CHAPTER 5

81-mm MORTAR, M29A1

The 81-mm mortar, M29A1, delivers timely, accurate fires to meet the requirements of supported troops. This chapter discusses personnel duties, mechanical training, and the characteristics of the mortar.

Section I. SQUAD AND SECTION ORGANIZATION AND DUTIES

Each member of the infantry mortar squad has principle duties and responsibilities. (See FM 7-90 for platoon drills.)

5-1. ORGANIZATION

For the 81-mm mortar section to operate effectively, each mortar squad member must be proficient in his individual duties. By performing those duties as a team member, he enables the mortar squad and section to perform as a fighting team. The platoon leader commands the platoon and supervises the training of the elements. He uses the chain of command to assist him in effecting his command and supervising duties.

5-2. DUTIES

The mortar squad consists of five men (Figure 5-1). Their firing positions and principal duties are as follows:

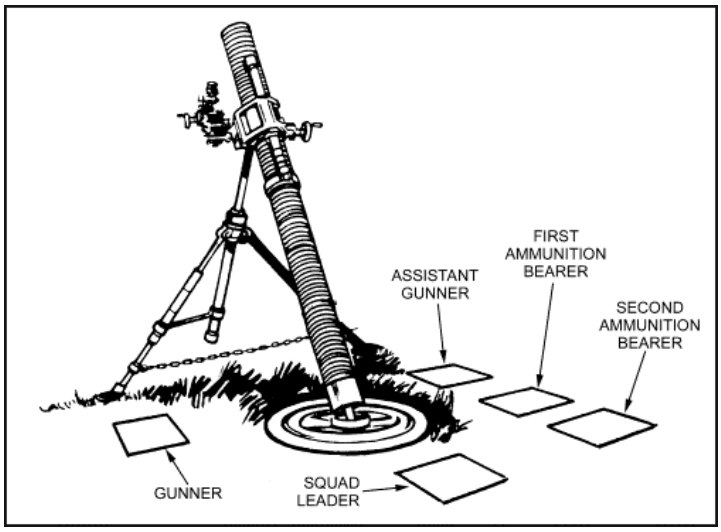

Figure 5-1. Positions of squad members.

a. The *squad leader* stands behind the mortar where he can command and control his squad. In addition to supervising the emplacement, laying, and firing of the mortar, he supervises all other squad activities.

b. The *gunner* stands on the left side of the mortar where he can manipulate the sight, elevating gear handle, and traversing assembly wheel. He places firing data on the sight and lays the mortar for deflection and elevation. He and assistant gunner make large deflection shifts by shifting the bipod assembly.

c. The *assistant gunner* stands on the right of the mortar, facing the barrel and ready to load. In addition to loading, he is responsible for swabbing the bore after every 10 rounds have been fired or after each fire mission. He assists the gunner in shifting the mortar when making large deflection changes.

d. The *first ammunition bearer* stands to the right rear of the mortar. He prepares the ammunition and passes it to the assistant gunner.

e. The *second ammunition bearer* is normally behind the mortar, maintaining the ammunition for firing, providing local security for the mortar position, filling sandbags, and performing other duties as the squad leader directs. He normally places out and retrieves the aiming post. The second ammunition bearer is also the squad truck driver. When his duties do not require him to be with the vehicle, he

is used as an ammunition bearer (performing the same duties as the first ammunition bearer).

Section II. COMPONENTS

This section contains the technical data and description of each component of the 81-mm mortar, M29A1. The 81-mm mortar is a smooth-bore, muzzle-loaded, high angle-of-fire weapon (Figure 5-2). It consists of a cannon assembly, bipod assembly, and baseplate.

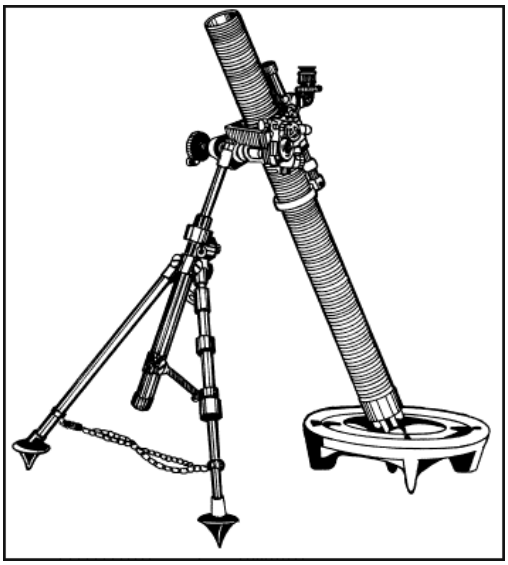

Figure 5-2. 81-mm mortar, M29A1.

5-3. TABULATED DATA

The tabulated data for the 81-mm mortar, M29A1, are as shown in Table 5-1.

Weights (pounds)	
System (including basic issue items)	121.5 (total in three loads)
Barrel	28
Mount	40
M3 Baseplate	25.4
M23A1 Baseplate	48
M53 Sightunit	5.25

Ammunition	HE	Smoke	Illum	Practice
Ready to fire	9.4	10.6	9.1	9.4
In single container	12.0	13.8	12.4	12.5
In three-round pack	57.0	63.0	60.0	60.0
***Note**: M3 baseplate is standard A.*				
Elevation				
Elevation (approximate	800 to 1511 mils			
For each turn of elevation crank (approximate)	10 mils			
Traverse				
Right or left from center (approximate)	95 mils (9 2 turns)			
Total turns of handwheel for full traverse (approximate)	190 mils (19 turns)			
Total traverse by movement of mount without moving baseplate	6400 mils			
Range				
Minimum to maximum	70 to 4,737 meters			
Rate of Fire				
Sustained	3 (charge 8) to 5 (charge 6) rounds per minute for 1 minute			
Maximum for 2 minutes	12 (charge 8) rounds per minute			
Maximum for 5 minutes	12 (charge 6) rounds per minute			
HE Lethality (M374 series)	34-meter diameter			
Smoke Screen (M375 series)	20-meter diameter			
Illumination (M301A3)	500,000 candlepower for 1 minute (1,200-meter area illuminated)			
HE Fuze Options	M524 PD, M536 PD, M532 proximity			
Sight	M53 series			

Table 5-1. Tabulated data.

5-4. CANNON ASSEMBLY, M29A1

The cannon assembly consists of the barrel, mount attachment ring, and base plug with a spherical projection that contains a removable firing pin (Figure 5-3).

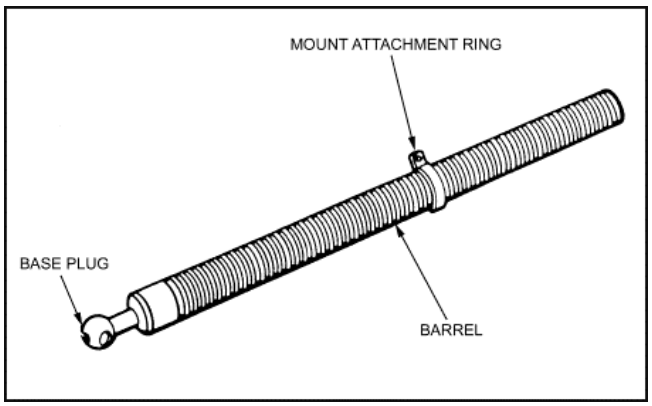

Figure 5-3. Cannon assembly, M29A1.

5-5. BIPOD ASSEMBLY, M23A1

The bipod assembly consists of the elevating and traversing mechanism, and bipod legs (Figure 5-4).

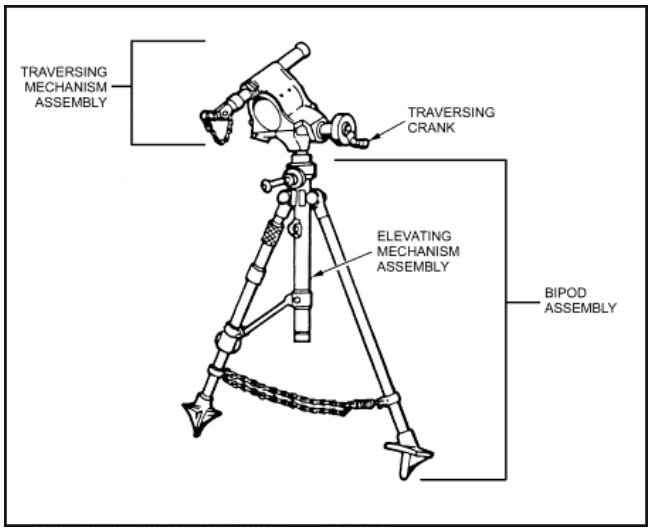

Figure 5-4. Bipod assembly, M23A1.

a. The *bipod legs* consist of two tubular steel legs that are hinged at the sides of the elevating mechanisms. The legs have spiked feet, and their spread is limited by an adjustable chain. A spring attached to the right end of the chain and the right leg relieves shock to the legs during firing. The right leg has no moving parts. The left leg has a cross-level mechanism consisting of a sliding bracket mounted on the leg with a locking sleeve and adjusting nut. The sliding bracket is connected to the elevating housing by a connecting rod. Any movement of the sliding bracket is transmitted through the connecting rod, elevating mechanism assembly, and traversing mechanism assembly to the barrel, moving it in a like manner. The locking nut locks the sliding bracket in any desired position on the leg. Cross-leveling is performed to remove any cant from the sight. The sight must be level to attain true readings in elevation and deflection. Cross-leveling is completed by rotating the adjusting sleeve on the upper part of the leg.

b. The *elevating mechanism* assembly includes a vertical spindle screw moving in an elevating housing assembly. The screw is turned by a bevel gear and pinion contained in the gear case. The gear and pinion are moved by an elevating crank. The top cover of the gear case contains an oil fitting for oiling the elevating screw, gear, and pinion.

c. The *traversing mechanism* consists of the yoke assembly, traversing mechanisms, and shock absorber. The yoke body supports the upper end of the barrel when the mortar is assembled.

Note: Older models of the yoke contain a level vial.

d. The sightunit is mounted in the dovetail sight slot on the left side of the yoke. The traversing mechanism is an internal screw shaft operating within a nut and tube. The handwheel turns the screw, which forces the nut to traverse the yoke and, therefore, the barrel. The tube over the nut is connected to the elevating shaft, which protrudes from the gear case of the bipod. The shock absorber is a compression spring-type unit mounted in the yoke. A shock absorber clevis screws to the projecting end of the shock absorber shaft. When the barrel is assembled to the yoke, this clevis is attached to the barrel ring with the shock absorber clevis locking pin.

5-6. BASEPLATE, M3

The baseplate (Figure 5-5) is of one-piece construction, and supports and aligns the mortar for firing. During firing, the base plug on the barrel is seated and locked to the rotatable socket in the baseplate. The barrel passes through the yoke of the mount and is secured to the shock absorber by a locking pin.

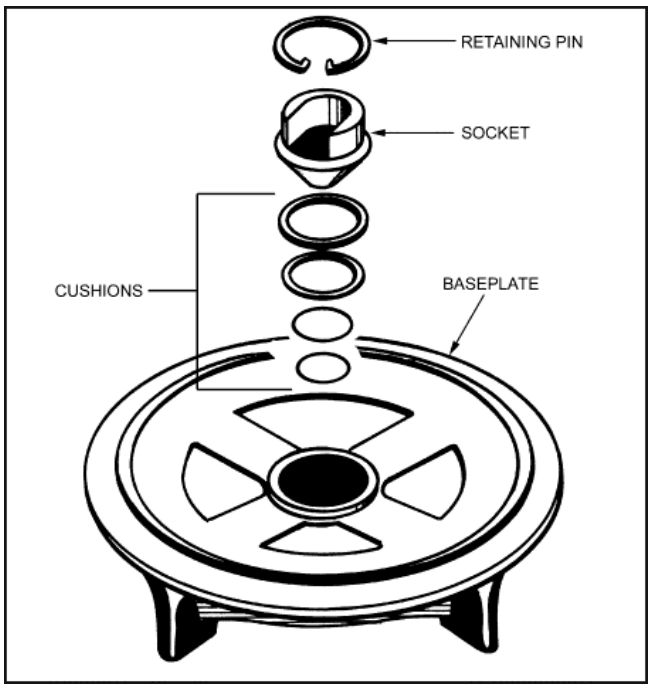

Figure 5-5. Baseplate, M3.

Section III. OPERATION

This section contains information on how to prepare the 81-mm mortar, M29A1, for firing, and how to conduct safety checks and misfire procedures.

5-7. PREMOUNT CHECKS

Before the mortar is mounted, the squad must perform premount checks. Each squad member should be able to perform the following premount checks:

a. The *gunner* checks the mount and ensures that--

(1) The spread chain is doubled, wrapped around the legs, and hooked, untangled, to the left leg.

(2) The clearance on the left leg above the adjusting sleeve is two fingers in width.

(3) The locking nut is neither too loose nor too tight.

(4) The traversing bearing is centered.

(5) The clevis locking pin is fully seated.

b. The *assistant gunner* checks the barrel and ensures that--

(1) The barrel ring is centered between the two beveled cutouts on the outer ring.

(2) The barrel is clean both inside and outside.

(3) The firing pin is visible.

(4) The spherical projection is clean and the firing pin is firmly seated.

c. The *first ammunition bearer* checks the baseplate and ensures that--

(1) The rotatable socket cap moves freely and has a light coat of oil.

(2) The ribs and braces are free from breaks and dents, and the inner ring is secured to the outer ring (M23A1 baseplate).

d. After each piece of equipment is checked, the squad members notify the gunner that either the baseplate (or cannon) is correct or they report what is wrong with that piece of equipment.

e. The *squad leader* supervises the conduct of squad drill and is responsible for supervising the laying out of the equipment as shown in Figure 5-6. The equipment is placed out the same for the gunner's examination.

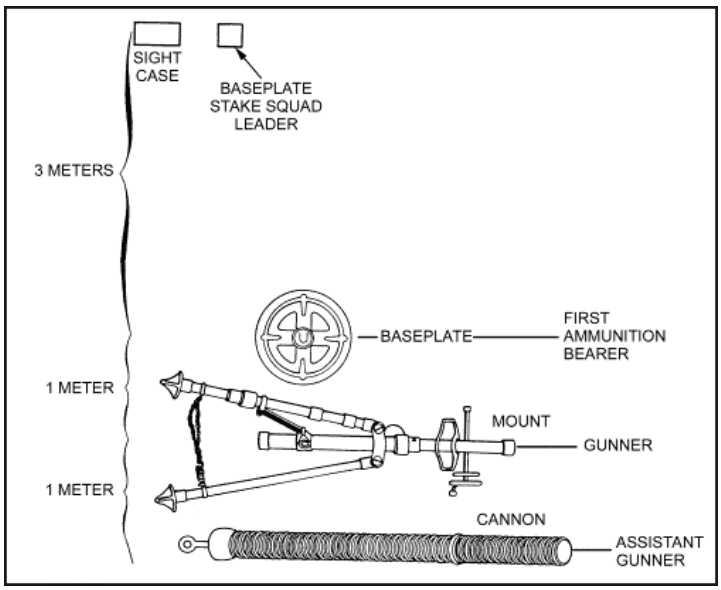

Figure 5-6. Layout of equipment.

5-8. MOUNTING OF THE MORTAR

The squad leader picks up the sight case and two aiming posts, and moves to the exact position where the mortar is to be mounted. He places the sight case and aiming posts to the left front of the mortar position. The squad leader points to the exact spot where the mortar is to be mounted. He indicates the initial direction of fire by pointing in that direction and commands ACTION.

a. The first ammunition bearer places the outer edge of the baseplate against the baseplate stake, so that the left edge of the cutout portion of the baseplate is aligned with the right edge of the stake (Figure 5-7). He then rotates the socket cap so that its open end is pointing in the direction of fire.

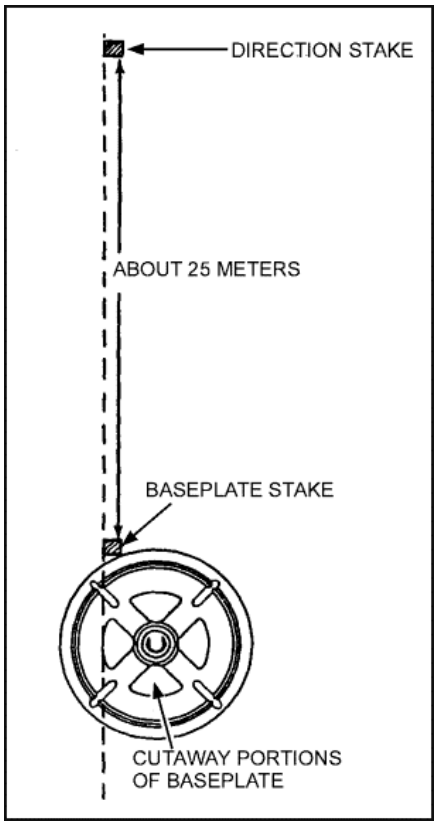

Figure 5-7. Baseplate placed against baseplate stake.

b. When the baseplate is in position, the gunner places his left hand on the traversing handwheel and his right hand on the sight slot, and lifts the bipod. He moves to the front, faces the baseplate, and places the bipod legs about 12 to 15 inches in front of the baseplate on line with the right edge so that an extension of the right edge of the baseplate would bisect the interval between the closed legs. Kneeling on his right knee in front of the bipod and supporting it with his left hand on the gear case, the gunner unhooks the doubled chain from the chain hook on the left leg, unwinds it, and rehooks the end loop on the chain hook. Lifting the left leg, he opens the legs to the full extent of the chain.

c. The gunner moves the elevating mechanism housing to the left until the traversing mechanism is in a horizontal position, and then tightens the locking sleeve.

d. The gunner rises and moves to the left rear of the bipod while supporting the bipod with his left hand on the shock absorber. He disengages the clevis locking pin and raises the yoke assembly to a horizontal position, keeping both hands on the shock absorber. He holds the clevis locking pin and chain out of the way with his right hand.

e. The assistant gunner inserts the barrel (mount attachment ring lug up and centered between the two beveled cutouts on the outer ring) into the yoke assembly with a slight twisting motion until the lug on the mount attachment ring fits into the shock absorber clevis (Figure 5-8). The gunner locks the clevis to the barrel ring with the clevis locking pin. The assistant gunner inserts the spherical projection of the base plug into the socket and rotates the barrel 90 degrees to lock it to the baseplate.

Figure 5-8. Bipod and mount attachment ring secured.

f. The gunner then places the traversing crank in its operating position. Removing the sight from its case, he mounts it on the mortar and sets it at a deflection of 3200 mils and an elevation of 1100 mils. He centers the elevation level bubble, centers the cross-level bubble, and rechecks the elevation bubble.

5-9. SAFETY CHECKS BEFORE FIRING

The following safety checks must be enforced before firing the mortar.

a. The *gunner* makes certain that--

(1) There is mask and overhead clearance.

(a) Since the mortar is normally mounted in defilade, there may be a mask such as a hill, trees, a building, or a rise in the ground. Overhead interference can be caused by overhanging branches of trees or roofs of buildings. However, the gunner must ensure that the round does not strike a obstacle.

(b) In selecting the exact mortar position, the leader checks quickly for mask clearance and overhead interference. After the mortar is mounted, the gunner makes a thorough check.

(c) The gunner determines mask and overhead clearance by sighting along the top of the barrel with his eye placed near the base plug. If the line of sight clears the mask, it is safe to fire. If not, he can still fire at the desired range by selecting a charge zone having a higher elevation. When firing under the control of an FDC, he reports to the FDC that mask clearance cannot be obtained at a certain elevation.

(d) Firing would be slowed if mask clearance had to be checked before each firing but this can be eliminated if minimum mask clearance is determined. This is accomplished by depressing the barrel until the top of the mask is sighted. The gunner levels the elevation bubble and reads the setting on the elevation scale and elevation micrometer--this setting is the minimum mask clearance. The squad leader notifies the FDC of the minimum mask clearance elevation. Any target that requires that elevation, or a lower one, cannot be engaged from that position.

(e) If the mask is not regular throughout the sector of fire, the gunner determines the minimum mask clearance as described above. Placing the mortar in position at night does not relieve the gunner of the responsibility of checking for mask clearance and overhead interference.

(2) The barrel is locked to the baseplate with the open end of the socket cap pointing in the direction of fire. The barrel ring should be positioned between the etched markings on the barrel.

(3) The shock absorber clevis locking pin is secure.

(4) The locking sleeve is wrist tight.

(5) The chain is taut and is hooked to the left leg.

b. The *assistant gunner* ensures that the bore is clean, and he swabs the bore dry.

c. The *ammunition bearer* ensures that each round is clean, the safety pin is present, and the ignition cartridge is in good condition.

5-10. SMALL DEFLECTION AND ELEVATION CHANGES

With the mortar mounted and the sight installed, the gunner lays the sight on the two aiming posts (placed out 50 and 100 meters from the mortar) on a referred deflection of 2800 mils and an elevation of 1100 mils. The mortar is within two turns of center of traverse. The vertical cross line of the sight is on the left edge of the aiming post.

a. The gunner is given a deflection change in a fire command between 20 and 60 mils. The elevation change announced must be less than 90 mils and more than 35 mils.

b. As soon as the sight data are announced, the gunner places it on the sight, lays the mortar for elevation, and then traverses onto the aiming post by turning the traversing handwheel and the adjusting nut in the same direction. A one-quarter turn on the adjusting nut equals one turn of the traversing handwheel. When the gunner is satisfied with his sight picture, he announces, "Up."

Note: All elements given in the fire command are repeated by the gunner.

c. After the gunner has announced, "Up," the mortar should be checked by the squad leader to determine if the exercise was performed correctly.

5-11. LARGE DEFLECTION AND ELEVATION CHANGES

With the mortar mounted and the sight installed, the gunner lays the sight on the two aiming posts (placed out 50 and 100 meters from the mortar) on a referred deflection of 2800 mils and an elevation of 1100 mils.

a. The gunner is given a deflection and elevation change in a fire command causing the gunner to shift the mortar between 200 and 200 mils and an elevation change between 100 and 200 mils.

b. As soon as the sight data are announced, the gunner places it on the sight, elevates the mortar until the elevation bubble floats freely, and then centers the traversing bearing. This ensures a maximum traversing capability after making the movement.

c. The assistant gunner moves into position to the front of the bipod on his right knee, places his right shoulder against the gear case, and grasps the bipod legs (palms out), lifting until they clear the ground enough to permit lateral movement. The gunner moves the mortar while the assistant gunner steadies it. The gunner attempts to horizontally maintain the traversing mechanism. To make the shift,

the gunner places the fingers of his right hand in the muzzle (Figure 5-9), his left hand on the left leg, and moves the mortar until the vertical line of sight is aligned approximately on the aiming post. When the approximate alignment is completed, the gunner signals the assistant gunner to lower the bipod by pushing down on the mortar.

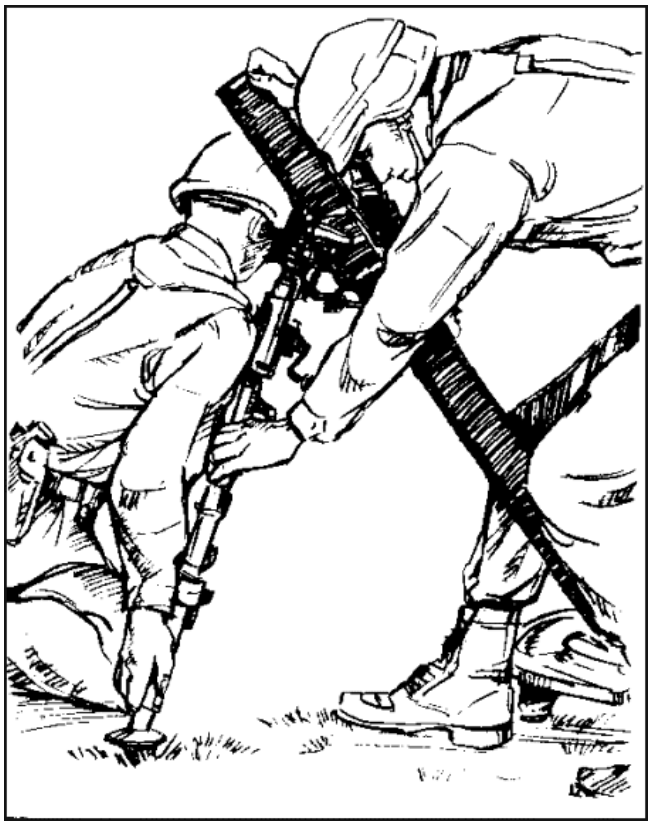

Figure 5-9. Large deflection changes.

5-12. REFERRING OF THE SIGHT AND REALIGNMENT OF AIMING POSTS USING M53 SIGHT

Referring and realigning aiming posts ensure that all mortars are set on the same data. The section leader, acting as FDC, has one deflection instead of two.

a. The mortar is mounted and the sight is installed. The sight is laid on two aiming posts (placed out 50 and 100 meters from the mortar) on a referred deflection of 2800 mils and an elevation of 1100 mils. The mortar is within two turns of center of traverse. The gunner is given an administrative command to lay the mortar on a deflection of 2860 or 2740 mils. The mortar is then re-laid on the aiming posts using the traversing crank.

b. The gunner is given a deflection change between 5 and 25 mils, either increasing or decreasing from the last stated deflection, and the command to refer and realign aiming posts.

EXAMPLE: REFER DEFLECTION TWO EIGHT SEVEN FIVE (2875), REALIGN AIMING POST.

c. Upon receiving the command REFER, REALIGN AIMING POST, two actions take place at the same time in the mortar squad. The gunner places the announced deflection on the sight (without disturbing the lay of the weapon) and looks through the sightunit. Also, the first ammunition bearer moves out to realign the aiming posts. He knocks down the near aiming post and proceeds to the far aiming post. Following the arm-and-hand signals of the gunner (who is looking through the sightunit), he moves the far aiming post so that the gunner obtains an aligned sight picture. The same procedure for aligning the far aiming post is used to align the near aiming post.

5-13. MALFUNCTIONS

See Chapter 3, paragraph 3-14 for a detailed discussion of malfunctions.

5-14. REMOVAL OF A MISFIRE

When a misfire occurs, any member of the squad immediately announces, "Misfire." The entire squad stays with the mortar. The gunner then kicks the barrel several times with his heel in an attempt to dislodge the round. If the round fires, the mortar is re-laid on the aiming point and firing is continued.

WARNING

During peacetime live-fire training, all personnel, except the gunner, move at least 50 meters to the rear of the mortar.

a. If the round does not fire, the gunner tests the barrel for heat. After one minute, if the barrel is cool enough to handle, the crew removes the round as described below. If the barrel is hot, the gunner may then apply water to the outside of the

barrel until it is cool. If no water is available, the gunner stands clear of the mortar until the barrel is cool.

WARNING

During peacetime live-fire training, if the round does not fire, the gunner joins the crew and waits one minute to avoid personal injury due to a cookoff. After waiting one minute, the gunner returns to the mortar and tests the barrel for heat. When the barrel is cool enough to handle, the gunner signals for the rest of the crew to come forward.

b. After the barrel cools, the gunner removes the sight and depresses the barrel to the minimum elevation. The assistant gunner braces the right leg of the bipod by placing his left leg in front of it. The gunner rotates the barrel while ensuring that he is positioned beside not behind, the weapon, until it is unlocked from the baseplate. The assistant gunner then places his right hand, palm up, under the barrel near the muzzle, and his left hand, palm down, on top of the barrel. He places the thumbs of both hands alongside the forefingers, being careful to keep both hands hand away from the muzzle.

c. The gunner lifts the base of the barrel until it is horizontal. He never lowers the base of the barrel below a horizontal position before the round has been removed. As soon as the barrel is in the horizontal position, and not before, the assistant gunner places the meaty portion of the thumb of each hand over the muzzle. When the fuze reaches the muzzle, the assistant gunner stops the round with his thumbs (avoiding the fuzes). He then carefully removes the round and passes it to the first ammunition bearer who inspects it to determine the cause of the misfire. If the primer of the ignition cartridge is dented, the ammunition bearer replaces the safety wire (if applicable) and places the round in a marked, safe location for disposition by ordnance personnel. If the primer is not dented, the round can be used again. The gunner shakes the barrel to dislodge any remnants from the last round fired, then locks the barrel.

d. If the procedure above fails to remove the misfire, the barrel must be kept horizontal. Then it is removed from the bipod and laid horizontally on the ground at the dud pit or safe area until it can be turned over to ordnance for disposal.

5-15. DISMOUNTING OF THE MORTAR

To dismount the mortar, the squad leader commands, OUT OF ACTION. At this command, the squad proceeds as follows:

a. The *second ammunition bearer* retrieves the aiming posts. The gunner removes the sight and places it in the sight box. He places an elevation of 800 mils and a

deflection of 3800 mils on the M53 sightunit. Then he lowers the mortars to its minimum elevation.

b. The *assistant gunner* turns the barrel 90 degrees, lifts up on the base end of the barrel and removes the barrel from the yoke assembly. He then turns to his left and places the barrel in the area designated by the squad leader.

c. The *gunner* disengages the clevis locking pin. He moves to the front of the bipod and faces it, kneels on his right knee with his left hand on the gear case, loosens the locking nut, and unhooks the chain from the left leg. He tilts the bipod to his left and closes the bipod legs, placing the chain around the legs and rehooking the chain. He stands up, placing his right hand on the sight slot and left hand on the traversing handwheel.

d. The *squad leader* picks up the aiming posts and sight. At the command MARCH ORDER, the squad places the mortar, equipment, and ammunition in the squad vehicle and trailer.

Section IV. AMMUNITION

This section implements STANAG 2321 and QSTAG 900 (Edition 1).

The ammunition that can be fired by the 81-mm mortar, M29A1, is identified and described herein. Ammunition is typed according to use (see Chapter 4, Table 4-2). High explosive is used against personnel and light-skinned vehicles. White phosphorus is used for screening, producing casualties, incendiary action, and signaling. Illuminating is used for battlefield illumination and signaling. Training practice is only for training.

The following are authorized cartridges for the 81-mm mortar, M29A1:

- High explosive--M374 series and M362 series.
- White phosphorus--M375 series, M370 series, and M57 series.
- Illuminating--M301 series.
- Training practice--M68 and M880 (SRTR).

The M29A1 may fire M821, M889, and M819 at reduced charges: charge 2 for training and charge 3 for combat.

Note: For a discussion of identification and ammunition lot numbers of cartridges, see Chapter 4, Section IV.

5-16. FUNCTION

Each cartridge has fins around the tail to stabilize it in flight and to cause it to strike fuze-end first. The propelling charge consists of an ignition cartridge and removable propellant

increments. The ignition cartridge (with primer) is fitted into the base of the fin shaft. The removable increments are fitted onto or around the shaft, depending on their type. The cartridge is dropped down the barrel, fin-end first. The ignition cartridge strikes the firing pin and detonates, which causes a flash that passes through the radial holes in the shaft. The propellant increments are ignited, which produce rapidly expanding gases that force the cartridge from the barrel. The obturating ring ensures equal muzzle velocities in hot or cold barrels by keeping all the gases in the barrel until the cartridge has fired. When fired, the cartridge carries the ignition cartridge with it, leaving the mortar ready for the next cartridge (Figures 5-10 and 5-11).

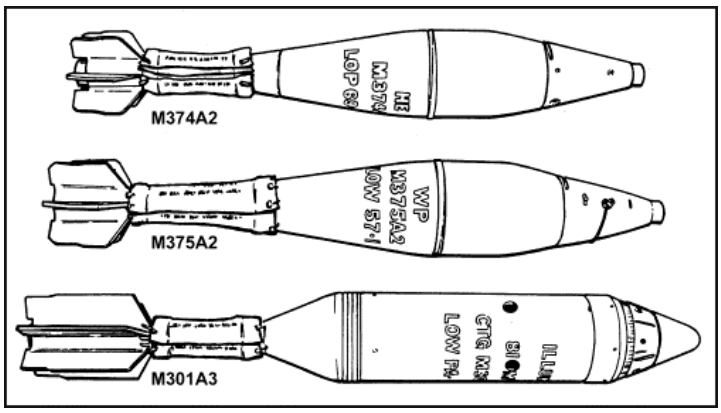

Figure 5-10. Standard A ammunition for 81-mm mortar, M29A1.

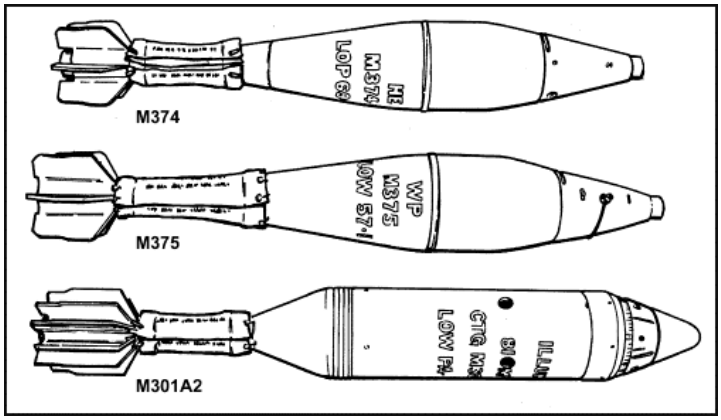

Figure 5-11. Standard B ammunition for 81-mm mortar, M29A1.

5-17. HIGH-EXPLOSIVE AMMUNITION

For a description of the types of HE ammunition, see Chapter 4, paragraph 4-18.

5-18. WHITE PHOSPHORUS AMMUNITION

For a description of the types of WP ammunition, see Chapter 4, paragraph 4-19.

5-19. ILLUMINATING AMMUNITION

For a description of the types of illuminating ammunition, see Chapter 4, paragraph 4-20.

5-20. TYPES OF FUZES

For a description of the types of fuzes, see Chapter 4, paragraph 4-21.

5-21. CHARACTERISTICS OF PROXIMITY FUZES

For an explanation of the characteristics of proximity fuzes, see Chapter 4, paragraph 4-22.

5-22. FUZE WRENCH AND FUZE SETTER

For details on the use of the fuze wrench and fuze setter, see Chapter 4, paragraph 4-23.

5-23. PREPARATION OF AMMUNITION

For an explanation of preparation of ammunition, see Chapter 4, paragraph 4-24.

5-24. CARE AND HANDLING

For proper care and handling of ammunition, see Chapter 4, paragraph 4-25.