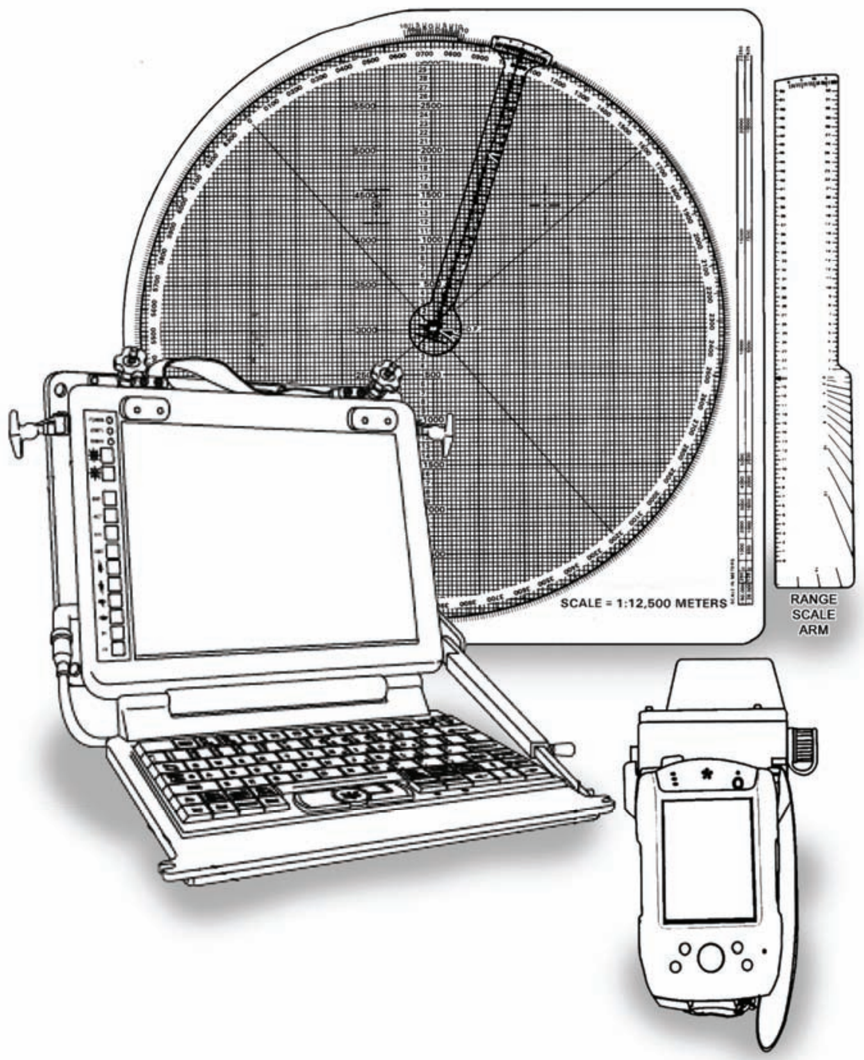
FM 3-22.91

MORTAR FIRE DIRECTION PROCEDURES



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Mortar Fire Direction Procedures

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Preface

This manual provides guidance for military occupational specialty (MOS) 11C Soldiers and their trainers on the employment of the 60-mm mortars (M224), 81-mm mortar (M252), and 120-mm mortar (M120). 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 FM 3-22.90 for information about mechanical training, crew drills, and the characteristics, components, and technical data of each mortar.)

This manual is divided into six parts. Part 1 discusses the fundamentals of mortar fire direction; Part 2 summarizes the operational procedures of a fire direction center (FDC); Part 3 describes the capabilities and use of the mortar ballistic computer (MBC); Part 4 describes the capabilities and use of the M16/M19 plotting boards; Part 5 discusses the Mortar Fire Control System (MFCS); and Part 6 discusses the lightweight handheld mortar ballistic computer (LHMBC).

This manual was revised to delete references to obsolete material and systems and add references to new material and systems. In addition to various editorial corrections, this revision—

- Removes all references to M2 and M19 mortar systems, as they are now obsolete.
- Removes all references to M29 and M29A1 mortar systems, as they are now obsolete, except for M29A1 use with the M303 subcaliber insert.
- Adds references to the LHMBC.
- Replaces references to common terms with their accepted modifications.

This publication prescribes DA Form 2188-R (Data Sheet), DA Form 2188-1-R (LHMBC/MFCS Data Sheet), DA Form 2399-R (Computer's Record), DA Form 5472-R (Computer's Record [MPI]), DA Form 2601-2-R (MET Data Correction Sheet 6400 Mils [Mortars]), and DA Form 2601-1-R (MET Data Correction Sheet for Mortars).

This publication applies to the Active Army, the Army National Guard (ARNG)/Army National Guard of the United States (ARNGUS), and the US Army Reserve (USAR) unless otherwise stated.

Terms that have joint or Army definitions are identified in both the glossary and the text. Terms for which FM 3-22.91 is the proponent FM are indicated with an asterisk in the glossary.

Uniforms depicted in this manual were drawn without camouflage for clarity of the illustration. Unless this publication states otherwise, masculine nouns and pronouns refer to both men and women.

The proponent for this publication is the US Army Training and Doctrine Command. The preparing agency is the US Army Infantry School. You may send comments and recommendations by any means (US mail, e-mail, fax, or telephone) as long as you use DA Form 2028 (Recommended Changes to Publications and Blank Forms) or follow its format. Point of contact information is as follows:

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PART ONE

Introduction and Fundamentals of Mortar Fire Direction

Chapter 1

Introduction

The mission of the mortar platoon is to provide close and immediate indirect fire support for maneuver battalions and companies.

ORGANIZATION

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

GENERAL DOCTRINE

1-2. Doctrine demands the timely and accurate delivery of indirect fire to meet the needs of supported units. All members of the indirect fire team must strive to reduce, by all possible measures, the time required to execute an effective fire mission; they must be thoroughly indoctrinated with a sense of urgency. A key principle of effective training is the use of appropriate doctrine. (See Appendix A for more information.)

1-3. Good observation is required for effective mortar fire. Limited observation results in a great expenditure of ammunition and less effective fire. Every target needs some type of observation to ensure that fire is placed on the target. Observation of close battle areas is usually visual. Radar or sound observation is best used 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. Lack of observation, however, must not preclude firing on targets that can be located by other means.

1-4. Mortar fire must be delivered using the most accurate means that time and the tactical situation permit. When possible, survey data will be used to accurately locate the mortar position and target. Under some conditions, only a rapid estimate of the relative location of weapons and targets may be possible.

1-5. To achieve effective massed fires, units should survey the area using accurate maps of mortar positions, registration points (RPs), and targets. 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 should be as brief as possible.

1-6. Mortars can inflict the greatest demoralizing effect on the enemy by delivering as many rounds as possible (from all mortars in a section or platoon) in the shortest period of time possible.

1-7. Mortar units must be prepared to handle 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.

1-8. In HBCT battalions, units can normally fire mortars from mortar carriers (mortars maintain their ground-mounted capability). This permits rapid displacement and quick reaction to the tactical situation.

INDIRECT FIRE TEAM

1-9. The team mission is to provide 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 are a team effort (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 is normally 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 consists of a fire support officer (FSO) in the fires cell (FC), forward observer (FO), a fire direction center (FDC), and mortar squads.

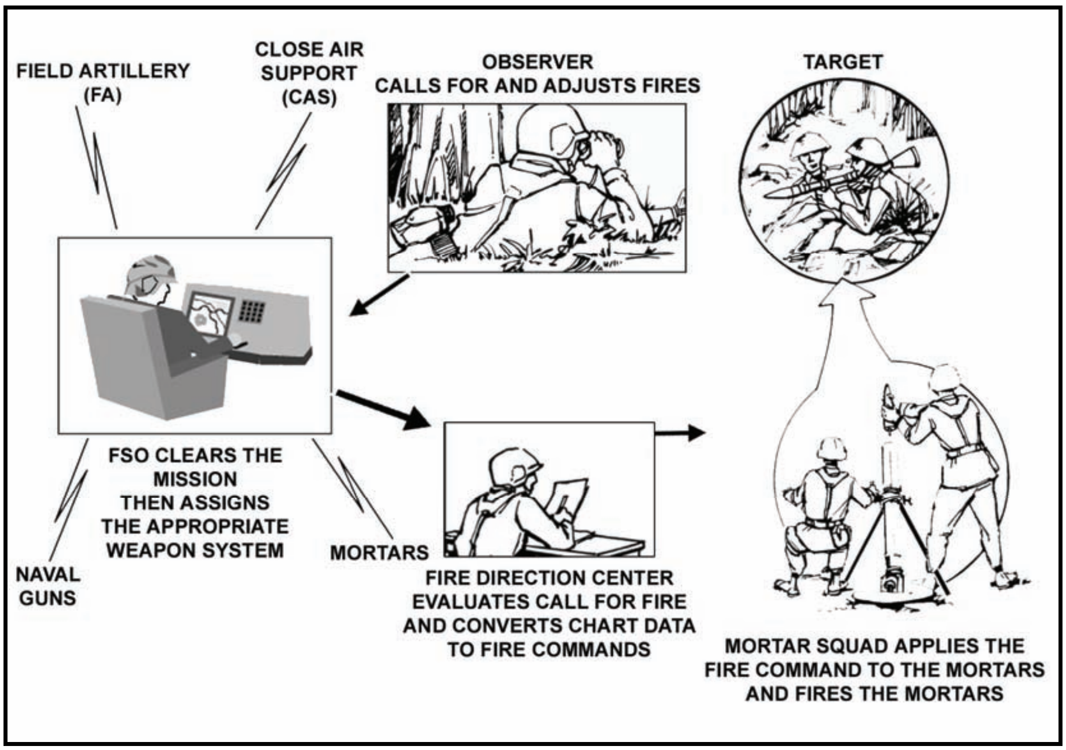

Figure 1-1. Indirect fire team.

1-10. The battalion FSO coordinates and synchronizes fire support for the maneuver battalion. He is in charge of the FC and is 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 for the unit to the FSO. Table 1-1 shows the organization of an FC in support of IBCT and HBCT battalions.

Table 1-1. Battalion fire support personnel.

BATTALION FIRE SUPPORT PERSONNEL		
	IBCT	HBCT
FSO	1	1
Fire Support Plans/ Targeting Officer	0	1
Fire Support Sergeant	1	1
Fire Support Specialist	2	2
Radio/Telephone Operators	0	2

1-11. The battalion HHC fire support platoon provides FISTs 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 fire support team (FIST) in support of IBCT and HBCT companies.

Table 1-2. Company fire support personnel.

COMPANY FIRE SUPPORT PERSONNEL		
	IBCT	HBCT
Company FSO	1	1
Fire Support Sergeant	1	1
Fire Support Specialist	1	1
Radio Operator	1	1
Platoon FO	3	0
Platoon FO Radio Operator	3	0

1-12. The FDC has two computer personnel in each section (except the 60-mm squad, which does not have assigned FDC personnel) 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.

1-13. Mortar squads organic to HBCT, and IBCT battalions consist of one squad leader, one gunner, one assistant gunner, and one ammunition bearer/driver. At company level, IBCT units have one six-man section consisting of one section sergeant, 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 are applied, the squad fires the mortar. The squad must also be able to fire without an FDC.

MORTAR POSITIONS

1-14. To protect mortars from enemy direct fire and observation, units should employ mortars in defilade positions when possible. These positions can also take the greatest advantage of the indirect fire role of mortars.

1-15. The use of defilade precludes sighting weapons directly at the target (direct lay); this is necessary for survival.

1-16. 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 also ensures the timely and accurate engagement of targets.

1-17. To apply the essential information and engage the target from a defilade position—

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

MISSIONS AND FIRE DIRECTION CONTROL PROCEDURES

1-18. Basic FDC procedures are the foundation of all mortar missions. Basic mortar missions consist only of basic FDC procedures, but special mortar missions include special FDC procedures, such as control measures.

BASIC FIRE DIRECTION CENTER PROCEDURES

1-19. Basic FDC procedures include—

- Grid.
- Shift from a known point.
- Polar plot.
- Special sheaf adjustments.
- Registration.
- Meteorological (MET) correction.

Grid

1-20. For a grid mission, the observer expresses the target location using the target's grid coordinates.

Shift from a Known Point

1-21. 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.

Polar Plot

1-22. For a polar plot mission, the observer expresses the target location using the target's direction and distance from the observer. The observer's location must be known prior to calling a polar plot mission.

Special Sheaf Adjustments

1-23. 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.

Registration

1-24. Registration involves applying fire corrections to resolve interior and exterior ballistics and errors in gun/target location. This process is similar to zeroing a rifle.

Meteorological Correction

1-25. MET correction involves correcting for variations in weather conditions.

SPECIAL FIRE DIRECTION CENTER PROCEDURES

1-26. Special FDC procedures include—

- Search.
- Traverse.
- Search and traverse.
- Illumination.
- Coordinated illumination.
- Split.
- Simo.
- Final protective fire (FPF).
- Smoke.

Search

1-27. Mortarmen use search procedures to fire upon targets that are deeper than the burst diameter of the round being fired.

> **NOTE:** Search procedures exclude use of the Mortar Fire Control System (MFCS).

Traverse

1-28. Mortarmen use traverse procedures to fire upon targets that are wider than the sections/platoons that engage them.

> **NOTE:** Traverse procedures exclude use of the MFCS.

Search and Traverse

1-29. Mortarmen use search and traverse procedures to fire upon targets with attitudes neither parallel nor perpendicular to the gun-target line.

> **NOTE:** Search and traverse procedures apply to the lightweight handheld mortar ballistic computer (LHMBC) only.

Illumination

1-30. Mortarmen use illumination procedures to illuminate a portion of the battlefield.

Coordinated Illumination

1-31. Coordinated illumination procedures combine illumination with high-explosive (HE), red phosphorus, or white phosphorus (WP) to illuminate and engage a target.

Split

1-32. Split procedures involve firing upon a single target from more than one location.

Simo

1-33. Simo procedures involve simultaneous fire upon two targets from a single location.

Final Protective Fire

1-34. Final protective fire (FPF) is a final defensive measure to prevent friendly units from being overrun.

Smoke

1-35. Mortarmen 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 screen or curtain.

FIRE CONTROL SYSTEMS

1-36. The six fire control systems include—

- M16 plotting board.
- M19 plotting board.
- M23 mortar ballistic computer (MBC).
- M95 MFCS.
- M96 MFCS.
- M32 LHMBC.

M16 Plotting Board

1-37. HBCT and IBCT BN Mortar, forces use the M16 plotting board as a backup manual fire control system.

M19 Plotting Board

1-38. IBCT Company sections use the M19 plotting board as a backup manual fire control system.

M23 Mortar Ballistics Computer

1-39. Since 1985, the M23 MBC has been the primary electronic fire control system for IBCT and HBCT forces, but it is currently being replaced by the M95 MFCS, M96 MFCS, or M32 LHMBC.

M95 Mortar Fire Control System

1-40. The M95 MFCS is installed in M1064 and M1129 Stryker mortar carriers.

M96 Mortar Fire Control System

1-41. The M96 MFCS is installed in the M577 in the HBCT.

M32 Lightweight Handheld Mortar Ballistic Computer

1-42. The M32 LHMBC is the new primary electronic fire control system for all dismounted forces.

Chapter 2

Fundamentals of Mortar Fire Direction

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

SECTION I. ELEMENTS OF FIRING DATA AND BALLISTICS

Mortarmen apply firing data to ammunition and mortars so that the fired projectile bursts at the desired location. These data are based on the direction, horizontal range, and vertical interval (VI) from the mortar to the target; the pattern of bursts desired at the target; and MET conditions. (See Appendix C for more information.)

DIRECTION

2-1. In mortar gunnery, direction is a horizontal angle measured from a fixed reference. 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 mounting azimuth, and then uses the direction to make angular shifts onto the target. Direction to the target may be computed, determined graphically, or estimated (Figure 2-1).

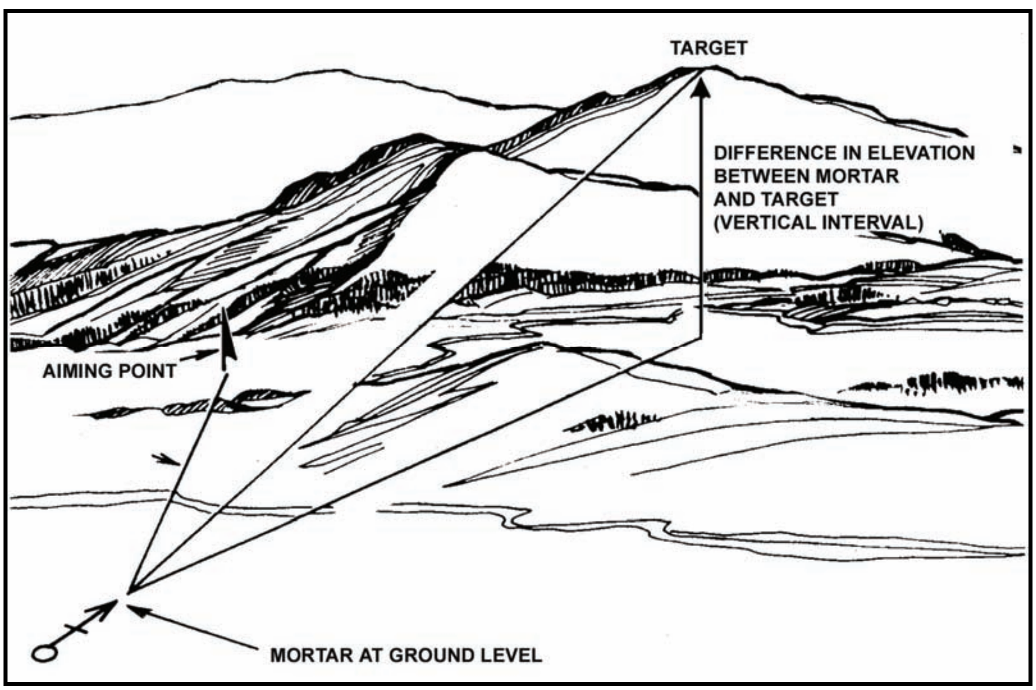

Figure 2-1. Direction to the target.

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

2-2. 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 elevation of the mortar.

VERTICAL INTERVAL

2-3. VI is the altitude 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

2-4. 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, mortarmen 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

2-5. Interior ballistics deals with 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).

NATURE OF PROPELLANTS AND PROJECTILE MOVEMENTS

2-6. Propellant, a low-order explosive that burns rather than detonates, 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.

2-7. 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.

2-8. Factors that affect the velocity of a mortar-ammunition combination include—

- 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 the 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.

STANDARD MUZZLE VELOCITY

2-9. Firing tables give the standard muzzle velocity for each charge. Values are based on a standard barrel and are guides, since they cannot be reproduced in a given instance. A specific mortar-ammunition combination cannot be selected with the assurance that it will result in a standard muzzle velocity when fired. Charge velocities are established indirectly by the military characteristics of a weapon. 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

2-10. 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

2-11. 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

2-12. 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 rotating disk, affect muzzle velocity. Projectile variations have a much more apparent effect on exterior ballistics than on interior ballistics.

TOLERANCES IN NEW WEAPONS

2-13. 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 armed with new mortars fires with a common lot of ammunition, mortars with the highest and lowest muzzle velocity will have a velocity difference of 3 or 4 MPS.

WEAR OF BARREL

2-14. 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

2-15. 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. Firing tables 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. The temperature of propellants in sealed packing cases remains fairly uniform, though not always standard (70 degrees Fahrenheit).

2-16. Once the propellant is unpacked, its temperature tends to approach 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 is erratic. A sudden change in propellant temperature can invalidate even the most recent corrections.

2-17. To let propellants reach air temperature uniformly—

- Ready ammunition should be kept off of the ground.
- Ammunition should be protected from dirt, moisture, and direct sunrays.
- An airspace should be created between the ammunition and protective covering.
- Unpack a sufficient number of 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

2-18. 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

2-19. The temperature of the barrel affects the muzzle velocity. A cold barrel offers more resistance to projectile movement than a warm barrel.

PROPELLANT RESIDUES

2-20. Burned propellant and certain chemical agents mixed with expanding gases cause residue deposits on the bore surface. Properly clean and care for the barrel to prevent such deposits from causing pits in the barrel (pitting will increase abrasion by the projectiles).

OIL OR MOISTURE

2-21. Oil or moisture in the barrel or on the rotating disk increases a round’s velocity by causing a better initial gas seal and reducing projectile friction on the bore surface. Too much oil or moisture in the barrel, however, decreases velocity, causing a short round.

EXTERIOR BALLISTICS

2-22. 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. When projectiles are fired into the air, their paths differ, since projectiles of different sizes or weights respond differently to the same atmospheric conditions. A given elevation and muzzle velocity can also result in a wide variety of trajectories, depending on the combined properties of the projectile and the atmosphere.

TRAJECTORY

2-23. Trajectory is the flight path that a projectile follows from the muzzle of the mortar to its point of impact (Figure 2-2). 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 summit, 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 summit above the point of origin.

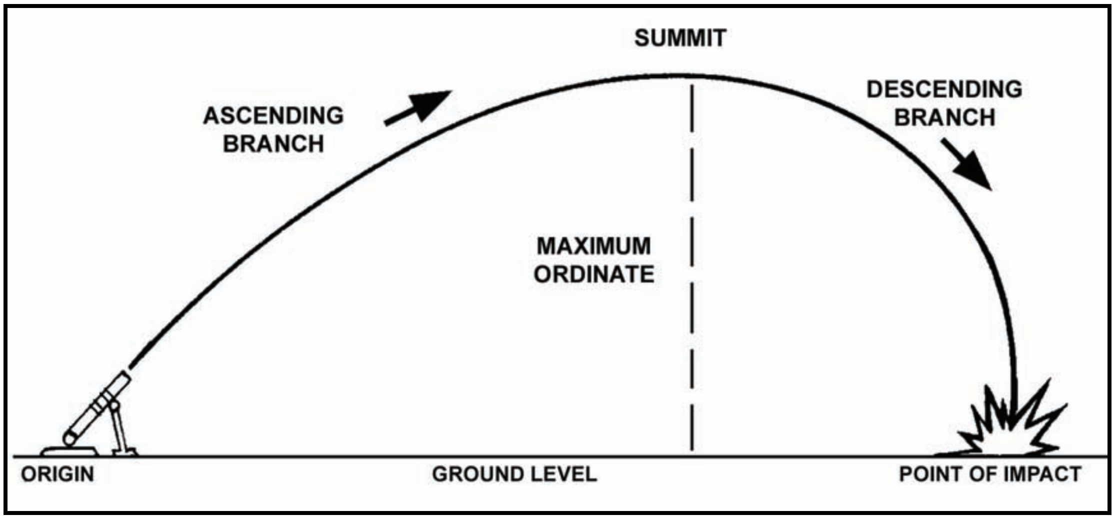

Figure 2-2. Elements of the trajectory.

TRAJECTORY IN ATMOSPHERE

2-24. 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 firing tables.

CHARACTERISTICS OF TRAJECTORY IN STANDARD ATMOSPHERE

2-25. The projectile's velocity at the level point is less than its velocity at its origin (Figure 2-2). The projectile travels more slowly beyond the summit 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.
- Vertical velocity is affected not only by gravity, but also by air resistance.

STANDARD CONDITIONS AND CORRECTIONS

2-26. As outlined in the introduction to the firing tables (Section II), certain atmospheric and material conditions are accepted as standard. When conditions vary from standard, the trajectory varies. Variations in the following conditions can be measured and corrected:

- Difference in altitude between the mortar and the target.
- Propellant temperature.
- Ballistic wind.
- Air temperature.
- Air density.
- Weight of the projectile.

SECTION II. FIRING TABLES

Firing tables are based on firing the weapon and its ammunition under, or correlated to, standard conditions (Figure 2-3). Those standards are used to compensate for variations in the weapon, weather, and ammunition at a given time and place. The atmospheric standards in United States' firing tables 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.

4 CHARGE TABLE D FT 120-E-1

M934 M734 BASIC DATA CTG, HE FUZE, MO

1	2	3	4	5	6	7
R	E	D ELEV	APPROX	LINE	TIME	AZIMUTH
A	L	PER	NO. OF	NO.	OF	CORRECTION
N	E	100 M	TURNS PER		FLIGHT	
G	V	DR	100 M DR			CW
E						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

Figure 2-3. Example of Firing Table 120-E-1.

PURPOSE

2-27. The main purpose of a firing table is to provide the data required to bring effective fire on a target under any condition. Data for firing tables are obtained by firing the weapon at various elevations and charges.

UNIT CORRECTIONS

2-28. Firing tables describe unit corrections as range corrections for an increase or decrease in range, wind, air temperature, density, and projectile weight, followed by the unit value in meters.

2-29. 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 length of time the projectile is exposed to that condition.

2-30. The weather's effect on a given projectile can be determined from a met message, if the maximum ordinate achieved is known. Personnel can compensate for those effects using the corrections listed in the appropriate firing tables.

STANDARD RANGE

2-31. The standard range is the range opposite the charge in the firing table, 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 firing table is based, the attained range and the standard range will be equal. The command range corresponds to the given elevation and charge that must be fired to reach the target.

EFFECT OF NONSTANDARD CONDITIONS

2-32. Deviations from standard conditions, if not corrected when computing firing data, causes the projectile to impact or burst somewhere other than the desired point. Nonstandard conditions that affect range also affect the time of flight.

2-33. 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 to a desired point; accuracy is related to the location of the mean point of impact (MPI) with respect to a desired point.

RANGE EFFECTS

2-34. Factors that affect the range include—

- Vertical jump.
- Projectile's weight.
- Air resistance.
- Finish of the shell.
- Ballistic coefficient.
- Range wind.

Vertical Jump

2-35. Vertical jump is a small change in barrel elevation caused by the shock of firing, which produces a minor range dispersion. In modern weapons, vertical jump cannot be predicted and is usually small, so it is not considered separately in gunnery.

Projectile’s Weight

2-36. The projectile’s weight affects the muzzle velocity. Two opposing factors affect the flight of a projectile of nonstandard weight. A heavier projectile is more efficient in overcoming air resistance, but its muzzle velocity is lower because it is more difficult to push through the barrel. An increase in projectile efficiency increases range, but a decrease in muzzle velocity decreases range. In firing tables, corrections for those two opposing factors are combined into a single correction. The change in muzzle velocity predominates at shorter times of flight; the change in projectile efficiency predominates at longer times of flight. Hence, for a heavier-than-standard projectile, the correction is plus at shorter times of flight and minus at longer times of flight. The reverse is true for a lighter-than-standard projectile.

Air Resistance

2-37. Air resistance affects both range and deflection during the flight of the projectile. Air’s 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 time of flight than they would be if drag were zero, as in a vacuum. The greater the drag, the shorter the range; and the heavier the projectile, the longer the range, all other factors being equal. Air density, air temperature, velocity, and diameter are factors considered in the computation of drag.

2-38. 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 firing tables are computed with a fixed relation between density and altitude. As the air temperature increases, the drag decreases, thereby increasing range.

2-39. The faster a projectile moves, the more the air resists its motion. Examination of a set of firing tables 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).

2-40. Two projectiles of identical shape but different size do not experience the same drag. For example, a larger projectile offers a larger area for the air to act upon, increasing its drag.

Finish of the Shell

2-41. The finish of the shell surface affects the muzzle velocity. A rough surface on the projectile or fuze increases air resistance, thereby decreasing range.

Ballistic Coefficient

2-42. The ballistic coefficient of a projectile is its efficiency in overcoming air resistance compared to an assumed standard projectile. Each projectile and projectile lot, however, has its own efficiency level. Therefore, to establish firing tables, 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 firing table standard. However, other projectile lots of the same type may not have the same ballistic coefficient as the one reflected in the firing tables. If another lot is more efficient (that is, has a higher ballistic coefficient than the firing table standard), it will achieve a greater range when fired. The reverse is true for a less efficient projectile lot.

NOTE: For ease in computations, all projectile types are classified into certain standard groups.

Range Wind

2-43. Range wind is that component of the wind blowing parallel to the direction of fire (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 (tail wind), it offers less resistance to the projectile and a longer range results; a head wind has the opposite effect.

DEFLECTION EFFECTS

2-44. Factors that affect the deflection include—

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

CROSSWIND

2-45. The crosswind is that component of the ballistic wind blowing across the DOF. Crosswind tends to carry the projectile with it and causes a deviation from the DOF. The lateral deviation of the projectile, however, 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 for a discussion of the wind component table.)

LATERAL JUMP

2-46. Lateral jump is a small change in barrel deflection caused by the shock of firing. The effect is ignored, since it is small and varies from round to round.

DRIFT

2-47. Drift is the departure of the projectile from standard direction due to air resistance and gravity. To understand the forces that cause drift, mortarmen must understand 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, down, left, up.

INITIAL YAW

2-48. Initial yaw is greatest near the muzzle and gradually subsides. The atmosphere offers greater resistance to a yawing projectile, so projectiles are designed to minimize yaw and to retard it in flight.

SUMMITAL YAW

2-49. Summital yaw occurs at the summit of the trajectory and directs the nose of the projectile slightly toward the direction of spin.

DISPERSION AND PROBABILITY

2-50. 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, in the bipod, or during flight. There are many conditions that affect accurate dispersion prediction, including—

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

DISPERSION PATTERN

2-51. If a number of rounds of the same caliber and same lot are fired from the same mortar with the same charge, elevation, and deflection, the rounds will not all fall at a single point. Instead, they will scatter in a pattern of bursts called the dispersion pattern.

CONDITIONS THAT AFFECT MUZZLE VELOCITY

2-52. 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 also affected by differences in the ignition of the charge, the weight of the projectile, and the form of the rotating disk.

CONDITIONS THAT AFFECT DIRECTION AND ELEVATION

2-53. 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

2-54. 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

2-55. For any large 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 (Figure 2-4).

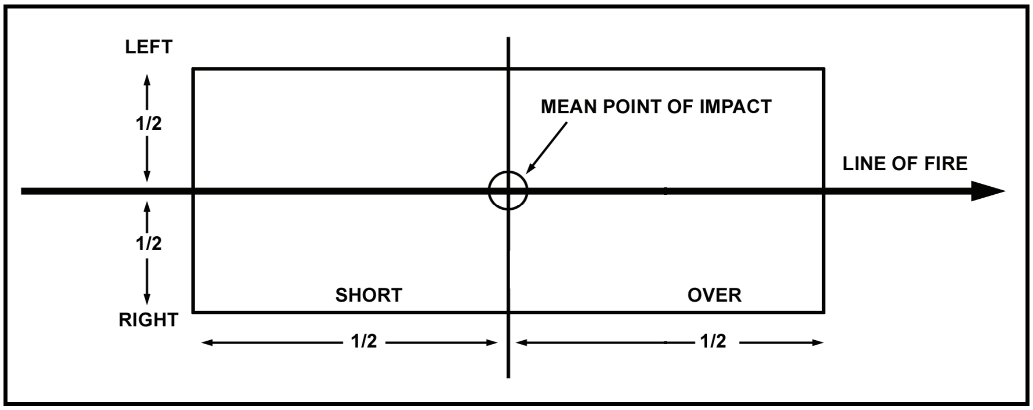

Figure 2-4. Mean point of impact.

DISPERSION SCALE

2-56. In a normal burst pattern, the number of rounds short of the MPI will be the same as the number of rounds over the MPI. The PE will be the same in both cases.

2-57. For any normal distribution (such as mortar fire), a distance of four PEs on either side of the MPI will include almost all 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.

2-58. A large number of bursts creates a roughly elliptical pattern (Figure 2-5). Since four PEs on either side of the MPI (in range and deflection) will encompass almost all rounds, a rectangle is drawn to include the full distribution of the rounds (Figure 2-6).

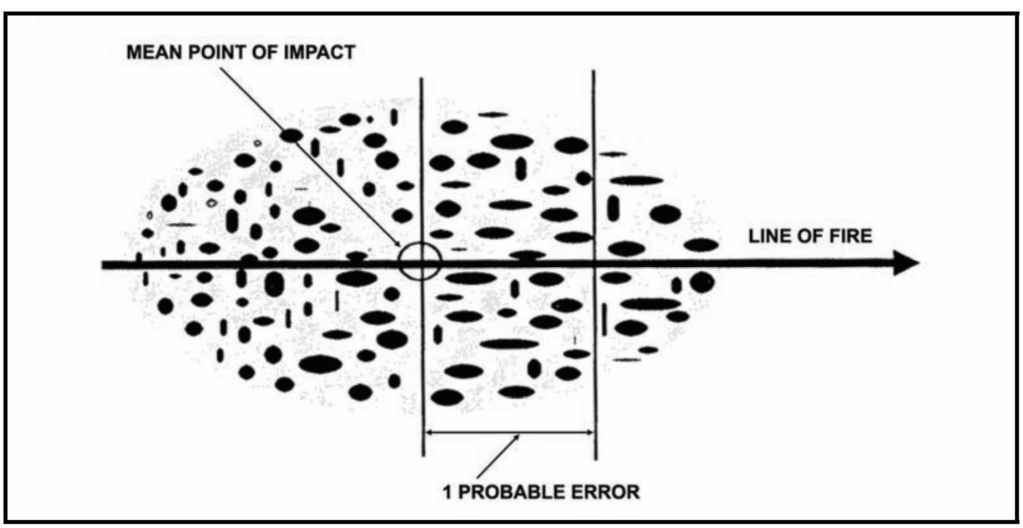

Figure 2-5. Burst in elliptical pattern.

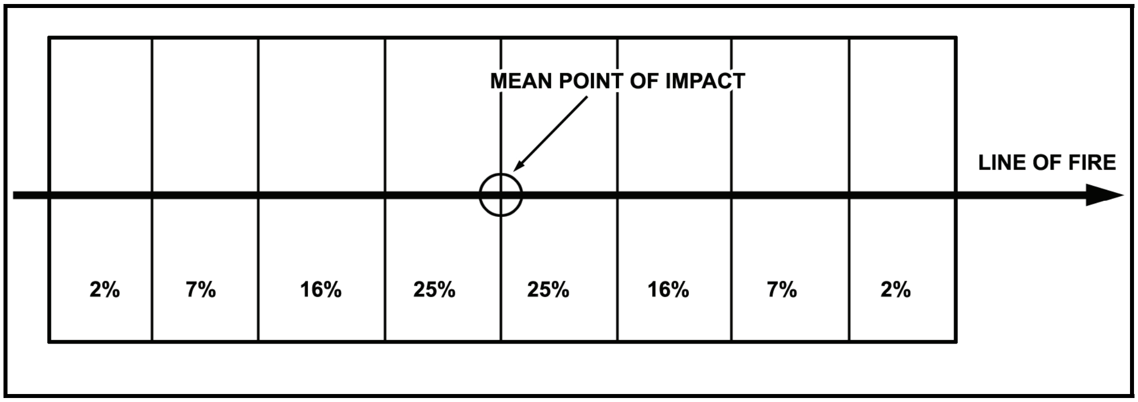

Figure 2-6. A 100-percent rectangle.

DISPERSION PATTERN

2-59. 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 will be as shown in Figure 2-7. The percentages have been found to be true by experiment. Again, what is true in range is also 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	LINE OF FIRE
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	

Figure 2-7. Dispersion rectangle.

PROBABLE ERROR

2-60. 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 (line AA, Figure 2-8). 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 (PE_r). A PE is the error exceeded as often as not. PE applies to short rounds, as well as to rounds to the left and right of the MPI.

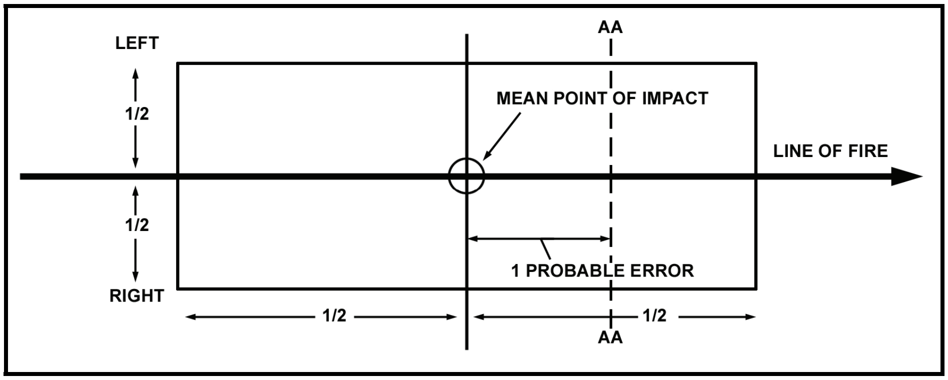

Figure 2-8. One probable error.

PROBABLE ERROR IN RANGE

2-61. The approximate value of the PE_r is shown in Table E, Supplementary Data, of the firing tables and can be taken as an index of the mortar's precision. Firing table values for PE_rs are based on the firing of specific ammunition under controlled conditions. The actual round-to-round PE_r experienced in the field is larger (Figure 2-9).

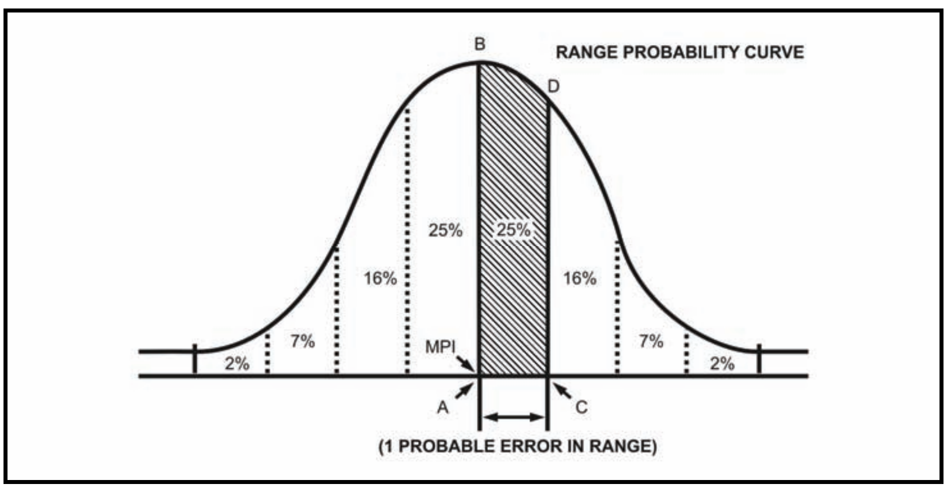

Figure 2-9. Range probability curve.

PROBABLE ERROR IN DEFLECTION

2-62. The value of the probable error in deflection (PE_d) is given in Table E, Supplementary Data, of the firing tables. For mortars, the PE_d is much smaller than the PE_r. For example, for a 120-mm mortar firing charge 4 at a range of 3,600 meters and elevation 1324, the PE_d is 25 meters (Figure 2-10). 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.

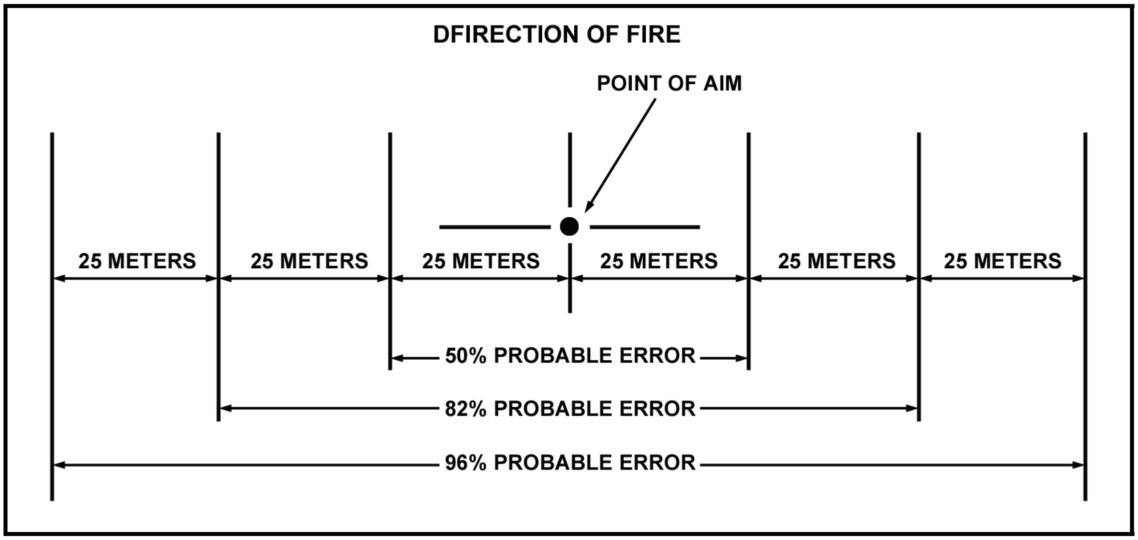

Figure 2-10. Probable error in deflection.

APPLICATION OF PROBABLE ERROR

2-63. Firing tables 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 two.

EXAMPLE

A 120-mm mortar has fired a number of 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

PE_r at 4,500 meters (charge 4) = 25 meters
Equivalent of 50 meters in PEs (50/25) = approximately 2
Percentage of rounds falling within 2 PEs = 25 percent plus 16 percent x 2 = 82 percent

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SECTION III. FIRE PLANNING

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

TERMINOLOGY

2-64. Common terms used in fire planning include—

- 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

2-65. 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 consists of 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

2-66. Targets of opportunity are targets for which fires have not been planned. Planned targets are scheduled or on-call.

Scheduled Targets

2-67. 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

2-68. 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

2-69. Mortars are often assigned groups of targets. A group of targets consists of 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 (Figure 2-11). The group designation consists of the letters assigned to the maneuver brigade by the division tactical operations center (TOC), 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.

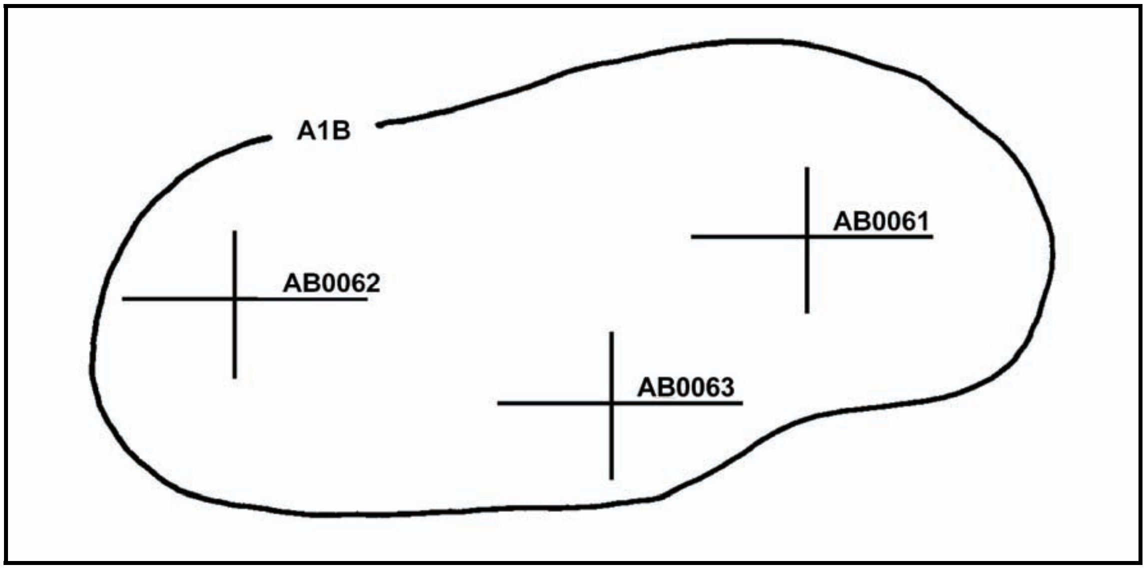

Figure 2-11. Group of targets.

SERIES OF TARGETS

2-70. A series of targets is a number of targets or groups of targets planned to support the operation (Figure 2-12). For example, a series of targets may be planned on a large objective so that fires are lifted or shifted as the support 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.

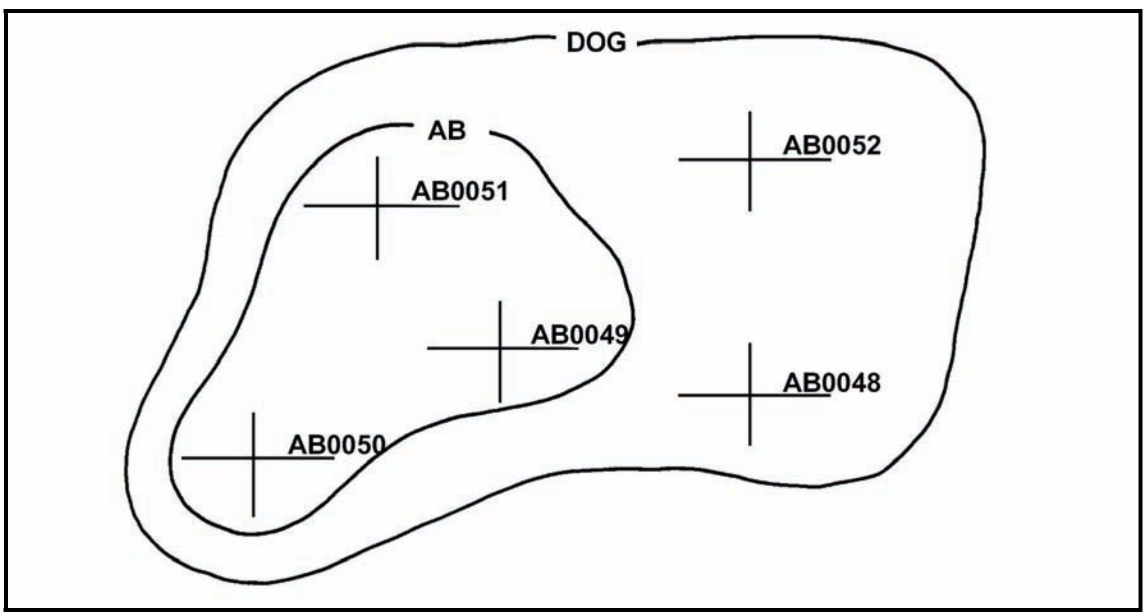

Figure 2-12. Series of targets.

FINAL PROTECTIVE FIRE

2-71. FPF is an immediately available prearranged barrier of fire designed to impede enemy movement across defensive lines or areas (Figure 2-13). 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.

2-72. 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.

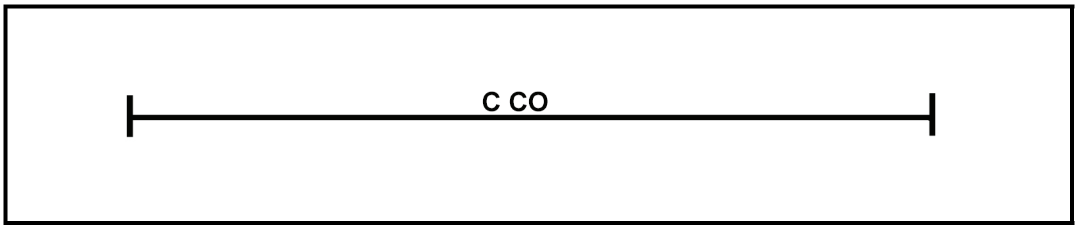

Figure 2-13. Final protective fires symbol.

PREPARATION

2-73. Preparation is the scheduled delivery of intense fires to support an attack. The commander decides to fire a preparation and orders the attack.

COUNTERPREPARATION

2-74. 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.

2-75. Counterpreparation is fired on the order of the force commander. The fires are planned and assigned to firing units, and firing data are kept current.

PROGRAM OF TARGETS

2-76. A program of targets, such as a countermortar program, is a number of targets planned on similar areas. Although the artillery battalion in DS 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

2-77. 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 should include the number of rounds to be fired and the times of firing. Varying the number of rounds and firing at irregular intervals greatly increases the effectiveness of those fires.

TARGET CONSIDERATIONS

2-78. Planned targets include known, suspected, and 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 will be resolved by the next higher headquarters.

KNOWN ENEMY LOCATIONS

2-79. Fires are planned on all known enemy locations that could hinder the support unit's mission.

SUSPECTED ENEMY LOCATIONS

2-80. 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

2-81. 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

2-82. 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.

SUPPORT OF OFFENSIVE OPERATIONS

2-83. 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 (LD) and may continue for a short 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.

SUPPORT ARTILLERY

2-84. An artillery preparation is usually phased to permit successive attacks on certain targets. The phasing should be planned to provide for early domination of enemy fire support means, the attack of local reserves and command and control installations, and the attack of enemy forward elements, in that order. The detail and extent of preparation plans depend on the availability of intelligence.

BATTALION MORTAR PLATOON

2-85. The battalion fire plan 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

2-86. 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 should consider ammunition resupply and availability of mortars to quickly attack targets of opportunity.

FIRES SUPPORTING THE ATTACK

2-87. 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 LD to the objective, on the objective, and beyond the objective.

OBJECTIVES

2-88. 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.
- Protect the supported unit during reorganization.
- Fire upon on-call targets, such as likely assembly areas and routes for enemy counterattacks.
- Provide supporting fires to prevent the enemy from reinforcing, supplying, or disengaging his forces.
- Quickly provide mutual fire support to lower, adjacent, and higher headquarters.

SUPPORT OF DEFENSIVE OPERATIONS

2-89. Fires in support of defensive operations include—

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

LONG-RANGE FIRES

2-90. 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

2-91. Close defensive fires are supporting fires employed to destroy enemy attack formations before the assault.

FINAL PROTECTIVE FIRES

2-92. 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 (FPL) and mortar and artillery FPF. Only those weapons whose FPF are 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.

2-93. Artillery and mortar FPF are integrated with machine gun FPL. Each artillery battery fires one FPF. The mortar platoon may fire one or two FPF, but the platoon’s fires are more effective in one FPF than in two.

2-94. DS artillery FPF are available to the supported brigade and its battalions. Typically, the FPF of any artillery reinforcing the DS battalion are available. 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

2-95. 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 fire plan and reported to the battalion. Fires within the battle area are planned to limit penetrations and to support counterattacks.

FIRE SUPPORT COORDINATION MEASURES

2-96. The FIST and fire support planners use fire support coordination measures (FSCMs) to ensure that fires impacting in their zone will not jeopardize troop safety, interfere with other fire support means, or disrupt adjacent unit operations.

BOUNDARIES

2-97. 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

2-98. 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 categories: permissive and restrictive.

Permissive Measures

2-99. 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 (CFL) that need not be further coordinated as long as 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.

Coordinated Fire Line

2-100. A coordinated fire line is a line beyond which conventional surface fire support means— mortars, FA, and naval gunfire (NGF)—may fire any time (within the zone of the establishing headquarters) without further coordination.

Fire Support Coordination Line

2-101. A fire support coordination line (FSCL) 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

2-102. A free-fire area is a designated area into which any weapon system may fire without further coordination with the establishing headquarters.

Restrictive Measures

2-103. 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 date-time group.

2-104. Restrictive measures include—

- Restrictive fire areas.
- No-fire areas.
- Restrictive fire lines.
- Airspace coordination areas (ACA).

Restrictive Fire Area

2-105. A restrictive fire area is an area in which specific restrictions are imposed and into which fires that exceed those restrictions will not be delivered without coordination with the establishing headquarters.

No-Fire Area

2-106. A no-fire area is an area in which no fires or effects of fires are allowed. There are two exceptions:

- When establishing headquarters approves fires temporarily within a no-fire area on a mission-by-mission basis.
- When an enemy force within the no-fire area engages a friendly force, and the commander engages the enemy to defend his force.

Restrictive Fire Line

2-107. A restrictive fire line 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

2-108. An 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 is usually informal.

COMPANY FIRE SUPPORT PLAN

2-109. 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 consists of the company commander, the company FSO, the mortar section/platoon 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 best results, the commander should include the team in every step of his decision-making process.

2-110. As the commander's special staff officer for fire support, the company FSO performs a critical role in this planning process. He ensures that the commander has all required information about available fire support and recommends the best way to apply it in concert with other resources.

2-111. 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 fire plan, the company commander approves or changes it.

2-112. The company commander supervises the preparation of the company fire plan and coordinates fire planning activities. The company FSO develops the company fire plan and consolidates it with the target lists prepared by the platoon FOs. He then submits this consolidated list to the company commander for approval.

2-113. Company fire planners inform the company commander of the fire support available. They also obtain the following information for or from the company commander:

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

2-114. Upon receipt of this information, fire planners begin planning fires to support the company. Through map inspection and terrain analysis, they prepare the target lists (Table 2-1). If time and facilities permit, they also 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 2-1. Consolidated target list.

TARGET NUMBER	DESCRIPTION	LOCATION	REMARKS
C-	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	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

2-115. 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/company fire plan and arranges the targets by target number, alphabetically, and numerically.

2-116. Once the company commander approves the fire plan, the company FSO distributes it to FOs, rifle platoon leaders, FDCs, company fire planners, and battalion operations and training officers (S3s). Also, he sends a copy of the approved target list to the FSO at battalion headquarters.

BATTALION FIRE SUPPORT PLAN

2-117. Fire planning at the battalion level is initiated the same way as in the company. The battalion fire planning team consists of the battalion commander, S3, battalion mortar platoon leader, and FSO. The battalion mortar platoon must always be directly responsive to the battalion commander's desires. The platoon leader assists the S3 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.

2-118. The battalion commander and S3 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.

2-119. The FSO receives target lists from the company FSO and from the battalion mortar platoon leader. Then, he deletes duplications and updates all fire plans by assigning target numbers or by consolidating targets. Then, the FSO submits all fire plans and target lists to the battalion S3 as the proposed battalion fire support plan.

2-120. The S3 ensures that the proposed fire support plan supports the scheme of maneuver. After the battalion commander approves the fire plan, 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.

SECTION IV. TARGET ANALYSIS AND ATTACK

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. He must also be informed of the present enemy situation. When conducting a target analysis and determining the MOA, the FDC chief considers target description, registration data, size of attack area, and the maximum rate of fire.

TARGET DESCRIPTION

2-121. The method of attacking a target depends largely 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.

2-122. Fortified targets must be destroyed by point-type fire using projectiles and fuzes appropriate for penetration. Mortar fire does not usually destroy armor, but it can harass and disrupt armor operations.

2-123. A target consisting of both men and materiel is normally attacked by area fire using air or impact bursts to neutralize the area. Flammable targets are engaged with HE projectiles to inflict fragmentation damage, and then with WP projectiles to ignite the material.

2-124. The method of attacking a target is governed by the results desired: suppression, neutralization, or destruction.

SUPPRESSION

2-125. Suppressive fires limit the ability of enemy troops in the target area to be an effective force. HE/PROX (proximity) creates apprehension or surprise and causes tanks to button up. Smoke is used to blind or confuse, but its effect lasts only as long as fires are continued.

NEUTRALIZATION

2-126. Neutralization knocks the target out of the battle temporarily. Ten percent or more casualties usually neutralize most units. The unit becomes effective again when casualties are replaced and equipment repaired.

DESTRUCTION

2-127. Destructive fires put the target out of action permanently. A unit with 30 percent or more casualties is usually rendered permanently ineffective, depending on the type and discipline of the force. Direct hits are required on hard materiel targets.

REGISTRATION AND SURVEY CONTROL

2-128. Firing corrections within the transfer limits should be maintained through registration, survey data, and current MET message. When those data are 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, firing for effect 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. (See Appendix D for more information.)

SIZE OF ATTACK AREA

2-129. 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

2-130. Surprise fire delivered with maximum intensity achieves the greatest effect, and massing the fires of several organic battalion units using time on target (TOT) procedures best attains intensity. The intensity of fires available is limited by each unit's maximum rate of fire and ammunition supply (Tables 2-2, 2-3, and 2-4). Maximum 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 more pronounced with higher charges.

Table 2-2. Rates of fire for the 60-mm 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	8 RPM
M302xx WP SMOKE	M935/M936 PD	30 RPM for 1 minute	8 RPM
M769 FRPC	M781 TRNG	30 RPM for 1 minute	8 RPM
M888 HE	M935 PD	30 RPM for 4 minutes	20 RPM
M720 HE	M734 MO	30 RPM for 4 minutes	20 RPM
M720A1HE	M734A1	30 RPM for 4 minutes	20 RPM
M722xx 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	20 RPM
M767 IR ILLUM	M776 MTSQ	30 RPM for 2 minutes	15 RPM
M766 SRTP	M779 TRNG	N/A	N/A
PD = Point-Detonating MTSQ = Mechanical Time Superquick DLY = Delay		TRNG = Training FRTR = Full-Range Training Round SRTR = Short-Range Training Round	

Table 2-3. Rates of fire for the 81-mm mortar.

81-mm MORTAR M252			
AMMUNITION TYPE	FUZE	MAXIMUM RATE OF FIRE	SUSTAINED RATE OF FIRE
M821 HE	M734 MOF	30 RPM for 2 minutes	15 RPM
M821A1 HE	M734 MOF	30 RPM for 2 minutes	15 RPM
M821A2 HE (IM)	M734A1 MOF	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 ILLUM	M772 MTSQ	30 RPM for 2 minutes	15 RPM
M819 RP	M772 MTSQ	30 RPM for 2 minutes	15 RPM
M374xx HE	M524/5/6/7 PD	25 RPM for 2 minutes	8 RPM
M375A1 WP	M524/5/6/7 PD	25 RPM for 2 minutes	8 RPM
M301A3 ILLUM	M84 MTSQ	25 RPM for 2 minutes	8 RPM
M816 ILLUM	M772 MTSQ	30 RPM for 2 minutes	15 RPM
M879 FRTP	M751 TRNG	30 RPM for 2 minutes	15 RPM
M880 SRTP	M775 TRNG	N/A	N/A
M43/M362/M374 HE	M524/5/6/7 PD M716/7 PD	3 RPM (charge 8) 5 RPM (charge 6) for 1 minute	12 RPM (charge 8) for 2 minutes, 12 RPM (charge 6) for 5 minutes
PD = Point-Detonating MTSQ = Mechanical Time Superquick TRNG = Training FRTR = Full-Range Training Round		SRTR = Short-Range Training Round MOF = Multi-Option Fuze IM = Insensitive Munitions	

Table 2-4. Rates of fire for the 120-mm mortar.

120-mm MORTAR M120/M121			
AMMUNITION TYPE	**FUZE**	**MAXIMUM RATE OF FIRE**	**SUSTAINED RATE OF FIRE**
M91 ILLUM	M776 MTSQ	15 RPM for 1 minute	4 RPM
M933 HE	M745 PD	16 RPM for 1 minute	4 RPM
M934 HE	M734 MOF	16 RPM for 1 minute	4 RPM
M934A1 HE	M734A1 MOF	16 RPM for 1 minute	4 RPM
XM929 WP SMOKE	M745 PD	16 RPM for 1 minute	4 RPM
M929 WP SMOKE	M734A1 MOF	16 RPM for 1 minute	4 RPM
M930 ILLUM	M776 MTSQ	16 RPM for 1 minute	4 RPM
M983 IR ILLUM	M776 MTSQ	16 RPM for 1 minute	4 RPM
M931 FRPC	M751 TRNG	16 RPM for 1 minute	4 RPM
PD = Point-Detonating MTSQ = Mechanical Time Superquick TRNG = Training		FRTR = Full-Range Training Round MOF = Multi-Option Fuze	

AMOUNT AND TYPE OF AMMUNITION

2-131. The amount of ammunition available is an important consideration when attacking targets. The controlled supply rate (CSR) should not be exceeded except by the authority of higher headquarters. When the CSR is low, units should fire only those missions that contribute the most to the supported units' mission. When the CSR is high, units may fire missions that include targets that affect planning or future operations and targets that require massing fires without adjustment.

2-132. 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 hard 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.

2-133. 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 and white phosphorous ammunition is used for producing casualties, incendiary effects, screening, marking, and harassing.
- Visible and infrared illumination use 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.

QUICK AND SUPERQUICK FUZES

2-134. Quick and superquick (SQ) fuzes are used for impact detonation. When an HE projectile with a quick or SQ fuze passes through trees, detonation may occur in the foliage. Therefore, its effectiveness may be either improved or lost, depending on the density of the foliage and the nature of the target.

PROXIMITY FUZES

2-135. Proximity fuzes are used with HE ammunition to obtain airbursts. PROX or variable time (VT) 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 proximity 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 proximity element fails to function, the fuze will operate as a superquick.

FUZE DELAY

2-136. Fuze delay produces a mine action caused by the round's penetration before detonation. The depth of the round's 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, but is not used against armor.

MULTIOPTION

2-137. With settings for delay, impact, near-surface burst, and proximity, the multioption fuze allows its user to select all types of fuzes. In the future, this fuze will replace all others.

M734A1

2-138. The air-powered M734A1 multioption fuze has four selectable functions:

- PRX 120 (4 meters/14 feet).
- PRX 60/81 (2 meters/7 feet).
- Impact (IMP).
- Delay (DLY).

2-139. In HE proximity mode, the HOB remains constant over all types of targets. The impact mode causes the round to function on contact with the target and is the first backup function for either proximity setting. In the delay mode, the fuze functions about 30 to 200 milliseconds after target contact. The delay mode is the backup for the impact and PRX modes. The impact and delay modes have not changed from the current M734 multioption fuze.

2-140. Radio frequency jamming can affect the functioning of proximity fuzes. Radio frequency jamming initiates a gradual desensitizing of the fuze electronics to prevent premature fuze function. Once the fuze is out of jamming range, the fuze electronics recover and function in the proximity mode if the designed HOB has not been passed. To limit the time of fuze radio frequency radiation, the proximity turn-on is controlled by an apex sensor that does not allow initiation of the fuze proximity electronics until after the apex of the ballistic trajectory has been passed.

2-141. In compliance with the safety requirements of military standard 1316C, the M734A1 uses ram air and setback to provide two independent environment sensors.

UNIT SELECTION

2-142. 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. Also, the rate of fire for the area or number of mortars may not be adequate to achieve the desired effect. The factors that affect the selection of units and the number of rounds fired upon a target are discussed below.

AVAILABILITY OF MORTAR FIRE

2-143. When few mortar units are available, more targets must be assigned to each mortar unit.

SIZE OF THE AREA TO BE COVERED

2-144. 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

2-145. Targets greater in depth or width than the standard sizes can be covered by—

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

CALIBER AND TYPE OF UNIT

2-146. The projectiles of larger calibers are more effective for destruction missions.

SURPRISE

2-147. To achieve surprise, a few rounds from many pieces are better than many rounds from a few pieces.

ACCURACY OF TARGET LOCATION

2-148. In certain circumstances, personnel may be unable to accurately locate important targets. Commanders ensure adequate coverage of these targets by having more than one unit fire upon a given target.

DISPERSION

2-149. At extreme ranges, the increasing PE causes mortar fire to be less dense, so more ammunition is required to effectively cover the target. When possible, the commander compensates for that dispersion by selecting a unit whose gun-target (GT) line coincides with the long axis of the target.

MAINTENANCE OF NEUTRALIZATION AND INTERDICTION FIRES

2-150. 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

2-151. Some targets, such as truck parks and troops in the open, should be attacked rapidly with massed fires while they are vulnerable.

TYPICAL TARGETS AND METHODS OF ATTACK

2-152. Mortar targets should include enough enemy materiel, fortifications, and troops to justify ammunition expenditure (Table 2-5). Mortar fire is not effective against minefields and barbed wire; mines are detonated only by direct hits (the mortar is an indirect fire weapon), and breaching barbed wire requires extravagant amounts of ammunition.

Table 2-5. Targets and methods of attack.

TYPE OF TARGET	TYPE OF ADJUSTMENT	PROJECTILE	FUZE	TYPE OF FIRE	REMARKS(SEE 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 type of fortification. (4)
Weapons (In Open)	Observed	HE, WP	PROX	Neutralization, Destruction	(1), (2), (3)
GROUP II					
Personnel (In Open)	Observed, Unobserved	Observed, Unobserved	PROX	Neutralization, Harassing, Destruction	PROX fuze settings should be fired at the lowest practical charge, as the steep angle of fall gives better fragmentation. Intermittent fire is better than continuous fire. (1)
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.

(1) Personnel should neutralize the area with HE projectiles (airbursts if practical); surprise is essential to producing casualties.
(2) Personnel should attack materiel 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.

Table 2-5. Targets and methods of attack (continued).

TYPE OF TARGET	TYPE OF ADJUSTMENT	PROJECTILE	FUZE	TYPE OF FIRE	REMARKS(SEE FOOTNOTES)
GROUP II (continued)					
Personnel (Under Light Cover)	Observed, Unobserved	HE	PROX, Delay	Neutralization, Harassing, Destruction	(4)
Roads and Railroads	Observed, Unobserved	HE	PROX, Delay	Neutralization	(3)
		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 materiel 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.					

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Part Two

Fire Direction Center

Chapter 3

Introduction

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

PRINCIPLES OF FIRE DIRECTION

3-1. 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.

3-2. Fire direction also 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. Tactical fire direction involves the FDC's control of mortars in the selection of targets, the designation of units to fire, and the allocation of ammunition for each mission.

3-3. Fire direction methods must ensure—

- Close, continuous, accurate, and timely indirect fire support in all types of weather, visibility, and terrain.
- 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 operation.

ORGANIZATION

3-4. 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 also determines and applies corrections to chart data and to standard firing table 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 of firing data from the MBC and plotting board.
- Clear transmission of commands to the mortar section.
- Accurate and rapid verification of firing data.
- Efficient division of duties.
- Adherence to standard techniques and procedures.
- Efficient use of FDC plotting equipment and other data-determining devices.
- Teamwork and operating in a specified sequence.
- Efficient use of communications, including the FDC switchboard.

PERSONNEL DUTIES

COMMANDER

3-5. Commanders are responsible for the unit's training; they must ensure that FDC personnel are certified to perform their duties. (See Appendix E for more information.)

FDC DUTIES

3-6. The FDC of an 120-mm mortar section consists of—

- One section sergeant.
- One chief computer.
- One check computer.
- One driver/radio-telephone operator (RTO).

3-7. The FDC of an 81-mm mortar platoon consists of—

- One section sergeant.
- Two computers.
- One driver/RTO.

Fire Direction Chief/Section Sergeant

3-8. As the senior enlisted member of the FDC, the fire direction chief (chief computer/section sergeant) 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 equipment operation.

3-9. The fire direction chief/section sergeant also—

- Makes the decision to fire. When a target is reported, the fire direction chief/section sergeant 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, he decides whether to fire. If he decides to engage the target, he uses that information to decide how to do so.
- Issues the FDC order. Once the fire direction chief/section sergeant decides to engage a target, he issues the FDC order to tell other FDC members how the mission will be conducted.
- Verifies corrections and commands. The fire direction chief/section sergeant verifies firing corrections obtained from a registration or a MET message before they are applied. He also cross-checks all firing data and fire commands sent to the mortar section to eliminate errors and resolves any discrepancies.
- Determines the altitude of a target from the map and announces it immediately after the FDC order so that the computers may compute and apply any altitude correction.
- Maintains records for all fire missions and all corrections to be applied.
- Evaluates and relays target surveillance data and intelligence reports from observers.
- Coordinates with the company FSO regarding sectors of responsibility and up-to-date tactical information. If the FDC receives a CFF for a target it cannot engage immediately or effectively, the fire direction chief/section sergeant informs the company FSO so that the mission can be assigned to another firing element.

3-10. In addition to the duties that the chief computer of a 120-mm mortar platoon performs, the section sergeant of an 81-mm mortar FDC—

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

Fire Direction Computer Personnel

3-11. 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. In 81- and 120-mm mortar sections, one acts as a RTO for communication with the observers, while the other relays fire commands to the section. FDC personnel cross-train in computer skills to allow rotation for round-the-clock operations.

3-12. The FDC uses the MBC, MFCS, or LHMBC to convert observer data into fire commands. These commands are then reported to the firing section. Under other circumstances, FDC personnel might 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 prevent errors in the FDC, personnel cross-check their information using two MBCs or two M16/M19 plotting boards at all times. Neither the MFCS nor the LHMBC require a check computer for firing.

3-13. Computer personnel—

- Prepare and maintain an MBC 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 and MET corrections.
- Plot the location of friendly elements, supported unit boundaries, observers, no-fire lines, and safety limits in the MBC or on the M16/M19 plotting board.
- Maintain DA Forms 2188-R (Data Sheets) with current firing information about all targets.

Driver/Radio-Telephone Operator

3-14. In the FDC, the RTO drives the FDC vehicle. He must be trained in communication procedures, as well as in the duties of the computer personnel.

3-15. The driver/RTO also—

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

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Chapter 4

Major Concerns of the Fire Direction Center

This chapter discusses the methods and techniques that FDCs use to convert CFFs into proper fire commands.

TYPES OF SHEAVES

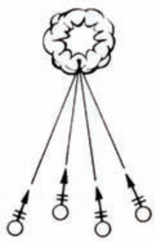
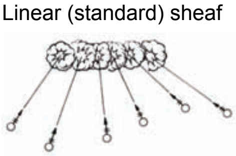
4-1. When the mortar section or platoon engages a target, it can use different sheaves depending on the type of target being engaged.

4-2. These types of sheaves include—

- Parallel sheaf.
- Converged sheaf.
- Open sheaf.
- Special sheaf.
- Linear (standard) sheaf.

4-3. Table 4-1 outlines the types of sheaves used for a given target and provides additional information.

Table 4-1. 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 the impacts of rounds 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 bursts of rounds in a linear sheaf. Normally, 60-mm mortar 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 mortar rounds in a linear sheaf. All mortars fire different deflections for an open sheaf.
Special sheaf 	Targets that are linear in nature such as roadways, bridges, and forward lines of troops (FPF)	A special sheaf is normally 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 (standard) sheaf 	Standard engagement against enemy formations	With the linear sheaf, rounds impact within the total effective width of the bursts, regardless of the mortar formation.

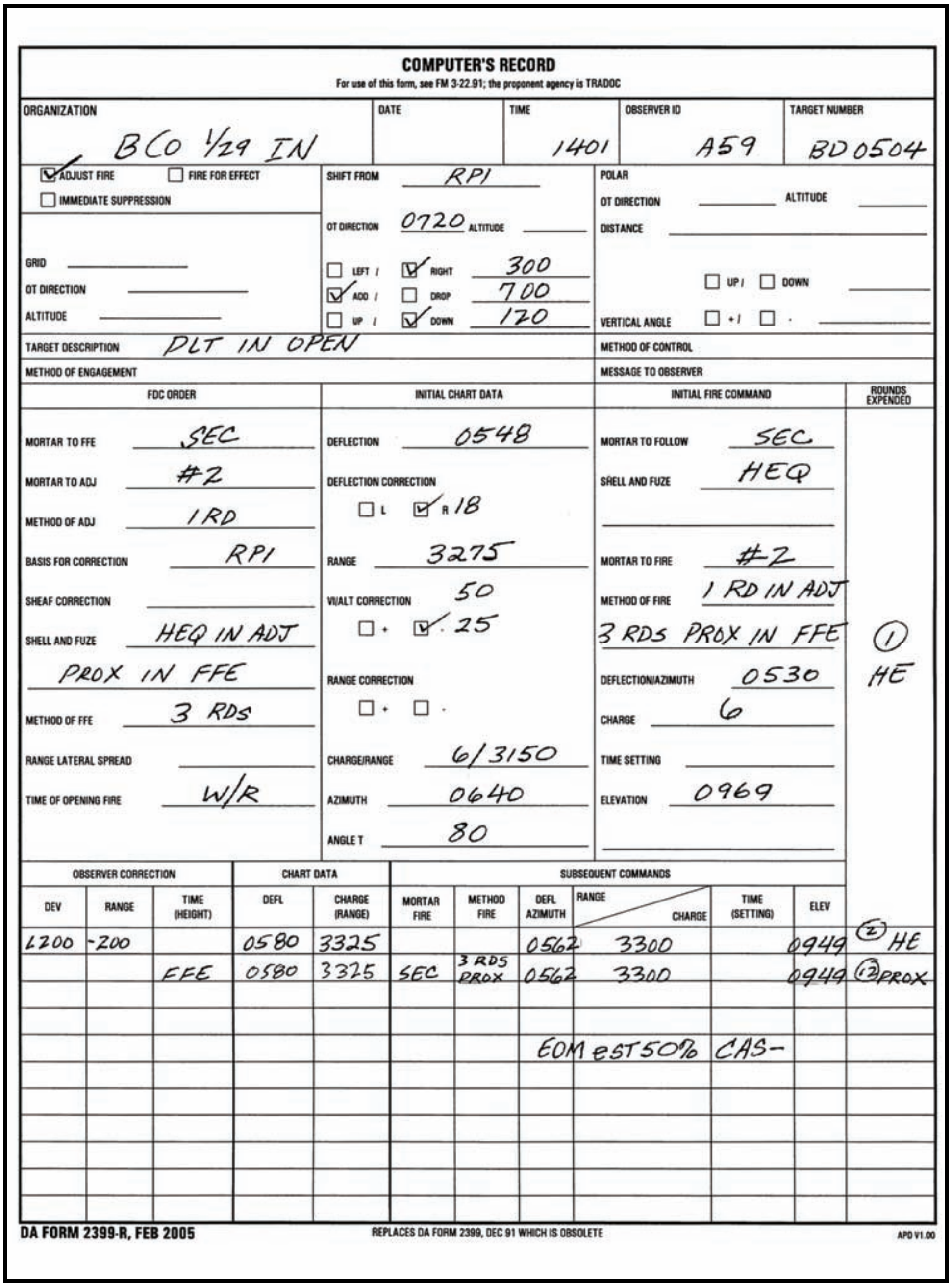
COMPUTER'S RECORD

4-4. DA Form 2399-R (Computer's Record) (Figure 4-1) is a form used to record—

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

4-5. 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-R.

NOTE: For a blank, reproducible copy of DA Form 2399-R, see the back of this publication.



COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN		1401	A59	BD0504

[x] ADJUST FIRE [ ] FIRE FOR EFFECT
[ ] IMMEDIATE SUPPRESSION

GRID ______
OT DIRECTION ______
ALTITUDE ______

SHIFT FROM RPI
OT DIRECTION 0720 ALTITUDE ______
[ ] LEFT / [x] RIGHT 300
[x] ADD / [ ] DROP 700
[ ] UP / [x] DOWN 120

POLAR
OT DIRECTION ______ ALTITUDE ______
DISTANCE ______
[ ] UP / [ ] DOWN ______
VERTICAL ANGLE [ ] + / [ ] - ______

TARGET DESCRIPTION PLT IN OPEN
METHOD OF ENGAGEMENT
METHOD OF CONTROL
MESSAGE TO OBSERVER

FDC ORDER
MORTAR TO FFE SEC
MORTAR TO ADJ #2
METHOD OF ADJ 1 RD
BASIS FOR CORRECTION RPI
SHEAF CORRECTION ______
SHELL AND FUZE HEQ IN ADJ PROX IN FFE
METHOD OF FFE 3 RDS
RANGE LATERAL SPREAD ______
TIME OF OPENING FIRE W/R

INITIAL CHART DATA
DEFLECTION 0548
DEFLECTION CORRECTION [ ] L [x] R 18
RANGE 3275
VI/ALT CORRECTION 50 [ ] + [x] - 25
RANGE CORRECTION [ ] + [ ] -
CHARGE/RANGE 6/3150
AZIMUTH 0640
ANGLE T 80

INITIAL FIRE COMMAND
MORTAR TO FOLLOW SEC
SHELL AND FUZE HEQ
MORTAR TO FIRE #2
METHOD OF FIRE 1 RD IN ADJ 3 RDS PROX IN FFE
DEFLECTION/AZIMUTH 0530
CHARGE 6
TIME SETTING ______
ELEVATION 0969

ROUNDS EXPENDED: 1 HE

OBSERVER CORRECTION: DEV	RANGE	TIME (HEIGHT)	CHART DATA: DEFL	CHARGE (RANGE)	SUBSEQUENT COMMANDS: MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	ROUNDS EXPENDED
L200	-200		0580	3325			0562	3300		0949	2 HE
		FFE	0580	3325	SEC	3 RDS PROX	0562	3300		0949	12 PROX

EOM EST 50% CAS-

DA FORM 2399-R, FEB 2005 REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE APD V1.00

Figure 4-1. Example of completed DA Form 2399-R (Computer's Record).

ORGANIZATION

4-6. In this field, the FDC documents the unit that fires the mission.

DATE

4-7. In this field, the FDC records the date that the mission is fired.

TIME

4-8. The FDC uses this field to document the time that the mission was received (the CFF recorded).

OBSERVER IDENTIFICATION

4-9. In the observer identification (ID) field, the FDC records the observer's call sign.

NUMBER TARGET

4-10. In this field, the FDC records the number assigned to the mission.

WARNING ORDER

4-11. The FDC uses this field to document the type of warning order used for the mission, such as adjust fire, FFE, or immediate suppression.

TARGET LOCATION

4-12. 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

4-13. In this field, the FDC provides a detailed description of the target (type, size, number, and protection).

METHOD OF ENGAGEMENT

4-14. The FDC records the types of adjustment and ammunition in this field. (For more information, see FM 6-30.)

METHOD OF CONTROL

4-15. In this field, the FDC documents the adjustment gun (when named by the FO) and time of delivery. (For more information, see FM 6-30.)

MESSAGE TO OBSERVER

4-16. The FDC records any messages sent to the FO in this field.

FDC ORDER

4-17. The chief computer/section sergeant usually completes the FDC order. This area describes how the mortars will engage the target. Table 4-2 highlights the fields found in this section and provides more information about each area.

Table 4-2. FDC order field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
Mortar to FFE	The mortar(s) that will be used during the FFE phase of the mission
Mortar to ADJ	The mortar(s) 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/or 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 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 in Adj, HEQ/WP in FFE
Method of FFE	Number and type of rounds for each mortar in the FFE phase of the mission Example: METHOD OF FFE: 2 Rds HEQ, 2 Rds WP
RG/Lateral Spread	Used with illumination, with one of the following: • RG spread (60-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 FO or FDC as “When ready” (W/R), “At my command” (AMC), or “Do not fire.”

INITIAL CHART DATA

4-18. The FDC uses initial chart data to determine initial or subsequent fire commands. Table 4-3 highlights the fields found in this section and provides more information about each area.

Table 4-3. Initial chart data field titles and information documented in each field.

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	VI/altitude difference and VI 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 corrected range used for the mission
Azimuth	The azimuth from the gun position to the target
Angle T	Difference (in mils) between the gun-target (GT) line and the observer-target (OT) line NOTE: Determine this difference to the nearest 1 mil, record to the nearest 10 mils, and transmit to the nearest 100 mils.

INITIAL FIRE COMMAND

4-19. The initial fire command is the first fire command that the FDC sends to the mortar section for a mission. To complete the initial fire command, the computer must use the information contained in the initial chart data, any corrections, and the FDC order. Table 4-4 highlights the fields found in this section and provides more information about each area.

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

FIELD	INFORMATION DOCUMENTED IN FIELD
Mortar to Follow	The mortar(s) to follow all commands or the mortar(s) that will be used in the 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 mortar(s) 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 FDC would be placed here. For example, one round HEQ in adjustment; two rounds HEQ/two rounds WP in FFE, 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 needed on mechanical time fuzes (normally illumination) 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

4-20. The FDC uses this space to record the number of rounds fired for the initial fire command.

OBSERVER CORRECTION

4-21. The observer sends the observer correction to the FDC to move the impact of the round to the target. Table 4-5 highlights the fields found in this section and provides more information about each area.

Table 4-5. Observer correction field titles and information documented in each 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

4-22. 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. Table 4-6 highlights the fields found in this section and provides more information about each area.

NOTE: Disregard this portion of DA Form 2399-R when using the MBC.

Table 4-6. Chart data field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
Deflection (DEFL)	The deflection read from the plotting board before any corrections are applied
Charge Range	Chart charge (or range) read from the plotting board before any corrections are applied

SUBSEQUENT COMMANDS

4-23. The FDC sends command data to the mortar(s) so they can fire the next round(s). Those commands, DEFL/CHG/ELEV, 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 4-7 highlights the fields found in this section and provides more information about each area.

Table 4-7. Subsequent command field titles and information documented in each field.

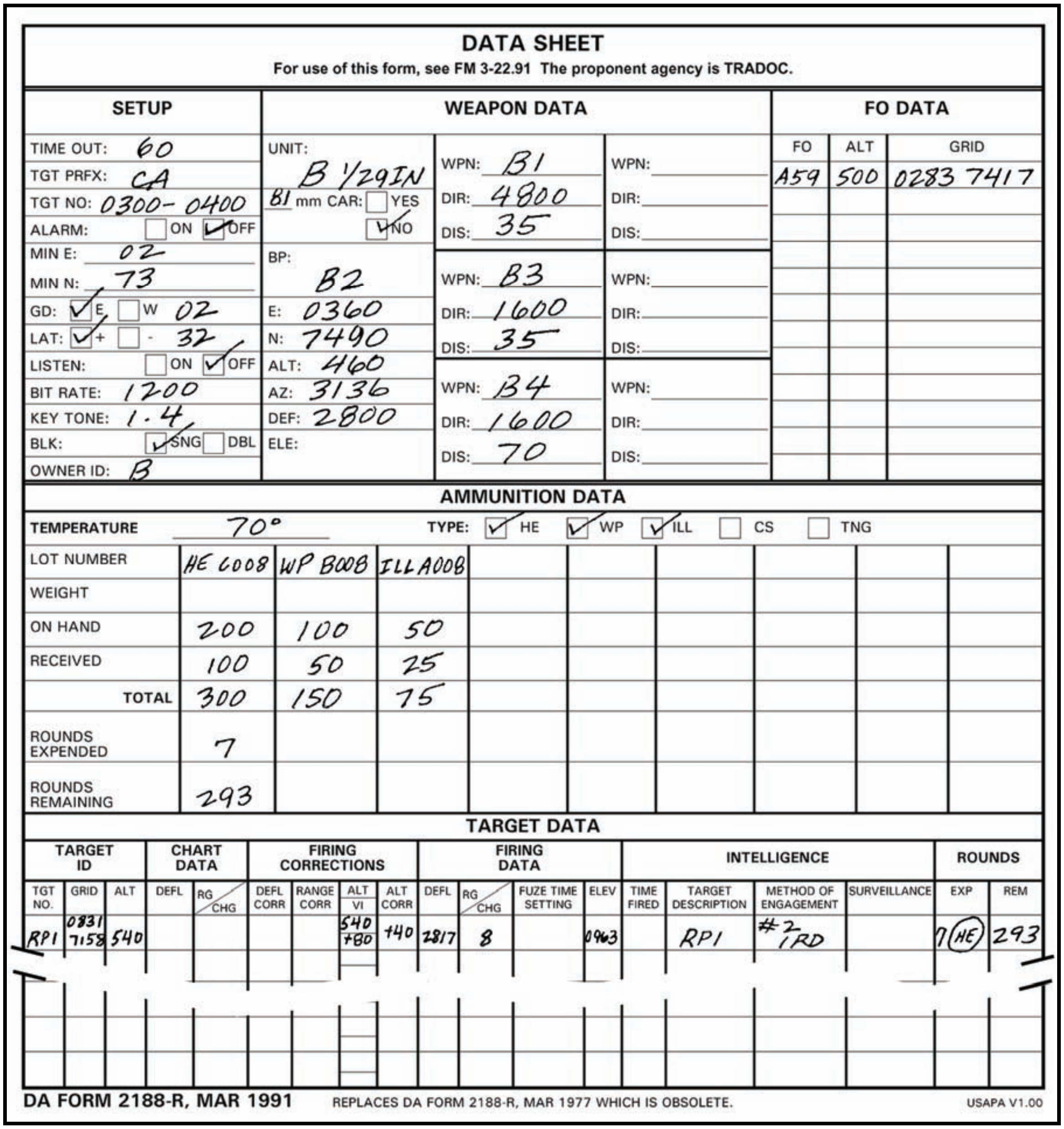
FIELD	INFORMATION DOCUMENTED IN FIELD
Mortar to Fire	The mortars to fire a mission
Method of Fire	The number of rounds and type of fire
Deflection (DEFL)	The command deflection(s) to fire the round(s)
Range/Charge	60-, 81-, and 120-mm mortars: The command range used for this round(s) and the charge, if different from the preceding round NOTE: The range is recorded and used to determine the charge that is given to 60-, 81-, and 120-mm mortars (range is not given to guns).
Time Setting	The time setting needed for the mechanical time fuze
Elevation (ELEV)	The elevation used for this round(s) and the command to fire (in the absence of fire control)

DA FORM 2188-R (DATA SHEET)

4-24. The computer uses DA Form 2188-R (Data Sheet) (Figure 4-2) to record data that pertains to the mortar section or platoon and the firing data for each target engaged.

NOTES: 1. The controlling FDC will keep the DA Form 2188-R.

2. For a blank, reproducible copy of DA Form 2188-R, see the back of this publication.



DATA SHEET

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

SETUP	WEAPON DATA			FO DATA		
TIME OUT: 60	UNIT: B 1/29IN	WPN: 81	WPN:	FO	ALT	GRID
TGT PRFX: CA		DIR: 4800	DIR:	A59	500	0283 7417
TGT NO: 0300-0400	81 mm CAR: YES / ✓ NO	DIS: 35	DIS:			
ALARM: ON / ✓ OFF						
MIN E: 02	BP: B2	WPN: 83	WPN:			
MIN N: 73		DIR: 1600	DIR:			
GD: ✓ E / W 02	E: 0360	DIS: 35	DIS:			
LAT: ✓ + / - 32	N: 7490					
LISTEN: ON / ✓ OFF	ALT: 460					
BIT RATE: 1200	AZ: 3136	WPN: 84	WPN:			
KEY TONE: 1.4	DEF: 2800	DIR: 1600	DIR:			
BLK: ✓ SNG / DBL	ELE:	DIS: 70	DIS:			
OWNER ID: B						

AMMUNITION DATA

TEMPERATURE 70° TYPE: ✓ HE ✓ WP ✓ ILL CS TNG

LOT NUMBER	HE C008	WP B008	ILL A008					
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 1RD		7 (HE)	293

DA FORM 2188-R, MAR 1991 REPLACES DA FORM 2188-R, MAR 1977 WHICH IS OBSOLETE. USAPA V1.00

Figure 4-2. Example of completed DA Form 2188-R (Data Sheet).

SETUP

4-25. The FDC uses this field to record the firing element's initialization data. Table 4-8 highlights the fields found in this section and provides more information about each area.

Table 4-8. Setup field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
Time Out	The time that must elapse before the MBC enters standby mode
TGT PRFX	Target prefix used by the firing element
TGT NO.	Target numbering block
Alarm	Alarm on and off function for messages
MIN E/MIN N	Minimum easting and northing coordinates from the map sheet
GD	East or west grid declination
LAT	Latitude from the map sheet
Listen	Message transmission and reception
BIT Rate	Message transmission rates for digital message device (DMD)-supported missions
Key Tone	Length of time required for a communications device
BLK	Transmit block mode for DMD-supported missions
Owner ID	Owner identification for DMD-supported missions

WEAPON DATA

4-26. The FDC uses this field to record the firing element's weapon initialization data. Table 4-9 highlights the fields found in this section and provides more information about each area.

Table 4-9. Weapon data field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
Unit	Unit mortar element assigned
__mm CAR	Weapon type, mounted or dismounted
BP	Basepiece number
E	Basepiece's easting map coordinate
N	Basepiece's northing map coordinate
ALT	Basepiece's altitude in meters
AZ	Basepiece's direction of fire in mils
DEF	Referred deflection used by the firing element
ELE	Elevation used for these rounds
WPN/DIR/DIS	Weapon number, direction, and distance from the basepiece NOTE: Continue to fill out until all weapons have been recorded for firing section.

Forward Observer Data

4-27. The FDC records the FO's location in this field. Table 4-10 highlights the fields found in this section and provides more information about each area.

Table 4-10. Forward observer data field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
FO	FO's call sign
ALT	Altitude at the FO's location
GRID	Grid coordinates of the FO's location

Ammunition Data

4-28. The FDC monitors the rounds using this section. After each mission, personnel update all fields. Table 4-11 highlights the fields found in this section and provides more information about each area.

Table 4-11. Ammunition data field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
Temperature	Current temperature
Type	Appropriate types of ammunition issued
Lot Number	Lot numbers of the rounds and fuzes on hand
On Hand	Number (by lot number) of rounds the firing element has on the firing position
Received	Number and type of rounds received
Total	Combination of rounds on hand and those received
Rounds Expended	Number of rounds expended for missions
Rounds Remaining	Number of rounds remaining

Target Data

4-29. The FDC records previously fired targets using this section.

Target Identification

4-30. Target identification (ID) includes the type of target; for example, troops in the open. Table 4-12 highlights the fields found in this section and provides more information about each area.

Table 4-12. Target identification field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
TGT NO.	Alphanumeric identifier assigned to a target
GRID	Six- or eight-digit coordinates of a target
ALT	Altitude of the target

Chart Data

4-31. Chart data includes the fire solution without adjustment or modification. Table 4-13 highlights the fields found in this section and provides more information about each area.

Table 4-13. Chart data field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
DEFL	Chart (M16/M19) or initial (MBC) deflection to the target
RG/CHG	Chart (M16) or initial (MBC) range and charge needed for the mortars to engage the target

Firing Corrections

4-32. This information is applied to the chart data. Table 4-14 highlights the fields found in this section and provides more information about each area.

Table 4-14. Firing correction field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
DEFL CORR	Direction (left/right) value and number of mils to apply to the chart deflection for firing data
RG CORR	The value and amount (+/-) of meters to apply to the chart range for firing data
ALT VI	Altitude of the target and VI difference, UP (+) or DOWN (-) in meters, between the target and the mortar altitudes
ALT CORR	The number of meters and direction (UP/DOWN) used for altitude corrections NOTE: For 60-, 81-, and 120-mm mortars, corrections for deflection and range are used on the modified and surveyed charts.

NOTE: If the chart data and the command data are the same, do not repeat the data in the range/charge block.

Firing Data

4-33. Firing data includes the base gun command data for targets. This information combines corrections and chart data to calculate firing data (command data) so that mortars can fire to the target's center of mass. Table 4-15 highlights the fields found in this section and provides more information about each area.

Table 4-15. Firing data field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
DEFL	Command deflection to hit the target's center of mass
RG/CHG	Command range and charge to hit the target
Fuze Time SETT	Fuze/time setting on mechanical/electronic fuzes, recorded to the nearest 0.1 second
ELEV	Elevation used to fire the round for 60-, 81-, and 120-mm mortars; the elevation from the firing tables for the command range

Intelligence

4-34. Intelligence combines information provided by the FO and the FDC. Table 4-16 highlights the fields found in this section and provides more information about each area.

Table 4-16. Intelligence field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
Time Fired	The time the CFF was received NOTE: The FDC completes this field.
Target DESCR	What the target was (from the CFF on DA Form 2399-R) NOTE: The FO completes this field.
Method of Engagement	How the target was engaged (number of mortars, number and type of rounds fired in the FFE) NOTE: The FDC completes this field.
Surveillance	The battle damage assessment (BDA) of the engagement NOTE: The FO provides this information to the FDC.

Rounds

4-35. This section contains information regarding the rounds expended for the mission and the amount remaining for future missions.

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

4-36. The computer uses DA Form 2188-1-R (LHMBC/MFCS Data Sheet) (Figure 4-3) 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.

NOTES: 1. The controlling FDC will keep the DA Form 2188-1-R.

2. For a blank, reproducible copy of DA Form 2188-1-R, see the back of this publication.

LHMBC/MFCS DATA SHEET

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

GEO REF

Ellipsoid:	WGS 1984
Datum:	WE-WGS
Min Easting:	687000
Min Northing:	3569000
Zone:	16
Hemi:	N

DATA

TGT Prefix:	AB
MIN:	0001
MAX:	0100
Alarm:	☐ ON ☒ OFF
Next:	0001

WEAPON DATA

Firing Unit: D Co 2/29 INF

81 mm CAR: Y ☐ N ☒

Unit Name:	A1	Unit Name:	A3
Easting/DIR:	15560	Easting/DIR:	15480
Northing/DIS:	90116	Northing/DIS:	90124
ALT:	0148	ALT:	0148
AZ:	0100	AZ:	0100
DEF:	2800	DEF:	2800
Obs Num:		Obs Num:	
Unit Name:	A2	Unit Name:	A4
Easting/DIR:	15520	Easting/DIR:	15440
Northing/DIS:	90120	Northing/DIS:	90128
ALT:	0148	ALT:	0148
AZ:	0100	AZ:	0100
DEF:	2800	DEF:	2800
Obs Num:		Obs Num:	

SUBSCRIBERS

FDC IP: 130.139.112.031

Unit:	URN:	ADR:	Grid:	Alt:	Obs#:
A1	10021613	41			
A2	10021614	42			
A3	10021615	43			
A4	10021616	44			
FOS1	10021617	40	00905 92350	0175	01
FSE1	10021618	50	00913 92358	0168	02
FDC	10021612	31	15517 90089	0145	99

COMMO	A	B
Protocol:	C220	
Device Type:	SINCGAR	
Modulation:	NRZ	
Data Rate:	N4800	
COMSEC:	CT	
FH Mode:	FH	
EDC Mode:	None	
NAD Method:	DAPNAD	
NET Usage:	Data Only	
Num Stations:	7	
Rank:	3	

AMMUMITION DATA TEMP 70

Shell Type:	HE	IL	RP		
Lot Number:	A-C868 212	B-248C2	C-23479		
On Hand:	24	0	0		
Received:	100	50	100		
TOTAL:	124	50	100		
RNDS Expended:					
RNDS Remaining:					

TARGET DATA

TARGET ID			CHART DATA		FIRING CORRECTIONS				FIRING DATA				INTELLIGENCE			ROUNDS	
TGT NO.	GRID	ALT	DEFL/ AZ	RG CHG	DEFL/ AZ CORR	RANGE CORR	ALT VI	ALT CORR	DEFL/ AZ	RG CHG	FUZE/TIME SETTING	ELEV	TGT DESC.	METHOD OF ENGAGEMENT	SURVEILLANCE	EXP	REM
AB0001	15700 9210	132			-025	+013			0097	1898 2		1287	TIO	SEC HEQ 3 RDS	TGT DEST	12	112

DA FORM 2188-1-R, SEP 2008

APD PE v1.00

Figure 4-3. Example of completed DA Form 2188-1-R (LHMBC/MFCS Data Sheet).

GEOGRAPHICAL REFERENCE FIELD

4-37. The FDC uses the GEO REF field to record the geographical reference data. Table 4-17 highlights the fields found in this section and provides more information about each area.

Table 4-17. Geographical Reference field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
Ellipsoid	Default is WGS1984, 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	Set to North if north of the equator; set to South if south of the equator.

DATA FIELD

4-38. The FDC uses this field to record the firing element's setup data. Table 4-18 highlights the fields found in this section and provides more information about each area.

Table 4-18. Data field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
TGT PRFX	Target prefix used by the firing element
MIN	The first number in the unit's designated target block
MAX	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

4-39. The FDC uses this field to record the firing element's weapon initialization data. Table 4-19 highlights the fields found in this section and provides more information about each area.

Table 4-19. 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 basepiece
Northing/DIS	The northing portion of the grid coordinate or the distance to the mortar from the basepiece
ALT	The mortar's altitude in meters
AZ	The mounting azimuth used by the firing element for degraded ops
DEF	Referred 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.

SUBSCRIBERS FIELD

4-40. 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 4-20 highlights the fields found in this section and provides more information about each area.

Table 4-20. Subscribers field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
FDC IP	Supplied by Unit signal officer. This 12 digit address will set the first 9 digits of the IP Address' for all subscriber units.
Unit	Designation assigned to a given subscriber. First character must be a letter
URN	Unit Reference Number. Supplied by the units signal officer. The URN of the Force XXI battle command—brigade and below (FBCB2) computer and the URN of the MFCS are different, even though they refer to the same unit.
ADR	The last 3 digits of the 12 digit IP address for the subscriber
Grid	Grid coordinates of the subscribers location
Alt	Altitude at the subscribers location
Obs#	Observer number if the subscriber is acting as an observer

COMMO FIELD

4-41. The FDC records the communication information in this field. Table 4-21 highlights the fields found in this section and provides more information about each area.

Table 4-21. Commo field titles and information documented in each field.

FIELD	INFORMATION DOCUMENTED IN FIELD
Protocol	A220 for VMF PKG 11 or C220 for VMF R5
Device Type	Set to SINCGARS if using FM communications or 2-Wire for a hardwired connection.
Modulation	Either Non-Return to Zero(NRZ) or Frequency Shift Keying-FSK188C
Data Rate	Speed that data is transferred on the network, ranging from 75 to 1200 bps
COMSEC	Set to cipher text (CT) for secure communications or plain text (PT) for unsecured communications
FH Mode	Select FH for frequency hop or SC for single channel communications
EDC Mode	Error detection and correction mode Selectable modes include forward error correction, time-dispersal coding, and scrambling.
NAD Method	Deterministic adaptable priority network access delay (DAPNAD) (default), hybrid, priority random, or round-robin (LHMBC only)
NET Usage	Data or data and voice Voice will take 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 FDC in the network

AMMUNITION DATA FIELD

4-42. The FDC monitors the rounds using this section. This section is filled out in the same manner as DA Form 2188-R. See paragraph 4-28 for instructions.

TARGET DATA FIELD

4-43. The FDC records previously fired targets using this section. This section is filled out in the same manner as DA Form 2188-R. See paragraphs 4-29 through 4-35 for instructions.

ANGLE T

4-44. Angle T is the angle, or difference in mils, between the OT line and GT line (Figure 4-4). 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 that the FO can cut his corrections in half to compensate for dispersion.

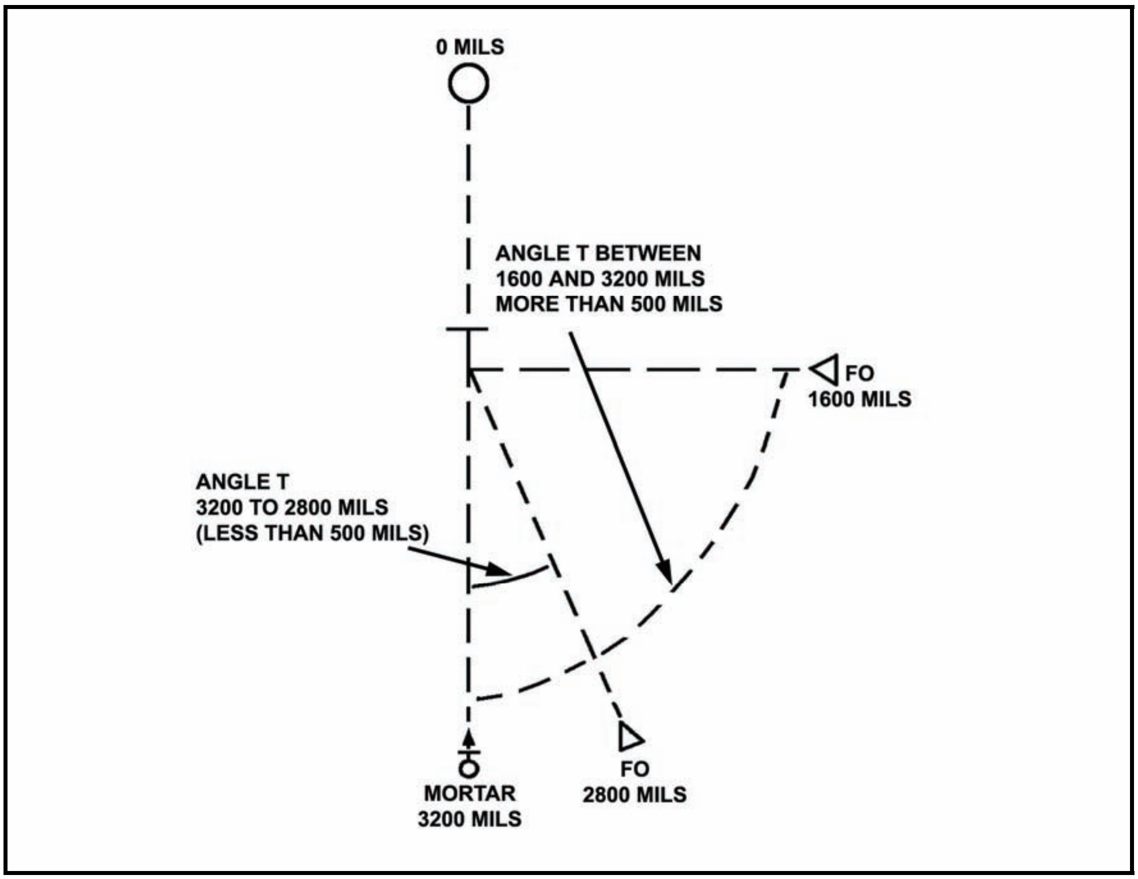


Figure 4-4. Angle T between 400 and 1600 mils.

4-45. 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 when it is 500 mils or greater. To determine angle T, the computer must compare the OT azimuth and GT azimuth, subtracting the smaller from the larger.

- 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 his CFF or with his first correction.

NOTE: For shift from a known point and polar plot missions, the FO must send the OT azimuth in the CFF. For grid missions, however, the FO may not send the OT azimuth in the CFF, but he must send 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.

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

4-46. Because angle T exceeds 499 mils in the third example above, the FDC notifies the observer so that he 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 (Figure 4-5), but if the correction is more than asked for, he reduces the deviation corrections proportionately.

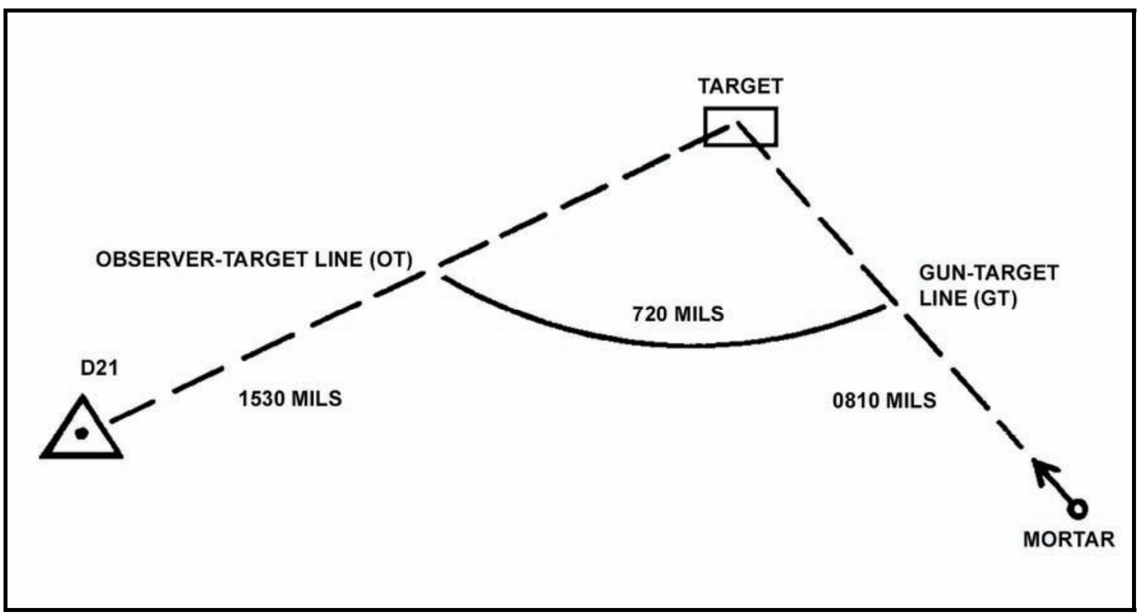


Figure 4-5. Angle T exceeding 499 mils.

FIRING TABLES

4-47. Firing tables 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 material.
- A nonstandard trajectory exists under conditions of weather and material differing from standard conditions.

NOTE: Refer to the appropriate firing tables for rounds not listed in this manual.

4-48. The following information describes the firing table for a 60-mm mortar. An example is shown in Figure 4-6.

- Parts I, II, III, and IV of FT 60-P-1 contain firing data for various rounds that use propelling charges. Each part contains five tables:
  - Table A provides the components of a 1-knot wind.
  - Table B provides air temperature and density corrections.
  - Table C provides variations in muzzle velocity due to propellant temperature.
  - Table D provides basic data and nonstandard correction factors.
  - Table E provides supplementary data.
- Each part addresses a given round:
  - Part I includes the M720 HE round.
  - Part II includes the M49A4 HE round.
  - Part III includes the M302A1 WP round.
  - Part IV includes the M83A3 illumination round.
  - The appendices contain trajectory charts for the M720 HE round.
- FT-6-Q-1 contains information for M49A4 HE, M50A3 training practice, M302A1 WP, and M83A3 illumination rounds for the M31 subcaliber assembly.

CHARGE 2 — TABLE D — FT 60-P-1

BASIC DATA — CTG, HE, M720 / 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
			US	LS			
M	MIL	MIL				SEC	MIL
1100	1314	28	3	2	3	30.2	3.2
1125	1307	28	3	2	3	30.1	3.2
1150	1300	29	3	2	3	30.1	3.1
1175	1293	29	3	2	3	30.0	3.0
1200	1286	29	3	2	3	30.0	2.9
1225	1278	29	3	2	3	29.9	2.9
1250	1271	30	3	2	3	29.9	2.8
1275	1264	30	3	2	3	29.8	2.7
1300	1256	30	3	2	3	29.7	2.7
1325	1248	31	3	2	3	29.7	2.6
1350	1241	31	3	2	3	29.6	2.6
1375	1233	31	3	2	3	29.5	2.5
1400	1225	32	3	2	3	29.5	2.5
1425	1217	32	3	2	3	29.4	2.4
1450	1209	33	3	3	3	29.3	2.4
1475	1201	33	3	3	3	29.2	2.3
1500	1192	34	4	3	3	29.1	2.3
1525	1184	34	4	3	3	29.0	2.2
1550	1175	35	4	3	3	28.9	2.2
1575	1167	35	4	3	3	28.8	2.1
1600	1158	36	4	3	3	28.7	2.1
1625	1149	37	4	3	3	28.6	2.0
1650	1139	38	4	3	3	28.	2.0
1675	1130	38	4	3	3	28.4	2.0
1700	1120	39	4	3	3	28.3	1.9
1725	1110	40	4	3	3	28.2	1.9
1750	1100	41	4	3	3	28.0	1.9
1775	1090	43	4	3	3	27.9	1.8
1800	1079	44	5	3	3	27.7	1.8
1825	1068	46	5	4	3	27.6	1.7
1850	1056	47	5	4	3	27.4	1.7
1875	1044	49	5	4	3	27.2	1.7
1900	1031	52	5	4	3	27.0	1.6

FT 60-P-1 — TABLE D — CHARGE 2

CTG, HE, M720 / FUZE, MO, M734 — CORRECTION FACTORS

1	8	9	10	11	12	13	14	15
RANGE	RANGE CORRECTIONS FOR							
	MUZZLE VELOCITY 1 M/S		RANGE WIND 1 KNOT		AIR TEMP 1 PCT		AIR DENSITY 1 PCT	
	DEC	INC	HEAD	TAIL	DEC	INC	DEC	INC
M	M	M	M	M	M	M	M	M
1100	10.3	-8.6	4.5	-3.5	0.0	0.0	-3.2	3.1
1125	10.6	-8.9	4.5	-3.5	0.0	0.0	-3.2	3.2
1150	10.8	-9.1	4.5	-3.6	0.0	0.0	-3.3	3.3
1175	11.0	-9.3	4.5	-3.6	0.0	0.0	-3.4	3.3
1200	11.3	-9.5	4.5	-3.6	0.0	0.0	-3.4	3.4
1225	11.5	-9.7	4.5	-3.6	0.0	0.0	-3.5	3.5
1250	11.8	-9.9	4.5	-3.6	0.0	0.0	-3.6	3.5
1275	12.0	-10.1	4.5	-3.6	0.0	0.0	-3.6	3.6
1300	12.3	-10.3	4.5	-3.6	0.0	0.0	-3.7	3.7
1325	12.5	-10.5	4.6	-3.6	0.0	0.0	-3.8	3.7
1350	12.7	-10.7	4.6	-3.6	0.0	0.0	-3.8	3.8
1375	13.0	-10.9	4.6	-3.7	0.0	0.0	-3.9	3.8
1400	13.2	-11.1	4.6	-3.7	0.0	0.0	-..0	3.9
1425	13.5	-11.3	4.6	-3.7	0.0	0.0	-4.0	4.0
1450	13.7	-11.5	4.6	-3.7	0.0	0.0	-4.1	4.0
1475	14.0	-11.7	4.6	-3.7	0.0	0.0	-4.1	4.1
1500	14.2	-11.9	4.6	-3.7	0.0	0.0	-4.2	4.2
1525	14.5	-12.1	4.6	-3.7	0.0	0.0	-4.3	4.2
1550	14.7	-12.3	4.6	-3.8	0.0	0.0	-4.3	4.3
1575	15.0	-12.5	4.6	-3.8	0.0	0.0	-4.4	4.3
1600	15.2	-12.7	4.6	-3.8	0.0	0.0	-4.5	4.4
1625	15.5	-12.9	4.6	-3.8	0.0	0.0	-4.5	4.5
1650	15.7	-13.2	4.6	-3.8	0.0	0.0	-4.6	4.5
1675	16.0	-13.4	4.6	-3.8	0.0	0.0	-4.6	4.6
1700	16.2	-13.6	4.6	-3.8	0.0	0.0	-4.7	4.6
1725	16.5	-13.8	4.6	-3.8	0.0	0.0	-4.8	4.7
1750	16.7	-14.0	4.6	-3.9	0.0	0.0	-4.8	4.7
1775	17.0	-14.2	4.5	-3.9	0.0	0.0	-4.9	4.8
1800	17.2	-14.4	4.5	-3.9	0.0	[illegible]	-4.9	4.9
1825	17.5	-14.6	4.5	-3.9	0.0	0.0	-5.0	4.9
1850	17.7	-14.8	4.5	-3.9	0.0	0.0	-5.1	5.0
1875	18.0	-15.0	4.4	-3.9	0.0	0.0	-5.1	5.0
1900	18.3	-15.2	4.4	-3.9	0.0	0.0	-5.2	5.1

Figure 4-6. Sample pages from firing tables for 60-mm mortar.

4-49. The following information describes the firing table for the 81-mm mortar. An example is shown in Figure 4-7.

NOTE: To round off range, look for the range at the lowest charge, then round it off to the closest range.

- Part I contains six parts, the first of which contains data for corrections for the HE M889 cartridge. The other five parts contain firing data for a given propelling charge using the HE M821 cartridge. Tables A, B, C, D, and E provide the same data for all mortar firing tables.
- Part II contains four parts and provides data for the M819 cartridge, red phosphorus. All four parts contain data for given propelling charges.
- The appendices contain trajectory charts. The computer uses these charts to determine the height of a round for a given charge and the nearest 100-mil elevation the round will travel to a given range. These charts assist computer in determining what round to use during urban combat.
- FT 81-AI-3 contains data similar to that of the FT 81-AR-2, but addresses M374A2 HE, M374 HE, M375A2 WP, M375 WP, M375A2 WP, and M301A3 illumination rounds. It also contains a section that gives the range, elevation, and maximum ordinate for the M68 training round.
- FT 81-AQ-1 contains data for M374A3 HE and M375A3 WP rounds similar to that contained in FT 81-AR-2.

CHARGE 2 — TABLE D — FT 81-AR-2

BASIC DATA — CTG, HE, M821 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
1125	1422	16	2	5	39.6	4.0
1150	1418	16	2	5	39.6	3.9
1175	1414	16	2	5	39.6	3.8
1200	1410	16	2	5	39.5	3.7
1225	1406	16	2	5	39.5	3.6
1250	1402	16	2	5	39.5	3.6
1275	1398	16	2	4	39.4	3.5
1300	1394	16	2	4	39.4	3.4
1325	1390	16	2	4	39.3	3.3
1350	1386	17	2	4	39.3	3.2
1375	1381	17	2	4	39.2	3.2
1400	1377	17	2	4	39.2	3.1
1425	1373	17	2	4	39.1	3.0
1450	1369	17	2	4	39.1	3.0
1475	1365	17	2	4	39.0	2.9
1500	1360	17	2	4	39.0	2.8
1525	1356	17	2	4	38.9	2.8
1550	1352	17	2	4	38.8	2.7
1575	1348	17	2	4	38.8	2.7
1600	1343	17	2	4	38.7	2.6
1625	1339	17	2	4	38.7	2.6
1650	1335	17	2	4	38.6	2.5
1675	1330	17	2	4	38.5	2.5
1700	1326	17	2	4	38.5	2.4
1725	1322	18	2	4	38.4	2.4
1750	1317	18	2	4	38.3	2.3
1775	1313	18	2	4	38.3	2.3
1800	1308	18	2	4	38.2	2.2
1825	1304	18	2	4	38.1	2.2
1850	1299	18	2	4	38.0	2.2
1875	1295	18	2	4	38.0	2.1
1900	1250	18	2	4	37.9	2.1

FT 81-AR-2 — TABLE D — CHARGE 2

CTG, HE, M821 FUZE, MO, M734 — CORRECTION FACTORS

1	8	9	10	11	12	13	14	15
RANGE	RANGE CORRECTIONS FOR							
	MUZZLE VELOCITY 1 M/S		RANGE WIND 1 KNOT		AIR TEMP 1 PCT		AIR DENSITY 1 PCT	
	DEC	INC	HEAD	TAIL	DEC	INC	DEC	INC
M	M	M	M	M	M	M	M	M
1125	8.8	-7.6	4.4	-3.6	0.1	-0.1	-2.9	2.8
1150	9.0	-7.8	4.4	-3.7	0.1	-0.1	-2.9	2.9
1175	9.2	-8.0	4.4	-3.7	0.1	-0.1	-3.0	3.0
1200	9.4	-8.1	4.4	-3.7	0.1	-0.1	-3.0	3.0
1225	9.6	-8.3	4.5	-3.7	0.1	-0.1	-3.1	3.1
1250	9.8	-8.5	4.5	-3.7	0.1	-0.1	-3.2	3.1
1275	10.0	-8.6	4.5	-3.7	0.1	-0.1	-3.2	3.2
1300	10.2	-8.8	4.5	-3.7	0.1	-0.1	-3.3	3.3
1325	10.4	-9.0	4.5	-3.7	0.1	-0.1	-3.3	3.3
1350	10.6	-9.2	4.5	-3.7	0.1	-0.1	-3.4	3.4
1375	10.8	-9.3	4.5	-3.7	0.1	-0.1	-3.5	3.4
1400	11.0	-9.5	4.5	-3.7	0.1	-0.1	-3.5	3.5
1425	11.2	-9.7	4.6	-3.7	0.1	-0.1	-3.6	3.6
1450	11.4	-9.9	4.6	-3.7	0.1	-0.1	-3.6	3.6
1475	11.6	-10.0	4.6	-3.7	0.1	-0.1	-3.7	3.7
1500	11.8	-10.2	4.6	-3.7	0.1	-0.1	-3.8	3.7
1525	12.0	-10.4	4.6	-3.7	0.1	-0.1	-3.8	3.8
1550	12.2	-10.6	4.6	-3.7	0.1	-0.1	-3.9	3.8
1575	12.4	-10.7	4.6	-3.8	0.1	-0.1	-3.9	3.9
1600	12.6	-10.9	4.7	-3.8	0.2	-0.1	-4.0	4.0
1625	12.8	-11.1	4.7	-3.8	0.2	-0.1	-4.0	4.0
1650	13.0	-11.2	4.7	-3.8	0.2	-0.1	-4.1	4.1
1675	13.2	-11.4	4.7	-3.8	0.2	-0.1	-4.2	4.1
1700	13.4	-11.6	4.7	-3.8	0.2	-0.1	-4.2	4.2
1725	13.6	-11.8	4.7	-3.8	0.2	-0.1	-4.3	4.2
1750	13.8	-11.9	4.7	-3.8	0.2	-0.1	-4.3	4.3
1775	14.0	-12.1	4.7	-3.8	0.2	-0.1	-4.4	4.4
1800	14.2	-12.3	4.8	-3.8	0.2	-0.1	-4.5	4.4
1825	14.4	-12.5	4.8	-3.8	0.2	-0.1	-4.5	4.5
1850	14.6	-12.6	4.8	-3.9	0.2	-0.1	-4.6	4.5
1875	14.8	-12.8	4.8	-3.9	0.2	-0.1	-4.6	4.6
1900	15.0	-13.0	4.8	-3.9	0.2	-0.1	-4.7	4.6

Figure 4-7. Sample pages from firing tables for 81-mm mortar.

4-50. The following information describes the firing table for the 120-mm mortar. An example is shown in Figure 4-8.

- Parts I and II provide elevation information for use with 120-mm NDI ammunition.
- Parts I and II provide general data, ground data, and correction factors for each round. Part I includes M57 HE and M68 WP rounds. Part II includes the M91 illumination round.

CHARGE 2 — TABLE D — FT 120-A-0

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
1500	1410	13	3	5	41.8	2.1
1525	1407	13	3	5	41.8	2.0
1550	1403	13	3	5	41.8	2.0
1575	1400	13	3	5	41.8	1.9
1600	1397	13	3	5	41.7	1.9
1625	1393	13	3	5	41.7	1.9
1650	1390	13	3	5	41.7	1.9
1675	1387	13	3	5	41.7	1.8
1700	1383	13	3	5	41.6	1.8
1725	1380	13	3	5	41.6	1.8
1750	1377	13	3	5	41.6	1.7
1775	1373	14	3	5	41.6	1.7
1800	1370	14	3	5	41.5	1.7
1825	1367	14	3	5	41.5	1.7
1850	1363	14	3	5	41.5	1.6
1875	1360	14	3	5	41.5	1.6
1900	1356	14	3	5	41.4	1.6
1925	1353	14	3	5	41.4	1.6
1950	1349	14	3	5	41.4	1.6
1975	1346	14	3	5	41.3	1.5
2000	1342	14	3	5	41.3	1.5
2025	1339	14	3	5	41.3	1.5
2050	1335	14	3	5	41.2	1.5
2075	1332	14	3	5	41.2	1.5
2100	1328	14	3	5	41.2	1.4
2125	1325	14	3	5	41.1	1.4
2150	1321	14	3	5	41.1	1.4
2175	1318	14	3	5	41.1	1.4
2200	1314	14	3	5	41.0	1.4
2225	1310	15	3	5	41.0	1.3
2250	1307	15	3	5	40.9	1.3
2275	1303	15	3	5	40.9	1.3
2300	1299	15	3	5	40.9	1.3

FT 120-A-0 — TABLE D — CHARGE 2

CTG. HE. M934 FUZE. MO. M734 — CORRECTION FACTORS

1	8	9	10	11	12	13	14	15
RANGE	RANGE CORRECTIONS FOR							
	MUZZLE VELOCITY 1 M/S		RANGE WIND 1 KNOT		AIR TEMP 1 PCT		AIR DENSITY 1 PCT	
	DEC	INC	HEAD	TAIL	DEC	INC	DEC	INC.
M	M	M	M	M	M	M	M	M
1500	11.7	-10.3	3.8	-3.1	0.0	0.0	-3.0	3.0
1525	11.9	-10.4	3.8	-3.2	0.0	0.0	-3.0	3.0
1550	12.1	-10.6	3.8	-3.2	0.0	0.0	-3.1	3.1
1575	12.3	-10.8	3.8	-3.2	0.0	0.0	-3.1	3.1
1600	12.5	-11.0	3.8	-3.2	0.0	0.0	-3.2	3.2
1625	12.7	-11.1	3.8	-3.2	0.0	0.0	-3.2	3.2
1650	12.9	-11.3	3.9	-3.2	0.0	0.0	-3.3	3.3
1675	13.1	-11.5	3.9	-3.2	0.0	0.0	-3.3	3.3
1700	13.3	-11.6	3.9	-3.2	0.0	0.0	-3.4	3.4
1725	13.5	-11.8	3.9	-3.2	0.0	0.0	-3.4	3.4
1750	13.7	-12.0	3.9	-3.2	0.0	0.0	-3.5	3.4
1775	13.9	-12.2	3.9	-3.2	0.0	0.0	-3.5	3.5
1800	14.1	-12.3	3.9	-3.2	0.0	0.0	-3.6	3.5
1825	14.3	-12.5	3.9	-3.2	0.0	0.0	-3.6	3.6
1850	14.5	-12.7	3.9	-3.2	0.0	0.0	-3.7	3.6
1875	14.7	-12.9	3.9	-3.2	0.0	0.0	-3.7	3.7
1900	14.9	-13.0	4.0	-3.2	0.0	0.0	-3.7	3.7
1925	15.1	-13.2	4.0	-3.2	0.0	0.0	-3.8	3.8
1950	15.3	-13.4	4.0	-3.3	0.0	0.0	-3.8	3.8
1975	15.4	-13.6	4.0	-3.3	0.0	0.0	-3.9	3.9
2000	15.6	-13.7	4.0	-3.3	0.0	0.0	-3.9	3.9
2025	15.8	-13.9	4.0	-3.3	0.0	0.0	-4.0	4.0
2050	16.0	-14.1	4.0	-3.3	0.0	0.0	-4.0	4.0
2075	16.2	-14.2	4.0	-3.3	0.0	0.0	-4.1	4.1
2100	16.4	-14.4	4.0	-3.3	0.0	0.0	-4.1	4.1
2125	16.6	-14.6	4.1	-3.3	0.0	0.0	-4.2	4.1
2150	16.8	-14.8	4.1	-3.3	0.0	0.0	-4.2	4.2
2175	17.0	-14.9	4.1	-3.3	0.0	0.0	-4.3	4.2
2200	17.2	-15.1	4.1	-3.3	0.0	0.0	-4.3	4.3
2225	17.4	-15.3	4.1	-3.3	0.0	0.0	-4.4	4.3
2250	17.6	-15.5	4.1	-3.3	0.0	0.0	-4.4	4.4
2275	17.8	-15.6	4.1	-3.4	0.0	0.0	-4.5	4.4
2300	18.0	-15.8	4.1	-3.4	0.0	0.0	-4.5	4.5

Figure 4-8. Sample pages from firing tables for the 120-mm mortar.

DA FORM 3675-R (BALLISTIC MESSAGE)

4-51. DA Form 3675-R (Ballistic Message) and DA Form 3677-R (Computer MET Message) allow the user to determine necessary firing data corrections so that the section has better accuracy and target effect without re-registering every two to four hours.

USE OF METEOROLOGICAL MESSAGE

4-52. MET messages provide information about air temperature and density, and the speed and direction of the wind between the mortar platoon and the targets. The validity of a MET message increases over time. There are no specific rules for determining how long a MET message is usable, since that determination depends on the atmospheric conditions.

4-53. To be valid, the MET message must be received with the initial registration mission. To ensure that the first MET message will be current, the FDC requests a MET message shortly after setting up the surveyed firing chart. This message alone is not adequate to determine firing corrections, but it can tell the

FDC how many registration corrections are due to weather. After the FDC receives and computes the first MET message, they receive a second within four hours, compare the two, and determine the data used to update the firing equipment.

SOURCE OF METEOROLOGICAL MESSAGE

4-54. In the modular force, each BCT, whether heavy or light, will have one MET system in the fires battalion. Each fires brigade will have three MET systems; however, owing to a lack of assets, each fires brigade will initially be fielded with one MET system. The FA 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 radiosonde 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.

RECEIPT OF METEOROLOGICAL MESSAGE

4-55. The MET message has two parts: the introduction and the body. It is broadcasted in six-character groups, as shown in Figure 4-9. The examples of completed DA Forms 3675-R (Figure 4-10) and 3677-R (Figure 4-11) use the same six-character groups to show how they are entered on the form.

NOTE: See FM 3-09.15 for guidance concerning the use of the aforementioned forms.

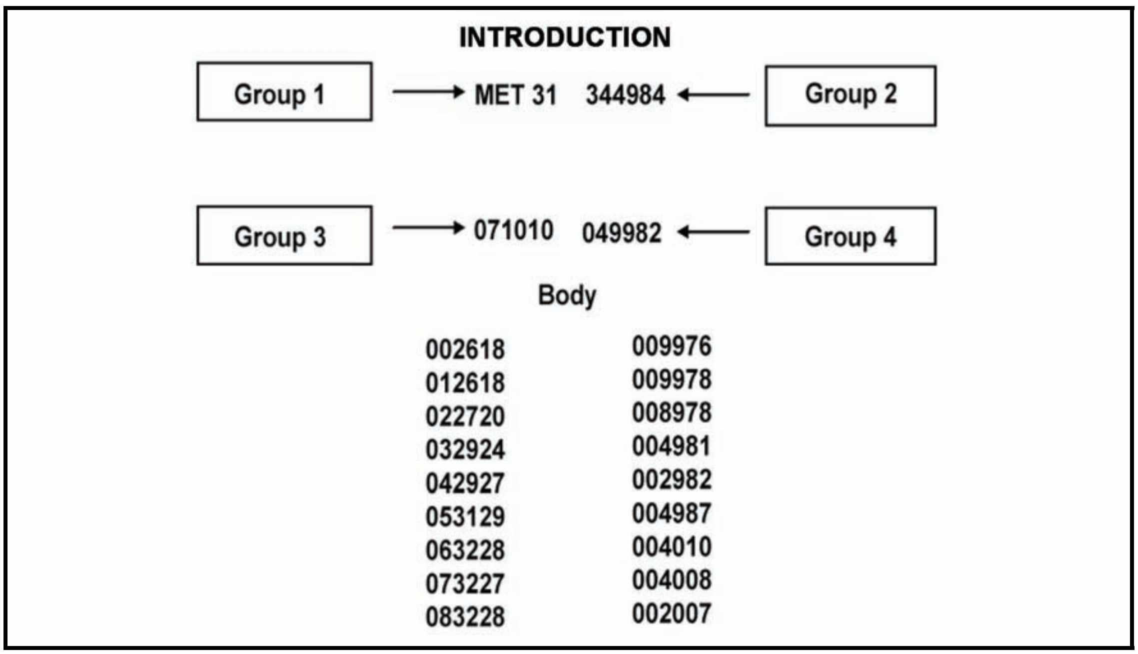


Figure 4-9. Six-character groups.

BALLISTIC MESSAGE

For use of this form, see FM 3-09.15; the proponent agency is TRADOC.

IDENTIFICATION METB	TYPE MSG K	OCTANT Q	LOCATION $L_aL_aL_a$ or xxx	LOCATION $L_oL_oL_o$ or xxx	DATE YY	TIME (GMT) G_oGG_o	DURATION (HOURS) G	STATION HEIGHT (10s M) hhh	MDP PRESSURE % OF STD
METB	3	1	344	985	07	101	0	049	982

ZONE HEIGHT (METERS)	LINE NUMBER ZZ	BALLISTIC WINDS DIRECTION (100s MILS) dd	BALLISTIC WINDS SPEED (KNOTS) FF	BALLISTIC AIR TEMPERATURE (% OF STD) TTT	BALLISTIC AIR DENSITY (% OF STD) ΔΔΔ
SURFACE	00	26	18	009	976
200	01	26	18	009	978
500	02	27	20	008	978
1000	03	29	24	004	981
1500	04	29	27	002	982
2000	05	31	29	004	987
3000	06	32	28	004	010
4000	07	32	27	004	008
5000	08	32	28	002	007
6000	09	31	28	001	005
8000	10				
10000	11				
12000	12				
14000	13				
16000	14				
18000	15				

REMARKS

DELIVERED TO: RECEIVED FROM:	TIME (GMT)	TIME (LST)

MESSAGE NUMBER	DATE
RECORDER	CHECKED

DA FORM 3675-R, MAY 92 PREVIOUS EDITIONS ARE OBSOLETE. APD V1.01

Figure 4-10. Example of completed DA Form 3675-R (Ballistic Message).

BALLISTIC MESSAGE

For use of this form, see FM 3-09.15; the proponent agency is TRADOC.

IDENTIFICATION	TYPE MSG	OCTANT	LOCATION $L_aL_aL_a$ or xxx	LOCATION $L_oL_oL_o$ or xxx	DATE	TIME (GMT)	DURATION (HOURS)	STATION HEIGHT (10s M)	MDP PRESSURE
METB	K	Q	xxx	xxx	YY	G_o G G_o	G	hhh	% OF STD
METB	3	1	356	321	08	1030	0	040	976

ZONE HEIGHT (METERS)	LINE NUMBER ZZ	BALLISTIC WINDS DIRECTION (100s MILS) dd	BALLISTIC WINDS SPEED (KNOTS) FF	BALLISTIC AIR TEMPERATURE (% OF STD) TTT	BALLISTIC AIR DENSITY (% OF STD) ΔΔΔ
SURFACE	00	19	19	000	976
200	01	20	18	989	975
500	02	21	20	000	999
1000	03	20	20	001	002
1500	04	18	19	997	982
2000	05	20	21	001	983
3000	06	17	18	987	987
4000	07				
5000	08				
6000	09				
8000	10				
10000	11				
12000	12				
14000	13				
16000	14				
18000	15				

REMARKS

DELIVERED TO: / RECEIVED FROM:	TIME (GMT)	TIME (LST)

MESSAGE NUMBER	DATE
RECORDER	CHECKED

DA FORM 3675-R, MAY 92 PREVIOUS EDITIONS ARE OBSOLETE. APD V1.01

Figure 4-11. Example of completed DA Form 3675-R (Ballistic Message).

Introduction

4-56. The first four character groups in the MET message, the introduction, identify the type of message and the MET station transmitting the message. Table 4-22 identifies these character groups and explains their meanings.

Table 4-22. Character groups in the introduction and their corresponding meanings.

CHARACTER	MEANING
Group 1: MET B 31 (METCM) for computer MET	
MET	Indicates that the transmission is a MET message
B	Type of fire; indicates that the message is a ballistic 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. Example: MIF MIF 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 tenth of a degree
985	Indicates the longitude of the center of the area, expressed to the nearest tenth 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 tenth of an hour, Greenwich mean time (GMT) NOTE: To convert GMT to standard time, see FM 3-09.15.
0	Indicates the duration of the MET message NOTE: For US armed forces, the MET data is presumed valid until a later message is received.
Group 4: 049982	
049	Indicates the altitude of the MET station above sea level, expressed in tens of meters
982	Indicates the atmospheric pressure at the MET datum plane (MDP), expressed to the nearest one-tenth 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

4-57. The next group of six-character blocks, the body, contains MET data listed by line number. Figure 4-12 depicts the relationship of the line numbers and zone heights to the meteorological datum plane. Table 4-23 identifies two of the character groups and explains their meanings. The remaining 16 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 seven lines (00-006) need to be recorded (Figure 4-13).

Table 4-23. Character groups in the body and their corresponding meanings.

CHARACTER	MEANING
002618	
00	The line number indicating the standard height relative to the MDP
26	The direction from which the ballistic wind is blowing (measured clockwise from north, expressed in hundreds 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.

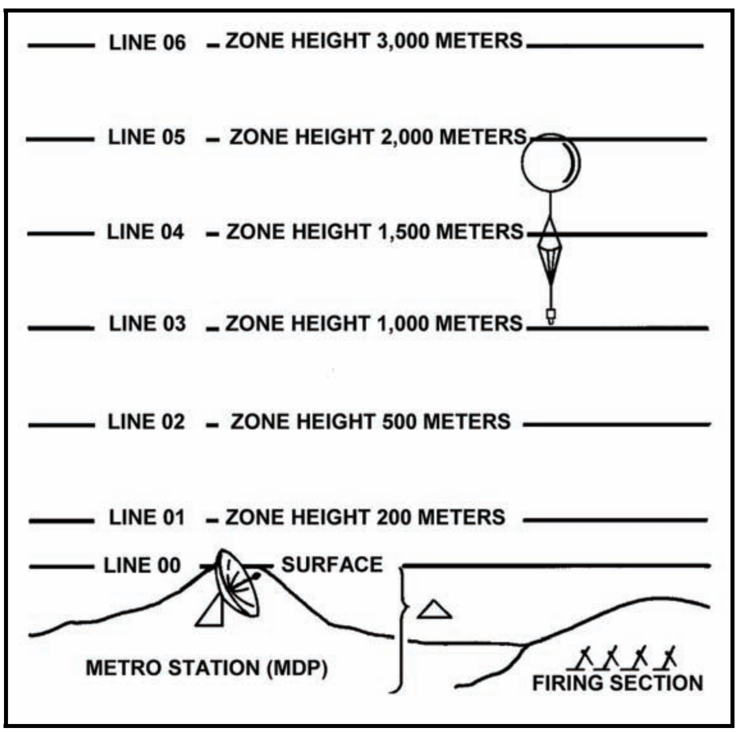


Figure 4-12. Line number and zone height relative to meteorological data plane.

BALLISTIC MESSAGE

For use of this form, see FM 3-09.15; the proponent agency is TRADOC.

IDENTIFICATION	TYPE MSG	OCTANT	LOCATION		DATE	TIME (GMT)	DURATION (HOURS)	STATION HEIGHT (10s M)	MDP PRESSURE
			$L_aL_aL_a$ or xxx	$L_oL_oL_o$ or xxx					
METB	K	Q	xxx	xxx	YY	G_oGG_o	G	hhh	% OF STD
METB	3	1	356	321	08	1030	0	040	976

ZONE HEIGHT (METERS)	LINE NUMBER ZZ	BALLISTIC WINDS DIRECTION (100s MILS) dd	BALLISTIC WINDS SPEED (KNOTS) FF	BALLISTIC AIR TEMPERATURE (% OF STD) TTT	BALLISTIC AIR DENSITY (% OF STD) ΔΔΔ
SURFACE	00	19	19	000	976
200	01	20	18	989	975
500	02	21	20	000	999
1000	03	20	20	001	002
1500	04	18	19	997	982
2000	05	20	21	001	983
3000	06	17	18	987	987
4000	07				
5000	08				
6000	09				
8000	10				
10000	11				
12000	12				
14000	13				
16000	14				
18000	15				

REMARKS

DELIVERED TO:
RECEIVED FROM:

TIME (GMT) TIME (LST)

MESSAGE NUMBER DATE

RECORDER CHECKED

DA FORM 3675-R, MAY 92 PREVIOUS EDITIONS ARE OBSOLETE. APD V1.01

Figure 4-13. Example of completed first seven lines for DA Form 3675-R (Ballistic Message).

Recording of the Meteorological Message

4-58. As the battalion headquarters sends the MET message, the computer records it on DA Forms 3675-R and 3677-R. (See FM 3-09.15 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 him to ask for that portion of the message to be repeated.

Meteorological Message Computation

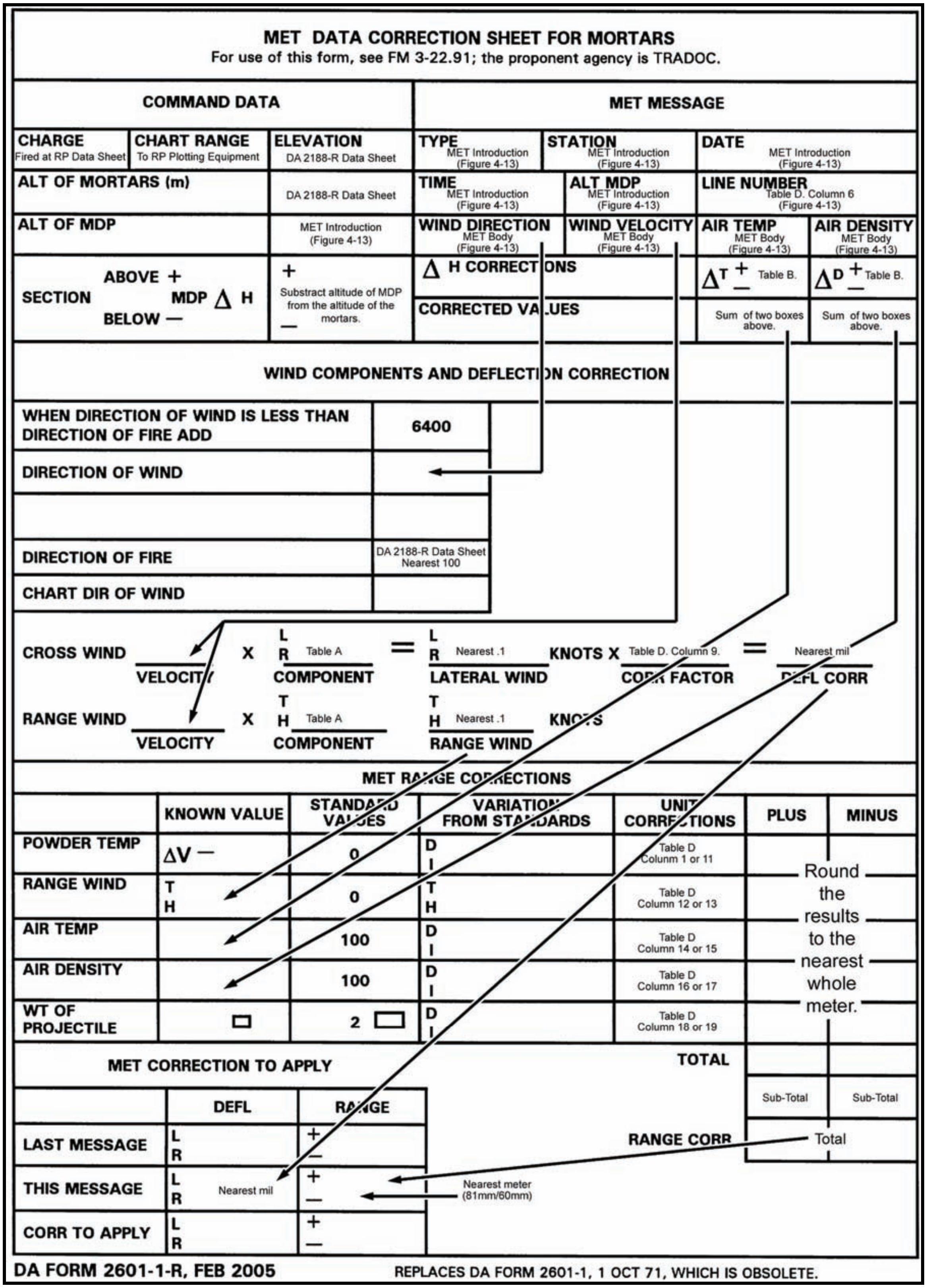
4-59. After recording the MET message, the FDC uses DA Form 2601-1-R (MET Data Correction Sheet for Mortars) to compute the MET and determines the corrections that will be applied when updating the firing equipment (Figures 4-14 and 4-15). Personnel record known data in the proper spaces on the form. These data are available at the mortar platoon or section (obtained from DA Form 2188-R, DA Form 2188-1-R, or section sergeant).

NOTE: For a blank, reproducible copy of DA Form 2601-1-R, see the back of this publication.

4-60. Table 4-24 highlights the fields found in this form and provides more information about each area.

Table 4-24. DA Form 2601-1-R (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 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 of the mortar platoon or section to the nearest 10 meters
Line Number	The number in this field is used for the MET and can be recorded before the MET message is received. To do so, the computer enters the firing tables as follows: • For 60-, 81-, or 120-mm mortars, 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 FDC has received and recorded the MET message, record the introduction and information from the line number being used. • Since the altitude of the MDP is expressed in tens of meters and the wind direction is expressed in hundreds 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.



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

COMMAND DATA			MET MESSAGE			
CHARGE Fired at RP Data Sheet	CHART RANGE To RP Plotting Equipment	ELEVATION DA 2188-R Data Sheet	TYPE MET Introduction (Figure 4-13)	STATION MET Introduction (Figure 4-13)	DATE MET Introduction (Figure 4-13)	
ALT OF MORTARS (m)		DA 2188-R Data Sheet	TIME MET Introduction (Figure 4-13)	ALT MDP MET Introduction (Figure 4-13)	LINE NUMBER Table D. Column 6 (Figure 4-13)	
ALT OF MDP		MET Introduction (Figure 4-13)	WIND DIRECTION MET Body (Figure 4-13)	WIND VELOCITY MET Body (Figure 4-13)	AIR TEMP MET Body (Figure 4-13)	AIR DENSITY MET Body (Figure 4-13)
SECTION ABOVE + MDP Δ H BELOW —		+ Substract altitude of MDP from the altitude of the mortars. —	Δ H CORRECTIONS		ΔT + — Table B.	ΔD + — Table B.
			CORRECTED VALUES		Sum of two boxes above.	Sum of two boxes above.

WIND COMPONENTS AND DEFLECTION CORRECTION

WHEN DIRECTION OF WIND IS LESS THAN DIRECTION OF FIRE ADD	6400
DIRECTION OF WIND	
DIRECTION OF FIRE	DA 2188-R Data Sheet Nearest 100
CHART DIR OF WIND	

CROSS WIND ____ VELOCITY X L R Table A COMPONENT = L R Nearest .1 LATERAL WIND KNOTS X Table D. Column 9. CORR FACTOR = Nearest mil DEFL CORR

RANGE WIND ____ VELOCITY X T H Table A COMPONENT T H Nearest .1 RANGE WIND KNOTS

MET RANGE CORRECTIONS

	KNOWN VALUE	STANDARD VALUES	VARIATION FROM STANDARDS	UNIT CORRECTIONS	PLUS	MINUS
POWDER TEMP	ΔV —	0	D I	Table D Column 1 or 11	Round the results to the nearest whole meter.	
RANGE WIND	T H	0	T H	Table D Column 12 or 13		
AIR TEMP		100	D I	Table D Column 14 or 15		
AIR DENSITY		100	D I	Table D Column 16 or 17		
WT OF PROJECTILE	▭	2 ▭	D I	Table D Column 18 or 19		
				TOTAL		
					Sub-Total	Sub-Total
				RANGE CORR	Total	

MET CORRECTION TO APPLY

	DEFL	RANGE
LAST MESSAGE	L R	+ —
THIS MESSAGE	L R Nearest mil	+ —
CORR TO APPLY	L R	+ —

Nearest meter (81mm/60mm)

DA FORM 2601-1-R, FEB 2005 — REPLACES DA FORM 2601-1, 1 OCT 71, WHICH IS OBSOLETE.

Figure 4-14. Data guide for DA Form 2601-1-R (MET Data Correction Sheet for Mortars).

MET DATA CORRECTION SHEET FOR MORTARS

For use of this form, see FM 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		ΔT + − .2	ΔD + − .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 1.4 (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	T 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-R, FEB 2005 — REPLACES DA FORM 2601-1, 1 OCT 71, WHICH IS OBSOLETE.

Figure 4-15. Example of completed DA Form 2601-1-R (MET Data Correction Sheet for Mortars).

AIR TEMPERATURE AND AIR DENSITY CORRECTIONS

4-61. To determine the corrected values for air temperature and density—

(1) The computer must determine the location of the platoon or section in relationship to the MDP (difference in H correction). To do so, he 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 (-).

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(2) Once he has calculated the distance above or below the MDP, the computer can enter Table B (Figure 4-16), which shows the correction that must be applied to the ballistic AIR TEMP AIR DENSITY on the DA Form 2601-1-R (Figure 4-14). 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.

(3) The numbers 0, +100-, +200-, and +300- in the left column of the table represent a difference in H expressed in hundreds of meters. The numbers 0 and +10- through +90- across the top represent a difference in H in tens of meters. The corrections can be found where the proper hundreds row crosses the proper tens 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 hundreds column, go across to +30-column). Those corrections are entered on DA Form 2601-1-R, and the corrected values can then 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.

Figure 4-16. Sample page from firing table for air temperature and density corrections.

WIND COMPONENT CORRECTIONS

4-62. To determine corrections for wind components—

(1) 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)

(2) He then uses the remainder (CHART DIRECTION OF WIND) to enter Table A at the CHART DIRECTION OF WIND (Figure 4-17). Table A divides a 1-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.

(3) 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-R.

(4) 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 WIND COMPONENTS
FUZE, MO, M734

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

Figure 4-17. Sample page from firing table for wind components.

Crosswind (Deflection Correction)

4-63. To determine the deflection correction—

(1) The computer multiplies the wind speed (Table A) by the wind velocity (MET). This yields the lateral wind.

(2) Once the lateral wind is determined, he enters Table D (Figure 4-18), goes to column 7 (60-mm/81-mm/120-mm mortars), and finds the correction factor.

(3) He 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.

(4) The product is the deflection correction for this MET. The computer records it in the proper space on DA Form 2601-1-R.

CHARGE 4 | TABLE D | FT 120-E-1

BASIC DATA | CTG, WP, XM929 FUZE, PD, M745

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
1200	1511	7	2	7	56.3	6.0
1225	1509	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

FT 120-E-1 | TABLE D | CHARGE 4

CTG, WP, XM929 FUZE, PD, M745 | CORRECTION FACTORS

1	8	9	10	11	12	13	14	15
RANGE	RANGE CORRECTIONS FOR							
	MUZZLE VELOCITY 1 M/S		RANGE WIND 1 KNOT		AIR TEMP 1 PCT		AIR DENSITY 1 PCT	
	DEC	INC	HEAD	TAIL	DEC	INC	DEC	INC
M	M	M	M	M	M	M	M	M
1200	4.9		7.7		2.7			4.1
1225	5.0		7.7		2.8	-0.8		4.2
1250	5.1	-4.0	7.7		2.9	-0.9	-4.3	4.2
1275	5.2	-4.1	7.7		2.9	-0.9	-4.4	4.3
1300	5.3	-4.2	7.7		3.0	-0.9	-4.4	4.4
1325	5.4	-4.2	7.7		3.0	-0.9	-4.5	4.5
1350	5.5	-4.3	7.7		3.1	-0.9	-4.6	4.6
1375	5.6	-4.4	7.8		3.1	-1.0	-4.7	4.6
1400	5.7	-4.5	7.8		3.2	-1.0	-4.8	4.7
1425	5.8	-4.6	7.8		3.3	-1.0	-4.8	4.8
1450	6.0	-4.7	7.8		3.3	-1.0	-4.9	4.9
1475	6.1	-4.7	7.8		3.4	-1.0	-5.0	5.0
1500	6.2	-4.8	7.8		3.4	-1.0	-5.1	5.0
1525	6.3	-4.9	7.8		3.5	-1.1	-5.2	5.1
1550	6.4	-5.0	7.8	-7.0	3.5	-1.1	-5.2	5.2
1575	6.5	-5.1	7.8	-7.0	3.6	-1.1	-5.3	5.3
1600	6.6	-5.2	7.9	-7.0	3.7	-1.1	-5.4	5.4
1625	6.7	-5.2	7.9	-7.0	3.7	-1.1	-5.5	5.4
1650	6.8	-5.3	7.9	-7.0	3.8	-1.1	-5.6	5.5
1675	6.9	-5.4	7.9	-7.0	3.8	-1.2	-5.6	5.6
1700	7.0	-5.5	7.9	-7.0	3.9	-1.2	-5.7	5.7
1725	7.1	-5.6	7.9	-7.0	3.9	-1.2	-5.8	5.8
1750	7.2	-5.7	7.9	-7.0	4.0	-1.2	-5.9	5.8
1775	7.3	-5.8	7.9	-7.0	4.0	-1.2	-6.0	5.9
1800	7.4	-5.8	8.0	-7.0	4.1	-1.2	-6.0	6.0
1825	7.5	-5.9	8.0	-7.0	4.2	-1.3	-6.1	6.1
1850	7.7	-6.0	8.0	-7.0	4.2	-1.3	-6.2	6.1
1875	7.8	-6.1	8.0	-7.0	4.3	-1.3	-6.3	6.2
1900	7.9	-6.2	8.0	-7.0	4.3	-1.3	-6.4	6.3
1925	8.0	-6.3	8.0	-7.0	4.4	-1.3	-6.4	6.4
1950	8.1	-6.3	8.0	-7.1	4.4	-1.3	-6.5	6.5
1975	8.2	-6.4	8.1	-7.1	4.5	-1.4	-6.6	6.5
2000	8.3	-6.5	8.1	-7.1	4.5	-1.4	-6.7	6.6

Figure 4-18. Sample pages from firing table for basic data and correction factors.

Range Wind

4-64. To determine the range wind, the computer—

(1) Multiplies the component by the wind speed.

(2) Carries the sign of the component (H or T from Table D).

(3) Determines to the nearest 0.1 mil.

(4) Records it in the proper space on DA Form 2601-1-R.

Range Corrections

4-65. All values should be recorded in the proper spaces except DV, which is found as follows:

(1) The computer enters Table C, which shows the corrections to the muzzle velocity for various temperatures of the propellant charges (Figure 4-19).

(2) He finds the temperature closest to that recorded for the propellant; DV appears in the center column on the same line as the temperature.

(3) The computer records that value in the proper space.

(4) Then, he determines the amount by which all known values vary from the standard values upon which the firing tables are based.

NOTE: Within the firing tables, D means decrease from standard, and I means increase from standard.

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(5) Once those variations are determined, the computer enters Table D (Command Charge and Range, 60-mm/81-mm/120-mm mortar, Figure 4-18) 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 PROPELLANT TEMPERATURE

FUZE, PD, M935

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 4-19. Sample page from firing table for propellant temperature.

(6) 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.

(7) Once all corrections have been multiplied, the computer compares the minus (-) and plus (+), subtracts the smaller form the larger, and uses the sign of the larger. He determines the result to the nearest meter for 60-mm/ 81-mm/120-mm mortars and records it in the proper space.

COMPUTER METEOROLOGICAL MESSAGE

4-66. Instead of the ballistic MET that FDC personnel use when manually plotting with the M16 plotting board, the M23 MBC, M95/96 MFCS, and the LHMBC, along with artillery, use computerized MET (CMET). The following example highlights CMET with the M23 MBC.

NOTE: See Chapter 15 for the MFCS CMET and Chapter 17 for the LHMBC CMET.

4-67. When no MET is available, the computer uses the standard MET that is stored within itself. The MET menu has two main options: new and current. When a new MET message is received, it is entered into the computer using the new option in the MET menu. Once the update * option is selected, the new MET becomes the current MET and is applied to the firing data.

EXAMPLE

METEOROLOGICAL: NEW
QUADRANT: 0
LATITUDE: 322
LONGITUDE: 845
DATE: DAY: 02
TIME: 100
DURATION: 0
STATION HEIGHT: 014
ATMOSPHERIC PRESSURE: 003

00	231	002	2957	1003
01	200	008	2937	0902
02	230	013	3013	0064
03	185	009	2980	0921
04	000	000	2940	0868
05	074	013	2935	0820
06	057	023	2931	0074
07	067	027	2897	0730
08	070	029	2861	0688

4-68. To input new MET data—

(1) Press the MET switch. “MET: NEW CURRENT” displays. Using multiple choice entry, select NEW.

(2) Press the SEQ switch. Using numeric entry, enter the quadrant— 0.

(3) Press the SEQ switch. Using numeric entry, enter the latitude and longitude— 322 and 845.

(4) Press the SEQ switch. Using numeric entry, enter the day of the month and time of the MET message (CMT)—02 and 100.

(5) Press the SEQ switch. Using numeric entry, enter the duration, station altitude, and atmospheric pressure—0, 014, and 003.

(6) Press the SEQ switch. Using numeric entry, enter wind direction and speed for line 00— 231 and 002.

(7) Press the SEQ switch. Using numeric entry, enter the temperature and air pressure for line 00—2957 and 1003.

(8) Using the procedures above, repeat steps (6) and (7) to line 9.

(9) Press the SEQ switch. After line 8, UPDATE MET * is displayed. Using the multiple choice entry, select the flashing asterisk (*) to update the NEW MET stored in the MBC, placing the NEW MET in the CURRENT MET file, while retaining a copy in the NEW file. Sequence to ready.

NOTE: The MBC, M23, calculates the effect of the MET on the round when determining firing data. Only new MET files may be changed, and then they must be updated to the current file.

(10) To check MET, enter the MET switch, select CURR, and review the MET message.

(11) If a change is needed, enter NEW, make the necessary corrections, and select UPDATE MET *.

6400-MIL METEOROLOGICAL MESSAGE

4-69. The target area is usually larger than the transfer limits of the RP, and yet time, ammunition, and the tactical situation will permit firing only one registration.

4-70. By assuming negligible error in surveys or maps, lay of the weapons, and preparation of the plotting boards or MBC 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.

4-71. 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 can then 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.

COMPUTATION OF METEOROLOGICAL CORRECTIONS FOR LARGE SECTOR CAPABILITY

4-72. A special worksheet, such as DA Form 2601-2-R (MET Data Correction Sheet 6400 Mils [Mortars]) (Figures 4-20 and 4-21), is needed to compute multiple MET corrections from a single registration. The supplemental (imaginary) RPs are spaced 800 mils apart, extending to the right and left of the RP as far as needed to cover the sector of responsibility. DA Form 2601-2-R shows a full 6400-mil capacity. On the firing chart, imaginary RPs are plotted at the same range from the mortar position as the real RP. Following is the process that the FDC uses to compute MET corrections.

NOTE: For a blank, reproducible copy of DA Form 2601-2-R, see the back of this manual.

MET DATA CORRECTION SHEET 6400 MILS (MORTARS)
For use of this form, see FM 3-22.91; the proponent agency is TRADOC

FIRING DATA			MET MESSAGE		
CHARGE 4	CHART RANGE 1811	ELEVATION 1178	TYPE 3	STATION 344983	DATE 12 / TIME
ALTITUDE OF MORTARS (M)	460	ALT MDP 370	LINE NUMBER 3	WIND DIRECTION 2400	
ALTITUDE OF MDP	370	WIND VELOCITY 19	AIR TEMP 103.9	AIR DENSITY 97.4	
SECTION ABOVE + / BELOW − MDP ΔH	+ 90	ΔH CORRECTIONS	ΔT − .2	ΔD − .9	
		CORRECTED VALUES	103.7	96.5	

WIND COMPONENTS

WHEN DIRECTION OF WIND IS LESS THAN DIRECTION OF FIRE ADD	6400
DIRECTION OF WIND	2400
TOTAL	8800
DIRECTION OF FIRE	4800

	I (RP)	II	III	IV	V	VI	VII	VIII
CHART DIRECTION OF WIND (6400 IS LESS THAN CORRESPONDING DIRECTIONAL VARIATION TO CHECK POINTS) 4000	4000	4000	4000	4000	4000	4000	4000	4000
DIRECTIONAL VARIATION TO CHECK POINTS	ø	0800	1600	2400	3200	4000	4800	5600
CHART WIND TO CHECK POINTS	4000	3200	2400	1600	0800	ø	5600	4800
DEFLECTION CORRECTIONS								
WIND VELOCITY (KNOTS)	19	19	19	19	19	19	19	19
CROSS WIND COMPONENT	L .71	L/R ø	R .71	L/R	L/R	L/R	L/R	L/R
CROSS WIND	L 13.5	L/R ø	R 13.5	L/R	L/R	L/R	L/R	L/R
CROSS WIND CORRECTION FACTOR	1.4	1.4	1.4					
DEFLECTION CORRECTION	L 19	L/R ø	R 19	R 27	R 19	L/R ø	L 19	L 27
RANGE CORRECTIONS								
WIND VELOCITY (KNOTS)	19	19	19	19	19	19	19	19
RANGE WIND COMPONENT	T .71	T 1	T .71	T/H ø	H .71	H 1	H .71	T/H ø
RANGE WIND	T 13.5	T 19	T 13.5	T/H ø	H 13.5	T 19	H 13.5	T/H ø
RANGE WIND UNIT CORRECTION	−2.9	−2.9	−2.9	ø	3.8	3.8	3.8	ø
RANGE WIND CORRECTION	− 39	− 55	− 39	± ø	+ 51	+ 72	+ 51	± ø

	KNOWN VALUE	STANDARD VALUES	VARIATION FROM STANDARD	UNIT	PLUS	MINUS
POWDER TEMP 77°F	ΔV − − .3	ø	D .3	−15.3		5
AIR TEMP	103.7	100	D 3.7	− 0 −	− 0 −	
AIR DENSITY	96.5	100	D 3.5	− 37		13
PROJECTILE WT	NOT COMPUTED	FOR	81 MM MORTARS			
						18
			BALLISTIC RANGE CORR.			−18

ABSOLUTE REGISTRATION CORRECTIONS

REGISTRATION CORRECTION	+ 125	L 11
RP MET CORRECTION	− 60	L 19
ABSOLUTE REG. CORRECTION	+ 65	L 30

DIRECTIONAL CORRECTIONS

	I (RP)	II	III	IV	V	VI	VII	VIII
BALLISTIC RANGE CORR.	− 18	− 18	− 18	− 18	− 18	− 18	− 18	− 18
RANGE WIND CORRECTION	− 39	− 55	− 39	± ø	+ 51	+ 72	+ 51	± ø
TOTAL RANGE CORRECTION	− 60	− 70	− 60	− 20	+ 30	+ 50	+ 30	− 20
MET CORRECTION	− 60 L 19	− 70 L/R ø	− 60 R 19	− 20 L/R ø	+ 30 L/R 19	+ 50 L/R ø	+ 30 L 19	− 20 L 27
ABSOLUTE REG. CORRECTION	+ 65 L 30	+ 65 L/R 30	+ 65 L/R 30	+ 65 L 30	+ 65 L/R 30	+ 65 L 30	+ 65 L 30	+ 65 L 30
CORRECTIONS TO APPLY	+ 5 L 39	− 5 R 30	+ 5 R 11	+ 45 L 30	+ 95 R 11	+ 115 L 30	+ 95 L 49	+ 45 R 57

DA Form 2601-2-R, SEP 2008 APD PE v1.00

Fig 4-20

Figure 4-20. Example of completed DA Form 2601-2-R (MET Data Correction Sheet 6400 mils [Mortars]).

MET DATA CORRECTION SHEET 6400 MILS (MORTARS)
For use of this form, see FM 3-22.91; the proponent agency is TRADOC.

FIRING DATA			MET MESSAGE		
CHARGE 17 4/8	CHART RANGE 2910	ELEVATION 900	TYPE 53	STATION 344985	DATE 07 / TIME
ALTITUDE OF MORTARS (M)	460	ALT MDP 490		LINE NUMBER 03	WIND DIRECTION 2900
ALTITUDE OF MDP		WIND VELOCITY 24		AIR TEMP 100.4	AIR DENSITY 98.1
SECTION ABOVE + / BELOW − MDP ΔH	− 30	ΔH CORRECTIONS		ΔT + .1	ΔD − 3
		CORRECTED VALUES		100.5	98.4

WIND COMPONENTS

WHEN DIRECTION OF WIND IS LESS THAN DIRECTION OF FIRE ADD	6400
DIRECTION OF WIND	2900
TOTAL	9300
DIRECTION OF FIRE	−4300

		I (RP)	II	III	IV	V	VI	VII	VIII
CHART DIRECTION OF WIND (6400 IS LESS THAN CORRESPONDING DIRECTIONAL VARIATION TO CHECK POINTS)	5000	5000	5000	5000	5000	5000	5000	5000	5000
DIRECTIONAL VARIATION TO CHECK POINTS		−0	−800	−1600	−2400	−3200	−4000	−4800	−5600
CHART WIND TO CHECK POINTS		5000	4200	3400	2600	1800	1000	200	5800
DEFLECTION CORRECTIONS									
WIND VELOCITY (KNOTS)		24	24	24	24	24	24	24	24
CROSS WIND COMPONENT		R .98	R .83	R .20	L .56	L .98	L .83	L .20	R .56
CROSS WIND		R 23.5	R 19.9	R 4.8	L 13.4	L 23.5	L 19.9	L 4.8	R 13.4
CROSS WIND CORRECTION FACTOR		.9	.9	.9	.9	.9	.9	.9	.9
DEFLECTION CORRECTION		R 21	R 18	R 4	L 12	L 21	L 18	L 4	R 12
RANGE CORRECTIONS									
WIND VELOCITY (KNOTS)		24	24	24	24	24	24	24	24
RANGE WIND COMPONENT		T .20	H	H .98	H .83	H .20	T .56	T .98	T .83
RANGE WIND		T 4.8	H 13.4	H 23.5	H 19.9	H 4.8	T 13.4	T 23.5	T 19.9
RANGE WIND UNIT CORRECTION		5.1	−3.7	−3.7	−3.7	−3.7	5.1	5.1	5.1
RANGE WIND CORRECTION		− 24	+ 50	+ 77	+ 74	+ 18	− 68	− 120	− 101

	KNOWN VALUE	STANDARD VALUES	VARIATION FROM STANDARD	UNIT	PLUS	MINUS
POWDER TEMP 60°F	ΔV = − 0.5	0	I 0.5	23.4	12	
AIR TEMP	100.5	100	D 0.5	0		
AIR DENSITY	98.4	100	I 1.6	− 6.7		11
PROJECTILE WT	3 ▭	2 ▭	D 1 ▭	11	11	
					23	11
					11	
			BALLISTIC RANGE CORR.		12	

ABSOLUTE REGISTRATION CORRECTIONS

REGISTRATION CORRECTION	− 60	R 23
RP MET CORRECTION	− 40	R 21
ABSOLUTE REG. CORRECTION	− 20	R 2

DIRECTIONAL CORRECTIONS

	I (RP)	II	III	IV	V	VI	VII	VIII
BALLISTIC RANGE CORR.	− 12	− 12	− 12	− 12	− 12	− 12	− 12	− 12
RANGE WIND CORRECTION	− 24	+ 50	+ 77	+ 74	+ 18	− 68	− 120	− 101
TOTAL RANGE CORRECTION	− 40	+ 40	+ 70	+ 60	+ 10	− 80	− 130	− 110
MET CORRECTION	− 40 R 21	+ 40 R 18	+ 70 R 4	+ 0 L 12	+ 10 L 21	− 80 L 18	− 130 L 4	− 110 R 12
ABSOLUTE REG. CORRECTION	− 20 R 2	− 20 R 2	− 20 R 2	− 20 R 2	− 20 R 2	− 20 R 2	− 20 R 2	− 20 R 2
CORRECTIONS TO APPLY	− 60 R 23	− 20 R 20	+ 50 L 6	+ 40 L 10	− 10 L 19	− 100 L 16	− 150 L 2	− 130 R 14

DA Form 2601-2-R, SEP 2008 APD PE v1.00

4-21

Figure 4-21. Example of completed DA Form 2601-2-R (MET Data Correction Sheet 6400 mils [Mortars]) for a full 6400-mil capacity.

(1) Complete the top section of the sheet, and compute the difference in H corrections and the corrected values for AIR TEMP and AIR DENSITY.

(2) Determine the CHART DIRECTION OF WIND. Record the result in the box marked I (RP), and copy the result in as many boxes as there are imaginary RPs (II is 800 mils clockwise from the RP, and the numbers increase in a clockwise direction to VIII, which is 800 mils counterclockwise from the RP).

(3) Add the directional variations to the CHART DIRECTION OF WIND, subtracting 6400 if the result is more than 6400.

(4) Copy the wind velocity into the first row of boxes under DEFLECTION CORRECTIONS and RANGE CORRECTIONS. Do not use any column that does not have the CHART DIRECTION OF WIND written on top.

(5) From Table A (Figure 4-17), extract the appropriate crosswind (record it in the DEFLECTION CORRECTIONS section) and range wind (record it in the RANGE CORRECTIONS section) components for each value of CHART WIND TO CHECKPOINTS.

(6) Multiply the velocity by the components to get values for crosswind and range wind.

(7) Find the crosswind correction factor corresponding to the adjusted RP charge in Table D, (column 7, 60-mm/81-mm/ 120-mm mortars). Multiply it by the crosswind to get the MET DEFLECTION CORRECTION.

(8) Find the proper range wind unit correction in Table D, (columns 10 and 11, 60-mm/81-mm mortars). Multiply it by the range wind to get the RANGE WIND CORRECTION.

(9) Compute the MET RANGE CORRECTIONS for POWDER TEMP, AIR TEMP, AIR DENSITY, and PROJECTILE WT in the usual manner. The net of the four is the ballistic range correction.

(10) Combine the ballistic range correction with the various range wind corrections to obtain the total range corrections.

(11) Obtain the total MET corrections by bringing together the MET RANGE CORRECTION and the MET DEFLECTION CORRECTION for each of the points.

(12) Determine the absolute registration correction. First, calculate the registration correction. The registration range correction is the difference between the chart range to the RP and the range corresponding to the initial range at the RP; it is plus if the chart range is smaller. The DEFLECTION CORRECTION is the LARS (left, add; right, subtract) correction, which must be applied to the initial deflection read at the RP to get the firing deflection that hit it. The RP MET correction, which has been recorded under I (RP), is then subtracted from the registration correction; the result is the absolute registration correction.

(13) Add the absolute registration correction to each point MET correction to obtain the corrections to apply at the points.

METEOROLOGICAL CORRECTIONS

4-73. To place fire on a target without adjustment, the FDC must know the target's exact location and must be able to compensate for all nonstandard conditions. Registration and re-registration are the most accurate methods of determining and maintaining firing corrections, but re-registration is not always practical. Between registrations, the MET message helps to determine corrections due to changes in conditions that affect the flight of rounds. Those conditions include changes in powder temperature, air temperature, air density, and the speed and direction of the wind. The FDC assumes that all other factors remain relatively constant until the section displaces.

4-74. Corrections computed from MET messages are not adequate firing corrections alone, but the use of MET corrections can eliminate the need for re-registration. To be of value to the FDC, a valid MET message must be received with or within four hours of the registration. Computing this MET message with the registration tells the FDC how much of the total registration correction is due to weather. By comparing the corrections from a later MET message, the FDC can modify the registration corrections to account for changes in weather.

4-75. For MET corrections to be of use, the FDC must receive two MET messages. The corrections from the two are compared to determine the current corrections to update the firing corrections determined from the registration. Once the two messages are computed, the correcting areas (deflection correction and range correction) are compared, and the product is used to update the registration corrections.

EXAMPLE

Assume that:
MET 1: Deflection correction L20 (Figure 4-22)
Range correction -100
Place the correction from the MET message on a MET cross.

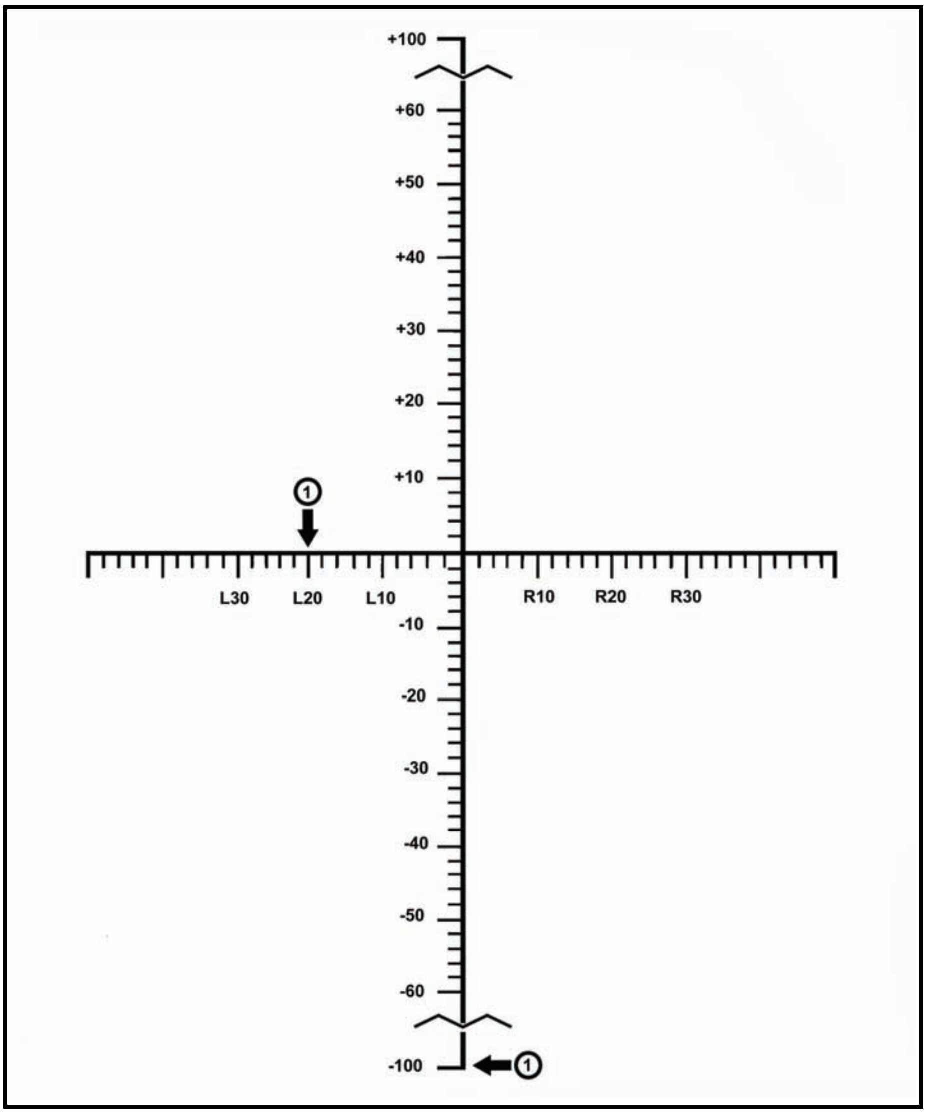

Figure 4-22. Initial meteorological message.

EXAMPLE

Assume that:
MET 2: Deflection correction R10 (Figure 4-23)
Range correction +25
Place the correction from the MET message on a MET cross.

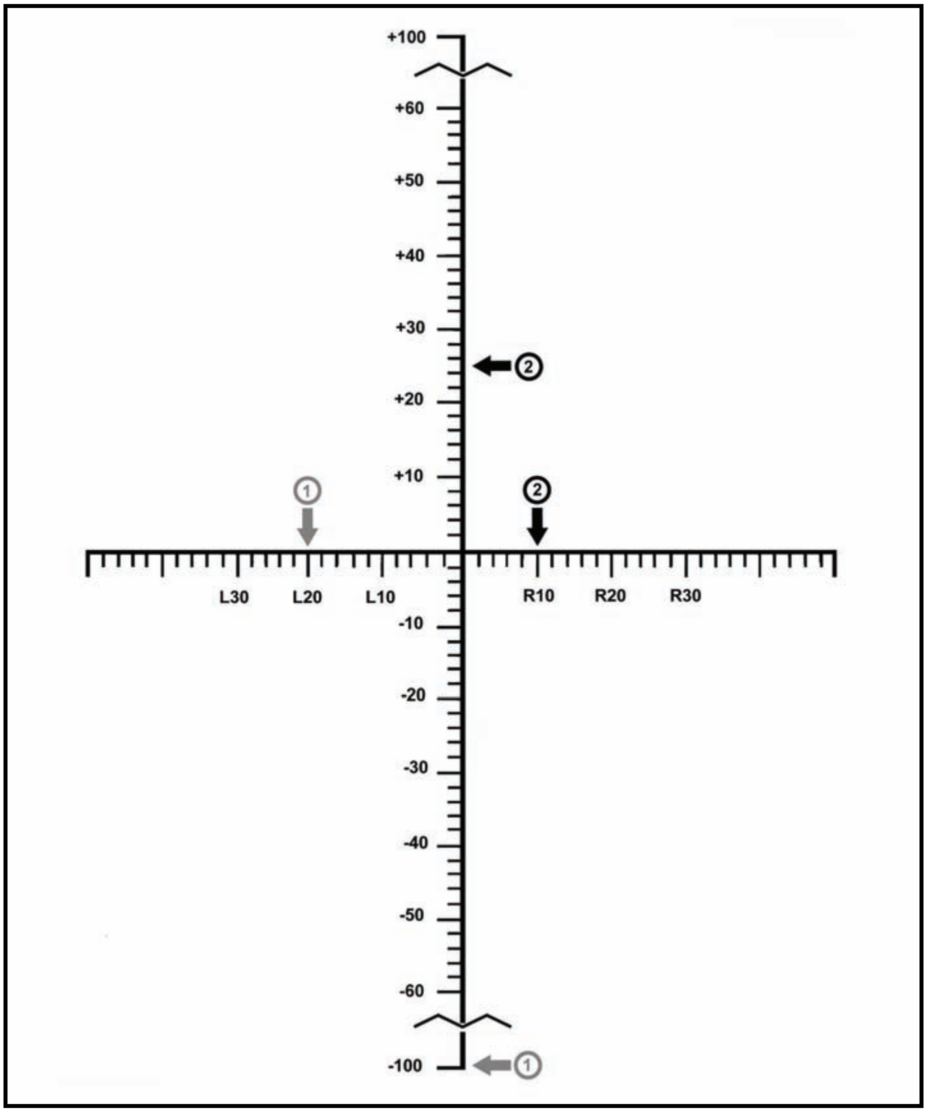

Figure 4-23. Second meteorological message.

4-76. The MET cross helps answer three key questions:

- Where are you? L20 - 100 (MET 1)
- Where are you going? R10 + 25 (MET 2)
- What is required to get there?

DEFLECTION CORRECTION

4-77. To get from L20 to R10, first go from L20 to 0, then right to R10. In doing so, you went R20, then R10, for a total of R30 (Figure 4-24).

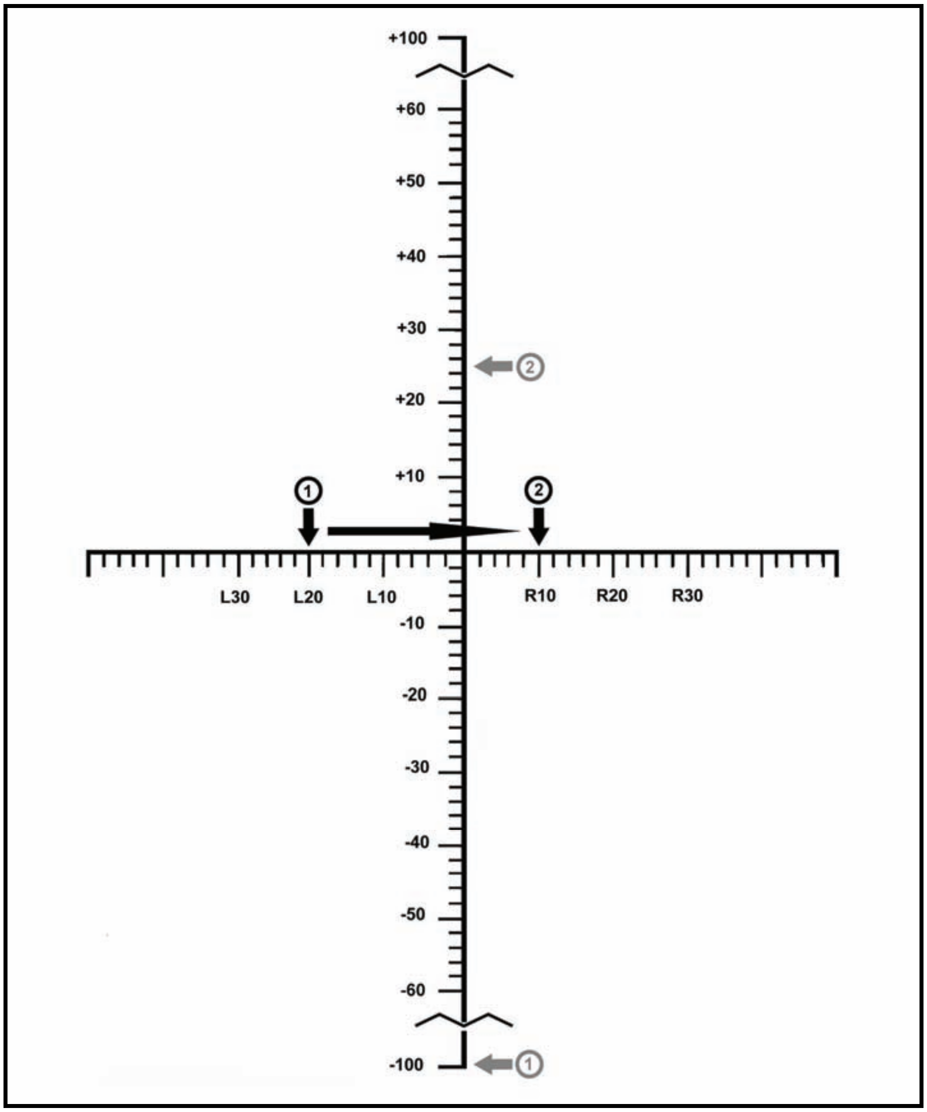

Figure 4-24. Updated registration corrections, deflection.

RANGE CORRECTION

4-78. To get from -100 to +25, first go from -100 to 0, then up the scale to +25. In doing so, you went +100, then +25, for a total correction of +125 (Figure 4-25).

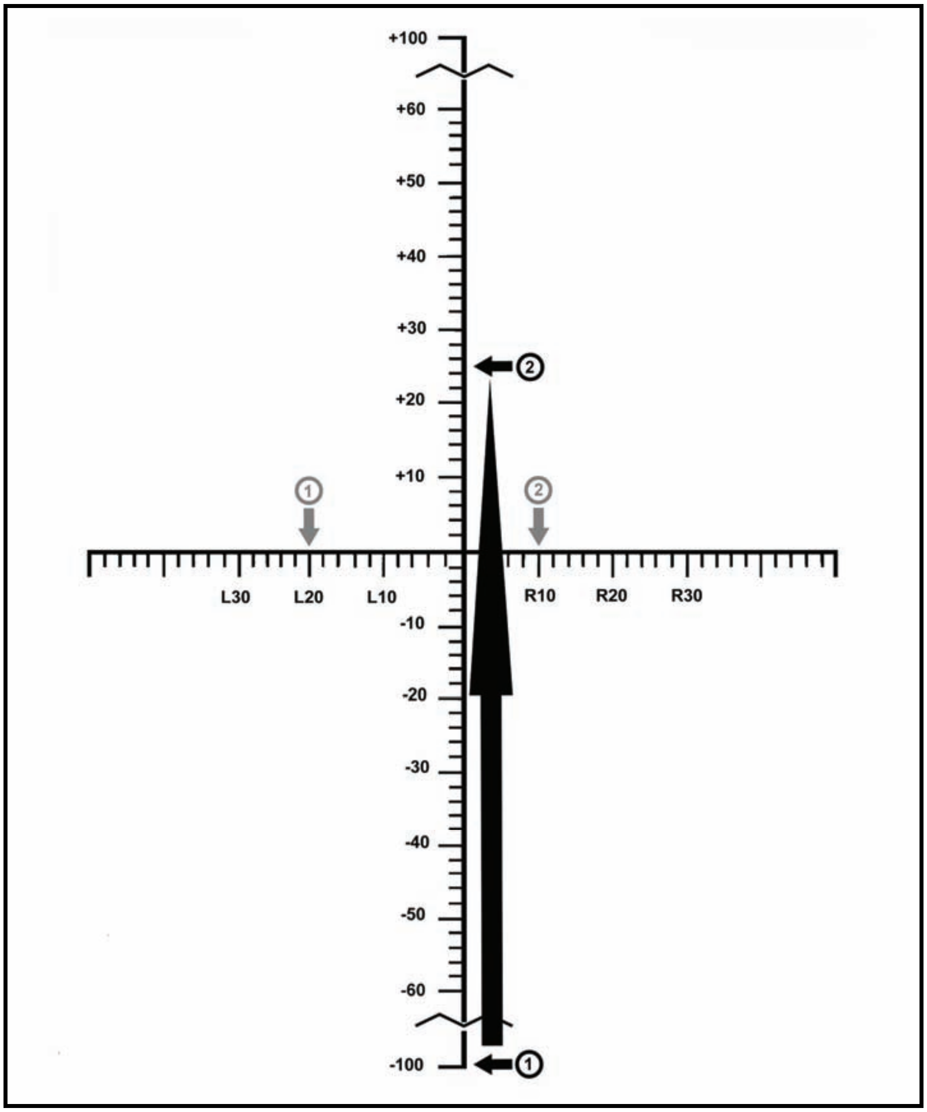

Figure 4-25. Updated registration corrections, range.

EXAMPLE

MET messages on the same side of the MET cross (Figure 4-26).

Assume that:	MET 1:	Deflection correction L30
		Range correction +50
	MET 2:	Deflection correction L40
		Range correction +75
		Deflection correction L30 + L40 = L10
		Range correction +50 + 25

4-79. Always use this procedure to determine corrections. Remember, MET 1 is compared to MET 2, and MET 2 to MET 3. This procedure continues as long as MET messages are received and the unit remains in the same position.

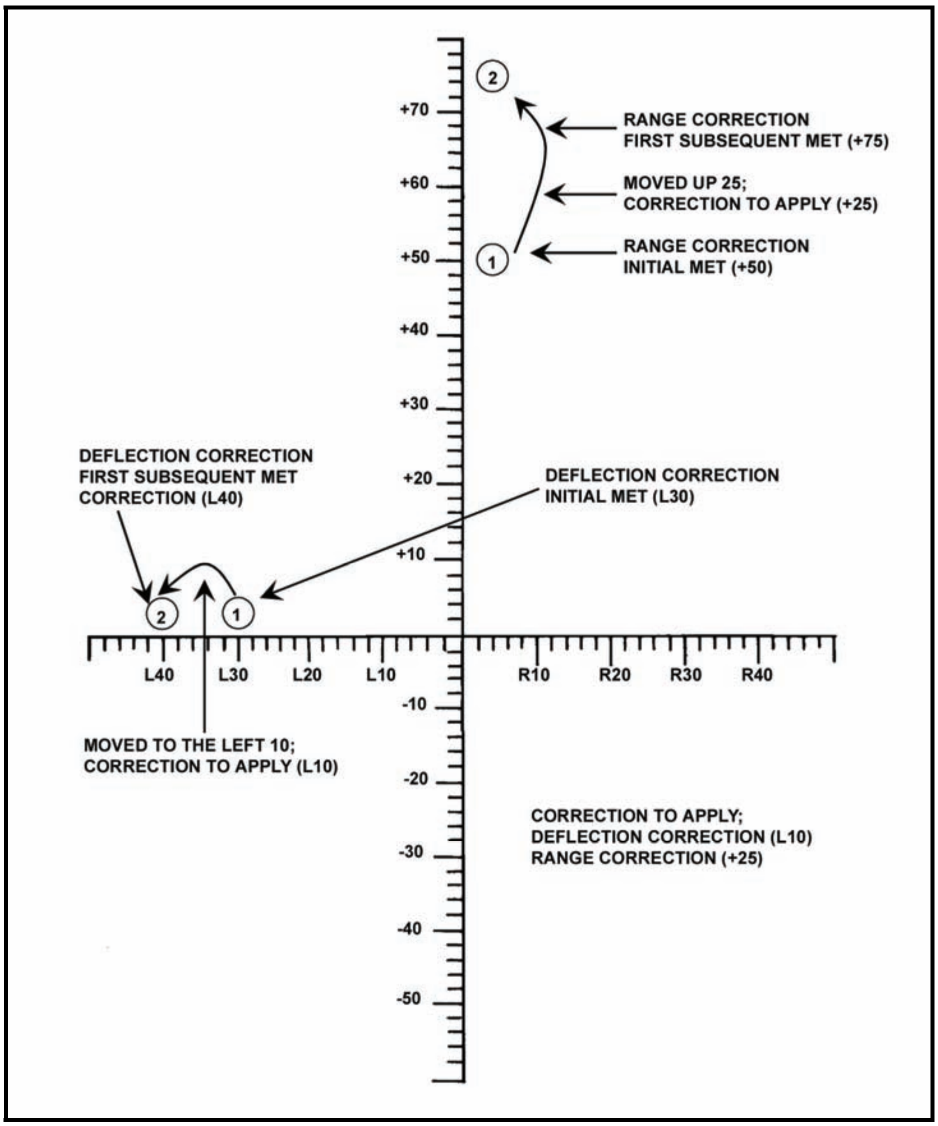

Figure 4-26. Deflection and range corrections.

4-80. Once MET corrections have been determined, the FDC can determine the corrections for updating the MET. MET is based on the RP; therefore, MET corrections are applied to corrections determined from the registration.

RANGE CORRECTION

4-81. Compare the range correction from the RP and the MET range correction. For different signs, subtract the smaller from the larger, and use the sign of the larger for the new range correction for the RP. If the signs are the same, add the values.

EXAMPLE

Range correction from the registration +150
Range correction from the METS +25
+150 + 25 = +175 range correction

RANGE CORRECTION FACTOR

4-82. Once the range correction has been determined, the FDC determines the range correction factor (RCF) by dividing the initial chart range (rounded to the nearest hundred and expressed in thousandths) into the range correction.

EXAMPLE

New range correction: +175
Initial chart range: 3,050
(100's = 3100; 1000's = 3.1)

+56.4 = +56 RCF
+3.1/ +175.0

Deflection correction from registration L12
Deflection correction from METs R10
L2= DEF CORR

4-83. Once the new corrections have been determined, the FDC updates the DA Form 2188-1-R (RP and previously fired targets). Because the chart is based on the RP, the FDC updates it first.

4-84. Chart data remain the same because the known points have not moved. Apply the new corrections to the chart to obtain new command data (Figure 4-27). For previously fired targets, chart data remain the same.

4-85. To obtain the range correction, multiply the new RCF by the range (rounded to the nearest hundred and expressed in thousandths) (Figure 4-27).

NOTE: For a blank, reproducible copy of DA Form 2188-1-R, see the back of this manual.

4-86. For new targets within the transfer limits of the RP, apply the new corrections the same as for previous registration corrections.

Next: ________ | Obs Num: ______ | Obs Num: ______ | RNDS Exp...: | RNDS Remaining:

TARGET DATA

TARGET ID			CHART DATA		FIRING CORRECTIONS				FIRING DATA				INTELLIGENCE			ROUNDS	
TGT NO.	GRID	ALT	DEFL/ AZ	RG / CHG	DEFL/ AZ CORR	RANGE CORR	ALT / VI	ALT CORR	DEFL/ AZ	RG / CHG	FUZE/ TIME SETTING	ELEV	TGT DESC.	METHOD OF ENGAGEMENT	SURVEILLANCE	EXP	REM

DA FORM 2188-1-R

Figure 4-27. Example for updating target data.

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Chapter 5

Call for Fire

A CFF is a concise message prepared by the observer. It contains all of the information that the FDC needs to determine the method of target attack.

INTRODUCTION

5-1. The CFF is a request for fire from the observer. The observer must send it quickly, yet clearly enough for the FDC to understand, record, and read it back without error.

5-2. 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 consists of—
  - Observer ID.
  - Warning order.
- The second transmission consists of—
  - Target location.
- The third transmission consists of—
  - Target description.
  - Method of engagement (optional).
  - Method of fire and control (optional).

NOTE: When the observer sees a target, he should notify 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.

5-3. Further, CFFs typically require authentication.

OBSERVER IDENTIFICATION

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

WARNING ORDER

5-5. The warning order clears the net for the fire mission. The warning order consists of the—

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

TYPES OF MISSIONS

5-6. There are four types of missions for a warning order:

- Adjust fire.
- Fire for effect.
- Suppress.
- Immediate suppression or immediate smoke.

Adjust Fire

5-7. When the observer decides that an adjustment is needed because of a questionable target location or lack of registration corrections, he announces, "Adjust fire (A/F)."

Fire for Effect

5-8. The observer should always strive 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, he announces, "Fire for effect."

Suppress

5-9. To quickly bring fire on an inactive target, the observer announces, "Suppress (target identification number)." Suppression missions are normally fired on preplanned targets, and the duration is associated with the CFF.

Immediate Suppression or Immediate Smoke

5-10. When engaging a planned target or target of opportunity that has taken friendly maneuver or aerial elements under fire, the observer announces, "Immediate suppression (IS)." If the desired effect is a hasty screen for obscuration, the FO announces, "Immediate smoke."

SIZE OF THE ELEMENT TO FIRE FOR EFFECT

5-11. The observer may request the size of the unit to FFE.

METHODS OF TARGET LOCATION

5-12. This element enables the FDC to plot (M16/M19 plotting board) or enter (MBC/MFCS/LHMBC) the location of the target so that personnel can determine firing data.

GRID

5-13. 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

5-14. 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 will be 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: The vertical shift is ignored unless it exceeds 30 meters.

POLAR PLOT

5-15. 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 his 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 also be described by a vertical angle (VA) in mils relative to the observer's location; this method is used when conducting a laser polar plot mission.

TARGET DESCRIPTION

5-16. The section sergeant selects different ammunition for different types of targets. The observer must describe the target in detail to allow the section sergeant 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 should give 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 should give the radius.
  - The observer may describe linear targets using length, width, and attitude.

METHOD OF ENGAGEMENT

5-17. The observer may indicate how he wants to attack the target. This element consists of the—

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

TYPE OF ADJUSTMENT

5-18. In an adjustment, area or precision fire may be used.

Area Fire

5-19. If no specific type of adjustment is designated, area fire will be used. Split a 100-meter bracket to achieve area fire.

Precision Fire

5-20. Precision fire is conducted with one weapon engaging a point target. Currently the only precision mortar mission is registration. Registration is initiated by the FDC and is used to determine corrections for subsequent missions.

Danger Close

5-21. 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

5-22. If the observer does not request a specific projectile or fuze, he is given shell HE, fuze IMP.

5-23. The observer may initially request one type of projectile or fuze, and then request another type to complete the fire mission.

Smoke

5-24. 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

5-25. When the observer wants a combination of projectiles or fuzes in effect, he must state 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

5-26. The observer may also request the volume of fire he needs for FFE. If the observer does not specify the number of rounds to be fired in effect, the FDC should notify the observer of the number of rounds that will be fired in effect.

DISTRIBUTION OF FIRE

5-27. A linear sheaf is fired on an area target in FFE. When another type of sheaf is desired, the observer must announce the type of sheaf desired; for example, “Converged” or “Open sheaf.”

METHODS OF FIRE AND CONTROL

5-28. The methods of fire 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 methods of fire and control using the terms discussed below.

METHOD OF FIRE

5-29. Adjustment is normally conducted with the number two 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, he may request, “Section right (left).”

5-30. The normal interval of time between the rounds fired by a section right or left is 10 seconds. If the observer wants another interval, he may so specify.

METHOD OF CONTROL

5-31. 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 when ready (W/R) or under the FDC's control. The observer announces the method of control using the following terms:

- At my command.
- Cannot observe.
- Time on target.
- Continuous illumination.
- Coordinated illumination.
- Cease fire.
- Check fire.
- Continuous fire.
- Repeat.
- Followed by.

At My Command

5-32. "At my command (AMC)" indicates that the observer wants to control the delivery of fire.

5-33. The observer announces, "At my command," immediately before the adjust fire 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, he announces, "Fire." This method of control remains in effect until the observer announces, "Cancel at my command" or "End of mission."

Cannot Observe

5-34. This announcement indicates that the observer cannot adjust fire, but he 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

5-35. The observer may tell the FDC when he wants the rounds to impact by requesting, "Time on target (number desired) minutes from now" or "Time on target (time desired) hours." The observer must conduct a time check to ensure that his timepiece is synchronized with the FDC's timepiece.

Continuous Illumination

5-36. If the observer has not given an interval, the section sergeant 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

5-37. 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

5-38. 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 already been loaded (hung rounds).

Check Fire

5-39. This command is used to cause an immediate halt in firing.

Continuous Fire

5-40. In mortars, this command means loading and 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 loading” or “Check fire.”

Repeat

5-41. This command can mean one of 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 FFE. Changes to the number of guns, gun data, interval, or ammunition may be requested.

Followed By

5-42. 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

5-43. 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 a message to observer (MTO).

5-44. The MTO consists of the following four items:

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

5-45. The following information can also be transmitted in the MTO:

- Angle T.
- Time of flight.

UNIT(S) TO FIRE

5-46. This element consists of the number of mortars that will fire the mission.

EXAMPLE

In a four-gun 120-mm mortar platoon, two guns are already involved in a fire mission. The other two are available, but the FDC only wants to use one mortar on the new target. The FDC would announce to the observer, "One gun."

CHANGES TO THE CALL FOR FIRE

5-47. This element contains any changes to the CFF.

EXAMPLE

The observer requested IMP in effect, and the FDC decides to fire PROX in effect.

NUMBER OF ROUNDS

5-48. This element contains the number of rounds for each tube in FFE.

TARGET NUMBER

5-49. A target number is assigned to each mission to help the processing of subsequent corrections.

ANGLE T

5-50. The FDC sends angle T to the observer when it is equal to or greater than 500 mils or when requested.

NOTE: See Chapter 4 for more information about angle T.

TIME OF FLIGHT

5-51. The FDC sends time of flight to an observer during moving target or aerial observer missions, or when requested.

NOTE: See FM 6-30 for more information about MTOs.

CALL FOR FIRE FORMAT

5-52. The following is the format for a CFF.

- Observer identification
- Warning order
  - Adjust fire
  - Fire for effect
  - Suppression
  - Immediate suppression/smoke
- Target location
  - Grid coordinates: direction
  - Shift from a known point
    - Direction
    - Lateral shift
    - Range shift
    - Vertical shift
  - Polar plot coordinates
    - Direction
    - Distance
    - Vertical shift from the observation point (OP)

- Target description
- Method of engagement
  - Type of adjustment
    - Area
    - Precision (registration)
    - Danger close
  - Ammunition and fuze
  - Distribution
    - Linear sheaf
    - Parallel sheaf
    - Open sheaf
    - Converged sheaf
    - Special sheaf
    - Traversing fire
    - Searching fire
    - Range spread, lateral spread, or range lateral spread (illumination only)
- Method of fire and control
  - Method of fire
  - Method of control
    - Fire when ready
    - At my command
    - Cannot observe
    - Time on target
    - Continuous illumination
    - Coordinated illumination
    - Cease firing
    - Check firing
    - Continuous fire
    - Repeat
    - Request splash
    - Do not fire

AUTHENTICATION

5-53. 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.

5-54. Challenge and reply authentication requires two-way communications, whereas transmission authentication does not. Challenge and reply authentication is used when possible.

CHALLENGE AND REPLY AUTHENTICATION

5-55. The FDC inserts the challenge in the last read-back 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

5-56. 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, and FPF and IS.

5-57. The observer is given a transmission authentication table in accordance with the unit SOP. The table consists of 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.

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Part Three

Mortar Ballistic Computer

Chapter 6

Introduction

This chapter outlines the description, audio alarm characteristics, capabilities, and memory storage of the MBC.

DESCRIPTION

6-1. The M23 MBC (Figure 6-1) is handheld, lightweight, and battery-powered. It is used for automated computations, digital communications, and displaying mortar-related information. The MBC weighs seven pounds (including the battery) or eight pounds (including the battery and case assembly). It is portable, can be used in all-weather operations, and has built-in self-test circuits. The MBC requires fire mission data input to compute fire commands needed to effectively execute a mortar fire mission. When the MBC is connected to an external communication device, such as a digital message device (DMD) or the forward observer system (FOS), the FO fire mission inputs are automatically entered and may be reviewed and edited by the MBC operator. When the MBC is not connected to an external communication device, the MBC operator manually enters all fire mission data. The fire commands are then relayed to the gun line in accordance with the unit standing operating procedures (SOP).

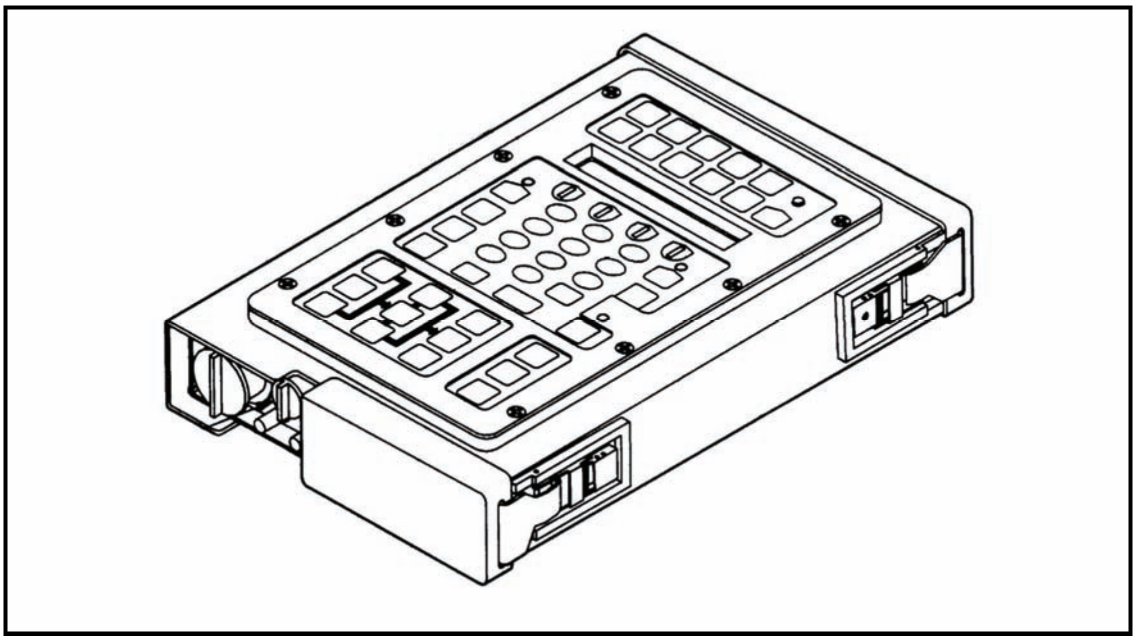

Figure 6-1. Mortar ballistic computer.

INITIALIZATION SWITCHES

6-2. The initialization switches (Figure 6-2) for the MBC include—

- SET UP switch.
- WPN DATA switch.
- FO LOC switch.
- REG DATA switch.
- BRT switch.
- ON/OFF switch.
- FIRE ZONES switch.
- MET switch.
- KNPT/TGT switch.
- AMMO DATA switch.
- TEST switch.

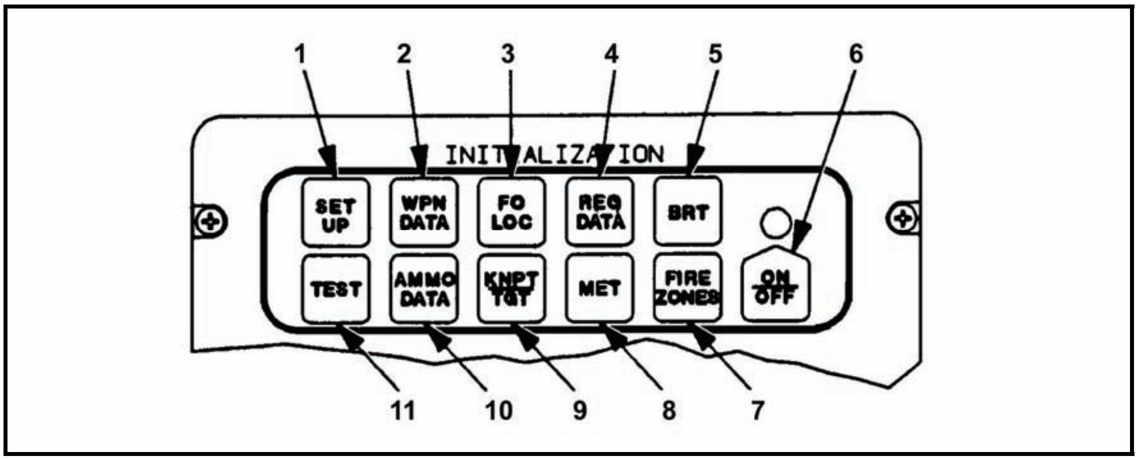

Figure 6-2. Initialization switches.

SET UP Switch

6-3. The SET UP switch (1, Figure 6-2) displays the menu for entering setup data. This menu contains the following:

- Timeout.
- Target prefix and block number range.
- Audio alarm.
- Minimum easting and northing coordinates.
- Location grid declination.
- Latitude.
- Listen-only mode.
- Message transmission rate.
- Transmitter warm-up delay time.
- Single or double message block mode.
- Owner identification.

WPN DATA Switch

6-4. The WPN DATA switch (2, Figure 6-2) displays menus for entering or reviewing weapon data for each unit. This menu allows the operator to select as many as three firing sections and allows him to enter—

- As many as six individual gun locations for each section.
- The weapon type, carrier- or ground-mounted, altitude, azimuth of fire (AOF), and referred deflection being used.

FO LOC Switch

6-5. The FO LOC switch (3, Figure 6-2) displays a menu for entering data. This menu contains the following:

- FO number (12 FOs maximum).
- Grid location.
- Altitude.

REG DATA Switch

6-6. The REG DATA switch (4, Figure 6-2) displays menus for manually entering a registration data file for an RP or reviewing RP data. These menus contain the following:

- 0RP number.
- Location.
- Altitude.
- Weapon unit and number.
- Charge for 60-, 81-, and 120-mm mortars.
- Type of MET data used when the RP was fired, including range and deflection correction factors.

BRT Switch

6-7. The BRT switch (5, Figure 6-2) controls the level of brightness for the display area and the background lighting for the keyboard.

NOTES: 1. The MBC can be operated in total darkness if the brightness is set at low.

2. When set at low, the keyboard is still lit.

ON/OFF Switch

6-8. The ON/OFF switch (6, Figure 6-2) turns the MBC on or off.

NOTE: When turned on, the display temporarily shows "POWERUP TEST," and then shows "READY."

FIRE ZONES Switch

6-9. The FIRE ZONES switch (7, Figure 6-2) displays menus for entering or reviewing fire zone and fire line boundaries. These menus contain the following:

- Location points for fire lines.
- Zone numbers.
- Number of points for a fire zone (no-fire area).
- Location points for fire zone boundaries.

MET Switch

6-10. The MET switch (8, Figure 6-2) displays menus for entering nonstandard MET data. These menus contain the following:

- MET station data and location.
- Nine lines of MET data, including wind direction, speed, temperature, and pressure for each line.

KNPT/TGT Switch

6-11. The KNPT/TGT switch (9, Figure 6-2) displays menus for entering known points or target reference points. These menus contain the following:

- Known point or target number.
- Grid location.
- Altitude.

AMMO DATA Switch

6-12. The AMMO DATA switch (10, Figure 6-2) displays menus for entering ammunition data for each caliber of weapon in use. These menus contain the following:

- Ammunition types.
- Powder temperature change.
- Correction factors for projectile weight.

TEST Switch

6-13. The TEST switch (11, Figure 6-2) allows the user to manually begin a self-test of the microprocessor (ROM, RAM, and instruction set) for all switches and keys, the display (character generation), the modem (communication device), the software revision number, and communications (transmit test message).

ACTION SWITCHES

6-14. The action switches (Figure 6-3) include—

- MSG switch.
- SEQ switch.
- BACK switch.
- XMIT switch.
- CLEAR ENTRY switch.
- COMPUTE switch.
- EOM switch.
- MSN switch.
- SURV switch.
- REVIEW switch.

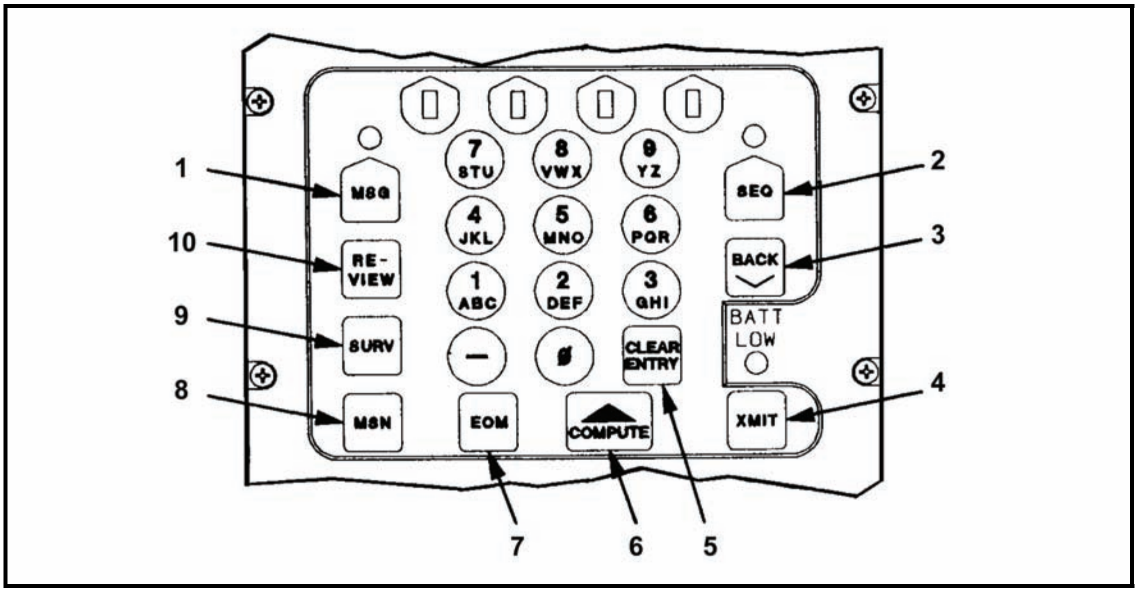

Figure 6-3. Action switches.

MSG Switch

6-15. The MSG switch (1, Figure 6-3) displays the first line of a message transmitted by a DMD.

SEQ Switch

6-16. The SEQ switch (2, Figure 6-3) displays the next line of a menu to allow viewing or entry of data.

NOTE: Press the SEQ switch to store data entered from the keyboard.

BACK Switch

6-17. The BACK switch (3, Figure 6-3) displays the previous menu line to allow reviewing or data changes.

XMIT Switch

6-18. The XMIT switch (4, Figure 6-3) starts MTO and command message to observer (CMD) menus for entering and transmitting firing information to the observer.

CLEAR ENTRY Switch

6-19. The CLEAR ENTRY switch (5, Figure 6-3) removes the last (right-most) character from a data field and allows re-keying of an entry.

COMPUTE Switch

6-20. The COMPUTE switch (6, Figure 6-3) initiates computation of fire mission data, survey data, registration data, and adjustments.

EOM Switch

6-21. The EOM switch (7, Figure 6-3) displays menus for manually entering end-of-mission instructions, such as delete all mission data or end the active mission, and storing the final target grid location in the target file.

MSN Switch

6-22. The MSN switch (8, Figure 6-3) displays menus for reviewing current fire mission data and assigning a mission number, which makes the mission operational, allows changes to mission buffers, and enables corrections to a subsequent mission to be applied.

SURV Switch

6-23. The SURV switch (9, Figure 6-3) displays menus for manually entering survey data for computation.

- Survey types are resection, intersection, and traverse.
- Data entries are horizontal and vertical angles, and distances.

6-24. Computed answers may be stored as a known point, target, FO location, or base mortar location.

REVIEW Switch

6-25. The REVIEW switch (10, Figure 6-3) returns the display to the first line of a message or to a main menu currently in use.

ALPHANUMERIC AND MINUS SIGN KEYS

6-26. Eleven keys are used to enter alphanumeric characters and the minus sign (Figure 6-4). For combination keys, alpha or numeric selection is either automatic or menu-selectable.

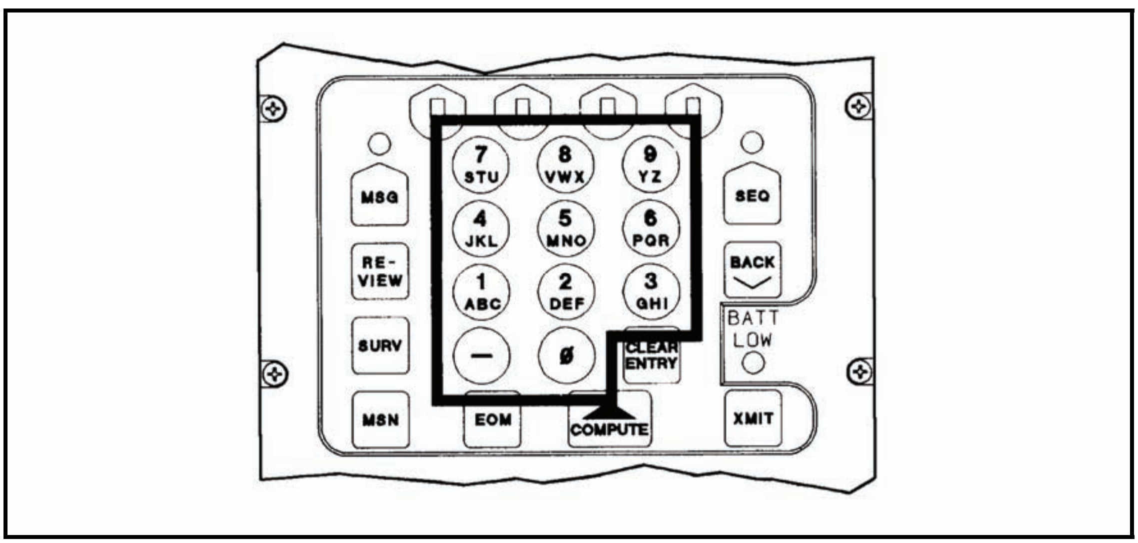

Figure 6-4. Alphanumeric and minus sign keys.

FIRE MISSION KEYS

6-27. The fire mission keys (Figure 6-5) include—

- GRID key.
- ADJ key.
- REG key.
- TFC key.
- FPF key.
- WPN/AMMO key.
- BURST key.
- POLAR key.
- SHIFT key.

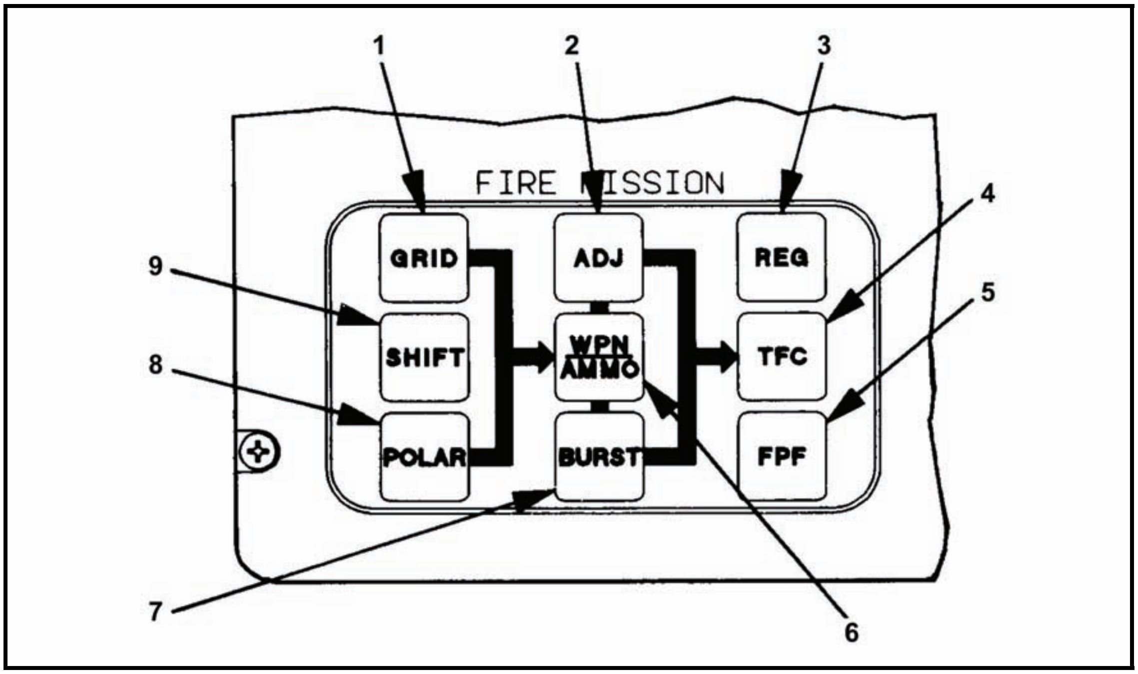

Figure 6-5. Fire mission keys.

GRID Key

6-28. The GRID key (1, Figure 6-5) is used to manually enter grid fire mission data when the target location is identified by grid coordinates. Entries are—

- FO ID number.
- FO direction to target.
- Target location.
- Altitude, when known.

ADJ Key

6-29. The ADJ key (2, Figure 6-5) is used to manually enter fire mission adjustment data (corrections) from the FO. Correction entries are—

- Left or right deviations.
- Plus or minus range.
- Up or down height.

REG Key

6-30. The REG key (3, Figure 6-5) is used to review registration data, and to compute and store RP correction factors. The computation results in a range correction factor and a deflection correction amount.

TFC Key

6-31. The TFC key (4, Figure 6-5) is used to manually enter or change technical firing data, such as the sheaf, method of control, and weapons to fire.

FPF Key

6-32. The FPF key (5, Figure 6-5) is used to manually enter the FPF line data, safety fan, and minimum/maximum charge. Entries are—

- FPF location.
- Target altitude.
- Target width.
- Attitude.

WPN/AMMO Key

6-33. The WPN/AMMO key (6, Figure 6-5) is used to manually enter or change the weapon or ammunition data for a fire mission. Entries are—

- Weapon unit and number (A section, number 3 gun).
- Shell and fuze combination.
- Charge (60- and 81-mm mortars).

NOTE: When 120-mm mortar data becomes available, the computer must be updated.

BURST Key

6-34. The BURST key (7, Figure 6-5) is used to manually enter burst location data (corrections) supplied by a laser-equipped FO. Entries, from laser to burst, are—

- Direction.
- Distance.
- Vertical angle.

POLAR Key

6-35. The POLAR key (8, Figure 6-5) is used to manually enter polar plot data for normal and laser-designated polar plot fire missions.

- Normal polar plot mission targets are identified by direction, distance, and up/down height from an FO.
- Laser polar plot mission targets are identified by laser direction, laser distance, and laser vertical angle.

SHIFT Key

6-36. The SHIFT key (9, Figure 6-5) is used to manually enter shift from a known point fire mission data when a target location is identified using a shift from a known point. Entries are—

- FO ID.
- Known/target number of direction to target.
- Direction.
- Amount of shift.

OUTPUT SWITCHES

6-37. The output switches (Figure 6-6) include—

- FIRE DATA switch.
- SFTY DATA switch.
- REPLOT switch.

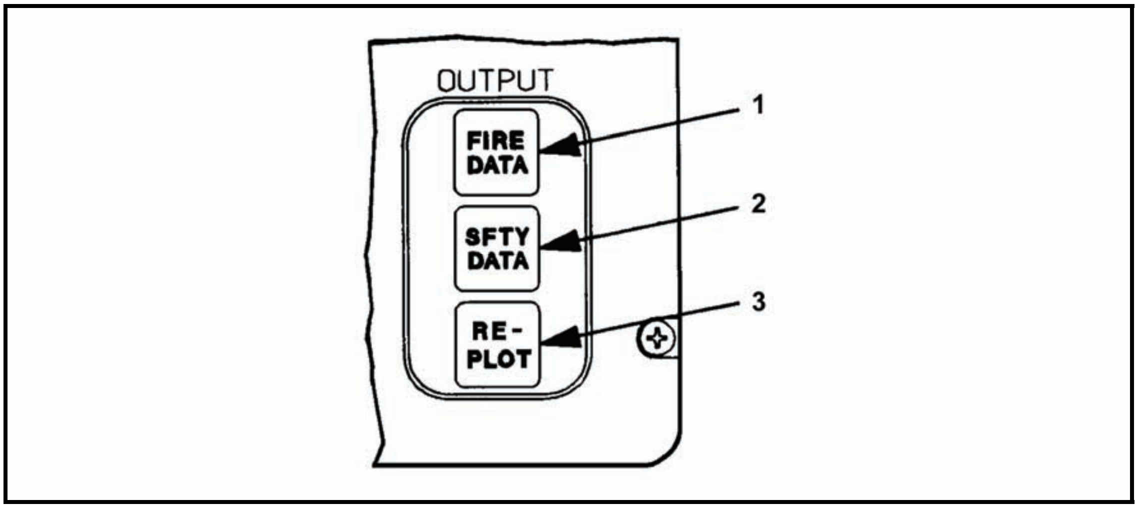

Figure 6-6. Output switches.

FIRE DATA Switch

6-38. The FIRE DATA switch (1, Figure 6-6) is used for reviewing the fire commands of active fire missions. Data are the same as the COMPUTE switch output.

SFTY DATA Switch

6-39. The SFTY DATA switch (2, Figure 6-6) allows the operator to review safety factors by accessing data menus for active fire missions. These menus allow the operator to enter boundaries for a safe firing area or a minimum and maximum charge for the safety area.

REPLOT Switch

6-40. The REPLOT switch (3, Figure 6-6) is used to review target replot data and to increase target location accuracy.

6-41. To compute a new grid location, the operator enters a new target altitude, and then presses the REPLOT switch.

DISPLAY SWITCHES

6-42. The display area features up to 16 alphanumeric characters (Figure 6-7). A flashing character block signals a need for an operator action. To respond, the operator presses the display switch below the flashing block or the SEQ switch. Any combination of blocks (or none) may flash. If no block is flashing, no action is required, and the operator cannot change what is shown on the display.

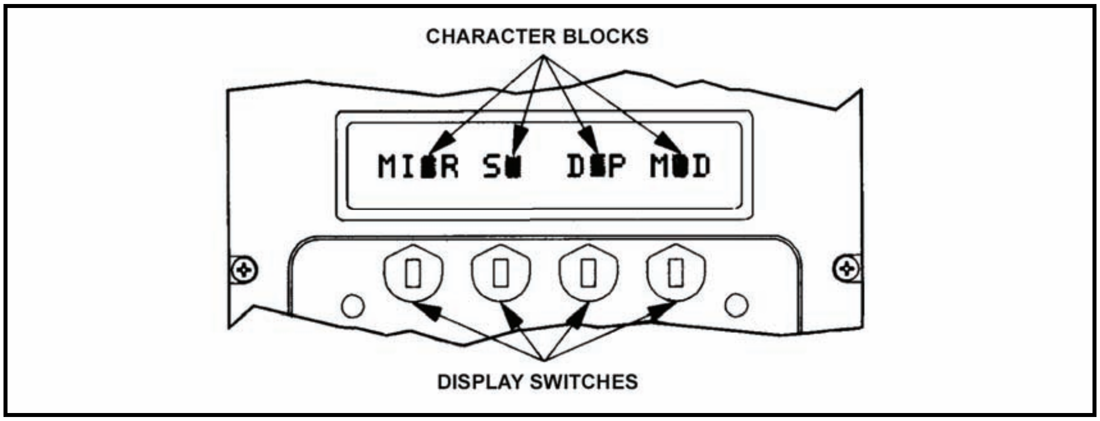

Figure 6-7. Display switches.

LIGHT-EMITTING DIODE INDICATORS

6-43. The corresponding keys for the light-emitting diode (LED) indicators (Figure 6-8) include—

- Standby indicator.
- Sequence indicator.
- BATT LOW indicator.
- Message indicator.

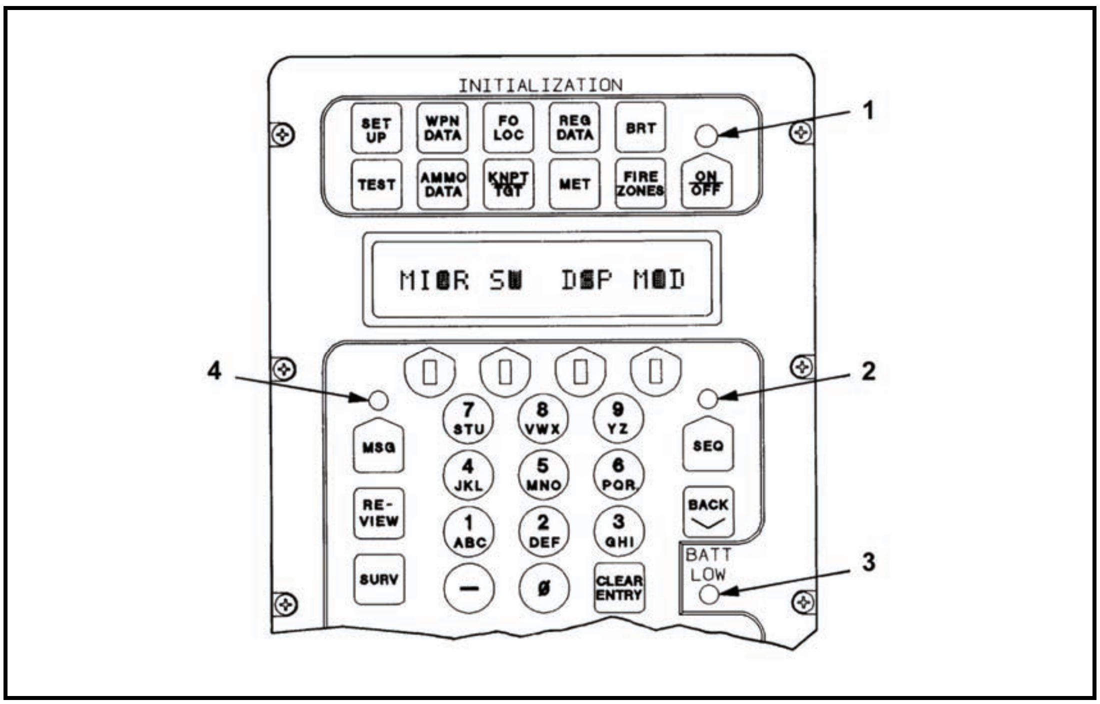

Figure 6-8. Light-emitting diode indicators.

Standby Indicator

6-44. The standby indicator (1, Figure 6-8) flashes when the display timeout period has expired. It flashes once every six seconds while the display is "timed out." To return to the last display, press any key once.

NOTE: Using the FIRE MISSION keys to turn the display back on is not recommended. Some of these keys are highly sensitive and a fire mission can be initiated accidentally. The safest key to use is the sequence key.

Sequence Indicator

6-45. The sequence indictor (2, Figure 6-8) flashes when more data are available for the current menu or display.

BATT LOW Indicator

6-46. The BATT LOW indicator (3, Figure 6-8) flashes when the internal 12-volt battery is low. This indicator starts flashing when the battery output reaches 11 volts, and the MBC shuts off at 10 volts. If the BATT LOW indicator starts flashing during a fire mission, continue with the mission, and change the battery as soon as possible.

Message Indicator

6-47. The message indicator (4, Figure 6-8) flashes when the MBC has received one or more digital messages. The flash rate increases with the number of messages received. Flash rates are:

- 1.25 times per second = one message.
- 2.5 times per second = two or more messages.
- 5 times per second = one or more FO CMD messages.

AUDIO ALARM

6-48. The internal audio alarm beeps continuously when digital messages are received. The alarm beeps noticeably faster for an FO CMD message than for other message types. To turn off the beeping alarm, the operator presses any switch or key.

NOTE: To turn the alarm off or on, access the SET UP switch function.

CAPABILITIES

6-49. The MBC communicates with the DMD. There are two types of incoming messages: fire request messages and information-only messages. When the message indicator is lit or the audio alarm sounds and the MSG switch is pressed, the first line of the first message received is displayed. When the message is a fire mission, the MBC automatically assigns a mission and target number, unless three active fire missions are in progress. If so, the MBC displays, "NO AVAIL MSN," and discards the message.

6-50. The MBC:

- Computes and applies registration and MET corrections.
- Computes firing data for all fire mission types.
- Allows mortar dispersion up to 999 meters from the basepiece.

6-51. The ammunition file in the MBC contains only the ammunition depicted in Table 6-1.

Table 6-1. Mortars and corresponding ammunition.

MORTAR / TYPE OF AMMUNITION	M224, 60-mm MORTAR	M252 AND ##M29, 81-mm MORTARS	120-mm MORTAR	M303 INSERT, 81-mm MORTAR
HIGH-EXPLOSIVE	*M720 ##M49A4 M888	*##M374 M374A2 M374A3 M821 M889 #M889A1 #M821A1	M933 *M934 ##M57	*M374 M37A42 M374A3
ILLUMINATION	*M83A3 M721	*M301A3 M853A1	M91 *M930	M301A3
WHITE PHOSPHORUS	*M302A1 #M302A2 M722	##M375 *M375A2 ##M375A3	##M68 *M929	M375 *M375A2 M375A3
RED PHOSPHORUS		M819		
TRAINING/PRACTICE		(Ground-mounted mode only) *##M1 ##M68 M879 #M880		M880
NOTE: * = Default ammunition # = Revision III/A ## = No longer in inventory				

MEMORY STORAGE CAPACITY

6-52. The MBC can store—

- 3 active fire missions.
- 3 messages in the message buffer.
- Up to 18 weapon systems—3 sections/platoons with up to 6 mortars each.
- 12 FO locations with their call signs.

NOTE: At this time, the MBC revision III/A does not allow entries with the same identifier. For example, once the identifier B02 is used, the number 02 cannot be used again.

- 50 known points/targets.
- 16 RPs.
- 3 firing sections.
- 10 no-fire zones with between 3 and 8 points each; 80 total points are available. All zones share the 80-point pool.
- 3 FPF files, 1 for each section/platoon.
- 3 safety fans, 1 for each section/platoon, with each diagram capable of having 10 fans (0 to 9).
- 1 no-fire line.

NOTE: Error messages may occur while using the MBC. Appendix F discusses the possible errors and provides actions to correct the problem.

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Chapter 7
Preparation of Fire Control Equipment

This chapter discusses the different types of data entry for the MBC. The different levels of initialization are also explained. Figure 7-1 provides an overview of the groupings of switches and indicators used when setting up the MBC for the tactical scene.

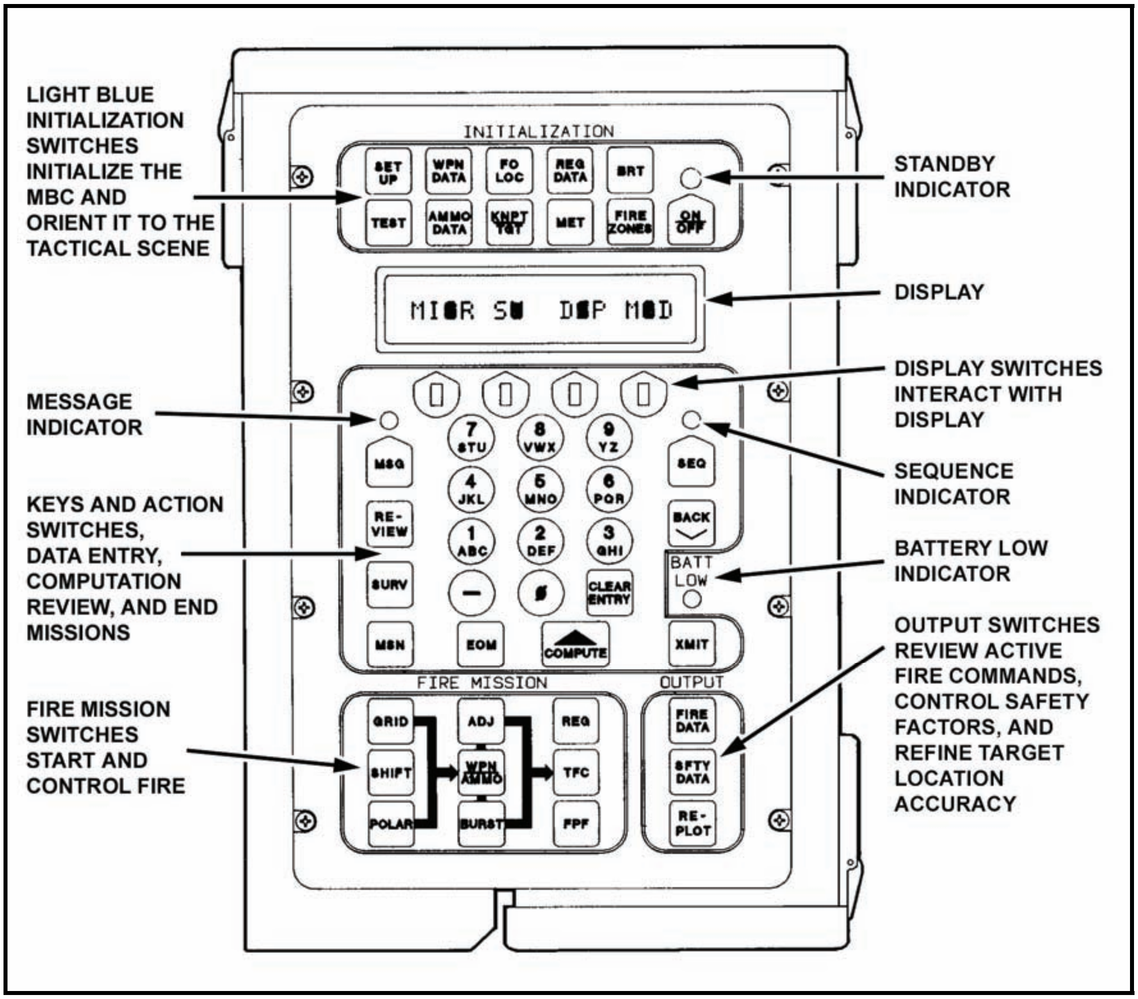

Figure 7-1. Mortar ballistic computer switch panel.

TYPES OF DATA ENTRY

7-1. The types of MBC data entry are—
- Default (computer-selected).
- Alphabetical.
- Numerical.
- Correction.
- Minimum easting and minimum northing.
- Direction.
- Multiple choice.

7-2. The following examples use only the SET UP menu to demonstrate each type of data entry. The data entry examples apply to all menus.

7-3. Before entering data, press the ON/OFF switch to activate the MBC. The display shows, "POWERUP TEST," and then shows, "READY."

NOTE: The self-test should be conducted when the MBC is turned on. However, the operator must first know how to make menu selections to conduct the self-test.

DEFAULT ENTRY

7-4. Default entries are those that the computer automatically uses until the operator manually changes the data. One example would be the default setup data:

(1) Press the SET UP switch. The MBC displays the menu for setup data: timeout, target prefix, target number block, grid declination, message transmission rate, transmitter warm-up delay time, transmission single or double block mode, and owner identification.

(2) The display window of the MBC shows, "TIME OUT: 15." Timeout means that the computer will automatically turn off the display if another switch is not selected before the given time runs out.

NOTE: The screen will darken if the time runs out. The computer is not off, just conserving energy. To reactivate the display screen, press any key (except the fire mission keys, which are Grid, Shift, and Polar).

---

(3) The flashing cursor on the display indicates that the computer's timeout setting can be changed. The timeout can be set to 15, 30, 45, or 60 seconds. The computer defaults to a timeout period of 15 seconds, thereby maintaining the highest energy conservation. During training, the timeout period should be changed to 60 seconds.

(4) Select the blue display switch beneath the flashing cursor in the display window. The display shows, "15 30 45 60," with flashing cursors on each number. The four blue display switches interact with the numbers displayed directly above them. For example, if the switches were numbered from left to right (1, 2, 3, and 4), and the timeout is to be changed to 60 seconds, select display switch 4. The computer now shows, "TIME OUT: 60."

ALPHABETICAL ENTRY

7-5. First, the operator must enter the alphabetical portion of the target number block, the target prefix. For example, the mortar platoon is assigned a target number block, AH0001 - AH0099. To enter the target prefix, AH, in the underlined blanks on the display—

(1) Press the SEQ switch. The display shows, "TGT PRFX:_ _."

(2) Press the 1/ABC key. The display shows, "A B C." Since a numerical entry is not required at this time, the MBC automatically deletes the number 1 from the screen.

(3) Press display switch 1 to select A. The display shows, "TGT PRFX:A _."

(4) Press the 3/GHI key. The display shows, "G H I." Since a numerical entry is not required at this time, the MBC automatically deletes the number 3 from the display screen.

(5) Press display switch 2 to select H. The display shows, "TGT PRFX:AH."

(6) Once the prefix has been entered, press the SEQ switch to activate the computer's memory storage.

7-6. The target prefix selected will be used to identify all of the targets that are programmed into the MBC. The prefix will be used until changed or until the computer is cleared.

NUMERICAL ENTRY

7-7. After the SEQ switch is selected to store the target prefix, the display screen asks for the numerical half of the target block number, 0001 - 0099. The display shows, "TN:_ _ _ _ - _ _ _ _." To make the numerical entry—

(1) Press the 0 key three times. The screen shows, "TN:0 0 0 _ - _ _ _ _."

(2) Press the 1/ABC key. Since an alphabetical entry is not required at this time, the MBC automatically displays the number 1. The display shows, "TN:0 0 0 1 - _ _ _ _."

(3) Press the 0 key twice and the 9/YZ key twice. Once again, since an alphabetical entry is not required at this time, the MBC automatically displays the number 9. The screen shows, "TN:0 0 0 1 - 0 0 9 9."

(4) Press the SEQ switch to store the target block entries in the MBC's memory. The computer may now use the target numbers.

7-8. If a mistake is made when entering the target block numbers, the operator must make a correction entry.

7-9. If the SEQ switch is pressed before making the correction entry, press the BACK key to return to the last screen of information.

- Clearing the right-most character only.

EXAMPLE

The last digit entered for the target block number is a 9, but is supposed to be a 5.

(1) Press the CLEAR ENTRY switch one time, and the display shows, "TN:0 0 0 1 - 0 0 9 _."

(2) Now, select the proper number. Press the 5/MNO key. The display shows, "TN:0 0 0 1 - 0 0 9 5."

- Clearing the entire field.

EXAMPLE

During firing, your section leader tells you that the target block numbers have been changed from AH-0095 to AH-8000. The flashing cursors above display switches 1 and 3 indicate that both fields may be changed. To clear the entire field, in this case the 0095, follow these instructions:

(1) Press display key 3. The field is cleared, and the display shows, "TN:0 0 0 1 - _ _ _ _ ."

(2) Enter the new number by pressing the 8/VWX key once and the 0 key three times. The display shows, "TN:0 0 0 1 - 8 0 0 0."

CORRECTION ENTRY

7-10. A correction entry is any change made to the default alphabetical or numerical entries discussed in the paragraphs above.

> **NOTE:** The ALARM OFF/ON function display is discussed in Chapter 9. Press the SEQ switch once to advance to the next display. The computer defaults the selection to "ALARM: OFF."

MINIMUM EASTING AND MINIMUM NORTHING ENTRIES

7-11. The next two displays, "MIN E:_ _ _ 0 0 0" and "MIN N:_ _ _ 0 0 0," are entered with numerical selections. The minimum easting (MIN E) and the minimum northing (MIN N) are the coordinates at the lower left corner of a map sheet. Each of these coordinates are entered into the MBC preceded by a 0—for example, the grid intersection of a map sheet (lower left corner) is 50/89. The MIN E is entered into the computer as 050, and the MIN N is entered as 089. The three trailing zeros are automatically entered for each display.

DIRECTION ENTRY (DISPLAY-SELECTABLE)

7-12. Select the SEQ switch, and the display shows, "E W GD:_ _ _." This display is one example of a direction entry with an amount. East (E) or west (W) must be selected from the display before filling in the underlined blanks for grid declination (GD).

(1) Locate the GD in the map sheet legend of the area of operations. Before entering the GD, round it off to the nearest 10, and express it in tenths. For example, a GD of 132 is 130; expressed in tenths is 13 (Figure 7-2).

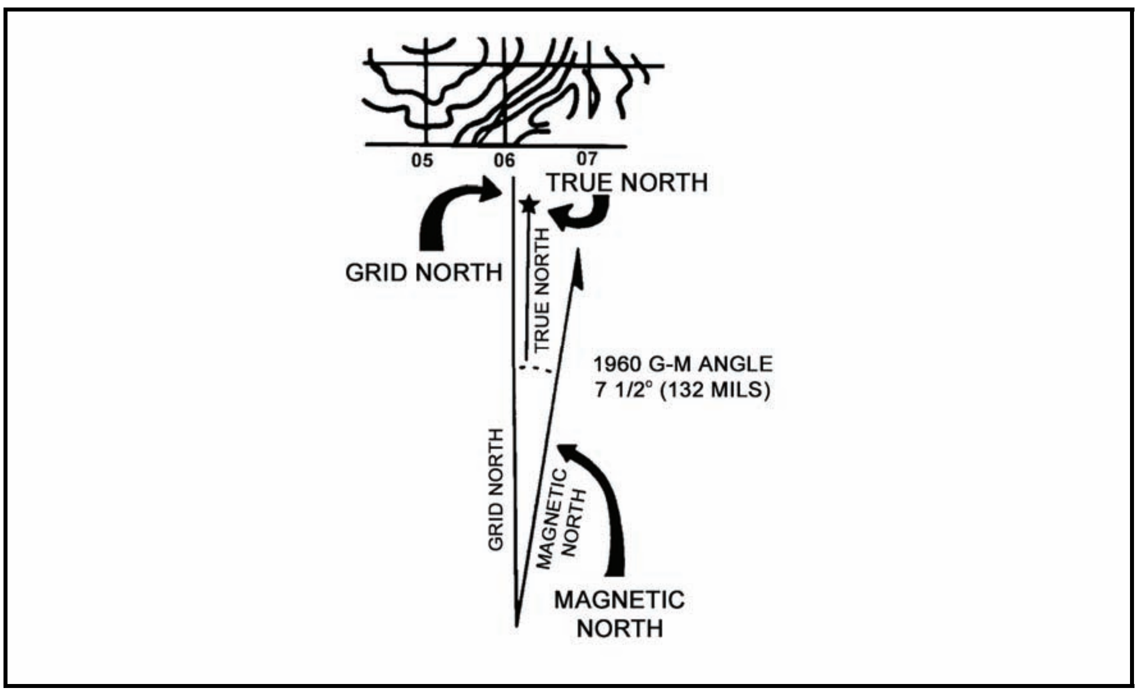

Figure 7-2. Declination diagram.

(2) Since the GD is easterly, select the display switch beneath the E. The display shows, "E W GD: E _ _." The declination diagram shows the declination in both degrees and mils. Use the mils value given. The difference between grid north and magnetic north is 100 mils, but is entered into the MBC in tens of mils. Press the 1/ABC key once and the 0 key once. The display shows, "E W GD: E 1 0."

NOTE: Additional direction indicators found in other menus are—

H = Horizontal	S = Slant
L = Left	R = Right
U = Up	D = Down
+ = Add	− = Drop
+ = North	− = South

When these symbols appear in later chapters, their meaning will be discussed in depth.

(3) Select the SEQ switch once to store the grid declination in the computer.

NOTE: Latitude (LAT -/+) comes from a map sheet of an area of operations. Enter plus (+) for the northern hemisphere or minus (−) for the southern hemisphere. The latitude is an optional entry.

MULTIPLE CHOICE ENTRY

7-13. The keytone is the length of time required for a communications device (FM radio) to enable the transmitter before sending data. When a radio is hot from frequent use, it takes a lower keytone to send a message. Similarly, if the radio is cold from the outside temperature, it takes longer to send a message. The normal or default value is 1.4 seconds. For this example, change the keytone to 3.5 seconds as follows:

NOTE: The next three screens are explained in later chapters. Press the SEQ switch four times to advance the display to the keytone menu.

(1) Press display switch 3 under the flashing cursor. This rejects the default value and gives the first four selections: 0.2 0.7 1.4 2.1. The selection 3.5 is not available on this display. The sequence indicator bulb is flashing to indicate that there are more selections to be viewed.

(2) Press the SEQ switch again, and the remaining selections appear in the display: 2.8 3.5 4.2 4.8. Press the display switch under 3.5. The display shows, "KEYTONE: 3.5."

(3) Return to the READY display. Press the SEQ switch twice to advance to the last fill-in-the-blank selection in the SET UP menu. The display shows, "OWN ID: __." The owner identification code found in the signal operation instructions (SOI) must be entered here, A through Z or 0 through 9. For this example, enter 1. Press the 1/ABC key once. Press display key 4 (under the 1) once. The display now shows, "OWN ID: 1."

NOTE: The FO and FDC must coordinate to ensure that both know the owner's identification when using DMD.

INITIALIZATION

7-14. This paragraph discusses the initialization switches and how they are affected by the different modes of operation.

SELF-TEST

7-15. The MBC can perform its own internal tests. When the operator turns on the MBC or suspects a malfunction, he should initiate the self-test.

NOTE: The test should be performed when time is available.

(1) Press the ON/OFF switch; the MBC shows, "POWERUP TEST," while performing internal circuit checks, and then it shows, "READY."

NOTE: If any other display appears, turn in the MBC to the sustainment maintenance team. If the BATT LOW indicator flashes or the display does not appear, replace the battery or check the power connections.

(2) Perform the four self-tests in any sequence. The SELF-TEST switch provides testing of the microprocessor (MICR), all switches and keys (SW), the display and indicators (DSP), and the modem (MOD).
(3) Press the TEST switch. The software revision number (Revision 3/A) displays.

NOTE: If the correct software revision number is not displayed, turn in the MBC to the sustainment maintenance team.

Microprocessor

(1) Press the SEQ switch.
(2) Use the multiple choice entry to select MICR. The test begins.
(3) Once the test is complete (about 38 seconds), the display shows, " MICR: PASS."

NOTE: If any other display appears, turn in the MBC to the sustainment maintenance team.

Switches and Keys

(1) Use the multiple choice entry to select SW.
(2) Press the switch or key indicated in the display.
(3) When a switch fails or is pressed out of sequence, the display shows, "ERROR." The display returns to the name of the switch to be pressed. If the specified switch is pressed and an error occurs, the switch is inoperative.

NOTE: If the MBC doesn't respond to normal keystrokes, the keyboard assembly may be malfunctioning, and the MBC must be turned in to the sustainment maintenance team.

(4) After all of the switches and keys have been tested, the display shows, "END OF TEST," and then "READY."

Display

(1) Use the multiple choice entry to select DSP.
(2) Press the SEQ switch three times to check for unlit dot segments in each character space.
(3) During the first part of the display test, make sure all dot segments are lit in the 16-character display.
(4) In the second part of the test, check for character generation and indicators.

NOTE: Even if one or more dot segments are out, use the MBC if the characters are readable. If the characters are not readable or an indicator is not flashing, turn in the MBC to the sustainment maintenance team.

CAUTION

Do not test the modem while connected to a radio. This could cause internal damage to the MBC.

Modem

(1) Use the multiple choice entry to select MOD.

(2) After the modem test (about 20 seconds), the display shows, "MODEM PASS" or "MODEM FAIL."

NOTE: If "MODEM FAIL" shows, message transmission and reception are inoperative. The MBC still accepts manual input data and computes fire missions.

BASIC DATA INPUT

7-16. Before computing a fire mission, the operator must use certain initialization switches to input basic data. Overall MBC initialization is directly related to the tactical scene. Operators must always initialize SET UP, WPN DATA, and AMMO DATA switches, initializing other switches as needed.

Manual Mode

7-17. When the MBC is not connected to an external communication device, all data are manually entered.

Digital Mode

7-18. When the MBC is connected to an external device (DMD-supported), data are digitally entered into the appropriate switch memory. Data entered digitally may be reviewed or supplemented manually.

MINIMUM INITIALIZATION

7-19. Minimum initialization is the least amount of data needed to compute a standard mission. For minimum initialization, operators use the sequence outlined in the following paragraphs.

TEST and BRT Switches

7-20. These switches are used to check overall MBC operation and to set the display brightness.

NOTE: The low setting in the BRT menu lights up the keyboard for night or limited visibility use.

SET UP and WPN DATA Switches

7-21. These two switches must be initialized. They are always manually entered in the MBC. Data will never change due to other switch action; however, the operator may review and update data as needed.

When the AMMO DATA switch default values are suitable, this switch is not needed for initialization. The default values are:

- 60-mm mortar: HE, M720; WP, M302A1; and ILLUM, M83A3.
- 81-mm mortar: HE, M374; WP, M375; ILLUM, M301A3; TNG, M1; and smoke M819 (red phosphorus).
- 120-mm mortar: HE, M933, M934; WP, M929; and ILLUM, M930.
- 120-mm mortar (insert): HE, M374; WP, M375A2; and ILLUM, M301A3.

MINIMUM MISSION DATA

7-22. Once the MBC is turned on and the self-test is conducted, the following minimum Mission Data must be entered to compute for a standard grid mission.

EXAMPLE

SET UP (menu)
Timeout: 60 seconds
Target prefix: AH
Target numbering block: 0001 - 0200
Easting (area of operation): 096000
Northing (area of operation): 029000

NOTE: Precede each easting and northing coordinate with a zero.

(Digital communications data)
Computer owner's identification:
WPN DATA (menu)
Unit: A (section)
Caliber: 120-mm
Carrier-mounted: YES
Basepiece: A2
Basepiece location: E: 0400, N: 4700
Altitude: 0750 meters
Azimuth of fire: 0800 mils

NOTE: If firing a parallel sheaf with all mortars online, the only weapon needed is the basepiece. When the situation allows, enter the rest of the section.

Weapon No. 1: Direction - 1600 mils
Distance - 060 meters
Weapon No. 3: Direction - 4800 mils
Distance - 060 meters
Weapon No. 4: Direction - 4800 mils
Distance - 120 meters

WARNING

Using the default firing data for all guns in the firing section may cause rounds to be fired outside of the safety fan or firing zone. Therefore, always use the technical fire control (TFC) menu when a safety fan or firing zone is used. This gives the MBC operator a warning message to indicate if any rounds will land outside of the safety fan or firing zone. For Revision 3/A, the operator must override the message to continue.

(1) Press the ON/OFF switch. The display shows, "POWERUP TEST," momentarily, and then shows, "READY."
(2) Use the TEST switch to manually start the MBC self-test. Perform the self-test as the situation permits or as advised by the supervisor.
(3) Use the BRT switch to select the level of display character brightness (LOW, MED, HI, or MAX). Use the LOW level to turn on the keyboard background lighting. Character brightness is always set at high when the MBC is turned on or when the BRT switch is pressed.
(4) Press the SEQ switch. The display shows, "READY." Press the SET UP switch. Use the multiple choice entry to change the timeout to the desired number of seconds (15, 30, 45, or 60).
(5) Press the SEQ switch. Using alphabetical entry, enter the target prefix, AH.
(6) Press the SEQ switch. Using numerical entry, enter the target numbering block, 0001 - 9999.
(7) Press the SEQ switch. Use the default shown (ALARM:OFF). Use the message alarm for DMD-supported missions, if needed.
(8) Press the SEQ switch. Using numerical entry, enter the minimum easting coordinate, 096.
(9) Press the SEQ switch. Using numerical entry, enter the minimum northing coordinate, 029.
(10) Press the SEQ switch until the display shows, "OWN ID: _." "E W GD:," " + − LAT:," "LISTEN ONLY: OFF," "BIT RATE: 1200," "KEYTONE: 1.4," and "BLK: SNG" information may be entered for expanded initialization.
(11) The final entry in the SET UP menu is the OWN ID. Enter the unit identification code located in the SOI.

Weapon Data

7-23. Use the WPN DATA switch to enter the weapon data for section A, B, and or C. Assign weapons to one, two, or all three sections. A total of 18 weapons may be assigned (six for each section): A1 through A6, B1 through B6, and C1 through C6. The first weapon entered in a section becomes the basepiece. The basepiece is the reference point for the MBC to locate and add weapons to a section.

NOTE: The basepiece does not have to be the number 2 gun or adjusting piece. It is preferable that the basepiece is the centermost gun in the sheaf to ensure balanced fires when firing a parallel sheaf.

---

(1) Press the WPN DATA switch. Use the multiple choice entry to select the desired section (A). With the weapon types displayed, select the caliber, 81-/120-mm.
(2) After the caliber of weapon is selected, the choice of carrier- or ground-mount is next (except for the 60-mm mortar). The MBC defaults to "CARRIER: NO," indicating that the section is to be ground-mounted. Ensure that all weapons in the section are mounted the same. Using the multiple choice entry, select "CARRIER: YES," which indicates that the section is to be carrier-mounted. After entering the selection of carrier-mounted, press the SEQ switch, and the display shows, "CARRIER MV ENTERED." The muzzle velocity is figured differently for ground-

mounted and carrier-mounted mortars; carrier-mounted muzzle velocity corrections for that section are entered into the MBC's memory.

(3) Press the SEQ switch. Enter the basepiece number using multiple choice entry (A2). The basepiece is a reference for the MBC to locate the other mortars in that section. Time and effort are usually saved if one of the flank mortars is used as the basepiece.

(4) Press the SEQ switch. Enter the basepiece easting and northing grid coordinates. Most mortar locations are known to within eight-digit grid coordinates. To enter the coordinates, follow these instructions:

- Given the grid location for the basepiece as 04004700, enter the first four easterly digits by pressing the alphanumeric key for that number, followed with a zero. Press the 0 key. The display shows, "E:0_ _ _ _ N:_ _ _ _ _." Enter the rest of the coordinates. The final display shows, "E:04000 N:47000." Do the same if only a six-digit coordinate is known—for example, "123456" is entered as "12300 45600."

NOTES: 1. Only numbers can be entered; letters are not part of the selection process for grid coordinates.

2. All easting and northing grid coordinates require five-digit entries.

- Press the SEQ switch. Use the multiple choice entry to enter the altitude of the basepiece in meters (0750). The altitude is a mandatory entry. If the FDC does not know the altitude, an entry of 0000 is used. This entry tells the MBC to compute from sea level. Altitude entries may range from 9999 meters to -999 meters.
- Press the SEQ switch. Use a multiple choice entry to enter the direction of fire (azimuth 0800) and referred deflection (2800) in mils.
- Press the SEQ switch, and the display shows, "CONT END." Select Continue (CONT) if the rest of the section is to be entered at this time. If not, select END, and the computer shows, "READY."
- To continue entering weapons, select CONT, and the MBC shows, "WPN:A_ NXT CLR." Enter the weapon number (1) using the 1/ABC alphanumeric key.
- Press the SEQ switch. Use the multiple choice entry to enter weapon direction (1600 mils) and distance (035 meters) from the basepiece.
- Press the SEQ switch. Repeat the steps in the paragraphs above until all guns in the section have been entered. Select END, and the MBC display shows, "READY."

Ammunition Data Default Values

7-24. If the AMMO DATA default values are suitable, the minimum initialization is complete. If suitable, the operator uses the AMMO DATA to select shell types for each ammunition type for the caliber in use. Powder temperature default is 70 degrees and is correctable. When corrections are entered, the word "NO" on the right side of the display is changed to "CR." Weight changes are entered in pounds or squares. When pounds or squares are entered, a conversion is made to show both unit entries.

(1) Press the AMMO DATA switch. The display shows, "60 81 120 TEMP." Select the caliber of weapon being used by pressing display switch 3 beneath the number.

(2) The display now shows, "HE: _____ :NO_____." Flashing cursors are on the 2 and the N, which means that the display may be changed. However, the round also comes in different weights as explained earlier. Once the entry has been made by weight in pounds or in squares, press the SEQ switch, and the display shows, "HE: _____ :CR._____."

(3) Press the SEQ switch. Continue the above procedures until all ammunition requirements are entered.

NOTE: The ammunition menus for all the mortars are similar in format.

EXPANDED INITIALIZATION

7-25. Expanded initialization includes the MET, FIRE ZONES, Forward Observer Location (FO LOC), Known Point/Target (KNPT/TGT, and Registration Data (REG DATA). These data are initialized as they become available.

- Always manually initialize MET when entering nonstandard MET data. If the MET switch is not used, the MBC uses standard conditions for MET data. When the MET is entered, ensure that the SET UP menu has the current data for the grid declination and latitude (LAT).
- Always manually initialize and update FIRE ZONES information, when needed.
- Manually initialize and update FO LOC information when using the manual mode. When the MBC is DMD-supported, input is automatically entered when a valid observer location message is received. This is also a good time to update the SET UP menu. The communication data are "LISTEN ONLY: OFF," "BIT RATE: 1200," "KEYTONE: 1.4," and "BLK:SNG."

NOTE: The bit rate and transmit block mode are located in the SOI.

- Initialize and update KNPT/TGT information at any time, regardless of the mode of operation. The KNPT/TGT switch may be updated automatically using the EOM, REPLOT, and SURV switches, or by receiving digital messages related to the known point/target.
- Manually initialize REG DATA to maintain a registration file when enough data are known from conducting a fire mission. Normally, registration data are generated automatically using the REG switch during fire mission processing, but data manually entered with the REG DATA switch are automatically updated when the REG switch is used to compute registration.

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Chapter 8

Types of Missions

All fire missions, except FPFs, begin with the GRID, SHIFT, or POLAR switches. The necessary elements of the fire request are entered into the MBC. The WPN/AMMO switch is used to identify the section and the adjusting piece. The firing data are displayed after pressing the COMPUTE switch.

GRID MISSION SWITCH

8-1. The GRID mission switch is used to begin a fire mission when the target is located with grid coordinates. The following paragraphs describe the procedures for conducting a grid mission.

8-2. Press the GRID switch (red) to start the GRID menu. "FR GRID" displays. Press the SEQ switch, and perform the following:

(1) Enter the FO's call sign in the FO LOC menu (W/12).

NOTE: Entry of the FO's call sign may be omitted.

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(2) Press the SEQ switch.
(3) Enter MSN:1.
(4) "TN:AA0001" is displayed, indicating that this is the first mission out of a possible three. The display also shows the target number assigned to this mission by the MBC.
(5) Press the SEQ switch.
(6) Enter the OT direction (DIR:0500). If the OT direction is not known, the GT may be selected using display switch 1. When this entry is omitted, the MBC automatically inputs the GT direction.
(7) Press the SEQ switch.
(8) Enter the target's grid coordinates (E:06670 N:48832).
(9) Press the SEQ switch.
(10) Enter the target's altitude (ALT:0600).
(11) Press the SEQ switch.
(12) The Ready light will display.

8-3. Select the WPN/AMMO switch (red), and perform the following:

(1) Sequence past the following:
- FO calling in the fire mission (FO:W/12\-).
- Mission and target numbers assigned to the mission (MSN:1 TN:AA0001).

(2) Enter the adjusting weapon (WP:A2).
(3) Press the SEQ switch.

NOTE: Once the firing section is selected, the weapon type is displayed along with the adjusting weapon (120mm WPN:A2).

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(4) Review the shell and fuze combination (SH/FZ:HE PD). If other combinations are needed, use display switch 3 for shell changes and display switch 4 for fuze changes.
(5) Sequence "CHG:" to "READY."

NOTE: The MBC selects the lowest charge possible, or the operator can manually input the charge of his choice.

8-4. Push the COMPUTE switch (green) to receive firing data.

(1) The display "AF STD RP" indicates the following:
- Method of control used.
  - AF = adjust fire.
  - FFE = fire for effect.
- Type of MET.
  - STD = standard.
  - CURR = current.
- Registration point (when used).

(2) Press the SEQ switch.

NOTE: When the COMPUTE switch is pressed before the WPN/AMMO switch, the computer automatically enters the WPN/AMMO menu.

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(3) Review the deflection and charge (A2DF:2611 CH:2).
(4) Press the SEQ switch.
(5) Review the fuze setting and elevation (A2FS: EL:1161).
(6) Press the SEQ switch.

NOTE: The fuze setting applies only to the fuzes that require a time setting.

---

(7) The time of flight is displayed (A2 TOF:40.0).
(8) Press the SEQ switch.
(9) "READY" is displayed.

8-5. Push the SFTY DATA switch (orange) to receive safety information.

(1) The display, "RN:3238 AZ:0987," indicates the following:
- Range from the gun position to the target.
- Azimuth from the gun position to the target.

NOTE: At this point, it is not necessary to continue in the SFTY DATA menu.

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(2) Press the BACK switch (green) to "READY."

8-6. Push the XMIT switch (green) to receive or format messages to the observer.

(1) Press display switch 1 under "MTO" (MSN:1). The target number displays (TN:AA0001).

NOTE: In most cases, angle T information is the only concern.

---

(2) Press the SEQ switch 11 times to receive the angle T. The angle T displays (ANG T:0200MILS).
(3) To exit out of this menu, press the MSN switch (light green), and then press the BACK switch.
(4) "READY" is displayed.

8-7. Wait for FO adjustments (if any). To make FO adjustments—

(1) Press the ADJ switch (red).

(2) "ADJ MPI" is displayed.

(3) Press display switch 1 under the ADJ switch.

(4) "ENT REV" is displayed.

(5) To enter adjustments, select ENT. To review the last adjustment, select REV.

(6) Press display switch 1, "ENT."

(7) "ADJUST FO:W/12\-" is displayed.

(8) Press the SEQ switch.

(9) The mission and target numbers assigned to the mission display (MSN:1 TN:AA0001).

(10) Press the SEQ switch.

(11) Current registration and MET data display (REG/MET: NO, no current registration or MET data apply to this mission).

(12) Press the SEQ switch.

(13) The type of MET displays (MET:STD - MET to be applied to this mission will be standard).

(14) Press the SEQ switch.

(15) The FO's direction to the target is displayed (GT DIR:0987).

(16) Press the SEQ switch.

(17) "L R DEV" is displayed.

NOTE: During the initial input of the mission, the MBC operator bypasses the direction entry. The direction shown is the GT direction, also known as the initial azimuth. At this point, the MBC operator ensures that the FO's direction is shown. To clear the portion of the display showing the direction, press display switch 3 under the flashing display cursor, or press the CLEAR ENTRY switch once to clear a digit at a time. Once the GT azimuth is cleared, the FO's direction (0500) may be inserted.

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(18) Enter the lateral deviation adjustment (if any) by selecting the corresponding display switch under the deviation direction letter. Follow the entry with the number of meters to deviate in lateral adjustment (R0050).

(19) Press the SEQ switch.

(20) "+ − RN:" is displayed.

(21) Enter the range adjustment (if any) by selecting the corresponding display switch under the range adjustment letter. Follow the entry with the number of meters to adjust in range (−0050).

(22) Press the SEQ switch.

(23) "HGT: MTR" is displayed.

(24) Enter the height adjustment that applies. Height entries are in meters. This can be changed to feet by pressing display switch 2 and selecting "FT" (display switch 2).

(25) Press the SEQ switch.

(26) "U D HT:" is displayed.

(27) Enter the altitude adjustment (if any) by selecting the corresponding display switch under the height adjustment letter. Follow the entry with the number of meters (or feet) to adjust in height.

8-8. Push the COMPUTE switch (green) to receive firing data.

(1) The method of control used, type of MET, and RP (when used) display (AF STD RP).

(2) Press the SEQ switch.

(3) The deflection and charge display (A2DF:2589 CH:2).

(4) Press the SEQ switch.

(5) The fuze setting and elevation display (A2FS: . EL:1165).

(6) Press the SEQ switch.

(7) The time of flight is displayed (A2 TOF:40.1).

(8) Press the SEQ switch.

(9) "READY" is displayed.

8-9. Once all adjustments have been made or the FO requests FFE, decide how to engage the target. Based on the information given by the FO in the CFF, use the TFC key.

8-10. Press the TFC switch (red), and conduct the following procedures:

(1) The call sign of the FO calling in the fire mission displays (TFC FO:W/12\-).

(2) Press the SEQ switch.

(3) The mission and target numbers assigned to the mission display (MSN:1 TN:AA0001).

(4) Press the SEQ switch.

(5) The sheaf type preferred by the FDC for this mission displays (SHEAF:PRL).

NOTE: The preferred sheaf type can be changed when necessary.

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(6) Press the SEQ switch.

(7) The method of control displays (CON:AF).

NOTE: The method of control can be changed when necessary.

---

(8) Enter FFE.

(9) Press the SEQ switch.

(10) The section and the weapons assigned to the FFE display (GUNS:A2 13).

NOTE: The section and the weapons assigned to the FFE can be changed when necessary.

---

(11) Press the SEQ switch.

(12) Current registration or MET data that apply to this mission display (REG/MET:NO - no current registration or MET data apply to this mission).

NOTE: Current registration or MET data that apply to this mission can be changed when necessary.

---

(13) Press the SEQ switch.

(14) The type of MET displays (MET:STD - MET to be applied to this mission will be standard).

NOTE: The type of MET can be changed when necessary.

---

(15) Press the SEQ switch.

(16) "PUSH COMPUTE" is displayed.

8-11. Press the COMPUTE switch (green) to receive firing data. Press the SEQ switch to receive firing data for each gun.

NOTE: Once EOM is received, use the SFTY DATA switch to obtain the burst point coordinates (06691 48764).

8-12. Press the EOM switch (green) to end the mission.

- EOM ends the mission without saving.
- EOMRAT ends the mission and records it as a target or known point.

NOTE: The flashing red light over the SEQ switch indicates that additional information is available for the current menu or display.

- EOMFPF ends the mission and records it as an FPF.

8-13. Press EOM (green key), then EOMRAT. Sequence and save the mission as known point 00. Sequence to "READY."

SHIFT MISSION SWITCH

8-14. The SHIFT mission switch is used to initiate a fire request that uses the shift from a known point method of target location. The following paragraphs describe the procedures for conducting a shift from a known point mission.

8-15. Press the SHIFT switch. "FR SHIFT" is displayed. Press the SEQ switch.

(1) "FO:/00\-" is displayed.
(2) Enter the FO call sign (W12).
(3) Press the SEQ switch.
(4) "FROM:TGT KNPT" is displayed.
(5) Select a target or known point to shift from (ENTER KP00).
(6) Press the SEQ switch.
(7) "GT DIR:" is displayed.
(8) Enter the direction from the CFF (DIR 0500).
(9) Press the SEQ switch.
(10) The mission and target numbers assigned to the mission display (MSN:* TN:******, * denotes the target number assigned by the MBC).
(11) Press the SEQ switch.
(12) "L R DEV" is displayed.
(13) Enter the lateral deviation correction that applies (L0500).
(14) Press the SEQ switch.
(15) "+ − RN:" is displayed.
(16) Enter the range correction that applies (-0100).
(17) Press the SEQ switch.
(18) "U D HGT:" is displayed.
(19) Enter the altitude correction that applies (U100).
(20) Press the SEQ switch.
(21) "READY" is displayed.

8-16. Press the WPN/AMMO switch. "WPN/AMMO" is displayed. Press the SEQ switch.

(1) The call sign of the FO calling in the fire mission displays (FO:*/**\-).
(2) Press the SEQ switch.
(3) The mission and target numbers assigned to the mission display (MSN:* TN:******).
(4) Press the SEQ switch.
(5) "WPN:" is displayed.
(6) Enter the adjusting weapon (WPN:A2).
(7) Press the SEQ switch.
(8) The shell and fuze combination displays (SH/FZ: HE PD).

(9) Change the shell and fuze combination, if needed.
(10) Sequence past "CHG:" to "READY."

8-17. Push the COMPUTE switch to receive firing data.
(1) Sequence past "AF STD RP."
(2) Review the deflection and charge (A2DF:2725 CH:2).
(3) Press the SEQ switch.
(4) Review the fuze setting and elevation (A2FS: . EL:1212).
(5) Press the SEQ switch.
(6) The time of flight is displayed (A2 TOF:40.3).
(7) Press the SEQ switch.
(8) "READY" is displayed.

8-18. Push the SFTY DATA switch to receive safety information.
(1) Review the range and azimuth (RN:2916 AZ:0872).
(2) Press the BACK switch to "READY."

8-19. Push the XMIT switch to receive or format the message to the observer.
(1) Press display switch 1 under "MTO."
(2) Press the SEQ switch 11 times to receive the angle T (ANG T:0200 mils).
(3) To exit this menu, press the MSN switch (light green), and then press the BACK switch.
(4) "READY" is displayed.

8-20. Wait for FO adjustments (if any). To make these adjustments—
(1) Press the ADJ switch.
(2) "ADJ MPI" is displayed.
(3) Press display switch 1 under "ADJ."
(4) "ENT REV" is displayed.
(5) Press display switch 1.
(6) "ENT" is displayed.
(7) Sequence to GT.
(8) The FO's direction to the target displays (DIR:****).
(9) Press the SEQ switch.
(10) "L R DEV" is displayed.
(11) Enter the lateral deviation correction that applies (L0050).
(12) Press the SEQ switch.
(13) "+ − RN:" is displayed.
(14) Enter the range correction that applies (+0050).
(15) Press the SEQ switch.
(16) The height entry is displayed (HGT:MTR).
(17) Press the SEQ switch.

NOTE: Height entries appear in meters, but can be changed to feet by pressing display switch 2 and selecting "FT" (display switch 2).

(18) "U D HT:" is displayed.
(19) Enter the altitude adjustment (D0050).
(20) Press the SEQ switch.
(21) "READY" is displayed.

8-21. Push the COMPUTE switch to receive firing data, and then follow these procedures:

(1) Sequence past "AF STD RP."
(2) Review the deflection and charge (A2DF:2748 CH:2).
(3) Press the SEQ switch.
(4) Review the fuze setting and elevation (A2FS . EL:1209).
(5) Press the SEQ switch.
(6) The time of flight is displayed (A2 TOF:40.5).
(7) Press the SEQ switch.
(8) "READY" is displayed.

8-22. Once all adjustments have been made or the FO requests FFE, decide how to engage the target. Based on the information given by the FO in the CFF, press the TFC switch, and follow these procedures:

(1) The call sign of the FO calling in the fire mission displays (TFC FO:*/**\-).
(2) Press the SEQ switch.
(3) The mission and the target numbers assigned to the mission display (MSN:* TN:******).
(4) Press the SEQ switch.
(5) The sheaf type preferred by the FDC for this mission displays (SHEAF:PRL).

NOTE: The preferred sheaf type can be changed when necessary.

(6) Press the SEQ switch.
(7) The method of control displays (CON:AF).

NOTE: The method of control can be changed when necessary.

(8) Enter FFE.
(9) Press the SEQ switch.
(10) The section and the weapons assigned to the FFE display (GUNS:A2 13).

NOTE: The section and the weapons assigned to the FFE can be changed when necessary.

(11) Press the SEQ switch.
(12) Current registration or MET data that apply to this mission display (REG/MET:NO - no current registration or MET data apply to this mission).

NOTE: Current registration or MET data that apply to this mission can be changed when necessary.

(13) Press the SEQ switch.
(17) The type of MET displays (MET:STD - MET to be applied to this mission will be standard).

NOTE: The type of MET can be changed when necessary.

(14) "PUSH COMPUTE" is displayed.

8-23. Press the COMPUTE switch to receive firing data. Then, press the SEQ switch to receive the firing data for each gun.

8-24. Press the EOM switch (green) to end the mission.

- EOM ends the mission without saving.
- EOMRAT ends the mission and records it as a target or known point.

NOTE: The flashing red light over the SEQ switch indicates that additional information is available for the current menu or display.

- EOMFPF ends the mission and records it as an FPF.

8-25. Press EOM, then EOMRAT. Sequence and save the mission as known point 01. Now, sequence to "READY."

POLAR MISSION SWITCH

8-26. The POLAR switch is used to initialize a mission that uses the polar plot method of target location. The following paragraphs describe the procedures for conducting a polar plot mission.

8-27. Press the POLAR switch.

(1) "NORMAL LASER" is displayed.
(2) Select "NORMAL."

NOTE: The FO conducts this mission in the normal mode. NORMAL is a method of target location using a map or any nonlaser device. LASER is a method of target location using laser equipment.

(3) "FR POLAR" is displayed.
(4) Press the SEQ switch.
(5) "FO:/00\-" is displayed.
(6) Enter the FO's call sign (W/12).
(7) Press the SEQ switch.
(8) The mission and target numbers assigned by the MBC display (MSN:* TN:******, * denotes the target number).
(9) Press the SEQ switch.
(10) "DIR:" is displayed.
(11) Enter the direction from the CFF (DIR:0800).
(12) Press the SEQ switch.
(13) "DIS:" is displayed.
(14) Enter the distance from the CFF (DIS:2000).
(15) Press the SEQ switch.
(16) "U D HGT:" is displayed.
(17) Enter the altitude correction that will be applied (D050).
(18) Press the SEQ switch.
(19) "READY" is displayed.

8-28. Press the WPN/AMMO switch.

(1) "WPN/AMMO" is displayed.
(2) Press the SEQ switch.
(3) The FO's call sign entered in step 1 displays (FO:*/**\-, * denotes the FO’s call sign).
(4) Press the SEQ switch.
(5) The mission and target numbers assigned by the MBC display (MSN:* TN:******, * denotes the target number).

(6) Enter the adjusting weapon (WPN:A2).
(7) Press the SEQ switch.
(8) The shell and fuze combination displays (SH/FZ: HE PD).
(9) Change the shell and fuze combination, if needed.
(10) Press the SEQ switch.
(11) "CHG:" displays. The operator can manually set the charge.
(12) Press the SEQ switch.
(13) "READY" displays.

8-29. Push the COMPUTE switch to receive firing data.
(1) Sequence past "AF STD RP."
(2) Review the deflection and the charge (A2DF:2452 CH:1).
(3) Press the SEQ switch.
(4) Review the fuze setting and elevation (A2FS. EL:1139).
(5) Press the SEQ switch.
(6) The time of flight is displayed (A2 TOF:31.5).
(7) Press the SEQ switch.
(8) "READY" is displayed.

8-30. Push the SFTY DATA switch to receive safety information.
(1) Review the range and azimuth (RN:2121 AZ:1146).
(2) Press the BACK switch to "READY."

8-31. Push the XMIT switch to receive and format messages to the observer by performing these procedures:
(1) Press display switch 1 under "MTO."
(2) Press the SEQ switch 11 times to receive the angle T (ANG T:0300 MILS).
(3) To exit out of the menu, press the MSN switch (light green), and then press the BACK switch. "READY" is displayed.

8-32. Wait for FO adjustments (if any). To make adjustments—
(1) Press the ADJ switch.
(2) "ADJ MIP" is displayed.
(3) Press display switch 1 under "ADJ."
(4) "ENT REV" is displayed.
(5) Press display switch 1, "ENT."
(6) Sequence to the FO's direction to the target (GT DIR:****).
(7) Press the SEQ switch.
(8) "L R DEV" is displayed.
(9) Enter the lateral deviation correction that applies (L0050).
(10) Press the SEQ switch.
(11) "+ - RN" is displayed.
(12) Enter the range correction that applies (+0025).
(13) Press the SEQ switch.
(14) "U D HT" is displayed.
(15) Enter the altitude correction that applies.
(16) Press the SEQ switch.
(17) "READY" is displayed.

8-33. Push the COMPUTE switch to receive firing data.

(1) Sequence past "AF STD RP."
(2) Review the deflection and charge (A2DF:2479 CH:1).
(3) Press the SEQ switch.
(4) Review the fuze setting and elevation (A2FS: . EL:1138).
(5) Press the SEQ switch.
(6) The time of flight is displayed (AZ TOF:31.5).
(7) Press the SEQ switch.
(8) "READY" is displayed.

8-34. Once all adjustments have been made or the FO requests an FFE, decide how to engage the target. Based on the information given by the FO in the CFF, use the TFC key.

(1) Press the TFC key.
(2) The FO calling in the fire mission displays (TFC FO:*/**\-).
(3) Press the SEQ switch.
(4) The mission and target numbers assigned to the mission display (MSN:* TN:******).
(5) Press the SEQ switch.
(6) The sheaf type preferred by the FDC for this mission displays (SHEAF:PRL).

NOTE: The preferred sheaf type can be changed when necessary.

(7) Press the SEQ switch.
(8) The method of control displays (CON:AF).

NOTE: The method of control can be changed when necessary.

(9) Enter FFE.
(10) Press the SEQ switch.
(11) The section and the weapons assigned to the FFE display (GUNS:A2 13).

NOTE: The section and the weapons assigned to the FFE can be changed when necessary.

(12) Press the SEQ switch.
(13) Current registration or MET data that apply to this mission display (REG/MET:NO - no current registration or MET data apply to this mission).

NOTE: Current registration or MET data that apply to this mission can be changed when necessary.

(14) Press the SEQ switch.
(15) The type of MET displays (MET:STD - MET to be applied to this mission will be standard).

NOTE: The type of MET can be changed when necessary.

(16) "PUSH COMPUTE" is displayed.

8-35. Press COMPUTE to receive firing data.

(1) Press the SEQ switch.

(2) Firing data for each gun is displayed.

NOTE: Once EOM is received, the MBC operator uses the SFTY DATA switch to obtain the burst point coordinates.

8-36. Press the EOM switch (green) to end the mission.

- EOM ends the mission without saving.
- EOMRAT ends the mission and records it as a target or known point.

NOTE: The flashing red light over the SEQ switch indicates that additional information is available for the current menu or display.

- EOMFPF ends the mission and records it as an FPF.

8-37. Press EOM (green key), and then "EOM 1," the display switch under EOM.

TECHNICAL FIRE CONTROL

8-38. Based on information given in the CFF, the FDC chief/section leader decides how best to engage the target. Once the FO enters the FFE phase, the MBC operator can use the technical fire control (TFC) switch to engage the target (as directed by the FDC order).

8-39. The TFC control menu allows the FDC to enter or change information for the following default values:

- Sheaf: Parallel.
- Method of control: Adjust fire.
- Weapons to fire: Basepiece selected.
- Registration data: No.
- MET data: Standard.

8-40. When all of the defaults are acceptable, the TFC switch is not needed. Table 8-1 provides a brief description of the TFC menu abbreviations and their uses.

NOTE: Always use the TFC switch when using a safety fan or fire zones.

Table 8-1. TFC menu abbreviations and their uses.

ABBREVIATIONS	USES
SHEAF:PRL	The type of sheaf needed to engage the target Selections include— • PRL (parallel). • CVG (converge). • SPECIAL.
CON:AF: CON	Means of controlling fires Selections include— • AF (adjust fire). • FFE (fire for effect). • DST (destruction). • REG (registration). NOTE: In the adjust fire mode, only the weapon selected through the WPN AMMO switch is shown. When the operator enters FFE, all assigned available weapons in that section are included in the computation of fire data. When control is FFE or DST, some weapons (not the adjusting weapon) may be deleted by using a correction entry.
GUNS	Mortars available for the designated control of fires For example, if AF appears on the previous screen, the only mortar shown on this display is the piece designated by the MBC operator in the WPN/AMMO menu.
REG/MET	If a MET has been entered and made current, this display would show REG/MET: YES. This tells the operator that MET or registration corrections will be applied to the target firing data. If the display shows REG/MET: NO, no corrections are applied.
MET:STD	Type of MET corrections used for the fire mission Selections include STD (standard) and CURR (current).

SHEAVES

8-41. The term sheaf denotes the lateral distribution of the bursts of two or more weapons firing at the same target at the same time. The distribution of bursts is the pattern of bursts in the area of the target. Normally, all weapons of the platoon or section fire with the same deflection, charge, and elevation. However, since targets may be various shapes and sizes and the weapons may be deployed irregularly, it is best to adjust the pattern of bursts to the shape and size of the target.

8-42. Individual weapon corrections for deflection, charge, and elevation are computed and applied to obtain a specific pattern of bursts. These corrections, called special corrections, are computed and applied based on the target's attitude, width, length, and adjusting point.

8-43. When the mortar section or platoon engages a target, different sheaves can be used. The types of sheaves include—

- Parallel.
- Converged.
- Open.
- Linear (standard).
- Special.

NOTE: See Chapter 4 for more information.

PARALLEL SHEAF

8-44. When mortars fire a parallel sheaf, the distance between impacts of rounds is the same as the distance between mortars. The mortars all fire using the same firing data. Parallel sheaves are normally used on area targets.

CONVERGED SHEAF

8-45. When mortars fire a converged sheaf, rounds from two or more mortars impact on the same point in the target area. This sheaf is normally used on point targets, such as bunkers or machine gun positions.

OPEN SHEAF

8-46. When mortars fire an open sheaf, the distance between impacts of rounds is half the distance between mortars. Normally, 120-mm mortars are positioned 60 to 75 meters apart, and 81-mm are positioned 35 to 40 meters apart; thus, in an open sheaf, rounds should land about 60 meters apart. For 60-mm mortars, which are normally positioned 25 to 30 meters apart, rounds should land about 45 meters apart. All mortars fire using different deflections. Open sheaves are used when the target is slightly wider than the area a linear sheaf would cover.

LINEAR (STANDARD) SHEAF

8-47. When mortars fire a linear sheaf, rounds impact within the total effective width of the bursts, regardless of the mortar locations.

SPECIAL SHEAF

8-48. When mortars fire a special sheaf, each mortar has a certain point to engage. The mortars may have different deflections, charges, and elevations. This sheaf is normally used in an attitude mission.

NOTE: When mortars fire an open or linear sheaf, the operator must use the special sheaf function and enter the appropriate data to obtain the desired results.

TRAVERSING FIRE

8-49. Mortars use traversing fire when the target is wider than the area a standard or open sheaf would cover. They engage wide targets using a distributed FFE. Each mortar of the section covers a portion of the total target area and traverses the area. The mortars are manipulated for deflection between rounds until the number of rounds given in the fire command has been fired.

NOTES: 1. The target's attitude should be within 100 mils of the mortar section's attitude (WPN DATA menu).

2. The target's attitude should be perpendicular to the gun’s direction of fire. When firing at targets using anything other than perpendicular angles, a combination of traverse and search will result.

8-50. Upon receiving the CFF, the section leader/chief computer determines from the size and description of the target that (in this example) traversing fire will be used to cover the target. He then issues the FDC order (Figure 8-1).

NOTE: Distribution of mortar fire to cover area targets (depth or width) is computed at one round for each 30 meters and four rounds for each 100 meters for 81-mm mortars, and one round for each 60 meters and 2 rounds for each 100 meters for 120-mm mortars.

COMPUTER'S RECORD

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

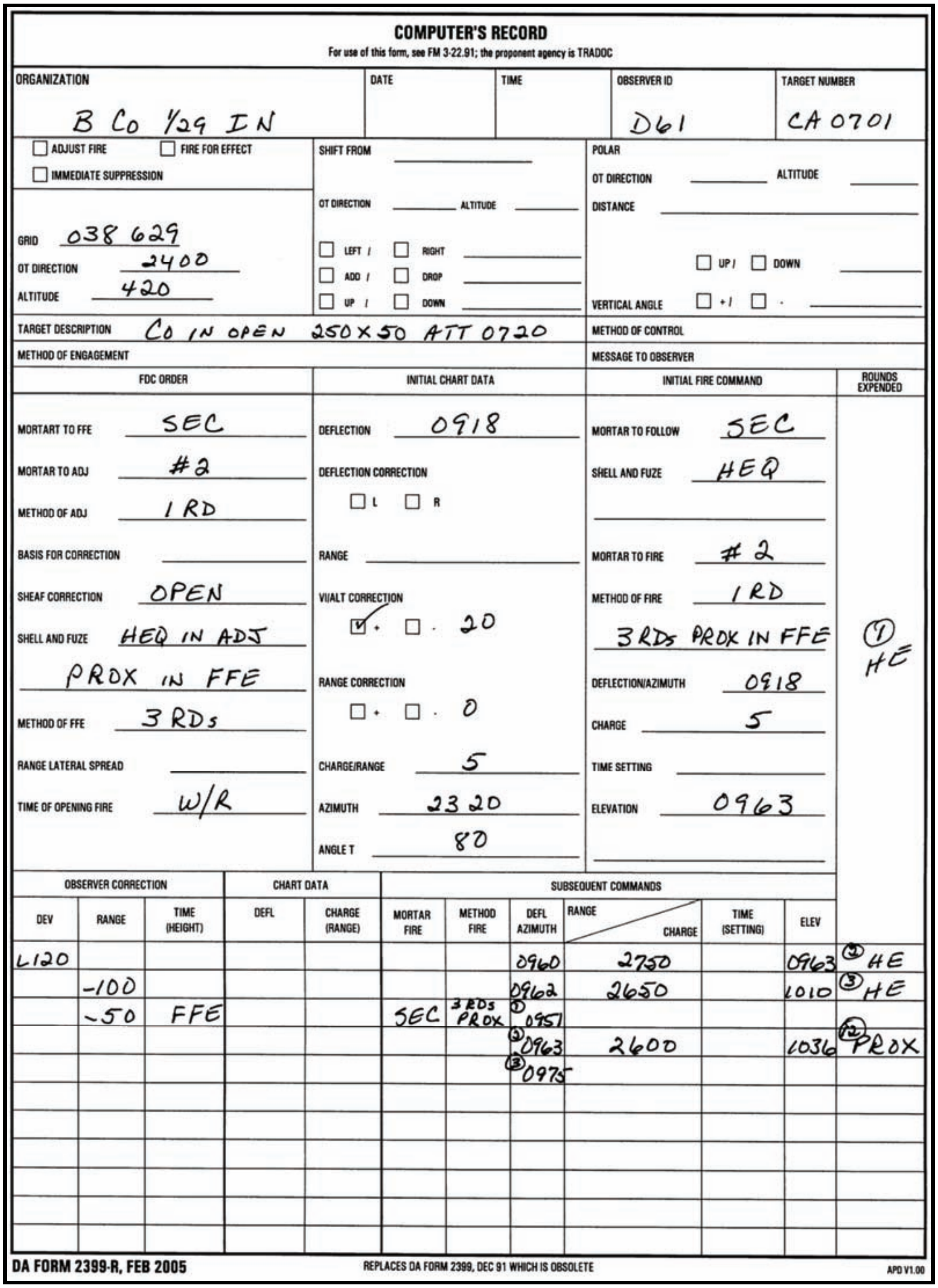
ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN			D61	CA0701

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION	SHIFT FROM ____	POLAR
GRID 038 629 OT DIRECTION 2400 ALTITUDE 420	OT DIRECTION ____ ALTITUDE ____ ☐ LEFT / ☐ RIGHT ____ ☐ ADD / ☐ DROP ____ ☐ UP / ☐ DOWN ____	OT DIRECTION ____ ALTITUDE ____ DISTANCE ____ ☐ UP / ☐ DOWN ____ VERTICAL ANGLE ☐ + / ☐ - ____
TARGET DESCRIPTION Co IN OPEN 250 X 50 ATI 0720		METHOD OF CONTROL
METHOD OF ENGAGEMENT		MESSAGE TO OBSERVER

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTART TO FFE SEC	DEFLECTION ____	MORTAR TO FOLLOW ____	
MORTAR TO ADJ #2	DEFLECTION CORRECTION ☐ L ☐ R	SHELL AND FUZE ____	
METHOD OF ADJ 1 RD		____	
BASIS FOR CORRECTION ____	RANGE ____	MORTAR TO FIRE ____	
SHEAF CORRECTION OPEN	VI/ALT CORRECTION ☐ + ☐ -	METHOD OF FIRE ____	
SHELL AND FUZE HEQ IN ADJ PROX IN FFE		____	
	RANGE CORRECTION ☐ + ☐ -	DEFLECTION ____	
METHOD OF FFE 3 RDS		CHARGE ____	
RANGE LATERAL SPREAD ____	CHARGE/RANGE ____	TIME SETTING ____	
ZONE ____	AZIMUTH ____	ELEVATION ____	
TIME OF OPENING FIRE W/R	ANGLE T ____	____	

Figure 8-1. Excerpt from example DA Form 2399-R (Computer's Record) with call for fire and FDC order completed.

8-51. When using the information in the CFF, FDC order, and FO corrections, the FDC computes the data to adjust the base mortar (usually the No. 2 mortar) onto the center of mass for the target area. He computes the firing data to the center of mass. The FDC selects the SFTY DATA switch and records the range and burst point grid coordinates on DA Form 2399-R (Figure 8-2).



COMPUTER'S RECORD

For use of this form, see FM 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

GRID 038 629

OT DIRECTION 2400

ALTITUDE 420

SHIFT FROM; OT DIRECTION; ALTITUDE; LEFT / RIGHT; ADD / DROP; UP / DOWN

POLAR; OT DIRECTION; ALTITUDE; DISTANCE; UP / DOWN; VERTICAL ANGLE + / -

TARGET DESCRIPTION Co IN OPEN 250 X 50 ATT 0720

METHOD OF ENGAGEMENT

METHOD OF CONTROL

MESSAGE TO OBSERVER

FDC ORDER		INITIAL CHART DATA		INITIAL FIRE COMMAND		ROUNDS EXPENDED
MORTART TO FFE	SEC	DEFLECTION	0918	MORTAR TO FOLLOW	SEC	
MORTAR TO ADJ	#2	DEFLECTION CORRECTION	L / R	SHELL AND FUZE	HEQ	
METHOD OF ADJ	1 RD					
BASIS FOR CORRECTION		RANGE		MORTAR TO FIRE	#2	
SHEAF CORRECTION	OPEN	VI/ALT CORRECTION	+ 20	METHOD OF FIRE	1 RD	
SHELL AND FUZE	HEQ IN ADJ PRDX IN FFE				3 RDs PROX IN FFE	1 HE
		RANGE CORRECTION	0	DEFLECTION/AZIMUTH	0918	
METHOD OF FFE	3 RDs			CHARGE	5	
RANGE LATERAL SPREAD		CHARGE/RANGE	5	TIME SETTING		
TIME OF OPENING FIRE	W/R	AZIMUTH	2320	ELEVATION	0963	
		ANGLE T	80			

OBSERVER CORRECTION DEV	RANGE	TIME (HEIGHT)	CHART DATA DEFL	CHARGE (RANGE)	SUBSEQUENT COMMANDS MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	ROUNDS EXPENDED
L120							0960	2750		0963	2 HE
	-100						0962	2650		1010	3 HE
	-50	FFE			SEC	3 RDs PROX	1 0957				
							3 0963	2600		1036	12 PROX
							3 0975				

DA FORM 2399-R, FEB 2005 — REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE — APD V1.00

Figure 8-2. Example of completed DA Form 2399-R (Computer's Record) for adjustment.

8-52. After the adjustment is complete, the FDC must perform the following procedures:

(1) Divide the target into equal segments by dividing the target's width by the number of mortars in the FFE.

EXAMPLE

Target's width = 300 meters
Number of mortars in the FFE = 3
300/3 = 100 meters each mortar has to cover

(2) Determine and apply the modification (either +/− range correction or left/right deviation correction). Divide the segment width by 2 to determine the appropriate modification. For example, 100/2 = 50. Use one of the following methods to apply the modification.

- Use Table 8-2 to determine the direction (plus or minus) for the modification.

Table 8-2. Gun-target azimuth chart.

GUN-TARGET AZIMUTH 4901-1499	
TRAVERSE LEFT (+) TRAVERSE RIGHT (-)	
GUN-TARGET AZIMUTH 1500-1700	
ATTITUDE < 1600 TRAVERSE LEFT (-) TRAVERSE RIGHT (+)	ATTITUDE > 1600 TRAVERSE LEFT (+) TRAVERSE RIGHT (-)
GUN-TARGET AZIMUTH 1701-4699	
TRAVERSE LEFT (-) TRAVERSE RIGHT (+)	
GUN-TARGET AZIMUTH 4700-4900	
ATTITUDE < 1600 TRAVERSE LEFT (+) TRAVERSE RIGHT (-)	ATTITUDE > 1600 TRAVERSE LEFT (-) TRAVERSE RIGHT (+)

EXAMPLE

Consider a GT of 5300 mils, traverse right. Since the GT azimuth falls in the azimuth block of 4901-1499, the modification will be a plus if traversing left and a minus if traversing right. Since the mortars will traverse right, their modification will be −50.

OR

- When the FDC finds itself without the GT azimuth chart, personnel need an alternative method of computing the modification. Therefore, draw the situation to help new FDC personnel understand how and why the MBC computes the traverse data.

EXAMPLE (Figures 8-3 through 8-5)

Target = 300 x 50 meters
Attitude (TGT) = 0400 mils
GT azimuth (DOF) = 5300 mils
Three-mortar section
Guns must be placed so they are using the direction of the target's attitude (400 mils). The FDC determines if it needs a plus or minus correction to get to the starting point.

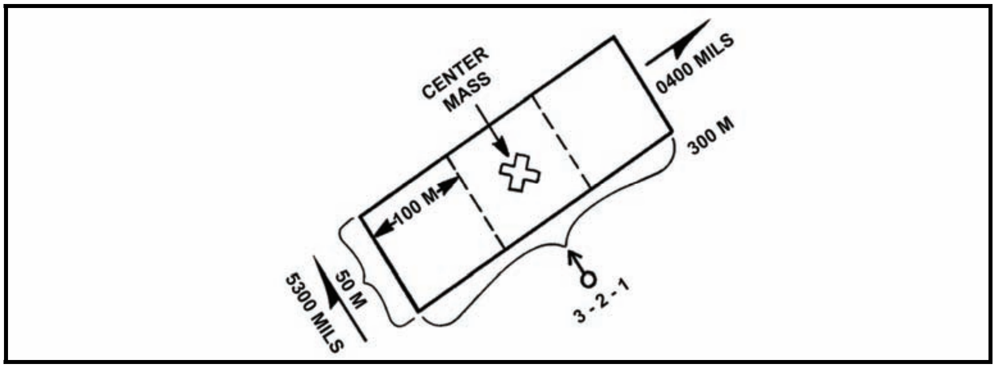


Figure 8-3. Example situation chart number 1.

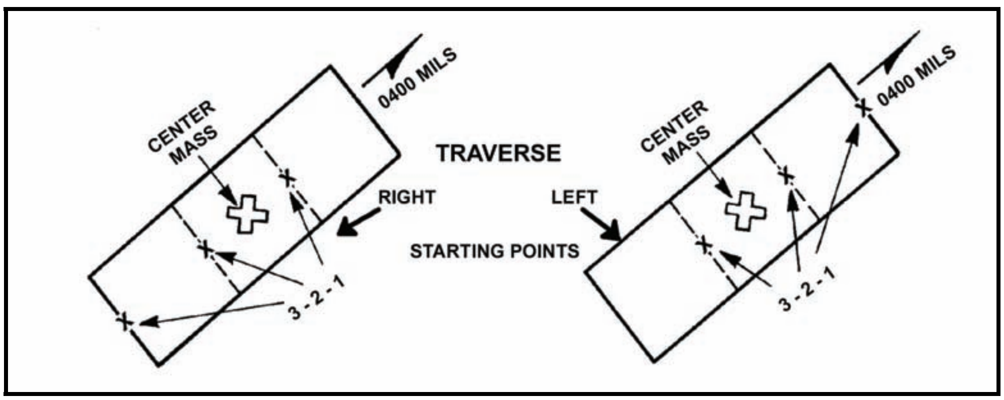


Figure 8-4. Example situation charts numbers 2 and 3.

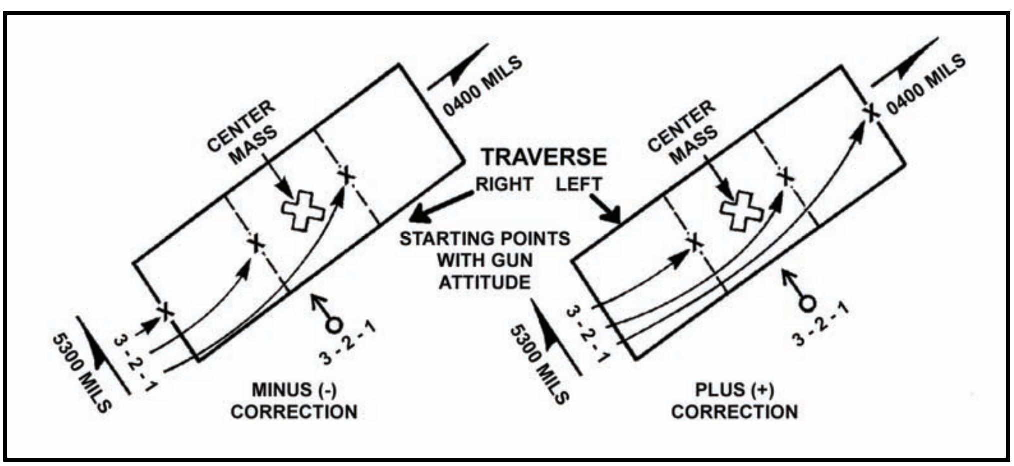


Figure 8-5. Example situation charts numbers 4 and 5.

OR

- Use the following procedure:
  - (1) Determine the perpendicular to the attitude (add or subtract 1600 mils; use whichever is closer to the final azimuth of fire), and apply the modification as a left or right correction. When computing for firing data using the perpendicular, copy the range and burst point grid coordinates, and the final azimuth of fire.
  - (2) Add or subtract 1600 mils from the target's attitude. Use the answer that comes closest to the final azimuth of fire for the direction correction in the ADJ menu.
  - (3) Select the ADJ switch, and change the direction to the perpendicular azimuth.
  - (4) Make a deviation correction instead of making a range correction (as in previous examples). This correction is one-half the distance each mortar must cover.
  - (5) Enter a right deviation correction if traversing left; enter a left deviation correction if traversing right.

(3) Once the modification has been entered into the ADJ menu of the MBC, press the TFC switch, and change or enter the following data:

- Change SHEAF:PRL to read SHEAF:SPECIAL.
- Change ADJ PT:FLANK to read ADJ PT:CENTER.
- Enter the target's width (total area to be covered in the CFF), such as 300 x 50 meters.
- Enter target's attitude, such as 400 mils.
- Change CON:AF to read CON:FFE.
- Press the COMPUTE switch and receive firing data.

(4) Determine the number of rounds for each segment.

EXAMPLE

Assume that the target is 350 meters wide.

(1) Divide the area into equal segments: 350/3 = 116. Each mortar covers 116 meters of the target area.

(2) Determine the number of rounds needed to cover one segment: 4 rounds (for 100 meters) + 1 round (for the remaining 16 meters) = 5 rounds per segment.

---

(5) Determine the mil width of one segment; the other segments are the same. Use one of two methods to determine the number of mils for one segment:

- In the first method, the start point deflections for all the mortars are given. Compare the mil difference between either No. 1 mortar and No. 2 mortar or No. 2 mortar and No. 3 mortar (or No. 3 mortar and No. 4 mortar, if available). For example, No. 1 mortar has a deflection of 2719 mils, and No. 2 mortar has a deflection of 2773 mils. The mil difference is 54 mils (subtract the smaller from the larger: 2773 - 2719 = 54 mils).
- The second method uses the deflection conversion table (DCT, shown in Figure 8-6). Enter the DCT at the final range, rounded off to the nearest 100. Follow the deflection in meters line to the closest meters 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.

RANGE IN METERS	DEFLECTION IN METERS														
	1	10	20	30	40	50	75	100	125	150	175	200	300	400	500
500	3.0	20	41	61	81	102	152	201	250	297	34	388	550	687	800
600	1.7	17	34	51	68	85	127	168	209	250	289	328	472	599	708
700	1.5	15	29	44	58	73	109	145	180	215	250	284	412	529	632
800	1.3	13	25	33	51	64	95	127	158	189	219	250	365	472	569
900	1.1	11	22	34	45	57	85	113	141	168	195	223	328	426	517
1000	1.0	10	20	31	41	51	76	102	127	152	176	201	297	388	473
1100	.93	9	18	28	37	46	69	92	115	138	161	183	271	355	435
1200	.85	8	17	25	34	42	64	85	106	127	148	168	249	328	402
1300	.79	8	16	23	31	39	59	78	98	117	136	155	231	304	374
1400	.73	7	15	22	29	36	55	73	91	109	127	145	215	283	349
1500	.68	7	14	20	27	34	51	68	85	102	118	135	201	265	328
1600	.63	6	13	19	25	32	48	64	80	95	111	127	189	250	309
1700	.60	6	12	18	24	30	45	60	75	90	104	119	178	235	291
1800	.57	6	11	17	23	28	42	57	71	85	99	113	168	223	276
1900	.54	5	11	16	21	27	40	54	67	80	94	107	160	211	262
2000	.51	5	10	15	20	25	38	51	64	76	89	102	152	201	250
2100	.49	5	10	15	19	24	36	48	61	73	85	97	145	192	238
2200	.46	5	9	14	19	23	35	46	58	69	81	92	138	183	228
2300	.44	4	9	13	18	22	33	44	55	66	77	88	132	175	218
2400	.43	4	8	13	17	21	32	42	53	63	74	85	127	168	209
2500	.41	4	8	12	16	20	31	41	51	61	71	81	122	162	201
2600	.39	4	8	12	16	20	29	39	49	59	68	78	117	155	194
2700	.38	4	8	11	15	19	28	38	47	57	66	75	113	150	187
2800	.37	4	7	11	15	18	27	36	45	55	64	73	109	145	180
2900	.35	4	7	11	14	18	26	35	44	53	61	70	105	140	174
3000	.34	3	7	10	14	17	25	34	42	51	59	68	102	135	168
3100	.33	3	7	10	13	16	25	33	41	49	57	66	98	131	163
3200	.32	3	6	10	13	16	24	32	40	48	56	64	95	127	158
3300	.31	3	6	9	12	15	23	31	39	46	54	62	92	123	153
3400	.30	3	6	9	12	15	22	30	37	45	52	60	90	119	149
3500	.30	3	6	9	12	15	22	29	36	44	51	58	87	116	145
3600	.29	3	6	8	11	14	21	28	35	42	49	57	85	113	141
3700	.28	3	6	8	11	14	21	28	34	41	48	55	82	110	137
3800	.27	3	5	8	11	13	20	27	33	40	47	54	80	107	133
3900	.27	3	5	8	10	13	20	26	33	39	46	52	78	104	130
4000	.26	3	5	8	10	13	19	26	32	38	45	51	76	102	127

Figure 8-6. Example of deflection conversion table.

(6) To determine the number of turns it will take to cover one segment, divide the number of mils for each turn on the traversing handcrank by the mil width of one segment.

EXAMPLE

10 (number of mils for each turn) ÷ 54 = 5.4 (rounded off to the nearest 1/2 turn) or 5 1/2 turns to cover 116 meters

NOTE: Divide by 5 (mils per turn) when using the 120-mm mortar. There are 10 mils per turn of the deflection handwheel for both the 60-mm and 81-mm mortars.

(7) To compute the number of turns between rounds, the number of rounds to be fired must be known for each segment (FFE). This information is in the FDC order. To determine the turns between rounds, divide the total turns by the intervals (always one less than the number of rounds) between rounds.

EXAMPLE

5 rounds	=	4 intervals; 5.5 (total turns) ÷ 4 (intervals):
5.5 ÷ 4	=	1.3 (rounded to nearest 1/2 turn)
1.3	=	1 1/2 turns between rounds

SEARCHING FIRE

8-53. Mortars use searching fires to effectively engage area targets that have more depth than a linear sheaf covers. Targets having more depth than 50 meters can be covered by mortars by elevating or depressing the barrel during the FFE.

8-54. In the CFF, the FO sends the target's size and attitude. He gives the width and depth on the target's attitude. Attitude is the direction (azimuth) through the target's long axis.

8-55. All mortar systems use searching fire. Before determining the search data, the FDC must compute any corrections sent with the FFE command and record the burst point grid coordinates.

(1) Press the ADJ switch, and enter the target's attitude in place of the direction.

NOTE: Whether searching up or down, always determine the firing data for the far edge of the target area first. This saves time if the charge designated at the near edge differs from the one designated at the far edge.

(2) When using searching fire, enter an add correction that is half the total target length. This places the mortars on the far edge of the target.

(3) Compute and record the firing data for the far edge.

(4) Enter a correction to place the mortars on the opposite edge of the target. The correction will be a drop, and the distance will be the entire length of the target area.

(5) Compare the charge needed to hit the near edge of the target with the charge needed to hit the far edge. The charges must be the same. If they are not, select the charge designated for the far edge using the WPN/AMMO menu, and recompute the near edge firing data.

(6) Determine the number of turns between rounds by determining the mil distance needed to cover the target area and dividing it by 10 (approximate number of mils in one turn of the elevation handcrank). Round off the answer to the nearest one-half turn. Compute the distribution of mortar fire to cover area targets (depth or width) at one round for each 30 meters and four rounds for each 100 meters.

- Compare the far edge elevation to the near edge elevation, and subtract the smaller from the larger.
- Divide the mil distance by 10 (divide by 5 for the 120-mm mortar), and round off to the nearest half turn.

(7) Determine the turns between rounds by dividing the intervals into the turns and rounding off to the nearest half turn. The intervals are always one less than the number of rounds in the FFE.

ILLUMINATION

8-56. Illumination assists friendly forces with light for night operations.

8-57. The FDC uses one of the flank mortars to adjust the illumination, leaving the base mortar ready to adjust HE rounds if a target is detected.

NOTE: Normally, when a four-mortar section is firing, the No. 4 mortar is used to adjust the illumination, leaving the No. 2 mortar as the base mortar. When the No. 1 mortar is used to adjust illumination, the No. 3 mortar becomes the base mortar.

8-58. The FO makes range and deviation corrections for illumination rounds in increments of no less than 200 meters. He also makes corrections for height of burst (up or down) in increments of no less than 50 meters.

8-59. Multiple mortar illumination procedures are used when single mortar illumination does not provide enough light or when visibility is poor. Two mortars, usually side-by-side, fire rounds at the same time at the same deflection, charge, and time setting to provide a large amount of light in a small area. If the FO suspects a large target or if he is uncertain of the target's location and wishes for a larger area to be illuminated, he may call for illumination:

- Range.
- Lateral.
- Range-lateral spread.

RANGE SPREAD

8-60. Two mortars fire one round each at the same deflection, but with different charges so that rounds burst at different ranges along the same line.

8-61. The spread between the rounds depends on the type of mortar firing the mission. The 120-mm mortar rounds have 1,500 meters between bursts, and the 81-mm mortar rounds have 500 meters between bursts.

8-62. When four mortars are present in the firing section, the No. 2 and No. 3 mortars normally fire the range spread. When firing a three-mortar section, the range spread may be fired with just one mortar, which fires both rounds. Follow these procedures:

(1) Enter the type of target location called in by the FO into the MBC to initiate the mission. The weapon selected by the FDC in the WPN/AMMO menu (to activate the section) should be one of the mortars that will fire the mission. The initial firing data determined for the mission are center of mass target data. These data are not fired, but are used as the starting point for adjustment of the spread.

(2) Enter the ADJ menu. Change the OT direction to GT direction, and enter a correction for the first round of the spread. Compute and record the firing data.

(3) Select the ADJ menu, and enter a correction to achieve the required distance between rounds, which depends on the mortar system being used.

(4) Compute and record the firing data, and fire the two rounds for the range spread.

NOTE: The two rounds should burst at the same time. The far round must be fired first, with the near round being fired afterward, at the difference between the time settings.

EXAMPLE

Assume the mortar selected to fire is the No. 2 mortar.

(1) Enter the initial target location, and determine the center of mass data.

(2) Enter the ADJ menu, and give the No. 2 mortar a correction of +250 (for 81-mm mortars) or +750 (for 120-mm mortars).

(3) Compute and record these data.

(4) Enter the ADJ menu again, and make a correction of -500 (for 81-mm mortars) or -1500 (for 120-mm mortars).

(5) Compute and record these data.

(6) Use both sets of data to fire the rounds; rounds will burst at the desired length (1,500 meters for 120-mm mortars, and 500 meters for 81-mm mortars) between the rounds on the GT line.

NOTE: A range spread should be fired with one mortar firing both rounds— one long and one short.

Lateral Spread

8-63. When using lateral spread, two mortars fire one round each at different deflections, but with the same charge. Therefore, the rounds burst at the same range, along the same attitude.

(1) Use the No. 2 mortar to process the CFF, and determine firing data for the center of mass.

(2) Use the ADJ menu to enter left and right corrections. Use the GT as the direction, and enter the first correction.

NOTE: The No. 2 mortar is used for the initial round. The first correction can be either a right or left correction. For example, the first correction for the 81-mm mortar round is 250; the first correction for the 120-mm mortar round is L 750.

(3) Compute and record the firing data.

(4) Select the ADJ menu, and enter the reverse of the first correction, the entire distance required between rounds: L/R 500 meters for the 81-mm mortar, or L/R 1,500 meters for the 120-mm mortar.

RANGE-LATERAL SPREAD

8-64. If the target area is extremely large or if visibility is limited, the FO may call for a range-lateral spread (Figure 8-7). This procedure combines the two methods to form a large diamond-shaped pattern of bursts. Using flank mortars for the lateral spread and center mortars for the range spread removes the danger of rounds crossing in flight.

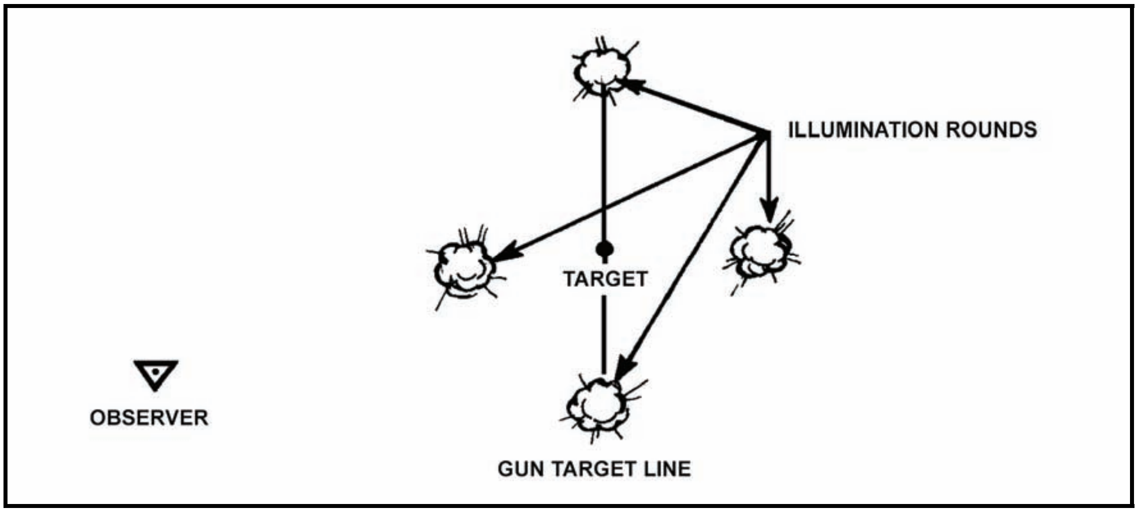


Figure 8-7. Range-lateral spread.

COORDINATED ILLUMINATION

8-65. When a suspected area is illuminated and produces a target, coordinated illumination is used to engage the target.

(1) The illumination round has been adjusted over the target area. The computer receives a CFF for coordinated illumination.

(2) The mark method is the method of coordinated illumination most commonly used. The FDC and the FO must know for which round the illumination mark will be given.

(3) 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."

(4) Before computing the time to fire the HE round, the computer drops all tenths and subtracts the time of flight for the HE round and the illumination round.

EXAMPLE

Illumination round - 53 seconds and the HE round - 19 seconds = time to fire the HE round will be 34 seconds after the illumination round is fired

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(5) When firing coordination missions, the computer operator uses a new DA Form 2399-R to record the illumination mission. The data used to fire the first illumination round is taken from the DA Form 2399-R used to adjust the illumination mission.

(6) The FO sends corrections and precedes each correction with the type of round the correction is intended for. For example, "Illumination. Up five zero. HE. Right five zero. Add five zero." He records each correction on separate lines. The FDC keeps track of the 50-meter increments by using the DA Form 2399-R of the illumination mission.

(7) 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.

(8) When the FO is certain that he can hit the target with the next round, he commands, "Continuous illumination. Fire for effect" or "Continuous illumination. HE. Drop twenty-five. Fire for effect."

(9) By requesting the continuous illumination, the FO is telling the FDC that he wants the target illuminated both during and after the fire for effect to allow him to make his target surveillance. Upon completion of the mission, he records the data on the DA Form 2188-R.

Chapter 9

Special Procedures

Procedures for basic fire missions are simple and require little coordination by the indirect fire team. The one element that is lacking in these procedures is accuracy, which the indirect fire team strives to improve. In-depth planning and prior coordination between the elements of the indirect fire team help ensure the delivery of timely and accurate fires. This chapter discusses the special procedures needed to conduct registration missions, FPF, and quick or immediate smoke.

REGISTRATION AND SHEAF ADJUSTMENT

9-1. If time and the tactical situation permit, the registration is the first mission completed. The two types of registration missions are coordinated and uncoordinated.

COORDINATED REGISTRATION

9-2. A coordinated registration is a planned mission using an available surveyed RP, known to at least an eight-digit grid coordinate. Firing corrections may be determined and applied after the registration mission is fired. The FDC usually initiates this mission.

UNCOORDINATED REGISTRATION

9-3. An uncoordinated registration is not planned, and units may not have a surveyed RP to fire upon. This registration is used mainly to adjust the sheaf and to establish a known point within the area of responsibility. If the RP is not surveyed, firing data corrections cannot be determined or applied. The FO usually initiates this mission.

MBC REGISTRATION PROCEDURES

9-4. When using the MBC for registration, the computer processes the mission as a standard grid mission until the FO determines that the registration is complete. He adjusts the basepiece onto the RP as in any standard adjust mission. Once the FDC receives a "Registration complete" call from the FO, he computes any refinement corrections received with the command. After these data are given to the mortars, the section fires a section left or a section right. The basepiece does not fire.

EXAMPLE

Consider a final correction of "Drop 25, registration complete," sent by the FO. Perform the following actions:

(1) Use the ADJ menu to enter the correction of −25.
(2) Press the COMPUTE switch to process the refinement data.

NOTE: Step 3 applies to coordinated registrations only.

---

(3) Press the REG fire mission switch once the refinement firing data are available.
(4) The registration number and FO identification (if the FO was entered with the CFF) are displayed.

(5) Press the SEQ switch.
(6) The mission target numbers are displayed.
(7) Press the SEQ switch.
(8) The FO's direction to the target is displayed.
(9) Press the SEQ switch.
(10)The RP grid is displayed.

NOTE: This grid is the initial grid used from the CFF, not the adjusting point grid.

(11)Press the SEQ switch.
(12)The altitude of the RP is displayed.
(13)Press the SEQ switch.
(14)The weapon caliber and number of the adjusted piece are displayed.
(15)Press the SEQ switch.
(16)The charge used to reach the RP is displayed.
(17)Press the SEQ switch.
(18)The MBC provides a prompt to push COMPUTE to determine the firing corrections.
(19)Press the COMPUTE switch.
(20)The assigned RP number is displayed.
(21)Press the SEQ switch.
(22)The type of MET used and the range correction factor (RCF) are displayed.
(23)Press the SEQ switch.
(24)The type of MET used and the deflection correction are displayed.
(25)Press the SEQ switch.
(26)"READY" is displayed.

9-5. As shown in the example above, the MBC has determined the firing corrections; while it will not apply them to any subsequent data during this mission, it automatically applies the correction factors to all following missions that are within the transfer limits of this RP. The FDC copies this data to the appropriate spaces on the DA Form 2188-R.

9-6. To prepare the MBC for sheaf adjustments, the computer uses the TFC menu to change the control from "CON:AF" to "CON:FFE,"and then presses the COMPUTE switch.

NOTE: The operator must change "CON:AF" to "CON:FFE" and press COMPUTE before adjusting individual guns.

9-7. The FDC initiates the sheaf adjustment by telling the FO, "Prepare to adjust the sheaf." The FO responds with, "Section left/right." The section left/right is fired without the basepiece, unless the FO specifies otherwise. The operator prepares to receive corrections for each mortar not firing within the sheaf. Then, he records the corrections and computes them separately.

NOTE: The MBC can only compute one correction at a time; therefore, if the computer records the corrections, he may compute for the corrections as he desires. Smaller corrections should be entered first since the mortars will not likely be fired again.

9-8. To adjust the sheaf—

(1) Press ADJ.

(2) Sequence to "ADJ:AUF" ("Adjusting:Adjusting Unit of Fire").

(3) Change the "AUF" to "SHEAF."

(4) Sequence to "WPN:."

(5) Enter the number of the weapon that requires adjustment.

NOTE: The correction impacts only the weapon identified. Other weapons will still use the last firing data.

---

(6) Enter the correction.

(7) Compute the correction.

NOTE: If a correction is over 50 meters, the mortar will be refired. If the correction is less than 50 meters, the mortar will not be refired, but the correction will be made.

---

(8) Use the ADJ switch, and sequence to "WPN:NXT CONT."

- The abbreviation "WPN" is for weapon.
- The abbreviation "NXT" is for the next mortar to adjust.
- The abbreviation "CONT" means continue with the same mortar identified above.

(9) Sequence to "WPN:."

(10) Enter the weapon that requires adjustment and the correction.

(11) Compute the correction.

(12) Use the firing data menu to sequence through the data and record the new fire commands.

9-9. After the sheaf has been adjusted, the section/platoon must refer the sight and realign the aiming post on the last deflection of the basepiece used for the registration. The mission is ended using the EOM menu.

9-10. The computer uses the REG DATA menu to store and update information concerning the RP. Then, the MBC applies the correction factors to all subsequent fire requests that are within the transfer limits of the RP.

9-11. The RP must be updated for any MET data or reregistrations. To update or reregister on the RP, the computer follows the same procedures as a grid mission until the FO determines that the update or reregistration is complete. The operator will then—

(1) Press the REG DATA switch.

(2) Press the display switch under "NXT."

(3) "RP00" is displayed.

(4) Press the display switch under "CLR."

(5) "CLEAR RP 00 *" is displayed.

(6) Press the display switch under "*."

(7) "RP: NXT CLR" is displayed.

(8) Press the BACK switch until "READY" appears.

(9) Press the REG switch.

(10) Sequence through until "PUSH COMPUTE" appears.

(11) Press the COMPUTE switch for a new deflection correction and RCF.

(12) Press the EOM switch instead of EOMRAT. Data is stored already from the initial registration mission.

MEAN POINT OF IMPACT REGISTRATION

9-12. Special procedures permit registration under unusual conditions. This paragraph discusses one of the special procedures available, the mean point of impact (MPI) registration. Fire cannot be visually adjusted onto an RP at night without illumination. During desert, jungle, or arctic operations, clearly defined RPs are not usually available.

9-13. In an MPI registration, two FOs are normally used. For accuracy, the computer must know the location and altitude of each FO and enter the information into the MBC using the FO LOC menu. The computer must also know the expected point of impact and mortar position.

9-14. To determine the initial firing data—

(1) Start the mission using the GRID menu.
(2) Enter the expected burst point (as the grid to the target) and altitude.

NOTE: An FO ID and direction should not be entered using this menu.

---

(3) Use the WPN/AMMO menu to assign the mission to an adjusting piece.
(4) Press COMPUTE to determine the firing data and record the necessary information, such as the burst point to the target.

NOTE: The MBC does not allow access to the MPI menu under the ADJ switch until a mission has been activated using the GRID and WPN/AMMO menus.

9-15. After the FOs' locations and the target point are known, the FDC computes and reports the orienting data to the FOs.

NOTE: The FOs must be given their orienting data before firing.

9-16. To determine the observer's orienting data—

(1) Press the ADJ switch.
(2) Select "MPI:."
(3) "FILE CONT INIT" is displayed.
(4) Select "INIT" to initialize the MPI mission.
(5) "INIT YES NO" is displayed.
(6) Select "YES."
(7) The MBC provides a prompt for one of the FOs' IDs.
(8) Enter one of the FOs' IDs.
(9) Press the SEQ switch.
(10) The orienting direction for the FO entered displays.
(11) Press the SEQ switch.
(12) The vertical angle for the FO entered displays.
(13) Press the SEQ switch.
(14) Enter the target number.
(15) Press the SEQ switch.
(16) The orienting data are ready to be transmitted to the FO. If the MBC is DMD-supported, select "YES" to digitally transmit the information. If the MBC is not DMD-supported, select "NO."
(17) The MBC provides a prompt for the other FO's ID.
(18) Follow steps (8) through (16) for the other FO.

(19) If the MBC is not DMD-supported, transmit the orienting data to the FOs using the following format:

FDC: Prepare to observe MPI registration. Hotel 42. Direction 2580. Vertical angle +40. Hotel 41. Direction 2850. Vertical angle +10. Report when ready to observe.

9-17. The FOs should announce, “Ready to observe,” after they have received their orienting data and have set up their instruments.

9-18. The section leader/chief computer directs the firing of the orienting round using the computed firing data. The FOs use the round to check the orientation of their instruments. The orienting round should be within 50 mils of the expected point of impact.

- If the round lands 50 mils or more away from the expected point of impact, the FO reorients his instrument and announces the new direction to the FDC. If one FO reorients his instrument, the other FO's spotting is disregarded. When either of the FOs must reorient, the operator enters the new direction using the ADJ menu and follows these procedures:
  - Enter the ADJ menu.
  - Press the ADJ switch.
  - Select "MPI."
  - Select "INIT."
  - Reenter the FO’s ID when prompted.
- If the burst impacts less than 50 mils away from the expected point of impact, the FO sends the FDC a spotting. The spotting contains the number of mils left or right of the expected point of impact.

9-19. When both FOs report that their instruments are ready, the adjusting mortar fires the number of rounds needed to get six usable spottings. The FDC enters these spottings into the MBC.

9-20. To enter the spottings into the MBC—

(1) Press the ADJ switch.
(2) Select "MPI."
(3) The computer displays "FILE CONT INIT."
(4) Select "FILE" to enter the spottings.
(5) The MBC requests the sighting number.
(6) Enter the sighting number.
(7) Press the SEQ switch.
(8) Determine the azimuth from the FO to the target using the RALS (right add, left subtract) rule. Add or subtract this correction from the FO’s referred (orienting) direction. Enter the azimuth as the FO’s direction.
(9) Press the SEQ switch.
(10) The MBC prompts for the vertical angle from the FO to the round. Enter the vertical angle, if any.
(11) Press the SEQ switch.
(12) The second FO’s ID is displayed.
(13) Enter the sighting number.
(14) Determine the azimuth from the FO to the target using the RALS rule. Add or subtract the correction from the FO’s referred direction. Enter the azimuth as the FO’s direction.

NOTE: The MBC computes for only one vertical angle correction. This correction applies only to the first FO entry. When the vertical angle entry must be computed, the operator ensures that the proper FO is entered.

(15) Press the SEQ switch.
(16) The MBC prompts the operator for the next sighting.
(17) Press the COMPUTE switch.
(18) Enter the FOs' sightings as described until all sightings have been entered. After the last sighting has been entered, select "END" on this display.
(19) Press the COMPUTE switch.
(20) Sequence to view the RP corrections.
(21) Press the EOM switch to end the mission.

RADAR REGISTRATION

9-21. The radar registration requires only one OP: radar. It requires less survey, fewer communication facilities, and less coordination. Radar registration can be conducted quickly and during poor visibility.

NOTE: Radar registrations may be conducted as grid or polar plot missions. Grid mission procedures are discussed below.

9-22. Radar registration missions are coordinated missions and are conducted as normal grid missions with the following exceptions:

- The FO does not send corrections; he sends grid coordinates to the impact of the rounds fired.
- The FDC, instead of the FOs, converts spottings to corrections.

9-23. The following example depicts a radar registration mission and outlines the proper procedures.

EXAMPLE

(1) The FDC sends an MTO: “Prepare to register RP 1, grid 03817158.”
(2) The radar operator orients his radar set and tells the FDC, “Ready to observe.”
(3) The first round is fired, and the radar operator sends a grid of the round's impact point to the FDC.
(4) The FDC records the eight-digit grid coordinates and compares it to the RP grid coordinates to determine the spotting. Then, he sends a grid (03557120) to the first round fired.

	Easting	**Northing**
RP grid	0381(0)	7158(0)
First round grid	- 0355(0)	- 7120(0)
	26(0)	38(0)

NOTE: To use 10-digit grid coordinates, add a zero to the end of each easting or northing coordinate until there are 10 digits. For example, the grid 123456 becomes 1230045600.

- Using a blank piece of scrap paper, the FDC draws a large square to represent a 1,000-meter grid square.
- The FDC labels the bottom left corner of the square with the grid intersection of the RP (03/71) (Figure 9-1).
- He divides the large square into four smaller squares by drawing a line through the center of the box from top to bottom and from left to right.
- He estimates the location of both grid coordinates and plots them inside the box.
- By looking at these plots, the FDC can tell whether the round is left or right and over or short of the RP. This is the spotting of the round. For this example, the spotting is left (260 meters) and short (380 meters).

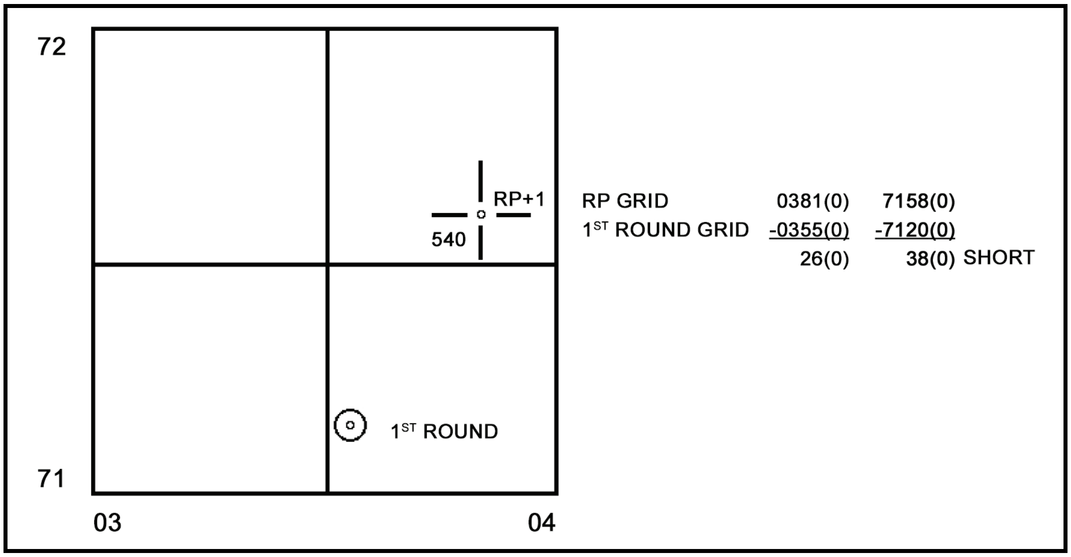

Figure 9-1. Determination of a spotting.

- The spotting is then converted to a correction by converting the left spotting to a right correction (R 260) and the short spotting to an add correction(+ 380). Using the ADJ menu, the operator enters the corrections:
  - Change the direction to 6400 (or 0000).
  - Enter "R 0260" for the deviation correction.
  - Enter "+ 0380" for the range correction.
  - Sequence to "READY."
- The operator then computes the firing data and sends it to the guns.

(5) The second round is fired, and the FO sends the grid coordinates (04007180). The second correction follows the same process as the first correction.

- The FDC compares the grids and determines the spotting ("Right 190" and "Over 220").
- The corrections (L 190 and - 220) are made in the ADJ menu, and the firing data are sent to the mortars.

(6) The computer repeats this procedure until the spotting is within 25 meters of the RP and the FO has given “End of mission, registration complete.” The FDC—

- Enters the final correction through the ADJ menu and computes the data.
- Presses the REG switch and sequences through the REG menu. He ensures that the data pertaining to the RP are correct.
- Presses COMPUTE when indicated at the end of the REG menu to determine the RCF and deflection correction (DEFK).

(7) After the registration is completed, the FDC informs the FO, “Prepare to adjust the sheaf.” To adjust the sheaf—
- The FDC converges the sheaf on the RP. Using the TFC switch, the operator changes the method of control (CON) from "AF" to "FFE."
- The operator sequences through the menu, ensuring that all data match with the FDC order. He presses the COMPUTE switch when the MBC reads "PUSH COMPUTE."
- All mortars are fired (except the BP) at 10- to 20-second intervals.
- The radar operator sends the FDC the grid coordinates of the impact of each round fired.
- The FDC compares the impact grid coordinates with the grid coordinates of the RP and determines the deviation corrections for each mortar. THE FDC DOES NOT USE RANGE CORRECTIONS.

NOTES: 1. The operator compares the full grid coordinates of all rounds fired. Any extreme deviation or range spotting means that there is a problem in the setup of that mortar position.

2. If the operator is using the MBC to apply these corrections, he must first enter and compute all corrections under 50 meters.

- All corrections more than 50 meters are refired, the new grids are compared to the RP grid, and the new data are computed for those weapons.

(8) Once the sheaf is adjusted, the FDC must open the sheaf. Using the DCT, the FDC opens the sheaf mathematically the distance required based on the mortar system used.

(9) The FDC now has the mortars refer their sights to the hit data (the deflection, elevation, and charge used to hit the RP).

FINAL PROTECTIVE FIRES

9-24. FPFs are the highest priority missions that the mortar section/platoon fires. They are prearranged barriers of fire designed to protect friendly troops and to stop the enemy’s advance. When integrated with the supported units' other weapons, FPF cover dead space and likely avenues of approach. Normally, mortar FPFs are targeted on an avenue of likely dismounted attack. They can be any distance from the friendly position that fits into the ground commander’s situation, but are always within the range of organic direct-fire weapons (normally within 100 to 400 meters of friendly troops) (Table 9-1).

NOTE: The approximate widths below are based on linear sheaves.

Table 9-1. Normal final protective fire dimensions, for each number of mortars.

SIZE	TYPE	AMMUNITION SERIES	NUMBER OF MORTARS	WIDTH	DEPTH
				(in meters)	
120-mm	M120	M9xxxx	4 (platoon)	240	70
120-mm	M120	M9xxxx	2 (section)	120	70
81-mm	M252	M3xxxx	4 (platoon)	140	40
81-mm	M252	M3xxxx	2 (section)	70	40
81-mm	M252	M8xxxx	4 (platoon)	160	50
81-mm	M252	M8xxxx	2 (section)	80	50
60-mm	M224	M7xxxx	2 (section)	50	30

NOTE: Ammunition is listed by series. M8xxxx represents all ammunition beginning with the prefix M8, such as M821 or M889.

PRECAUTIONS

9-25. The target location given in the CFF is not the FPF's location. The FO must add a 200- to 400-meter safety factor to the FPF's location, but the FDC never adds a safety factor. Since the FPF is adjusted to within 200 meters of friendly forces—

- The adjustment is danger close.
- The creeping method of adjustment is used.

PROCEDURES

9-26. FPF adjustments can be fired using one of two methods (in order of preference):

- Adjusting mortar-by-mortar.
- Adjusting danger close mortar only.

Adjustment Mortar-by-Mortar

9-27. In the CFF, the FO may give a section left or a section right to determine the danger close mortar (the one impacting closest to friendly forces).

9-28. The operator uses the FPF switch to enter, compute, adjust, review, and delete data for FPFs. Three FPFs may be stored and identified as line 1, 2, or 3, with each line located by a set of grid coordinates marking the left or right limit. The stored data include the line number and fire commands for each weapon assigned (up to six) for that line.

9-29. Then the altitude, width, and attitude are entered. When the corrections for each adjusting weapon have been entered and recomputed, they are stored. Further corrections are not applied after advancing to the next weapon. The corrections made to each mortar are automatically applied to the next weapon to be adjusted. Follow these procedures:

NOTES: 1. The FO will tell the FDC the left or right limit grid (for example, L140 versus FPF grid).

2. All adjusting rounds should be set for fuze delay to further reduce the danger to friendly forces. After entering the FPF line, a safety fan may be entered.

(1) Press the FPF switch.
(2) Select "INIT."
(3) Enter the line number (1, 2, or 3) and the section/weapon number.
(4) The display shows "LINE: 1 WPN:A1."
(5) Press the SEQ switch.

NOTE: The default entry for shell/fuze combination (HE PD) is normally not changed.

(6) Press the SEQ switch.
(7) Select the GT, or enter the FO's direction to target.
(8) Press the SEQ switch.
(9) Enter the FPF right or left limit.

NOTE: If the right limit grid coordinates are entered for the FPF, adjust the right flank mortar first. If the left limit grid coordinates are entered for the FPF, adjust the left flank mortar first.

(10) Press the SEQ switch.
(11) Enter the FPF altitude (if known).
(12) Press the SEQ switch.
(13) Enter the left or right limit and the FPF line width in meters.
(14) The display shows "L R WID: L 350." The coordinate point becomes the left or right limit.

NOTE: The direction of the FPF should be left if the right flank mortar (No. 1) is adjusting and right if the left flank mortar (No. 3 or No. 4) is adjusting.

(15) Press the SEQ switch.
(16) Enter the attitude of the FPF.

NOTE: The attitude of the FPF is a MANDATORY ENTRY.

(17) Press the SEQ switch.
(18) Follow the MBC's instructions.
(19) Press the COMPUTE switch to receive firing data.
(20) Sequence through the firing data until "ADJ *" is displayed.

NOTE: If the "ADJ*" selection is passed, the MBC displays "READY." To continue adjusting the FPF, press the FPF mission switch, and select "ADJ." Proceed to step 22.

(21) Select the display key beneath the asterisk (*).
(22) Enter the number of the weapon that requires adjustment. If another weapon is to be adjusted, select NXT.

NOTE: The MBC considers the previous weapon adjusted, and it saves the firing commands in the FPF data file. When the last weapon is adjusted, select NXT in this display to end the mission. The MBC displays "FPF ADJUSTED."

(23) Press the SEQ switch.
(24) The MBC displays the direction to the target.
(25) Press the SEQ switch.
(26) Enter the deviation correction from the FO (if any).
(27) Press the SEQ switch.
(28) Enter the range correction (if any).
(29) Press the SEQ switch. (The operator may change the height corrections from meters [default] to feet.)
(30) Press the SEQ switch.
(31) Enter the vertical correction from the FO (if any).
(32) Press the SEQ switch.
(33) The MBC displays "PRESS COMPUTE."
(34) Press the COMPUTE switch to receive the firing data.
(35) Repeat the procedures in steps 20 through 34 until each weapon in the section has been adjusted. Repeat the procedures in steps 20 through 21 to end the mission.

Adjustment of Danger Close Mortar Only

9-30. In the CFF, the FDC is given the attitude of the target area. From this attitude, the FDC can determine the danger close mortar.

- The operator uses the FPF menu to fire and adjust as with the mortar-by-mortar method.
- Once the danger close mortar is adjusted, the other mortars involved in the FPF will have firing data already computed.
- The difference between this method and the mortar-by-mortar adjustment method is that each mortar will not actually fire on the FPF. Rather, the firing data for the nonfiring mortars are calculated based on the firing data for the danger close mortar and the attitude of the target area.

DATA REVIEW

9-31. The FPF data for the section may be reviewed at any time using the FPF menu switch. To review the data—

(1) Press the FPF switch, and select "DATA."
(2) Press the SEQ switch, and enter the line number of the FPF to be displayed.
(3) Sequence through the display to review each mortar's data.

SAFETY DATA

9-32. After an FPF has been initiated, the operator can review the safety data at any time. To review the data—

(1) Press the FPF mission switch. The sequence indicator should blink, indicating that another choice is available (for multiple entries).
(2) Press the SEQ switch.
(3) The fifth choice, "SFTY," is displayed.
(4) Select the display key beneath the flashing cursor to select "SFTY."
(5) Press the SEQ switch.
(6) Enter the line number of the FPF safety data to be viewed.
(7) Press the SEQ switch.
(8) The MBC provides a prompt to press the SEQ switch to view the burst-point grid coordinate.
(9) Press the SEQ switch.
(10) The easting and northing are displayed.
(11) Press the SEQ switch.
(12) The maximum ordinate of the last round to its burst-point is displayed.
(13) Press the SEQ switch.
(14) The time of flight is displayed.
(15) Press the SEQ switch.
(16) "READY" is displayed.

IMMEDIATE SMOKE OR IMMEDIATE SUPPRESSION

9-33. When engaging a planned target or a target of opportunity that has taken friendly forces under fire, the FO announces (in the CFF) either 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.

- FOs use immediate smoke missions to obscure the enemy's vision for short periods. This aids maneuver elements in breaking contact or evading enemy direct fire; these missions are not intended as screening missions.

NOTE: Immediate smoke missions can cover an area of 160 meters or less (four guns, 81-mm mortars; 240 meters, four guns, 120-mm mortars).

- FOs use immediate suppression missions to indicate that the unit is receiving enemy fire. This request should be processed at once. Planned and delivered to suppress the enemy, these fires hamper enemy operation and limit his ability to perform his mission in the target area.

9-34. The procedures for firing an IS or immediate smoke mission are the same except for the ammunition used. High-explosive quick (HEQ) is used for the immediate suppression mission, and WP or red phosphorus is used in the immediate smoke mission.

9-35. The procedures for firing these missions follow:

(1) The FDC receives a CFF from the FO. In the warning order, the word "immediate" will precede either "suppression" or "smoke."

(2) The target location is normally expressed using grid coordinates. The FDC processes this CFF as a normal grid mission using the GRID menu with one exception. After the WPN/AMMO menu displays, the FDC will immediately use the TFC switch and change the method of control (CON) from "AF" to "FFE."

NOTE: The TFC menu may be deleted from this procedure if the mortars to fire are parallel to the rest of the section and if they are all the same distance apart (a perfect linear position).

WARNING

Using the default firing data for all guns in the firing section may cause rounds to be fired outside of the safety fan or firing zone. Therefore, always use the TFC menu when a safety fan or firing zone is used. The MBC will warn the operator if any of the rounds for a weapon will land outside the safety fan or firing zone. For revision III/A, the operator must override the message in order to continue.

(3) If any adjustments are needed, the entire section conducts them, firing the same number of rounds each time, as in the previous command.

QUICK SMOKE

9-36. 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.

9-37. Clearance to fire, ammunition requirements, and general considerations discussed in this segment apply to all mortars.

9-38. The mortar unit establishes screening smoke between the enemy and friendly units or installations. It uses smoke to—

- Hamper observation.
- Reduce observed fire.
- Hamper and confuse hostile operations.
- Deceive the enemy as to friendly operations.

9-39. The main consideration in planning for a smoke screen is that it must accomplish 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 must ensure that flank unit commanders who may be affected have been informed.

9-40. 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.

AMMUNITION

9-41. 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 he does determine the amount of ammunition for the most unfavorable conditions that might be expected.

9-42. A quick smoke mission is usually 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 is fired to see if it hits the desired location.
- Phase 2: Establishment Phase. The computer establishes the screen by firing twice the number of rounds required to maintain the screen for one minute, but not less than 12 rounds. These rounds are fired as quickly as possible (FFE phase for any other mission).
- Phase 3: Maintenance Phase. The computer maintains the screen by firing the determined number of rounds per minute (RPM), times the length of time the screen is to be in place.

9-43. The computer uses the smoke chart to compute the number of rounds needed to maintain a screen for one minute (Tables 9-2 and 9-3). 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 S2 or by estimation).
- Temperature gradient (obtained from the battalion S2 or by estimation).

9-44. 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).

9-45. 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 one minute with a flank wind. The result (8.0, in this example) 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, 3 rounds each.
- 120-mm mortar two gun section, 6 rounds each.
- 81-mm mortar platoon, 3 rounds each.
- 81-mm mortar section, 6 rounds each.

EXAMPLE

For conditions of 60 percent humidity, a neutral temperature gradient, and a 4-knot wind, it would take 4 rounds per minute 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:

(1) Express the width as hundreds of meters.

400 meters would be expressed as 4.

(2) 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)

(3) Multiply the width factor by the table value for total rounds per minute.

0.8 (width factor) × 4 (table value) = 3.2

(4) Round this value (3.2) to the nearest whole number. This is the total number of rounds to maintain for 1 minute.

3.2 = 4 (rounds per minute)

Table 9-2. Smoke chart for the 120-mm M929 WP.

<table>
<tr><th colspan="9">Smoke Ammunition Requirements for 120-mm M929 WP

Number of M929 WP rounds per minute to maintain a smoke curtain on a 500-meter front in flank winds. See items (1), (2), and (3) below.</th></tr>
<tr><th colspan="2"></th><th colspan="7">WIND SPEED (KNOTS)</th></tr>
<tr><th>RELATIVE HUMIDITY (PERCENT)</th><th>TEMPERATURE GRADIENT</th><th>2</th><th>4</th><th>9</th><th>13</th><th>18</th><th>22</th><th>26</th></tr>
<tr><td></td><td></td><td colspan="7">ROUNDS REQUIRED</td></tr>
<tr><td>30</td><td>LAPSE
NEUTRAL
INVERSION</td><td>12
12
6</td><td>6
6
6</td><td>6
4
3</td><td>6
4</td><td>6</td><td>8</td><td>12</td></tr>
<tr><td>60</td><td>LAPSE
NEUTRAL
INVERSION</td><td>12
12
6</td><td>4
4
6</td><td>4
3
3</td><td>6
4</td><td>6</td><td>6</td><td>8</td></tr>
<tr><td>90</td><td>LAPSE
NEUTRAL
INVERSION</td><td>8
8
6</td><td>4
3
4</td><td>3
3
3</td><td>4
3</td><td>4</td><td>6</td><td>6</td></tr>
<tr><td colspan="9">(1) Employ volley fire to establish a smoke curtain, using a two-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 head and tail winds 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 FM 3-50 or FM 6-30 for an explanation of temperature gradient conditions.)</td></tr>
</table>

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 one minute; must be at least 12 rounds
Maintenance phase	=	Number of rounds to maintain for one 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 considered to be part of the maintenance phase.

Table 9-3. Smoke chart for the 81-mm M819 red phosphorus.

Smoke Ammunition Requirements for 81-mm M819 red phosphorus Number of M819 RP rounds per minute to maintain a smoke curtain on a 500-meter front in flank winds. See items (1), (2), and (3) below.								
		WIND SPEED (KNOTS)						
RELATIVE HUMIDITY (PERCENT)	**TEMPERATURE GRADIENT**	2	4	9	13	18	22	26
		ROUNDS REQUIRED						
30	LAPSE NEUTRAL INVERSION	6 2 2	6 4 3	12 8 8	12 8	16 16	24	24
60	LAPSE NEUTRAL INVERSION	6 2 2	6 3 2	8 6 6	8 8	16 12	16	24
90	LAPSE NEUTRAL INVERSION	2 2 1	3 2 2	8 6 4	8 8	12 8	12	16

(1) Employ volley fire to establish a smoke curtain, using a two-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 head and tail winds 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 FM 3-50 or FM 6-30 for an explanation of temperature gradient conditions.)

MORTARS REQUIRED

9-46. 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 are not normally 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.

9-47. A limitation, however, 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 RPM exceeds the rate of fire, the platoon must request supporting fire from flank units or artillery.

EFFECTS DESIRED

9-48. 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.

ORDERING OF AMMUNITION

9-49. 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.

BRIEFING OF THE OBSERVER

9-50. 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 OP from which the screen can be observed.

CALL FOR FIRE

9-51. 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 should specify the wind direction.

EXACT AMMUNITION REQUIREMENT

9-52. 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.

MISSION COMPUTATION

9-53. The chief computer/section leader issues the FDC order (Figure 9-2). 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.

FDC ORDER

MORTAR TO FIRE: SEC

MORTAR TO ADJUST: #4

METHOD OF ADJUST: 1 RD

BASIS FOR CORRECTION: ______

SHEAF CORRECTION: OPEN 300M

SHELL AND FUZE: HE/WP I/A

RP IN FFE

METHOD OF FFE: 4 RDS

RANGE/LATERAL SPREAD: ______

ZONE: ______

TIME OF OPENING FIRE: W/R

Figure 9-2. Fire direction center order.

9-54. The following procedures are used in mission computation:

(1) Upon receipt of the FDC order, the MBC operator processes the fire commands as he would a normal grid mission until the final correction.

NOTE: HE is adjusted to within 100 meters of the adjusting point.

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(2) The FO splits the 100-meter bracket and calls for one round of WP (in adjustment) to see if it will strike the adjusting point and if the weather conditions are affecting the smoke as predicted.

(3) The MBC operator uses the WPN/AMMO menu to change the shell and fuze combination.

(4) After the shell and fuze correction is entered, the MBC operator computes the final adjustment and relays this information to the adjusting mortar.

(5) The FO makes corrections for the WP. When the FO requests FFE, the FDC tells the mortars how many rounds to fire (employing volley fire).

(6) The maintenance phase begins almost immediately after the establishment phase. If the FO notices the screen thinning in one place (usually the upwind end), the rate of fire may be doubled for one or more mortars. The FO can adjust the placement of the WP during any part of the maintenance phase by specifying which gun(s) will continue firing or by transmitting a correction.

FOUR PHASES TO SCREENING MISSION

9-55. When a linear sheaf will not cover the area, a screening mission is conducted. Screening missions have four phases:

- Phase 1. Using HE ammunition, the FO adjusts the upwind flank mortar to the upwind edge of the area to be screened.
- Phase 2. At the end of the adjustment phase, the mortars fire one round of smoke to see if it hits the adjustment point.
- Phase 3. The FO calls for the sheaf to be opened.

NOTE: Do not confuse this step with a normal open sheaf.

- Phase 4. The FDC presses the TFC switch and performs the following procedures:
  (1) Change "SHEAF:PRL" to "SPECIAL."
  (2) Select "ADJ PT:FLANK."
  (3) Enter the direction and size of the screen based on the adjusting (upwind) mortar. If No. 1 mortar is adjusting, select "L "(Left) and enter the size of the area to be screened. If the No. 3 (or 4) mortar is adjusting, select "R" (Right) and enter the size of the area to be screened.
  (4) Enter the attitude of the target area.
  (5) Change "CON:AF" to "CON:FFE."
  (6) Push COMPUTE and observe the firing data.

END OF MISSION

9-56. 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.

SPECIAL KEYS AND FUNCTIONS

9-57. This paragraph describes some of the functions of the following special keys:

- Message (MSG).
- Review (REVIEW).
- Survey (SURV).
- Mission (MSN).
- Transmit (XMIT).
- Safety Data (SFTY DATA).

MESSAGE SWITCH

9-58. A maximum of three incoming digital messages can be stored. Incoming messages are of two types: fire request and information-only.

9-59. When the message indicator is lit or the audio alarm sounds and the MSG switch is pressed, the first line of the first message received is displayed. When the message is a fire request, the MBC automatically assigns a mission and target number, unless there are already three active missions. If so, the MBC displays "NO AVAIL MSN" and discards the message. This menu includes the information outlined in Table 9-4.

Table 9-4. Message switch entries and related information.

ENTRY	RELATED INFORMATION
FR GRID (SHIFT, POLAR, or LASER)	Fire request using grid coordinates, shift from a known point, polar plot corrections, or laser data
OBS LOC	FO location data
SUBQ ADJ	Subsequent adjustment to a fire request
SA COORDS	Subsequent adjustment using coordinates
PREC ADJ	Precision adjustment
SA LASER	Subsequent adjustment to a laser fire request
EOM & SURV	End of mission and surveillance data
FPF	Request for FPF
QF KNPT or QF TGT	Quick fire request on a known point or known target
ASKNPT	FO request to assign a known point number
FO CMD	FO command message
HB/MPI	High burst/mean point of impact
FL TRACE	Front-line trace data
RDR REG	Radar registration data
FREE TEXT	Free text form messages

REVIEW SWITCH

9-60. The REVIEW switch returns the display to the first line of a message or to the beginning of the last main menu selected.

SURVEY SWITCH

9-61. The SURV switch can be used to solve three survey problems:

- Resection (RES).
- Intersection (INT).
- Traverse (TRV).

9-62. These functions are used to determine the coordinates and altitude of an unknown point using measurements from known point(s). Computed coordinates may be stored as a—

- Basepiece.
- FO.
- Known point.
- Target.

NOTE: Before using any of the SURV functions, the operator must enter the known points into the MBC using the KNPT/TGT menu.

MISSION SWITCH

9-63. The MSN switch is used to review current active fire mission data and to specify which mission is operational. The MBC can store data for three active fire missions and compute fire commands for each of these missions one at a time.

9-64. The MBC assigns a mission and target number to a mission each time the GRID, SHIFT, or POLAR switch is pressed. Use these switches only when starting a fire mission to avoid misuse of target numbers.

NOTES: 1. The operator can enter or change data for operational missions only.

2. A mission must be active before the WPN AMMO, REG, TFC, SFTY DATA, EOM, and REPLOT switches can be used to input or display data.

TRANSMIT SWITCH

9-65. The XMIT switch is used to display or send MTO and command messages when operating in manual or digital mode. This menu includes the information outlined in Table 9-5.

Table 9-5. Transmit switch entries and related information.

ENTRY	RELATED INFORMATION
NR VOL	The number of volleys for the FFE
NR UNITS	The number of units to be used in the FFE
PR ERR:	The probable error entered by the MBC
ADJ SF	Adjusting shell/fuze entered by the MBC
1ST SF:	Shell/fuze for the first round for FFE entered by the computer
SUBS SF	Shell/fuze combination for subsequent rounds for FFE entered by the MBC
MOE	Method of engagement NOTE: Use the default value.
CON: WR AF	Method of control (WR = when ready, and AF = adjust fire)
TOF	Time of flight for the next (or last) round
ANG T	Angle T entered by the computer

SAFETY DATA SWITCH

9-66. The SFTY DATA switch is used to review the safety factors in effect for a current fire mission. This menu includes the information outlined in Table 9-6.

Table 9-6. Safety Data switch entries and related information.

ENTRY	RELATED INFORMATION
RN: AZ	Range and azimuth from the guns to the target (GT)
BURST POINT SEQF	The coordinate of impact for the round fired can be found by sequencing forward (SEQF).
BP	Burst point easting and northing grid coordinates
MAX ORD	The maximum ordinate (top of the trajectory) of the round fired, measured in meters from sea level
SAFETY DIAGRAM	Entries can be made to store up to three safety fans (one for each section/platoon in WPN DATA menu) identified as A, B, or C
LLAZ	Left limit azimuth in mils
RLAZ	Right limit azimuth in mils
MAX RN	Maximum range in meters
MIN RN	Minimum range in meters
MIN:_ MAX	Minimum and maximum charges

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Chapter 10
Digital Device Support

The MBC may transmit and receive digital communications using a DMD or the FOS. This ability reduces the mission processing time and provides a more secure communication network.

APPLICATION

10-1. All DMD-supported missions occur in response to the receipt of an FO message. The input data for the mission are supplied by digital transmission from the FO's DMD and automatically entered into the MBC's memory.

10-2. To conduct a digital communications check—

(1) Press the SELF-TEST switch.
(2) The MBC displays "MICR SW DSP MOD." The sequence indicator blinks, indicating that another choice is available.
(3) Press the SEQ switch.
(4) The MBC displays "XMIT TEST MSG."
(5) Select XMIT.
(6) The MBC displays "ROUTE: *XMIT." The route is found in the SOI.
(7) Enter the route.
(8) Select XMIT.
(9) The MBC displays "XMITING."

10-3. The MBC transmits the test message to the DMD. When the DMD accepts the message, it transmits an acknowledgement (ACK). If the message is not accepted, the MBC displays "NO RESP RETRY 1." The operator should try to retransmit the message at least three times. If the message is still not accepted, the communication system should be repaired.

COMMUNICATIONS

10-4. The MBC can store a maximum of three incoming digital messages. Incoming messages are of two types: fire mission messages and information-only messages. When the message indicator is lit or the audio alarm sounds and the MSG switch is pressed, the MBC displays the first line of the first message received. When a message is a fire mission, the MBC automatically assigns mission and target numbers, unless three active missions have already been stored. In this case, the MBC displays "NO AVAIL MSN," and discards the message.

RECEIVING MESSAGES

10-5. The flashing MSG indicator tells the operator that a message has been received.

10-6. To view a message—

(1) Select the MSG switch.
(2) The MBC displays a heading to identify the type of message. If the message is not a fire request, the applicable data are automatically stored in the correct menu.
(3) Select the SEQ switch.

(4) The MBC displays the FO and net identification. The FO authentication code is displayed.
(5) Select the SEQ switch.
(6) Validate the code in the authentication table.
(7) Select the SEQ switch.
(8) Review each line of the message.

NOTE: After the FDC order has been completed, the operator clears the message from the message buffer. If the message is a fire request, the mission is automatically activated. The operator must assign the mission using the WPN/AMMO switch and compute the firing data.

TRANSMITTING MESSAGES TO OBSERVER

10-7. When the MBC is DMD-supported, the FO must receive an MTO and a shot/splash.

10-8. To prepare and send an MTO—

(1) Select the XMIT switch.
(2) Select MTO using the display key directly below the flashing cursor on MTO.
(3) The mission and target numbers entered by the MBC are displayed.
(4) Select the SEQ switch.
(5) The adjusting weapon is displayed.
(6) Select the SEQ switch.
(7) Enter the number of volleys to be fired.
(8) Select the SEQ switch.
(9) The number of weapons firing is displayed. The display should indicate only one weapon when adjusting.
(10) Select the SEQ switch.
(11) The probable error is displayed as "PR ERR: NOT GVN" (probable error: not given).
(12) Select the SEQ switch.
(13) The ADJ shell/fuze is displayed.
(14) Select the SEQ switch.
(15) The shell/fuze for the first round of the FFE is displayed. This was received in the fire request the FO sent.
(16) Select the SEQ switch.
(17) The shell/fuze for subsequent rounds of the FFE is displayed.
(18) Select the SEQ switch.
(19) Use the multiple choice entry to select the proper method of engagement: HI (high angle) or DC (danger close).
(20) Select the SEQ switch.
(21) The method of control (CON: WR AF) is displayed.
(22) Select the SEQ switch.
(23) The time of flight is displayed.
(24) Select the SEQ switch.
(25) The angle T is displayed.
(26) Select the SEQ switch.
(27) The mission number for the current mission is displayed.
(28) Select the SEQ switch.
(29) The FO's identification is displayed.
(30) Enter the appropriate route.

(31) Select the SEQ switch.
(32) Enter the authentication code.
(33) Select the flashing asterisk (*) to transmit the MTO to the FO.
(34) When the message is received, the MBC displays "ACK."

TRANSMITTING SHOT/SPLASH

10-9. To transmit the shot/splash to the FO—

(1) Select the XMIT switch.
(2) Use the multiple choice entry to select CMD.
(3) The mission and target numbers are displayed.
(4) Select the SEQ switch.
(5) The type of firing information being sent is displayed. The MBC defaults to SHOT. Splash is automatically transmitted about five seconds before the round impacts. The operator may decide to transmit only splash by changing the display from SHOT to SPLASH.
(6) Select the SEQ switch.
(7) Select DIGITAL when the MBC is DMD-supported.

NOTE: Select MANUAL for the MBC to notify (with an audio warning) the operator when to orally transmit the splash. If manual is selected, the MBC displays "*SHOT." The operator presses the asterisk (*) when the round is fired. The MBC notifies (with an audio warning) the operator when to transmit the splash. The MBC displays "READY," when any key is pressed.

(8) Select the SEQ switch.
(9) The FO identification is displayed.
(10) Enter the route number.
(11) Select the SEQ switch.
(12) Enter the authentication (COMSEC) code from the SOI to transmit SHOT.
(13) Select the SEQ switch.
(14) Enter the authentication (COMSEC) code from the SOI to transmit SPLASH.
(15) Select the SEQ switch.
(16) The MBC displays "*XMIT." When the command to fire is given, press the asterisk (*), and the shot is automatically transmitted to the FO. XMITTING is displayed until it is time to send the splash. The splash is momentarily displayed, and then XMITTING. ACK is received when the DMD accepts the message.

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Part Four

M16 and M19 Plotting Boards

Chapter 11

Introduction

M16 and M19 plotting boards are the secondary means of fire control for all forms of digital mortar fire control. Using these tools, the computer can determine deflections, azimuths, and ranges.

CAPABILITIES

11-1. Computers use plotting boards when determining azimuths, deflections, and ranges.

- The computer determines the azimuth by rotating the azimuth disk to the correct alignment.
- Before the deflection can be determined, the computer must establish a mounting azimuth and index the referred deflection.
- Range is determined by measuring the distance between the plotted mortar position and the plotted target. M16 and M19 plotting boards use different scales for determining range.

NOTE: See Chapter 12 for more information about the different scales for determining range.

CAUTION

When plotting on the plotting board, use a soft lead pencil. NEVER use map pins, needles, ink pens, or grease pencils since these can damage the board.

11-2. The straightedge of the plotting board should always be on the computer's right. Each plot is circled and numbered for identification. To avoid distortion, the computer should place his eye directly over the location of a plot and hold the pencil perpendicular to the board. The plot should be so small that it is difficult to see. The computer must be careful when placing a plot on the disk, since a small plotting error could cause the final data to be off by as much as 25 meters in range and more than 10 mils in deflection. For example, to determine azimuths—

(1) Read the first three numbers from the azimuth disk, left of the index mark.

(2) Read the fourth number, or the last mil, using the azimuth disk and the right side of the vernier scale (Figure 11-1).

EXAMPLE

Consider azimuth 3033 in Figure 11-1. The first and second numbers are the first 100-mil indicator to the left of the index mark (30). To obtain the third number, count the 10-mil graduations between the 100-mil indicator and the index mark (3). The fourth number, or the last mil, is read by counting the 1-mil graduations from 0 to the right on the vernier scale until one of the 1-mil graduations align with one of the 10-mil graduations on the azimuth disk (3).

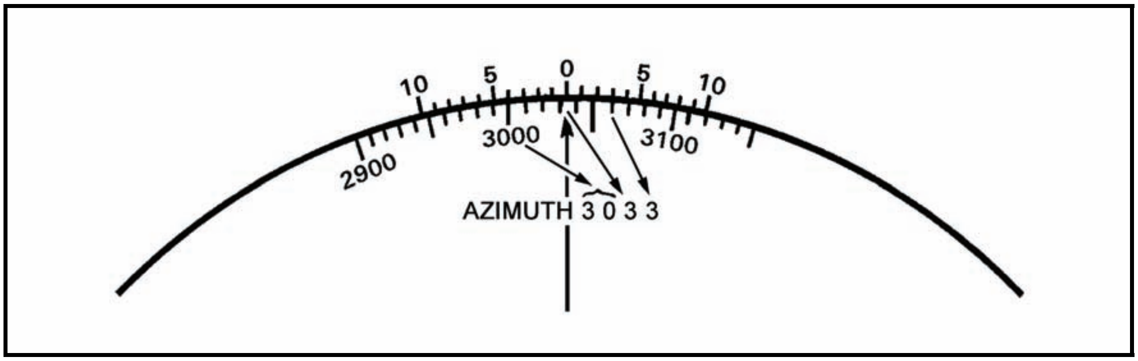

Figure 11-1. Vernier scale.

M16 PLOTTING BOARD

11-3. The M16 plotting board is the secondary means of fire control for 81-mm and 120-mm mortars. It consists of a base, azimuth disk, and a range arm or range scale arm (Figure 11-2).

BASE

11-4. 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 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.

11-5. 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.

11-6. 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

11-7. The azimuth disk, 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.

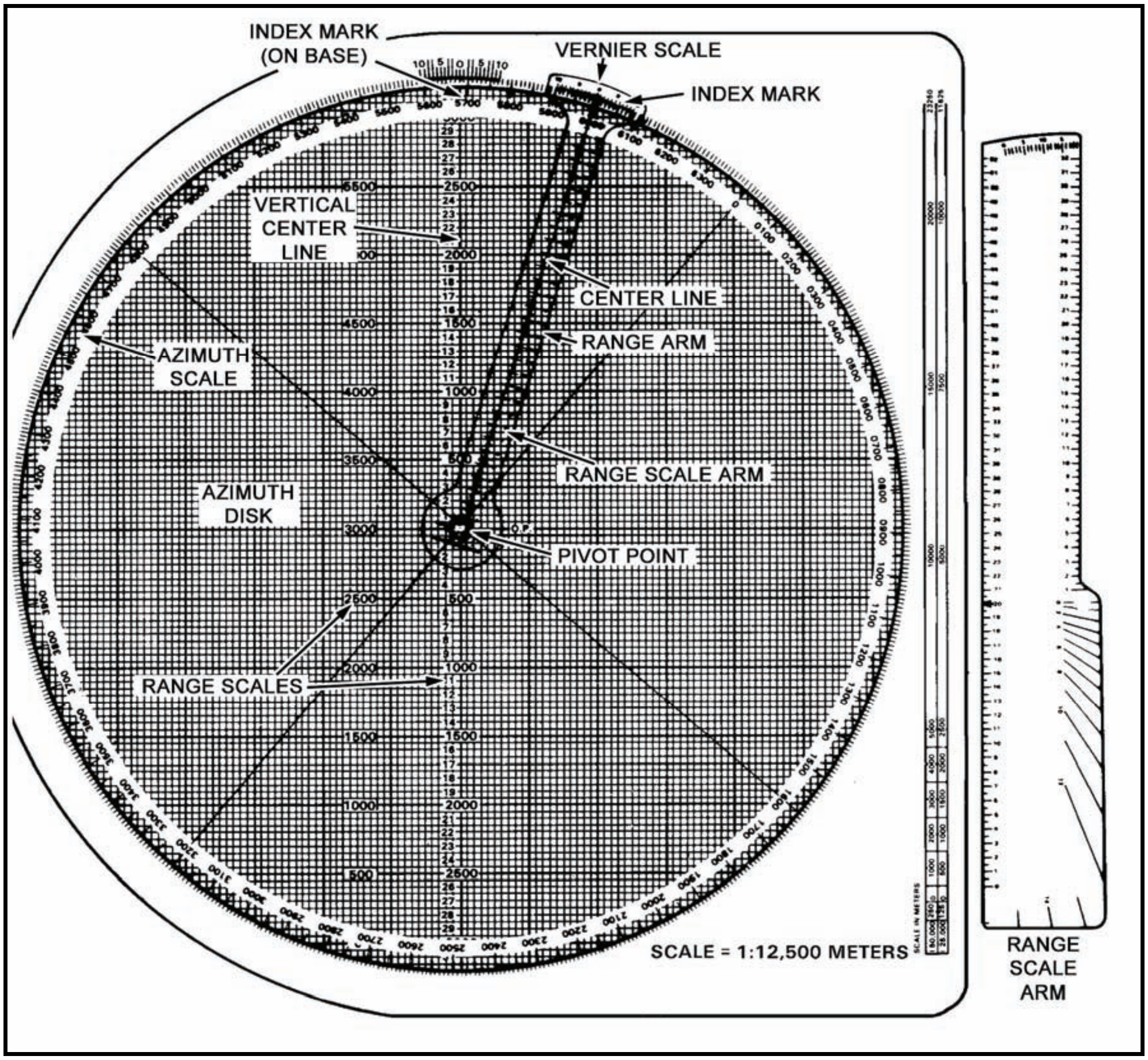

Figure 11-2. M16 plotting board.

RANGE ARM

11-8. Made of plastic, the range arm is used when the mortars are plotted at the pivot point. The arm has a vertical centerline with a range scale and a vernier scale, both of which are the same as on the base.

RANGE SCALE ARM

11-9. The range scale arm, a transparent plastic device, has a knob with a pivot pin, 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

11-10. The M19 plotting board is the secondary means of fire control for the 60-mm mortar. It consists of a rotating disk of transparent plastic and a removable range arm, both attached to a flat grid base (Figure 11-3).

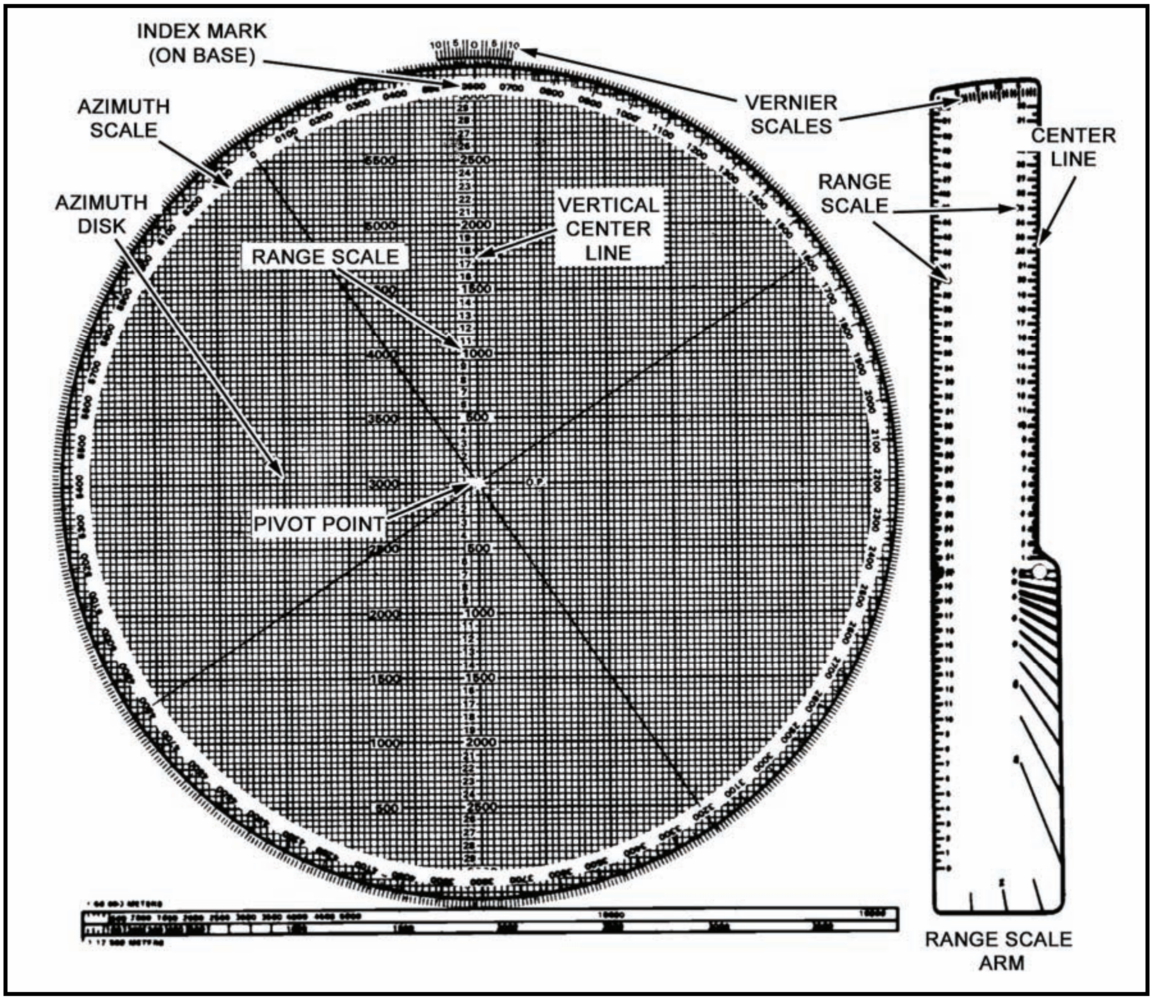

Figure 11-3. M19 plotting board.

BASE

11-11. 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 hundreds of meters, with a maximum range of 3,200 meters. Each small grid square is 100 meters by 100 meters.

11-12. 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 No. 2 mortar.

11-13. 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.

11-14. 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

11-15. 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 SCALE ARM

11-16. The range scale 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 scale arm. On the right edge is a range scale that corresponds to the range scale found on the vertical centerline. An alternative range scale ranging from 0 to 6,000 meters is on the left edge of the range scale arm and is used when plotting away from the pivot point. The vernier scale at the upper end of the range scale 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 scale 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 scale 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 scale arm and read to 10.

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Chapter 12

Preparation of Fire Control Equipment

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 FIRING CHARTS

12-1. The mobile nature 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.

PIVOT-POINT METHOD WITHOUT USE OF RANGE ARMS

12-2. The observed firing chart is the simplest and fastest way to plot. The mortars are plotted at the pivot point. This allows the computer to use 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.

Preparation of the Plotting Board

12-3. Two items are needed to set up the plotting board for operation: a direction (azimuth) and a range from the mortar position to the target. The azimuth and range from the mortar position to the target are usually 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 (Figure 12-1). For example, the computer determines the initial direction (azimuth) between the mortar position and target is 3220, and the range is 2,600 meters.

Determination of Mounting Azimuth

12-4. To determine the mounting azimuth (MAZ) from the DOF, the computer rounds off the DOF to the nearest 50 mils. (Round-off rule for obtaining the mounting azimuth: 0 to 24, round to 00; 25 to 74, round to 50; 75 to 99, round to 100.) The aiming circle operator uses the mounting azimuth 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 referred deflection scale at a longer graduation.

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

12-5. The aiming circle operator gives the referred deflection to the FDC after the section is laid. The referred deflection can be any 100-mil deflection from 0 to 6300, as long as all of the mortars can place out their aiming posts on the same deflection. Normally, the referred deflection used is 2800 to the front or 0700 to the rear. If one or more mortars has a sight block at the given deflection, the gunner may slip the scale to a point where his poles can be set out at the proper interval. For more information about slipping the scales, see FM 3-22.90.

NOTE: Use 2800 and 0700 to avoid any sight blocks caused by the cannon.

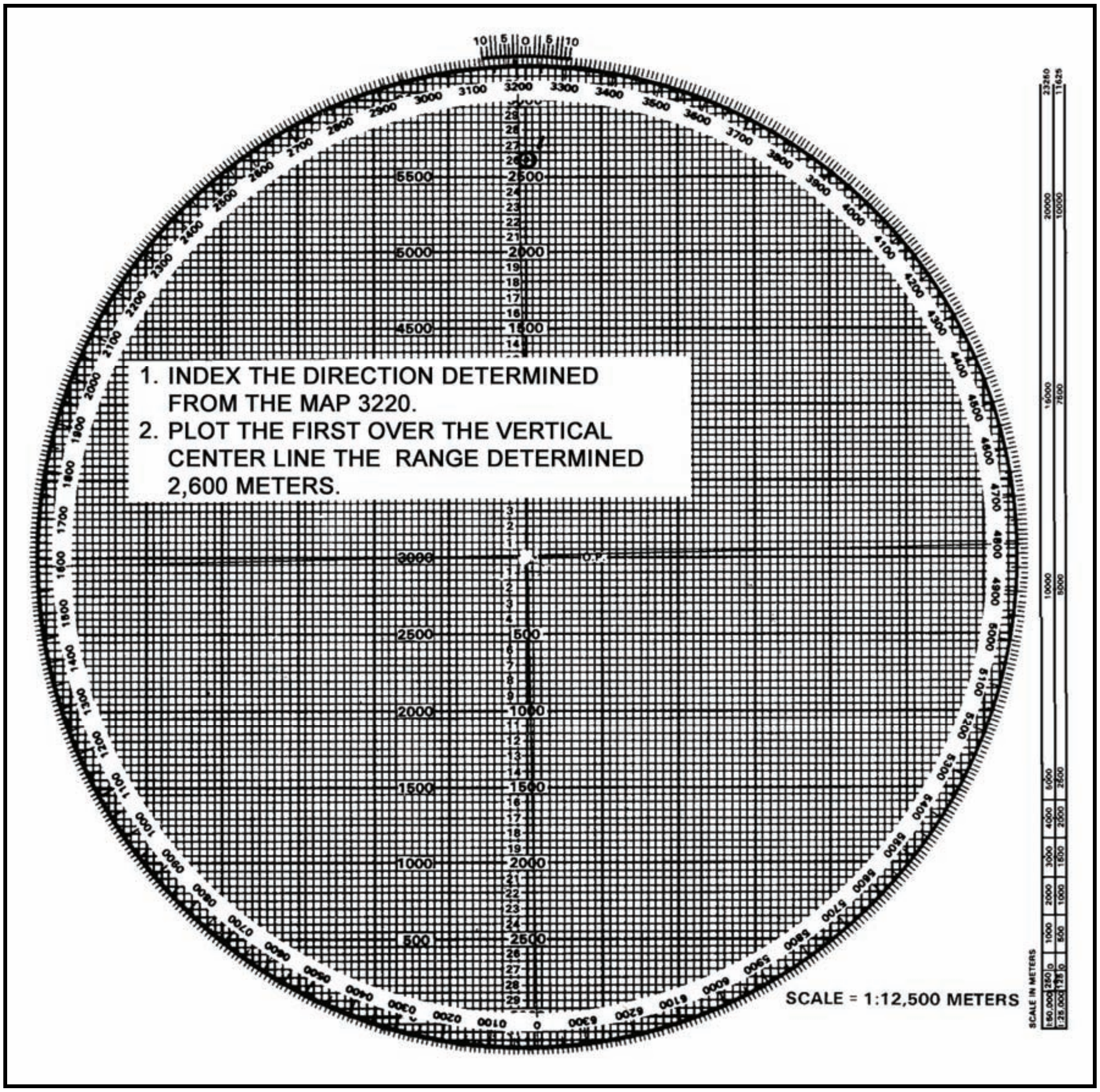

Figure 12-1. Preparation of the plotting board.

Superimposition of Referred Deflection

12-6. The referred deflection is superimposed (written) on the azimuth disk under the mounting azimuth using the LARS rule. The disk is normally numbered 400 mils left and right of the referred deflection, which is usually enough to cover the area of operation (Figure 12-2). However, if needed, the deflection scale can be superimposed all the way around the azimuth disk.

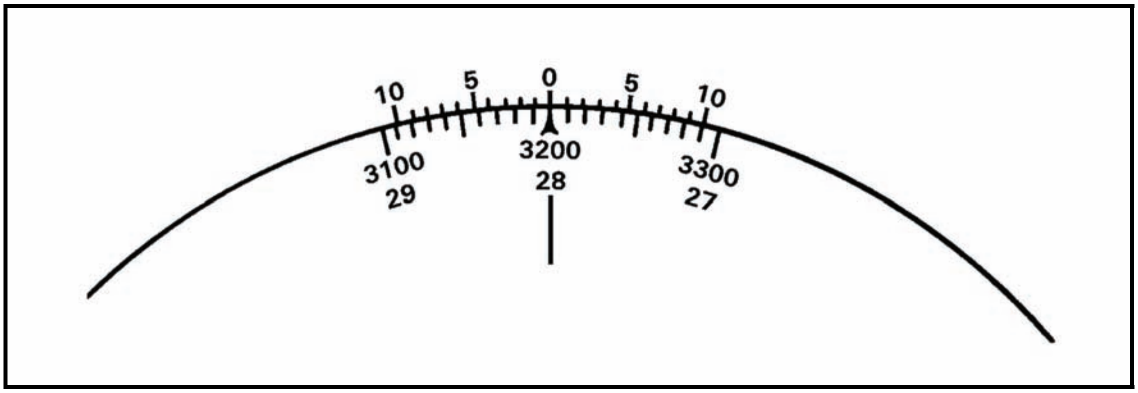

Figure 12-2. Superimposition of referred deflection scale under the mounting azimuth.

Determination of Firing Data

12-7. 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. He determines the deflection to fire the first round by using the deflection scale and the left portion of the vernier scale (Figure 12-3).

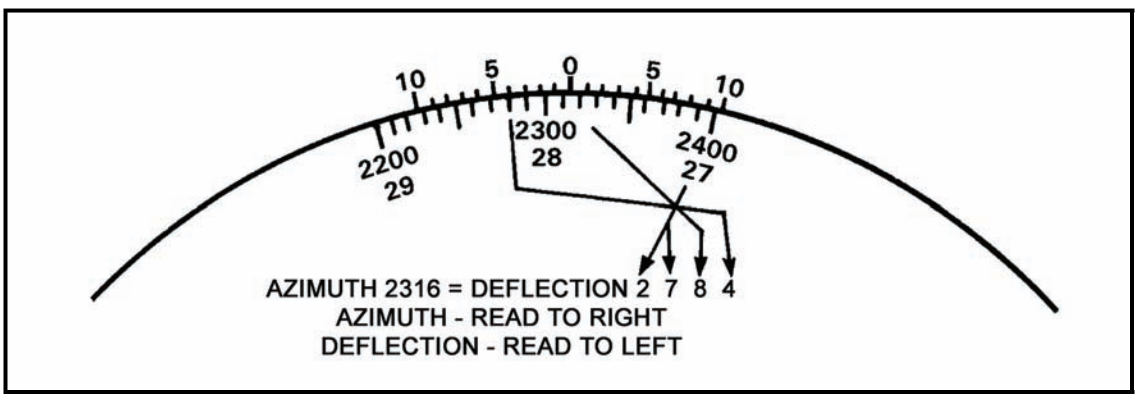

Figure 12-3. Determination of the deflection.

12-8. Read the first two digits from the deflection scale. 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.

12-9. 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.

12-10. Read the fourth digit at 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.

12-11. Determine the range by rotating the plot over the vertical centerline and reading the range to the nearest 25 meters. Enter the firing table (such as FT 81-AI-3) and determine the charge as follows: Locate the Charge vs. Range table (Figure 12-4) in the appropriate firing table (normally the last page of the introduction or the last page preceding Part I). This page is the charge vs. 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 (Figure 12-5). The first charge line the straightedge crosses is the lowest charge possible to engage the target.

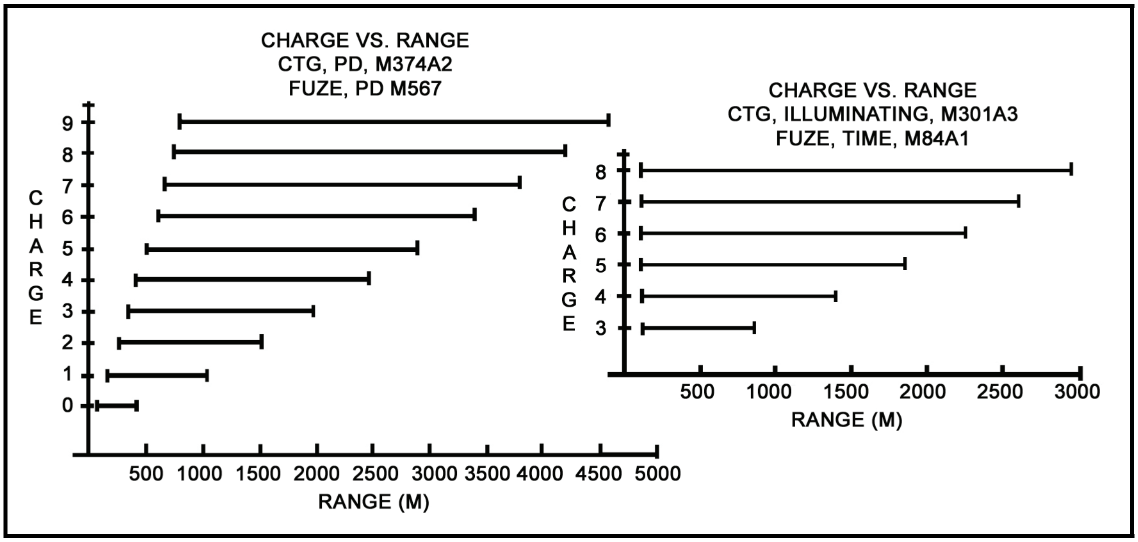

Figure 12-4. Charge versus range chart.

PART 1			PART 2		
CARTRIDGE, HE, M374A2 AND WP, M375A2			CARTRIDGE, ILLUMINATING, M301A3		
PART 1-0	CHARGE 0	70 - 401	PART 2-3	CHARGE 3	100-850
PART 1-1	CHARGE 1	181 - 1037	PART 2-4	CHARGE 4	100-1400
PART 1-2	CHARGE 2	263-1508	PART 2-5	CHARGE 5	100-1850
PART 1-3	CHARGE 3	348-1991	PART 2-6	CHARGE 6	100-2250
PART 1-4	CHARGE 4	432-2466	PART 2-7	CHARGE 7	100-2600
PART 1-5	CHARGE 5	513-2929	PART 2-8	CHARGE 8	100-2950
PART 1-6	CHARGE 6	592-3374	PART 209	FUZE SETTING CORRECTIONS	
PART 1-7	CHARGE 7	668-3802			
PART 1-8	CHARGE 8	741-4209			
PART 1-9	CHARGE 9	811-4595			

Figure 12-5. Determination of charge.

12-12. Another method that can be used is to turn to page II in the firing table. There is a listing of charges for M374A2 (HE) and M375A2 (WP) from charge 0 through charge 9. Below that listing is the charge listing for M301A3 illumination (ILLUM) from charge 0 through charge 8. Write in after each charge the minimum and the maximum ranges that each charge zone covers (Figure 12-6). By looking at the maximum range, the correct charge to use can easily be determined.

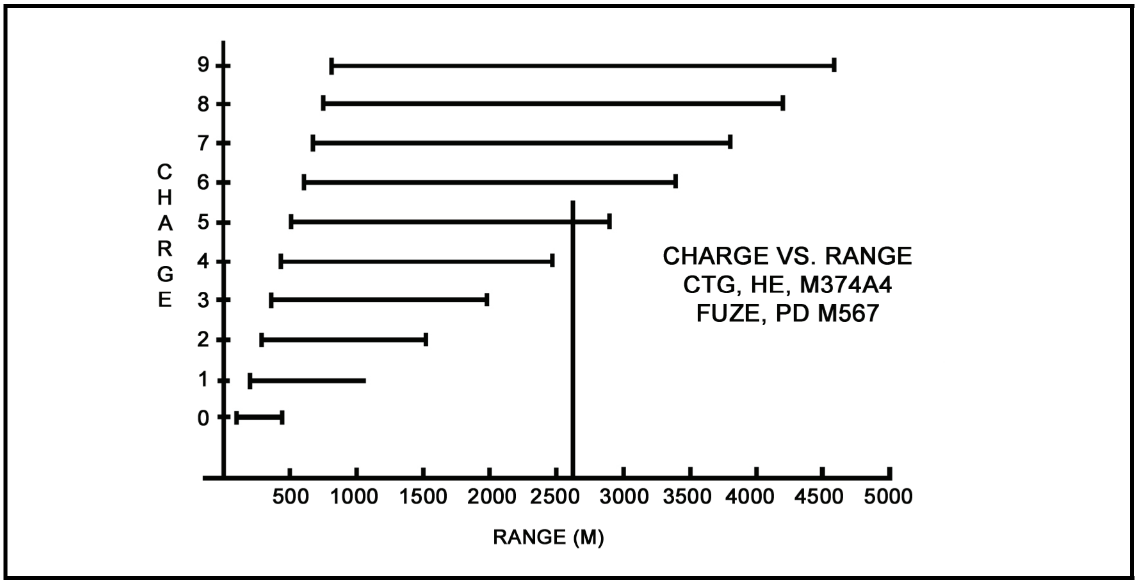

Figure 12-6. Charge zone and range.

Plotting of Observer Corrections

12-13. 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, he applies the FO's corrections.

12-14. 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 (Figure 12-7).

12-15. 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 "No. 2." To determine the firing data, rotate the disk until the No. 2 plot is over the vertical centerline. Then, read the deflection and range (Figure 12-8). Using the firing table, determine the charge and elevation to fire the round, and compute the subsequent fire command.

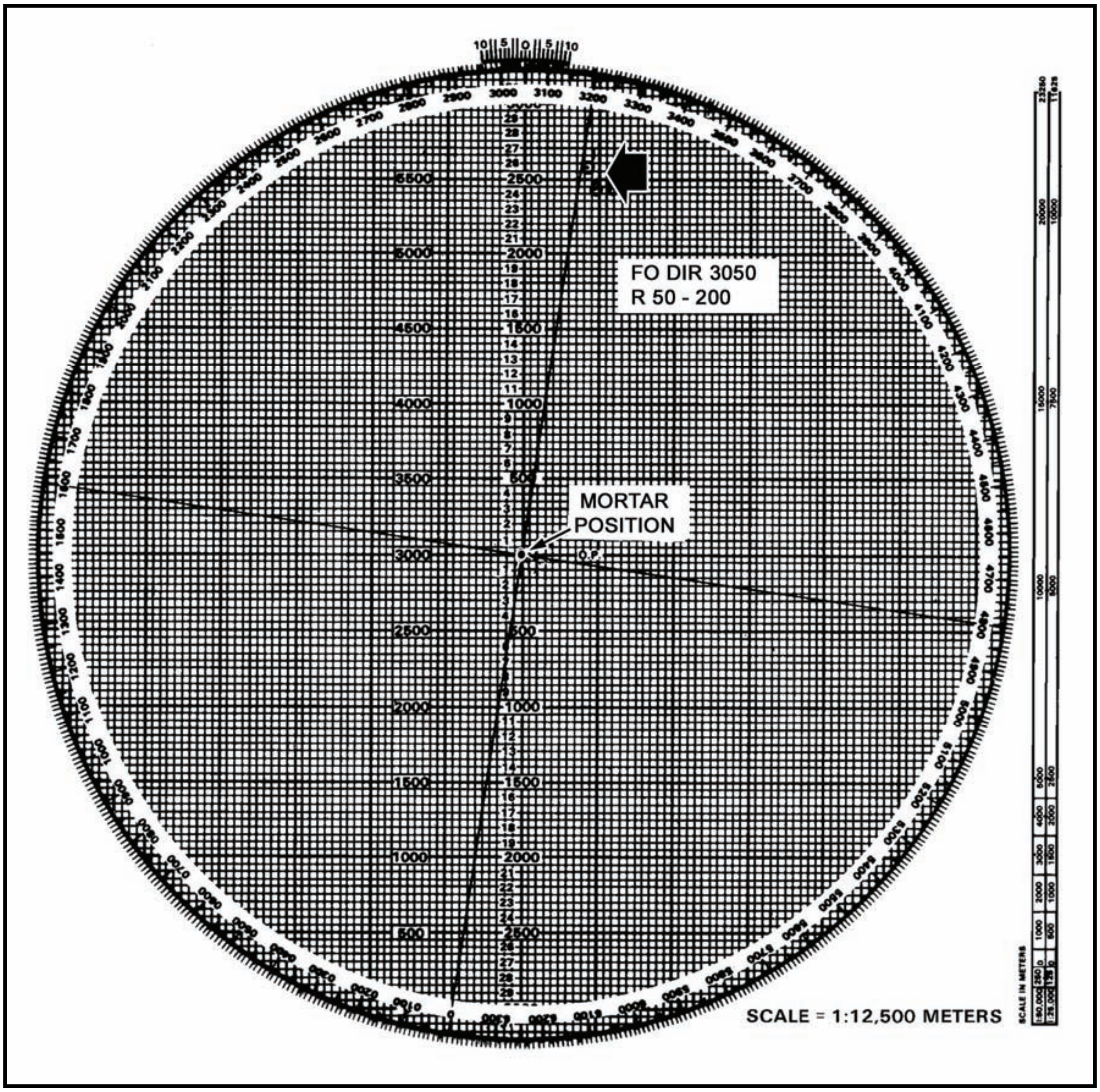

Figure 12-7. Plotting of observer's correction.

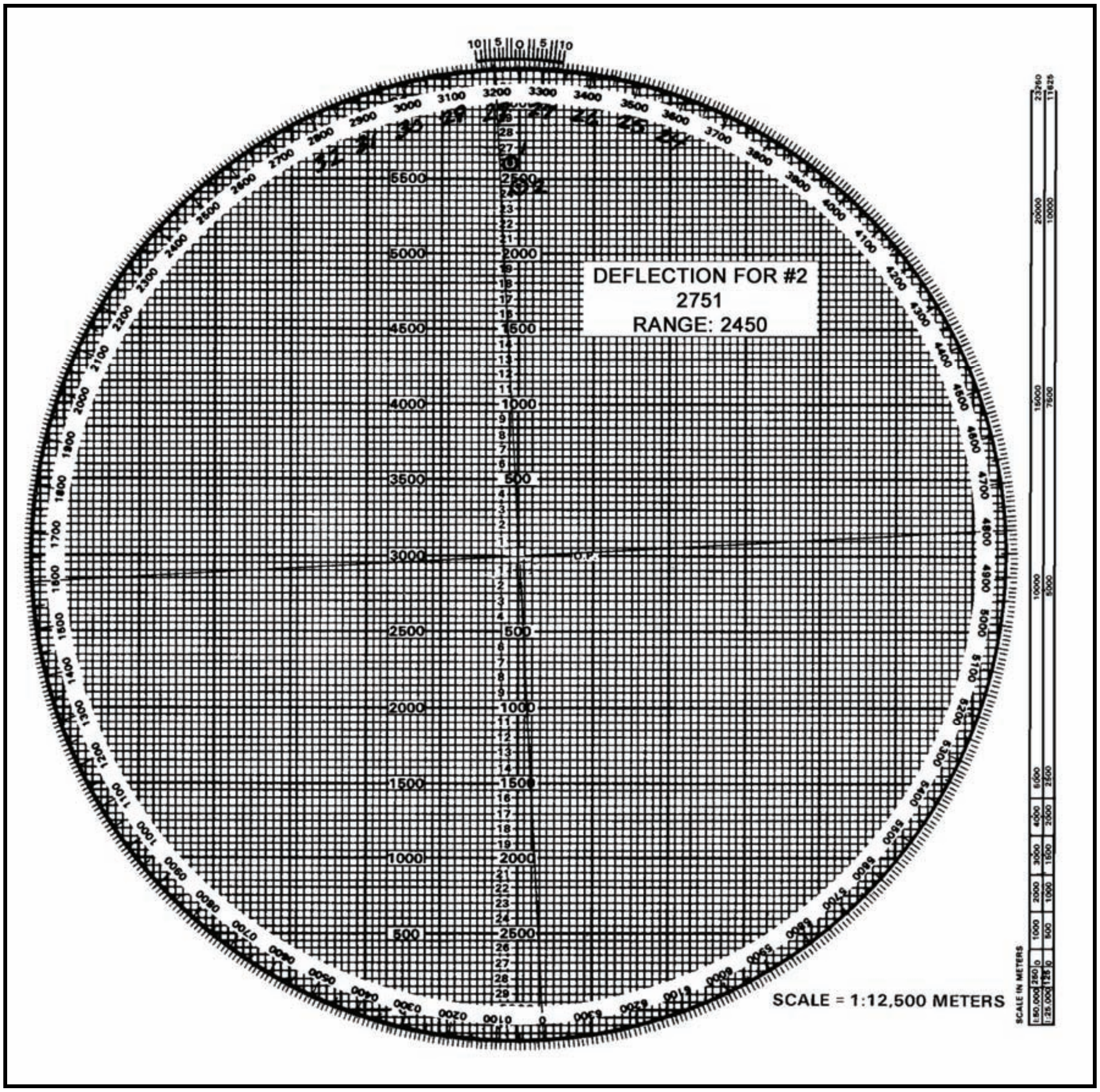

Figure 12-8. Determination of deflection and range.

12-16. Once the EOM has been given, update the M16/M19 plotting board (Figure 12-9). 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 (Figure 12-10).

Engagement of Other Targets

12-17. To fire other targets on this chart, the computer must perform the following actions:

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

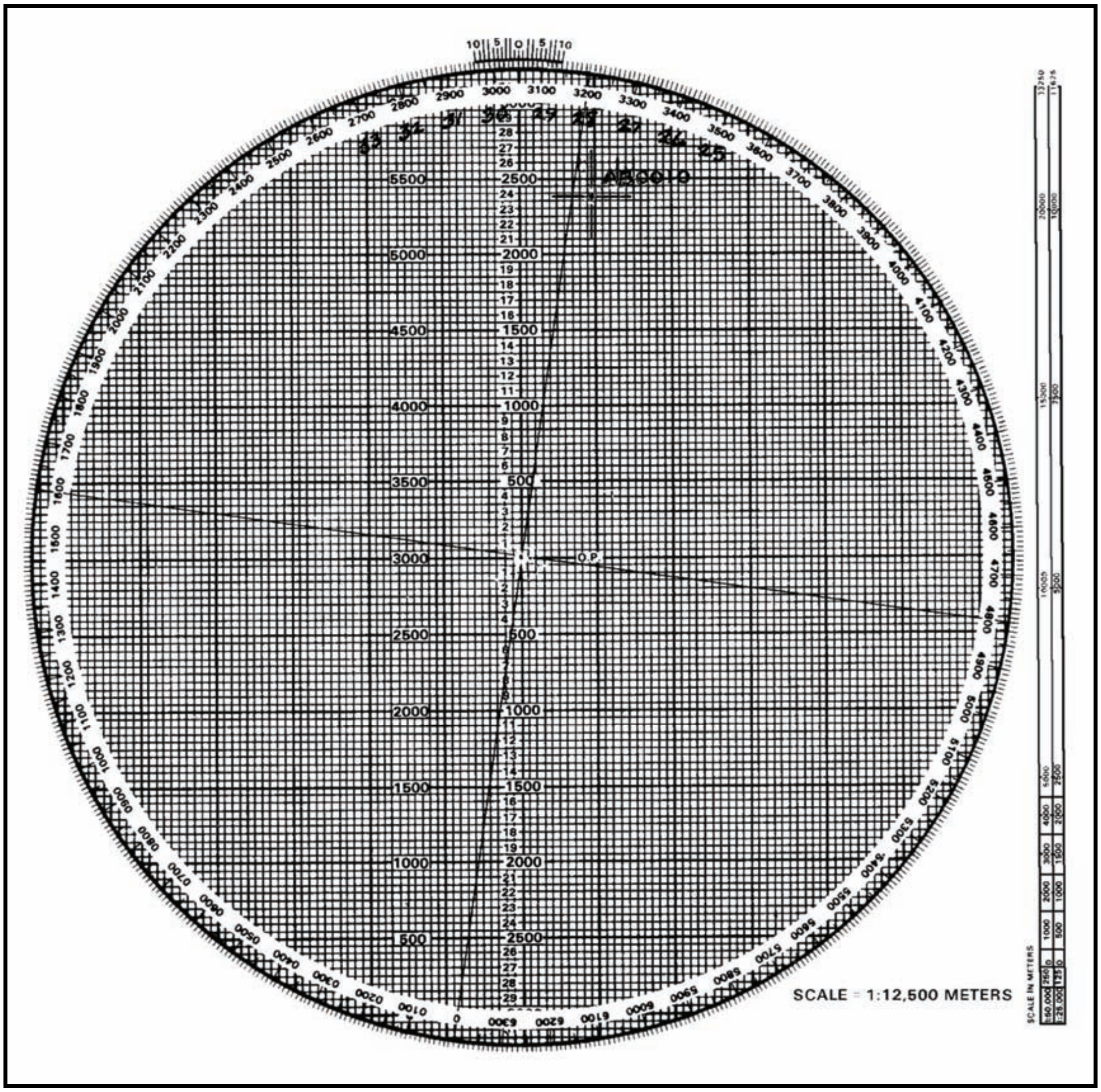

Figure 12-9. Board updated.

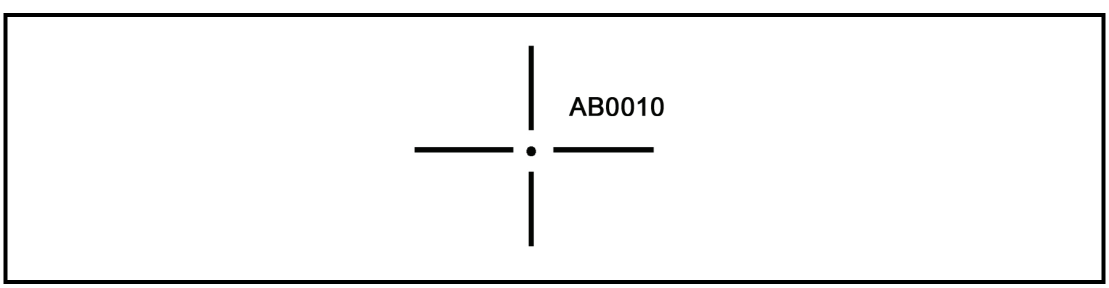

Figure 12-10. Hollow cross with target number.

BELOW PIVOT-POINT METHOD

12-18. The observed firing chart (with mortars plotted below pivot point) is used when the ranges to the targets being engaged are over 2,900 meters. When the initial range to the target is 2,900 meters or more, mortars are always plotted below the pivot point.

12-19. Two items are needed to set up the board for operation: a gun-target azimuth and a range from the mortar position to the target. To construct the chart—

(1) Index the gun-target azimuth.

(2) Drop below the pivot point 1,000 meters for 60-mm mortars, 2,000 meters for 81-mm mortars, and 3,000 meters for 120-mm mortars.

NOTE: When firing 800-series ammunition with the 81-mm mortar, drop 3,000 meters below the pivot point to accommodate the extended range.

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(3) Plot the mortar position 500 meters left or right of the vertical centerline (Figure 12-11).

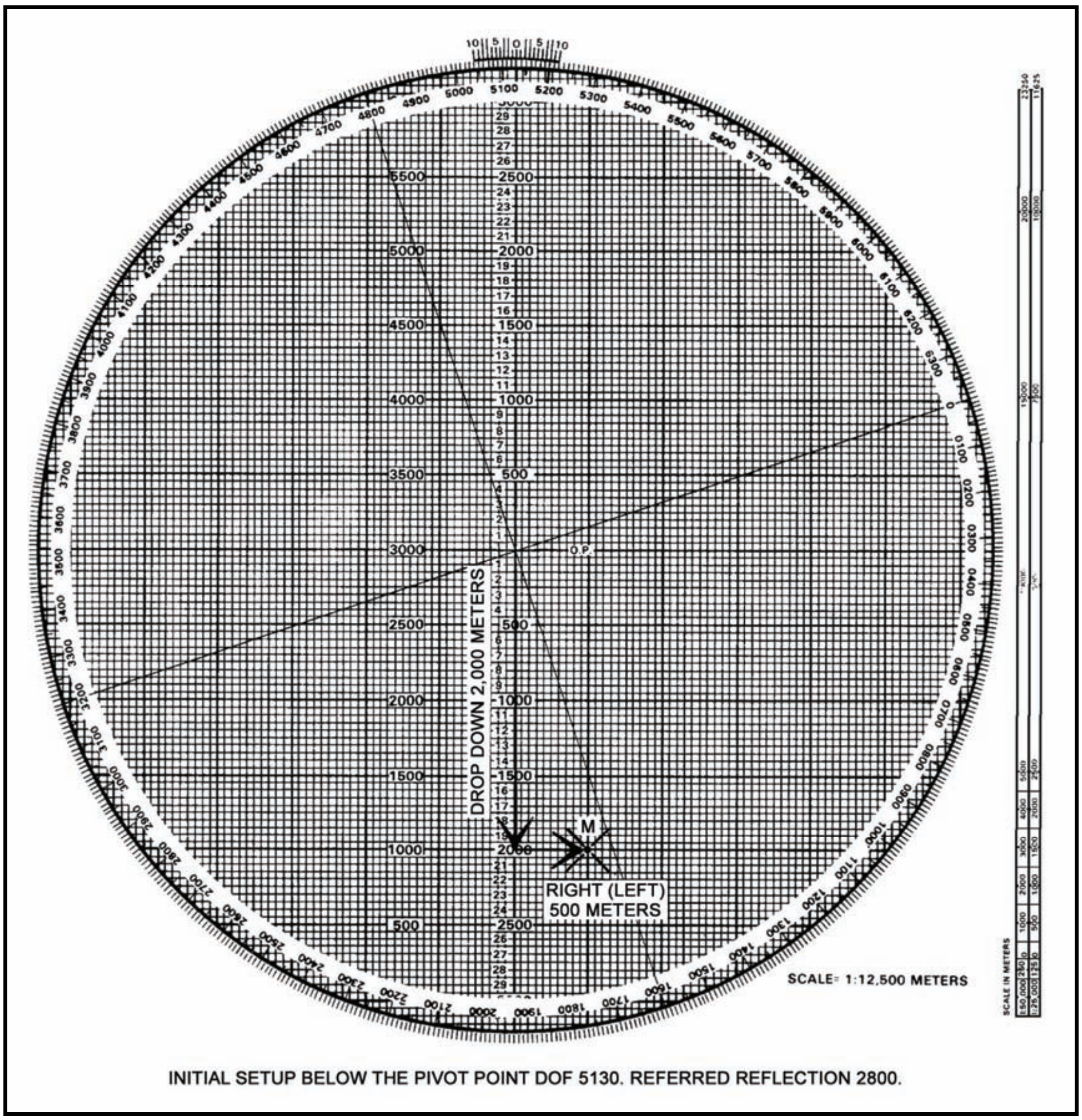

Figure 12-11. Plotting of mortar position.

12-20. Once these actions have been taken, ensure that the azimuth disk is still indexed on the gun target azimuth. Then, from the mortar position, plot the first round at the range determined using the parallel-line method of plotting (Figure 12-12). Determine the mounting azimuth and referred deflection the same way as with the pivot-point method.

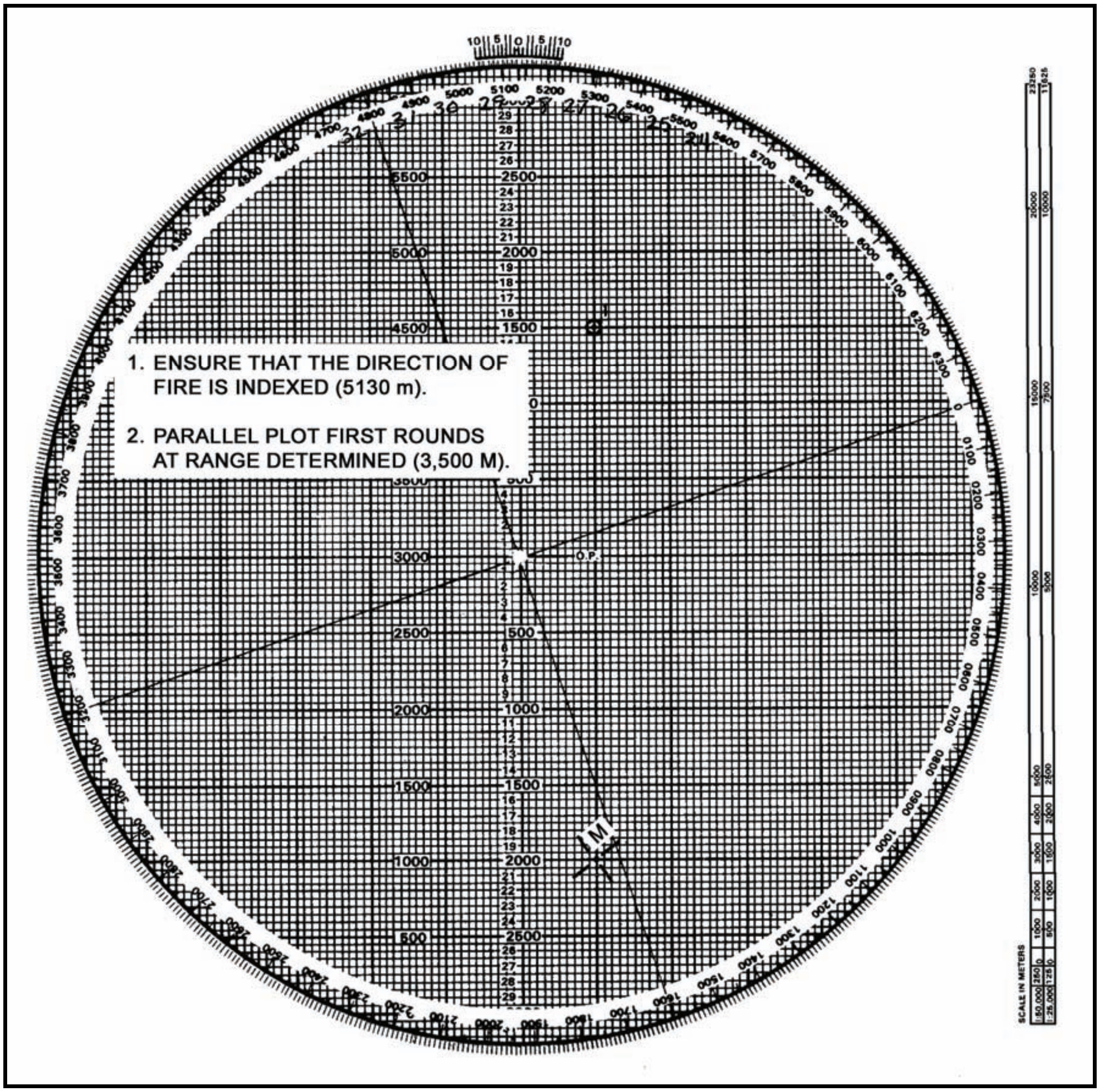

Figure 12-12. Plotting of first round.

12-21. 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 (Figure 12-13).

NOTE: All directions are read from bottom to top.

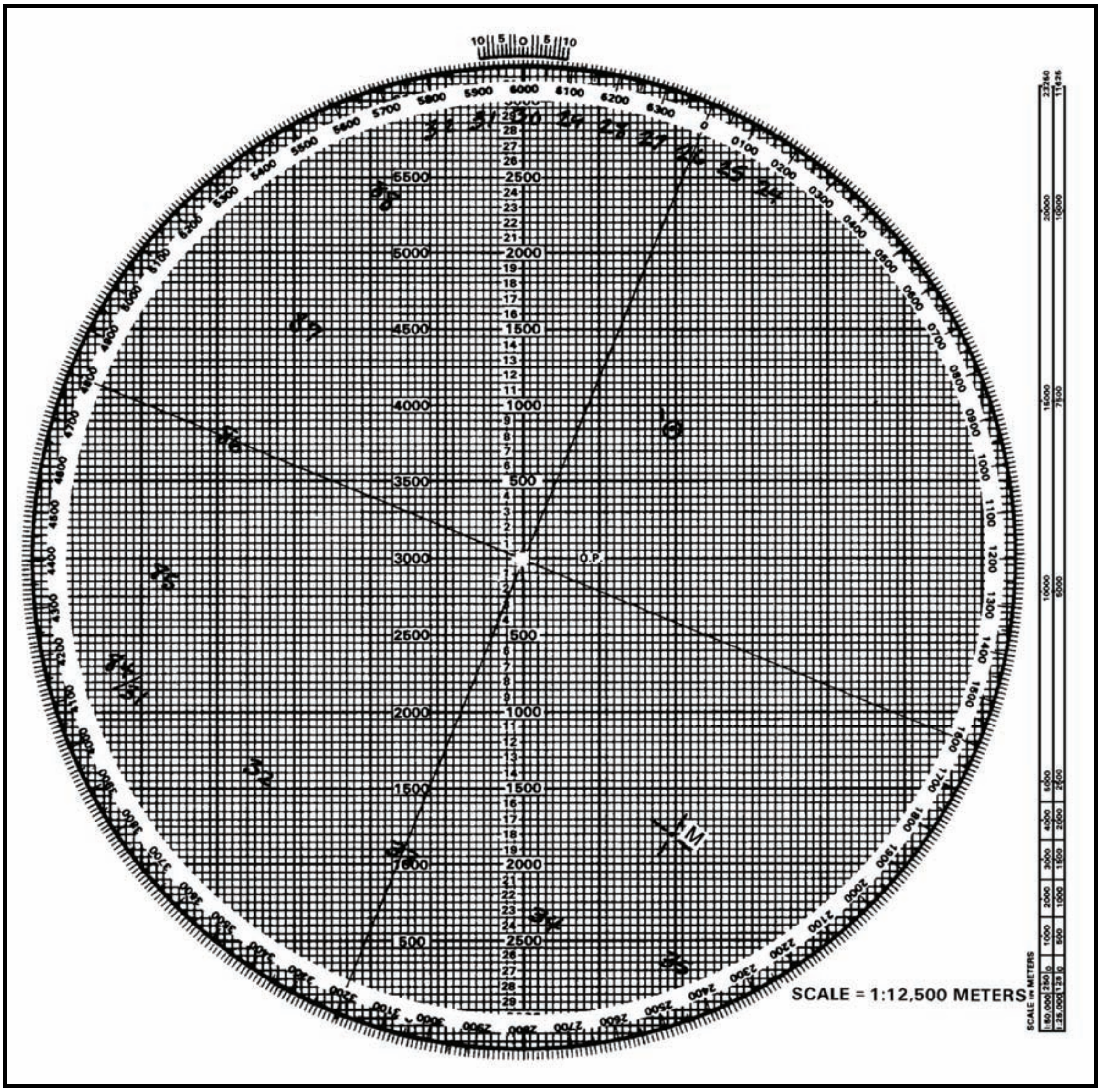

Figure 12-13. Parallel-line plotting.

12-22. Range must now be determined using one of the following 3 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-R alongside the two plots on the plotting board (mortar and target). Then make a tick mark on the edge of the DA Form 2399-R at each plot. Using the alternate range scale to the left of the pivot point, lay the DA Form 2399-R along this scale with the mortar tick mark at 0 and read the range (Figure 12-14).

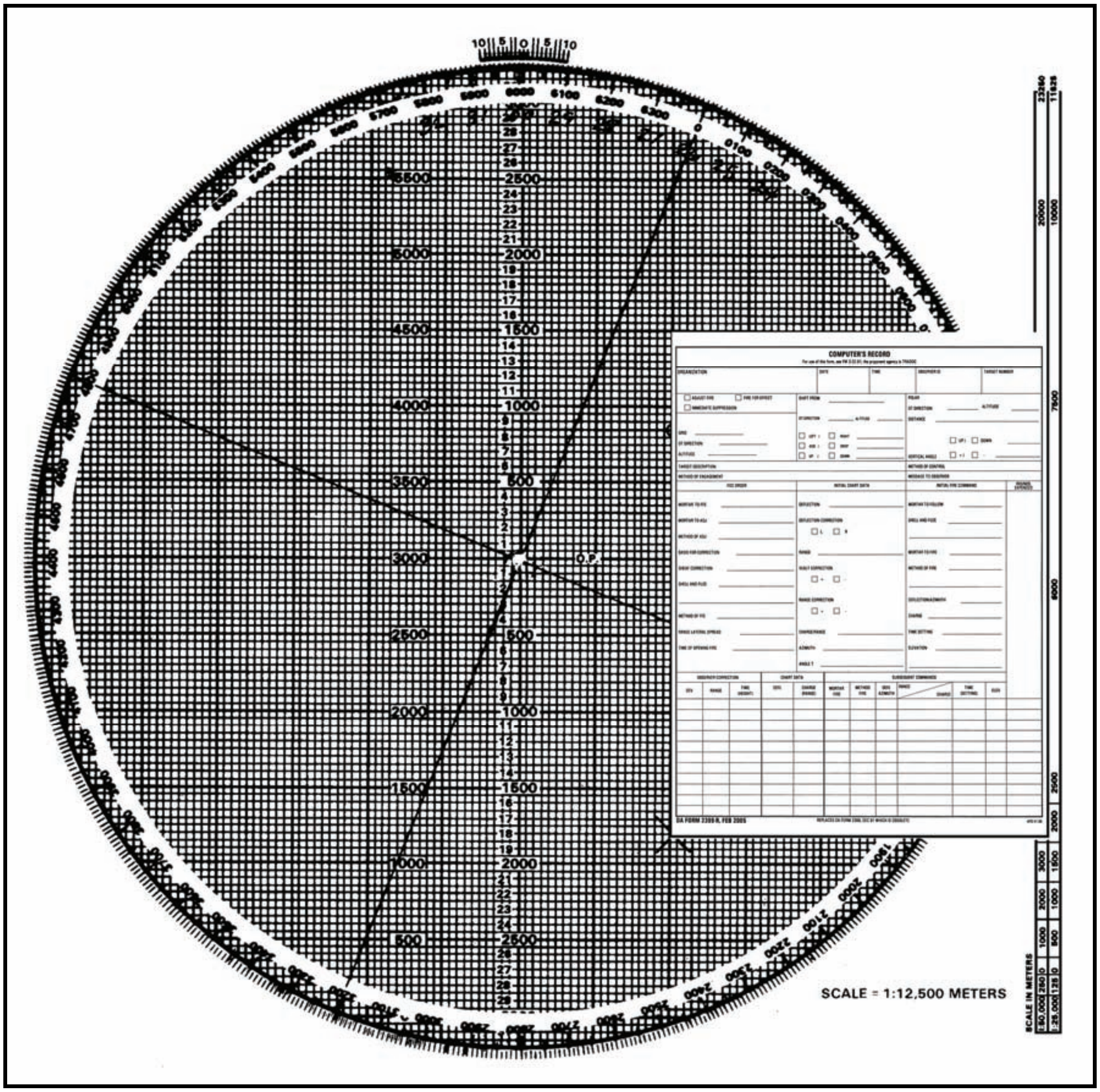

Figure 12-14. Determination of range with edge of DA Form 2399-R (Computer's Record).

12-23. To update the board after the 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.

MORTARS PLOTTED AT PIVOT POINT

12-24. With the pivot pin inserted in the pivot point of the plotting board, the computer can use the range scale arm or the range arm to determine deflections and range to both the initial and subsequent rounds.

(1) 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 mounting azimuth, and superimpose a deflection scale on the azimuth disk.

(2) 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 mounting azimuth because of the round-off rule. Use the scale on the vertical centerline to make the initial plot at the correct range.

(3) 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 IAW 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.

(4) Plot additional corrections, and use the range scale 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.

MORTARS PLOTTED BELOW PIVOT POINT

12-25. With the pivot pin inserted in the pivot point, the computer can use the left edge of the range scale arm to plot the initial round. The mounting azimuth 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 scale arm on the vertical centerline. Next, he makes a small plot at the zero range on the left edge of the range scale arm. Then, still using the left edge, he 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 scale arm is removed, and the left edge is used as a range scale.

CARE AND CLEANING OF PLOTTING BOARDS

12-26.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 cause them to warp. 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 nongritty (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.

MODIFIED-OBSERVED FIRING CHART

12-27. 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.

NOTE: See survey firing chart in Chapter 14.

DETERMINATION OF DIRECTION OF FIRE

12-28. The section sergeant usually determines DOF. In most cases, it is to the center of sector. The mortar location can be surveyed by map inspection, terrain inspection, or pacing from a known point on an azimuth, as long as the position of the base gun is known to a valid eight digits.

12-29. 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 (Figure 12-15).

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

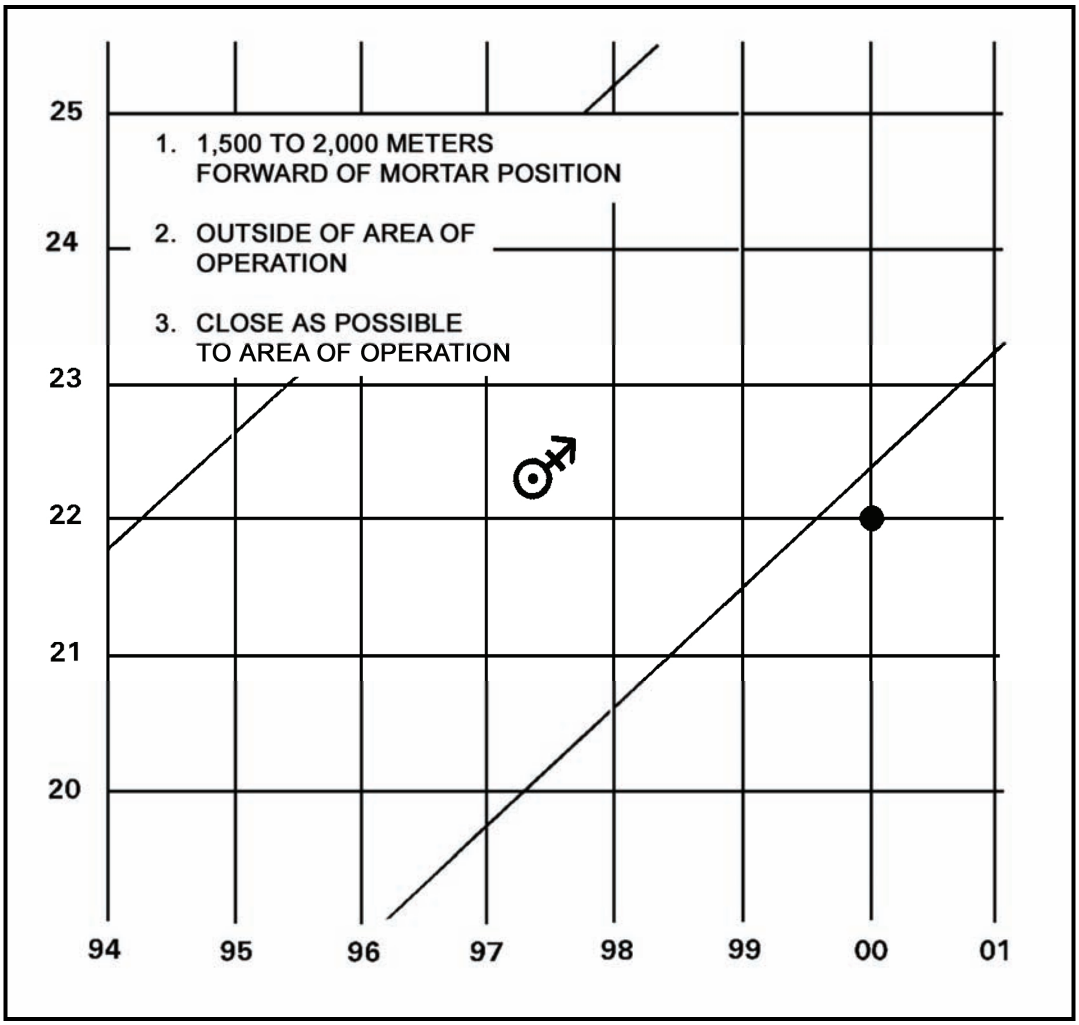

Figure 12-15. Grid intersection to represent pivot point.

12-30. 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 also 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

12-31. Once the grid intersection has been determined, the computer indexes "0" on the azimuth disk. He 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, he 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, he retains a scale of 1:12,500 on the board (Figure 12-16).

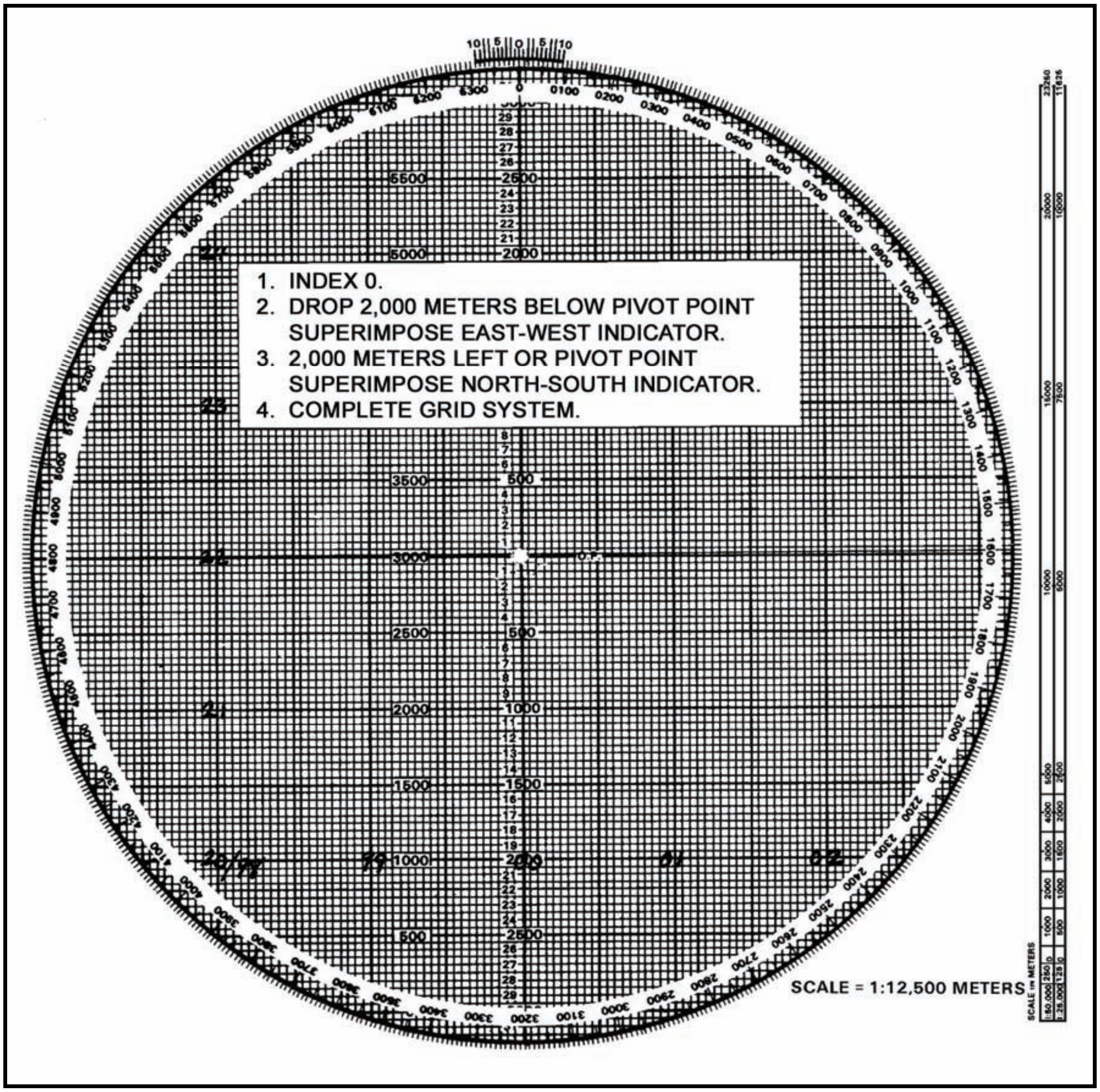

Figure 12-16. Superimposition of the grid.

PLOTTING OF MORTAR POSITION

12-32. Now that a grid system is on the board, the computer can plot any grid coordinates. To do this, he must—

(1) Ensure that the azimuth disk is indexed at 0.
(2) Read like a map: RIGHT and UP.
(3) Remember that the scale is 1:12,500 (each small square is 50 meters by 50 meters) (Figure 12-17).

12-33. To superimpose the deflection scale, the computer writes the referred deflection on the board the same way as with the observed chart. Firing data are determined by using the parallel-line method of plotting.

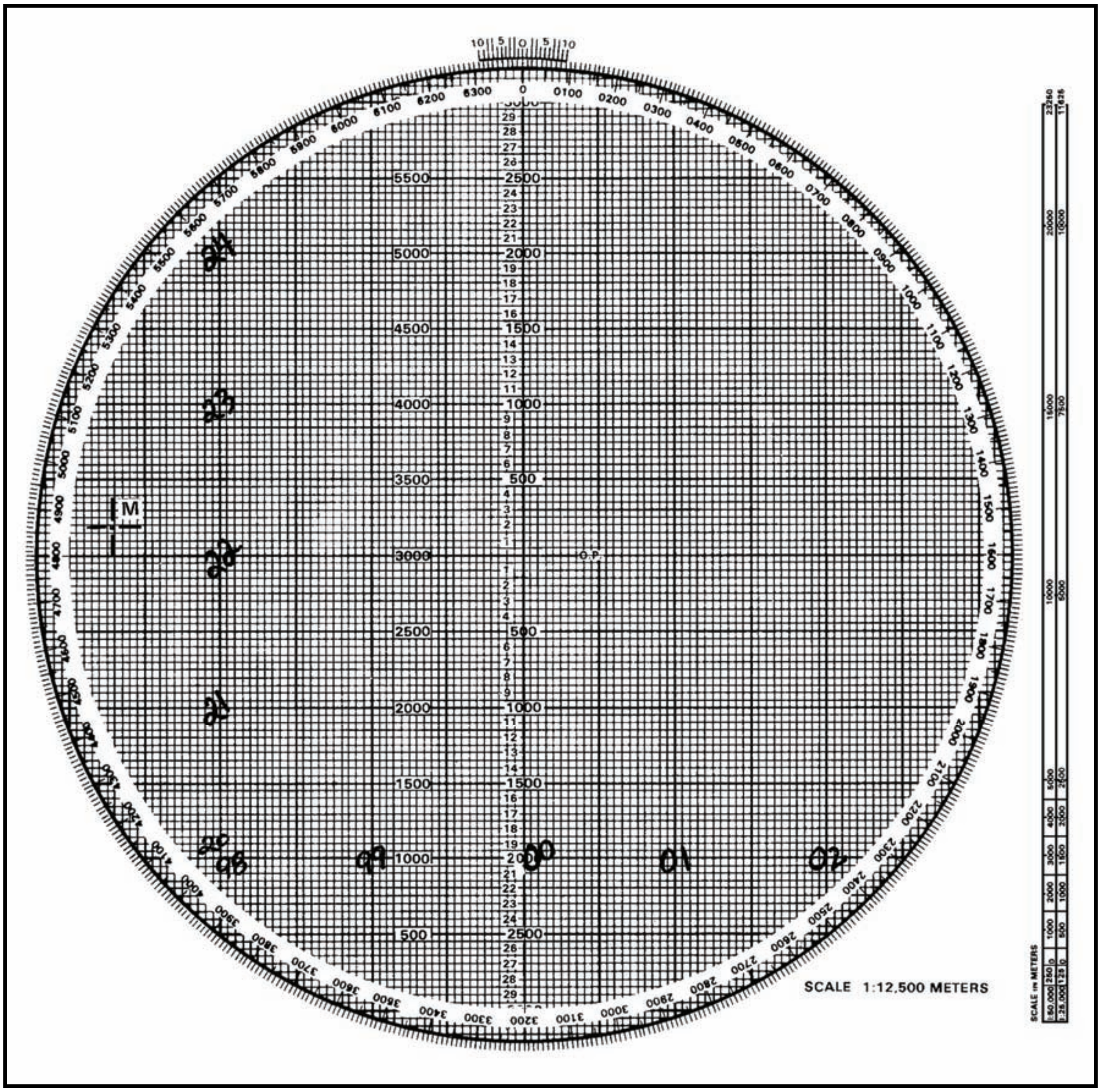

Figure 12-17. Plotting of a mortar position.

FIELD-EXPEDIENT METHOD FOR CONSTRUCTION

12-34. 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:

(1) Index the DOF.

(2) Drop below the pivot point on the vertical centerline 2,000 to 2,500 meters.

(3) Go 500 to 1,000 meters left or right of the vertical centerline and make a plot (Figure 12-18).

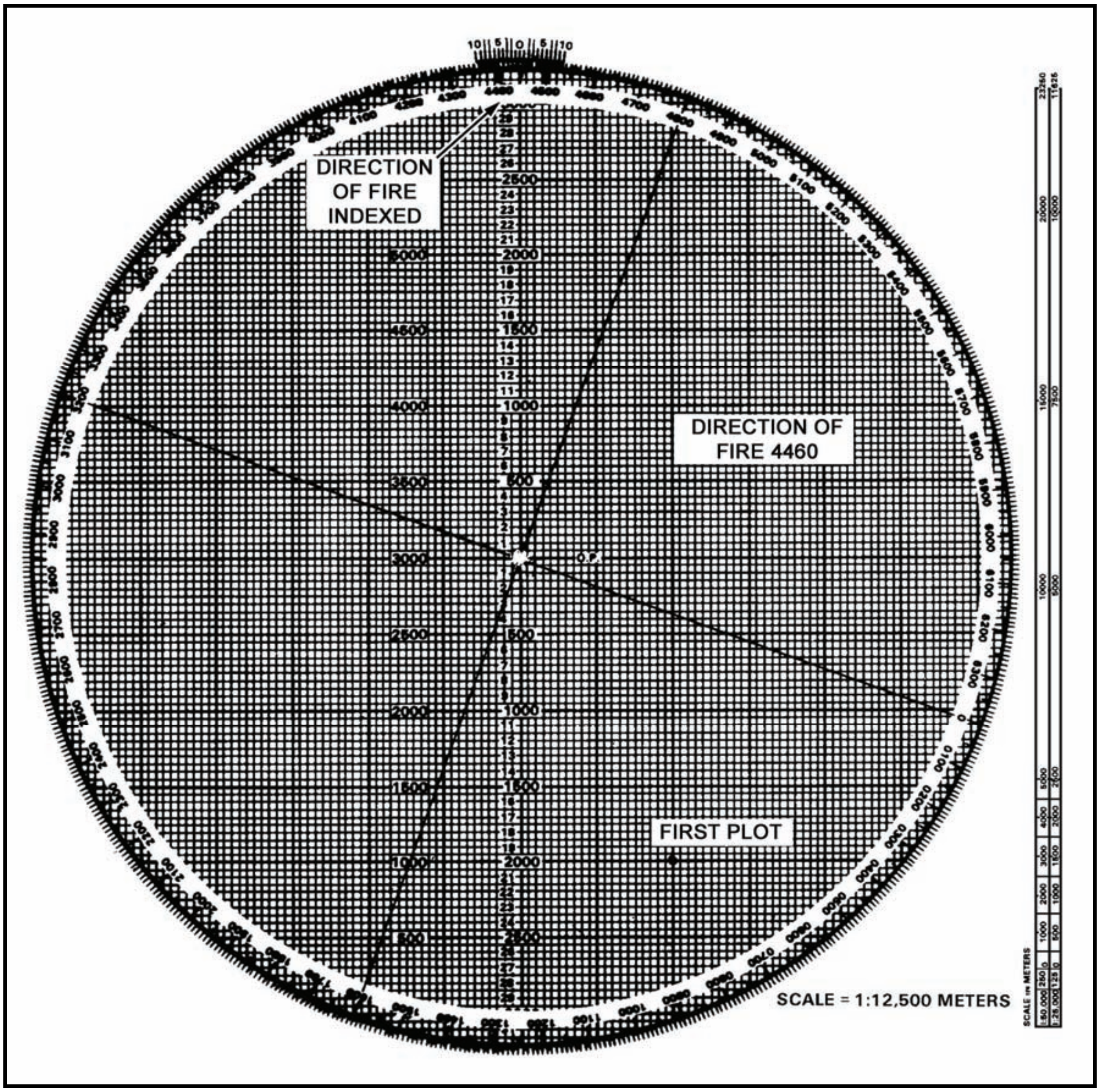

Figure 12-18. First plot.

(4) Rotate the azimuth disk and index "0."

(5) Determine the 1,000-meter grid that contains the mortars (Figure 12-19). The first, second, fifth, and sixth numbers of the mortar grid give the 1,000-meter grid square.

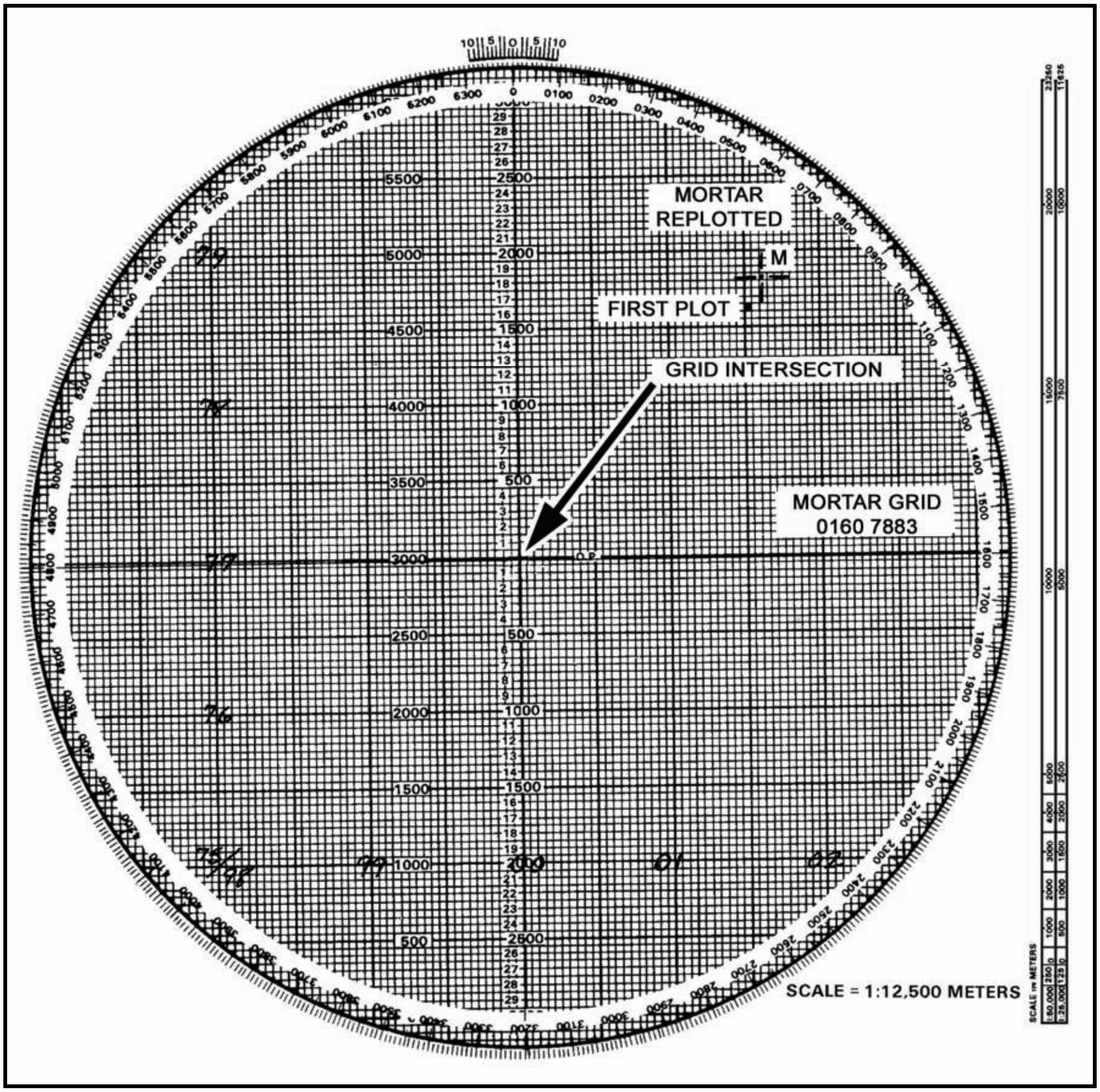

Figure 12-19. Replotting of mortar location.

(6) Superimpose the grid system.

(7) Replot the mortar location to the surveyed grid.

TRANSFER OF TARGETS

12-35. 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 is always 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 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 (Figure 12-20). 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 (Figure 12-21).

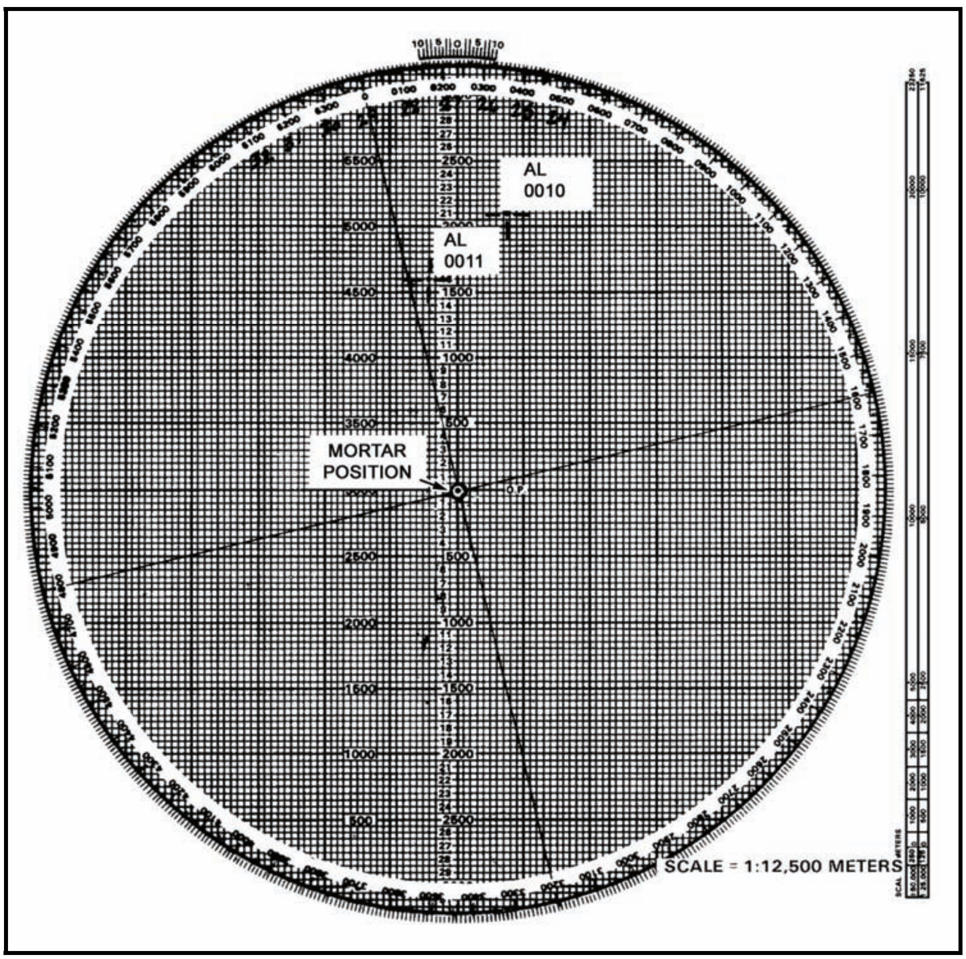

Figure 12-20. Observed chart.

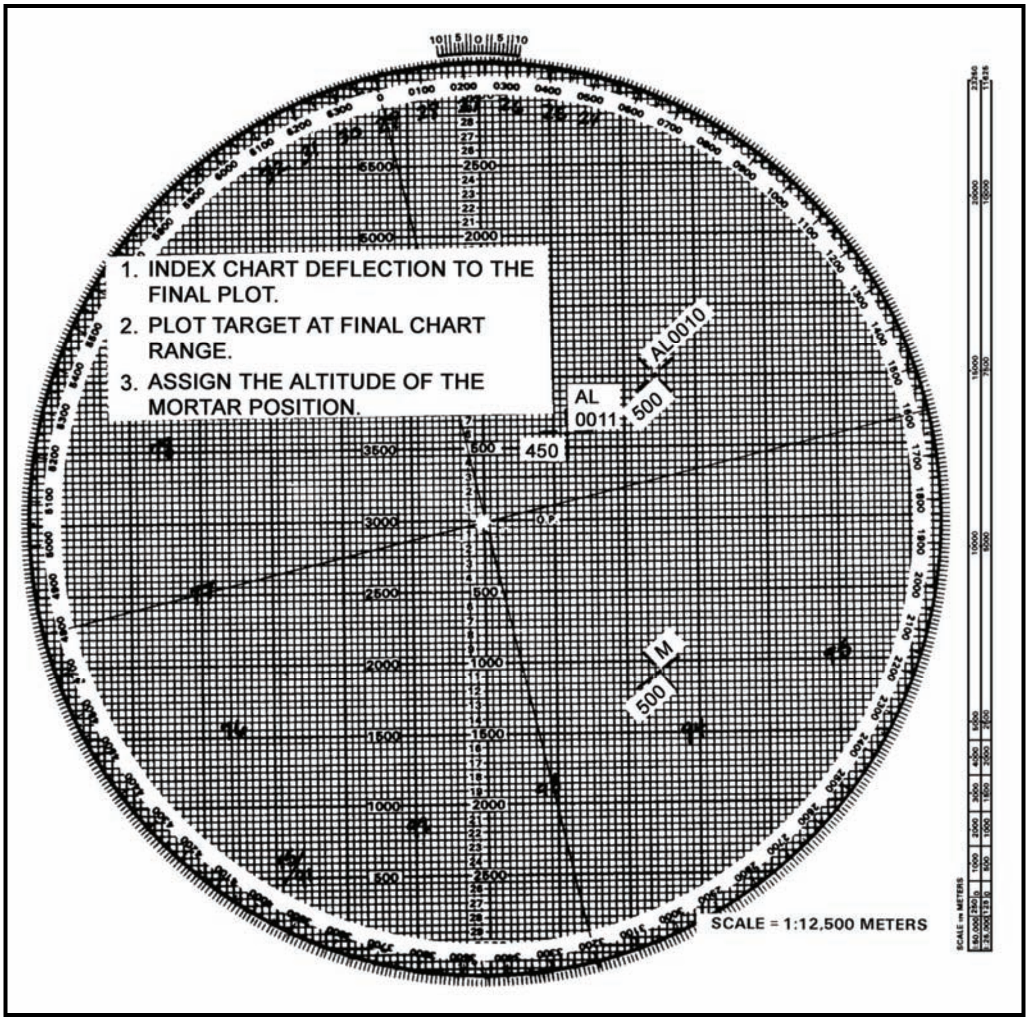

Figure 12-21. Forward plotting target to modified-observed chart from the observed chart.

TARGET PLOTTING

12-36. After transfer, through coordination with the FO, an RP or target may be identified to valid eight-digit coordinates. The plotting board is then 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.

- 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 locations of the targets.
- The same holds true for the modified-observed chart, except that with some targets, altitude correction (VI) may have been used. When replotting the target at the end of the mission, strip this altitude 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 actual location of the target.

Plotting of Previously Fired Targets

12-37. 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 the most accurate 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 (Table 12-1). 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 12-1. Replotting of previously fired targets.

COMMAND DATA	FIRING CORRECTIONS	COMPUTATIONS	CHART DATA FOR REPLOT
TARGET AL0010			
Deflection 2786	Deflection R12 RCF - 18	2786 + 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	2850 + 52 - 25 = 2877	RANGE 2875

DEFLECTION CONVERSION TABLE

12-38. 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 must determine the new data and convert the deviation corrections required into mils. He can use the deflection conversion table (Figure 12-22) or the mil-relation formula.

NOTE: If the target has been mechanically surveyed, enter the DCT at the initial range plot. If the target is non-surveyed (even if it is an eight-digit grid), enter the DCT at the final range plot.

12-39. 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.

12-40. 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 the required meters. If the range is greater than 4,000 meters, divide the range and mil correction by two.

RANGE IN METERS	DEFLECTION IN METERS														
	1	10	20	30	40	50	75	100	125	150	175	200	300	400	500
500	3.0	20	41	61	81	102	152	201	250	297	34	388	550	687	800
600	1.7	17	34	51	68	85	127	168	209	250	289	328	472	599	708
700	1.5	15	29	44	58	73	109	145	180	215	250	284	412	529	632
800	1.3	13	25	33	51	64	95	127	158	189	219	250	365	472	569
900	1.1	11	22	34	45	57	85	113	141	168	195	223	328	426	517
1000	1.0	10	20	31	41	51	76	102	127	152	176	201	297	388	473
1100	.93	9	18	28	37	46	69	92	115	138	161	183	271	355	435
1200	.85	8	17	25	34	42	64	85	106	127	148	168	249	328	402
1300	.79	8	16	23	31	39	59	78	98	117	136	155	231	304	374
1400	.73	7	15	22	29	36	55	73	91	109	127	145	215	283	349
1500	.68	7	14	20	27	34	51	68	85	102	118	135	201	265	328
1600	.63	6	13	19	25	32	48	64	80	95	111	127	189	250	309
1700	.60	6	12	18	24	30	45	60	75	90	104	119	178	235	291
1800	.57	6	11	17	23	28	42	57	71	85	99	113	168	223	276
1900	.54	5	11	16	21	27	40	54	67	80	94	107	160	211	262
2000	.51	5	10	15	20	25	38	51	64	76	89	102	152	201	250
2100	.49	5	10	15	19	24	36	48	61	73	85	97	145	192	238
2200	.46	5	9	14	19	23	35	46	58	69	81	92	138	183	228
2300	.44	4	9	13	18	22	33	44	55	66	77	88	132	175	218
2400	.43	4	8	13	17	21	32	42	53	63	74	85	127	168	209
2500	.41	4	8	12	16	20	31	41	51	61	71	81	122	162	201
2600	.39	4	8	12	16	20	29	39	49	59	68	78	117	155	194
2700	.38	4	8	11	15	19	28	38	47	57	66	75	113	150	187
2800	.37	4	7	11	15	18	27	36	45	55	64	73	109	145	180
2900	.35	4	7	11	14	18	26	35	44	53	61	70	105	140	174
3000	.34	3	7	10	14	17	25	34	42	51	59	68	102	135	168
3100	.33	3	7	10	13	16	25	33	41	49	57	66	98	131	163
3200	.32	3	6	10	13	16	24	32	40	48	56	64	95	127	158
3300	.31	3	6	9	12	15	23	31	39	46	54	62	92	123	153
3400	.30	3	6	9	12	15	22	30	37	45	52	60	90	119	149
3500	.30	3	6	9	12	15	22	29	36	44	51	58	87	116	145
3600	.29	3	6	8	11	14	21	28	35	42	49	57	85	113	141
3700	.28	3	6	8	11	14	21	28	34	41	48	55	82	110	137
3800	.27	3	5	8	11	13	20	27	33	40	47	54	80	107	133
3900	.27	3	5	8	10	13	20	26	33	39	46	52	78	104	130
4000	.26	3	5	8	10	13	19	26	32	38	45	51	76	102	127

Figure 12-22. Deflection conversion table.

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 No. 1 and No. 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 No. 1 and No. 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 No. 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 No. 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 deflection conversion table available, use the mil-relation formula (W/R x M) to 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 (in this case M [mils]). The remainder of the formula states: divide W (width in meters) by R (range in thousandths).

W/R = 20/2.8 = M   20 ÷ 2.8 = 7.1 = 7 mils

W/R = 30/2.8 = M   30 ÷ 2.8 = 10.7 = 11 mils

These are exactly the same figures determined using the DCT.

GRID MISSION

12-41. For an observed chart, the grid coordinates of the target must be plotted on the map, 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.

NOTE: Corrections for VI can be used on the modified and surveyed charts.

SHIFT FROM A KNOWN POINT MISSION

12-42. 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.

POLAR PLOT MISSION

12-43. 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 three ways:

- By resection.
- By direction and distance.
- By range and azimuth from a known point.

RESECTION

12-44. 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. (Figure 12-23).

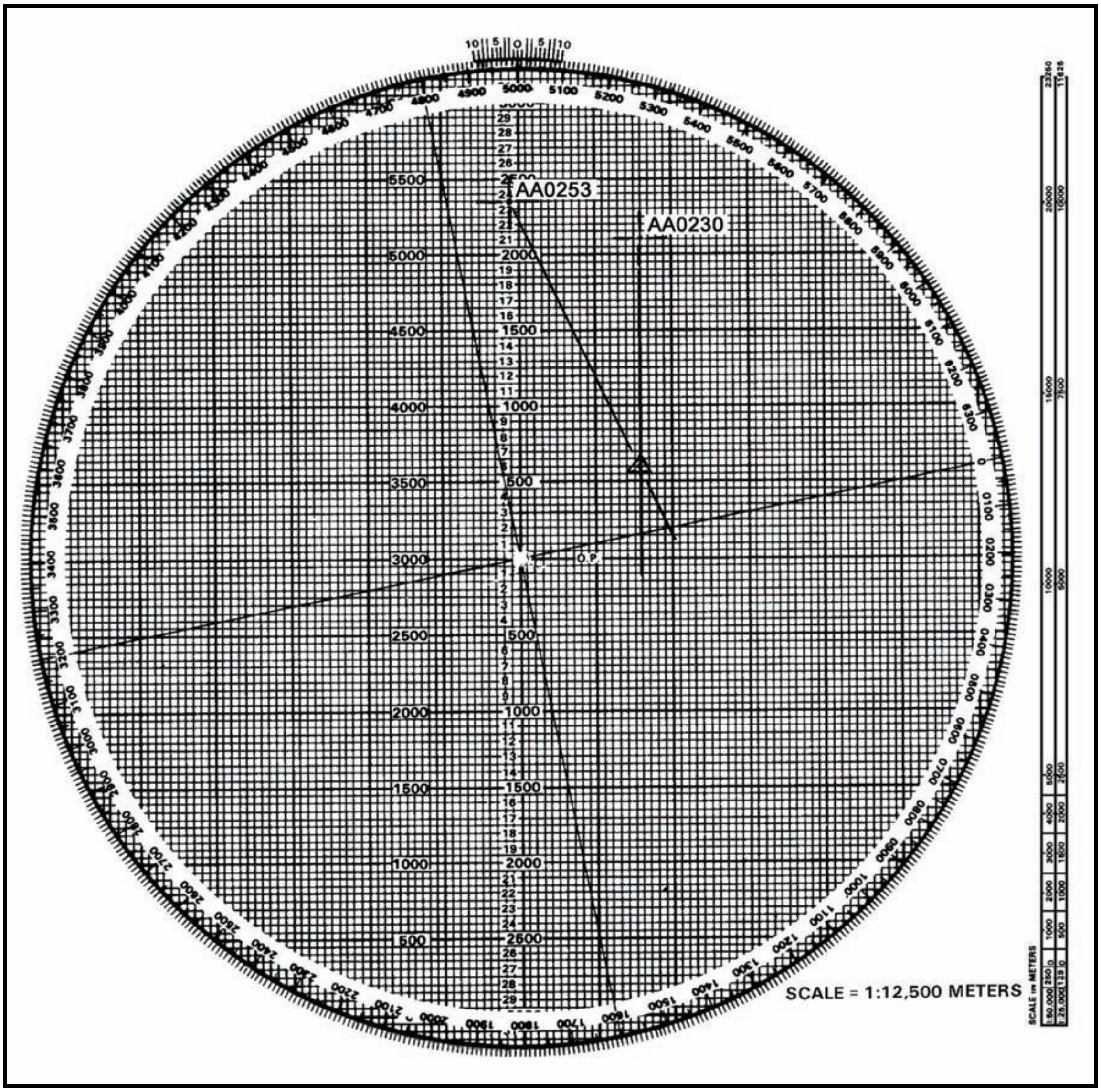

Figure 12-23. Resection.

INTERSECTION

12-45. Similar to resection, intersection (Figure 12-24) is a method of location that requires two separate observers that 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/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/point of interest.

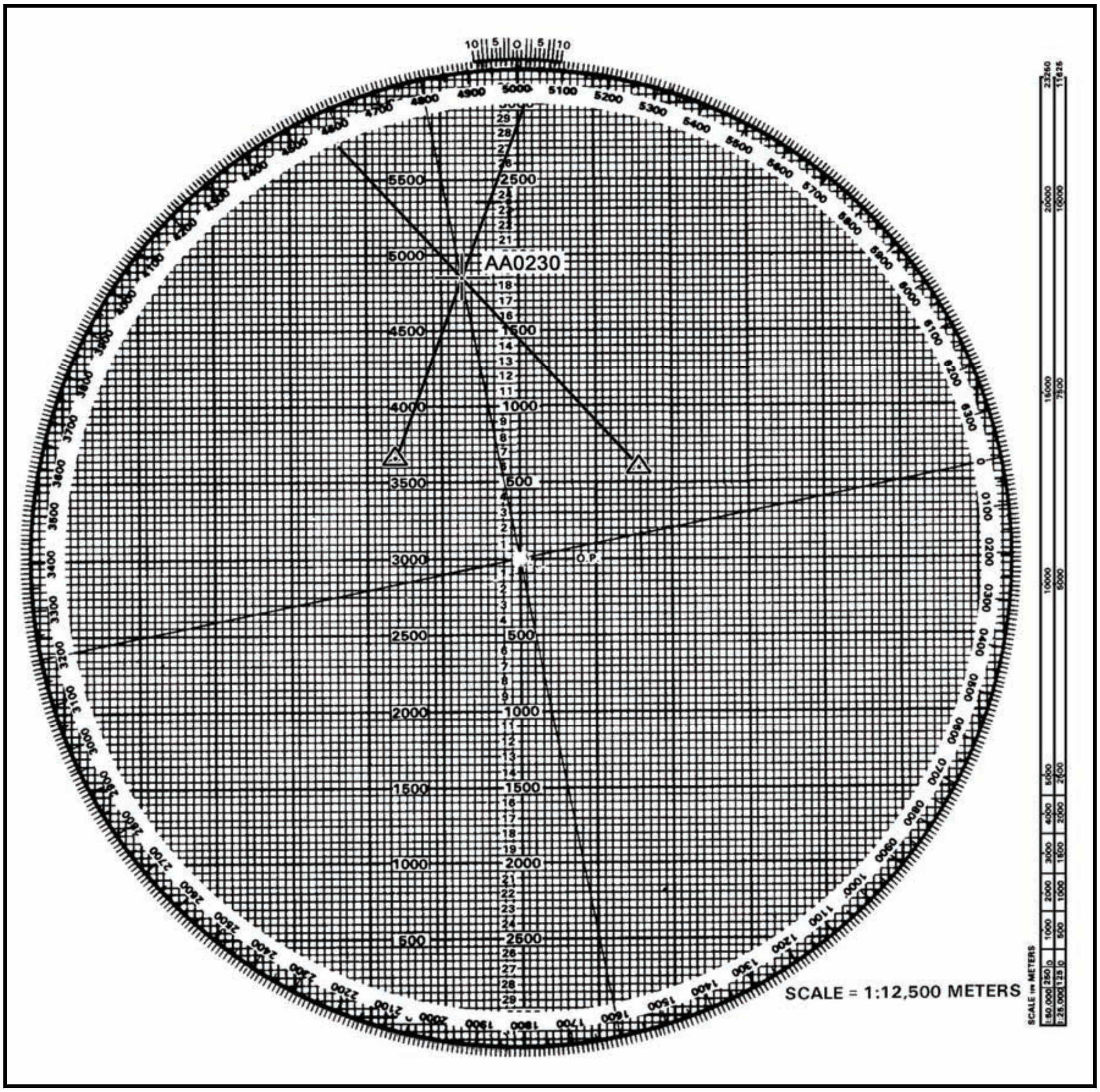

Figure 12-24. Intersection.

DIRECTION AND DISTANCE

12-46. 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. (Figure 12-25).

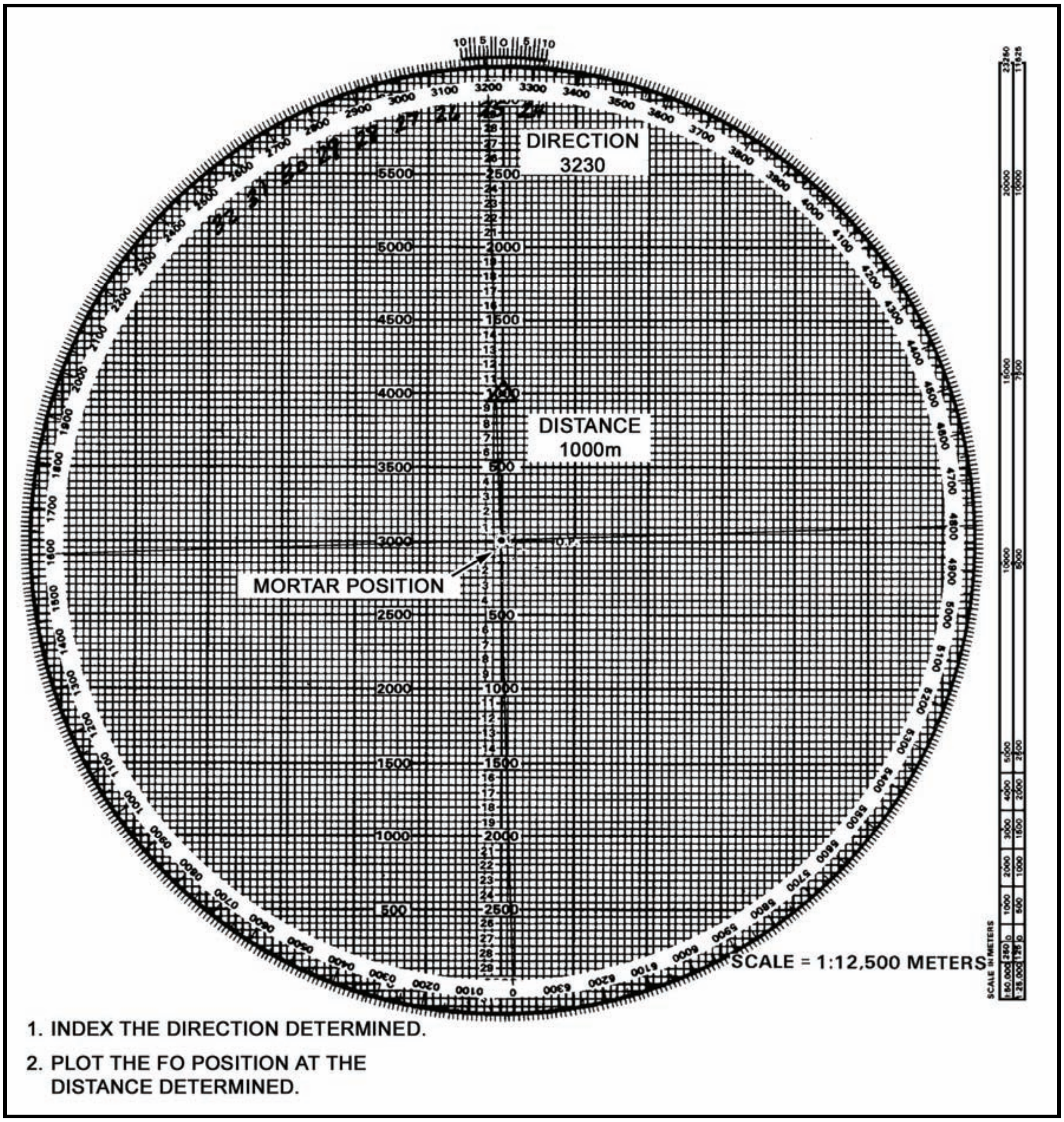

Figure 12-25. Direction and distance.

RANGE AND AZIMUTH FROM A KNOWN POINT

12-47. The FO must send 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 (Figure 12-26). 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 not known, then the computer can use resection, direction and distance, or range and azimuth from a known point.

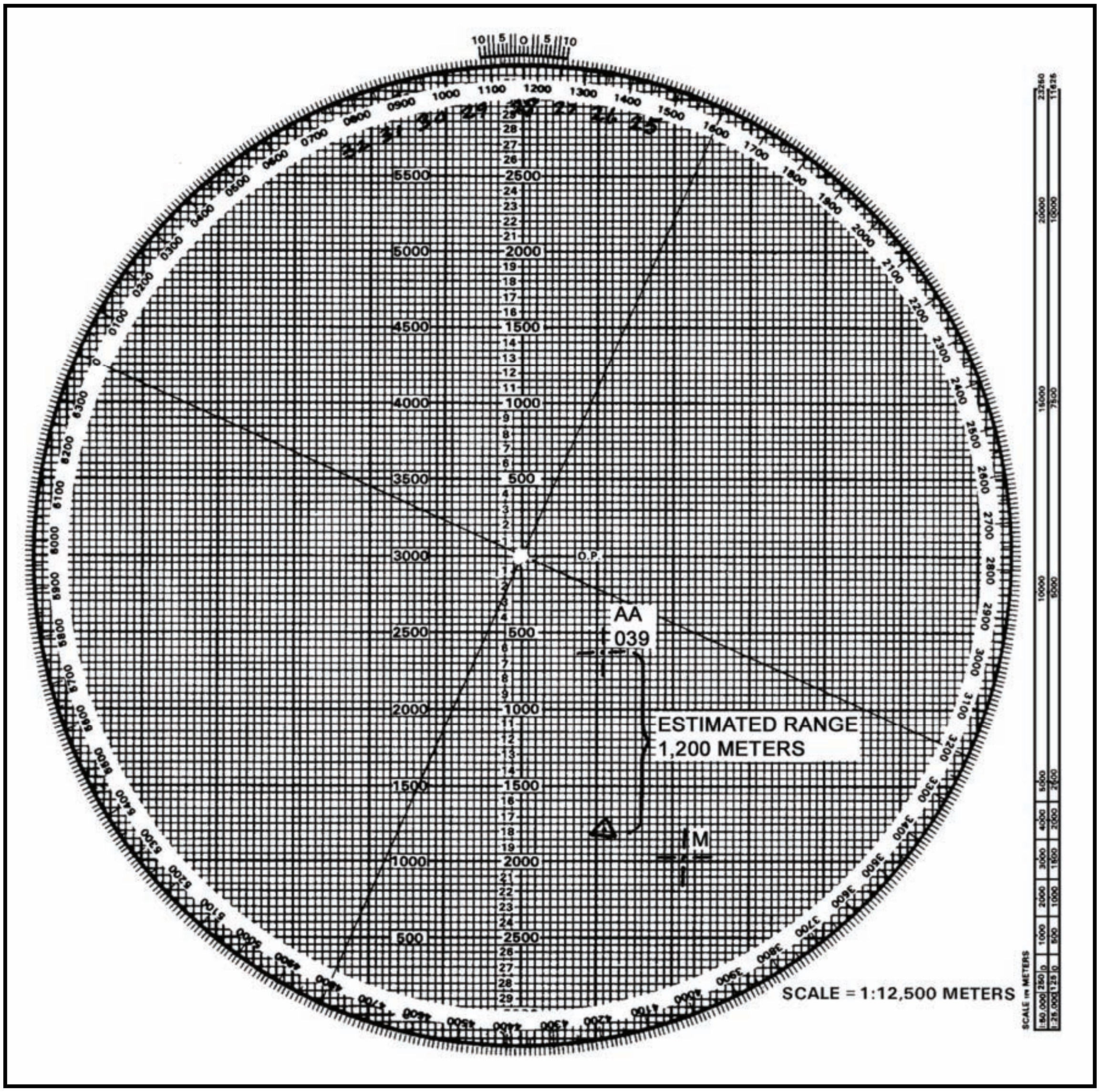

Figure 12-26. Estimate of range from the reference point of the forward observer's location.

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Chapter 13

Types of Missions

Certain missions require special procedures for the effective engagement of targets; therefore, these missions should not be fired on the observed chart. Area targets have width or depth (or both), requiring the mortar section to use either searching or traversing fire, or a combination of both.

TRAVERSING FIRE

13-1. 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.

13-2. The M16/M19 plotting board can be constructed as any of the three firing charts. The following data are used to set up the plotting board for traversing fire:

- Grid intersection.
- Direction of fire.
- Mounting azimuth.
- Mortar position.
- Mortar position attitude.
- Mortar altitude.
- Referred deflection.

13-3. Upon receiving the CFF, the section sergeant determines from the target's size and description that traversing fire must be used to cover the target. To effectively engage a target using traversing fire, the section sergeant ensures that the target's attitude is within 100 mils of the firing section's attitude. The section sergeant then completes the FDC order (Figure 13-1).

13-4. The three or four mortars are plotted separately on the M16/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.

EXAMPLE

Table 13-1 lists the data used to set up the M16 plotting board for traversing fire.

Table 13-1. M16 plotting board data for traversing fire.

Grid Intersection	04/64
Direction of Fire	2700 mils
Mounting Azimuth	2700 mils
Mortar Position	FB02006500
Mortar Position Attitude	1080 mils
Mortar Altitude	400 meters
Referred Deflection	0700 mils

During the adjustment phase of the mission, the impact point is aligned with the No. 2 mortar plot. Using the information in the CFF, the FDC order, and the observer corrections, compute the data to adjust the No. 2 mortar onto the target's center of mass. After the adjustment is complete (Figure 13-2)—

(1) Plot the target's length (250 meters) on the plotting board using the target's attitude.
(2) Divide the target into segments.
(3) Determine the number of rounds for each segment.
(4) Determine the mil width of one segment.
(5) Determine the number of turns required to cover one segment.
(6) Determine the number of turns that must be taken between rounds.

COMPUTER'S RECORD
For use of this form, see FM 3-22.91; the proponent agency is TRADOC

ORGANIZATION: B Co 1/29 IN | DATE | TIME | OBSERVER ID: D61 | TARGET NUMBER: CA 0701

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 038 629
OT DIRECTION: 2400
ALTITUDE: 420

SHIFT FROM ______
OT DIRECTION ______ ALTITUDE ______
☐ LEFT / ☐ RIGHT ______
☐ ADD / ☐ DROP ______
☐ UP / ☐ DOWN ______

POLAR
OT DIRECTION ______ ALTITUDE ______
DISTANCE ______
☐ UP / ☐ DOWN ______
VERTICAL ANGLE ☐ + / ☐ - ______

TARGET DESCRIPTION: CIO 250X50 ATT 0720
METHOD OF CONTROL
METHOD OF ENGAGEMENT
MESSAGE TO OBSERVER

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTART TO FFE: SEC	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ: #2	DEFLECTION CORRECTION ☐ L ☐ R	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd	RANGE	MORTAR TO FIRE	
BASIS FOR CORRECTION	V/ALT CORRECTION ☑ + ☐ -	METHOD OF FIRE	
SHEAF CORRECTION: OPEN	RANGE CORRECTION ☐ + ☐ -	DEFLECTION/AZIMUTH	
SHELL AND FUZE: HEQ IN ADJ PROX IN FFE	CHARGE/RANGE	CHARGE	
METHOD OF FFE: 3 Rds	AZIMUTH	TIME SETTING	
RANGE LATERAL SPREAD	ANGLE T	ELEVATION	
TIME OF OPENING FIRE: W/R			

OBSERVER CORRECTION			CHART DATA		SUBSEQUENT COMMANDS						
DEV	RANGE	TIME (HEIGHT)	DEFL	CHARGE (RANGE)	MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	

DA FORM 2399-R, FEB 2005 REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE APD V1.00

Figure 13-1. Example of DA Form 2399-R (Computer's Record) with a completed call for fire and fire direction center order.

COMPUTER'S RECORD

For use of this form, see FM 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

GRID 038 629
OT DIRECTION 2400
ALTITUDE 420

SHIFT FROM ______
OT DIRECTION ______ ALTITUDE ______
☐ LEFT / ☐ RIGHT ______
☐ ADD / ☐ DROP ______
☐ UP / ☐ DOWN ______

POLAR
OT DIRECTION ______ ALTITUDE ______
DISTANCE ______
☐ UP / ☐ DOWN ______
VERTICAL ANGLE ☐ + / ☐ - ______

TARGET DESCRIPTION CIO 250X50 ATT 0720
METHOD OF ENGAGEMENT

METHOD OF CONTROL
MESSAGE TO OBSERVER

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTART 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			
BASIS FOR CORRECTION:	RANGE:	MORTAR TO FIRE: #2	
SHEAF CORRECTION: Open	VI/ALT CORRECTION ☑ + ☐ - 20	METHOD OF FIRE: 1 Rd	
SHELL AND FUZE: HEQ IN ADJ PROX IN FFE		3 Rds PROX IN FFE	
	RANGE CORRECTION ☐ + ☐ - 0	DEFLECTION/AZIMUTH: 0918	
METHOD OF FFE: 3 Rds		CHARGE: 5	
RANGE LATERAL SPREAD:	CHARGE/RANGE: 5	TIME SETTING:	
TIME OF OPENING FIRE: W/R	AZIMUTH: 2320	ELEVATION: 0963	
	ANGLE T: 80		

OBSERVER CORRECTION: DEV	RANGE	TIME (HEIGHT)	CHART DATA: DEFL	CHARGE (RANGE)	SUBSEQUENT COMMANDS: MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	ROUNDS EXPENDED
L120			0960	2750			0960			0963	① HE
	-100		0962	2650			0962			1010	② HE
	-50	FFE	0963	2600	PREPARE TO TRAVERSE RIGHT						

DA FORM 2399-R, FEB 2005 REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE APD V1.00

Figure 13-2. Example of DA Form 2399-R (Computer's Record) with completed adjustment.

(1) 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 of the plots except the last one. After ensuring that 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 must cover with fire (Figure 13-3).

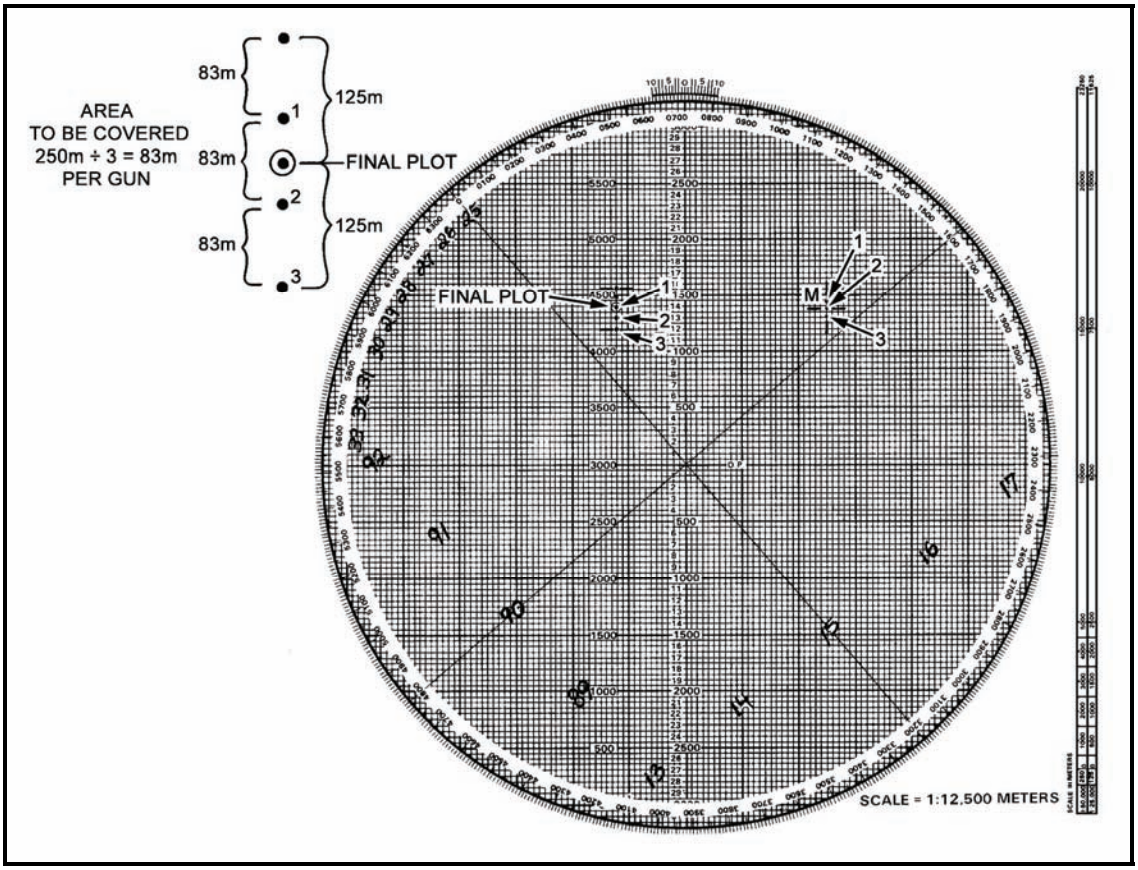

Figure 13-3. Plotting of starting points.

(2) The target is now divided into three segments (each being 83 meters, in the example). Once the remaining data for one segment have been determined, the data will apply to all three mortars. If the computer determines the mil width of one segment, the other two will be the same. The computer can use one of two methods to determine the mil width of one segment.

- In the first method, the computer knows the deflection that was used to hit the No. 3 point. First, he aligns the No. 2 plot and No. 3 mortar to determine the proper deflection for the mortars to hit the start point for the No. 2 mortar (Figure 13-4). Then, he subtracts these two numbers to determine the segment's mil width.

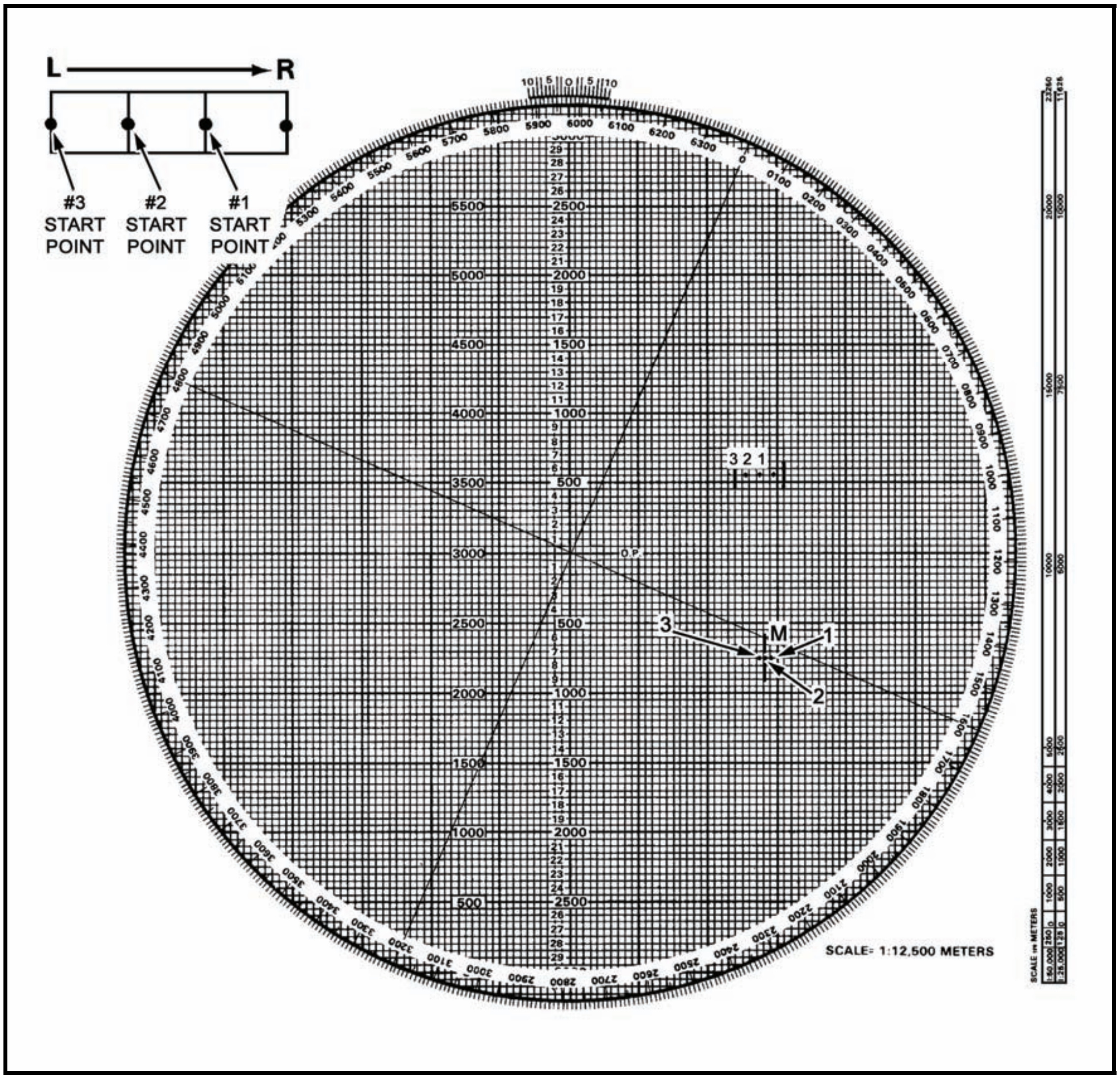

Figure 13-4. Alignment of No. 2 and No. 3 plots.

EXAMPLE

2993 mils (No. 3 plot deflection) - 2942 mils (No. 2 plot deflection) = 51 mils (mil width of segment)

- The second method 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). He 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)

(3) To compute the number of turns that must be taken between rounds, the computer must know how many rounds will be fired for each segment. This information is given in the FDC order (three rounds, in the 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 will always 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 1 round for 60 meters for 120-mm mortars.

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.

(4) The computer determines the deflection and range for each mortar by aligning each mortar with its start point. Then, he completes the subsequent command and issues it to the mortar section.

NOTE: If there is a range change of 25 meters or more, the mortar will receive its own elevation.

(5) Upon completion of the adjustment phase of the mission, the section is given 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 (Figure 13-5).

COMPUTER'S RECORD

For use of this form, see FM 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

GRID 038 629

OT DIRECTION 2400

ALTITUDE 420

SHIFT FROM

OT DIRECTION ALTITUDE

☐ LEFT / ☐ RIGHT

☐ ADD / ☐ DROP

☐ UP / ☐ DOWN

POLAR

OT DIRECTION ALTITUDE

DISTANCE

☐ UP / ☐ DOWN

VERTICAL ANGLE ☐ + / ☐ -

TARGET DESCRIPTION CIO 250 X 50 ATT 0720

METHOD OF CONTROL

METHOD OF ENGAGEMENT

MESSAGE TO OBSERVER

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTART TO FFE: Sec	DEFLECTION: 0918	MORTAR TO FOLLOW: SEC	
MORTAR TO ADJ: #2	DEFLECTION CORRECTION ☐ L ☐ R	SHELL AND FUZE: HEQ	
METHOD OF ADJ: 1 Rd			
BASIS FOR CORRECTION:	RANGE:	MORTAR TO FIRE: #2	
SHEAF CORRECTION: Open	VI/ALT CORRECTION	METHOD OF FIRE: 1 Rd	
SHELL AND FUZE: HEQ in Adj PROX in FFE	☑ + ☐ - 20	3 Rds PROX in FFE	① HE
	RANGE CORRECTION	DEFLECTION/AZIMUTH: 0918	
METHOD OF FFE: 3 Rds	☐ + ☐ -	CHARGE: 5	
RANGE LATERAL SPREAD:	CHARGE/RANGE: 5	TIME SETTING:	
TIME OF OPENING FIRE: W/R	AZIMUTH: 2320	ELEVATION: 0963	
	ANGLE T: 80		

OBSERVER CORRECTION			CHART DATA		SUBSEQUENT COMMANDS							
DEV	RANGE	TIME (HEIGHT)	DEFL	CHARGE (RANGE)	MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	
L120			0960	2750			0960			0963	③ HE
	-100		0962	2650			0962			1010	③ HE
	-50	FFE	0963	2600	PREPARE TO TRAVERSE RIGHT						
					Sec	3 Rds PROX	TRAVERSE RIGHT 1½ TURNS				
							① 0958	2625		1021	
							② 0974	2600		1031	
							③ 1000	2575		1041	⑨ PROX

DA FORM 2399-R, FEB 2005 REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE APD V1.00

Figure 13-5. Example of a completed DA Form 2399-R (Computer's Record) for a completed mission.

SEARCHING FIRE

13-5. Mortars can cover area targets more than 50 meters deep by either elevating or depressing the barrel during the FFE. Sections can cover areas up to 50 meters (three mortars firing four rounds on the same elevation and deflection) due to range and deflection dispersion.

13-6. In the CFF, the FO sends the target's size and attitude since it has more depth than a section firing a linear sheaf can engage. The FO gives the width and depth of the target's attitude. Attitude is the direction (azimuth) through the target's long axis.

13-7. For the mortar section to effectively engage a target using only searching fire with the M16/M19 plotting board, the target's attitude cannot be more than 100 mils difference from the gun section's attitude. If the difference is more than 100 mils, the target should be engaged using a combination of searching and traversing fire, or traversing fire only. When a section fires a searching mission, the adjustment phase is the same as that of a regular mission using the base mortar (No. 2) as the adjusting mortar. The base mortar is adjusted to the target's center of mass.

13-8. Upon completion of the adjustment phase of the mission, the computer must compute the data needed to cover the target with fire using the target area given in the CFF. He must determine the number of rounds necessary to cover the target, the number of turns required to cover the target, and the number of turns taken between rounds.

NOTES: 1. When firing on a target using traversing or searching fire, the computer uses four rounds for every 100 meters of target width or depth, or one round for every 30 meters for 81-mm mortars; or two rounds per 100 meters of target width, or 1 round for 60 meters for 120-mm mortars.

2. The computer must always consider the number of rounds on hand and the resupply rate when determining the number of rounds to fire.

EXAMPLE

Assume that the target's depth is 350 meters, and the engagement is with 81-mm mortars.

(1) Four rounds are required to cover 100 meters.

350 ÷ 100 = 3.5 (or 3 even 100s)

4 x 3 (for 300, the number of 100s of meters) = 12

(2) For the remainder of the target depth (50 meters), add one round for every 30 meters.

12 + 1 = 13 (rounds)

(3) At this point, 20 meters of target is left. To cover the 20 meters, add one more round.

13 + 1 = 14 (rounds to cover 350 meters)

(1) When determining the number of turns needed to cover the target, the computer can use one of two methods.

- If the computer is using the unabridged firing table, the number of turns in elevation required for a 100-meter change in range is given in column 4 of Table D (Basic Data).

EXAMPLE

Assume the target is 350 meters in depth, the range to the target's center of mass is 2,125 meters (always use chart range), and the firing charge is 4.

To determine the number of turns needed to cover the target —

(1) Determine the range to the target's center of mass (2,125).
(2) Enter the firing table at charge 4, range 2,125, and go across to column 4.
(3) Four turns are needed to cover 100 meters.
(4) Multiply 4 by 3.5 (range in hundreds) to get the number of turns needed to cover the target.

4 x 3.5 (range in hundreds) = 14 (turns needed to cover the target area)

The mortars are adjusted to the center of mass. To obtain the range to the far edge (search up), add half of the target area to the range to the center of mass.

175 (half of the target area) + 2,125 (range to the center of mass) = 2,300 (range to the far edge)

EXAMPLE

The range to the center of mass is 2,125 meters; the target area is 100 meters by 350 meters; and the range to the far end is 2,300 meters.

(1) Divide the target's depth by two.

350 (target's depth) ÷ 2 = 175 meters (half of the target depth)

(2) To search down, start at the near edge and subtract half of the target depth from target center.

2125 (target center) – 175 meters (half of the target depth) = 1950meters

---

- To apply the second method, the computer must determine the mil length of the target using FTs. He uses the elevation for the far end of the target (adjusting point) and the elevation to hit the near end of the target.

EXAMPLE

Range to adjusting point	2,300 meters	Elevation	974 mils
Range to near end	1,950 meters	Elevation	1128 mils

(1) Subtract the two elevations to determine the mil length of the target.

1128 mils (elevation for the range to the near end)
- 974 mils (elevation for the range to the adjusting point)
154 mils (length of the target)

NOTE: Each turn of the elevating crank is 10 mils (5 mils for the 120-mm mortars).

(2) Divide the mil length of the target (154 mils) by 10 to get the total number of turns needed to cover the target. Round to the nearest whole turn.

154.0 (mil length of the target) ÷ 10 = 15.4 = 15 (total turns needed to cover the target)

NOTE: Table D (Basic Data) gives the number of turns per 100 meters difference in range. This data may be used to determine the total number of turns needed to cover the target.

(2) To compute the number of turns that must be taken between rounds, the computer must know how many rounds each mortar will fire. The computer computes this information or finds it in the FDC order (14 rounds, in the example). To determine the number of turns that must be taken between rounds, he divides the total number of turns by the intervals between rounds. The computer rounds the product to the nearest half turn.

NOTE:
1. There will always be one less interval than the number of rounds. For example, 14 rounds = 13 intervals.
2. Turns between rounds will be rounded to the nearest half turn.

EXAMPLE

15.0 (total number of turns) ÷ 13 (intervals between rounds) = 1.15 = 1 (turn between rounds).

RULE: The number of rounds to fire is based on the rule: four rounds per 100 meters of target depth, or one round per 30 meters for 81-mm mortars; or two rounds per 100 meters of target width, or 1 round for 60 meters for 120-mm mortars.

(3) At this point, the computer has all of the information needed to complete the subsequent command. The command can then be issued to the mortars (Figure 13-6).

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN			G 35	AL 0015

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION

GRID 149 908
OT DIRECTION 5840
ALTITUDE

SHIFT FROM
OT DIRECTION ALTITUDE
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR
OT DIRECTION ALTITUDE
DISTANCE
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ -

TARGET DESCRIPTION Supply Depot 100 X 350 ATT 5400
METHOD OF ENGAGEMENT
METHOD OF CONTROL
MESSAGE TO OBSERVER

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTART TO FFE SEC	DEFLECTION 3472	MORTAR TO FOLLOW SEC	
MORTAR TO ADJ #2	DEFLECTION CORRECTION	SHELL AND FUZE HEQ	
METHOD OF ADJ 1 Rd	☐ L ☐ R		
BASIS FOR CORRECTION	RANGE 2300	MORTAR TO FIRE #2	
SHEAF CORRECTION	VI/ALT CORRECTION	METHOD OF FIRE 1 Rd	
SHELL AND FUZE HEQ	☐ + ☑ - 30	14 Rds in FFE	1
	RANGE CORRECTION	DEFLECTION/AZIMUTH 3472	
METHOD OF FFE 14 Rds	☐ + ☐ -	CHARGE 4	
RANGE LATERAL SPREAD	CHARGE/RANGE 4	TIME SETTING	
TIME OF OPENING FIRE W/R	AZIMUTH 5440	ELEVATION 0974	
	ANGLE T 450		

OBSERVER CORRECTION: DEV	RANGE	TIME (HEIGHT)	CHART DATA: DEFL	CHARGE (RANGE)	SUBSEQUENT COMMANDS: MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	ROUNDS EXPENDED
L100	-100		3534	2250			3534	2250		1002	6
	-100		3558	2175			3558	2175		1039	3
	+50	FFE	3544	2200	SEC	AMC 14 Rds Search UP 1 turn	3544	2375	(FAR EDGE)	0922	45

DA FORM 2399-R, FEB 2005 REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE APD V1.00

Figure 13-6. Example of completed DA Form 2399-R (Computer's Record) for a search mission.

13-9. 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 him (Figure 13-7).

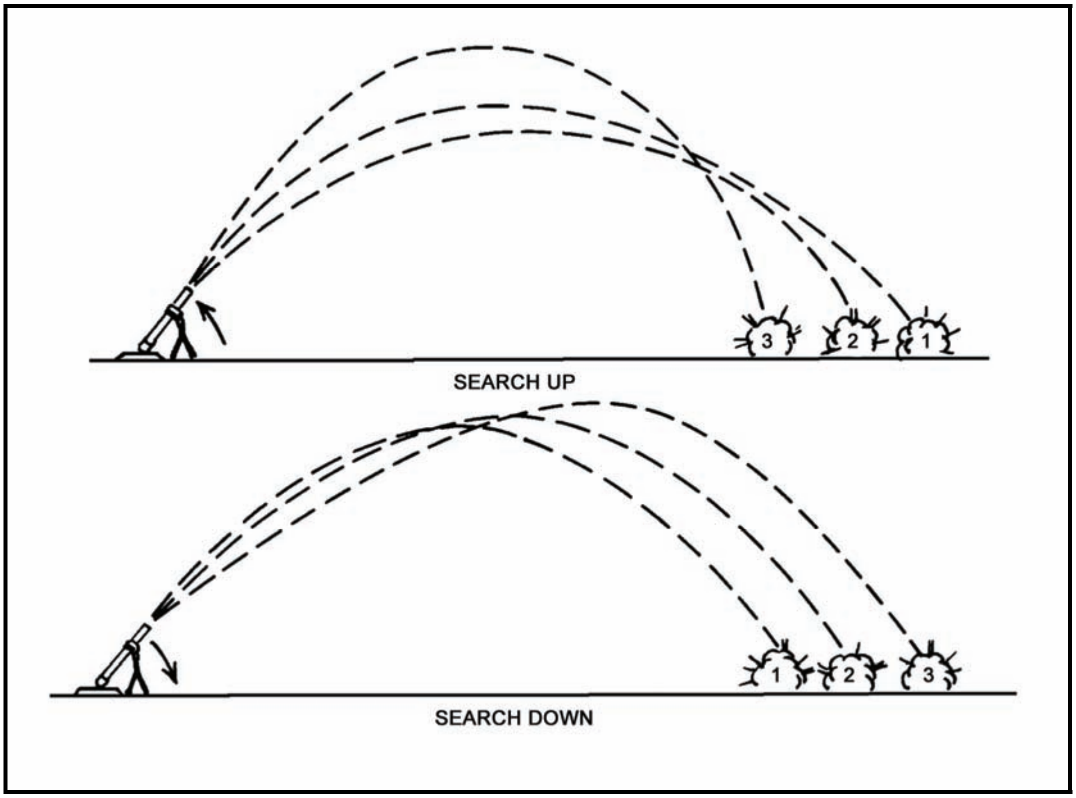

Figure 13-7. Fall of rounds during a search mission.

ILLUMINATION

13-10. 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: Deviation corrections are no less than 200 meters, and height corrections (up/down) are no less than 50 meters.

OBSERVERS

13-11. Observers who adjust illumination should be informed when 81-mm mortars are firing M301A3 illumination rounds.

- The M301A3 has a HOB of 600 meters (Figure 13-8), while the M301A1 and M301A2 rounds have a 400-meter HOB.
- 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 based on the fact that all three of the rounds fall at a rate of 6 meters per second (Table 13-2).

Table 13-2. Example of illumination adjustment.

ROUNDS	RATE OF FALL (MPS)	BURN TIME (SECONDS)	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

13-12. Corrections to the HOB are used to move the round up or down in relation to the HOB line (Figure 13-8).

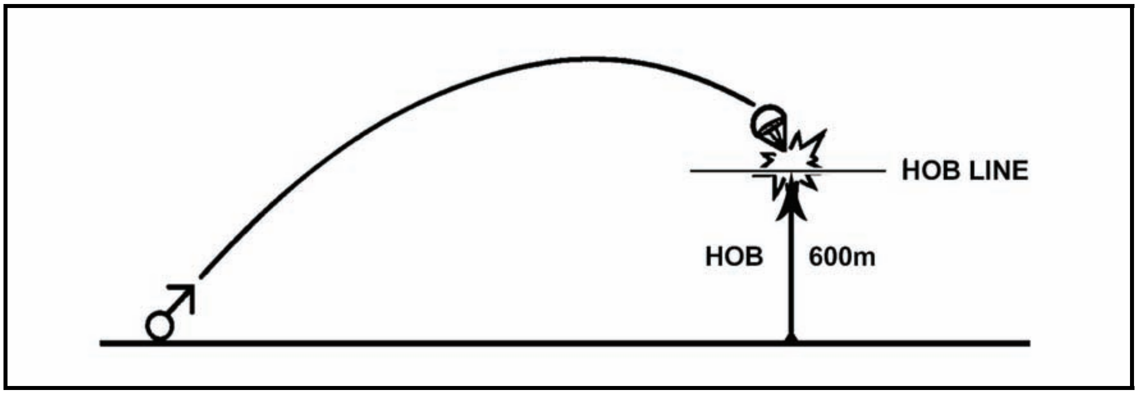

Figure 13-8. Height of burst line for an M301A3.

ADJUSTMENTS

13-13. 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 his corrections to the FDC.

FIRST EXAMPLE

13-14. The example will help illustrate 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

Consider the chart range to the first round fired: 2,525 meters.

(1) Enter 2,550 meters into FT 81-A1-3 (Figure 13-9).

Optimum charge to use: 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 8I-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

Figure 13-9. FT 81-A1-3, charge 8, used in determination of location of round in relation to the height of burst.

(3) The round is fired, and the FO sends, "Add two zero zero (200). Up one zero zero (100)" (Figure 13-10). The computed range is now:

2,725 = 2,750

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) 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).

(6) Multiply the increments by the correction factors given in these columns. Use FT 81-A1-3, charge 8 (Figure 13-9).

- Range to burst: 2,750 meters, +2 increments
- 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)

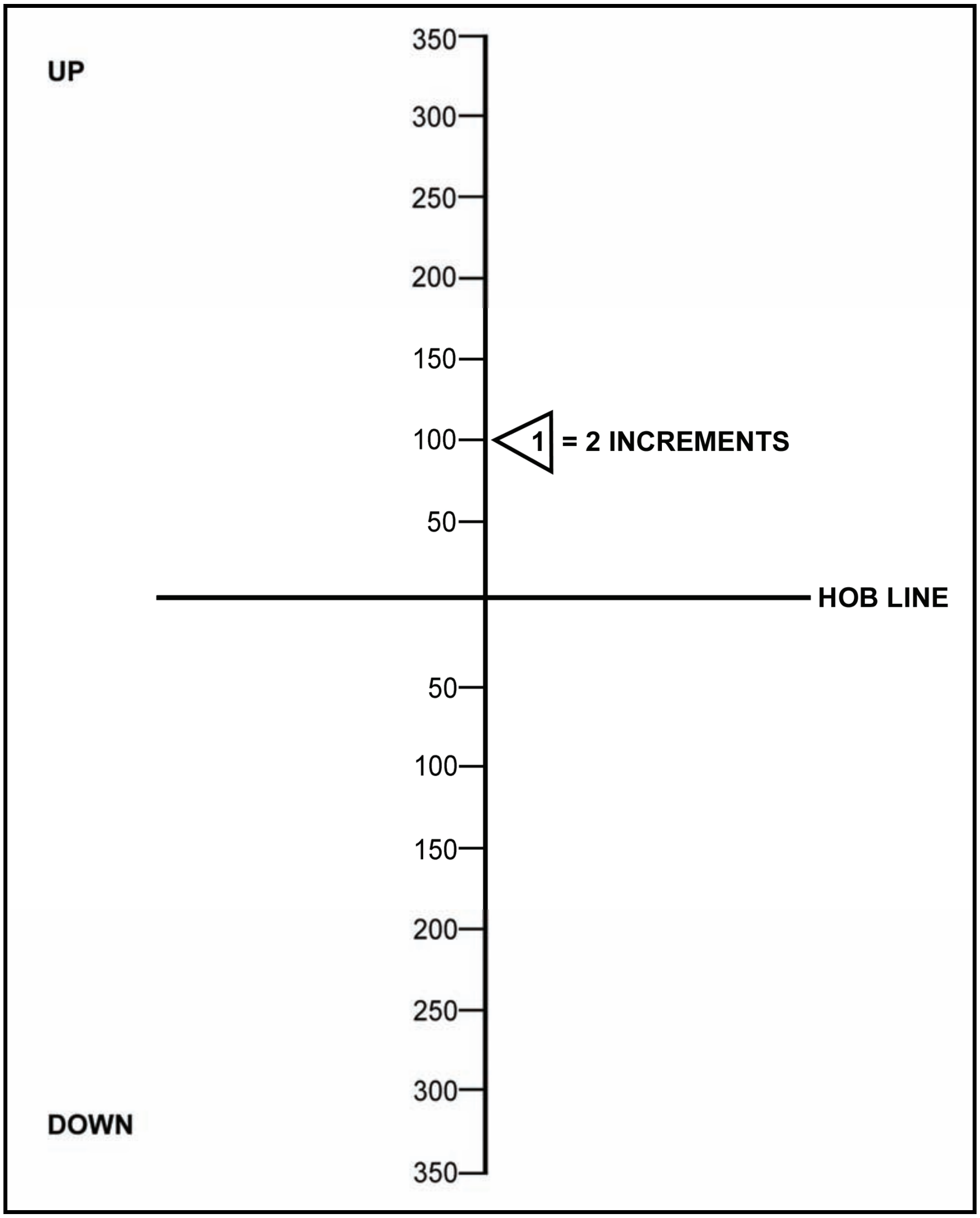

Figure 13-10. Firing adjustment.

(8) Assume that the second round is fired and the FO sends, "Down fifty (50)" (Figure 13-11). 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.
- The computer is now 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)

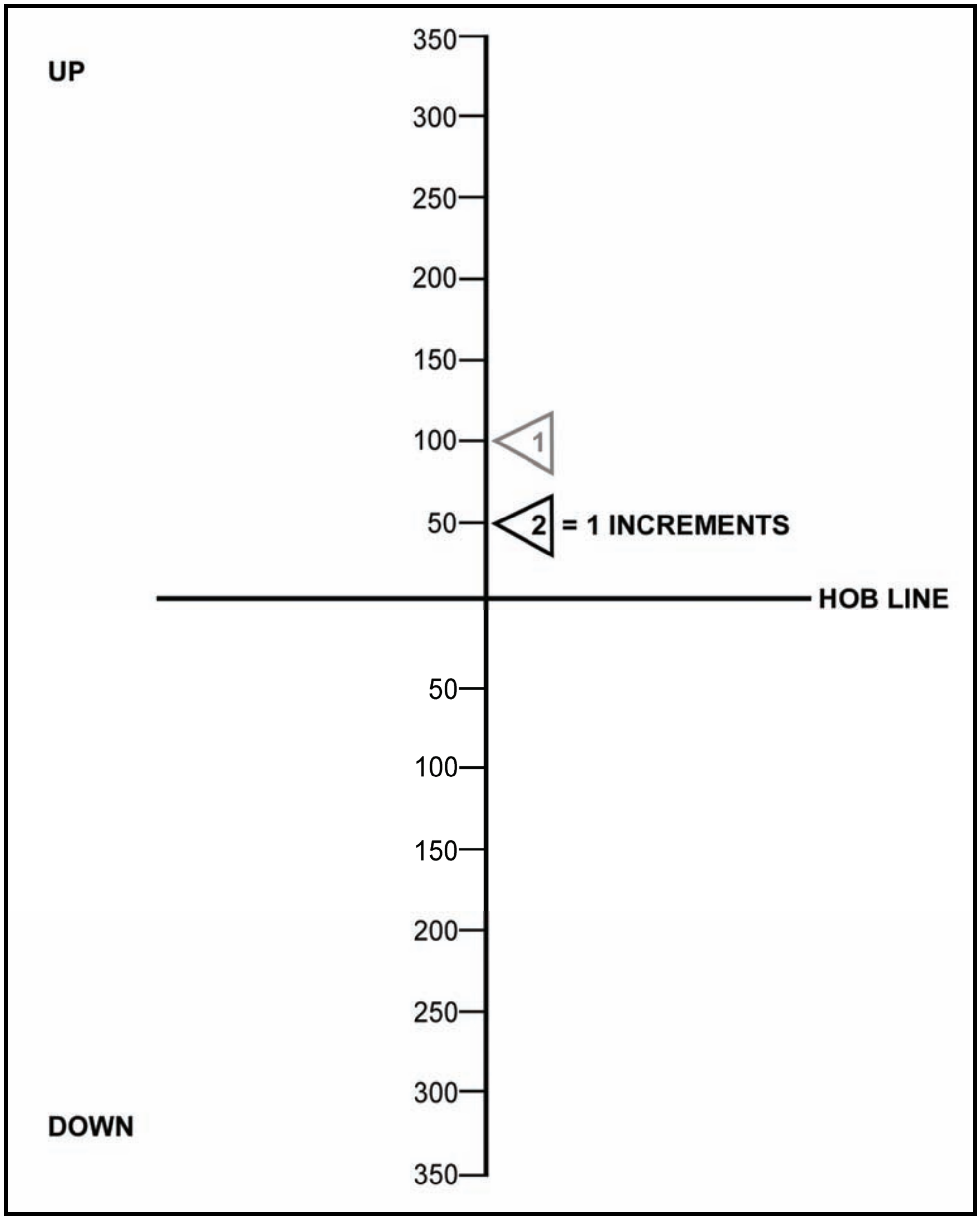

Figure 13-11. Firing adjustment.

SECOND EXAMPLE

13-15. This example will help illustrate the adjustments that the FDC computes when the round is below the HOB line. Charge 5 will be used, as shown in FT 81-A1-3 (Figure 13-12).

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 FOR 50M INCREASE IN HEIGHT OF BURST ELEV	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.

Figure 13-12. FT 81-A1-3, charge 5, used in determination of location of round in relation to the 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

The FO sends, "Drop two zero zero (200). Down one five zero (150)" (Figure 13-13). Assume that the new range is 1,325 meters (= 1,350), 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 a 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)

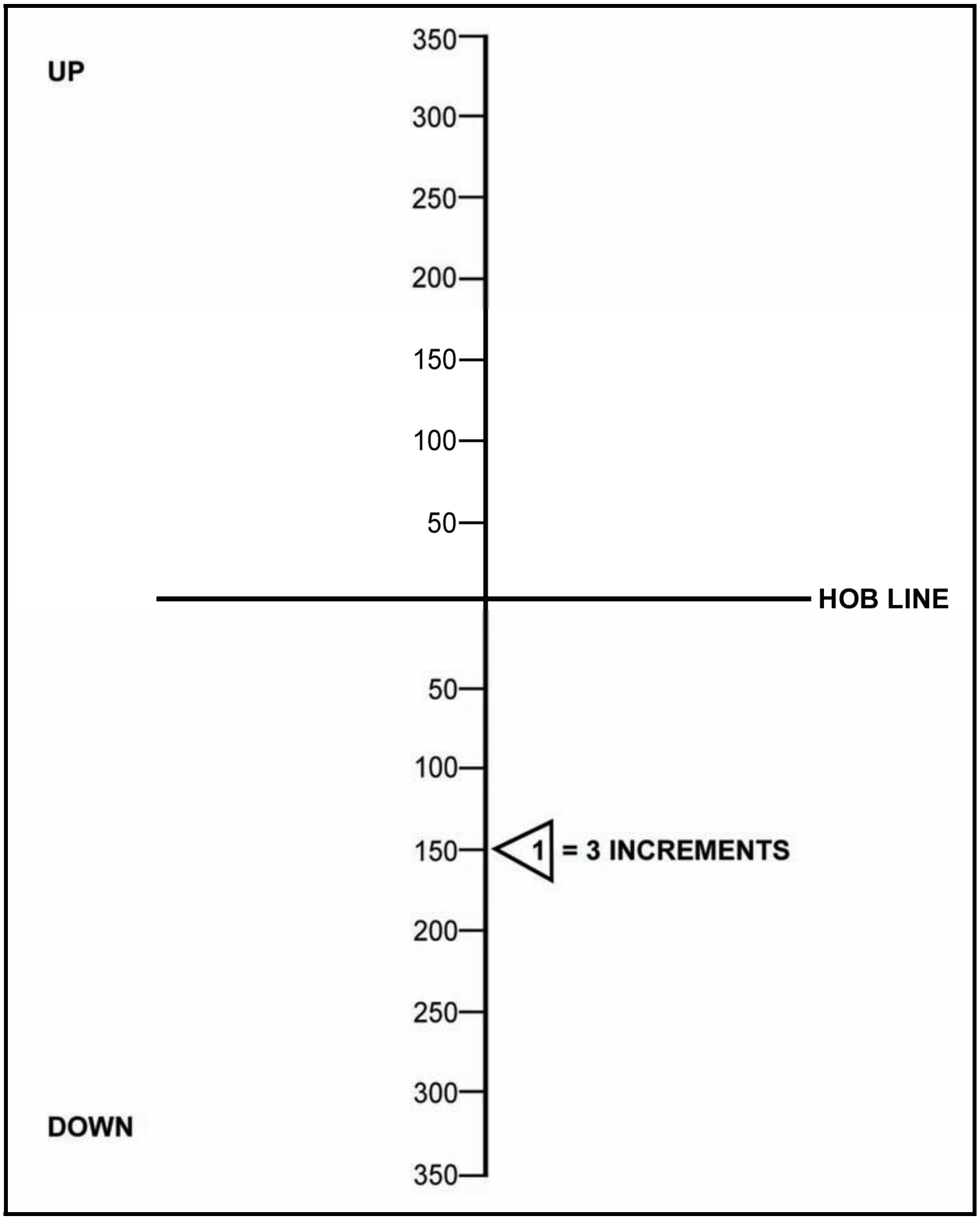

Figure 13-13. Firing adjustment.

Chapter 14

Special Considerations

This chapter discusses special procedures applied to some missions to effectively engage targets.

REGISTRATION AND SHEAF ADJUSTMENT

14-1. Firing the registration is the first mission that will be completed if time and the tactical situation permit.

FIRING COORDINATED AND NONCOORDINATED MISSIONS

14-2. Two types of registration missions are fired on the surveyed chart: coordinated and noncoordinated.

Firing Coordinated Missions

14-3. 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

14-4. 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.

CONSTRUCTING SURVEYED FIRING CHART

14-5. The surveyed firing chart is the most accurate chart that can be constructed. It can be used to determine all the correcting factors that are 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 similar to the modified-observed chart.

(1) To obtain the DOF after constructing the chart, align the mortar position with the RP. Determine the DOF to the nearest mil.

(2) To determine the mounting azimuth, round off the DOF to the nearest 50 mils.

(3) To superimpose the deflection scale, the referred deflection is received from the section sergeant. Then, construct the deflection scale in the same manner as for the modified-observed chart.

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

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(4) Determine correction factors after the registration has been completed. Apply these factors to all other targets within the transfer limits of the RP.

OBTAINING FIRING DATA

14-6. 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 (Figure 14-1). Refinement corrections are sent to the FDC and the mission is ended. Table 14-1 provides information to be used in setting up the plotting boards to fire a surveyed registration.

NOTE: See FM 6-30 for more information.

OBSERVER CORRECTION			CHART DATA		SUBSEQUENT COMMANDS						
DEV	RANGE	TIME (HEIGHT)	DEFL	CHARGE (RANGE)	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	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	

Figure 14-1. Splitting of a 50-meter bracket.

Table 14-1. Plotting of a surveyed registration.

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

ADJUSTING THE SHEAF

14-7. The purpose of adjusting the sheaf is to align the fires of all of the mortars. Mortars are positioned with gun No. 1 through 4 for 81-mm and 120-mm mortars (when employed as a platoon), or No. 1 through 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 (Figure 14-2).

NOTE: If the target has been mechanically surveyed, enter the DCT at the initial range plot. If the target is a nonsurveyed target (even if it is an eight-digit grid), enter the DCT at the final range plot.

RANGE IN METERS	DEFLECTION IN METERS														
	1	10	20	30	40	50	75	100	125	150	175	200	300	400	500
500	3.0	20	41	61	81	102	152	201	250	297	34	388	550	687	800
600	1.7	17	34	51	68	85	127	168	209	250	289	328	472	599	708
700	1.5	15	29	44	58	73	109	145	180	215	250	284	412	529	632
800	1.3	13	25	33	51	64	95	127	158	189	219	250	365	472	569
900	1.1	11	22	34	45	57	85	113	141	168	195	223	328	426	517
1000	1.0	10	20	31	41	51	76	102	127	152	176	201	297	388	473
1100	.93	9	18	28	37	46	69	92	115	138	161	183	271	355	435
1200	.85	8	17	25	34	42	64	85	106	127	148	168	249	328	402
1300	.79	8	16	23	31	39	59	78	98	117	136	155	231	304	374
1400	.73	7	15	22	29	36	55	73	91	109	127	145	215	283	349
1500	.68	7	14	20	27	34	51	68	85	102	118	135	201	265	328
1600	.63	6	13	19	25	32	48	64	80	95	111	127	189	250	309
1700	.60	6	12	18	24	30	45	60	75	90	104	119	178	235	291
1800	.57	6	11	17	23	28	42	57	71	85	99	113	168	223	276
1900	.54	5	11	16	21	27	40	54	67	80	94	107	160	211	262
2000	.51	5	10	15	20	25	38	51	64	76	89	102	152	201	250
2100	.49	5	10	15	19	24	36	48	61	73	85	97	145	192	238
2200	.46	5	9	14	19	23	35	46	58	69	81	92	138	183	228
2300	.44	4	9	13	18	22	33	44	55	66	77	88	132	175	218
2400	.43	4	8	13	17	21	32	42	53	63	74	85	127	168	209
2500	.41	4	8	12	16	20	31	41	51	61	71	81	122	162	201
2600	.39	4	8	12	16	20	29	39	49	59	68	78	117	155	194
2700	.38	4	8	11	15	19	28	38	47	57	66	75	113	150	187
2800	.37	4	7	11	15	18	27	36	45	55	64	73	109	145	180
2900	.35	4	7	11	14	18	26	35	44	53	61	70	105	140	174
3000	.34	3	7	10	14	17	25	34	42	51	59	68	102	135	168
3100	.33	3	7	10	13	16	25	33	41	49	57	66	98	131	163
3200	.32	3	6	10	13	16	24	32	40	48	56	64	95	127	158
3300	.31	3	6	9	12	15	23	31	39	46	54	62	92	123	153
3400	.30	3	6	9	12	15	22	30	37	45	52	60	90	119	149
3500	.30	3	6	9	12	15	22	29	36	44	51	58	87	116	145
3600	.29	3	6	8	11	14	21	28	35	42	49	57	85	113	141
3700	.28	3	6	8	11	14	21	28	34	41	48	55	82	110	137
3800	.27	3	5	8	11	13	20	27	33	40	47	54	80	107	133
3900	.27	3	5	8	10	13	20	26	33	39	46	52	78	104	130
4000	.26	3	5	8	10	13	19	26	32	38	45	51	76	102	127

Figure 14-2. Deflection conversion table.

EXAMPLE

The sheaf of an 81-mm platoon is being adjusted. No. 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 (No. 1, 3, 4) with 10-second intervals between rounds. The mortar that was used to register (No. 2) will not fire. The sheaf is adjusted perpendicular to the gun-target line. The observer notes where each round lands and sends back deviation corrections in meters; range corrections are ignored if less than 50 meters. If a deviation correction is 50 meters or more, it must be refired. Corrections to be refired should always be transmitted first by the FO.

If angle T is greater than 499 mils, each piece is adjusted onto the RP, and the FDC computes the data for the sheaf. In adjusting the sheaf, all rounds must be adjusted on line at about the same range (within 50 meters) and with the lateral spread between rounds equal to the bursting diameter of the ammunition used.

The spottings from the FO are No. 4, right 20, No. 3, left 60, and No. 1, left 30 (Figure 14-3). The FO then sends these corrections to the FDC; No. 3, right 60 (it is transmitted first because it needs to be refired [since it is greater than 50 meters]), No. 4, left 20 No.4 is adjusted, and finally No.1, right 30 No. 1 is adjusted. The No. 3 mortar is now fired, and the round impacts 10 meters right of the desired burst point. The FO would then send: No. 3, left 10, No. 3 is adjusted, sheaf is adjusted, end of mission.

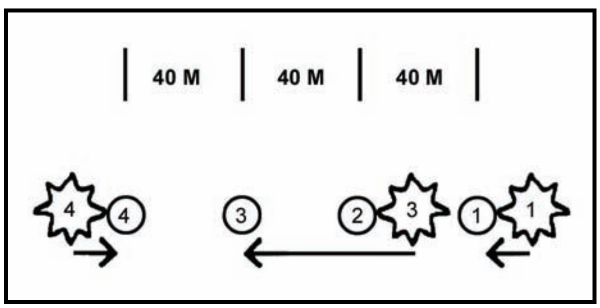

Figure 14-3. No. 1, No. 3, and No. 4 mortars out of sheaf.

OBTAINING CORRECTIONS USING THE DEFLECTION CONVERSION TABLE

14-8. 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 to apply. He 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 linear.

DETERMINING FIRING CORRECTIONS

14-9. Once registration is completed, the firing corrections (range correction factor and deflection correction) are applied to all targets within the transfer limits of the RP (Figure 14-4). The computer applies correction factors to correct for nonstandard conditions (weather and equipment wear) affecting the round.

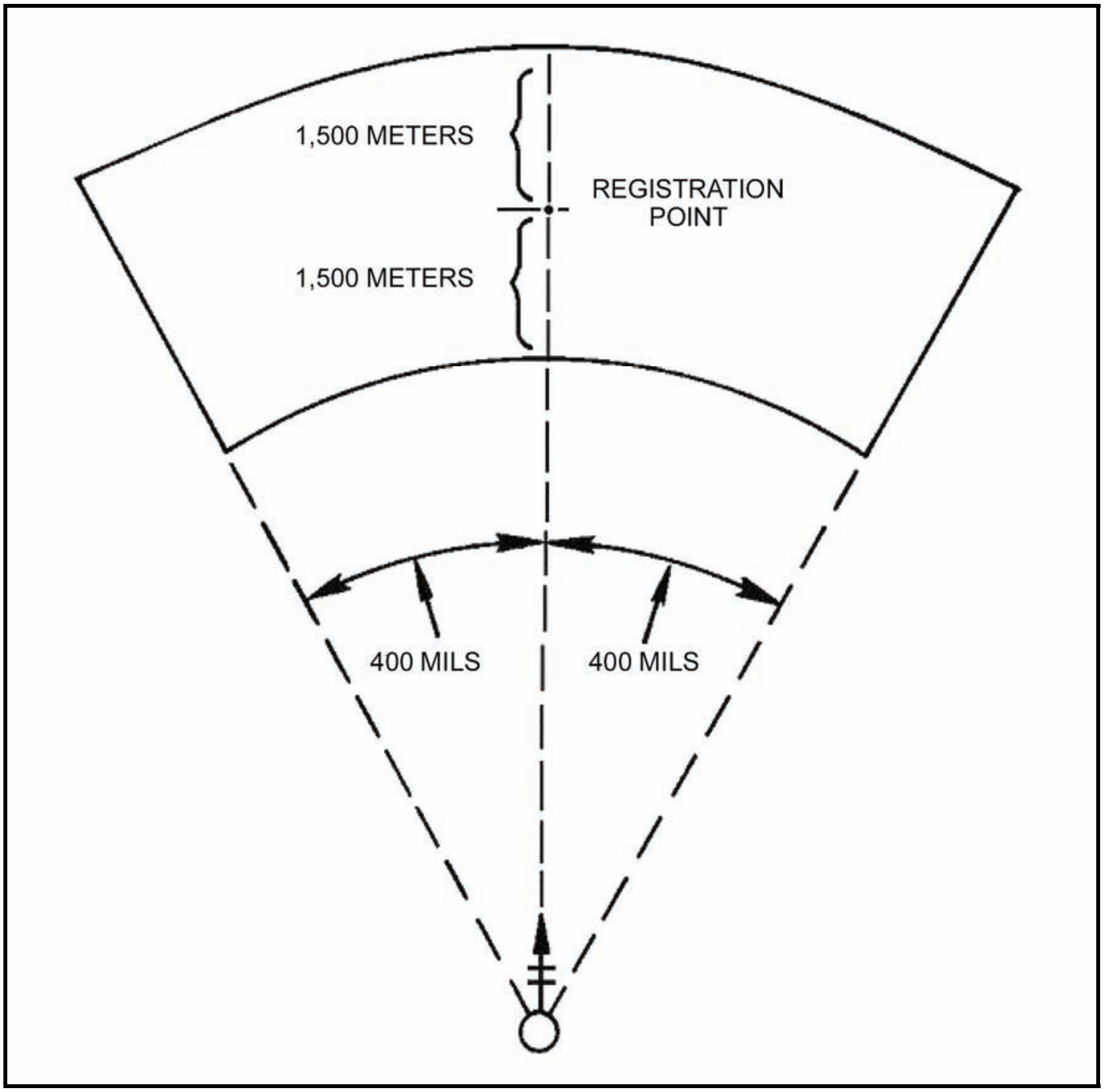

Figure 14-4. Transfer limits for one registration point.

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

DETERMINING MULTIPLE REGISTRATION POINTS

14-10. The ideal situation would be to have multiple RPs, if the tactical situation permits (Figure 14-5). Keep in mind each RP has its own range correction factor and deflection correction. 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 14-6, the initial chart range to the RP was 3,050 meters; the final adjusted chart range (range used to hit the RP) was 3,200.

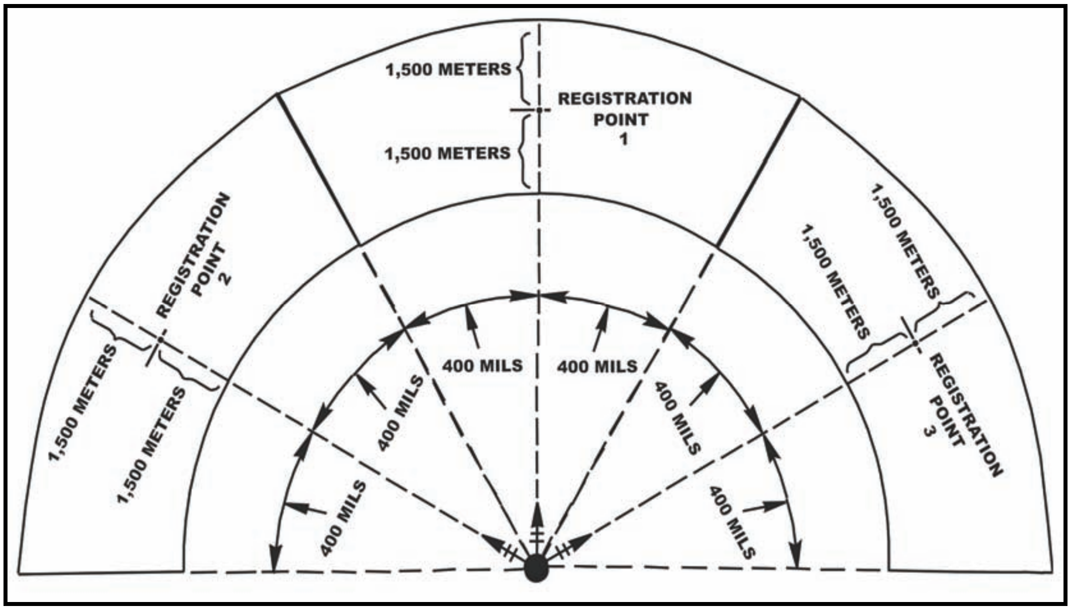

Figure 14-5. Multiple transfer limits.

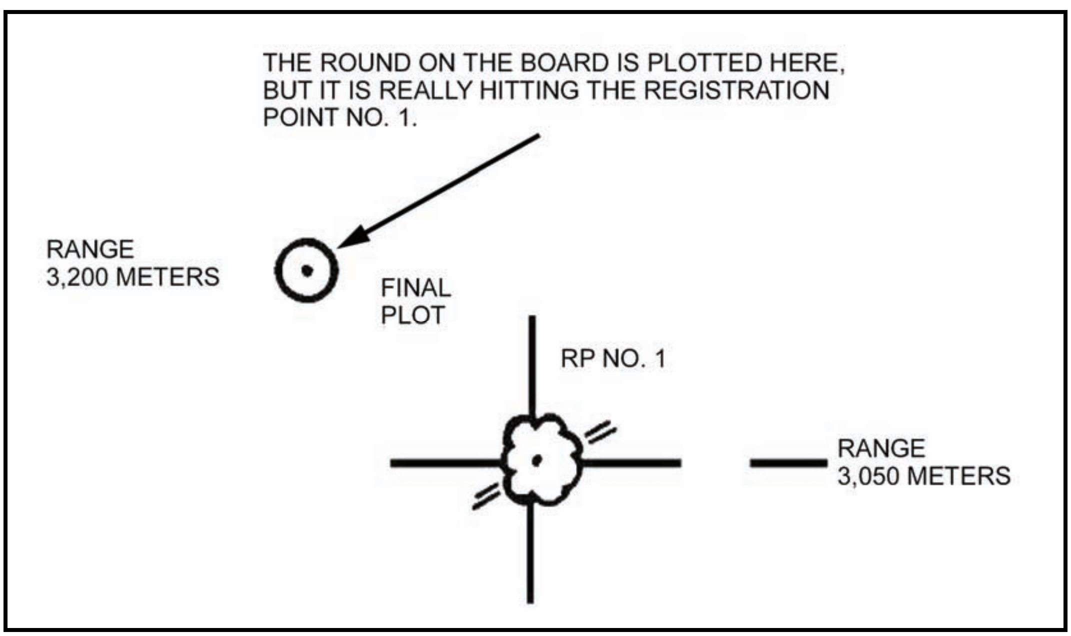

Figure 14-6. Plotting of rounds.

DETERMINING RANGE DIFFERENCE

14-11. The computer compares the initial chart range and the final adjusted chart range and subtracts the smaller from the larger. This gives the range difference. If the initial chart range is larger than the final adjusted 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: 3,050; final adjusted chart range: 3,200

Then, 3,200 - 3,050 = +150 meters.

Initial chart range larger: 3,200; final adjusted chart range: 3,050

Then 3,200 - 3,050 = -150 meters.

Range Correction Factor

14-12. The RCF is the number of meters per thousand 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 3,050 range to the RP, the RCF (+150) will also 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 thousandths. Determine to the nearest whole meter and use the sign of the range correction.

EXAMPLE

Range difference:	+150
Initial chart range:	3,050
Rounded to nearest 100:	3,100
Expressed in thousandths:	3.1

Divide the range in thousandths 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

14-13. The deflection correction 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 (Figure 14-7). Compare the initial chart deflection and the final chart deflection and subtract the smaller from the larger.

RULE: Final chart deflection (hit) larger = LEFT deflection correction; final chart deflection (hit) smaller = RIGHT deflection correction.

EXAMPLE

Hit Larger
Final chart deflection: 2,801
Initial chart deflection: 2,790
(2,801 – 2,790 = L11)

Hit Smaller
Final chart deflection: 2,790
Initial chart deflection: 2,801
(2,790 – 2,801 = R11)

14-14. Range and deflection corrections are applied to all other targets within the transfer limits of the RP.

FIRING OF A TOTAL RANGE CORRECTION MISSION

14-15. The procedure for a TRC mission on the surveyed chart is the same as with the modified-observed chart. However, now the firing corrections are applied to chart data to obtain command data (firing data sent to the mortars). For example, the computer assumes that the board is still set up on the information for the registration mission, and the mission in Figure 14-7 has been received. It is within the transfer limits.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN			P88	AB 0101

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION

GRID ______ OT DIRECTION ______ ALTITUDE ______

SHIFT FROM RP #1

OT DIRECTION 3550 ALTITUDE ______

☐ LEFT / ☑ RIGHT 200

☐ ADD / ☑ DROP 100

☐ UP / ☐ DOWN ______

POLAR

OT DIRECTION ______ ALTITUDE ______

DISTANCE ______

☐ UP / ☐ DOWN ______

VERTICAL ANGLE ☐ + / ☐ - ______

TARGET DESCRIPTION PIO

METHOD OF ENGAGEMENT

METHOD OF CONTROL

MESSAGE TO OBSERVER

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTART TO FFE: SEC	DEFLECTION: 2715	MORTAR TO FOLLOW: SEC	
MORTAR TO ADJ: #2	DEFLECTION CORRECTION: ☑ L ☐ R	SHELL AND FUZE: HEQ	
METHOD OF ADJ: 1 Rd			
BASIS FOR CORRECTION: RP1	RANGE: 2975	MORTAR TO FIRE: #2	
SHEAF CORRECTION:	VI/ALT CORRECTION: 50 ☐ + ☑ - 25	METHOD OF FIRE: 1 Rd	
SHELL AND FUZE: HEQ in ADJ PROX in FFE		3 Rds PROX in FFE	1 HE
	RANGE CORRECTION: +144	DEFLECTION/AZIMUTH: 2726	
METHOD OF FFE: 3 Rds	TRC ☑ + ☐ - 119	CHARGE: 6	
RANGE LATERAL SPREAD:	CHARGE/RANGE: 6/3100	TIME SETTING:	
TIME OF OPENING FIRE: W/R	AZIMUTH: 3360	ELEVATION: 0991	
	ANGLE T: 190		

DEV	RANGE	TIME (HEIGHT)	DEFL	CHARGE (RANGE)	MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	ROUNDS EXPENDED
		FFE			SEC	3 Rds PROX				0991	3 PROX
						EOM	EST	60%	CAS		
	NOTE:	+48 × 3.0 =	+144 − 25 = +119 TRC								

DA FORM 2399-R, FEB 2005 REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE APD V1.00

Figure 14-7. Example of completed DA Form 2399-R (Computer's Record) for firing a total range correction mission on the surveyed chart.

APPLYING FIRING CORRECTIONS

14-16. Once the chart data have been determined, the computer applies the deflection correction by either adding or subtracting the deflection correction to the chart data determined. When working with deflection corrections, the computer uses the LARS rule. The deflection correction must be applied to each chart deflection throughout the mission.

EXAMPLE

2,715 + L11 = 2,726

Range Correction

14-17. Determine the initial chart range, then round to the nearest hundred and express it in thousandths; for example, 2975 = 3000 = 3.0. Multiply the range in thousandths times 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

14-18. The TRC is the total correction that must be applied to get the command range to fire the target. TRC is the range correction (RCF x range in thousandths) plus or minus the altitude correction.

EXAMPLE

Range correction = +144 - 25 (altitude correction) = +119 TRC

14-19. The two factors (RCF and altitude 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 firing tables, the command range is rounded to the nearest 25 meters.

FIRING REREGISTRATION

14-20. The FDC must consider weather changes to ensure the accuracy of the firing data (firing corrections) from the surveyed chart. Two methods can be used to do this: reregistration 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 countermortar-radar, determining and applying the MET messages may be safer. The choice is dictated by the tactical situation and the availability of MET messages.

(1) Fire the reregistration at the established RP using only the mortar that originally fired the registration (Figure 14-8). (The FDC assumes that the sheaf is still parallel; therefore, the sheaf should not need adjusting again.) The chart data are the same as with the initial registration. Apply the firing corrections to obtain the command data (Figure 14-8). A blank reproducible copy of DA Form 2188-R (Figure 14-9) is located at the back of this manual.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN			P 88	RP 1

☑ 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 ______
☐ UP / ☐ DOWN ______
VERTICAL ANGLE ☐ + / ☐ - ______

TARGET DESCRIPTION RP 1
METHOD OF CONTROL
METHOD OF ENGAGEMENT
MESSAGE TO OBSERVER PREPARE TO RE REG RP 1

FDC ORDER

MORTART TO FFE #2
MORTAR TO ADJ ______
METHOD OF ADJ 1 Rd
BASIS FOR CORRECTION RP 1
SHEAF CORRECTION ______
SHELL AND FUZE HEQ
METHOD OF FFE ______
RANGE LATERAL SPREAD ______
TIME OF OPENING FIRE W/R

INITIAL CHART DATA

DEFLECTION 2790
DEFLECTION CORRECTION ☑ L ☐ R 11
RANGE 3050
VI/ALT CORRECTION ☐ + ☑ - 50
RANGE CORRECTION ☐ + ☑ - 25
CHARGE/RANGE 6
AZIMUTH 3660
ANGLE T 140

INITIAL FIRE COMMAND

MORTAR TO FOLLOW #2
SHELL AND FUZE HEQ
MORTAR TO FIRE ______
METHOD OF FIRE 1 Rd
DEFLECTION/AZIMUTH 2801
CHARGE 6
TIME SETTING ______
ELEVATION 0958

ROUNDS EXPENDED: 1

OBSERVER CORRECTION			CHART DATA		SUBSEQUENT COMMANDS						ROUNDS EXPENDED
DEV	RANGE	TIME (HEIGHT)	DEFL L11	CHARGE (RANGE)	MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	
R50	-100		2783	+125 2950			2794	3075		1001	2
	+25	EOM R/C	2777	2975			2788	3100		0991	3

NOTE: CHART DEF 2790 ADV CMD RNG 3125
DEF 2788 INT CHT RNG 3050
+75 RNG CORR
R 2 DEF CORR
3.1 $\frac{+24.1}{75.00}$ = 24 RCF
3100 + 25 = 3125
CMD RNG W/O VI CORR = ADJ CMD RNG

DA FORM 2399-R, FEB 2005 REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE APD V1.00

Figure 14-8. Example of completed DA Form 2399-R (Computer's Record) for a reregistration.

DATA SHEET

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

SETUP		WEAPON DATA			FO DATA		
TIME OUT: 60		UNIT: B 1/29	WPN: 1	WPN:	FO	ALT	GRID
TGT PRFX: AB			DIR: 5250	DIR:	P88	620	010 622
TGT NO: 0100 – 0500		81 mm CAR: ☐ YES ☑ NO	DIS: 50	DIS:			
ALARM: ☐ ON ☑ OFF		BP: 2	WPN: 3	WPN:			
MIN E: 096		E: 0086	DIR: 2050	DIR:			
MIN N: 029		N: 6158	DIS: 50	DIS:			
GD: ☑ E ☐ W 10		ALT: 520	WPN: 4	WPN:			
LAT: ☑ + ☐ - 34		AZ: 3650	DIR: 2050	DIR:			
LISTEN: ☐ ON ☑ OFF		DEF: 2800	DIS: 100	DIS:			
BIT RATE: 1200		ELE:					
KEY TONE: 1.4							
BLK: ☑ SNG ☐ DBL							
OWNER ID: A							

AMMUNITION DATA

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

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 5884	470	2790	3050	L11	+150	470 / -50	-25	2801	3175		0958		RP #1		R/C	7 HE	293
AB 0105		470	2715	2975	L11	+144	470 / -50	-25	2726	3100		0991		PIO	SEC 3 RD PROX	S/A EST 60% CAS	14 HE	279
RP1		470			L11	-25	470 / -50	-25	2788	3100		0991		RP #1		RR/C	3 HE	276
					UP DATING AFTER REREGISTRATION													
RP1			2790	3050	R2	+75	470 / -50	-25	2788	3100			0991					
AB 0105			2715	2975	R2	+72	470 / -50	-25	2713	3025			1019					

DA FORM 2188-R, MAR 1991 REPLACES DA FORM 2188-R, MAR 1977 WHICH IS OBSOLETE. USAPA V1.00

Figure 14-9. Example of completed DA Form 2188-R (Data Sheet).

(2) The chart deflection plus or minus deflection correction equals command deflection. The chart range plus or minus the range correction plus or minus the altitude correction equals the command range.

(3) Carry out the mission the same as with the initial registration. Once the EOM, "Registration complete," has been given, determine firing corrections again.

(4) In the initial registration, the FDC compared the initial chart range and the final chart range difference. Determining the range difference after the reregistration is the same; however, now determine the final adjusted range. During the reregistration, firing corrections were applied for each round. Now apply those same corrections.

(5) Adjusted range is the final range with the correction for altitude correction deleted.

EXAMPLE

Final command range: 3,100 meters; altitude correction: -25
Final adjusted range: 3,100 + 25 = 3,125

The altitude correction is added since it was initially subtracted. If the altitude correction had been a plus (+), then it would have been subtracted to obtain the final adjusted range.

(6) Once the final adjusted range has been determined, compare the initial chart and the final adjusted 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 thousandths) into the new range correction to determine the new RCF.

(7) To determine the deflection correction, 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.

(8) Apply the new firing corrections to all targets that have been and are fired within the transfer limits. 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.

MEAN POINT OF IMPACT REGISTRATION

14-21. The FDC uses MPI registration during darkness and on featureless terrain to determine firing corrections. Two M2 aiming circles or radar must be used to conduct an MPI registration. MPI registration can also be used for reregistration.

CONDUCT OF A MEAN POINT OF IMPACT REGISTRATION

14-22. To fire the MPI registration, the FDC must proceed as follows:

(1) Set up the M16/M19 plotting board as a surveyed firing chart (eight-digit grids to the mortar position and RP).

(2) Plot the location and altitudes of the two FO points to be used. Because the FOs will be sending azimuth readings for the impact points of the rounds, they must see the area of the RP using the M2 aiming circle.

(3) Record all data on DA Form 2188-R. To determine each FO's direction to the RP, rotate the azimuth disk until the FO's position is aligned with the RP. Read the azimuth scale to the nearest mil. To determine each FO's vertical angle (VA), compare the altitudes of each FO's location and the RP, and subtract the smaller from the larger. This remainder is the VI, which is used to determine the vertical angle and carries the sign of the larger. Determine the range from each FO's location. Round the range to the nearest 100 and express it in thousandths. Divide the

range expressed in thousandths into the VI and determine the product to the nearest whole mil. The sign (+/-) of the VA is the same as the VI sign (+/-).

EXAMPLE

Assume that the VI is -80 for FO 1 and +50 for FO 2.
The range for FO 1 is 2,525 meters; for FO 2 is 3,000 meters.

FO 1: 2,525 = 2,500 = -800 ÷ 25 = -32 VA: -32 mils

FO 2: 3,000 = 3,000 = +500.0 ÷ 30 = +16.6 VA: +17 mils

Send the direction and VA to the FOs so they can set up their M2 aiming circles.

(4) To determine the firing data, align the mortar position with the RP. Determine the chart data and apply the range correction for altitude between the mortar and target. During the registration, only the range correction for altitude is used. Give the firing command to the base mortar. Three to six rounds will be fired at 10-second to 20-second intervals. The FO uses this interval to give himself time to determine the azimuth readings to each round. If the azimuth for one or more rounds is determined to be 50 or more mils different, then another round may be fired for each erratic round. Six rounds are needed for the most accurate MPI registration, but as few as three rounds give correction data.

(5) As the rounds are fired, the FO reads the azimuth to each round and records it. When the last round has been fired, he sends the data recorded to the FDC. Once the rounds are fired and the readings are recorded in the FDC, plot the MPI as follows:

- Determine the total by adding all the readings from each FO.
- Divide the total by the number of readings to determine the average of the readings to the nearest mil.

EXAMPLE

	FO 1	**FO 2**
1	6104	0400
2	6110	0402
3	6105	0404
4	6106	0405
5	6107	0401
6	6109	0400
TOTAL	36,641 mils	2,412 mils

36,641 ÷ 6 = 6,106.8 = 6,107 mils (average azimuth)

2,412 ÷ 6 = 402 = 402 mils (average azimuth)

NOTE: FDC may send the average azimuth.

- Once the average azimuth for each FO has been determined, index the average azimuth and draw a line from each FO position toward the top of the board; where the lines intersect is the MPI. Determine and record the eight-digit grid coordinates and altitude of the MPI.

DETERMINATION OF RANGE CORRECTION FACTORS

14-23. With the MPI and RP on the board and the altitude determined, correction factors to be applied to other targets within the transfer limits of the RP must be determined. Again, because of the effects of interior and exterior ballistics on the round, the MPI may not be plotted in the same location on the plotting board as the surveyed point. Therefore, the corrections to hit that surveyed point must be determined. These corrections are noted on DA Form 5472-R (Computer's Record [MPI]) (Figure 14-10). A blank reproducible copy of DA Form 5472-R is located at the back of this manual.

Range Difference

(1) Compare the command range to the MPI point (minus the altitude correction) and the initial chart range to the RP.

EXAMPLE

Command range MPI = M Alt 500 mils, MPI Alt 450 mils, VI = -50, Alt Corr -25. Adjusted chart range to the MPI = command range 2,650 M + 25 (to delete altitude correction, reverse the sign) = 2,675 adjusted chart range to the MPI.

---

(2) The sign of the range difference is determined by how the move from the MPI to the RP must be made. If the RP range is larger, the difference is a plus (+); if smaller, it is a minus (-).

EXAMPLE

Initial chart range to the RP is 2,600 meters; adjusted chart range to the MPI is 2,675 meters.

2,675 - 2,600 = -75 range difference

COMPUTER'S RECORD (MPI)

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

UNIT | DATE | TIME

MESSAGE TO OBSERVERS

PREPARE TO OBSERVE MPI REGISTRATION

OP#	DIR	VA
1	6105	− 32
2	0400	+ 17

REPORT WHEN READY TO OBSERVE

OBSERVER'S READINGS

ROUND NO	OP# 1	OP# 2
1.	6104	0400
2.	6110	0402
3.	6105	0404
4.	6106	0405
5.	6107	0401
6.	6109	0400
7.		
8.		
9.		
10.		
(MUST BE SIX USABLE AZIMUTHS)		
TOTAL OF AZIMUTHS (ADD EACH COLUMN)	36641	2412
AVG OF AZIMUTHS (TOTAL ÷ 6)	6107	0402
DIR TO MPI	6107	0402

VERTICAL ANGLE COMPUTATIONS

RP ALTITUDE 450

OP #	1	OP #	2
RP ALT	450	RP ALT	450
OP ALT	370	OP ALT	400
VI −	80	VI +	50
OP RANGE	2525	OP RANGE	3000
W / RXM		W / RXM	

(VI ÷ RN IN THOUSANDS = VA)

100/R		100/R	
VI x 100/R (NEAREST .1)		VI x 100/R (NEAREST .1)	
VA − (NEAREST MIL)	32	VA + (NEAREST MIL)	17

DATA SECTION

81-MM/60-MM

RP GRID | CHA | ELE

RP ALT	450	MPI ALT	450
MORT ALT	500	MORT ALT	500
VI −	50	VI −	50
ALT CORR −	25	ALT CORR −	25
RP CHART DATA		MPI DATA	
DEF	2790	DEF	2810
RN	2600	RN	2675
(MINUS ALT CORR)		(MINUS ALT CORR)	
DEF CORR		RANGE CORR	
RP DEF	2790	RP RN	2600
MPI DEF	2810	MPI RN	2675
DIFF L/R	20	DIFF +	75
DEF CORR L	20	RCF +	27
(TO APPLY, REVERSE SIGN)		(TO APPLY, REVERSE SIGN)	

120 mm

MPI ALT | CHA FIRED

MORT ALT | CHA CORR ±

VI

(USE THIS VI TO COMP CHA CORR)
(SUBTRACT IF + AND IF -)

CHART CHARGE TO MPI

CHART DEFL TO MPI

(DRAW THE ADJ CHG GAGE LINE FROM THE MPI POINT TO THE CHART CHG OF THE MPI POINT)

CHART RANGE TO MPI

DEFL FIRED

DEFL CORR R/L

(DETERMINE THE LARS CORR TO GET FROM MPI TO RP DEFL)

GRID OF MPI

DA FORM 5472-R, FEB 2005 — REPLACES DA FORM 5472-R, OCT 85, WHICH IS OBSOLETE. — APD V1.00

Figure 14-10. Example of completed DA Form 5472-R (Computer's Record [MPI]).

Range Correction Factor

14-24. Once the range difference has been determined, divide it by the chart range to the MPI rounded to the nearest 100 expressed in thousandths and round it to the nearest whole meter. The sign is the same as the range difference.

EXAMPLE

Range difference - 75	
Chart range to MPI	2,675 meters
Round to the nearest 100	= 2,700 meters
Express in thousandths	= 2.7
	-75.00 ÷ 2.7 = -28 meters RCF

Deflection Correction

14-25. Compare the chart deflection of the MPI and the chart deflection of the RP to determine the deflection correction (Figure 14-10). The sign of the deflection correction will be determined by how the move from the MPI to the RP must be made.

RULE: RP deflection is greater than the MPI deflection = LEFT deflection correction. RP deflection is less than MPI deflection = RIGHT deflection correction.

EXAMPLE

MPI chart deflection = 2810; RP chart deflection = 2,790
2,810 – 2,790 = L20 (correction to apply R20)

14-26. The application of the correction factors to other targets, within the transfer limit of the RP, is the same as with the other registration corrections except that the sign of the corrections must be reversed.

NOTE: The only time the corrections will be applied with the signs as determined is when the corrections are being applied to move the strike of the round from the MPI to the RP.

VERTICAL INTERVAL CORRECTION FACTORS

14-27. When the mortar position is known to surveyed accuracy and a map is being used, the computer can work with altitude differences and the correction factor for those altitude differences. As noted earlier, the term used for altitude difference is VI.

Determination of Vertical Interval

14-28. The computer compares the altitude of the mortar position and the altitude of the target being engaged. If the altitude 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 (-) (Figure 14-11).

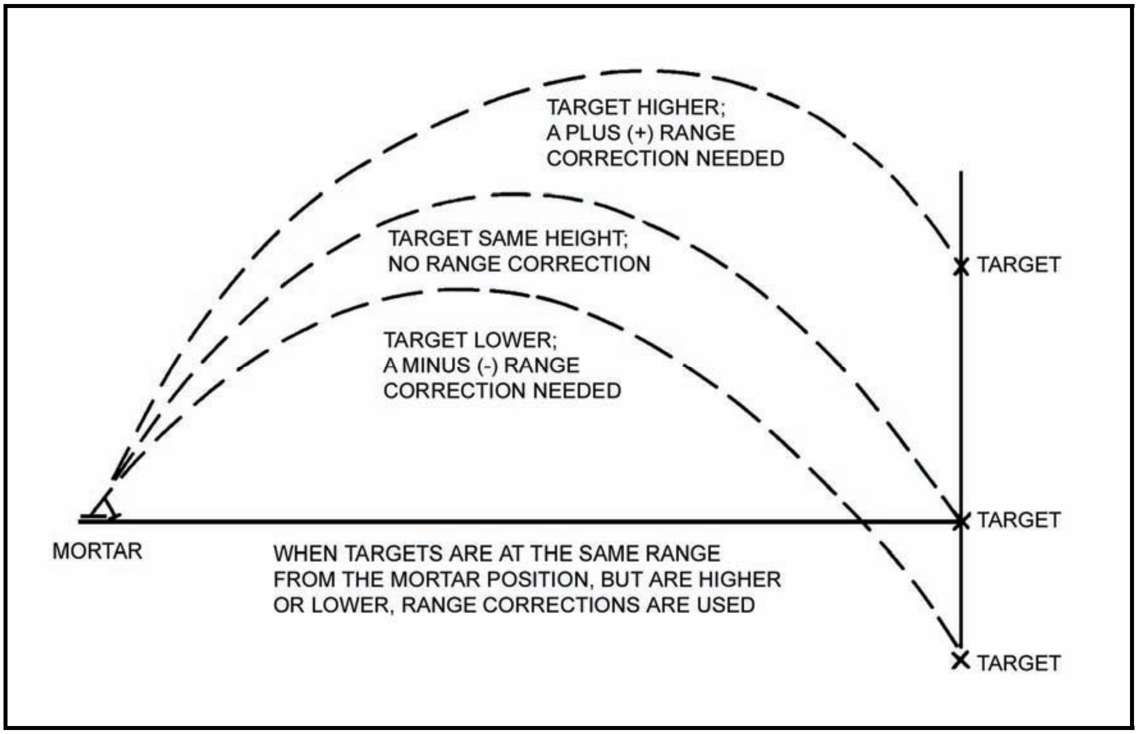

Figure 14-11. Altitude correction.

CORRECTION FOR VERTICAL INTERVAL

14-29. Because of the VI, a range correction must be applied to the chart range to obtain the range to be fired (command). The range correction to apply is half of the VI; it is determined to the nearest whole meter.

EXAMPLE

VI = 75 meters
1/2 = 38 meters (altitude [range] correction)

14-30. The altitude (range) correction must be 25 meters or more to be applied. The range correction is then added to or subtracted from the chart range. If the target is higher than the mortar, the computer adds the range correction; if lower, the computer subtracts to get the altitude to be fired (command). The altitude 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.

DETERMINATION OF VERTICAL INTERVAL FOR DIFFERENT MISSIONS

14-31. When there is a difference in altitude between the mortar position and the target, a range correction is made. Since the mortar round has a steep angle of fall, corrections are made only when differences of 50 meters or more in altitude exist. The chart range is corrected by one-half the difference in altitude expressed in meters. The correction is added when the target is above the mortar, and subtracted when the target is below the mortar. Difference in altitude can be determined from contour maps, by estimating, or by measuring the angle of sight, and by using the mil-relation formula.

Grid Missions

14-32. The target is plotted on the map and the altitude determined. If the altitude of the target cannot be determined, then the computer assumes that it is the same as that of the mortars.

Shift From a Known Point Missions

14-33. The target is assumed to be the same altitude 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 Missions

14-34. The altitude 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, then 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 of the target, then it is possible to determine the VI for the mission and, finally, the altitude correction to apply. Remember, VI is the difference in altitude between the mortars and the target.

RADAR REGISTRATION

14-35. Radar registration is another method used by the FDC to obtain firing corrections to apply to the firing data to obtain better accuracy.

14-36. Two types of radar units can be used: AN/PPS-5, which gives direction and distance to impact; and AN/PPS-4, which gives grid of impact. The one used will determine which method the FDC will use during the registration. At the unit level, the AN/PPS-5 will probably be used for the 60-mm and 81-mm mortars; the AN/PPS-4 for the 120-mm mortars.

NOTE: Registration of the AN/PPS-5 is explained here for the 60-mm and 81-mm mortars.

14-37. The M16/M19 plotting board must be set up as a surveyed firing chart. That is, the mortar position, RP, and radar site must be plotted to surveyed accuracy. The procedure for obtaining firing data is the same as with a regular registration mission. The altitude correction is the only firing correction used. Because this is a polar-type mission, the VI is now obtained as with a polar plot mission. The firing corrections are obtained in the same manner as with the regular registration mission.

14-38. After the board is set up and the direction and distance from the radar to the target have been determined, the FDC informs the radar operator of this information. The radar operator then orients the radar set using the information and calls the FDC when the set is ready. Once the radar is ready, the FDC then gives the initial data to the mortar section. The base mortar will adjust and then the sheaf will be established.

(1) When the first round impacts, the radar operator sends the FDC the direction and distance to that round.

(2) The FDC then indexes that direction and plots the round at the distance sent (the plot is made from the radar position plot, using the distance sent).

(3) The FDC indexes the mortar RP azimuth and determines the spotting by comparing the round's impact plot with the RP plot. The FDC, acting as the FO, determines all spottings (Figure 14-12).

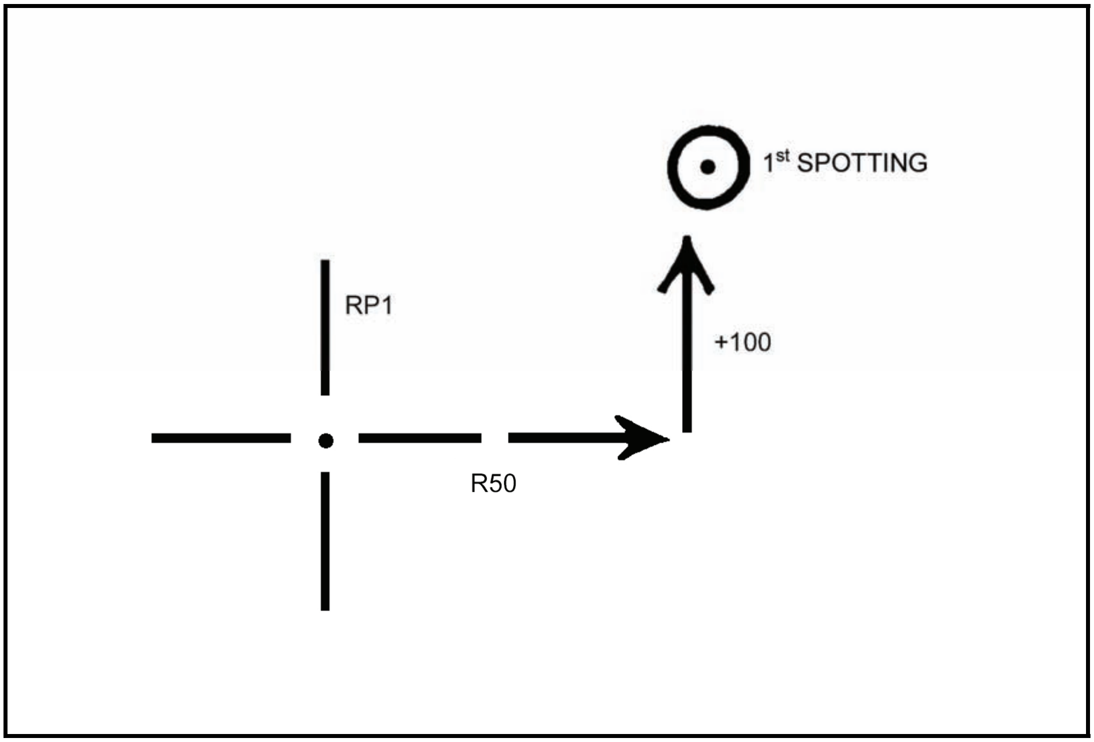

Figure 14-12. Determination of a spotting.

(4) Once the spotting has been determined, the FDC converts the spotting into a correction to fire the second round. He does this by reversing the signs of the spotting. He then applies that to the RP on the azimuth of the radar position (Figure 14-13).

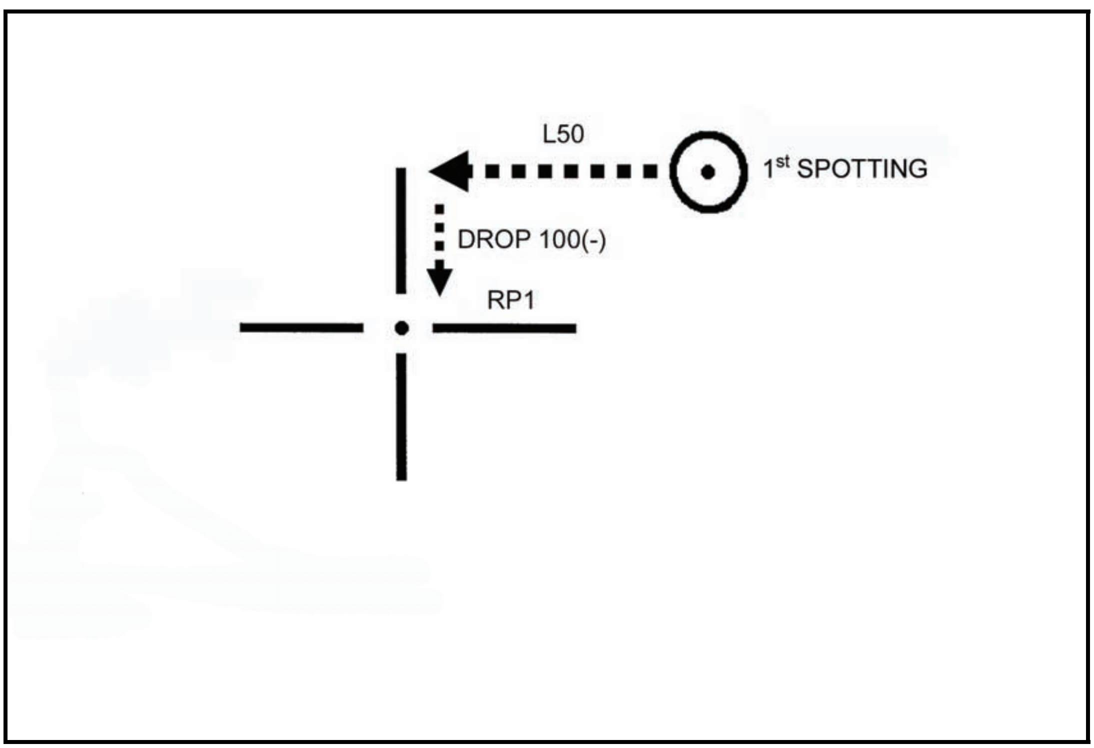

Figure 14-13. Application of correction to fire the second round.

(5) The firing data are then obtained by aligning the new plot with the mortar position. (6) The spottings for additional rounds are spotted from the initial RP, but the corrections (spotting reversed) are applied to the last fired plot. This procedure is repeated for all adjustment rounds until a range correction of 50 meters is split.

FINAL PROTECTIVE FIRES

14-39. The highest priority mission for the mortar section is FPF. The FPF is a barrier of steel designed to stop the enemy. 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 not more than 200 meters in front of friendly forces; however, the exact position of the FPF is based on the tactical situation.

14-40. The M16/M19 plotting board can be set up as any one of the three firing charts for FPF. With regard to the area of an FPF, the 60-mm and 81-mm mortar platoons can fire up to three FPF (one for each mortar).

14-41. 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.

14-42. 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 both the mortar section and the FPF, compute only the data for the FPF, with no rounds being fired (least desirable method).

14-43. Obtaining the firing data is still performed by aligning the mortar location with the plot being engaged and using the azimuth disk and vernier scale.

NOTE: If the FPF is within 200 meters of friendly troops, the FO should call for HE delay in adjustment (preferred method) and use the creeping method of adjustment.

14-44. When adjusting each mortar, the FO may (in the CFF) give a section left (SL) or section right (SR) to determine the danger close mortar. The danger close mortar is the one impacting closest to friendly troops.

(1) Once the danger mortar is known, it is adjusted onto the FPF line (Figure 14-14).

(2) Once the danger mortar has been adjusted, the next mortar (No. 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.

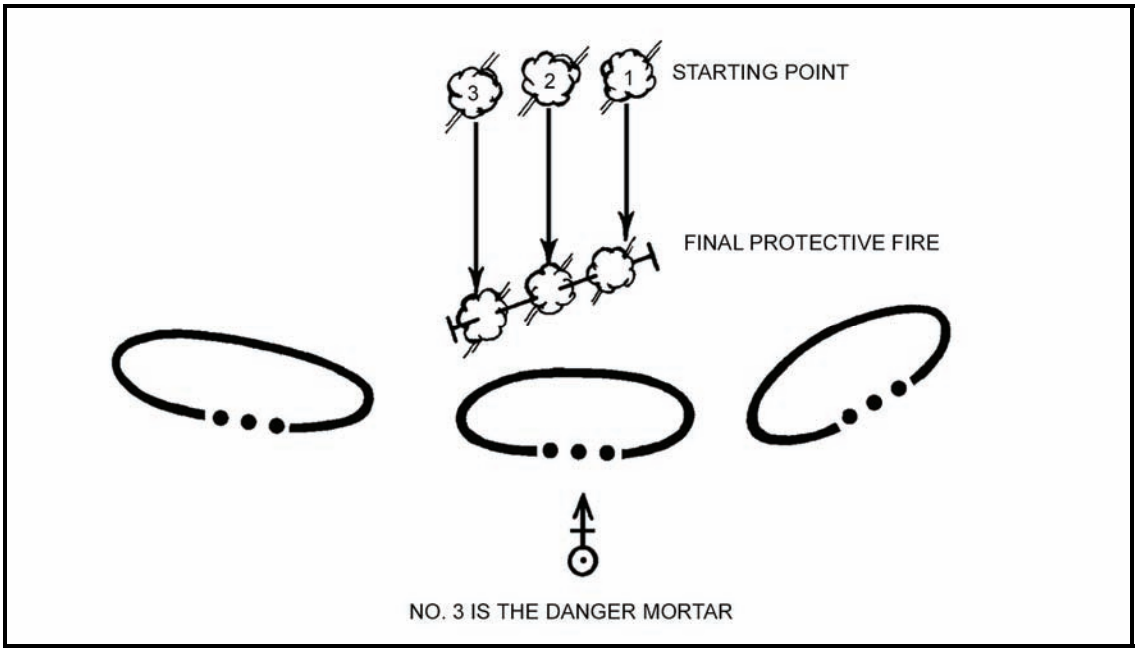

Figure 14-14. Determination of danger mortar.

(3) 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 are then given to each mortar and placed on the mortar after each mission. Also, the predetermined number (unit SOP) of rounds is set aside ready to fire (Figure 14-15).

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
B Co 1/29 IN			P 88	FPF

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

(ENCODED)
GRID 009 644
OT DIRECTION 3020
ALTITUDE

SHIFT FROM
OT DIRECTION ALTITUDE
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR
OT DIRECTION ALTITUDE
DISTANCE
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ -

TARGET DESCRIPTION FPF ATT 3740
METHOD OF ENGAGEMENT DANGER CLOSE
METHOD OF CONTROL SECTION LEFT
MESSAGE TO OBSERVER

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTART TO FFE: SEC	DEFLECTION: 2800	MORTAR TO FOLLOW: SEC	
MORTAR TO ADJ:	DEFLECTION CORRECTION: ☐ L ☐ R	SHELL AND FUZE: HED	
METHOD OF ADJ: 1 Rd S/L			
BASIS FOR CORRECTION:	RANGE: 2775	MORTAR TO FIRE: 1 Rd S/L	
SHEAF CORRECTION: Special	VI/ALT CORRECTION: ☑ + ☐ - 70	METHOD OF FIRE:	
SHELL AND FUZE: HEQ IN ADJ HEQ IN FFE	RANGE CORRECTION: ☑ + ☐ - 35	DEFLECTION/AZIMUTH: 2800	4
METHOD OF FFE: 20 Rds		CHARGE: 5	
RANGE LATERAL SPREAD:	CHARGE/RANGE: 5	TIME SETTING:	
TIME OF OPENING FIRE: AMC	AZIMUTH: 2630	ELEVATION: 0984	
	ANGLE T: 390		

OBSERVER CORRECTION			CHART DATA		SUBSEQUENT COMMANDS						
DEV	RANGE	TIME (HEIGHT)	DEFL	CHARGE (RANGE)	MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	
#1 L100	-100		2820	2825	# 1		2820	2850/5		0899	5
	-50		2814	2800	# 1		2814	2825/5		0918	6
#1 ADJ	REPEAT	# 2			# 2		2814	2825/5		0918	6
R50	-50		2825	2750	# 2		2825	[illegible]/5		0949	8
#2 ADJ	REPEAT	# 3			# 3		2825	2775/5		0949	9
L20	-25	EOM FPF ADJ	2830		#3	DNF	2830	2750/5		0963	

DA FORM 2399-R, FEB 2005 REPLACES DA FORM 2399, DEC 91 WHICH IS OBSOLETE APD V1.00

Figure 14-15. Example of completed DA Form 2399-R (Computer's Record) for computing final protective fire missions.

14-45. When adjusting only the danger close mortar, the computer is given the attitude of the target in the CFF.

(1) 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 (Figure 14-16).

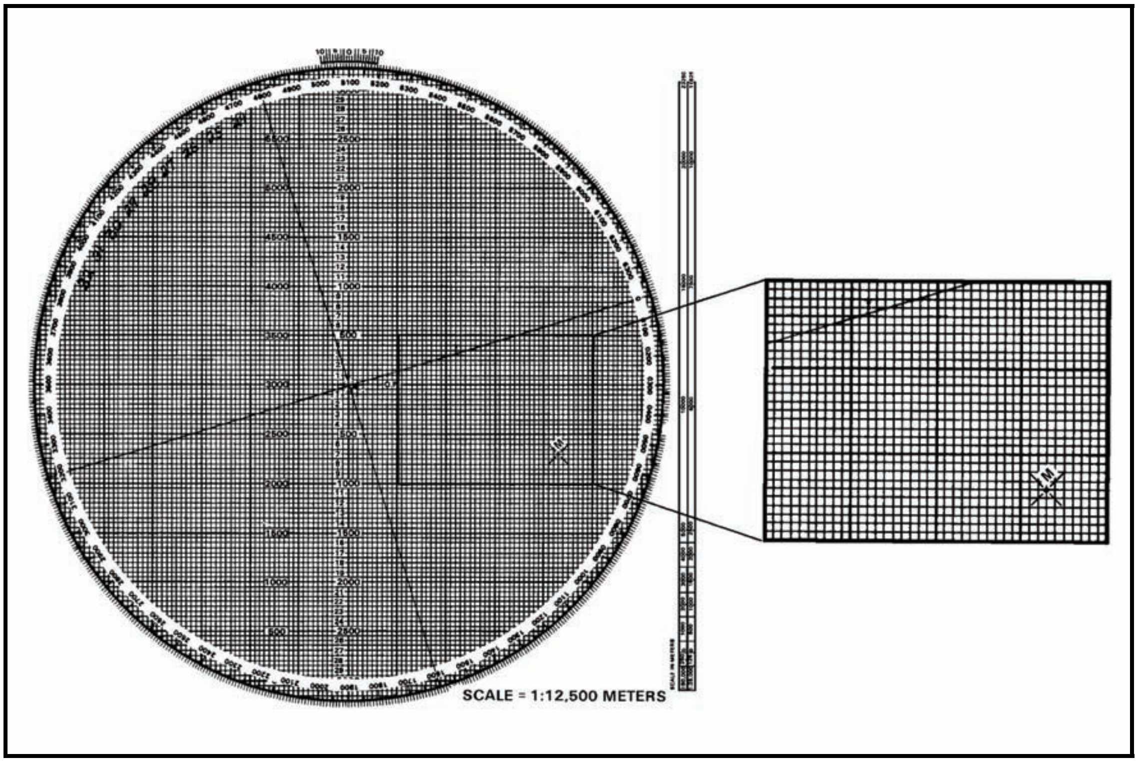

Figure 14-16. Drawing final protective fire symbol with attitude indexed.

(2) 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 (Figure 14-17).

- 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 danger mortar is fired and adjusted to the FPF line.

(3) After the danger mortar is adjusted to the FPF line, the computer then indexes the FPF attitude and erases all but the last plot.

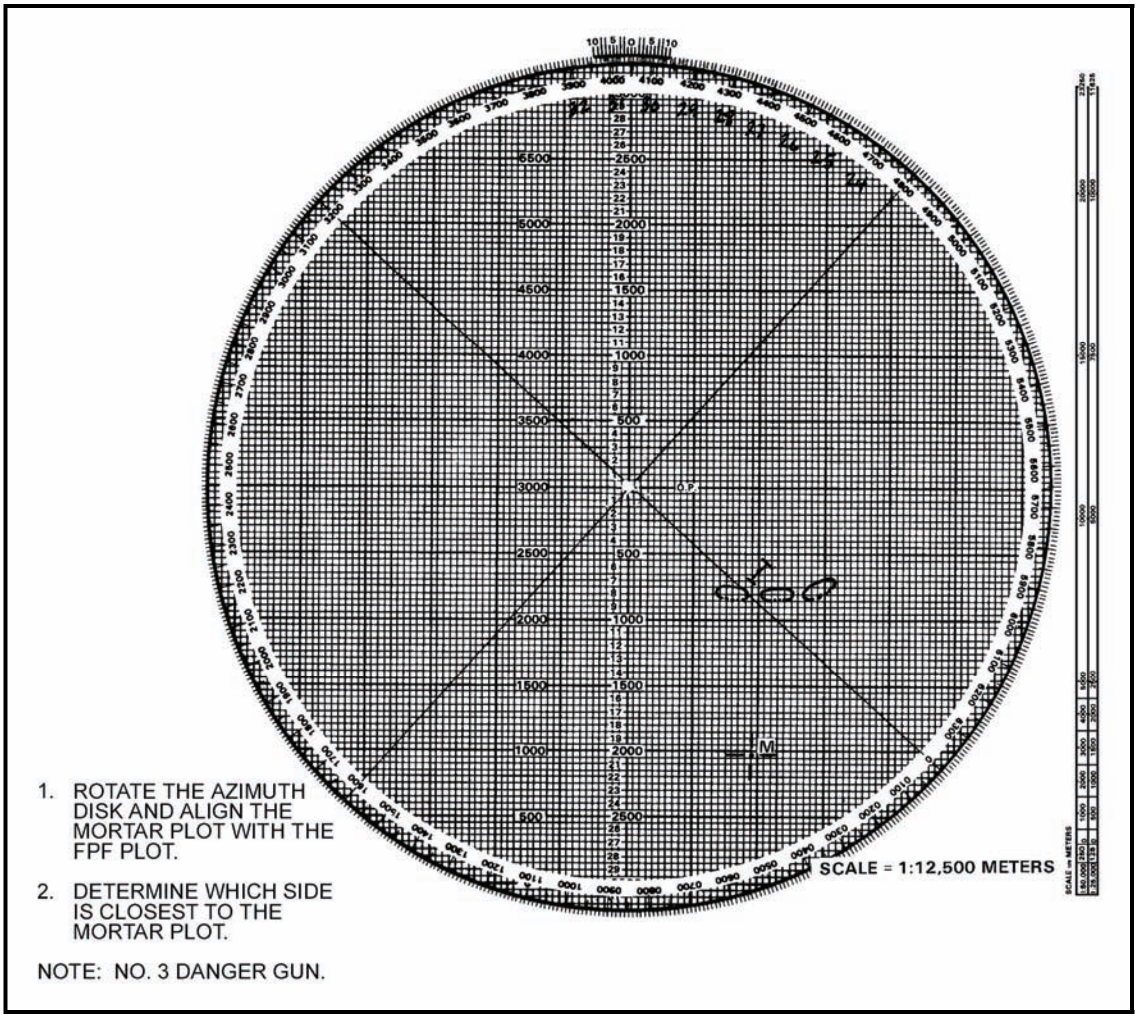

Figure 14-17. Determination of danger mortar.

(4) Using the last plot, the computer draws the FPF symbol by extending a line 90 meters long toward the top of the board and 10 meters long from the plot towards the bottom of the board. This shows the full 100-meter width of the FPF.

(5) The remaining plots for the No. 1, No. 2, and No. 3 mortars are then plotted 40 meters apart (Figure 14-18).

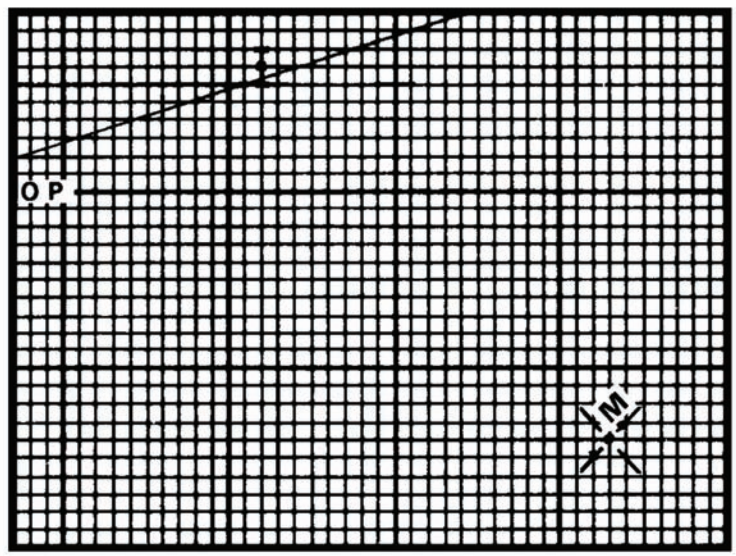

Figure 14-18. Plotting of No. 1, No. 2, and No. 3 mortars.

(6) 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 (Figure 14-19).

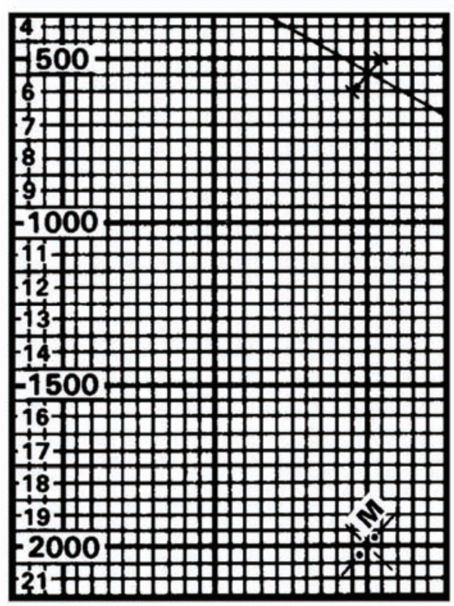

Figure 14-19. Alignment of each mortar with its impact point.

(7) Again, these data are placed on the mortar after each mission, and the rounds are readied to fire.

14-46. 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.

(1) The computer then indexes the attitude of the mortar section and plots the No. 1, No. 3, and No. 4 mortars 40 meters above and below the No. 2 mortar plot.

(2) Once the FPF and mortars have been plotted, each mortar is aligned with its impact plot, and the data determined.

(3) These data are given to the mortars and, again, are set on the mortars between missions.

(4) This method is used when ammunition is low and time or the tactical situation does not permit the adjustment of the FPF.

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Part Five

Mortar Fire Control System

Chapter 15

Introduction

The Mortar Fire Control System (MFCS) provides a complete, fully-integrated, digital, onboard fire control system for the carrier-mounted 120-mm mortar. It provides a "shoot and scoot" capability to the carrier-mounted M121 mortar. With the MFCS, the mortar FDC computes fire commands to execute fire missions and controls its gun tracks. The carrier-mounted MFCS components work together to compute targeting solutions, direct the movement of vehicles into firing positions, allow real-time orientation, and present gun orders to the gunner.

SECTION I. INITIALIZATION AND CONFIGURATION

This section discusses the introduction, initialization, and configuration of the MFCS.

DESCRIPTION

15-1. The MFCS 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 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 are then transmitted digitally or by radio. Should the FDC become disabled, each mortar crew can compute its own fire missions if the FDC is configured as a gun/FDC. System accuracy is increased through the use of a Global Positioning System (GPS), an onboard azimuth reference for the gun, and digital MET updates. The MFCS (Figure 15-1) enables self-surveying mortars, digital call for fire exchange, and automated ballistic solutions.

NOTE: For more information about the MFCS, see TM 9-1220-248-10 and FM 3-22.90.

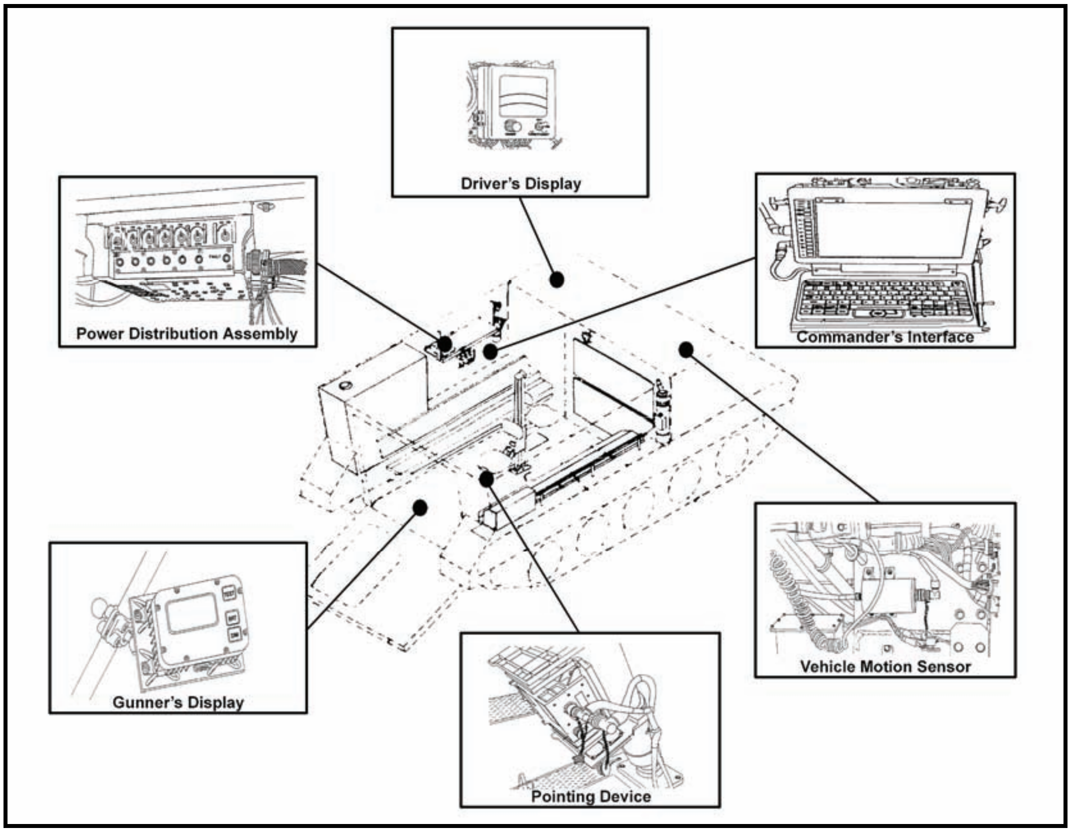

Figure 15-1. Mortar Fire Control System.

COMMANDER'S INTERFACE

15-2. The CI (Figure 15-2) 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 CI's graphic user interface (GUI) to operate the system using the built-in mouse or the keyboard to point and click buttons and tabs. Data are presented on screens designed for specific missions and operations. The CI's keys and their functions are as follows.

Function Keys

15-3. 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 15-2) to make selections in the software (F11 and F12 are not used). Table 15-1 identifies the assignment of keys.

Table 15-1. Function keys.

FUNCTION KEY	ASSIGNMENT
F1	This Menu
F2	Use All
F3	Undo Changes
F4	FSCMs
F5	Hipshoot
F6	Final Protective Fire (FPF)
F7	Boresight
F8	Safety Fan
F9	Checkfire
F10	To Be Determined
F11	Not Used
F12	Not Used

Keyboard Backlighting Control

15-4. This control (2, Figure 15-2) adjusts the intensity of the light (with off, low, and high settings).

Number Lock Key and Indicator

15-5. 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 15-2) may result in the inability to perform other desired functions. When activated, the indicator light is illuminated.

Mouse

15-6. The mouse (4, Figure 15-2) allows the operator to move the cursor on the screen and make selections.

Windows Key

15-7. The Windows key (5, Figure 15-2) is not used by the operator.

Alpha, Numeric, and Special Character Keys

15-8. The alpha, numeric, and special character keys (6, Figure 15-2) function as a standard keyboard to compose messages and enable operators to enter data into the system.

Blackout Key

15-9. The Blackout key (7, Figure 15-2) blacks out the screen to guard against enemy detection in a tactical environment.

Right, Left, Down, and Up Direction Arrow Keys

15-10. The right, left, down, and up direction arrow keys (11 through 14, Figure 15-2) enable operators to make selections in the software. Mouse or keyboard use is recommended.

Enter Key

15-11. The Enter (ENT) key (15, Figure 15-2) brings up a menu of function keys.

Control, Alternate, and Escape Keys

15-12. The Control (CTL), Alternate (ALT), and Escape (ESC) keys (16 through 18, Figure 15-2) are not used in this application.

Screen Brightness Intensity Buttons

15-13. The screen brightness intensity buttons (19 and 20, Figure 15-2) decrease and increase the brightness of the LCD screen.

Battery 1 and Battery 2 Indicators

15-14. The Battery 1 (BTRY1, shown in 22, Figure 15-2) and Battery 2 (BTRY2, shown in 21, Figure 15-2) 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

15-15. The Power indicator (23, Figure 15-2) illuminates with green light when the computer is being powered with external power (PDA, AC/DC adapter) and with amber light when battery power only is used.

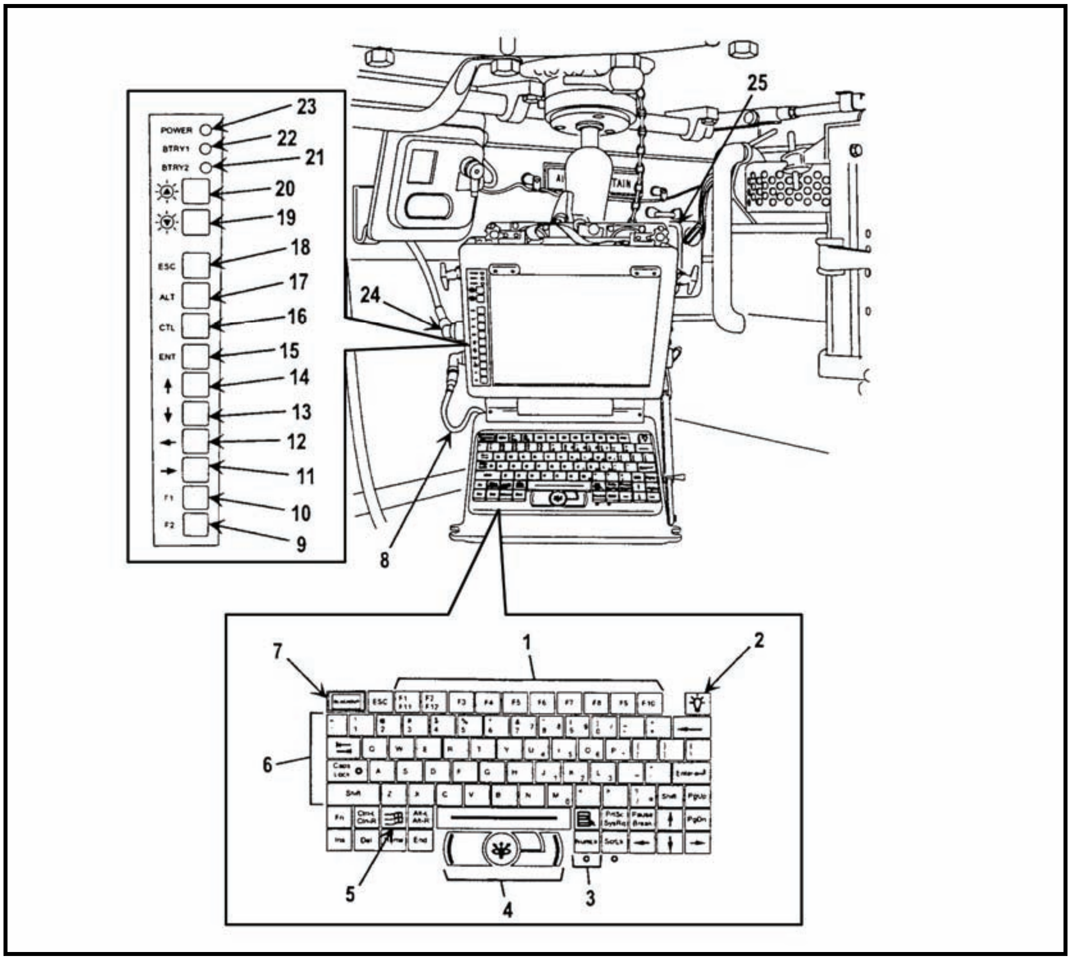

Figure 15-2. Commander's interface.

POWER DISTRIBUTION ASSEMBLY

15-16. The power distribution assembly (PDA, shown in Figure 15-3) accepts direct current (DC) and alternating current (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 also protects the MFCS components against reverse polarity and power surges.

To support classroom training and nonfield usage, the PDA also provides a 115-220v AC interface for connection to available line power, which preserves the battery charge level.

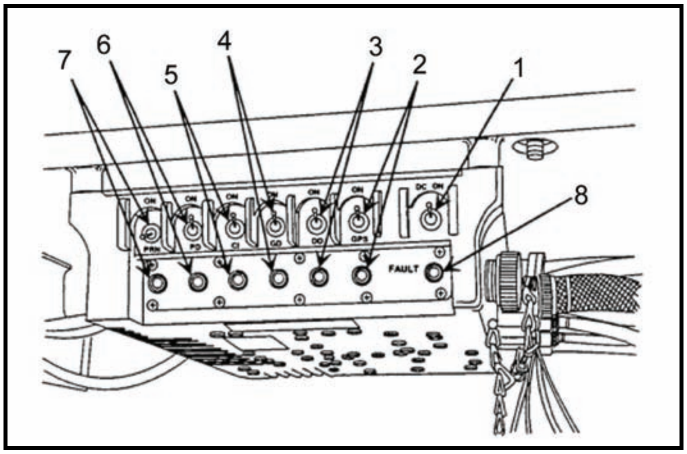

Figure 15-3. Power distribution assembly.

Power On Switch

15-17. The Power On switch (1, Figure 15-3) turns the PDA on and off for DC power only.

Switch and Light-Emitting Diode Indicator for the Global Positioning System

15-18. This switch (2, Figure 15-3) distributes power to the precision lightweight Global Positioning System receiver (PLGR) on the M1064 only. The LED turns green when the switch is on.

Switch and Light-Emitting Diode Indicator for the Driver's Display

15-19. This switch (3, Figure 15-3) distributes power to the driver's display (DD) on the M1064 only. The LED turns green when the switch is on.

Switch and Light-Emitting Diode Indicator for the Gunner's Display

15-20. This switch (4, Figure 15-3) distributes power to the gunner's display (GD) on the M1064 only. The LED turns green when the switch is on.

Switch and Light-Emitting Diode Indicator for the Commander's Interface

15-21. This switch (5, Figure 15-3) distributes power to the CI. The LED turns green when the switch is on.

Switch and Light-Emitting Diode Indicator for the Pointing Device

15-22. This switch (6, Figure 15-3) distributes power to the pointing device (PD) on the M1064 only. The LED turns green when the switch is on.

Switch and Light-Emitting Diode Indicator for the Printer

15-23. This switch (7, Figure 15-3) 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 situation.

Fault Light-Emitting Diode Indicator

15-24. This indicator (8, Figure 15-3) illuminates with amber light and may flicker if the PDA malfunctions.

POINTING DEVICE

15-25. The PD (Figure 15-4) is mounted in the M1064 mortar carrier 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 (IMU) provides the weapon with absolute knowledge of vehicle position and mortar barrel azimuth and elevation. The IMU can determine the orientation of the mortar barrel without survey control points, aiming circles, or aiming posts—allowing the mortar platoon to emplace anywhere, anytime. To maintain a high degree of accuracy, the IMU 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 of overall performance.

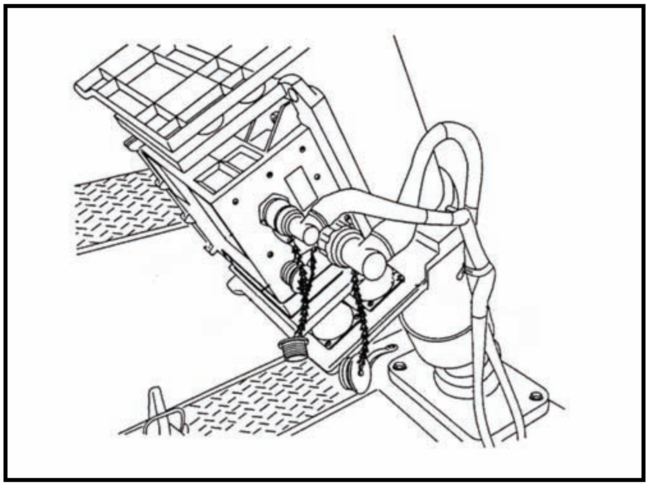

Figure 15-4. Pointing device.

GUNNER'S DISPLAY

15-26. The GD (Figure 15-5) provides the gunner with the necessary information (deflection, elevation, check fire, and CFF commands) to aim and fire the mortar. It is mounted to the left center bipod leg. Function keys are used to start various displays that cover the gunner's functional needs for information, status, and reporting.

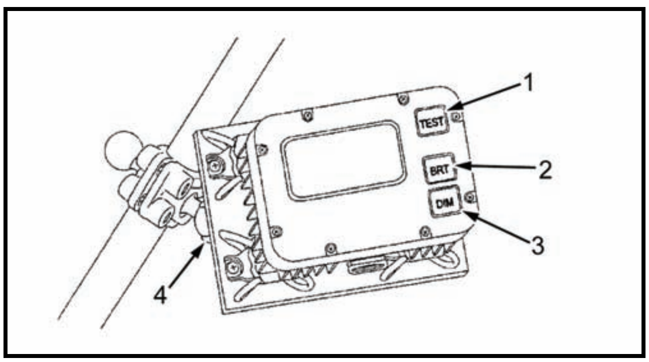

Figure 15-5. Gunner's display.

Test Key

15-27. The Test key (1, Figure 15-5) initiates the internal built-in test (BIT) display.

Bright and Dim Keys

15-28. The Bright (BRT) and Dim (DIM) keys (2 and 3, Figure 15-5) increase and decrease the brightness of the LCD.

Locking Clamp

15-29. The locking clamp (4, Figure 15-5) is used to allow movement of the GD from the mounting wall.

DRIVER'S DISPLAY

15-30. Located within the driver's vision, the DD (Figure 15-6) displays the steering directions and compass orientation to move the vehicle to the next firing location or waypoint. It also provides information to correctly orient the vehicle at the next emplacement. Information is graphically displayed for steering directions and compass orientation, and numerically for distance and heading.

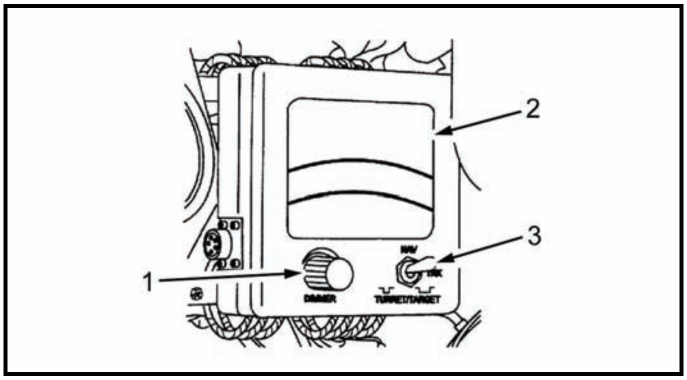

Figure 15-6. Driver's display.

Dimmer Knob

15-31. The dimmer knob (1, Figure 15-6) controls the brightness of the LCD.

Liquid Crystal Display

15-32. The LCD (2, Figure 15-6) displays directions to the next position. The LCD blinks when a call for fire is received.

Toggle Switch

15-33. With the toggle switch (3, Figure 15-6) turned to NAV, the LCD displays directional instructions. The TRK and TURRET/TARGET toggle positions are not used.

VEHICLE MOTION SENSOR

15-34. The VMS (Figure 15-7) 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 engine compartment in front of the driver's cab on the M1064 carrier.

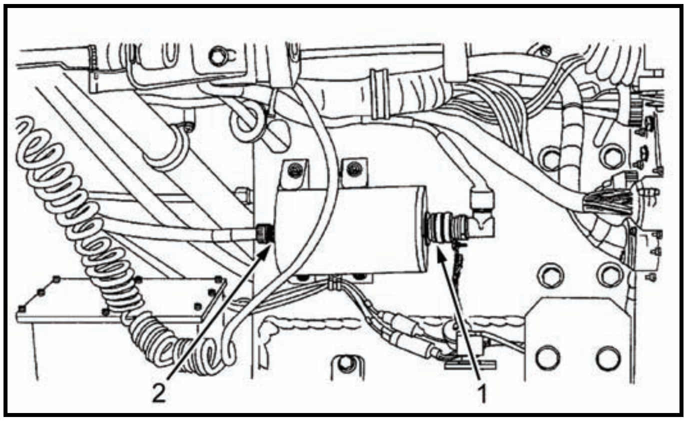

Figure 15-7. Vehicle motion sensor.

CAPABILITIES

15-35. The computer design permits the system to be upgraded to match expanding demands on field terminal equipment. Currently, the MFCS is capable of storing—

- 18 gun positions.
- 3 gun sections.
- 50 known points.
- 50 known targets.
- 16 RPs.
- 3 FPFs.
- 12 FO locations.

COMMANDER'S INTERFACE PROCESSING CAPABILITIES

15-36. The CI can simultaneously process up to six active fire missions, consisting of one to six guns per mission, as long as no mission consists of guns from different sections and no gun is assigned to more than one mission concurrently. It can also—

- 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.

15-37. The CI can be powered with dual nickel metal hydride (NiMh) rechargeable lithium batteries. Power can also be supplied through power adapter options of 12- to 32-volt DC or 110- or 220-volt AC power. The CI also contains power-saving circuitry.

15-38. The CI accepts digital messages from the Forward Observer System (FOS), the Advanced Field Artillery Tactical Data System (AFATDS), and the interim fire support artillery software (IFSAS) to support FSCMs and digital messaging devices (DMDs). It has an integral speaker and software to control its output and provides the following safety geometry:

- No-fire areas (NFA).
- Coordinated fire lines (CFL).
- Restricted fire areas (RFA).
- Restricted fire lines (RFL).
- Lateral boundaries (LB).
- Airspace coordination areas (ACA).
- Forward line of own troops (FLOT).

COMMANDER'S INTERFACE BATTERY SPECIFICATIONS

15-39. The CI holds two rechargeable NiMh batteries, which are for backup power purposes only. The CI can operate without batteries. It also 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 approximately four hours at 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. See MAM 06-019 for more information.**

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 installed in the CI at all times.**

SOLDIER GRAPHIC USER INTERFACE

15-40. A Soldier GUI (Figure 15-8) is a display that allows the operator to use menus, windows, and icons rather than type complicated commands.

SCREEN AREA

15-41. 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.

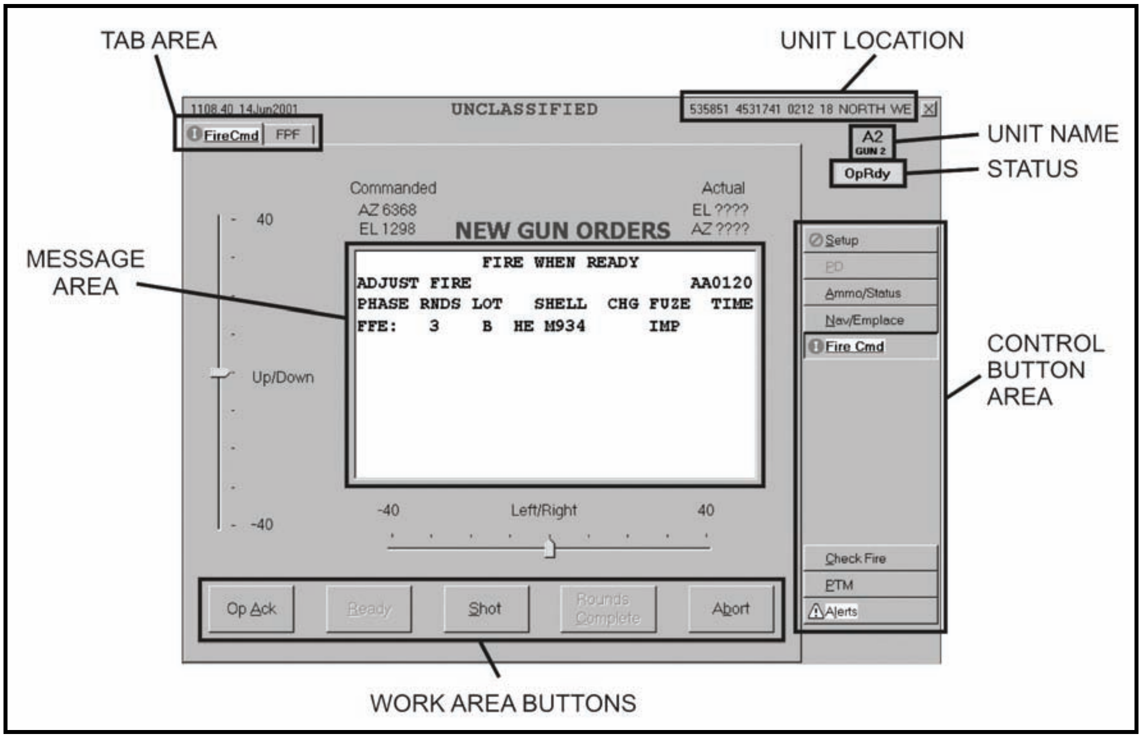

Figure 15-8. Graphic user interface.

Control Button Area

15-42. 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 (PD).
- Ammunition/Status (Ammo/Status).
- Navigation/Emplacement (Nav/Emplace).
- Fire Command (Fire Cmd).
- Check Fire.
- Plain Text Messages (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

15-43. Tabs are similar to 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

15-44. The work area is located in the center of the screen. This is where information can be viewed, selected, or modified.

Work Area Buttons

15-45. Work area buttons are located 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

15-46. 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

15-47. These are located just below the position location.

COMMON ACTIONS

15-48. When using the MFCS, the operator repeatedly uses the same commands. These are usually done by clicking buttons in the working button area of the screen or responding to a query in a message box. These commands include—

- Operationally acknowledge (OpAck).
- Record data.
- Message to the observer (MTO) accept or deny.
- Process or delete.
- Select the guns to fire the mission.
- Confirm gun orders.
- Accept or modify data.

Operationally Acknowledge

15-49. Clicking the operationally acknowledge (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

15-50. Data is recorded throughout the process to maintain a record and to preserve data should the MFCS fail. Data is transcribed onto DA Form 2399-R or DA Form 2188-R. The phrase "record data" is used throughout the chapter to indicate this action.

Message to the Observer Accept or Deny

15-51. 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 becomes visible and, when clicked, deletes the mission. If an error is beyond FDC control, the only choice is MTO Deny.

Process or Delete

15-52. The MFCS usually presents a choice to process or delete the fire mission. The operator can click 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

15-53. Guns for the mission are preselected by the software and are checked in the 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 also 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.

15-54.

Confirm Gun Orders

15-55. When a solution is displayed and the operator is satisfied with the data, the operator will select “Send Gun Orders.” A message box will be displayed to confirm the order. The operator clicks “Yes” to confirm the action.

Accept or Modify Data

15-56. If required, the operator makes adjustments to the mission data. To undo any changes, he 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

15-57. Starting the MFCS on the M1064 must be done in sequence to ensure that the system performs properly. Follow these steps to start the MFCS and its ancillary equipment.

(1) Ensure that the radios are in the stand-by mode, and turn on the vehicular or AC power. Ensure that sufficient vehicular or auxiliary power is available by checking the power gauge meter on the driver’s instrument panel.

(2) Turn on the power distribution assembly (PDA). The PDA distributes power to the MFCS components and the PLGR. Use the toggle switch to turn on power for each.

(3) Turn on the PLGR. The PLGR self-test is successfully performed when the PLGR screen states, “No faults found.” For all MFCS operations, the PLGR must have current COMSEC codes installed.

(4) Turn on the PD. The PLGR screen states, “Remote control only zeroized key activated.”

(5) Turn on the CI. Check to see if the batteries are installed in the battery compartment and the power cable is connected to the computer. Turn on the CI switch on the PDA. 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.

(6) Establish continuous mode for the PLGR. The upper left portion of the PLGR screen should display “Cont.”

(7) Turn on the radios

(8) Turn on the DD.

(9) Turn on the GD.

NOTE: See TM 9-1220-248-10 for more detailed information.

LOG-IN PROCEDURES

15-58. The log-in screen (Figure 15-9) is displayed after system startup is complete. The log-in screen ensures that only authorized personnel have access to the system. The operator enters his name and password, and then clicks the Enter button.

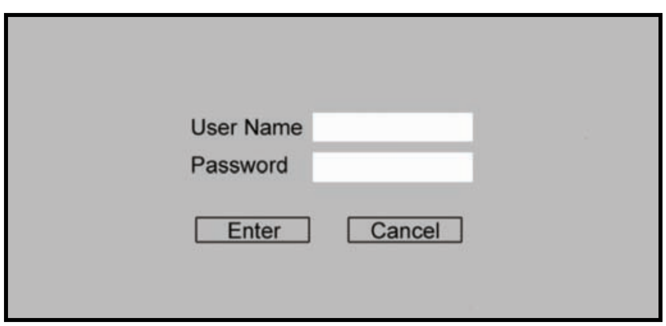

Figure 15-9. Log-in screen.

DATA INITIALIZATION AND SYSTEM CONFIGURATION

15-59. 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.

15-60. 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 9-1220-248-10 for a list of these icons.

15-61. To initialize and configure the MFCS—

NOTE: 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.

(1) Click the Setup button.
(2) The Unit List screen appears.

NOTE: The Unit List and Configuration tabs are the only tabs shown.

(3) Enter the required information for the Unit List and Configuration screens.

NOTE: All other setup tabs display.

(4) Enter, modify, or confirm the information on each of these screens:
- Data.
- Geographical Reference.
- Position.
- Channel A and Channel B.

UNIT LIST SCREEN

15-62. The Unit List screen is the default screen; it appears after the operator clicks the Setup button. The Unit List screen (Figure 15-10) lists all of the units assigned or used by the FDC. This screen allows the operator to view, enter, edit, or delete a—
- Unit name.
- URN.
- Long name.
- Device.
- Observer number.

NOTES: 1. If previously configured, the system defaults to the data already entered.

2. There is a limit of 100 unit entries.

15-63. 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.

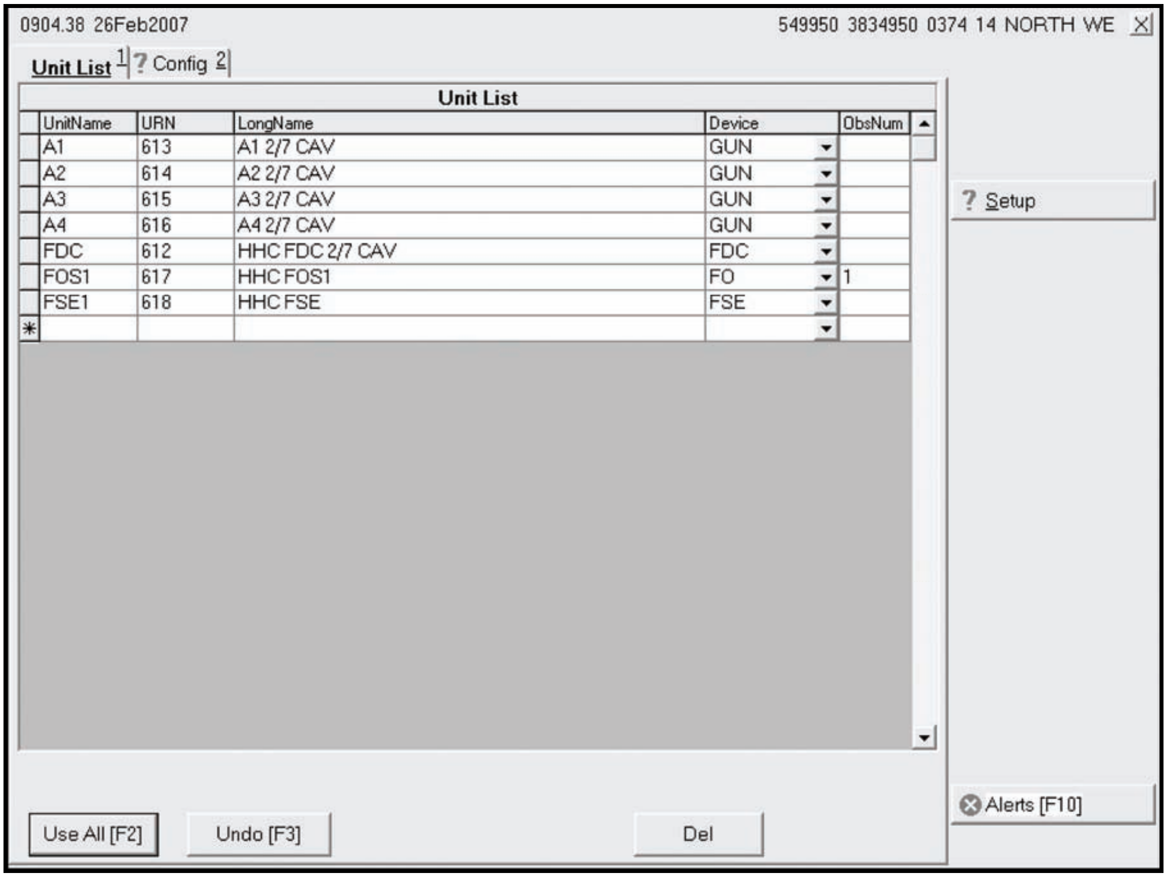

Figure 15-10. Unit List screen.

Unit Name

15-64. A lock icon displays in the index box at the beginning of a row when that platform has already 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

15-65. The unit reference number (URN) must be unique to the unit.

Long Name

15-66. The long name must be less than 30 characters long.

Device

15-67. The operator accesses the drop-down menu in the Device field to select FDC, GUN, FO, FSE, or OTHER.

Observer Number

15-68. In the last field, ObsNum, the operator assigns a number to each observer or any unit that may act as an observer.

CONFIGURATION SCREEN

15-69. The operator selects the Use All working area button on the Unit List screen to display the Configuration screen (Figure 15-11). This screen allows the operator to enter or reconfigure information by selecting one of the options on the drop-down menus for—

- Platform.
- Role.
- Unit.
- Communication (Commo, see note).
- Security Classification.
- Mode.
- Controlling FSE.

15-70. A red question mark displays on the Config tab until the operator clicks Use All.

NOTES: 1. If previously configured, the system defaults to the data already entered.

2. MFCS Versions 3.0 and later include a Commo field. This field is used to select Variable Message Format (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.

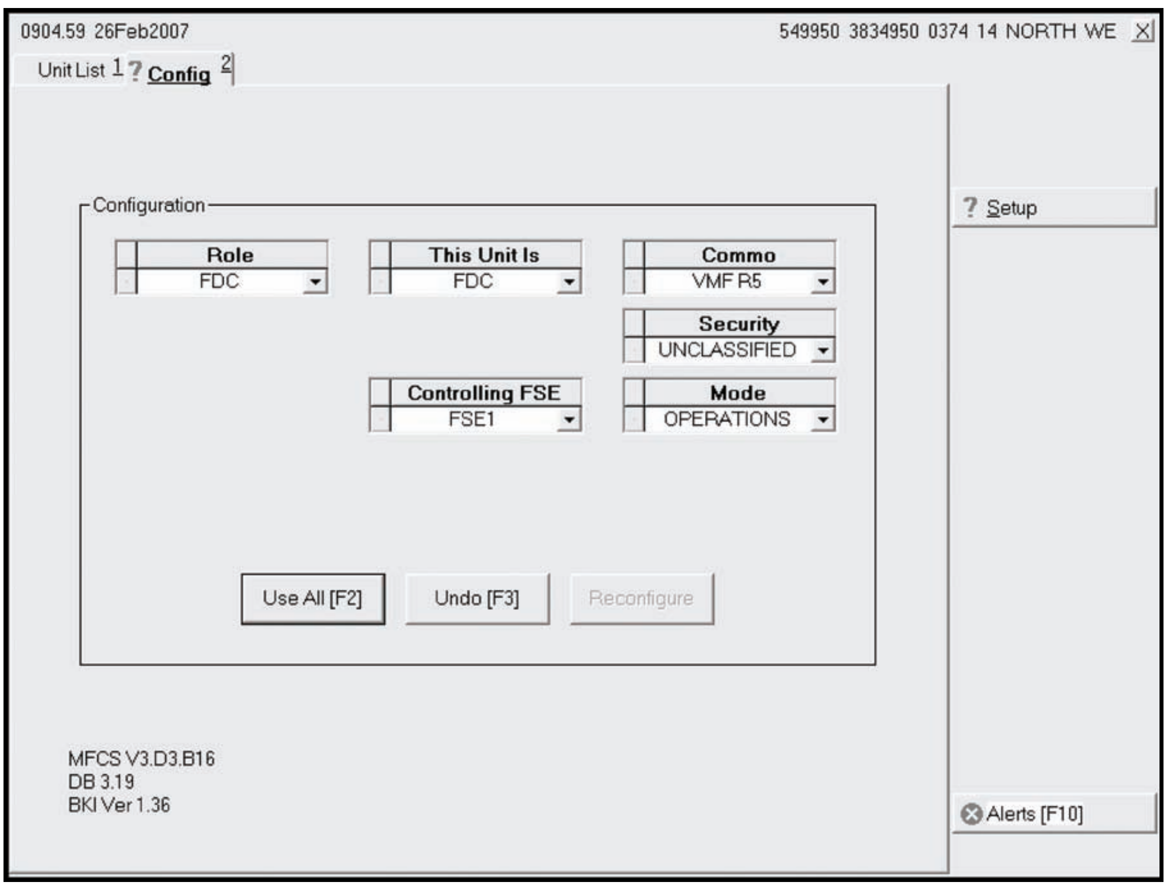

Figure 15-11. Unit Configuration screen.

DATA SCREEN

15-71. The operator selects the Data tab to display the Data screen (Figure 15-12). This screen allows the operator to verify, view, or set the—

- System date/time.
- Audio alarm.
- Target number.
- Splash offset.

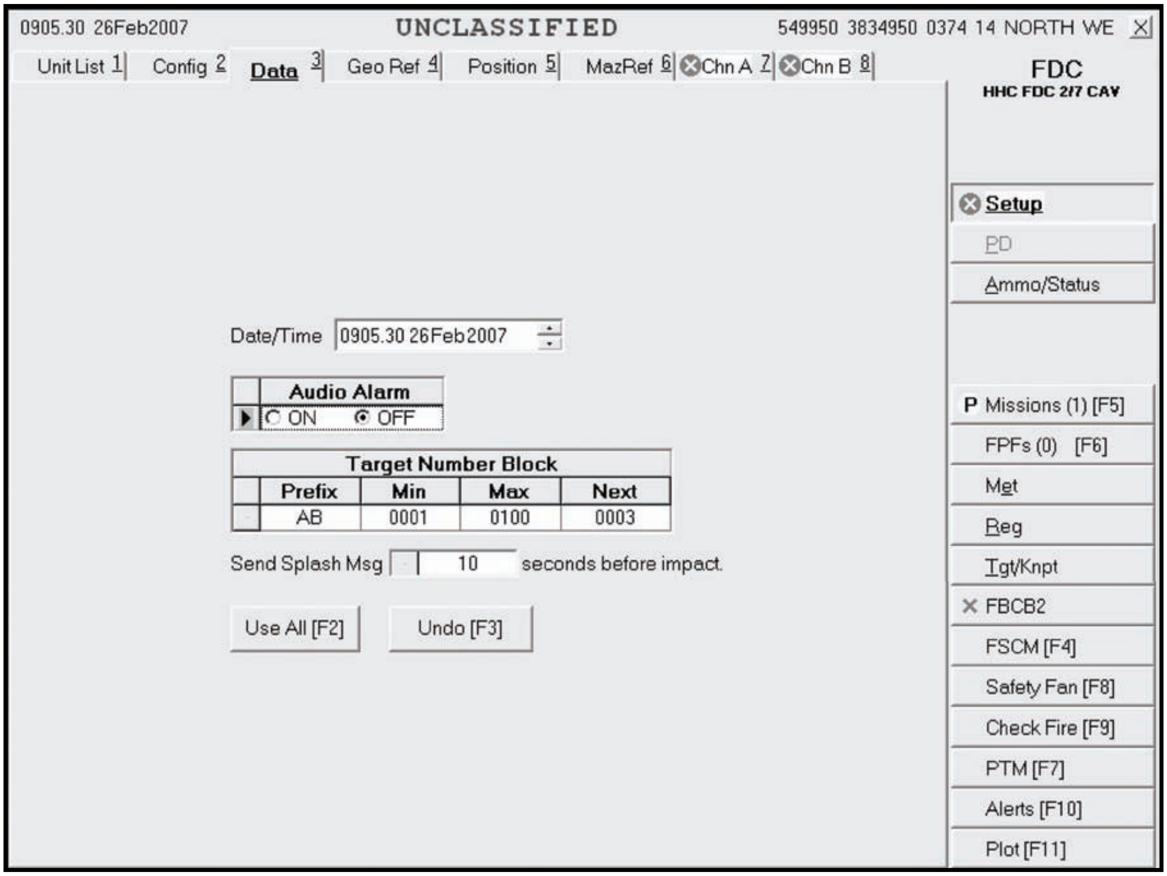

Figure 15-12. Data screen.

GEOGRAPHIC REFERENCE SCREEN

15-72. This screen (Figure 15-13) allows the operator to set the geographic positioning system by filling the following fields:

- Ellipsoid.
- Datum.
- Map Mod.

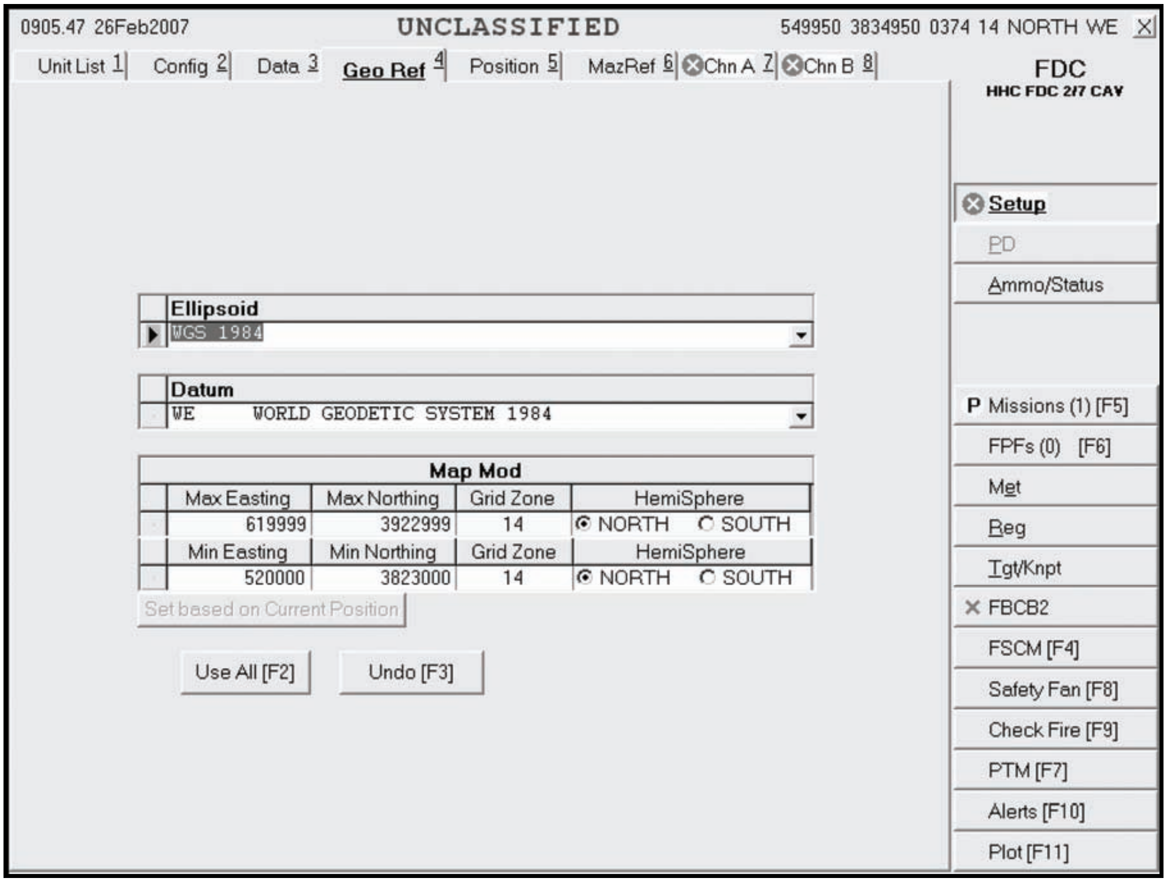

Figure 15-13. Geographic Reference screen.

Ellipsoid and Datum Fields

15-73. To fill the Ellipsoid and Datum fields—

(1) Click the down arrow in the Ellipsoid field, and select the appropriate choice.

(2) The corresponding default datum for the ellipsoid automatically displays in the Datum field.

(3) Change the Datum field by choosing another option.

(4) The screen value is updated, and a pencil icon displays in the index box at the beginning of each row.

15-74. To undo the changes, click Undo Changes; any unsaved changes (indicated by a pencil icon) are refreshed with the original data.

Map Mod Field

15-75. The Map Mod field is comprised of eight sub-fields:

- 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

15-76. The Max Easting and Max Northing fields are read-only and are automatically filled when the operator enters the fields.

Grid Zone and Hemisphere Fields (Maximum Field Row)

15-77. The Grid Zone and HemiSphere fields in the Maximum field row are also read-only and are automatically filled and updated when the operator enters the Minimum values.

Minimum Easting and Northing Fields

15-78. The Min Easting and Min Northing fields are disabled if there are any active missions. The MFCS uses the 13-digit Military Grid Reference System (MGRS) to calculate the map modification. The minimum easting must be six digits long; the minimum northing must be seven digits long.

Grid Zone and Hemisphere Fields (Minimum Field Row)

15-79. The grid zone and hemisphere can be determined using the map sheet. The Grid Zone Designation is located in the Grid Reference box at the bottom center of the map sheet. It consists of 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

15-80. The operator selects the Position tab to display the Position screen (Figure 15-14). This screen allows the operator to view or update his 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.

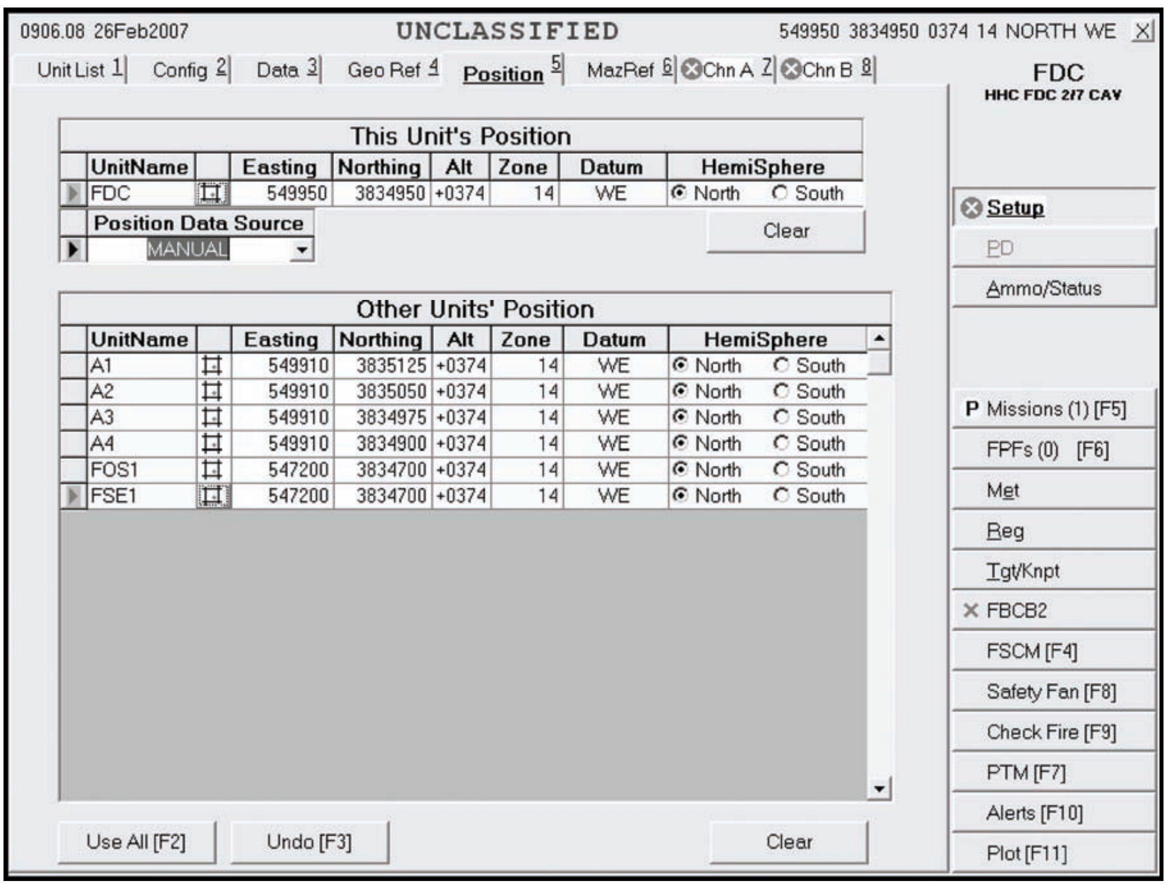

Figure 15-14. Position screen.

This Unit's Position

15-81. This portion of the screen contains eight fields:

- Unit Name (UnitName).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).
- Position Data Source.

15-82. As necessary, the operator may click—

- Use All.
- Undo.
- Cancel.

Unit Name Field

15-83. The UnitName field is read-only and is automatically filled with the unit names selected in the Configuration screen.

Zone, Datum, and Hemisphere Fields

15-84. The Zone, Datum, and HemiSphere fields are also read-only and are automatically filled when the operator enters the Map Mod field.

Position Data Source, Easting, Northing, and Altitude Fields

15-85. With the Position Data Source field set to Manual, the operator can also 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 9999 meters.

NOTE: If the PD is available and operational, the operator must ensure that the position data source is set to PD, GPS, or FBCB2. These fields are read-only.

Other Units' Position Fields

15-86. This portion of the screen contains seven fields:

- Unit Name (UnitName).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).

15-87. As necessary, the operator clicks Use All, Undo, or Cancel.

Unit Name Field

15-88. The UnitName field is read-only and is automatically filled with the unit names selected in the Configuration screen.

Zone, Datum, and Hemisphere Fields

15-89. The Zone, Datum, and HemiSphere fields are also read-only and are automatically filled when the operator enters the Map Mod field.

Easting, Northing, and Altitude Fields

15-90. 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 9999 meters.

15-91. 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 now displayed in the upper right corner of the screen.

Alternate Methods of Entering Position

15-92. Using pop-up screens, the operator may also enter positions using universal transverse mercator (UTM), polar coordinates, Military Grid Reference System (MGRS), or latitude and longitude. These methods may be used in a voice CFF.

15-93. To use these methods—

(1) Click the icon on the appropriate unit's row.

(2) The Enter Position screen appears.

(3) Click the desired alternate method to enter the unit's location.

Universal Transverse Mercator

15-94. To enter the unit's location using UTM (Figure 15-15), enter the following for the selected unit—

- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).

15-95. If the coordinates entered are for a valid location, they will appear on the Use button.

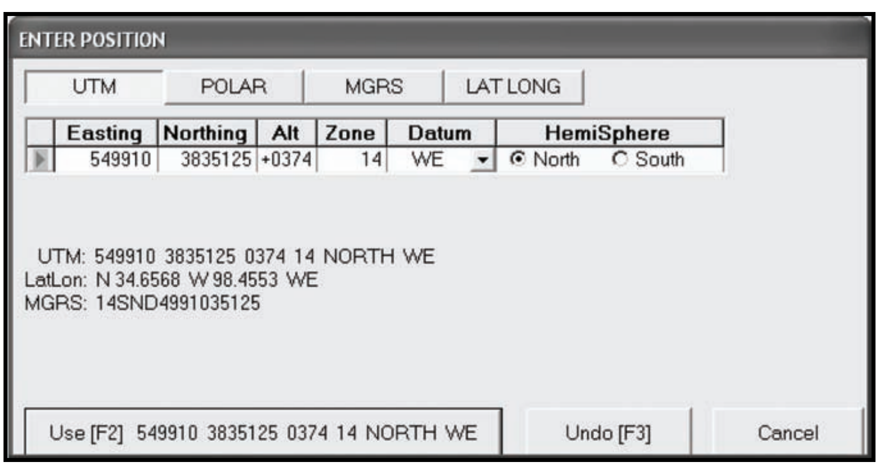

Figure 15-15. Universal Transverse Mercator Alternate Methods screen.

Polar Coordinates

15-96. To enter the unit's location using polar coordinates (Figure 15-16), enter the following for the selected unit—

- Direction (Dir).
- Horizontal distance (Dist).
- Vertical interval (VI), indicating the direction + (for up [default]) or – (for down).

15-97. If the location is valid, UTM coordinates will be displayed on the Use button. Easting, Northing, Alt, Zone, Datum, and HemiSphere will auto-fill.

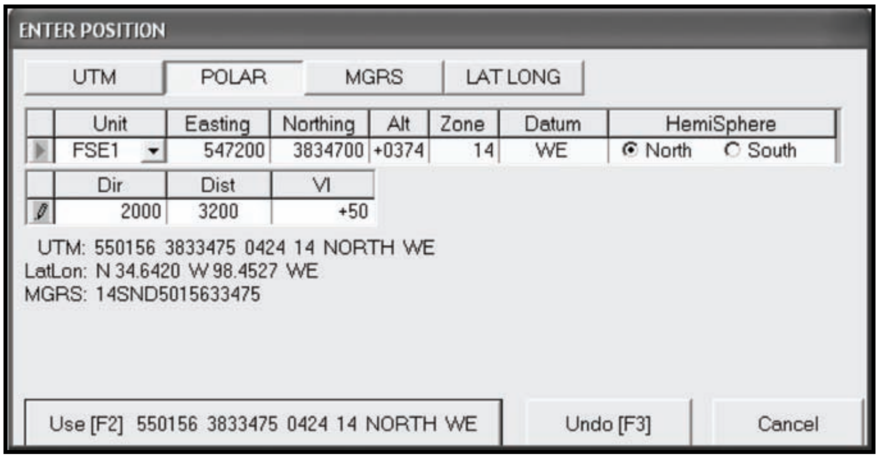

Figure 15-16. Polar Alternate Methods screen.

Military Grid Reference System

15-98. To enter the unit's location using the MGRS (Figure 15-17), enter the following for the selected unit—

- Zone.
- Square (100,000 square meter identifier).
- Coordinates.

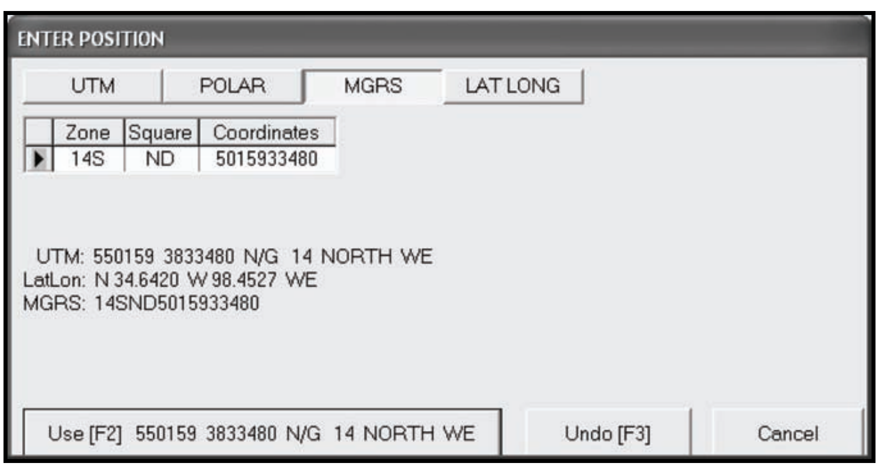

Figure 15-17. Military Grid Reference System Alternate Methods screen.

Latitude and Longitude

15-99. To enter the unit's location using the latitude and longitude (Figure 15-18), enter the latitude and longitude. If the location is valid, UTM coordinates will be displayed on the Use button.

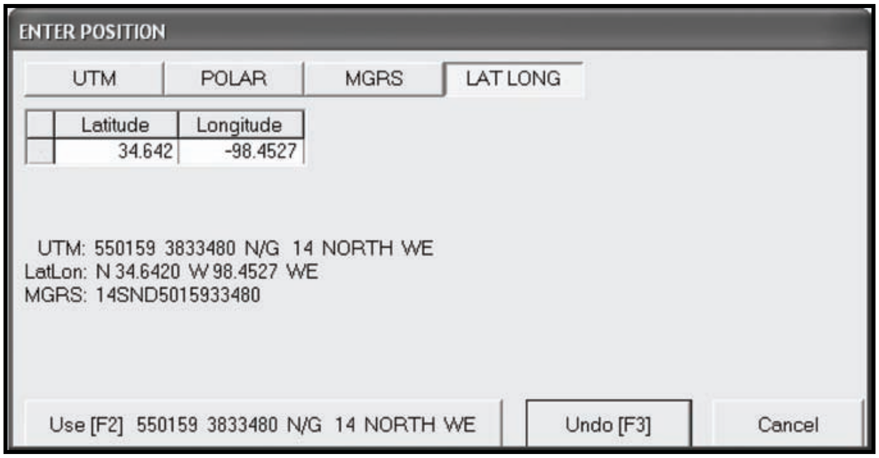

Figure 15-18. Latitude/ Longitude Alternate Methods screen.

Undo, Cancel, and Use Buttons

15-100. 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

15-101. When necessary, the MFCS can be operated in conventional mode by mounting an M67 sight and placing aiming stakes as described in FM 3-22.90. To display deflections, a mounting azimuth and referred deflection must be entered on the MazRef screen (Figure 15-19).

15-102. To manually enter the MazRef, complete the following fields, and then click Use All.

- Unit Name (UnitName).
- Mounting Azimuth (Mnt Az).
- Use Reference (Use Ref).

15-103. When a gun's PD is not operational or available, the gun operator must provide MazRef data for the MFCS to compute deflection solutions. The FDC operator does not need the MazRef data if deflection information is not required. If the situation permits, the gun operator completes the MazRef data to provide backup capability should the PD malfunction 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 deflection.

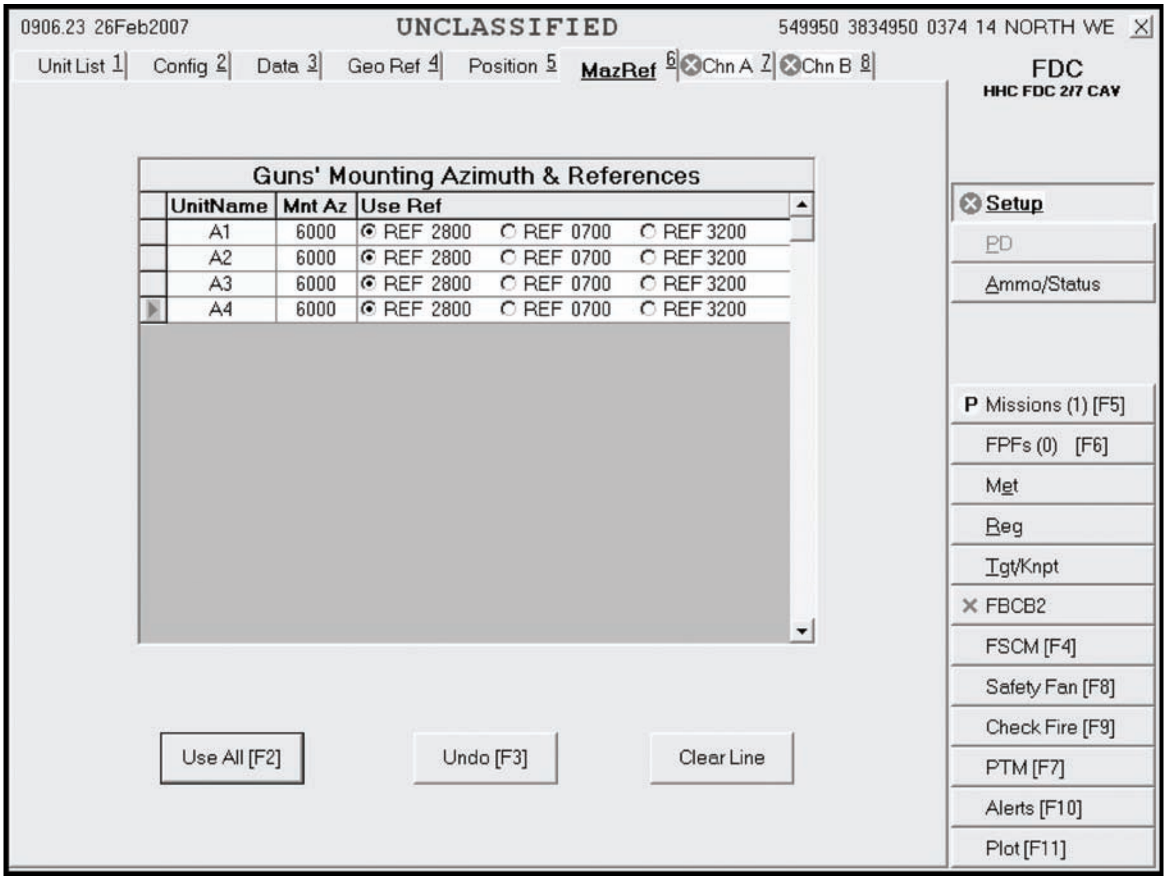

Figure 15-19. Mounting Azimuth and References screen.

Unit Name Field

15-104. This field is read-only from the guns listed in the Unit List screen.

Mounting Azimuth Field

15-105. In this field, the operator enters the mounting azimuth for the appropriate gun. The last digit must be a zero.

Use Reference Field

15-106. In this field, the operator may choose REF 2800, REF 0700, or REF 3200 by clicking in the appropriate circle.

Undo Button

15-107. The operator can press this button to undo entries before saving.

Clear Line Button

15-108. The operator can press this button to erase a line of information.

Use All Button

15-109. The operator can press this button to save all of the information on the screen.

CHANNEL A AND CHANNEL B SCREENS

15-110. These screens (Figure 15-20) allow the operator to enter, view, or update net parameters for Channel A or B subscribers. Both channels share the same setup procedures and can be set up for

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 tracks 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.

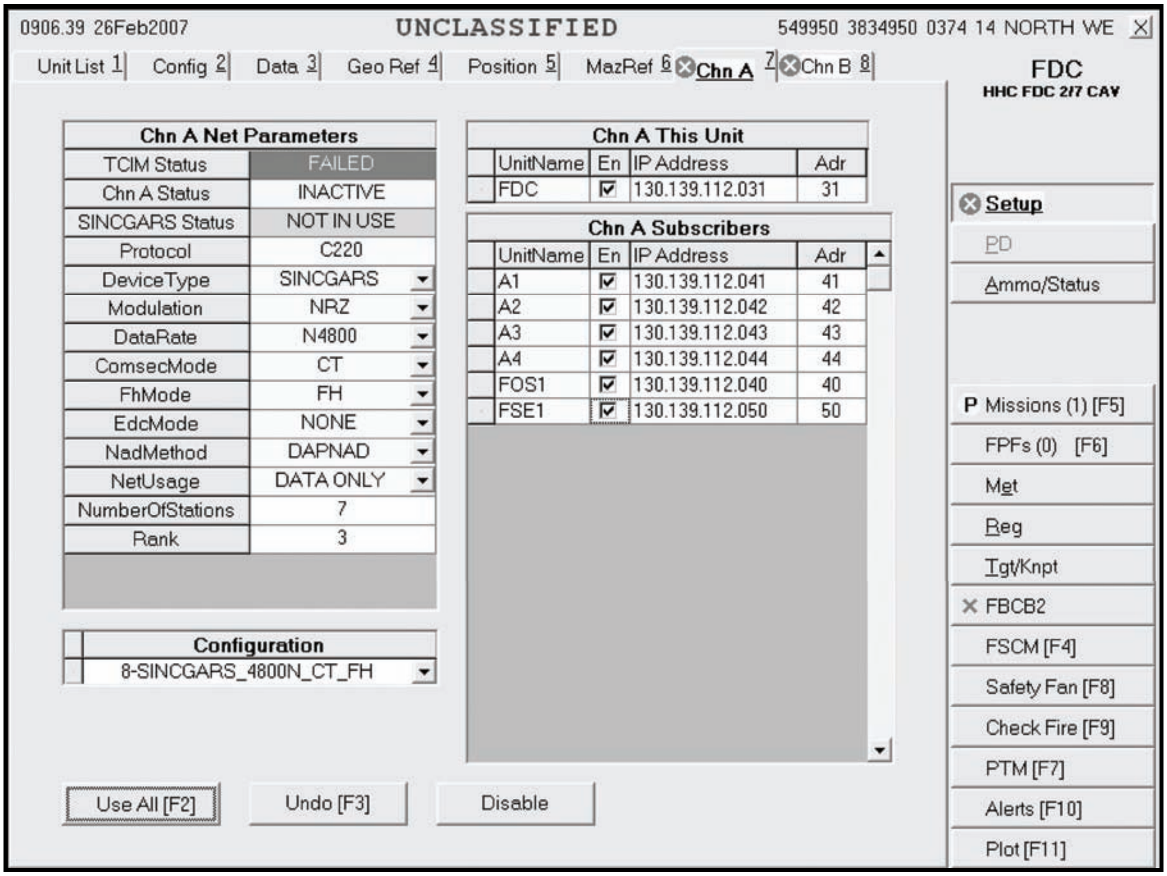

Figure 15-20. Channel A screen.

Channel A and Channel B Net Parameters Fields

15-111. The operator sets the radio or wire defaults or manually selects the parameters to set the net parameters. To determine the parameters, he coordinates with the communications officer.

15-112. Channel A and Channel B Net Parameters fields include the following sub-fields:

- 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 are editable. All yellow fields are auto-filled and cannot be changed.

Tactical Communication Interface Modem Status, Channel A Status, Channel B Status, and Protocol Fields

15-113. Tactical Communication Interface Modem (TCIM) Status, Chn A Status, Chn B Status, and Protocol are read-only and are automatically filled. TCIM Status and Chn A/Chn B Status reflect the current status.

Device Type, Modulation, Data Rate, Communication Security Mode, Frequency Hop Mode, Error Detection and Correction Mode, Network Access Delay Method, and Network Usage Fields

15-114. 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

15-115. The operator enters the number of stations and rank, as supplied by the communications officer.

Channel A and Channel B This Unit Fields

15-116. Channel A and Channel B This Unit fields include the following sub-fields:

- Unit Name (UnitName).
- Internet Protocol (IP) Address.
- Abbreviated Address (Adr).

Unit Name Field

15-117. The UnitName field is read-only and is automatically filled with the unit name listed in the Unit List screen.

Internet Protocol Address Field

15-118. 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

15-119. The fourth set of numbers in the IP address is the abbreviated address of the unit.

Channel A and Channel B Subscriber Fields

15-120. Channel A and Channel B This Unit fields include the following sub-fields:

- Unit Name (UnitName).
- Enabled (En)
- Internet Protocol (IP) Address.
- Abbreviated Address (Adr).

Unit Name Field

15-121. The UnitName field is read-only and is automatically filled with the unit names listed in the Unit List screen.

Internet Protocol Address Field

15-122. In the IP Address field, the operator enters the last two digits of the IP address for each unit name.

Abbreviated Address Field

15-123. This field is automatically filled when the operator enters the last two digits of the IP address for each unit name and moves to another field.

Enabled Box

15-124. 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

15-125. 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

15-126. 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

15-127. If disabling communication becomes necessary, the operator clicks Disable.

SECTION II. ADDITIONAL FUNCTIONS

Additional functions and procedures of the MFCS include—

- Determining ammunition status.
- Transmitting check fires.
- Sending and receiving plain text messages (PTMs).
- Using the Alerts function.
- Using the Plot function.

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

15-128. Ammunition information about the unit, lot, shell, lot number, and quantity is transmitted digitally from the gun tracks. This function allows the operator to enter, modify, delete, and sort these data. This button also includes procedures for checking, entering, or changing ammunition status. When the operator presses the Ammo/Status button, three tabs display:

- Ammo Fire Unit.
- Ammo Roll Up.
- Status Fire Unit.

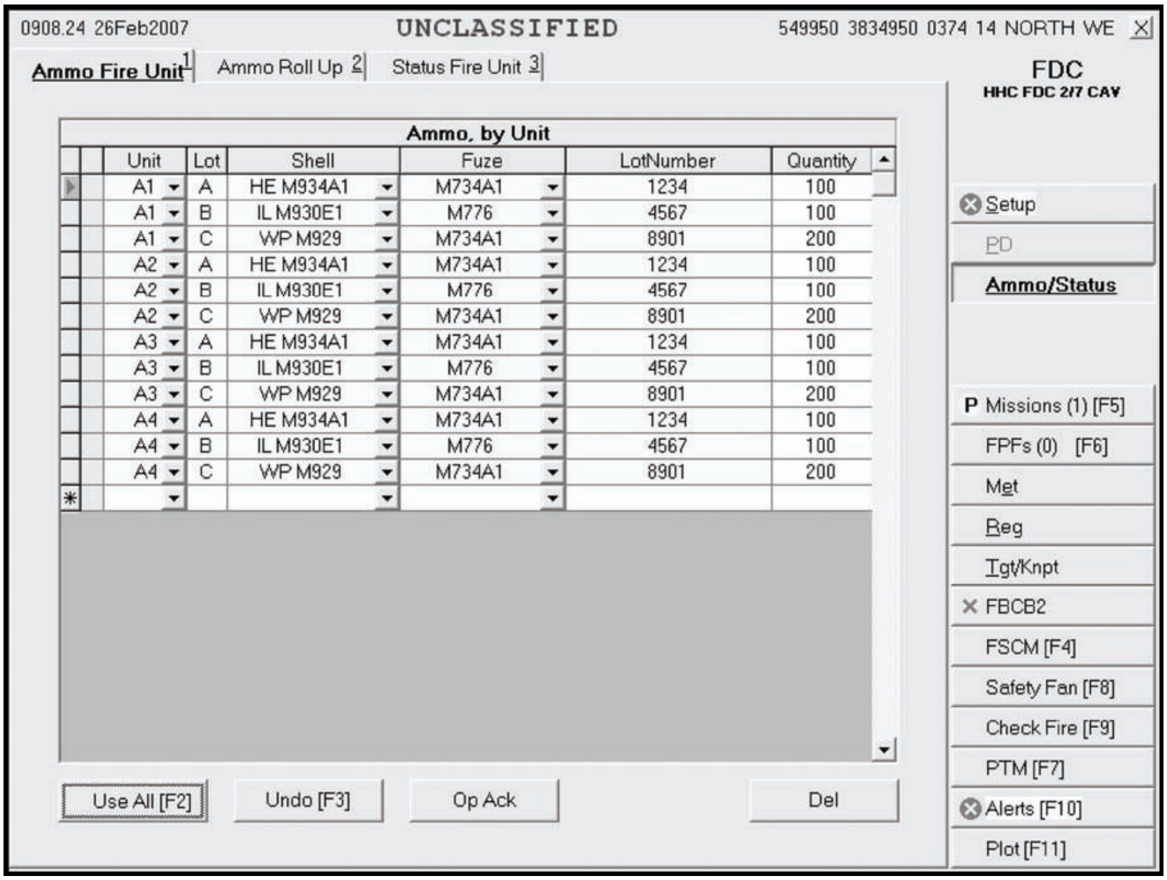

Figure 15-21. Ammo By Unit screen.

AMMO FIRE UNIT SCREEN

15-129. 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 (Figure 15-22).

15-130. This screen include the following fields:

- Unit.
- Lot.
- Shell.
- Fuze.
- Lot Number (LotNumber).
- Quantity.

15-131. 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 digitally received 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 track.

15-132. 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 automatically transmitted to the guns.

15-133. The system automatically arranges ammunition alphabetically by lot, but the operator can click another column heading to sort data by another field.

15-134. The operator can click—

- Use All to save information.
- Del to delete information.
- Undo to undo any changes.
- OpAck to acknowledge receipt of ammunition status and turn off the alarm.

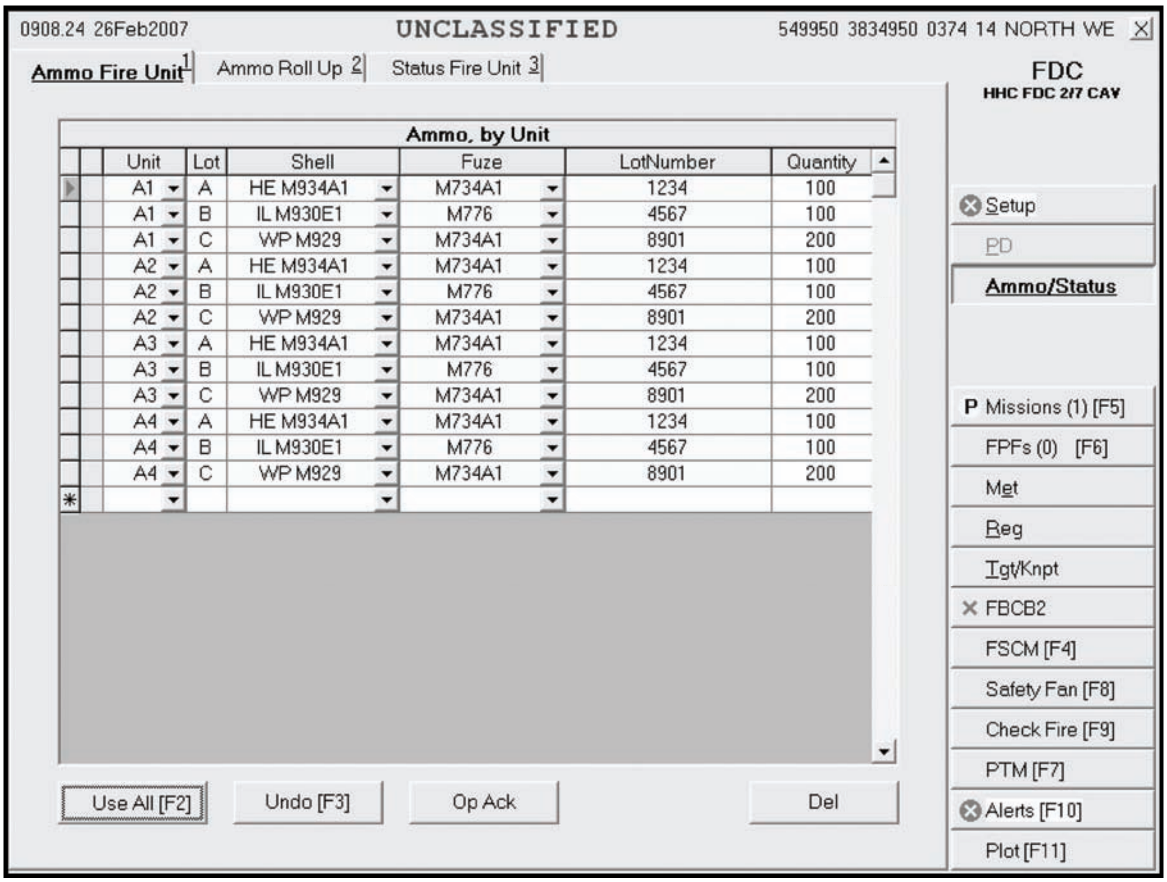

Figure 15-22. Ammo Fire Unit screen.

AMMO ROLL UP SCREEN

15-135. This screen (Figure 15-23) displays all of the ammunition carried by the gun carrier. Ammunition information is read-only, is automatically filled, and includes the following information:

- Lot.
- Shell.
- Lot number.
- Total number of rounds.

15-136. To send the FU ammunition status to the FC, the operator clicks the Send Ammo to FSE button.

NOTE: The message "Not Sent" (Figure 15-23) 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 date and time group of when it was sent will be displayed.

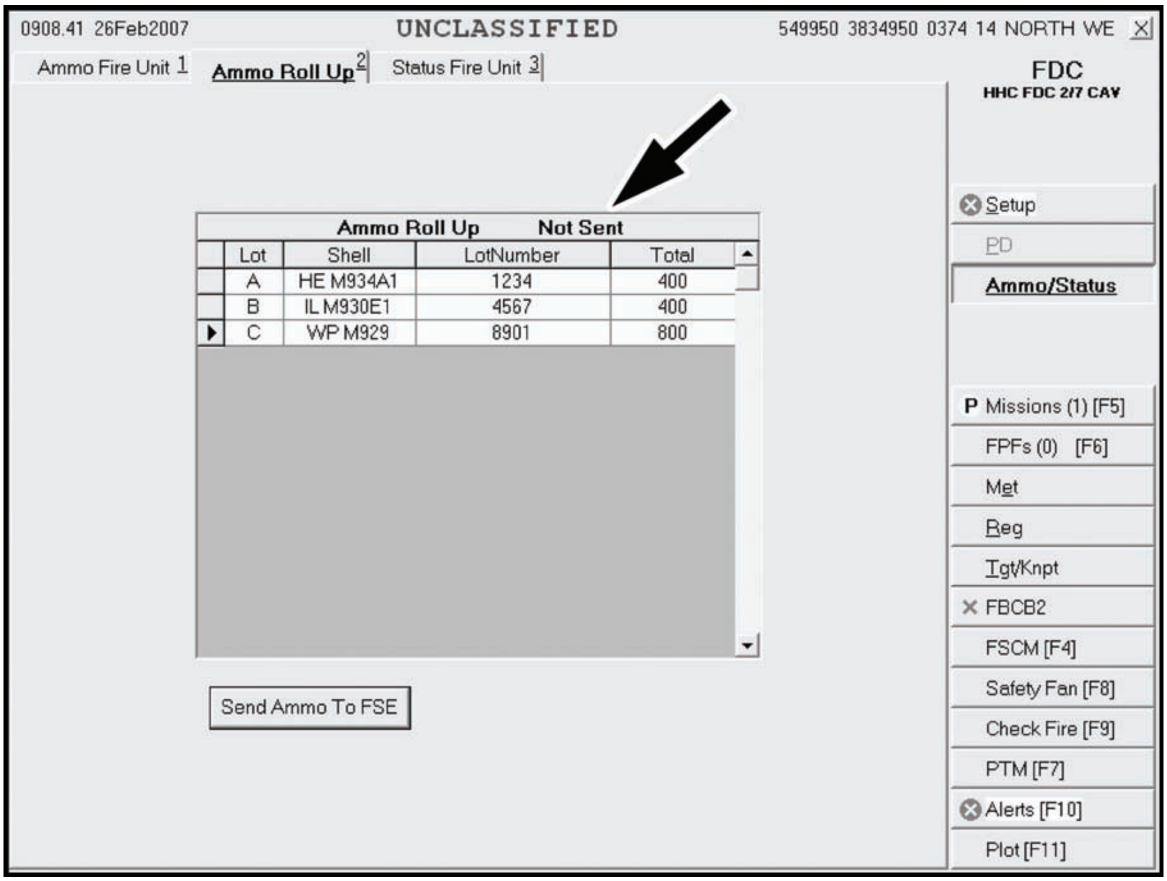

Figure 15-23. Ammo Roll Up screen.

STATUS FIRE UNIT SCREEN

15-137. This screen (Figure 15-24) contains two parts:

- Status, by Gun.
- Status Fire Unit.

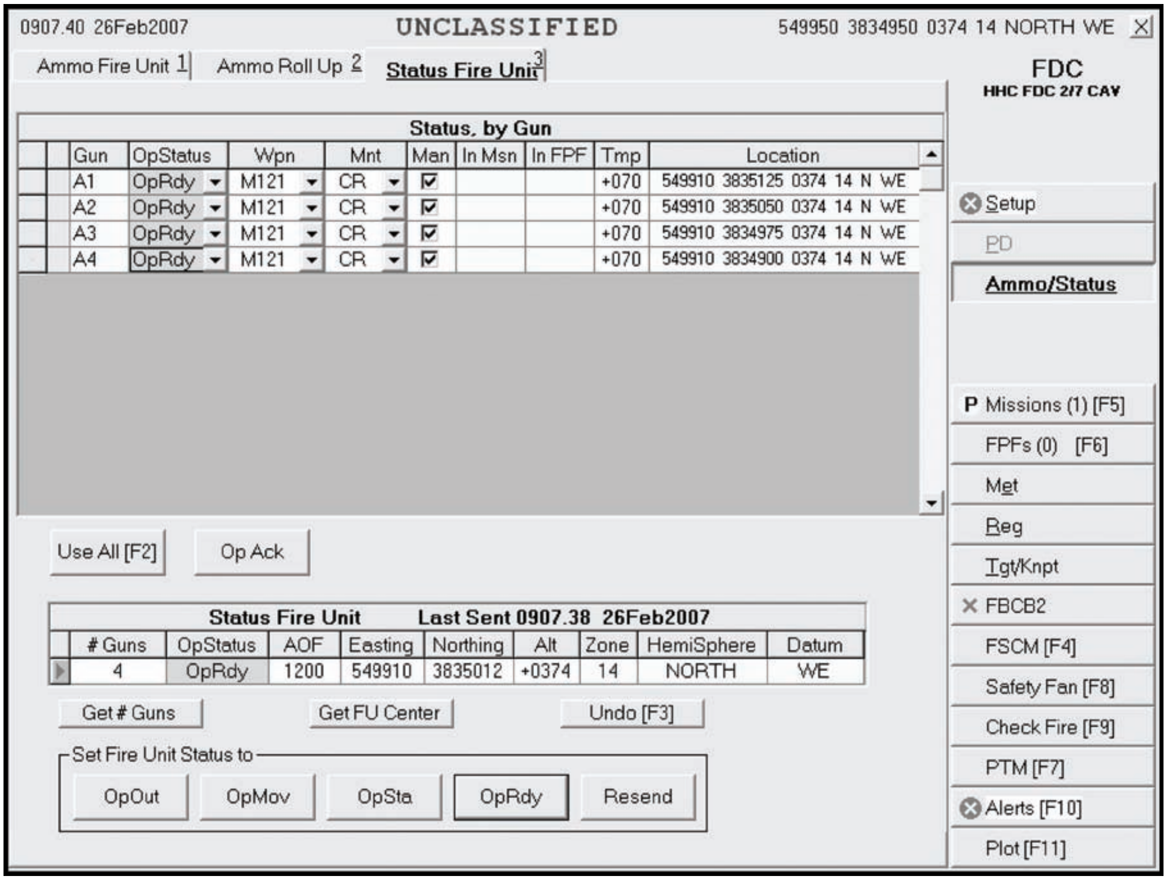

Figure 15-24. Status Fire Unit screen.

Status, By Gun

15-138. Status is received digitally from the guns, and the information is automatically filled. Meteorological data (MET) is automatically sent to the FDC Alerts messages when a gun reports "OpRdy."

15-139. This section contains the following fields:

- Gun.
- Operational Status (OpStatus).
- Weapon (Wpn).
- Mount (Mnt).
- Manual (Man).
- In Mission (In Msn).
- In FPF.
- Temperature (Tmp).
- Location.

Gun, In Mission, In Final Protective Fire, and Location Fields

15-140. These fields are read-only.

Operational Status Field

15-141. The operator may change the OpStatus field using the drop-down 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 his normal status to the controlling FDC and OpDet to a noncontrolling FDC.

Weapon Field

15-142. The operator may change the Wpn field using the drop-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, he must select a weapon type from the pull-down list.

Mount Field

15-143. The operator may change the mount status using the drop-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, he must select a type of mount from the list that is displayed.

Manual Box

15-144. 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 mounting azimuth and reference data entered and saved for that gun before checking the Man box.

Temperature Field

15-145. The operator may enter or change the temperature by clicking in the Tmp field, but he must override a warning.

Status Fire Unit

15-146. This section provides the overall status of all of 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.

15-147. It also 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

15-148. 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, he selects the Get # Guns button, and the field automatically updates according to the number of guns enabled.

Operational Status and Ammunition Fields

15-149. The OpStatus and Ammo fields are read-only.

Azimuth Of Fire Field

15-150. The operator enters data into the AOF field.

Easting, Northing, and Altitude Fields, and Get Fire Unit Center Button

15-151. To get the geographical center of the firing unit, the operator clicks Get FU Center, which displays the easting, northing, and altitude to the center point of all available guns. To manually enter or change the FU center location, the operator enters data in the Easting (6 digits), Northing (7 digits), and Alt fields (-400 through 9999 meters).

Zone, Hemisphere, and Datum Fields

15-152. Zone, HemiSphere and Datum fields are read-only.

Set Fire Unit Status Buttons

15-153. 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.

15-154. 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, he clicks the Resend button.

METEOROLOGICAL DATA SCREEN

15-155. The MET data provides the same information as DA Form 3675-R and DA Form 3677-R. 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 (Figure 15-25).

15-156. The MET Data screen contains three tabs:

- Msgs.
- New.
- Current.

METEOROLOGICAL DATA—NEW TAB

15-157. This tab contains the following fields:

- Station Name.
- Octant.
- Station Height (10's M).
- MDP Pressure (MB).
- Latitude (LaLaLa).
- Longitude (LoLoLo).
- Line.
- Altitude.
- Direction.
- Speed.
- Temperature.
- Pressure.

NOTE: If the MFCS is configured using VMF R5 (Figure 15-25), Station Name and Octant are not used and will not be displayed. If the MFCS is configured using VMF PKG11 (Figure 15-26), Station Name and Octant are displayed.

15-158. It also contains the following buttons:

- Save.
- Undo.
- Clear Line.
- Clear All.
- Apply New Met.

15-159. 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, he clicks Clear All. To undo any changes before saving, he clicks Undo Changes. Once the operator verifies that the changes are correct, he clicks Save. Then, he clicks Apply New Met.

15-160. The new MET becomes the current MET, and the view changes to the Current tab. The current MET (the newly active MET) is automatically transmitted to the guns. The operator then receives an alert from the guns indicating whether the new MET has been successfully processed.

NOTE: The new MET cannot be processed while a fire mission or FPF is active and will cause an alert message.

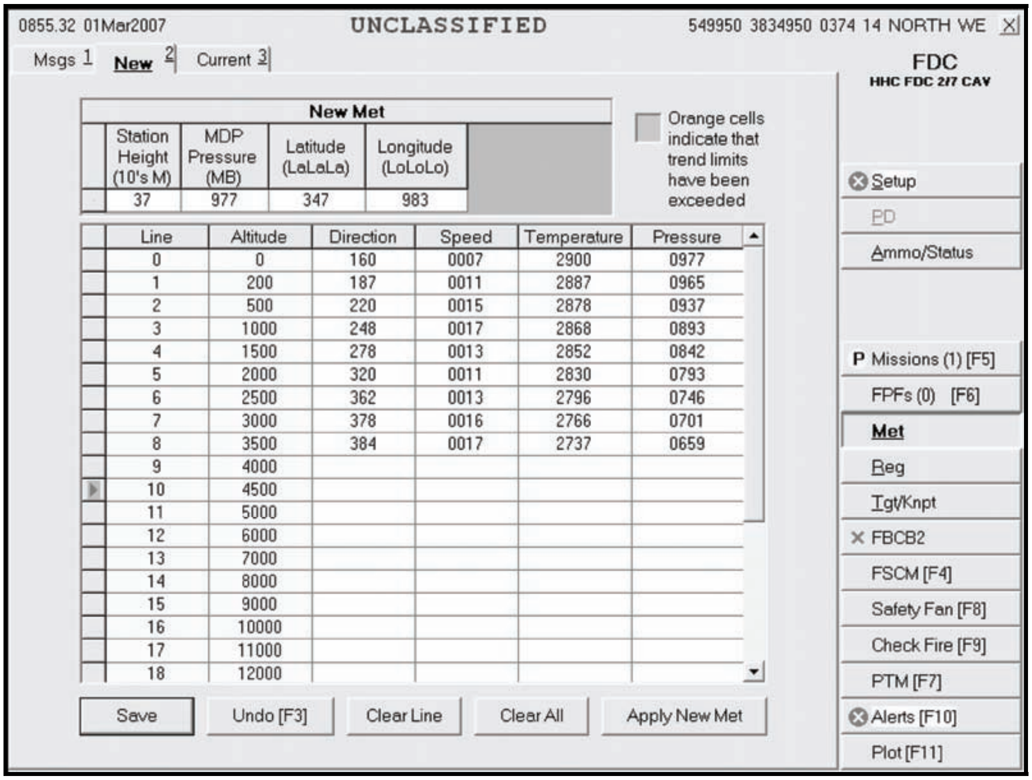

Figure 15-25. New Meteorological Data screen using VMF R5.

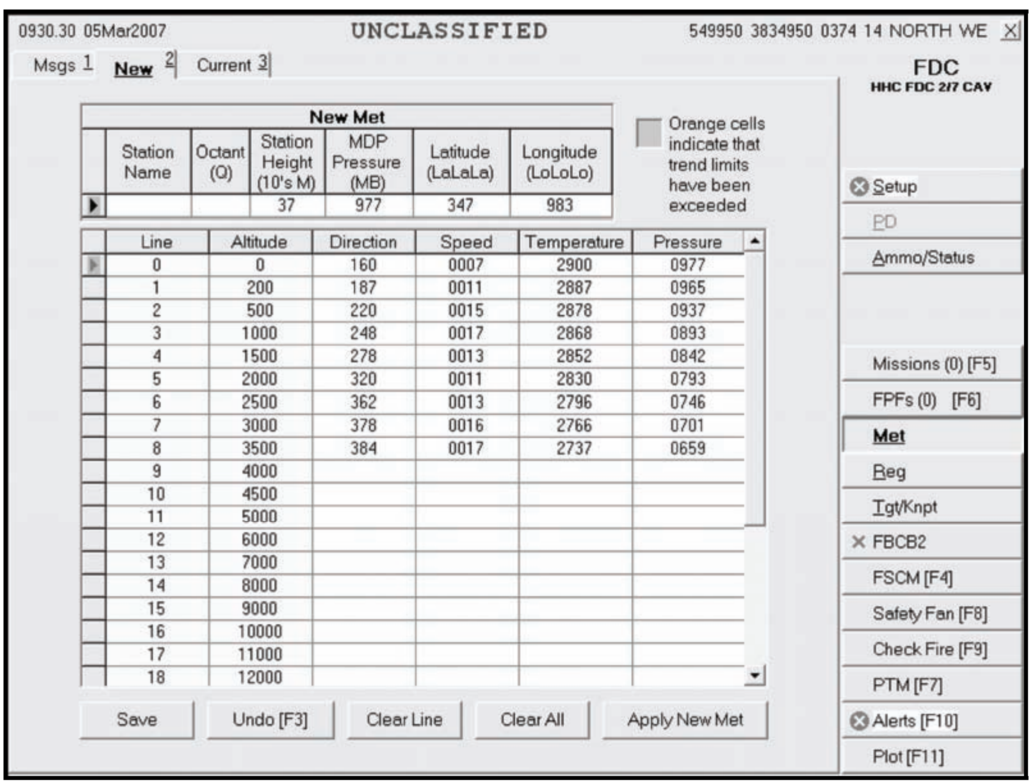

Figure 15-26. New Meteorological Data screen using VMF PKG 11.

METEOROLOGICAL DATA—CURRENT TAB

15-161. When the Current tab is selected, the screen in Figure 15-27 is displayed. This screen 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.

15-162. This screen also contains two buttons:

- Use Standard.
- Resend Met.

15-163. When a gun reports OpRdy, the current MET is automatically sent to the gun as an alert.

Resend Meteorological Data Button

15-164. To send the MET message to the guns again, the operator clicks Resend Met.

Use Standard Button

15-165. To use the standard MET, the operator clicks Use Standard.

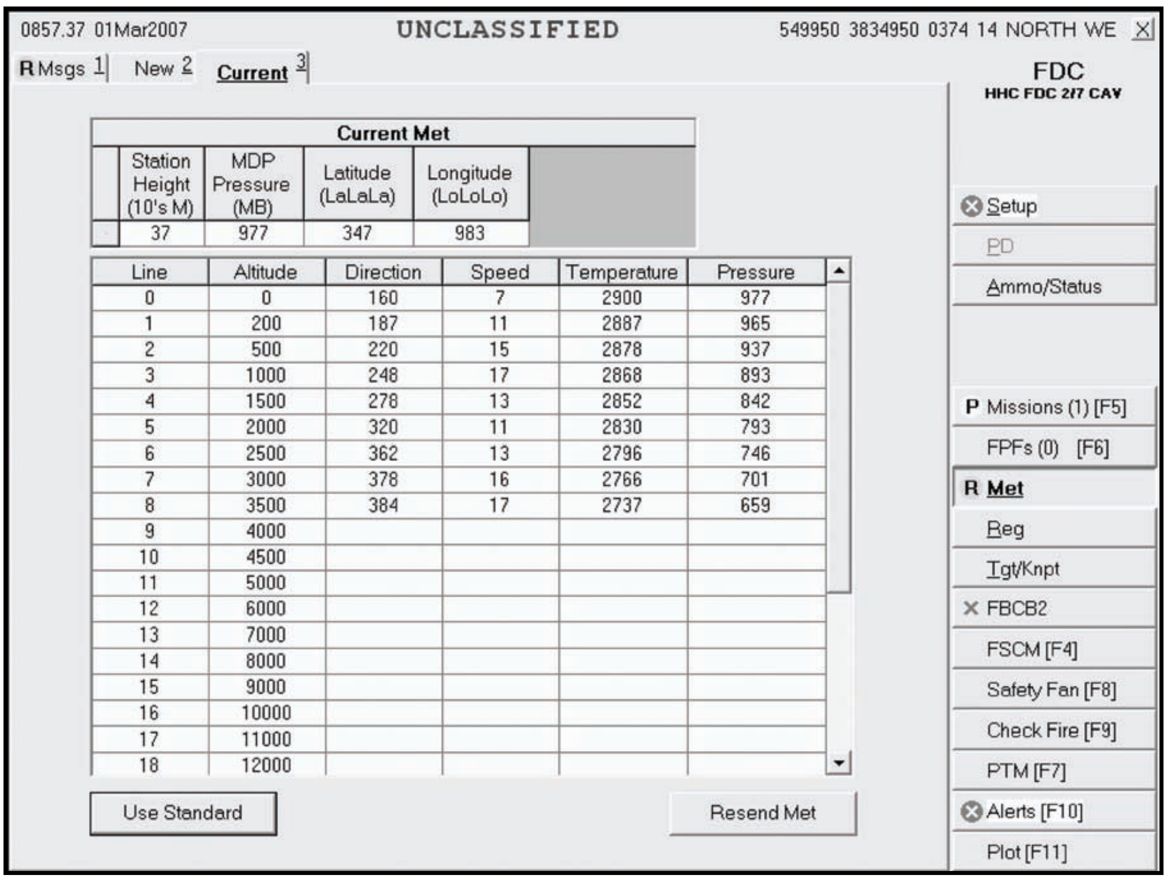

Figure 15-27. Current screen.

Meteorological Data Trend Limits

15-166. The MFCS also 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--If 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 should decrease as altitude increases).

TARGET/KNOWN POINT SCREEN

15-167. Targets and known points are locations that can be entered into the MFCS and used as targets or target references. They can also 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.

15-168. When the Tgt/KnPt button is selected, the screen in Figure 15-28 is displayed.

TARGETS SCREEN

15-169. This screen contains the following fields:

- Target Number (TgtNum).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).

15-170. It also contains three buttons:

- Use All.
- Undo.
- Delete (Del).

15-171. Targets are received digitally at the EOM or can be entered and edited manually by the operator.

Target Number Field

15-172. 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

15-173. The operator enters easting, northing, altitude, zone, and choice of datum or hemisphere data into the fields.

Use All Button

15-174. To save information, the operator clicks Use All.

Undo Button

15-175. To undo changes, the operator clicks the Undo button.

Delete Button

15-176. To delete an entry, the operator highlights the index box in front of the entry that he wants to delete and clicks Del.

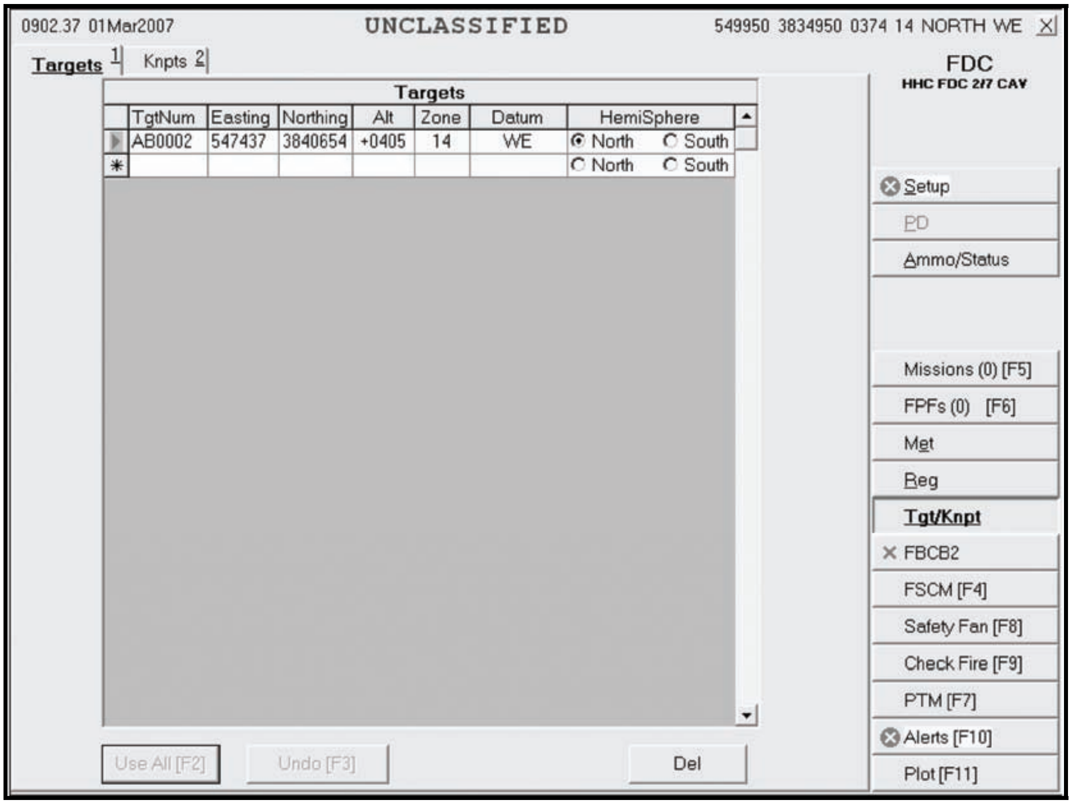

Figure 15-28. Targets screen.

KNOWN POINTS SCREEN

15-177. 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.

15-178. When the KnPts tab is selected, the screen in Figure 15-29 is displayed. This screen contains the following fields:

- Known Point (KnPt).
- Observer (Obs).
- Target Number (TgtNum).
- Easting.
- Northing.
- Altitude (Alt).
- Zone.
- Datum.
- Hemisphere (HemiSphere).

15-179. It also contains four buttons:

- Use All.
- Undo.
- Clear Target Number (Clear Tgt Num).
- Delete (Del).

Known Point Field

15-180. 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

15-181. 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

15-182. The operator enters easting, northing, altitude, zone, and choice of datum or hemisphere data into the fields.

Use All Button

15-183. To save information, the operator clicks Use All.

Undo Button

15-184. To undo changes, the operator clicks the Undo button.

Delete Button

15-185. To delete an entry, the operator highlights the index box in front of the entry that he wants to delete and clicks Del.

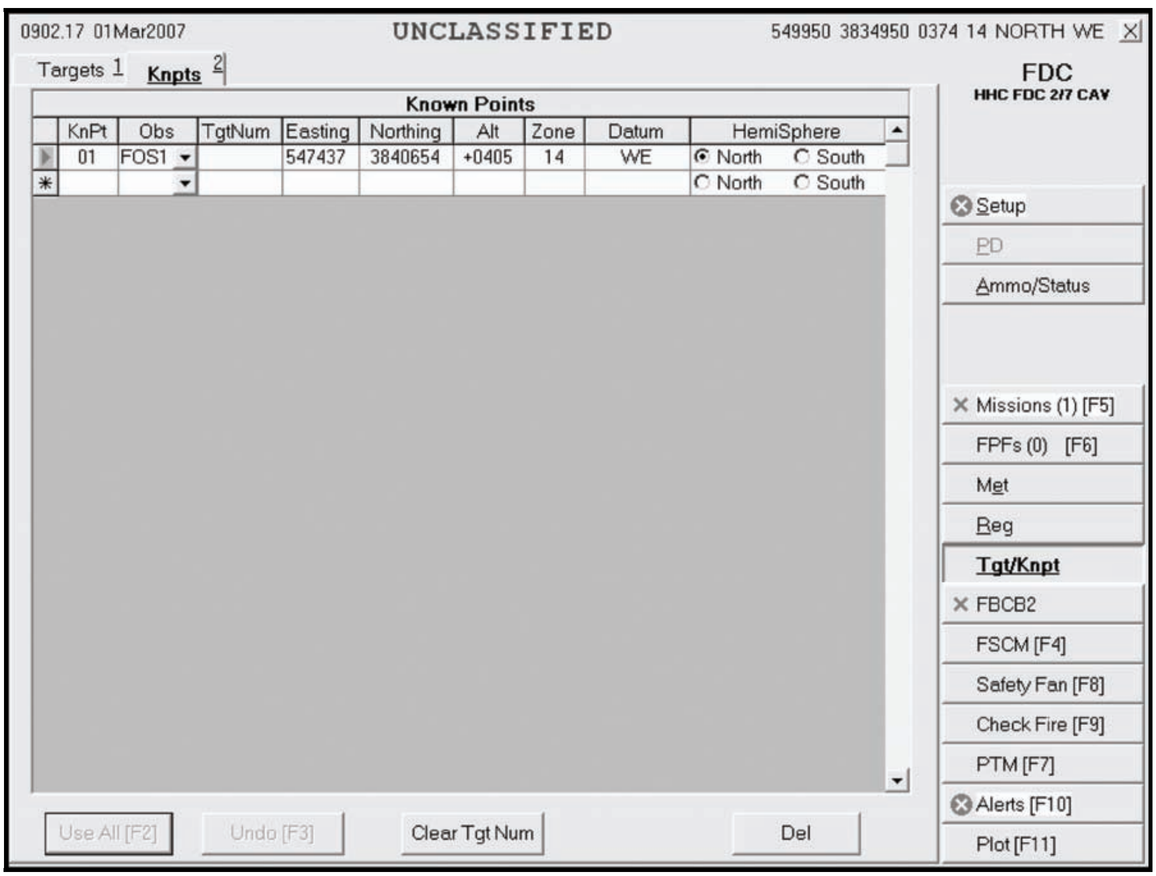

Figure 15-29. Known Points screen.

SAFETY FAN SCREEN

15-186. 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.

15-187. Up to 10 safety fans can be stored in the MFCS. The operator can manually input safety fan data into the system.

15-188. When the Safety Fan button is selected, the Safety Fans screen (Figure 15-30) 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).

15-189. Perform the following steps to enter data for a safety fan:

(1) Enter the easting and northing of the firing point location. Zone, Datum and HemiSphere fields will auto-fill. You may also utilize the alternate methods of entering a position (as described in 15-92 to 15-93) by clicking the icon.

(2) Enter the left and right azimuth (0 to 6399).

NOTE: The interior angle must not exceed 3200 mils.

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(3) Enter the minimum range (0 to 7,999 meters) and the maximum range (1 to 8,000 meters).

(4) Enter the minimum charge (0 to 9) and the maximum charge (0 to 10) based on the ammunition.

(5) Select the ammunition to be used inside the safety fan. The choices are high-explosive (HE), illumination (ILL), white phosphorus (WP), or infrared (IR).

(6) 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.

(7) To undo entries, click Undo. Click Use All to display the safety fan. To delete the safety fan, click Delete Fan. All of the fields will be cleared, and the Plot screen deleted.

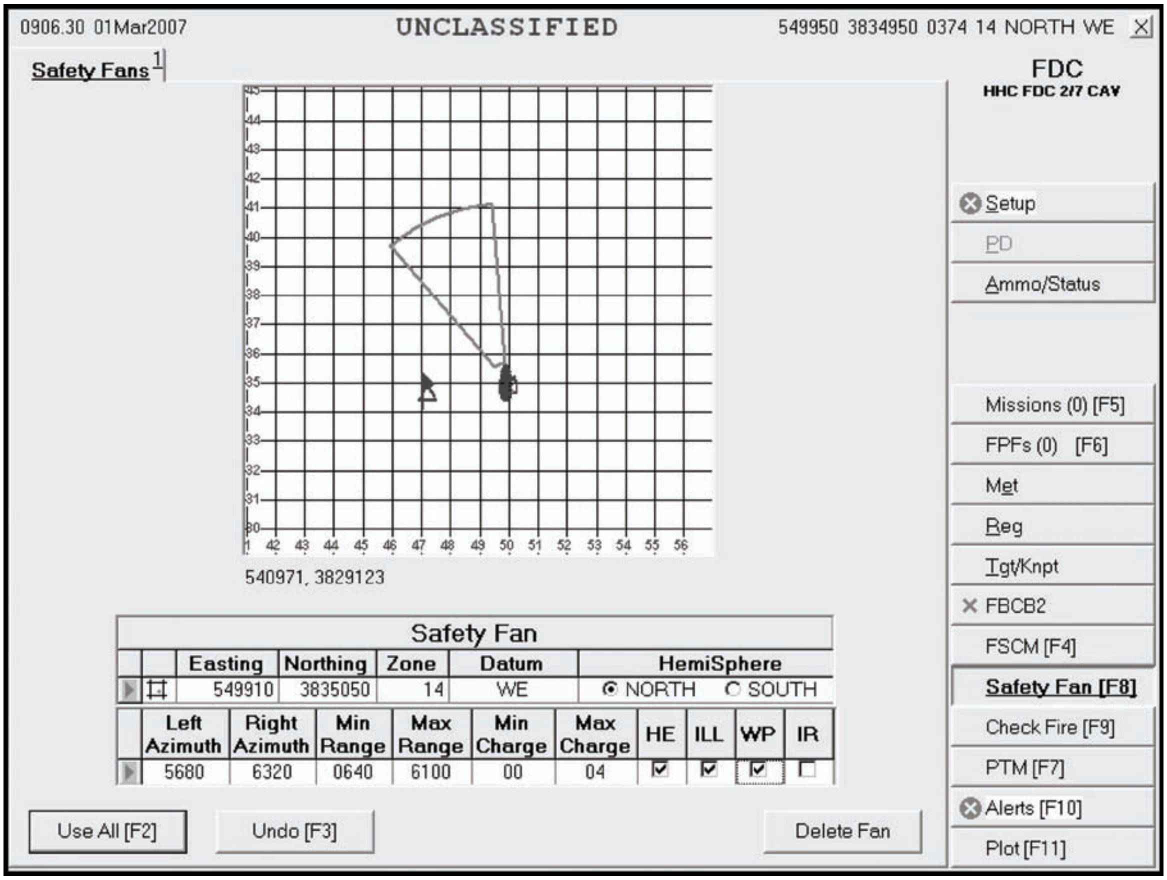


Figure 15-30. Safety Fans screen.

CHECK FIRE

15-190. 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 FC or FO is sent as an alert.

15-191. When the operator receives a Check Fire command from the FC—

- (1) A red "CF" message displays in the control tab area in front of Missions and Check Fire.
- (2) Click the Check Fire button to display the Check Fire screen (Figure 15-31).
- (3) An exclamation point (!) indicator is displayed in the index box.
- (4) Click OpAck to acknowledge the message; the indicator and audio alarm (if set) will be turned off.

15-192. To initiate or transmit a Check Fire message to all guns in the firing unit—

- (1) Click the Check Fire All button on the Check Fire screen.
- (2) This sends a Check Fire banner message to all guns and halts the mission until a valid Cancel Check Fire command is transmitted.

15-193. To initiate a Check Fire Target message—

- (1) Enter the target number.
- (2) Click Check Fire Target.
- (3) This transmits a Check Fire banner to the guns engaged in a mission with the associated target.

15-194. To cancel the Check Fire command—

(1) Click the indicator for the appropriate Check Fire message.

(2) Click Cancel Check Fire.

(3) This forwards the Cancel Check Fire message to all units in the firing unit. Fire missions may then continue.

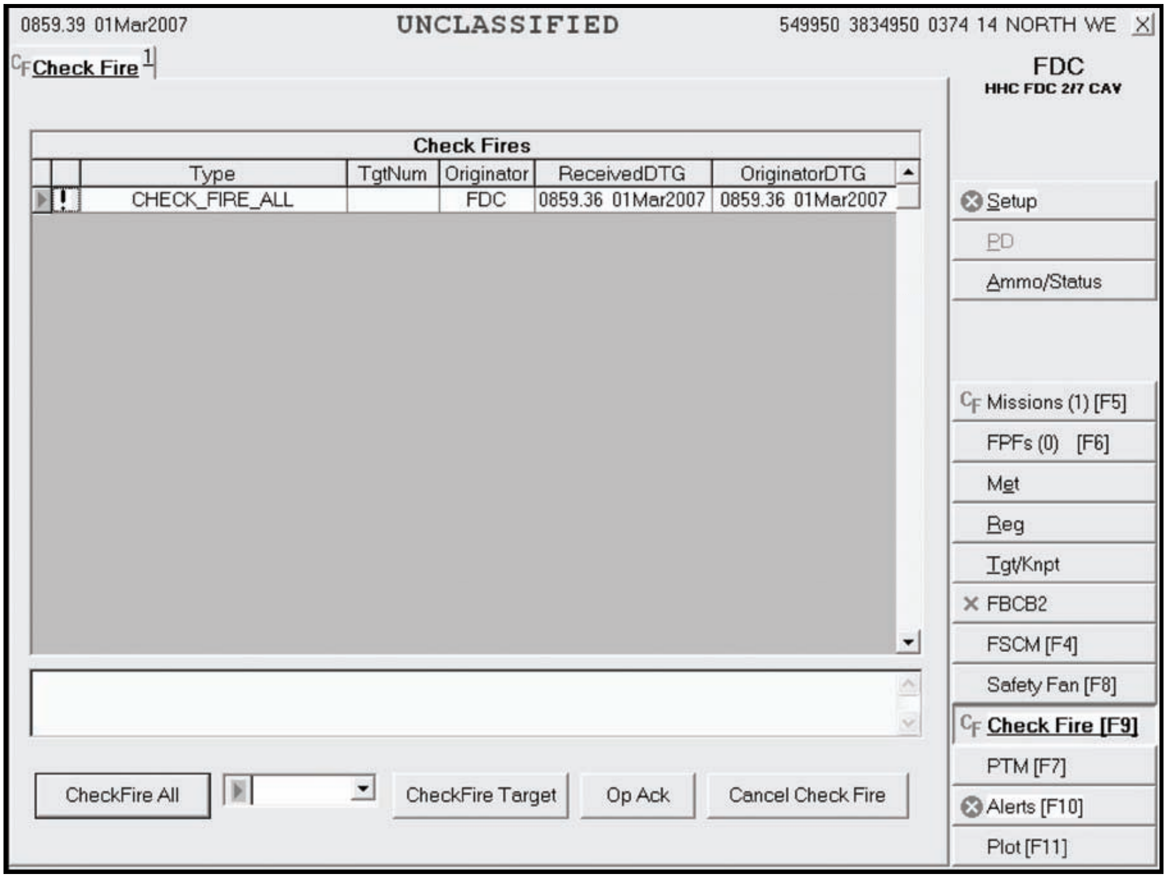


Figure 15-31. Check Fire screen.

PLAIN TEXT MESSAGES

15-195. The plain text messages (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 15-32 is displayed.

READ SCREEN

15-196. Upon receipt of a PTM, an indicator displays on the PTM button. The operator clicks the PTM button to display the Read screen (Figure 15-32). Messages are listed with—

- Priority.
- From.
- Description.
- Received DTG.
- Originator DTG.

15-197. Messages also have four categories:

- Flash (F).
- Immediate (I).
- Priority (P).
- Routine (R).

15-198. 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.

15-199. Follow these steps to read a message:

(1) Access the PTM screen by clicking the PTM button.

(2) Click the Read tab to read messages.

(3) 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.

(4) Click Reply to send a reply. The Send screen is displayed.

(5) To delete a message, highlight it and click Del.

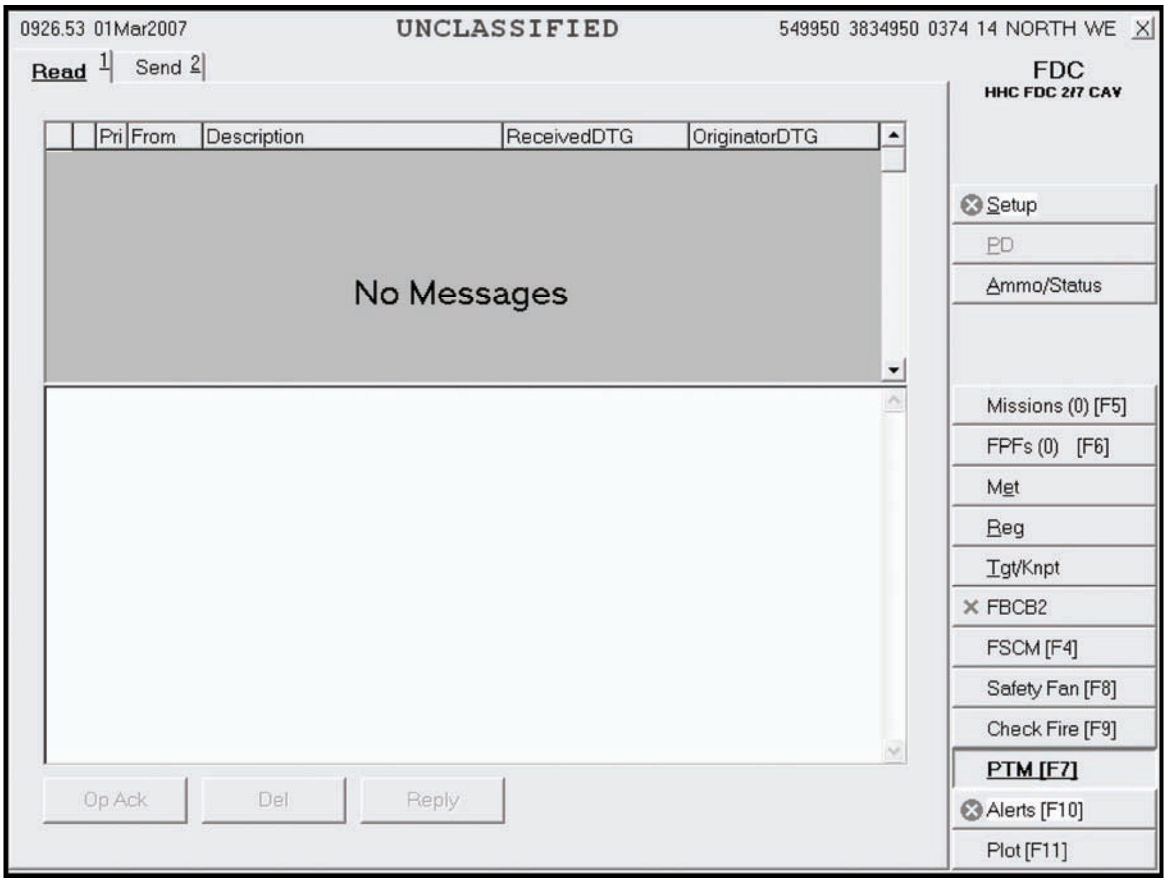


Figure 15-32. Plain Text Message Read screen.

SEND SCREEN

15-200. The operator selects the Send tab to display the Send screen (Figure 15-33). Follow these steps to read a message:

(1) Either click Sel in Destinations to select the units to which you will send the message, choose Click All to send the message to everyone in Destinations, or select None to deselect all units in Designations.

(2) Type the message using the keyboard.

(3) Click Send.

(4) A Send Status box displays, showing the destination and status. The status options include—

- Machine Acknowledgement (MAck).
- Retry (the system is retrying).
- Failed (the message did not reach the destination).

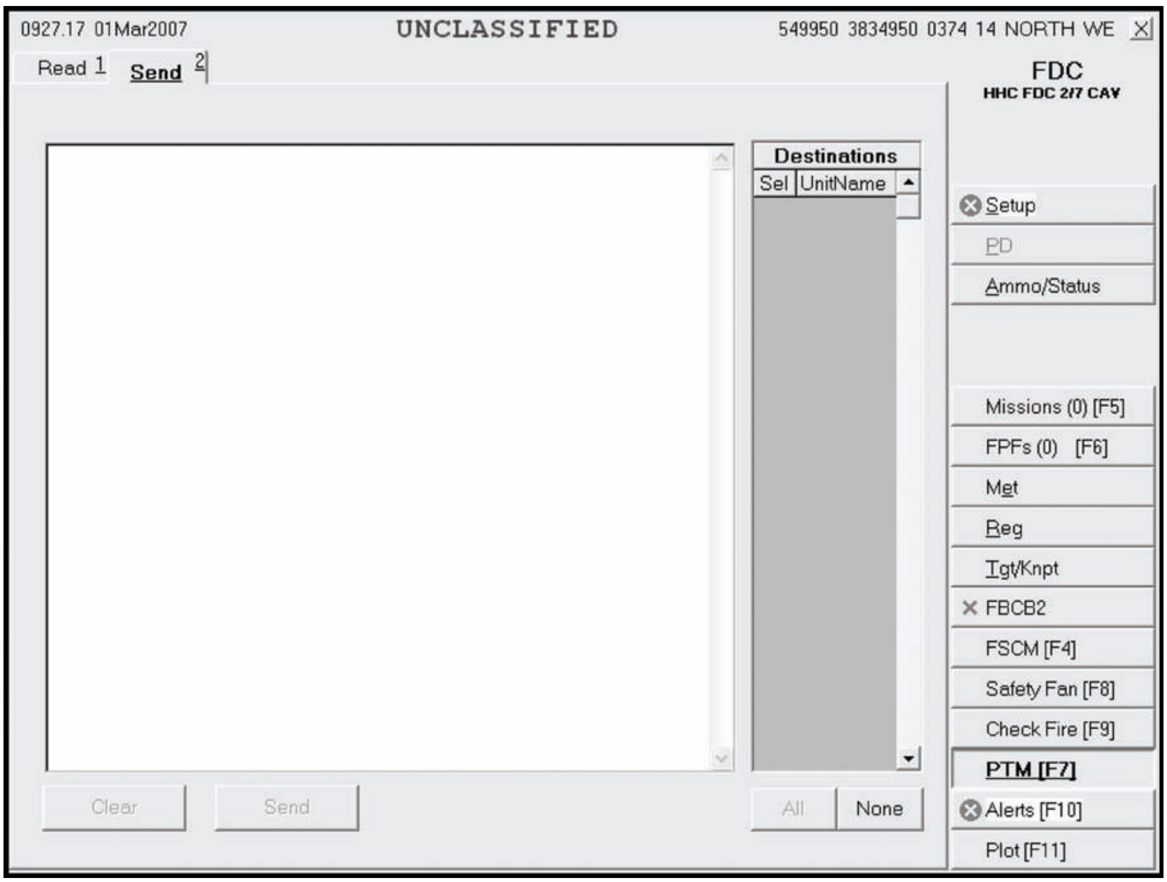


Figure 15-33. Send screen.

ALERTS FUNCTION

15-201. The Alerts function (Figure 15-34) allows the operator to receive automated system messages, such as information, error, and warning alerts.

15-202. When an icon indicating that there are alerts in the queue displays, the operator selects the Alerts button. The Alert screen is displays, showing the—

- Date-time group (DTG).
- Type (TY).
- Description.

15-203. Then, he selects OpAck to deactivate the alarm. To delete an alert, the operator clicks the row to be deleted and clicks Del.

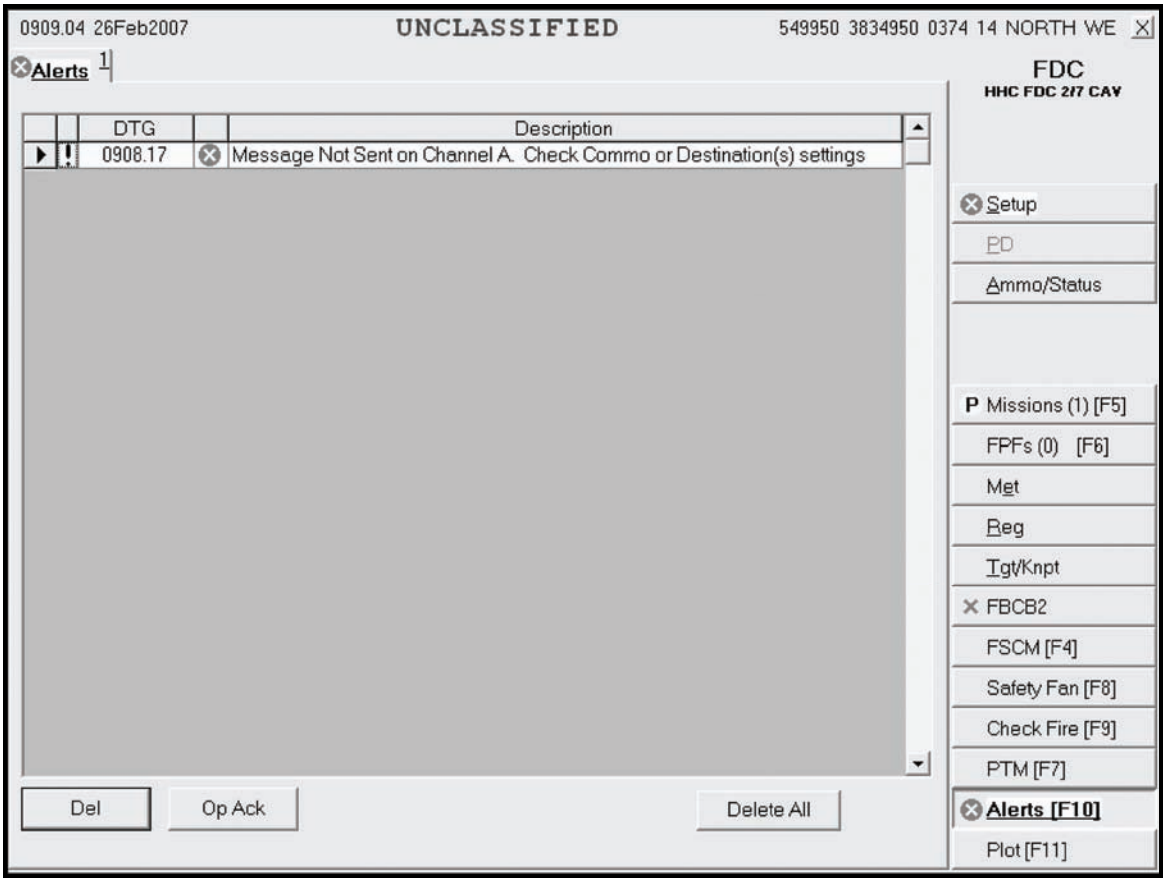


Figure 15-34. Alerts screen.

Chapter 16

Fire Missions

This chapter consists of three sections: parts of a standard fire mission; basic fire missions, which contains basic digital and manual fire mission procedures; and special missions, which details specific missions such as registration, illumination, coordinated illumination, and FPF.

SECTION I. PARTS OF A STANDARD FIRE MISSION

This section discusses the features of basic digitally and manually 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. This section explains the steps common to all digital and manual fire missions.

STANDARD FIRE MISSION PROCEDURES

16-1. 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 also uses common actions to process fire missions and transmit commands. Special missions (registration, illumination, coordinated illumination, and FPF) also use the standard set of screens, as well as the same common actions.

SEQUENCE OF ACTIONS FROM THE INITIAL CALL FOR FIRE TO THE END OF MISSION

16-2. 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 also be stopped at any time with an EOM from the FC or FO. This sequence is as follows:

(1) The initial fire mission occurs. The initial fire mission can be a new or an established target.

(2) The fire is adjusted onto the target. This may be omitted if the initial impact hits within the target area or if the mission is an FFE.

(3) The FO or FC calls for an FFE.

(4) An EOM is sent from the FC or FO, and the mission is saved or deleted.

DIGITAL AND MANUAL FIRE MISSION TABS AND SCREENS

16-3. Figure 16-1 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.

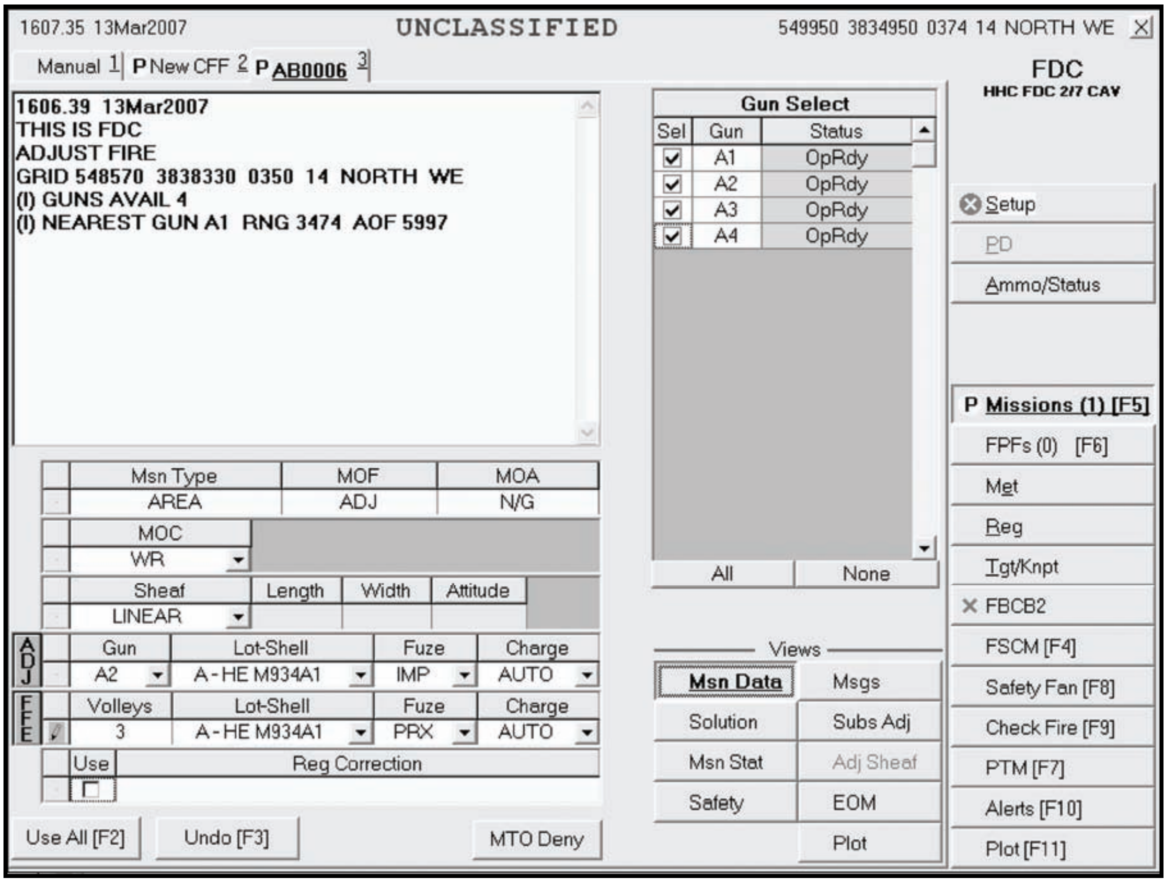


Figure 16-1. Mission Data screen.

16-4. The MFCS uses tabs and views to display the mission and related data. Table 16-1 lists the tabs and screens typically used during digital, manual, and special fire missions.

NOTE: For more information about special fire missions, see Section III of this chapter.

Table 16-1. Tabs and screens.

TABS OR SCREEN	INFORMATION AND ACTIONS
New Call for Fire Tab	The operator— • Receives the new CFF. • Accepts (Process) the fire mission. • Refuses (MTO Deny) the fire mission.
Manual Call for Fire Tab	The operator manually designates and performs grid, polar plot, shift from a known point, 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. • 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 Screen	This screen displays adjustment data. The operator reviews and adjusts data.
EOM Screen	This screen houses these features: • Not save the mission. • Save as a target. • Save as a known point.
Plot Screen	This screen displays a digital plot of the mission with icons for key data.
Manual Subsequent Adjust Screen	The operator manually performs a subsequent adjustment.
Manual EOM	The operator manually records the mission as a target (known point). This screen houses these features: • Not save the mission. • Save as a target. • Save as a known point.

COMMON ACTIONS

16-5. 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 refusing the mission.
- Processing or deleting the mission.
- Selecting the guns to fire the mission.
- Confirming gun orders.
- Accepting or modifying data.

ACKNOWLEDGING RECEIPT

16-6. 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

16-7. The operator records data throughout the process to maintain a record and to preserve data should the MFCS fail. He transcribes data onto DA Form 2399-R or DA Form 2188-R. The phrase “record data” is used throughout the chapter to indicate this action.

MESSAGE TO THE OBSERVER ACCEPT OR MESSAGE TO THE OBSERVER DENY

16-8. The MFCS operator selects message to the observer (MTO) Accept to accept the mission and MTO Deny to refuse 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 to refuse the mission" is used throughout the chapter to indicate this action.

PROCESS OR DELETE

16-9. The operator may select Process to continue with the mission or Delete to stop the mission. The terms “process” and “delete” are used throughout the chapter to indicate this action.

SELECTING THE GUNS TO FIRE THE MISSION

16-10. 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 also select all or none of the guns listed by selecting All or None. The phrase “select guns” is used throughout the chapter to indicate this action.

ACCEPTING OR MODIFYING DATA

16-11. If required, the operator adjusts the mission data. To undo any changes, he selects Undo Changes, and the data fields display the original data. If any changes were made, he selects Use All to accept all of the changes. If no changes were made, he selects Use All. The phrase “modify data if necessary” is used throughout the chapter to indicate this action.

SECTION II. BASIC FIRE MISSIONS

This section details how the MFCS is used to conduct digital and manual fire missions using each method of target location. It also explains how the MFCS records RPs, targets, and known points.

BASIC DIGITAL MISSIONS

16-12. New basic fire missions are received digitally from the FC or FO. The FC 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.

16-13. 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 from a known point 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

16-14. 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 (Figure 16-2). The operator can select MTO Deny to deny the mission or Process to display the Mission Data screen.

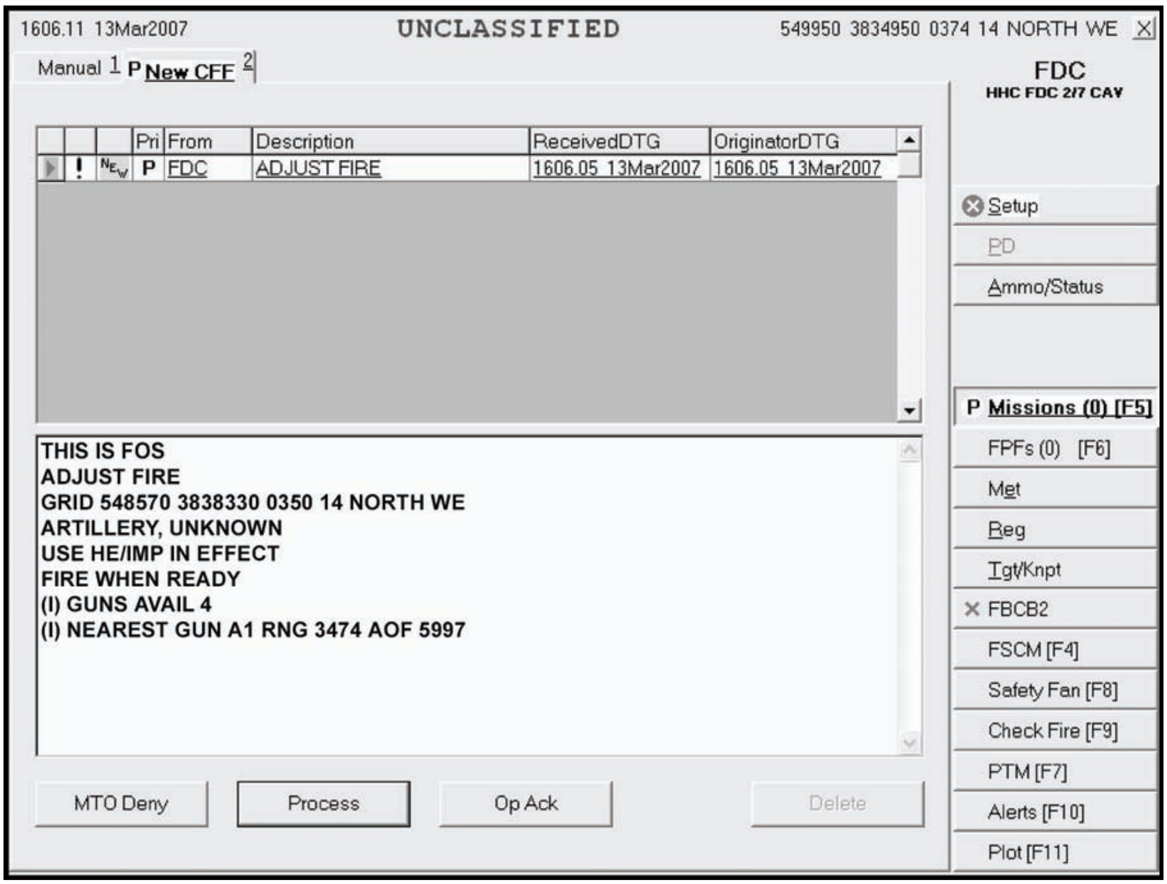


Figure 16-2. New Call for Fire screen.

MISSION DATA SCREEN

16-15. The Mission Data screen (Figure 16-3) 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, method of control (MOC), type of sheaf, and fuze-shell combinations. Once satisfied, the operator selects Use All (if he made any changes) or Solution.

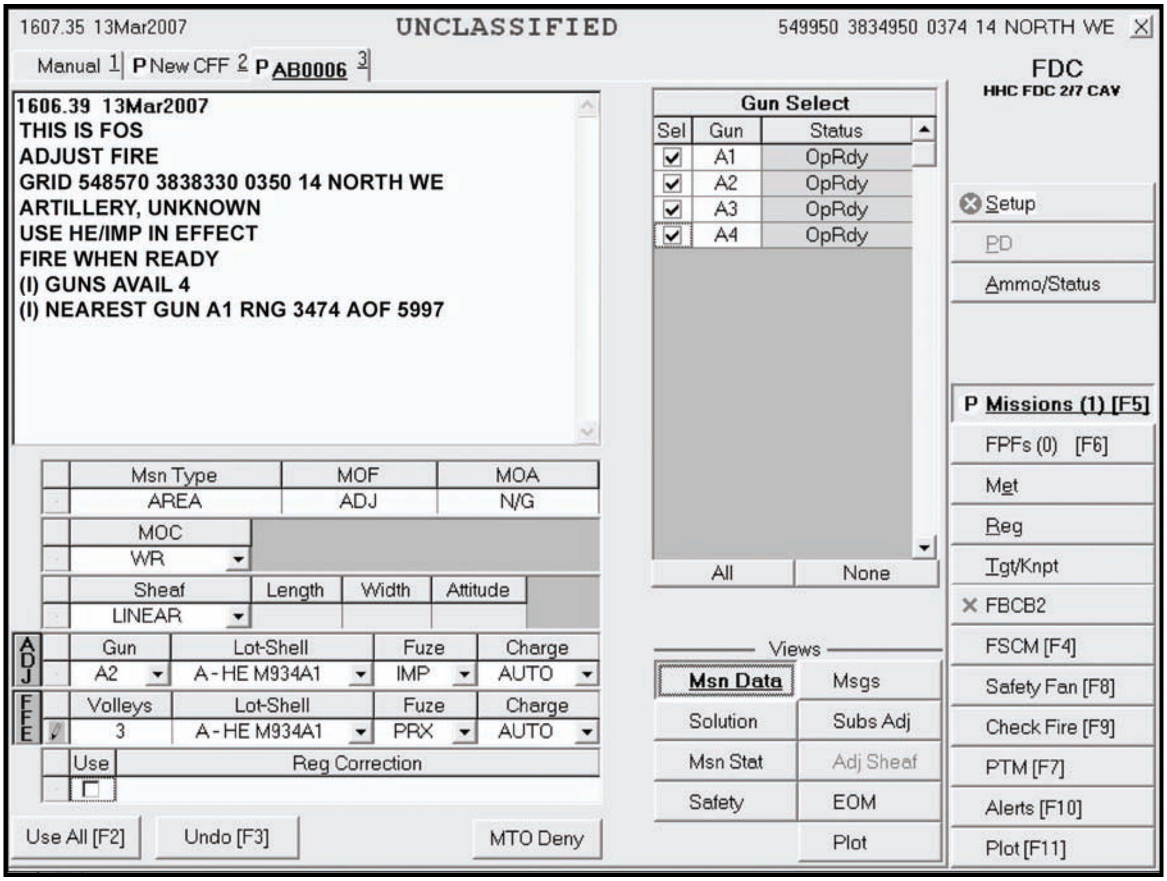


Figure 16-3. Mission Data screen.

SOLUTION SCREEN

16-16. The Solution screen (Figure 16-4) shows the gun orders, the guns selected, and 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.

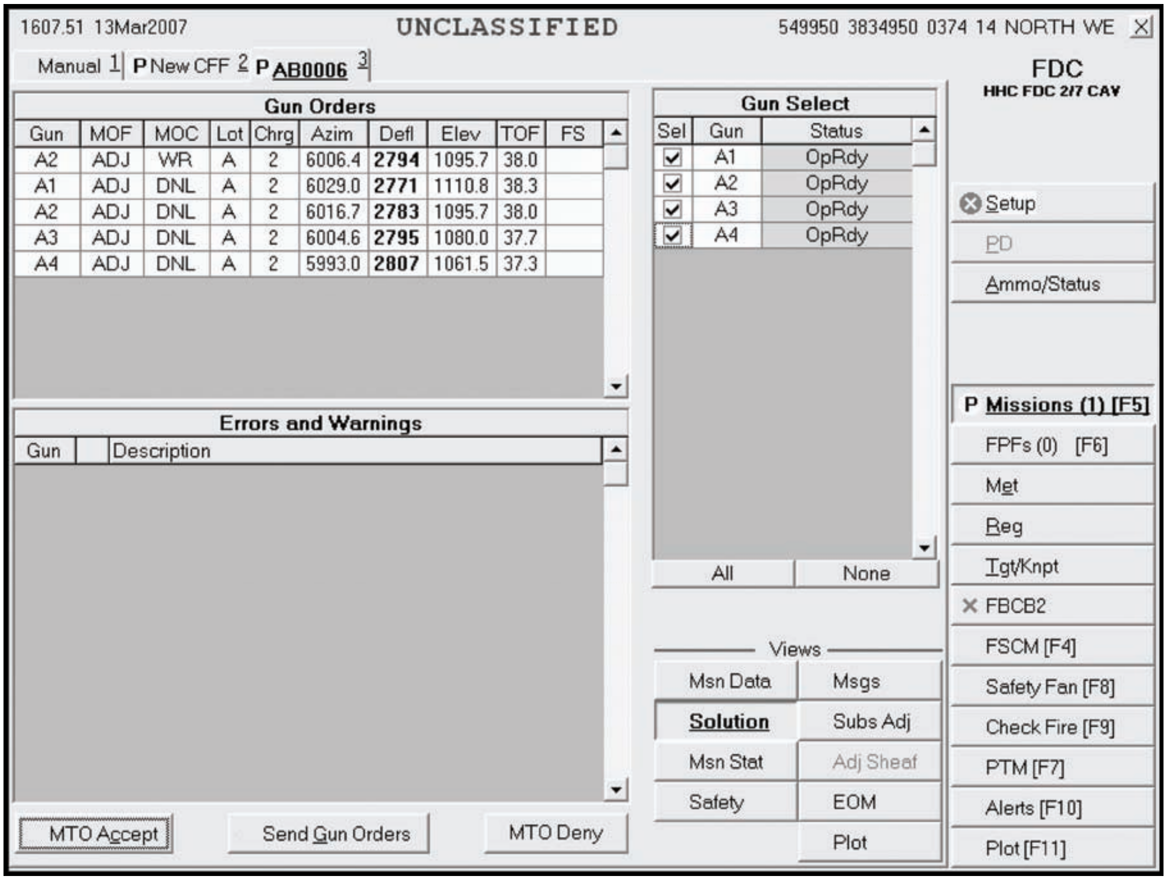
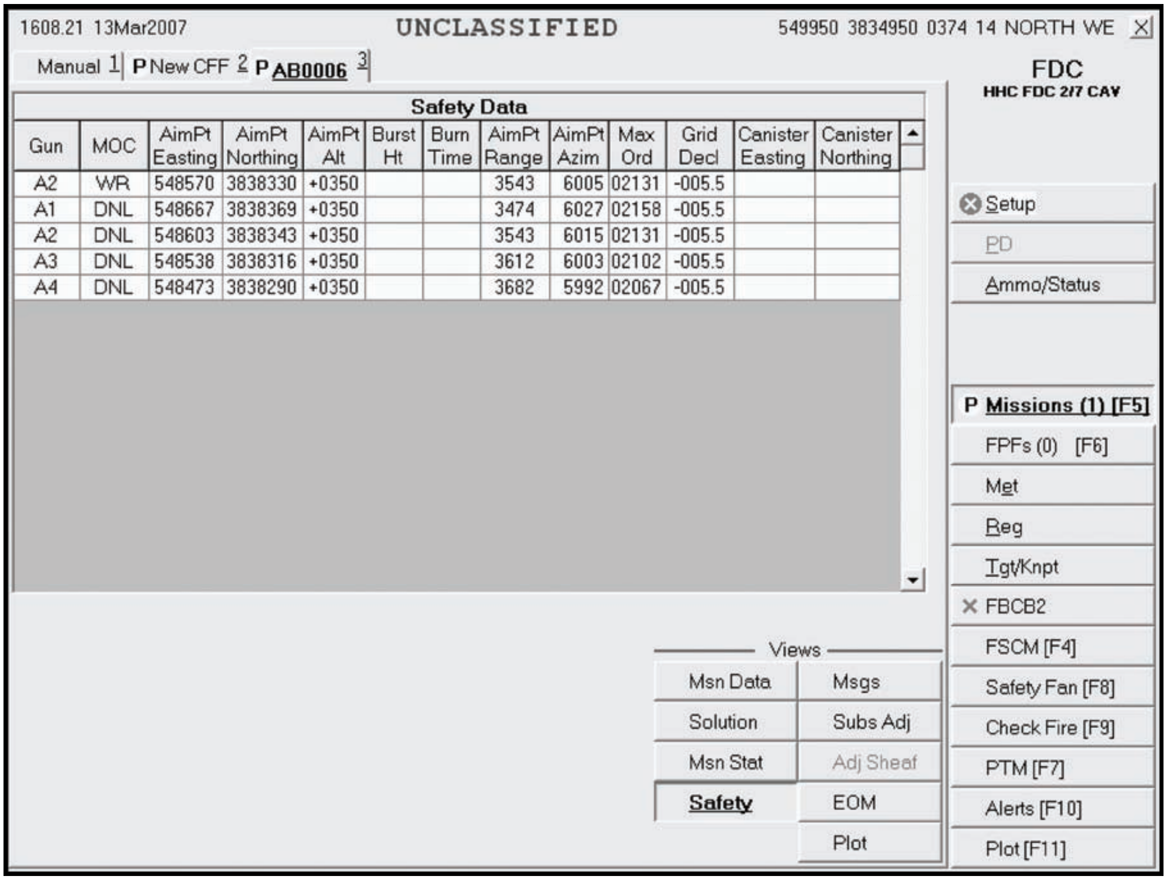


Figure 16-4. Solution screen.

SAFETY DATA SCREEN

16-17. Prior to sending gun orders or at any time, the operator can review and record the safety data using the Safety Data screen (Figure 16-5).



Gun	MOC	AimPt Easting	AimPt Northing	AimPt Alt	Burst Ht	Burn Time	AimPt Range	AimPt Azim	Max Ord	Grid Decl	Canister Easting	Canister Northing
A2	WR	548570	3838330	+0350			3543	6005	02131	-005.5		
A1	DNL	548667	3838369	+0350			3474	6027	02158	-005.5		
A2	DNL	548603	3838343	+0350			3543	6015	02131	-005.5		
A3	DNL	548538	3838316	+0350			3612	6003	02102	-005.5		
A4	DNL	548473	3838290	+0350			3682	5992	02067	-005.5		

Figure 16-5. Safety Data screen.

PLOT SCREEN

16-18. The Plot screen (Figure 16-6) 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 FBCB2, 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, he selects the Solution button.

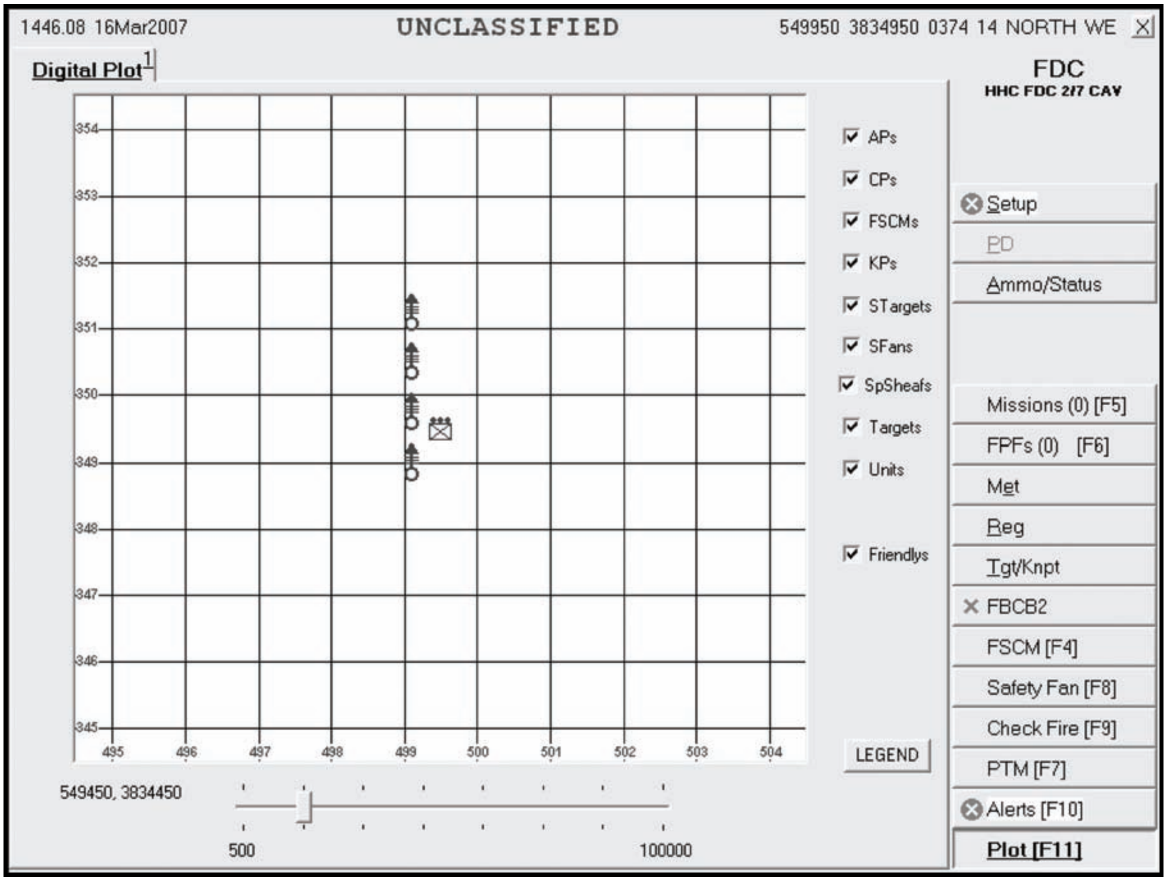


Figure 16-6. Plot screen.

SOLUTION SCREEN

16-19. On the Solution screen (Figure 16-7), the operator reviews the gun orders and other data. 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. A Send Status box is displayed, showing the destination and status of the message to the guns. The status shows Machine Acknowledgement (MAck), Retry (the system is retrying), or Failed (the message did not reach its destination). The Mission Status Screen is then displayed.

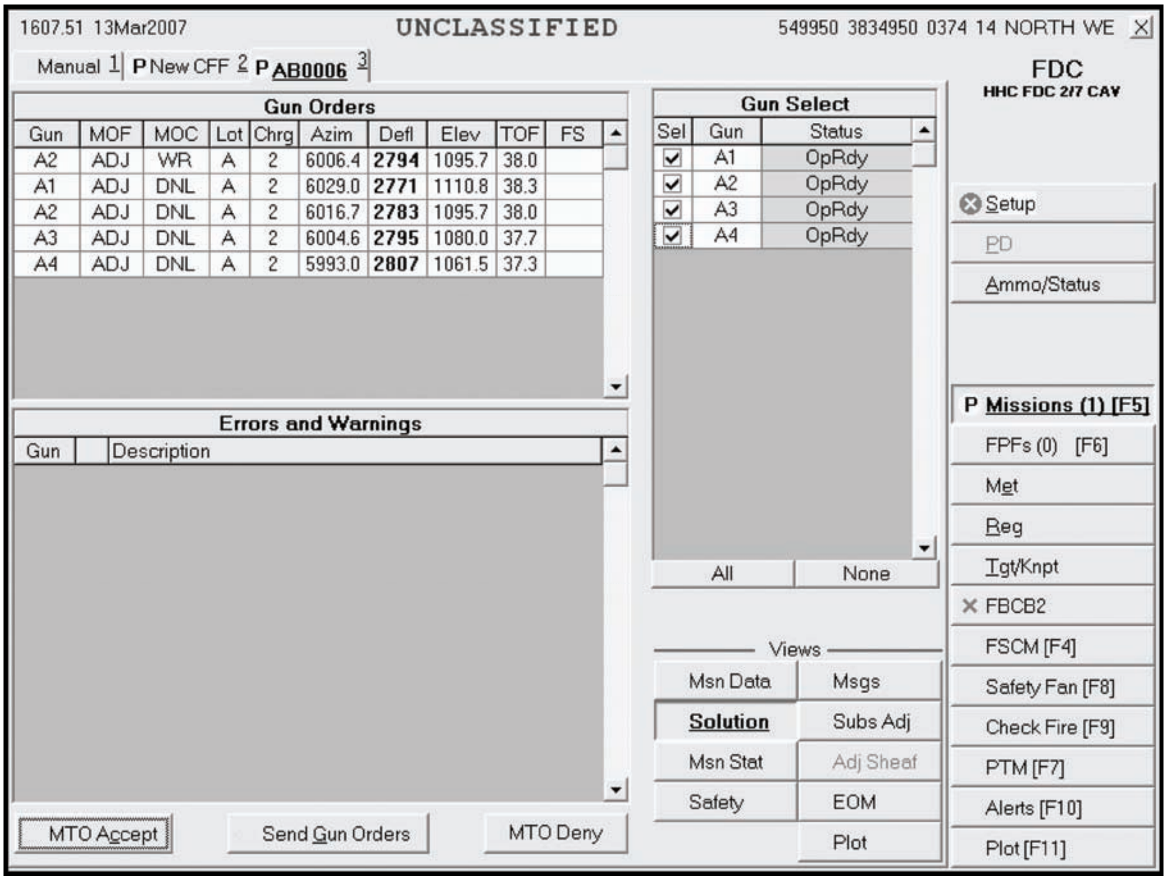


Figure 16-7. Solution screen.

MISSION STATUS SCREEN

16-20. When the operator sends gun orders, the Mission Status screen (Figure 16-8) 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 FC or FO.

- On receiving "Shot," a checkmark appears in the checkbox, and the box turns green. The time of flight and a red splash sign are also displayed.
- If a gun aborts the mission, a checkmark appears in the Abort box, and a reason is displayed.

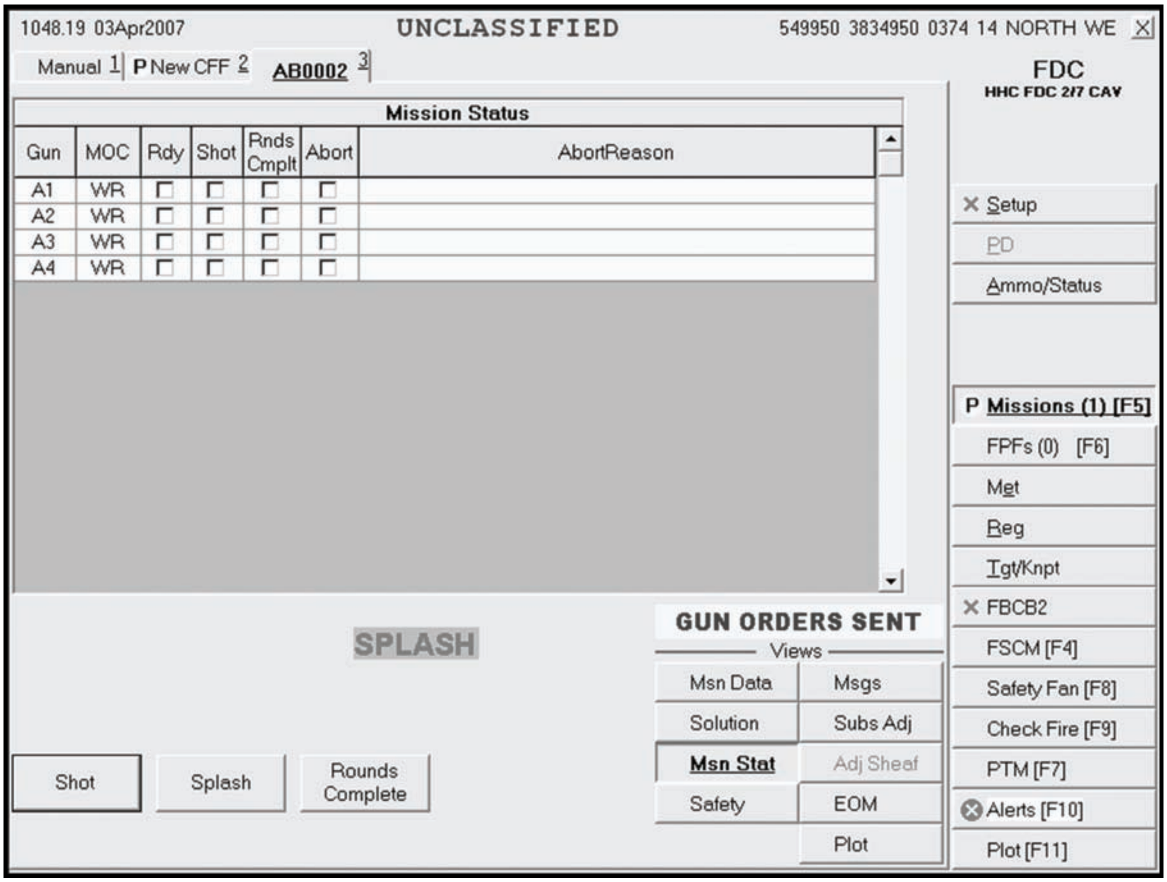


Figure 16-8. Mission Status screen.

SUBSEQUENT ADJUSTMENT, MESSAGES SCREEN

16-21. The operator selects the Messages screen (Figure 16-9) and waits for subsequent messages. There are two main subsequent messages: adjust fire and FFE. The FC or FO can order an FFE or continue to make adjustments. 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, he selects Process to display the Mission Data screen.

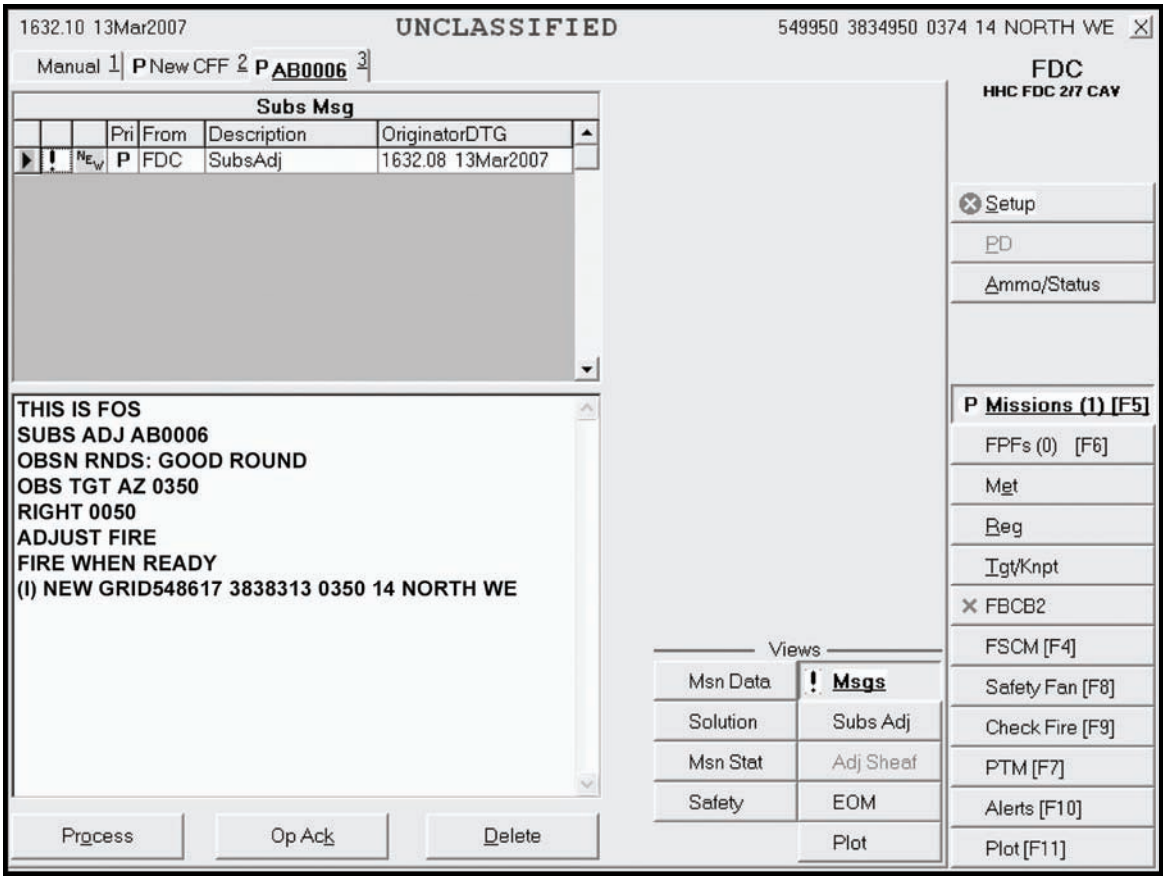


Figure 16-9. Messages screen.

SUBSEQUENT ADJUST-ADJUST FIRE

16-22. Until an FFE or EOM is ordered, the operator can make adjustments using the steps described in paragraphs 16-15 to 16-20. The operator continues to review and modify data on the Mission Data, Solution, and Safety Data screens. He also controls the mission on the Mission Status screen.

SUBSEQUENT ADJUST-FIRE FOR EFFECT

16-23. The Mission Data screen (Figure 16-10) appears when an FFE command is received. The operator records the data and selects OpAck to deactivate the audio alarm. He can choose Process or Delete. If he selects Process, the Mission Data screen appears, and he 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 he made any changes) or Solution. The Solution screen appears. The operator can also select the Safety Data screen. If the MOC is “at my command" (AMC), 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.

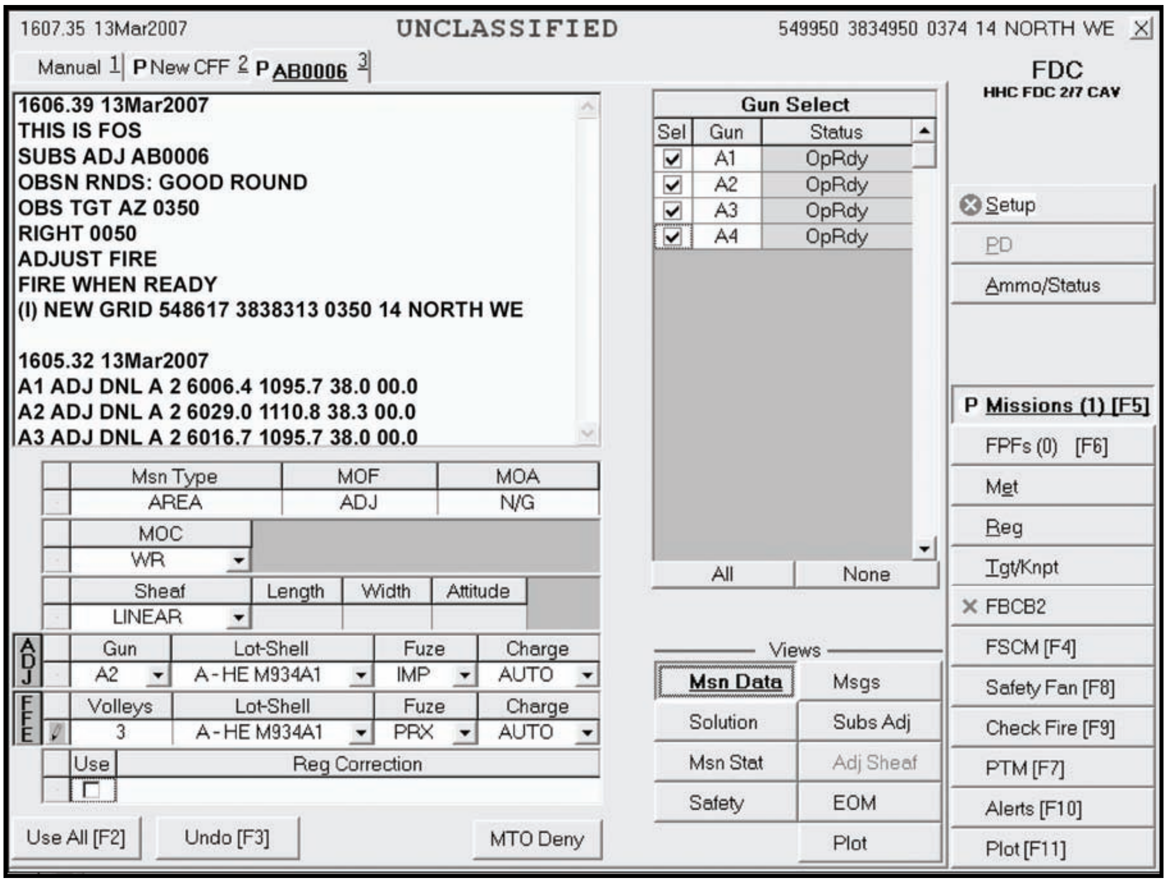


Figure 16-10. Mission Data screen.

END OF MISSION

16-24. 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 (Figure 16-11). If the operator does not need to save or record the mission, he selects Process. The New CFF tab for the fired mission appears, and the operator selects Delete.

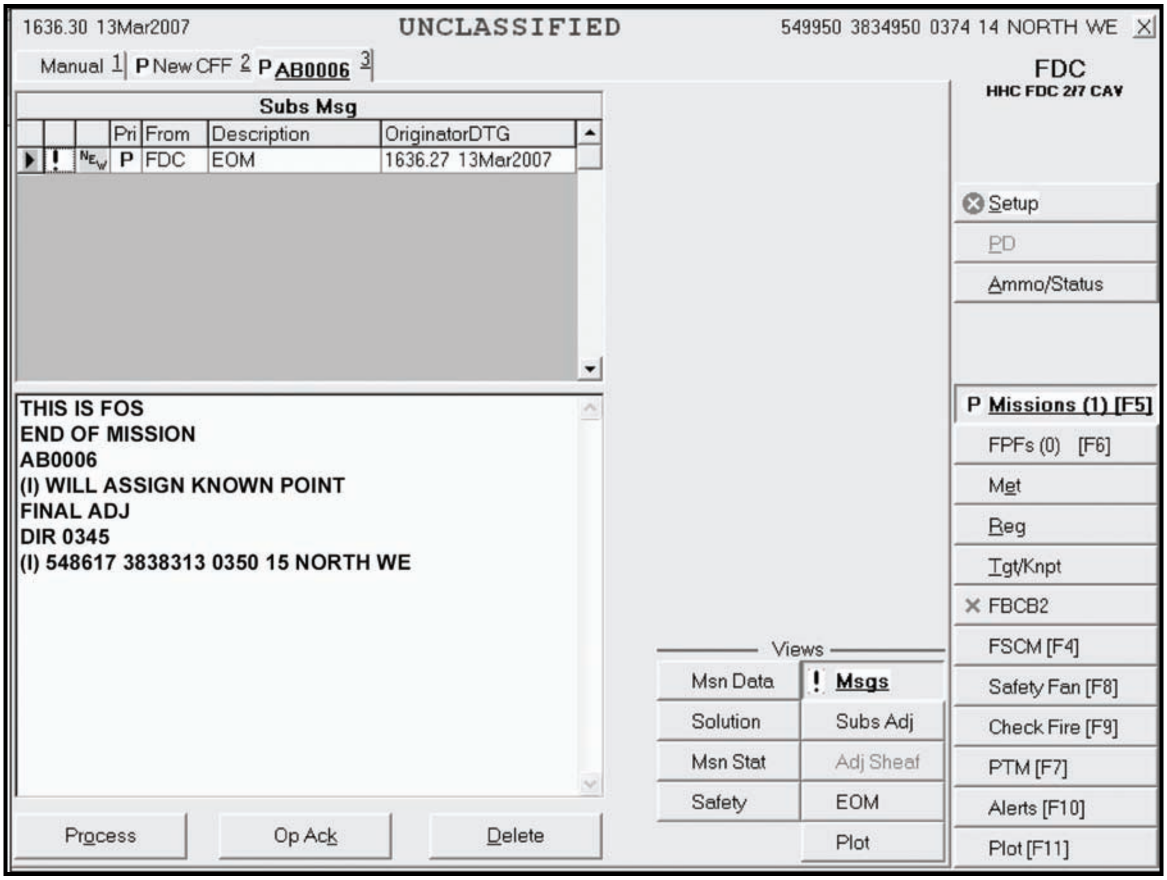


Figure 16-11. End of Mission message.

SAVE DATA

16-25. When the operator receives an EOM message with instructions to record the mission (from the FC or FO), he can save it as a known point or as a target. A box appears on the screen, and the operator completes the information required (Figure 16-12). He then selects Process and deletes the mission. The operator can also use the EOM button to do the same.

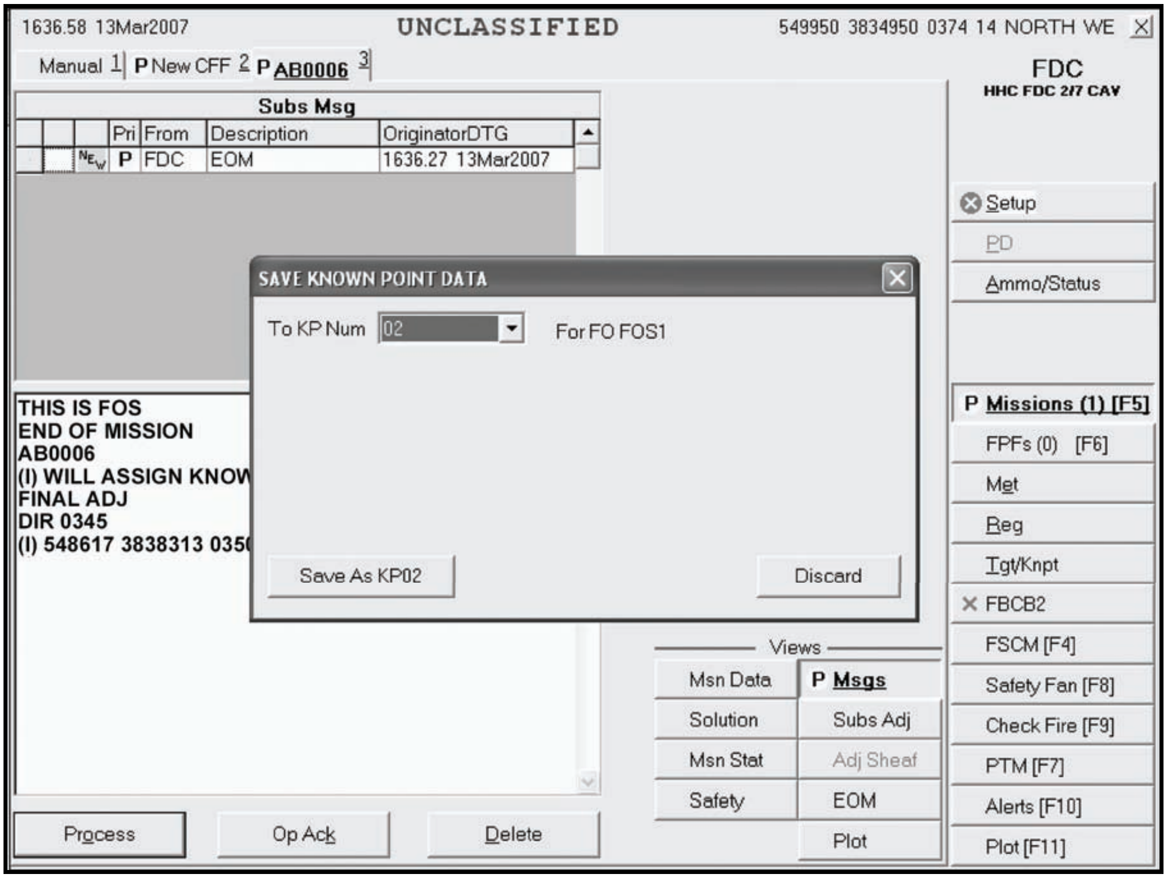


Figure 16-12. Save Data screen.

MANUAL MISSIONS

16-26. During manual fire missions, the FDC receives the data from the FC or FO by radio or some other non-digital 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 have to be entered into the MFCS. After the data have been entered, the operator processes missions using the sequence of screens described in paragraphs 16-13 to 16-25.

MANUAL CALL FOR FIRE

16-27. The operator selects the Missions button and the Manual tab. The Manual CFF screen (Figure 16-13) 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. The operator uses the procedures described in paragraphs 16-15 to 16-24 to process the new CFF.

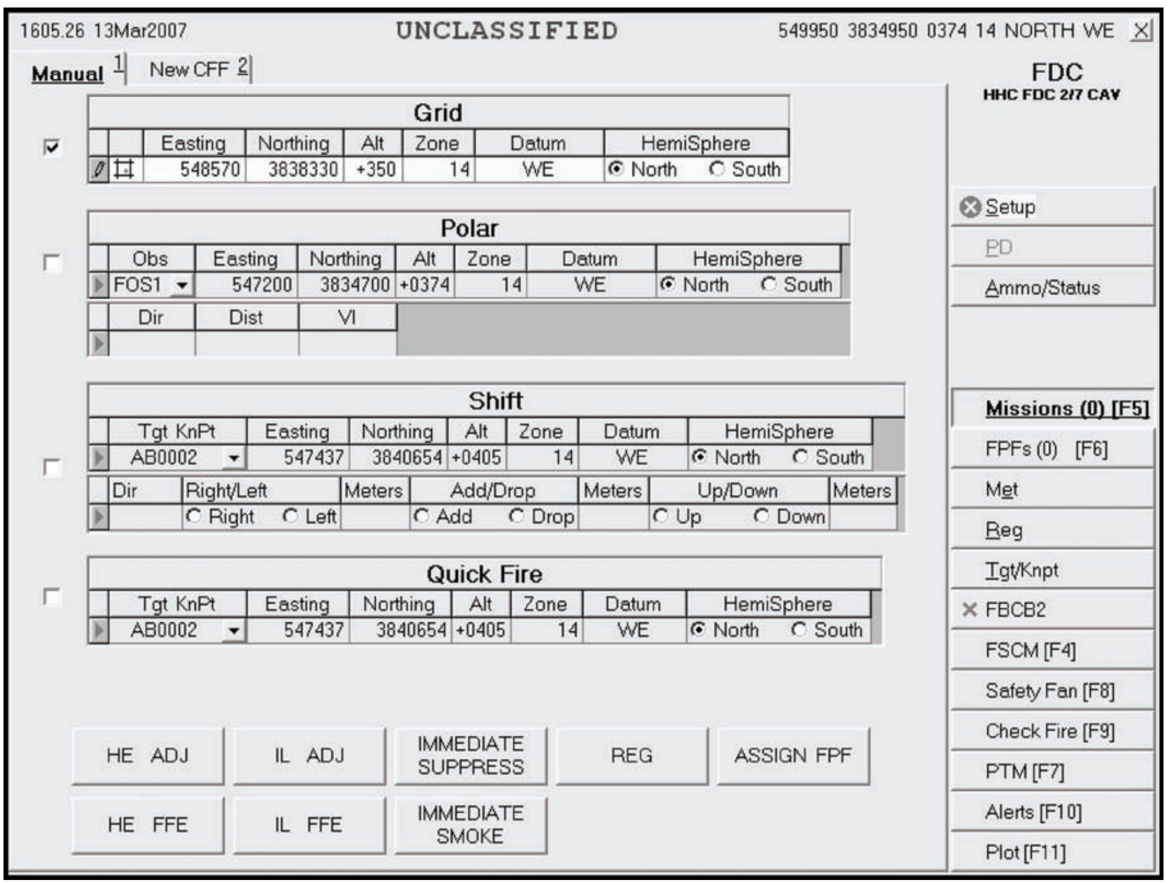


Figure 16-13. Manual Call for Fire screen.

Data Common for all Missions

16-28. The operator enters data into the Easting, Northing, and Alt fields. The Zone, Datum, and Hemisphere fields are auto-filled. At the bottom of the screen, he also selects the type of round and the method of fire (HE ADJ is used in the example).

Data for Polar Plot Missions

16-29. In addition to the common data, the operator enters the following data for a polar plot mission:

- Observer (Obs) (from a pick list).
- Direction (Dir) from 0000 to 6399.
- Distance (Dist) from 0000 to 9999.
- Vertical interval (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.

Data for Shift From a Known Point Missions

16-30. In addition to the common data, the operator enters the following data for a shift from a known point mission:

- Observer (Obs) (from a pick list).
- Known point (KnPt) (from a pick list).
- Direction (Dir) 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.
- VI (up/down) 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.

Quick Fire

16-31. In addition to the common data, the operator enters the following data for a quick fire mission:

- Target number (from a pick list).
- HE FFE or IL FFE (from the bottom of the screen).

MANUAL ADJUST FIRE

16-32. The operator waits for subsequent messages by selecting the Messages screen. If the FO requests an adjust fire, the operator enters the data from the message into the MFCS by selecting the Subsequent Adjust button in the Mission Status screen (Figure 16-14). Then, he enters the FO's adjustment, and the MFCS calculates the gun orders.

16-33. Next, the operator processes the manual adjust fire mission as he would a digital adjust fire mission (see paragraph 16-21). He repeats this step until he receives an FFE or an EOM. At the FFE command, the operator uses the procedures described in paragraph 16-23.

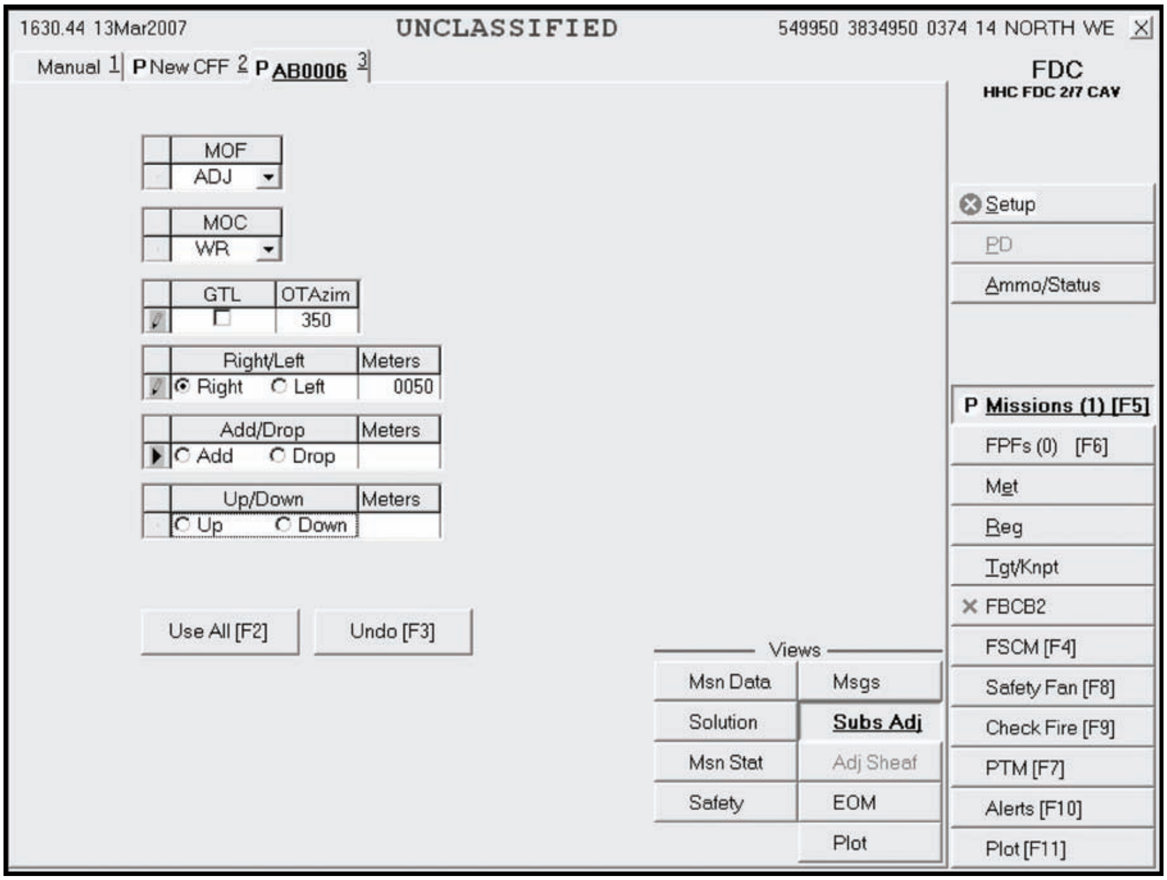


Figure 16-14. Manual Adjust Fire screen.

MANUAL END OF MISSION

16-34. To end the mission, the operator selects the EOM button. The Manual End of Mission screen (Figure 16-15) 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.

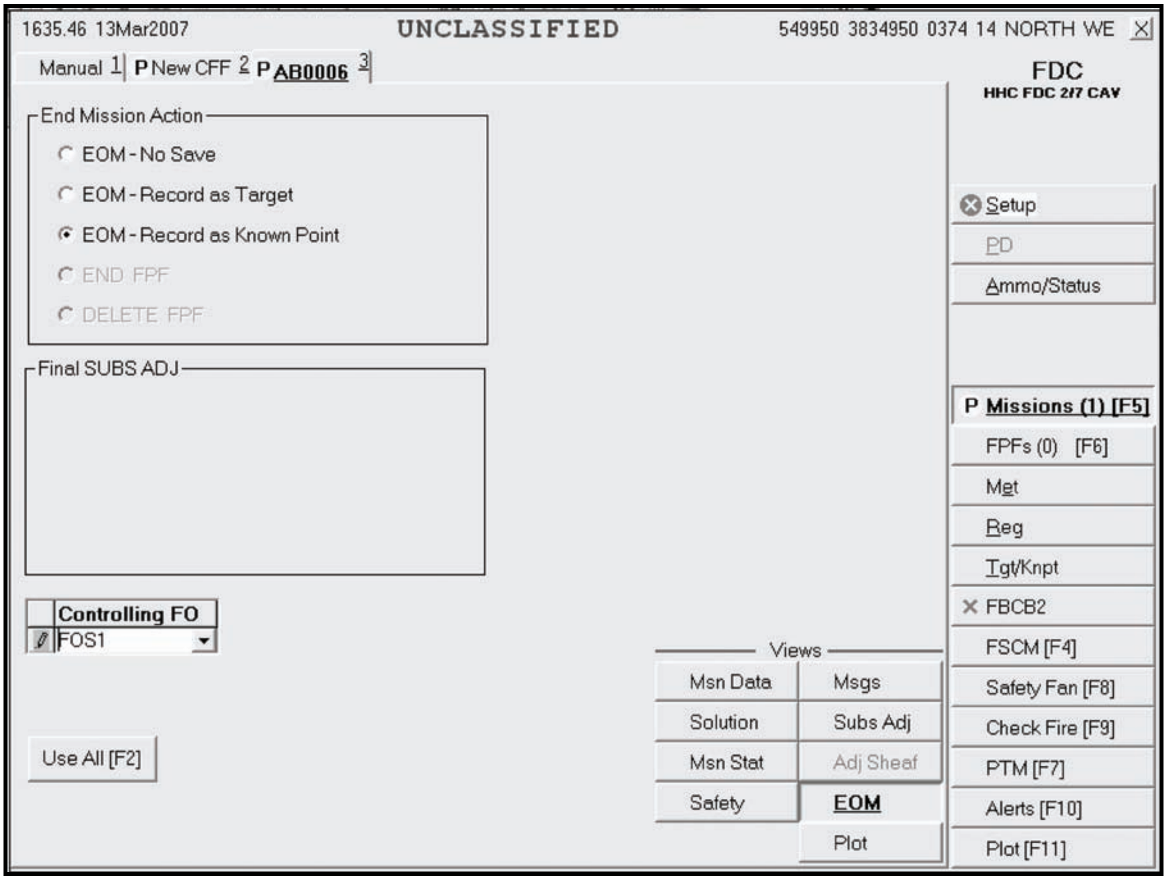


Figure 16-15. Manual End of Mission screen.

End Of Mission-No Save

16-35. If the operator does not need to save or record the mission, he selects Process. The New CFF screen appears, and the operator selects Delete.

End Of Mission -Record as Target

16-36. The Subsequent Message screen is displayed, with the words "End of Mission with Known Point." The operator selects Process, and the New CFF screen appears. Then, he selects Delete.

End Of Mission -Record as Known Point

16-37. 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.

SECTION III. SPECIAL MISSIONS

In addition to manual and digital fire missions, the MFCS operator can process special fire missions, which include registration, illumination, coordinated illumination, and FPFs. Each special mission has a button in the control button area.

REGISTRATION POINT

16-38. 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 FC or FDC determines whether the mission should be saved as an RP.

FIRING THE REGISTRATION

16-39. 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

16-40. At the end of a grid mission, the FC or FO sends an EOM.

- To record the RP number, the operator selects the RP number and then selects the Save As RP button when the Save Registration Data box is displayed (Figure 16-16). The range and azimuth correction factors are also displayed.
- The data can also be discarded by pressing the Discard button.

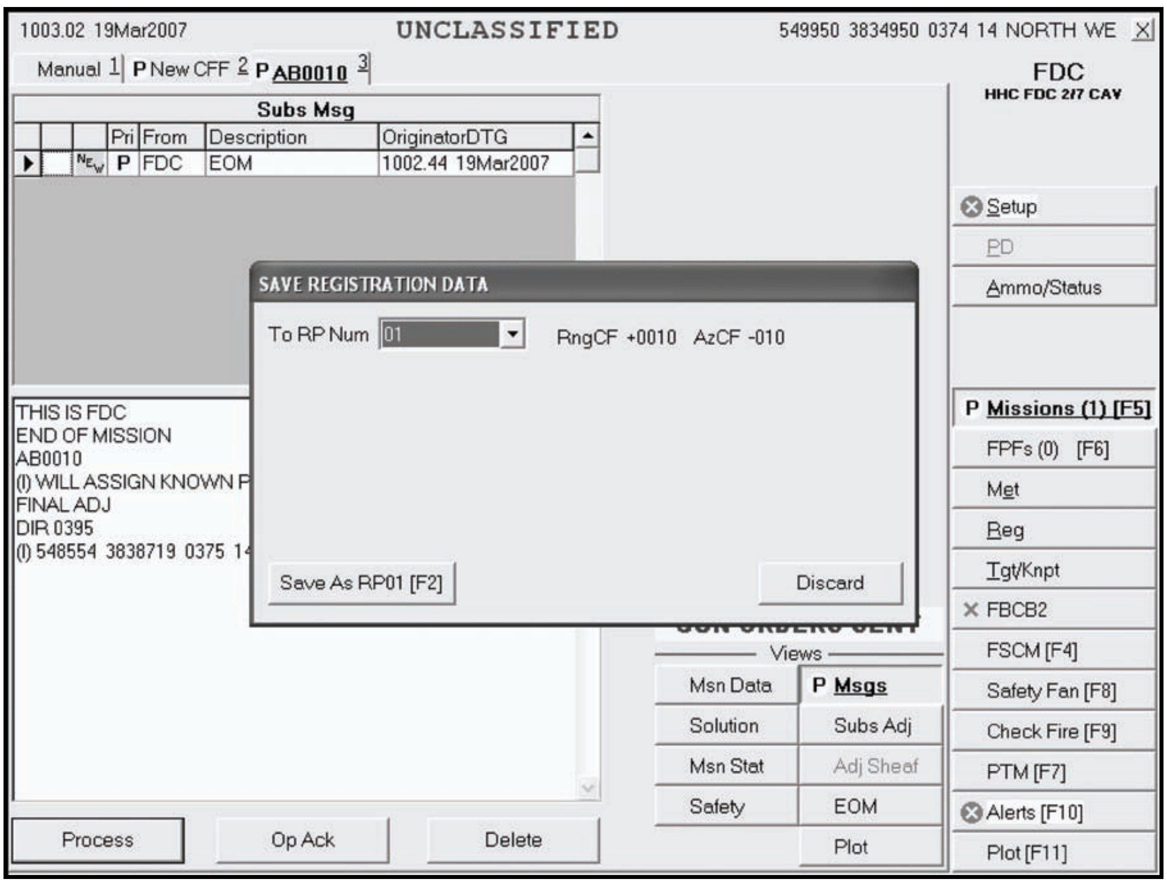


Figure 16-16. Save Registration screen.

SAVING THE REGISTRATION AFTER A MANUAL MISSION

16-41. On the Manual screen, the operator enters the same data as he would during a manual grid mission. He selects Registration (Reg) at the bottom of the screen and processes the mission using the procedures described in paragraphs 16-27 to 16-39. The mission can be saved manually and recorded as a known point by following the instructions in paragraph 16-16.

REGISTRATION SCREEN

16-42. When the Reg button is selected, the Registration screen (Figure 16-17) is displayed. This screen displays the data for up to sixteen 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:

(1) Select the index box in front of the desired RP at the top left of the screen. Information auto-fills into the fields.

(2) 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 geographic reference (GeoRef).

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(3) To center on a particular point, double-click on the point.

(4) To obtain information about a particular icon on the plot, place the cursor over the icon.

(5) To enter or update data, enter the appropriate information, and select Use All. This also updates the Plot screen.

(6) To undo changes that have not been committed to the database, select Undo Changes.

(7) To delete an RP, highlight the RP to be deleted, and select Delete RP. All fields are cleared, and the Plot screen is deleted.

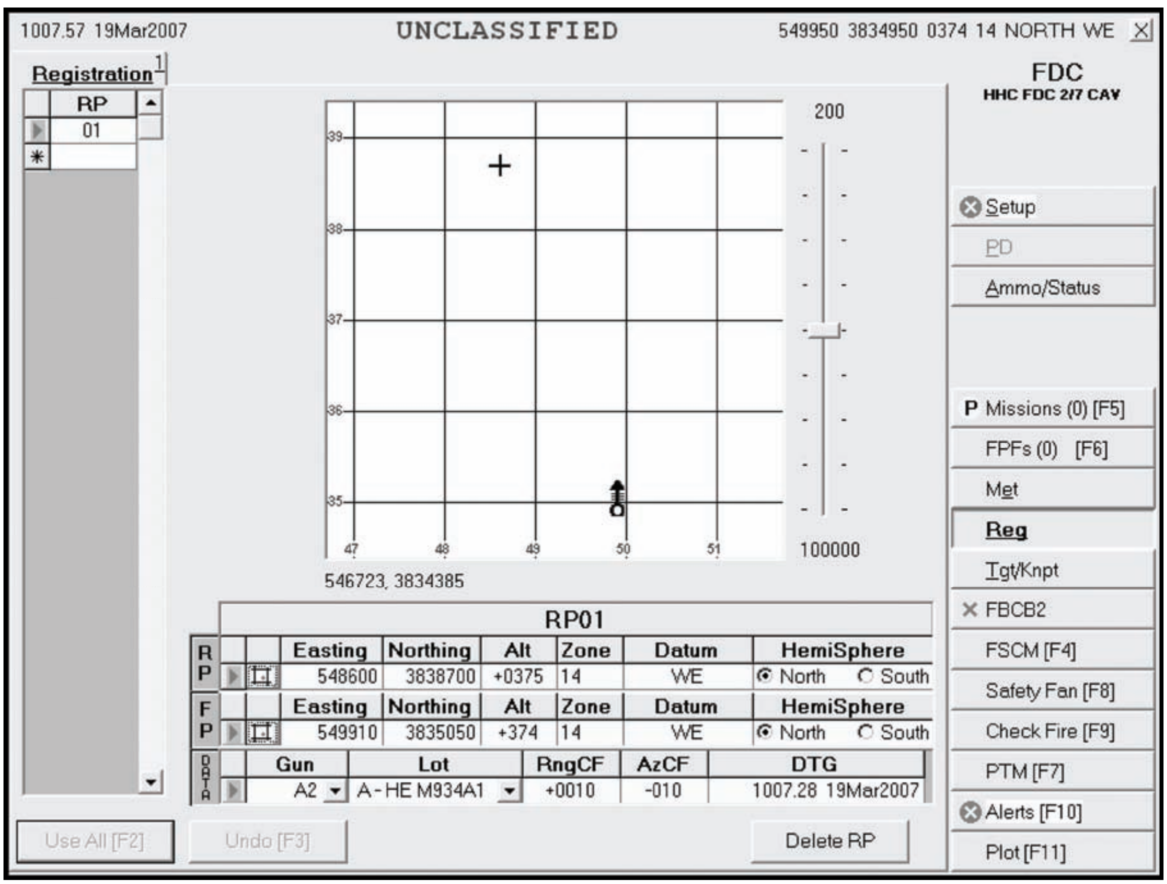


Figure 16-17. Registration screen.

TARGET/KNOWN POINT

16-43. The MFCS provides procedures for viewing and entering up to 50 targets and 50 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

16-44. When the operator selects Tgts, the Targets screen (Figure 16-18) appears. All of the targets designated at the EOM are listed. The operator can also manually enter or edit targets. To manually enter or edit a target, use the following procedures:

(1) Enter the two letters (AA to ZZ) and the target number prefix, followed by a four-digit target number (0000 to 9999) (for example, AA0027).

(2) Enter the easting, northing, altitude (Alt), zone, and choice of datum and hemisphere.

(3) 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 you want to delete and selecting Del.

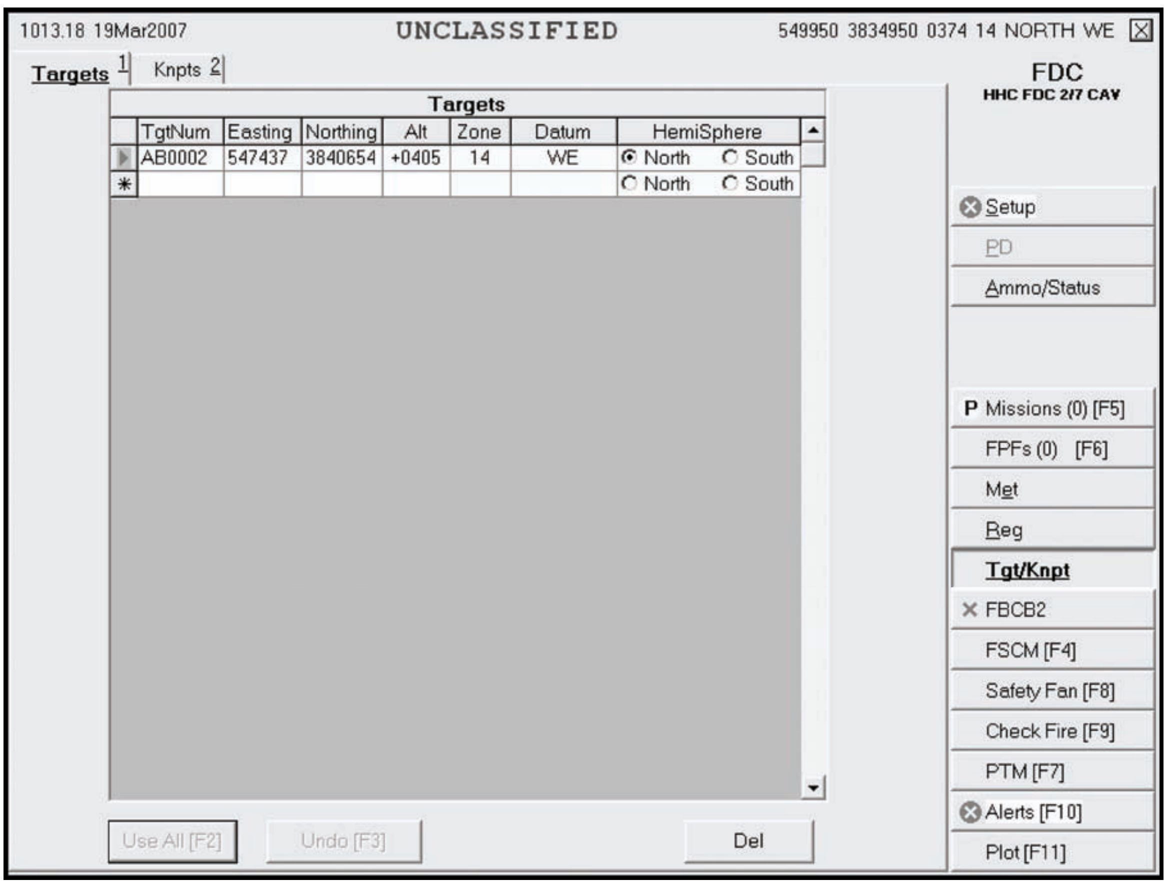


Figure 16-18. Targets screen.

KNOWN POINTS SCREEN

16-45. Known points are received digitally at the EOM, and a dialog box is displayed to enter the required data (Figure 16-19). A known point must be associated with an observer. The operator can also enter known points manually by performing the same actions described above for targets, except that he 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, he selects Use All to save the information.

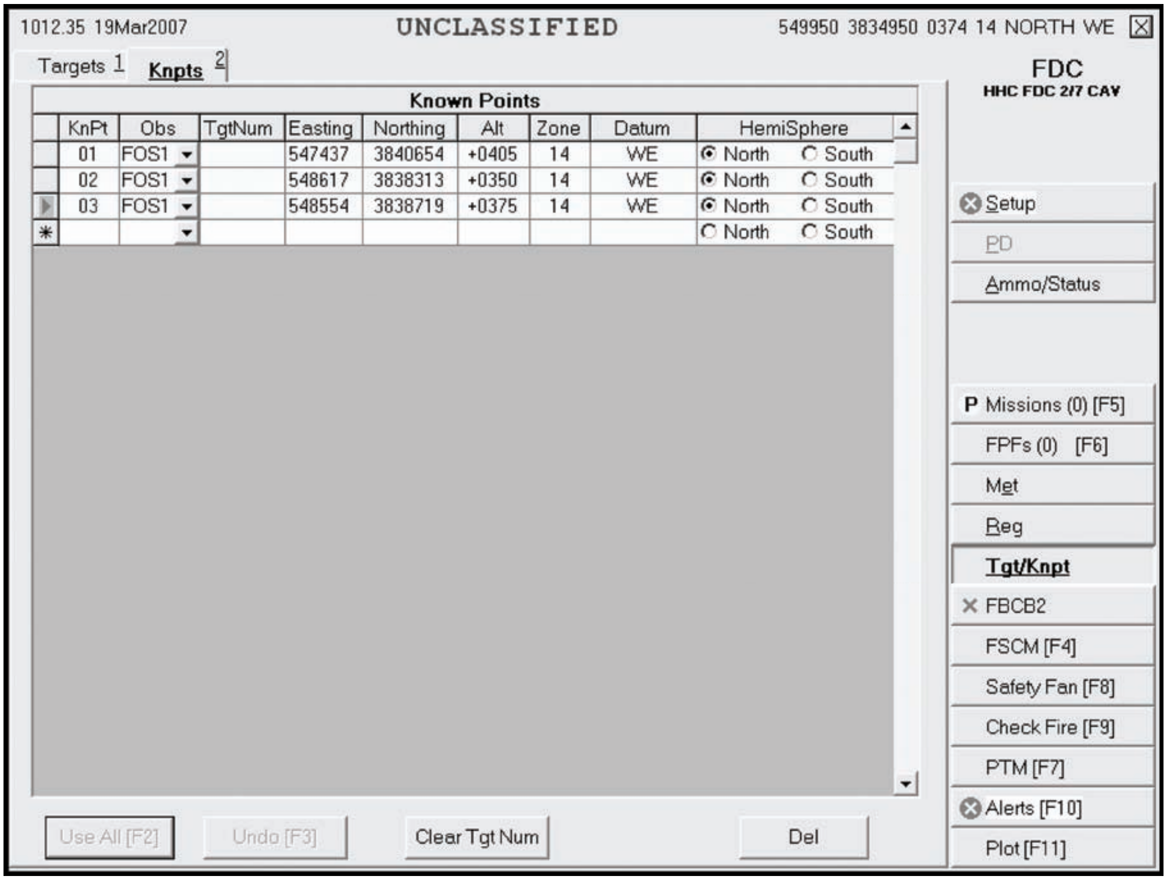


Figure 16-19. Known Points screen.

ILLUMINATION MISSION

16-46. 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.

16-47. 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

16-48. 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 (Figure 16-20). 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.

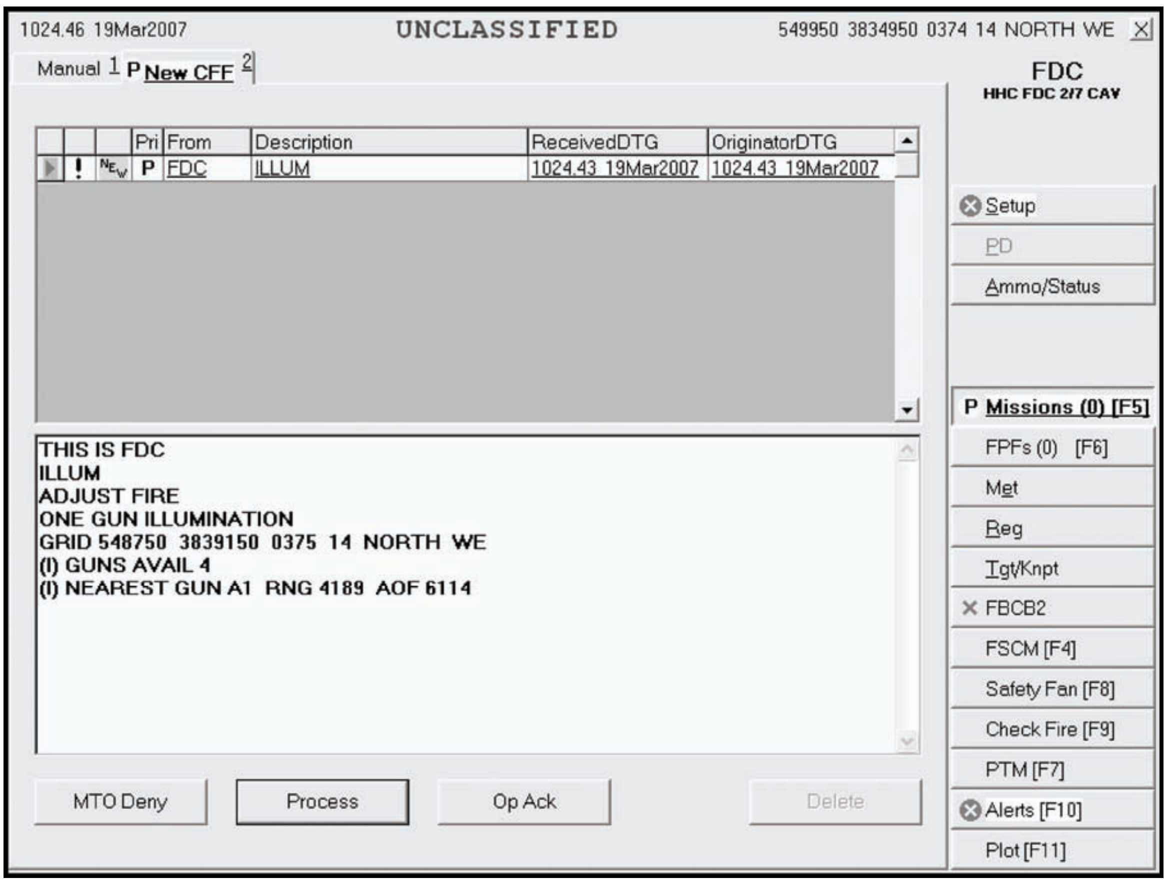


Figure 16-20. New Call for Fire screen.

MISSION DATA SCREEN

16-49. The Mission Data screen (Figure 16-21) 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. In a one-gun illumination mission, when deselecting one gun and selecting another, the ammunition and sheaf selections in the Fire Command fields automatically change to an HE round and linear sheaf. The operator must reselect the correct shell, and the sheaf automatically defaults to "1 Gun IL." If necessary, the operator makes adjustments to the mission data. For example, he may change the MOC from WR to AMC. Then, he selects the Use All button to display the Solution screen.

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.

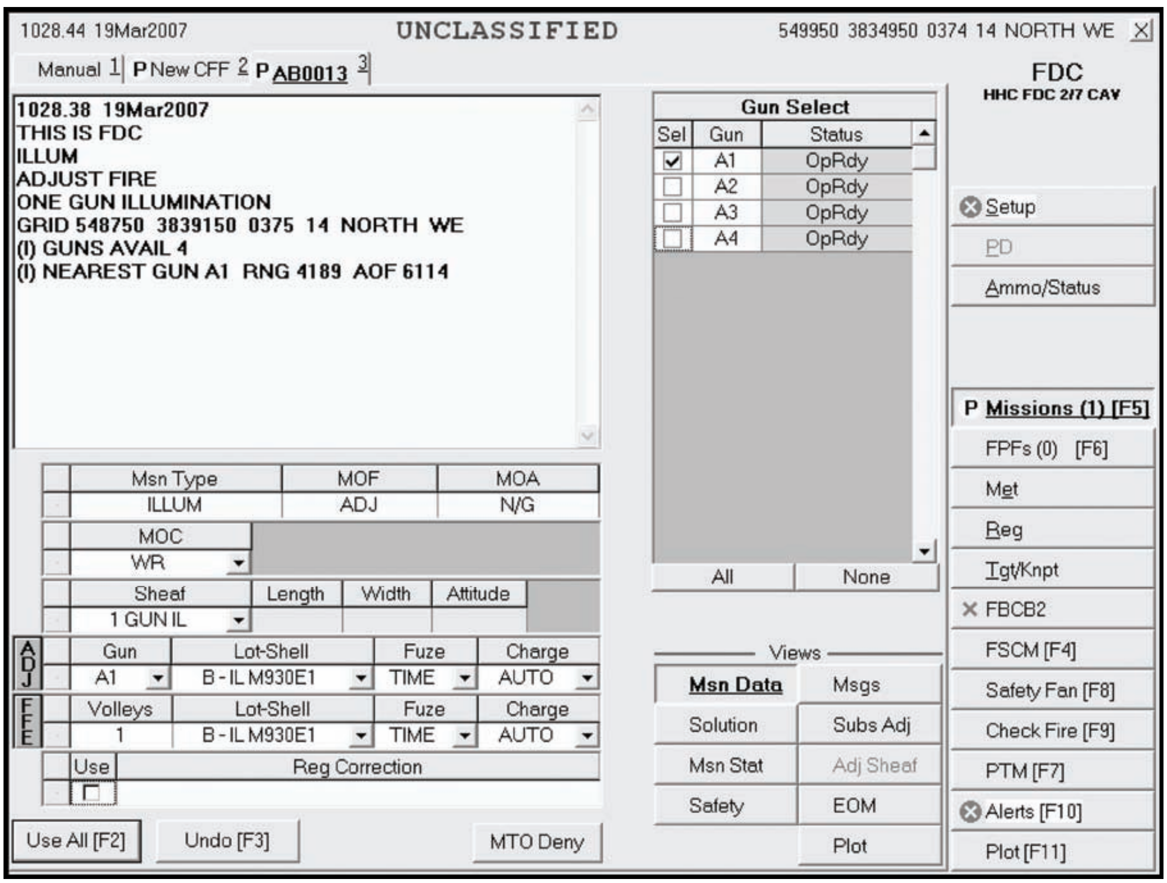


Figure 16-21. Mission Data screen.

SOLUTION SCREEN

16-50. The Solution screen (Figure 16-22) 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.

16-51. 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.

16-52. The operator can change the guns selected based on errors and warnings.

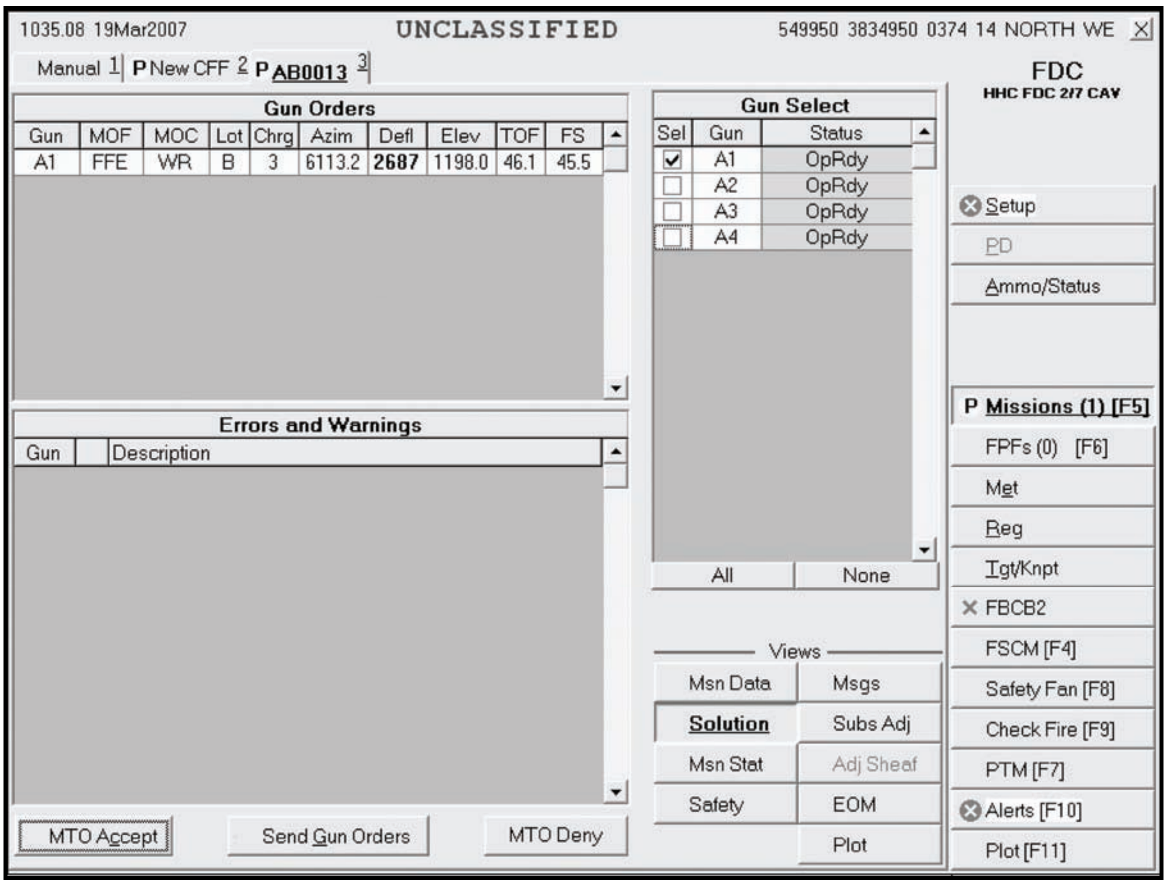


Figure 16-22. Solution screen.

SAFETY DATA SCREEN

16-53. 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 (Figure 16-23) 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.

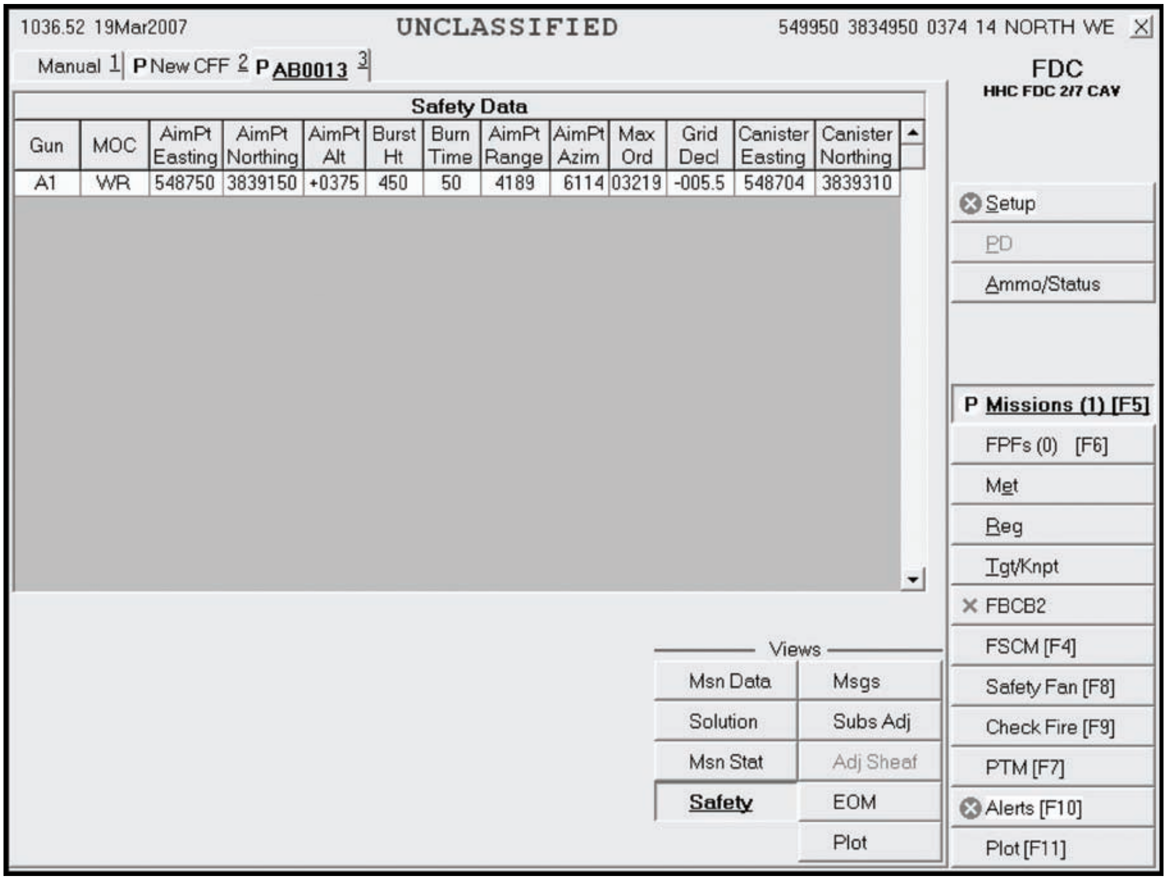


Figure 16-23. Safety Data screen.

SOLUTION SCREEN

16-54. Once the operator is satisfied with the mission and safety data, he returns to the Solution screen (Figure 16-24) and selects the Send Gun Orders button. He also confirms the order by selecting Yes in the box with the message "Confirm Send Gun Orders Yes/No." A Send Status box is then displayed, showing the destination and status.

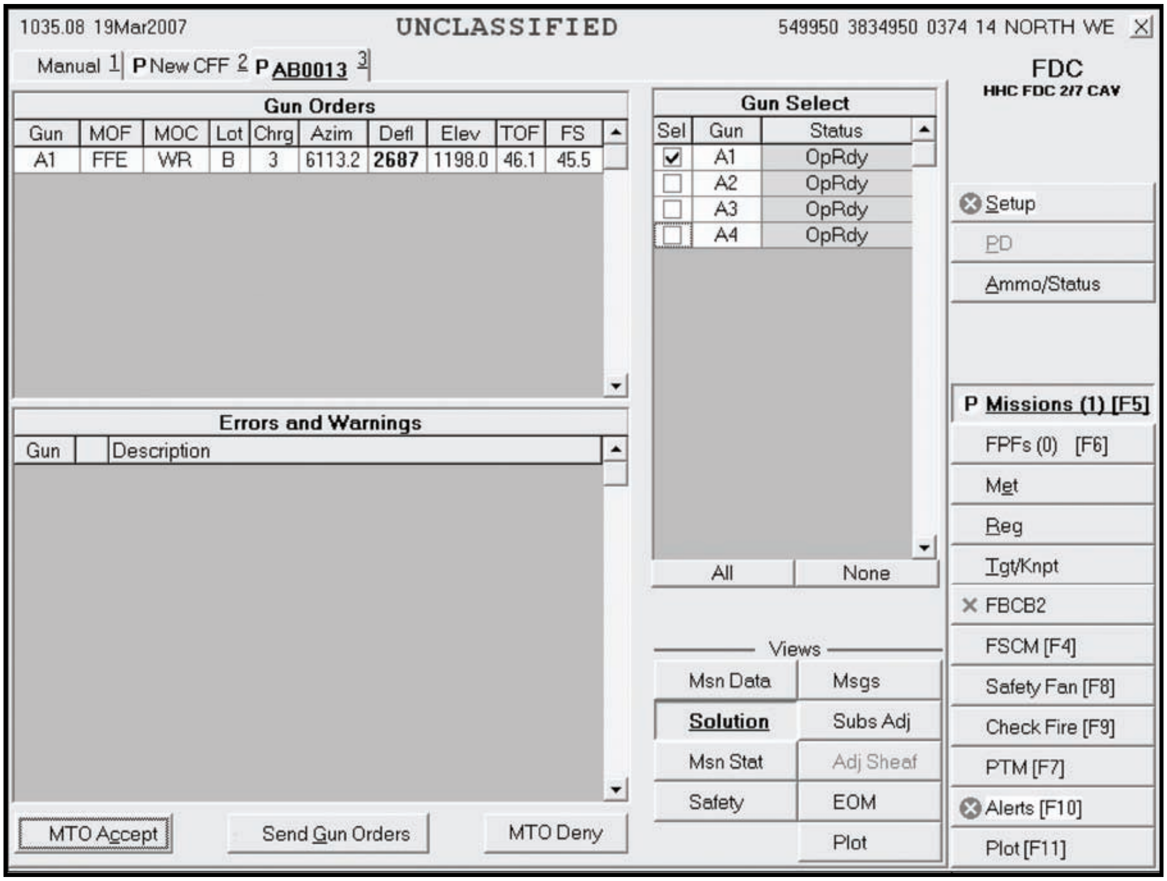


Figure 16-24. Solution screen.

MISSION STATUS SCREEN

16-55. When the operator sends gun orders, the Mission Status screen (Figure 16-25) 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 FC. 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 FC or FO.

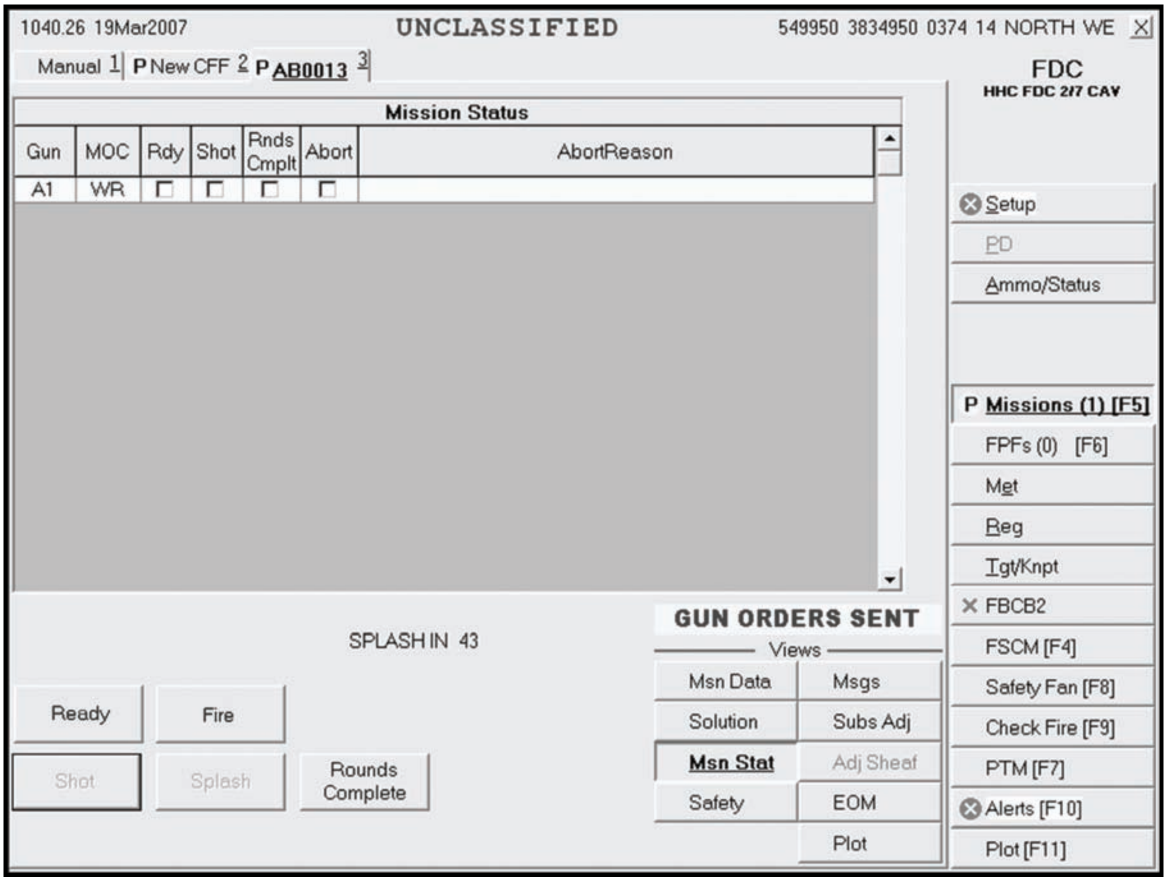


Figure 16-25. Mission Status screen.

SUBSEQUENT MESSAGES ADJUST FIRE

16-56. When the operator selects the Msgs button, the Messages screen (Figure 16-26) appears, and the operator waits for subsequent messages from the FO or FC. Upon receipt of an adjust fire 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.

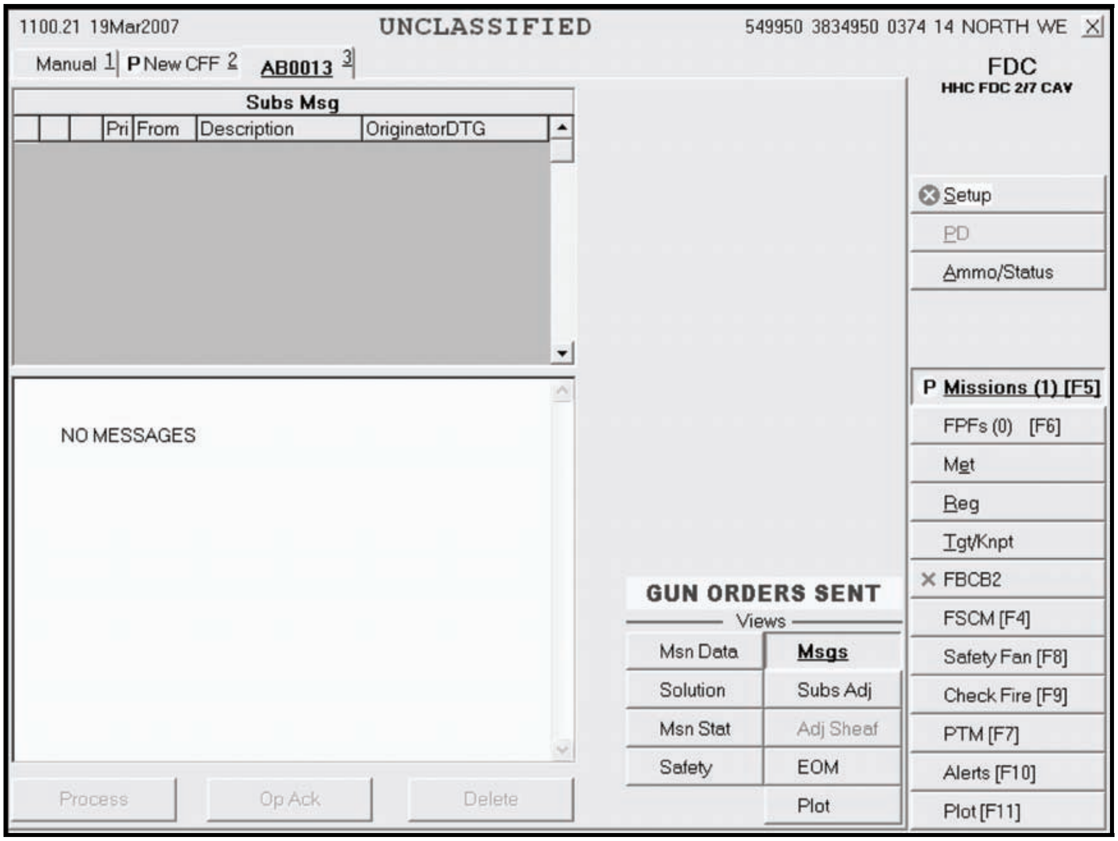


Figure 16-26. Messages screen.

16-57. To complete the illumination mission, the operator continues to make adjustments to the illumination until he receives an EOM message or another mission, such as coordinated illumination, from the FO or FC.

16-58. The FC or FO contacts the FDC to "Mark Illumination," and the operator records the mark time. The MFCS operator also sends a plain text message to the illumination gun to inform the squad leader that the illumination has been marked and that he needs to maintain a minimum of three to five rounds with the current data. The mission stays open in case corrections are needed later.

COORDINATED ILLUMINATION MISSION

16-59. 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 used for a suspected POL point. There are three parts to a coordinated illumination mission:

- Adjustment of the illumination and ordering its fire during the HE adjustment and FFE.
- The adjustment of the HE.
- The coordination of illumination and HE fires.

ADJUSTMENT AND FIRING OF THE ILLUMINATION

16-60. The adjustment and firing of the illumination mission is similar to that of the digital fire mission. Illumination is fired and, if necessary, adjusted throughout the coordinated illumination mission. Once the illumination is adjusted, the operator receives a subsequent adjust message for FFE for the illumination gun mission and processes it without adjustments using the Mission Status screen. During the HE adjustment and FFE, the operator receives subsequent messages (from the FO) to fire illumination in coordination with the HE. To do this, he alternates between the Illumination Mission tab and the HE Mission tab. After the illumination is adjusted, the method of command for both fires is changed from WR to AMC.

HIGH-EXPLOSIVE ADJUSTMENT

16-61. In illumination missions, the procedures associated with HE adjustment are similar those that occur during the adjustment phase of a basic digital mission.

(1) Upon receipt of a fire mission, the Missions button is highlighted. The operator selects the Missions button, and a New CFF tab appears.

NOTE: Because of present software limitations, the CFF message states that this is an illumination mission, but it also serves for a coordinated illumination mission.

The operator decides whether to deny or process the mission. If the mission is acceptable, he records the data and selects Process.

(2) The screen now displays the mission data. The operator processes the mission in the same way and uses the same screens as he would for a regular HE adjustment, except for the MOC. The MOC is changed from WR to AMC. After making any other adjustments to the data, he selects Use All, and the Solution screen appears.

(3) The Solution screen shows the gun orders, the guns selected, and errors and warnings. This screen allows the operator to review the gun status and to change the gun selection based on errors and warnings received. From this screen, the operator can select MTO Deny (if necessary) or MTO Accept, and send gun orders.

(4) Before sending the gun orders, the operator checks the safety data by selecting the Safety Data button (he can also check the Plot screen). He reviews and records the safety data and selects the Solution button to return to the Solution screen.

(5) When ready, the operator selects Send Gun Orders and confirms the order. A Send Status box showing the destination and status now appears.

(6) The Mission Status screen appears, displaying the words “Gun Orders Sent.” The mission is monitored from this screen. Gun status is checked off as completed, and messages are automatically sent to the FO or FC. When the adjusting HE gun sends “Ready,” the operator begins coordinating the illumination and HE fires.

(7) A Subsequent Adjust message is received for the illumination gun mission. The operator processes the mission without adjustment and selects the Fire button.

(8) The operator waits for the appropriate mark time and clicks the Fire button for the HE mission.

(9) The operator continues to perform the steps above until the Subsequent Adjust FFE or EOM message is received.

FIRE FOR EFFECT

16-62. Upon receipt of the Subsequent Adjust FFE message, the operator records the data and can either process or delete the mission. Selecting Process displays the Mission Data screen.

(1) The operator changes the method of command from WR to AMC. When complete, he selects the Use All or Solution button.

(2) At the Solution screen, the operator reviews and records data. He also checks the Safety Data and Plot screens. Then, he selects the Solution button to return to the Solution screen. When satisfied, the operator selects Send Gun Orders and confirms the order. Then, he waits for all guns to report a “Ready” status.

(3) A Subsequent Adjust message is received for the illumination gun mission. The operator processes the mission without adjustment and selects the Fire button.

(4) The operator waits for the splash signal and the appropriate mark time. He then selects Fire for the HE mission.

(5) When each gun reports "Rounds Complete," a checkmark appears in the Rnds Complt box. The operator then responds to any subsequent messages.

(6) When the EOM message is received, the HE mission can be saved as a target. The operator discards or saves the mission using the procedures described in paragraphs 16-24 and 16-25. He can save it manually by following the instructions in paragraphs 16-36 to 16-39.

(7) The operator also ends the illumination mission but does not save it.

CALL FOR FIRE FROM FIRE SUPPORT ELEMENT OR FORWARD OBSERVER — ILLUMINATION AND COORDINATED ILLUMINATION POLAR PLOT MISSION

16-63. 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

16-64. 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 are automatically changed to zero.

MANUAL ILLUMINATION AND COORDINATED ILLUMINATION MISSIONS

16-65. Procedures for a manual mission are similar to those for a digital mission. The only differences are that the operator must manually initiate the CFF, manually select Subs Adj whenever a subsequent adjust is warranted, and manually click EOM to end the mission.

NOTE: See paragraphs 16-13 through 16-25 for details on manual missions.

FINAL PROTECTIVE FIRES

16-66. 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

16-67. 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 (Figure 16-27) 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, he selects Process.

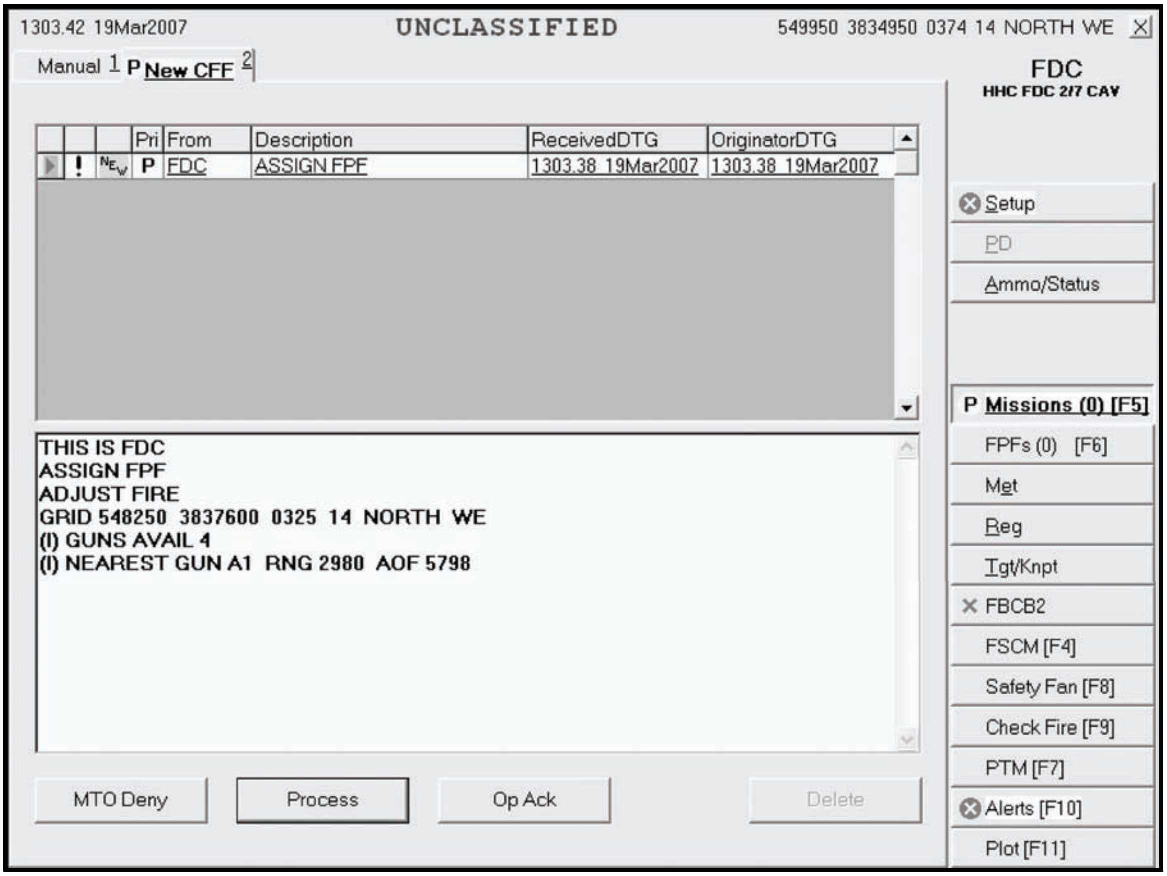


Figure 16-27. New Call for Fire screen.

MISSION DATA SCREEN

16-68. The operator selects Process and the FPF button; the screen displays a New FPF Target Number tab and the Mission Data screen (Figure 16-28). Guns for the mission are preselected by the software, but can be modified by the operator. If necessary, the operator makes adjustments to the mission data. In Figure 16-28, the MOF is ADJ, and the MOA 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. For a special sheaf, the system allows the operator to enter the length, width, and attitude. 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 also 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, he selects the checkmark in the Use box to deselect it. If no changes are made, he selects the Solution button or selects Use All to display the Solution screen.

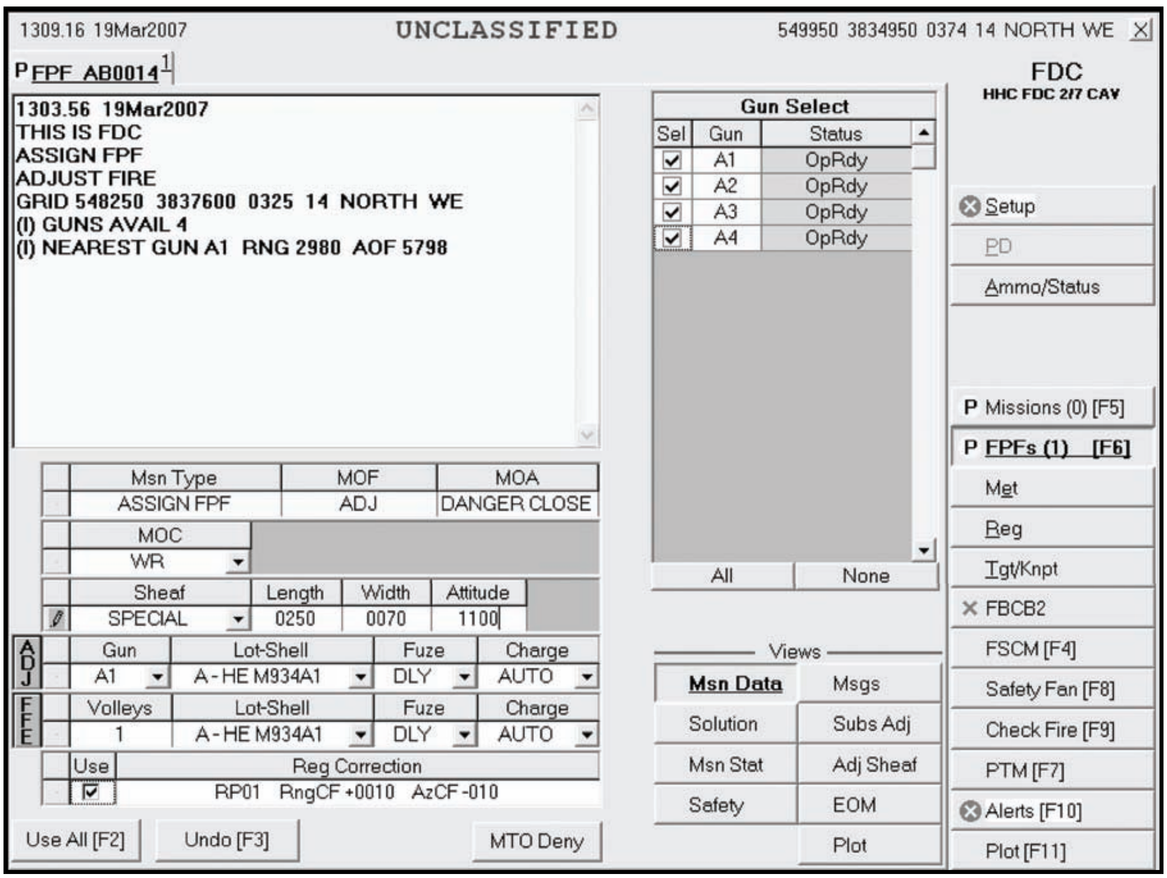


Figure 16-28. Final Protective Fire Mission Data screen.

SOLUTION SCREEN

16-69. In this step, the operator can review the gun status and change the gun selection based on errors and warnings received. He also checks the safety data.

FINAL PROTECTIVE FIRE SOLUTION SCREEN

16-70. The Solution screen (Figure 16-29) shows gun orders, selected guns, and any errors and warnings. 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.

- 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.

16-71. The operator can change the gun selection based on errors and warnings, if necessary.

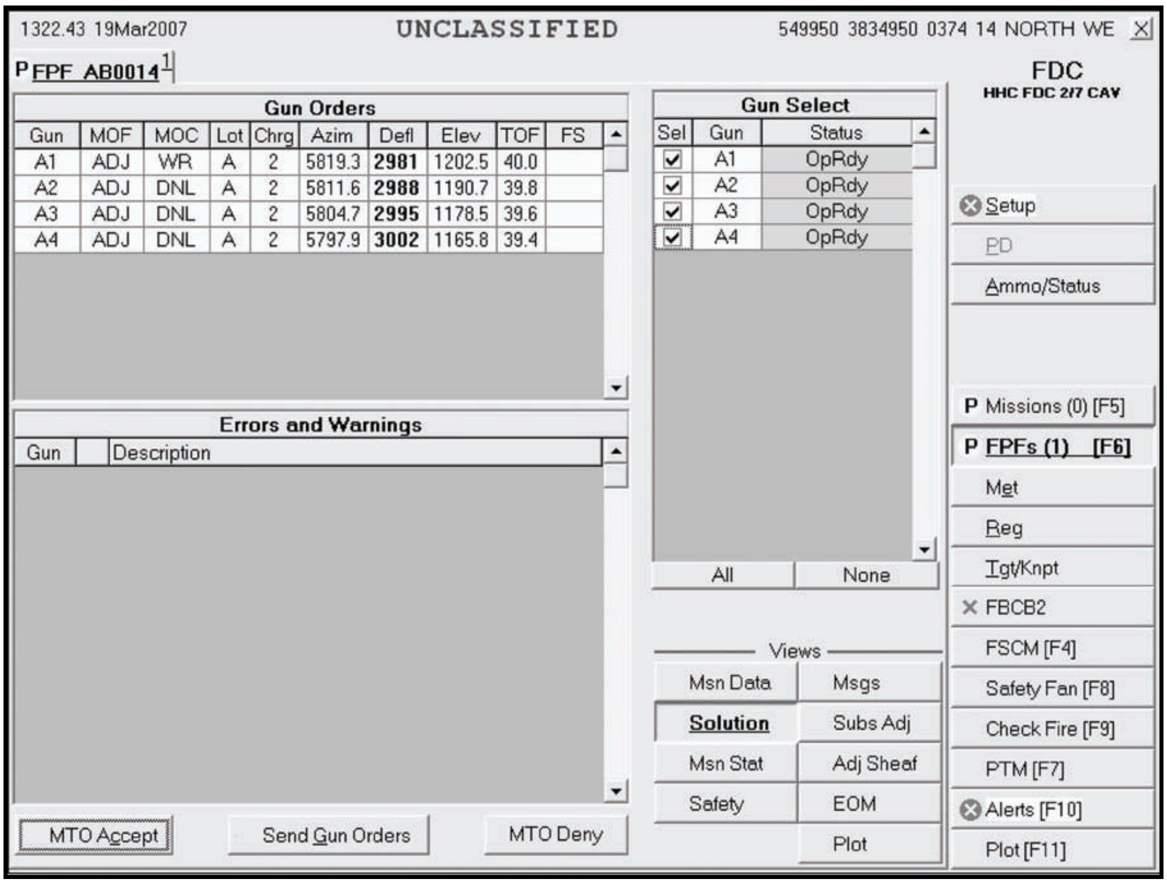


Figure 16-29. Final Protective Fire Solution screen.

Safety Data Screen

16-72. Before sending gun orders, the operator checks the safety data by selecting the Safety Data button. The Safety Data screen (Figure 16-30) displays. The operator reviews and records the safety data and, when satisfied, selects the Solution button.

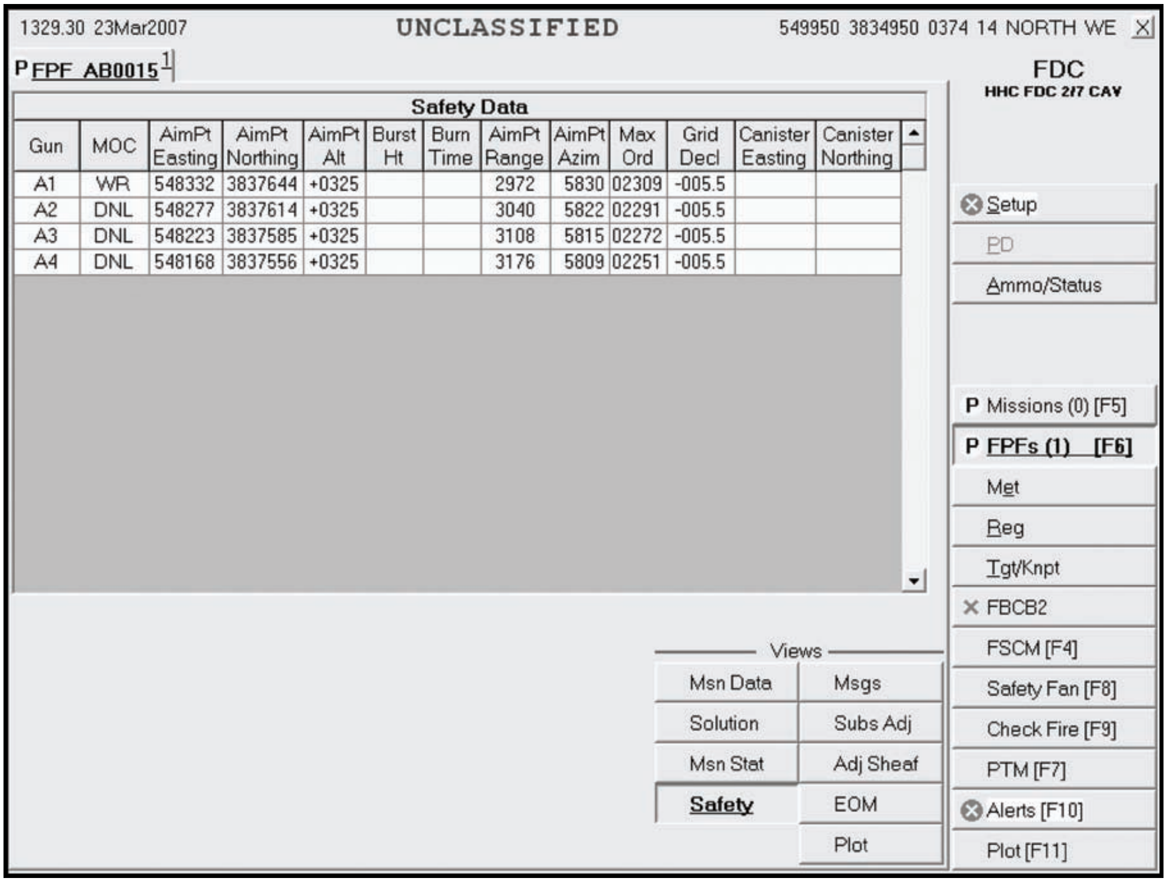


Figure 16-30. Safety Data screen.

NOTE: The Plot screen is available to review the plot at any time during the mission.

SOLUTION SCREEN

16-73. The operator selects Solution to return to the Solution screen (Figure 16-31). In this example, the MOC for the adjusting gun is AMC; do not load (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.

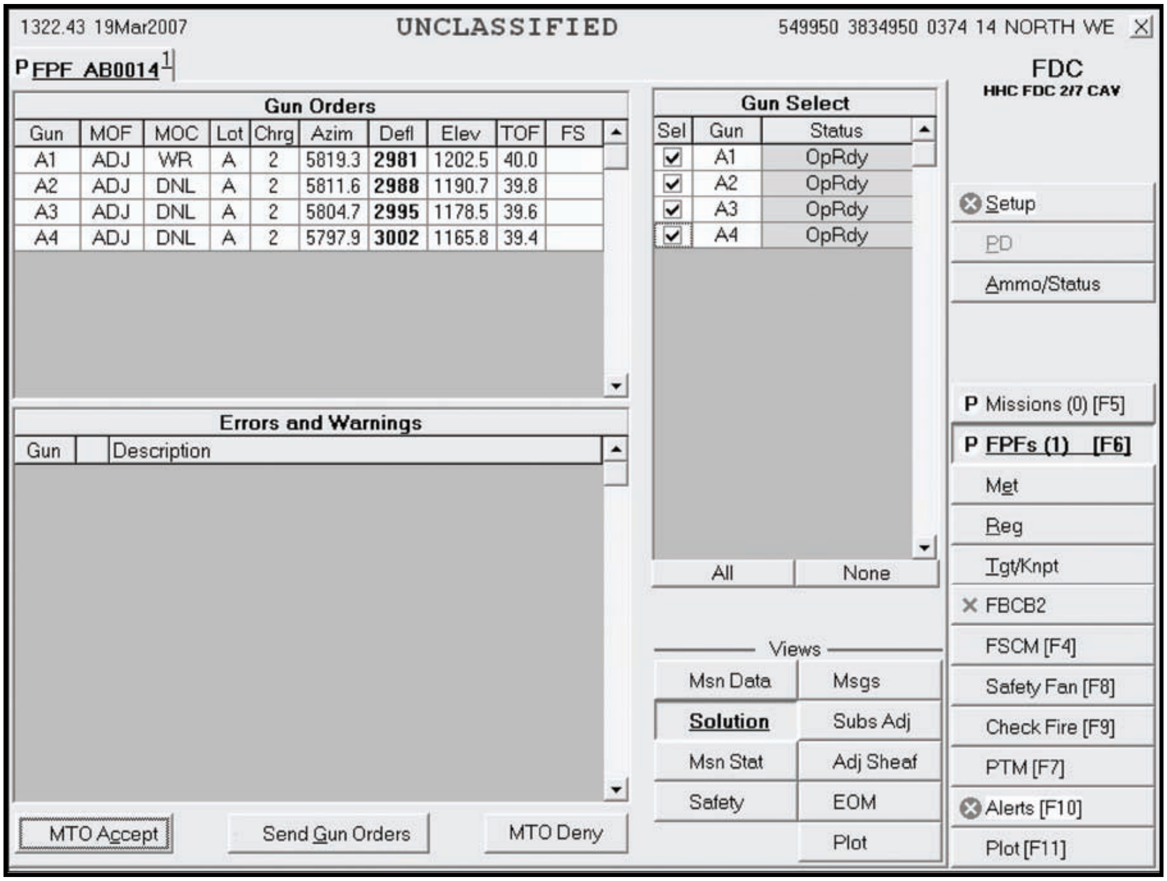


Figure 16-31. Solution screen.

PLOT SCREEN

16-74. The operator may view a graphic depiction of the FPF by choosing the Plot button. The Plot screen (Figure 16-32) 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 re-center the image. The operator may place the cursor over any icon to display a description of that icon.

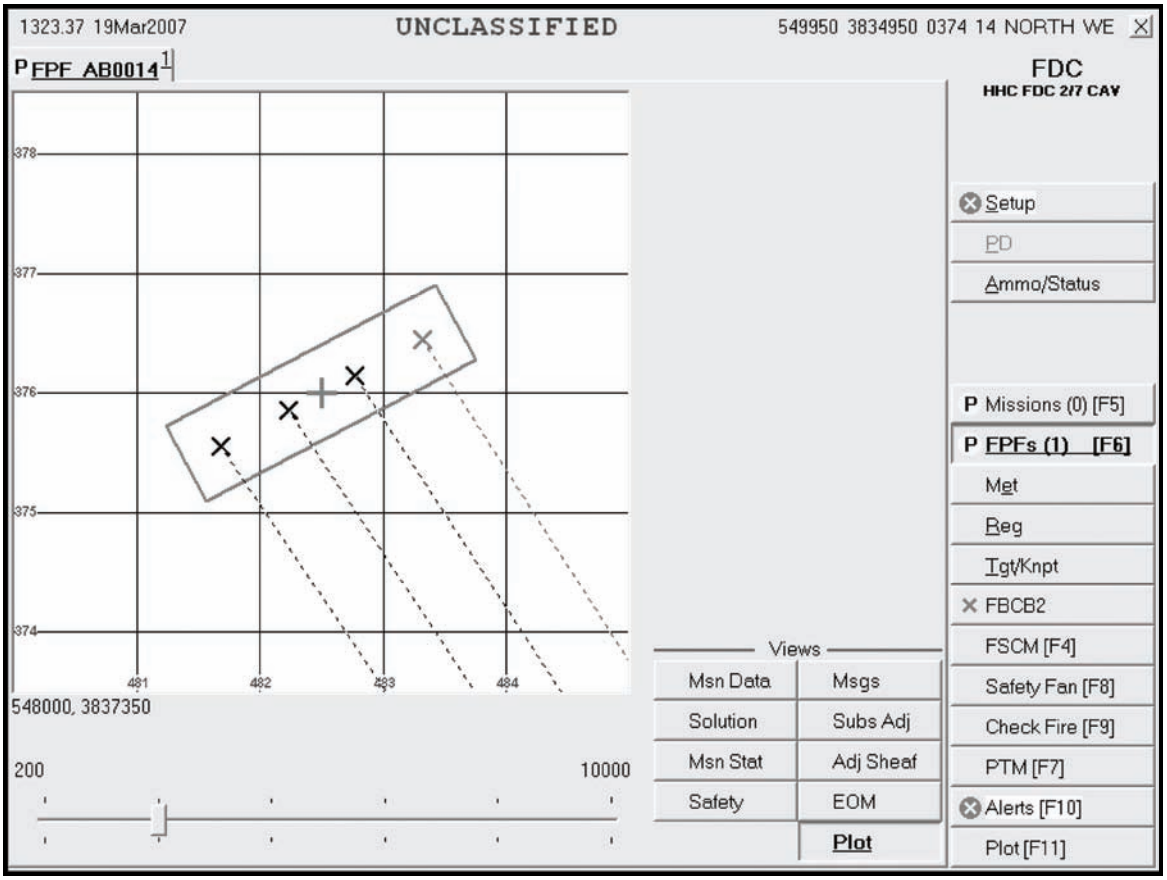


Figure 16-32. Plot screen.

MISSION STATUS SCREEN

16-75. When the operator sends gun orders, the Mission Status screen (Figure 16-33) 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 FC or FO.

> **NOTE:** Once gun orders are sent, the operator must process a subsequent adjust before computing and sending a new set of gun orders.

- When the adjusting gun sends "Ready," the operator selects the Ready button to send the message to the FC or FO.
- If the mission is AMC, the operator receives an order to fire from the FC or FO, and then selects the Fire button. The Fire button is shaded.
- Upon receiving "Shot," a checkmark appears in the Shot box, the box turns green, and the Shot button is shaded. The time of flight and a red splash are then displayed, and the Splash button is shaded.
- 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.

16-76. The operator continues to process the orders until the gun is adjusted.

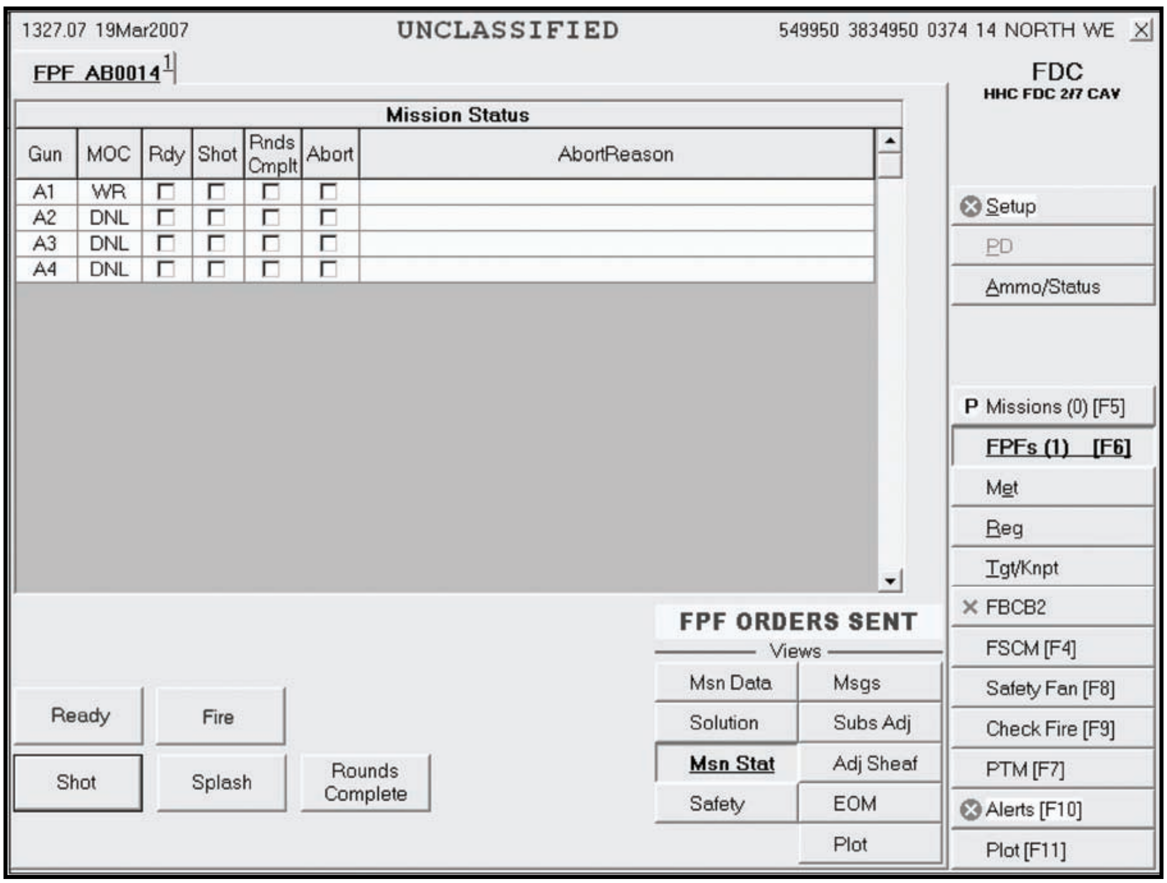


Figure 16-33. Mission Status screen.

SUBSEQUENT MESSAGES TO ADJUST ALL THE GUNS

16-77. Once the first gun is adjusted in the sheaf, the FO may transition to each of the other guns until all are properly adjusted (Figure 16-34). The FDC operator must change 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, he 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.

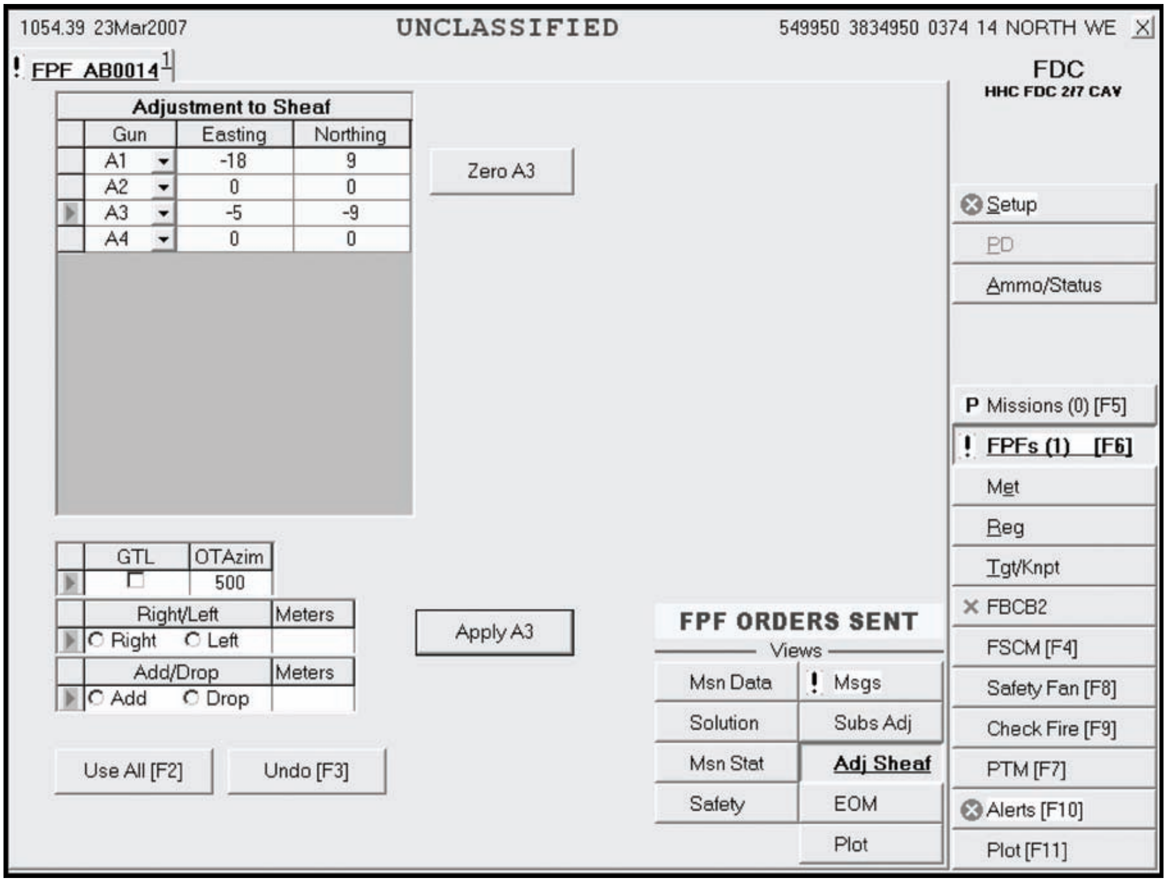


Figure 16-34. Subsequent Adjust screen.

End of Mission and Store the Final Protective Fire

16-78. When the FO or FC orders an EOM, the operator stores the FPF using the EOM screen (Figure 16-35). The EOM-Store FPF option is the only available selection. The operator selects the down arrow in the Controlling FO field, chooses the correct FO participating in the mission, and then selects Use All. The Subsequent Message screen is displayed, stating "End of Mission" and the target number.

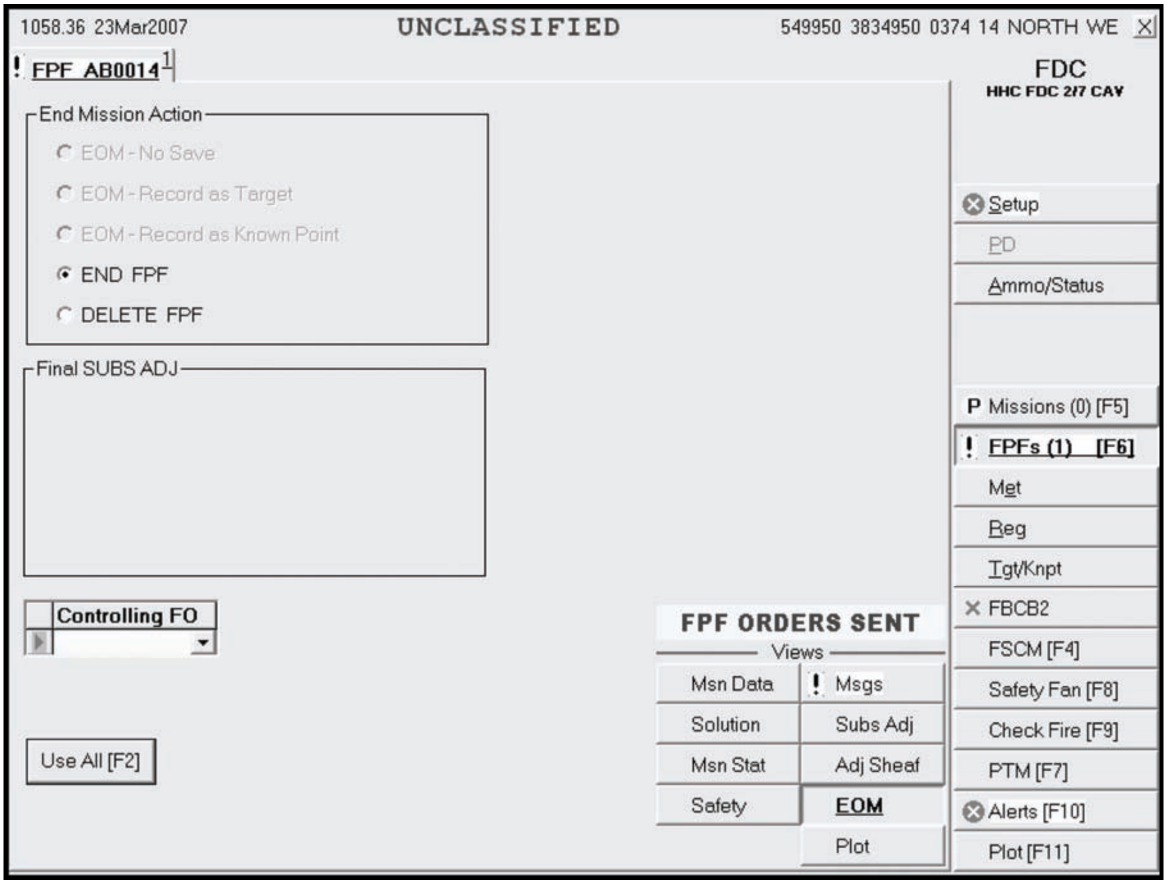


Figure 16-35. Solution End of Mission screen.

Mission Status Screen

16-79. The words "Stored FPF" are displayed in blue letters over the Views section (Figure 16-36). 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.

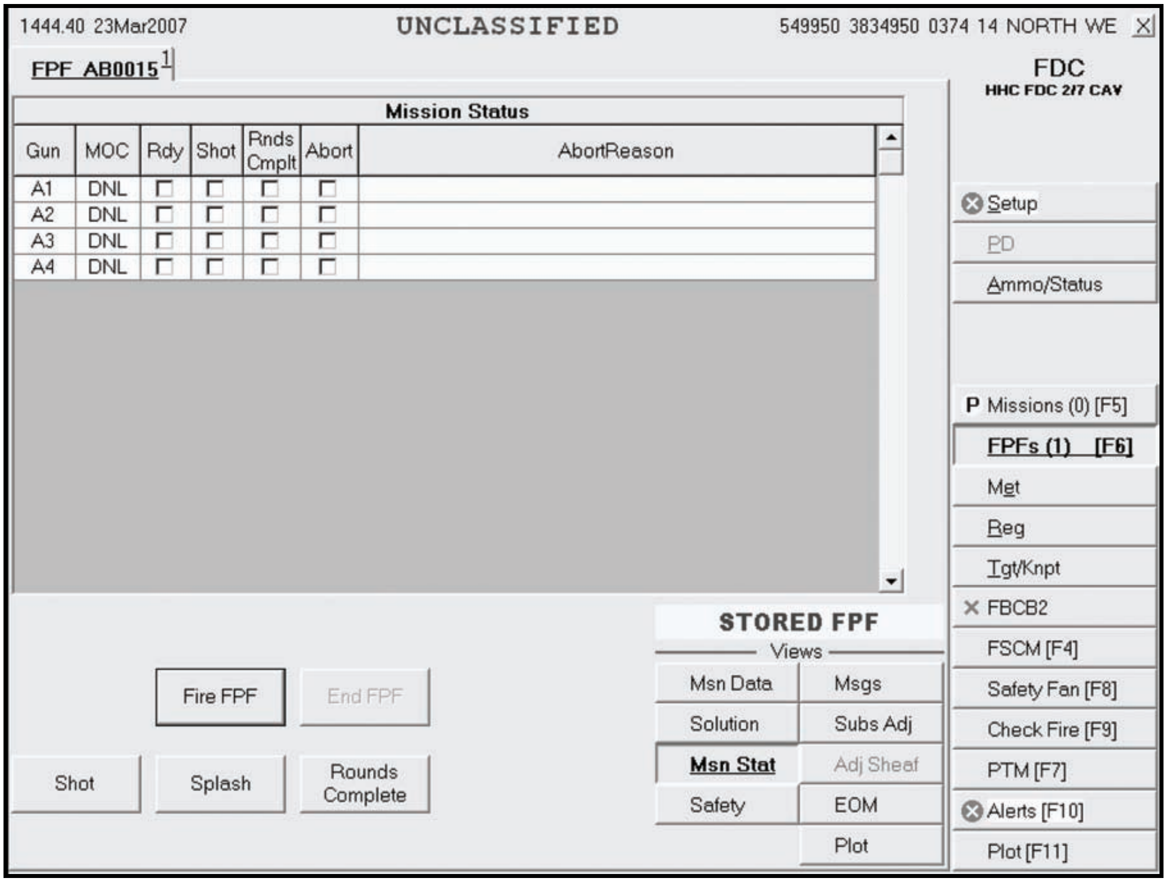


Figure 16-36. Mission Status screen.

CALL FOR FIRE FROM THE FIRE SUPPORT ELEMENT OR FORWARD OBSERVER TO FIRE THE FINAL PROTECTIVE FIRE

16-80. Upon receipt of the fire FPF message, the operator selects FPF to bring up the FPF buffer. He 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.” He 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

16-81. The operator selects EOM. Delete FPF is the only option. He selects Use All, and the Messages screen (Figure 16-37) 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.

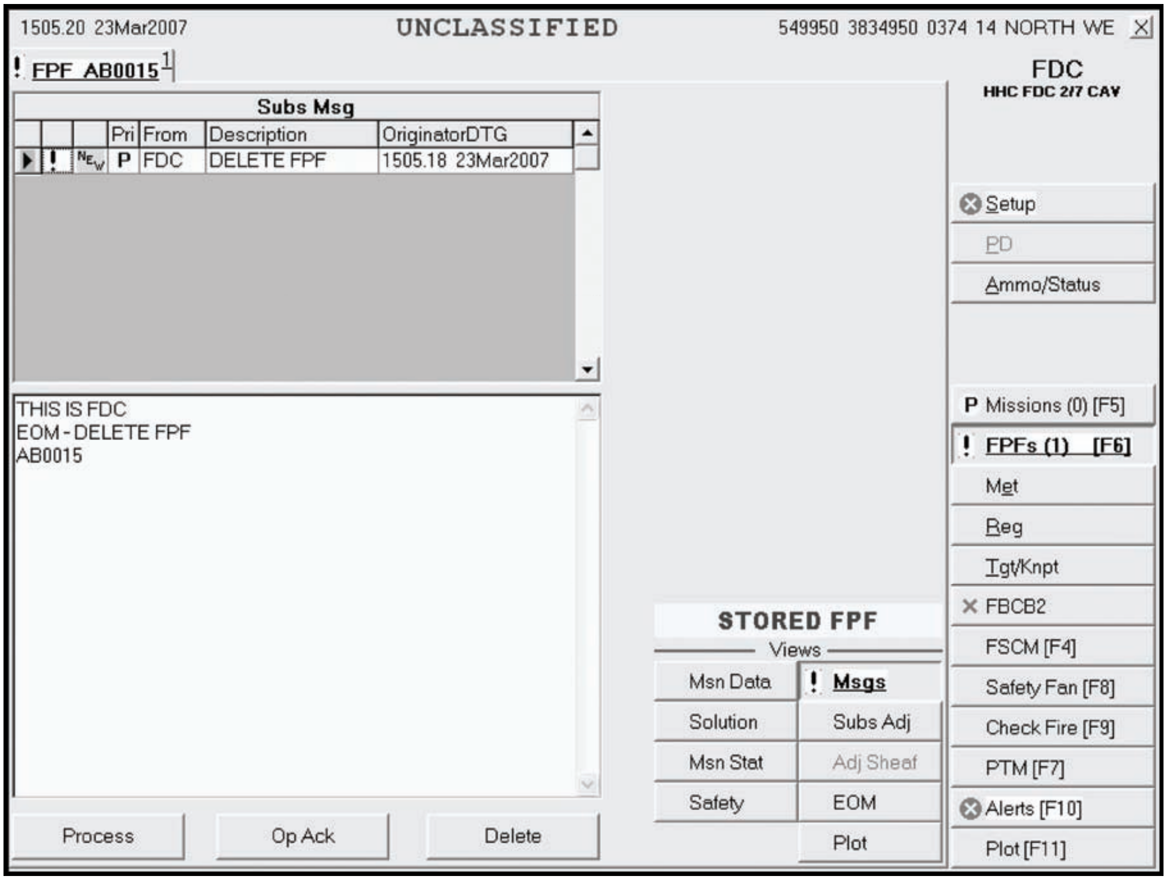


Figure 16-37. Messages screen.

MANUALLY CONDUCTED FINAL PROTECTIVE FIRE MISSIONS

16-82. Procedures for a manual FPF mission are similar to those for a digital mission. The only differences are that the operator must manually initiate the CFF, manually process all adjustments, and manually select EOM to end the mission.

SMOKE MISSIONS

16-83. Smoke missions are used to conceal ground maneuver, obstacle breaching, and recovery operations, as well as key assembly areas, supply routes, and logistical facilities. The two types of smoke missions are quick and immediate.

QUICK SMOKE MISSIONS

16-84. Smoke missions are conducted using a combination of the MFCS and traditional FDC procedures. The standard smoke mission covers 500 meters for a period of 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 CFF and adjustment.
- The calculation of the rounds required using the smoke card.
- The establishment of the smoke screen.
- The maintenance of the smoke screen.

Call for Fire and Adjustment of the Smoke Mission

16-85. 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.

Calculation of the Rounds Required Using the Smoke Card

16-86. As the rounds are adjusted, the section sergeant 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: See Chapter 9 for details about use of the smoke card.

Establishing the Smoke Screen

16-87. Once the adjustments are made, the guns fire 12 smoke cartridges to establish the curtain. The M819RP 81-mm smoke cartridge uses a time setting to burst the red phosphorous approximately 175 meters above the target area. The M929WP 120-mm smoke cartridge uses the 120-mm PROX setting to burst the cartridge 14 feet above the target area.

Maintaining the Smoke Screen

16-88. The guns fire the number of rounds per minute needed to sustain the smoke screen. The FDC controls these fires by alternating fire between the guns assigned to the mission.

IMMEDIATE SMOKE MISSIONS

16-89. The primary requirement for an immediate smoke mission is speed. The CFF is usually conducted by voice radio. Manual MFCS methods are used, with the MFCS operator entering the data and then selecting the Immediate Smoke button.

Part Six

Lightweight Handheld Mortar Ballistic Computer

Chapter 17

Introduction

The LHMBC is a lightweight ruggedized personal digital assistant (RPDA) that has replaced the M23 MBC in IBCTs. 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 US Army mortar cartridges. The basic model of the LHMBC can be expanded to include global positioning system (GPS) and digital communications.

SECTION I. INITIALIZATION AND CONFIGURATION

This section discusses the introduction, initialization, and configuration of the LHMBC.

DESCRIPTION

17-1. The LHMBC (Figure 17-1) 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 (SD) card or the onboard system ROM. System accuracy can be increased through the use of a GPS and digital MET messages. The LHMBC allows for self-surveying mortars, digital CFF exchange, and automated ballistic solutions.

NOTE: See TM 9-1220-252-12 & P for additional operator instructions on the LHMBC.

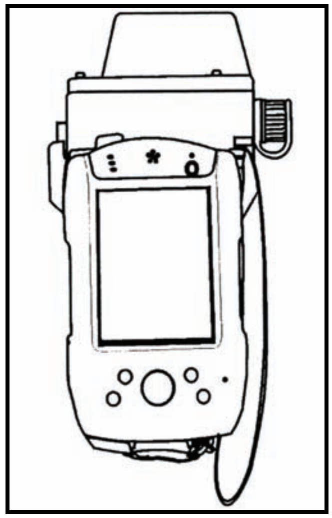


Figure 17-1. Lightweight handheld mortar ballistic computer.

MANUAL ENTRY BUTTONS

17-2. The manual entry buttons for the LHMBC include the—

- Manual Missions button.
- Mission Solution button.
- Mission Gun Select button.
- Mission Subsequent Adjust button.
- CFF button.
- Sleep button (Power button).

17-3. See Figure 17-2 for the corresponding buttons.

Manual Missions Button

17-4. The Manual Missions button (1, Figure 17-2) allows the operator to sequence through active missions.

Mission Solution Button

17-5. The Mission Solution button (2, Figure 17-2) 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.

Mission Gun Select Button

17-6. The Mission Gun Select button (3, Figure 17-2) 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

17-7. The Mission Subsequent Adjust button (4, Figure 17-2) displays the Subsequent Adjust screen for the active mission.

NOTE: This button is inactive when no missions are active.

Call for Fire Button

17-8. If Commo is enabled, the CFF button (5, Figure 17-2) displays the CFF screen.

Sleep Button (Power Button)

17-9. The Sleep button (6, Figure 17-2) puts computer in sleep mode or toggles backlight on and off.

DISPLAY SCREEN

17-10. The LHMBC (7, Figure 17-2) display screen is a touch-sensitive, transflective, thin-film transistor (TFT) liquid crystal display (LCD) screen. The display is equally 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.

NOTE: See TM 9-1220-252-12&P for a complete description of controls and indicators.

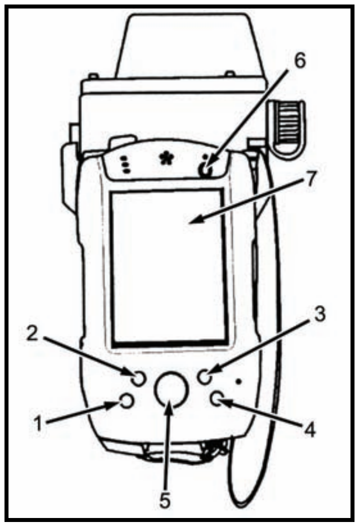


Figure 17-2. Lightweight handheld mortar ballistic computer interface.

CAPABILITIES

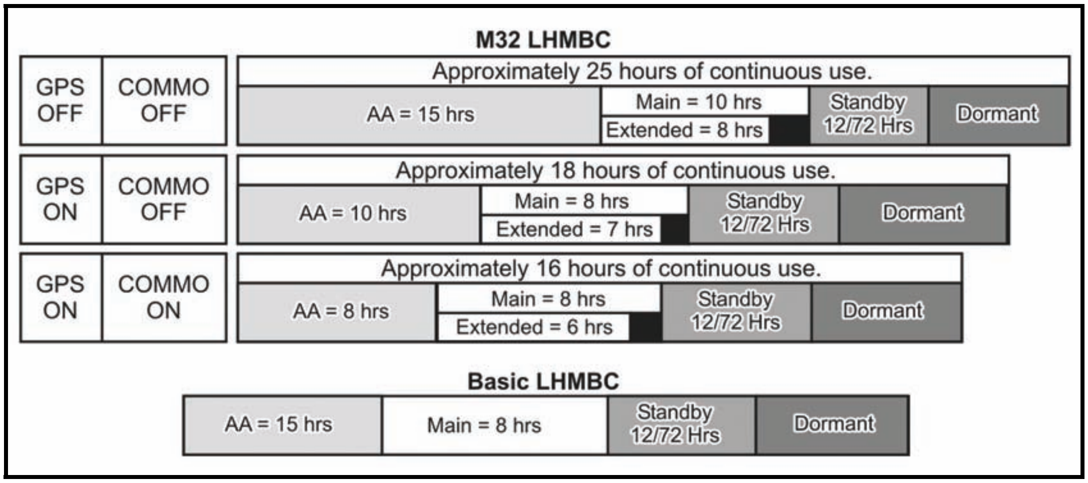
17-11. The LHMBC's design allows the system to be upgraded to match future system demands. Currently, the system can—

- Store 24 gun positions.
- Store 3 FPFs.
- Store a combined total of 100 targets and known points.
- Store 16 RPs.
- Store 25 FO locations.
- Accept 100 digital messages.
- Handle the full range of current mortar ammunition.
- Conduct registration missions and automatically apply all registration corrections.
- Receive, compute, and automatically calculate all applied MET corrections.
- Store 1 safety fan, with up to 10 separate fan segments.
- Provide a ten-digit grid to impact for all rounds.
- Connect to radio or wire for digital communications.

BATTERY LIFE

17-12. Table 17-1 illustrates projected battery life for the M32 LHMBC based on continuous operations. The actual battery life varies greatly depending upon M32 usage, age, and temperature of the batteries; it will be significantly greater if the unit is not used continuously.

Table 17-1. Battery life expectancy.



NOTE: In the M32 configuration, the extended battery in the expansion pack will charge the main battery, as the main battery powers the LHMBC. The main battery will power the LHMBC for approximately one to two hours after the power of the extended battery falls below 3.2 volts and the extended battery stops charging the main battery.

GRAPHIC USER INTERFACE

17-13. The LHMBC's graphic user interface (GUI, Figure 17-3) allows the operator to use menus, windows, and icons, rather than complicated commands.

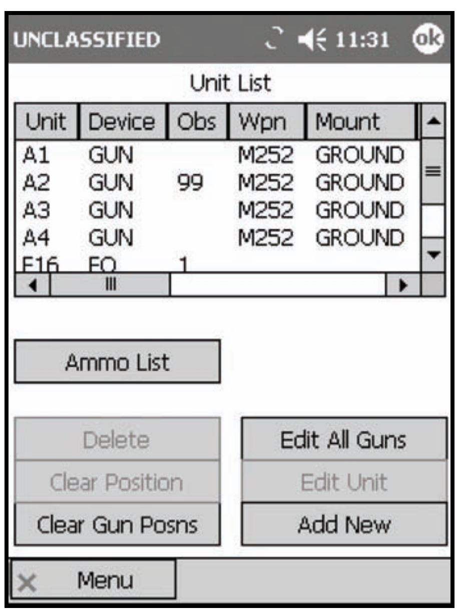


Figure 17-3. Lightweight handheld mortar ballistic computer graphic user interface.

SCREEN AREA

17-14. The LHMBC's screen area displays buttons, tabs, fields, and menus.

Desktop

17-15. The desktop (Figure 17-4) consists of various pull-down menus, the Start button, a time display, a volume control, and a New button. The stylus is used to access all functions from this screen.

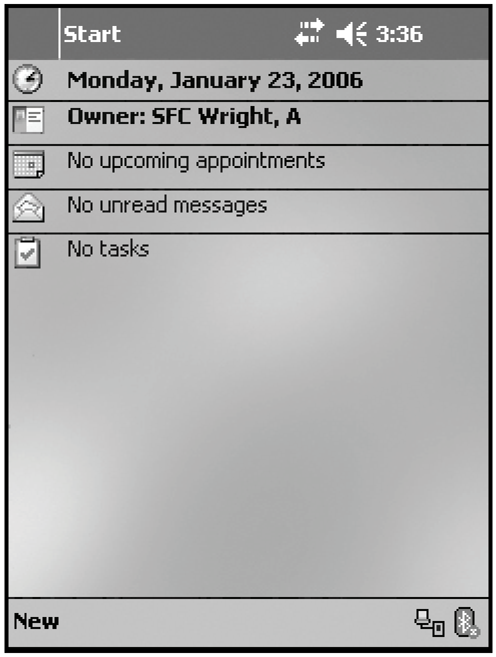


Figure 17-4. Desktop.

Action Buttons

17-16. 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

17-17. The operator accesses the scroll bars to view data that does not fit on the screen.

Data Lines

17-18. Data lines display data particular to the screen. The operator adjusts the columns using the stylus to increase or decrease the field area.

17-19. 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.

17-20. 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

17-21. The screen title displays at the top center of each screen.

Classification

17-22. The classification displays in the upper left corner of the screen.

X or OK

17-23. X or OK displays in the upper right corner. This button has no function in the LHMBC software.

Time

17-24. The time displays in the upper right corner.

Tabs

17-25. Tabs display at the top of the screen after the operator selects a control button.

Pull-Down Menus

17-26. The operator activates pull-down menus by clicking buttons or icons to display a selection of operations or programs.

COMMON ACTIONS

17-27. When using the LHMBC, the operator repeatedly uses the same commands to perform actions, such as acknowledging receipt (OpACK), accepting or denying the messages to observer (MTOs), 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

17-28. Data is transcribed onto DA Form 2399-R or DA Form 2188-R throughout the process to maintain a record and to preserve data should the LHMBC fail. The phrase "record data" is used throughout the chapter to indicate this action.

Process or Message to Observer Deny

17-29. 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.

17-30. 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

17-31. 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.

MESSAGE ICONS

17-32. The LHMBC alerts the operator to warnings, messages, and processing statuses through message icons and audio alarms. Table 17-2 lists all message icons and their definitions.

Table 17-2. Message icons.

ICON	DEFINITION	ICON	DEFINITION
CF	Check Fire	NEW	New
✕	Error	P	Priority Priority
!	Exclamation	PRC	Processed
F	Flash Priority		Processing Wheel
I	Immediate Priority	R	Routine Priority
	Low Battery/No External Power Attached	⚠	Warning
		i	Information

MESSAGE PRIORITIES

17-33. Table 17-3 indicates the priorities of messages received by the LHMBC.

Table 17-3. Message priorities.

Message Type	Message Precedence
Plain Text Message (PTM)	Routine R
Check Fire CF	Flash F
Fire Support Meteorological Message	Routine R
Call for Fire	Immediate I
Observer Mission Update	Priority P
Ammunition Inventory	Routine R
Command to Fire	Priority P
Message to Observer	Immediate I
Fire Support Coordination Measures	Routine R
End of Missions and Surveillance	Immediate I
Fire Unit Status	Routine R
Subsequent Adjust	Immediate I
Observer Status	Immediate I

ENTERING DATA

17-34. 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.

17-35. 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.

17-36. All gray data is read-only and cannot be directly changed.

POSITION ENTRY

17-37. The LHMBC offers four methods for locating a position:

- Universal Transverse Mercator (UTM) grids.
- Polar plot.
- Military Grid Referencing System (MGRS).
- Latitude and longitude coordinates.

17-38. To select a method from any Position Edit screen, select the tab that corresponds to the desired method of location.

Universal Transverse Mercator Grids

17-39. UTM grids consist of ten-digit grid coordinates and an altitude with a range of -400 to 9999 meters.

Polar Plot

17-40. Polar plot defines a position as seen from a previously determined position that is already entered in the unit list.

Military Grid Referencing System

17-41. Similar to UTM grids, MGRS consists of a position entered with its zone; 100,000-meter grid square identifier; grid coordinates; and altitude.

Latitude and Longitude Coordinates

17-42. Latitude and longitude coordinates may also be used for location.

NOTE: See FM 3-25.26, Map Reading, for more information.

STARTUP

17-43. Two internal batteries power the RPDA:

- The main internal battery is a 3.2v lithium ion battery capable of powering the unit for approximately 5 hours.

NOTE: Before starting the LHMBC, ensure that the main internal battery is charged.

- The backup battery, a smaller 3.2v lithium ion battery, maintains the LHMBC software and data for short periods of time while the main internal battery is being replaced.

NOTE: The backup battery will not run the LHMBC.

17-44. The RPDA can also accept external power from a variety of conventional power sources, ranging from 11V-36VDC to 100-240VAC.

NOTE: See TM 9-1220-252-12&P for complete power capabilities/modes and usage.

SLEEP BUTTON

17-45. Press the Sleep button (Power button) to power up the RPDA. The password screen (Figure 17-5) is displayed. The user password must be entered each time the unit powers on or comes out of sleep mode.

17-46. LHMBC passwords must be six digits long, with no digit used more than twice consecutively. The default password is 112233.

NOTE: See TM 9-1220-252-12&P, WP 0006, and WP 0004 for complete password software usage.

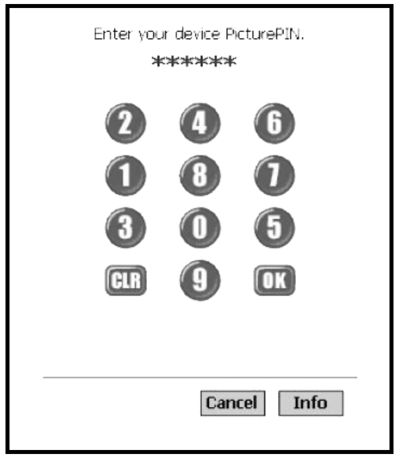


Figure 17-5. Password screen.

START BUTTON

17-47. After entering the proper password, the desktop will display. To start the LHMBC software—

(1) Select the Start button at the upper left of the display.

(2) Select LHMBC from the pull-down menu.

USE ALL BUTTON

17-48. Read the DOD security message, and then select Use All.

DATA INITIALIZATION AND CONFIGURATION

17-49. The following procedures describe the process for initializing and configuring the LHMBC.

SYSTEM STARTUP SETTINGS SCREEN

17-50. When the DOD security message is closed, the System Startup Settings screen displays. To initialize the LHMBC in the basic configuration—

(1) Select Commo Off and GPS Off.

- If Commo is on, digital communication will be possible through two-wire (landline) communication or FM transmission.
- If GPS is on, the LHMBC can auto-fill its position as a gun, FDC, FO, etc.

NOTE: See 17-6 for GPS setup.

---

(2) Select Use All to continue.

SETUP GEOGRAPHICAL REFERENCE SCREEN

17-51. To access the Setup Geographical Reference screen (Figure 17-6)—

(1) Select Menu.

(2) Select Setup.

(3) Select Geo Ref.

NOTE: The Setup Geographical Reference screen automatically displays if no Geo Ref was previously set.

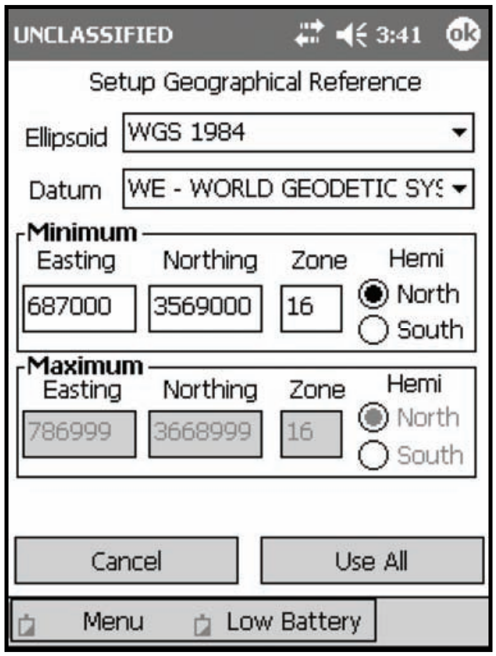


Figure 17-6. Setup Geographical Reference screen.

Ellipsoid Field

17-52. The ellipsoid (spheroid) of the map sheet displays in the marginal information. The default ellipsoid is World Geodetic System (WGS) 1984. Use the Ellipsoid pull-down menu to change the default setting.

Datum Field

17-53. The default datum is WE – WGS 1984. When the ellipsoid is set, the corresponding default datum automatically displays.

Minimum Easting and Northing Fields

17-54. The minimum easting and northing are entered in the 13-digit format – 6 digits for easting, 7 digits for northing. This information is located in the bottom left corner of the map sheet. The western-most grid line is labeled as the minimum easting (1, Figure 17-7), and the southern-most grid line is labeled as the minimum northing (2, Figure 17-7). Figure 17-7 has a minimum easting of 87000 and a minimum northing of 3569000.

NOTE: The Maximum Easting and Maximum Northing fields are automatically filled.

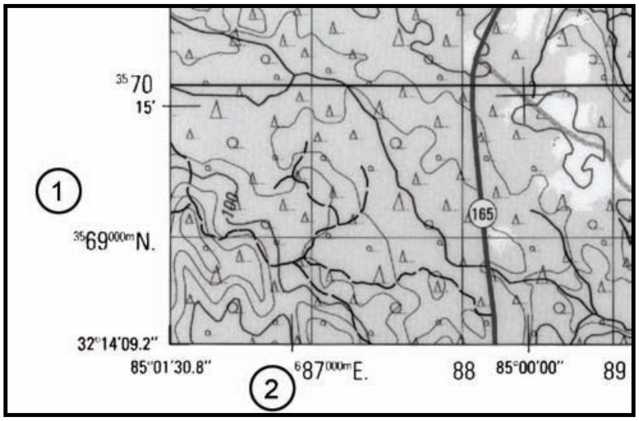


Figure 17-7. Minimum easting and northing.

NOTE: If the correct number of digits are not entered in the Minimum Easting or Minimum Northing fields, an SMI error message will appear (Map Mod ERROR min Easting must be >= 0100000). Select OK, and enter the correct values.

Minimum Zone Field

17-55. 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 (Figure 17-8). The grid zone designator consists of two digits and one letter. The LHMBC does not use the letter.

NOTE: If an invalid Map Mod (Zone) is entered, an SMI error message will appear. Select OK, and enter the correct values.

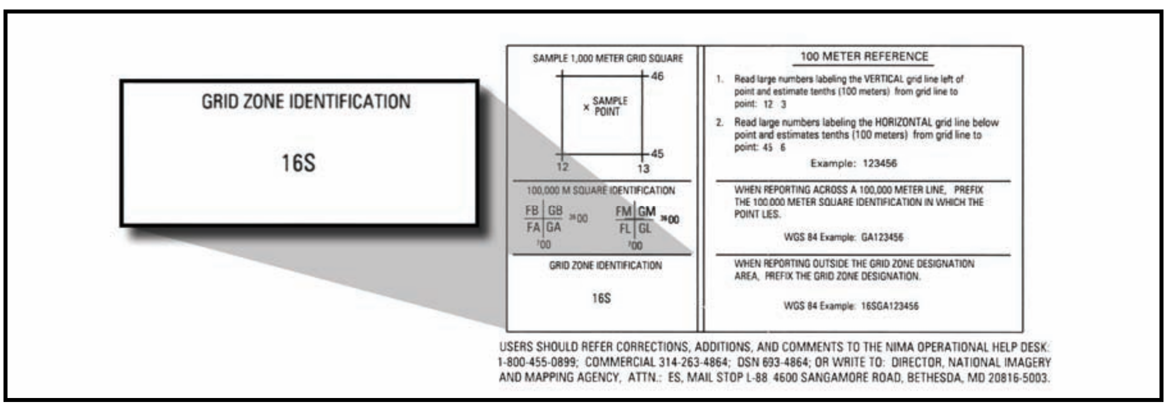


Figure 17-8. Locating minimum zone.

17-56. Figure 17-6 has a minimum zone of 16S, which is entered into the LHMBC as 16.

NOTE: The Maximum Zone field is automatically filled.

Hemisphere Field

17-57. Enter north or south in the Hemisphere field to indicate if your unit is operating in the northern or southern hemisphere.

NOTE: The Hemisphere field is automatically filled.

UNIT LIST SCREEN

17-58. The Unit List screen (Figure 17-9) lists all of 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, and additional required entries for specific devices.

NOTES: 1. This screen automatically displays if no devices were previously entered.

2. The FDC is automatically on the list and cannot be deleted.

17-59. 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.

17-60. To display the Unit List screen—

(1) Select Menu.

(2) Select Unit List.

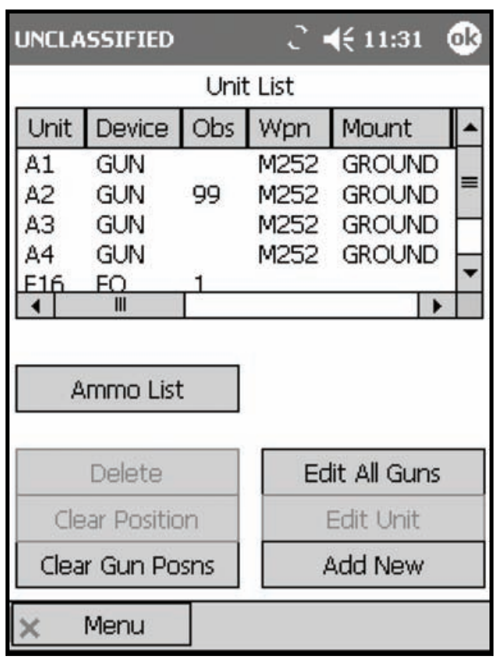


Figure 17-9. Unit List screen.

Unit List Add/Edit Screen

17-61. To add a unit from the Unit List screen (Figure 17-10), select the Add New button. To edit a unit that is already entered—

(1) Select the appropriate unit data line.

(2) Select Edit Unit.

NOTE: Only the Unit Name, Obs Num, and Device fields will be available until a device is selected.

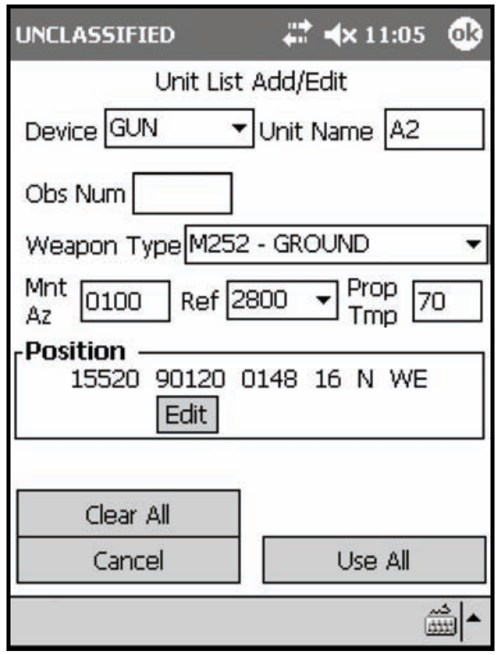


Figure 17-10. Unit List Add/Edit screen.

Unit Name Field

17-62. 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

17-63. The available devices are—

- GUN.
- FDC.
- FO.
- FSE.
- OR STA.
- OTHER.

17-64. The required entries change depending on the device selected. When GUN is selected, entry boxes are displayed for weapon type, mounting azimuth (Mnt Az), referred deflection (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

17-65. To fill the Position field, use one of the three methods listed:

- Enter the position manually in the form of 10-digit grid coordinates.
  (1) Below the Position field, select Edit. The default positioning mode is UTM grid.
  (2) Enter the easting, northing, and altitude of the unit.
  (3) Select Use All.
- Enter the position as a polar plot from a previously entered unit.
  (1) Below the Position field, select Edit.
  (2) Select the Polar tab.
  (3) Select a unit from the Unit pull-down menu.
  (4) Enter the direction, distance, and vertical interval from the plotting unit to the unit to be located.
  (5) Select Use All.
- Auto-fill the position based on satellite information.
  (1) If the GPS is installed and on, the GPS Control button will display below the Position field. Select GPS.
  (2) After entering the appropriate information for each unit, select Use All.

NOTE: GPS survey must be conducted at the location of the baseplate for each gun position.

Edit All Guns

17-66. To edit gun setup information for all guns from the Unit List screen, select the Edit All Guns button. From this menu, you may set the weapon type, mounting azimuth (Mnt Az), referred deflection (Ref), and propellant temperature (Prop Tmp) for all guns.

AMMUNITION SCREEN

17-67. In the Ammunition screen, the LHMBC tracks ammunition by unit (gun) number.

17-68. To display the Ammunition screen (Figure 17-11), 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.
  (1) Select Menu.
  (2) Select Ammo.
  (3) Select Ammo List.

17-69. 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.

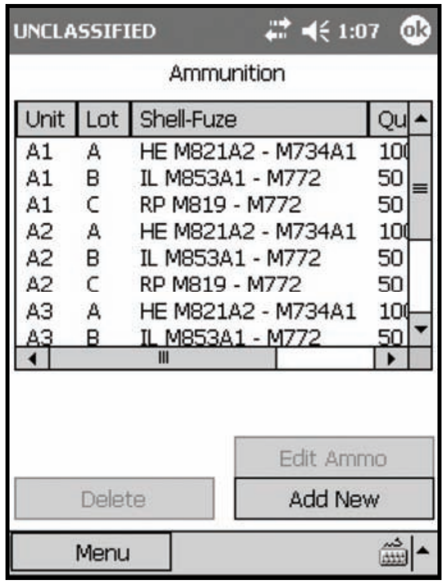


Figure 17-11. Ammunition screen.

ADD/EDIT SCREEN

17-70. To add ammunition—

(1) Select Add/New. The Ammunition Add/Edit screen (Figure 17-12) appears.

(2) Select the weapon you would like to modify using the Unit field pull-down menu. This menu displays all weapons that have been entered into the LHMBC.

(3) Select the Lot field to enter the lot letter. Letters range from A to Z.

(4) Select the appropriate ammunition using the Shell - Fuze field pull-down menu. Ammunition is arranged alphabetically by type – HE, IL, IR, RP, TRN, and WP.

(5) Enter the lot number in the Lot Number field. Lot numbers contain as many as 16 characters.

(6) In the Quantity field, enter the quantity of the lot allocated to the current weapon.

(7) Repeat steps 2 through 6 for the remaining types and quantities of ammunition for each gun.

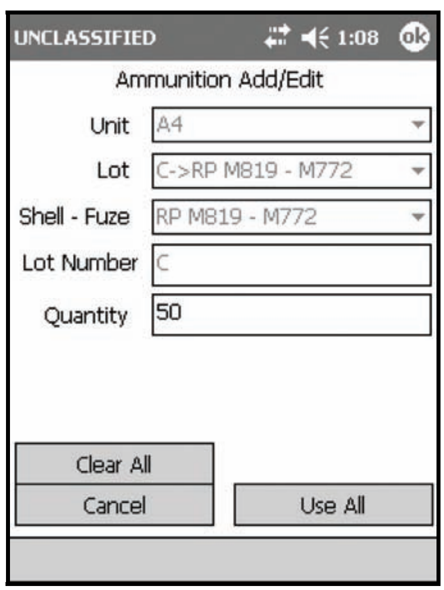


Figure 17-12. Ammunition Add/Edit screen.

AMMUNITION ROLL-UP SCREEN

17-71. The Ammunition Roll-Up screen (Figure 17-13) lists the total quantity of ammunition by lot. To display this screen—

(1) Select Menu.

(2) Select Ammo.

(3) Select Ammo Roll-up.

17-72. 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.

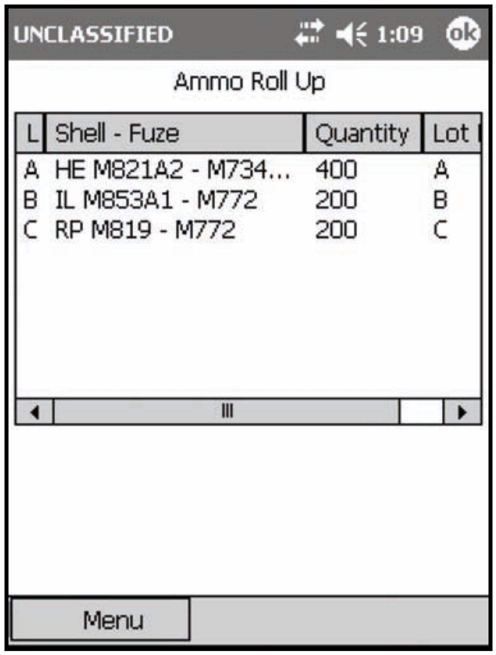


Figure 17-13. Ammunition Roll-Up screen.

SETUP DATA SCREEN

17-73. The Setup Data screen (Figure 17-14) allows the operator to set the system clock, security mode, target block, and splash time (if using Commo), and to enable/disable the audio alarm. To display this screen—

(1) Select Menu.

(2) Select Setup.

(3) Select Data.

Date and Time Fields

17-74. If the GPS is enabled, the GPS Time button will display. Select the GPS Time button to auto-fill the Date and Time fields.

17-75. If operating in the 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.

Security Mode Field

17-76. 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.

Target Block

17-77. 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

17-78. The default splash message time is five seconds.

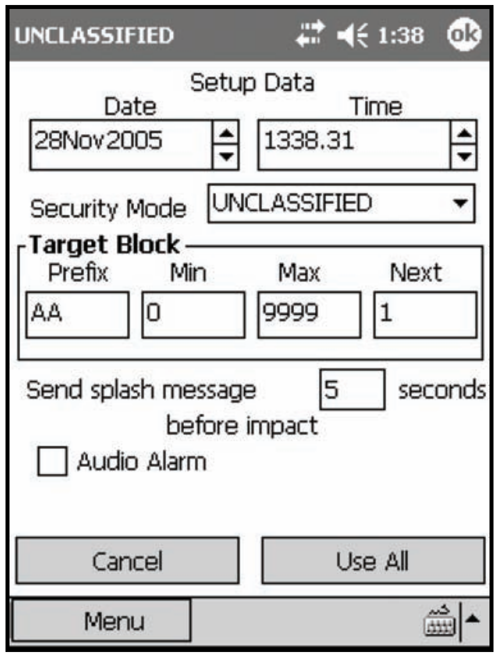


Figure 17-14. Setup Data screen.

METEOROLOGICAL DATA

17-79. The LHMBC uses a computerized MET message to correct for changes in the atmospheric condition as they apply to ballistic calculation. When no MET is available, the LHMBC uses the standard MET that is stored in the LHMBC.

17-80. When a new MET message is received and stored, 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

17-81. If the MET is sent digitally, an alert displays to confirm receipt of the MET message. After confirming receipt, you must apply the MET:

(1) Select Menu.
(2) Select Met.
(3) Select Messages.
(4) Select the most recent message.
(5) Select Process. This message becomes the current MET.

ENTERING MANUAL METEOROLOGICAL DATA MESSAGES

17-82. To enter the MET message, manually record it on DA Form 3677-R (Figure 4-15). Chapter 4 gives a complete overview of meteorological messages.

17-83. To input a new manual MET message—

(1) Select Menu.

(2) Select Met.

(3) Select New. The Met New screen (Figure 17-15) displays.

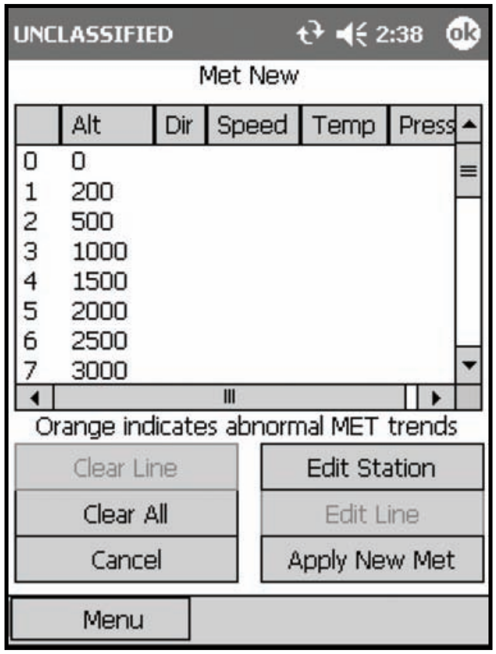


Figure 17-15. Met New screen.

(4) Select Edit Station. The Met Edit Station screen (Figure 17-16) displays.

(5) 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, 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.

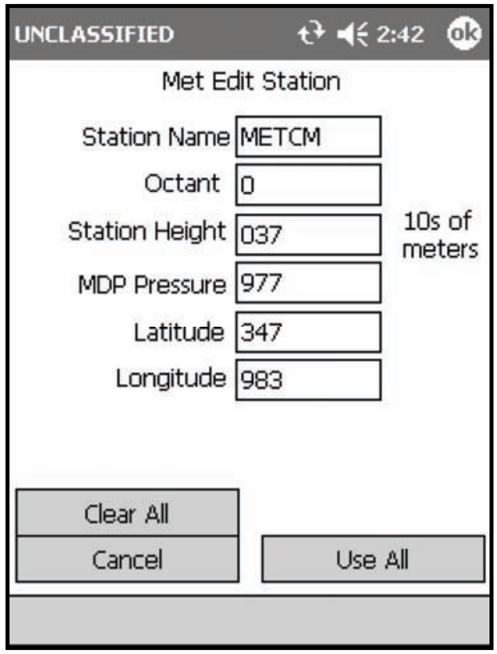


Figure 17-16. Met Edit Station screen.

(6) Select Use All. The LHMBC returns to the Met New screen.

(7) Enter surface zone information by selecting line 0 in the data field and selecting Edit Line. The Met New Edit Lines screen (Figure 17-17) displays.

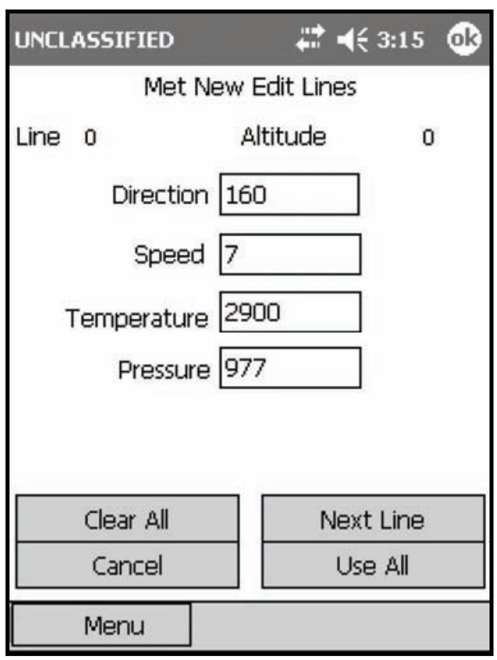


Figure 17-17. Met New Edit Lines Screen.

(8) Enter surface and zone MET data (Direction, Speed, Temp, and Pressure fields).

(9) Select Next Line to proceed to the next surface zone line. Complete all applicable lines. At a minimum, the first eight lines must be completed in order to apply MET data.

(10) 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.

(11) Select Apply New Met to use the new MET.

SWITCH BETWEEN METEOROLOGICAL DATA MESSAGES

17-84. To toggle between the current MET and the standard MET from the Met Current screen—

(1) Select Use Standard. The Met Standard screen displays.

(2) Select Use Current. The Met Current screen (Figure 17-18) displays.

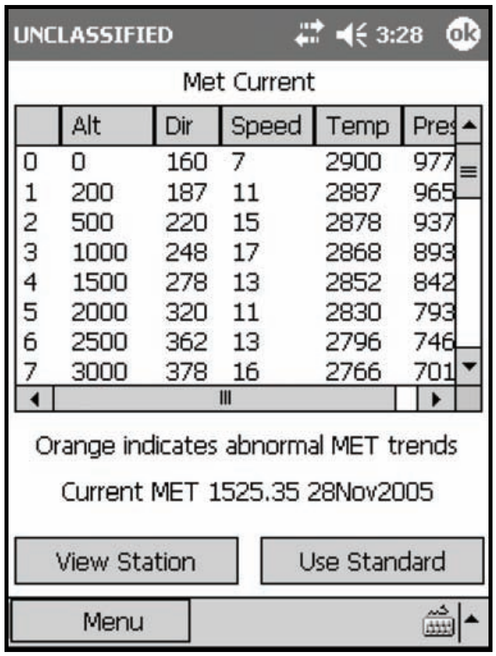


Figure 17-18. Met Current screen.

SAFETY FAN

17-85. 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 in accordance with the Mortar Surface Danger Area (Appendix C).

17-86. The LHMBC stores 1 safety fan with as many as 10 segments (Figure 17-19). 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.

17-87. 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 distances (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 radii are as follows:

- 60-mm – 100 meters
- 81-mm – 150 meters
- 120-mm – 200 meters
- 120-mm – 250 meters (firing M91 Illum)

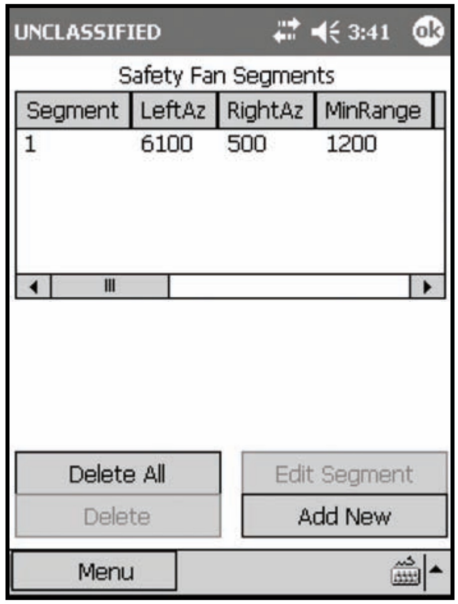


Figure 17-19. Safety Fan Segment screen.

ENTER SAFETY FAN INFORMATION

17-88. To enter a safety fan into the LHMBC—

(1) Select Menu.

(2) Select Setup.

(3) Select Safety Fan.

(4) Select Add New. The Add New Safety Fan Segment screen (Figure 17-20) displays.

(5) 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.

(6) After entering the azimuths and the minimum and maximum ranges, determine the minimum and maximum charges that may be fired.

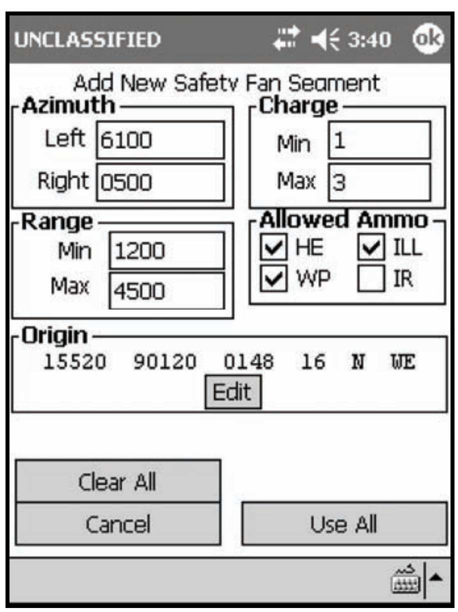


Figure 17-20. Add New Safety Fan Segment screen.

DELETE SAFETY FAN INFORMATION

17-89. To delete a specific segment—

(1) Select the bottom (right-most) fan segment from the Safety Fan Segments menu.

(2) Select Delete.

(3) Select Confirm.

(4) 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.

17-90. To delete the entire fan, select Delete All and Confirm from the Safety Fan Segments menu.

CHECK FIRE

17-91. To immediately cease fire and preserve data for all missions or for a single target, the mortar section/platoon implements a check fire. The FO will receive a digital message informing him of 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 enabled.

INITIATE

17-92. To initiate a check fire of all targets—

(1) Select Menu.

(2) Select Check Fire.

(3) Select ChkFire All.

NOTE: All active fire missions will be halted, and all inactive missions will remain inactive until the check fire is cancelled. A (!) indicator will display, along with a mission number for every mission.

17-93. To initiate a check fire by target number—

(1) Select Menu.

(2) Select Check Fire.

(3) Select ChkFire Tgt.

NOTE: The selected mission will be halted. All other missions will remain active, and new missions may be initiated. A (!) indicator will display, along with the target number for the specified mission.

CANCEL

17-94. To cancel a check fire—

(1) Select Menu.

(2) Select Check Fire.

(3) Select the mission to be removed from check fire status.

(4) Select Cancel ChkFire.

(5) A "Confirm Cancel Check Fire" message will display. Select OK.

NOTE: All selected missions will now be available for mission processing.

SECTION II. COMMUNICATION

The LHMBC is capable of communicating on the fire support network with the Advanced Field Artillery Tactical Data System (AFATDS, with PKG11), Forward Observer System (FOS, Version 12 or later), 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

17-95. To enable digital communications, select Commo On during initial startup (see 17-51). The LHMBC can utilize two-wire (landline) or FM communication.

17-96. To install the two-wire connector or the radio cable (Figure 17-21)—

(1) Remove the connector covers from the communications connector on top of the LHMBC (1) and the cable connector on the two-wire or radio connector (2).

(2) Insert the appropriate cable into the communications connector (1), and twist the cable connector (2) back and forth while pushing the cable in until it clicks into place.

(3) Turn the communications connector knob (3) clockwise to secure the cable.

(4) Attach the radio cable connector (4) 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 FM communications, see the appropriate TM for your radio set.

2. The two-wire connector will communicate with any other LHMBC or supported digital device connected in the communications loop.

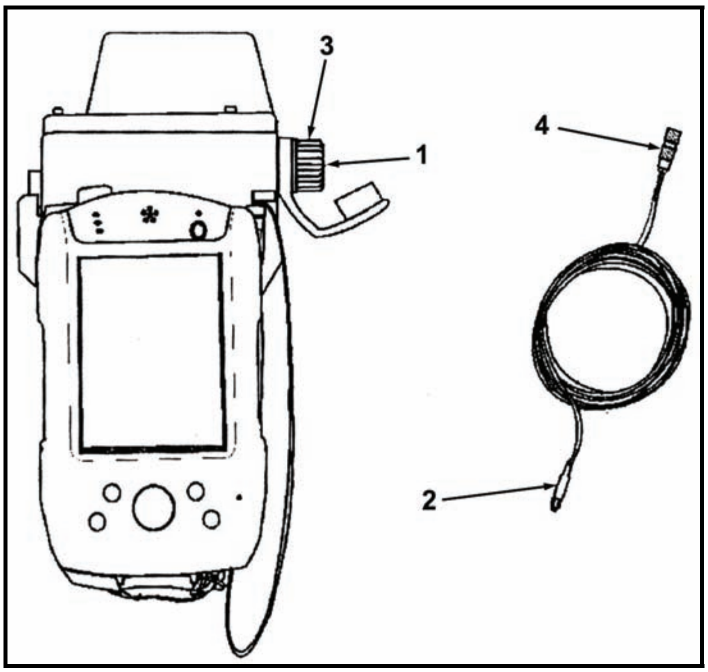


Figure 17-21. Lightweight handheld mortar ballistics computer communications connector.

PARAMETER SETUP

17-97. To set up parameters—

(1) Select Menu.

(2) Select Commo.

(3) Select Channel Params. The Setup Commo Parameters screen (Figure 17-22) displays.

(4) 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, etc.) must have identical setup in the fields outlined in Table 17-4.

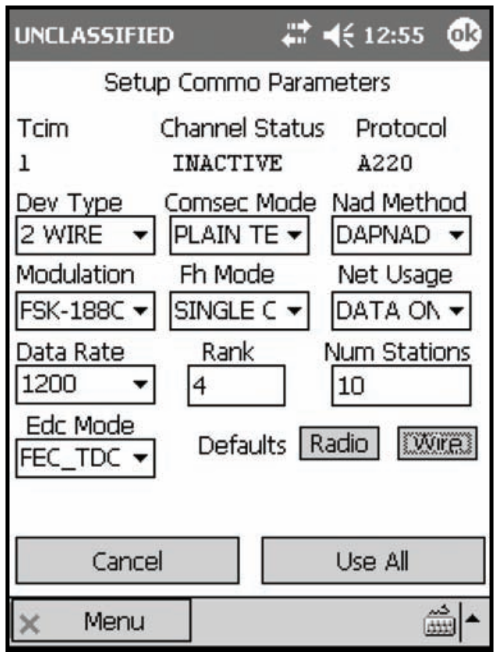


Figure 17-22. Setup Commo Parameters screen.

Table 17-4. Parameter Setup fields and settings.

FIELD	SETTING AND RELATED INFORMATION
Dev Type	2 Wire or SINCGARS
Comsec Mode	Plain Text for 2 Wire Plain Text or Cipher Text for SINCGARS
Network Access Delay (Nad) Method	RANDOM, HYBRID, PRIORITY, DAPNAD, or RROBIN NOTE: The Network Access Delay ensures that multiple users on a single network all have transmission opportunities.
Modulation	FSK-188C (default; must be used with the FOS) or NRZ (non-return-to-zero interface) NOTE: The NRZ interface is used primarily with digital equipment.
Fh Mode	Single channel or frequency hop mode NOTE: This setting allows the operator to communicate in single channel or frequency hop mode when the LHMBC is connected through an FM 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 baud rate of 600 or 1200 bps for wire communications A baud rate of 2400 or 4800 bps for FM communications
Num Stations	The total number of units using the network, including the operator
Error Detection and Correction (Edc) Mode	Double_FEC_TDC, FEC_ONLY, FEC_Scrambling, FEC_TDC, FEC_TDC_Scrambling, NO_EDC, or Scrambling_Only NOTE: Error Detection and Correction compensates for errors in transmission.

UNIT PRIORITIES

17-98. 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 FC, 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

17-99. To set up a unit address—

(1) Display the Setup Commo Addresses screen (Figure 17-23) by:

- Selecting Use All.
- Selecting Menu, Commo, and then Channel Addrs.

NOTE: All units on the Unit List are listed, except guns.

(2) Enter the FDC address, and then the addresses of other units.

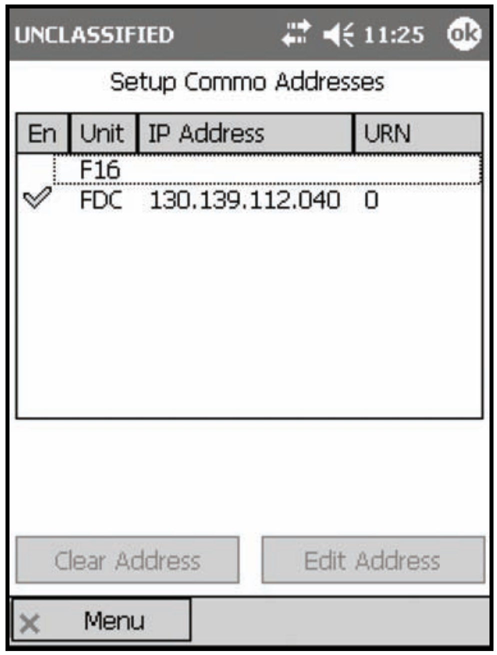


Figure 17-23. Setup Commo Addresses screen.

EDIT A UNIT ADDRESS

17-100. To edit a unit—

(1) Select a unit from the list of units.

(2) Select Edit Address. The Edit Commo Address screen (Figure 17-24) displays.

(3) Enter the proper Commo address values.

17-101. Select Use All.

NOTE: If the unit is an FDC, the channel will be enabled, and a checkmark will appear in the En field of the Setup Commo Address screen.

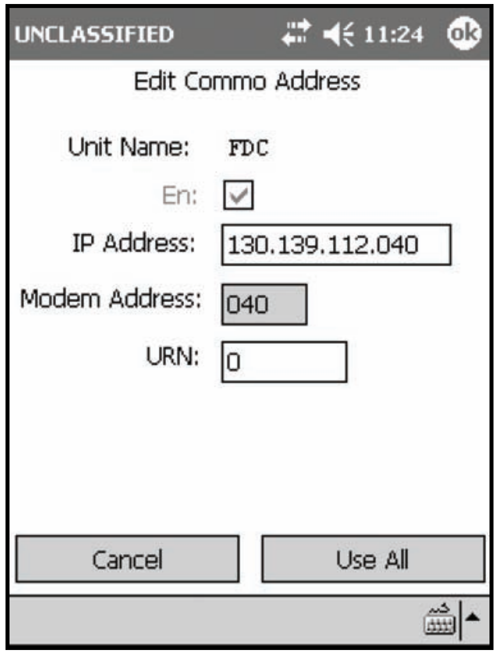


Figure 17-24. Edit Commo Address screen.

UNIT NAME FIELD

17-102. The unit name is listed at the top of the Edit Commo Address screen.

EN FIELD

17-103. 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.

IP ADDRESS FIELD

17-104. The IP address is supplied through the unit Information Manager's Office.

MODEM ADDRESS FIELD

17-105. The modem address is the last three digits of the IP address and is filled automatically. The number can range from 040 to 095.

URN FIELD

17-106. The URN identifies the specific LHMBC on the network and has a range from 0 to 16777215.

ENABLE OR DISABLE A CHANNEL

17-107. To enable or disable a channel—

(1) Select Menu.

(2) Select Commo.

(3) Select Enable Channel.

NOTE: A message confirming the channel's status appears. This message only confirms that the channel is enabled or that there was an error enabling the channel, not that the network is working.

SEND STATUS SCREEN

17-108. If a channel is enabled, Send Status becomes functional. To display the Send Status screen (Figure 17-25)—

(1) Select Menu.

(2) Select Commo.

(3) Select Send Status.

17-109. Once a message has been sent, the Send Status screen automatically displays.

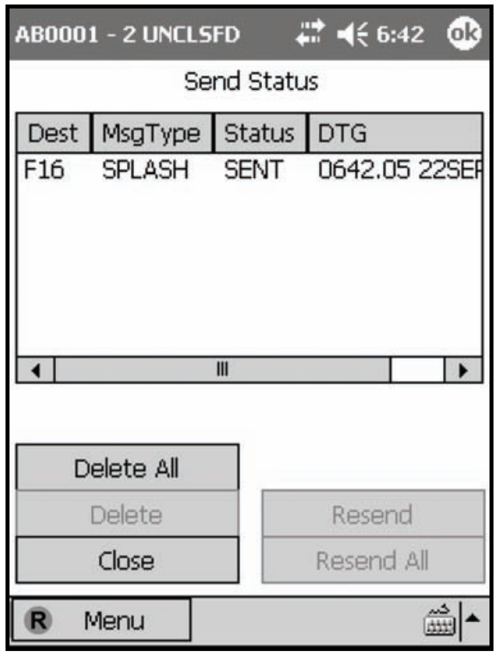


Figure 17-25. Send Status screen.

PLAIN TEXT MESSAGING

17-110. The LHMBC's plain text messaging (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 MESSAGING READ SCREEN

17-111. The PTM Read screen consists of a message log and a message log box. To display the PTM Read screen—

(1) Select Menu.

(2) Select Commo.

(3) Select PTM Read.

17-112. 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

17-113. The PTM Send screen contains a message box for typing messages. To display the PTM Send screen—

- Select Menu, Commo, and then PTM Send.

  OR

- Select the Reply button on the PTM Read screen.

17-114. To send a message to a specific unit—

(1) Select the unit name from the Unit Name box.

NOTES: 1. If the PTM Send screen was displayed via the Reply button, the sending unit's name will be selected in the Unit Name box.

2. To send a message to all units in the Unit Name box, select Check All.

3. To clear units that have been checked, select Check None.

---

(2) Type your message. To clear a message, select the Clear button.

(3) Select Send. The Send Status screen displays.

SECTION III. GLOBAL POSITIONING SYSTEM

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 9-1220-252-12&P, WP 0034 00 for ordering info.

2. The correct Map Mod (Geo Ref) must be entered to obtain a GPS position (Figure 17-6).

SETUP AND INITIALIZATION

17-115. To display the GPS Status screen—

(1) Select Menu.

(2) Select Setup.

(3) Select GPS.

17-116. The GPS Status screen (Figure 17-26) displays the following fields:

- 000State.
- 001Position.
- 002GPS Accuracy.
- 003.
- 004.
- 005ALMANAC AGE or 005NO ALMANAC.
- 006.

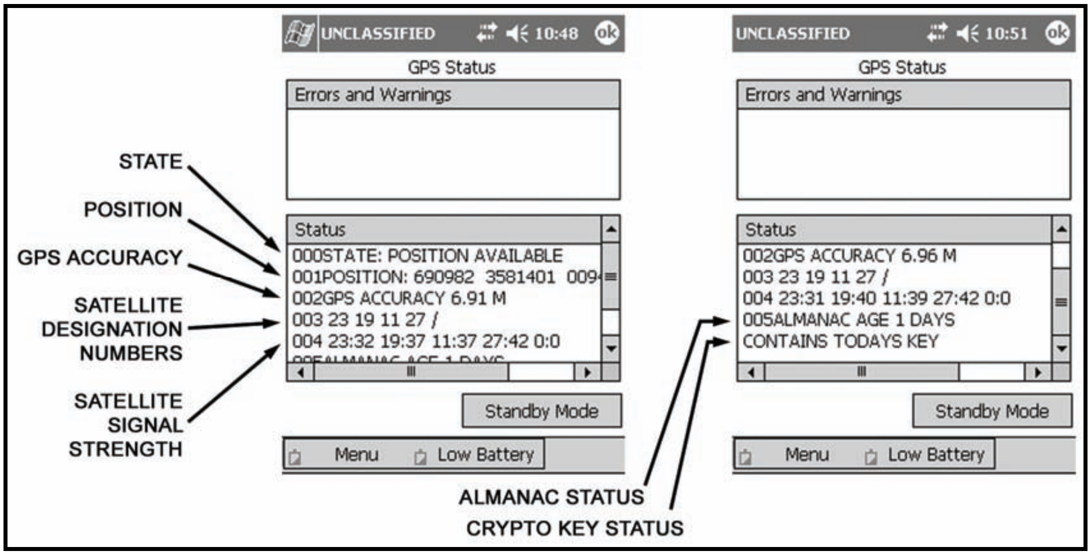


Figure 17-26. Global Positioning System Status screen.

00STATE

17-117. This field displays the following:

- Initialize.
- Searching.
- Position Available.
- Unknown.

001POSITION

17-118. This field displays the present position only when the State field displays "Position Available."

002GPS ACCURACY

17-119. This field indicates the accuracy of Position. The LHMBC requires the accuracy to be 25 meters or less before displaying the position.

003

17-120. 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.

004

17-121. 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.

17-122. Signal strength ranges from 0 (no signal) to 50 (max signal). A signal strength of 30-40 is usually strong enough for the GPS to receive data.

005ALMANAC AGE OR 005NO ALMANAC

17-123. 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.

006

17-124. This field displays the crypto key status. The status displayed are shown in Table 17-5. GPS keys are required if satellite signals are scrambled.

Table 17-5. 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 Todays Key	The key is in use.
Todays Key Incorrect	The group unique variable (GUV) crypto key is invalid.
Waiting for SV Data	The LHMBC is waiting for the satellite vehicle; the crypto key may be installed, but is too old.
CV Zeroize Successful	The crypto variable and almanac have been zeroized.
CV Zeroize Failed	The GPS has failed to zeroize. Perform a soft reset, and then attempt to zeroize the GPS. If problem continues, perform a hard reset. Attempt to zeroize the GPS again. If problem persists, evacuate the LHMBC to unit maintenance. NOTE: See TM 9-1220-252-12&P WP 0040 00 for soft and hard reset procedures).
Key Loaded	This message is displayed for approximately 2 seconds when loading the key.

STANDBY MODE

17-125. 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 COMSEC KEY

17-126. To fill the LHMBC—

(1) Select Menu.

(2) Select Setup.

(3) Select GPS. The GPS Status screen displays.

17-127. 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

17-128. 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—

(1) Select Start.

(2) Select Maintenance.

(3) Select Zeroize GPS.

(4) A call box will display to confirm zeroizing the GPS. Select ***Yes***. The GPS key and almanac are now zeroized.

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Chapter 18

Fire Missions

The LHMBC provides a standard set of steps and screens to view the fire mission data for grid, polar plot, laser polar, shift from a known point, quick fire, direct lay, and hipshoot missions. The sequence of actions from the initial CFF to the end of mission (EOM) is standard for all CFFs, although some steps may be omitted or repeated. This chapter consists of three sections: manual fire missions, digital fire missions, and special fire missions. The LHMBC can handle up to six active missions at a time.

SECTION I. MANUAL FIRE MISSIONS

Manual missions are fire missions that the FDC does not receive digitally from the FC or FO. A fire mission can be received from the FO by radio or any other form of verbal communication.

NOTE: Chapter 17 describes the steps required to initialize the LHMBC. Initialization must be performed before processing most fire missions.

All manual missions are initiated from the Manual Missions menu (Figure 18-1). To access this menu, select Menu, and then Manual Missions. The Manual Missions submenu is displayed. This menu lists the method of target location for all manual missions. These methods include—

- Grid.
- Polar plot.
- Laser polar.
- Shift from a known point.
- Quick fire.
- Direct lay.
- Hipshoot.

NOTE: The following LHMBC grid mission screens depict an actual fire mission. This example uses no sheaf corrections (Reg/MET).

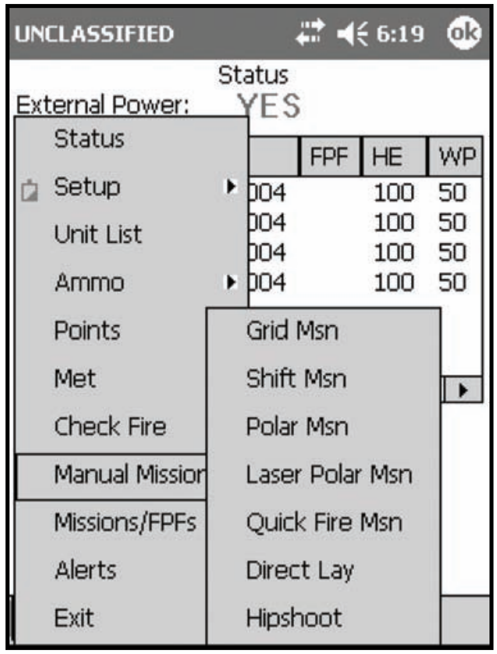


Figure 18-1. Manual Missions menu.

GRID MISSIONS

18-1. After recording the CFF on DA Form 2399-R—

(1) Select Menu.
(2) Select Manual Missions.
(3) Select Grid Msn.
(4) The Grid Mission screen (Figure 18-2) displays.

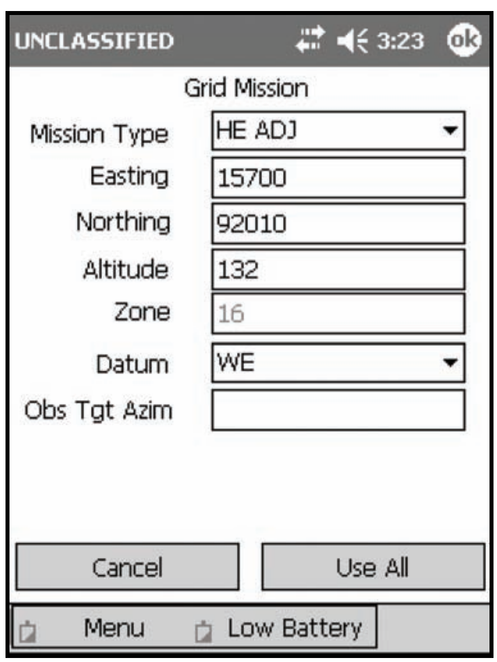


Figure 18-2. Manual grid mission entry.

(5) Enter all required information in the Grid Mission screen fields (Table 18-1).

Table 18-1. 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 FFE (HE FFE). • Illumination adjustment (ILL ADJ). • Illumination FFE (ILL FFE). • Suppression (SUPPRESS). • Immediate smoke (IM SMOKE). • Registration. • 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 Geo Ref setup and is read-only.
Datum	The Datum field is auto-filled by the Geo Ref. 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 prior to making the first adjustment, or the LHMBC will default to the gun-target (GT) line.

(6) Select Use All.

(7) The Mission Data screen (Figure 18-3) displays. The Mission Data screen allows the operator to enter the method of control and gun/sheaf refinements.

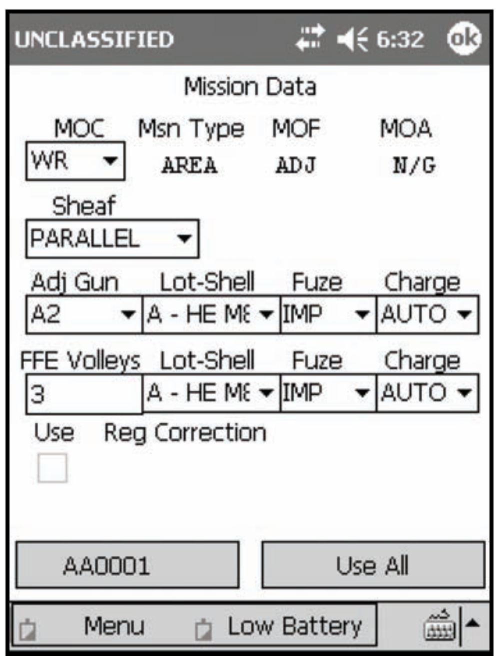


Figure 18-3. Mission Data screen.

(8) Use the fields outlined in Table 18-2 to enter and view information.

Table 18-2. Mission Data screen fields and related information.

FIELD	RELATED INFORMATION
Method of control (MOC)	The options for the MOC field include— • When ready (WR). • At my command (AMC). • Do not load (DNL)/ Do not Fire.
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— • LINEAR. • OPEN. • CONVERGED. • SPECIAL. • PARALLEL (default). • Search and traverse (SRCH/TRAV). NOTE: SPECIAL and SRCH/TRV sheaves will display additional fields for required entries. These fields are described in detail later in this chapter.
Adjusting gun (Adj Gun)	The adjusting gun defaults to the gun nearest to the center of the firing unit. The FDC operator must ensure that the proper adjusting gun is used for calculations.
Lot, Shell, 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 an 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. 2. The available fuze settings will correlate with the mission type selected (i.e., illumination missions will include MTSQ). 3. See Appendix B of FM 7-90, Tactical Employment of Mortars, for joint munitions effectiveness manuals (JMEMS), charts, and additional engagement criteria.
Use Registration Correction (Use Reg Correction)	If an RP is recorded, the Use Reg Correction box will be checked. To process a mission without the registration corrections, deselect the checkbox.

(9) Select Use All.

(10) If there are no errors or warnings, the Solution/Gun Orders screen (Figure 18-4) displays. Table 18-3 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 also be accessed from the active mission menu by selecting Solution. The active mission menu (labeled with the mission number) can be accessed by selecting Menu, Missions, FPFs, and then the mission number.

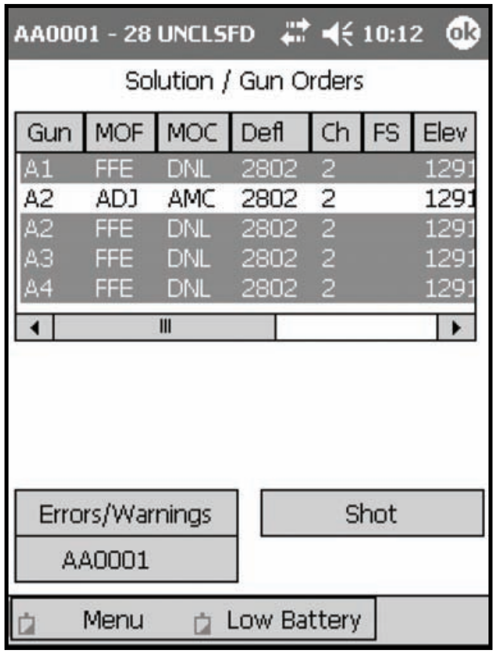


Figure 18-4. Solution/Gun Orders screen.

Table 18-3. Solution/Gun Orders screen fields and 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 in the digital mode. This button also acts as an accumulator for the rounds fired for the mission.
Gun Data field	In this field, FFE data will display for all guns in red during the adjustment phase. This allows non-firing 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.
<Target> button	The <Target> button (labeled AA0001 in Figure 18-5) displays the <Target> screen.

(11) Select the Shot button.

(12) Select the <Target> button.

(13) The <Target> screen (Figure 18-5) displays. The <Target> screen allows the operator to review, verify, and adjust fires; 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 (AA0001 in the example). Table 18-4 outlines all <Target> screen buttons and related information.

NOTE: The <Target> screen can be accessed by selecting Menu/Missions/FPFs/<target number>, or by selecting the <Target> button from any mission screen.

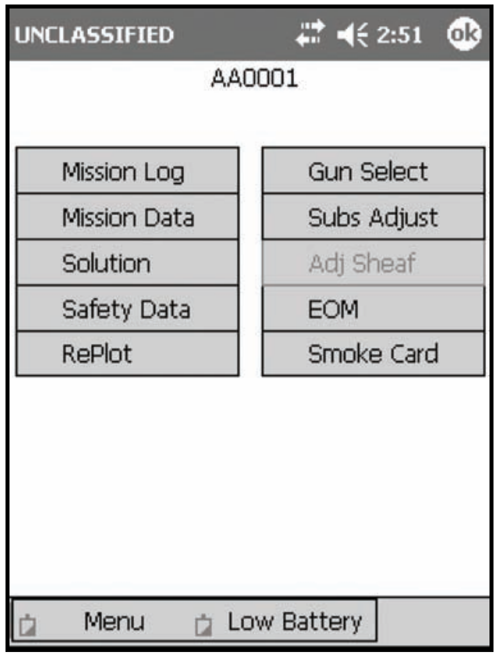


Figure 18-5. <Target> screen.

Table 18-4. <Target> screen buttons and related information.

BUTTON	RELATED INFORMATION
Mission Log	The Mission Log stores a chronological history of all information entered for the active mission.
Mission Data	This button displays the Mission Data screen.
Solution	This button displays the Solution/Gun Orders screen.
Safety Data	This button displays the Safety Data screen.
RePlot	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.
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.
Subsequent Adjustments (Subs Adjust)	This button displays a screen used to input subsequent adjustments.
Adjust Sheaf (Adj Sheaf)	This button displays the Adjust Sheaf screen. This screen is read-only until the FFE phase. The Adjust Sheaf screen enables the operator to make adjustments to any gun that is used in the active mission. NOTE: Section III covers registration and sheaf adjustment.
End of Mission (EOM)	This button displays the EOM screen.
Smoke Card	This button displays the Smoke Card screen. This function is available from the <Target> screen. NOTE: Section III covers smoke missions and the use of the smoke card.

(14) Select Solution.

(15) Select <Target>.

(16) Select Safety Data.

(17) The Safety Data screen (Figure 18-6) displays. 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 18-5 displays the data fields for this screen.

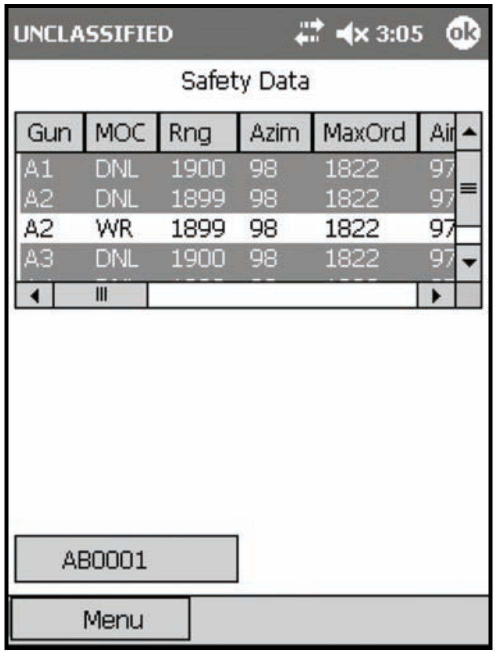


Figure 18-6. Safety Data screen.

Table 18-5. 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). • 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.
Azimuth (Azim)	This field contains the grid azimuth to the target.
Maximum Ordnance (MaxOrd)	This field contains the maximum ordnance, expressed as the actual height of the round at its summit. NOTE: The maximum ordnance takes into account the actual station height.
Aiming Point Azimuth	This field contains the direction the mortar must be aimed to hit the target. This direction takes into account the total correction from exterior ballistics, such as registration and MET.
Aiming Point	This field contains the grid location for the specified gun to impact at its correct location in the sheaf.
Burst Height	This field contains the calculated height at which the round will burst.
Burn Time	This field contains the amount of time the round will burn before burning out.
Canister Easting	This field contains the easting to where the canister will impact if the round malfunctions.
Canister Northing	This field contains the northing to where the canister will impact if the round malfunctions.
Grid Declination	This field contains the grid declination constant for the area of operations. The grid declination constant accounts for the difference between grid north and magnetic north.

(18) Select the <Target> button.
(19) The <Target> screen displays.
(20) Select Subs Adjust.
(21) The Subsequent Adjust screen displays. The Subsequent Adjust screen (Figure 18-7) enables the operator to make gun adjustments. Table 18-6 displays the data fields for this screen.

NOTES: 1. Adjustments may be made using the observer-target azimuth (OTAzim) or, if made from the gun position, using the gun-target line (GTL). If using the observer-target (OT) azimuth, the observer must give his azimuth to the target prior to 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 also uses the following FO call to show the appropriate positioning of information:

FO Call: Dir 100. Left 100. Drop 100.

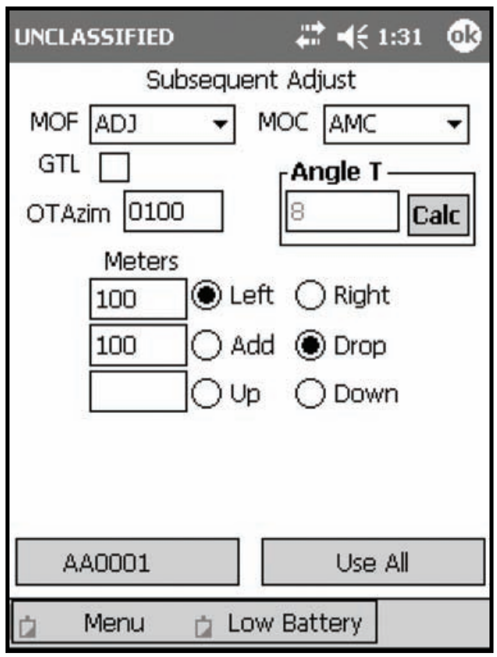


Figure 18-7. Subsequent Adjust screen.

Table 18-6. Subsequent Adjust screen fields and related information.

FIELD	RELATED INFORMATION
Method of Fire (MOF)	MOF options are— • ADJ. • CONT. • FFE. • Repeat FFE (RFFE).
Method of Control (MOC)	MOC options are— • AMC. • WR. • DNL.

(22) Select Use All.
(23) The Solution/Gun Orders screen displays.
(24) Select Shot.
(25) Select the <Target> button.
(26) The <Target> screen displays.
(27) Select Subs Adjust.
(28) Change MOF from Adjust to FFE.
(29) Select Use All.
(30) The Solution/Gun Orders screen displays.
(31) Select Shot.
(32) Select the <Target> button.
(33) The <Target> screen displays.
(34) Select EOM.
(35) The End of Mission screen (Figure 18-8) displays. 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.

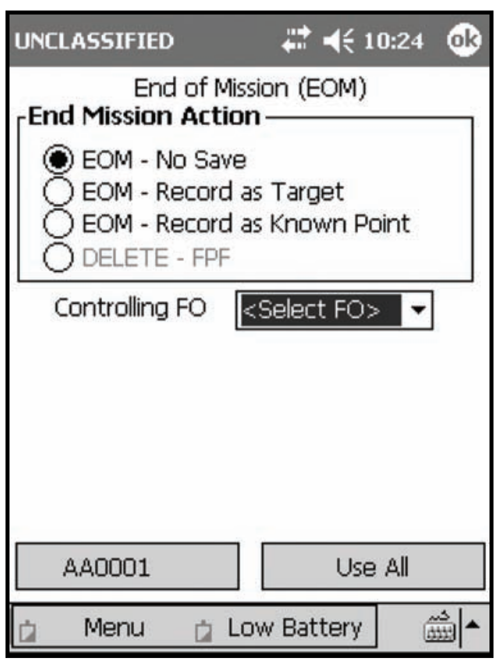


Figure 18-8. End of Mission screen.

(36) Choose one of the selections outlined in Table 18-7.

Table 18-7. End of Mission screen selections and related information.

BUTTON	RELATED INFORMATION
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 FO must be selected when saving the mission. After selecting Use All, the Select Known Point Number screen displays. The Known Point pull-down 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 - FPF	The DELETE - FPF option is active only during an FPF mission and will end the mission without storing or applying FPF corrections.

(37) Select Use All.

(38) The Ammunition Expended screen (Figure 18-9) displays. 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 a number of rounds used of each lot by each gun.

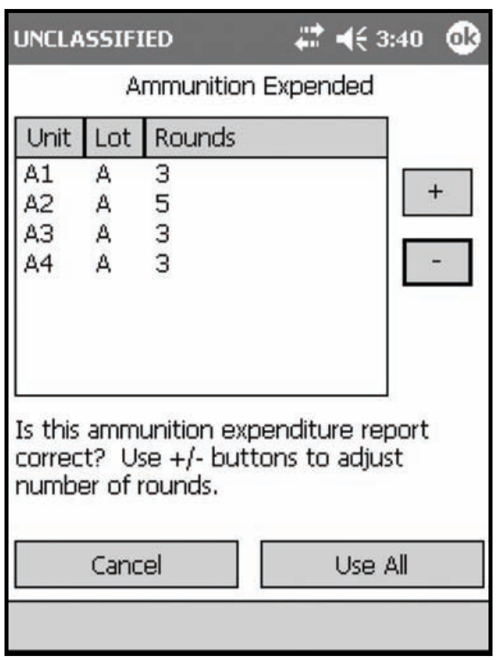


Figure 18-9. Ammunition Expended screen.

(39) 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.

(40) 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 MISSIONS

18-2. Prior to 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-R—

(1) Select Menu.
(2) Select Manual Missions.
(3) Select Shift Msn.
(4) The Shift Mission screen (Figure 18-10) displays.

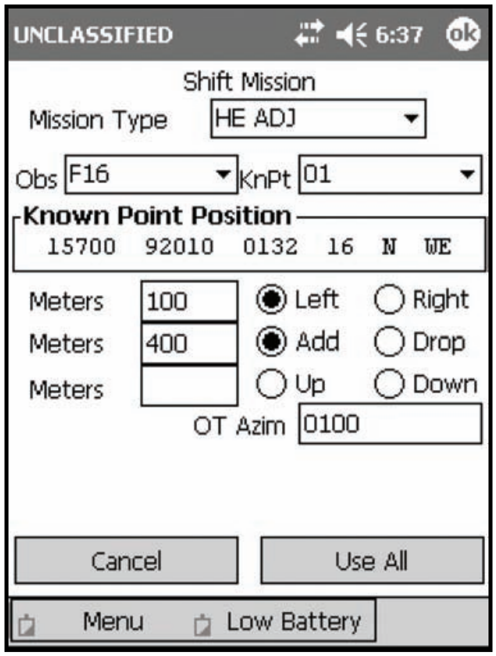


Figure 18-10. Shift Mission screen.

(5) Set the mission type (HE ADJ, HE FFE, ILL ADJ, ILL FFE, or FPF).
(6) Enter the observer name and the number of the known point to be shifted from.
(7) The known point position displays.
(8) 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 there is no up or down given, the altitude for the target will be the same as the known point.

---

(9) Enter the OT azimuth.
(10) 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 MISSIONS

18-3. After recording the CFF on DA Form 2399-R—

(1) Select Menu.
(2) Select Manual Missions.
(3) Select Polar Msn.
(4) The Polar Mission screen (Figure 18-11) displays.
(5) Select the mission type.
(6) 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.

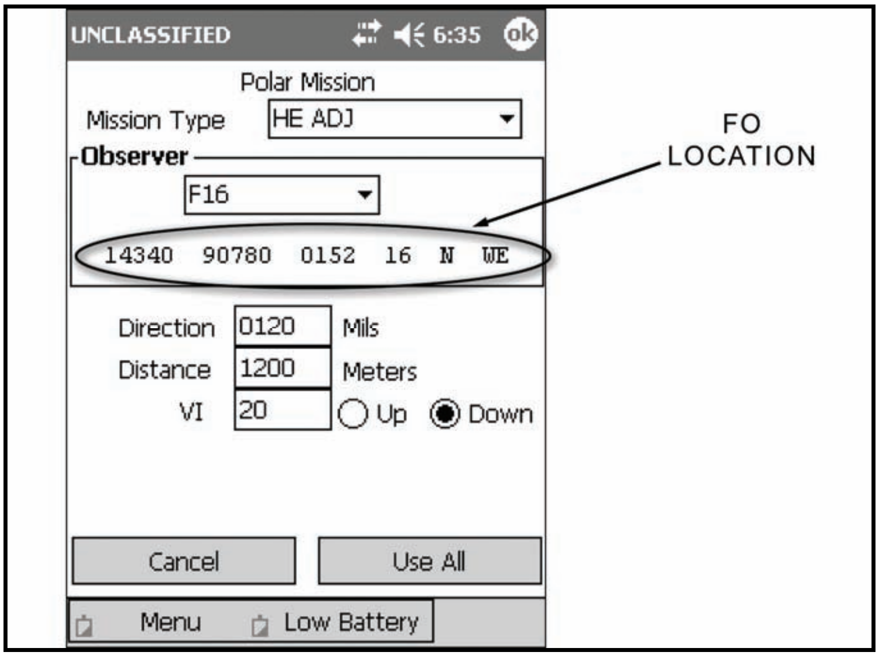


Figure 18-11. Polar Mission screen.

LASER POLAR PLOT MISSIONS

18-4. The laser polar plot mission differs from the standard polar plot mission in that the laser takes into account the full range to the target including the altitude change (slant range). The altitude correction is expressed as a vertical angle, expressed in mils. After recording the CFF on DA Form 2399-R—

(1) Select Menu.

(2) Select Manual Missions.

(3) Select Laser Polar Msn.

(4) The Manual Laser Polar Mission screen (Figure 18-12) displays.

NOTE: After the initial method of target location is given, the mission is completed in the same manner as a basic grid mission.

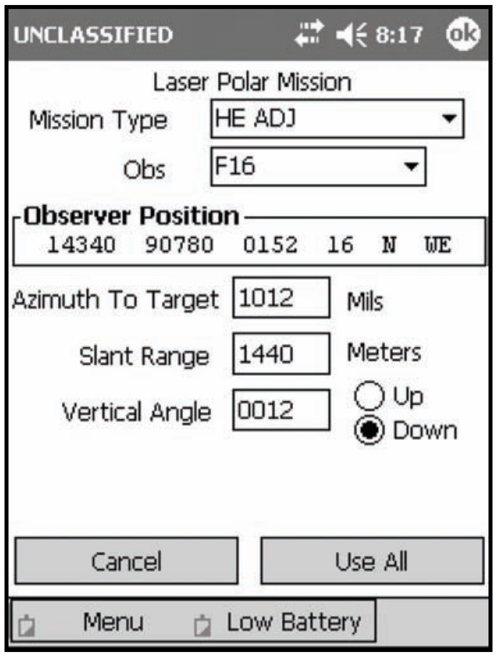


Figure 18-12. Laser Polar Mission screen.

QUICK FIRE MISSIONS

18-5. The quick fire mission is used to fire a previously engaged target. After recording the CFF on DA Form 2399-R—

(1) Select Menu.

(2) Select Manual Missions.

(3) Select Quick Fire Msn.

(4) The Quick Fire Mission screen (Figure 18-13) displays.

(5) Set the mission type (HE FFE, ILL FFE, SUPPRESS, IM SMOKE, or FPF).

(6) Select the target to be fired from the pull-down menu.

(7) 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.

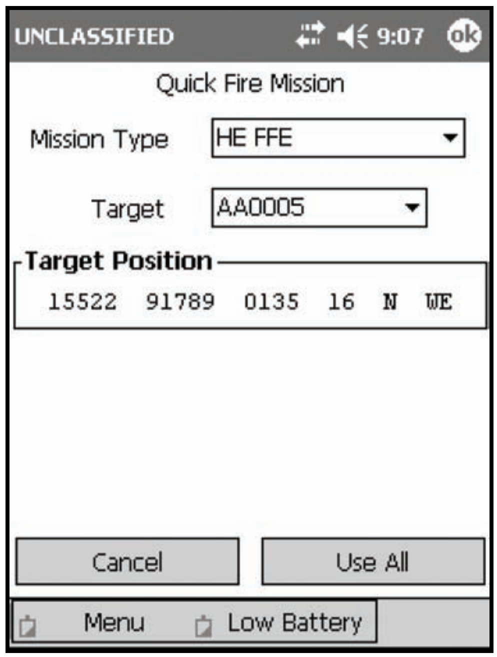


Figure 18-13. Quick Fire Mission screen.

DIRECT LAY MISSIONS

18-6. The direct lay mission generates the proper charge, elevation, fuze setting, and time of flight (TOF) to engage a target at a designated range. In the direct lay method, the gunner sees the target through the mortar sight. No directional posts, aiming posts, FOs, or FDCs are used. The LHMBC includes the direct lay mission as an automated firing table/ballistic calculator. To fire a direct lay mission—

(1) Select Menu.
(2) Select Manual Missions.
(3) Select Direct Lay.
(4) The Direct Lay Mission screen (Figure 18-14) displays.
(5) Enter the range to the target and the vertical interval (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.
(6) Enter the appropriate weapon type from the pull-down menu.
(7) Enter the proper charge from the pull-down menu.
(8) Enter the proper fuze from the pull-down menu.
(9) Select Calculate.
(10) The LHMBC displays the proper charge, elevation, fuze setting (when applicable), and TOF.
(11) Enter subsequent range corrections in the Adj field.
(12) If the target's estimated range has increased, select Add; if it has decreased, select Drop.

18-7. Figure 18-14 shows the Direct Lay Mission screen before and after the Calculate button has been selected. Figure 18-15 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 Fire without a Fire Direction Center in FM 3-22.90.

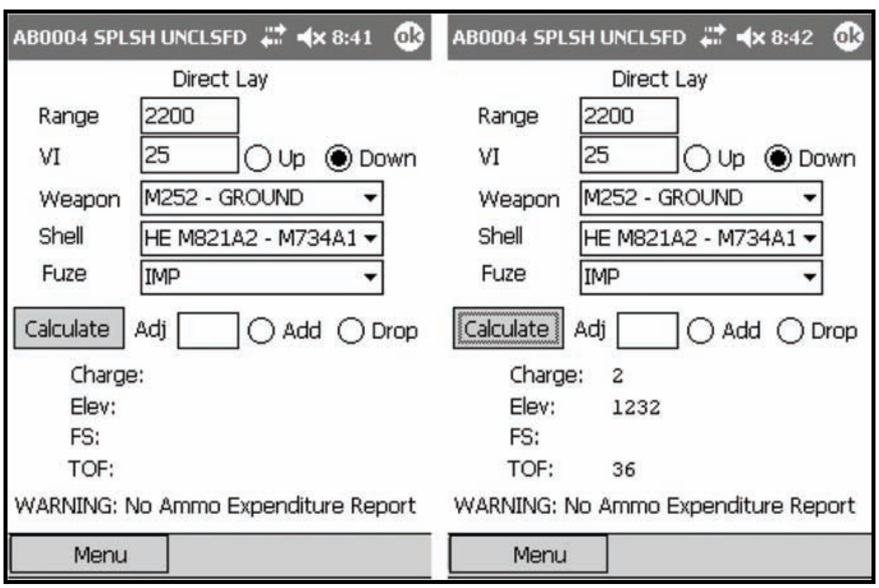


Figure 18-14. Direct Lay Mission screen.

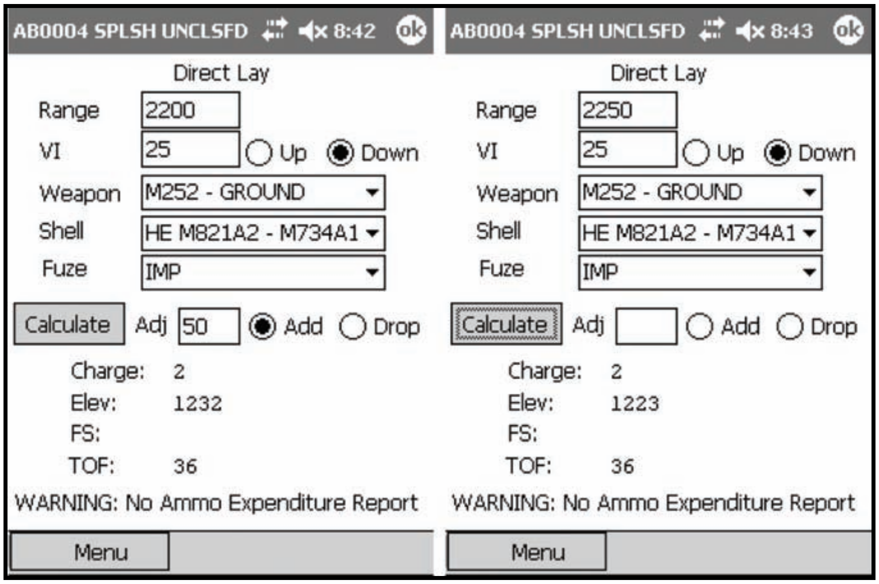


Figure 18-15. Direct Lay: first adjustment.

HIPSHOOT MISSIONS

18-8. Hipshoot missions provide a means to obtain firing data when the firing unit is on the move. When firing a hipshoot mission, the only setup information required prior to entering the mission is the geographical reference.

18-9. After recording the CFF on DA Form 2399-R—

(1) Select Menu.

(2) Select Manual Missions.

(3) Select Hipshoot.

(4) The Hipshoot Mission screen (Figure 18-16) displays.

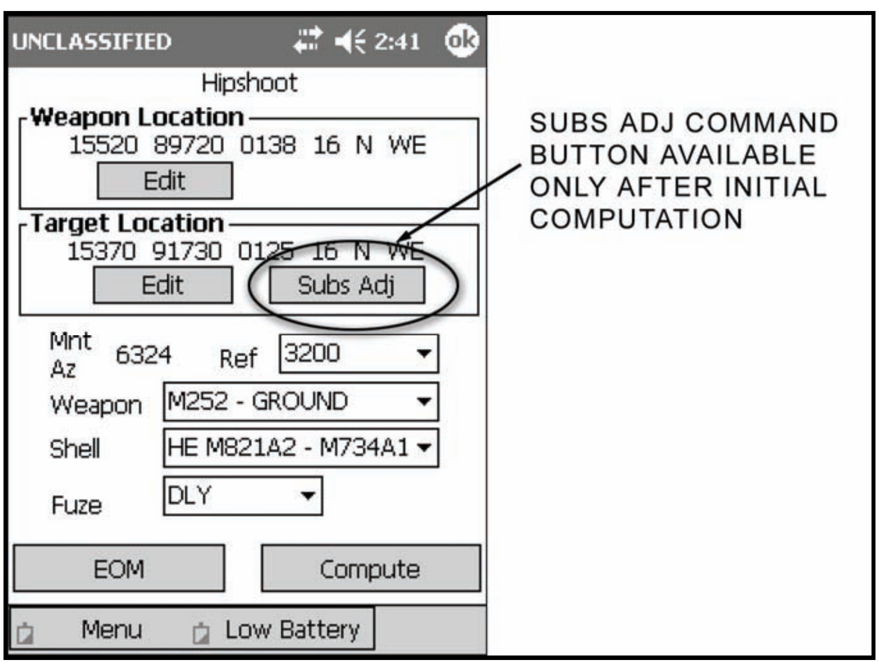


Figure 18-16. Hipshoot Mission screen.

(5) Enter your location, the target location, and the proper weapon, shell, and fuze type.

(6) Select a referred deflection from the quick-fill values (0700, 2800, or 3200), or enter a value between 0000 and 6399 manually.

(7) Select a fuze. The available fuze options will correspond to the shell and fuze selected. For example, the M734A1 multi-option fuze may be set to Delay (DLY), Impact (IMP), or Proximity (PRX).

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.

---

(8) Select Compute to process the mission.

(9) The Hipshoot Solution screen (Figure 18-17) displays. All solution and safety data for the hipshoot mission is displayed on the Hipshoot Solution screen.

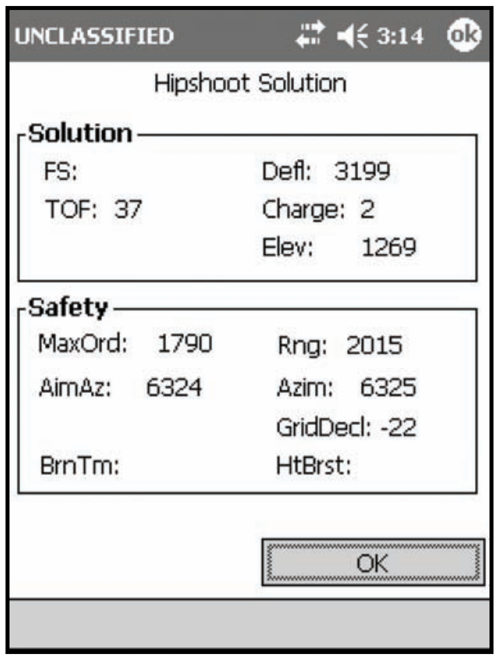


Figure 18-17. Hipshoot Solution screen.

(10) Select OK.

(11) The Hipshoot Mission screen displays.

18-10. To process observer corrections on the Hipshoot Mission screen—

(1) Select Subs Adjust in the Target Location field.

(2) The Hipshoot Subsequent Adjust screen (Figure 18-18) displays.

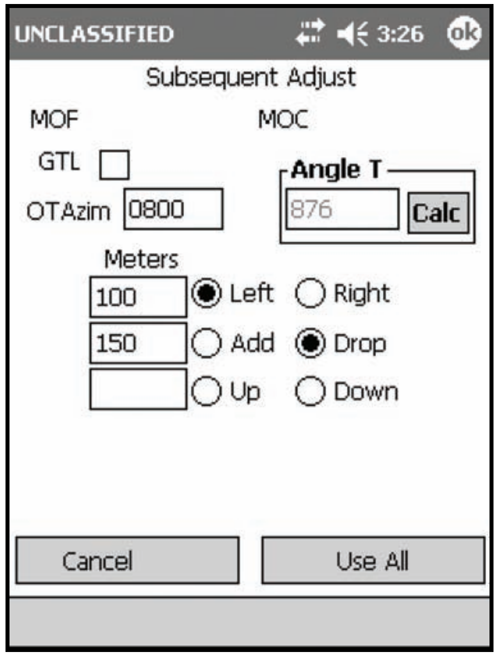


Figure 18-18. Hipshoot: Subsequent Adjustment screen.

NOTE: This screen is identical to the Subsequent Adjust screen used for grid missions, except the <Target> control button has been replaced with the Cancel button. Select Cancel to return to the Hipshoot Mission screen without processing data.

---

(3) Make the appropriate adjustments.

(4) Process the adjustments by selecting Use All.

(5) The Hipshoot Solution screen displays.

18-11. After EOM has been announced by the FO—

(1) Select EOM from the Hipshoot screen.

(2) The Hipshoot EOM screen (Figure 18-19) displays.

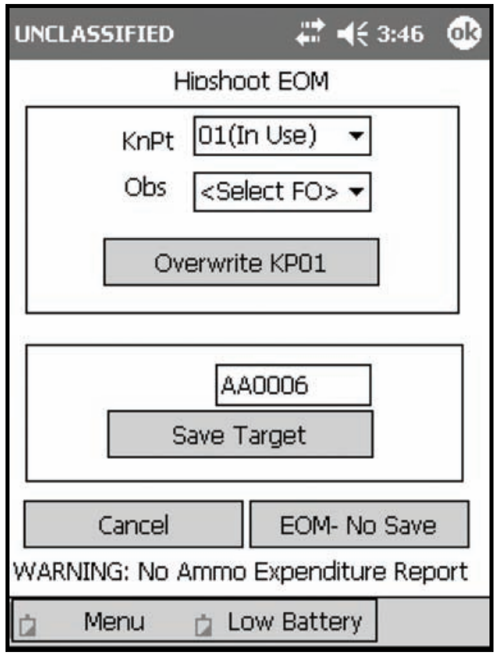


Figure 18-19. Hipshoot End of Mission screen.

(3) 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 recorded in the Obs field.

TARGETS/KNOWN POINTS

18-12. The LHMBC provides the means to view, add, edit, and delete targets and known points. There are 99 available slots for a combination of targets and known points. When a known point is entered with a target number, the target also appears on the Targets screen. To view the Targets screen—

(26) Select Menu.

(27) Select Points.

(28) Select Targets.

(29) The Targets screen displays (Figure 18-20).

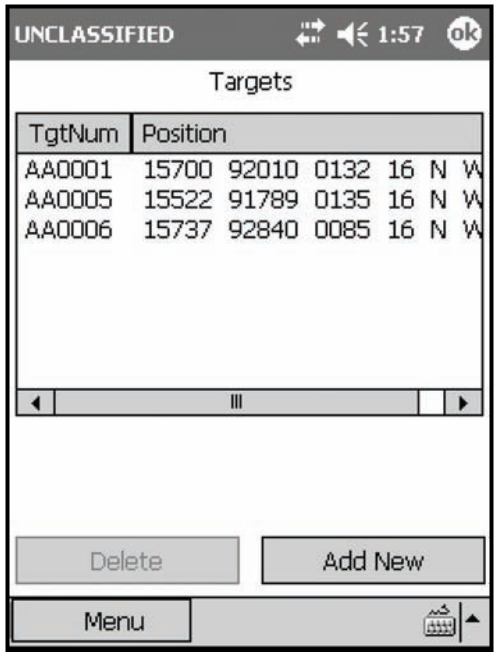


Figure 18-20. Targets screen.

SECTION II. DIGITAL FIRE MISSIONS

Like manual missions, digital missions generally 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 he records the method of target location on DA Form 2399-R.

RECEIPT OF THE MESSAGE

18-13. 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 Menu button (Figure 18-21).

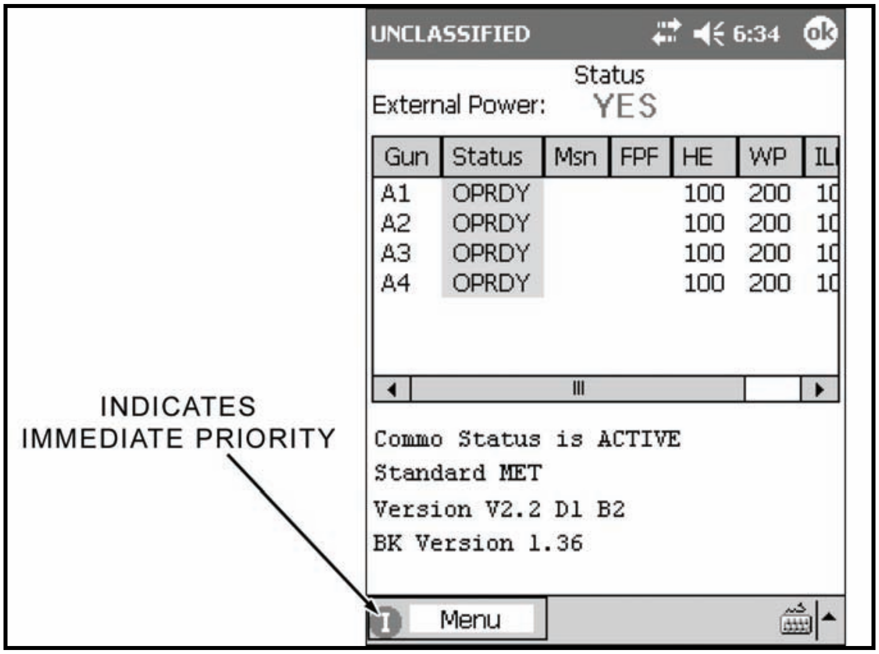


Figure 18-21. Mission priority icon displayed on the Menu button.

18-14. To follow the priority message icons through the menu—

(1) Select Menu.

(2) Select Call For Fire (Figure 18-22).

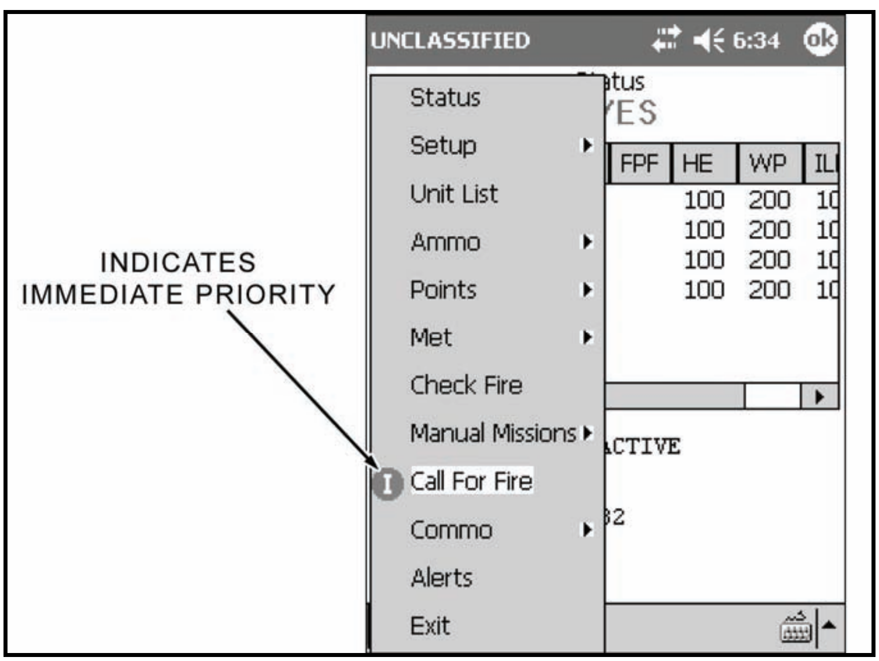


Figure 18-22. Call for fire menu selection.

(3) The New Call For Fire screen (Figure 18-23) displays. The New Call For Fire screen is comprised of four control buttons (Table 18-8), the Message window and its seven fields (Table 18-9), and the Message Log window.

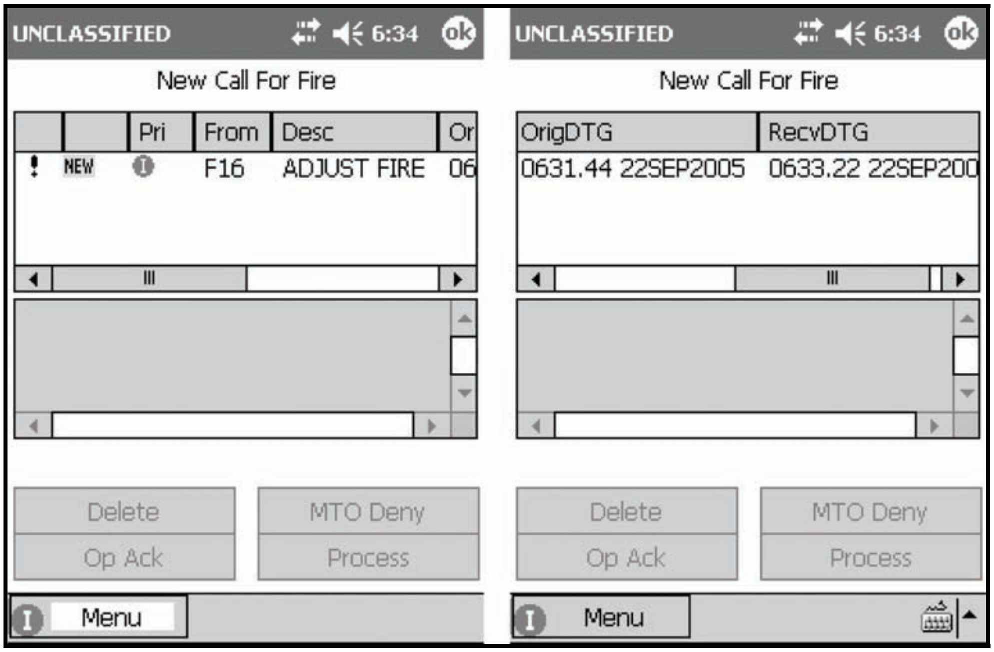


Figure 18-23. Digital Fire Mission: New Call For Fire screen.

Table 18-8. 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.
Operator 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 18-9. Digital Fire Mission: Message box fields and purposes.

FIELD	PURPOSE
Unlabelled	This field serves as a message indicator.
Unlabelled	This field serves as a message status.
Pri	This field lists the priority of the message received. The priorities are (in order of precedence)— • Flash Priority (F). • Immediate Priority (I). • Priority Priority (P). • Routine Priority (R).
From	This field identifies the sending unit.
Desc	This field identifies the type of mission.
OrigDTG	This field notes the date and time group of the sending unit's transmission.
RecvDTG	This field notes the date and time group of the receiving unit upon receipt.

(4) Select a message from the Message window to view the message.
(5) The message displays in the Message Log window.
(6) If the mission is acceptable, record this information on DA Form 2399-R.
(7) Select OpAck.

NOTE: An exclamation point displays next to the mission (Figure 18-23) until it is acknowledged by selecting OpAck. This action also disables the audio alarm if the alarm is set to ON.

(8) Select Process.

NOTE: The  icon displays to the left of the message until it has been processed (Figure 18-23).

(9) The Mission Data screen (Figure 18-24) displays.

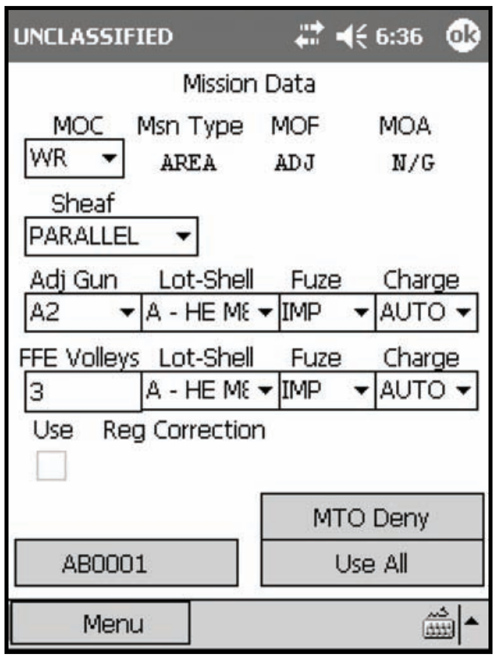


Figure 18-24. Digital Fire Mission: Mission Data screen.

(10) Review the Mission Data screen to ensure that all of the information is correct.

NOTE: Use the MTO Deny control button to send an MTO if the mission cannot be fired.

(11) If the data is correct, select Use All.
(12) The Solution/Gun Orders screen (Figure 18-25) displays.

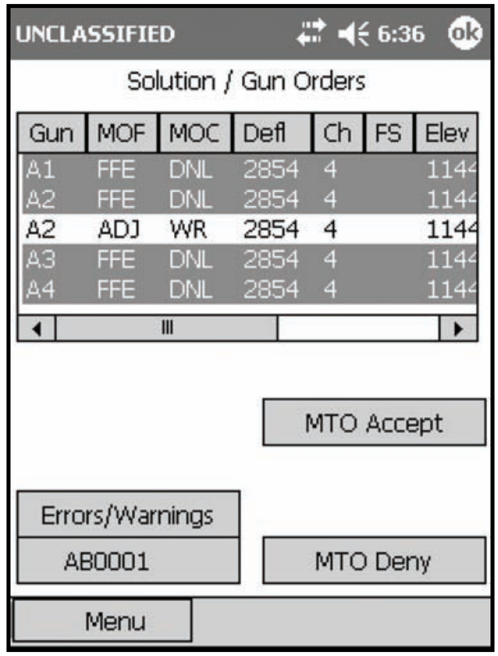


Figure 18-25. Digital Fire Mission: Solution/Gun Orders screen.

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.

---

(13) If there are no Errors or Warnings, record the gun and safety data on DA Form 2399-R.

(14) Select MTO Accept.

(15) The Send Status screen (Figure 18-26) displays.

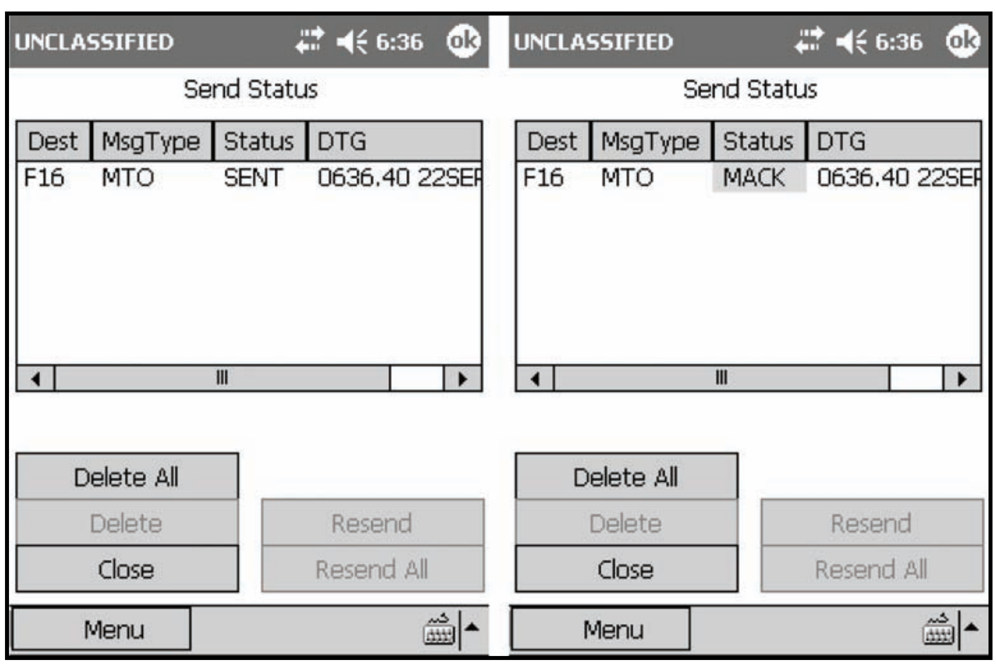


Figure 18-26. Digital Fire Mission: Message Send Status screens.

(16) Review the information in the four fields displayed in the Message window (Table 18-10).

Table 18-10. Digital Fire Mission: Send Status screen Message window fields and purposes.

FIELD	PURPOSE
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. • PTM. • FUC (Fire Unit Center). • AMMO – INV. • OBS 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 (Figure 18-26). • MACK (Machine Acknowledgement) – The message has been received and read (Figure 18-26). • RETRY – The message is being resent. The 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.

(17) Select Close.

(18) The Solution/Gun Orders screen displays.

(19) Select the <Target> button.

(20) The <Target> screen (Figure 18-27) displays.

NOTE: When operating in the digital mode, the <Target> screen displays two additional control buttons, Msn Status and Msn Messages (Figure 18-27).

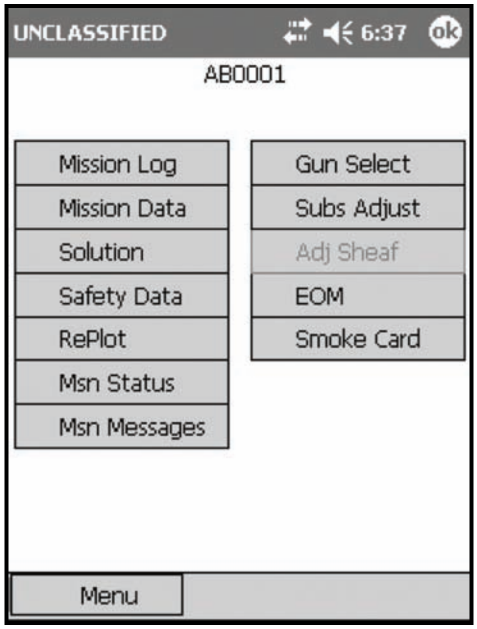


Figure 18-27. Digital Fire Mission: <Target> screen.

(21) Select the Msn Status button.

(22) The Mission Status screen (Figure 18-28) displays. The Mission Status screen is only available for digital messaging. This screen contains a Status window and five control buttons (Table 18-11).

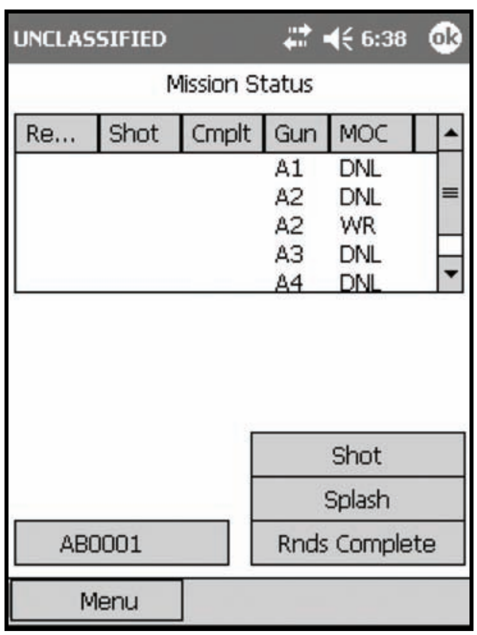


Figure 18-28. Digital Fire Mission: Mission Status screen.

Table 18-11. Digital Fire Mission: Mission Status screen fields and 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 MOC is AMC, or after Shot or Rounds Complete has been transmitted. • Shot – This field displays a green checkmark when the Shot has been transmitted. • Cmplt – This field displays a green checkmark when Rounds Complete has been sent. • Method of Control – This field displays the MOC for each solution calculated.
Shot button	When selected, this button sends a message to the 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 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.
<Target> button	This button displays the <Target> screen.

(23) After sending a message to the FO by selecting one of the mission status buttons, select OK in the call box that displays.

(24) The Send Status screen displays.

(25) The Send Status screen now displays the message and its current status.

(26) Select the Close control button.

(27) The Mission Status screen displays.

NOTE: The Ready and Shot fields both display a green checkmark for the guns used during this shot.

---

(28) Select the <Target> button.

(29) The <Target> screen displays.

(30) Select the Msn Messages button to await the first/next adjustment.

(31) The Mission Messages screen (Figure 18-29) displays.

NOTE: The Mission Messages screen will display the ! and NEW icons in the same manner as the New Call For Fire screen (Figure 18-23). The two screens are essentially the same, except that the MTO Deny button of the New Call For Fire screen has been replaced with the <Target> command button to return to the <Target> screen.

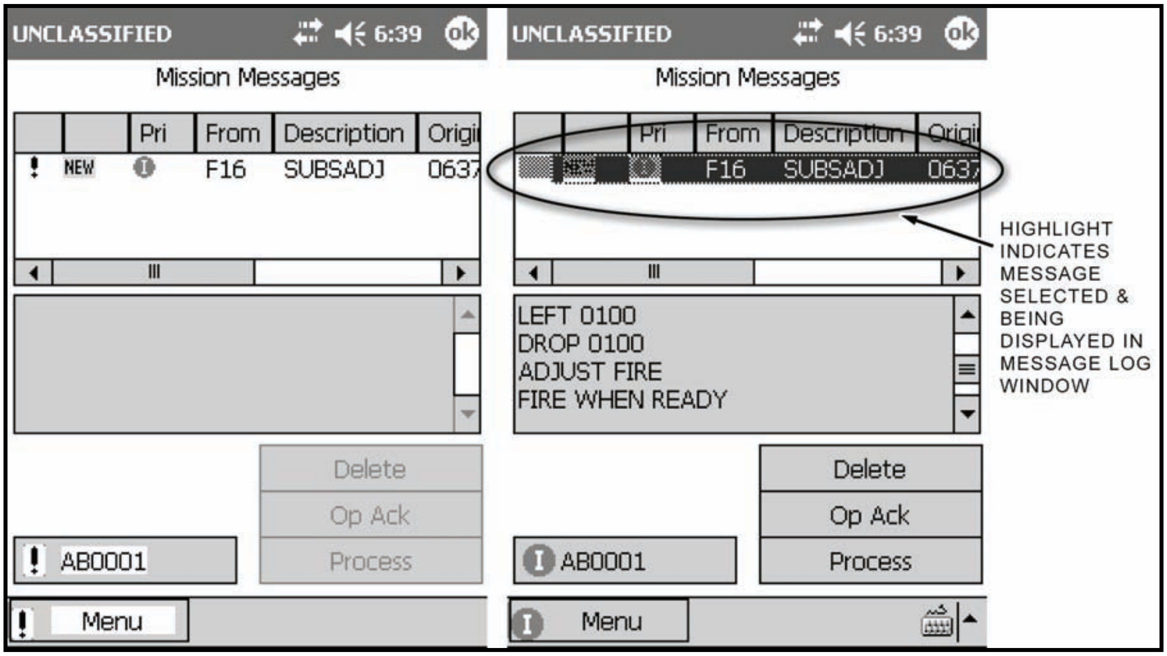


Figure 18-29. Digital Fire Mission: Mission Messages screens.

(32) Review and record this information as described for the New Call For Fire screen.
(33) Select Process.
(34) The Solution/Gun Orders screen (Figure 18-30) displays.

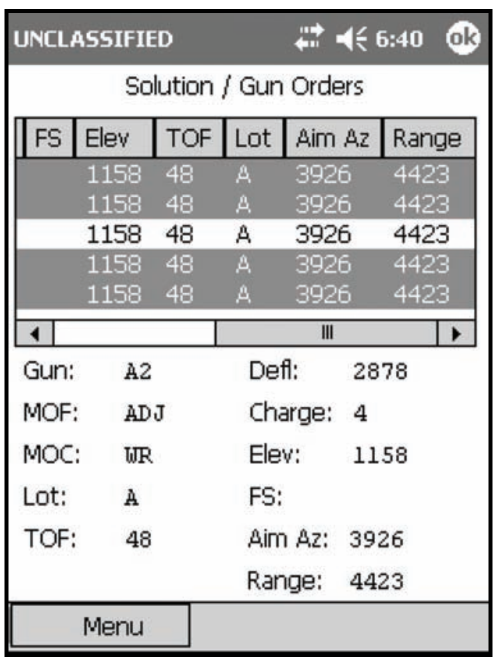


Figure 18-30. Digital Fire Mission: first adjustment.

(35) Record all information from the Solution/Gun Orders screen on DA Form 2399-R.
(36) Select the <Target> control button.
(37) The Target screen displays.
(38) Select Msn Status.

(39) Select Shot to transmit the shot to the FO.
(40) Select OK when the shot confirmation call box appears.
(41) The Send Status screen displays.
(42) Confirm the information displayed.
(43) Select the Close control button.
(44) Continue to process the mission as described in the steps above.
(45) When the FO transmits the final adjustment (Figure 18-31) and requests an FFE, review and record the message.
(46) Select Process.

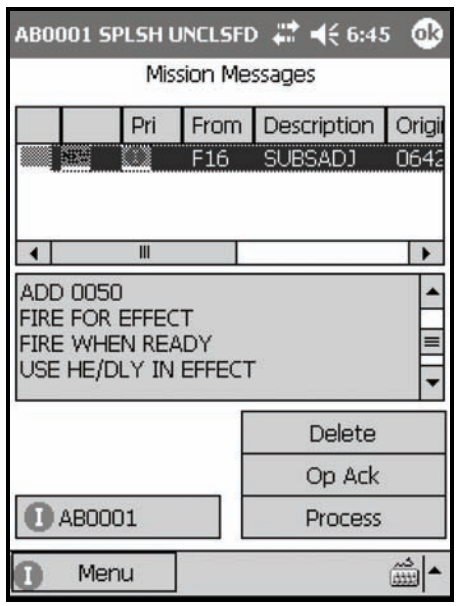


Figure 18-31. Digital Fire Mission: final adjustment.

(47) The Solution/Gun Orders screen (Figure 18-32) displays.

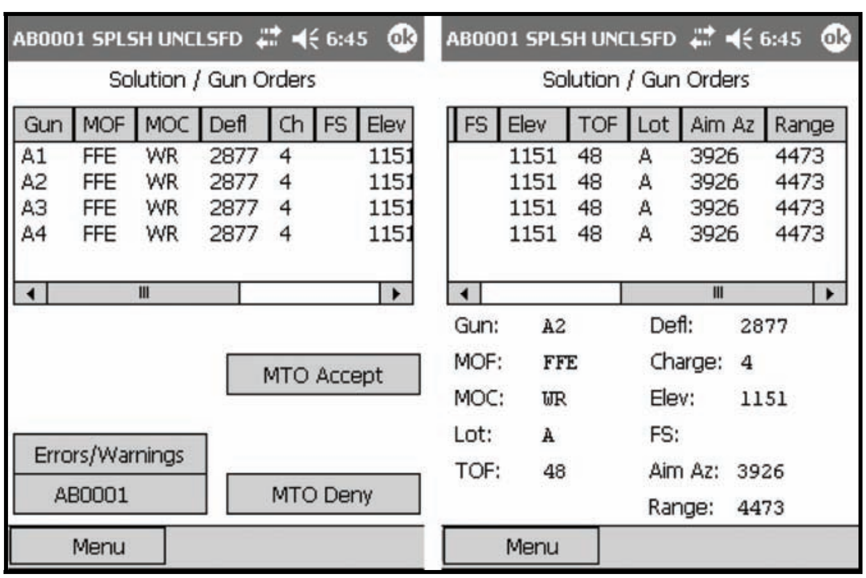


Figure 18-32. Digital Fire Mission: Fire for Effect Solution screen.

NOTE: When the MOF is FFE, the LHMBC displays data for each gun. In Figure 18-32, the sheaf is parallel so all solutions are the same. In all other instances, each gun will have unique data.

(48) Review and record the data.
(49) Select MTO Accept.
(50) Select the <Target> control button.
(51) The <Target> screen displays.
(52) Select the Msn Status button.
(53) Select Shot.
(54) When the call box displays, select OK to notify the observer that the first round has been fired.
(55) The Send Status screen displays.

NOTE: The message and its current status are listed.

(56) Navigate to the Mission Status screen.
(57) When the last round has been fired, select Rnds Complete (Figure 18-33).

Figure 18-33. Digital Fire Mission: selecting Rnds Complete.

(58) Select the <Target> control button.
(59) The <Target> screen displays.
(60) Select the Msn Message button.
(61) The Msn Message screen (Figure 18-34) displays. The screen shot on the left depicts the mission message before it is acknowledged. The screen shot on the right depicts the mission message after it is acknowledged.

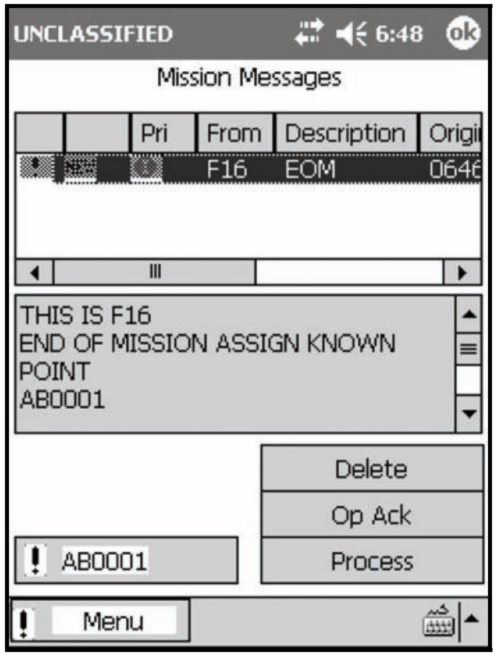


Figure 18-34. Digital Fire Mission: end of mission message.

(62) Await the next message.
(63) Select the message to review it.
(64) Select OpAck to acknowledge receipt of the message and turn off the audio alarm.
(65) Select the message again.
(66) Select Process.
(67) The Select Known Point Number screen displays (Figure 18-35).

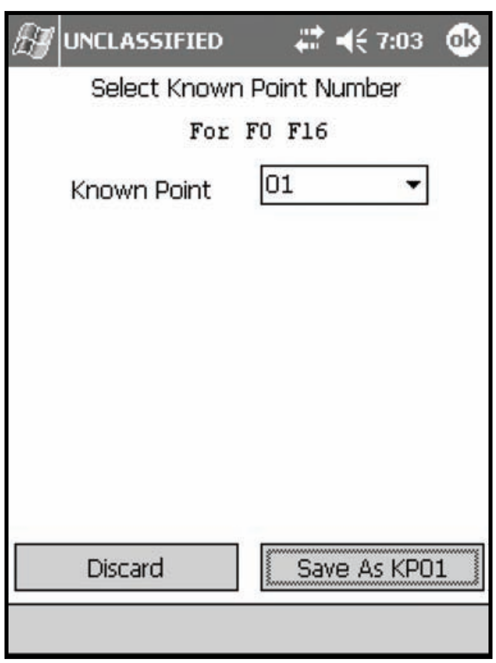


Figure 18-35. Digital Fire Mission: Select Known Point Number screen.

(68) From the pull-down menu, select a known point to save (Save as KP [number of known point]) or discard (Discard). 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.

---

(69) The Ammunition Expended screen displays. The Ammunition Expended screen enables 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 a number of rounds used of each lot (by alpha number).

---

(70) 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.

---

(71) Select Use All. The ammunition inventory will be updated accordingly.
(72) The Status screen displays.
(73) Update DA Form 2188-R using the information listed on DA Form 2399-R. Verify that the ammunition amounts are correct and that the proper target numbers have been assigned.

SECTION III. SPECIAL MISSIONS

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.

REGISTRATION MISSIONS

18-15. 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 grid mission until the FFE stage.

NOTES: 1. For a complete overview of registration, see Chapter 14.

2. This chapter illustrates an LHMBC manual registration mission.

---

(1) Select Menu.
(2) Select Manual Missions.
(3) Select Grid Msn. The Grid Mission screen (Figure 18-36) displays.

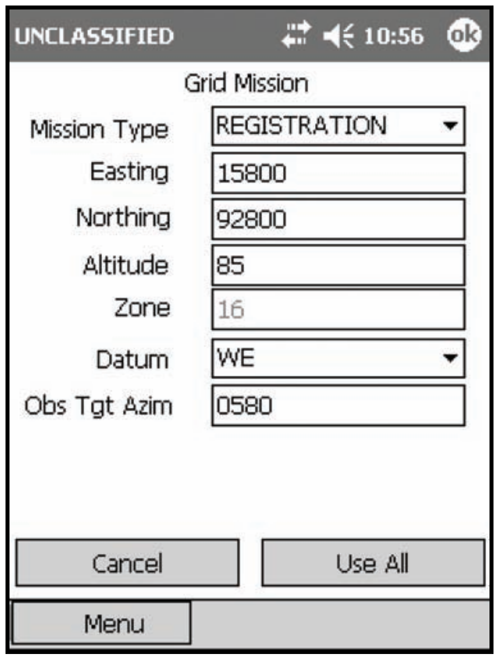


Figure 18-36. Registration: Mission Initialization screen.

(4) Change Mission Type from HE ADJ to REGISTRATION.
(5) Select Use All.
(6) The Mission Data screen displays.
(7) Verify that the Mission Data information is correct.
(8) If the mortar section is not set up in a linear formation, change Sheaf from PARALLEL to LINEAR.
(9) Select Use All.

(10) The Solution/Gun Orders screen (Figure 18-37) displays.

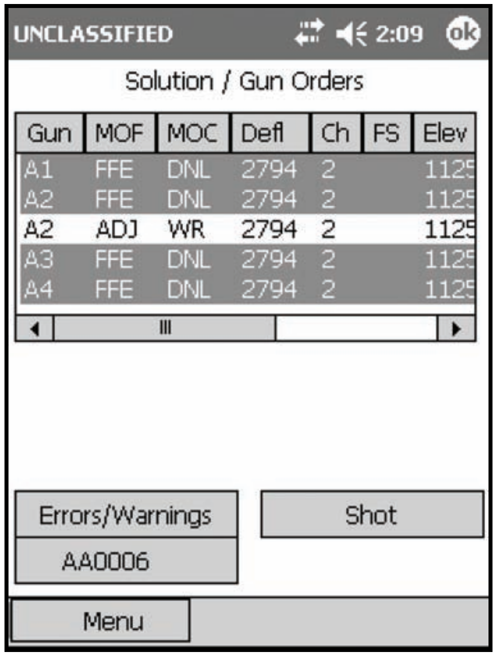


Figure 18-37. Registration: Solution/Gun Orders screen.

(11) Select Shot.
(12) 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.

---

(13) Select the <Target> button (AA0006 in the example).
(14) The <Target> screen displays.
(15) Enter corrections by selecting Subs Adjust.
(16) The Subsequent Adjust screen displays.
(17) Make the appropriate adjustments using the Left, Right, Add, Drop, Up, and Down buttons in the Meters field.
(18) Select Use All.
(19) The Solution/Gun Order screen displays.
(20) Continue adjusting in this manner until the adjusting gun is adjusted.
(21) When the adjusting gun is adjusted, change the MOF field to FFE.
(22) Select Use All.
(23) The Solution/Gun Order screen displays.
(24) Record the Solution/Gun Orders Data.

NOTES: 1. If corrections exceed 50 meters (deviation left or right only), the mortar must be refired.

2. Range corrections are ignored if they are less than 50 meters.

---

(25) Enter the appropriate information in the proper fields on DA Form 2399-R.

EXAMPLE

FO Call: Left 100 (Figure 18-38).

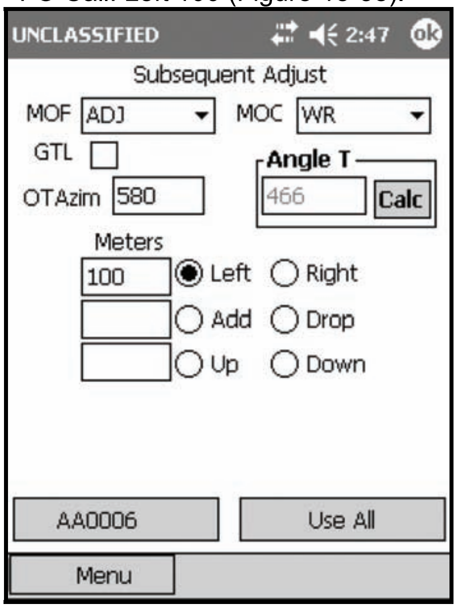


Figure 18-38. Registration: first subsequent adjustment.

FO Call: Right 50 (Figure 18-39).

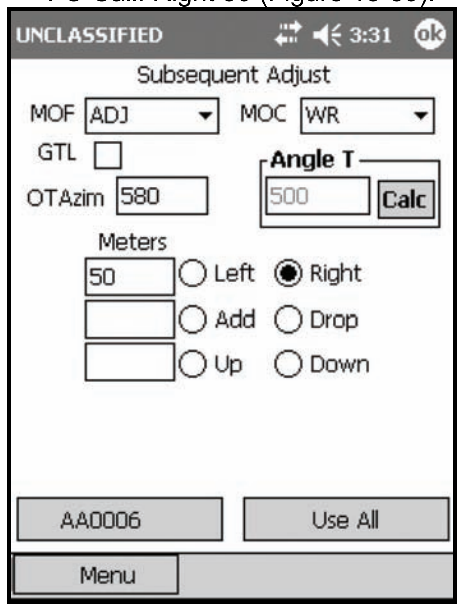


Figure 18-39. Registration: second subsequent adjustment.

FO Call: Left 25. Registration complete.

To enter the fire for effect stage, MOF must be changed to FFE. As an example—

(1) From the Subs Adjust screen, change MOF to FFE and input Add 25.

(2) Select Use All.

(3) The Solution/Gun Order screen displays (Figure 18-40).

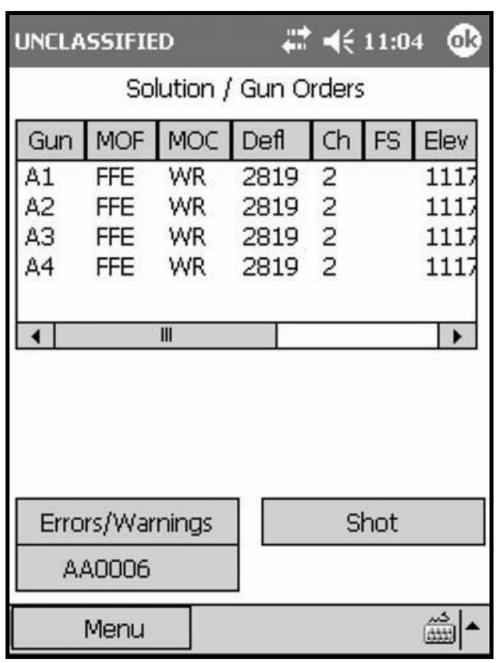


Figure 18-40. Registration: Fire For Effect Solution screen.

(4) Record the Solution/Gun Orders data.

NOTE: A2's last deviation correction was "left 25." This gun will not fire when the sheaf is adjusted.

(5) In the Mortar to Fire and Method of Fire columns of DA Form 2399-R, enter SEC S/R 1RD #2 DNF (Section – Section Right, 1 Rd, #2 Gun Do Not Fire).

NOTE: The sheaf must now be adjusted to ensure that the mortars are firing parallel to each other. The FDC coordinates with the FO to determine the method of fire. If the FO requests, for example, section right, the mortars will fire the sheaf, starting from the right (#1 Gun), with a set interval (normally 5 seconds) between the rounds. If the angle T is greater than 499 mils, the sheaf is converged, and the mortars are adjusted onto the RP.

(26) Select the <Target> button.
(27) The <Target> screen displays.
(28) Select Adj Sheaf.
(29) The Adjust Sheaf screen (Figure 18-41) displays.

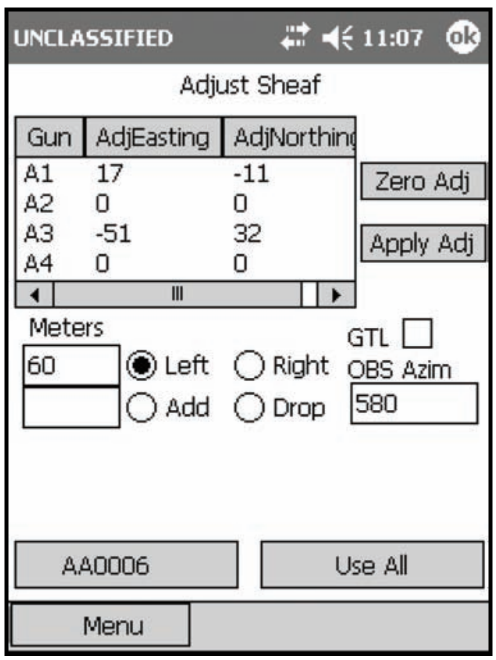


Figure 18-41. Registration: Adjust Sheaf screen.

(30) Enter the corrections for each gun, as described in the <Target> screen summary (see paragraph 18-13).
(31) Select Use All.
(32) The Mission Data screen displays.
(33) Verify the information, and select Use All.

NOTE: A warning (Figure 18-42) displays if the calculated impact point of the guns does not conform to the requirements of a linear sheaf. This message is normal.

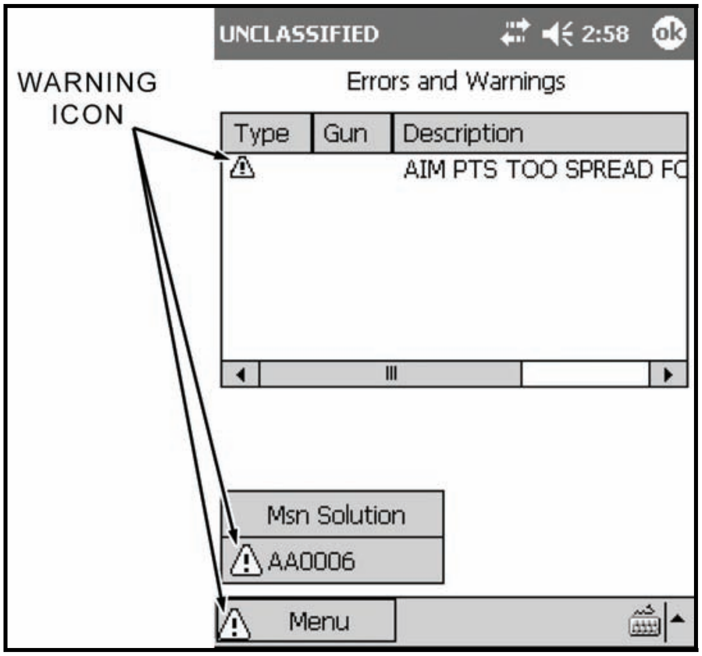


Figure 18-42. Registration: Error and Warnings screen.

(34) Select Msn Solution.
(35) The Solution/Gun Orders screen displays, and the firing data is recorded.
(36) Announce new data, such as deflections and methods of fire.
(37) If the adjustment is more than 50 meters, the mortar must be refired.
(38) Select Shot.
(39) Select the <Target> button.
(40) The <Target> screen displays.
(41) Select EOM.
(42) Select Discard, or if the RP is to be recorded as a known point, select EOM – Record as Known Point.
(43) Select the controlling FO from the pull-down menu.
(44) Select Use All.

(45) The Save Registration Point screen (Figure 18-43) displays. This screen displays the range correction factor (RngCF) and the azimuth correction factor (AzCF).

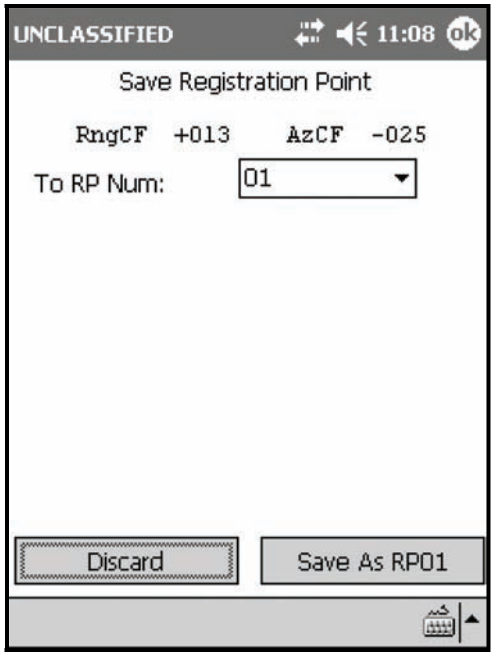


Figure 18-43. Registration: Save Registration Point screen.

(46) Record this information on DA Form 2399-R.
(47) Select Save As RP01.
(48) The Ammunition Expended screen displays.
(49) Ensure that the number of rounds expended for each gun is correct.
(50) Select Use All.
(51) The Status screen displays.
(52) Update DA Form 2188-1-R accordingly.

ILLUMINATION MISSIONS

18-16. 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, and is discussed in detail in the example.

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.

18-17. Upon receipt of a CFF, record the information and initiate the illumination mission using the following procedures:

(1) Select Menu.
(2) Select Manual Missions.
(3) Select Grid Msn.

(4) The Grid Mission screen (Figure 18-44) displays.

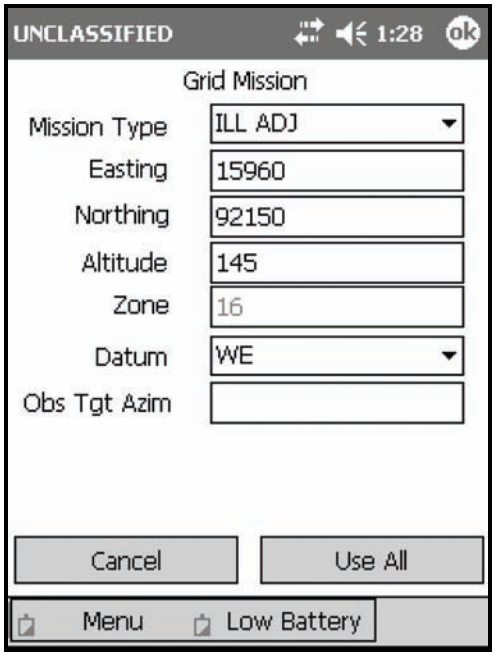


Figure 18-44. Illumination: Mission Initialization screen.

(5) Fill out this screen as described in paragraph 18-2. The mission type will be Ill Adj.
(6) Select Use All.
(7) The Mission Data screen is displayed.
(8) Set the Sheaf field to the number of guns firing the illumination mission.

NOTE: The guns selected must match this number.

---

(9) Select Use All.
(10) The Solution/Gun Orders screen displays.
(11) Select the <Target> button.
(12) The <Target> screen displays.
(13) Select the Gun Select button.
(14) The Gun Select screen displays.
(15) Deselect guns A2, A3, and A4 by clearing the appropriate checkboxes.
(16) Select Use All.

(17) The Mission Data screen displays (Figure 18-45).

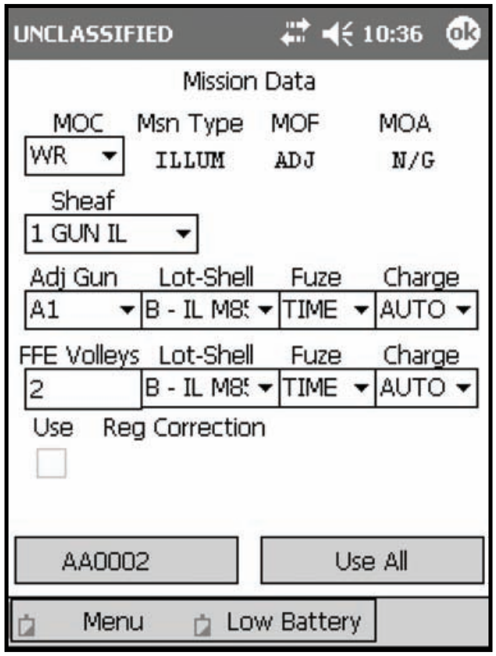


Figure 18-45. Illumination: Targets screen.

(18) Choose the adjusting gun.

NOTE: 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.

---

(19) Choose a type of sheaf.

NOTE: In addition to all of the normal sheaves available for HE, illumination makes use of 5 additional sheaves: 1 GUN Il, 2 GUN Il, 2 GUN L, 2 GUN R, and 4 GUN Il. The differences in sheaves are indicated in Table 18-12.

Table 18-12. Illumination: additional sheaves and related information.

BUTTON	RELATED INFORMATION
1 GUN II	This type of sheaf utilizes one gun firing illumination rounds.
2 GUN II	This type of sheaf utilizes two mortars to provide greater illumination for a point or area target. The 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 with the resulting calculated burst points centered around the target location, perpendicular to the gun-target line. See Table 18-13 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 18-13 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.

Table 18-13. Illumination: two-gun range and lateral spread distances.

GUN SYSTEM	ROUND	FUZE	DISTANCE BETWEEN BURST POINTS (METERS)
M224 60-mm	ILL M721	MTSQ M776	800
M224 60-mm	ILL M83A3	TIME M65A1	300
M224 60-mm	IR XM767	MTSQ M776	500
M252 81-mm	ILL M301A3	TIME M84A1	500
M252 81-mm	ILL M853A1	MTSQ M772	500
M252 81-mm	IR XM816	MTSQ M772	500
M303 81-mm	ILL M301A3	TIME M772	500
M120 120-mm	ILL M930	MTSQ	1500
M120 120-mm	IR M983	MTSQ	1500

EXAMPLE

Change Sheaf to 1 GUN IL, and select A1 as the adjusting gun. Change Lot-Shell to illumination. 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.

(20) Select Use All.

(21) The Solution/Gun Orders screen is displayed.

(22) Read and record the data on DA Form 2399-R.

NOTES:

1. Do not read the fuze setting from the data window. When displayed in the Gun Solution data line, only the integer part of the fuze setting is listed. Select the A1 ADJ data line, and drag the stylus to the bottom of the screen to read the proper fuze setting. Select the fuze setting again before performing the next step. (See Figure 18-46)

2. The Solution/Gun Orders screen is read and recorded for illumination the same as with a standard HE mission.

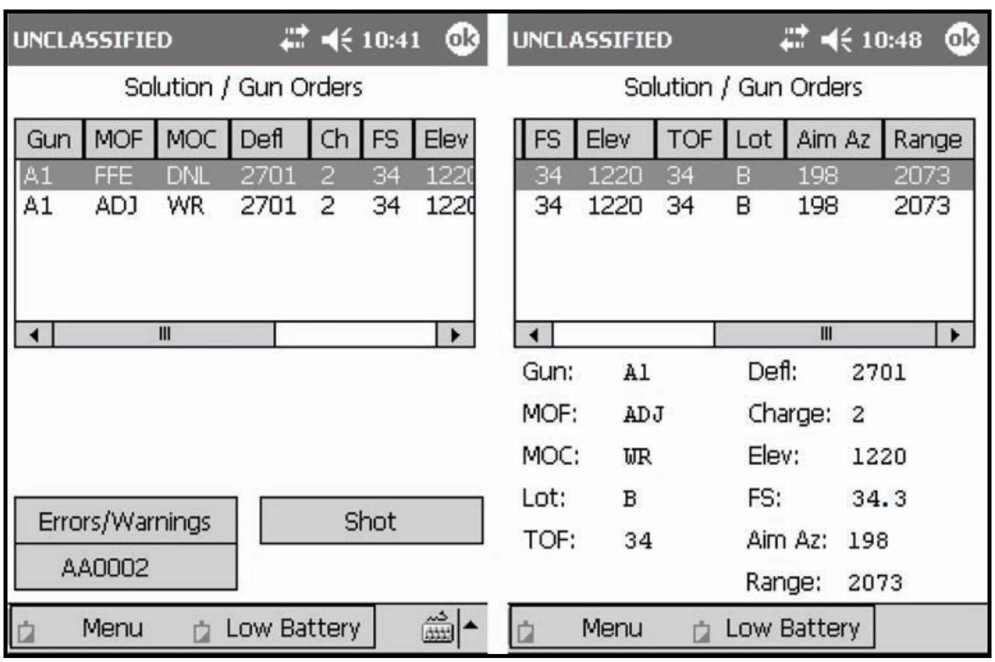


Figure 18-46. Illumination: solution and display of fuze setting.

(23) Select Shot to start the clock and, if operating digitally, to notify the FO that the adjusting gun has fired.

(24) To record the canister impact grid, navigate to the Safety Data screen (Figure 18-47).

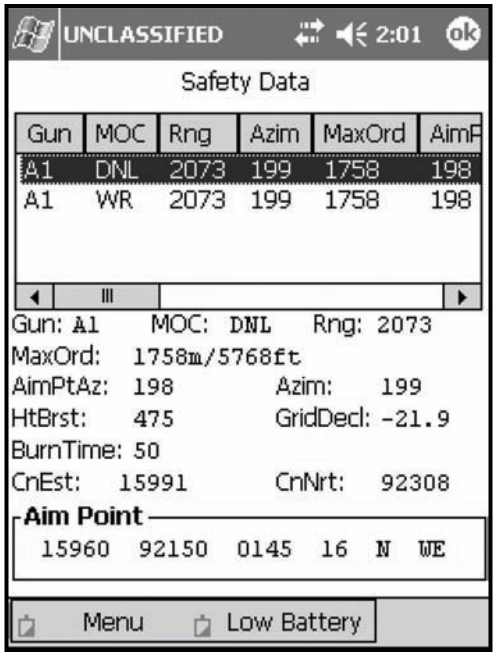


Figure 18-47. Illumination: Safety Data screen.

(25) 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.

---

(26) Navigate to the Subsequent Adjust screen to await the first adjustment.

(27) Process illumination subsequent adjustments in the same manner as HE adjustments with the addition of the up/down adjustments.

(28) 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. (Figure 18-48)

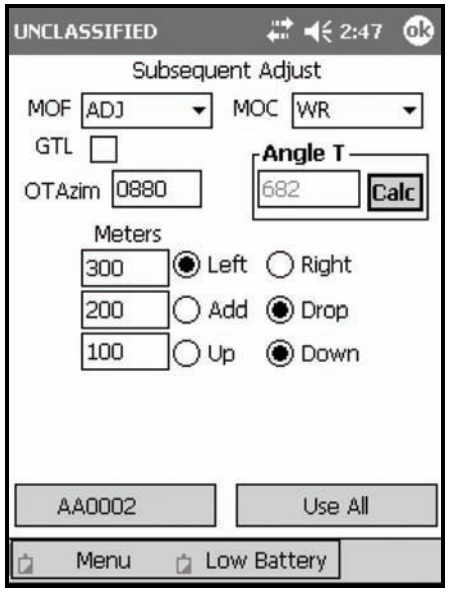


Figure 18-48. Illumination: first subsequent adjustment.

EXAMPLE

FO Call: Up 50. Prepare to mark illumination. (Figure 18-49)

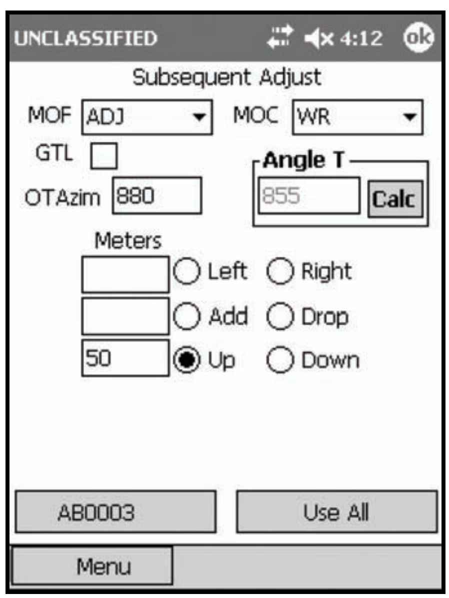


Figure 18-49. Illumination: second subsequent adjustment.

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 illumination 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-R, along with the FFE data (Figure 18-50). This computer record will continue to be used to record illumination rounds fired during firing the coordinated illumination. A separate DA Form 2399-R will be initiated for HE/WP.

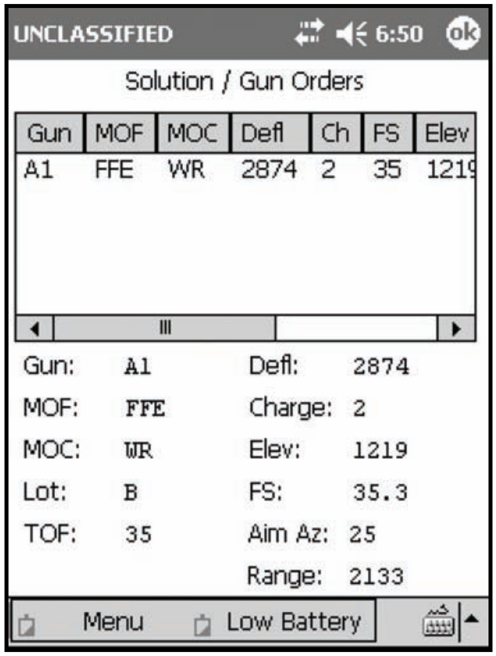


Figure 18-50. One-gun Illumination Fire For Effect Solution screen.

COORDINATED ILLUMINATION MISSIONS

18-18. Illumination missions are often coordinated with other suppressive fires. The illumination exposes possible targets, which are then engaged with HE. The FDC operator alternates between the illumination fire mission and the HE fire mission.

18-19. 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 adjustment begins. During the HE adjustment and FFE, the operator receives subsequent messages from the FO to fire illumination in coordination with the HE. He alternates between the illumination mission (<AA0002>, in the illumination mission example) and the HE mission (in the example, <AA0003>). After the illumination is adjusted, the method of command for both fires is changed from WR to AMC.

NOTE: The adjustment of the HE is identical to a standard fire mission.

EXAMPLE

To navigate to the illumination mission—

(1) Select Menu.
(2) Select Missions.
(3) Select FPFs.
(4) Select AA002.

- To navigate to the HE mission—

(1) Select Menu.
(2) Select Missions.
(3) Select FPFs.
(4) Select AA003.

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 in both the adjustment and in the FFE (Figure 18-51).

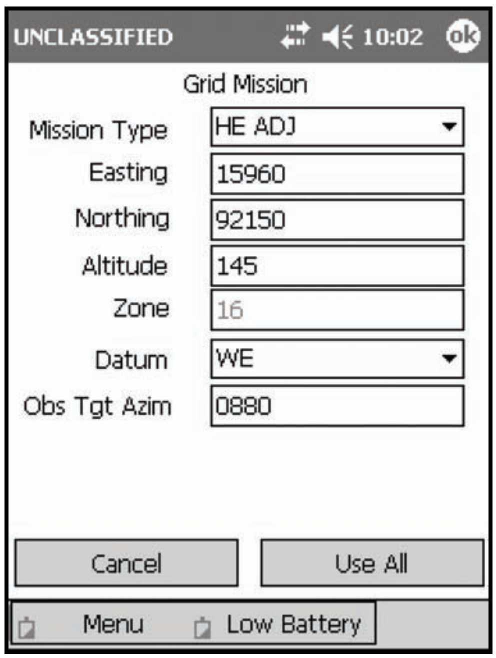


Figure 18-51. Coordinated Illumination: Mission Initialization screen.

18-20. To conduct a coordinated illumination mission—

(1) From the Grid Mission screen, verify all target location information, and select Use All.

(2) The Mission Data screen displays.

NOTE: Now that HE is being fired again, the Use Reg Correction box is enabled and selected (Figure 18-52).

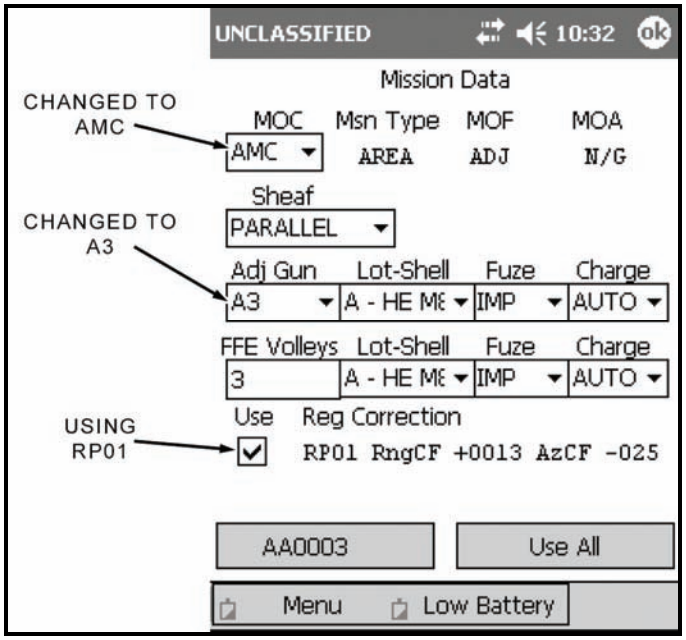


Figure 18-52. Coordinated Illumination: Mission Data screen.

(3) Confirm that all mission data is correct, and select Use All.

(4) The Solution/Gun Orders screen (Figure 18-53) displays.

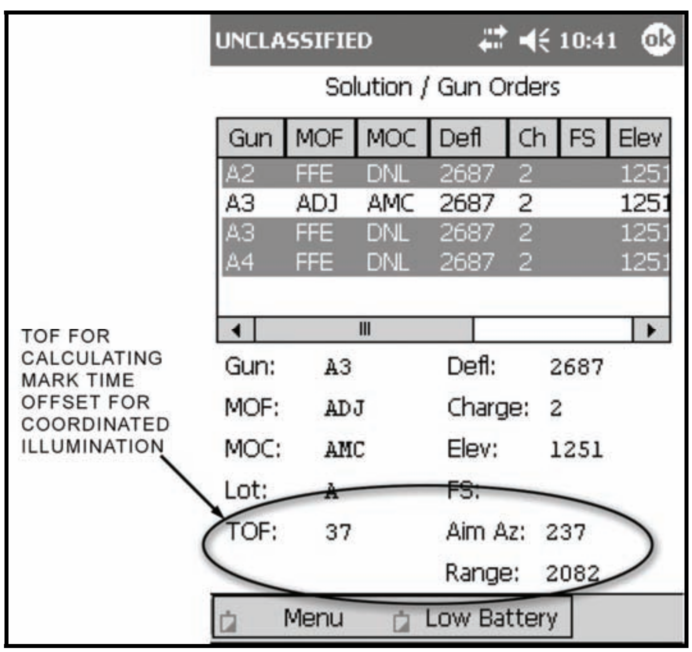


Figure 18-53. Coordinated Illumination: High-Explosive Solution screen.

(5) Calculate the firing times for the HE and WP. In the example, the mark time for the illumination mission is 52 seconds, and the TOF for the HE is 37 seconds. This means the delay between the firing of the illumination and the HE is 15 seconds (52 – 37 = 15). This way, the illumination will be at its optimum height when the HE impacts.

(6) Fifteen seconds after "Shot" is announced to the illumination gun, "Shot" will be given to the HE adjusting gun.

(7) Navigate to the illumination mission by—
- Selecting Menu.
- Selecting Missions.
- Selecting FPFs.
- Selecting the target number.
- Selecting Solution.

(8) Select Shot.

(9) Navigate to the HE mission by—
- Selecting Menu.
- Selecting Missions.
- Selecting FPFs.
- Selecting the target number.
- Selecting Solution.

(10) After the delay time has elapsed (15 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.

(11) 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 fire for effect and afterward so he can make his surveillance which will be reported back to the FDC.

(12) Record the FO's surveillance on DA Form 2399-R.

(13) End both missions, and update the ammunition expenditure as described in paragraph 18-2.

FINAL PROTECTIVE FIRES

18-21. 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.

18-22. To initiate the FPF—

(1) Select Menu.

(2) Select Manual Missions.

(3) Select Grid Msn.

(4) The Grid Mission screen is displays.

(5) Change the mission type to FPF (Figure 18-54).

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 from a known point missions are conducted in the same manner.

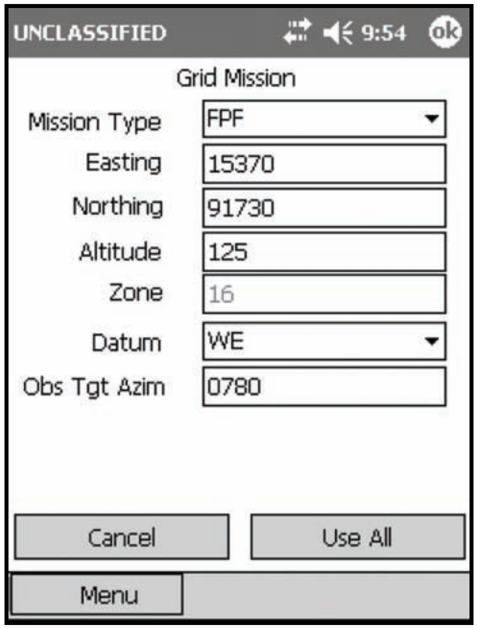


Figure 18-54. Manual Grid Final Protective Fire: Mission Initialization screen.

(6) Complete the screen.
(7) Select Use All.
(8) The Mission Data screen (Figure 18-55) displays.

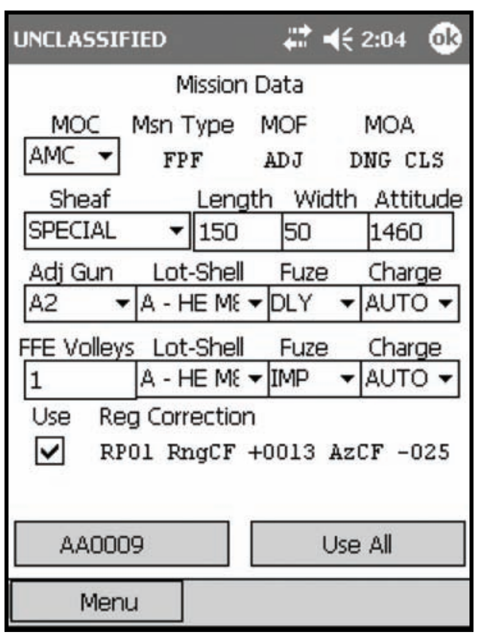


Figure 18-55. Final Protective Fire: Mission Data screen.

NOTE: The MOC for FPF remains AMC during the adjustment phase. The sheaf is set to Special and cannot be changed.

(9) 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.

(10) Change the fuze setting for the FFE to IMP.
(11) Ensure that all other data is correct, and select Use All.
(12) The Solution/Gun Orders screen (Figure 18-56) displays.

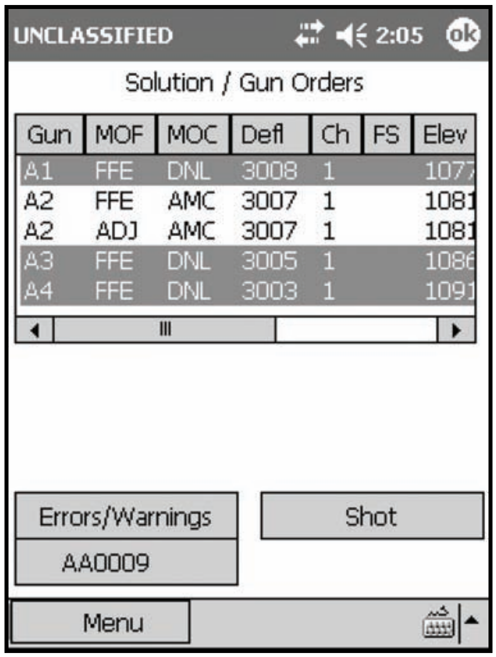


Figure 18-56. Final Protective Fire: Initial Solution screen.

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 should fire in the initial adjustment 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 (SR) or a section left (SL). For this example, a section right is used. The FO determines that A1 is the danger gun.

(13) Record the solution and safety data on DA Form 2399-R.
(14) When the first gun fires, select Shot to start the shot clock.
(15) Select the <Target> button.
(16) The <Target> 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: #1 Danger close. Right 100. Drop 25.

Record this adjustment on DA Form 2399-R.

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 to reduce the risk of injury to friendly Soldiers while adjusting the FPF.

(17) Select Mission Data.
(18) The Mission Data screen displays.
(19) Change Adj Gun from the original choice to the danger gun (Figure 18-57).

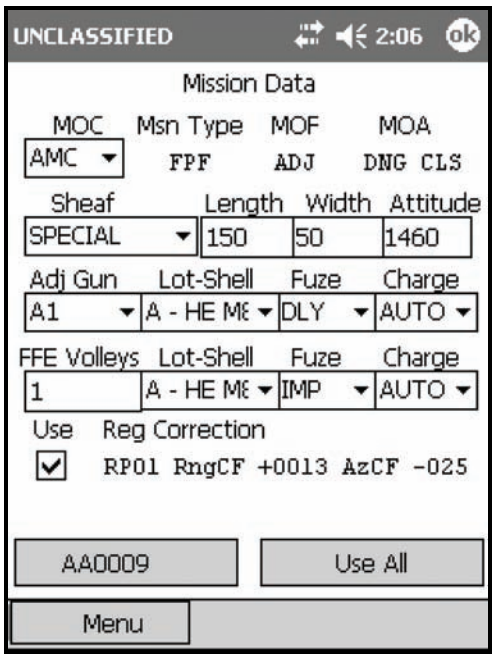


Figure 18-57. Final Protective Fire: changing the adjusting gun.

(20) Select Use All.
(21) The Solution/Gun Orders screen is displayed.

NOTE: The adjustment still must be entered, so disregard this solution.

(22) Select the <Target> button.
(23) The <Target> screen displays.
(24) Select Subs Adust.

(25) The Subsequent Adjust screen displays (Figure 18-58).

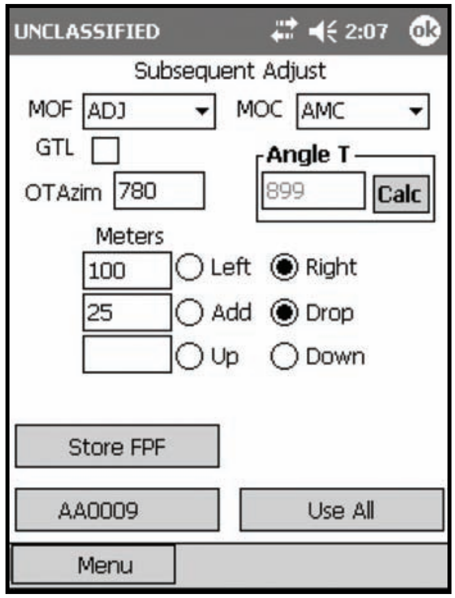


Figure 18-58. Final Protective Fire: first adjustment.

(26) Enter the subsequent adjust as described for a manual grid mission (paragraph 18-2, Basic Manual Missions).

NOTE: If the FO did not send the OT azimuth in the initial CFF, he 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.

---

(27) Select Use All.

(28) The Solution/Gun Orders screen (Figure 18-59) displays.

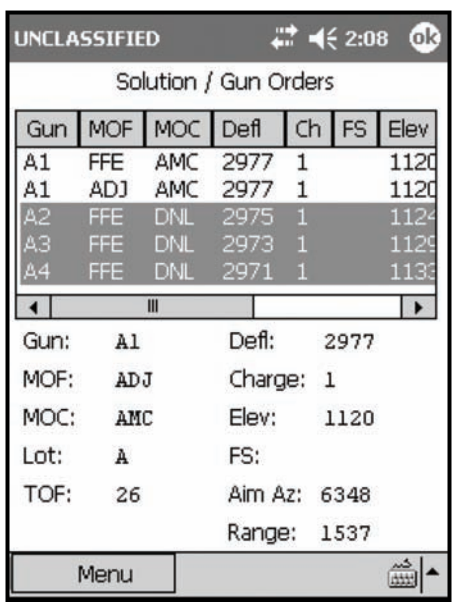


Figure 18-59. Final Protective Fire: A1's initial adjustment.

(29) Record the solution safety data for A1 on DA Form 2399-R.
(30) Send the data to the guns.
(31) Select Shot.
(32) The shot clock displays.
(33) Select the <Target> button.
(34) Select Sub Adjust.
(35) The Subsequent Adjustment screen displays.
(36) , 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 18-60).

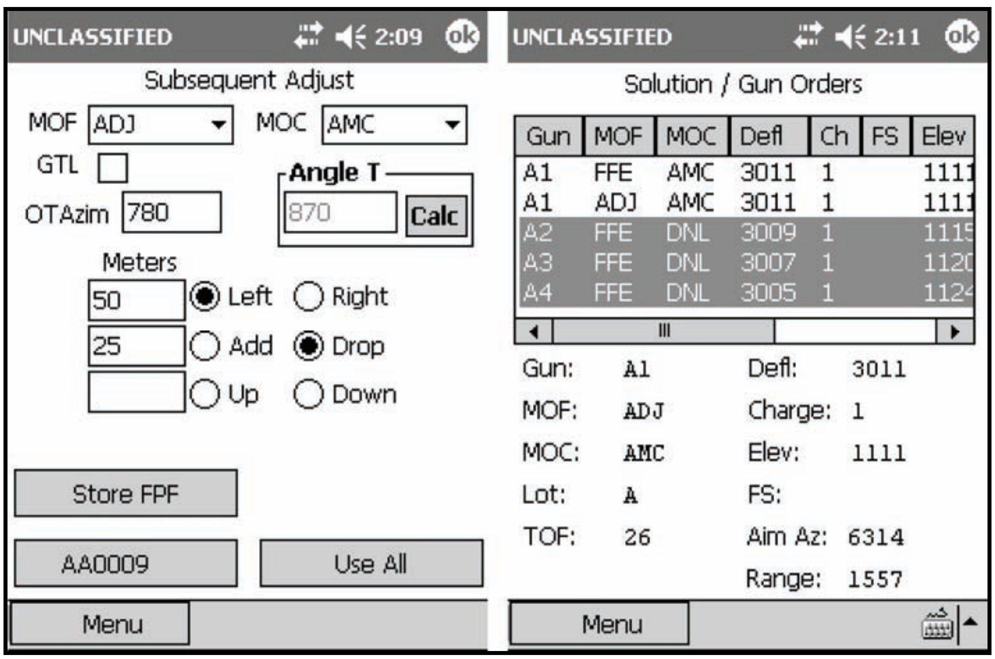


Figure 18-60. Final Protective Fire: A1's second adjustment and solution.

EXAMPLE

FO Call: A1 adjusted. Prepare to adjust sheaf.

(37) To adjust the sheaf, change the MOF from ADJ to FFE on the Subsequent Adjust screen (Figure 18-61).

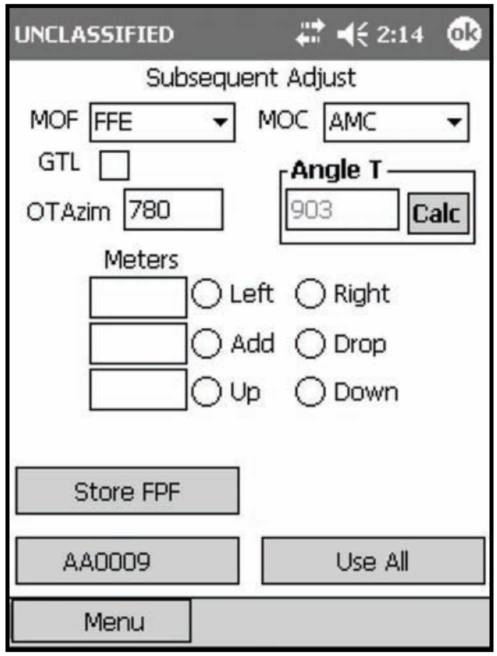


Figure 18-61. Final Protective Fire: preparing to adjust the sheaf.

(38) There were no further adjustments given, so in the example, A1 is considered adjusted.
(39) Select Use All.
(40) The Solution/Gun Orders screen displays.
(41) Record the solution and safety data for A2 (in the example) before issuing gun orders.

EXAMPLE

FO Call: A2 right 10. Gun adjusted. Repeat A3.

---

(42) To modify the sheaf, from the <Target> screen, select Adj Sheaf.

(43) The Adjust Sheaf screen (Figure 18-62) displays.

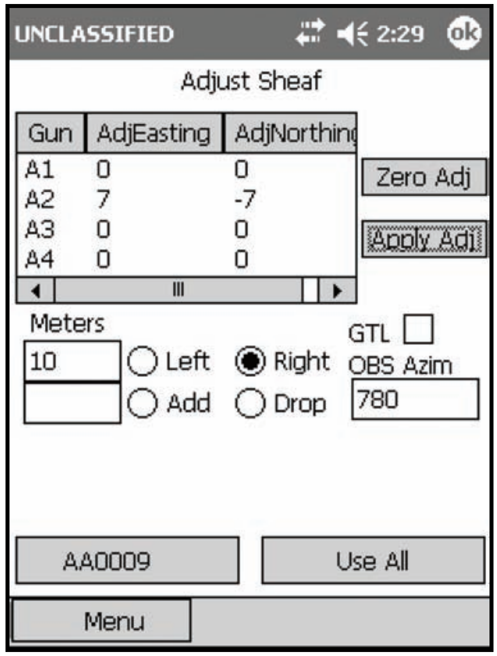


Figure 18-62. Final Protective Fire: adjusting A2.

(44) Select the Right radio button.

(45) Enter the number of meters (10, in the example) in the corresponding Meters field.

(46) Highlight A2 (in the example), and select Apply Adj.

NOTE: The modification is now displayed in the Adjustment window with the corresponding easting and northing corrections displayed.

(47) Select Use All.

(48) 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.

(49) The Mission Data screen is displayed by default.

NOTE: When in the sheaf adjustment phase, the adjusting gun listed is irrelevant.

(50) Select Use All.

(51) The Solution/Gun Orders screen displays (Figure 18-63).

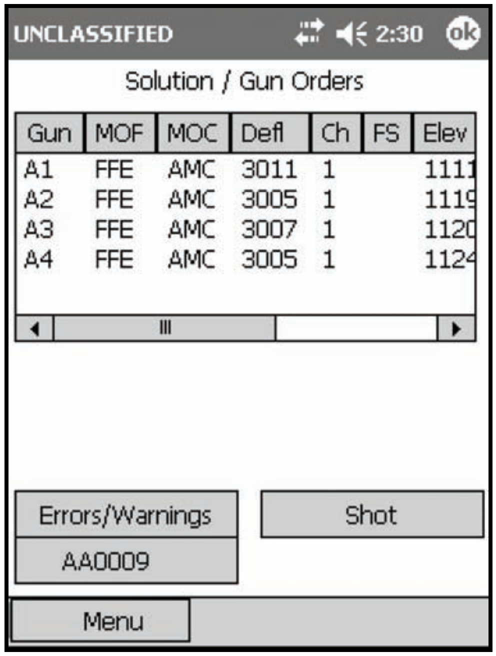


Figure 18-63. Final Protective Fire: A3's solution.

(52) Record A2 and A3's (for this example) 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. Sheaf adjusted. EOM RAT 09.

---

(53) Navigate to the Adjust Sheaf screen, and enter A4's correction as previously described (Figure 18-64).

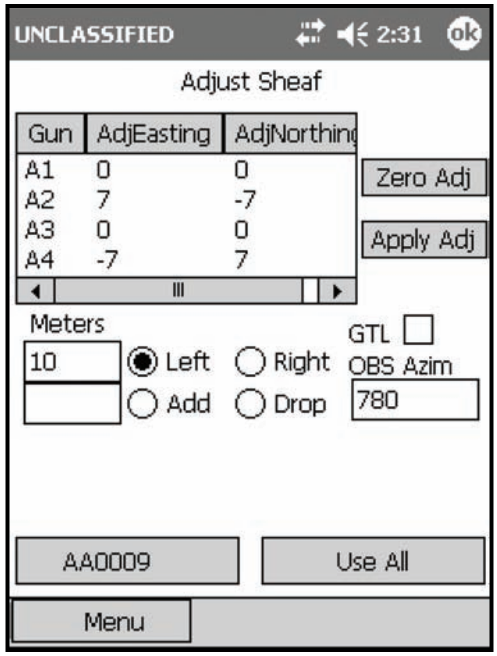


Figure 18-64. Final Protective Fire: A4's adjustment solution.

(54) Select Use All.
(55) The Mission Data screen displays.
(56) Select Use All.
(57) The Solution/Gun Orders screen displays (Figure 18-65).
(58) Record the solution/safety data on DA Form 2399-R.
(59) Select the <Target> button.

(60) The <Target> screen displays.

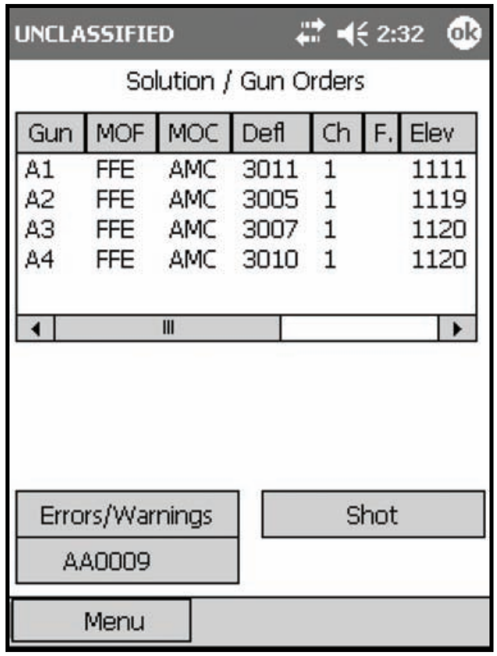


Figure 18-65. Final Protective Fire: section solution.

(61) Select Mission Data.

(62) The Mission Data screen displays (Figure 18-66).

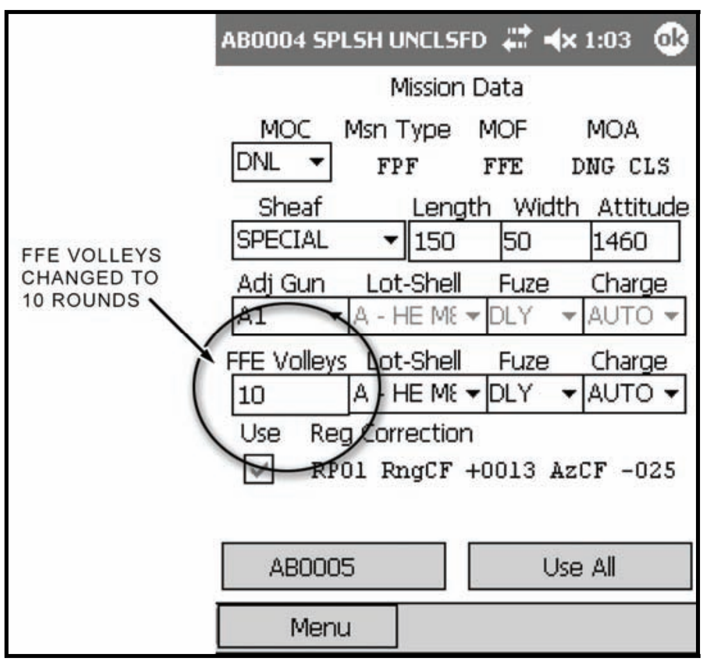


Figure 18-66. Final Protective Fire: changing the fire for effect volleys.

(63) Change the number of FFE Volleys from 1 to a predetermined number of rounds to be set aside for the FFE (10 rounds in the example).

NOTE: When an FPF is fired, the section/platoon will continue firing until all rounds are expended or a cease fire command is given.

(64) Select Use All.
(65) The Solution/Gun Orders screen displays.
(66) Navigate to the Subsequent Adjust screen (Figure 18-67).

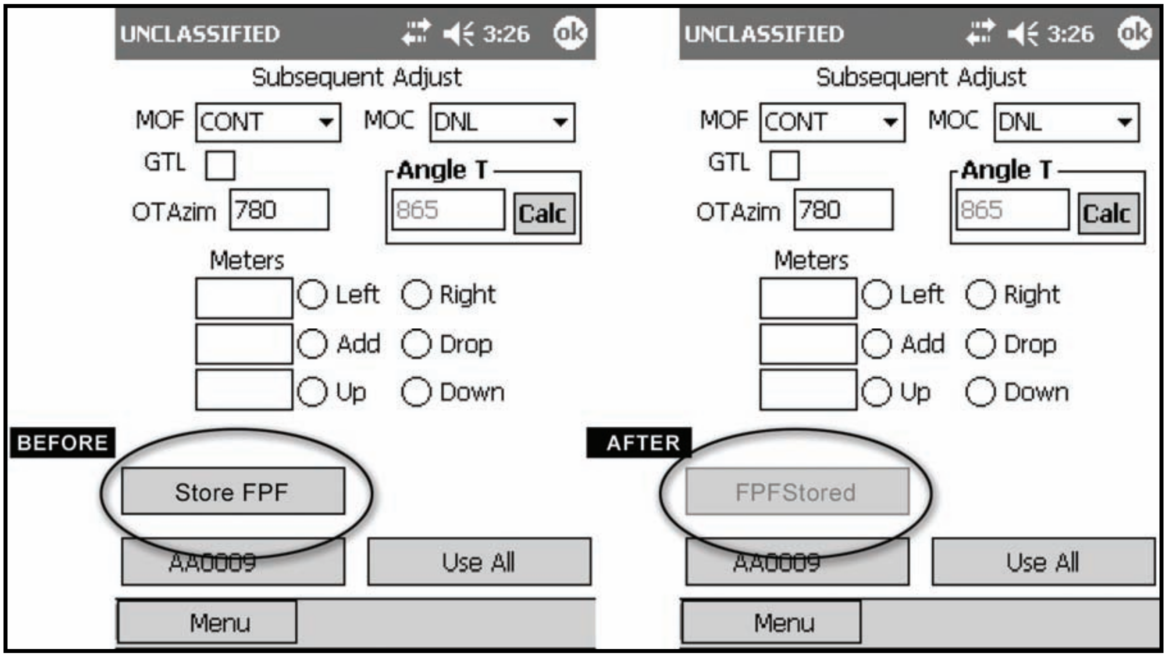


Figure 18-67. Final Protective Fire: storing the final protective fires.

(67) Select Store FPF.

NOTE: The MOF is automatically changed to CONT, and the MOC is automatically changed to DNL. The Store FPF button is now shaded and reads "FPF Stored."

(68) Select Use All.
(69) The Solution/Gun Orders screen displays.
(70) Record one copy of each gun's firing data, the trigger (such as Budweiser), 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 visible at all times.

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, etc.). The FPF may now be accessed through the Missions/FPFs menu using the following path: Menu/Missions/FPFs/AA0009.

(71) Select the <Target> button.
(72) Select the Mission Data button.
(73) The Mission Data menu displays.

(74) Fire the FPF by performing the following steps:
- Change the MOC from DNL to WR.
- 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.

(75) Select the <Target> button.
(76) The <Target> screen displays.
(77) Select EOM.
(78) The EOM screen displays.
(79) Delete FPF is selected, and all other EOM options are shaded.
(80) Select Use All.
(81) The Ammunition Expended screen displays.
(82) Adjust the total number of rounds fired.
(83) Select Use All.
(84) The Status screen displays.

SMOKE MISSIONS

18-23. Smoke missions are used to conceal ground maneuver, obstacle breaching, and recovery operations, as well as key assembly areas, supply routes, and logistical facilities. There are two types of smoke missions: quick and immediate.

QUICK SMOKE MISSIONS

18-24. The standard smoke mission covers a 500-meter front for a predetermined amount of time. This 500-meter front can be scaled up or down using a scaling factor. Quick smoke missions are considered smoke screening missions.

WARNING

Phosphine is highly toxic; it can easily kill in relatively low concentrations. Be cautious when handling red or white phosphorous munitions.

18-25. A quick smoke mission can be initiated using any of the methods of target location.

NOTE: See Chapter 9 for further quick smoke information.

18-26. To initialize a quick smoke mission—

(1) Select Menu.
(2) Select Manual Missions.
(3) Select Grid Mission.

(4) Complete the target location information (Figure 18-68).

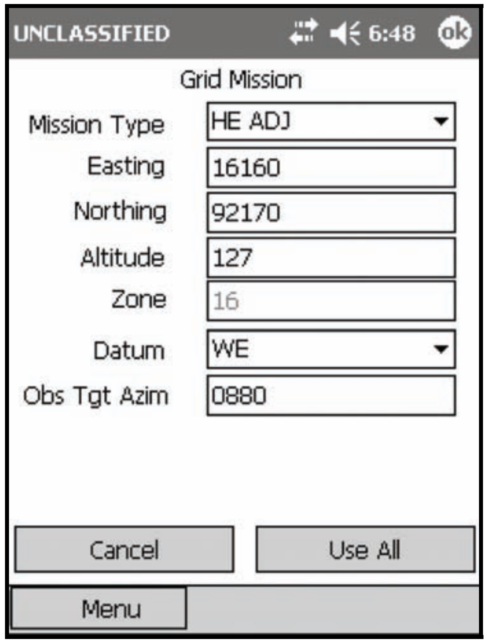


Figure 18-68. Quick Smoke: target location information.

(5) Select Use All.

(6) The Mission Data screen (Figure 18-69) displays.

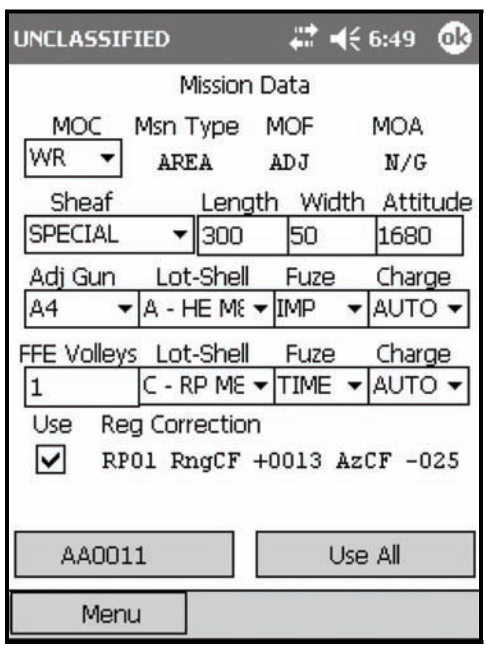


Figure 18-69. Quick Smoke: Mission Initialization screen.

(7) Change the sheaf to SPECIAL.

(8) Three additional fields for target length, width, and attitude display.

(9) Use these fields (outlined in Table 18-14) to enter and view information.

Table 18-14. Quick Smoke: Mission Data screen fields and related information.

FIELD	RELATED INFORMATION
Length	The long edge of the target
Width (depth)	The short edge of the target
Attitude	Read along the target's long edge

EXAMPLE

In this example, change FFE Volleys from 3 to 1, and the FFE Lot-Shell to the RP/WP lot.

(10) Select Use All.
(11) The Solution/Gun Orders screen displays.
(12) Continue to process the mission as a standard grid mission, as shown in the following example (Figures 18-70 to 18-76).

NOTE: See paragraph 18-2 for more information about processing a grid mission.

EXAMPLE

In this example, the adjusting gun will be the upwind gun. The flank wind is blowing from left to right (from #4 gun to #1 gun) across the gun line. # 4 is the upwind gun.

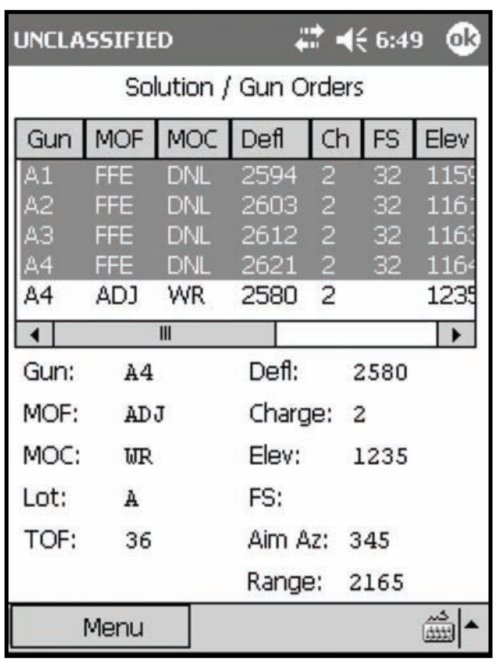
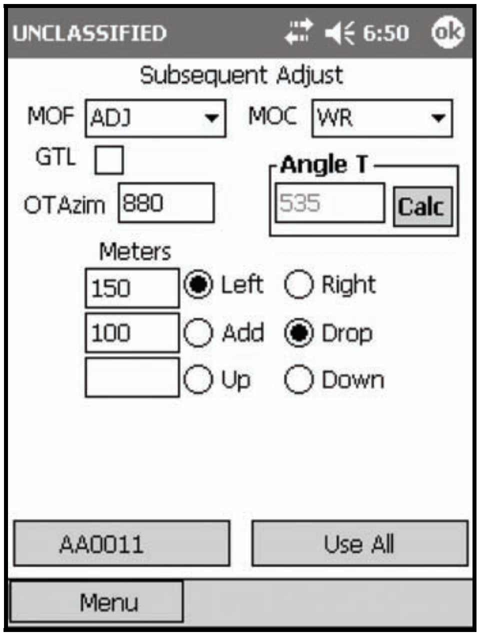


Figure 18-70. High-Explosive Adjustment Phase – first solution.

FO Call: Left 150. Drop 100. (Figures 18-71 and 18-72)



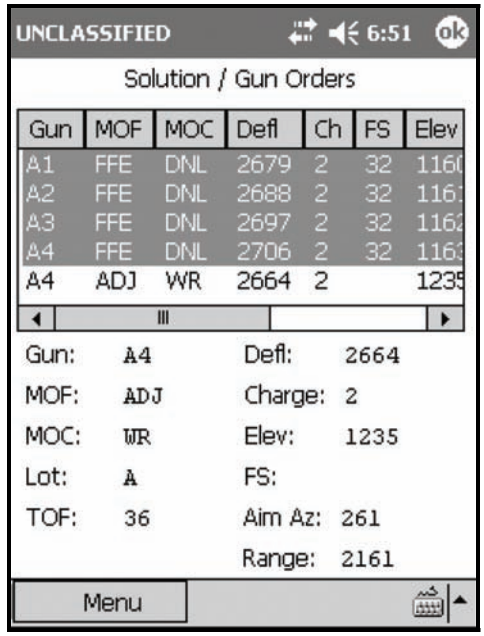
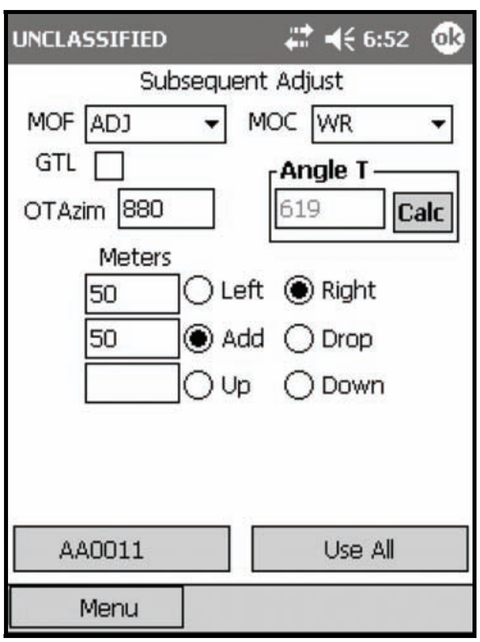


Figure 18-71. High-Explosive Adjustment Phase: first adjustment.

Figure 18-72. High-Explosive Adjustment Phase: first adjustment solution.

FO Call: Right 50. Add 50. (Figures 18-73 and 18-74)



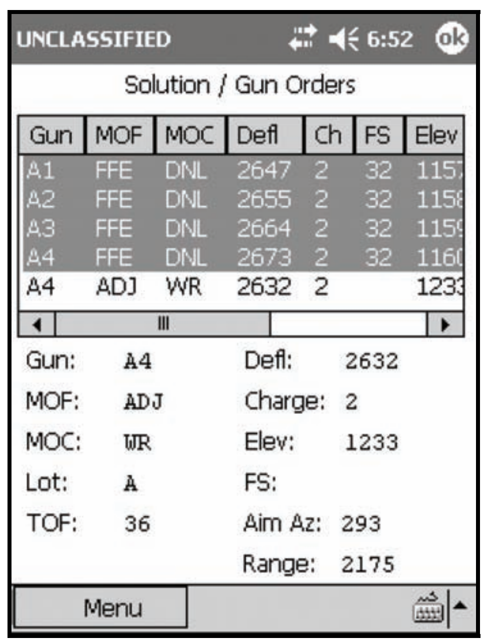


Figure 18-73. High-Explosive Adjustment Phase: second adjustment.

Figure 18-74. High-Explosive Adjustment Phase: second adjustment solution.

FO Call: Repeat WP.

When the HE has been adjusted, the FO will call for a round of smoke to confirm that the smoke lands in the proper location and with the desired effects. Then—

(1) From the Subsequent Adjust screen, change the MOF from ADJ to FFE (Figure 18-75).

(2) Select Use All.

(3) The Solution/Gun Orders screen displays.

Firing data is displayed for all guns; however, A4 is the only gun that will fire the confirmation (Figure 18-76). If the smoke is satisfactory, the adjustment phase is complete.

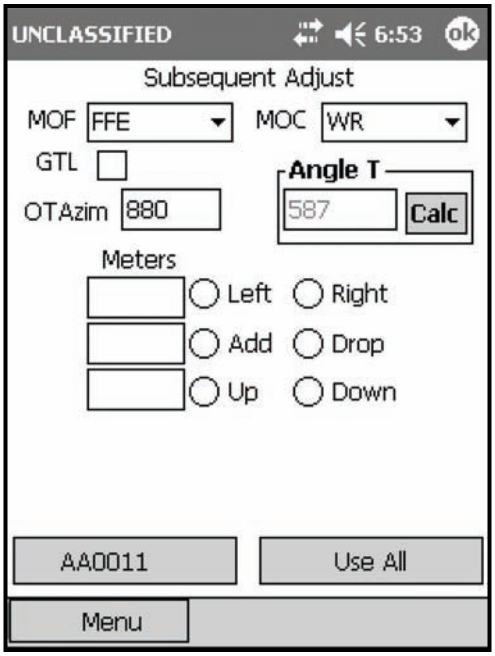


Figure 18-75. High-Explosive Adjustment Phase: change the method of fire from adjust to fire for effect.

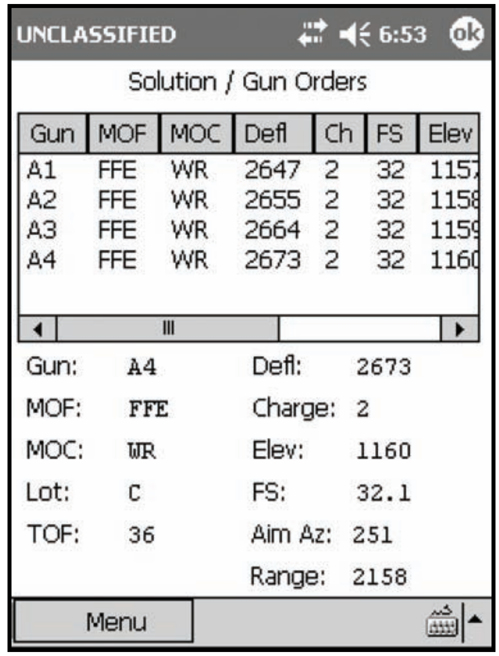


Figure 18-76. High-Explosive Adjustment Phase: first confirmation round.

(13) Calculate the number of rounds for the establishment and maintenance phases from the <Target> screen by selecting Smoke Card.

(14) The Smoke Card screen displays (Figure 18-77). The smoke card uses weather and target width information to calculate the number of rounds required to provide adequate smoke for the given target area. The weather conditions originate from the meteorological data station or can be extracted from the current MET message. If using conditions from the current MET message, humidity will need to be estimated.

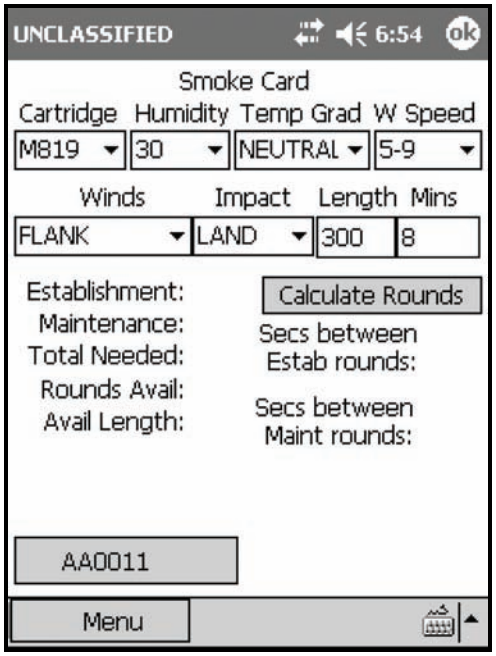


Figure 18-77. Smoke Card screen.

NOTE: It is the responsibility of the coordinating FSO to supply weather conditions a minimum of 20 minutes before firing a coordinated quick smoke mission. This affords the FDC and gun crew time to process the mission ammunition requirements and prepare the ammunition for the mission.

---

(15) After calculating the total number of smoke rounds for the quick smoke mission, divide the number of rounds necessary for establishment by the number of guns.

EXAMPLE

In the example shown in Figure 18-78, the LHMBC calculates that 10 rounds will be necessary to establish the initial smoke screen.

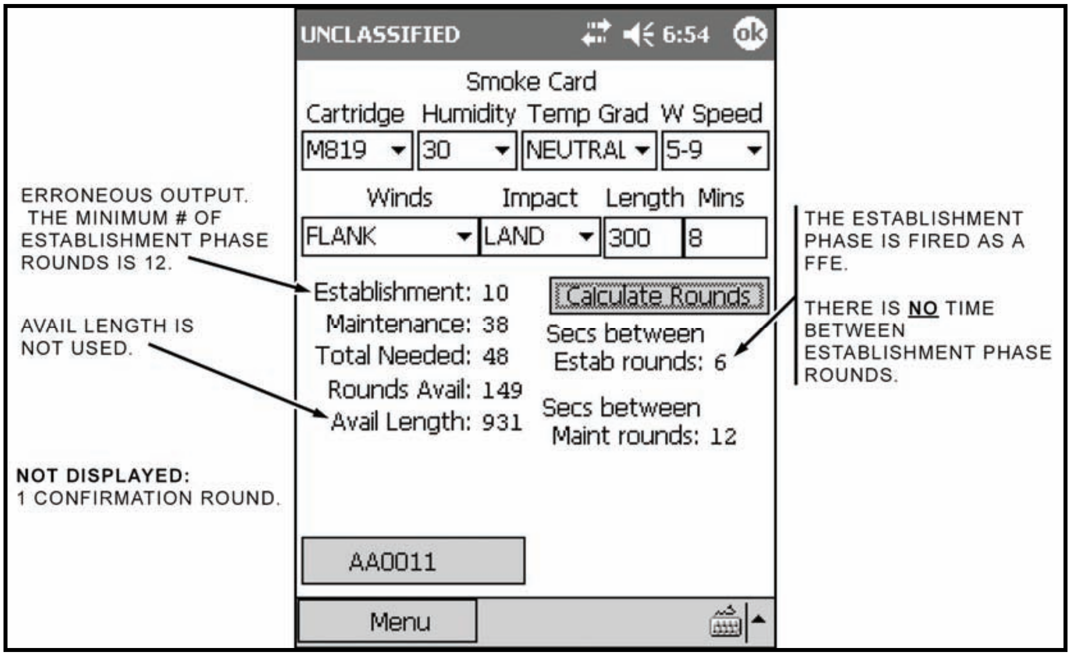


Figure 18-78. Smoke Card example with solution.

NOTE: All smoke screens are established with a minimum of 12 rounds. If the number for the establishment phase is not divisible by the number of guns, round up to the next number that is divisible by the number of guns. For example—

Establishment = 10

Number Guns = 4, round up to 12 rounds

12/4 = 3 rounds per gun

The LHMBC erroneously displays an interval between rounds for establishment (Figure 18-50). There is NO interval between rounds during the establishment phase. The FDC will control all guns after the first round of the maintaining phase.

(16) When the last round of the establishment phase has been fired, the section will continue firing the maintaining rounds at the predetermined interval.

NOTE: Individual gun squad leaders will be responsible for ensuring that their guns fire in the proper sequence, at the proper interval.

EXAMPLE

For this example (Figure 18-79), #4 gun is the upwind gun, so the section will fire a section left with a 12-second interval between rounds.

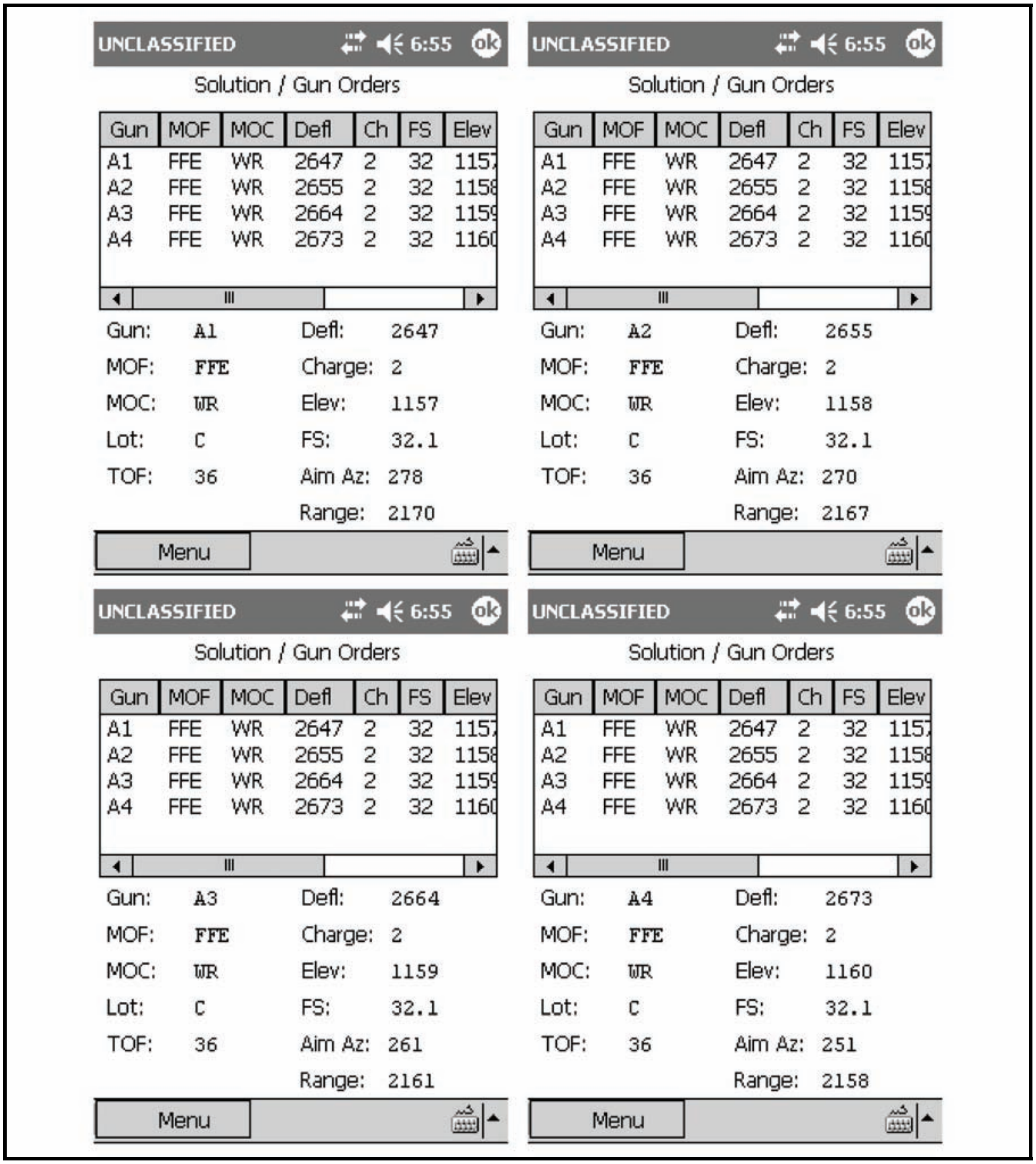


Figure 18-79. Quick Smoke: guns A1, A2, A3, and A4 solutions for the maintaining phase.

(17) After the section announces, “All rounds complete,” the FDC sends an MTO of “All rounds complete.”

(18) Navigate to the EOM screen (Figure 18-80).

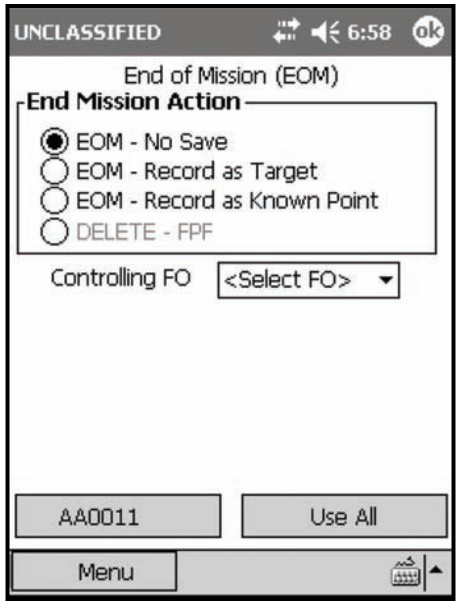


Figure 18-80. Quick Smoke: End of Mission screen.

(19) Select EOM – No Save, EOM – Record as Target, or EOM – Record as Known Point.

(20) Select Use All.

(21) The Ammunition Expended screen displays (Figure 18-81).

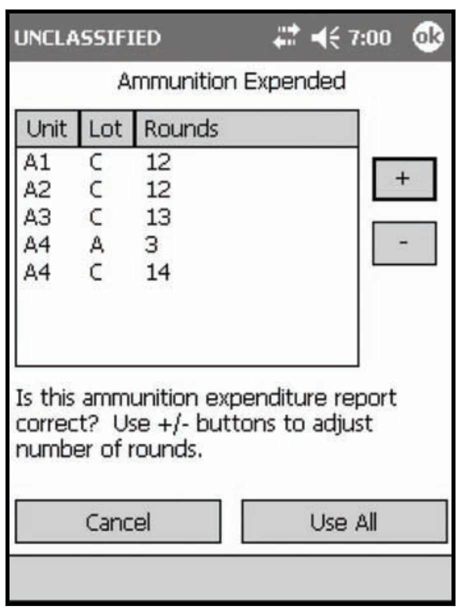


Figure 18-81. Quick Smoke: Ammunition Expended screen.

(22) Update the ammunition manually.

NOTE: The quick smoke card is not integrated with the actual mission, so the ammunition must be updated manually.

---

(23) Select Use All.

(24) The Status screen displays.

IMMEDIATE SMOKE AND IMMEDIATE SUPPRESSION MISSIONS

18-27. 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 immediate suppression. The delivery of fires is performed as quickly as possible. Immediate response is more important than the accuracy of these fires.

Immediate Smoke Missions

18-28. The FO uses immediate smoke to obscure the enemy's vision, allowing friendly forces to disengage. It is not intended as a screening mission.

18-29. To initialize an immediate smoke mission—

(1) Select Menu.

(2) Select Manual Missions.

(3) Select Grid Msn.

(4) Change the Mission Type to IM SMOKE, and complete the rest of the target location information (Figure 18-82).

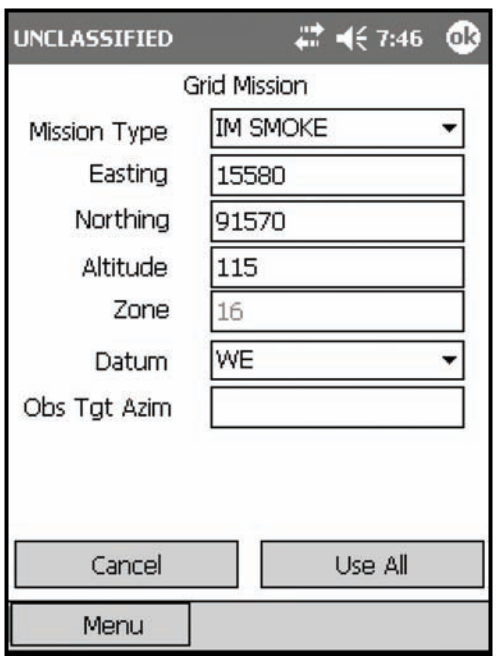


Figure 18-82. Immediate Smoke: Mission Initialization screen.

(5) Select Use All.

(6) The Mission Data screen displays with a default FFE Volleys of 2 rounds. The Lot-Shell will default to RP/WP (Figure 18-83).

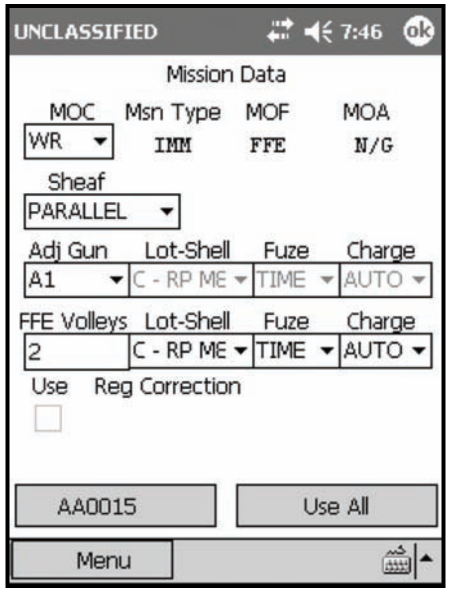


Figure 18-83. Immediate Smoke: Mission Data screen.

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 (Figure 18-84). 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.

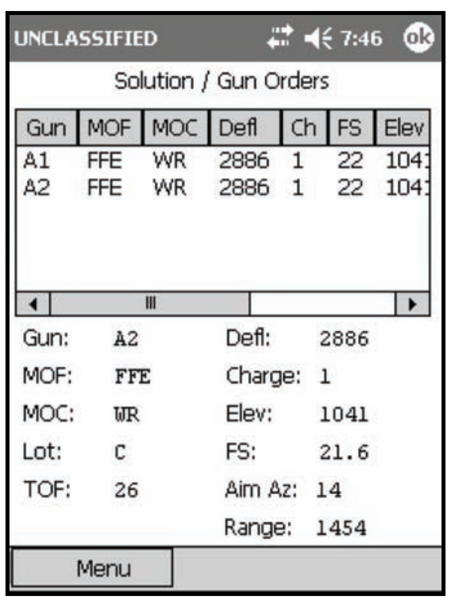


Figure 18-84. Immediate Smoke: Solution/Gun Orders screen.

(7) Upon receipt of an EOM from the FO, end the mission via the EOM screen (See paragraph 18-2).

Immediate Suppression Missions

18-30. The FO uses immediate suppression to indicate that his unit is receiving enemy fire. His request should be processed at once. These fires are used suppress the enemy and limit his ability to perform his mission.

18-31. To initialize an immediate suppression mission—

(1) Select Menu.

(2) Select Manual Missions.

(3) Select Grid Msn.

(4) Change the Mission Type to SUPPRESS, and complete the rest of the target location information (Figure 18-85).

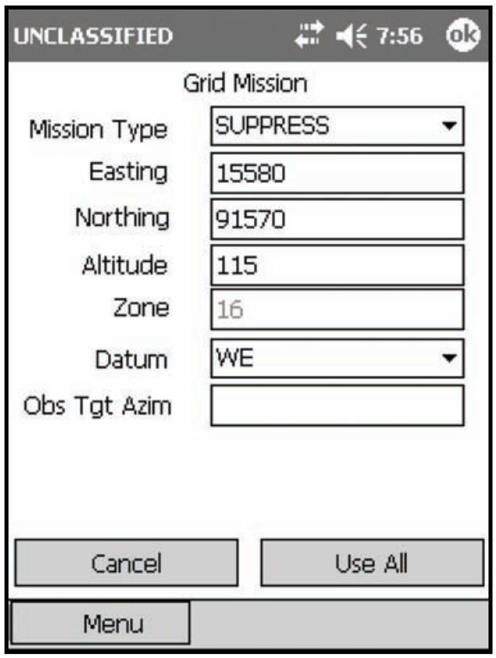


Figure 18-85. Immediate Suppression: Mission Initialization screen.

(5) Select Use All.

(6) The Mission Data screen displays with a default FFE Volleys of 2 rounds. The Lot-Shell defaults to HE (Figure 18-86).

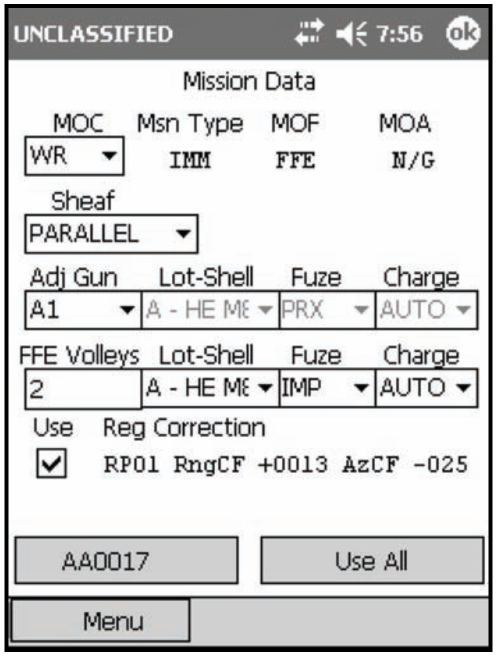


Figure 18-86. Immediate Suppression: Mission Data screen.

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 (Figure 18-87). 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.

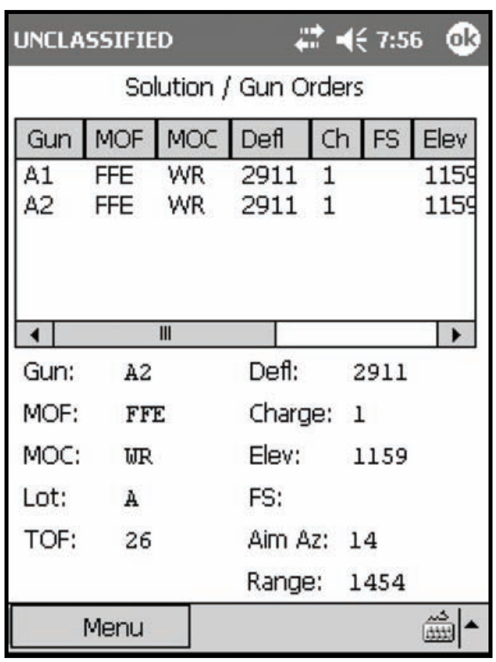


Figure 18-87. Immediate Suppression: Solution/Gun Orders screen.

(7) Upon receipt of an EOM from the FO, end the mission via the EOM screen (see paragraph 18-2).

SEARCH AND TRAVERSE MISSIONS

18-32. 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 traverse mission, but search missions employ similar procedures.

2. The LHMBC issues a warning when the gun-target line 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 gun-target lines 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 gun-target lines between guns exceeds 150 mils.

18-33. To initialize a traverse mission—

(1) Select Menu.

(2) Select Manual Missions.

(3) Select Grid Msn.

(4) The Grid Mission screen (Figure 18-88) displays.

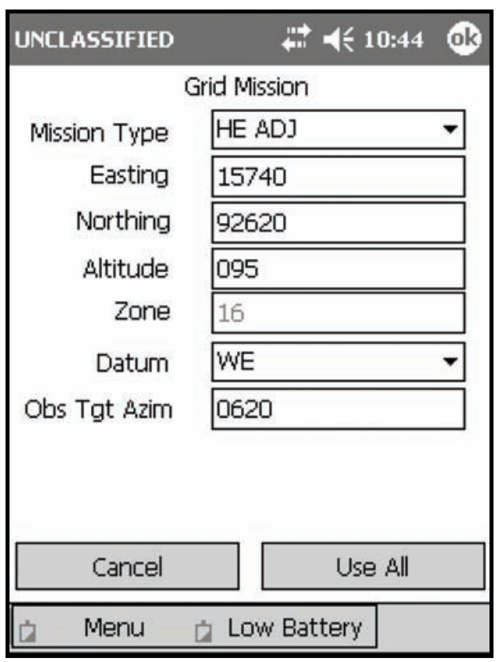


Figure 18-88. Search and Traverse: Mission Initialization screen.

(5) Enter the grid mission initialization data as described in paragraph 18-2.

(6) Select Use All.

(7) The Mission Data screen (Figure 18-89) displays.

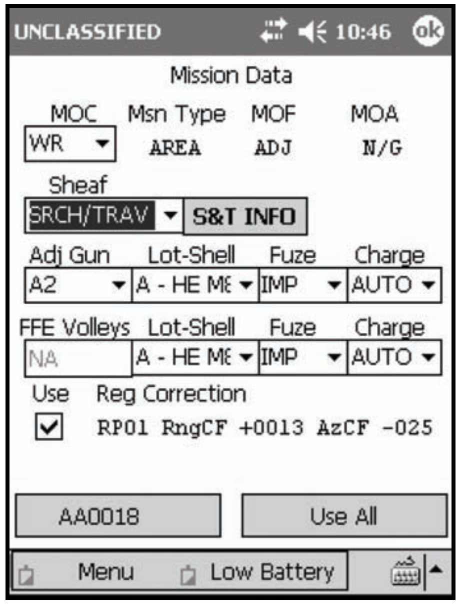


Figure 18-89. Search and Traverse: Mission Data screen.

(8) In the Sheaf field, change the sheaf to SRCH/TRAV.

(9) Select S&T INFO. The Search/Traverse Sheaf Information screen displays. The Search/Traverse Sheaf Information screen (Figure 18-90) enables the FDC operator to define the target attitude, the location of the adjusting point, and the size of the target area.

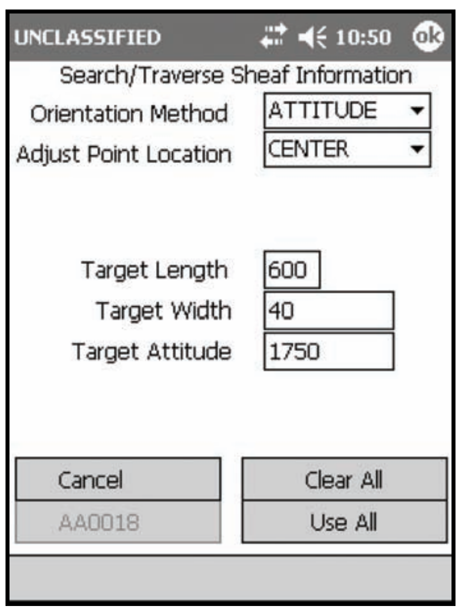


Figure 18-90. Search and Traverse Sheaf Information screen.

(10) Use the fields outlined in Table 18-15 to enter and view information.

Table 18-15. 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 CFF) to determine the attitude of the target, or the actual attitude of the target may be used.
Adjust Point Location	The FO must specify the adjusting point location to the controlling 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-TGT Line. This field may be changed to OTHER to use, for instance, the OT azimuth.

(11) Select Use All.

(12) The Mission Data screen displays.

(13) Select Use All.

(14) The Search/Traverse Operation screen (Figure 18-91) displays. The Search/Traverse Operation screen provides the FDC operator with—

- Relative Orientation.
- Max Search Limit.
- Max Traverse Limit.
- Search/Trav Type.
- Search/Trav Method.

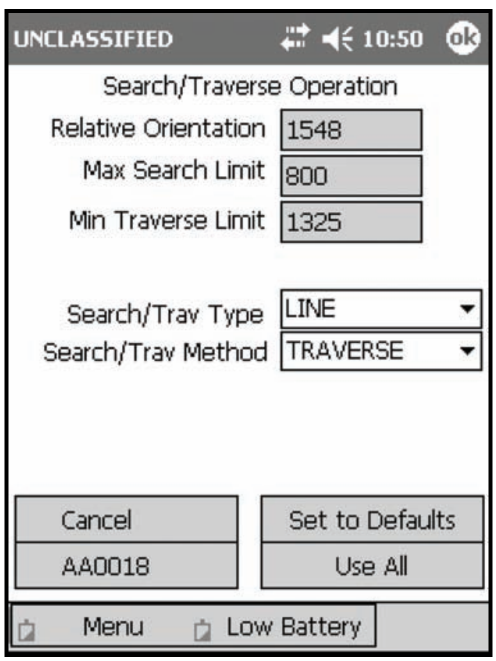


Figure 18-91. Search and Traverse Operation screen.

(15) Use the fields outlined in Table 18-16 to enter and view information.

NOTE: See Table 18-17 for more information about the types and methods outlined in these fields.

Table 18-16. Search and Traverse Sheaf Operation screen fields and related information.

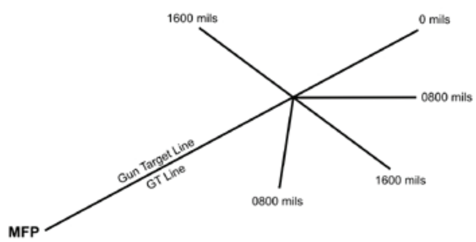
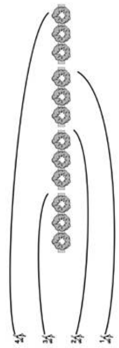
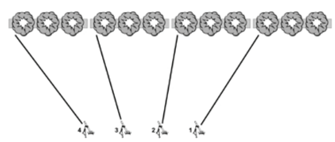
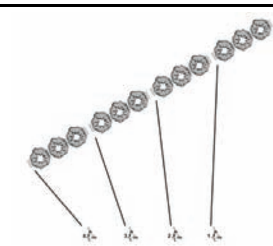
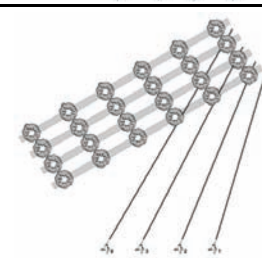
FIELD	RELATED INFORMATION
Relative Orientation 	The relative orientation is the angular difference, in mils, between the gun-target line and the target's attitude. The relative orientation will always be measured between 0 mils (in-line with the gun-target line) and 1600 mils (perpendicular to the gun-target line). The 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 he deems 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/Trav 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 has the ability to 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 has the ability to calculate both search and traverse missions using the area method.
Search/Trav Type	This field may be set to SEARCH, TRAVERSE, or COMBINED (Table 18-17). The LHMBC operator may change to a method he deems appropriate.

Table 18-17. Search and Traverse types and methods.

Search and Traverse Type / Search and Traverse Method	LINE	AREA
Search		
Traverse		
Combined Search and Traverse		

(16) Select Use All.

(17) The Solution/Gun Orders screen (Figure 18-92) displays.

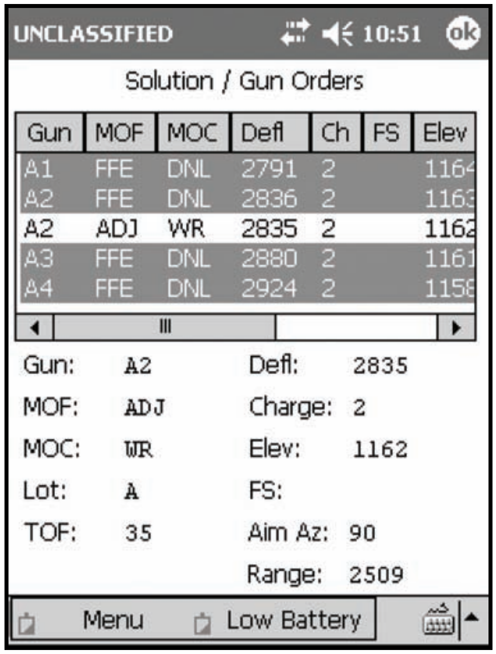


Figure 18-92. Search and Traverse: initial solution.

(18) Conduct the adjustment phase of the mission in the same manner as a conventional manual mission (Figures 18-93 and 18-94).

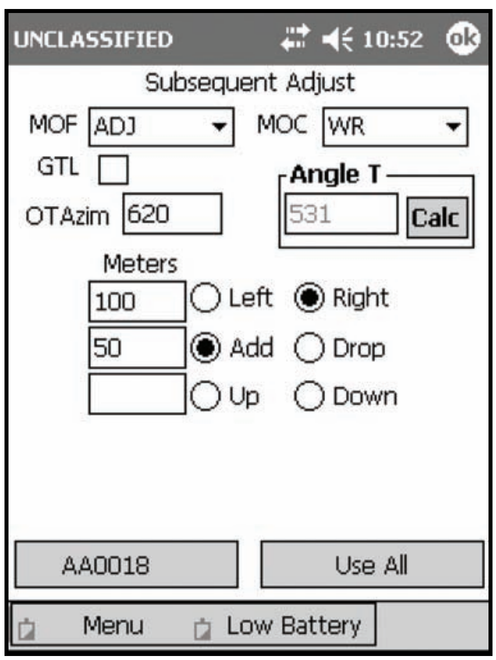


Figure 18-93. Search and Traverse: first adjustment.

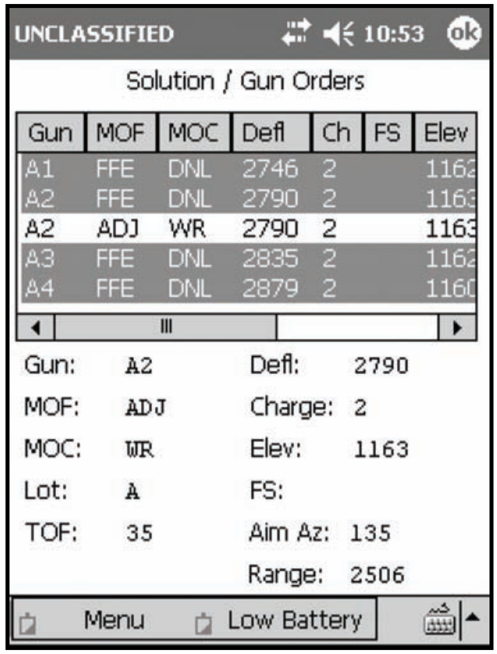


Figure 18-94. Search and Traverse: second solution.

(19) Upon receipt of the FFE command from the FO, from the Subsequent Adjust screen (Figure 18-95), change the MOF to FFE, and enter any last refinements.

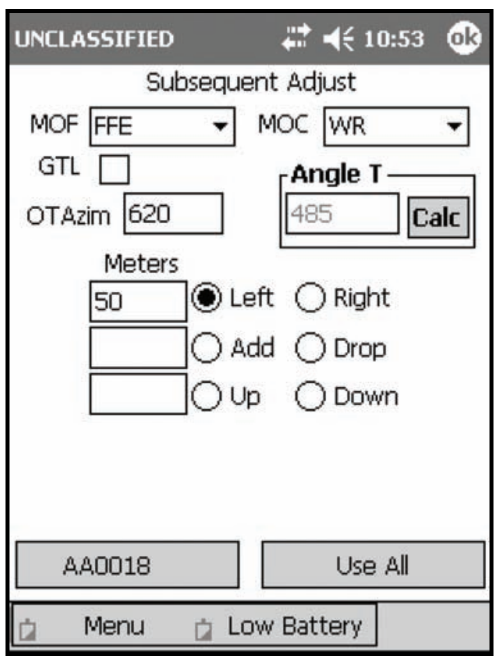


Figure 18-95. Search and Traverse: final adjustment.

(20) Select Use All.

(21) The Solution/Gun Orders screen (Figure 18-96) displays.

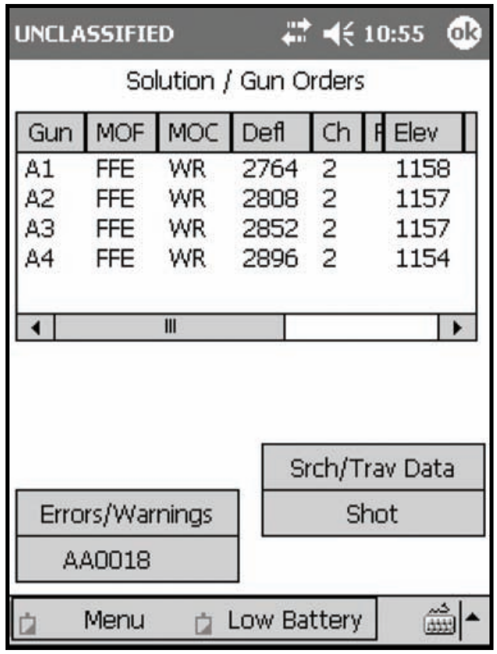


Figure 18-96. Search and Traverse: fire for effect solution.

(22) Select Srch/Trav Data.

(23) The S/T Round and Hand Wheel Fire Data screen (Figure 18-97) displays. This screen is comprised of the following fields:

- Rounds per Weapon.
- Deflection.
- Elevation.

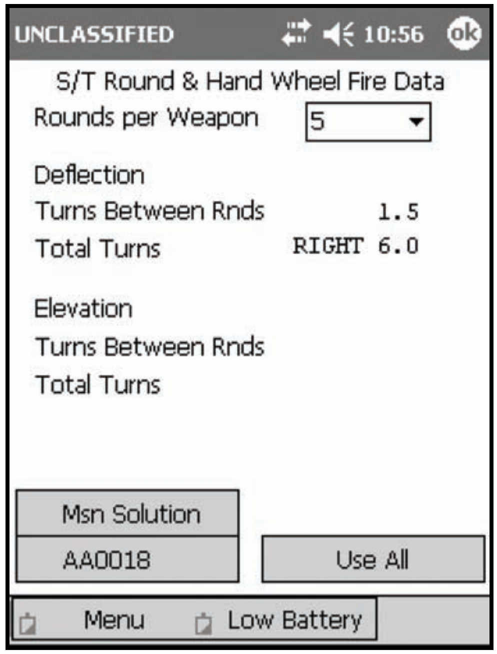


Figure 18-97. Search and Traverse Round and Hand Wheel Fire Data screen.

(24) Use the fields outlined in Table 18-18 to enter and view information.

Table 18-18. 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 Rnds: 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. This is calculated by subtracting one from the number of rounds per weapon, multiplied by the deflection turns between rounds.
Elevation	These two fields correspond to searching across the target area. • Turns Between Rnds: 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. This is calculated by subtracting one from the number of rounds per weapon, multiplied by elevation turns between rounds.

(25) Record this data on DA Form 2399-R.
(26) Select Use All.
(27) The Solution/Gun Orders screen displays.
(28) End the mission, and record the ammunition expenditure in the same manner as a standard manual mission (paragraph 18-2, Basic Manual Missions) (Figure 18-98).

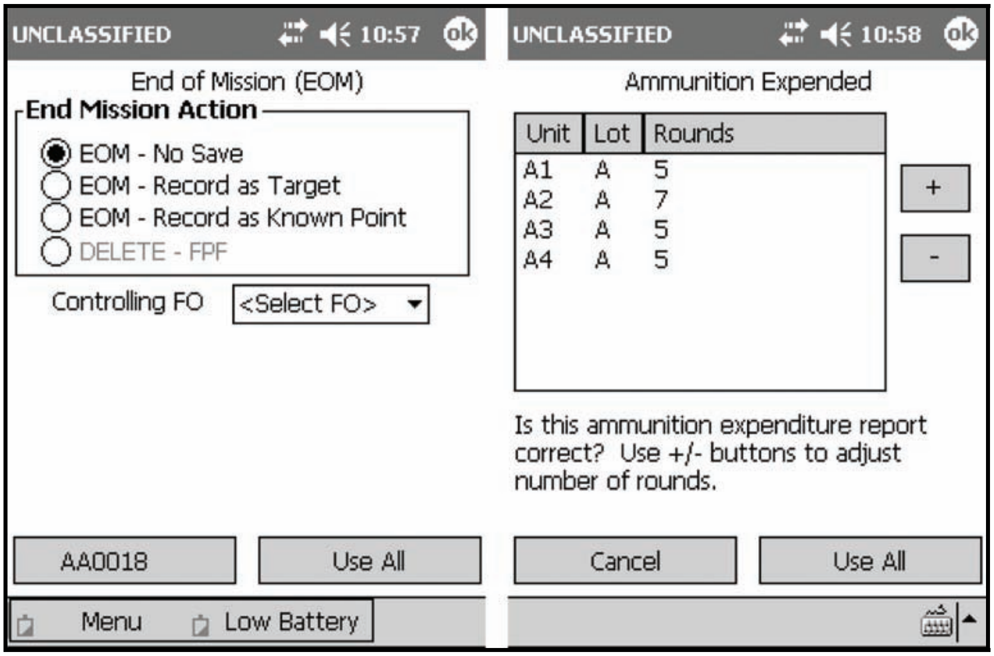


Figure 18-98. Search and Traverse: End of Mission and Ammunition Expended screens.

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Appendix A
Mortar Training Strategy

This appendix provides a comprehensive unit training strategy for training mortarmen. Leaders have the means to develop a program for training their mortar units to full mission proficiency. This training strategy applies to ALL mortars in ALL organizations of the US Army. Although not prescriptive in nature, mortar training strategy must adapt to a unit's mission, local training resources, commander's guidance, and unit training status.

GENERAL

A-1. The mortar training strategy helps the mortar crew become proficient and effective on the battlefield. The gunner is required to be proficient in mechanical drill and FDC when computing the fire mission from the FO.

TRAINING EVALUATION

A-2. Evaluation cannot be separated from effective training. Training evaluation occurs during the top-down analysis when planners develop the training plan. Planners use various sources of information to assess their unit's individual and collective training status. Evaluation is continuous during training. Soldiers receive feedback through coaching and after-action reviews (AARs). Leaders also assess their own training plan and the instructional skills of their subordinate leaders. After training, leaders evaluate by sampling training or reviewing AARs. Much of this evaluation is conducted informally. Formal evaluations occur under the Individual Training and Evaluation Program (ITEP) and the Army Training and Evaluation Program (ARTEP) to assess individual and collective training respectively.

INDIVIDUAL TRAINING

A-3. Individual training is a clearly defined and measurable activity accomplished by an individual.

Commander's Evaluation

A-4. The commander's evaluation is routinely conducted in units. Commanders select and evaluate individual tasks that support their unit mission and contribute to unit proficiency. The evaluation may be performed through local tests or assessments of Soldier proficiency on crucial MOS tasks or common tasks. The commander's evaluation is based on year-round, constant evaluation by the chain of command and supported by the MOS 11C Soldier's manuals, trainer's guides, and job books.

Gunner's Examination

A-5. The gunner's examination is a continuation of the mortar-based drills in which a mortarman's proficiency as a gunner is established. The examination includes situations similar to combat. The examination contained in Chapter 9 of FM 3-22.90 includes tasks, conditions, standards, and administrative procedures, while focusing on the individual qualification of the Soldier in the role of a gunner. However, the gunner's success also depends on the collective performance of his assistants. Within these limitations, evaluators should try to standardize the examination. The squad leader, gunner, and assistant gunner should pass the gunner's exam semiannually. All gunners should have a current qualification before a live-fire exercise (LFX), whether using service or subcaliber ammunition.

Fire Direction Center Certification

A-6. FDC certification allows commanders to verify that their FDC mortarmen have the knowledge and skills for their positions: squad leader, FDC computer, section sergeant, platoon sergeant, and platoon leader. Certification helps ensure that ammunition is wisely expended and that training is conducted safely and effectively. Mortarmen are certified when they receive a passing score of 90 percent and 70 percent on the two-part examination.

COLLECTIVE TRAINING

A-7. Collective training is a clearly defined and measurable activity accomplished by individuals and organizations.

External Evaluation

A-8. The commander formally determines the status of his collective training through external evaluation. The external evaluation gives the commander an objective appraisal of this status by using mortar expertise found outside the normal chain of command. The external evaluation is not a test that a unit passes or fails; it is a diagnostic tool that identifies training strengths and weaknesses. It must be emphasized that an external evaluation is not a specific training event but a means to evaluate a training event. Mortar units undergo external evaluations during an LFX or field training exercise (FTX), or a combination of both. The unit may be evaluated alone, as part of its parent unit, or with other mortar units. The mission training plan (MTP) provides guidance on planning, preparing, and conducting an external evaluation.

Evaluation of the Indirect Fire Team

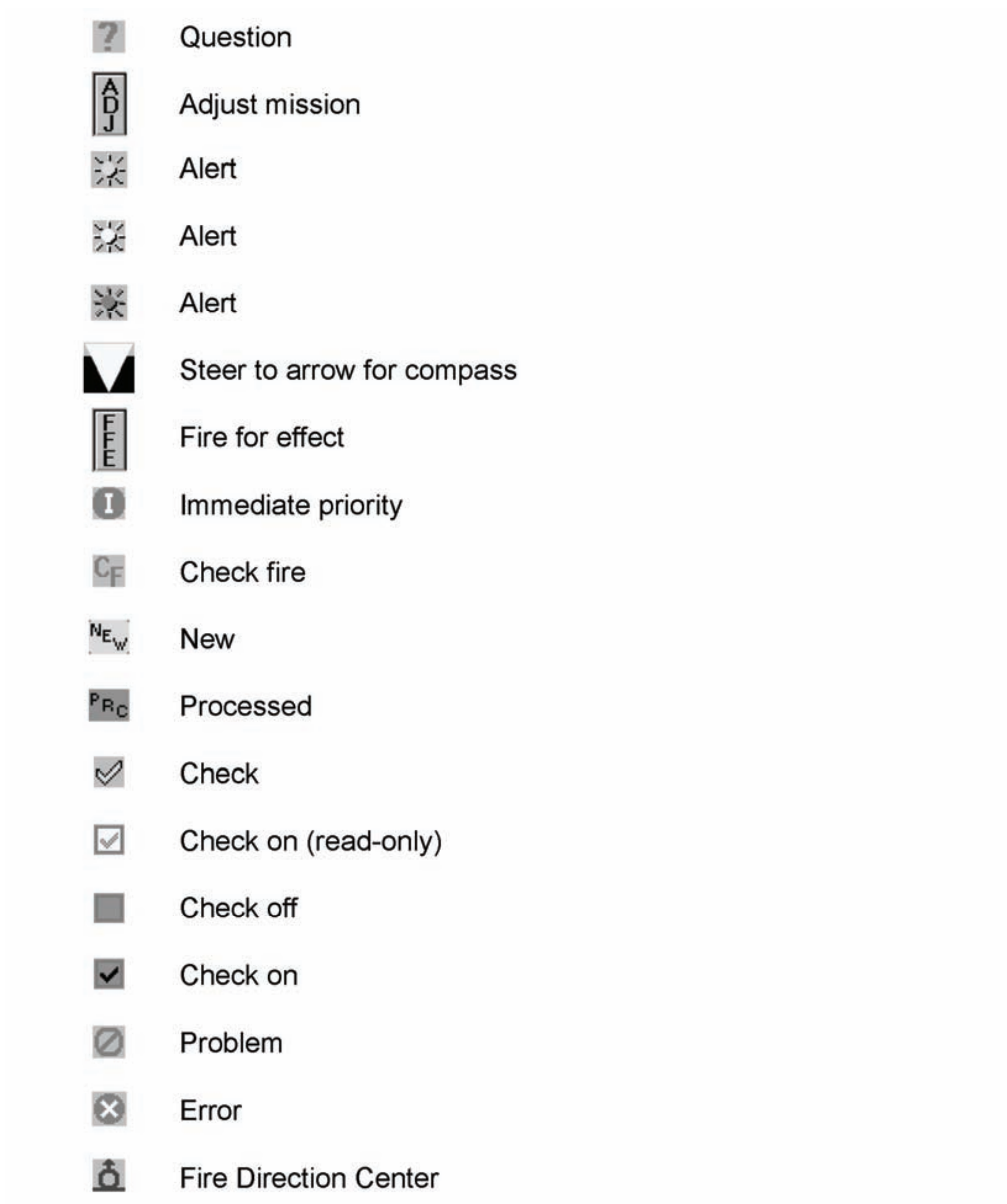
A-9. The members of the indirect fire team must train and correctly execute their respective tasks to successfully complete any fire mission. The team training event sequence should include a step to confirm that the fires have been cleared. For example, while the battalion FSO coordinates airspace clearance and friendly troop locations, the FDC confirms that the charge-shell combination does not violate any maximum ordinate restrictions or other control measures. Failure to do so should be identified as a training deficiency. However, only as a last resort should the fire mission be deleted from the evaluation. Evaluators should determine the reason why any fire mission fails to meet standards in order to determine where additional training is required. The indirect fire team should be given the opportunity to successfully complete the fire mission. This can be accomplished in the following ways:

- Allow the mission to continue if the detected error will still result in the rounds impacting within the safety limits. The team must train to accomplish the mission by finding and correcting any errors based on the round's impact. The appropriate evaluator should intervene only if the team prepares to fire incorrect data that is out of the safety area or when ammunition is constrained.
- Start the fire mission over. Although ammunition constraints during live-fire may not permit this, tasks can be repeated using devices or, less preferably, dry-fire.
- The evaluator corrects the error when the mission data would result in rounds fired out of the safety area. The FO evaluator at the observation post can change the call for fire or correction to reflect proper procedures. The FDC evaluator may correct the improperly computed firing data while the mortar squad evaluator may correct improperly set data or a faulty sight picture.

Appendix B

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.



Emergency priority

Forward observer

Fire support element

Gun

Flash priority

Information

Lock

Steer to legend

Exclamation

Priority priority

Record current (without focus)

Not record current

Record current (with focus)

Record in editing mode (with focus)

Record in editing mode (without focus)

Routine priority

Registration point (RP)

Firing point (FP)

Data

Target

Warning

Appendix C
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 are then presented in graphic form on a range safety diagram. They are also 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

C-1. Range control personnel or the officer in charge (OIC) 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 must then 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

C-2. The safety officer must first determine whether the impact area limits provided to him include secondary danger areas A and B. These areas are established by AR 385-63.

C-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 (Figure C-1). Depending on the mortar being fired, secondary danger area A varies from 250 to 400 meters.

C-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 (Figure C-1).

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

C-5. The initial impact area must be reduced again to account for the normal dispersion of rounds fired. The safety officer must determine the maximum PEs for both range and deflection.

(1) The safety officer checks columns 3 and 4 of Table E in the tabular firing tables for the mortar and ammunition to be used. He checks all possible charge and elevation combinations to ensure he has found the maximum PEs at the distance to the far edge of the impact area.

(2) The safety officer then reduces the maximum range by a factor of eight times the PE_r. He also adjusts the minimum range toward the center of impact by a factor of 12 times the PE_r.

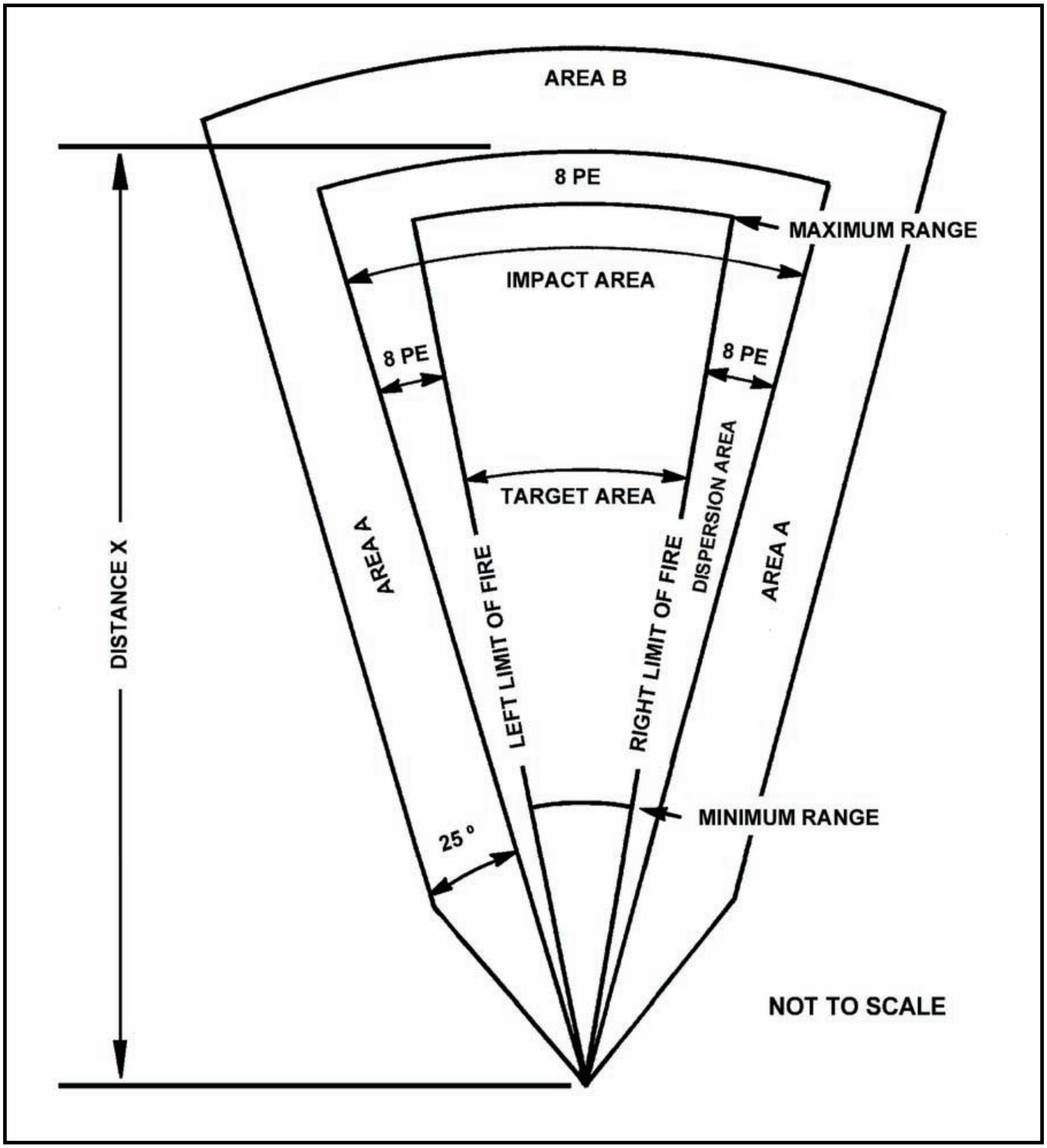


Figure C-1. Mortar surface danger zone.

(3) Once the ranges have been adjusted, the safety officer adjusts the left and right limits inward by a factor of eight times the maximum PE_d.

NOTE: The safety officer must determine whether range control personnel have already performed this computation before designating the impact area.

VERTICAL INTERVAL AND CREST CLEARANCE

C-6. The safety officer must compare the altitude of the mortar position and that of the impact area. If there are significant differences in the VI between these two areas, he must adjust the safety limits to preclude any rounds impacting short or long of the impact area (Figure C-2).

(1) The mini-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.

(2) The safety officer determines VI by subtracting the mortar firing position altitude from the altitude of the applicable range line. The resulting number is either positive or negative.

(3) 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.

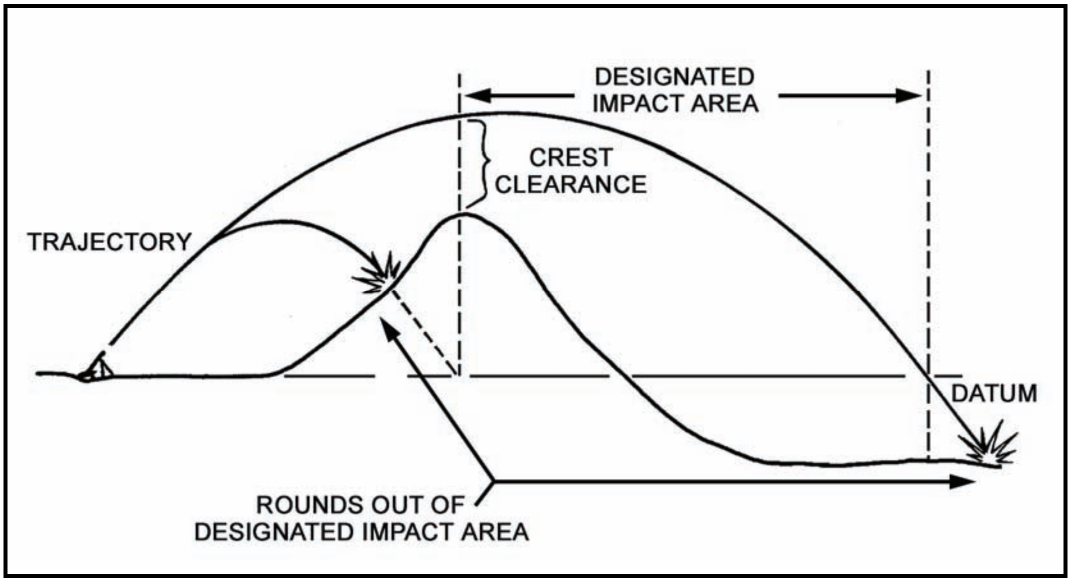


Figure C-2. Effects of vertical interval and crest clearances.

(4) The safety officer must then make a map inspection to determine the highest point between the mortar position and the edge of the impact area. He then compares this highest point with the lowest maximum ordinate value found in Table E in the tabular firing tables. As long as 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)

C-7. 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.

(1) The safety officer must determine the width and depth of the mortar section as it is arranged on the ground (at the firing position). He then reduces the left and right limits by half the section width.

(2) 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

C-8. After a registration (survey chart), a reregistration, or a MET update has been conducted and corrections have been determined, the safety officer must modify the original basic safety diagram by applying the registration corrections. New elevations are determined that correspond to the minimum and maximum ranges. Deflections are modified by applying the total deflection correction to each lateral limit.

SAFETY DIAGRAM

C-9. The safety diagram graphically displays the computed safety limits. Data are logically presented and arranged for the FDC to use. Once the diagram is constructed, data from it are used to draw the safety T.

C-10. The range safety officer determines the lateral safety limits and the minimum and maximum ranges of the target area. These data must then be converted to deflections and elevations. In the case of mechanical time (illumination) and variable time (VT 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 (min rg) is 2,400 meters.
- Maximum range (max rg) 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 is 390 meters.

C-11. The basic safety diagram is constructed (Figure C-3) as follows:

(1) On a sheet of paper, draw a line representing the direction of fire for the firing unit. Label this line with its azimuth (AZ) and the referred deflection (DF) for the weapon system.

(2) Draw lines representing the lateral limits in proper relation to the line on which the section is laid. 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 (FZ) time (TI) is different from the minimum range, draw a dashed line between the safety limits to represent the minimum range for FZ TI. 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. 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).

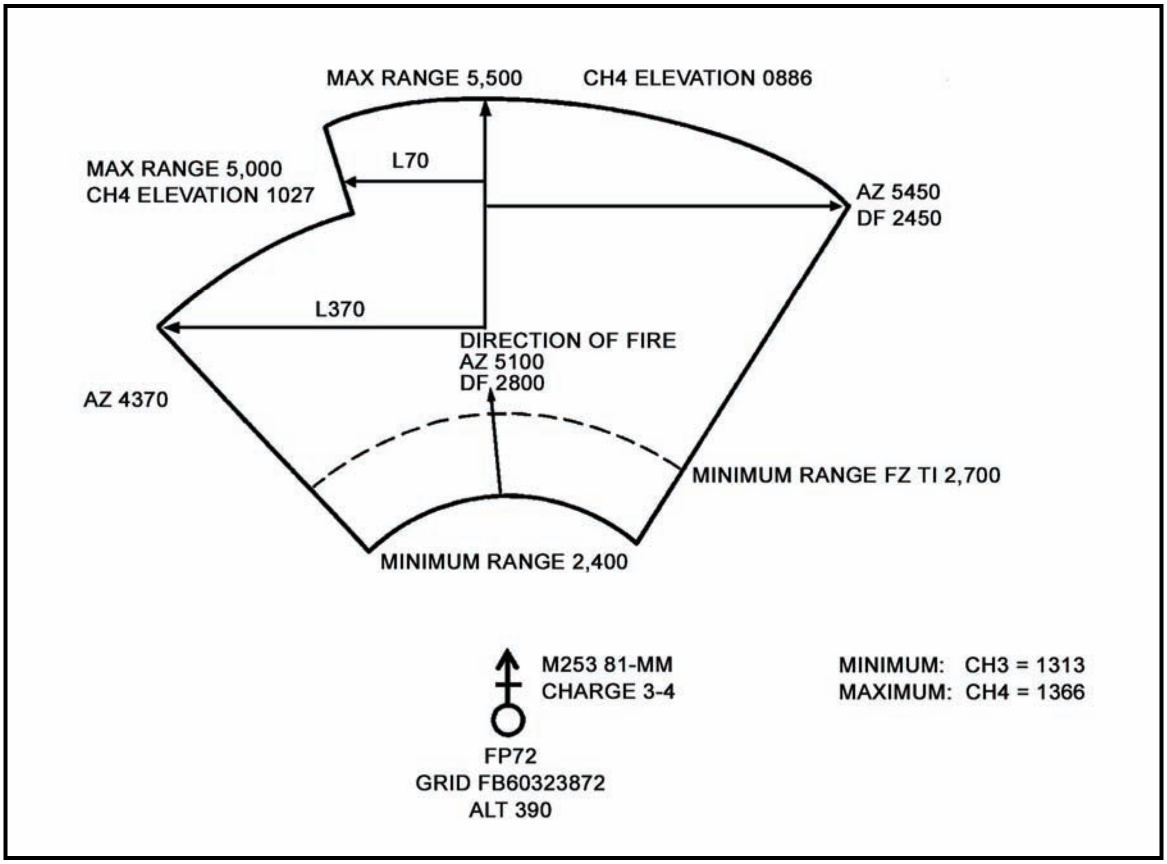


Figure C-3. Basic safety diagram.

C-12. Once the basic safety diagram is drawn, the FDC uses the tabular firing tables to determine the proper charges, elevations, and time settings. He then applies them to complete the diagram.

C-13. 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 C-4 shows the safety T taken from the completed range safety diagram.

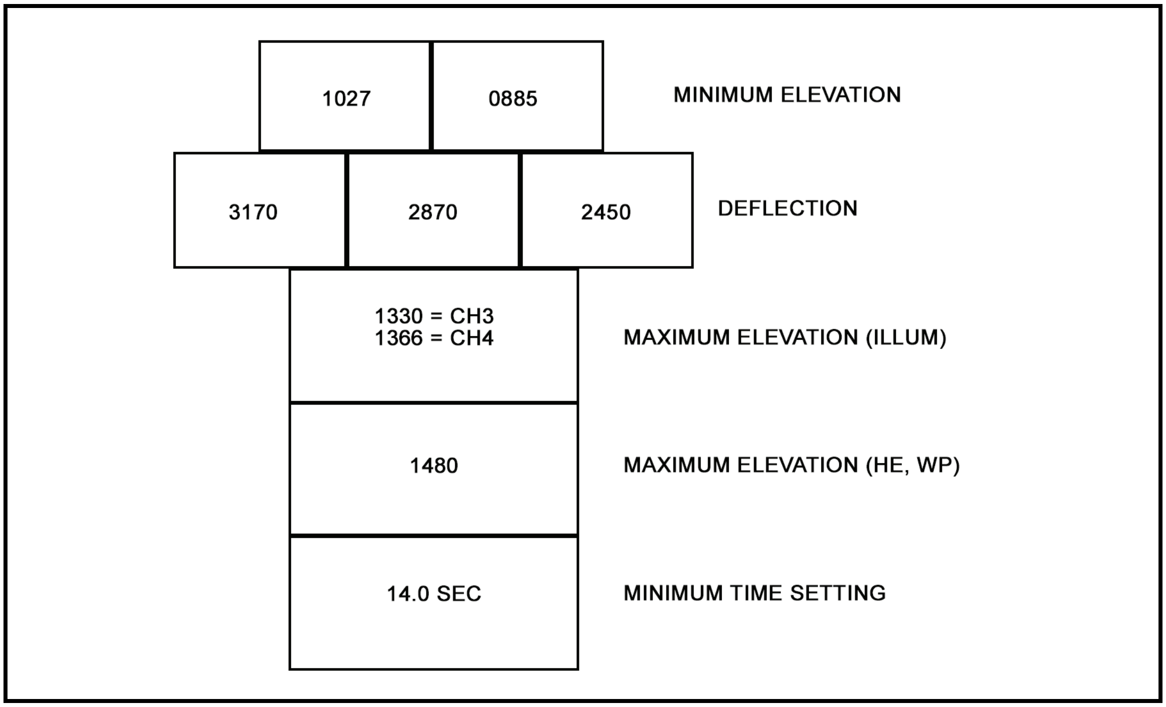


Figure C-4. Safety T.

Appendix D

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 more accurate platoon center location.

GRAPHIC RESECTION

D-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 on the basis of the coordinates of the nearby resected point. The platoon may be required to locate its own 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 procedures:

(1) Identify three distant points that also appear on a map (Figure D-1).

(2) With an aiming circle, measure the azimuth to those points. Preferably, the angles between the points should be greater than 400 mils.

(3) On tracing paper, place a dot representing the aiming circle location.

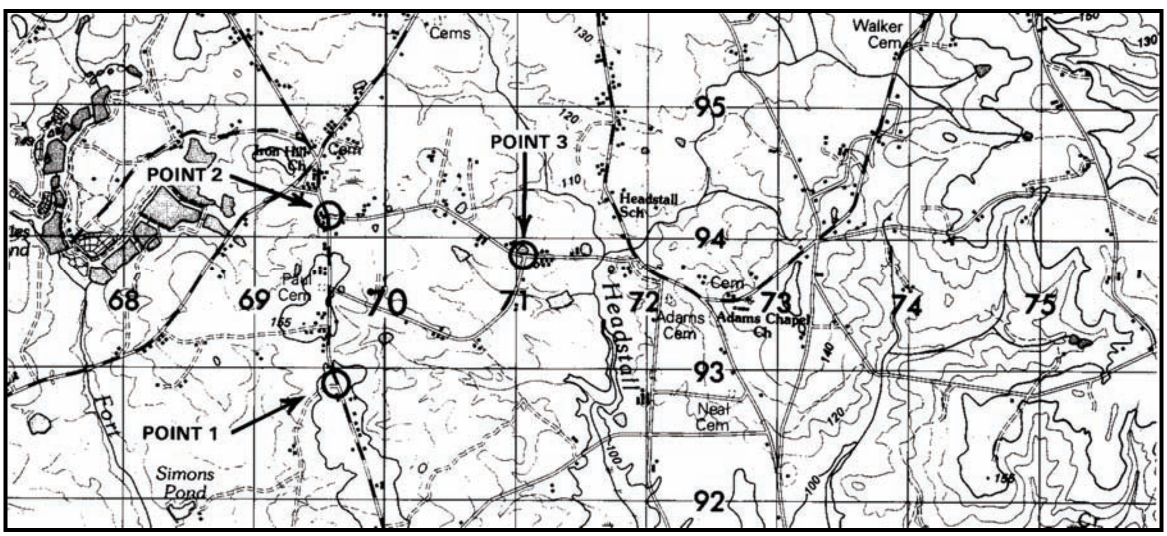


Figure D-1. Three distant points.

(4) Draw a line from this dot in any direction (Figure D-2).

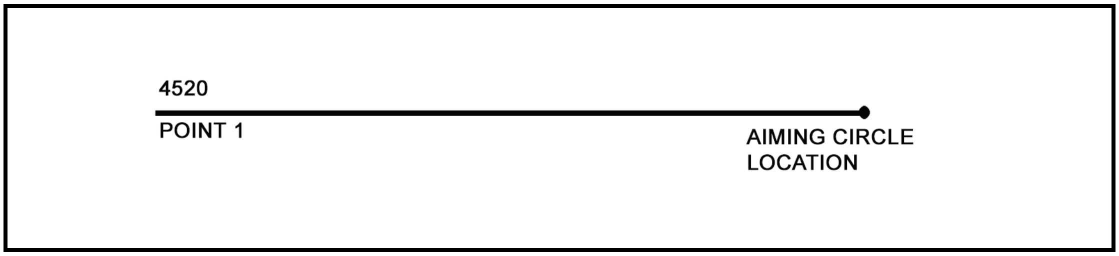


Figure D-2. Line drawn in any direction.

(5) With a protractor aligned with the correct azimuth on the line (Figure D-3), draw two lines from the dot on the measured azimuths (Figure D-4).

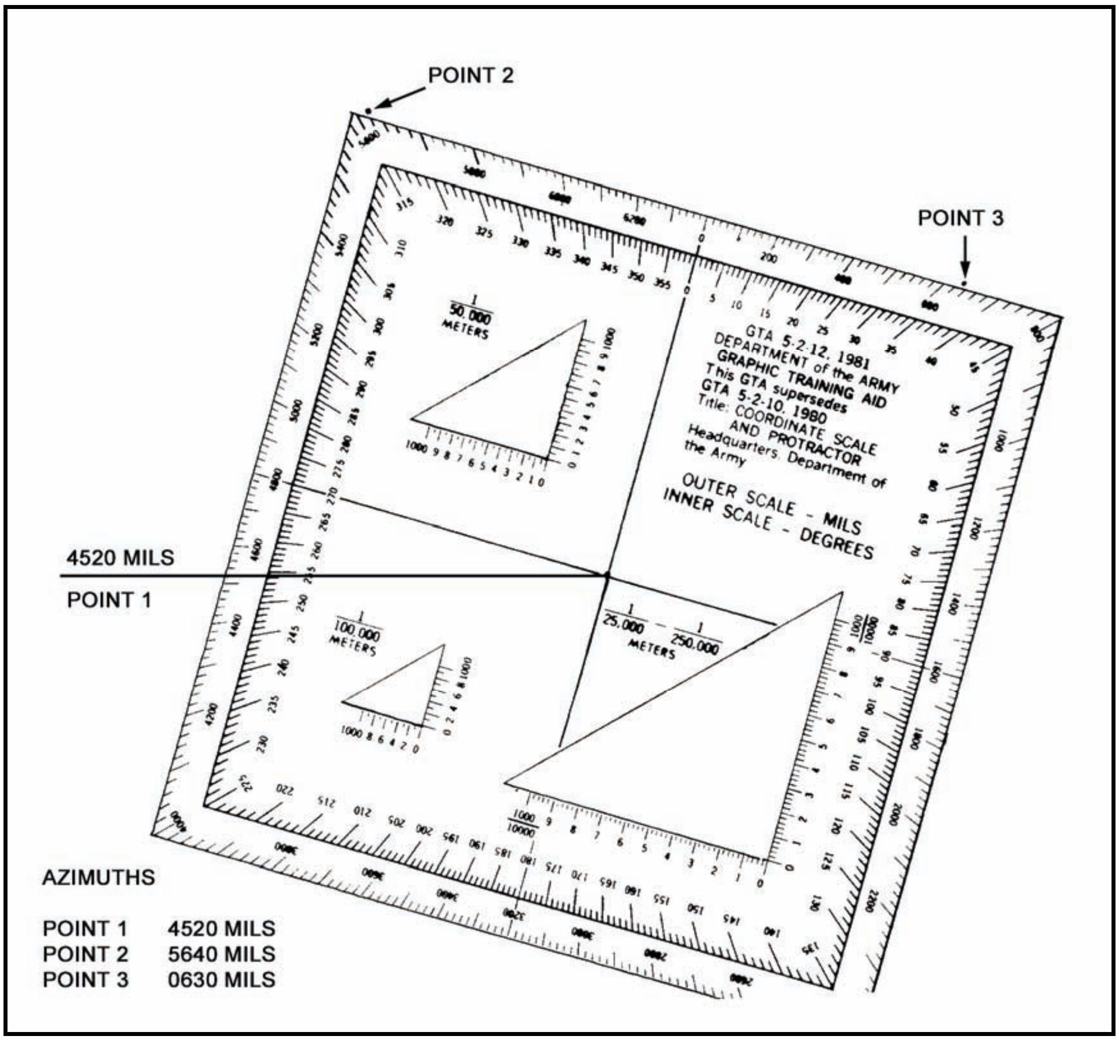


Figure D-3. Protractor aligned with correct azimuth.

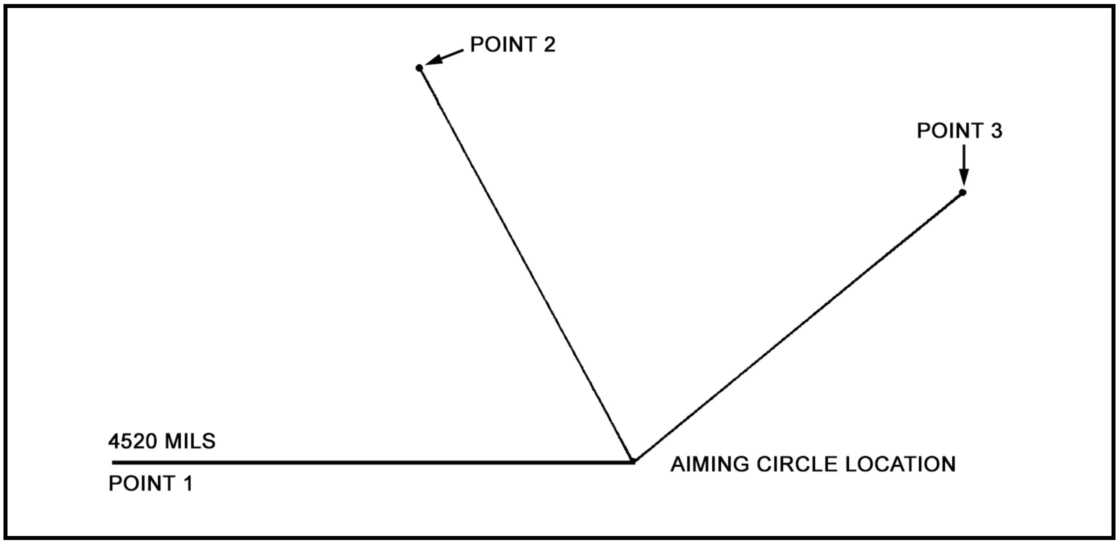


Figure D-4. Two more lines drawn from dot.

(6) 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 (Figure D-5). The dot on the tracing paper represents the location of the aiming circle (mortar position) on the map.

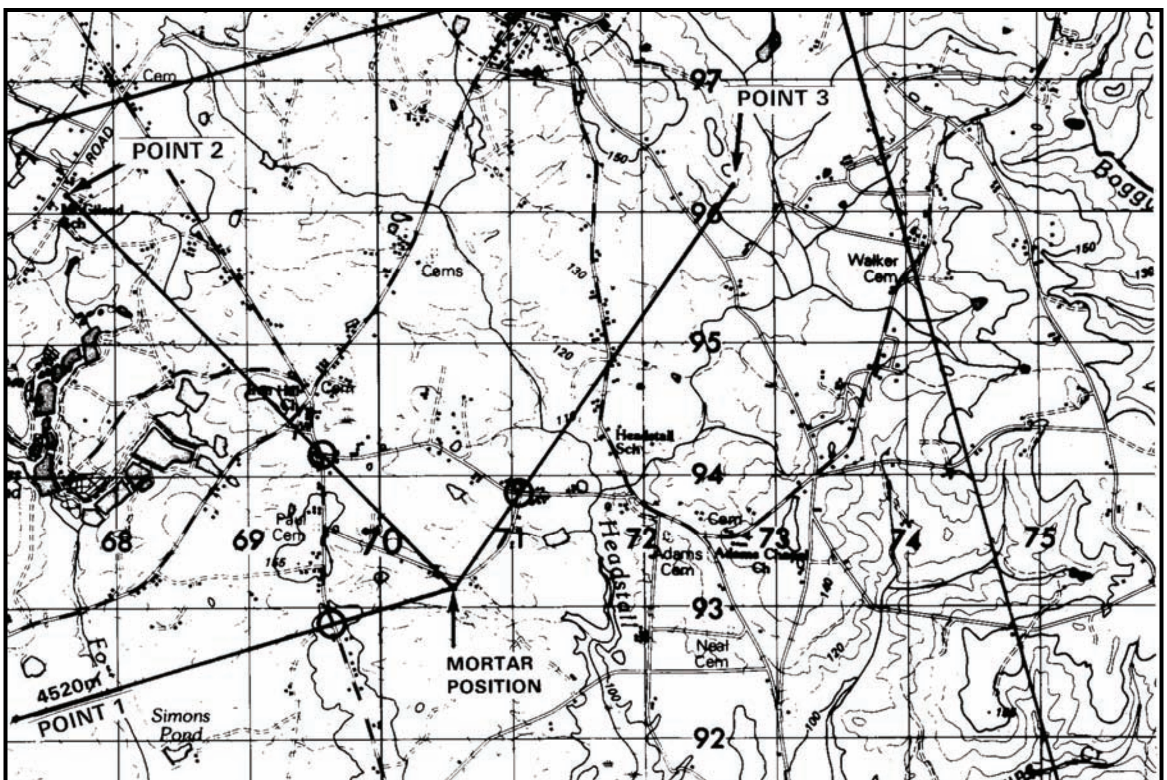


Figure D-5. Positioning of tracing paper.

(7) 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

D-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 (Figure D-6).

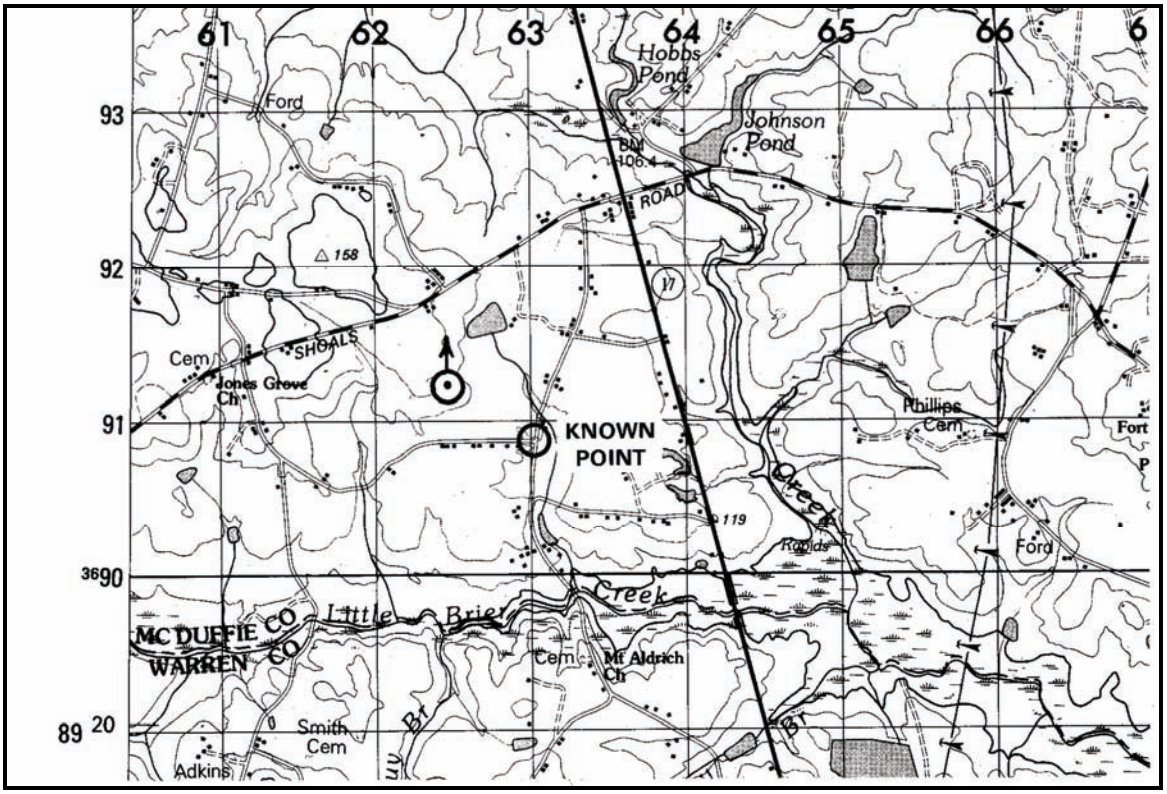


Figure D-6. Hasty survey.

(1) To begin the hasty survey, set the M2 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.

(2) While the "circle" man is measuring the grid's azimuth, an assistant (the "post" man) moves toward the desired mortar position with the two aiming posts. Before moving, the "post" man 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 (Figure D-7).

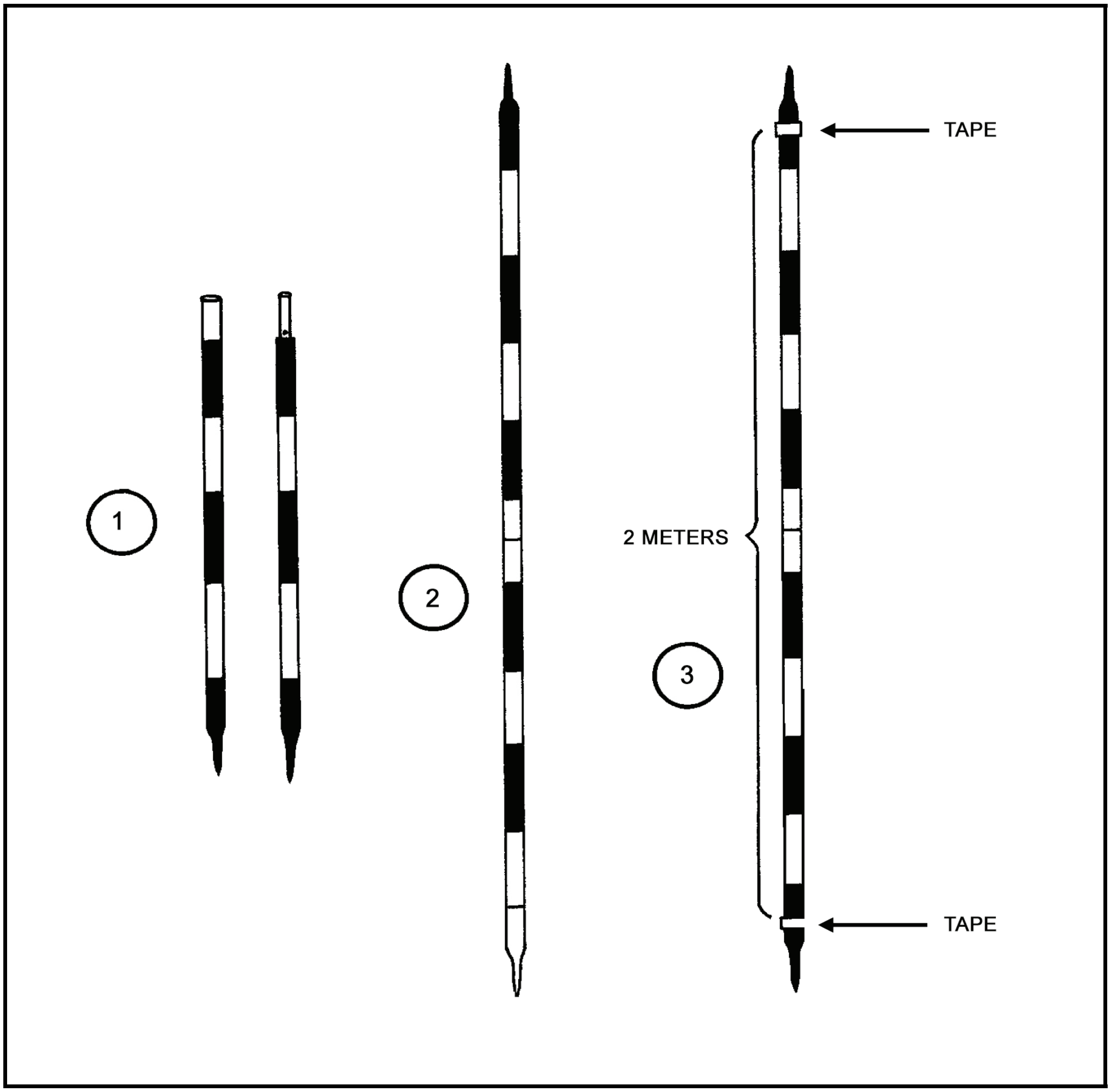


Figure D-7. Subtense bar.

(3) At this point, the first leg of the hasty survey can be done. The “circle” man directs the “post” man to move toward the desired mortar position until he is within 290 meters and to place the post into the ground. This point on the ground becomes traverse station 1 (TS-1).

(4) The “circle” man then rotates the azimuth motion (upper motion) until the vertical crossline in the telescope is on the center of the post. He records the azimuth to the post and labels it traverse leg 1 (TL-1) (Figure D-8).

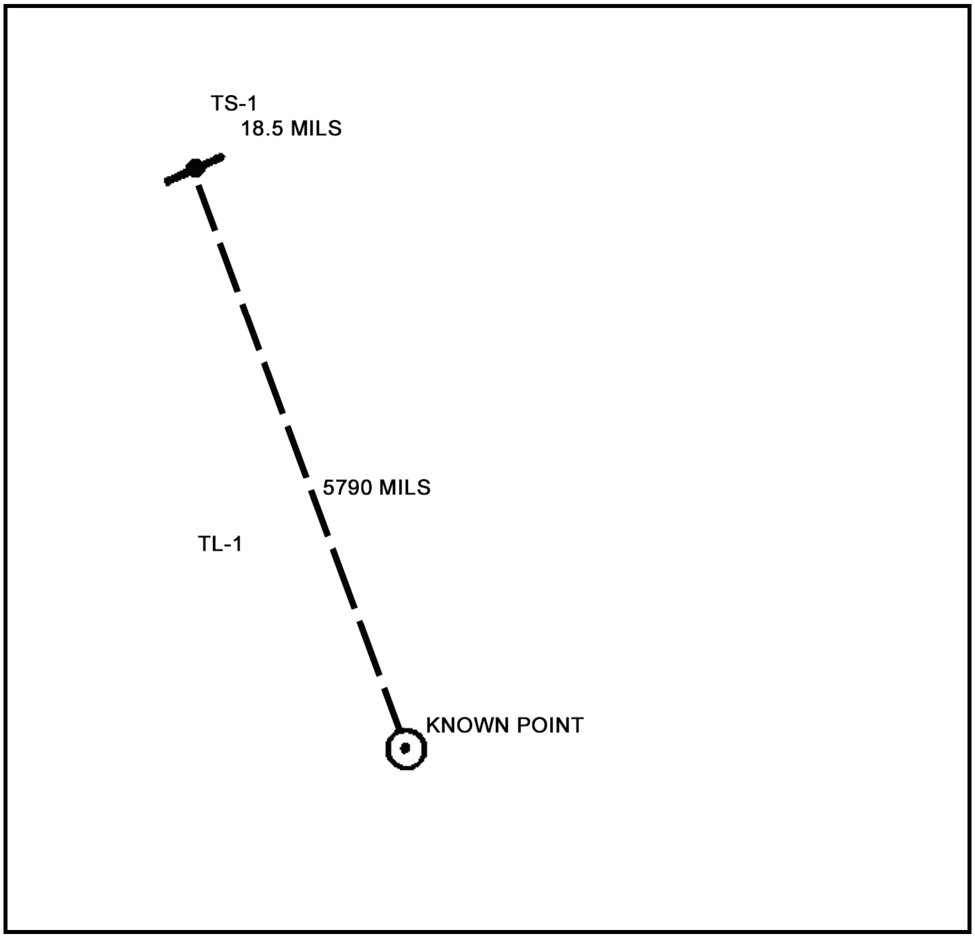


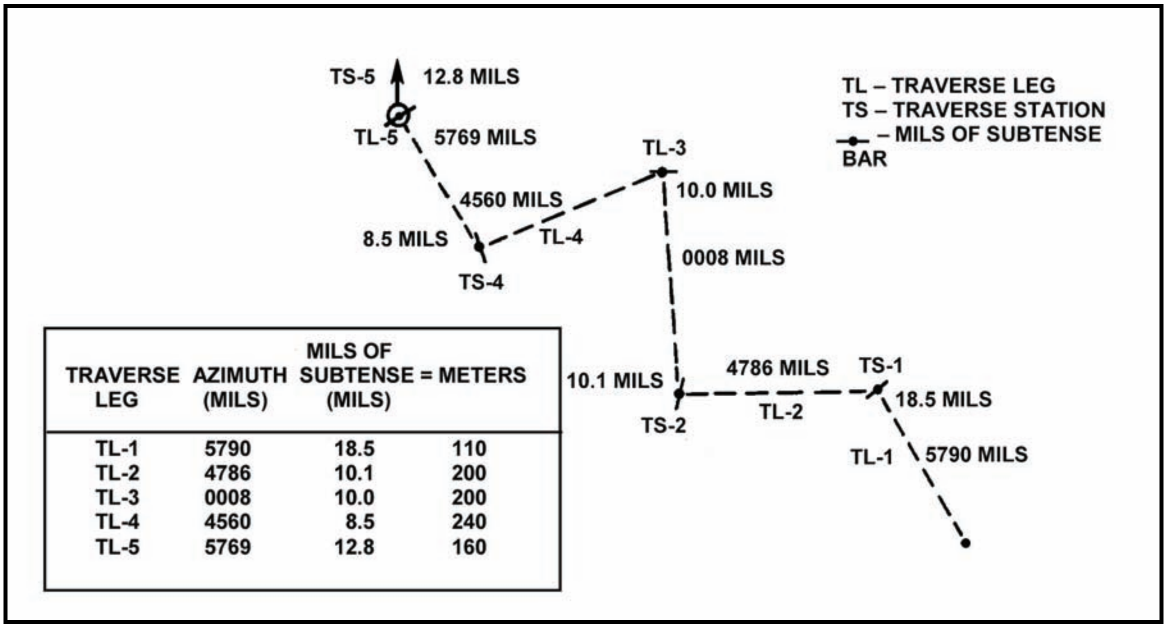
Figure D-8. Traverse leg 1.

(5) Next, the “post” man removes the post and holds it parallel to the ground, facing the aiming circle.

(6) The “circle” man 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 (Figure D-8).

(7) The post is then replaced into the ground and the “circle” man moves forward to this point and sets up the aiming circle directly over this point. This completes the first traverse leg.

(8) 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 traverse station, or a diagram may be constructed (Figure D-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 D-9. Construction of a diagram.

(9) The information recorded by the "circle" man 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.

(10) 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.
- Refer to the distance table (Figure D-10) 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. Again, 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.
- Refer to 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 D-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 (remember: 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.

Appendix E

Fire Direction Center Certification

FDC certification is required for all units with mortars and tests the proficiency of Soldiers to perform their duties as FDC computers and section sergeants. This appendix provides the commander with a means to verify that mortarmen are trained in FDC procedures. FDC certification tests all FDC personnel subject to certification on the M16/M19 plotting board and, depending on their equipment, either on the MBC, MFCS, or LHMBC. This appendix contains an example test for the units; units should develop their own test based on their METL. At a minimum, certification will cover the tasks listed for the primary FDC equipment, the MBC or the MFCS, and the M16/M19 plotting boards. Ninety percent of all section leaders, squad leaders, and FDC personnel will have passed the FDC exam within the past six months.

SECTION I. CONDUCT OF THE PROGRAM

The FDC certification program (FDCCP) consists of a hands-on and written test, in which commanders are responsible for the conduct and certification of the program. For the M16/M19 plotting board, MBC (both the M23 and the M31), MFCS, or LHMBC, participants prepare the equipment and, using the data provided, answer multiple-choice questions. Either component may be changed to conform to a particular mortar organization. Units with the MFCS or LHMBC take the same test on the plotting boards and must meet unit-based certification requirements that cover, as a minimum, the tasks listed in paragraphs E-7 through E-10 for the MFCS and those in paragraphs E-11 through E-14 for the LHMBC. An example of the written test, contained in this appendix, includes multiple choice questions (some of which use the Fort Benning Installation Map as a reference) for units to use as a guide in the development of their own test. The answer key is not included; units should develop their own key when they construct their test.

ELIGIBLE PERSONNEL

E-1. Soldiers should meet the following criteria to be evaluated for certification:

- FDC radiotelephone operation.
- FDC computer.
- Section sergeant.
- Squad leaders that perform FDC operations (CAV, BCT, and so on).

NOTE: All sergeants and the above personnel should be administered an FDC certification, but only personnel that perform FDC operations must certify for live-fire operations. A squad leader's failure to pass the FDC certification does not preclude his squad from firing if that squad operates under a controlling FDC.

QUALIFICATION

E-2. The FDCCP is designed to be a battalion-sponsored program that the battalion commander can use to certify FDC personnel. The goal is to certify all leaders under a standardized evaluation program.

E-3. Soldiers must receive a minimum score of 90 percent on the hands-on/written test for the M16/M19 plotting board and the MBC. Soldiers must be certified on all tasks listed for the MFCS in paragraphs E-7 through E-10 and those for the LHMBC in paragraphs E-11 through E-14. For example, the hands-on/written test in Sections V and VI contains 20 questions on the M16/M19 plotting boards and 55 questions on the MBC; the student must correctly answer 18 and 50 questions respectively.

E-4. 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 FDCCP during the next evaluation. Those who fail a second time should be considered for administrative action.

GENERAL RULES

E-5. The FDCCP should be conducted at regiment/brigade level. Battalions should provide scorers (staff sergeants and above) who are Infantry Mortar Leader's Course (IMLC)/11C or Maneuver Advanced Noncommissioned Officer Course (MANCOC) graduates. Considerable training value can be obtained by using a centralized evaluation and by obtaining the experience of several units' noncommissioned officers (NCOs). Conditions should be the same for all candidates during the certification. The examining board ensures that information obtained by a candidate during testing is not passed to another candidate.

SECTION II. CERTIFICATION

This section outlines the criteria used to test the candidate's ability to perform FDC tasks using the M16/M19 plotting boards, the MFCS, the LHMBC, and the MBC.

M16/M19 PLOTTING BOARD CERTIFICATION

E-6. The candidate analyzes the situation, and then selects the appropriate answer. A Fort Benning Installation Map 1:50,000, Edition 1-DMA, Series: V745Z is required for the example certification test. The certification consists of, but is not limited to, 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.
- Process subsequent FO corrections on all charts.
- Determine data for sheaf adjustments.
- Determine data for registration, re-registration, and application of the corrections.
- Record information on DA Form 2399-R.
- Record MET data using DA Form 3675-R.
- Determine MET corrections using DA Form 2601-1-R and apply MET corrections.
- Locate and compute data for a grid mission.
- Locate and compute data for a polar plot mission.
- Locate and compute data for a shift from a known point mission.
- Compute data for open, converged, and special sheaves.
- Compute data for traversing fire.
- Compute data for searching fire (60-mm, 81-mm, and 120-mm mortars).
- Compute data for battlefield illumination.
- Compute data for a coordinated illumination/HE mission.
- Determine angle T.
- Prepare an FDC order (section sergeant).
- Locate an unknown point on a map or plotting board using intersection.
- Locate an unknown point on a map or plotting board using resection.

MORTAR FIRE CONTROL SYSTEM CERTIFICATION

E-7. This paragraph outlines the criteria used to test the candidate's ability to perform FDC tasks using the MFCS. The certification consists of, but is not limited to, the following tasks:

START AND INITIALIZE THE MORTAR FIRE CONTROL SYSTEM

E-8. Perform the following:

(1) Start up the MFCS on M577 and the M1064A4 carriers in the proper sequence.

(2) Initialize the data and configure the MFCS, which includes inputting and checking data on the following screens:

- Unit List.
- Configuration.
- Data.
- Geographical Reference.
- Position.
- Channel A.
- Channel B.

OPERATE THE MORTAR FIRE CONTROL SYSTEM

E-9. Conduct the following:

(1) Check the status of all guns assigned to the FDC, to include:

- Operational status.
- Location.

(2) Determine the overall status of the fire unit.

(3) Obtain information and update ammunition status, to include:

- Ammunition for each gun.
- Ammunition for all guns controlled by the FDC.
- Ammunition status manually updated.

(4) Obtain information and update MET data, to include:

- Accept and apply new MET data.
- Understand why MET data are highlighted due to exceeding MET trend limits.
- Manually enter or edit the new MET message.

(5) Identify targets or known points, to include:

- Designate a target after a fire mission.
- Manually enter a target or a known point.

(6) Enter and modify a safety fan.

(7) Initiate a check fire message.

(8) Send and receive a PTM.

(9) Respond to and correct alerts, to include—

- Information alerts.
- Reason for error alerts.
- Warning alerts.

CONDUCT FIRE MISSIONS

E-10. Conduct the following:

(1) Receive and transmit a digital fire mission.
(2) Receive, process, and transmit a manual fire mission.
(3) Enter, update, and store an RP.
(4) Process an illumination mission.
(5) Process a coordinated illumination mission.
(6) Initiate and process an FPF mission.
(7) Process a smoke mission.

LIGHTWEIGHT HANDHELD MORTAR BALLISTIC COMPUTER CERTIFICATION

E-11. This paragraph outlines the criteria used to test the candidate's ability to perform FDC tasks using the LHMBC. The certification consists of, but is not limited to, the following tasks:

START AND INITIALIZE THE LIGHTWEIGHT HANDHELD MORTAR BALLISTIC COMPUTER

E-12. Initialize the data and configure the LHMBC, which includes inputting and checking data on the following screens:

- Geographical Reference.
- Setup Data.
- Unit List.
- Setup Commo Parameters

OPERATE THE LIGHTWEIGHT HANDHELD MORTAR BALLISTIC COMPUTER

E-13. Conduct the following:

(1) Obtain information and update ammunition status for each gun.
(2) Obtain information and update MET data, to include:
  - Accepting and applying new MET data.
  - Understanding why MET data are highlighted (due to exceeding MET trend limits).
  - Manually entering or editing the new MET message.
(3) Identify targets or known points, to include:
  - Designating a target after a fire mission.
  - Manually entering a target or a known point.
(4) Enter and modify a safety fan.
(5) Initiate a check fire message.
(6) Send and receive a PTM.
(7) Respond to and correct alerts, to include:
  - Information alerts.
  - Reason for error alerts.
  - Warning alerts.

CONDUCT FIRE MISSIONS

E-14. Conduct the following:

(1) Receive and transmit a digital fire mission.
(2) Receive, process, and transmit a manual fire mission.
(3) Enter, update, and store an RP.
(4) Process an illumination mission.
(5) Process a coordinated illumination mission.
(6) Initiate and process an FPF mission.

MORTAR BALLISTIC COMPUTER CERTIFICATION

E-15. This paragraph outlines the criteria used to test the candidate's ability to perform FDC tasks using the M23 MBC. Units with the M31 MBC should modify this certification to conform to the capabilities of the M31. The certification consists of, but is not limited to, the following tasks:

- Prepare an MBC for operation (minimum initialization).
- Process subsequent FO corrections.
- Determine data for sheaf adjustments.
- Determine data for registration and re-registration.
- Record information on DA Form 2399-R.
- Record MET data using DA Form 2601-1-R or DA Form 2601-2-R.
- Determine MET corrections.
- Compute data for a grid mission.
- Compute data for a shift from a known point mission.
- Compute data for a polar plot mission.
- Compute data for open, converged, and special sheaves.
- Compute data for traversing fire.
- Compute data for searching fire (60-mm, 81-mm, and 120-mm mortars).
- Compute data for battlefield illumination.
- Compute data for a coordinated illumination/HE mission.
- Determine angle T.
- Prepare an FDC order (section sergeant).
- Locate an unknown point using intersection.
- Locate an unknown point using resection.

SECTION III. MORTAR BALLISTIC COMPUTER EXAMPLE TEST

The candidate analyzes the following situations, and then selects the appropriate answer. Figure E-1 shows a completed DA Form 2399-R for Situation A. This example was created using an M23 MBC; however, it may be used as a template to create FDCCP tests for the M31 MBC, M32 LHMBC, and the M95/M96 MFCS.

SITUATION A

The following takes place while operating the MBC.

TASK: Place the MBC into operation using internal or external power sources.
CONDITIONS: Given a BA 5588/U battery, power supply cable, MBC, and a variable power supply.
STANDARDS: Place the MBC into operation.

TASK: Operate the panel switches on the MBC.
CONDITIONS: Given an MBC.
STANDARDS: Operate the panel switches without error.

TASK: Perform the MBC system self-test.
CONDITIONS: Given an operating MBC.
STANDARDS: Perform the self-test without error and report any deficiencies, shortcomings, or failures to your supervisor.

TASK: Prepare an MBC with initialization data.
CONDITIONS: Given an MBC with setup, weapon, and ammunition data.
STANDARDS: Enter the setup, weapon, and ammunition data into the MBC without error.

SETUP
- TIME OUT: 30
- TGT PREFIX: AB
- TN: 0400-0800
- ALARM: OFF
- MIN E: 010
- GD: E01
- LAT: +31
- LISTEN ONLY: OFF
- BIT RATE: 1200
- KEYTONE: 1.4
- BLK: SNG
- OWN ID: A

WEAPON DATA
- UNIT: A Co 2/41 IN
  81-mm (M252)
- CARRIER-MOUNTED: NO
- BP: A2 GRID PA 15880 88950
- ALT 0410
- AZ: 6400 DEF: 2800
- A1: Dir 1600 Dis 035
- A3: Dir 4800 Dis 035
- A4: Dir 4800 Dis 070

AMMO DATA
- TEMP: 70 deg
- HE: M374A2
- WP: M375A2
- ILL: M301A3

TASK: Compute data for a grid mission.
CONDITIONS: Given an initialized MBC, CFF using grid coordinates as the method of target location, DA Form 2399-R, FDC order, and DA Form 2188-R.
STANDARDS: Compute data for the mission's initial fire command to within 1 mil for deflection and elevation.

TASK: Record information on firing records.
CONDITIONS: Given a DA Form 2399-R and DA Form 2188-R, CFF, FO's corrections, information to complete the FDC order, ammunition count, mortar platoon/ section SOP, and MBC.
STANDARDS: Record and compute the mission. Correctly complete all required blocks and spaces on the DA Form 2399-R. Record the information and data needed for the type of mortar and ammunition being fired at the end.

COMPUTER'S RECORD
For use of this form, see FM 3-22.91; The proponent agency is TRADOC.

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
A Co 2/41 IN	06/03/98	0806	T43	AB400

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 1515 9195
OT DIRECTION: 5850
ALTITUDE: 0350

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ –

TARGET DESCRIPTION: Trucks in woodline
METHOD OF ENGAGEMENT:
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: SEC	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ: #2	DEFLECTION CORRECTION:	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd	☐ L ☐ R		
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE: HEQ in ADJ	☐ + ☐ –		
HED in FFE	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE: 2 Rds	☐ + ☐ –	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE: W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-1. Situation A (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

1. What is the initial range?
   - (a) 3018
   - (b) 2970
   - (c) 3087
   - (d) 3047

2. What is the correct initial fire command?

(a)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW .... Sec
SHELL AND FUZE .... HED

MORTAR TO FIRE .... #2
METHOD OF FIRE 1 Rd in ADJ
2 Rds HEQ in FFE
DEFLECTION 3042
CHARGE 6
TIME SETTING ....
ELEVATION 1039

(b)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW .... Sec
SHELL AND FUZE .... HEQ

MORTAR TO FIRE .... #2
METHOD OF FIRE 1 Rd in ADJ
2 Rds in FFE
DEFLECTION 3042
CHARGE 6
TIME SETTING ....
ELEVATION 1030

(c)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW .... Sec
SHELL AND FUZE .... HEQ

MORTAR TO FIRE .... #2
METHOD OF FIRE 1 Rd in ADJ
2 Rds HED in FFE
DEFLECTION 3042
CHARGE 6
TIME SETTING ....
ELEVATION 1019

(d)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW .... Sec
SHELL AND FUZE .... HEQ

MORTAR TO FIRE .... #2
METHOD OF FIRE 1 Rd in ADJ
2 Rds HED in FFE
DEFLECTION 3042
CHARGE 6
TIME SETTING ....
ELEVATION 1039

NOTE: The first round is fired, and the FO sends: RIGHT 100, DROP 100.

TASK:	Compute data for subsequent FO corrections using the MBC.
CONDITIONS:	Given an MBC with a mission already in progress and corrections from the FO.
STANDARDS:	Compute data for the corrections to within 1 mil for deflection and elevation.

NOTE: That round is fired, and the FO sends: DROP 50, FFE.

---

3. What is the correct subsequent fire command for the FFE?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	SEC	2 HEQ	2994			1080
(b)	SEC	2HED	2994			1056
(c)	SEC	2HED	2994			1072
(d)	SEC	2HED	2994			1064

NOTE: The FO sends: END OF MISSION (EOM), 4 TRUCKS DESTROYED, EST 6 CAS. The computer records: EOMRAT AB0400, KNPT 00.

SITUATION B

A fire mission is conducted using the CFF and FDC order in Figure E-2.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			T43	

☐ ADJUST FIRE ☑ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID:
OT DIRECTION:
ALTITUDE:

SHIFT FROM: AB 0400
OT DIRECTION: 5590 ALTITUDE:
☑ LEFT / ☐ RIGHT 800
☐ ADD / ☑ DROP 200
☑ UP / ☐ DOWN 50

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ −

TARGET DESCRIPTION: Troops in woodline
METHOD OF ENGAGEMENT:
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ	DEFLECTION CORRECTION: ☐ L ☐ R	SHELL AND FUZE	
METHOD OF ADJ	RANGE	MORTAR TO FIRE	
BASIS FOR CORRECTION	VI/ALT CORRECTION: ☐ + ☐ −	METHOD OF FIRE	
SHEAF CORRECTION	RANGE CORRECTION: ☐ + ☐ −	DEFLECTION	
SHELL AND FUZE HED	CHARGE/RANGE	CHARGE	
METHOD OF FFE 2 Rds	AZIMUTH	TIME SETTING	
RANGE LATERAL SPREAD	ANGLE T	ELEVATION	
TIME OF OPENING FIRE W/R			

Figure E-2. Call for fire and FDC order (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

TASK: Compute data for a shift from a known point mission.
CONDITIONS: Continued from Situation A.
STANDARDS: Compute data for the mission to within 1 mil for deflection and elevation.

4. What is the correct initial fire command?

(a)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HED
MORTAR TO FIRE	
METHOD OF FIRE	2 Rds
DEFLECTION	3226
CHARGE	5
TIME SETTING	
ELEVATION	0905

(b)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HED
MORTAR TO FIRE	
METHOD OF FIRE	2 Rds
DEFLECTION	3226
CHARGE	4
TIME SETTING	
ELEVATION	0905

(c)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HED
MORTAR TO FIRE	#2
METHOD OF FIRE	2 Rds
DEFLECTION	3226
CHARGE	4
TIME SETTING	
ELEVATION	0953

(d)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HED
MORTAR TO FIRE	
METHOD OF FIRE	2 Rds
DEFLECTION	2842
CHARGE	7
TIME SETTING	
ELEVATION	0980

NOTE: The FO sends: EOM, EST 30 PERCENT CAS. The computer records: EOMRAT AB 0401, KNPT 01.

SITUATION C

The FO calls in a polar plot mission. His location must be determined before the polar plot mission can be computed. (Figure E-3 shows a completed DA Form 2399-R for Situation C.)

TASK:	Determine an unknown location by using resection (SURV key).
CONDITIONS:	Continued from Situation B.
STANDARDS:	Determine the unknown location as a grid coordinate to within 1 meter and record it as an FO location.

NOTE: The FO's call sign is T43. T43 sees KNPT 00 at a direction of 5850 and KNPT 01 at a direction of 5590.

TASK:	Compute firing data for a polar plot mission.
CONDITIONS:	Continued from above and using the CFF and FDC order in Figure E-3.
STANDARDS:	Compute the firing data for the mission to within 1 mil for deflection and elevation.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			T43	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: ____
OT DIRECTION: ____
ALTITUDE: ____

SHIFT FROM: ____
OT DIRECTION: ____ ALTITUDE: ____
☐ LEFT / ☐ RIGHT ____
☐ ADD / ☐ DROP ____
☐ UP / ☐ DOWN ____

POLAR:
OT DIRECTION: 6240 ALTITUDE: ____
DISTANCE: 1800
☐ UP / ☐ DOWN ____
VERTICAL ANGLE ☐ + / ☐ – ____

TARGET DESCRIPTION: POL Point
METHOD OF ENGAGEMENT: WP in FFE
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ: #2	DEFLECTION CORRECTION:	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd	☐L ☐R		
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE: HEQ in ADJ	☐+ ☐–		
WP + HEQ in FFE	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE: 3 WP 3 HEQ	☐+ ☐–	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE: W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-3. Situation C (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

NOTE: The initial round is fired, and the FO sends LEFT 100.

TASK: Compute data for subsequent FO corrections using the MBC.
CONDITIONS: Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS: Compute data for the corrections to within 1 mil for deflection and elevation.

NOTE: The round is fired and the FO sends: LEFT 50, ADD 50, FFE.

TASK: Compute data for subsequent FO corrections using the MBC.
CONDITIONS: Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS: Compute data for the corrections to within 1 mil for deflection and elevation.

5. What is the correct subsequent fire command for the FFE?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	SEC	3 HEQ 3 WP	2470			1092
(b)	SEC	3 HEQ 3 WP	2491			1131
(c)	SEC	3 HEQ 3WP	2470			1092
(d)	SEC	3 HEQ 3 WP	2491			1088

NOTE: The FO calls back: EOM, POL POINT BURNING. The computer records: EOMRAT ABO402, KNPT 02.

6. What is the FO's grid location?
   (a) 16743 89354
   (b) 16843 89254
   (c) 16943 89154
   (d) 16154 89943

NOTE: Clear the computer before starting Situation D.

SITUATION D

Your platoon has moved to a firing range.

SETUP
TIME OUT: 30
TGT PREFIX: AA
TN: 0200-0600
ALARM: OFF
MIN E: 003
MIN N: 089
GD: E01
LAT: +31
LISTEN ONLY: OFF
BIT RATE: 1200
KEYTONE: 1.4
BLK: SNG
OWN ID: A

WEAPON DATA
UNIT: A Co 2/41 IN
81-mm (M252)
CARRIER-MOUNTED: NO
BP: A2 GRID AP 07550 93650
ALT: 0460
AZ: 1600 DEF: 2800
A1: Dir 3200 Dis 035
A3: Dir 6400 Dis 035
A4: Dir 6400 Dis 070

AMMO DATA
TEMP: 70 deg
HE: M374A2
WP: M375A2
ILL: M301A3

FO LOCATION
W13 AP: 08250 92550
ALT: 0500

TASK:	Prepare an MBC with initialization data.
CONDITIONS:	Given an MBC with setup, weapon, ammunition, and FO location data.
STANDARDS:	Enter the setup, weapon, and ammunition data into the MBC without error.

TASK:	Store safety data in the MBC.
CONDITIONS:	Continuation of situation D and safety diagram data.
STANDARDS:	Store the safety diagram data without error.

LLAZ: 1200
RLAZ: 2000
MAX RN: 4000
MIN RN: 0350
MIN CHG: 1
MAX CHG: 8

TASK: Store MET data and update to the current file in the MBC.
CONDITIONS: Given an initialized MBC and a completed DA Form 3677-R (Figure E-4).
STANDARDS: Enter MET data in the MBC without error.

COMPUTER MET MESSAGE
For use of this form, see FM 3-09.15; 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	145	925	09	100	0	017	002

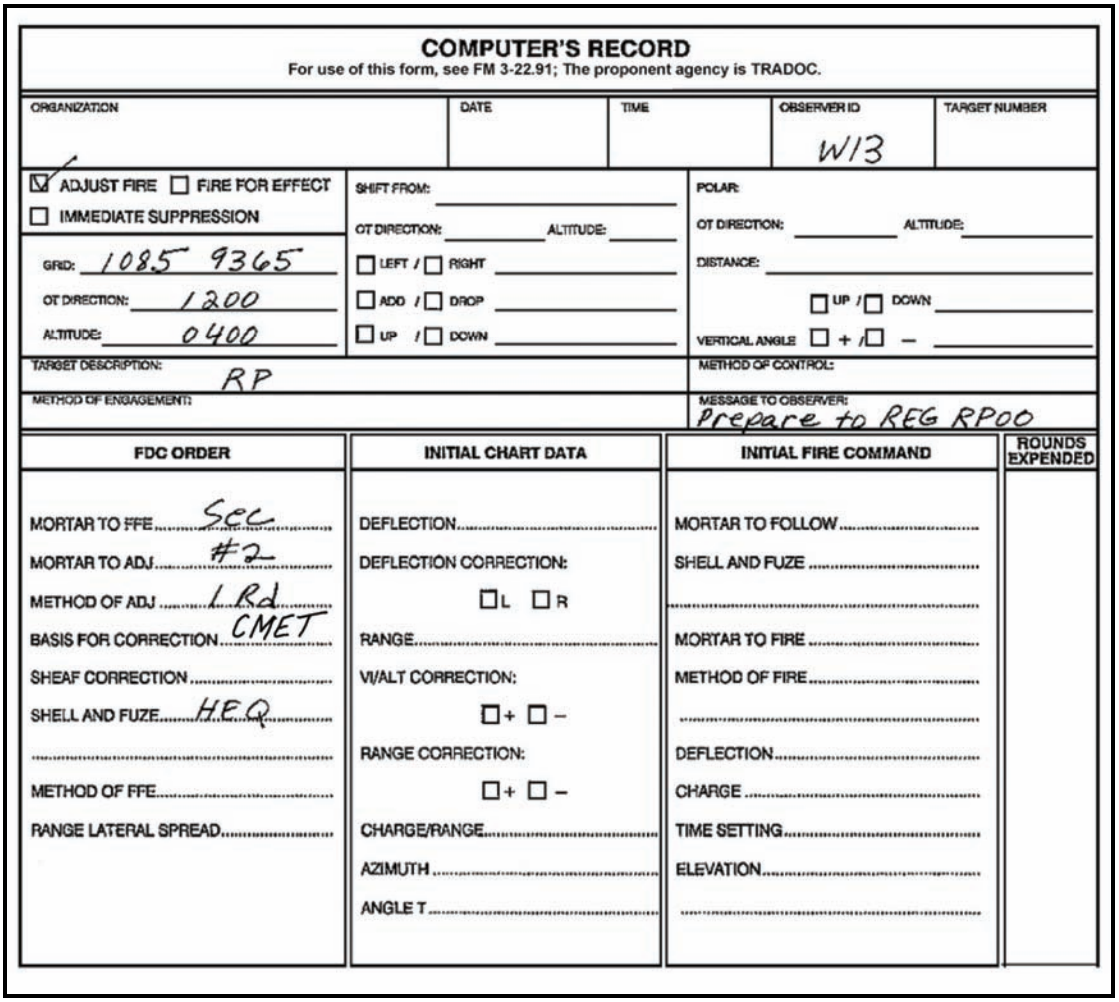
ZONE HEIGHTS METERS	LINE NUMBER ZZ	ZONE VALUES: WIND DIRECTION (10s M) ddd	WIND SPEED (KNOTS) FFF	TEMPERATURE (1/10°K) TTTT	PRESSURE (MILLIBARS) PPPP
SURFACE	00	221	002	2947	1002
200	01	202	007	2976	0991
500	02	220	014	3011	0963
1000	03	190	008	2978	0919
1500	04	000	000	2939	0872
2000	05	063	015	2933	0821
2500	06	052	019	2918	0772
3000	07	058	025	2899	0729
3500	08	064	028	2864	0689
4000	09				
4500	10				
5000	11				
6000	12				
7000	13				
8000	14				
9000	15				
10000	16				
11000	17				
12000	18				
13000	19				
14000	20				
15000	21				
16000	22				
17000	23				
18000	24				
19000	25				
20000	26				

FROM TO	DATE AND TIME (GMT)	DATE AND TIME (LST)
MESSAGE NUMBER	RECORDER	CHECKED

DA FORM 3677-R, MAY 92 PREVIOUS EDITIONS ARE OBSOLETE. APD V1.01

Figure E-4. Situation D: first mission (an example of completed DA Form 3677-R [Computer MET Message]).

TASK: Store MET data and update to the current file in the MBC.
CONDITIONS: Given an initialized MBC and a completed DA Form 3677-R (Figure E-4).
STANDARDS: Enter MET data in the MBC without error.



COMPUTER'S RECORD
For use of this form, see FM 3-22.91; The proponent agency is TRADOC.

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			W13	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 1085 9365
OT DIRECTION: 1200
ALTITUDE: 0400

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ −

TARGET DESCRIPTION: RP
METHOD OF CONTROL:
METHOD OF ENGAGEMENT:
MESSAGE TO OBSERVER: Prepare to REG RP00

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ #2	DEFLECTION CORRECTION: ☐ L ☐ R	SHELL AND FUZE	
METHOD OF ADJ 1 Rd	RANGE	MORTAR TO FIRE	
BASIS FOR CORRECTION CMET	W/ALT CORRECTION: ☐ + ☐ −	METHOD OF FIRE	
SHEAF CORRECTION	RANGE CORRECTION: ☐ + ☐ −	DEFLECTION	
SHELL AND FUZE HE Q	CHARGE/RANGE	CHARGE	
METHOD OF FFE	AZIMUTH	TIME SETTING	
RANGE LATERAL SPREAD	ANGLE T	ELEVATION	

Figure E-5. Situation D: second mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

7. What is the correct initial fire command?

(a)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HEQ
MORTAR TO FIRE	#2
METHOD OF FIRE	1 Rd
2 Rds in FFE	
DEFLECTION	2800
CHARGE	6
TIME SETTING	
ELEVATION	0936

(b)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HEQ
MORTAR TO FIRE	#2
METHOD OF FIRE	1 Rd
DEFLECTION	2800
CHARGE	6
TIME SETTING	
ELEVATION	0965

(c)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HEQ
MORTAR TO FIRE	#2
METHOD OF FIRE	1 Rd
DEFLECTION	2800
CHARGE	6
TIME SETTING	
ELEVATION	0936

(d)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HEQ
MORTAR TO FIRE	#2
METHOD OF FIRE	1 Rd
2 Rds in FFE	
DEFLECTION	2801
CHARGE	6
TIME SETTING	
ELEVATION	0965

8. What is the angle T?
   - (a) 0450 mils
   - (b) 0500 mils
   - (c) 0400 mils
   - (d) 0300 mils

NOTE: The FO sends: LEFT 100, ADD 150.

---

9. What is the correct elevation?
   - (a) 1069 mils
   - (b) 1042 mils
   - (c) 0961 mils
   - (d) 1061 mils

NOTES: 1. The FO sends: RIGHT 50, ADD 50.

2. That round is fired, and the FO sends: DROP 25, EOM, REGISTRATION COMPLETE.

---

10. What is the RCF?
    - (a) +44
    - (b) -51
    - (c) +51
    - (d) -44

11. What is the DEFK?
    - (a) R33
    - (b) R36
    - (c) L36
    - (d) L33

TASK:	Compute data for sheaf adjustment.
CONDITIONS:	Given an initialized MBC, completed registration mission, DA Form 2399-R, and corrections from the FO for the adjustment of the remainder of the section.
STANDARDS:	Adjust the sheaf and determine the sheaf data to within 1 mil for deflection and elevation.

NOTE: The FDC sends an MTO, "Prepare to adjust sheaf," and the FO replies, "Section right."

---

12. What is the correct subsequent command?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	Sec	1 Rd S/R #2 DNF	2840	7		1023
(b)	Sec	1 Rd S/R #2 DNF	2837			1030
(c)	Sec	S/R	2840	7		1023
(d)	Sec	S/R	2838			1050

NOTE: The FO calls back: NUMBER 1 GUN RIGHT 60; NUMBER 3 GUN LEFT 20; NUMBER 4 ADJUSTED.

---

13. What are the correct subsequent commands?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	#1	DNF	1) 2823			
			3) 2845			1017
(b)	#3		2845			
	#1		2823			1017
(c)	#3	DNF	2872			
	#1		2851			1001
(d)	#1		2821			1024
	#3	DNF	2842			

NOTE: The FO spots the last round and sends: EOM, SHEAF ADJUSTED. The computer records as: EOMRAT AA0200, KNPT 00.

SITUATION E

While the section is referring and realigning their aiming posts, the section leader hands you a CFF.

TASK:	Compute data for a shift from a known point mission.
CONDITIONS:	Continue from Situation D using the CFF in Figure E-6.
STANDARDS:	Compute data for the mission to within 1 mil for deflection and elevation.

TASK:	Record all information on firing records.
CONDITIONS:	Given a DA Form 2399-R and DA Form 2188-R, CFF, FO's corrections, information to complete the FDC order, ammunition count, mortar platoon/section SOP, and MBC.
STANDARDS:	Record and compute the mission. Correctly complete all required blocks and spaces on the DA Form 2399-R. Record the information and data needed for the type of mortar and ammunition being fired at the end. Complete the DA Form 2188-R.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			W 13	

- ☑ ADJUST FIRE ☐ FIRE FOR EFFECT
- ☐ IMMEDIATE SUPPRESSION

GRID:
OT DIRECTION:
ALTITUDE:

SHIFT FROM: RP00
OT DIRECTION: 1400 ALTITUDE:
☐ LEFT / ☑ RIGHT 500
☐ ADD / ☑ DROP 200
☐ UP / ☑ DOWN 50

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ –

TARGET DESCRIPTION: TROOPS IN BUNKER
METHOD OF CONTROL:
METHOD OF ENGAGEMENT:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE SEC	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ #2	DEFLECTION CORRECTION: ☐L ☐R	SHELL AND FUZE	
METHOD OF ADJ 1 Rd	RANGE	MORTAR TO FIRE	
BASIS FOR CORRECTION RP00/CMET	VI/ALT CORRECTION: ☐+ ☐–	METHOD OF FIRE	
SHEAF CORRECTION CVG #2	RANGE CORRECTION: ☐+ ☐–	DEFLECTION	
SHELL AND FUZE HEQ IN ADJ HED IN FFE	CHARGE/RANGE	CHARGE	
METHOD OF FFE 3 Rds	AZIMUTH	TIME SETTING	
RANGE LATERAL SPREAD	ANGLE T	ELEVATION	
TIME OF OPENING FIRE W/R			

Figure E-6. Situation E (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

14. What is the correct initial fire command?

(a)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HEQ
MORTAR TO FIRE	#2
METHOD OF FIRE	1 Rd in ADJ 3 Rds HED in FFE
DEFLECTION	2572
CHARGE	6
TIME SETTING	
ELEVATION	1071

(b)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HED
MORTAR TO FIRE	#2
METHOD OF FIRE	1 Rd
DEFLECTION	2674
CHARGE	7
TIME SETTING	
ELEVATION	1047

(c)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HEQ
MORTAR TO FIRE	#2
METHOD OF FIRE	1 Rd in ADJ 3 Rds HED in FFE
DEFLECTION	2671
CHARGE	7
TIME SETTING	
ELEVATION	1054

(d)

INITIAL FIRE COMMAND	
MORTAR TO FOLLOW	Sec
SHELL AND FUZE	HEQ
MORTAR TO FIRE	#2
METHOD OF FIRE	1 Rd in ADJ 3 Rds HED in FFE
DEFLECTION	2674
CHARGE	7
TIME SETTING	
ELEVATION	1047

TASK:	Compute data for subsequent FO corrections using the MBC.
CONDITIONS:	Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS:	Compute data for the corrections to within 1 mil for deflection and elevation.

NOTE: The FO spots the first round and sends: ADD 100. That round is fired, and the FO sends: RIGHT 50, ADD 50, FFE.

TASK: Compute data for a converged sheaf.

CONDITIONS: Given an initialized MBC using a grid coordinate as the method of target location, DA Form 2399-R, and DA Form 2188-R.

STANDARDS: Compute the firing data for the initial and subsequent fire commands to within 1 mil for deflection and elevation.

15. What is the correct subsequent fire command for the FFE?

SUBSEQUENT COMMANDS

	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	Sec	3HED	1) 2662			
			2) 2672			
			3) 2682			
			4) 2692			1030
(b)	Sec	3 HED	1) 2681			1009
			2) 2671			1008
			3) 2661			1006
			4) 2651			1005
(c)			1) 2684			1002
			2) 2674			1000
			3) 2664			0999
			4) 2654			0997
(d)			1) 2674			1000
			2) 2664			0999
			3) 2654			0998
			4) 2644			0998

NOTE: The FO sends: EOM. BUNKER DESTROYED, EST 50 PERCENT CAS EOMRAT AA0201, KNPT 01.

SITUATION F

The FO calls in a new mission.

TASK: Compute data for a grid mission using the CFF and FDC order in Figure E-7.

CONDITIONS: Given an initialized MBC, CFF using grid coordinates as the method of target location, DA Form 2399-R, and DA Form 2188-R.

STANDARDS: Compute data for the mission's initial fire command to within 1 mil for deflection and elevation.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			W13	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 1015 9305
OT DIRECTION: 1320
ALTITUDE: 380

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ –

TARGET DESCRIPTION: Foot Bridge 100M ATT 6350
METHOD OF ENGAGEMENT:
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ #2	DEFLECTION CORRECTION:	SHELL AND FUZE	
METHOD OF ADJ 1 Rd	☐L ☐R		
BASIS FOR CORRECTION SPECIAL	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION 100 M WD	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE HEQ	☐+ ☐–		
	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE 3 Rds	☐+ ☐–	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-7. Situation F (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

NOTE: The initial round is fired, and the FO sends: RIGHT 100, ADD 100.

16. What is the correct subsequent command?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)			2586			0912
(b)			2584			0965
(c)			2686			0941
(d)			2694			1072

NOTE: The FO spots the round and sends: ADD 50, FFE.

TASK:	Compute data for a special sheaf using the CFF and FDC order in Figure E-7.
CONDITIONS:	Given an MBC with a mission already in progress.
STANDARDS:	Compute data for the corrections to within 1 mil for deflection and elevation, and determine turns to the nearest one-half turn.

17. What is the correct subsequent command for the FFE?

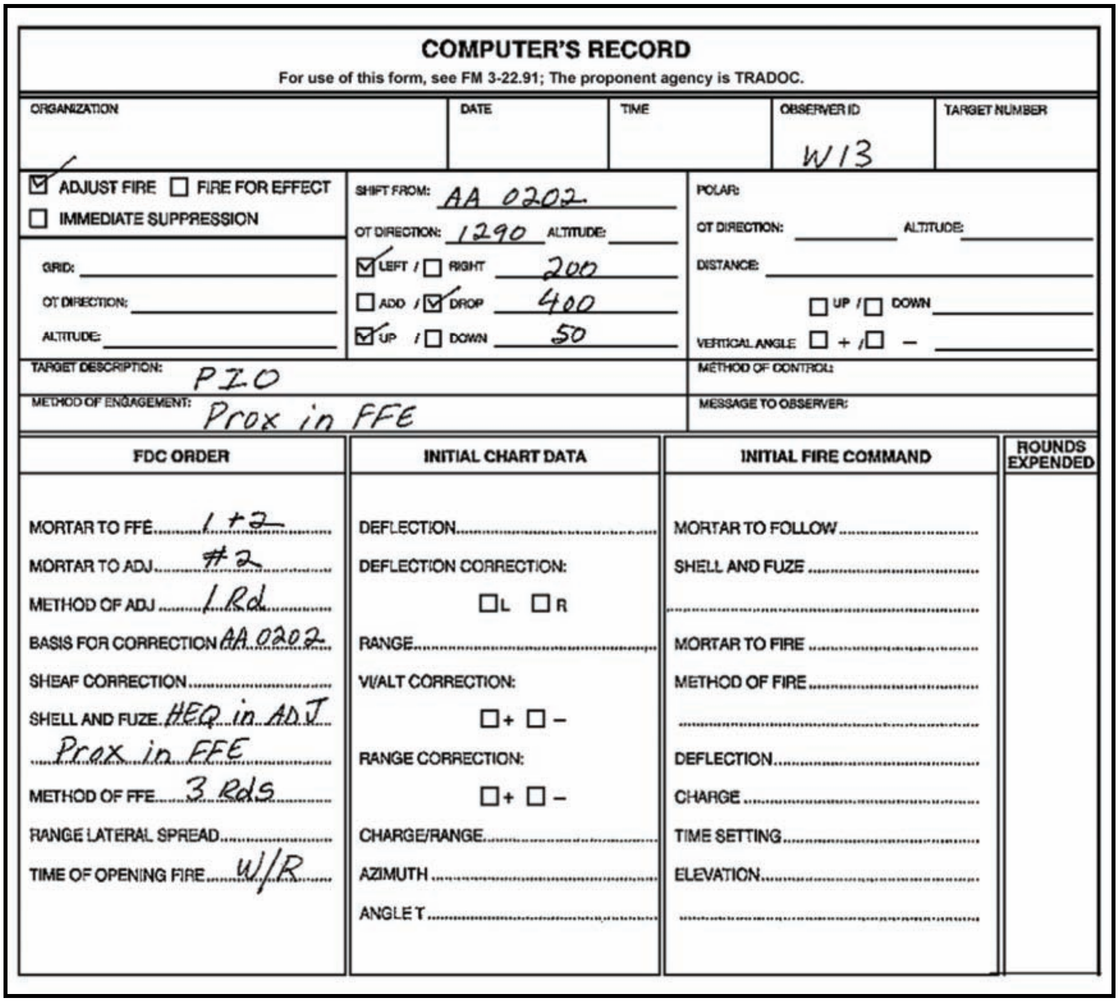
	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	Sec	3Rds	1) 2599	6		1086
			2) 2594			1086
			3) 2605			1080
			4) 2710			1080
(b)	Sec	3Rds	1) 2602	6		1056
			2) 2595			1061
			3) 2589			1065
			4) 2582			1069
(c)	Sec	3Rds	1) 2613	5		1060
			2) 2601			1059
			3) 2589			1056
			4) 2576			1053
(d)	Sec	3Rds	1) 2578			1087
			2) 2569			1072
			3) 2561			1060
			4) 2553			1053

NOTE: The FO sends: EOM, BRIDGE DESTROYED, EOMRAT AA0202, KNPT 02.

SITUATION G

W13 sends in the fire request in Figure E-8.

TASK:	Record information on firing records.
CONDITIONS:	Given a DA Form 2399-R and DA Form 2188-R, CFF, FO's corrections, information to complete the FDC order, ammunition count, mortar platoon/ section SOP, and MBC.
STANDARDS:	Record and compute the mission. Correctly complete all required blocks and spaces on the DA Form 2399-R. Record the information and data needed for the type of mortar and ammunition being fired at the end. Complete the DA Form 2188-R.



COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			W13	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID:
OT DIRECTION:
ALTITUDE:

SHIFT FROM: AA 0202
OT DIRECTION: 1290 ALTITUDE:
☑ LEFT / ☐ RIGHT 200
☐ ADD / ☑ DROP 400
☑ UP / ☐ DOWN 50

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ −

TARGET DESCRIPTION: PIO
METHOD OF ENGAGEMENT: Prox in FFE
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER
MORTAR TO FFE 1+2
MORTAR TO ADJ #2
METHOD OF ADJ 1 Rd
BASIS FOR CORRECTION AA 0202
SHEAF CORRECTION
SHELL AND FUZE HEQ in ADJ
Prox in FFE
METHOD OF FFE 3 Rds
RANGE LATERAL SPREAD
TIME OF OPENING FIRE W/R

INITIAL CHART DATA
DEFLECTION
DEFLECTION CORRECTION:
☐ L ☐ R
RANGE
VI/ALT CORRECTION:
☐ + ☐ −
RANGE CORRECTION:
☐ + ☐ −
CHARGE/RANGE
AZIMUTH
ANGLE T

INITIAL FIRE COMMAND
MORTAR TO FOLLOW
SHELL AND FUZE
MORTAR TO FIRE
METHOD OF FIRE
DEFLECTION
CHARGE
TIME SETTING
ELEVATION

ROUNDS EXPENDED

Figure E-8. Situation G: first mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

W13 immediately sends in another fire request. The section leader assigns No. 1 and No. 2 guns to the first mission (SHIFT), and No. 3 and No. 4 guns to the second mission (POLAR).

TASK:	Compute data for a shift from a known point mission using the CFF and FDC orders in Figure E-8.
CONDITIONS:	Given an initialized MBC, CFF using shift from a known point, DA Form 2399-R, and DA Form 2188-R.
STANDARDS:	Compute data for the mission to within 1 mil for deflection and elevation.

TASK:	Compute firing data for a polar plot mission using the CFF and FDC orders in Figure E-9.
CONDITIONS:	Given an initialized MBC, CFF, DA Form 2399-R, and DA Form 2188-R.
STANDARDS:	Compute the firing data for the mission to within 1 mil for deflection and elevation.

TASK:	Compute firing data for a polar plot mission using the CFF and FDC orders in Figure E-9.
CONDITIONS:	Given an initialized MBC, CFF, DA Form 2399-R, and DA Form 2188-R.
STANDARDS:	Compute the firing data for the mission to within 1 mil for deflection and elevation.

COMPUTER'S RECORD
For use of this form, see FM 3-22.91; The proponent agency is TRADOC.

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			W13	

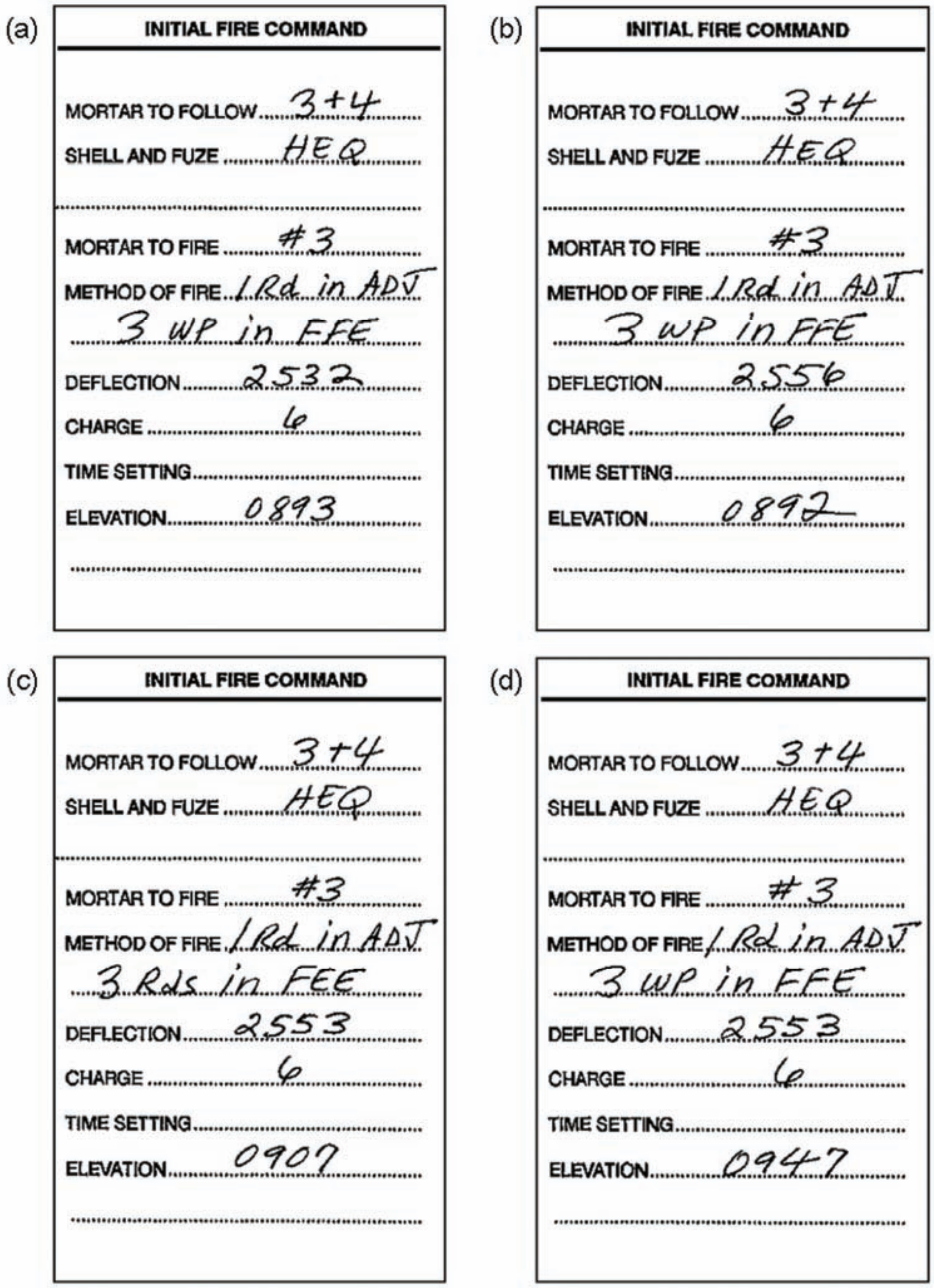
☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION	SHIFT FROM:	POLAR:
GRID:	OT DIRECTION: ALTITUDE:	OT DIRECTION: 1520 ALTITUDE:
OT DIRECTION:	☐ LEFT / ☐ RIGHT	DISTANCE: 2400
ALTITUDE:	☐ ADD / ☐ DROP	☐ UP / ☑ DOWN 100
	☐ UP / ☐ DOWN	VERTICAL ANGLE ☐ + / ☐ −
TARGET DESCRIPTION: Stalled BMP		METHOD OF CONTROL:
METHOD OF ENGAGEMENT:		MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE 3+4	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ #3	DEFLECTION CORRECTION:	SHELL AND FUZE	
METHOD OF ADJ 1 Rd	☐L ☐R		
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE HEQ in ADJ	☐+ ☐−		
WP in FFE	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE 3 Rds	☐+ ☐−	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-9. Situation G: second mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

18. What is the correct range for the first round in mission one?
    - (a) 2,408 meters
    - (b) 3,628 meters
    - (c) 3,354 meters
    - (d) 2,508 meters

19. What is the correct initial fire command for mission two?



(a) INITIAL FIRE COMMAND

MORTAR TO FOLLOW 3+4
SHELL AND FUZE HEQ
MORTAR TO FIRE #3
METHOD OF FIRE 1 Rd in ADJ 3 WP in FFE
DEFLECTION 2532
CHARGE 6
TIME SETTING
ELEVATION 0893

(b) INITIAL FIRE COMMAND

MORTAR TO FOLLOW 3+4
SHELL AND FUZE HEQ
MORTAR TO FIRE #3
METHOD OF FIRE 1 Rd in ADJ 3 WP in FFE
DEFLECTION 2556
CHARGE 6
TIME SETTING
ELEVATION 0892

(c) INITIAL FIRE COMMAND

MORTAR TO FOLLOW 3+4
SHELL AND FUZE HEQ
MORTAR TO FIRE #3
METHOD OF FIRE 1 Rd in ADJ 3 Rds in FFE
DEFLECTION 2553
CHARGE 6
TIME SETTING
ELEVATION 0907

(d) INITIAL FIRE COMMAND

MORTAR TO FOLLOW 3+4
SHELL AND FUZE HEQ
MORTAR TO FIRE #3
METHOD OF FIRE 1 Rd in ADJ 3 WP in FFE
DEFLECTION 2553
CHARGE 6
TIME SETTING
ELEVATION 0947

NOTE: The first mission's initial round is fired, and the FO sends: RIGHT 50, DROP 100.

TASK:	Compute data for subsequent FO corrections using the MBC.
CONDITIONS:	Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS:	Compute data for the corrections to within 1 mil for deflection and elevation.

20. What is the correct subsequent command for mission one?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	#2		2556	4		0939
(b)	#2	1Rd	2547	4		1112
(c)			2543	4		0895
(d)			2543	4		0928

NOTE: The FO spots the round for mission two and sends: DROP 50, FFE.

21. What is the correct subsequent command for the second mission?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	#2		2556	4		0939
(b)	#2	1Rd	2547	4		1112
(c)			2543	4		0895
(d)			2543	4		0928

NOTES: 1. The FO spots the second round for the first mission and sends: ADD 50, FFE.

2. The FO calls back on the second mission: EOM, BMP DESTROYED, EOMRAT AA204, KNPT 04.

22. What is the correct subsequent command for the first FFE mission?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	3+4	3 Prox	2559			1081
(b)	1+2	3Prox	2557	5		1094
(c)	1+2	3Prox	2559			1081
(d)	1+2	3Prox	2557	5		1107

NOTE: The FO sends: EOM, EST 80 PERCENT CAS, EOMRAT AA0203, KNPT03.

SITUATION H

The company commander orders the mortar platoon to displace. The platoon occupies the new position. The initialization data is entered into the MBC.

TASK: Prepare an MBC with initialization data.
CONDITIONS: Given an MBC with weapon and FO location data.
STANDARDS: Enter the weapon and FO location data into the MBC without error.

WEAPON DATA	FO LOCATION
81-MM (M252)	F21 AP: 09850 93100
CARRIER-MOUNTED: NO	ALT: 0300
BP: A2 GRID: AP: 13225 92885	
ALT: 0420	
AZ: 5340 DEF: 2800	
A1: Dir 0540 Dis 035	
A3: Dir 3740 Dis 035	
A4: Dir 3740 Dis 070	

TASK: Store a no-fire line/zone in the MBC.
CONDITIONS: Given an initialized MBC and coordinates for a no-fire line/zone.
STANDARDS: Store a no-fire line/zone without error.

NO-FIRE LOCATION

ZN1 04 PTS
PT1 09450 93300
PT2 10650 93300
PT3 10650 93500
PT4 09450 93500

TASK: Store safety data in the MBC.
CONDITIONS: Given an initialized MBC and a completed safety diagram.
STANDARDS: Store the safety diagram data without error.

SAFETY DATA

LLAZ 4940
RLAZ 5740
MAX RN 3800
MIN RN 0450
MIN CHG 1
MAX CHG 7

The company commander has directed that an FPF be placed at grid 10850 93410. The platoon leader informs the FO, and the FO sends the CFF in Figure E-10.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			F21	FPF

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 1085 9341
OT DIRECTION: 1300
ALTITUDE: 280

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ −

TARGET DESCRIPTION: FPF ATT: 0540
METHOD OF CONTROL: Section Left
METHOD OF ENGAGEMENT: Danger Close HED in ADJ
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ	DEFLECTION CORRECTION: ☐ L ☐ R	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd	RANGE	MORTAR TO FIRE	
BASIS FOR CORRECTION	VI/ALT CORRECTION: ☐ + ☐ −	METHOD OF FIRE	
SHEAF CORRECTION: L140	RANGE CORRECTION: ☐ + ☐ −	DEFLECTION	
SHELL AND FUZE: HED in ADJ, HEQ in FFE	CHARGE/RANGE	CHARGE	
METHOD OF FFE: 5 Rds	AZIMUTH	TIME SETTING	
RANGE LATERAL SPREAD	ANGLE T	ELEVATION	
TIME OF OPENING FIRE: AMC			

Figure E-10. Situation H (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

TASK:	Compute firing data for an FPF.
CONDITIONS:	Given an initialized MBC, a CFF (requesting adjustment of an FPF), DA Form 2399-R, and DA Form 2188-R.
STANDARDS:	Compute data for an FPF to the nearest 1 mil for deflection and elevation.

NOTE: No. 4 gun is the danger close gun.

23. What is the burst point grid for the first round?
    (a) 10850 93410
    (b) 10788 93304
    (c) 10920 93411
    (d) 10790 93000

24. What are the correct initial deflections and elevations?

		DEF (mils)	ELEV (mils)			DEF (mils)	ELEV (mils)
(a)	No. 1	3128	1045	(b)	No. 1	3180	0995
	No. 2	3127	1045		No. 2	3179	0995
	No. 3	3126	1046		No. 3	3178	0994
	No. 4	3200	0900		No. 4	3124	0900
(c)	No. 1	3040	0945	(d)	No. 1	3141	0969
	No. 2	3039	0994		No. 2	3141	0969
	No. 3	3038	0946		No. 3	3141	0969
	No. 4	3200	0900		No. 4	3141	0969

NOTE: The FO spots the round and sends: NO. 4 GUN, LEFT 25, ADD 25.

TASK: Compute data for subsequent FO corrections using the MBC.

CONDITIONS: Given an MBC with a mission already in progress and corrections from the FO to apply.

STANDARDS: Compute data for the corrections to within 1 mil for deflection and elevation.

NOTE: The round is fired and the FO sends: NO. 4 GUN ADJUSTED, REPEAT NO. 3 GUN.

25. What is the correct deflection and elevation for No. 3 gun?

	DEF (mils)	ELEV (mils)		DEF (mils)	ELEV (mils)
(a)	3134	1059	(b)	3124	1050
(c)	3126	3127	(d)	3134	0975

NOTES:
1. The FO spots the round and sends: RIGHT 25.
2. That round is fired, and the FO sends: NO. 3 ADJUSTED, REPEAT NO. 2 GUN.
3. The round is fired, and the FO sends: RIGHT 25, ADD 25.

26. What is the correct deflection and elevation for the No. 2 gun?

	DEF (mils)	ELEV (mils)		DEF (mils)	ELEV (mils)
(a)	3126	0974	(b)	3141	0977
(c)	3127	0975	(d)	3141	0950

NOTES:
1. The round is fired, and the FO sends: NO. 2 ADJUSTED, REPEAT NO. 1 GUN.
2. The round is fired, and the FO sends: EOM, FPF ADJUSTED.

SITUATION I

A short time after adjusting the FPF, you receive the CFF and FDC order in Figure E-11.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			F21	

☐ ADJUST FIRE ☐ FIRE FOR EFFECT
☑ IMMEDIATE SUPPRESSION

GRID: 1065 9435
OT DIRECTION:
ALTITUDE:

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ –

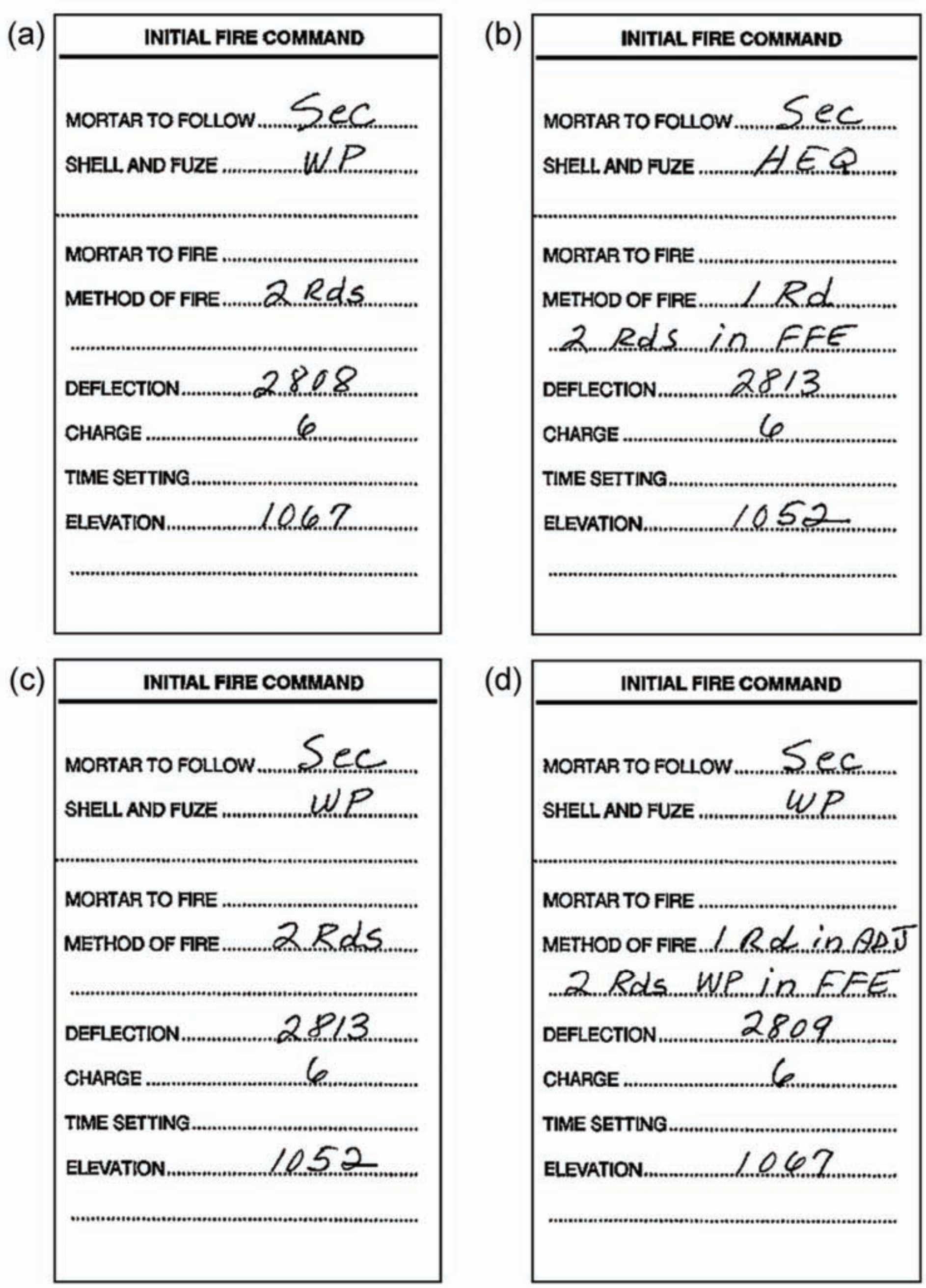
TARGET DESCRIPTION: Smoke
METHOD OF ENGAGEMENT:
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ	DEFLECTION CORRECTION: ☐ L ☐ R	SHELL AND FUZE	
METHOD OF ADJ			
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE: WP	☐ + ☐ –		
	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE: 2 Rds	☐ + ☐ –	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE: W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-11. Situation I (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

TASK:	Compute data for a grid mission using the CFF and FDC order in Figure E-11.
CONDITIONS:	Given an initialized MBC, CFF using grid coordinates as the method of target location, DA Form 2399-R, and DA Form 2188-R.
STANDARDS:	Compute data for the mission's initial fire command to within 1 mil for deflection and elevation.

27. What is the correct initial fire command?



(a) INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE WP
MORTAR TO FIRE
METHOD OF FIRE 2 Rds
DEFLECTION 2808
CHARGE 6
TIME SETTING
ELEVATION 1067

(b) INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE HEQ
MORTAR TO FIRE
METHOD OF FIRE 1 Rd
2 Rds in FFE
DEFLECTION 2813
CHARGE 6
TIME SETTING
ELEVATION 1052

(c) INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE WP
MORTAR TO FIRE
METHOD OF FIRE 2 Rds
DEFLECTION 2813
CHARGE 6
TIME SETTING
ELEVATION 1052

(d) INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE WP
MORTAR TO FIRE
METHOD OF FIRE 1 Rd in ADJ
2 Rds WP in FFE
DEFLECTION 2809
CHARGE 6
TIME SETTING
ELEVATION 1067

NOTE: The FO sends: EOM, AREA SCREENED, EOMRAT AA0205, KNPT 05.

SITUATION J

The commander wants a screen at grid 11850 94150. The platoon leader informed the FSO and the FO. A short time later you receive the CFF in Figure E-12.

TASK:	Compute firing data for a quick-smoke mission.
CONDITIONS:	Given an initialized MBC, call fire (requesting a quick smoke mission), weather conditions, smoke card, DA Form 2399-R, and DA Form 2188-R.
STANDARDS:	Compute the initial and subsequent fire commands to the nearest 1 mil for deflection and elevation, and the correct number of rounds in the FFE.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			F21	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 1185 9415
OT DIRECTION: 1110
ALTITUDE: 300

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ −

TARGET DESCRIPTION: Screen Suspected Enemy Pit 300m Wide.
METHOD OF ENGAGEMENT: Quartering – 9 Min Duration
METHOD OF CONTROL: ATT: 0550
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ: #1	DEFLECTION CORRECTION: ☐ L ☐ R	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd	RANGE	MORTAR TO FIRE	
BASIS FOR CORRECTION	VI/ALT CORRECTION: ☐ + ☐ −	METHOD OF FIRE	
SHEAF CORRECTION	RANGE CORRECTION: ☐ + ☐ −	DEFLECTION	
SHELL AND FUZE: HEQ/WP in ADJ, WP in FFE	CHARGE/RANGE	CHARGE	
METHOD OF FFE	AZIMUTH	TIME SETTING	
RANGE LATERAL SPREAD	ANGLE T	ELEVATION	
TIME OF OPENING FIRE: W/R			

Figure E-12. Situation J (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

NOTE: Temperature gradient: neutral; wind speed: 9 knots; humidity: 60 percent.

28. What is the deflection for the last round fired?

(a) 2468
(b) 2498
(c) 2388
(d) 2598

NOTES: 1. The FO spots the round and sends: LEFT 50, ADD 100.

2. The round is fired and the FO sends: ADD 100.

3. The FO spots the round and sends: REPEAT WP.

4. The FO sees the WP and sends: FFE, CONTINUOUS FIRE FROM THE LEFT.

---

29. What is the time interval between rounds?
(a) 20 seconds
(b) 10 seconds
(c) 12 seconds
(d) 6 seconds

30. What is the total number of WP rounds computed for the mission?
(a) 37 rounds
(b) 40 rounds
(c) 41 rounds
(d) 28 rounds

NOTE: The FO calls back: EOM, AREA SCREENED, EOMRAT AA0206, KNPT 06.

SITUATION K

The platoon leader has been ordered to displace No. 3 and No. 4 guns to a new firing point. Enter the following weapon data:

TASK: Prepare an MBC with initialization data.
CONDITIONS: Given an MBC with weapon data.
STANDARDS: Enter the weapon data into the MBC without error.

WPN DATA
BP: B3
CARRIER-MOUNTED: NO
GRID: 10750 91300
ALT: 0350
AZ: 6400 DEF: 2800
B4: Dir 4900 Dis 040

Shortly after the section occupies its new position, another fire request is received. Use the CFF and FDC order in Figure E-13 to compute the mission.

TASK: Compute firing data for a polar plot mission using the CFF and FDC orders in Figure E-13.

CONDITIONS: Given an initialized MBC, CFF, DA Form 2399-R, and DA Form 2188-R.

STANDARDS: Compute the firing data for the mission to within 1 mil for deflection and elevation.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			W13	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION	SHIFT FROM:	POLAR:
GRID:	OT DIRECTION: ALTITUDE:	OT DIRECTION: 0750 ALTITUDE:
OT DIRECTION:	☐ LEFT / ☐ RIGHT	DISTANCE: 3700
ALTITUDE:	☐ ADD / ☐ DROP	☐ UP / ☑ DOWN 100
	☐ UP / ☐ DOWN	VERTICAL ANGLE ☐ + / ☐ −
TARGET DESCRIPTION: Tanks in Open		METHOD OF CONTROL:
METHOD OF ENGAGEMENT:		MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ # B3	DEFLECTION CORRECTION:	SHELL AND FUZE	
METHOD OF ADJ 1 Rd	☐ L ☐ R		
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE HEQ in ADJ	☐ + ☐ −		
WP in FFE	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE 3 Rds	☐ + ☐ −	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-13. Situation K (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

31. What is the correct initial fire command?

(a)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW B Sec
SHELL AND FUZE
MORTAR TO FIRE #3
METHOD OF FIRE 1 Rd
3 WP in FFE
DEFLECTION 2803
CHARGE 8
TIME SETTING
ELEVATION 0951

(b)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW #1
SHELL AND FUZE HEQ
MORTAR TO FIRE
METHOD OF FIRE 1 Rd
3 WP in FFE
DEFLECTION 2803
CHARGE 8
TIME SETTING
ELEVATION 0981

(c)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW B Sec
SHELL AND FUZE HEQ
MORTAR TO FIRE #3
METHOD OF FIRE 1 Rd in ADJ
3 Rds WP in FFE
DEFLECTION 2796
CHARGE 8
TIME SETTING
ELEVATION 0962

(d)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE HEQ
MORTAR TO FIRE #1
METHOD OF FIRE 1 Rd in ADJ
3 Rds WP in FFE
DEFLECTION 2796
CHARGE 8
TIME SETTING
ELEVATION 0962

TASK: Compute data for subsequent FO corrections using the MBC.
CONDITIONS: Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS: Compute data for the corrections to within 1 mil for deflection and elevation.

NOTE: The FO sends the correction: ADD 50, FFE.

32. What is the correct subsequent command?

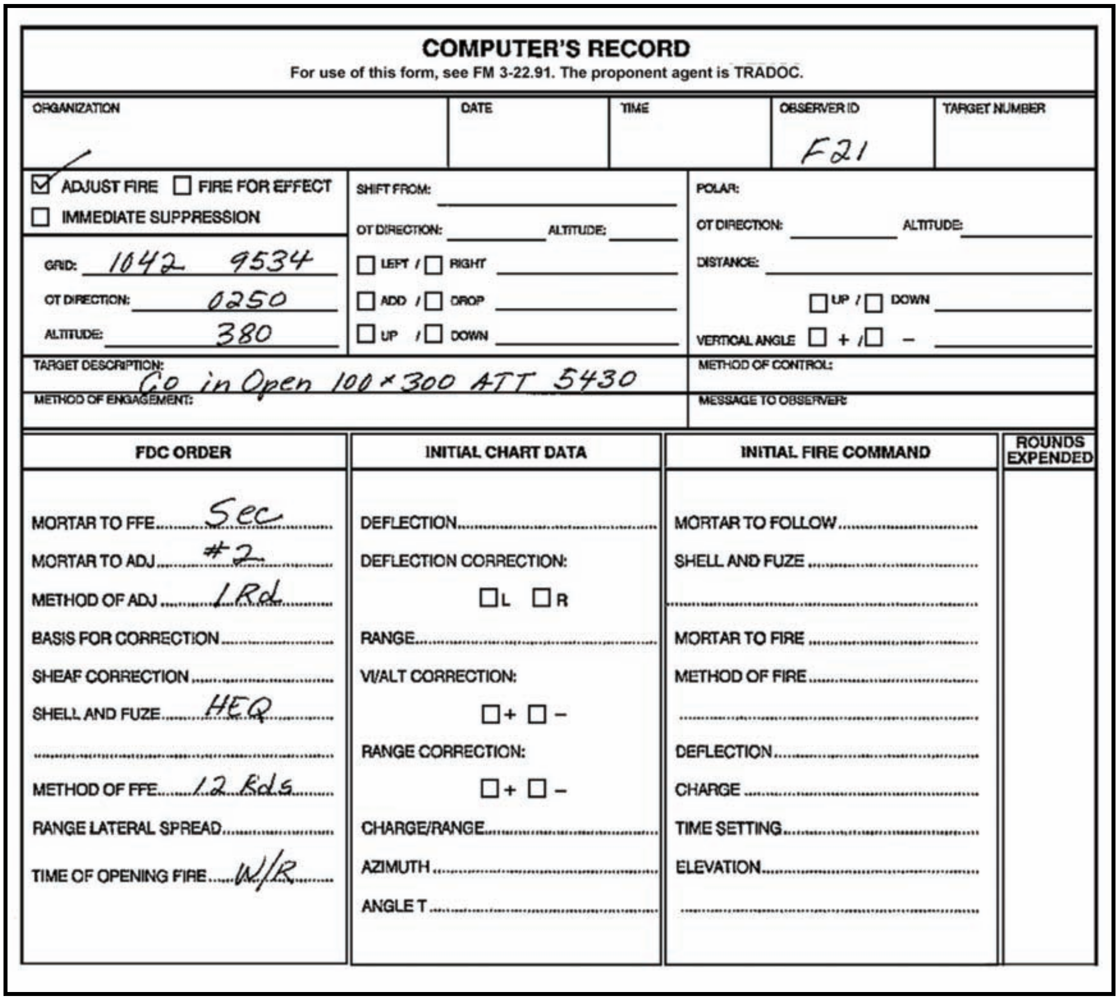
	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	Sec	3 Rds WP	B3+4 2787			0949
			#1+2 2536			1033
(b)	Sec	3 Rds WP	B3+4 2794			0968
			#1+2 2542			1039
(c)	Sec	3 Rds WP	2787			0949
(d)	Sec	3 Rds WP	2536			1033

NOTE: The FO sends: EOM, TANKS BURNING, EOMRAT AA0207, KNPT 07.

SITUATION L

The No. 3 and No. 4 guns have now displaced back to their position with the rest of the platoon. Another mission is received in the FDC. Use the CFF and FDC order in Figure E-14 to compute the mission.

TASK: Compute data for a searching mission using the CFF and FDC order in Figure E-14.
CONDITIONS: Given an MBC with a mission already in progress.
STANDARDS: Compute data for the corrections to within 1 mil for deflection and elevation, and determine turns to the nearest one-half turn.



COMPUTER'S RECORD

For use of this form, see FM 3-22.91. The proponent agent is TRADOC.

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			F21	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 1042 9534
OT DIRECTION: 0250
ALTITUDE: 380

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ −

TARGET DESCRIPTION: Co in Open 100 × 300 ATT 5430
METHOD OF ENGAGEMENT:
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ: #2	DEFLECTION CORRECTION:	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd	☐ L ☐ R		
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE: HEQ	☐ + ☐ −		
	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE: 12 Rds	☐ + ☐ −	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE: W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-14. Situation L (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

TASK: Compute data for subsequent FO corrections using the MBC.
CONDITIONS: Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS: Compute data for the corrections to within 1 mil for deflection and elevation.

NOTES: 1. The FO spots the initial round and sends a correction: RIGHT 200, DROP 200.

2. That round is fired, and the FO sends his next correction: LEFT 50, DROP 100.

3. That round is fired, and the observer calls back: ADD 50, FFE.

---

33. What is the correct deflection, charge, and elevation for the near edge of the target?

	DEF (mils)	CHG	ELEV (mils)		DEF (mils)	CHG	ELEV (mils)
(a)	2652	6	1062	(b)	2642	7	1083
(c)	2645	7	1072	(d)	2642	7	1072

34. What is the correct deflection, charge, and elevation to the far edge of the target?

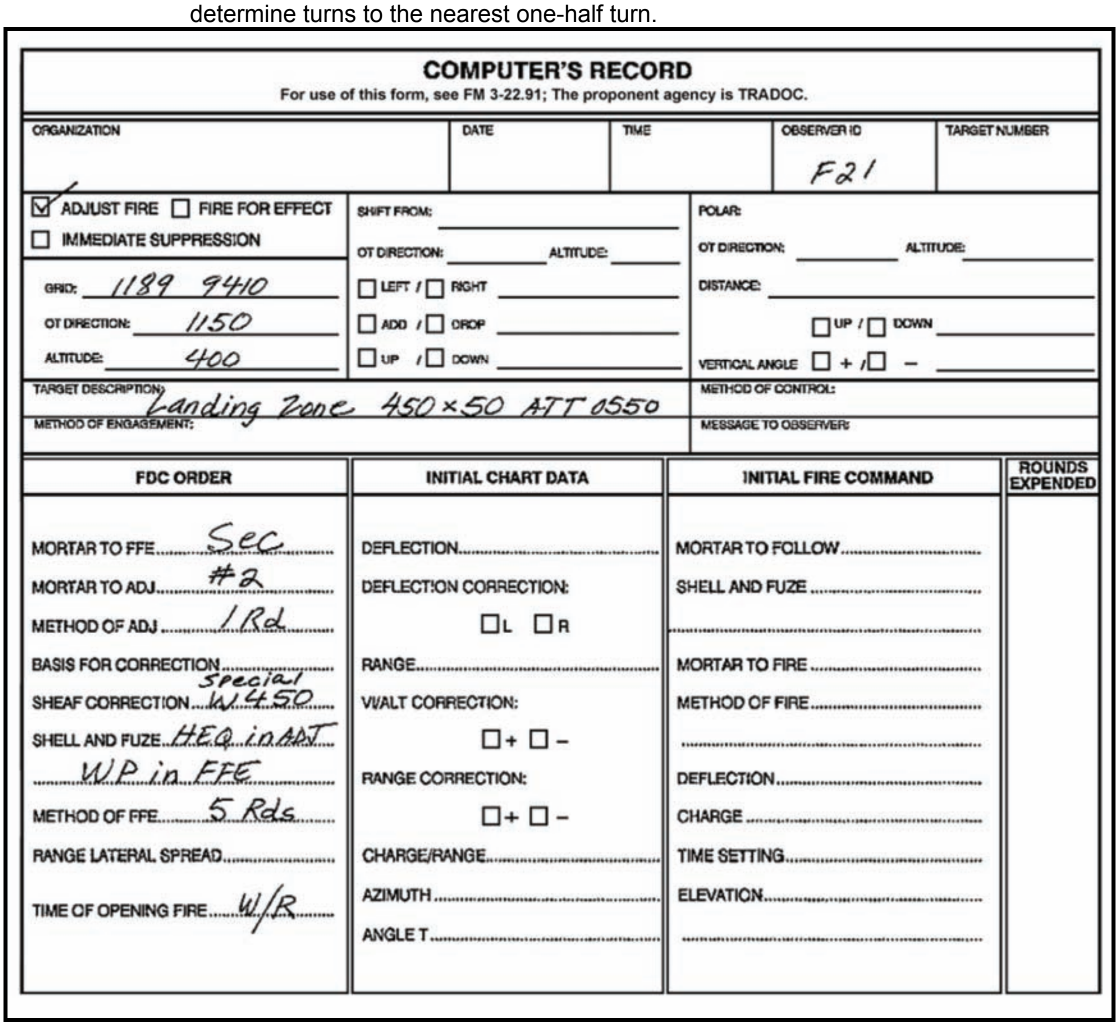
	DEF (mils)	CHG	ELEV (mils)		DEF (mils)	CHG	ELEV (mils)
(a)	2649	6	0982	(b)	2649	7	0997
(c)	2645	7	1051	(d)	2649	7	0982

NOTE: The FO observes the FFE and sends: EOM, TROOPS DISPENSING, EOMRAT AA0208, KNPT 08.

SITUATION M

Just at dusk of the same day, the FDC receives another fire request. Use the CFF and FDC order in Figure E-15 to compute the mission.

TASK:	Compute data for a traversing mission using the CFF and FDC order in Figure E-15.
CONDITIONS:	Given an MBC with a mission already in progress.
STANDARDS:	Compute data for the corrections to within 1 mil for deflection and elevation, and determine turns to the nearest one-half turn.



COMPUTER'S RECORD
For use of this form, see FM 3-22.91; The proponent agency is TRADOC.

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			F21	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 1189 9410
OT DIRECTION: 1150
ALTITUDE: 400

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ −

TARGET DESCRIPTION: Landing Zone 450×50 ATT 0550
METHOD OF ENGAGEMENT:
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ #2	DEFLECTION CORRECTION: ☐L ☐R	SHELL AND FUZE	
METHOD OF ADJ 1 Rd	RANGE	MORTAR TO FIRE	
BASIS FOR CORRECTION	VI/ALT CORRECTION: ☐+ ☐−	METHOD OF FIRE	
SHEAF CORRECTION Special W450	RANGE CORRECTION: ☐+ ☐−	DEFLECTION	
SHELL AND FUZE HE Q in ADJ WP in FFE	CHARGE/RANGE	CHARGE	
METHOD OF FFE 5 Rds	AZIMUTH	TIME SETTING	
RANGE LATERAL SPREAD	ANGLE T	ELEVATION	
TIME OF OPENING FIRE W/R			

Figure E-15. Situation M (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

TASK:	Compute data for subsequent FO corrections using the MBC.
CONDITIONS:	Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS:	Compute data for the corrections to within 1 mil for deflection and elevation.

NOTES: 1. The FO spots the round and sends the correction: LEFT 200, DROP 200.

2. The round is fired, and the FO sends another correction: RIGHT 100, ADD 25.

3. The round is spotted by the FO, and he sends the correction: LEFT 50, FFE, TRAVERSE RIGHT.

35. What is the subsequent command for the FFE?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	Sec	6 Rds WP	1) 2580			1119
			2) 2638			1126
			3) 2696			1131
			4) 2713			1147
(b)	Sec	5 Rds WP	1) 2645	Traverse Right	1 turn	1115
			2) 2685			1119
			3) 2724			0862
			4) 2762			0867
(c)	Sec	5 Rds WP	1) 2598	Traverse Right	1 turn	1122
			2) 2637			1126
			3) 2677			1129
			4) 2716			1132
(d)	Sec	6 Rds WP	1) 2617			1124
			2) 2676			1129
			3) 2735			0910
			4) 2762			0915

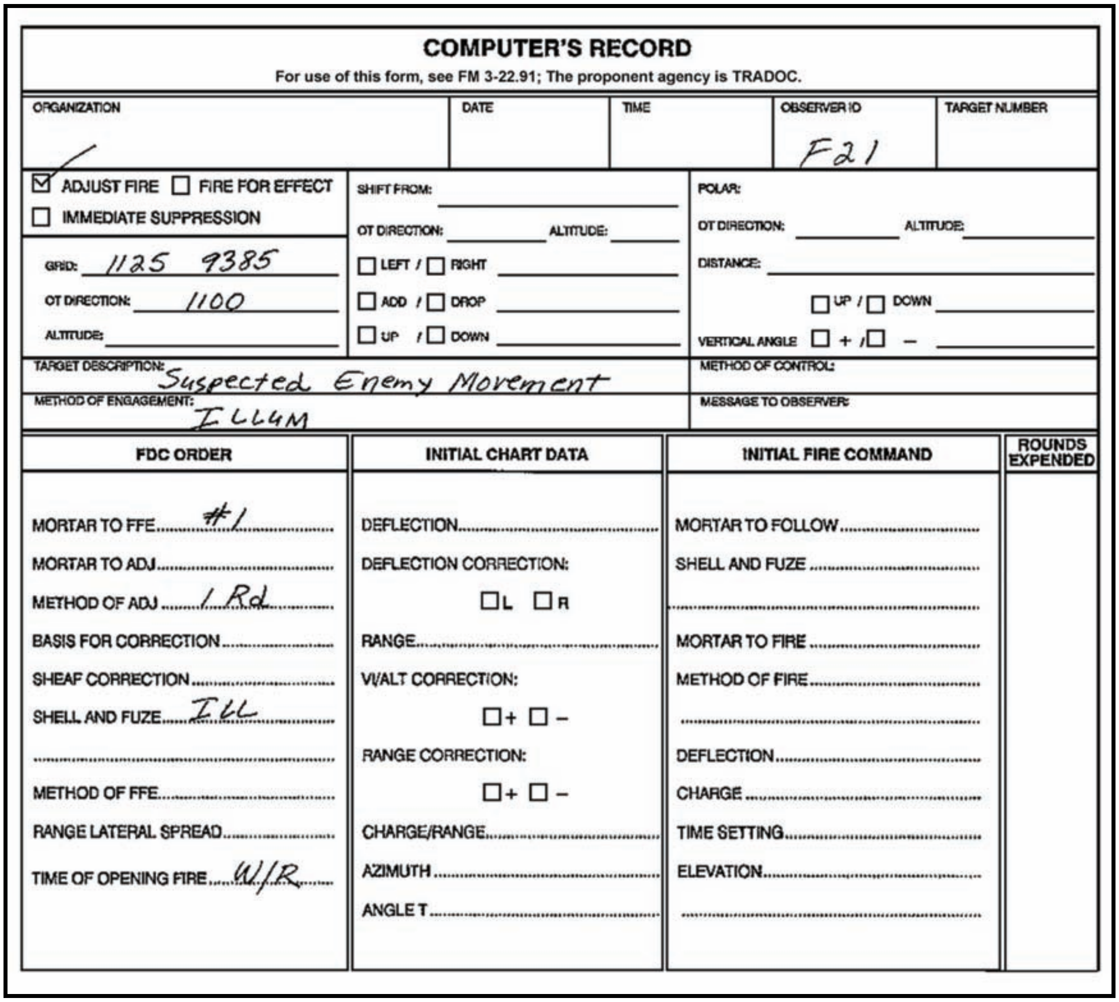
36. How many turns are there between rounds?
   (a) 1/2 turn
   (b) 1 turn
   (c) 1 1/2 turns
   (d) 2 turns

NOTE: The FO observes the FFE and sends: EOM LZ DESTY.

SITUATION N

It is now dark and the platoon is prepared for night firing. The FDC receives a fire request. Use the CFF and FDC order in Figure E-16 to compute the mission.

TASK:	Compute firing data for an illumination mission.
CONDITIONS:	Given an initialized MBC, CFF, DA Form 2399-R, and DA Form 2188-R.
STANDARDS:	Compute data for an illumination mission to the nearest 1 mil for deflection and elevation, and time setting to within one-tenth of a second.



COMPUTER'S RECORD

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

ORGANIZATION | DATE | TIME | OBSERVER ID: F21 | TARGET NUMBER

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 1125 9385
OT DIRECTION: 1100
ALTITUDE:

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ –

TARGET DESCRIPTION: Suspected Enemy Movement
METHOD OF CONTROL:
METHOD OF ENGAGEMENT: ILLUM
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: #1	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ	DEFLECTION CORRECTION: ☐L ☐R	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd			
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION: ☐+ ☐–	METHOD OF FIRE	
SHELL AND FUZE: ILL			
	RANGE CORRECTION: ☐+ ☐–	DEFLECTION	
METHOD OF FFE		CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE: W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-16. Situation N (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

TASK:	Compute data for subsequent FO corrections using the MBC.
CONDITIONS:	Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS:	Compute data for the corrections to within 1 mil for deflection and elevation.

NOTE: The round is fired and the FO sends the correction: RIGHT 200, DROP 400, DOWN 100.

37. What is the correct subsequent command?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	#1	1 Rd	3088		26.4	1026
(b)			3089		28.9	1021
(c)	#1	1 Rd	3089		26.4	1026
(d)			3088		26.4	1026

TASK: Compute data for a coordinated illumination mission using the CFF in Figure E-17.

CONDITIONS: Given an initialized MBC, CFF, DA Form 2399-R, and DA Form 2188-R.

STANDARDS: Compute firing data for the deflection and elevation to within 1 mil for all high-explosive and illumination rounds for the initial and subsequent fire commands.

NOTE: The round is fired, and the FO sends a coordinated illumination and HE CFF.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			F21	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION	SHIFT FROM:	POLAR:
GRID: 1125 9385	OT DIRECTION: ALTITUDE:	OT DIRECTION: ALTITUDE:
OT DIRECTION: 1100	☐ LEFT / ☐ RIGHT	DISTANCE:
	☐ ADD / ☐ DROP	☐ UP / ☐ DOWN
ALTITUDE: 300	☐ UP / ☐ DOWN	VERTICAL ANGLE ☐ + / ☐ −
TARGET DESCRIPTION: Enemy Veh		METHOD OF CONTROL:
METHOD OF ENGAGEMENT: WP in FFE		MESSAGE TO OBSERVER:

Figure E-17. Situation N: second mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

38. What is the correct FDC order?

(a)

FDC ORDER	
MORTAR TO FFE	2 + 3
MORTAR TO ADJ	#2
METHOD OF ADJ	1 Rd
BASIS FOR CORRECTION	
SHEAF CORRECTION	
SHELL AND FUZE	HEQ in ADJ WP in FFE
METHOD OF FFE	3 Rds
RANGE LATERAL SPREAD	
TIME OF OPENING FIRE	W/R

(b)

FDC ORDER	
MORTAR TO FFE	Sec
MORTAR TO ADJ	#2
METHOD OF ADJ	1 Rd
BASIS FOR CORRECTION	
SHEAF CORRECTION	
SHELL AND FUZE	HEQ in ADJ WP in FFE
METHOD OF FFE	3 Rds
RANGE LATERAL SPREAD	
TIME OF OPENING FIRE	AMC

(c)

FDC ORDER	
MORTAR TO FFE	2 + 3 + 4
MORTAR TO ADJ	#2
METHOD OF ADJ	1 Rd
BASIS FOR CORRECTION	
SHEAF CORRECTION	
SHELL AND FUZE	HEQ in ADJ WP in FFE
METHOD OF FFE	3 Rds
RANGE LATERAL SPREAD	
TIME OF OPENING FIRE	AMC

(d)

FDC ORDER	
MORTAR TO FFE	Sec
MORTAR TO ADJ	#2
METHOD OF ADJ	1 Rd
BASIS FOR CORRECTION	
SHEAF CORRECTION	
SHELL AND FUZE	HEQ in ADJ WP in FFE
METHOD OF FFE	3 Rds
RANGE LATERAL SPREAD	
TIME OF OPENING FIRE	W/R

TASK: Compute data for subsequent FO corrections using the MBC.
CONDITIONS: Given an MBC with a mission already in progress and corrections from the FO to apply.
STANDARDS: Compute data for the corrections to within 1 mil for deflection and elevation.

NOTES:
1. No. 1 gun fires an illumination round and the FO sends: ILLUM MARK.
2. The MARK TIME is 50 seconds.
3. ILL and HE rounds are fired and the FO calls back: HE, DROP 100.

39. What is the range to the target for this correction?
    (a) 2,358 meters
    (b) 2,318 meters
    (c) 2,198 meters
    (d) 2,258 meters

NOTE: ILL and HE rounds are fired, and the FO calls back: HE, RIGHT 50, DROP 50, FFE.

40. What is the correct deflection and elevation for the No. 2, No. 3, and No. 4 guns in the FFE?

	DEF (mils)	ELEV (mils)		DEF (mils)	ELEV (mils)
(a)	2946	1047	(b)	2946	1055
(c)	2946	1063	(d)	2946	1070

NOTE: The FO observes the FFE and sends: EOM, VEHICLES BURNING, EOMRAT AA0409, KNPT 09.

SITUATION O

The following are questions relating to various MBC situations:

41. When the MBC is connected to a radio, it is proper procedure to conduct a MODEM test.

TRUE FALSE

42. While operating the MBC, the computer becomes unusually hot and a hissing sound is detected. The first thing to do is turn the MBC off.

TRUE FALSE

43. When storing the MBC, the battery can be left in the computer for an unlimited length of time.

TRUE FALSE

44. While operating the MBC using an external power source in the vehicle, the vehicle should not be started.

TRUE FALSE

45. Never use a sharp object, such as a pencil, to press the switches when operating the MBC.

TRUE FALSE

46. The MBC is waterproof when one switch on the keyboard is punctured.

TRUE FALSE

47. The first step before operating the MBC is to place a battery into the battery compartment.

TRUE FALSE

48. The last check before operating the MBC is to conduct a self-test.

TRUE FALSE

49. How many messages can the MBC receive from a digital device?
    (a) a. 4
    (b) 9
    (c) 14
    (d) 2

50. When receiving a completed fire request (FR) message from a digital device, why must you review it before processing the mission?
    (a) To prevent errors.
    (b) To be able to send an MTO.
    (c) To receive an ACK.
    (d) To manually enter the GRID switch.

51. When entering SET-UP data, what two entries must be the same as the digital device to communicate digitally?
    (a) Listen Only and Bit Rate.
    (b) Bit Rate and Block Mode.
    (c) Key Tone and Black Mode.
    (d) Bit Rate and Key Tone.

52. After pushing the COMPUTE switch during a mission and the display window displays *RANGE ERR*, what is the correct action to take?
    (a) End the mission.
    (b) Clear the MET.
    (c) Verify initialization and input entries.
    (d) Enter a higher charge and recompute.

53. When receiving an FR from a digital device, the display window shows SAFETY VIOLATION. What corrective action should be taken?
    (a) Recompute.
    (b) Send an MTO.
    (c) Send a CMD message.
    (d) Clear out safety diagram.

54. Which FM or technical manual (TM) is used when performing preventive maintenance checks and services (PMCS) on the M23 mortar ballistic computer?
    (a) FM 3-22.90.
    (b) TM 9-1350-261-10.
    (c) TM 9-1300-257-10.
    (d) TM 9-1220-246-12&P.

55. After entering safety data into the MBC, the need for safety T's is no longer warranted.

TRUE FALSE

SECTION IV. PLOTTING BOARD TEST

The candidate analyzes the following situations and then selects the appropriate answers.

SITUATION A

You are going to the firing range. The platoon leader goes to range control and obtains the safety information. Using the information that follows, construct a safety diagram.

TASK:	Construct a safety diagram on the M16 plotting board.
CONDITIONS:	Given an M16 plotting board, right and left limit azimuths, minimum and maximum ranges, type of weapon, firing point with either 8- or 10-digit grid coordinates, charge zones, and 300-series firing table.
STANDARDS:	Convert left and right limits to deflections, and minimum and maximum ranges to elevations. Construct a diagram on an M16 plotting board without error.

Mortar grid: 06406580
Left limit azimuth: 4800
Right limit azimuth: 5600
Maximum range: 4,000
Minimum range: 500
Charge zone: 2-8
Referred deflection: 2800

1. What are the left and right deflections?

	LEFT DEF (mils)	RIGHT DEF (mils)
(a)	2400	1200
(b)	4800	5600
(c)	2800	2400
(d)	3200	2400

2. What is the minimum elevation (mils that can be fired at the maximum range)?
   (a) 0941 mils
   (b) 1471 mils
   (c) 0907 mils
   (d) 1428 mils

SITUATION B

You move out to the field. The platoon leader determines an eight-digit grid and an altitude to the mortar position. He instructs you to construct a modified-observed firing chart.

TASK:	Prepare a plotting board for operation using the modified-observed firing chart.
CONDITIONS:	Given an M16 plotting board, a Fort Benning Installation Map 1:50,000, Edition 1-DMA, Series:V745Z; a mil protractor; an area of responsibility; a direction of fire (DOF); an eight-digit coordinate to the mortar position; a target or RP; and a grid intersection to represent the pivot point.
STANDARDS:	Superimpose a grid system on the M16 plotting board using the grid intersection given without error.

TASK:	Forward plot a target to the modified-observed chart from an observed chart.
CONDITIONS:	Given an M16 plotting board, DA Form 2188-R with previously fired targets, setup data, DA Form 2399-R, CFF, and firing table.
STANDARDS:	Plot the target, compute the firing data to within 1 mil with a 10-mil tolerance for deflection and 25 meters for range with a 25-meter tolerance, and record and update firing records without error.

Mortar grid: 07506539	Altitude: 440
OP No. 1: 096660	Altitude: 450
Direction of fire: 2020 mils	
Grid intersection: 09/64	
Mounting azimuth: 2000 mils	
Referred deflection: 4800 mils	
Forward plot AC070:	Chart deflection: 4536 mils
	Chart range: 2,950 meters
	Altitude: 440 meters

The section leader receives a CFF and checks the map. He then hands you the CFF in Figure E-18 and instructs you to compute the mission.

TASK:	Compute data for a grid mission using the CFF and FDC order in Figure E-18.
CONDITIONS:	Given an M16 plotting board, sector of fire, 1:50,000 map, protractor, DA Form 2399-R, tabular firing tables, CFF for a grid mission, FO corrections, paper, and pencil.
STANDARDS:	Determine the deflection to within 1 mil with a 10-mil tolerance and the range to within 25 meters with a 25-meter tolerance.

TASK:	Determine the VI between the mortar altitude and the target altitude.
CONDITIONS:	Given the mortar altitude and the target altitude.
STANDARDS:	Determine the VI to the nearest whole meter and the range correction to apply without error.

TASK:	Determine VI to the nearest whole meter and the range correction to apply without error.
CONDITIONS:	Given an M16 plotting board, altitude of the mortar position, CFF with the target altitude, and a firing table.
STANDARDS:	Apply the VI correction without error when computing a mission. Record and update firing records. Determine deflections to the nearest 1 mil with a 10-mil tolerance. Determine the range to within 25 meters with a 25-meter tolerance. Convert the range to the correct charge and elevation.

TASK:	Compute angle T.
CONDITIONS:	Given the observer to target (OT) direction, direction of fire (GT), No. 2 pencil, and paper.
STANDARDS:	Determine the angle T to the nearest 1 mil. Record the angle T to the nearest 10 mils. Send the angle T to the nearest 100 mils to the FO. Notify the FO in the message to observer when the angle T exceeds 500 mils.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			H51	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: 098 654
OT DIRECTION: 1800
ALTITUDE: 490

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ −

TARGET DESCRIPTION: ENY DEF POS
METHOD OF CONTROL:
METHOD OF ENGAGEMENT:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ: #2	DEFLECTION CORRECTION: ☐L ☐R	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd			
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION: ☐+ ☐−	METHOD OF FIRE	
SHELL AND FUZE: HEQ			
	RANGE CORRECTION: ☐+ ☐−	DEFLECTION	
METHOD OF FFE: 2 Rds		CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE: W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-18. Situation B: first mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

3. What is the initial chart deflection?
   (a) 3205 mils
   (b) 5205 mils
   (c) 2800 mils
   (d) 0700 mils

4. What is the command range to fire the first round?

NOTE: The chart range is 2,300.

   (a) 2,300 meters
   (b) 2,325 meters
   (c) 2,375 meters
   (d) 2,275 meters

NOTE: The FO spots the first round and sends these corrections: RIGHT 150, DROP 50, FFE; OT direction 1800.

5. What is the correct subsequent fire command?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)		2 Rds	5365	2450 / 4		0840
(b)	Sec	2Rds	5140	2250		1002
(c)	Sec	2 Rds	5362	2450		0840
(d)		2 Rds	5140	2250		1002

NOTE: The rounds are fired and the FO sends EOM. Update and mark as target AC071.

You receive the CFF in Figure E-19 and see that it is in your area of operations. You are instructed to compute the mission.

TASK:	Compute data for a grid mission using the CFF and FDC order in Figure E-19.
CONDITIONS:	Given an M16 plotting board, sector of fire, 1:50,000 map, protractor, DA Form 2399-R, tabular firing tables, CFF for a grid mission, FO corrections, paper, and No. 2 pencil.
STANDARDS:	Determine deflection to within 1 mil with a 10-mil tolerance and range to within 25 meters with a 25-meter tolerance.

TASK:	Determine the VI between the mortar altitude and the target altitude.
CONDITIONS:	Given the mortar altitude and target altitude.
STANDARDS:	Determine the VI to the nearest whole meter and the range correction to apply without error.

TASK:	Determine VI and the correction to apply when computing a mission using the M16 plotting board.
CONDITIONS:	Given an M16 plotting board, altitude of the mortar position, CFF with the target altitude, and firing table.
STANDARDS:	Apply the VI correction without error when computing a mission. Record and update firing records. Determine deflections to the nearest 1 mil with a 10-mil tolerance. Determine the range to within 25 meters with a 25-meter tolerance. Convert range to the correct charge and elevation.

TASK:	Compute angle T.
CONDITIONS:	Given the observer-target (OT) direction, direction of fire (GT), No. 2 pencil, and paper.
STANDARDS:	Determine the angle T to the nearest 1 mil. Record the angle T to the nearest 10 mils. Send the angle T to the nearest 100 mils to the FO. Notify the FO in the message to observer when the angle T is 500 mils or more.

COMPUTER'S RECORD

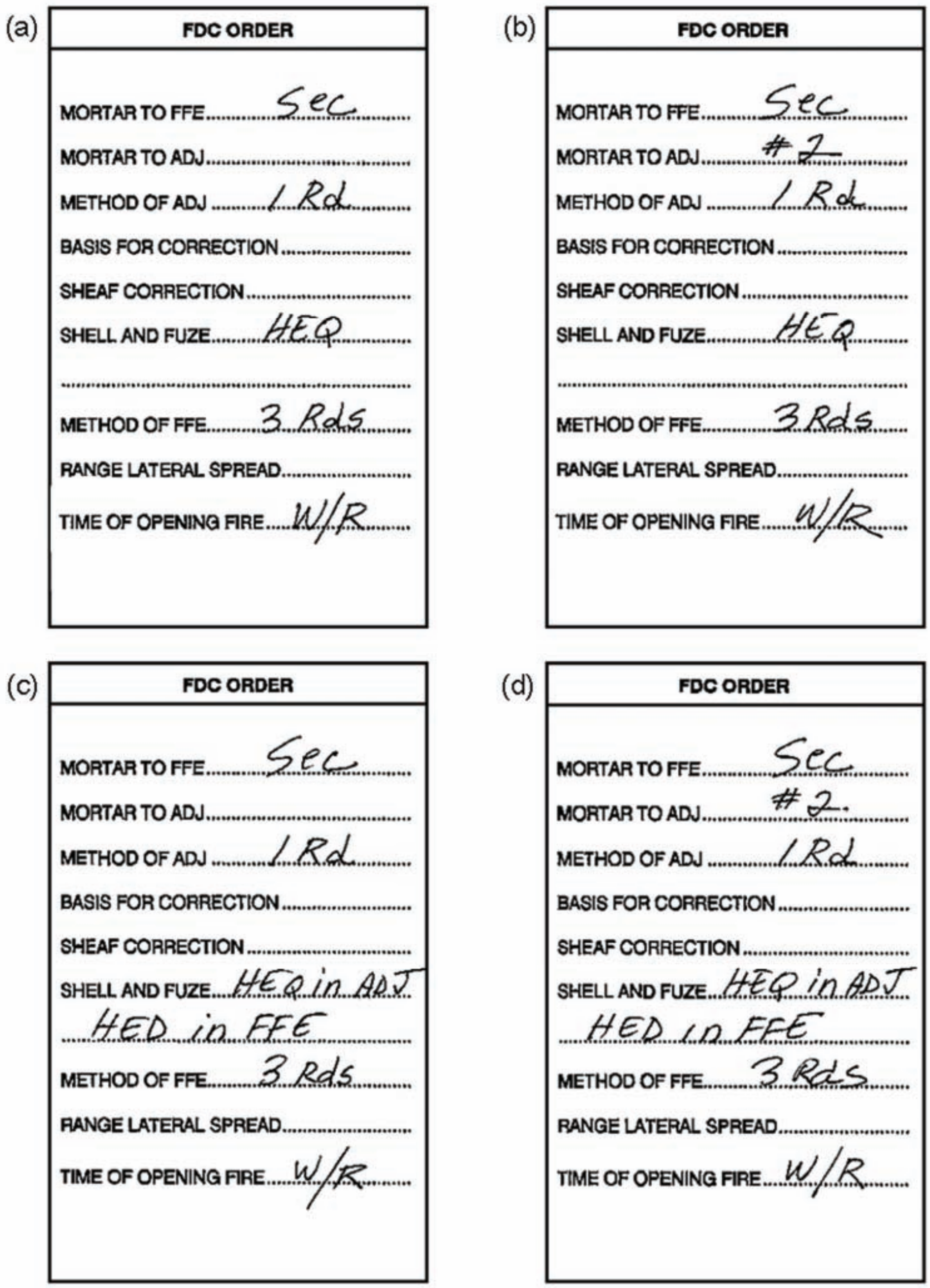
For use of this form, see FM 3-22.91; The proponent agency is TRADOC.

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			H51	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT ☐ IMMEDIATE SUPPRESSION	SHIFT FROM:	POLAR:
GRID: 115 648	OT DIRECTION: ALTITUDE:	OT DIRECTION: ALTITUDE:
OT DIRECTION: 1900	☐ LEFT / ☐ RIGHT	DISTANCE:
ALTITUDE: 490	☐ ADD / ☐ DROP	☐ UP / ☐ DOWN
	☐ UP / ☐ DOWN	VERTICAL ANGLE ☐ + / ☐ −
TARGET DESCRIPTION: Bunkers		METHOD OF CONTROL:
METHOD OF ENGAGEMENT: HED in FFE		MESSAGE TO OBSERVER:

Figure E-19. Situation B: second mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

6. What is the FDC order?



(a)

FDC ORDER

MORTAR TO FFE: Sec
MORTAR TO ADJ:
METHOD OF ADJ: 1 Rd
BASIS FOR CORRECTION:
SHEAF CORRECTION:
SHELL AND FUZE: HEQ
METHOD OF FFE: 3 Rds
RANGE LATERAL SPREAD:
TIME OF OPENING FIRE: W/R

(b)

FDC ORDER

MORTAR TO FFE: Sec
MORTAR TO ADJ: #2
METHOD OF ADJ: 1 Rd
BASIS FOR CORRECTION:
SHEAF CORRECTION:
SHELL AND FUZE: HEQ
METHOD OF FFE: 3 Rds
RANGE LATERAL SPREAD:
TIME OF OPENING FIRE: W/R

(c)

FDC ORDER

MORTAR TO FFE: Sec
MORTAR TO ADJ:
METHOD OF ADJ: 1 Rd
BASIS FOR CORRECTION:
SHEAF CORRECTION:
SHELL AND FUZE: HEQ in ADJ
HED in FFE
METHOD OF FFE: 3 Rds
RANGE LATERAL SPREAD:
TIME OF OPENING FIRE: W/R

(d)

FDC ORDER

MORTAR TO FFE: Sec
MORTAR TO ADJ: #2
METHOD OF ADJ: 1 Rd
BASIS FOR CORRECTION:
SHEAF CORRECTION:
SHELL AND FUZE: HEQ in ADJ
HED in FFE
METHOD OF FFE: 3 Rds
RANGE LATERAL SPREAD:
TIME OF OPENING FIRE: W/R

You are handed the CFF and FDC order in Figure E-20 and are instructed to compute the mission.

TASK:	Compute data for a shift from a known point mission using a plotting board.
CONDITIONS:	Given a plotting board, DA Form 2399-R, firing table, CFF for a shift from a known point mission, and FO corrections.
STANDARDS:	Determine deflection to within 1 mil with a 10-mil tolerance and range to within 25 meters with a 25-meter tolerance.

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			H51	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID:
OT DIRECTION:
ALTITUDE:

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: 2200 ALTITUDE:
DISTANCE: 1500
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ –

TARGET DESCRIPTION: 3 Stalled Tanks
METHOD OF ENGAGEMENT:
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ	DEFLECTION CORRECTION:	SHELL AND FUZE	
METHOD OF ADJ 1 Rd	☐ L ☐ R		
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE HEQ in ADJ	☐ + ☐ –		
HEQ/WP in FFE	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE 2 HEQ/2 WP	☐ + ☐ –	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-20. Situation B: third mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

7. What is the initial deflection?
   (a) 4606 mils
   (b) 4994 mils
   (c) 4800 mils
   (d) 4660 mils

8. The initial chart range is 2,375. What is the command range?
   (a) 2,325 meters
   (b) 2,350 meters
   (c) 2,375 meters
   (d) 2,400 meters

NOTE: The FO spots the first round and sends this correction: ADD 50, FFE.

9. What is the final deflection for the adjusting mortar?
   (a) 4999 mils
   (b) 4805 mils
   (c) 4665 mils
   (d) 4611 mils

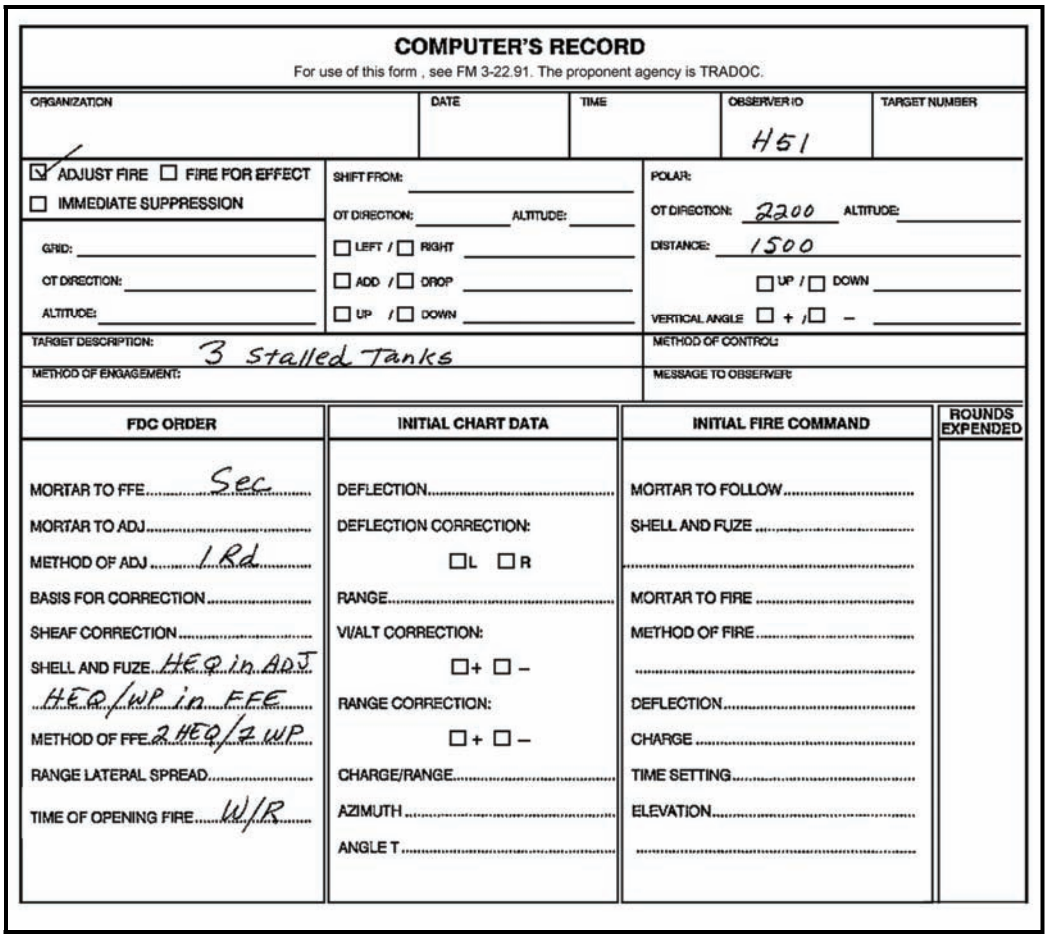
NOTE: The adjusted chart range is 2,450.

10. What is the deflection for No. 3?
    (a) 4627
    (b) 4611
    (c) 4595
    (d) 4665

NOTE: The FO sends EOM. Mark as target AC073.

You receive the CFF, check the map, and issue the FDC order to the computers. Using the CFF and FDC order in Figure E-21, compute the mission.

TASK:	Compute data for a polar plot mission using a plotting board.
CONDITIONS:	Given an M16 plotting board prepared for operation to include the mortar position, reference points, and FO positions plotted; firing tables; DA Form 2399-R; CFF using the polar method of target location; and subsequent corrections.
STANDARDS:	Determine deflection to the nearest 1 mil with a 10-mil tolerance, determine range to 25 meters with a 25-meter tolerance, and convert range to the correct charge and elevation.



COMPUTER'S RECORD

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

ORGANIZATION | DATE | TIME | OBSERVER ID: H51 | TARGET NUMBER

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID:
OT DIRECTION:
ALTITUDE:

SHIFT FROM:
OT DIRECTION: ALTITUDE:
☐ LEFT / ☐ RIGHT
☐ ADD / ☐ DROP
☐ UP / ☐ DOWN

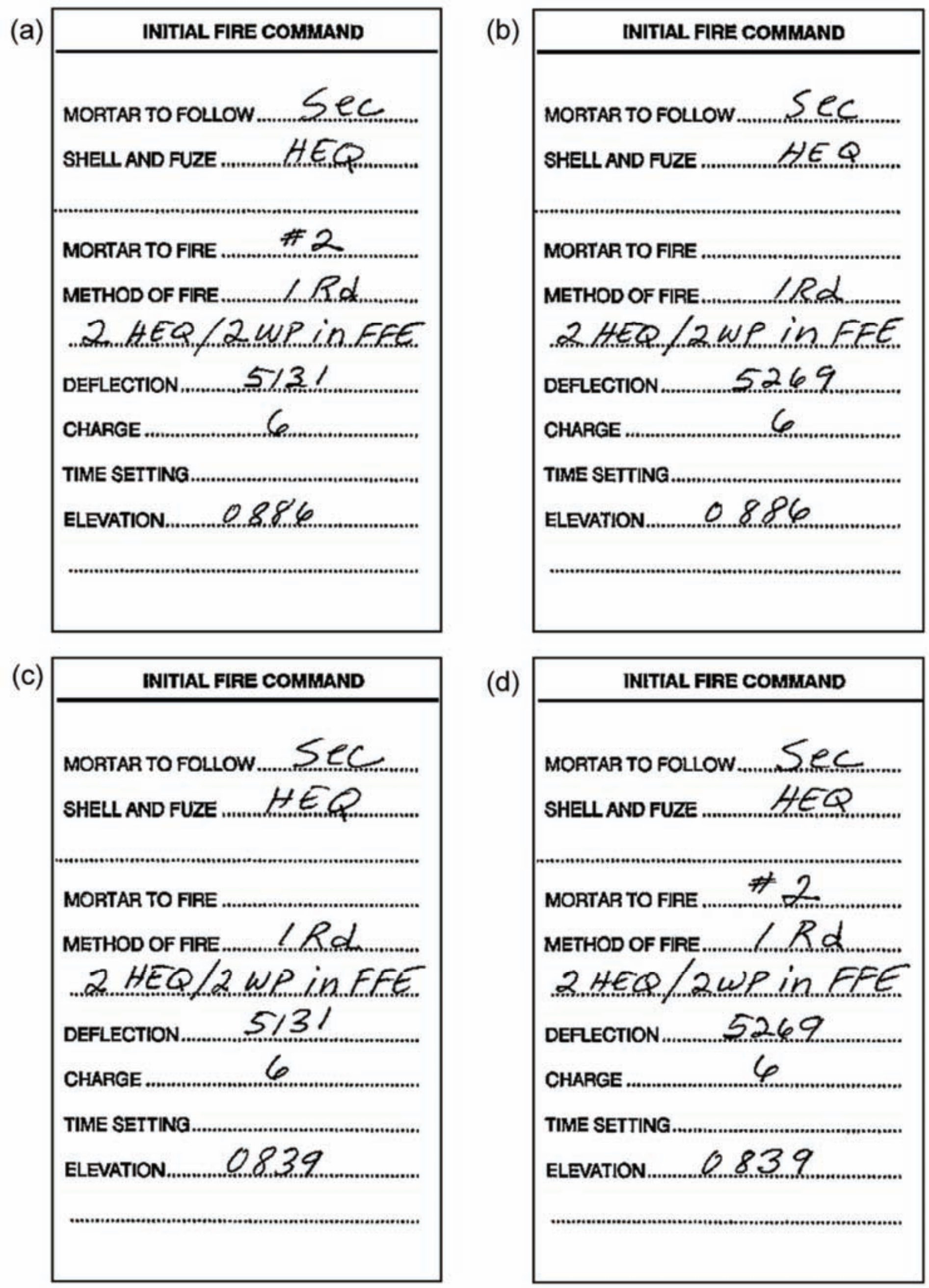
POLAR:
OT DIRECTION: 2200 ALTITUDE:
DISTANCE: 1500
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + /☐ –

TARGET DESCRIPTION: 3 Stalled Tanks
METHOD OF ENGAGEMENT:
METHOD OF CONTROL:
MESSAGE TO OBSERVER:

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE: Sec	DEFLECTION	MORTAR TO FOLLOW	
MORTAR TO ADJ	DEFLECTION CORRECTION:	SHELL AND FUZE	
METHOD OF ADJ: 1 Rd	☐L ☐R		
BASIS FOR CORRECTION	RANGE	MORTAR TO FIRE	
SHEAF CORRECTION	VI/ALT CORRECTION:	METHOD OF FIRE	
SHELL AND FUZE: HEQ in ADJ	☐+ ☐–		
HEQ/WP in FFE	RANGE CORRECTION:	DEFLECTION	
METHOD OF FFE: 2 HEQ/2 WP	☐+ ☐–	CHARGE	
RANGE LATERAL SPREAD	CHARGE/RANGE	TIME SETTING	
TIME OF OPENING FIRE: W/R	AZIMUTH	ELEVATION	
	ANGLE T		

Figure E-21. Situation B: fourth mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

11. What is the correct initial fire command?



(a)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE HEQ

MORTAR TO FIRE #2
METHOD OF FIRE 1 Rd
2 HEQ/2 WP in FFE
DEFLECTION 5131
CHARGE 6
TIME SETTING
ELEVATION 0886

(b)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE HEQ

MORTAR TO FIRE
METHOD OF FIRE 1 Rd
2 HEQ/2 WP in FFE
DEFLECTION 5269
CHARGE 6
TIME SETTING
ELEVATION 0886

(c)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE HEQ

MORTAR TO FIRE
METHOD OF FIRE 1 Rd
2 HEQ/2 WP in FFE
DEFLECTION 5131
CHARGE 6
TIME SETTING
ELEVATION 0839

(d)

INITIAL FIRE COMMAND

MORTAR TO FOLLOW Sec
SHELL AND FUZE HEQ

MORTAR TO FIRE #2
METHOD OF FIRE 1 Rd
2 HEQ/2 WP in FFE
DEFLECTION 5269
CHARGE 6
TIME SETTING
ELEVATION 0839

NOTE: The FO spots the first round and sends: DROP 50, FFE.

12. What is the correct subsequent fire command?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	Sec	2 HEQ 2 WP	5260			0839
(b)		2 HEQ 2 WP	5140			0886
(c)	Sec	2 HEQ 2 WP	5140			0839
(d)		2 HEQ 2 WP	5260			0886

NOTE: The FO sends EOM.

SITUATION C

Your platoon is moving to a defensive position for a few days. Your platoon leader has the site surveyed. He then instructs you to set up a surveyed firing chart and to conduct a coordinated registration. Using the information below, construct a surveyed chart. Using the information in Figure E-22, conduct the registration mission.

TASK:	Construct a surveyed firing chart.
CONDITIONS:	Given an M16 plotting board, a grid intersection to represent the pivot point, a surveyed mortar position, a surveyed RP, and a referred deflection.
STANDARDS:	Determine the direction of fire to the nearest mil, determine the mounting azimuth to the nearest 50 mils, and superimpose the deflection scale without error.

TASK:	Compute data for a registration mission using a plotting board.
CONDITIONS:	Given an M16 plotting board, surveyed mortar position, and surveyed RP.
STANDARDS:	Determine the deflection to within 1 mil with a 10-mil tolerance. Determine the range to within 25 meters with a 25-meter tolerance. Convert the range to the correct charge and elevation without error.

Mortar grid: 06726544 Altitude: 450 meters
RP No. 1 grid: 09946362 Altitude: 400 meters
Referred deflection: 3800 mils
Grid intersection: 08/64

13. What is the direction of fire?
   (a) 2270 mils
   (b) 2130 mils
   (c) 3800 mils
   (d) 2170 mils

COMPUTER'S RECORD

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

ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER
			H51	

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID: ______
OT DIRECTION: 3250
ALTITUDE: ______

SHIFT FROM: ______
OT DIRECTION: ______ ALTITUDE: ______
☐ LEFT / ☐ RIGHT ______
☐ ADD / ☐ DROP ______
☐ UP / ☐ DOWN ______

POLAR:
OT DIRECTION: ______ ALTITUDE: ______
DISTANCE: ______
☐ UP / ☐ DOWN ______
VERTICAL ANGLE ☐ + / ☐ – ______

TARGET DESCRIPTION:
METHOD OF CONTROL:
METHOD OF ENGAGEMENT:
MESSAGE TO OBSERVER: Register RP

FDC ORDER	INITIAL CHART DATA	INITIAL FIRE COMMAND	ROUNDS EXPENDED
MORTAR TO FFE ....SEC	DEFLECTION....	MORTAR TO FOLLOW....	
MORTAR TO ADJ....#2	DEFLECTION CORRECTION:	SHELL AND FUZE....	
METHOD OF ADJ ....1 Rd	☐L ☐R	....	
BASIS FOR CORRECTION....	RANGE....	MORTAR TO FIRE....	
SHEAF CORRECTION....	VI/ALT CORRECTION:	METHOD OF FIRE....	
SHELL AND FUZE....HEQ	☐+ ☐–	....	
....	RANGE CORRECTION:	DEFLECTION....	
METHOD OF FFE....	☐+ ☐–	CHARGE....	
RANGE LATERAL SPREAD....	CHARGE/RANGE....	TIME SETTING....	
TIME OF OPENING FIRE....W/R	AZIMUTH....	ELEVATION....	
	ANGLE T....	....	

Figure E-22. Situation C: first mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

14. What is the command deflection and command range for the first round?

	DEF (mils)	RANGE (mils)
(a)	3373	3775
(b)	3820	3750
(c)	3820	3675
(d)	3773	3625

NOTE: The FO spots the first round and sends these corrections: LEFT 50, ADD 50.

15. What is the deflection and elevation for the second round?

	DEF (mils)	RANGE (mils)
(a)	3831	0880
(b)	3801	0839
(c)	3959	0896
(d)	3781	0862

NOTES: 1. The FO spots the second round and sends: ADD 25, EOM, REGISTRATION COMPLETE.

2. The FDC sends a message to the FO: PREPARE TO ADJUST SHEAF.

3. The FO sends: SECTION LEFT.

TASK: Compute firing data for a sheaf adjustment using the plotting board.
CONDITIONS: Given an M16 plotting board, an active registration mission, FO corrections for sheaf adjustments, DA Form 2399-R, and firing tables.
STANDARDS: Determine total range correction to apply within 25 meters range with a 25-meter tolerance.

16. What is the correct subsequent fire command?

	SUBSEQUENT COMMANDS					
	MORTAR FIRE	METHOD FIRE	DEFL	RANGE / CHARGE	TIME (SETTING)	ELEV
(a)	Sec	1 Rd S/L #2 DNF	3830	3750		0862
(b)	Sec	1 Rd S/L #2 DNF	3830	3750		0896
(c)	Sec	1 Rd	3802	3750		0880
(d)	Sec	1 Rd S/L #2 DNF	3785	3750		0839

NOTES: 1. The FO makes a spotting and sends: NO. 3, RIGHT 10; NO. 1, RIGHT 20; NO. 4 ADJUSTED, EOM S/A.

2. The command range to the target is 3,750 meters.

17. What are the deflections for the No. 3 and No. 1 guns?

	No. 3 DEF (mils)	No. 1 DEF (mils)
(a)	3777	3780
(b)	3843	3840
(c)	3793	3797
(d)	3827	3824

TASK:	Determine firing corrections.
CONDITIONS:	Given the altitude of a mortar position and RP in meters, chart deflection, chart range, adjusted deflection, adjusted range for the RP, or a completed DA Form 2399-R for a registration mission.
STANDARDS:	Determine corrections to include:

a. Altitude correction to within 1 meter.
b. Range difference to the nearest 25 meters.
c. Range correction factor to within 1 meter.
d. Deflection correction to within 1 mil.

18. If the initial chart deflection was 3820 and the final chart deflection was 3830, what is the deflection correction for RP No. 1?
    (a) R10
    (b) 0
    (c) L10
    (d) L30

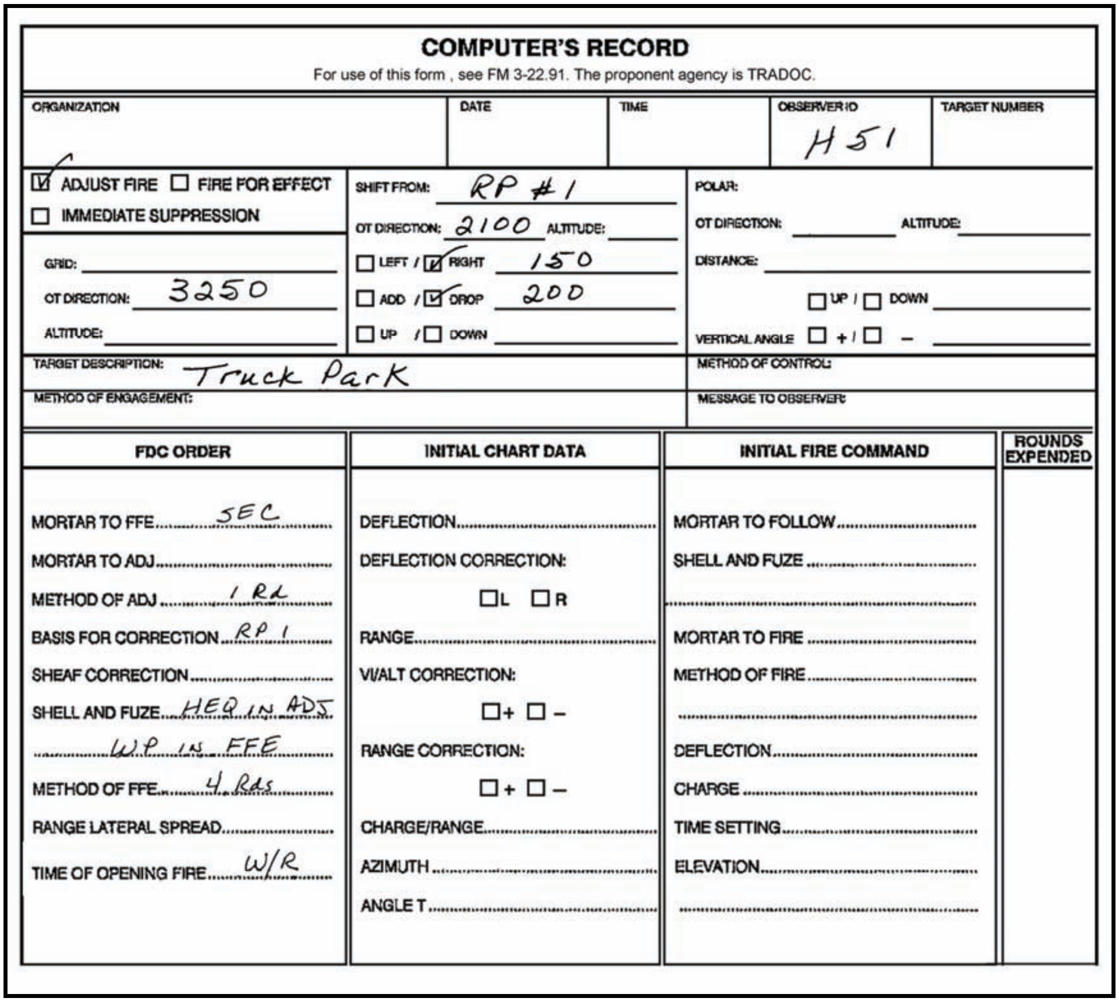
19. The initial chart range was 3,700 and the RP was hit at a command range of 3,750. What is the range correction factor?
    (a) +50
    (b) +20
    (c) -50
    (d) +75

After updating and computing all the corrections, you receive a CFF. The section leader hands you the CFF and the FDC order in Figure E-23 and instructs you to compute the mission.

TASK:	Compute data for a shift from a known point mission using a plotting board.
CONDITIONS:	Given a plotting board, DA Form 2399-R, firing table, CFF for a shift from a known point mission, and FO corrections.
STANDARDS:	Determine deflection to within 1 mil with a 10-mil tolerance and range to within 25 meters with a 25-meter tolerance.

TASK:	Compute firing data from a surveyed firing chart for a total range correction mission using a plotting board.
CONDITIONS:	Given an M16 plotting board, an RP with deflection correction and range correction factors, CFF, DA Form 2399-R, and firing tables.
STANDARDS:	Determine total range correction to apply within 25 meters for range with a 25-meter tolerance.

20. What is the total range correction for this mission?
    (a) -25
    (b) +70
    (c) 3500
    (d) +45



COMPUTER'S RECORD

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

ORGANIZATION
DATE
TIME
OBSERVER ID: H51
TARGET NUMBER

☑ ADJUST FIRE ☐ FIRE FOR EFFECT
☐ IMMEDIATE SUPPRESSION

GRID:
OT DIRECTION: 3250
ALTITUDE:

SHIFT FROM: RP #1
OT DIRECTION: 2100 ALTITUDE:
☐ LEFT / ☑ RIGHT 150
☐ ADD / ☑ DROP 200
☐ UP / ☐ DOWN

POLAR:
OT DIRECTION: ALTITUDE:
DISTANCE:
☐ UP / ☐ DOWN
VERTICAL ANGLE ☐ + / ☐ –

TARGET DESCRIPTION: Truck Park
METHOD OF CONTROL:
METHOD OF ENGAGEMENT:
MESSAGE TO OBSERVER:

FDC ORDER

MORTAR TO FFE: SEC
MORTAR TO ADJ:
METHOD OF ADJ: 1 Rd
BASIS FOR CORRECTION: RP 1
SHEAF CORRECTION:
SHELL AND FUZE: HEQ in ADJ
WP in FFE
METHOD OF FFE: 4 Rds
RANGE LATERAL SPREAD:
TIME OF OPENING FIRE: W/R

INITIAL CHART DATA

DEFLECTION:
DEFLECTION CORRECTION:
☐L ☐R
RANGE:
VI/ALT CORRECTION:
☐+ ☐–
RANGE CORRECTION:
☐+ ☐–
CHARGE/RANGE:
AZIMUTH:
ANGLE T:

INITIAL FIRE COMMAND

MORTAR TO FOLLOW:
SHELL AND FUZE:
MORTAR TO FIRE:
METHOD OF FIRE:
DEFLECTION:
CHARGE:
TIME SETTING:
ELEVATION:

ROUNDS EXPENDED

Figure E-23. Situation C: second mission (excerpt from an example of completed DA Form 2399-R [Computer's Record]).

Appendix F
Error Messages

This appendix addresses all the possible error messages that may appear while using the MBC. Explanations and actions are also discussed.

CHARACTERS

F-1. Along with text, the three common characters found within an error message are alpha, numeric, and alphanumeric:

- @ = Alpha character.
- # = Numeric character.
- $ = Alphanumeric character.

MESSAGES, EXPLANATIONS, AND ACTIONS

F-2. Error messages confirm that a problem has occurred and specific actions must be taken to compute or log data on the MBC. The various types of messages that may appear and the appropriate action that should be taken to correct the error are as follows:

ERROR MESSAGE	EXPLANATION and ACTION
@@ * RANGE ERR *	Target location cannot be precisely achieved by ballistic calculations. The following menu indicates error magnitude. ACTION: Verify all initialization and input data. Check error magnitude in following menu. If error is excessive, use alternate weapon or ammunition type.
@# ACTIVE, MSN #	Weapon selected (@#) is now activated for mission #. ACTION: Choose an alternate weapon not now in use, or terminate mission #.
@# IS BP	When entering WPN BATA, basepiece number entered as alternate piece. ACTION: Enter correct weapon number.
@# MISSED: ####	Follows *RANGE ERR* message. Indicates error magnitude as distance in meters from target. ACTION: Verify all initialization and input entries. If error is excessive, select an alternate charge, weapon, or ammunition type.
@# NOT FOUND	No WPN DATA entered for this weapon. ACTION: Enter WPN DATA for this weapon or choose an alternate weapon.
@#:@# DANGER	WARNING: Friendly weapon is positioned at or near computed target location. First @# is firing weapon ID. Second @# is endangered weapon position ID. ACTION: Verify target and FO location entries. If locations are correct and endangered FO is still in place, verify mission.

ERROR MESSAGE	EXPLANATION and ACTION
@#:@/## DANGER	WARNING: Friendly FO is positioned at or near computed target location. The @# is firing weapon ID. The @/## is endangered FO ID. ACTION: Verify target and FO location entries. If locations are correct and endangered FO is still in place, verify mission.
^ AZ TOO BIG	Difference between safety fan LLAZ and RLAZ entries is 3200 mils or more. ACTION: Change safety fan LLAZ and RLAZ entries to get delta azimuth of less than 3200 mils.
^ AZ TOO SMALL	Difference between safety fan LLAZ and RLAZ entry is less than 400 mils. ACTION: Change safety fan LLAZ and RLAZ entry to get delta azimuth of at least 400 mils.
^ RANGE TOO SMALL	Difference between safety fan MIN RN and MAX RN entries is less than 200 meters. ACTION: Change SFTY DATA MIN RN and MAX RN entry to get delta range of 200 meters or greater.
ADJ COMPLETE	All weapons in sheaf are already adjusted. ACTION: No further adjustments are possible within current mission.
BAD AIR DENSITY	Temperature and pressure entries will not yield ballistics solution. ACTION: Verify temperature and pressure values. If correct for given MET, data are not usable in MBC.
BAD CHARGE ZONE	SFTY DATA, MIN CHG entry is greater than MAX CHG entry. ACTION: Change MIN CHG and MAX CHG entries so that MIN CHG is less than or equal to MAX CHG.
BAD FO:@/## FR	FR message received from FO for which no initialization was entered. Corrections cannot be computed. ACTION: If action is required, enter FO LOC initialization data.
BAD HEIGHT	Absolute altitude or delta height is outside the range (400 meters to 10,000 meters). ACTION: Verify all altitude, height, or vertical angle entries. If all values are correct, given mission cannot be computed.
BAD KNPT:## SHFT	Upon receipt of FR SHIFT message, known point message is not stored in KNPT buffer. ACTION: If known point is valid, enter KNPT data. If known point number is in error, orally request retransmission of corrected message.
BAD POWER UP	Hardware malfunction; memory probably corrupted. ACTION: Power down and back up several times. If this or another power-up error occurs, check battery or power supply. If error still occurs, return MBC to next higher maintenance level.
BAD ^ HEIGHT	Similar to BAD HEIGHT error. Computed delta height exceeds acceptable limits. ACTION: Verify all altitude, height, and vertical angle entries. If all values are correct, given mission cannot be computed.

ERROR MESSAGE	EXPLANATION and ACTION
BAD ^ WIND ##-##	Direction and velocity entries in consecutive MET datum planes yield easting and northing wind components that differ by more than 29 knots. The ##-## indicates MET datum planes in error. ACTION: Verify direction and velocity entries for stated MET datum planes. If correct for given MET, data are not usable in MBC.
BANK:FAIL	Memory bank switching hardware failure. ACTION: Return MBC to next higher maintenance level.
BAT @ NOT FOUND	Initialization data not yet entered for this battery. ACTION: Enter initialization data for this battery or select weapon from another battery.
CHARGE VIOLATION	Illegal cartridge-fuze-charge combination entry, such as: 81-mm, with VT fuze, at charge 0. ACTION: Make alternate WPN/AMMO entries to avoid the above illegal combinations.
CHG TOO BIG	Minimum range for user-selected charge is greater than range to target. ACTION: Leave charge field blank (MBC selects optimum charge) or enter valid smaller alternate charge. If valid charge cannot be found for these WPN/AMMO entries, make alternate WPN/AMMO entries.
CHG TOO LOW	User-selected charge maximum range is less than the range to target. ACTION: Leave the charge field blank (MBC selects optimum charge) or enter valid larger alternate charge. If valid charge cannot be found for these WPN/AMMO entries, make alternate WPN/AMMO entries.
DEFL TOO BIG	Required deflection exceeds maximum left or right traverse limitations for carrier-mounted 107-mm mortars. ACTION: Select alternate weapon for which limitations are not exceeded.
DISP $$$ MEM $$$	Follows REV NO. FAILURE error message. Indicates revision numbers for display/processor and memory respectively. ACTION: Return MBC to next higher maintenance level.
DUPLICATE WPNS	Same weapon number entered two or more times into TFC, GUNS selection for multiple weapon missions. ACTION: Delete duplicate entries.
E TOO BIG	Computed delta easting exceeds 32767. ACTION: Verify all entries affecting delta easting. Also verify that MIN E and MIN N entries in the SET UP data are appropriate for mission coordinates.
ENTRY NOT FND	Required FO, KNPT, or TGT initialization data not yet entered into the appropriate memory file. ACTION: Enter initialization data for required FO, KNPT, or TGT, or choose alternate course of action not requiring this data.
EXCESSIVE WIND	Wind deviations exceed stability limitations of MBC. ACTION: Verify MET entries. If correct, this MET is unusable.

ERROR MESSAGE	EXPLANATION and ACTION
FATAL ERR, REINIT	Mission data have been corrupted. ACTION: End mission with EOM and restart mission from beginning.
FILE EMPTY	No data in initialization data buffer. ACTION: Verify the initialization function selection under review and enter the required initialization data.
FILE FULL	No more initialization data storage space available in buffer. ACTION: Delete unneeded data to make space for new initialization data entries.
FO TOO CLOSE	FO is too close to target to perform MPI mission (within 10 meters). ACTION: Verify FO and target coordinate entries.
FORMAT ERROR	All valid data not entered into blank menu fields. ACTION: Enter all required data into blank menu fields or select alternate menu sequence using appropriate action switch.
FPF LN EMPTY	Selected FPF line is now unused. ACTION: Select appropriate FPF line having stored data.
GUN IS ADJUSTED	Adjustments have already been completed for this weapon. ACTION: Select new weapon to adjust only after all adjustments have been completed for the current weapon. Once new weapon is selected, previous adjustments are fixed and further adjustment is not permitted for weapon currently in use.
ID ASSIGNED	This KNPT number or TGT number entry has already been used. ACTION: Choose alternate number for data storage, or delete stored data before storing new data.
ILL ENTRY	Illegal value entered into blank field of data entry menu. ACTION: Determine proper value range for data and change data entry accordingly.
ILLEGAL CHARGE	Manually entered charge is invalid for selected ammunition. ACTION: Leave charge field blank (MBC selects optimum charge) or enter valid alternate charge.
ILLEGAL SWITCH	Invalid keypress. ACTION: Check entry. Make only valid entries.
ILLEGAL TGT NUM	Target number is within target number block range assigned in SET UP. ACTION: Manually enter a target number outside range defined in SET UP, or notify sender to retransmit valid target number.
INST:FAIL	Processor failure. ACTION: Return MBC to next higher maintenance level.
LN ALREADY INIT	FPF line is already in use (initialized). ACTION: Select alternate FPF line or clear line to reinitialize.

ERROR MESSAGE	EXPLANATION and ACTION
MAX NOT GREATER	MAX fire line is closer than MIN fire line. ACTION: Verify MIN and MAX fire line entries.
MODEM:FAIL	Modem CCA failure. ACTION: Return MBC to next higher maintenance level.
MSG BUFFER EMPTY	No messages are stored in message buffers. ACTION: DO NOT press MSG switch unless message lamp is blinking.
MSN # UNASSIGNED	Unassigned mission selected for activation. ACTION: Activate an alternate mission when operating on a previously initiated mission.
MSN ERROR	Probable MBC software fault. ACTION: End mission and reenter. Compute mission. If error reoccurs, return MBC to next higher maintenance level.
N TOO BIG	Computed delta northing exceeds 32767. ACTION: Verify all entries affecting delta northing. Also, verify that MIN E and MIN N entries in SET UP data are appropriate for mission coordinates.
NO ACTIVE MSN	No missions are stored in mission buffers or no mission is presently activated. ACTION: Initiate new mission using GRID, SHIFT, or POLAR switch or FR message; or select a stored mission using MSN switch and appropriate display switch.
NO ADJUST DATA	All required adjust data have not been entered. ACTION: Do not press COMPUTE switch for an ADJ before viewing ADJ data entry field (DEV).
NO AVAIL MSN	Mission buffers are full (three missions stored). ACTION: Terminate one stored mission by selecting EOM, EOMRAT, or EOMFPF. Then initiate new mission.
NO CURRENT MET	Current MET has not been initialized. ACTION: Enter or review appropriate NEW MET data and initialize CURR MET by pressing UPDATE*, or select STD MET.
NO FO ENTERED	No FO entry in mission input data. ACTION: When sending digital response to manual input mission, enter FO ID when beginning mission. FO ID is entered automatically in BMD-supported missions.
NO MAP MOD	Computation (such as computing gun orders) requires MIN E and MIN N coordinates, and none were assigned in SET UP data entry. ACTION: Completely initialize SET UP data.
NO OUTPUT DATA	Review of FIRE DATA or SFTY DATA or other operation (such as ADJ, REG, or REPLOT) requires existing output data. ACTION: Press COMPUTE switch after properly entering appropriate mission input data.

ERROR MESSAGE	EXPLANATION and ACTION
NO SHEAF DATA	Special sheaf selected but without width or direction entry. ACTION: Enter all sheaf data before pressing COMPUTE switch.
NO TGT DATA	Insufficient target location data. ACTION: Press MSN switch, then sequence through mission input data menus. Enter all input data on all entry menus.
NO TGT NUM	Target numbers not yet assigned for target block definition in SET UP data. ACTION: Assign new block of target numbers using SET UP initialization menu sequence.
NO TRIANGLE	Line segments in SURV INT or RES problem do not converge. ACTION: Verify input angle and coordinate data entries.
NO WPN DATA	Weapon not yet selected using WPN/AMMO switch. ACTION: Enter weapon on WPN select menu before pressing COMPUTE switch.
POWER FAILURE	MBC powered down by means other than ON/OFF switch, such as by removing battery or external power. ACTION: Turn power off using ON/OFF switch before disconnecting power source.
PTS AVAIL:##	Remaining number of points available in fire zone storage buffer when new fire zone entry contains too many points. ACTION: Define new fire zone with fewer points or delete unused fire zones to provide additional buffer storage space.
RAM:FAIL @##	IMICRO test random access memory failure. ACTION: Return MBC to next higher maintenance level.
RANGE TOO SMALL	Range to target is zero, or when entering FIRE ZONES data, distance between points is less than 10 meters. ACTION: Verify mission input entry or FIRE ZONES data entry.
REG TOO BIG	Range corrections exceed 999 meters when computing a registration. ACTION: Register target only when range corrections are 999 meters or less (usually much less).
REV NO. FAILURE	Memory CCA and display/processor CCA have incompatible revision numbers. ACTION: Return MBC to next higher maintenance level.
RANGE TOO BIG	Entered or computed range is too large. ACTION: Change distance or coordinate entries to reduce range to acceptable value.
ROM:FAIL A##	MICRO test read-only-memory failure. ACTION: Return MBC to next higher maintenance level.

ERROR MESSAGE	EXPLANATION and ACTION
SAFETY VIOLATION	Impact point is outside defined safety fan boundaries. ACTION: Verify target location and safety data entries. Reenter, if necessary. No further action can be taken.
SINGLE WPN ONLY	More than one weapon is designated on TFC sequence GUNS: @# ________ menu but selected TFC CONtrol allows only one weapon. ACTION: Select TFC CONtrol function allowing multiple weapons, or DO NOT enter additional weapons.
SPC SHEAF ERROR	Weapon registration is illegal while in TFC CONtrol (SPECial SHEAF). ACTION: To perform a registration, change TFC CONtrol selection.
SUPERSONIC	Calculated shell velocity exceeds mach 1. ACTION: Prevailing nonstandard conditions provide inaccurate MBC calculations. Verify all nonstandard initialization entries including AMMO powder TEMP, AMMO weight corrections, all MET data, and target and weapon ALT.
TEMP OUT OF RNGE	Powder temperature entry outside range (-70 to 140). ACTION: Verify that powder temperature entry is within allowable range.
TEMP TOO LOW	MBC cannot compute gun orders for 107-mm mortars with extension when powder temperature is below -30 degrees. ACTION: Mission cannot be fired under given conditions. Verify ammunition powder temperature and target location entries.
TEMP TOO LOW	Air temperature in MET data is below 1536 (153.6 degrees Kelvin or -183.2 degrees Fahrenheit). ACTION: Verify that air temperature entry is 1536 or above.
TGT HIGH/RN BIG	Target is beyond maximum range or maximum altitude at maximum allowable safe charge, and charge has not been manually entered. ACTION: Mission cannot be fired under given conditions. Verify WPN/AMMO and target location entries.
TGT LOW/RN SMALL	Target is below minimum range or minimum altitude at minimum allowable safe charge, and charge has not been manually entered. ACTION: Mission cannot be fired under given conditions. Verify WPN/AMMO and target location entries.
TGT TOO HIGH	Target altitude is greater than 90 percent of MAX ORD of computed flight trajectory. Reliable results cannot be obtained. ACTION: Increase charge or elevation entries, if possible.

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Glossary

SECTION I. ACRONYMS AND ABBREVIATIONS

AAR	after-action report; after-action review
AC	alternating current
ACA	airspace coordination areas
A/F	adjust fire
AFATDS	Army Field Artillery Tactical Data System
ALT	alternate, used when describing the ALT key
AMC	at my command
AOF	azimuth of fire
AR	Army Regulation
ARTEP	Army Training and Evaluation Program
AZ	azimuth, used in conjunction with the LHMBC, MBC, and MFCS
BIT	built-in test
BOLAD	boundary outer limit alert distances
BPS	bits per second
CAS	close air support
CFF	call for fire
CFL	coordinated fire line
CI	commander's interface
CMD	command, used in conjunction with the MBC
COMSEC	communications security
CS	O-cholorobrnxylmalonstrile ("tear gas")
CSR	controlled supply rate
DA	Department of the Army
DC	direct current
DCT	deflection conversion table
DD	driver's display
DEFK	deflection correction
DF	deflection
DLY	delay
DMD	digital message device
DNL	do not load
DOF	direction of fire
DS	direct support
ELEV	elevation
EOM	end of mission
FA	field artillery
FBCB2	Force XXI battle command—brigade and below
FC	fires cell
FCS	frame check sequencing
FDC	fire direction center
FDCCP	Fire Direction Center Certification Program
FEC	forward error correction
FFE	fire for effect
FIST	fire support team

FLOT	forward lines of own troops
FM	frequency modulation; field manual
FO	forward observer
FOS	forward observer system
FPF	final protective fires
FPL	final protective line
FR	fire request
FSCL	fire support coordination line
FSCMs	fire support coordination measures
FSCOORD	fire support coordinator
FSE	fire support element
FSO	fire support officer
FT	firing table
FTX	field training exercise
FZ	fuze, used in conjunction with fire control equipment
GD	grid declination, gunner's display
GEOREF	geographical reference
GMT	Greenwich mean time
GPS	Global Positioning System
GT	gun-target
GUI	graphic user interface
HE	high explosive
HEQ	high-explosive quick
HOB	height of burst
IAW	in accordance with
ID	identification
ILLUM	illumination
IMLC	Infantry Mortar Leader’s Course
IMP	impact
IMU	inertial measurement unit
IR	infrared
IS	immediate suppression
ITEP	Individual Training and Evaluation Program
JMEM	joint munitions effectiveness manual
KNPT	known point, used in conjunction with the MBC
L	left, used in conjunction with fire control equipment
LARS	left add, right subtract
LAT	latitude, used in conjunction with fire control equipment
LB	lateral boundaries
LCD	liquid crystal display
LD	line of departure
LED	light-emitting diode
LFX	live-fire exercise
LHMBC	lightweight handheld mortar ballistic computer
LZ	landing zone
m	meter(s)
MANCOC	Maneuver Advanced Noncommissioned Officer Course
MAZ	mounting azimuth

MBC	mortar ballistic computer
MDP	meteorological datum plane
MET	meteorological
METL	mission-essential task list
MFCS	Mortar Fire Control System
MGRS	Military Grid Reference System
MIN	minimum, used in conjunction with fire control equipment
mm	millimeter
MOA	method of attack
MOC	method of control
MOF	method of fire, multi-option fuze
MOS	military occupational specialty
MPI	mean point of impact
MPS	meters per second
MSDA	mortar surface danger area
Msg	message, used in conjunction with fire control equipment
MTO	message to observer
MTP	mission training plan
MTSQ	mechanical time superquick
NCO	noncommissioned officer
NFA	no-fire area
NGF	naval gunfire
NiMH	nickel metal hydride
Obs Num	observer number
OIC	officer in charge
OP	observation point; operation
OpACK	operationally acknowledge, used in conjunction with fire control equipment
OpOUT	operationally out, used in conjunction with fire control equipment
OpRDY	operationally ready, used in conjunction with fire control equipment
OpSTA	operationally stationary, used in conjunction with fire control equipment
OpStatus	operation status, used in conjunction with fire control equipment
OT	observer-target
PD	point-detonating
PDA	personal digital assistant (Chapter 17 only); power distribution assembly (Chapter 15)
PE	probable error
PE_d	probable error in deflection
PE_r	probable error in range
PLGR	precision lightweight Global Positioning System receiver
PMCS	preventive maintenance checks and services
PRN	printer, used in conjunction with fire control equipment
PROX	proximity
PTM	plain text message
QWERTY	standard typewriter keyboard, top row left, first six letters
R	right, used in conjunction with fire control equipment
RALS	right add, left subtract
RAM	random access memory; volatile; stores data only until device is turned off or loses power
RCF	range correction factor
RFA	restricted fire area
RFL	restricted fire line

Rnds Cmplt	rounds complete, used in conjunction with fire control equipment
ROM	read-only memory
RP	registration point, red phosphorus
RPDA	ruggedized personal digital assistant
RPM	rounds per minute
RTO	radiotelephone operator
S-3	operations and training officer
SAASM	selective availability antispoof module (type of GPS card)
SD	secure digital (memory card)
SL	section left
SOI	signal operating instructions
SOP	standing operating procedure
SQ	superquick
SR	section right
STX	situational training exercise
TC	training circular
TCIM	tactical communication interface modem
TDC	time dispersal coding
TFC	technical fire control
TFT	thin-film transistor
TGT	target, used in conjunction with fire control equipment
TL	traverse leg
TM	technical manual
TMPC	terrain mortar position correction
TOC	tactical operations center
TOF	time of flight
TOT	time on target
TRADOC	United States Army Training and Doctrine Command
TRC	total range correction
TS	traverse station
TTT	time to target
UO	urban operations
URN	unit reference number
US	United States
UTM	universal transverse mercator
V	volt
VA	vertical angle
VDC	volt direct current
VI	vertical interval
VMS	vehicle motion sensor
VT	variable time
WP	white phosphorus
WPN	weapon, used in conjunction with fire control equipment
WR	when ready, used in conjunction with fire control equipment

SECTION II. TERMS

decrement	a gradual decrease in quality or quantity; or the amount of decrease
random-access memory	read-write computer memory on which the location of data does not affect the speed of its retrieval; especially, the main storage available to the user for programs and data
read-only memory	a usually small computer memory that contains special-purpose information, such as operating system software, which must not and cannot be altered
volatile memory	memory that stores data only until device is turned off or loses power
zeroize	to return to zero

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Index

G

N

O

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MET DATA CORRECTION SHEET FOR MORTARS

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

COMMAND DATA			MET MESSAGE			
CHARGE	CHART RANGE	ELEVATION	TYPE	STATION	DATE	
ALT OF MORTARS (m)			TIME	ALT MDP	LINE NUMBER	
ALT OF MDP			WIND DIRECTION	WIND VELOCITY	AIR TEMP	AIR DENSITY
SECTION ABOVE + MDP Δ H BELOW —		+ —	Δ H CORRECTIONS		ΔT ±	ΔD ±
			CORRECTED VALUES			

WIND COMPONENTS AND DEFLECTION CORRECTION

WHEN DIRECTION OF WIND IS LESS THAN DIRECTION OF FIRE ADD	6400
DIRECTION OF WIND	
DIRECTION OF FIRE	
CHART DIR OF WIND	

CROSS WIND ________ X L R ________ = L R ________ KNOTS X ________ = ________
VELOCITY COMPONENT LATERAL WIND CORR FACTOR DEFL CORR

RANGE WIND ________ X T H ________ T H ________ KNOTS
VELOCITY COMPONENT RANGE WIND

MET RANGE CORRECTIONS

	KNOWN VALUE	STANDARD VALUES	VARIATION FROM STANDARDS	UNIT CORRECTIONS	PLUS	MINUS
POWDER TEMP	ΔV —	0	D I			
RANGE WIND	T H	0	T H			
AIR TEMP		100	D I			
AIR DENSITY		100	D I			
WT OF PROJECTILE	☐	2 ☐	D I			
				TOTAL		
				RANGE CORR		

MET CORRECTION TO APPLY

	DEFL	RANGE
LAST MESSAGE	L R	+ —
THIS MESSAGE	L R	+ —
CORR TO APPLY	L R	+ —

DA FORM 2601-1-R, FEB 2005 REPLACES DA FORM 2601-1, 1 OCT 71, WHICH IS OBSOLETE.

MET DATA CORRECTION SHEET 6400 MILS (MORTARS)

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

FIRING DATA			MET MESSAGE			
CHARGE	CHART RANGE	ELEVATION	TYPE	STATION	DATE	TIME

ALTITUDE OF MORTARS (M)		ALT MDP	LINE NUMBER	WIND DIRECTION
ALTITUDE OF MDP		WIND VELOCITY	AIR TEMP	AIR DENSITY
SECTION ABOVE + BELOW − MDP Δ H	+ −	Δ H CORRECTIONS	Δ T ±	Δ D +
		CORRECTED VALUES		

WIND COMPONENTS

WHEN DIRECTION OF WIND IS LESS THAN DIRECTION OF FIRE ADD	
DIRECTION OF WIND	
TOTAL	
DIRECTION OF FIRE	

	(RP) I	II	III	IV	V	VI	VII	VIII
CHART DIRECTION OF WIND (6400 IS LESS THAN CORRESPONDING DIRECTIONAL VARIATION TO CHECK POINTS)								
DIRECTIONAL VARIATION TO CHECK POINTS								
CHART WIND TO CHECK POINTS								
DEFLECTION CORRECTIONS								
WIND VELOCITY (KNOTS)								
CROSS WIND COMPONENT	L R	L R	L R	L R	L R	L R	L R	L R
CROSS WIND	L R	L R	L R	L R	L R	L R	L R	L R
CROSS WIND CORRECTION FACTOR								
DEFLECTION CORRECTION	L R	L R	L R	L R	L R	L R	L R	L R
RANGE CORRECTIONS								
WIND VELOCITY (KNOTS)								
RANGE WIND COMPONENT	T H	T H	T H	T H	T H	T H	T H	T H
RANGE WIND	T H	T H	T H	T H	T H	T H	T H	T H
RANGE WIND UNIT CORRECTION								
RANGE WIND CORRECTION	±	±	±	±	±	±	±	±

	KNOWN VALUE	STANDARD VALUES	VARIATION FROM STANDARD	UNIT	PLUS	MINUS
POWDER TEMP	Δ V = −		D I			
AIR TEMP			D I			
AIR DENSITY			D I			
PROJECTILE WT	☐	☐	D I			
			BALLISTIC RANGE CORR.			

ABSOLUTE REGISTRATION CORRECTIONS

REGISTRATION CORRECTION	±	L R
RP MET CORRECTION	±	L R
ABSOLUTE REG. CORRECTION	±	L R

DIRECTIONAL CORRECTIONS

	I (RP)	II	III	IV	V	VI	VII	VIII
BALLISTIC RANGE CORR.	±	±	±	±	±	±	±	±
RANGE WIND CORRECTION	±	±	±	±	±	±	±	±
TOTAL RANGE CORRECTION	±	±	±	±	±	±	±	±
MET CORRECTION	± L R	± L R	± L R	± L R	± L R	± L R	± L R	± L R
ABSOLUTE REG. CORRECTION	± L R	± L R	± L R	± L R	± L R	± L R	± L R	± L R
CORRECTIONS TO APPLY	± L R	± L R	± L R	± L R	± L R	± L R	± L R	± L R

DATA SHEET

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

SETUP		WEAPON DATA			FO DATA		
TIME OUT:	UNIT:	WPN:	WPN:		FO	ALT	GRID
TGT PRFX:		DIR:	DIR:				
TGT NO:	___ mm CAR: ☐ YES ☐ NO	DIS:	DIS:				
ALARM: ☐ ON ☐ OFF							
MIN E:	BP:	WPN:	WPN:				
MIN N:		DIR:	DIR:				
GD: ☐ E ☐ W	E:	DIS:	DIS:				
LAT: ☐ + ☐ -	N:						
LISTEN: ☐ ON ☐ OFF	ALT:	WPN:	WPN:				
BIT RATE:	AZ:	DIR:	DIR:				
KEY TONE:	DEF:	DIS:	DIS:				
BLK: ☐ SNG ☐ DBL	ELE:						
OWNER ID:							

AMMUNITION DATA

TEMPERATURE ____________ TYPE: ☐ HE ☐ WP ☐ ILL ☐ CS ☐ TNG

LOT NUMBER									
WEIGHT									
ON HAND									
RECEIVED									
TOTAL									
ROUNDS EXPENDED									
ROUNDS REMAINING									

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

LHMBC/MFCS DATA SHEET

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

GEO REF

Ellipsoid: ______

Datum: ______

Min Easting: ______

Min Northing: ______

Zone: ______

Hemi: ______

DATA

TGT Prefix: ______

MIN: ______

MAX: ______

Alarm:

☐ ON ☐ OFF

Next: ______

WEAPON DATA

Firing Unit:

______ mm CAR: Y ☐ N ☐

Unit Name: ______	Unit Name: ______
Easting/DIR: ______	Easting/DIR: ______
Northing/DIS: ______	Northing/DIS: ______
ALT: ______	ALT: ______
AZ: ______	AZ: ______
DEF: ______	DEF: ______
Obs Num: ______	Obs Num: ______
Unit Name: ______	Unit Name: ______
Easting/DIR: ______	Easting/DIR: ______
Northing/DIS: ______	Northing/DIS: ______
ALT: ______	ALT: ______
AZ: ______	AZ: ______
DEF: ______	DEF: ______
Obs Num: ______	Obs Num: ______

SUBSCRIBERS

FDC IP:

Unit:	URN:	ADR:	Grid:	Alt:	Obs#:

COMMO

COMMO	A	B
Protocol:		
Device Type:		
Modulation:		
Data Rate:		
COMSEC:		
FH Mode:		
EDC Mode:		
NAD Method:		
NET Usage:		
Num Stations:		
Rank:		

AMMUMITION DATA TEMP

Shell Type:					
Lot Number:					
On Hand:					
Received:					
TOTAL:					
RNDS Expended:					
RNDS Remaining:					

TARGET DATA

TARGET ID			CHART DATA		FIRING CORRECTIONS				FIRING DATA				INTELLIGENCE			ROUNDS	
TGT NO.	GRID	ALT	DEFL/ AZ	RG CHG	DEFL/ AZ CORR	RANGE CORR	ALT VI	ALT CORR	DEFL/ AZ	RG CHG	FUZE/TIME SETTING	ELEV	TGT DESC.	METHOD OF ENGAGEMENT	SURVEILLANCE	EXP	REM

COMPUTER'S RECORD (MPI)

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

UNIT ____ DATE ____ TIME ____

MESSAGE TO OBSERVERS

PREPARE TO OBSERVE MPI REGISTRATION

OP# ____ DIR ____ VA ± ____

OP# ____ DIR ____ VA ± ____

REPORT WHEN READY TO OBSERVE

VERTICAL ANGLE COMPUTATIONS

RP ALTITUDE ____

OP # ____	OP # ____
RP ALT ____	RP ALT ____
OP ALT ____	OP ALT ____
VI ± ____	VI ± ____
OP RANGE ____	OP RANGE ____
W / RXM ____	W / RXM ____

(VI + RN IN THOUSANDS = VA)

100/R ____	100/R ____
VI x 100/R ____ *(NEAREST .1)*	VI x 100/R ____ *(NEAREST .1)*
VA ± ____ *(NEAREST MIL)*	VA ± ____ *(NEAREST MIL)*

OBSERVER'S READINGS

ROUND NO	OP #	OP #
1.		
2.		
3.		
4.		
5.		
6.		
7.		
8.		
9.		
10.		
(MUST BE SIX USABLE AZIMUTHS)		
TOTAL OF AZIMUTHS *(ADD EACH COLUMN)*		
AVG OF AZIMUTHS *(TOTAL ÷ 6)*		
DIR TO MPI		

DATA SECTION

81-MM/60-MM

RP GRID ____ CHA ____ ELE ____

RP ALT ____	MPI ALT ____
MORT ALT ____	MORT ALT ____
VI ± ____	VI ± ____
ALT CORR ± ____	ALT CORR ± ____
RP CHART DATA	**MPI DATA**
DEF ____	DEF ____
RN ____	RN ____
(MINUS ALT CORR)	*(MINUS ALT CORR)*
DEF CORR	**RANGE CORR**
RP DEF ____	RP RN ____
MPI DEF ____	MPI RN ____
DIFF L/R ____	DIFF ± ____
DEF CORR L/R ____	RCF ± ____
(TO APPLY, REVERSE SIGN)	*(TO APPLY, REVERSE SIGN)*

120 mm

MPI ALT ____ CHA FIRED ____

MORT ALT ____ CHA CORR ± ____

VI ____

(USE THIS VI TO COMP CHA CORR)
(SUBTRACT IF + AND IF -)

CHART CHARGE TO MPI ____

CHART DEFL TO MPI ____

(DRAW THE ADJ CHG GAGE LINE FROM THE MPI POINT TO THE CHART CHG OF THE MPI POINT

CHART RANGE TO MPI ____

DEFL FIRED ____

DEFL CORR R/L ____

(DETERMINE THE LARS CORR TO GET FROM MPI TO RP DEFL)

GRID OF MPI ____

COMPUTER'S RECORD

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ORGANIZATION	DATE	TIME	OBSERVER ID	TARGET NUMBER

☐ ADJUST FIRE ☐ FIRE FOR EFFECT

☐ IMMEDIATE SUPPRESSION

GRID ____

OT DIRECTION ____

ALTITUDE ____

SHIFT FROM ____

OT DIRECTION ____ ALTITUDE ____

☐ LEFT / ☐ RIGHT ____

☐ ADD / ☐ DROP ____

☐ UP / ☐ DOWN ____

POLAR

OT DIRECTION ____ ALTITUDE ____

DISTANCE ____

☐ UP / ☐ DOWN ____

VERTICAL ANGLE ☐ + / ☐ - ____

TARGET DESCRIPTION

METHOD OF CONTROL

METHOD OF ENGAGEMENT

MESSAGE TO OBSERVER

FDC ORDER

MORTART TO FFE ____

MORTAR TO ADJ ____

METHOD OF ADJ ____

BASIS FOR CORRECTION ____

SHEAF CORRECTION ____

SHELL AND FUZE ____

____

METHOD OF FFE ____

RANGE LATERAL SPREAD ____

TIME OF OPENING FIRE ____

INITIAL CHART DATA

DEFLECTION ____

DEFLECTION CORRECTION

☐ L ☐ R

RANGE ____

VI/ALT CORRECTION

☐ + ☐ -

RANGE CORRECTION

☐ + ☐ -

CHARGE/RANGE ____

AZIMUTH ____

ANGLE T ____

INITIAL FIRE COMMAND

MORTAR TO FOLLOW ____

SHELL AND FUZE ____

____

MORTAR TO FIRE ____

METHOD OF FIRE ____

____

DEFLECTION/AZIMUTH ____

CHARGE ____

TIME SETTING ____

ELEVATION ____

____

ROUNDS EXPENDED

OBSERVER CORRECTION			CHART DATA		SUBSEQUENT COMMANDS						ROUNDS EXPENDED
DEV	RANGE	TIME (HEIGHT)	DEFL	CHARGE (RANGE)	MORTAR FIRE	METHOD FIRE	DEFL AZIMUTH	RANGE / CHARGE	TIME (SETTING)	ELEV	

By Order of the Secretary of the Army:

GEORGE W. CASEY, JR.
General, United States Army
Chief of Staff

Official:

JOYCE E. MORROW
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0817801

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