TC 3-22.91

MORTAR FIRE DIRECTION PROCEDURES

AUGUST 2025

INCORPORATING CHANGE 1, MARCH 2026

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This publication supersedes TC 3-22.91, dated 15 May 2017.

HEADQUARTERS, DEPARTMENT OF THE ARMY

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Change 1
Training Circular
No. 3-22.91

Headquarters
Department of the Army
Washington, DC, 24 March 2026

MORTAR FIRE DIRECTION PROCEDURES

1. This change updates the wording in appendix D.

2. A plus character (+) marks a new change.

3. TC 3-22.91, 24 March 2026, is changed a follows:

Change Version Page(s)	Change Description
page 487	adds the word preferably
page 488	adds the word preferably

4. An updated Authentication Page has amended the prior publication reflected in the rear of this publication.

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*TC 3-22.91

Training Circular
No. 3-22.91

Headquarters
Department of the Army
Washington, DC, 29 August 2025

MORTAR FIRE DIRECTION PROCEDURES

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Preface

TC 3-22.91 guides military occupational specialty 11C Soldiers and their trainers on the employment of the 60-millimeter (mm) mortar (M224), 81-mm mortar (M252), and 120-mm mortar (M120/M121). It discusses the practical applications of ballistics and a system combining the principles, techniques, and procedures essential to the delivery of timely and accurate mortar fire. (See TC 3-22.90 for information about mechanical training, crew drills, and the characteristics, components, and technical data of each mortar.)

The principal audience for TC 3-22.91 is all members of the profession of arms. Commanders and staffs of Army headquarters serving as joint task force or multinational headquarters should also see 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 Service members operate in accordance with the law of armed conflict and the rules of engagement. (See FM 6-27 for legal compliance.)

TC 3-22.91 applies to the Active Army, Army National Guard/Army National Guard of the United States and United States Army Reserve unless otherwise stated.

The proponent of TC 3-22.91 is the United States Army Maneuver Center of Excellence. The preparing agency is the Department of Tactics, Training, and Doctrine, United States Army Maneuver Center of Excellence. Send comments and recommendations on DA Form 2028 (*Recommended Changes to Publications and Blank Forms)* to Commander, United States Army Maneuver Center of Excellence and Fort Benning, ATZK-TDD (TC 3-22.91), 1 Karker Street, Fort Benning, GA 31905-5410; by email to usarmy.benning.mcoe.mbx.doctrine@army.mil; or submit an electronic DA Form 2028.

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Introduction

TC 3-22.91 is divided into 10 chapters and 5 appendixes:

- Chapter 1 discusses the organization and employment of mortar platoons.
- Chapter 2 summarizes the operational procedures of a fire direction center (FDC).
- Chapter 3 delves into the elements of firing data and ballistics, firing tables, fire planning, target analysis, and methods of attack.
- Chapter 4 discusses the elements, message to observer, format, and authentication in a call for fire.
- Chapter 5 introduces plotting boards.
- Chapter 6 discusses fire mission procedures applied to both basic and advanced missions to effectively engage targets.
- Chapter 7 discusses Lightweight Handheld Mortar Ballistic Computer (LHMBC), a lightweight ruggedized personal digital assistant that has replaced the M23 Mortar Ballistic Computer (MBC).
- Chapter 8 discusses the LHMBC fire missions.
- Chapter 9 discusses the Mortar Fire Control System (MFCS) that provides a complete, fully integrated, digital, fire control system for the mortar systems.
- Chapter 10 discusses MFCS specific missions, such as registration, illumination, coordinated illumination, and final protective fire.
- Appendix A discusses icons for the MFCS.
- Appendix B discusses safety procedures.
- Appendix C discusses field-expedient survey techniques.
- Appendix D discusses FDC certification.
- Appendix E discusses mortar qualification DA forms.

TC 3-22.91 was revised to add references to new material and systems; delete references to obsolete materiel and systems. This revision—

- Updates and standardizes the evaluation for the FDC Certification Program discussed in paragraph D-2.
- Adds mark center sector information.
- Removes all references to the M23 Mortar Ballistic Computer.
- Prescribes the following forms:
  - DA Form 2188 (*Data Sheet*).
  - DA Form 2188-1 (*LHMBC/MFCS Data Sheet*).
  - DA Form 2399 (*Computer's Record*).
  - DA Form 2601-1 (*MET Data Correction Sheet for Mortars*).

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Chapter 1

Organization and Employment

The mission of the mortar platoon is to provide timely, accurate indirect fire support for maneuver battalions and companies. This chapter will cover organization and employment.

ORGANIZATION

1-1. Mortars are organized as part of a company, battalion, and Cavalry squadron. They are organized as sections or platoons in the Infantry brigade combat team (IBCT) or Stryker brigade combat team (SBCT) companies or as platoons in Armored brigade combat team (ABCT) battalions. Regardless of the organization to which they belong, mortars have the role of providing the maneuver commander with immediate organic indirect fires on the battlefield. Mortars fulfill this mission when all the elements responsible for placing effective mortar fire on the enemy are trained properly.

1-2. In ABCT and SBCT battalions, units fire their 120-millimeter (mm) mortar systems from mortar carriers with the ABCT maintaining its ground-mounted capability. The Recoil Mortar System 6-Light (RMS6-L) used by the SBCT, cannot be fired from the ground. The SBCT maintains its ground-mount capabilities through 81-mm and 60-mm mortars. This permits rapid displacement and quick reaction to the tactical situation.

1-3. In the IBCT, the mortars are found with one platoon of 120-mm mortars and 81-mm mortars assigned at the battalion level. One mortar section of 60-mm mortars is assigned at the company level. The IBCT can achieve rapid displacement and quick reaction to the tactical situation using the Mortar Fire Control System-Dismounted (MFCS-D).

EMPLOYMENT

1-4. Modern combat demands the timely and accurate delivery of indirect fire to meet the needs of supported units. All indirect fire team members strive to reduce the time required to execute an effective fire mission; they must be thoroughly indoctrinated with a sense of urgency. The use of appropriate doctrine is a key principle of effective training.

1-5. Good observation is required for effective mortar fire. Limited observation results in a greater ammunition expenditure and less effective fire. Every target needs some type of observation to ensure fire is placed on the target. Observation of close battle areas is usually visual. Radar or sound observation works best when terrain features hide targets or when great distance or limited visibility is involved. When observation is possible, corrections can be made to place mortar fire on the target using adjustment procedures. However, lack of observation must not preclude firing on targets that can be located by other means.

1-6. Mortar fire must be delivered using the most accurate means; time and the tactical situation permitting. When possible, survey data is used to accurately locate the mortar position and target. Under some conditions, only a rapid estimate of the relative location of weapons and targets is possible.

1-7. To achieve effective massed fires, units survey the area using accurate maps of mortar positions, and registration points (RPs). The target location uses a refined grid, surveyed point or located by techniques, with meteorological (MET) data applied. The immediate objective is to deliver a large volume of accurate, timely fire to cause as many enemy casualties as possible. Surprise fire often increases the number of casualties inflicted in a target area. If surprise massed fires cannot be achieved, the time required to bring effective fires on the target is as brief as possible.

1-8. Mortars inflict the greatest demoralizing effect on the enemy by delivering as many rounds as possible in the shortest period possible.

1-9. Mortar units must be prepared to manage multiple fire missions. Mortars are area fire weapons, but units can employ them to neutralize or destroy area or point targets, to screen large areas with smoke for sustained periods, to provide illumination, or to provide an immediate, heavy volume of accurate fire for sustained periods.

INDIRECT FIRE TEAM

1-10. The team provides an accurate, timely response to the unit it supports. Effective communication is vital to the successful coordination of the indirect fire team's efforts. Indirect fire procedures require a team effort. (See figure 1-1.) They include locating the target, designating the correct asset to fire the mission, determining firing data, clearing indirect surface-to-surface fires, applying data to the mortar, and preparing the ammunition. Since the mortar normally is fired from the defilade position (where the crew cannot see the target), the indirect fire team gathers and applies the required data, and coordinates and synchronizes the fires with the concept of the operation. This team includes the following:

- Fire support officer (FSO) in the fires cell (FC) (who is typically assigned to echelons battalion and above:
  - Referred to as the fire support element (FSE).
  - Found in mortar digital software.
- Forward observer (FO) (who is typically assigned as fire support teams [FISTs] at battalion level and below).
- Fire direction center (FDC) and mortar squads.

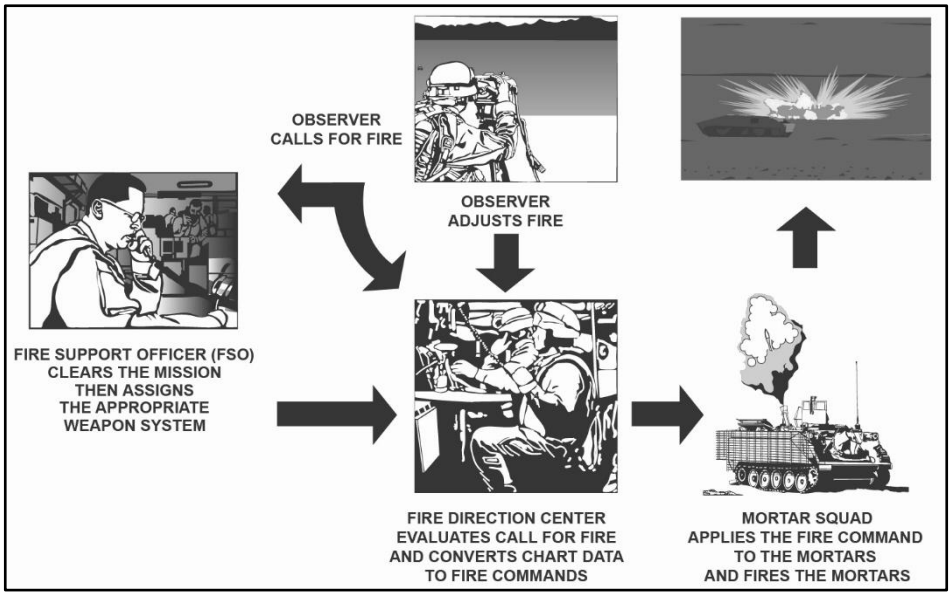


Figure 1-1. Indirect fire team

1-11. The battalion FSO coordinates and synchronizes fire support for the maneuver battalion. The FSO oversees the FC and serves as the principal fire support advisor to the maneuver battalion commander. The FC is located with the operations element of the maneuver force. The commander is responsible for integrating fire support, but typically delegates planning and supervisory authority for clearing indirect fires, when needed, for the unit to the FSO. Table 1-1 shows the organization of an FC in support of IBCT, SBCT, and ABCT battalions.

Table 1-1. Battalion fire support personnel

Battalion Fire Support Personnel			
	IBCT	***ABCT***	***SBCT***
Fire support officer	1	1	1
Fire support plans/targeting officer	0	1	1
Fire support sergeant	1	1	1
Fire support specialist	2	2	1
Radio/telephone operator	0	2	0
Legend: ABCT—Armored brigade combat team; IBCT—Infantry brigade combat team; SBCT—Stryker brigade combat team			

1-12. The battalion headquarters and headquarters company fire support platoon provides the FIST to the battalion's maneuver companies upon deployment. FISTs typically move to and remain with their supported companies and platoons. Table 1-2 shows the organization of a FIST in support of IBCT, SBCT, and ABCT companies.

Table 1-2. Company fire support personnel

Company Fire Support Personnel			
	IBCT	***ABCT***	***SBCT***
Company fire support officer	1	1	1
Fire support sergeant	1	1	1
Fire support specialist	1	1	1
Radio/telephone operator	1	1	1
Platoon forward observer	3	0	3
Platoon forward observer radio/telephone operator	3	0	3
Legend: ABCT—Armored brigade combat team; IBCT—Infantry brigade combat team; SBCT—Stryker brigade combat team			

1-13. The FDC has two computer personnel in each section (except the 60-mm section, where the section leader and squad leader act as the FDC) who control the firing of mortars. They convert data received from the FO in a call for fire (CFF) into firing data that can be applied to the mortar and ammunition.

1-14. Mortar squads organic to ABCT and IBCT battalions consist of one squad leader, one gunner, one assistant gunner, and one ammunition bearer/driver. Mortar squads organic to SBCTs at the company, troop, and battalion levels consist of one squad leader, one gunner, one assistant gunner, one ammunition bearer, and one driver. At the company level, IBCT units have one six-Soldier section consisting of one section leader, one squad leader, two gunners, and two assistant gunners. The squad lays the mortar and prepares the ammunition using data from the FDC fire command. When the data is applied, the squad fires the mortar. The squad must be able to fire without an FDC.

MORTAR POSITIONS

1-15. To protect mortars from enemy direct fire and observation, units employ mortars in defilade positions when possible. These positions take the greatest advantage of the indirect fire role of mortars.

1-16. The use of defilade precludes sighting weapons directly at the target (direct lay), which is necessary for survival.

1-17. Mortars are indirect fire weapons. Special procedures ensure that the weapon and ammunition settings used cause the projectile to burst on the target or at the proper height above it. A coordinated effort by the indirect fire team ensures the timely and accurate engagement of targets.

1-18. To apply the essential information and engage the target from a defilade position:

- Locate targets and mortar positions.
- Determine chart data (direction, range, altitude/elevation, and vertical interval [VI] from mortars to targets).
- Convert chart data into firing data.
- Apply firing data to the mortar and to the ammunition.
- Apply FO corrections and fire for subsequent rounds until a fire for effect (FFE) is achieved.

Lay of the Section

1-19. When all mortars in the section are mounted and using Mortar Fire Control Systems (MFCSs), they use terrain positioning. When operating in degraded mode or as required for training, the section leader lays the section parallel on the prescribed azimuth with an aiming circle. The mortar section normally fires a parallel sheaf. (See figure 1-2, page 6.) To obtain this sheaf, the mortars must be laid parallel. When a section moves into a firing position, the FDC determines the azimuth on which the section is to be laid and notifies the platoon sergeant (or section leader). Before laying the mortars parallel, the section leader calibrates the mortar sights. All mortars then are laid parallel using the aiming circle, mortar sight, or compass. The section normally is laid parallel by using the following steps:

- Establish the 0 to 3200 line of the aiming circle parallel to the mounting azimuth (MAZ).
- Lay the section parallel to the 0 to 3200 line of the aiming circle (reciprocal lay).

CAUTION

The 60-mm dispersion distance when ground mounted is a minimum of 30 to 35 meters. The 81-mm dispersion distance when ground mounted is a minimum of 40 to 45 meters. The 120-mm dispersion distance when ground mounted is a minimum of 60 to 65 meters. See figure 1-2, page 6.

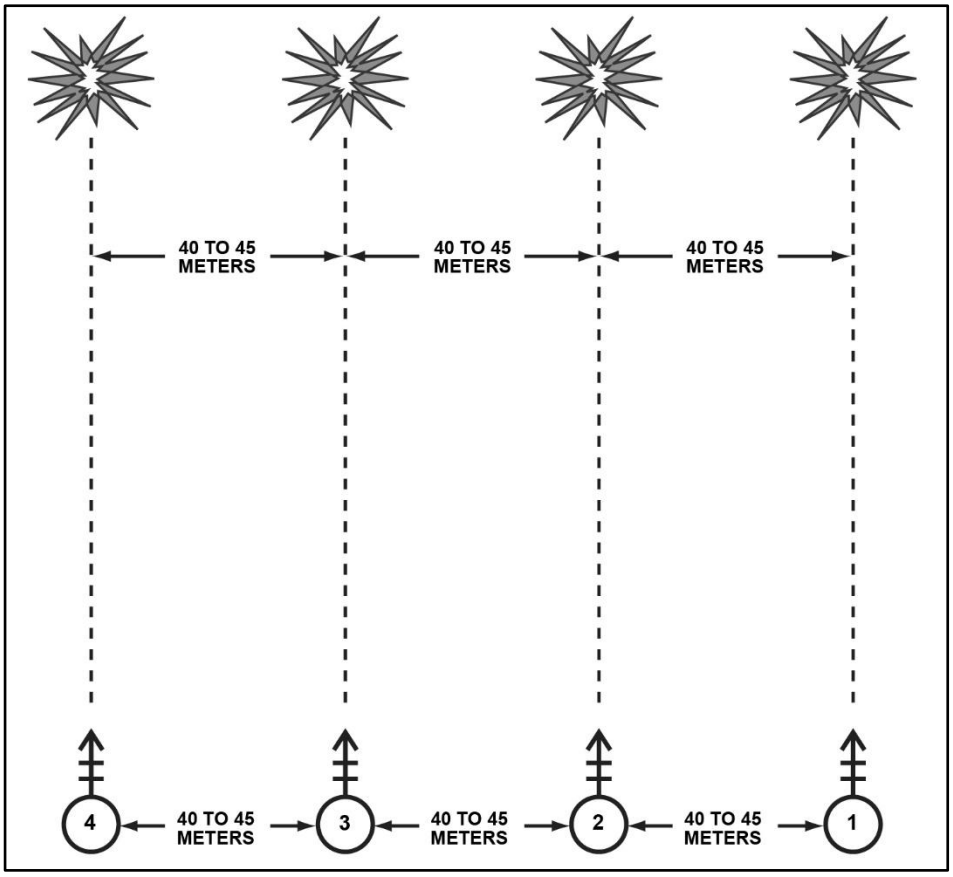


Figure 1-2. Parallel sheaf (81-millimeter mortars)

Reciprocal Lay

1-20. Reciprocal lay is a procedure by which the 0 to 3200 line of one instrument (aiming circle) and the 0 to 3200 line of another instrument (sight unit) are laid parallel. (See figure 1-3.) When the 0 to 3200 lines of an aiming circle and the 0 to 3200 line of the sight unit are parallel, the barrel is parallel to both 0 to 3200 lines if the sight has been calibrated and boresighted properly. The principle of reciprocal lay is based on the geometric theorem that states if two parallel lines are cut by a transversal, the alternate interior angles are equal. The parallel lines are the 0 to 3200 lines of the instruments, and the transversal is the line of sight between the two instruments. The alternate interior angles are the equal deflections placed on the instruments.

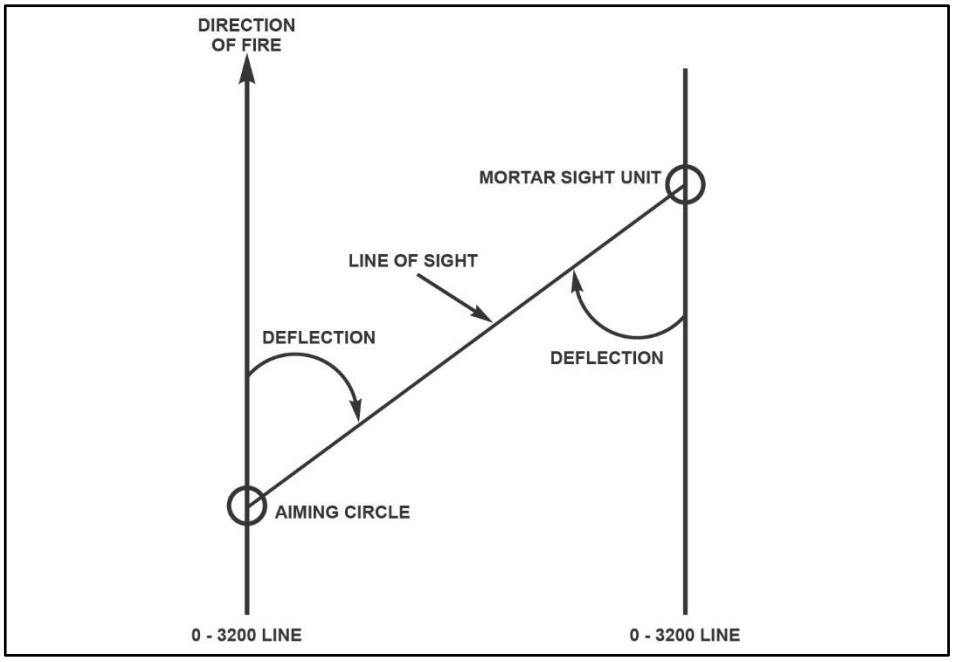


Figure 1-3. Reciprocal lay

1-21. Orient the aiming circle so that the 0 to 3200 line of the aiming circle is parallel to the MAZ. The section leader announces to the mortar gunners (either by voice or visual signal), SECTION, AIMING POINT THIS INSTRUMENT. The gunners turn their sights until the vertical crossline of the sight is sighted on the lens of the aiming circle and the mortar is level. The gunners announce (either by voice or visual signal), NUMBER[s] 1, 2, [and so on], AIMING POINT IDENTIFIED. The section leader, using the upper motion, sights on the lens of the sight unit, reads the deflection on the azimuth micrometer scales, and announces the deflection to the gunner on the mortar. The gunner sets the deflection on the sight unit and causes the mortar to be moved until the vertical crossline of the sight is sighted again on the lens of the aiming circle and the mortar is level.

1-22. When the sight has been sighted on the aiming circle, the gunner reports, READY FOR RECHECK. The platoon sergeant (or section leader) again sights on the lens of the sight unit and reads and announces the deflection. This procedure is repeated until the gunner reports a difference of 0 (or 1) mil between successive deflections. Then the mortar was laid.

Reciprocal Lay on a Grid Azimuth

1-23. This paragraph discusses the commands and procedures used to reciprocal lay the mortar section on a given grid azimuth. The example below illustrates the commands and procedures. The example uses a MAZ of 5550 mils and an aiming circle with a declination constant of 450 mils. In this example, the situation occurs as follows:

Step 1

1-24. The FDC directs the section to lay the mortar parallel on a mounting (grid) azimuth.

Step 2

1-25. The platoon sergeant (section leader) receives the command, MOUNTING AZIMUTH FIVE FIVE FIVE ZERO [5550 mils], from the FDC.

Step 3

1-26. The section leader calculates the number of mils to set on the aiming circle (see example):

EXAMPLE

Declination constant 450 mils	+	6400 mils
Sum		6850 mils
Minus the mounting (grid) azimuth	-	5550 mils
Remainder to set on aiming circle		1300 mils

Step 4

1-27. The platoon sergeant (or section leader) mounts and levels the aiming circle at a point from which the platoon sergeant can observe the sights of all the mortars in the section (normally the left front or left rear of the section).

Step 5

1-28. The platoon sergeant (or section leader) places 1300 mils on the azimuth and micrometer scales of the aiming circle (recording motion).

1-29. Using the orienting knob, the platoon sergeant (or section leader) centers the magnetic needle in the magnetic needle magnifier. This orients the 0 to 3200 line of the aiming circle in the desired direction (MAZ 5550 mils).

Step 6

1-30. The platoon sergeant (or section leader) announces, SECTION, AIMING POINT THIS INSTRUMENT.

Step 7

1-31. All gunners refer their sights to the aiming circle with the vertical crossline laid on the center of the aiming circle. The gunner then announces, NUMBERS [2, 1, or 3], AIMING POINT IDENTIFIED.

Note. To lay the mortar barrel parallel to the 0 to 3200 line of the aiming circle (see figure 1-4), the platoon sergeant (or section leader) uses the recording motion, orienting the aiming circle until the vertical crossline is laid on the center of the lens of the mortar sight. The platoon sergeant reads the azimuth and micrometer scales and announces the deflection; for example, NUMBER 2, DEFLECTION TWO ZERO ZERO ZERO [2000].

Step 8

1-32. The gunner repeats the announced deflection, NUMBER 2, DEFLECTION TWO ZERO ZERO ZERO, and the gunner places it on the sight. Assisted by the assistant gunner, the gunner lays the mortar so that the vertical line once is once again laid on the center of the aiming circle then the gunner announces, NUMBER 2, READY FOR RECHECK.

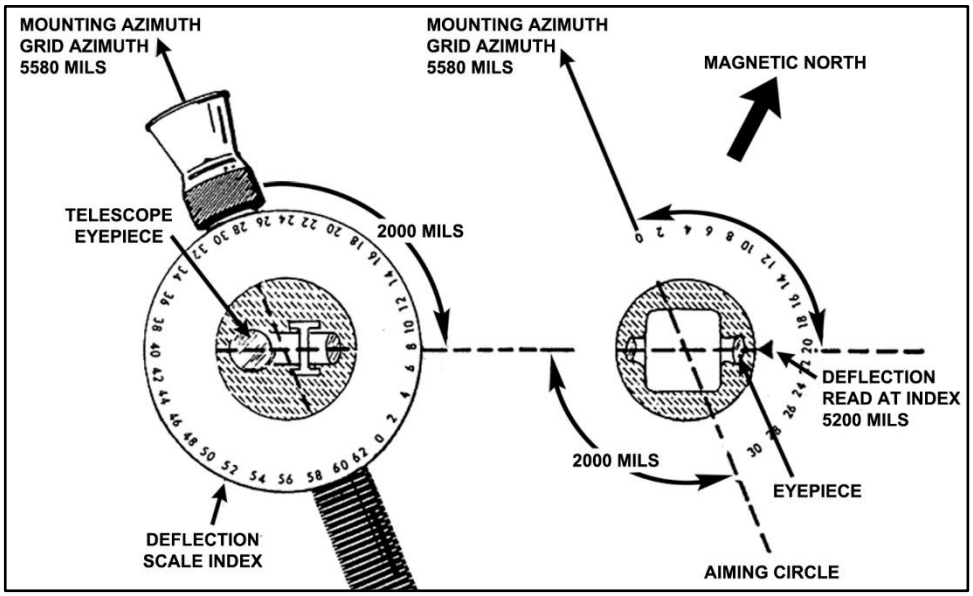


Figure 1-4. Mortar laid parallel with the aiming circle

Step 9

1-33. Using the recording motion, the platoon sergeant (or section leader) again lays the vertical crossline of the aiming circle on the lens of the mortar sight. The platoon sergeant reads the new deflection from the azimuth and micrometer scales and announces the reading; for example, NUMBER 2, DEFLECTION TWO ZERO ZERO ZERO.

Step 10

1-34. The gunner repeats the new deflection (NUMBER 2, DEFLECTION TWO ZERO ZERO ZERO) and places it on the sight. Assisted by the assistant gunner, the gunner

lays the mortar with the vertical crossline of the sight on the center of the aiming circle and then announces, NUMBER 2, READY FOR RECHECK.

Note. The above procedure is repeated until the mortar sight and aiming circle are sighted on each other with a difference of not more than 1 mil between the deflection readings. When laid, the gunner announces, NUMBER 2 [1 or 3], 0 MILS [1 MIL], MORTAR LAID. Now the mortar barrel is laid parallel to the 0 to 3200 line of the aiming circle.

Note. The section leader uses the same procedure to lay each of the other mortars in the section parallel. When all mortars are parallel to the 0 to 3200 line of the aiming circle, they are parallel to each other and lay in the desired azimuth. (See figure 1-5.)

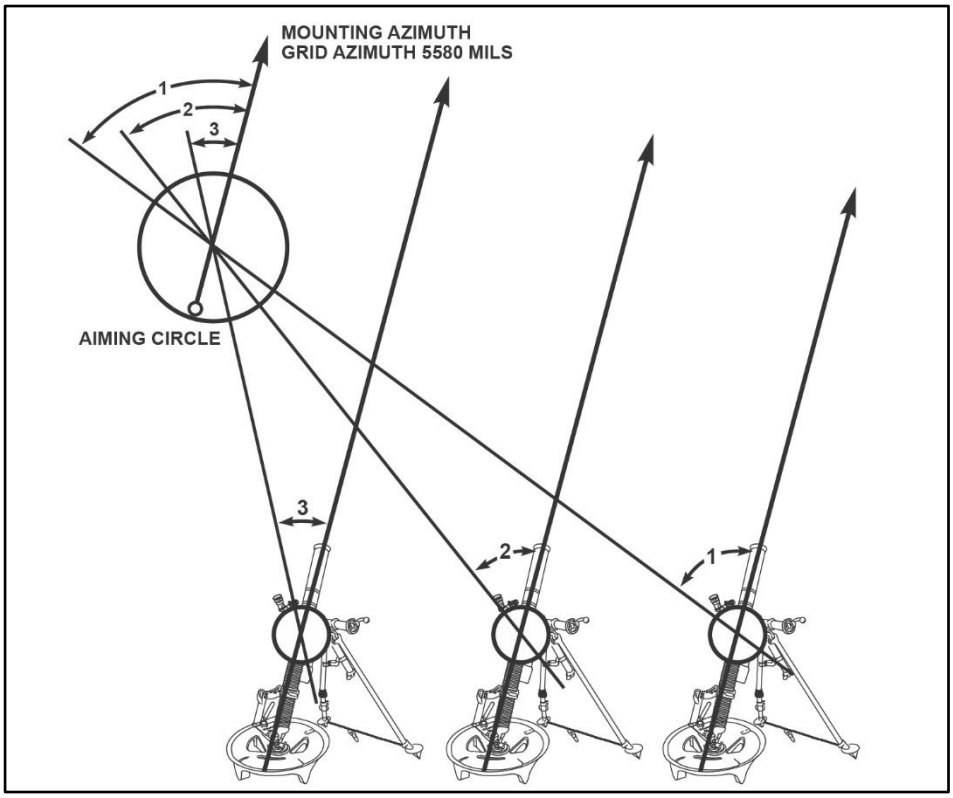


Figure 1-5. Mortars laid parallel in the desired azimuth

Note. The section can be laid parallel by laying all mortars at the same time. The instrument operator reads deflections to each of the mortars in turn. As soon as the gunner of any mortar announces, READY FOR RECHECK, the instrument operator reads the new deflection to that mortar. By laying all mortars at the same time, the section is quickly ready to fire.

1-35. As soon as each mortar is laid, the platoon sergeant or section leader commands, DEFLECTION TWO EIGHT ZERO ZERO, REFER, PLACE OUT AIMING POSTS. The aiming posts normally are placed out on a referred deflection (Ref) of 2800 mils. The gunner, without disturbing the lay of the mortar, places the announced deflection on the sight and aligns the aiming posts with the vertical line of the mortar sight. The gunner then announces, UP.

1-36. When all mortar gunners announce, UP, the instrument operator covers the head of the aiming circle but leaves the instrument in position to permit a rapid recheck of any mortar.

Reciprocal Lay on a Magnetic Azimuth

1-37. Although the section normally is laid parallel on a grid azimuth, it can be laid parallel on a magnetic azimuth by subtracting the magnetic MAZ from 6400 mils and by setting the remainder on the azimuth and micrometer scales of the aiming circle. The section leader orients the instrument and lays the section.

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Chapter 2
Fire Direction

This chapter contains information about the principles of fire direction, organization, duties, and responsibilities of FDC personnel.

PRINCIPLES OF FIRE DIRECTION

2-1. Fire direction is the tactical and technical employment of firepower, the exercise of tactical command of one or more units in the selection of targets, the massing or distribution of fire, and the allocation of ammunition for each mission.

2-2. Fire direction includes the methods and techniques FDCs use to convert CFFs into proper fire commands. The FDC is the element of the mortar platoon headquarters that controls the fire of a mortar section and relays information and intelligence from observers to higher headquarters.

2-3. Fire direction methods ensure—

- Close, continuous, accurate, and timely indirect fire support in all types of terrain, visibility, and weather.
- Flexibility to engage all targets within the company's or battalion's area of responsibility.
- The ability to engage two or more targets at the same time.
- The ability to implement independent gun operations.

2-4. The FDC is the element of the indirect fire team that receives the CFF from the FO, company FSO, or higher headquarters; determines firing data; and announces fire commands to the firing section(s). The FDC determines and applies corrections to chart data and to standard firing table (FT) values to achieve accuracy in firing. The FDC normally produces firing data, but this data may be produced by a firing unit operating as a gun/FDC, if the FDC is unavailable or not assigned. Accuracy, flexibility, and speed of fire missions depend on—

- Accurate and rapid computation and verification of firing data from Lightweight Handheld Mortar Ballistic Computer (LHMBC), MFCS, or plotting board.
- Adherence to standard techniques and procedures.
- Clear transmission of commands to the mortar section.
- Efficient division of duties.
- Efficient use of communications.
- Teamwork and operating in a specified sequence.

FIRE DIRECTION CENTER DUTIES

2-5. Each member of the FDC has a different role to play to ensure efficient performance throughout the duration of indirect fire operations.

Note. Duties are aligned and established based on unit type and configuration.

2-6. The FDC of a 120-mm M1064 equipped mortar section includes the following:
- One section leader.
- One chief computer.
- One check computer.
- One driver or radiotelephone operator (RTO).

2-7. The FDC of a 120-mm M120A1-mm with a M326 mortar stowage kit (also called MSK) equipped mortar section includes the following:
- One chief computer.
- One driver/RTO.

2-8. The FDC of a RMS6-L Stryker-equipped mortar section includes one FDC or squad leader.

2-9. The FDC of a 60-mm mortar section includes the following:
- One section leader (chief computer).
- One squad leader (check computer).

FIRE DIRECTION CHIEF/SECTION LEADER

2-10. As the senior enlisted member of the FDC, the fire direction chief (chief computer or section leader) plans, coordinates, and supervises all FDC activities and is responsible for the training of all FDC members. The fire direction chief must be able to operate all FDC equipment, as well as supervise their operation.

2-11. The fire direction chief or section leader—
- Makes the decision to fire:
  - When a target is reported, the fire direction chief/section leader examines its location relative to friendly troops, boundary lines, no-fire lines, and fire coordination lines.
  - Using that information, along with the nature of the target, the ammunition available, and the policy of the commander, the fire direction chief decides whether to fire.
  - If the fire direction chief decides to engage the target, the chief will use that information to decide how to do so.
- Issues the FDC order. Once the fire direction chief or section leader decides to engage a target, the chief issues the FDC order to tell other FDC members how the mission will be conducted.
- Verifies corrections and commands:
  - The fire direction chief or section leader verifies firing corrections obtained from registration.
  - The chief cross-checks all firing data and fire commands sent to the mortar section to eliminate errors and resolves any discrepancies.
- Determines the altitude/elevation of a target once determined from the map, the fire direction chief/section leader announces it immediately after the FDC order so that the computers may compute and apply any altitude/elevation correction.
- Maintains records and details on all fire missions and all corrections applied are recorded.
- Evaluates and relays all target surveillance data and intelligence reports from observers are analyzed and passed to the appropriate channels.

- Coordinates with the FSO and the fire direction chief/section leader syncs information regarding sectors of responsibility and up-to-date tactical information including:
  - Planning targets.
  - Where to best register the gun once at the site.
  - The round count.
  - A distribution plan amongst the platoon.
  - Briefing the company commander on mortar tactics and capabilities.
  - If the FDC receives a CFF request for a target it cannot engage immediately or effectively, the fire direction chief/section leader informs the FSO so the mission can be assigned to another firing element.

2-12. In addition to the duties that the chief computer of a 120-mm mortar platoon performs, running split section operations, the section leader of an 81-mm mortar FDC is responsible for—

- Selecting sites for tactical employment of mortar squads.
- Supervising tactical deployment of mortar squads.
- Supervising the laying of the mortar section.
- Supervising the section during fire missions.

FIRE DIRECTION COMPUTER PERSONNEL

2-13. To reduce errors, increase speed and efficiency, and allow for the platoon or section to be split to fire multiple missions, all mortar sections, except that of the 60-mm mortar, have two fire direction computer personnel. The 60-mm section leader and squad leader act as chief computer and check computers whenever possible. In 81- and 120-mm mortar sections, one confirms communications between the RTO and the observers, while the other relays fire commands to the section. FDC personnel cross train in computer skills to allow rotation for continuous operations.

2-14. The FDC uses the MFCS or LHMBC to convert observer data into fire commands. These commands are reported to the firing section. Under other circumstances, FDC personnel use the M16 (an alternate means of fire control for all mortars) or M19 (an alternate means of fire control for 60-mm mortar sections) plotting board to convert observer data.

2-15. To prevent errors in the FDC, personnel cross-check their information. It is recommended that FDC personnel cross-check the data put into the MFCS. FDC personnel cross-check the LHMBC firing solutions with another LHMBC and those of a plotting board with another plotting board. Plotting boards cannot check the MFCS or LHMBC devices.

Note. It is recommended to confirm all data put into all devices (manually or digitally) to include firing data.

2-16. Computer personnel—

- Prepare and maintain a LHMBC, MFCS, or plotting board for plotting targets and producing firing data.
- Plot target locations called in by an observer and update them with observer corrections.

- Determine and announce the gun(s) to fire, number of rounds, deflection, charge, and elevation.
- Determine the size of angle T and announce it to the observer when angle T exceeds 500 mils, or when requested.
- Number and replot targets for future reference.
- Compute and apply registration.
- Plot the location of friendly elements, supported unit boundaries, observers, no-fire lines, and safety limits in the LHMBC, MFCS, or on the M16/M19 plotting board.
- Maintain DA Form 2188 with current firing information for all targets.

DRIVER/RADIOTELEPHONE OPERATOR

2-17. In the FDC, the RTO drives the FDC vehicle. The RTO must be trained in communication procedures, as well as in the duties of the computer personnel.

2-18. The driver or RTO—

- Operates the telephones and radios within the FDC.
- Repeats calls for fire received from an observer.
- Issues the message to the observer.

PERTINENT INFORMATION OF THE FIRE DIRECTION CENTER

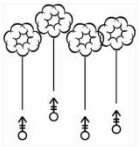
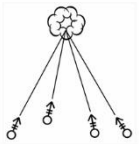
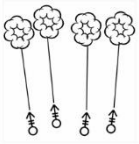
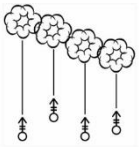
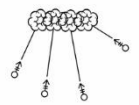
2-19. When converting CFFs into proper fire commands, specific methods and techniques are used. Each of those are discussed in paragraphs 2-20 to 2-34.

Sheaves

2-20. When the mortar section or platoon engages a target, it can use different sheaves depending on the type of target.

2-21. Table 2-1 outlines the types of sheaves used for a given target and provides additional information.

Table 2-1. Types of sheaves

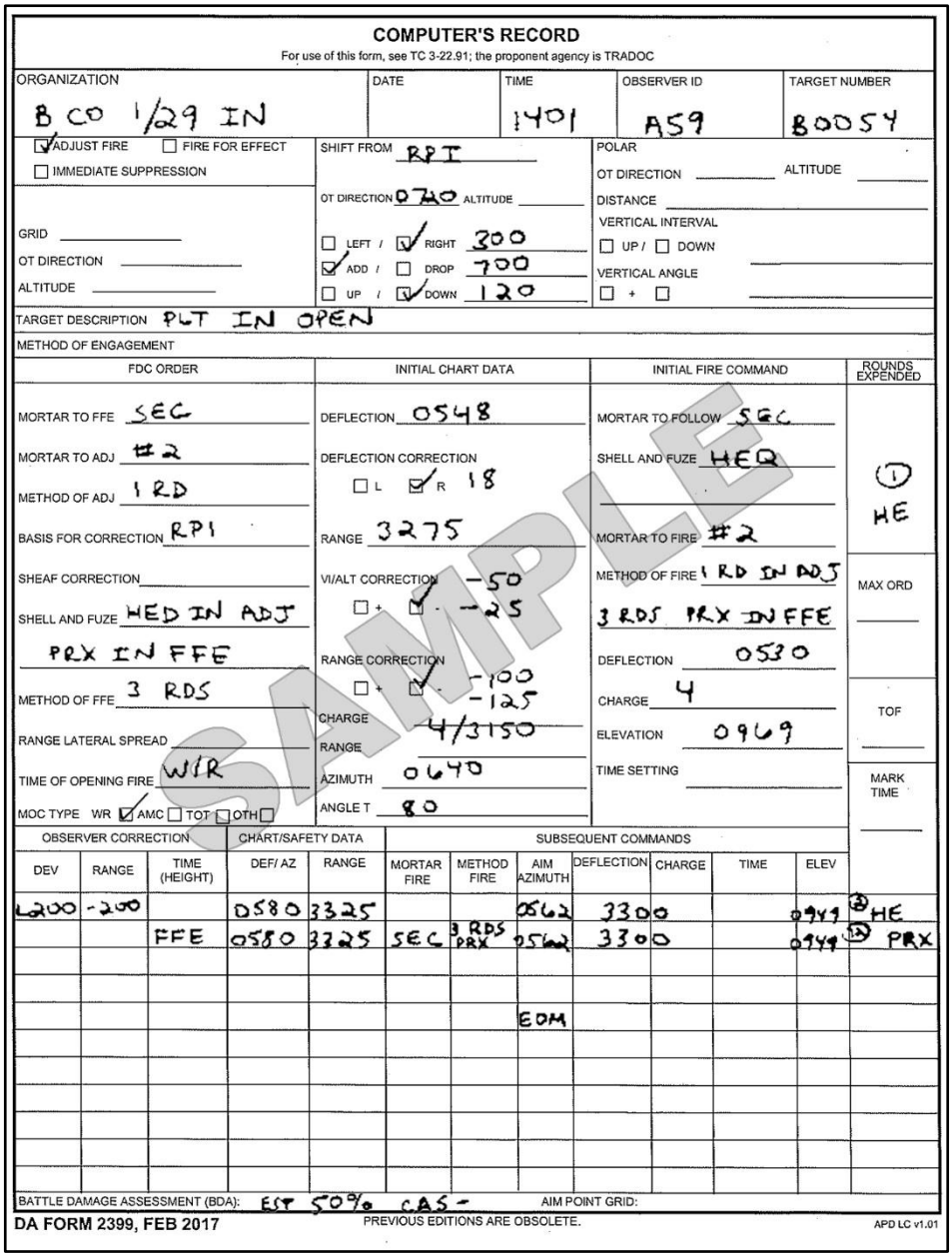
Type of Sheaf	*Type of Target*	*Related Information*
Parallel sheaf 	Area targets.	To fire a parallel sheaf, two or more mortars fire the same deflection, elevation, and charge with the distance between rounds being the same distance being the same as the distance between the mortars.
Converged sheaf 	Point targets, such as bunkers or machine gun positions.	When firing converged sheaves, mortar sections or platoons fire two or more mortars (each firing a different deflection) to impact the same target.
Open sheaf 	Targets that are wider than a linear sheaf.	The distance between impacts of rounds from two or more mortars is one and a half times the distance between the burst of rounds in a linear sheaf. Normally, 60-mm (millimeter) rounds impact 30-meters apart, 81-mm rounds impact 40-meters apart, and 120-mm rounds impact 70-meters apart. For example, in an open sheaf with 60-mm mortars, rounds would impact 45-meters apart; one and a half times the distance that separates 60-mm rounds in a linear sheaf. All mortars fire from different deflections for an open sheaf.
Special sheaf 	Targets that are linear in nature such as roadways, bridges, and final protective fires (FPFs).	A special sheaf normally is used in attitude missions and when needed for the FPF. Each mortar has a certain point to engage. The mortars may have different deflections and elevations.
Linear sheaf 	Engagements against enemy formations.	With the linear sheaf, rounds impact within the total effective width of the bursts, regardless of the mortar location.

Computer's Record

2-22. DA Form 2399 (see figure 2-1) is a form used to record—

- The FO's CFF and corrections.
- Firing data.
- Commands to mortars during a fire mission.

2-23. The FDC uses this form to record each mission that the FDC receives and fires. This section provides instructions on how to complete a DA Form 2399.



COMPUTER'S RECORD

For use of this form, see TC 3-22.91; the proponent agency is TRADOC

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B CO 1/29 IN		1401	A59	B0054

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION

SHIFT FROM RPI

OT DIRECTION 0720 ALTITUDE

☐ LEFT / ☑ RIGHT 300

☑ ADD / ☐ DROP 700

☐ UP / ☑ DOWN 120

POLAR

OT DIRECTION ALTITUDE

DISTANCE

VERTICAL INTERVAL

☐ UP / ☐ DOWN

VERTICAL ANGLE

☐ + ☐

GRID

OT DIRECTION

ALTITUDE

TARGET DESCRIPTION PLT IN OPEN

METHOD OF ENGAGEMENT

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE SEC	DEFLECTION 0548	MORTAR TO FOLLOW SEC	
MORTAR TO ADJ #2	DEFLECTION CORRECTION ☐ L ☑ R 18	SHELL AND FUZE HEQ	① HE
METHOD OF ADJ 1 RD	RANGE 3275	MORTAR TO FIRE #2	
BASIS FOR CORRECTION RPI	VI/ALT CORRECTION ☐ + ☑ - 50 -25	METHOD OF FIRE 1 RD IN ADJ	MAX ORD
SHEAF CORRECTION	RANGE CORRECTION ☐ + ☑ - -100 -125	3 RDS PRX IN FFE	
SHELL AND FUZE HED IN ADJ PRX IN FFE	CHARGE 4/3150	DEFLECTION 0530	TOF
METHOD OF FFE 3 RDS	RANGE	CHARGE 4	
RANGE LATERAL SPREAD	AZIMUTH 0640	ELEVATION 0969	MARK TIME
TIME OF OPENING FIRE WIR	ANGLE T 80	TIME SETTING	
MOC TYPE WR ☑ AMC ☐ TOT ☐ OTH ☐			

OBSERVER CORRECTION			CHART/SAFETY DATA		SUBSEQUENT COMMANDS							
DEV	RANGE	TIME (HEIGHT)	DEF/ AZ	RANGE	MORTAR FIRE	METHOD FIRE	AIM AZIMUTH	DEFLECTION	CHARGE	TIME	ELEV	
L200	-200		0580	3325			0562	3300			0949	② HE
		FFE	0580	3325	SEC	3 RDS PRX	0562	3300			0949	③ PRX
							EOM					

BATTLE DAMAGE ASSESSMENT (BDA): EST 50% CAS - AIM POINT GRID:

DA FORM 2399, FEB 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.01

SAMPLE

Figure 2-1. Sample completed DA Form 2399 (Computer's Record)

Organization

2-24. The FDC documents the unit that fires the mission in this field.

Date

2-25. The FDC records the date that the mission is fired in this field.

Time

2-26. The FDC uses this field to document the time that the mission was received (The CFF is recorded.)

Observer Identification

2-27. The FDC records the observer's call sign in the observer identification field, which is labeled identification (ID) on the form.

Target Number

2-28. The FDC records the number assigned to the mission in this field.

Warning Order

2-29. The FDC uses this field to document the type of warning order used for the mission, such as adjust fire (A/F), FFE, or immediate suppression (IS).

Target Location

2-30. In this field, the FDC records the method used to locate the target, such as grid, shift from a known point, or polar plot.

Target Description

2-31. The FDC provides a detailed description of the target (type, size, number, and protection) in this field.

Method of Engagement

2-32. The FDC records the types of adjustment and ammunition in this field. (See ATP 3-09.30 for more information.)

Method of Control

2-33. The FDC documents the adjustment gun (when named by the FO) and time of delivery in this field. (See ATP 3-09.30 for more information.)

Message to Observer

2-34. The FDC records any messages sent to the FO in this field.

FIRE DIRECTION CENTER ORDER

2-35. The chief computer, or section leader, usually completes the FDC order. This area describes how the mortars will engage the target. Table 2-2 highlights the fields found in this section and provides more information about each area.

Table 2-2. Fire direction center order field titles and information documented in each field

Field	*Information Documented in Field*
Mortar to FFE (fire for effect)	The mortar that will be used during the FFE phase of the mission.
Mortar to ADJ (adjust)	The mortar that will be used during the adjustment phase of the mission. Note. Leave this field blank if the "Mortar to ADJ" is the same as the "Mortar to FFE."
Method of ADJ	Number of rounds used by the adjusting mortar(s) for each correction during the adjustment phase of the mission.
Basis for Correction	Point (usually the registration point [RP]) from which the correction factors to be applied are determined (surveyed chart only) and the latest meteorological corrections.
Sheaf Correction	Type of sheaf, other than the default sheaf, that will be used during the FFE. This is parallel for all fire control systems except the Mortar Fire Control System (MFCS), which uses a default sheaf of linear.
Shell and Fuze	Shell and fuze combination that will be used for the mission. The first line documents the ammunition that will be fired during the adjustment phase. The second line records the ammunition that will be fired in the FFE, if it changes from the adjustment round type. If different types of ammunition will be used during the mission, the different rounds are listed. Example: SHELL AND FUZE: HEQ (high explosive super quick) in ADJ, HEQ/WP (white phosphorous) in FFE.
Method of FFE	Number and type of rounds for each mortar in the FFE phase of the mission. Example. Method of FFE: two rounds HEQ, two rounds WP.
Range (RG)/Lateral spread	Used with illumination, with one of the following: RG spread (60-millimeter [mm] mortar, 250 meters between rounds; 81-mm mortar, 500 meters between rounds; and 120-mm mortar, 1,500 meters between rounds). Lateral spread (60-mm mortar, 250 meters between rounds; 81-mm mortar, 500 meters between rounds; and 120-mm mortar, 1,500 meters between rounds). RG/Lateral spread, which is a combination of range spread and lateral spread.
Time of Opening Fire	The fire control for the mission given by the forward observer (FO) or fire direction center (FDC) as "When ready" (WR), "At my command" (AMC), or "Do not fire" (DNF).

Initial Chart Data

2-36. The FDC uses the initial chart data to determine initial or subsequent fire commands. Table 2-3, page 22 highlights the fields found in this section and provides more information about each area.

Table 2-3. Initial chart data field titles and information documented in fields

Field	*Information Documented in Field*
Deflection	Initial deflection from the mortar position to the target being engaged.
Deflection Correction	Deflection correction used for the mission.
Range	Initial chart range from the mortar position to the target being engaged.
VI/ALT Correction (vertical interval/altitude)	The vertical interval and altitude correction used for the mission.
Range Correction	The total range correction (TRC) used for the mission.
Note. Deflection, deflection correction, range, VI/ALT correction, and range correction are calculated only when using the plotting board.	
Charge/Range	Charge and command range used for the mission.
Azimuth	The azimuth from the gun position to the target.
Angle T	Difference (in mils) between the gun-target line (GTL) and the observer-target (OT) line. ***Note.*** Determine this difference to the nearest mil, record to the nearest 10 mils, and transmit to the nearest 100 mils. When the determined difference is between 0500 and 2700 mils, transmit this information.

Initial Fire Command

2-37. The initial fire command is the first fire command the FDC sends to the mortar section for a mission. To complete the initial fire command, the computer uses the information contained in the initial chart data, any corrections, and the FDC order. Table 2-4 highlights the fields found in this section and provides more information about each area.

Table 2-4. Initial fire command field titles and information documented in field

Field	*Information Documented in Field*
Mortar to Follow	The mortar to follow all commands or the mortar that will be used in the fire for effect (FFE).
Shell and Fuze	The shell and fuze combination used during the mission. ***Note.*** If the mission is an adjustment mission, that is the round used during the adjustment.
Mortar to Fire	The mortars to be used during the adjustment phase.
Method of Fire	The number of rounds to be used for adjustment and in the FFE, and the type, if mixed. Any control by the fire direction center (FDC) would be placed here. For example, one round high explosive super quick) HEQ in adjustment; two rounds HEQ/two rounds white phosphorous (WP) in FFE, at my command (AMC); three rounds HEQ. Announcing the number of rounds in the FFE gives the ammunition bearer time to prepare those rounds in the event of, for example, an immediate suppression mission.
Deflection	The command deflection needed to fire the first round.
Charge	The command charge needed to fire the first round.
Time Setting	The time setting for munitions that utilize time fuzes to obtain the desired effects over the target area.
Elevation	The elevation used to engage the target at a specific range with the given charge. ***Note.*** The elevation is also the command to fire in the absence of fire control.

Rounds Expended

2-38. The FDC uses this space to record the number of rounds fired for the initial fire command.

OBSERVER CORRECTION

2-39. The observer sends the observer correction to the FDC to move the impact of the round to the target. Table 2-5, page 24 highlights the fields found in this section and provides more information about each area.

Table 2-5. Observer correction field titles and information documented in field

Field	*Information Documented in Field*
Deviation (DEV)	The left/right correction (in meters) sent by the observer. Example: "DEV: L 200" means the observer wants a "left 200 meters" correction.
Range (RG)	The add/drop correction (in meters) sent by the observer. Example: "RG: Add 200" is recorded as +200, while "Drop 200" is recorded as "-200."
Height (Time)	The up/down (height) correction the observer wants. Example: The observer will send "UP/DOWN: UP 200" or "DOWN 200" and record the same. ***Note.*** This element is usually used with illumination.

CHART DATA

2-40. The FDC obtains chart data from the M16/M19 plotting boards for the observer's requested corrections. Personnel use this section when firing corrections must be applied to chart data to obtain firing data.

SUBSEQUENT COMMANDS

2-41. The FDC sends command data to the mortar(s) so they can fire the next round(s). Those commands, deflection/charge/elevation, contain chart data and all firing corrections. In subsequent fire commands, only commands that change the initial fire command or the previous subsequent fire command are announced. Regardless of changes, the FDC always announces the elevation. Table 2-6 highlights the fields found in this section and provides more information about each area.

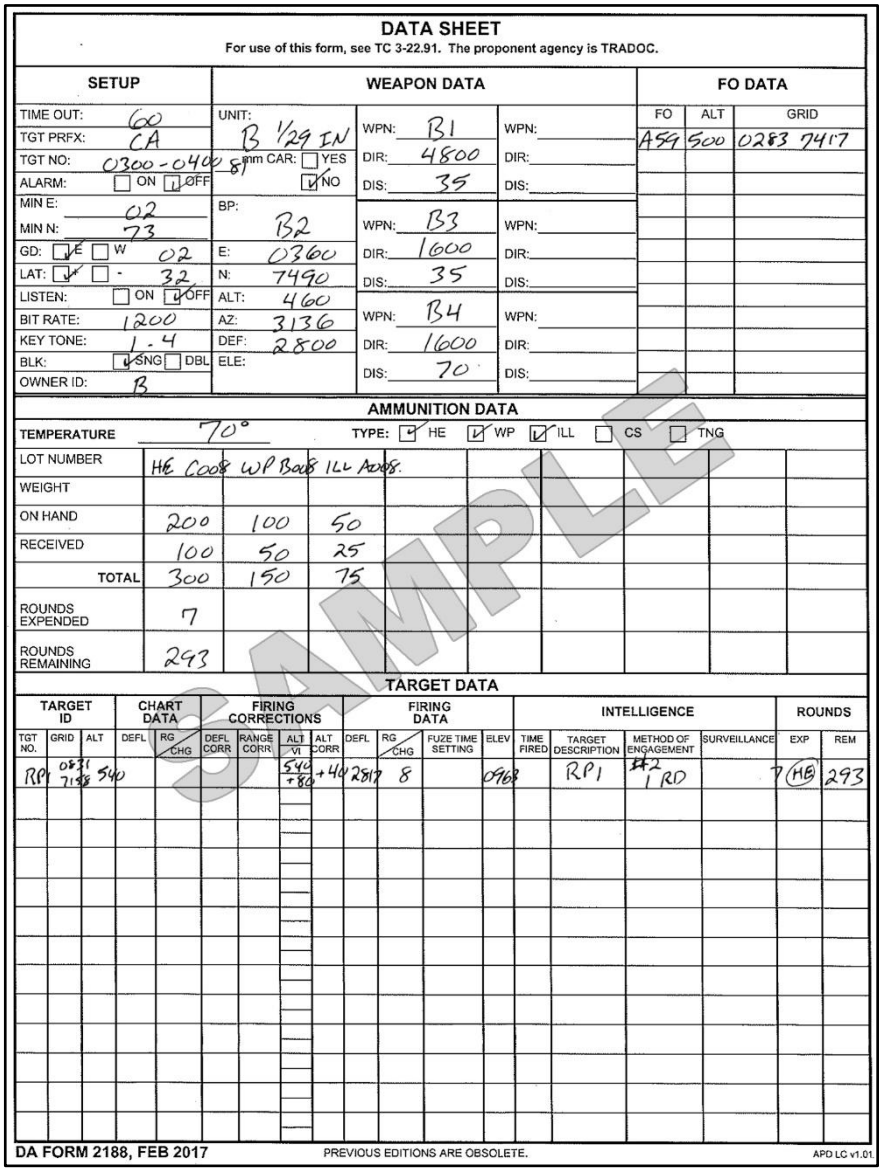
Table 2-6. Subsequent command field titles and information documented in field

Field	*Information Documented in Field*
Mortar to Fire	The mortars to fire a mission.
Method of Fire	The number of rounds and type of fire.
Deflection (DEFL)	The command deflection to fire the round.
Range/Charge (RG/CHG)	The command range and any changes to the charge from the preceding round are included. ***Note.*** The range is recorded and used to determine the charge that is given to mortars.
Time Setting	The time setting needed for the mechanical time fuze.
Elevation (ELEV)	The elevation used for this round and the command to fire (in the absence of fire control).

DA FORM 2188 (DATA SHEET)

2-42. The computer uses DA Form 2188 (see figure 2-2) to record data that pertains to the mortar section or platoon and the firing data for each target engaged.

Note. The controlling FDC keeps the DA Form 2188.



DATA SHEET

For use of this form, see TC 3-22.91. The proponent agency is TRADOC.

SETUP		WEAPON DATA				FO DATA		
TIME OUT: 60	UNIT: B 1/29 IN	WPN: B1	WPN:	FO	ALT	GRID
TGT PRFX: CA		DIR: 4800	DIR:	A59	500	0283 7417
TGT NO: 0300-0400	81mm CAR: ☐ YES ☑ NO	DIS: 35	DIS:			
ALARM: ☐ ON ☑ OFF	BP: B2	WPN: B3	WPN:			
MIN E: 02		DIR: 1600	DIR:			
MIN N: 73	E: 0360	DIS: 35	DIS:			
GD: ☑ E ☐ W 02	N: 7490	WPN: B4	WPN:			
LAT: ☑ ☐ - 32	ALT: 460	DIR: 1600	DIR:			
LISTEN: ☐ ON ☑ OFF	AZ: 3136	DIS: 70	DIS:			
BIT RATE: 1200	DEF: 2800					
KEY TONE: 1-4	ELE:					
BLK: ☑ SNG ☐ DBL						
OWNER ID: B						

AMMUNITION DATA

TEMPERATURE 70° TYPE: ☑ HE ☑ WP ☑ ILL ☐ CS ☐ TNG

LOT NUMBER	HE Coos WP Bad ILL Adds.								
WEIGHT									
ON HAND	200	100	50						
RECEIVED	100	50	25						
TOTAL	300	150	75						
ROUNDS EXPENDED	7								
ROUNDS REMAINING	293								

TARGET DATA

TARGET ID			CHART DATA		FIRING CORRECTIONS				FIRING DATA				INTELLIGENCE				ROUNDS	
TGT NO.	GRID	ALT	DEFL	RG / CHG	DEFL CORR	RANGE CORR	ALT / VI	ALT CORR	DEFL	RG / CHG	FUZE TIME SETTING	ELEV	TIME FIRED	TARGET DESCRIPTION	METHOD OF ENGAGEMENT	SURVEILLANCE	EXP	REM
RP1	0831 7158	540					540 +80	+40	2817	8		0963		RP1	#2 1 RD		7 (HE)	293

DA FORM 2188, FEB 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.01

SAMPLE

Figure 2-2. Sample of completed DA Form 2188 (Data Sheet)

DA FORM 2188-1 (LHMBC/MFCS DATA SHEET)

2-43. The computer uses DA Form 2188-1 (see figure 2-3, page 26) to record data that pertains to the mortar section or platoon and the firing data for each target engaged when using the LHMBC or MFCS.

Note. The controlling FDC keeps the DA Form 2188-1.

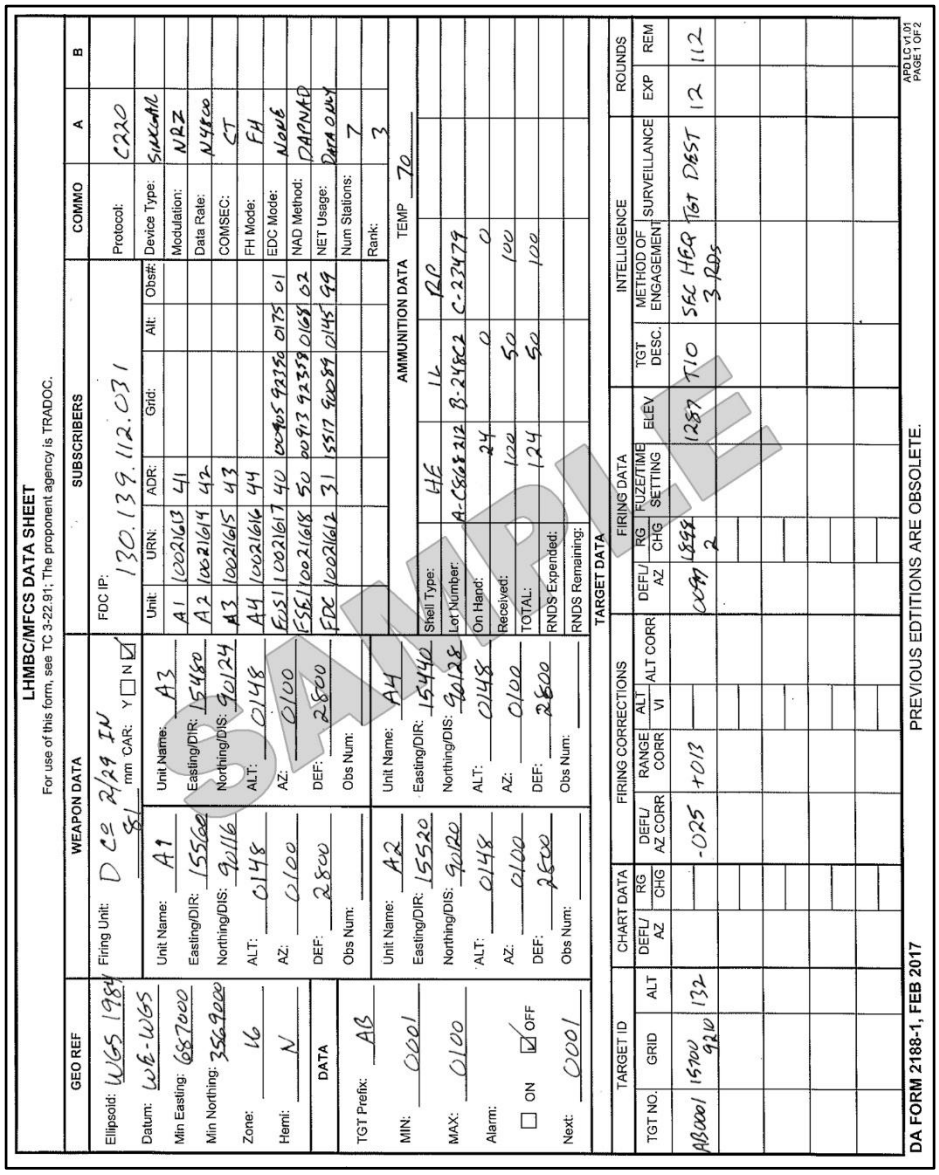


Figure 2-3. Sample completed DA Form 2188-1 (LHMBC/MFCS Data Sheet)

2-44. The FDC uses the geographic reference (GEOREF) field to record the GEOREF data. Table 2-7 highlights the fields found in this section and provides more information about each area.

Table 2-7. Geographic reference field titles and information documented in each field

Field	*Information Documented in Field*
Ellipsoid	Default is World Geodetic System (WGS) 1984, Set to <ALL> to view all data.
Datum	When the Ellipsoid is set, the corresponding default datum is set.
Min Easting	Minimum Easting coordinates from the map sheet.
Min Northing	Minimum Northing coordinates from the map sheet.
Zone	Zone coordinates from the map sheet.
Hemi (hemisphere)	Set to North if north of the equator; set to South if south of the equator.

DATA FIELD

2-45. The FDC uses this field to record the firing element's setup data. Tables 2-8 and 2-9 highlight the fields found in this section and provide more information about each area.

Table 2-8. Data field titles and information documented in each field

Field	*Information Documented in Field*
TGT PRFX (target prefix)	Target prefix used by the firing element.
MIN (minimum)	The first number in the unit's designated target block.
MAX (maximum)	The last number in the unit's designated target block.
Alarm	Alarm on and off function for messages.
Next	The target number to be assigned to the next mission.

Table 2-9. Data field titles and information documented in each field Weapon Data Field

Field	*Information Documented in Field*
TGT PRFX (target prefix)	Target prefix used by the firing element.
MIN (minimum)	The first number in the unit's designated target block.
MAX (maximum)	The last number in the unit's designated target block.
Alarm	Alarm on and off function for messages.
Next	The target number to be assigned to the next mission.

WEAPON DATA FIELD

2-46. The FDC uses this field to record the firing element's weapon initialization data. Table 2-10, page 28 highlights the fields found in this section and provides more information about each area.

Table 2-10. Weapon data field titles and information documented in each field

Field	*Information Documented in Field*
Firing Unit	Unit mortar element assigned.
mm CAR: Y/N	Weapon type mounted or dismounted.
Unit Name	Designation given to the specific weapon (for example, A1).
Easting/DIR	The Easting portion of the grid coordinate or the direction to the mortar from the base piece.
Northing/DIS	The Northing portion of the grid coordinate or the distance to the mortar from the base piece.
ALT	The mortar's altitude/elevation in meters.
AZ	The mounting azimuth used by the firing element for degraded ops.
DEF	Deflection used by the firing element for degraded ops.
Obs Num	Observer number of the firing unit (if used). ***Note.*** Continue to fill out until all weapons have been recorded for firing section.
Legend: ALT—Altitude; AZ—Azimuth; CAR—Carrier; DEF—Deflection; DIR—Direction; DIS—Distance; mm—millimeter; Obs Num—observer number; Y/N—yes/no	

SUBSCRIBERS FIELD

2-47. The FDC records the observer(s) and additional friendly units' information in this field. Any unit with which the FDC wishes to digitally communicate must be on this list. Table 2-11 highlights the fields found in this section and provides more information about each area.

Table 2-11. Subscribers field titles and information documented in each field

Field	*Information Documented in Field*
FDC IP (Fire Direction Center Internet protocol)	Supplied by unit signal officer. This 12-digit address will set the first nine digits of the IP address for all subscriber units.
Unit	Designation assigned to a given subscriber. The first character must be a letter.
URN (Unit Reference Number)	Unit Reference Number. Supplied by the unit's signal officer. The URN of the Force XXI Battle Command, brigade and below (FBCB2) computer and the URN of the Mortar Fire Control System (MFCS) are different, even though they refer to the same unit.
ADR (Address)	The last three digits of the 12-digit IP address for the subscriber.
Grid	Grid coordinates of the subscriber's location.
Alt	Altitude/elevation at the subscriber's location.
Obs# (Observer number)	Observer number if the subscriber is acting as an observer.

COMMUNICATION FIELD

2-48. The FDC records the communication (Commo) information in this field. Table 2-12, page 30 highlights the fields found in this section and provides more information about each area.

Table 2-12. Commo field titles and information documented in field

Field	*Information Documented in Field*
Protocol	6017, 6017A, 6017B.
Device Type	Set to single-channel ground and airborne radio system (SINCGARS) if using frequency modulation communications or two wire for a hardwired connection.
Modulation	Either Nonreturn to Zero (NRZ) or Frequency Shift KeyingFSK188C.
Data Rate	Speed that data is transferred on the network, ranging from 75 to 1,200 bits per second (bps).
Communications security (COMSEC)	Select cipher text (CT) for secure communications or plain text (PT) for unsecured communications.
Frequency hop (FH) Mode	Select FH for frequency hop or single channel (SC) for single channel communications.
Error detection and correction (EDC) Mode	Selectable modes include forward error correction, time-dispersal coding, and scrambling.
Network Access Delay (NAD) Method	Deterministic adaptable priority network access delay (DAPNAD) (default), hybrid, priority random, or round-robin (lightweight handheld mortar ballistic computer [LHMBC] only).
Network (NET) Usage	Data or data and voice. Voice takes priority on networks that are data and voice enabled, significantly increasing data transmission times.
# Stations	Number of stations using the network.
Rank	Rank of the Fire Direction Center (FDC) in the network.

Ammunition Data Field

2-49. The FDC monitors records the rounds using this section. This section is filled out in the same manner as DA Form 2188.

Target Data Field

2-50. The FDC records previously fired targets using this section. This section is filled out in the same manner as DA Form 2188.

ANGLE T

2-51. Angle T is the angle, or difference in mils, between the observer-target (OT) line and gun-target line (GTL). (See figure 2-4.) Angle T is not important to the FDC when computing, but the FDC notifies the FO if angle T is between 500 and 2700 mils so the FO can cut the corrections in half to compensate for dispersion.

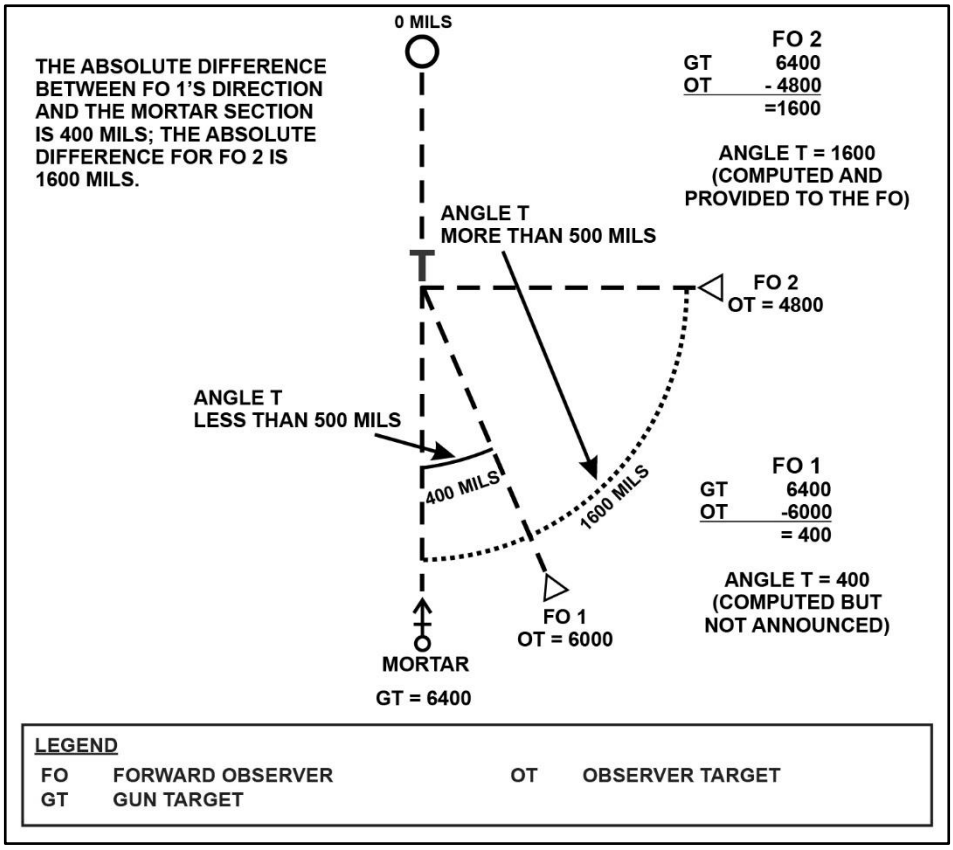


Figure 2-4. Angle T between 400 and 1,600 mils

2-52. The computer determines angle T to the nearest mil, records it to the nearest 10 mils, and announces it to the observer to the nearest 100 mils when requested or if angle T is between 500 and 2700 mils. To determine angle T, the computer compares the OT azimuth and gun target (GT) azimuth, subtracting the smaller from the larger (see examples 1 through 3):

- GT azimuth is the azimuth that corresponds to the initial chart deflection of the target being engaged.
- OT azimuth is the azimuth that the observer gives in the CFF or with the first correction.

Note. For shift from a known point and polar plot missions, the FO sends the OT azimuth in the CFF. For grid missions, however, the FO may not send the OT azimuth in the CFF, but the FO sends it before or with the first subsequent adjustment.

EXAMPLE 1

If OT = 2950 mils and GT = 3190 mils, then 3190-2950 = 240 mils (angle T).

EXAMPLE 2

Consider OT = 6210 mils and GT = 0132 mils. Because the azimuths are on either side of 6400 (0), subtracting the smaller from the larger would not yield the angle T. The computer must add 6400 to the smaller value, and then subtract from the larger value:

0132 + 6400 = 6532
6532 - 6210 = 322, recorded as 320

Note. Use this procedure only when one azimuth is between 0 (6400) and 1600, and one is between 4800 and 6400.

EXAMPLE 3

For an angle T exceeding 499 mils, subtract the smaller from the larger.

Note. If angle T does not exceed 499 mils, angle T will not be sent to the FO.

If OT = 1530 mils and GT = 810 mils, then 1530 - 810 = 720 mils (angle T).

2-53. Because angle T exceeds 499 mils in the third example, the FDC notifies the observer so the observer can use this information to make any corrections. When angle T exceeds 499 mils, the FO continues to use the OT factor to make deviation corrections (see figure 2-5), but if the correction is more than requested, the FO reduces the deviation corrections proportionately.

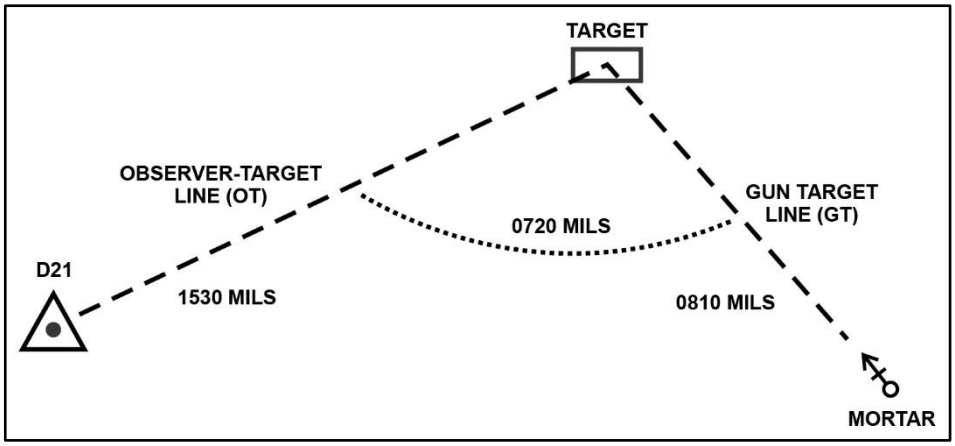


Figure 2-5. Angle T greater than 499 mils

METEOROLOGICAL MESSAGE

2-54. MET messages provide information about air temperature and density, and the speed and direction of the wind between the mortar and the targets. The validity of a MET message decreases over time. There are no specific rules for determining how long a MET message is usable since that determination depends on the atmospheric conditions. However, 4 hours is considered the maximum usable duration for a MET message.

Note. Mortar units request an 11-line (00-10) MET message as standard.

DA FORM 3677 (COMPUTER MET MESSAGE)

2-55. DA Form 3677 (*Computer MET Message*) allows the user to record MET data received so that the section has better accuracy and target effect.

2-56. To be valid, the MET message must be received with the initial registration mission. To ensure that the first MET message is current, the FDC requests a MET message shortly after setting up the surveyed firing chart. This message alone is inadequate to determine firing corrections, but it tells the FDC how many registration corrections are weather-related. After the FDC receives and computes the first MET message, the FDC receives a second within 4 hours, compares the two, and determines the data used to update the firing equipment.

2-57. In the modular force, each brigade combat team has one MET system in the fires battalion. Each fires brigade has three MET systems; however, due to a lack of assets, each fires brigade initially fields one MET system. The field artillery unit operations officer coordinates with the MET station leader and unit signal staff officers to prioritize the means of communicating and disseminating messages, and to assign radio frequencies. If a ballistic MET message is necessary (such as when only the M16 plotting board is used), the MET message can be transmitted by any means, including a digital plain text message (PTM).

RECEIPT OF THE METEOROLOGICAL MESSAGE

2-58. The MET message has two parts: the introduction and the body. It is broadcast in six-character groups, as shown in figure 2-6. The sample of completed DA Form 3677 (see figure 2-7) use the same six-character groups to show how they are entered on the form.

Note. See TC 3-09.81 for guidance concerning the use of the previously mentioned forms.

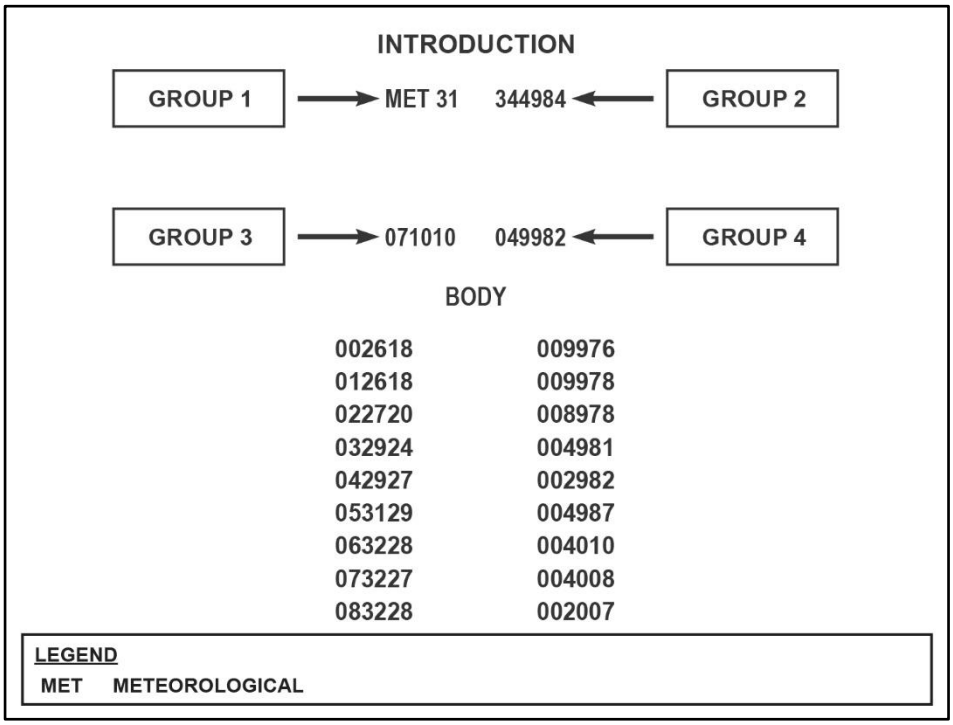


Figure 2-6. Six-character groups

COMPUTER MET MESSAGE

For use of this form, see TC 3-09.81 the proponent agency is TRADOC.

IDENTIFICATION	OCTANT	LOCATION $L_aL_aL_a$ or xxx	LOCATION $L_oL_oL_o$ or xxx	DATE	TIME (GMT)	DURATION (HOURS)	STATION HEIGHT (10's M)	MDP PRESSURE MB
METCM	Q			YY	$G_oG_oG_o$	G	hhh	$P_dP_dP_d$
METCM	1	347	984	07	138	0	036	974

ZONE HEIGHTS METERS	LINE NUMBER	ZONE VALUES: WIND DIRECTION (10s M)	WIND SPEED (KNOTS)	TEMPERATURE (1/10°K)	PRESSURE (MILLIBARS)
	ZZ	ddd	FFF	TTTT	PPPP
SURFACE	00	329	003	3060	0974
200	01	362	006	3040	0959
500	02	406	014	3030	0933
1000	03	403	018	3020	0891
1500	04	378	010	2990	0842
2000	05	356	007	2950	0795
2500	06	329	004	2910	0750
3000	07	304	004	2870	0707
3500	08	299	004	2840	0665
4000	09	306	004	2800	0627
4500	10	321	004	2770	0590
5000	11	349	003	2740	0554
6000	12	415	003	2690	0504
7000	13	438	003	2630	0443
8000	14	443	003	2580	0389
9000	15	494	004	2510	0340
10000	16	257	007	2430	0296
11000	17	252	009	2350	0256
12000	18	482	006	2270	0221
13000	19	423	007	2190	0190
14000	20	390	007	2120	0162
15000	21	350	005	2070	0137
16000	22	300	007	2040	0115
17000	23	174	008	2020	0115
18000	24	156	008	2020	0098
19000	25	153	017	2040	0070
20000	26	152	019	2070	0059

FROM B BTRY 1-30TH FA TO A BBRTY 1-30TH FA	DATE AND TIME (GMT) 270800RMAY13	DATE AND TIME (LST) 270800RMAY13
MESSAGE NUMBER 1307-04	RECORDER RB	CHECKED RB

DA FORM 3677, JAN 2016 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.00

SAMPLE

LEGEND

BTRY	BATTERY	LST	LOCAL STANDARD TIME
FA	FIELD ARTILLERY	MB	MILLIBARS
GMT	GREENWICH MEAN TIME	MDP	METEOROLOGICAL DATUM PLANE

Figure 2-7. Sample completed DA Form 3677 (Computer MET Message)

Introduction Character Groups

2-59. The first four-character groups are the introduction of the MET message and identify the type of message and the MET station transmitting the message. Table 2-13 identifies these character groups and explains their meanings.

Table 2-13. Character groups in the introduction and their corresponding meanings

Character	*Meaning*
Group 1: (MET is meteorological/B indicates ballistic/CM indicates computer message) MET B/CM 31 (MET CM for computer MET)	
MET	Indicates that the transmission is a MET message.
B (CM)	Type of fire; indicates that the message is a ballistic (computer) MET message.
3	Indicates that the message is for surface-to-surface fire. ***Note.*** For use with mortars, the number 3 must appear.
1	Indicates the octant of the globe in which the MET message applies. When code 9 is sent for the octant, the area is transmitted in code, not in numbers. ***Note.*** Octants are further defined in the firing tables.
Group 2: 344985	
344	Indicates the latitude of the center of the area, expressed to the nearest 10th of a degree.
985	Indicates the longitude of the center of the area, expressed to the nearest 10th of a degree.
Group 3: 071010	
07	Indicates the day of the month.
101	Indicates the hour the period of validity begins, expressed to the nearest 10th of an hour, Greenwich mean time (GMT). ***Note.*** To convert GMT to standard time, see Training Circular 3-09.81.
0	Indicates the duration of the MET message. ***Note.*** For U.S. Armed Forces, the MET data is presumed valid until a later message is received.
Group 4: 049982	
049	Indicates the altitude/elevation of the MET station above sea level, expressed in 10s of meters.
982	Indicates the atmospheric pressure at the MET datum plane (MDP), expressed to the nearest 1/10 of a percent of standard atmospheric pressure at sea level. ***Note.*** When this value is 100 or greater, the initial digit 1 is omitted.

Body Character Groups

2-60. The next group of six-character groups contain MET data body listed by line number. Figure 2-8 depicts the relationship of the line numbers and zone heights to the meteorological datum plane (MDP). Table 2-14, page 38 identifies two of the character

groups and explains their meanings. The remaining lines contain the same information. Because of the height at which mortars can fire, not all 16 lines are applicable for mortars; only the first 11 lines (00-10) need to be recorded. (See figure 2-7, page 35.)

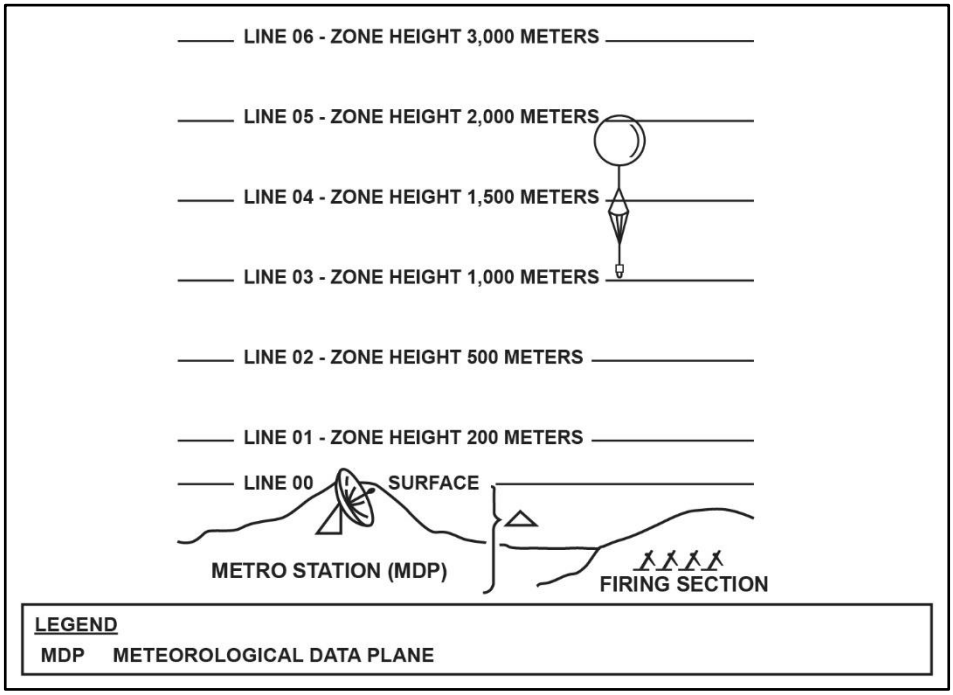


Figure 2-8. Line number and zone height relative to meteorological data plane

Table 2-14. Character groups in the body and their corresponding meanings

Character	*Meaning*
002618	
00	The line number indicating the standard height relative to the meteorological (MET) datum plane (MDP).
26	The direction from which the ballistic wind is blowing (measured clockwise from north, expressed in 100s of mils). Example: This number represents 2600 mils.
18	The ballistic wind speed to the nearest knot. Example: This number represents 18 knots.
009976	
009	The ballistic air temperature to the nearest 0.1 percent of standard. ***Note.*** The initial digit 1 is omitted when the value is 100 or greater.
976	The ballistic air density to the nearest 0.1 percent of standard. ***Note.*** As with temperature, the initial 1 is omitted when the value is 100 or greater.

Recording of the Meteorological Message

2-61. As the battalion headquarters sends the MET message, the computer records it on the DA Form 3677. (See TC 3-09.81 for guidance on the use of these forms.) If the computer misses something or records the wrong information during the transmission, the format of the form allows the computer to ask for that portion of the message to be repeated.

Meteorological Message Computation

2-62. After recording the MET message, the FDC uses DA Form 2601-1 to compute the MET and determines the corrections that will be applied when updating the firing equipment. (See figure 2-9, page 40 and figure 2-10, page 41.) Personnel record known data in the proper spaces on the form (obtained from DA Form 2188, DA Form 2188-1, or section leader).

2-63. Table 2-15 highlights the fields found in this form and provides more information about each area.

Table 2-15. DA Form 2601-1 (MET Data Correction Sheet for Mortars) field titles and information documented in each field

Field	*Information Documented in Field*
Charge	The command charge used to hit the registration point (RP). ***Note.*** This charge is used to determine the line number to be used for computing the message.
Chart Range	The command range from the mortar platoon or section to the RP. ***Note.*** Using the command charge and range puts the round at its highest ordinate for that range, where the round is affected most.
Elevation	The elevation used to hit the RP.
Altitude of Mortars	The altitude/elevation of the mortar to the nearest 10 meters.
Line Number	The number in this field is used for the meteorological (MET) and can be recorded before the MET message is received. To do so, the computer enters the firing tables as follows: • Find the command charge. Go to column 1 (range) and find the command range. Go to column 5. The number at that range in column 5 is the line number. • Once the fire direction center (FDC) has received and recorded the MET message, record the introduction and information from the line number being used. • Since the altitude of the MET datum plane (MDP) is expressed in 10s of meters and the wind direction is expressed in 100s of mils, change them to read their actual values. Then, determine the MET values (the corrections for this MET).
Direction of Fire	The azimuth to the RP to the nearest 100 mils.
Powder Temp	The temperature of the propellants. ***Note.*** If the temperature of the powder cannot be determined, air temperature at the platoon or section can be used.

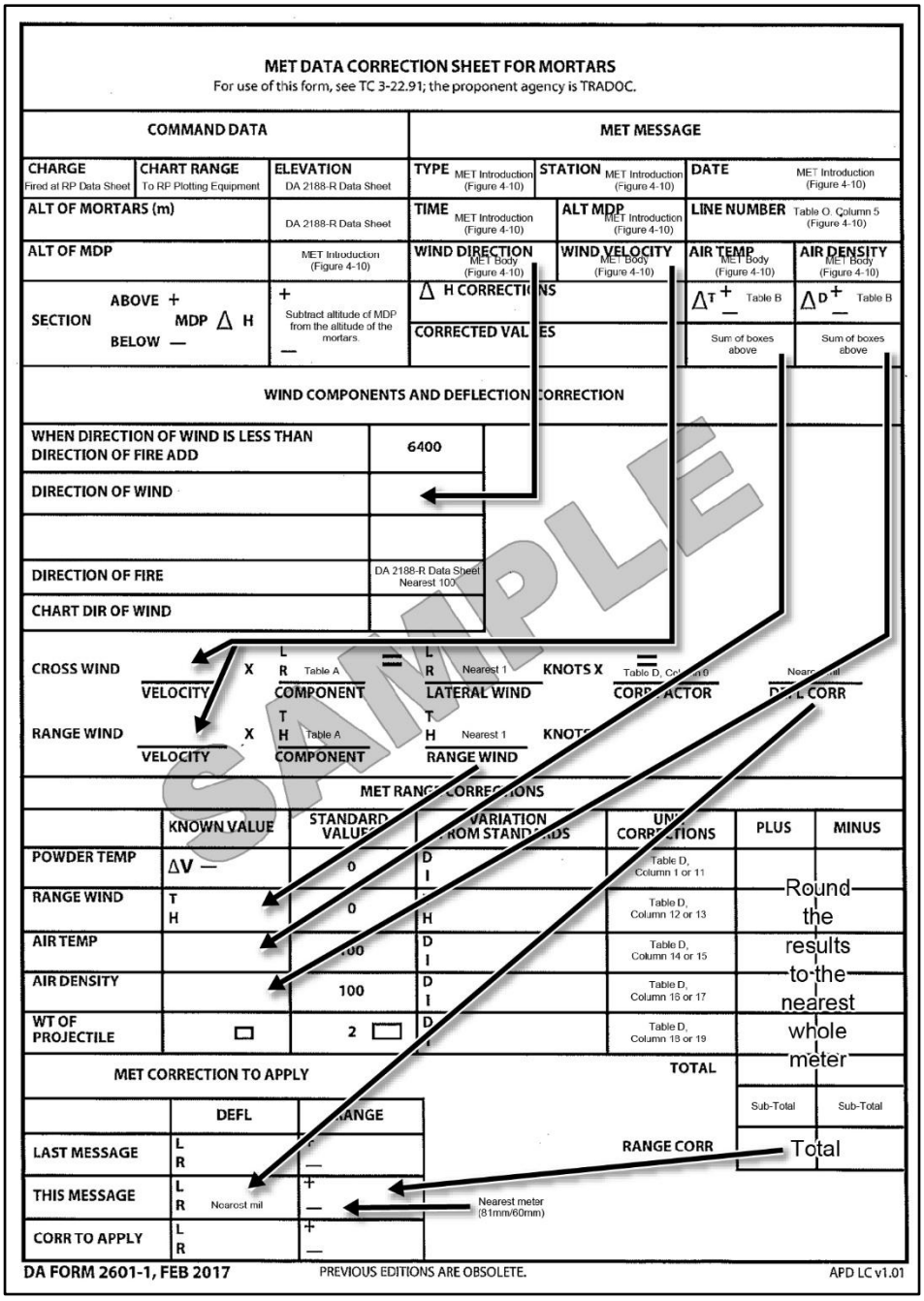


Figure 2-9. Data guide for DA Form 2601-1 (MET Data Correction Sheet for Mortars)

MET DATA CORRECTION SHEET FOR MORTARS
For use of this form, see TC 3-22.91; the proponent agency is TRADOC.

COMMAND DATA			MET MESSAGE				
CHARGE 4	CHART RANGE 1811	ELEVATION 1178	TYPE 3	STATION 344983	DATE 12		
ALT OF MORTARS (m)	460		TIME 1430	ALT MDP 370	LINE NUMBER 3		
ALT OF MDP	370		WIND DIRECTION 2400	WIND VELOCITY 19	AIR TEMP 103.9	AIR DENSITY 97.4	
SECTION (ABOVE +) BELOW — MDP Δ H	(+) 90 (—)		Δ H CORRECTIONS		Δ T (+) 0.2	Δ D (+) .9	
			CORRECTED VALUES		103.7	96.5	

WIND COMPONENTS AND DEFLECTION CORRECTION

WHEN DIRECTION OF WIND IS LESS THAN DIRECTION OF FIRE ADD	6400
DIRECTION OF WIND	2400
	8800
DIRECTION OF FIRE	4800
CHART DIR OF WIND	4000

CROSS WIND 19 (VELOCITY) X (L) R .71 (COMPONENT) = (L) R 13.5 (LATERAL WIND) KNOTS X ~~7.4~~ (CORR FACTOR) L19 (DEFL CORR)

RANGE WIND 19 (VELOCITY) X (T) H .71 (COMPONENT) (T) H 13.5 (RANGE WIND) KNOTS

MET RANGE CORRECTIONS

	KNOWN VALUE	STANDARD VALUES	VARIATION FROM STANDARDS	UNIT CORRECTIONS	PLUS	MINUS
POWDER TEMP 77°F	ΔV +.3	0	D (I) .3	−15.3		5
RANGE WIND	(T) H 13.5	0	(C) H 13.5	−2.9		39
AIR TEMP	103.7	100	D (I) 3.7	Ø	Ø	
AIR DENSITY	96.5	100	D (I) 3.5	−3.7		13
WT OF PROJECTILE	□	2 □	D I NA			
MET CORRECTION TO APPLY				TOTAL		57
				RANGE CORR		57

	DEFL	RANGE
LAST MESSAGE	L R	+ —
THIS MESSAGE	(L) R 19	+ (—) 57
CORR TO APPLY	L R	+ —

DA FORM 2601-1, FEB 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.01

SAMPLE

Figure 2-10. Sample completed DA Form 2601-1 (MET Data Correction Sheet for Mortars)

Air Temperature and Air Density Corrections

2-64. To determine the corrected values for air temperature and density, take the following actions:

- The computer determines the location of the platoon or section in relationship to the MDP (difference in height [also called H] correction).
  - To do so, the FDC compares the altitude of the section and the MDP and subtracts the smaller from the larger.
  - The remainder is the height of the platoon or section above or below the MDP.

Note. If the altitude of the section is above the MDP, the sign is plus (+); if below, the sign is minus (-).

- Once the FDC has calculated the distance above or below the MDP, the FDC can enter Table B (see figure 2-11), which shows the correction that must be applied to the ballistic AIR TEMP AIR DENSITY on the DA Form 2601-1 (see figure 2-11).
  - This correction compensates for the difference in altitude between the platoon or section and the MDP and determines the corrections for AIR TEMP (difference in T) and AIR DENSITY (difference in D).
  - Those corrections modify the AIR TEMP and AIR DENSITY determined at the MDP to determine values at the mortar platoon or section.
  - Corrections for a difference in T and a difference in D are arranged in four double rows in the table.
- The numbers 0, +100-, +200-, and +300- in the left column of the table represent a difference in H expressed in 100s of meters.
  - The numbers 0 and +10- through +90- across the top represent a difference in H in 10s of meters.
  - The corrections can be found where the proper 100s row crosses the proper 10s column.
  - The numerical sign of the corrections is opposite of the difference in H sign.

EXAMPLE

Assume that the difference in H is -30, the corrected value for the difference in H is +0.1, and the difference in D is +0.3. (Enter a 0 in 100s column, go across to +30-column.) Those corrections are entered on DA Form 2601-1, and the corrected values then can be determined and recorded in the proper spaces.

CHARGE 2

TABLE B

FT 81-AR-2

TEMPERATURE AND DENSITY CORRECTIONS

CTG, HE, M821
FUZE, MO, M734

CORRECTIONS TO TEMPERATURE (DT) AND DENSITY (DD), IN PERCENT, TO COMPENSATE FOR THE DIFFERENCE IN ALTITUDE, IN METERS, BETWEEN THE BATTERY AND THE MDP

DH		0	+10-	+20-	+30-	+40-	+50-	+60-	+70-	+80-	+90-
0	DT	0.0	0.0	0.0	-0.1+	-0.1+	-0.1+	-0.1+	-0.2+	-0.2+	-0.2+
	DD	0.0	-0.1+	-0.2+	-0.3+	-0.4+	-0.5+	-0.6+	-0.7+	-0.8+	-0.9+
+100-	DT	-0.2+	-0.2+	-0.2+	-0.3+	-0.3+	-0.3+	-0.3+	-0.4+	-0.4+	-0.4+
	DD	-1.0+	-1.1+	-1.2+	-1.3+	-1.4+	-1.5+	-1.6+	-1.7+	-1.8+	-1.9+
+200-	DT	-0.5+	-0.5+	-0.5+	-0.6+	-0.6+	-0.6+	-0.6+	-0.7+	-0.7+	-0.7+
	DD	-2.0+	-2.1+	-2.2+	-2.3+	-2.4+	-2.5+	-2.6+	-2.7+	-2.8+	-2.9+
+300-	DT	-0.7+	-0.7+	-0.7+	-0.8+	-0.8+	-0.8+	-0.8+	-0.9+	-0.9+	-0.9+
	DD	-3.0+	-3.1+	-3.2+	-3.3+	-3.4+	-3.5+	-3.6+	-3.7+	-3.8+	-3.9+

NOTES - 1. DH IS BATTERY HEIGHT ABOVE OR BELOW THE MDP.
2. IF ABOVE THE MDP, USE THE SIGN BEFORE THE NUMBER.
3. IF BELOW THE MDP, USE THE SIGN AFTER THE NUMBER.

LEGEND

CTG	CARTRIDGE	MDP	METEOROLOGICAL DATUM PLANE
FT	FIRING TABLE	MO	MULTI-OPTION FUZE
HE	HIGH EXPLOSIVE		

Figure 2-11. Example page from firing table for air temperature and density corrections

Wind Component Corrections

2-65. To determine corrections for wind components, take the actions in the example. The computer compares the direction of wind and the direction of fire (DOF). If the direction of wind is less than the DOF, it adds 6400 mils, and then subtracts the DOF.

EXAMPLE

DOF 4300
DIRECTION OF WIND (MET) 2900
2900 + 6400 = 9300 - 4300 = 5000 mils (chart direction of wind)
The FDC then uses the remainder (CHART DIRECTION OF WIND) to enter Table A at the CHART DIRECTION OF WIND. (See figure 2-12.) Table A divides a one-knot wind into crosswind and range wind components to show the effect on a round in flight. The chart direction of wind is the angle formed by the DOF and direction of wind.
The computer reads across that row to find the crosswind and range wind components and records them in the proper spaces in DA Form 2601-1.
Once the wind components have been determined, the computer determines crosswind and range wind corrections.

FT 81-AR-2 TABLE A CHARGE 2

CTG, HE, M821
FUZE, MO, M734 WIND COMPONENTS

COMPONENTS OF A ONE KNOT WIND

CHART DIRECTION OF WIND MIL	CROSS WIND KNOT	RANGE WIND KNOT	CHART DIRECTION OF WIND MIL	CROSS WIND KNOT	RANGE WIND KNOT
0	0	H1.00	3200	0	T1.00
100	R.10	H.99	3300	L.10	T.99
200	R.20	H.98	3400	L.20	T.98
300	R.29	H.96	3500	L.29	T.96
400	R.38	H.92	3600	L.38	T.92
500	R.47	H.88	3700	L.47	T.88
600	R.56	H.83	3800	L.56	T.83
700	R.63	H.77	3900	L.63	T.77
800	R.71	H.71	4000	L.71	T.71
900	R.77	H.63	4100	L.77	T.63
1000	R.83	H.56	4200	L.83	T.56
1100	R.88	H.47	4300	L.88	T.47
1200	R.92	H.38	4400	L.92	T.38
1300	R.96	H.29	4500	L.96	T.29
1400	R.98	H.20	4600	L.98	T.20
1500	R.99	H.10	4700	L.99	T.10
1600	R1.00	0	4800	L1.00	0
1700	R.99	T.10	4900	L.99	H.10
1800	R.98	T.20	5000	L.98	H.20
1900	R.96	T.29	5100	L.96	H.29
2000	R.92	T.38	5200	L.92	H.38
2100	R.88	T.47	5300	L.88	H.47
2200	R.83	T.56	5400	L.83	H.56
2300	R.77	T.63	5500	L.77	H.63
2400	R.71	T.71	5600	L.71	H.71
2500	R.63	T.77	5700	L.63	H.77
2600	R.56	T.83	5800	L.56	H.83
2700	R.47	T.88	5900	L.47	H.88
2800	R.38	T.92	6000	L.38	H.92
2900	R.29	T.96	6100	L.29	H.96
3000	R.20	T.98	6200	L.20	H.98
3100	R.10	T.99	6300	L.10	H.99
3200	0	T1.00	6400	0	H1.00

NOTE - FOR A COMPLETE EXPLANATION OF THE USE OF THIS TABLE, SEE PAGE XXXII.

LEGEND

CTG	CARTRIDGE	MDP	METEOROLOGICAL DATUM PLANE
FT	FIRING TABLE	MO	MULTI-OPTION FUZE
HE	HIGH EXPLOSIVE		

Figure 2-12. Sample page from firing table for wind components

Crosswind Deflection Correction

2-66. To determine the deflection correction (DEFK)—

- The computer multiplies the wind speed (Table A) by the wind velocity (MET). This yields the lateral wind.
- Once the lateral wind is determined, the FDC enters Table D (see figure 2-13), goes to column 7 (60-mm, 81-mm, 120-mm mortars), and finds the correction factor.
- The FDC records the correction factor in the proper space, multiplies it by the lateral wind, carries the sign of the component (left/right), and determines the product to the nearest mil.
- The product is the DEFK for this MET. The computer records it in the proper space on DA Form 2601-1.

CHARGE 4 — TABLE D — FT 120-E-1

BASIC DATA — CTG, HE, M934 FUZE, MO, M734

1	2	3	4	5	6	7
RANGE	ELEV	D ELEV PER 100 M DR	APPROX NO. OF TURNS PER 100 M DR	LINE NO.	TIME OF FLIGHT	AZIMUTH CORRECTION CW OF 1 KNOT
M	MIL	MIL			SEC	MIL
6800	912	31	7	5	44.9	0.8
6825	904	33	7	5	44.7	0.8
6850	895	35	8	5	44.4	0.8
6875	887	38	8	5	44.1	0.8
6900	877	41	9	5	43.7	0.8
6925	866			5	43.4	0.8
6950	854			5	42.9	0.8
6975	841			5	42.5	0.8
7000	824			5	41.8	0.7
7024	800			5	40.9	0.7

LEGEND

APPROX	APPROXIMATE	FT	FIRING TABLE
CTG	CARTRIDGE	HE	HIGH EXPLOSIVE
CW	CROSS WIND	M	METER
D ELEV	DIFFERENCE (CHANGE) IN ELEVATION	M/O	MULTI-OPTION FUZE
DR	DIFFERENCE IN RANGE	NO.	NUMBER
		SEC	SECOND

Figure 2-13. Sample pages from firing table for basic data and correction factors

Range Wind

2-67. To determine the range wind, the computer takes the following actions:

- Multiplies the component by the wind speed.
- Carries the sign of the component (H or T from Table D).
- Determines to the nearest 0.1 mil.
- Records it in the proper space on DA Form 2601-1.

Range Corrections

2-68. All values are recorded in the proper spaces except deviation, which is found as follows:

- The computer enters Table C, which shows the corrections to the muzzle velocity for various temperatures of the propellant charges (see figure 2-14, page 48).
- The FDC finds the temperature closest to that recorded for the propellant; deviation appears in the center column on the same line as the temperature.
- The computer records that value in the proper space.
- Then, the FDC determines the amount by which all known values vary from the standard values upon which the FTs are based.

Note. Within the FTs, D means decrease from standard, and I means increase from standard.

- Once those variations are determined, the computer enters Table D (Command Charge and Range, 60-mm/81-mm/120-mm mortar, figure 2-13) goes to columns 8 to 15 (60-mm, 81-mm, and 120-mm), and records the unit corrections for each variation.

Note. The sign of the unit correction must be recorded; numbers without a sign are a plus (+). If the column ends, the last listed numbers are considered to continue.

FT 81-AR-2 TABLE C CHARGE 2

CTG, HE, M889
FUZE, PD, M935

PROPELLANT TEMPERATURE

VARIATIONS IN MUZZLE VELOCITY DUE TO PROPELLANT TEMPERATURE

TEMPERATURE OF PROPELLANT	VARIATION IN VELOCITY	TEMPERATURE OF PROPELLANT
DEGREES F	M/S	DEGREES C
-40	-4.9	-40.0
-35	-4.8	-37.2
-30	-4.6	-34.4
-25	-4.4	-31.7
-20	-4.2	-28.9
-15	-4.0	-26.1
-10	-3.8	-23.3
-5	-3.6	-20.6
0	-3.4	-17.8
5	-3.2	-15.0
10	-2.9	-12.2
15	-2.7	-9.4
20	-2.5	-6.7
25	-2.3	-3.9
30	-2.0	-1.1
35	-1.8	1.7
40	-1.5	4.4
45	-1.3	7.2
50	-1.0	10.0
55	-0.8	12.8
60	-0.5	15.6
65	-0.3	18.3
70	0.0	21.1
75	0.3	23.9
80	0.5	26.7
85	0.8	29.4
90	1.1	32.2
95	1.4	35.0
100	1.7	37.8
105	2.0	40.6
110	2.3	43.3
115	2.6	46.1
120	2.9	48.9
125	3.2	51.7
130	3.5	54.4

Figure 2-14. Sample page from firing table for propellant temperature

- Once the variations have been recorded, the computer multiplies the variations from standard by the unit corrections and places the result (rounded to the nearest whole meter) in the column with the same sign as the unit correction.
- Once all corrections have been multiplied, the computer compares the minus (-) and plus (+), subtracts the smaller form from the larger, and uses the sign of the larger.
- The FDC determines the result to the nearest meter for 60-mm, 81-mm, 120-mm mortars and records it in the proper space.

2-69. The target area usually is larger than the transfer limits of the RP. However, time, ammunition, and the tactical situation will permit firing only one registration.

2-70. By assuming negligible error in surveys or maps, lay of the weapons, and preparation of the plotting boards, MFCS, or LHMBC computer, the FDC can divide registration corrections for the RP into two corrections. The first is a function of the range fired; it is constant for a given range, regardless of direction. The second is a function of the direction fired.

2-71. If the amount of concurrent MET computed for the RP is subtracted from the total registration correction, the result is an absolute registration correction that does not change with the direction fired or the weather. The FDC then can plot an imaginary RP at the same range as the original RP, but in other directions (800 mils apart), compute a MET correction for each of those directions, and, by adding the different MET corrections to the absolute registration correction, determine different firing corrections for each of the imaginary RPs. The firing corrections determined for the imaginary RPs can be applied when engaging targets within their transfer limits.

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Chapter 3

Foundation of Fire Direction

This chapter discusses the elements of firing data and ballistics, FTs, fire planning, target analysis, and methods of attack. This information enables the FDC to engage the enemy, even during adverse conditions.

SECTION I – ELEMENTS OF FIRING DATA

3-1. Indirect fire Infantryman apply firing data to ammunition and mortars so that the fired projectile bursts at the desired location. This data is based on the direction, horizontal range, and VI from the mortar to the target; the pattern of bursts desired at the target; and MET conditions.

DIRECTION

3-2. Direction is a horizontal angle measured from a fixed reference point. The indirect fire team measures direction in mils clockwise from grid north (the direction of the north-south grid lines on a tactical map). The team emplaces its mortars on a MAZ and then uses the direction to make angular shifts onto the target. Direction to the target may be computed, determined graphically, or estimated. (See figure 3-1.)

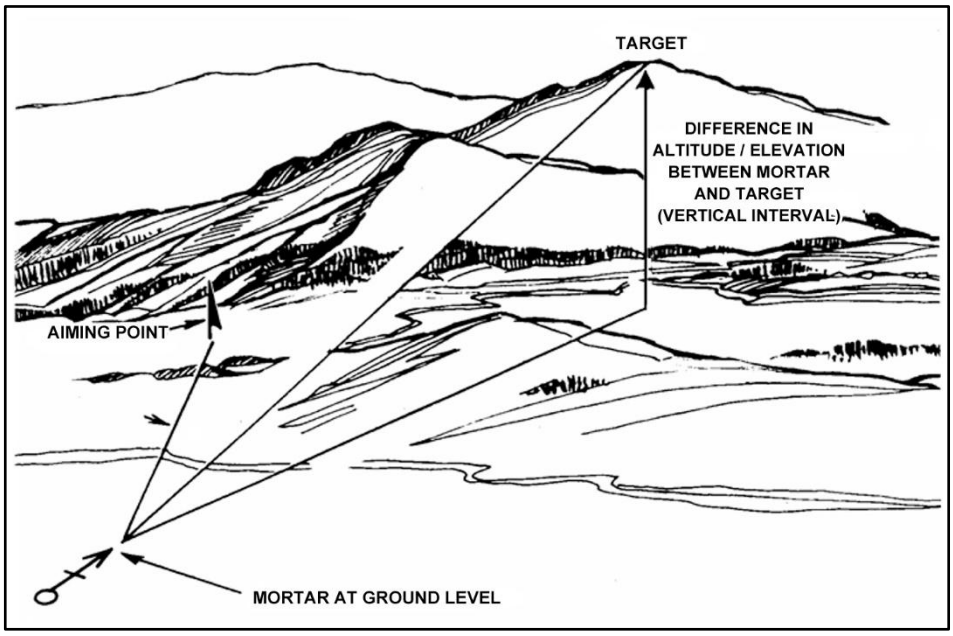


Figure 3-1. Direction to the target

Note. In mortar gunnery, the unit of angular measurement is the mil. A mil equals about 0.056 of a degree. There are 17.8 mils in a degree and 6400 mils in a 360-degree circle.

RANGE

3-3. Range is the computed, measured, or estimated horizontal distance (expressed in meters) from the mortar to the target. The range of a projectile depends on its muzzle velocity and the mortar's elevation.

VERTICAL INTERVAL

3-4. VI is the altitude or elevation difference between the mortar section and the target or point of burst. It is determined using maps, survey, or a shift from a known point.

DISTRIBUTION OF BURSTS

3-5. Distribution of bursts is the pattern of bursts in the target area. When in a standard formation, all mortars of a section or platoon generally fire with the same deflection, fuze setting, charge, and elevation. Since targets may be various shapes and sizes and mortars may use terrain positioning, indirect fire Infantryman either adjust the pattern of bursts to the shape and size of the target or compute and apply individual mortar corrections for deflection, fuze setting, charge, and elevation to achieve a specific pattern of bursts.

INTERIOR BALLISTICS

3-6. Interior ballistics are the factors affecting the motion of a mortar round before it leaves the muzzle of the barrel. The total effect of all interior ballistic factors determines the velocity with which the projectile leaves the muzzle. This type of velocity, called muzzle velocity, is expressed in meters per second (MPS). Muzzle velocity is based on munition, propellant charge, and propellant temperature (Prop Tmp).

TYPES OF MUZZLE VELOCITY

3-7. Tabular firing tables (TFTs), known under the common term: FTs give muzzle velocity for each charge. The two types of velocity are standard and nonstandard.

STANDARD MUZZLE VELOCITY

3-8. Values are based on a standard barrel and are guides. A specific mortar-ammunition combination cannot be selected with the assurance that it results in a standard muzzle velocity when fired. Charge velocities are established indirectly by the weapon's characteristics. Since mortars are high-angle-of-fire weapons, they require greater variation in charges than howitzers, which are capable of low angles of fire. This variation helps achieve a range overlap between charge zones and the desired range trajectory. Other factors considered in establishing charge velocities are the maximum range specified for the weapon and the maximum elevation and charge (with the resulting maximum pressure) that the weapon can accommodate.

NONSTANDARD MUZZLE VELOCITY

3-9. In mortar gunnery, nonstandard velocity is expressed as a variation (plus or minus MPS) from an accepted standard. Round-to-round corrections for dispersion cannot be made. Each factor causing nonstandard muzzle velocity is treated as independent of related factors.

Velocity Trends

3-10. Not all rounds of a series fired from the same weapon using the same ammunition lot will develop the same muzzle velocity. Some muzzle velocities are higher than average, and some are lower. This is called velocity dispersion. Under most conditions, the first few rounds follow a somewhat regular pattern, rather than the random pattern associated with normal dispersion. This is called velocity trend. The magnitude and extent (number of rounds) of velocity trends vary with the mortar, charge, barrel condition, and firings that precede the series. Velocity trends cannot be predicted, so computer personnel should not attempt to correct for their effects.

Ammunition Lots

3-11. Each lot of ammunition has its own performance level when related to the same mortar barrel. Although the round-to-round probable error (PE) within each lot is about the same, the mean velocity developed by one lot may be higher or lower than that of another lot. Variations in the projectile, such as the diameter and hardness of the obturator band, affect muzzle velocity. Projectile variations have a more apparent effect on exterior ballistics than on interior ballistics.

Tolerances in New Weapons

3-12. New mortars of a given size and model do not always develop the same muzzle velocity. In a new barrel, the main factors are variations in the powder chamber and in the interior dimensions of the bore. If a battalion equipped with new mortars fires a common lot of ammunition, mortars with the highest and lowest muzzle velocity will have a velocity difference of 3 or 4 MPS.

Barrel Wear

3-13. Heated gases, chemical action, and friction from projectiles during continued firing wear away the bore. This wear is more pronounced when higher charges are being fired. Barrel wear allows more gases to escape past the obturator band, decreasing resistance to initial projectile movement and lessening pressure buildup, thereby decreasing muzzle velocity. Wear can be reduced by careful selection of the charge and proper cleaning of the weapon and ammunition.

Temperature of the Propellant

3-14. Combustible material burns rapidly when it is heated before ignition. When a propellant burns more rapidly, the resulting pressure on the projectile is greater, increasing muzzle velocity. FTs show the magnitude of that change. Appropriate corrections to firing data can be computed, but such corrections are valid only if they

reflect the true propellant temperature. TFTs are calculated with an ambient air temperature of 70 degrees Fahrenheit.

Note. Currently, mortar units are not equipped as part of their basic issue item with a device or means to measure ammunition accurately or propellant charge temperatures. Computer systems and the FTs adjust ranges affected by propellant charges.

3-15. In the field, the propellant temperature is affected by the prevailing air temperature. The time and type of exposure to weather results in propellant temperature variations. It is not practical to measure propellant temperature and to apply corrections for each round fired by each mortar. Propellant temperatures must be kept uniform; if they are not, firing becomes erratic. A sudden change in propellant temperature can invalidate even the most recent corrections.

3-16. To let propellants reach air temperature uniformly—

- Ready ammunition should be kept off the ground.
- Ammunition should be protected from dirt, moisture, and direct sun.
- An air space should be created between the ammunition and protective covering.
- Unpack enough rounds so that they are not mixed with newly unpacked ammunition.
- Fire rounds in the order in which they are unpacked.

Moisture Content of Propellant

3-17. Handling and storage can cause changes in the moisture content of the propellant, which affects the velocity. Protect ammunition from moisture because moisture content cannot be measured or corrected.

Barrel Temperature

3-18. The temperature of the barrel affects the muzzle velocity. A cold barrel offers more resistance to projectile movement than a warm barrel.

Propellant Residues

3-19. Burned propellant and certain chemical agents mixed with expanding gases leave residue deposits on the bore surface. Thoroughly clean and care for the barrel to prevent such deposits from causing pits in the barrel. (Pitting increases abrasion by the projectiles.)

Oil or Moisture

3-20. Oil or moisture in the barrel or on the obturator band increases a round's velocity by causing a better initial gas seal and reducing projectile friction on the bore surface. However, too much oil or moisture in the barrel decreases velocity, causing a short round.

Exterior Ballistics

3-21. Exterior ballistics, mainly gravity and air, affect the motion of a projectile after it leaves the muzzle of the barrel. Gravity causes the projectile to fall, but air resistance impedes it. Since projectiles of different sizes or weights respond differently to the same atmospheric conditions, their paths differ when they are fired. A given elevation and muzzle velocity can result in a wide variety of trajectories, depending on the combined properties of the projectile and the atmosphere.

TRAJECTORY

3-22. Trajectory is the flight path that a projectile follows from the muzzle of the mortar to its point of impact. (See figure 3-2.) The ascending branch is the portion of the trajectory traced while the projectile rises from its origin. The descending branch is the portion of the trajectory traced while the projectile falls. The apex, the highest point of the trajectory, is located at the end of the ascending branch and at the beginning of the descending branch. The maximum ordinate is the altitude (in meters) at the apex above the point of origin.

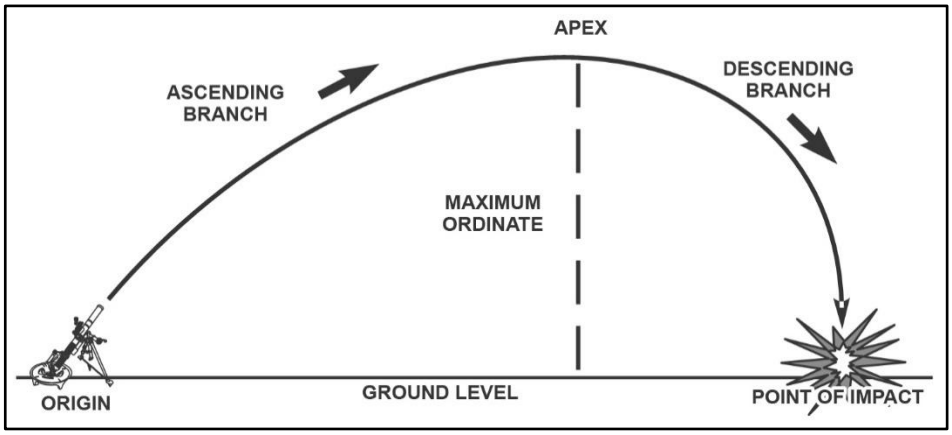


Figure 3-2. Elements of the trajectory

3-23. FTs contain data based on standard and nonstandard trajectories for a given weapon and combination of cartridge, fuze, and propelling charge. A standard trajectory, fired at a given elevation, theoretically exists under arbitrarily chosen conditions of weather and materiel. A nonstandard trajectory exists under conditions of weather and materiel differing from standard conditions.

Trajectory in Atmosphere

3-24. Air's resistance to a projectile depends on the air's movement, density, and temperature. Standard atmosphere (an assumed density and temperature and a condition of no wind) is used to compute FTs.

Characteristics of Trajectory in Standard Atmosphere

3-25. The projectile's velocity at the level point is less than its velocity at its origin. (See figure 3-2, page 55.) The projectile travels slower beyond the apex than before it, so it does not travel as far. Its descending branch is shorter than its ascending branch, and its angle of fall is greater than its angle of elevation. In standard atmosphere, trajectory is affected by the following factors:

- Horizontal velocity decreases with continued time of flight (TOF).
- Vertical velocity is affected by gravity and air resistance.

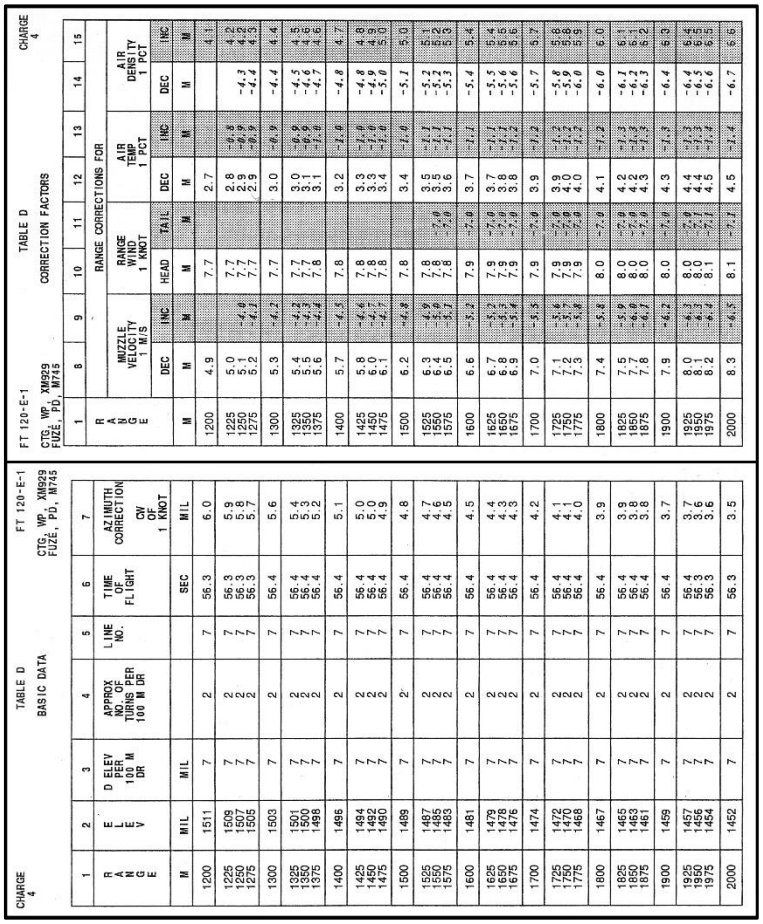
Standard Conditions and Corrections

3-26. As outlined in the introduction to the FTs certain atmospheric and materiel conditions are accepted as standard. When conditions vary from the standard, the trajectory varies. Variations in the following conditions can be measured and corrected:

- Difference in altitude/elevation between the mortar and the target.
- Propellant temperature.
- Ballistic wind.
- Air temperature.
- Air density.

SECTION II – TABULAR FIRING TABLES

3-27. FTs are based on firing the weapon and its ammunition under, or correlated to, standard conditions. (See figure 3-3.) Those standards are used to compensate for variations in the weapon, weather, and ammunition at a given time and place. The atmospheric standards in U.S. FTs reflect the mean annual conditions in the North Temperate Zone. The main elements measured in experimental firing are angle of elevation, angle of departure, muzzle velocity, attained range, and concurrent atmospheric conditions. (See page 51 and appropriate TFTs for more information on FTs.) Electronic copies of mortar TFTs are available through an electronic tabular FT library. The U.S. Army Combat Capabilities Development Command, Armaments Center Firing Tables and Ballistics Division manages access to this library of electronic tabular FTs online.



CHARGE 4 — TABLE D — BASIC DATA — FT 120-E-1 — CTG, WP, XM929 FUZE, PD, M745

1 RANGE M	2 ELEV MIL	3 D ELEV PER 100 M OR MIL	4 APPROX NO. OF TURNS OF FFR 100 M OR	5 LINE NO.	6 TIME OF FLIGHT SEC	7 AZIMUTH CORRECTION CW OF 1 KNOT MIL
1200	1511	7	2	7	56.3	6.0
1225	1508	7	2	7	56.3	5.9
1250	1507	7	2	7	56.3	5.8
1275	1505	7	2	7	56.3	5.7
1300	1503	7	2	7	56.4	5.6
1325	1501	7	2	7	56.4	5.4
1350	1500	7	2	7	56.4	5.3
1375	1498	7	2	7	56.4	5.2
1400	1496	7	2	7	56.4	5.1
1425	1494	7	2	7	56.4	5.0
1450	1492	7	2	7	56.4	5.0
1475	1490	7	2	7	56.4	4.9
1500	1489	7	2	7	56.4	4.8
1525	1487	7	2	7	56.4	4.7
1550	1485	7	2	7	56.4	4.6
1575	1483	7	2	7	56.4	4.5
1600	1481	7	2	7	56.4	4.5
1625	1479	7	2	7	56.4	4.4
1650	1478	7	2	7	56.4	4.3
1675	1476	7	2	7	56.4	4.3
1700	1474	7	2	7	56.4	4.2
1725	1472	7	2	7	56.4	4.1
1750	1470	7	2	7	56.4	4.1
1775	1468	7	2	7	56.4	4.0
1800	1467	7	2	7	56.4	3.9
1825	1465	7	2	7	56.4	3.9
1850	1463	7	2	7	56.4	3.8
1875	1461	7	2	7	56.4	3.8
1900	1459	7	2	7	56.4	3.7
1925	1457	7	2	7	56.4	3.7
1950	1456	7	2	7	56.3	3.6
1975	1454	7	2	7	56.3	3.6
2000	1452	7	2	7	56.3	3.5

CHARGE 4 — TABLE D — CORRECTION FACTORS — FT 120-E-1 — CTG, WP, XM929 FUZE, PD, M745

1 RANGE M	8 MUZZLE VELOCITY 1 M/S DEC M	8 MUZZLE VELOCITY 1 M/S INC M	9 RANGE CORRECTIONS FOR: RANGE WIND 1 KNOT HEAD MIL	10 RANGE WIND 1 KNOT TAIL MIL	11 AIR TEMP 1 PCT DEC M	12 AIR TEMP 1 PCT INC M	13 AIR DENSITY 1 PCT DEC M	14 AIR DENSITY 1 PCT INC M	15
1200	4.9		7.7		2.7				4.1
1225	5.0		7.7		2.8				4.2
1250	5.1	-4.9	7.7		2.9	-2.8	-4.3		4.3
1275	5.2	-4.9	7.7		2.9	-2.9	-4.4		4.3
1300	5.3	-4.2	7.7		3.0	-2.9	-4.4		4.4
1325	5.4	-4.3	7.7		3.0	-2.9	-4.5		4.5
1350	5.5	-4.3	7.7		3.1	-3.0	-4.6		4.6
1375	5.6	-4.4	7.8		3.1	-3.0	-4.7		4.6
1400	5.7	-4.4	7.8		3.2	-3.0	-4.8		4.7
1425	5.8	-4.6	7.8		3.3	-3.0	-4.8		4.8
1450	6.0	-4.7	7.8		3.3	-3.0	-4.9		4.9
1475	6.1	-4.7	7.8		3.4	-3.0	-5.0		5.0
1500	6.2	-4.8	7.8		3.4	-3.0	-5.1		5.0
1525	6.3	-4.9	7.8	-2.0	3.5	-3.1	-5.2		5.1
1550	6.4	-5.0	7.8	-2.0	3.5	-3.1	-5.2		5.2
1575	6.5	-5.0	7.8	-2.0	3.6	-3.1	-5.3		5.3
1600	6.6	-5.2	7.9	-2.0	3.7	-3.1	-5.4		5.4
1625	6.7	-5.2	7.9	-2.0	3.7	-3.1	-5.5		5.4
1650	6.8	-5.3	7.9	-2.0	3.8	-3.2	-5.6		5.5
1675	6.9	-5.4	7.9	-2.0	3.8	-3.2	-5.6		5.6
1700	7.0	-5.5	7.9	-2.0	3.9	-3.2	-5.7		5.7
1725	7.1	-5.6	7.9	-2.0	3.9	-3.2	-5.8		5.8
1750	7.2	-5.7	7.9	-2.0	4.0	-3.2	-5.9		5.8
1775	7.3	-5.8	7.9	-2.0	4.0	-3.2	-6.0		5.9
1800	7.4	-5.8	8.0	-2.0	4.1	-3.2	-6.0		6.0
1825	7.5	-5.9	8.0	-2.0	4.2	-3.3	-6.1		6.1
1850	7.7	-6.0	8.0	-2.0	4.2	-3.3	-6.2		6.2
1875	7.8	-6.0	8.0	-2.0	4.3	-3.3	-6.3		6.2
1900	7.9	-6.2	8.0	-2.0	4.3	-3.3	-6.4		6.3
1925	8.0	-6.3	8.0	-2.0	4.4	-3.3	-6.4		6.4
1950	8.1	-6.4	8.0	-2.1	4.4	-3.3	-6.5		6.5
1975	8.2	-6.4	8.1	-2.1	4.5	-3.4	-6.6		6.5
2000	8.3	-6.5	8.1	-2.1	4.5	-3.4	-6.7		6.6

Figure 3-3. Example of firing table 120-E-1

PURPOSE

3-28. An FT provides the data required to bring effective fire on a target under any conditions. Data for FTs is obtained by firing the weapon at various elevations and charges.

UNIT CORRECTIONS

3-29. FTs describe unit corrections as range corrections for an increase or decrease in range, wind, air temperature, and density, followed by the unit value in meters.

3-30. Each correction is computed on the assumption that all other conditions are standard, but corrections differ slightly if one or more of the other conditions are nonstandard. The amount of difference depends on the effect of the other nonstandard conditions. The effect one nonstandard condition has on another is known as an interaction effect. The effect of a nonstandard condition depends on the duration of time the projectile is exposed to that condition.

3-31. If the maximum ordinate achieved is known, the weather's effect on a given projectile can be determined from a MET message. Personnel can compensate for those effects using the corrections listed in the appropriate FTs.

RANGE

3-32. Range is defined as the distance, measured on the surface of a sphere concentric with the earth, from the muzzle to a target at a level point.

STANDARD RANGE

3-33. The standard range is the range opposite the charge in the FT, which is the horizontal distance from the origin to the level point. The attained range is reached by firing with a given elevation and charge. If actual firing conditions duplicate the ballistic properties and MET conditions upon which the FT is based, the attained range and the standard range are equal. The command range corresponds to the given elevation and charge that must be fired to reach the target.

NONSTANDARD CONDITIONS

3-34. If not corrected when computing firing data, deviations from standard conditions cause the projectile to impact or burst somewhere other than the desired point. Nonstandard conditions that affect range affect the TOF.

3-35. Corrections are made for nonstandard conditions to improve accuracy. The accuracy of mortar fires depends on the accuracy and completeness of data available, computation procedures used, and care in laying the weapons. Accuracy should not be confused with precision. Precision is related to the tightness of the dispersion pattern without regard to its nearness desired point. Accuracy is related to the location of the mean point of impact (MPI) with respect to a desired point.

RANGE EFFECTS

3-36. Factors that affect the range include the following:

- Vertical jump.
- Air resistance.
- Finish of the shell.
- Ballistic coefficient.
- Range wind.

VERTICAL JUMP

3-37. Vertical jump is a minor change in barrel elevation caused by the shock of firing, which produces a minor range dispersion. In modern weapons, vertical jump cannot be predicted. It is usually small, and it is not considered separately in gunnery.

AIR RESISTANCE

3-38. Air resistance affects both range and deflection during the flight of the projectile. Air resistance to the direction of flight is called drag. Because of drag, both the horizontal and vertical components of velocity are less at any given TOF than they would be with no drag, as in a vacuum. All other factors being equal the greater the drag,

the shorter the range; and the heavier the projectile, the longer the range. Air density, air temperature, velocity, and diameter are considered in the computation of drag.

3-39. The drag of a given projectile is proportional to the density of the air through which it passes. For example, an increase in air density of a given percentage increases the drag by the same percentage. Since the air density at a particular place, time, and altitude varies widely, the standard trajectories reflected in FTs are computed with a fixed relation between density and altitude. As the air temperature increases, the drag decreases, increasing range.

3-40. The faster a projectile moves, the more the air resists its motion. An examination of a set of FTs shows that, for a given elevation, the effect of 1 percent of air density (1 percent of drag) increases with an increase of charge (muzzle velocity).

3-41. Two projectiles of identical shapes but different sizes do not experience the same drag. For example, a larger projectile offers a larger surface area for the air to act upon, increasing its drag.

FINISH OF THE SHELL

3-42. The finish of the shell surface affects the muzzle velocity. A rough surface on the projectile or fuze increases air resistance, decreasing range.

BALLISTIC COEFFICIENT

3-43. The ballistic coefficient of a projectile is its efficiency in overcoming air resistance compared to an assumed standard projectile. However, each projectile and projectile lot has its own efficiency level. Therefore, to establish FTs, one specific projectile lot must be selected and fired. Based on the performance of that lot, standard ranges are determined. The ballistic coefficient of that lot becomes the FT standard. However, other projectile lots of the same type may not have the same ballistic coefficient as the one reflected in the FTs. If another lot is more efficient (that is, has a higher ballistic coefficient than the FT standard), it will achieve a greater range when fired. The opposite is true for a less efficient projectile lot.

Note. All projectile types are classified into certain standard groups for easier computations.

RANGE WIND

3-44. Range wind is that component of the wind blowing parallel to the DOF and in the plane of fire. Range wind changes the relationship between the velocity of the projectile and the velocity of the air nearby. If the air is moving with the projectile (tailwind), it offers less resistance to the projectile and a longer-range result. A headwind has the opposite effect.

CHARGE

3-45. Charge is defined as a propellant. Mortar propellants are low-order energetics that burn rather than detonate.

3-46. Propellant is the mortar fire's semi-fixed ammunition. When gases from the burning propellant develop enough pressure to overcome projectile weight and initial bore resistance, the projectile begins to move.

3-47. Gas pressure peaks quickly and subsides gradually after the projectile begins to move. The peak pressure, together with the travel of the projectile in the bore, determines the speed at which the projectile leaves the barrel.

3-48. Factors that affect the velocity of a mortar-ammunition combination include the following:

- An increase or decrease in the rate of burning propellant increases or decreases gas pressure.
- An increase in the size of the weapon's chamber, without a corresponding increase in the amount of propellant, decreases gas pressure.
- Gas escaping around the projectile in the barrel decreases the pressure.
- An increase in bore resistance to projectile movement before peak pressure further increases the pressure.
- An increase in bore resistance has a dragging effect on the projectile and decreases velocity.
- Temporary variations in bore resistance are caused by carbon buildup in the barrel or imperfections in bore shape.

ELEVATION

3-49. Elevation is defined as the angle of the gun in the vertical plane required to reach the range tabulated in column 1.

DEFLECTION EFFECTS

3-50. Deflection is defined as any deviation of the projectile from the vertical plane of fire. Factors that impact the deflection include the following:

- Crosswind.
- Lateral jump.
- Drift.
- Initial yaw.
- Summital yaw.

CROSSWIND

3-51. The crosswind is the ballistic wind blowing across the DOF. Crosswind tends to carry the projectile and causes a deviation from the DOF. However, the lateral deviation of the projectile is not as large as the velocity of the crosswind acting on that projectile. Wind component tables simplify the reduction of the ballistic wind into its two components—crosswind and range wind—with respect to the DOF. (See chapter 4 of this publication for a discussion of the wind component table.)

Lateral Jump

3-52. Lateral jump is a minor change in barrel deflection caused by the shock of firing. The effect is ignored, since it is small and varies by round.

Drift

3-53. Drift is the departure of the projectile from standard direction due to air resistance and gravity. To understand the forces that cause drift, the indirect fire Infantryman understands the angle of yaw, which is the angle between the projectile's direction of motion and axis. The yaw of a spinning projectile changes constantly: right, left, down, up.

Initial Yaw

3-54. Initial yaw is greatest near the muzzle and subsides gradually. The atmosphere offers greater resistance to a yawing projectile, so projectiles are designed to minimize yaw and to retard it in flight.

Summital Yaw

3-55. Summital yaw occurs at the apex of the trajectory and directs the nose of the projectile slightly toward the direction of spin.

DISPERSION AND PROBABILITY

3-56. The points of impact of the projectiles are scattered both laterally (deflection) and in-depth (range) due to minor variations of many elements from round to round. These variations must not be confused with those caused by mistakes or constant errors. Mistakes can be removed, and constant errors compensated for, but errors that cause dispersion may be due to conditions in the bore or the bipod, or during flight. Many conditions affect accurate dispersion prediction, including the following:

- Dispersion pattern.
- Muzzle velocity.
- Direction and elevation.
- Air resistance.

Dispersion Pattern

3-57. If several rounds of the same caliber and same lot are fired from the same mortar with the same charge, elevation, and deflection, the rounds do not all fall at a single point. Instead, they scatter in a pattern called the dispersion pattern.

Conditions that Affect Muzzle Velocity

3-58. Muzzle velocity is affected by conditions in the bore, such as minor variations in the weight, moisture content, temperature, and arrangement of the propelling charge. It is affected by differences in the ignition of the charge, the weight of the projectile, and the form of the obturator band.

Conditions that Affect Direction and Elevation

3-59. Direction and elevation are affected by conditions of the bipod, such as play (looseness) in the traversing mechanism, physical limitations on precision in setting scales, and inconsistent reactions to firing stresses.

Conditions that Affect Air Resistance

3-60. Air resistance is affected by conditions during flight, such as differences in the weight, velocity, and form of the projectile and by changes in air density, wind velocity, and temperature.

MEAN POINT OF IMPACT

3-61. For any considerable number of rounds fired, a line drawn perpendicular to the line of fire divides the points of impact equally. Half of the points will be beyond the line, or over; half will be inside the line, or short. For the same group of rounds, another line drawn parallel to the line of fire divides the points equally. Half of the points will be to the right of the line; half will be to the left. The first line (at right angles to the line of fire) represents the mean range; the second (parallel to the line of fire) represents the mean deflection. The lines intersect at the MPI. (See figure 3-4.)

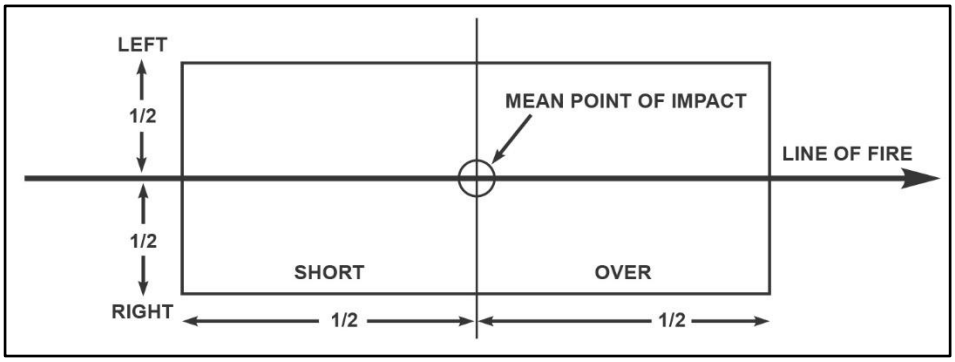


Figure 3-4. Mean point of impact

Dispersion Scale

3-62. In a normal burst pattern, the number of rounds short of the MPI is the same as the number of rounds over the MPI. The PE is the same in both cases.

3-63. For any normal distribution (such as mortar fire), four PEs on either side of the MPI will include most of the rounds in the pattern. A small fraction of rounds (about 7 out of 1,000) will fall outside of four PEs on either side of the MPI.

3-64. Many bursts create a rough elliptical pattern. (See figure 3-5.) Since four PEs on either side of the MPI (in range and deflection) will encompass most rounds, a rectangle is drawn to include the full distribution of the rounds. (See figure 3-6.)

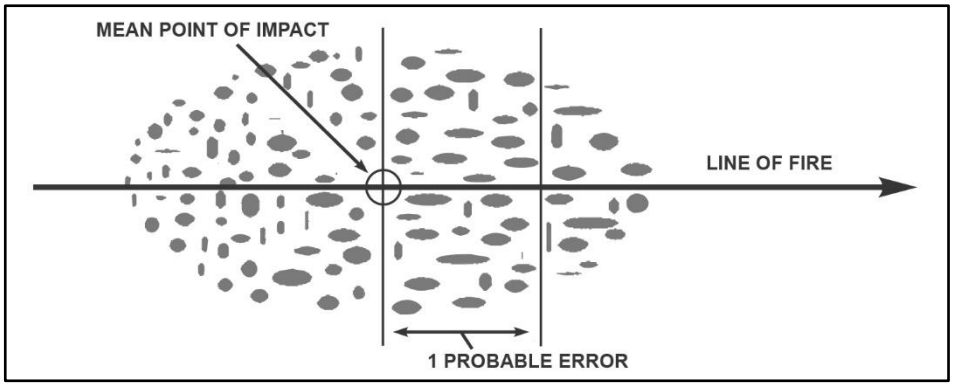


Figure 3-5. Burst in elliptical pattern

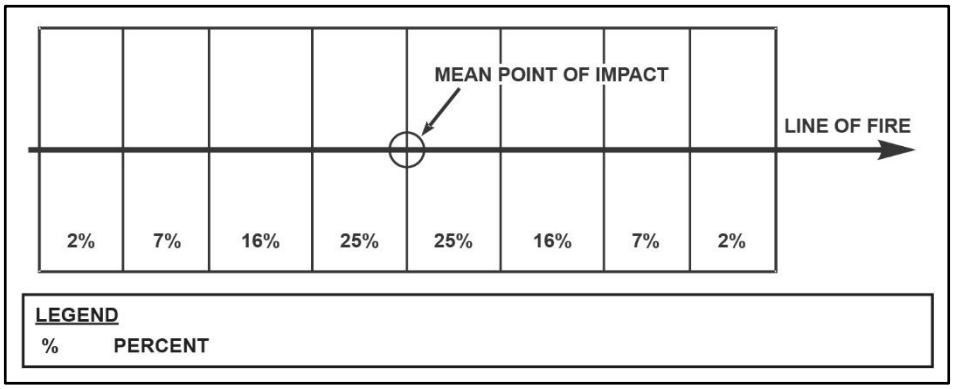


Figure 3-6. 100-percent rectangle

Dispersion Pattern

3-65. If one PE is used as the limit of measurement to divide the dispersion rectangle evenly into eight range zones, the percentage of rounds falling into each zone as shown in figure 3-7, page 64. The percentages have been found to be true by experiment. Again, what is true in range is true in deflection. If range dispersion zones and deflection dispersion zones are both considered, a set of small rectangles is created.

	0.02	0.07	0.16	0.25	0.25	0.16	0.07	0.02
0.02	0.0004	0.0014	0.0032	0.0050	0.0050	0.0032	0.0014	0.0004
0.07	0.0014	0.0049	0.0112	0.0175	0.0175	0.0112	0.0049	0.0014
0.16	0.0032	0.0112	0.0256	0.0400	0.0400	0.0256	0.0112	0.0032
0.25	0.0050	0.0175	0.0400	0.0625	0.0625	0.0400	0.0175	0.0050
0.25	0.0050	0.0175	0.0400	0.0625	0.0625	0.0400	0.0175	0.0050
0.16	0.0032	0.0112	0.0256	0.0400	0.0400	0.0256	0.0112	0.0032
0.07	0.0014	0.0049	0.0112	0.0175	0.0175	0.0112	0.0049	0.0014
0.02	0.0004	0.0014	0.0032	0.0050	0.0050	0.0032	0.0014	0.0004

LINE OF FIRE

Figure 3-7. Dispersion rectangle

PROBABLE ERROR

3-66. At some point along the line of fire, beyond the MPI, a second horizontal line can be drawn at right angles to the line of fire. This line divides rounds over into two equal parts. (See Line AA, figure 3-8.) All rounds beyond the MPI manifest an error in range—they are all over. Some of the rounds falling over are more in error than others. If the distance from the MPI to Line AA is a measure of error, half of the rounds over have a greater error, and half have a lesser error. The distance from the MPI to Line AA becomes a convenient unit of measure. That distance is called one probable error in range (PEr). PE applies to short rounds, as well as to rounds to the left and right of the MPI.

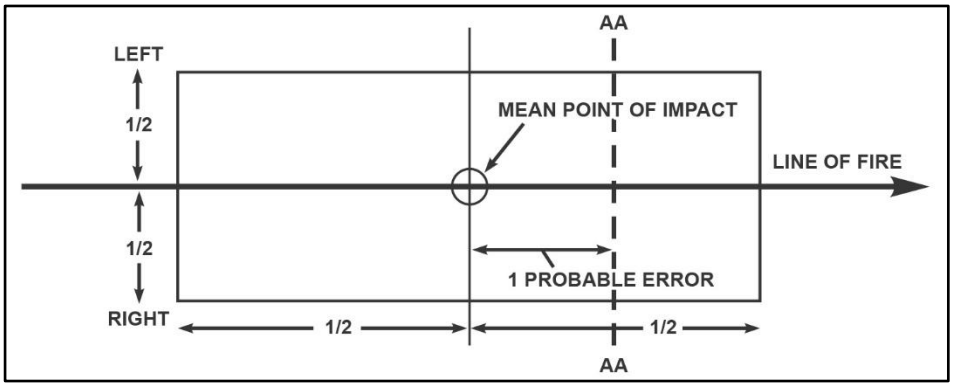


Figure 3-8. One probable error

PROBABLE ERROR IN RANGE

3-67. The approximate value of the PEr is shown in Table E, Supplementary Data, of the FTs (use the web link found in the References section of this publication for detailed information) and can be taken as an index of the mortar's precision. FT values for PErs are based on the firing of specific ammunition under controlled conditions. The actual

round-to-round PEr experienced in the field is greater. The letters A, B, C, and D in figure 3-9 represent mathematical line points.

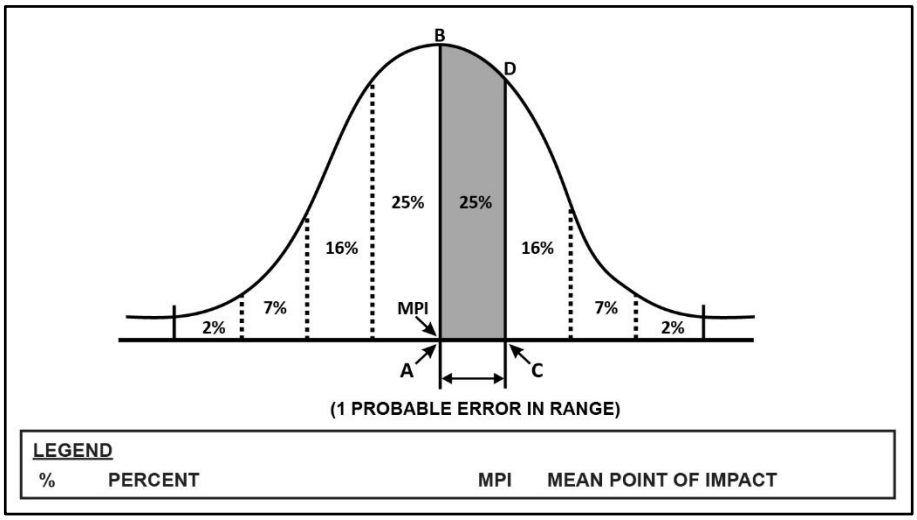


Figure 3-9. Range probability curve

Probable Error in Deflection

3-68. The value of the probable error in deflection (PEd) is given in Table E, Supplementary Data, of the FTs. For mortars, the PEd is much smaller than the PEr. For example, for a 120-mm mortar firing charge 4 at a range of 3,600 meters and elevation 1,324, the PEd is 25 meters. (See figure 3-10.) In other words, 50 percent of the projectiles fired will hit within 25 meters, 82 percent will hit within 50 meters (two PEs), and 96 percent will hit within 75 meters (three PEs) of the mean deflection.

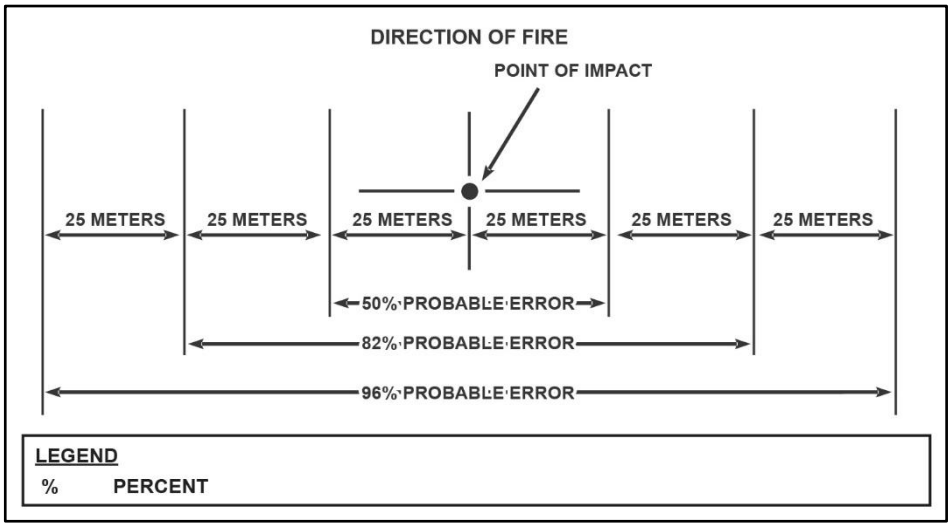


Figure 3-10. Probable error in deflection

Application of Probable Error

3-69. FTs list PEs for range and deflection at each listed range. It is possible to express a given distance in terms of PEs and to solve problems using the dispersion scale or probability tables. To compute the probability of a round landing within an error of a certain magnitude, the specified error is reduced to equivalent PEs in one direction along the dispersion scale, and the sum is multiplied by 2.

EXAMPLE

A 120-mm mortar has fired several rounds with charge 4, elevation 1245, and an MPI of at least 4,500 meters has been determined. What is the probability that the next round fired will fall within 50 meters of the MPI?
ANSWER:
PEr at 4,500 meters (charge 4) = 25 meters
Equivalent of 50 meters in PEs (50/25) = approximately 2
Percentage of rounds falling within two PEs = 25 percent plus 16 percent x 2 = 82 percent

SECTION III – FIRE PLANNING

3-70. Mortar platoons' ability to engage targets with accurate and sustained fires depends on the precision and detail of fire plans (FPs). Fire planning is concurrent and continuous at all levels of command. The principles of fire planning used by field artillery apply to mortars. These principles are close and continuous support of the battalion, coordination with adjacent and higher units, and continuous planning.

Note. In combat, the FDC pays an increased amount of attention to the probability of error, when determining minimum safe distance (MSD). As combat requirements of indirect support may require specific intentional fire to the maximum ability of the mortar system, to ensure the success of defensive or close in offensive actions.

DANGER CLOSE

3-71. Danger close for mortars is 600 meters. Both the maneuver commander and the FDC need to take proper precautions (troops take cover, FDC employs creeping fire). The term danger close is included in the CFF when there are friendly troops or positions within 600 meters (for mortars) of the targeted location.

3-72. An MSD is defined as the distance in meters from the intended center of impact at which a specific degree of risk and vulnerability will not be exceeded with a 99 percent assurance. MSDs are not danger close distances and are used when in close contact or as a planning figure when echeloning fires. MSDs are computed by adding the maximum pattern radius plus three circular error probable.

RISK-ESTIMATE DISTANCE

WARNING

Risk-estimate distances are for combat use and are not MSD for peacetime training.

3-73. Risk-estimate distances allow the supported commander to estimate the risk in terms of the percentage of friendly casualties that may result from fires against an enemy threat along the forward line of own troops. The risk estimate distance is defined as the minimum distance friendly troops can approach the effects of friendly fires without suffering appreciable casualties of 0.1 percent probability of incapacitation (PI) or higher. Friendly forces outside the 0.1 percent PI distance are still subject to weapons fragments, but at a lower risk. Commanders carefully weigh the choice of ordnance, accuracy, and proficiency of the firing unit in relation to the risk of fratricide. Taking steps to protect friendly Soldiers, such as prone, or behind cover, can reduce the risk. Risk estimate distances are based on fragmentation and blast patterns.

WARNING

0.1 percent PI numbers are for combat use only during "danger" close situations and are not MSD for peacetime training.

3-74. The surface-to-surface MSD depends on the type of mortar. (See table 3-1.) The creeping method of adjusting surface-to-surface fires (no adjustment greater than 100 meters) is used during danger close missions.

Table 3-1. Mortar minimum safe distance

Mortar Type	*Minimum Safe Distance*
60-mm (millimeter)	200 meters (not used during training)
81-mm	300 meters (not used during training)
120-mm	400 meters (not used during training)

3-75. Cannon risk-estimates were calculated using the following assumptions:

- GTL is perpendicular to the forward line of own troops.
- An observer has adjusted the fires onto the target and unadjusted FFE fires may entail greater risk.
- The friendly troops are standing unprotected in the open, in winter clothing and helmet, and on a line perpendicular to the line of fire.

Note. Friendly forces outside the PI distance still may be subject to weapons fragments, but at a lower risk. Commanders and fire supporters carefully weigh the choice of ordnance and the accuracy and proficiency of the firing unit in relation to the risk of fratricide.

3-76. The risk-estimate distance considers the bursting radius of particular munitions and the characteristics of the delivery system and associates this combination with a percentage for the PI of Soldiers at a given range. Table 3-2 provides the risk-estimate distance for mortars. (See ATP 3-21.8 for more information.)

WARNING

Risk-estimate distances are for combat use and do not represent the maximum fragmentation envelopes of the weapons listed. Risk estimate distances are not MSDs for peacetime training use.

Table 3-2. Probability of incapacitation risk-estimate distances for mortars

System	*Description*	*Danger Close*	*Range*	*0.1 % Probability Of Incapacitation (PI)*	
				Standing	Prone
M224	60-mm mortar	600m	1/3	115m/378’	115m/378’
			2/3	125m/410’	120m/394’
			Max	145m/476’	145m/476’
M252	81-mm mortar	600m	1/3	170m/558’	160m/525’
			2/3	195m/640’	190m/624’
			Max	195m/640’	185m/607’
M120/121	120-mm mortar	600m	1/3	280m/919’	260m/853’
			2/3	395m/1296’	365m/1198’
			Max	430m/1411’	410m/1345’

Legend: %—percent; ‘—foot; mm—millimeter; m—meter; Max—maximum

TERMINOLOGY

3-77. Common terms used in fire planning include the following:

- Target.
- Targets of opportunity.
- Scheduled targets.
- On-call targets.
- Group of targets.
- Series of targets.
- Final protective fire (FPF).

- Preparation.
- Counterpreparation.
- Program of targets.
- Harassing and interdiction fires.

TARGET

3-78. A target is troops, weapons, equipment, vehicles, buildings, or terrain that warrants engagement by fire. Targets may be numbered for future reference and are designated on overlays as a solid cross with its center representing the center of the target. The target number includes two letters and four numbers allocated by higher headquarters. This numbering system identifies the headquarters that planned the target, distinguishes one target from another, and prevents duplication.

TARGETS OF OPPORTUNITY

3-79. Targets of opportunity are targets for which fires have not been planned. Planned targets are scheduled or on-call.

SCHEDULED TARGETS

3-80. Scheduled targets are fired at a specific time before or after H-Hour, or upon completion of a predetermined movement or task.

ON-CALL TARGETS

3-81. On-call targets are fired only upon request. They include targets for which firing data is kept current and those for which firing data is not prepared in advance. For example, a road junction (a prominent terrain feature) that the FO may use as a reference point.

GROUP OF TARGETS

3-82. Mortars often are assigned groups of targets. A group of targets includes two or more targets to be fired upon at the same time. Groups of targets are graphically designated by a circle and a group designation. (See figure 3-11, page 70.) The group designation includes the letters assigned to the maneuver brigade by the division tactical operations center, with a number inserted between them; for example, A1B for the first group of targets that the fires battalion FDC plans for a brigade assigned the letters A and B. The designation of a group of targets does not preclude firing upon individual targets within the group.

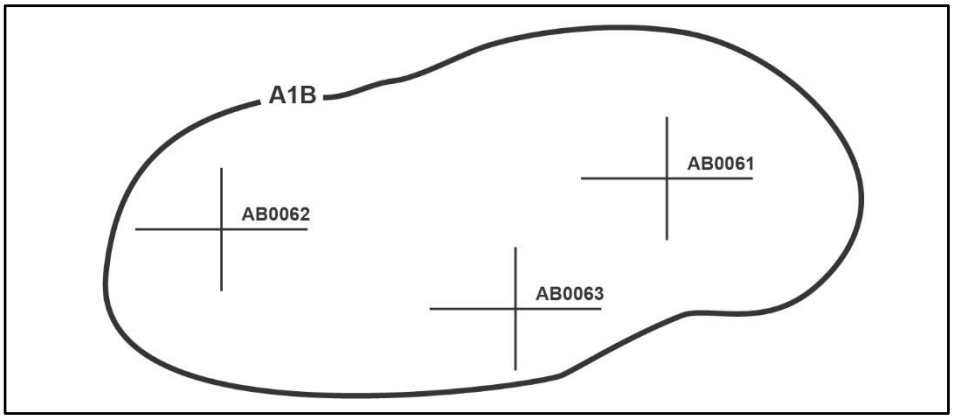


Figure 3-11. Group of targets

Series of Targets

3-83. A series of targets is several targets or groups of targets planned to support the operation. (See figure 3-12.) For example, a series of targets may be planned on a large objective so that fires are lifted or shifted as the supported unit advances. Graphically, a series is shown as individual targets or groups of targets within a prescribed area. The series is given a code name. The designation of a series of targets does not preclude the attack of individual targets or groups of targets within the series.

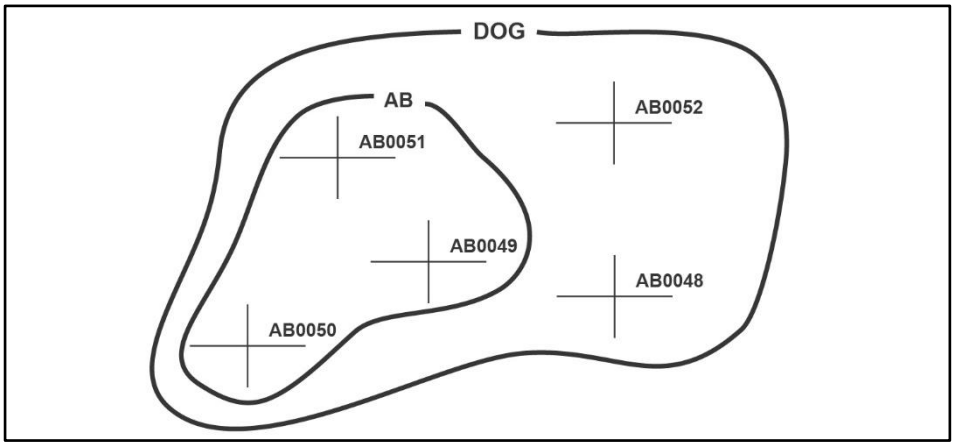


Figure 3-12. Series of targets

Final Protective Fire

3-84. FPF is an immediately available prearranged barrier of fire designed to impede enemy movement across defensive lines or areas. (See figure 3-13.) It is integrated with the maneuver commander's defensive plans and may vary in shape and pattern to suit the tactical situation. On maps or firing charts, FPF is represented by a linear plot, with

the unit designated to fire the FPF indicated above it. The length of the plot depends on the type of unit assigned to fire the FPF. (See chapter 9 of this publication for more information.)

3-85. The maneuver commander determines the precise location of FPF, and the company FSO reports the desired location to the supporting FDC. Authority to call the FPF is vested in the maneuver commander (often the company commander or platoon leader) in whose area the FPF is located.

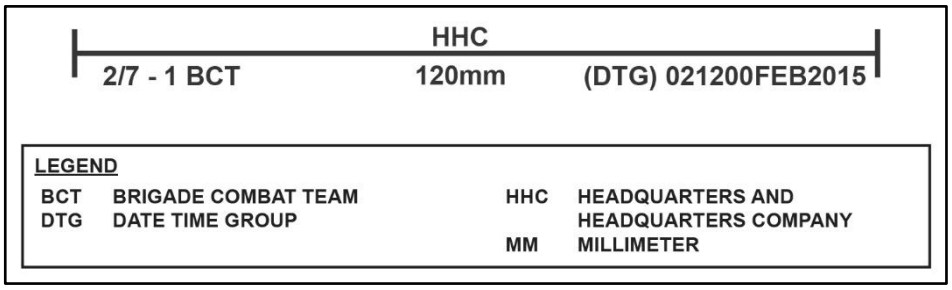


Figure 3-13. Final protective fire symbol

Preparation

3-86. Preparation is the scheduled delivery of intense fires to support an attack. The commander decides to fire a preparation and orders the attack.

Counterpreparation

3-87. Counterpreparation is the delivery of intense planned fires when an enemy attack is imminent. It is designed to break up enemy formations, to disorganize command and communications systems, to reduce the effectiveness of enemy preparations, and to impair the enemy's offensive spirit.

3-88. Counterpreparation is fired on the order of the force commander. The fires are planned and assigned to firing units, and firing data is kept current.

PROGRAM OF TARGETS

3-89. A program of targets, such as a countermortar program, is several targets planned on similar areas. Although the artillery battalion in direct support of the brigade plans counterpreparation and programs and designates groups and series of targets, the battalion mortar platoon and company mortar section that are assigned the targets are considered in the planning.

HARASSING AND INTERDICTION FIRES

3-90. Fires planned on known enemy positions to inflict losses, curtail movement, and disrupt the enemy to keep him off balance are called harassing fires. Interdiction fires are planned on critical areas (bridges, possible observation posts, road junctions) to deny the enemy use of those areas. Harassing and interdiction fires include the number of rounds to be fired and the times of firing. Varying the number of rounds and firing at irregular intervals increases the effectiveness of those fires.

TARGET CONSIDERATIONS

3-91. Planned targets include known, suspected, likely enemy locations and prominent terrain features. These areas are determined through intelligence sources, knowledge of the situation, and map and terrain study. They are planned without regard to boundaries or weapon abilities. Duplication of effort is resolved by the next higher headquarters.

Known Enemy Locations

3-92. Fires are planned on all known enemy locations that could hinder the support unit's mission.

Suspected Enemy Locations

3-93. Suspected enemy locations include probable operations, troop positions, assembly areas, avenues of approach, and routes of withdrawal. Fires are planned on suspected locations so that fires are available if the target is confirmed.

Likely Enemy Locations

3-94. Targets in this category are determined from a careful study of the terrain and maps, and from knowledge of the enemy's methods of placing troops and weapons.

PROMINENT TERRAIN FEATURES

3-95. Hilltops, road junctions, manufactured objects, and other easily identifiable locations on a map and on the ground are planned as targets to provide reference points from which to shift to targets of opportunity.

OFFENSIVE OPERATIONS

3-96. Fires planned to support an attack consist of a preparation (if ordered) and subsequent fires. The preparation may be delivered before the assault elements advance from their line of departure and may continue for a brief time thereafter. Fires planned for the preparation are limited to known targets and suspected areas. The delivery of fires on scheduled targets should be consistent with the threat imposed, time available for coordination, and availability of ammunition.

BATTALION MORTAR PLATOON

3-97. The battalion FP table for a preparation may include fires by the battalion mortar platoon. Once the preparation is fired, the mortar platoon is available for fire support of the battalion maneuver elements. In some situations, the battalion commander may exclude the mortars from the preparation and retain them for targets of opportunity throughout the attack.

COMPANY MORTAR SECTION

3-98. The company mortar section may be required to fire preparation fires that are limited to the engagement of enemy forward elements. Before committing mortars to preparation fires, the commander considers ammunition resupply and availability of mortars to attack targets of opportunity quickly.

FIRES SUPPORTING THE ATTACK

3-99. Fires planned to support the attack are shifted to conform to the movements of the supported unit. They are planned in the form of targets, groups of targets, and series of targets. They may be fired on a time schedule or on-call and may include targets from the line of departure to the objective, on the objective, and beyond the objective.

3-100. Range criteria impacts mortar position selection and the order of movement. The maximum and minimum mortar ranges determine whether mortars can support from selected firing positions. Mortars should be able to fire at least one-half to two-thirds of their range to the front of the forward elements of the supported friendly force. These range criteria are only a guide, not inflexible rules. These may vary due to factors of METT-TC (I) mission, enemy, terrain and weather, troops and support available, time available, civil considerations, and informational considerations or due to the commander's guidance. The mortars must be positioned far enough back so that fires can be placed directly in front of and behind the rifle platoon defensive positions. The longer ranges available from the 120-mm mortars do not mean platoons equipped with these weapons must be located further to the rear than those with the shorter-ranged 81-mm or 60-mm mortars. The added range allows the platoon leader flexibility in choosing firing positions.

OBJECTIVES

3-101. Supporting fires have several objectives. They—

- Assist the advance of the supported unit by neutralizing enemy forces, weapons, and observation short of the objective.
- Assist the supported unit in gaining fire superiority on the objective so that the assaulting force can close to assault distance.
- Fire upon on-call targets, such as likely assembly areas and routes for enemy counterattacks.
- Protect the supported unit during reorganization.
- Provide supporting fires to prevent the enemy from reinforcing, supplying, or disengaging the forces.
- Provide quick, mutual fire support to lower, adjacent, and higher headquarters.

DEFENSIVE OPERATIONS

3-102. Fires in support of defensive operations include—

- Long-range fires.
- Close defensive fires.
- FPFs.
- Fires within the battle area.

LONG-RANGE FIRES

3-103. Long-range fires are designed to engage the enemy as early as possible to inflict casualties, delay his advance, harass him, interdict him, and disrupt his organization. They consist of the fires of those supporting weapons within the battle area capable of long-range fires. Long-range weapons engage the enemy as soon as he comes within range. As a result, the volume of fire increases as the enemy continues to advance and comes within range of additional weapons.

CLOSE DEFENSIVE FIRES

3-104. Close defensive fires are supporting fires employed to destroy enemy attack formations before the assault.

FINAL PROTECTIVE FIRES

3-105. FPF are planned to prohibit or break up the enemy assault on the forward defense area. They consist of prearranged fires of supporting weapons to include machine gun final protective lines and mortar and artillery FPF. Only those weapons with FPFs in front of the threatened units fire their assigned fires; all other available weapons use observed fire to supplement or reinforce the FPF in the threatened area. To reinforce the FPF, direct-fire weapons engage those targets in front of the threatened area or others.

3-106. Artillery and mortar FPFs are integrated with machine gun final protective line. Each artillery battery fires one FPF. The mortar platoon may fire one or two FPFs, but the platoon's fires are more effective in one FPF than in two.

3-107. Direct support artillery FPF is available to the supported brigade and its battalions. The brigade commander designates general areas for available FPF or allocates them to maneuver battalions. The maneuver battalion commander, in turn, designates general locations or allocates them to maneuver companies.

FIRES WITHIN THE BATTLE AREA

3-108. The precise location of an FPF is the responsibility of the company commander in whose sector it falls. The exact locations of FPF within each forward company are included in the FP and reported to the battalion. Fires within the battle area are planned to limit penetrations and to support counterattacks.

FIRE SUPPORT COORDINATION MEASURES

3-109. The FIST, FDC, and fire support planners use fire support coordination measures (FSCMs) to ensure that fires impacting in their zone do not jeopardize troop safety, interfere with other fire support means, or disrupt adjacent unit operations.

BOUNDARIES

3-110. Boundaries determined by maneuver commanders establish the operational zone for a maneuver unit and the area in which the commander fires and maneuvers freely. A unit may fire and maneuver against clearly identified enemy targets near or over its boundary, as long as such action does not interfere with adjacent units.

COORDINATION MEASURES

3-111. Coordination measures designate portions of the battlefield where actions may or may not be taken. The battalion or company FSO recommends FSCMs; the commander establishes them. FSCMs facilitate operations by establishing rules and guidelines for selected areas for a given time. There are two FSCM categories: permissive and restrictive.

PERMISSIVE MEASURES

3-112. Permissive measures allow fires into an area, such as a free-fire area or beyond a line. An example of such is a coordinated fire line that need not be further coordinated if fires remain within the zone of the establishing headquarters and beyond the line. On overlays and maps, permissive measures are drawn in black, are titled, and indicate the establishing headquarters and the effective date-time group (DTG).

Coordinated Fire Line

3-113. A coordinated fire line is a line beyond which conventional surface fire support means—mortars, field artillery, and naval gun fire—may fire any time (within the zone of the establishing headquarters) without further coordination.

Fire Support Coordination Line

3-114. A fire support coordination line is a line beyond which all targets may be attacked by any weapon system without endangering troops or requiring further coordination with the establishing headquarters. The effects of any weapon system may not fall short of this line.

Free Fire Area

3-115. A free fire area is a designated area into which any weapon system may fire without further coordination with the establishing headquarters.

Restrictive Measures

3-116. Restrictive measures mean that fires into an area or across a line must be coordinated with the establishing headquarters on a case-by-case basis. Graphically, they are drawn in red, are titled, and indicate the establishing headquarters and the effective DTG.

3-117. Restrictive measures include the following:

- Restrictive fire areas (RFAs).
- No-fire areas (NFAs).
- Restrictive fire lines (RFLs).
- Airspace coordination areas (ACAs).

Restrictive Fire Areas

3-118. An RFA is an area in which specific restrictions are imposed and into which fires that exceed those restrictions are not to be delivered without coordination with the establishing headquarters.

No-Fire Areas

3-119. An NFA is an area in which no fires or effects of fires are allowed. There are two exceptions:

- When establishing headquarters approved fires temporarily within an NFA on a mission-by-mission basis.

- When an enemy force within the NFA engages a friendly force and the commander engages the enemy to defend the force.

Restrictive Fire Lines

3-120. An RFL is a line established between converging friendly forces that prohibits fires or effects from fires across the line without coordination with the affected force.

Airspace Coordination Area

3-121. ACA is a block of airspace in the target area in which friendly aircraft are reasonably safe from friendly surface fires. It may be a formal measure, but usually is informal.

BATTALION FIRE SUPPORT PLAN

3-122. Fire planning at the battalion level is initiated the same way as in the company. The battalion fire planning team includes the battalion commander, operations and training officer, battalion mortar platoon leader, and FSO. The battalion mortar platoon must be directly responsive to the battalion commander's desires. The platoon leader assists the operations and training officer in planning and obtaining fire support. The FSO is the battalion FSO, but the battalion mortar platoon leader serves in the absence of an FSO.

3-123. The battalion commander and operations and training officer present the commander's concept of the operation, which (as in the case of the company) includes the scheme of maneuver and the plan for fire support. After the FSO has consolidated the target lists prepared by the company fire planners, the battalion commander approves the consolidated target list as part of the battalion fire support plan. The written plan becomes an annex to the operation plan.

3-124. The FSO receives target lists from the company FSO and from the battalion mortar platoon leader. Then the FSO deletes duplications and updates all FPs by assigning target numbers or by consolidating targets. Then, the FSO submits all FPs and target lists to the battalion operations and training officer as the proposed battalion fire support plan.

3-125. The operations and training officer ensures that the proposed fire support plan supports the scheme of maneuver. After the battalion commander approves the FP, the plan becomes an annex to the battalion operation plan. It is disseminated to all subordinate elements, such as rifle companies and the battalion mortar platoon.

COMPANY FIRE SUPPORT PLAN

3-126. The company commander's fire planning begins with the receipt or assumption of a mission and continues throughout mission execution. The company fire planning team includes the company commander, the company FSO, the mortar platoon or section leader, and the platoon's FIST FOs. During the process of evaluating, refining, revising, and deciding how to accomplish the mission, the commander constantly seeks the most efficient and effective application of resources to produce maximum combat power. For the best results, the commander includes the team in every step of the decision-making process.

3-127. As the commander's staff officer for fire support, the company FSO plays a critical role in this planning process. The company FSO ensures the commander has all required information and recommends the best way to apply echelon of fires with available resources.

3-128. The company commander gives guidance to the fire planning team in the form of a concept. This concept outlines the scheme of maneuver and the desire for fire support. Later, when the company FSO submits the proposed consolidated target list and company FP, the company commander approves or changes it.

3-129. The company commander supervises the preparation of the company FP and coordinates fire planning activities. The company FSO develops the company FP and consolidates it with the target lists prepared by the platoon FOs. The company FSO then submits this consolidated list to the company commander for approval.

3-130. Company fire planners inform the company commander of the fire support available. They obtain the following information:

- Exact location of the company.
- Fires desired.
- Known enemy locations, avenues of approach, and assembly areas.
- Location of forward elements.
- Location of battalion mortar and artillery FPF.
- Location of the command post.
- Scheme of maneuver.

3-131. After receiving this information, fire planners begin planning fires to support the company. Through map inspection and terrain analysis, they prepare the target lists. (See table 3-3, page 78.) If time and facilities permit, they prepare an overlay giving a graphic representation. The target list includes the target number, map coordinates, description, and amplifying remarks for each target. It does not include target altitudes, which are determined by the respective FDCs.

Table 3-3. Consolidated target list

Target Number	*Description*	*Location*	*Remarks*
C-	FIRE PROTECTIVE FIRES (FPF)	14898346	
1-66	FPF	15508330	
1-45	FPF	15908330	
AA0050	DEFENSIVE TARGET	15278336	
AA0051	DEFENSIVE TARGET	15368319	
AA0052	HILLTOP	14848250	
AA0053	HILLTOP	15038196	
AA0054	CROSSROADS	15248171	
AA0055	RIDGE	15118081	
AA0056	MORTAR POSITION	152802	
AA0150	DEFENSIVE TARGET	14948381	
AA0152	DEFENSIVE TARGET	15008325	
AA0153	DEFENSIVE TARGET	15528303	
AA0154	OBSERVATION POST (OP)	1428287	
AA0155	OP	15108245	
AA0156	HILL	15128286	
AA0157	EMERGENCY POSITION	161188288	
AA0158	ROAD JUNCTION	14608190	
AA0159	ROAD JUNCTION	15638160	
AA0160	ROAD JUNCTION	16308183	
AO7000	DEFENSIVE TARGET	15808424	
AC7001	DEFENSIVE TARGET	15818353	
AC7002	DEFENSIVE TARGET	15968320	
AC7003	ROAD JUNCTION	15728272	
AC7004	BRIDGE	152791	DESTROY ON CALL

3-132. Target information can be submitted to the FDC using any means available, such as telephone or radio. The company FSO assigns numbers to targets not included in the list from the platoon FO or mortar platoon leader. Then, the company FSO transfers numbers from the separate target lists to the corresponding targets on the approved consolidated target list or company FP and arranges the targets by target number, alphabetically, and numerically.

3-133. Once the company commander approves the FP, the company FSO distributes it to FOs, rifle platoon leaders, FDCs, company fire planners, and battalion operations and training officers. Also, the company FSO sends a copy of the approved target list to the FSO at battalion headquarters.

SECTION IV – TARGET ANALYSIS AND METHODS OF ATTACK

3-134. When planning fires or deciding to engage a target, the company FSO ensures that the fire conforms to the support unit's scheme of maneuver. The company FSO must be informed of the present enemy situation. When conducting a target analysis and determining the methods of attack, the FDC chief considers target description, registration data, size of attack area, and the maximum rate of fire.

TARGET ANALYSIS

3-135. The method of attacking a target depends on its description, which includes the type, size, density, cover, mobility, and importance. Those factors are weighed against the guidelines established by the commander. The FDC then decides the type and number of projectiles, fuze, and fuze setting to be used.

3-136. The Air Force publishes Joint Munitions Effectiveness Manuals (JMEMs) for all surface-to-surface weapons to include mortars. These manuals provide detailed data concerning the expected fraction of casualties to personnel targets or damage to materiel targets given the number and type of rounds fired. The data in JMEMs are taken from test firings, actual combat performance, and mathematical modeling. The JMEMs normally are classified "confidential." The battalion personnel staff officer can establish the classified documents account with the Air Force to receive these manuals, and the battalion intelligence staff officer can store them when they are not being used.

3-137. Fortified targets must be destroyed by point-type fire using projectiles and fuzes appropriate for penetration. Mortar fire usually does not destroy armor, but it can harass and disrupt armor operations.

3-138. A target consisting of both Soldiers and materiel normally is attacked by area fire using air or impact bursts to neutralize the area. Flammable targets are engaged with high explosive (HE) projectiles to inflict fragmentation damage, and then with white phosphorous (WP) projectiles to ignite the materiel.

3-139. The method of attacking a target is governed by the results desired: suppression, neutralization, or destruction.

SUPPRESSION

3-140. Suppressive fires limit the ability of enemy troops in the target area to be an effective force. HE/proximity (PROX) creates apprehension or surprise and causes tanks to button up. Smoke is used to blind or confuse, but its effects last only as long as fires continue.

NEUTRALIZATION

3-141. Neutralization temporarily knocks the target out of the battle. Ten percent or more casualties usually neutralize most units. The unit becomes effective again when casualties are replaced, and equipment is repaired.

DESTRUCTION

3-142. Destructive fires put the target out of action permanently. A unit with 30 percent or more casualties usually is rendered permanently ineffective, depending on the type and discipline of the force. Direct hits are required on hard materiel targets.

METHODS OF ATTACK

3-143. Firing corrections within the transfer limits should be maintained through registration, survey data, and current MET message. When the data is unavailable or inadequate, targets should be attacked with observed fire since unobserved fires may be ineffective. Surveillance should be obtained on all missions to determine the results of the FFE. If accurate, FFE without adjustment is highly effective against troops and mobile equipment because damage is inflicted before the target can take evasive action. All destruction missions and missions fired at moving targets must be observed, and FFE should be adjusted on the target.

SIZE OF ATTACK AREA

3-144. The size of the attack area is determined by the estimated (based on intelligence and experience in similar situations) size of the target or the area in which the target is known or suspected to be located. The size of the attack area is limited when considering units to fire. Due to their versatility in making range changes and maintaining high rates of fire, mortars are the best weapons for engaging targets in-depth. All mortars can fire traversing fires with minor manipulations.

MAXIMUM RATE OF FIRE

3-145. Surprise fire delivered with maximum intensity achieves the greatest effect and massing the fires of several organic battalion units using time on target procedures best attains intensity. The intensity of fires available is limited by each unit's maximum rate of fire and ammunition supply. (See table 3-4, table 3-5, page 82, and table 3-6, page 83.) Maximum (Max) rates cannot be exceeded without danger of damaging the tube. To maintain rates to either neutralize a target or to attack a series of targets, mortars must be rested, or cooled, from previous firing. If not, heat can cause ignition of the increment or charges on a round before it reaches the bottom of the barrel. The lowest charge possible should be used during prolonged firing since heating is greater with higher charges.

Table 3-4. Rates of fire for the 60-millimeter mortar

60-mm Mortar, M224			
Ammunition Type	***Fuze***	***Maximum Rate of Fire***	***Sustained Rate of Fire***
M83A3 ILLUM	M65A1 PD	30 RPM for 1 minute, then 18 for the next 4 minutes	8 RPM
M302A1 WP SMOKE	M935/M936 PD	30 RPM for 1 minute, then 18 for the next 4 minutes	8 RPM
M769 FRPC	M781 TRNG	30 RPM for 4 minutes	15 RPM
M888 HE	M935 PD	30 RPM for 4 minutes	20 RPM
M720 HE	M734 M/O	30 RPM for 4 minutes	20 RPM
M720A1HE	M734A1	30 RPM for 4 minutes	15 RPM
M722A1 WP SMOKE	M745/M783 PD	30 RPM for 4 minutes	20 RPM
M721 ILLUM	M776 MTSQ	30 RPM for 4 minutes	20 RPM
M768 HE	M783 PD/DLY	30 RPM for 4 minutes	15 RPM
M767 IR ILLUM	M776 MTSQ	30 RPM for 4 minutes	20 RPM
XM1061 HE	M743A1	30 RPM for 4 minutes	20 RPM

Legend: DLY—delay; FRPC—full-range practice cartridge; HE—high explosive; ILLUM—illumination; IR—infrared; mm- millimeter; M/O—multioption; MTSQ—mechanical time super quick; PD—point detonating; RPM—rounds per minute; TRNG—training; WP—white phosphorous

Table 3-5. Rates of fire for the 81-millimeter mortar

81-mm Mortar, M252			
Ammunition Type	***Fuze***	***Maximum Rate of Fire***	***Sustained Rate of Fire***
M821 HE	M734 M/O	30 RPM for 2 minutes	15 RPM
M821A1 HE	M734 M/O	30 RPM for 2 minutes	15 RPM
M821A2 HE (IMP)	M734A1 M/O	30 RPM for 2 minutes	15 RPM
M889 HE	M935 PD	30 RPM for 2 minutes	15 RPM
M889A1 HE	M935 PD	30 RPM for 2 minutes	15 RPM
M853A1 ILL	M772 MTSQ	30 RPM for 2 minutes	8 RPM
M819 RP	M772 MTSQ	30 RPM for 2 minutes	15 RPM
M374A2 HE	M524/5/6/7 PD	25 RPM for 2 minutes	8 RPM
M374A3	M524/5/6/7 PD	30 RPM for 2 minutes	15 RPM
M375A1 WP	M524/5/6/7 PD	25 RPM for 2 minutes	8 RPM
M375A3	M524/5/6/7 PD	30 RPM for 2 minutes	15 RPM
M301A3 ILL	M84 MTSQ	25 RPM for 2 minutes	8 RPM
M816 ILL	M772 MTSQ	30 RPM for 2 minutes	8 RPM
M879 FRPC	M751 TRNG	30 RPM for 2 minutes	15 RPM

Legend: FRPC—full-range practice cartridge; HE—high explosive; ILL—illumination; IMP—impact; mm—millimeter; M/O—multioption; MTSQ—mechanical time super quick; PD—point detonating; RPM—rounds per minute; TRNG—training; WP—white phosphorous

Table 3-6. Rates of fire for the 120-millimeter mortar

120-mm Mortar, M120/M121			
Ammunition Type	***Fuze***	***Maximum Rate of Fire***	***Sustained Rate of Fire***
M91 ILL	M776 MTSQ	15 RPM for 1 minute	4 RPM
M933 HE	M745 PD	16 RPM for 1 minute	4 RPM
M934 HE	M734 M/O	16 RPM for 1 minute	4 RPM
M934A1 HE	M734A1 M/O	16 RPM for 1 minute	4 RPM
M929 WP SMOKE	M745 PD	16 RPM for 1 minute	4 RPM
M929 WP SMOKE	M734A1 M/O	16 RPM for 1 minute	4 RPM
M930 ILL	M776 MTSQ	16 RPM for 1 minute	4 RPM
M983 IR ILL	M776 MTSQ	16 RPM for 1 minute	4 RPM
M931 FRPC	M751 TRNG	16 RPM for 1 minute	4 RPM
Legend: FRPC—full-range practice cartridge; HE—high explosive; ILL—illumination; IR—infrared; mm—millimeter; M/O—multioption; MTSQ—mechanical time super quick; PD—point detonating; RPM—rounds per minute; TRNG—training; WP—white phosphorous			

AMOUNT AND TYPE OF AMMUNITION

3-146. The amount of ammunition available is an important consideration when attacking targets. The controlled supply rate should not be exceeded except by the authority of higher headquarters. When the controlled supply rate is low, units fire only those missions which contribute the most to the supported units' missions. When the controlled supply rate is high, units may fire missions that include targets that affect planning or future operations and targets that require massing fires without adjustment.

3-147. The selection of a charge with which to engage a target depends on the elevation required. The range and terrain dictate the elevation. Hence, targets at great distances require the lowest elevations and greatest charges, while targets in deep defilade require the highest elevations. Targets in deep defilade and at great range are difficult to engage. 60-, 81-, and 120-mm mortars vary both the elevation and charge but attempt to stay at the lowest charge while varying the elevation. For most engagements a low angle, low charge solution is preferable as this results in a smaller circular error probable and a shorter TOF. Some targets that are in deep defilade will require a higher elevation and charge to overcome target mask by way of a steeper angle of fall.

3-148. The type of ammunition selected to engage a target depends on the nature of the target and the characteristics of the ammunition available:

- HE is used for destruction, harassing, interdiction, and neutralization fire. The effects of this ammunition vary depending on the type of fuze used.
- Red phosphorous and WP ammunition is used for producing casualties, incendiary effects, screening, marking, and harassing.
- Visible and infrared (IR) illumination ammunition uses a time fuze that gives an airburst depending on the time setting on the charge and elevation.
- The height of burst (HOB) can be adjusted to give the best illumination on the desired location.

MULTIOPTION FUZES

3-149. Many modern fuzes have more than one action, referred to as multioption fuzes. With settings for delay, impact, near-surface burst, and PROX, the multioption fuze allows its user to select all types of fuzes. In the future, the multioption fuze will replace all others. (See TC 3-22.90 and TM 43-0001-28 for more information.)

Proximity Fuze

3-150. Proximity fuzes are used with HE ammunition to obtain airbursts (1 to 4 meters above ground). PROX or variable time fuzes detonate automatically when approaching the object and allow the user to obtain airbursts without adjusting the HOB. The HOB varies according to the caliber of projectile, the angle of fall, and the type of terrain in the target area. If the terrain is wet or marshy, the HOB is increased. Light foliage has little effect on a PROX fuze, but heavy foliage increases the HOB by about the height of the foliage. The greater the angle of fall, the closer the burst is to the ground.

Note. If the PROX element fails to function, the fuze operates as a super quick.

Near Surface Burst Fuze

3-151. Near surface burst settings effectively engage exposed enemy troops that are standing. The round explodes on or near the ground (0 to 1 meter). Shell fragments travel outward perpendicular to the long axis of the standing target.

Quick and Super Quick Fuzes

3-152. Quick and super quick fuzes are used for impact detonation. When an HE projectile with a quick or super quick fuze passes through trees, detonation may occur in the foliage. Therefore, its effectiveness may be either improved or decreased, depending on the density of the foliage and the nature of the target.

Delay Fuze

3-153. Delay produces a mine action caused by the round's penetration before detonation. The depth of penetration depends on the type of soil and the round's terminal velocity. Fuze delay is effective against earth and log emplacements, some masonry, and concrete structures. The standard mortar delay time is 0.05 seconds.

UNIT SELECTION

3-154. The unit selected for a mission must have weapons of the proper caliber and range to cover the target area quickly, effectively, and economically. If the unit selected to fire cannot mass its fires in an area as small as the target area, ammunition is wasted. Conversely, if a unit can cover only a small part of the target area at a time, surprise is lost during the shifting of fire. The rate of fire for the area or number of mortars may not be adequate to achieve the desired effect. The factors affecting the selection of units and the number of rounds fired upon a target are discussed in paragraphs 3-155 through 3-164.

AVAILABILITY OF MORTAR FIRE

3-155. When few mortar units are available, more targets must be assigned to each mortar unit.

SIZE OF THE AREA TO BE COVERED

3-156. The size of the area to be covered must be compared to the effective depth and width of the sheaf to be used by the platoon(s) available.

INCREASED AREA COVERAGE

3-157. Targets greater in-depth or width than the standard sizes can be covered by—

- Dividing the target into several targets and assigning portions to different firing elements.
- Increasing the number of units firing.
- Shifting fire laterally with a single unit or with several units acting as a single fire unit.
- Traversing or search fire with each mortar covering a portion of the target.

CALIBER AND TYPE OF UNIT

3-158. The projectiles of larger calibers are more effective for destruction missions.

SURPRISE

3-159. To achieve surprise, a few rounds from many mortars are better than many rounds from a few mortars.

ACCURACY OF TARGET LOCATION

3-160. In certain circumstances, personnel may be unable to locate important targets accurately. Commanders ensure adequate coverage of these targets by having more than one unit fire upon a given target.

DISPERSION

3-161. At extreme ranges, the increasing PE causes mortar fire to be less dense, so more ammunition is required to cover the target effectively. When possible, the commander compensates for that dispersion by selecting a unit with a GTL that coincides with the long axis of the target.

MAINTENANCE OF NEUTRALIZATION AND INTERDICTION FIRES

3-162. Neutralization and interdiction fires may be maintained using a few small units. A unit may fire other missions while it maintains these fires.

VULNERABILITY OF TARGETS

3-163. Some targets, such as parked trucks and troops in the open, should be attacked rapidly with massed fires while they are vulnerable.

TYPICAL TARGETS AND METHODS OF ATTACK

3-164. Mortar targets include enough enemy materiel, fortifications, and troops to justify ammunition expenditure. (See table 3-7.) Mortar fire is not effective against minefields and barbed wire. Mines are detonated only by direct hits and breaching barbed wire requires substantial amounts of ammunition.

Table 3-7. Targets and methods of attack

Type of Target	*Type of Adjustment*	*Projectile*	*Fuze*	*Type of Fire*	*Remarks (Footnotes)*
Group I					
Vehicles (Rendezvous)	Observed, unobserved	HE, WP	IMP	Neutralization, destruction	(1), (2), (3)
Vehicles (Moving)	Observed	HE, WP	IMP	Neutralization, destruction	(2), (3), (5) TOT missions are most effective.
Weapons (Fortified)	Observed	HE	Delay	Neutralization, destruction	Airbursts are desirable if the weapon is firing. After the weapon has been silenced, it is attacked for destruction. Choice of fuze is determined by the fortification. (4)
Weapons (in open)	Observed	HE, WP	PROX	Neutralization, destruction	(1), (2), (3)
Group II					
Personnel (in open)	Observed, unobserved	HE	PROX	Neutralization, harassing, destruction	PROX fuze settings should be lowest practical charge for greater accuracy and reduced time of flight. Intermittent fire is better than continuous fire.

Table 3-7. Targets and methods of attack (continued)

Type of Target	*Type of Adjustment*	*Projectile*	*Fuze*	*Type of Fire*	*Remarks (Footnotes)*
Group II					
Personnel (in dugouts or caves)	Observed	HE, WP	PROX	Neutralization, harassing, destruction	Airbursts are necessary, but surprise is not. WP/RP are useful in driving Soldiers out of holes and into the open.
Personnel (under light cover)	Observed, unobserved	HE	PROX, delay	Neutralization, harassing, destruction	(4)
Roads and railroads	Observed, unobserved	HE	PROX, delay	Neutralization	(3)
Roads and railroads	Observed, unobserved	HE	IMP	Destruction, harassing, interdiction	Critical points, defiles, fills, crossings, culverts, bridges, and narrow portions must be attacked. The DOF should coincide with the direction of the road.
Supply installations	Observed, unobserved	HE, WP	PROX	Neutralization, destruction	(1), (3)

(1) Personnel should neutralize the area with HE projectiles (airbursts if practical); surprise is essential to producing casualties.
(2) Personnel should attack material remaining in the area for destruction using the appropriate projectile and fuze.
(3) Personnel should combine WP projectiles with HE when the target contains flammable material and when the smoke will not obscure adjustment.
(4) Personnel should fire HE projectiles with a delay fuze setting at intervals to clear away camouflage, earth cover, and rubble.
(5) Personnel should stop the vehicle's movement by establishing a deep bracket so that the target will not move out of the initial bracket during adjustment. Speed of adjustment is essential. If possible, personnel stop the column at a point where vehicles cannot change their route and where one stalled vehicle will cause others to stop. Vehicles moving on a road can be attacked by adjusting on a point in front of the vehicle (in the direction in which the vehicle is moving) and timing rounds so they arrive at that point when the vehicle is passing it. A firing unit or several units, if available, may fire at different points on the road at the same time.

Legend: DOF—direction of fire; HE—high explosive; IMP—impact; PROX—proximity; RP—red phosphorous; TOT—time on target; WP—white phosphorous

SECTION V – AIMING CIRCLE

3-165. The aiming circle is used to measure azimuth and elevation angles with respect to a preselected baseline. It is a low-power telescope that is mounted on a composite

body and contains a magnetic compass, adjusting mechanisms, and leveling screws for establishing a horizontal plane. The instrument is supported by a baseplate for mounting on a tripod. Angular measurements in azimuth are indicated on graduated scales and associated micrometers. (See TM 9-6675-262-10 for more information.)

CHARACTERISTICS

3-166. Selected characteristics of the aiming circles are shown in table 3-8.

Table 3-8. Selected characteristics of the M2A2 aiming circle

Characteristic	*M2A2*
Weight (without equipment)	9 pounds
Weight (with/equipment less batteries)	21 pounds
Azimuth rotation	6400 mils
Elevation (maximum)	1100 mils
Depression (maximum)	400 mils
Magnification	4 power
Field of view	10 degrees

DESCRIPTION

3-167. M2A2 aiming circles consist of an elbow telescope mounted on orienting and elevating mechanisms, which are contained within a main housing. The main housing, in turn, is supported by adjusting screws through the base plate.

USE

3-168. The M2A2 aiming circle (see figure 3-14) is used for the precise measurement of the azimuth and elevation angles of a ground or aerial target with respect to a preselected baseline as required for the orientation of indirect fire weapons. It can be used for general topographical surveying.



Figure 3-14. Aiming circle, M2A2, and accessory equipment

ORIENTING AND ELEVATING MECHANISMS

3-169. The orienting and elevating mechanisms permit unlimited azimuth orienting movement (360 degrees [6400 mils]) and limited elevation and depression (M2A2, 1500 mils). Two orienting knobs (see figure 3-15, page 90) control the azimuth orienting rotation. The azimuth micrometer knob controls azimuth measurement. The elevation micrometer knob controls elevation and depression movement. The azimuth micrometer worm can be disengaged to provide rapid azimuth measurement of movement by exerting pressure on the azimuth micrometer knob against the pressure of an internal spring-loaded plunger (nonrecording motion). Releasing the pressure on the azimuth micrometer knob allows the mechanism to reengage (recording motion). A similar throw-out mechanism permits the azimuth orienting worm to be disengaged to provide rapid azimuth orienting movement.

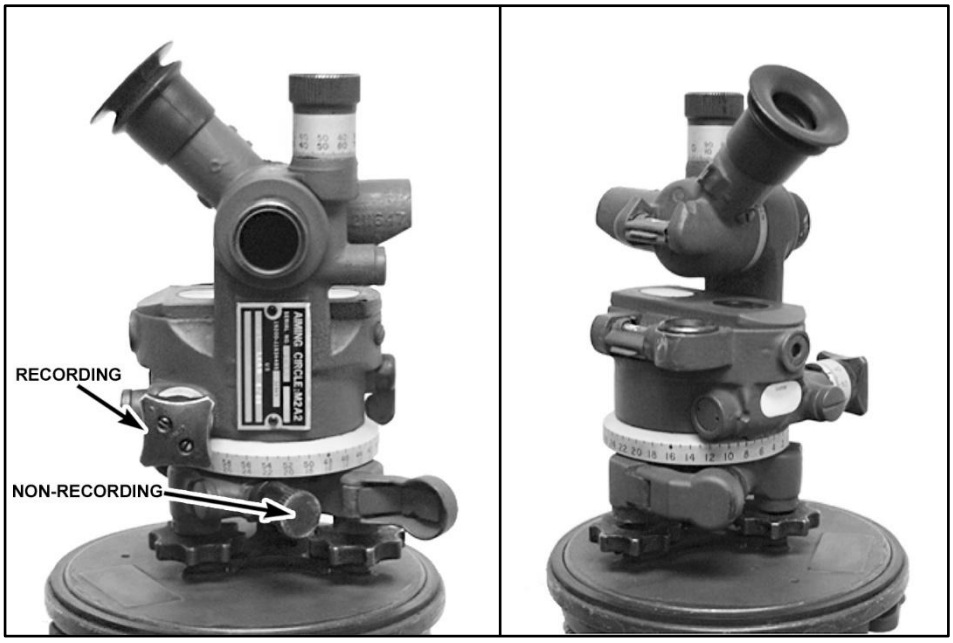


Figure 3-15. Aiming circle, M2A2

Telescope

3-170. The telescope of the aiming circle is a four-power, fixed-focus, elbow-type instrument. The reticle of the telescope contains crosslines graduated to give azimuth and elevation angular readings from 0 to 85 mils in 5-mil increments. Thus, the operator can read small angular values directly from the reticle without referring to the azimuth and elevation micrometer scales. An externally stowed filter is provided for protection against the sunlight. A slotted bracket provides the means of securing the lamp bracket on one lead wire of the M51 instrument light to provide illumination of the reticle during night operations. The reflector can be illuminated and used in conjunction with the sight units on the mortars during night operations to backlight the vertical centerline of the aiming circle.

Levels

3-171. Three levels are contained within the telescope body and main housing of the aiming circle. One tubular level, held between two bosses on the telescope body, is used to establish a true horizontal line-of-sight. The two bosses supporting this level are machined to form an open sight for approximate alignment of the telescope and target, and for quick or emergency sighting. One circular level and one tubular level are held within bosses on the main housing. The circular level is used for rough leveling of the aiming circle, and the tubular level is used for fine-leveling adjustments. The three leveling screws on the baseplate are used to level the instrument and each is controlled by a leveling screw knob.

Magnetic Compass Needle

3-172. A magnetic compass needle is in a recess in the top of the housing. A magnifier and rectangular reticle located at one end of the recess enable the operator to observe the end of the compass needle and to align the line of sight of the telescope with the needle. The compass needle can be locked in position by actuating the locking lever on the side of the housing.

Azimuth and Elevation Scales

3-173. Azimuth and elevation scales are employed to measure azimuth or elevation angles. The scales provide coarse readings, and the micrometer provides fine readings. The two readings added together give the angle. Graduation intervals and numeral scales are graduated into relatively large round number intervals for convenience in reading. The scale intervals are in graduations of 100 mils:

- The azimuth scale is graduated from 0 to 6400 mils (0 equals 6400).
  - The upper series, colored black, forms the main azimuth scale and is numbered at 200-mil intervals.
  - The lower series, colored red, is numbered from 0 to 3200 mils (the large zero in the main scale equals 3200).
  - The red scale should only be used when verifying the lay of the aiming circle with another aiming circle.
- The azimuth micrometer scale is graduated at 1-mil intervals and numbered from 0 to 100 at 10-mil intervals.
- The elevation scale is graduated and numbered on both sides of 0. Minus (red) readings represent depression and plus (black) readings represent elevations at 100-mil intervals from minus 400 to plus 800 mils.
- The elevation micrometer scale is graduated at 1-mil intervals from 0 to 99 mils.
  - Large zero is designated 0 and 100.
  - Red numerals represent depression and black numerals represent elevation.

Notation Strip

3-174. A notation strip is provided on the baseplate. This strip is a raised and machined surface on which scale readings, settings, or other data can be recorded for reference.

ACCESSORY EQUIPMENT

3-175. The accessory equipment for the M2A2 aiming circle includes the aiming circle cover, M24 tripod, and the accessory kit that includes the M51 instrument light, backplate, cloth cover, plumb bob, and a lamp holder and remover. This equipment is mounted on the M24 tripod when the instrument is set up for use.

Aiming Circle Cover

3-176. The aiming circle cover is a metal cover that protects and houses the aiming circle when not in use. It attaches to the baseplate of the aiming circle and can be carried by means of its strap. When the aiming circle is in use, the cover is placed on the tripod.

Tripod, M24

3-177. The M24 tripod comprises three telescoping wooden legs hinged to a metal head, which contains a captive screw for attaching the aiming circle. When not in use, the tripod cover is fitted on the head and the legs retracted and held by a strap. The aiming circle cover and cloth cover with attached accessory equipment can be mounted on its legs when the aiming circle is set up for use. A hook is provided to suspend the plumb bob and attached thread.

Instrument Light, M51

3-178. The M51 instrument light is used with the M2A2 aiming circle during night operations and for certain test and adjustment procedures. The light is powered by two flashlight batteries and contains two attaching lead wires. A lamp bracket attached to one lead wire can be inserted into the slotted bracket of the aiming circle telescope for illumination of the telescope reticle, while a hand light is attached to the other lead wire and used for general purpose illumination. Rotation of the rheostat knob turns the two lamps on and off and increases or decreases the intensity of illumination.

Backplate

3-179. The backplate secures and protects the instrument light and lamp bracket, hand light, and lead wires of the light. The plate with the attached instrument light is stored within the cloth cover.

Cloth Cover

3-180. The cloth cover is used to store the backplate, its attached instrument light, the plumb bob, and the lamp holder and remover. When the aiming circle is set up for use, the cloth cover is attached to one of the legs of the M24 tripod.

Plumb Bob

3-181. The plumb bob aids in orienting the aiming circle over an exact point, such as a declination station marker, on the ground. It is composed of a pointed weight attached to a nylon thread that can be suspended from the hook under the tripod head when in use. The effective length of the thread can be adjusted with the slide.

Lamp Holder and Remover

3-182. A lamp holder and remover are used to hold and remove incandescent lamps for the M51 instrument light.

SETUP AND LEVELING OF THE AIMING CIRCLE

Note. The aiming circle always must be level during operation.

3-183. In order to set up and level the aiming circle, first remove the strap from the tripod legs. Loosen the leg clamp thumbscrews. Extend the legs so that the tripod is about chest high and tighten the leg clamp thumbscrews. Spread the legs about 18 inches

apart, adjust the legs so the tripod head is about level, and plant the feet firmly in the ground.

3-184. Remove the tripod head cover. Open the baseplate cover of the aiming circle head. Keeping the baseplate cover pointed toward you, thread the tripod guide screw assembly into the aiming circle until it is firmly seated. The base of the aiming circle should not protrude over the machine surface of the tripod head. Pull out and down on the strap latch assembly. Remove the cover and hang it on the tripod head cover.

3-185. If the instrument is to be set up over an orienting point, attach the plumb bob to the hook. Adjust the tripod legs and aiming circle head until it is over the point.

3-186. Loosen the leveling screws to expose sufficient threads (9 to 13-mm—3/8 to 1/2 inches) on the three screws to permit the instrument to be leveled. Number the leveling screws clockwise, 1, 2, and 3. (See figure 3-16.) Now place the tubular level vial over the notation pad. Grasp leveling screw Number 1 between the thumb and forefinger of the right hand and grasp leveling screw Number 2 between the thumb and forefinger of the left hand. Turn the screws so that the thumbs move toward or away from each other. Using these two leveling screws, center the bubble. The bubble moves in the same direction as the left thumb.

3-187. Rotate the aiming circle head until the magnifier is over the notation pad. Level the tubular level by turning only level screw Number 3. The bubble remains level in any direction that the aiming circle is rotated. A variation of one graduation from the center of the vial is acceptable. If the bubble does not remain level, repeat this procedure.

3-188. The aiming circle should be set up at the distance indicated by table 3-9, page 94.

Note. If the spring plate is bent, the aiming circle cannot be leveled and must be turned in for maintenance.

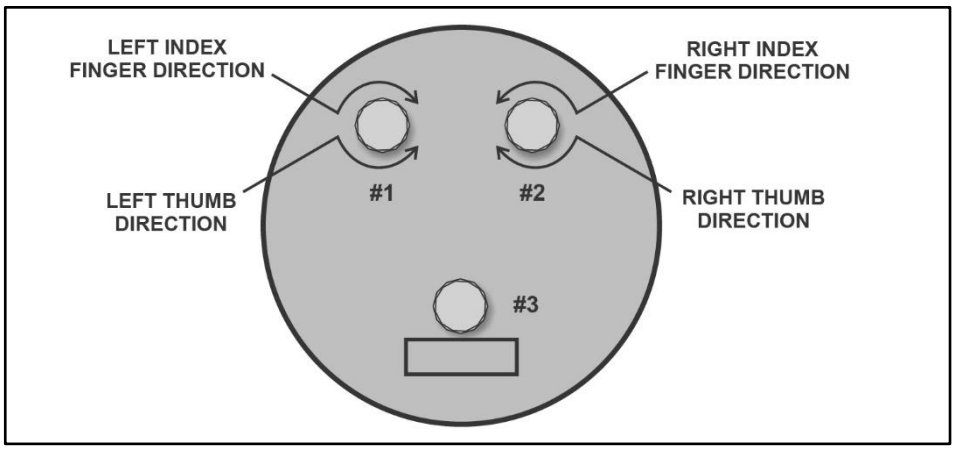


Figure 3-16. Leveling screws

Table 3-9. Set-up distance from objects

Object	*Distance (Meters)*
High-tension power lines	150
Electronic equipment	150
Railroad tracks	75
Tanks and trucks	75
Vehicles	50
Barbed wire	30
Mortars or telegraph wire	25
Helmets and so forth	10

Note. Failure to distance the aiming circle from metallic objects or power sources (overhead and underground power lines) can alter readings and cause inaccurate information data.

DECLINATION CONSTANT

3-189. Since the magnetic needle of an aiming circle points toward magnetic north and not the grid north on a map, it is necessary to correct for this difference by using the declination constant. The declination constant of an instrument is the clockwise angle between grid north and magnetic north; that is, the grid azimuth of magnetic north. This constant differs slightly for different instruments and must be recorded on each instrument. The constant varies for the same instrument in different localities. Use the following to determine the declination constant.

DECLINATION STATION

3-190. Declination stations are established by fires battalion survey teams to determine the declination constants of instruments and to correct for local attractions, annual variations, and instrument errors. When a unit moves from one location to another, a station should be established where all instruments are declinated. If the declination constants for all instruments of a unit are determined at the same station, grid azimuths measured with each instrument will agree with the map grid, and all instruments will agree with each other. The point chosen for the declination station must have a view of at least two distant, well-defined points with a known grid azimuth. Two additional points are desirable, one in each quadrant, as a check.

PROCEDURE FOR DECLINATING THE AIMING CIRCLE AT A DECLINATION STATION

3-191. Where a declination station is available, the procedure for declinating the aiming circle is as follows:

- Set up and fine level the aiming circle directly over the declination station marker using the plumb bob.
- Place the grid azimuth of the first azimuth marker on the scales using the recording motion:

  - Place the vertical crossline of the telescope on the azimuth marker using the nonrecording (orienting) motion.
  - The aiming circle now is oriented on grid north.
- With the recording motion, rotate the instrument to 0:
  - Release the magnetic needle and look through the magnifier.
  - Center the north-seeking needle using the recording motion and then relock the magnetic needle.
- Notice the new azimuth on the scale, which is the declination constant and record it.
- Recheck the aiming circle level and repeat steps 2 through 4 using the remaining azimuth markers until three readings have been taken. If there is only one marker, repeat the entire procedure twice using the same marker.
- Find the average declination constant using these three readings.

EXAMPLE 1

1st point reading = 6399 mils
2nd point reading = 6398 mils
3rd point reading = 6398 mils
Total = 19195 mils
19195/3 = 6398.3 (rounded off to the nearest whole number) = 6398 mils (average declination constant)

EXAMPLE 2

First point reading = 0030 mils
Second point reading = 0031 mils
Third point reading = 0029 mils
Total = 0090 mils
0090/3 = 0030 mils (average declination constant)

- Record the average declination constant in pencil on the notation (strip) pad of the aiming circle as its declination constant:
  - All readings should be within 2 mils of each other; if not, repeat steps 2 through 4.
  - Ensure the aiming circle is directly over the station marker to obtain the 2-mil tolerance.
- If the desired 2-mil accuracy is not gained after two tries, the aiming circle is defective and should be turned in for repair.

USE OF THE GRID MAGNETIC ANGLE

3-192. If an aiming circle is used in a new area without a declination station, a declination constant can be determined by using the grid-magnetic (G-M) angle from a map. When the G-M angle (converted to mils) is westerly, it is subtracted from 6400 mils. The remainder is the declination constant. When the G-M angle is easterly, the angle (in mils) is the declination constant.

PROCEDURE FOR DECLINATING AN AIMING CIRCLE WHEN A DECLINATION STATION IS NOT AVAILABLE

Note. This procedure is the least desirable and should be used only when no other means are available. It does not compensate for the error that could be inherent in the aiming circle.

3-193. To declinate an aiming circle when a declination station is not available, determine the G-M angle from the map of the area in which the aiming circle is to be used. The G-M angle is used as indicated:

- In 1, figure 3-17, the difference between grid north and magnetic north is 200 mils (westerly).
  - This total is subtracted from 6400 mils.
  - The declination constant that can be used is 6200 mils.
- In 2, figure 3-17, the difference between grid north and magnetic north in a clockwise direction is 120 mils. This can be used as the declination constant.

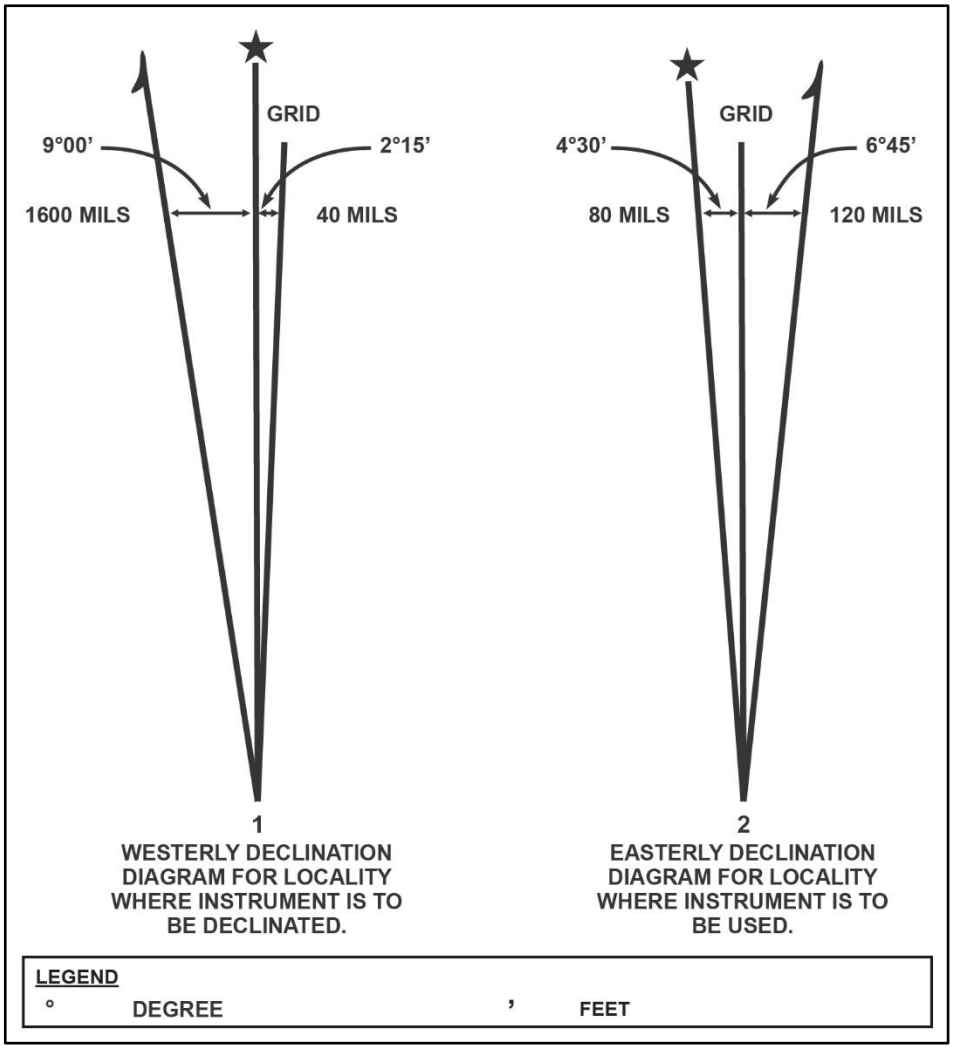


Figure 3-17. Marginal data from a map

WHEN TO DECLINATE THE AIMING CIRCLE

3-194. Certain rules prescribe how often and under what circumstances the aiming circle should be declinated to keep the declination constant current. The rules are as follows:

- The aiming circle should be declinated when it is moved 25 miles or more from the area in which it was last declinated; in some locations, a move of less than 25 miles can require a declination of the aiming circle.
- The aiming circle must be declinated after an electrical storm or after receiving a severe shock, such as a drop the bed of a truck to the ground because the magnetic needle is a delicately balanced mechanism, and any shock can cause a significant change in the declination constant.
- The aiming circle should be declinated every 30 days to guard against changes that may have occurred due to unreported accidents to the instrument. If a radical change is observed, the instrument should be declinated again within a few days to determine if the observed change was due to a magnetic storm or is a real change in the characteristics of the instrument.
- The aiming circle should be declinated when it initially is received and when it is returned from support maintenance repair.

ORIENTING OF THE INSTRUMENT ON GRID NORTH TO MEASURE GRID AZIMUTH TO OBJECTS

3-195. The procedure to orient the aiming circle on grid north to measure grid azimuth to objects is as follows:

- Level the instrument.
- Set the azimuth micrometer and azimuth scale on the declination constant of the instrument.
- Release the magnetic needle.
- With the orienting knob, align the south end of the needle accurately with the center etched line by using the magnetic needle magnifier.
- Lock the magnetic needle and close the orienting knob covers.
- Using the throw-out mechanism (azimuth knob), turn the telescope until the vertical line of the reticle is about on the object.
- By rotating the azimuth knob, bring the vertical line exactly on the object.
- Read the azimuth to the object on the azimuth and micrometer scales.

MEASURING OF THE HORIZONTAL ANGLE BETWEEN TWO POINTS

Note. To measure the horizontal angle between two points, at least two measurements are made.

3-196. To measure the horizontal angle between two points—

- Set the azimuth micrometer and the azimuth scale at zero.
- Rotate the instrument using the orienting knob throw-out mechanism until the vertical line of the telescope is about on the left edge of the left-hand object.
- Lay the vertical line exactly on the right edge of the left-hand object by rotating the orienting knob.
- Using the throw-out mechanism (azimuth knob), turn the telescope clockwise until the vertical line is about on the left edge of the right-hand object.
- Lay the vertical line exactly on the left edge of the right-hand object by turning the azimuth knob.
- Read the horizontal angle on the scales and record the value to the nearest 0.5 mil. This completes the first repetition.
- Rotate the aiming circle, using the lower motion, until the vertical crossline is again on the rear station.

Note. The value obtained from the first repetition is still on the scales.

- Rotate the aiming circle body, using the upper motion, until the vertical crossline is again on the forward station.
- Read and record the accumulated value of the two measurements of the angle to the nearest 0.5 mil. This completes the second repetition.
- Divide the second reading by two to obtain the mean angle to the nearest 0.1 mil. This mean angle must be within 0.5 mil of the first reading, if it is not, the measurement is void and the angle is measured again.

ORIENTING OF THE 3200 LINE ON A GIVEN GRID AZIMUTH

3-197. The procedure for orienting the 0 to 3200 line of the aiming circle on a given grid azimuth is illustrated below. In this example, the MAZ is 5550 mils, and the aiming circle is assumed to have a declination constant of 6380 mils. The steps are as follows:

- Set up and level the aiming circle.
- Subtract the announced MAZ from the declination constant of the aiming circle (adding 6400 to the declination constant of the aiming circle if the MAZ is larger). In this case, subtract the MAZ 5550 from the declination constant 6380.

SOLUTION

Declination constant	6380 mils
Announced MAZ	- 5550 mils
Remainder	830 mils

- Set the remainder on the azimuth and micrometer scales of the aiming circle. In this case, the remainder is 830 mils (recording motion).
- Release the compass needle:
  - Look through the window in the cover housing and rotate the instrument until the needle floats freely using the orienting knob throw-out mechanism.

- For fine adjustments, use orienting knobs until the magnetic needle is exactly centered on the etched marks on the magnifier.
- Relock the compass needle to orient the 0 to 3200 line of the aiming circle on the MAZ.
- In this case, the grid azimuth is 5550 mils (see figure 3-18).

- Do not disturb the lower motion of the aiming circle once it is oriented.

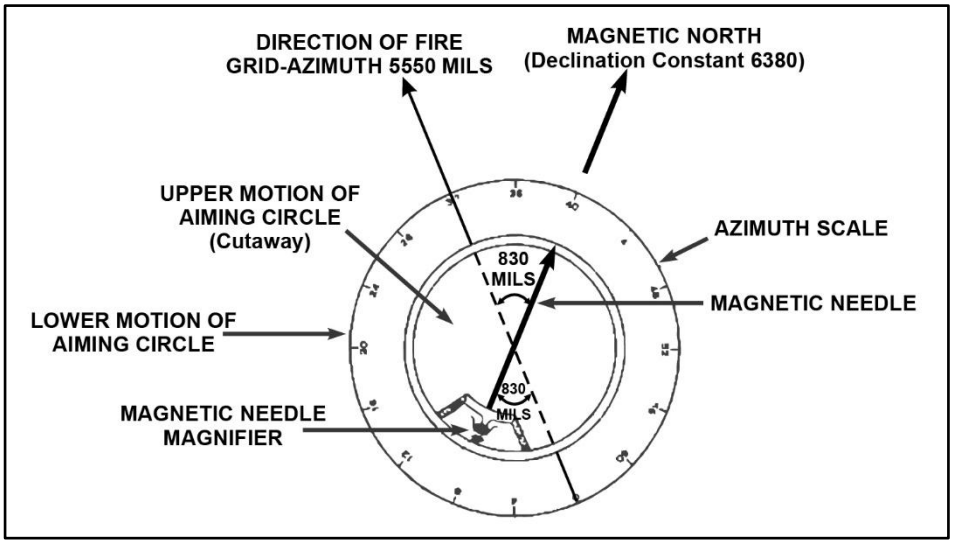


Figure 3-18. Aiming circle oriented in the desired direction of fire

ORIENTING BY ORIENTING ANGLE

3-198. Orienting by orienting angle eliminates errors that result from the use of the magnetic needle of the aiming circle.

Note. The magnetic needle is not used to orient the aiming circle.

3-199. An orienting angle is the horizontal clockwise angle from the MAZ to the orienting line, the vertex being at the orienting station. It is a line of known direction established on the ground near the firing section, which serves as a basis for laying for direction. A survey team establishes this line.

3-200. To orient the aiming circle using the orienting angle—

- Set the aiming circle over the orienting station and level it.
- Place the orienting angle on the azimuth scale.
- Sight on the far end of the orienting line, using the lower motion.

Note. Before performing the next step, close the orienting knob cover to prevent unintentional movement of the lower motion.

- The 0 to 3200 line of the aiming circle now is oriented parallel to the MAZ. Example: the azimuth of the orienting line is 3200 mils.
  - The azimuth on which the section leader wishes to lay the section is 1600 mils.
  - The orienting angle is 1600 mils (see figure 3-19).

SOLUTION

Azimuth of orienting line		3200 mils
Minus MAZ	-	1600 mils
Orienting angle		1600 mils

- The aiming circle is set up over the orienting station using the plumb bob. The upper motion is used to set off 1600 mils on the aiming circle:
  - The section leader sights on the end of the orienting line using the lower motion.
  - The 0 to 3200 line of the aiming circle is now oriented.

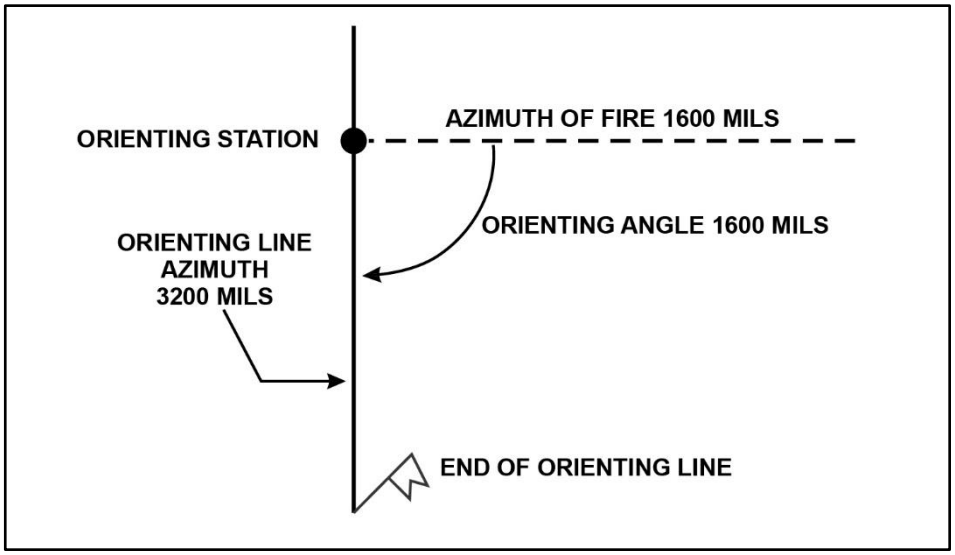


Figure 3-19. Orienting by orienting angle

ORIENTING OF THE 0 TO 3200 LINE ON A GIVEN MAGNETIC AZIMUTH

3-201. The procedure for orienting the 0 to 3200 line of the aiming circle on a given magnetic azimuth is as follows:

- Subtract the announced magnetic azimuth from 6400.
- Set the remainder on the azimuth and micrometer scales of the aiming circle.
- Release the compass needle, rotate the orienting knob until the magnetic needle is exactly centered in the magnetic needle magnifier, and lock the compass needle.

- The 0 to 3200 line of the aiming circle now is oriented on a given magnetic azimuth.

VERIFICATION OF THE LAY OF THE PLATOON

3-202. To verify the lay of the platoon, the following steps should be taken:

- After the section or platoon is laid with an M2A2 aiming circle or compass (referred to as the lay circle), the leader verifies the lay by using another M2A2 aiming circle or compass, (referred to as the safety circle).
  - The leader or designated safety officer sets up and orients an M2A2 aiming circle by using the method that was used with the lay circle (see figure 3-20).
  - The aiming circle must be located where it can be seen by all mortars and should be no closer than 10 meters to the lay circle.
- After picking up a line of sight on the lay circle, the safety circle operator commands, LAY CIRCLE, REFER, AIMING POINT THIS INSTRUMENT. The lay circle operator sights the instrument onto the safety circle by use of the recording motion.
- When the aiming circle is used to orient another aiming circle for direction, the reading between the two circles will be 3200 mils apart, because both circles measure horizontal clockwise angles from the line of fire.
  - To prevent confusion, remember that if red is seen, read red.
  - One half of the aiming circle azimuth scale has a second red scale that goes in the opposite direction of the black scale.
- There should be no more than 10 mils difference between the circles.
- If the lay circle and the safety circle deflection are within the 10-mil tolerance, the instrument operator on the safety circle places the deflection reading by the lay circle on the upper motion of the safety circle.
  - With the lower motion, the instrument sights back on the lay circle.
  - This serves to align the 0 to 3200 line of the safety circle parallel to the 0 to 3200 line of the lay circle.
- The instrument operator on the safety circle commands, PLATOON, REFER, AIMING POINT THIS INSTRUMENT.
  - All gunners refer and announce the deflection to the safety circle.
  - If the deflection referred by the mortar is within 10 mils, the operator on the safety circle announces that the mortar is safe.
- Once the mortars are safe, the operator announces, THE PLATOON IS SAFE.
- The platoon leader walks the gun line and visually checks the guns to ensure they are parallel, and an M2 compass should be used to ensure the guns are on the azimuth of fire.

Note. A safety circle is only mandatory for training and is not required for real-world operation, though it is advised when time and tactical situation permit.

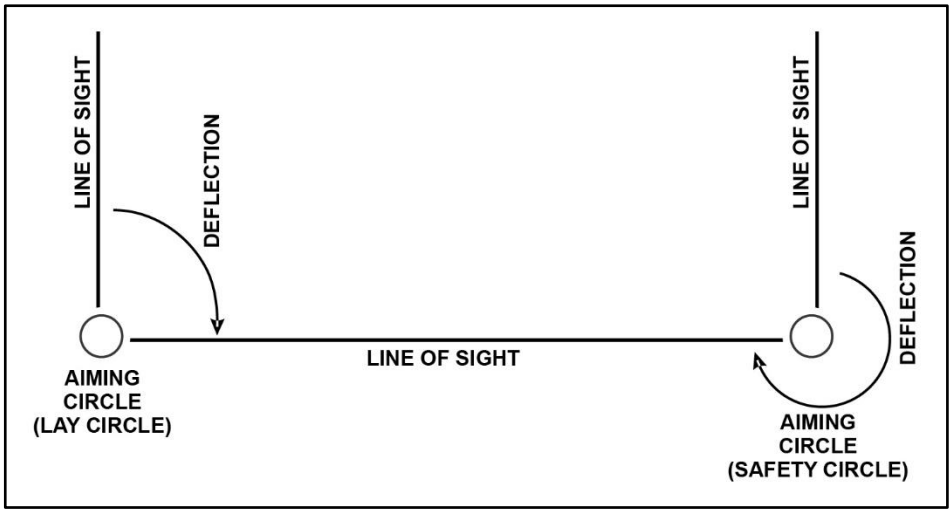


Figure 3-20. Method used to orient an aiming circle, M2A2

DISASSEMBLY OF THE AIMING CIRCLE

3-203. Instructions for disassembling the aiming circle are located inside the circle cover.

CARE AND MAINTENANCE

3-204. The aiming circle cannot withstand rough handling or abuse. Proper care prolongs its life and ensures better results for the user. Inaccuracies or malfunctions result from mistreatment. The following precautions must be observed:

- Since stops are provided on instruments to limit the travel of the moving parts, do not attempt to force the rotation of any knob beyond its stop limit.
- Keep the instrument as clean and dry as possible, and if the aiming circle is wet, dry it carefully.
- When not in use, keep the equipment covered and protected from dust and moisture.
- Do not point the telescope directly at the sun unless a filter is used; the heat of the focused rays can damage optical elements.
- Keep all exposed surfaces clean and dry to prevent corrosion and etching of the optical elements.
- To prevent excessive wear of threads and other damage to the instrument, do not tighten leveling, adjusting, and clamping screws beyond a snug contact.

Note. Only maintenance personnel are authorized to lubricate the aiming circle.

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Chapter 4

Call for Fire and Fire Missions

A CFF is a concise message prepared by the observer. It contains all the information needed by the FDC to determine the method of target attack. This chapter will discuss the elements, message to observer (MTO), format, and authentication in a CFF. Types of mission show what indirect fire Infantrymen must know and be able to conduct to meet the commander's intent. The selection of these missions are based off a crosswalk that must be done to outline the training needs. This chapter will discuss the basic and advance fire missions.

CALL FOR FIRE

4-1. The CFF is a request for fire from the observer. The observer sends it quick and clear enough for the FDC to understand, record, and read back without error.

4-2. The CFF is sent in three transmissions consisting of six elements with a break and a read back after each transmission. The transmissions and elements are as follows:

- The first transmission, which includes the following:
  - Observer identification.
  - Warning order.
- The second transmission includes the target location.
- The third transmission, which includes the following:
  - Target description.
  - Method of engagement (optional).
  - Method of fire (MOF) and control (optional).

Note. When the observer sees a target, the observer notifies the RTO so the RTO can begin the CFF while the target location is determined. The RTO sends the information as it is determined, instead of waiting until a complete CFF has been prepared.

4-3. CFFs may also require authentication.

FIRST TRANSMISSION

4-4. The first transmission ensures that the FO is in contact with the desired firing element and alerts the firing element that a CFF is in progress.

OBSERVER IDENTIFICATION

4-5. Observer identification tells the FDC who is calling for fire. It includes the appropriate call signs or codes needed to establish contact between the observer and the FDC.

WARNING ORDER

4-6. The warning order clears the net for the fire mission. The warning order includes the—

- Type of mission.
- Size of the element to FFE (optional).
- Method of target location.

TYPES OF MISSIONS

4-7. There are four types of missions for a warning order:

- A/F.
- FFE.
- Suppress.
- IS or immediate smoke.

ADJUST FIRE

4-8. When the observer decides that an adjustment is needed because of a questionable target location or lack of registration corrections, the observer announces, ADJUST FIRE.

FIRE FOR EFFECT

4-9. The observer always strives for first-round FFE. The accuracy required to FFE depends on the target and the ammunition being used. When the observer is certain that the target location is accurate and that the first volley will have the desired effect on the target with little or no adjustment, the observer announces, FIRE FOR EFFECT.

SUPPRESS

4-10. To bring fire on an inactive target quickly, the observer announces, SUPPRESS [target identification number]. Suppression missions normally are fired on preplanned targets, and the duration is associated with the CFF.

IMMEDIATE SUPPRESSION OR IMMEDIATE SMOKE

4-11. When engaging a planned target or target of opportunity that has taken friendly maneuver or aerial elements under fire, the observer announces, IMMEDIATE SUPPRESSION. If the desired effect is a hasty screen for obscuration, the FO announces, IMMEDIATE SMOKE.

SIZE OF ELEMENT TO FIRE FOR EFFECT

4-12. The observer may request the size of the unit to FFE.

SECOND TRANSMISSION

4-13. This element enables the FDC to plot (M16/M19 plotting board) or enter (MFCS/LHMBC) the location of the target so that personnel can determine firing data.

Note. Target altitude should be sent; if it is not, the FDC should ask for it.

Methods of Target Location

4-14. Methods of target location include grid, shift from a known point and polar plot.

Grid

4-15. If the target is located using the grid method, the FO announces, GRID [six-digit grid coordinates for typical mission; eight-digit grid coordinates for RPs or other points for which greater accuracy is required]. Since the FDC does not need the OT direction to locate the target, the observer sends the direction (to the nearest 10 mils) at the end of the CFF or just before the initial correction.

Shift From a Known Point

4-16. If the target is located using the shift from a known point method, the FO announces, SHIFT FROM KNOWN POINT [known point designation or target number]. In a shift from a known point mission, both the observer and the FDC must know the point from which the shift will be made; the observer announces it in the warning order. The observer then sends the OT direction. Normally, direction to the target is sent to the nearest 10 mils; however, the FDC can use mils, degrees, or cardinal directions, whichever is specified by the observer. Next, the observer sends the lateral shift (the target's distance left or right of the known point, expressed to the nearest 10 meters), the range shift (the target's distance farther [add] or closer to [drop] the known point, expressed to the nearest 100 meters), and the vertical shift (the target's distance above [up] or below [down] the known point, expressed to the nearest 5 meters).

Note. Unless it exceeds 30 meters, the vertical shift is ignored.

Polar Plot

4-17. If the target is located using the polar plot method, the observer announces, POLAR, in the warning order to alert the FDC that the target will be located with respect to the observer's position, which must be known to the FDC. The observer sends the direction (to the nearest 10 mils) and distance (to the nearest 100 meters) to the target from the position. A vertical shift (to the nearest 5 meters) tells the FDC how far the target is located above (up) or below (down) the observer's location. Vertical shift may be described by a vertical angle in mils relative to the observer's location.

THIRD TRANSMISSION

4-18. This element gives the FDC a detailed description, method of engagement, MOF, and control. This provides the ability to use proper ammunition to place effective fires on a target or area at the requested time.

Target Description

4-19. The section leader selects different ammunition for different types of targets. The observer describes the target in detail to allow the section leader to determine the amount and type of ammunition to use. The observer's description should be brief, but accurate, and contain the following:

- What the target is (troops, equipment, supply dump, trucks).
- What the target is doing (digging in, establishing an assembly area).
- The number of elements in the target (squad, platoon, three trucks, six tanks).
- The degree of protection (in the open, in fighting positions, in bunkers with overhead cover).
- The target size and shape, if significant.
- When the target is rectangular, the observer gives the length and width in meters, and the attitude (azimuth of the long axis) to the nearest 100 mils; for example, 400 meters by 100 meters; attitude 2600.
- When the target is circular, the observer gives the radius.

Method of Engagement

4-20. The observer may indicate how the observer wants to attack the target. This element includes the following:

- Type of adjustment.
- Ammunition.
- Distribution of fire.

Type of Adjustment

4-21. In an adjustment, area or point fires may be used.

Area Fire

4-22. If no specific type of adjustment is designated, area fire will be used. Split a 100-meter bracket to achieve area fire.

Point Fire

4-23. Point fire is conducted with one weapon engaging a point target. An example of precision point mortar mission is registration. Registration is initiated by the FDC and is used to determine corrections for subsequent missions.

Danger Close

4-24. The observer includes the term “danger close” in the method of engagement when the target is located within 600 meters of friendly troops for mortars and cannon artillery, 750 meters for 5-inch naval guns.

Ammunition

4-25. If the observer does not request a specific projectile or fuze, the observer is given shell HE, fuze impact (IMP).

4-26. The observer initially may request one type of projectile or fuze and then request another type to complete the fire mission.

Smoke

4-27. When the observer requests smoke, the chief computer normally directs the use of HE for the adjustment phase and WP for the completion of the adjustment and FFE.

Combination of Projectiles or Fuzes

4-28. When the observer wants a combination of projectiles or fuzes in effect, the observer states so in this element of the CFF. For example, the observer may request, HE AND WP IN EFFECT or IMP AND PROX IN EFFECT.

Volume of Fire

4-29. The observer may request the volume of fire needed for FFE. If the observer does not specify the number of rounds to be fired in effect, the FDC notifies the observer of the number of rounds that will be fired in effect.

Distribution of Fire

4-30. A linear sheaf is fired on an area target in FFE. When another type of sheaf is desired, the observer announces the type of sheaf desired; for example, CONVERGED or OPEN SHEAF.

Methods of Fire and Control

4-31. The MOFs and control indicate the desired manner of attacking the target, whether the observer wants to control the time of delivery of fire, or if the observer can observe the target. The observer announces the MOFs and control using the terms discussed in paragraphs 4-32 through 4-34.

Method of Fire

4-32. Adjustment normally is conducted with the Number 2 mortar. The observer may request any weapon or combination of weapons to adjust. For example, if the observer wants to see where each of the mortars in a section hits, the observer may request, SECTION RIGHT [LEFT].

4-33. The normal interval of time between the rounds fired by a section right or left is 10 seconds. If the observer wants another interval, the observer specifies this.

Method of Control

4-34. The control element indicates the type of control that the observer exercises over the time of fire delivery and if any or no adjustments are to be made. In the absence of observer control, the firing section fires WR or under the FDC's control. The observer announces the method of control (MOC) using the following terms:

- AT MY COMMAND (AMC).
- CANNOT OBSERVE.
- TIME ON TARGET.
- CONTINUOUS ILLUMINATION.
- COORDINATED ILLUMINATION.

- CEASE FIRE.
- CHECK FIRE.
- CONTINUOUS FIRE.
- REPEAT.
- FOLLOWED BY.

AT MY COMMAND

4-35. AMC indicates that the observer wants to control the delivery of fire.

4-36. The observer announces, AT MY COMMAND, immediately before the A/F or FFE. When the weapons are ready to fire, FDC personnel announce, SECTION IS READY. Then, when the observer wants the mortar section to fire, the observer announces, FIRE. This MOC remains in effect until the observer announces, CANCEL AT MY COMMAND, or END OF MISSION.

CANNOT OBSERVE

4-37. This announcement indicates that the observer cannot A/F, but the observer believes that a target exists at the given location, and the target is important enough to justify firing upon it without adjustment.

TIME ON TARGET

4-38. The observer may tell the FDC when the observer wants the rounds to impact by requesting, TIME ON TARGET [number desired] MINUTES FROM NOW, or TIME ON TARGET [time desired] HOURS. The observer conducts a time check to ensure that the timepiece is synchronized with the FDC's timepiece. The FDC subtracts the TOF from the desired time of impact to determine the time at which the round must be fired.

CONTINUOUS ILLUMINATION

4-39. If the observer has not given an interval, the section leader determines the interval by the burn time of the illuminating ammunition in use. If another interval is required, it is indicated in seconds.

COORDINATED ILLUMINATION

4-40. While the preferred method is to have the FDC compute the interval between HE and illuminating rounds, the observer may order this interval in seconds. This command causes the HE round to impact at the point of optimum illumination, or the observer may use AMC procedures.

CEASE FIRE

4-41. This command is used to stop the loading of rounds into mortars when firing two or more rounds. Gun sections may fire any rounds that have been loaded already (hung rounds).

CHECK FIRE

4-42. This command is used to cause an immediate halt in firing.

CONTINUOUS FIRE

4-43. In mortars, this command means firing as rapidly as possible, consistent with accuracy and within the prescribed rate of fire for the mortar being used. Firing continues until suspended by the commands, CEASE FIRE, or CHECK FIRE.

REPEAT

4-44. This command can mean two things:

- During adjustment, REPEAT means to fire another round(s) using the last data and adjust for any change in ammunition.
- During FFE, REPEAT means to fire the same number of rounds using the same method of FFF while changes to the number of guns, gun data, interval, or ammunition may be requested.

FOLLOWED BY

4-45. This term is used to indicate a change in the rate of fire, the type of ammunition, or another order for FFE.

MESSAGE TO OBSERVER

4-46. After receiving the CFF, the FDC determines if and how the target will be attacked. That decision may be announced to the observer in the form of an MTO.

4-47. The MTO includes four items:

- Unit(s) to fire.
- Changes to the CFF.
- Number of rounds.
- Target number.

4-48. The following information can be transmitted in the MTO:

- Angle T.
- TOF.

UNIT TO FIRE

4-49. This element includes the number of mortars that will fire the mission.

CHANGES TO CALL FOR FIRE

4-50. This element contains any changes to the CFF.

NUMBER OF ROUNDS

4-51. This element contains the number of rounds for each tube in FFE.

TARGET NUMBER

4-52. A target number is assigned to each mission to help the processing of subsequent corrections.

ANGLE T

4-53. The FDC sends angle T to the observer when it is between 500 and 2700 mils or when it is requested.

Note. See chapter 2 for more information about angle T.

TIME OF FLIGHT

4-54. The FDC sends TOF to an observer during moving target or aerial observer missions, or when it is requested.

Note. See ATP 3-09.30 for more information about MTOs.

AUTHENTICATION

4-55. Authentication is considered a normal element of the initial request for indirect fire. Two methods of authentication are authorized for use:

- Challenge and reply.
- Transmission.

4-56. Challenge and reply authentication requires two-way communication, whereas transmission authentication does not. Challenge and reply authentication is used when possible.

CHALLENGE AND REPLY AUTHENTICATION

4-57. The FDC inserts the challenge in the last readback of the CFF. The FO transmits the correct authentication reply immediately following the challenge. Authentication replies exceeding 20 seconds are automatically suspect, and the FDC may rechallenge. Subsequent adjustments of fire or immediate engagement of additional targets by the FO who originated the fire request normally do not require continued challenge.

TRANSMISSION AUTHENTICATION

4-58. Transmission authentication is used only if authentication is required, and it is not possible or desirable for the receiving station to reply. (For example, message instruction, imposed radio silence, FPF, and IS.)

4-59. The observer is given a transmission authentication table following the unit standard operating procedure (SOP). The table includes 40 columns with authenticators in each column. After each authenticator is used, a line may be drawn through it to avoid using the same one again.

TYPES OF FIRE MISSIONS

4-60. Fire missions range from basic to advanced. Within each of those types of fire missions there are factors to consider.

BASIC FIRE MISSIONS

4-61. The basic fire missions are the missions every indirect fire Infantryman will be able to conduct per mortar certification publications. These missions are the foundation and will support all mission-essential task lists (METLs) throughout the Army.

Mark Center Sector

4-62. Mark-center-of-sector is used to determine the center of the unit's area of responsibility. The FDC will compute this information by using the left, right, minimum, and maximum limits.

Registration

4-63. Registration involves applying fire corrections to resolve interior and exterior ballistics and errors in gun/target location. This process is like zeroing a rifle.

Special Sheaf Adjustment

4-64. Special sheaf adjustments involve altering the placement of rounds on the ground between guns. The sheaf may be open, converged, linear (formerly known as standard), parallel, or special.

Meteorological Correction

4-65. MET correction involves correcting for variations in weather conditions.

Grid

4-66. For a grid mission, the observer expresses the target location using the target's grid coordinates. A six-digit grid covers 100-meter area, an eight-digit grid covers 10 meters, and a ten-digit grid covers 1 meter. Mortars consider eight digits as a surveyed grid.

Shift from a Known Point

4-67. For a shift from a known point mission, the observer expresses the target location using the target's direction and distance from a known point or target.

Polar Plot

4-68. For a polar plot mission, the observer expresses the target location using the target's direction and distance from the observer's location. Before calling for a polar plot mission, the observer's location must be known and transmitted to the FDC.

Immediate Suppression/Smoke

4-69. When engaging a planned target or target of opportunity that has taken friendly maneuver or aerial elements under fire, the observer announces, IMMEDIATE SUPPRESSION, or IMMEDIATE SMOKE. The delivery of these fires is performed as quickly as possible while keeping safety and accuracy in mind.

Illumination

4-70. Indirect fire Infantryman use illumination procedures to illuminate a portion of the battlefield.

ADVANCED FIRE MISSIONS

4-71. The advanced fire missions are the mission's indirect fire Infantryman will be able to conduct per mortar certification publications. These missions are selected through the task crosswalk and will support the unit's METL.

Coordinated illumination

4-72. Coordinated illumination procedures combine illumination with HE, red phosphorous, or WP to illuminate and engage a target.

Final Protective Fire

4-73. FPF is a final defensive measure to prevent friendly units from being overrun by enemy units.

Search

4-74. Indirect fire Infantryman use search procedures to fire upon targets that are deeper (vertical) than the burst diameter of the round being fired.

Traverse

4-75. Indirect fire Infantryman use traverse procedures to fire upon targets that are wider (horizontal) than the sections or platoons that engage them.

Search and Traverse

4-76. Indirect fire Infantryman use search and traverse procedures to fire upon targets with attitudes neither parallel nor perpendicular to the GTL.

Quick Smoke

4-77. Indirect fire Infantryman may use immediate or quick smoke. Advanced planning of quick smoke is essential, since it requires large amounts of ammunition and prior coordination with all troops in the vicinity of the intended curtain or screen.

Simultaneous

4-78. Simultaneous procedures involve simultaneous fire upon two targets from a specific location.

Split Section

4-79. Split section procedures involve firing upon a single target from more than one location.

Time on Target

4-80. The observer may tell the FDC when the observer wants the rounds to impact by requesting, TIME ON TARGET [numbered desired] MINUTES FROM NOW or TIME ON TARGET [time desired] HOURS. The observer conducts a time check to ensure that the timepiece is synchronized with the FDC's timepiece.

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Chapter 5

Plotting Board Introduction

The plotting board is an instrument used to compute the deflection, range, and azimuth for indirect firing of the mortar. The M16 plotting board is used with the 81-mm M252 and M252A1 and the 120-mm M120/M121 and M120A1. The M19 is used with the 60-mm M224 and M224A1 mortar.

SECTION I – DESCRIPTION

5-1. M16 and M19 plotting boards are the secondary means of fire control. Using these tools, the computer can determine deflections, azimuths, and ranges. The plotting boards are known as the analog systems of FDC.

M16 PLOTTING BOARD

5-2. The M16 plotting board is the secondary means of fire control for 81-mm and 120-mm mortars. It includes a base, azimuth disk, and a range arm. (See figure 5-1, page 118.)

Note. GTA 07-01-029 can be found at local training support centers.

WARNING

Do not use for live fire.

BASE

5-3. The base is a white plastic sheet bonded to a magnesium alloy backing. The grid system printed on the base is to a scale of 1:12,500, making each small square 50 meters by 50 meters and each large square 500 meters by 500 meters. At the center of the base, is the pivot point to which the azimuth disk is attached. Extending up and down from the pivot point is the vertical centerline. The vertical centerline range scale is graduated every 50 meters and numbered every 100 meters from 0 (pivot point) to 3,100 meters, with a total range from the pivot point of 3,200 meters. The vertical centerline ends with an arrowhead at the top of the board.

5-4. The arrowhead, known as the index mark pointer, is used in determining azimuths and deflections to the nearest 10 mils. It points to the index mark of the vernier scale (0 mark), which is used to determine azimuths and deflections to the nearest mil. The vernier scale is divided every mil and numbered every 5 mils, with a total of 10 mils left and right of the 0.

5-5. To the left of the vertical centerline, is the secondary range scale. The secondary range scale is numbered every 500 meters (from 0 to 6,000), with a total range of

6,400 meters. It is used to determine range when the mortar position is plotted at points other than the pivot point. Two additional range scales 1:50,000 and 1:25,000 are on the right edge of the base. They are used with maps in determining ranges.

AZIMUTH DISK

5-6. The azimuth disk, which is made of clear plastic, is roughened on one side so that it can be written on with a soft lead pencil. The azimuth scale on the outer edge is numbered every 100 mils (from 0 to 6300) and divided every 10 mils with a longer line at every 50 mils, giving a complete circle of 6400 mils.

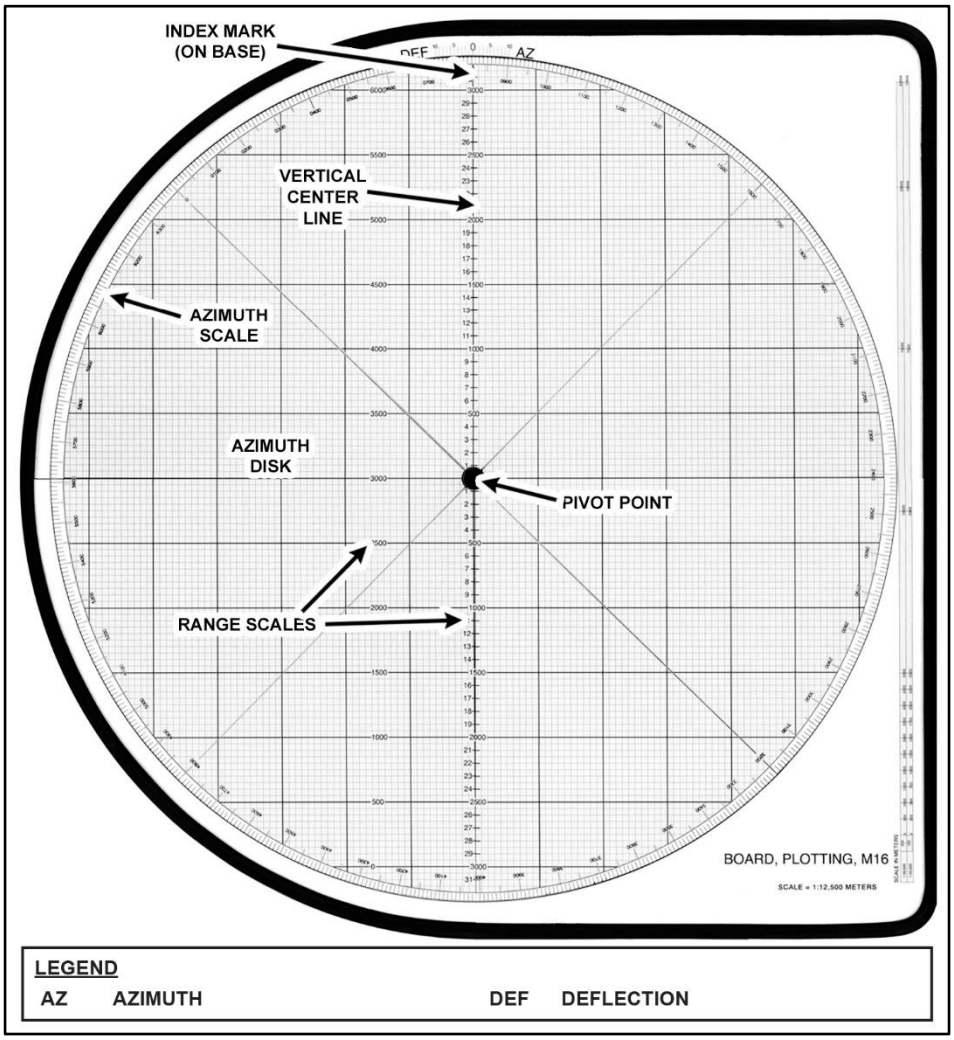


Figure 5-1. M16 plotting board

RANGE ARM

5-7. The range arm, a transparent plastic device, has two range scales (one on each edge), a protractor on the right bottom, and a vernier scale across the top. The range scales are numbered every 100 meters and graduated every 50 meters. The protractor is graduated every 100 mils from 0 to 1600 mils.

M19 PLOTTING BOARD

5-8. The M19 plotting board is the secondary means of fire control for the 60-mm mortar. It includes a rotating disk of transparent plastic and a removable range arm, which are both attached to a flat grid base. (See figure 5-2.)

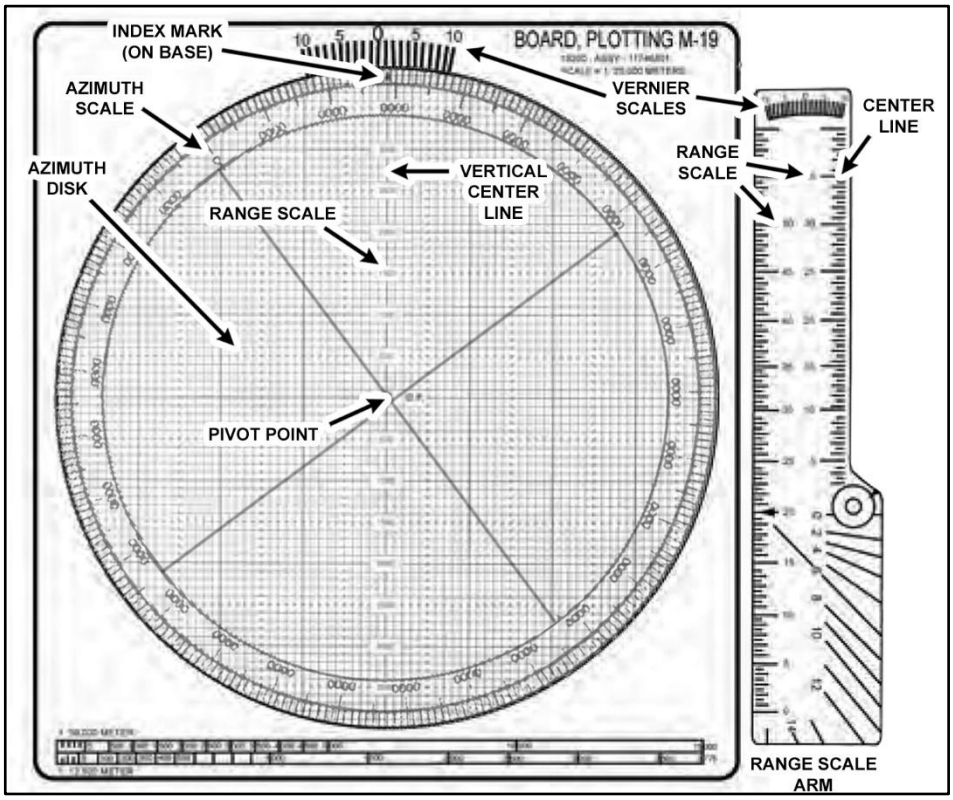


Figure 5-2. M19 plotting board

BASE

5-9. The base is a white plastic sheet bonded to a magnesium alloy backing. A grid is printed on the base (in green) at a scale of 1:25,000. The vertical centerline is graduated and numbered up and down (from 0 through 32) from the center (pivot point) in 100s of meters, with a maximum range of 3,200 meters. Each small grid square is 100 meters by 100 meters.

5-10. The index mark points to the center of the vernier scale at the top edge of the plotting board. It is the point at which deflections or azimuths may be read to the nearest 10 mils. When plotting at the pivot point, the pivot point represents the location of the Number 2 mortar.

5-11. In addition to the grid pattern, a vernier scale is printed on the base. It is used to obtain greater accuracy when reading the mil scale on the azimuth disk. The vernier scale permits the operator to read azimuths and deflections accurately to the nearest mil.

5-12. On the bottom of the base, a double map scale in meters with representative fractions of 1:50,000 and 1:12,500 is used to transfer to and from a map that has one of those scales.

AZIMUTH DISK

5-13. The rotating azimuth disk is made of plastic. Its upper surface is roughened for marking and writing. A mil scale on the outer edge is used for plotting azimuths and angles. It reads clockwise to conform to the azimuth scale of a compass. The scale is divided into 10-mil increments (from 0 to 6400) and is numbered every 100 mils. Also, the disk has two black lines called centerlines. These centerlines are printed across the center of the disk from 0 to 3200 and from 1600 to 4800 mils.

RANGE ARM

5-14. The range arm is used when mortars are plotted at the pivot point. It is made of plastic and can be plugged into the pivot point. Two range scales are on the range arm. On the right edge, is a range scale that corresponds to the range scale found on the vertical center line. An alternative range scale is on the left edge of the range arm and is used when plotting away from the pivot point. The vernier scale at the upper end of the range arm is used to read azimuths or deflection when plotting at the pivot point without rotating the disk back to the vertical centerline. The direction of the FO can be indexed at the index point. The vernier scale on the range arm is read in reverse of the one on the grid base. The left portion is read for azimuth, and the right portion is read for deflection. The protractor lines below the range arm knob may be used to place a sector of fire on the disk:

- To read the azimuth to 1 mil, read the left portion, starting at 0, and read to the 10 in the center.
- To read deflections, start at the right edge of the range arm and read to 10.

SECTION II – CONFIGURATION

5-15. This section will cover the configuration of the plotting board. To ensure proper set up is conducted, the computer includes the following information:

- Knowledge of the different firing charts and when to use them.
- Weapon systems capabilities to help determine between pivot point and below pivot point method (range).
- DOF (azimuth).
- MAZ.
- Refer deflection, superimposed.

FIRING CHARTS

5-16. Three types of firing charts can be constructed on the M16/M19 plotting board: the observed firing chart, the modified observed firing chart, and the surveyed firing chart. This chapter discusses methods of constructing these charts.

OBSERVED FIRE CHARTS

5-17. The mobility of modern combat often requires mortars to provide accurate and responsive indirect fire support before survey information is available. The observed firing chart provides this ability.

PREPARATION

5-18. Two items are needed to set up the plotting board for observed firing chart operations:

- Range from the mortar position to the target.
- DOF (azimuth).

5-19. The range and azimuth from the mortar position to the target usually are obtained from a map by plotting each position and then determining the grid azimuth and range. That information is then transferred to the plotting board by converting the DOF (azimuth) into the MAZ. (See figure 5-3, page 122.)

DETERMINATION OF THE MOUNTING AZIMUTH

5-20. To determine the MAZ from the DOF (azimuth), the computer rounds off the DOF to the nearest 50 mils. (Round-off rule for obtaining the MAZ: 0 to 24, round to 00; 25 to 74, round to 50; 75 to 99, round to 100.) The aiming circle or M2 compass the operator uses the MAZ to lay the section, and the computer uses it to prepare the M16/M19 plotting board. This gives the computer a starting point for superimposing the Ref scale.

EXAMPLE
DOF 3200 = MAZ 3200
DOF 1625 = MAZ 1650
DOF 3150 = MAZ 3150

Note. DOF 3150 is already at the nearest 50 mils; there is no need to round off.

REFERRED DEFLECTION

5-21. The Ref can be any 100-mil deflection from 0 to 6300 if all the mortars can place out their aiming posts on the same deflection. Normally, the Ref used is 2800 to the front or 0700 to the rear. The Ref used is any deflection that does not cause a sight block of one or more mortars. The use of an additional aiming stake, placed in an alternate direction assists in mitigating sight block.

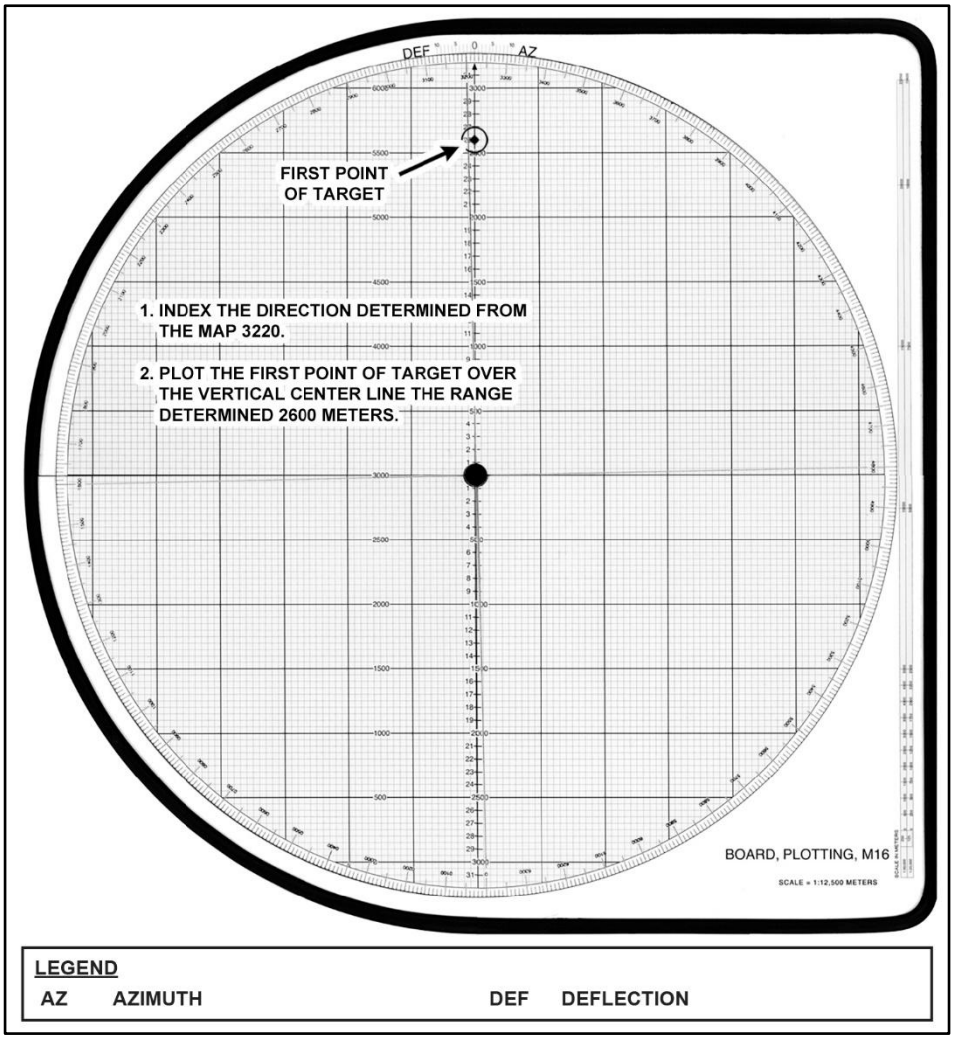


Figure 5-3. Preparation of the plotting board

SUPERIMPOSITION OF REFERRED DEFLECTION

5-22. The Ref is superimposed (written) on the azimuth disk under the MAZ using the left add, right subtract (LARS) rule. The disk is numbered at least 400 mils left and right of the Ref, which is enough to cover the area of operation. (See figure 5-4.) However, if needed, the deflection scale can be superimposed all the way around the azimuth disk.

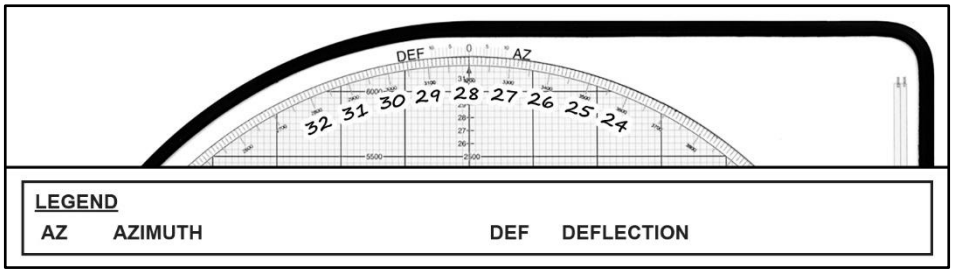


Figure 5-4. Superimposition of referred deflection scale under the mounting azimuth

PIVOT POINT AND BELOW PIVOT POINT METHODS

5-23. Pivot point and below pivot point methods are used to ensure the computer has the necessary range available to cover the weapon's capabilities.

PIVOT POINT

5-24. When the mortars are plotted at the pivot point, the computer uses the vertical center line for aligning the mortar position and plot. Range can be determined by simply reading the range of the plot on the range scale of the vertical center line.

5-25. Use the vertical centerline to determine the range and the vernier scale to determine deflections to both the initial and subsequent rounds by taking these steps:

- Determine the range and direction to the center of the sector from a map or by visual observation:
  - Round off the azimuth to the initial round or DOF to the nearest 50 mils to determine a MAZ
  - Superimpose a deflection scale on the azimuth disk.
- Make the initial plot by indexing the DOF, or initial azimuth, to the initial round at the index mark.
  - This may be different from the MAZ because of the round-off rule.
  - Use the scale on the vertical centerline to make the initial plot at the correct range.
- When the FO calls in a target direction (the OT azimuth), index the azimuth disk on the M16/M19 plotting board at the OT azimuth.
  - It remains indexed on that azimuth until the mission is completed.
  - Plot corrections from the FO according to procedures.
  - Once a correction has been plotted, rotate the range arm until the right edge of the range arm is over the new plot.
  - Determine the range to the nearest 25 meters and read the deflection to the nearest mil using the vernier scale.
- Plot additional corrections and use the range arm to determine range and deflection.
- Once the azimuth disk is indexed on the OT azimuth, the disk does not have to be rotated to determine ranges or deflections.

BELOW PIVOT POINT

5-26. The computer uses the left edge of the range arm to plot the initial round. The MAZ and azimuth to the initial round are determined as for mortars plotted at pivot point. The computer indexes the azimuth disk on the DOF and aligns the right edge of the range arm on the vertical centerline. Next, the FO makes a small plot at the zero range on the left edge of the range arm. Then, still using the left edge, the FO makes a small plot at the range for the initial round. The mortar position plot must be marked with a hollow cross to further identify its position. Once the initial round is fired, the range arm is removed, and the left edge is used as a range scale.

5-27. The below pivot point method is used when the ranges to the targets being engaged are more than 2,900 meters. When the initial range to the target is 2,900 meters or more, mortars always are plotted below the pivot point.

5-28. Two items are needed to set up the board for operation: a GT azimuth and a range from the mortar position to the target.

5-29. To construct the chart—

- Index the GT azimuth.
- Drop below the pivot point 2,000 meters for 60-mm and 81-mm mortars, and 3,000 meters for 120-mm mortars.
- Plot the mortar position 500 meters left or right of the vertical centerline (see figure 5-5).

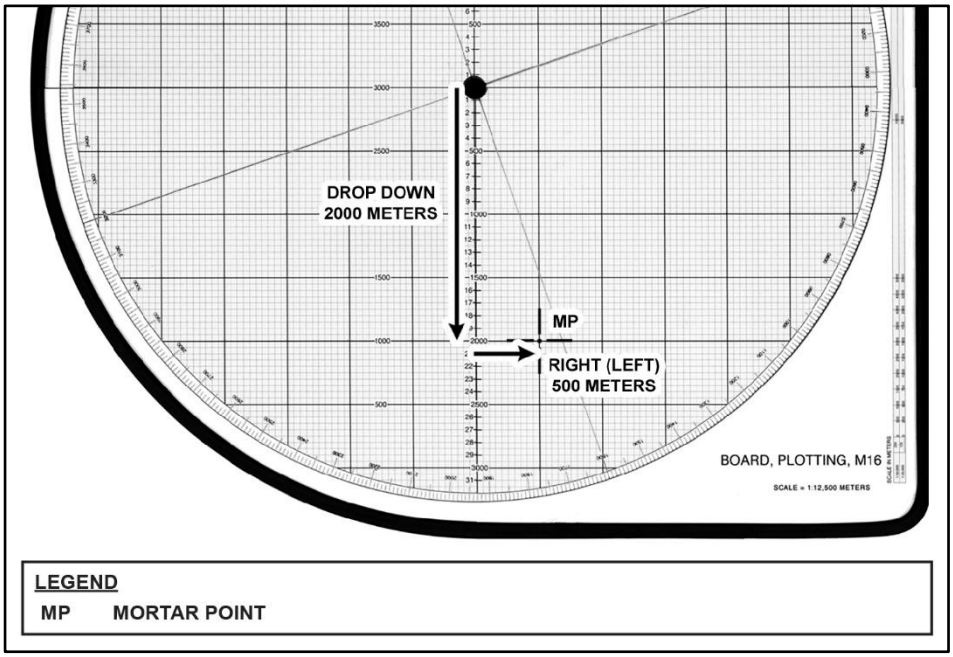


Figure 5-5. Plotting of mortar position

5-30. Once these actions have been taken, ensure that the azimuth disk still is indexed on the GT azimuth. Then, from the mortar position, plot the first round at the range

determined using the parallel-line method of plotting. (See figure 5-6.) Determine the MAZ and Ref the same way as with the pivot-point method.

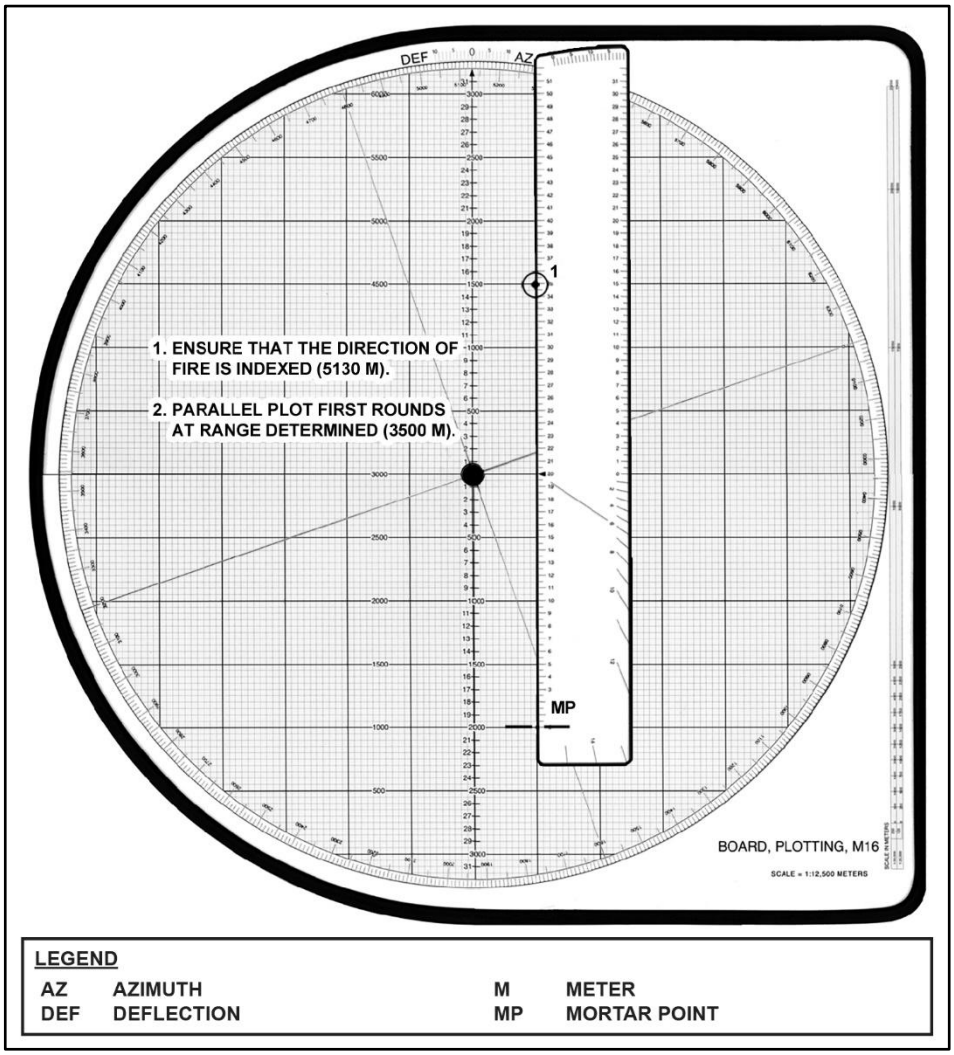


Figure 5-6. Plotting of first round

Note. Hold this line; it is parallel to the mortar firing point.

5-31. To determine the firing data to send to the mortar, align the mortar position below the target being engaged using the parallel-line method of plotting. Then read the deflection using the azimuth disk and vernier scale and measure the range between the mortars and target. To align the mortar position and target, since the mortar position is being plotted away from the pivot point, use the parallel-line method of plotting. With

the mortar position and target plotted, rotate the disk until the mortar position and the target are an equal distance from, or on, the same vertical line. (See figure 5-7.)

Note. All directions are read from bottom to top.

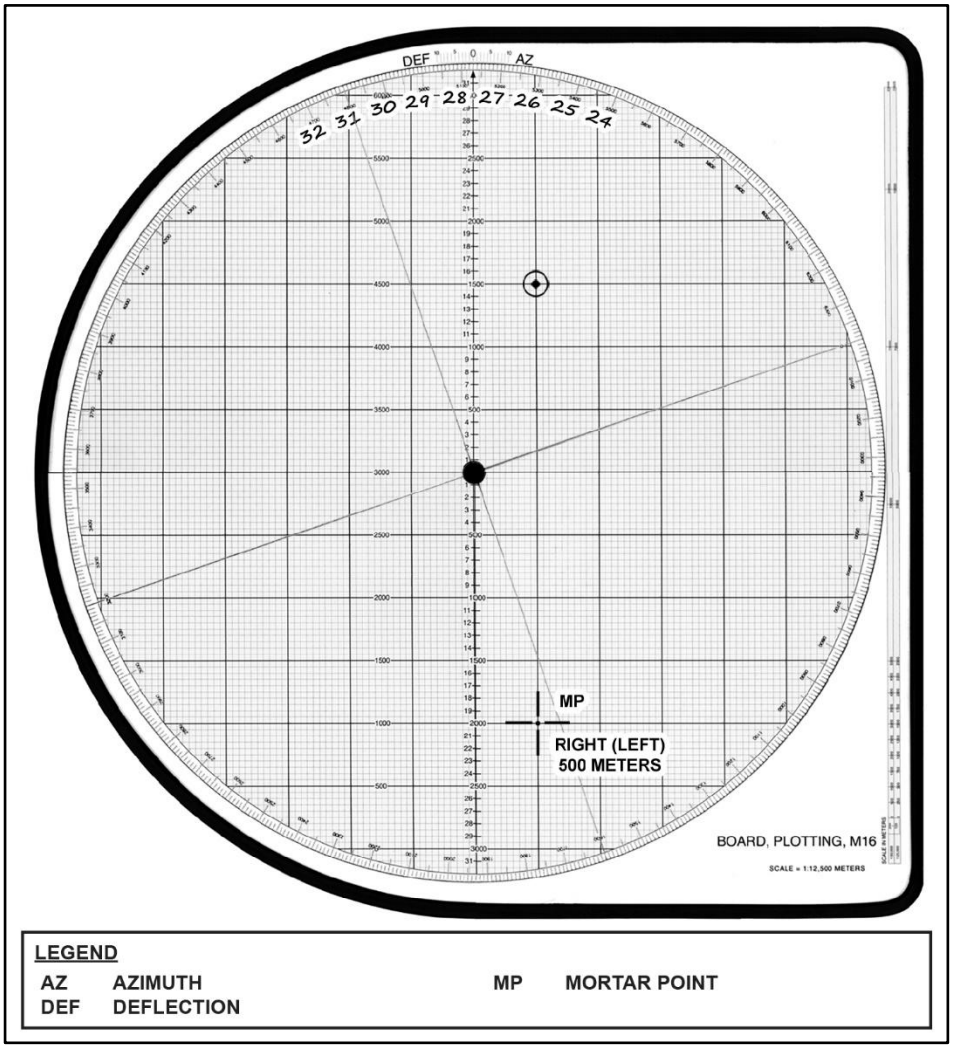


Figure 5-7. Parallel line plotting

5-32. Range now must be determined using one of the following three techniques:

- Count each of the 50-meter squares from the mortar position to the target.
- Use the scale on the left edge of the range arm to measure the distance from the mortar position to the target.
- Place the edge of the DA Form 2399 alongside the two plots on the plotting board (mortar and target).
  - Then make a tick mark on the edge of the DA Form 2399 at each plot.
  - Using the alternate range scale (built into the board) to the left of the pivot point, lay the DA Form 2399 along this scale with the mortar tick mark at 0 and read the range. (See figure 5-8.)

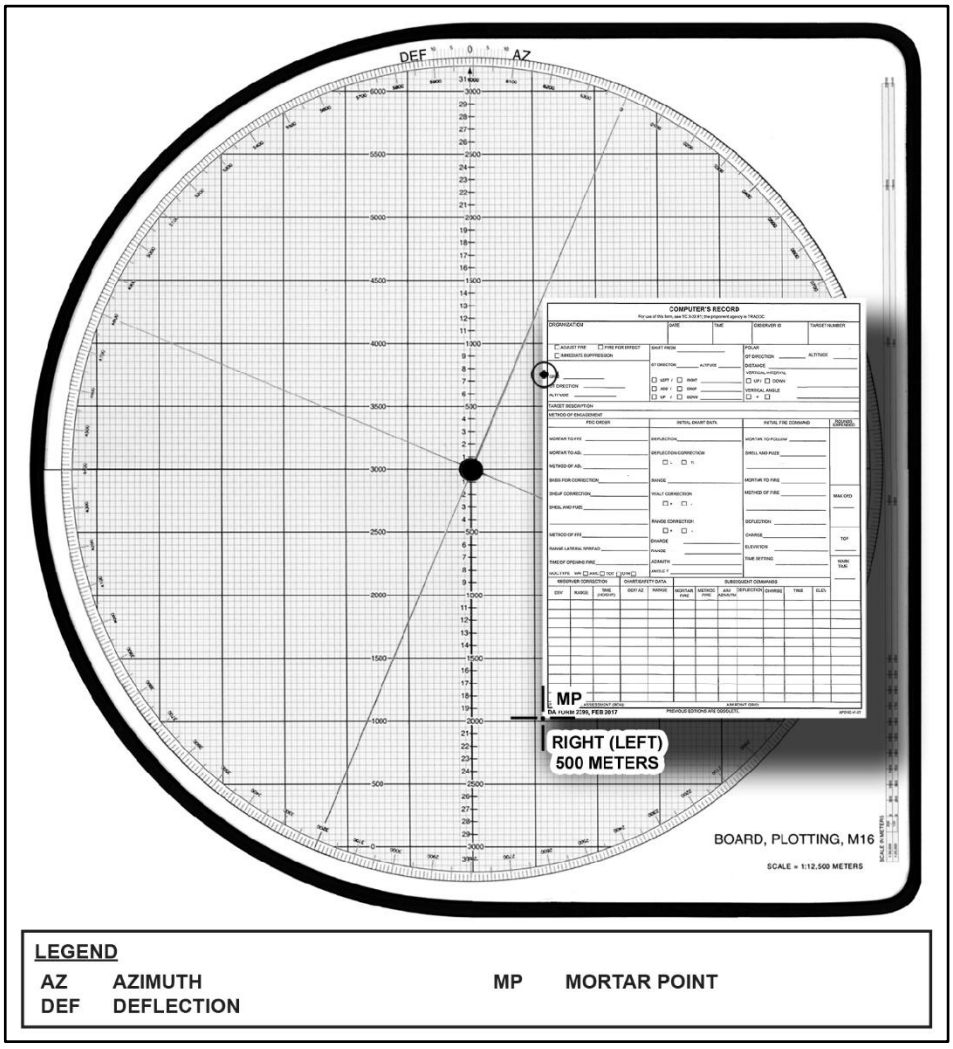


Figure 5-8. Determination of range with edge of DA Form 2399 (Computer's Record)

5-33. To update the board after the end of mission (EOM) is given or to engage other targets, use the same method as with the pivot-point method.

Note. When operating the M16 plotting board as an observed firing chart (pivot-point or below-pivot-point methods), no correction factors are applied to the data.

DETERMINATION OF FIRING DATA

5-34. After plotting the first round on the DOF at the determined range and superimposing the deflection scale, the computer rotates the azimuth disk until the first round is over the vertical centerline. The FO determines the deflection to fire the first round by using the deflection scale and the left portion of the vernier scale. (See figure 5-9.)

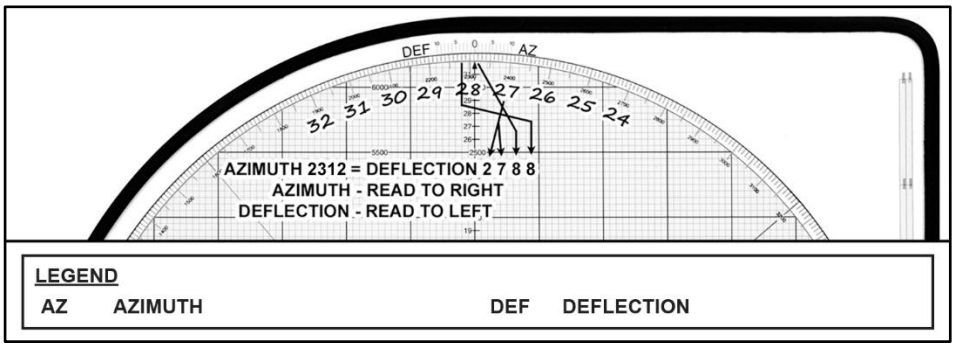


Figure 5-9. Determination of the deflection

Step 1

5-35. Read the first two digits from the deflection scale (see figure 5-9). Since deflections increase to the left, read the first number (100-mil indicator) to the right of the index mark. In this example, it is 27.

Step 2

5-36. Read the third digit from the 10-mil graduations between deflection scale numbers 27 and 28 (100-mil indicators). Count the 10-mil graduations on the azimuth disk (from 27 to the index mark) to find that the index mark is between the eighth and ninth 10-mil graduations, making the third digit 8 (see figure 5-9).

Step 3

5-37. Read the fourth digit on the vernier scale. For deflections, use the left half of the vernier scale. Count the 1-mil graduations, starting at the 0, to the left until one of the 1-mil graduations of the vernier scale and one of the 10-mil graduations on the azimuth disk are aligned. In this example, the fourth 1-mil graduation is aligned, making the fourth digit 4 (see figure 5-9).

Step 4

5-38. Determine the range by rotating the plot over the vertical centerline and reading the range to the nearest 25 meters. Enter the FT, such as FT 81-AI-3, and determine the charge as follows:

- Locate the charge versus range table (see figure 5-10) in the appropriate FT (normally the last page of the introduction).
- This page is the charge versus range chart:
  - It can be used to determine the lowest charge to engage the target.
  - To use the chart, find the range to the target using the range bar at the bottom of the chart.
- The range bar is numbered every 500 meters from 0 to 5,000 meters.
- Since the range to the target was determined to be 2,600 meters, estimate the 2,600 meters on the range bar.
- After determining the 2,600-meter point on the range bar, place a straightedge at the point so that it crosses the charge lines.
- The first charge line the straightedge crosses is the lowest charge possible to engage the target.

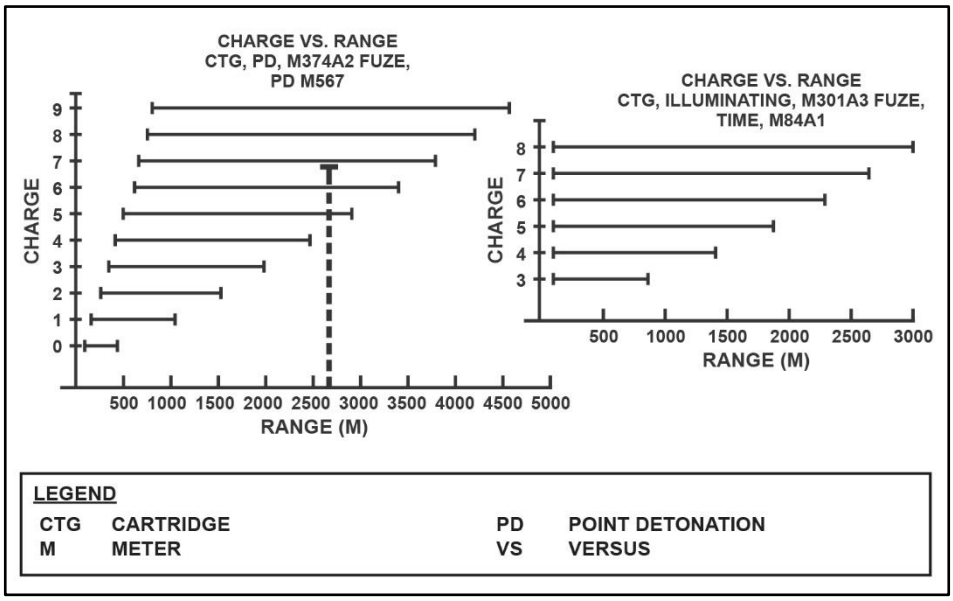


Figure 5-10. Charge versus range chart

PLOTTING OF OBSERVER CORRECTION

5-39. To plot the FO's corrections, the computer first indexes the FO's direction to the target. That OT direction is given in the CFF or with the first correction. Going from the last round, the FO applies the FO's corrections.

5-40. For example, assume that the OT direction is 3050, and the FO sends these corrections: "Right 50, drop 200." Ensuring that OT direction is indexed, make these corrections from the first plot. (See figure 5-11, page 130.)

5-41. To do this, move to the right one small square (50 meters), then straight down the board four small squares (200 meters). Then, make a small plot, circle it, and label it "Number 2." To determine the firing data, rotate the disk until the Number 2 plot is over the vertical centerline. Then, read the deflection and range. (See figure 5-12.) Using the FT, determine the charge and elevation to fire the round, and compute the subsequent fire command.

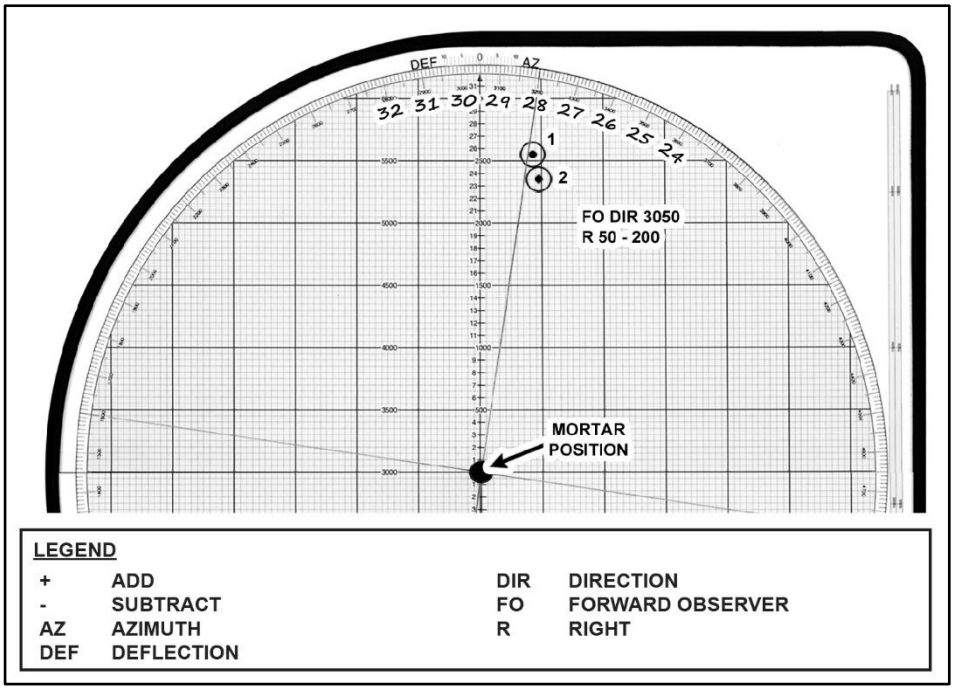


Figure 5-11. Plotting of observer's correction

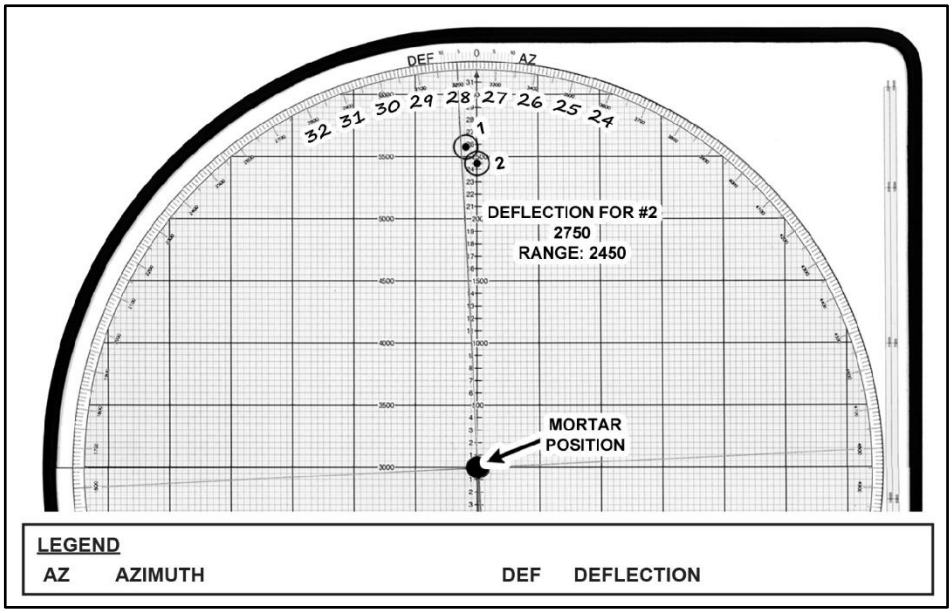


Figure 5-12. Determination of deflection and range

5-42. Once the EOM has been given, update the M16- and M19-plotting board. (See figure 5-13, page 132.) To do this, erase all the plots except the final plot. Then enclose that plot with a hollow cross and number it with the target number. (See figure 5-14, page 132.)

ENGAGEMENT OF OTHER TARGETS

5-43. To fire other targets on this chart, the computer performs the following actions:

- Grid—go back to the map, plot the target location, and determine the range and direction from the mortar firing point.
- Shift—index the FO's direction to the target and apply the correction from the known point, which must be plotted on the chart.

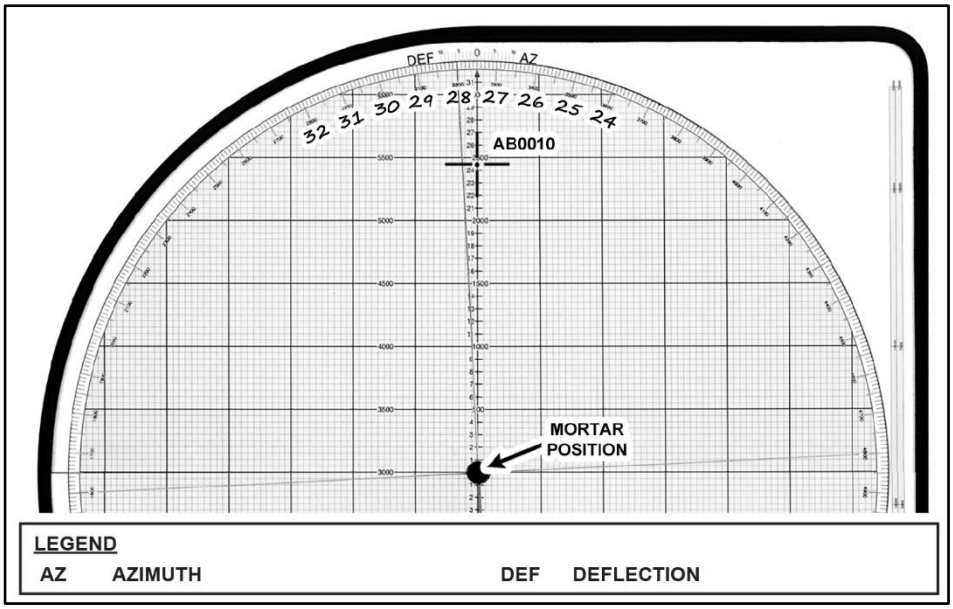


Figure 5-13. Updated board

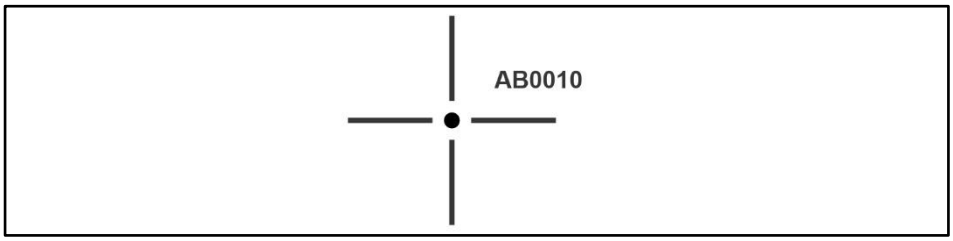


Figure 5-14. Hollow cross with target number

MODIFIED OBSERVED FIRE CHART

5-44. The modified observed firing chart can be constructed on the M16 plotting board. It is constructed when the mortar position or target is known to survey accuracy. The three basic items needed to construct a modified observed chart are: a DOF (usually to the center of the platoon area of responsibility), one point (mortar position, target, or reference point) that must be known to surveyed accuracy (eight-digit grid coordinates), and a grid intersection to represent the pivot point.

Determination of Direction of Fire

5-45. The section leader usually determines DOF. In most cases, it is to the center of the sector. The mortar location can be surveyed by map inspection, terrain inspection, or pacing from a known point on an azimuth, if the position of the base gun is known to a valid eight digits.

5-46. For the 60-mm and 81-mm mortars, the grid intersection representing the pivot point is between 1,500 and 2,000 meters forward of the mortar location. This allows the full range of the mortar to be used. (See figure 5-15.)

Note. With the 120-mm mortar, the grid intersection should be 3,000 to 4,000 meters forward of the mortar position.

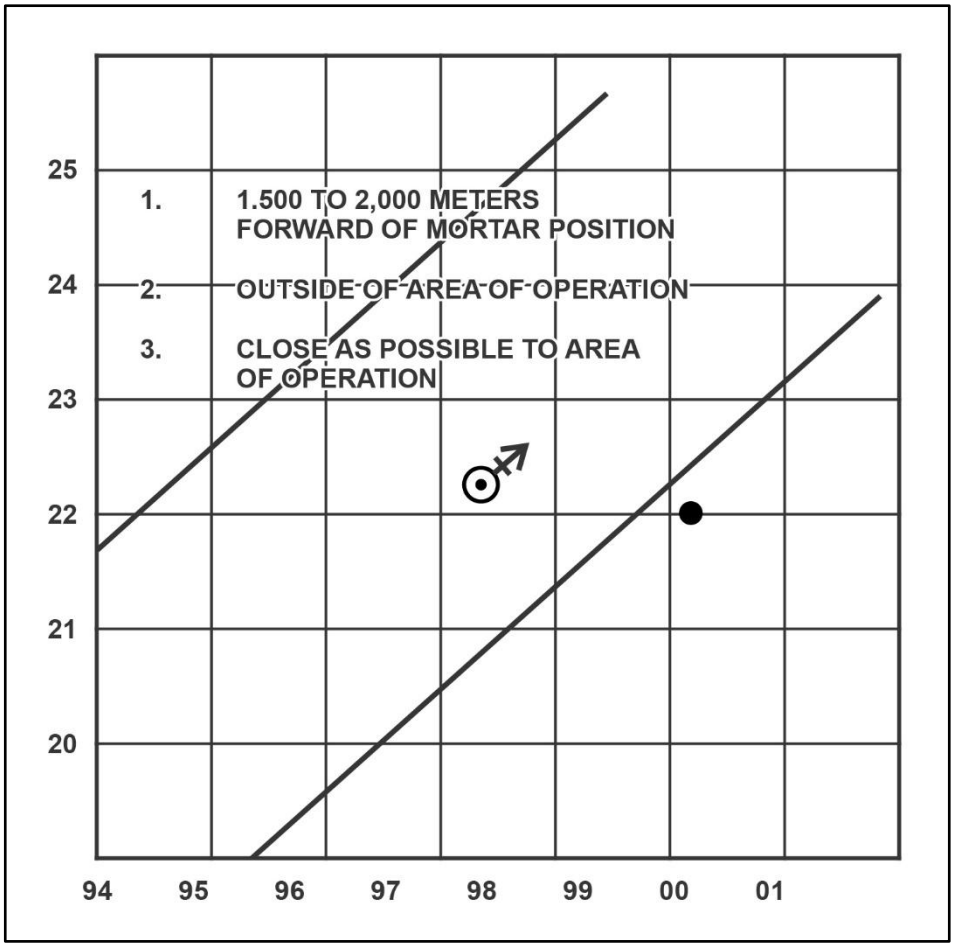


Figure 5-15. Grid intersection to represent pivot point

5-47. The grid intersection should be outside the area of responsibility. This ensures that the pivot point does not interfere with plotting targets or corrections. The grid intersection is as close as possible to the area of responsibility. This ensures that as much of the area of responsibility as possible will be on the plotting board.

Superimposition of Grid System on Plotting Board

5-48. Once the grid intersection has been determined, the computer indexes “0” on the azimuth disk. The section leader then drops down 2,000 meters below the pivot point and writes in the east/west indicator on the vertical centerline at the 2,000-meter mark. Next, the section leader goes 2,000 meters to the left of the pivot point on the heavy center horizontal line and writes the north/south indicator. To complete the grid system, the computer writes in the other north/south, east/west grid numbers as though looking at a map. By numbering every other heavy dark line (two large squares) on the plotting board, the section leader retains a scale of 1:12,500 on the board. (See figure 5-16.)

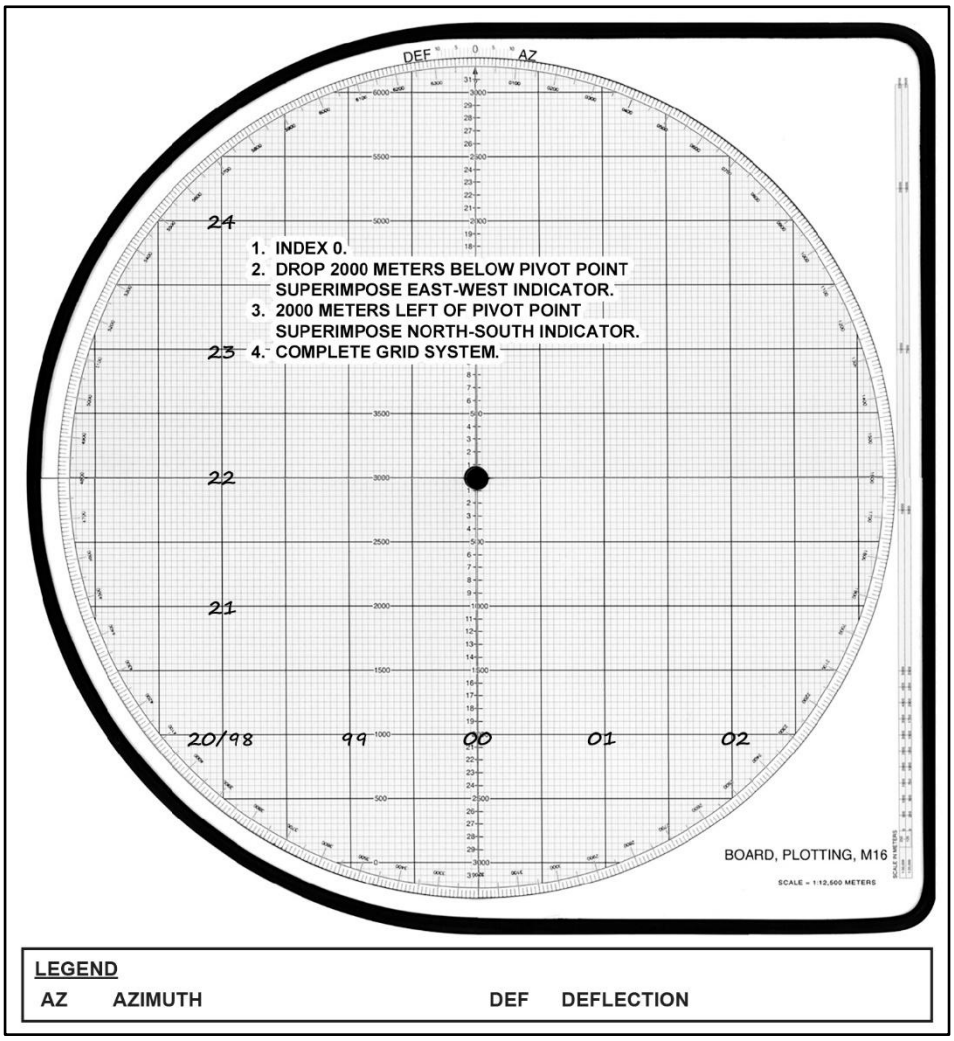


Figure 5-16. Superimposition of the grid

Plotting of Mortar Position

5-49. Now that a grid system is on the board, the computer can plot any grid coordinates. To do this, the section leader—

- Ensures that the azimuth disk is indexed at 0.
- Reads like a map: right and up.
- Remembers that the scale is 1:12,500 and each small square is 50 meters by 50 meters (see figure 5-17).

5-50. To superimpose the deflection scale, the computer writes the Ref on the board the same way as with the observed chart. Firing data is determined by using the parallel-line method of plotting.

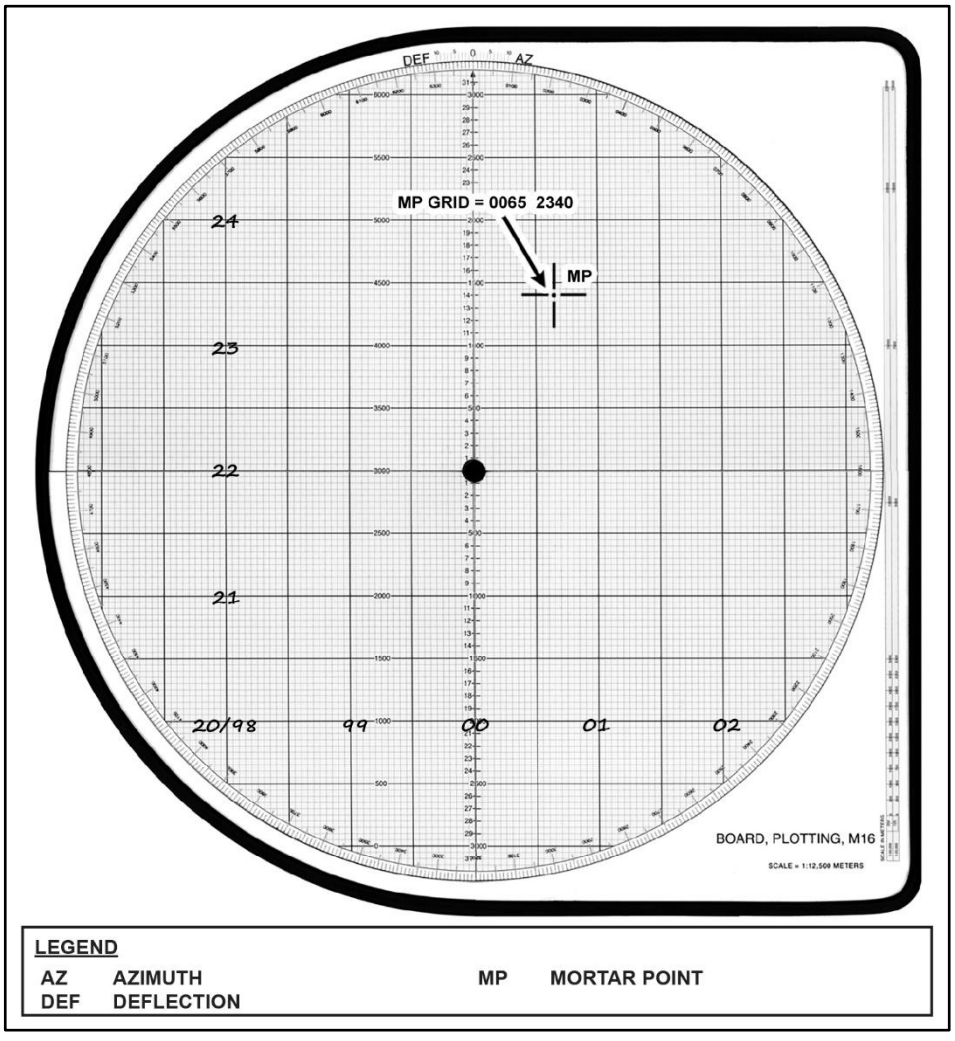


Figure 5-17. Plotting of a mortar position

Field Expedient Method of Construction

5-51. If the grid coordinates of the mortar position are known but a map is not available for determining the grid intersection to represent the pivot point, the computer can construct the modified observed firing chart using the following procedures:

- Index the DOF.
- Drop below the pivot point on the vertical centerline 2,000 to 2,500 meters.
- Go 500 to 1,000 meters left or right of the vertical centerline and make a plot (see figure 5-18).

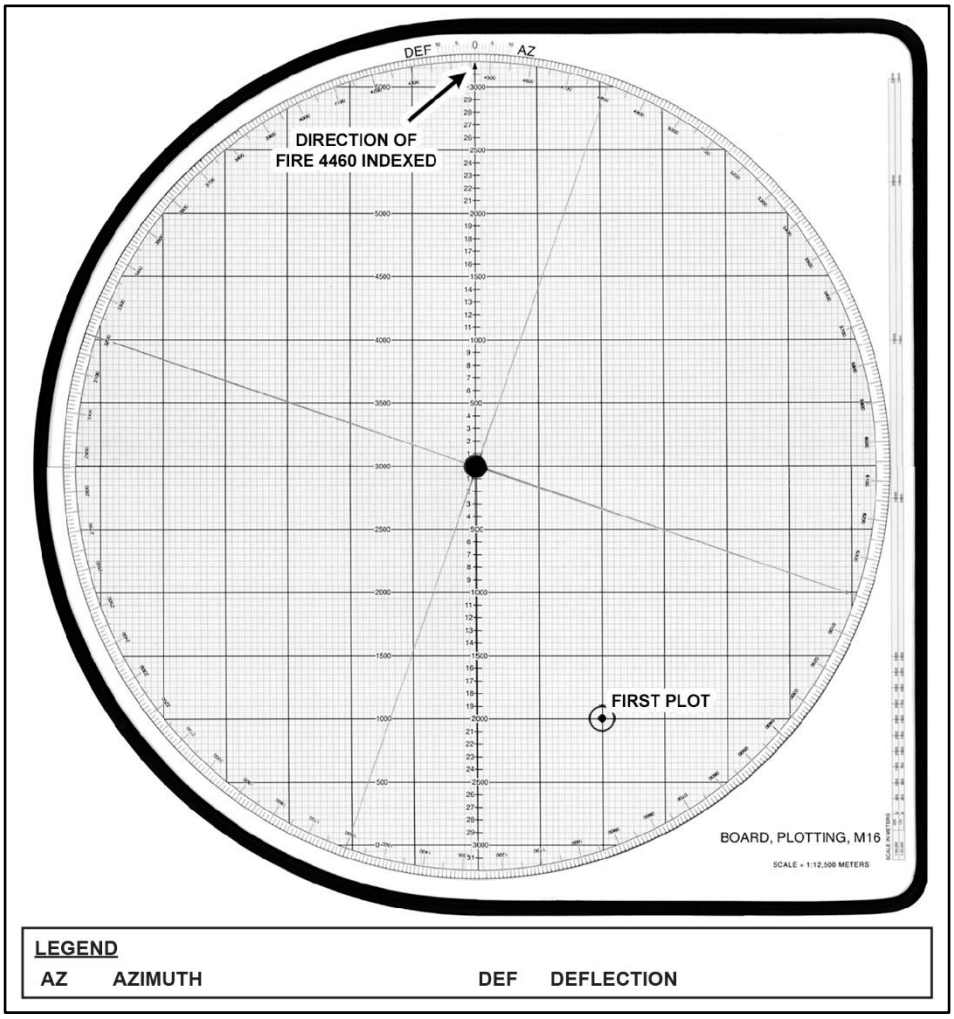


Figure 5-18. First plot

- Rotate the azimuth disk and index "0."
- Determine the 1000-meter grid that contains the mortars (see figure 5-19).

- The first, second, fifth, and sixth numbers of the mortar grid give the 1,000-meter grid square.

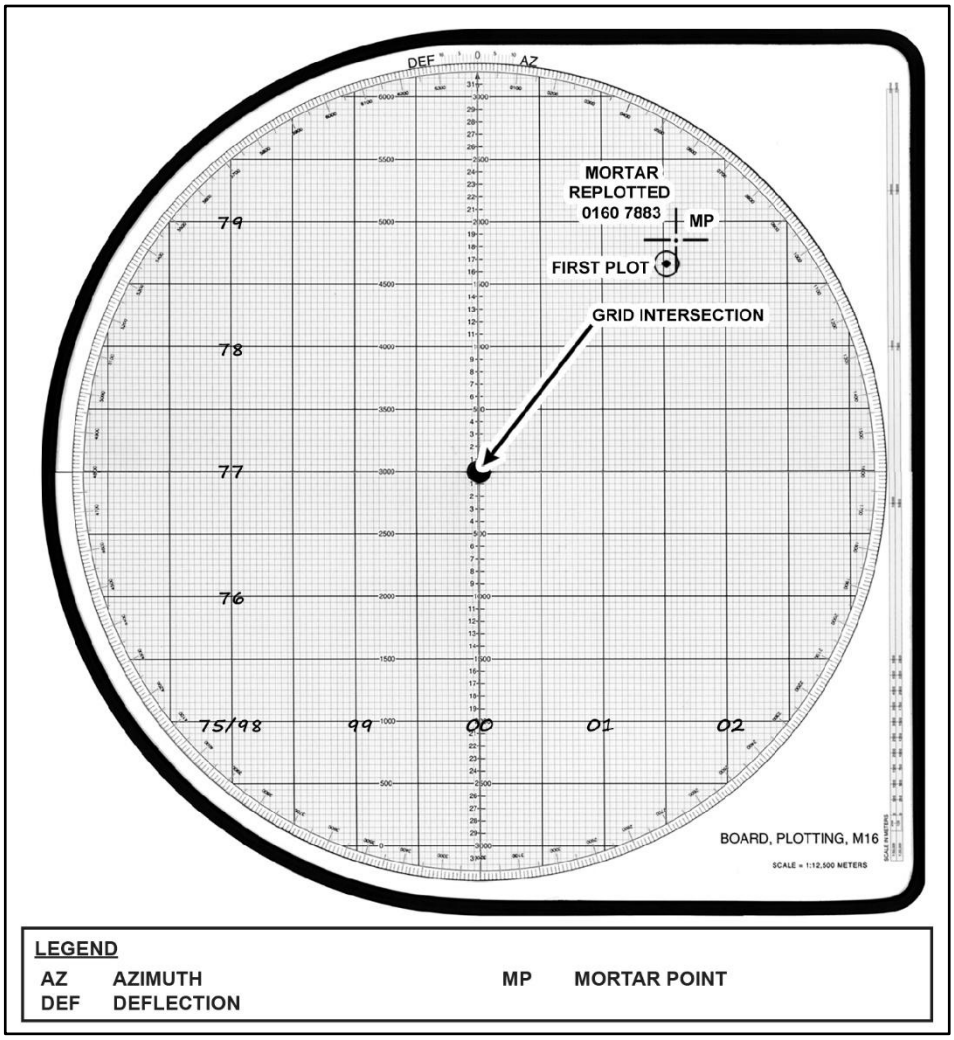


Figure 5-19. Replotting of mortar location

- Superimpose the grid system.
- Replot the mortar location to the surveyed grid.

SURVEYED FIRE CHART

5-52. The surveyed firing chart is the most accurate chart constructed. It is used to determine all the correcting factors needed to fire more first-round FFE missions than the other firing charts. Three items must be known to construct the surveyed chart: a grid intersection to represent the pivot point, a surveyed mortar position, and a surveyed RP. The construction of the surveyed chart is like the modified-observed chart:

- To obtain the DOF after constructing the chart, align the mortar position with the RP and determine the DOF to the nearest mil.
- To determine the MAZ, round off the DOF to the nearest 50 mils.
- To superimpose the deflection scale, the Ref is received from the section leader and then the deflection scale is constructed in the same manner as the modified-observed chart.

Note. The procedure to obtain the firing data is the same as with all firing charts.

- Determine correction factors after the registration has been completed and apply these factors to all other targets within the transfer limits of the RP.

SECTION III – SPECIAL CONSIDERATIONS

5-53. This section will cover the special considerations needed during plotting board (manual) operations. It will cover transfer of targets, deflection conversion table (DCT), and care and cleaning of plotting boards.

TRANSFER OF TARGETS

5-54. Transfer is the process of transferring a target from the observed chart to the modified-observed chart, or from the modified-observed chart to the surveyed chart, as more information becomes available. This occurs since the targets transferred are known points to the FO and FDC, and these points may be used in future missions. Transfer always is done using chart data (deflection and range to the final plot).

Note. No firing corrections are used with the observed chart. Once transferred to the modified-observed chart, the altitude/elevation of the target is assumed to be the same as that of the mortar position.

EXAMPLE

Assume that the mortar section is at grid 939756 (six digits: observed chart) and two targets have been fired on. (See figure 5-20.) The platoon leader determines that the eight-digit grid to the mortar position is 93937563 (modified-observed chart) and designates the grid intersection to represent the pivot point. The computer constructs the chart and transfers the targets from the observed chart. (See figure 5-21, page 140.)

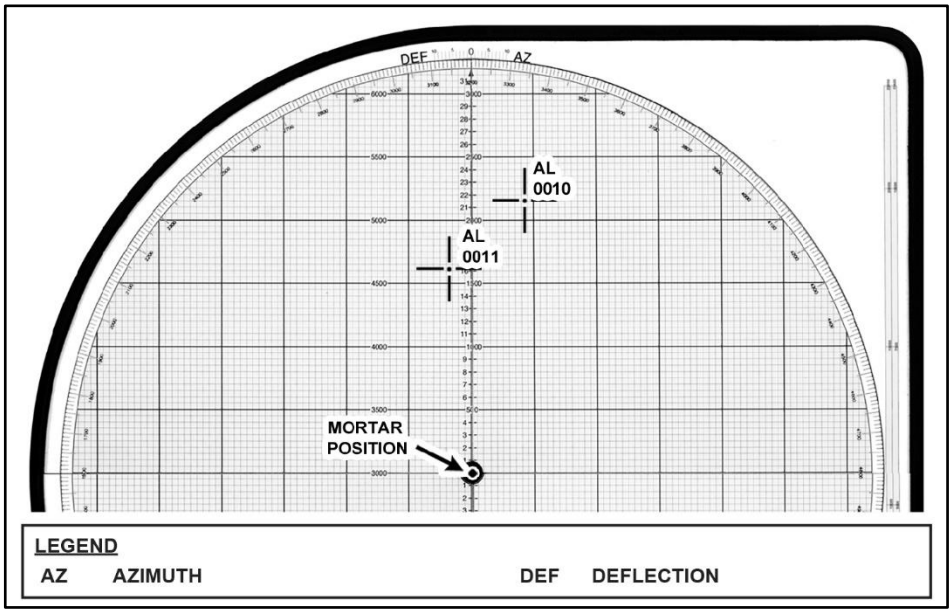


Figure 5-20. Observed chart

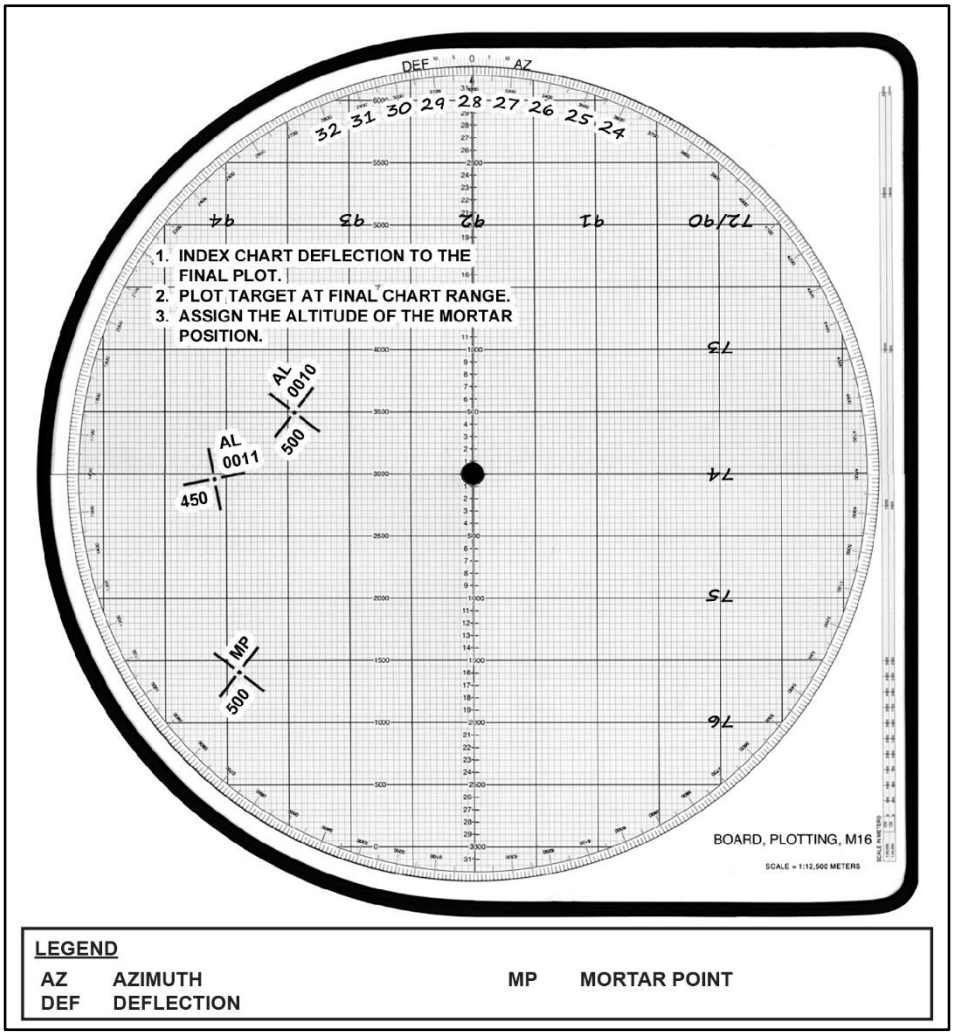


Figure 5-21. Forward plotting target to modified observed chart from the observed chart

TARGET PLOTTING AFTER TRANSFER

5-55. After transfer, through coordination with the FO, an RP or target may be identified to valid eight-digit coordinates. Then, the plotting board is reconstructed as a surveyed chart. When the situation permits, a registration mission should be conducted on the point for which the valid eight-digit coordinates were determined. Then, firing corrections are computed as follows:

- When transferring targets from one type of chart to another, remember that the target plots on the observed chart are plotted at the data it takes to hit the target. This is not always the location of the targets.

- The same holds true for the modified-observed chart, except that with some targets, may have been used.
  - When replotting the target at the end of the mission, strip this altitude/elevation correction from the command range and plot the target using this range.
  - Using this procedure gives a more accurate picture of the exact location of the target than the observed chart; however, it is not always the target's actual location.

PLOTTING OF PREVIOUSLY FIRED TARGETS

5-56. At the completion of the surveyed registration mission and the computation of the firing corrections, previously fired targets plotted on the plotting board must be forward plotted. Since the surveyed chart is the most accurate chart to use, all information on it should be as accurate as possible.

EXAMPLE

When targets AL0010 and AL0011 were fired before the surveyed registration, the data and the plots included all firing corrections, even though they may have been unknown at the time of firing. (See table 5-1, page 142.) To forward plot these targets, the computer strips the firing correction from the range and deflection to plot them at their actual location.

Note. To strip out the corrections, the signs must be reversed.

Table 5-1. Replotting of previously fired targets

Attack Command	*Firing Corrections*	*Computations*	*Chart Data for Replot*
Target AL0010			
Deflection 2786	Deflection R12 Range Control Correction Factor (RCF) -18	2788 + L12 = 2798 +18 X 1.8 = +32	Deflection 2798
Range 1825	Altitude correction + 25	1825 + 32 – 25 = 1832	Range 1825
Target AL0011			
Deflection 3115	Deflection R12 RCF -18	3115 + L12 = 3127 + 18 X 2.9 = + 52	Deflection 3127
Range 2850	Altitude correction + 25	2852 + 52 – 25 = 2877	Range 2875
Legend: L—left; R—right; RCF—range correction factor			

DEFLECTION CONVERSION TABLE

5-57. When an adjustment is made to a sheaf, such as after the completion of the registration, the sheaf is paralleled or converged if engaging a point-type target or opened when engaging a wider target. In these situations, the computer determines the new data and converts the deviation corrections required into mils. The section leader can use the DCT (see table 5-2) or the mil-relation formula. The mil-relation formula is an approximate adjustment. The DCT is a more accurate deflection adjustment and should be used when available.

> ***Note.*** If the target has been mechanically surveyed, enter the DCT at the initial chart range. If the target is nonsurveyed (even if it is an eight-digit grid), enter the DCT at the final chart range.

5-58. To use the DCT, first round off the range at which the section is firing to the nearest 100 meters. This is required because the ranges on the table are divided into 100-meter increments. Next, go down the range column to find the range. The deflection is in meters across the top of the card.

5-59. Using the number of meters, the FO requested to move the strike of the round, find that number of meters and go straight down that column until it intersects with the range. This number is the number of mils that would have to be applied to the mortar sight to move the strike of the round to the required number of meters. If the range is greater than 4,000 meters, divide the range and mil correction by two.

Table 5-2. Deflection conversion table

RANGE IN METERS	DEFLECTION IN METERS														
	1	10	20	30	40	50	75	100	125	150	175	200	300	400	500
500	2	20	41	61	81	102	152	201	250	297	343	388	551	687	800
600	2	17	34	51	68	85	127	168	209	250	289	328	472	599	708
700	1	15	29	44	58	73	109	145	180	215	250	284	412	529	632
800	1	13	25	38	51	64	95	127	158	189	219	250	365	472	569
900	1	11	23	34	45	57	85	113	141	168	196	223	328	426	517
1000	1	10	20	31	41	51	76	102	127	152	176	201	297	388	472
1100	1	9	19	28	37	46	69	92	115	138	161	183	271	355	435
1200	1	8	17	25	34	42	64	85	106	127	148	168	250	328	402
1300	1	8	16	24	31	39	59	78	98	117	136	156	231	304	374
1400	1	7	15	22	29	36	55	73	91	109	127	145	215	284	349
1500	1	7	14	20	27	34	51	68	85	102	118	135	201	265	328
1600	1	6	13	19	25	32	48	64	79	95	111	127	189	250	309
1700	1	6	12	18	24	30	45	60	75	90	105	119	178	235	291
1800	1	6	11	17	23	28	42	57	71	85	99	113	168	223	276
1900	1	5	11	16	21	27	40	54	67	80	94	107	160	211	262
2000	1	5	10	15	20	25	38	51	64	76	89	102	152	201	250
2100	0	5	10	15	19	24	36	48	61	73	85	97	145	192	238
2200	0	5	9	14	19	23	35	46	58	69	81	92	138	183	228
2300	0	4	9	13	18	22	33	44	55	66	77	88	132	175	218
2400	0	4	8	13	17	21	32	42	53	64	74	85	127	168	209
2500	0	4	8	12	16	20	31	41	51	61	71	81	122	162	201
2600	0	4	8	12	16	20	29	39	49	59	68	78	117	156	194
2700	0	4	8	11	15	19	28	38	47	57	66	75	113	150	187
2800	0	4	7	11	15	18	27	36	45	55	64	73	109	145	180
2900	0	4	7	11	14	18	26	35	44	53	61	70	105	140	174
3000	0	3	7	10	14	17	25	34	42	51	59	68	102	135	168
3100	0	3	7	10	13	16	25	33	41	49	57	66	98	131	163
3200	0	3	6	10	13	16	24	32	40	48	56	64	95	127	158
3300	0	3	6	9	12	15	23	31	39	46	54	62	92	123	153
3400	0	3	6	9	12	15	22	30	37	45	52	60	90	119	149
3500	0	3	6	9	12	15	22	29	36	44	51	58	87	116	145
3600	0	3	6	8	11	14	21	28	35	42	49	57	85	113	141
3700	0	3	6	8	11	14	21	28	34	41	48	55	82	110	137

Table 5-2. Deflection conversion table (continued)

3800	0	3	5	8	11	13	20	27	33	40	47	54	80	107	133
3900	0	3	5	8	10	13	20	26	33	39	46	52	78	104	130
4000	0	3	5	8	10	13	19	25	32	38	45	51	76	102	127
4100	0	2	5	7	10	12	19	25	31	37	43	50	74	99	124
4200	0	2	5	7	10	12	18	24	30	36	42	48	73	97	121
4300	0	2	5	7	9	12	18	24	30	36	41	47	71	94	118
4400	0	2	5	7	9	12	17	23	29	35	40	46	69	92	115
4500	0	2	5	7	9	11	17	23	28	34	40	45	68	90	113
4600	0	2	4	7	9	11	17	22	28	33	39	44	66	88	110
4700	0	2	4	7	9	11	16	22	27	33	38	43	65	86	108
4800	0	2	4	6	8	11	16	21	27	32	37	42	64	85	106
4900	0	2	4	6	8	10	16	21	26	31	36	42	62	83	104
5000	0	2	4	6	8	10	15	20	25	31	36	41	61	81	102
5100	0	2	4	6	8	10	15	20	25	30	35	40	60	80	100
5200	0	2	4	6	8	10	15	20	24	29	34	39	59	78	98
5300	0	2	4	6	8	10	14	19	24	29	34	38	58	77	96
5400	0	2	4	6	8	9	14	19	24	28	33	38	57	75	94
5500	0	2	4	6	7	9	14	19	23	28	32	37	56	74	92
5600	0	2	4	5	7	9	14	18	23	27	32	36	55	73	91
5700	0	2	4	5	7	9	13	18	22	27	31	36	54	71	89
5800	0	2	4	5	7	9	13	18	22	26	31	35	53	70	88
5900	0	2	3	5	7	9	13	17	22	26	30	35	52	69	86
6000	0	2	3	5	7	8	13	17	21	25	30	34	51	68	85
6100	0	2	3	5	7	8	13	17	21	25	29	33	50	67	83
6200	0	2	3	5	7	8	12	16	21	25	29	33	49	66	82
6300	0	2	3	5	6	8	12	16	20	24	28	32	48	65	81
6400	0	2	3	5	6	8	12	16	20	24	28	32	48	64	79
6500	0	2	3	5	6	8	12	16	20	24	27	31	47	63	78
6600	0	2	3	5	6	8	12	15	19	23	27	31	46	62	77
6700	0	2	3	5	6	8	11	15	19	23	27	30	46	61	76
6800	0	1	3	4	6	7	11	15	19	22	26	30	45	60	75
6900	0	1	3	4	6	7	11	15	18	22	26	30	44	59	74
7000	0	1	3	4	6	7	11	15	18	22	25	29	44	58	73
7100	0	1	3	4	6	7	11	14	18	22	25	29	43	57	72
7200	0	1	3	4	6	7	11	14	18	21	25	28	42	57	71

FORMULA FOR POPULATING THE DEFLECTION CONVERSION TABLE

Mils = 17.78 (arctan [width/range]) Or
Mils = 17.78 (TAN-1 [width/range])

EXAMPLE

The mortar section has completed a registration mission and is prepared to adjust the sheaf. The initial range for the RP is 2,750 meters. The Number 1 and Number 3 mortars fire one round each. The FO sends the following corrections: NUMBER 3, R30; NUMBER 1, L20; END OF MISSION, SHEAF ADJUSTED. Any corrections of 50 meters or more must be refired.

For this example, the last deflection fired from Number 1 and Number 3 was 2931 mils. Using the DCT, round off the range to the nearest 100 meters (2,800). Find 2,800 meters in the range column and using the FO's corrections, find 30 and 20 in the deflection-in-meters column. Go across and down those columns to where they intersect. The table shows that the requirements are 11 mils for 30 meters and 7 mils for 20 meters.

Using this information, use the previous deflection fired, which was 2931 mils. Since the FO's correction for the Number 3 mortar was R30, which equals R11 mils (using the LARS rule), subtract 11 mils from 2931 mils. This gives a new deflection of 2920 mils. The correction for Number 1 mortar was L20, which equals L7 mils. Using the LARS rule for deflection, add 7 mils to 2931, which gives a new deflection of 2938 mils.

If there is no DCT available, use the mil-relation formula (W divided by R x M) (in this case, W [width], R [range], and M [mils]) to approximately convert the corrections from meters to mils. To use the formula for the same FO's corrections of R30 and L20 used in the example cited, cover the item needed. The remainder of the formula states: divide W (width in meters) by R (range in thousandths).

W ÷ R = 20 ÷ 2.8 = M (7) 20 ÷ 2.8 = 7.1 = 7 mils
W ÷ R = 30 ÷ 2.8 = M (11) 30 ÷ 2.8 = 10.7 = 11 mils

CARE AND CLEANING OF PLOTTING BOARDS

5-60. Plotting boards must be handled with care to prevent bending, scratching, or chipping. They must be kept away from excessive heat or prolonged exposure to the sun, which may warp them. When storing a board, place it in its carrying case, base down, on a horizontal surface. Do not place the board on an edge or have other equipment stored on it. Normally the plotting board is cleaned with a non-gritty (art gum) eraser. If the board is excessively dirty, a damp cloth should be used. The contact surfaces of the disk and base are cleaned often. The disk is removed by pushing a blunt instrument through the pivot point hole from the back of the base.

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Chapter 6
Plotting Board Fire Missions

This chapter discusses fire mission procedures applied to both basic and advanced missions to engage targets effectively.

BASIC FIRE MISSIONS

6-1. The basic fire missions are the missions every indirect fire Infantryman will be able to conduct according to mortar certification publications. These missions are the foundation and will support all METLs throughout the Army.

MARK CENTER SECTOR

6-2. Marking the center of sector orients the mortar section towards the center of the unit's area of responsibility and the FO uses the marking round as a reference point for the FO's own orientation and follow-on targets.

6-3. The FDC begins by extracting information from the operation order or safety diagram.

6-4. Figure 6-1, page 148 (example 1) depicts a visual representation of information used to mark center sector (MCS).

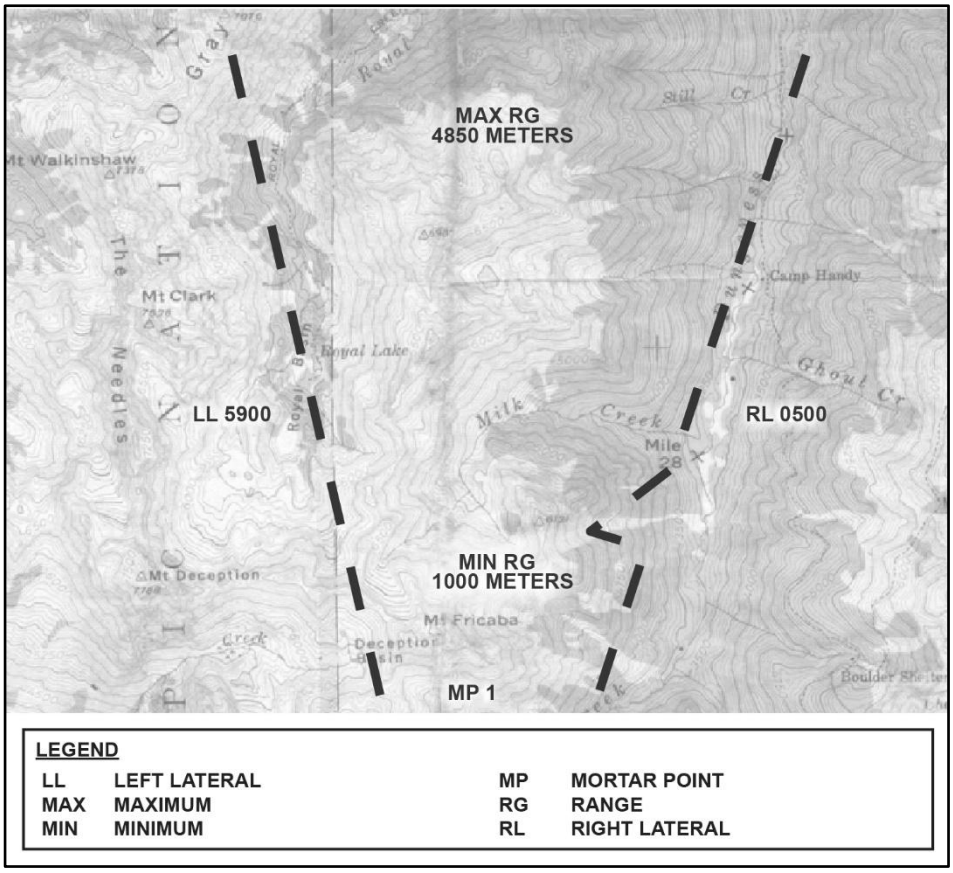


Figure 6-1. Mark center sector

6-5. Determine the MCS azimuth: right lateral (RL) – left lateral (LL) (if the RL is smaller than the LL, add 6400 to the RL) to obtain the total area in mils. Divide the total area by two and add the remainder to the LL. This is the MCS azimuth.

- (0500 + 6400) = 6900 - 5900 = 1000 mils total in the area of responsibility.
- 1000/2 = 500.
- 5900 + 500 = 6400 (or 0) mils MCS azimuth.

Note. Place the marking round where the FO is most likely to observe it; otherwise, marking the exact center of sector serves no purpose. Ensure that the location is as close to the center of the sector as observable.

6-6. Figure 6-2, example 2, depicts a visual representation of a sector overlay used to MCS.

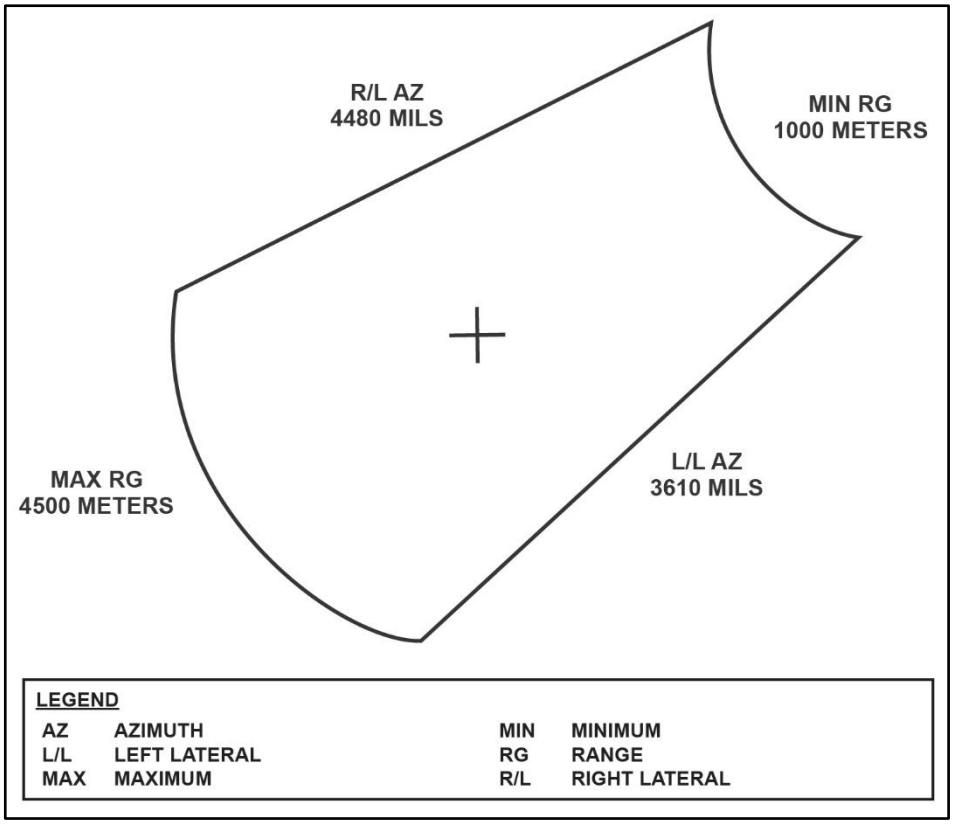


Figure 6-2. Sector overlay

6-7. There are two methods to determine MCS azimuth:

- Method A.
  - Determine MCS azimuth: RL 4480-LL 3610 = 870 mils.
  - 870/2 = 435 mils.
  - 3610 + 435 = 4045 MCS azimuth.
  - Max range + Min range/2 = MCS range.
- Method B. For this example, determine the MCS azimuth by adding the LL and RL together then dividing them by 2 with the remainder being the MCS azimuth.

Note. This example has both azimuths on one side of the 0 (6400 mils):

  - 4480 + 3610 = 8090.
  - 8090/2 = 4045 mils MCS azimuth.
  - Determine the MCS range using the same technique as method A (Max range + Min range/2 = MCS range).

6-8. When firing a marking round, FDC selects to fire an easily identifiable round, such as WP or an illumination, however, HE or full range training cartridge can be used.

6-9. After the FO identifies the marking round, the FO uses the shift-from-a-known-point method to engage the target. The FO also may use the round to identify a point to orient oneself.

REGISTRATION

6-10. Firing the registration is the first mission that will be completed if time and the tactical situation permits.

FIRING COORDINATED AND NONCOORDINATED MISSIONS

6-11. Two types of registration missions are fired on the surveyed chart: coordinated and noncoordinated.

Firing Coordinated Missions

6-12. The FDC and FO coordinate the location of the RP before the FO joins the unit to support it. Once the FO is in position, the FDC sends a message telling the FO to prepare to register RP 1. The FO sends the OT direction to the RP.

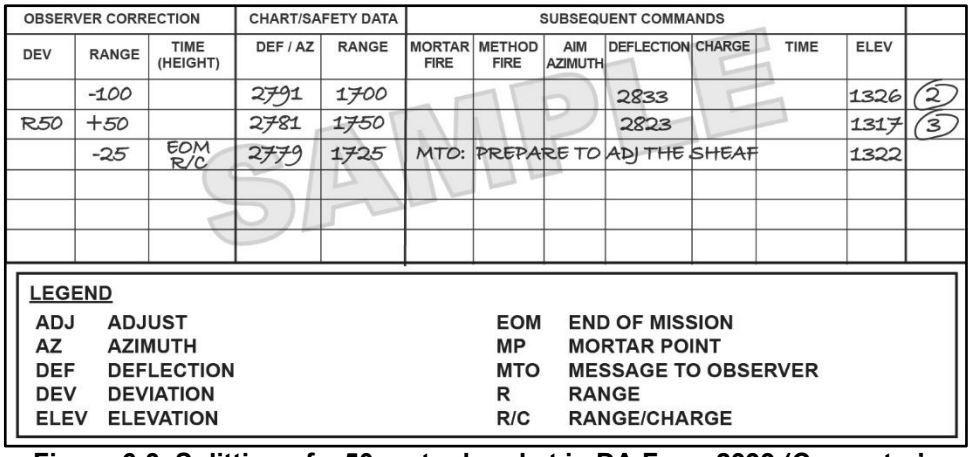
Firing Noncoordinated Missions

6-13. The FO, upon joining the unit to support it, checks the area of responsibility and selects a point to be used as the RP. This point must be identifiable both on the ground and on the map to allow a valid eight-digit grid to be determined. The FO then sends the CFF to register the RP.

OBTAINING FIRING DATA

6-14. Obtaining the firing data is the same as with any mission, except that the FO continues to adjust until a 50-meter bracket is split and the last fired round is within 25 meters of the target. (See figure 6-3.) Refinement corrections are sent to the FDC, and the mission is ended. Table 6-1 provides information to be used to fire a surveyed registration.

Note. See ATP 3-09.30 for more information.



OBSERVER CORRECTION			CHART/SAFETY DATA		SUBSEQUENT COMMANDS							
DEV	RANGE	TIME (HEIGHT)	DEF / AZ	RANGE	MORTAR FIRE	METHOD FIRE	AIM AZIMUTH	DEFLECTION	CHARGE	TIME	ELEV	
	-100		2791	1700				2833			1326	(2)
R50	+50		2781	1750				2823			1317	(3)
	-25	EOM R/C	2779	1725	MTO: PREPARE TO ADJ THE SHEAF						1322	

SAMPLE

LEGEND

ADJ	ADJUST	EOM	END OF MISSION
AZ	AZIMUTH	MP	MORTAR POINT
DEF	DEFLECTION	MTO	MESSAGE TO OBSERVER
DEV	DEVIATION	R	RANGE
ELEV	ELEVATION	R/C	RANGE/CHARGE

Figure 6-3. Splitting of a 50-meter bracket in DA Form 2399 (Computer's Record)

Table 6-1. Data for a surveyed registration

Data	*Input*
MORTAR GRID: 0086 6158	ALT: 0520
RP 1 GRID: 9953 5884	ALT: 0470
GRID INTERSECTION:	01/59
DOF:	3660 mils
MAZ:	3650 mils
REF DEF:	2800 mils
INIT DEF (1ST RD):	2790 mils
Legend: ALT—altitude; DOF—direction of fire; INIT DEF—initial deflection; MAZ—mounting azimuth; RD—round; REF DEF—referred deflection; RP—registration point	

OBTAINING CORRECTIONS USING THE DEFLECTION CONVERSION TABLE

6-15. The computer enters the DCT at the initial chart range rounded to the nearest 100 meters: 3,050 = 3,100. Remember that the RP is at a surveyed grid, and it has not moved. Using the deflection-in-meters line at the top of the table, the computer finds the meters needed to correct the sheaf. Where the range line and the correction line meet is the number of mils needed. The FO applies the mils to the base deflection. When working with deflections, use the LARS rule. Once the FO has given EOM, SHEAF ADJUSTED, the section is given, SECTION, REFER DEFLECTION TWO EIGHT ZERO ONE [2801], REALIGN AIMING POSTS, (2801 was the base mortar's hit deflection). This procedure allows all mortars to be fired with the same data, and the resulting sheaf will be parallel.

DETERMINING FIRING CORRECTIONS

6-16. Once registration is completed, the firing corrections (range correction factor and DEFK are applied to all targets within the transfer limits of the RP. (See figure 6-4.) The computer applies correction factors to correct for nonstandard conditions (weather and equipment wear) affecting the round.

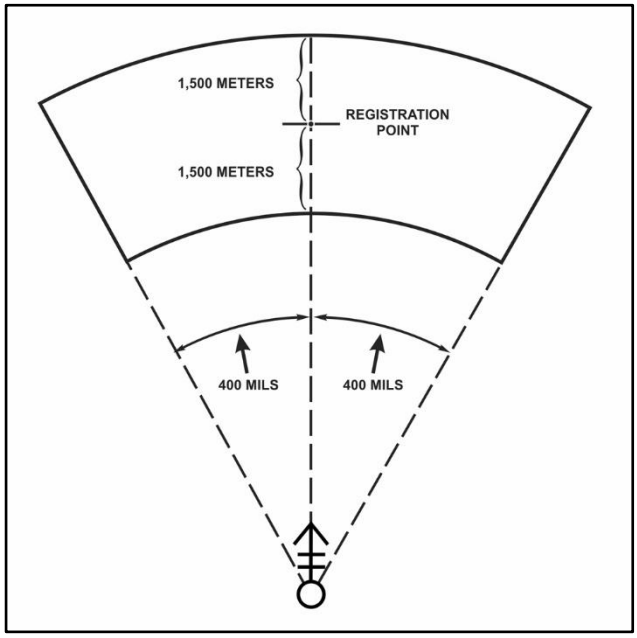


Figure 6-4. Transfer limits for one registration point

Note. If a target is plotted outside of the transfer limits, the range correction factor and DEFK are no longer applied.

DETERMINING RANGE DIFFERENCE

6-17. The computer compares the initial chart range and the final chart range and subtracts the smaller from the larger. This gives the range difference. If the initial chart range is larger than the final chart range, then the range correction is a minus (-). If it is smaller, then the range correction is a plus (+).

EXAMPLE

Initial chart range smaller: 3050; final chart range: 3200
Then, 3200 - 3050 = +150 meters.
Initial chart range larger: 3200; final chart range: 3050
Then 3200 - 3050 = -150 meters.

Range Control Correction Factor

6-18. The range control correction factor (RCF) is the number of meters per 1000 to be applied to the initial chart range of a target within the transfer limits resulting in a range correction for that mission. Continuing the preceding example, since the ranges to other targets will be different from the 3050 range to the RP, the RCF (+150) will differ. Range corrections must be determined for each target. Once the range difference has been determined, round the initial chart range to the nearest 100, and then express that number in 1,000ths. Determine the nearest whole meter and use the sign of the range correction.

EXAMPLE

Range difference: +150
Initial chart range: 3050
Rounded to nearest 100:3100
Expressed in 1000ths: 3.1
Divide the range in 1000ths into the range difference. To get the range correction factor, round the result to the nearest whole number.
+150 ÷ 3.1 = 48.3 = +48 RCF

Deflection Correction

6-19. The DEFK is the number of mils needed to correct the deflection to hit the target since nonstandard conditions again caused the plots on the board to be either left or right of the initial chart deflection. (See figure 6-5, page 154.) Compare the initial chart deflection and the final chart deflection and subtract the smaller from the larger.

RULE

Final chart deflection (hit) larger = LEFT DEFK;
Final chart deflection (hit) smaller = RIGHT DEFK.

EXAMPLE Hit larger

Final chart deflection: 2801
Initial chart deflection: 2790
(2801 - 2790 = L11)

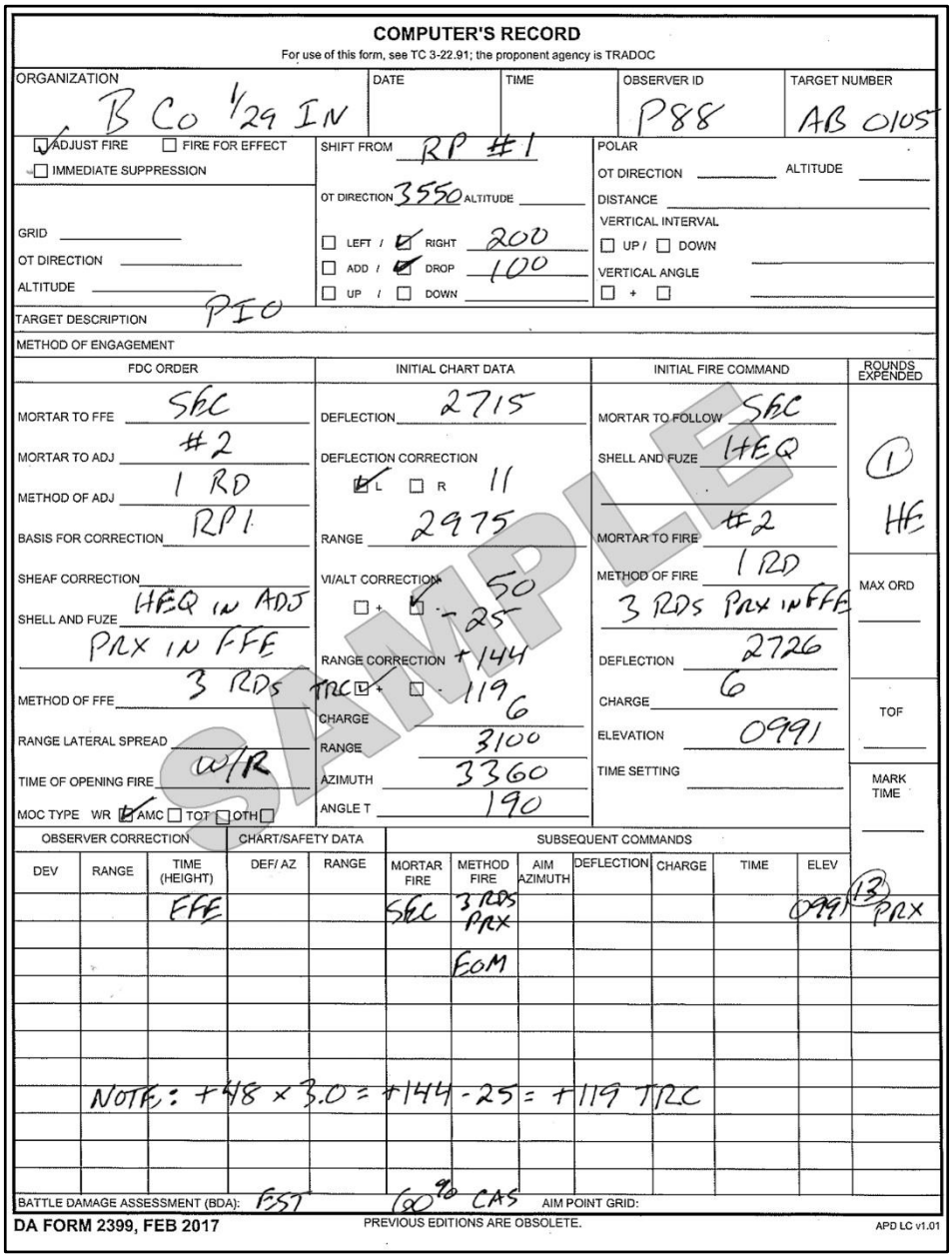
EXAMPLE Hit smaller

Final chart deflection: 2790
Initial chart deflection: 2801
(2790 - 2801 = R11)

6-20. Range and DEFKs are applied to all other targets within the transfer limits of the RP.

FIRING OF A TOTAL RANGE CORRECTION MISSION

6-21. The procedure for a total range correction (TRC) mission on the surveyed chart is to apply the attitude correction and range correction to obtain the command range. (See figure 6-5.)



COMPUTER'S RECORD

For use of this form, see TC 3-22.91; the proponent agency is TRADOC

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN			P88	AB 0105

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION

SHIFT FROM RP #1

OT DIRECTION 3550 ALTITUDE

☐ LEFT / ☑ RIGHT 200

☐ ADD / ☑ DROP 100

☐ UP / ☐ DOWN

POLAR

OT DIRECTION ALTITUDE

DISTANCE

VERTICAL INTERVAL

☐ UP / ☐ DOWN

VERTICAL ANGLE

☐ + ☐

GRID

OT DIRECTION

ALTITUDE

TARGET DESCRIPTION PIO

METHOD OF ENGAGEMENT

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE SBC	DEFLECTION 2715	MORTAR TO FOLLOW SBC	(1)
MORTAR TO ADJ #2	DEFLECTION CORRECTION ☑ L ☐ R 11	SHELL AND FUZE HEQ	HE
METHOD OF ADJ 1 RD	RANGE 2975	MORTAR TO FIRE #2	
BASIS FOR CORRECTION RPI	VI/ALT CORRECTION ☐ + ☑ - 50	METHOD OF FIRE 1 RD	MAX ORD
SHEAF CORRECTION	RANGE CORRECTION ☐ + ☑ - 25	3 RDS PRX IN FFE	
SHELL AND FUZE HEQ IN ADJ	TRC ☑ + ☐ - 144	DEFLECTION 2726	
PRX IN FFE	CHARGE 119	CHARGE 6	TOF
METHOD OF FFE 3 RDS TRC	RANGE 3100	ELEVATION 0991	
RANGE LATERAL SPREAD	AZIMUTH 3360	TIME SETTING	MARK TIME
TIME OF OPENING FIRE W/R	ANGLE T 190		
MOC TYPE WR ☑ AMC ☐ TOT ☐ OTH ☐			

OBSERVER CORRECTION			CHART/SAFETY DATA		SUBSEQUENT COMMANDS							
DEV	RANGE	TIME (HEIGHT)	DEF/ AZ	RANGE	MORTAR FIRE	METHOD FIRE	AIM AZIMUTH	DEFLECTION	CHARGE	TIME	ELEV	
		FFE			SBC	3 RDS PRX					0991	(13) PRX
						EOM						

NOTE: +48 x 3.0 = +144 -25 = +119 TRC

BATTLE DAMAGE ASSESSMENT (BDA): FST (90) CAS AIM POINT GRID:

DA FORM 2399, FEB 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.01

SAMPLE

Figure 6-5. Sample of completed DA Form 2399 (Computer's Record) for firing a total range correction mission on the surveyed chart

APPLYING FIRING CORRECTIONS

6-22. Once the chart data have been determined, the computer applies the DEFK by either adding or subtracting the DEFK to the chart data determined. When working with

DEFKs, the computer uses the LARS rule. The DEFK must be applied to each chart deflection throughout the mission.

EXAMPLE
2715 + L11 = 2726

Range Correction

6-23. Determine the initial chart range, then round to the nearest 100 and express it in 1000ths; for example, 2975 = 3000 = 3.0. Multiply the range in 1,000ths by the RCF and use the sign of the RCF: 3.0 x +48 = +144. This gives the range correction for this target.

Total Range Correction

6-24. The TRC is the total correction that must be applied to get the command range to the target. TRC is the range correction plus or minus the altitude/elevation correction.

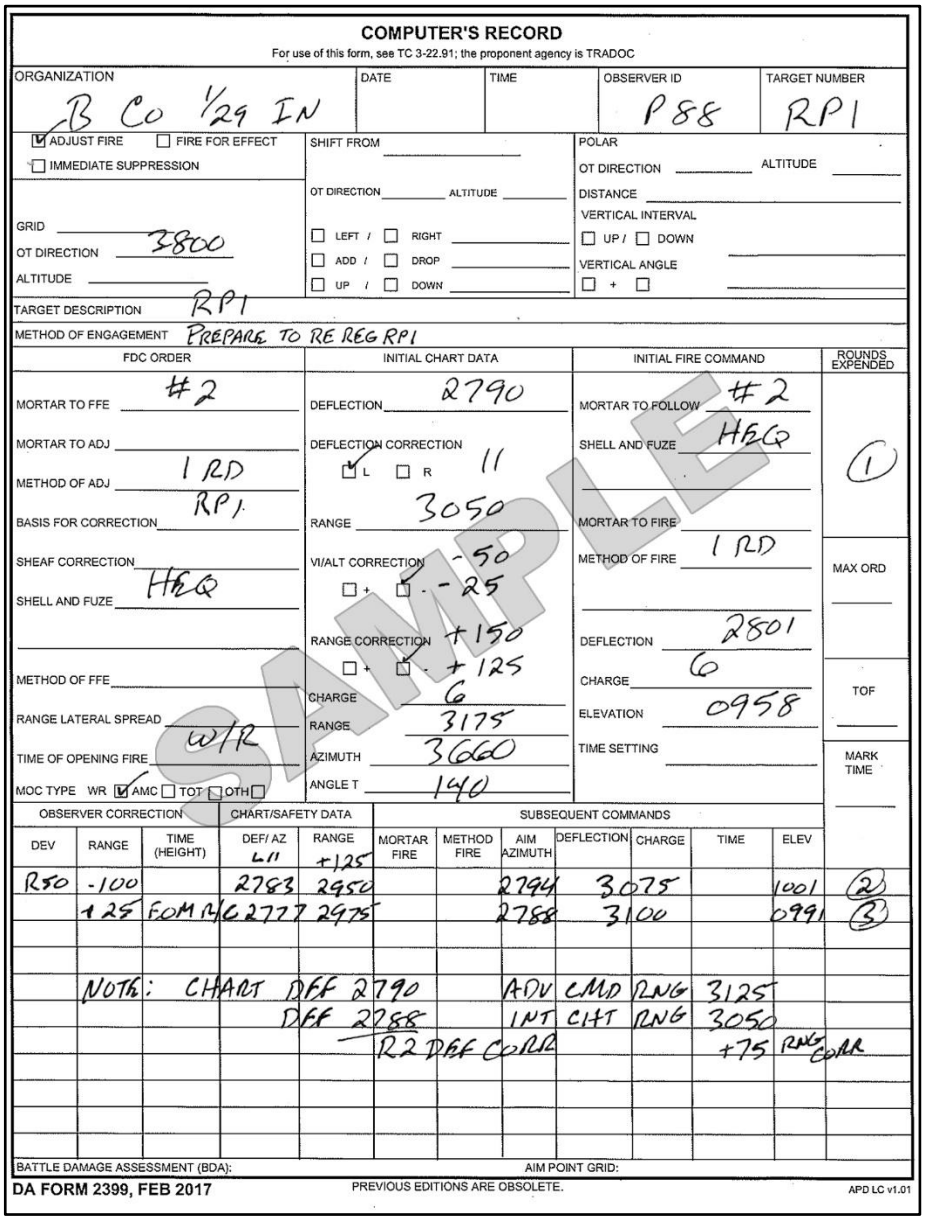
EXAMPLE
Range correction = +144 - 25 (altitude/elevation correction)
= +119 TRC

6-25. The two factors (range correction and altitude/elevation correction) are compared. If one of these factors is a negative, subtract the smaller from the larger. The sign of the larger is used for the TRC. If both factors are negative or positive, then add the two factors to get the TRC. This must be applied to every chart range to obtain command range. To enter the FTs, the command range is rounded to the nearest 25 meters.

Firing Reregistration

6-26. The FDC considers weather changes to ensure the accuracy of the firing data (firing corrections) from the surveyed chart. Two methods can be used to do this: re-registration on the RP or MET message. Of those two methods, reregistration is the better because all the unknown (nonstandard) factors are fired out. However, due to tactical situations and enemy capabilities, such as counter-mortar radar, determining and applying the MET messages may be safer. The choice is dictated by the tactical situation and the availability of MET messages.

6-27. Fire the reregistration at the established RP using only the mortar that originally fired the registration. (The FDC assumes that the sheaf still is parallel; therefore, the sheaf should not need readjusting.) The chart data is the same as with the initial registration. Apply the firing corrections to obtain the command data. (See figure 6-6.) The updated command data also is applied to the target data section of the DA Form 2188. Figure 6-7, page 158 shows an example of DA Form 2188.



COMPUTER'S RECORD

For use of this form, see TC 3-22.91; the proponent agency is TRADOC

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN			P88	RP1

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION

GRID
OT DIRECTION 3800
ALTITUDE

SHIFT FROM
OT DIRECTION ALTITUDE
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR
OT DIRECTION ALTITUDE
DISTANCE
VERTICAL INTERVAL
☐ UP / ☐ DOWN
VERTICAL ANGLE
☐ + ☐

TARGET DESCRIPTION RP1
METHOD OF ENGAGEMENT PREPARE TO RE REG RP1

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE #2	DEFLECTION 2790	MORTAR TO FOLLOW #2	
MORTAR TO ADJ	DEFLECTION CORRECTION ☑ L ☐ R 11	SHELL AND FUZE HEQ	(1)
METHOD OF ADJ 1 RD			
BASIS FOR CORRECTION RP1	RANGE 3050	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION ☐ + ☑ - -50	METHOD OF FIRE 1 RD	MAX ORD
SHELL AND FUZE HEQ	☐ + ☑ - -25		
	RANGE CORRECTION +150	DEFLECTION 2801	
METHOD OF FFE	☐ + ☑ - +125	CHARGE 6	TOF
RANGE LATERAL SPREAD	CHARGE 6	ELEVATION 0958	
TIME OF OPENING FIRE W/R	RANGE 3175	TIME SETTING	MARK TIME
MOC TYPE WR ☑ AMC ☐ TOT ☐ OTH ☐	AZIMUTH 3660		
	ANGLE T 140		

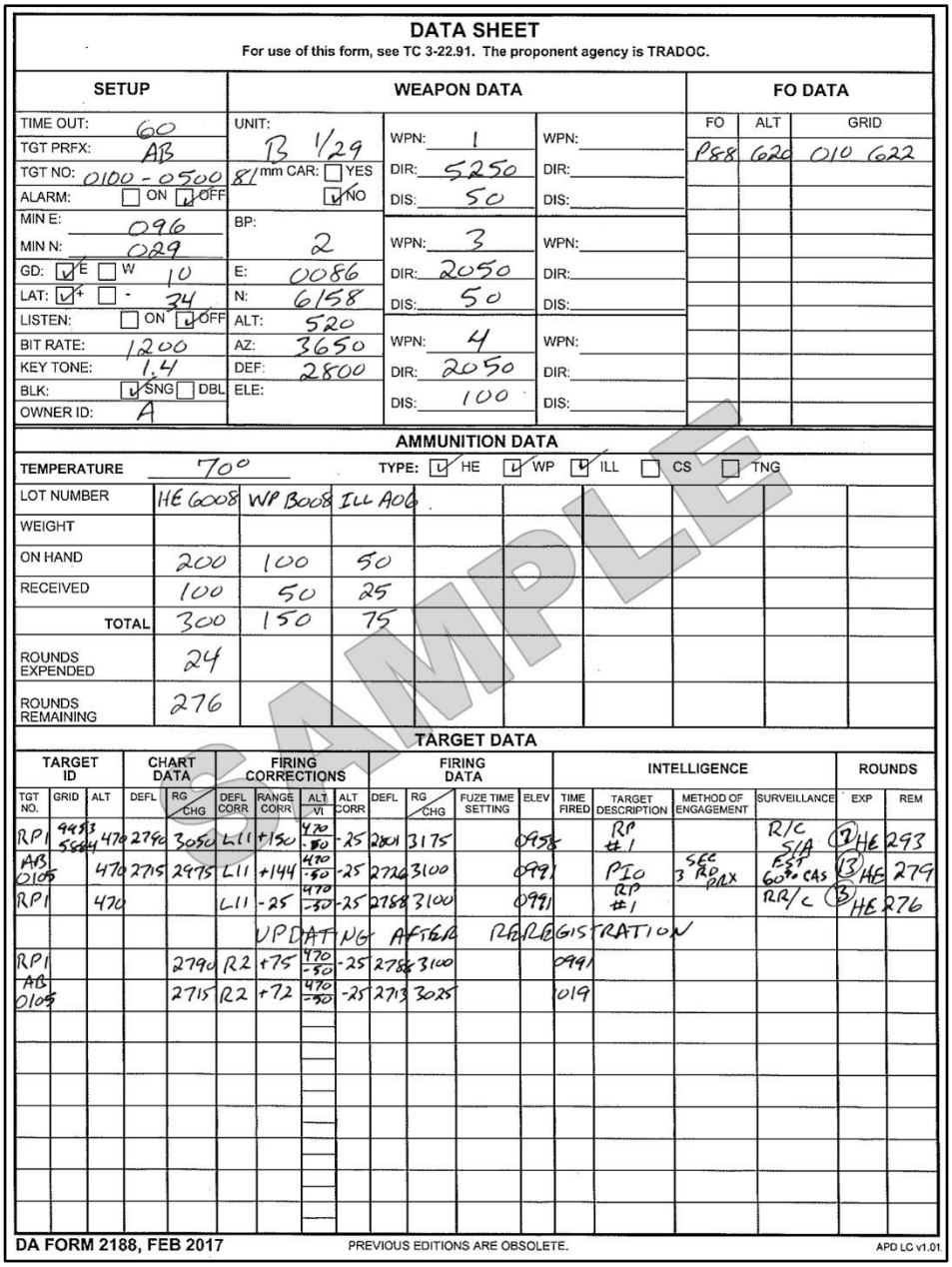
OBSERVER CORRECTION			CHART/SAFETY DATA		SUBSEQUENT COMMANDS							
DEV	RANGE	TIME (HEIGHT)	DEF/ AZ L11	RANGE +125	MORTAR FIRE	METHOD FIRE	AIM AZIMUTH	DEFLECTION	CHARGE	TIME	ELEV	
R50	-100		2783	2950			2794	3075			1001	(2)
	125	FOM M6	2777	2975			2788	3100			0991	(3)
	NOTE:	CHART	DEF	2790			ADV	CMD	RNG	3125		
			DEF	2788			INT	CHT	RNG	3050		
			R2 DEF CORR							+75	RNG CORR	

BATTLE DAMAGE ASSESSMENT (BDA): AIM POINT GRID:

DA FORM 2399, FEB 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.01

SAMPLE

Figure 6-6. Sample of completed DA Form 2399 (Computer's Record) for a reregistration



DATA SHEET

For use of this form, see TC 3-22.91. The proponent agency is TRADOC.

SETUP

TIME OUT:	60
TGT PRFX:	AB
TGT NO:	0100 - 0500
ALARM:	☐ ON ☑ OFF
MIN E:	096
MIN N:	029
GD:	☑ E ☐ W 10
LAT:	☑ + ☐ - 34
LISTEN:	☐ ON ☑ OFF
BIT RATE:	1200
KEY TONE:	1,4
BLK:	☑ SNG ☐ DBL
OWNER ID:	A

WEAPON DATA

UNIT:	B 1/29
81mm CAR:	☐ YES ☑ NO
BP:	2
E:	0086
N:	6158
ALT:	520
AZ:	3650
DEF:	2800
ELE:	

	WPN:	DIR:	DIS:
	1	5250	50
	3	2050	50
	4	2050	100

FO DATA

FO	ALT	GRID
P88	620	010 622

AMMUNITION DATA

TEMPERATURE: 70°

TYPE: ☑ HE ☑ WP ☑ ILL ☐ CS ☐ TNG

	HE	WP	ILL
LOT NUMBER	HE 6008	WP B008	ILL A06
WEIGHT			
ON HAND	200	100	50
RECEIVED	100	50	25
TOTAL	300	150	75
ROUNDS EXPENDED	24		
ROUNDS REMAINING	276		

TARGET DATA

TARGET ID			CHART DATA		FIRING CORRECTIONS				FIRING DATA				INTELLIGENCE				ROUNDS	
TGT NO.	GRID	ALT	DEFL	RG CHG	DEFL CORR	RANGE CORR	ALT VI	ALT CORR	DEFL	RG CHG	FUZE TIME SETTING	ELEV	TIME FIRED	TARGET DESCRIPTION	METHOD OF ENGAGEMENT	SURVEILLANCE	EXP	REM
RP1	9953 5584	470	2790	3050	L11	+150	470 -50	-25	2801	3175		0958		RP #1		R/C S/A	(12) HE	293
AB 0105		470	2715	2975	L11	+144	470 -50	-25	2726	3100		0991		PIO RP #1	3 SEC RD PRX	EST 60° CAS	(13) HE	279
RP1		470			L11	-25	470 -50	-25	2788	3100		0991				RR/C	(3) HE	276
						UPDATING AFTER REGISTRATION												
RP1				2790	R2	+75	470 -50	-25	2786	3100			0991					
AB 0105				2715	R2	+72	470 -50	-25	2713	3025			1019					

SAMPLE

DA FORM 2188, FEB 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.01

Figure 6-7. Sample of completed DA Form 2188 (Data Sheet)

6-28. The chart deflection plus or minus DEFK equals command deflection. The chart range plus or minus the range correction plus or minus the altitude/elevation correction equals the command range.

- Carry out the mission the same as with the initial registration and once the EOM, REGISTRATION COMPLETE, has been given, determine firing corrections again.
- In the initial registration:
  - The FDC compares the initial chart range and the final chart range difference.
  - Determines the range difference after the reregistration is similar.
  - The determination of the final adjusted command range must be made.
  - During the reregistration, firing corrections were applied for each round.
- Final adjusted command range is the final command range with the altitude correction deleted.

EXAMPLE

Final command range: 3,100 meters; altitude/elevation correction: - 25
Final adjusted command range: 3,100 + 25 (reversing the sign of the altitude/elevation correction) = 3125

- The altitude/elevation correction is added since it was subtracted initially, but if the altitude/elevation correction had been a plus (+), then it would have been subtracted to obtain the final adjusted command range.
- Once the final adjusted command range has been determined:
  - Compare the initial chart and the final adjusted command range. Subtract the smaller from the larger to determine the RCF.
  - The sign (+/-) would be determined as with the initial registration.
  - Again, divide the range (initial chart range rounded to the nearest 100 expressed in 1,000ths) into the new range correction to determine the new RCF.
- To determine the DEFK, compare the initial chart deflection and the final command deflection.
- Subtract the smaller from the larger and determine the sign (L or R) to apply.
- Apply the new firing corrections to all targets that have been and are fired within the transfer limits and for those targets that are already plotted on the board, apply the new firing corrections, and update the target data:
  - The chart data does not change.
  - The target does not move; however, the weather conditions do change.

DETERMINATION OF VERTICAL INTERVAL

6-29. The computer compares the altitude/elevation of the mortar position and the altitude/elevation of the target being engaged. If the altitude/elevation of the target is higher than that of the mortar position, then the VI will be a plus (+); if lower, it will be a minus (-). (See figure 6-8, page 160.)

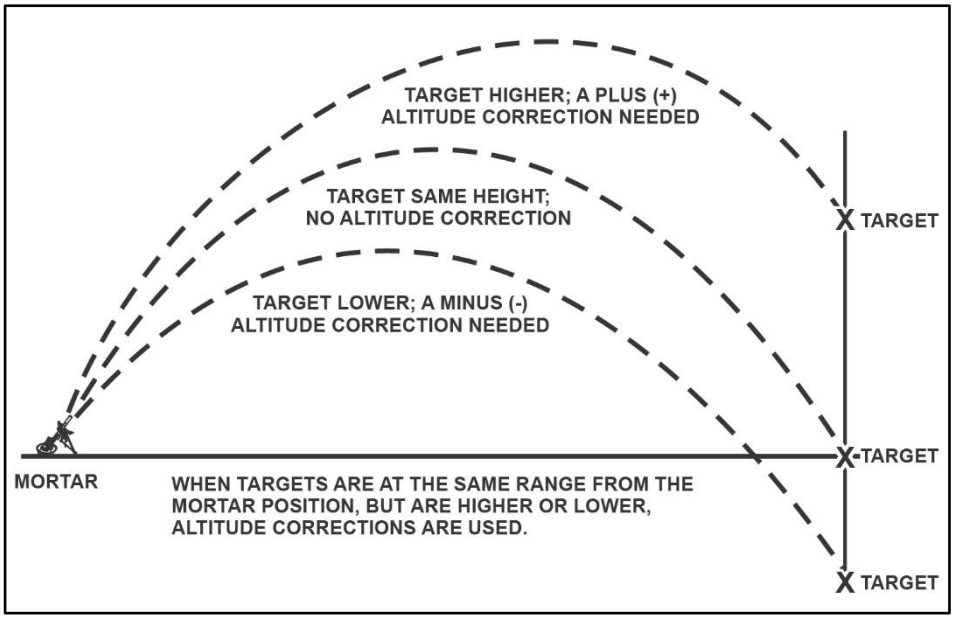


Figure 6-8. Altitude/elevation correction

CORRECTION FOR VERTICAL INTERVAL

6-30. Because of the VI, an altitude/elevation range correction must be applied to the chart range to obtain the range to be fired (command). The range altitude/elevation correction to apply is half of the VI; it is determined to the nearest whole meter.

EXAMPLE
VI = 75 meters
1/2 of the VI = 38 meters (altitude/elevation [range] correction)

6-31. The altitude/elevation (range) correction is applied. If the target is higher than the mortar, the computer adds the range altitude/elevation correction; if it is lower, the computer subtracts to get the altitude to be fired (command). The altitude/elevation correction is applied to every chart range throughout the mission.

Note. A VI of less than 50 meters is not used when working with the modified-observed chart.

VERTICAL INTERVAL CORRECTION FACTORS

6-32. When the mortar position is known to surveyed accuracy and a map is being used, the computer can work with altitude/elevation differences and the correction factor for those altitude/elevation differences. As noted earlier, the term used for altitude/elevation difference is VI.

ADJUSTING THE SHEAF

6-33. The purpose of adjusting the sheaf is to align the fires of all the mortars. Mortars are positioned with gun Number 1 through Number 4 for 81-mm and 120-mm mortars (when employed as a platoon), or Number 1 through Number 2 for all other mortar systems (when employed as a section) from right to left as seen from behind the guns. There is normally a 10-second interval between rounds. The FO needs that time to observe the impact of the rounds and to determine corrections. If the corrections are 50 meters or more (deviation left/right only), the mortar must be refired. The corrections can be plotted on the board, or the DCT can be used to determine the number of mils to add or subtract from the base mortar deflection.

Note. If the target has been mechanically surveyed, enter the DCT at the initial chart range plot. If the target is a nonsurveyed target (even if it is an eight-digit grid), enter the DCT at the final chart range plot.

EXAMPLE

The sheaf of an 81-mm platoon is being adjusted. Number 2 mortar conducted the registration. The FDC has requested to prepare to adjust the sheaf. The FO requests section right. The entire platoon then fires, in order, starting at the right (Numbers 1, 3, 4) with 10-second intervals between rounds. The mortar used to register (Number 2) will not fire. The sheaf is adjusted perpendicular to the GTL. The observer notes where each round lands and sends back deviation corrections in meters; range corrections are ignored if they are less than 50 meters. If a deviation correction is 50 meters or greater, it must be refired. Corrections to be refired should always be transmitted first by the FO.

The spotting from the FO is Number 4, right 20, Number 3, left 60, and Number 1, left 30. (See figure 6-9.) The FO then sends these corrections to the FDC; Number 3, right left 60 (it is transmitted first because it needs to be refired [since it is greater than 50 meters]), Number 4, left right 20 Number 4 is adjusted, and finally Number 1, right left 30 Number 1 is adjusted. The Number 3 mortar now is fired, and the round impacts 10 meters right of the desired burst point. The FO then would send: Number 3, left 10, Number 3 is adjusted, sheaf is adjusted, EOM.

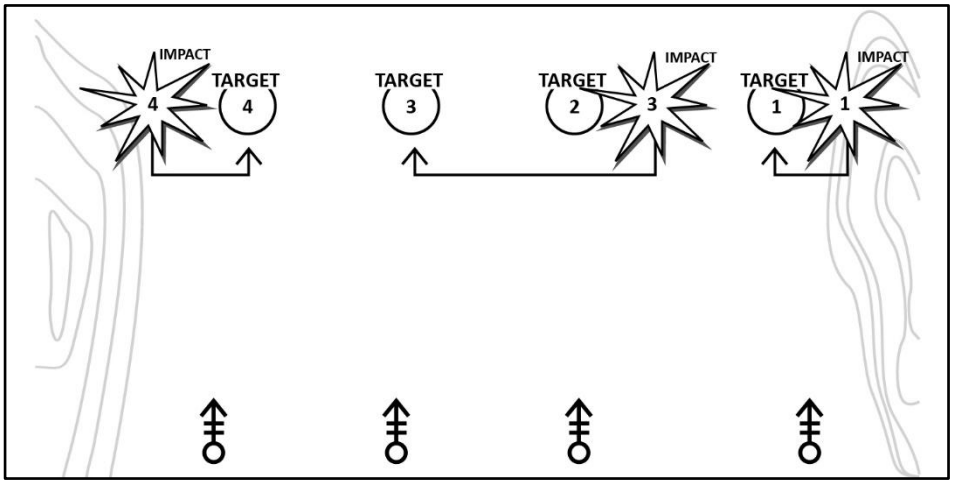


Figure 6-9. Numbers 1, 3, and 4 mortars out of sheaf

DETERMINING MULTIPLE REGISTRATION POINTS

6-34. The ideal situation is to have multiple RPs, if the tactical situation permits. (See figure 6-10.) Keep in mind each RP has its own range correction factor and DEFK. Range correction is the difference in meters between the initial chart range and the final chart range for the RP. As the registration mission is fired and completed, the rounds on

the plotting board may not be plotted at the point where the RP was plotted. Because of wind and weather, the rounds may have to be fired at a greater or lesser range and to the right or left of the target to hit it. As shown in figure 6-11, the initial chart range to the RP was 3,050 meters; the final chart range (range used to hit the RP) was 3,200.

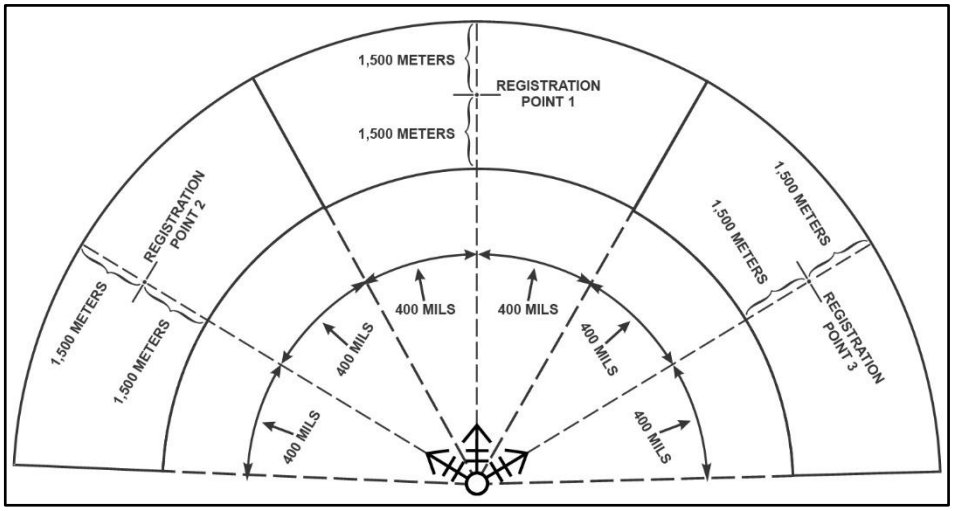


Figure 6-10. Multiple transfer limits

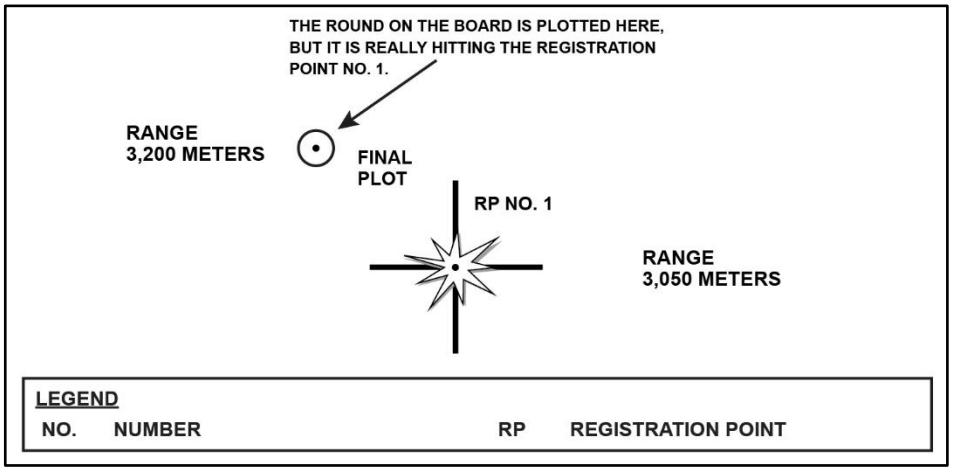


Figure 6-11. Plotting of rounds

GRID MISSION

6-35. The grid coordinates of the target must be plotted on the map with the altitude/elevation determined, and a direction and distance determined from the mortar location to the target. For modified and surveyed charts, index "0" and plot the target using the grid coordinates.

SHIFT FROM A KNOWN POINT MISSION

6-36. For an observed chart, the known point must be plotted on the firing chart. This may be a fired-in target or a mark-center-of-sector round. The OT azimuth is indexed, and the correction applied is sent in the CFF. For modified and surveyed charts, the same procedure is used as for the observed chart.

6-37. The target is assumed to be the same altitude/elevation as the point being shifted from unless, in the CFF, the FO sends a vertical shift (up or down). Therefore, that shift is applied to the point being shifted from, and that is the altitude of the new target.

POLAR PLOT MISSION

6-38. The FO's location must be plotted on the plotting board before a polar plot mission can be fired. For an observed chart, the location can be plotted in four ways:

- By resection.
- By intersection.
- By direction and distance.
- By range and azimuth from a known point.

6-39. The altitude/elevation of the target is assumed to be the same as that of the FO's position if no vertical shift is given. If one is given, the computer applies the shift to the FO's altitude, and that is the altitude of the new target. Once the computer has determined the altitude/elevation of the target, it is possible to determine the VI for the mission and, finally, the altitude correction. Remember, VI is the difference in altitude/elevation between the mortars and the target.

RESECTION

6-40. Plot two known points on the plotting board. Then index the azimuths the FO sends from these two points and draw lines from the known points toward the bottom of the board. The intersection of these lines is the FO's location. (See figure 6-12.)

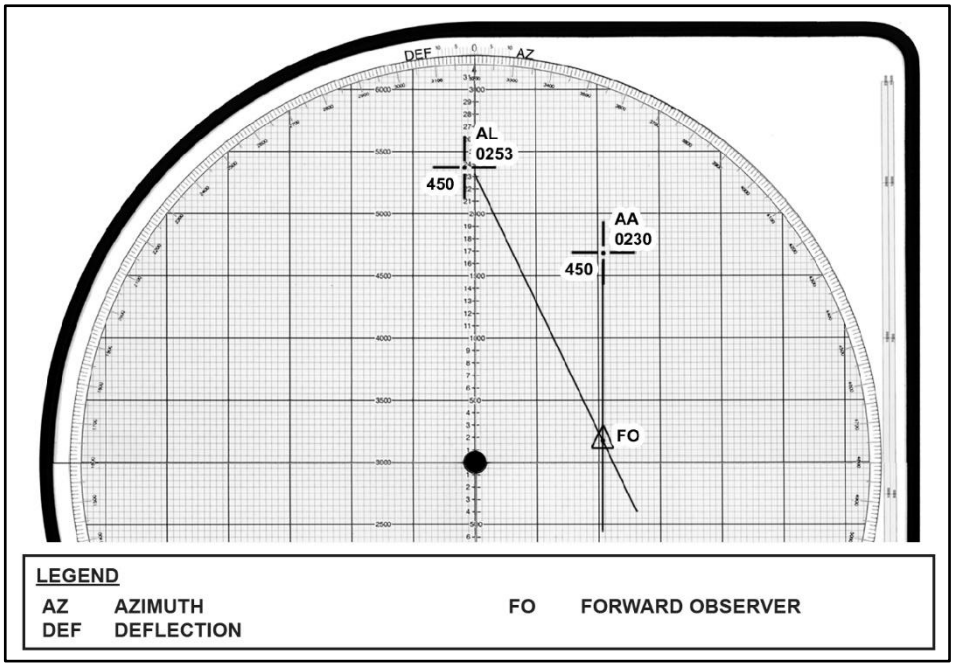


Figure 6-12. Resection

INTERSECTION

6-41. Like resection, intersection (see figure 6-13, page 166) is a method of location that requires two separate observers who can see the same target/point of interest. Plot the two FOs on the plotting board. Index the azimuth from the first FO to the target/point of interest. Draw a line from the first FO to the top of the board. Next, index the azimuth from the second FO to the target or point of interest. Draw a line from the second FO to the top of the board. These two lines intersect at the location of the target or point of interest.

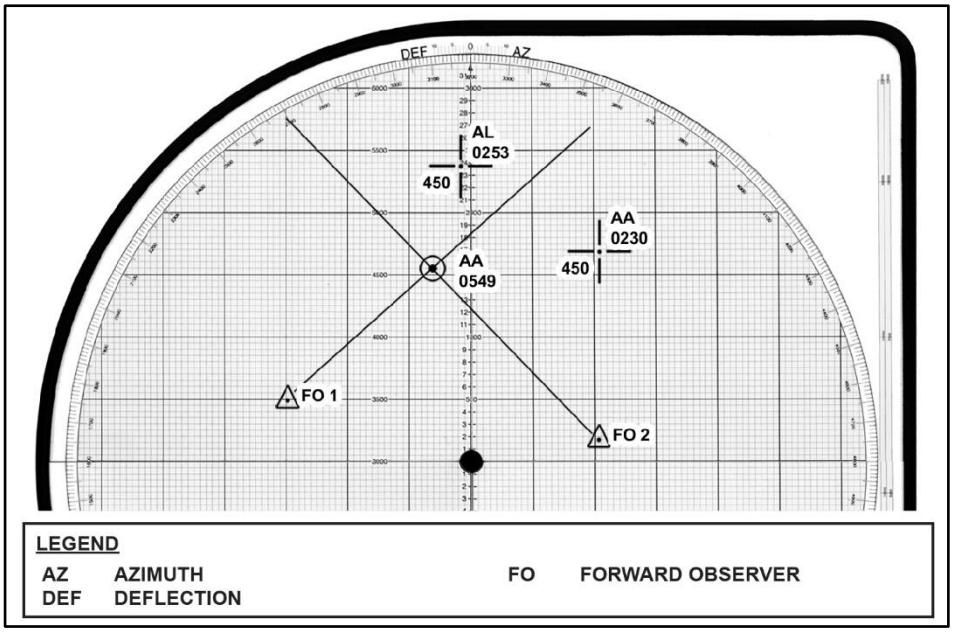


Figure 6-13. Intersection

DIRECTION AND DISTANCE

6-42. The FO sends the computer the grid to the FO position. The computer then plots the grid on the map, determines the direction and distance from the mortar position to that grid, transfers the direction and distance to the plotting board, and plots the FO's location. (See figure 6-14.)

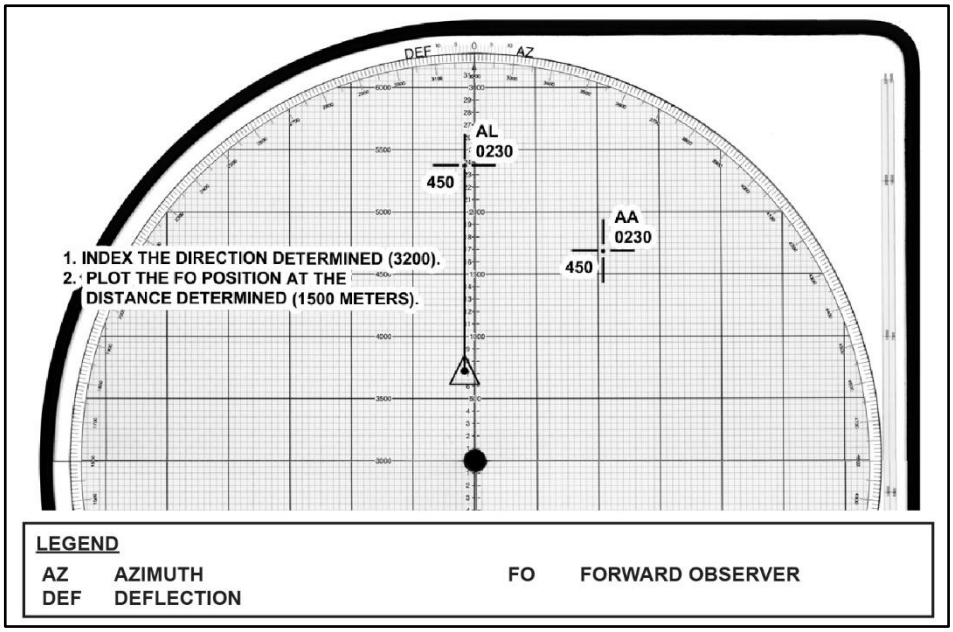


Figure 6-14. Direction and distance

RANGE AND AZIMUTH FROM A KNOWN POINT

6-43. The FO sends the range from the known point and the azimuth on which that point is seen. Once that is known, the computer can index the azimuth, drop below the known point the range given, and plot the FO's location. (See figure 6-15, page 168.) For modified and surveyed charts, the FO's location can be plotted if the grid of the FO is known, by indexing "0" and plotting the FO grid. If the grid is unknown, then the computer can use resection, direction and distance, or range and azimuth from a known point.

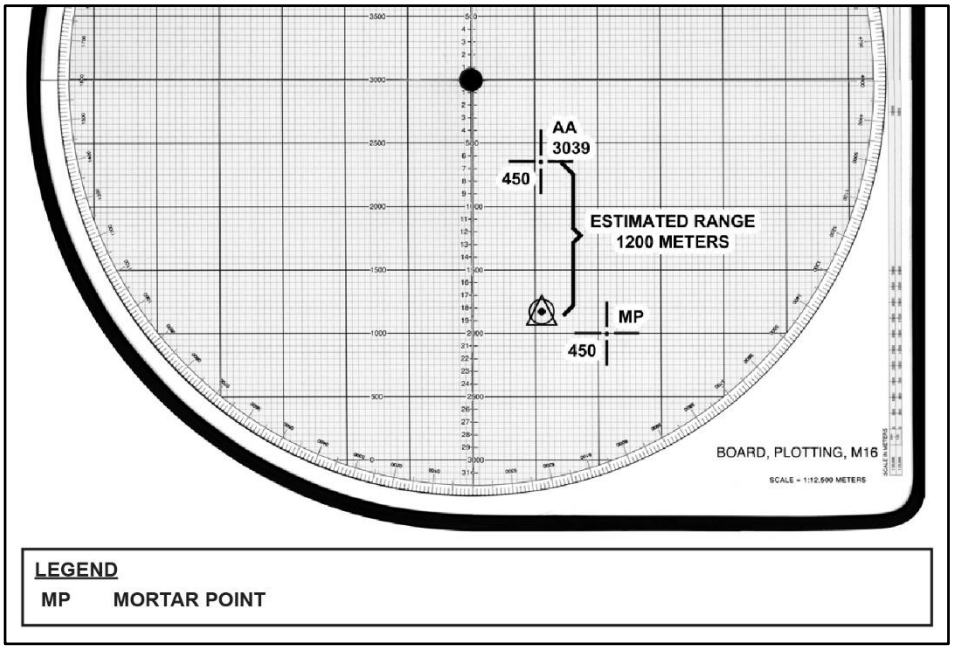


Figure 6-15. Estimate of range from the reference point of the forward observer's location

IMMEDIATE SUPPRESSION, IMMEDIATE SMOKE

6-44. When engaging a planned target or target of opportunity that has taken friendly maneuver or aerial elements under fire, the observer announces, IMMEDIATE SUPPRESSION or IMMEDIATE SMOKE. The delivery of these fires is performed as quickly as possible while keeping safety and accuracy in mind.

ILLUMINATION

6-45. Illumination assists friendly forces with light for night operations. The M16/M19 can be set up for illumination as any of the three types of firing charts. Determining firing data is the same as with any type of mission, only now the FDC uses one of the flank mortars to adjust the illumination, leaving the base mortar ready to adjust HE. The FO enters range corrections for the illumination rounds.

> ***Note.*** Illumination deviation corrections are no less than 200 meters, and height corrections (up/down) are no less than 50 meters, because of the dimensions of the illuminated area.

OBSERVERS

6-46. Observers who adjust illumination should be informed when 81-mm mortars are firing M301A3 illumination rounds.

6-47. The M301A3 has a HOB of 600 meters (see figure 6-16), while the M301A1 and M301A2 rounds have a 400-meter HOB.

6-48. There is a difference in adjustment procedures. M301A1 and M301A2 rounds are adjusted to a ground-level burnout; the M301A3 round should have a burnout of 150 to 200 meters above the ground. This procedure is because all three of the rounds fall at a rate of 6 MPS. (See table 6-2.)

Table 6-2. Example of illumination adjustment

Rounds	*Rate of Fall (Meters Per Second [MPS])*	*Burn Time (Seconds)*	*Height of Burst (Hob) (Meters)*	*Fall Before Burnout (Meters)*
M301A1	6	60	400	6 x 60 = 360
M301A2	6	60	400	6 x 60 = 360
M301A3	6	60	600	6 x 60 = 360

CORRECTIONS

6-49. Corrections to the HOB are used to move the round up or down in relation to the HOB line. (See figure 6-16.)

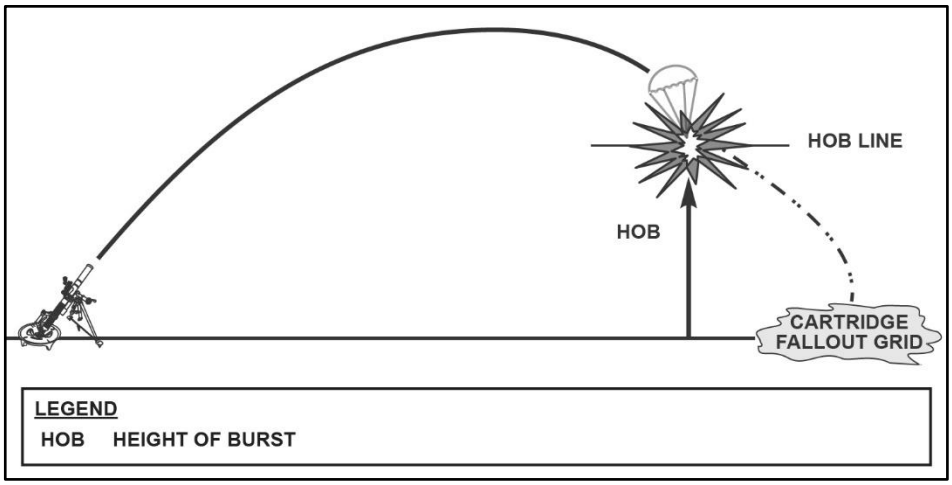


Figure 6-16. Height of burst line for an M301A3

ADJUSTMENTS

6-50. Adjustments are made after the initial illumination CFF has been made. This is done by observing the initial illumination burst in relation to the target. The observer will call in the corrections to the FDC.

Example 1

6-51. The example will help illustrates the adjustments computed by the FDC. Once information has been given to the FDC from the FO, the FDC computes the data and sends the corrections to the gun section.

EXAMPLE 1

Consider the chart range to the first round fired: 2,525 meters.

1. Enter 2,550 meters into FT 81-AI-3. (See figure 6-17.) Optimum charge to use is charge 8.

2. Columns 1 (Range to Burst), 2 (Elevation), and 3 (Fuze Setting) of Basic Data will give the basic HOB for 600 meters above the mortar position.
   Range to burst = 2,550 meters
   Elevation = 1107 mils
   Fuze setting = 31.0

FT 81-AI-3 CHARGE 8

CTG, ILLUMINATING, M301A3
FUZE, TIME, M84A1

1	2	3	4	5	6	7
RANGE TO BURST	ELEV	FUZE SETTING	CHANGE IN ELEV FOR 50M INCREASE IN HEIGHT OF BURST	CHANGE IN FS FOR 50M INCREASE IN HEIGHT OF BURST	MAX ORD	RANGE TO IMPACT
M	MILS		MILS		M	M
1500	1351	34.6	-2	-0.4	1903	1621
1550	1342	34.5	-2	-0.4	1895	1675
1600	1332	34.4	-2	-0.4	1886	1730
1650	1322	34.3	-3	-0.4	1876	1784
1700	1313	34.2	-3	-0.4	1866	1839
1750	1303	34.1	-3	-0.4	1856	1894
1800	1293	34.0	-3	-0.4	1845	1949
1850	1282	33.8	-3	-0.4	1834	2004
1900	1272	33.7	-3	-0.4	1822	2060
1950	1261	33.6	-3	-0.4	1809	2115
2000	1250	33.4	-4	-0.4	1796	2171
2050	1239	33.3	-4	-0.4	1782	2226
2100	1227	33.1	-4	-0.4	1768	2282
2150	1216	32.9	-4	-0.4	1753	2338
2200	1204	32.7	-5	-0.4	1737	2395
2250	1191	32.5	-5	-0.4	1720	2451
2300	1179	32.3	-5	-0.5	1703	2508
2350	1165	32.1	-6	-0.5	1684	2565
2400	1152	31.9	-6	-0.5	1664	2623
2450	1137	31.6	-7	-0.5	1643	2681
2500	1123	31.3	-7	-0.5	1621	2739
2550	1107	31.0	-8	-0.5	1597	2798
2600	1091	30.7	-9	-0.6	1571	2858
2650	1073	30.4	-10	-0.6	1543	2919
2700	1054	30.0	-12	-0.6	1512	2981
2750	1034	29.5	-14	-0.7	1478	3045
2800	1011	29.0	-17	-0.8	1439	3110
2850	985	28.4	-22	-1.0	1394	3179
2900	953	27.6	-34	-1.3	1337	3253
2950	907	26.5			1254	3342

LEGEND

CTG	CARTRIDGE	M	METER
ELEV	ELEVATION	MAX	MAXIMUM
FS	FUZE SETTING	ORD	ORDINATE
FT	FIRING TABLE		

Figure 6-17. Firing Table 81-AI-3, charge 8, used in determination of location of round in relation to the height of burst

EXAMPLE 1 (cont)

3. The round is fired, and the FO sends, ADD TWO ZERO ZERO [200]. UP ONE ZERO ZERO [100]. The computed range is now:
2725 = 2750
The basic data only gave a HOB of 600 meters, but the FO requested an “up 100” correction, meaning that the round needs more height.

4. To compute this change, determine where this round will be in relation to the HOB line.
HOB = 600 meters
“Up 100” is two increments above the HOB line.

5. Multiply the increments by the correction factors given in these columns. Use FT 81-AI-3, charge 8. (See figure 6-18.) Range to burst: 2,750 meters, +2 increments
|
6. Once the number of increments has been determined, go to column 4 (Change in Elevation for 50-meter Increase in HOB) and column 5 (Changes in Fuze Setting for 50-meter Increase in HOB). Column 4 = -14
-14 (number in column 4) x 2 (increments)
(100 meters above HOB) = -28 mils
Column 5 = -0.7
-0.7 (number in column 5) x 2 increments
(100 meters above HOB) = -1.4 seconds

7. Basic data:
1034 mils (number in column 2) -28 mils = 1006 mils (elevation)
29.5 (number in column 3) -1.4 sec = 28.1 (fuze setting)

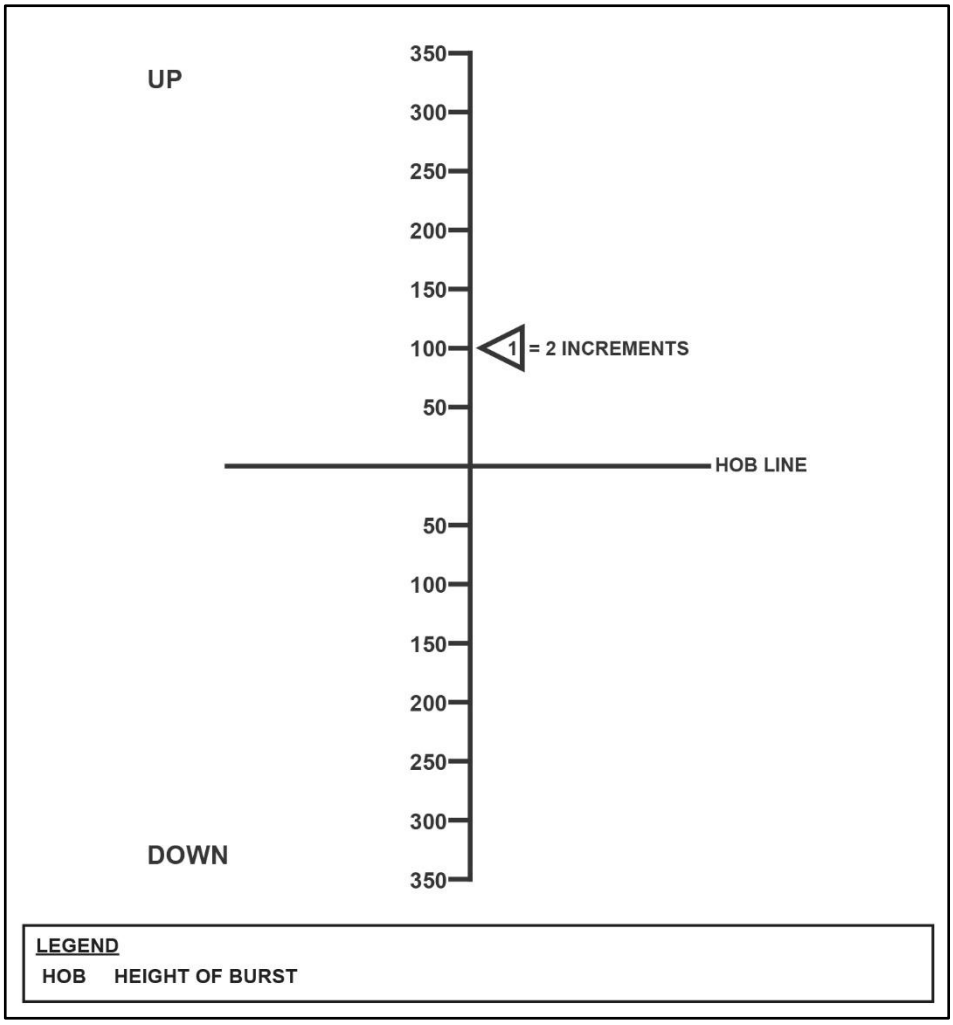


Figure 6-18. Firing adjustment

EXAMPLE 1 (cont)

8. Assume that the second round is fired, and the FO sends, DOWN FIFTY [50]. (See figure 6-19.) Note that a range change was not sent, but a HOB correction was sent.

9. Again, determine the relation to the HOB line, and apply the correction factors to the Basic Data to obtain the firing data.
Range to burst 2,750 meters, charge 8, down 50.
Now the computer is working with one increment above the HOB line.
Increments (relationship to HOB, 600 meters)
1 x -14 (number in column 4) = -14
1 x -0.7 (number in column 5) = -0.7
New data:
1034 mils (basic data) -14 = 1020 mils (elevation)
29.5 (basic data) -0.7 = 28.8 (fuze setting)

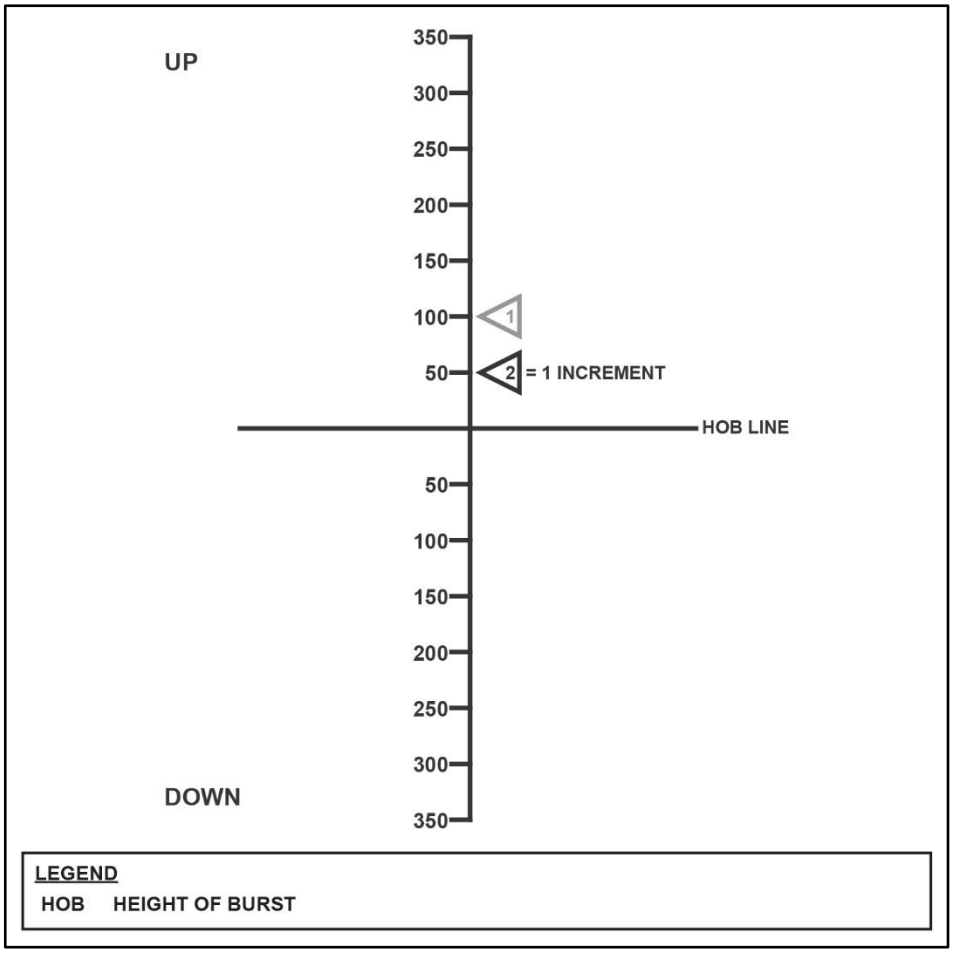


Figure 6-19. Firing adjustment down 50

Example 2

6-52. This example will help illustrates the adjustments that the FDC computes when the round is below the HOB line. Charge 5 will be used, as shown in FT 81-AI-3. (See figure 6-20, page 176.)

CHARGE
5

FT 81-AI-3

CTG, ILLUMINATING, M301A3
FUZE, TIME, M84A1

1	2	3	4	5	6	7
RANGE TO BURST	ELEV	FUZE SETTING	CHANGE IN ELEV FOR 50M INCREASE IN HEIGHT OF BURST	FS	MAX ORD	RANGE TO IMPACT
M	MILS		MILS		M	M
100	1450	4.5	13	0.4	600	714
150	1378	4.5	19	0.4	600	1033
200	1309	4.6	24	0.4	600	1317
250	1244	4.7	29	0.4	600	1561
300	1183	4.9	33	0.4	600	1766
350	1127	5.0	36	0.4	600	1933
**********						
400	1506	28.0	-1	-0.4	1348	453
450	1494	27.9	-2	-0.4	1345	510
500	1482	27.9	-2	-0.4	1341	567
550	1469	27.8	-2	-0.4	1337	624
600	1457	27.8	-2	-0.4	1333	681
650	1445	27.7	-2	-0.4	1328	738
700	1432	27.6	-3	-0.4	1323	795
750	1419	27.6	-3	-0.4	1317	853
800	1406	27.5	-3	-0.5	1311	910
850	1393	27.4	-3	-0.5	1305	967
900	1380	27.3	-4	-0.5	1298	1025
950	1366	27.2	-4	-0.5	1290	1083
1000	1352	27.0	-4	-0.5	1282	1141
1050	1338	26.9	-5	-0.5	1273	1199
1100	1324	26.8	-5	-0.5	1263	1258
1150	1309	26.6	-5	-0.5	1253	1317
1200	1294	26.5	-6	-0.5	1242	1376
1250	1278	26.3	-6	-0.5	1230	1436
1300	1262	26.1	-7	-0.6	1218	1495
1350	1245	25.9	-8	-0.6	1204	1556
1400	1228	25.7	-8	-0.6	1189	1617
1450	1210	25.4	-9	-0.6	1173	1679
1500	1190	25.1	-11	-0.7	1155	1742

NOTE - FOR RANGES UP TO 350 METERS THE BURST WILL APPEAR ON THE ASCENDING BRANCH OF THE TRAJECTORY.

LEGEND

CTG	CARTRIDGE	M	METER
ELEV	ELEVATION	MAX	MAXIMUM
FS	FUZE SETTING	ORD	ORDINATE
FT	FIRING TABLE		

Figure 6-20. Firing Table 81-AI-3, charge 5, used in determination of location of round in relation to height of burst

CAUTION

When the correction is below the HOB line, use the sign opposite of that found in columns 4 and 5 to obtain the same HOB.

EXAMPLE 2

The FO sends, DROP TWO ZERO ZERO [200]. DOWN ONE FIVE ZERO [150]. (See figure 6-21.) Assume that the new range is 1,325 meters (= 1350), and the optimum charge is 5. The procedure for determining the increments is the same as with the last example.

600-meter basic HOB, down 150 = 3 increments below the HOB line

1. Determine the correction factors as before but reverse the signs since columns 4 and 5 are set up for increases in HOB.

3 x -8 (number in column 4) = -24 mils = +24 mils

3 x -0.6 (number in column 5) = -1.8 sec = +1.8 sec

2. Determine new firing data as before.

Basic data:

1245 mils (number in column 2) +24 mils = 1269 mils (elevation)

25.9 (number in column 3) +1.8 sec = 27.7 (fuze setting)

3. Assume that the second round is fired, and the FO sends, DROP TWO ZERO ZERO [-200], and the new range is 1,150 meters. Note that a range change is given, but not an HOB correction.

Note. When only a range change is sent, only the increments below the HOB line for the old range must be applied to the new range to keep the HOB correct.

4. To determine the data, apply the steps as before.

Increments below HOB = 3

Correcting factors: 3 (increments) x -5 = -15 = +15 (sign reversed)

3 (increments) x -0.5 = -1.5 = +1.5 (sign reversed)

New data:

1309 mils + 15 mils = 1,324 mils elevation

26.6 + 1.5 = 28.1 (fuze setting)

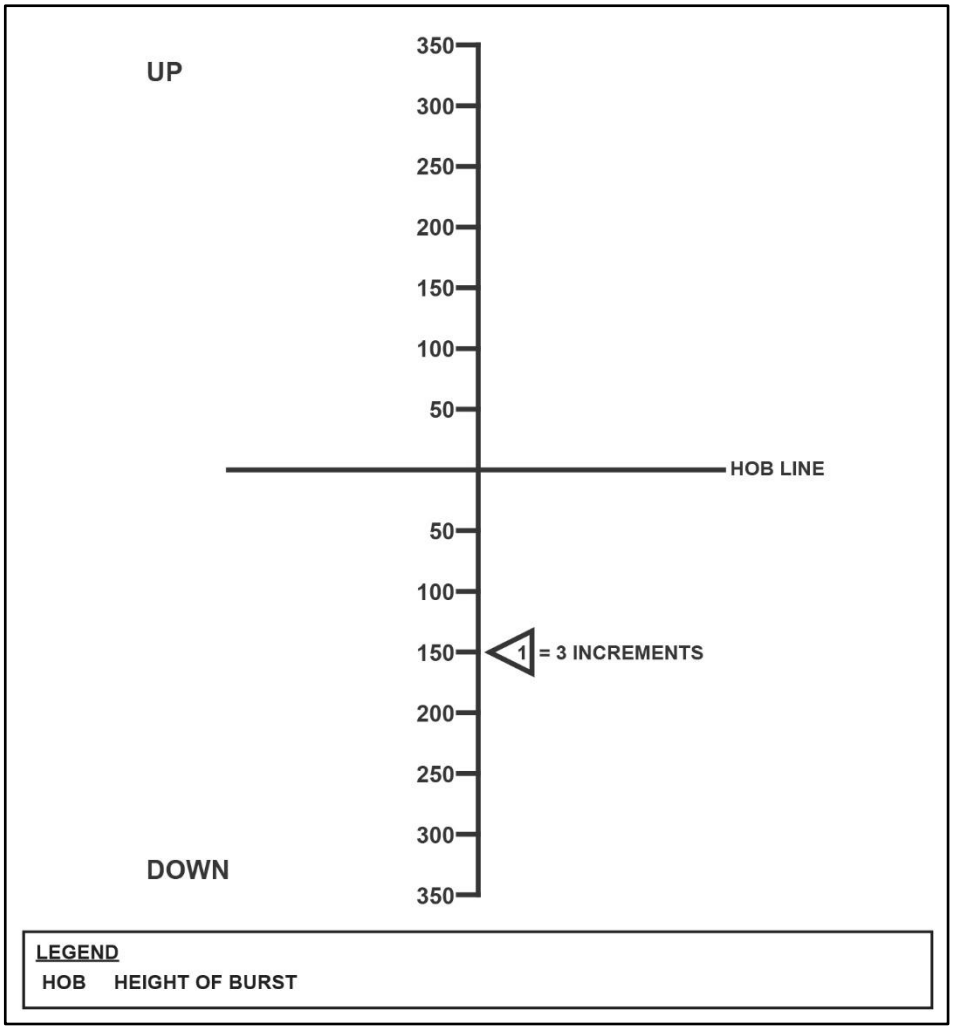


Figure 6-21. Firing adjustment down 150

ADVANCED FIRE MISSIONS

6-53. The advanced fire missions are the mission that indirect fire Infantryman will conduct per mortar certification publication. These missions are selected through the task crosswalk and will support the unit's METL.

COORDINATED ILLUMINATION

6-54. When a suspected area is illuminated and produces a target, coordinated illumination is used to engage the target:

- The illumination round has been adjusted over the target area, and the computer receives a CFF for coordinated illumination.
- The mark method is the method of coordinated illumination most used, and the FDC and the FO must know for which round the illumination mark will be given.
- When the illumination round has been adjusted to provide the best light on the target, the FO gives the command, MARK ILLUMINATION. The FDC times the flight of the round from the time it is fired until the command, MARK.
- To compute the time to fire the HE round, the computer subtracts the TOF for the HE round from the MARK TIME and drops all the "10ths."

EXAMPLE

Illumination MARK TIME of 55 seconds minus, the HE TOF 41.7 = 13.3 seconds. Drop the 10ths (.3) then apply the remainder of 13 seconds between firing the illumination and the HE.

- When firing coordination missions, the computer operator uses a new DA Form 2399 to record the illumination mission.
- The data used to fire the first illumination round is taken from DA Form 2399 used to adjust the illumination mission.
- The FO sends corrections and precedes each correction with the type of round the correction is intended for.
  - For example, HE. RIGHT FIVE ZERO. ADD FIVE ZERO then records each correction.
  - The FDC keeps track of the 50-meter increments by using the DA Form 2399 of the coordinated illumination mission.
  - The illumination round cannot be adjusted after mark time is established or the mission will need to be restarted.
- There are two methods normally used to adjust illumination (mark method and shell) and HE.
- Coordinated illumination using the mark method involves the FDC controlling the firing of both the HE and illumination rounds, and coordinated illumination using the shell method involves FO commands.
  - The FO controls the firing of each round.
  - The FO sends corrections and computes the data that is sent to the mortars from the FDC.
  - The mortars then report when they are up.
  - The FDC notifies the FO, and the FO gives the command to fire each round.
- When the FO is certain that the FO can hit the target with the next round, the FO commands, CONTINUOUS ILLUMINATION. FIRE FOR EFFECT or CONTINUOUS ILLUMINATION. HE. DROP TWENTY-FIVE. FIRE FOR EFFECT.

- By requesting the continuous illumination, the FO is telling the FDC that the FO wants the target illuminated both during and after the FFE to allow the FO to make the target surveillance. Upon completion of the mission, the FO records the data on DA Form 2188.

FINAL PROTECTIVE FIRES

6-55. FPF is the highest priority mission for the mortar section. FPF is a preplanned target in the defense and linear in nature. FPF is established on a high-speed avenue of approach and designed to impede enemy advance. It is integrated with the other weapons of the unit being supported to cover dead space or likely avenues of approach. The FPF is a last-ditch effort to stop the enemy force from overrunning the unit. Normally, it is placed no more than 200 meters in front of friendly forces; however, the exact position of the FPF is based on the tactical situation.

6-56. The target location given in the CFF is not the location of the FPF. A 200- to 400-meter safety factor is added to the location of the FPF by the FO. This is the location given in the CFF.

Note. The computer never adds a safety factor.

6-57. An FPF adjustment can be fired in three ways:

- Adjust each mortar onto the FPF (most desirable method).
- Adjust only the danger close mortar, using the attitude of the target and mortar position to compute data for the other mortars.
- Using the attitude of the mortar section and the FPF, compute only the data for the FPF, with no rounds being fired (least desirable method).

6-58. Obtaining the firing data still is performed by aligning the mortar location with the plot being engaged and using the azimuth disk and vernier scale.

Note. When the FO calls for the FPF the FO uses HE delay when adjusting the FPF (preferred method) and uses the creeping method of adjustment.

6-59. When adjusting each mortar, the FO may (in the CFF) give a section left or section right to determine the danger close mortar. The danger close mortar is the one impacting closest to friendly troops.

- Once the danger mortar is known, it is adjusted onto the FPF line. (See figure 6-22, page 182.)
- Once the danger mortar has been adjusted, the next mortar (Number 2) is given the danger mortar data and fired. The firing of the same data should put the impact of the next mortar 40 meters left or right of the adjusted mortar. This distance also depends on the type of mortar being fired as the distance is greater for 120-mm mortars than for 60-mm or 81-mm mortars.

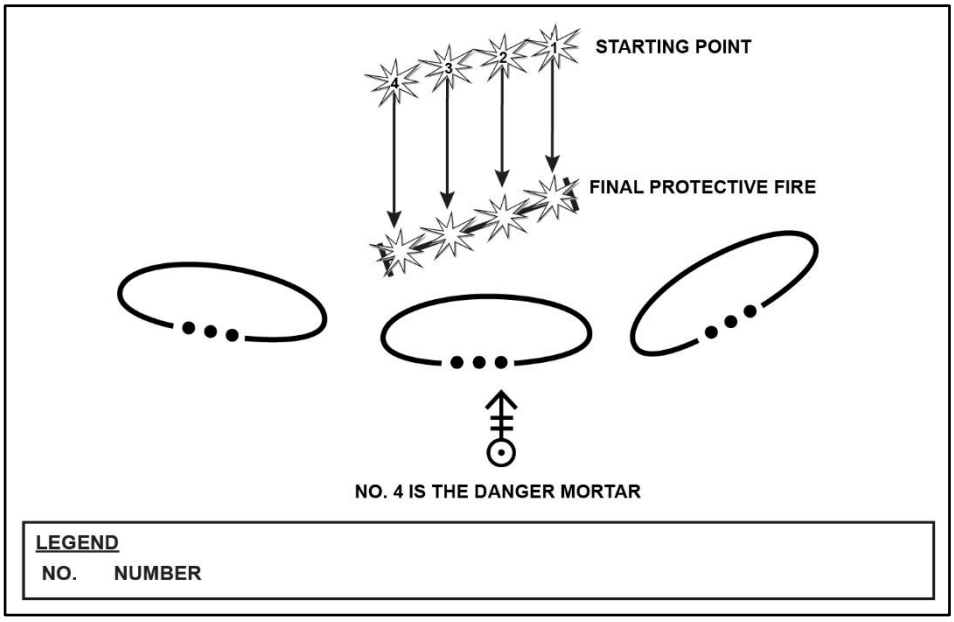
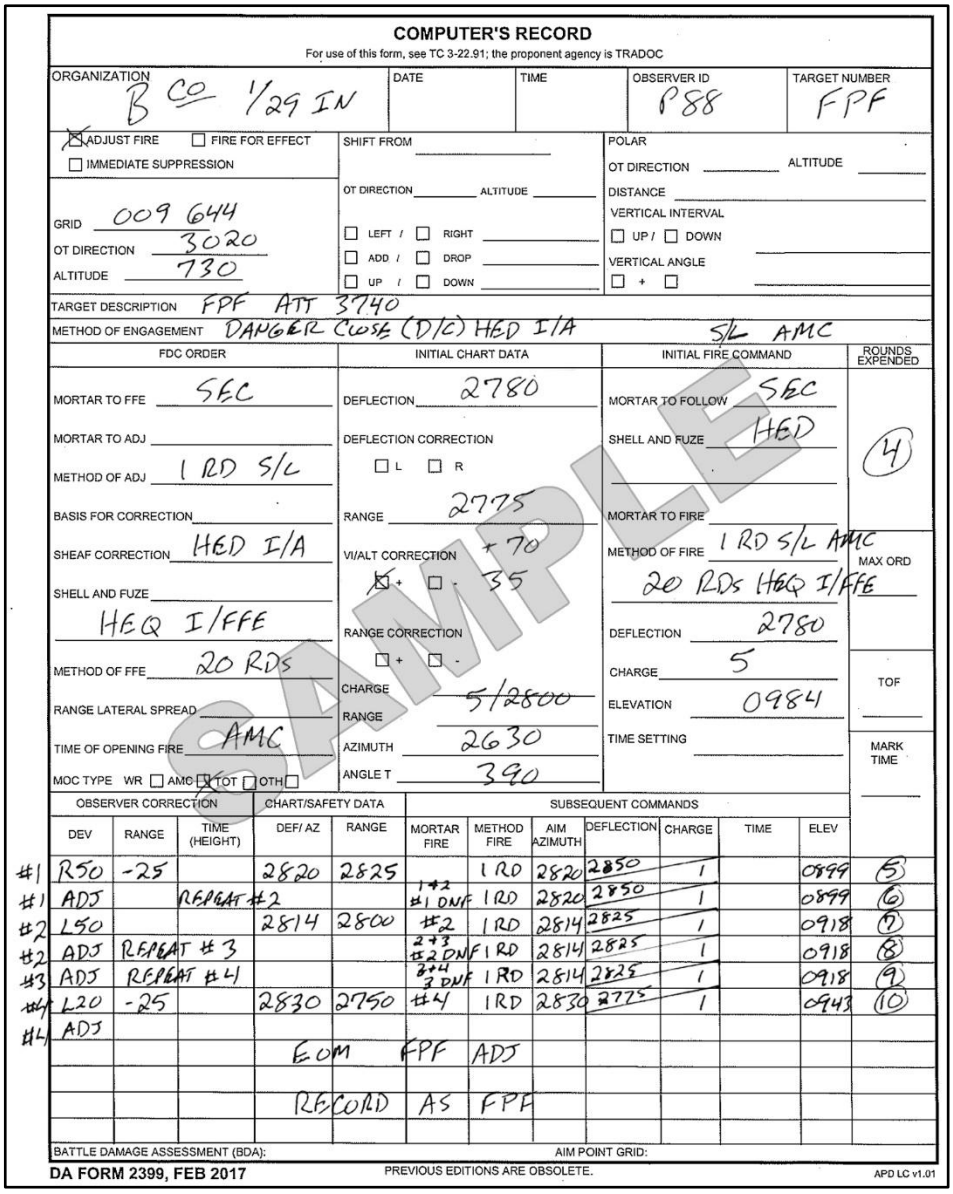


Figure 6-22. Determination of danger mortar

- This procedure is used for the remaining mortars until each is on the FPF line. As each mortar is adjusted to the FPF line, the data is then given to each mortar and placed on the mortar after each mission. The predetermined number (found in the unit SOP) of rounds is set aside. (See figure 6-23.)



COMPUTER'S RECORD

For use of this form, see TC 3-22.91; the proponent agency is TRADOC

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B CO 1/29 IN			P88	FPF

☒ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION

SHIFT FROM

POLAR — OT DIRECTION ____ ALTITUDE ____ DISTANCE ____

GRID 009 644
OT DIRECTION 3020
ALTITUDE 730

OT DIRECTION ____ ALTITUDE ____
☐ LEFT / ☐ RIGHT ____
☐ ADD / ☐ DROP ____
☐ UP / ☐ DOWN ____

VERTICAL INTERVAL ☐ UP / ☐ DOWN ____
VERTICAL ANGLE ☐ + ☐ ____

TARGET DESCRIPTION FPF ATT 3740

METHOD OF ENGAGEMENT DANGER CLOSE (D/C) HED I/A S/L AMC

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE SEC	DEFLECTION 2780	MORTAR TO FOLLOW SEC	
MORTAR TO ADJ	DEFLECTION CORRECTION ☐ L ☐ R	SHELL AND FUZE HED	(4)
METHOD OF ADJ 1 RD S/L	RANGE 2775		
BASIS FOR CORRECTION	VI/ALT CORRECTION ☒ + ☐ - 35	MORTAR TO FIRE	
SHEAF CORRECTION HED I/A	RANGE CORRECTION ☐ + ☐ -	METHOD OF FIRE 1 RD S/L AMC	MAX ORD
SHELL AND FUZE HEQ I/FFE	CHARGE 5/2800	20 RDS HEQ I/FFE	
METHOD OF FFE 20 RDS	RANGE	DEFLECTION 2780	
RANGE LATERAL SPREAD	AZIMUTH 2630	CHARGE 5	TOF
TIME OF OPENING FIRE AMC	ANGLE T 390	ELEVATION 0984	
MOC TYPE WR ☐ AMC ☒ TOT ☐ OTH ☐		TIME SETTING	MARK TIME

	OBSERVER CORRECTION			CHART/SAFETY DATA		SUBSEQUENT COMMANDS							
	DEV	RANGE	TIME (HEIGHT)	DEF/ AZ	RANGE	MORTAR FIRE	METHOD FIRE	AIM AZIMUTH	DEFLECTION	CHARGE	TIME	ELEV	
#1	R50	-25		2820	2825		1 RD	2820	2850	1		0899	(5)
#1	ADJ		REPEAT #2			1+2 #1 DNF	1 RD	2820	2850	1		0899	(6)
#2	L50			2814	2800	#2	1 RD	2814	2825	1		0918	(7)
#2	ADJ	REPEAT #3				2+3 #2 DNF	1 RD	2814	2825	1		0918	(8)
#3	ADJ	REPEAT #4				2+4 #3 DNF	1 RD	2814	2825	1		0918	(9)
#4	L20	-25		2830	2750	#4	1 RD	2830	2775	1		0943	(10)
#4	ADJ												
				EOM		FPF	ADJ						
				RECORD		AS	FPF						

BATTLE DAMAGE ASSESSMENT (BDA): AIM POINT GRID:

DA FORM 2399, FEB 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.01

SAMPLE

Figure 6-23. Sample of completed DA Form 2399 (Computer's Record) for computing final protective fire missions

6-60. When adjusting only the danger close mortar, the computer is given the attitude of the target in the CFF by taking the following steps:

- The FDC can determine the danger close mortar by indexing the target attitude and drawing a line from the initial FPF plot (given in the CFF) 50 meters above and below. (See figure 6-24.)

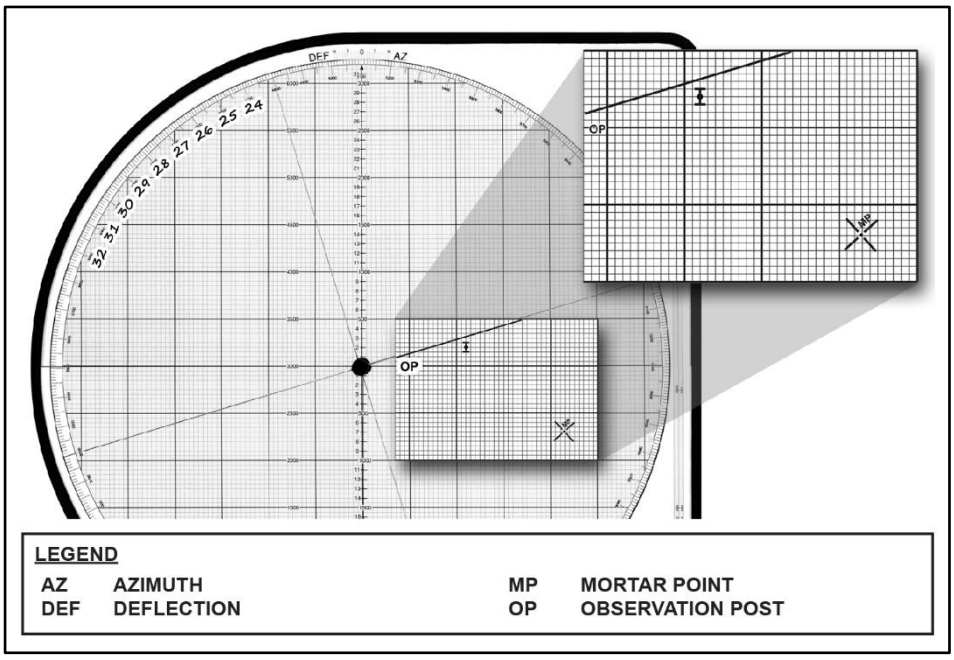


Figure 6-24. Drawing final protective fire symbol with attitude indexed

- After drawing the FPF line, the computer rotates the azimuth disk and aligns the mortar plot with the FPF plot to see which side of the line is closest to the friendly troops. (See figure 6-25.)
  - To use this method, the frontline trace of the supported unit must be plotted on the board.
  - Once the danger mortar has been determined that mortar is fired and adjusted to the FPF line.
- After the danger mortar is adjusted to the FPF line, the computer then indexes the FPF attitude and erases all but the last plot.

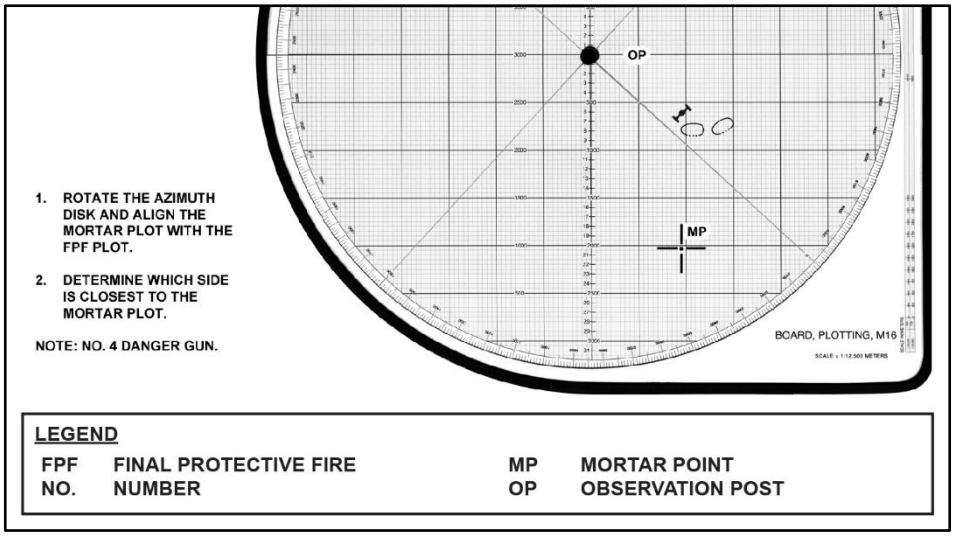


Figure 6-25. Determination of the danger mortar

- Using the last plot, the computer draws the FPF symbol by extending a line 90 meters toward the top of the board and 10 meters from the plot towards the bottom of the board which shows the full 100-meter width of the FPF.
- The remaining plots for the Numbers 1, 3, and 4 mortars are then plotted 40 meters apart at the spacing of the base plates. (See figure 6-26, page 186.)

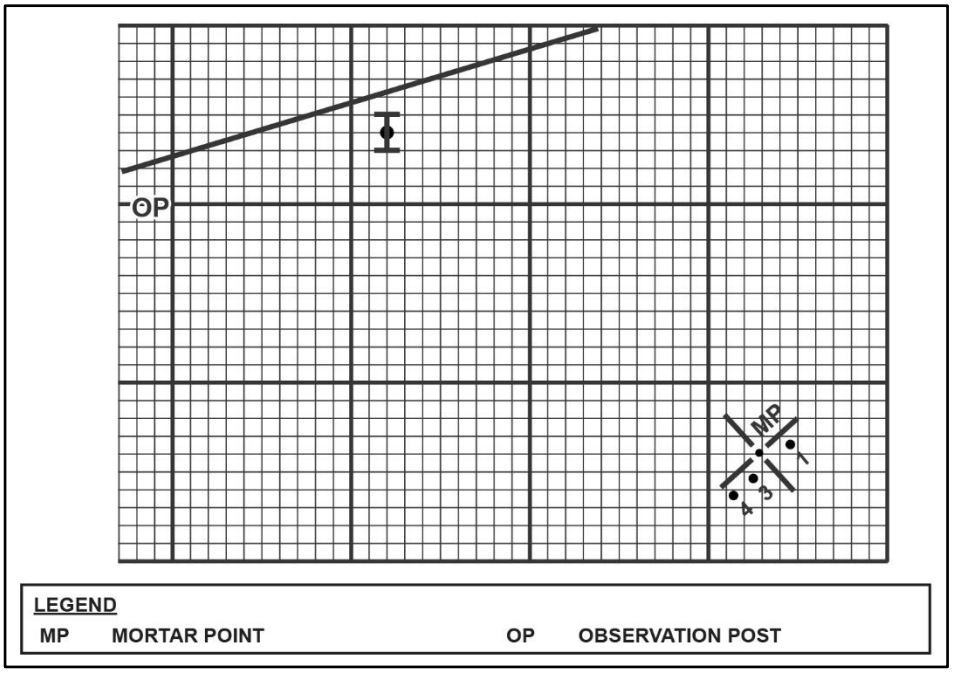


Figure 6-26. Plotting the Numbers 1, 3, and 4 mortars

- Once the plots are on the plotting board, the computer determines the firing data for each mortar by aligning each mortar plot with its intended impact plot. (See figure 6-27.)

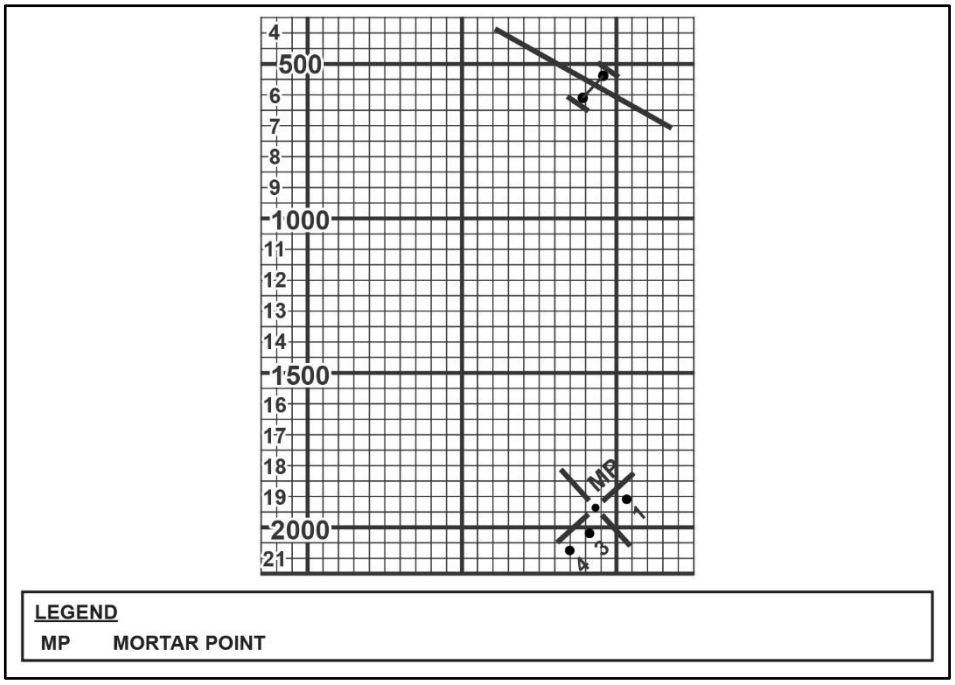


Figure 6-27. Alignment of each mortar with its impact point

- Again, these data are placed on the mortar after each mission, and the rounds are readied to fire.

6-61. To compute data for FPF without adjustment, the computer indexes the attitude of the FPF line and makes a plot 40 meters above and below the FPF starting plot. This process includes the following steps:

- The computer then indexes the attitude of the mortar section and plots the Numbers 1, 3, and 4 mortars at the spacing of the base plates in meters above and below the Number 2 mortar plot.
- Once the FPF and mortars have been plotted, each mortar is aligned with its impact plot, and the data is determined.
- This data is given to the mortars and, again, are set on the mortars between missions.
- This method is used when ammunition is low and time or the tactical situation does not permit the adjustment of the FPF.

SEARCHING FIRE

6-62. Mortars can cover area targets more than 50 meters in length by either elevating or depressing the barrel during the FFE.

6-63. The information needed to fire a search mission is as follows:

- Adjusting range, which includes the following steps:
  - Range to center of mass of target area given in the CFF.
  - Range to near or far edge (start point).
  - Target area (description) given in the CFF.
- Computing data, which includes the following steps:
  - FTs (Table D, Column 4).
  - Rounds needed to cover an area.
  - Number of rounds in the FFE.
  - Number of intervals.
  - Number of turns between rounds (during intervals).
  - Number of total turns.

ADJUSTING RANGE

6-64. When a section fires a searching mission, the adjustment phase is the same as that of a regular mission using the base mortar as the adjusting mortar. The base mortar is adjusted to the target's center of mass then computed for the near edge or far edge start point range.

Range

6-65. Range to the center mass of the target area is given by the FO during the CFF. This is needed to determine the near edge (search down) or far edge (search up) range.

6-66. The near edge range (search down) is determined by taking the area to be covered and dividing it in two, then subtracting this remainder by the center mass range.

6-67. The far edge range (search up) is determined by taking the area to be covered and dividing it by two, then adding this remainder to the center mass range.

6-68. The altitude correction is added or subtracted for difference in elevation.

Target Area

6-69. In the CFF, the FO sends the target's area (length and width) and the attitude since it has more depth than a section firing a linear sheaf can engage.

6-70. The length of a target is the longer or longest dimension of a distance from one end to the other. The width of a target is the linear extent or measurement from side to side, usually being the shortest dimension.

6-71. The attitude of a target is the direction (azimuth) from north in mils of a linear or rectangular target along its long axis. It is used with target length and width to enable the computation of data to provide a special sheaf, or the determination of multiple aiming points to engage the total target area.

6-72. The attitude is always determined to the nearest 100 mils and is always less than 3200 mils. If an attitude is received and is more than 3200 mils, compute the back azimuth.

COMPUTING DATA

6-73. Upon completion of the adjustment phase of the mission, the computer computes the data needed to cover the target with fire using the target area given in the CFF. The data is computed by using the current FTs of the ammunition being used to determine the number of rounds in the FFE phase, number of intervals between rounds, the number of turns between rounds (during intervals) and the total number of turns.

Firing Tables

6-74. Using the final chart range received in the CFF and using Table D, Column 4 (number of turns per 100 meters). (See table 6-3.)

Table 6-3. Example for 81-millimeter mortar

Example For 81-mm (Millimeter) Mortar		
Final Chart Range	2125	
800-series ammunition	Charge 2	Charge 4
Number of turns per 100m (pulled from firing table D column 4)	2	1
Legend: m—meter		

Number of Rounds in Fire for Effect

6-75. To determine the number of rounds in a search mission is by knowing the rounds needed to cover an area by system. The computer will need to know the number of rounds to cover 100 meters.

6-76. When firing on a target using traversing or searching fire, the computer uses the settings in table 6-4.

Table 6-4. Rounds needed to cover an area by system

Mortar	*100 Meters*	*One Round*
60 millimeter (mm)	8 rounds	15 meters
81 mm	4 rounds	30 meters
120 mm	2 rounds	60 meters

6-77. Determine the number of rounds to cover all the 100s of meters. Then add the one round ratio for the remaining area needed to be covered. This will allow for overlapping fires and ensure the entire area is covered. (See table 6-5, page 190.)

Table 6-5. Number of rounds needed in fire for effect

Example For 81-Millimeter (mm) Mortar	
Area to be covered.	350 meters (m)
350 meters (m) expressed in 100ths.	3.5
Number of 100ths.	3
Number of rounds needed to cover 100m.	x 4
Number of rounds needed to cover 300m.	12
Number of rounds needed to cover 50m.	+ 2
Number of rounds needed in fire for effect (FFE).	14

Number of Intervals

6-78. The intervals are the time between rounds when the adjustments (turns) are made. To determine the intervals, take the number of rounds needed in the FFE and minus one. (See table 6-6.)

Table 6-6. Number of intervals

Example For 81-Millimeter (mm) Mortar	
Number of rounds in fire for effect (FFE).	14
Minus one.	-1
Number of intervals.	13

Number of Turns Between Rounds

6-79. The number of turns between rounds tells the gunner how many turns of the elevation hand crank is needed during the intervals to search up or down to cover the desired target area. This is determined by taking the number of turns per 100 meters multiply the area to be covered expressed in 100ths then dividing the number of intervals. (See table 6-7.)

Table 6-7. Number of turns between rounds

Example For 81-Millimeter (mm) Mortar		
800 series ammunition.	Charge 2	Charge 4
Number of turns per 100 meters (m) (pulled from firing table D, column 4).	2	1
Multiply the area to be covered expressed in 100ths.	x 3.5	
	7	3.5
Then divide by the number of intervals.	÷ 13	
	.53	.27
Round to the nearest half turn.	.5 or 1/2	.5 or 1/2

Total Number of Turns

6-80. The total number of turns is determined by taking the number of turns between rounds rounded to the nearest half turn then multiply the number of intervals. (See table 6-8.)

Table 6-8. Total number of turns

Example For 81-Millimeter (mm) Mortar	
Number of turns between round (rounded to nearest half turn).	.5
Multiply the number of intervals.	x 13
Total number of turns.	6.5

Note. The computer always considers the number of rounds available and the resupply rate when determining the number of rounds to fire.

6-81. Once all the information is computed update computer records and give the initial fire command to the guns. At the EOM update all computer records and data sheets.

6-82. The only difference between a search-up mission and a search-down mission is the starting point. Normally, a search mission is fired by searching up. This allows the FO to better observe the effect of the rounds on a target, as the rounds walk toward the FO. (See figure 6-28.)

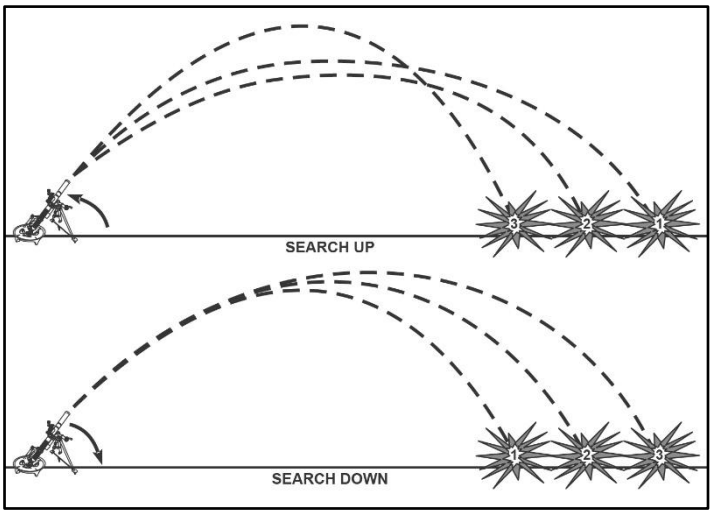


Figure 6-28. Fall of rounds during a search mission

TRAVERSING FIRE

6-83. Traversing fire is used when the target has more width than a section firing a parallel sheaf can engage. Each mortar of the section covers part of the total target area and traverses the area.

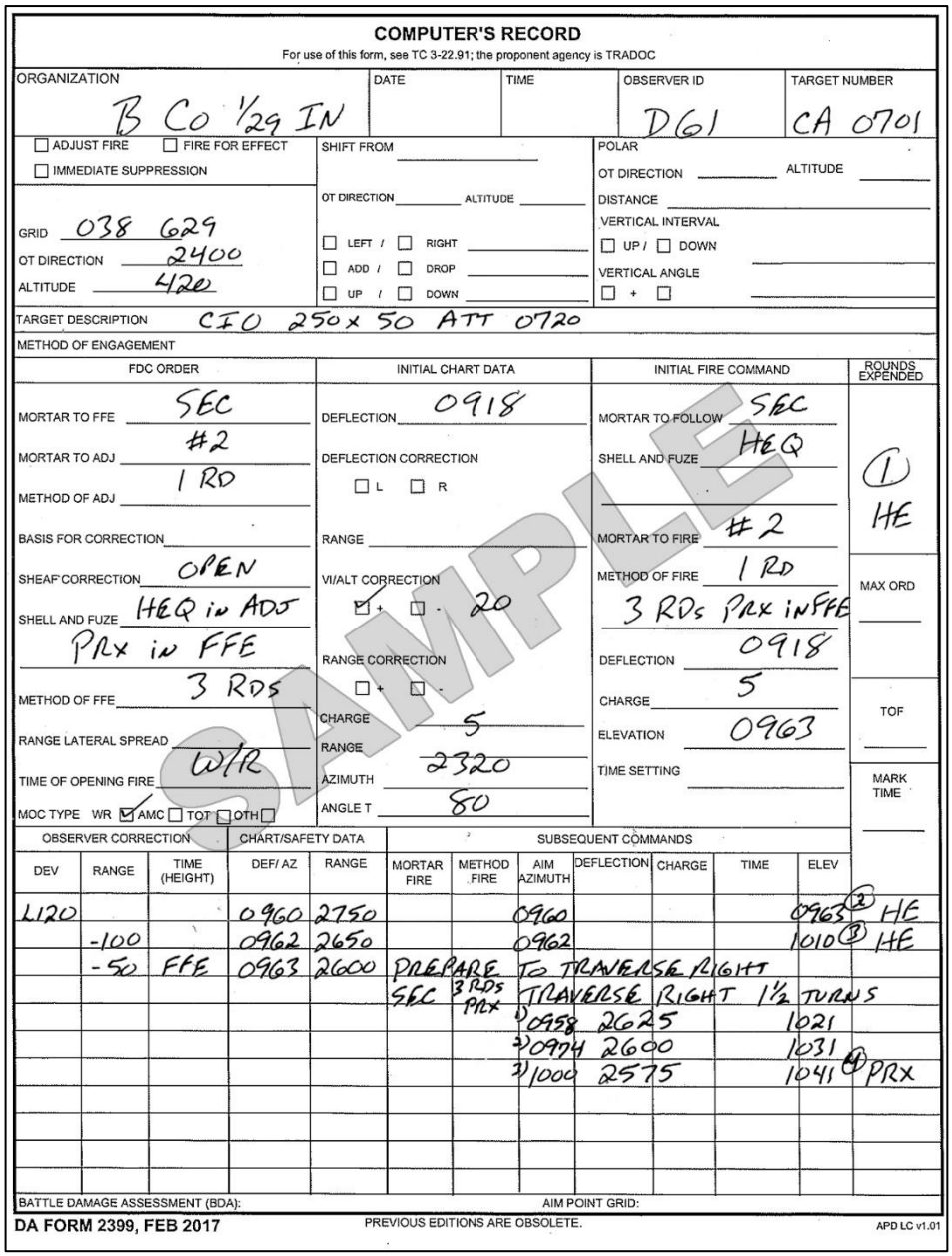
6-84. The M16- and M19-plotting board can be constructed as any of the three firing charts. The following data is used to set up the plotting board for traversing fire:

- Direction of fire.
- Grid intersection.
- MAZ.
- Mortar position.
- Mortar position attitude.
- Mortar altitude/elevation.
- Ref.

6-85. Upon receiving the CFF, the section leader determines from the target's size and description that traversing fire must be used to cover the target. To engage a target effectively using traversing fire, the section leader ensures that the target's attitude is within 100 mils of the firing section's attitude. The section leader then completes the FDC order. (See figure 6-29.)

6-86. Plot each mortar separately on the M16- and M19-plotting board, using the section's attitude. During the mission, the computer ensures that the correct plots are used to determine the data required.

6-87. Table 6-9, page 194, lists the data used to set up the M16 plotting board for traversing fire.



COMPUTER'S RECORD

For use of this form, see TC 3-22.91; the proponent agency is TRADOC

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN			D61	CA 0701

☐ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION

SHIFT FROM _____

OT DIRECTION _____ ALTITUDE _____

☐ LEFT / ☐ RIGHT _____

☐ ADD / ☐ DROP _____

☐ UP / ☐ DOWN _____

POLAR

OT DIRECTION _____ ALTITUDE _____

DISTANCE _____

VERTICAL INTERVAL

☐ UP / ☐ DOWN _____

VERTICAL ANGLE

☐ + ☐ _____

GRID 038 629

OT DIRECTION 2400

ALTITUDE 420

TARGET DESCRIPTION CIO 250 x 50 ATT 0720

METHOD OF ENGAGEMENT

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: SEC	DEFLECTION: 0918	MORTAR TO FOLLOW: SEC	① HE
MORTAR TO ADJ: #2	DEFLECTION CORRECTION ☐ L ☐ R	SHELL AND FUZE: HEQ	
METHOD OF ADJ: 1 RD	RANGE:	MORTAR TO FIRE: #2	
BASIS FOR CORRECTION:	VI/ALT CORRECTION ☑ + ☐ - 20	METHOD OF FIRE: 1 RD	MAX ORD
SHEAF CORRECTION: OPEN	RANGE CORRECTION ☐ + ☐ -	3 RDs PRX in FFE	
SHELL AND FUZE: HEQ in ADJ	CHARGE: 5	DEFLECTION: 0918	
PRX in FFE	RANGE: 2320	CHARGE: 5	TOF
METHOD OF FFE: 3 RDs	AZIMUTH:	ELEVATION: 0963	
RANGE LATERAL SPREAD: W/R	ANGLE T: 80	TIME SETTING:	MARK TIME
TIME OF OPENING FIRE:			
MOC TYPE WR ☑ AMC ☐ TOT ☐ OTH ☐			

OBSERVER CORRECTION			CHART/SAFETY DATA		SUBSEQUENT COMMANDS							
DEV	RANGE	TIME (HEIGHT)	DEF/ AZ	RANGE	MORTAR FIRE	METHOD FIRE	AIM AZIMUTH	DEFLECTION	CHARGE	TIME	ELEV	
L120			0960	2750			0960				0963 ②	HE
	-100		0962	2650			0962				1010 ③	HE
	-50	FFE	0963	2600	PREPARE SEC	3 RDs PRX	TO TRAVERSE RIGHT TRAVERSE RIGHT				1½	TURNS
							1) 0958	2625		1021		
							2) 0974	2600		1031		
							3) 1000	2575		1041	④	PRX

BATTLE DAMAGE ASSESSMENT (BDA): AIM POINT GRID:

DA FORM 2399, FEB 2017 PREVIOUS EDITIONS ARE OBSOLETE. APD LC v1.01

SAMPLE

Figure 6-29. Sample of DA Form 2399 (Computer's Record) with a completed call for fire

Table 6-9. M16 plotting board example data for traversing fire

Grid Intersection	4/64
Direction Of Fire	700 mils
Mounting Azimuth	700 mils
Mortar Position	WD02006500
Mortar Position Attitude	0800 mils
Mortar Altitude	00 meters
Referred Deflection	700 mils

6-88. During the adjustment phase of the mission, the impact point is aligned with the Number 2 mortar plot. Using the information in the CFF, the FDC order and the observer corrections, compute the data to adjust the Number 2 mortar onto the target's center of mass. After the adjustment is complete—

- Plot the target length by placing a dot at the start and end point for (250 meters) on the plotting board using the targets attitude.
- Divide the target into segments, by the number of guns.
- Determine the number of rounds for each segment, by the gun type.
- Determine the mil width of one segment.
- Determine the number of turns required to cover one segment.
- Determine the number of turns that must be taken between rounds.

6-89. To plot the target on the plotting board, the computer rotates the azimuth disc until the target attitude (taken from the CFF) is indexed. The computer erases all the plots except the last one. After ensuring the attitude is indexed, the computer divides the total target area into segments. These plots represent the starting points for each mortar. The area between the plots is the area each mortar covers with fire. (See figure 6-30.)

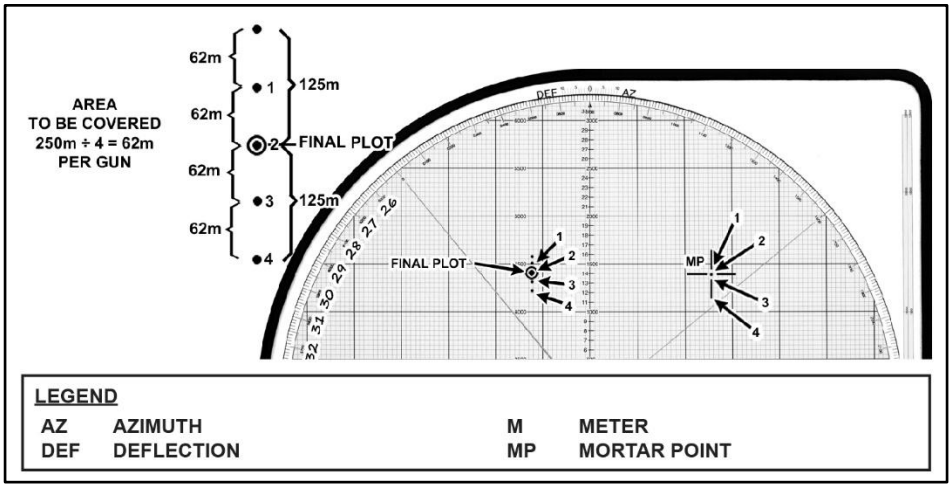


Figure 6-30. Plotting of starting points

6-90. The target is divided into four segments. (Each being 62 meters in figure 6-30.) Once the remaining data for one segment have been determined, the data will apply

applies to all three mortars. If the computer determines the mil width of one segment, the other three are the same. The computer can use one of two methods to determine the mil width of one segment.

6-91. The computer parallel plots the mortar with its corresponding starting point to obtain the initial deflection. This process must be conducted with each mortar. (See figure 6-31.)

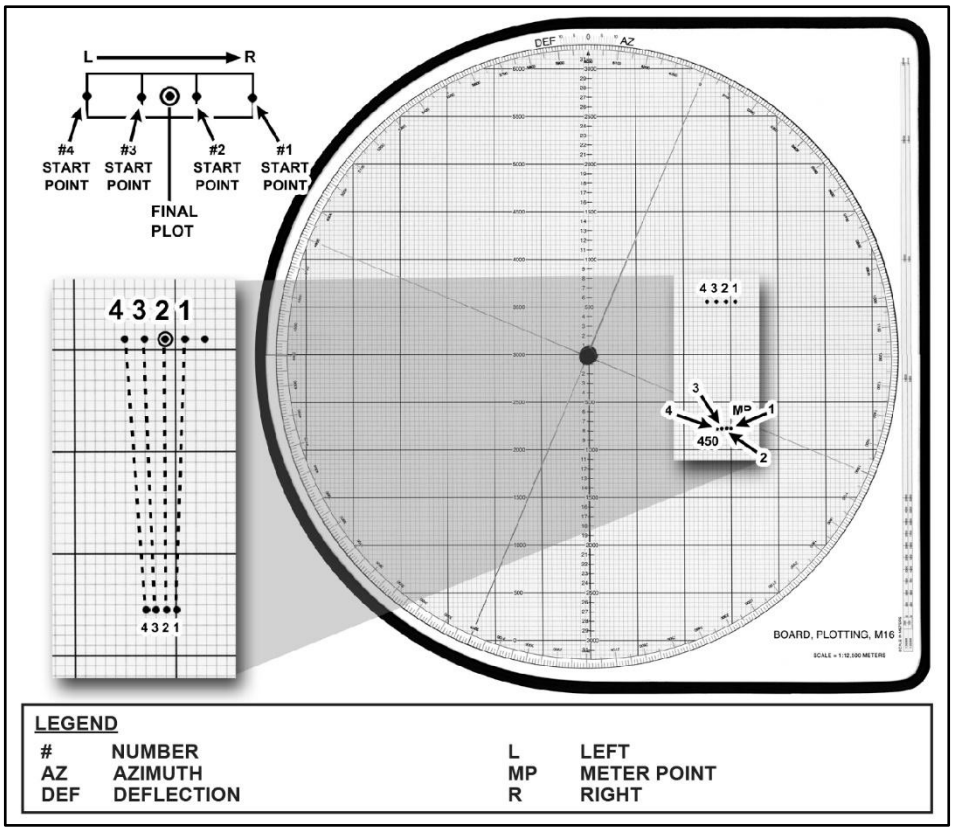


Figure 6-31. Alignment of Numbers 2 and 3 plots

EXAMPLE

2993 mils (Number 3 plot deflection)-2942 mils (Number 2 plot deflection) = 51 mils (mil width of segment)

6-92. The computer uses the DCT to determine the mil width of one segment. The computer enters the DCT at the final chart range (rounded off to the nearest 100 meters). The FO follows the deflection in meters line to the closest number of meters (75) needed to cover the segment. The point at which the range line and the deflection line meet is the number of mils that will cover the segment. Each turn of the traversing handwheel is about 10 mils. By dividing the mil width of each segment (29) by 10, the computer

obtains the total number of turns needed to cover the segment (round off to the nearest whole turn).

EXAMPLE

29.0 (mil width of each segment) ÷ 10 = 2.9
Round to the nearest whole turn = 3 (turns needed to cover the segment)

Note. For a four-gun section the target area will be divided into four equal segments.

6-93. To compute the number of turns that must be taken between rounds, the computer knows how many rounds will be fired for each segment. This information is given in the FDC order (three rounds, for example). To determine the number of turns that must be taken between rounds, the computer divides the total number of turns by the interval between rounds.

RULES

1. There always will be one less interval than the number of rounds. Three rounds = two intervals, for example.
2. The turns taken between rounds are rounded to the nearest half turn.
3. The number of rounds to fire is based on the rule: four rounds per 100 meters of target width, or one round per 30 meters for 81-mm mortars; or two rounds per 100 meters of target width, or one round for 60 meters for 120-mm mortars.

Note. 60-mm mortars are capable of firing search, traverse, and search and traverse missions using the same process as 81-mm and 120-mm mortars. However, due to the amount of ammunition required, 60-mm mortars would not be assigned those missions.

EXAMPLE

3.0 (total number of turns) ÷ 2 (interval between rounds) = 1.5 = 1 1/2 (turns taken between rounds).
In this instance, there is no need to round to the nearest half turn.

6-94. The computer determines the deflection and range for each mortar by aligning each mortar with its start point. Then, the FO completes the subsequent command and issues it to the mortar section.

6-95. Upon completion of the adjustment phase of the mission, the section is giving the command, PREPARE TO TRAVERSE RIGHT [LEFT]. The gunners then traverse the mortars in the direction opposite to that given, back off two turns, and await further instructions.

Note. If there is a range change of 25 meters or more, the mortar will receive its own elevation.

QUICK SMOKE

6-96. The techniques that mortar units use to attack targets with smoke are influenced by factors independent of the mission. These factors include:

- Weather.
- Terrain.
- Dispersion.
- Adjustment.
- Distribution of fire.
- Ammunition availability.

6-97. Clearance to fire, ammunition requirements, and general considerations discussed in this segment apply to all mortars.

6-98. The mortar unit establishes screening smoke between the enemy and friendly units or installations. It uses smoke to—

- Confuse hostile operations.
- Deceive the enemy as to friendly operations.
- Obscure observation.
- Reduce observed fire.

6-99. The main consideration in planning for a smoke screen is that it accomplishes its purpose without interfering with the activities of friendly forces. This requires much planning. Authority to fire smoke missions rests with the highest commander whose troops will be affected. The unit commander ensures that flank unit commanders who may be affected have been informed.

6-100. Normally, the section/platoon is given a smoke mission through command channels. The methods used to accomplish the mission are not usually prescribed but are developed by the section leader/chief computer and the FO who will conduct the mission. The following factors help in deciding how to engage the target.

MORTARS REQUIRED

6-101. Under favorable conditions, a 120-mm mortar platoon can screen an area about 800-meters wide and an 81-mm mortar platoon can screen an area about 500-meters wide.

Note. 60-mm mortar sections normally are not used to produce large-scale smoke screens. They can be used to augment the screening smoke of a larger caliber mortar unit, and they can produce useful point obscuration during urban operations.

6-102. A limitation is their maximum and sustained rates of fire. For the entire platoon, the rates of fire are multiplied by the number of mortars firing. If the required number of rounds per minute (RPM) exceeds the rate of fire, the platoon requests supporting fire from flank units or artillery.

EFFECTS DESIRED

6-103. If smoke is to be placed directly on the target for blinding or casualty-producing effects, the FO adjusts the center of impact of the rounds onto the center of the target. The number of RPM to produce this effect is twice that for a normal quick smoke mission.

AMMUNITION

6-104. The number of rounds required to establish and maintain a screen is based on the target's size and the weather conditions affecting the dispersion of the smoke. The chief computer cannot accurately determine the weather conditions that will exist at the time the mission is fired, but the chief computer does determine the amount of ammunition for the most unfavorable conditions that might be expected.

6-105. A quick smoke mission is conducted in three phases. Phase 1: Adjustment Phase. The computer adjusts the upwind flank mortar to the upwind edge of the target area using HE ammunition. At the end of this phase, one round of WP or red phosphorous is fired to see if it hits the desired location.

6-106. Phase 2: Establishment Phase. The computer establishes the screen by firing twice the number of rounds required to maintain the screen for 1 minute, but not less than 12 rounds. These rounds are fired as quickly as possible (FFE phase for any other mission).

6-107. Phase 3: Maintenance Phase. The computer maintains the screen by firing the determined number of RPM, times the length of time the screen is to be in place.

6-108. The computer uses the smoke chart to compute the number of rounds needed to maintain a screen for 1 minute. (See table 6-10, page 200 and table 6-11, page 201.) This chart is prepared for various weather conditions and a screen 500-meters wide. Other widths are computed by scaling the values proportionally. To extract the proper value from the chart, the FDC must know the—

- Wind speed (confirmed by the FO before firing).
- Wind direction (confirmed by the FO before firing).
- Relative humidity (obtained from the battalion intelligence staff officer or by estimation).
- Temperature gradient (obtained from the battalion intelligence staff officer or by estimation).

6-109. The temperature gradient is a measure of how air temperature changes with altitude. It determines which line to use. Neutral occurs when there is no appreciable temperature change with an increase in altitude (midday). It is the most common condition. Lapse conditions exist when the temperature changes with an increase in altitude (evening). Inversion conditions exist when the temperature rises with an increase in altitude (early morning).

6-110. The wind speed in knots determines which column to use. The box where the proper row and column intersect contains the number of RPM needed to maintain a screen 500-meters wide for 1 minute with a flank wind. The result (8.0, in table 6-10, page 200) is always rounded up (no less than 12 rounds will be fired in the establishment phase). Each mortar fires as follows:

- 120-mm mortar four-gun platoon: three rounds each.
- 120-mm mortar two-gun section: six rounds each.
- 81-mm mortar four-gun platoon: three rounds each.
- 81-mm mortar two-gun section: six rounds each.

EXAMPLE

For conditions of 60 percent humidity, a neutral temperature gradient, and a 4-knot wind, it would take four RPM to maintain a 500-meter screen with a flank wind. This is the smoke chart table value.
To scale the screen to a different width, use the following procedure:
Express the width as hundreds of meters.
400 meters would be expressed as 4.
Multiply this number by 0.2 (the 500-meter scaling factor) to get the width factor.
4 (the width, in 100s of meters) x 0.2 (the 500-meter scaling factor) = 0.8 (width factor)
Multiply the width factor by the table value for total RPM.
0.8 (width factor) x 4 (table value) = 3.2
Round this value (3.2) up, to the nearest whole number. This is the total number of rounds to maintain for 1 minute.
3.2 = 4 (RPM).

Table 6-10. Smoke chart for the 120-millimeter M929 white phosphorous

Smoke Ammunition Requirements For 120- Millimeter (mm) M929 WP (White Phosphorous) ***Number of M929 WP Rounds Per Minute to Maintain a Smoke Curtain on a 500-Meter Front in Flank Winds. See Notes 1, 2, and 3 Below***								
		Wind Speed (Knots)						
Relative Humidity (Percent)	Temperature Gradient	2	4	9	13	18	22	26
		Rounds Required						
30	Lapse	12	6	6	6			
	Neutral	12	6	4	4			
	Inversion	6	6	3		6	8	12
60	Lapse	12	4	4	6			
	Neutral	12	4	3	4			
	Inversion	6	6	3		6	6	8
90	Lapse	8	4	3	4			
	Neutral	8	3	3	3			
	Inversion	6	4	3		4	6	6

Notes.
1. Employ volley fire to establish a smoke curtain, using a 2-minute ammunition requirement (but not less than 12 rounds). Equally space rounds on the front to be curtained.
2. For quartering winds, multiply table values by 2; for tail winds, by 2; and for head winds, by 2 1/2. Values for headwinds and tailwinds are based on curtain impact lines of 500 meters in front of enemy lines. Wind directions are indicated with respect to the enemy target or the smoke screen. If the curtain impact line is 500 meters, ammunition requirements will be considerably larger. OBSERVERS MUST CONTROL FIRES AT ALL TIMES.
3. The upwind adjustments point is 100 meters.
(See Army techniques publication 3-09.30 for an explanation of temperature gradient conditions.)

6-111. The total number of smoke rounds needed for the mission is computed as follows:

- Adjustment phase = 1 round (confirmation round).
- Establishment phase = 2 x number of rounds to maintain for 1 minute; must be at least 12 rounds.
- Maintenance phase = Number of rounds to maintain for 1 minute times the total number of minutes.
- Total rounds for the mission = adjustment phase + establishment phase + maintenance phase.

Note. The time used during the establishment phase is not to be part of the maintenance phase.

Table 6-11. Smoke chart for the 81-millimeter M819 red phosphorous

Smoke Ammunition Requirements For 81 Millimeter (mm) M819 Red Phosphorous Number of M819 Red Phosphorous Rounds Per Minute to Maintain a Smoke Curtain on A 500-Meter Front in Flank Winds. See Notes 1, 2, and 3 Below								
		Wind Speed (Knots)						
Relative Humidity (Percent)	Temperature Gradient	2	4	9	13	18	22	26
		Rounds Required						
30	Lapse	6	6	12	12	16		
	Neutral	2	4	8	8	16		
	Inversion	2	3	8			24	24
60	Lapse	6	6	8	8	16		
	Neutral	2	3	6	8	12		
	Inversion	2	2				16	24
90	Lapse	2	3	8	8	12		
	Neutral	2	2	6	8	8		
	Inversion	1	2	4			12	16

Notes.
1. Employ volley fire to establish a smoke curtain, using a 2-minute ammunition requirement (but not less than 12 rounds). Equally space rounds on the front to be curtained.
2. For quartering winds, multiply table values by 2; for tail winds, by 2; and for head winds, by 2 1/2. Values for headwinds and tailwinds are based on curtain impact lines of 500 meters in front of enemy lines. Wind directions are indicated with respect to the enemy target or the smoke screen. If the curtain impact line is 500 meters, ammunition requirements will be considerably larger. OBSERVERS MUST CONTROL FIRES AT ALL TIMES.
3. The upwind adjustments point is 100 meters.
(See Army techniques publication 3-09.30 for an explanation of temperature gradient conditions.)

Ordering of Ammunition

6-112. When ordering ammunition for a mission, the FDC estimates the weather conditions, remembering that it is better to have too much ammunition than too little.

Exact Ammunition Requirement

6-113. About the time that the CFF is received, the chief computer/section leader makes a final check on the weather and directs the computation of the exact ammunition requirements for the mission. The section/platoon breaks down (at least) this amount of ammunition and prepares it to be fired.

BRIEFING OF THE OBSERVER

6-114. Due to the many clearances required to fire the mission, the FDC chief or section leader normally has ample time to brief the FO on the quick smoke screen. This briefing should include a map reconnaissance of the area to be screened so that the FO can identify it on the ground and select an observation post from which the screen can be observed.

QUICK SMOKE CALL FOR FIRE

6-115. At the appointed time, usually 10 to 20 minutes before the mission is to be fired, the FO sends the CFF. This provides the time needed for the FDC to process the data and prepare the necessary ammunition.

Note. The CFF specifies the wind direction.

MISSION COMPUTATION

6-116. The chief computer/section leader issues the FDC order. (See figure 6-32.) The method of FFE is the number of rounds computed to establish the screen, divided by the number of mortars to FFE. The chief computer/section leader commands the time of opening fire. Once the first round of smoke is fired, all commands should be such that they can be applied with minimal reaction time.

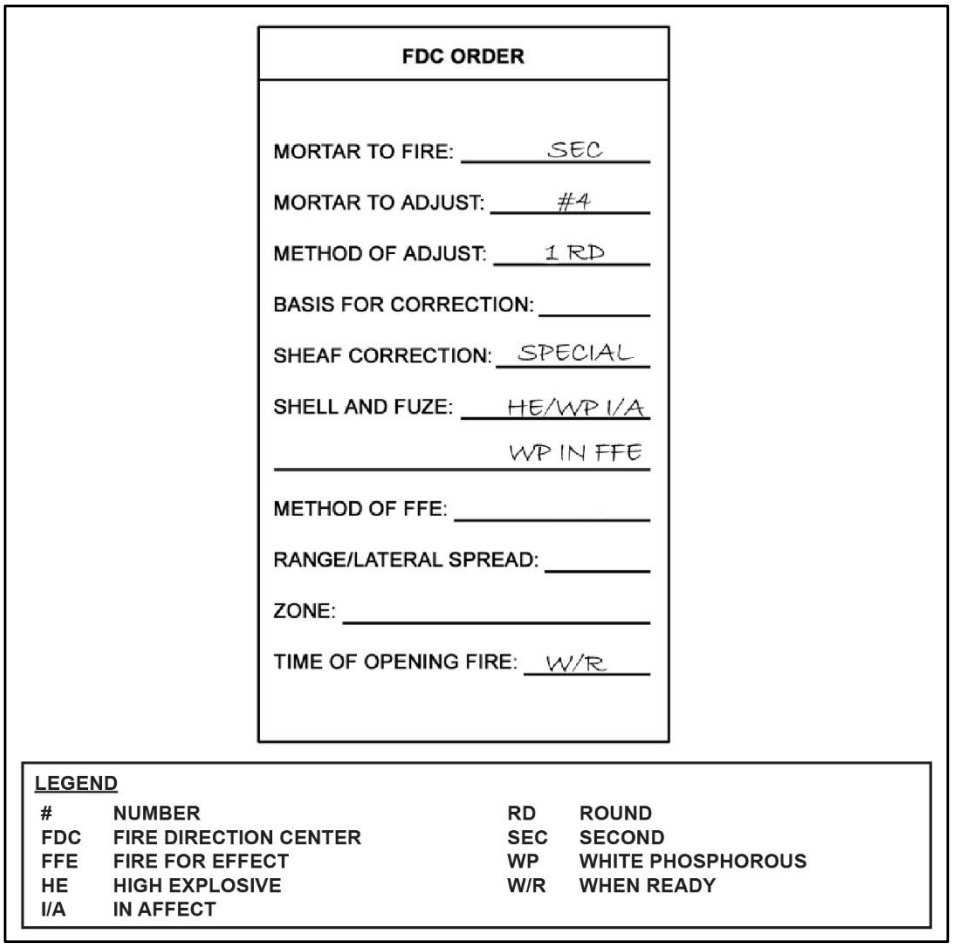


Figure 6-32. Fire direction center order

FIRE DIRECTION CENTER ORDER

6-117. The following procedures are used in mission computation:

- This mission will be carried out as a regular grid mission with minor adjustments.
- Once the FO announces repeat smoke, the adjusting gun will fire one round of smoke (WP or red phosphorous) to confirm the adjustment.
- FO announces, FIRE FOR EFFECT and all guns will fire the FFE number of rounds figured out from the steps previously mentioned.
- Once rounds are complete, the section leader or FDC chief will announce SEC LEFT, 1 ROUND or SEC RIGHT, 1 ROUND for the number of sections determined from the steps above.
- Each gun will fire the set amount determined for that quick smoke mission.

END OF MISSION

6-118. The control in ending the screening mission rests with the commander who ordered it established. Normally, screens are fired according to a time schedule; however, the commander may order the screen to be maintained beyond the scheduled termination time. In the absence of external control, the FDC controls the timing, ordering the section/platoon to cease fire. Squad leaders give the FDC a count of the rounds expended (or remaining) at the end of the mission.

SIMULTANEOUS

6-119. Simultaneous procedures involve simultaneous fire upon two targets from a single location.

SPLIT

6-120. Split section procedures involve firing upon a single target from more than one location.

TIME ON TARGET

6-121. The observer may tell the FDC when the observer wants the rounds to impact by requesting, TIME ON TARGET [numbered desired] MINUTES FROM NOW or TIME ON TARGET [time desired] HOURS. The observer must conduct a time check to ensure that the timepiece is synchronized with the FDC's timepiece.

MATH METHOD

6-122. The Math Method is an alternate plotting method that is used when a map is not available, or time is of the essence. It is a more precise method than traditional analog observed firing chart plotting.

6-123. This form of processing a fire mission is designed to be used in conjunction with the observed firing chart.

- Inverse tangent, when used properly, will give azimuth to the nearest mil.
- Pythagorean Theorem, when used properly, will give distance to the nearest meter as show in example 3.

EXAMPLE 3

Make all grids 10 digits by adding 0.
Compare mortar firing position Easting to target Easting and mortar firing position Northing to Target Northing.

E: 23450 N: 95120
E: - 21450 N: - 94150
= 2000M = 970M (meters)

Note. Subtract smaller from larger. (See figure 6-33.)

E: 23450 N: 95120
E: - 21450 N: - 94150
=Left 2000 meters from the MFP = Up 970 meters from the MFP

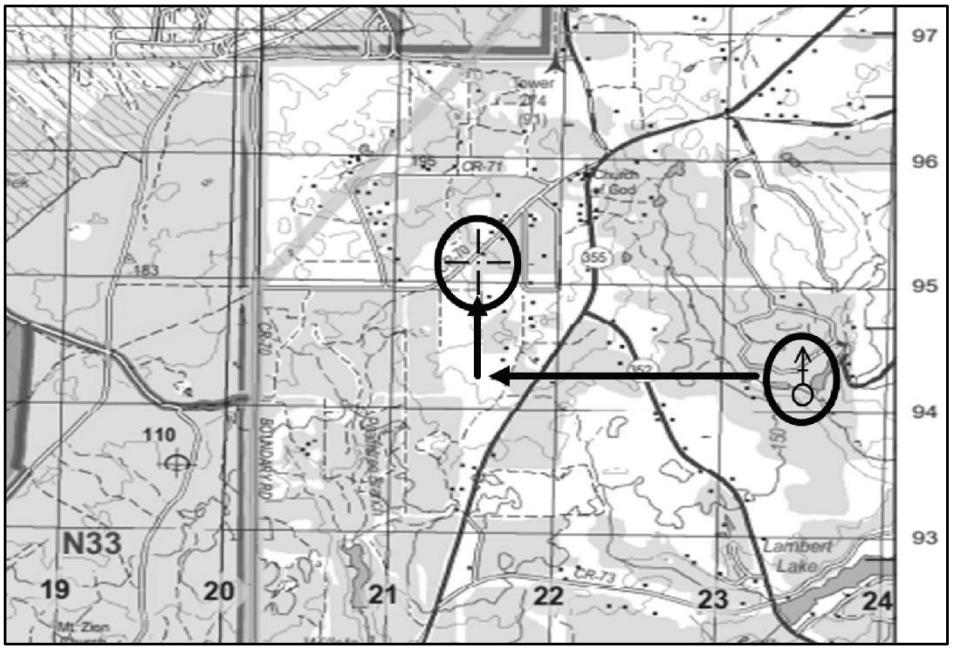


Figure 6-33. Math Method

ACTIONS ON PLOTTING BOARD PIVOT POINT METHOD

6-124. Certain actions need to occur on the plotting board pivot point method—

- Index 0 to represent North on a map.

- Apply Easting and Northing difference from MFP to Target (Left 2,000 meters and Up 970 meters) and plot the target.
- With the target parallel plotted above the MFP, obtain initial chart data.
- Superimpose preferred Ref on MAZ.

Note. If the Easting or Northing deviation exceeds 2,900 meters in range from the MFP, move to the "Off Pivot Point" method. (See figure 6-34, page 206.)

Note. When comparing MFP and target grids that fall in different grid zones see the Off Pivot Point Method.

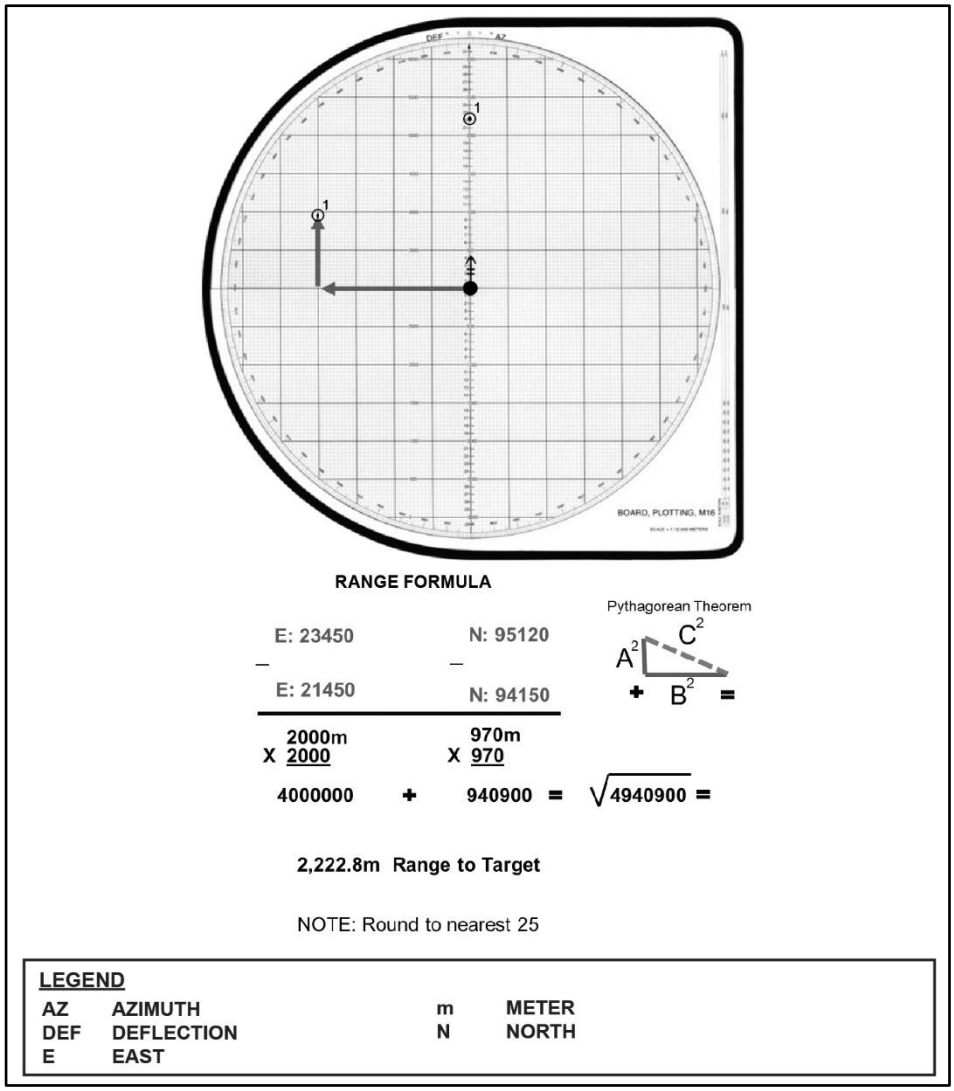


Figure 6-34. Range formula

OFF THE PIVOT POINT METHOD

6-125. Actions to take for off the pivot point method—

- Index 0 to represent North on a map.
- Plot MFP on any intersecting lines with enough room for the difference to target.
- Apply the Easting difference from MFP to Target (Left 1,000 meters).
- Apply the Northing Difference from MFP to Target (Down 5,000 meters) and plot the Target.

- Parallel line plot the Target above the MFP and obtain initial chart data. (See figures 6-35 and 6-36, page 208.)

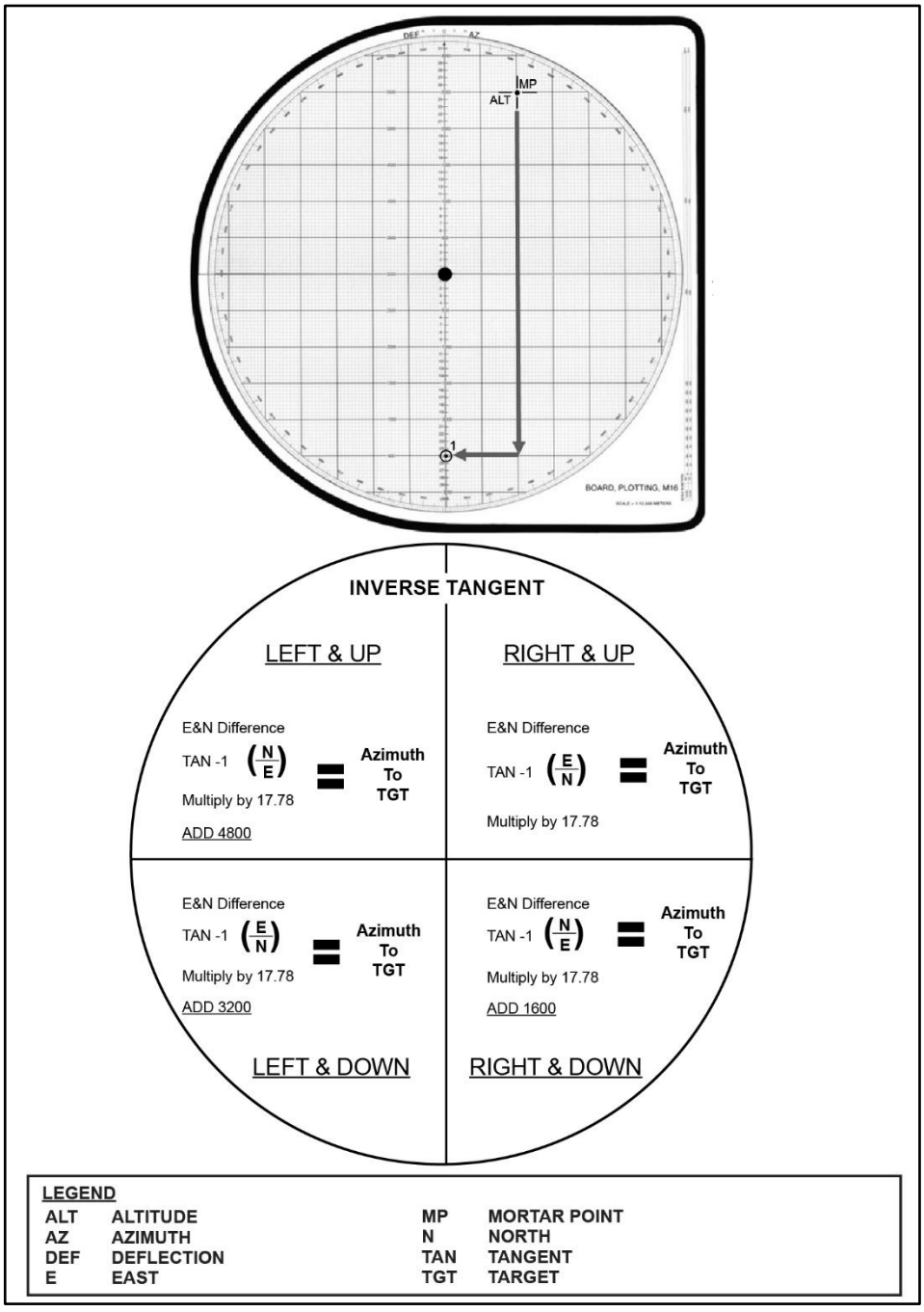


Figure 6-35. Inverse tangent parallel plot line

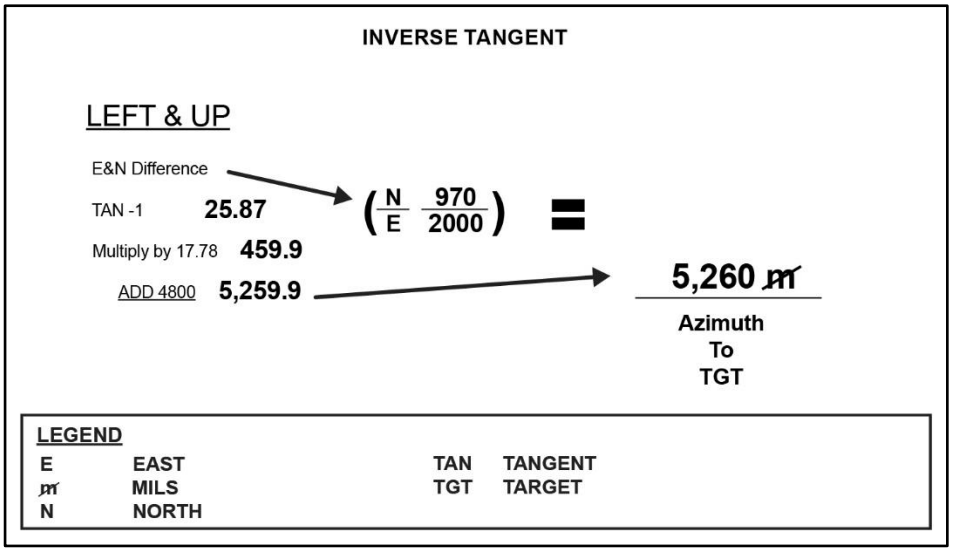


Figure 6-36. Inverse tangent

Chapter 7

Lightweight Handheld Mortar Ballistic Computer Introduction

The LHMBC is a ruggedized personal digital assistant (RPDA) that replaced the M23 Mortar Ballistic Computer. It provides the essential functions of the MFCS with similar software in a portable package and allows the operator to quickly calculate accurate ballistic solutions for all current U.S. Army mortar cartridges. The basic model of the LHMBC can be expanded to include the Global Positioning System (GPS) and digital communications.

Note. Different versions of LHMBC may not be listed in this manual. Reference individual manuals for that specific system.

SECTION I – INITIALIZATION AND CONFIGURATION

7-1. This section discusses the introduction, initialization, and configuration of the LHMBC.

DESCRIPTION

7-2. The LHMBC is an automated fire control system designed to improve the command and control of mortar fires and the speed of employment, accuracy, and survivability of mortars. The system is comprised of the LHMBC software package installed in an RPDA. The LHMBC software can be easily upgraded or reinstalled from either a secure digital card or the onboard system read-only memory. System accuracy can be increased using GPS and digital MET messages. The LHMBC allows for self-surveying mortars, digital CFF exchange, and automated ballistic solutions.

MANUAL ENTRY BUTTONS

7-3. The manual entry buttons for the LHMBC include the following (see figure 7-1, page 210, for the corresponding buttons.):

- Manual Missions button.
- Mission Solution button.
- Mission Gun Select button.
- Mission Subsequent Adjust button.
- CFF button.
- Suspend button (Power button).
- Manual Missions button.

7-4. The Manual Missions button (13, figure 7-1, page 210) allows the operator to select and initiate a manual mission.

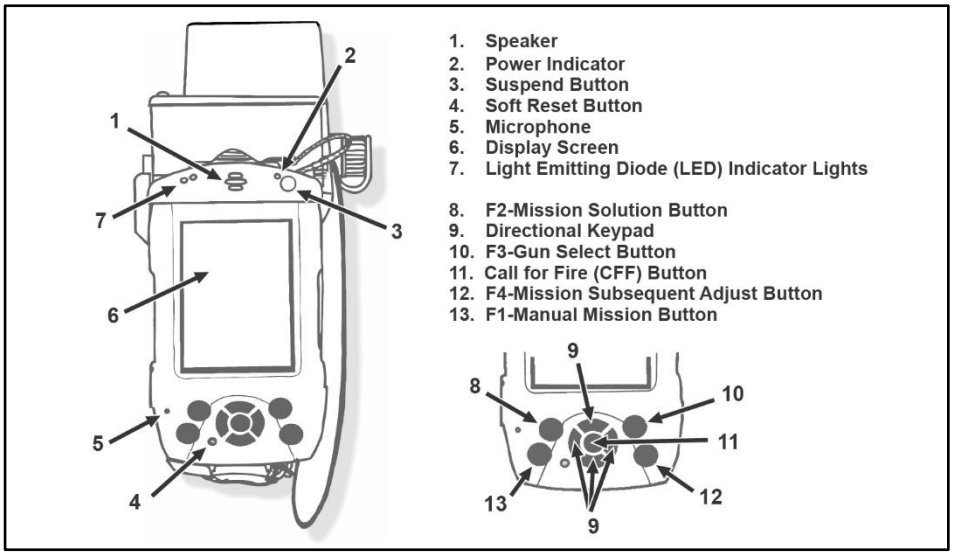


Figure 7-1. Lightweight Handheld Mortar Ballistic Computer interface

MISSION SOLUTION BUTTON

7-5. The Mission Solution button (8, figure 7-1) displays the solution for the active mission. If multiple missions are active, the Solution/Gun Orders screen displays.

Note. This button is inactive when no missions are active.

GUN SELECT BUTTON

7-6. The Gun Select button (10, figure 7-1) displays the Gun Select screen for the active mission. If multiple missions are active, the Gun Select screen displays.

Note. This button is inactive when no missions are active.

MISSION SUBSEQUENT ADJUST BUTTON

7-7. The Mission Subsequent Adjust button (12, figure 7-1) displays the Subsequent Adjust screen for the active mission.

Note. This button is inactive when no missions are active.

CALL FOR FIRE BUTTON

7-8. If Commo is enabled, the CFF button (11, figure 7-1) displays the CFF screen.

SUSPEND BUTTON (POWER BUTTON)

7-9. The Suspend button (3, figure 7-1) puts the computer in sleep mode or toggles backlight on and off.

DISPLAY SCREEN

7-10. The LHMBC display screen (6, figure 7-1) is a touch-sensitive, transflective, thin-film transistor. The display is readable in low light and sunlight. Objects displayed on the screen may be selected, opened, launched, or depressed by tapping directly on the screen with the stylus. (See table 7-1, page 212.)

Note. See TM 9-1220-255-13&P for a complete description of controls and indicators.

Table 7-1. Front of RPDA-57 controls and indicators

Key Control/ Indicator Function	*Key Control/ Indicator Function*	*Key Control/Indicator Function*
1	Speaker	Provides audio alerts
2	Power Indicator	Displays charge state: Flashing charging; Solid fully charged; Off no external power.
3	Suspend Button	Enters/exits the ruggedized personal digital assistant (RPDA) from suspend mode if depressed briefly. Turns the backlight on/off if depressed for 3 seconds.
4	Soft Reset Button	Reboots the RPDA. (Use stylus to depress gently.)
5	Microphone	Not enabled on the Lightweight Handheld Mortar Ballistic Computer (LHMBC).
6	Display Screen	Displays the software user interface.
7	Light-Emitting Diode (LED) Indicator Lights	Not enabled on the LHMBC.
8	F2 – Mission Solution Button	No active missions: Nothing happens.
9	Directional Keypad	Re-centers the plotting screen in the selected direction.
10	F3 – Gun Selection Button	No active missions: Nothing happens. One active mission: Gun Select screen for that mission is displayed. Multiple active missions: If a mission is currently active in the display, the Gun Select screen for that mission is displayed. If no mission is currently active in the display, the mission menu listing active mission is displayed.
11	Call For Fire (CFF) Button	Commo (communication) disabled: Nothing happens. Commo enabled: CFF screen is displayed.
12	F4 – Mission Subsequent Adjust Button	No active missions: Nothing happens. One active mission: Subsequent Adjust screen for that mission is displayed. Multiple active missions: If a mission is currently active in the display, the Subsequent Adjust screen for that mission is displayed. If no mission is currently active in the display, the mission menu listing active missions is displayed.
13	F1 – Manual Mission Button	Displays manual mission selection menu.

CAPABILITIES

7-11. The LHMBC's design allows the system to be upgraded to match future system demands. Currently, the system can control—

- Ballistic calculations for all U.S. 60-mm, 81-mm, and 120-mm mortar weapons and ammunition.
- Mission capability, which includes:
  - Grid, shift, polar, and laser polar.
  - Illumination (range and lateral).
  - Immediate smoke, quick smoke.
  - FPF.
  - Search and traverse.
  - Time on target.
  - Quick fire.
  - Hipshoot.
  - Direct lay.
- Sheaves, which include:
  - Parallel.
  - Converge.
  - Special.
  - Open.
  - Search.
  - Traverse.
- Storage of targets and known points.
- Individual gun adjustments within the sheaf.
- Meteorological data, which includes:
  - Standard.
  - Season regional.
  - Computer.
- Safety fans.
- Computer records.
- FSCMs, which include:
  - ACA.
  - NFA.
  - RFA.
  - Coordinated fire line.
  - RFL.
  - Forward line of own troops.
  - Boundary line.
  - Fire support coordination line.
- Multiple position entry methods, which include:
  - GPS.
  - Universal transverse Mercator (UTM).
  - Polar.
  - Military grid reference system (MGRS).
  - Latitude/longitude.
  - Survey (section/resection).
- Plotting.

- GPS interface, which includes:
  - Internal. (Expansion pack required.)
  - Precision Lightweight GPS Receiver.
  - Defense Advanced Global Positioning System receiver.
  - Platform Integration Kit.
- Digital communications (variable message format [VMF] 6017, 6017A, 6017B).
- Precision MPI registration.
- As many as six missions and three FPFs.
- Ammunition management.
- Calculators.

BATTERY LIFE

7-12. The projected battery life for the M32 LHMBC is 5 hours based upon continuous operations. The actual battery life varies depending upon M32 LHMBC usage, age, and temperature of the batteries; it will be significantly greater if the unit is not used continuously.

Note. In the M32 LHMHC configuration, the extended battery in the expansion pack charges the main battery, as the main battery powers the LHMBC. For more information see TM 9-1220-255-13&P.

GRAPHIC USER INTERFACE

7-13. The M32 LHMBCs graphic user interface (GUI) (see figure 7-2) allows the operator to use menus, windows, and icons, rather than complicated commands.

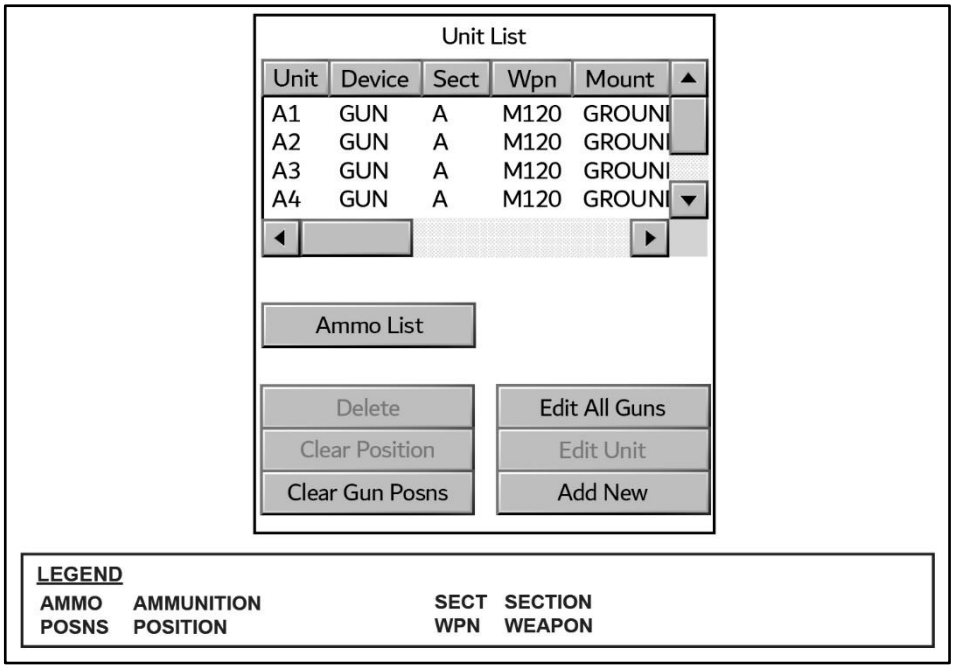


Figure 7-2. Lightweight handheld ballistic computer graphical user interface

SCREEN AREA

7-14. The M32 LHMBC's screen area displays buttons, tabs, fields, and menus.

DESKTOP

7-15. The desktop includes various pull-down menus, the Start button, a time display, and a volume control. The stylus is used to access all functions from this screen.

Action Buttons

7-16. The operator accesses these buttons to add, edit, clear, delete, view, or acknowledge data.

> ***Note.*** These buttons are active only when required fields are filled. Grayed buttons are inactive.

Scroll Bars

7-17. The operator accesses the scroll bars to view data that does not fit on the screen.

Data Lines

7-18. Data lines display data particular to the screen. The operator adjusts the columns using the stylus to increase or decrease the field area.

7-19. To display the details of each data line, the operator selects a line with the stylus, drags it to the bottom of the screen, and lifts the stylus. The data will replace the action buttons at the bottom of the screen. Then, the operator taps the stylus in the data field to close the details and return action buttons to the bottom of the screen.

7-20. For a quick reference, the operator presses the stylus on the data line. The details display at the bottom of the screen until the operator lifts the stylus.

Screen Title

7-21. The screen title displays at the top center of each screen.

Classification

7-22. The classification displays in the upper left corner of the screen.

X or OK

7-23. X or okay (OK) displays in the upper right corner. This button will exit the software.

Time

7-24. The time displays in the upper right corner.

Tabs

7-25. Tabs display at the top of the screen after the operator selects a control button.

Pull-Down Menu

7-26. The operator activates pull-down menus by clicking buttons or icons to display a selection of operations or programs.

Common Actions

7-27. When using the M32 LHMBC, the operator repeatedly uses the same commands to perform actions, such as acknowledging receipt or operationally acknowledge (OpAck), accepting or MTO, selecting the guns to fire the mission, confirming gun orders, and accepting or modifying data. The operator can quickly access these commands by tapping the stylus on a button on the screen or in response to a query in a message box.

Recording Data

7-28. Data is transcribed onto DA Form 2399 or DA Form 2188 throughout the process to maintain a record and to preserve data if the M32 LHMBC fails. The phrase “record data” is used throughout the chapter to indicate this action.

Process or Message to Observer Deny

7-29. To accept and process a mission, the operator selects Process; to refuse a mission, the operator selects MTO Deny. This chapter uses these terms to describe these processes.

7-30. If the operator selects the MTO Deny button, the Delete button displays and, when tapped, deletes the mission. If there is an error beyond FDC control, the only choice is MTO Deny.

Select Action Button/Data Line

7-31. Selecting a button or data field line with the stylus is the equivalent of clicking a button or data field line on a personal computer with a mouse; therefore, the actions select and hold and select and drag are equivalent to click and hold and click and drag with a standard computer mouse.

7-32. The LHMBC alerts the operator to warnings, messages, and processing statuses through message icons and audio alarms. Table 7-2, page 218 lists all message icons and their definitions.

Table 7-2. Message icons

Icon	*Definition*	*Icon*	*Definition*
	Check Fire		Emergency message
	Commo (communication) Loading (yellow X, gray background)		Error (red X, gray background) (Commo notification)
	Data entered may not be correct		Error (white X, red circle)
	New Message		New message received
	Flash Priority		Immediate priority
	Information		Low battery/No external power attached
	Priority		Processed
	Rounds Crossing		Routine priority
	Task Completed Successfully		Warning
	Aimpoint		Known point
	Aimpoint. Do Not Load (DNL)		Target
	Canister		Stored target/Registration point
	Canister. Do Not Load (DNL)		Fire direction center (FDC)
	Gun 60 millimeters		Fire support element (FSE)
	Gun 81 millimeters		Forward observer (FO)
	Gun 120 millimeters		Friendly or other

MESSAGE PRIORITIES

7-33. Table 7-3 indicates the priorities of messages received by the LHMBC.

Table 7-3. Message priorities

Message Type	
Plain Text Message (PTM)	Message to Observer
Check Fire	Fire Support Coordination Measures
Fire Support Meteorological Message	End of Missions and Surveillance
Call for Fire	Fire Unit Status
Observer Mission Update	Subsequent Adjust
Ammunition Inventory	Observer Status
Command to Fire	
Message Precedence	
F = FLASH	P = IMMEDIATE
I = PRIORITY	R = ROUTINE

ENTERING DATA

7-34. When selecting a field, an alphanumeric or a numeric keyboard that corresponds to the type of data that may be entered will display. To remove the keyboard from the screen, tap the screen outside of the keyboard.

7-35. An arrow next to an entry box indicates that a selection list is available. Select the arrow to display the selection field. Selections also may be made by selecting checkboxes or circles.

7-36. All gray data is read-only and cannot be changed directly.

POSITION ENTRY

7-37. The LHMBC offers five methods for locating a position:

- UTM grids.
- Polar plot.
- MGRS.
- Latitude and longitude coordinates.
- Survey.

7-38. To select a method from any Position Edit screen, select the tab that corresponds to the desired method of location.

Universal Transverse Mercator Grid

7-39. UTM grids consist of 10-digit grid coordinates and an altitude with a range of 400 to 9,999 meters.

Polar Plot

7-40. Polar plot defines a position as seen from a previously determined position that is already entered in the unit list.

Military Grid Reference System

7-41. Like UTM grids, MGRS includes a position entered with its zone; 100,000-meter grid square identifier; grid coordinates; and altitude.

Latitude and Longitude Coordinates

7-42. Latitude and longitude coordinates may be used for location.

Survey

7-43. Survey calculates the position based on relative location to two known points using resection or intersection information.

Note. See TC 3-25.26 for more information.

STARTUP

7-44. Two internal batteries power the RPDA:

- The main internal battery is a 3.2-volt lithium-ion battery capable of powering the unit for approximately 5 hours.
- The backup battery, a smaller 3.2-volt lithium-ion battery, maintains the LHMBC software and data for short periods of time while the main internal battery is being replaced.

7-45. The RPDA can accept external power from a variety of conventional power sources, ranging from 11V-36VDC to 100-240VAC.

Note. See TM 9-1220-255-13&P for complete power capabilities/modes and usage.

Suspend Button

7-46. Press the Suspend button (Power button) to power up the RPDA. The password screen is displayed. The user password must be entered each time the unit powers on or comes out of sleep mode.

7-47. LHMBC standard systems use default passwords.

Note. See TM 9-1220-255-13&P for complete password software usage.

Start Button

7-48. After entering the proper password, the desktop will display. To start the LHMBC software, take the followings actions:

- Select the Start button on the display.
- Select LHMBC from the menu.

Use All Button

7-49. Read the Department of Defense security message, and then select Use All.

DATA INITIALIZATION AND CONFIGURATION

7-50. The procedures in paragraphs 7-51 through 7-93 describe the process for initializing and configuring the LHMBC.

System Startup Settings Screen

7-51. When the Department of Defense security message is closed, the System Startup Settings screen displays. To initialize the LHMBC in the basic configuration, take the following actions:

- Select Commo Off and GPS Off while taking the following in consideration:
  - If Commo is on, digital communication will be possible through two-wire (landline) communication or frequency modulation transmission.
  - If GPS is on, the LHMBC can auto-fill its position as a gun, FDC or FO, for example.

Note. See section III for GPS set-up.

- Select Use All to continue.

Setup Geographic References Screen

7-52. To access the Setup Geographic Reference screen (see figure 7-3, page 222), take the following actions:

- Select Menu.
- Select Setup.
- Select GEOREF.

Note. The Setup Geographic Reference screen automatically displays if no GEOREF was set previously.

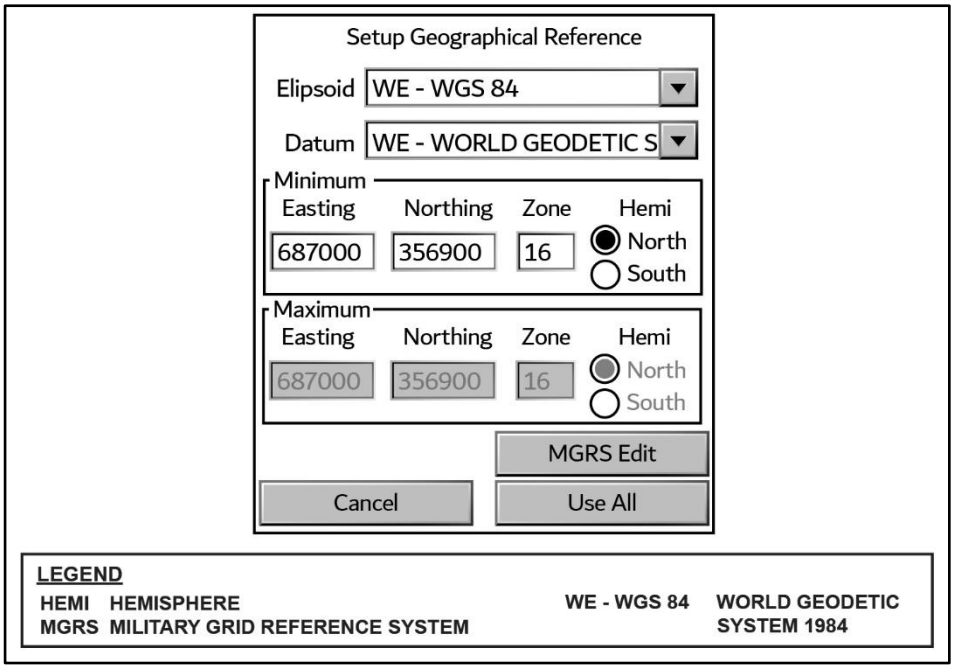


Figure 7-3. Setup of Geographic Reference screen

Ellipsoid Field

7-53. The ellipsoid (spheroid) of the map sheet displays in the marginal information. The default ellipsoid is World Geodetic System 1984 (WGS 84). Use the ellipsoid pull-down menu to change the default setting.

Datum Field

7-54. The default datum is WE-WGS WGE-WGS 84. When the ellipsoid is set, the corresponding default datum automatically displays.

Minimum Easting and Northing Fields

7-55. The minimum Easting and Northing are entered in the 13-digit format—six digits for Easting, seven digits for Northing. This information is in the bottom left corner of the map sheet. The western-most grid line is labeled as the minimum Easting (2, figure 7-4), and the southern-most grid line is labeled as the minimum Northing (1, figure 7-4). Figure 7-4 has a minimum Easting of 687000 and a minimum Northing of 3569000.

Note. The Maximum Easting and Maximum Northing fields are filled automatically.

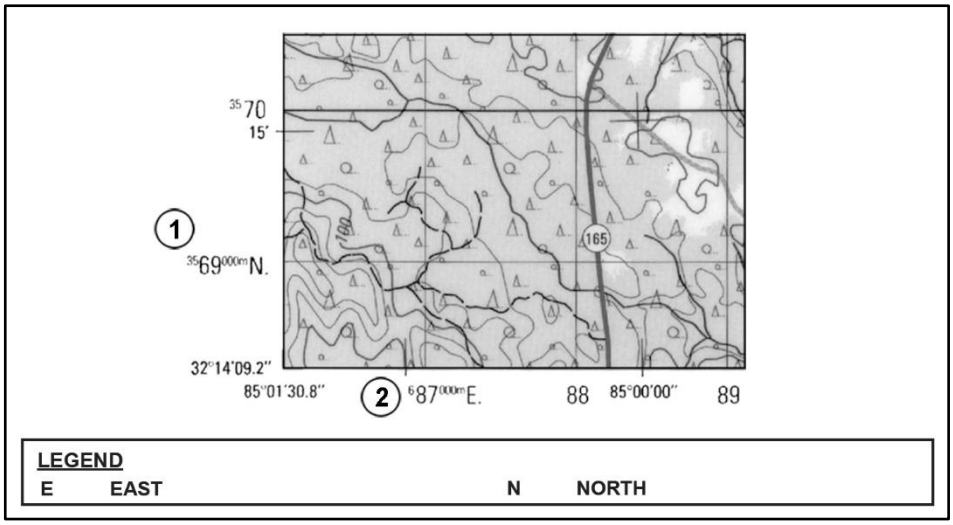


Figure 7-4. Minimum Easting and Northing

Note. If the correct number of digits are not entered in the Minimum Easting or Minimum Northing fields, a Soldier/machine interface error message appears (Map Mod [map modification] ERROR min Easting must be >= 0100000). Select OK and enter the correct values.

Minimum Zone Field

7-56. The minimum zone must be between 1 and 60 and can be found in the map marginal information centered at the bottom of the map sheet. (See figure 7-5, page 224.) The grid zone designator includes two digits and one letter. The LHMBC does not use the letter.

Note. If an invalid Map Mod (Zone) is entered, a Soldier/machine interface error message appears. Select OK and enter the correct values.

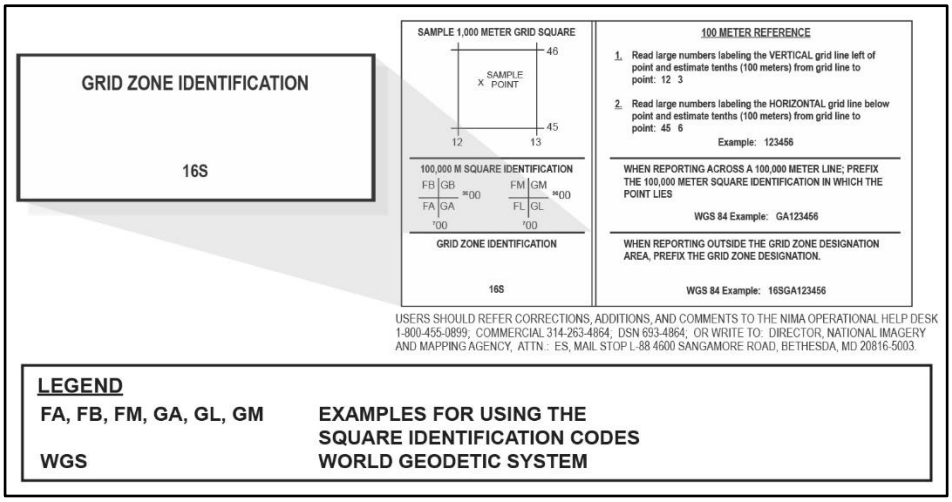


Figure 7-5. Location of minimum zone

Note. The Maximum Zone field is filled automatically.

Hemisphere Field

7-57. Enter north or south in the Hemisphere field to indicate the unit is operating in the northern or southern hemisphere.

Note. The Hemisphere field is filled automatically.

Military Grid Reference System Edit

7-58. The MGRS Edit screen allows entry of the bottom left (southwestern) map mod coordinate using MGRS notation instead of UTM notation. See position entry earlier in this chapter.

Setup Data Screen

7-59. The Setup Data screen (see figure 7-6) allows the operator to set the system clock, crew response, target block, and splash time (if using Commo), security mode, and to enable/disable the audio alarm. To display this screen, take the following actions:

- Select Menu.
- Select Setup.
- Select Settings.

Date and Time Fields

7-60. If the GPS is enabled, the GPS Time button will display. Select the GPS Time button to auto-fill the Date and Time fields.

7-61. If operating in manual mode, use the stylus to select the portion of the date or time that requires adjustment, and then use the up or down arrows to adjust the selected portion. To apply the changes, select the Use All button.

Target Block

7-62. These fields contain the unit's assigned target block. The target block contains a two- letter prefix, a number between 0 and 9999 for the target block minimum, and a number between 1 and 9999 for the target block maximum. The Target Block Next field contains a number between 0 and 9999. This does not prevent other targets from being entered with a different block sequence; it only sets the default target-labeling sequence.

Send Splash Message Field

7-63. The default splash message time is 5 seconds.

Security Mode Field

7-64. If sensitive information, such as actual target locations or friendly positions, will be received through the built-in Commo, set the security mode according to the security setting of the sending unit. The default security setting is unclassified.

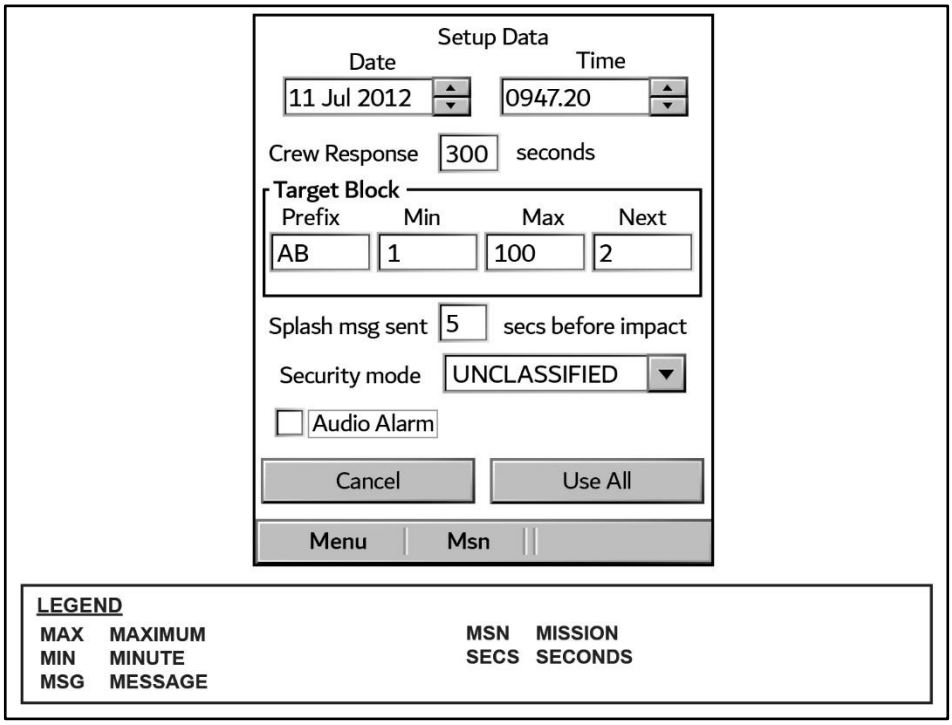


Figure 7-6. Setup Data screen

Unit List Screen

7-65. The Unit List screen (see figure 7-7) lists all the units assigned or used by the FDC. It allows the operator to view, enter, edit, or delete the unit name, the device, the observer number (Obs Num), and additional required entries for specific devices.

Notes. 1. This screen automatically displays if no devices were entered previously.

2. The FDC is automatically on the list and cannot be deleted.

7-66. This screen is comprised of two areas:

- The upper half of the screen contains the Unit List field. This field displays information by unit designation for GUN, FDC, FO, FSE, OR STA, and OTHER.
- The bottom half of the screen contains seven action buttons:
  - Ammo List displays the ammunition screen.
  - Delete is used to delete the selected unit.
  - Clear Position is used to clear the position of a selected unit.
  - Clear Gun Posns is used to clear the positions for all the guns at the same time.
  - Edit All Guns allows the operator to enter the data for all guns at the same time.
  - Edit Unit is used to edit the fields of a selected unit.
  - Add New is used to add a new unit.

7-67. To display the Unit List screen, take the following actions:

- Select Menu.
- Select Unit List.

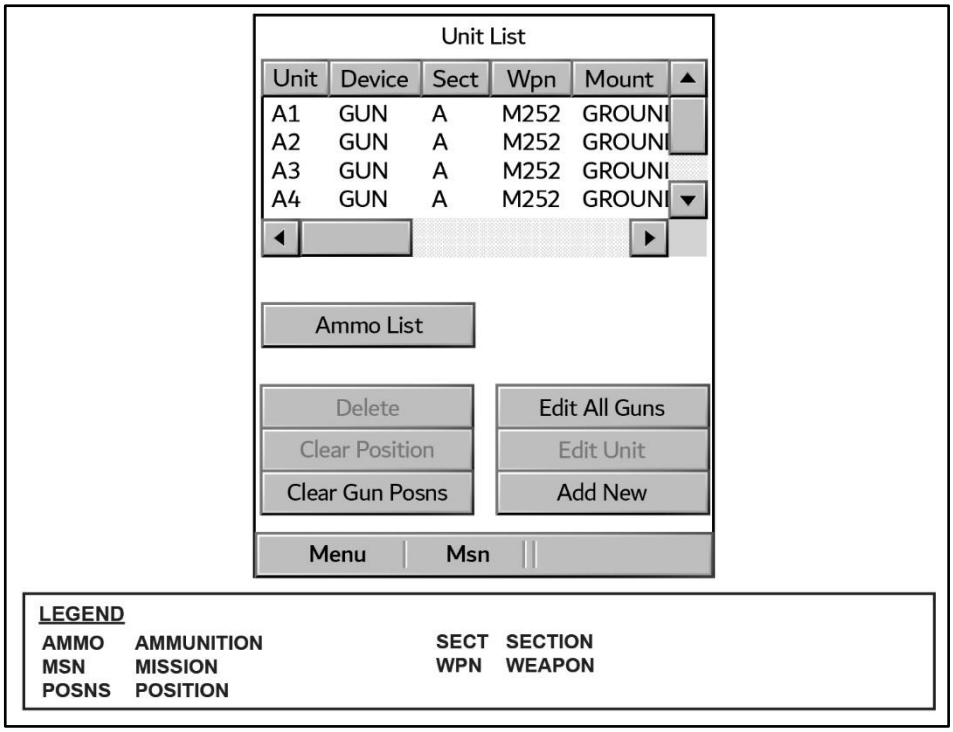


Figure 7-7. Unit List screen

Unit List Add/Edit Screen

7-68. To add a unit from the Unit List screen (see figure 7-8, page 228), select the Add New button. To edit a unit that is entered already, take the following actions:

- Select the appropriate unit data line.
- Select Edit Unit.

Note. Only the Unit Name, Obs Num, and Device fields are available until a device is selected.

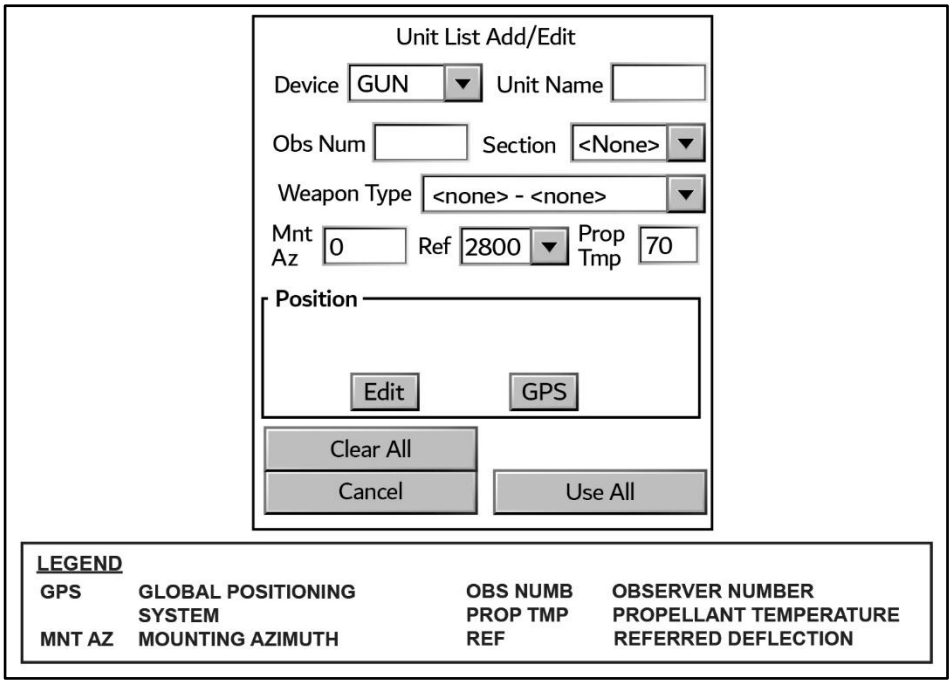


Figure 7-8. Unit List Add/Edit screen

Unit Name Field

7-69. Unit names must be two to four characters in length, and the first character must be a letter. There is a limit of 100-unit entries.

Device Field

7-70. The available devices include:

- GUN.
- FDC.
- FO.
- FSE.
- OR STA.
- OTHER.

7-71. The required entries change depending on the device selected. When GUN is selected, entry boxes are displayed for weapon type, section, mounting azimuth (Mnt Az), Ref, propellant temperature (Prop Tmp), and position (POS). Later, the operator may add this information for all guns using the Edit All Guns menu.

Position

7-72. The position is entered manually or, if using the M32 LHMBC with the GPS turned on, by tapping the GPS tab the position will auto-fill based on the satellite information with accuracy of 0 to 25 meters.

Note. A GPS survey must be conducted at the location of the baseplate for each gun position.

Edit All Guns

7-73. To edit gun set-up information for all guns from the Unit List screen, select the Edit All Guns button. The Edit All Guns screen is displayed by selecting Edit All Guns from the Unit List screen. This screen allows data common to all guns to be edited at the same time.

Note. Only those fields that require a change need to be edited.

7-74. The Edit section allows the selection of the subset of guns that will be edited. The options include:

- All guns apply edits to all guns on the unit list.
- No Selection applies edits only to those guns which are not part of a Section.
- Section A, B, or C applies edits only to the selected Section.
- If no sections have been entered on the unit list, the Edit Section pull-down will be inactive, and all guns will be edited.

7-75. Weapon Type provides the ability to change the weapon type of the selected guns.

7-76. Mnt Az provides the ability to change the MAZ of the selected guns. The Mnt Az must be between 0000 to 6399 mils.

7-77. Ref provides the ability to change the refer deflection of the selected guns. The pull-down list provides the options of 700, 2800, and 3200 mils. A custom Ref can be entered within the range of 0 to 6399 mils using the numeric keyboard.

7-78. Prop Tmp provides the ability to change the Prop Tmp of the selected guns. The Prop Tmp must be a number between -70 degrees and 140 degrees Fahrenheit.

7-79. Clear All clears all information on the Unit List Add/Edit screen.

7-80. Cancel provides the means to exit the Edit All Guns screen and return to the Unit List screen without saving any data or changes.

7-81. Use All applies any data entered or changes made on the Unit List Add/Edit screen.

Ammunition Screen

7-82. In the Ammunition screen, the LHMBC tracks ammunition by unit (gun) number or section.

7-83. To display the Ammunition screen (see figure 7-9), use one of the two methods listed:

- Select the Ammo List button from the Unit List screen.
- Access the Ammunition screen using the main menu, and by taking the following actions:
  - Select Menu.
  - Select Ammo.
  - Select Ammo List.

7-84. To add or edit ammunition, use one of the two methods listed:

- Select Add New for an initial entry.
- Select Edit Ammo to update the ammunition quantities.

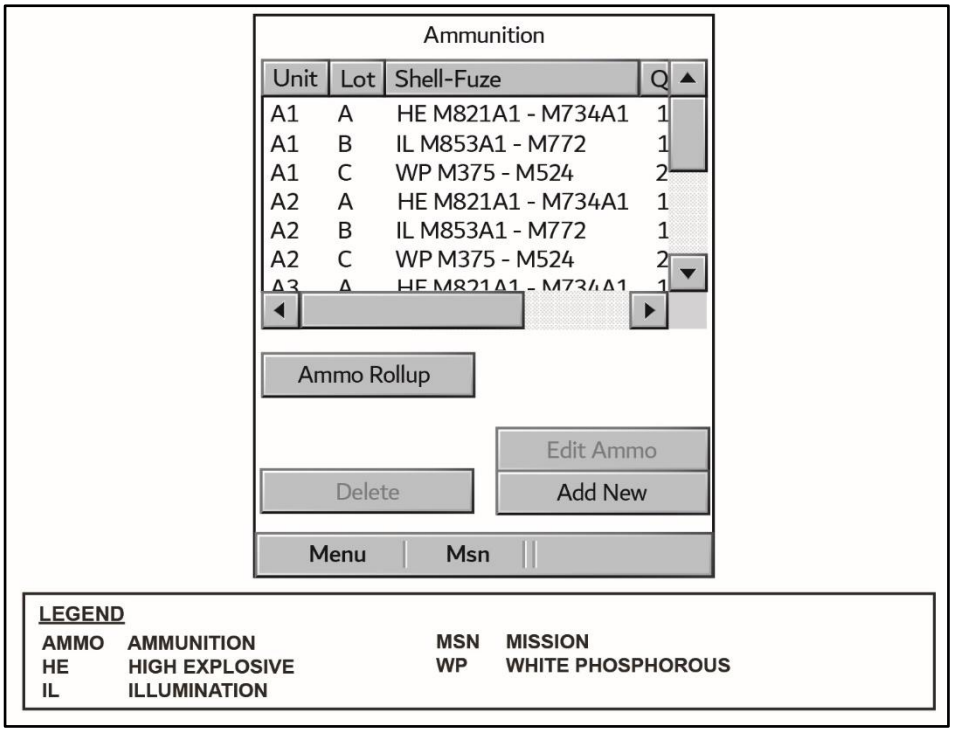


Figure 7-9. Ammunition screen

Add/Edit Screen

7-85. To add ammunition, take the following actions:

- Select Add/New. The Ammunition Add/Edit screen (see figure 7-10) appears.

- Select the weapon or section that needs to be modified using the Unit field pull-down menu. This menu displays all weapons that have been entered into the LHMBC.
- Select the Lot field to enter the lot letter. Letters range from A to Z.
- Select the appropriate ammunition using the Shell-Fuze field pull-down menu. Ammunition is arranged alphabetically by type: HE, illumination (ILL), IR, red phosphorous, training, and WP.
- Enter the lot number in the Lot Number field. Lot numbers contain as many as 16 characters.
- In the Quantity field, enter the quantity of the lot allocated to the current weapon.
- Repeat steps 2 through 6 for the remaining types and quantities of ammunition for each gun or by unit section.

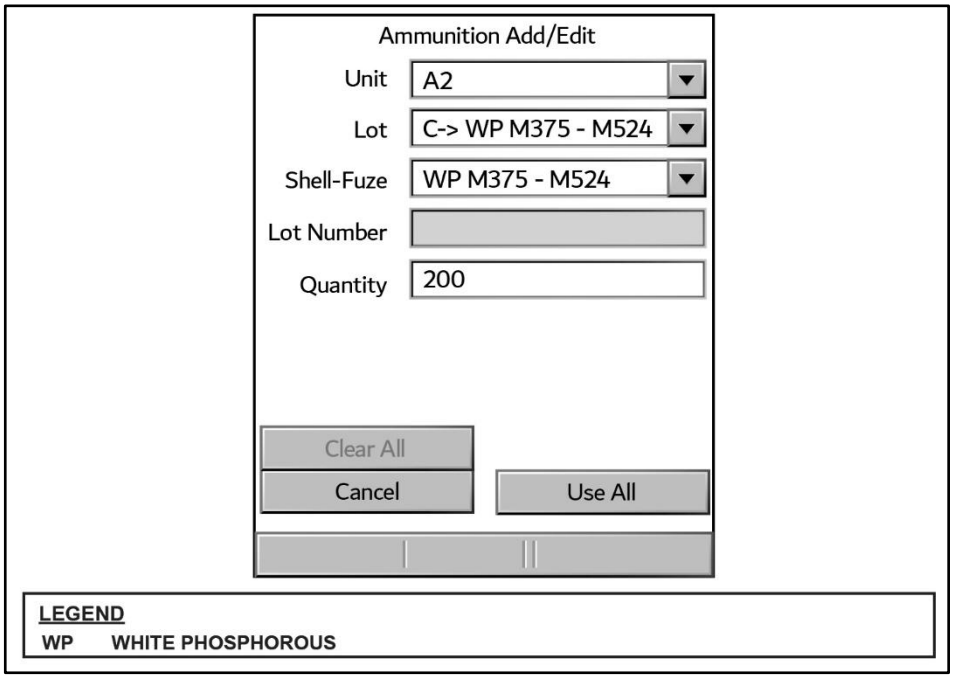


Figure 7-10. Ammunition Add/Edit screen

Ammunition Roll-Up Screen

7-86. The Ammunition Roll-Up screen (see figure 7-11, page 232) lists the total quantity of ammunition by lot. To display this screen, take the following actions:

- Select Menu.
- Select Ammo.
- Select Ammo Roll-up.

7-87. If Commo is enabled, the Send to FSE action button will display. Select Send to FSE to send the ammunition roll-up to the controlling FC.

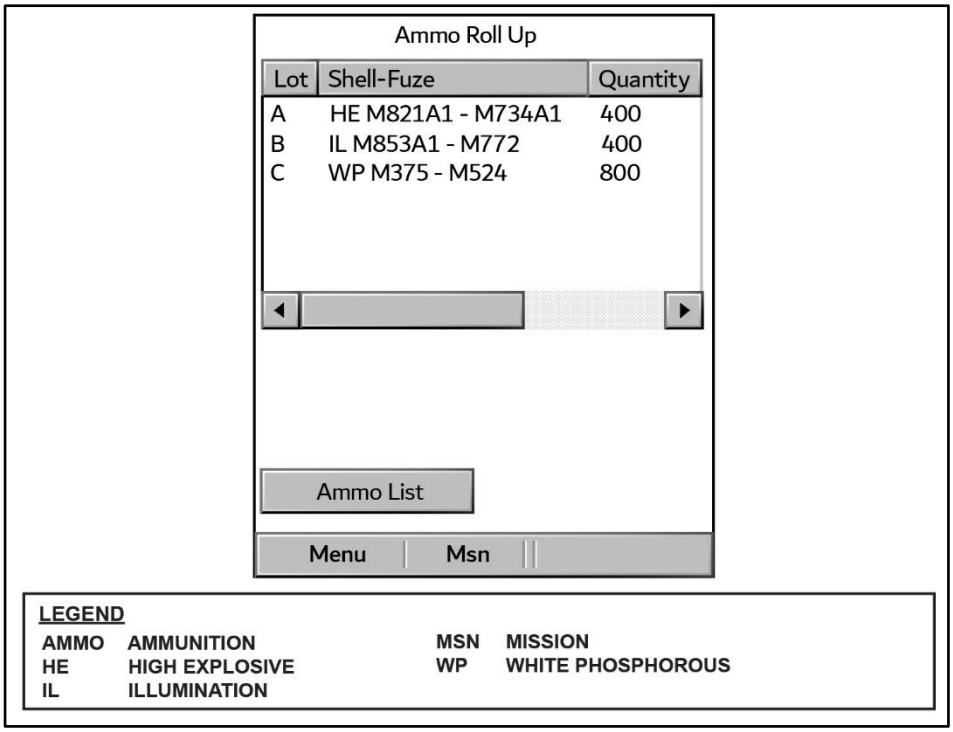


Figure 7-11. Ammunition Roll-Up screen

Meteorological Data

7-88. The LHMBC uses a computerized MET message to correct for changes in the atmospheric condition as they apply to ballistic calculation. The LHMBC defaults to standard FTs MET data; However, seasonal regional MET data is available for use when computer MET messages are unavailable and weather conditions warrant using season regional MET data instead of standard FT MET data. The use of MET does not eliminate the need to conduct registration.

7-89. When a new MET message is received and applied, it becomes the current MET and is applied to all firing data. The computer MET message may be received digitally or entered manually.

Note. Ballistic MET is not compatible with the LHMBC.

Applying Meteorological Data

7-90. If the MET is sent digitally, an alert displays to confirm receipt of the MET message. After confirming receipt, apply the MET by taking the following actions:

- Select Menu.
- Select MET.

- Select Messages.
- Select the most recent message.
- Select Process. This message becomes the current MET.

Entering Manual Meteorological Data Messages

7-91. To enter the MET message, manually record it on DA Form 3677. Chapter 2 of this publication gives a complete overview of MET messages.

7-92. To input a new manual MET message, take the following actions:

- Select Menu.
- Select MET.
- Select New. The MET New screen (see figure 7-12) displays.

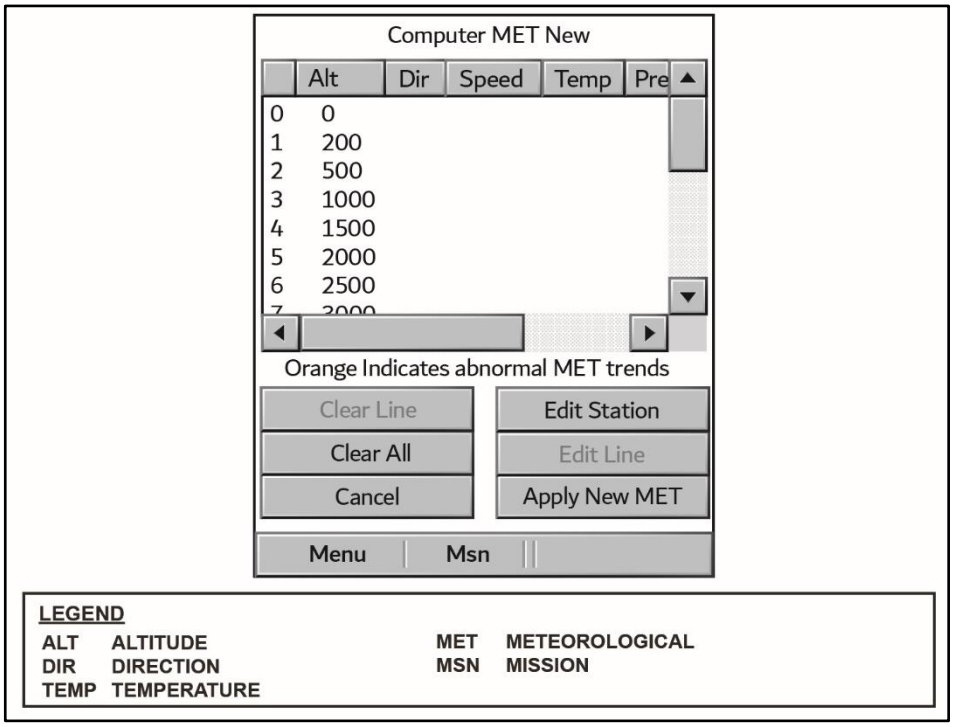


Figure 7-12. Meteorological New screen

- Select Edit Station. The MET Edit Station screen (see figure 7-13, page 234) displays.
- Fill in the data entry fields using the information received in the computer MET message. The first two data entry fields, (Station Name and Octant) are not required but may be entered; refer to Group 1 of the computer MET message. The next two fields, Station Height and MDP Pressure, refer to Group 4. Latitude and Longitude refer to Group 2. Group 3 is not used in the LHMBC.

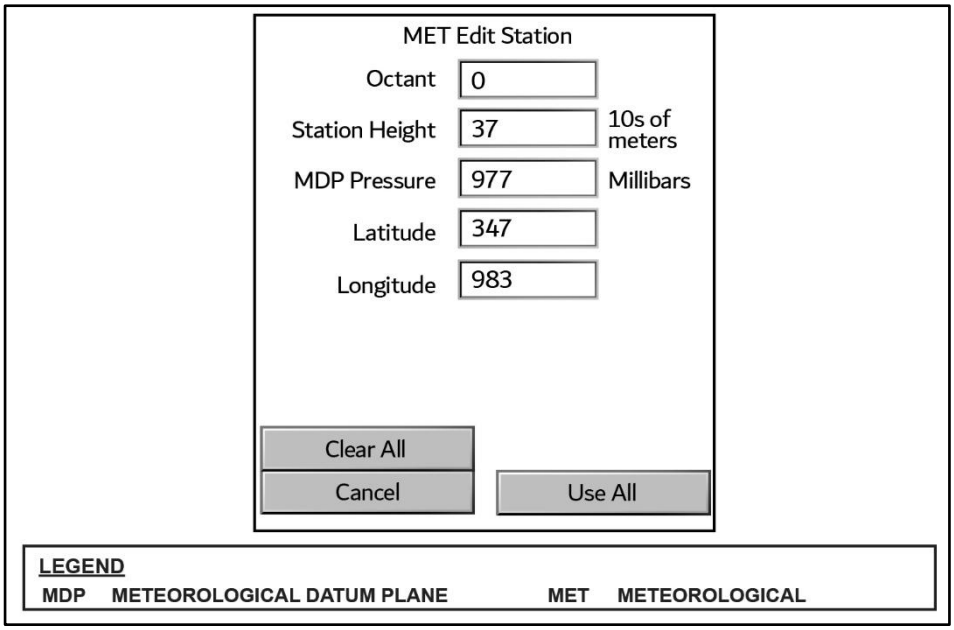


Figure 7-13. Meteorological Edit Station screen

- Select Use All. The LHMBC returns to the MET New screen.
- Enter surface zone information by selecting line 0 in the data field and selecting Edit Line. The MET New Edit Lines screen (see figure 7-14) displays.

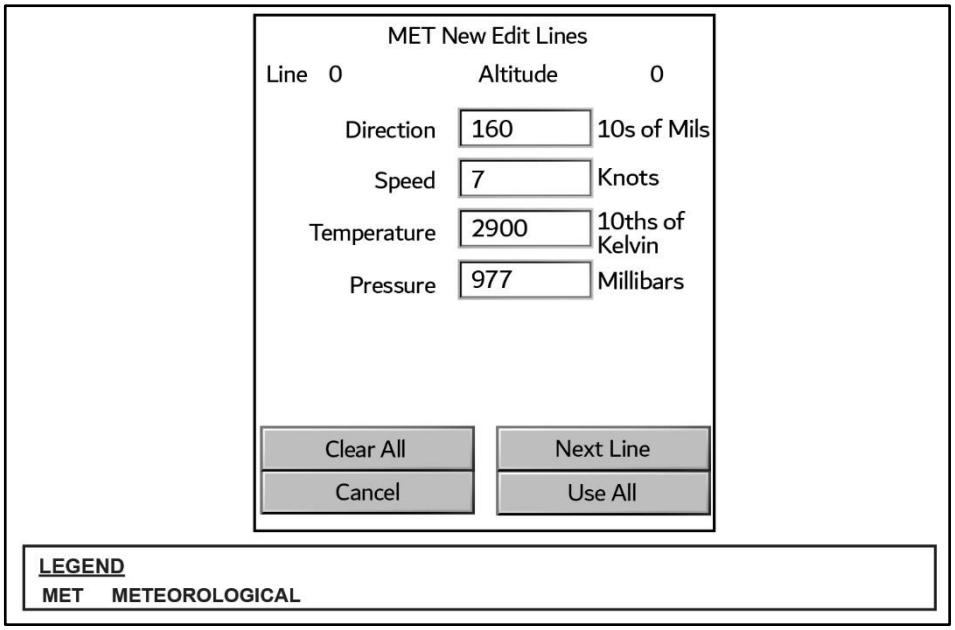


Figure 7-14. Meteorological New Edit Lines screen

- Enter surface and zone MET data (Direction, Speed, Temp, and Pressure fields).
- Select Next Line to proceed to the next surface zone line. Complete all applicable lines. At a minimum, the first 11 lines must be completed to apply MET data.
- Select Use All to return to the MET New screen. Any abnormalities in the MET message will be highlighted in orange. If abnormalities are displayed, validate the MET with the FC.

Note. Orange fields only indicate that the MET has an abnormal trend, not that the MET message is invalid.

- Select Apply New MET to use the new MET.

Switch Between Meteorological Data Messages and Seasonal Regional Meteorological

7-93. To toggle between the current MET and the standard MET from the MET Current screen—

- Select Use Standard. The MET Standard screen displays.
- Select Use Current. The MET Current screen (see figure 7-15, page 236) displays.
- Select use Seasonal Regional MET.

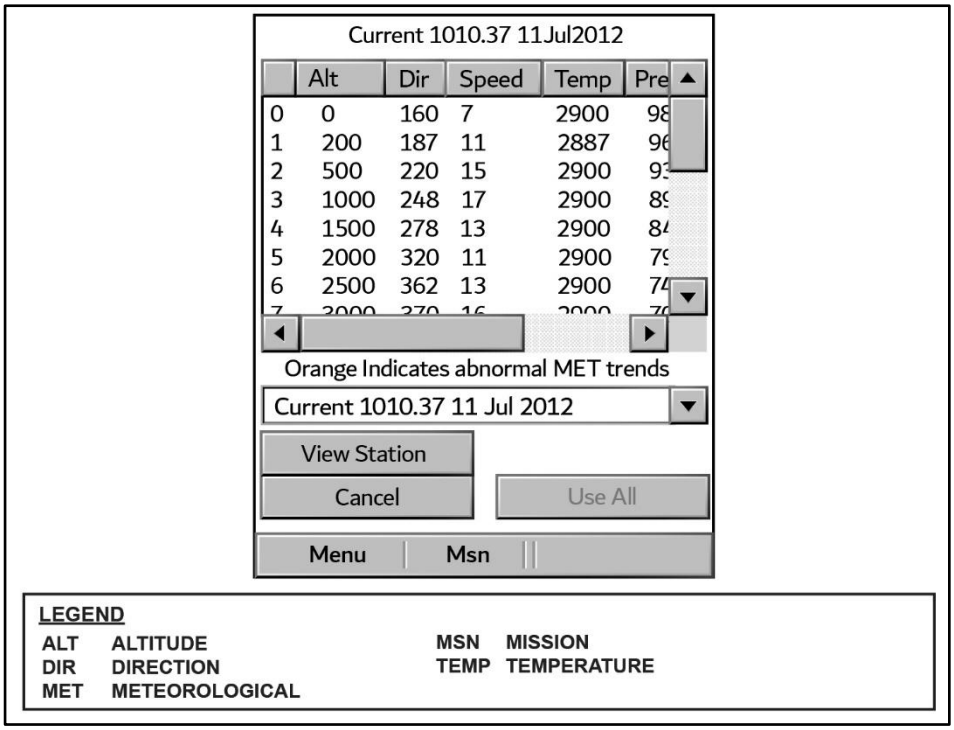


Figure 7-15. Meteorological Current screen

SAFETY FAN

7-94. A safety fan is a restrictive firing measure used during training to ensure that the firing unit does not process data located outside of the safe zone of impact. Firing units calculate safety fans per the Mortar Surface Danger Area. (See appendix B of this publication for more information.)

7-95. The LHMBC stores one safety fan with as many as 10 segments. (See figure 7-16.) Each fan segment is defined by left and right limits, minimum and maximum ranges, and minimum and maximum charges. Targets outside of these limits are considered unsafe.

7-96. A safety fan violation cannot be overridden, and data for engagement will not display. If a violation occurs or if the solution endangers any stored friendly locations, a warning message will display. Friendly positions are protected by a buffer zone known as the boundary outer limit alert distance (BOLAD). Firing data that impacts inside of a BOLAD will not be processed, and an error message will display on the Mission Solution screen for each gun that impacts inside of the BOLAD. The buffer radius for the various weapon's systems are as follows:

- 60-mm – 100 meters.
- 81-mm – 150 meters.
- 120-mm – 200 meters.
- 120-mm – 250 meters (firing M91 Illum/M57 HE).

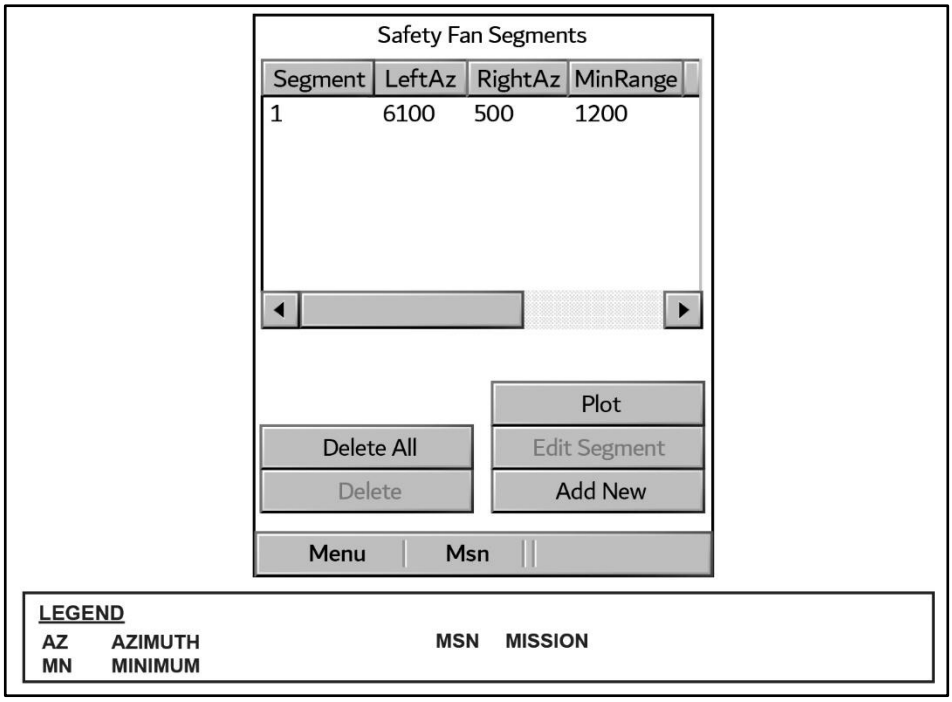


Figure 7-16. Safety Fan Segment screen

Enter Safety Fan Information

7-97. To enter a safety fan into the LHMBC—

- Select Menu.
- Select Setup.
- Select Safety Fan.
- Select Add New. The Add New Safety Fan Segment screen (see figure 7-17, page 238) displays.
- Enter segments, beginning with the left-most fan segment. Each additional fan segment uses the previous fan segment's right azimuth as its left azimuth.
- After entering the azimuths and the minimum and maximum ranges, determine the minimum and maximum charges that may be fired.

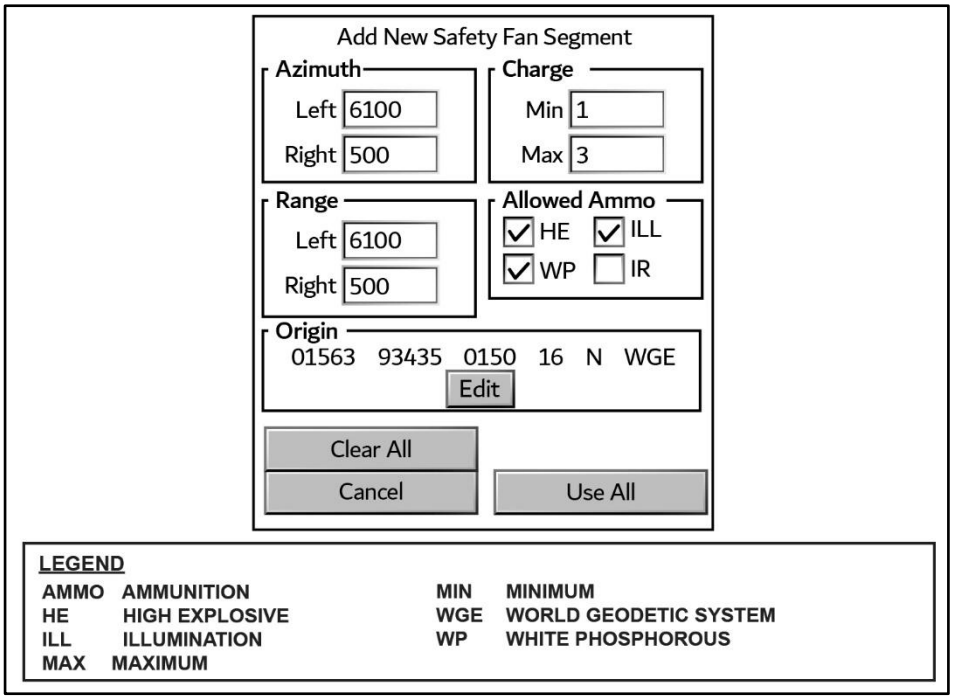


Figure 7-17. Add New Safety Fan Segment screen

Delete Safety Fan Information

7-98. To delete a specific segment—

- Select the bottom (right-most) fan segment from the Safety Fan Segments menu.
- Select Delete.
- Select Confirm.
- Continue deleting segments from the bottom of the Safety Fan Segments menu until the desired segment has been deleted. For example, to delete the left-most safety fan segment, all fan segments must be deleted.

7-99. To delete the entire fan, select Delete All and confirm from the Safety Fan Segments menu.

FIRE SUPPORT COORDINATION MEASURES

7-100. FSCMs can be entered manually by tapping Menu FSCM and then selecting the desired FSCM type. The pull-down box lists the different FSCM types available. (See figure 7-18.) The screen title changes based on the FSCM type selected:

- Plot displays the graphical representation of the selected FSCM.
- View Points displays the FSCM Points screen for the selected FSCM.
- Add New FSCM displays the FSCM Data Edit screen to manually enter a new FSCM.

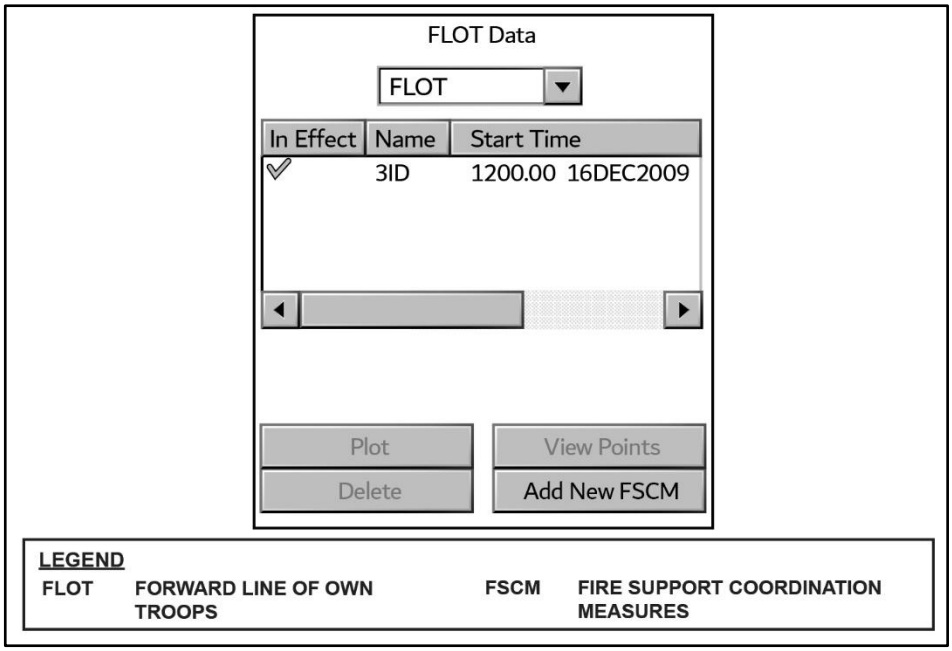


Figure 7-18. Fire Support Coordination Measure pull-down box

Fire Support Coordination Measure Data Edit Screen

7-101. The FSCM Data Edit screen is displayed by selecting the desired FSCM type from the pull-down box and tapping Add New FSCM. The following fields will prompt input:

Note. FSCM start and end dates must fall between the years 2006 and 2037.

- Name. The designation for the FSCM being entered must be 30 characters or less (for example, ACA1).
- Start. The time the FSCM becomes active.
- End. The time the FSCM becomes inactive (FSCM will be deleted automatically at this time).
- Infinite End Time. Enters the FSCM without an end time. FSCM will expire on January 1 of the following year or until deleted manually.
- Min Alt. The minimum altitude of the ACA in feet (only displayed for ACA FSCM).
- Max Alt. The maximum altitude of the ACA in feet (only displayed for ACA FSCM).
- Width. The width of the ACA in meters (only displayed for ACA FSCM).
- HE, WP/red phosphorous, ILL/IR. Permits selection of the ammunition that is restricted from fire into an RFA (only displayed for RFA FSCM).
- Add Points. Displays the FSCM Add Points screen to enter the data points.

Fire Support Coordination Measure Points Screen

7-102. The FSCM Points screen (see figure 7-19) is displayed by entering the FSCM data and tapping Add Points. The following fields will prompt input:

- Plot. Displays graphical representation of the FSCM.
- Add New Point. Displays the Position Edit screen to enter a new point.
- Edit. Displays the Position Edit screen for the selected point.
- Delete. Deletes the selected point.
- FSCM Data (for example, NFA Data). Returns to the Data screen for the FSCM. (Returning before entering the minimum number of points will cancel the new FSCM entry.)
- Use All. Stores the new FSCM. (Only displayed after the minimum number of points has been entered.)

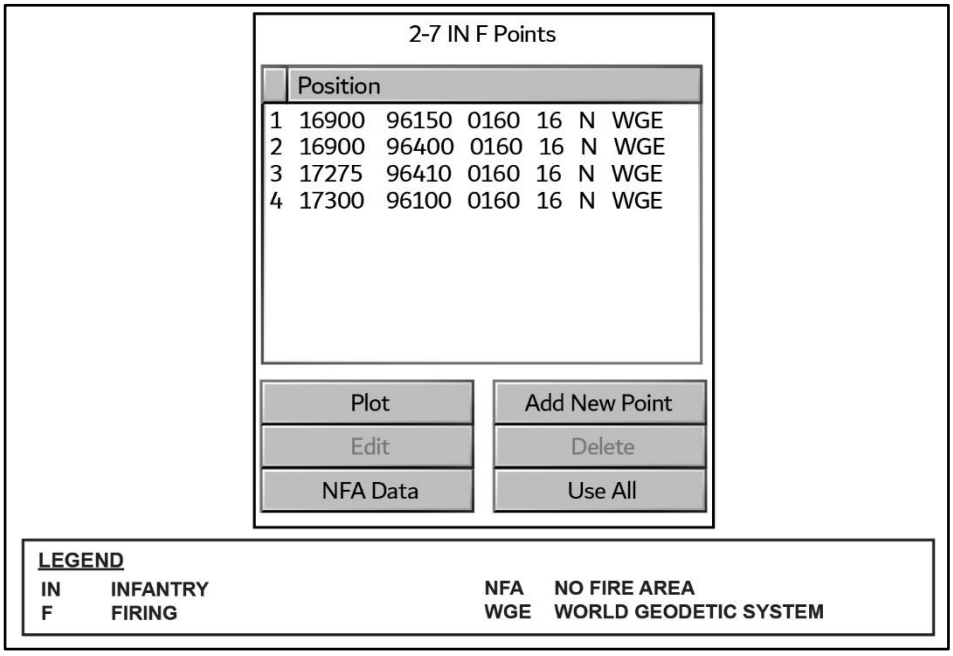


Figure 7-19. Fire Support Coordination Measure Points screen

CAUTION

Line FSCM points must be entered from left to right in relation to the MAZ of the gun line. Shape FSCM points must be entered sequentially in a clockwise or counterclockwise order around the circumference of the shape. Failure to do so will result in the LHMBC orienting a line or drawing a shape incorrectly.

7-103. Tap Add New Point to enter the location of the first point for the FSCM. (See TM 9-1220-255-13&P for information on entering positions.)

Note. If entering a NFA or RFA, the Add New Point button gives the operator the option to enter the FSCM as a circle. If the FSCM is a circle, the operator need only enter the radius and the center position of the circle.

7-104. Continue tapping Add New Point to enter all remaining points for the FSCM. Tap Use All on the FSCM Points screen to lock the FSCM.

Viewing Locked Fire Support Coordination Measures

7-105. Locked FSCMs can be viewed at any time but cannot be modified.

All Data Screen

7-106. The All Data screen (see figure 7-20) is displayed by tapping Menu FSCMs ALL. Any FSCMs that are in effect have a green checkmark in the first column.

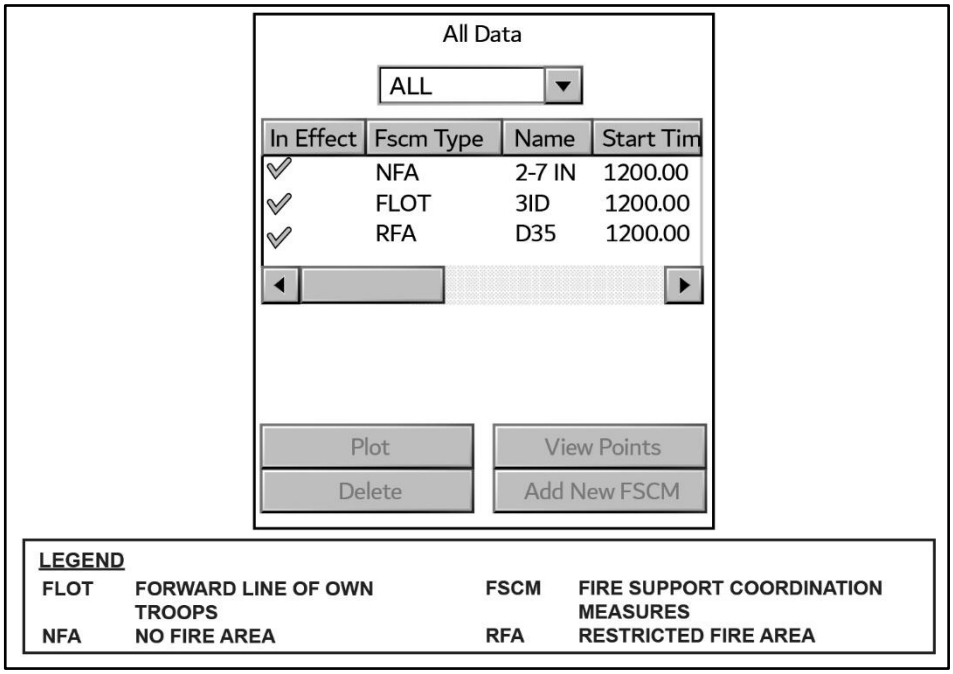


Figure 7-20. All Data screen

7-107. The pull-down box allows filtering and entry of FSCMs by type:

- Plot. Displays a graphical representation of the selected FSCM.
- View Points. Displays the points of the selected FSCM.
- Delete. Deletes the selected FSCM.
- Add New FSCM. Disabled while ALL is selected in the pull-down list. Select a specific FSCM type from the pull-down to enable this button.

Plot Screen

7-108. Tapping Plot (see figure 7-21) on any of the individual FSCM screens displays graphical representation of the FSCM:

- Legend. Displays an explanatory list of the symbols that appear on the plot screen.
- FSCM Data/FSCM Points. Returns to screen the Plot options were selected from, either the FSCM Data or FSCM Points screen as applicable.

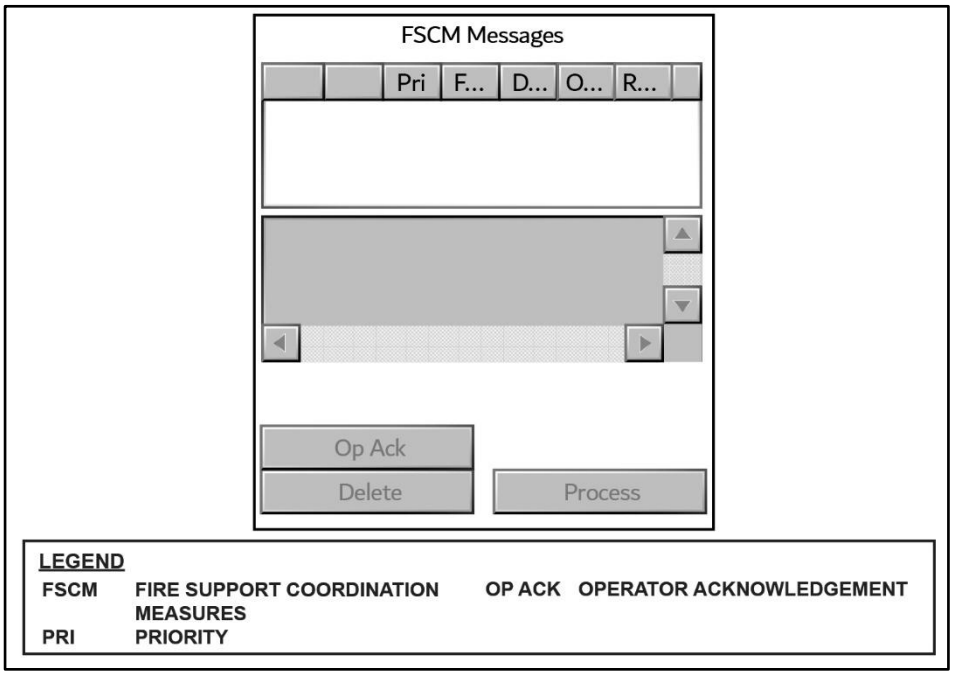


Figure 7-21. Plot screen

Fire Support Coordination Measure Messages

7-109. If the operator receives a digital FSCM from an FSE, the message will be displayed on the FSCM Messages screen. (See figure 7-22.) The FSCM Messages screen is displayed by tapping Menu FSCMs Messages. This option only appears on the M32 LHMBC if 6017, 6017A, or 6017B under Commo have been selected at system startup.

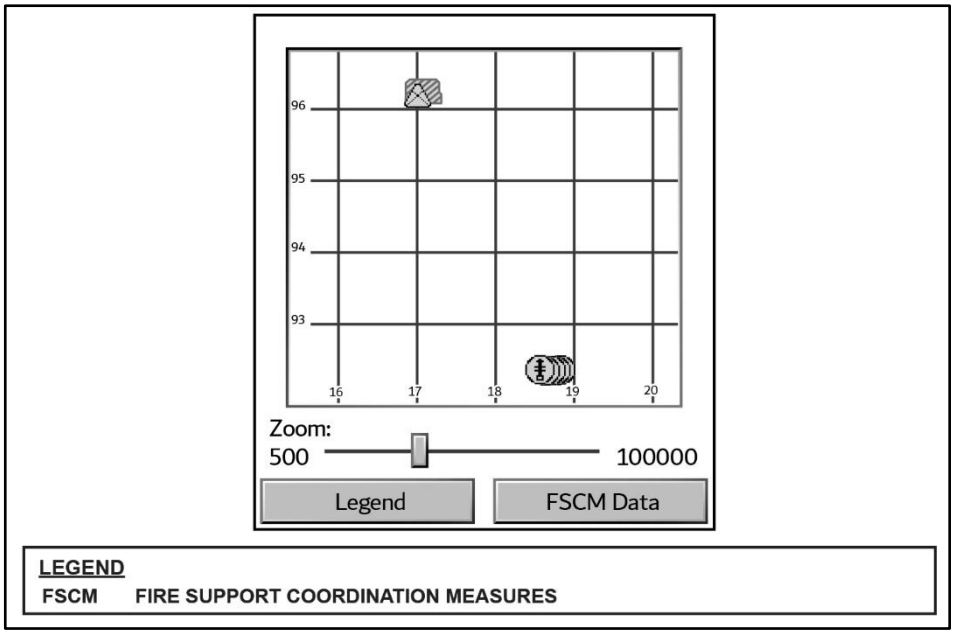


Figure 7-22. Fire Support Coordination Measure Messages screen

TARGET KNOWN POINTS

7-110. The LHMBC provides the means to view, add, edit, and delete targets and known points. There are 200 slots available for a combination of targets and known points, of which 99 can be known points. When a known point is entered with a target number, the target appears on the Targets screen. To view the Targets screen, take the following actions:

- Select Menu.
- Select Points.
- Select Targets/Known Points.
- The Targets/Known Points screen displays (see figure 7-23, page 244).

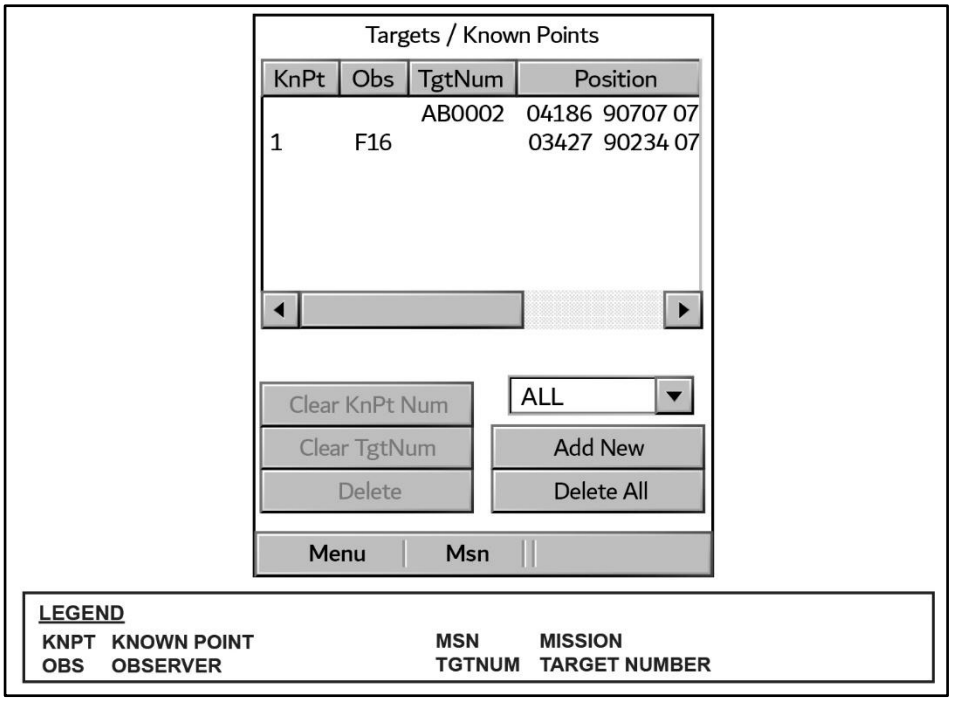


Figure 7-23. Targets screen

CHECK FIRE

7-111. To immediately cease fire and preserve data for all missions or for a single target, the mortar section or platoon implements a check fire (ChkFire). The FO will receive a digital message informing the unit's check fire status. If the FO initiates a check fire, the LHMBC will receive a digital notification and the alarm will sound, if it is enabled.

Initiate

7-112. To initiate a check fire of all targets, take the following actions:

- Select Menu.
- Select Check Fire.
- Select Check Fire All.

Note. All active fire missions will be halted, and all inactive missions will remain inactive until the check fire is cancelled. A "Check Fire!" indicator will display, along with a mission number for every mission.

7-113. To initiate a check fire by target number, take the following actions:

- Select Menu.
- Select Check Fire.
- Select check fire (ChkFire) target (TGT).

Note. The selected mission will be halted. All other missions will remain active, and new missions may be initiated. A Check Fire indicator will display, along with the target number for the specified mission.

Cancel

7-114. To cancel a check fire, take the following actions:

- Select Menu.
- Select Check Fire.
- Select the mission to be removed from check fire status.
- Select Cancel ChkFire.
- A "Confirm Cancel Check Fire" message will display. Select Yes.

Note. Now all selected missions will be available for mission processing.

SECTION II – COMMUNICATION AND GLOBAL POSITIONING SYSTEM

7-115. The LHMBC can communicate on the fire support network with the Advanced Field Artillery Tactical Data System (AFATDS), forward observer system (FOS), and legacy systems to integrate mortar fires into the digital fire support network. Digital communication eliminates the need for voice communications and reduces the risk of human error.

CABLE CONNECTION

7-116. To enable digital communications, select 6017, 6017A, or 6017B under Commo during initial startup. (See paragraph 7-51.) The LHMBC can use two-wire (landline) or frequency modulation communication.

7-117. To install the two-wire connector or the radio cable, take the following actions:

- Remove the connector covers from the communications connector on top of the LHMBC and the cable connector on the two-wire or radio connector.
- Insert the appropriate cable into the communications connector and twist the cable connector back and forth while pushing the cable in until it clicks into place.
- Turn the communications connector knob clockwise to secure the cable.
- Attach the radio cable connector to the audio data connector on the radio set or connect the two-wire connector to the communications loop.

Notes. 1. For more setup information for frequency modulation communications, see the appropriate technical manual for the radio set.

2. The two-wire connector will communicate with any other LHMBC or supported digital device connected in the communications loop.

PARAMETER SETUP

7-118. To set up parameters, take the following actions:

- Select Menu.
- Select Commo.
- Select Parameters. The Setup Commo Parameters screen displays (see figure 7-24).
- Select the appropriate device type in the Dev Type field or enter the default settings by selecting the Radio or Wire default buttons. The LHMBC and the sending device (FOS, AFATDS, and so forth) must have identical setup in the fields outlined in table 7-4.

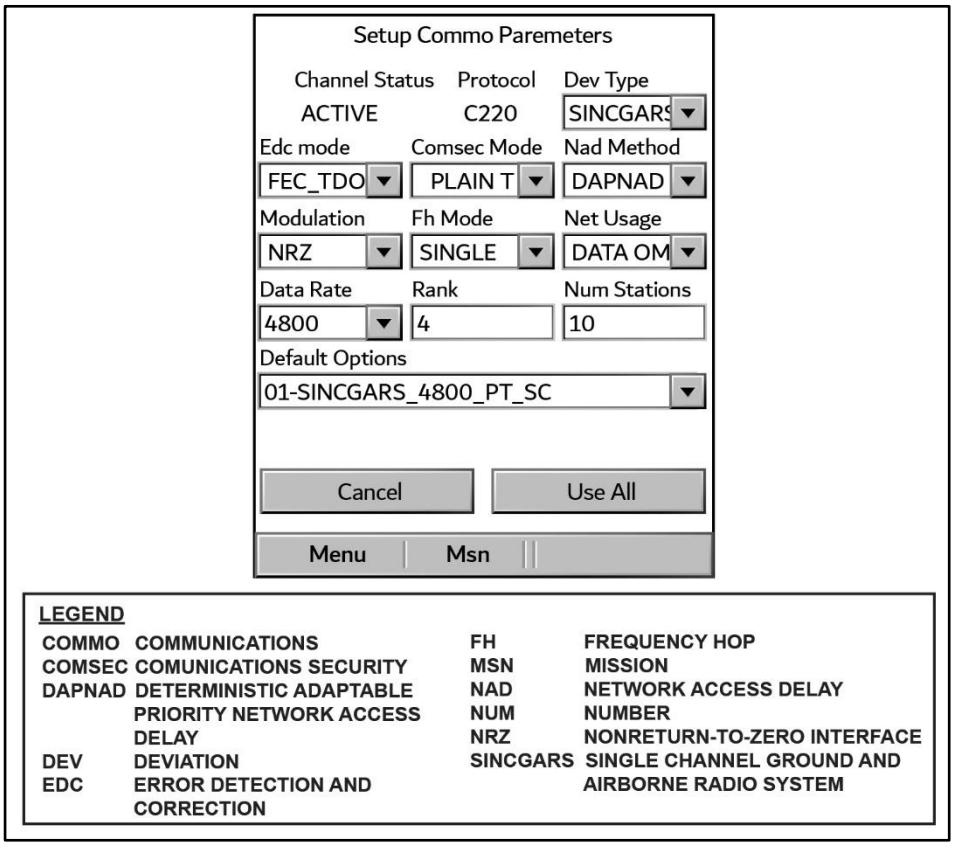


Figure 7-24. Setup Commo Parameters screen

Table 7-4. Parameter Setup fields and settings

Field	*Setting and Related Information*
Dev Type	Two-wire or SINCGARS.
Error Detection and Correction (Edc) Mode	Error Detection and Correction compensates for errors in transmission.
Comsec Mode	Plain Text for two-wire. Plain Text or Cipher Text for SINCGARS.
Network Access Delay (Nad) Method	The Network Access Delay ensures that multiple users on a single network all have transmission opportunities.
Modulation	The nonreturn to zero (NRZ) interface is used primarily with digital equipment for radios.
Fh Mode	Single channel or frequency hop mode for radio. Single channel for wire. ***Note***. This setting allows the operator to communicate in single channel or frequency hop mode when the LHMBC is connected through a frequency modulation device.
Net Usage	Data or Data and Voice. ***Note***. The Data setting is preferable, since it eliminates voice interruptions that take precedence over data communications
Data Rate	A rate of 16000 or 32000 for wire communications, depending on the modulation selected. A rate of frequency modulation communications.
Rank	The order of authority for communications systems using the net.
Num Stations	The total number of units using the network, including the operator.
Default Options	Provides the means to select one of several common configurations for either radio or two-wire. Parameters on the screen automatically update based on the configuration selected.

Legend: CDP—conditioned di phase; DAPNAD—deterministic adaptable priority network access delay; FEC—forward error correction; Fh—frequency hop; FOS—Forward Observer System; LHMBC—Lightweight Handheld Mortar Ballistic Computer; Num—number; SINCGARS—single-channel ground and airborne radio system

UNIT PRIORITIES

7-119. Rank determines a unit's priority on the network. This is the only field that will not be identical to the channel parameters of other units operating on the network. Each rank is a unique identifier for that unit. Common priorities for rank are as follows:

- FSE – 01.
- FO1 – 02.
- FO2 through FO'X' -3 - 'X + 1'.
- FDC - 'X' + 2.

EXAMPLE

For one FSE, three FOs, and one FDC, the standard labeling convention will be:

- FSE - Rank = 1
- FO1 - Rank = 2
- FO2 - Rank = 3
- FO3 - Rank = 4
- FDC - Rank = 5

SET UP A UNIT ADDRESS

7-120. To set up a unit address, take the following actions:

- Display the Setup Commo Addresses screen (see figure 7-25) by: Selecting Menu, Commo, and then Channel Addresses.

Note. All units on the Unit List are listed, except guns.

- Enter the FDC address, and then the addresses of other units.

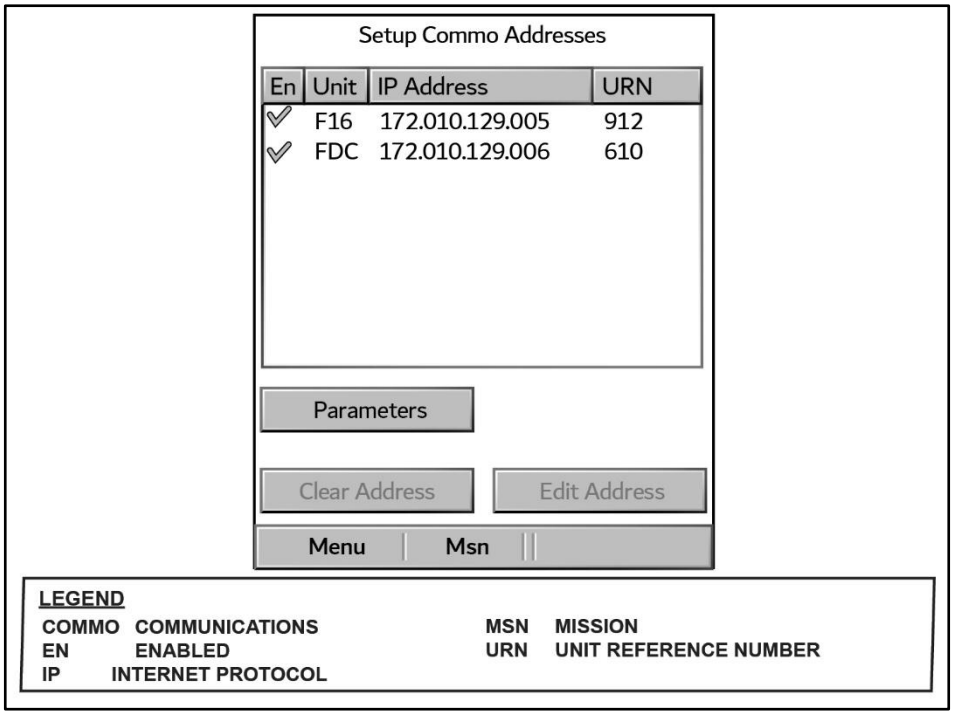


Figure 7-25. Setup Commo Addresses screen

EDIT A UNIT ADDRESS

7-121. To edit a unit, take the following actions:

- Select a unit from the list of units.
- Select Edit Address. The Edit Commo Address screen displays (see figure 7-26, page 250).
- Enter the proper Commo Address values.
- Select Use All.

Note. If the unit is an FDC, the channel will be enabled, and a checkmark will appear in the enabled (En) field of the Setup Commo Address screen.

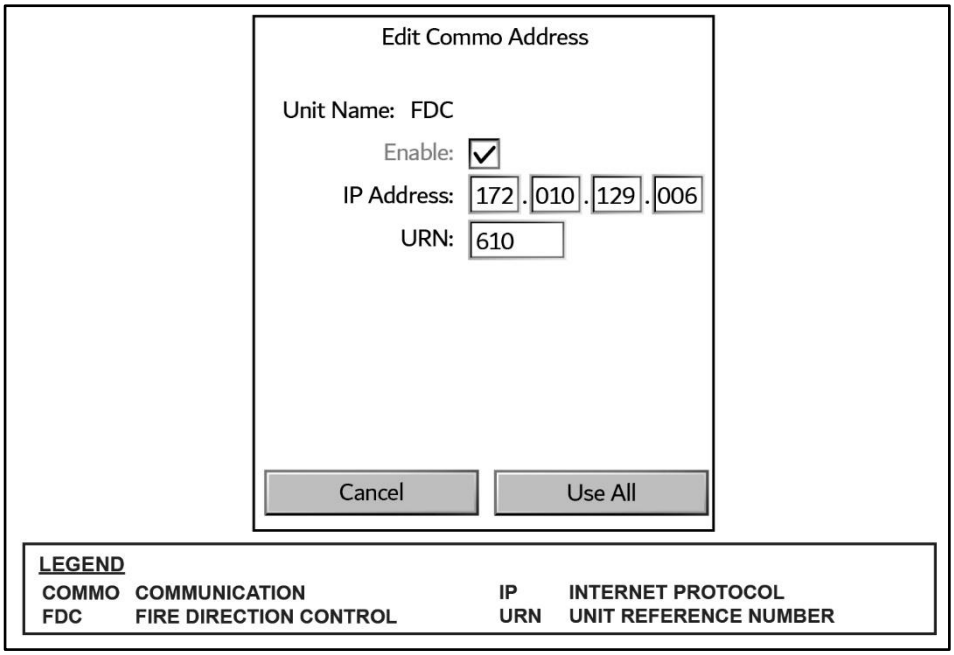


Figure 7-26. Edit Commo Address screen

Unit Name Field

7-122. The unit name is listed at the top of the Edit Commo Address screen.

En Field

7-123. If the channel has been enabled, the En field will be checked. This field is read-only for FDCs; all other units may be enabled for communications by selecting this field.

Internet Protocol Address Field

7-124. The Internet protocol (IP) address is supplied through the unit Information Manager's Office.

Modem Address Field

7-125. The modem address is the last three digits of the IP address and is filled automatically. The number can range from 0040 to 095.

Unit Reference Number Field

7-126. The unit reference number identifies the specific LHMBC on the network and has a range from 0 to 64999999.

Enable Or Disable a Channel

7-127. To enable or disable a channel, take the following actions:

- Select Menu.
- Select Commo.
- Select Enable.

Note. A message confirming the channel's status appears. This message only confirms the channel is enabled or there was an error enabling the channel, not that the network is working.

Send Status Screen

7-128. If a channel is enabled, Send Status becomes functional. To display the Send Status screen (see figure 7-27), take the following actions:

- Select Menu.
- Select Commo.
- Select Send Status.

7-129. Once a message has been sent, the Send Status screen automatically displays.

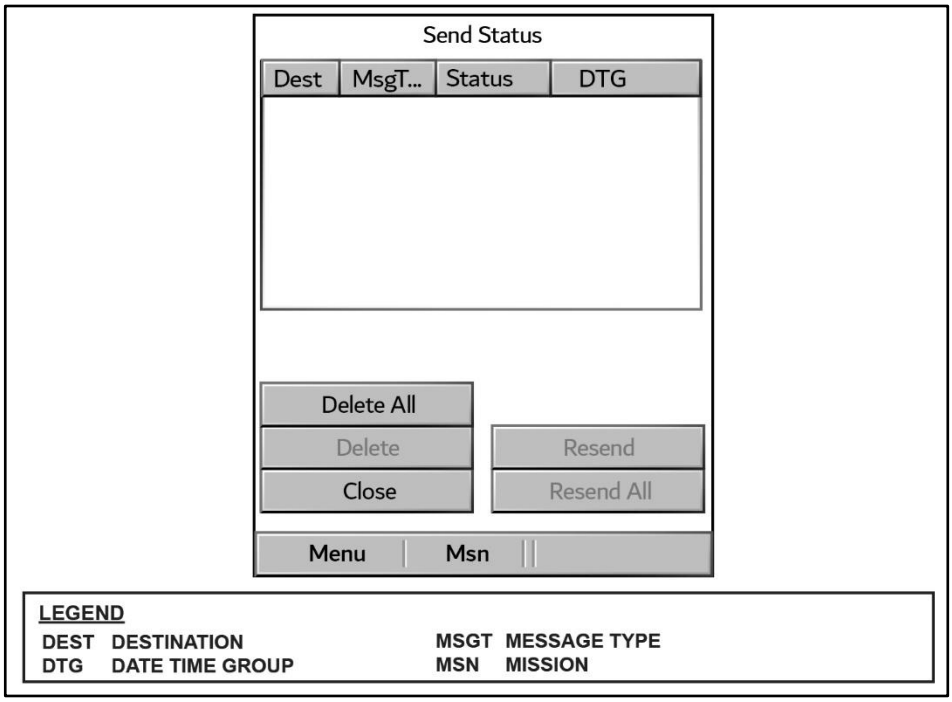


Figure 7-27. Send Status screen

PLAIN TEXT MESSAGES

7-130. The LHMBC's PTM function allows all units, except guns, to communicate via text messaging. Two screens, PTM Send and PTM Read, are available for text messages. Upon receipt of a PTM, the routine priority icon will display on the left side of the Menu button.

Plain Text Message Read Screen

7-131. The PTM Read screen includes a message log and a message log box. To display the PTM Read screen, take the following actions:

- Select Menu.
- Select Commo.
- Select PTM Read.

7-132. Select a message from the log to display the message in the Message Log box. The Reply button allows the operator to reply to the message sender by displaying the PTM Send screen.

Plain Text Messaging Send Screen

7-133. The PTM Send screen contains a message box for typing messages. To display the PTM Send screen, select Menu, Combo and then PTM Send; or select the Reply button on the PTM Read screen. To send a message to a specific unit, take the following actions:

- Select the unit name from the Unit Name box.

Notes. If the PTM Send screen was displayed via the Reply button, the sending unit's name will be selected in the Unit Name box.

To send a message to all units in the Unit Name box, select Check All.

To clear units that have been checked, select Check None.

- Type the message. To clear a message, select the Clear button.
- Select Send. The Send Status screen displays.

GLOBAL POSITIONING SYSTEM

7-134. The LHMBC expansion pack contains a built-in GPS receiver. If the LHMBC detects the expansion pack, the GPS can be enabled from the System Startup Settings screen. An external GPS antenna may be connected to the LHMBC using the external GPS connector located on the right side of the expansion pack.

Notes. 1. See TM 9-1220-255-13&P for ordering information.

2. The correct Map Mod (GEOREF) must be entered to obtain a GPS position.

Setup and Initialization

7-135. To display the GPS Status screen, take the following actions:

- Select Menu.
- Select Setup.
- Select GPS.

7-136. The GPS Status screen (see figure 7-28) displays the following fields:

- 000 State.
- 001 Position.
- 002 GPS Accuracy.
- 003 Satellite designation numbers.
- 004 Strength of a satellite signal.
- 005 ALMANAC AGE or 005 NO ALMANAC.
- 006 Crypto key status.
- 007 Software.
- 008 NUM SVS Tracking.
- 009 NUM Health SVS.

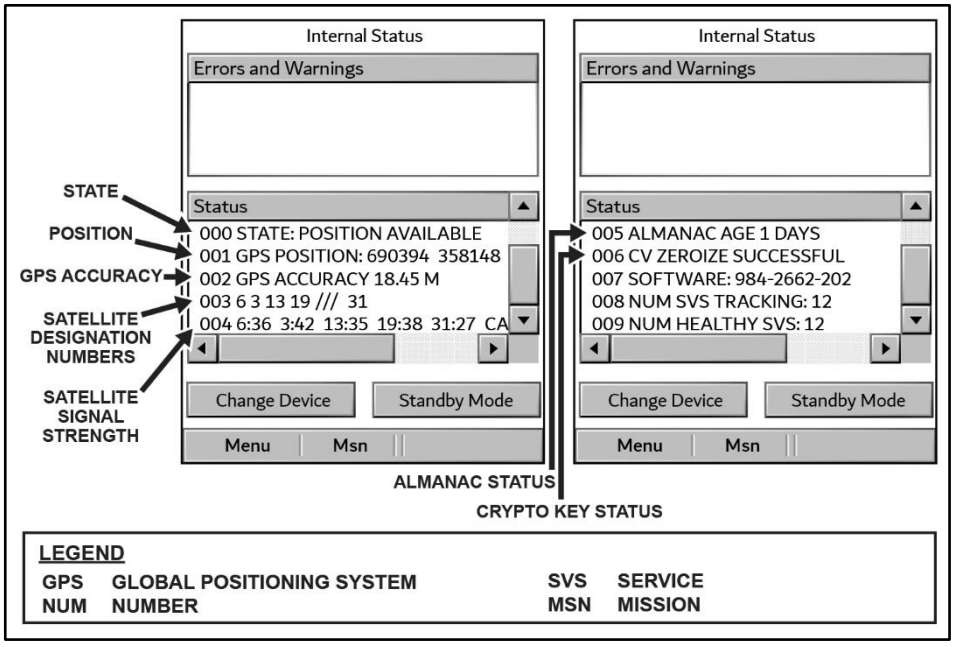


Figure 7-28. Global Positioning System Status screen

000State

7-137. This field displays the following:

- Initialize.
- Searching.

- Position available.
- Unknown.

001Position

7-138. This field displays the present position only when the State field displays "Position Available."

002GPS Accuracy

7-139. This field indicates the accuracy of Position. The LHMBC requires the accuracy to be 25 meters or less before displaying the position.

003Satellite Designation

7-140. This field indicates the five satellite designation numbers that the LHMBC is tracking and the good/weak signal indicator. A slash serves as the good/weak indicator; satellites to the right of the slash have weak signal strength. For example, 003 4 13 11/10 20 indicates that satellites 4, 13, 11, 10, and 20 are the five satellites currently being tracked by the LHMBC. Satellites 4, 13, and 11 have good signal strength; satellites 10 and 20 have weak signal strength.

004Strength of Satellite

7-141. This field indicates the strength of a satellite signal. For example, 004 4:36 13:42 11:32 10:12 20:0 indicates that satellite 4 has a signal strength of 36, satellite 13 has a signal strength of 42, and so on.

7-142. Signal strength ranges from 0 (no signal) to 50 (max signal). A signal strength of 30 to 40 is usually strong enough for the GPS to receive data.

005ALMANAC AGE or NO ALMANAC

7-143. This field indicates the age of the almanac in days. When the GPS is using NO ALMANAC or an almanac that is more than a few days old, it will take longer to acquire a position.

006Crypto Key

7-144. This field displays the crypto key status. The status displayed fields are shown in table 7-5. GPS keys are required if satellite signals are scrambled.

Table 7-5. Global Positioning System crypto key status and meaning

Crypto Key Status	*Meaning*
Not Keyed	No key has been loaded.
No Key for Today	The key loaded is invalid or expired.
Contains Today's Key	The key is in use.
Today's Key Incorrect	The group unique variable (GUV) crypto key is invalid.
Waiting for satellite vehicle (SV) Data	The Lightweight Handheld Mortar Ballistic Computer (LHMBC) is waiting for the satellite vehicle; the crypto key may be installed but is too old.
Crypto variable (CV) Zeroize Successful	The crypto variable and almanac have been zeroized.
CV Zeroize Failed	The Global Positioning System (GPS) has failed to zeroize. Perform a soft reset, and then attempt to zeroize the GPS. If the problem continues, perform a hard reset. Attempt to zeroize the GPS again. If problem persists, evacuate the LHMBC to unit maintenance. ***Note.*** See TM 9-1220-255-13&P for soft and hard reset procedures.
Key Loaded	This message is displayed for approximately 2 seconds when loading the key.

Legend: CRYPTO—cryptographic; TM—technical manual

Standby Mode

7-145. Use standby mode to turn the GPS off and save power. The initial position will be available within 20 minutes of being switched back to continuous mode.

Global Positioning System Communications Security Key

7-146. To fill the LHMBC—

- Select Menu.
- Select Setup.
- Select GPS. The GPS Status screen displays.

7-147. The LHMBC does not require the operator to be on the GPS Status screen to receive the fill, but this will enable the operator to verify that the LHMBC has received the crypto key and confirm its status.

Zeroizing the Global Positioning System Crypto Key

7-148. The GPS crypto key may be zeroized from the Maintenance screen. This process will also zeroize the GPS almanac. To launch the LHMBC Maintenance screen from the desktop—

- Select Start.
- Select Maintenance.
- Select Zeroize GPS.
- A call box will display to confirm zeroizing the GPS. Select Yes. Now the GPS key and almanac are zeroed.

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Chapter 8

Lightweight Handheld Mortar Ballistic Computer Fire Missions

This chapter will cover the LHMBC fire missions. The sequence of actions from the initial CFF to the EOM is standard for all CFFs, although some steps may be omitted or repeated. This chapter includes three sections: special considerations, basic fire missions, and advance fire missions. The LHMBC can handle up to six active missions at a time.

SECTION I – SPECIAL CONSIDERATIONS

8-1. This section covers the special considerations for firing specific missions either with or without an FDC. It will cover direct lay/direct alignment and hipshoot.

DIRECT LAY/DIRECT ALIGNMENT

8-2. The direct lay mission generates the proper charge, elevation, fuze setting, and TOF to engage a target at a designated range. In the direct lay method, the gunner sees the target through the mortar sight. Directional posts, aiming posts, FOs, or FDCs are not used. The LHMBC includes the direct lay mission as an automated FT/ballistic calculator. To fire a direct lay mission, take the following steps:

- Select mission (Msn).
- Select Manual Missions.
- Select Direct Lay.
- When the Direct Lay Mission screen displays (see figure 8-1, page 258), enter the range to the target and the VI between the target and the mortar position (optional). If the target is above the mortar position, select Up. If the target is below the mortar position, select Down.
- Enter the appropriate weapon type from the pull-down menu.
- Enter the proper charge from the pull-down menu.
- Enter the proper fuze from the pull-down menu.
- Select Calculate.
- When the LHMBC displays the proper charge, elevation, fuze setting (when applicable), and TOF, enter subsequent range corrections in the Adj field.
- If the target's estimated range has increased, select Add; if it has decreased, select Drop.

8-3. Figure 8-1 shows the Direct Lay Mission screen before and after the Calculate button has been selected. Figure 8-2, page 259 depicts a correction being entered. After the correction has been entered by selecting Calculate, the Display field and the radio button are cleared. The new charge, elevation, fuze setting, and TOF are displayed.

Note. For more information about the procedures used to conduct a direct lay mission, see TC 3-22.90.

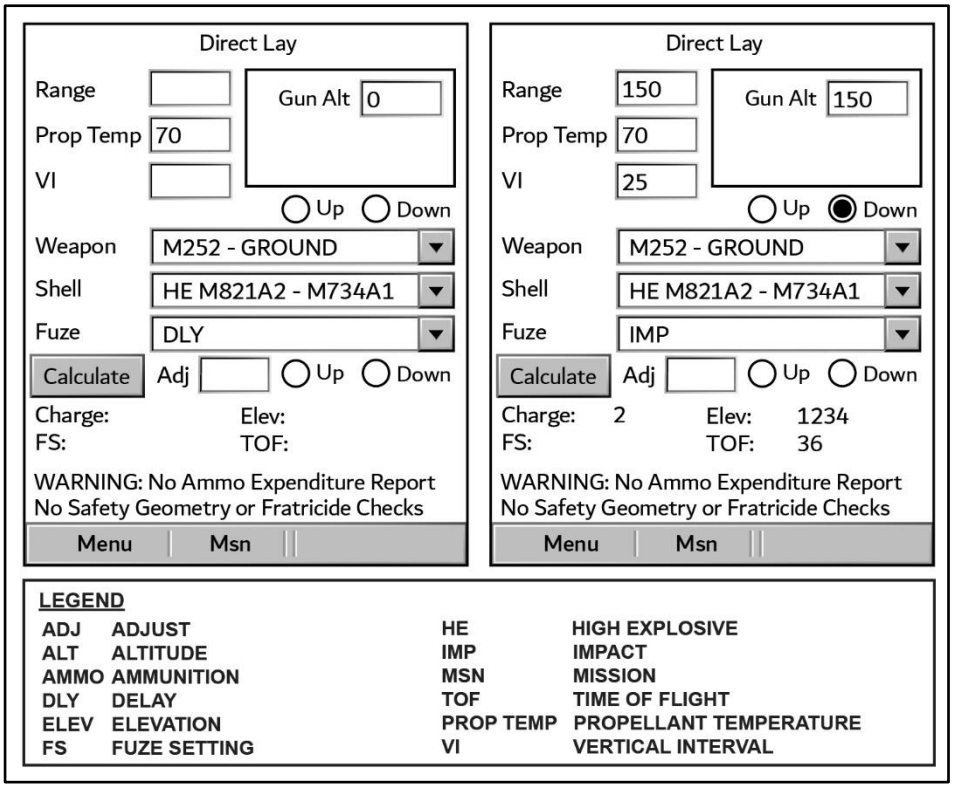


Figure 8-1. Direct Lay Mission screen

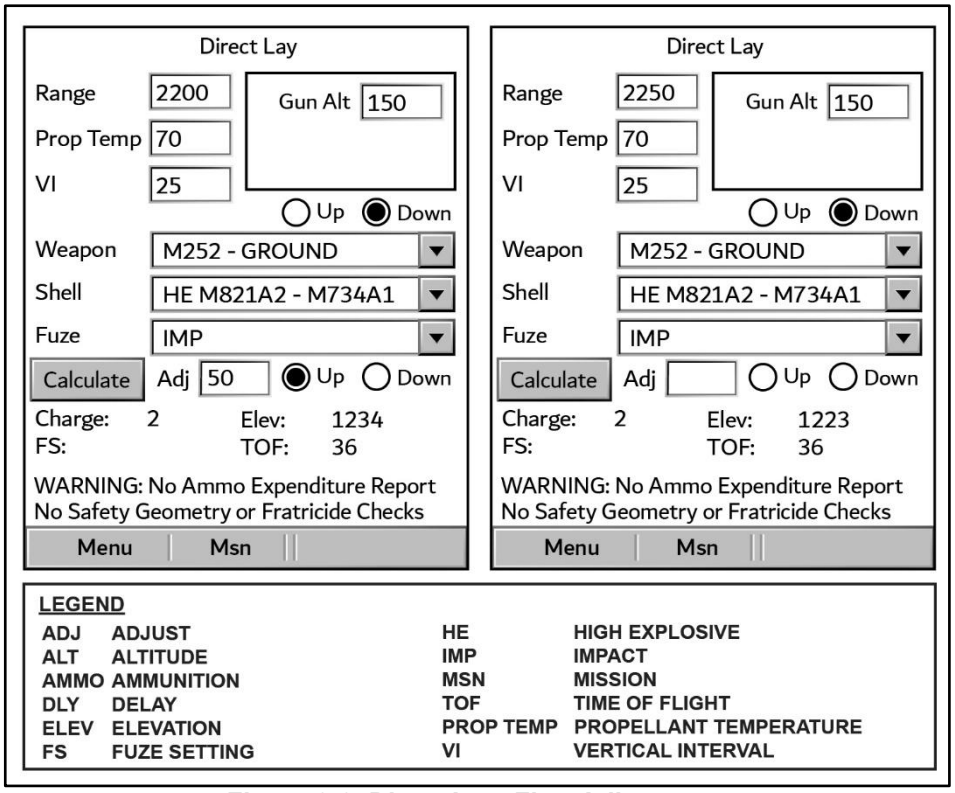


Figure 8-2. Direct Lay: First Adjustment

HIPSHOOT

8-4. Hipshoot missions provide a means to obtain firing data when the firing unit is on the move. When firing a hipshoot mission, the only set-up information required before entering the mission is the GEOREF.

8-5. After recording the CFF on DA Form 2399, take the following actions:

- Select Msn.
- Select Manual Missions.
- Select Hipshoot.
- After the Hipshoot Mission screen displays (see figure 8-3, page 260), enter the location, the target location, and the proper weapon, shell, and fuze type.

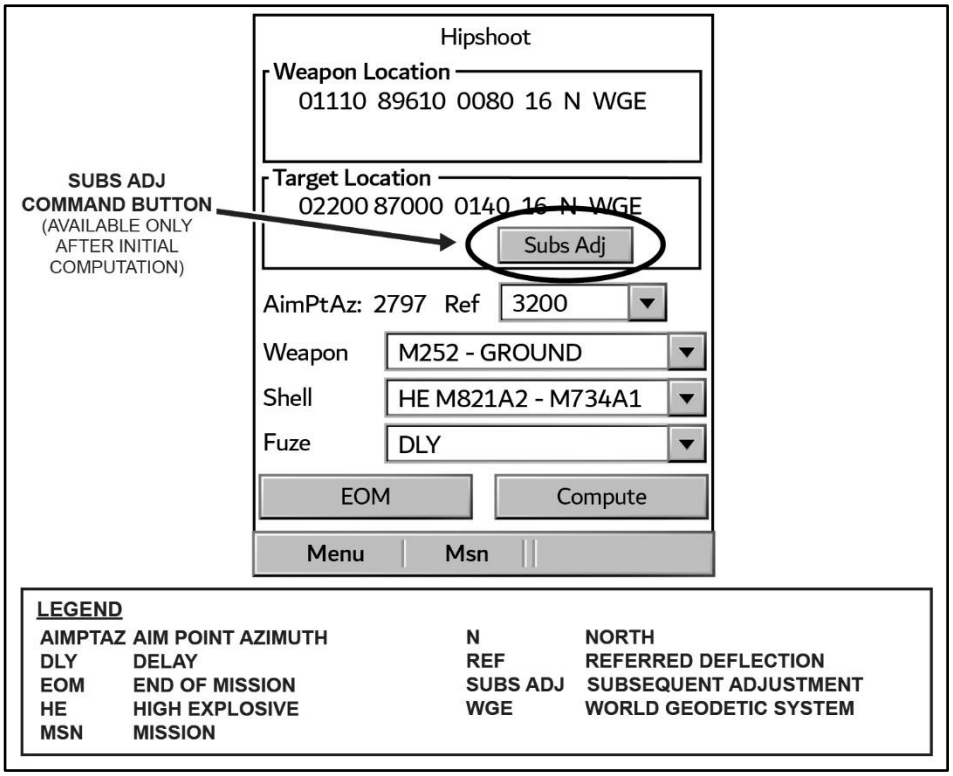


Figure 8-3. Hipshoot Mission screen

- Select a Ref from the quick-fill values (0700, 2800, or 3200), or enter a value between 0000 and 6399 manually.
- Select a fuze. The available fuze options will correspond to the shell and fuze selected. For example, the M734A1 multioption fuze may be set to delay (DLY), impact (IMP), or PROX.

Note. Unlike other basic missions, there is no target screen for the hipshoot mission, nor is the ammunition list updated when the mission is completed.

- Select Compute to process the mission.
- The Hipshoot Solution screen displays (see figure 8-4). All solution and safety data for the hipshoot mission is displayed on the Hipshoot Solution screen.

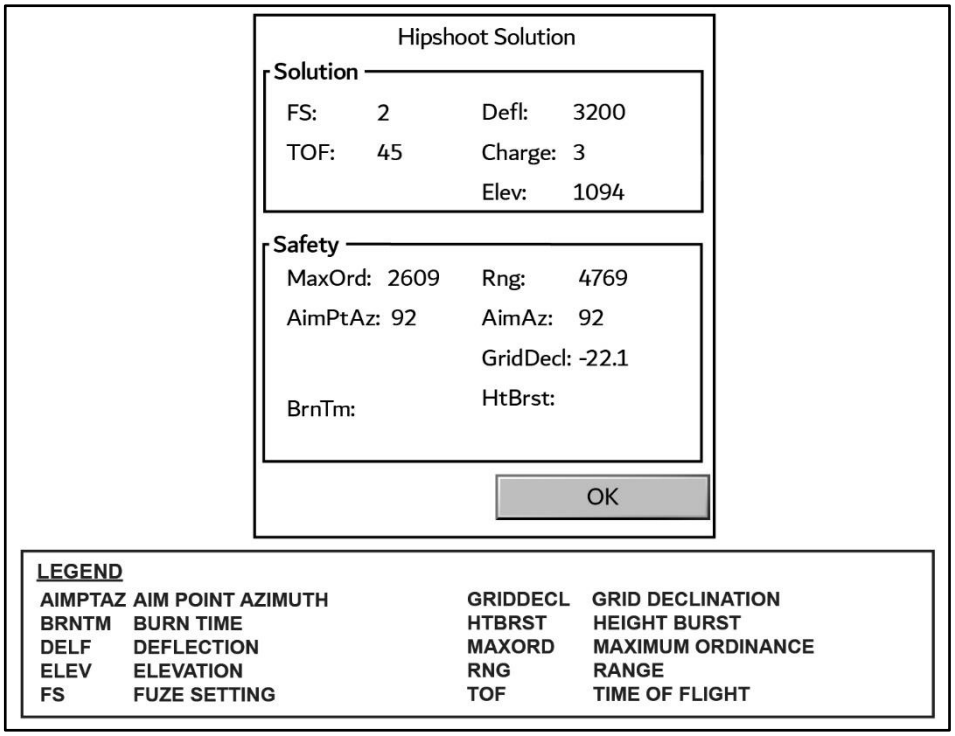


Figure 8-4. Hipshoot Solution screen

- Select OK.
- The Hipshoot Mission screen displays.

8-6. To process observer corrections on the Hipshoot Mission screen, take the following actions:

- Select Subs Adjust in the Target Location field.
- The Hipshoot Subsequent Adjust screen displays (see figure 8-5, page 262).

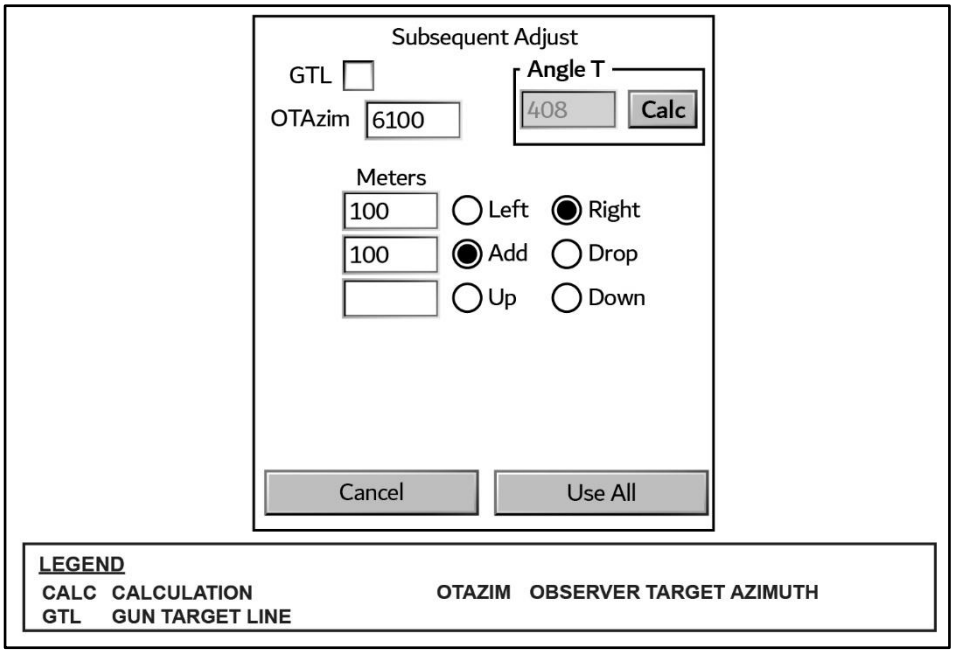


Figure 8-5. Hipshoot: Subsequent Adjustment screen

Note. This screen is like the Subsequent Adjust screen used for grid missions, except this screen has no MOC, MOF; and the <Target> Mission control button has been replaced with the Cancel button. Select Cancel to return to the Hipshoot Mission screen without processing data.

- Make the appropriate adjustments.
- Process the adjustments by selecting Use All.
- The Hipshoot Solution screen displays.

8-7. After EOM has been announced by the FO, take the following actions:

- Select EOM from the Hipshoot screen.
- The Hipshoot EOM screen displays (see figure 8-6).

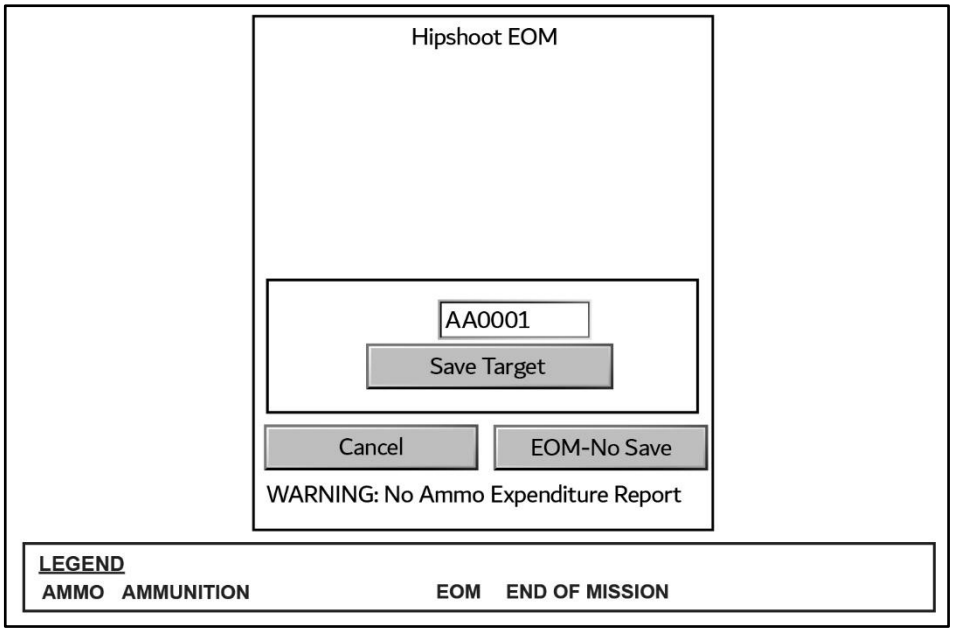


Figure 8-6. Hipshoot: End of Mission screen

- Save the target as a known point or a target or end the mission without saving by selecting the EOM-No Save control button.

Note. To save a mission as a known point, the FO who called the mission must be entered in the Unit list.

SECTION II – BASIC FIRE MISSIONS

8-8. Analog missions are fire missions that the FDC does not receive digitally from the FSE or FO. A fire mission can be received from the FO by radio or any other form of verbal communication.

Note. Chapter 7 describes the steps required to initialize the LHMBC. Initialization must be performed before processing most fire missions.

8-9. All manual missions are initiated from the Manual Missions menu. (See figure 8-7, page 264.) To access this menu, select Msn, and then Manual Missions. The Manual Missions submenu is displayed. This menu lists the method of target location for all manual missions.

Note. The following LHMBC grid mission screens depict an actual fire mission. This example uses no sheaf corrections (Reg/MET).

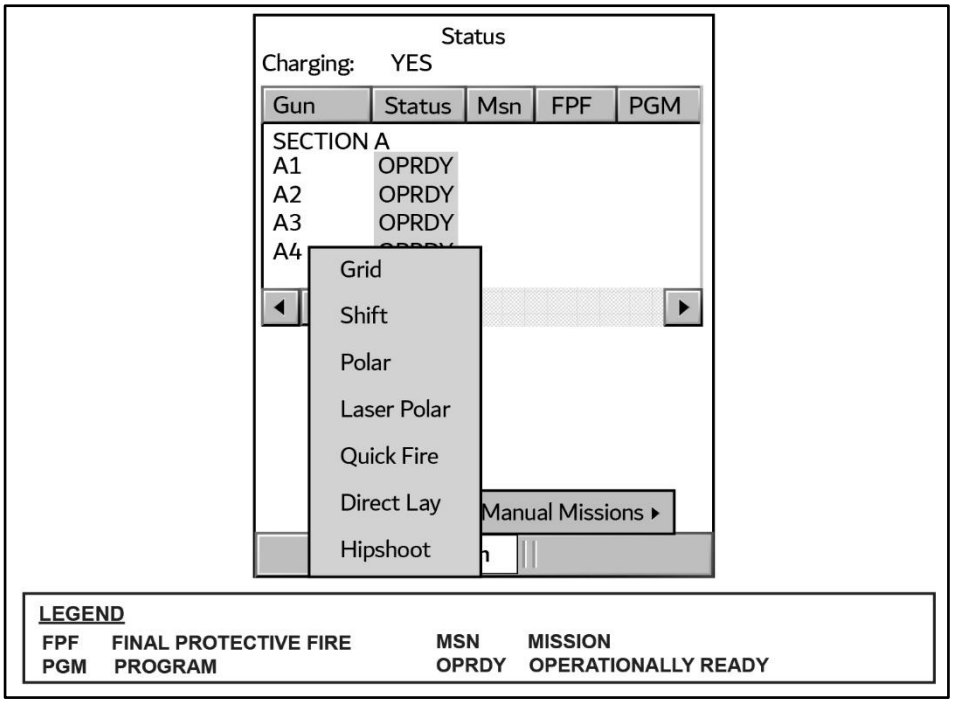


Figure 8-7. Manual Missions menu

MARK CENTER SECTOR

8-10. Marking the center of sector orients the mortar section towards the center of the unit's area of responsibility and the FO uses the marking round as a reference point for the FO's own orientation and follow-on targets.

REGISTRATION

8-11. If time and the tactical situation permit, registration will be the first mission fired. A registration mission requires surveyed target and mortar positions. It follows the steps of a normal mission, but the Mission Type is REGISTRATION. Enter Mission Grid mission until the FFE stage by taking the following actions:

Notes. 1. For a complete overview of registration, see chapter 9 of this publication.

2. This chapter illustrates an LHMBC manual registration mission.

- Select Msn.
- Select Manual Missions.
- Select Grid Msn. The Grid Mission screen displays (see figure 8-8).

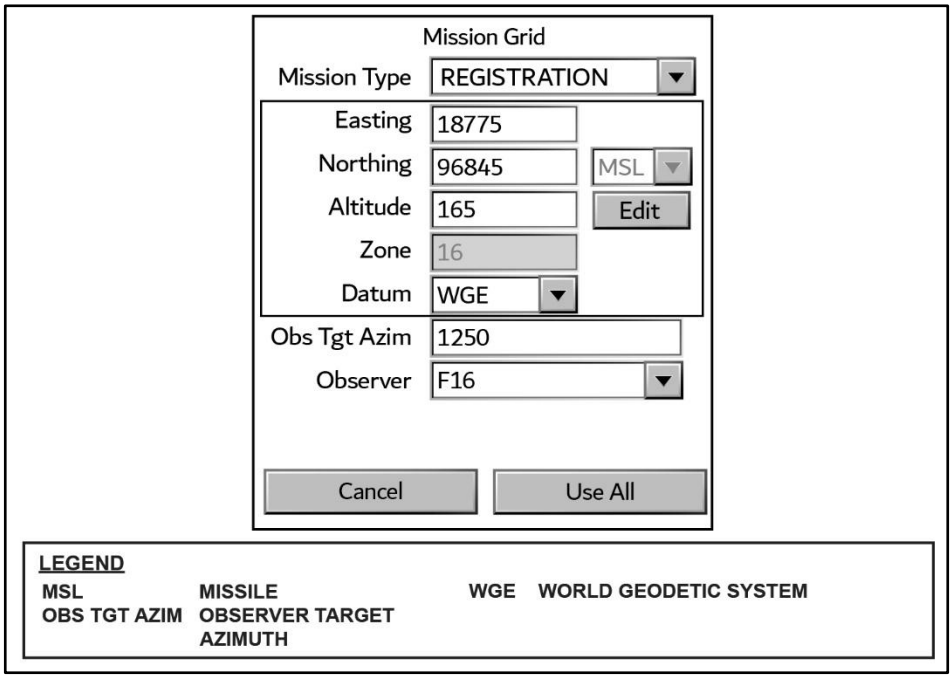


Figure 8-8. Registration: Mission Initialization screen

- Change Mission Type from HE ADJ to REGISTRATION.
- Select Use All.
- The Mission Data screen displays.
- Verify that the Mission Data information is correct.
- Select Use All.
- The Solution/Gun Orders screen displays (see figure 8-9, page 266).

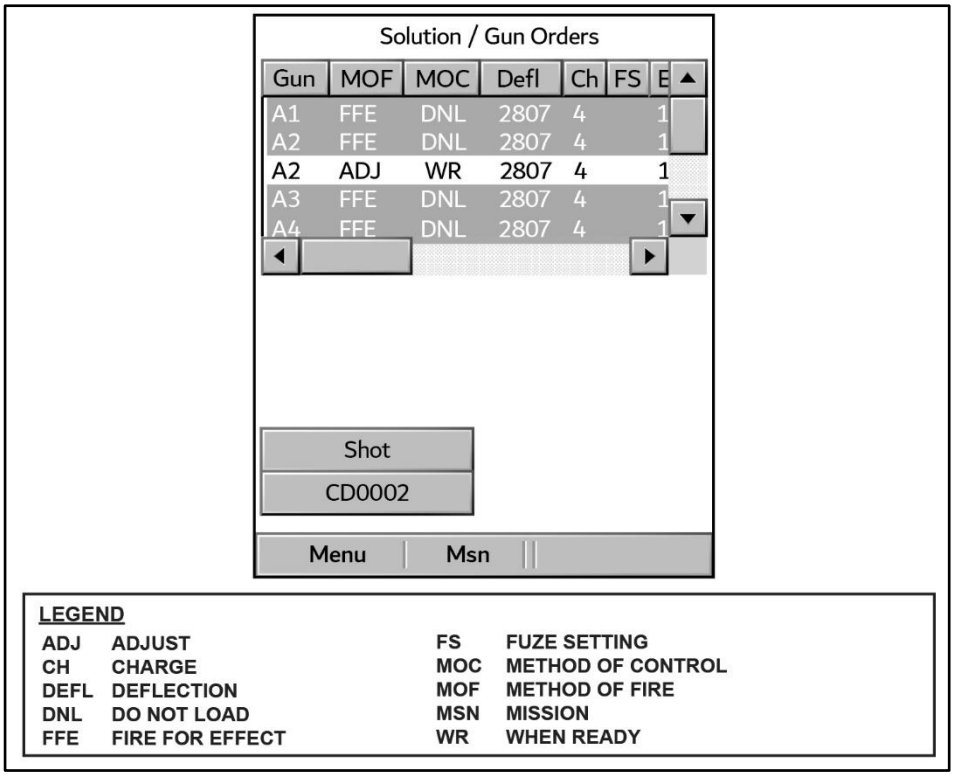


Figure 8-9. Registration: Solution/Gun Orders screen

- Select Shot.
- The Shot Clock displays.

Notes. 1. The Shot Clock counts down to zero.

2. If operating digitally, the FO receives both shot and splash notifications.

- Select the <Target>Mission button (AA0006 CD0002 in the example).
- The <Target>Mission screen displays.
- Enter corrections by selecting Subs Adjust.
- The Subsequent Adjust screen displays (see figure 8-10).
- Make the appropriate adjustments using the Left, Right, Add, Drop, Up, and Down buttons in the Meters field.
- Select Use All.
- The Solution/Gun Order screen displays.
- Continue adjusting in this manner until the adjusting gun is adjusted.
- When the adjusting gun is adjusted, change the MOF field to FFE.
- Select Use All.
- The Solution/Gun Order screen displays.

- Record the Solution/Gun Orders Data.

Note. If corrections the deviation correction exceeds 50 meters (deviation left or right only), the mortar must be refired.

- Enter the appropriate information in the proper fields on DA Form 2399.

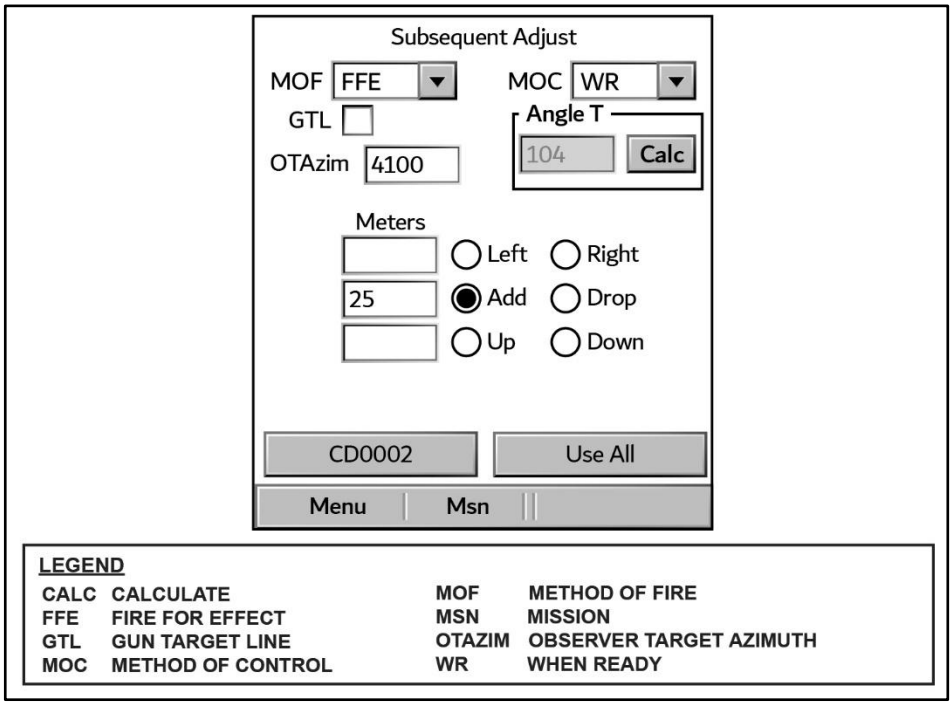


Figure 8-10. Registration: Final Subsequent Adjustment

EXAMPLE

FO Call: Add 25. Registration complete.

8-12. To enter the FFE stage, MOF must be changed to FFE. As an example—

- From the Subs Adjust screen, change MOF to FFE and input Add 25.
- Select Use All.
- The Solution/Gun Order screen displays (see figure 8-11, page 268).

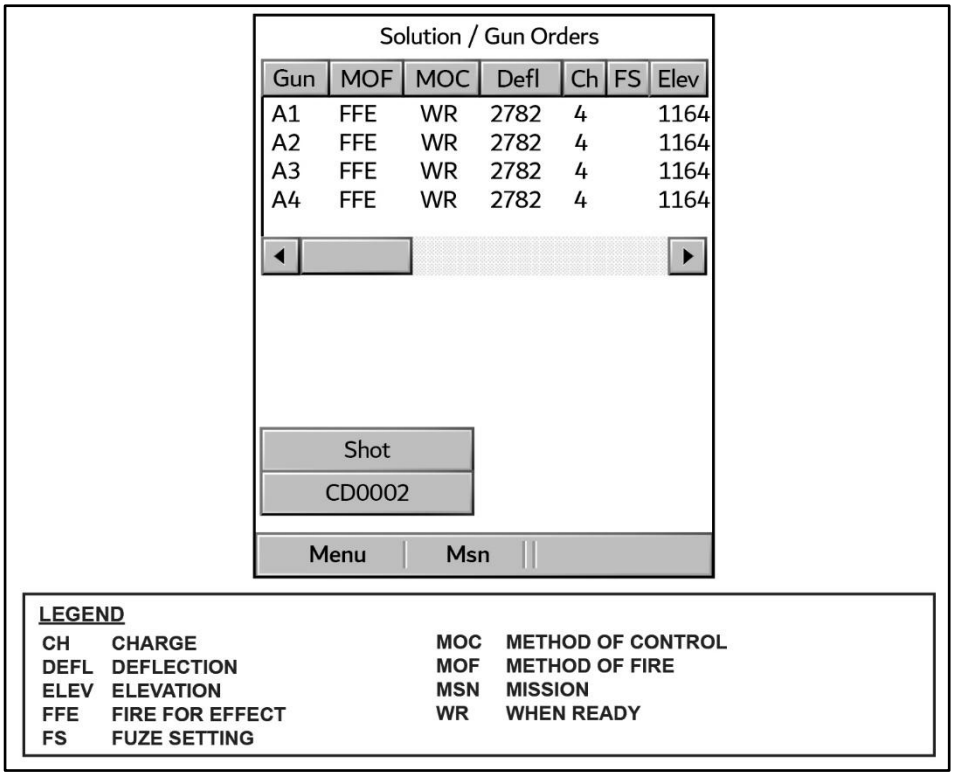


Figure 8-11. Registration: Fire for Effect Solution screen

- Record the Solution/Gun Orders data.
- In the Mortar to Fire and Method of Fire columns of DA Form 2399, enter SEC S/R 1RD Number 2 DNF (Section - Section Right, 1 Round, Number 2 Gun Do Not Fire).

Note. Now the sheaf must be adjusted to ensure that the mortars are firing parallel to each other. The FDC coordinates with the FO to determine the MOF. If the FO requests, for example, section right, the mortars will fire the sheaf, starting from the right (Number 1 Gun), with a set interval (normally 5 seconds) between the rounds.

- Select the <Target>Mission button.
- The <Target>Mission screen displays.
- Select Adj Sheaf.
- The Adjust Sheaf screen displays (see figure 8-12).

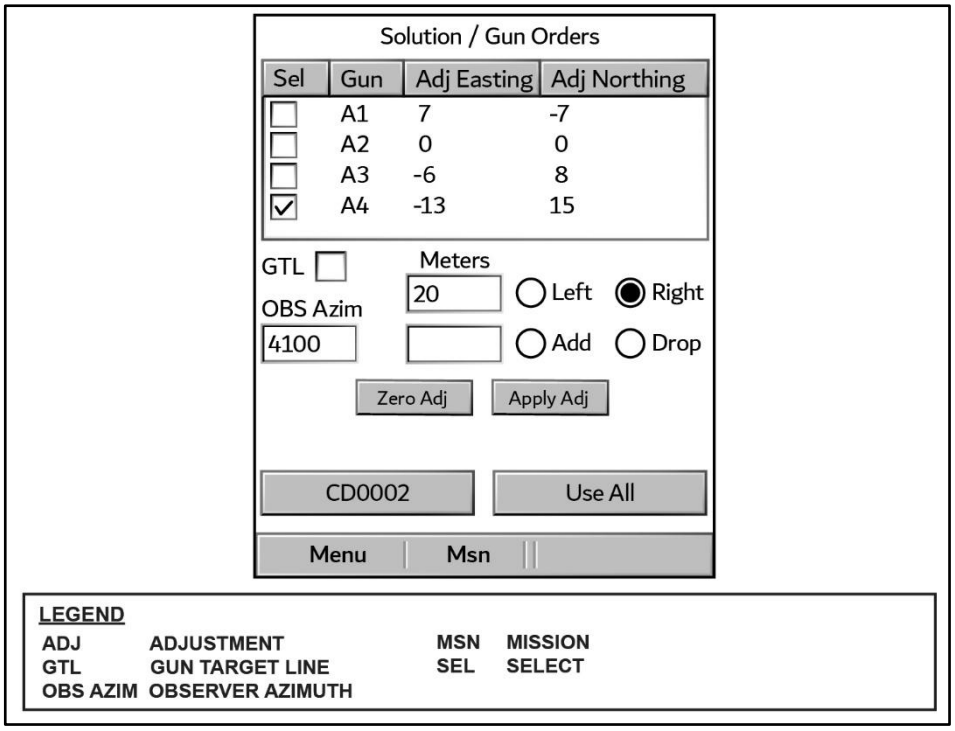


Figure 8-12. Registration: Adjust Sheaf screen

- Enter the corrections for each gun.
- Select Use All.

Note. A warning (see figure 8-13, page 270) displays if the calculated impact point of the guns does not conform to the requirements of a parallel sheaf. This message is normal.

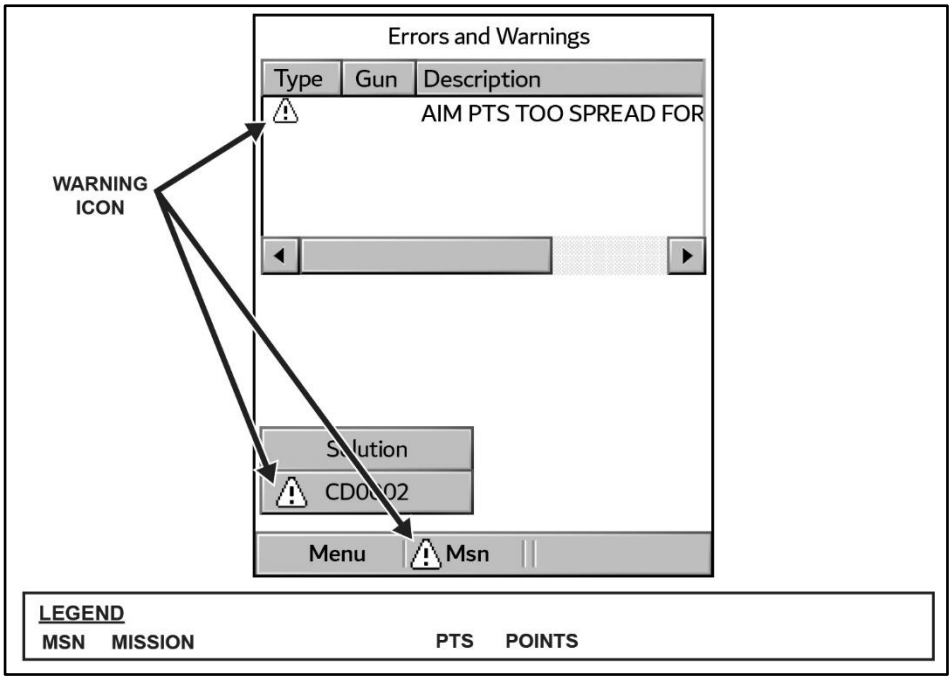


Figure 8-13. Registration: Error and Warnings screen

- The Solution/Gun Orders screen displays, and the firing data is recorded.
- Announce new data, such as deflections (DFs) and MOFs.
- If the adjustment is more than 50 meters, the mortar must be refired.
- Select the <Target>Mission button.
- The <Target>Mission screen displays.
- Select EOM.
- Select EOM – No Save.
- The Save Registration Point screen displays (see figure 8-14). This screen displays the range correction factor (RngCF) and the azimuth correction factor (AzCF).

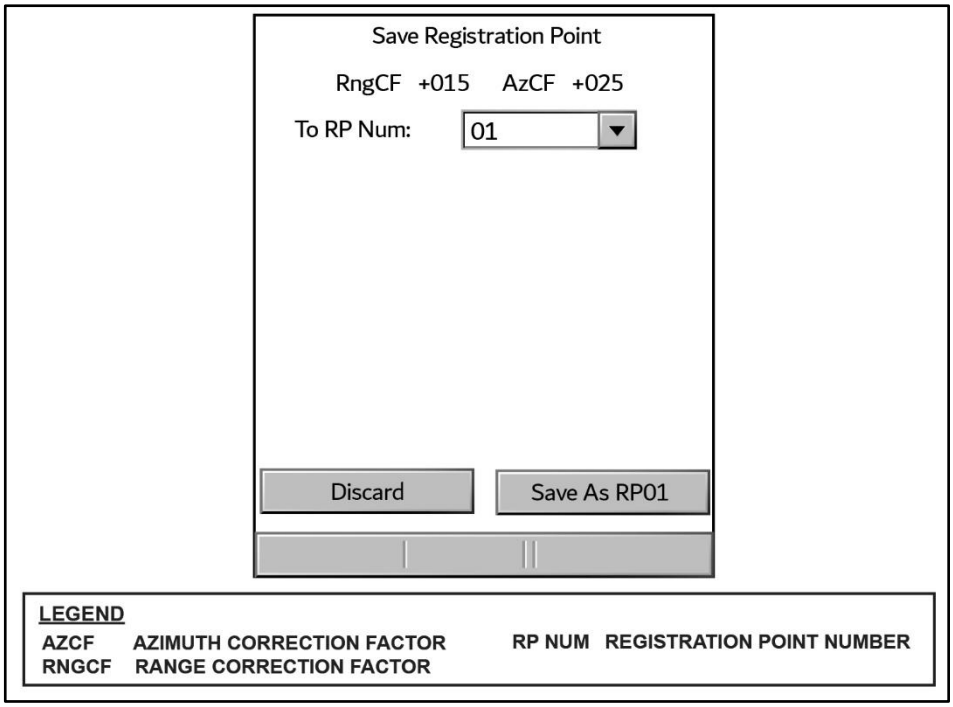


Figure 8-14. Registration: Save Registration Point screen

- Record this information on DA Form 2399.
- Select Save As RP01.
- The Ammunition Expended screen displays.
- Ensure that the number of rounds expended for each gun is correct.
- Select Use All.
- The Status screen displays.
- Update DA Form 2188-1 accordingly.

GRID

8-13. After recording the CFF on DA Form 2399—

- Select Msn.
- Select Manual Missions.
- Select Grid Msn.
- The Grid Mission screen displays (see figure 8-15, page 272).

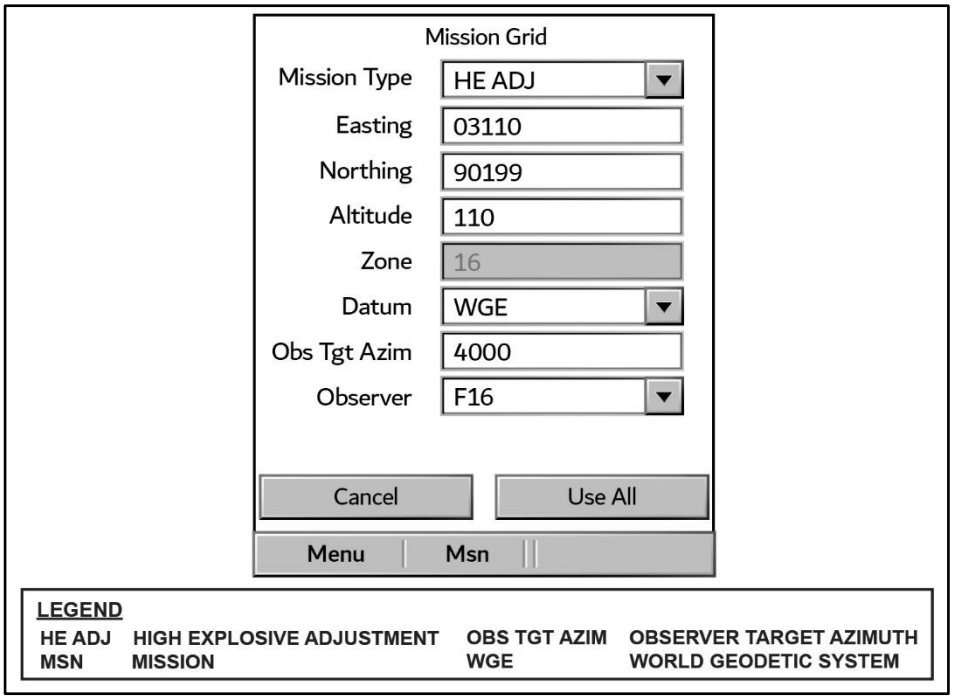


Figure 8-15. Manual Grid Mission entry

- Enter all required information in the Grid Mission screen fields (see table 8-1).

Table 8-1. Grid Mission screen fields and related information

Field	*Related Information*
Mission Type	The Mission Type field defaults to HE ADJ. The options for this field include: High-explosive adjustment (HE ADJ). High-explosive fire for effect (HE FFE). Illumination adjustment (ILL ADJ). Illumination FFE (ILL FFE). Immediate Suppression (IM SUPPRESS). Immediate smoke (IM SMOKE). Quick Smoke. Registration. Final protective fire (FPF).
Easting	Easting must be entered in a five-digit format.
Northing	Northing must be entered in a five-digit format.
Altitude	The altitude is not required but is entered if given. If the altitude is not entered, the target altitude will be calculated at the same altitude as the firing unit.
Zone	The Zone field displays the zone entered in the geographic reference (GEOREF) setup and is read only.
Datum	The Datum field is auto filled by the GEOREF. Although a different datum may be selected, it will not be saved for future missions.
Observer Target Azimuth (Obs |TGT Azim)	The observer-target azimuth must be entered before making the first adjustment, or the LHMBC will default to the gun-target line (GTL).
Observer	Identifies the observer calling for fire on the target but is not required to start a mission. Selecting an observer automatically determines the observer-target azimuth.

- Select Use All.
- The Mission Data screen displays (see figure 8-16, page 274). The Mission Data screen allows the operator to enter the MOC and gun or sheaf refinements.

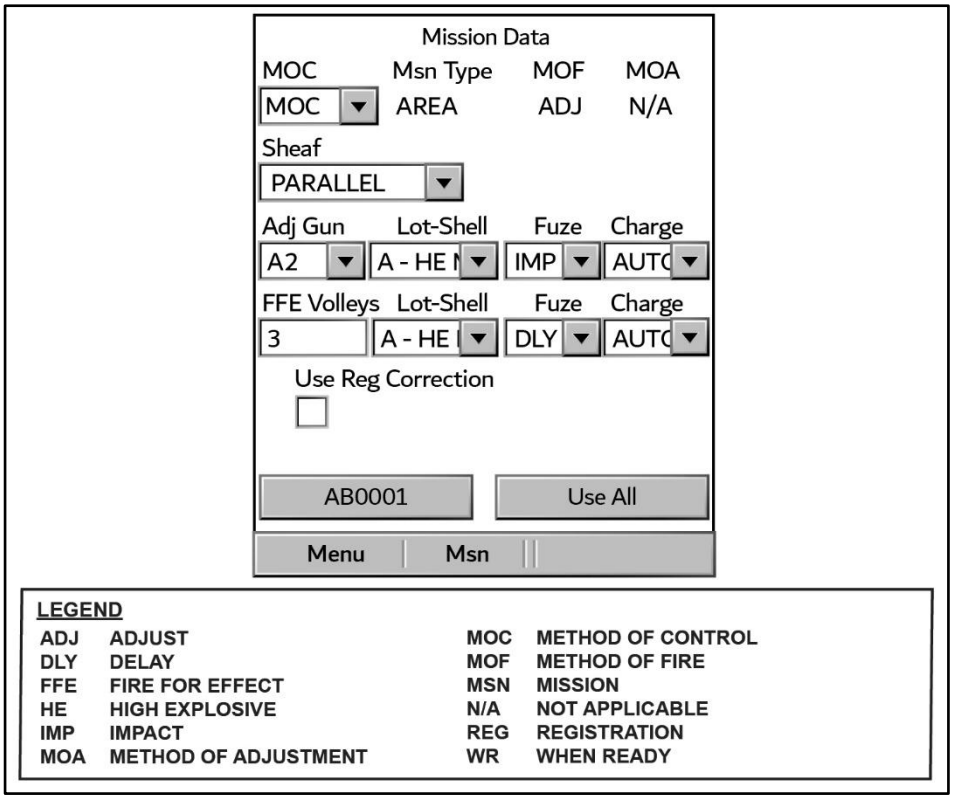


Figure 8-16. Mission Data screen

- Use the fields outlined in table 8-2 to enter and view information.

Table 8-2. Mission data screen fields and related information

Field	*Related Information*
Method of control (MOC)	The options for the MOC field include— At my command (AMC). Do not load (DNL)/ Do not Fire. Time on Target (TOT). When ready (WR).
Mission type (Msn Type)	Msn Type, MOF, and MOA fields are read-only. They are displayed for an operator's reference only. Each field is set according to the mission type selected.
Method of fire (MOF)	
Method of adjustment (MOA)	
Sheaf	The operator must use the ammunition available to determine the mission to be fired and the target description to choose the appropriate sheaf. The options for the Sheaf field include— CONVERGED. LINEAR. OPEN. PARALLEL (default). SPECIAL/CENTER. SPECIAL/FLANK. Search and traverse (SRCH/TRAV). ***Note.*** SPECIAL/CENTER, SPECIAL/FLANK, and SRCH/TRV sheaves will display additional fields for required entries.
Adjusting gun (Adj Gun)	The adjusting gun defaults to the gun to the right of center of the firing unit in reference to initial Mounting Azimuth/DOF (referred deflection). The Fire Direction Center (FDC) operator must ensure that the proper adjusting gun is used for calculations.
Lot, Shell, Fuze, and Charge	These fields allow the operator to designate the ammunition to be fired during the adjustment phase (from available lots) and the fuze setting, and enable the operator to force the charge, if so desired. If the mission is a fire for effect (FFE), there will be no adjustment phase, and these fields will be read-only.
FFE Volleys	These four fields designate the number of rounds to be fired during the FFE phase. The LHMBC defaults to three rounds. ***Notes.*** 1. There must be enough ammunition entered for the number of volleys selected. The Lot-Shell field will only display the appropriate ammunition available from the Ammunition List. The available fuze settings will correlate with the mission type selected (such as., illumination missions will include multioption super quick). See appendix B of ATP 3-21.90 for Joint Munitions Effectiveness Manuals (JMEMs), charts, and additional engagement criteria.
Use Registration Correction (Use Reg Correction)	If a registration point (RP) is recorded, the Use Reg Correction box will be checked. To process a mission without the registration corrections, deselect the checkbox.

- Select Use All.

- If there are no errors or warnings, the Solution/Gun Orders screen displays (see figure 8-17). Table 8-3 outlines all Solution/Gun Orders screen fields and buttons, and related information.

Notes. 1. If there are errors or warnings, they will be displayed on an Errors and Warnings screen. This screen warns the FDC operator of a possible danger or an actual firing violation.

2. The Solution/Gun Orders screen may be accessed from the active mission menu by selecting Solution. The active mission menu (labeled with the mission number) can be accessed by selecting Msn, and then the mission number.

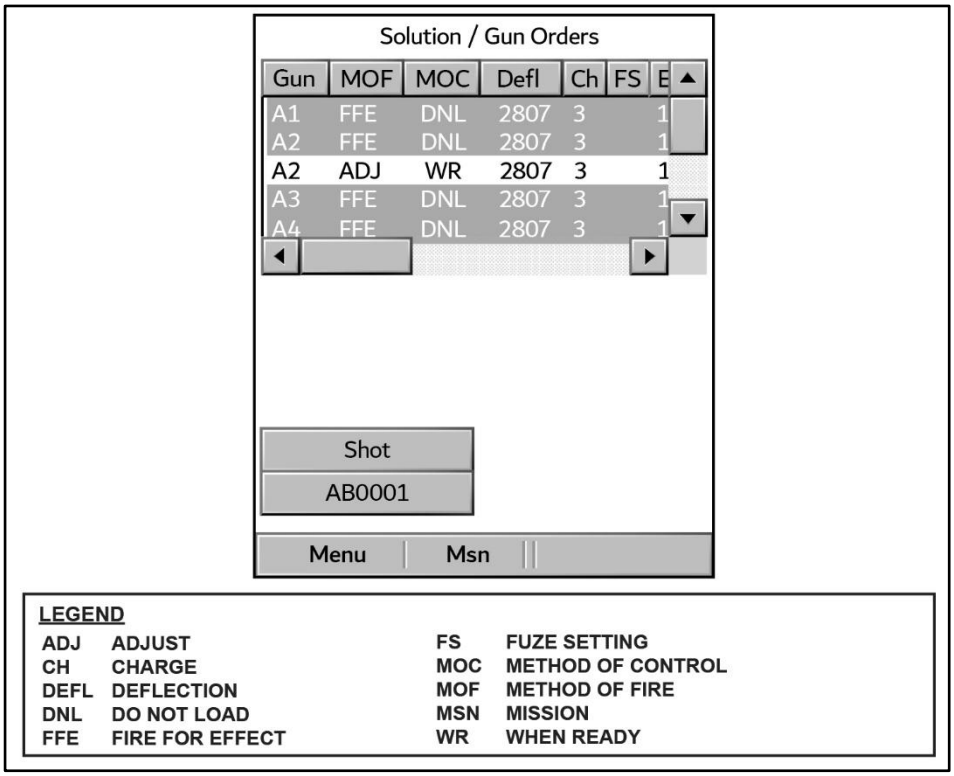


Figure 8-17. Solution/Gun Orders screen

Table 8-3. Solution/gun orders screen fields, buttons, and related information

Field/Button	*Related Information*
Shot button	The shot clock is displayed in the top left corner (with the mission number) and counts down from the time of flight to 0. The Shot button acts as a shot clock in the manual mode and will notify the observer of a shot and splash in the digital mode. This button also acts as an accumulator for the rounds fired for the mission. When ready (WR).
Solution/Gun Orders field	In this field, fire for effect (FFE) data will display for all guns in red during the adjustment phase. This allows nonfiring guns to follow the adjustment more accurately. The adjusting round will display with black lettering on a white background. Gun data may display at the bottom of the screen by selecting the desired line with the stylus and dragging it to the bottom of the screen. ***Note.*** To display the action buttons, tap anywhere outside of the displayed gun data.
Errors/Warnings button	This button displays the Errors/Warnings screen.
Mission button	The Mission button displays the Mission screen.

- Select the Shot button.
- Select the Mission<Target> button.
- The Mission <Target> screen displays (see figure 8-18, page 278):
  - The Mission <Target> screen allows the operator to review, verify, and A/Fs; and modify or end the active mission; and provides access to all mission functions of the active mission.
  - The target number is displayed at the top of the screen (ABA0001 in the example).
  - Table 8-4, page 279 outlines all Mission <Target> screen buttons and related information.

Note. The < Mission Target> screen can be accessed by selecting Msn/<target number>, or by selecting the Mission<Target> button from any mission screen.

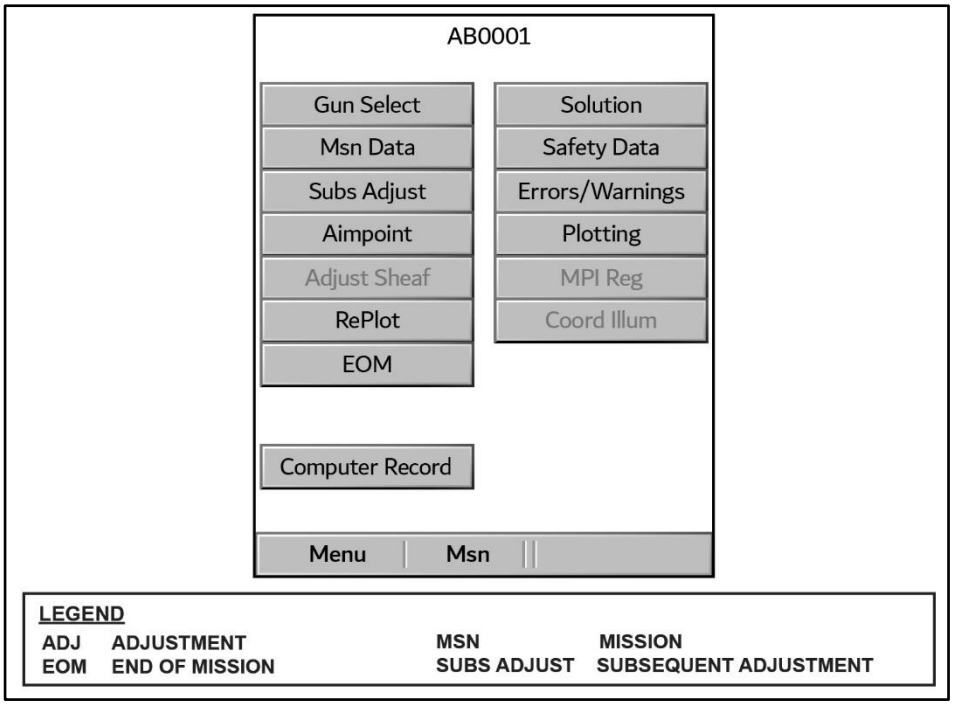


Figure 8-18. Mission screen

Table 8-4. Mission screen buttons and related information

Button	*Related Information*
Gun Select	This button displays a screen used to designate guns to support the active mission. To process two simultaneous missions, for instance, this screen would be used to designate which guns fire each mission.
Mission Data	This button displays the Mission Data screen.
Subsequent Adjustments (Subs Adjust)	This button displays a screen used to input subsequent adjustments.
Aim Point	Aim Point will display the grid-to-grid azimuth from the gun to the target.
Adjust Sheaf (Adj Sheaf)	This button displays the Adjust Sheaf screen. This screen is read-only until the fire for effect (FFE) phase. The Adjust Sheaf screen enables the operator to adjust any gun that is used in the active mission.
RePlot	***Note.*** Section III covers registration and sheaf adjustment.
End of Mission (EOM)	This button displays the Mission RePlot screen. This function is used to designate the altitude of a previously processed target. This will adjust the burst point grid to that of the corrected target height and trajectory.
Computer Record	This button displays the EOM screen.
Solution	The Computer Record stores a chronological history of all information entered for the active mission.
Safety Data	This button displays the Solution/Gun Orders screen.
Errors/Warnings	This button displays the Safety Data screen.
Plotting	The Errors and Warnings screen provides information on any errors or warnings in effect for the current mission.

- Select Solution.
- Select <mission>.
- Select Safety Data.
- The Safety Data screen displays (see figure 8-19, page 280). This screen allows the operator to review and verify the safety data for each gun in the active mission. All guns used in the mission are displayed on the left side of the screen. Data for each gun is listed to the right. Table 8-5, page 281, displays the data fields for this screen.

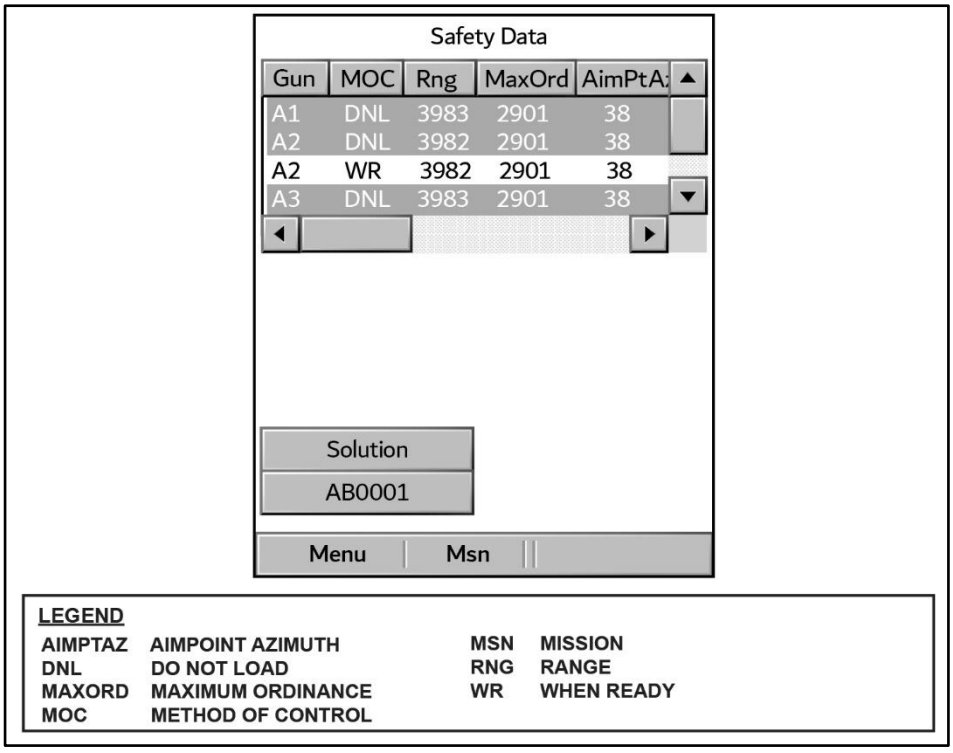


Figure 8-19. Safety Data screen

Table 8-5. Safety data screen fields and related information

Field	*Related Information*
Method of Control (MOC)	The options for the MOC field include— At my command (AMC). Do not load (DNL). Fire for effect (FFE). Time on Target (TOT). When ready (WR).
Range (Rng)	This field contains the range to the target, expressed as a linear horizontal distance to the target. Differences in altitude (slope range) are not included.
Maximum Ordnance (MaxOrd)	This field contains the maximum ordnance, expressed as the actual height of the round at its apex.
Aiming Point Azimuth (AimPtAzim/AimPtAz)	***Note.*** The maximum ordnance considers the actual station height.
Aiming Point	The azimuth from the gun directly to the target (chart azimuth).
Burst Height	This field contains the grid location for the specified gun to impact at its correct location in the sheaf.
Burn Time	This field contains the calculated height at which the round will burst.
Canister Easting	This field contains the amount of time the round will burn before burning out.
Canister Northing	This field contains the Easting to where the canister will impact if the round malfunctions.
Grid Declination	This field contains the Northing to where the canister will impact if the round malfunctions.

- Select the Mission button.
- The Mission screen displays.
- Select Subs Adjust.
- The Subsequent Adjust screen displays. The Subsequent Adjust screen (see figure 8-20, page 282) enables the operator to make gun adjustments. Table 8-6, page 282, displays the data fields for this screen.

Notes. 1. Adjustments may be made using the OT azimuth or, if made from the gun position, using the GTL. If using the OT azimuth, the observer must give the azimuth to the target before the first correction. This may be either a part of the initial CFF or the first part of the initial adjustment transmission.

2. The following LHMBC Subsequent Adjust screen depicts an actual fire mission. This example uses no sheaf corrections (Reg/MET). It uses the following FO call to show the appropriate positioning of information: FO Call: Dir 4000. Left 1200. Drop 1200.

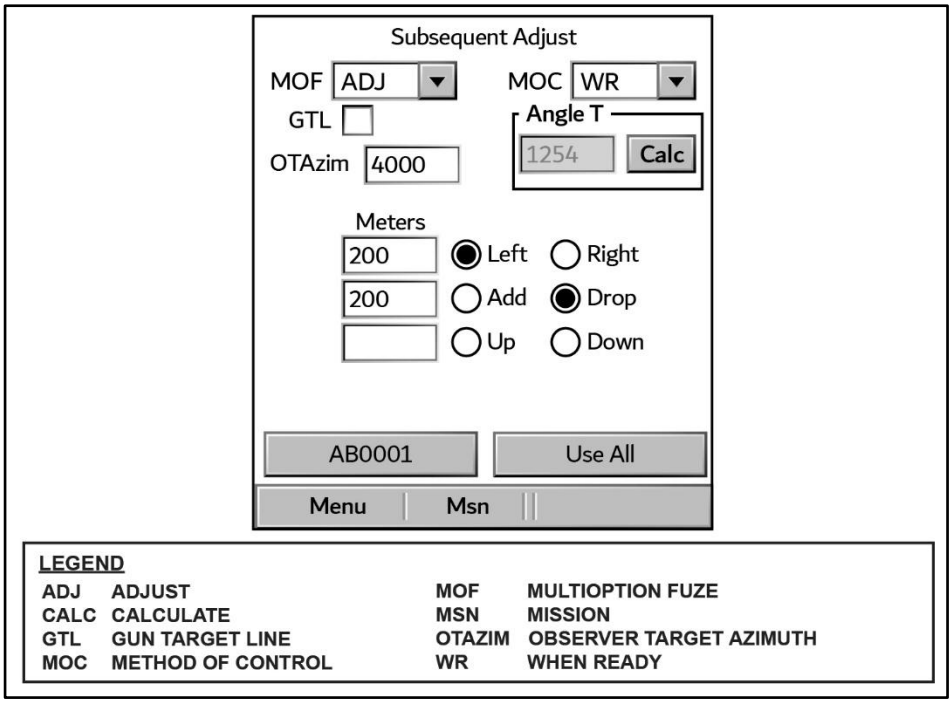


Figure 8-20. Subsequent Adjust screen

Table 8-6. Subsequent adjust screen fields and related information

Field	*Related Information*
Method of Fire (MOF)	MOF options are— ADJ (adjust). CONT (continue). Fire for effect (FFE). Repeat fire for effect (RFFE).
Method of Control (MOC)	MOC options are— AMC (At my command). WR (When ready). DNL (Do not load).

- Select Use All.
- The Solution/Gun Orders screen displays; record Solution Data.
- Select Safety Data, record Safety Data.
- Select Solution.
- Select Shot.
- Select the Mission button.
- The Mission screen displays.
- Select Subs Adjust.
- Change MOF from Adjust to FFE.
- Select Use All.
- The Solution/Gun Orders screen displays; record Solution Data.
- Select Safety Data, record Safety Data.
- Select Solution.
- Select Shot.
- Select the Mission button.
- The Mission screen displays.
- Select EOM.
- The EOM screen displays (see figure 8-21). The EOM screen enables the operator to end the active mission and to discard the data or save it as a target or a known point.

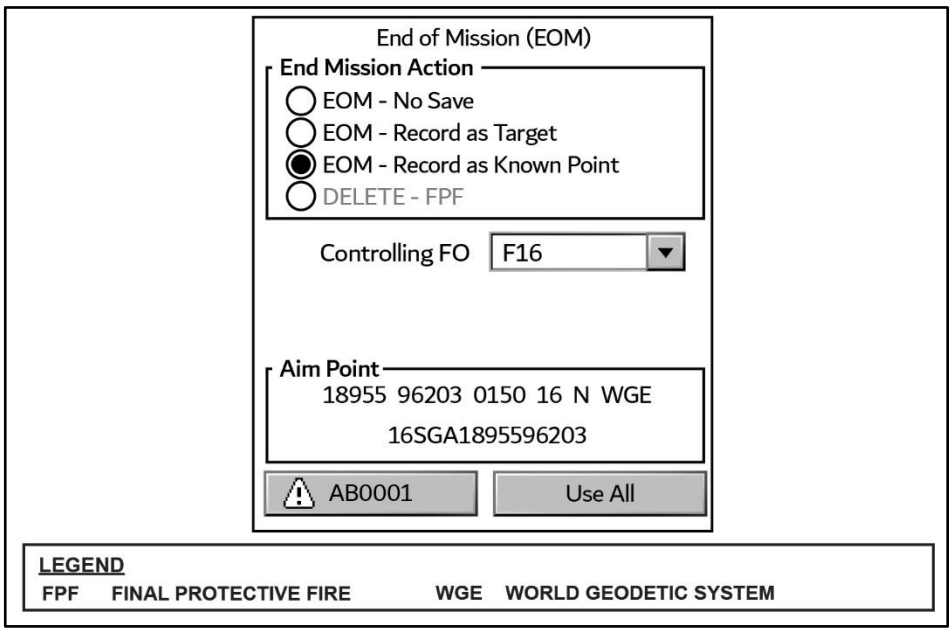


Figure 8-21. End of Mission screen

- Choose one of the selections outlined in table 8-7, page 284.

Table 8-7. End of Mission screen selections and related information

Button	*Related Information*
End of mission (EOM) – No Save	Choose this option to display the Status screen without recording the known point data.
EOM – Record as Target	If the mission is saved as a target, it will be saved as the target number used to fire the mission.
EOM – Record as Known Point	If the mission is saved as a known point, a controlling forward observer (FO) must be selected when saving the mission. After selecting Use All, the Select Known Point Number (KP#) screen displays. The Known Point pulldown menu displays a list of known point numbers, defaulting to the next available known point number. Known point numbers in use will display, with the words “In Use” next to the known point number. If the operator picks a known point number currently in use, the previously stored data for that number will be overwritten, and the Save As KP# control button will display Overwrite KP#. When a known point is entered with a target number, the target also appears on the target screen.
DELETE – final protective fire (FPF)	The DELETE – FPF option is active only during an FPF mission and will end the mission without storing or applying FPF corrections.

- Select Use All.
- The Ammunition Expended screen displays (see figure 8-22). The Ammunition Expended screen enables the operator to view or edit the number of rounds that have been expended by each gun used in the active mission.

Note. The ammunition is displayed as several rounds used of each lot by each gun.

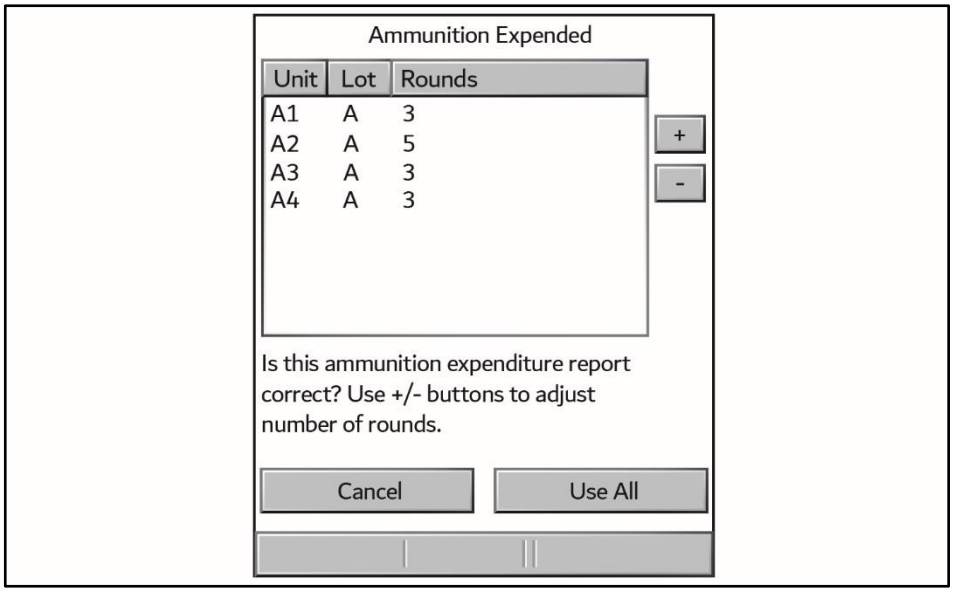


Figure 8-22. Ammunition Expended screen

- Increase or decrease the number of rounds per gun by selecting the gun number, and then using the plus and minus signs to adjust the number of rounds for the selected gun.
- Select Use All to update the ammunition inventory.

Note. If Cancel is selected, the message "Ammo expended for mission must be adjusted manually in inventory" displays.

SHIFT FROM A KNOWN POINT

8-14. Before calling a shift from a known point mission, both the observer's position and the location of the known point must be entered into the LHMBC. After recording the CFF on DA Form 2399—

- Select Msn.
- Select Manual Missions.
- Select Shift Msn.
- The Shift Mission screen displays (see figure 8-23, page 286).

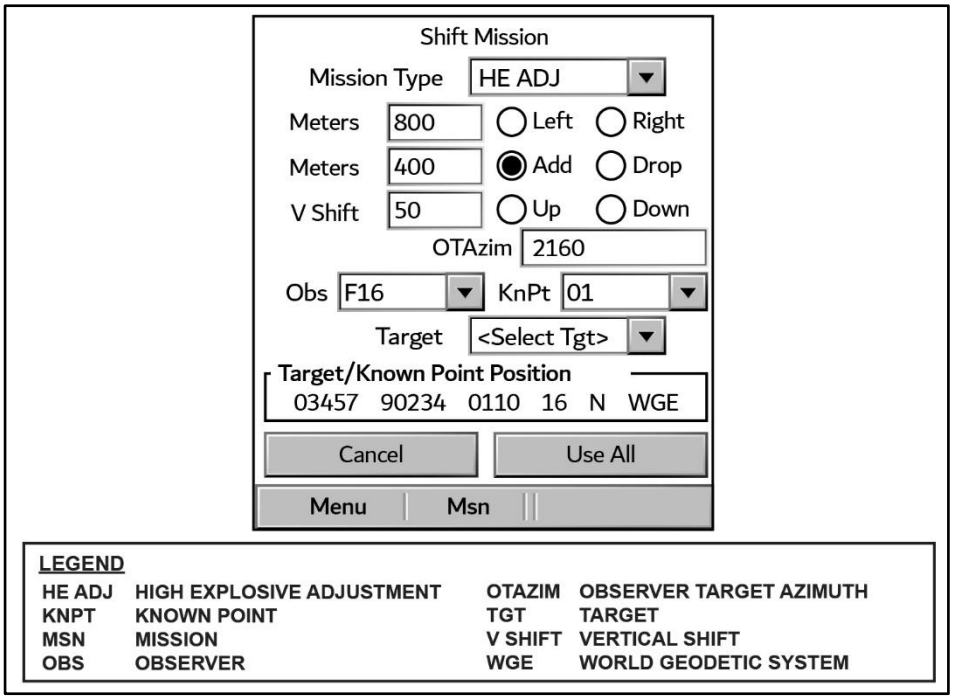


Figure 8-23. Shift Mission screen

- Set the mission type (HE ADJ, HE FFE, illumination adjustment [ILL ADJ], ILL FFE, FPF, or Quick Smoke).
- Enter the observer's name and the number of the known point to be shifted from.
- Enter the observer's name and the number of the known point or target to be shifted from.
- The known point position displays.
- Enter the initial shift data in the appropriate fields.

Note. If no modification is entered into a field, the modification is assumed to be the same as the known point. For instance, if no up or down is given, the altitude for the target will be the same as the known point.

- Enter the OT azimuth.
- Select Use All to process the mission.

Note. After the initial method of target location is given, the mission is completed in the same manner as a basic grid mission.

POLAR PLOT

8-15. After recording the CFF on DA Form 2399—

- Select Msn.
- Select Manual Missions.
- Select Polar Msn.
- The Polar Mission screen displays (see figure 8-24).
- Select the mission type.
- Select the Observer name from pull-down list, and enter the direction, distance, and VI from the observer's location. Enter the unit name and the direction, distance, and VI from the observer's location.

Note. After the initial method of target location is given, the mission is completed in the same manner as a basic grid mission.

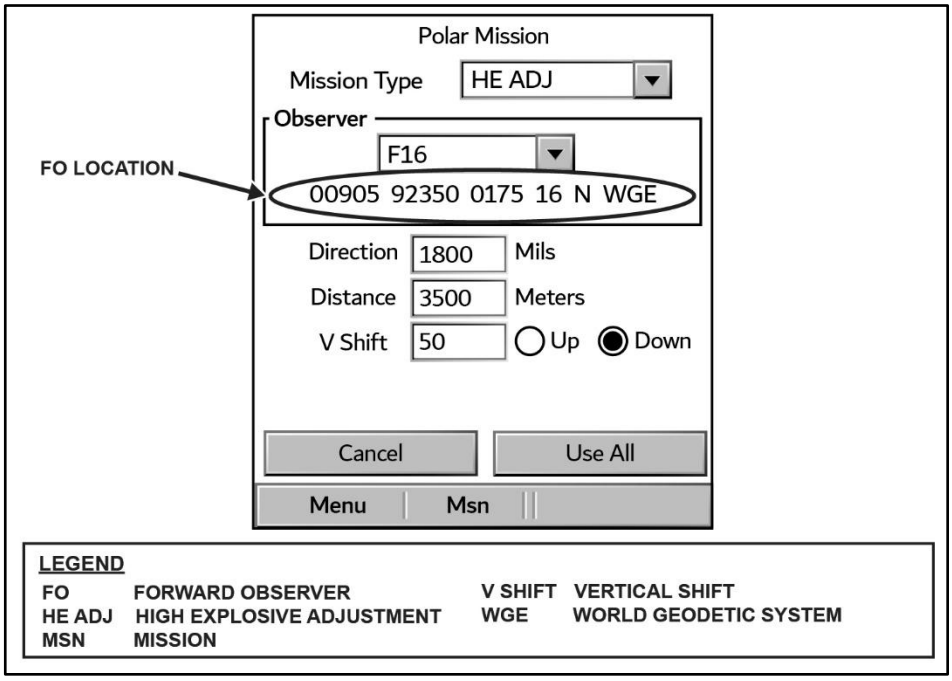


Figure 8-24. Polar Mission screen

IMMEDIATE SMOKE AND IMMEDIATE SUPPRESSION MISSIONS

8-16. When engaging a planned target or a target of opportunity that has taken friendly forces under fire, the FO announces (in the CFF) immediate smoke or IS. The delivery of fires is performed as quickly as possible. Immediate response is more important than the accuracy of these fires.

IMMEDIATE SUPPRESSION MISSION

8-17. The FO uses IS to indicate that the unit is receiving enemy fire. The FO's request is processed at once. These fires are used to suppress the enemy and limit his ability to perform his mission.

8-18. To initialize an IS mission—

- Select Msn.
- Select Manual Missions.
- Select Grid Msn.
- Change the Mission Type to SUPPRESS and complete the rest of the target location information (see figure 8-25).

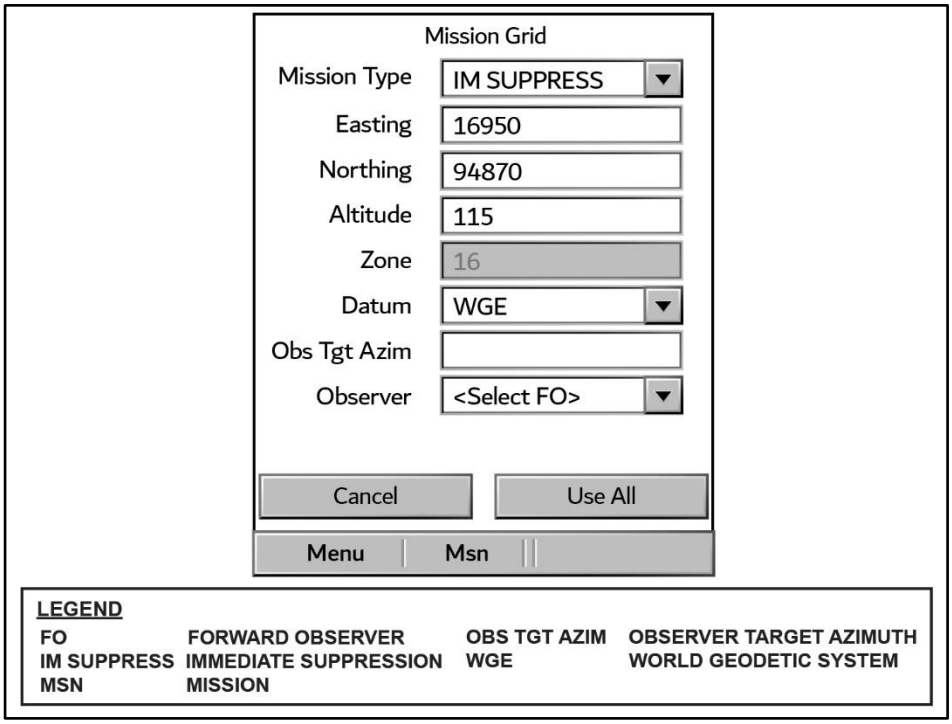


Figure 8-25. Immediate Suppression: Mission Initialization screen

- Select Use All.
- The Mission Data screen displays default FFE volleys of two rounds. The Lot-Shell defaults to HE (see figure 8-26).

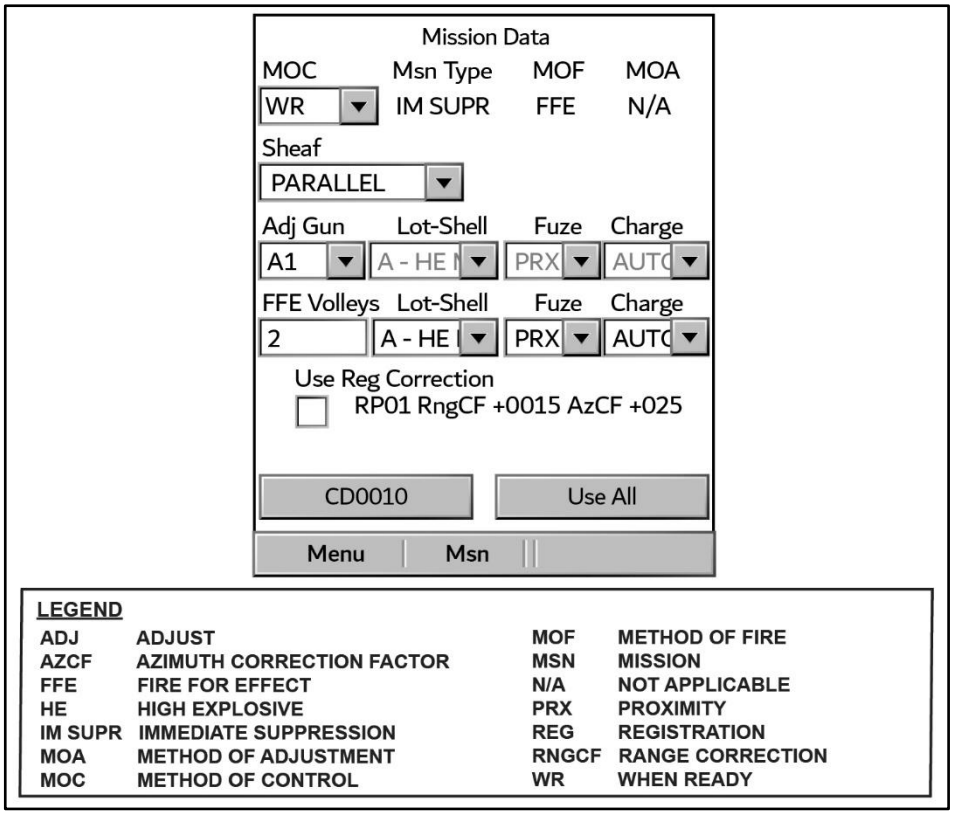


Figure 8-26. Immediate Suppression: Mission Data screen

Note. The default number of guns that are included is two, A1 and A2. (See figure 8-27, page 290.) This may be scaled up or down depending on the target description. The number of guns to be included in the mission may be changed from the Gun Select screen.

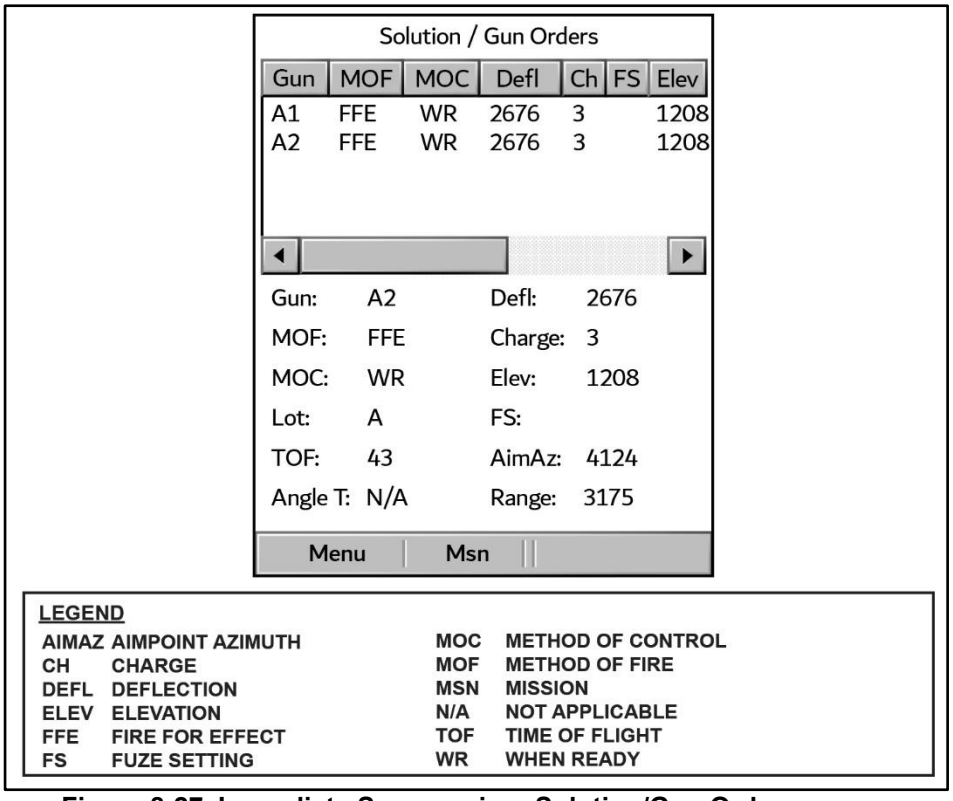


Figure 8-27. Immediate Suppression: Solution/Gun Orders screen

- Upon receipt of an EOM from the FO, end the mission via the EOM screen (see paragraph 8-28, page 318).

IMMEDIATE SMOKE MISSION

8-19. The FO uses immediate smoke to obscure the enemy's vision, allowing friendly forces to disengage. It is not intended as a screening mission.

8-20. To initialize an immediate smoke mission—

- Select Msn.
- Select Manual Missions.
- Select Grid Msn.
- Change the Mission Type to immediate (IM) SMOKE and complete the rest of the target location information (see figure 8-28).

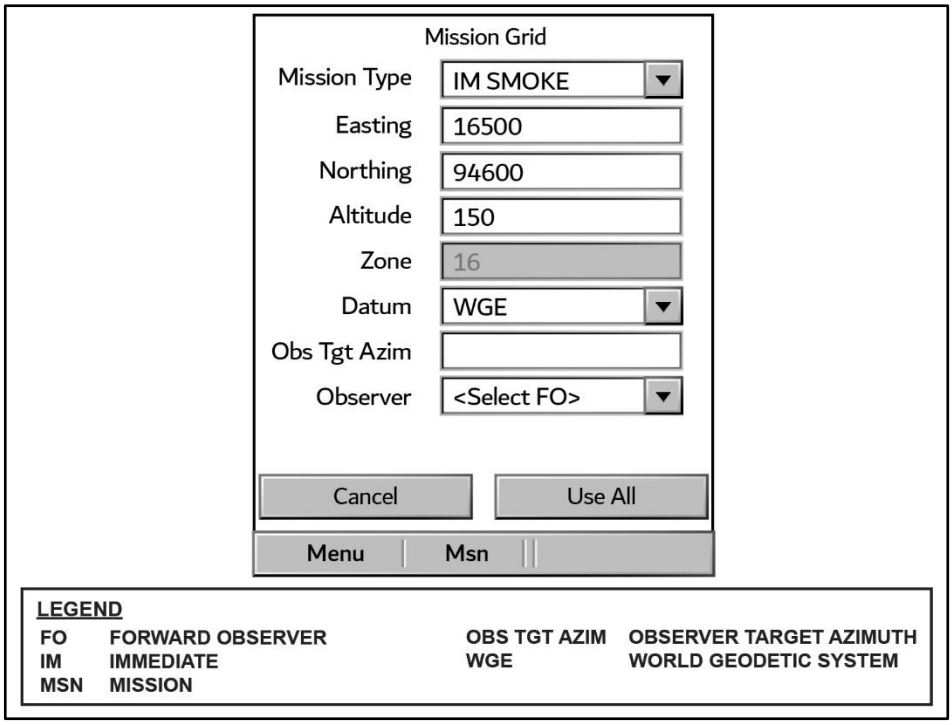


Figure 8-28. Immediate Smoke: Mission Initialization screen

- Select Use All.
- The Mission Data screen displays default FFE volleys of two rounds. The Lot-Shell defaults to RP/WP (see figure 8-29, page 292).

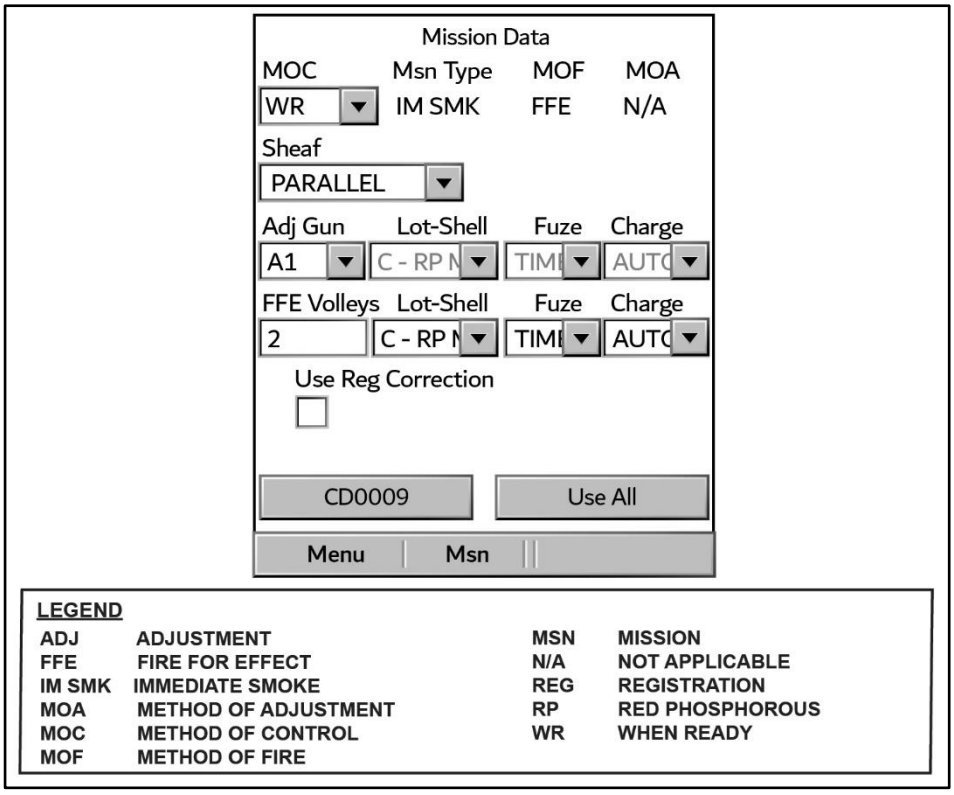


Figure 8-29. Immediate Smoke: Mission Data screen

Notes. 1. The adjusting gun is irrelevant. If adjustments are necessary, all guns included in the mission will fire each adjustment.

2. The default number of guns that are included is two, A1 and A2. (See figure 8-30.) This may be scaled up or down depending on the target description. The number of guns to be included in the mission may be changed from the Gun Select screen.

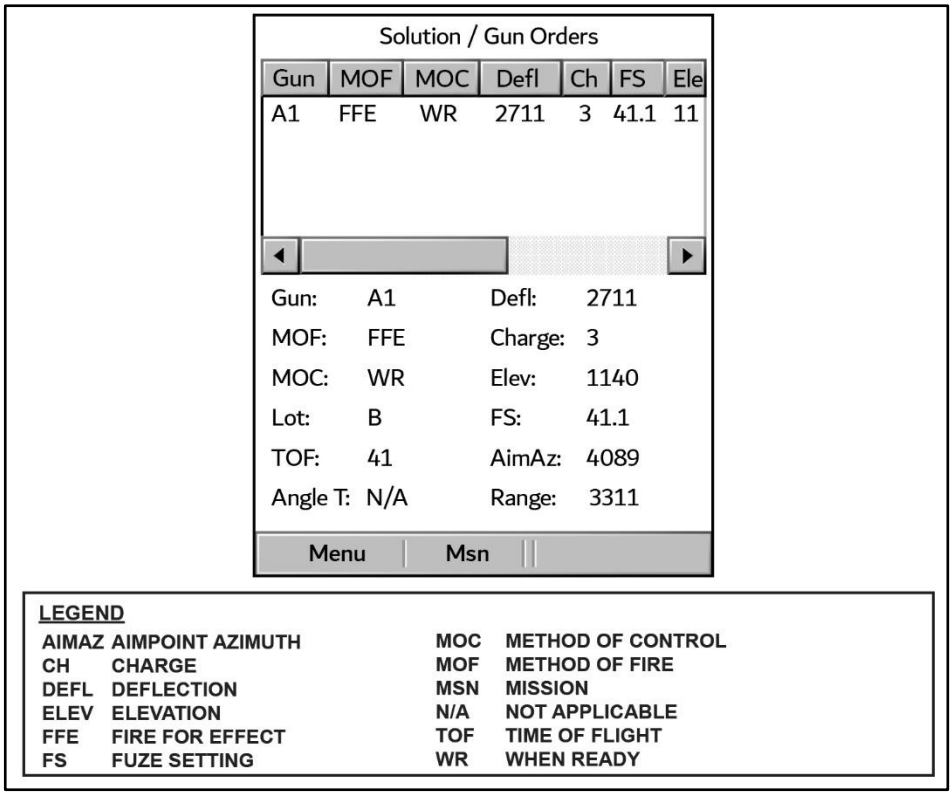


Figure 8-30. Immediate Smoke: Solution/Gun Orders screen

QUICK FIRE

8-21. The quick fire mission is used to fire a previously stored known point or target (for example, an engaged target which has been saved). After recording the CFF on DA Form 2399—

- Select Msn.
- Select Manual Missions.
- Select Quick Fire Msn.
- The Quick Fire Mission screen displays (see figure 8-31, page 294).
- Set the mission type (HE FFE, ILL FFE, IM SUPPRESS, IM SMOKE, or FPF).
- Select the target or known point to be fired from the pull-down menu.
- Verify the target grid displayed in the Target Position field.

Note. After the initial method of target location is given, the mission is completed in the same manner as a basic grid mission.

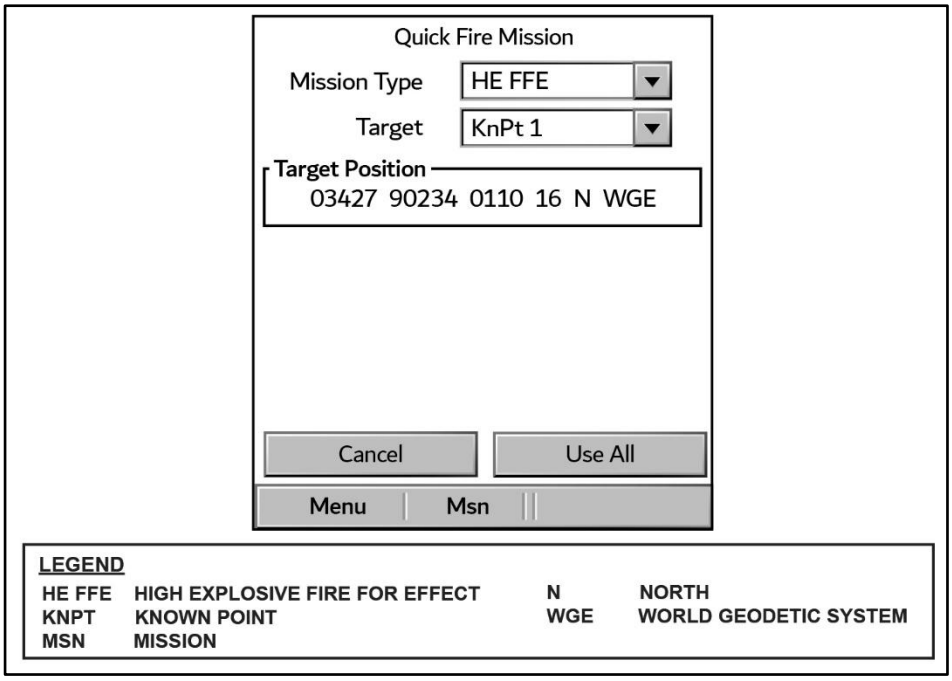


Figure 8-31. Quick Fire Mission screen

ILLUMINATION MISSION

8-22. Illumination missions are used to reveal the location of enemy forces hidden by the cover of darkness. Digital missions are processed as described in section II, with the addition of fuze time settings and vertical adjustments (up or down) as listed in this section.

Notes. 1. A mark time must be recorded for illumination.

2. This paragraph uses a grid mission to illustrate the process of receiving, adjusting, saving, and firing an illumination mission. Missions using polar plots or shifts from a known point are conducted in the same way.

8-23. Upon receipt of a CFF, record the information and initiate the illumination mission using the following procedures:

- Select Msn.
- Select Manual Missions.
- Select Grid Msn.
- The Illumination Mission Initialization screen displays (see figure 8-32).

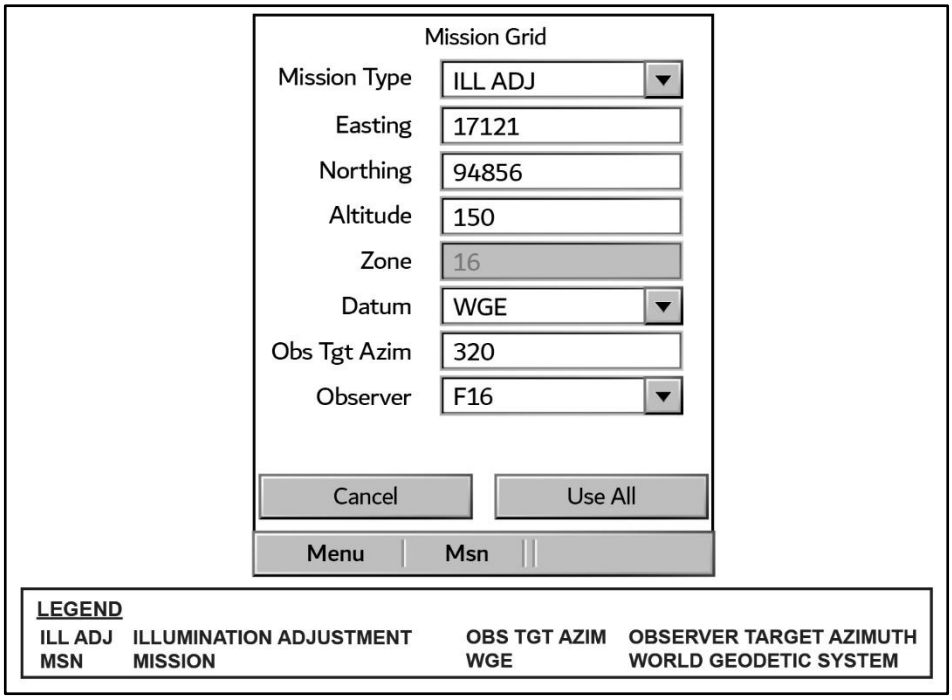


Figure 8-32. Illumination: Mission Initialization screen

- The mission type will be Ill Adj.
- Select Use All.
- The Mission Data screen is displayed.
- Select the <Mission> button.
- The Mission screen displays.
- Select the Gun Select button.
- The Gun Select screen displays (see figure 8-33, page 296).
- Deselect guns A2, A3, and A4 by clearing the appropriate checkboxes.
- Select Use All.
- The Mission Data screen is displayed.
- Select appropriate sheaf from pull-down menu.

Note. The guns selected must match this number.

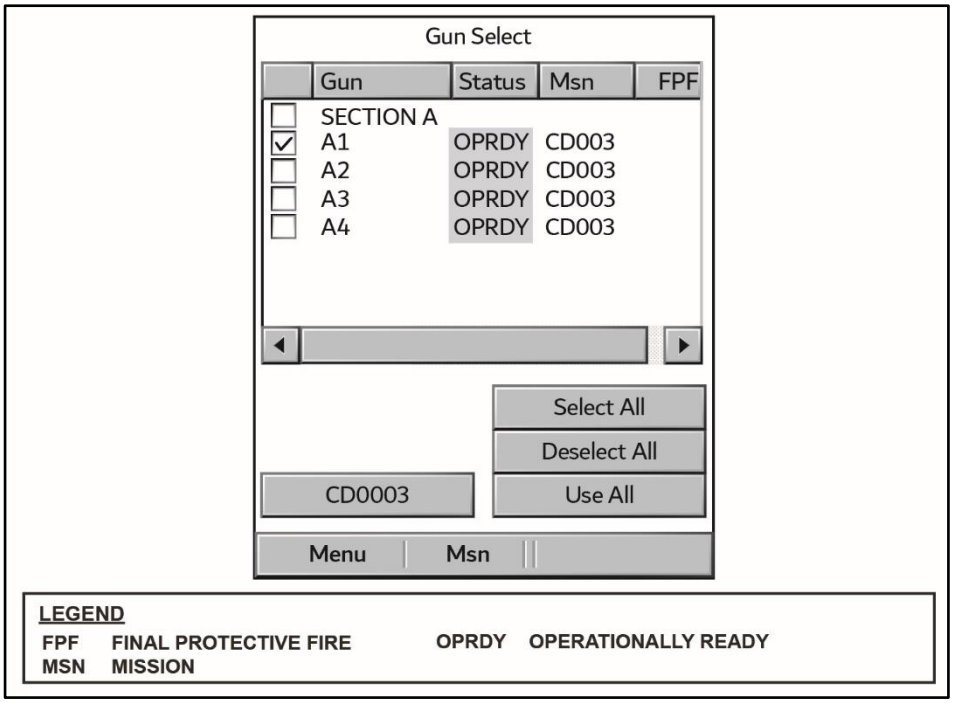


Figure 8-33. Gun Select

Note. Since illumination rounds are selected, a Ground Burst checkbox is displayed. Checking the Ground Burst checkbox will change the Fuze to impact (IMP).

- The Illumination: Targets screen displays (see figure 8-34).

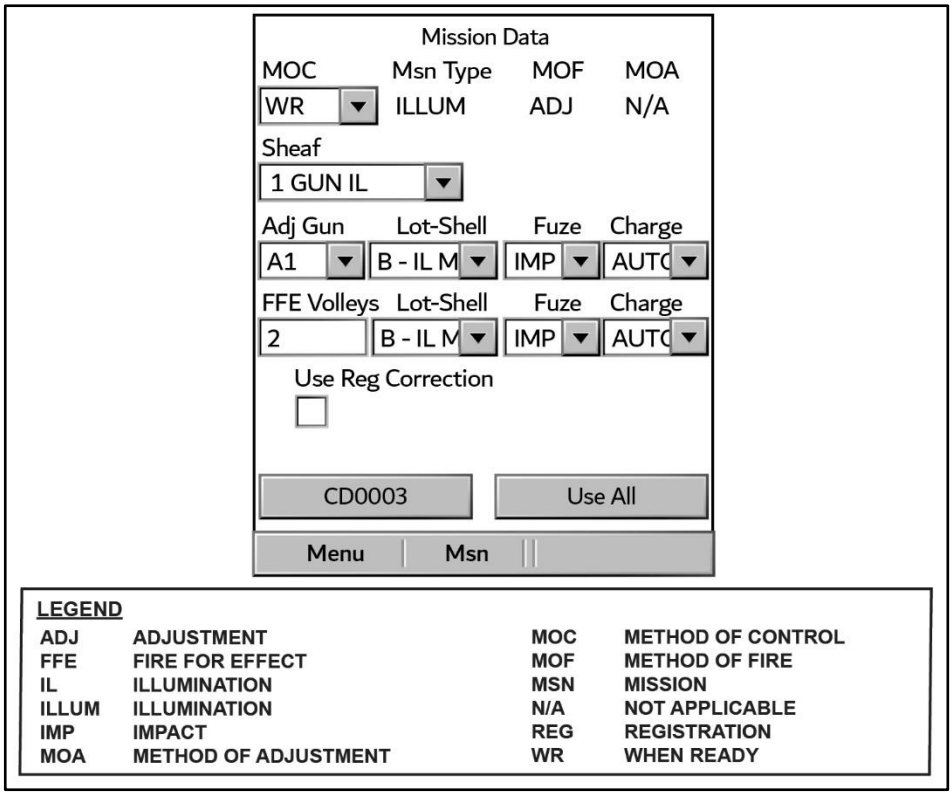


Figure 8-34. Illumination: Targets screen

- Choose the adjusting gun.

Notes. 1. Using a flank gun to fire illumination enables the normal adjusting piece to focus on the task of engaging possible targets. For this example, we will adjust illumination with A1.

2. Checking the Ground Burst checkbox will change the fuze to impact.

- Choose a type of sheaf.

Note. In addition to all the normal sheaves available for HE, ILL makes use of five additional sheaves: 1 GUN IL, 2 GUN IL, 2 GUN IL L, 2 GUN IL R, and 4 GUN IL. The differences in sheaves are indicated in table 8-8, page 298 and table 8-9, page 299. Figure 8-35, page 299 shows illumination coverage by caliber.

Table 8-8. Illumination: additional sheaves and related information

Button	*Related Information*
1 GUN II	This type of sheaf utilizes one gun firing illumination (ILL) rounds.
2 GUN II	This type of sheaf utilizes two mortars to provide greater ILL for a point or area target. The Lightweight Handheld Mortar Ballistic Computer (LHMBC) will provide fire orders for two guns, with calculated burst points for each round (separated by the distances): 120-mm: 105 meters. 81-mm: 60 meters. 60-mm: 45 meters.
2 GUN II L (Lateral)	This type of sheaf utilizes two mortars to provide greater illumination for a linear or area target. The LHMBC will calculate different deflections for each gun, thus producing illumination perpendicular to the gun-target line (GTL) with the resulting calculated burst points centered around the target location, perpendicular to the GTL. See table 8-9 for distance between rounds.
2 GUN II R (Range)	This type of sheaf utilizes two mortars to provide greater illumination for a linear/area target. The LHMBC will calculate different elevations for each gun, thus producing illumination along the adjusting gun's gun-to-target line with the resulting calculated burst points centered around the target's location. See table 8-9 for the distance between rounds.
4 GUN II	This type of sheaf utilizes four mortars to combine both range and lateral spread to provide illumination over a large area. The flank mortars will fire the lateral spread rounds. The two center guns will fire the near- and far-ranging rounds. The LHMBC will select which gun fires which round, ensuring that the rounds do not cross.
Legend: mm—millimeter	

Table 8-9. Illumination: Two-gun range and lateral spread distances

Gun System	*Round*	*Fuze*	*Distance Between Burst Points (Meters)*
M224 60-mm	ILL M721	MTSQ M776	460
M224 60-mm	ILL M83A3	TIME M65A1	250
M224 60-mm	IR M767	MTSQ M776	630
M252 81-mm	ILL M301A3	TIME M84A1	450
M252 81-mm	ILL M853A1	MTSQ M772	624
M252 81-mm	IR M816	MTSQ M772	855
M303 81-mm	ILL M301A3	TIME M772	450
M120 120-mm	ILL M930	MTSQ	890
M120 120-mm	IR M983	MTSQ	1,219
M120 120-mm	M91	MTSQ	890

Legend: ILL—illumination; IR—infrared; mm—millimeter; MTSQ—mechanical time super quick

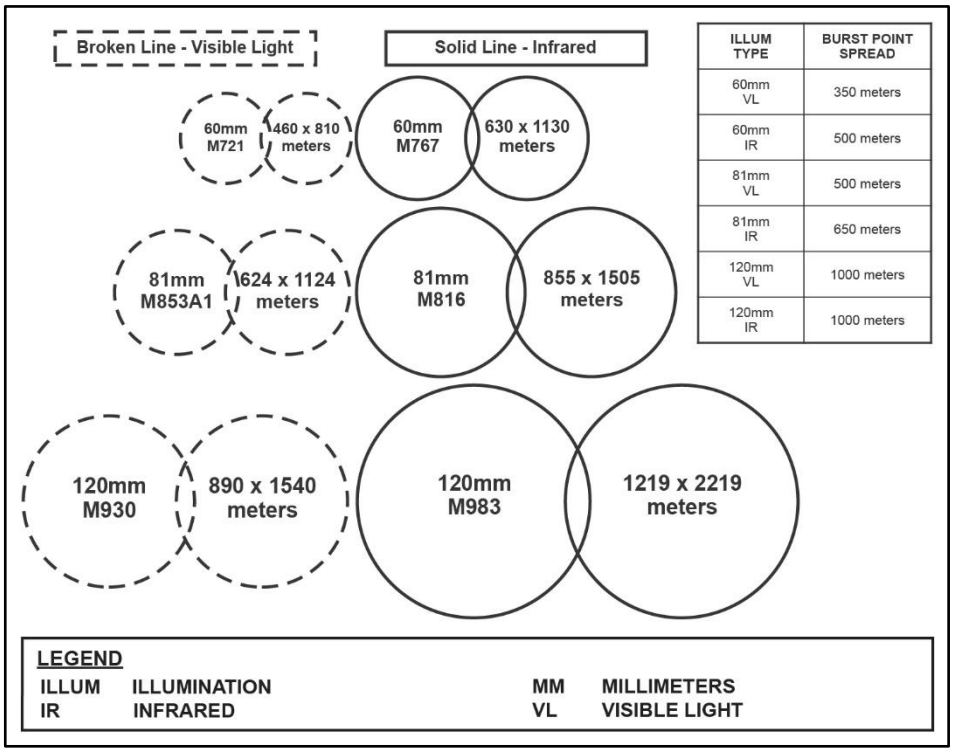


Figure 8-35. Illumination: coverage by caliber

EXAMPLE

Change Sheaf to 1 GUN IL and select A1 as the adjusting gun. Change Lot-Shell to ILLUM. Change FFE Volleys to 2.

Note. Registration corrections are not applied to illumination missions. The Use Reg Correction box is deselected and cannot be enabled.

- Select Use All.
- The Solution/Gun Orders screen is displayed.
- Read and record the data on DA Form 2399.

Note. The Solution/Gun Orders screen (see figure 8-36) is read and recorded for illumination the same as with a standard HE mission to include fuze setting.

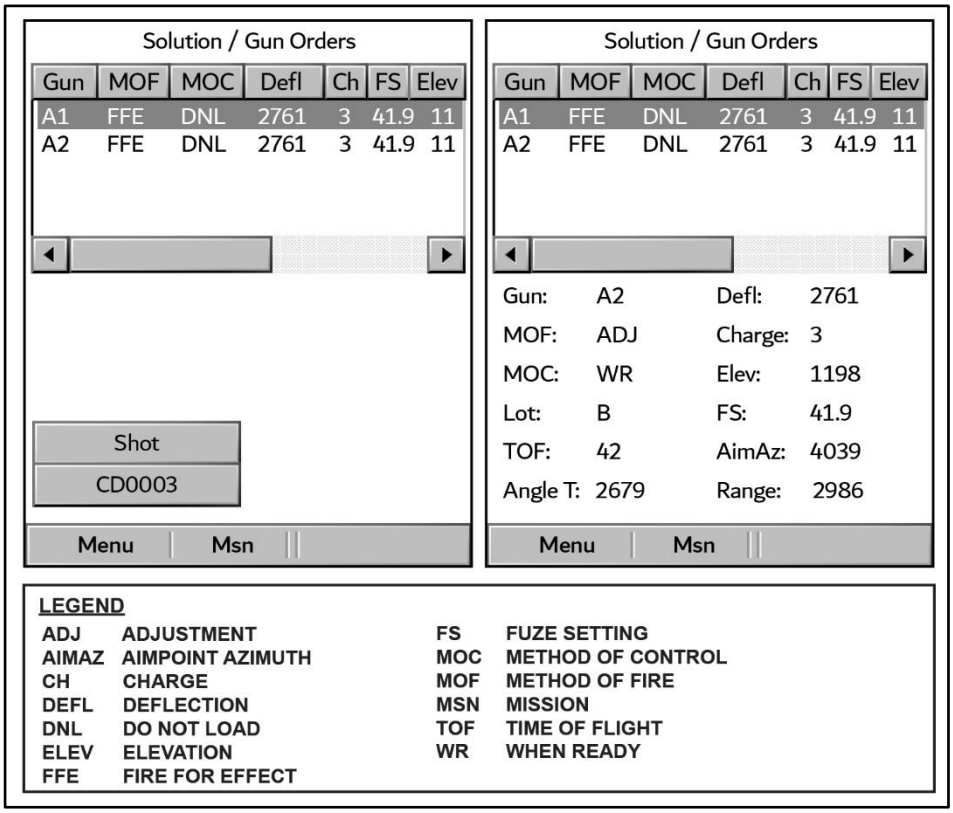


Figure 8-36. Illumination: solution and display of fuze setting

- Select Shot to start the clock and, if operating digitally, notify the FO that the adjusting gun has fired.
- To record the canister impact grid, navigate to the Illumination Safety Data screen (see figure 8-37).

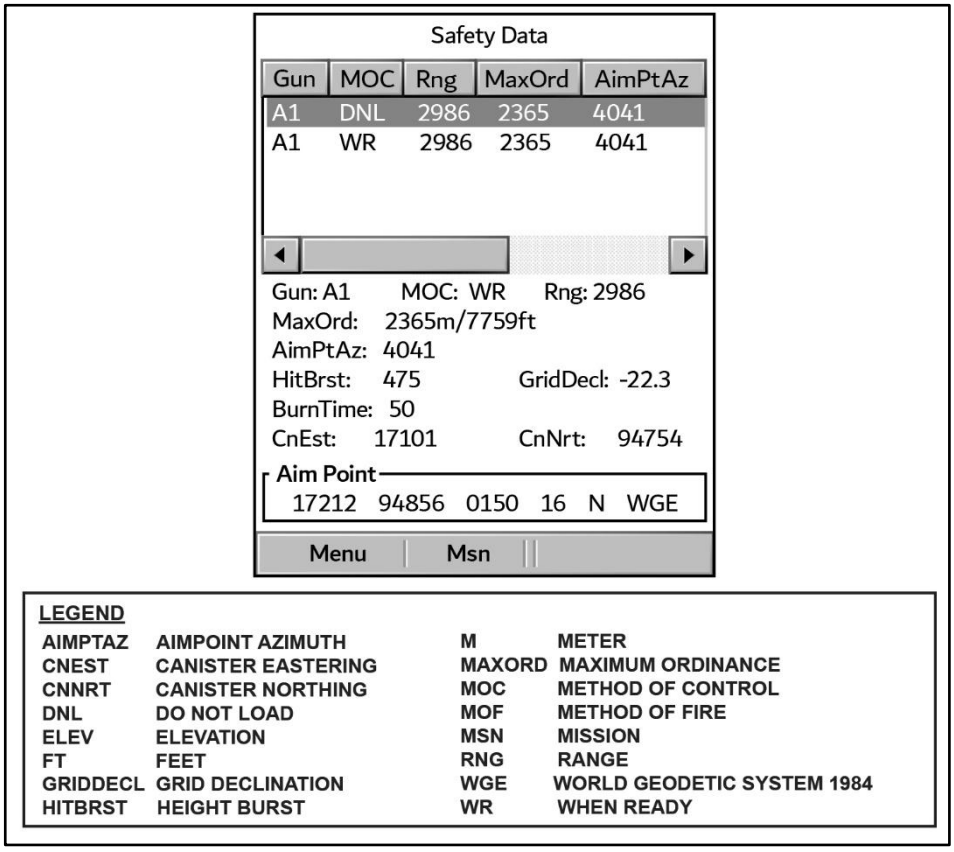


Figure 8-37. Illumination: safety data screen

- Select the adjusting gun's data line and drag the stylus to the bottom of the screen to read the complete safety data.

Note. The canister Easting and Northing coordinates (CnEst: and CnNrt:) are displayed at the bottom of the screen. If the solution produces a canister impact grid outside of a safety fan or in a BOLAD, no solution will be produced, and a warning message describing the violation will be displayed on the Errors/Warnings screen.

- Navigate to the Subsequent Adjust screen to await the first adjustment.
- Process illumination subsequent adjustments in the same manner as HE adjustments with the addition of the up/down adjustments.

- Ensure that the OT azimuth has been entered before applying any adjustments. If not, the LHMBC will revert to the GT line for all corrections.

EXAMPLE

FO Call: Left 300. Drop 200. Down 100. (See figure 8-38.)

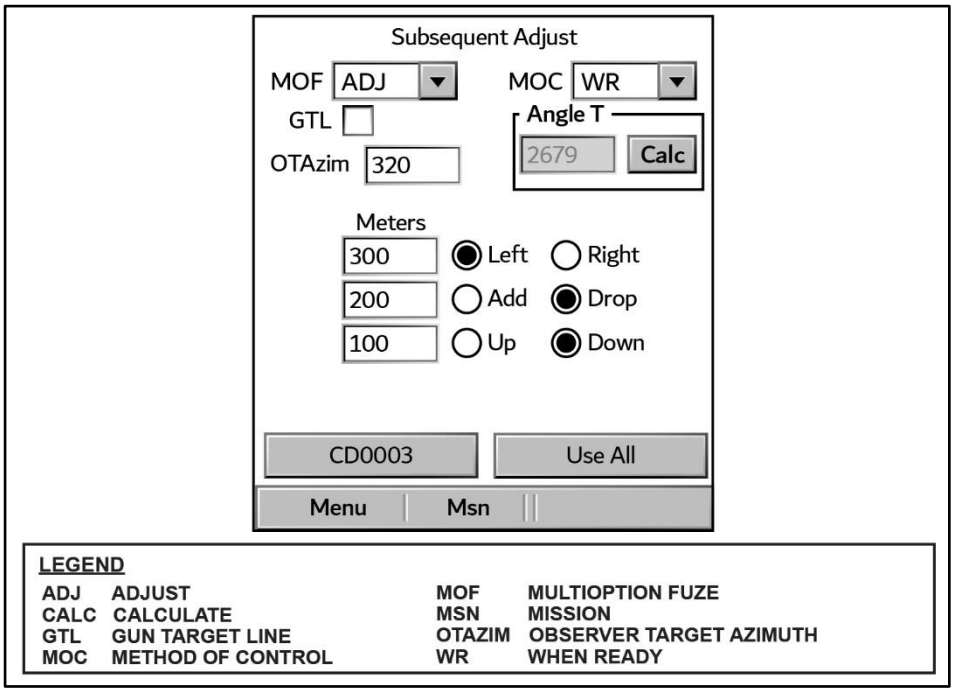


Figure 8-38. Illumination: first subsequent adjustment

EXAMPLE

FO Call: Up 50. Prepare to mark illumination. (See figure 8-39.)

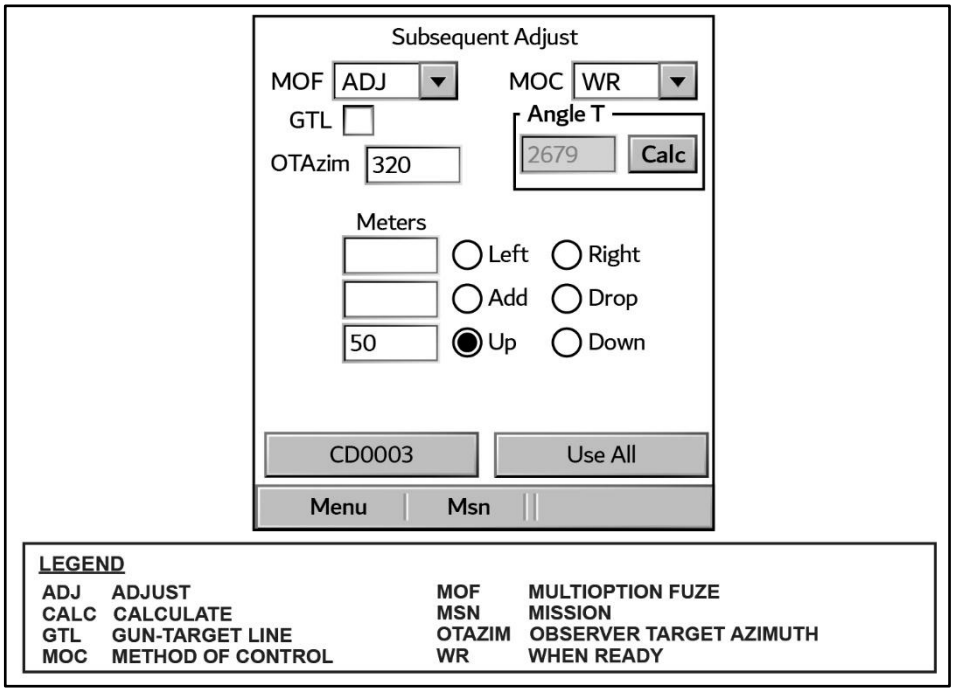


Figure 8-39. Illumination: Second subsequent adjustment

Note. Mark time represents the length of time after the illumination is fired that the FO wants effects on the target. If the FO simply wants to illuminate an area, a mark time is not necessary. If a mark time is used, the FDC operator will time each ILL round from the time it is fired until it has completely burned out. When the illumination reaches the height of optimal illumination, the FO will call MARK. After establishing a mark time, the mark is recorded on DA Form 2399, along with the FFE data. (See figure 8-40, page 304.) This computer record will continue to be used to record ILL rounds fired during firing the coordinated illumination. A separate DA Form 2399 will be initiated for HE/WP.

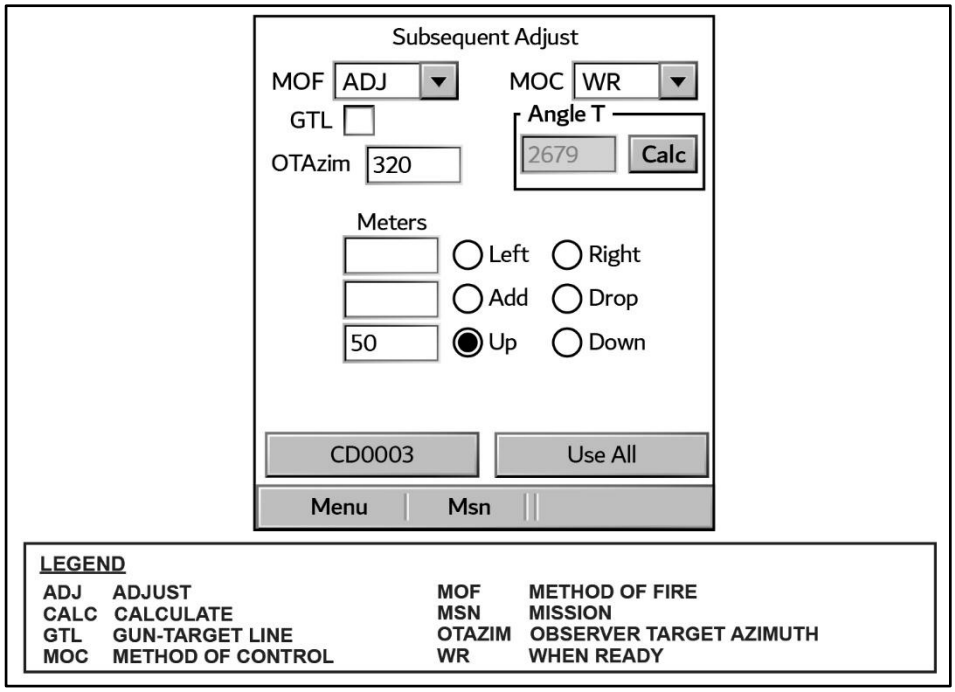


Figure 8-40. One gun illumination fire for effect solution screen

DIGITAL FIRE MISSIONS

8-24. Like manual missions, digital missions have the same sequence of screens for processing a mission. The LHMBC automatically processes the proper method of target location. The FDC operator must read the initial CFF and ensure that the FDC operator records related information about the method of target location on DA Form 2399.

8-25. When operating digitally, notification of a message is made both audibly, through the audio alarm (if set to ON), and visibly, using a mission priority icon displayed on the Mission button.

8-26. To follow the priority message icons through the menu—

- Select the Mission button.
- Select Call For Fire and Select OpAck to silence audio and remove visual alerts.
- The New Call for Fire screen displays (see figure 8-41) and is comprised of four control buttons (see table 8-10): the Message window and its seven fields (see table 8-11, page 306), and the Message Log window.

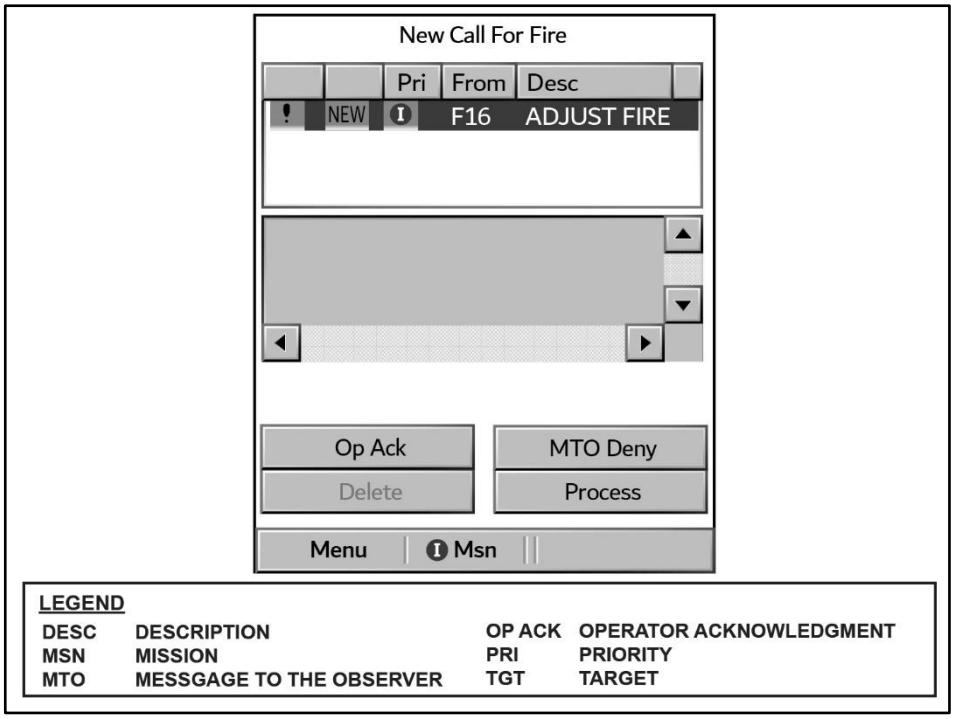


Figure 8-41. Digital fire mission: new call for fire screen

Table 8-10. Digital fire mission: new call for fire screen control buttons and related information

Button	*Related Information*
Delete	Delete button allows for the manual deletion of messages.
Operationally Acknowledge (OpAck)	OpAck button acknowledges receipt of the MTO.
Message to the Observer Deny (MTO Deny)	MTO Deny button sends an MTO that the mission must be denied.
Process	Process button is used to accept and process the mission.

Table 8-11. Digital fire mission: message box fields and purposes

Field	*Related Information*
Unlabeled	This field serves as a message indicator.
Unlabeled	This field serves as a message status.
Pri (priority)	This field lists the priority of the message received. The priorities are (in order of precedence)— Flash Priority (F). Immediate Priority (I). Priority (P). Routine Priority (R).
From	This field identifies the sending unit.
Desc (description)	This field identifies the type of mission.
OrigDTG (originator datetime group)	This field notes the DTG of the sending unit's transmission.
RecvDTG (receiver date-time group)	This field notes the DTG of the receiving unit upon receipt.

- Select a message from the Message window to view the message.
- The message displays in the Message Log window.
- If the mission is acceptable, record this information on DA Form 2399.
- Select OpAck.

Note. An exclamation point displays next to the mission (figure 8-42) until it is acknowledged by selecting OpAck. This action disables the audio alarm if the alarm is set to ON.

- Select Process.

Note. The icon displays to the left of the message until it has been processed. (See figure 8-20, page 282.)

- The Mission Data screen displays (see figure 8-42).

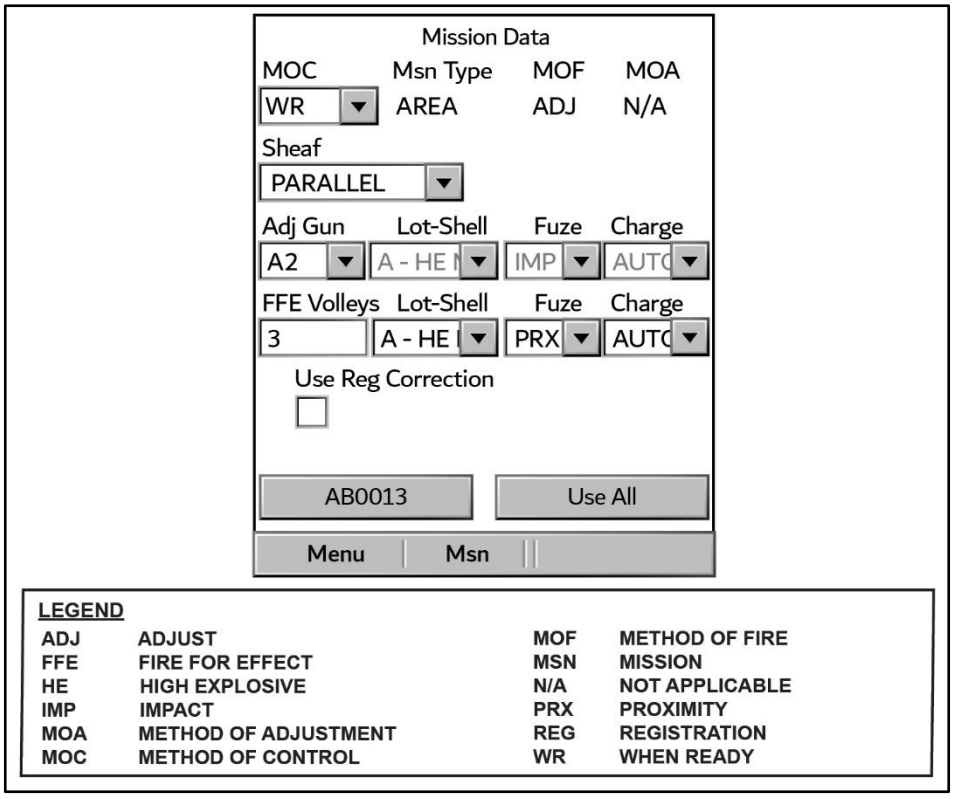


Figure 8-42. Digital fire mission: mission data screen

- Review the Mission Data screen to ensure that all the information is correct.
- If the data is correct, select Use All.
- The Solution/Gun Orders screen displays (see figure 8-43, page 308).

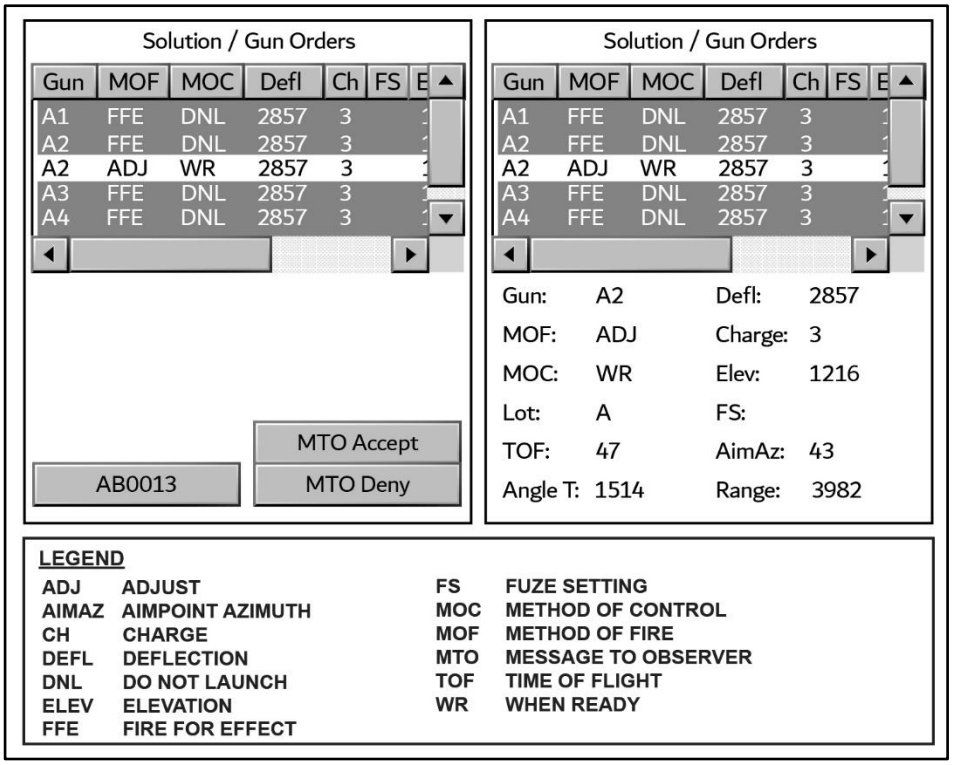


Figure 8-43. Digital fire mission: solution/gun orders screen

Note. If an Errors and Warning screen displays, correct any solution errors or warnings. If the errors or warnings cannot be corrected, select MTO Deny.

- If there are no Errors or Warnings, record the gun and safety data on DA Form 2399.
- Select MTO Accept.
- The Send Status screen displays (see figure 8-44).

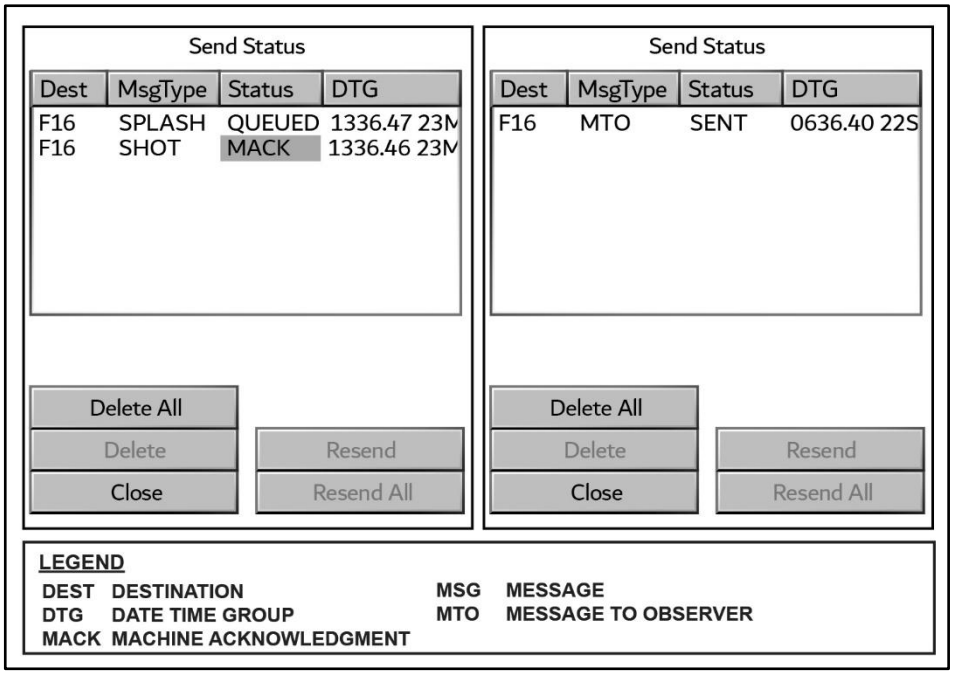


Figure 8-44. Digital fire mission: message send status screens

- Review the information in the four fields displayed in the Message window (see table 8-12, page 310).

Table 8-12. Digital fire mission: send status screen message window fields and purposes

Field	*This field displays the unit ID (identification) of the recipient*
Destination (Dest)	This field displays the unit ID of the recipient.
Message Type (Msg Type)	This field displays the category of message. The message categories include— •MTO (Message to Observer). •PTM (Priority Text Message). •FUC (Fire Unit Center). •AMMO – INV (Ammunition - Invoice). •OBS NOTIFICATION (Observer Notification).
Status	This field displays the status of the message transmittal. The statuses include— •SENT – The message has been received but has not been read (see figure 8-50, page 317). •Machine Acknowledgement (MACK) – The message has been received and read (see figure 8-50, page 317). •RETRY – The message is being resent. The Lightweight Handheld Mortar Ballistic Computer (LHMBC) will attempt to resend the message twice before displaying a fault status of FAILED. •FAILED – The message failed to reach the intended unit. To resend the message, select it in the Message window, and then select RETRY. •QUEUED – The LHMBC will attempt to send the message after the currently transmitting message has been sent or fails.
Date and Time Group (DTG)	This field displays the date and time group of the message transmission.

- Select Close.
- The Solution/Gun Orders screen displays.
- Select the <Target>Mission button.
- The <Target>Mission screen displays.

Note. When operating in the digital mode, the <Target>Mission screen displays two additional control buttons, Mission Status (Msn Stat) and Msn Messages.

- Select the Msn Status button.
- The Mission Status screen displays (see figure 8-45):
  - The Mission Status screen is only available for digital messaging.
  - This screen contains a Status window and five control buttons (see table 8-13, page 312).

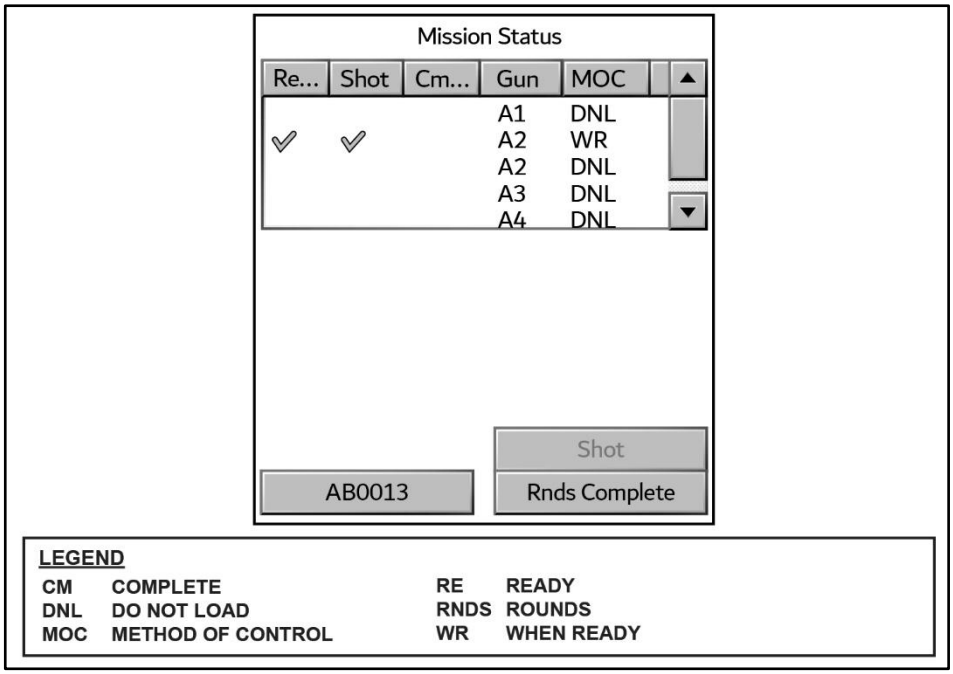


Figure 8-45. Digital fire fission: mission status screen

Table 8-13. Digital fire mission: mission status screen fields, buttons, and purposes

Field/Button	*Purpose*
Status window	The Status Window contains a list of guns active in the mission with four additional fields: •Ready. This field displays a green checkmark when the guns have been reported ready, when the method of control (MOC) is "At my command" (AMC), or after Shot or Rounds Complete has been transmitted. •Shot. This field displays a green checkmark when the Shot has been transmitted. •Cmplt (complete). This field displays a green checkmark when Rounds Complete has been sent. •MOC. This field displays the MOC for each solution calculated.
Shot button	When selected, this button sends a message to the forward observer (FO) that shots were fired, and the shot clock begins to count down from the time of flight to 0. When the countdown reaches the predefined splash time, splash is transmitted to the FO automatically.
Splash button	This button sends a splash message to the FO without displaying the shot clock.
Rounds Complete button (Rnds Complete)	This button calculates the number of rounds fired during the mission. It is used after the fire for effect (FFE) is complete and notifies the observer that the last round has been fired.
Ready button	This button displays only when the MOC is AMC. When all guns are up and ready to fire, selecting this button will notify the FO that the section is ready to fire. A green checkmark appears in the Ready column of all guns active in the mission.
Mission button	This button displays the Mission screen.

- After sending a message to the FO by selecting one of the mission status buttons, select OK in the call box that displays.
- The Send Status screen displays.
- The Send Status screen now displays the message and its current status.
- Select the Close control button.
- The Mission Status screen displays.

Note. The Ready and Shot fields both display a green checkmark for the guns used during this shot.

- Select the <Target>Mission button.
- The <Target>Mission screen displays.
- Select the Msn Messages button to await the first/next adjustment.
- The Mission Messages screen displays (see figure 8-46).

Note. The Mission Messages screen will display the icons in the same manner as the New Call for Fire screen. (See figure 8-46.) The two screens are the same, except that the MTO Deny button of the New Call for Fire screen has been replaced with the <Target>Mission control button to return to the <Target>Mission screen.

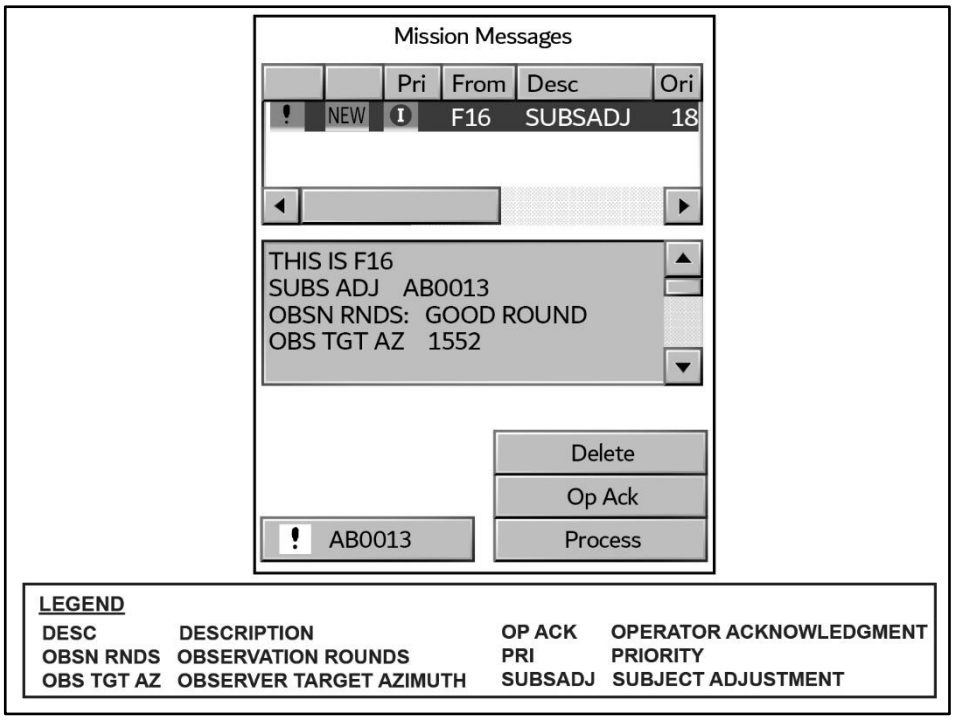


Figure 8-46. Digital fire mission: mission messages screen

- Review and record this information as described for the New Call for Fire screen.
- Select Process.
- The Solution/Gun Orders screen displays.
- Record all information from the Solution/Gun Orders screen on DA Form 2399.
- Select the <Target>Mission control button.
- The Target screen displays.
- Select Msn Status.
- Select Shot to transmit the shot to the FO.
- Select OK when the shot confirmation call box appears.
- The Send Status screen displays.
- Confirm the information displayed.
- Select the Close control button.
- Continue to process the mission as described in the steps above.

- When the FO transmits the final adjustment (see figure 8-47) and requests an FFE, review and record the message.
- Select Process.

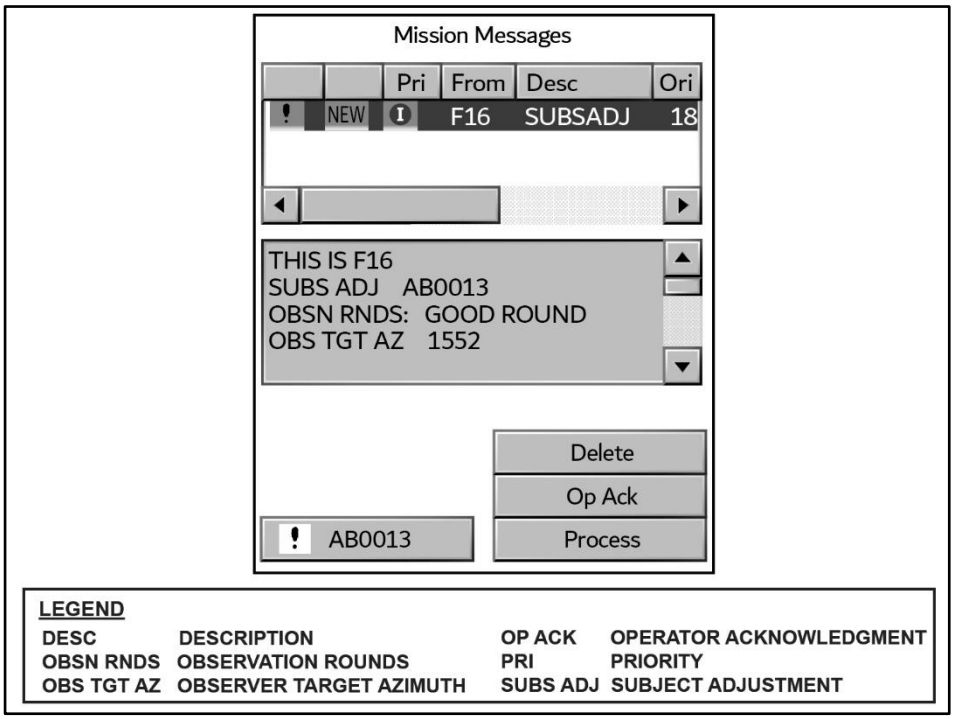


Figure 8-47. Digital fire mission: final adjustment

- The Solution/Gun Orders screen displays (see figure 8-48).

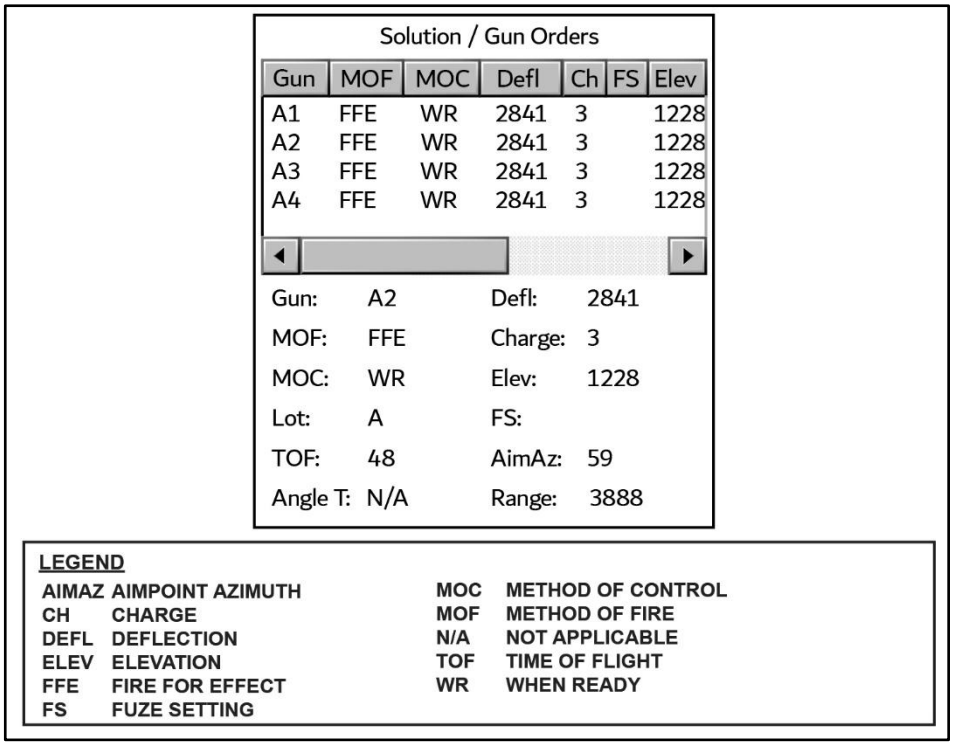


Figure 8-48. Digital fire mission: fire for effect solution screen

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Note. When the MOF is FFE, the LHMBC displays data for each gun. In figure 8-48, the sheaf is parallel, so all solutions are the same. In all other instances, each gun will have unique data.

- Review and record the data.
- Select Process and MTO Accept.
- Select the <Target>Mission control button.
- The <Target>Mission screen displays.
- Select the Msn Status button.
- Select Shot.
- When the call box displays, select OK to notify the observer that the first round has been fired.
- The Send Status screen displays.

Note. The message and its status are listed.

- Navigate to the Mission Status screen.
- When the last round has been fired, select Rnds Complete (see figure 8-49, page 316).

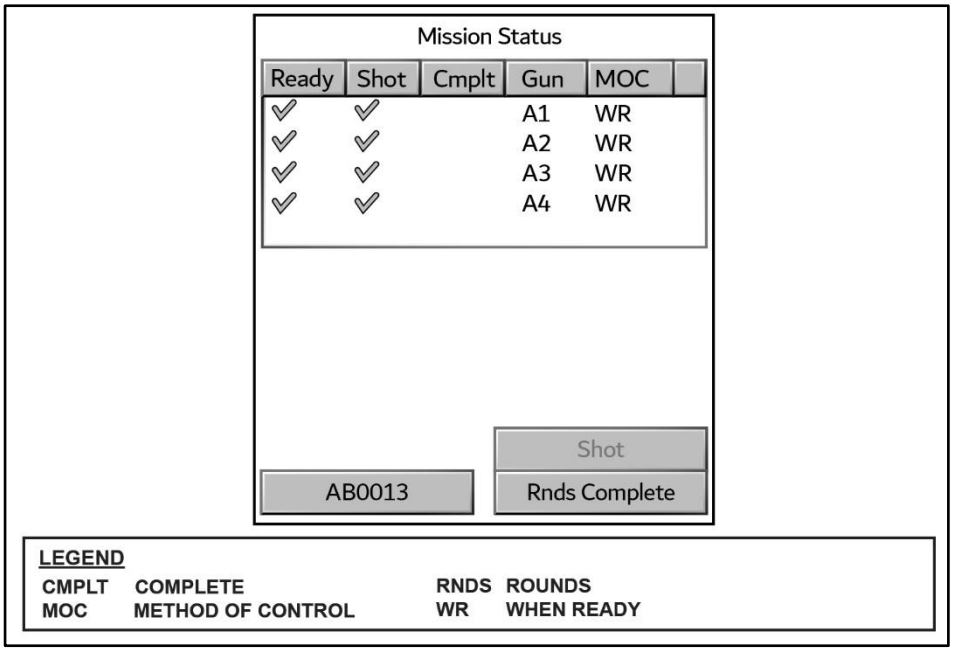


Figure 8-49. Digital fire mission: selecting rounds complete

- Select the <Target>Mission control button.
- The <Target>Mission screen displays.
- Select the Msn Message button.
- The Msn Message screen displays (see figure 8-50) and the screen shot depicts the mission message before it is acknowledged.

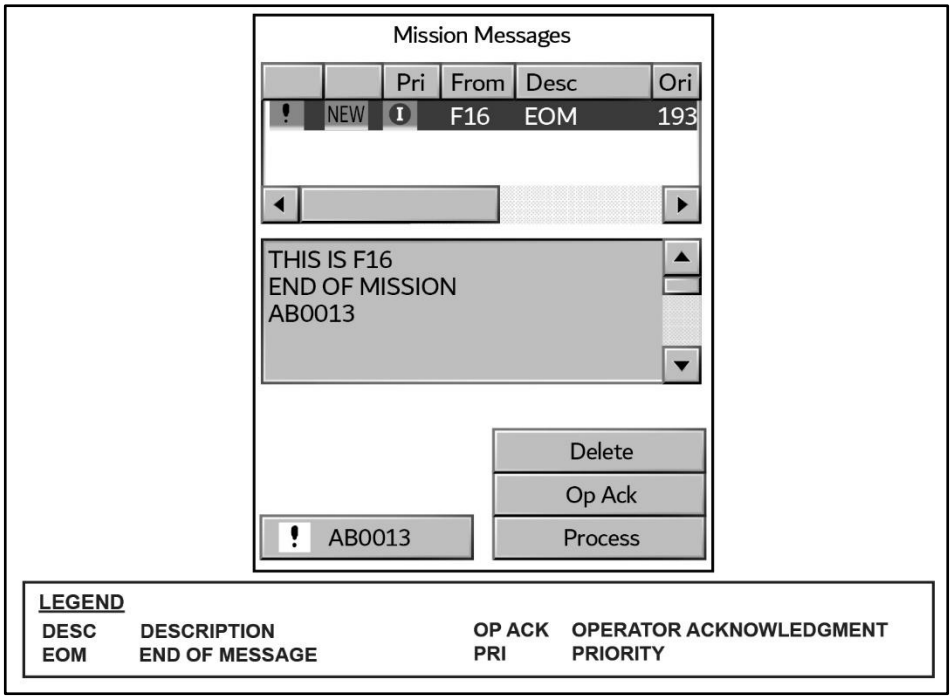


Figure 8-50. Digital fire mission: end of mission message

- Await the next message.
- Select the message to review it.
- Select OpAck to acknowledge receipt of the message and turn off the audio alarm.
- Select the message again.
- Select Process.
- The Select Known Point Number screen displays.
- From the pull-down menu, select a known point (KP) to save (Save as KP [number of known points]) or discard (Discard) and then select the Save As KP# control button.

Notes. 1. The Known Point pull-down menu displays a list of known point numbers, defaulting to the next available known point number.

2. Known point numbers that are in use display "In Use" next to the known point number. If the operator picks a known point number that is currently in use, the previously stored data for that number will be overwritten, and the Save As KP# control button will read Overwrite KP#.

3. If Discard is tapped, the Status screen will be displayed without recording the known point data.

- The Ammunition Expended screen displays enabling the operator to view and edit the number of rounds that have been expended by each gun used in the active mission.

Note. The ammunition is displayed as several rounds used of each lot (by alpha number).

- To increase or decrease the number of rounds per gun, select the gun number, and then use the plus and minus signs to adjust the number of rounds for the selected gun.

Note. If Cancel is selected, the message "Ammo expended for mission must be adjusted manually in inventory" displays.

- Select Use All the ammunition inventory will be updated accordingly.
- The Status screen displays.
- Update DA Form 2188 using the information listed on DA Form 2399 and verify that the ammunition amounts are correct and that the proper target numbers have been assigned.

SECTION III – ADVANCED FIRE MISSIONS

8-27. In addition to the basic fire missions covered in the previous section, the LHMBC includes special missions that allow the mortar section to correct for interior/exterior ballistic variances and engage unique targets. Depending upon the method of target location, each special mission is available from the Mission Type pull-down menu on the Mission screen. These missions are—

- Registration.
- Illumination.
- Coordinated illumination.
- FPF.
- Smoke.
- Search and traverse.

Note. Coordinated Illumination Missions are disabled in LHMBC V4.1 Software.

COORDINATED ILLUMINATION

Note. Coordinated Illumination Missions are disabled in LHMBC V4.1 Software.

8-28. Illumination missions are often coordinated with other suppressive fires. The illumination exposes possible targets, which then are engaged with HE. The FDC operator alternates between the illumination fire mission and the HE/WP fire mission.

8-29. The illumination portion of the mission is identical to a standard illumination mission, but once the FFE has been initiated for the illumination mission, HE/WP adjustment begins. During the HE/WP adjustment and FFE, the operator receives subsequent messages from the FO to fire illumination in coordination with the HE/WP. The operator alternates between the illumination mission (<AA0002>, in the illumination mission example) and the HE/WP mission (in the example, <AA0003>). After the illumination is adjusted, the method of command for both fires is changed from when ready (WR) to AMC.

Note. The adjustment of the HE/WP is identical to a standard fire mission.

8-30. Upon receipt of a fire mission, the FDC operator initiates the appropriate fire mission by selecting the proper method of target location. For this example, we will locate our target using grid coordinates and fire HE/WP in both the adjustment and in the FFE. (See figure 8-51.)

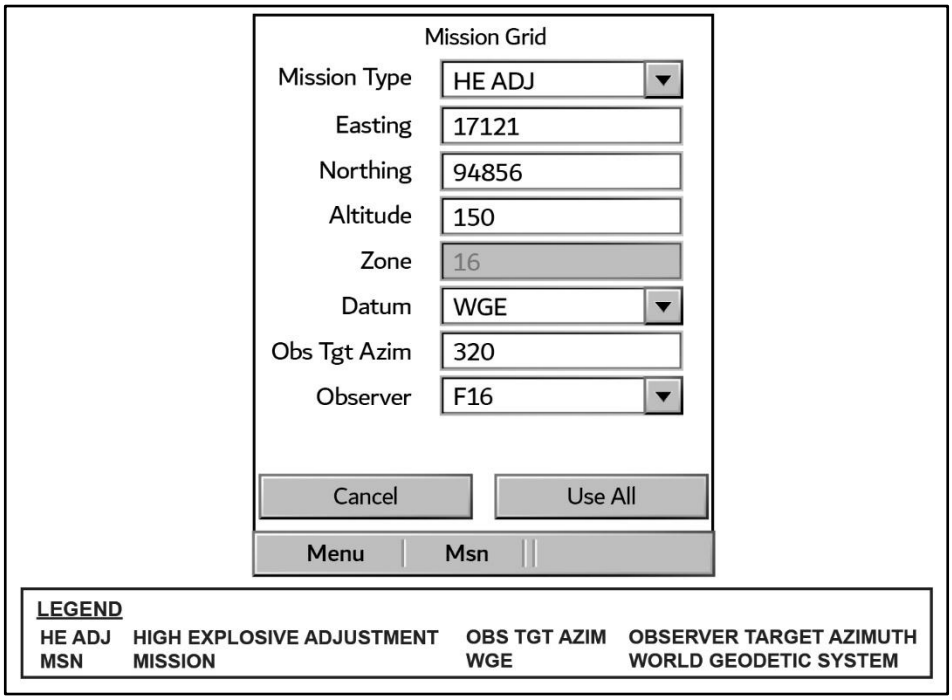


Figure 8-51. Coordinated illumination: mission initialization screen

8-31. To conduct a coordinated illumination mission—

- From the Grid Mission screen, verify all target location information, and select Use All.
- The Mission Data screen displays (see figure 8-52, page 320).

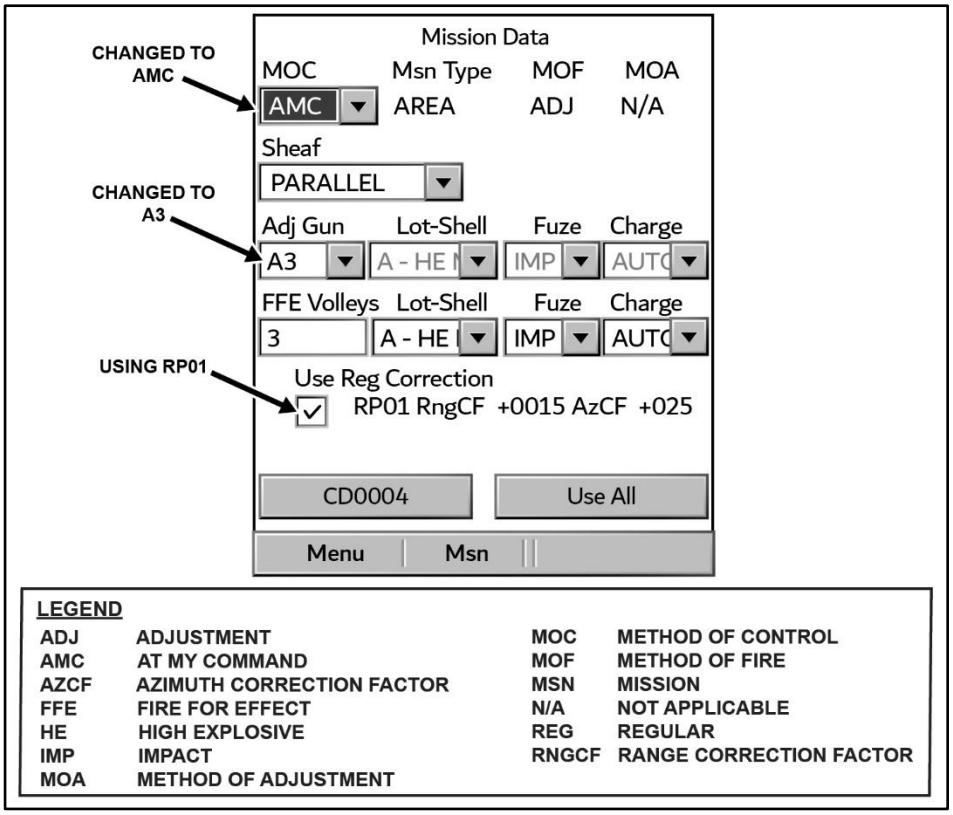


Figure 8-52. Coordinated illumination: mission data screen

- Confirm that all mission data is correct and select Use All.
- The Solution/Gun Orders screen displays (see figure 8-53).

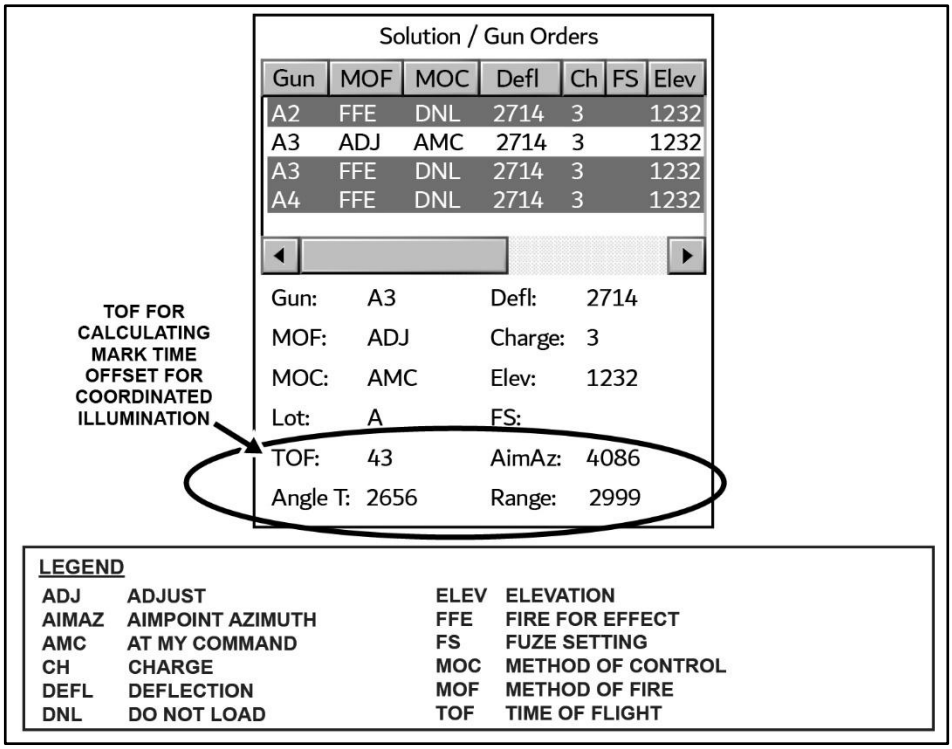


Figure 8-53. Coordinated illumination: high explosive solution screen

- Calculate the firing times for the HE. In the example, the mark time for the illumination mission is 52 seconds, and the TOF for the HE is 43 seconds. This means the elapsed time between the firing of the ILLUM and the HE is 9 seconds (52 - 37 = 15). This way, the ILLUM will be at its optimum height when the HE impacts. Calculate the firing times for the HE/WP. In the example, the mark time for the illumination mission is 52 seconds, and the TOF for the HE is 43 seconds. This means the pause between the firing of the ILLUM and the HE is 9 seconds (52 - 43 = 9). This way, the ILLUM will be at its optimum height when the HE impacts.
- Nine seconds after SHOT is announced to the ILLUM gun, SHOT will be given to the HE adjusting gun.
- Navigate to the illumination mission by—
  - Selecting Msn.
  - Selecting the target number.
  - Selecting Solution.
- Select Shot.
- Navigate to the HE mission by—
  - Selecting Msn.
  - Selecting the target number.
  - Selecting Solution.
- After the delay time has elapsed (9 seconds, in the example), select Shot.

Note. To perform this procedure when operating digitally, the FDC operator must navigate to the Mission Status screen to select Shot for each mission.

- Navigate to the HE Subsequent Adjust screen to await the FO's adjustment.

EXAMPLE

FO Call: Continuous illumination. HE. Left 50. Fire for effect.

Note. The request for continuous illumination indicates that the FO wants the target illuminated during the FFE and afterward so the FO can make the surveillance which will be reported back to the FDC.

- Record the FO's surveillance on DA Form 2399.
- End both missions and update the ammunition expenditure.

FINAL PROTECTIVE FIRES

8-32. An FPF is an immediately available, prearranged barrier of fire designed to impede enemy movement across defensive lines or areas. The LHMBC can store up to three FPFs at a time. If an active mission is in progress and an FPF order is received, the FPF mission has the higher priority.

8-33. To initiate the FPF—

- Select Msn.
- Select Manual Missions.
- Select Grid Msn.
- The Grid Mission screen is displayed.
- Change the mission type to FPF (see figure 8-54).

Note. The following LHMBC FPF mission screens depict an actual fire mission. This example includes the registration corrections from the example registration mission (RP01). This example uses a grid mission to illustrate the process of receiving, adjusting, saving, and firing an FPF. Polar plot or shift missions are conducted in the same manner. Polar plot or shift from a known point missions are conducted in the same manner.

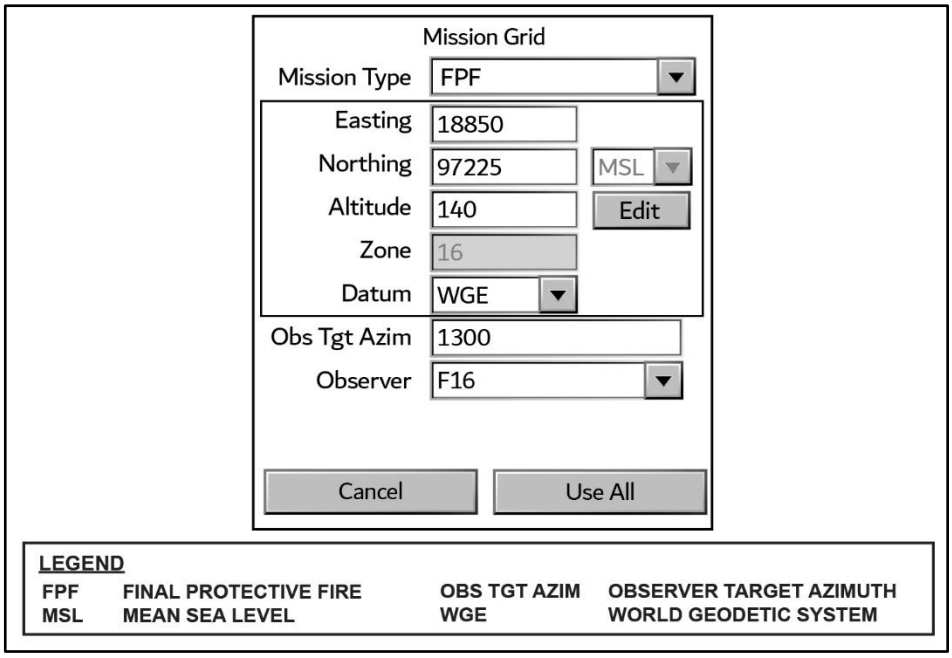


Figure 8-54. Manual grid final protective fire: mission initialization screen

- Complete the screen.
- Select Use All.
- The Mission Data screen displays (see figure 8-55, page 324).

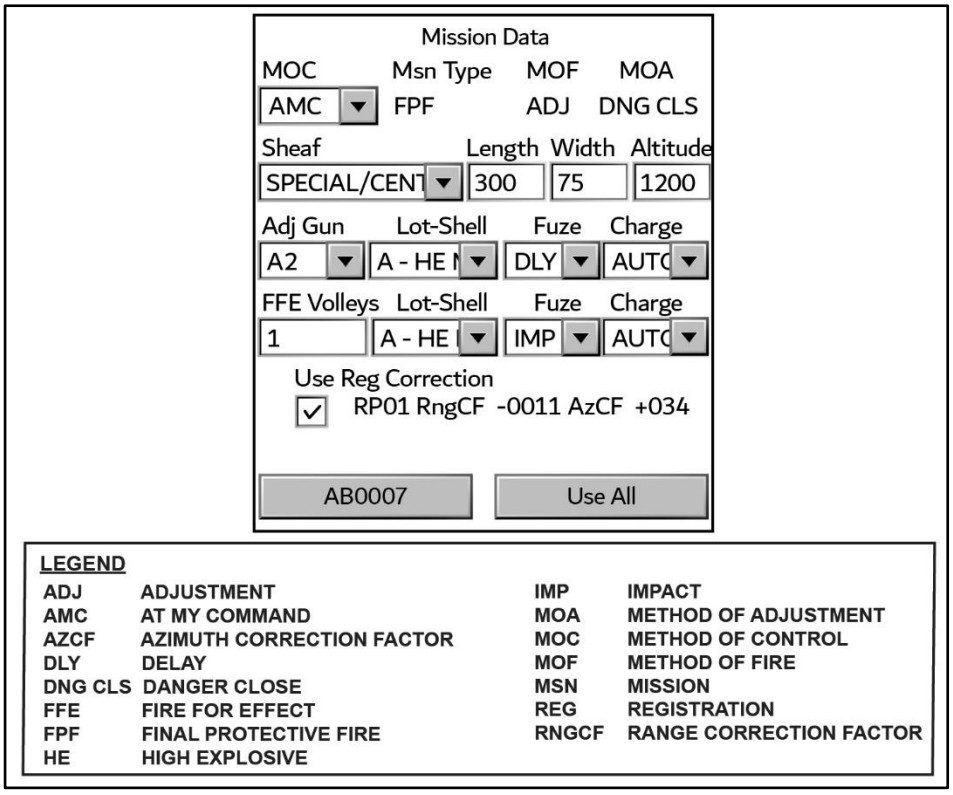


Figure 8-55. Final protective fire: mission data screen

Note. The MOC for FPF remains AMC during the adjustment phase. The sheaf is set to Special and cannot be changed.

- Enter the length, width, and attitude of the FPF.

Note. Since this mission is danger close, the default fuze setting for both the adjustment and the FFE of the FPF is DLY, but the standard fuze setting for an FPF FFE is IMPACT.

- Ensure that all other data is correct and select Use All.
- The Solution/Gun Orders screen displays (see figure 8-56).
- Select target number (TGTNum) button.
- Select Sub. Adj.
- Change AF to FFE.
- Select Use All.

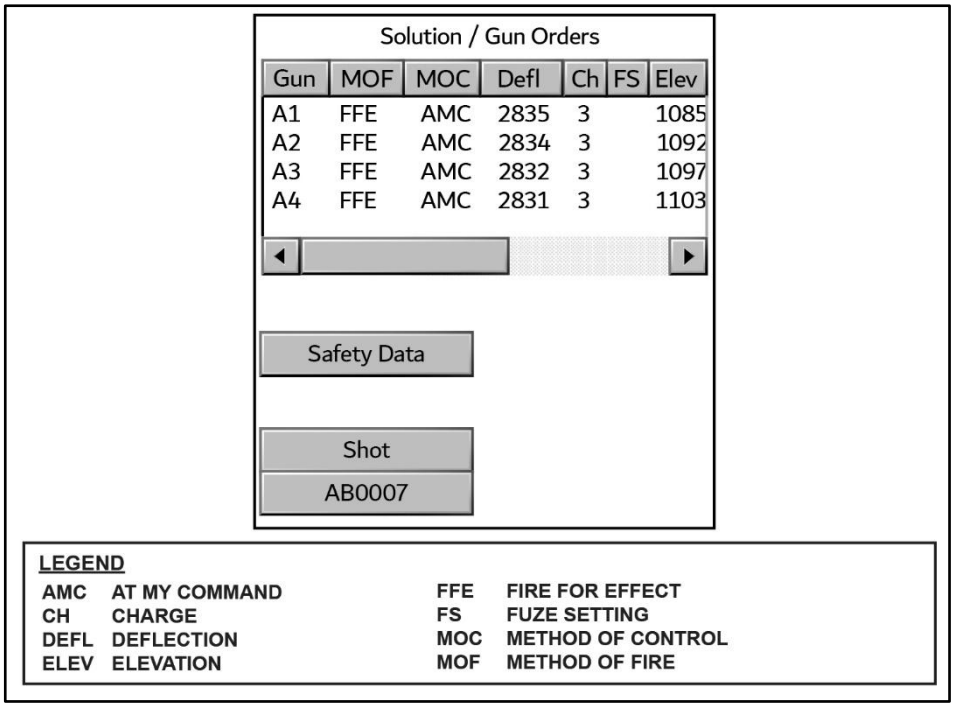


Figure 8-56. Final protective fire: initial solution screen

Note. The LHMBC displays the adjusting solution for the adjusting piece and FFE data for all guns. In the example, the adjusting piece is A2. The entire section fires their FFE Data so the FO can determine which gun is impacting the closest to the friendly forces (the danger gun). This is accomplished by firing either a section right or a section left. For this example, a section right is used. The FO determines that A1 is the danger gun.

- Record the solution and safety data on DA Form 2399.
- When the first gun fires, select Shot to start the shot clock.
- Select the <Target>Mission button.
- The <Target>Mission screen displays.

Note. The target location given in the CFF is not the location of the FPF. The FO must add a 200- to 400-meter safety factor to the location of the FPF. The FDC never adds a safety factor.

EXAMPLE

The FO has determined that A1 is the danger gun and sends the following:
FO Call: Number 1 Danger close. Right 100. Drop 25. Record this adjustment on DA Form 2399.

Note. The type of adjustment is danger close. The FO must use the creeping fire method of adjustment. The fuze setting for all adjustments is set to DELAY reducing the risk of injury to friendly Soldiers while adjusting the FPF.

- Select Mission Data.
- The Mission Data screen displays.
- Change Adj Gun from the original choice to the danger gun (see figure 8-57).

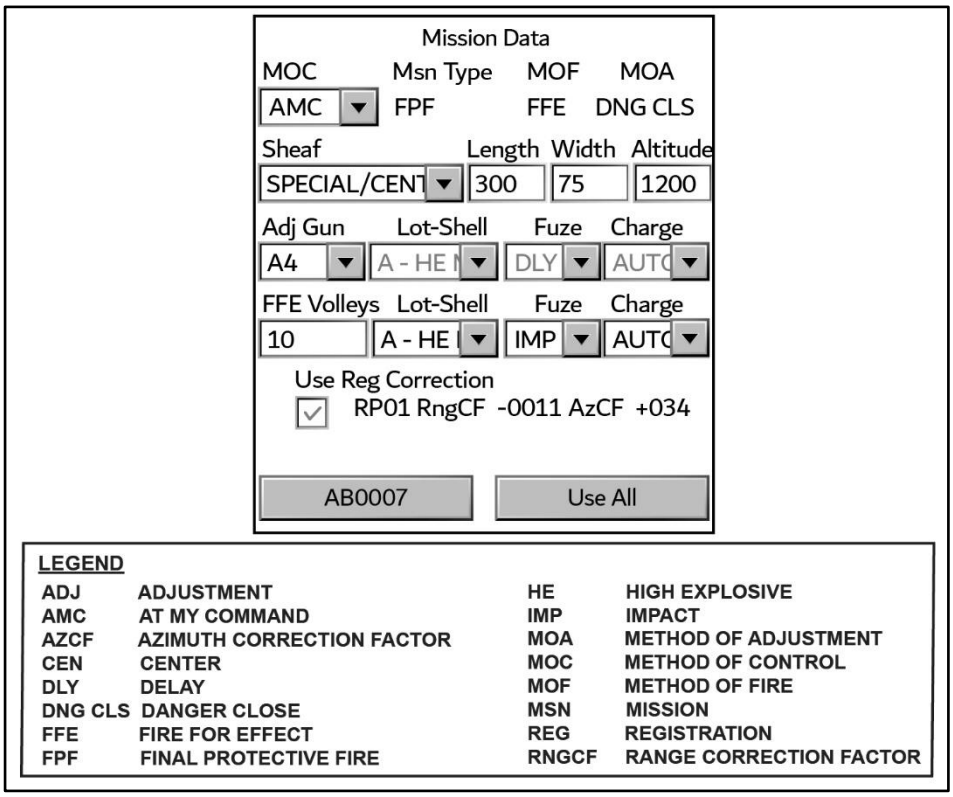


Figure 8-57. Final protective fire: changing the adjusting gun

- Change FFE volleys as needed and DLY to IMP.
- Select Use All.

- The Solution/Gun Orders screen is displayed.

Note. The adjustment still must be entered, so disregard this solution.

- Select the <Target>Mission button.
- The <Target>Mission screen displays.
- Select Subs Adjust.
- The Subsequent Adjust screen displays (see figure 8-58).

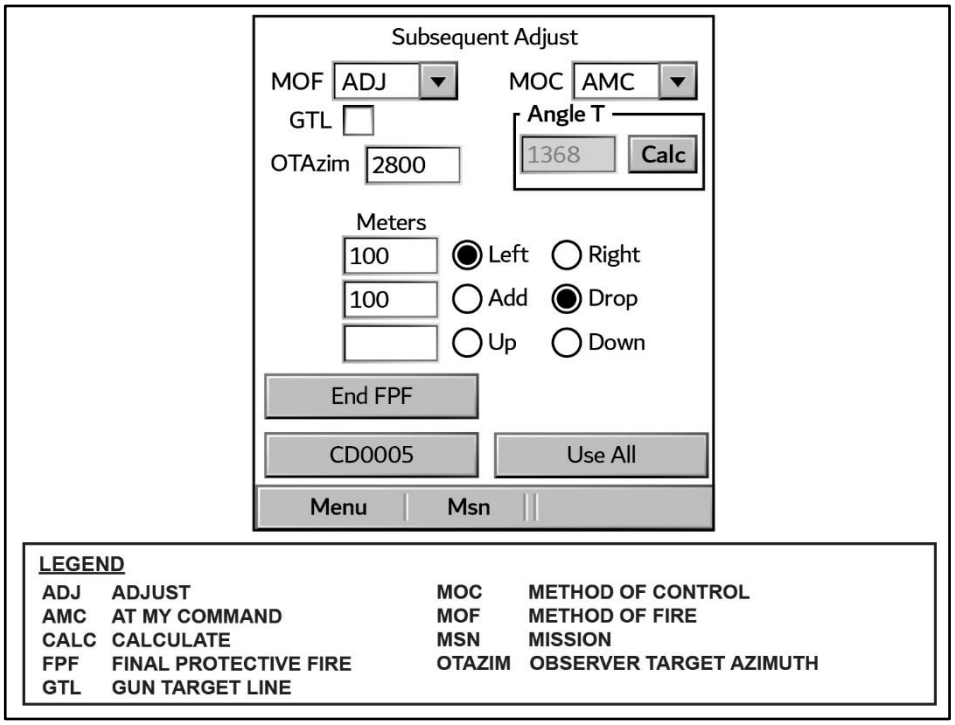


Figure 8-58. Final protective fire: first adjustment

- Enter the subsequent adjust as described for a manual grid mission.

Note. If the FO did not send the OT azimuth in the initial CFF, the FO must send the OT azimuth before the FDC can process any subsequent adjustments. If the OT azimuth is entered from the Subsequent Adjust screen, select Calc to display the new angle T. If the angle T is more than 499 mils but less than 2700 mils, the FDC must send an MTO stating that angle T is in effect.

- Select Use All.
- The Solution/Gun Orders screen displays the initial adjustment (see figure 8-59, page 328).

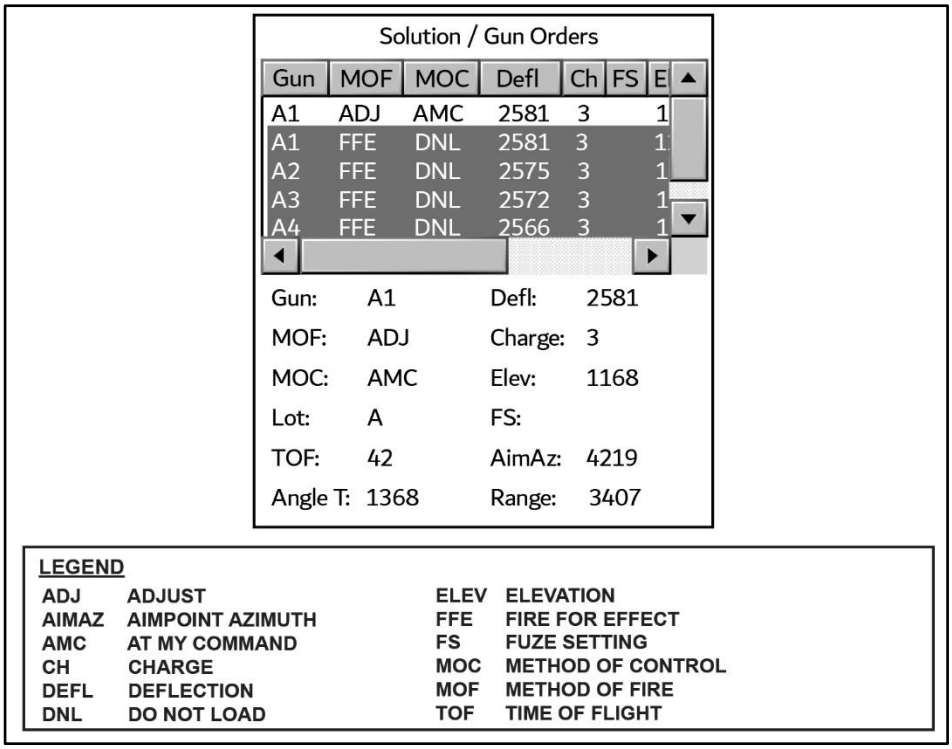


Figure 8-59. Final protective fire: A1's initial adjustment

- Record the solution safety data for A1 on DA Form 2399.
- Send the data to the gun.
- Select Shot.
- The shot clock displays.
- Select the <Target>Mission button.
- Select Sub Adjust.
- The Subsequent Adjustment screen displays (see figure 8-60).
- Wait for the next adjustment.

EXAMPLE

FO Call: Left 50. Drop 25.

Note. Unlike a normal HE mission where only adjustments of 50 meters, or more are fired, adjustments in the FPF will be fired until they are within 25 meters of the proper FPF location.

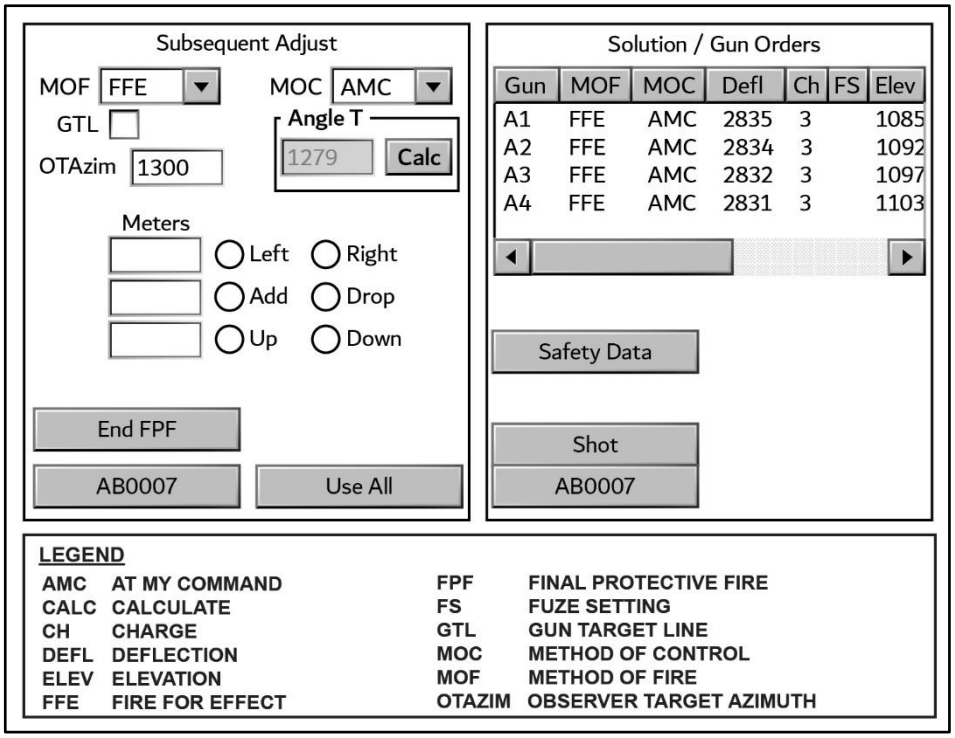


Figure 8-60. Final protective fire: A1's second adjustment and solution

EXAMPLE

FO Call: A1 adjusted. Prepare to adjust sheaf.

- To adjust the sheaf, change the MOF from ADJ to FFE on the Subsequent Adjust screen (see figure 8-61, page 330).

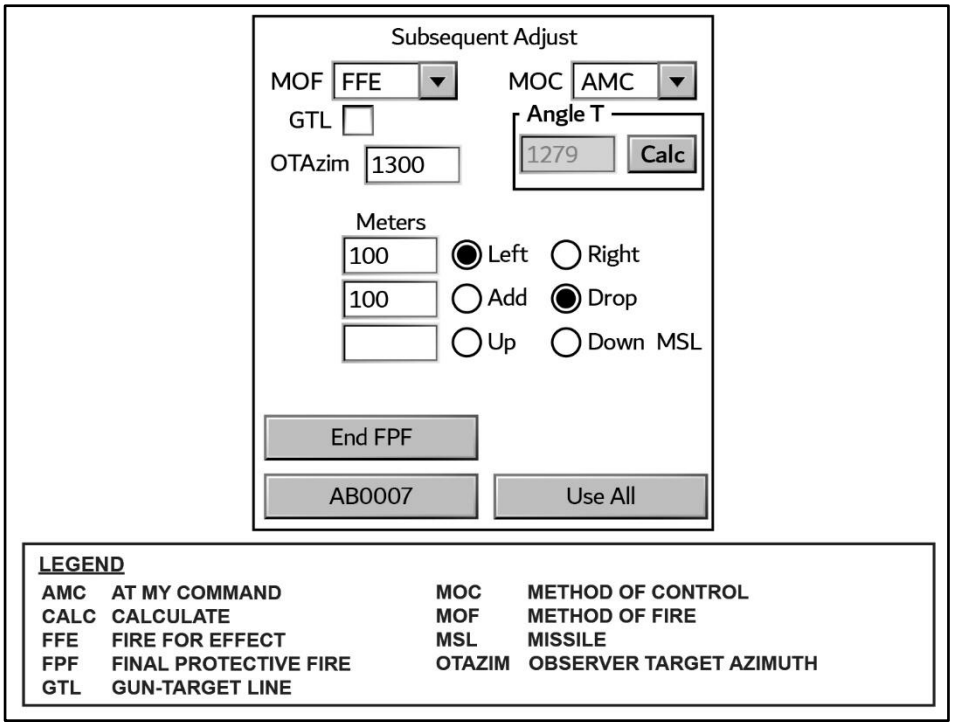


Figure 8-61. Final protective fire: preparing to adjust the sheaf

- There were no further adjustments given, so in the example, A1 is considered adjusted.
- Select Use All.
- The Solution/Gun Orders screen displays.
- Record the solution and safety data for A2 before issuing gun orders.

EXAMPLE

FO Call: A2 right 10. Gun adjusted. Repeat A3.

- To modify the sheaf, from the <Target>Mission screen, select Adj Sheaf.
- The Adjust Sheaf screen displays (see figure 8-62).

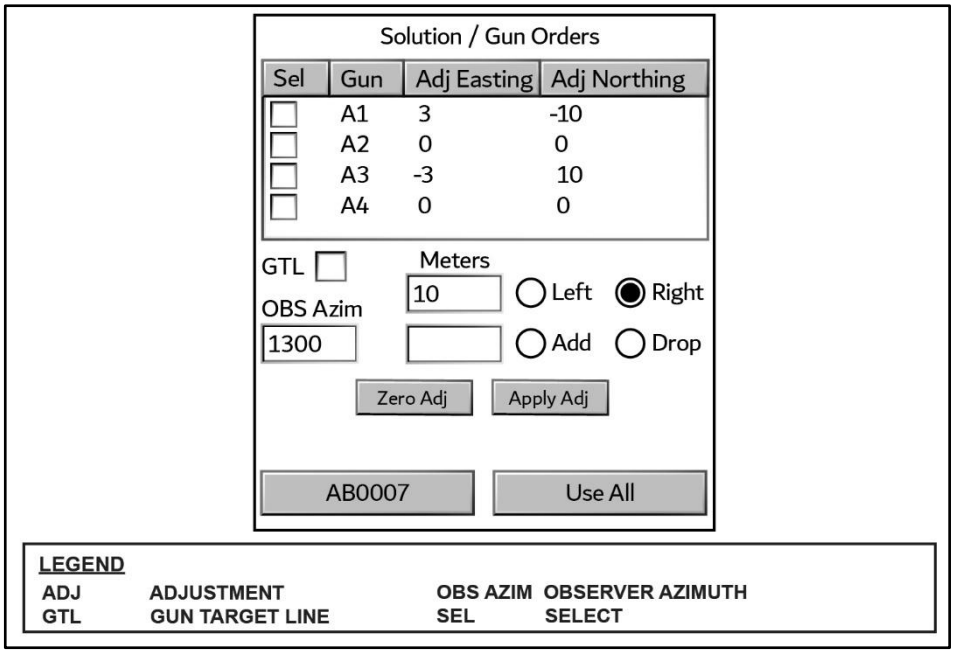


Figure 8-62. Final protective fire: adjusting A2

- Select the Right radio button.
- Enter the number of meters (10, in the example) in the corresponding Meters field.
- Highlight A2 (in the example), and select Apply Adj.

Note. The modification is displayed in the Adjustment window with the corresponding Easting and Northing corrections displayed.

- Select Use All.
- The Mission Data screen displays.

Note. Corrections are entered in the form of a direction (left or right of the OT azimuth) and distance (farther or nearer along the OT azimuth). The adjustments displayed in the Adjustment window refer to the modifications of the calculated burst point grid coordinate.

- The Mission Data screen is displayed by default.

Note. When in the sheaf adjustment phase, the adjusting gun listed is irrelevant.

- Select Use All.

- The Solution/Gun Orders screen displays. (See figure 8-63.)

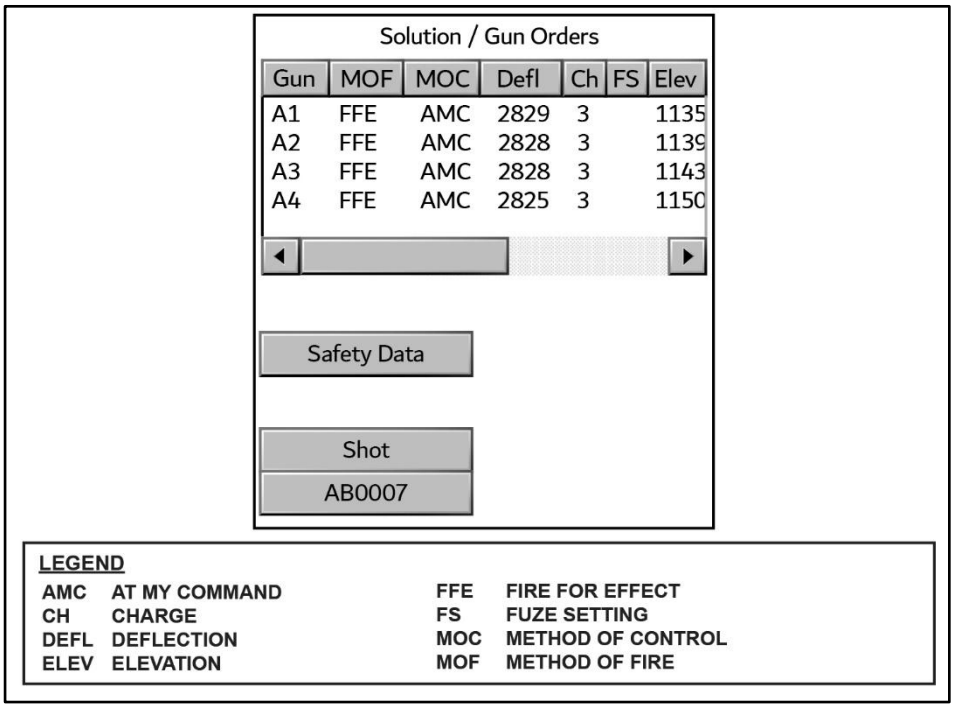


Figure 8-63. Final protective fire: A3's solution

- Record A2 and A3's firing and safety data before sending it to the guns.

EXAMPLE

FO Call: A3 adjusted. Repeat A4.
Record A4's firing/safety data from the Solution/Gun Orders screen.
FO Call: A4 left 10. FPF Adjusted.

- Navigate to the Adjust Sheaf screen and enter A4's correction as previously described (see figure 8-64).

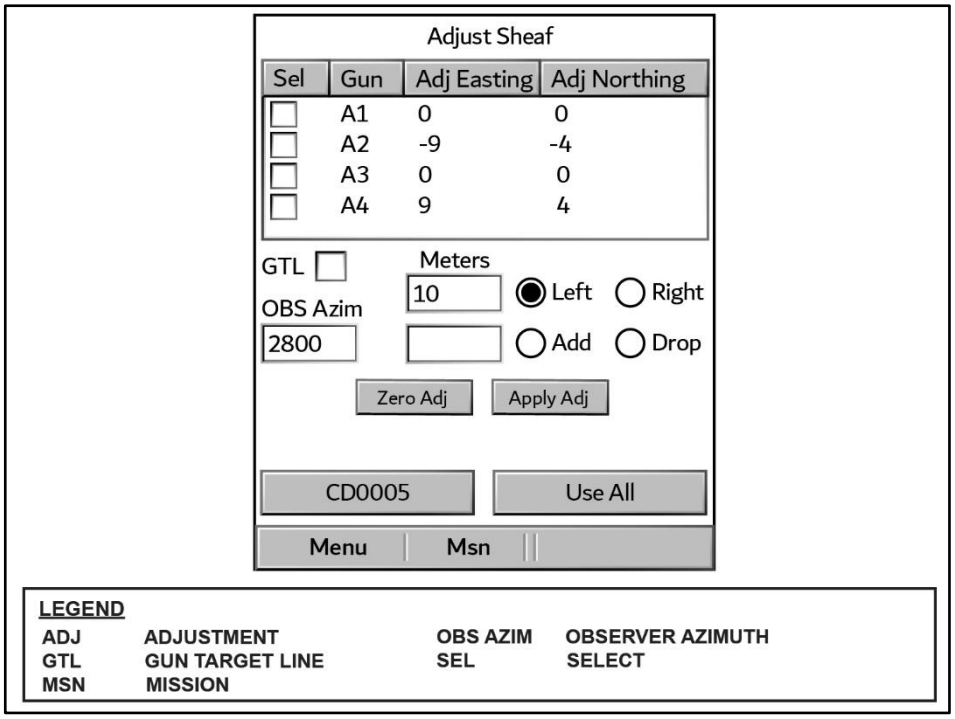


Figure 8-64. Final protective fire: A4's adjustment solution

- Select Use All.
- The Mission Data screen displays.
- Select Use All.
- The Solution/Gun Orders screen displays (see figure 8-65, page 334).
- Record the solution/safety data on DA Form 2399.
- Select the Mission button.
- The Mission screen displays.

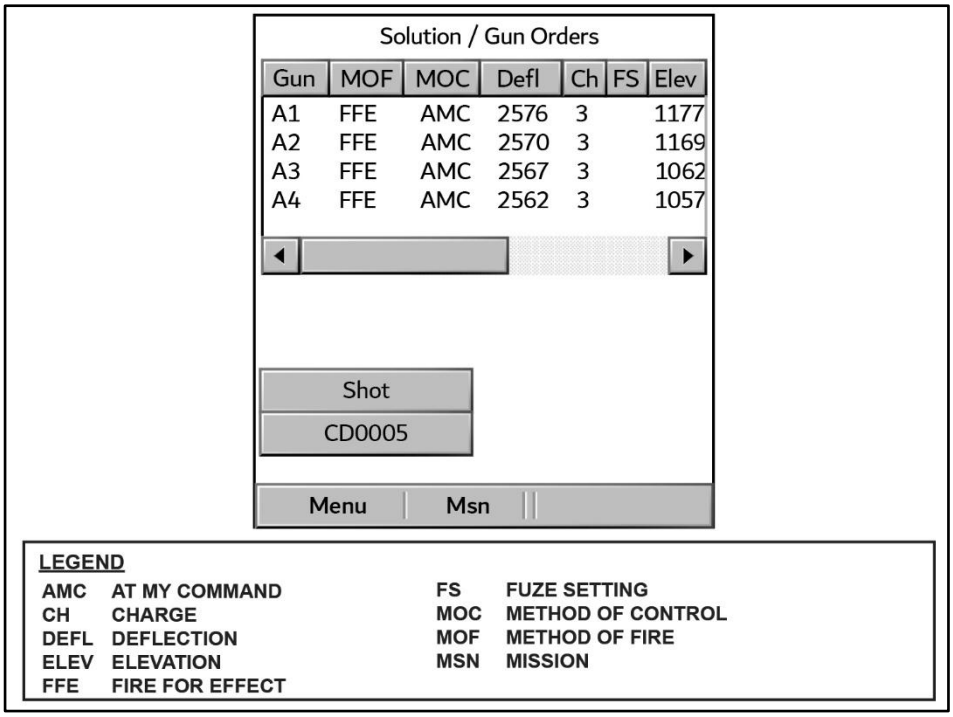


Figure 8-65. Final protective fire: section solution

- Select Mission Data.
- The Mission Data screen displays (see figure 8-66).

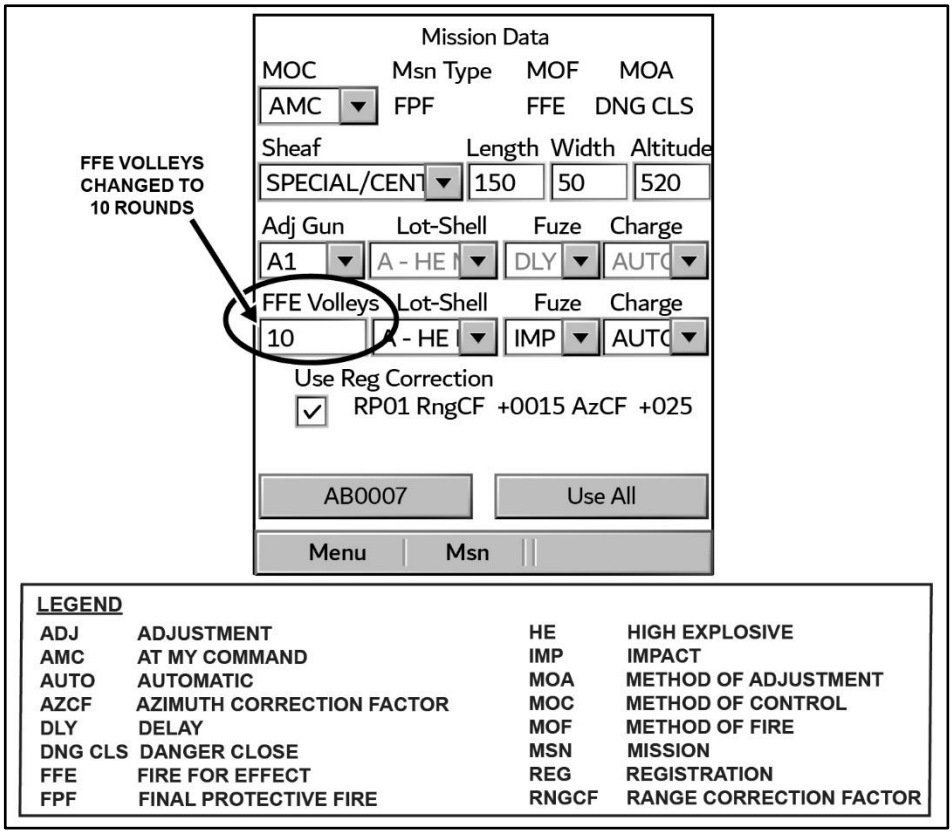


Figure 8-66. Final protective fire: changing the fire for effect volleys

- Change the number of FFE volleys from one to a predetermined number of rounds to be set aside for the FFE (10 rounds in the example), if not already done.

Note. When an FPF is fired, the section/platoon will continue firing until all rounds are expended, or a cease fire command is given.

- Select Use All.
- The Solution/Gun Orders screen displays.
- Navigate to the Subsequent Adjust screen (see figure 8-67, page 336).

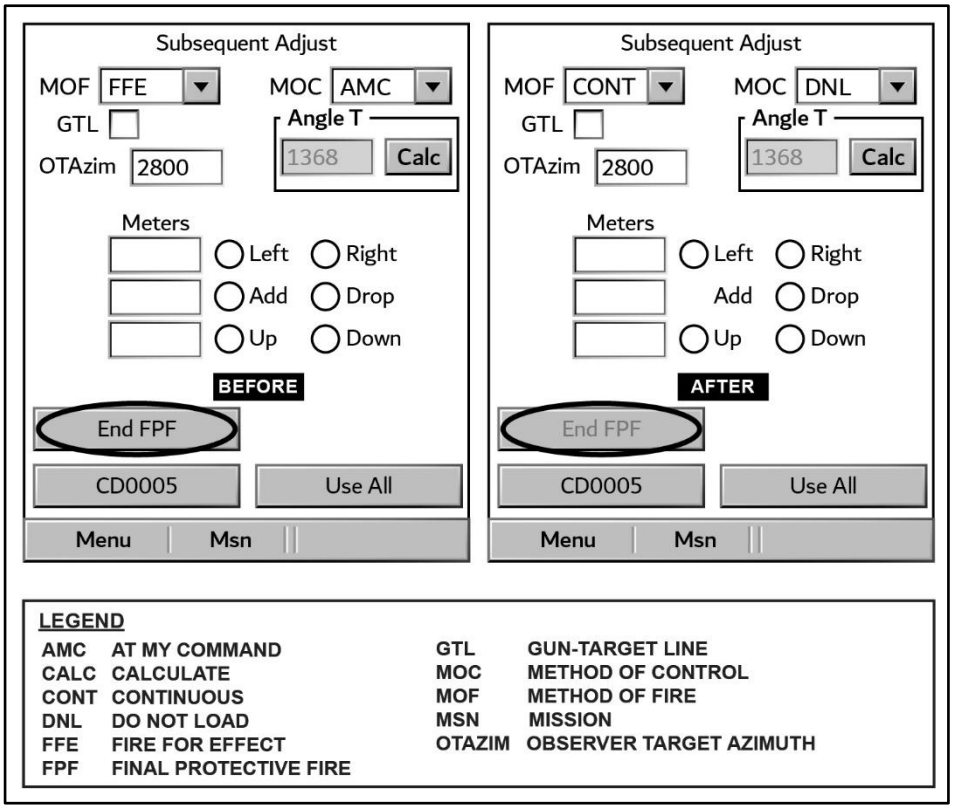


Figure 8-67. Final protective fire: storing the final protective fires

- Select END FPF.

Note. The MOF is changed automatically to CONT, and the MOC is changed automatically to do not load (DNL). The END FPF button is shaded and reads "End FPF."

- Select Use All.
- The Solution/Gun Orders screen displays.
- Record one copy of each gun's firing data, the trigger, and a specific number of rounds to be set aside for the FPF.

Notes. 1. Each gun must post the FPF data on or near the gun to be fired so that it is always visible.

2. The FPF is left as an active mission until the platoon/section displaces or the FPF is no longer valid (troops moved, change in mission, and so forth). The FPF may be accessed through the Missions/FPFs menu using the following path: Missions/AA0009/FPF.

- Select the Mission button.
- Select the Subs. ADJ button.
- The Subs ADJ menu displays.
- Fire the FPF by performing the following steps:
  - Change the MOC from DNL to WR MOF from Cont to FFE.
  - Select Use All.
  - The Solution/Gun Orders screen is displayed.
  - Select Shot.
  - The Shot Clock is displayed, and the LHMBC records the number of rounds fired.
- Select the Mission button.
- The Mission screen displays.
- Select EOM.
- The EOM screen displays.
- Delete FPF is selected, and all other EOM options are shaded.
- Select Use All.
- The Ammunition Expended screen displays.
- Adjust the total number of rounds fired.
- Select Use All.
- The Status screen displays.

SEARCH AND TRAVERSE

8-34. Mortars use searching and traversing fire when target areas cannot be completely engaged with linear or open sheaves. To increase the depth of a target area, mortars employ searching fire. To increase the breadth of a target area, mortars employ traversing fire. Search and traverse may be employed simultaneously to engage a target that is deeper and wider than a linear sheaf.

Notes. 1. The example is given for a basic search traverse mission, but traverse search missions employ similar procedures.

2. The LHMBC issues a warning when the GTL between individual guns exceeds 300 mils and when the target is too wide.

3. Due to the angular difference between guns as they search or traverse across the target area, the LHMBC limits the difference between GTLs for individual guns to 300 mils. This restriction prevents the impact of rounds from diverging as the guns fire subsequent rounds.

4. A warning will display if the difference in GTLs between guns exceeds 150 mils.

8-35. To initialize a traverse mission—

- Select Msn.
- Select Manual Missions.
- Select Grid Msn.
- The Grid Mission screen displays (see figure 8-68, page 338).

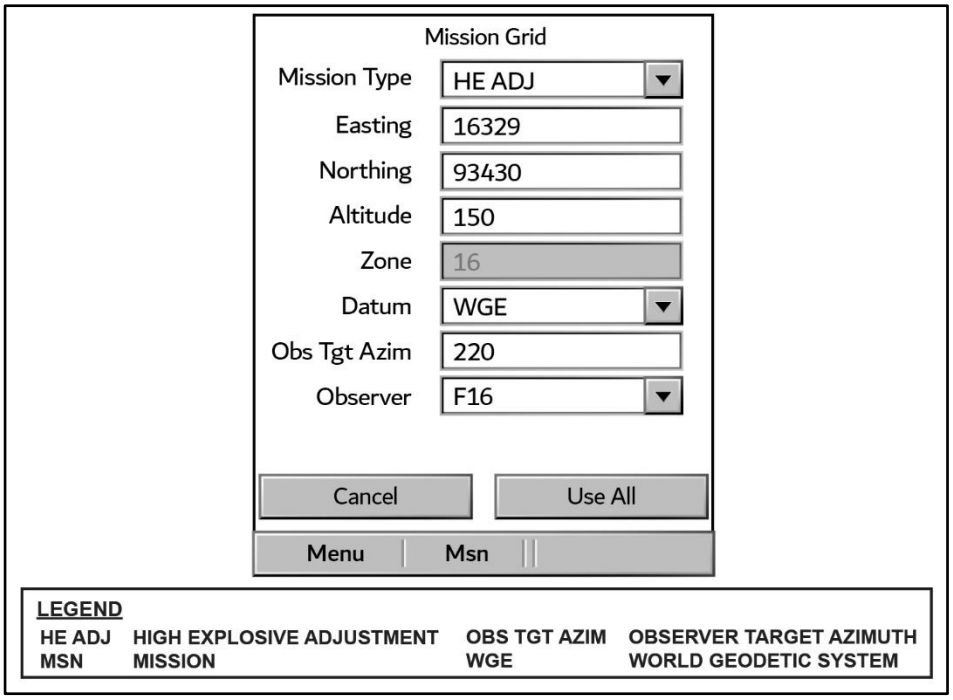


Figure 8-68. Search and traverse: mission initialization screen

- Enter the grid mission initialization data.
- Select Use All.
- The Mission Data screen displays (see figure 8-69).

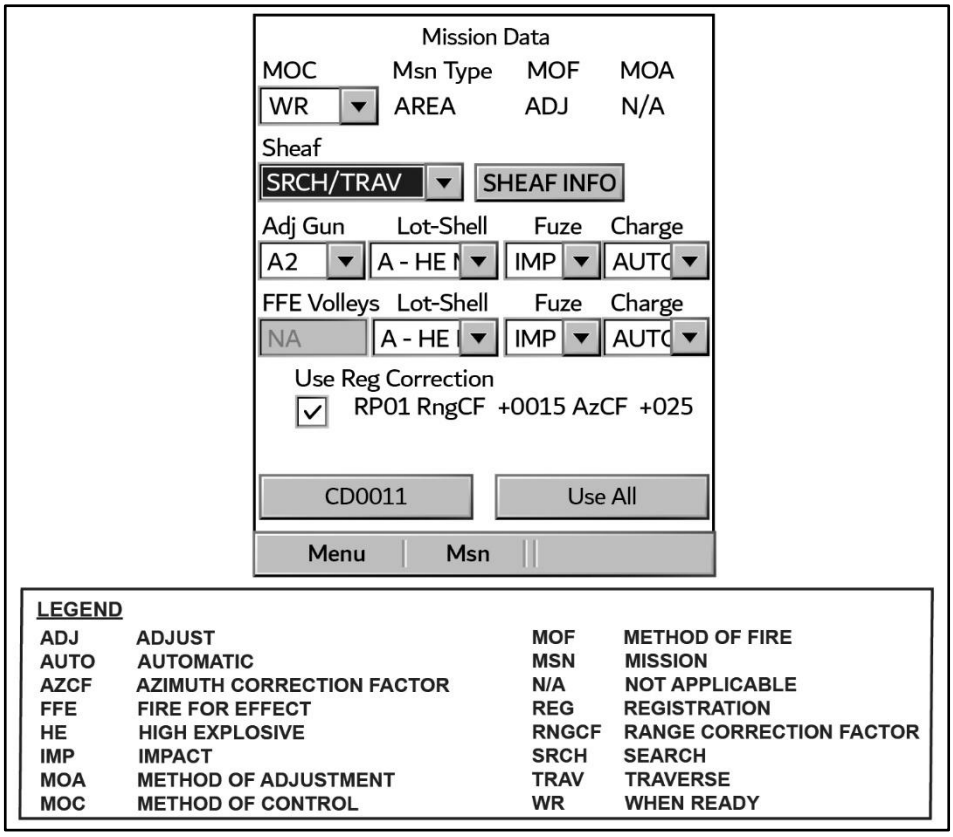


Figure 8-69. Search and traverse: mission data screen

- In the Sheaf field, change the sheaf to SRCH/TRAV.
- Select SHEAF INFOS&T INFO. The Search/Traverse Sheaf Information screen displays. The Search/Traverse Sheaf Information screen (see figure 8-70, page 340) enables the FDC operator to define the target attitude, the location of the adjusting point, and the size of the target area.

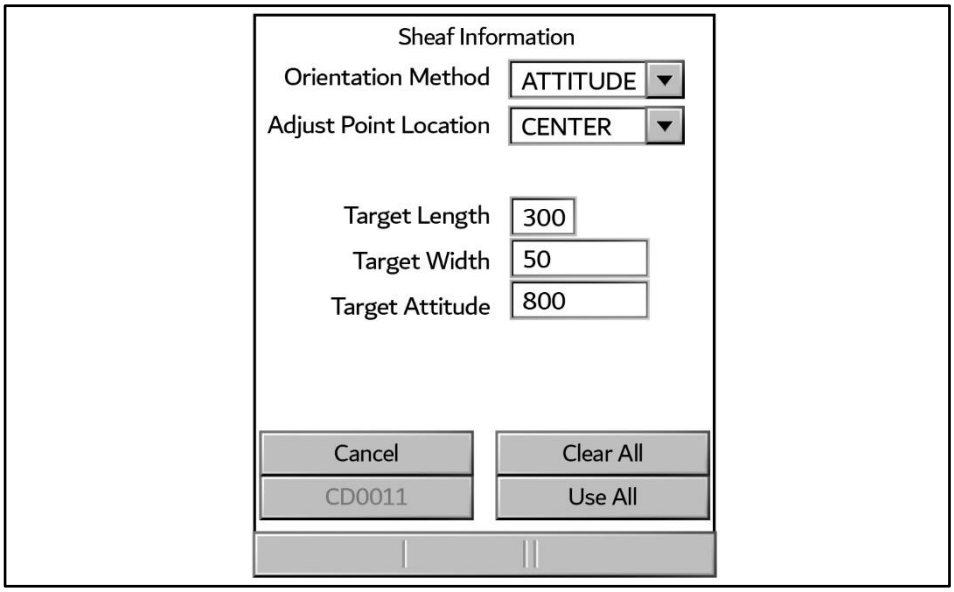


Figure 8-70. Search and traverse: sheaf information screen

- Use the fields outlined in table 8-14 to enter and view information.

Table 8-14. Search and traverse sheaf information screen fields and related information

Field	*Related Information*
Orientation Method	This field can be set to use a second point (in addition to the initial point called in the call for fire [CFF]) to determine the attitude of the target, or the actual attitude of the target may be used.
Adjust Point Location	The forward observer (FO) must specify the adjusting point location to the controlling Fire Direction Center (FDC). This field may be set to FLANK or CENTER. If the method selected is CENTER, the Target Length, Target Width, and Target Attitude fields will display. If FLANK is selected, two additional fields, Reference Direction and Reference Azimuth, will display. The Reference Direction defaults to gun-target (GUN-TGT) line. This field may be changed to OTHER to use, for instance, the observer-target (OT) azimuth.

- Select Use All.
- The Mission Data screen displays.
- Select Use All.
- The Search/Traverse Operation screen displays (see figure 8-71) and provides the FDC operator with the following:
  - Relative Orientation.
  - Max Search Limit.

- Max Traverse Limit.
- Search/Trav Type.
- Search/Trav Method.

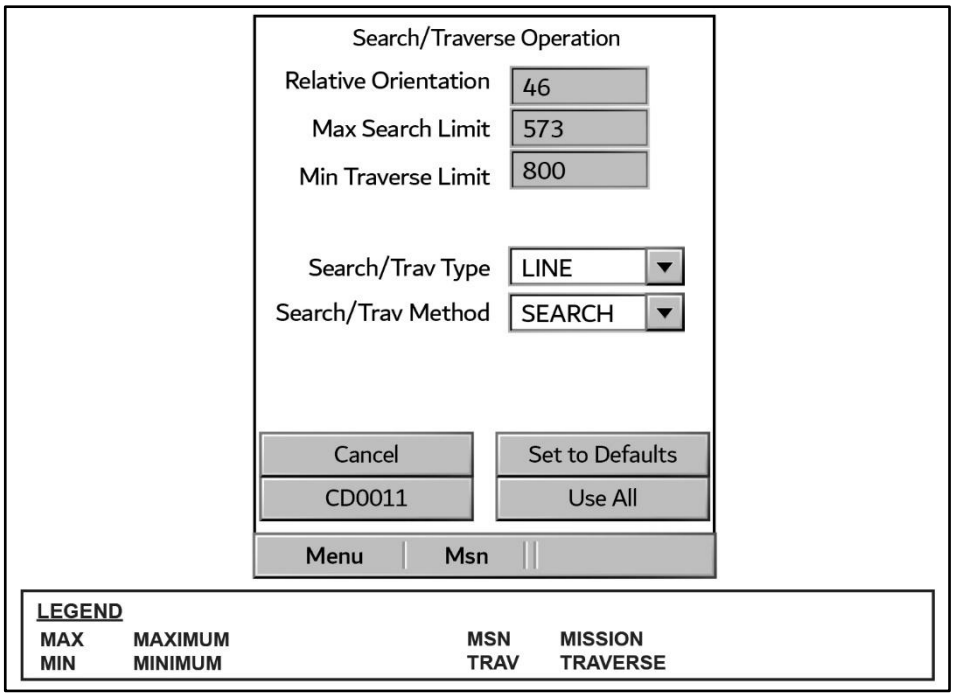


Figure 8-71. Search and traverse: operation screen

- Use the fields outlined in table 8-15a and table 8-15b, pages 342 and 343 to enter and view information.

Note. See table 8-15a and table 8-15b, pages 342 and 343 for more information about the types and methods outlined in these fields.

Table 8-15a. Search and traverse sheaf operation screen fields and related information

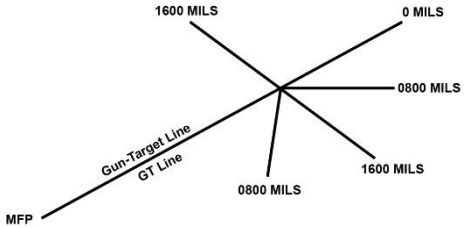
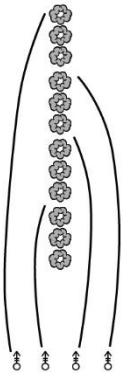
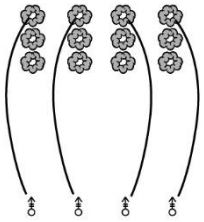
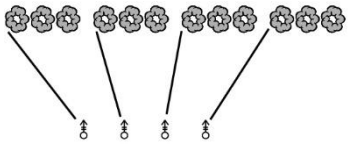
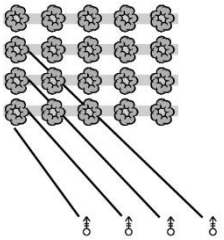
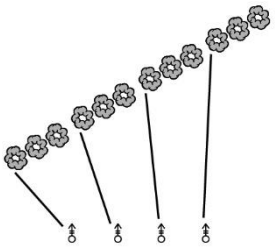
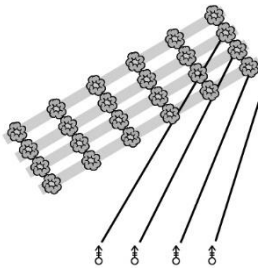
Field	*Related Information*
Relative Orientation 	The relative orientation is the angular difference, in mils, between the gun-target line (GTL) and the target's attitude. The relative orientation will always be measured between 0 mils (in line with the GTL) and 1600 mils (perpendicular to the GTL). The Lightweight Handheld Mortar Ballistic Computer (LHMBC) will recommend— SEARCH when the relative orientation is nearly 0 mils. TRAVERSE when the relative orientation is nearly 1600 mils. COMBINED search and traverse when the burst radius of the round is not sufficient to cover the target area using strictly search or traverse. Although the LHMBC recommends a search and traverse method, the LHMBC operator may change to a method deemed appropriate.
Max Search Limit	This field displays the maximum relative orientation for a search mission to cover the target area effectively, based on segment length and burst radius.
Max Traverse Limit	This field displays the minimum relative orientation for a traverse mission to cover the target area effectively, based on segment width and burst radius.
Search/Traverse Type	This may be either LINE or AREA. A line mission is used to engage a target that does not exceed the burst diameter of the ammunition being used to engage the target. The LHMBC can calculate both search and traverse missions using the line method. An area mission is used to engage a target that exceeds the burst diameter of the ammunition being used to engage the target. The LHMBC can calculate both search and traverse missions using the area method.
Search/Traverse Type	This field may be set to SEARCH, TRAVERSE, or COMBINED The LHMBC operator may change to a method deemed appropriate.

Table 8-15b. Search and traverse sheaf operation screen fields and related information

Field	*Related Information*	
Search and Traverse Type Search and Traverse Method	Line	Area
Search		
Traverse		
Combined Search and Traverse		

- Select Use All.
- The Solution/Gun Orders screen displays (see figure 8-72, page 344).

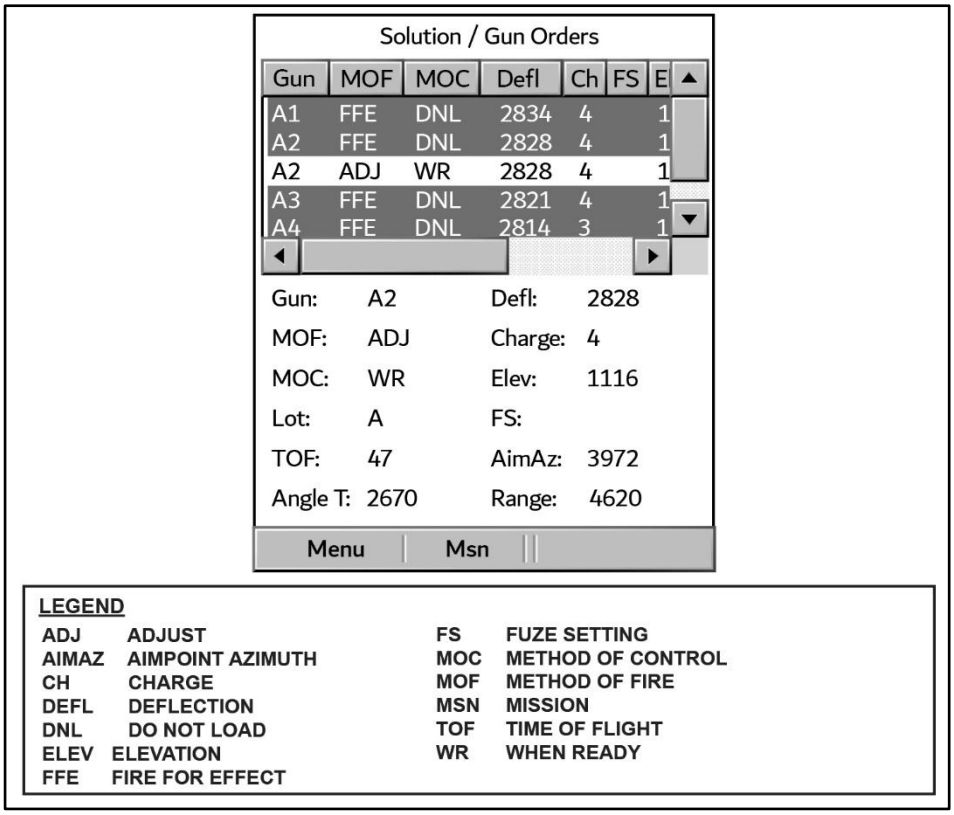


Figure 8-72. Search and traverse: initial solution

- Conduct the adjustment phase of the mission in the same manner as a conventional manual mission (see figure 8-73 and figure 8-74, page 346).

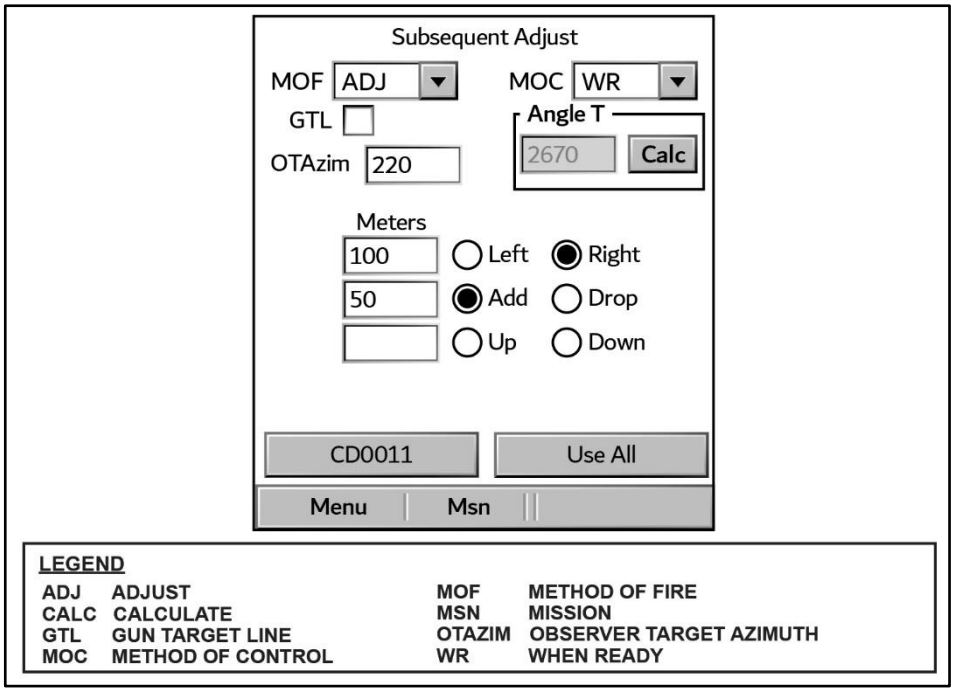


Figure 8-73. Search and traverse: first adjustment

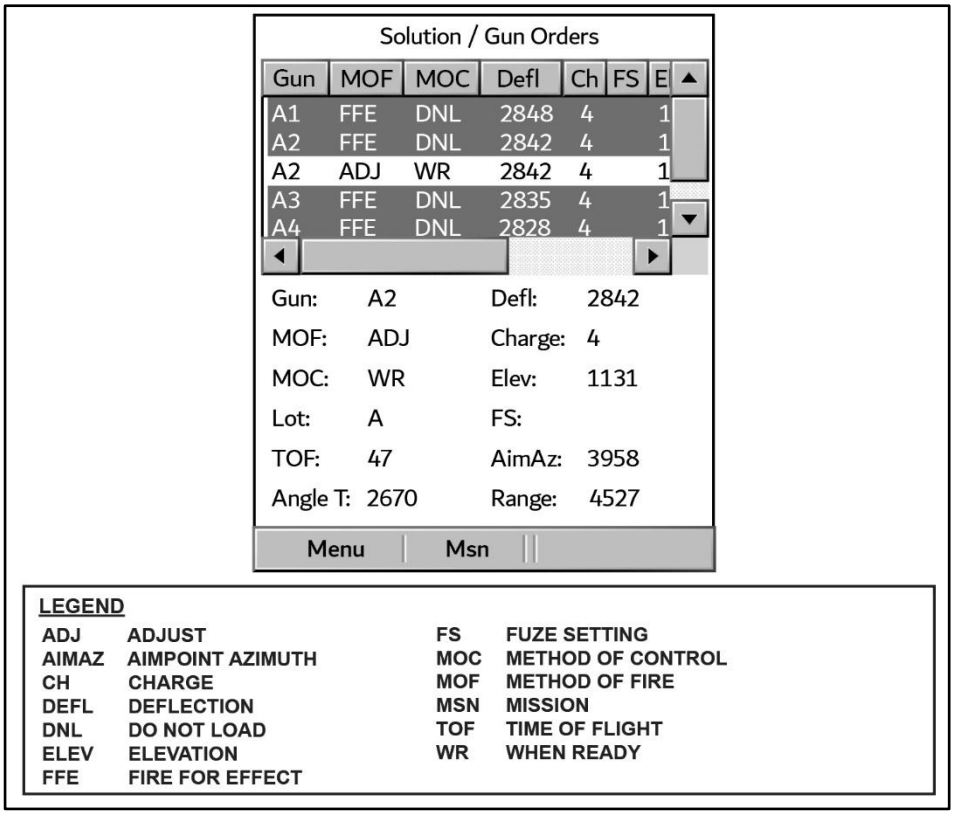


Figure 8-74. Search and traverse: second solution

- Upon receipt of the FFE command from the FO, from the Subsequent Adjust screen (see figure 8-75), change the MOF to FFE, and enter any last refinements.

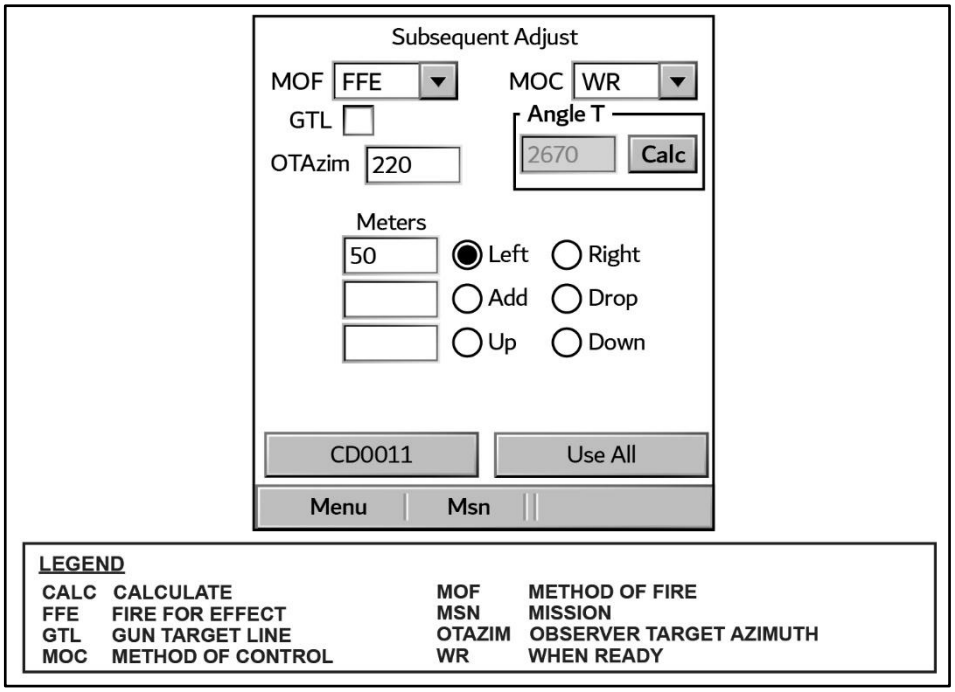


Figure 8-75. Search and traverse: final adjustment

- Select Use All.
- The Solution/Gun Orders screen displays (see figure 8-76, page 348).

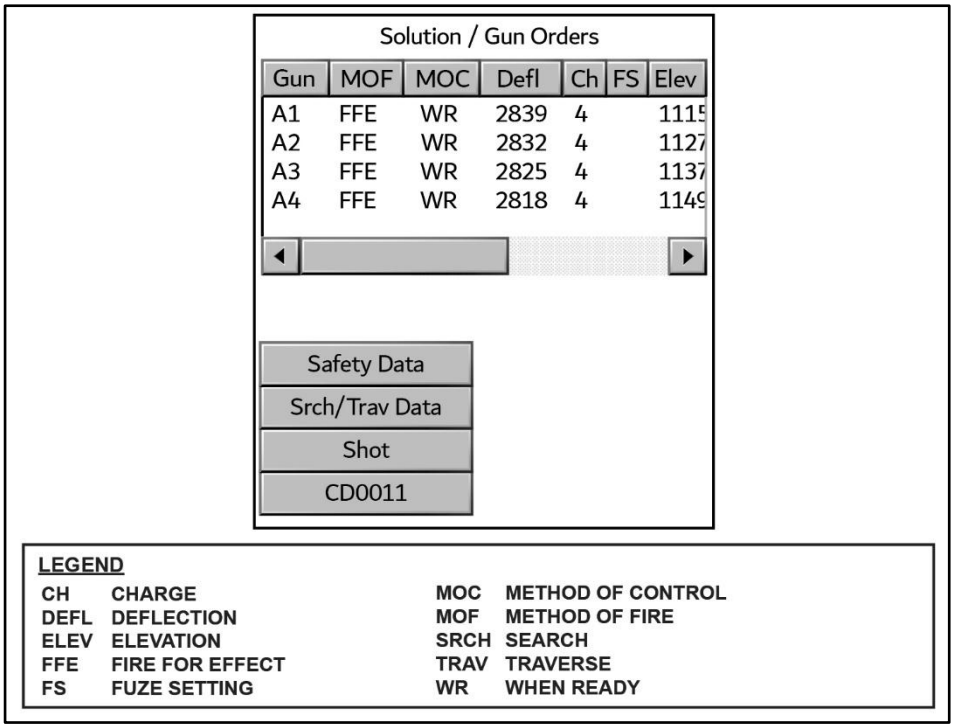


Figure 8-76. Search and traverse: fire for effect solution

- Select Srch/Trav Data.
- The S/T Round and Hand Wheel Fire Data screen displays (see figure 8-77) and is comprised of the following fields:
  - Rounds per weapon.
  - Deflection.
  - Elevation.

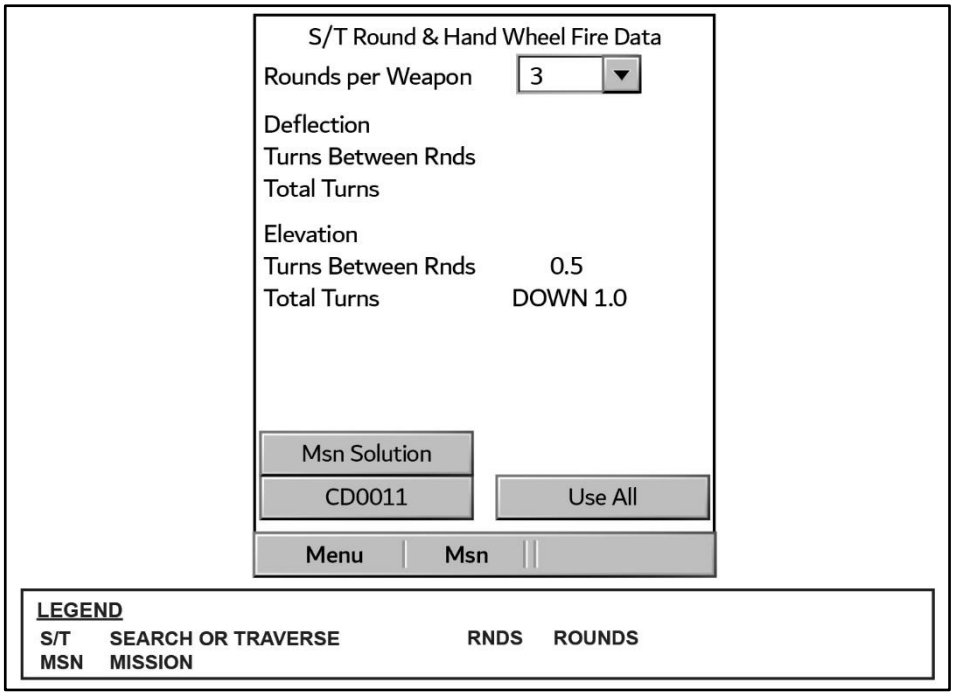


Figure 8-77. Search and traverse: Round and Hand Wheel Fire Data screen

- Use the fields outlined in table 8-16, page 350 to enter and view information.

Table 8-16. Search and traverse round and hand wheel fire data screen fields and related information

Field	*Related Information*
Rounds per weapon	This field defaults to the number of rounds required to properly engage the target area depending upon the burst radius of the given munitions. This field may be changed to a lesser number of rounds, which will decrease the effectiveness of the engagement, but will conserve ammunition.
Deflection	These two fields correspond to traversing across the target area. Turns Between Rounds: This field is read-only. The number of turns between rounds will be adjusted according to the number of rounds to be fired. Total Turns: The total number of turns and the direction to be traversed.
Elevation	These two fields correspond to searching across the target area. Turns Between Rounds: This field is read-only. The number of turns between rounds will be adjusted according to the number of rounds to be fired. Total Turns: The total number of turns and the direction to be searched.

- Record this data on DA Form 2399.
- Select Use All.
- The Solution/Gun Orders screen displays.
- End the mission and record the ammunition expenditure in the same manner as a standard manual mission (see figure 8-78).

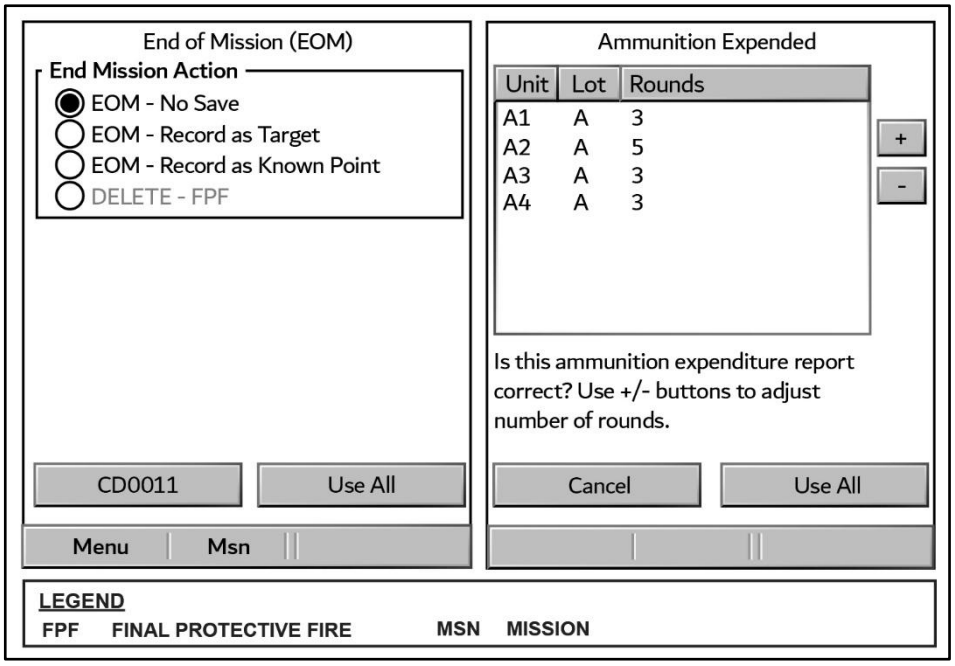


Figure 8-78. Search and traverse: end of mission and ammunition expended screens

QUICK SMOKE MISSION

8-36. Smoke missions are conducted using a combination of the LHMBC and traditional FDC procedures. The standard smoke mission covers 500 meters for 10 minutes, but this width and time can be adjusted depending on the mission requirements. The four primary steps in a smoke mission are—

- The calculation of the rounds required using the smoke card.
- The CFF and adjustment.
- The establishment of the smoke screen.
- The maintenance of the smoke screen.

CALCULATION OF THE ROUNDS REQUIRED USING THE SMOKE CARD

8-37. As the rounds are adjusted, the section leader uses the smoke card to determine the number of rounds required to sustain the smoke screen based on relative humidity, temperature gradient, and wind speed.

Note. The smoke card is available as a smoke data button on the mission data screen.

CALL FOR FIRE AND ADJUSTMENT OF THE SMOKE MISSION

8-38. The smoke mission is received digitally or by radio as a standard new CFF. The FO, the LHMBC operator, and the gun adjust the fires using HE. Due to ballistic differences between the HE and smoke shell and varying wind conditions, a smoke round is fired to confirm the adjustments and wind conditions in the target area.

ESTABLISHING THE SMOKE SCREEN

8-39. Once the adjustments are made, the guns fire no fewer than 12 smoke cartridges to establish the curtain. The M819 red phosphorous 81-mm smoke cartridge uses a time setting to burst the red phosphorous approximately about 175 meters above the target area. The M929 WP 120-mm smoke cartridge uses the 120-mm PROX setting to burst the cartridge 14 feet above the target area.

MAINTAINING THE SMOKE SCREEN

8-40. The guns fire the number of RPM needed to sustain the smoke screen. The FDC controls these fires by alternating fire between the guns assigned to the mission.

SIMULTANEOUS

8-41. Simultaneous procedures involve simultaneous fire upon two targets from a single location.

SPLIT SECTION

8-42. Split section procedures involve firing upon a single target from more than one location.

TIME ON TARGET

8-43. The observer may tell the FDC when the observer wants the rounds to impact by requesting, TIME ON TARGET [numbered desired] MINUTES FROM NOW or TIME ON TARGET [time desired] HOURS. The observer must conduct a time check to ensure that the timepiece is synchronized with the FDC’s timepiece.

Chapter 9

Mortar Fire Control System Introduction

MFCS provides a complete, fully integrated, digital, fire control system for mortar systems. With the MFCS, the mortar FDC computes fire commands to execute fire missions and control the mortars. The MFCS components work together to compute targeting solutions, direct the movement of vehicles into firing positions, allow real-time orientation, and send firing commands to the guns. The MFCS-D (M150/M151), MFCS-Mounted (M1064/M577), and MFCS-Stryker (RMS6-L) use the MFCS operating system functions identically. For more information on the MFCS-D and components of the M120A1 system see TM 9-1230-205-10, TM 9-1230-205-23&P, and TM 9-1230-208-13.

Note. Due to continuous software updates, images may differ from users' software displays.

SECTION I – INITIALIZATION AND CONFIGURATION

9-1. This section discusses the introduction, initialization, and configuration of the MFCS.

DESCRIPTION

9-2. The MFCS is an automated fire control system designed to improve the mission command of mortar fires and the speed of employment, accuracy, and survivability of mortars. The commander's interface (CI) microprocessor, controlled by a software operating system, manages computer activities, performs computations, and controls the interface with peripheral and external devices. The CI operator enters data at the keypad and composes messages using the liquid crystal display (LCD). Completed messages then are transmitted digitally or by radio. If the FDC become disabled, each mortar crew can compute its own fire missions if the crew's computer is reconfigured as its own gun/FDC. System accuracy is increased by a GPS, an onboard azimuth reference for the gun, and digital MET updates. The MFCS (see figure 9-1, page 354) enables self-surveying mortars, digital CFF exchange, and automated ballistic solutions.

Note. See TC 3-22.90 for more information about the MFCS.

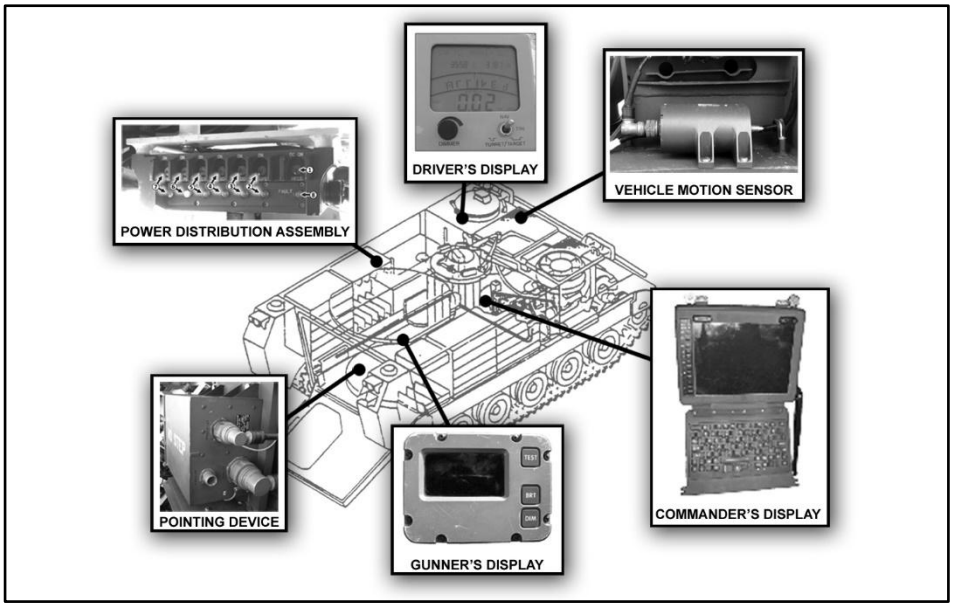


Figure 9-1. Mortar fire control system

COMMANDER'S INTERFACE

9-3. The CI (see figure 9-2) is a computer terminal that provides high-speed data processing, an LCD, and a "QWERTY-style" keyboard similar to that of a common personal computer. It has a built-in modem, allowing a wide variety of data exchange requirements. The operator works with the CIs GUI to operate the system using the built-in mouse or the keyboard to point and click buttons and tabs. Data is presented on screens designed for specific missions and operations. The CIs keys and their functions are as follows.

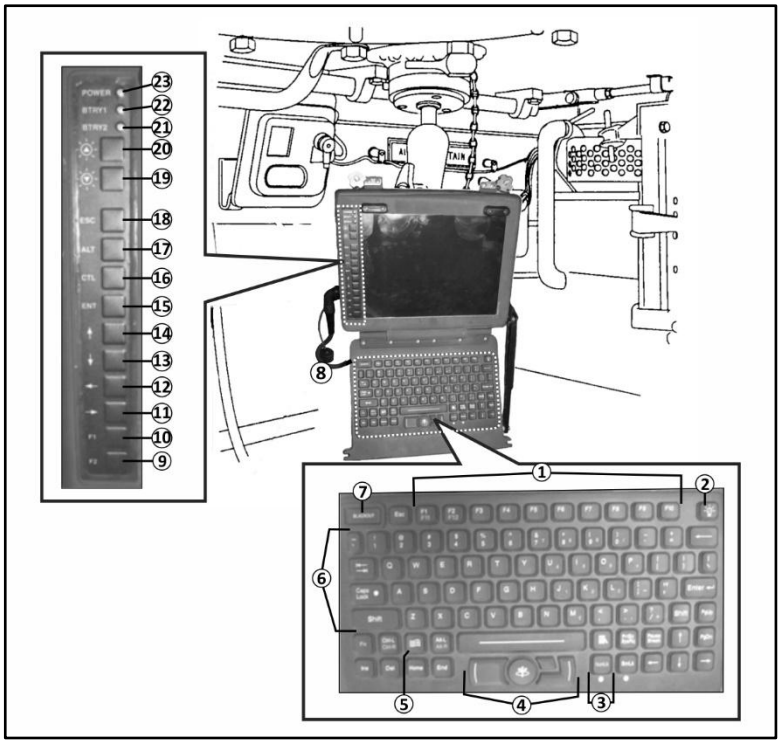


Figure 9-2. Commander's interface

FUNCTION KEYS

9-4. Although the primary method of operating the CI is the built-in mouse, the operator can use the F1 through F10 function keys (1, figure 9-2) to make selections in the software. (Function key F12 is not used.) Table 9-1, page 356 identifies the assignment of keys.

Table 9-1. Function keys

Function Key	*Assignment*
F1	HOTKEY MENU
F2	Use All
F3	Undo
F4	Fire Support Coordination Measure (FSCM)
F5	Missions
F6	Final Protective Fires (FPFs)
F7	Plain Text Message (PTM)
F8	Safety Fans
F9	Check fire
F10	Alerts
F11	Plot
F12	Not Used

KEYBOARD BACKLIGHTING CONTROL

9-5. This control (2, figure 9-2, page 355) adjusts the intensity of the light (with off, low, and high settings).

NUMBER LOCK KEY AND INDICATOR

9-6. With blue numerals and arithmetic functions, these keys can be used as a number pad. Inadvertent use of the Number Lock (NUM LK) key (3, figure 9-2, page 355) may result in the inability to perform other desired functions. When activated, the indicator light is illuminated.

MOUSE

9-7. The mouse (4, figure 9-2, page 355) allows the operator to move the cursor on the screen and make selections.

WINDOWS KEY

9-8. The Windows key (5, figure 9-2, page 355) is not used by the operator.

ALPHA, NUMERIC, AND SPECIAL CHARACTERS KEYS

9-9. The alpha, numeric, and special character keys (6, figure 9-2, page 355) function as a standard keyboard to compose messages and enable operators to enter data into the system.

BLACKOUT KEY

9-10. The blackout key (7, figure 9-2, page 355) blacks out the screen to guard against enemy detection in a tactical environment.

RIGHT, LEFT, DOWN, AND UP DIRECTION ARROW KEYS

9-11. The right, left, down, and up direction arrow keys (11 through 14, figure 9-2, page 355) enable operators to make selections in the software. Mouse or keyboard use is recommended.

ENTER KEY

9-12. The Enter (ENT) key (15, figure 9-2, page 355) brings up a menu of function keys.

CONTROL, ALTERNATE, AND ESCAPE KEYS

9-13. The control (CTL), alternate (ALT), and escape (ESC) keys (16 through 18, figure 9-2, page 355) are not used in this application.

SCREEN BRIGHTNESS INTENSITY BUTTON

9-14. The screen brightness intensity buttons (19 and 20, figure 9-2, page 355) decrease and increase the brightness of the LCD screen.

BATTERY 1 AND BATTERY 2 INDICATORS

9-15. The Battery 1 (BTRY1, shown in 22, figure 9-2, page 355) and Battery 2 (BTRY2, shown in 21, figure 9-2, page 355) indicators illuminate with green light when the capacity of the respective battery is 50 to 100 percent of power, with amber light when capacity is 25 to 50 percent, and with no illumination when the capacity drops below 25 percent.

POWER INDICATOR

9-16. The Power indicator (23, figure 9-2, page 355) illuminates with green light when the computer is being powered with external power (power distribution assembly, Alternating Current [AC]/Direct Current [DC] adapter) and with amber light when battery power is used.

POWER DISTRIBUTION ASSEMBLY

9-17. The power distribution assembly, shown in figure 9-3, page 358 accepts DC and AC to power the MFCS components. It filters vehicle power through a DC-to-DC power system that isolates the MFCS components from fluctuations in vehicle power, including starting the vehicle. It protects the MFCS components against reverse polarity and power surges. To support classroom training and nonfield use, the power distribution assembly provides a 115-to-220-volt AC interface for connection to available line power, which preserves the battery charge level.

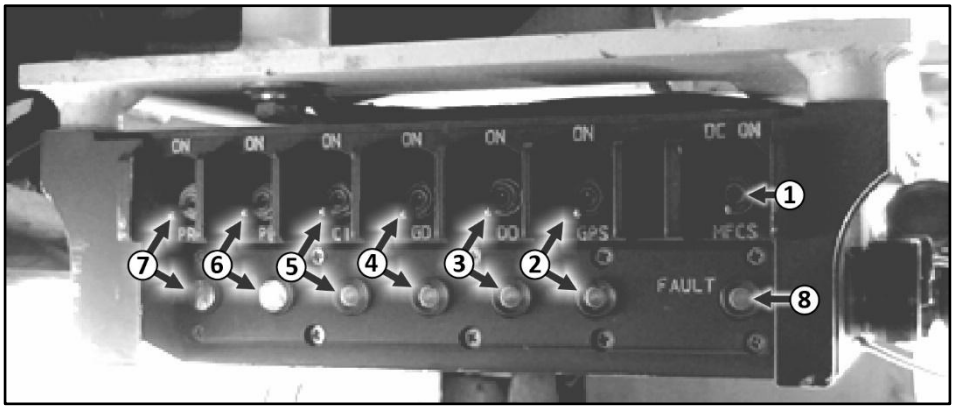


Figure 9-3. Power distribution assembly

POWER ON SWITCH

9-18. The Power On switch (1, figure 9-3) turns the power distribution assembly on and off for DC power only.

SWITCH AND LIGHT-EMITTING DIODE INDICATOR FOR THE DEFENSE ADVANCED GLOBAL POSITIONING SYSTEM

9-19. This switch (2, figure 9-3) distributes power to the DAGR. The light-emitting diode (LED) turns green when the switch is on.

SWITCH AND LIGHT-EMITTING DIODE INDICATOR FOR THE DRIVER'S DISPLAY

9-20. This switch (3, figure 9-3) distributes power to the driver's display. The LED turns green when the switch is on.

SWITCH AND LIGHT-EMITTING DIODE INDICATOR FOR THE GUNNER'S DISPLAY

9-21. This switch (4, figure 9-3) distributes power to the gunner's display. The LED turns green when the switch is on.

SWITCH AND LIGHT-EMITTING DIODE INDICATOR FOR THE COMMANDER'S INTERFACE

9-22. This switch (5, figure 9-3) distributes power to the CI. The LED turns green when the switch is on.

SWITCH AND LIGHT-EMITTING DIODE INDICATOR FOR THE POINTING DEVICE

9-23. This switch (6, figure 9-3) distributes power to the pointing device (PD). The LED turns green when the switch is on.

SWITCH AND LIGHT-EMITTING DIODE INDICATOR FOR THE PRINTER

9-24. This switch (7, figure 9-3) distributes power to the printer, or in an emergency, the printer port can be used to power the PD. The LED turns green when the switch is on. This switch is not used in this application except in an emergency.

FAULT LIGHT-EMITTING DIODE INDICATOR

9-25. This indicator (8, figure 9-3) illuminates with amber light and may flicker if the power distribution assembly malfunctions.

POINTING DEVICE

9-26. The PD (see figure 9-4) is mounted and aligns the M121 mortar. It can maintain alignment and accuracy within 3 mils of the azimuth and 1 mil of the elevation in all conditions. It provides pointing and positional performance at an operational range of 80 degrees south to 84 degrees north latitude. An inertial measurement unit provides the weapon with absolute knowledge of vehicle position and mortar barrel azimuth and elevation. The inertial measurement unit can determine the orientation of the mortar barrel without survey control points, aiming circles, or aiming posts—allowing the mortar platoon to emplace anywhere at any time. To maintain a high degree of accuracy, the inertial measurement unit incorporates information from the GPS and a vehicle motion sensor (VMS). The PD's design allows for loss of the GPS, the VMS, or both devices without substantial degradation in overall performance.

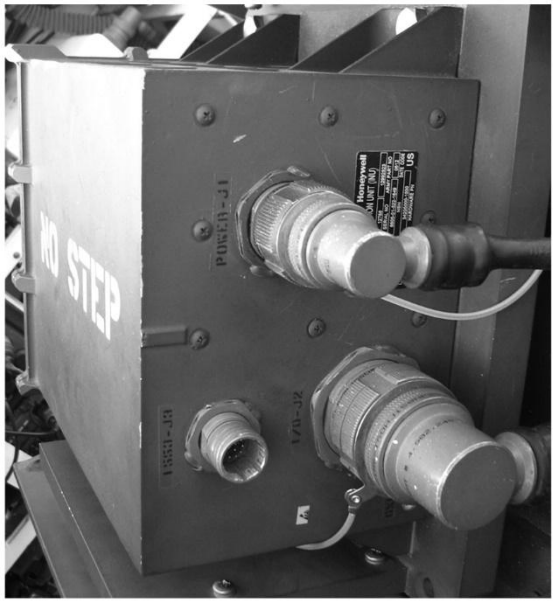


Figure 9-4. Pointing device

GUNNER'S DISPLAY

9-27. The gunner's display (see figure 9-5) provides the gunner with the necessary information (deflection elevation, check fire, and CFF commands) to aim and fire the mortar. Function keys are used to start various displays that cover the gunner's functional needs for information, status, and reporting.

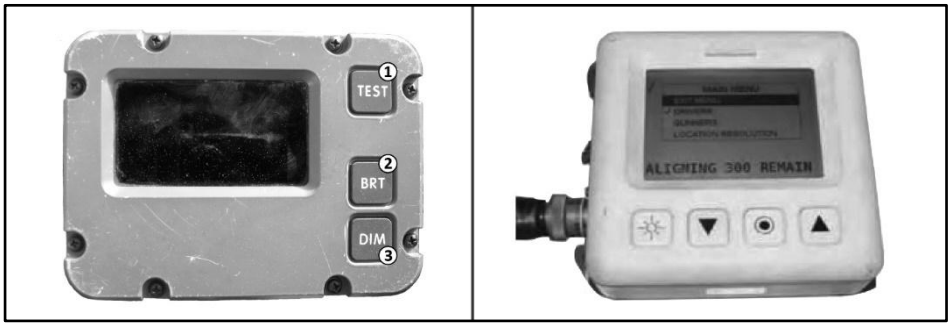


Figure 9-5. Gunner's display

TEST KEY

9-28. The Test key (1, figure 9-5) initiates the internal built-in test (BIT) display.

BRIGHT AND DIM KEY

9-29. The Bright (BRT) and Dim (DIM) keys (2 and 3, figure 9-5) increase and decrease the brightness of the LCD.

LOCKING CLAMP

9-30. The locking clamp is used to allow movement of the gunner's display from the mounting ball.

DRIVER'S DISPLAY

9-31. Located within the driver's vision, the driver's display (see figure 9-6) shows the steering directions and compass orientation to move the vehicle to the next firing location or waypoint. It provides information to correctly orient the vehicle at the next emplacement. Information is displayed graphically for steering directions and compass orientation, and numerically for distance and heading.

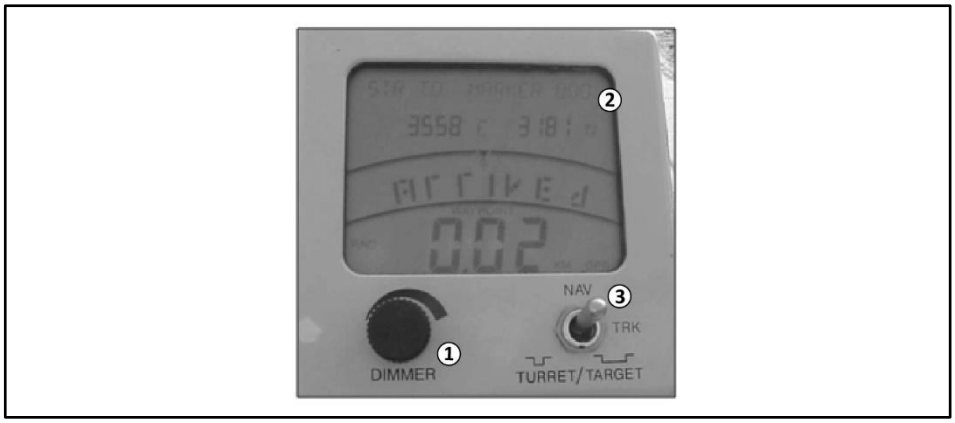


Figure 9-6. Driver's display

DIMMER KNOB

9-32. The dimmer knob (1, figure 9-6) controls the brightness of the LCD.

LIQUID CRYSTAL DISPLAY

9-33. The LCD (2, figure 9-6) displays directions to the next position. The LCD blinks when a CFF is received.

TOGGLE SWITCH

9-34. With the toggle switch (3, figure 9-6) turned to NAV (navigation), the LCD displays directional instructions. The track (TRK) and TURRET/TARGET toggle positions are not used.

FIRE CONTROL DISPLAY

9-35. The fire control display (see figure 9-7) can be programmed for use as a gunner's display or as a driver's display (M95 MFCS only). The gunner's display and driver's display is no longer supplied and is being replaced by the fire control display.



Figure 9-7. Fire control display

VEHICLE MOTION SENSOR

9-36. The VMS (see figure 9-8) provides the PD with vehicle velocity data to reduce the vertical position error and improve location accuracy. Rotation of the drive wheels, and, thus, motion of the vehicle, creates a pulse, which represents forward or backward motion of the vehicle. The VMS is mounted inside the carrier.

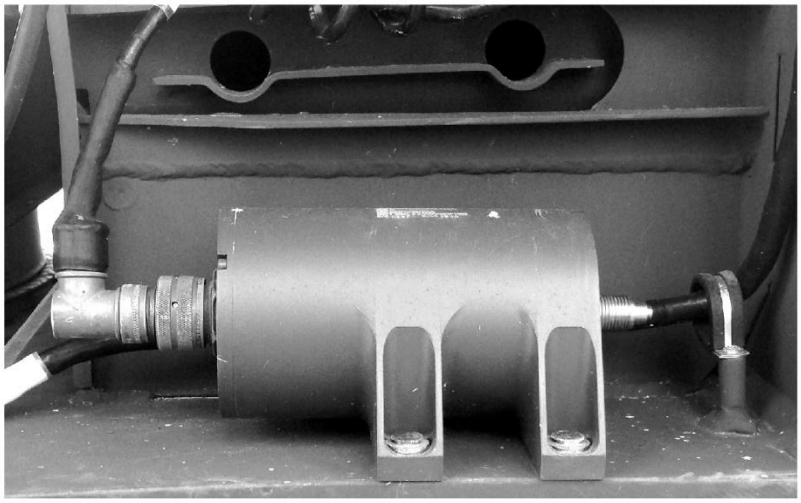


Figure 9-8. Vehicle motion sensor

CAPABILITIES

9-37. The computer design permits the system to be upgraded to match expanding demands for field terminal equipment. Currently, the MFCS can store—

- 18-gun positions.
- 3-gun sections.
- 50 known points.
- 50 known targets. 200 known points and targets combined.
- 16 RPs.
- 3 FPFs.
- 25 FO locations.

COMMANDER'S INTERFACE PROCESSING CAPABILITIES

9-38. The CI can simultaneously process up to six active fire missions, consisting of one to six guns per mission if no mission includes guns from different sections and no gun is assigned to more than one mission concurrently. It can—

- Accept up to 100 digital messages.
- Handle a full range of mortar ammunition per type.

- Conduct registration missions and apply all registration corrections automatically.
- Receive, compute, and automatically apply all MET corrections.
- Store a maximum of 10 safety fans.
- Provide a 13-digit grid to impact for all rounds.
- Provide azimuth and range from the gun to the impact for each round.
- Connect to radio or wire for digital communications.

9-39. The CI can be powered through power adapter options of 12- to 32-volt DC or 110- or 220-volt AC power or with rechargeable lithium batteries. The CI contains power-saving circuitry.

9-40. The CI accepts digital messages from the FOS, the AFATDS, and the interim fire support artillery software to support FSCMs and digital messaging devices. It has an integral speaker and software to control its output and provides the following safety geometry:

- NFAs.
- Coordinated fire lines.
- Restricted fire areas.
- Restricted fire lines.
- Lateral boundaries.
- ACA.
- Forward line of own troops.
- Fire support coordination line.

COMMANDER'S INTERFACE BATTERY SPECIFICATIONS

9-41. The CI holds two rechargeable nickel metal hydride (NiMh) batteries, which are for backup power purposes only. The CI can operate without batteries. It includes the following features:

- Single batteries can be replaced while the system is in operation.
- Batteries cannot be installed incorrectly.
- Battery power will last for about 4 hours in ambient conditions.

WARNINGS

1. The battery indicator is no longer reliable. The conditioning process recalibrates the battery indicator, and without recalibration, that indicator becomes inaccurate. Remaining battery life can be determined by applying external power to the CI and observing the BTRY1 and BTRY2 indicators. 2. CI batteries do not require conditioning or deep cycling. The CI should never be used to condition batteries. 3. Charging two batteries simultaneously can create internal noise and grounding loops in the CI. Ensure that only one battery is always installed in the CI.

GRAPHICAL INTERFACE

9-42. The Soldier GUI (see figure 9-9) is a display that allows the operator to use menus, windows, and icons rather than type complicated commands.

SCREEN AREA

9-43. The screen area is located on the screen of the laptop computer. The screen will display an image with buttons, tabs, fields, and menus. It displays the classification of the information on the current screen in the upper center of the screen.

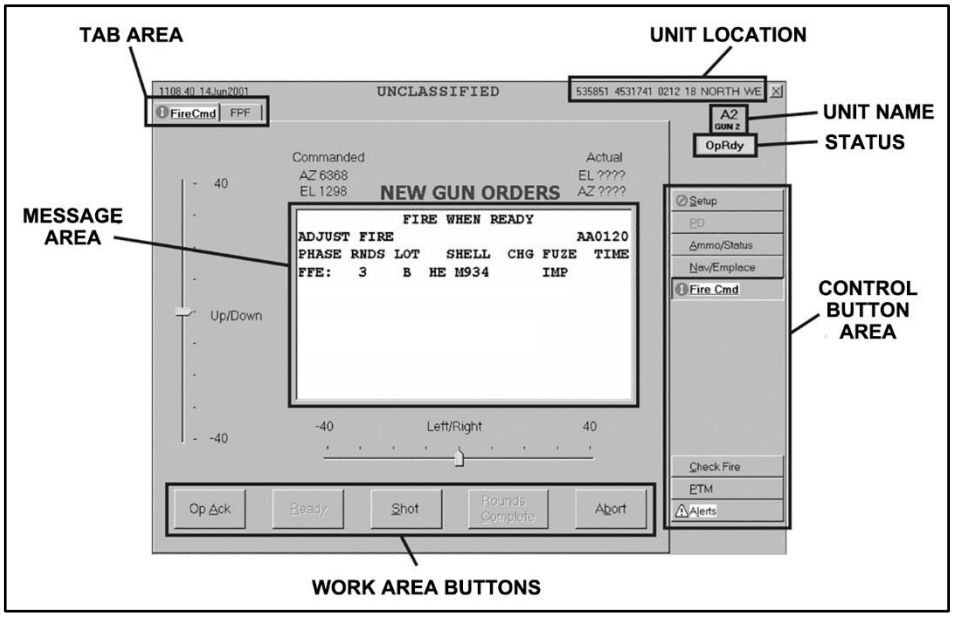


Figure 9-9. Graphic user interface

CONTROL BUTTON AREA

9-44. The control button area displays the buttons used to access all available MFCS functions for the gun and is located on the right side of the GUI. The buttons include—

- Setup.
- Pointing device.
- Ammunition/status (Ammo/Status).
- Navigation/emplacement (Nav/Emplace).
- Fire command (Fire Cmd).
- Check fire.
- PTM.
- Alerts.

Note. The control button area displays only those buttons available for the function currently being used. For example, the setup display above does not include the fire mission functions of FPF, FSCMs, MET, and so on.

TABS

9-45. Tabs are like buttons and are displayed at the top of the screen after a control button has been selected. When a tab is selected, the appropriate screen appears, and the operator can review and enter information and execute actions.

WORK AREA

9-46. The work area is in the center of the screen. This is where information can be viewed, selected, or modified.

WORK AREA BUTTONS

9-47. Work area buttons are in the center and at the bottom of the screen. They are used to accept, process, or refuse data presented in the work area.

POSITION LOCATION

9-48. Position location is in the upper right corner of the screen. It can be the actual position, a series of question marks (if the position is not established), or a note such as "Position Not Available."

UNIT NAME AND LONG NAME

9-49. These are located just below the position location.

COMMON ACTIONS

9-50. When using the MFCS, the operator repeatedly uses the same commands. These usually are done by clicking buttons in the working button area of the screen or responding to a query in a message box. These commands include—

- OpAck.
- Record data.
- MTO accept or deny.
- Process or delete.
- Select the guns to fire the mission.
- Confirm gun orders.
- Accept or modify data.

OPERATIONALLY ACKNOWLEDGE

9-51. Clicking the OpAck button acknowledges receipt of a message and, if turned on, deactivates the audio alarm. The phrase "click the OpAck button" is used throughout the chapter to indicate this action.

RECORD DATA

9-52. Data is recorded throughout the process to maintain a record and to preserve data if the MFCS fails. Data is transcribed onto DA Form 2399 or DA Form 2188. The phrase "record data" is used throughout the chapter to indicate this action.

MESSAGE TO THE OBSERVER ACCEPT OR DENY

9-53. The phrases "click MTO Accept to accept the mission" or "click MTO Deny to refuse the mission" are used throughout the chapter to indicate these actions. If the operator selects MTO Deny, the Delete button appears and, when selected, deletes the mission. If an error is beyond FDC control, the only choice is MTO Deny.

PROCESS OR DELETE

9-54. The MFCS usually presents a choice to process or delete the fire mission. The operator can select Process to continue with the mission or Delete to end the mission. The terms "process" and "delete" are used throughout the chapter to indicate these actions.

SELECT THE GUNS TO FIRE THE MISSION

9-55. Guns for the mission are preselected by the software and are checked in the select (Sel) box in Gun Select. The operator can modify these selections by clicking in the Sel box to select or deselect any operationally ready (OpRdy) gun. The operator can select all or none of the guns listed by clicking All or None. The phrase "select guns" is used throughout the chapter to indicate this action.

CONFIRM GUN ORDERS

9-56. When a solution is displayed and the operator is satisfied with the data, the operator selects "Send Gun Orders." A message box is displayed to confirm the order. The operator clicks "Yes" to confirm the action.

ACCEPT OR MODIFY DATA

9-57. If required, the operator adjusts the mission data. To undo any changes, the operator clicks Undo Changes, and the data fields display the original data. To accept all changes made, click Use All. If no changes are made, click Use All. The phrase "modify data if necessary" is used throughout the chapter to indicate this action.

STARTUP

9-58. Starting the MFCS must be done in sequence to ensure that the system performs properly. Follow these steps to start the MFCS and its ancillary equipment.

- Ensure that the radios are in the stand-by mode and turn on the vehicular or AC power.
- Ensure that sufficient vehicle or auxiliary power is available by checking the power gauge meter on the driver's instrument panel.
- Turn on the power distribution assembly:
  - The power distribution assembly distributes power to the MFCS components and the DAGR.
  - Use the toggle switch to turn on power for each.
- Turn on the DAGR—the DAGR self-test is performed successfully when the DAGR screen states, "Self-Test: Pass." For all MFCS operations, the DAGR must have current communications security (COMSEC) codes installed:
- To confirm the COMSEC press the Status Button on the DAGR, CRYPTO message appears.
- If the DAGR display is blank, press and hold the PWR button on the DAGR to power-on the device.
- Turn on the PD.
- Turn on the CI and check to see if the batteries are installed in the battery compartment and if the power cable is connected to the computer. Turn on the CI switch on the power distribution assembly. If the Power indicator

illuminates with amber light, the CI is not receiving external power. If the Power indicator illuminates with green light, the CI has external power.

- Establish continuous mode for the DAGR. The lower right corner of the DAGR screen should display "Continuous." Push the Enter key, acknowledge any messages, press POS, and view the lower right corner of the top field on the DAGR screen, Continuous should be displayed. If continuous is not displayed, push the menu key. Using cursor control keys highlight Select op mode. Then push the Enter key. Use the cursor control keys and highlight Continuous. The message instructing the operator to acknowledge initialization is displayed, push the Enter key. The display then returns to the position screen with the operating mode change made in the lower right corner of the top field should display Continuous.
  - When the DAGR is in continuous mode. Press Menu twice to show the Main Menu, then press the down arrow as needed to highlight Receiver Setup.
  - Press Enter to show the Receiver Setup screen; then press the down arrow as needed to highlight GPS Setup.
  - Press Enter to show the GPS Setup screen. If the third line on the GPS Set up screen shows Frequency as L1 Primary, go to step g. If not, continue with step d.

Note. The DAGR frequency field: Displays one of three frequency selections; L1 primary, L2 primary, and L1 only. See TM 9-1230-208-13 for more information.

  - Press Enter to highlight Operating Mode.
  - Press down arrow as needed to highlight Frequency.
  - Press Enter to show the Frequency screen and ensure that L1 Primary is selected.
  - Press and hold POS until the Position screen is displayed.
- Turn on the radios.
- Turn on the driver's display.
- Turn on the gunner's display.

Note. See TM 9-1230-208-13 for more information.

LOG-IN PROCEDURES

9-59. The log-in screen (see figure 9-9, page 365) is displayed after system startup is complete. The log-in screen ensures that only authorized personnel have access to the system. The operator enters the username and password and then clicks the Enter button. (See TM 9-1230-208-13 for username and password.)

DATA INITIALIZATION AND SYSTEM CONFIGURATION

9-60. CI initialization and configuration is performed after the startup is completed. The operator inputs or selects information for fields to provide the system with the necessary information. The operator configures the system to the platform using the mouse or keyboard.

9-61. Various symbols or icons may appear on the screen while using the CI. These symbols assist the operator by highlighting actions that must be completed, such as status of operations and changes to data.

Note. See TM 9-1230-208-13 for a list of these icons.

9-62. Initialize and configure the MFCS. Until the system is configured, only the Setup and Alert buttons appear. The setup button is located at the top of the control button area:

- The Unit List screen appears automatically after log in.

Note. The Unit List and Configuration tabs are the only tabs shown.

- Enter the required information for the Unit List and Configuration screens.

Note. All other setup tabs display.

- Enter, modify, or confirm the information on each of these screens:
  - Data.
  - GEOREF.
  - Position.
  - MazRef.
  - Channel A and Channel B.

UNIT LIST SCREEN

9-63. This Unit List screen is the default screen. This Unit List screen (see figure 9-10, page 370) lists all the units assigned or used by the FDC. This screen allows the operator to view, enter, edit, or delete a—

- Unit name.
- Unit reference number.
- Long name.
- Device.
- Observer number.
- Commo.

Notes. 1. If previously configured, the system defaults to the data already entered.

2. There is a limit of 100-unit entries.

9-64. Once complete, the operator accepts the existing or modified data. A red question mark displays until the system is configured with Use All on the Config tab. When the system is configured, additional tab choices will display, and the remaining control buttons will be enabled.

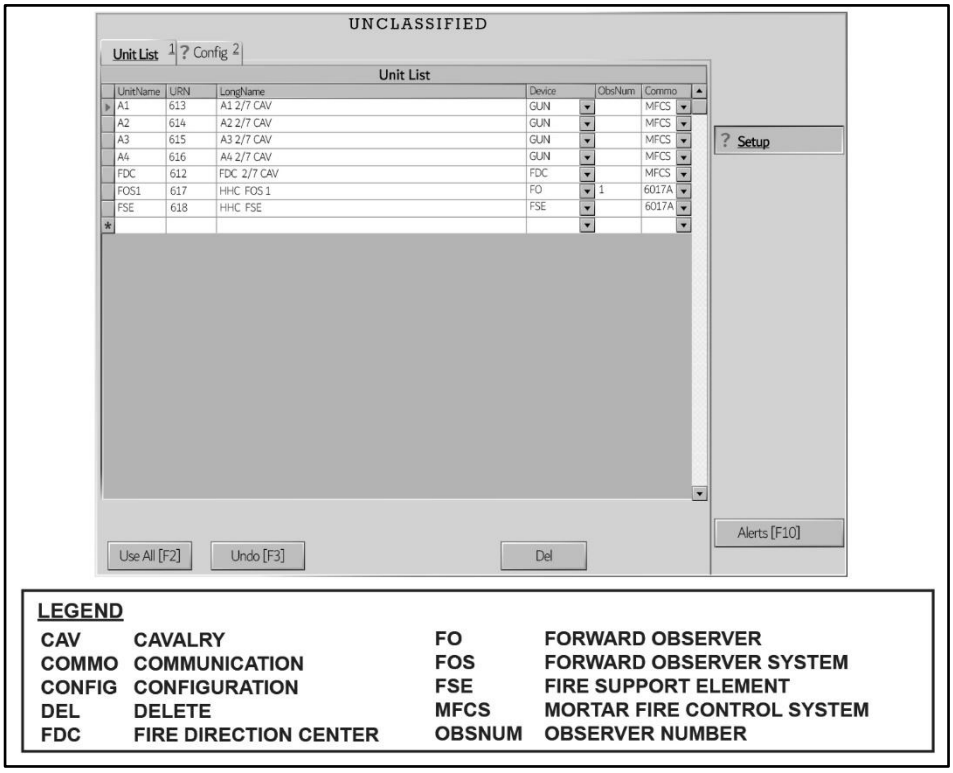


Figure 9-10. Unit List screen

UNIT NAME

9-65. A lock icon displays in the index box at the beginning of a row when that platform already has been assigned a unit name. The unit name must be two to four characters long, and the first character must be a letter.

UNIT REFERENCE NUMBER

9-66. The unit reference number must be unique to the unit.

LONG NAME

9-67. The long name must be less than 30-characters long.

DEVICE

9-68. The operator accesses the pull-down menu in the Device field to select FDC, GUN, GUN/FDC, FO, FSE, or OTHER.

OBSERVER NUMBER

9-69. In the last field, Obs Num, the operator assigns a number to each observer or any unit that may act as an observer.

COMMUNICATION

9-70. This field should be filled in to reflect which Commo package the device will be using to communicate.

Notes. 1. If previously configured, the system defaults to the previously entered data.

2. MFCS Versions 3.0 and later include a Commo field. This field is used to select VMF PKG11 or VMF R5. If using FOS Version 7.1 or AFATDS Version 6.4 or later, select VMF R5. Otherwise, select VMF PKG11.

CONFIGURATION SCREEN

9-71. The operator selects the Use All working area button on the Unit List screen to display the Configuration screen. (See figure 9-11, page 372.) This screen allows the operator to enter or reconfigure information by selecting one of the options on the pull-down menus for—

- Platform.
- Role.
- Unit.
- Security classification.
- Mode.
- Controlling FSE.

9-72. A red question mark displays on the Config tab until the operator clicks Use All.

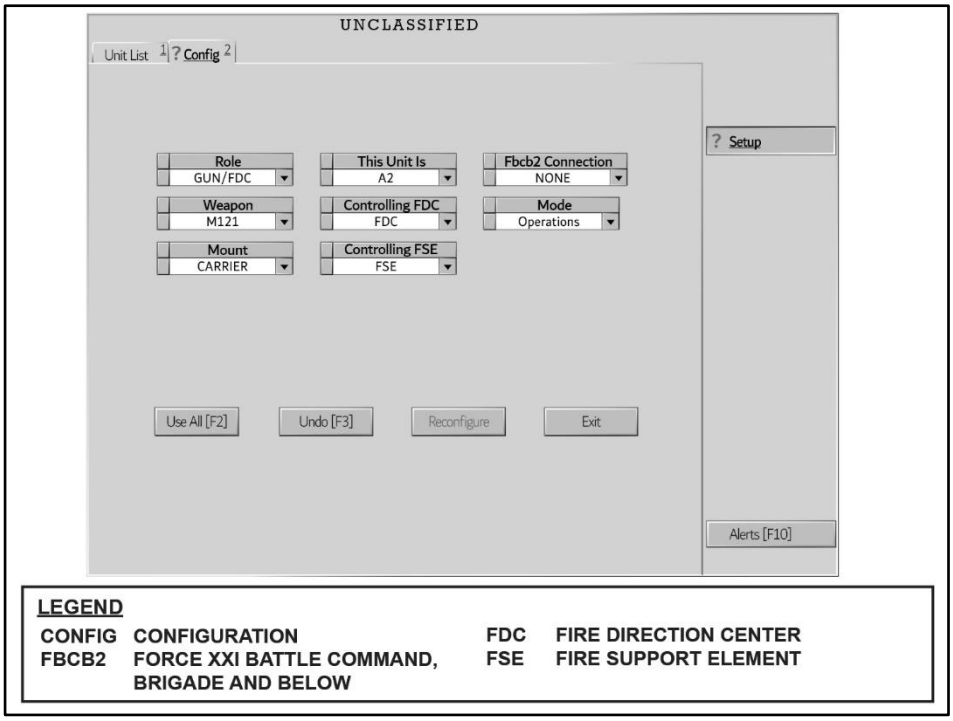


Figure 9-11. Unit Configuration screen

DATA SCREEN

9-73. The operator selects the Data tab to display the Data screen. (See figure 9-12.) This screen allows the operator to verify, view, or set the—

- System date/time.
- Audio alarm.
- Target number.
- Splash offset.
- Time OK (to validate the time).

Note. All computers should have the same date and time.

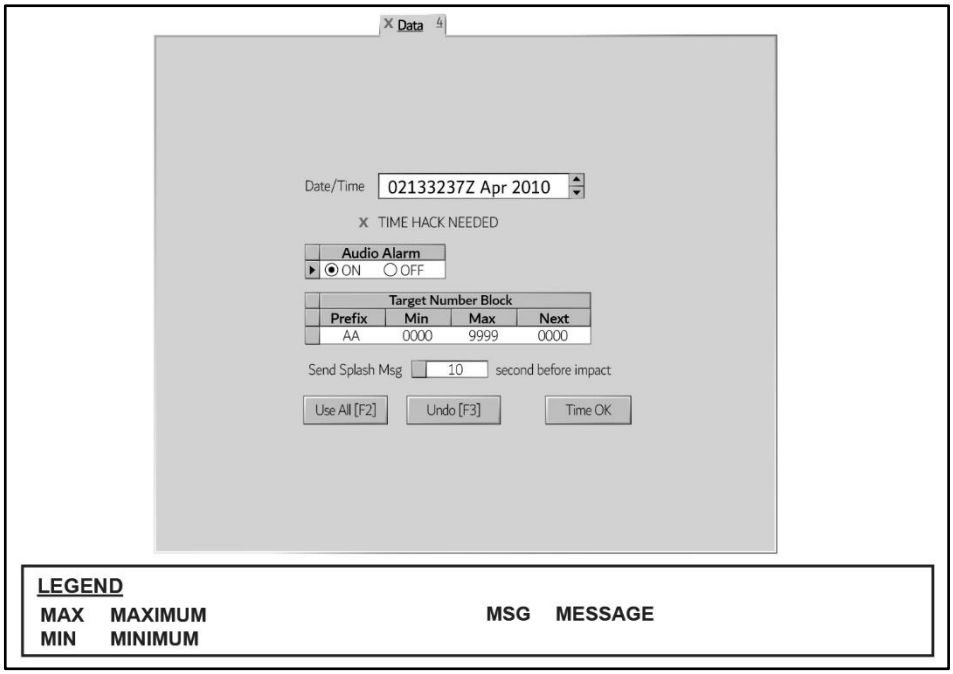


Figure 9-12. Data screen

GEOGRAPHIC REFERENCE SCREEN

9-74. The geographic reference screen (see figure 9-13, page 374) allows the operator to set the geographic positioning system by filling the following fields:

- Ellipsoid.
- Datum.
- Map Mod.

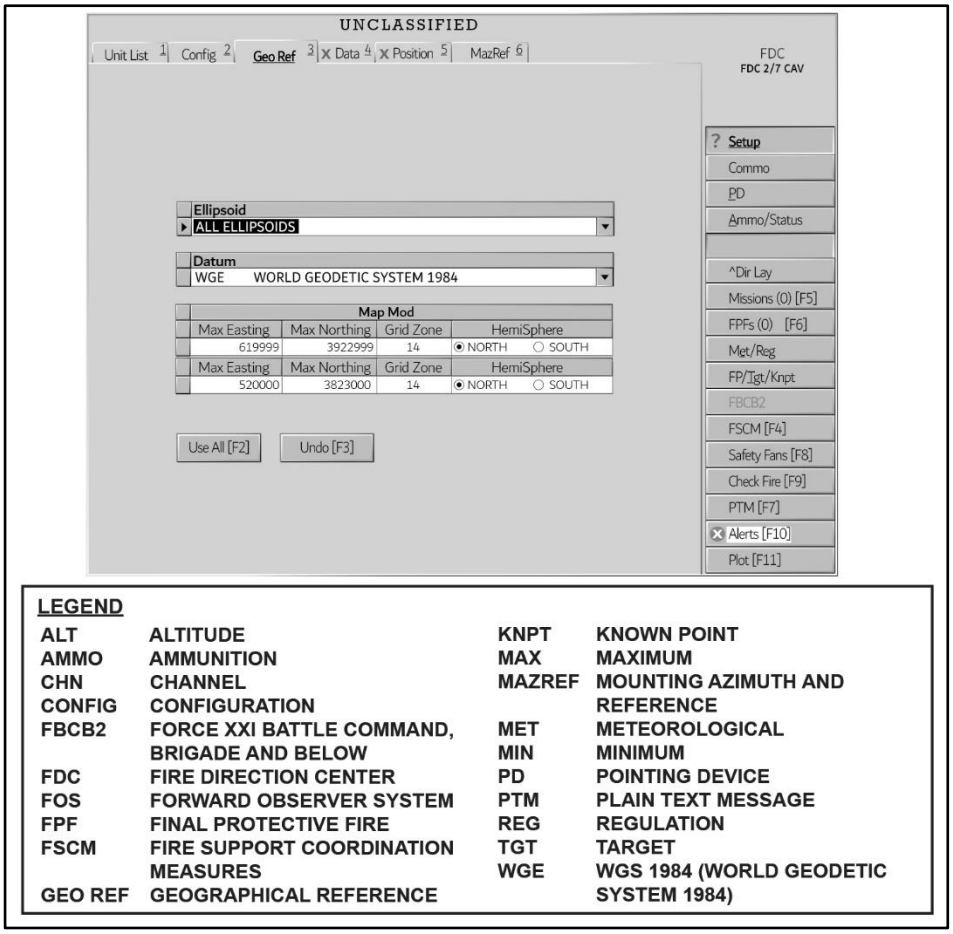


Figure 9-13. Geographic reference screen

ELLIPSOID AND DATUM FIELDS

9-75. To fill the Ellipsoid and Datum fields—

- Click the down arrow in the Ellipsoid field and select the appropriate choice.
- The corresponding default datum for the ellipsoid automatically displays in the Datum field.
- Change the Datum field by choosing another option.
- The screen value is updated, and a pencil icon displays in the index box at the beginning of each.

9-76. To undo the changes, click Undo Changes; any unsaved changes (indicated by a pencil icon) are refreshed with the original data.

MAP MOD FIELD

9-77. The Map Mod field is comprised of eight subfields:

- Maximum Easting (Max Easting).
- Maximum Northing (Max Northing).
- Grid Zone (maximum field row).
- Hemisphere (HemiSphere, maximum field row).
- Minimum Easting (Min Easting).
- Minimum Northing (Min Northing).
- Grid Zone (minimum field row).
- Hemisphere (HemiSphere, minimum field row).

Maximum Easting and Northing Fields

9-78. The Max Easting and Max Northing fields are read-only and are filled automatically when the operator enters the fields.

Grid Zone and Hemisphere Fields (Maximum Field Row)

9-79. The Grid Zone and HemiSphere fields in the Maximum field row are read-only and are filled automatically and updated when the operator enters the Minimum values.

Minimum Easting and Northing Fields

9-80. The Min Easting and Min Northing fields are disabled if there are any active missions. The MFCS uses the 13-digit MGRS to calculate the map modification. The minimum Easting must be six digits; the minimum Northing must be seven digits.

Grid Zone and Hemisphere Fields (Minimum Field Row)

9-81. The grid zone and hemisphere can be determined using the map sheet. The Grid Zone Designation is in the Grid Reference box at the bottom center of the map sheet. It includes two numbers and a letter. The letter is not entered into the MFCS. The HemiSphere field is set to north if operating north of the equator, or south if operating south of the equator.

POSITION SCREEN

9-82. The operator selects the Position tab to display the Position screen. (See figure 9-14, page 376.) This screen allows the operator to view or update the operator's and other units' current positions. The operator must update the position if a red circle with an X through it displays on the Position tab.

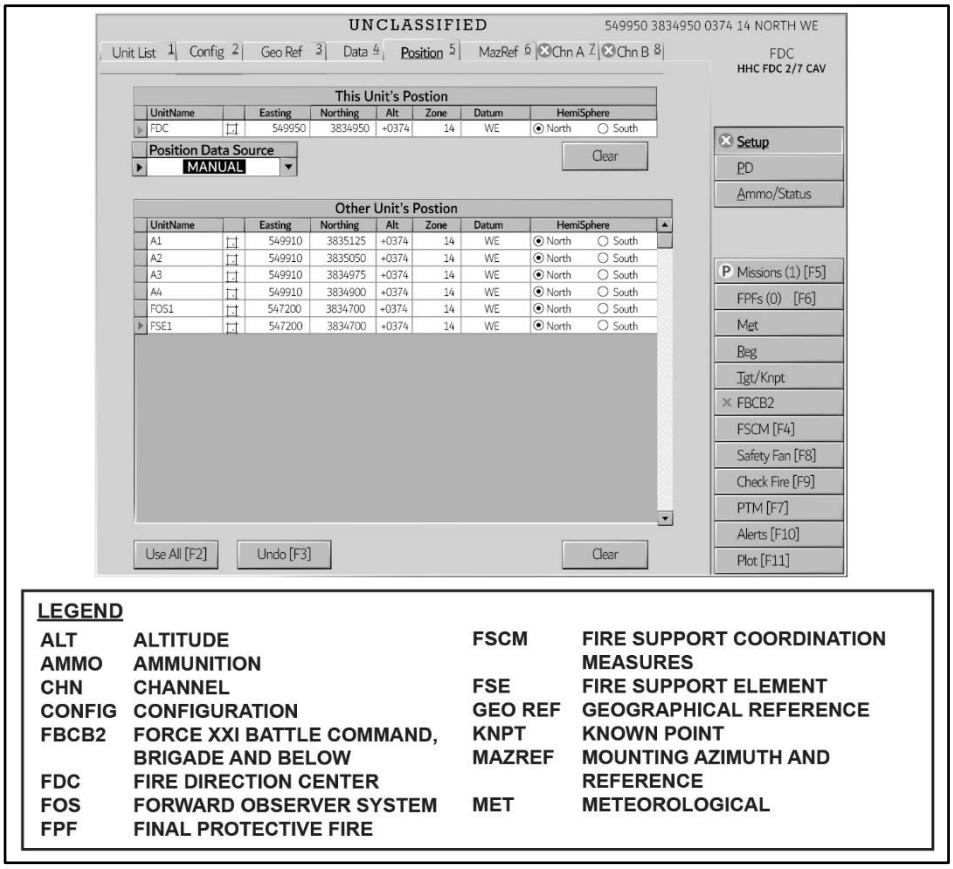


Figure 9-14. Position screen

THIS UNIT'S POSITION

9-83. This portion of the screen contains eight fields:

- Unit Name (UnitName).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).
- Position Data Source.

9-84. As necessary, the operator may click—

- Use All.
- Undo.
- Cancel.

UnitName Field

9-85. The UnitName field is read-only and is filled automatically with the unit names selected in the Configuration screen.

Zone, Datum, and HemiSphere Fields

9-86. The Zone, Datum, and HemiSphere fields are read-only and are filled automatically when the operator enters the Map Mod field.

Position Data Source, Easting, Northing, and Altitude Fields

9-87. With the Position Data Source field set to Manual, the operator can manually update or modify the fields as follows:

- The Easting field with six digits.
- The Northing field with seven digits.
- The Alt field with a range of values from -400 to 9,999 meters.
- Anywhere a position is entered, the first digit of the Easting and first two digits of Northing are calculated based on the entered MapMod and the five-digit Easting/Northing entered.

Note. If the PD is available and operational, the operator must ensure that the position data source is set to PD, GPS, or Force XXI Battle Command, brigade and below. These fields are read-only.

OTHER UNITS' POSITION FIELDS

9-88. This portion of the screen contains seven fields:

- Unit Name (UnitName).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).

9-89. As necessary, the operator clicks Use All, Undo, or Cancel.

UnitName Field

9-90. The UnitName field is read-only and is filled automatically with the unit names selected in the Configuration screen.

Zone, Datum, and HemiSphere Fields

9-91. The Zone, Datum, and HemiSphere fields are also read-only and are filled automatically when the operator enters the Map Mod field.

Easting, Northing, and Altitude Fields

9-92. Although the values for Easting, Northing, and Alt are transmitted from the gun, the operator has the option to update them manually, as follows:

- The Easting field with six digits.
- The Northing field with seven digits.
- The Alt field with a range of values from -400 to 9,999 meters.

9-93. If the operator enters a value which is not within the map modification, a message box will appear indicating the incorrect range.

Note. The operator's position is displayed in the upper right corner of the screen.

ALTERNATE METHODS OF ENTERING POSITION

9-94. The grid conversion box, the operator may enter positions using UTM, polar coordinates, MGRS, short, or latitude and longitude. These methods may be used in a voice CFF.

9-95. To use these methods—

- Click the icon on the appropriate unit's row.
- The Enter Position screen appears.
- Click the desired alternate method to enter the unit's location.

UNIVERSAL TRANSVERSE MERCATOR

9-96. To enter the unit's location using UTM (see figure 9-15), enter the following for the selected unit—

- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).

9-97. If the coordinates entered are for a valid location, they will appear on the Use button.

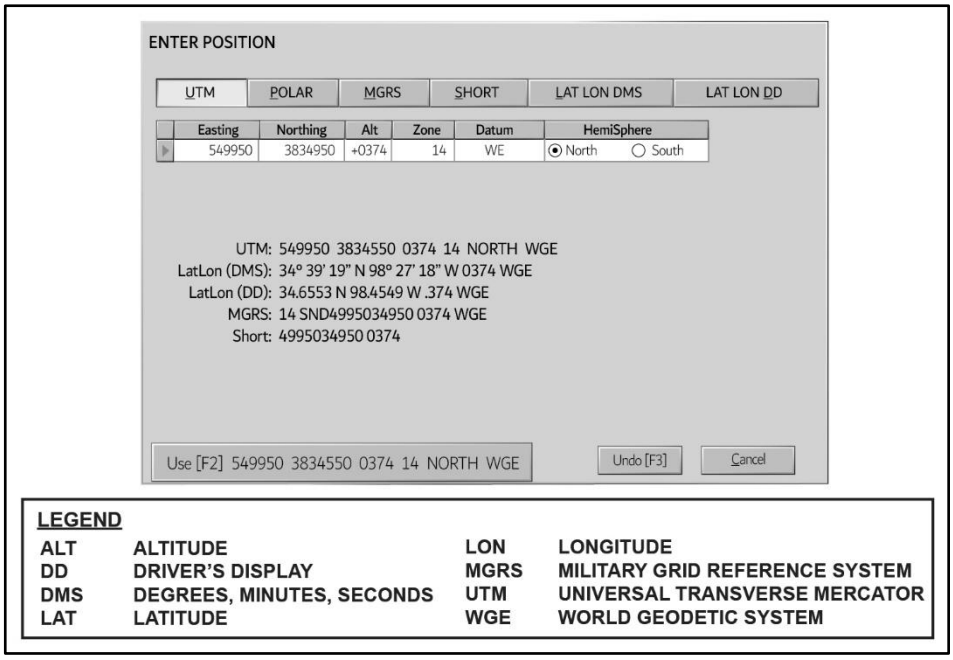


Figure 9-15. Universal Transverse Mercator Alternate Methods screen

Polar Coordinates

9-98. To enter the unit's location using polar coordinates (see figure 9-16, page 380), enter the following for the selected unit:

- Direction (Dir).
- Horizontal distance (Dist).
- VI, indicating the direction + (for up [default]) or - (for down).

9-99. If the location is valid, UTM coordinates are displayed on the Use button. Easting, Northing, Alt, Zone, Datum, and HemiSphere autofills.

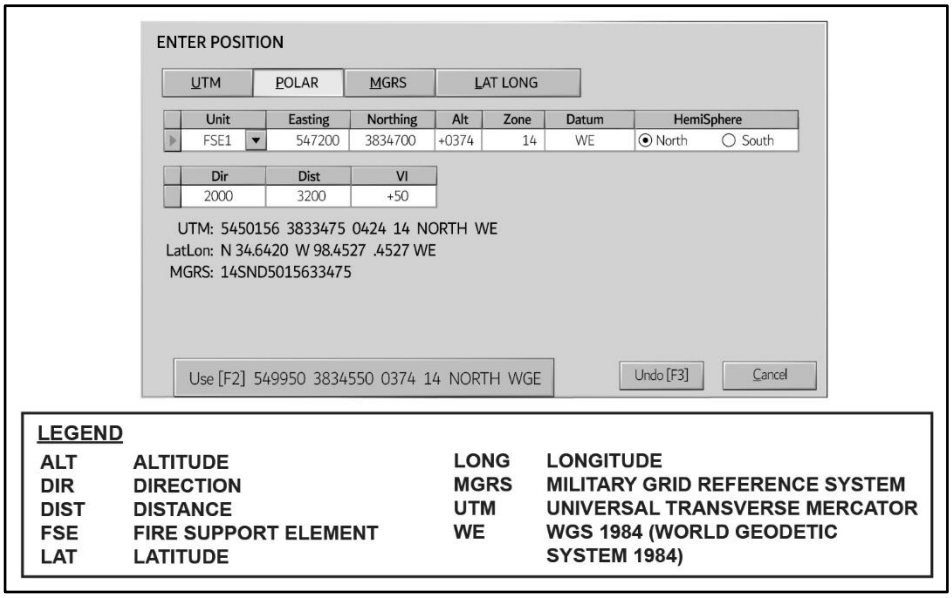


Figure 9-16. Polar Alternate Methods screen

Military Grid Reference System

9-100. To enter the unit's location using the MGRS (see figure 9-17), enter the following for the selected unit—

- Zone.
- Square (100,000-square meter identifier).
- Coordinates.

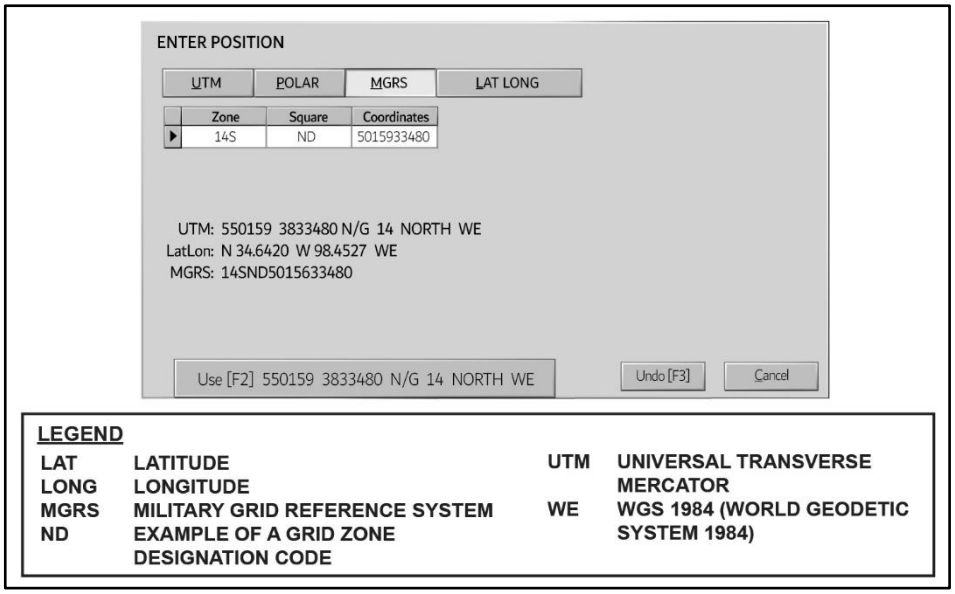


Figure 9-17. Military Grid Reference System Alternate Methods screen

Short

9-101. This option provides an abbreviated form of target or unit location in that it uses the MGRS coordinates without the grid zone identifier. When a mission is initiated with short MGRS coordinates, MFCS will try to compute the solution for a target in the gun's current grid zone.

> ***Note.*** Short MGRS coordinates do not provide enough information for MFCS to determine if a target is in a different grid zone.

Latitude and Longitude

9-102. To enter the unit's location using the latitude and longitude (see figure 9-18, page 382), enter the latitude and longitude. If the location is valid, UTM coordinates display on the Use button.

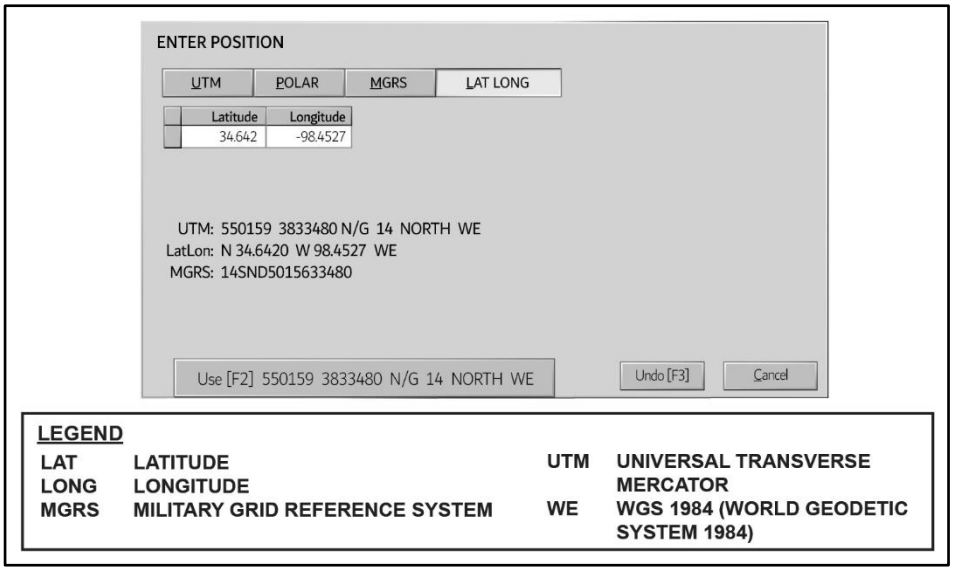


Figure 9-18. Latitude/longitude alternate methods screen

Undo, Cancel, and Use Buttons

9-103. For all of the alternative methods, the operator can click Undo to undo the entries, Cancel to exit without using the information, or Use to accept the entries. The unit's coordinates are now displayed on the Position screen. The coordinates are saved by clicking Use All on the Position screen.

MOUNTING AZIMUTH AND REFERENCE SCREEN

9-104. When necessary, the MFCS can be operated in conventional mode by mounting an M67 sight and placing aiming stakes as described in TC 3-22.90. To display deflections, a mounting azimuth and Ref must be entered on the mounting azimuth and reference (MazRef) screen. (See figure 9-19.)

9-105. To manually enter the MazRef, complete the following fields, and then click Use All:

- Unit Name (UnitName).
- Mounting Azimuth (Mnt Az).
- Use Referred Deflection (Use Ref).

9-106. When a gun's PD is not operational or available, the gun operator must provide MazRef data for the MFCS to compute DF solutions. The FDC operator does not need the MazRef data if DF information is not required. If the situation permits, the gun operator completes the MazRef data to provide backup capability if the PD malfunctions during a mission.

Note. If a gun is operating using a manual position data source, the FDC operator must enter and save the MazRef data for that gun before checking the Manual (Man) box in the Status, by Gun section of the Status Fire Unit screen. Then, the MFCS can compute gun orders in DF.

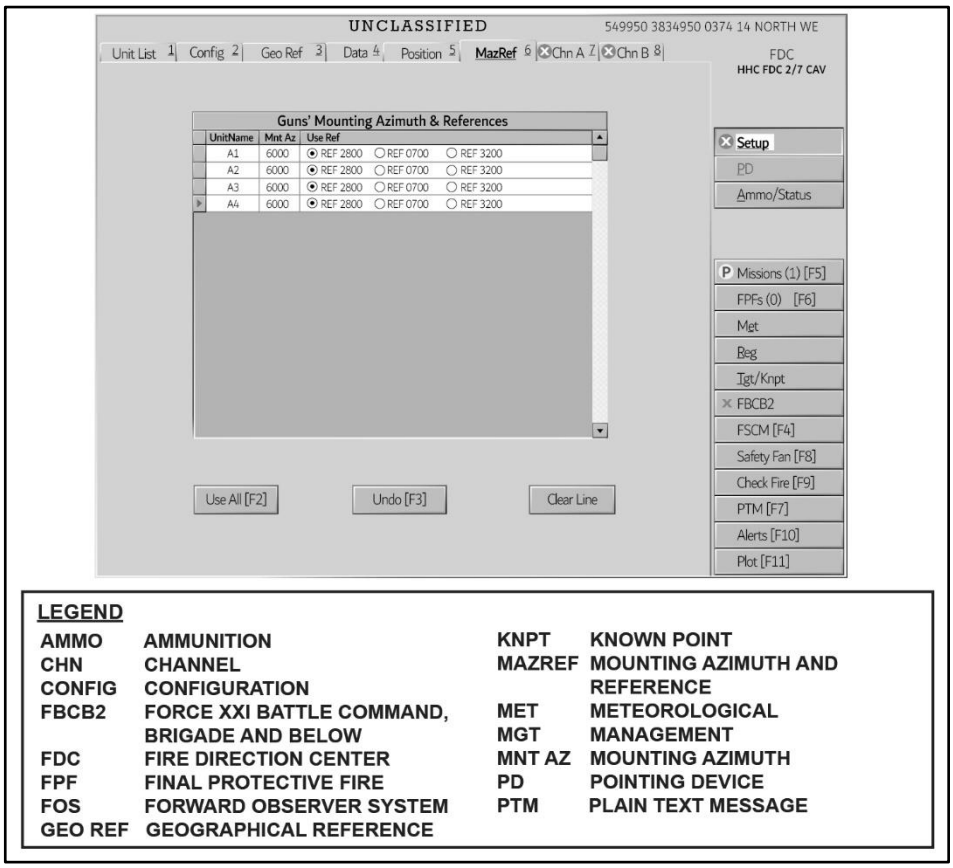


Figure 9-19. Mounting Azimuth and Reference screen

UnitName Field

9-107. This field is read-only from the guns listed in the Unit List screen.

Mounting Azimuth Field

9-108. In this field, the operator enters the MAZ for the appropriate gun. The last digit must be a zero.

Use Referred Deflection Field

9-109. In this field, the operator may choose Ref 2800, Ref 0700, or Ref 3200 by clicking in the appropriate circle.

Undo Button

9-110. The operator can press this button to undo entries before saving.

Clear Line Button

9-111. The operator can press this button to erase a line of information.

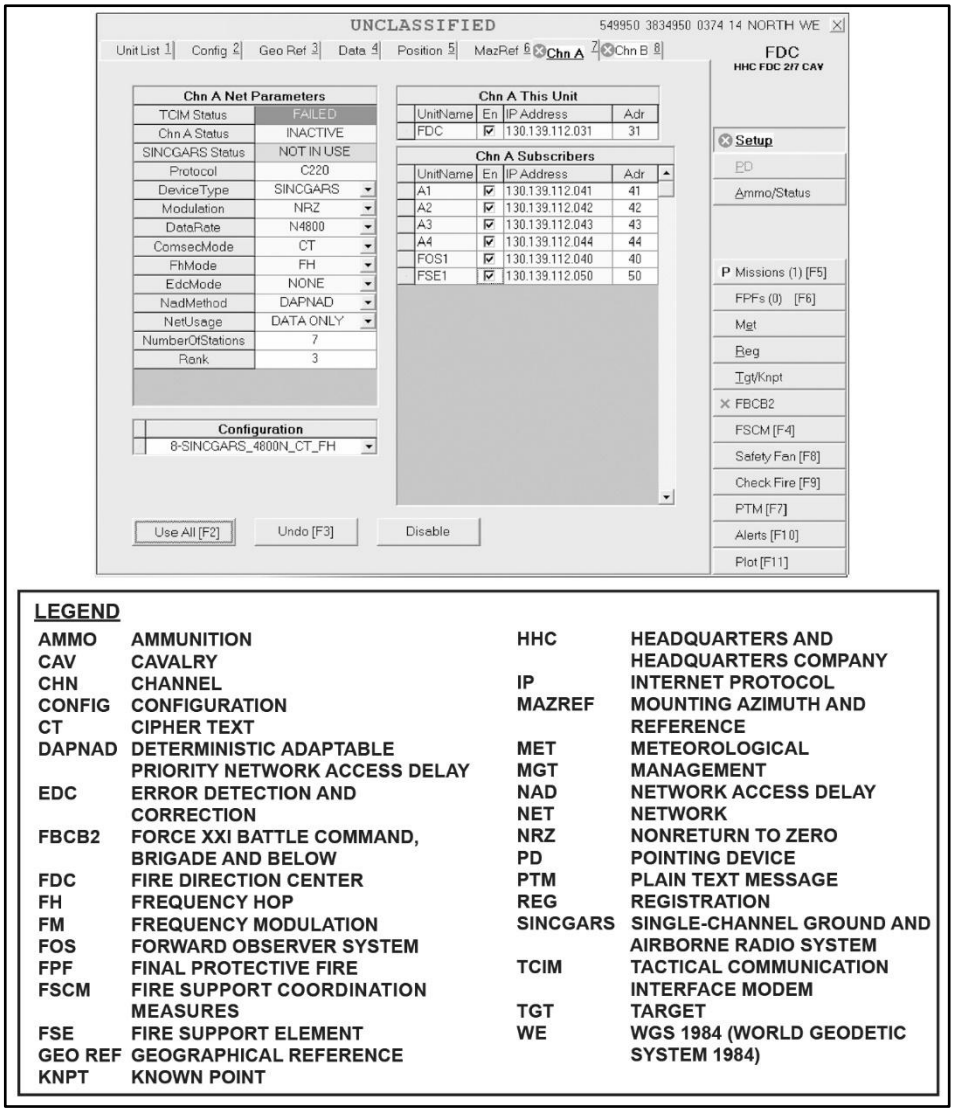
Use All Button

9-112. The operator can press this button to save all the information on the screen.

CHANNEL A AND CHANNEL B SCREENS

9-113. These screens (see figure 9-20) allow the operator to enter, view, or update net parameters for Channel A or B subscribers. Both channels share the same set-up procedures and can be set up for single-channel ground and airborne radio system (SINCGARS), but only Channel A can be set up for wire. Using Channel A for SINCGARS and digital communication between the FDC and the gun is recommended. If a red circle with an X through it displays on the Chn A or Chn B tab, the parameters and subscribers must be set up.

Note. If a channel is not being used, click the Disable button for that channel.



LEGEND

AMMO	AMMUNITION	HHC	HEADQUARTERS AND HEADQUARTERS COMPANY
CAV	CAVALRY	IP	INTERNET PROTOCOL
CHN	CHANNEL	MAZREF	MOUNTING AZIMUTH AND REFERENCE
CONFIG	CONFIGURATION	MET	METEOROLOGICAL
CT	CIPHER TEXT	MGT	MANAGEMENT
DAPNAD	DETERMINISTIC ADAPTABLE PRIORITY NETWORK ACCESS DELAY	NAD	NETWORK ACCESS DELAY
EDC	ERROR DETECTION AND CORRECTION	NET	NETWORK
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW	NRZ	NONRETURN TO ZERO
FDC	FIRE DIRECTION CENTER	PD	POINTING DEVICE
FH	FREQUENCY HOP	PTM	PLAIN TEXT MESSAGE
FM	FREQUENCY MODULATION	REG	REGISTRATION
FOS	FORWARD OBSERVER SYSTEM	SINCGARS	SINGLE-CHANNEL GROUND AND AIRBORNE RADIO SYSTEM
FPF	FINAL PROTECTIVE FIRE	TCIM	TACTICAL COMMUNICATION INTERFACE MODEM
FSCM	FIRE SUPPORT COORDINATION MEASURES	TGT	TARGET
FSE	FIRE SUPPORT ELEMENT	WE	WGS 1984 (WORLD GEODETIC SYSTEM 1984)
GEO REF	GEOGRAPHICAL REFERENCE		
KNPT	KNOWN POINT		

Figure 9-20. Channel A screen

CHANNEL A AND CHANNEL B NET PARAMETERS FIELD

9-114. The operator sets the radio or wire defaults or manually selects the parameters to set the net parameters. To determine the parameters, the operator coordinates with the communications officer.

9-115. Channel A and Channel B net parameters fields include the following subfields:

- Tactical communication interface modem (TCIM) status.
- Channel A/Channel B status (Chn A/Chn B Status).
- SINCGARS status.

- Protocol.
- Device type.
- Modulation.
- Data rate (DataRate).
- Communication security mode (ComsecMode).
- Frequency hop mode (FhMode).
- Error detection and correction mode (EdcMode).
- Network access delay method (NadMethod).
- Network usage (NetUsage).
- Number of stations (NumberOfStations).
- Rank.

Note. Only white fields can be edited. All yellow fields are filled automatically and cannot be changed.

Tactical Communication Interface Modem Status, Channel A Status, Channel B Status, and Protocol Fields

9-116. TCIM Status, Chn A Status, Chn B Status, and Protocol are read-only and are filled automatically. TCIM Status and Chn A/Chn B Status reflect the current status.

Data Type, Modulation, Data Rate, Communication Security Mode, Frequency Hop Mode, Error Detection and Correction Mode, Network Access Delay Mode, and Network Usage Fields

9-117. The operator clicks the Configuration working area button to select the radio defaults for Device Type, Modulation, DataRate (Baud), ComsecMode, FhMode, EdcMode, NadMethod, and NetUsage.

Note. When using SINCGARS FSK188-C, ensure that SINCGARS is the device type and FSK188-C is the modulation.

Number of Stations and Rank Fields

9-118. The operator enters the number of stations and rank, as supplied by the communications officer.

Channel A and Channel B This Unit Fields

9-119. Channel A and Channel B This Unit fields include the following subfields:

- Unit name (UnitName).
- IP address.
- Abbreviated address (Adr).

UnitName Field

9-120. The UnitName field is read-only and is filled automatically with the unit name listed in the Unit List screen.

Internet Protocol Address Field

9-121. To update or enter the IP address, the operator types the correct address. Each IP address has four sets of numbers, three digits in each set. The first set must range from 128 to 254. The second and third sets must range from 001 to 254. The fourth set must range from 004 to 095.

Abbreviated Address Field

9-122. The fourth set of numbers in the IP address is the abbreviated address of the unit.

Channel A and Channel B Subscriber Fields

9-123. Channel A and Channel B This Unit fields include the following subfields:

- Unit name (UnitName).
- Enabled (En).
- IP address.
- Abbreviated address (Adr).

UnitName Field

9-124. The UnitName field is read-only and is filled automatically with the unit names listed in the Unit List screen.

Internet Protocol Address Field

9-125. In the IP Address field, the operator enters the last two digits of the IP address for each unit name.

Abbreviated Address Field

9-126. This field is filled automatically when the operator enters the last two digits of the IP address for each unit name and moves to another field.

Enabled Box

9-127. The operator clicks the En box for each unit name to enable communication with that subscriber. A green checkmark is displayed in the box when communication has been established.

Undo Changes Button

9-128. To undo any changes, the operator clicks Undo Changes; any unsaved changes (indicated by a pencil icon at the beginning of the row) are refreshed with the original data.

Use All Button

9-129. The operator clicks the Use All working area button to save all screen information and activate the channel status, which will cause Chn A Status to go from inactive to loading to active, and TCIM Status to go from operating to downloading to operating.

Note. Allow some time for the channel activation. Do not keep clicking the Use All button.

Disable Button

9-130. If disabling communication becomes necessary, the operator clicks Disable.

SECTION II – ADDITIONAL FUNCTIONS

9-131. Additional functions and procedures of the MFCS include—

- Ammunition status.
- MET status.
- FP, target and known point status.
- Safety fan.
- Check fire.
- PTMs.
- Alert Function.

9-132. This section displays the sequences used to review, modify, and use data during FDC operations. As previously discussed, the MFCS operator uses the GUI or keystrokes to navigate and use the system.

AMMUNITION/STATUS FUNCTION

9-133. Ammunition information about the unit, lot, shell, lot number, and quantity is transmitted digitally from the gun. When the operator presses the Ammo/Status button on the three tabs display (see figure 9-21), this button shows procedures for checking, entering, or changing ammunition status. This function allows the operator to enter, modify, delete, and sort these data:

- Ammo fire unit.
- Ammo roll up.
- Status fire unit.

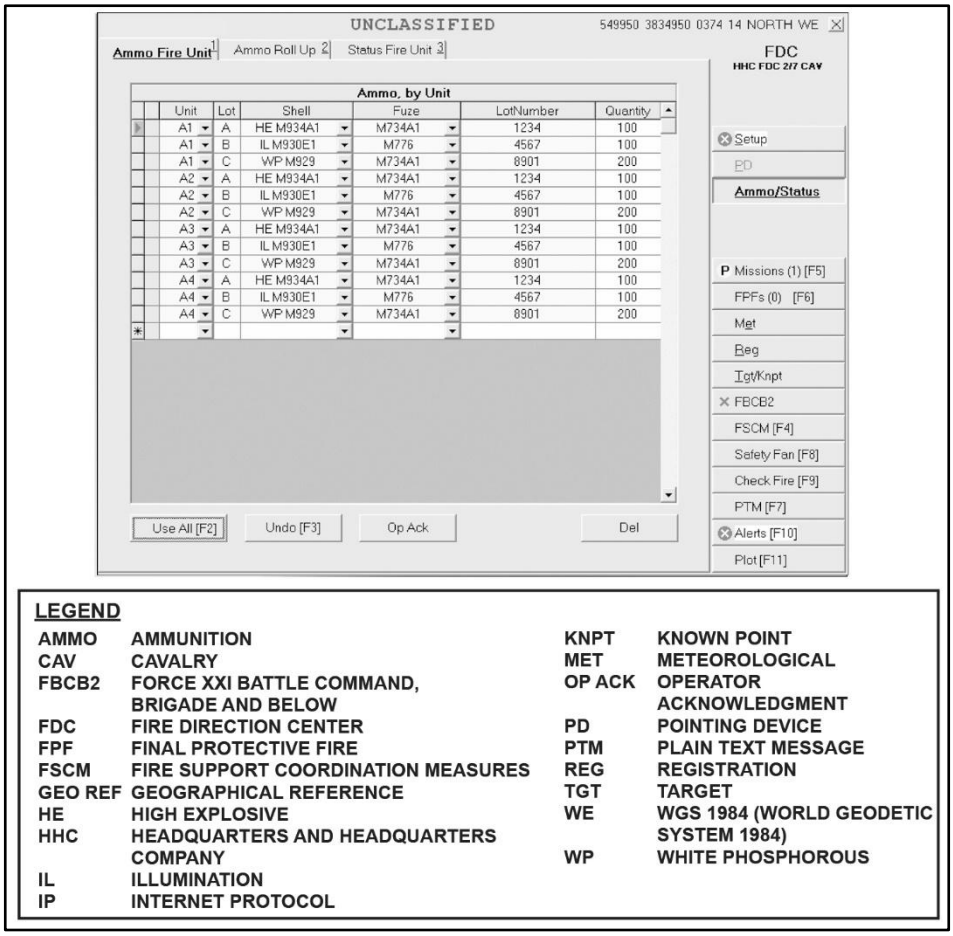


Figure 9-21. Ammo by unit screen

AMMO FIRE UNIT SCREEN

9-134. The operator clicks the Ammo/Status button in the control button area and then clicks the Ammo Fire Unit tab to display the Ammo Fire Unit screen. (See figure 9-22, page 390.)

9-135. This screen includes the following fields:

- Unit.
- Lot.
- Shell.
- Fuze.
- Lot number (LotNumber).
- Quantity.

9-136. The Ammo Fire Unit screen uses symbols and colors to provide information. A green sunburst icon on the Ammo/Status button indicates that the ammunition has been

changed. When an ammunition report is received digitally from the guns, an exclamation point (!) is displayed in the index at the beginning of each row for which ammunition is received. A field with a red background indicates a discrepancy between the data residing in the MFCS and the data received from the gun.

9-137. Ammunition information about the unit, lot, shell, fuze, lot number, and quantity is received digitally from the gun, but the FDC can manually update ammunition. When the Use All tab is clicked, the ammunition data is transmitted automatically to the guns.

9-138. The system automatically arranges ammunition alphabetically by lot, but the operator can click another column heading to sort data by another field.

9-139. The operator can click—

- Use All to save information.
- Delete (DEL) to erase information.
- Undo to undo any changes.
- OpAck to acknowledge receipt of ammunition status and turn off the alarm.

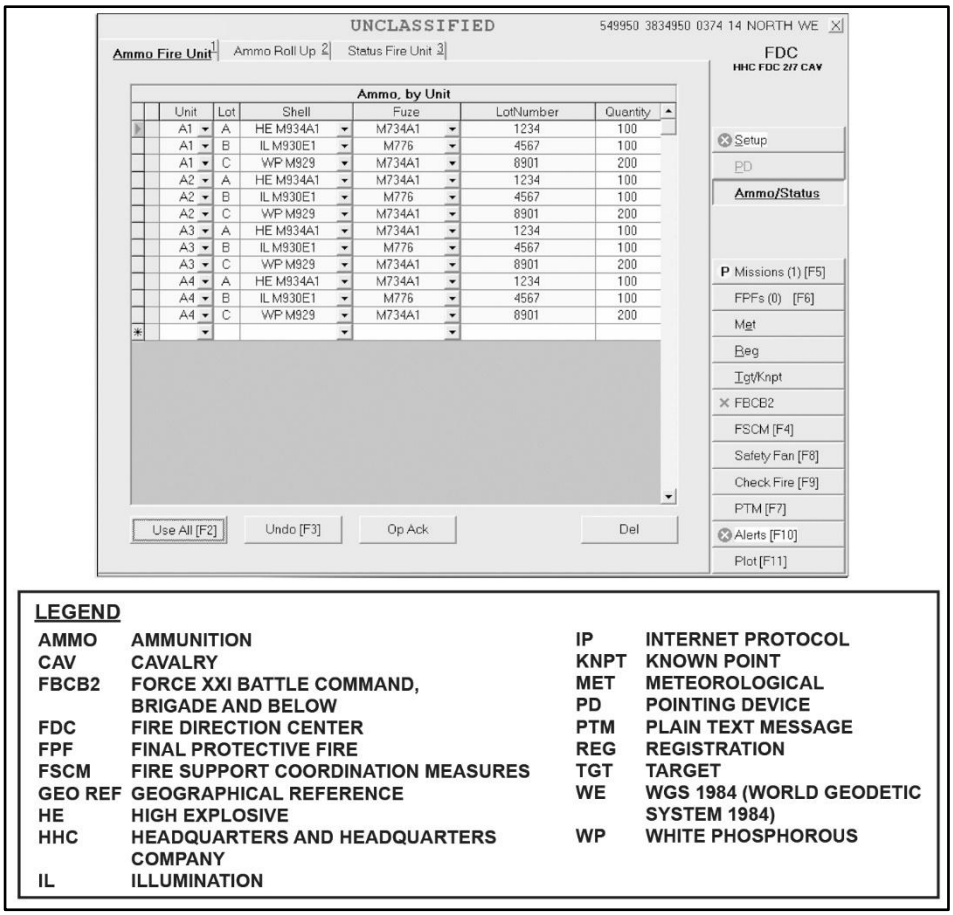


Figure 9-22. Ammo fire unit screen

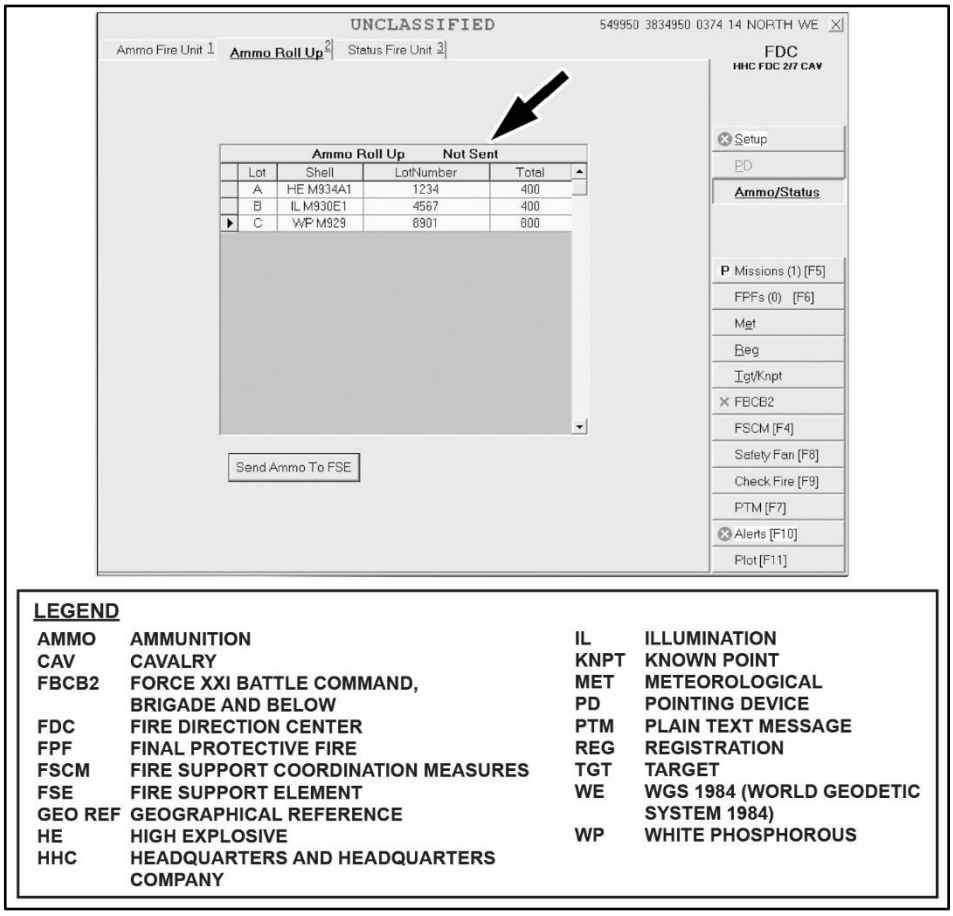
AMMO ROLL UP SCREEN

9-140. This screen (see figure 9-23) displays all the ammunition carried by the gun carrier. Ammunition information is read-only, is filled automatically, and includes the following information:

- Lot.
- Shell.
- Lot number.
- Total number of rounds.

9-141. To send the fire unit ammunition status to the fire support cell, the operator clicks the Send Ammo to FSE button.

Note. The message "Not Sent" (see figure 9-23) will be displayed after the Ammo Roll-Up heading if the ammunition has not been sent from the guns. If the ammunition has been sent, the DTG when it was sent is displayed.



LEGEND

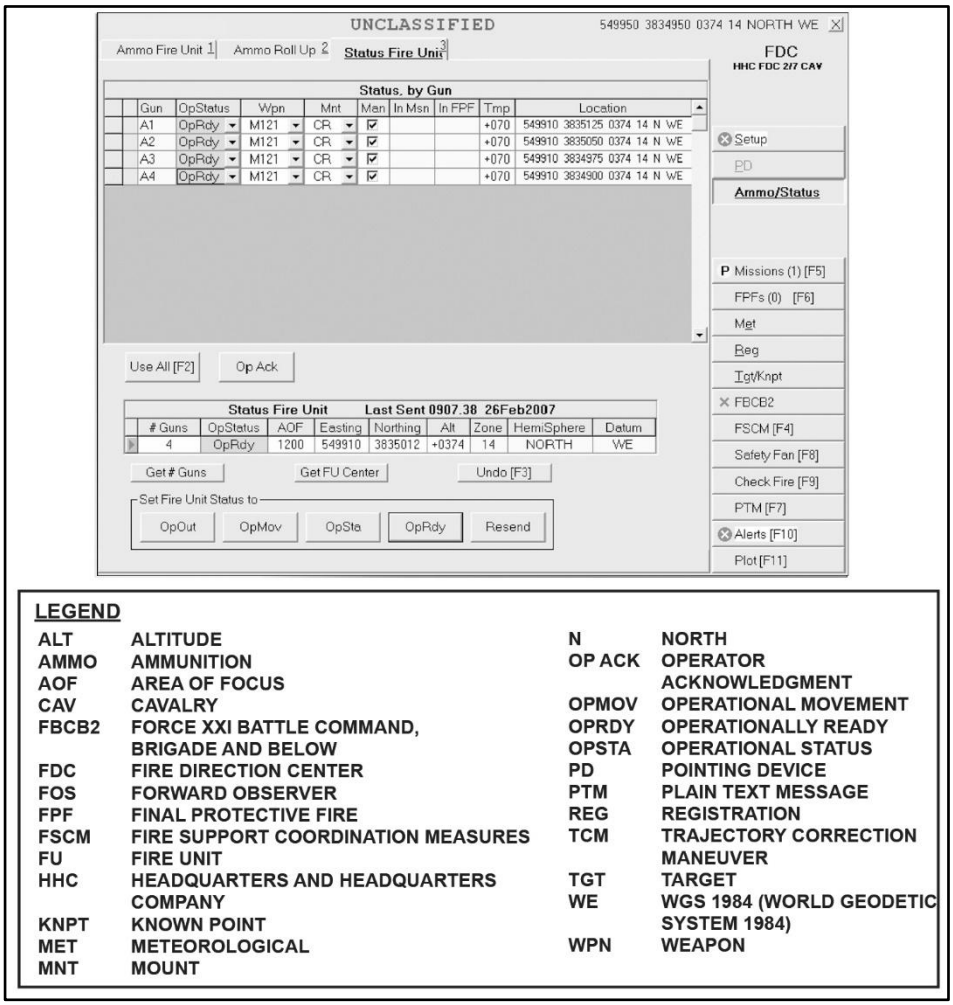
AMMO	AMMUNITION	IL	ILLUMINATION
CAV	CAVALRY	KNPT	KNOWN POINT
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW	MET	METEOROLOGICAL
		PD	POINTING DEVICE
FDC	FIRE DIRECTION CENTER	PTM	PLAIN TEXT MESSAGE
FPF	FINAL PROTECTIVE FIRE	REG	REGISTRATION
FSCM	FIRE SUPPORT COORDINATION MEASURES	TGT	TARGET
FSE	FIRE SUPPORT ELEMENT	WE	WGS 1984 (WORLD GEODETIC SYSTEM 1984)
GEO REF	GEOGRAPHICAL REFERENCE		
HE	HIGH EXPLOSIVE	WP	WHITE PHOSPHOROUS
HHC	HEADQUARTERS AND HEADQUARTERS COMPANY		

Figure 9-23. Ammo Roll-Up screen

STATUS FIRE UNIT SCREEN

9-142. This screen (see figure 9-24) contains two parts:

- Status by gun.
- Status fire unit.



LEGEND

ALT	ALTITUDE
AMMO	AMMUNITION
AOF	AREA OF FOCUS
CAV	CAVALRY
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW
FDC	FIRE DIRECTION CENTER
FOS	FORWARD OBSERVER
FPF	FINAL PROTECTIVE FIRE
FSCM	FIRE SUPPORT COORDINATION MEASURES
FU	FIRE UNIT
HHC	HEADQUARTERS AND HEADQUARTERS COMPANY
KNPT	KNOWN POINT
MET	METEOROLOGICAL
MNT	MOUNT
N	NORTH
OP ACK	OPERATOR ACKNOWLEDGMENT
OPMOV	OPERATIONAL MOVEMENT
OPRDY	OPERATIONALLY READY
OPSTA	OPERATIONAL STATUS
PD	POINTING DEVICE
PTM	PLAIN TEXT MESSAGE
REG	REGISTRATION
TCM	TRAJECTORY CORRECTION MANEUVER
TGT	TARGET
WE	WGS 1984 (WORLD GEODETIC SYSTEM 1984)
WPN	WEAPON

Figure 9-24. Status Fire Unit screen

STATUS BY GUN

9-143. Status is received digitally from the guns, and the information is filled automatically. MET is sent automatically to the FDC Alerts messages when a gun reports “OpRdy.”

9-144. This section contains the following fields:

- Gun.

- Operational status (OpStatus).
- Weapon (Wpn).
- Mount (Mnt).
- Manual (Man).
- In Mission (In Msn).
- In FPFs.
- Temperature (Tmp).
- Location.

Gun, In Mission, In Final Protective Fire, and Location Fields

9-145. These fields are read-only.

Operational Status Field

9-146. The operator may change the OpStatus field using the dropdown menu. The options for this menu include—

- Operationally Moving (OpMov).
- Operationally Stationary (OpSta).
- Operationally Ready (OpRdy).
- Operationally Out (OpOut).
- Operationally Detached (OpDet).

Note. OpDet is used in split section operations. When more than one FDC is active in the platoon, the gun reports normal status to the controlling FDC and OpDet to a noncontrolling FDC.

Weapon Field

9-147. The operator may change the Wpn field using the pull-down menu. A warning alerts the operator that entering a weapon type that differs from the gun will cause a solution mismatch and asks if the operator still wants to change it. If the operator chooses Yes, the operator must select a weapon type from the pull-down list.

Manual Field

9-148. The operator may change the mount status using the pull-down menu. A warning alerts the operator that entering a mount type that differs from the gun will cause a solution mismatch and asks if the operator still wants to change it. If the operator chooses Yes, the operator must select a type of mount from the list that is displayed.

Manual Box

9-149. The operator must check the Man box if a gun is operating using a manual position data source. However, the FDC operator must have the MAZ and reference data entered and saved for that gun before checking the Man box.

Temperature Field

9-150. The operator may enter or change the temperature by clicking in the Tmp field, but the operator must override a warning.

Status Fire Unit

9-151. This section provides the overall status of all the firing units assigned to the FDC. It contains the following fields:

- Number of guns (# Guns).
- Operational status (OpStatus).
- Azimuth of fire (AOF).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Hemisphere (HemiSphere).
- Datum.

9-152. It includes the following buttons:

- Get Number of Guns (Get # Guns).
- Get the Fire Unit Center (Get FU Center).
- Undo.
- Set Fire Unit Status to:
  - OpOut.
  - OpMov.
  - OpSta.
  - OpRdy.
  - Resend.

Number of Guns Field

9-153. To enter or change the number of guns, the operator clicks the field and enters the correct number within a range of 0 through 18. Then, the operator selects the Get # Guns button, and the field automatically updates according to the number of guns enabled.

Operational Status and Ammunition Fields

9-154. The OpStatus and Ammo fields are read-only.

Azimuth of Fire Field

9-155. The operator enters data into the azimuth of fire field.

Easting, Northing, and Altitude Fields, and Get Fire Unit Center Button

9-156. To get the geographic center of the firing unit, the operator clicks Get Fire Unit Center, which displays the Easting, Northing, and altitude to the center point of all available guns. To manually enter or change the fire unit center location, the operator

enters data in the Easting (six digits), Northing (seven digits), and Alt fields (-400 through 9,999 meters).

Zone, Hemisphere and Datum Fields

9-157. Zone, HemiSphere, and Datum fields are read-only.

Set Fire Unit Status Buttons

9-158. If the FC is not on the Unit List, the Set Fire Unit Status buttons are not available. A line at the bottom of the screen states "FSE UNKNOWN." The buttons for OpOut, OpMov, OpSta, and OpRdy are also shaded.

9-159. If the FC is on the Unit List, the operator clicks OpOut, OpMov, OpSta, or OpRdy, as appropriate, to send the status to the FC. To resend, the operator clicks the Resend button.

METEOROLOGICAL DATA SCREEN

9-160. The MET data provides the same information as the DA Form 3677. MET data provides the corrections needed to compensate for air temperature and density, and the wind speed and direction. New MET data may be received digitally or entered manually. Upon digital receipt of new MET data, the operator receives a message and an option to apply the new MET data. To apply, click Process, and the new MET is displayed.

9-161. The MET Data screen contains four tabs:

- Msgs.
- New.
- Current.
- Registration.

METEOROLOGICAL DATA-NEW TAB

9-162. This tab contains the following fields:

- Octant.
- Station height (10s M).
- MDP pressure (MB).
- Latitude (LaLaLa).
- Longitude (LoLoLo).
- Line.
- Altitude.
- Direction.
- Speed.
- Temperature.
- Pressure.

9-163. It contains the following buttons:

- Save.
- Undo.
- Clear line.

- Clear all.
- Apply new MET.

9-164. If the MET data is acceptable, the operator clicks Save and Apply New MET. To manually enter or edit the new MET, the operator enters information as appropriate. To clear a line, the operator places the triangular pointer icon in the index box of the line to be cleared and clicks the Clear Line working area button. To clear all entries for direction, speed, temperature, and pressure, the operator clicks Clear All. To undo any changes before saving, the operator clicks Undo Changes. Once the operator verifies that the changes are correct, the operator clicks, Save. Then, the operator clicks, Apply New MET.

9-165. The new MET becomes the current MET, and the view changes to the Current tab. The current MET (the newly active MET) is transmitted automatically to the guns. The operator then receives an alert from the guns indicating whether the new MET has been processed successfully.

Note. The new MET cannot be processed while a fire mission or FPF is active and will cause an alert message.

SEASONAL REGIONAL METEOROLOGICAL

9-166. To use Seasonal Meteorological, click Use Seasonal Regional MET. The Seasonal Regional MET screen displays that MFCS is using Seasonal Regional MET.

Note. Seasonal Regional MET button is only enabled only after getting Fire Unit Center.

9-167. If a computer MET message is not available, MET data based on time of year (season) and latitude (region) may be used to perform ballistic computations. These computer-MET messages are defined for two seasons (summer, winter) and four regions (tropic, sub tropic, temperate, and polar). The seasons are based on the time of year.

METEOROLOGICAL DATA-CURRENT TAB

9-168. The Current tab contains the same fields as the New screen, but the entries on this screen are read-only; the fields can be accessed by clicking on the Current tab or Apply New MET via the New tab.

9-169. This screen contains three buttons:

- Use Standard.
- Use of Seasonal Regional.
- Resend MET.

9-170. When a gun reports OpRdy, the current MET is automatically sent to the gun as an alert.

Resend Meteorological Data Button

9-171. To send the MET message to the guns again, the operator clicks Resend MET.

Use Standard Button

9-172. To use the standard MET, the operator clicks Use Standard.

Meteorological Data Trend Limits

9-173. The MFCS has MET trend limits to check the MET data for possible incorrect data. When these limits are exceeded, a visual indicator appears on the Current MET screen-the cell will be orange. The trend limits compare the current data entries with data from the previous message. The following is a list of parameter thresholds which, when exceeded, result in an indicator appearing in the cell:

- Direction—if the difference is more than 100 (10s of mils).
- Speed—f the difference is more than 15 knots.
- Temperature—if the difference is more than 20 degrees Kelvin.
- Pressure—if the air pressure increases on a higher line number (pressure decreases as altitude increases).

FIRE PLAN/TARGET/KNOWN POINT SCREEN

9-174. To manually enter an FP, click on Fire Plan/Target/Known Point (FP/TGT/Knpt) control button. When the FP/TGT/Knpt control button is selected, the screen displays a choice of Fire Plan, FP A, FP B, FP C, TGTs, and Knpts tabs. (See figure 9-25.) A maximum of three FPs can be stored at one time. Each FP may be associated with up to 36 targets.

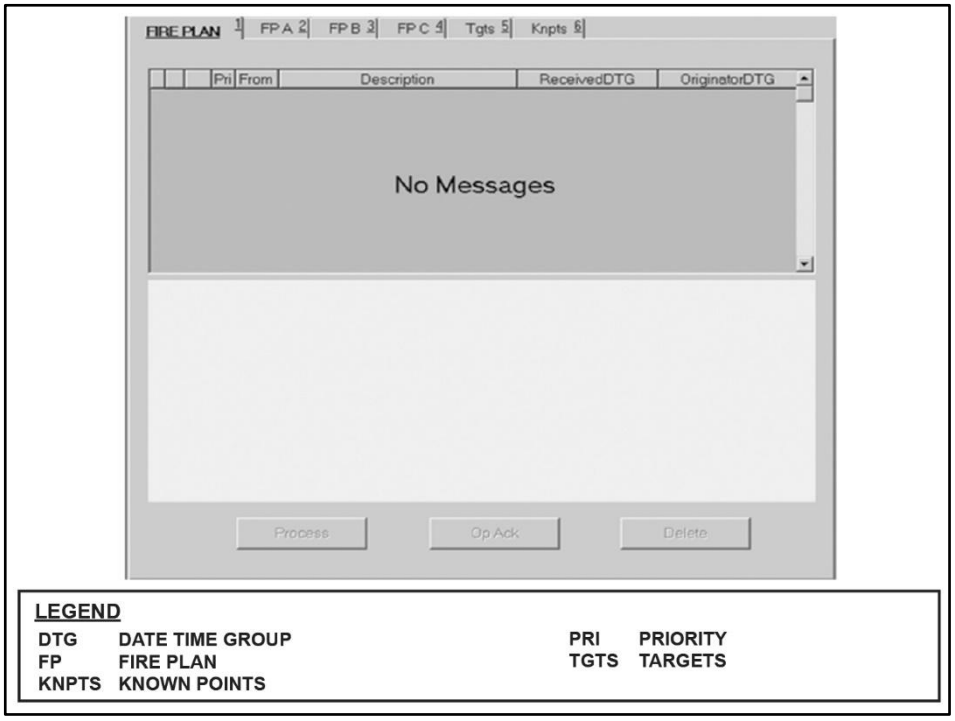


Figure 9-25. Fire Plan/Target/Known Point screen

9-175. When manually entering targets and/or known points, a maximum combined total of 200 targets and/or known points is allowed. Upon reaching 200 targets and/or known points, an error message will be received. Targets used exclusively by the FPs will not count toward the stored target limits. If the operator reaches the 200 targets and/or known point limit but selected EOM, Record as Known Point, the option to overwrite a known point currently in use will be given.

Note. A single observer is limited to a maximum of 99 known points.

9-176. FPs can be received digitally from AFATDS or can be entered manually.

9-177. The MFCS (version 6.1) processes a digital FP message from AFATDS when the Schedule of Fire Type in the message block is Transmit FP Target Scheduling List. The MFCS does not process Target Group and/or Target Series in an FP. A digital FP message containing a Target Group name and/or Target Series name will not be processed.

Note. FP End Time is not part of an FP message and therefore will not be transmitted from AFATDS to MFCS.

9-178. Digitally received FP messages will be displayed on the FP screen. After process is selected, the screen will transition to the first unused FP buffer (A, B, or C) if one is available. Manually entered FPs and digitally received FPs can be edited by the FDC or Gun/FDC. An FP target cannot be deleted from the stored target list if it is used by another FP or as a stored target.

9-179. To manually enter an FP (see figure 9-26)—

- Click on FP/TGT/Knpt control button and then click on FP A, FP B, or FP C tab.
- Enter a name with a maximum of 20 characters in the Fire Plan Name box (blank spaces are allowed).
- Click on the down arrow in the Originator box and select (originator is an optional field).

Note. If making entries, the operator must enter a Start Time before entering the End Time. The End Time must be at least 1 minute after the Start Time.

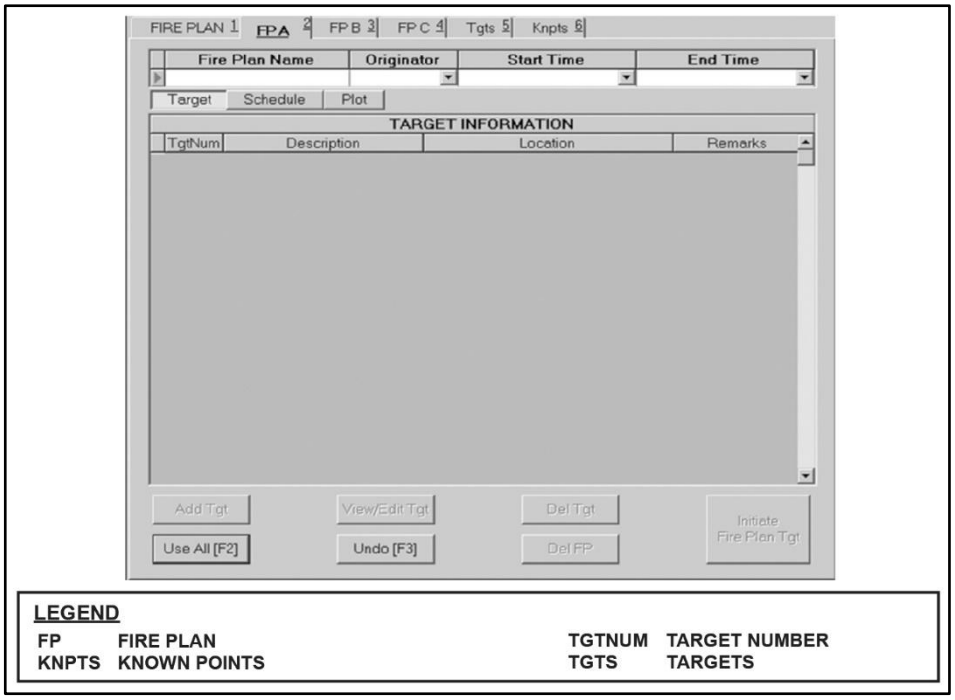


Figure 9-26. Fire plan A screen

- Start Time and End Time appear in Zulu time format: ddhhmmZmmmyyyy. Times can be selected by clicking on the down arrow in each box. Call out boxes, Enter Fire Plan Start Time (see figure 9-27, page 400) and Enter Fire Plan End Time (see figure 9-28, page 401), will appear. Select a time and click OK to lock in the time and date (or click Cancel if desired). Start Time and End Time are optional fields.

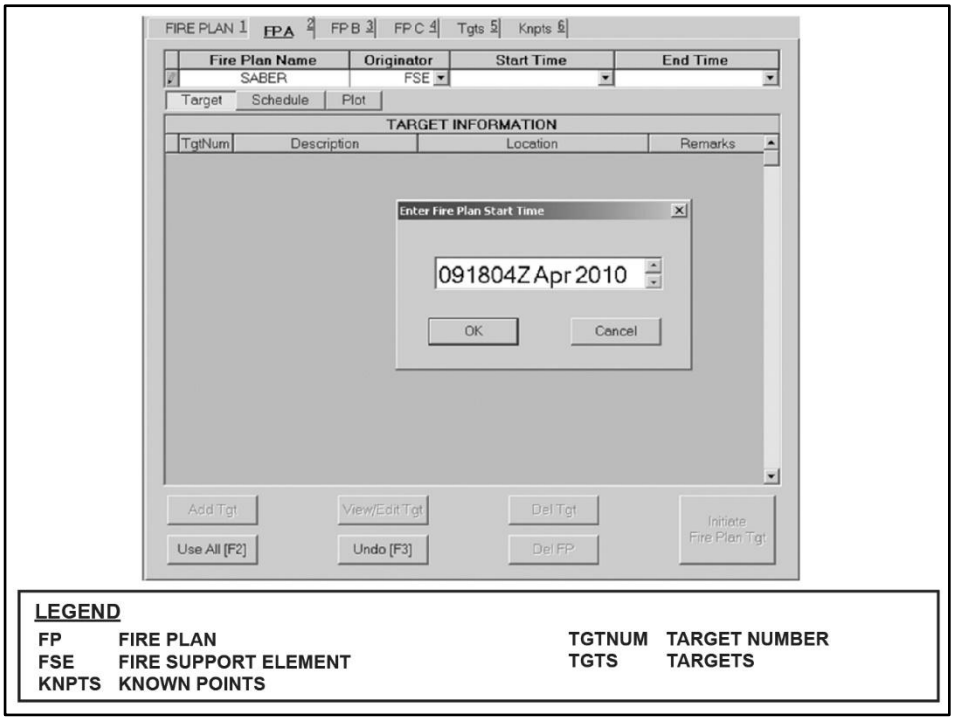


Figure 9-27. Fire plan start time

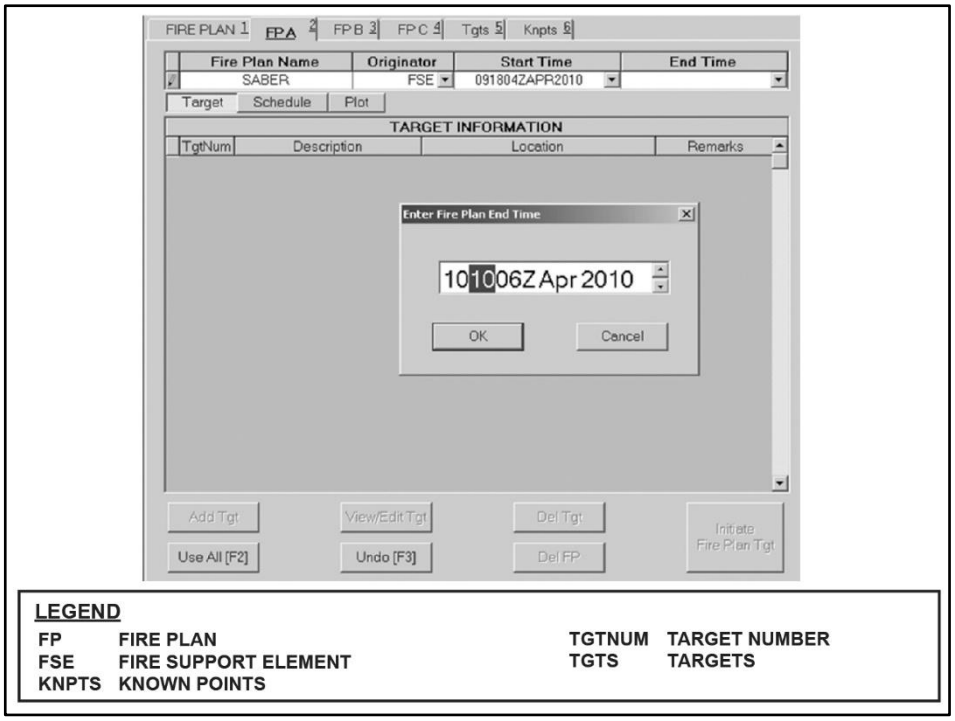


Figure 9-28. Fire plan end time

- To undo changes, select Undo.
- Click Use All to save the FP, add target (Add TGT) and delete fire plan (Del FP) buttons become active (see figure 9-29, page 402).

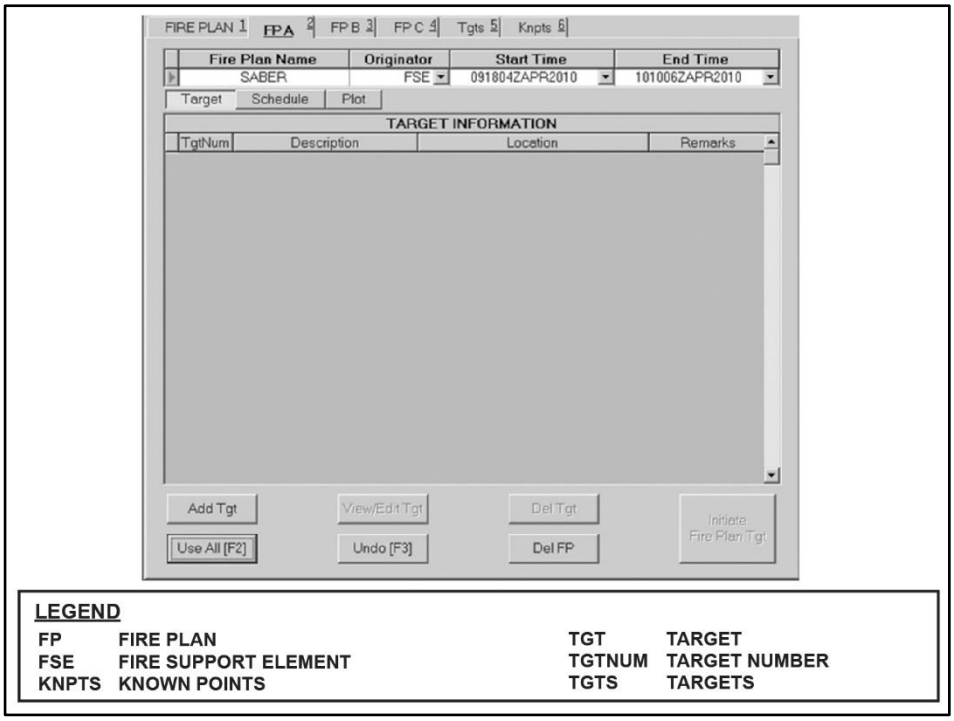


Figure 9-29. Fire plan screen with Add Target and Delete Fire Plan active

- Click Add TGT and the Enter Target Information screen will appear (see figure 9-30).

ENTER TARGET INFORMATION

9-180. This screen allows the operator to select an existing target from the stored targets list or enter a new target manually. If a new target is added, it will also update the Target list.

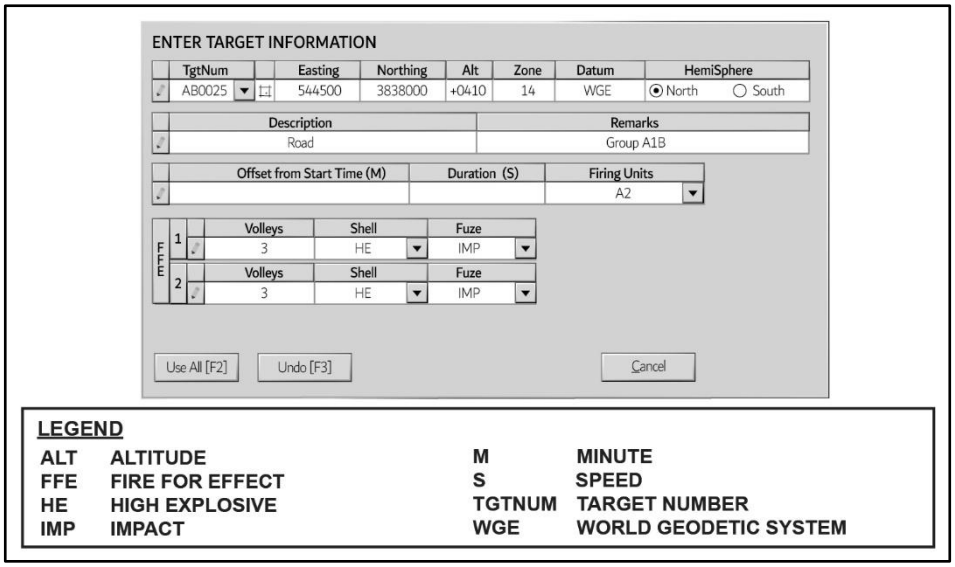


Figure 9-30. Enter target information screen

- Enter a target number in the TGTNum Box and select a previously stored target by clicking on the down arrow or manually enter a new target number.
- Enter Easting, Northing, and Alt:
  - The first digit of Easting and the first two digits of Northing will be auto filled.
  - The prefix numbers are updated when the last five digits are entered, Zone, Datum, and Hemisphere will auto-fill.

Note. Information to be entered in steps 3 through 7 is optional for unplanned and unscheduled targets and it may be entered at any time.

- Enter information about the target in Description and Remarks.
- Enter the number of minutes from the start time of the FP for the target in Offset from Start Time (M) with the allowable range of minutes -999 to +999.
- Enter the total time in seconds that the target is to be engaged in Duration (S) within the range of 1 to 59,940 seconds.
- Select in the Firing Units box, click on the down arrow and select the appropriate unit.
- Enter the number of volleys from 1 to 99 and choose the appropriate shell and fuze for both FFE 1 and 2 if desired.
- To undo changes, click Undo.
- To cancel the target, click Cancel.
- Click Use All to save the target. The FP A screen will appear with the Fire Plan Name, Originator, Start Time, and End Time and with all control buttons active (see figure 9-31, page 404).
- Now the FP is complete and will remain in effect for the entered time.

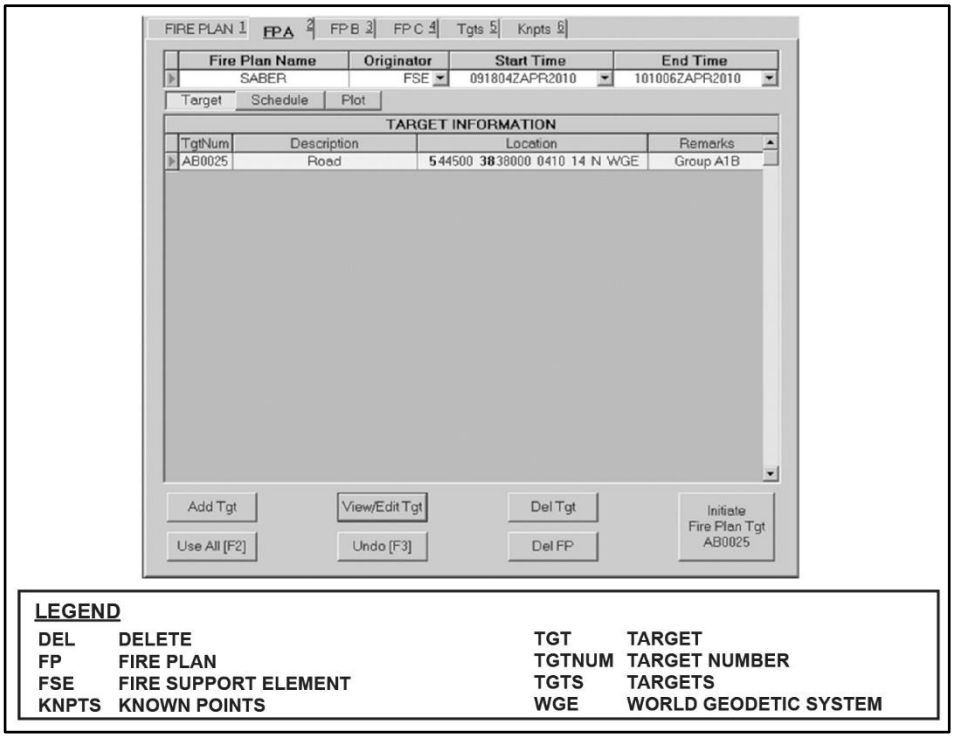


Figure 9-31. Fire plan A screen with target information

9-181. Targets and known points are locations that can be entered into the MFCS and used as targets or target references. They can be a known point selected by an observer, a planned target designated by the unit commander, or the location of a completed mission. Target and known points can be entered or edited manually by the operator or designated at the end of a previous mission.

9-182. When the FP/TGT/KnPt button is selected, the screen in figure 9-32, page 406 is displayed.

TARGET SCREEN

9-183. The target screen contains the following fields:

- Target Number (TGTNum).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).

9-184. It contains three buttons:

- Use All.
- Undo.

- Delete (Del).

9-185. Targets are received digitally at the EOM or can be entered and edited manually by the operator.

TARGET NUMBER FIELD

9-186. To manually enter or edit the target number, the operator enters the two-letter target number prefix (AA to ZZ), followed by a four-digit target number (0000 to 9999).

EASTING, NORTHING, ALTITUDE, ZONE, DATUM, AND HEMISPHERE FIELDS

9-187. The operator enters Easting, Northing, altitude, zone, and choice of datum or hemisphere data into the fields.

USE ALL BUTTON

9-188. To save information, the operator clicks Use All.

UNDO BUTTON

9-189. To undo changes, the operator clicks the Undo button.

DELETE BUTTON

9-190. To delete an entry, the operator highlights the index box in front of the entry that the operator wants to delete and clicks Del.

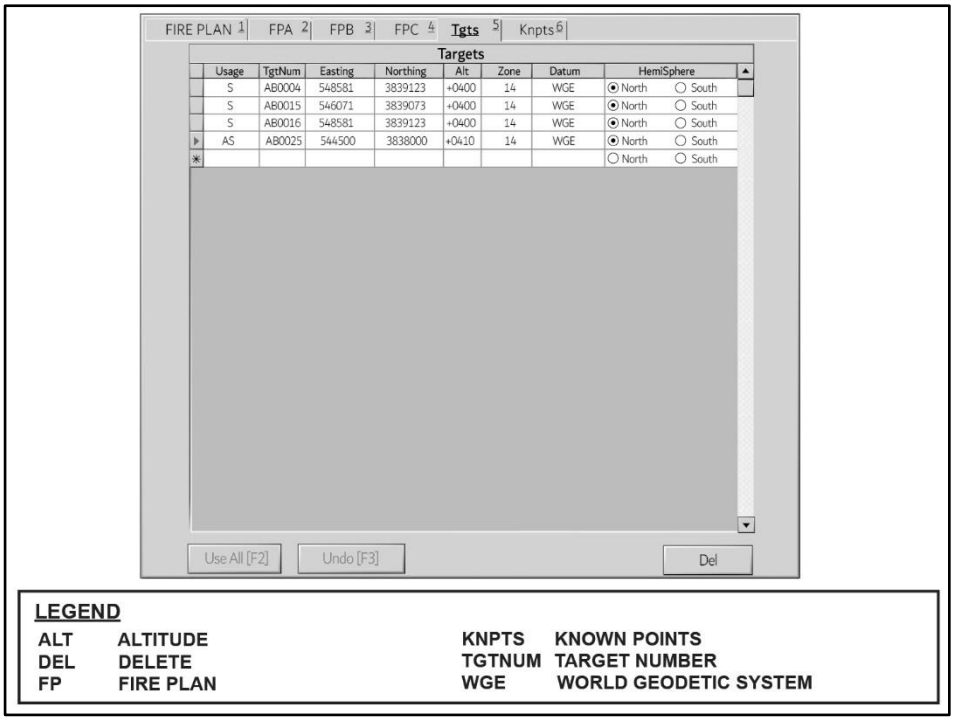


Figure 9-32. Targets screen

KNOWN POINTS SCREEN

9-191. Known points are received digitally at the EOM or can be entered manually by the operator. A known point must be associated with an observer.

9-192. When the KnPts tab is selected, the screen in figure 9-33, page 408 is displayed. This screen contains the following fields:

- Known point (KnPt).
- Observer.
- Target number (TGTNum).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).

9-193. It contains four buttons:

- Use All.
- Undo.
- Clear target number (Clear TGT Num).
- Del.

Known Point Field

9-194. To manually enter or edit a known point, the operator enters a two-digit number from 00 to 99. A duplicate known point will only be accepted if it is associated with a different observer.

Observer Field

9-195. To manually enter or edit information in this field, the operator chooses the observer from the list.

Easting, Northing, Altitude, Zone, Datum, and Hemisphere Fields

9-196. The operator enters Easting, Northing, altitude, zone, and choice of datum or hemisphere data into the fields.

Use All Button

9-197. To save information, the operator clicks Use All.

Undo Button

9-198. To undo changes, the operator clicks the Undo button.

Delete Button

9-199. To delete an entry, the operator highlights the index box in front of the entry the operator wants to delete and clicks Del.

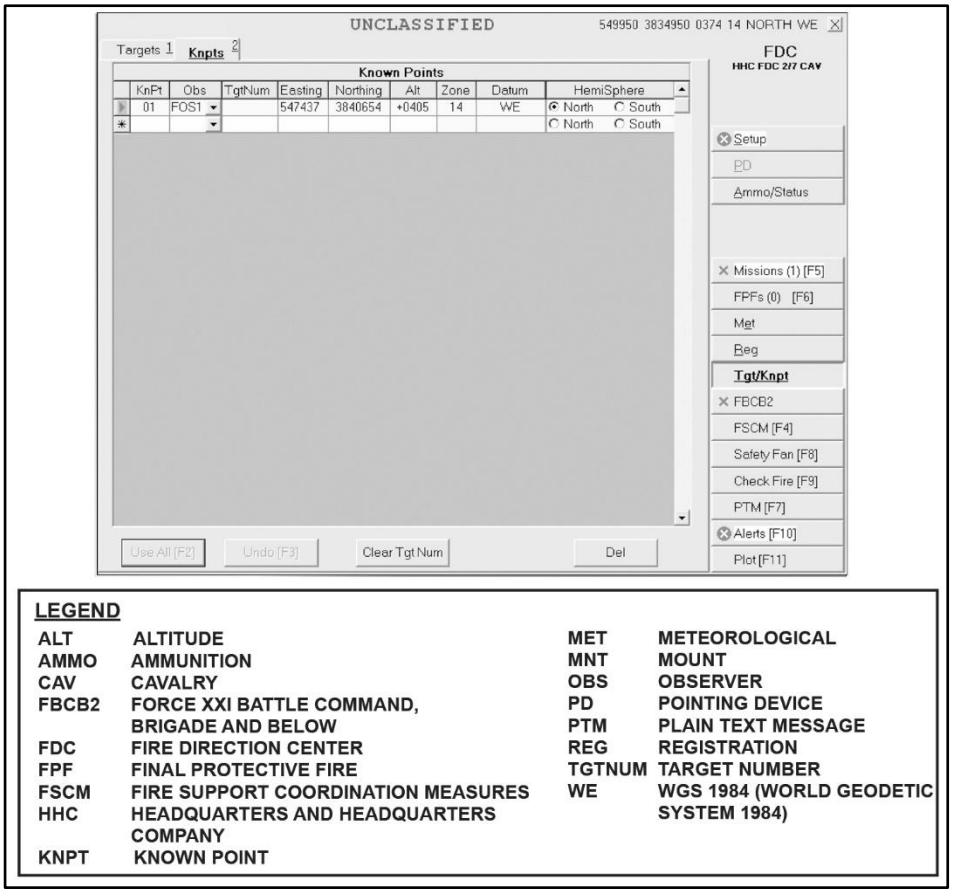


Figure 9-33. Known Points screen

SAFETY FAN SCREEN

9-200. The safety fan operation enables the FDC to enter and modify data originating at the FDC and to review safety fans generated from other sources. The MFCS then alerts the FDC if the fire mission violates the boundaries of a safety fan. The operator cannot override a safety fan violation, and gun orders are not displayed or transmitted to the gun(s) causing the violation.

9-201. Up to 18 safety fans can be stored with 10 segments each in the MFCS. The operator can manually input safety fan data into the system.

9-202. When the Safety Fan button is selected, the Safety Fans screen (see figure 9-34, page 410) is displayed. This screen contains the following fields:

- Easting.
- Northing.
- Zone.
- Datum.

- Hemisphere (HemiSphere).
- Left azimuth.
- Right azimuth.
- Minimum range (Min Range).
- Maximum range (Max Range).
- Minimum charge (Min Charge).
- Maximum charge (Max Charge).

9-203. Perform the following steps to enter data for a safety fan:

- Enter the Easting and Northing of the firing point location.
  - Zone, Datum, and HemiSphere fields will auto-fill.
  - Utilize the alternate methods of entering a position (see figure 9-34, page 410) by clicking the icon.
- Enter the left and right azimuth (0 to 6399).

Note. The interior angle must not exceed 3200 mils.

- Enter the minimum range (0 to 7,999 meters) and the maximum range (1 to 8,000 meters).
- Enter the minimum charge (0 to 9) and the maximum charge (0 to 10) based on the ammunition.
- Select the ammunition to be used inside the safety fan. The choices HE, ILL, WP, or IR.
- In the upper part of the screen, the safety fan displays the UTM (short coordinates) as seen on the map, units, targets, burst points, and canister points. To obtain information about a particular icon on the plot, place the cursor over the icon.
- To undo entries, click Undo. Click Use All to display the safety fan. To delete the safety fan, click Delete Fan and all the fields will be cleared, and the Plot screen deleted.

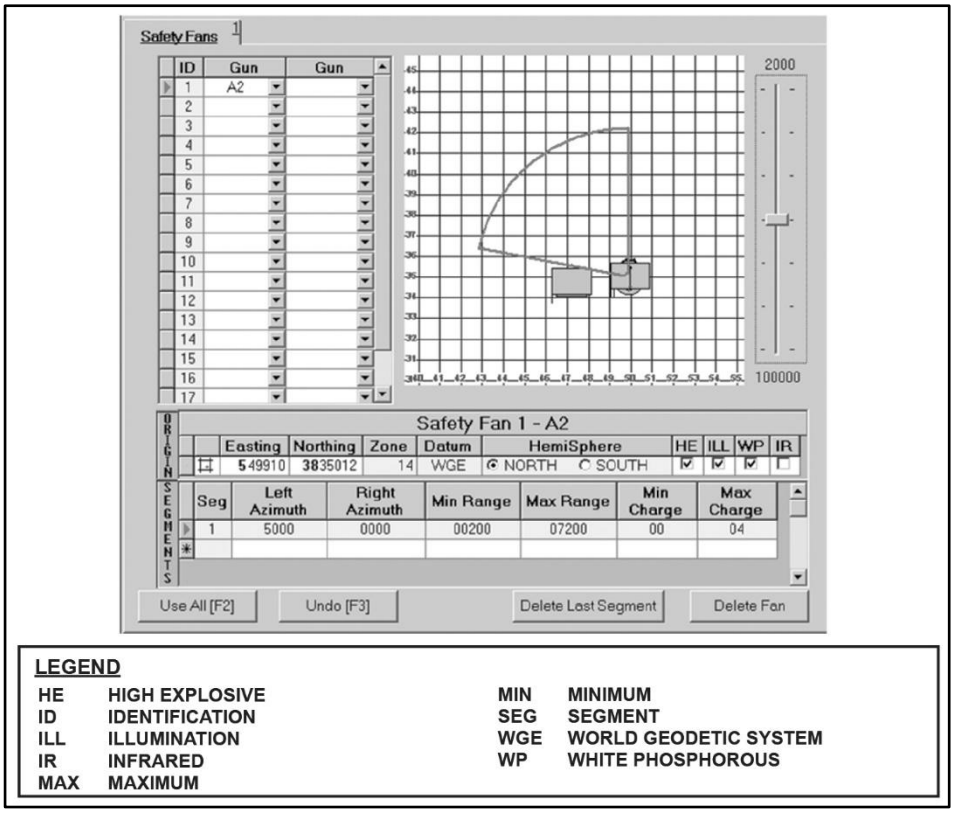


Figure 9-34. Single Safety Fan screen

CHECK FIRE

9-204. The Check Fire button lets the FDC send a message to the guns to immediately cease fire and preserve data. When a Check Fire command is received, all active fire missions come to a halt, and inactive fire missions cannot be activated. When a Check Fire by Target Number command is received, the specified fire mission is halted. A Check Fire message from the FSE or FO is sent as an alert.

9-205. When the operator receives a Check Fire command from the FSE—

- A red "CF" message displays in the control tab area in front of Missions and Check Fire.
- Click the Check Fire button to display the Check Fire screen (see figure 9-35).
- An exclamation point (!) indicator is displayed in the index box.
- Click OpAck to acknowledge the message; the indicator and audio alarm (if set) will be turned off.

9-206. To initiate or transmit a Check Fire message to all guns in the firing unit—

- Click the Check Fire All button on the Check Fire screen.
- This sends a Check Fire banner message to all guns and halts the mission until a valid Cancel Check Fire command is transmitted.

9-207. To initiate a Check Fire Target message—

- Enter the target number.
- Click Check Fire Target.
- This transmits a Check Fire banner to the guns engaged in a mission with the associated target.

9-208. To cancel the Check Fire command—

- Click the indicator for the appropriate Check Fire message.
- Click Cancel Check Fire.
- This forwards the Cancel Check Fire message to all units in the firing unit and then fire missions may continue.

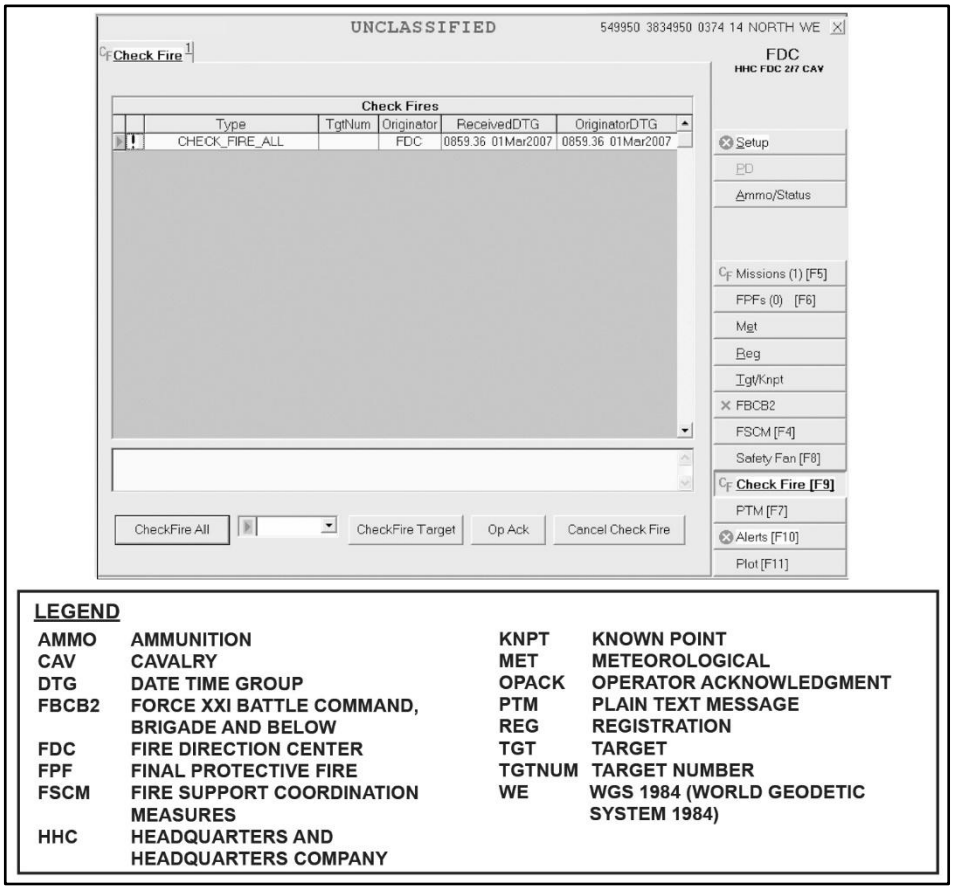


Figure 9-35. Check Fire screen

PLAIN TEXT MESSAGES

9-209. The PTM function allows the FDC to send and receive messages concerning supply, administration, or other subjects. When the PTM button is selected, the screen in figure 9-36, page 413 is displayed.

READ SCREEN

9-210. Upon receipt of a PTM, an indicator displays on the PTM button. The operator clicks the PTM button to display the Read screen. (See figure 9-36.) Messages are listed with—

- Priority.
- From.
- Description.
- Received DTG.
- Originator DTG.

9-211. Messages have four categories:

- Flash (F).
- Immediate (I).
- Priority (P).
- Routine (R).

9-212. When a message is received, an exclamation point (!) indicator will display in the status box before the priority. The triangle pointer in the index box indicates which message is being read.

9-213. Follow these steps to read a message:

- Access the PTM screen by clicking the PTM button.
- Click the Read tab to read messages.
- Click OpAck to acknowledge receipt of a new message, this will delete the exclamation point (!) indicator from the status box and turn off the alarm, if activated.
- Click Reply to send a reply and the Send screen is displayed.
- To delete a message, highlight it and click Del.

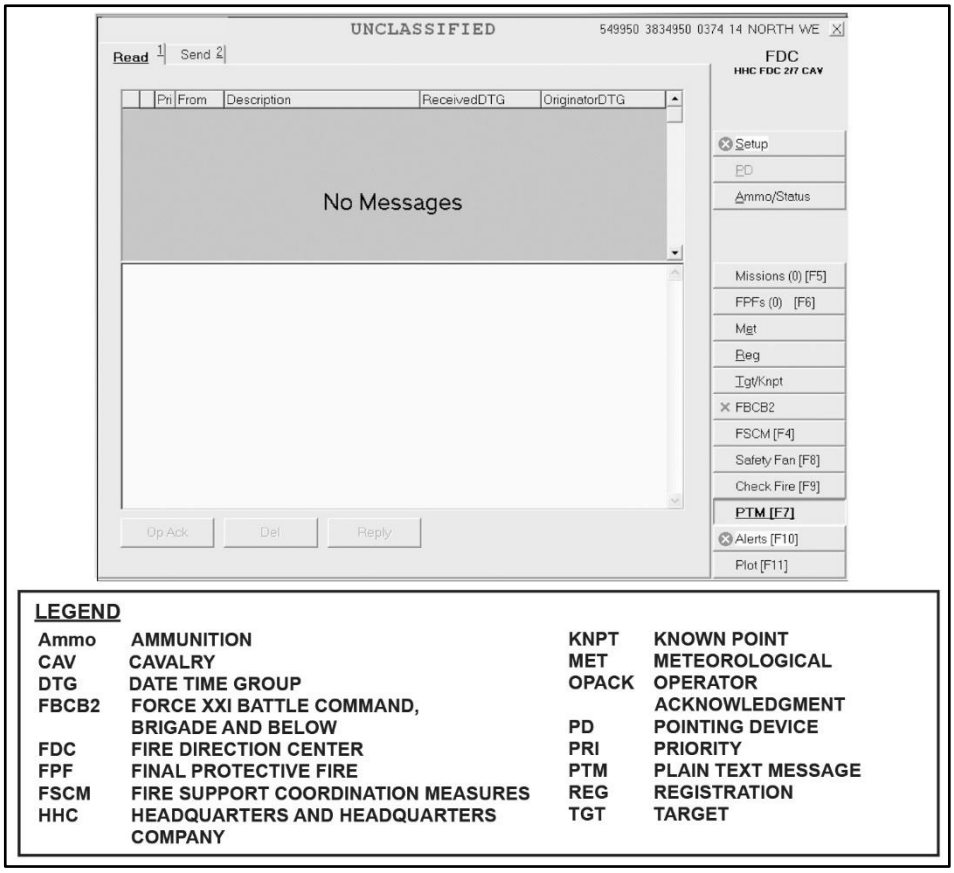


Figure 9-36. Plain text message read screen

SEND SCREEN

9-214. The operator selects the Send tab to display the Send screen. (See figure 9-37, page 414.) Follow these steps to read a message:

- Either click Sel in Destinations to select the units to which to send the message, choose Click All to send the message to everyone in Destinations, or select None to deselect all units in Designations.
- Type the message using the keyboard.
- Click Send.
- A Send Status box displays, showing the destination and status; the status options include—
  - Machine Acknowledgement.
  - Retry—the system is retrying.
  - Failed—the message did not reach the destination.

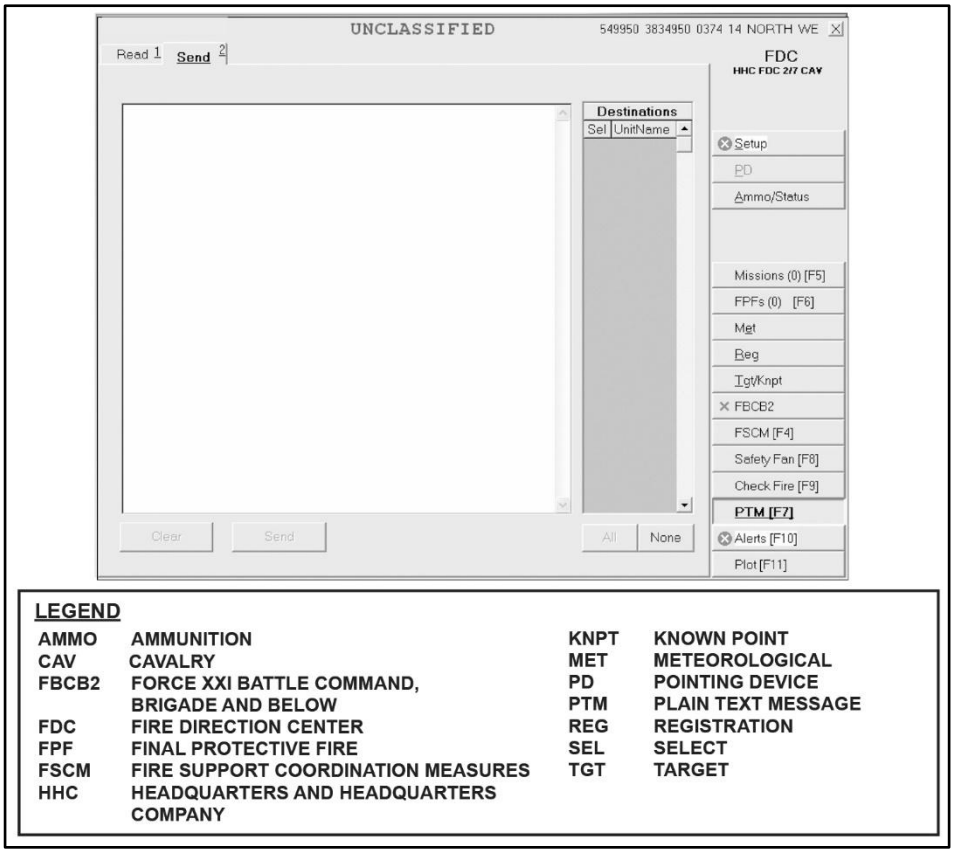


Figure 9-37. Send screen

ALERTS FUNCTION

9-215. The Alerts function (see figure 9-38) allows the operator to receive automated system messages, such as information, error, and warning alerts.

9-216. When an icon indicating that there are alerts in the queue displays, the operator selects the Alerts button. The Alert screen displays, showing the—

- DTG.
- Type (TY).
- Description.

9-217. Then, the operator selects OpAck to deactivate the alarm. To delete an alert, the operator clicks the row to be deleted and clicks Del.

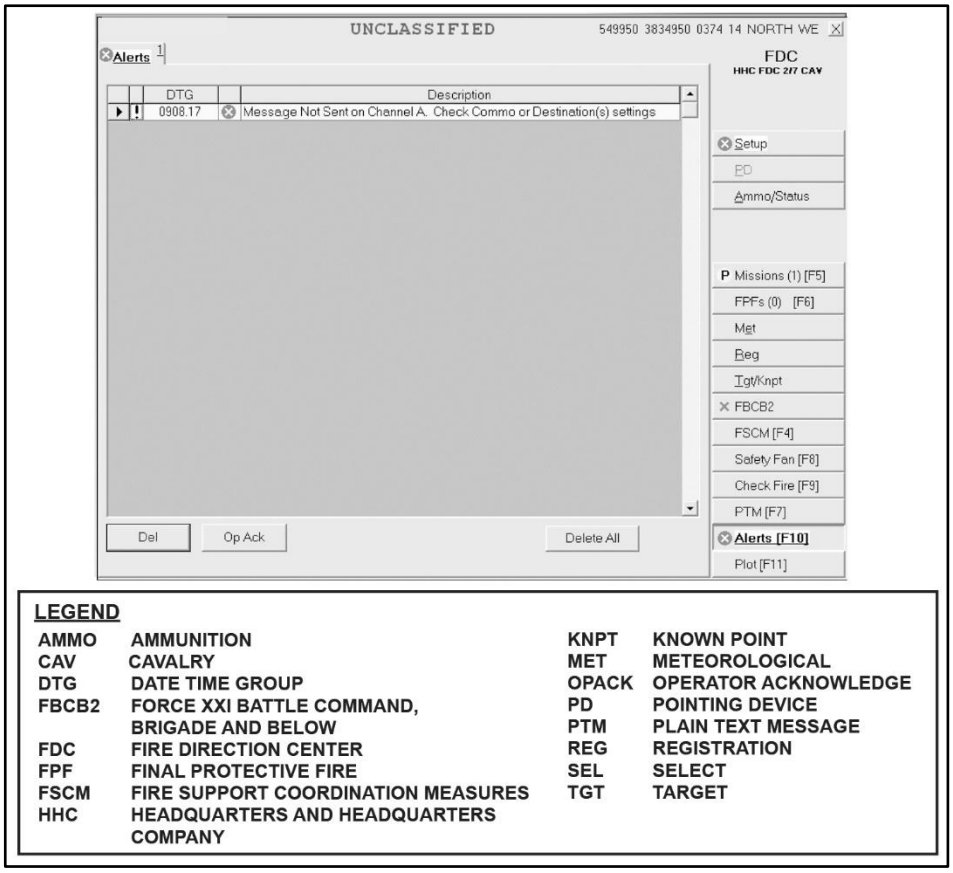


Figure 9-38. Alerts screen

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Chapter 10

Mortar Fire Control System Fire Missions

This chapter includes three sections: parts of a standard fire mission; basic fire missions, which contain basic digital and manual fire mission procedures; and special missions, which detail specific missions such as registration, illumination, coordinated illumination, and FPF.

SECTION I – PARTS OF A STANDARD FIRE MISSION

10-1. This section discusses the features of basic generated MFCS fire missions. It includes the sequence of actions and screens used by the MFCS operator during a fire mission, and common actions performed throughout the operation.

PROCEDURES

10-2. The MFCS provides a standard set of steps and screens to view the fire mission data for grid, polar plot, shift from a known point, and quick fire missions, whether the missions are input manually or received digitally. From the initial CFF to the EOM, the sequence of actions is standard, although some steps may be omitted or repeated for all CFF, regardless of the type of equipment supporting the FDC. The MFCS uses common actions to process fire missions and transmit commands. Advanced missions use the standard set of screens, as well as the same common actions.

SEQUENCE OF ACTIONS

10-3. Fire missions are composed of four basic components: the initial CFF, adjustment to the initial data to move the fire onto the target, an FFE, and an EOM. The sequence can be stopped at any time with an EOM from the FC FSE or FO. This sequence is as follows:

- The initial fire mission occurs on a new or an established target.
- The fire is adjusted onto the target which may be omitted if the initial impact hits within the target area or if the mission is an FPF.
- The FO or FSE calls for an FPF.
- An EOM is sent from the FSE or FO, and the mission is saved or deleted.

DIGITAL AND MANUAL FIRE MISSION TABS AND SCREENS

10-4. Figure 10-1, page 418 illustrates the format of all View screens. The control button area, displayed to the right, is used to select the MFCS functions. The tab area, located at the top of the screen, displays the types of missions available to the user (Manual, New CFF, or a previously saved mission). The working button area, located at the bottom of the screen, contains buttons to accept, modify, or refuse the data shown in the working area. The working area can have up to four subareas: the Messages screen, the

gun status area, the Fire Command fields, and the View button areas. The View button area provides the operator with the means to select different fields for viewing data.

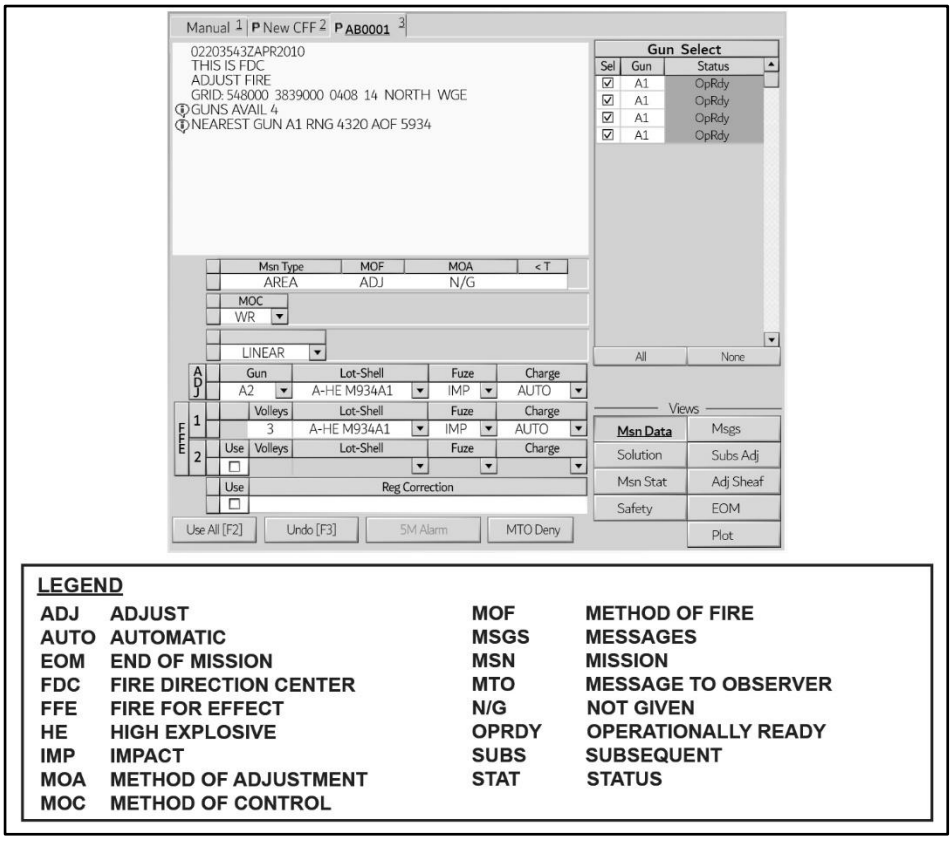


Figure 10-1. Mission Data screen

10-5. The MFCS uses tabs and views to display the mission and related data. Table 10-1 lists the tabs and screens typically used during digital, manual, and special fire missions.

Note. For more information about special fire missions, see this chapter, section III.

Table 10-1. Tabs and view screens

Tabs or Screen	*Information and Actions*
New Call for Fire Tab	The operator— Receives the new Call for Fire (CFF). Accepts (Process) the fire mission. Refuses (Message to Observer [MTO] Deny) the fire mission.
Manual Call for Fire Tab	The operator manually designates and performs grid, polar plot, shift, or quick fire missions.
Mission Tab	The operator— Receives the CFF for a previously saved mission. Accepts (Process) the fire mission. Refuses (MTO Deny) the fire mission.
Mission Data Screen	This screen displays— Target number. Call for fire (CFF). Mission data. The operator reviews data and makes adjustments.
Solution Screen	This screen displays— Gun orders. Errors and warnings. Selected guns. The operator sends orders to the guns.
Mission Status Screen	The operator monitors the mission.
Safety Data Screen	This screen displays safety data. The operator reviews and records data.
Messages Screen	The operator receives subsequent messages.
Subsequent Adjust View Screen	This screen displays adjustment data. The operator reviews and adjusts data.
Adjust Sheaf View Screen	The operator can review or manually adjust sheaf.
End of mission (EOM) View Screen	This screen houses these features: Not save the mission. Save as a target. Save as a known point.
Plot View Screen	This screen displays a digital plot of the mission with icons for key data.
Manual EOM	The operator manually records the mission as a target or as a known point. This screen houses these features: Not save the mission. Save as a target. Save as a known point.

COMMON ACTIONS

10-6. The MFCS operator repeatedly uses commands throughout the fire mission. These commands are usually performed by selecting a button or responding to a query in a message box. Common actions include—

- Acknowledging receipt of the message.
- Accepting or denying the mission.
- Processing or deleting the mission.

- Selecting the guns to fire the mission.
- Accepting or modifying data.

ACKNOWLEDGING RECEIPT

10-7. The operator selects the OpAck button to acknowledge receipt of a message and deactivate the audio alarm if it is turned on. The phrase "acknowledge receipt by selecting the OpAck button" is used throughout the chapter to indicate this action.

RECORDING DATA

10-8. The operator records data throughout the process to maintain a record and to preserve data if the MFCS fails. The operator transcribes data onto DA Form 2399 or DA Form 2188. The phrase "record data" is used throughout this chapter to indicate this action.

ACCEPT OR DENY MESSAGE TO OBSERVER

10-9. The MFCS operator selects MTO Accept to accept the mission and MTO Deny refusing the mission. If the operator selects MTO Deny, the Delete button becomes visible and, when selected, deletes the mission. If there is an error beyond FDC control, the only choice is MTO Deny. The phrase "select MTO Accept to accept the mission or select MTO Deny refusing the mission" is used throughout this chapter to indicate this action.

PROCESS OR DELETE

10-10. The operator may select Process to continue with the mission or Delete to stop the mission. The terms "process" and "delete" are used throughout this chapter to indicate this action.

SELECTING THE GUNS TO FIRE THE MISSION

10-11. The software preselects guns for the mission; they are checked in the Sel box in Gun Select. The operator can modify these selections by checking or removing the checkmark in the Sel box beside any OpRdy gun. The operator may select all or none of the guns listed by selecting All or None. The phrase "select guns" is used throughout this chapter to indicate this action.

ACCEPTING OR MODIFYING DATA

10-12. If required, the operator adjusts the mission data. To undo any changes, the operator selects Undo Changes, and the data fields display the original data. If any changes were made, the operator selects Use All to accept all the changes. If no changes were made, the operator selects Use All. The phrase "modify data if necessary" is used throughout the chapter to indicate this action.

MANUAL MISSIONS

10-13. During manual fire missions, the FDC receives the data from the FO by radio or some other nondigital means. On the Manual Mission screen, the operator selects the type of mission (grid, polar plot, shift from a known point, or quick fire) and enters the required data into the displayed fields. Once the type of mission and the initial firing

data are entered, a manual fire mission is processed in the same manner as a digital mission, except for commands from the FO. The example outlined in the screenshots uses a grid mission to explain the steps involved in a manual mission.

Note. For a manual fire mission, commands from the FO must be entered into the MFCS. After the data have been entered, the operator processes missions using the sequence of screens described below.

MANUAL CALL FOR FIRE

10-14. The operator selects the Missions button and the Manual tab. The Manual CFF screen (see figure 10-2) is displayed. This screen allows the user to select and enter data for one of the four types of missions: grid, polar plot, shift from a known point, and quick fire. After selecting the desired ammunition/mission combination, the New CFF tab is displayed.

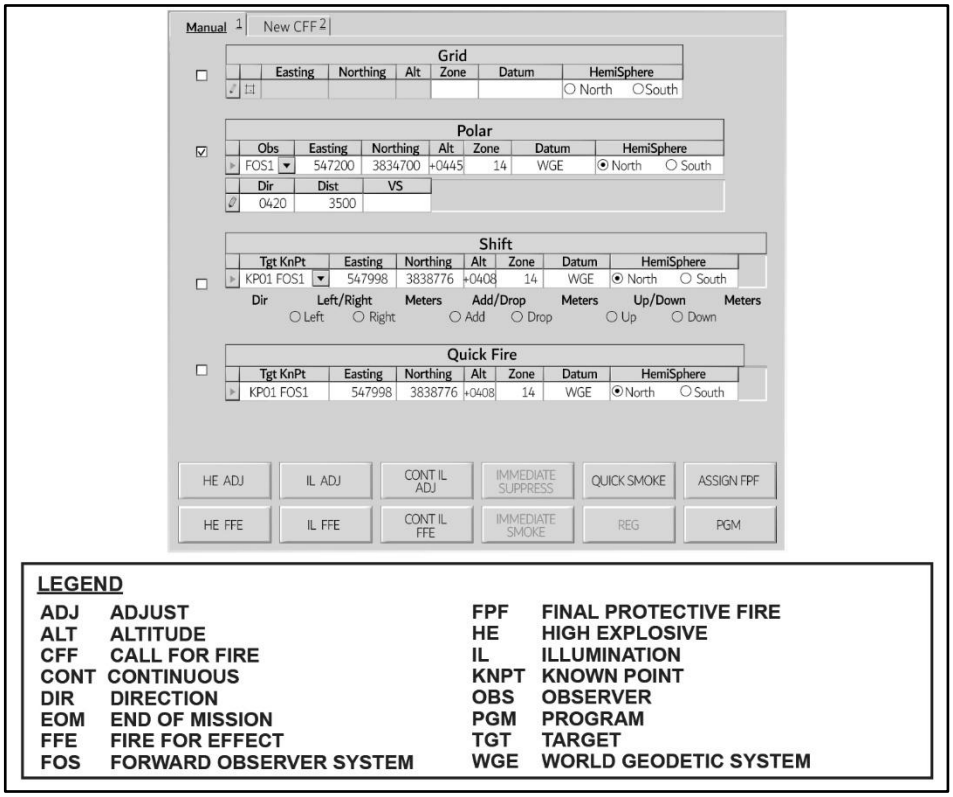


Figure 10-2. Manual Call For Fire screen

MANUAL ADJUST FIRE

10-15. The operator waits for subsequent messages from the FO. If the FO requests an A/F, the operator enters the data from the message into the MFCS by selecting the

Subsequent Adjust button (see figure 10-3). Then, the operator enters the FO's adjustment, and the MFCS calculates the gun orders.

10-16. Next, the operator processes the manual A/F mission as the operator would a digital A/F mission. The operator repeats this step until the operator receives an FFE or an EOM. At the FFE command, the operator uses the procedures described in paragraph 10-34.

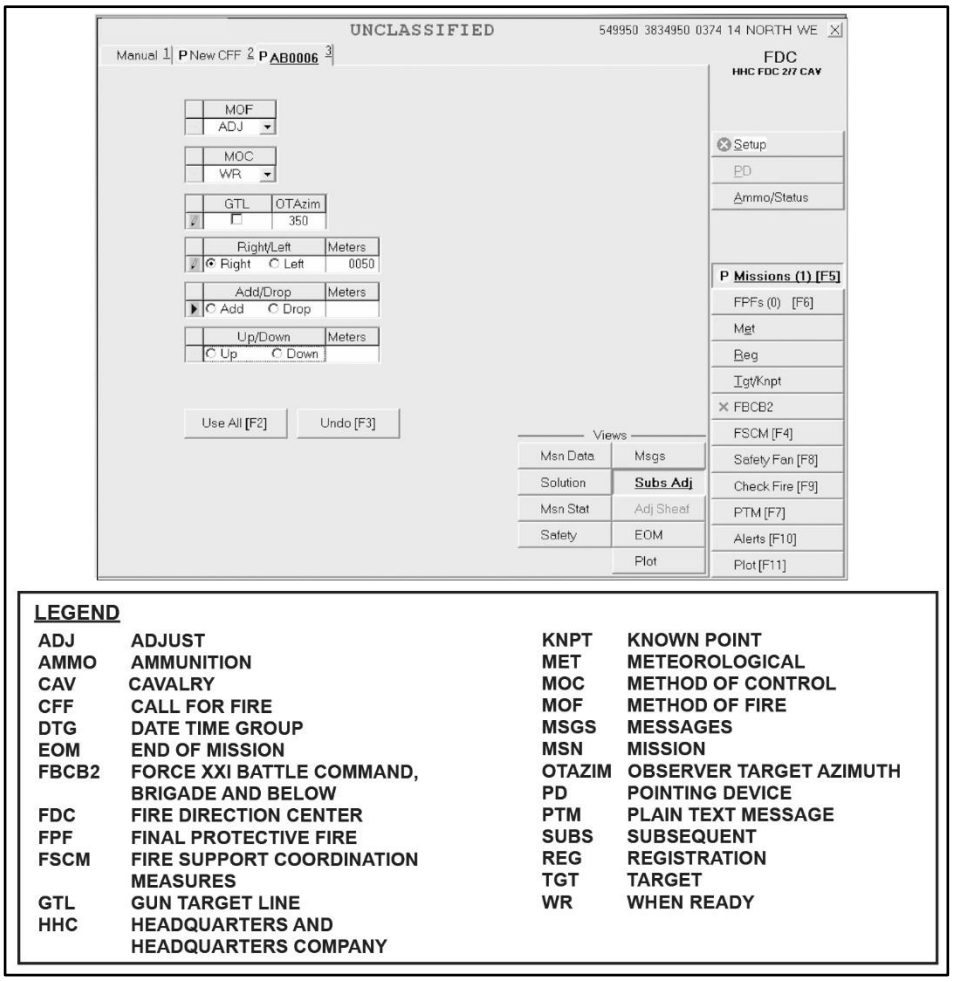


Figure 10-3. Manual Adjust Fire screen

MANUAL END OF MISSION

10-17. To end the mission, the operator selects the EOM button. The Manual End of Mission screen (see figure 10-4) is displayed. The operator can choose one of the three options: EOM-No Save, EOM-Record as a Target, or EOM-Record as a Known Point.

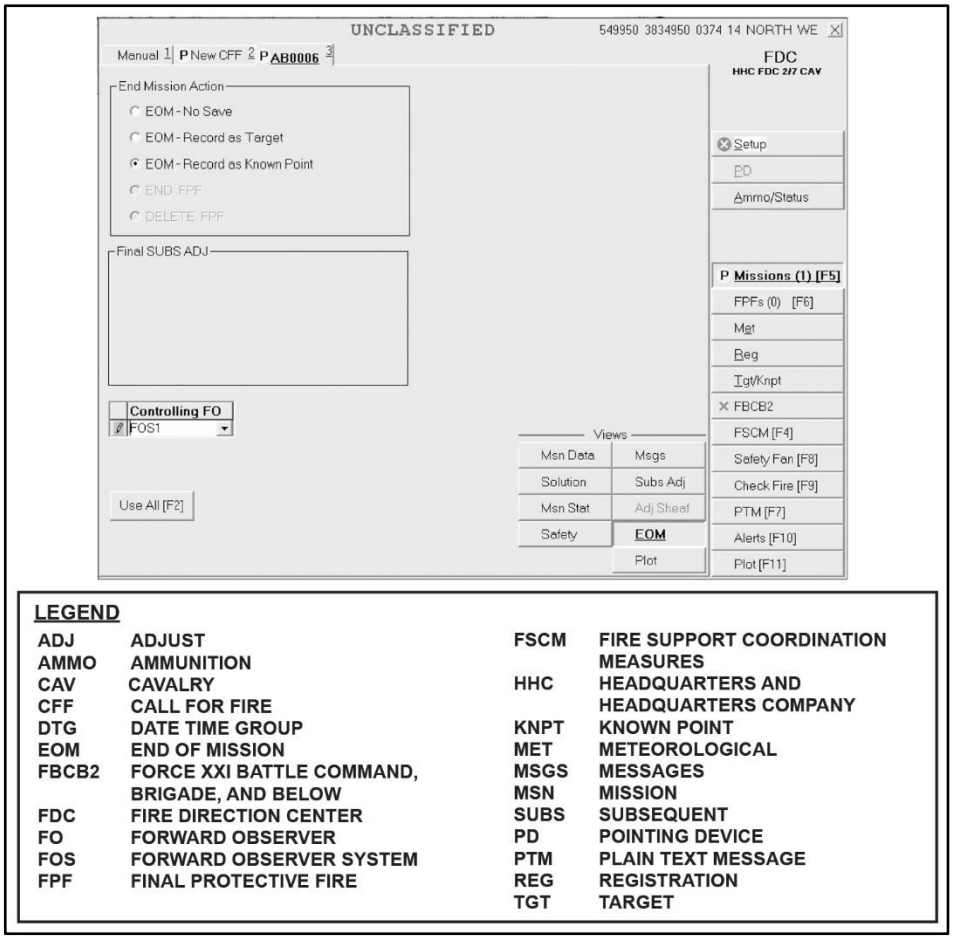


Figure 10-4. Manual End of Mission screen

End of Mission No Save

10-18. If the operator does not need to save or record the mission, the operator selects Process. The New CFF screen appears, and the operator selects Delete.

End of Mission Record as Target

10-19. The Subsequent Message screen is displayed, with the words “End of Mission Record as Target.” The operator selects Process, and the New CFF screen appears. Then, the operator selects Delete.

End of Mission Record as Known Point

10-20. On the EOM screen, the operator selects the controlling FO, and then selects Use All. A message box appears, and the operator selects the known point number and the Save As button.

DIGITAL MISSIONS

10-21. New basic fire missions are received digitally from the FSE or FO. The FSE or FO identifies the target's location using grid coordinates, polar plots, or shifts from a known point. Once a mission has been fired, it can be saved and designated as a target or known point.

10-22. The following screen shots provide an example of a new digital CFF using the grid method of target location. The process is the same when using the polar plot or shift method of target location. Except for the initial CFF screen, the adjustment of fires, FFE, and previously fired missions are conducted in the same manner.

RECEIPT OF A FIRE MISSION

10-23. Upon receipt of a fire mission, the Missions button is highlighted and, if enabled, the audio alarm sounds. The operator selects the Missions button, and the New CFF tab appears. (See figure 10-5.) The operator can select MTO Deny to deny the mission or Process to display the Mission Data screen.

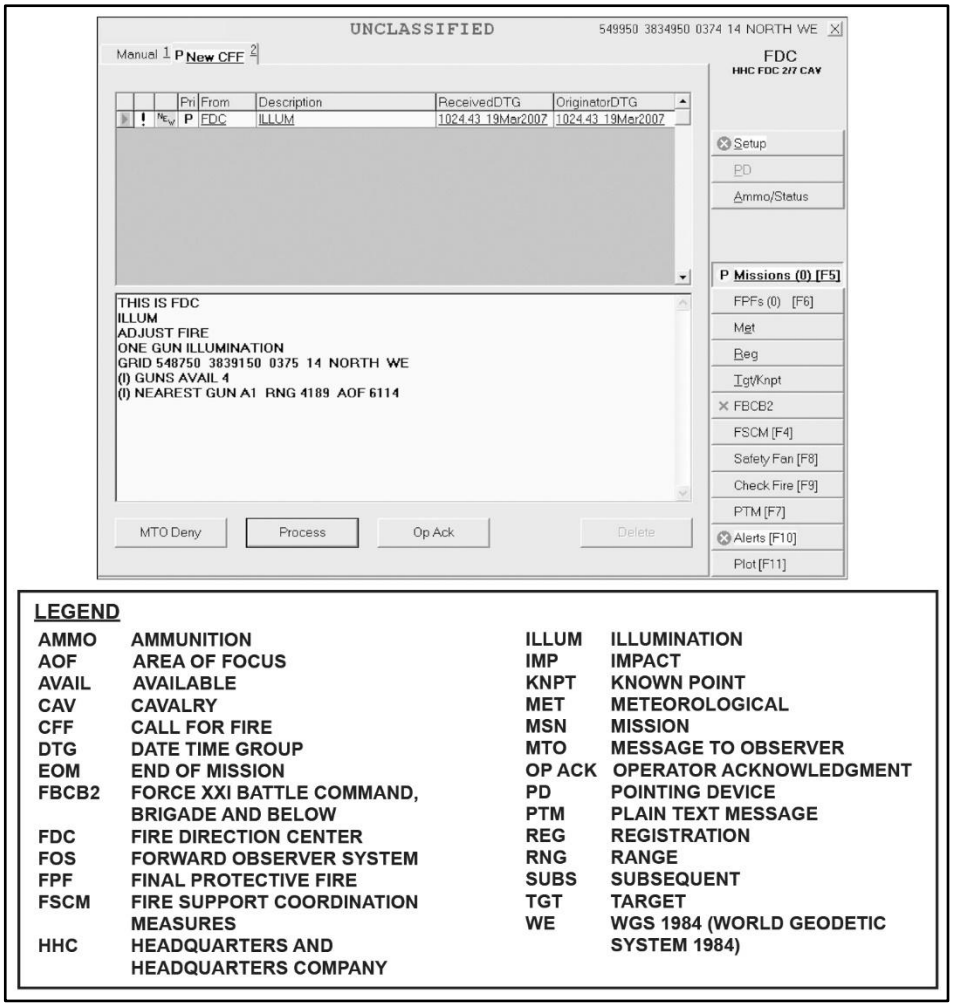
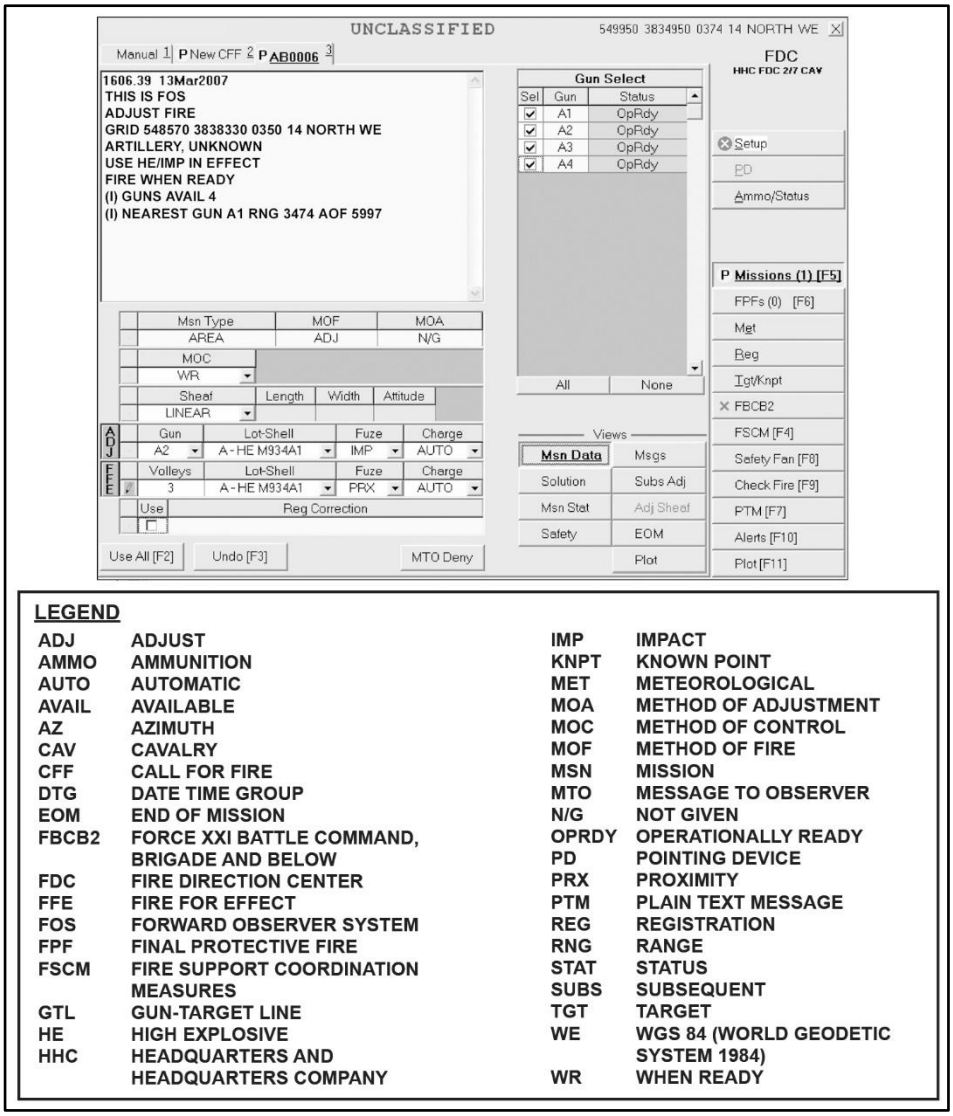


Figure 10-5. New Call for Fire screen

MISSION DATA SCREEN

10-24. The Mission Data screen (see figure 10-6, page 426) automatically generates a new target number and displays the mission data. It allows the operator to review, record, and adjust mission data, such as the guns to fire the mission, MOC, type of sheaf, and fuze-shell combinations. Once satisfied, the operator selects Use All (if the operator made any changes) or Solution.



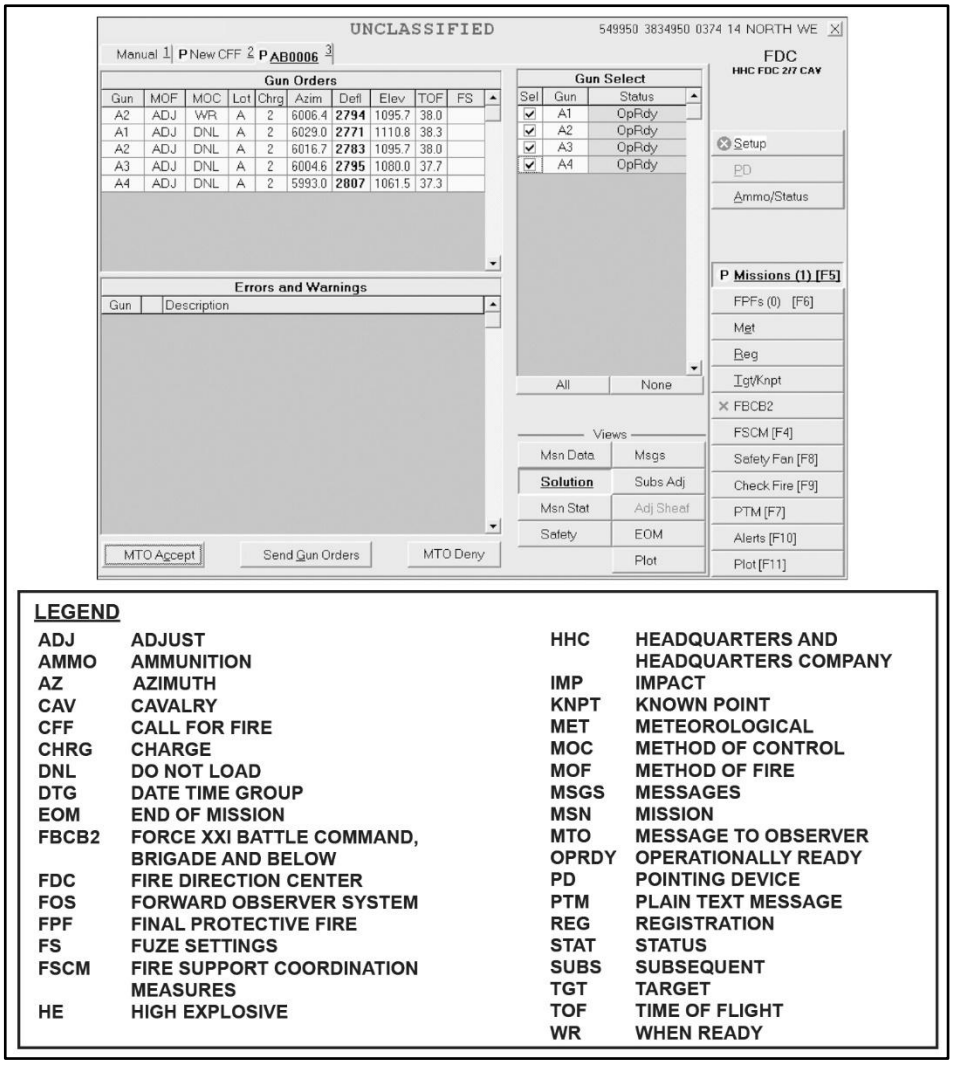
LEGEND

ADJ	ADJUST	IMP	IMPACT
AMMO	AMMUNITION	KNPT	KNOWN POINT
AUTO	AUTOMATIC	MET	METEOROLOGICAL
AVAIL	AVAILABLE	MOA	METHOD OF ADJUSTMENT
AZ	AZIMUTH	MOC	METHOD OF CONTROL
CAV	CAVALRY	MOF	METHOD OF FIRE
CFF	CALL FOR FIRE	MSN	MISSION
DTG	DATE TIME GROUP	MTO	MESSAGE TO OBSERVER
EOM	END OF MISSION	N/G	NOT GIVEN
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW	OPRDY	OPERATIONALLY READY
		PD	POINTING DEVICE
FDC	FIRE DIRECTION CENTER	PRX	PROXIMITY
FFE	FIRE FOR EFFECT	PTM	PLAIN TEXT MESSAGE
FOS	FORWARD OBSERVER SYSTEM	REG	REGISTRATION
FPF	FINAL PROTECTIVE FIRE	RNG	RANGE
FSCM	FIRE SUPPORT COORDINATION MEASURES	STAT	STATUS
		SUBS	SUBSEQUENT
GTL	GUN-TARGET LINE	TGT	TARGET
HE	HIGH EXPLOSIVE	WE	WGS 84 (WORLD GEODETIC SYSTEM 1984)
HHC	HEADQUARTERS AND HEADQUARTERS COMPANY	WR	WHEN READY

Figure 10-6. Mission data screen

SOLUTION SCREEN

10-25. The Solution screen (see figure 10-7) shows the gun orders, the guns selected, errors, and warnings. This screen allows the operator to review the gun status and to change the gun selection based on any errors and warnings received. From this screen, the operator can select MTO Deny (if necessary) and send gun orders.



LEGEND

ADJ	ADJUST	HHC	HEADQUARTERS AND HEADQUARTERS COMPANY
AMMO	AMMUNITION	IMP	IMPACT
AZ	AZIMUTH	KNPT	KNOWN POINT
CAV	CAVALRY	MET	METEOROLOGICAL
CFF	CALL FOR FIRE	MOC	METHOD OF CONTROL
CHRG	CHARGE	MOF	METHOD OF FIRE
DNL	DO NOT LOAD	MSGS	MESSAGES
DTG	DATE TIME GROUP	MSN	MISSION
EOM	END OF MISSION	MTO	MESSAGE TO OBSERVER
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW	OPRDY	OPERATIONALLY READY
FDC	FIRE DIRECTION CENTER	PD	POINTING DEVICE
FOS	FORWARD OBSERVER SYSTEM	PTM	PLAIN TEXT MESSAGE
FPF	FINAL PROTECTIVE FIRE	REG	REGISTRATION
FS	FUZE SETTINGS	STAT	STATUS
FSCM	FIRE SUPPORT COORDINATION MEASURES	SUBS	SUBSEQUENT
HE	HIGH EXPLOSIVE	TGT	TARGET
		TOF	TIME OF FLIGHT
		WR	WHEN READY

Figure 10-7. Solution screen

SAFETY DATA SCREEN

10-26. Before sending gun orders or at any time, the operator can review and record the safety data using the Safety Data screen. (See figure 10-8, page 428.)

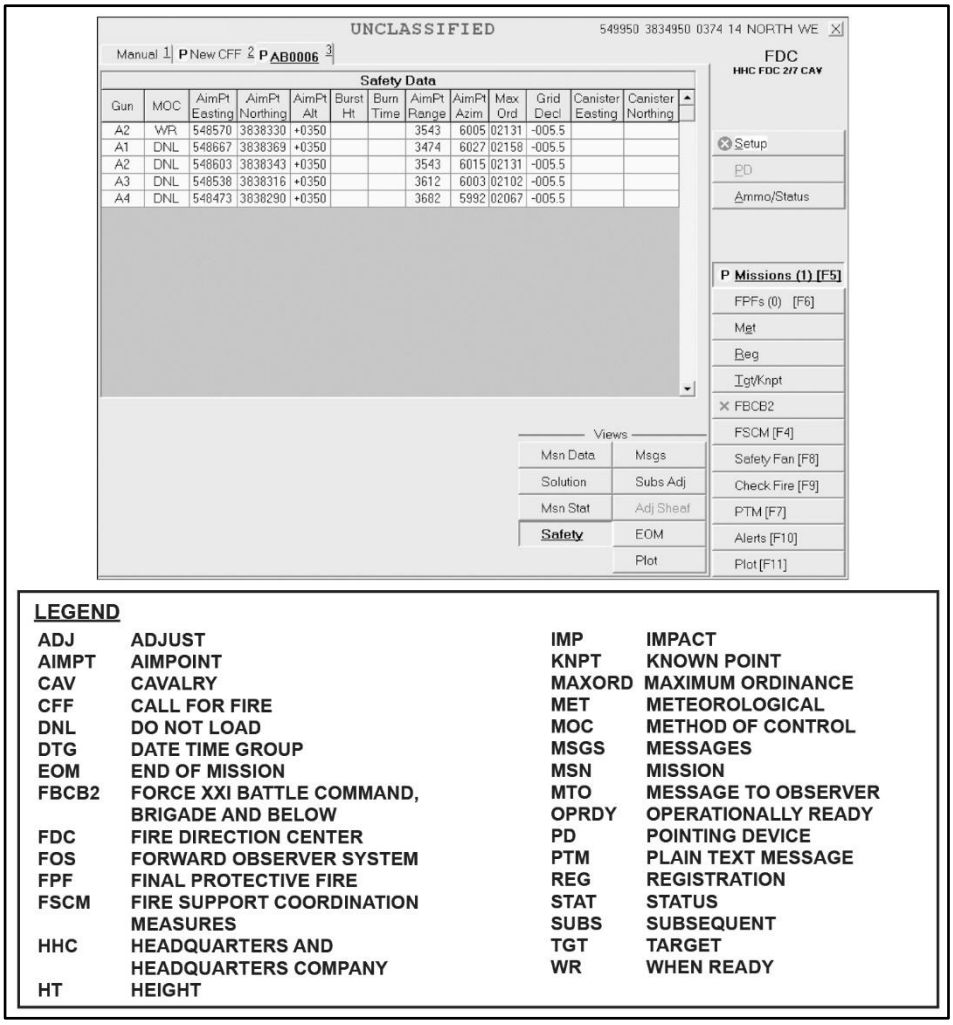


Figure 10-8. Safety data screen

PLOT SCREEN

10-27. The Plot screen (see figure 10-9) is available at any time during the mission. This screen displays burst points, canister points, FSCMs, known points, stored targets, units, and waypoints. When connected to Force XXI Battle Command, brigade and below, it also stores friendly unit locations. The operator can change the items displayed by selecting or deselecting the boxes in the list above the Legends button. (The default shows all items checked.) To obtain information about an icon on the plot, the operator places the cursor over the icon. To return to the Solution screen, the operator selects the Solution button.

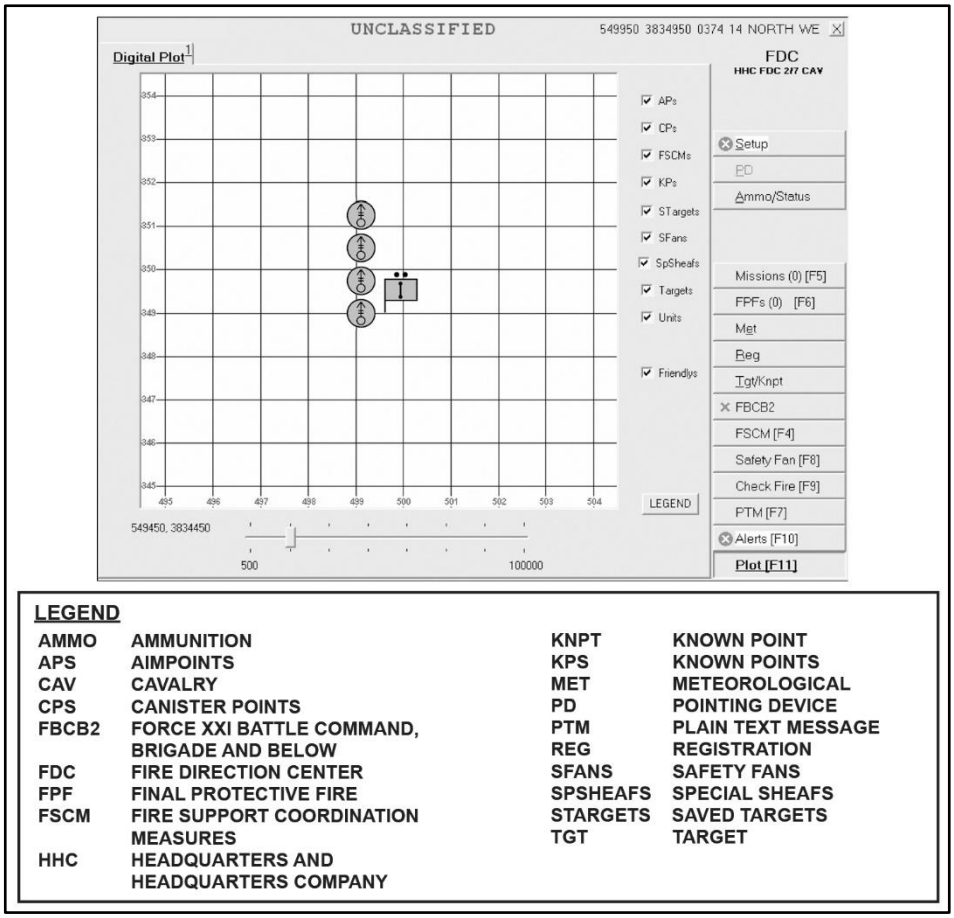


Figure 10-9. Plot screen

10-28. Once satisfied with the data, the operator selects the Send Gun Orders button. A message box appears for the operator to confirm the order; the operator selects Yes to confirm. (See figure 10-10, page 430.) A Send Status box is displayed, showing the destination and status of the message to the guns. The status shows Machine Acknowledgement, Retry (the system is retrying), or Failed (the message did not reach its destination). The Mission Status screen is then displayed.

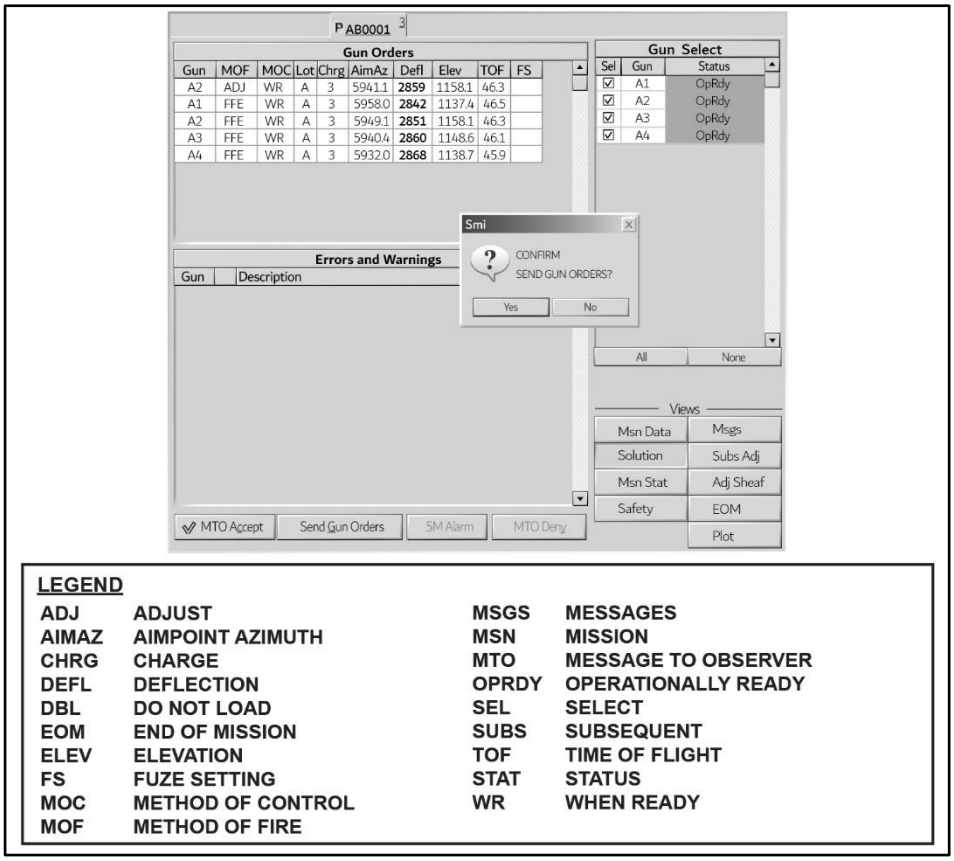


Figure 10-10. Message box

MISSION STATUS SCREEN

10-29. When the operator sends gun orders, the Mission Status screen (see figure 10-11) is shown, and the words "Gun Orders Sent" appear. The operator monitors the mission from this screen. The operator updates the status of the guns (Ready, Shot, Rounds Complete, and Abort) from this screen, and the MFCS automatically sends this information to the FSE or FO.

10-30. On receiving "Shot," a checkmark appears in the checkbox, and the box turns green. The TOF and a red splash sign are displayed.

10-31. If a gun aborts the mission, a checkmark appears in the Abort box, and a reason is displayed.

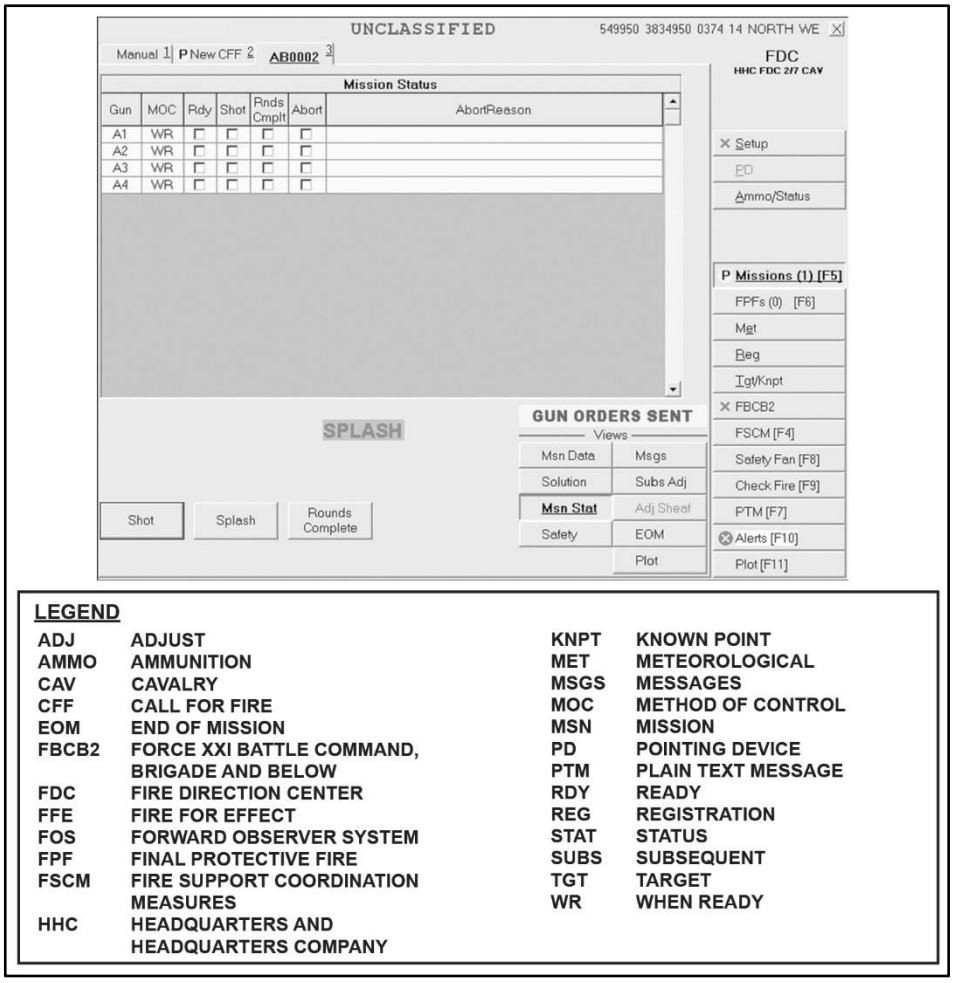
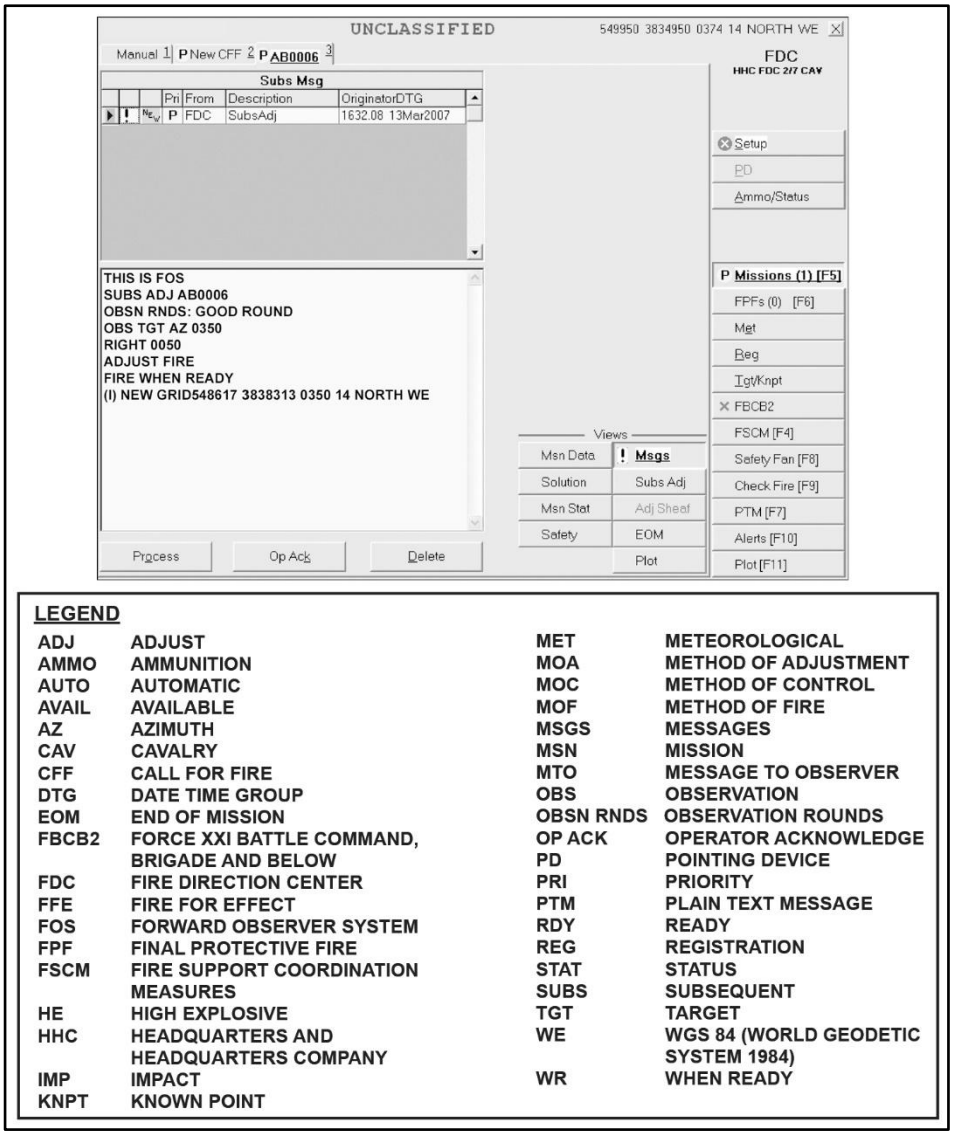


Figure 10-11. Mission status screen

SUBSEQUENT ADJUSTMENT, MESSAGES SCREEN

10-32. The operator selects the Messages screen (see figure 10-12, page 432) and waits for subsequent messages. There are two main subsequent messages: A/F and FFE. The FSE or FO can order an FFE or continue to adjust. For subsequent adjustments, the operator can choose to process or modify the data or delete the adjustment. Upon receipt of "Adjust Fire," the operator records the data and selects OpAck to deactivate the audio alarm. Then, the operator selects Process to display the Mission Data screen.



LEGEND

ADJ	ADJUST	MET	METEOROLOGICAL
AMMO	AMMUNITION	MOA	METHOD OF ADJUSTMENT
AUTO	AUTOMATIC	MOC	METHOD OF CONTROL
AVAIL	AVAILABLE	MOF	METHOD OF FIRE
AZ	AZIMUTH	MSGS	MESSAGES
CAV	CAVALRY	MSN	MISSION
CFF	CALL FOR FIRE	MTO	MESSAGE TO OBSERVER
DTG	DATE TIME GROUP	OBS	OBSERVATION
EOM	END OF MISSION	OBSN RNDS	OBSERVATION ROUNDS
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW	OP ACK	OPERATOR ACKNOWLEDGE
		PD	POINTING DEVICE
FDC	FIRE DIRECTION CENTER	PRI	PRIORITY
FFE	FIRE FOR EFFECT	PTM	PLAIN TEXT MESSAGE
FOS	FORWARD OBSERVER SYSTEM	RDY	READY
FPF	FINAL PROTECTIVE FIRE	REG	REGISTRATION
FSCM	FIRE SUPPORT COORDINATION MEASURES	STAT	STATUS
		SUBS	SUBSEQUENT
HE	HIGH EXPLOSIVE	TGT	TARGET
HHC	HEADQUARTERS AND HEADQUARTERS COMPANY	WE	WGS 84 (WORLD GEODETIC SYSTEM 1984)
IMP	IMPACT	WR	WHEN READY
KNPT	KNOWN POINT		

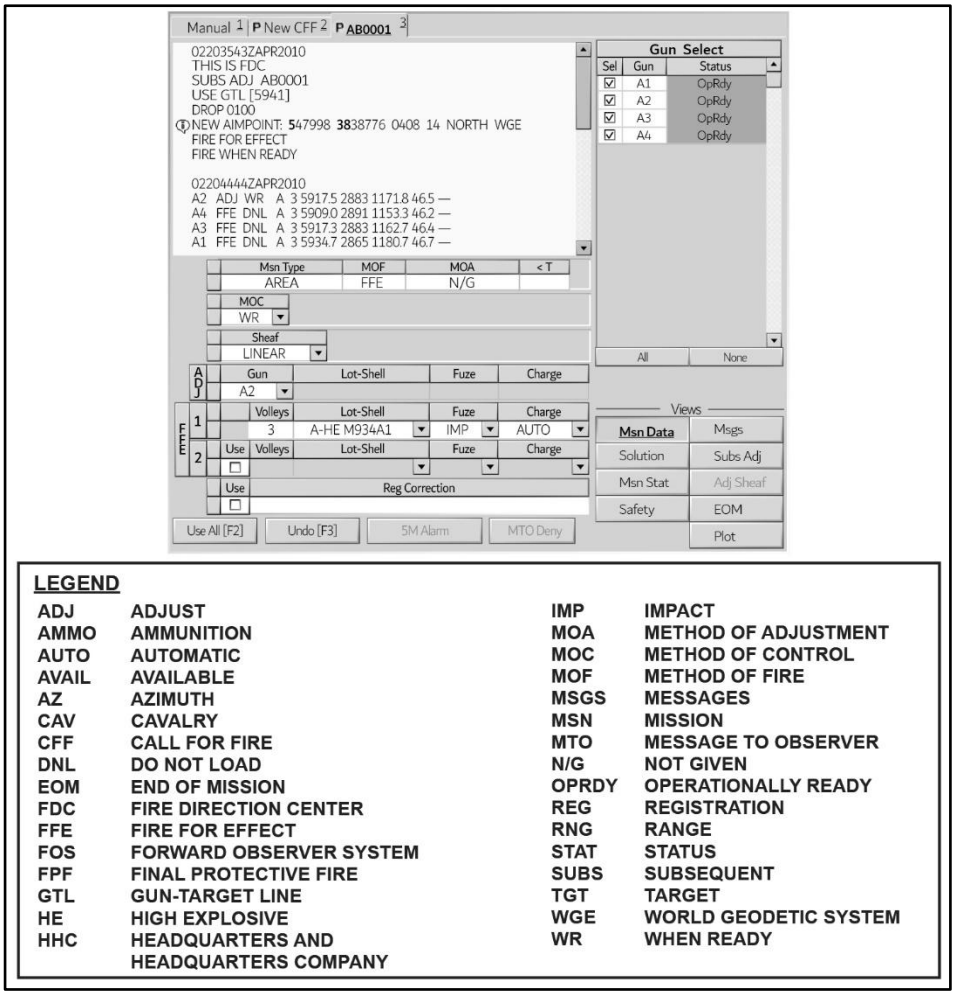
Figure 10-12. Messages screen

SUBSEQUENT ADJUST/ADJUST FIRE

10-33. Until an FFE or EOM is ordered, the operator can adjust using the steps described in paragraphs 10-15 and 10-16. The operator continues to review and modify data on the Mission Data, Solution, and Safety Data screens. The operator controls the mission on the Mission Status screen.

SUBSEQUENT ADJUST/FIRE FOR EFFECT

10-34. The Mission Data screen (see figure 10-13, page 434) appears when an FFE command is processed. The operator records the data and selects OpAck to deactivate the audio alarm. The operator can choose Process or Delete. If the operator selects Process, the Mission Data screen appears, and the operator can change the guns to fire the mission and other mission data, such as MOC, type of sheaf, and fuze-shell combinations. Once satisfied, the operator selects Use All (if the operator made any changes) or Solution. The Solution screen appears. The operator also can select the Safety Data screen. If the MOC is "at my command," the Ready and Fire buttons appear on the Mission Status screen. When the gun sends "Ready," the Ready button becomes shaded, and a green checkmark appears in the Rdy box on the Mission Status screen. The FDC operator then selects the Fire button. A checkmark appears in the Rounds Complete box when the guns send the information. Then, the operator selects the Message button and waits for subsequent messages to appear on the Messages screen.



LEGEND

ADJ	ADJUST	IMP	IMPACT
AMMO	AMMUNITION	MOA	METHOD OF ADJUSTMENT
AUTO	AUTOMATIC	MOC	METHOD OF CONTROL
AVAIL	AVAILABLE	MOF	METHOD OF FIRE
AZ	AZIMUTH	MSGS	MESSAGES
CAV	CAVALRY	MSN	MISSION
CFF	CALL FOR FIRE	MTO	MESSAGE TO OBSERVER
DNL	DO NOT LOAD	N/G	NOT GIVEN
EOM	END OF MISSION	OPRDY	OPERATIONALLY READY
FDC	FIRE DIRECTION CENTER	REG	REGISTRATION
FFE	FIRE FOR EFFECT	RNG	RANGE
FOS	FORWARD OBSERVER SYSTEM	STAT	STATUS
FPF	FINAL PROTECTIVE FIRE	SUBS	SUBSEQUENT
GTL	GUN-TARGET LINE	TGT	TARGET
HE	HIGH EXPLOSIVE	WGE	WORLD GEODETIC SYSTEM
HHC	HEADQUARTERS AND HEADQUARTERS COMPANY	WR	WHEN READY

Figure 10-13. Mission data screen

END OF MISSION

10-35. The operator can end any active mission or receive an EOM at any point in the mission. The Messages screen displays an EOM message from the FO. (See figure 10-14.) If the operator does not need to save or record the mission, the operator selects Process. The New CFF tab for the fired mission appears, and the operator selects Delete.

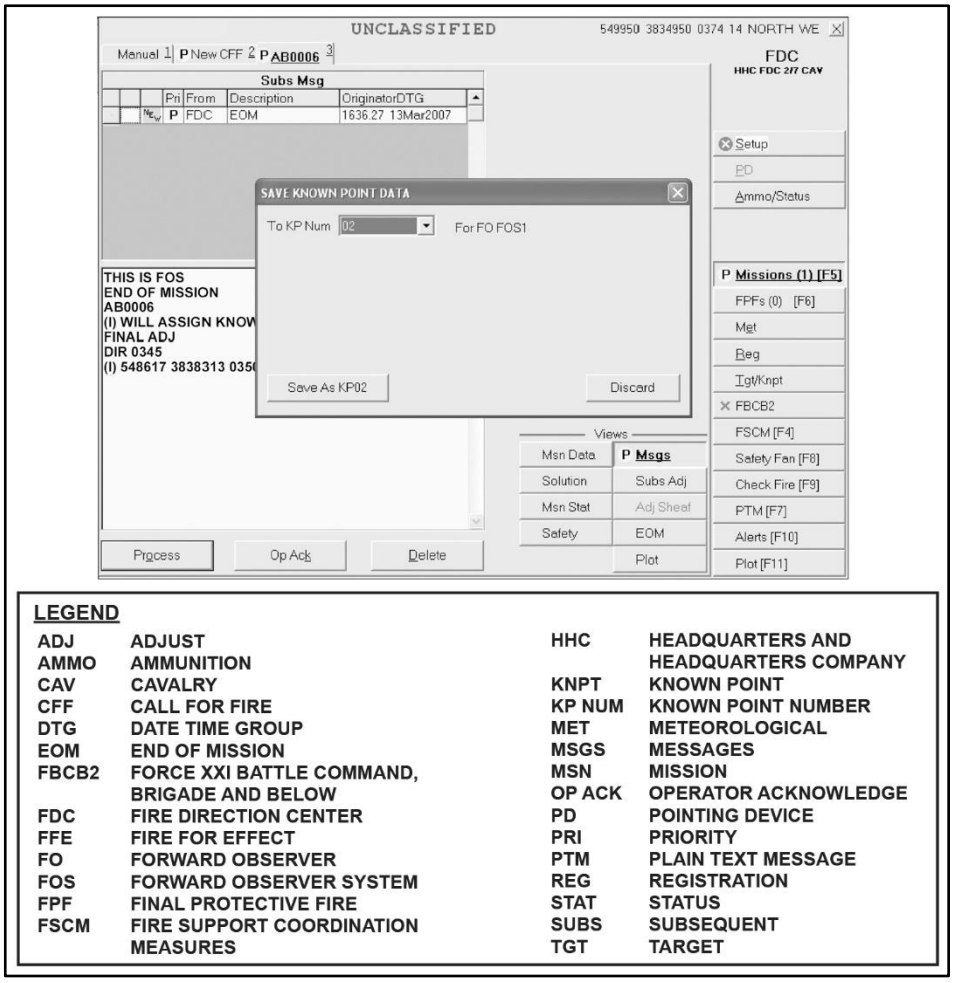


Figure 10-14. End of mission screen

SAVE DATA

10-36. When the operator receives an EOM message with instructions to record the mission (from the FC or FO), the operator can save it as a known point or as a target. A box appears on the screen, and the operator completes the information required. The operator then selects Process and deletes the mission. The operator can use the EOM button to do the same.

TARGET/KNOWN POINT

10-37. The MFCS provides procedures for viewing and entering up to 200 targets and known points. The procedures for both are essentially the same, except that known points must be assigned to a designated observer. When the TGT/KnPt button is selected, the operator can choose the TGTs or KnPts tab.

TARGETS SCREEN

10-38. When the operator selects TGTs, the Targets screen (see figure 10-15) appears. All the targets designated at the EOM are listed. The operator can enter or edit targets manually. To manually enter or edit a target, use the following procedures:

- Enter the two letters (AA to ZZ) of and the target number prefix, followed by a four-digit target number (0000 to 9999) (for example, AA0027).
- Enter the Easting, Northing, altitude (Alt), zone, and choice of datum and hemisphere.
- Select Use All when completed. Select Undo Changes to undo all changes. Delete a target by highlighting the index box in front of the entry that needs to be deleted and select Del.

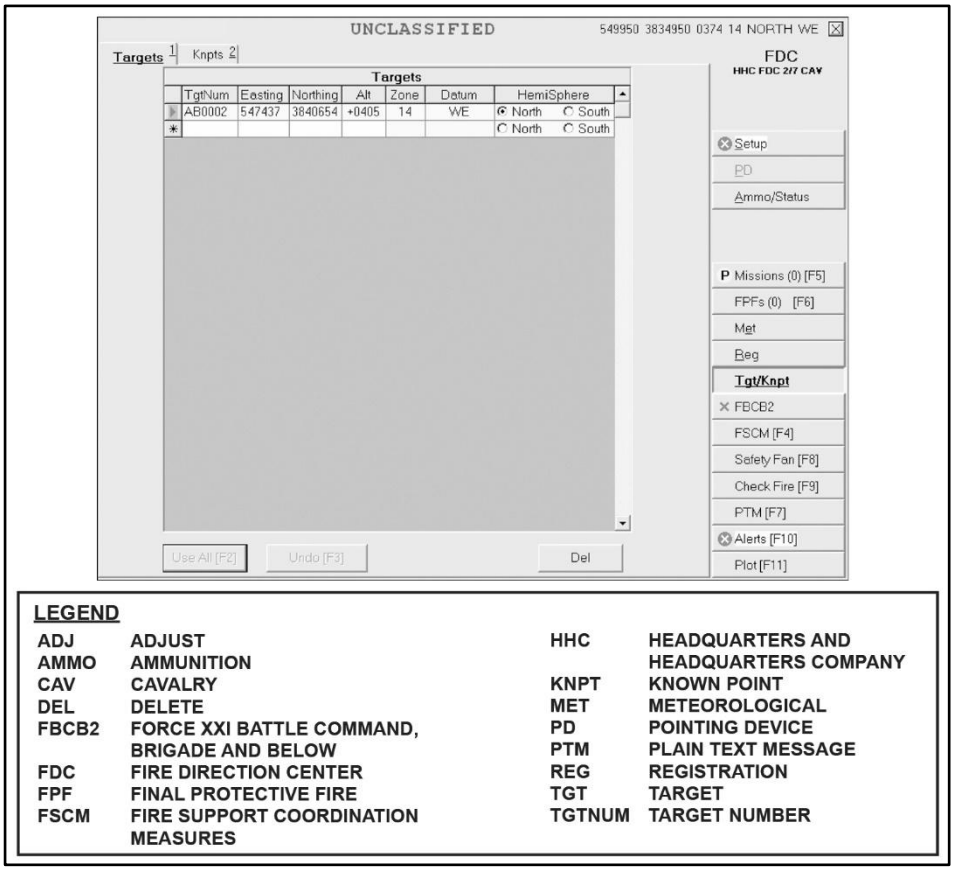


Figure 10-15. Targets screen

KNOWN POINTS SCREEN

10-39. Known points are received digitally at the EOM, and a dialog box is displayed to enter the required data. (See figure 10-16.) A known point must be associated with an observer. The operator can enter known points manually by performing the same actions described above for targets, except that the operator must fill the KnPt field with a

two-digit number from 00 to 99 and choose an observer (Obs) from the pick list. Once the operator has reviewed the data and made the necessary changes, the operator selects Use All to save the information.

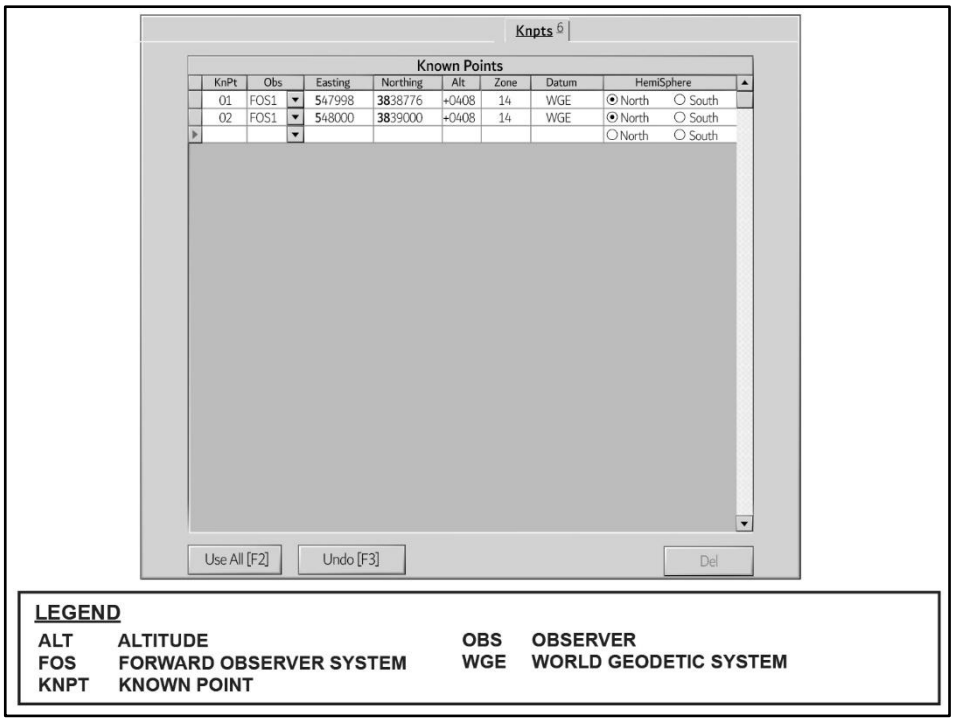


Figure 10-16. Known Points screen

SECTION II – BASIC FIRE MISSIONS

10-40. This section details how the MFCS is used to conduct basic fire missions. The following areas will be covered:

- Mark-center-of-sector.
- Registration.
- Grid.
- Shift from a known point.
- Polar plot.
- Immediate smoke and IS.
- Illumination.

MARK CENTER OF SECTOR

10-41. Marking the center of sector orients the mortar section towards the center of the unit's area of responsibility and the FO uses the marking round as a reference point for the FO's own orientation and follow-on targets.

REGISTRATION

10-42. An RP is a surveyed terrain feature or other designated point on which fire is adjusted for the purpose of obtaining corrections to firing data. The MFCS provides procedures for entering, updating, and storing RP data. The FDC determines whether the mission should be saved as an RP.

FIRING THE REGISTRATION

10-43. A registration fire mission is conducted in the same way as a digital or manual fire mission. A grid mission must be fired before it can be saved as an RP.

SAVING THE REGISTRATION AFTER A DIGITAL MISSION

10-44. At the end of the registration mission, the FO sends an EOM.

- To record the RP number:
  - The operator selects EOM record as target, then select the RP number and then selects the Save As RP button when the Save Registration Data box is displayed (see figure 10-17).
  - The range and azimuth correction factors are displayed.
- The data can be discarded by pressing the Discard button.

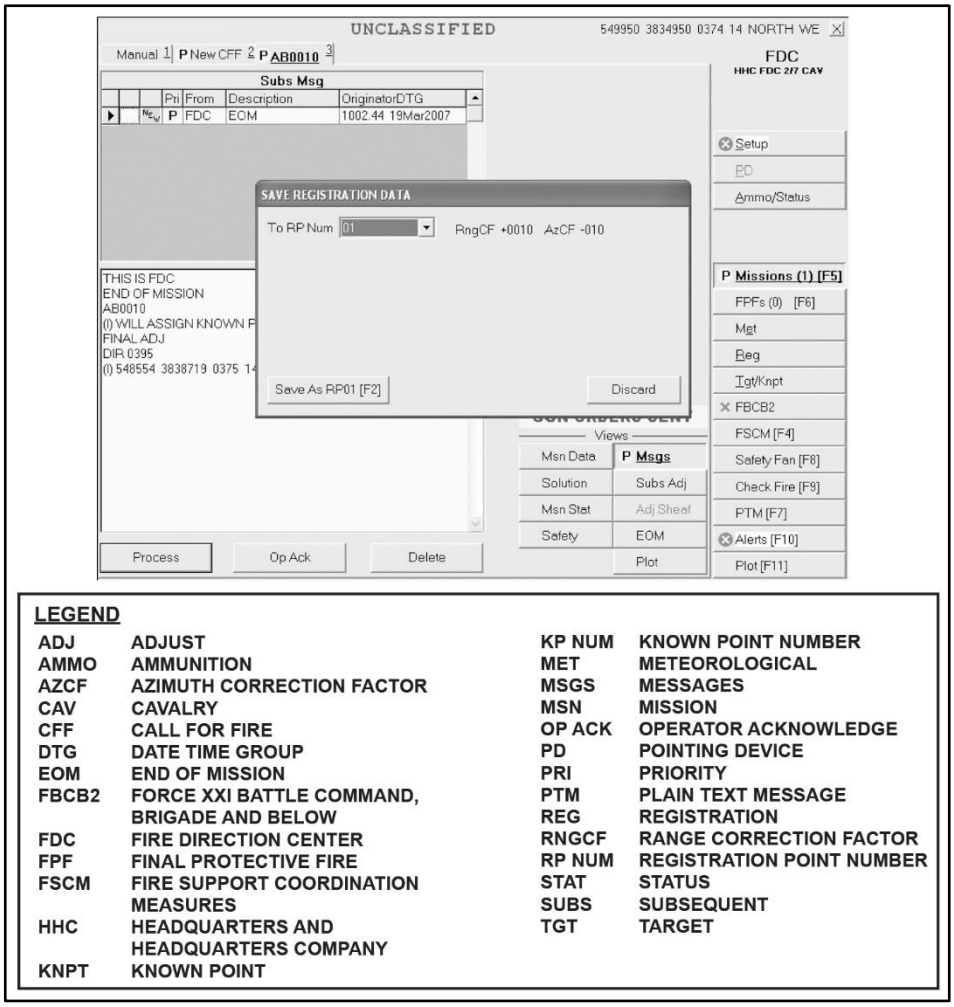


Figure 10-17. Save Registration screen

SAVING THE REGISTRATION AFTER A MANUAL MISSION

10-45. On the Manual screen, the operator enters the same data as during a manual grid mission. The operator selects Registration (Reg) at the bottom of the screen and processes the mission. The mission can be saved manually and recorded as a known point by following the instructions in paragraph 10-16.

REGISTRATION SCREEN

10-46. When the Reg button is selected, the Registration screen (see figure 10-18, page 441) is displayed. This screen displays the data for up to 16 stored RPs. The plot portion

of the screen includes icons showing RPs, firing points, and units. To view a specific RP, the operator uses the following procedures:

- Select the index box in front of the desired RP at the top left of the screen and information auto-fills into the fields.
- To zoom in on a point in the plot, move the plot area slider control within a range of 200 to 100,000 meters.

Note. If the operator leaves this screen and later returns, the slider control resets to its default position at the center of the slider control. The program does not allow the operator to zoom or recenter beyond the Map Mod specified in the GEOREF.

- To center on a particular point, double-click on the point.
- To obtain information about a particular icon on the plot, place the cursor over the icon.
- To enter or update data, enter the appropriate information, and select Use All updating the Plot screen.
- To undo changes that have not been committed to the database, select Undo Changes.
- To delete an RP, highlight the RP to be deleted, and select Delete RP (all fields are cleared, and the Plot screen is deleted).

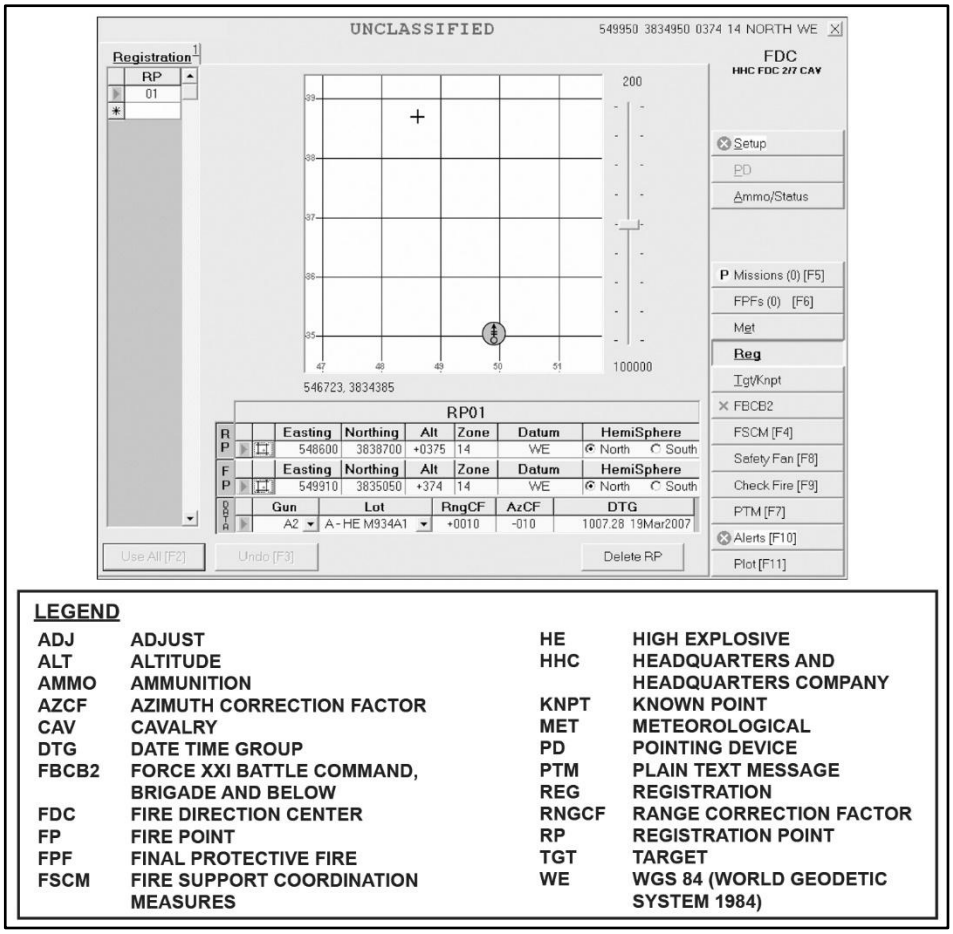


Figure 10-18. Registration screen

GRID

10-47. The operator enters data into the Easting, Northing, and Alt fields. The Zone, Datum, and Hemisphere fields are filled automatically. At the bottom of the screen, the operator selects the type of round and the MOF.

SHIFT FROM A KNOWN POINT

10-48. In addition to the common data, the operator enters the following data for a shift from a known point mission:

- Direction from 0000 to 6399.
- Lateral displacement direction of right or left and a lateral displacement distance from 0000 to 9999.
- Range displacement direction of add or drop and a range displacement distance from 0000 to 9999.

- Vertical shift (up/down) between the observer and the target (a plus sign for up [up is the default setting] or a minus sign for down, and four digits from 0000 to 9999). The vertical shift is not required.

POLAR PLOT

10-49. In addition to the common data, the operator enters the following data for a polar plot mission:

- Observer (Obs) (from a pick list).
- Direction from 0000 to 6399.
- Distance (Dist) from 0000 to 9999.
- VI between the observer and the target (a plus sign for up [up is also the default setting] or a minus sign for down, and four digits from 0000 to 9999, the VI is not required).

IMMEDIATE SMOKE AND IMMEDIATE SUPPRESSION MISSIONS

10-50. When engaging a planned target or a target of opportunity that has taken friendly forces under fire, the FO announces (in the CFF) immediate smoke or IS. The delivery of fires is performed as quickly as possible. Immediate response is more important than the accuracy of these fires.

Immediate Smoke Missions

10-51. Smoke missions are used to conceal ground maneuver, obstacle breaching, and recovery operations, as well as key assembly areas, supply routes, and logistical facilities.

10-52. The primary requirement for an immediate smoke mission is speed. The CFF usually is conducted by voice radio. Manual MFCS methods are used, with the MFCS operator entering the data (as done with Grid, Shift, or Polar) and then selecting the Immediate Smoke button.

Note. See TM 9-1230-208-13 MFCS V6.1 for more information on time on target missions, direct lay missions, and search and traverse missions.

Quick Fire

10-53. In addition to the common data, the operator enters the following data for a quick fire mission:

- Target number/known point (from a pick list).
- HE FFE or ILL FFE (from the bottom of the screen).

ILLUMINATION

10-54. Illumination missions are used to reveal the location of enemy forces hidden by darkness. The following screen captures use the grid method of target location to illustrate the procedures, but the same methods apply to targets located using the polar plot and shift from a known point methods of target location.

10-55. The procedures for an illumination mission are generally the same as the ones described for a digital CFF; therefore, only the general procedures, sequence, and differences in the procedures are described.

NEW CALL FOR FIRE SCREEN

10-56. Upon receipt of a fire mission, the Missions button is highlighted. The operator selects the Missions button to display the mission data on a New CFF screen. (See figure 10-19.)

- The operator can accept the mission by selecting the Process button or refuse it by selecting the MTO Deny button.
- If there is an error beyond FDC control, the only choice is MTO Deny.
- The Mission Data screen appears when the Process button is selected.

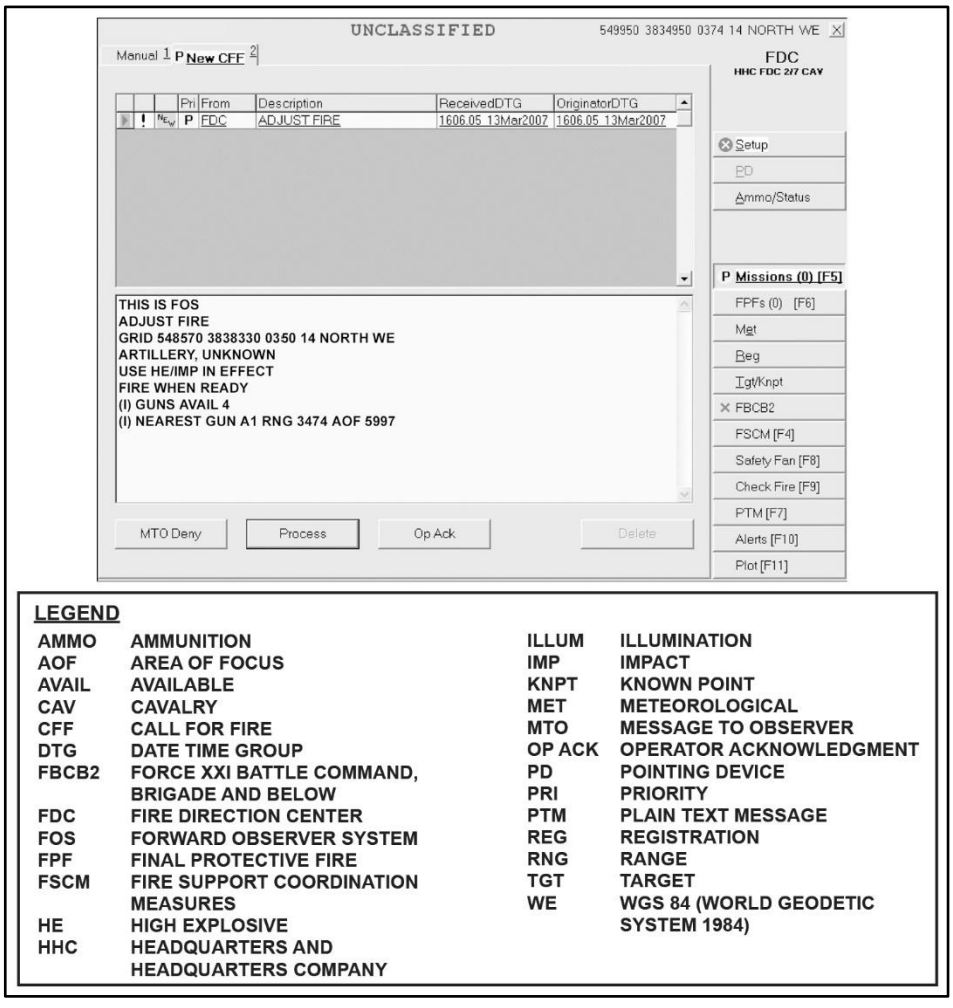


Figure 10-19. New call for fire screen

MISSION DATA SCREEN

10-57. The Mission Data screen presents mission data and a new target number. It allows the operator to review mission data and make any necessary adjustments. Guns for the mission are preselected, but the operator can modify the selection by checking the box beside any OpRdy gun. If necessary, the operator adjusts the mission data. For example, the operator may change the MOC from WR to AMC. Then, the operator selects the Use All button to display the Solution screen. (See figure 10-20.)

Note. Two-gun lateral sheaves are recommended for area targets, and two-gun illumination sheaves are recommended for point targets. The standard coverage for 120-mm mortar illumination is 1,500 meters.



LEGEND

ADJ	ADJUST
AMMO	AMMUNITION
AZIM	AZIMUTH
CAV	CAVALRY
CFF	CALL FOR FIRE
CHRG	CHARGE
DEFL	DEFLECTION
ELEV	ELEVATION
EOM	END OF MISSION
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW
FDC	FIRE DIRECTION CENTER
FFE	FIRE FOR EFFECT
FPF	FINAL PROTECTIVE FIRE
FS	FUZE SETTINGS
FSCM	FIRE SUPPORT COORDINATION MEASURES
HHC	HEADQUARTERS AND HEADQUARTERS COMPANY
KNPT	KNOWN POINT
MET	METEOROLOGICAL
MOC	METHOD OF CONTROL
MOF	METHOD OF FIRE
MSGS	MESSAGES
MSN	MISSION
MTO	MESSAGE TO OBSERVER
OPRDY	OPERATIONALLY READY
PD	POINTING DEVICE
PTM	PLAIN TEXT MESSAGE
REG	REGISTRATION
SEL	SELECT
SUBS	SUBSEQUENT
STAT	STATUS
TGT	TARGET
TOF	TIME OF FLIGHT
WR	WHEN READY

Figure 10-20. Solution screen

Solution Screen

10-58. The Solution screen (see figure 10-20, page 445) allows the operator to—

- View and send gun orders.
- Review the selected guns, and any errors and warnings.
- Review gun status.
- Change the gun selection based on errors and warnings received.

10-59. The operator uses this screen to review, change, and record the mission data. The operator can either accept (MTO Accept) or refuse (MTO Deny) the mission.

- If the indicated errors cannot be corrected, the operator's only choice is MTO Deny.
- If the indicated warnings cannot be corrected, the operator can continue the mission, if authorized.

10-60. The operator can change the guns selected based on errors and warnings.

Safety Data Screen

10-61. Before sending gun orders or at any time during the mission, the operator can check the safety data by selecting the Safety Data button. This screen includes the location and altitude of burst, and the impact point of the canister. The Plot button is available to review the plot at any time during the mission.

Solution Screen

10-62. Once the operator is satisfied with the mission and safety data, the operator returns to the Solution screen (see figure 10-20, page 445) and selects the Send Gun Orders button. The operator confirms the order by selecting the Yes function in the box with the message "Confirm Send Gun Orders Yes/No." A Send Status box is then displayed, showing the destination and status.

Mission Status Screen

10-63. When the operator sends gun orders, the Mission Status screen (see figure 10-21) appears, and the words "Gun Orders Sent" are displayed in the Views section. The Fire button is displayed because the MOC was AMC. When the guns send "Ready," the Ready button is shaded, and the operator can select the Fire button when required or when ordered by the FO or FSE. The mission is monitored from this screen. The operator updates the status of the guns (Ready, Shot, Rounds Complete, and Abort) from this screen, and the MFCS automatically sends this information to the FSE or FO.

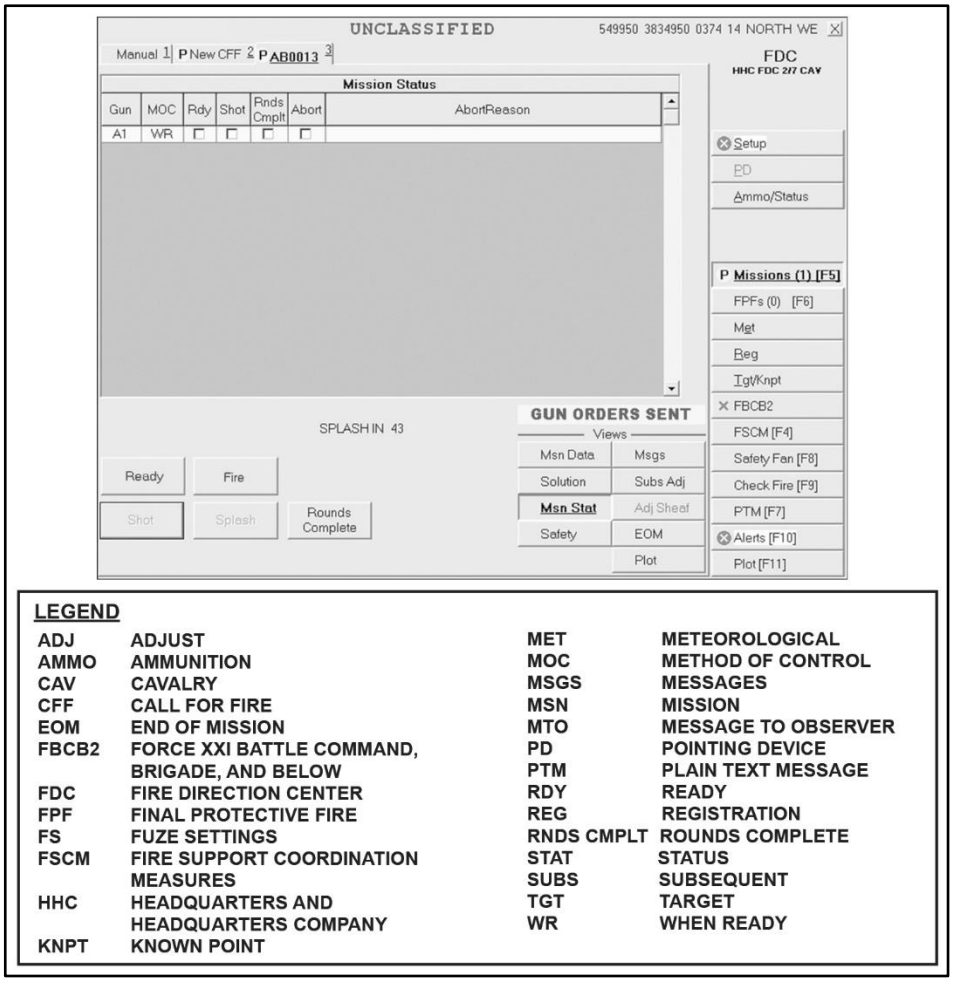


Figure 10-21. Mission Status screen

SUBSEQUENT MESSAGES - ADJUST FIRE

10-64. When the operator selects the Msgs button, the Messages screen (see figure 10-22, page 448) appears, and the operator waits for subsequent messages from the FO or FSE. Upon receipt of an A/F message, data are recorded, and the operator acknowledges receipt. The operator has a choice to Process or Delete the adjustment. When Process is selected, the Mission Data screen is displayed. The operator makes the necessary adjustments to the data and selects the Solution or Use All button.

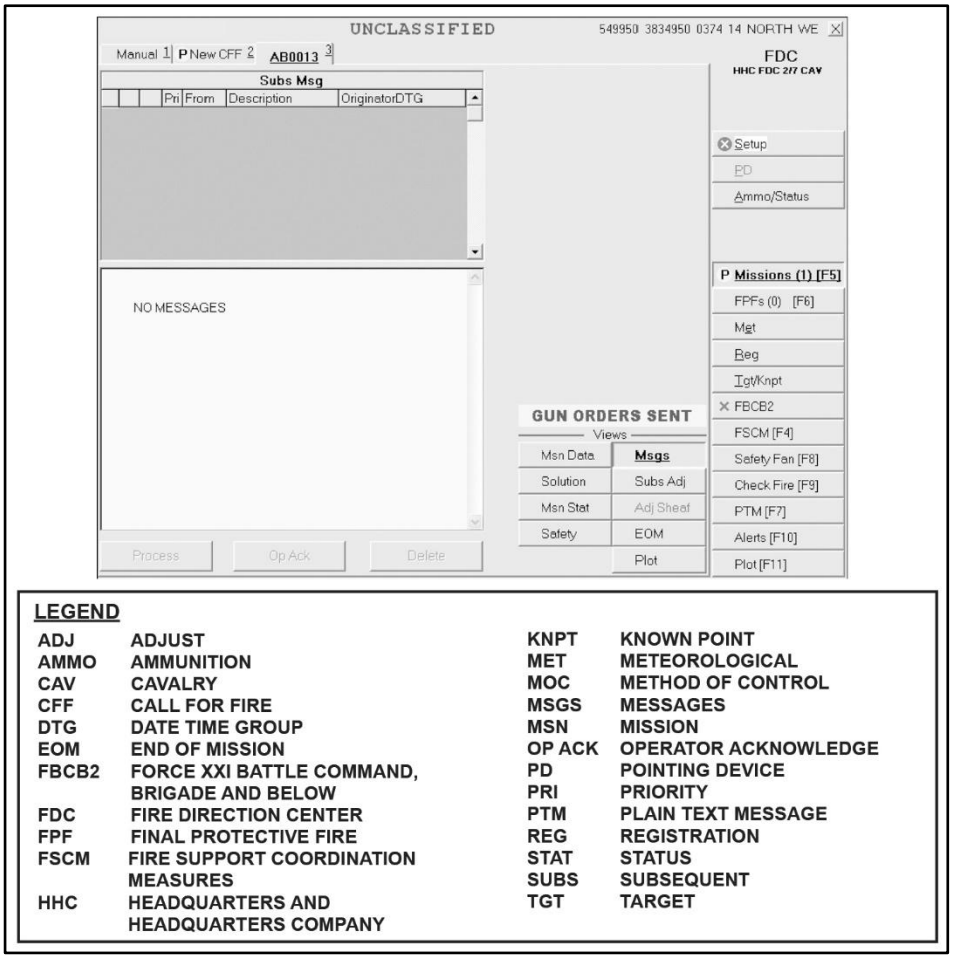


Figure 10-22. Messages screen

10-65. To complete the illumination mission, the operator continues adjusting the illumination until receiving an EOM message or another mission, such as coordinated illumination, from the FO or FSE.

10-66. The FSE or FO contacts the FDC to "Mark Illumination," and the operator records the mark time. The MFCS operator informs the squad leader that the illumination has been marked and that the squad leader needs to maintain a minimum of three to five rounds with the current data. The mission stays open in case corrections are needed later.

SECTION III – ADVANCED MISSIONS

10-67. In addition to manual and digital fire missions, the MFCS operator can process special fire missions, which include registration, illumination, coordinated illumination,

continuous illumination, IS, immediate smoke, quick smoke, and FPFs. Each special mission has a button in the control button area.

COORDINATION ILLUMINATION MISSION

10-68. Illumination fires are often coordinated with HE fires to expose and kill or suppress the enemy. This mission is essentially two separate fire missions, with the operator alternating between the illumination and HE fire missions by clicking the tabs for each mission. The type of round and fuze combination used with illumination depends on the type of target. For example, HE is used for troops in open areas, and WP is used for a suspected petroleum, oil, and lubricants point.

MANUAL CALL FOR FIRE/COORDINATED ILLUMINATION GRID MISSION

10-69. A manual coordinated illumination grid fire mission with a subsequent adjustment and FFE begins with a CFF. The adjustment and firing of the illumination mission is like that of the digital fire mission. Illumination is fired and, if necessary, adjusted throughout the coordinated illumination mission. During the HE adjustment and FFE, the operator receives subsequent messages (from the FO) to fire illumination in coordination with the HE.

10-70. To do this the operator takes the following steps:

Note. The procedures shown represent a grid mission. If desired, a polar, shift, or quick fire mission can be conducted using the MFCS.

- Clicks the mission control button.
- Selects the manual tab and the manual tab screen allows the operator to manually perform a grid, polar, shift, or quick fire mission.
- Clicks in the white box to the left of Grid, displaying a checkmark in the box.
- Enter Easting, Northing, and Alt; the first digits of Easting and Northing are auto filled.
- At the bottom of the screen, select HE ADJ and the new CFF mission will be displayed (see figure 10-23, page 450).

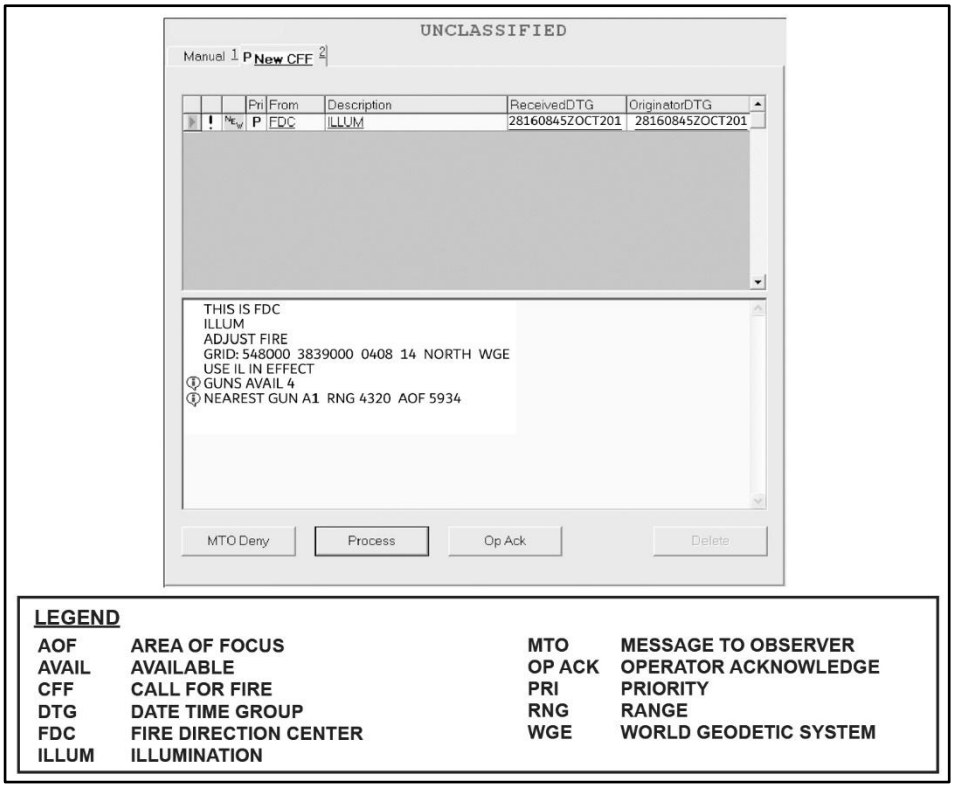


Figure 10-23. New call for fire-manual mission screen

- Record data and click Op Ack to deactivate audio alarm.

Notes. 1. The operator chooses to Process or Message to Observer (MTO Deny). If the operator selects MTO Deny, a pop-up box becomes visible allowing the operator to add a description of the reason for denial.

2. If there is an error beyond FDC control, the only choice will be MTO Deny.

3. If MTO Deny is selected, a pop-up box is displayed. (See figure 10-24.) If a target number is available, the number is included in the MTO Deny screen at the top.

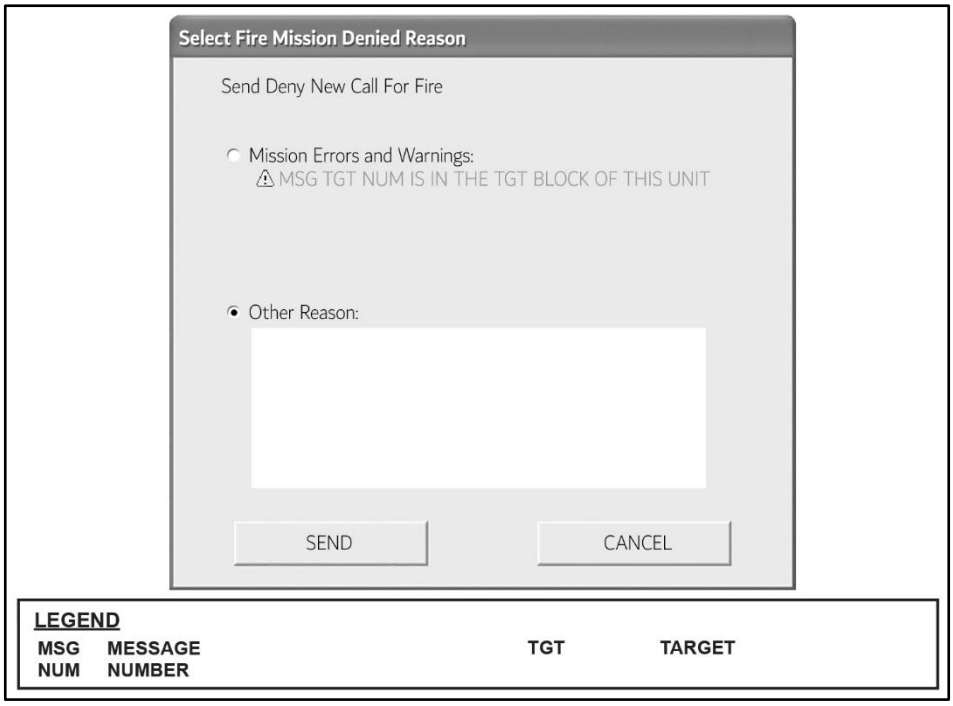


Figure 10-24. Select fire mission denied reason box

10-71. Any errors or warnings associated with the mission will be auto generated in the Mission Errors and Warnings area. To enter an operator reason, the operator selects Other Reason, and then takes the following steps:

- Click Send (or Cancel if desired) and the message will be sent as a PTM along with the MTO Deny Message.
- If the mission is acceptable, click Process.

10-72. The Soldier/machine interface Warning window will appear with the message, "WARNING (W) DUPLICATE TGT WITH AB0010 CONTINUE PROCESSING? Click OK."

10-73. The mission data screen is then displayed with a new target number and the mission data view. It allows the operator to review the mission data and modify as necessary. The guns for the mission are pre-selected by the software and are checked in the Sel Box in Gun Select. The operator has the option to modify these selections by clicking the Sel Box to select or deselect any OpRdy gun. There is also an option to select all or none of the guns listed by clicking All or None.

10-74. MOC should be changed to AMC so FDC can control when illumination adjustment and HE rounds are fired.

10-75. If necessary, the operator can modify mission data. To undo changes the operator clicks Undo. The operator clicks Use All to display the Solution view screen.

10-76. The Solution screen shows Gun Orders, Errors, and Warnings. It allows the operator to review gun status and to change gun selection. It provides for MTO Accept or MTO Deny and is the screen from which gun orders are sent.

WARNING

If an Up/Down adjustment is made to an illumination found, the canister Easting and Canister Northing (cartridge fail point) on the safety screen will not be accurate. Do not rely on the accuracy of this canister grid location. Ensure that the canister grid location area is clear of any personnel before firing the round or personnel injury may occur.

10-77. Before sending gun orders, the operator—

- Checks safety data by clicking on Safety view button. The operator reviews and records safety data.
- Clicks the Solution button to return to the Solution view screen.

Notes. There may be a slight difference in the azimuth on the Solution screen (command data) and the azimuth on the Safety screen (chart data). These differences can be due to the use of MET, registration corrections, slight rotation of the round, and/or differences in earth rotation beneath the airborne round.

Plot view button is available to review plot at any time during the mission. The operator always checks canister Easting and Northing location.

- Sends Gun Orders—the operator clicks send gun orders, a message box will be displayed with Confirm Send Gun Orders.
- Selects Yes to confirm.

10-78. A send status box will be displayed showing priority (Pri), destination, and status. Status will show MACK (machine acknowledgement), RETRY (system is retrying), CANTPRO (cannot process message), CANTCO (cannot compute mission), FAIL (message did not reach destination), or CANCEL (cancel). MFCS will attempt to send the message three times. If it is unsuccessful, the message will be marked in send status box as failed.

MISSION STATUS

10-79. When the operator sends gun orders the Msn Stat screen will be displayed and the words GUN ORDERS SENT will be displayed in the Views section. The mission is monitored from this screen. Ready, Shot, Rounds Complete, and Abort will be checked off, as applicable, when the gun(s) send them.

10-80. When the gun in the HE mission sends Ready, a check will appear in the Rdy box, and the background of the box will be green.

Note. The FDC does not send Ready to the FO; the operator will be coordinating between the illumination mission and the HE mission. The operator will determine the difference in the TOF between the Mark time and the HE round. The difference is the time required to have optimum light on the target as the HE impacts.

- The FDC operator goes into the illumination mission and enters the subsequent adjust view.
  - The MOC is changed to AMC and Use All is selected.
  - FDC operator sends AMC data to the gun in the illumination mission.
- When the gun in the illumination mission sends Ready, a check will appear in the Rdy box, and the background of the box will be green.
- WR has been received for both missions, the FDC operator clicks FIRE button for the illumination gun mission.
- Upon receiving Shot, a check will appear in the Shot box and the background of the box will be green and the Shot button and Splash button will gray out.
- TOF will be displayed. Upon burst, a red Splash sign is displayed for a few seconds.
- The FDC operator goes to the HE Mission, Msn Stat screen at the established coordinated time for the HE gun to fire and clicks the FIRE button.
- Upon receiving Shot, a check will appear in the Shot box and the background of the box will be green and the Shot button and Splash button will gray out.
- TOF will be displayed; upon impact, a red Splash sign is displayed for a few seconds.

SUBSEQUENT ADJUST-FIRE FOR EFFECT

10-81. To perform a Subsequent Adjust-Adjust Fire, the operator takes the following actions:

- Clicks on the Subsequent Adjust (Subs Adj) button in Views.
- Changes the MOF to FFE.
- Clicks Use All.
- Records data and clicks OpAck to deactivate audio alarm; there is a choice to Process or Delete.
- If necessary, modifies mission data. MOC should be AMC.
- To undo changes, clicks Undo.
- Clicks Use All to display the Solution view screen.
- Reviews screen and records data.
- If MTO Accept is selected, a green check is displayed before MTO Accept, and MTO Deny will be grayed out.
- Before sending gun orders, checks safety data by clicking on Safety view button.
- Reviews and records safety data.
- Clicks Solution button to return to the Solution view screen.

- Clicks Send Gun Orders.
- When gun sends Ready, a check will appear in the Rdy box.

Note. The operator again will be coordinating time between the illumination gun mission and the HE gun mission.

- The FDC operator will enter the illumination mission and perform a manual subsequent adjust.
  - Change MOF to FFE and select Use All. FDC operator then sends gun orders to the illumination gun.
  - WR has been received by all guns, click the Fire button for the illumination gun mission.
- Upon receiving Shot, a check will appear in the Shot box and the box will turn green. The Shot button and Splash button will gray out.
- TOF will be displayed; upon burst, a red Splash sign is displayed for a few seconds.
- At the coordinated time, FDC will click Fire button in the HE mission.
- Upon receiving Shot, a check will appear in the Shot box and the box will turn green and the Shot button and Splash button will gray out.
- TOF will be displayed. Upon impact, a red Splash sign is displayed for a few seconds.
- When all guns send rounds complete, a check will appear in the Rnds Complt box and rounds Complete button will gray out.

10-82. Perform the EOM procedures for both the HE and ILL missions in compliance with the unit SOP.

CALL FOR FIRE FROM FIRE SUPPORT ELEMENT OR FORWARD OBSERVER/ILLUMINATION AND COORDINATED ILLUMINATION POLAR PLOT MISSION

10-83. These missions are conducted the same way as grid missions, but the New CFF screen has the Polar method checked.

CALL FOR FIRE FROM FIRE SUPPORT ELEMENT OR FORWARD OBSERVER/ILLUMINATION AND COORDINATED ILLUMINATION SHIFT FROM A KNOWN POINT MISSION

10-84. These missions are conducted the same way as grid missions, but the New CFF screen has the Shift method checked. The FO automatically converts a shift from a known point mission to a grid mission before the FDC receives it. The location is not as precise as a regular grid mission since the last digits of the direction, the lateral displacement distance, and the range displacement distance automatically are changed to zero.

MANUAL ILLUMINATION AND COORDINATED ILLUMINATION MISSION

10-85. Procedures for a manual mission are like those for a digital mission. The only differences are that the operator manually initiates the CFF, manually selects Subs Adj

whenever a subsequent adjust is warranted, and manually clicks EOM to end the mission.

FINAL PROTECTIVE FIRES

10-86. An FPF is an immediately available, prearranged barrier of fire designed to impede enemy movement across defensive lines or areas. The MFCS can store up to three FPFs at a time. If an active mission is in progress and an FPF order is received, the FPF mission has the higher priority.

Note. This paragraph uses a grid mission to illustrate the process of receiving, adjusting, saving, and firing an FPF. Missions using the polar plot or shift from a known point method to locate the FPF are conducted the same way.

NEW CALL FOR FIRE

10-87. Upon receipt of a fire mission, the Missions button is highlighted, and the audio alarm sounds (if enabled). The operator selects the Missions button, and the New CFF screen (see figure 10-25, page 456) appears. The message contains the words “Assign FPF.” The operator selects OpAck to deactivate the audio alarm and acknowledge receipt of the message. If the mission is acceptable, the operator selects Process.

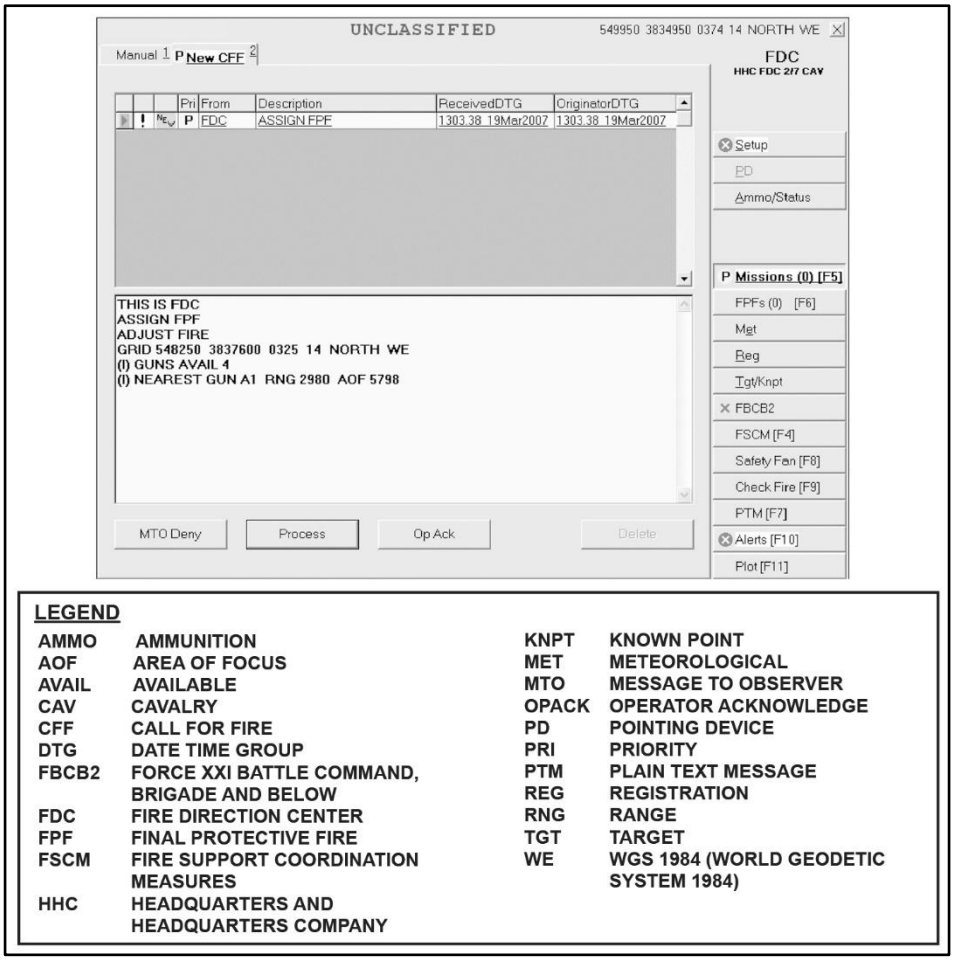
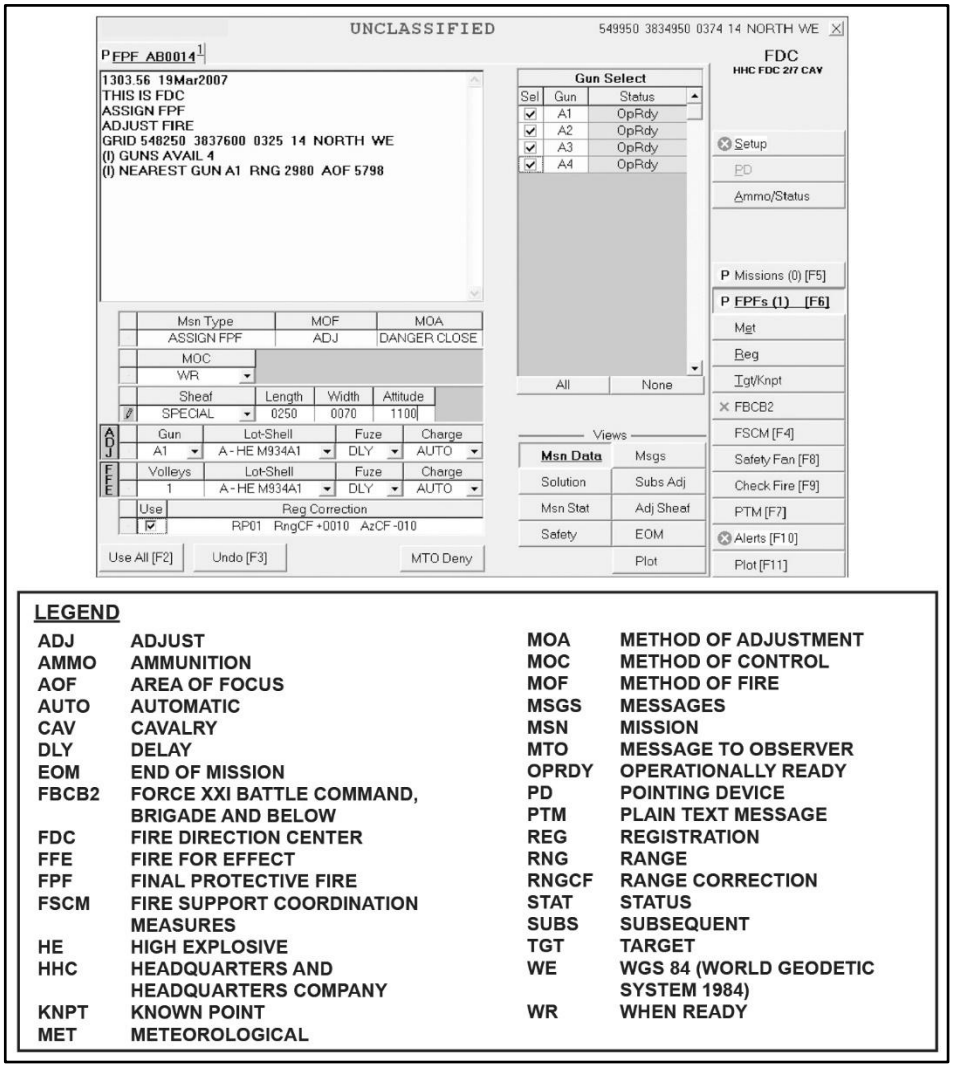


Figure 10-25. New call for fire screen

MISSION DATA SCREEN

10-88. The operator selects Process and the FPF button; the screen displays a New FPF Target Number tab and the Mission Data screen. (See figure 10-26.) Guns for the mission are preselected by the software but can be modified by the operator. If necessary, the operator adjusts the mission data. In figure 10-26, the MOF is ADJ, and the method of adjustment is danger close; these fields are auto filled and read-only. The MOC is AMC. The sheaf defaults to Linear, but the preferred sheaf for an FPF is Special, allowing the operator to enter the length, width, and attitude. (The FPF is a special mission, by default a special sheaf mission.) Based on the attitude of the target, the operator ensures that the adjusting gun is the one closest to the FPF. Since the FPF mission is danger close, the preferred fuze to adjust is Delay. In the ADJ section, the operator chooses DLY for fuze, if available. The Use box is checked automatically when a registration correction is available. If a registration correction is available, the operator

has the option to use Reg Correction. If the operator decides not to use it, the operator selects the checkmark in the Use box to deselect it. If no changes are made, the operator selects the Solution button or selects Use All to apply data changes and display the Solution screen.



LEGEND

ADJ	ADJUST	MOA	METHOD OF ADJUSTMENT
AMMO	AMMUNITION	MOC	METHOD OF CONTROL
AOF	AREA OF FOCUS	MOF	METHOD OF FIRE
AUTO	AUTOMATIC	MSGS	MESSAGES
CAV	CAVALRY	MSN	MISSION
DLY	DELAY	MTO	MESSAGE TO OBSERVER
EOM	END OF MISSION	OPRDY	OPERATIONALLY READY
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW	PD	POINTING DEVICE
		PTM	PLAIN TEXT MESSAGE
FDC	FIRE DIRECTION CENTER	REG	REGISTRATION
FFE	FIRE FOR EFFECT	RNG	RANGE
FPF	FINAL PROTECTIVE FIRE	RNGCF	RANGE CORRECTION
FSCM	FIRE SUPPORT COORDINATION MEASURES	STAT	STATUS
		SUBS	SUBSEQUENT
HE	HIGH EXPLOSIVE	TGT	TARGET
HHC	HEADQUARTERS AND HEADQUARTERS COMPANY	WE	WGS 84 (WORLD GEODETIC SYSTEM 1984)
KNPT	KNOWN POINT	WR	WHEN READY
MET	METEOROLOGICAL		

Figure 10-26. Final protective fire mission data screen

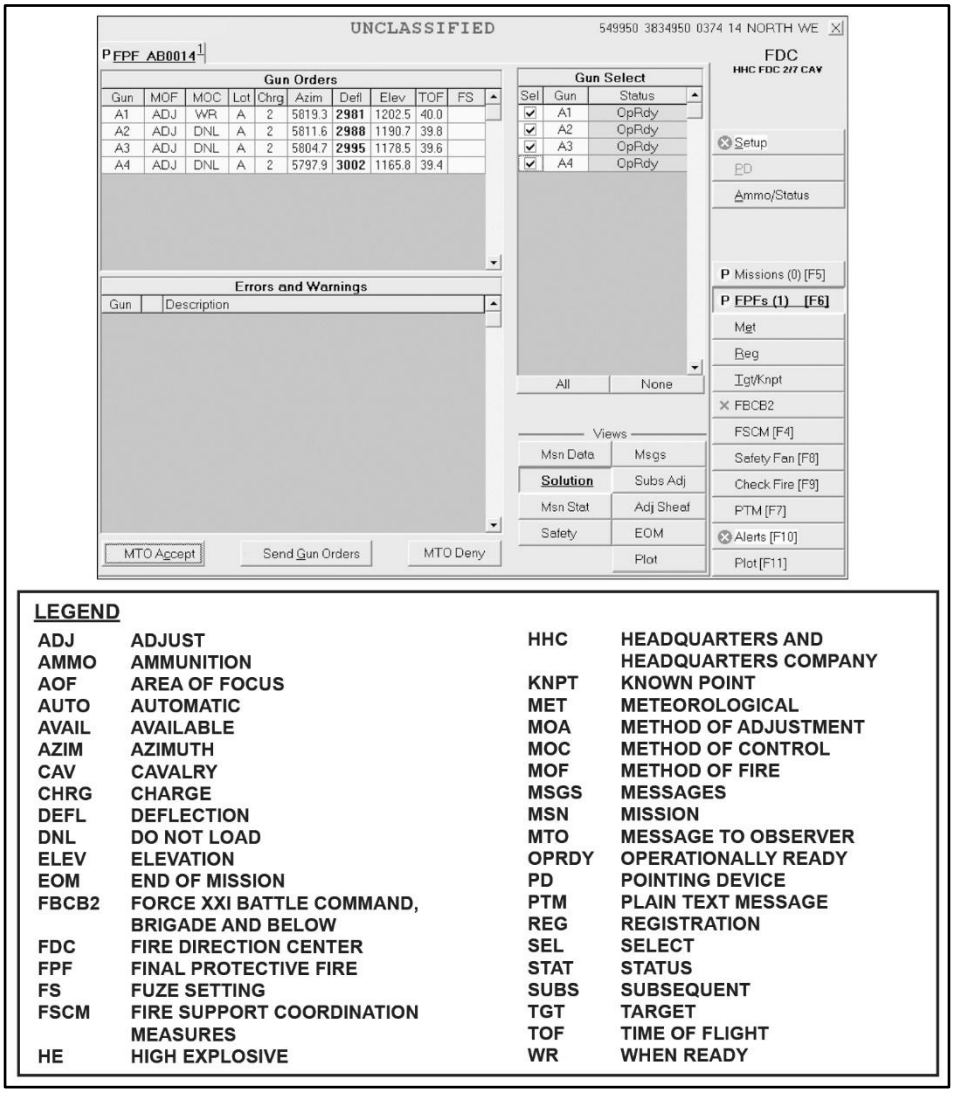
FINAL PROTECTIVE FIRE SOLUTION SCREEN

10-89. The Solution screen (see figure 10-27, page 458) shows gun orders, selected guns, and any errors and warnings. In this step, the operator can review the gun status and change the gun selection based on errors and warnings received. The operator checks the safety data. It also allows the operator to accept (MTO Accept) or refuse (MTO Deny) a mission and send gun orders. The operator reviews the screen and records

data. On the mission data screen, the FDC operator selects the pull-down for the specified gun. The FDC operator selects F2 Use All and then selects Send Gun Order.

- If any indicated errors cannot be corrected, the operator's only choice is MTO Deny.
- If any indicated warnings cannot be corrected, the operator can continue the mission, if authorized. If MTO Accept is selected, a green checkmark is displayed before MTO Accept, and MTO Deny is shaded.

10-90. The operator can change the gun selection based on errors and warnings, if necessary.



LEGEND

ADJ	ADJUST	HHC	HEADQUARTERS AND HEADQUARTERS COMPANY
AMMO	AMMUNITION	KNPT	KNOWN POINT
AOF	AREA OF FOCUS	MET	METEOROLOGICAL
AUTO	AUTOMATIC	MOA	METHOD OF ADJUSTMENT
AVAIL	AVAILABLE	MOC	METHOD OF CONTROL
AZIM	AZIMUTH	MOF	METHOD OF FIRE
CAV	CAVALRY	MSGS	MESSAGES
CHRG	CHARGE	MSN	MISSION
DEFL	DEFLECTION	MTO	MESSAGE TO OBSERVER
DNL	DO NOT LOAD	OPRDY	OPERATIONALLY READY
ELEV	ELEVATION	PD	POINTING DEVICE
EOM	END OF MISSION	PTM	PLAIN TEXT MESSAGE
FBCB2	FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW	REG	REGISTRATION
FDC	FIRE DIRECTION CENTER	SEL	SELECT
FPF	FINAL PROTECTIVE FIRE	STAT	STATUS
FS	FUZE SETTING	SUBS	SUBSEQUENT
FSCM	FIRE SUPPORT COORDINATION MEASURES	TGT	TARGET
		TOF	TIME OF FLIGHT
HE	HIGH EXPLOSIVE	WR	WHEN READY

Figure 10-27. Final protective fire solution screen

SAFETY DATA SCREEN

10-91. Before sending gun orders, the operator checks the safety data by selecting the Safety Data button. The Safety Data screen (see figure 10-28) displays. The operator reviews and records the safety data and, when satisfied, selects the Solution button.

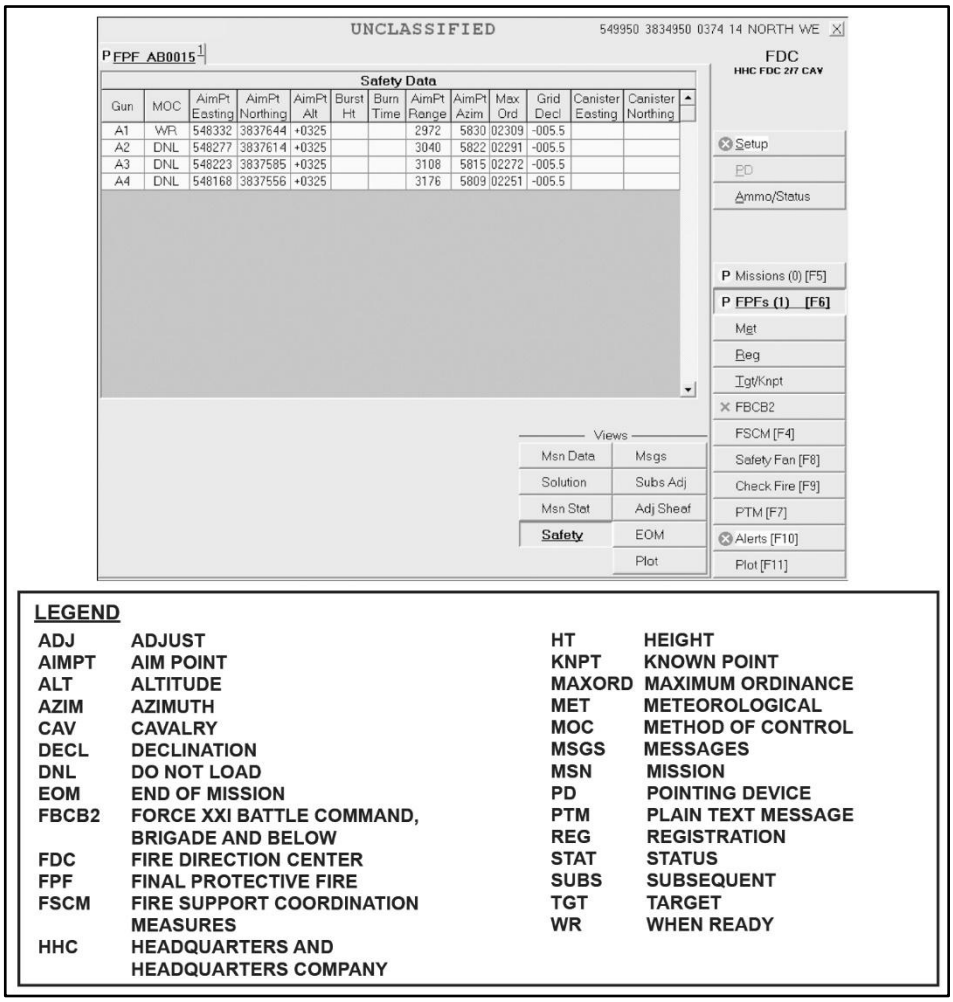


Figure 10-28. Safety data screen

Note. The Plot screen is available to review the plot at any time during the mission.

SOLUTION SCREEN

10-92. The operator selects Solution to return to the Solution screen. (See figure 10-29, page 460.) In this example, the MOC for the adjusting gun is AMC; DNL is the MOC for the other guns. When satisfied that all information is correct, the operator selects

Send Gun Orders and confirms them. A Send Status box is displayed, showing the destination and status.

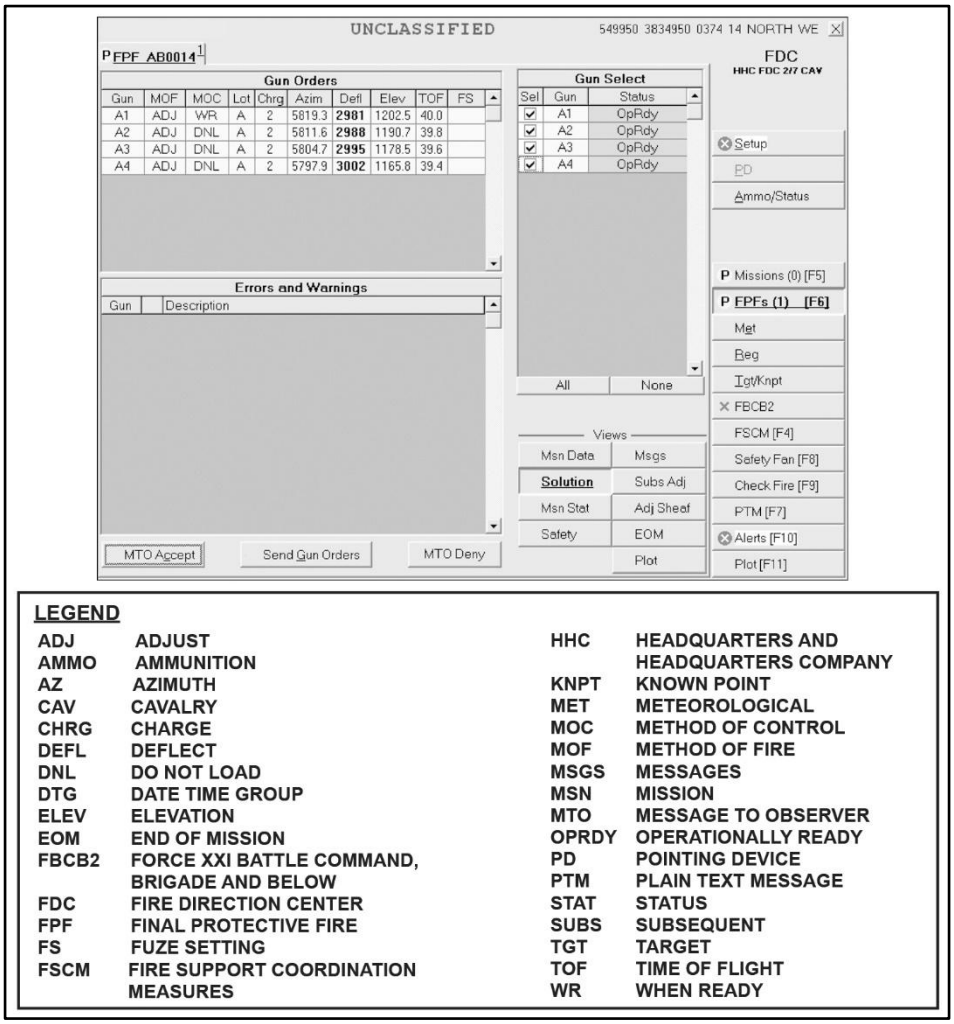


Figure 10-29. Solution screen

PLOT SCREEN

10-93. The operator may view a graphic depiction of the FPF by choosing the Plot button. The Plot screen (see figure 10-30) displays. The operator may zoom in or out on the image using the slider and may double-click on any point in the image to recenter the image. The operator may place the cursor over any icon to display a description of that icon.

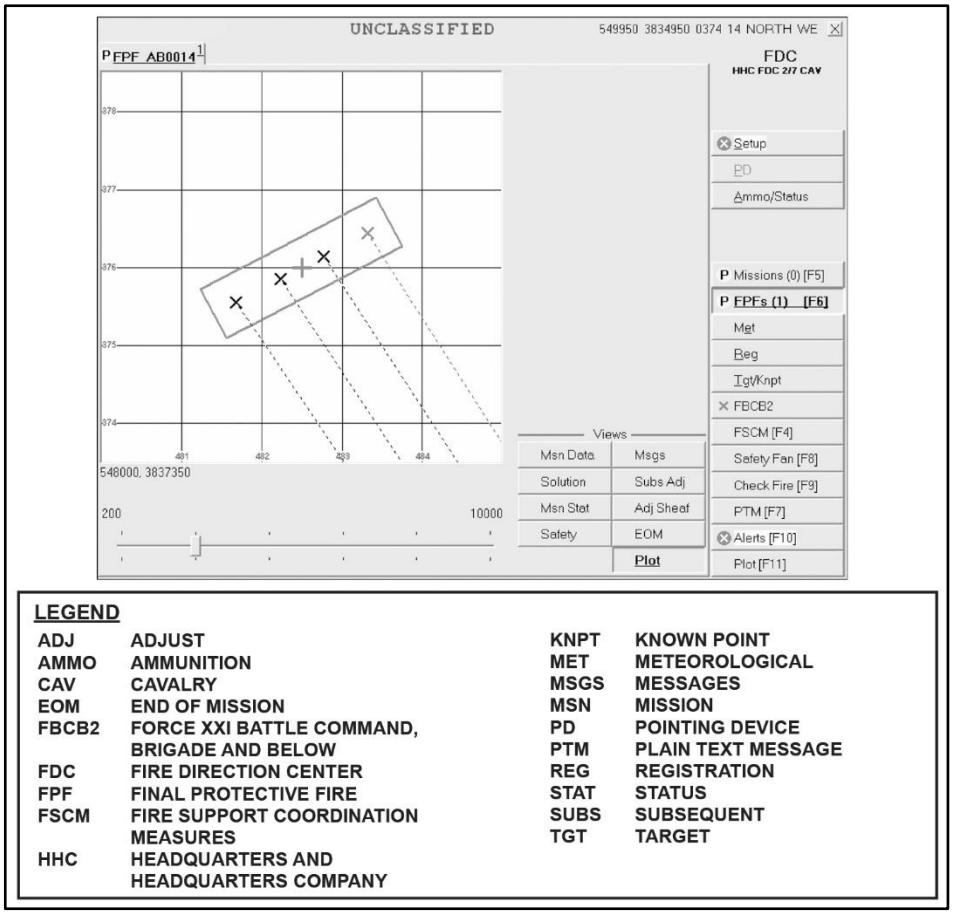


Figure 10-30. Plot screen

MISSION STATUS SCREEN

10-94. When the operator sends gun orders, the Mission Status screen (see figure 10-31, page 462) is displayed, and the words "FPF Orders Sent" are displayed in the Views section. The mission is monitored from this screen. The operator updates the status of the guns (Ready, Shot, Rounds Complete, and Abort) from this screen, and the MFCS automatically sends this information to the FSE or FO.

Note. Once gun orders are sent, the operator processes a subsequent adjust before computing and sending a new set of gun orders.

10-95. When the adjusting gun sends "Ready," the operator selects the Ready button to send the message to the FO.

10-96. If the mission is AMC, the operator receives an order to fire from the FO and then selects the Fire button. The Fire button is shaded.

10-97. Upon receiving "Shot," a checkmark appears in the Shot box, the box turns green, and the Shot button is shaded. The TOF and a red splash are then displayed, and the Splash button is shaded.

10-98. If the gun aborts the mission, a checkmark appears in the Abort box, and the reason for the abort is displayed in the Abort Reason field.

10-99. The operator continues to process the orders until the gun is adjusted.

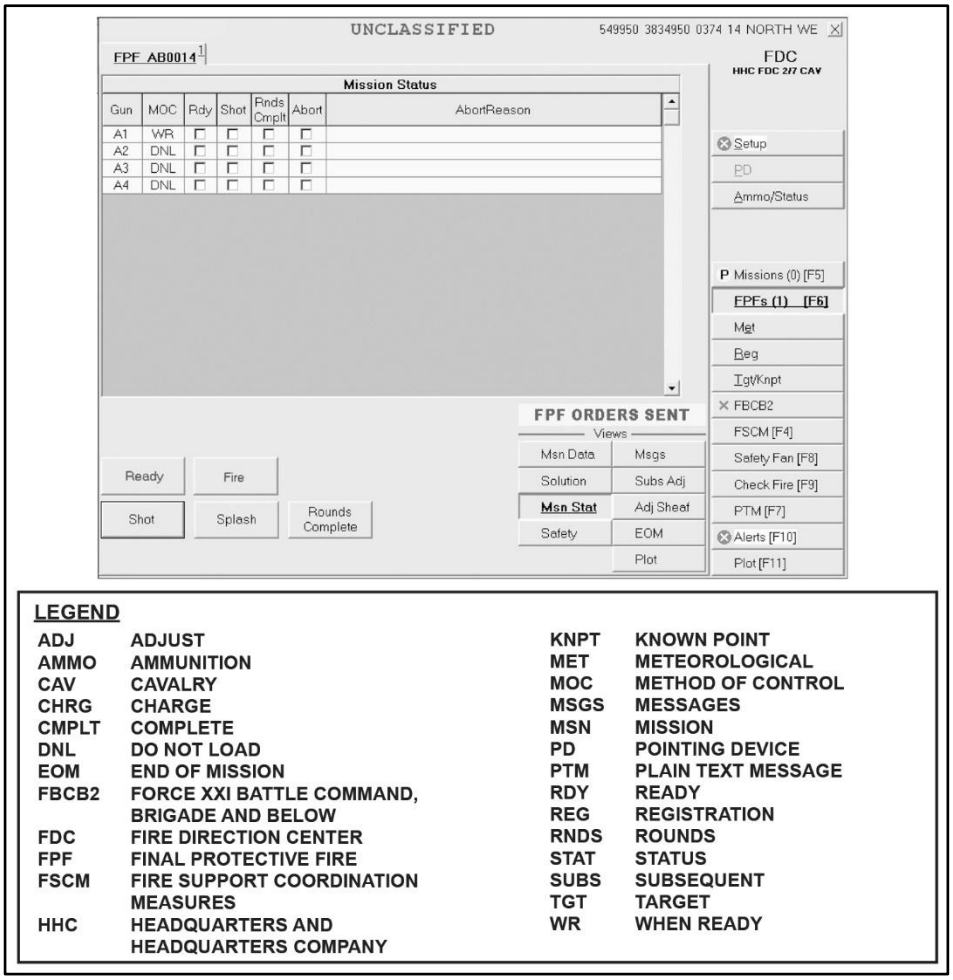


Figure 10-31. Mission status screen

SUBSEQUENT MESSAGES TO ADJUST ALL THE GUNS

10-100. Once the first gun is adjusted in the sheaf, the FO may transition to each of the other guns until all are properly adjusted. (See figure 10-32.) The FDC operator changes the MOF from ADJ to FFE. The Adj Sheaf button becomes active. The operator enters the OT azimuth or, if the OT azimuth is not available or not given, uses the GT azimuth. The operator selects the Adj Sheaf button and enters the correction for each gun by

selecting the gun in the Adjustment to Sheaf menu and entering the appropriate correction. Then, the operator selects the Apply <Gun number> button. The correction displays in relation to the total correction to the Easting and the total correction to the Northing of the burst point grid for the firing gun. On the mission data screen, the FDC operator selects the pull-down for the specified gun. Then selects F2 Use All. Then the operator selects Send Gun Orders.

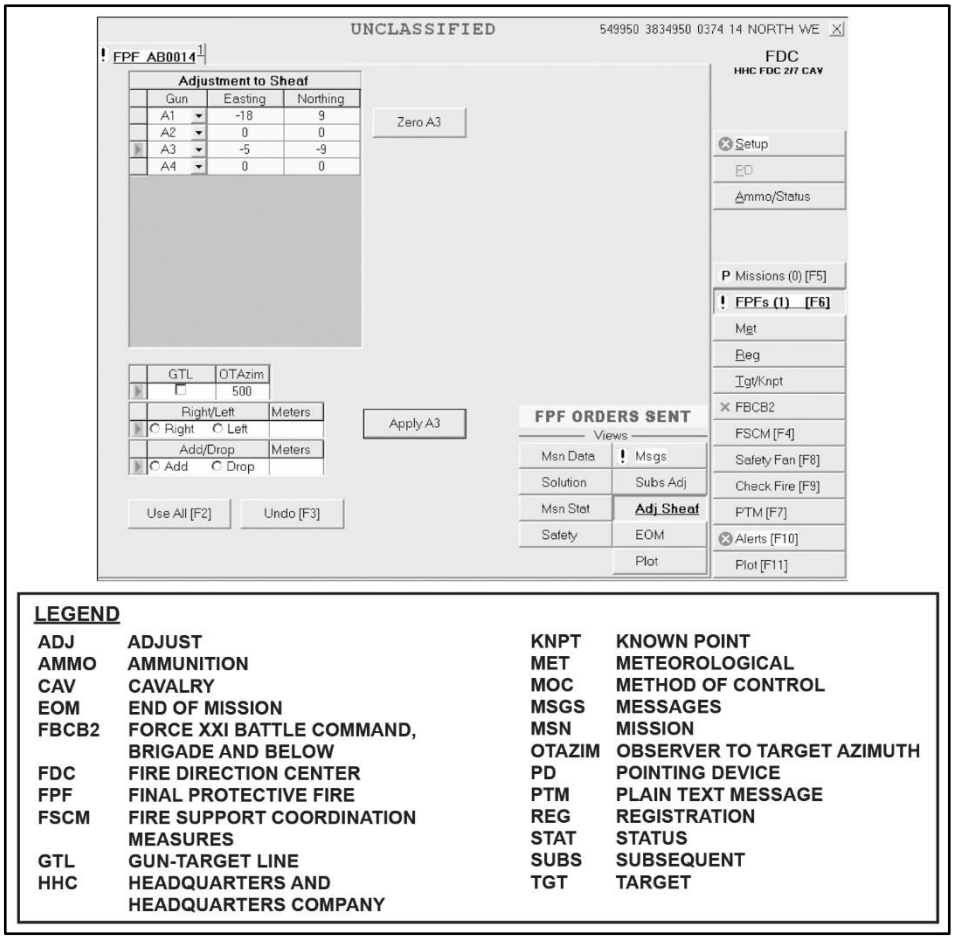


Figure 10-32. Subsequent adjust screen

END OF MISSION AND STORE THE FINAL PROTECTIVE FIRE

10-101. When the FO or FSE orders an EOM, the operator stores the FPF using the EOM screen. (See figure 10-33, page 464.) The EOM-Store FPF option is the only available selection. The operator selects the EOM button, and then selects Use All. The Subsequent Message screen is displayed, stating “End of Mission” and the target number.

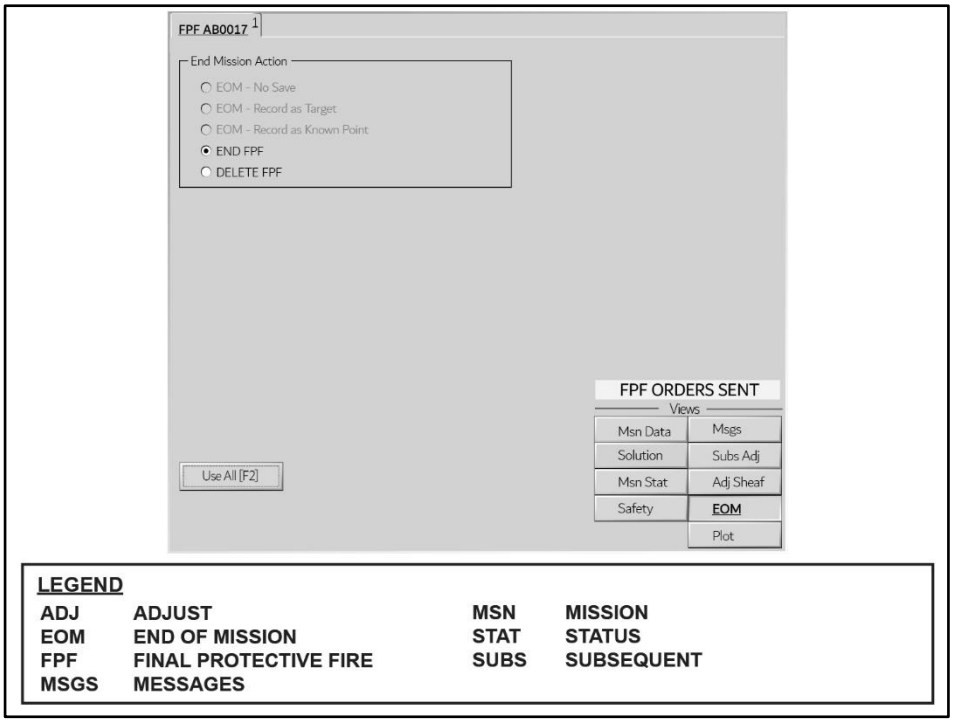


Figure 10-33. Solution end of mission screen

MISSION STATUS SCREEN

10-102. The words “Stored FPF” are displayed in blue letters over the Views section. (See figure 10-34.) The FPF is stored in the FPF buffer and in the gun FPF buffer until the operator receives a plain text or radio message to fire the FPF.

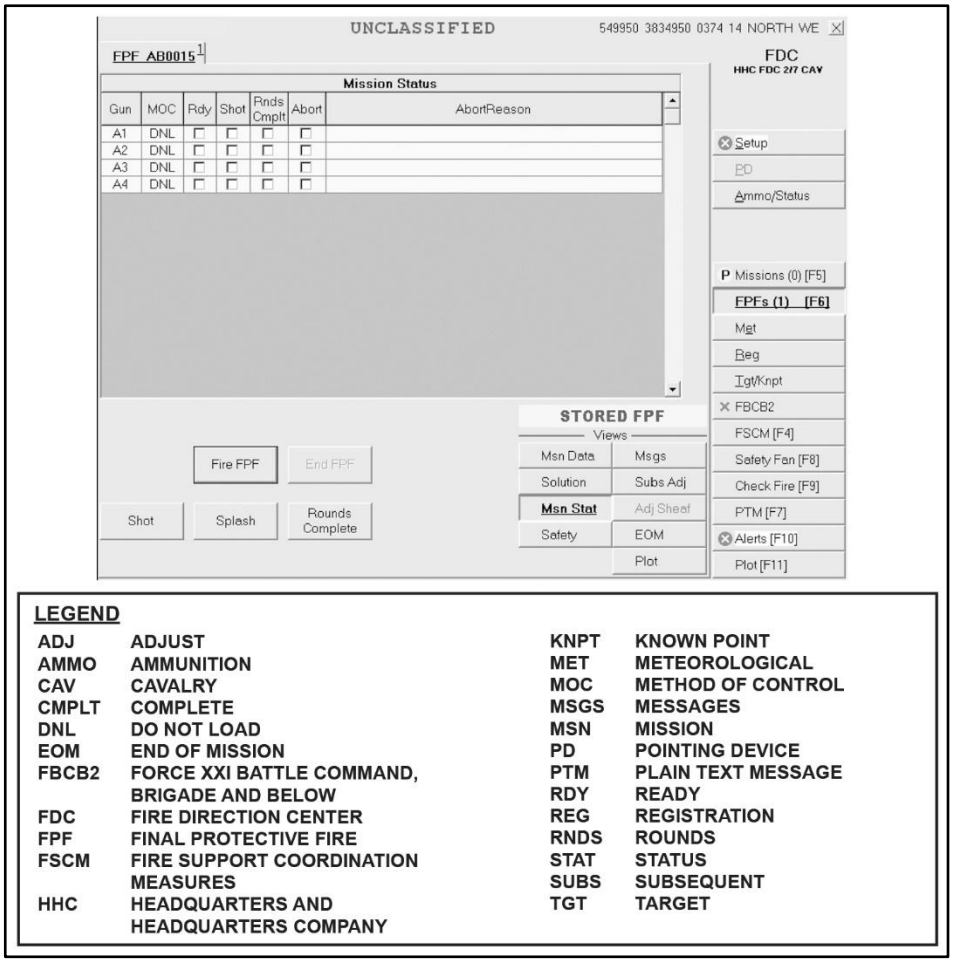


Figure 10-34. Mission status screen

CALL FOR FIRE FROM THE FIRE SUPPORT ELEMENT OR FORWARD OBSERVER TO FIRE THE FINAL PROTECTIVE FIRE

10-103. Upon receipt of the fire FPF message, the operator selects FPF to bring up the FPF buffer. The operator selects the appropriate FPF tab, selects the Msn Stat button in the Views section, and selects Fire FPF. The operator receives a message to "Confirm Send Fire FPF to Guns." The operator selects OK. The Fire FPF button is shaded, and the End FPF button is displayed. After the guns send "Shot," the Shot and Splash buttons are shaded. When ammunition is exhausted, the Rnds Cmplt button is shaded, and End FPF becomes available. The operator selects End FPF, receives a message to "Confirm Send End FPF to Guns," and selects OK.

ENDING THE FINAL PROTECTIVE FIRE MISSION

10-104. The operator selects EOM. Delete FPF is the only option. The operator selects Use All, and the Messages screen (see figure 10-35) appears. The operator selects Process and deletes the active FPF, which sends a "Delete FPF" message to the guns and automatically deletes the FPF from their buffer.

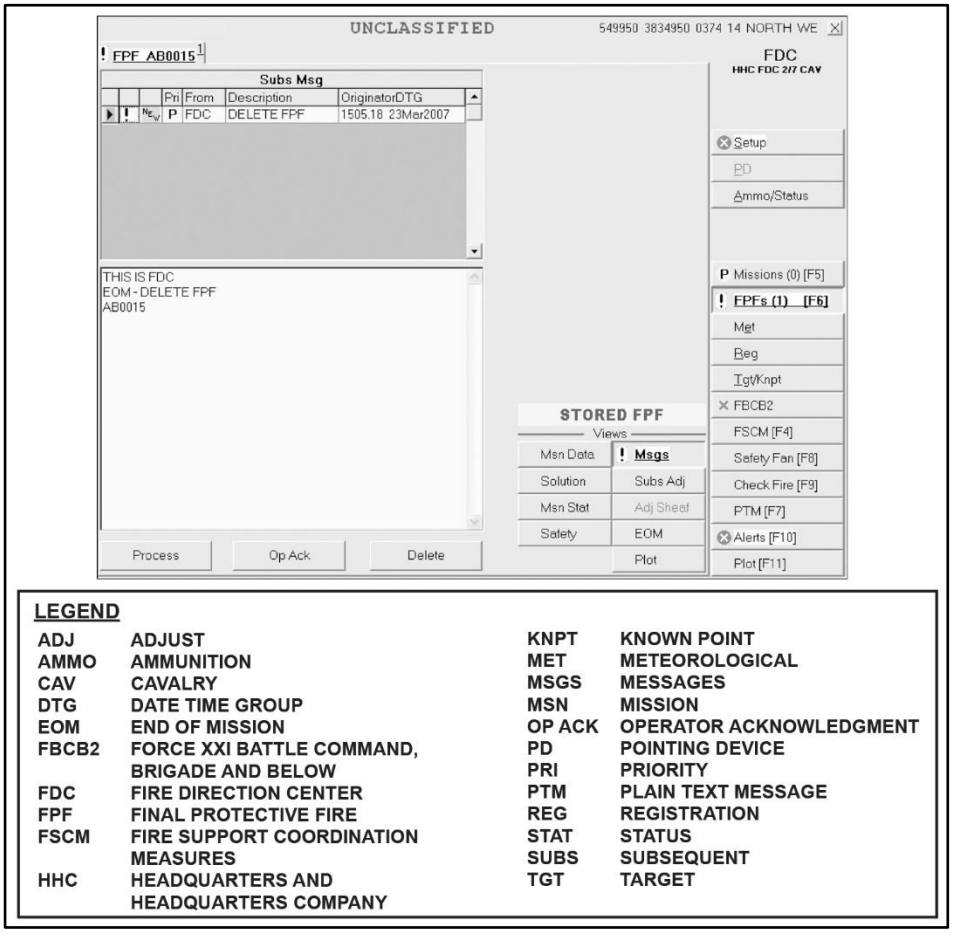


Figure 10-35. Messages screen

MANUALLY CONDUCTED FINAL PROTECTIVE FIRE MISSIONS

10-105. Procedures for a manual FPF mission are like those for a digital mission. The only differences are that the operator manually initiates the CFF, manually processes all adjustments, and manually selects EOM to end the mission.

SEARCH AND TRAVERSE

10-106. Mortars use searching and traversing fire when target areas cannot be completely engaged with linear or open sheaves. To increase the depth of a target area,

mortars employ searching fire. To increase the breadth of a target area, mortars employ traversing fire. Search and traverse may be employed simultaneously to engage a target that is deeper and wider than a linear sheaf.

QUICK SMOKE MISSION

10-107. Smoke missions are conducted using a combination of the MFCS and traditional FDC procedures. The standard smoke mission covers 500 meters for 10 minutes, but this width and time can be adjusted depending on the mission requirements. The four primary steps in a smoke mission are:

- The calculation of the rounds required using the smoke card.
- The CFF and adjustment.
- The establishment of the smoke screen.
- The maintenance of the smoke screen.

Calculation of the Rounds Required Using the Smoke Card

10-108. As the rounds are adjusted, the section leader uses the smoke card to determine the number of rounds required to sustain the smoke screen based on relative humidity, temperature gradient, and wind speed.

Note. The smoke card is available as a smoke data button on the mission data screen.

Call for Fire and Adjustment of the Smoke Mission

10-109. The smoke mission is received digitally or by radio as a standard new CFF. The FO, the MFCS operator, and the gun adjust the fires using HE. Due to ballistic differences between the HE and smoke shell and varying wind conditions, a smoke round is fired to confirm the adjustments and wind conditions in the target area.

Establishing the Smoke Screen

10-110. Once the adjustments are made, the guns fire no fewer than 12 smoke cartridges to establish the curtain. The M819 red phosphorous 81-mm smoke cartridge uses a time setting to burst the red phosphorous approximately about 175 meters above the target area. The M929 WP 120-mm smoke cartridge uses the 120-mm PROX setting to burst the cartridge 14 feet above the target area.

Maintaining the Smoke Screen

10-111. The guns fire the number of RPM needed to sustain the smoke screen. The FDC controls these fires by alternating fire between the guns assigned to the mission.

SIMULTANEOUS

10-112. Simultaneous procedures involve simultaneous fire upon two targets from a single location.

SPLIT SECTION

10-113. Split section procedures involve firing upon a single target from more than one location.

TIME ON TARGET

10-114. The observer may tell the FDC when the observer wants the rounds to impact by requesting, TIME ON TARGET [numbered desired] MINUTES FROM NOW or TIME ON TARGET [time desired] HOURS. The observer conducts a time check to ensure that the timepiece is synchronized with the FDC's timepiece.

Appendix A

Icons for the Mortar Fire Control System

This appendix provides a comprehensive listing of the various icons (and their meanings) that may appear on various screens while using the CI. (See figure A-1.) Modifications and software versions may alter icons and the meanings associated with them, reference the appropriate technical manual for the version used for an accurate listing of icons.

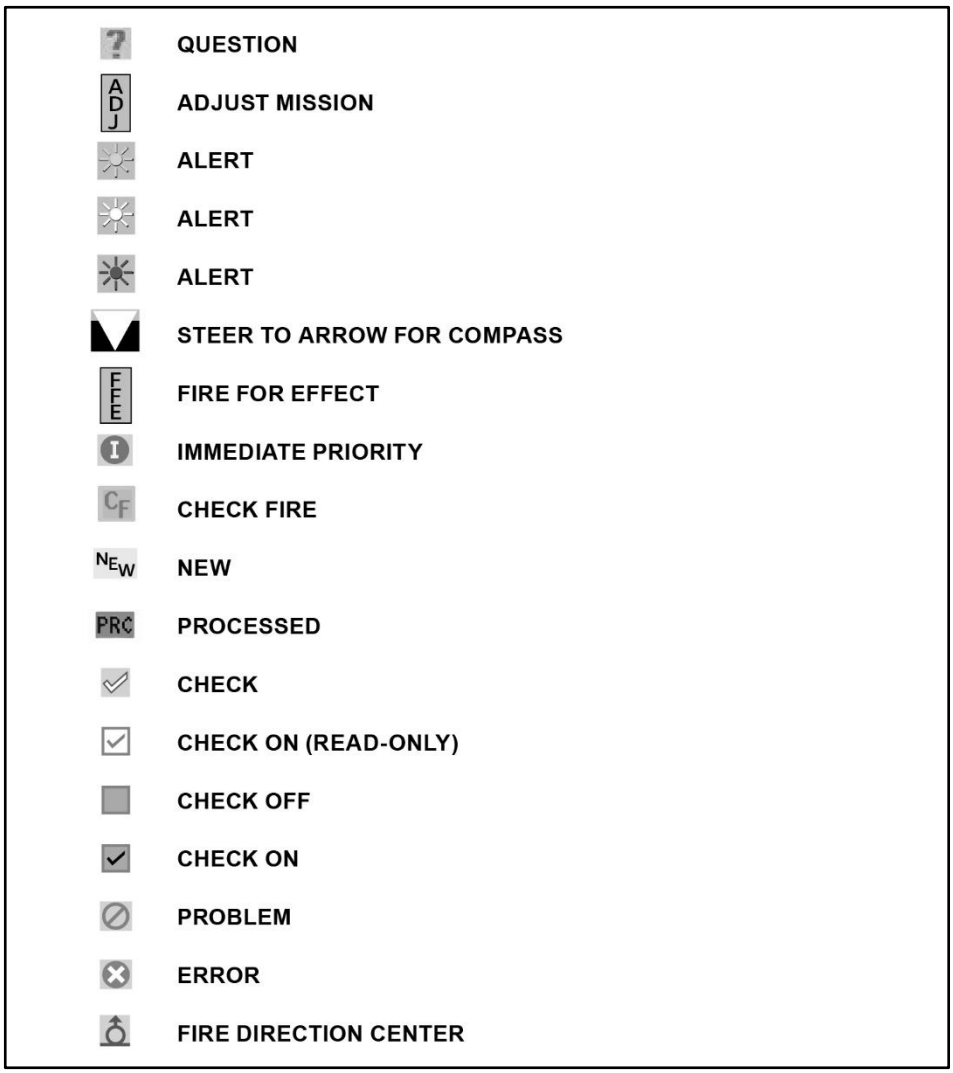


Figure A-1. Icon listing

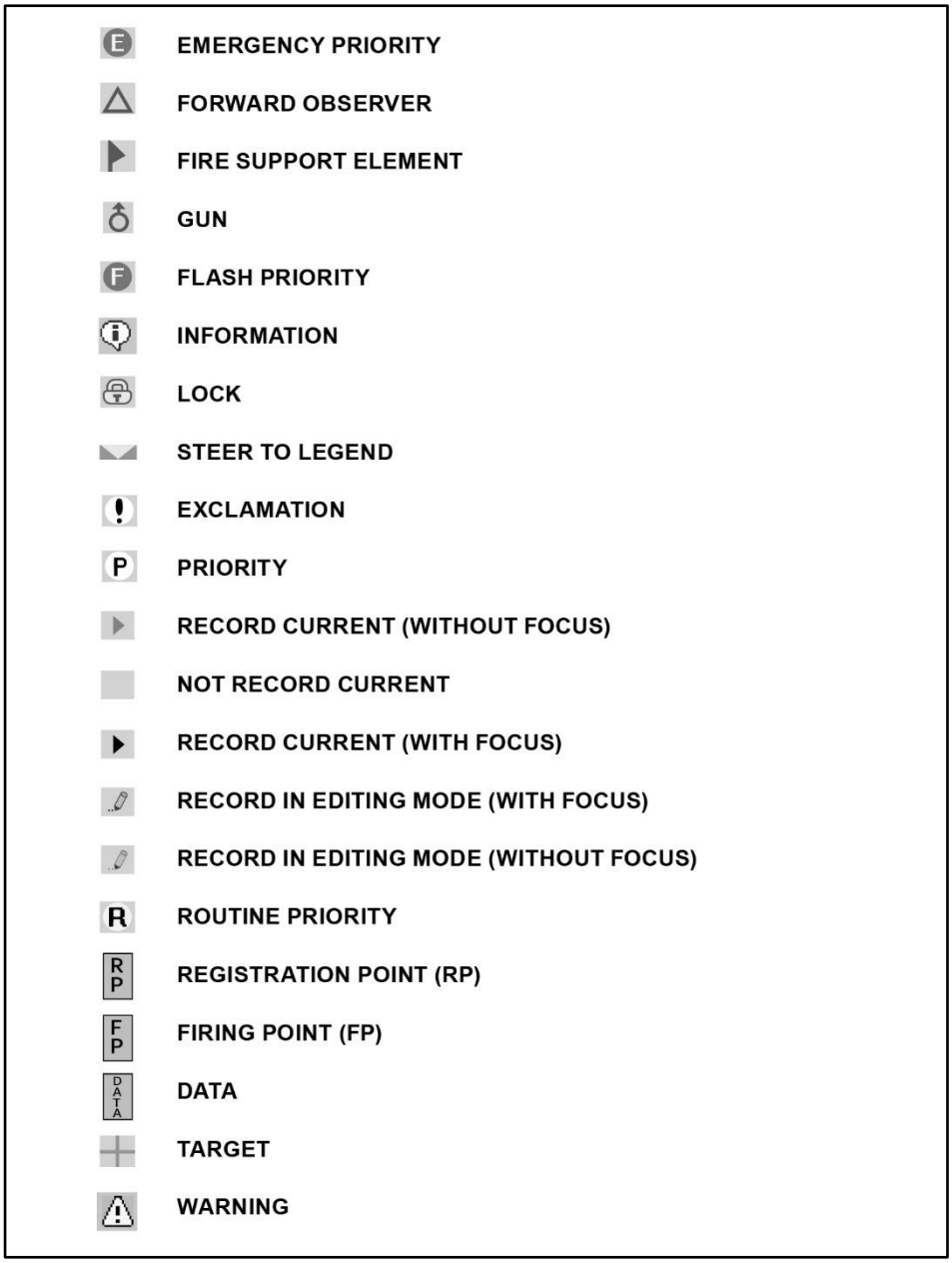


Figure A-1. Icon listing (continued)

Appendix B

Safety Procedures

Minimum and maximum elevations, deflection limits, and minimum fuze settings must be computed to ensure all rounds impact or function within the designated impact area. These data then are presented in graphic form on a range safety diagram. They are arranged in a simplified format (the safety T) for each mortar squad leader. This appendix discusses the computation of safety data using tabular and graphical data.

SURFACE DANGER ZONES

B-1. Range control personnel or the officer in charge provides the safety officer with the precise location and size of the impact area. The impact area can either be defined by a series of grid coordinates representing the corner points or lateral azimuths and minimum and maximum distances from a fixed RP. Either method defines an area on the ground, perhaps irregularly shaped, within which all rounds fired must either impact or function. The safety officer then must compute the safety limits of this impact area and construct the safety diagram and the safety T. To compute the safety limits the safety officer must consider the following:

SECONDARY DANGER AREAS A AND B

B-2. The safety officer first determines whether the impact area limits provided include secondary danger areas A and B. These areas are established by AR 385-63.

B-3. Secondary Danger Area A parallels the impact area laterally and is provided to contain fragments from rounds exploding on the right or left edges of the impact area. (See figure B-1, page 472.) Depending on the mortar being fired, Secondary Danger Area A varies from 250 to 400 meters.

B-4. Secondary Danger Area B is on the downrange side of the impact area and Area A. It contains fragments from rounds exploding on the far edge of the impact area. Depending on the mortar being fired, Secondary Danger Area B varies from 300 to 500 meters. (See figure B-1, page 472.)

Note. If the designated impact area does not already consider areas A and B, it must be reduced by the appropriate amount to ensure no rounds impact within or outside of either area.

PROBABLE ERRORS IN RANGE AND DEFLECTION

B-5. The initial impact area must be reduced again to account for the normal dispersion of rounds fired. The safety officer determines the maximum PEs for both range and DF:

- The safety officer checks columns 3 and 4 of Table E in the tabular TFTs for the mortar and ammunition to be used.

- The safety officer checks all possible charge and elevation combinations to ensure the safety officer has found the maximum PEs at the distance to the far edge of the impact area.
- The safety officer then reduces the maximum range by a factor of 8 times the PEr. The safety officer also adjusts the minimum range toward the center of impact by a factor of 12 times the PEr.

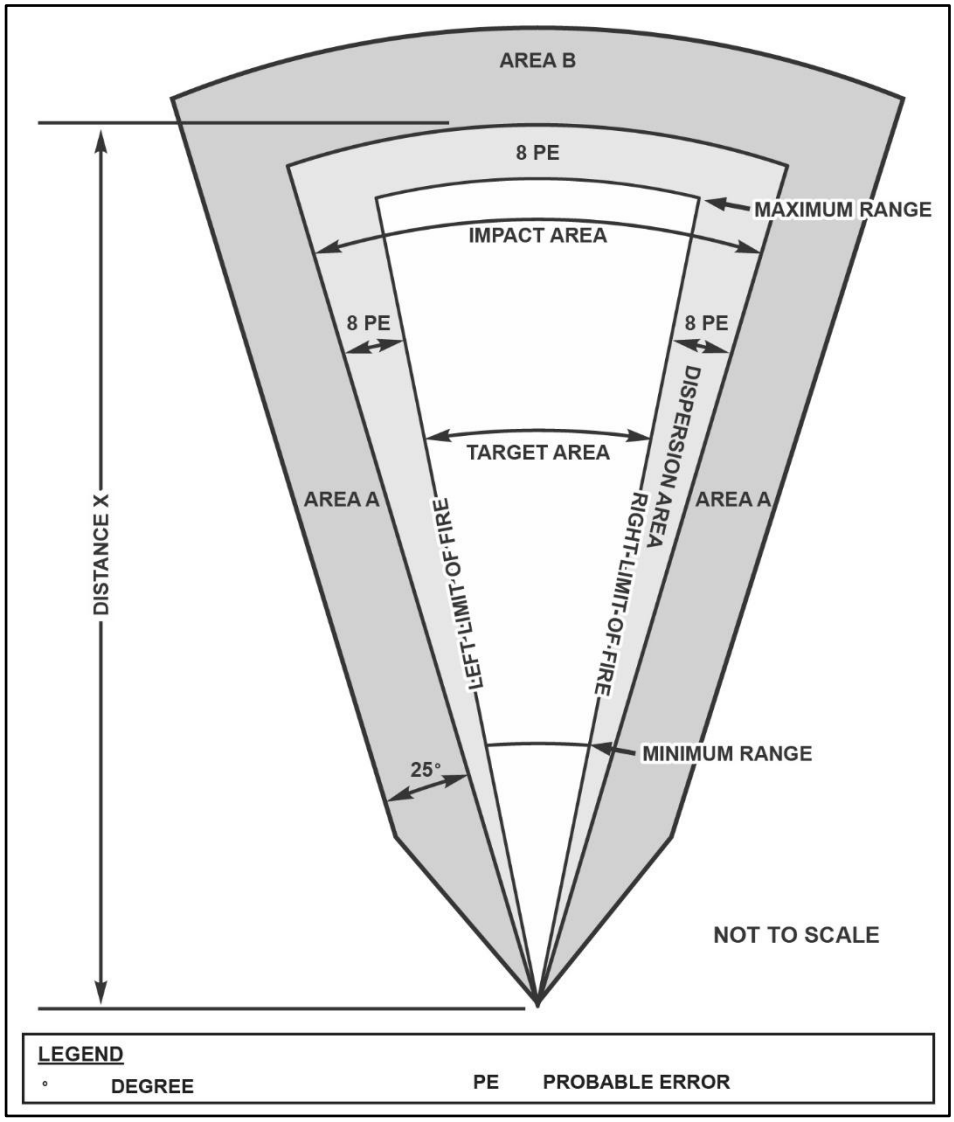


Figure B-1. Mortar surface danger zone

- Once the ranges have been adjusted, the safety officer adjusts the left and right limits inward by a factor of eight times the maximum PEd.

Note. The safety officer determines whether range control personnel have already performed this computation before designating the impact area.

SAFETY PROCEDURES

B-6. Minimum and maximum elevations, deflection limits, and minimum fuze settings must be computed to ensure all rounds impact or function within the designated impact area. These data then are presented in graphic form on a range safety diagram. They are arranged in a simplified format (the safety T) for each mortar squad leader.

VERTICAL INTERVAL AND CREST CLEARANCE

B-7. The safety officer compares the altitude/elevation of the mortar position and that of the impact area. If there are significant differences in the VI between these two areas, the safety officer adjusts the safety limits to preclude any rounds impacting short or long of the impact area (see figure B-2):

- The min-max rule determines the correct VI for safety purposes.
  - At the minimum range, the maximum altitude is selected.
  - At the maximum range, the minimum altitude is selected.
  - If the contour interval is in feet, it is converted to meters.
- The safety officer determines VI by subtracting the MFP altitude from the altitude of the applicable range line. The resulting number is either positive or negative.
- The safety officer adds half the value of the VI determined for each applicable range line, to that line. This either increases or decreases the apparent size of the impact area, depending on whether the VI is positive or negative.

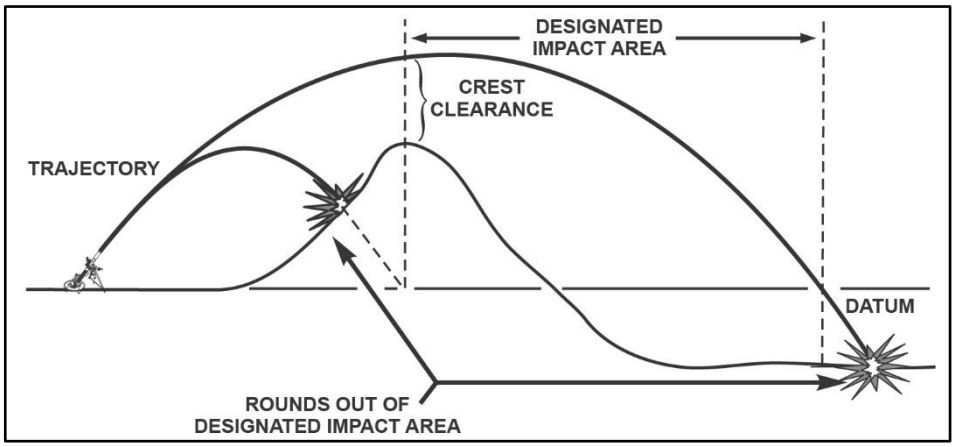


Figure B-2. Effects of vertical interval and crest clearances

- The safety officer then makes a map inspection to determine the highest point between the mortar position and the edge of the impact area.
- The safety officer then compares this highest point with the lowest maximum ordinate value found in Table E in the TFTs:

- If the maximum ordinate exceeds the VI of the highest point, no correction need be made.
- If not, all charge and elevation combinations that do not allow crest clearance must be noted and applied to the safety diagram.

SECTION WIDTH AND DEPTH (MANUAL PLOTTING ONLY)

B-8. If a mortar near the center of the section is used as the adjusting mortar, any mortar significantly left or right of this "base" can put rounds out of impact, unless corrections are made. If the mortars are arranged in the firing position with any significant depth, the rearward or forward mortar can put rounds short or long of the impact area unless a correction is made.

B-9. The safety officer determines the width and depth of the mortar section as it is arranged on the ground (at the firing position). The safety officer then reduces the left and right limits by half the section width.

B-10. The safety officer adds half the section depth to the minimum range and subtracts half the section depth from the maximum range.

REGISTRATION AND METEOROLOGICAL CORRECTIONS

B-11. After a registration (survey chart), a reregistration, or a MET update has been conducted and corrections have been determined, the safety officer modifies the original basic safety diagram by applying the registration corrections. New elevations are determined that correspond to the minimum and maximum ranges. DFs are modified by applying the total DEFK to each lateral limit.

SAFETY DIAGRAM

B-12. The safety diagram graphically displays the computed safety limits. Data are presented logically and arranged for the FDC to use. Once the diagram is constructed, data from it are used to draw the safety T.

B-13. The range safety officer determines the lateral safety limits and the minimum and maximum ranges of the target area. These data then must be converted to DFs and elevations. In the case of mechanical time (ILLUM) and variable time (or PROX) fuzes, a minimum time setting must be determined. For example, assume the following limits were provided by the range safety officer:

- Left azimuth limit is 4730 mils.
- Right azimuth limit is 5450 mils.
- Minimum range is 2,400 meters.
- Maximum range is 5,500 meters.
- From azimuth 4730 mils to azimuth 5030 mils, the maximum range is 5,000 meters.
- Minimum range for fuze time is 2,700 meters.
- Authorized weapons and charge zones are the M252 81-mm mortar and charges 3 and 4 (M821 HE round).
- Firing point 72 is located at grid FB60323872; altitude/elevation is 390 meters.

B-14. The basic safety diagram is constructed (see figure B-3) as follows:

1. On a sheet of paper, draw a line representing the DOF for the firing unit and label this line with its azimuth and the Ref for the weapon system.
2. Draw lines representing the lateral limits in proper relation to the line on which the section is laid and label the lateral limits with the appropriate azimuths.
3. Draw lines between the lateral safety limits to represent the minimum and maximum ranges:
   - Label each line with the appropriate range.
   - If the minimum range for fuze time is different from the minimum range, draw a dashed line between the safety limits to represent the minimum range for fuze time.
   - Label the line with the appropriate range.
4. Compute the angular measurements from the azimuth of lay to the left and right safety limits by comparing the azimuth of lay to the azimuth of each limit and on the diagram, draw arrows indicating the angular measurements and label them.
5. Apply the angular measurements to the deflection corresponding to the azimuth of fire to determine the deflection limits (LARS).

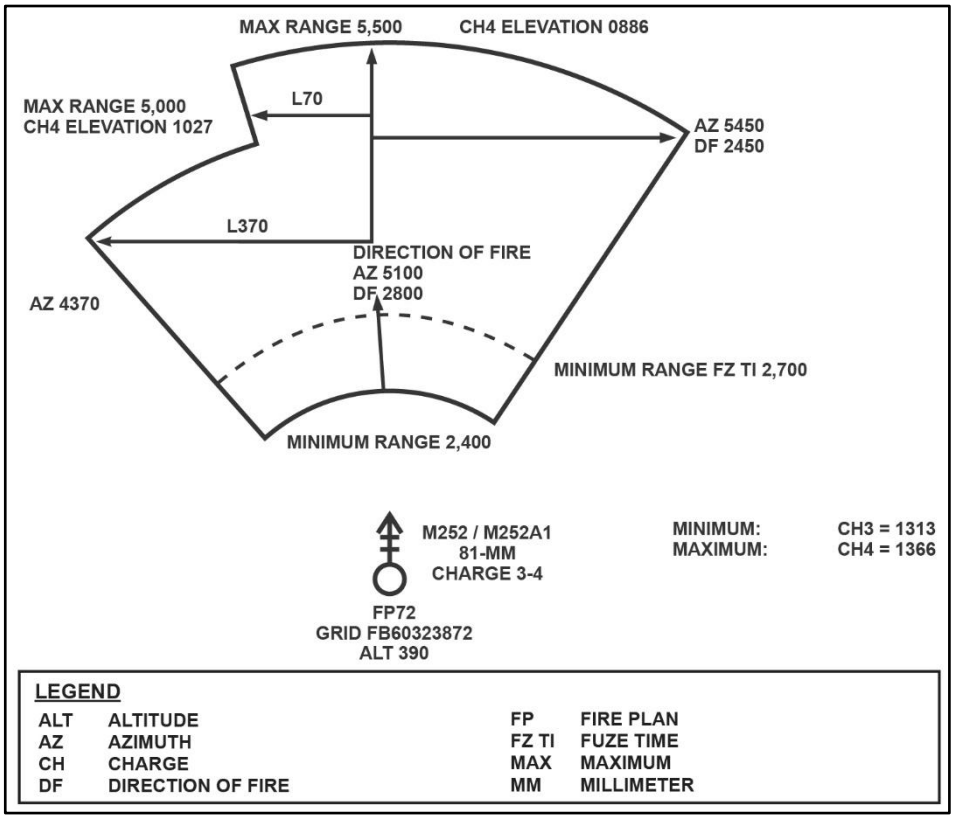


Figure B-3. Basic safety diagram

B-15. Once the basic safety diagram is drawn, the FDC uses the TFTs to determine the proper charges, elevations, and time settings. The FDC then applies them to complete the diagram.

B-16. The safety T is a method of passing safety data on to the mortar squad leaders in a simplified form. The information needed by the squad leader is extracted from the completed safety diagram and placed on a 3-by 5-inch card or a similar form. Figure B-4 shows the safety T taken from the completed range.

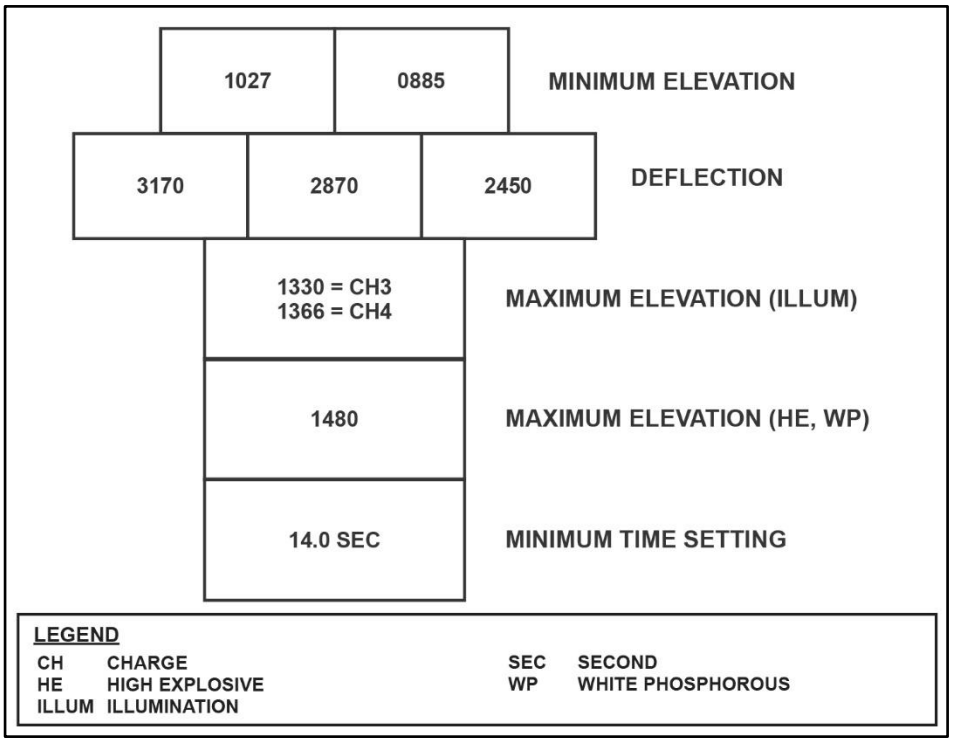


Figure B-4. Safety T

Appendix C

Field-Expedient Survey Techniques

Surveyed locations may be provided by the artillery survey personnel. Normally, a map spot location to six-digit or eight-digit grid coordinates is estimated by the platoon supervisor that is the most qualified. With the "roving mortars" concept, new methods of position location are needed. Two such methods are described in this appendix. The mortar position should be constantly improved to include a more accurate platoon center location.

GRAPHIC RESECTION

C-1. A graphic resection can be used to establish the coordinates of a point or to check the accuracy of a map spot. If the resection cannot be performed from platoon center, the platoon center coordinates can be estimated based on the coordinates of the nearby resected point. The platoon may be required to locate its roving gun (split section) and primary, alternate, or supplementary positions as accurately as possible. Often, the location of those positions can be determined by a simple map spot location. Whenever possible, a more accurate method of location should be used. Graphic resection is a simple method using the aiming circle, tracing paper, and a map. Follow these steps:

- Identify three distant points that appear on a map (see figure C-1).
- With an aiming circle, measure the azimuth to those points, and preferably, the angles between the points should be greater than 400 mils.
- On tracing paper, place a dot representing the aiming circle location.

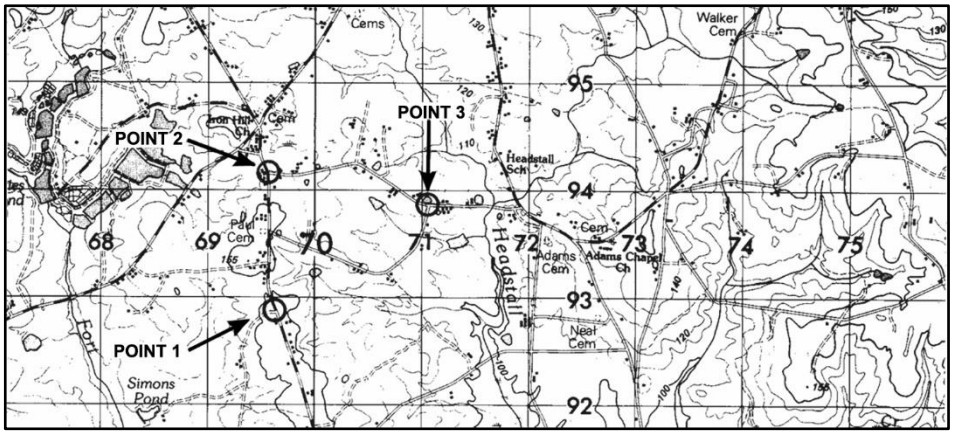


Figure C-1. Three distant points

- Draw a line from this dot in any direction (see figure C-2, page 478).

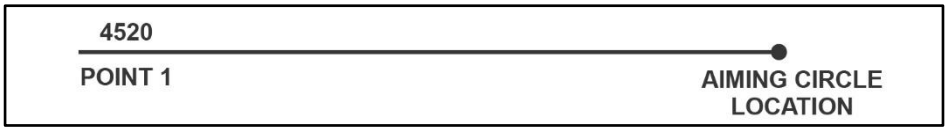


Figure C-2. Line drawn in any direction

- With a protractor aligned with the correct azimuth on the line (see figure C-3), draw two lines from the dot on the measured azimuths (see figure C-4).

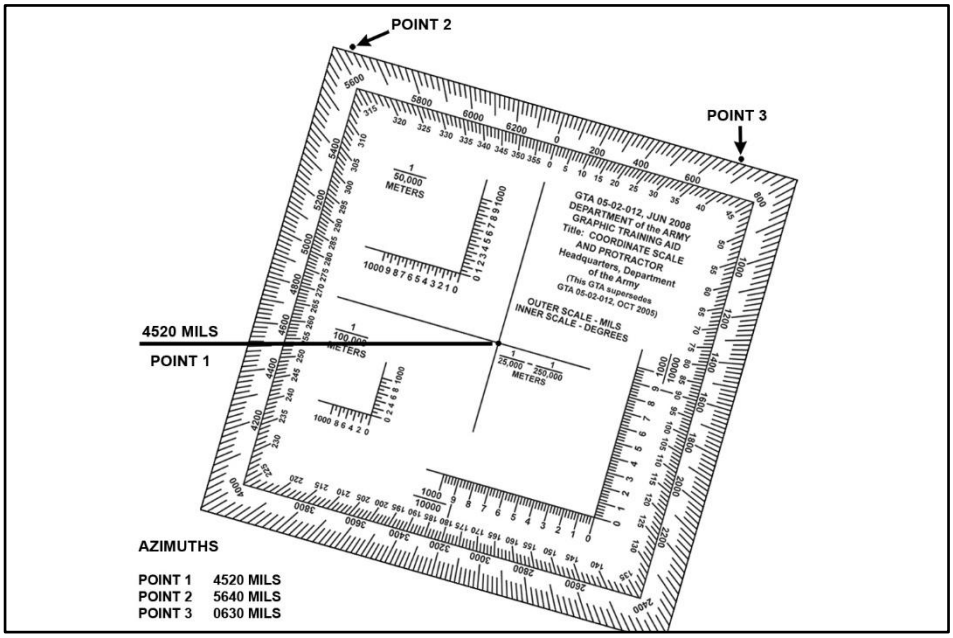


Figure C-3. Protractor aligned with correct azimuth

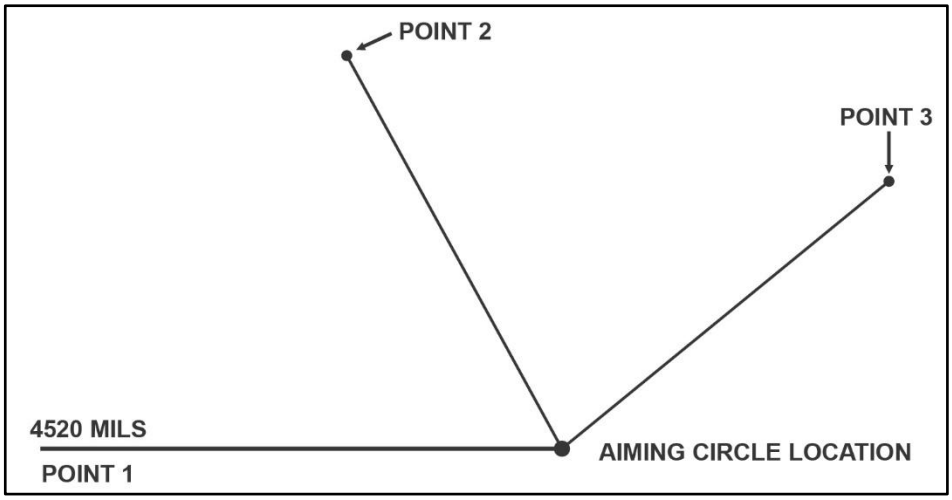


Figure C-4. Two more lines drawn from dot

- Place the tracing paper over the map of the area and slide it around until it is positioned so that the three lines pass through their respective distant points (see figure C-5).
- The dot on the tracing paper represents the location of the aiming circle (mortar position) on the map.

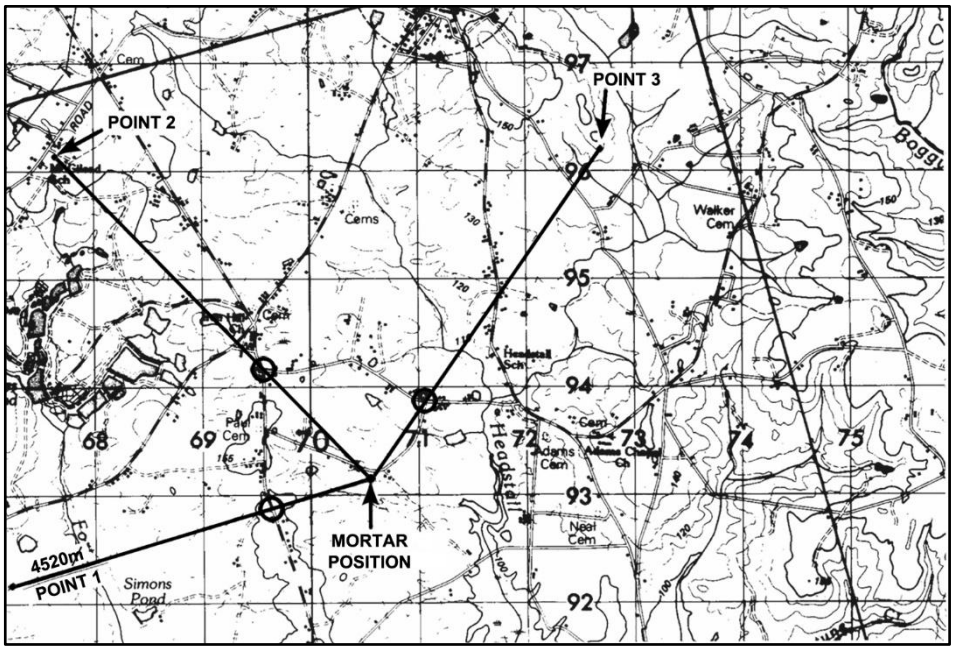


Figure C-5. Positioning of tracing paper

- If the angles are plotted with a standard protractor (accurate to about 10 mils) and oriented over a 1:50,000 scale map, the resection should be accurate within 100 meters.

HASTY SURVEY

C-2. A terrain feature or man-made object is needed close to the desired mortar position for a hasty survey. This identifies the mortar position on a map by eight-digit grid coordinates. The hasty survey begins at this point, using the pivot point of the M16 plotting board to represent the selected known position. (See figure C-6.)

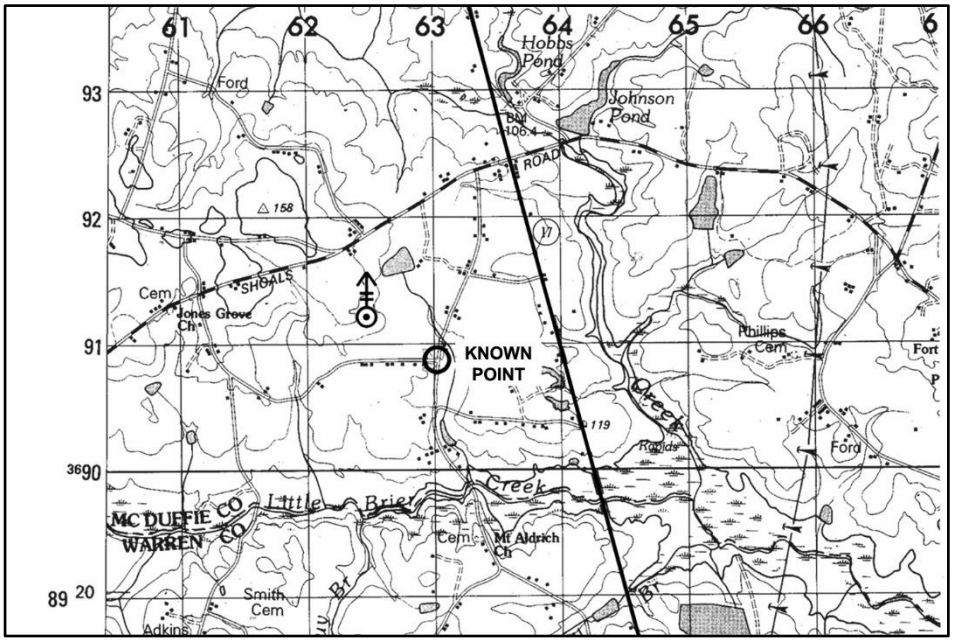


Figure C-6. Hasty survey

STEP 1

C-3. To begin the hasty survey, set the M2A2 aiming circle over the known point, level it, index the declination constant using the azimuth micrometer knob, and, with the nonrecording (lower) motion, orient the magnetic needle toward north. Now the grid azimuth can be measured.

STEP 2

C-4. While the "circle" Soldier is measuring the grid's azimuth, an assistant (the "post" Soldier) moves toward the desired mortar position with the two aiming posts. Before moving, the "post" Soldier will have joined the posts together and placed reflective or black tape strips exactly 2 meters apart on each post. Thus, the post becomes a subtense bar. (See figure C-7.)

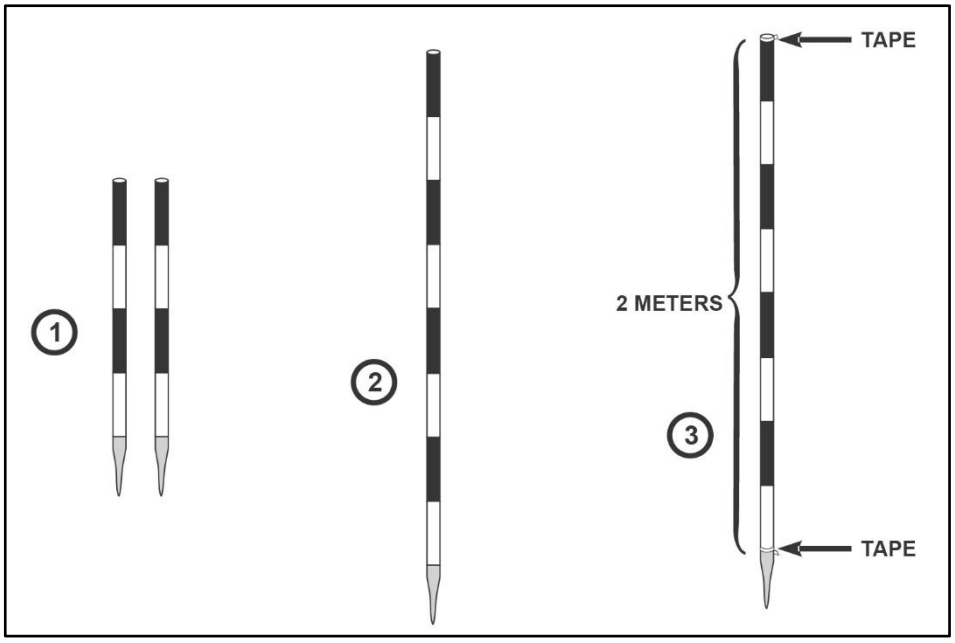


Figure C-7. Subtense bar

STEP 3

C-5. At this point, the first leg of the hasty survey can be done. The "circle" Soldier directs the "post" Soldier to move toward the desired mortar position until the "post" Soldier is within 290 meters and to place the post into the ground. This point on the ground becomes traverse station-1 (TS-1).

STEP 4

C-6. The "circle" Soldier then rotates the azimuth motion (upper motion) until the vertical crossline in the telescope is on the center of the post. The "circle" Soldier records the azimuth to the post and labels it traverse leg 1. (See figure C-8, page 482.)

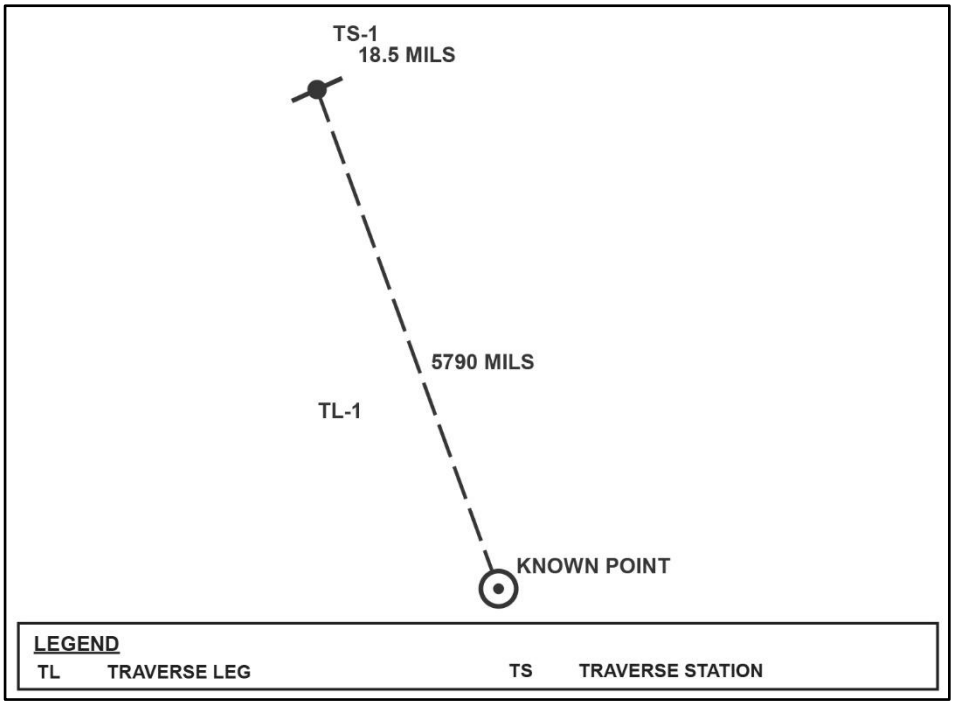


Figure C-8. Traverse leg

STEP 5

C-7. Next, the "post" Soldier removes the post and holds it parallel to the ground, facing the aiming circle.

STEP 6

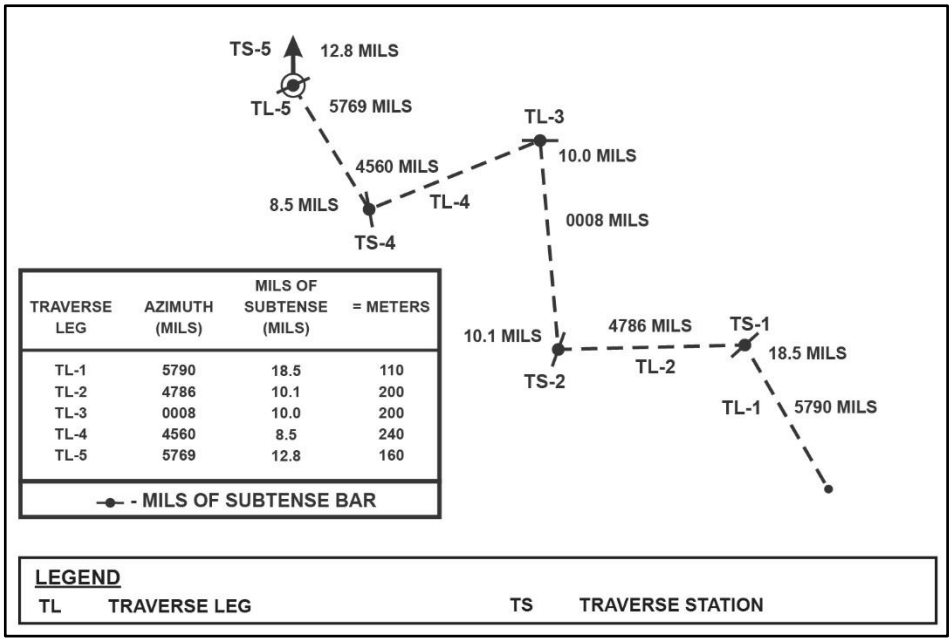
C-8. The "circle" Soldier measures the mil angle between the two strips of tape on the post (subtense bar) and records the mil reading along with the azimuth to TS-1. (See figure C-8.)

STEP 7

C-9. The post then is replaced into the ground and the "circle" Soldier moves forward to this point and sets up the aiming circle directly over this point. This completes the first traverse leg.

STEP 8

C-10. This procedure is repeated until the desired mortar position is reached. The information obtained may either be written down as an azimuth, a mil angle, and a TS, or a diagram may be constructed. (See figure C-9.) To avoid confusing others working with a hasty survey, any diagram should reflect the route of the various traverse legs and should be close to scale.



TRAVERSE LEG	AZIMUTH (MILS)	MILS OF SUBTENSE (MILS)	= METERS
TL-1	5790	18.5	110
TL-2	4786	10.1	200
TL-3	0008	10.0	200
TL-4	4560	8.5	240
TL-5	5769	12.8	160

Figure C-9. Construction of a diagram

STEP 9

C-11. The information recorded by the "circle" Soldier goes to the FDC either as the traverse legs are made or after all the legs have been completed. The beginning known point is represented by the pivot point of the M16 plotting board.

STEP 10

C-12. Starting at the pivot point, the data are applied on the board for each leg of the hasty survey. For example:

- The azimuth on the first traverse leg was 5790 mils; index that information on the M16 plotting board.
- The distance between the two strips of tape on the aiming posts was 18.5 mils.
- See the distance table (see figure C-10, page 484) for the 2-meter subtense bar width:
  - A mil angle of 18.5 mils is equal to a distance of 110 meters.
  - For the hasty survey, make one square on the plotting board equal to 25 meters.
- From the pivot point on the direction of 5790 mils, move 110 meters (4 2/5 squares) along the index line, place a dot, and circle it; this point, marked as TS-1, completes traverse leg 1.
- The azimuth for the second traverse leg was 4786 mils; index this information on the plotting board.
- At TS-2, the mil angle measured for the 2-meter subtense bar width was 10.1 mils.

- See the distance table for the 2-meter subtense bar width; 10.1 mils equals a distance of 200 meters.

Angle (mils)	Distance (meters)	Angle (mils)	Distance (meters)	Angle (mils)	Distance (meters)	Angle (mils)	Distance (meters)	Angle (mils)	Distance (meters)	Angle (mils)	Distance (meters)
7.0	291.03	14.0	145.51	21.0	97.01	28.0	72.75	35.0	58.20	42.0	48.50
.2	280.99	.2	142.96	.2	95.86	.2	72.11	.2	57.97	.2	48.21
.5	271.62	.5	140.49	.5	94.75	.5	71.48	.5	57.38	.5	47.93
.8	262.86	.8	137.65	.8	93.66	.8	70.85	.8	56.98	.8	47.65
8.0	254.65	15.0	135.81	22.0	92.60	29.0	70.24	36.0	56.58	43.0	47.37
.2	246.93	.2	133.58	.2	91.56	.2	69.64	.2	56.19	.2	47.10
.5	239.67	.5	131.42	.5	90.54	.5	69.05	.5	55.81	.5	46.82
.8	231.50	.8	129.34	.8	89.54	.8	68.47	.8	55.43	.8	46.56
9.0	226.35	16.0	127.32	23.0	88.57	30.0	67.90	37.0	55.05	44.0	46.29
.2	220.23	.2	125.36	.2	87.62	.2	67.34	.2	54.68	.2	46.08
.5	214.44	.5	123.46	.5	86.68	.5	66.79	.5	54.32	.5	45.77
.8	208.94	.8	121.62	.8	85.77	.8	66.24	.8	53.96	.8	45.47
10.0	203.72	17.0	119.83	24.0	84.88	31.0	65.71	38.0	53.60	45.0	45.26
.2	198.75	.2	118.09	.2	84.00	.2	65.18	.2	53.25		
.5	194.02	.5	116.41	.5	83.15	.5	64.67	.5	52.91		
.8	188.63	.8	114.77	.8	82.31	.8	64.16	.8	52.57		
11.0	185.20	18.0	113.17	25.0	81.48	32.0	63.66	39.0	52.23		
.2	181.08	.2	111.62	.2	80.68	.2	63.16	.2	51.90		
.5	177.14	.5	110.11	.5	79.89	.5	62.68	.5	51.57		
.8	173.38	.8	108.65	.8	79.11	.8	62.20	.8	51.24		
12.0	169.76	19.0	107.22	26.0	78.35	33.0	61.73	40.0	50.92		
.2	166.30	.2	105.82	.2	77.60	.2	61.26	.2	50.67		
.5	162.97	.5	104.47	.5	76.87	.5	60.81	.5	50.29		
.8	159.78	.8	103.15	.8	76.15	.8	60.36	.8	49.99		
13.0	156.70	20.0	101.86	27.0	75.45	34.0	59.91	41.0	49.68		
.2	153.75	.2	100.60	.2	74.75	.2	59.47	.2	49.38		
.5	150.90	.5	99.37	.5	74.07	.5	59.04	.5	49.08		
.8	148.16	.8	98.17	.8	73.41	.8	58.62	.8	48.79		
To be used with 2-meter subtense bar.											

Figure C-10. Distance table for a 2-meter subtense bar

- With 4786 mils indexed on the plotting board, move up 200 meters from TS-1 along or parallel to a vertical line (eight squares), place a dot, and circle it.
- This point, marked TS-2, completes traverse leg 2, repeat the same procedure for traverse legs 3, 4, and 5.
- Rotate the M16 plotting board until TS-5 (mortar position) is directly over the vertical centerline.
- Read the azimuth from the top of the plotting board; this is the direction from the known starting point to the base mortar squad's position.
- Count the number of squares along the index line between the pivot point and TS-5:
  - Each square equals 25 meters.
  - This is the straight-line distance from the known starting point to the base mortar squad's position.
- If given data were properly applied in the example, a known starting point-base mortar squad azimuth should have been obtained of 5961 mils, and a known starting point-based mortar squad distance of 690 meters (+/-5 mils and 10 meters).
- Apply these data to the map:
  - From the known starting point along the direction of 5961 mils, move 690 meters.

  - The new point is the eight-digit grid coordinate for the base mortar squad's position.
- The FDC now establishes a modified-observed firing chart or, if the FO can find an eight-digit location in the target area, a surveyed firing chart.

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Appendix D

Fire Direction Center Certification

FDC certification is required for all units with mortars; it tests the proficiency of Soldiers to perform their duties as FDC computers and section leaders. This appendix provides the commander with a means to verify that Indirect Fire Infantryman are trained in FDC procedures. All FDC personnel and those who perform FDC operations are subject to certification. A set of example tests are provided to assist in the development of unit certification programs. Units based their certification program on their METL and assigned equipment. A certified FDC, certified mortar crew, and a certified FO are required for live fire training.

The mortar training strategy can be found in TC 3-22.90.

CONDUCT OF THE PROGRAM

D-1. The lethality of mortars on the battlefield and their ability to set conditions requires the highest standards of proficiency. To ensure accurate organic indirect fires, the unit's FDC certification minimums should require 70 percent of all section leaders, squad leaders, and FDC personnel pass the FDC certification. Certification should be conducted every 6 months or during the training and sustaining cycles, of the appropriate force generation pool, following the unit's execution plan.

D-2. The FDC certification program should be conducted as centralized training at the regiment or brigade level. Commanders select an examination board made up of + experienced senior indirect fire Infantryman who are preferably Infantry Mortar Leader Course graduates. The examination board is responsible for the set-up, conduct and certification of the program. The FDC certification program includes a hands-on skills test and a system-based test conducting seven FDC missions.

Note. Considerable training value can be obtained by using a centralized evaluation and by obtaining the experience of several units' noncommissioned officers.

D-3. The examination board is responsible for the following:

- Reviewing required Soldier certification tasks (tasks listed on page 487).
- Developing mission set up information (missions listed on page 488).
- Developing all scoresheets and answer keys.
- Developing all secondary and retest material.
- Safeguarding FDC certification program testing information.
- Serving as the arbitration committee to hear and decide on testing grievances.

D-4. The examination board refers to chapter 6 for plotting board, chapter 10 for MFCS, or chapter 7 for LHMBC.

PERSONNEL SUBJECT TO CERTIFICATION

D-5. Soldiers in the following positions are subject to be evaluated for certification:

- FDC computer.
- Section leader.
- Squad leaders who perform FDC operations (Cavalry, brigade combat team, and so on).
- FDC RTO.

Note. All sergeants and the above should be administered an FDC certification, but only personnel that perform FDC operations certifies for live-fire operations. A squad leader's failure to pass the FDC certification does not preclude the squad from firing if that squad operates under a certified controlling FDC.

GENERAL RULES

D-6. The FDC certification program is designed to be a program that the commanders can use to certify FDC personnel. Battalions provide scorers (staff sergeant and above) + who are preferably Infantry Mortar Leader Course graduates to grade units other than their own. The goal is to certify under a standardized evaluation program with qualified leaders, who are internal to the parent organization. Conditions should be the same for all Soldiers during the certification. The examining board ensures that information obtained by a Soldier during testing is not passed to another Soldier. The examining board ensures consistency of the certification across the entire regiment/brigade. Validation of unit mortar SOPs are secondary objective. However, the examining board adjudicates issues between testing requirements and SOPs.

QUALIFICATION

D-7. Soldiers pass the hands-on certification tasks for each system before conducting the FDC certification missions. To be certified, Soldiers score a minimum of 70 percent on each of the seven missions listed for each system assigned to the unit. The goal of hands-on testing is the demonstration of skills required to operate all FDC systems assigned to the unit. The goal of mission testing is demonstrating the skills required to perform duties as the FDC computer and providing the correct firing data to the mortar crews. The Soldier certifies using the primary FDC computer and the M16- and M19-plotting board. Soldiers may retest only once on any part of the test they have failed. Soldiers who fail the retest will not be certified and will be required to repeat the FDC certification program during the next evaluation.

CERTIFICATION TASKS

D-8. Certain criteria are used to test the Soldier's ability to perform hands-on tasks required to operate each FDC system. The certification includes, but is not limited to, the tasks listed for each system.

M16- AND M19-PLOTTING BOARD

D-9. The Soldier demonstrates hands-on ability to perform the following tasks:

- Prepare a plotting board for operation as an observed chart (pivot point).
- Prepare a plotting board for operation as an observed chart (below pivot point).
- Prepare a plotting board for operation as a modified-observed chart.
- Prepare a plotting board for operation as a surveyed chart.
- Locate an unknown point on a map or plotting board using intersection.
- Locate an unknown point on a map or plotting board using resection.

LIGHTWEIGHT HANDHELD MORTAR BALLISTIC COMPUTER

D-10. The Soldier demonstrates hands-on ability to perform the following tasks:

- Start and initialize the LHMBC.
- Initialize the data and configure the LHMBC.
  - Input and check GEOREF Data.
  - Input and check Setup Data.
  - Input and check Unit List.
  - Setup Commo Parameters.
- Operate the LHMBC.
  - Obtain and update ammunition status for each gun.
  - Obtain and update MET data.
- Accept new MET data.
- Apply new MET data.
- Explain highlighted MET data (due to exceeding MET trend limits).
- Manually entering and edit new MET message.
- Identify targets or known points:
  - Designating a target after a fire mission.
  - Manually entering a target or a known point.
  - Enter and modify a safety fan.
  - Initiate a check fire message.
- Respond to and correct alerts:
  - Information alerts.
  - Error alerts.
  - Warning alerts.

MORTAR FIRE CONTROL SYSTEM TASK CERTIFICATION

D-11. The Soldier demonstrates hands-on ability to perform the following tasks:

- Start and Initialize the MFCS.
  - Start up the MFCS on the M577, Stryker, M1064A4 carrier, or the M150 MFCS-D in the proper sequence.
  - Initialize the data and configure the MFCS.
- Inputting and check data screens:
  - Unit List.

  - Configuration.
  - Data.
  - GEOREF.
  - Position.
  - Channel A.
  - Channel B.
- Operate the MSCS.
  - Check the status of all guns assigned to the FDC.
  - Operational status.
  - Location.
  - Determine the overall status of the fire unit.
  - Obtain information and update ammunition status.
  - Ammunition for each gun.
- Ammunition for all guns controlled by the FDC.
- Ammunition status manually updated.
- Obtain information and update MET data.
- Accept and apply new MET data.
- Explain highlighted MET data (due to exceeding MET trend limits).
- Manually enter or edit the new MET message.
- Identify targets or known points.
- Designate a target after a fire mission.
- Manually enter a target or a known point.
  - Enter and modify a safety fan.
  - Initiate a check fire message.
  - Send and receive a PTM.
  - Respond to and correct alerts.
- Information alerts.
- Error alerts.
- Warning alerts.

Appendix E

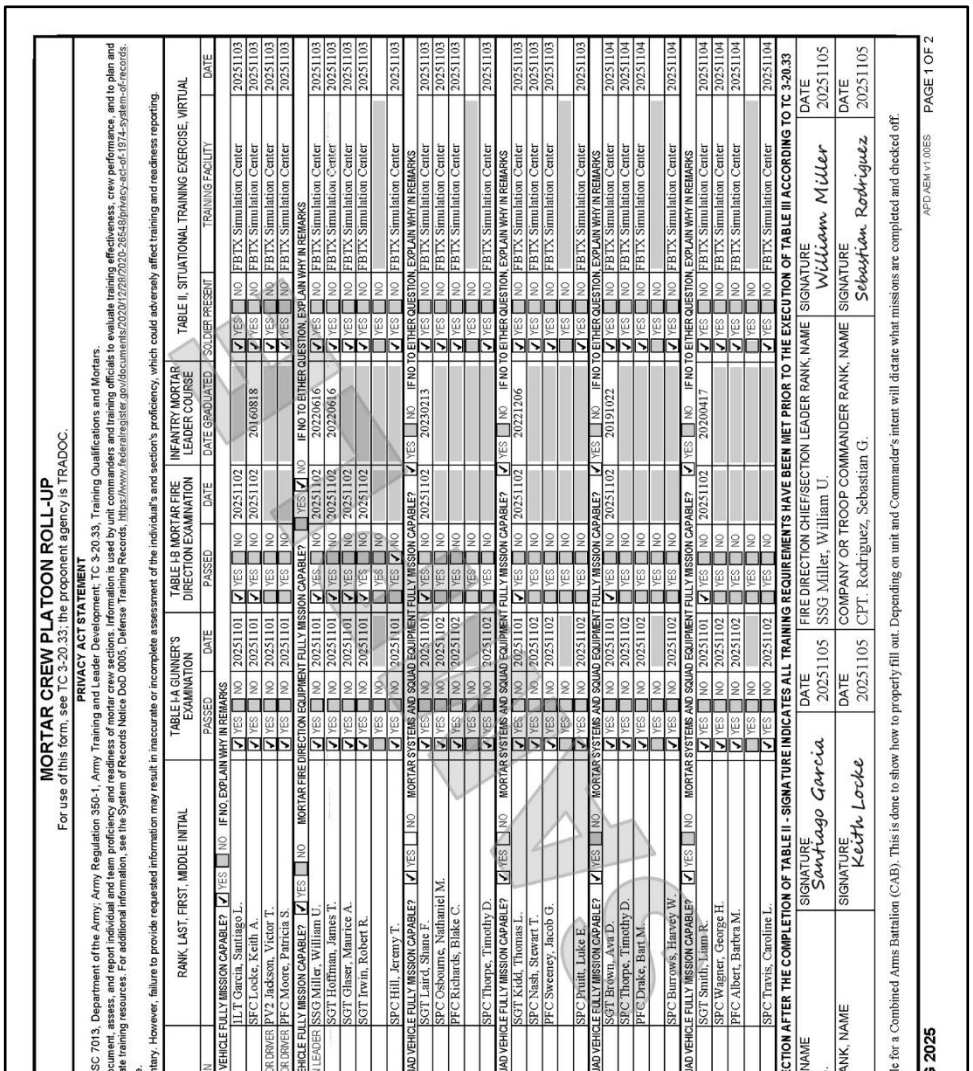
Mortar Qualification DA Forms

This appendix describes the use of the mortar crew roll-up and mortar crew fire mission scoresheet DA forms. These forms were developed to bring transparency and accountability to mortar training and qualification. These forms are digitally fillable and digitally signable. They are the required records used to capture mortar training Tables I through VI and any mortar validation event.

MORTAR CREW ROLL-UP

E-1. The mortar crew for qualification includes the key leaders, mortar fire direction personnel, and mortar system squads. Mortar formations qualify as their entire formation. A mortar platoon qualifies as a platoon, not as sections, or squads. A company or troop mortar section qualifies as a section, not as squads.

E-2. There are two separate mortar crew roll-up DA forms. DA Form 7882 (*Mortar Crew Platoon Roll-Up)* is used to record the crew qualification of a mortar platoon. DA Form 7883 (*Mortar Crew Section Roll-Up)* is used to record the crew qualification of a company or troop mortar section. Each form has two pages, front and back. These forms are available on the Army Publishing Directorate website. See figures E-1 through E-4, pages 492 through 495.



MORTAR CREW PLATOON ROLL-UP
For use of this form, see TC 3-20.33; the proponent agency is TRADOC.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 7013, Department of the Army; Army Regulation 350-1, Army Training and Leader Development; TC 3-20.33, Training Qualifications and Mortars.

PRINCIPAL PURPOSE: To document, assess, and report individual and team proficiency and readiness of mortar crew sections. Information is used by unit commanders and training officials to evaluate training effectiveness, crew performance, and to plan and allocate training resources. For additional information, see the System of Records Notice DoD 0005, Defense Training Records, https://www.federalregister.gov/documents/2020/12/28/2020-28548/privacy-act-of-1974-system-of-records.

ROUTINE USES: None.

DISCLOSURE: Voluntary. However, failure to provide requested information may result in inaccurate or incomplete assessment of the individual's and section's proficiency, which could adversely affect training and readiness reporting.

ORGANIZATION NAME: 1-35 AR REG, FBTX

RANK, LAST, FIRST, MIDDLE INITIAL	TABLE I-A GUNNER'S EXAMINATION		TABLE I-B MORTAR FIRE DIRECTION EXAMINATION		INFANTRY MORTAR LEADER COURSE	TABLE II, SITUATIONAL TRAINING EXERCISE, VIRTUAL	
ASSIGNED DUTY POSITION	PASSED	DATE	PASSED	DATE	DATE GRADUATED	SOLDIER PRESENT	TRAINING FACILITY	DATE
PLATOON HEADQUARTERS VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO IF NO, EXPLAIN WHY IN REMARKS								
PLATOON LEADER	1LT Garcia, Santiago L.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102	☑ YES ☐ NO	FBTX Simulation Center	20251103
PLATOON SERGEANT	SFC Locke, Keith A.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102	20160818	☑ YES ☐ NO	FBTX Simulation Center	20251103
RADIO TELEPHONE OPERATOR (RTO) OR DRIVER	PV2 Jackson, Victor T.	☑ YES ☐ NO	20251101	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251103
RADIO TELEPHONE OPERATOR (RTO) OR DRIVER	PFC Moore, Patricia S.	☑ YES ☐ NO	20251101	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251103
FIRE DIRECTION CENTER VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO MORTAR FIRE DIRECTION EQUIPMENT FULLY MISSION CAPABLE? ☐ YES ☑ NO IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS								
FIRE DIRECTION CHIEF / SECTION LEADER	SSG Miller, William U.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102	20220616	☑ YES ☐ NO	FBTX Simulation Center	20251103
FIRE DIRECTION COMPUTER	SGT Hoffman, James T.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102	20220616	☑ YES ☐ NO	FBTX Simulation Center	20251103
FIRE DIRECTION COMPUTER	SGT Glaser, Maurice A.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102		☑ YES ☐ NO	FBTX Simulation Center	20251103
FIRE DIRECTION COMPUTER	SGT Irwin, Robert R.	☑ YES ☐ NO	20251101	☐ YES ☐ NO	20251102		☑ YES ☐ NO	FBTX Simulation Center	20251103
FIRE DIRECTION COMPUTER		☐ YES ☐ NO		☐ YES ☐ NO			☐ YES ☐ NO		
RTO OR DRIVER	SPC Hill, Jeremy T.	☑ YES ☐ NO	20251101	☐ YES ☑ NO			☐ YES ☐ NO	FBTX Simulation Center	20251103
1ST SQUAD VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE? ☑ YES ☐ NO IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS								
SQUAD LEADER	SGT Laird, Shane F.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102	20230213	☑ YES ☐ NO	FBTX Simulation Center	20251103
GUNNER	SPC Osbourne, Nathaniel M.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251103
ASSISTANT GUNNER	PFC Richards, Blake C.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251103
AMMUNITION BEARER		☐ YES ☐ NO		☐ YES ☐ NO			☐ YES ☐ NO		
DRIVER	SPC Thorpe, Timothy D.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251103
2ND SQUAD VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE? ☑ YES ☐ NO IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS								
SQUAD LEADER	SGT Kidd, Thomas L.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102	20221206	☑ YES ☐ NO	FBTX Simulation Center	20251103
GUNNER	SPC Nash, Stewart T.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251103
ASSISTANT GUNNER	PFC Sweeney, Jacob G.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251103
AMMUNITION BEARER		☐ YES ☐ NO		☐ YES ☐ NO			☐ YES ☐ NO		
DRIVER	SPC Pruitt, Luke E.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251103
3RD SQUAD VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE? ☑ YES ☐ NO IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS								
SQUAD LEADER	SGT Brown, Ava D.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102	20191022	☑ YES ☐ NO	FBTX Simulation Center	20251104
GUNNER	SPC Thorpe, Timothy D.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251104
ASSISTANT GUNNER	PFC Drake, Bart M.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251104
AMMUNITION BEARER		☐ YES ☐ NO		☐ YES ☐ NO			☐ YES ☐ NO		
DRIVER	SPC Burrows, Harvey W.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251104
4TH SQUAD VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE? ☑ YES ☐ NO IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS								
SQUAD LEADER	SGT Smith, Liam R.	☑ YES ☐ NO	20251101	☑ YES ☐ NO	20251102	20200417	☑ YES ☐ NO	FBTX Simulation Center	20251104
GUNNER	SPC Wagner, George H.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251104
ASSISTANT GUNNER	PFC Albert, Barbra M.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251104
AMMUNITION BEARER		☐ YES ☐ NO		☐ YES ☐ NO			☐ YES ☐ NO		
DRIVER	SPC Travis, Caroline L.	☑ YES ☐ NO	20251102	☐ YES ☐ NO			☑ YES ☐ NO	FBTX Simulation Center	20251104

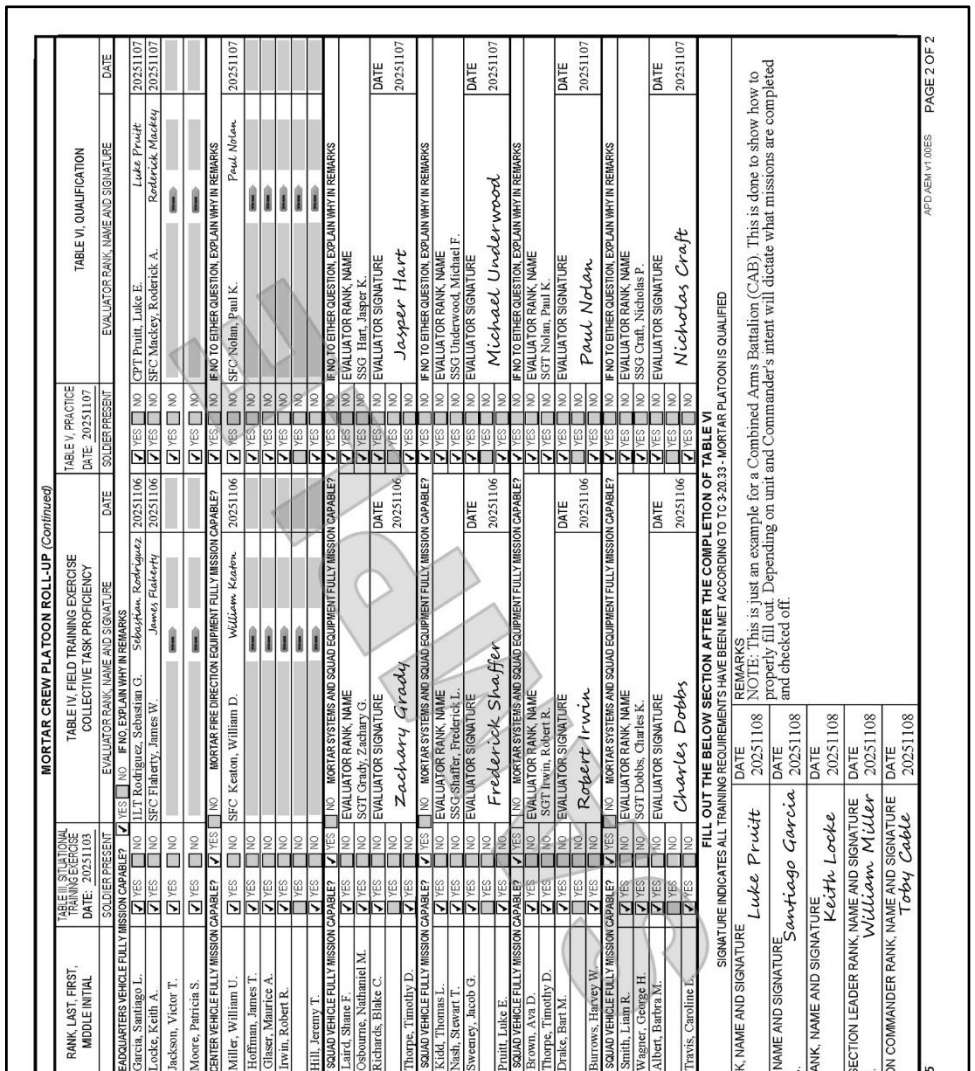
FILL OUT THE BELOW SECTION AFTER THE COMPLETION OF TABLE II - SIGNATURE INDICATES ALL TRAINING REQUIREMENTS HAVE BEEN MET PRIOR TO THE EXECUTION OF TABLE III ACCORDING TO TC 3-20.33

PLATOON LEADER RANK, NAME	SIGNATURE	DATE	FIRE DIRECTION CHIEF/SECTION LEADER RANK, NAME	SIGNATURE	DATE
1LT Garcia, Santiago L.	*Santiago Garcia*	20251105	SSG Miller, William U.	*William Miller*	20251105
PLATOON SERGEANT RANK, NAME	SIGNATURE	DATE	COMPANY OR TROOP COMMANDER RANK, NAME	SIGNATURE	DATE
SFC Locke, Keith A.	*Keith Locke*	20251105	CPT. Rodriguez, Sebastian G.	*Sebastian Rodriguez*	20251105

REMARKS
NOTE: This is just an example for a Combined Arms Battalion (CAB). This is done to show how to properly fill out. Depending on unit and Commander's intent will dictate what missions are completed and checked off.

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Figure E-1. DA Form 7882 (Mortar Crew Platoon Roll-Up) page 1



MORTAR CREW PLATOON ROLL-UP *(Continued)*

ORGANIZATION NAME: 1-35 AR REG, FBTX	RANK, LAST, FIRST, MIDDLE INITIAL	TABLE III, SITUATIONAL TRAINING EXERCISE DATE: 20251103	TABLE IV, FIELD TRAINING EXERCISE COLLECTIVE TASK PROFICIENCY		TABLE V, PRACTICE DATE: 20251107	TABLE VI, QUALIFICATION	
ASSIGNED DUTY POSITION	SOLDIER PRESENT		EVALUATOR RANK, NAME AND SIGNATURE	DATE	SOLDIER PRESENT	EVALUATOR RANK, NAME AND SIGNATURE	DATE
PLATOON HEADQUARTERS VEHICLE FULLY MISSION CAPABLE?	☑ YES ☐ NO	☑ YES ☐ NO	IF NO, EXPLAIN WHY IN REMARKS				
PLATOON LEADER	☑ YES ☐ NO	1LT Rodriguez, Sebastian G.	*Sebastian Rodriguez*	20251106	☑ YES ☐ NO	CPT Pruitt, Luke E.	*Luke Pruitt* 20251107
PLATOON SERGEANT	☑ YES ☐ NO	SFC Flaherty, James W.	*James Flaherty*	20251106	☑ YES ☐ NO	SFC Mackey, Roderick A.	*Roderick Mackey* 20251107
FIRE DIRECTION COMPUTER / RADIO TELEPHONE OPERATOR/DRIVER	☑ YES ☐ NO	PV2 Jackson, Victor T.			☐ YES ☐ NO		
RADIO TELEPHONE OPERATOR/RTO/DRIVER	☑ YES ☐ NO	PFC Moore, Patricia S.			☐ YES ☐ NO		
FIRE DIRECTION CENTER VEHICLE FULLY MISSION CAPABLE?	☑ YES ☐ NO	MORTAR FIRE DIRECTION EQUIPMENT FULLY MISSION CAPABLE?			☑ YES ☐ NO	IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS	
FIRE DIRECTION CHIEF / SECTION LEADER	☑ YES ☐ NO	SFC Keaton, William D.	*William Keaton*	20251106	☑ YES ☐ NO	SFC Nolan, Paul K.	*Paul Nolan* 20251107
FIRE DIRECTION COMPUTER	☑ YES ☐ NO				☑ YES ☐ NO		
FIRE DIRECTION COMPUTER	☑ YES ☐ NO				☑ YES ☐ NO		
FIRE DIRECTION COMPUTER	☑ YES ☐ NO				☐ YES ☐ NO		
FIRE DIRECTION COMPUTER	☐ YES ☐ NO				☐ YES ☐ NO		
RTO OR DRIVER	☑ YES ☐ NO				☐ YES ☐ NO		
1ST SQUAD VEHICLE FULLY MISSION CAPABLE?	☑ YES ☐ NO	MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE?			☑ YES ☐ NO	IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS	
SQUAD LEADER	☑ YES ☐ NO	EVALUATOR RANK, NAME			☑ YES ☐ NO	EVALUATOR RANK, NAME	
GUNNER	☑ YES ☐ NO	SGT Grady, Zachary G.			☑ YES ☐ NO	SSG Hart, Jasper K.	
ASSISTANT GUNNER	☑ YES ☐ NO	EVALUATOR SIGNATURE		DATE	☑ YES ☐ NO	EVALUATOR SIGNATURE	DATE
AMMUNITION BEARER	☐ YES ☐ NO	*Zachary Grady*		20251106	☐ YES ☐ NO	*Jasper Hart*	20251107
DRIVER	☑ YES ☐ NO				☑ YES ☐ NO		
2ND SQUAD VEHICLE FULLY MISSION CAPABLE?	☑ YES ☐ NO	MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE?			☑ YES ☐ NO	IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS	
SQUAD LEADER	☑ YES ☐ NO	EVALUATOR RANK, NAME			☑ YES ☐ NO	EVALUATOR RANK, NAME	
GUNNER	☑ YES ☐ NO	SSG Shaffer, Frederick L.			☑ YES ☐ NO	SSG Underwood, Michael F.	
ASSISTANT GUNNER	☑ YES ☐ NO	EVALUATOR SIGNATURE		DATE	☑ YES ☐ NO	EVALUATOR SIGNATURE	DATE
AMMUNITION BEARER	☐ YES ☐ NO	*Frederick Shaffer*		20251106	☐ YES ☐ NO	*Michael Underwood*	20251107
DRIVER	☑ YES ☐ NO				☑ YES ☐ NO		
3RD SQUAD VEHICLE FULLY MISSION CAPABLE?	☑ YES ☐ NO	MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE?			☑ YES ☐ NO	IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS	
SQUAD LEADER	☑ YES ☐ NO	EVALUATOR RANK, NAME			☑ YES ☐ NO	EVALUATOR RANK, NAME	
GUNNER	☑ YES ☐ NO	SGT Irwin, Robert R.			☑ YES ☐ NO	SGT Nolan, Paul K.	
ASSISTANT GUNNER	☑ YES ☐ NO	EVALUATOR SIGNATURE		DATE	☑ YES ☐ NO	EVALUATOR SIGNATURE	DATE
AMMUNITION BEARER	☐ YES ☐ NO	*Robert Irwin*		20251106	☐ YES ☐ NO	*Paul Nolan*	20251107
DRIVER	☑ YES ☐ NO				☐ YES ☐ NO		
4TH SQUAD VEHICLE FULLY MISSION CAPABLE?	☑ YES ☐ NO	MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE?			☑ YES ☐ NO	IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS	
SQUAD LEADER	☑ YES ☐ NO	EVALUATOR RANK, NAME			☑ YES ☐ NO	EVALUATOR RANK, NAME	
GUNNER	☑ YES ☐ NO	SGT Dobbs, Charles K.			☑ YES ☐ NO	SSG Craft, Nicholas P.	
ASSISTANT GUNNER	☑ YES ☐ NO	EVALUATOR SIGNATURE		DATE	☑ YES ☐ NO	EVALUATOR SIGNATURE	DATE
AMMUNITION BEARER	☐ YES ☐ NO	*Charles Dobbs*		20251106	☐ YES ☐ NO	*Nicholas Craft*	20251107
DRIVER	☑ YES ☐ NO				☑ YES ☐ NO		

FILL OUT THE BELOW SECTION AFTER THE COMPLETION OF TABLE VI

SIGNATURE INDICATES ALL TRAINING REQUIREMENTS HAVE BEEN MET ACCORDING TO TC 3-20.33 - MORTAR PLATOON IS QUALIFIED

SENIOR EVALUATOR RANK, NAME AND SIGNATURE	*Luke Pruitt*	DATE 20251108
PLATOON LEADER RANK, NAME AND SIGNATURE	*Santiago Garcia*	DATE 20251108
PLATOON SERGEANT RANK, NAME AND SIGNATURE	*Keith Locke*	DATE 20251108
FIRE DIRECTION CHIEF / SECTION LEADER RANK, NAME AND SIGNATURE	*William Miller*	DATE 20251108
BATTALION OR SQUADRON COMMANDER RANK, NAME AND SIGNATURE	*Toby Cable*	DATE 20251108

REMARKS

NOTE: This is just an example for a Combined Arms Battalion (CAB). This is done to show how to properly fill out. Depending on unit and Commander's intent will dictate what missions are completed and checked off.

DA FORM 7882, AUG 2025 APD AEM V1.00ES PAGE 2 OF 2

Figure E-2. DA Form 7882 (Mortar Crew Platoon Roll-Up) page 2

MORTAR CREW SECTION ROLL-UP

For use of this form, see TC 3-20.33; the proponent agency is TRADOC.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 7013, Department of the Army; Army Regulation 350-1, Army Training and Leader Development; TC 3-20.33, Training Qualifications and Mortars.

PRINCIPAL PURPOSE: To document, assess, and report individual and team proficiency and readiness of mortar crew sections. Information is used by unit commanders and training officials to evaluate training effectiveness, crew performance, and to plan and allocate training resources. For additional information, see the System of Records Notice DoD 0005, Defense Training Records, https://www.federalregister.gov/documents/2020/01/28/2020-26548/privacy-act-of-1974-system-of-records.

ROUTINE USES: None.

DISCLOSURE: Voluntary. However, failure to provide requested information may result in inaccurate or incomplete assessment of the individual's and section's proficiency, which could adversely affect training and readiness reporting.

ORGANIZATION NAME: ○ TRP, 4/2 CR

ASSIGNED DUTY POSITION	RANK, LAST, FIRST, MIDDLE INITIAL	TABLE I-A GUNNER'S EXAMINATION		TABLE I-B MORTAR FIRE DIRECTION EXAMINATION		INFANTRY MORTAR LEADER COURSE	TABLE II, SITUATIONAL TRAINING EXERCISE, VIRTUAL		
		PASSED	DATE	PASSED	DATE	DATE GRADUATED	SOLDIER PRESENT	TRAINING FACILITY	DATE
SECTION HEADQUARTERS VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO ☐ N/A	**MORTAR FIRE DIRECTION EQUIPMENT FULLY MISSION CAPABLE?** ☑ YES ☐ NO ☐ N/A						**IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS**		
SECTION LEADER	SFC Ingram, Alfred C.	☑ YES ☐ NO		☑ YES ☐ NO			☑ YES ☐ NO		
DRIVER	PFC Irwin, Robert R.	☑ YES ☐ NO		☐ YES ☑ NO			☑ YES ☐ NO		
1ST SQUAD VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO ☐ N/A	**MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE?** ☑ YES ☐ NO ☐ N/A						**IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS**		
SQUAD LEADER	SSG Black, Jeffrey V.	☑ YES ☐ NO		☑ YES ☐ NO			☑ YES ☐ NO		
GUNNER	SPC Drake, Bart M.	☑ YES ☐ NO		☐ YES ☐ NO			☑ YES ☐ NO		
ASSISTANT GUNNER	PFC Eldridge, Ethan H.	☑ YES ☐ NO		☐ YES ☐ NO			☑ YES ☐ NO		
AMMUNITION BEARER	PFC Fields, Nathan C.	☑ YES ☐ NO		☐ YES ☐ NO			☑ YES ☐ NO		
DRIVER	PVT Yarbrough, David P.	☑ YES ☐ NO		☐ YES ☐ NO			☑ YES ☐ NO		
2ND SQUAD VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO ☐ N/A	**MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE?** ☐ YES ☐ NO ☐ N/A						**IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS**		
SQUAD LEADER	SSG Craft, Nicholas P.	☑ YES ☐ NO		☑ YES ☐ NO			☑ YES ☐ NO		
GUNNER	SPC Burows, Harley W.	☑ YES ☐ NO		☐ YES ☐ NO			☑ YES ☐ NO		
ASSISTANT GUNNER	PFC Dobbs, Charles K.	☑ YES ☐ NO		☐ YES ☐ NO			☑ YES ☐ NO		
AMMUNITION BEARER	PV2 Pruitt, Luke E.	☑ YES ☐ NO		☐ YES ☐ NO			☑ YES ☐ NO		
DRIVER	PV2 Kidd, Thomas L.	☑ YES ☐ NO		☐ YES ☐ NO			☑ YES ☐ NO		

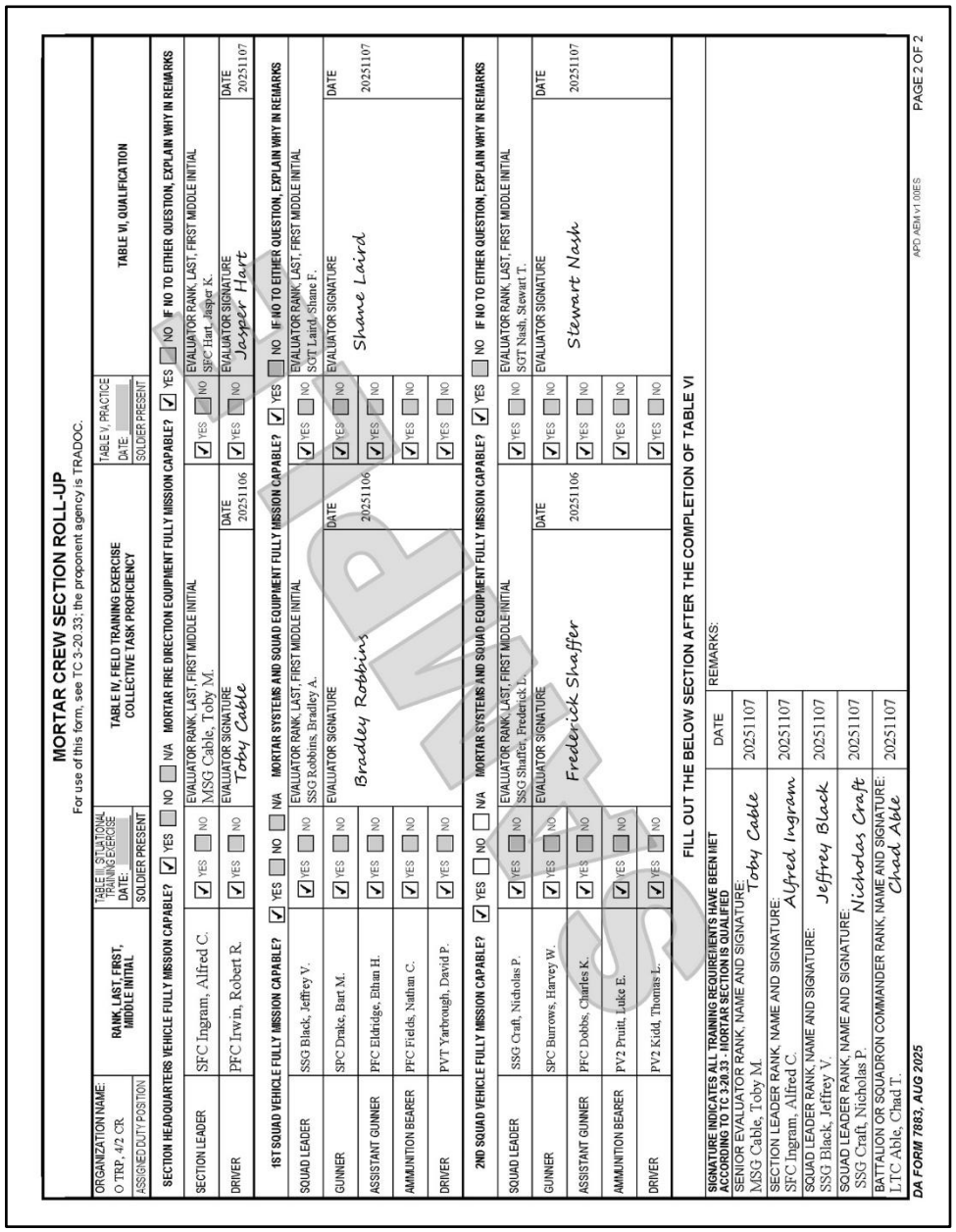
FILL OUT THE BELOW SECTION AFTER THE COMPLETION OF TABLE II

SIGNATURE INDICATES ALL TRAINING REQUIREMENTS HAVE BEEN MET PRIOR TO THE EXECUTION OF TABLE III ACCORDING TO TC 3-20.33	DATE
SECTION LEADER RANK, NAME AND SIGNATURE: SFC Ingram, Alfred C. *Alfred Ingram*	20251102
SQUAD LEADER RANK, NAME AND SIGNATURE: SSG Black, Jeffrey V. *Jeffrey Black*	20251102
SQUAD LEADER RANK, NAME AND SIGNATURE: SSG Craft, Nicholas P. *Nicholas Craft*	20251102
COMPANY OR TROOP COMMANDER RANK, NAME AND SIGNATURE: CPT Flaherty, James W. *James Flaherty*	20251102

REMARKS:
NOTE: This is just an example for an CAV Troop Mortar Section. This is done to show how to properly fill out. Depending on unit and Commander's intent will dictate what missions are completed and checked off.

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Figure E-3. DA Form 7883 (Mortar Crew Section Roll-Up) page 1



MORTAR CREW SECTION ROLL-UP

For use of this form, see TC 3-20.33; the proponent agency is TRADOC.

ORGANIZATION NAME: O TRP, 4/2 CR
ASSIGNED DUTY POSITION

TABLE III, SITUATIONAL TRAINING EXERCISE DATE: SOLDIER PRESENT ☑ YES ☐ NO

TABLE IV, FIELD TRAINING EXERCISE COLLECTIVE TASK PROFICIENCY ☐ N/A

TABLE V, PRACTICE DATE: SOLDIER PRESENT

TABLE VI, QUALIFICATION

RANK, LAST, FIRST, MIDDLE INITIAL	SECTION HEADQUARTERS VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO	EVALUATOR RANK, LAST, FIRST MIDDLE INITIAL / EVALUATOR SIGNATURE	DATE
SECTION LEADER	SFC Ingram, Alfred C.	MSG Cable, Toby M.	
DRIVER	PFC Irwin, Robert R.	*Toby Cable*	20251106

MORTAR FIRE DIRECTION EQUIPMENT FULLY MISSION CAPABLE? ☑ YES ☐ NO IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS

RANK, LAST, FIRST, MIDDLE INITIAL	1ST SQUAD VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO	EVALUATOR RANK, LAST, FIRST MIDDLE INITIAL / EVALUATOR SIGNATURE	DATE
SQUAD LEADER	SSG Black, Jeffrey V.	SSG Robbins, Bradley A.	
GUNNER	SPC Drake, Bart M.	*Bradley Robbins*	20251106
ASSISTANT GUNNER	PFC Eldridge, Ethan H.		
AMMUNITION BEARER	PFC Fields, Nathan C.		
DRIVER	PVT Yarbrough, David P.		

MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE? ☑ YES ☐ NO IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS

RANK, LAST, FIRST, MIDDLE INITIAL	2ND SQUAD VEHICLE FULLY MISSION CAPABLE? ☑ YES ☐ NO	EVALUATOR RANK, LAST, FIRST MIDDLE INITIAL / EVALUATOR SIGNATURE	DATE
SQUAD LEADER	SSG Craft, Nicholas P.	SSG Shaffer, Frederick L.	
GUNNER	SPC Burrows, Harvey W.	*Frederick Shaffer*	20251106
ASSISTANT GUNNER	PFC Dobbs, Charles K.		
AMMUNITION BEARER	PV2 Pruitt, Luke E.		
DRIVER	PV2 Kidd, Thomas L.		

MORTAR SYSTEMS AND SQUAD EQUIPMENT FULLY MISSION CAPABLE? ☑ YES ☐ NO IF NO TO EITHER QUESTION, EXPLAIN WHY IN REMARKS

RANK, LAST, FIRST, MIDDLE INITIAL	EVALUATOR RANK, LAST, FIRST MIDDLE INITIAL / EVALUATOR SIGNATURE	DATE
SQUAD LEADER	SGT Nash, Stewart T.	
GUNNER	*Stewart Nash*	20251106
ASSISTANT GUNNER		
AMMUNITION BEARER		
DRIVER		

FILL OUT THE BELOW SECTION AFTER THE COMPLETION OF TABLE VI

SIGNATURE INDICATES ALL TRAINING REQUIREMENTS HAVE BEEN MET ACCORDING TO TC 3-20.33 - MORTAR SECTION IS QUALIFIED	DATE	REMARKS:
SENIOR EVALUATOR RANK, NAME AND SIGNATURE: MSG Cable, Toby M. *Toby Cable*	20251107	
SECTION LEADER RANK, NAME AND SIGNATURE: SFC Ingram, Alfred C. *Alfred Ingram*	20251107	
SQUAD LEADER RANK, NAME AND SIGNATURE: SSG Black, Jeffrey V. *Jeffrey Black*	20251107	
SQUAD LEADER RANK, NAME AND SIGNATURE: SSG Craft, Nicholas P. *Nicholas Craft*	20251107	
BATTALION OR SQUADRON COMMANDER RANK, NAME AND SIGNATURE: LTC Able, Chad T. *Chad Able*	20251107	

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Figure E-4. DA Form 7883 (Mortar Crew Section Roll-Up) page 2

E-3. Different mortar formations have differing personnel across brigade combat team types. These forms are used for all Army mortar formations. Mortar leaders will fill out the administrative data for their unit and their mortar formation personnel.

E-4. When a duty position is not filled, the mortar leader will leave the RANK, LAST, FIRST, MIDDLE INITIAL cell blank. When a duty position is not authorized by

modified table of organization and equipment (MTOE) for that mortar formation, the mortar leader will write in the RANK, LAST, FIRST, MIDDLE INITIAL cell "NOT AUTHORIZED BY MTOE."

E-5. These DA forms are updated after the completion of each table. The mortar leader completes the TABLE I-A GUNNER'S EXAMINATION column by checking the block YES if the Soldier passed or NO if the Soldier did not pass, then input the date of the event. The mortar leader completes the TABLE I-B MORTAR FIRE DIRECTION EXAMINATION by checking the block YES if the Soldier passed or NO if the Soldier did not pass, then input the date of the event.

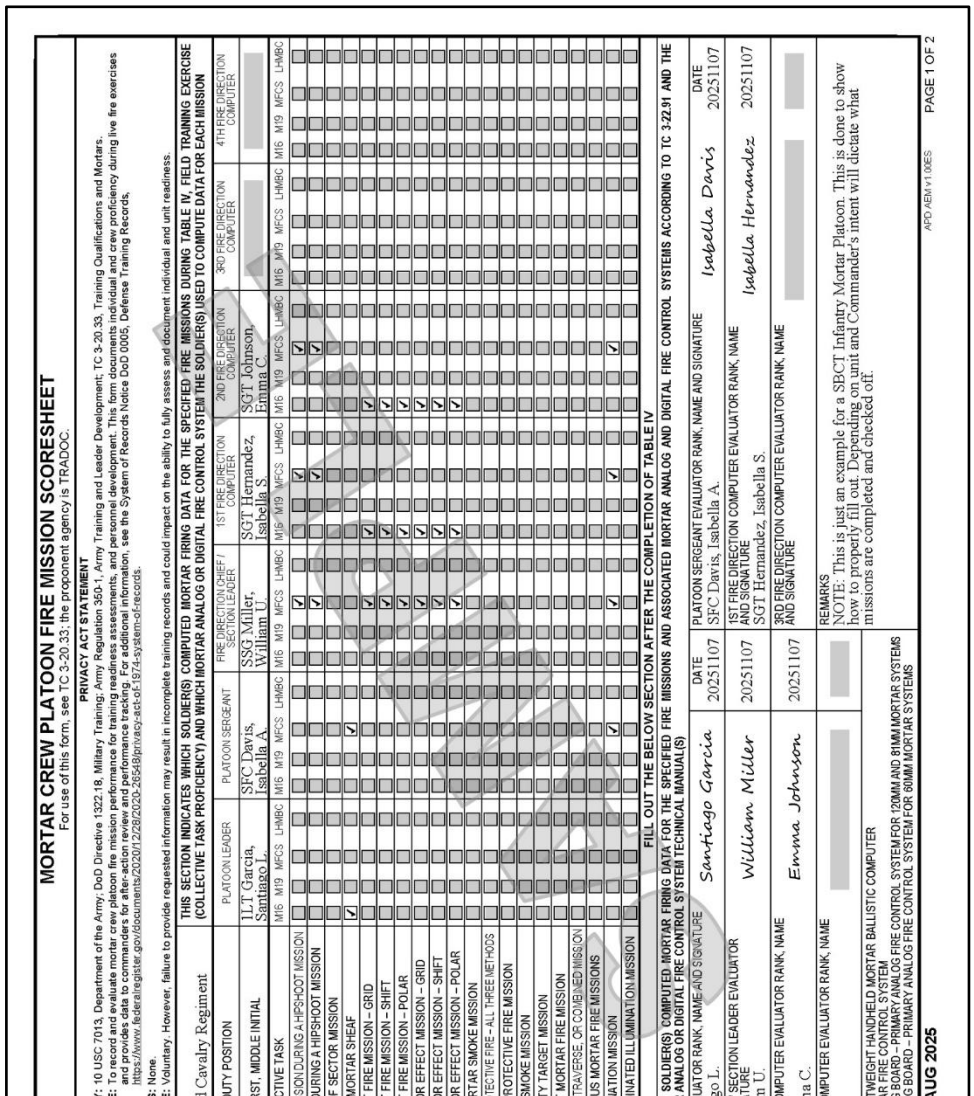
E-6. The mortar leader completes the INFANTRY MORTAR LEADER COURSE column by filling in the date after viewing the Soldier's certificate of graduation from the Infantry Mortar Leader Course. Leave the date blank if the Soldier has not graduated from the Infantry Mortar Leader Course.

E-7. The mortar leader completes the TABLE II, SITUATIONAL TRAINING EXERCISE, VIRTUAL by checking the block YES if the Soldier was present at and participated in the training and NO if the Soldier was not present at or did not participate in the training. The mortar leader then fills in the training facility where the Table II training was conducted; Call for Fire Trainer, Virtual Battlespace, Combat Close Tactical Trainer, or Training Area.

MORTAR CREW FIRE MISSION SCORESHEET

E-8. The mortar formations must be able quickly and accurately engage enemy targets using all authorized mortar analog and digital fire control systems. There is a training and evaluation outline for each type of mortar fire mission. The mortar formation is evaluated on their ability to accurately engage targets first in a mortar ammunition dry status during Table IV, then in a mortar ammunition live fire status in Table VI. The mortar crew fire mission scoresheet used to record the results of which fire missions where evaluated, who received the fire mission and computed mortar firing data, and on which mortar analog or digital fire control system was used to compute the fire mission.

E-9. There are two separate mortar fire mission scoresheet DA forms. DA Form 7881 (*Mortar Crew Platoon Fire Mission Scoresheet*) is used to record the fire missions of a mortar platoon during Tables IV and VI. DA Form 7880 (*Mortar Crew Section Fire Mission Scorecard)* is used to record the fire missions of a company or troop mortar section during Tables IV and VI. These forms are available on the Army Publishing Directorate website. See figures E-5 through E-8, pages 497 through 500.



MORTAR CREW PLATOON FIRE MISSION SCORESHEET

For use of this form, see TC 3-20.33; the proponent agency is TRADOC.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 7013, Department of the Army; DoD Directive 1322.18, Military Training; Army Regulation 350-1, Army Training and Leader Development; TC 3-20.33, Training Qualifications and Mortars.

PRINCIPAL PURPOSE: To record and evaluate mortar crew platoon fire mission performance for training readiness assessments, and personnel development. This form documents individual and crew proficiency during live fire exercises and provides data to commanders for after-action review and performance tracking. For additional information, see the System of Records Notice DoD 0005, Defense Training Records, https://dpcld.defense.gov/Privacy/SORNsIndex/DOD-wide-SORN-Article-View/Article/570713/dtr-19/.

ROUTINE USES: None.

DISCLOSURE: Voluntary. However, failure to provide requested information may result in incomplete training records and could impact on the ability to fully assess and document individual and unit readiness.

ORGANIZATION NAME: HHT, 3 SQDN, 2nd Cavalry Regiment

THIS SECTION INDICATES WHICH SOLDIER(S) COMPUTED MORTAR FIRING DATA FOR THE SPECIFIED FIRE MISSIONS DURING TABLE IV, FIELD TRAINING EXERCISE (COLLECTIVE TASK PROFICIENCY) AND WHICH MORTAR ANALOG OR DIGITAL FIRE CONTROL SYSTEM THE SOLDIER(S) USED TO COMPUTE DATA FOR EACH MISSION

ASSIGNED DUTY POSITION	PLATOON LEADER	PLATOON SERGEANT	FIRE DIRECTION CHIEF / SECTION LEADER	1ST FIRE DIRECTION COMPUTER	2ND FIRE DIRECTION COMPUTER	3RD FIRE DIRECTION COMPUTER	4TH FIRE DIRECTION COMPUTER
RANK, LAST, FIRST, MIDDLE INITIAL	1LT Garcia, Santiago L.	SFC Davis, Isabella A.	SSG Miller, William U.	SGT Hernandez, Isabella S.	SGT Johnson, Emma C.		

COLLECTIVE TASK	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC
FIRE IMMEDIATE SUPPRESSION DURING A HIPSHOOT MISSION											✓				✓					
ADJUST MORTAR FIRE DURING A HIPSHOOT MISSION																				
FIRE A MARK CENTER OF SECTOR MISSION																				
REGISTER A PARALLEL MORTAR SHEAF	✓																			
FIRE A MORTAR ADJUST FIRE MISSION – GRID							✓				✓									
FIRE A MORTAR ADJUST FIRE MISSION – SHIFT							✓				✓									
FIRE A MORTAR ADJUST FIRE MISSION – POLAR							✓				✓				✓					
FIRE A MORTAR FIRE FOR EFFECT MISSION – GRID							✓				✓				✓					
FIRE A MORTAR FIRE FOR EFFECT MISSION – SHIFT							✓				✓				✓					
FIRE A MORTAR FIRE FOR EFFECT MISSION – POLAR							✓				✓				✓					
FIRE AN IMMEDIATE MORTAR SMOKE MISSION																				
ADJUST MORTAR FINAL PROTECTIVE FIRE – ALL THREE METHODS																				
FIRE A MORTAR FINAL PROTECTIVE FIRE MISSION																				
FIRE A MORTAR QUICK SMOKE MISSION																				
FIRE A MORTAR PRIORITY TARGET MISSION																				
FIRE A TIME ON TARGET MORTAR FIRE MISSION																				
FIRE A MORTAR SEARCH, TRAVERSE, OR COMBINED MISSION																				
CONDUCT SIMULTANEOUS MORTAR FIRE MISSIONS							✓				✓									
FIRE A MORTAR ILLUMINATION MISSION							✓				✓				✓					
FIRE A MORTAR COORDINATED ILLUMINATION MISSION																				

FILL OUT THE BELOW SECTION AFTER THE COMPLETION OF TABLE IV

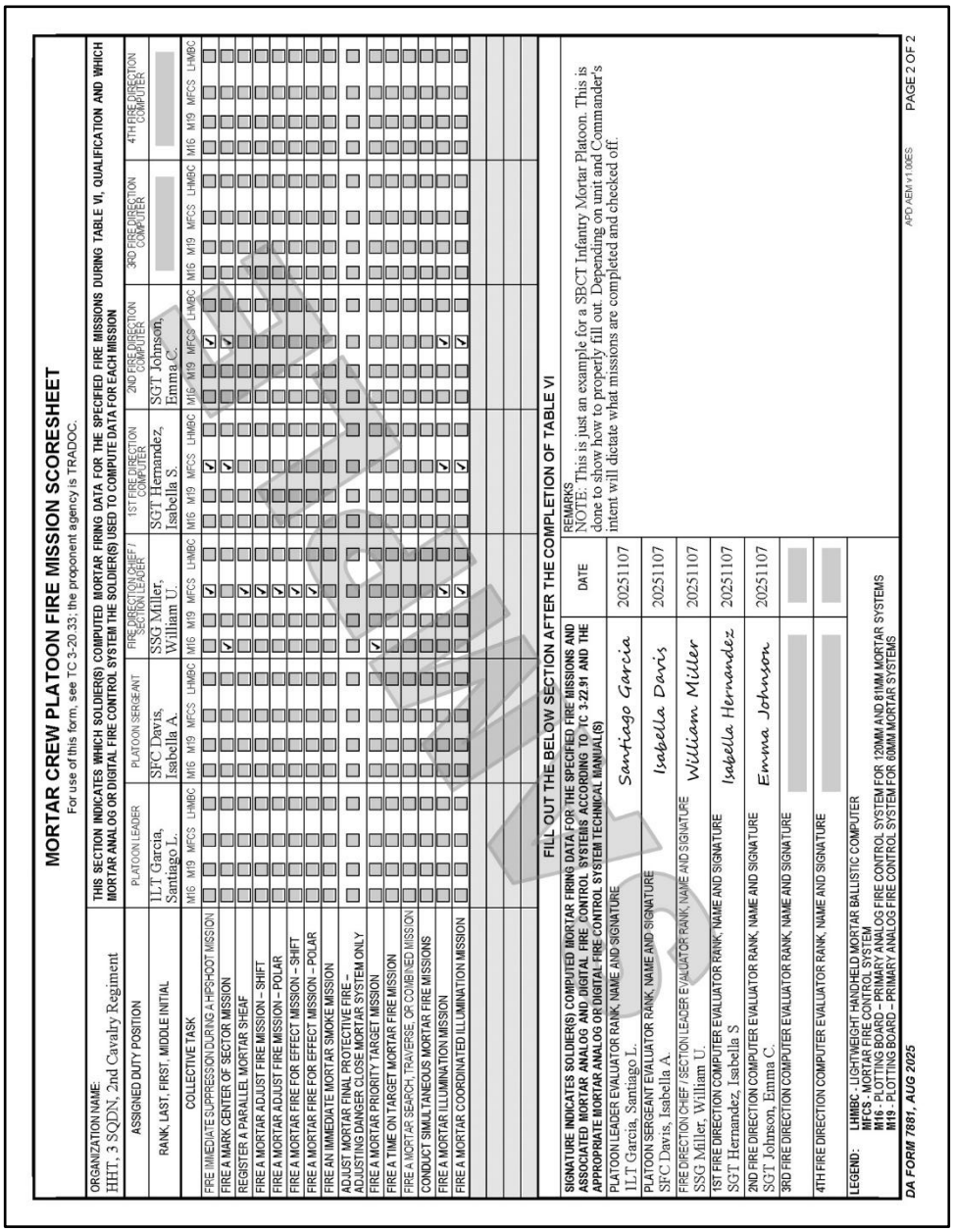
SIGNATURE INDICATES SOLDIER(S) COMPUTED MORTAR FIRING DATA FOR THE SPECIFIED FIRE MISSIONS AND ASSOCIATED MORTAR ANALOG AND DIGITAL FIRE CONTROL SYSTEMS ACCORDING TO TC 3-22.91 AND THE APPROPRIATE MORTAR ANALOG OR DIGITAL FIRE CONTROL SYSTEM TECHNICAL MANUAL(S)

PLATOON LEADER EVALUATOR RANK, NAME AND SIGNATURE 1LT Garcia, Santiago L. *Santiago Garcia*	DATE 20251107	PLATOON SERGEANT EVALUATOR RANK, NAME AND SIGNATURE SFC Davis, Isabella A. *Isabella Davis*	DATE 20251107
FIRE DIRECTION CHIEF / SECTION LEADER EVALUATOR RANK, NAME AND SIGNATURE SSG Miller, William U. *William Miller*	20251107	1ST FIRE DIRECTION COMPUTER EVALUATOR RANK, NAME AND SIGNATURE SGT Hernandez, Isabella S. *Isabella Hernandez*	20251107
2ND FIRE DIRECTION COMPUTER EVALUATOR RANK, NAME AND SIGNATURE SGT Johnson, Emma C. *Emma Johnson*	20251107	3RD FIRE DIRECTION COMPUTER EVALUATOR RANK, NAME AND SIGNATURE	
4TH FIRE DIRECTION COMPUTER EVALUATOR RANK, NAME AND SIGNATURE		REMARKS NOTE: This is just an example for a SBCT Infantry Mortar Platoon. This is done to show how to properly fill out. Depending on unit and Commander's intent will dictate what missions are completed and checked off.	

LEGEND: LHMBC - LIGHTWEIGHT HANDHELD MORTAR BALLISTIC COMPUTER
MFCS - MORTAR FIRE CONTROL SYSTEM
M16 - PLOTTING BOARD – PRIMARY ANALOG FIRE CONTROL SYSTEM FOR 120MM AND 81MM MORTAR SYSTEMS
M19 - PLOTTING BOARD – PRIMARY ANALOG FIRE CONTROL SYSTEM FOR 60MM MORTAR SYSTEMS

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Figure E-5. DA Form 7881 (Mortar Crew Platoon Fire Mission Scoresheet) page 1



MORTAR CREW PLATOON FIRE MISSION SCORESHEET

For use of this form, see TC 3-20.33; the proponent agency is TRADOC.

ORGANIZATION NAME: HHT, 3 SQDN, 2nd Cavalry Regiment

THIS SECTION INDICATES WHICH SOLDIER(S) COMPUTED MORTAR FIRING DATA FOR THE SPECIFIED FIRE MISSIONS DURING TABLE VI, QUALIFICATION AND WHICH MORTAR ANALOG OR DIGITAL FIRE CONTROL SYSTEM THE SOLDIER(S) USED TO COMPUTE DATA FOR EACH MISSION

ASSIGNED DUTY POSITION	PLATOON LEADER	PLATOON SERGEANT	FIRE DIRECTION CHIEF / SECTION LEADER	1ST FIRE DIRECTION COMPUTER	2ND FIRE DIRECTION COMPUTER	3RD FIRE DIRECTION COMPUTER	4TH FIRE DIRECTION COMPUTER
RANK, LAST, FIRST, MIDDLE INITIAL	1LT Garcia, Santiago L.	SFC Davis, Isabella A.	SSG Miller, William U.	SGT Hernandez, Isabella S.	SGT Johnson, Emma C.		

COLLECTIVE TASK	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC
FIRE IMMEDIATE SUPPRESSION DURING A HIP/SHOOT MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐
FIRE A MARK CENTER OF SECTOR MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
REGISTER A PARALLEL MORTAR SHEAF	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
FIRE A MORTAR ADJUST FIRE MISSION – SHIFT	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
FIRE A MORTAR ADJUST FIRE MISSION – POLAR	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
FIRE A MORTAR FIRE FOR EFFECT MISSION – SHIFT	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
FIRE A MORTAR FIRE FOR EFFECT MISSION – POLAR	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐
FIRE AN IMMEDIATE MORTAR SMOKE MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
ADJUST MORTAR FINAL PROTECTIVE FIRE – ADJUSTING DANGER CLOSE MORTAR SYSTEM ONLY	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
FIRE A MORTAR PRIORITY TARGET MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
FIRE A TIME ON TARGET MORTAR FIRE MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
FIRE A MORTAR SEARCH, TRAVERSE, OR COMBINED MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
CONDUCT SIMULTANEOUS MORTAR FIRE MISSIONS	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
FIRE A MORTAR ILLUMINATION MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐	☐
FIRE A MORTAR COORDINATED ILLUMINATION MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐	☐

FILL OUT THE BELOW SECTION AFTER THE COMPLETION OF TABLE VI

SIGNATURE INDICATES SOLDIER(S) COMPUTED MORTAR FIRING DATA FOR THE SPECIFIED FIRE MISSIONS AND ASSOCIATED MORTAR ANALOG AND DIGITAL FIRE CONTROL SYSTEMS ACCORDING TO TC 3-22.91 AND THE APPROPRIATE MORTAR ANALOG OR DIGITAL FIRE CONTROL SYSTEM TECHNICAL MANUAL(S)

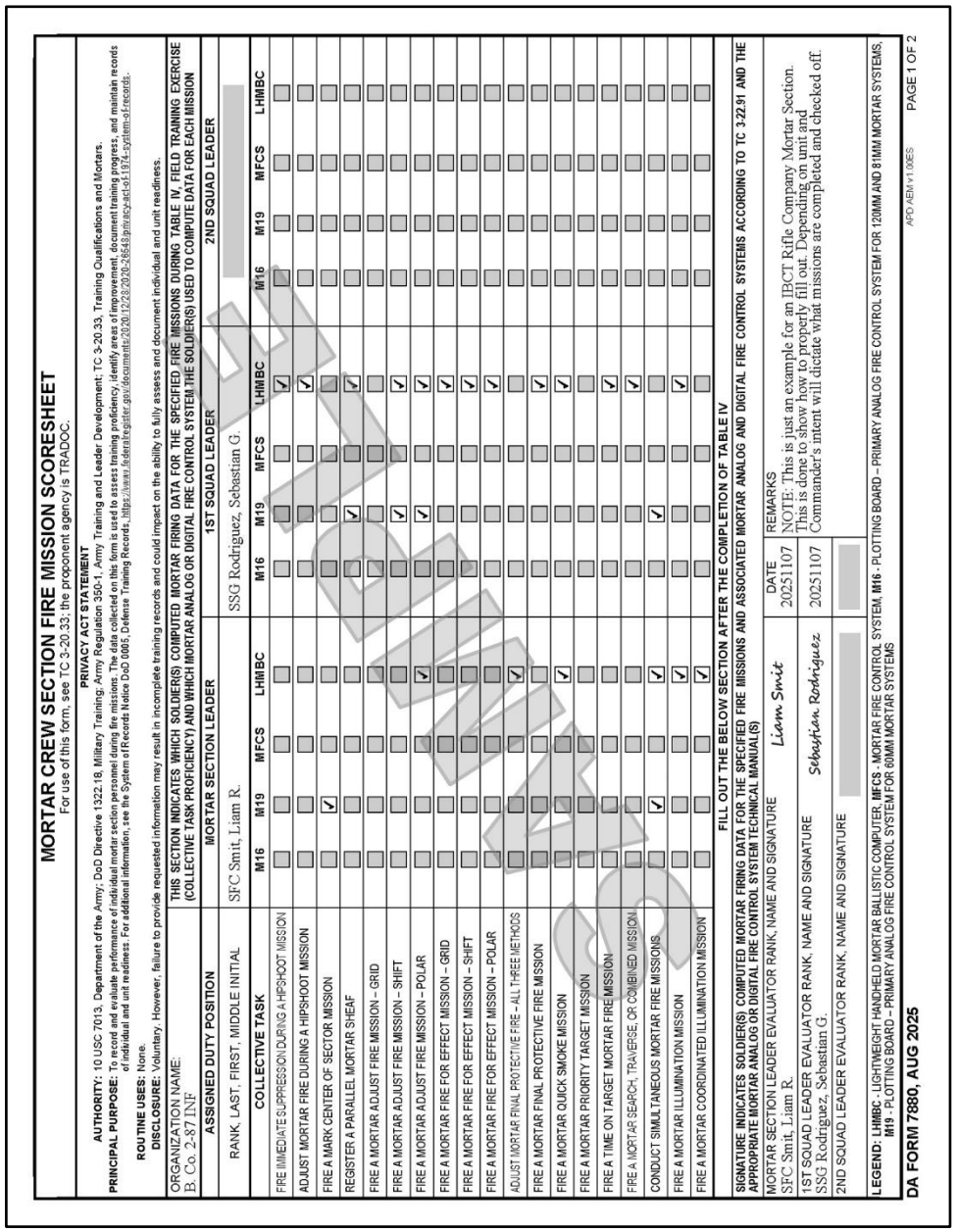
	DATE
PLATOON LEADER EVALUATOR RANK, NAME AND SIGNATURE 1LT Garcia, Santiago L. *Santiago Garcia*	20251107
PLATOON SERGEANT EVALUATOR RANK, NAME AND SIGNATURE SFC Davis, Isabella A. *Isabella Davis*	20251107
FIRE DIRECTION CHIEF / SECTION LEADER EVALUATOR RANK, NAME AND SIGNATURE SSG Miller, William U. *William Miller*	20251107
1ST FIRE DIRECTION COMPUTER EVALUATOR RANK, NAME AND SIGNATURE SGT Hernandez, Isabella S *Isabella Hernandez*	20251107
2ND FIRE DIRECTION COMPUTER EVALUATOR RANK, NAME AND SIGNATURE SGT Johnson, Emma C. *Emma Johnson*	20251107
3RD FIRE DIRECTION COMPUTER EVALUATOR RANK, NAME AND SIGNATURE	
4TH FIRE DIRECTION COMPUTER EVALUATOR RANK, NAME AND SIGNATURE	

REMARKS
NOTE: This is just an example for a SBCT Infantry Mortar Platoon. This is done to show how to properly fill out. Depending on unit and Commander's intent will dictate what missions are completed and checked off.

LEGEND: **LHMBC** - LIGHTWEIGHT HANDHELD MORTAR BALLISTIC COMPUTER
MFCS - MORTAR FIRE CONTROL SYSTEM
M16 - PLOTTING BOARD – PRIMARY ANALOG FIRE CONTROL SYSTEM FOR 120MM AND 81MM MORTAR SYSTEMS
M19 - PLOTTING BOARD – PRIMARY ANALOG FIRE CONTROL SYSTEM FOR 60MM MORTAR SYSTEMS

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Figure E-6. DA Form 7881 (Mortar Crew Platoon Fire Mission Scoresheet) page 2



MORTAR CREW SECTION FIRE MISSION SCORESHEET

For use of this form, see TC 3-20.33; the proponent agency is TRADOC.

PRIVACY ACT STATEMENT

AUTHORITY: 10 USC 7013, Department of the Army; DoD Directive 1322.18, Military Training; Army Regulation 350-1, Army Training and Leader Development; TC 3-20.33, Training Qualifications and Mortars.

PRINCIPAL PURPOSE: To record and evaluate performance of individual mortar section personnel during fire missions. The data collected on this form is used to assess training proficiency, identify areas of improvement, document training progress, and maintain records of individual and unit readiness. For additional information, see the System of Records Notice DoD 0005, Defense Training Records., https://www.federalregister.gov/documents/2020/12/28/2020-28643/privacy-act-of-1974-system-of-records.

ROUTINE USES: None.

DISCLOSURE: Voluntary. However, failure to provide requested information may result in incomplete training records and could impact on the ability to fully assess and document individual and unit readiness.

ORGANIZATION NAME: B. Co. 2-87 INF

THIS SECTION INDICATES WHICH SOLDIER(S) COMPUTED MORTAR FIRING DATA FOR THE SPECIFIED FIRE MISSIONS DURING TABLE IV, FIELD TRAINING EXERCISE (COLLECTIVE TASK PROFICIENCY) AND WHICH MORTAR ANALOG OR DIGITAL FIRE CONTROL SYSTEM THE SOLDIER(S) USED TO COMPUTE DATA FOR EACH MISSION

ASSIGNED DUTY POSITION	MORTAR SECTION LEADER				1ST SQUAD LEADER				2ND SQUAD LEADER			
RANK, LAST, FIRST, MIDDLE INITIAL	SFC Smit, Liam R.				SSG Rodriguez, Sebastian G.							
COLLECTIVE TASK	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC
FIRE IMMEDIATE SUPPRESSION DURING A HIPSHOOT MISSION	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
ADJUST MORTAR FIRE DURING A HIPSHOOT MISSION	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
FIRE A MARK CENTER OF SECTOR MISSION	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
REGISTER A PARALLEL MORTAR SHEAF	☐	☐	☐	☐	☐	☑	☐	☑	☐	☐	☐	☐
FIRE A MORTAR ADJUST FIRE MISSION – GRID	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
FIRE A MORTAR ADJUST FIRE MISSION – SHIFT	☐	☐	☐	☐	☐	☑	☐	☑	☐	☐	☐	☐
FIRE A MORTAR ADJUST FIRE MISSION – POLAR	☐	☐	☐	☑	☐	☑	☐	☑	☐	☐	☐	☐
FIRE A MORTAR FIRE FOR EFFECT MISSION – GRID	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
FIRE A MORTAR FIRE FOR EFFECT MISSION – SHIFT	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
FIRE A MORTAR FIRE FOR EFFECT MISSION – POLAR	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
ADJUST MORTAR FINAL PROTECTIVE FIRE – ALL THREE METHODS	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐
FIRE A MORTAR FINAL PROTECTIVE FIRE MISSION	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
FIRE A MORTAR QUICK SMOKE MISSION	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐
FIRE A MORTAR PRIORITY TARGET MISSION	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
FIRE A TIME ON TARGET MORTAR FIRE MISSION	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
FIRE A MORTAR SEARCH, TRAVERSE, OR COMBINED MISSION	☐	☐	☐	☐	☐	☐	☐	☑	☐	☐	☐	☐
CONDUCT SIMULTANEOUS MORTAR FIRE MISSIONS	☐	☑	☐	☑	☐	☑	☐	☐	☐	☐	☐	☐
FIRE A MORTAR ILLUMINATION MISSION	☐	☐	☐	☑	☐	☐	☐	☑	☐	☐	☐	☐
FIRE A MORTAR COORDINATED ILLUMINATION MISSION	☐	☐	☐	☑	☐	☐	☐	☐	☐	☐	☐	☐

FILL OUT THE BELOW SECTION AFTER THE COMPLETION OF TABLE IV

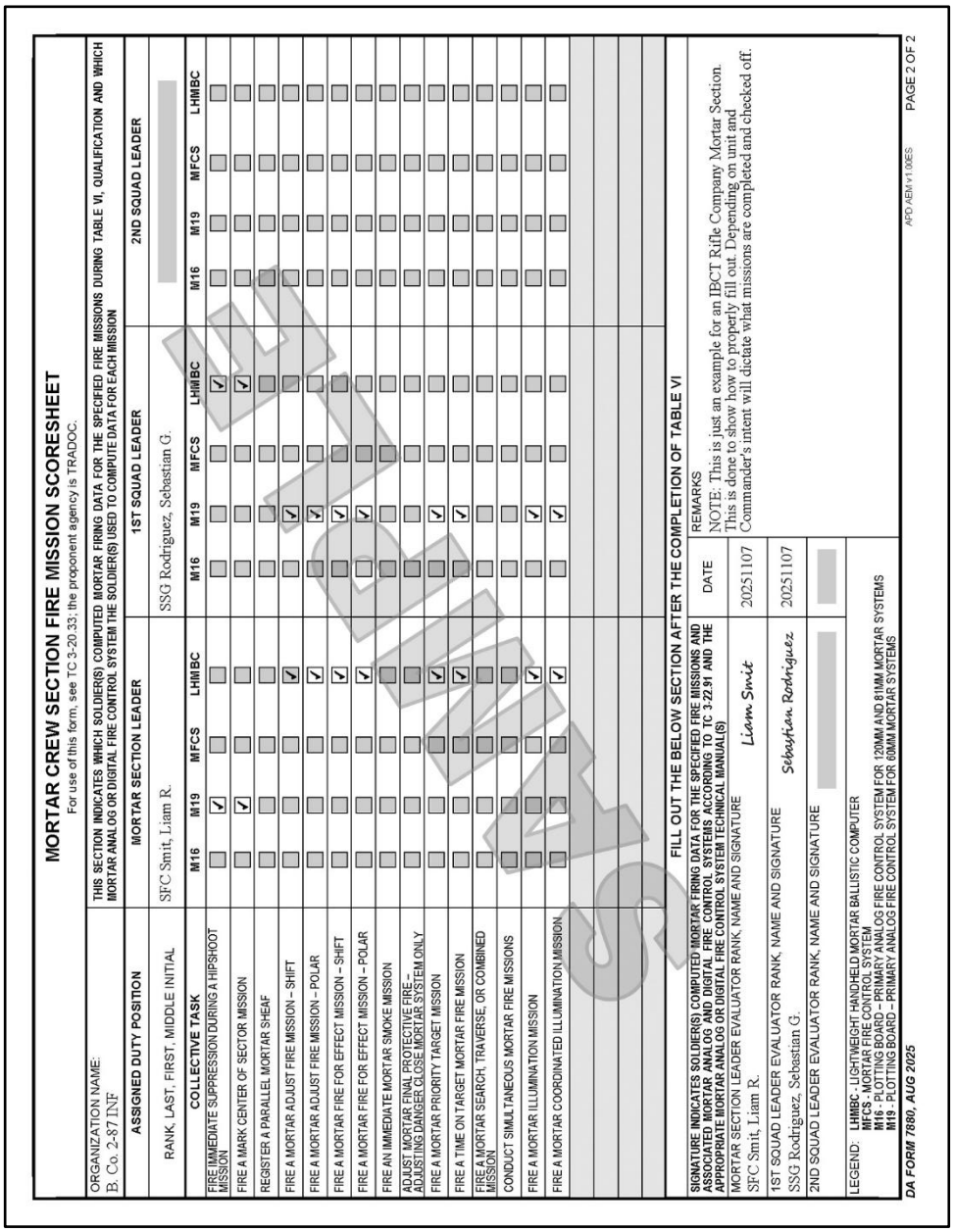
SIGNATURE INDICATES SOLDIER(S) COMPUTED MORTAR FIRING DATA FOR THE SPECIFIED FIRE MISSIONS AND ASSOCIATED MORTAR ANALOG AND DIGITAL FIRE CONTROL SYSTEMS ACCORDING TO TC 3-22.91 AND THE APPROPRIATE MORTAR ANALOG OR DIGITAL FIRE CONTROL SYSTEM TECHNICAL MANUAL(S)

		DATE	REMARKS
MORTAR SECTION LEADER EVALUATOR RANK, NAME AND SIGNATURE SFC Smit, Liam R.	*Liam Smit*	20251107	NOTE: This is just an example for an IBCT Rifle Company Mortar Section. This is done to show how to properly fill out. Depending on unit and Commander's intent will dictate what missions are completed and checked off.
1ST SQUAD LEADER EVALUATOR RANK, NAME AND SIGNATURE SSG Rodriguez, Sebastian G.	*Sebastian Rodriguez*	20251107	
2ND SQUAD LEADER EVALUATOR RANK, NAME AND SIGNATURE			

LEGEND: LHMBC - LIGHTWEIGHT HANDHELD MORTAR BALLISTIC COMPUTER; **MFCS** - MORTAR FIRE CONTROL SYSTEM; **M16** - PLOTTING BOARD – PRIMARY ANALOG FIRE CONTROL SYSTEM FOR 120MM AND 81MM MORTAR SYSTEMS; **M19** - PLOTTING BOARD – PRIMARY ANALOG FIRE CONTROL SYSTEM FOR 60MM MORTAR SYSTEMS

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Figure E-7. DA Form 7880 (Mortar Crew Section Fire Mission Scoresheet) page 1



MORTAR CREW SECTION FIRE MISSION SCORESHEET

For use of this form, see TC 3-20.33; the proponent agency is TRADOC.

ORGANIZATION NAME: B. Co. 2-87 INF

THIS SECTION INDICATES WHICH SOLDIER(S) COMPUTED MORTAR FIRING DATA FOR THE SPECIFIED FIRE MISSIONS DURING TABLE VI, QUALIFICATION AND WHICH MORTAR ANALOG OR DIGITAL FIRE CONTROL SYSTEM THE SOLDIER(S) USED TO COMPUTE DATA FOR EACH MISSION

ASSIGNED DUTY POSITION	MORTAR SECTION LEADER				1ST SQUAD LEADER				2ND SQUAD LEADER			
RANK, LAST, FIRST, MIDDLE INITIAL	SFC Smit, Liam R.				SSG Rodriguez, Sebastian G.							
COLLECTIVE TASK	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC	M16	M19	MFCS	LHMBC
FIRE IMMEDIATE SUPPRESSION DURING A HIPSHOOT MISSION		✓						✓				
FIRE A MARK CENTER OF SECTOR MISSION		✓						✓				
REGISTER A PARALLEL MORTAR SHEAF												
FIRE A MORTAR ADJUST FIRE MISSION – SHIFT				✓		✓						
FIRE A MORTAR ADJUST FIRE MISSION – POLAR				✓		✓						
FIRE A MORTAR FIRE FOR EFFECT MISSION – SHIFT				✓		✓						
FIRE A MORTAR FIRE FOR EFFECT MISSION – POLAR				✓		✓						
FIRE AN IMMEDIATE MORTAR SMOKE MISSION												
ADJUST MORTAR FINAL PROTECTIVE FIRE – ADJUSTING DANGER CLOSE MORTAR SYSTEM ONLY												
FIRE A MORTAR PRIORITY TARGET MISSION				✓		✓						
FIRE A TIME ON TARGET MORTAR FIRE MISSION				✓		✓						
FIRE A MORTAR SEARCH, TRAVERSE, OR COMBINED MISSION												
CONDUCT SIMULTANEOUS MORTAR FIRE MISSIONS												
FIRE A MORTAR ILLUMINATION MISSION				✓		✓						
FIRE A MORTAR COORDINATED ILLUMINATION MISSION				✓		✓						

FILL OUT THE BELOW SECTION AFTER THE COMPLETION OF TABLE VI

SIGNATURE INDICATES SOLDIER(S) COMPUTED MORTAR FIRING DATA FOR THE SPECIFIED FIRE MISSIONS AND ASSOCIATED MORTAR ANALOG AND DIGITAL FIRE CONTROL SYSTEMS ACCORDING TO TC 3-22.91 AND THE APPROPRIATE MORTAR ANALOG OR DIGITAL FIRE CONTROL SYSTEM TECHNICAL MANUAL(S)	DATE
MORTAR SECTION LEADER EVALUATOR RANK, NAME AND SIGNATURE SFC Smit, Liam R. *Liam Smit*	20251107
1ST SQUAD LEADER EVALUATOR RANK, NAME AND SIGNATURE SSG Rodriguez, Sebastian G *Sebastian Rodriguez*	20251107
2ND SQUAD LEADER EVALUATOR RANK, NAME AND SIGNATURE	

REMARKS

NOTE: This is just an example for an IBCT Rifle Company Mortar Section. This is done to show how to properly fill out. Depending on unit and Commander's intent will dictate what missions are completed and checked off.

LEGEND: **LHMBC** - LIGHTWEIGHT HANDHELD MORTAR BALLISTIC COMPUTER
MFCS - MORTAR FIRE CONTROL SYSTEM
M16 - PLOTTING BOARD – PRIMARY ANALOG FIRE CONTROL SYSTEM FOR 120MM AND 81MM MORTAR SYSTEMS
M19 - PLOTTING BOARD – PRIMARY ANALOG FIRE CONTROL SYSTEM FOR 60MM MORTAR SYSTEMS

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Figure E-8. DA Form 7880 (Mortar Crew Section Fire Mission Scoresheet) page 2

E-10. Use of DA Forms 7880 and 7881 will be the new qualification card for mortars through Table VI of mortar gunnery. It will be considered a matter of record showing that the mortar platoon or section is fully qualified.

Glossary

The glossary lists acronyms for TC 3-22.91.

ACRONYMS AND ABBREVIATIONS

ABCT	Armored brigade combat team
AC	alternating current
ACA	airspace coordination area
A/F	adjust fire
AFATDS	Advanced Field Artillery Tactical Data System
AMC	at my command
ATP	Army techniques publication
BOLAD	boundary outer limit alert distance
CFF	call for fire
ChkFire	check fire
CI	commander's interface
Commo	communication
COMSEC	communications security
DA	Department of Army
DC	direct current
DCT	deflection conversion table
DEFK	deflection correction
DF	deflection
DLY	delay
DNL	do not load
DOF	direction of fire
DTG	date-time group
En	enabled
EOM	end of mission
FC	fires cell
FDC	fire direction center
FFE	fire for effect
FIST	fire support team

FM	field manual
FO	forward observer
FOS	forward observer system
FP	fire plan
FPF	final protective fire
FSCM	fire support coordination measure
FSE	fire support element
FSO	fire support officer
FT	firing table
G-M	grid-magnetic
GEOREF	geographic reference
GPS	Global Positioning System
GT	gun target
GTL	gun-target line
GUI	graphic user interface
HE	high explosive
HOB	height of burst
IBCT	Infantry brigade combat team
ID	identification
ILL	illumination
IM	immediate
IMP	impact
IP	Internet protocol
IR	infrared
IS	immediate suppression
JMEM	Joint Munitions Effectiveness Manual
KP	known point
LARS	left add, right subtract
LCD	liquid crystal display
LED	light-emitting diode
LHMBC	Lightweight Handheld Mortar Ballistic Computer
LL	left lateral
M	mils
Map Mod	map modification
MAZ	mounting azimuth
MazRef	mounting azimuth and reference

MCS	mark center sector
MCO	Marine Corps order
MCTP	Marine Corps tactical publication
MDP	meteorological datum plane
MET	meteorological
METL	mission-essential task list
METT-TC (I)	mission, enemy, terrain and weather, troops and support available, time available, civil considerations, and informational considerations
MFCS	mortar fire control system
MFCS-D	mortar fire control system-dismounted
MFP	mortar firing position
MGRS	military grid reference system
mm	millimeter
Mnt Az	mounting azimuth
MOC	method of control
MOF	method of fire
MPI	mean point of impact
MPS	meters per second
MSD	minimum safe distance
Msn	mission
MTO	message to observer
NFA	no-fire area
Obs Num	observer number
OK	okay
OpAck	operationally acknowledge
OT	observer-target
PD	pointing device
PE	probable error
PEd	probable error in deflection
PEr	probable error in range
PI	probability of incapacitation
POS	position
Prop Tmp	propellant temperature
PROX	proximity
PTM	plain text message

R	range
RCF	range control correction factor
Ref	referred deflection
RFA	restrictive fire area
RFL	restrictive fire line
RL	right lateral
RMS6-L	Recoil Mortar System 6-Light
RP	registration point
RPDA	ruggedized personal digital assistant
RPM	rounds per minute
RTO	radiotelephone operator
SBCT	Stryker brigade combat team
SINCGARS	single-channel ground and airborne radio system
SOP	standard operating procedure
TC	training circular
TCIM	tactical communication interface modem
TFT	tabular firing table
TGT	target
TM	technical manual
TOF	time of flight
TRC	total range correction
TS	traverse station
U.S.	United States
UTM	universal transverse Mercator
VI	vertical interval
VMF	variable message format
VMS	vehicle motion sensor
WGS 84	World Geodetic System 1984
WP	white phosphorous
W	width
WR	when ready

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REQUIRED PUBLICATIONS

These documents must be available to intended users of this publication.

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24 March 2026

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RANDY A. GEORGE
General, United States Army
Chief of Staff

Official:



MATTHEW L. SANNITO
Administrative Assistant
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