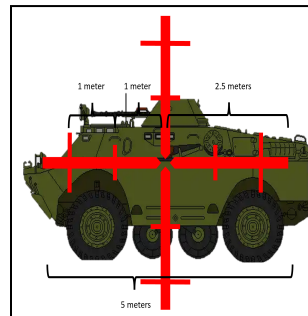
The crosshair quadrant measures 2.5 meters. Vertical and horizontal crosshairs measure 5 meters.



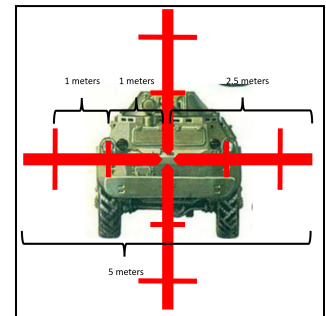
100 meter measurements



At 100 meters, the average man fits within two stadia lines



At 100 meters, the average light vehicle flank spills just outside the crosshairs.

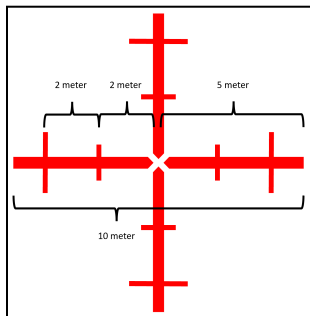


At 100 meters, the front of an average light vehicle fits roughly between two stadia lines.

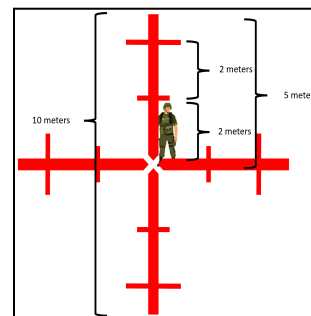
### 200 meter mil-reticle constant

1 stadia line = 2 meters at 200 meters

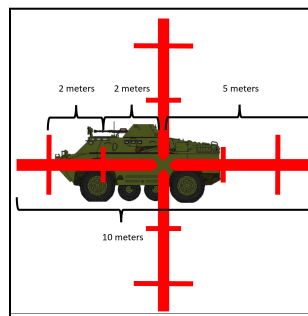
The crosshair quadrant measures 5 meters. Vertical and horizontal crosshairs measure 10 meters.



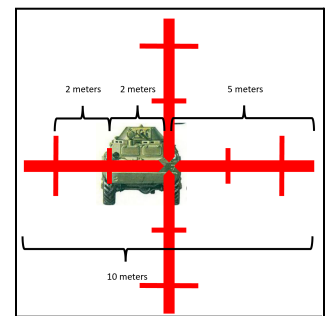
200 meter measurements.



At 200 meters, the average man fits within one stadia line.



At 200 meters, the average light vehicle flank fits inside three stadia lines.

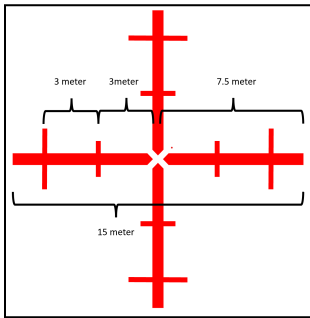


At 200 meters, the average front of a light vehicle fits within one stadia line.

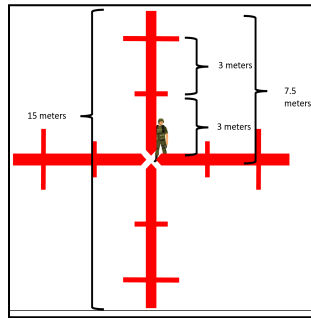
**300 meter mil-reticle constant**

1 stadia line = 3 meters at 300 meters

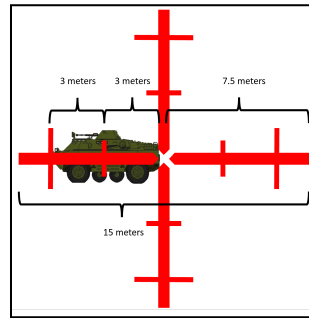
The crosshair quadrant measures 7.5 meters. Vertical and horizontal crosshairs measure 15 meters.



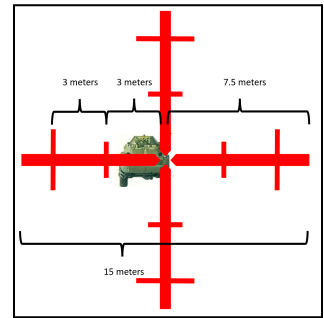
*300 meter measurements.*



*At 300 meters, the average man fits within one-half of a stadia line.*



*At 300 meters, the average light vehicle flank fits inside two stadia lines.*

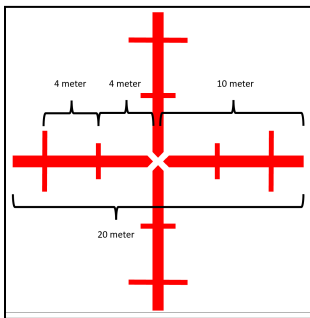


*At 300 meters, the average front of a light vehicle is just short of one stadia line.*

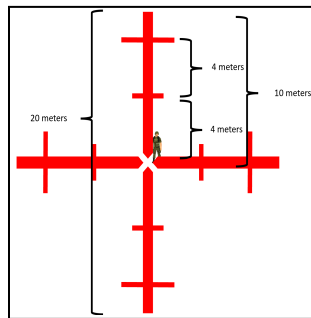
**400 meter mil-reticle constant**

1 stadia line = 4 meters at 400 meters

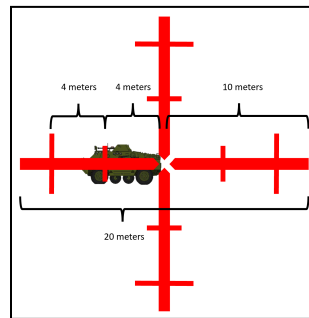
The crosshair quadrant measures 10 meters. Vertical and horizontal crosshairs measure 20 meters.



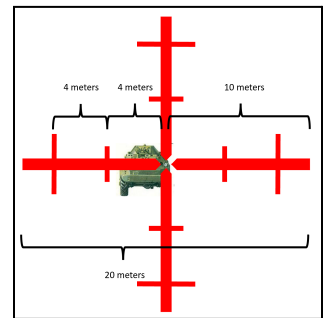
*400 meter measurements.*



*At 400 meters, the average man fits within one quarter of a stadia line.*



*At 400 meters, the average light vehicle flank fits one and a half stadia lines.*



*At 400 meters, the average light vehicle front fits within one half of a stadia line.*

## The M2A1 Sight on the M32A1 Grenade Launcher

Grenadiers need techniques to achieve the best possible effects. For better effects from 40mm grenades, use the M32A1's mil-reticle optic. Grenadiers need techniques not covered in manuals:

- Grenadiers adjust range, in the dark without light. They feel and hear for “clicks” and “clunks” when making range adjustments to the M2A1 sight.
- NVGs are not refocused to a narrow focal plane at night—manipulating NVGs while trying to adjust fire is time consuming. More time is spent fiddling with gear, than using gear.
- Grenadiers are trained to manipulate the M2A1 sight using free, large, and small adjustment techniques.

*“Range adjustment can be quickly achieved in 25 meter elevation increments using the indexed range plates.”*

— *Operator's Manual for 40mm Multi-shot Grenade Launcher Milkor, USA*

### Construct of the Mechanism

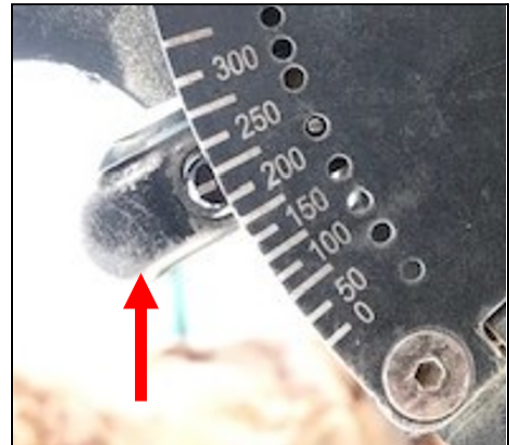
The M2A1 sight on the M32A1 is designed to quickly adjust for range, day or night.

The M2A1 has identical range plates on each side. The range plates are graduated in 25 meter increments from 0 through 375 meters. Range adjustments are made by pressing catch levers located on the range plates.

The sight is adjustable freely, in 50-meter or 25-meter increments.



*Range plate viewed from the right side.*



*Catch levers move the ranging mechanism.*

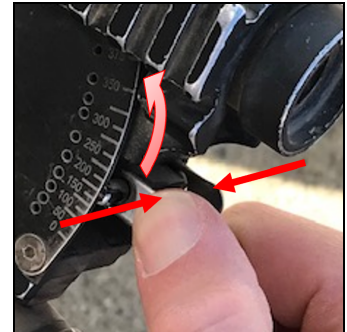
## Manipulation of the Range Mechanism

M32A1 Grenadiers make three different range adjustments: free, large, or small range adjustments. Large and small range adjustments can be made *day or night*.

### Free

Free adjustments are made when a new target and range is announced. In general, they apply to range corrections of more than 100 meters. Free adjustments can not be made at night without light. They may be made with adjustments to the focal plane of night vision.

Free adjustments are made by simultaneously squeezing the two catch levers inboard, and moving the mechanism to the appropriate range.



### Large Adjustments

Make large adjustments when a new target is less than 100 meters from initial range setting. Make large adjustments when bold corrections of 100 meters or less are needed. Large adjustments can be made, day or night by feel and sound. They do not require observing the range mechanism—no lights, no NVGs.

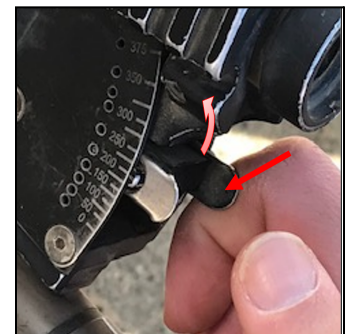
Make large corrections by simultaneously squeezing the two catch levers inboard, and moving the mechanism up or down until it catches, stops and “clicks.” In daylight, this can be seen by the “50-meter holes” on the range plates. With both catch levers pressed, each “clunk” is a 50-meter adjustment.



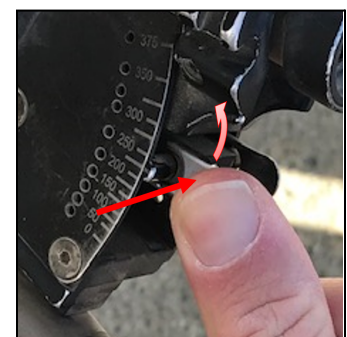
### Small—'marching corrections'

Make small adjustments when you need adjustments to a target range. Small adjustments are made in 25 meter increments. Small adjustments are made, day and night, by feel and sound. They do not require observing the ranging mechanisms—no lights, no NVGs.

Make small corrections by pushing in one catch lever (for example, the left catch lever) and applying a slight upward pressure until it catches, stops and “clunks.” That is a 25 meter adjustment.



To continue, push in the opposite catch lever (for example, the right catch lever) and apply slight upward pressure until it catches, stops and “clunks.” Repeat this pattern (“marching corrections”) as necessary. To drop range, apply the same technique with slightly downward pressure, alternating left and right.



**Other**

For range corrections less than 25 meters, Grenadiers establish a point of aim with the M2A1 sight's mil-reticle. Grenadiers use mil-reticle values based on range to target. See [M32 Range Estimation with M2A1 sight](#).

**Notes for Grenadiers**

When appropriate to the target, use the small-adjustment technique to provide searching fire.

**Listen Up!** If you make a series of small (“marching”) adjustments, then press both catch levers inboard to make a large adjustment, the “marching” pattern doesn’t repeat. That is, if you make small adjustments and end with the right catch lever, then make a large adjustment, the next small correction will not start with the left catch lever. In fact, there is no identifiable pattern. If you make small adjustments after a large adjustment, one of the catch levers may not work: just use the other one.

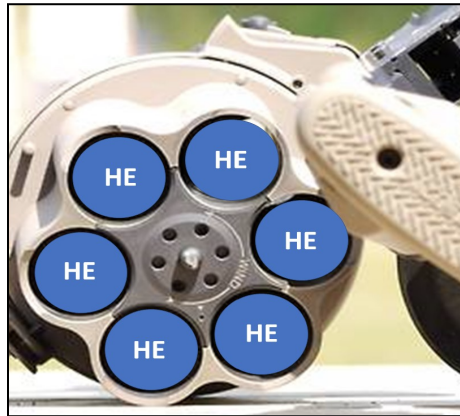
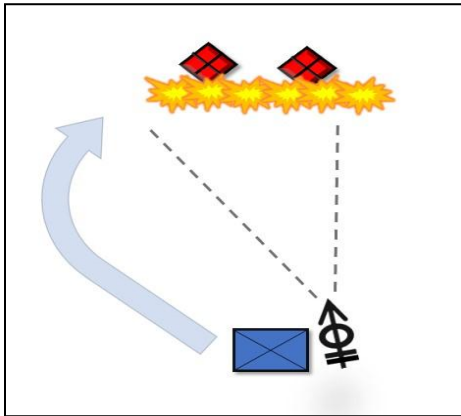
Train initial range. Before an action, or after an engagement, *reset the M2A1 range to a standard*. This allows you to apply corrections without looking at the sight. The recommended initial range is 200 meters—about half the maximum effective range.

M32A1 Grenadier Procedures

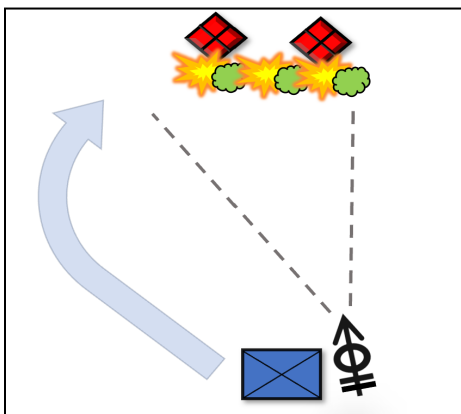
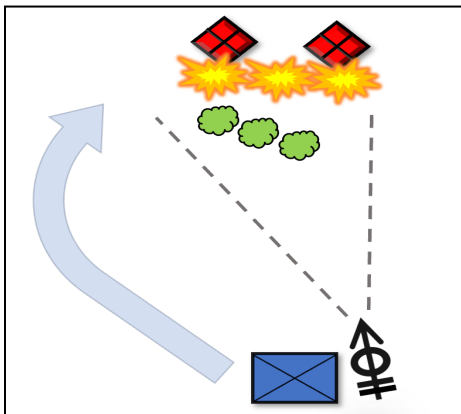
## Ammunition Loads

Base initial ammunition load on expected engagements and enemy assessment.

Suppress. To suppress an enemy position, fire (6) HE rounds as a sheaf.

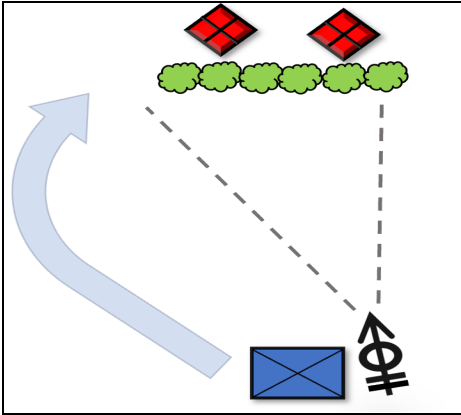


Obscure and suppress. Mix (3) smoke and (3) HE. Below are some examples.

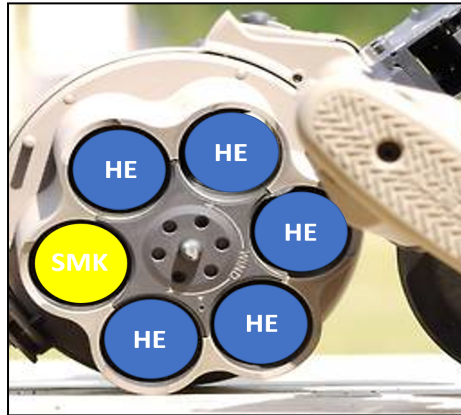
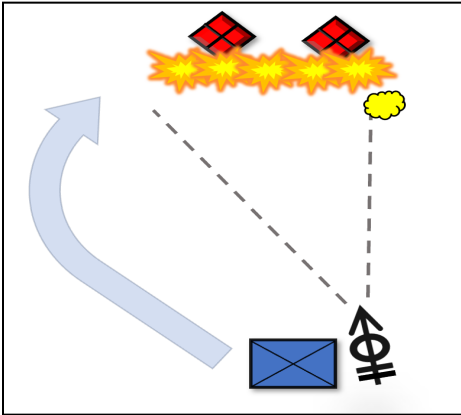




Obscure. Use smoke to obscure an enemy position from friendly actions.



Signal. Do not use similar ammunition as used for obscuring. For example, if you use smoke to obscure, use illumination on deck to signal. If using illumination on deck to obscure, use colored smoke to signal.



To maintain 40mm fire, M32A1 Grenadiers signal other Grenadiers that they are reloading. M320 Grenadiers cover the M32A1 Grenadier reloads. M32A1 loads include a signaling marker as the last round.

# Where to Shoot

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Grenadiers assess the target to determine where to shoot.

## Target Composition

Grenadiers consider the size of the target relative to the area effects 40mm can achieve. Sometimes a grenadier may choose to engage a single component as part of a larger target to achieve an effect.

- Material. What is the protection? Example: concrete, sandbags, dry wall.
- Disposition. Where is the protection? Example: front, flank, and overhead.
- Vulnerabilities. Where to shoot. Example: walls, windows, ceilings, flanks, firing ports.

## Degree of Protection

The primary consideration when determining point of impact is a target's degree of protection.

Categories of protection are generally descriptive. Degrees of protection are:

- Limited. Enemy positions are poor or their construction materials are of poor quality. May include hasty fighting positions, temporarily occupied urban positions, or rubble.
- Moderate. Enemy positions are developed. May include fighting positions, overhead protection, sand bags or semi-permanent material such as thick mud walls or concrete blocks.
- Excellent. Enemy positions are developed. They include extensive engineering and overhead protection.



*Examples of degrees of protection from the Russo-Ukrainian war.  
Left: limited protection. Center: Moderate protection. Right: excellent protection.*

Shoot at firing ports and surrounding surfaces such as walls, ceilings or exposed flanks. Shoot at surrounding surfaces of enemy positions without cover.



## Trajectory

At close range, Grenadiers shoot at firing ports and apertures. Due to the low-angle trajectory of the grenade, *range to target* is the limiting factor in firing. See [Characteristics of 40mm fire](#).

At mid- and long-range, Grenadiers' shoot at enemy positions behind cover and in dead space, but not in defilade. Shoot enemy positions in defilade from the flanks.

## Determine Point of Impact

Grenadiers use *direct* or *offset* points of impact to overcome the limitations of target composition, protection and trajectory.

### Direct Point of Impact

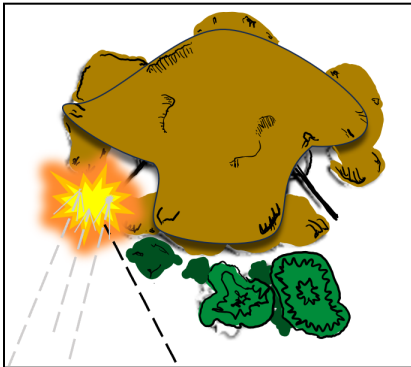
The greatest effects are achieved by 40mm impacting directly on or at firing apertures.

Use a direct point of impact when:

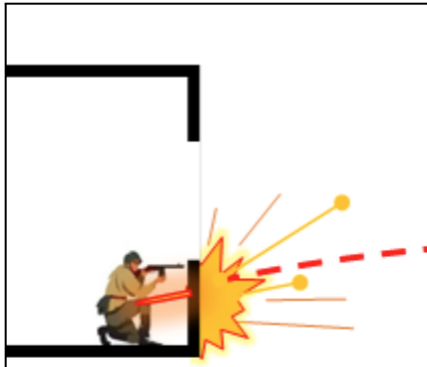
- enemy positions have excellent protection—especially overhead cover. Because of the 40mm grenade's area effect, targeting firing apertures may be the only way to suppress a position.
- Enemy positions with limited protection. Concentration of six rounds of HE from the M32 may reduce these positions.

Do **not** use direct points of impact when:

- An offset point of impact can better achieve the desired effect.



*Positions with excellent protection. Shoot at firing ports and apertures.*



*Positions with limited protection. Shoot to destroy protection.*

## Offset Points of Impact

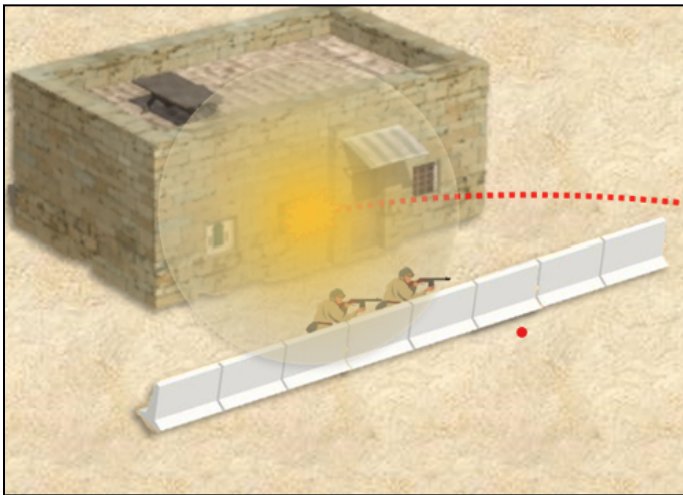
Offset points of impact target suitable exposed surfaces when enemy positions are within its ECR. Suitable surfaces are not penetrated and direct blast or fragmentation effects toward the enemy.

Use offset points of impact when:

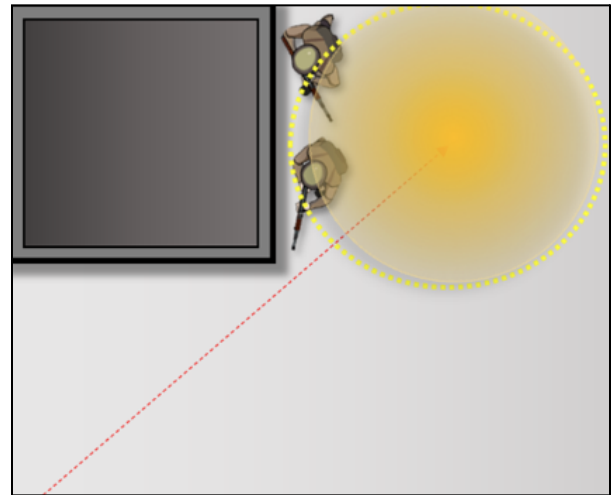
- Attacking targets behind cover that cannot be reduced or penetrated by 40mm.
- Maximizing the area effect of 40mm inside an enclosure.
- Seeking to create a combined arms dilemma

Do not use offset points of impact when:

- The point of impact is beyond ECR (5m) of the intended target
- Targeting armored vehicles
- There is a suitable direct point of impact



*Offset points of impact allow grenadiers to engage targets in cover. Use surfaces to detonate rounds within ECR of an enemy position.*



*Offset point of impact is particularly useful in urban terrain. Grenadiers shoot at targets near corners within the ECR of the round with an offset point of impact.*

# The M32A1 in Immediate Action

During immediate actions, M32A1 Grenadiers gain fire superiority to maneuver or break contact. There are multiple techniques for the M32A1 Grenadier.

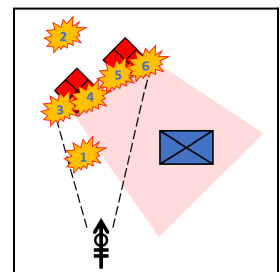
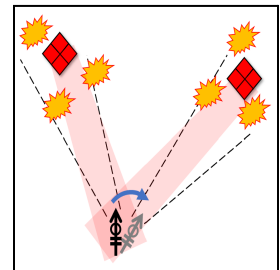
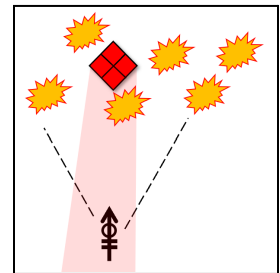
## Key Concept: Fire Superiority

Units gain fire superiority and exploit opportunities. They do **not** allow the enemy to regain advantage. The M32's round capacity and multi-shell combinations are key to fire superiority for the platoon and squad.

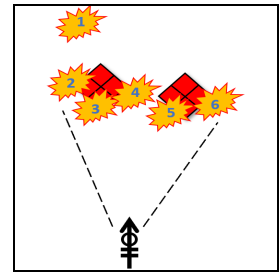
### Suppress

M32 Grenadiers suppress the enemy immediately.

1. Six rounds, immediate suppression, high-explosive.
  - Effectiveness is not guaranteed. Errors in range estimation occur.
  - No adjustment. M32 Grenadiers don't adjust rounds for 'did hit' final range.
  - Violent. When accurate, a six-round 'fire for effect' buys the unit time and advantage.
  
2. Two, three-round immediate suppression, high-explosive.
  - Enemy positions laterally separated greater than open-sheaf coverage.
  - No adjustment. M32 Grenadiers don't adjust rounds for 'did hit' final range.
  - By *indexing* rounds, a three-round immediate suppression is fired from an initial ammunition load of HE/smoke.
  - Useful on one or two enemy positions.
  
3. Two adjustment rounds, four-round immediate suppression, high-explosive.
  - Allows M32 Grenadier the ability to adjust on a target.
  - Preferable if the M32 Grenadier is outside any immediate kill zone.
  - Greater guarantee of accuracy on an enemy position.



4. One adjustment round, five-round immediate suppression, high-explosive.
  - One adjustment round is a better guarantee of accuracy on an enemy position.
  - Preserves the majority of 40mm grenades for immediate suppression.



*"I had been carrying an M32 grenade launcher for two months simply because I wanted to use it in a firefight. Imagine the world's most powerful revolver as a six-shot, rotary-magazine, 40mm weapon. Now I had my chance. It seemed like the thing to do since I still expected to die recrossing the field. As the corpsman worked on the wounded Marine, I started slinging grenades. With 40mm explosions not to their liking, Taliban fire slackened to an acceptable level. The corpsman pronounced the combat engineer ready to move and we headed back across the field..."*

— Major Tom Schueman, USMC And Zainullah Zaki, *The Golf Course*

### Obscure

M32 Grenadiers obscure enemy positions. Obscuring enemy positions:

- Limits enemy observation, especially when breaking contact.
- Limits enemy observation of a unit when reacting to contact.

There are two techniques:

1. Smoke
  - 'Mixed loads' provide options without reloading. See [Ammunition Loads](#).
2. Illumination
  - Illumination on the deck obscures night vision and thermal optics.
  - Illumination on the deck starts fires. Smoke from fires may be greater and more effective than the obscuration from 40mm smoke grenades.

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