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FM 1-40

DEPARTMENT OF THE ARMY FIELD MANUAL

Ch 1 2

ATTACK HELICOPTER GUNNERY

HEADQUARTERS, DEPARTMENT OF THE ARMY

JUNE 1969

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Changes in Force: C 1 and C 2

CHANGE
No. 2

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *30 September 1971*

ATTACK HELICOPTER GUNNERY

FM 1–40, 20 June 1969, is changed as follows:

1. New or changed material is indicated by a star.

2. Remove old pages and insert new pages as indicated below.

Remove old pages—	Insert new pages—
i and ii	i and ii
1–1 through 1–4	1–1 through 1–4
3–1 through 3–3	3–1 through 3–4
5–1 through 5–4	5–1 through 5–4
7–1 and 7–2	7–1 and 7–2
9–1 and 9–2	9–1 through 9–5
10–1 through 10–3	10–1 and 10–2
12–3	12–3
A–1 through A–4	A–1 through A–4
B–1 through B–3	B–1 through B–3
E–3 and E–4	E–3 and E–4
F–9 through F–12	F–9 through F–12
H–3 and H–4	H–3 and H–4
K–1 and K–2	K–1 and K–2
L–15 and L–16	L–15 and L–16
L–23 and L–24	L–23 and L–24
M–5 and M–6	M–5 and M–6
M–15 and M–16	M–15 and M–16
O–3 through O–6	O–3 through O–6
Index–1 through Index–6	Index–1 through Index–6

3. File this change sheet in the front of the manual for reference purposes.

By Order of the Secretary of the Army:

W. C. WESTMORELAND,
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Chief of Staff.

Official:
VERNE L. BOWERS,
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The Adjutant General.

Distribution:

To be distributed in accordance with DA Form 12–31 requirements for all Rotor Wing Aircraft for Operator and Crew (qty rqr block no. 77).

***This change supersedes FM 1–110, 8 July 1966.**

CHANGE No. 1

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ATTACK HELICOPTER GUNNERY

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i and ii	i and ii
1–1 through 1–4	1–1 through 1–4
3–1 and 3–2	3–1 through 3–2.2
5–1 through 5–4	5–1 through 5–4
6–3 through 6–6	6–3 through 6–6.1
7–1 and 7–2	7–1 and 7–2.1
11–1 and 11–2	11–1 and 11–2
12–1 and 12–2	12–1 and 12–3
13–1 and 13–2	13–1 and 13–2
A–1 through A–4	A–1 through A–4
B–1 through B–3	B–1 through B–3
C–1 and C–2	C–1 and C–2
C–29 through C–40	C–29 through C–31
K–1 and K–2	K–1 and K–2
L–17 and L–18	L–17 and L–18
L–23	L–23 and L–24
M–15	M–15 and M–16
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Index 1 through index 3	Index 1 through index 6

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FIELD MANUAL No. 1–40

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *20 June 1969*

ATTACK HELICOPTER GUNNERY

*This manual supersedes TC 1–24, 27 July 1967; TC 1–25, 27 August 1964; TC 1–30, 6 September 1966, including all changes; and TC 1–33, 27 July 1967.

PART ONE

GENERAL

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1-1. Purpose and Scope

a. This manual explains helicopter gunnery including practical applications of the science of ballistics and other procedures essential for the timely and accurate delivery of fire by attack helicopters. It includes techniques and procedures for the employment of attack helicopters (1-series TOE only) in support of ground tactical operations.

b. This manual is a guide for attack helicopter unit personnel, aviation staff officers, and commanders of supported tactical units. It does not cover all helicopter gunnery situations. Local modifications of the methods and techniques described herein may be necessary but should be made only when based upon firsthand knowledge and experience of the aircraft commander as measured against the state of training of his personnel. Any such modification should result in a gain in either accuracy or speed of response, or both. Modifications which might result in a degradation of accuracy or speed of response should be seriously questioned.

c. The scope of this manual includes—

(1) Characteristics and capabilities of weapons and ammunition.

(2) Fundamentals of ballistics.

(3) The helicopter gunnery problems.

(4) Techniques of fire.

(5) Fire control.

(6) Miscellaneous employment information.

d. The material presented herein is applicable to both nuclear and nonnuclear warfare, except as otherwise noted.

★*e*. Paragraphs 1-5, 4-5*c*, 6-11, and 10-8 are the subject of an international air standardization agreement, ASCC Air Standard 44/34, Tactical Formation Flying by Helicopter.

★1-2. Recommended Changes

Users of this manual are encouraged to submit recommended changes and comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons will be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commandant, United States Army Aviation School, ATTN: ATSAV-DL-L, Fort Rucker, Alabama 36360.

★1-2.1. Definition

Close air support is air attack against hostile targets which are in close proximity to friendly forces and which require detailed integration of each air mission with the fire and movement of those forces. It includes all fires delivered in close proximity to friendly forces by attack helicopters, light observation helicopters, and door gunners on troop-carrying helicopters.

1-3. Armed Helicopter Categories and Missions

An armed helicopter is any helicopter that has a mounted weapon system intended primarily for offensive use (e.g., UH-1 armed with M23 armament subsystem).

★*a. Attack Helicopter.* An attack helicopter is an armed helicopter modified or designed to search out and engage enemy targets or to supplement the fires of ground-based weapons (e.g., UH–1 armed with M21 armament subsystem or AH–1G). Attack helicopters perform three basic missions—*close air support, aerial escort,* and *reconnaissance and security.* These missions may occasionally be performed concurrently. The attack helicopter aircraft commander or fire team leader must be prepared to perform any one or all of them with a short notice. Only close air support missions are discussed in detail in this text. For information on aerial escort, see FM 1–100; and for information on reconnaissance and security, see FM 17–37. For information on the employment of attack helicopters by aerial field artillery, see FM 6–102.

b. Scout Helicopter. A scout helicopter is an armed helicopter designed primarily to conduct reconnaissance, including reconnaissance by fire (e.g., OH–6 armed with XM27 armament subsystem).

1–4. References

For details on each armament subsystem, preventive maintenance procedures, and ammunition required for each subsystem, see applicable 9-series TM (app A). For the characteristics and capabilities of each helicopter, see the appropriate aircraft operator's manual (TM 55-series–10).

1–4.1 Concept of Employment

★*a.* The Army airmobile concept, employing organic Army aircraft, dictates a requirement for immediate, responsive close air support during airmobile operations. The attack helicopter has proven to be a suitable platform which can accommodate a variety of weapons responsive to the fire support requirements of the ground commander. By providing accompanying and readily available close air support, the attack helicopter increases the number of possibilities available to the ground commander to more effectively apply his combat power. Missions requiring movement into enemy-held terrain can be undertaken with greater probability of success when attack helicopters are an integral element of the airmobile force.

★*b.* The concept of using attack helicopters in a fire support role visualizes their employment to supplement and extend the firepower available to the ground commander from ground-based weapons and close air support. As the Army's capabilities for combat mobility are expanded through the use of organic aircraft, the ability to provide close air support will also expand. Using appropriate tactics, the attack helicopter contributes greatly to mission accomplishment through its ability to operate in the same environment as the ground force. In addition, it is capable of delivering effective neutralization fire in the objective area at a crucial point in airmobile operations. The number of attack helicopters used on a particular mission will depend upon the airmobile capability allocated to the ground commander and the responsive fire support required.

★*c.* Attack helicopters play an essential role in augmenting the ground commander's capability for mobile and nuclear warfare. This role is emphasized in those instances where great dispersion of ground forces is required. The quick-reacting close air support that the attack helicopter can provide the ground or troop lift commander permits him the widest possible latitude in the assignment of missions to the airmobile force.

1–5. Attack Helicopter Element (Team)

★*a. Mission.* The attack helicopter element (team) consists of two or three helicopters and has the primary mission of delivering coordinated close air support for the ground commander. To provide immediate responsiveness to the requirements of the ground force, coordination of attack helicopter fires will normally be effected directly with the supported force commander or his tactical operations center. Procedures to accomplish the tasks involved in the coordination of fire will vary with the headquarters, the amount and type of fire support available, and the type of operation; however, every effort must be made to establish the attack helicopter unit in the lowest echelon which can effect complete coordination of the fire support mission.

b. Organization. Normally, the basic attack helicopter element is the fire team consisting of two helicopters. When circumstances require and resources permit, a heavy fire team consisting of three attack helicopters may be employed. The helicopters are mutually supporting by both fire and observation. The aircraft commanders of the fire team are—

(1) *Fire team leader.* Normally, the fire team leader is the aircraft commander of the lead helicopter. His primary responsibility is to insure mission accomplishment. He controls all the fires of the fire team as necessary to accomplish the

mission. He should be proficient in the techniques of properly employing attack helicopters. He is the requesting unit commander's immediate advisor for attack helicopter employment.

(2) *Wingman.* The wingman controls all fires of his crew, and his primary responsibility is to support the fire team leader. This support is typically accomplished by the wingman (and, in a heavy fire team, the third attack helicopter) augmenting the leader's fire or by providing fire for the leader. In an emergency, the wingman is capable of assuming the duties of the fire team leader.

1–6. Fundamentals of Employment of Attack Helicopters

Successful employment of attack helicopters demands responsive and accurate delivery of fires to meet the requirements of supported ground forces. Consideration of the fundamentals of surprise, flexibility, mobility, and fire and maneuver will enable the commander of an attack helicopter unit to recommend the best utilization of his unit in the support of the plan of action. For a detailed discussion of the fundamentals of employment, see FM 1–100.

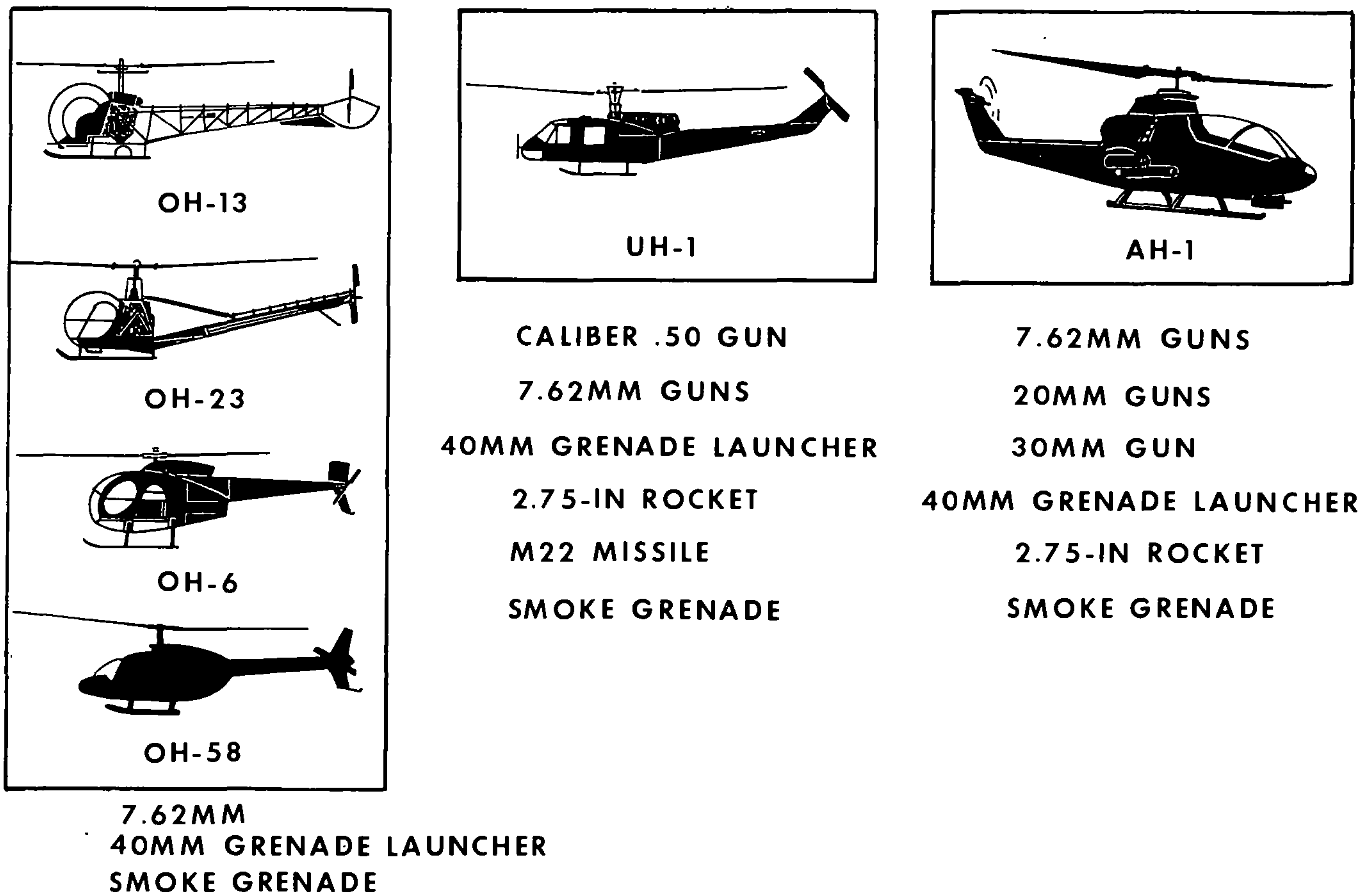
Section II. TYPES OF ARMAMENT

1–7. General

Attack helicopters normally carry a wide variety of armament (fig. 1–1) in order to have the widest possible mission profile on each sortie. For information on armament subsystems now in use or planned for use, see appendixes B through J; for a list of ammunition see appendix K.

1–8. Rifled-Bore Weapons

a. Ammunition. Ammunition for rifled-bore weapons varies from 5.56mm though 40mm. At present, most of this ammunition is percussion fired, with the propellant charge housed in brass casings. The current 20mm ammunition is electrically fired.



★*Figure 1–1. Helicopter armament.*

b. Firing Mode. Rifled-bore weapons may be mounted and fired in either the flexible or fixed mode. The flexible mode allows the gunner to shift his fire rapidly in any flight attitude or altitude.

c. Projectiles. Rifled-bore weapons projectiles vary from simple impact to high explosive and chemical. Fuzes for the high explosive and chemical projectiles may be point detonating (PD) or proximity type.

1–9. Rockets, Missiles, Warheads, and Fuzes

The rocket/missiles of weapons subsystems provide the standoff capability for attack helicopters.

a. Rockets. Because of their size and ballistic properties, rockets are launched in a fixed forward firing mode. They provide the fire required for attack helicopter engagement of area targets.

b. Missiles. Guided missiles provide attack helicopters the capability of engaging point targets (armor, bunkers, gun positions, etc.) with an extremely high probability of first-round hits.

c. Warheads. Guided missiles are capable of carrying a variety of warheads. However, existing stocks contain only practice and high explosive antitank (HEAT) warheads. Warheads for rockets include various chemical and high explosive (HE) and special purpose munitions in different sizes. Future warheads will be ballistically matched so that mixed loads may be carried and fired with a selectivity system.

d. Fuzes. The proper fuze must be used with each type warhead to cause the projectile to function at the time and place desired. Fuzes are classified according to the method of functioning—*time, impact, or proximity.* Impact fuzes are classified according to their position on the projectile —base-detonating (BD) or point-detonating (PD). At present, all guided missile fuzes are PD, but rocket warheads (app K) have a variety of fuzes.

(1) Time (T) and mechanical time (MT) fuzes contain a graduated time element in the form of a compressed powder train or a gear train (as in a clock) that may be set, prior to firing, to a predetermined time.

(2) Impact fuzes function when projectiles strike a solid object. Impact fuzes are further classified according to the speed of action after impact as *superquick, quick, nondelay* (base detonating only) and *delay.*

(3) Proximity (VT)[1] fuzes function when they approach any object which will reflect, with sufficient strength, the signal radiated from the fuze.

1–10. Free-Fall Stores

Delivery of free-fall stores reduces the effectiveness of attack helicopters because of the elimination of one or more weapon systems to accommodate the stores. Although the attack helicopter is not normally employed as the delivery aircraft, the tactical situation may necessitate responsive delivery of droppable munitions to include modified mortar projectiles, cluster bomb units, mines, chemical agents, or flares. Commanders must evaluate the advantages and disadvantages of employing the attack helicopter in this role and integrate their use into the ground unit's plan of action. Such use must be preplanned to insure effectiveness.

[1] Variable time.

CHAPTER 2

FUNDAMENTALS OF ATTACK HELICOPTER GUNNERY

Section I. ELEMENTARY BALLISTICS

2–1. General

Ballistics is the science which deals with the motion of projectiles and the conditions which affect that motion. The types of ballistics are *internal, external,* and *terminal.*

2–2. Internal Ballistics

Internal ballistics deals with the factors affecting the motion of the projectile within the tube. Since these factors are fixed for all aerial-fired weapons, they are only defined here.

a. Tube Wear. Movement of the gasses, residues generated by burning the propellant charge, and the projectile, may either wear away the inner surface of the tube or cause deposits to build up within it. Either condition results in a loss of muzzle velocity and may induce excessive yaw.

b. Propellant Charge. Propellant charges for aerial weapons are fixed; however, there are small differences in muzzle velocity and trajectory due to production variation. In addition, propellant burning is affected by temperature, moisture, and nonuniform distribution of propellant.

c. Projectile Weight. Projectiles of the same caliber may vary within tolerance in weight. This is especially true in linked ball and tracer ammunition. The heavier projectile, all other factors remaining unchanged, will have a lower velocity.

2–3. External Ballistics

External ballistics deals with the factors which affect the motion of the projectile as it moves along the trajectory. The trajectory is the path described by the center of gravity of the projectile as it passes from the muzzle of the weapon to the point of impact. Aerial-fired weapons have all the exterior ballistic factors associated with ground-fired weapons plus other factors which are unique because the weapons platform is moving.

a. General Ballistic Factors. Ballistic factors which affect both aerial-fired and ground-fired weapons are—

(1) *Air resistance (drag).* This resistance, caused by friction between the air and the projectile, opposes the acceleration or reduces the velocity of the projectile. Drag is proportional to both the cross-sectional area of the projectile and its velocity.

(2) *Gravity.* The drop due to gravity is proportional to the square of the time of flight of the projectile. Table 2–1 illustrates examples of the amount of correction necessary for gravity drop.

Table 2–1. Gravity Drop

Round	Range (feet/meters)	Gravity Drop (mils)
5.56mm	3,280/1,000	4.81
7.62mm	3,280/1,000	7.05
.50-cal	3,280/1,000	9.30
20mm	3,280/1,000	5.88
30mm	3,280/1,000	11.00
40mm	3,280/1,000	86.70

(3) *Yaw.* Yaw (fig. 2–1) is the angle between the centerline of the projectile and the trajectory. Yaw has negligible effect on the trajectory, but it does increase the affected surface area of the projectile and therefore the drag. The direction of the angle of yaw is constantly changing in a spinning projectile— right, down, left, and up. This initial yaw wobble is at a maximum near the muzzle and gradually subsides as the projectile stabilizes. Since the atmosphere offers greater resistance to a yawing projectile, it is fundamental in their design that yaw wobble be minimized and that it quickly dampen out in flight.

(4) *Projectile drift (horizontal plane gyroscopic effect).* U.S. Army projectiles, as viewed from the rear, usually spin in a clockwise direction. A spinning projectile acts as a gyroscope and exhibits the characteristic known as *gyroscopic precession.* When a projectile (with a clockwise spin) has a predominant plus yaw, aerodynamic lift and gyroscopic forces cause the projectile to precess, or move to the right. To compensate for this effect, it is necessary to aim to the left of the target (fig. 2–2).

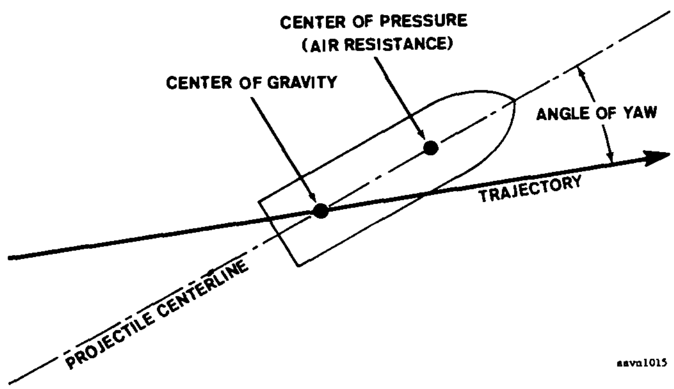


Figure 2-1. Yaw of projectile in flight.

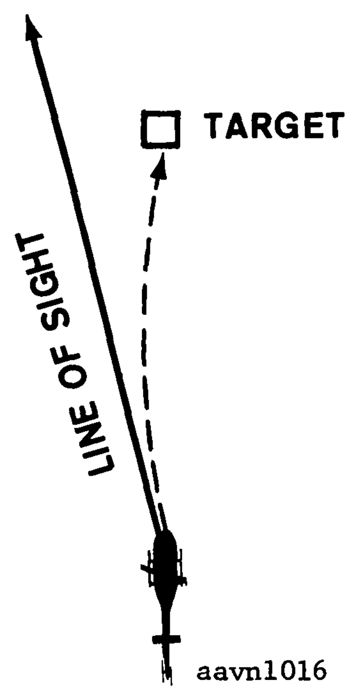


Figure 2-2. Aiming to compensate for projectile drift.

(5) *Coriolis effect.* The earth's rotation causes projectiles fired in the Northern Hemisphere to drift to the right. Projectiles fired to the east have less gravity drop than those fired to the west. The effect is negligible (less than 1 mil) for all helicopter-launched projectiles, and is important only for very long-range artillery.

(6) *Wind drift.* A projectile fired into a crosswind will drift downwind a distance equivalent to the product of the projectile's time of flight and the windspeed acting on the cross-sectional area of the projectile. Time of flight depends upon the range to the target and the average velocity of the projectile over this range. Firing into a crosswind requires that the weapons be aimed upwind to allow the wind to drift the projectile back to the target. Firing into the wind or downwind (A and B, fig. 2-5) will require no compensation laterally, but some adjustment is required in range.

b. Aerial Fire Ballistics. Ballistic factors peculiar to aerial-fired weapons depend upon whether the projectiles are spin-stabilized or fin-stabilized and whether they are fired from the fixed mode or the flexible mode.

(1) *Spin-stabilized projectile.*

(*a*) *Fixed mode.* Spin-stabilized projectiles fired in the fixed mode (straight ahead of the helicopter) generally have the same ballistic factors common to ground-fired weapons, except the velocity of the platform (helicopter) is added to the velocity of the projectile. To compensate for gravity drop when firing in a bank, the elevation of the weapon becomes deflection and it is necessary to aim high and opposite to the direction of bank.

(*b*) *Flexible mode.* In addition to the general ballistic factors, the ballistic factors affecting spin-stabilized projectiles fired in the flexible mode are—

1. Trajectory shift. When the boreline axis of the weapon differs from the flightpath of the helicopter, the velocity of the helicopter causes a change in the direction and velocity of the projectile (trajectory shift, fig. 2-3). For deflection shots within 90° of either side of the helicopter heading, trajectory shift causes the round to be left or right of the target. Trajectory shift is corrected by leading the target an amount depending upon the velocity of the helicopter, deflection angle, velocity of the projectile, and target range. Table 2-2 gives some typical lead angle values for firing a 60° deflection shot at 100/200 knots airspeed and 1,000 meters range.

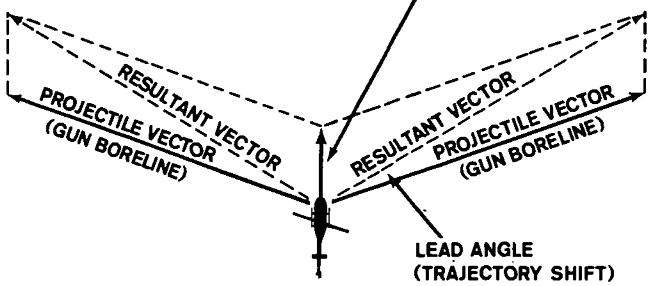


Figure 2-3. Trajectory shift.

Table 2-2. Typical Lead Angle Values for Firing a 60° Deflection Shot at 100/200 Knots Airspeed and 1,000 Meters Range

Round	Muzzle Velocity (feet per sec.)	Helicopter Velocity (knots)	Lead Angle (mils)
5.56mm	3,300	100/200	42/84
7.62mm	2,750	100/200	51/102
.50-cal	2,500	100/200	56/112
20mm	3,000	100/200	47/94
30mm	2,200	100/200	64/128
40mm	790	100/200	182/364

2. Port-starboard effect. Addition of the projectile drift factor (*a*(4) above) results in the *port-starboard effect*, so called because projectiles fired to the port (left) side of the helicopter require that *drift* be added to *shift*, while projectiles fired to the starboard (right) side require that *drift* be subtracted from *shift*.

3. Projectile jump (vertical plane gyroscopic effect). If a projectile is fired in any direction other than along the helicopter line of flight, an initial yaw due to the crosswind will be induced. A projectile elevation jump is produced that is proportional to initial yaw. For a projectile with a right-hand spin, firing from the right produces a downward jump, and firing from the left produces an upward jump. A gunner must aim slightly above a target on the right side of the helicopter and slightly below a target on the left side, even if the helicopter has a fire control computer. Fire control computers do not compensate for this effect. The amount of compensation (in the opposite direction from the jump) will increase with increases in helicopter velocity or the angular deflection of the gun.

(2) *Fin-stabilized projectile.* The ballistic factors affecting fin-stabilized projectiles (fig. 2-4) are of major importance. These factors are—

(*a*) *Air resistance.* The rocket is affected

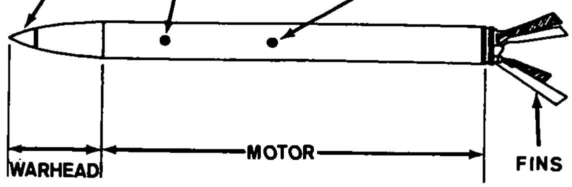


Figure 2-4. 2.75-inch FFAR.

by the relative wind of the helicopter; at launch, the rocket reacts to the relative wind and weathervanes into it. The extended fins are the largest surface area; consequently, this area causes the rocket to pivot about the center of gravity into the relative wind.

(*b*) *Propellant force.*

1. A bullet has its maximum velocity at the muzzle; however, a rocket continues to accelerate until motor burnout occurs (approximately 1.5 seconds after launch, for present motors). As the rocket reaches its greatest velocity, the kinetic energy that is contained in the rocket tends to overcome other forces and continue the rocket in a straight line of flight.

2. To provide equalization of thrust from exhaust nozzles, present rockets rotate less than 25 revolutions per second. Since this is not sufficient rotation for significant gyroscopic precession or yaw, these factors may be ignored.

(*c*) *Center of gravity.* Unlike a bullet, the center of gravity of the rocket is in front of the center of pressure (fig. 2-4). As the rocket propellant is consumed, the center of gravity will move further forward. The primary purpose of the fins is to insure that the center of pressure follows the center of gravity.

(*d*) *Crosswind effect.* The rocket will drift with a crosswind in an amount dependent upon the velocity of the wind and the time of flight of the rocket. To compensate for this factor, the pilot/copilot gunner's aim must be approximately 4 mils upwind for each 10 knots of crosswind about 10 knots for UH-1 helicopters. Since helicopter velocity is slower than that of the rocket, the gunner may experience an optical illusion that makes the helicopter appear to displace further than the rocket. The helicopter displaces laterally the same amount downwind as the rocket (C, fig. 2-5); however, the rocket has traversed a far greater distance toward the target during the time of flight. The gunner sees this motion relative to himself, causing the illusion of the rocket curving into the crosswind (C, fig. 2-5).

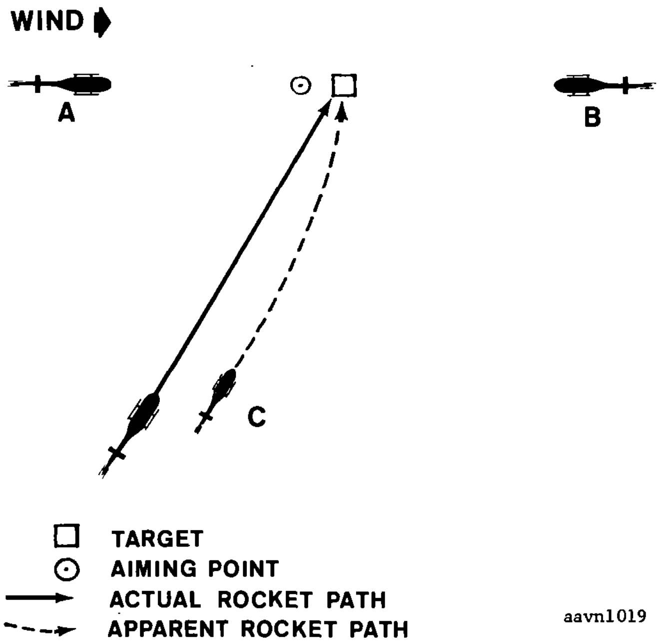


Figure 2-5. Optical illusion of rocket curving into the crosswind.

(*e*) *Relative wind effect.* If the helicopter is out of trim either horizontally or vertically at rocket launch, a relative wind will be created that will be other than the launch axis of the rocket (fig. 2-6). This relative wind acts on the larger surface area of the fins and cause the rocket nose to displace into it. For example, if the helicopter is 10° out of trim and the launch airspeed is 100 knots, the rocket will turn from about 3° to 5° into the relative wind. From this point it will drift downwind at the same speed and direction the wind is blowing.

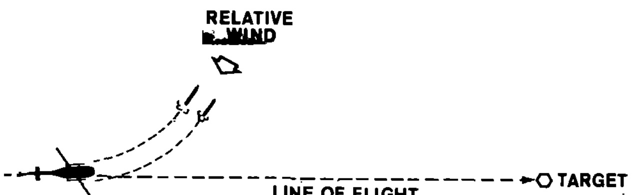


Figure 2-6. Relative wind effect.

1. A horizontal out-of-trim condition is usually the result of the pilot trying to maintain a straight groundtrack to the target by cross-controlling (or slipping) the helicopter. Inaccurate rocket fire is often the direct result of firing out of trim; consequently, trim is an important factor.

2. A vertical out-of-trim condition is the result of improper power setting (power setting being a function of airspeed, rate of descent, and aircraft load) which creates a vertical relative wind on the rocket at launch. For example, a rocket fired while the helicopter is in autorotation has a relative wind from below the helicopter; it will weathervane into the relative wind and impact short of the target. To maintain a good vertical trim condition, the proper procedure is to adjust the power setting to maintain the desired airspeed and rate of descent for dive control, harmonize the sight at 1,250 meters (midrange of the rocket) at this power setting, and then use this predetermined power setting when firing.

(*f*) *Miscellaneous factors.* Using the same motors, heavier warheads (in contrast to lighter ones) provide smoother launchings and greater accuracy. Other unpredictable factors which cannot be compensated for are—

1. Unequal burning of propellant, causing an erratic rocket flight.

2. During salvo fire, turbulence created by previous rockets, causing rockets to appear unstable.

3. Rockets with varying size warheads having different trajectories and terminal velocities. They sould never be fired as mixed loads.

2-4. Terminal Ballistics

Terminal ballistics concerns those factors which affect the projectile at the target. Projectile functioning (i.e., blast, heat, fragmentation, etc.) is influenced by fuze functioning and warhead/ fuze selection, angle of impact, and surface condition.

a. 2.75-inch FFAR Warhead/Fuze Selection. For a list of warheads and fuzes for the 2.75-inch FFAR, see appendix K.

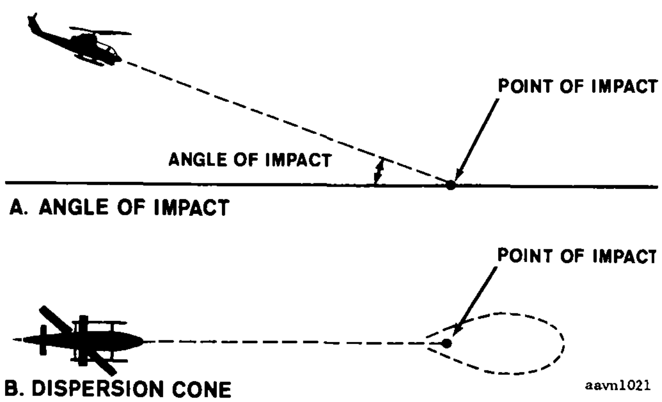


Figure 2-7. Dispersion pattern produced by low impact angle of projectile.

b. Angle of Impact. The angle at which the projectile strikes the target area affects the dispersion pattern. When fired at low impact angles, fragmenting projectiles create an elongated dispersion cone (fig. 2–7).

c. Surface Condition. The condition of the target surface area will affect the lethality of the projectile. If superquick-fuzed projectiles are employed on terrain covered with heavy jungle, the fuzes will function high in the jungle canopy with little or no lethal effect at ground level. If delay-type fuzed projectiles are employed on soft terrain (e.g., rice paddies), the warheads will penetrate the surface before detonation, thus decreasing lethal bursting radius.

Section II. DISPERSION

2–5. General

a. If a number of projectiles are fired from the same weapon with the same settings in elevation and deflection, the points of impact of the projectiles will be scattered both laterally (in deflection) and longitudinally (in range). This impact pattern is called *dispersion.*

b. Dispersion is caused by errors inherent in firing the projectile. These errors are caused, in part, by—

(1) *Conditions in the bore.* Muzzle velocity is affected by minor variations in weight, moisture content, and the temperature of the propellant charge; variations in the arrangement and content of the powder grains; differences in the ignition of the charge; differences in the weight of the projectiles; and variations in the temperature of the bore or tube.

(2) *Conditions in the mount.* Direction and elevation are affected by looseness in the mechanism of the mount and unequal reaction to firing stresses.

(3) *Vibrations in the mount.* Since the mount is fixed to the helicopter, vibrations in the helicopter are transmitted through the mount and affect both deflection and elevation.

(4) *Conditions during flight.* From round to round, air resistance (drag) is affected by differences in weight; velocity; form of projectile; and changes in wind, air density, and temperature.

2–6. Cone of Fire

For any large number of rounds fired, it is possible to draw a cone within which the trajectories of all the rounds will fall. Since the dispersion is considered equal throughout the cone, the *mean trajectory* is found anywhere along the length of the center of this cone. If a plane surface intersects the cone perpendicular to the mean trajectory, the dispersion pattern on the plane surface will be circular (fig. 2–8).

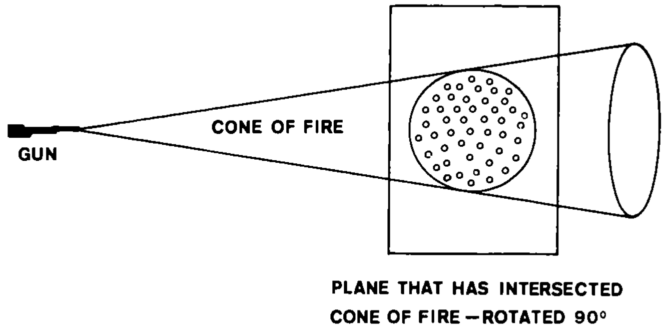


Figure 2–8. Circular dispersion pattern on plane intersecting cone of fire.

2–7. Circular Error Probable

This circular dispersion pattern is distributed equally about the center of the circle. If the distance from the center of the circle to each round is measured half the rounds have a greater error and half have a lesser error. These distances (radials) become a convenient unit of measure. This distance is called the *circular* (or *radial*) *error probable* (CEP), and is expressed in mils.

2–8. Dispersion Pattern

When the impacting surface is perpendicular to

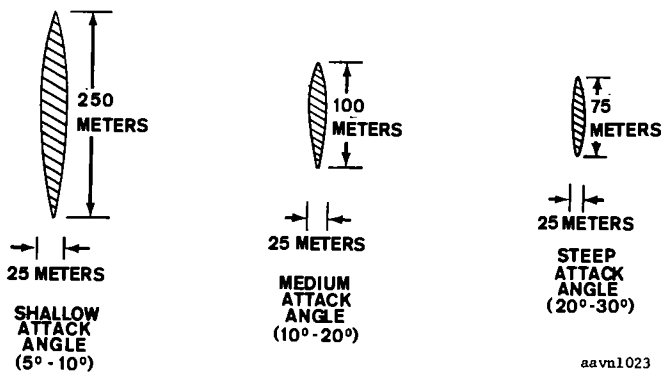


Figure 2–9. Elongated beaten zone for 7.62mm machinegun.

the mean trajectory, the normal impact pattern will show the same number of rounds equidistant from the center of impact. However, as the angle of the impact surface changes from perpendicular to oblique (fig. 2–9), the dispersion pattern becomes elongated; the same number of rounds are the same distance long as short. The circular error probable is the radius of a circle within which half of the rounds are expected to fall. In a normal distribution pattern, a distance of 4 CEP's in range and 1 CEP in deflection, on either side of the center of impact, will contain virtually all the rounds. However, since a difference in the angle of attack and the resulting angle of impact greatly affects the dispersion pattern, this is not altogether correct. The shallower the angle of impact the more elongated the dispersion pattern becomes, although the ratio of 4:1 holds true for practical purposes.

Section III. ATTACK HELICOPTER GUNNERY FIRING DATA

2–9. General

For a projectile fired from a helicopter weapons system to impact at the desired point, data is required on the direction, horizontal or slant range, weapon selected, speed of helicopter, sight picture, and desired pattern of impact at the target. Although the unit of angular measurement most commonly used for helicopter navigation is the degree (1/360 of the circumference of a circle), it is too large a unit for the aiming of weapons. The principal unit of angular measurement for aiming weapons is the mil (1/6400 of the circumference of a circle). An angular deflection of 1 mil results in a deflection of 1 meter at a thousand meters.

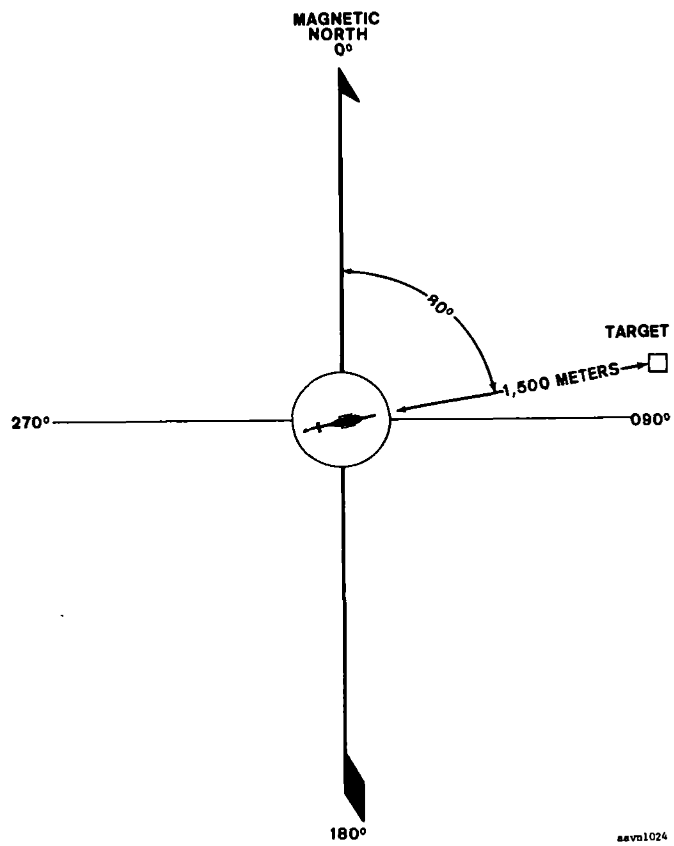


Figure 2–10. Degree method of referencing the target.

2–10. Direction to the Target

The direction from which attack helicopters may engage targets will depend upon the tactical situation. Direction is expressed as a measurement from a reference direction, usually magnetic north. (See chap 4 for factors affecting target engagement.)

a. Degree Method. Normally helicopter heading is expressed in degrees, with magnetic north as the reference direction. When the degree is used as the method of stating headings in helicopter attacks, usually the nearest 5° heading is given (e.g., 220°, 225°, etc.). A polar plot is obtained by adding the range to the direction (e.g., heading 080°, range 1,500 meters). Usually the helicopter is the reference or focal point (fig. 2–10).

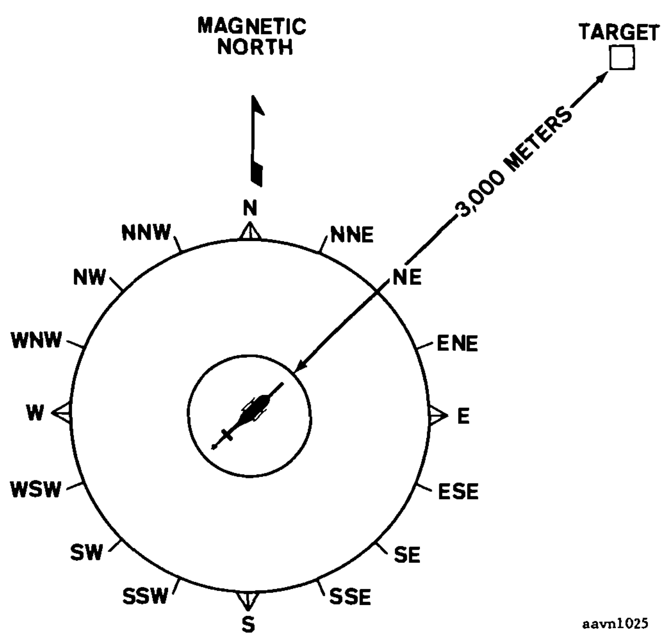


Figure 2–11. Cardinal heading method of referencing the target.

b. Cardinal Heading Method. Using magnetic north as the reference direction, helicopter attack headings may also be expressed as cardinal compass points (e.g., 225° SW, 045° NE, etc.). A polar plot (fig. 2–11) is obtained by adding range to the direction (e.g., bearing NE, range 3,000 meters).

c. Clock Method.

(1) Between aircraft commanders of an attack helicopter element, the clock method of expressing heading is most commonly used for identifying targets, positions, etc. The nose of the helicopter is always at the 12 o'clock position; target direction is measured clockwise from this 12 o'clock, position. For example (fig. 2–12), "Target at my 3 o'clock, range 500 meters."

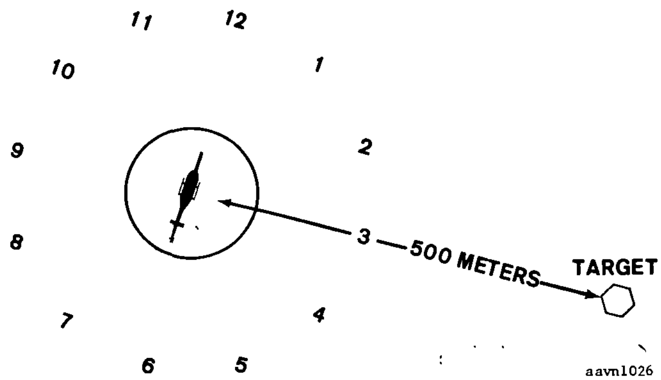


Figure 2–12. Clock method of referencing the target from the helicopter heading.

(2) The clock method can also be applied to landing zone operations. For this method, the 12 o'clock position is always the direction of landing. During combat assaults, the clock method provides an accurate and rapid means of pinpointing sources of hostile resistance.

2–11. Range

Range (fig. 2–13) may be expressed either as horizontal range (horizontal distance from a point below the helicopter to the target) or slant range (range from weapons to the target). Range is expressed in meters and may be measured graphically, measured electronically, or estimated. The range of any projectile is a function of the muzzle velocity (or terminal velocity for rockets) and the elevation of the tube. Elevation for helicopter gunnery is measured from the line of sight, and may be either positive (elevation) or negative (depression).

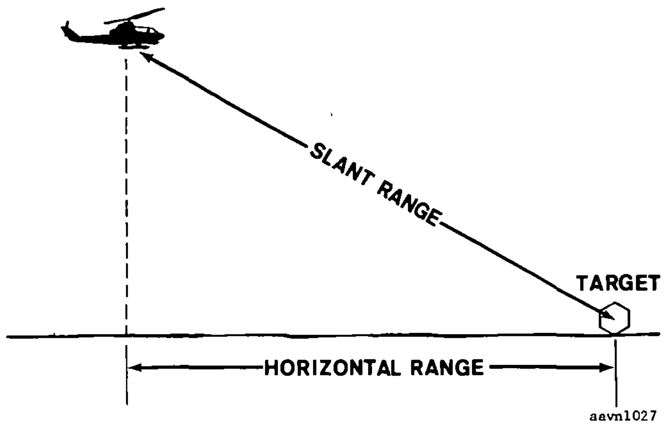


Figure 2–13. Range.

2–12. Speed of Helicopter

When closing with the target, helicopter speed requires a continual reestimating of range. As helicopter speed increases, deflection shots must have the correct lead factor applied to correct for trajectory shift.

2–13. Sight Picture

Because of the rapidly changing position of the helicopter in flight, application of the correct sight picture (chap 6) is more critical with aerial-fired weapons than with weapons fired from a fixed position.

2–14. Pattern of Impact

Distribution is the pattern of impact (beaten zone) in the target area. When possible, attack helicopters engage the target with enfilade fire. This means that the long axis of the beaten zone coincides with the long axis of the target. The size and shape of the beaten zone depends upon the attack angle of the weapon and the surface configuration. Attack helicopters may deliver diving fire, running fire, or hovering/stationary fire.

a. Diving Fire. Diving fire gives a nearly concentric beaten zone about the target. The size of the beaten zone depends upon the slant range, attack angle, weapons system used, and surface configuration.

b. Running Fire. Running fire may be delivered at any altitude with the helicopter in a level-flight attitude. Running fire results in a beaten zone, the size and dimensions of which vary with altitude, slant range, weapons system used, and surface configuration.

c. Hovering/Stationary Fire. Hovering or stationary fire may be delivered while the helicopter is in a covered or concealed position. When delivering hovering or stationary fire, the beaten zone of fire is extremely elongated. Firing from this mode does not significantly increase accuracy and, with certan weapons (e.g., the 2.75-inch FFAR), this method is impractical. Also, before deciding on this method of attack, thorough consideration must be given to increased aircraft vulnerability and loss of observation, mobility, flexibility, and maneuverability. This method of firing is to be used only when other methods or firing will be unsuccessful.

PART TWO

ATTACK HELICOPTER PROCEDURES AND TECHNIQUES

CHAPTER 3

★ATTACK HELICOPTER CLOSE AIR SUPPORT MISSIONS

Section I. GENERAL

★3–1. Close Air Support

Close air support fires delivered against hostile targets near friendly forces require detailed integration of each air mission with the fire and movement of the friendly forces. Coordination by the attack helicopter commander and the ground commander allows helicopter fires to supplement and be integrated into the committed firepower of the ground force.

★3–1.1. Command and Control

★*a. General.* To fully exploit the advantages of the versatile attack helicopter weapons system, attack helicopter command and control must be simple and direct. When not an integral part of the operation, aerial escort attack helicopters will normally be requested through fire support request channels. However, when the attack helicopters are acting in an aerial escort role at the time of request for close air support, the force commander establishes direct communications with the attack helicopter element and assigns the mission. The initial requestor, who is located in the combat area where the target has appeared, then advises the attack helicopter commander in the actual execution of the aerial attack. This insures that the requested close air support is available in the minimum amount of time and also provides the supported force commander with immediately control of a close air support system that can be integrated closely with the overall fire support effort.

b. Rules of Engagement. Since uncontrolled aerial helicopter fire is ineffective and dangerous, attack helicopter aircraft commanders must have positive control of their crews at all times. Crews only fire if permission has been granted by prearrangement or by requesting and receiving clearance as targets of opportunity occur. Prearrangement may include mission briefings, establishment of no-fire areas, or defining rules of engagement for a particular mission. When firing in close support of friendly forces, all firing must be closely coordinated. Before targets of opportunity acquired in an unexpected area may be engaged, they must be cleared by the commander responsible for that area. All attack helicopter personnel must know and observe the following rules of engagements. Attack helicopters will fire only when—

(1) Under positive control and in direct radio communication with the designated control agency.

(2) The target or target marks can be readily identified.

(3) Friendly and civilian positions are positively identified.

(4) They are defending themselves against ground fire and—

(*a*) The source can be visually identified.

(*b*) The strike can be positively oriented against the source.

(*c*) The intensity of fire warrants counteraction.

3–2. Types of Attack Helicopter Fires

The three general types of attack helicopter fires are *neutralization fires, destruction fires,* and *combined fires.* The distinction between these types depends upon results desired, weapons selected, and slant range to the target.

a. Neutralization Fires. To maintain fire on target, neutralization fires are often first delivered with heavy intensity and then followed by subsequent fires of lesser intensity. These fires are delivered for the purpose of reducing the combat efficiency of the enemy by—

(1) Hampering or interrupting the fire of his weapons.

(2) Reducing his freedom of action.

(3) Reducing his ability to inflict casualties on friendly troops.

(4) Severely restricting his movement within an area.

b. Destruction Fires. Destruction fires are those delivered for the sole purpose of destroying enemy troops and equipment.

Note. With all destruction fires, poststrike analysis is an assumed task requirement.

c. Combined Fires. Since attack helicopters can carry more than one type of ammunition and armament, fires may be combined. For example, neutralization fires may be used to protect the helicopter while it is engaged in destroying a point target.

3-3. Categories of Weapons

Weapons are categorized as *area target weapons, point target weapons,* or *dual-purpose weapons.* The category of each weapons system is determined by the inherent accuracy of the weapons system, the terminal ballistic characteristics of its projectile, and the volume of fire delivered.

a. Area Target Weapons. Because of inherent inaccuracies of area target weapons systems, they have a low probability of first-round hits. Included in this category are 7.62mm machineguns, 40mm grenade launchers, and 2.75-inch FFAR. The terminal ballistics of these weapons vary from a single 2.75-inch FFAR warhead with hundreds of fragments, to the impact of thousands of bullets fired from the automatic gun.

b. Point Target Weapons. Point target weapons require a high probability of first-round hits. Normally, point target weapons use a shaped-charge warhead capable of penetrating armor plating. Point fire is delivered by the wire-guided missile system.

c. Dual-Purpose Weapons. Dual-purpose weapons, such as the 30mm automatic gun and 2.75-inch FFAR, fire ammunition that is designed to be effective against personnel and light-armor materiel.

3-3.1. Attack Helicopter Employment

The types of targets best suited for attack helicopters are those that are relatively soft, small, lightly defended by antiaircraft weapons, difficult to detect, transitory, or very close to friendly troops.

a. Attack helicopters are the preferred system of aerial attack when—

(1) Friendly troops are less than 200 meters from the target.

(2) Targets are appearing in a changing and fast-moving situation requiring rapid response time, multiple target acquisition or tracking, direct communications, and close coordination.

(3) The target dictates that reaction to the ground commander's desires be immediate, closely integrated with the direct and indirect fires employed by the ground unit, and coordinated with the unit maneuver plan.

(4) Fixed wing attack aircraft cannot be used because of lack of immediate responsiveness and airspeed limitations.

(5) Discrete fires of minimum destruction are required for combat in populated areas.

(6) The enemy is well-dispersed and concealed.

(7) Preparation fires are needed on landing zones while transport helicopters are on final approach.

(8) Fire support is needed during the insertion or extraction of long range patrols.

(9) Neutralization fire is required to permit friendly maneuvers.

(10) Reconnoitering of the local battle area is required.

(11) Enemy action effectively closes runways required for fixed wing attack aircraft.

(12) Neutralization fire is needed on heavily fortified positions pending arrival of heavier fire support.

(13) Tactical chemical agent irritant (CS) fires are required. CS munitions are also effective against targets cited in (1) through (3), (6) through (10), and (12) above.

b. The attack helicopter is the superior system for the escort mission.

★Section II. PREPLANNED CLOSE AIR SUPPORT

3-4. Preplanned Fire Support

Preplanned fires are those that are planned for delivery in advance of takeoff. These fires are closely coordinated with the ground force commander and his fire support coordinator to insure support of the ground tactical plan. Planning normally includes target location, type and amount of weapons and ammunition, time of delivery, technique of delivery (chap 6) and method of adjustment (chap 9).

3-5. Target Acquisition and Control

Targets are acquired by all available means. Targets acquired by the ground element are engaged and controlled under the direction of the ground force commander to support his ground tactical plan. Engagement of targets acquired by other means will be in accordance with existing directives or policies of the supported headquarters.

3-6. Methods of Preplanned Support

Preplanned target fires, as with other supporting fires, are normally conducted to support a ground maneuver plan. Common preplanned close air support methods are—

a. Preparation Fires. Before and during the initiation of an assault, a heavy volume of preparation fire is delivered on a suspected or known enemy position. Various types of ammunition may be used in firing preparations for airmobile, amphibious, and airborne assaults; ground offensives; or raids.

b. Diversionary. Diversionary fires are delivered into an area to draw attention to it, with the intent that enemey forces may be drawn away from that principal area of operation. Diversionary fires may be used as an economy-of-force measure or in conjunction with ground offensive, defensive, or retrograde operations. The type ammunition to use is determined by the situation.

c. Harassing. Harassing fires are those delivered into an area for the purpose of disturbing the rest, curtailing the movement, and lowering the morale of enemy troops by the threat of casualties or losses in materiel.

d. Interdicting. Interdicting fires are those delivered into a designated area to deny the unrestricted use of that area to the enemy or to prevent the unimpeded withdrawal of the enemy from the combat area. Interdicting fires may be on-call or fired at random to provide a harassing effect in support of offensive, defensive, or retrograde operations.

e. Counterpreparation. Counterpreparation fire may be preselected area fire for targets of opportunity. Counterpreparation is the delivery of fire into the enemy's prepared fire support positions to deny the enemy a base of fire. Counterpreparation fires may be used against enemy mortar, artillery, armor, or other fire support weapons.

3-7. Preplanned Fires on Designated Point Targets

Preplanned fires on designated points are delivered with the intent of inflicting high losses to enemy personnel or equipment. Weapons should be those which insure a high probability of first-round hits; however, any type of weapon may be used. Normally, the high volume of fire required for area fire weapons to insure hits limits their use for point targets.

★Section III. IMMEDIATE CLOSE AIR SUPPORT

3-8. Target Acquisition and Fire Control

The requirement for *immediate fires* arises from targets of opportunity or changes in the tactical situation. Immediate fire targets may be acquired by any individual or element in the battle area; however, within his area the ground commander is responsible for the control of these fires. All immediate fires require close coordination of the fire team leader and the ground commander or his fire support coordinator.

3-9. Methods of Immediate Support

The common methods of immediate area target fire support are—

a. Preparation. A change in the forecasted tactical situation may require the firing of preparation fires into an area other than where originally planned. The rapid-reaction capability of attack helicopters permits their recall from a lower priority mission to fire preparation for an assault.

b. Base of Fire. In the fluid, fast-moving situations found in unconventional warfare, attack helicopters, without previous planning, may provide a base of fire for maneuvering elements.

c. Interdicting. As the tactical situation develops, immediate interdicting fires in support of the ground force may become necessary. To achieve good timing and target location and to locate friendly elements, interdicting fire delivery must be closely coordinated with the ground commander.

d. Targets of Opportunity. Targets of opportunity are those targets that randomly appear within the battle area and for which neutralization or destruction is desired. They should be engaged only when the engagement does not interfere with the primary tactical mission.

e. Countermeasure. Area countermeasure fires are those fires required for the defense of the aircraft against either an area-type hostile position or an all-hostile position within a determined quadrant. Generally these will be high volume, short duration fires allowing contact to be broken. The type of ammunition used will depend on the type target, as follows:

(1) *Soft.* Soft (i.e., lightly armored or bunkered) point targets will require high volume, short duration fires using all available weapons.

(2) *Hard.* Hard (i.e., heavily armored or bunkered) point targets place a different requirement on the pilot if he is to break contact successfully. Hard targets require larger caliber weapons, which presently are fired from the stowed mode. This requires that the pilot maneuver the helicopter to engage the target straight on.

(3) *Hostile aircraft.* Countermeasure fire against hostile aircraft allows the use of almost any type of weapon presently in the inventory. Some weapons systems require a high volume of fire to saturate the flightpath of the hostile aircraft. Other types of weapons are sufficiently accurate and responsive to allow a small expenditure of ammunition with a high probability of first-round hits.

f. Destruction Fires. Effective point target engagement normally requires that the target be clearly discernible at relatively greater ranges than for area targets; generally, the point target is acquired by the ground unit. The advantages of engaging these targets at maximum standoff distance are—

(1) Attacking helicopters have a high probability of first-round hits beyond the effective range of enemy small arms fire.

(2) Attack helicopters engaging targets several thousand meters in front of friendly positions provide friendly ground units reaction time and space to maneuver.

CHAPTER 4

CARDINAL RULES FOR ATTACK HELICOPTER EMPLOYMENT

4-1. General

Factors affecting the employment of attack helicopters are METT (mission, enemy, terrain and weather, and troops and equipment) and the established (cardinal) rules. For a discussion of METT, see FM 1-100. It is not always possible to follow the established rules precisely; however, as with the factors of METT, these rules must be weighed and then violated only when necessary to accomplish the mission. The 12 established rules (para 4-2 through 4-13) are combat-proven guides which enhance mission success and increase survivability in the combat environment.

4-2. Know the Situation

It is imperative that attack helicopter crews know the ground tactical situation if they are to provide the accurate, timely fire support required. Crewmembers must glean all the information possible from operations plans and orders, use complete prior planning, and constantly review intelligence reports.

4-3. Brief to the Man

To perform his duties properly, every member of the team must know the situation, the mission, and the plan of execution. Use of the five-paragraph operation format will insure clarity and completeness in the briefing. Debrief the team on completion of the mission. Debriefing will often bring out valuable intelligence information, and the crew will benefit from lessons learned. For checklist, see appendix N.

4-4. Avoid Flight in the "Deadman" Zone

When possible, flight in the "deadman" zone should be avoided. The *"deadman" zone* is that airspace where most aircraft hits occur. Experience factors gained in combat in Vietnam indicate that for that type conflict and under those terrain conditions, the "deadman" zone is from 50 to 1,000 feet above the terrain, with the airspace from 50 to 500 feet being the most hazardous. It will vary from area to area, under different intensities of conflict, and when facing different enemies. This zone is also that airspace which provides the best air-to-ground observation. For this reason, it is not always possible to meet the requirements for reconnaissance and stay out of the zone. When required to operate in or pass through the "deadman" zone, the flight should be completed as quickly as possible.

4-5. Avoid Flying the 180° Trail Position

a. When both the fire team leader and the wingman fly the same ground track, the following unacceptable conditions result:

(1) Observation as a team is reduced. Both helicopter crews are observing the same terrain.

(2) Enemy gunners can place enfilade fire on the entire team without changing their position.

(3) The hostile force is alerted by the first helicopter, and will either take cover or place fire on the second.

b. To properly employ his fire team, the leader should establish the axis of advance over the most favorable terrain for the entire team. The wingman is allowed to fly "free cruise" to provide the leader with both fire and observation support.

c. "Free cruise" varies 45° to either side of the axis of advance. Range and altitude separation between the helicopters will depend upon the altitude at which the team is operating. At low level (nap-of-the-earth) the wingman will normally fly slightly higher than the leader so that he can keep him in sight and be able to devote more attention to covering and staying in position, with minimum attention to obstacle clearance. The range separation will be that which provides effective fire support for low-level flight, usually 300 to 400 meters or greater as helicopter speed increases.

d. At higher altitudes, the wingman will normally fly slightly lower than the leader so that he can readily detect changes in the altitude of the lead helicopter. Also, the range separation should be increased so that the wingman can place effective fire under the lead helicopter and avoid excessively steep angles of attack.

4–6. Avoid Flying Parallel to Terrain Features

Terrain features, such as tree lines, provide good concealment for enemy forces who will normally orient their fields of fire toward the open areas. Flight parallel to these features could lead the fire team through the gauntlet of enemy fire. Continually flying parallel to terrain features establishes a pattern. The enemy will recognize and take advantage of this pattern to set up an ambush. Flight over linear terrain features should be conducted at maximum speed and at varying angles—the more nearly perpendicular, the better.

4–7. Always Assume the Area Is Hostile

The assumption that an area is safe just because no hostile fire has been received from it, especially in guerrilla-type conflicts, can be fatal. In addition, a reconnaissance by fire with negative results is not a guarantee that the area is safe. Well-trained enemy troops will not respond to reconnaissance by fire. The best approach is to assume that the area is hostile until proven safe, then to continually evaluate tactics and techniques and avoid establishing set patterns of employment.

4–8. Make a High Reconnaissance First

A high reconnaissance may not always be possible. Circumstances that can prevent a high reconnaissance include weather conditions such as low cloud ceilings, the tactical situation such as the known presence of .50 caliber or larger antiaircraft weapons, or situations when mission security would be jeopardized. If the situation permits, a high reconnaissance offers the following advantages:

a. Determines the objectives to be examined more closely during low reconnaissance.

b. Determines terrain over which to descend and ascend through the "deadman" zone.

c. Determines routes for contour flying into and away from critical areas.

d. Permits preliminary terrain analysis, especially with respect to enemy observation capability and fields of fire.

e. Reduces vulnerability to small arms fire to a minimum.

4–9. Locate the Friendly Troops

During fast-moving situations or when attack helicopters are called upon to furnish fire support with no prior knowledge of the ground tactical plan, it is of primary importance that friendly positions are positively located. Attack helicopter crews should not return hostile fire until the friendly positions are known. When possible, constant visual and radio contact should be maintained with friendly troops.

4–10. Avoid Target Overflight

Even when providing a large volume of fire, attack helicopters are more prone to sustain hits during target attacks near the target than on any other mission. Two steps to avoid overflying the target are—

a. Engage Target at Maximum Effective Range. To achieve maximum advantage from available weapons systems, it is desirable to engage the target at the maximum effective range of the system. Normally, the limitations on using this principle depend on the mission and the terrain. Visibility restrictions will require the helicopter to operate closer to the target.

b. Disengage Target Before Reaching Enemy's Effective Anti-aircraft Range. Depending upon the requirements of the mission, it is desirable to disengage a target before reaching the enemy's effective small arms antiaircraft range. Normally, current estimates of enemy capabilities, types of weapons, effective range, etc., will be provided through G2/S2 channels.

4–11. Avoid Firing Over the Heads of Friendly Troops

When enemy forces are engaged, the enemy positions normally parallel the friendly positions. Thus, attacking from over the friendly troops makes poor use of enfilade fire. Since enemy weapons are oriented toward the friendly force being supported, attack helicopters increase their exposure by attacking directly into the fields of fire. Also when attacking over friendly troop positions, falling rocket caps and machinegun brass can cause confusion and injuries among these troops.

4–12. Conserve Ammunition

Attack helicopter commanders must remember their mission and conserve their ammunition, using it wisely for that mission; they should avoid expending ammunition for other than support of the primary mission. Also, ammunition should be conserved for contingencies such as rescuing downed aviators and other unplanned tasks. One method of conserving ammunition is to regularly reserve a certain percentage of the ammunition load for contingencies. This technique should be specified in the unit SOP.

4–13. Take Your Time

To insure the application of sound tactics and accurate delivery of aerial fire, a plan of execution must be formulated for any aerial attack. Plans of execution are developed more rapidly as the crew gains experience. To prevent haste in plan execution, inexperienced crews must take time to consider the first 11 rules (para 4–2 through 4–12 above). Tactical results are better when (if necessary) extra time is taken to do the job right.

CHAPTER 5

★TARGET ACQUISITION

Section I. AERIAL ACQUISITION

★5–1. General

Using visual means or airborne surveillance equipment, targets may result from aerial reconnaissance by an attack helicopter crew or by an observer in another aircraft. An infantryman or a trained ground observer may also acquire targets (sec II). For calls for attack helicopter fire, see chapter 9.

★5–2. Target Acquisition

Normally, day target acquisition is by visual detection. It may also be by radar or specialized equipment. Night target acquisition may be by radar, specialized equipment, or artificial illumination (para 7–9).

a. Reconnaissance. Target acquisition always involves some type of reconnaissance. Reconnaissance is a continuous effort by the entire crew of an attack helicopter. A specific mission may or may not be stated as a reconnaissance task, but reconnaissance is a part of every mission. A thorough reconnaissance is necessary for either a known target location or for targets of opportunity.

(1) *Known target.*

(*a*) The known target is detected by some type of aerial surveillance or method of ground surveillance. The mission is given to the attack helicopter team. Their task is to pinpoint the target specifically before attacking it. To accomplish their task, the factors of METT and the established rules (chap 4) of attack helicopter employment must be considered. Based on this analysis of the target, the attack element then performs a reconnaissance of the target area by flying at the best altitude for observation,, depending upon the terrain, vegetation, and enemy situation. The attack helicopter element must find a position from which to best determine exactly *what the target is, what it looks like, and where it is located.* Once this has been determined, the leader of the element can form his plan of attack and issue his fire command.

(*b*) Before sending the helicopter element to attack a known target, aerial photography can be helpful in locating it. Aerial photography often gives the first indication that a target is in the area. If possible, a visual reconnaissance should be made before attacking a target identified by a photograph.

(2) *Targets of opportunity.* "Pop-up" or surprise targets which the attack helicopter element reconnaissance happens to locate are targets of opportunity. They may be spotted visually by the crew, or they may disclose their positions as a result of enemy fire directed toward the attack helicopter element.

(*a*) Targets spotted by the crew may be picked up by movement, fresh digging, trails, smoke from campfires, poorly camouflaged huts, fortifications, and many other clues which can arouse suspicion in the search area.

(*b*) Reconnaissance by fire is another method of locating targets. This leads a poorly disciplined enemy to move or to return fire and thus give away his position.

(*c*) Targets may be located by drawing enemy fire, even when not employing reconnaissance by fire. This is frequently the case when conducting a reconnaissance mission or escorting troop-lift helicopters en route. In either situation, some method of pinpointing the location must be used.

(*d*) Often the enemy fire will pinpoint the target; but if tracers, smoke, muzzle flash, or other motion is not detected, some sort of search of the general area must be conducted to locate it. Conduct of this search must be determined by and based on the factors of METT. Normally, the commander of the attack element must request permission from the ground commander or higher headquarters to engage the target. He will already be cleared when he is sent into the area of known targets, but he may have to verify friendly element locations before determining how to engage the target. Care must be taken to insure that targets of opportunity have been confirmed as the enemy.

b. Night Acquisition. At night or during periods of low visibility, target acquisition becomes more difficult and crew responsibilities take on added importance. Proper crew training and knowledge of techniques available can turn the operation into an advantage for the attack helicopter element. Aids to night target acquisition include—

(1) *Artificial illumination.* Night target illumination may be accomplished by aircraft flares, artillery illuminating rounds, and ground or helicopter-mounted searchlights (chap 7). When using artillery illumination, radio contact must be maintained between the fire team leader and the artillery unit firing the rounds. When using these artificial means of illumination, care must be taken to avoid being blinded and/or entangled with parachutes of flares that have burned out but are still aloft.

(2) *Infrared devices and starlight scopes.* Infrared devices and starlight scopes may be used effectively to locate targets at night; but even then, it is often difficult to identify the target location for other helicopters in the attack helicopter team. One method that is effective is to use the infrared device with an automatic rifle loaded with full tracer ammunition to mark the target. Another method of identifying the target is by illuminating it with an aircraft flare (chap 7), after locating it with the surveillance device. Still another method is to have the searchlight operator use the starlight scope to locate the target, then illuminate it with the searchlight.

(3) *Radar.* Ground radar units can vector the attack helicopter element to the target. Another method is to have observation aircraft using airborne surveillance equipment vector the attack helicopter to the target.

(4) *Aerial photographs.* Especially in unfamiliar areas, aerial photographs will help pilots find targets at night. The photographs will show terrain features such as canal lines, tree lines, and ridge lines which may be visible at night, making it easier to navigate to a known target.

(5) *Enemy fire.* By spotting muzzle flashes or tracers (para 8-1*a*), enemy fire may often be spotted from the air. However, the observer must rapidly pinpoint the muzzle flash or tracer location before it disappears and is lost.

c. Spot Reports. In many situations, the attack helicopter element commander must request permission in accordance with existing directives to attack a specific target. The spot report can be used to make the request. This report enables the ground commander or higher headquarters to keep abreast of the situation, determine the importance of the target in relation to the mission, and advise the attack helicopter element of situational changes in the target area, such as friendly movements. Reconnaissance reports should be transmitted using tactical speech security equipment, when available (FM 32-5). This type of report must include the following information—

(1) *Observer identification.* Identify yourself.

(2) *Description of target.* Identify target.

(3) *Location of target.* Give target coordinates.

(4) *Activity.* What is the target doing (e.g., moving convoy, troops moving, etc.)?

(5) *Requested action.* What action you desire to take against the target.

Section II. TARGETS ACQUIRED BY GROUND OBSERVERS

5-3. General

Ground elements acquire many targets for attack helicopters. Transmitting target information from the ground element to the attack helicopter element causes special problems. These problems are compounded during night operations or periods of low visibility. A simplified fire request system must be used by the ground observer to minimize the difficulties of calling for attack helicopter support. Usually this is accomplished by FM radio as a result of an exchange of SOI between the ground element and the attack helicopter element.

5-4. Employment Considerations

★*a.* To effectively employ the available close air support, the supported force commander must consider—

(1) *Nearness to friendly forces.* Several factors that determine how near aerial fires may be delivered to friendly forces are the enemy situation, nature of threat, amount of casualty risk acceptable to friendly forces, type of aerial fires, type of ammunition used, and disposition of friendly forces. Also, effective employment of the available close air support often depends on the

battlefield situation. The following employment distances are for planning purposes only. They should be used with discretion and adjusted as appropriate. Normally—

(*a*) Daytime machinegun and cannon fire may be brought to within 50 meters of friendly forces (25 meters in an emergency).

(*b*) Daytime rocket and grenade fire may be employed to within 75 meters (50 meters in an emergency). Depending on type of fuze and warhead (para K–7), employment distance for rockets may be greater.

(*c*) Night employment distances are generally greater than daytime distances due to the hazards of night flight close to the ground. However, accuracy and effectiveness of night fire support may depend on crew experience.

(2) *Response time.* The time required for the attack helicopter to reach the target area depends for the most part upon the proximity of the helicopter staging area to the target area. As a general rule, normal time for attack helicopter response has been found to be 15 to 20 minutes from receipt of mission until arrival on station.

(3) *Adverse weather.* For effective AH–1G daylight employment, ceiling should be at least 800 feet and visibility 1 mile (UH–1, 400 feet and 1 mile). For nighttime AH–1G employment, ceiling should be at least 1,500 feet and visibility 2 miles (UH–1, 800 feet and 2 miles). Ceiling and visibility requirements will increase in unfavorable terrain, e.g., mountains.

b. Prior to the execution of a particular mission, the supported force commander must determine the requirements for attack helicopter support. This support will be integrated into the overall plan of action.

5–5. Actions of Attack Helicopter Team

When under direction of a ground observer, the attack helicopter team must insure that—

a. Friendly positions are identified.

b. The ground observer's position is known.

c. If mark is used, it can be identified.

d. If mark is used, direction from the mark to the target is clearly understood by both the ground observer and the attack helicopter team.

e. If close-in fire is required to support friendly troops, a marking round or burst is fired into the target to insure positive identification and obtain any adjustment.

5–6. Direction to Target by Ground Observers

a. Friendly Elements Position. The ground observer and the attack helicopter commander must be sure that the attack helicopter element knows the location of the friendly elements on the ground. Two methods that may be used to insure that no mistake is made are—

(1) Using colored smoke or colored panels which can be seen from the air, mark the friendly positions indicating the right, left, and forward boundaries.

(2) Using normally encoded corrdinates, give friendly positions. (In premission briefings, it is necessary to insure that both elements are using the same code.)

b. Marking Target. The ground observer can mark or reference the target using any means which can be identified from the air; e.g., grenades, colored smoke, etc.

c. Directing to Target. If it is impossible to mark the target, the ground observer may elect to use smoke or panels to mark a position or use a prominent terrain feature. He will then measure or estimate the direction and distance to the target. This may be done using the clock method; however, the attack helicopter commander must know which direction the ground observer is using as his 12 o'clock position. This can be set up during premission coordination. A preferred method is to give a magnetic azimuth from the mark (colored smoke) to the target. Range from the mark or friendly position should be as accurate as possible. This can be measured on the map or estimated.

d. Describing Target. Care must be taken to describe the target, using a means which can be identified from the air and the ground. The ground observer should inform the attack helicopter commander of the type and intensity of enemy fires existing or supsected in the target area.

e. Types of Weapon Desired. If he has a preference, the ground observer should let the attack helicopter commander know what type weapon he desires—

(1) Rifle-bored weapons only (7.62mm, 20mm, 30mm, or 40mm).

(2) Rockets only.

(3) Missiles only.

(4) Any combination of weapons.

f. Adjustment by Ground Observer. The ground observer must be prepared to adjust initial fires of the attack helicopter using the observer-target line.

5–7. Night Operations

Night operations make it especially difficult for a ground observer to convey what he sees to the attack helicopter team. Several methods may be used to assist fire direction and target identification from the ground at night.

a. Illumination. Use of illumination is similar to that used for artificial night target illumination (para 5–2*b*(1)).

b. Radar. Ground radar units can vector the attack helicopter to the target (para 5–2*b*(3)).

c. Marking. Marking a target or friendly position at night by the ground observer is especially critical and requires close coordination. Flare pots or some other light system may be used instead of smoke; e.g., lights arranged in the shape of an arrow pointing in the direction of the target. Artillery or mortar fire may also be used to mark a target. Additional means of marking include strobe lights, railroad flares, trip flares, and tracers.

CHAPTER 6

SIGHTING AND ENGAGEMENT TECHNIQUES

Section I. SIGHTING TECHNIQUES

6–1. Introduction

Due to the maneuverability of the helicopter and the wide variety of target situations, the helicopter crew must have a thorough knowledge of their capabilities and limitations with their respective weapons systems. The techniques of engaging targets depends upon the weapons system being used. Basically, these systems can be broken into two groups: *fixed systems* (i.e., rockets and fixed/stowed guns) and *flexible systems.*

6–2. Special Considerations

a. Parallax. Parallax is the apparent displacement of an object due to a change in viewpoint. It is caused by a misalinement of the lens and can result in serious errors in gunnery. For a gunner, parallax is present in a reflex infinity sight when a change in his head position moves the pipper from the target. If the sight is free of a parallax error, the pipper will remain on the aiming point regardless of the gunner's head position.

b. Adjusting Tracer Fire. It is advisable to sight with both eyes when adjusting tracer fire because the gunner has better depth perception and is better able to acquire and adjust the tracer fire onto the target. This is especially desirable when firing at targets at greater or shorter ranges than boresight range.

c. Spatial Disorientation (Vertigo). This subjective lack (or disturbance) of equilibrium is caused by a discord of sensations coming to the brain from the eye and the internal ear. This sensation can occur while flying under instrument conditions, while changing attention from inside to outside the cockpit (such as navigating from a map), or when operating a swiveling gunner's station. Vertigo can be induced by rotor movement, anticollision light reflections, sudden flashes of light, etc. Night vertigo is of primary importance to attack helicopter crewmembers. Due to the steep dive angles and sharp turns incurred in helicopter attacks and the possible resulting loss of equilibrium, it is normally advisable for either the pilot or co-pilot to monitor the instruments during target attacks at night. In this manner, the symptoms of vertigo are easily recognized and positive control of the helicopter can be assumed by the crew member not affected. For a further discussion of vertigo, see TM 1–215.

d. Target Fixation. Target fixation is a condition found most often in inexperienced aviators intent on destroying a given target. It results in the loss of appreciation for speed, rate of closure, altitude, and other external stimuli. This condition can normally be avoided by practicing constant division of attention, even during target attacks.

6–3. Boresighting

Boresighting is the process by which the optical axes of the sight are made parallel (vertically and horizontally) to the boreline axis of the weapon. Depending upon availability of tools, type of weapon, etc, two methods are prescribed for boresighting each subsystem. These methods are the *distant aiming point* and the *parallel line.* For the step-by-step procedure, see the appropriate armament subsystem appendix or 9-series TM (app A).

a. Distant Aiming Point. A common point is selected at a relatively great distance (preferably infinity) to which the longitudinal axis of the helicopter, the sight, and the weapons are alined. If the aiming point is selected at less than infinity, the axis of each weapon will converge at the aiming point.

b. Parallel Line. This method usually uses a sighting board which is alined with the helicopter. Then the sight and the weapons are alined with measured points on the sighting board. In this method, the axes of the weapons do not converge.

6–4. Harmonization

Harmonization is the process of alining the weapons so that the rounds impact at the sighting point for a given range. This is accomplished by alining the sight, the weapons, or both, using the "burs-on-target" method. For the step-by-step procedures for harmonizing the various weapons, see the appropriate armament subsystem appendix or 9-series TM (app A).

6–5. Sighting Techniques

a. Fixed Systems. The techniques required to fire aerial rockets are more restrictive than those for firing fixed/stowed guns; therefore, this discussions will be limited to rocketry. The same techniques will insure accurate fire with fixed/stowed guns. Aerial rockets are affected by many variables (such as crosswind, relative wind, and flight coordination). To reduce the adverse effect of these variables on rocket accuracy, three methods of sighting were developed. These sighting methods are the *aircraft placard*, the *pipper intersection*, and the *combat sight*.

(1) *Aircraft placard method.* The aircraft placard method is based upon a constant aircraft load, launcher elevation, and altitude. The method was developed by mathematical computations at Redstone Arsenal for use with the XM3 armament subsystem. To employ this method, the aviator must—

(*a*) Select the airspeed and range from which he will fire.

(*b*) Apply the elevation setting for selected airspeed and range to the sight elevation/depression knob.

(*c*) Fly the helicopter at the selected airspeed at an altitude approximately 30 feet higher than the target.

(*d*) When the pipper is on the target, fire the rockets.

RANGE (meters)	SPEED (knots) 40	70	100	
500	+2.7	+2.7	+2.8	Elevation Setting (Degrees)
750	+2.3	+2.0	+1.8	
1,000	+1.9	+1.5	+1.2	
1,250	+1.5	+1.1	+1.6	
1,500	+1.1	+ .6	0	
1,750	+ .6	+ .1	− .6	
2,000	+ .2	− .5	−1.3	
2,250	− .4	−1.1	−2.0	
2,500	−1.0	−1.9	−2.9	

***Caution.* Since the aircraft placard computations were based on a constant altitude above the target, accuracy will not be obtained at altitudes above 100 feet. The requirement for a constant altitude limits helicopter maneuverability in a combat situation. The aircraft placard method is more suited for deliberate preplanned attacks where range can be accurately determined and the correct settings can be applied to the sights.**

(2) *Pipper intersection method.* Affixed to each infinity-type sight is a decal containing pipper intersection method reference data. The pipper intersection method differs from the placard method in that it provides for variable altitudes but requires altitude, airspeed, and range to be determined prior to launch. Generally these conditions are known only for preplanned fires (preparations, etc.) and require precise timing. However, even though the pipper intersection method does allow some variation in altitude, it seriously restricts maneuver and is normally unacceptable for most mission profiles. To use the pipper intersection method, apply the steps in the placard method. In addition, the —

(*a*) Aircraft must be at selected altitude.

(*b*) Target must be at selected range.

(*c*) Aircraft must fly at prescribed airspeed.

(*d*) Pipper must be on the target.

(3) *Combat sight method.* The combat sight method is the most widely used and gives the desired accuracy and timeliness over the widest variety of mission profiles. It requires very little mathematical or manual manipulation, either of which is distracting during target attack; and, by using a single sight setting, it allows engagement of targets over widely varying ranges without adjustment of the sight. It does require that offset correction ("Kentucky Windage") be applied for both range and wind conditions (fig. 6–1). The requirements for using the combat sight method are that—

(*a*) The helicopter be in coordinated flight (horizontal and vertical trim).

(*b*) The range be estimated within 100 meters.

(*c*) The proper amount of offset correction be applied.

b. Flexible Systems. The sighting techniques for flexible weapons systems are similar to those for fixed systems. However, specific weapons, sights, and sight displays will differ with weapons having high and low muzzle velocity.

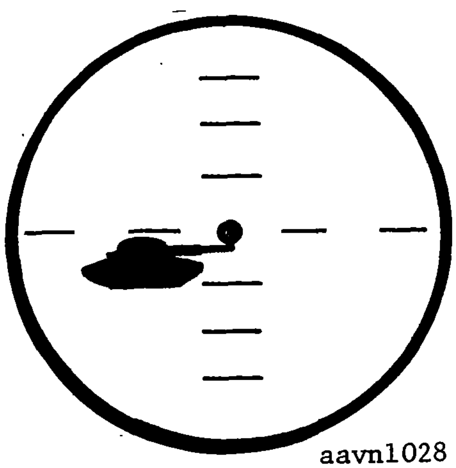


Figure 6–1. Combat sight method—corrected for a crosswind from the right.

(1) *High muzzle velocity.* Weapons with a high muzzle velocity have a relatively flat trajectory and are not affected by those ballistic factors associated with flexible weapons (chap 2) as much as low muzzle velocity weapons. This, in combination with the high rate of fire of flexible systems, eliminates the requirement for mil values on the sight reticle image. The procedures given below should be followed:

(*a*) Harmonize these weapons at their maximum effective range. Maximum effective range is dependent upon tracer burnout, volume of fire, and type of sight.

★(*b*) Place the pipper on the target. Fire and observe tracer impact. Adjust weapons so tracers impact on the target. Due to the high volume of fire and the relatively simple sighting techniques, fire from this type weapon is relatively accurate.

★(2) *Low muzzle velocity.* Weapons systems with a low muzzle velocity (less than 2,000 fps) have a relatively higher angle of fire and are affected considerably by the ballistic factors discussed in chapter 2. These weapons have a relatively slow rate of fire and may not have a tracer element. Sights for these systems require mil value/range lines and/or a complex lead-compensating sighting system. These systems are boresighted for one altitude and airspeed, and offset correction is required if these conditions are not met. For example, current 40mm subsystems are boresighted for 90 knots airspeed, 100 feet absolute altitude, and 700 meters range. As absolute altitude or airspeed is increased, the gunner must decrease range settings on the sight (aim short of the target). The same correction applies conversely: as absolute altitude or airspeed is decreased, the gunner must increase range settings on the sight (aim over the target). Deflection shots at other than boresight altitude and airspeed are very difficult as the lead and lag values are not easily determined. When employing this system, accurate range estimation is required, coupled with accurate application of lead or lag values. Due to the longer time-of-flight of the rounds, it is usually not possible to "walk" the rounds onto the target. Proper sighting techniques for this type system are to—

(*a*) Estimate range and altitude above the target and note airspeed.

(*b*) Apply factors for these conditions to the sight, including lead for deflection.

(*c*) Fire a short burst and note the impact.

(*d*) Make sighting adjustments on succeeding bursts, compensating for range closure.

Note. For the gunner to be accurate with low muzzle velocity weapons, sighting techniques require considerable training.

Section II. ENGAGEMENT TECHNIQUES

Note. Since the techniques for engaging targets using either the *pipper intersection* method or the *aircraft placard* method are seldom used, only the *combat sight* method is discussed below.

6–6. Establishing the Combat Sight

To better understand why the combat sight method of engaging targets is more widely used than other methods, it is helpful to understand the procedure for establishing the combat sight. Following is an example using the combat sight with the 2.75-inch FFAR; it is equally applicable to any fixed fire system.

a. Boresight the system in accordance with appendix D.

b. Select a target at 1,250 meters slant range. This range is one-half the maximum effective range of the weapon; however, the selected range will be that range from which the majority of all targets are engaged. This selected range may be made according to individual preference or unit SOP.

c. At a tactical altitude and airspeed and with the pipper on the target, fire one round. Note the impact of the round and rotate the knurled ring (elevation-depression) to put the *pipper on the burst.*

d. Repeat *c* above until the rounds are consistently hitting on the pipper. Usually three rounds will be sufficient to obtain the combat sight setting. This setting may be established at any range. Midrange allows the widest possible latitude for engaging targets. Using this method, targets may be engaged from 300 meters (minimum safe slant range) to 2,500 meters (maximum effective range), and the proper sight setting will still fall within the sight reticle (80 mils for the XM60 sight).

Note. The combat sight setting for machineguns is normally accomplished at slightly less than maximum effective range. Targets beyond maximum effective range may be engaged with an acceptable dispersion pattern. This is accomplished by adjusting the fire so that tracer burnout appears to occur just above the target.

6–7. Using the Combat Sight Setting

★*a.* At the altitude and airspeed chosen for obtaining the setting, the rounds will impact at the pipper at the selected range. Therefore, it is necessary to use this altitude, airspeed, and range, or to compensate for any changes. Changes in range are accomplished by aiming 4 mils high for each 100 meters beyond the range chosen for the setting, and 4 mils low for each 100 meters less (fig. 6–2). If the combat sight setting is made at 1,250 meters, the proper setting required to engage a target at 2,500 meters is to hold the pipper at 50 mils (4 x 12.5 = 50) above the target. If the target is at 300 meters, hold the pipper at 38 mils (4 x 9.5 = 38) below the target.

b. Once an entry altitude and airspeed have been selected, a constant power setting must be maintained and the same selected entry altitude and airspeed used in each pass at the target. For example, if the setting were obtained using 91 percent N_1 (gas producer speed) in the helicopter, this setting would result in nearly the same trajectory every time if the helicopter weight remains relatively constant.

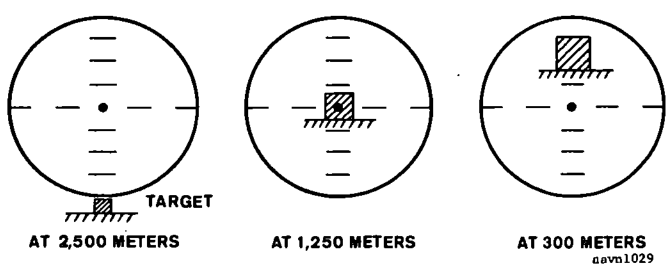


Figure 6–2. Using the combat sight setting.

c. Considering the factors in *a* and *b* above, one way to use the combat sight setting is to—

(1) Initiate the roll-in on the target run.

(2) Check the power setting and helicopter trim and adjust as necessary to maintain a trim condition.

(3) Estimate the slant range to the target and apply the compensation factors.

(4) Obtain the proper sight picture by flying the helicopter using only the cyclic control stick.

(5) While the helicopter is in its most stable flight, fire as soon as the proper sight picture is obtained. The helicopter becomes more unstable as the dive progresses and airspeed builds up.

(6) Use "burst on target" for subsequent adjustments.

6–8. Slant Range Estimation

Slant range (fig. 2–13) applies to aerial weapons systems. It is the distance along the line of sight from the weapon to the target. At the altitude and attack angles used by attack helicopters, slant range is slightly greater than horizontal distance to the target. The methods of determining slant range are *estimation by eye, sight mil values, tracer burnout, maps and photomaps,* and *electronic ranging devices.*

a. Estimation By Eye. The most common method used for determining range is estimation by eye. Normally this method is most accurate when the range is compared to known ranges; i.e., the number of 100-meter segments there are in the range. While this method is the most rapid, it is also the least accurate. Some reasons for this inherent inaccuracy are—

(1) *Nature of the target.*

(*a*) A target in contrast to its background appears closer.

(*b*) A target that blends with its background appears more distant.

(*c*) A target that is partially hidden appears more distant.

(2) *Nature of the terrain.*

(*a*) Over smooth terrain, the eye tends to underestimate the range.

(*b*) Over rough terrain, the eye tends to overestimate the range.

(3) *Visibility.*

(*a*) A target seen in full sunlight appears closer than one observed through haze or fog.

(*b*) When the sun is behind the target, the target appears more distant than it actually is. When the sun is behind the observer, the target appears closer.

b. Sight Mil Values. Because of sight vibration caused by aircraft flight, reading the mil value of target width in the sight is difficult or sometimes impossible. However, if this value can be found and the actual target width is known, the mil value for target width can easily be converted to the range. At a range of 1,000 meters, 1 mil equals 1 meter; therefore, if target width is known, range can be found by using the following formula—

$$R = \frac{W}{m} \times 1{,}000 \text{ meters}$$

where

R = range (meters)
W = known target width (meters)
m = mil value of target width (meters)

For example, a tank known to be 15 meters long covers 20 mils of reticle width (fig. 6–3)—

$$\bigstar R = \frac{15 \text{ meters}}{20 \text{ mils (meters)}} \times 1{,}000 \text{ meters} = 750 \text{ meters}$$

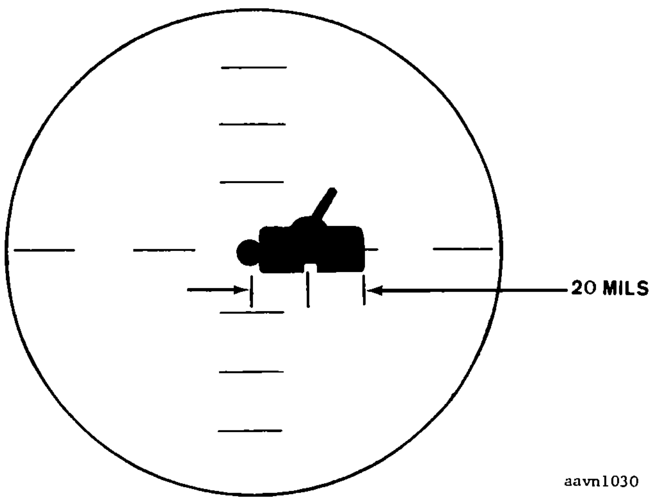


Figure 6–3. Reading sight mil value of target.

c. Tracer Burnout. Because the 7.62mm (NATO) round of tracer ammunition burns out at a range of approximately 750 meters, the gunner can use tracer burnout to make a range estimate. If the tracers burn out before reaching the target, he can compare the 750 meter tracer burnout distance to the total distance to the target. His range estimate is based on this comparison. For example, the gunner fires a burst of tracer ammunition from his machineguns that burns out halfway to the target. Thus he estimates that the range to the target is 1,500 meters.

d. Maps and Photomaps. Prior to the mission, ranges from prominent terrain features to the target area may be determined from maps and photomaps. This permits comparison of actual ranges with ranges estimated by eye and is very useful in teaching aviators to correctly estimate ranges by eye.

6–9. Flight Techniques

Before accuracy with aerial fire weapons can be expected, the aviator must be able to fly the helicopter without actually concentrating on the art of flying. However, to assure weapons accuracy, coordinated flight must be maintained by using smooth control pressures.

a. Coordination. Coordinated flight is especially important in aerial rocketry. An "out-of-trim" condition creates unacceptable dispersion in rocket fire (para 2–3*b*(2)(*e*)). Emphasis must be placed on flying in the helicopter to the proper sight picture. A common tendency is to cross-control using the antitorque pedals to get the proper sight picture.

b. Control Touch. Control touch affects both fixed and flexible firing modes. Since rough and abrupt control movements result in unacceptable dispersion patterns, smooth control pressures must be applied.

c. Spot Weld. For most aviators, the "spot weld" consists of bracing their right elbow on their right thigh. This braced position allows the proper muscle response for positive smooth control movements and permits the proper sight picture to be obtained in a much shorter time without the unnecessary movements which result in "chasing the pipper around the target."

6–10. Turning Error

Firing while in a bank affects both fixed and flexible weapons fire. To compensate for ballistic factors, the boreline axes of all weapons systems are elevated above the horizontal. If the weapon is fired while the helicopter is in a bank, this elevation becomes deflection (fig. 6–4). Firing results in rounds impacting short and inside the turn. To compensate for turning error, it is necessary to aim high and opposite to the direction of the

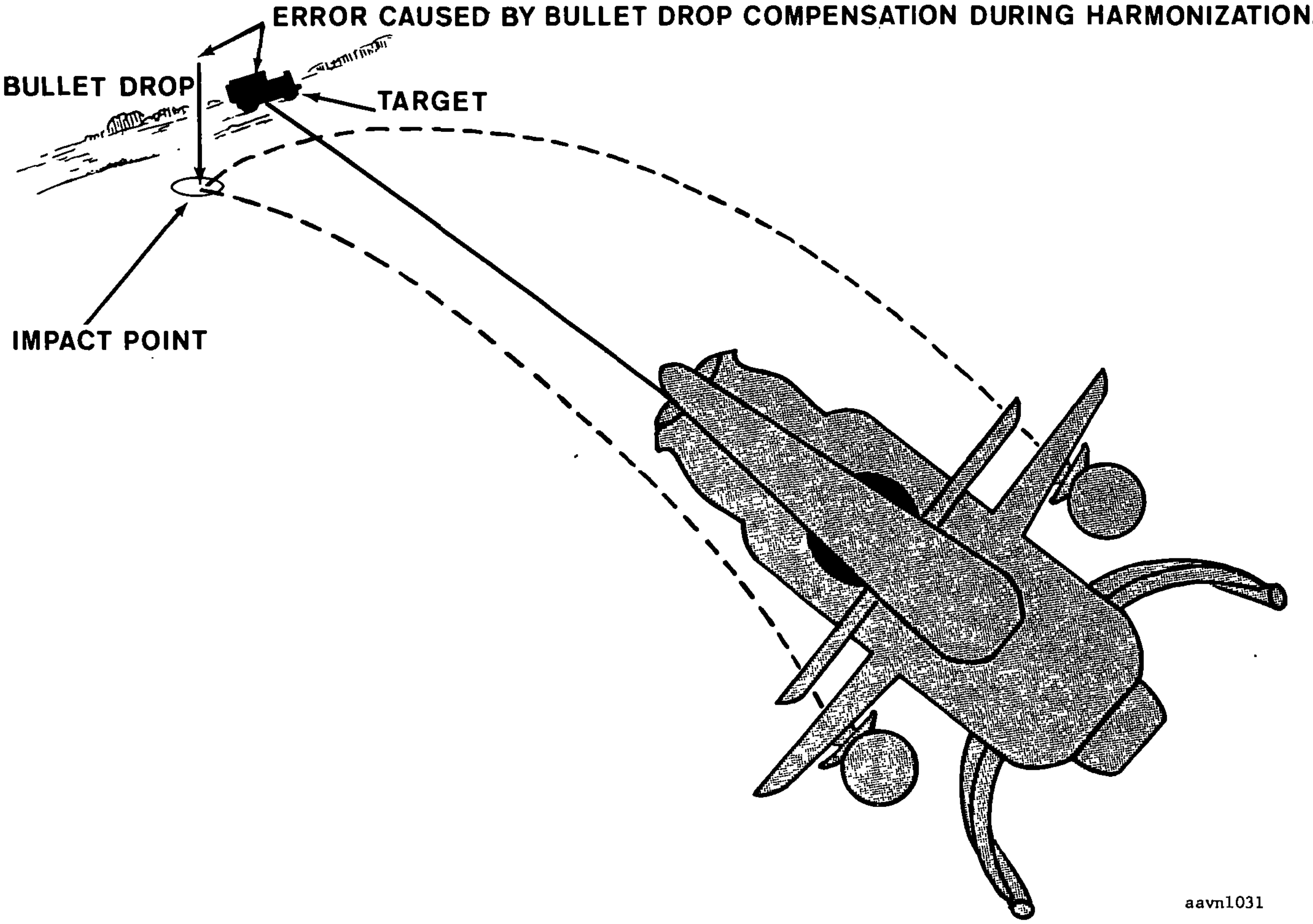


Figure 6-4. Turning error.

bank. In addition, a range estimation and power setting adjustment are necessary. Since this complicated technique makes accuracy nearly impossible, it should only be attempted in emergency situations.

★6-10.1 Methods of Attack

The method of attack will be selected by the attack helicopter mission commander based upon the factors of METT and conditions existing on the battlefield. Attack helicopters may attack a target by running/diving fire or hovering fire.

a. Running/Diving Fire. Running/diving fire is delivered on target while the helicopter is in forward flight. It can be delivered from any altitude, provided the slant range to the target is compatible with the maximum effective range of the weapon. Running fire delivered from the nap-of-the-earth flight mode takes maximum advantage of available cover and concealment. This mode provides fire which is highly effective against troops in the open, but the attack helicopter's vulnerability is increased if the troops are located in terrain offering cover. Higher flight altitudes during attack will result in diving fire at short slant ranges, which also increases vulnerability of the attacking helicopter. A dive angle of approximately 15° will give optimum point fire accuracy and maximum destruction of an enemy in foxholes or trenches, due to the resulting plunging fire. Steeper dive angles result in higher airspeeds that require initiating the disengagement at greater ranges to avoid target overflight. Targets may be engaged from the rear, the flanks, or the front. Succeeding passes should be made from different directions to preclude enemy anticipation of succeeding firing runs.

b. Hovering Fire. Hovering fire is delivered with the attack helicopter in a covered or concealed position. Available cover and concealment must be used during the approach and execution of the fire mission. Where terrain permits, the helicopter should be moved laterally between bursts of fire so that it does not appear to the enemy twice from the same position. Background for the helicopter should be chosen with care to avoid being silhouetted against the sky or light terrain. Fire teams will alternate their attacks in order to place continuous fire on the enemy position. The helicopter is extremely vulnerable when practically motionless over the ground. Firing from a hover does not significantly increase weapons accuracy. With certain weapons systems (e.g., the aerial rocket), a loss of accuracy causes fire from a hover to be impractical. Hovering fire should be used only when it is necessary to clear a terrain mask, or to attack lightly defended areas for short durations. Loss of observation, mobility, flexibility, and maneuver must be thoroughly considered by all commanders prior to the employment of attack helicopters in a hovering attack.

6–11. Attack Patterns and Formations

★*a. General.* Normally specific attack patterns cannot be preplanned. However, certain considerations apply to all patterns. The attack helicopter mission commander will adjust each attack to take advantage of the terrain and weather, to exploit enemy weaknesses, and to employ his combat elements to gain the maximum advantage. Important considerations in the selection of an attack pattern include the number of attacking elements, the target characteristics, weapons capabilities, friendly forces in the immediate area, the disposition of enemy defenses, and the requirement for a change in direction of subsequent attack runs. Overflying of friendly positions on target attacks should be avoided as much as possible.

b. Racetrack Pattern. The racetrack pattern (fig. 6–5) is the basic attack pattern from which the others are derived. This pattern may be used on any mission or may be modified as the situation dictates.

(1) *Advantages.*

(*a*) Any number of helicopters may be used in the pattern.

(*b*) The helicopters are mutually supporting by fire and observation.

(*c*) Continuous fire may be placed on the target.

(*d*) Engamement range, disengagement range, and timing are flexible.

(*e*) The mission commander has good control over the attack.

(2) *Disadvantages.*

(*a*) Target is covered from only one direction at a time.

(*b*) Enemy is able to place enfilade fire on the entire attack formation from one position.

(*c*) Direction of break is fixed.

(*d*) Only one helicopter can engage the target at a time.

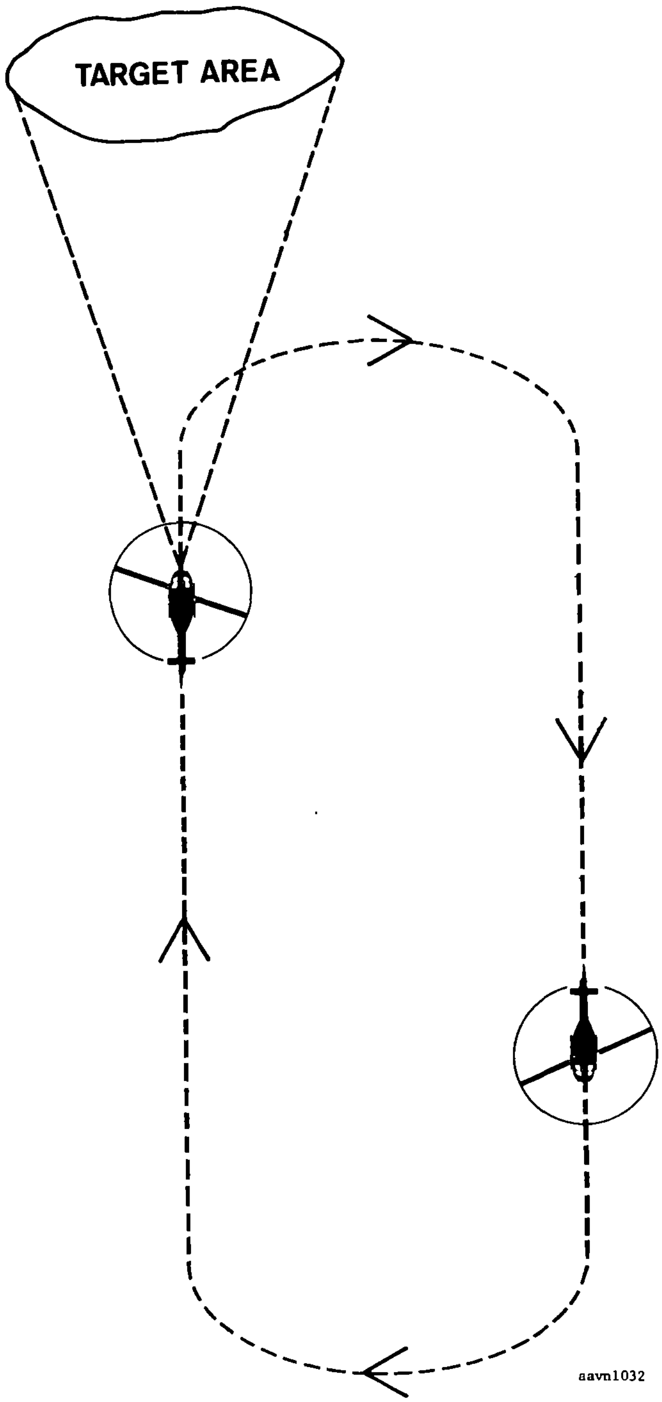


Figure 6–5. Racetrack pattern.

c. Cloverleaf Pattern. The cloverleaf attack pattern (fig. 6–6) may be employed during destruction missions against point or small area targets.

(1) *Advantages.*

(*a*) Changing direction for each attack prevents enemy concentration of fires in anticipation of subsequent attacks.

(*b*) Good target coverage from several directions requires enemy defenses to be constructed for all-around protection.

(*c*) By placing continuous fire on the target, this attack prevents enemy movement to reposition forces.

(*d*) Engagement range, disengagement range, and timing of attack are flexible.

(*e*) Attacking helicopters are mutually supporting, and the mission commander can maintain control of the attack.

(*f*) The pattern may be modified to adapt to the terrain and the number of firing passes required.

(*g*) Initial entry and the attack pass can be established at any point.

(2) *Disadvantages.*

(*a*) Hostile areas may be overflown.

(*b*) Care must be exercised not to fire into adjacent friendly positions.

(*c*) The number of helicopters that can be effectively used in the pattern is limited.

d. L *Pattern.* The L attack pattern (fig. 6–7) is most effective against targets requiring a large volume of fire for a short duration; therefore, this pattern is ideal for destruction of point targets. The L pattern is also excellent for attacking linear targets or targets which are masked on one side by high terrain. If a large volume of fire is not required, proper timing allows one helicopter at a time to fire neutralization fire for a sustained period.

(1) *Advantages.*

(*a*) The enemy is fixed during the period of maximum fire delivery.

(*b*) Surprise and speed of attack limit exposure of the helicopter to return fire for minimum period of time.

(*c*) Good target coverage is obtained from two directions simultaneously.

(*d*) The beaten zone of at least one attacking element will generally correspond to the long axis of the target.

(*e*) The enemy is forced to defend in two directions simultaneously.

(*f*) Maximum engagement and minimum disengagement ranges are allowed by this pattern.

(*g*) Use of reference points makes timing precise.

(2) *Disadvantages.*

(*a*) Control, timing, and formations are critical.

(*b*) Care must be exercised not to fire into (or over the heads of) adjacent friendly units.

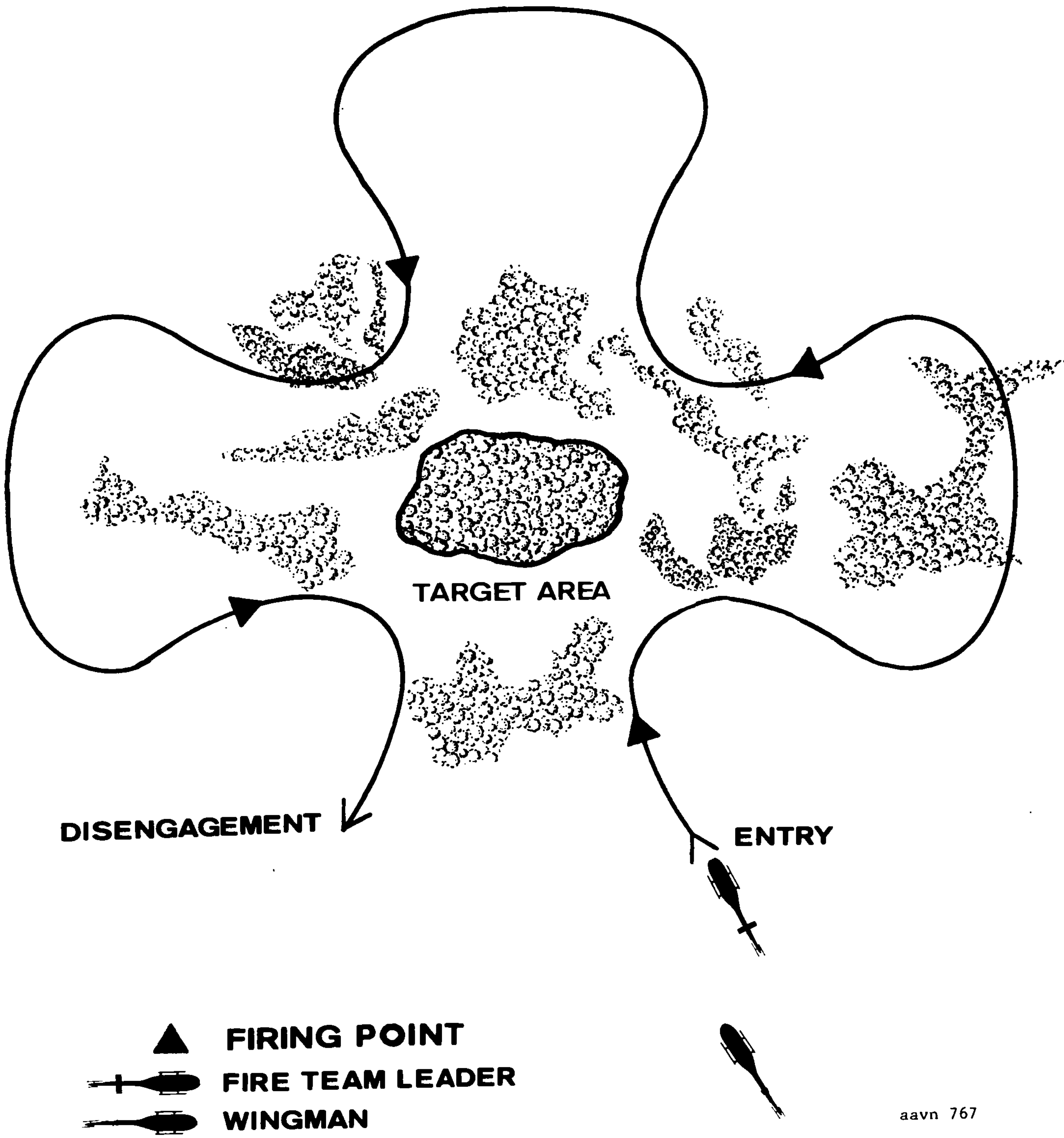


Figure 6–6. Cloverleaf attack pattern.

e. Extended Inverted V. The extended inverted V attack formation (fig. 6–8) is normally employed to deliver a large volume of fixed fire (i.e., aerial rockets) over a short time span. This formation is normally used in neutralization of large areas, such as *preparation* fire of an airmobile landing zone.

(1) *Advantages.*

(*a*) Surprise and speed of attack expose the helicopters for minimum time periods.

(*b*) The extended inverted V attack formation permits delivery of an extremely large volume of fire in a short period of time.

(2) *Disadvantages.*

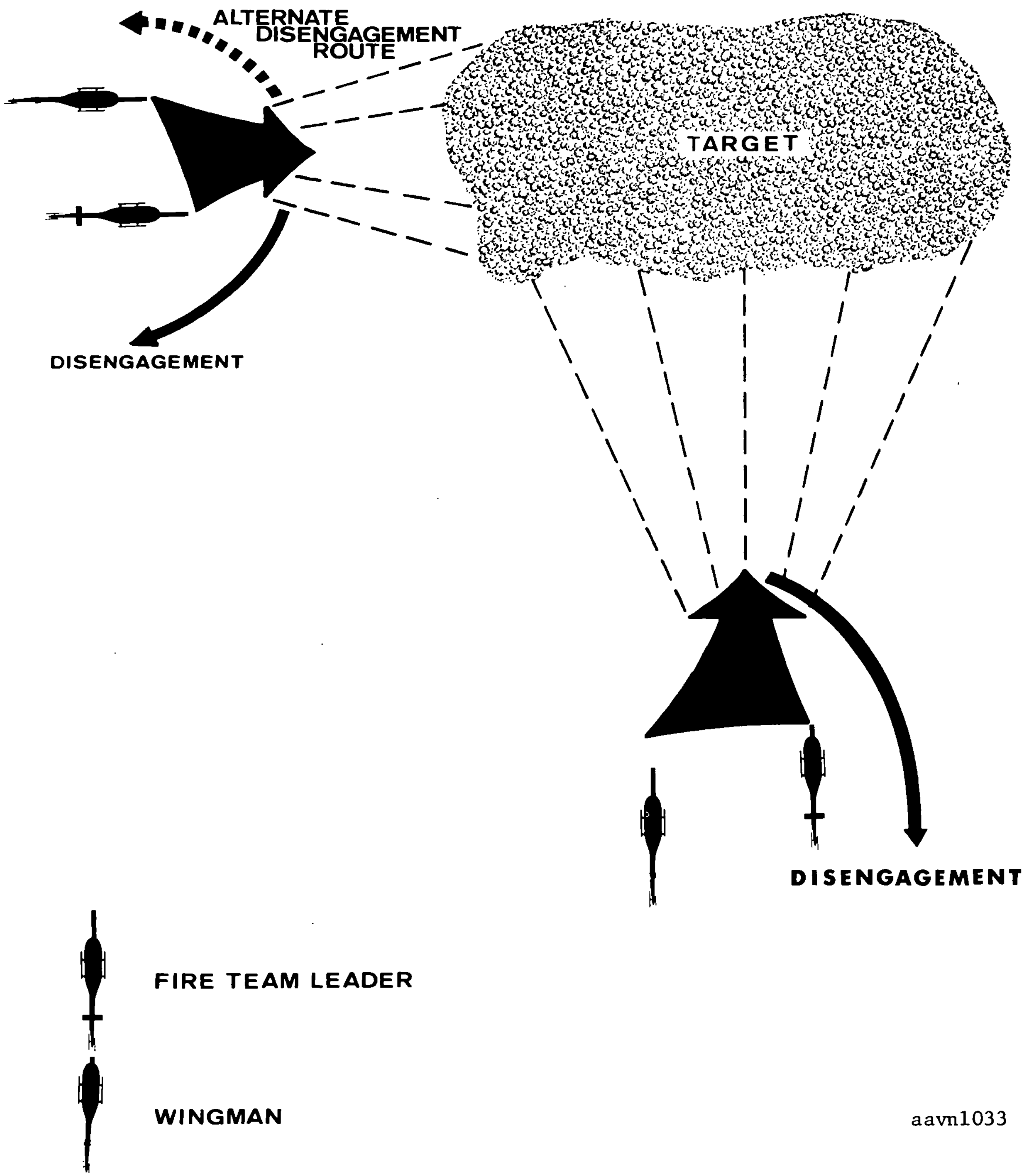


Figure 6–7. L attack pattern.

(*a*) Control, timing, and formation are critical.

(*b*) Target is covered from only one direction.

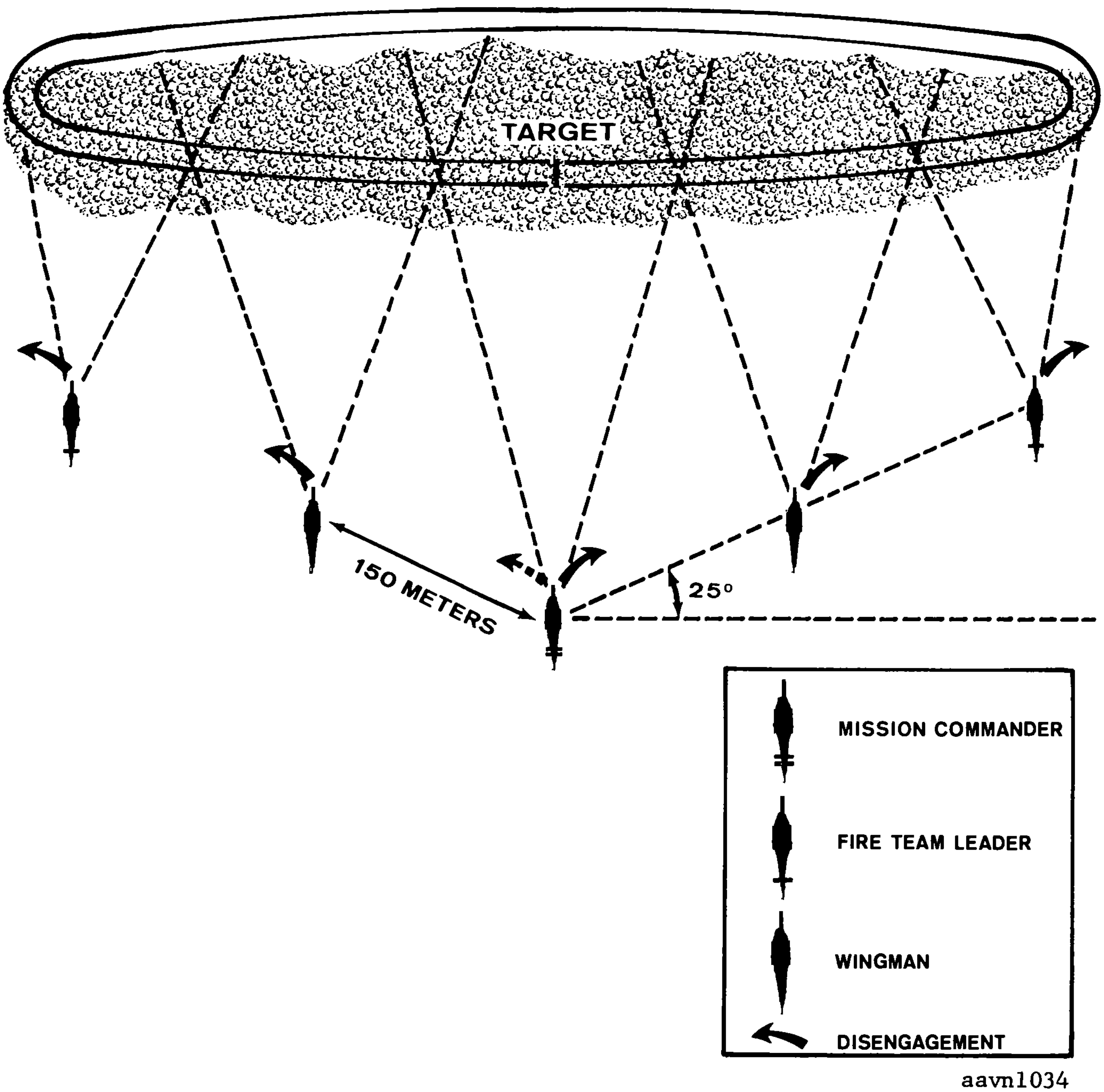


Figure 6-8. Extended inverted V attack formation.

(*c*) Helicopters are not mutually supporting during the break.

(*d*) Entry, direction and break points are fixed.

CHAPTER 7

NIGHT ATTACK HELICOPTER SUPPORT

Section I GENERAL

★7–1. Close Air Support

Attack helicopters normally will be expected to provide the same quality and types of close air support fires at night as they provide during daylight hours. To provide this support requires highly motivated, well-trained crews who are aware of their capabilities and limitations.

7–2. Factors Affecting Employment

The factors of METT and the cardinal rules apply equally well to night operations when it is understood that the visibility at night could work to the advantage of the attack helicopter team. For example, the limits of the "deadman" zone are sharply reduced. Attack helicopters can operate at altitudes and ranges which optimize accuracy using the cover of darkness to limit observation.

7–3. Night Vision

Light passes through the lens of the eye and then falls on the retina, which has two types of photoreceptors—rods and cones. The cones are effective only when illumination is abundant, while the rods are sensitive for night vision or low illumination. The rods provide peripheral (side) vision. However, bright light can impair the function of the rods for over one-half an hour. For the crew to prevent complete loss of night vision due to artificial illumination, one crewmember should, when possible, direct his eyes within the cockpit. Also, it is usually desirable to close one eye momentarily when firing an aircraft weapons system at night. This will permit at least partial night vision during the other critical portions of the attack.

7–4. Planning

Planning for night target attacks requires considerable care and coordination. Even with experienced crews, a detailed premission briefing is required. Included in the briefing area—

★*a.* Location, call sign, and frequency of support unit.

b. Target location and method of identification.

c. Time schedule (i.e., takeoff, en route, on station, off station, etc.).

d. Call sign and frequencies of en route and target area artillery.

e. Call sign and frequency of radar control facility.

f. Call sign and frequency of tactical air support.

g. Downed crew and other emergency procedures (unit SOP).

h. Procedures upon receipt of hostile fire.

i. Formations and altitudes to be used.

7–4.1. Control Measures

a. Orbital Point. Several orbit or rallying points may be established in the vicinity of the battle area so that helicopters can be quickly assembled at any time during or after the attack. These points should be readily identifiable by a navigation fix or by relative position to prominent terrain features such as rivers and towns.

b. Altitude. Night operations by attack helicopters are initiated from higher flight altitudes than daylight operations. Normally, it is not feasible to make nap-of-the-earth firing runs at night without illumination or special visual aids. Termination of firing runs should also be completed at a higher altitude, especially in uneven, hilly, or mountainous terrain.

c. Attack Headings. The attack helicopter commander or a control aircraft situated overhead can give attack headings to be flown for the firing runs. Vectoring aids control and reduces confusion in the target area.

d. Troop Safety Buffer Zone. A larger troop safety buffer zone must be established for night operations to preclude attack helicopters firing into friendly positions. Its location should be defined by easily identifiable terrain features or lighting devices.

e. Formations. Night formations will require greater separation between helicopters. Minimum lighting of a type to preclude observation from the ground should be used during formation flying over hostile areas. For details on night formation flying, see TM 1-260.

7-4.2. Helicopter Lighting

a. Cockpit. The panel lights should be as dim as possible during all phases of night operations to preclude canopy glare and yet allow the instruments to be adequately illuminated. Flashlights with red lens covers should be used only when necessary for map scrutiny, and then as briefly as possible.

b. Exterior. If the helicopter is not equipped with special night lighting devices, the following guidance should be followed:

(1) Only those lights essential to the successful conduct of the mission should be used. The bottom half of the navigation lights should be masked.

(2) In an emergency, additional exterior lighting should be used to aid other aircraft in locating a particular helicopter. If an aircraft is forced down in a hostile area, lights should be used only as necessary until its location has been determined.

(3) The searchlight and landing light should be in the extended position so that they can be quickly used if the helicopter is forced down.

7-4.3. Effects of Enemy Searchlights

Enemy searchlights focused directly on attacking helicopters produce a serious problem. Evasive action must be initiated immediately. A new approach angle and attack direction should be selected that will restrict the capability of the enemy searchlight. When feasible, the searchlight should be destroyed by fire.

7-4.4. Helicopter Servicing

a. Approach and Landing. Helicopters will make approaches to a lighted servicing area, and ground personnel will guide the helicopter to preselected parking locations within the area. If possible, the attack helicopters should approach and land at the preselected parking locations, thereby eliminating hovering and movement in the servicing area.

b. Rearming and Refueling. The helicopter may be refueled and rearmed with the engine running provided positive control is exercised and appropriate safety precautions are observed. Colored lights and ground guides should be used to direct the helicopter crews to the parking areas where ammunition is stacked and fuel is stored. Personnel used to rearm and refuel during the hours of darkness must be well trained and must have performed like functions numerous times during daylight hours.

Section II. NATURAL ILLUMINATION

7-5. General

Target attacks using natural lighting at night provide certain advantages which are not possible when using flare or lighting system (e.g., Firefly) illumination.

a. Advantages.

(1) The element of surprise is maintained longer.

(2) Night vision is conserved.

(3) All helicopters in the team maintain the security provided by the darkness.

(4) Ground fire is more readily seen.

b. Disadvantages.

(1) Target area and targets are more difficult to identify.

(2) Range is more difficult to determine.

(3) Even after initially identified, target locations are more difficult to maintain.

7-6. Target Identification

Target identification under natural light conditions at night may be difficult. As with daylight attacks, friendly positions must be positively known before commencing the attack. Positive radio contact is essential before the friendly positions are marked. Commanders must caution friendly troops not to mark their positions by firing tracers into the air. Several satisfactory methods of marking friendly positions and target locations are to—

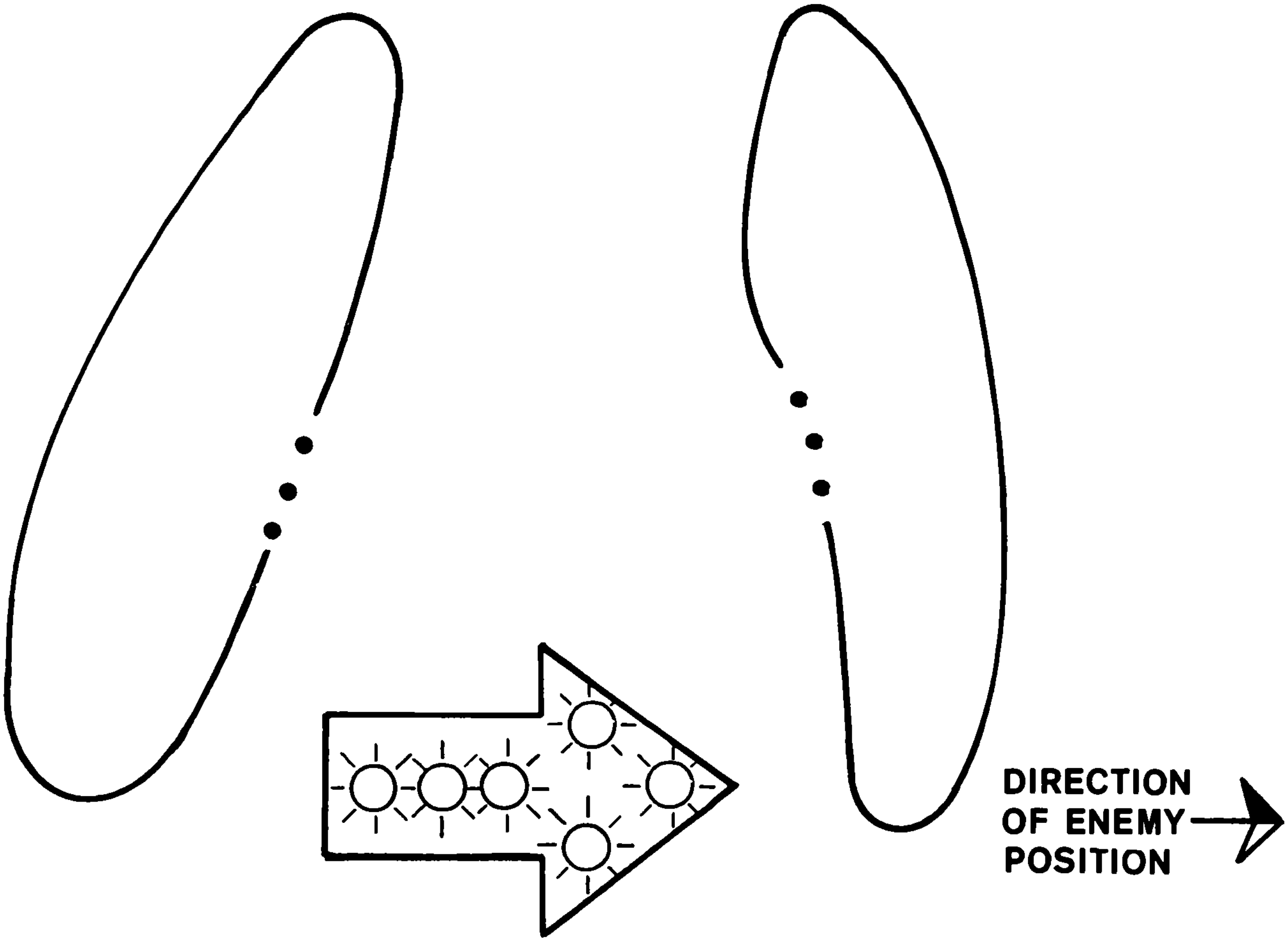


Figure 7–1. Marking target with a flaming arrow.

a. Have friendly flank positions fire tracers into the target area.

b. For fortified positions, use the "flaming arrow" technique (fig. 7–1). The arrow is made of wood mounted on a pivot. The flames are made by flare pots attached to the arrow. The distance from the arrow to the target can be provided by radio communication from the ground observer to the attack helicopter crew.

c. Have friendly troops mark their position with strobe lights and give range and azimuth to the target. Use of codes or voice scrambler radios will add to security and prevent disclosure of friendly positions.

7–7. Attack Formation

Because of the danger of midair collision, the wingman will normally fly at least 100 feet higher than the fire team leader. The prescribed formation must be rigidly adhered to at night, since everyone in the formation must know the location of the others. Standard procedure may be to assign airspace limitations in which each helicopter must operate unless given permission to deviate. For example, the lead helicopter will operate below 800 feet indicated altitude, the second helicopter between 800 and 1,000 feet, and the third helicopter (in a heavy fire team) above 1,000 feet indicated altitude.

7–8. Attack Patterns

The attack pattern most commonly used at night is the racetrack (fig. 6–5). Because of the degree of control required for more advanced or intricate patterns, they are not suitable for night at-

tacks. The racetrack pattern will normally be extended to allow sufficient time to insure that preceding helicopters are well clear of the target area prior to initiation of the attack run.

a. Since tracer fire will disclose the helicopters' position, machinegun fires should be kept to short bursts.

b. Rocket and grenade fires do not readily disclose the helicopters' position. Thus, to increase accuracy, these fires can be carried to lower altitudes and closer ranges than during daylight attacks.

Section III. ARTIFICIAL ILLUMINATION

7–9. General

Artificial illumination consists of all manmade light-producing or light-amplification devices which can be used to enhance target acquisition and sighting. These devices include flares, lighting systems (e.g., Firefly), infrared systems, and low light level television (LLLTV).

7–10. Flares

Flare illumination is provided by either aircraft flares or artillery illuminating rounds. It is a high intensity, short duration method of illuminating the target area. During periods of good weather conditions, flares can be used effectively to identify and illuninate targets for attack helicopters. However, because of the danger of encountering flare parachutes during target attacks, flares should be employed far enough away from the target so that the attack helicopters are well clear of the point. When friendly ground troops are closely engaged, flares will normally be dropped directly over their positions; this will illuminate the target without blinding the friendly troops. For further details on the employment of aircraft flares from Army aircraft, see TC 1–16.

7–11. Airborne Lighting Systems

Airborne lighting systems can be used effectively to illuninate targets for night helicopter attacks. However, the use of these systems is somewhat restricted during periods of poor visibility such as haze, fog, rain, and snow. The small particles of precipitation in the atmosphere reflect the high intensity light sufficiently to illuminate the cockpit. This illumination hinders pilot vision and requires him to rely on the instruments rather than following the terrain features. The major advantage of airborne lighting systems is that they provide relatively long term, highly selective illumination. When the light is on, the airborne lighting system also curtails nearly all overt enemy activity within the area of operation. An example of an airborne lighting system is the Firefly (fig. 7–2), with characteristics as explained below.

a. To allow sufficient room for the attacking helicopters to maneuver and for the light to illuminate a maximum area, the light is normally employed above 500 to 600 feet absolute altitude.

b. Once the target is located, the helicopter carrying the light orbits the target, maintaining the illumination until the mission is complete. These orbits should be large enough to maintain sufficient airspeed for protection, but not so large that the light is ineffective.

c. In addition to the primary cone of light produced by the Firefly, there is also an area of secondary illumination (halo area) (fig. 7–2). In the halo area, the illumination is inadequate for target engagement but is sufficient to silhouette the attacking helicopters. For this reason, the attack run should be discontinued before reaching the halo area.

7–12. Infrared and Light Amplification Systems

Infrared, sniper scope, and LLLTV light amplification systems can be used effectively to locate targets. However, the sensitivity of these systems to light normally prevents their use for actual target attacks.

a. Normally one helicopper equipped with a light amplification system precedes a fire team.

b. To provide the necessary protection from hostile ground fire, the helicopter with the light amplification system will be either totally blacked out (no external light) or will have only those lights that are visible from above.

c. Once the target is located and marked by the helicopter carrying the light amplification system, the attack can be initiated in the conventional manner using either natural or other artificial illumination (para 7–5 through 7–11).

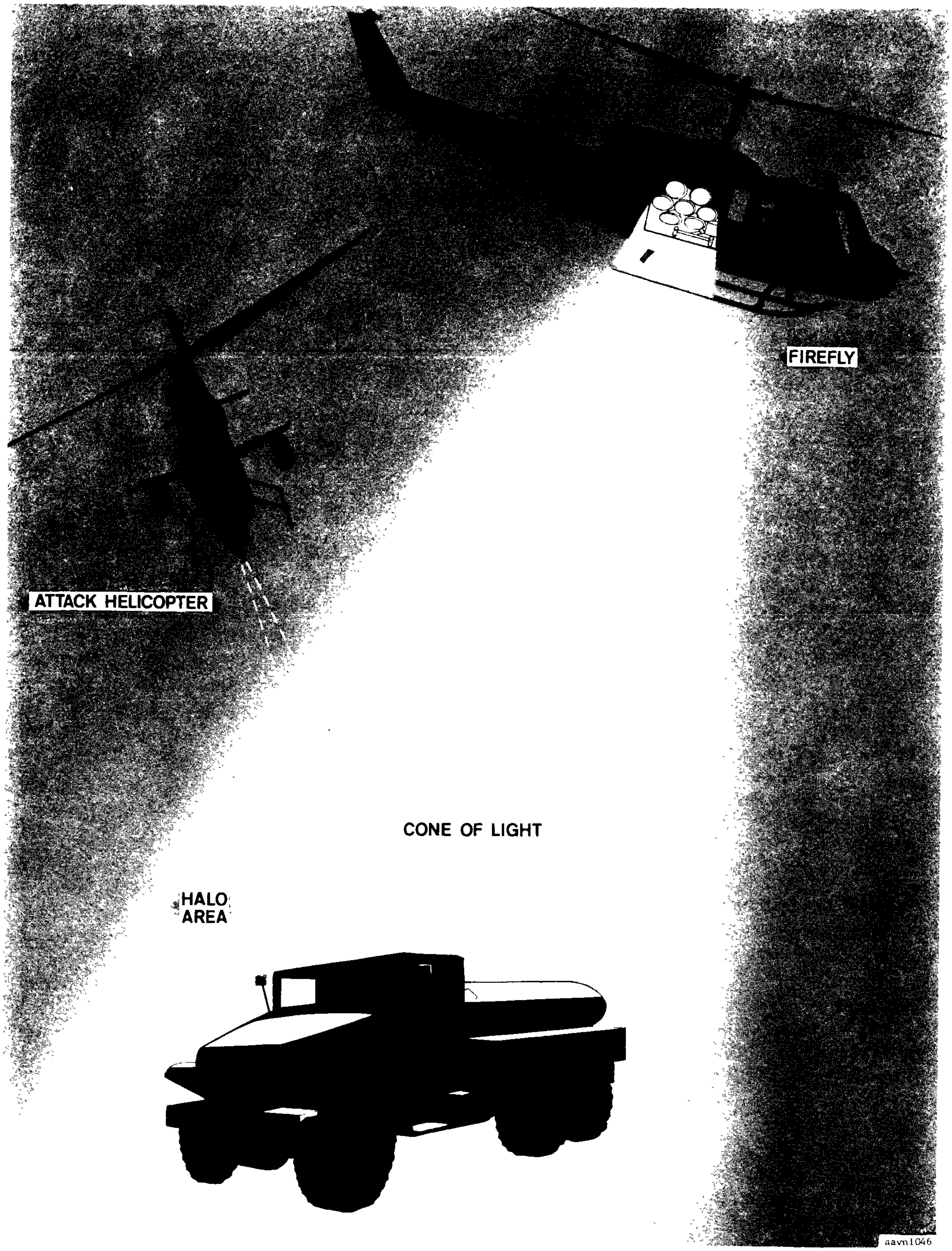


Figure 7-2. Firefly.

CHAPTER 8

HOSTILE FIRE COUNTERMEASURES

8–1. Detection of Hostile Fire

Hit data compiled by ballistic research laboratories reveals that the majority of aircraft hits occur during target attacks. The ability of an attack helicopter crew to successfully counter hostile fire depends upon the crew's state of training, alertness, aggressiveness, and ability to detect the hostile fire. At present, hostile fires can be detected visually or by sound. As the state-of-the-art progresses, acoustic or other electronic devices will be developed for use on attack helicopters to aid in the detection of hostile fire.

a. Visual Detection. Most hostile fire can be observed visually by detecting the characteristic orange color of muzzle flash or tracers. Much of the tracer ammunition used by Soviet-bloc nations has a slightly greenish tint that is easily distinguished from the orange-red tint of tracer ammunition used by Western nations.

b. Auditory Detection. Hostile fire can be detected by the sonic snap that bullents make when passing nearby. This sound is distinguishable from the sound of the rotor blades by both tone and duration.

8–2. Types of Countermeasures

Each crew must constantly train for the possible actions it will take if hostile fire is received. The tactical situation will determine whether these actions should be passive or active.

a. Passive. The unit SOP will contain the spot report format for reporting hostile fire. See appendix N for a sample format. Passive countermeasure actions include—

(1) *Evasive action.* Evasive aircraft maneuvers are employed to avoid being hit by hostile fire.

(2) *Smoke.* Smoke may be dropped either to mark the general location of the hostile fire or to screen movement from hostile observation. Unit SOP's will establish the color coding for the use of smoke grenades.

b. Active. Active countermeasure actions will normally include those passive actions in *a* above with the addition of countermeasure fire by—

(1) *Helicopter weapons.* Integral weapons may used to neutralize hostile fire long enough for the helicopter to break contact. Direct hits are not necessarily a requirement in neutralizing hostile fire; often the sound of the weapon being fired is sufficient to momentarily silence hostile fire. This is particularly true for the 2.75-inch folding fin aircraft rocket, which has a significant psychological effect that is derived from the noise of firing alone.

(2) *Friendly ground fire.* Fire by friendly ground elements can be effectively used to neutralize hostile ground-to-air fires directed at helicopters. Prior planning for this fire is essential to prevent friendly positions being mistaken for the hostile positions.

(3) *Artillery, tactical air, and naval gunfire.* Heavier fire support may be required to neutralize hostile antiaircraft fires. Complete, prior planning for these fires is normally required.

8–3. Techniques in Countermeasure Action

The particular technique or maneuver required will depend upon the type of hostile fire encountered.

a. Small Arms. Hostile small arms fire, including caliber .50 (12.7mm), is normally countered by high volume, short duration neutralization fire, accompanied by an immediate turn in direction as announced by the aircraft commander, away from the hostile fire and toward an area providing screening or concealment. If concealment is not readily available, sharp turns of unequal magnitude and at unequal time intervals will provide the best protection. These turns are continued until the helicopter is beyond the effective range of the hostile weapon. Immediately upon receipt of hostile small arms fire, a well-trained crew will—

(1) Mark the position with smoke.

(2) Report, "Receiving fire from ________" (direction) (i.e., right front, etc.).

(3) Determine if countermeasure fire is required.

b. Large Caliber Antiaircraft Fire. When large caliber antiaircraft fire is encountered, especially if fires are suspected to be radar controlled, an immediate 90° turn should be executed. If the first burst of flak does not hit the intended helicopter, this 90° turn will move the helicopter away from the burst and the radar will continue to track the burst. After turning, a straight line of flight should never be maintained more than 30 seconds before a second 90° turn is initiated. Through all turns and straight lines of flight, an immediate descent will further reduce the danger by getting the helicopter out of the killing zone of the large caliber weapon.

c. High Performance Aircraft. Upon sighting hostile high performance aircraft, the pilot should continue on the established flightpath until the hostile aircraft starts his attack dive. Once the attack dive is initiated, he turns immediately toward the attacker and descends. This maneuver will cause his attack angle to increase. The hostile aircraft must cease his attack or he will be unable to recover from the maneuver. Once the attack is broken, the helicopter should be maneuvered to take advantage of terrain and vegetation for concealment and cover to avoid being attacked again.

d. Night Operations. Evasive actions for hostile fire received at night consists of—

(1) An immediate turn away from the hostile fire.

(2) Turning out the anticollision light or those lights visible to the hostile gunner. When these lights are turned out, the navigation lights should be sufficient to provide aircraft identification and show position within the flight. The navigation lights give the other helicopters in the fire team the capability of providing effective neutralization fire. After the threat has been eliminated, lights are switched to normal.

Note. All aircraft should have the bottom half of navigation lights taped or painted to allow for in-flight aircraft identification and eliminate aircraft detection from the ground. Navigation lights should be placed on STEADY/DIM position.

(3) Target marking effected by automatic weapons with a tracer capability.

PART THREE

FIRE CONTROL

★CHAPTER 9

ATTACK HELICOPTER CALLS FOR FIRE AND FIRE ADJUSTMENT

Section I. CALLS FOR FIRE

9–1. Genneral

Prior to departing on any mission, the aircraft commander or fire team leader will normally be responsible for obtaining the frequencies and call signs of available firepower from the unit operations section.

a. Transmission of Calls for Fire. When an observer has determined the location of a target that he wishes to engage with attack helicopters, he transmits a call for fire through the request channels as outlined in FM 100–26. A call for fire is a concise message prepared by an individual containing all of the information needed to process his request and to get attack helicopter or another means of fire support to engage the target. The format conforms to the existing cannon call for fire (FM 6–40) and keeps transmissions to a minimum. If attack helicopters are en route or not available for the interim engagement of the target, this format also provides for the substitution of cannon support or for the simultaneous employment of cannon artillery and attack helicopters.

b. Elements and Sequence of Standard Call for Fire Format. Following are the six elements of the standard call for fire in the sequence in which they are transmitted:

(1) *Obsrver identification.*
(2) *Warning order.*
(3) *Location of target.*
(4) *Description of target.*
(5) *Method of engagement.*
(6) *Method of fire and control.*

9–2. Standardization and Terminology

Many military operations involve forces of Allied Nations. Therefore, the sequence and terminology used in calls for fire have been standardized among Allied Nations so that an observer may call for and adjust the fires of another nation's artillery. English is the principal language used in aviation and a generally accepted terminology has been developed. For example, *azimuth* is stated as *direction* and *coordinates* are stated as *grid.* The sequence and terminology used in calls for fire for attack helicopters in this chapter parallel the cannon artillery call for fire and adjustment procedures (FM 6–40).

9–3. Observer's Identification

The observer's identification element consists of appropriate call signs or codes necessary to establish contact between the observer, the unit FDC, the fire support coordinator, and the helicopter flight leader. For example the observer transmits, "Redleg 18 (call sign of FDC), this is Redleg 24 (call sign of the observer)."

9–4. Warning Order

a. The warning order is announced "Fire mission." This element is the notice sent by the observer to achieve communications priority.

(1) For aerial field artillery, the warning order element alerts the fire direction center.

(2) For air cavalry and divisional air support, the observer calls the appropriate authority.

b. Following the warning order, the observer may indicate the particular type of fire support needed. For example when he needs close air support, he indicates "Fire mission, attack helicopters."

9–5. Location of Target

For compatibility with cannon artillery, direction will be given in mils when possible; direction given in degrees is acceptable. The location of a target contains two or more elements that depend on the manner the target is reported by the observer.

a. Reference Line. The element that is always required in the call for fire by the ground observer is the reference line (para 9–14*g*). Should aerial field artillery attack helicopters not be available as interim fire support, the reference line in the observer's initial request for attack helicopters is used by the FDC to engage the target with cannon artillery. It also is used to provide for mortars or naval gunfire to be immediately employed as a substitute, an interim measure, or in conjunction with attack helicopter support.

b. Grid Coordinates. When a target is located by grid coordinates, the elements of the target location are transmitted in the following manner:

(1) *Grid coordinates.* For example, "Grid XU675134." Due to the large area over which attack helicopters operate, hundred thousand meter grid designators should always be used.

(2) *Grid azimuth from observer to target.* For example, "Direction 4800 (mils)." (Alternate means: "Direction 270 degrees.")

c. Shift From a Known Point. When a target is to be located by a shift from a known point, the elements of the target location are transmitted in the following sequence:

(1) *Known point.*

(2) *Observer-target azimuth.* For example, "Direction 1670 (mils) (94 degrees)."

(3) *Lateral shift (if any).* For example, "Right (left) 200."

(4) *Range shift (if any).* For example, "Add (drop) 400."

d. Known Point. The target number and known point are locations which are known to the observer and to the attack helicopter fire team leader.

e. Polar Coordinates. When the location of a target is reported by polar coordinates, the elements of the target location are transmitted in the following sequence:

(1) *Observer-target azimuth.* For example, "Direction 1620 (mils) (90 degrees)."

(2) *Observer-target distance.* For example, "Distance 2500."

9–6. Description of Target

To give attack helicopter fire team leaders sufficient information for safe mission accomplishment, the observer will give a brief description of the target. This target data should include—

a. Type of target; e.g., area or point.

b. Target defenses.

(1) Active—antiaircraft ground-to-air weapons; e.g., antiaircraft guns, missiles, tanks, and/or small arms fire.

(2) Number of enemy personnel.

(3) Location of friendly troops.

9–7. Method of Engagement

a. Type of Adjustment. Although point type targets can be engaged by attack helicopters, the adjustment procedures used by the observer are no different than for an area target.

b. Ammunition. If the observer has a preference, he should inform the FSCOORD/S3 or fire team leader what type ordnance he desires, e.g., "Flechette, HE." Urgency of mission, attack helicopters available and unit SOP may dictate the armament received.

9–8. Method of Fire and Control

a. Method of Fire. This element may be given to request the number of sections to be used in a firing run. If used, it may be given as, "One section (fire team) in adjustment, platoon in effect." However, this element is usually omitted by the requestor and left to the discretion of the flight leader, based upon his knowledge of the situation and the location of the observer; e.g., airborne or on the ground.

b. Method of Control.

(1) *Fire for effect.* When the location of a target is sufficiently accurate to eliminate the requirement for an adjustment, the observer announces, "Fire for effect." Accurate immediate fire for effect has appreciable surprise value and is preferred whenever possible. Fire for effect without an adjustment is warranted when the target has been clearly identified by the flight leader. Fire for effect indicates that the flight leader may engage the target when ready. The observer may indicate the amount of ordnance desired in fire for effect.

(2) *Cannot observe.* "Cannot observe" indicates that the observer is unable to adjust fire. However, he has reason to believe that a target

exists at the given location and that it is of sufficient importance to justify firing on without adjustment.

9–9. Example of a Call for Attack Helicopter Fire

a. Observer's Identification. "Redlegs 18, this is Redlegs 24."

b. Warning Order. "Fire mission, attack helicopter."

c. Location of Target. "Grid XM123456. Direction 1300 (mils) (75 degrees)."

d. Description of Target. "Troops in the open."

e. Method of Engagement. "Flechette, HE." For aerial field artillery, the term "Danger close" will be used when the target is within 600 meters of friendly troops.

f. Method of Fire (for Aerial Field Artillery). "One section in adjustment, platoon in effect."

Note. The method of fire for air cavalry and divisional fire support is regulated by the fire team leader.

g. Method of control. "At my command, adjust fire."

Section II. ATTACK HELICOPTER FIRE ADJUSTMENT AND FLIGHT LEADER COORDINATION PROCEDURES

9–10. General

a. Point Target. A point target may be attacked with all available firepower on the initial attack, if this is decided upon by the fire team leader.

b. Area Target Near Friendly Troops. Once all friendly positions have been positively identified, the recommended procedure is to fire only one pair of rockets or short bursts of machinegun fire into the target area. To continue fire on target, an individual on the ground, an aerial observer, or a helicopter crewmember must observe the initial bursts and make appropriate adjustments.

9–11. Adjustment by Forward Air Controller (FAC)

The forward air controller serves the same purpose during the conduct of an airstrike as the forward observer serves during the conduct of an artillery fire mission. That is, he controls the conduct of the strike by relaying adjustments to the strike aircraft and recommending the type of delivery and fire support to be delivered. Although it is sometimes necessary for the attack helicopter crew to communicate directly with the strike aircraft, it is normally desirable for communications to be relayed through the FAC. In an emergency, if no FAC is available the attack helicopter commander will use the same procedures the FAC would use..

9–12. Control

a. The initial request and control of an airstrike is normally made through the air liaison officer (ALO) by the Army aviation commander or the supported ground commander in the area of operations.

(1) When communication is established with the strike aircraft, the observer will be notified of the number of aircraft taking part in the strike and the type ammunition being carried. As the strike aircraft arrive on station, the observer should mark the target for positive identification by strike aircraft. *If friendly troops are in the near vicinity, their position must be positively identified (par 4–9).*

(2) Since the attack heading will normally remain oriented in the same direction throughout the strike, adjustments by the observer can be made with reference to the burst location.

b. When the strike has been completed, the observer should make an immediate poststrike damage analysis if the situation permits. The analysis should include—

(1) The percentage of ordnance in the target area.

(2) The percentage of target area covered.

(3) Any specific destruction (e.g., huts or bunkers destroyed, KIA, etc.).

c. The immediate poststrike damage analysis is relayed to the strike aircraft.

d. A report should also be submitted to the operations section to include—

(1) Target location.

(2) Number and type of strike aircraft.

(3) Type ordnance delivered.

(4) Time on target.

(5) Time off target.

(6) Percentage of ammunition expended in target areas.

(7) Percentage of target area covered.

(8) Any specific destruction.

9-13. Fire Adjustment

a. Format for Field Artillery Fire Direction Center (FDC). The field artillery fire direction center converts the observer's call for fire into usable data for the aerial field artillery attack helicopter. The FDC/S3 transmits the call for fire to the aerial field artillery attack helicopter unit using the format in the following examples:

(1) *FDC identification.* "Red Rider 18, this is Redleg 18."

(2) *Warning order.* "Fire mission."

(3) *Target location.* "Grid AF212212."

(4) *Target description.* "Troops in the open."

(5) *Method of engagement.* "Flechettes and HE."

(6) *Observer contact.* "Contact Redleg 24 on F1."

b. Fire Adjustment for Air Cavalry and Divisional Support Units. Air cavalry and divisional support units are usually given grid and radio call sign of ground element only. All other information (i.e., friendly and enemy situation) usually is gathered by the fire team leader, en route to the ground elements location, by radio contact with the observer.

9-14. Coordination Elements and Procedures

The sequence of information exchanged between the observer and the flight leader is as shown below.

a. Initial Contact. To permit rapid target engagement by the attack helicopter flight upon arrival in the target area, the flight leader makes the initial contact with the observer as soon as the attack helicopters are within transmitting range. The initial contact includes the full call sign of the mission leader and his estimated time in minutes until arrival (ETA) in the target area. For example, "Redlegs 18 this is Red Rider 31. Estimating your location in 04, over."

b. Situation Report. The observer provides the aerial field artillery attack helicopter commander with a situation report. This mandatory report includes as a minimum: the friendly situation, intensity of contact, and ground to air fire. For example, "All friendly elements are east of the river and in heavy contact with a platoon-size force with automatic weapons."

c. Location of Target. The observer may use any of the target locating methods discussed in paragraph 9-5.

d. Description of Target. Description of the target installation includes degree of protection, personnel, equipment, or activity which is observed. If there has been no change from the initial call for fire, this element may be omitted.

e. Friendly Troop Locations. Troop safety is a normal consideration. If the location of the target is such that troop safety is not a consideration or it is not desirable to identify friendly position, the flight leader should be advised, since this is an exception to normal procedure. The helicopter flight leader must positively identify the location of all friendly elements within the target area. The observer must insure that the method used to identify friendly positions is—

(1) Compatible with the location of the aircraft at the time the identification is accomplished.

(2) Readily identifiable by the flight leader during his attack of the target.

f. Direction of Attack. Based on the location of friendly elements and other fire support means to be employed against the target, the observer recommends the direction of attack to the nearest 10° or uses a cardinal direction. The final decision for direction of attack is decided by the fire team leader. Since troop safety is also his responsibility, the direction of attack must be acceptable to the maneuver element commander. Where friendly troops are in close proximity to the target, the attack direction normally parallels the front line trace of the friendly position. This is because aerial weapon system dispersion is considerably greater in range than in deflection.

g. Reference Line or Point for Adjustment. If not covered by SOP or if the attack helicopter unit providing the close air support is not familiar with ground unit SOP, the reference line or point must be agreeable to both the observer and the flight leader. After initial target location, the observer transmits firing corrections to the attack helicopter in relation to a reference line or point (spotting line). The three reference lines (spotting lines) and one reference point that the observer may select for use in making the adjustments are as follows:

(1) *Gun-target (GT) line.* This method is frequently used when the observer has visual contact with the aircraft and the area where the rounds are impacting. He cannot apply corrections directly, consequently he must extrapolate his corrections to the GT line (attack heading) of the attack helicopter.

(2) *The observer-target (OT) line.* This method requires that the observer mark his location. The observer's corrections to the flight leader are then made along the reference line between the observer and the target. The corrections made by the observer must be applied to the gun target (attack heading) line by the aircraft commander.

(3) *Line of known direction.* The observer may select a line formed by a road, a railroad, a canal, a series of objects, etc. The line must be readily identifiable to both the flight leader and the observer. The observer makes corrections in relation to the reference line and these corrections are applied to the gun target line by the aircraft commander.

(4) *Impact point.* This method requires the observer to make corrections from the impact of last rounds using compass directions, e.g., "Northwest 100." In some situations, attack helicopter commanders may experience difficulty in locating the point of impact of last rounds on subsequent firing passes. This method of adjustment is most adaptable for use by aerial observers.

h. Ammunition Status. The helicopter flight leader should inform the observer of the amount and type of ordnance carried by the attack helicopters. Also periodically throughout the conduct of the mission, he should inform the observer of the ammunition and fuel status of the flight. This enables the observer to determine if additional close air support is required to neutralize the target. If needed, a fire request can be initiated to permit aircraft relief on station. Normally, this permits immediate fire for effect by the relieving attack helicopter and negates the requirement for time consuming adjustments. (The observer may also relieve the on-station attack helicopter with cannon artillery or tactical air.)

i. Termination of Attack. Attack of the target is continued until (1) the target is destroyed, (2) the attack is terminated by the observer, (3) the attack is terminated by the aerial field artillery fire direction center, (4) all ammunition is expended, or (5) allowable fuel is expended. On completion of the mission, the flight leader passes in-flight damage assessment and intelligence reports to the appropriate agencies.

CHAPTER 10

★ATTACK HELICOPTER FIRE COMMANDS AND EXECUTION

★10–1. General

Fire commands allow the aircraft commander to begin, conduct, and end all aerial fires. The timely and accurate fires of the team are dependent upon complete understanding of commands by every member in the team.

★10–2. Fire Command Sequence

To insure complete understanding, the elements of the fire command are given in the following sequence:

Sequence number	Element of command	Example
1	Identification and warning order.	"Dragon 34 this is Dragon 33; fire mission * * *."
2	Reply.	"This is Dragon 34; send your mission * * *."
3	Target location and descrption.	"At my 10 o'clock, troops due in on the tree line * * *."
4	Attack direction.	"From NE to SW (225°)."
5	Attack formation.	"Racetrack" (when applicable).
6	Weapons to use.	"Machineguns only."
★7	Amount to expend.	"Expend five-zero percent (one-half)."
8	Direction of break.	"Break left."
9	Special restrictions.	"Keep all fires north of canal line."
10	Acknowledgment.	'This is Dragon 34, Roger."

★10–3. Elements of Fire Command

Paragraphs 10–4 through 10–13 explain each element of the fire command. Some of the elements listed are used only under special circumstances and are not announced when they have no application. When the attack require more than one firing pass, an abbreviated command should be given for each pass.

★10–4. Identification and Warning Order

During the course of any mission, several radio transmissions will pass from fire team leader to wingman. The words "Fire mission" warn the wingman that this transmission is of the highest priority and requires his fullest attention. This transmission will normally not be required on subsequent firing passes during the same attack.

★10–5. Reply

The wingman replies so that the fire team leader knows he is alerted and ready to receive the mission. Reply is not required unless a *warning* is given.

★10–6. Target Location and Description

This element of the command should be as concise as possible but not so concise as to preclude absolute understanding of the target and its location by all members of the team.

a. Location. Target location, especially in situations where the target is obscure, is perhaps the most important element of the command. An accurate description of the target location is necessary to insure that the first rounds are close to the target. During daylight hours, location may be described by grid coordinates, polar coordinates, or radar, or by adjusting from previous rounds or smoke. During night operation, location may be facilitated by using artificial illumination.

b. Description. To prevent engaging the wrong target, the target description must be clear and stated in terms understood by all. Target description normally will provide the basis for weapon selection.

★10–7. Attack Direction

When the fire team leader specifies the attack direction, he allows the wingman time to move into position to provide protective fires as well as prepare for his firing pass on the target. When determining the attack heading, the fire team leader will take into account those principles of target attack discussed in chapter 4. Attack direction or heading is given in general terms (i.e., northwest, southeast, north, south, etc.) to allow the wingman the widest possible latitude in order to provide protective fires for the leader and still be in position to initiate his firing pass. This element of the command will usually be required for each subsequent pass.

★10–8. Attack Formation

To position each element in the team at the proper location during the attack, the formation to be used in the attack will be given in the fire command. Unless otherwise specified, the free cruise formation technique will be used. For attack patterns and attack formations, see paragraph 6–11. Unless changed, this element of the command need not be repeated for subsequent passes.

★10–9. Weapons to Use

This element of the fire command is used by the fire team leader to control the type of fire delivered on the target. Unless specified otherwise, it applies only to those weapons to be used on the target. Weapons for self-protection, such as machineguns, may be employed at the discretion of each aircraft commander to protect himself, regardless of the weapons used on the target. This element of the command will usually be required for each firing pass.

★10–10. Amount of Ammunition to Expend

The fire team leader uses this element to control the *maximum* amount of ammunition that will be expended on the target. Of the total amount of ammunition specified, only the amount sufficient to obtain the desired results is expended. Normally, this element of the fire command applies only to that ammunition to be used on the target. Each aircraft commander is responsible to control any countermeasure fire required for self-protection during the firing pass. This element normally will be required for subsequent fire commands.

★10–11. Direction of Break

The fire team leader calls the direction of break so that the wingman can position himself to take advantage of the break. For example, if the break is to the left, the wingman normally will be on the leader's right side so that he can commence his firing pass as soon as the leader breaks without having to wait while the leader clears his line of fire. The direction of break will be governed by those principles of target attack discussed in chapter 4, and will be required for each fire command.

★10–12. Special Restrictions

The fire team leader uses the ninth element to limit the identification and warning order (para 10–4) with special restrictions that may apply. For example, attack helicopter fires will be directed away from areas occupied by friendly troops.

★10–13. Acknowledgment

All elements of the attack helicopter force must "Roger" the fire command to signifiy that they have received and understand the transmission. If any portion of the fire command is not understood, the recipient should request a clarification (i.e., "Say again, direction of break"). All subsequent fire commands must be acknowledge by each element.

PART FOUR

ATTACK HELICOPTER TRAINING

CHAPTER 11

AIRCREW TRAINING

11–1. Crew Duties

The training process for aircrews is never complete. Every crewmember has duties for which he alone is responsible, as well as other duties in which the responsibility is shared. By constant practice, every member of the crew must maintain proficiency in both his *primary* and *secondary* duties and, as time is available, cross train in the primary duties of another member of the crew. The following paragraphs discuss the duties of each member of the attack helicopter aircrew.

★*a. Aircraft Commander.* The aircraft commander is in command of the helicopter and all personnel aboard. He is responsible for the employment and training of the aircrew. The aircraft commander of an attack helicopter will also be either the fire team leader or wingman in a fire team (for these primary duties, see para 1–5*b*(1) and (2)). Also, the aircraft commander usually pilots his aircraft, fires the stowed weapons systems, and controls the fires of the other crewmembers.

b. Gunner/Copilot. The primary duty of the gunner/copilot is to fire those weapons systems for which he is responsible. En route he acts as navigator, maintains spatial orientation, observes to keep the helicopter clear from hazards, monitors instruments, and, when required, makes radio transmissions and flies the helicopter.

c. Crew Chief. The primary duty of the crew chief is to perform operator and limited organizational maintenance on the helicopter. In certain types of attack helicopters, he may be required to accompany the helicopter on combat operations as a door gunner. In this situation, he will—

(1) Observe to keep the helicopter clear of hazards.

(2) Provide surveillance within his zone of observation.

(3) Throw smoke grenades to mark targets or positions.

(4) On command of the aircraft commander, fire his weapon.

(5) When required, give first aid to other crewmembers.

11–2. Familiarization and Qualification Training

The type of training to be given to the individual flight crewmember depends upon the state of proficiency required for him to accomplish his mission. The two basic types of training given to flight crewmembers for gunnery are familiarization and qualification. Any crewmember must meet certain prerequisites prior to receiving weapons training. For example, pilot gunners must first be qualified to pilot the helicopter.

a. Familiarization. Familiarization training is given to an individual when the only required proficiency is the ability to start, aim, fire, stop, and safety the system. This training is less expensive and time consuming than qualification training (*b* below). If appropriate training devices are available, "live" fire is not necessary for this training.

b. Qualification. Ground commanders may be hesitant to use available attack helicopter support because of a lack of confidence from previous experience with untrained, unqualified teams. So that the ground commander can have confidence in the attack helicopter team's ability to provide the desired support, the attack helicopter unit commander should never commit unqualified personnel on combat operations. He should make every effort to conduct the training required to assure their initial qualification and to maintain their proficiency.

(1) For recommended firing tables for qualification training, see appendix L. Qualification training is also covered by appropriate ATP's and ASubjScd's.

(2) Commander should not rely on individual effort alone in the conduct of training, but should establish an orderly logical training program for their units.

CHAPTER 12

★COMBAT SERVICE SUPPORT

Section I. GENERAL

12–1. Personnel

The support crew consists of maintenance personnel, armorers, ammunition handlers, POL handlers, and other related aircraft support personnel. In general, it consists of all personnel, excepting the flight crew, required to support an aircraft on its mission.

12–2. Training and Motivation

For the attack helicopter team to provide responsive, accurate fires, proficiency and motivation of the support crew must be maintained at a high level. For each member of the support crew to do his job in a safe, expeditious manner, he must be instilled with a sense of importance of his contribution to the combat effort. Commanders at all levels should establish training programs to insure the safe, efficient, and complete performance of duties by all support personnel.

★12–2.1. Servicing Area

a. General. The servicing area may be located within the staging area, at the home heliport, or as an area by itself. Its location with respect to the mission area is of paramount importance to the force commander. The flight time from the servicing area to the battle area will determine the duration of on-target time. The time required to refuel/rearm and return to the target area will be a governing factor in continuous attack helicopter support.

b. Security. The supported unit is responsible for the security of rearming and refueling sites. A percentage of the attack helicopter force must be designated for immediate employment to defend the area. Unit SOP, supplemented by a current operation order, must include actions to be taken in this area. However, attack helicopters must not be used as stationary weapons.

c. Petroleum, oils, and lubricants (POL). The attack helicopter mission commander must arrange for pre-positioning of POL in the servicing area. Helicopters will be dispersed in the area as terrain and security requirements dictate. Since time is an important consideration in a refueling operation, the most rapid refueling devices available should be positioned with the fuel.

d. Ammunition. The attack helicopter unit does not have sufficient personnel or transportation to be responsible for prestocking and unpacking ammunition except at its own home station. Therefore, the attack helicopter mission commander should coordinate the following actions with the appropriate unit having responsibility for ammunition.

(1) Establishing an ammunition storage and rearm area near the parking area.

(2) Insuring that the rocket ammunition is properly assembled and ready to load.

(3) Arranging for adverse weather protection for the ammunition storage and rearm area.

e. Rations. All rations and water should be prepositioned for consumption while servicing is being accomplished. Once the tactical operation begins, the time available for eating is limited. The attack helicopter mission commander should coordinate with the supported force for assistance in stocking rations near the parking areas.

★12–2.2. Medical Support

Medical support plans, prior to the tactical operation, will be the responsibility of the Command Surgeon. Medical plans will include a thorough briefing of all flight personnel on the location of medical facilities in support of the tactical operation, crash rescue operations, medical evacuation support, the employment of nonmedical aircraft in the medical evacuation role, and medical support in the staging area.

★12-2.3 Maintenance Service

Special maintenance and supply considerations for attack helicopter operations are (1) the equipment that must be carried aboard each helicopter to maintain the weapons subsystems and the helicopter, (2) the equipment and supplies that must be pre-positioned at a servicing area to provide for anticipated support of a specific tactical operation, and (3) downed attack helicopter recovery. Only those personnel and that equipment essential for mission accomplishment should be moved to the staging area. More detailed maintenance support (FM 29-22) will be located at the unit's home field. When planning for this support, the attack helicopter unit commander should consider the combat requirements of personnel and equipment; the capacity of the helicopter to carry spare parts, etc.; the location of mechanics in the staging area; and resupply of essential items. Thorough coordination must be made with the supported force for these considerations.

Section II. CARE AND HANDLING OF AMMUNITION

12-3. General

Training support personnel in the care and handling of ammunition should be a continuous process at unit level. All ammunition storage, handling, and basic safety procedures should be in accordance with TM 9-1300-206 and TM 9-1305-200, unit SOP, and applicable AR. For ammunition characteristics, see appropriate 9-series TM (app A).

12-4. 7.62MM Ammunition

a. Storage. Ammunition should be—

(1) Stored in areas designated for ammunition storage.

(2) Rotated constantly to prevent a buildup of old ammunition.

b. Safety. Unit SOP will dictate specific safety procedures to be followed locally.

c. Loading. All loading and unloading procedures will be conducted according to the specific technical manual instructions on the individual weapons systems.

12-5. 20MM, 30MM, and 40MM Ammunition

a. Storage. Storage of ammunition should be in specified areas. Whenever possible, munitions should be stored in the original containers until ready for firing.

b. Handling. Munitions must not be handled roughly or dropped. The warheads are not "bore safe" and accidental detonation can occur.

c. Loading. For loading and unloading procedures for 40mm HE cartridges, see TM 9-1010-207-12.

12-6. 2.75-Inch FFAR Ammunition

a. Storage. At present, 2.75-inch FFAR's are packed in a wooden box containing four motors and four warheads. Future packing methods will take advantage of advances in packaging techniques and materials. Rockets should be stored in their containers until ready for firing. Storage areas should be dry, bunkered, and maintained within the temperature limits of —65° Fahrenheit to 150° Fahrenheit (as stenciled on containers).

(1) If the ammunition must be stored in an open area, raise it on dunnage at least 6 inches and cover it with a double thickness of tarpaulin.

(2) If rockets are prepared for firing but are not fired, they should be disassembled and returned to their original containers. Rocket motors should be stored pointed toward the area that poses the least hazard to personnel and equipment.

b. Handling. When possible, rockets should be handled while in the container. In any event, rockets must not be thrown, rolled, dragged, or handled roughly in any manner. If the motors are handled roughly, the propellant is likely to crack. (Cracking occurs more frequently at temperatures below 40° Fahrenheit.) Prior to loading, rockets should be kept free of sand, ice, snow, mud, grease, and other foreign matter.

c. Assembly. Prior to assembling the warhead and the motor, the spacer and rubber gasket are removed from the warhead. To tighten the warhead to the motor, a torque wrench should be used to apply 55 foot-pounds of torque to the warhead.

Caution: **Do not remove the static cover or grounding wire from the aft end of the rocket motor until ready to load the complete rocket into a launcher.**

d. Loading. Prior to loading, ascertain that the system is "cold"; the circuit breakers are "out"; and the helicopter is grounded and, if possible, oriented in a direction away from personnel and equipment. It is not necessary to make a "stray voltage" check prior to each loading, but it is advisable to do so before each day's firing to insure that the circuitry is functioning properly. For testing procedures, see TM 9–1055–217–20 or –35. Remove static cover and/or grounding wire, and load in accordance with the appropriate TM for the launcher being used.

e. Unloading. If the rockets are not fired and it is necessary to unload the launcher, perform the preloading check (circuit breakers "out," etc.) prior to attempting to unload. Then release the detent and push the rocket out the front of the tube.

★*f. Disassembly.* When practical, the rocket should be disassembled and stored in its original container. To disassemble, remove the warhead and replace the rubber gasket, support assembly, spacers, and ground wire/static cover. If it is not practical to disassemble the rocket, store it with the grounding wire and/or static cover in place. For additional information on the care, handling, and storage of rocket ammunition, see TM 9–1300–200 and TM 9–1300–206.

12–7. Guided Missiles

a. Storage. Guided missile ammunition requires no maintenance at the user level. Stacks will be limited to five rounds.

b. Handling. Guided missile ammunition should be handled only by trained personnel. Rough handling can cause ammunition malfunction, to include propellant explosion when ignited. For detailed handling instructions, see appropriate 9-series TM (app A).

c. Safety. Personnel engaged in handling, assembly, and loading of guided missile ammunition will observe the following precautions:

(1) The flightcrew must remove all rings and jewelry from their hands before assembling, installing, or disassembling missiles.

(2) Missiles will not be installed on the helicopter until the daily operational checks have been successfully completed.

(3) Missiles will not be mounted until the helicopter has been fueled, checked out, and is ready for flight.

(4) To approach or move away from missiles, personnel should move at a right angle to the line of fire.

(5) All persons not actively engaged in installing the missiles will remain at least 100 meters from the launchers and clear of the flightpath.

(6) The helicopter should be in an open area and positioned so that the missiles are pointing toward a safe, uninhabited area.

(7) Missiles should be mounted from the inside launcher to the outside, both left and right.

(8) Until just before helicopter takeoff, the explosive bolt cables will be connected to their shorting plugs.

(9) Never assemble missiles within 300 meters of a radio or radar installation that has more than 100 kilowatts of peak power.

d. Assembly, Loading, Unloading, and Disassembly. Guided missile ammunition will come from the ammunition supply point assembled and ready to load. Only qualified personnel will assemble, load, unload, and disassemble guided missile ammunition. For assembly, loading, unloading, and detailed disassembly instructions, see appropriate 9-series TM (app A).

CHAPTER 13

RANGE FIRING

Section I. RANGE OPERATION

13-1. Range Requirements

Range requirements are established by the United States Army Materiel Command (USAMC). The range requirements depend on the types of aircraft and weapons subsystems to be used on the range, the purpose of the range (i.e., qualification or familiarization), and whether qualified instructor pilots are used aboard each aircraft to control the firing.

13-2. Surface Danger Area

Basic guidance for surface danger areas is shown in figure 13-1. With proper justification to the United States Army Materiel Command, these requirements may be altered to fit local conditions. Each surface danger area is divided into the following major components:

a. Firing Lane. The helicopter must be in the firing lane when firing. The firing lane has lateral boundaries extending perpendicularly from each end of the start-fire line (SFL) to each end of the cease-fire line (CFL). Targets may be engaged beyond the CFL but firing must cease at the CFL. To permit target engagement at maximum effective range, the target lane (part of the firing lane) extends beyond the CFL.

b. Impact Area. All rounds must impact into the impact area. The impact area begins at each end of the SFL, includes the fan-shaped area that is swept out by a 20° angle on each side of the firing lane, and extends downrange a distance of "X" meters (fig. 13-1).

c. Area "G." Area "G" is required when one qualified aviator (not an instructor pilot) is giving another aviator familiarization weapon training (Plan 1, fig. 13-1). Beginning at each end of the SFL, area "G" sweeps out at a 15° angle from each side of the impact area and extends downrange the same distance as the impact area. This area may not be required when qualified instructor pilots are controlling the fires from each helicopter (Plan 2, fig. 13-1).

d. Buffer Zone (Areas "A" and "B"). The buffer zone surrounds the impact area to provide a margin for error. It also begins at each end of the SFL and sweeps out at a 25° angle from the impact area (or area "G," if required) until it reaches the width specified for the type ammunition in use. This width then parallels the end of the impact area (fig. 13-1).

13-3. Range SOP and/or Checklists

The safe and efficient use of available ranges depends upon establishing detailed range and crash/rescue SOP's and duties checklists; all personnel concerned must be familiar with the provisions of the appropriate SOP and/or checklist. For a sample SOP, see appendix L.

13-4. Range Officer

The range officer is the installlation commander's representative for operation and control of the range facilities. He is responsible for conducting training for range personnel, establishing the range SOP, insuring that the safety precautions are met, preparing and maintaining the ranges, posting warning signs, and placing barriers. Normally, he will also be responsible for scheduling range guards, ambulances and first aid personnel, crash/rescue equipment and operating personnel, and tower operations.

13-5. Officer in Charge (OIC)

The officer in charge supervises the range personnel and through the range officer, he is responsible for—

a. Opening the range for training.

b. Range safety.

c. Conducting all training that requires the firing of live ammunition.

d. Monitoring the loading of weapons.

e. Aircraft and weapons maintenance.

f. Flight operations.

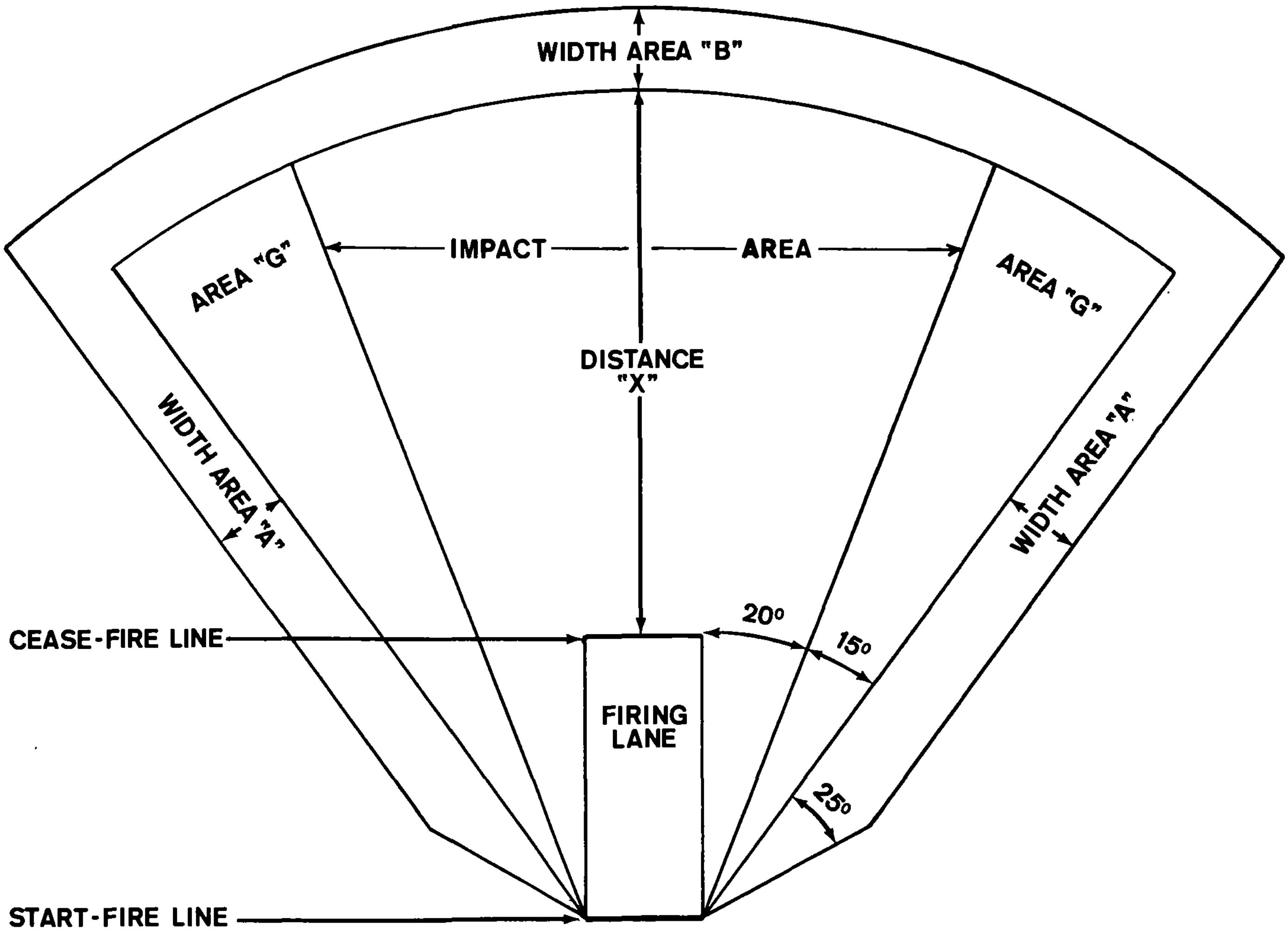
g. After firing has been completed, verifying range closing and completing required reports.

13–6. Range Control Officer (RCO)

The safety officer at the firing point is the RCO, who represents the OIC. Orders issued by the RCO which prohibit or restrict firing must be obeyed and can only be rescinded by the OIC. The RCO has operational control of the range noncommissioned officer in charge (NCOIC), the ammunition NCOIC, crash/rescue team, ambulance crew, and control tower personnel. In the discharge of his duties, the RCO should interfere as little as possible with training, provided that safety precautions are not violated. In addition, the RCO should not be assigned responsibilities to assist in training but should be free to monitor safety.

13–7. Range NCOIC

The range NCOIC, under RCO control, supervises all range support personnel operations and safety. Normally, the range NCOIC is permanently assigned to the range and is thoroughly familiar with the facilities and operations of the range.



CALIBER	WIDTH AREA "A" METERS	WIDTH AREA "B" METERS	DISTANCE "X" METERS	
			PLAN 1	PLAN 2
7.62MM	100	100	3,800	2,700
2.75-INCH (ROCKET)	300	300	7,700	5,400
40MM (M75)	200	200	3,000	2,100

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★*Figure 13–1. Surface danger area.*

13-8. Ammunition NCOIC

The NCOIC of the ammunition detail supervises the handling, assembly, and storage of all ammunition. He accounts for all ammunition. He must be familiar with the training schedule.

13-9. Senior Armorer

The senior armorer is the NCOIC of the armorer detail and supervises weapons maintenance, loading, unloading, harmonization, and boresighting. In addition, he is responsible for policing the firing line.

13-10. Conduct of Training

a. Prior to Firing. Prior to the beginning of live firing on the range—

(1) Range guards must be posted.

(2) Crash/rescue team and ambulance must be in position.

(3) Medical evacuation helicopter must be available.

(4) Control element must be in operation.

(5) Range flag must be flying.

(6) Range must be checked to insure that no personnel are in the surface danger area.

(7) Permission must be received from the range officer to commence firing.

b. During Firing. All safety restrictions must be met during firing; otherwise, the OIC or the RCO is required to stop training until they are corrected. To properly control traffic, the following radio communications are mandatory:

(1) Communications must be maintained between all aircraft and the tower at all times.

(2) Permission must be received from controller for all takeoffs and landings.

(3) Permission must be received from controller before placing any switch in the "hot" (ARMED) position.

(4) Controller must be notified when systems are "cold" (SAFE).

(5) Controller must be notified when "clear" of the surface danger area.

c. After Firing. Upon completion of training, all aircraft will be cleared and unarmed before leaving the range. The range officer should be notified of the conclusion of training, the amount and type of ammunition expended, and the location of any known duds. In addition, the area should be cleared of all debris and loose brass.

13-11. Layout of the Aerial Fire Range

a. Terrain. When practical, the firing lane should be laid out on relatively open terrain to facilitate emergency landings. In addition, it is desirable for the CFL markers to be visible from the tower. To facilitate harmonization of weapons systems, the first 500 meters of the firing lane should be clear and on relatively flat terrain. When possible, terrain other than the firing lane should be left in the natural state to add realism to the training.

b. Markings. The SFL and the CFL must be clearly marked and visible from the air. For control purposes, it is also desirable that they be visible from the tower. Landing pads on the firing line should be clearly marked for both day and night landings.

c. Targets. The nature and arrangement of targets should be varied to provide the widest latitude in training. To facilitate harmonizing, one target should be placed at the harmonization distance for each weapon system.

d. Tower. When practical, the tower should be a permanent structure incorporating electrical power for heating, lighting, and radios, and direct land-line communications to range headquarters and the crash/rescue telephone net. For safety, the tower should be erected on the same side of the firing lane as the traffic pattern.

e. Ammunition Area. An area for the assembly and storage of ammunition should be established away from the tower and firing line. This area should be well-drained, bunkered, and away from aircraft flightpaths.

f. Interlocking Range Fans. With proper spacing of firing lanes and adjustment of traffic patterns, it is possible to use a common impact area for five or more aerial fire ranges. However, final approval of such an arrangement is required from the United States Army Materiel Command.

Section II. RANGE SCORING

13-12. General

In conduct of qualification training, all live firing must be scored. Familiarization training normally does not require targets to be scored. Scoring may be by *visual* or electronic means.

13-13. Visual Scoring

Visual scoring may be accomplished by—

a. Hit-Count Method. The hit-count method requires an observer to make an actual count of the number of rounds that hit the target. Normally, this method is not suitable for aerial firing because it is too time-consuming and the target area is unsafe.

b. Estimation. The estimation method requires an observer to estimate the number of rounds that hit the target or the distance from the target that each round impacts. This method requires a high degree of training of the observer.

c. Triangulation. The triangulation method requires that at least two observation posts be established which can observe each impact. Each observer determines the azimuth from his position to the impact and, by using intersecting lines, triangulates the point of impact. While this method is extremely accurate, it requires well-trained observers and is time consuming.

13–14. Electronic Scoring

Electronic scoring makes use of acoustic or other electronic devices. Although electronic scoring is expensive, for aerial fire ranges the expense is outweighed by the speed and accuracy of scoring. In addition, electronic scoring provides greater safety by eliminating observers downrange.

Section III. RANGE SAFETY

13–15. General

Aerial gunnery training uses live ammunition to provide a realistic training situation. However, this live firing does not preclude the application of safety procedures in the training environment. Each unit should develop range firing and safety standing operating procedures applicable to their special situation. A recommended helicopter range firing and safety SOP is given in appendix L. Range safety includes flight safety, firing safety, and ground safety.

13–16. Flight Safety

During the conduct of live fire training, it is especially important that all helicopters be operated in a safe manner. Too often, to the detriment of all, bad habits acquired in training are carried over to actual operations. Anyone observing an unsafe act is responsible to report it to the OIC for corrective action. Flight safety also includes making the proper radio communications at the proper time.

13–17. Firing Safety

General safety requirements for firing machineguns are contained in AR 385–63. For safety requirements for each subsystem, see the applicable 9-series TM (app A). In addition to the inspection of individual weapons, firing safety includes insuring that—

a. Clearance is received from the controller.

b. The weapon is on or past the SFL.

c. Weapons are pointed downrange and within the range fan limits.

d. If on the ground, no one is in front of the weapons.

e. No other aircraft are within the surface danger area.

f. The weapons are not fired at less than the minimum safe slant range.

g. Prior to leaving the range, a visual safety inspection is made of each weapon.

13–18. Ground Safety

Ground support personnel must constantly be made aware of the dangers involved in live fire training. Support personnel should be trained in the care and handling of ammunition, loading and unloading procedures for each weapons subsystem, and procedures for working near operating helicopters. Reloading areas should be separated from refueling areas. In addition, support personnel should be drilled in their duties for emergency situations.

APPENDIX A

REFERENCES

A–1. Publication Indexes

Department of the Army Pamphlets of the 310-series should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

★A–2. Army Regulations (AR)

95-series	Aviation.
220–58	Organization and Training for Chemical, Biological, and Radiological (CBR) Operations.
310-series	Military Publications.
310–25	Dictionary of United States Army Terms.
310–50	Authorized Abbreviations and Brevity Codes.
350–1	Army Training.
380–5	Safeguarding Defense Information.
385–40	Accident Reporting and Records.
385–62	Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat.
385–63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
622–5	Qualification and Familiarization.
750–5	Organization, Policies, and Responsibilities for Maintenance Operations.
750–51	Maintenance Assistance and Instruction Team (MAIT) Program.

★A–3. Department of the Army Pamphlets (DA Pam)

108–1	Index of Army Motion Pictures and Related Audio-Visual Aids.
310-series	Military Publications Indexes.
750–1	Commander's Guide of Preventive Maintenance Indicators.

★A–4. Field Manuals (FM)

1–5	Aviation Company.
1–15	Aviation Battalion, Group, and Brigade.
1–80	Aerial Observer Techniques and Procedures.
1–100	Army Aviation Utilization.
1–105	Army Aviation Techniques and Procedures.
3–10	Employment of Chemical and Biological Agents.
3–12	Operational Aspect of Radiological Defense.
5–15	Field Fortifications.
5–20	Camouflage.
5–25	Explosives and Demolitions.
5–34	Engineer Field Data.
5–36	Route Reconnaissance and Classification.
6–40	Field Artillery Cannon Gunnery.
6–102	Field Artillery Battalion, Aerial Field Artillery.
9–6	Ammunition Service in the Theater of Operations.

10–8	Airdrop of Supplies and Equipment in the Theater of Operations.
17–1	Armor Operations.
17–12	Tank Gunnery.
17–36	Divisional Armored and Air Cavalry Units.
17-37	Air Cavalry Squadron.
20–60	Battlefield Illumination.
21–5	Military Training Management.
21–6	Techniques of Military Instruction.
21–11	First Aid for Soldiers.
21–26	Map Reading.
21–40	Chemical, Biological, Radiological and Nuclear Defense.
21–60	Visual Signals.
21–76	Survival, Evasion, and Escape.
22–100	Military Leadership.
23–67	Machinegun 7.62mm, M60.
24–1	Tactical Communications Doctrine.
24–18	Field Radio Techniques.
29–22	Maintenance Battalion and Company Operations (Nondivisional).
29–30	Maintenance Battalion and Company Operation in Divisions and Separate Brigades.
30–5	Combat Intelligence.
31–16	Counterguerrilla Operations.
31–20	Special Forces Operational Techniques.
31–21	Special Forces Operations—U.S. Army Doctrine.
31–50	Combat in Fortified and Built-Up Areas.
31–71	Northern Operations.
31–72	Mountain Operations.
(C)32–5	Signal Security (SIGSEC) (U).
33–1	Psychological Operations—U.S. Army Doctrine.
33–5	Psychological Operations—Techniques and Procedures.
57–35	Airmobile Operations.
100–26	The Air-Ground Operations System.
101–5	Staff Officers' Field Manual: Staff Organization and Procedure.

A–5. Training Circulars (TC)

1–16	Employment of Aircraft Flares From Army Aircraft.
3–16	Employment of Riot Control Agents, Flame, Smoke, Antiplant Agents and Personnel Detectors in Counterguerrilla Operations.

A–6. Technical Manuals (TM)

1–215	Attitude Instruments Flying.
1–225	Navigation for Army Aviation.
1–250	Fixed Wing Flight.
1–260	Rotary Wing Flight.
1–380-series	Aerial Observer Programed Texts.
3–210	Fallout Prediction.
★3–4240–219–14	Operators, Organizational, DS, and GS Maintenance Manual (Including Repair Parts and Special Tool Lists) Mask, Chemical-Biological: Aircraft, ABC-M24 and Accessories.
5–330	Planning and Design of Roads, Airbases, and Helicopters in the Theater of Operations.
8–230	Army Medical Department Handbook of Basic Nursing.
9–1005–243–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool List): Armament Subsystem Helicopter,

7.62-MM Machine Gun, Quad, M6 (XM6E3) (Used on UH–1B Helicopters).

9–1005–247–12 Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem Helicopter 7.62-MM Machine Gun Twin, M2 (Used on OH–13 (Series) and OH–23 (Series) Helicopters).

★9–1005–257–12 Operator and Organizational Maintenance Manual: Armament Pod, Aircraft, 7.62-Millimeter Machine Gun: XM18 (1005–930–5597) and Armament Pod, Aircraft, 7.62-MM Machine Gun: XM18A1 (1005–832–7498).

9–1005–262–15 Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Door Mounted Lightweight, B23 (1005–907–0720) (Use on UH–1D–Helicopters); Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Door Mounted, Lightweight, M24 (1005–763–1404) (Used on CH–47A Helicopters); and Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Ramp Mounted Lightweight, XM41 (1005–087–2046) (Used on CH–47A Helicopters).

★9–1005–298–12 Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62-MM Machine Gun High Rate, XM27E1 (1005–933–6242) (Used on OH–6A and OH–58A Helicopters).

★9–1005–299–12 Operator and Organizational Maintenance Manual: Armament Subsystem Helicopter, 20 Millimeter Automatic Gun: XM35 (1005–133–8193) (Used on AH–1G Helicopters).

★9–1005–304–12 Operator's and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—Caliber .50 Machine Gun: Door Mounted, XM59 (1005–133–8224) (Used on UH–1D and UH–1H Helicopters).

9–1010–207–12 Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 40 Millimeter Grenade Launcher: M5 (Used on UH–1B Helicopters).

9–1055–217–20 Organizational Maintenance Manual: Helicopters Armament Subsystem 2.75-Inch Rocket Launcher XM3 (Used on UH–1B Helicopter).

9–1055–217–35 DS, GS, and Depot Maintenance Manual: Helicopter Armament Subsystem 2.75-Inch Rocket Launcher XM3 (Used on UH–1B Helicopter).

★9–1090–202–12 Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—2.75-Inch Rocket Launcher M21 (1090–923–5971) (Used on UH–1B and UH–1C Helicopters).

9–1090–202–35 Direct and General Support and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists) Armament Subsystem, Helicopter, 7.62-MM Machine Gun—2.75-Inch Rocket Launcher: Twin, High Rate, XM21 (Used on UH–1B Helicopters).

★9–1090–203–12 Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—40 Millimeter Grenade Launcher: XM28 (1090–933–6701) and Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—40 Millimeter Grenade Launcher: XM28E1 (1090–134–3071) (Used on AH–1G Helicopter).

9–1090–204–12 Operator and Organizational Maintenance Manual: Mount, Multiarmament, Helicopter: XM156 (1090–930–5018) (Used on UH–1B or UH–1C Helicopters).

9–1300–200 Ammunition, General.

9–1300–206 Care, Handling, Preservation, and Destruction of Ammunition.

9–1305–200 Small-Arms Ammunition.

★9–1330–202–25 Organizational, DS, GS, and Depot Maintenance Manual (Including Repair Parts and Special Tools List) Dispenser, Grenade: Smoke XM20.

9-1370-200	Military Pyrotechnics.
9-1400-461-20	Organizational Maintenance Manual: Guided Missile Launcher, Helicopter Armament Subsystem M22 (Used on UH-1B Helicopter).
55-1520-209-10	Operator's Manual: Army Model CH-47A Helicopter.
55-1520-210-10	Operator's Manual: Army Model UH-1D/H Helicopter.
55-1520-218-10	Operator's Manual: Army Model UH-1A Helicopter.
55-1520-219-10	Operator's Manual: Army Model UH-1B Helicopter.
55-1520-220-10	Operator's Manual: Army Model UH-1C/M Helicopter.
55-1520-221-10	Operator's Manual: Army Model AH-1G Helicopter.

A-7. Common Tables of Allowances (CTA)

23-100-6	Ammunition, Rockets, and Missiles for Unit Training—Active Army and Reserve Components.

APPENDIX B

HELICOPTER ARMAMENT MODEL NUMBERS AND DEFINITIONS

★B–1. Model Numbers Applicable to the Army Aircraft Armament Program

The prefix "X" indicates incomplete development or that standard A classification will not be awarded.

a. Helicopter Armament Subsystems. The following list of helicopter armament subsystems is a guide to all armament subsystems, past and present. While not all of the systems listed are applicable to attack helicopters, they are included here to provide all gunnery information applicable to attack helicopters.

XM1, XM1E1 (LP)	Caliber .30 machinegun; twin gun (used on OH–13 series helicopters).
M2	7.62mm M60C machinegun; twin gun (used on OH–13-series and OH–23-series helicopters).
XM3	2.75-inch rocket launcher, 48-tube (used on UH–1B/C only; will not be standardized).
XM3E1	Improved XM3 2.75-inch rocket launcher. Subsystem launch tubes are 4 inches longer.
XM4	2.75-inch rocket launcher subsystem for the CH–34.
M5	40mm M75 grenade launcher nose-mounted on UH–1B/C.
M6	Quad 7.62mm M60C machinegun on UH–1B/C (formerly the XM–153 used on CH–21).
M6E1	Same as above, but on CH–34.
XM6E2	Same as above, but on UH–1B/C at station 69.
XM6E3 (M6)	Same as above, but on UH–1B/C at station 136 (now standard A and designated M6).
XM7	7.62mm machinegun; twin gun (the 7.62mm subsystem on the OH–6A; development suspended).
XM8	40mm grenade launcher (the XM129 on the OH–6A).
XM10	Development cancelled.
M16	Quad 7.62mm M60C machinegun; 2.75-inch, seven-tube rocket launcher (used on UH–1B/C helicopters; M6 modified to incorporate rocket capability).
XM17	2.75-inch rocket launcher 19-tube, reloadable, reusable, not repairable (used on UH–1B/C; two XM159 rocket pods on Kellet pylons).
M21	7.62mm high rate M134 machinegun; 2.75-inch rocket launcher XM158 (M16 modified by replacing four M60C machineguns with two M134 machineguns).
M22	Antitank guided missile subsystem for UH–1B/C using AGM–22B missile (formerly SS–11B1).
M23	7.62mm M60D machinegun; door pintle-mounted on UH–1D/H.
M24	7.62mm M60D machinegun; pintle-mounted on CH–47.
XM26 (TOW)	TOW (Tube launched, Optically tracked, Wire guided) missile, for UH–1B/C.
XM27	7.62mm machinegun—high rate; one M134 machinegun side-mounted on OH–6A.
XM27E1	Improved XM27 armament subsystem.
XM28	Two 7.62mm M134 machineguns; two 40mm XM129, grenade launchers; or one M134 machinegun and one XM129, turret-mounted on the nose of AH–1G.
XM29	One 7.62mm M6 OD machinegun; pintle-mounted on UH–1B/C (cannot be used if ex-

	ternal weapons subsystems are mounted).
XM30	30mm automatic gun XM140 on UH–1B/C.
XM31	20mm automatic gun; one pod-mounted M24A1 gun on each side of UH–1B/C.
XM32	Caliber .50 or 7.62mm machinegun mounted one on each side of CH–47A.
XM33	Caliber .50 machinegun ramp-mounted in rear of CH–47A.
XM34	Dual 20mm M24A1 guns mounted one on each side of the CH–47A.
XM35	20mm subsystem for the AH–1G.
XM41	One 7.62mm M60D machinegun; ramp-mounted on CH–47A.
Tactical Armament Turret—TAT–102A	Chin turret mounting one 7.62mm M134 machinegun on the nose of AH–1G.

b. Weapons Used in Helicopter Armament Subsystems.

M60C	Machinegun, 7.62mm, electrically fired.
M60D	Machinegun, 7.62mm, spade grip with thumb triggers.
M61	Gun, three-barrel, 20mm cannon, Gatling-type; electrically driven, Vulcan, barrel length 60 inches.
M61A1	Same as M61 except barrel length is 40 inches.
M75	Launcher, grenade, 40mm.
XM129	Launcher, grenade, 40mm (redesign of M75).
XM130	Gun, 20mm, automatic, (redesign of M61 to provide gas drive).
XM133	Gun, 7.62mm, high cyclic rate machinegun w/gas drive.
M134	Gun, 7.62mm, high cyclic rate machinegun w/electric drive.
XM140	Gun, 30mm, automatic, single barrel.
XM141	Launcher, 2.75-inch rocket, seven-tube reusable.
XM157	Launcher, 2.75-inch FFAR, seven-tube reusable, not repairable (LP).
XM158	Launcher, 2.75-inch rocket, seven-tube reusable, repairable (LP).
XM159	Launcher, 2.75-inch FFAR, 19-tube reusable, not repairable (LP).
XM200	Launcher, 2.75-inch FFAR, 19-tube, reusable, repairable.

c. Multiarmament Helicopter Mount.

XM156	Mount, multiarmament, used on UH–1B/C having M16 subsystem internal wiring (for XM157, XM158, and XM 159 2.75-inch rocket launchers).

d. Sights for Helicopter Armament Subsystems.

M5	Sight, reflex, infinity, flexible, gunner's sight for M5 subsystem turret.
Mk 8	Sight, antioscillation, flexible, for M22 subsystem.
XM28	Sight, reflex, infinity, flexible, gunner's sight for XM28 subsystem turret.
XM58	Sight, antioscillation, flexible, for M22 subsystem.
M60	Sight, infinity, flexible, (pilot sight for M16 and M21 subsystems).
XM70E1	Sight, reflex, infinity, used on OH–6A helicopter for XM27E1 and XM8 subsystem (flexible in elevation and depression only).
XM73	Sight, reflex, infinity, used on AH–1G helicopter for all wing stores and fixed forward firing turret weapons.

e. Aircraft Armament Pods.

XM12	20 mm automatic gun—turbine driven (uses M61 gun) (SUU–16/A, AF).
XM13	40mm grenade launcher (uses M75 launcher).
XM14	Caliber .50 machinegun (uses M3 machinegun) (LP).
XM18	7.62mm high rate M134 machinegun (SUU–11A/A, AF) (LP).
XM19	7.62mm machinegun; twin gun (uses M60C machinegun).
XM25	20mm automatic gun—gas driven (SUU–11A, AF).

f. Aircraft Dispensers.

XM3	Dispenser, antipersonnel, mine (see XM47 mine dispersing subsystem).

XM9	Dispenser, bomb (modified SUU 7 for UH-1B/C, see SUU 14/A).
XM15	Dispenser for XM165 aircraft flares.
XM18	Dispenser for XM54 grenades and XM170 aircraft flares.
XM19	Dispenser for XM170 aircraft flares.
XM20	Smoke grenade dispenser for AH-1G.
XM25	Dispenser, bomb, aircraft (XM18 dispenser and XM144 frag bombs).
XM27	Dispenser, grenade, aircraft (XM18 dispenser and XM54 grenade).
XM47	Mine dispersing subsystem (XM3 dispenser and XM27 mines).

g. Mines.

XM27	Mines, antipersonnel (see XM47 mine dispersing subsystem).

h. Canisters.

XM15	50-pound cluster of eight modules of XM16 CS canisters.
XM165	130-pound cluster of two XM15 CS canisters.

B-2. Definitions

a. Clockwise Rotation—When an armament system is viewed from the rear, rotation in the direction of the hands of a clock.

b. Gunner—The copilot-gunner.

c. Gatling—Machinegun operation where barrels rotate through a loading, firing, and ejecting cycle.

d. Pod—An externally mounted armament subsystem that is contained with a firing.

APPENDIX C

7.62MM RIFLED-BORE ARMAMENT SUBSYSTEMS

Section I. M2 ARMAMENT SUBSYSTEM

★C–1. Capabilities

The twin caliber 7.62mm machinegun helicopter armament subsystem M2 (figs. C–1, C–2, and C–3) is designed for use on the OH–13 and OH–23 series helicopters. As a normal reconnaissance function, the M2 helicopter armament subsystem is used in a neutralization fire role. It is most effective against area type soft targets; however, other types of targets may be engaged to develop reconnaissance information (reconnaissance by fire).

C–2. Limitations

The M2 helicopter armament subsystem is not effective for use at night or during periods of low visibility and it is vulnerable to small arms and other types of air defense fires.

C–3. Description

The M2 armament subsystem is lightweight, simple in construction, requires little maintenance, and can be readily installed with only minor modification of the helicopter. Weight, size, and operating characteristics are—

a. Fixed Cal. 7.62mm Machinegun, M60C.

(1) Type ______________Fixed machinegun.

(2) Weight (two machineguns) ____42.0 lb.

(3) Rate of fire (combined) _____________ 1,100 shots per minute (approx.)

b. Ammunition.

(1) 7.62mm ____________________All types

(2) Weight (1,100 rounds: four rounds of ball to one round of tracer, linked) ______________________________74.0 lb.

c. Mount, M2.

(1) Weight (two mount assemblies) 88.55 lb.

(2) Overall length ______________65.8 in.

(3) Overall height ________________15.6 in.

(4) Overall width ________________7.25 in.

(5) Distance between guns _______70.55 in.

(6) Ground clearance OH–13H ______9.5 in.

(7) Elevation range __________________9°.

(8) Elevation rate__6° per second (approx.)

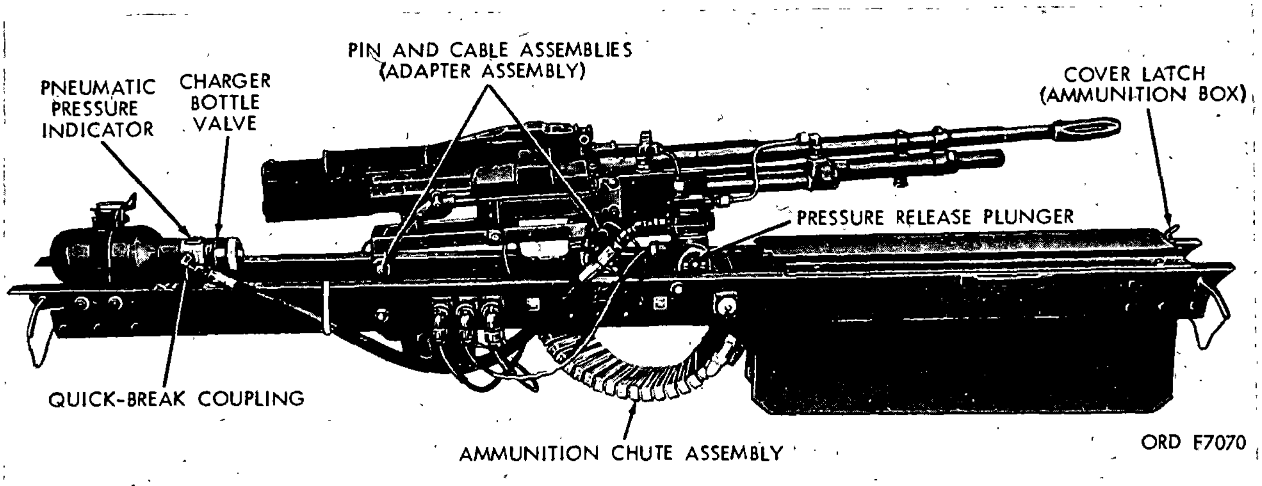


Figure C–1. Helicopter armament subsystem M2—right side view.

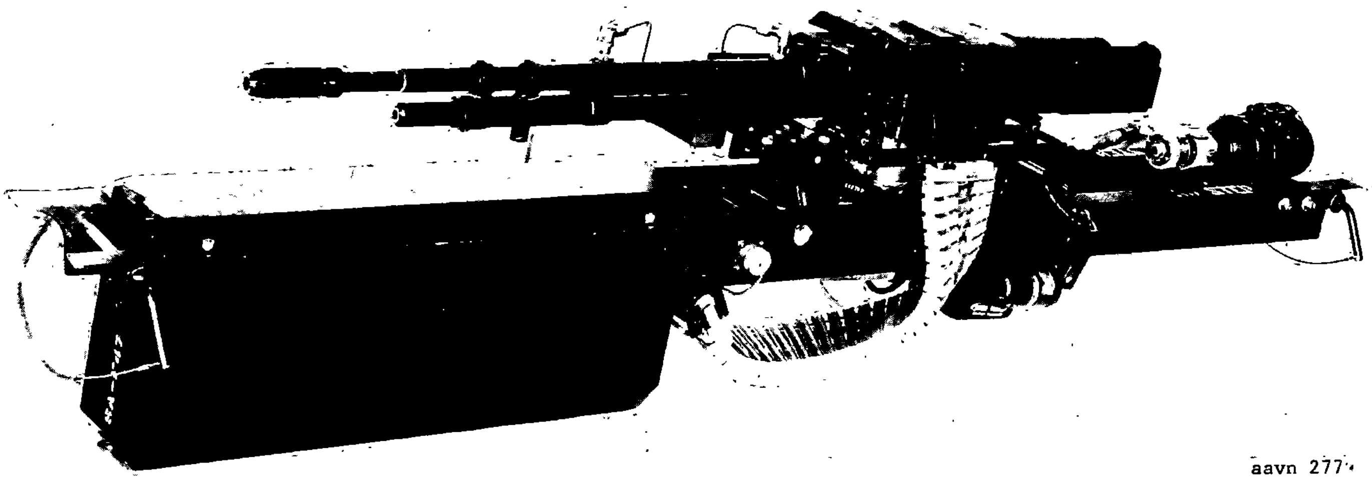


Figure C–2. Helicopter armament subsystem M2—left side view.

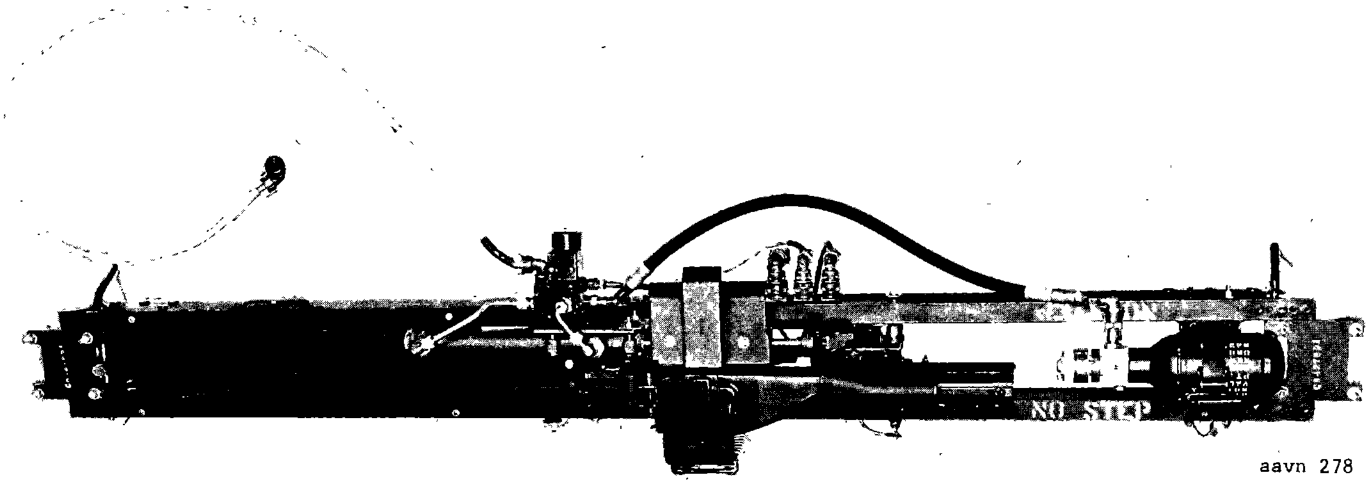


Figure C–3. Helicopter armament subsystem M2—top view.

(9) Depression rate 9° per second (approx.)
(10) Elevation drive ---------------- Electric.
(11) Charging and safetying mechanism ---------------- Pneumatic.
(12) Charger supply cylinder volume ---------------- 30 cu. in.
(13) Charger supply pressure 2,000 to 3,000 psi.
(14) Charging cycles per cylinder --- 22 to 25.
(15) Charger line pressure ---------- 350 psi.
(16) Charging time ---- 1 second (approx.)
(17) Total ammo capacity ---------- 1,150 rd. (On each side: Ammunition box—550 (approx), chute—25 (approx).)

d. Center of Gravity (CG) Limits.

(1) Forward ---------------- 81.5 in.
(2) Aft ---------------- 89 in.

★*e. Boresighting.* The machineguns are boresighted in the azimuth plane for the rounds to converge at 500 meters.

C–4. Fire Control and Operation

Since there is no sight for this subsystem, the aviator can provide his own sight reference which can be a 4-inch vertical line and short horizontal lines spaced at one-half inch intervals, made with a grease pencil on the helicopter bubble. Arming, charging, safetying, elevating, and firing operations are remotely controlled by the aviator, who can perform these operations without releasing the collective or cyclic controls. Controls for operating the subsystem are installed on the cyclic and collective controls and on the console. The subsystem consists of two M60C (7.62mm) machineguns (left-hand feed), the subsystem mount, and the necessary ancillary equipment. The machineguns are mounted on aluminum supporting structures on each side of the helicopter.

a. Machinegun, M60C. The M60C machinegun (fig. C–4) is basically the M60 7.62mm machinegun. This gun is modified by removing the stock group, bipod, foregrip, carrying handle, front and rear sights, manual safety, and trigger mechanism group. The manual trigger mechanism group is replaced with a solenoid-operated, spring-laded sear arm. One machinegun is mounted on either side of the helicopter on a mount assembly. The machineguns are interchangable and can be quickly detached from the mount.

b. Mount, M2. The machinegun mount consists of two mount assemblies, one installed on each side of the helicopter straddling the front and rear cross tubes. The mounts are interchangable and easily removed from the helicopter. They contain recoil buffers to reduce recoil and counterrecoil forces transmitted to the helicopter during firing. Each mount contains a pneumatic charger which controls the charging and safetying operation. Electrically operated elevating mechanisms and elevating limit switches are contained in the mounts. An ammunition box with a capacity of approximately 550 rounds is located on the forward end of each mount. The ammunition chute has an approximate capacity of 25 rounds, for a total ammunition load of approximately 575 rounds per gun.

c. Controls and Switches. The armament subsystem M2 is controlled by the use of controls and switches located inside the cockpit. With the guns loaded as prescribed in paragraph C–6, movement of the ARM/SAFE switch to the SAFE position completes the circuit operating the SAFE light, the elevation switch, and the aircharger valve. Deenergizing the valve allows air to enter the charger, forcing the bolt to the rear. Movement of the ARM/SAFE switch to the ARM position completes the circuit to the ARM light, to the gun trigger switch, to the elevation switch, and to the air charger valve, energizing the valve and stopping the airflow to the charger. Stopping the air flow to the charger permits the bolt to go forward, chambering the round.

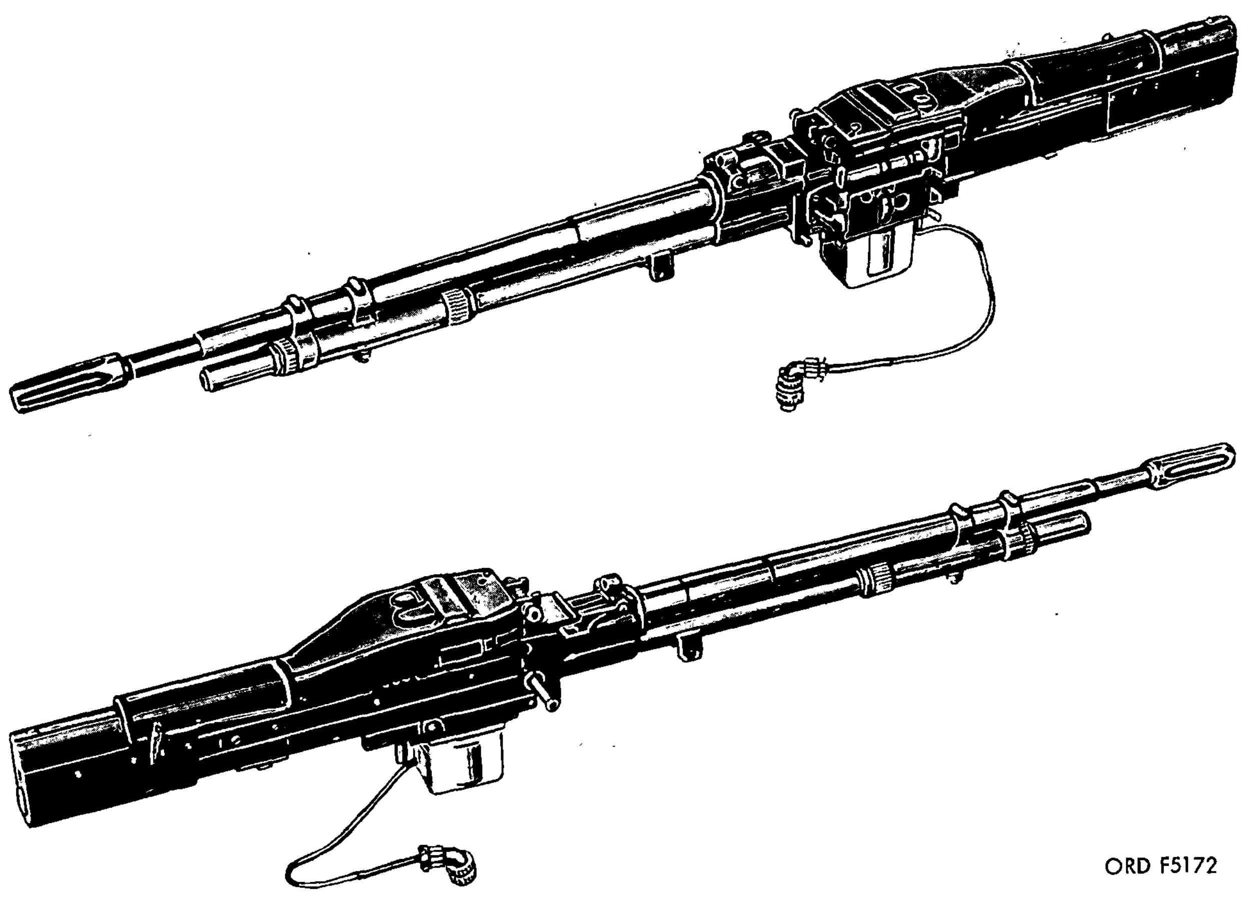


Figure C–4. M60C machinegun.

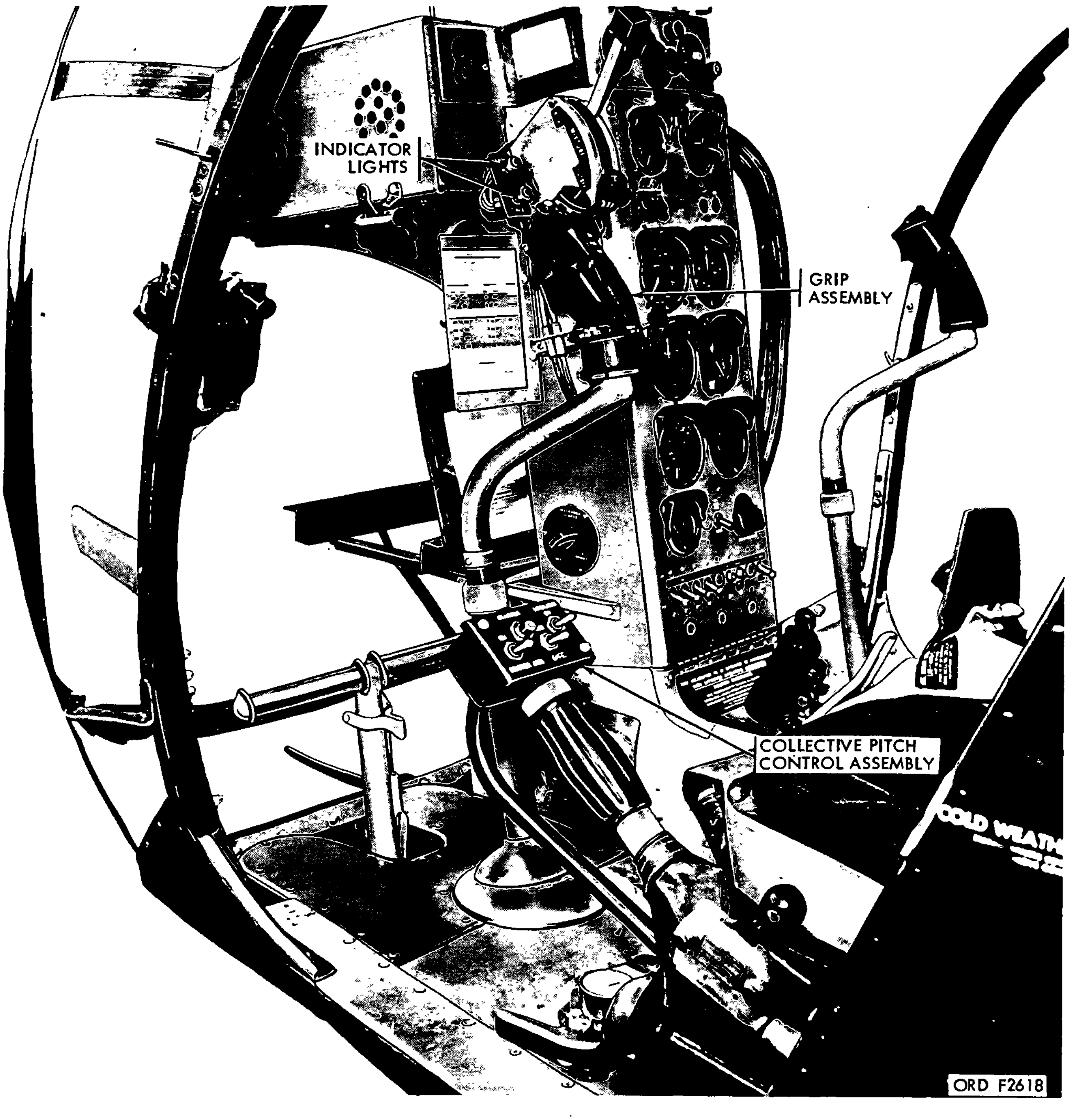


Figure C–5. Location of armament subsystem M2 controls in OH–13 cockpit.

(1) *ARM and SAFE indicator lights.* The ARM (red) and SAFE (green) indicator lights (figs. C–5 and C–6) are mounted on the upper left side of the control console.

(2) *ARM/SAFE switch.* The ARM/SAFE switch (fig. C–7) is located in the center of the control box mounted on the collective pitch control.

(*a*) When the ARM/SAFE switch is in the ARM position, power is furnished to the ARM light, to the gun trigger switch on the cyclic stick, to the elevation switch, and to the air charger valve.

***Warning:* The ARM/SAFE switch must be in the SAFE or OFF position except when actually firing.**

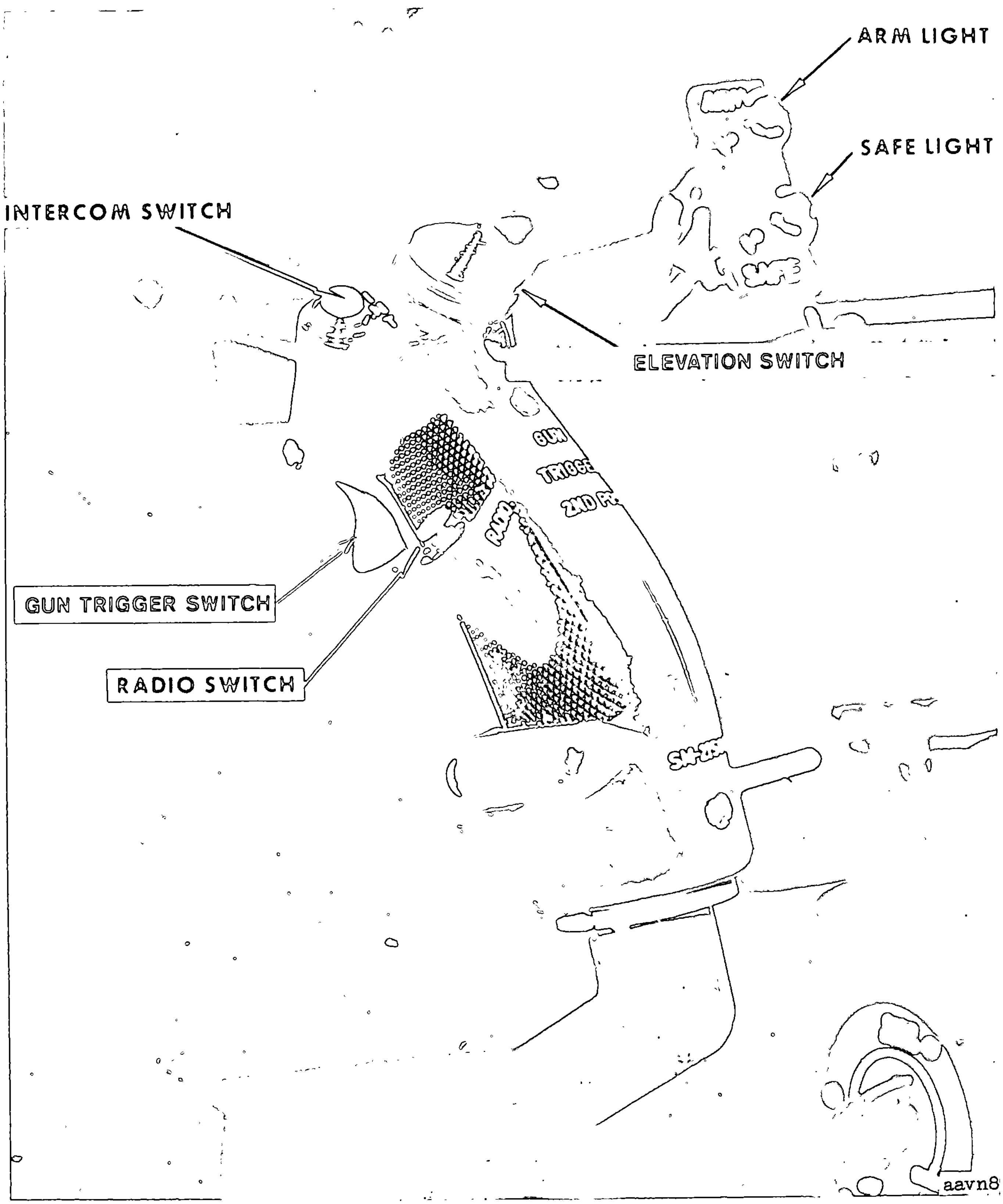


Figure C–6. Cyclic control stick grip assembly and ARM/SAFE lights.

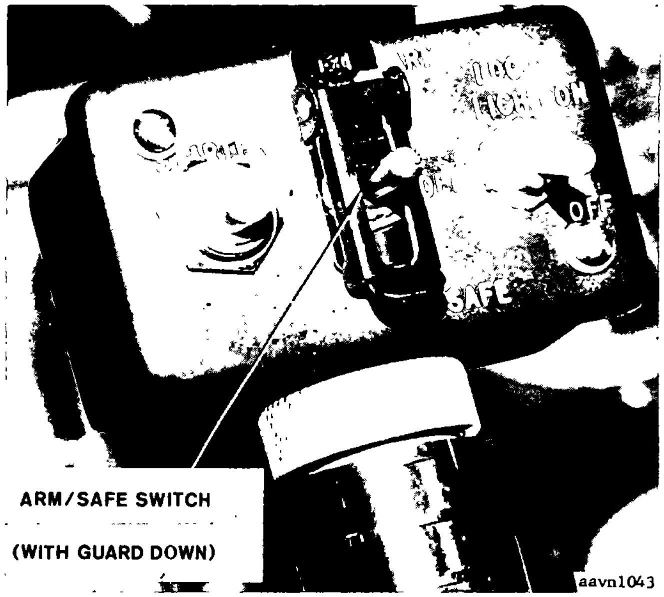


Figure C–7. ARM/SAFE switch.

(*b*) When the switch is in the SAFE position, power is furnished to the SAFE light and to the elevation switch on the cyclic stick. The movement breaks the circuit to the air-charger valve and deenergizes it, permitting airflow to the charger and retracting the bolt to the rear (open) position. At this phase, the solenoid-operated latch engages the charger piston to retain the bolt in the rear (safe) position.

(*c*) When the switch is in the OFF position, all power to the armament subsystem is interrupted. The bolt will remain in the rear (safe) position.

(3) *Elevation switch.* The elevation switch (fig. C–6) is located on the top forward portion of the grip assembly of the cyclic stick.

(4) *Gun trigger switch.* The gun trigger switch (fig. C–6) is located on the top forward portion of the grip assembly of the cyclic stick. Firing is accomplished by depressing the gun trigger switch which actuates the firing solenoids on both weapons. Releasing the gun trigger switch deactivates the solenoids and stops fire of the guns. (This switch was previously the intercom transmit switch.)

C–5. Preparation for Loading

Prior to loading machineguns, check for the following:

a. Valve assemblies of pneumatic charger bottles—open.

b. Bolts of machineguns held in rear position by extended pneumatic cylinder assembly pistons.

c. Guns are elevated to maximum position or barrels are removed to provide clearance for loading (or unloading) the ammunition.

***Warning:* Before removing gun barrels, take the necessary precautions if the barrels are hot from firing.**

d. Helicopter master battery switch—OFF.

e. ARM/SAFE switch—OFF.

f. Warning lights—out.

C–6. Loading

Pull ammunition box cover latches to the front and remove covers from ammunition boxes. Insert end link plug in the single loop at the end of each ammunition belt. Fold a full complement of ammunition into the boxes with single-link end first and the projectile pointing to the left (figs. C–8 and C–9). Place double-link end of ammunition belts over roller and insert into the feed chutes in the front of the ammunition boxes and guide through chutes up to the machineguns. Replace covers on ammunition boxes. Replace barrels if removed. Rotate cover latch levers and raise covers on machineguns. Place leading rounds on the feed trays (fig. C–10) and position over belt holding pawls. Hold in position and close covers of the machineguns.

Note. A full complement of ammunition for each gun is a 550-round belt.

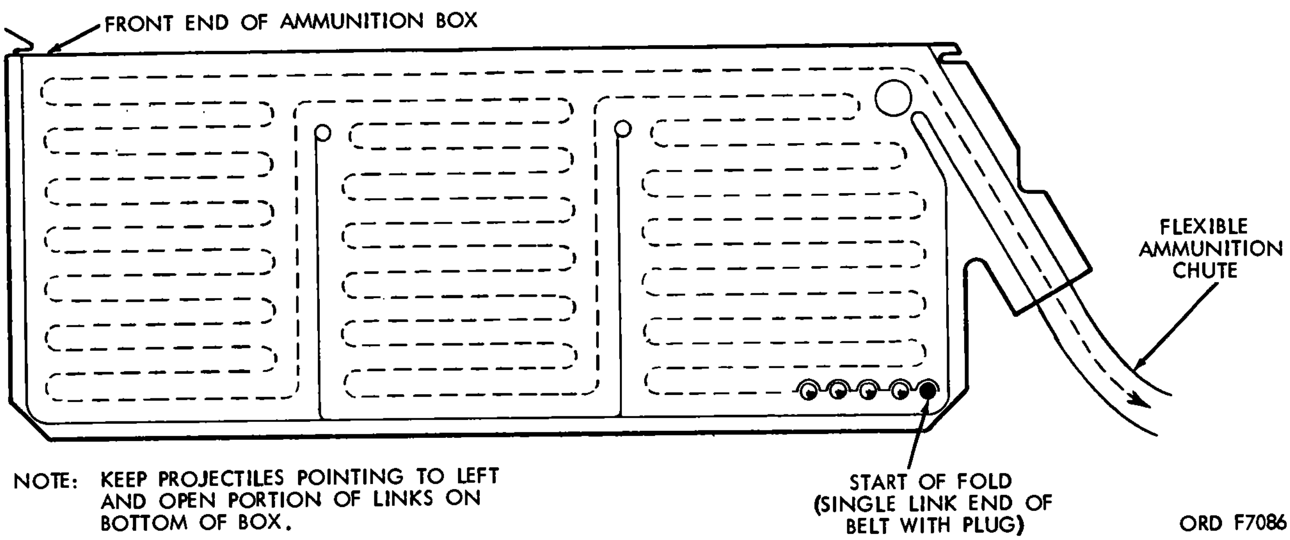


Figure C–8. Schematic drawing of ammunition belt "folded" into the ammunition box assembly.

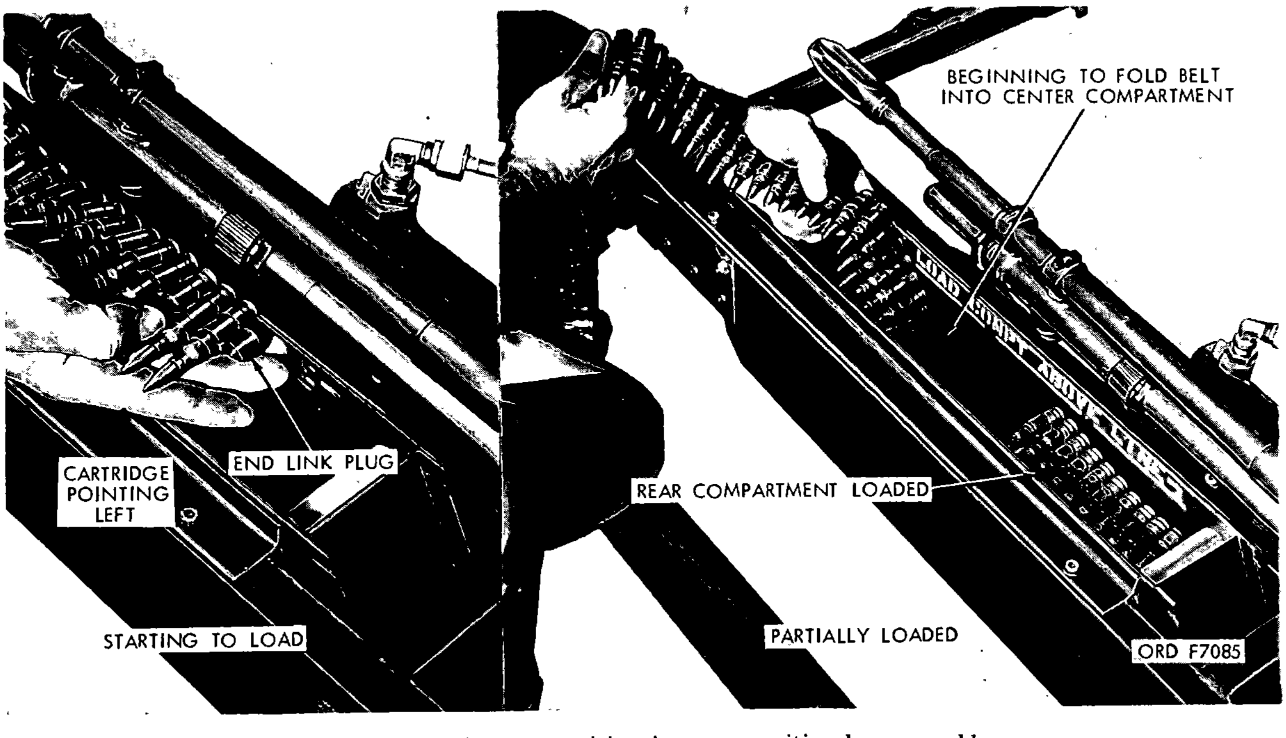


Figure C–9. Loading ammunition into ammunition box assembly.

C–7. Unloading

Prior to unloading, insure that conditions exist as listed in paragraph C–5.

a. Rotate cover latch levers, raise covers on machineguns, and remove unused ammunition from machineguns.

b. Check to make sure no rounds are in the weapon and close cover assemblies of machineguns.

Caution: **Bolt assemblies must be in rearward position before closing cover assemblies.**

c. Remove unused ammunition from the ammunition chutes and boxes.

d. Turn pneumatic valves on charger bottles clockwise to the CLOSED position.

e. Release pneumatic pressure in each cylinder assembly and rubber hose by simultaneously actuating release plunger of the pneumatic valve as-

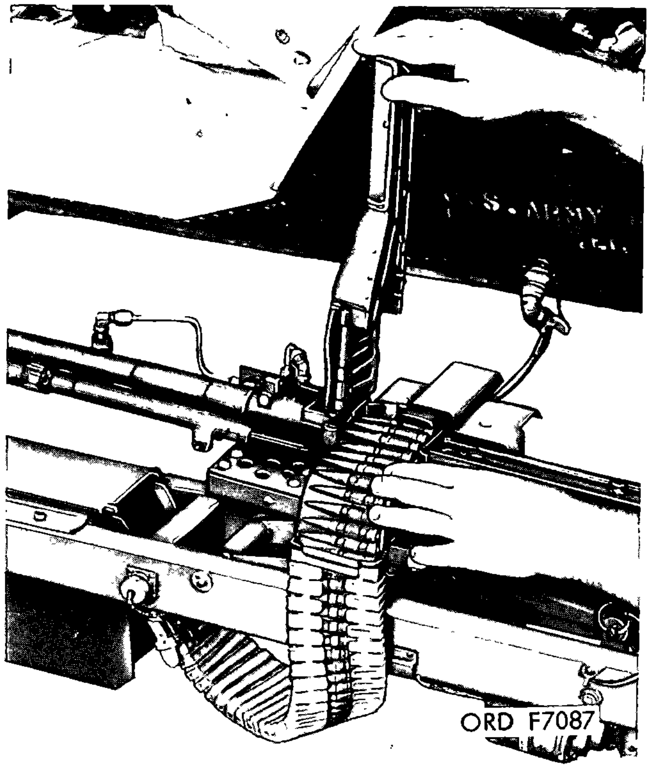


Figure C–10. Positioning leading rounds of ammunition belt in machinegun.

sembly and plunger disk in bottom of firing actuator solenoid and cable assembly. Actuate until presure is exhausted and bolts are in forward position.

C–8. Stoppage

A *stoppage* is any inadvertent interruption or failure of an armament weapons subsystem. The most common types of stoppages with the 7.62mm machineguns are—

a. Failure to feed.

b. Failure to eject.

C–9. Malfunctions

A *malfunction* is any failure (stoppage) of the armament subsystem M2 that cannot be remedied while in flight. (For corrective actions, see TM 9–1005–247–12.) Common malfunctions are—

a. Failure to eject.

b. Failure to charge.

C–10. Immediate Action

Immediate action is the prompt action taken by the gunner to reduce a stoppage without investigating the cause. It is applied as soon as a stoppage occurs.

C–11. Action to Eliminate In-Flight Stoppage

If a gun stoppage occurs during flight, the ARM/SAFE switch is moved to the SAFE position, then back to the ARM position. This action (a charge cycle) will extract the unfired round and recock the machinegun. The SAFE position is maintained for 1 or 2 seconds to allow the charging system to function. The aviator can then continue firing.

C–12. Action in Case of an In-Flight Malfunction

If a malfunction occurs (except a runaway gun), no corrective action can be taken during flight. In the event of a runaway gun, the ARM/SAFE switch should be moved to the SAFE position. This action will interrupt the electrical circuit and *may* stop the firing. In the event this corrective action fails to produce the desired results, the aviator must decide whether to continue the mission with nonfiring or malfunctioning guns, to touch down in the area of operation for corrective action, or to return to the unit maintenance facility for repair.

C–13. Preventive Maintenance

Preventive maintenance consists of preflight, postflight, daily, weekly, bimonthly, and semi-annual inspections performed by the helicopter crew. For detailed instructions, see TM 9–1005–247–12.

C–14. Preflight

The helicopter crew will check the weapon system as outlined below to insure that all controls are functioning properly and that the system is in operational readiness.

a. Outside Cabin.

(1) Check mounting pins of guns and mount assemblies for proper installation.

(2) Check electrical and pneumatic connections.

(3) Check indicators on air bottles to insure that they contain sufficient air pressure.

(4) Open charger bottle valves to retract bolts on guns.

(5) Remove barrels from guns and open covers.

(6) Inspect chambers for dirt, oil, or foreign matter.

(7) Run a cloth patch through bores of guns.

(8) Replace gun barrels.

(9) Close machinegun covers.

(10) Release bolts by moving ARM/SAFE switch to the ARM position.

(11) Open valves on air bottles (bolts will move to rear SAFE position).

b. Inside Cabin.

(1) Move the ARM/SAFE switch to SAFE (green SAFE indicator light will go on).

(2) Operate elevation switch and observe whether guns elevate and depress to their full limits of travel. Leave guns in elevated positions.

(3) Move the ARM/SAFE switch to ARM (red ARM light will go on and the cocking handle will move forward).

(4) Dry fire guns by depressing gun trigger switch on the cyclic control stick.

(5) Move ARM/SAFE switch to SAFE (bolts will move to retracted (rear) position).

(6) Move ARM/SAFE switch to OFF (all power to the armament subsystem is off).

c. Loading Machinegun. Prior to loading the machinegun, the crew chief will check to make sure the conditions listed in paragraph C–5 exist. The guns are then loaded following the procedures outlined in paragraph C–6.

***Warning:* Keep clear of the pins and charger hooks as bolts retract to the SAFE position.**

C–15. Pilot Checklist

A recommended pilot checklist is shown below.

a. Exterior.

(1) Check mounting pins for proper installation.

(2) Check electrical connections.

(3) Check airhose connection to air bottles.

(4) Check pneumatic valves for open position, machinegun bolts to the rear, and indicators on bottles for sufficient pressure.

(5) Check ammunition for desired load.

(6) Check ammunition for proper loading.

b. Interior.

(1) ARM/SAFE switch—OFF.

(2) Indicator lights—OFF.

c. In-Flight Firing Sequence.

(1) ARM/SAFE switch—SAFE.

(2) SAFE light—on.

(3) ARM/SAFE switch—ARM

(4) SAFE light—off.

(5) ARM light—on.

d. Safetying Machinegun.

(1) ARM/SAFE switch—SAFE.

(2) SAFE light— on.

(3) ARM light—off.

Note. Before debarking from the helicopter, visually insure that gun bolts are in the retracted position.

C–16. Postflight

Prior to unloading, the crew chief must insure that the conditions listed in paragraph C–5 exist. The guns are then unloaded following the procedures outlined in paragraph C–7.

Section II. M6 ARMAMENT SUBSYSTEM

C–17. Capabilities

The helicopter armament subsystem, M6 series, provides the helicopter with a neutralization fire capability. The weapons subsystem—

a. Provides an immediately responsible and highly mobile means of delivering offensive or defensive area fires against ground troops in the open or in unprepared positions, lightly armored vehicles, and other soft material targets.

b. Has a high degree of accuracy when all four guns are boresighted or harmonized to converge at ranges of 700 to 750 meters.

c. Is capable of operating within a speed range of 0 to 160 knots.

d. Will function satisfactorily in all normal helicopter positions or attitudes.

e. Can be operated in all tactical environmental conditions in which the helicopter can operate.

f. Can be detached quickly from the helicopter and transported by Army utility aircraft or by motor vehicle.

C-18. Limitations

The M6 series armament subsystem is vulnerable to all types of air defense fires, including small arms, and has the following limitations:

a. Effectiveness of operation is reduced at night and during periods of low visibility due to limitations in target acquisition and range estimation.

b. Engagement of targets is limited by functions of gun-target range, altitude, airspeed, and helicopter degree of bank as they relate to the subsystem's flexible limitations.

c. The copilot-gunner can fire the subsystem from either the stow or flexible position while the pilot-gunner can only fire the subsystem from the stow position.

***Warning*: Extreme caution must be exercised when firing from the UH-1 on the ground. The guns are located behind the cargo doors and occupants must not leave or enter the helicopter in front of loaded guns. Remove gun barrels before entering or leaving the helicopter.**

C-19. Description

The quad 7.62mm machinegun helicopter armament subsystem, M6 series (fig. C-11), is a flexible subsystem that has a stowed position capability for standby or emergency use. It consists basically of a control panel, two power-operated flexible gun mounts, four M60C machineguns, an ammunition supply, and a sighting station.

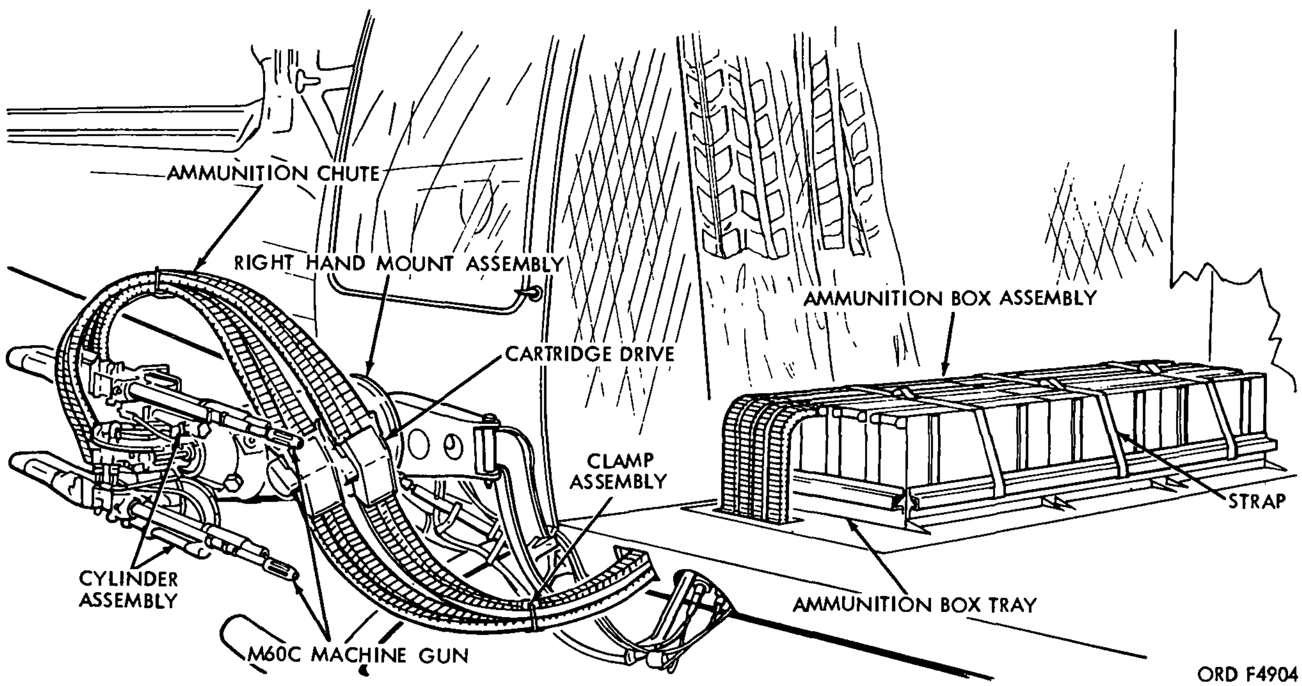


Figure C-11. Components of armament subsystem M6 installed on UH-1B/C helicopter—right side shown.

a. Control Panel. The control panel (fig. C-12) is mounted to the right of the gunner's station (copilot's seat) in the helicopter pedestal console. The face of the panel contains the OFF-SAFE-ARMED switch, the GUN SELECTOR switch, the ARMED/SAFE indicator lights, stow variable resistors, and two panel edge lights.

(1) *OFF-SAFE-ARMED* switch. When the OFF-SAFE-ARMED switch (fig. C-12) is moved to the SAFE position, 28 volts DC power is applied to the subsystem. By means of zener diodes, part of the 28-volt power is reduced and regulated within narrow limits to provide a stabilized voltage of 28 volts DC to the servo valves, followup variable resistors, command variable resistors, stow variable resistors, and the servo amplifier components. Simultaneously, unregulated 28-volt power is applied to the stow lock-release solenoids, making manual gun mount movement possible. Hydraulic power is also made

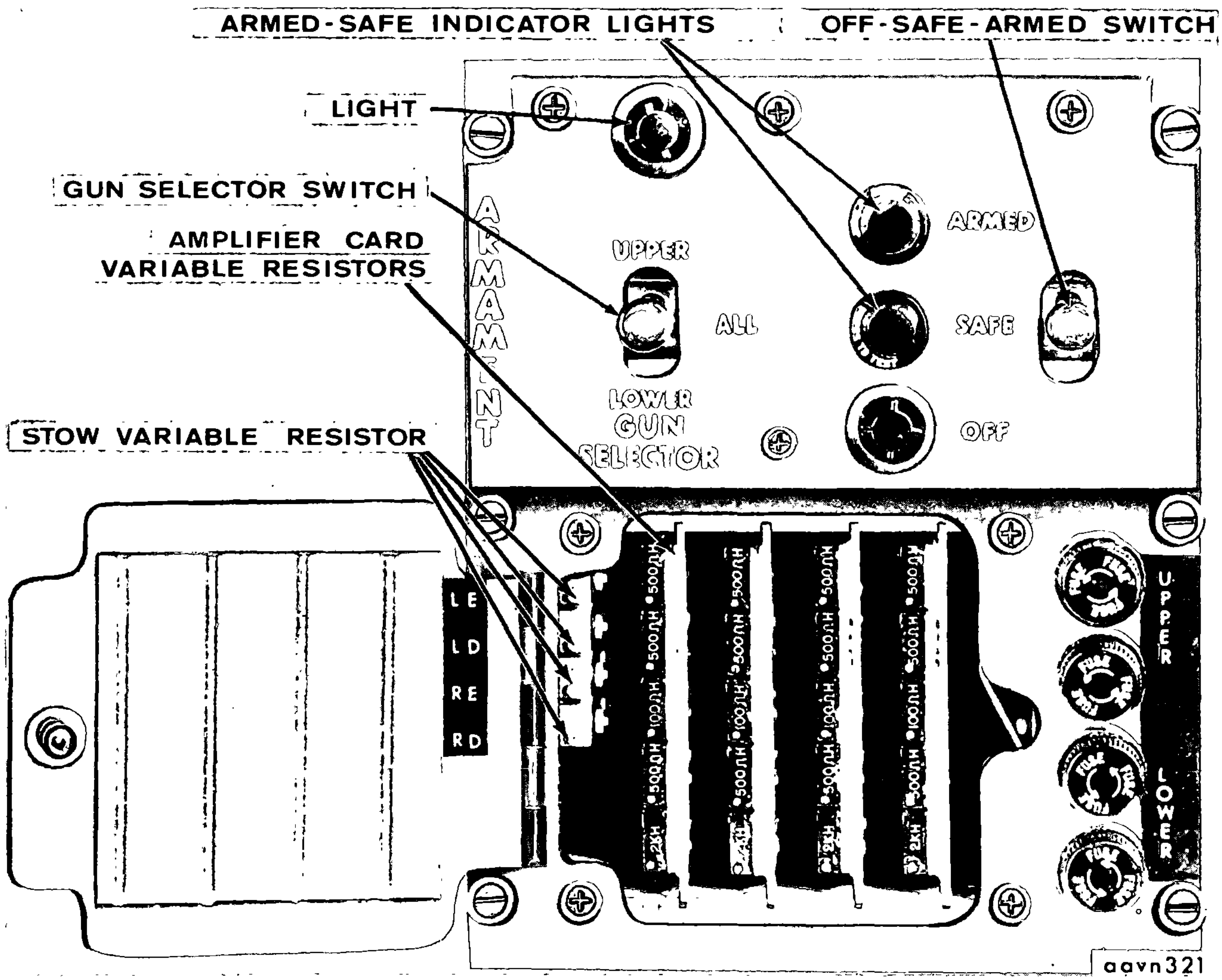


Figure C-12. Control panel.

available by energizing the hydraulic power shutoff valve to the helicopter supply.

(*a*) When the OFF-SAFE-ARMED switch is moved to the ARMED position, the charger control valves and charger lock-release solenoids are energized, making the cylinder assemblies (chargers) (*b*(1) below) ready to allow firing. Any time the charger control valves are deenergized, the cylinder assemblies actuate to the aft position, holding the guns "out-of-battery" or SAFE.

(*b*) When the OFF-SAFE-ARMED switch is moved to the ARMED position and the action switch is depressed, the motion of the gun mount assemblies will follow the sighting station commands.

(2) *GUN SELECTOR switch.* The firepower of the subsystem is controlled by the GUN SELECTOR switch (fig. C-12). This switch permits selection of the upper guns of each mount, the lower guns, or all guns if maximum firepower is desired.

(3) *ARMED and SAFE indicator lights* (fig. C-12). The green SAFE indicator light illuminates when electric and hydraulic power are applied to the subsystem and the OFF-SAFE-ARMED switch is moved to SAFE. This light indicates that cylinder assembly pistons have retracted machinegun bolts to the "out-of-battery" position and are holding the bolts there. The red ARMED indicator light illuminates when electric and hydraulic power are applied to the subsystem and the OFF-SAFE-ARMED switch is moved to ARMED. This light indicates that machinegun bolts are in "out-of-battery" position but that cylinder assembly pistons have retracted and are no longer holding bolts out of battery. For night

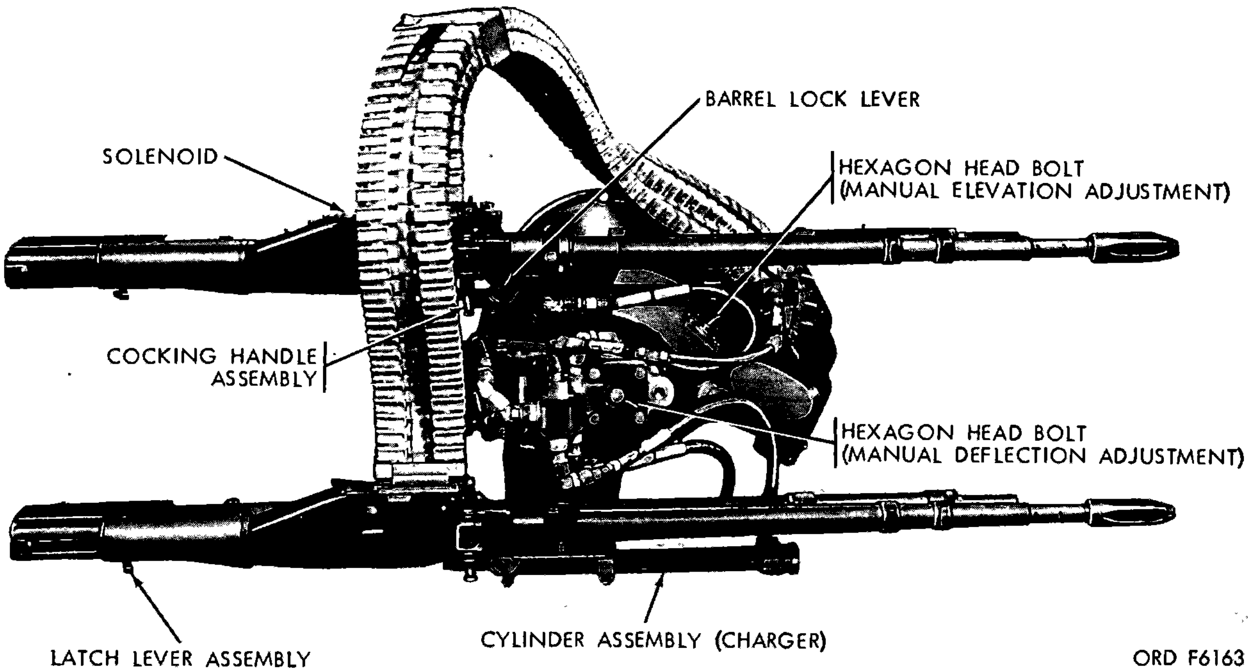


Figure C–13. Machineguns and mount assembly.

operations, the cap of each indicator light can be turned to regulate the intensity of light emitted.

b. Flexible Gun Mounts. The two flexible gun mounts provide support for four M60C (7.62mm) machineguns and the necessary mechanisms to position them as directed by the gunner (*f* below and fig. C–23). These gun mounts are installed on each side of the helicopter and each mount supports two machineguns (fig. C–13). The guns are mounted on their sides, one above the other. Ammunition is fed into the guns from above, and the spent cases and links are ejected downward, away from the helicopter. Each gun is attached to the gun mount by a quick-release latch which is an integral part of the deflection drive output shaft. The quick-release latch fastens to the tripod pintle mounting pins provided at the balance point of the M60C machinegun.

(1) *Cylinder assemblies (chargers).* The cylinder assemblies (chargers) (fig. C–13) are hydraulically operated, double-action cylinders which mechanize the manual cocking and charging action of the 7.62mm machineguns M60C. The cylinder assemblies are bolted to the mount assemblies forward of the cocking handle assembly. The end of each cylinder assembly piston is locked onto the gun-cocking handle assembly by a spring-loaded latch. A ball lock detent actuated by the piston is used to lock the cylinder assembly (and thus the gun) in the "out-of-battery" position.

(*a*) *OFF-SAFE-ARMED switch in SAFE position.* With the helicopter running, the master (battery) switch in the ON position, M6 circuit breakers engaged, and the OFF-SAFE-ARMED switch in the SAFE position, hydraulic pressure is applied at both sides of the piston within the cylinder assembly, one side having a greater area than the other. The resulting differential force drives the piston and the cocking handle assembly to the "out-of-battery" position. In this position, the ball lock detent engages the cylinder body, and the cylinder assembly piston is locked "out-of-battery." Simultaneously, the sear engages the sear notch on the operating rod and the bolt assembly is locked "out-of-battery." The ball-type detent lock may be manually released (with gun removed) by depressing the plunger, located centrally in the end of the piston. The piston may then be pushed forward to "battery" position.

(*b*) *OFF-SAFE-ARMED switch in ARMED position.* When the OFF-SAFE-ARMED switch is moved to the ARMED position, the solenoid valve located within the pylon is energized. This relieves the hydraulic pressure from one end of the cylinder assembly. The piston then returns to the "battery" position, carrying with it the cocking handle assembly on the gun; the bolt assembly remains in the "out-of-battery" position until the trigger switch is depressed.

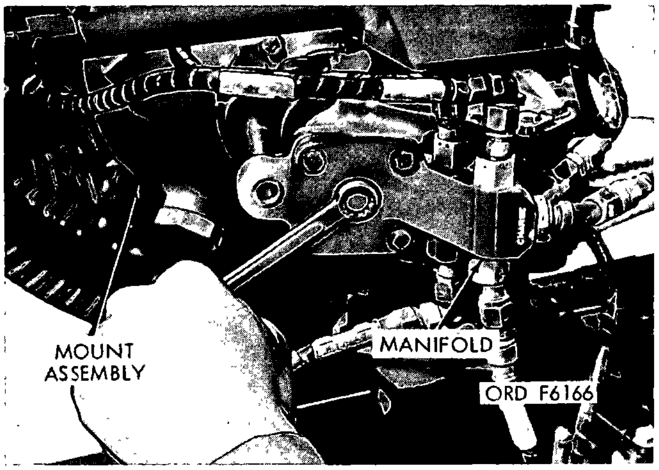


Figure C–14. Manually adjusting mount assembly in deflection.

(2) *Manual deflection adjustment.* Manual adjustment of the mount assembly, in either left or right deflection, may be accomplished (with electrical power on, hydraulic power off) by turning the hexagon-head bolt clockwise or counterclockwise (fig. C–14).

(3) *Manual elevation adjustment.* Manual adjustment of the mount assembly, in either elevation or depression, may be accomplished (with electrical power on or off, hydraulic power must be off) by turning the hexagon-head bolt clockwise or counterclockwise (fig. C–15).

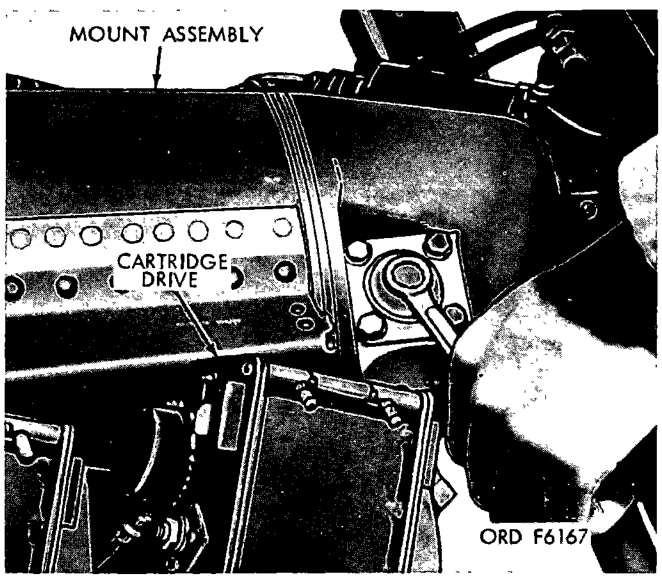


Figure C–15. Manually adjusting mount assembly in elevation.

(4) *Deflection variable resistor.* The mount assembly may be alined in deflection with the sighting station by rotating the slotted screw at the base of the deflection variable resistor (fig. C–16) either clockwise or counterclockwise too adjust the worm and pinion on the variable resistor for left and right deflection.

(5) *Elevation variable resistor.* The mount assembly variable resistor is located in the mount assembly and may be reached by removing a plug on top of the mount assembly (fig. C–17). A 3/16-inch socket-head screw key is required to adjust the worm and pinion on the variable resistor to aline the mount assembly in elevation with the sighting station (fig. C–18).

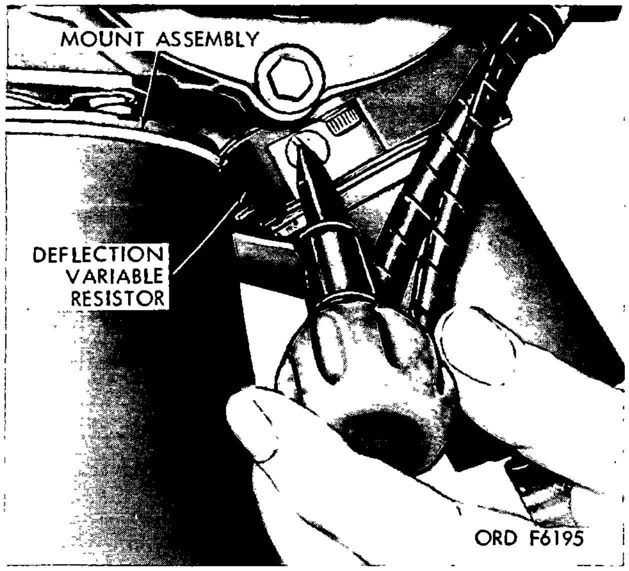


Figure C-16. Adjusting deflection variable resistor.

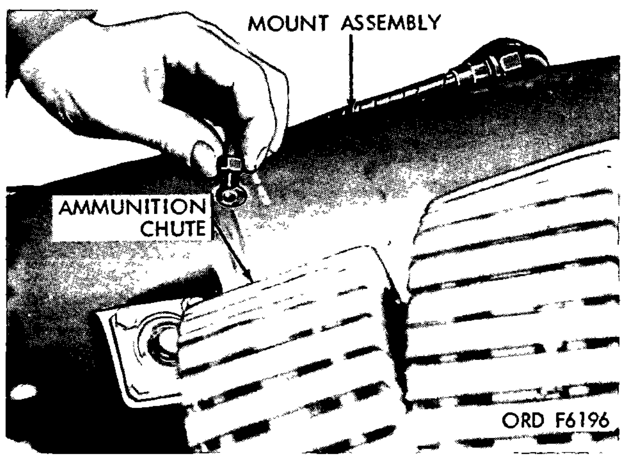


Figure C-17. Installing or removing variable resistor plug.

(6) *Power supply.* Hydraulic motors drive both axes of the mount through gear reductions. Power for the hydraulic drive motors is supplied directly from the helicopter's hydraulic pressure system of 1,000 $\pm$ 50 psi. Electrical power is supplied directly from the helicopter's 28-volt generator.

***Caution:* Loss of hydraulic fluid from either flexible gun mount indicates that the weapons system must be shut off immediately to prevent complete hydraulic failure in the helicopter.**

(7) *Pylons.* A sheet metal pylon is bolted to the base of the elevation drive housing to cover the two hydraulic motors and their control valves and piping. The gun charger valves are also located in the pylon. The opposite end of the pylon has a mounting flange for attaching the gun mount to the helicopter.

(8) *Pylon mounting.* A supporting hinge, half of which is fastened to the pylon and the other half to the helicopter mounting ring, is provided to facilitate installation and servicing. The supporting hinge and bolt pattern permit the pylon to be mounted on the helicopter in only one position.

(9) *Deflection stops.* Both gun mount axes contain positive mechanical stops which prevent motion of the guns beyond safe limits (*f*, *g*, and *h* below).

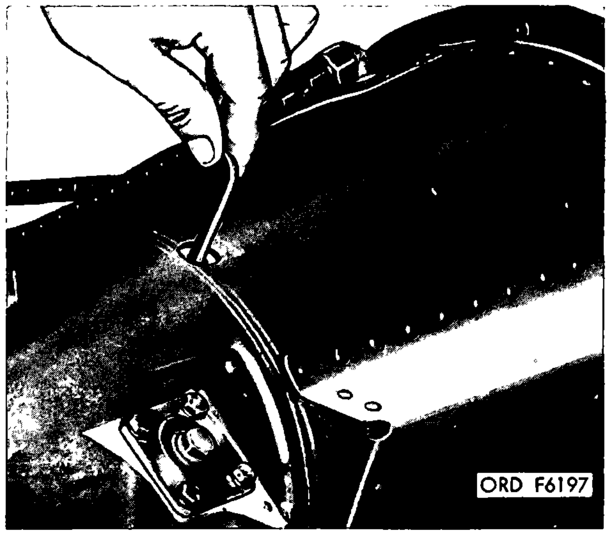


Figure C–18. Adjusting elevation variable resistor.

c. Machineguns.

(1) *Modification of M60 machineguns to M60C machineguns.* The M60 machineguns are modified to M60C machineguns for adaptation to the M6 series subsystem as follows:

(*a*) *Parts removed.* Parts removed from the M60 machinegun are—bipod, front sight, rear sight, forearm assembly, carrying handle, trigger housing, trigger assembly, trigger safety, trigger hinge pin, feed tray, butt stock, safety spring, and safety plunger.

(*b*) *Parts added.* Parts added to the M60 machinegun are—deflector, solenoid, clinching rim flange with one bolt and locking wire, solenoid housing, feed tray (modified), and back plate assembly.

(2) *Controls.* Machinegun controls are the—

(*a*) *Barrel lock lever.* The barrel lock lever (fig. C–13) is located on the right front end of the receiver. The lever is secured to the barrel locking shaft and rotates the shaft to lock or unlock the barrel. When pressed forward, the lever unlocks the barrel; when pressed rearward, it locks the barrel. However, to prevent the barrel lock from vibrating into an unlocked position, a locking plate should be positioned in the dovetail rear sight base of each machinegun (fig. C–19). The barrel lock lever plate can be made from sheet metal using the dimensions shown in figure C–19.

(*b*) *Cocking handle assembly.* The cocking handle assembly (fig. C–13) is located between the gun cover and firing actuator assembly. When connected to the cylinder assembly (charger) piston, the cocking handle assembly is extended or retracted by the hydraulically actuated piston. The cocking handle assembly is also used to charge the weapon manually. When the handle is pulled to the rear, the bolt is in the cocked or "out-of-battery" position.

(*c*) *Latch lever assembly.* The latch lever assembly (fig. C–13) is located at the right rear end of the feed cover. It actuates the cover latch which is spring-loaded, and secures the cover in the closed position. When the lever is vertical, it is in the locked position; turning the lever counterclockwise to the rear or horizontal position unlocks the cover.

(*d*) *Solenoid.* The solenoid (fig. C–13) is a springloaded sear rocker arm. One side of the rocker arm bears on the solenoid operating rod; the other side is spring-loaded against the solenoid action, and engages the sear notch on the gun operating arm. When the OFF-SAFE-ARMED switch is in the ARMED position and the trigger switch and action switch are depressed, an electrical impulse is supplied to the solenoid. The solenoid then actuates the sear. This in turn allows the operating rod and bolt to be driven forward by the operating spring. The firing pin then strikes the primer and fires the machinegun. For further details concerning the operation of the machinegun, see FM 23–67 and TM 9–1005–243–12.

d. Ammunition Supply. All types of conventional 7.62mm ammunition using a disintegrating linked belt can be used with this subsystem. The number of ammunition boxes used on the UH–1B/C helicopter is 12 (three ammunition boxes for each gun).

(1) *Ammunition boxes.* The sheet metal ammunition boxes are divided into three compartments having a total capacity of approximately 500 rounds per box. Flexible ammunition chutes

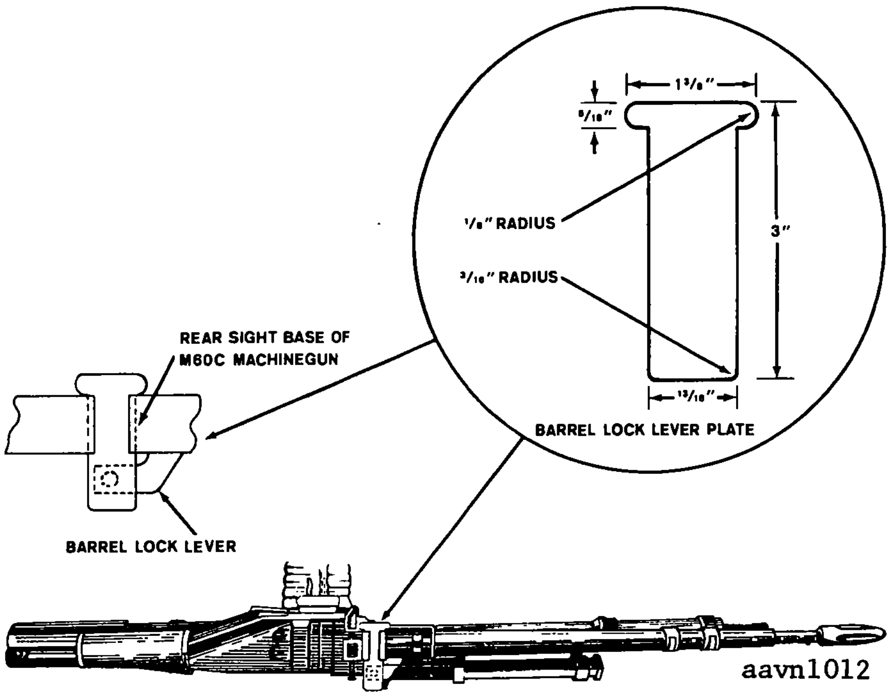


Figure C–19. Barrel lock lever plate (in locked position).

connect the boxes to the guns. Cartridge drives pull the ammunition from the boxes to the cartridge drives and aid in transporting the ammunition from the cartridge drives to the guns.

(2) *M6 installation.* In the M6 installation for the UH–1B/C helicopter, 12 boxes of ammunition are placed into the ammunition box tray located under the seat in the aft cargo compartment. These boxes are arranged three in a row and four rows deep (fig. C–20). The gun feed end is to the left for rows one and two and to the right for rows three and four. Rows one and two are separated to allow the seat supports to fit between the boxes. The boxes are locked together by means of channel sections containing right-angle slots. The channel sections are inserted from above, between each row of boxes. The channel slots are inserted over the pins protruding from the sides of the boxes, and then moved slightly crosswise to lock in place. After all boxes are locked together, the complement of ammunition is held in place by straps fastened to the cargo tiedown points. Four of the eight sections of flexible ammunition chutes lead from the boxes through holes in the cargo deck to the cartridge drive motors; the other four sections of chutes lead from the drive motors to the guns. The total ammunition capacity of the 12 ammunition boxes is 6,000 rounds. An additional 700 rounds may be loaded into the ammunition chutes, making a total complement of 6,700 rounds.

(3) *Cartridge drives.* The cartridge drives (fig. C–29), mounted on the forward side of the gun mount pylon, pull the ammunition from the boxes through the chuting and feed it to the guns. The cartridge drive consists of a small direct current motor assembly which turns a sprocket through a spur drive gear. The drive motor assembly includes a transistorized series-type current limiter. For all normal modes of operation, the limiter allows nearly all of the supply voltage to be transmitted to the motor. It also reduces the voltage transmitted under stall or abnormal load conditions. This limiting action prevents the excessive and destructive flow of current in the armature windings which would otherwise occur under stalled-motor conditions. The cartridge drives are energized if a particular gun is selected and the trigger switch or either auxiliary trigger switch (para C–20) is depressed. Also, each cartridge drive will operate by depressing the cartridge drive push switch (para C–20*b*(7) and fig. C–21). This push switch is used primarily to feed ammunition to the gun tray during loading operations.

e. Sighting Station Description. The sighting station (fig. C–22) provides the gunner with the means of remotely directing and firing the guns. The sighting station is composed of two major elements—the *suspension linkage* and the *controller.*

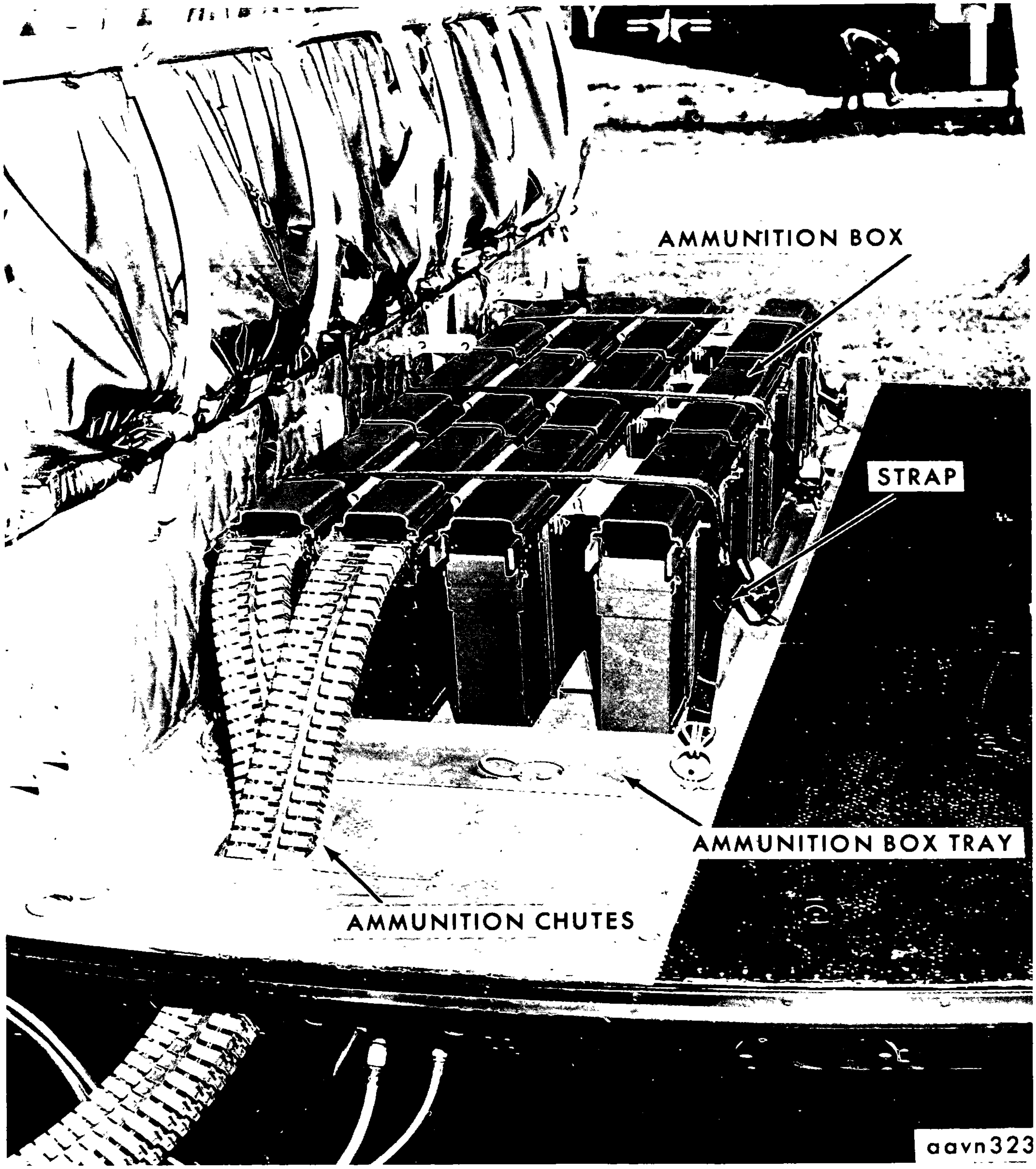


Figure C-20. UH-1B/C ammunition boxes.

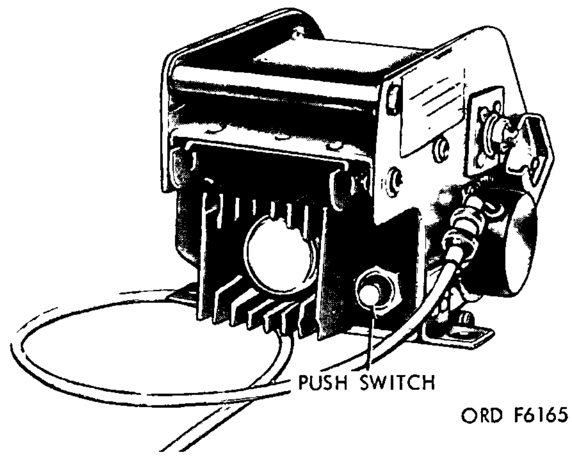


Figure C–21. Cartridge drive push switch.

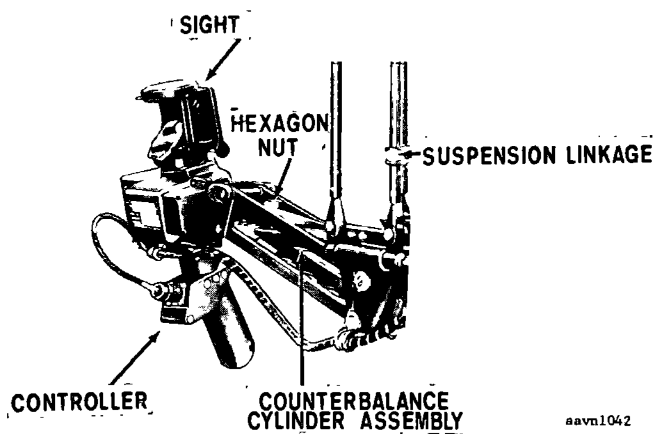


Figure C–22. Sighting station.

(1) *Suspension linkage.* The suspension linkage is a space parallelogram arrangement which supports the controller from the ceiling of the helicopter and provides a means for sighting and aiming the controller around cockpit obstructions without impairing the reference planes of the axes. (Parallax generated by moving the controller in this manner is negligible.) One end of the linkage contains the mounting pad, which is bolted to the cockpit overhead. The opposite end of the linkage is bolted to one end of the elevation drive shaft which runs horizontally through the controller.

(2) *Controller.* The axis system is the same elevation-deflection system as the gun mount, so that the correct relationship between controller and gun mount may be maintained throughout the field of fire. When not in use, the controller

and horizontal support linkage are stowed out of the way by moving the controller into the suspension linkage. A detent lock on the end of the counterbalance spring cartridge holds the assembly in this position. The counterbalance spring cartridge supports the controller weight in all positions to reduce operator fatigue. The desired spring tension to sustain the sighting station in a given position is controlled by adjusting a hexagon nut located on the end of the counterbalance cylinder assembly (fig. C–22). To use the controller, the gunner pulls it outward, away from the linkage, by the control handle. The detent is overridden and the controller is ready for use.

f. Elevation and Deflection Limits. The opposite end of the elevation drive shaft is geared to drive the elevation command potentiometers. Bearings support the elevation drive shaft in the controller housing so that the housing will pivot to rotate about the shaft. Through the use of the sighting station (fig. C–22), the gunner may direct the fire of the guns independently of the helicopter attitude. The guns can be elevated* 15°, depressed* 60°, and deflected 12° inboard and 70° outboard (fig. C–23). The sighting station is synchronized to the gun mount axis limitations by providing a mounting surface which is designed and installed with proper relationship to the helicopter vertical and horizontal reference lines.

g. Deflection Axis Shaft. The deflection axis shaft runs vertically through the controller housing. The upper end of the deflection shaft supports the reflex gunsight. A control handle is attached to the lower end of the deflection shaft. The shaft is a hollow tube containing the gunsight reticle lamp. The deflection command potentiometers are geared to the outside of the shaft. Positive stops limit the rotation of the shaft to 70° on either side of the helicopter centerline, corresponding to the 70° outboard stops on the gun mounts.

h. Limits of Motion About the Deflection Axis. Both gun mounts follow the position of the controller, but the limits of motion vary for the two mounts about the deflection axis. When moving the mounts through the field of coverage in deflection, one mount must stop at its inboard limit while the other mount continues its movement outboard. This is accomplished by using two command potentiometers in the controller, one for each mount. These potentiometers are wound to give a fixed position indication of the inboard limit, even if the controller is moved beyond that limit. Therefore, a mount being driven toward the helicopter will stop at the inboard limit and be held in that position even though the controller and the other guns continue to move. Power to the firing solenoids and the cartridge drives of the stalled guns is interrupted by a switch located on the mount, so the guns cease firing when they reach the 12° inboard limits.

* Elevation and depression limits are expressed with reference to a line drawn perpendicular to the centerline of the rotor mast. On the UH–1B/C helicopter, the rotor mast is tilted 6° forward, giving an elevation limit of 9° and a depression limit of 66° with reference to the helicopter level line.

C–20. Subsystem Operation

a. Sighting Station Controls.

(1) *Action switch.* The action switch is located on the forward lower portion of the control handle (fig. C–24), which is geared to optical elements of the sighting station. It provides an electrical connection between the controller unit and the input to elevation and deflection servos in the mount. This switch permits control of the machinegun and mount line of sight by the control handle. After the hydraulic and electrical circuits have been energized by placing the OFF-SAFE-ARMED switch in the ARMED position, the subsystem is ready for operation. Although the control handle may be manipulated by the gunner without depressing the action switch, the guns and mount will remain in the "stowed" position until the action switch is depressed. Also the guns cannot be fired from this station without depressing the action switch before depressing the trigger switch.

(2) *Trigger switch.* The trigger switch (fig. C–24) is located on the forward upper portion of the control handle. When depressed, the trigger switch contacts a spring-loaded detent plunger, energizing the electrical circuit; this in turn actuates the firing solenoid to fire the machinegun(s). To fire the gun(s), the action switch must be depressed before the trigger switch is depressed.

(3) *Control handle.* The control handle (fig. C–24), located directly under and attached to the controller head, is manipulated by the operator to control the movement of the machineguns and mounts through their full limits of travel in deflection and elevation.

(4) *Reticle lamp switch.* This switch, located on the left upper portion of the control handle (fig. C–24), is used to turn the reticle

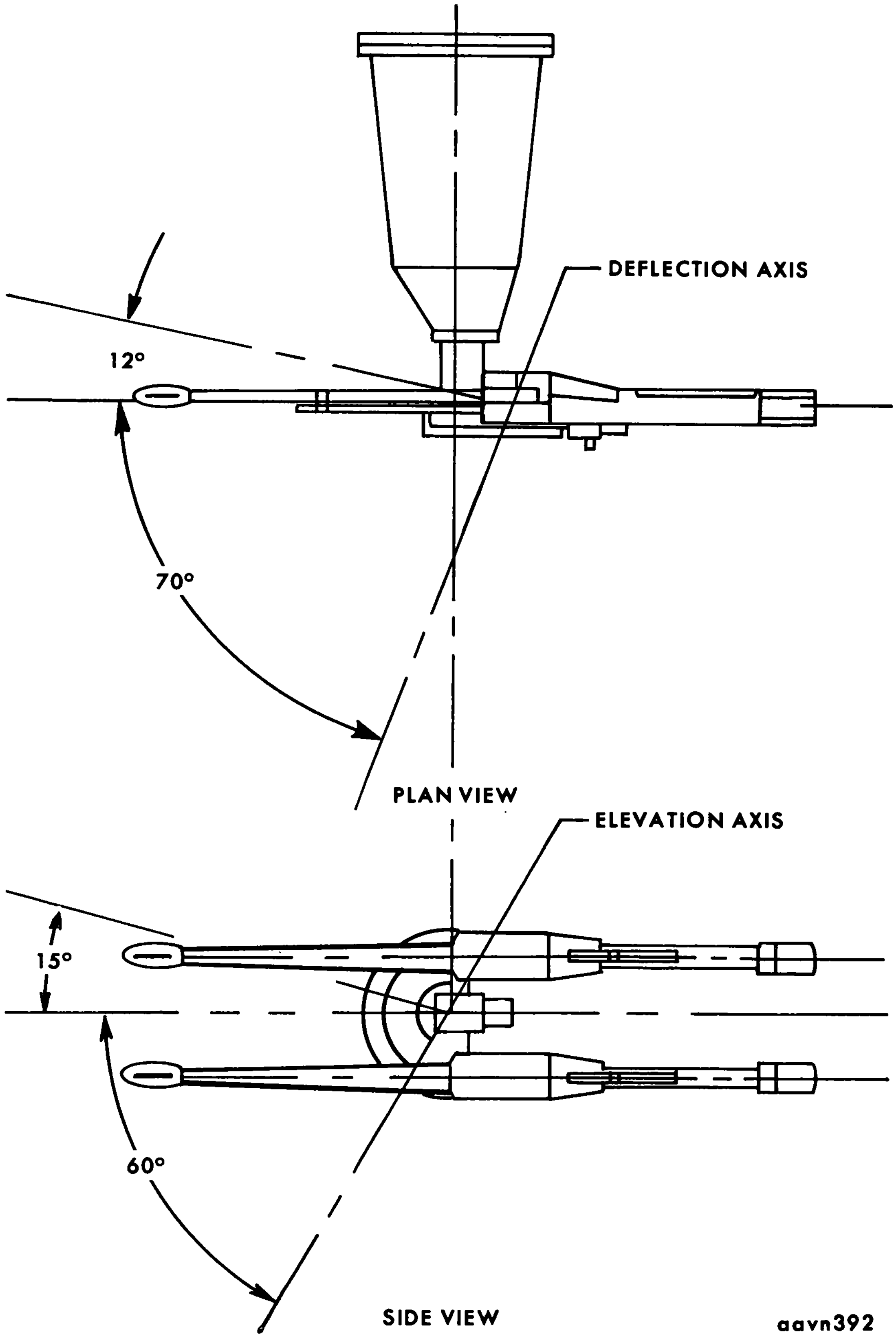


Figure C–23. Elevation and deflection limits.

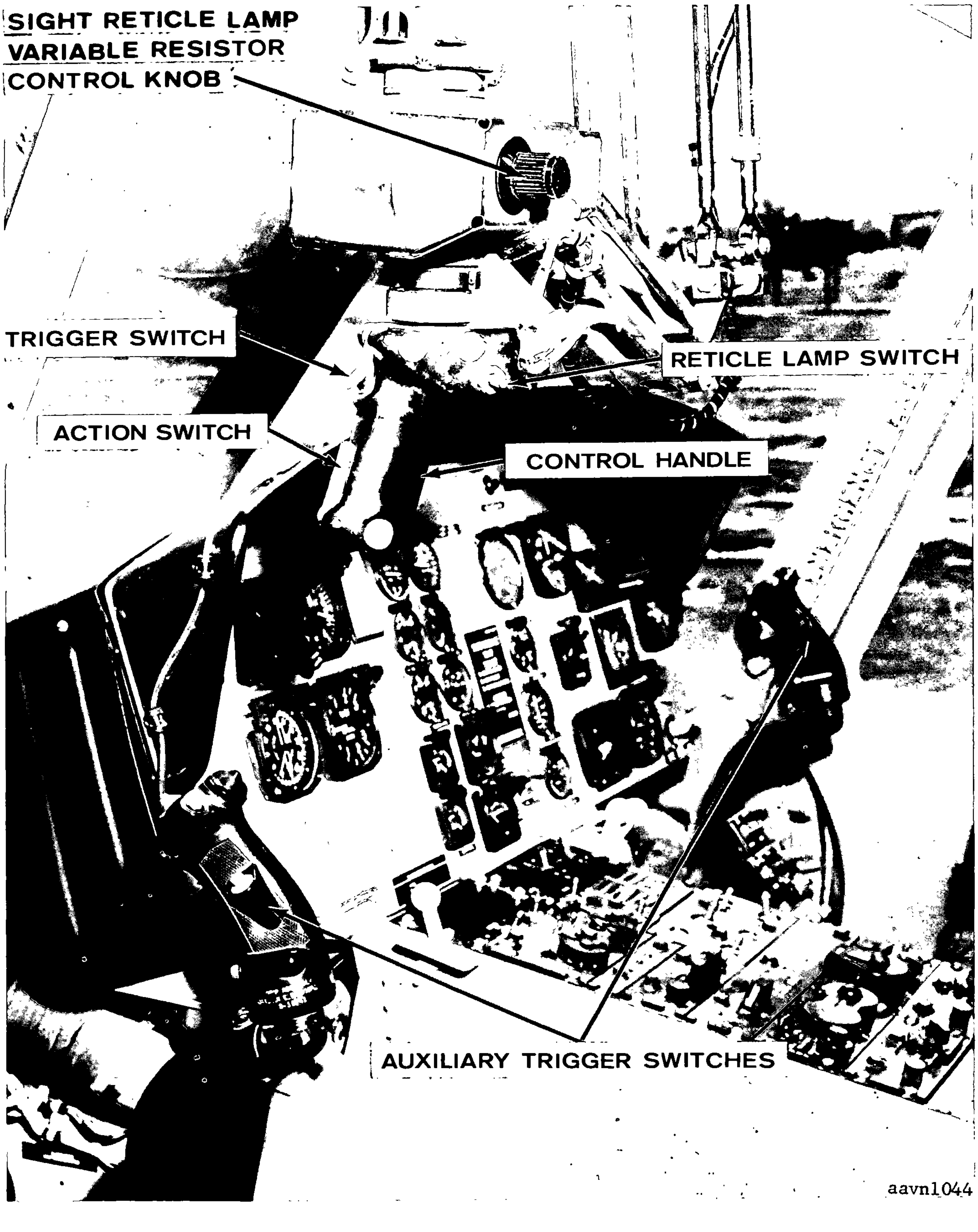


Figure C-24. Helicopter armament controls (sighting station).

lamp on and off. The reticle lamp is a dual filament type lamp, and will light when the switch is moved to either side of the OFF (straight-up) position. The reticle lamp illuminates the reticle pattern in the optical sight head.

(5) *Sight reticle lamp variable resistor.* The sight reticle lamp variable resistor (fig. C-24) is contained in an oblong housing, and is located on the left side of the sighting station below the sight. Reticle illumination may be varied by turning the round knob at the rear of the resistor housing. On the rear of the sight is a colored lens (sunshade) which allows the gunner to clearly see the reticle on bright sunny days.

(6) *Auxiliary trigger switches.* The pilot or copilot may fire the machineguns in the stowed (fixed) position by depressing the auxiliary trigger switches located on the cyclic sticks (fig. C-24). The pilot must maneuver the helicopter to aim the machineguns when the auxiliary trigger switches are used to fire the weapons. These trigger switches can be used only when the action switch is *not* depressed.

b. Loading Ammunition. Improper loading of ammunition is a major cause of stoppages with the M6 series subsystem. The ammunition must be carefully loaded to insure uninterrupted functioning of the guns. The arrangement of ammunition in the boxes will vary slightly for each type helicopter and between pairs of guns on the same helicopter, depending on how the guns are fixed to the mounts and how the chuting is arranged. Regardless of the type helicopter or the side of the helicopter on which the guns are mounted, *the double link end of the belt must be fed into the guns first, with the projectiles pointing forward.* If any confusion arises during loading, the ammunition may be traced back from the guns to determine how it must be placed in the boxes. Loading procedures for the M6 armament subsystem are—

(1) *Inspect for proper linkage.* To insure proper linkage, all ammunition must be inspected before loading. Long or short rounds tend to hang up in the chuting and cause stoppages. Some long and short rounds are found during linking and packing; however, most are found during unpacking and loading because of improper handling of assembled belts. No attempt should be made to assemble ammunition belts in excess of 250 rounds. Handling of longer belts will cause the links to twist and pull until they become distorted and no longer hold the individual rounds firmly, resulting in long or short rounds. These distorted links will also cause stoppages.

(2) *Use an end link plug or adjust trailing link.* The *trailing link* (open single link at the end of the belt)may also cause stoppages. To prevent trailing-link stoppage, an end link plug 1005-994-9647 (figs. C-25 and C-26) is inserted in the trailing link; or, as an alternate method, the trailing link is bent slightly closed with a pair of pliers so that it will hold an additional round of ammunition firmly. When this additional round is inserted in the single link, it will travel freely through the chuting.

(3) *Load ammunition boxes.* The ammunition boxes are loaded with all rounds pointing forward; the single link end of the belt is loaded into the box first (fig. C-27). To begin loading, start with the end of the ammunition box to which the chuting is attached and "S" fold the ammunition into the first compartment, with the single link end first (figs. C-25 and C-26). Working away from the chuting, continue to load all boxes. When the last compartment is loaded, bring the ammunition belt back across the full boxes and insert the double link end into the chuting. Each of the ammuntion boxes may be loaded separately while removed from the helicopter, or they may all be loaded while installed in the helicopter. To reduce turn-around time, the ammunition boxes should be removed from the helicopter for loading so that the helicopter can be released for refueling or maintenance.

(*a*) *Loading with ammunition boxes removed from helicopter.* With the ammunition properly oriented, fill all boxes in the same way regardless of their placement in the helicopter.

1. To load each box, start with the single link end of a properly oriented belt ((3) above) at the payout end of the box (the end without the interlock keys).

2. Lay the end of the belt over the edge of the box and fold the ammunition, in layers, into the first compartment until it is full; fill the other two compartments the same way.

3. Finish with the double link end of the belt at the aft end of the last compartment (figs. C-25 and C-26).

4. When all 12 ammunition boxes are filled, place them into the ammunition box tray in the helicopter. In each row of three boxes, remove any excess ammunition and link the belts together. Remove the excess ammunition that was left hanging over the payout end of the first box in each row and attach the chuting.

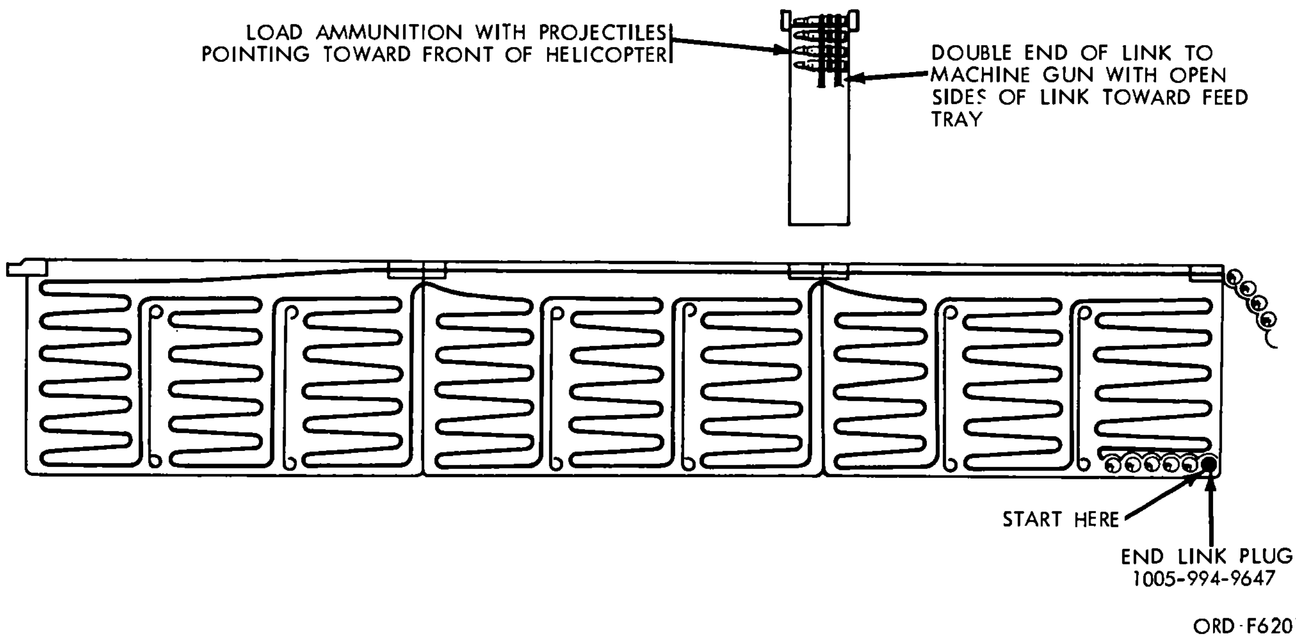


Figure C–25. Cartridges loaded in ammunition box assemblies—left side feed (UH–1B/C installation).

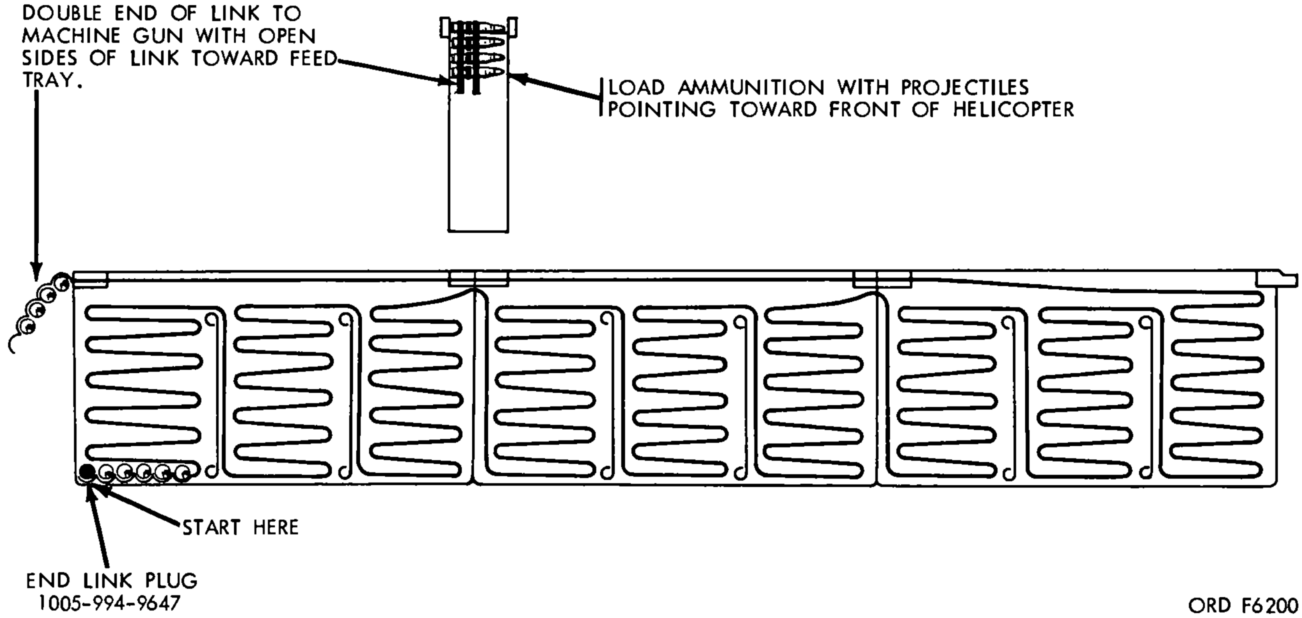


Figure C–26. Cartridges loaded in ammunition box assemblies—right side feed (UH–1B/C installation).

(*b*) *Loading with ammunition boxes installed in helicopter.* This loading procedure is somewhat simplified since the three boxes in each row are already hooked together and may be considered as one continuous box. The trailing link should be prepared first ((2) above). Then with the ammunition properly oriented ((3) above), start at the *bottom* of the first compartment and fill each compartment in turn ((*a*) above).

(4) *Attach an additional belt of 180 rounds of ammunition.* Attach an additional belt of 180 rounds of ammunition to the double link end of the belt at the aft end of the last box in each row. Place the belt, from the aft end, across the top of the filled compartments to the payout end of the first box in the row (fig. C–28).

Note. When loaded in this way, the last compartment is emptied first and the belt is fed across full compartments to the chute. This prevents stoppages that occur when the ammunition belt sags into the empty boxes, causing excessive drag on the cartridge drive motors. This reverse loading also turns the belt over so that the links are properly oriented as they are fed to the guns (fig. C–28).

(5) *Replace box lids.* Replace the box lids and secure the boxes to the helicopter.

Note. Although the ammunition box lids prevent foreign objects from dropping into the ammunition supply, they hinder clearance of stoppages within the boxes and also prevent visual inspection of ammunition for potential stoppages and for ammunition count.

(6) *Hand feed ammunition belt to cartridge drive.* Feed the ammunition belt by hand through the chuting to the cartridge drive. Open the cartridge drive and pull about 1 foot of the belt from the chute leading to the guns. Insure that the sprocket of the cartridge drive is properly engaged with the belt and that the cover on the cartridge drive is closed.

(7) *Use cartridge drive to feed ammunition belt to guns.* After the ammunition has been fed through the cartridge drives of all four guns, turn the helicopter battery switch to ON, engage M6 circuit breakers, turn the nonessential bus switch to MANUAL ON (aft position), and move the OFF-SAFE-ARMED switch to the SAFE position. Then feed the ammunition belt through the chuting to the guns by depressing the cartridge drive push switch on each drive assembly (fig. C–29). *Feed the double link end of the belt into the guns first, with the projectile pointing forward (figs. C–25 and C–26).* Open each gun

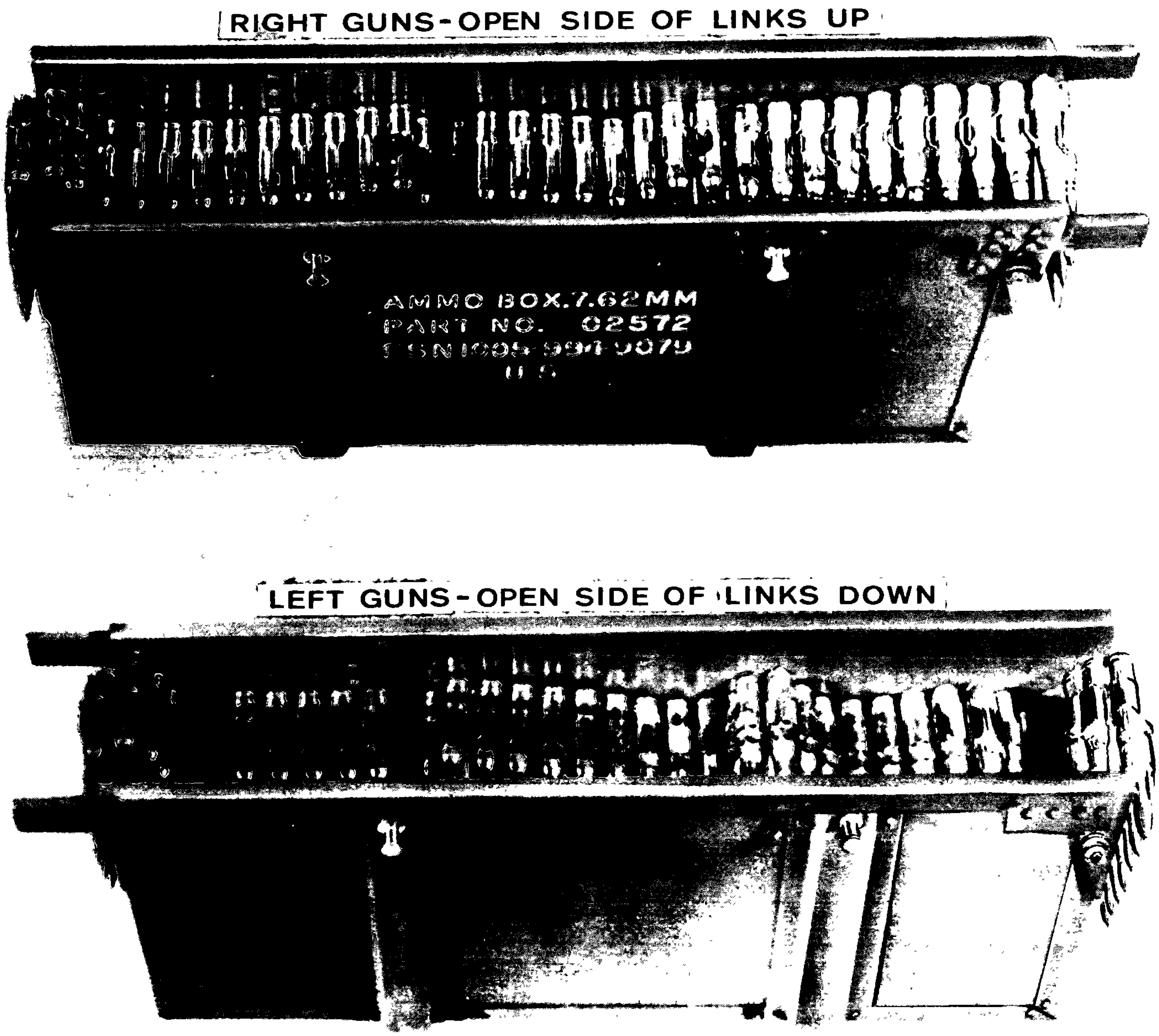


Figure C–27. Cartridges loaded for right side and left side feed (UH–1B/C installation).

cover, position the first round in the belt on the feed tray, and close the covers (insuring that the ammunition chuting is clear).

Note. Never force the gun cover closed. If the first round is positioned properly on the feed tray, the cover will close easily.

(8) *Force feed each ammunition chute.* Force feed the chute leading to each gun by de-

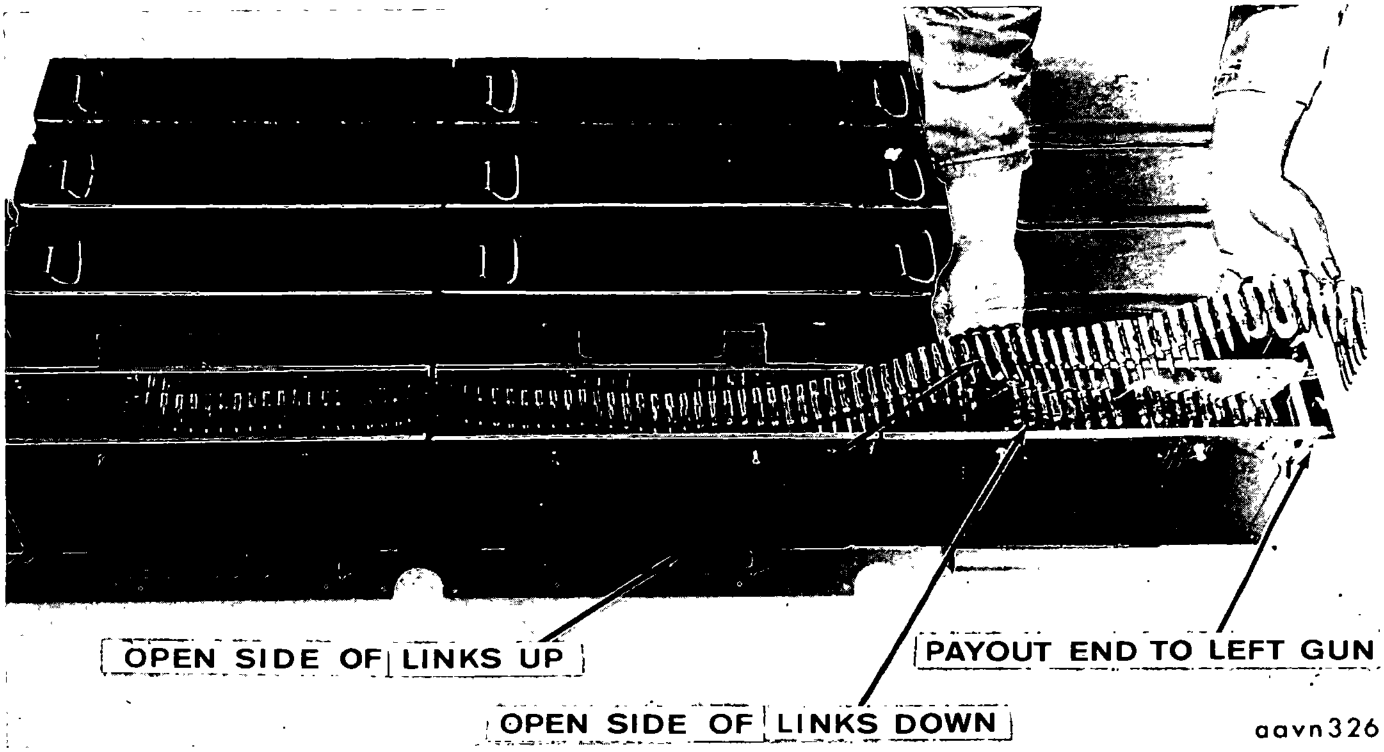


Figure C–28. Double link end of ammunition belt fed across top layers of fully loaded ammunition boxes to the left gun (UH–1B/C installation).

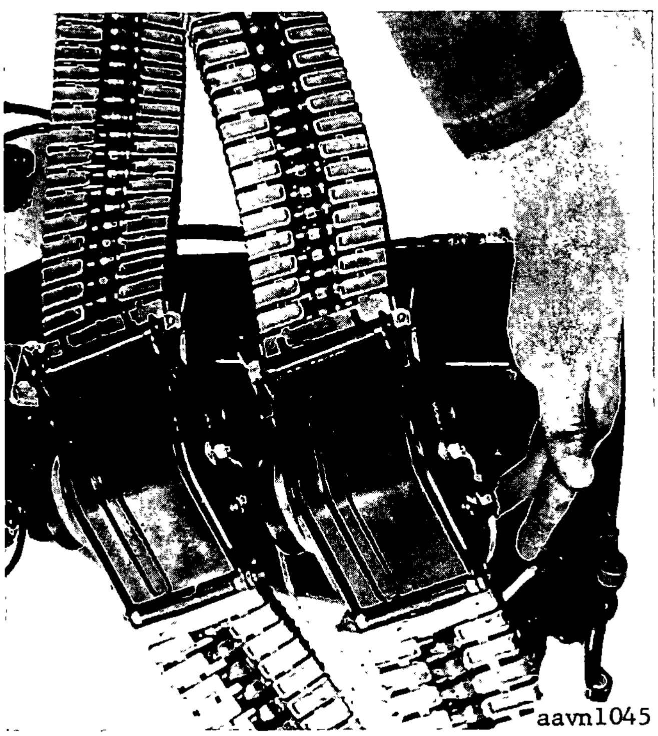


Figure C–29. Depressing cartridge drive push switch.

pressing each of the cartridge drive push switches. Then return the OFF-SAFE-ARMED switch to the OFF position and turn the helicopter battery switch to OFF.

c. *Firing Procedure.* The subsystem may be put into operation in either the *stow* or *flexible* mode. Electrical and hydraulic power is applied to the turrets and chargers by moving the OFF-SAFE-ARMED switch to SAFE. To allow the components to warm up and stabilize, the switch should be placed in the SAFE position 10 to 15 minutes before firing. However, the turrets will not follow the motions of the control handle with the switch in this position. The system can be left in this position until nearing the target area, since none of the four guns will fire, even with complete electrical or hydraulic failure. When the OFF-SAFE-ARMED switch is moved to the ARMED position, the charger control valves are energized, and the charger action is returned to the "in-battery" position. Simultaneously, power is provided to the auxiliary trigger switches, and the guns may be fired from the stowed position by depressing either of the auxiliary trigger switches.

(1) *Stow mode.* The guns may be stowed in a predetermined position and fired as a fixed weapon by either the gunner or the pilot. This secondary capability enables either the pilot or the gunner to fire the system straight ahead in an emergency. Observing the strike of tracers fired from the fixed guns, the pilot changes the attitude of the helicopter to aim the guns. Accuracy of fire delivery is thus limited by helicopter maneuverability. There is no sight for stow fire; however, the pilot or gunner may provide his own reference point on the windshield. To obtain the reference point, he fires a few rounds to observe the strike of the bullets, placing in the line of sight a 6-inch vertical grease line with five centered horizontal crosslines at 1-inch intervals.

(2) *Flexible mode.* For flexible operation, the sighting station is used, as follows:

(*a*) To disengage the sight from its stowed position, remove retaining pin, grasp the sighting station control handle, and pull down and outboard.

(*b*) To illuminate the reticle lamp, move the reticle lamp switch on the side of the control handle either forward or aft from the center OFF position. Two filaments are used in the reticle lamp to insure reticle illumination during action. Should one filament burn out during action, the switch may be moved to the opposite position to reilluminate the reticle. On bright sunny days in order to see the reticle more clearly, it will be necessary to position the sunshade on the rear of the sight to the up position.

(*c*) To control the reticle light intensity during night operations, turn the round knob on the sight reticle lamp variable resistor located below the sight.

(*d*) Depress the action switch on the control handle to transfer firing voltage from the auxiliary trigger switches to the control handle trigger switch. Simultaneously, control is transferred from the stowing potentiometers to the controller command potentiometers and the guns may be directed by moving the controller.

(*e*) Acquire the target by moving the controller until the target appears inside the reticle pattern on the sight viewing glass. When the controller is moved, the command potentiometers are displaced from the stowed position, causing error signals to appear at the input of the servo amplifier. These signals cause the mounts to follow the motion of the controller until the followup potentiometers are at a coincidental position. This reduces the error signal to a fixed value. The guns will remain in this position until the controller is moved again.

(*f*) As long as the action switch is depressed, use the trigger switch on the upper forward portion of the control handle. Should the action switch be released for any reason, control is returned to the stowing potentiometers. The error signal resulting from the voltage difference between the stowing potentiometers and the followup potentiometers causes the mounts to be driven immediately to the stowed position. Simultaneously, electrical power is removed from the control handle trigger switch and transferred to the auxiliary trigger switches.

(*g*) When engaging target in the flexible mode, depress the action switch before depressing the trigger switch. If the controller is aligned on the target and the trigger switch depressed before the action switch is depressed, the guns will begin firing straight ahead (from the stowed position) and continue firing while they swing into position.

(3) *GUN SELECTOR switch.* The firepower of the subsystem is controlled by the GUN SELECTOR switch located on the control panel. This switch permits selection of the upper guns of each mount, the lower guns, or all guns if maximum firepower is desired. The system permits coincidental aiming and firing of both gun mounts in a deflection axis sector, including an angle of 12° to the right and left from the centerline (fig. C-30). Within this 24° sector, the

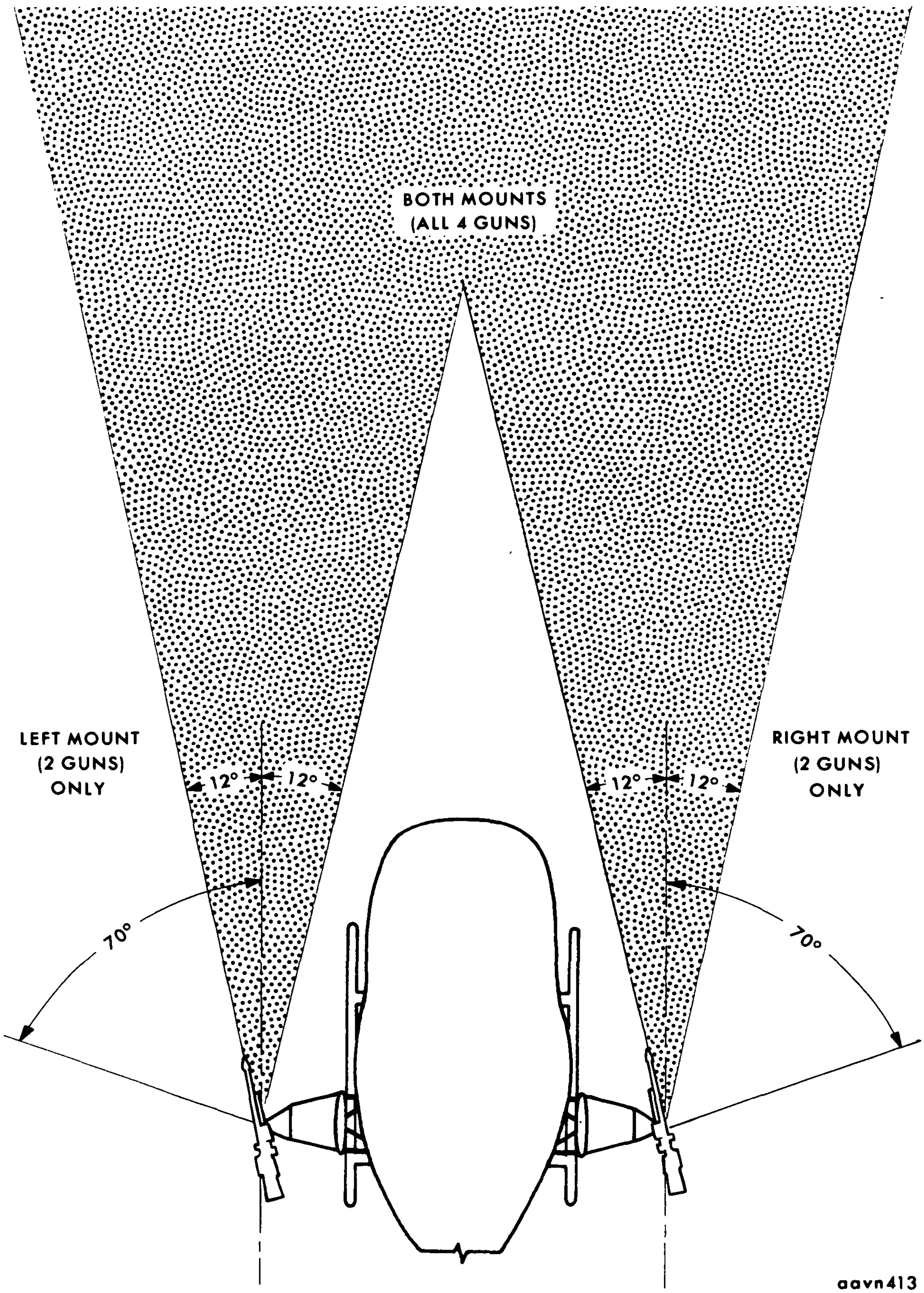


Figure C–30. Firepower in the deflection axis.

fire interrupter switches on both gun mounts permit simultaneous firing of all guns (with the GUN SELECTOR switch in the ALL position, the maximum combined firepower of the mount is 2,200 rounds per minute). When the guns are deflected outside of this 24° sector, only one gun mount ma ybe brought to bear on the target. The gun mount on the opposite side of the helicopter is held in a 12° inboard position by the controller command potentiometer for this mount, and the fire interrupter switch precludes the operation of the firing circuit (maximum combined firepower of the mount is 1,100 rounds per minute).

(4) *Cartridge drive.* Simultaneously with the actuation of the firing cycle, the cartridge drive motors servicing the selected weapons are energized. Ammunition is drawn from the boxes, through the feed chutes to the guns, providing a continuous supply until the firing circuit is interrupted.

(5) *Moving OFF-SAFE-ARMED switch to the OFF position.* To safety the weapons, move the OFF-SAFE-ARMED switch through the SAFE position to the OFF position. This operation closes the main hydraulic shutoff valve and opens all electrical power circuits, thus making the system inoperative. The charger assemblies will remain in the SAFE position, holding the guns "out-of-battery."

Note. If the OFF-SAFE-ARMED switch is moved through the SAFE position too rapidly, the charger will not have time to operate before hydraulic power is shut off and the guns will remain "in-battery."

C-21. Emergency Procedures

a. Stoppage. If a stoppage occurs during firing, release the control handle, move the OFF-SAFE-ARMED switch to the SAFE position, then move it back to the ARMED position. This recycles the selected guns, removing and ejecting the dud, and chambering a new round. Depress the action switch; then depress the trigger switch. If the gun still fails to fire, the mission may be continued by using the remaining guns until the helicopter can be landed and the malfunction cleared.

b. Runaway Guns. If the guns continue to fire after the trigger switch on the control handle has been released (runaway guns), move the OFF-SAFE-ARMED switch slowly through the SAFE position to the OFF position, pull the M6 circuit breakers, clear the weapon upon landing, and record the malfunction on DA Form 2408-13.

C-22. Boresighting Procedure

The M6 series armament subsystem was developed as a neutralization fire subsystem designed for an area fire capability only. However, subsequent tests and field usage have proven that the subsystem has a high degree of point fire accuracy that can be exploited without sacrificing the area fire capability of the subsystem. The flexibility and high slew rate of the mounts allow the gunner to shift his fire rapidly for effective coverage of a large area. To allow the gunner to take advantage of the accuracy of the subsystem and place his initial bursts on target, all four guns should be boresighted or harmonized (para C-23) to converge at 700 to 750 meters, depending on normal target acquisition ranges in the area of operations. Boresighting should be checked at intervals necessary to insure accuracy in firing.

a. Select a target with clearly defined right angles (99°) at 700 meters ± 20 meters. An automotive vehicle or a natural object such as a tree is an adequate target.

Note. If using a tree as a target, do not use a reference point higher than 10 feet from the ground.

b. Position the helicopter on a level surface facing the selected target. Remove back plate assembly, buffer assembly, operating rod group, and bolt assembly from the upper machineguns on both left- and right-hand mount assembly.

c. Provide full electrical and hydraulic power to the mount assemblies. This is done by connecting an external electrical and hydraulic power unit to their proper receptacles and fittings at the helicopter. The external electrical power unit should deliver 28 ± 2 volts on all helicopters and the hydraulic pressure delivered to the UH-1B/C helicopter should be at least 1,000 psi. However, electrical and hydraulic power may be supplied directly from the helicopter.

Note. Before initiating the boresighting procedure, the OFF-SAFE-ARMED switch will be placed in the SAFE position and a 15-minute warmup period allowed to stabilize the electrical components of the control box panel.

d. Boresighting of the M6 subsystem requires two individuals—one stationed in the cockpit and one outside the helicopter to position the helicopter, make adjustments to the variable resistors, and make visual boresight observations through the barrels. During boresighting, it is assumed that the variabe resistors in the sighting station are in proper alinement and adjustment as they are preset at assembly.

***Warning:* Before making adjustments in (1) and (2) below, make sure that ammunition is not loaded.**

(1) *Deflection boresight adjustments.*

(*a*) Check machineguns to make sure they are securely attached to the mount assemblies by grasping the barrels firmly and, applying moderate pressure, attempt to move the guns in elevation and deflection.

(*b*) Using a piece of tape, tape down the action switch on the lower portion of the control handle.

(*c*) Remove alinement pin from its stowage clamp on the elbow assembly of sighting station. Aline hole in the contoller housing beneath the sunshade on the front of the sighting station with hole in sight shaft; insert pin until fully shouldered. This prevents any movement of the sighting station on the deflection axis.

(*d*) Place the OFF-SAFE-ARMED switch in the ARMED position.

(*e*) Turn on the sight reticle lamp switch by moving the toggle handle to either side of the center OFF position. Move the sight reticle lamp variable resistor as necessary to adjust reticle brightness.

(*f*) Hold sighting station in normal sighting position. Place center dot of sight reticle on sight point on target in elevation-depression axis. The groundman will then physically position helicopter left or right in a horizontal plane until center dot of sight reticle is on sight point on target in the deflection axis.

(*g*) Sight though barrels of upper guns. The sight point on target should appear centered in the machinegun bores.

(*h*) Should the sight point be outside the field of view through the barrels in a vertical direction, i.e., up or down, the sight may be moved in elevation, thus moving the sight reticle dot slightly above or below the sight point.

(*i*) Should the sight point not appear centered in the gun bores in deflection when sighting through the barrels, alter the position of the deflection variable resistor as follows:

1. Using a screwdriver, turn adjusting screw at base of deflection variable resistor clockwise or counterclockwise, as required, to center sight point in deflection (fig. C–16).

2. Stand clear of mount assemblies and guns. Request cockpit operator to remove alinement pin from front of sighting station and move sight slowly in its deflection axis several times across the sight point and return it to its original position, i.e., reticle dot on sight point.

3. Observe sight point through gun barrels. Sight point should be centered in deflection.

(2) *Elevation boresight adjustments.* Using the same target and with electrical and hydraulic power supplied to subsystem, check the elevation axis of the subsystem in the following manner:

(*a*) Using a piece of tape, tape down the action switch on the lower portion of the control handle.

(*b*) Insert alinement pin as outlined in (1)(*c*) above.

(*c*) Place the OFF-SAFE-ARMED switch in the ARMED position.

(*d*) Turn on sight reticle lamp.

(*e*) Hold sighting station in normal sighting position. Place center dot of sight reticle on sight point on target in elevation and deflection axis.

(*f*) Sight through barrels of upper guns. The sight point on target should appear centered in the machinegun bores.

(*g*) Should the sight point not be centered in the gun bores, alter the position of the elevation variable resistor in the following manner:

1. Place OFF-SAFE-ARMED switch in the OFF position.

2. Remove the elevation variable resistor plug located on each mount assembly (fig. C–17). This plug is labeled "Elev. Cal."

3. Insert a 3/16-inch socket-head screw key into hole vacated by the variable resistor plug. When key is seated in the top of the socket-head screw which rotates the elevation variable resistor, place OFF-SAFE-ARMED switch in the ARMED position.

4. Recheck sight reticle as outlined in (*f*) above.

5. While observing sight point through gun bore, adjust the elevation variable resistor by slowly rotating socket-head screw key clockwise or counterclockwise to center the sight point in the gun bore (fig. C–18).

6. Groundman: stand clear of mount assemblies and guns.

7. Cockpit operator: move sighting station in its elevation axis several times above and below the sight point and return to its original position, i.e., reticle dot on aiming point.

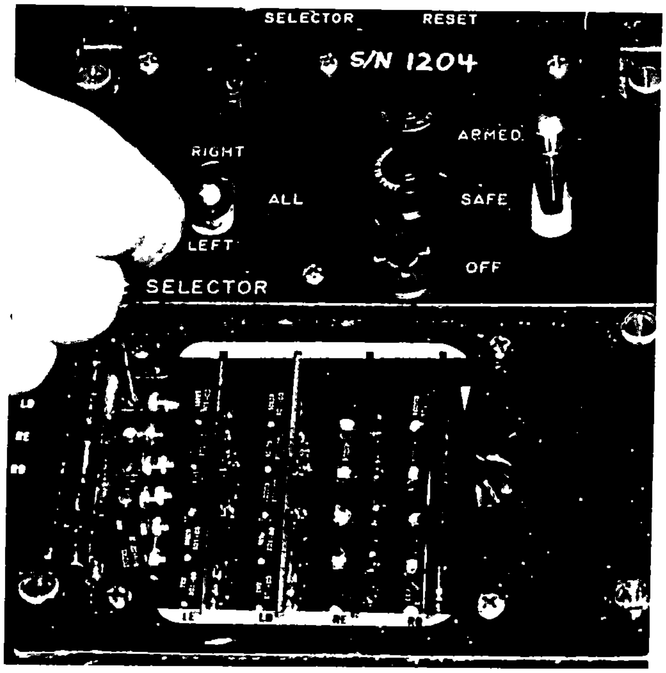
8. Observe sight point through gun barrels. Sight point should be centered in elevation.

9. Install variable resistor plug (fig. C–17).

10. Remove tape from action switch.

11. Remove and stow alinement pin.

e. Boresighting for stow position can now be accomplished. The purpose of boresighting the



★*Figure C–31. Adjusting deflection/elevation stow variable resistor.*

subsystem M6 series in the stow position is to compensate for the helicopter's position (nose down) when flying at speeds between 80 to 100 knots.

★(1) Select a target with clearly defined right angles (90°) at 700 meters ± 20 meters. A building or a natural object, such as a tree, is an adequate target. Select a reference point at least 10 but not over 30 feet above the ground.

(2) Using a screwdriver, open the door on the control box panel by turning "dzus" fastener counterclockwise.

(3) Sight through barrels of upper guns. The sight point should appear centered in the machine-gun bores.

(4) Should the sight point be outside the field of view through the barrel in a deflection or vertical direction, alter the position of the stow variable resistors located in the control box panel.

(5) Groundman: observe target through barrels of guns and give cockpit operator directional signals to correct for deflection/elevation errors.

(6) Cockpit operator: adjust mount assemblies by turning the screw adjustment on any or all variable resistors with jeweler's screwdriver 5120–180–0728 clockwise or counterclockwise, whichever is applicable (fig. C–31). The stow position variable resistors are marked "LE" (left elevation), "LD" (left deflection), "RE" (right elevation), and "RD" (right deflection). They are adjusted in elevation/deflection in the following manner:

(*a*) Clockwise movement of "LE" adjustment—depresses left-hand guns.

(*b*) Counterclockwise movement of "LE" adjustment—elevates left-hand guns.

(*c*) Clockwise movement of "LD" adjustment—traverses left-hand guns to right.

(*d*) Counterclockwise movement of "LD" adjustment—traverses left-hand guns to left.

(*e*) Clockwise movement of "RE" adjustment—elevates right-hand guns.

(*f*) Counterclockwise movement of "RE" adjustment—depresses right-hand guns.

(*g*) Clockwise movement of "RD" adjustment—traverses right-hand guns to left.

(*h*) Counterclockwise movement of "RD" adjustment—traverses right-hand guns to right.

(7) Place OFF-SAFE-ARMED switch in OFF position.

f. After boresighting has been completed, check to see that the firing interrupter switch is properly adjusted. Perform any adjustment required as outlined in TM 9–1005–243–12.

C–23. Harmonization Procedures

a. Flexible Mode.

(1) Armorer/crewchief adjusts deflection and elevation variable resistors as described in paragraph C–19*b*(4) and (5).

(2) Gunner depresses action switch, places the pip on target, and fires short bursts. Then armorer adjusts resistors ((1) above) until rounds are hitting the target. Gunner keeps action switch depressed and pip on target throughout harmonization.

(3) Once harmonization is established at a known distance, pip holdover or under (Kentucky windage) must be used for greater or lesser ranges.

b. Stowed Position. Adjustment of the guns in the stowed position is accomplished by turning the screw adjustment on each stowed position variable resistor utilizing a jeweler's type screwdriver. The stowed position variable resistors are marked LE, LD, RE, RD (para C–22*e*(6)).

(1) The gunner fires a short burst prior to each adjustment.

(2) Armorer/crewchief adjusts variable resistors until the rounds are hitting the target.

Section III. XM27 AND XM27E1 ARMAMENT SUBSYSTEMS

★C–24. XM27 Armament Sybstem

The high rate, 7.62mm, air-cooled machinegun helicopter armament subsystem XM27 is mounted on the left side of the OH–6A helicopter. It may be fired by the pilot's or copilot's firing switch on each cyclic control stick. The subsystem is designed for use as a direct fire area weapon against troops and soft material targets. It provides an immediately responsive and highly mobile means of delivering volume area nonnuclear fire in support of ground maneuver elements. For details on the XM27 subsystem, see TM 9–1005–281–15.

★C–25. XM27E1 Armament Subsystem

The XM27E1 armament subsystem is an improved XM27 subsystem mounted on the left sides of the OH–6A and OH–58A helicopters. The ammunition boxes are more compact and there are differences in the fairing assembly, mount assembly, and the reflex sight assembly. The XM27E1 also has an improved gun drive assembly and a ram air induction system for the delinking feeder. For details on the XM27E1 subsystem, see TM 9–1005–298–12.

APPENDIX D

7.62MM RIFLED-BORE AND/OR 2.75–INCH ROCKET ARMAMENT SUBSYSTEMS

Section I. XM3 ARMAMENT SUBSYSTEM

D–1. Capabilities

a. The XM3 armament subsystem is designed to provide the UH–1B/C helicopter with area firepower against troop concentrations, groups of unarmored vehicles, and supply installations.

b. The XM3 subsystem is capable of selective fire in the following modes:

(1) Pair—single rocket from each pod.

(2) Ripples of 2, 3, 4, 6, or 24 pairs (48 rockets).

c. Maximum effective range is 2,500 meters.

d. Minimum range is 300 meters (safe slant range).

e. Daily rate of fire is limited only by ammunition resupply and number of personnel available for ammunition preparation. These factors are a major planning consideration.

D–2. Limitations

The following limitations apply to the employment of the XM3 subsystem:

a. Effectiveness of operation is limited at night and during periods of low visibility.

b. The XM3 subsystem is vulnerable to all types of air defense fires, including small arms.

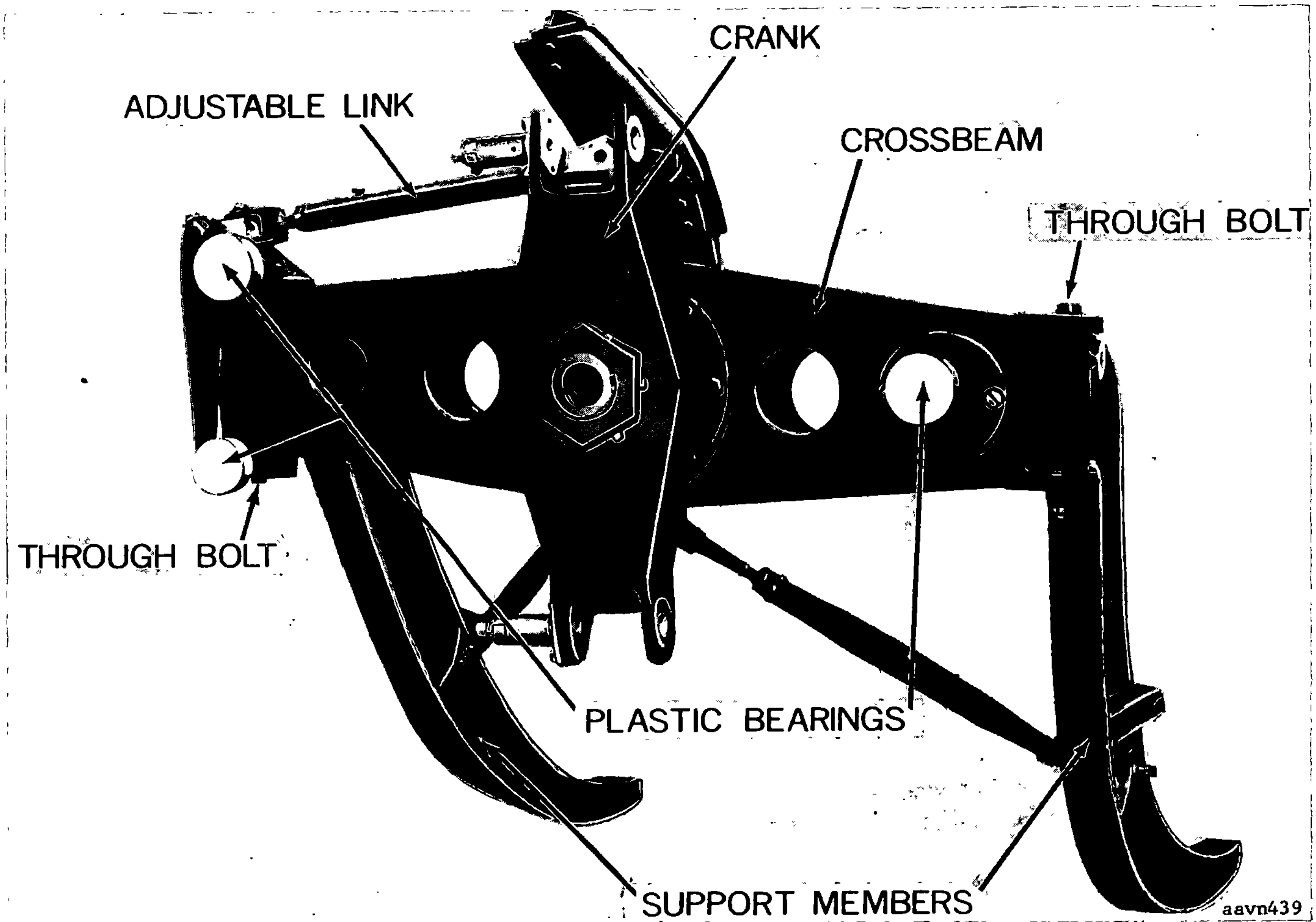


Figure D–1. Supporting structure.

D–3. Description

The XM3 armament subsystem is designed to fire the 2.75-inch modified folding fin aircraft rocket (FFAR). The modified rocket has the thrust nozzles cut at a 24° angle to impart a 15–rps spin to the rocket during flight; this spin increases stability and decreases dispersion of the rocket. The armament subsystem consists of a *launcher system* and a *fire control system.* A launcher pod containing 24 rocket tubes is attached to the universal mount on each side of the helicopter. The fire control system includes a sight, armament panel, and interconnecting box; it provides the means of aiming, selecting rockets, and firing. Electrically fired explosive bolts are provided for jettisoning the launchers in the event of an emergency.

a. Launcher System. The launcher system consists of a *supporting structure, crank, crossbeam, adapter frame,* and *launcher pod* located on each side of the helicopter.

(1) *Supporting structure.* Figure D–1 shows the supporting structure on the right-hand side of the helicopter. The support members are used to attach the crank-and-crossbeam assembly to the helicopter. The adjustable link allows adjustment of pod elevation during alinement. The plastic bearings allow an adjustment of the pod azimuth during alinement. The two through bolts hold the crossbeam and adjustable link bracket to the ends of the support members.

(2) *Crank, crossbeam, and adapter frame.* Figure D–2 shows the adapter frame to which the pod is attached. The two explosive bolts are used to attach the adapter frame to the crank. In an emergency, they can be exploded to jettison the pod. The two bolt catchers prevent damage to the helicopter when the bolts are exploded. The four module-attaching brackets, one at each corner of the adapter frame, are the attaching points for the inner module of a pod.

(3) *Launcher pod.* The launcher pod (fig. D–3) consists of four module assemblies (fig. D–4). The innermost module is pinned to the adapter frame with four pin assemblies. Each succeeding module is pinned to the next innermost module. Each module is composed of six launcher tubes, making a total of 24 launcher tubes in each launcher pod. See figure D–5 for tube firing sequence.

b. Fire Control System. The fire control system consists of an interconnecting box, a rocket-armament panel, an Mk 8 reflex infinity sight with mounting brackets, an intensity control panel, firing switches, and external electrical cables and harness assemblies.

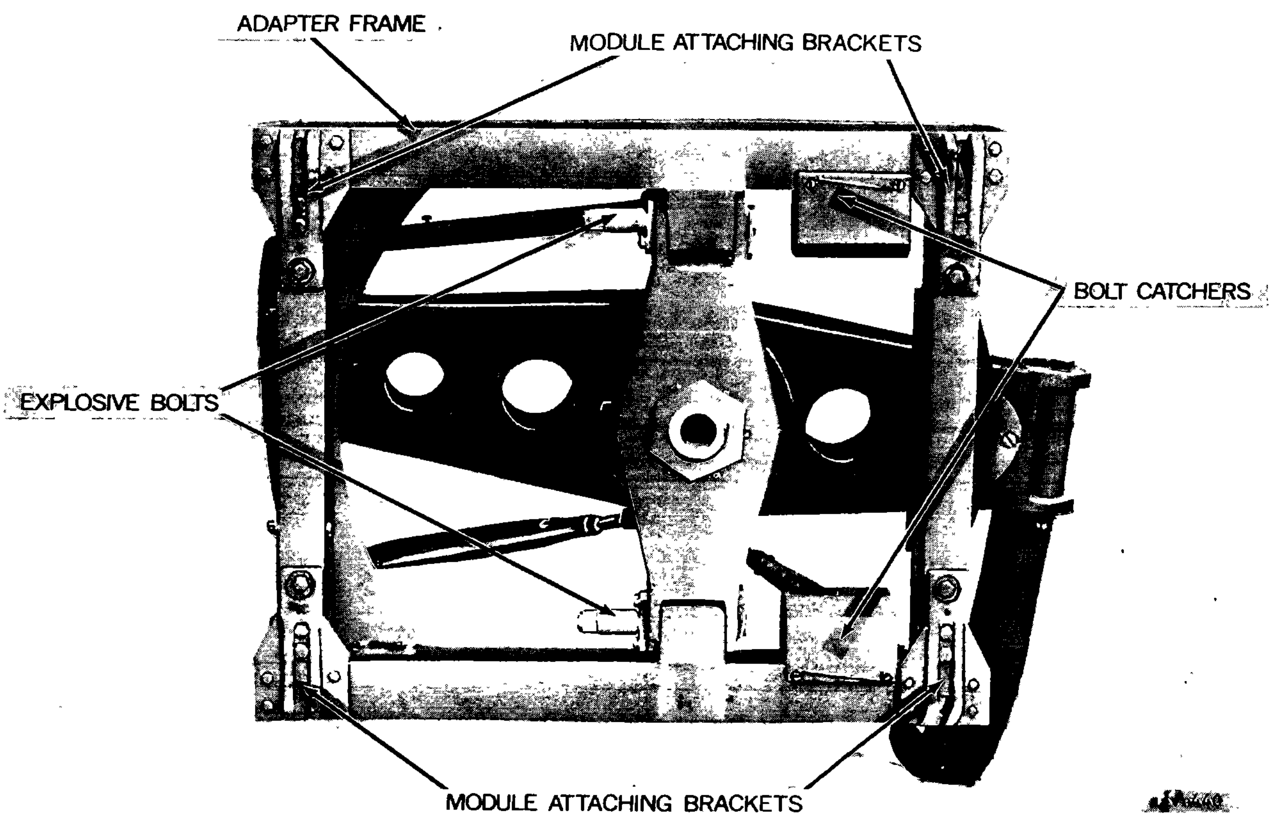


Figure D–2. Crank, crossbeam, and adapter frame.

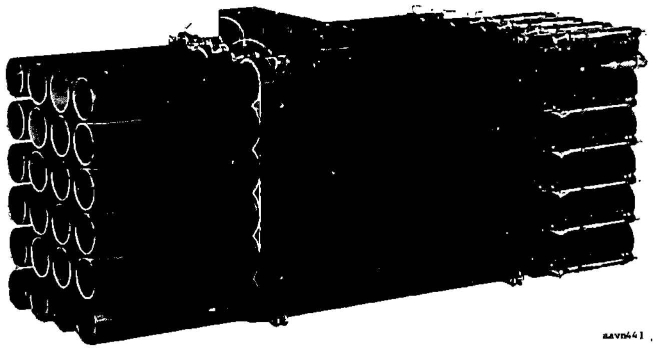


Figure D-3. Launcher pod.

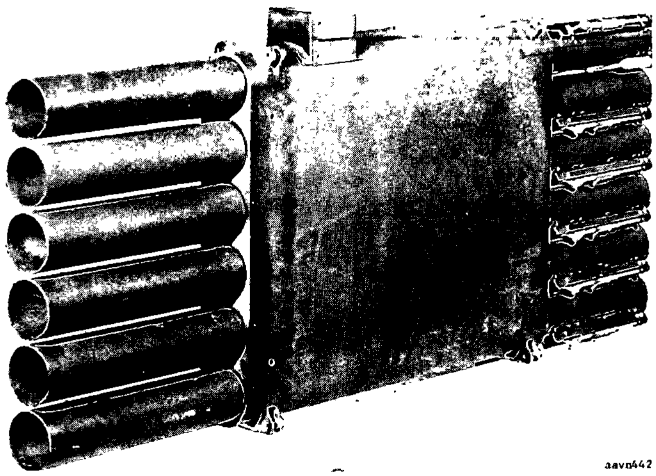


Figure D-4. Module.

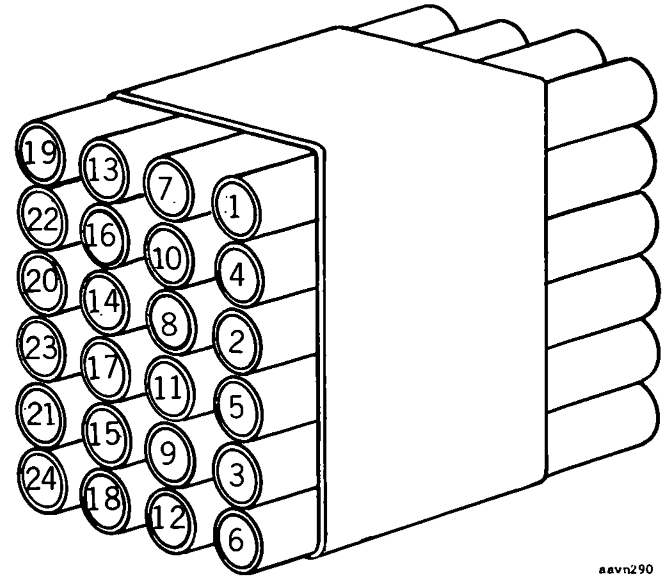


Figure D-5. Firing sequence diagram.

(1) *Interconnecting box.* The interconnecting box (fig. D-6), which is installed in the helicopter baggage compartment, contains the circuits to fire the rockets and the explosive bolts. It is connected electrically to the other fire control circuits through six of the connectors visible on the front (fig. D-6). (Two of the connectors, J6 and J8, are not used for subsystem operation; J8 is used only to supply power during tests and J6 is not used at all.)

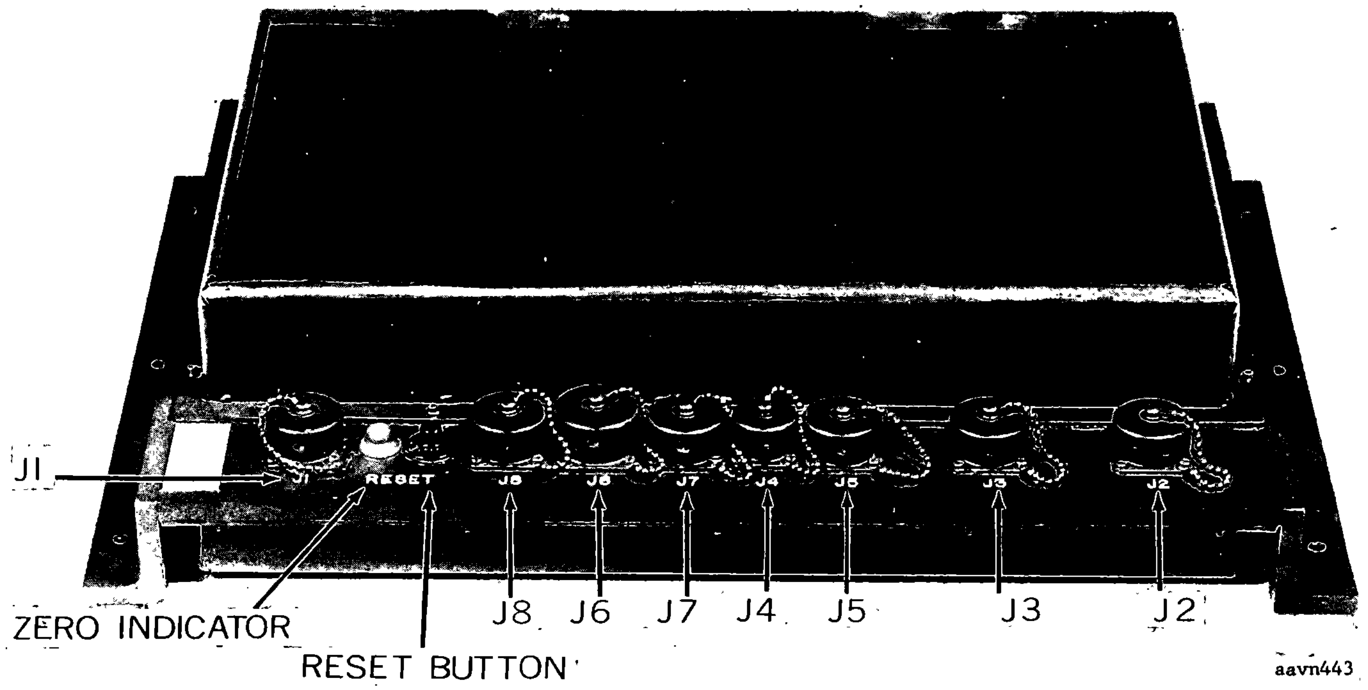


Figure D-6. Interconnecting box.

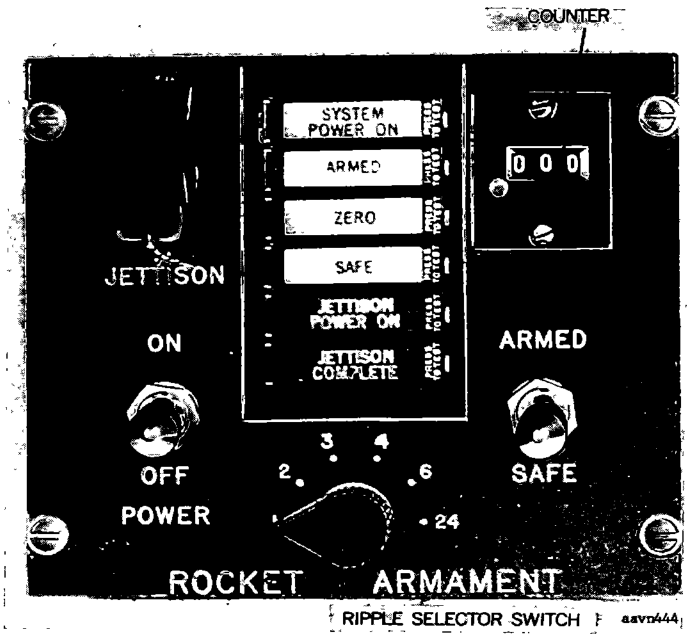


Figure D–7. Rocket-armament panel.

(2) *Rocket-armament panel.* The rocket-armament panel (fig. D–7) is installed in the lower left of the pilot's pedestal, and has controls and indicators for arming the firing circuits, selecting the number of rockets to be fired, and firing the explosive bolts.

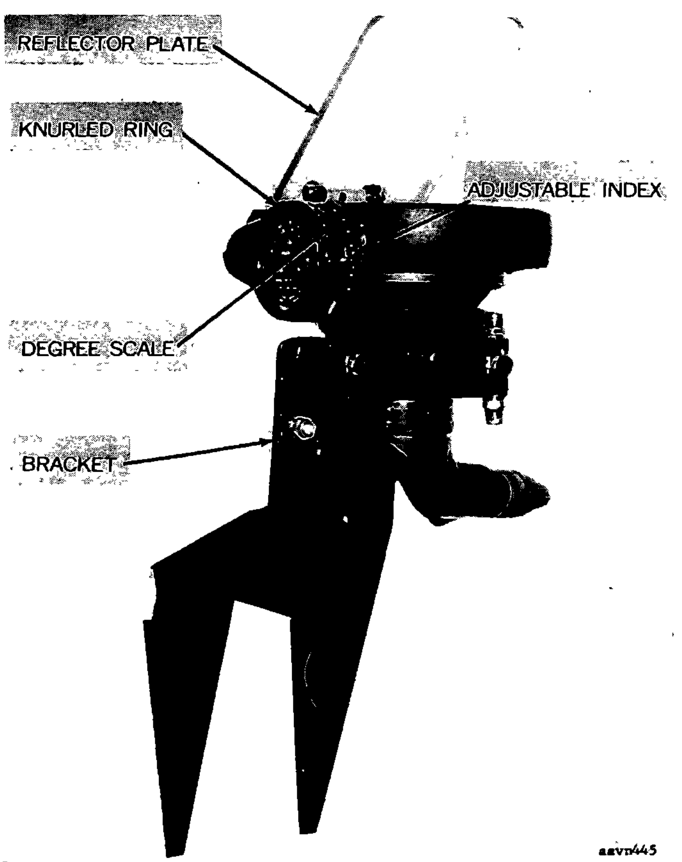


Figure D–8. Left side of Mk 8 reflex infinity sight.

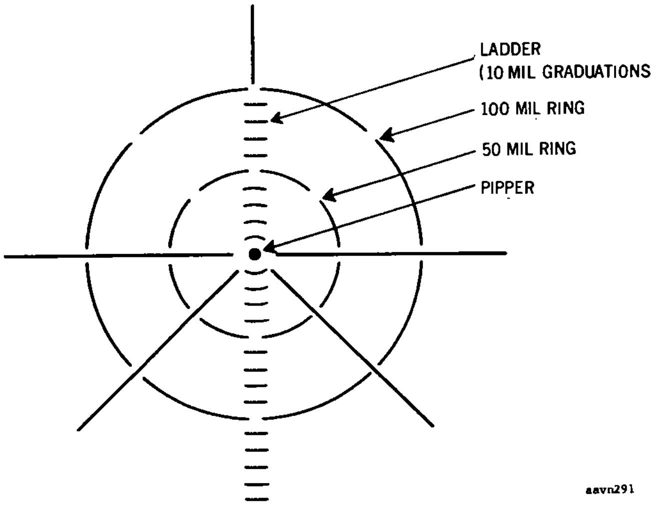


Figure D–9. Reticle image.

(3) *Mk 8 reflex infinity sight.* The Mk 8 reflex infinity sight (fig. D–8) is a reticle-type sight illuminated by two filaments and located on a bracket attached to the instrument panel in front of the aviator. The sight is mounted parallel to the longitudinal axis of the helicopter and provides the aviator with a projected image. The aviator centers this image on the target and maintains this sight picture.

(*a*) *Operation.* Illumination of the sight is controlled from the light control panel in the aft-left portion of the helicopter instrument pedestal. Operation of the sight is accomplished by moving the toggle switch to the desired filament and adjusting the rheostat.

(*b*) *Reflector adjustment.* Rotation of the knurled ring (fig. D–8) on the left side of the sight causes the reflector plate to tilt. Tilting of the reflector plate (fig. D–8) causes a shift in elevation of the collimated reticle image. The angular shift (in degrees) of the reticle image from the zero setting is shown on a degree scale (fig. D–8) inscribed on the knurled ring. The angular movement allows 4° elevation and at least 25° depression of the line of sight with respect to the detented (bore-sight datum line) position of the reflector plate. Alongside the knurled ring is an

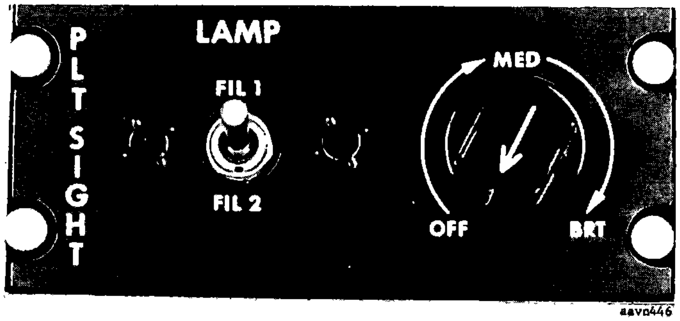


Figure D–10. Intensity control panel.

adjustable index (fig. D-8) fitted with a spring brake to hold the index in any position in which it is set. A fixed index scale, graduated in mils, is fastened to the tilting mechanism housing and is located so that the zero reading matches the zero of the degree scale when the knurled ring is in its detented position.

(*c*) *Reticle image.* The red light reticle image (fig. D-9) consists of a pipper, 50-mil ring, 100-mil ring, a ladder with 10-mil graduations, horizontal line, and 45° lines.

(4) *Intensity control panel.* The intensity control panel (fig. D-10) is located in the lower left of the pilot's pedestal, and has controls for selecting one or the other filament in the sight lamp and varying the intensity of illumination of the sight reticle.

(5) *Firing switch.* Figure D-11 shows the firing switch on the pilot's cyclic control stick, which is pressed to fire the number of pairs of rockets selected on the rocket armament panel. An identical firing switch is located on the copilot's control stick..

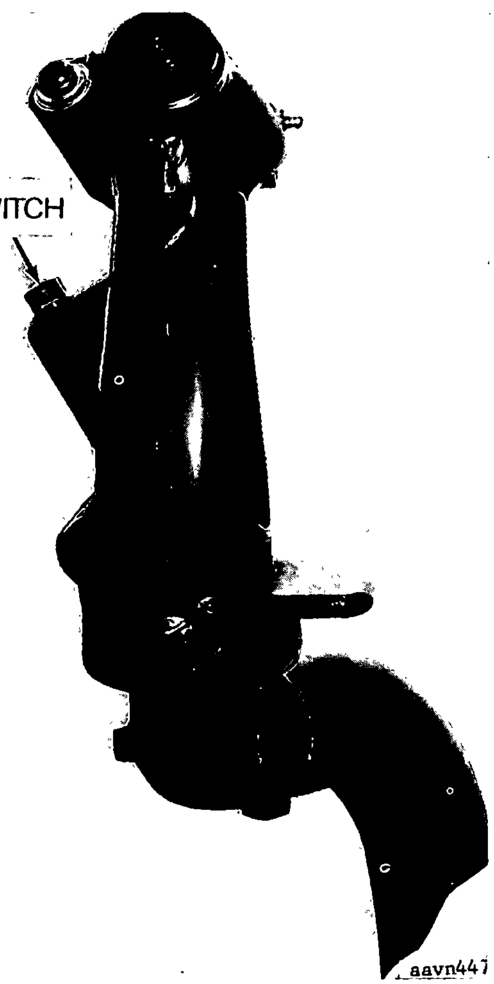


Figure D-11. Firing switch.

(6) *External electrical cables and harness assemblies.* External electrical cables and harness assemblies connect parts of the subsystem not connected by the permanently installed helicopter wiring. Figure D-12 shows cable and harness installed and secured. On each side of the helicopter, one harness assembly runs from a connector on the helicopter skin to the explosive bolts and to the lanyard disconnect on the launcher, from which a cable runs to the junction boc on the pod.

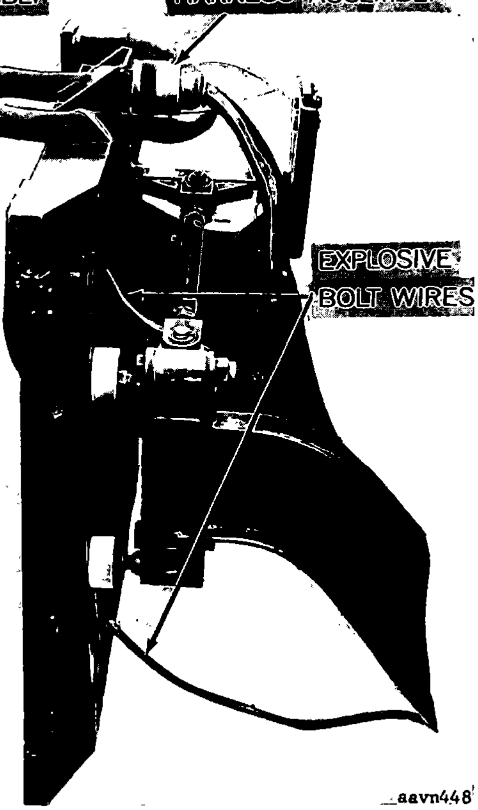


Figure D-12. Cable and harness installed and secured.

D-4. Circuit Breakers

Two circuit breakers for the subsystem are located on the helicopter overhead breaker panel. Each rocket-jettison circuit breaker is rated 15 amps at 28 volts DC. The Mk 8 sight circuit breaker is rated 5 amps at 28 volts DC. Before turning on power, whether for preflight check or during flight, check that these breakers are IN.

D-5. Controls and Indicators

Controls and indicators of the subsystem are listed in table D-1.

D-6. Operation

This paragraph supplements operating procedures for the helicopter armament subsystem XM3 found in other publications (app A).

Knowledge of these prodedures is essential to safe operation of the system.

a. Preflight Check. The preflight check by the pilot consists of a visual inspection and a brief operational check of the subsystem in preparation for firing. Prior to each day's firing, the system will be checked for proper voltage, using the multimeter TS 352. Procedure is shown in paragraph D–9.

Table D–1. Controls and Indicators

Control or indicator	Type	Function
On the rocket-armament panel (fig. D–7):		
Counter	Electro-mechanical	Shows the number of pairs of rounds fired during the mission.
Counter reset button		When pressed, resets the counter to 000.
Selector switch	Six-position rotary	Selects the number of pairs of rounds (1, 2, 3, 4, 6, or 24) to be fired.
Arm switch	Toggle	When set to SAFE, prevents firing the weapon; when set to ARMED, permits firing the weapon.
Power switch	Toggle	Turns power to fire the rockets on or off.
Jettison switch	Safety toggle	When set to the FIRE position, fires explosive bolts to jettison both pod assemblies.
Armed indicator	Lamp	Glows when the ARM switch is set to ARMED.
Safe indicator	Lamp	Glows when the ARM switch is set to SAFE.
Zero indicator	Lamp	Glows when the stepping switch in the interconnecting box is placed in the starting position by pushing reset button on interconnecting box.
Jettison power on indicator	Lamp	Glows when the two rocket jettison circuit breakers are closed, to show that the jettison circuit is armed.
System power on indicator	Lamp	Glows when the POWER switch is set to ON.
Jettison complete indicator	Lamp	Glows when both pod assemblies have been jettisoned.
On the interconnecting box (fig. D–6):		
Reset switch (button)	Pushbutton	Cycles the stepping switch to the starting position.
Zero indicator	Lamp	Glows when the stepping switch is in the starting position.
On the intensity control panel (fig. D–10):		
Filament switch	Two-position rotary	Depending on whether it is set to FIL–1 or FIL–2, selects one or the other filament in the lamp of the sight.
Intensity control	Rotary	Varies the intensity of illumination of the sight reticle.
On the cyclic control sticks (fig. D–11):		
Firing switch	Pushbutton	Fires the rockets.

***Warning:* The launcher pods must be empty before preflight check is made.**

(1) *Exterior.* Check for secure attachment of—

(*a*) The modules to each other and to the adapter frame.

(*b*) The three plastic bearings to their mounting points.

(*c*) The adapter frames to the cranks with explosive bolts.

(*d*) The front and rear bearing areas to the adapter frames.

(*e*) Nuts and keeper washers on the ends of the crank-and-crossbeam assembly shaft.

(*f*) Supporting structures to the hard points on the helicopter.

(*g*) Electrical cables to connectors on the helicopter and to the pods and explosive bolt squibs.

(2) *Interior.* Make the following checks:

(*a*) Rocket jettison circuit breaker—OUT.

(*b*) Connect an external power unit or start the helicopter engine to provide power for the subsystem. Before turning on power to the subsystem, check for the following conditions:

1. The POWER switch—OFF.

2. The arm switch—SAFE.

3. The JETTISON switch—OFF.

4. The following indicators are out: SYSTEM POWER ON, JETTISON POWER ON, JETTISON COMPLETE, ARMED, SAFE, AND ZERO.

(*c*) Close the rocket jettison circuit breaker. The JETTISON POWER ON indicator glows.

(*d*) Set the POWER switch to ON. On the rocket armament panel, the SAFE, ZERO, and SYSTEM POWER ON indicators glow. If the ZERO indicator does not glow, press the RESET button on the interconnecting box and hold it down until the ZERO indicator does glow.

(*e*) See that the ZERO indicator on the interconnecting box glows.

(*f*) Press the ARMED and JETTISON COMPLETE indicators on the rocket armament panel. Each indicator glows while pressed.

(*g*) Turn the POWER switch to OFF. All indicators except the JETTISON POWER ON indicator go out.

(*h*) Pull out the rocket jettison circuit breaker. The JETTISON POWER ON indicator goes out.

(*i*) Close the sight illumination circuit breaker.

(*j*) Turn the filament switch to both FIL–1 and FIL–2 positions. See that the sight reticle is illuminated in both positions.

(*k*) Pull out the sight illumination circuit breaker.

b. Assembly of Rockets. To assemble motors and warheads—

(1) Remove the fuzed warhead and motor from the container. The shipping support is snap-fitted to the head closure in the motor. On some motors, there is a rubber gasket ring under the lip of the warhead shipping support and a fiber shim (spacer) between the head shipping support and head closure. Remove and dispose of the spacer and rubber gasket before threading the warhead to the motor.

(2) To tighten the warhead to the motor, a torque wrench should be used to apply 55 foot-pounds of torque to the warhead. If a torque wrench is not available, hand-tighten the warhead as much as possible without causing the head closure to turn and force the visible lockwire in or out of the elongated hole in the motor tube lockwire groove. Movement of the tab within the elongated hole is normal.

***Caution:* Do not force lockwire tab down into the motor lockwire groove or out of the elongated hole. The enlarged tab traveling through the lockwire groove would bulge the rocket motor and make it unsafe to fire. Motors with lockwire tabs displaced should be discarded as unserviceable.**

(3) *Inspection of rockets.* To insure proper assembly, all 2.75-inch rockets must be inspected before loading. Check to insure that the warhead is tightened to rocket motor ((2) above). When fin protector is removed, check to insure that launcher latch retaining groove and contact disc are free of grease and dirt. Check igniter wires for breaks.

c. Preloading Checks. Following the preflight check (*a* above)—

***Warning:* Helicopters with loaded launchers or launchers being loaded and unloaded should be pointed in a direction which offers the least exposure to personnel or property in the event of accidental ignition of the rocket.**

(1) Check that the rocket armament panel counter reads 000, and that the ZERO indicators on the panel and the interconnectiog box glow when the rocket-jettison circuit breaker is closed and the POWER switch is set to ON.

(2) Set the POWER switch to OFF and pull out the rocker-jettison circuit breaker.

(3) Set the helicopter master battery switch to the OFF position.

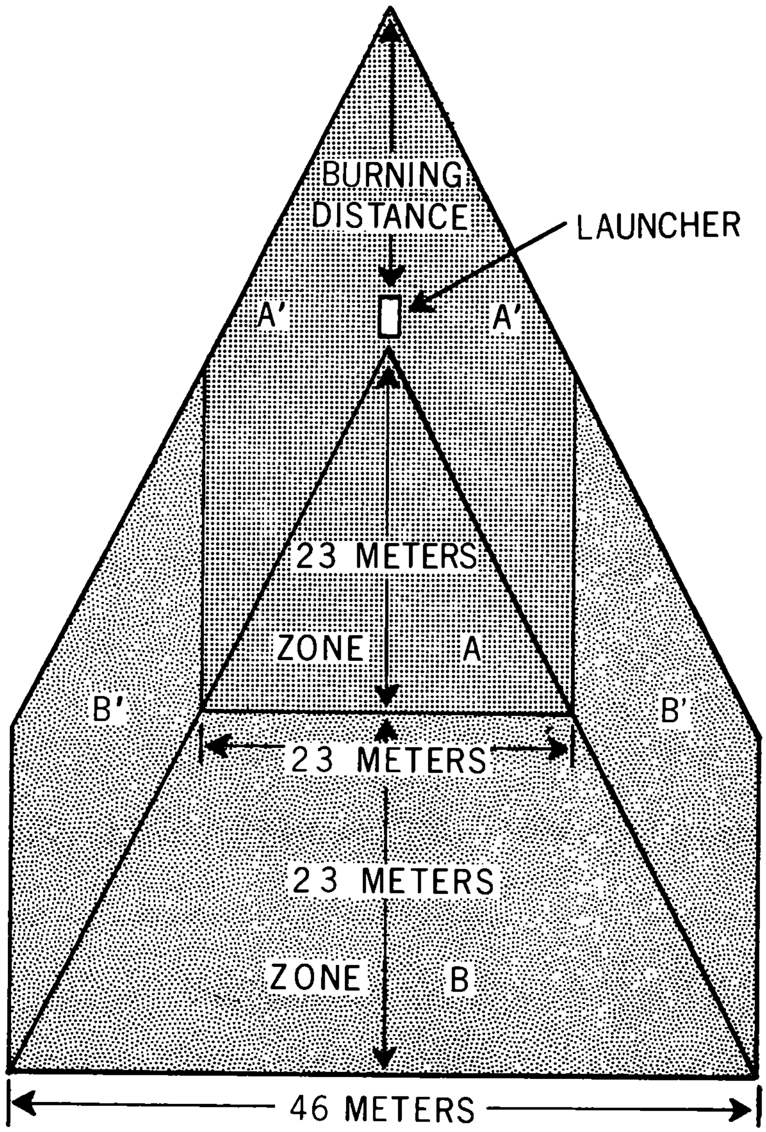
(4) Disconnect the main battery plug from the battery.

(5) Electrically ground the helicopter to an earth ground (use a static ground cable).

(6) Check that the JETTISON switch cover is closed and wired with copper breakwire.

d. Loading. The launcher should not be loaded until the preloading checks (*c*(1) above) have been accomplished.

***Warning:* When loading rockets, have all firing circuits open. Be careful to prevent damage to the fins, rocket motors, and fuze. Do not load rocket with damaged fins or motors; damaged motors may cause rocket to blow up, and damaged fins will cause erratic flight. Do not remove the fin protector until just before loading the rocket. Do not use rockets which have a gap between the warhead and motor. Because of the danger of back blast (fig. D–13), keep personnel away from the rear of the loaded launchers.**



DANGER ZONE A - BACKBLAST OF FLAME AND EXPULSION OF FRAGMENTS OF NOZZLE CLOSURE AND IGNITER WIRE.

DANGER ZONE B - EXPULSION OF FRAGMENTS OF NOZZLE CLOSURE AND IGNITER WIRE ONLY.

DANGER ZONES A' AND B' - WHEN ROCKETS LEAVE LAUNCHER, DANGER ZONES A AND B MOVE FORWARD TO ENCOMPASS A' AND B'

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Figure D-13. Rocket back blast danger area.

(1) Swing the firing pin assembly clear of the breech and insert the rocket from the breech end of the tube (fig. D-14).

(2) Remove the fin protector from the rocket. Check that the fin retainer (contact disc) is in place and that the retaining groove and contact disc are free of grease and dirt.

(3) Push the rocket into the tube until two

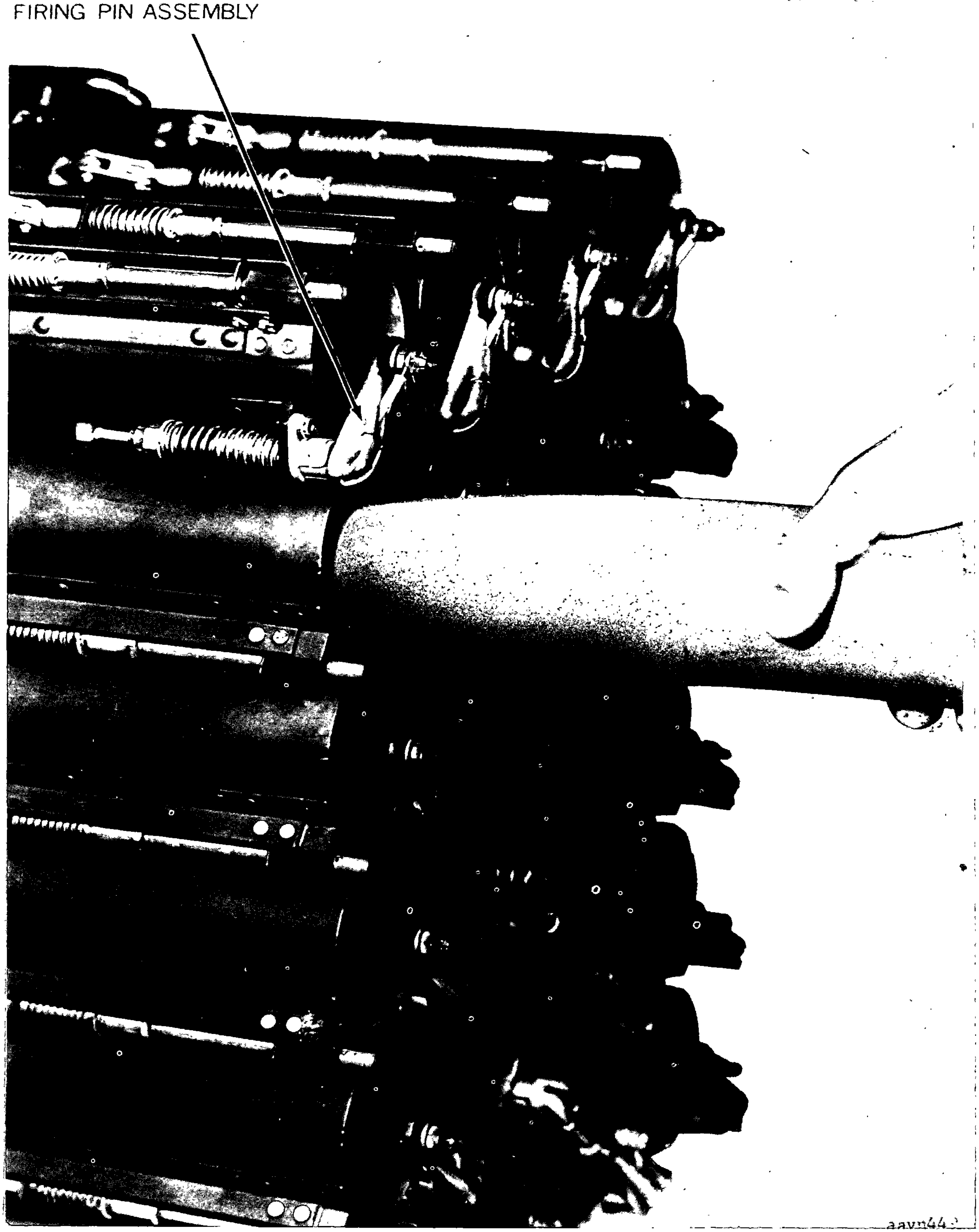


Figure D–14. Loading—step 1.

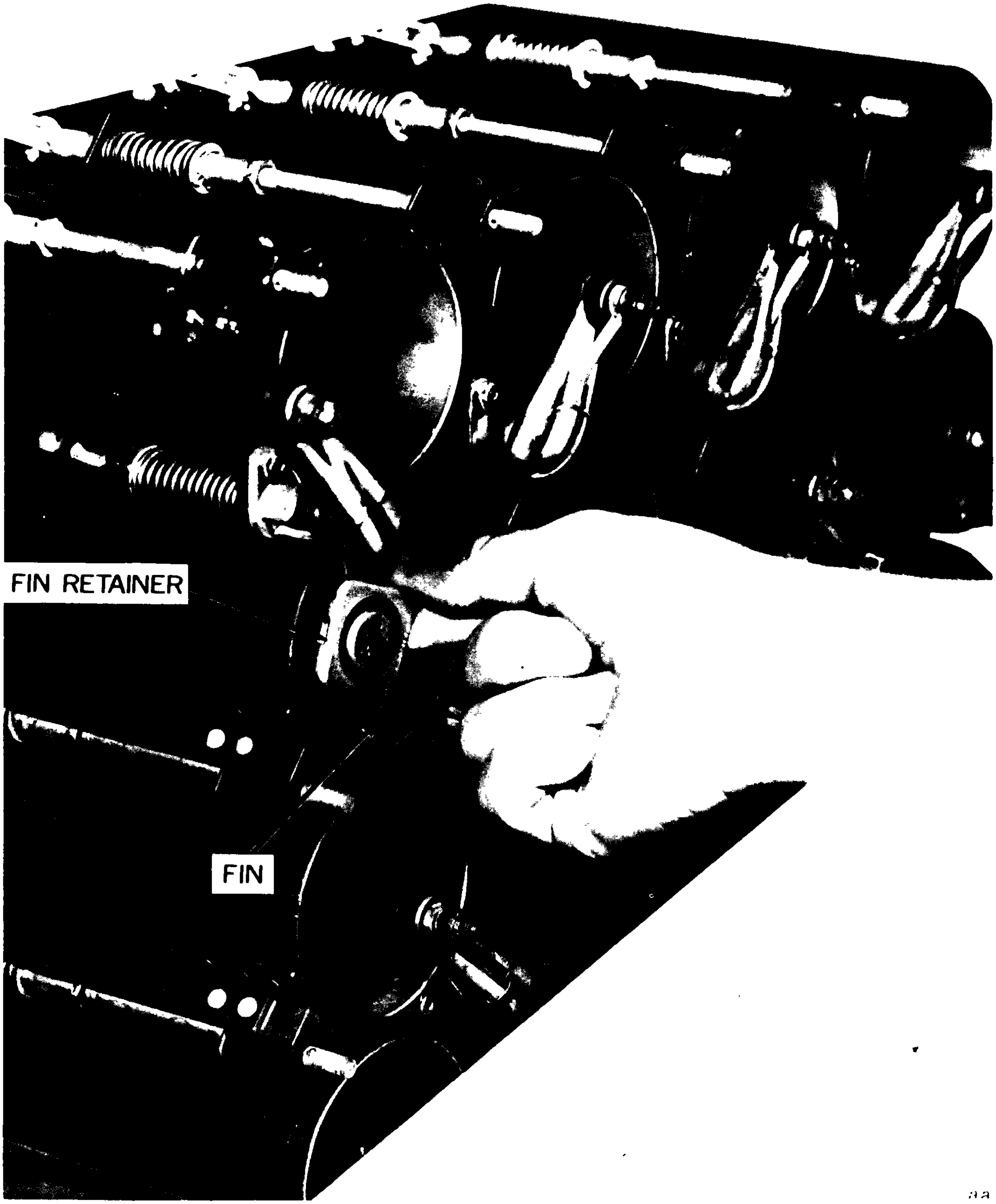


Figure D–15. Loading—step 2.

snaps are heard. Then grasp a fin (not the fin retainer) and pull the rocket back slightly (fig. D–15).

(4) Swing the launcher firing pin back over the breech until the assembly snaps forward and seats the firing pin firmly on the contact disc in the fin retainer assembly (fig. D–16).

(5) When all tubes have been loaded, place aluminum shear wire (stock no. 8932315) in the holes in the detent rods on each launcher tube, bending the wire for positive retention (fig. D–17).*

(6) Connect battery plug.

(7) Start helicopter.

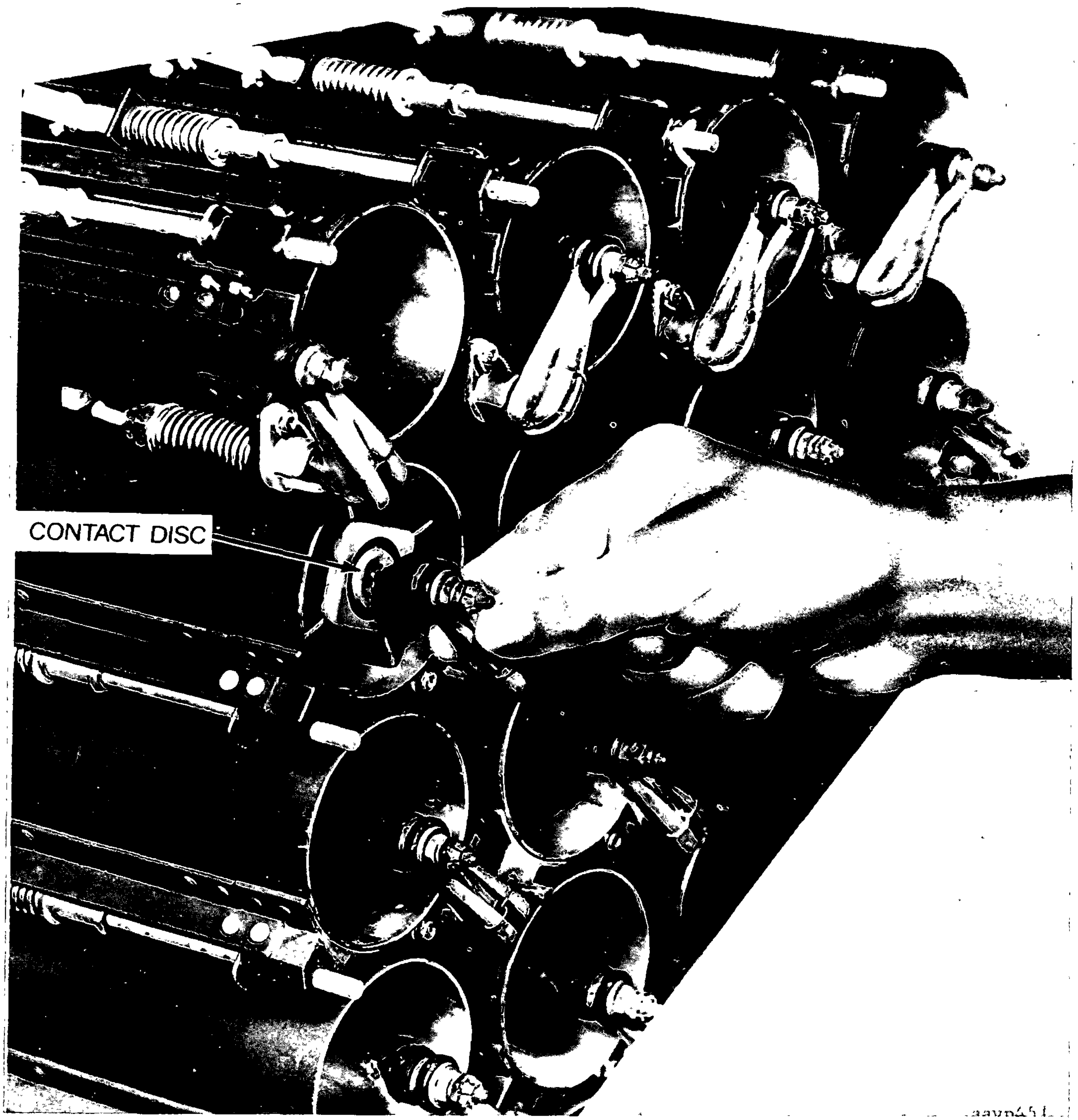


Figure D–16. Loading—step 3.

* This step may be omitted in a combat situation.

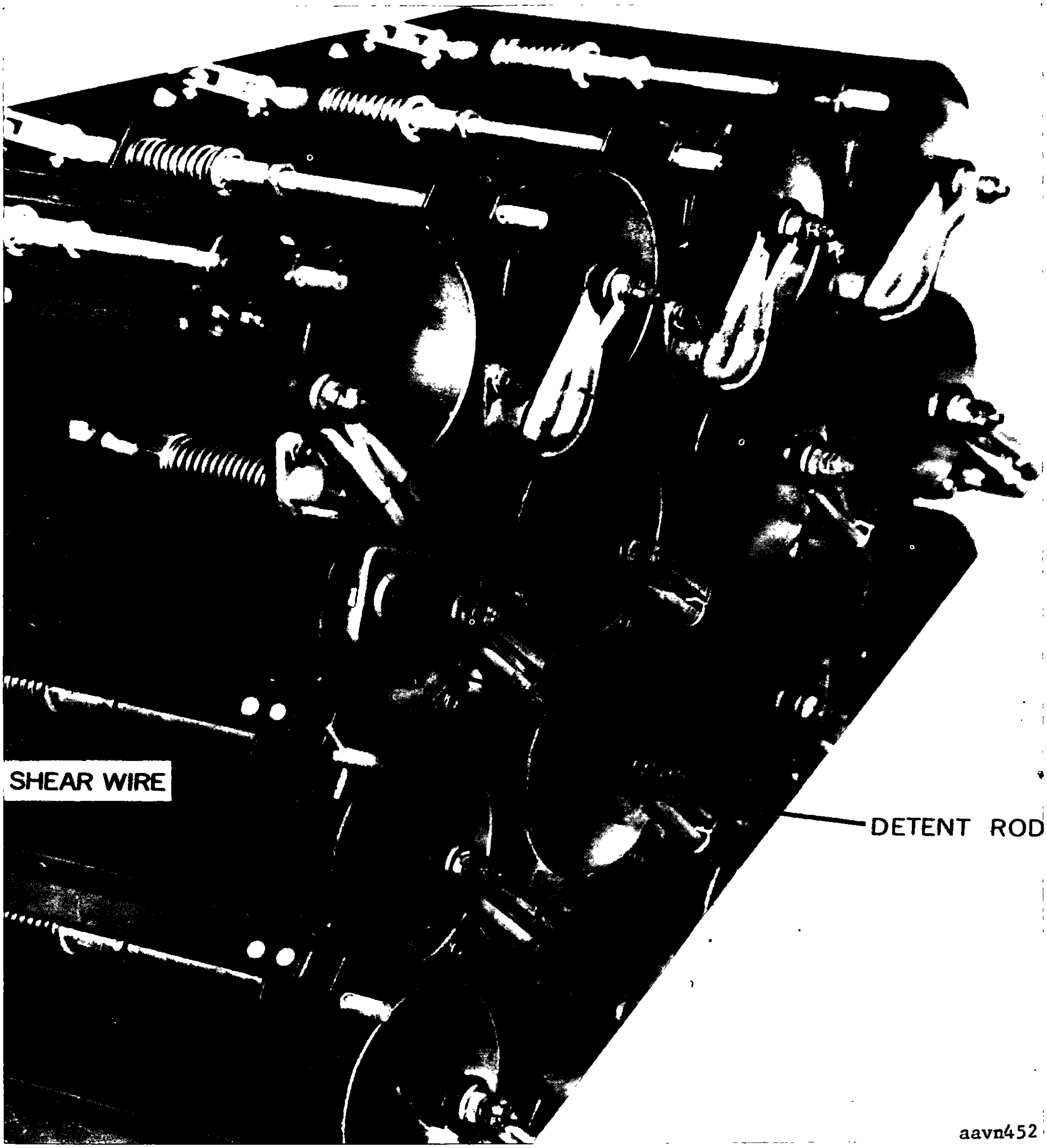


Figure D–17. Shear wire in detent rod.

(8) Remove electric grounding cable.

Caution: **When launchers remain loaded for an extended period of time, warheads should be checked for tightness. Temperature changes can loosen warheads.**

e. Firing.

(1) *Before* takeoff, close the rocket jettison and rocket sight circuit breakers; the JETTISON POWER ON indicator should glow.

(2) *After* takeoff, prepare for firing by setting the POWER switch to ON. The SYSTEM POWER ON, SAFE, and ZERO indicators on the armament panel should glow.

(3) Check that doors and windows are closed.

(4) Set selector switch on the armament panel for the number of pairs of rockets to be fired.

(5) Turn sight on and adjust light intensity to desired level.

(6) By setting desired degree scale reading at the zero mark of the fixed index scale, set sight for target engagement range and speed.

(7) Set arm switch to ARMED. The SAFE indicator goes out and the ARMED indicator glows.

(8) Aline sight reticle on target by aiming the helicopter.

(9) When ready, fire the rockets by pressing and holding the firing switch on the cyclic control stick. The ZERO indicator will go out when the first pair of rockets is fired.

Note. The number of rockets selected need not all be fired. To interrupt the ripple, release the firing switch again; the interrupted ripple will not be resumed, but a new one will begin.

(10) Set the arm switch to SAFE. The ARMED indicator goes out and the SAFE indicator glows.

(11) When firing is ended, set the POWER switch to OFF. All indicators except the JETTISON POWER ON and ZERO go out.

f. Unloading.

(1) *Preparation for unloading.* Before unloading the launcher—

(*a*) Check that the rocket-armament panel counter reads 000.

***Warning:* If there are misfired rockets in the launcher, turn the power switch to OFF and wait 10 minutes after last attempt to fire before unloading rockets.**

(*b*) Check that the ZERO indicators on the panel and the interconnecting box glow when the rocket-jettison circuit breaker is closed and the POWER switch is set to ON.

(*c*) Set the helicopter master battery switch to the OFF position.

(*d*) Set the POWER switch to OFF and pull out the rocket-jettison circuit breaker.

(*e*) Electrically ground the helicopter to an earth ground.

(*f*) Disconnect the battery plug from the battery.

(2) *Unloading.*

(*a*) Swing the firing pin assembly away from the breech.

(*b*) Remove the shear wire from the detent rod.*

(*c*) Push the rocket forward until it protrudes from the tube. Grasp it at the front end and pull it out of the tube.

(*d*) Install the fin protector over the fins. See TM 9–1300–206 for disposition of rounds removed.

g. Emergency Procedure.

(1) *Failure to fire.* If there is a misfire, continue mission firing until all 24 pairs of rockets should have been fired. Then set the POWER switch to OFF and the arm switch to SAFE. Note that the ZERO indicator on the rocket armament panel glows. Set the rocket armament panel counter to 000. Leave the selector switch set on 24, aim the helicopter at a target, and press and hold the firing switch until the counter indicates 24. If the misfired rounds do not fire on this second attempt, set the POWER switch to OFF and the arm switch to SAFE. Wait 10 minutes before unloading rockets. Rockets will be unloaded by organizational maintenance personnel; see instructions for unloading in *f* above.

(2) *Jettisoning.* The rocket pods should be jettisoned in the event of a fire or explosion in a rocket pod, or an aircraft emergency requiring a forced landing. The pods should be jettisoned in an aircraft emergency to reduce the fire and explosion hazard. The autorotational characteristics of the helicopter are normal with empty pods.

(*a*) To jettison the pods, first make sure the JETTISON POWER ON indicator glows. When ready to jettison, set the JETTISON switch to the FIRE position. Both pods will be jettisoned, and the JETTISON COMPLETE indicator will glow. Pull out the rocket jettison circuit breaker.

(*b*) For safe airspeed and sideslip limits for jettisoning of the XM3 rocket pods when used in combination with the M5 subsystem (UH–1C), see TM 55–1520–220–10.

D–7. Alinement of the Subsystem

The XM3 armament subsystem must be alined so that the standard sight settings will be accurate in azimuth and range. Alinement is accomplished by determining the helicopter centerline, leveling the sight, and alining the sight and pods. The pods are set at a fixed quadrant elevation.

a. Preparation for Alinement.

(1) Place the helicopter on an airstrip or other level surface pointed in the approximate direction of a distant aiming point at 1,200 to 1,500 meters.

*This step may be omitted in a combat situation.

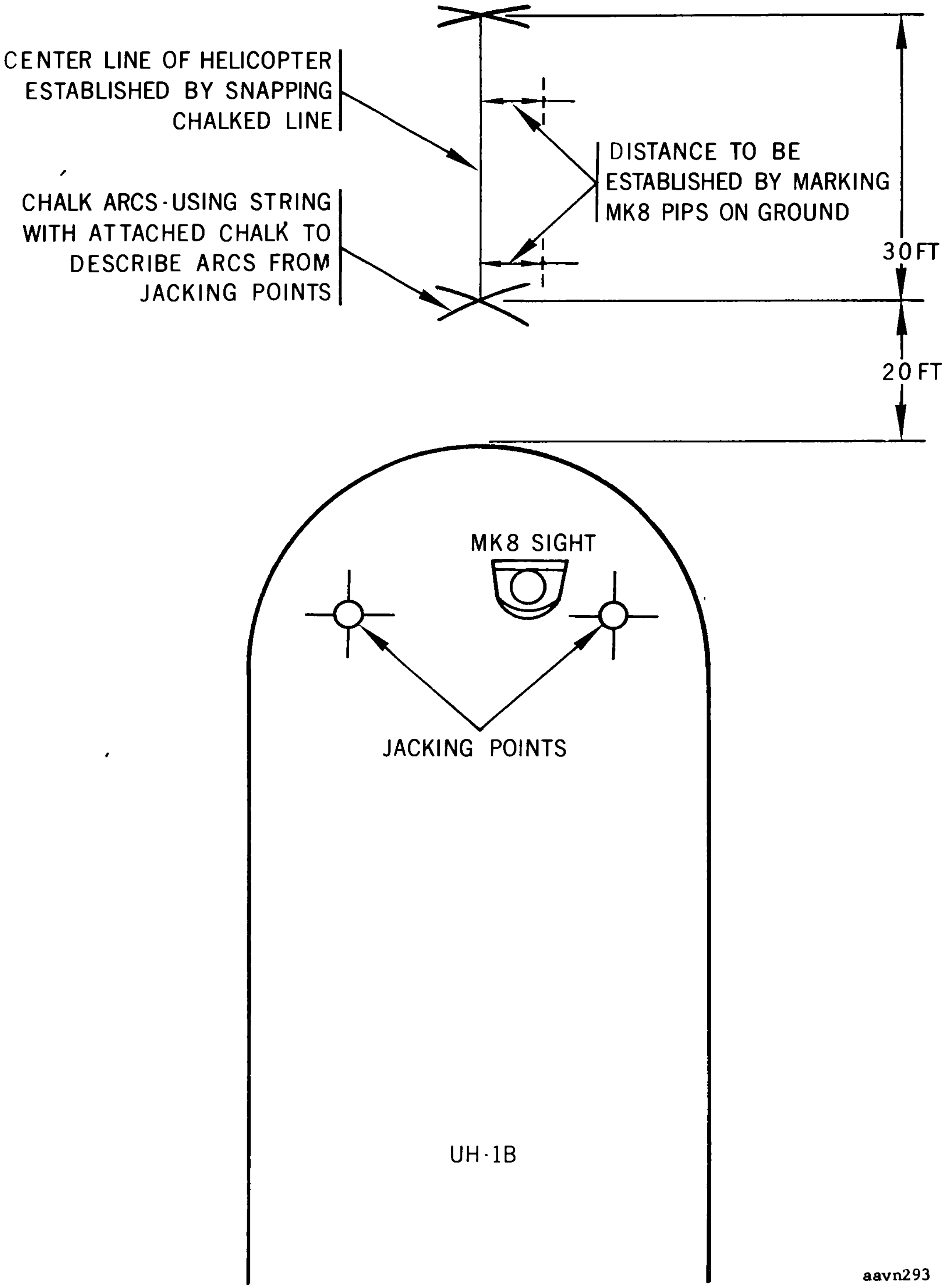


Figure D–18. Alinement diagram.

(2) Level the helicopter, using a plumb bob placed in the left-hand cargo door. For additional instructions, see TM 9–1055–217–20.

(3) Stabilize the helicopter by placing wooden blocks under the skids where the cross-tubes attach (four positions). The blocks must be at least 4 inches wide and present a firm, flat surface to both the ground and the skid.

***Caution:* Personnel will be allowed in the helicopter while it is on jacks only if it is stabilized as described above.**

(4) Establish the centerline of the helicopter on the ground from 20 to 50 feet in front of the helicopter (fig. D–18). This may be done by using two lengths of nonstretch string or wire, one 25 and the other 55 feet long. Attach the 25-foot string to the forward right-hand jacking point and scribe an arc on the ground with a piece of chalk on the end of the string. Repeat, using the forward left-hand jacking point. Do the same thing with the 55-foot string and, using a chalked string, mark a line on the ground connecting the intersections of the two pairs of arcs. This line will be the helicopter centerline reference for alinement procedures covered in *b* and *c* below.

b. Alinement of the Infinity Sight.

(1) Aline the sight approximately parallel to the centerline of the helicopter by loosening the two clamp screws (fig. D–19) and adjusting the azimuth boresight adjustment nuts (fig. D–19).

(2) Adjust the sight in cant and elevation until both leveling vials are level. Center the bubble in the rear (cant) leveling vial by adjusting the right and left mounting screws (fig. D–19); center the side (elevation) vial by adjusting the

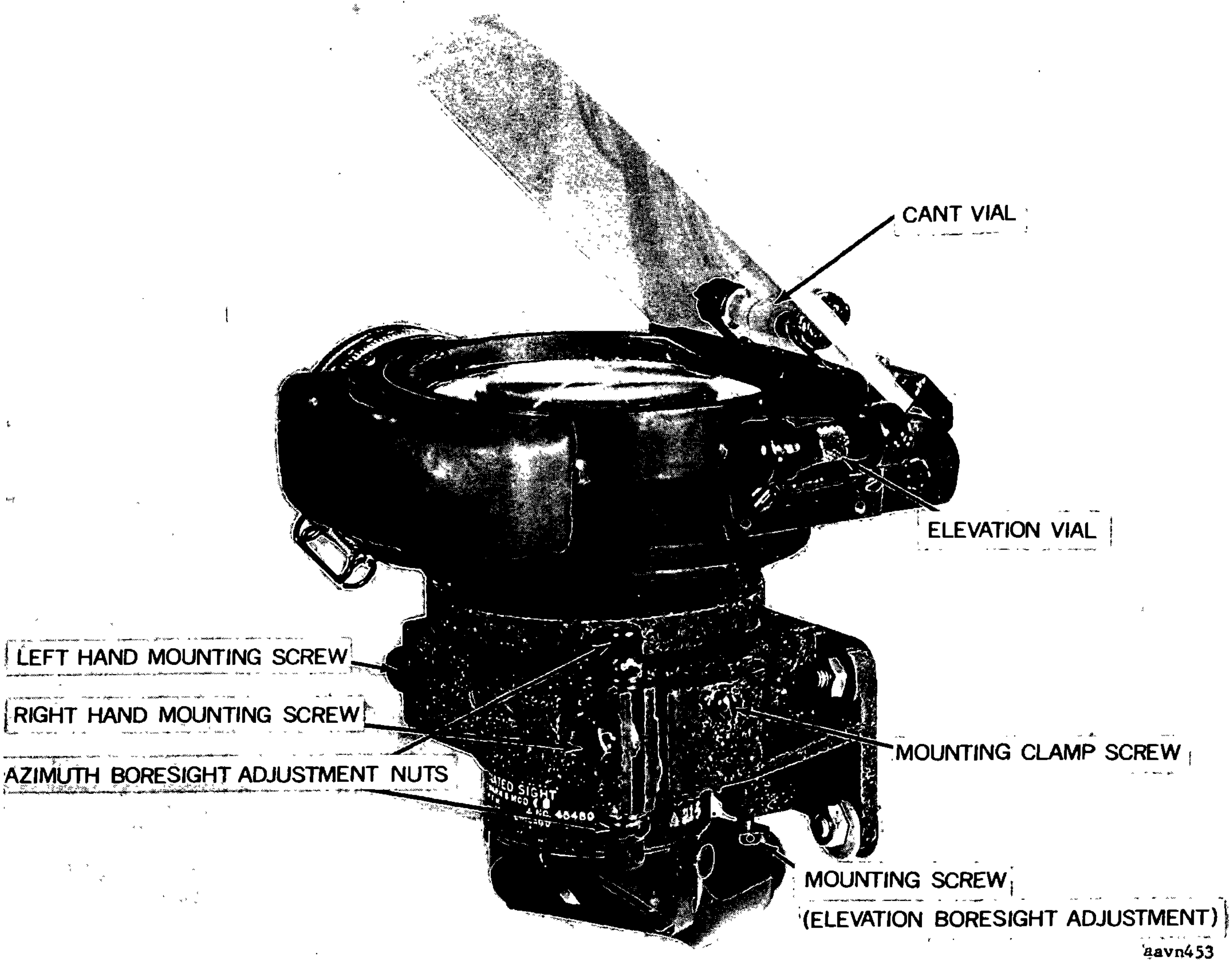


Figure D–19. Right side of Mk 8 reflex infinity sight.

mounting screw (elevation boresight adjustment) (fig. D-19).

(3) Illuminate the sight reticle by pushing in the sight-illumination circuit breaker on the overhead breaker panel and adjusting the intensity control (fig. D-10) until a clear reticle pattern is visible.

Note. When sighting during alinement, hold your eye 10 to 15 inches from the reflector and move your eye until the intensity of illumination of the 50-mil ring appears even.

(4) Adjust the sight reflector to place the pip of the reticle pattern at a minimum distance, and mark this point on the ground. Readjust the reflector to place the pip farther along the helicopter centerline, and mark this point on the ground (fig. D-18).

(5) Measure the distance from the centerline to the two pip marks. If the two distances are not equal, make them equal by adjusting the sight in azimuth with the azimuth boresight adjustment nuts (fig. D-19). This adjustment must be made so that the reticle pip can be moved anywhere along the centerline and remain the same distance from it.

c. Methods of Pod Alinement. Two methods of pod alinement are the *distance aiming point method* and the *parallel line method.*

(1) *Distance aiming point method.*

(*a*) With helicopter level, use gunner's quadrant (fig. D-20) to set rocket pod elevation at 103.2 mils. Adjust pod elevation by rotating the turnbuckle of the mechanical adjusting link (fig. D-21).

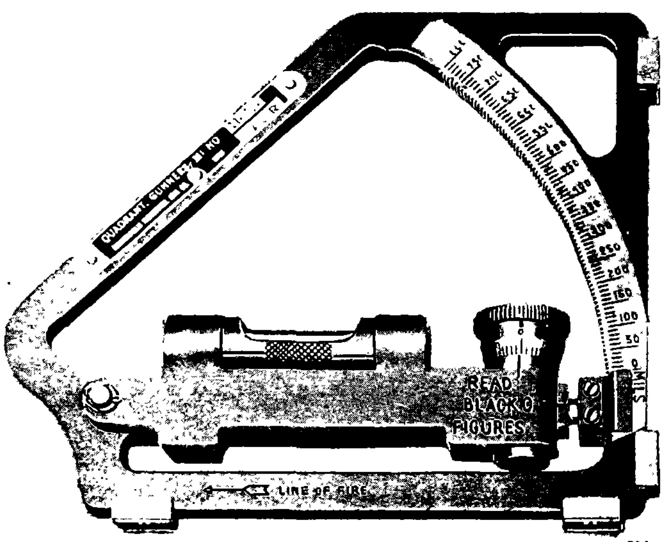


Figure D-20. Gunner's quadrant.

(*b*) Reposition the helicopter, if necessary, to place the reticle pip on the point target already selected (*a* above).

(*c*) Set the sight reflector elevation to +5.8°.

(*d*) By adjusting the jacks, reposition the helicopter in elevation so that the sight pip is on the point target.

(*e*) Insert the boresight (fig. D-22) in number 14 tube (fig. D-5) of the right-hand pod (fig. D-23).

(*f*) Adjust the plastic bearings on the right-hand pod until the boresight reticle croshairs and the sight pip fall at the same place on

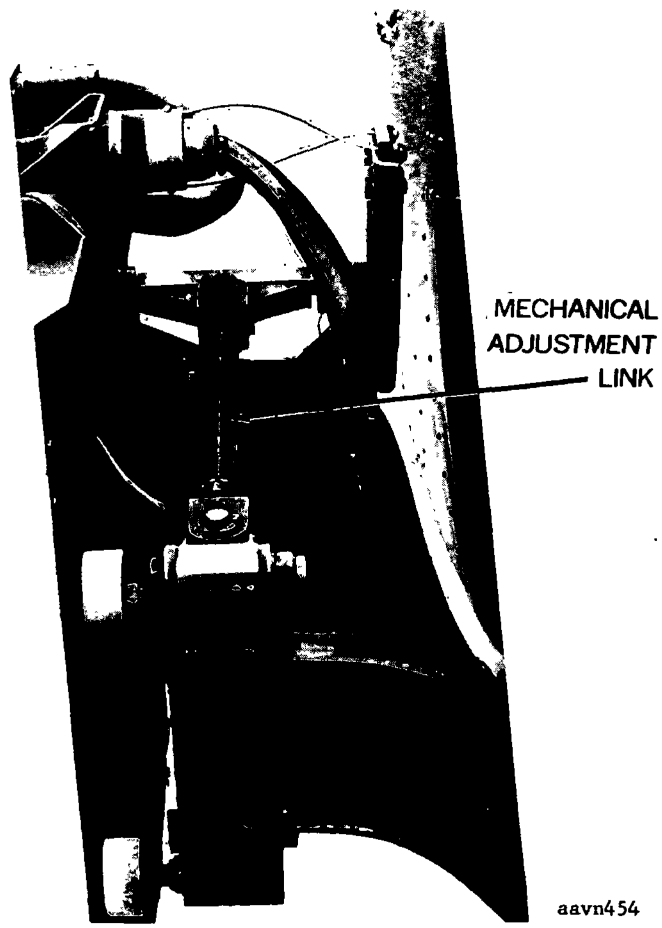


Figure D-21. Mechanical adjusting link.

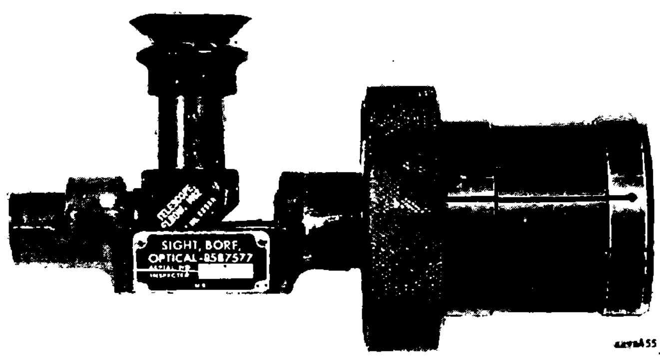


Figure D-22. Optical boresight.

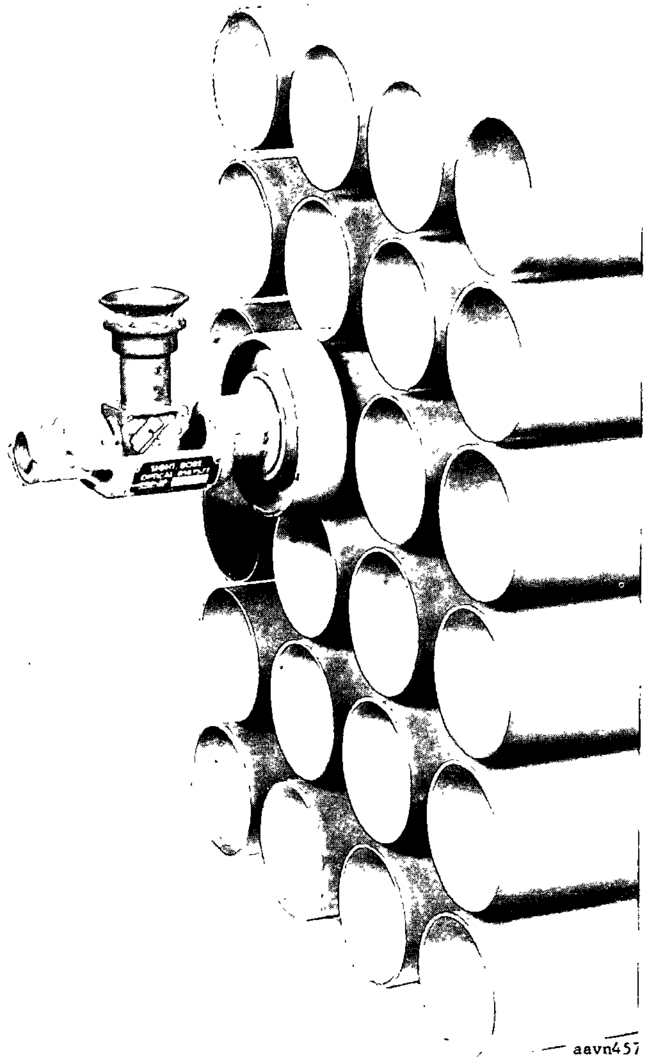


Figure D-23. Boresight installed in launcher pod.

the point target. Lock the plastic bearings (fig. D-1) with their lock nuts.

Note. If pods will not adjust to the selected point, adjust as close as possible to the point, then adjust sight to the new point.

(*g*) Repeat (*e*) and (*f*) above for the left-hand launcher pod.

(2) *Parallel line method.*

(*a*) Using gunner's quadrant, level the right-hand launcher pod. Adjust the pod elevation by rotating the turnbuckle of the mechanical adjusting link (fig. D-21).

(*b*) Place the boresight telescope in the front opening of the upper-row outboard tube of the right-hand launcher pod. Drop a plumb line from the boresight and aline the vertical line of the boresight reticle with the plumb line. Mark the point on the ground indicated by the plumb bob.

(*c*) Remove the boresight and place it in the rear of the same tube. Repeat the procedure of (*b*) above.

(*d*) Make a chalkline on the ground connecting the two marks established in (*b*) and (*c*) above (fig. D-24).

(*e*) Measure the distances from the centerline of the helicopter to the front and rear of the line under the launcher pod. If the distances are not equal, make them equal by adjusting the plastic bearings on the pod mount. Lock the plastic bearings (fig. D-1) with their lock nuts.

(*f*) Using gunners quadrant, set the elevation of each pod at 103.2 mils.

(*g*) Repeat the procedure given in (*a*) through (*f*) above for the left-hand launcher pod, using the corresponding launcher tube.

Note. If pods cannot be adjusted to the determined centerline, then a new centerline must be determined within pod adjustment range.

D-8. Preventive Maintenance

Preventive maintenance services are the responsibility of the crew chief and organizational maintenance personnel. They consist of *before-operation, after-operation, daily,* and *periodic* services. Intervals specified are minimum under usual conditions. Under unusual conditions such as extreme temperatures; dusty, moist, or salty atmosphere; or rain or snow; the preventive maintenance services should be performed more often. For detailed instructions, see appropriate TM (app A).

D-9. System Tests

Before each day's firing, perform system tests on the *firing circuits* and the *jettison circuits*.

***Warning:* Do not make system tests with rockets in the launcher tubes.**

a. Firing Circuits. Check the firing circuits, including the intervalometer and interconnecting box, to insure that—

(1) Circuitry to each pod is operating properly.

(2) Operation of the firing switch will send electrical current to the firing tubes selected by the mode selector switch.

(3) Accidental firing by stray voltage will not occur.

b. Jettison Circuits. Check the jettison circuits to assure that operation of the jettison switch sends the required electrical firing voltage.

***Warning:* Before performing jettison circuit tests, insure that the four explosive bolt wires are disconnected.**

(1) The tests are performed with a *multi-*

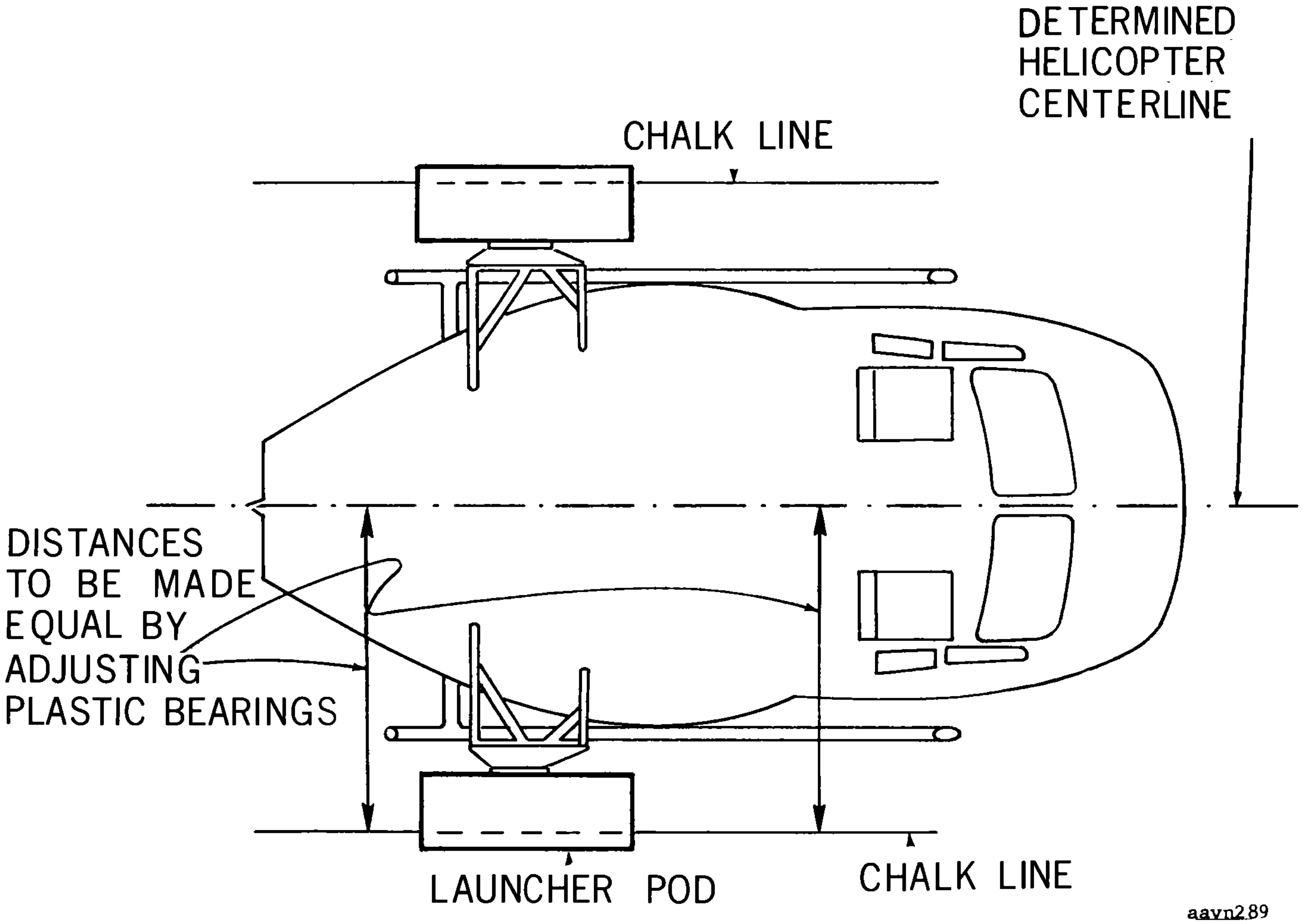


Figure D–24. Parallel line method.

meter, system test box, and *test cables* (fig. D–25). This test equipment is normally available at the organizational level of maintenance.

(2) Procedures for testing are found in TM 9–1055–217–20 or TM 9–1055–217–35.

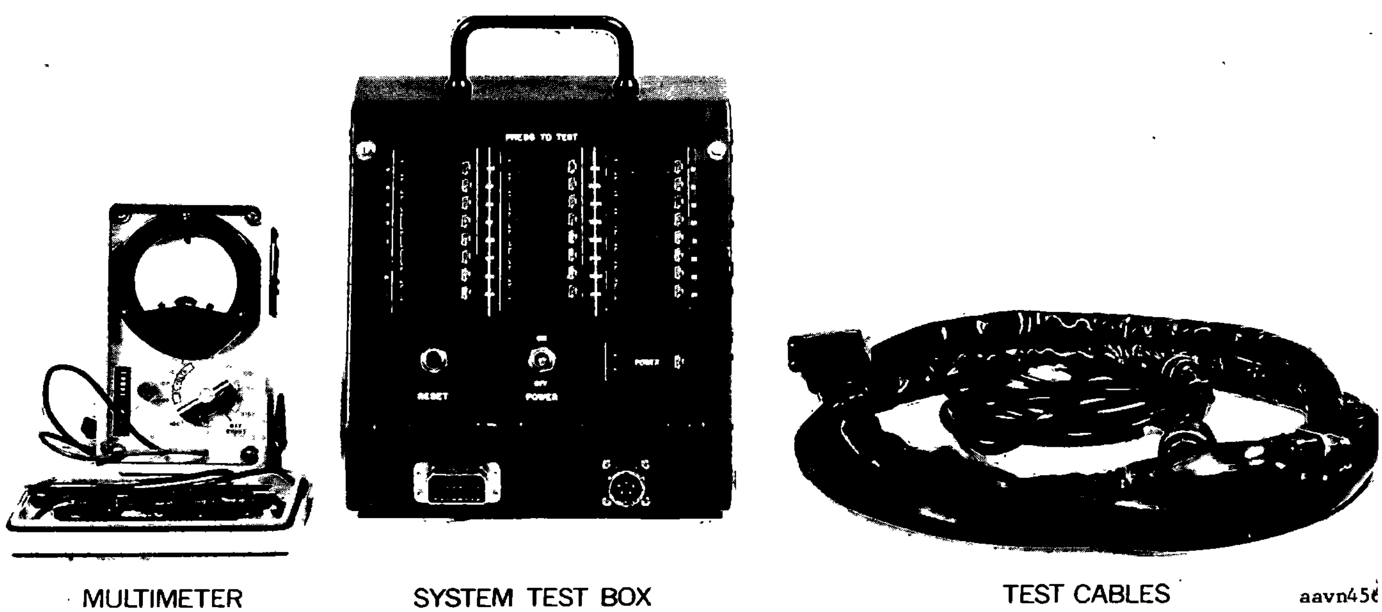


Figure D–25. Multimeter, system test box, and test cables.

Section II. M16 ARMAMENT SUBSYSTEM

D–10. Capabilities

The M16 helicopter armament subsystem used on UH–1B/C helicopters (figs. D–26 and D–27) provides the helicopter with a dual-weapon inflight neutralization fire capability. The weapons subsystem—

a. Provides an immediately responsive and highly mobile means of delivering offensive or defensive rocket or light weapons area fires against personnel in the open, soft material targets, and lightly armored vehicles.

b. Has a high degree of accuracy when all four guns are boresighted or harmonized to converge at 700 meters and the rocket launchers are boresighted to converge rocket fires at 1,250 meters.

c. Is capable of operating within a speed range of 0 to 160 knots.

d. Will function satisfactorily in all coordinated helicopter positions or attitudes.

e. Can be operated in all tactical environmental conditions in which the helicopter can operate.

f. Has 7.62mm machineguns and 2.75-inch rocket launchers that can be replaced easily and quickly if rendered inoperative by combat damage.

g. Has rocket launchers that can be electrically or manually jettisoned in case of in-flight emergency.

h. Can be used to simultaneously engage dual targets with the flexible 7.62mm machineguns and the 2.75-inch rockets.

i. Can be detached quickly from the helicopter and transported by Army utility aircraft or by motor vehicle.

j. Has dual-weapons capability that provides for selection of weapons best suited to the target.

k. Is capable of selective fire in the following modes:

(1) *Machineguns, 7.62mm.*

(*a*) Flexible, using gunner's flexible sighting station.

(*b*) Stowed, using the XM60 infinity sight and the firing switch on the cyclic control stick.

(2) *2.75-inch spin stabilized folding fin aerial rocket (SSFFAR).*

(*a*) Pair—single rocket from each launcher.

(*b*) Ripples of 2, 3, 4, 5, 6, or 7, pairs (14 rockets).

l. Has the following range:

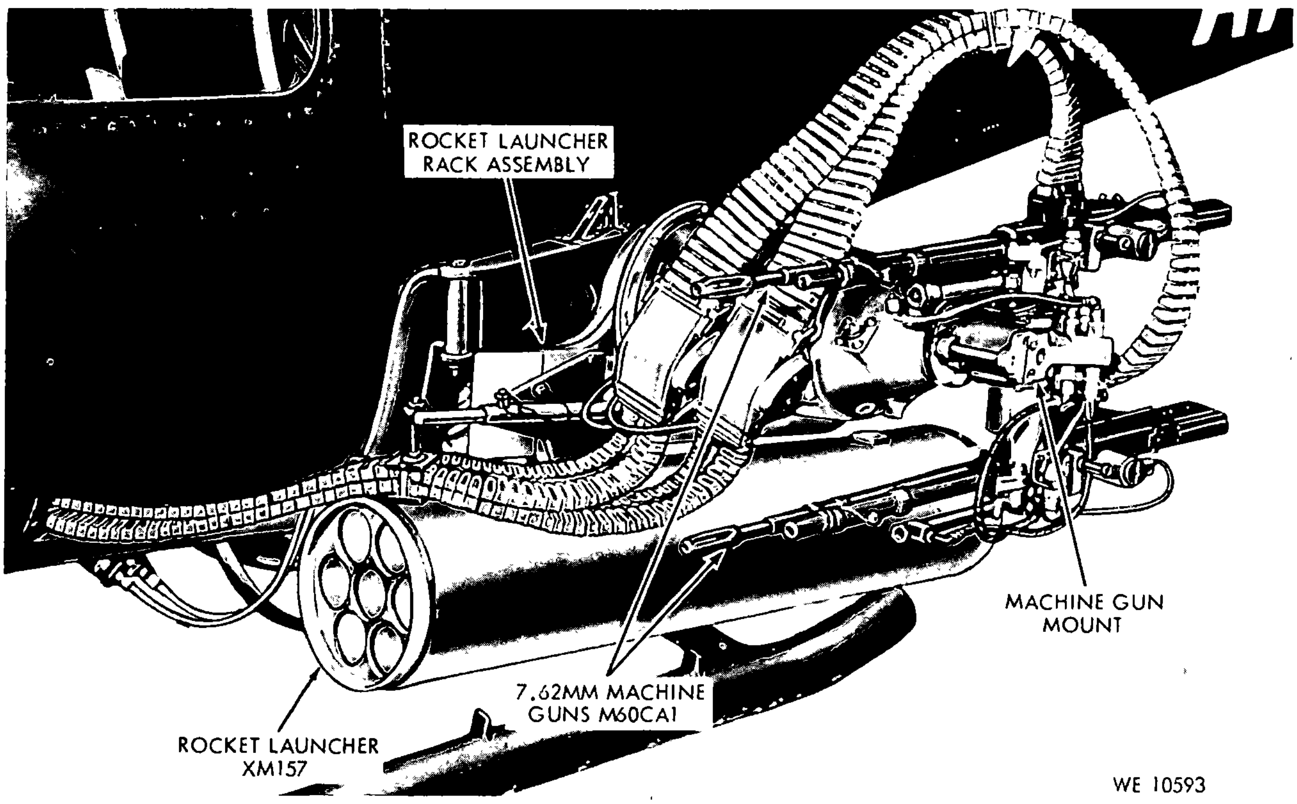


Figure D-26. 7.62mm machinegun, 2.75-inch rocket launcher helicopter armament subsystem M16 (launcher XM157 installed).

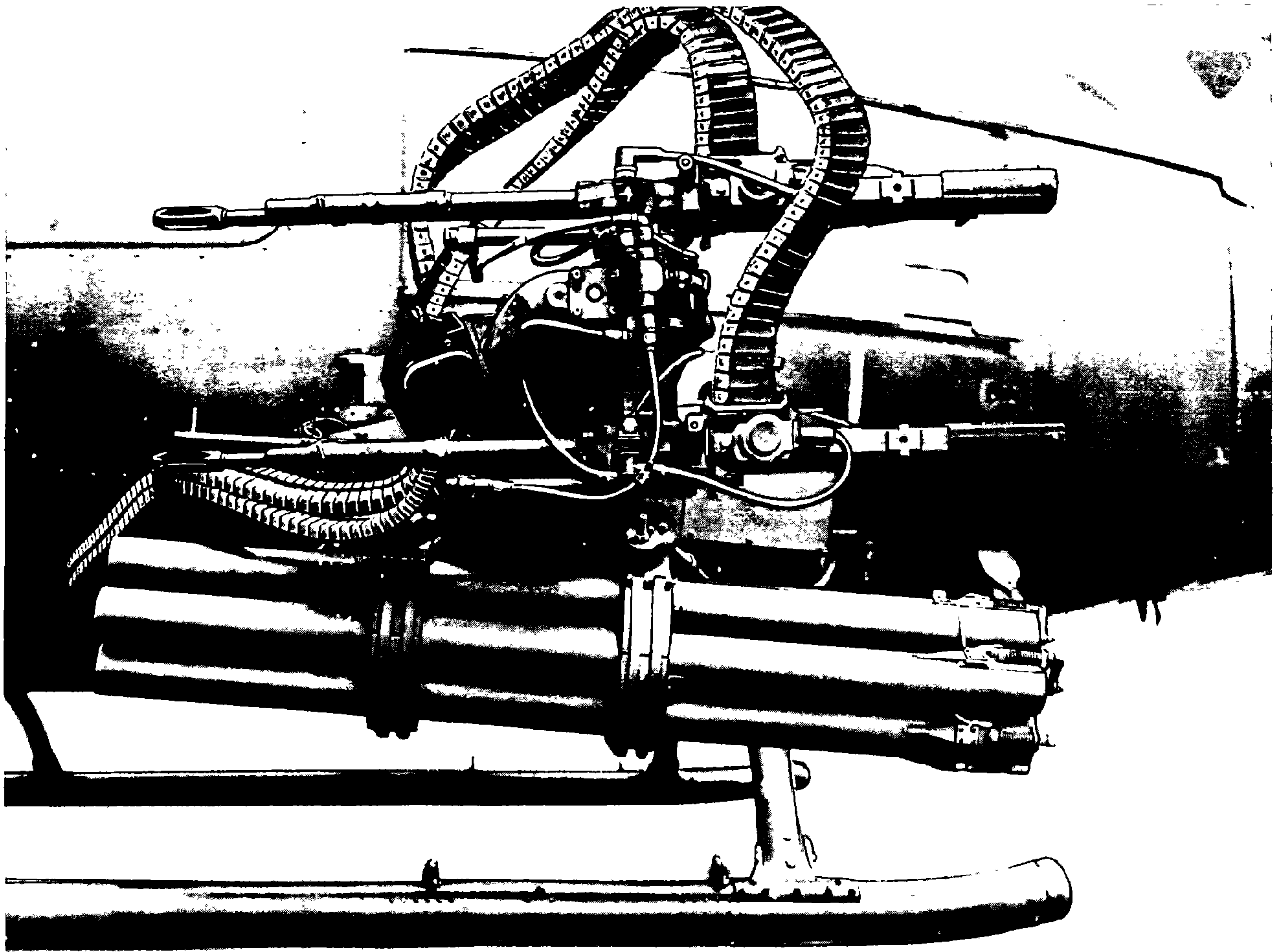


Figure D–27. 7.62mm machinegun, 2.75-inch rocket launcher helicopter armament subsystem M16 (launcher XM158 installed).

(1) *Maximum effective.*
(*a*) Machineguns—1,000 meters.
(*b*) 2.75-inch FFAR—2,500 meters.
(2) *Minimum* (*safe slant range*).
(*a*) Machineguns—100 meters.
(*b*) 2.75-inch FFAR—300 meters.

D–11. Limitations

The M16 armament subsystem is vulnerable to all types of air defense fires, including small arms, and has the following limitations:

a. Effectiveness of operation is reduced at night and during periods of low visibility due to limitations in target acquisition and range estimation.

b. Engagement of targets is limited by subsystem's gun/launcher limits in relation to target range, altitude, airspeed, and helicopter degree of bank.

Warning: **Extreme caution must be exercised when firing from the UH–1 on the ground. The guns and rocket launchers are located behind the cargo doors and occupants must not leave or enter the helicopter in front of loaded guns or rocket launchers. Before entering or leaving the helicopter, remove gun barrels and disconnect subsystem electrical connectors on rocket launchers.**

D–12. Description

The M16 armament subsystem (figs. D–26 and D–27) has a quad 7.62mm machinegun subsystem combined with two 2.75-inch XM157 or XM158 rocket launchers. The subsystem has a gun control panel, an intervalometer control panel, two rack and support assemblies, two power-operated flexible gun mounts with an ammunition supply and feed system, a flexible machinegun sighting station, and an infinity reflecting sight for firing rockets and machineguns from stow position (fig. D–28). The 7.62mm machineguns have a stow fire capability for standby or emergency use. For description of flexible machinegun components, see appendix C and TM 9–1005–243–12.

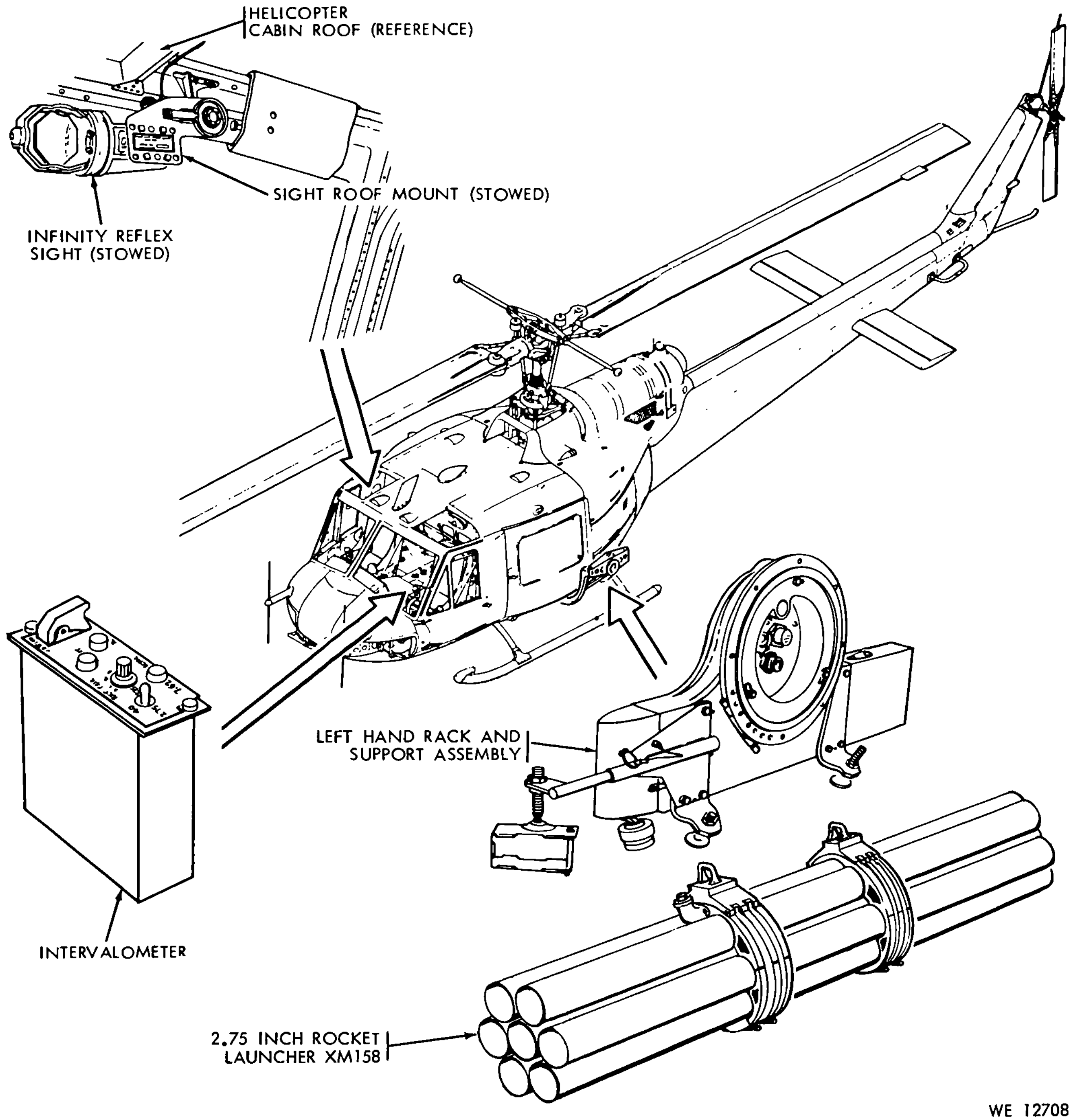
a. Gun Control Panel. The face of the gun control panel (fig. D–29) contains the OFF-SAFE-ARMED switch, the GUN SELECTOR switch, the ARMED-SAFE indicator lights, and two panel edge lights.

(1) *OFF-SAFE-ARMED switch* (fig. D–29).

(a) *SAFE position.* Moving the OFF-SAFE-ARMED switch to the SAFE position applies 28 volts of DC power to the subsystem.

1. The gun control and intervalometer panels are energized.

2. Through zener diodes, part of the 28-volt DC power applies to the stow lock-release solenoids and makes gun mount movement possible.



D–28. Components of the 2.75-inch rocket launcher portion of the M16 subsystem on UH–1B/C helicopter.

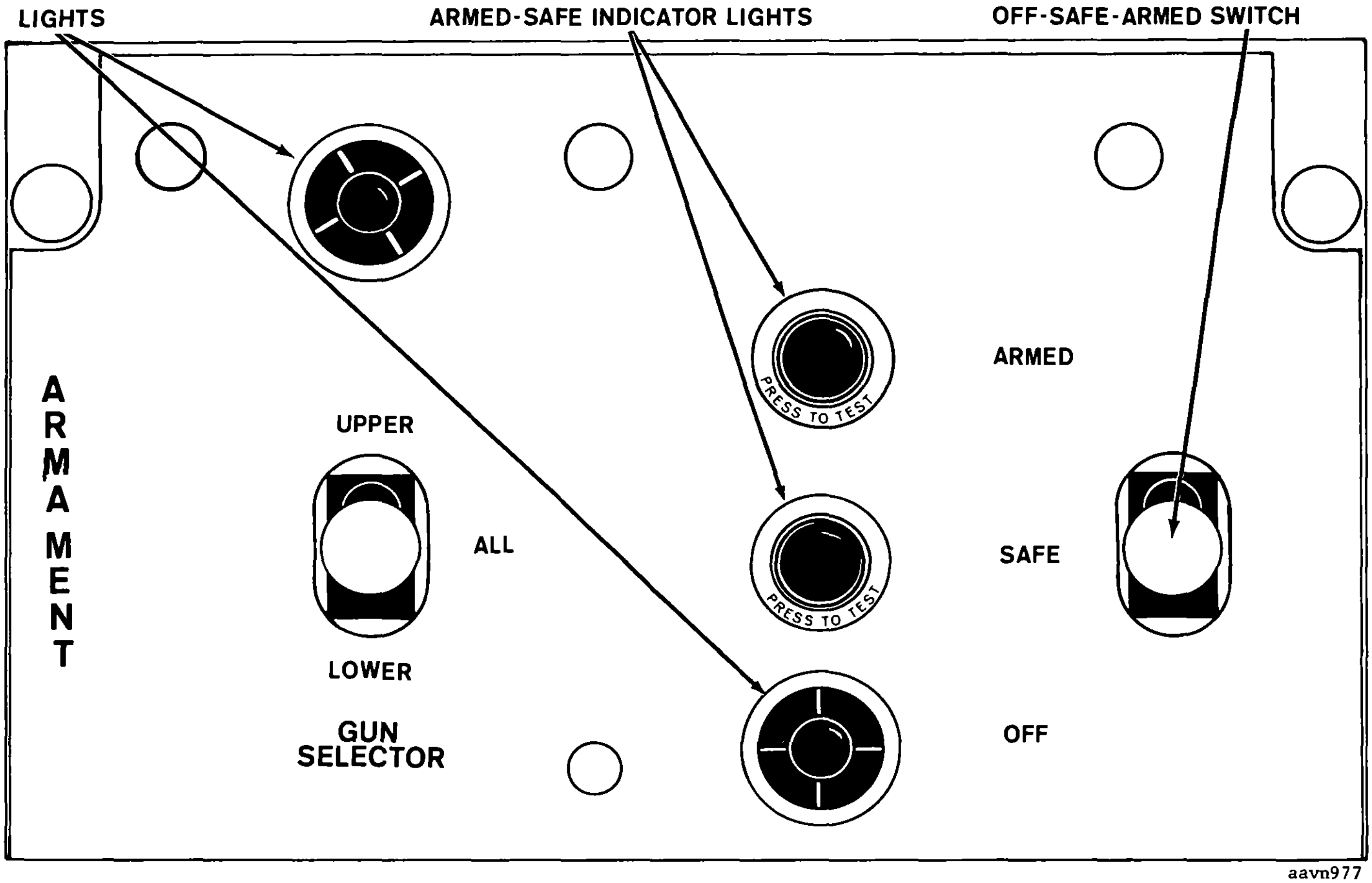


Figure D-29. Gun control panel.

3. The helicopter hydraulic power shutoff valve is energized, making hydraulic power available.

(*b*) *ARMED position.* Moving the OFF-SAFE-ARMED switch to the ARMED position—

1. Energizes the cylinder assembly (charger) control valves and lock-release solenoids, making the chargers ready to allow firing. However, when the charger control valves are de-energized, the chargers return to the aft "out-of-battery" position, holding the guns on SAFE.

2. Allows the gun mount assemblies to follow the sighting station commands when the action switch is depressed.

3. Automatically provides a 2 to 3 seconds time delay by a module in the gun control panel. This time delay allows the hydraulic charger assemblies enough time to make a complete cycle. Machineguns cannot be fired until the red ARMED indicator light illuminates ((3) (*b*) below).

4. Illuminates reticle in gunner's flexible machinegun firing station.

(2) *GUN SELECTOR switch* (fig. D-29). Subsystem firepower is controlled by the GUN SELECTOR switch. This switch permits selection of the UPPER guns of each mount, the LOWER guns, or ALL guns if maximum firepower is desired.

(3) *ARMED-SAFE indicator lights* (fig. D-29). When electric and hydraulic power are applied to the subsystem and the OFF-SAFE-ARMED switch is moved to—

(*a*) *SAFE position,* the green SAFE indicator light illuminates. This light indicates that charger pistons have retracted machinegun bolts to the "out-of-battery" position, holding the bolts there.

(*b*) *ARMED position,* the red ARMED indicator light illuminates. This light indicates that machinegun bolts are in "out-of-battery" position but that charger pistons have retracted and no longer hold bolts out of battery.

Note. Turning the cap of each indicator light regulates the intensity of light emitted.

b. Intervalometer Control Panel. The intervalometer control panel (fig. D-30) is electrically interconnected with the gun control panel and controls rocket firing. The panel has an armament selector switch, ROCKET PAIR SELECTOR switch, rocket circuit RESET switch, and a launcher JETTISON switch. When the arma-

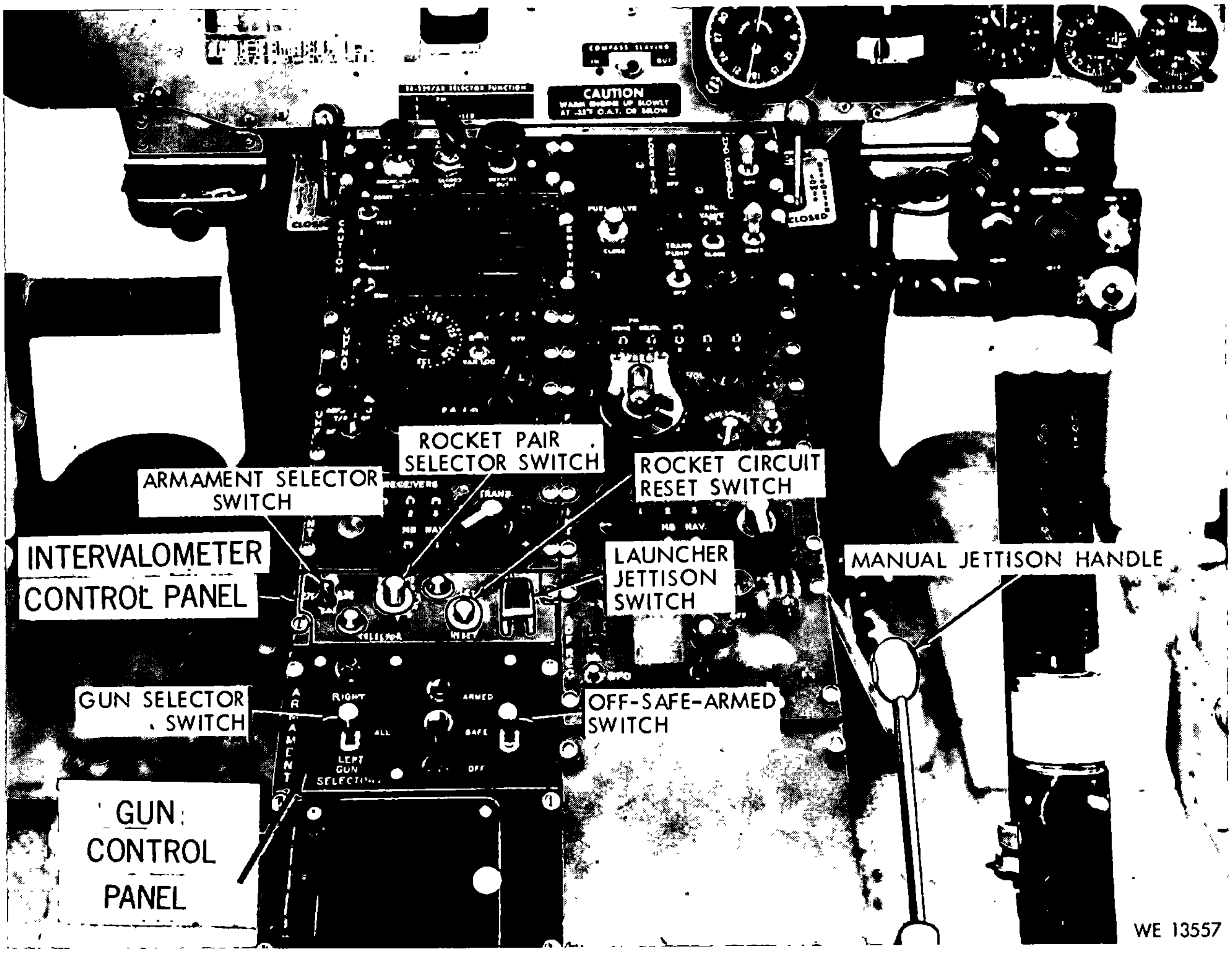


Figure D–30. Gun control panel and intervalometer control panel.

ment selector switch has been set to 2.75 and the ROCKET PAIR SELECTOR switch has been set, depressing either cyclic firing switch distributes electrical power from the intervalometer control panel to the rocket launchers.

(1) *Armament selector switch.* This three-position toggle switch allows the gunner or pilot to select the weapon that is to be fired by either cyclic firing switch; it has no affect on the gunner's flexible sighting station. The armament selector switch is placed in the following firing position:

(*a*) Machineguns—7.62.

(*b*) Rockets—*2.75*.

(*c*) 40mm grenade launcher—*40*.

***Warning:* If the M5 subsystem is not mounted on the helicopter, do not use the 40mm position setting on the armament selector switch. Rockets can be fired when the armament selector switch is in the 40mm position.**

(2) *ROCKET PAIR SELECTOR switch.* Rocket subsystem firepower is controlled by the ROCKET PAIR SELECTOR switch. This switch permits selection of one pair (a single rocket from each launcher) and ripples of 2, 3, 4, 5, 6, or 7 pairs (14 rockets) if maximum firepower is desired. Maximum accuracy is achieved by firing single pairs.

(3) *Rocket circuit RESET switch.* To recycle the intervalometer and the rack firing switch, depress the rocket circuit RESET switch.

Note. Before depressing the rocket circuit RESET switch, place the OFF-SAFE-ARMED switch in the SAFE position.

(4) *Launcher JETTISON switch.* To electrically jettison the rocket launchers, lift the red switch guard and move the spring-loaded launcher JETTISON switch forward. The 28 volts DC in the jettison circuit energizes solenoids in the rack and support assemblies. The solenoids then open the bomb rack hooks. The jettison circuit receives its power direct from a 28-volt DC circuit breaker on the armament circuit breaker panel.

c. Rack and Support Assemblies. Two rocket launcher rack and support assemblies, one on

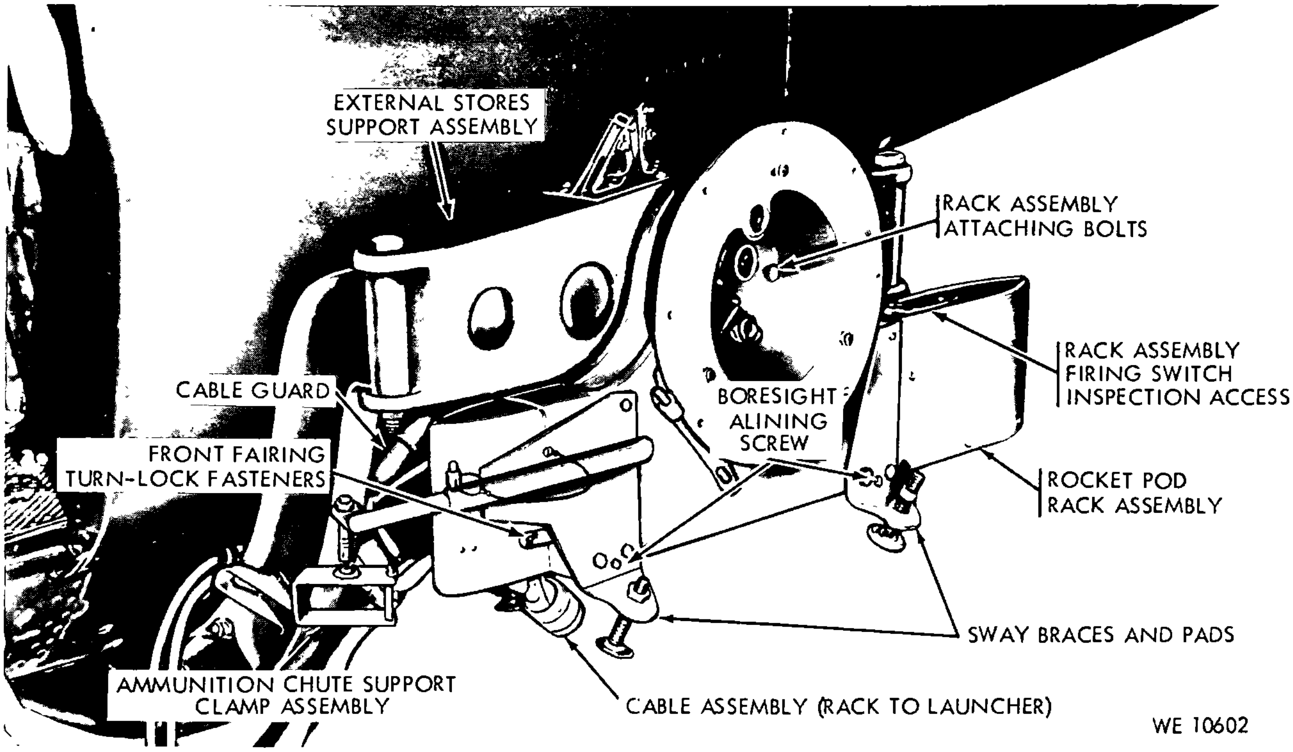


Figure D–31. Rack and support assembly installed on external stores support assembly—left side.

each side of the helicopter, mount on external stores support assemblies (fig. D–31) and provide mounting for the machineguns. The assemblies also hold one 2.75-inch rocket launcher (XM157 or XM158) each and provide electrical or manual jettisoning of rocket launchers. Each rack and support assembly is equipped with a rack firing switch that distributes the firing voltage in proper sequence to the launcher tubes.

D–13. Quad 7.62MM Machinegun Subsystem

For details of quad 7.62mm machineguns and mounts, see paragraph C–19.

D–14. Rocket Launchers

The rack and support assemblies will accept either the 2.75-inch rocket launcher XM157 (fig. D–32) or XM158 (fig. D–34).

a. The 2.75-Inch Rocket Launcher XM157 (fig. D–33). The XM157 launcher has an electrical receptacle on top and is attached to the rack and support assembly by two suspension lugs. It contains seven identical rocket launcher tubes. Since the electrical rocket firing contacts are stationary in the rear end of each tube, rockets must be loaded from the front of the launcher. A locking detent retains a rocket in each tube until launch. Launcher disassembly is not authorized since all components are sealed permanently within it.

b. The 2.75-Inch Rocket Launcher XM158 (fig. D–34). The XM158 launcher is attached to the rack and support assembly by two suspension lugs strapped to the segment assemblies. An electrical cable assembly connects the rack and support assembly to a receptacle on the launcher. The launcher electrical wiring goes through a conduit to a receptacle in front of the forward segment assembly. This launcher is made of aluminum and has seven identical rocket launcher tubes. The electrical contact can be pushed aside to clear each launcher tube for rocket launcher loading from the rear. A locking detent retains the rocket in each tube until launch. The contact is then returned to center position. Since all components can be removed and replaced, rocket launcher disassembly is authorized.

D–15. Sighting Stations

a. Flexible Machinegun Sighting Station (fig. C–24, app C). For a description of the flexible machinegun sighting station and sighting controls, see paragraph C–20*a*.

b. Infinity Sight XM60. The infinity sight XM60 (fig. D–35) is used by the pilot when effective weapon fire depends on flying a target collision course. The XM60 is primarily used as a sighting station for rocket firing and as a means of sighting the machineguns in the emergency or standby-stow position. It receives its power from

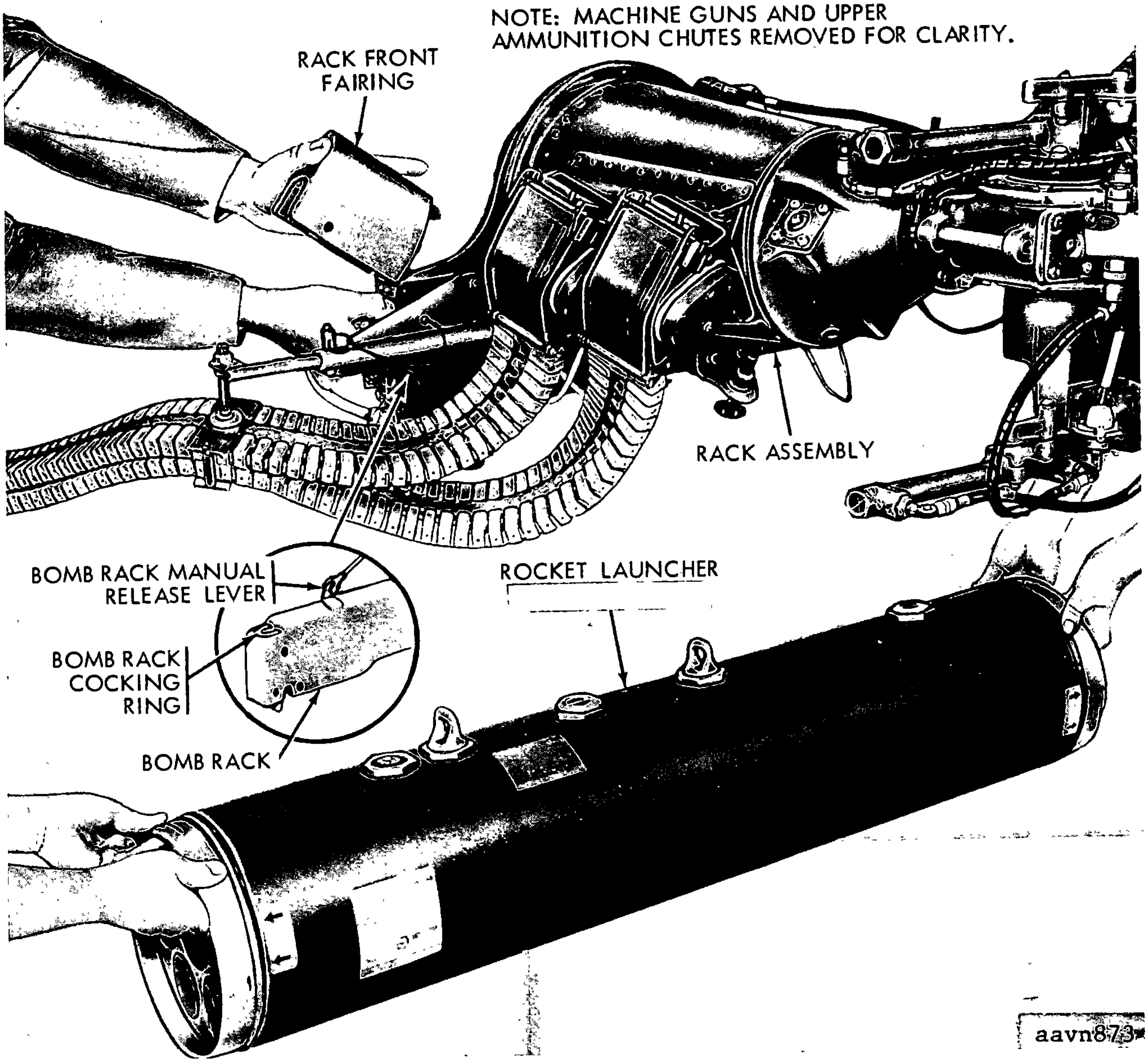


Figure D-32. Installing or removing XM157 rocket launcher.

a 28-volt DC circuit breaker on the armament circuit breaker panel. The sight is composed of a sight mount, power control housing, and a body assembly.

(1) *Sight mount.* The sight mount has an indented mounting ring and a locking lever which lock the sight in the stow or operate position.

(2) *Power control housing.* The power control housing contains a reticle lamp switch and a dimmer rheostat knob (fig. D-35) for controlling reflected reticle image brightness.

(*a*) *Reticle lamp switch.* The reticle lamp switch turns the reticle lamp on and off. The reticle lamp is a dual-filament type that will light when the switch is moved to either side of the OFF (straight-up) position. The reticle lamp illuminates the reticle pattern in the reticle and lamp housing assembly.

(*b*) *Dimmer rheostat knob.* The dimmer rheostat knob controls the sight reticle lamp variable resistor contained in the power control housing. Reticle image brightness can be varied by turning the dimmer rheostat knob (fig. D-35).

(3) *Body assembly.* The body assembly contains—

(*a*) An elevation-depression knob for reticle elevation adjustments.

(*b*) An inclinometer for reference while maintaining coordinated flight.

(*c*) A transparent reflector plate that re-

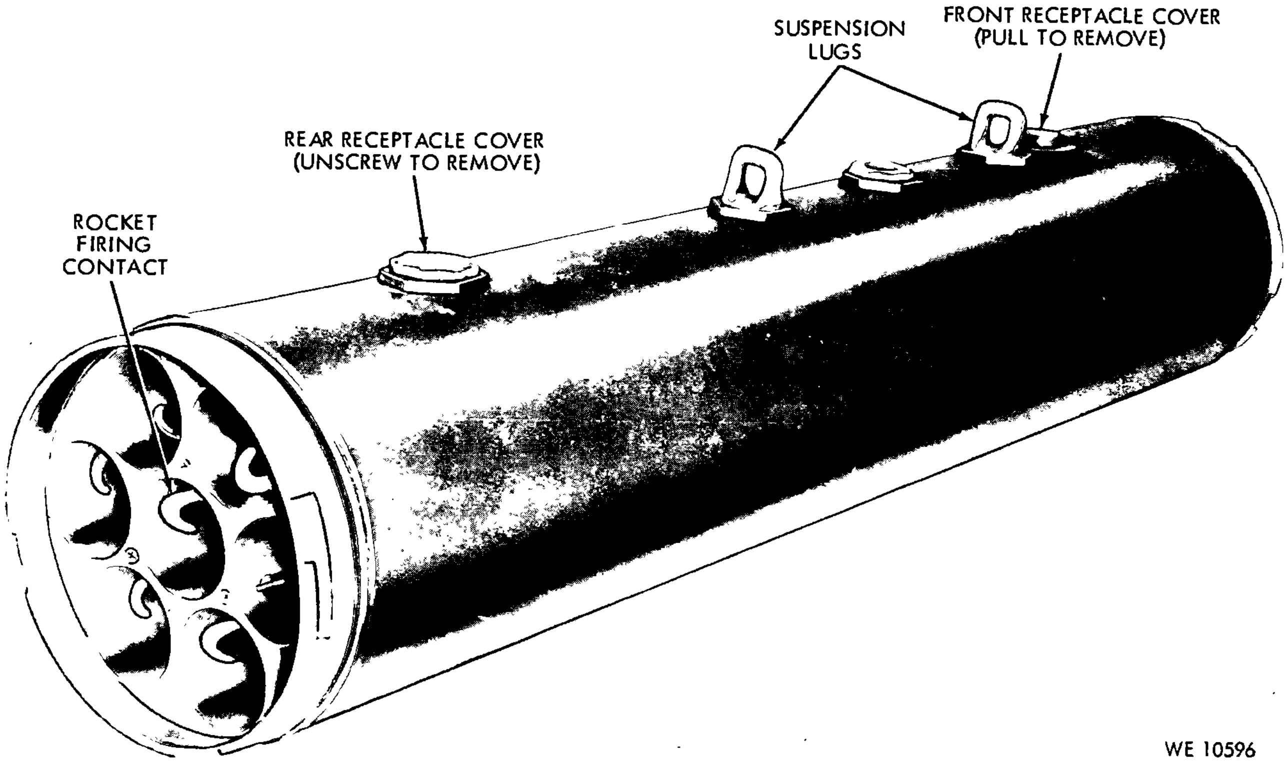


Figure D-33. The 2.75-inch rocket launcher XM157—right rear view.

flects the projected reticle image into the gunner's eye.

(*d*) A reticle and lamp housing assembly at the base of the sight.

D-16. Components of Optical Sights

The optical sight has four main parts—

a. Light Source. The light source, or lamp, is usually housed in a light-reflecting cavity to keep

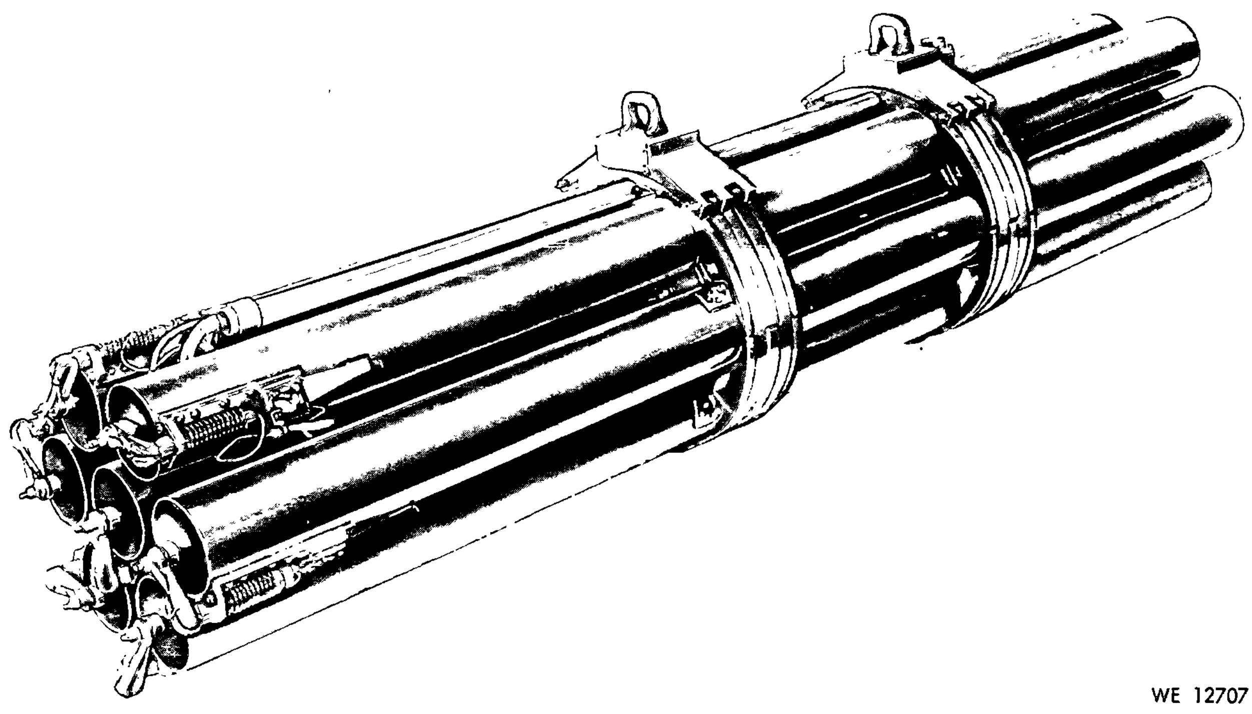


Figure D-34. The 2.75-inch rocket launcher XM158—right rear view.

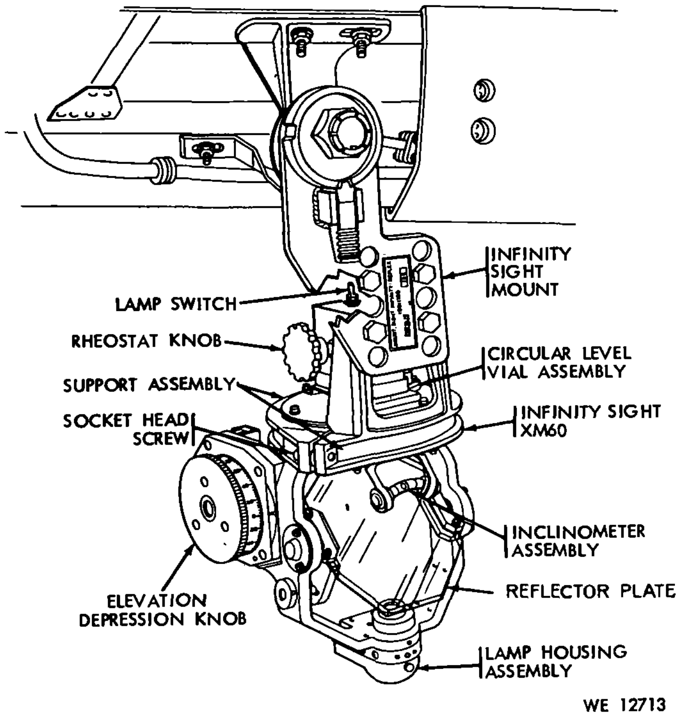


Figure D–35. Infinity sight XM60.

light losses at a minimum. Should a filament burnout during firing, a dual-filament type bulb is provided for reilluminating the reticle.

b. The Reticle (fig. D–36). The reticle is a small plate of thin metal or etched glass installed, at the principal focus of the lens, between the light source and the lens. The plate is perforated (or etched) with the reticle image. The remainder of the plate blocks off all light except those passing through the perforation.

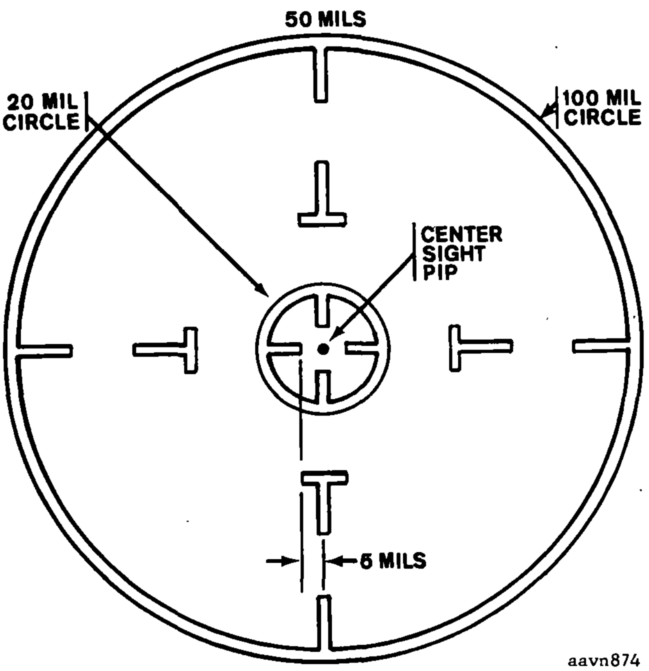


Figure D–36. XM60 sight reticle.

c. The Collimating Lens. The purpose of the collimating lens is to collimate (make parallel) all of the light rays coming from the reticle. This may be done by a series of lenses or by one lens. As the light rays pass through the collimating lens, the rays are magnified and collimated until all of the light rays coming through the optical system from one point on the reticle are parallel with each other.

d. The Reflector Plate. The transparent reflector plate presents the reticle image to the gunner's eye and permits him to visually superimpose the reticle image on the target.

D–17. Effect of the Collimating Lens on the Reticle Image

After passing through the collimating lens, the reticle image usually is interrupted by a transparent reflector plate where the image appears to be viewed by the eye. The cylinder and column of light appear as a ring and dot of light on the reflector plate. The ring and dot of light form the reticle image. Because of the refractive effect of the lens, the light rays forming the reticle image are parallel. The reticle image will appear to be projected to infinity, and always appears to lie in the same direction from the observer. Since the reticle image can be seen by the gunner on any portion of the reflector plate (within limits determined by the size of the lens and reflector plate), the gunner can move his head in any direction without altering the relationship between the reticle image and the target. Regardless of where the eyes are focused, the reticle image can be extended to any distance. As a result, when the eyes are focused on the target, the ring and pipper appear at the same focal distance as the target. The collimating-type lens in the optical sight affects the light rays that form the reticle image as follows:

a. Effect on the Ring and Pipper. All of the light rays coming from any one point on the reticle are collimated when they pass through the lens. Therefore, the pipper is actually a column made up of parallel light rays. The ring is a cylinder of parallel light rays formed by the lens from the light rays passing through the ring in the reticle. Because of the collimation of the light rays, the gunner can move his head and the pipper will still remain on the target. If he moves his head too far, he will not see the pipper.

b. Effect on Angular Value. The ring of the reticle image and the gunner's eye form a cone, with its apex at the gunner's eye. As the gunner moves his head, many of these cones will be formed. However, all of the cones will be parallel. Because these cones are parallel, the angular value of the reticle image will remain constant regardless of head position, and the ring will appear to be the same size regardless of the distance at which the eye is focused.

D–18. Parallax

Parallax is the apparent difference in the position of the reticle image when viewed from two different points. Whenever the reticle image moves away from a distant target as the head moves, parallax is present. Parallax occurs when the optical system is out of collimation (alinement). Some parallax is present in all lenses; careful and accurate adjustment is essential to reduce the parallax to an acceptable amount. These adjustments should be made by qualified repairmen only.

D–19. Removal and Installation of Rocket Launcher XM157 or XM158

To complete an assigned mission, rocket launchers that have sustained combat damage may need to be removed and replaced. At times crew-members must perform this task when armament maintenance personnel are not available to do it. To reduce helicopter turnaround time and to develop the teamwork needed to complete the procedures in a minimum length of time, all crewmembers should be familiar with the following procedures:

a. Removal (fig. D–32).

(1) Two crewmembers take positions at each end of the rocket launcher to support it after release.

(2) The crewmember at the muzzle end of the launcher disconnects the electrical cable from the forward receptacle on top of the launcher.

(3) A third crewmember opens the front of the rack and support assembly and pushes the bomb rack manual release lever.

(4) The other two crewmembers then lower the launcher.

b. Installation (fig. D–32).

(1) Loosen sway braces and two crewmembers take positions at each end of the rocket launcher. (To prevent installing launcher backwards, they insure that the rocket launcher is properly oriented to the rack and support assembly.)

(2) These two crewmembers check bomb rack hooks to insure they are open. (If hooks are not open, the front crewmember pushes the bomb rack release lever.)

(3) The two crewmembers lift launcher to bomb rack hooks.

(4) A third crewmember opens front fairing of rack and support assembly and pulls bomb rack cocking ring to secure launcher.

(5) A crewmember then connects an electrical cable to the forward receptacle on top of the launcher.

(6) If launcher is loose on the rack, a crewmember adjusts the sway brace pads.

Note. If moved or replaced, rocket launchers should be reboresighted as soon as the tactical situation will allow. Some degree of accuracy is sacrificed if replacement launchers are not boresighted to converge at a known distance point.

D–20. Loading and Unloading Ammunition

a. Loading of 7.62mm Ammunition. For loading procedures for the 7.62mm ammunition on the M16 armament subsystem, see paragraph C–20*b*.

b. Loading of 2.75-Inch SSFFAR Ammunition. Loading procedures for 2.75-inch SSFFAR are—

(1) *Assembly of rockets.* To assemble motors and warheads—

(*a*) Remove the fuzed warhead and motor from the container. The shipping support is snap-fitted to the head closure in the motor. On some motors, there is a rubber gasket ring under the lip of the warhead shipping support and a fiber shim (spacer) between the head shipping support and head closure. Remove and dispose of the spacer and rubber gasket before threading the warhead to the motor.

(*b*) Hand tighten the warhead as much as possible without causing the head closure to turn and force the visible lockwire in or out of the elongated hole in the rocket motor lockwire groove. Movement of the tab within the elongated hole is normal.

***Caution:* Do not force lockwire tab down into the motor lockwire groove or out of the elongated hole. The enlarged tab traveling through the lockwire groove would bulge the motor and make it unsafe to fire. Motors with lockwire tabs displaced should be discarded as unserviceable.**

(2) *Inspection of rockets.* To insure proper assembly, all 2.75-inch rockets must be inspected before loading. Check to insure that the warhead is tightened to rocket motor ((1) (*b*) above). When fin protector is removed, check to insure that launcher latch retaining groove and contact disc are free of grease and dirt. Check igniter wires for breaks.

***Warning:* Do not load rockets with dam-**

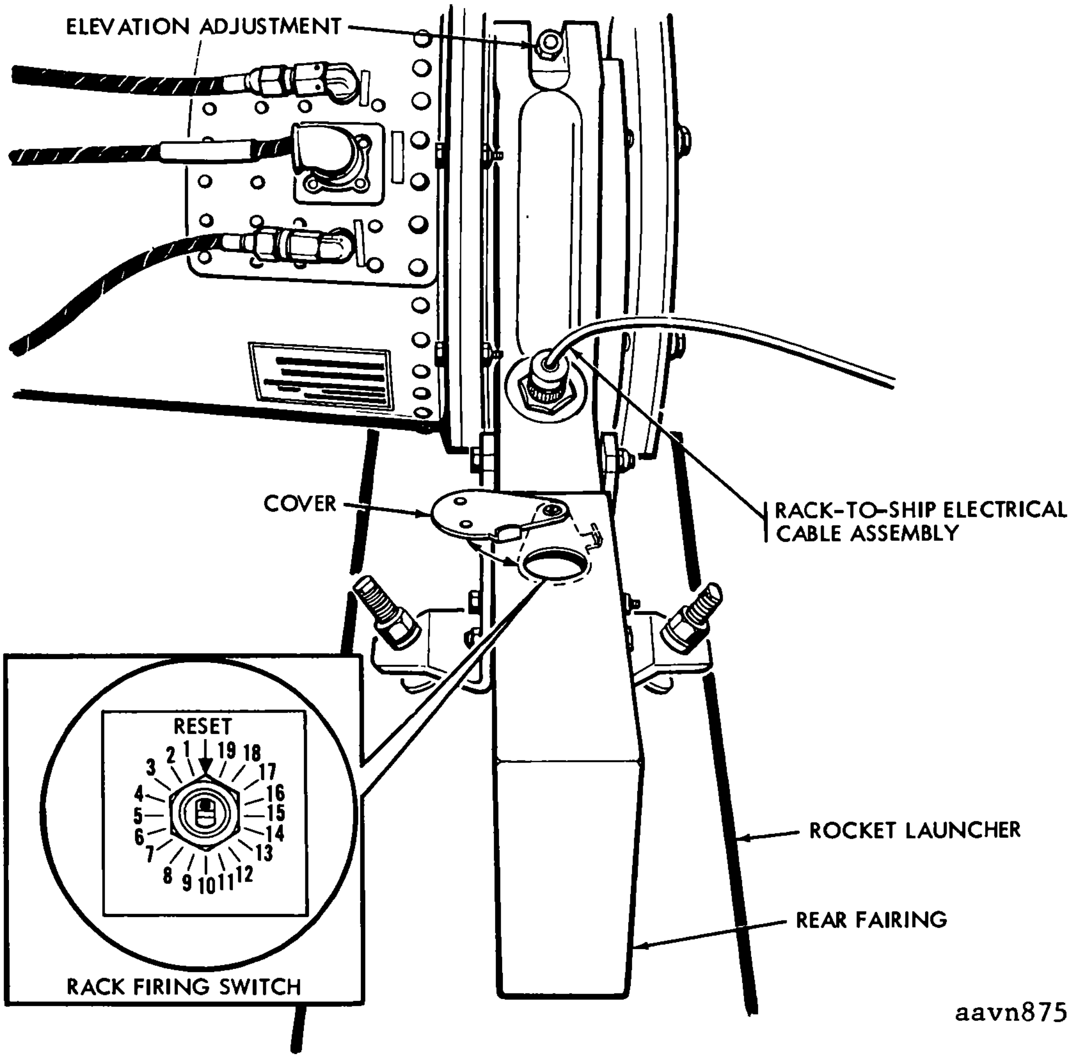


Figure D–37. Preparation for loading or unloading the rocket launcher.

aged fins or motors; damaged motors may cause rocket to break up, and damaged fins will cause erratic flight.

(3) *Preloading procedures.*

(*a*) Position OFF-SAFE-ARMED switch to OFF.

(*b*) Pull all firing circuit breakers.

(*c*) Position armament selector switch to 7.62.

(*d*) Position ROCKET PAIR selector switch to indicate zero pairs.

(*e*) Ground helicopter with a static ground cable.

(*f*) Disconnect external power source (if connected to the helicopter).

(*g*) Manually position the rack firing switch (fig. D–37) to RESET.

(4) *Loading of XM157 rocket launcher* (fig. D–38). The XM157 rocket launcher must be loaded from the front of the launcher.

Note. Arrow markers on the forward bulkhead of the XM157 rocket launcher are loading reference marks for positioning fins during loading.

(*a*) Load rocket so that arrow marker of tube is midway between two rocket fins. Keep the rocket in this position and slide gently into the launcher until the detent clicks and holds the rocket.

Caution: **Do not ram rocket against firing contact. Broken firing contacts cannot be replaced or repaired.**

(*b*) Inspect the aft end of the launcher to insure rocket is held securely and is against the firing contact.

Caution: **Do not remove fin protector from the assembled rocket until immediately before loading the rocket into the XM157 launcher.**

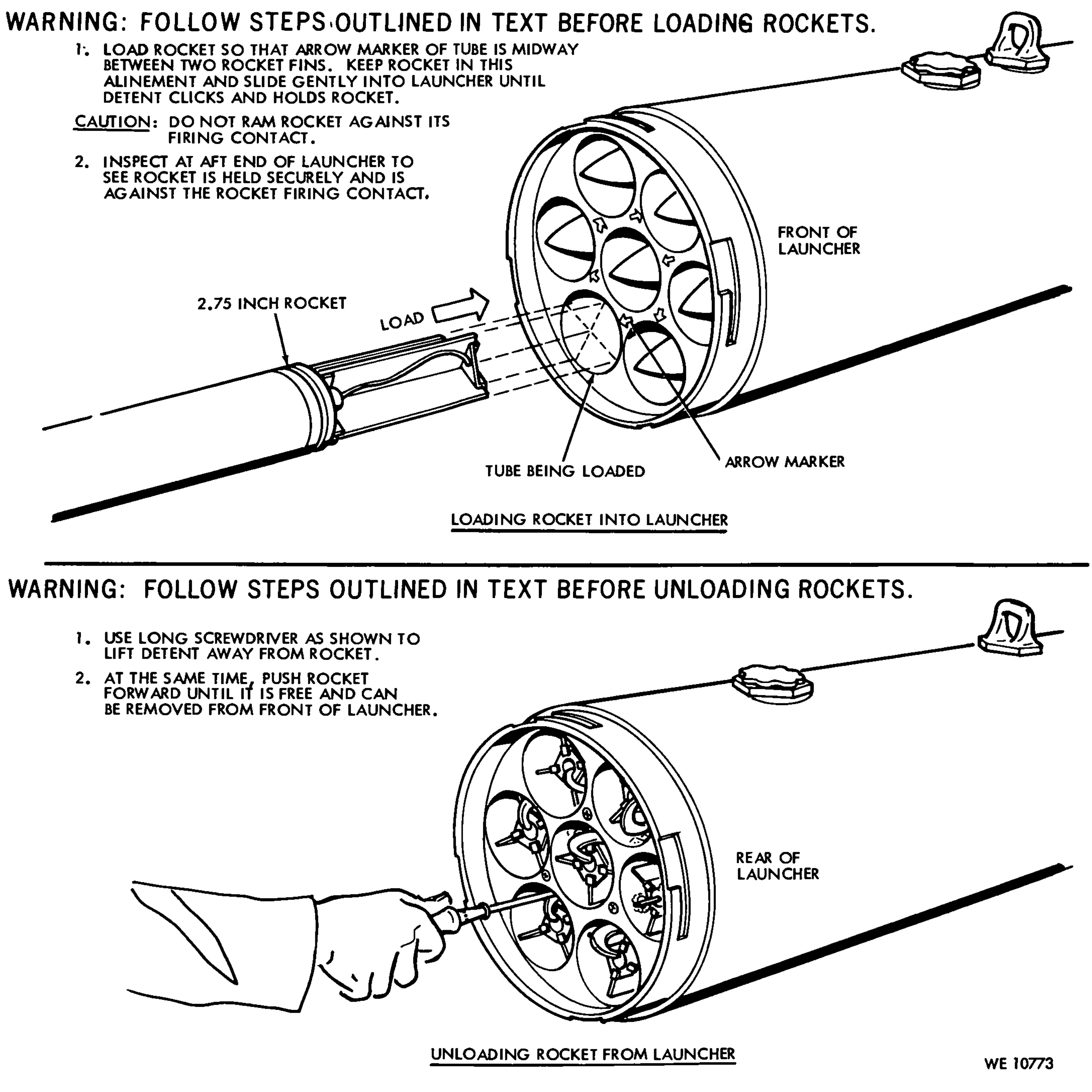


Figure D–38. Loading or unloading rockets from XM157 launcher.

(5) *Loading of the XM158 rocket launcher.* The XM158 launcher must be loaded (fig. D–39) from the rear of the launcher.

(*a*) Swing each firing arm contact clear of the aft end of each launcher tube.

(*b*) Insert rocket into each launcher tube and slide forward until fin protector contacts the tube.

(*c*) Remove fin protector.

***Caution:* Push rocket into tube until fin protector contacts launcher.**

(*d*) Push the rocket into the tube until the locking detent clicks and holds rocket.

(*e*) When all tubes have been loaded, swing the firing arm contacts over the rocket fin retainer assembly until the firing arm snaps forward and seats the firing contact firmly in the contact disc.

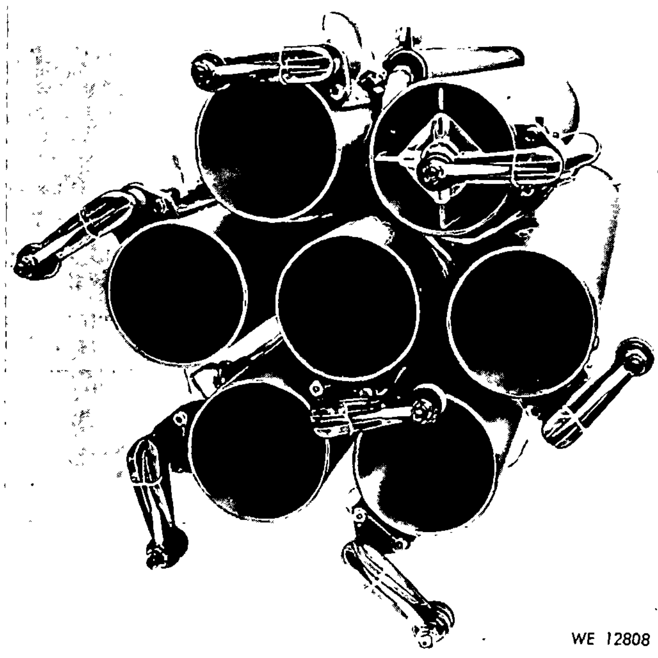


Figure D–39. Rocket loaded in tube number five of XM158 launcher.

(*f*) Start helicopter.

(*g*) Remove electric grounding cable.

c. Unloading 2.75-Inch SSFFAR Ammunition (fig. D–38). Rocket misfires and subsystem malfunctions may require unloading 2.75-inch FFAR ammunition from the rocket launchers.

***Caution:* If there are misfired rockets in the launcher, turn the power switch to OFF and wait 10 minutes before unloading rockets.**

(1) *Preparation for unloading.* Complete the unloading procedures given in TM 9–1090–201–12.

(2) *Unloading* (fig. D–38).

(*a*) On the XM158 launcher, swing the firing arm away from the aft end of the rocket.

(*b*) Use a screwdriver to release the detent holding the rocket tube, and push the rocket forward until it can be grasped and pulled out of the front of the tube.

(*c*) Install fin protector on rocket.

D–21. Firing Procedure

The machinegun portion of the subsystem may be put into operation in either the stow or flexible mode; however, the 2.75-inch rocket launchers are fixed to the support assembly and can only be fired from the stow position.

a. Flexible Mode (Machineguns). The copilot (gunner) can fire the machineguns from the flexible position by using the flexible sighting station (fig. C–24). For a complete description of flexible firing procedures, see paragraph C–20*c*(2).

b. Stow Mode (Machineguns). The guns may be stowed in predetermined position and fired as a fixed weapon by gunner or pilot. This enables either the pilot or the gunner to fire the subsystem straight ahead in an emergency. To fire the machineguns in the stow position, the armament selector switch must be positioned to 7.62 and the OFF-SAFE-ARMED switch positioned to ARMED. The guns may be fired in the stow position by depressing either of the cyclic firing switches.

(1) *Stow fire by the pilot.* By using the XM60 infinity sight and observing the strike of tracers fired from fixed guns, the pilot changes the attitude of the helicopter to aim the guns. Thus, accuracy of fire delivery is limited by helicopter maneuverability. The pilot may use the XM60 infinity sight for stow fire by turning the elevation depression knob on the sight to cause the sight reticle pipper to coincide with the strike of the rounds.

(2) *Stow fire by the gunner.* There is no sight for stow fire at the gunner's station; however, the gunner may provide his own reference marks on the windshield with a grease pencil. To verify his constant head position, he—

(*a*) Fires a few rounds.

(*b*) Observes bullet strike.

(*c*) Places a 6-inch vertical line on the windshield that coincides with the observed strike of the bullets.

(*d*) Can place a dot or circle on the vertical line to coincide with the center of bullet strike.

c. Rocket Firing Procedures.

(1) *Before takeoff.*

(*a*) *Armament circuit breakers.* Close the 7.62mm gun, rocket jettison, and XM60 sight circuit breakers.

(*b*) *OFF-SAFE-ARMED switch.* Set the OFF-SAFE-ARMED switch to the SAFE position and check that the green SAFE indicator light illuminates.

(*c*) *Rocket PAIR SELECTOR switch.* Check to insure that the rocket PAIR SELECTOR switch is indicating zero pairs.

(*d*) *RESET switch.* Depress the RESET switch on the intervalometer panel in order to reset the firing switches of the rack and support assembly (fig. D–37).

Warning: **Do not use the cyclic firing switch to recycle the rack firing switches.**

(*e*) *XM60 infinity sight.* Conduct operational check of the XM60 infinity sight as follows:

1. Depress the locking lever to disengage the sight from the stow indent. Swing the sight outboard and down from its stow position until the locking lever engages the operate indentation.

2. Illuminate the reticle lamp by moving the reticle lamp switch on top of the power control housing left or right from the center OFF position. Two filaments are used in the reticle lamp to insure illumination during firing. If one filament burns out, the switch may be moved to the opposite position to reilluminate the reticle.

3. To control reticle light intensity, turn the rheostat knob on the left of the power control housing. Set intensity to desired level.

4. Set desired scale reading at the zero mark of the fixed index scale on the elevation-depression knob.

(2) *In-flight operation.*

(*a*) *Prepare for firing.* Set the—

1. Armament selector switch to 2.75.

2. Rocket PAIR SELECTOR switch to the desired number of rocket pairs to be fired.

3. OFF-SAFE-ARMED switch to ARMED and check for the SAFE indicator light to go out and the ARMED indicator light to illuminate.

(*b*) *Acquire target.* Acquire the target by flying a target-collision course, using the sight reticle pipper center of reticle) as reference aiming point. The pilot changes the attitude of the helicopter as necessary to aline the sight reticle on the target.

(*c*) *Fire rockets.* When the proper sight picture has been developed (para 6–5), fire the rockets by depressing the firing switch on either cyclic control stick.

(*d*) *After firing.* Set the—

1. OFF-SAFE-ARMED switch to SAFE.

2. Armament selector switch to 7.62.

3. Rocket PAIR SELECTOR switch to zero pairs.

(*e*) *After landing.* Before helicopter shutdown, set OFF-SAFE-ARMED switch to OFF position and then pull out all armament circuit breakers.

D–22. Emergency Procedures

a. Machinegun Emergency Procedures. For machinegun emergency procedures, see paragraph C–21.

b. Rocket Emergency Procedures.

(1) *Jettisoning.* To reduce fire and explosion hazards in a rocket launcher or in an emergency requiring a forced landing, jettison loaded rocket pods. In the case of a rocket hangfire in the launcher, the tactical situation may permit the pilot to salvo all remaining rockets into the target area while retaining the burning rocket in the launcher and slipping the helicopter to keep the fire away from the helicopter. However, pods should not be jettisoned during apparent sideslip (when the needle and ball are not centered in the turn and slip indicator). Jettison during sideslip may result in damage to the helicopter. Jettisoning can be safely accomplished during hovering, climbing, and level flight in the speed range from zero to 100 knots, and during autorotation and descending flight up to 80 knots. To jettison—

(*a*) Lift the red switch guard to break copper safety wire on launcher jettison switch (fig. D–30).

(*b*) Push launcher jettison switch forward and check support assemblies to insure that jettison is complete.

(*c*) If launchers fail to jettison, check to insure that jettison circuit breaker is closed, then attempt jettison again.

(*d*) If launchers will not jettison electrically, pull manual jettison handle located on the right side of the pedestal console (fig. D–30).

(2) *Failure to fire.* If there is a misfire, continue the firing mission until all other rockets have been fired. With the helicopter pointed toward a safe impact area, set the OFF-SAFE-ARMED switch to SAFE position and push the reset switch. Switch back to ARMED, set the selector switch to seven pairs, and depress firing button on the cyclic control stick. If rockets fail to fire, repeat this procedure.

Warning: **If the misfired rounds do not fire on this second attempt, position armament selector switch to 7.62, ROCKET PAIR SELECTOR switch to zero pairs, the OFF-SAFE-ARMED switch to OFF, and open all armament circuit breakers prior to unloading (para D–20*c*).**

(3) *Rocket breakup.* Rockets may break up immediately after launch because of improper handling or assembly, or combat damage. Normally, the 7,000 foot-pounds of initial thrust is

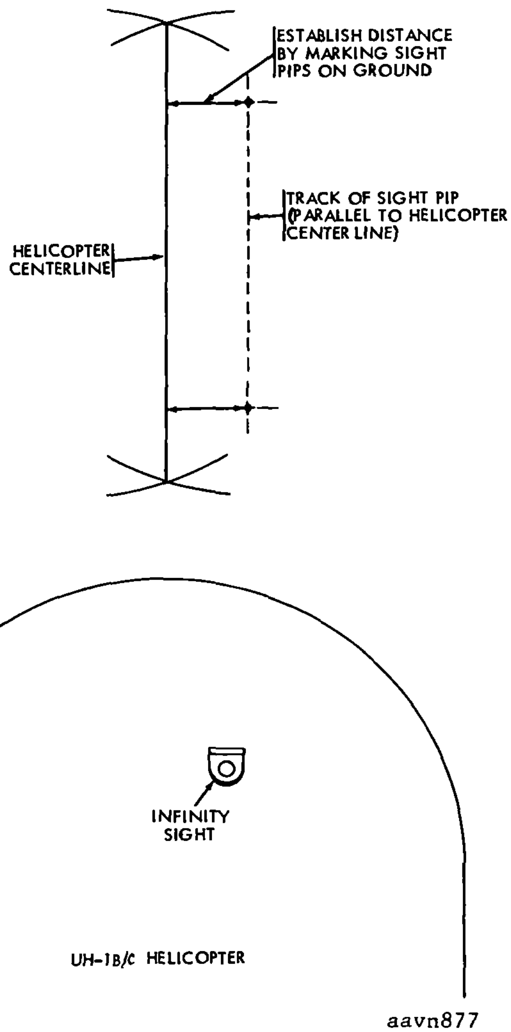


Figure D–40. Boresighting launchers and infinity sight.

sufficient to cause breakup to occur well ahead of the helicopter. Upon seeing a rocket break up, the pilot must avoid flying through the particles of the rocket; a slight cyclic climb usually will be adequate.

D–23. Boresighting Procedure

Warning: **Do not attempt boresighting with rockets loaded in rocket launchers. Unload all rockets before proceeding.**

The M16 armament subsystem was developed as a neutralization fire subsystem with area fire capability. However, it has a high degree of point-fire accuracy that can be used without sacrificing the area fire capability of the subsystem. To allow the gunner and the pilot to take advantage of the accuracy of the subsystem, all four guns should be boresighted to converge at 1,250 meters or the normal target acquisition range in the area of operation. For mcahinegun boresighting procedures, see paragraph C–28. For boresighting XM157/XM158 rocket launchers and alining the XM60 infinity sight—

a. Establish Helicopter Centerline. To establish helicopter centerline, use procedures described in paragraph D–7*a*(4).

b. Boresighting Launchers and Infinity Sight (fig. D–40).

(1) Loosen sight sockethead screw and aline sight approximately parallel to helicopter centerline.

(2) Adjust sight in support until level vial assembly and inclinometer indicate that the sight is level.

(3) Turn sight reticle lamp on.

(4) Adjust sight in azimuth until light pipper will track a line parallel to helicopter centerline when elevation-depression knob is rotated through full travel.

(*a*) Adjust the elevation-depression knob to place the pipper of the reticle at minimum distance; mark this point on the ground.

(*b*) Readjust the elevation-depression knob to place the pipper further along the line of sight; mark this point on the ground.

(*c*) Measure distances from helicopter centerline to each pipper mark. If the adjustment was made correctly, the two distances should be equal.

(5) Tighten sight sockethead screw.

(6) Set elevation-depression knob at +5.8°. Jack and reposition helicopter as necessary to put sight pipper on distant aiming point.

(7) Use a gunner's quadrant (M1A1 or equivalent) to determine the fore-aft attitude of helicopter floor.

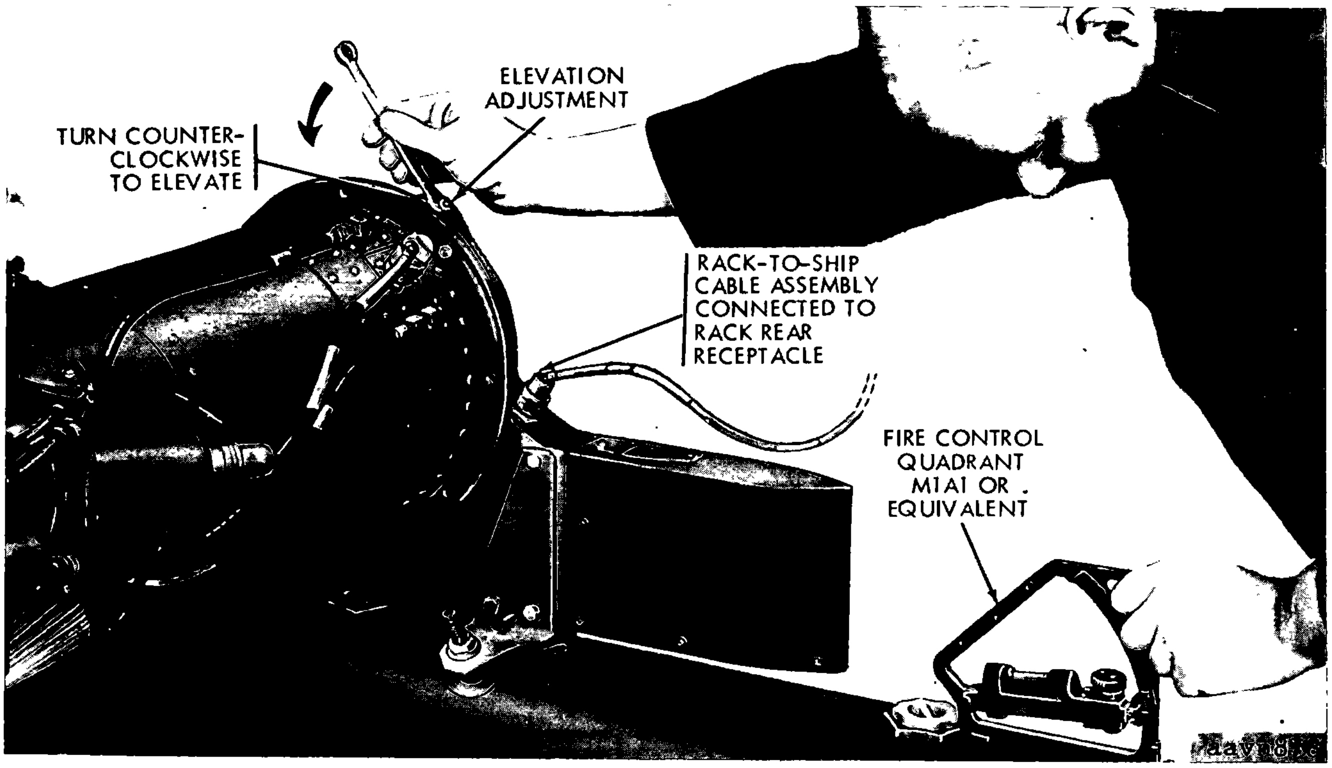
(8) Set quadrant elevation at 103.2 mils relative to the helicopter floor.

(9) Place quadrant between rear receptacle and welding bead (fig. D–41).

(10) Turn elevation adjustment nut (fig. D–42) until quadrant bubble centers. Rocket launchers are now set at 103.2 mils.

(11) Loosen left rocket launcher sway braces. Install optical boresight in center launcher tube.

(12) Adjust boresight alining screw (fig. D–31) until boresight reticle is on distant aiming point. Tighten sway braces (fig. D–42) flush with launcher hard points; tighten another one-quarter turn, and lock.



Figur D-41. Adjusting the rack and support assembly in elevation (left side).

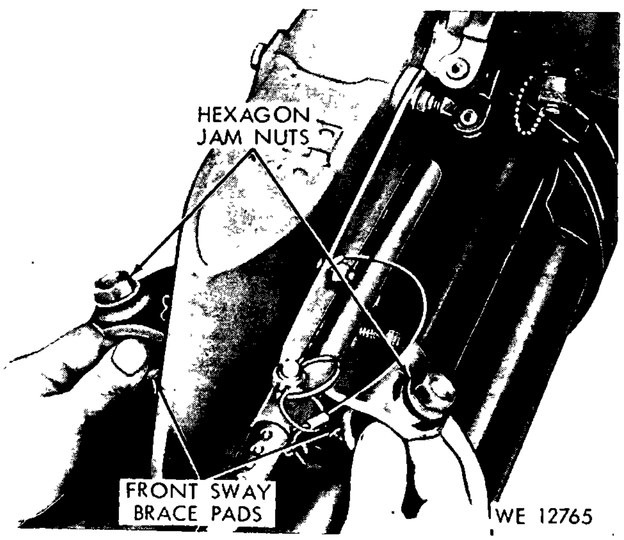


Figure D-42. Adjusting sway brace pads.

Note. Adjust both front sway brace pads (fig. D-42) at the same time, then both rear sway brace pads. Do not adjust both left or both right sway brace pads at the same time.

(13) Repeat (11) and (12) above for right rocket launcher.

(14) Loosen alining screws one-quarter turn.

Note. If pods will not adjust to the selected point, adjust as close as possible to the point and then readjust sight to the new point.

Section III. M21 ARMAMENT SUBSYSTEM

D-24. Capabilities

The M21 helicopter armament subsystem provides the ground force commander with an immediately responsive and highly mobile means for armed reconnaissance and continuous direct fire support. The weapons subsystem—

a. Can deliver offensive or defensive area fires by means of rockets or automatic guns against personnel in the open, soft material targets, and lightly armored vehicles.

b. Has dual-weapon capability permitting selec-

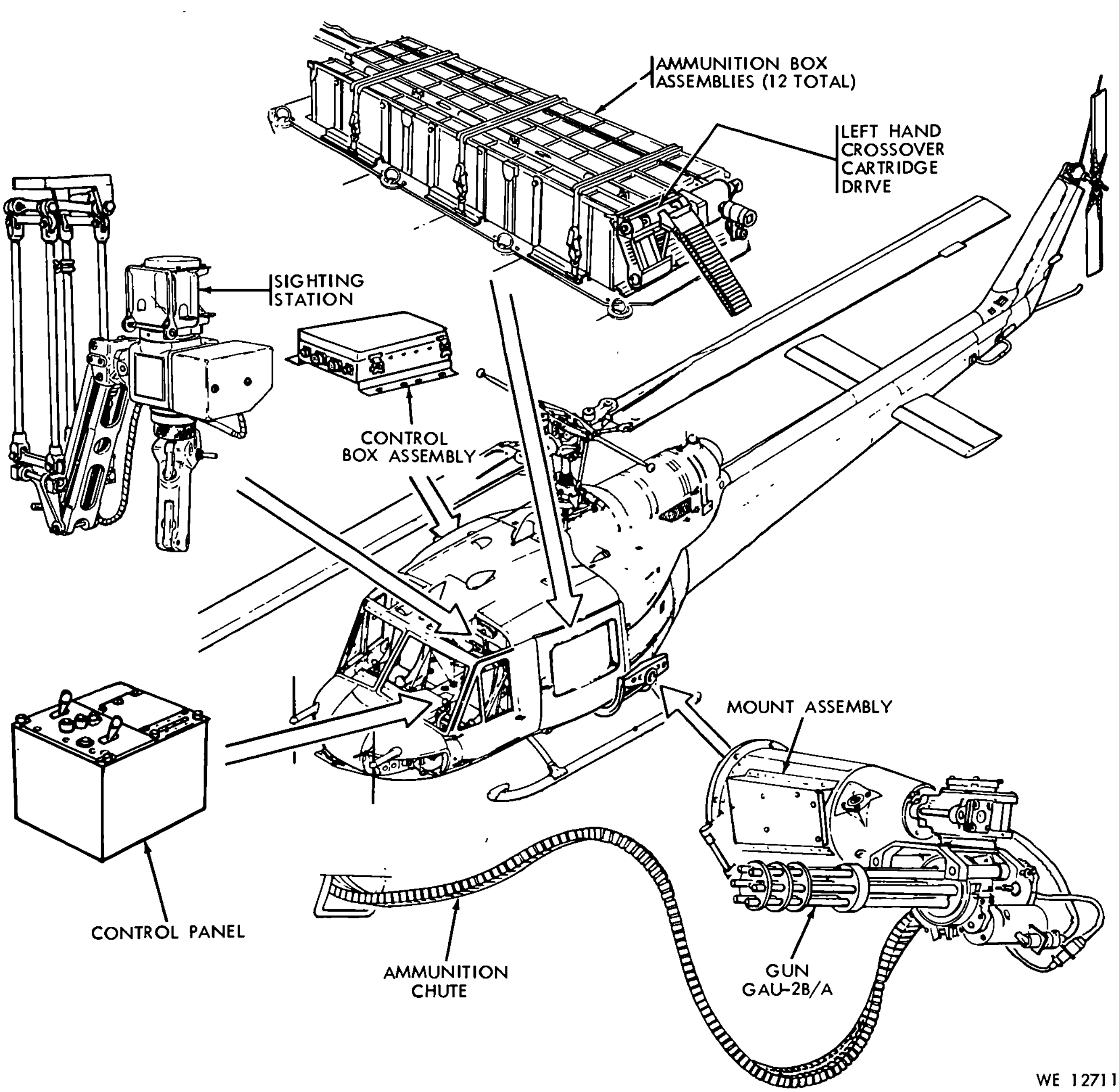


Figure D–43. Automatic gun components.

tion of the best weapon for the target or simultaneous engagement of two area targets.

c. Is capable of selective fire in the following modes:

(1) *High rate 7.62mm automatic guns.*

(*a*) Flexible, using gunner's flexible sighting station.

(*b*) Stowed, using the XM60 infinity sight and the firing switch on the cyclic control stick.

(2) *2.75-inch spin stabilized folding fin aerial rocket (SSFFAR).*

(*a*) Pair—single rocket from each launcher.

(*b*) Ripples of 2, 3, 4, 5, 6, or 7 pairs (14 rockets).

d. Will function satisfactorily in all coordinated helicopter positions or attitudes and within helicopter speed range of 0 to 160 knots.

e. Has rocket launchers that can be electrically or manually jettisoned in case of in-flight emergency.

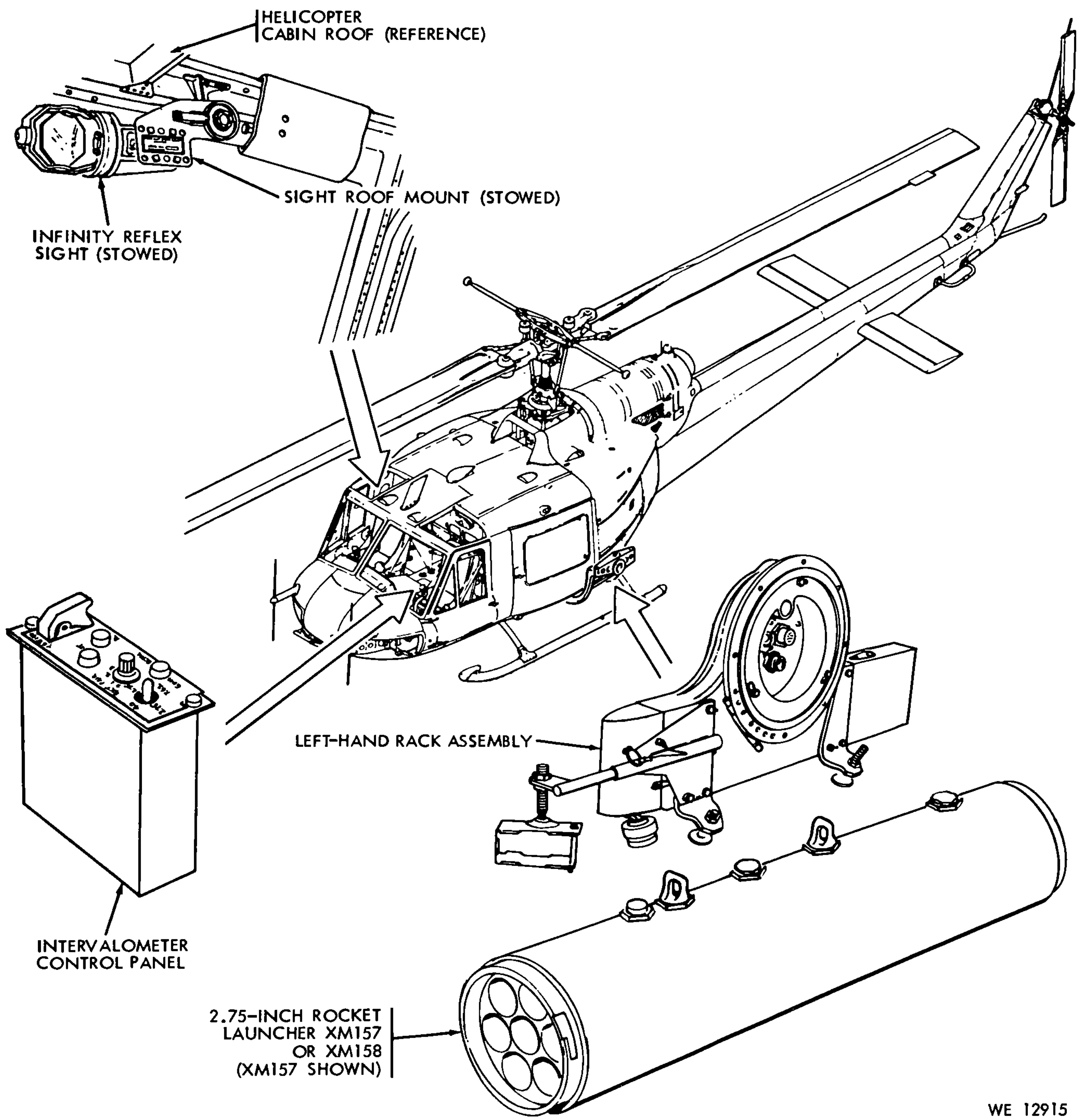


Figure D–44. Rocket launcher components.

f. Can be operated in all tactical environmental conditions in which the helicopter can operate.

g. Has a high degree of accuracy when both guns are boresighted or harmonized to converge at 1,000 meters and the rocket launchers are boresighted to converge rocket fires at 1,250 meters.

h. Has the following range:

(1) *Maximum effective.*

(*a*) Machineguns—1,000 meters.

(*b*) 2.75-inch SSFFAR—2,500 meters.

(2) *Minimum* (*safe slant range*).

(*a*) Machineguns—100 meters.

(*b*) 2.75-inch SSFFAR—300 meters.

i. Is designed so that the automatic guns and rocket launchers can easily and quickly be replaced if rendered inoperative by combat damage.

j. Can be detached quickly from the helicopter and transported by Army utility aircraft or motor vehicle.

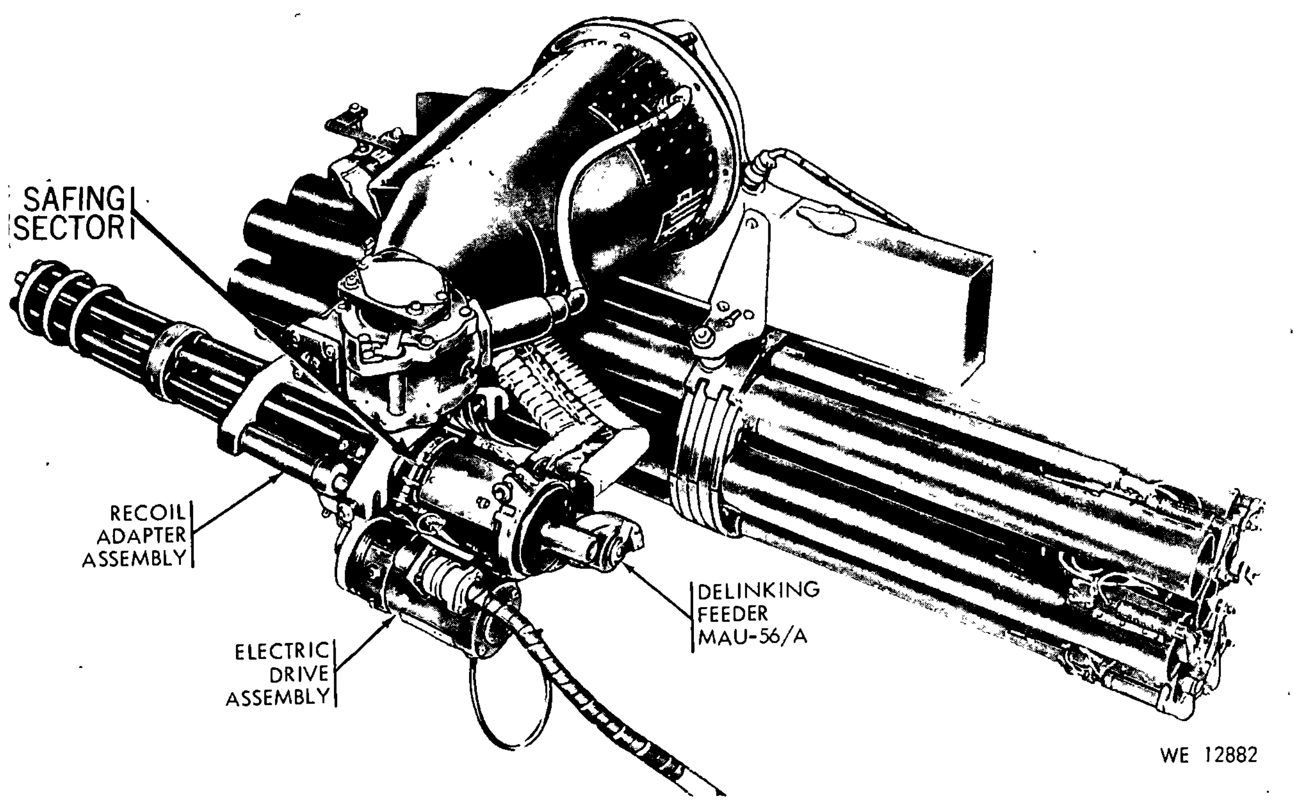


Figure D-45. Gun and rocket launcher.

D-25. Limitations

The M21 armament subsystem is vulnerable to all types of air defense fires, including small arms, and has the following limitations:

a. Effectiveness of operation is reduced at night and during periods of low visibility due to limitations in target acquisition and range estimation.

b. Engagement of targets is limited by the subsystem's gun/launcher limits in relation to target range, altitude, airspeed, and helicopter degree of bank.

D-26. Description

The M21 armament subsystem has two high-rate-of-fire 7.62mm M134 automatic guns combined with two XM158, 2.75-inch rocket launchers (fig. D-43 and D-44).

D-27. Automatic Gun Components

a. M134 7.62mm Automatic Guns. Each of two automatic guns is an electrically driven, air-cooled, six-barreled weapon which fires 2,400 to 4,000 shots per minute. The electric drive assembly (fig. D-45) rotates the gun in its housing by means of gears. The gun housing contains a camway in which the six bolts are rotated through their complete firing cycle. The delinking feeder accepts linked ammunition, strips the rounds from the links, ejects the links, and feeds the rounds into the chambers.

(1) An important safety feature is that each gun is completely cleared after each firing burst. Whenever a gun ceases to fire, a minimum of six live rounds will be cleared through each feeder and ejected overboard.

(2) On the ground, safing of the guns can be accomplished by removing the safing sector (fig. D-45) on each gun. This action removes that portion of the camway which guides the bolts and rounds into the chambers.

Warning: **A firing pin may be cocked and ready to be released. Before removing safety sector, barrels should be rotated clockwise (opposite firing direction) to prevent firing.**

(3) With the gun mounts in the stow position, the electric drive assembly motor will only receive enough voltage to drive the gun at a rate of 2,400 shots per minute.

(4) When moving the mounts through the field of deflection, one mount must stop at its inboard limit. Upon reaching the inboard limit, the gun will cease to fire and the opposite gun will

accelerate to 4,000 shots per minute; therefore, with both guns operational, the constant rate of fire is 4,000 rounds per minute. This rate can be reduced to 2,400 rounds per minute by selecting one gun (left or right) with the GUN SELECTOR switch (fig. D-30) on the control panel.

b. Gun Control Panel. The gun control panel (fig. D-30) contains—

(1) An OFF-SAFE-ARMED switch for the subsystem.

(2) A GUN SELECTOR switch which permits either the LEFT or RIGHT gun or ALL (both) guns to be selected for firing.

c. Control Box Assembly. The control box assembly (fig. D-43) is located in the aft baggage compartment. It contains circuit breakers, relays, and other electrical components to control the guns.

d. 7.62mm Ammunition Storage Assembly. The 12 ammunition boxes (four rows of three boxes each) (fig. D-43) hold 6,000 rounds with the right and left ammunition chutes holding an additional 400 rounds. The ammunition is fed through the flexible chuting to the delinking feeder on each gun. The left-hand crossover cartridge drive is attached to the end boxes of the two forward rows. By electrical power, it pulls ammunition from the primary or secondary row of boxes to feed the left gun. The right-hand crossover cartridge drive is attached to the end boxes of the two rear rows and feeds ammunition to the right gun.

e. Flexible Automatic Gun Sighting Station. The copilot-gunner uses the flexible automatic gun sighting station (fig. D-43) to aim and fire the guns in the flexible mode. The sighting station controls allow the gunner to remotely position the guns within the flexible limits of +10° in elevation to −90° depression and from 12° inboard traverse to 70° outboard. When not in use, the sighting station may be stowed over the gunner's head.

D-28. Rocket Launcher Components

a. 2.75-Inch Rocket Launcher, XM158. Each XM158 rocket launcher (fig. D-44) has seven tubes firing 2.75-inch folding-fin aerial rockets. The launchers are reusable and the launcher tubes replaceable individually.

b. Intervalometer Control Panel. The intervalometer control panel (fig. D-30) contains—

(1) A three-position armament selector switch.

(*a*) The *7.62* position selects the automatic guns as the primary weapon.

(*b*) The *2.75* position selects the rockets as the primary weapon.

(*c*) The *40* position is not used with the M21 subsystem.

***Caution:* Do not use the 40 (40mm) position as a safety position. Depression of the firing switch with the armament selector switch in this position will result in the firing of rockets.**

(2) A rocket PAIR SELECTOR switch for the selection of from one to seven pairs of rockets.

(3) An electrical JETTISON switch for the rocket launchers.

(4) A rocket RESET switch to reset the rack and support assembly firing switches.

c. XM60 Infinity Sight. The pilot uses the XM60 infinity sight (fig. D-35) to aim the rockets and the stowed automatic guns. When this sight is not in use, it may be stowed near the helicopter's ceiling in front of the pilot (fig. D-44).

D-29. Automatic Gun Firing Procedures

The automatic gun portion of the subsystem may be put into operation in either the stow or flexible mode. Three seconds after depression of the firing switch on the cyclic stick or flexible sighting station, a burst limiter will stop the firing. Each gun ceases firing and clears itself by continuing to drive without being fed ammunition. A minimum of six live rounds will be cleared through each feeder and ejected overboard. By releasing the firing switch during a burst or by activating the limit switches, the guns will clear. The gunner can fire the 7.62mm subsystem automatic guns from the stow or flexible position, while the pilot-gunner can only fire the subsystem from the stow position.

a. Stow Mode. The guns may be stowed in a predetermined position and fired as a fixed weapon by the gunner or the pilot. This permits straight-ahead firing in an emergency by use of the firing switch (fig. D-11) on the pilot's or gunner's cyclic stick. To fire the automatic guns in the stow position, the armament selector switch is moved to 7.62 and the OFF-SAFE-ARMED switch to ARMED.

(1) *Stow fire by the pilot.* The pilot uses the XM60 infinity sight for stow fire by turning the elevation depression knob until the sight reticle pipper coincides with the strike of the bullets. When using the sight to observe the strike of tra-

cers fired from fixed guns, the pilot changes the attitude of the helicopter to aim the guns; therefore, accuracy of fire delivery is limited by helicopter maneuverability.

(2) *Stow fire by the gunner.* There is no sight for stow fire at the gunner's station; however, the gunner may provide his own reference marks on the windshield. To verify his constant head position, he fires a few rounds and places a line on the windshield (similar to M16, para D–21*b*(2)) that loinnides with the observed strike of the bullets. He can place a dot or circle on this line to coincide with the center of bullet strike.

b. Flexible Mode. For flexible mode operation, the gunner's procedure is to—

(1) Disengage the sighting station (fig. C–24) from its stowed position, grasp the control grip, and pull down and outboard.

(2) Move the reticle lamp switch (fig. C–24) either forward or aft of the center off position to illuminate the reticle lamp. (Two filaments are used in the reticle lamp to insure reticle illumination during action. Should one filament burn out, move the switch to the opposite position to reilluminate the reticle.)

(3) Turn the rheostat knob (fig. C–24) to set reticle light intensity at desired level during night operations.

(4) Depress the action switch on the control grip to transfer firing voltage from the cyclic stick firing switches to the control grip trigger switch. Then by moving the sighting station, the gun may be electrically aimed and fired.

Note. When engaging a target in the flexible mode, the gunner always depresses the action switch before depressing the trigger switch. He uses the control grip trigger switch as long as the action switch is depressed. Whenever the action switch is released, control is returned to the stowing potentiometers and the mounts are driven immediately to the stowed position. Simultaneously, electrical power is transferred from the control grip trigger switch to the cyclic stick firing switches.

D–30. Rocket Firing Procedures

The 2.75-inch rocket launchers are fixed to the support assembly and can only be fired from the stow position. When the armament selector switch is positioned at *2.75,* the primary subsystem mode is rocket firing by means of the cyclic stick firing switches. However, automatic gun firing can still be accomplished by using the flexible sighting station (para D–29*b* above). While firing rockets, the automatic gun firing will be interrupted as long as the cyclic stick firing switch is depressed. Rocket firing procedures are as follows:

a. Before Takeoff.

(1) Close the 7.62mm, rocket jettison, and XM60 sight circuit breakers.

(2) Position the OFF-SAFE-ARMED switch to SAFE and check to see that the green SAFE indicator light illuminates.

(3) Position the armament selector switch (on the intervalometer control panel) to *7.62.* This will prevent accidental rocket firing before takeoff.

(4) Check to insure that the rocket PAIR SELECTOR switch is indicating zero pairs.

(5) Depress the RESET switch (on the intervalometer control panel) to reset the firing switch on each rack and support assembly.

Caution: **Do not use the cyclic firing switch to recycle the rack firing switches.**

(6) Conduct an operational check of the XM60 infinity sight (fig. D–35) as follows:

(*a*) Depress the locking lever to disengage the sight from the stow indent, then swing the sight outboard and down from its stowed position until the locking lever engages the operate indention.

(*b*) Move the reticle lamp switch either forward or aft of the center off position, to illuminate the reticle lamp. (Two filaments are used in the reticle lamp to insure illumination during action. Should one filament burn out, move the switch to the opposite position to reilluminate the reticle.)

(*c*) Turn the rheostat knob to set the reticle light intensity to desired level.

(*d*) Set desired scale reading at the fixed index scale on the sight.

b. After Takeoff.

(1) Prepare for firing by setting the armament selector switch to *2.75* and the rocket PAIR SELECTOR switch to the desired number of rocket pairs to be fired.

(2) Position the OFF-SAFE-ARMED switch to ARMED and check to see that the SAFE indicator light goes out and that the ARMED indicator light illuminates.

(3) Using the sight reticle pipper (center of reticle, fig. D–36) as a reference aiming point, acquire the target by flying a target-collision course, changing the attitude of the helicopter as necessary to aline the sight reticle on the target.

(4) When the proper sight picture has been developed, fire the rockets by depressing the firing switch on the cyclic control stick.

(5) After firing, position the—

(*a*) OFF-SAFE-ARMED switch to SAFE.

(*b*) Armament selector switch to *7.62*.

(*c*) Rocket PAIR SELECTOR switch to zero pairs.

(6) Before helicopter shutdown, position the OFF-SAFE-ARMED switch to OFF and then open all armament circuit breakers.

D–31. Emergency Procedures

a. Automatic Gun Emergency Procedures.

(1) *Guns fail to fire.*

(*a*) Make sure that the 7.62mm and M21 GUN POWER circuit breakers are pushed in and that the following switches are in the positions indicated:

1. OFF-SAFE-ARMED switch—ARMED.

2. Gun selector switch—*7.62*.

3. Action switch—depressed.

(*b*) Press gun trigger switch on sighting station grip assembly. If guns fail to fire, release grip assembly and move OFF-SAFE-ARMED switch to SAFE. Recheck positions in (*a*) above, then move ARMED-SAFE-OFF switch to ARMED. Attempt to fire the guns by depressing the firing switch on either cyclic stick. If guns still will not fire, place the OFF-SAFE-ARMED switch on SAFE, pull out the M21 GUN POWER circuit breaker, and immediately upon landing, remove the safing section.

(2) *Runaway guns.* If guns continue to fire after the trigger switch on the grip assembly has been released, immediately release the action switch and grip assembly, place the OFF-SAFE-ARMED switch in OFF position, and pull out the M21 GUN POWER circuit breaker.

(3) *Single gun malfunction.* If a malfunction or emergency (e.g., runaway gun) occurs in only one gun, isolate this gun from the firing circuit by selecting the opposite gun with the gun selector switch.

b. Rocket Emergency Procedures. For rocket emergency procedures, see paragraph D–22*b*; for instructions for unloading, see TM 9–1090–202–12.

APPENDIX E

M22 ANTITANK GUIDED MISSILE SYSTEM ON UH–1 HELICOPTERS

Section I. GENERAL

E–1. Subsystem Description and Capabilities

The M22 is a helicopter-mounted missile armament subsystem (fig. E–1). Missiles are fired, controlled, and guided by a gunner in the copilot's seat of the UH–1B/C helicopter. The gunner operates an airplane-type control stick to signal the missile in pitch and yaw commands. These directional commands are transmitted to the in-flight missile through two guidance wires which play out from spool assemblies inside the missile. The command impulses are decoded inside the missile and routed to its flight control devices.

a. The M22 armament subsystem installed on the UH–1B/C helicopter (fig. E–2) provides frontline troop support with a point-fire weapon capability. Primarily an antitank weapon, it is also effective against gun emplacements, road blocks, fortifications, and similar targets. Responsive and highly mobile, the UH–1B/C M22 missile subsystem may be employed with airmobile and ground maneuver elements in the role of aerial point-fire support.

b. The subsystem's six missiles can be fired from any helicopter mode (static, hovering, or in-flight). The firing has no adverse effects upon the helicopter.

c. The missiles can be fired at ranges between 500 and 3,500 meters in forward flight, or between 500 and 2,900 meters in a static or hovering mode.

Figure E–1. M22 armament subsystem.

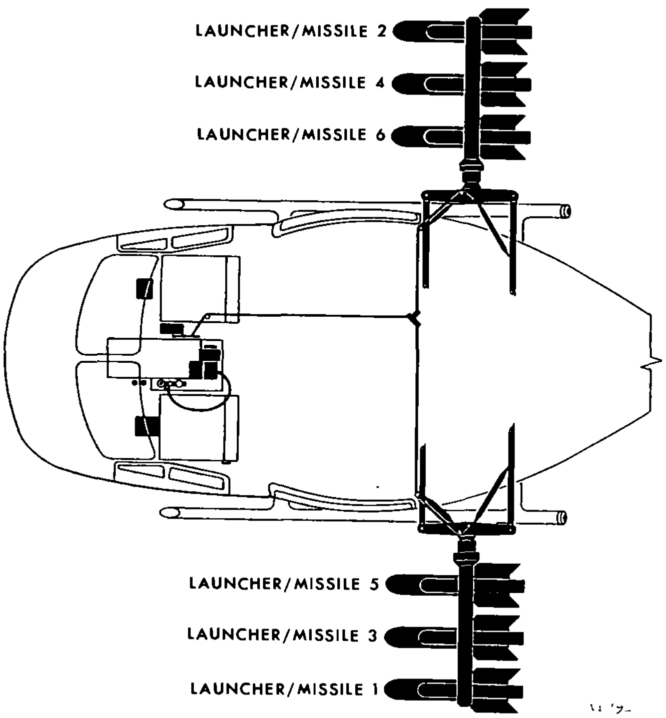


Figure E–2. Launcher/missile location.

d. The daily rate of fire is limited only by ammunition resupply and possible time-compliance parts change or maintenance.

e. General data describing the M22 subsystem is given in table E–1.

E–2. Subsystem Limitations

The M22 subsystem is vulnerable to all types of air defense fires, including small arms. Following are operational limitations:

a. The helicopter must be exposed to the target from launch to impact since the missile is guided by the gunner's line-of-sight vision.

b. Effectiveness is reduced at night and during periods of low visibility (for the reason in *a* above).

c. Use of the M55 binocular sight requires that the helicopter be equipped with yaw stabilization (AN/ASW–12). However, the XM58 sight does not require yaw stabilization.

d. Only one missile can be fired at a time.

Table E–1. Major Subsystem Components

Item	Length (In.)	Width (In.)	Height (In.)	Diameter (In.)	Weight (Lbs.)	Fig. No.
Missile (AGM–22B)	48	20 (wingspan)	----	6½	64	E–3
Housing Assembly	8	--------	----	7	11	E–11
Launcher Support Assembly	49	--------	----	4	15	E–12
Fixed Housing	30	4¼	4½	---	6	E–13
Launcher	31¾	4½	4½	---	6	E–14
Pilot's Sight (including mount)	18	--------	----	---	10	E–15
Gunner's Sight M55 (including mount)	----	12	15	---	18½	E–16
Gunner's Sight XM58 (with control amplifier)	----	7	15	---	50	E–17
Control Stick Assembly	----	--------	4	3¼	2	E–18
Guidance Control Unit T10K3	12¼	5½	6	---	13	E–22
Selection Box	10	5	4½	---	6½	E–23
Complete Subsystem (w/six missiles installed)	----	--------	----	---	650	E–2

Section II. MISSILE

E–3. General

The missile (fig. E–3) is shipped as a complete round of ammunition in an individual shipping container. The missile's two major components are its warhead and the missile body. See table E–2 for components data. For proper assembly, installation, and disassembly of the missile, see paragraphs E–58 and E–59.

E–4. Warhead
(A, fig. E–4)

The warhead (1) of the AGM–22B* has a 3 ½-pound shaped charge fixed to it inside the pointed end. For firing, the warhead screws onto the fuze body neck at the front of the missile body. The

* *AGM* (HEAT warhead).

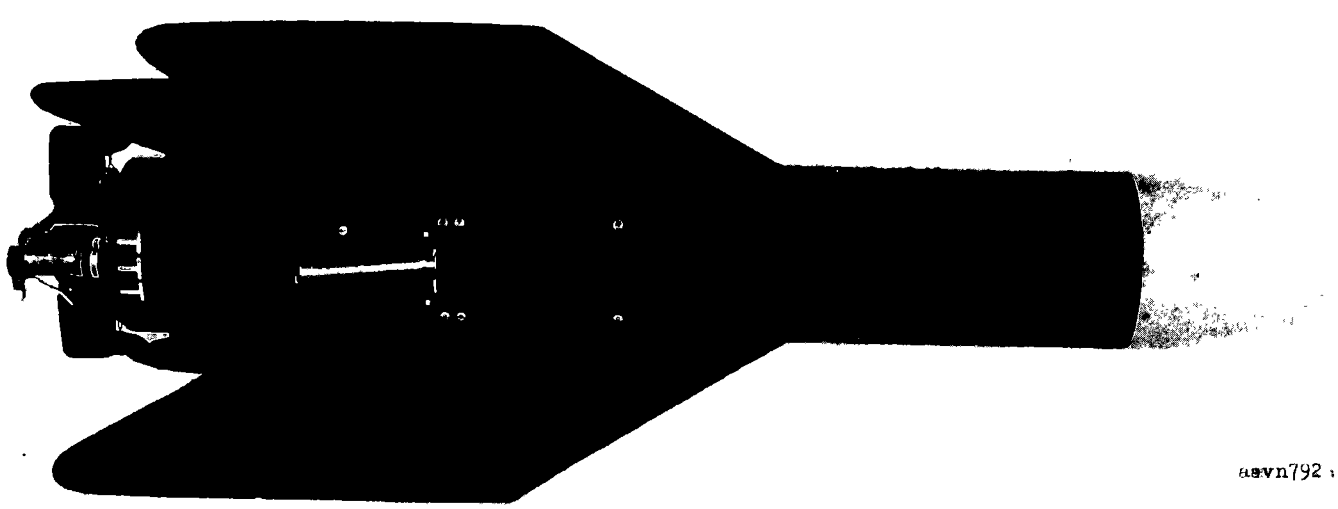


Figure E–3. M22 Missile

Table E–2. Missile Components

Item	Length (in.)	Diameter (in.)	Weight (lb)	Material	See Fig. No
★Warhead	16	6.5	17.5		E–4, at A①
Missile Body	32	6.5	46.5	Magnesium casting	E–4, at A–D
Battery Holders				Stamped steel	E–4, at D
Fuze Detonator Assembly				Duralumin	E–5
Booster Motor and Exhaust Nozzles					E–4, at C–D
Sustainer Motor and Exhaust Tubes					E–4, at A, D
Decoder					E–4, at B
Gyroscopic Distributor					E–6, E–7
Deflector Assembly				Molybdenum arm	E–4, at C; E–8
Wing Assembly				Aluminum skin Balsa wood filler	E–4, at B
Spool Assemblies					E–4, at A, C
Junction Box					E–4, at A, C
Batteries					E–9
Rear Cover and Tracer Flares					E–4, at C
Mounting Lugs				Steel	E–4, at C
Missile Circuit Test Socket					E–4, at A

rear edge of the warhead enters the front end of the missile body (D, fig. E–4) when the missile is completely assembled.

a. The AGM–22B missile has a 140mm shaped charge HEAT** warhead.

b. The ATM–22B*** training missile has an inert warhead. It contains a red, nonexplosive marking powder as well as the weights needed for ballast.

Caution: **Although alike except for color coding, the warheads cannot be interchanged on AGM and ATM missiles. The tactical round has a fuze and detonator in the missile body, but the training round does not have a detonator.**

E–5. Missile Body
(fig. E–4)

a. The missile body houses—

(1) Battery holders
(2) Fuze detonator assembly
(3) Sustainer motor and exhaust nozzle
(4) Booster motor and exhaust nozzles
(5) Decoder
(6) Gyroscopic distributor
(7) Deflector assembly

b. The body also provides the mounting surface for—

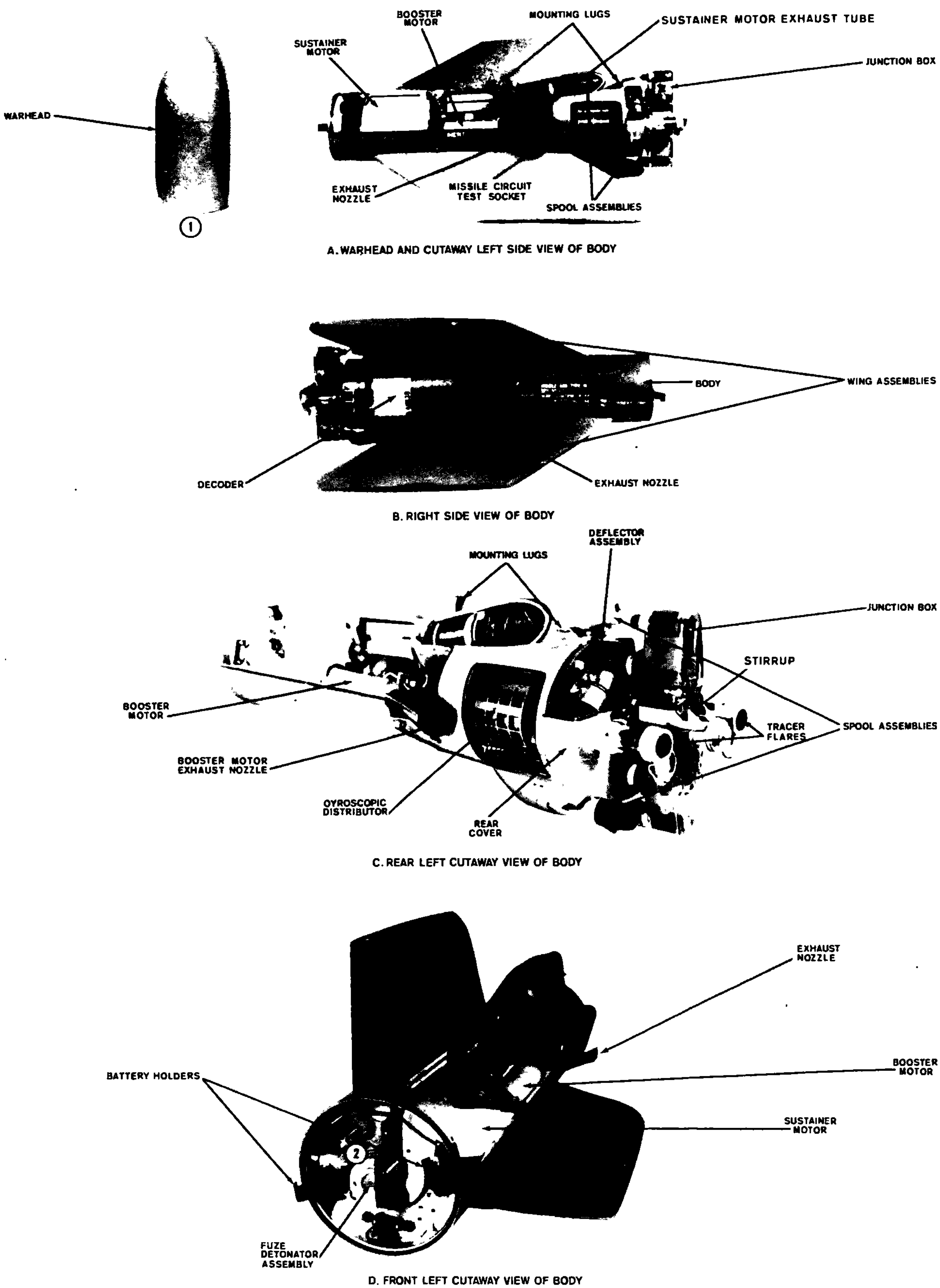


Figure E–4. Missile components.

(1) Wing assemblies
(2) Spool assemblies
(3) Junction box
(4) Two batteries
(5) Rear cover and tracer flares
(6) Mounting lugs
(7) Missile circuit test socket

E-6. Battery Holders
(D, fig. E-4)

The two battery holders are steel rings secured to the front of the fuze body by four screws each. The individual holder has two battery plugs, each having two guide pins similar to telephone jacks, and four blades that enter the battery sockets and connect them in series to the electromagnet circuit. Each battery, when installed, is held in position by a stainless steel leaf spring. These springs, by lapping out of the missile body when empty, keep the warhead from being screwed on before the batteries are installed.

E-7. Fuze Detonator Assembly
(D, fig. E-4)

The fuze* is screwed into the front end of the sustainer motor chamber. It is cylindrical and contains a wieghted spring-loaded firing pin. This firing pin is locked in unarmed position by a shear pin (A, fig. E-5). The detonator** is screwed into a central mounting hole in front of the fuze body. Arming (para E-39) makes a red piston stick out from the fuze body (B, fig. E-5).

Warning: **Before handling the missile body, see if the red plastic piston is protruding. If it is, keep hands off, evacuate the area, and call for explosive ordnance disposal personnel.**

E-8. Booster Motor and Exhaust Nozzles
(A, C, and D, fig. E-4)

The booster has seven cylindrical blocks of solid propellant that are glued to a spring grid at the front and held by a fixed grid at the rear. A ring-shaped igniter casing with 36 grams of black powder and two igniter filaments are attached to the rear grid. The propellant burns overall on outside surfaces except at the front face (where showed by an inhibitor).

a. The booster motor chamber opens into two lateral exhaust nozzles spaced 180° apart in the rear of the motor casing and 90° to the igniter lead-ins.

b. Each exhaust nozzle axis is inclined 18° to the long axis of the missile, and each nozzle is sealed by a celluloid pellet to protect the motor from moisture.

E-9. Sustainer Motor and Exhaust Tubes
(A and D, fig. E-4)

The sustainer motor has a single cylindrical block of solid propellant that burns evenly on the rear surface; an inhibitor has been applied to the front and outside surfaces of the propellant. The rear surface of the propellant has concentric grooves. These grooves hold three ring-shaped ignition casings that contain 1.2 grams of black powder.

a. Three tubes are molded into the motor 120° apart. Opening toward the front of the chamber, the tubes supply the fuze with the exhaust gases that arm it (fig. E-5).

b. The rear of the motor is covered by a chamber head from which the centerline exhaust tube protrudes. This tube goes from the sustainer motor through the booster motor to the nozzle outlet (the inside end of which is also plugged by a moisture-guarding pellet).

E-10. Decoder
(B, fig. E-4)

The decoder has a printed circuit, 12 transistors, eight diodes, and various resistors and capacitors. The entire assembly is coated in a white "plotting" plastic. Mounted on two supports with four shock absorbers, the decoder has electrical connections to the two spool assemblies, the two missile batteries, and the gyroscopic distributor.

E-11. Gyroscopic Distributor
(C, fig. E-4)

The gyroscopic distributor is mounted beside the decoder on its own support plate. It has a gyroscope rotor (in a frame pivoted on the missile roll axis) and a commutator assembly with wipers. The gyroscopic distributor is sealed in a cocoon-like casing to protect it from moisture and dust.

a. The rotor contains a powder charge and an igniter filament. Its cylinder is pierced with two tangent nozzles at opposite sides. The igniter filament wires pass through one of these nozzles.

b. The gyroscope is caged by a spring lever bearing a stud which holds the gyro in position when at rest. The lever is held in place by a solenoid armature (fig. E-6). The opposite end of the armature operates a double pole switch which controls the battery circuit.

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*Type 20P45 C1
**Type 6 PS 35

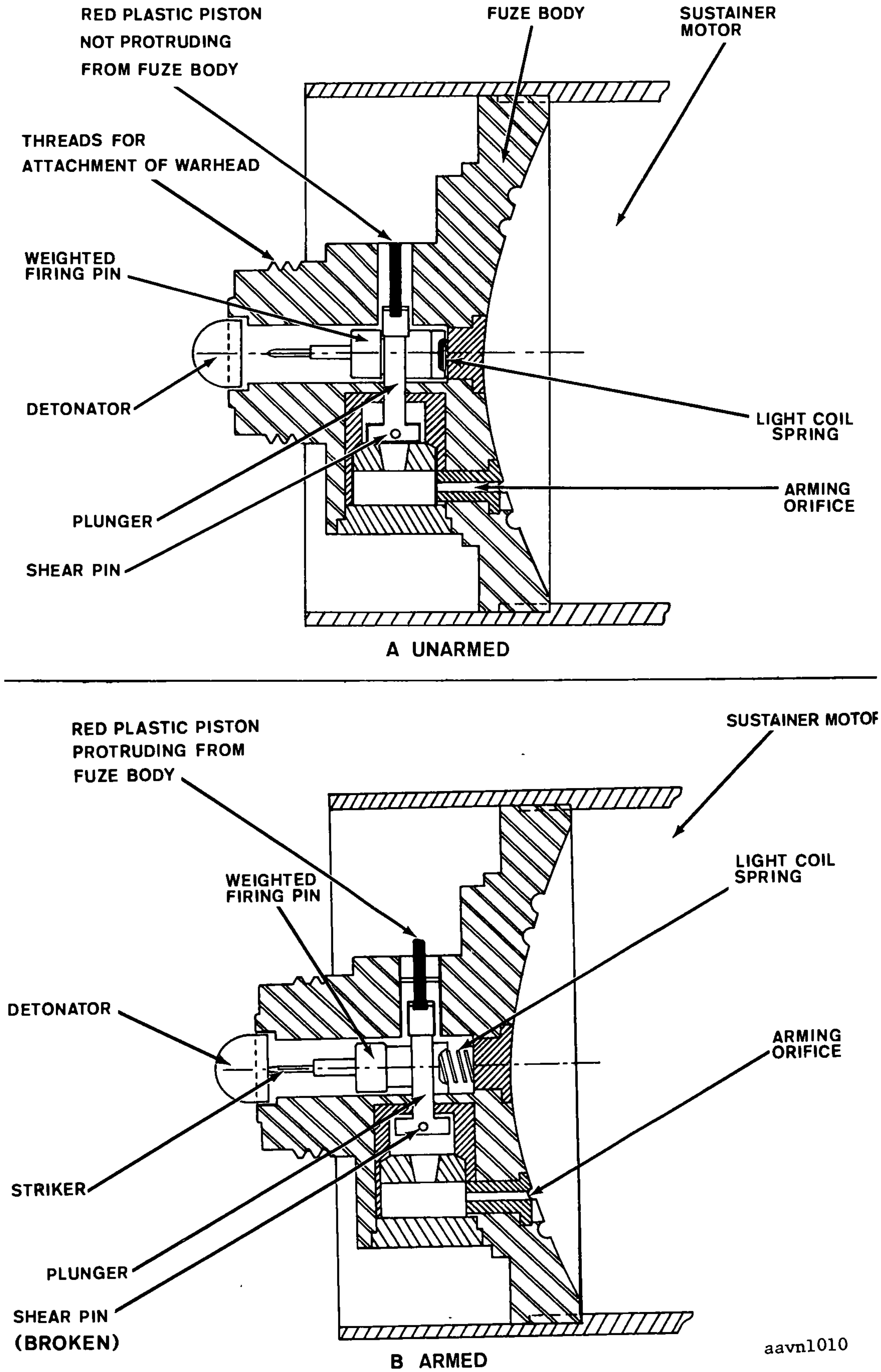

Figure E–5. Fuze detonator assembly.

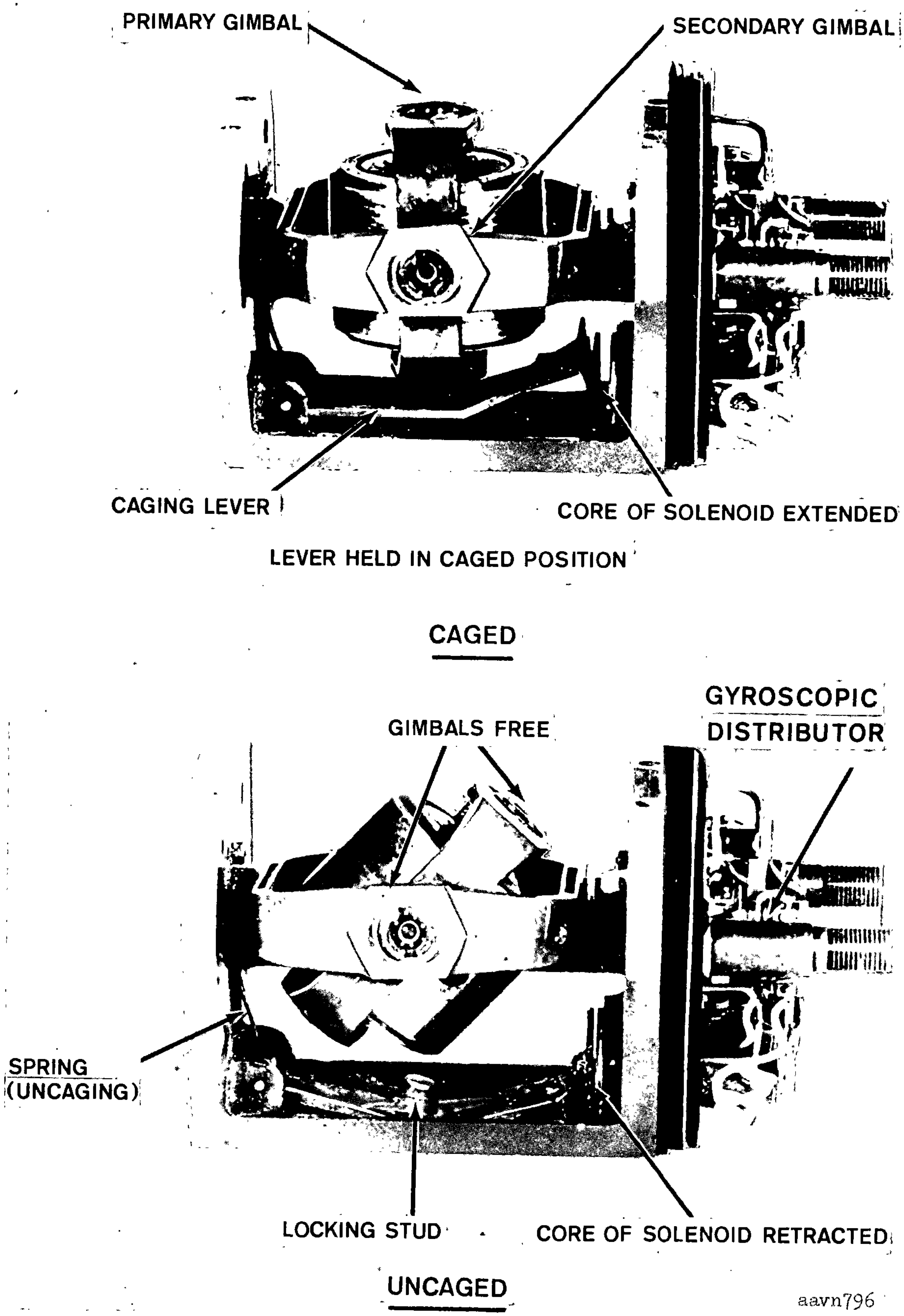

Figure E–6. Caged and uncaged gyroscope.

c. The commutator has four slip rings with four brushes connected to the decoder (fig. E–7). Four wipers of the jetavator electromagnets (para E–12) brush the four-segment commutator.

E–12. Deflector Assembly
(C, fig. E–4 and fig. E–8)

This assembly (commonly called *jetavators*) has four jet deflectors, each controlled by two electro-

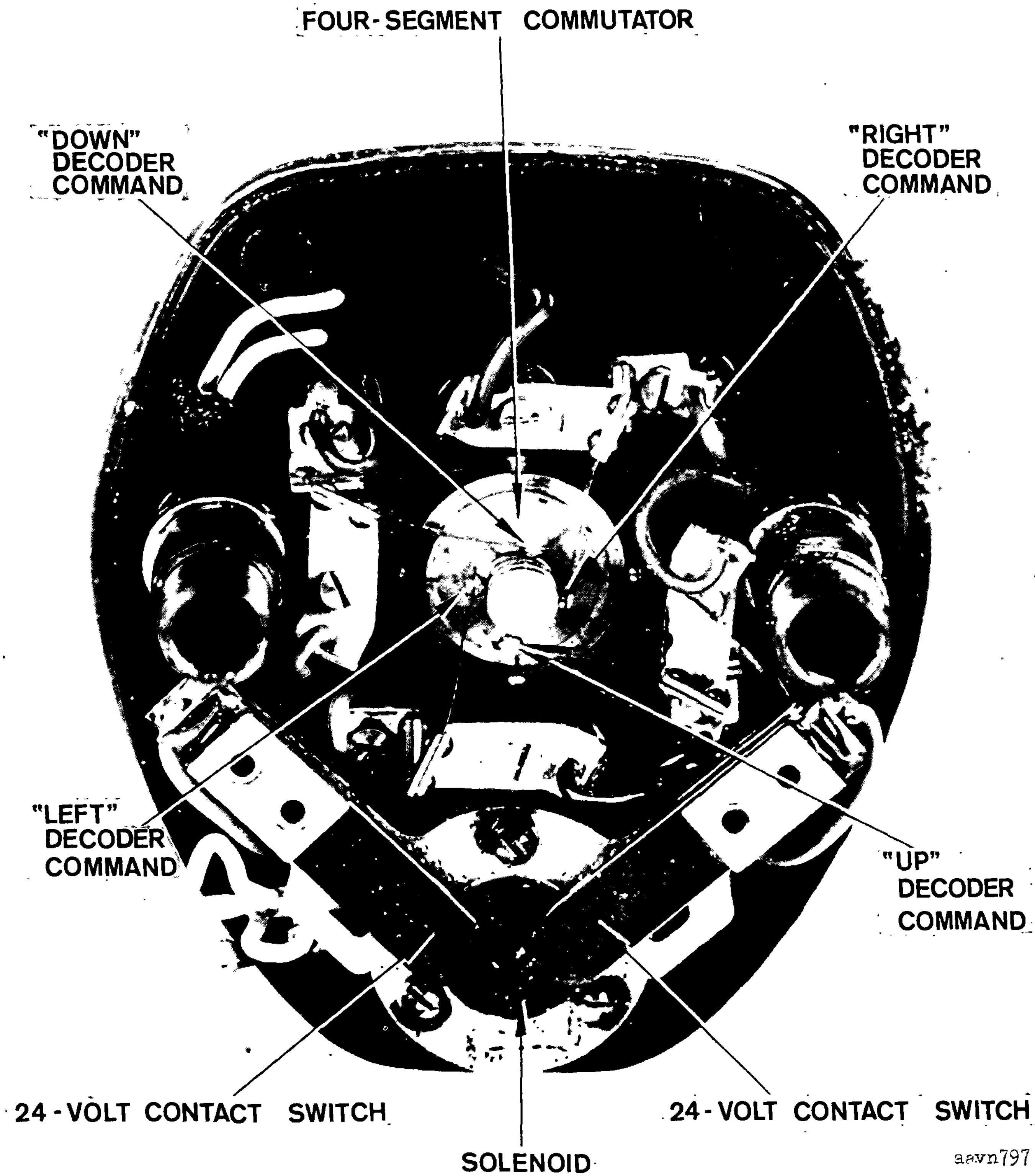

Figure E–7. Gyroscopic distributor.

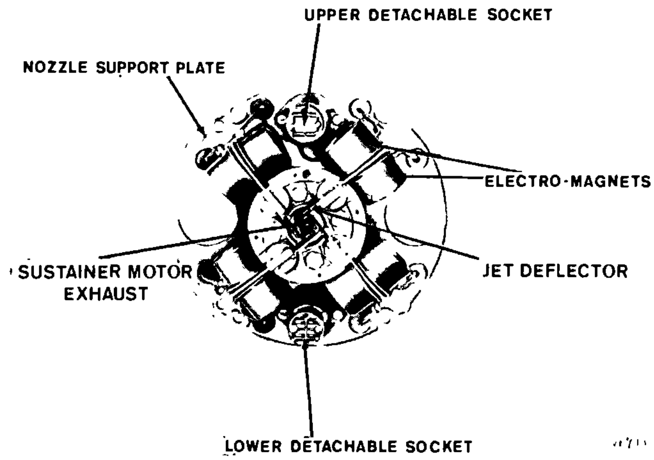

Figure E–8. Jet deflector assembly.

magnets with a common blade. Each deflector has a specially shaped arm. The heat-resistant arm may be completely outside, or it may be partially inserted into, the jet cross-section at the sustainer motor exhaust outlet. When so inserted, the arm deflects the exhaust gases and provides missile control. The deflectors vibrate in and out of the exhaust at a frequency in time with the roll rate of the missile. The vibration is caused by the insulation between segments of the commutator (para E–11*c*).

E–13. Wing Assemblies
(B, fig. E–4)

The missile has four opposed wings, each having a rounded leading edge and a tapered trailing edge. The wings are attached to the missile body by mounting flanges. Each missile is dynamically balanced at the factory by means of lead balance weights in the small recesses at the forward edge of each wing. The wings are set at an angle of 48 minutes to the long axis of the missile, which causes it to spin in flight. The rate is 3 to 3⅝ revolutions per second.

E–14. Spool Assemblies
(A, C, fig. E–4)

There are two spool housings in recesses on the top and bottom of the missile body. Each contains a spool of enameled steel wire (0.18 to 0.29mm in diameter) 3,300 meters long. The spools are handwound with naval windings (as on a fishing reel). The base of the spool is mounted at the forward end. The rear of the spool housing is machined in the shape of a radiator to reduce the heat from wire friction during its unwinding. The guidance wire leading to the junction box goes through a hole in the rear end also.

a. One end of each guidance wire is connected to the decoder. The other end, protected with a rubber cap, is connected to a tip jack in the junction box.

b. Enamel insulation on the wires prevents electrical short circuits when the missile spins (and the wires twist) in flight. The insulation also permits flight over water.

E–15. Junction Box
(A, C, fig. E–4)

The junction box, though shipped as a part of the missile, remains locked to the launcher (para E–25) after the missile has been launched.

a. The front face of the junction box has two curved locator plates and two missile connector plugs. The plates fit around the sustainer nozzle. The plugs (four-pin) fit detachable sockets. Each plug is mounted loosely on the box, being held to the socket by a spring on the bevel of the socket sleeve of the missile's rear cover.

b. The two ends of the guidance wires from the spool assemblies are connected to tip jacks within sleeves. One sleeve is at the top end of the junction box and the other at the bottom end. Each sleeve contains a small explosive charge and igniter to jettison the wire ends after missile impact.

c. On the sides of the junction box are rubber grommets and a steel stirrup. The grommets are for tracer flare igniter wires. The stirrup permits the junction box to be attached to the launcher (para E–25*d*).

d. The junction box plastic rear cover is rectangular and has tapered round ends. This cover has a seven-pin connector for electrical mating to a plug on the launcher. The connector, mounted internally on a connection box, contains a printed circuit with 10-ohm resistors for the motor ignition circuit, tracers, and detachable connector sockets.

Note. Except for the resistors, igniter wires could fuze together during explosive detonation and cause a short circuit. Since a short circuit draws maximum voltage, the short would burn up the missile circuits. The resistors are safety devices to prevent this.

E–16. Missile Batteries
(fig. E–9)

The power for missile guidance comes from two batteries, connected in series, each supplying at least 12 volts. These batteries are plugged in at the battery holder. A strip of tape around each battery (removed before test and assembly) protects the connections from moisture and other foreign matter. Two types of batteries may be used, as described below.

a. CIPEL Batteries. Each CIPEL battery has nine cells of 1.5 volts each. All cells are enclosed in a molded plastic case which is waterproof and olive drab in color.

b. SANTIS Batteries. These batteries (procured in limited quantity) are similar in appearance to the CIPEL batteries, but differ in color. They are cold storage batteries (0° ±5° C.) which must be used within 90 days from the date raised to normal temperature.

E–17. Rear Cover and Tracer Flares
(C, fig. E–4)

The rear cover fits over the rear casing that holds the deflector assembly.

a. This cover includes mounting ears and collars for the two tracer flares. The flares (two sealed metal tubes) contain a fusing powder that has a combustion time of 21 seconds (minimum) at +50° C. and 23 seconds at −30° C. In other words, flare duration is slightly greater than the greatest missile flight time at similar temperatures.

b. Each flare has two electrical igniters. These are connected in parallel on a plastic and metal plug that closes the rear end of the flare. The plug, having a mobile pin socket connected to the missile junction box, is ejected immediately after tracer ignition.

c. The cover also holds two four-pin connectors to the junction box. They provide the final circuitry into the missile.

E–18. Mounting Lugs
(C, fig. E–4)

The missile has four mounting lugs, two on the top and two on the bottom. Helicopter-mounted launchers use only the two top lugs. Each lug has two ears that slide in guide rails on the launcher. (The ears on the forward lug are wider and higher than those on the rear lug.)

E–19. Missile Circuit Test Socket
(A, fig. E–4)

The missile circuit test socket is located just below the left exhaust nozzle of the booster motor. It has two metal contacts, one connected to the missile battery positive pole and the other to the decoder. The test socket is protected by a threaded plastic plug that has to be removed. To use the test socket, the plug is removed and a screwdriver or knife blade inserted between the socket contacts. This completes the circuit to the decoder, applies power to the jet deflector assembly, and results in audible clicks of the jetavators against the electromagnets. (This clicking noise is a down and right command given by the decoder after input of a zero command signal.) This action by the operator tells him that the batteries are properly seated and that the missile circuit is operating properly, even before the gyro locking lever connects battery power to the circuit.

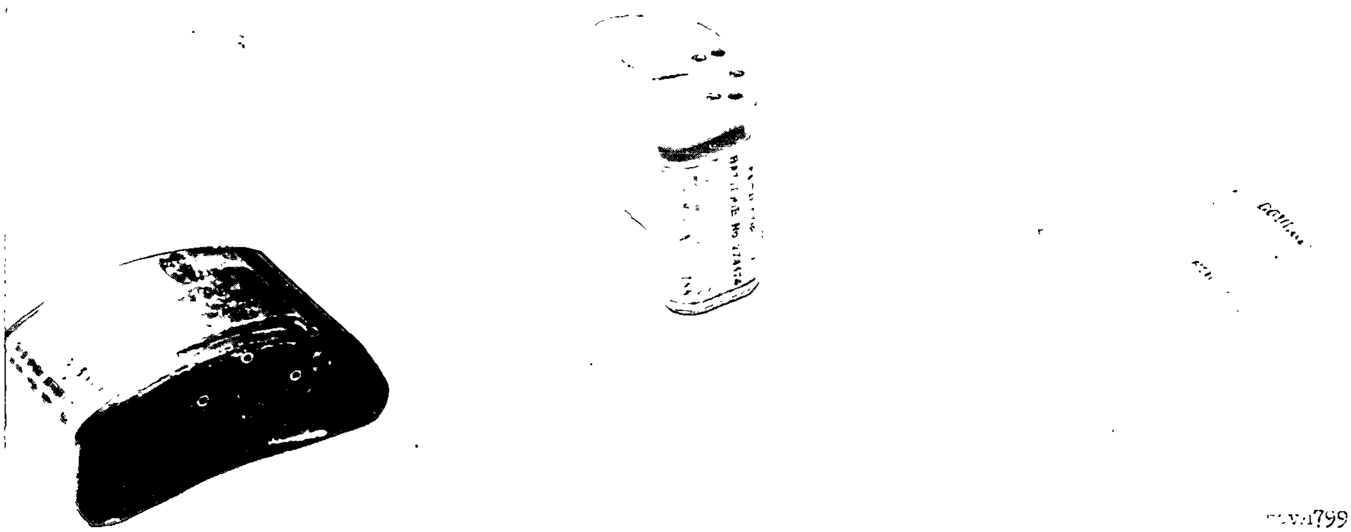

Figure E–9. Missile batteries.

Section III. EXTERNAL SUBSYSTEM COMPONENTS

E–20. General

M22 armament subsystem components mounted externally on the helicopter transport the missiles. These components are light in weight and simple in construction, using an external stores assembly which is compatible with the M6, XM3, and M16 armament subsystems. For proper assembly and disassembly of external components, see TM 9–1400–461–20. For weights and dimensions, see table E–3.

E–21. Cable Assembly
(fig. E–10)

The cable assembly on each side of the UH–1 has a 37-pin connector(1) at one end, a 29-pin quick-disconnect(2) at the other, and threaded collar(3). The connector mates to the external electric socket below the rear doorsill of the helicopter. The quick-disconnect is spring-loaded. When the cable is threaded through the rear access panel of the housing assembly, the quick-disconnect is mated to the fixed electrical socket inside the launcher support assembly. The threaded collar of the cable permits drawing the cable tight between the helicopter and the housing assembly. This restricts the amount of cable outside the housing assembly and also prevents cable slippage after installation.

Table E–3. Weights and Dimensions of External Components

Item	Length (In.)	Width (In.)	Height (In.)	Diameter (In.)	Weight (Lbs.)
Cable	54½	--	--	--	3½
Housing Assembly	8	--	--	7	11
Launcher Support Assembly	49	--	--	4	15
Fixed Housing	30	4¼	4½	--	6
Launcher	31¾	4½	5¼	--	18½

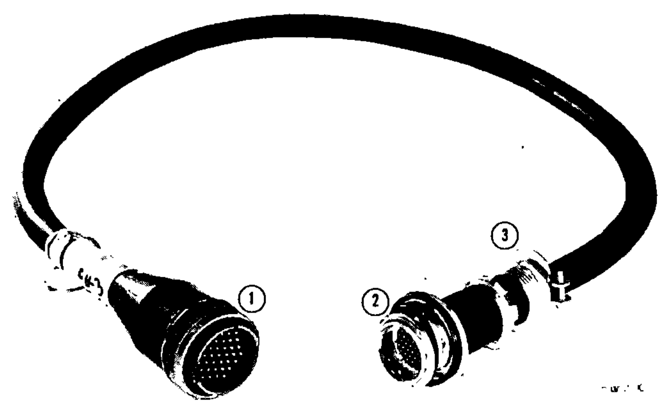

Figure E–10. Cable assembly.

E–22. Housing Assembly
(fig. E–11)

A housing assembly on each side of the helicopter adapts the external stores assembly to the M22 armament subsystem and lets the pilot mechanically jettison the external portion of the system if necessary. One end of the housing assembly has holes for eight mounting bolts which secure it to the crossbeam of the external stores assembly.

a. On top of the housing assembly are two one-hole lugs; these lugs are spaced for another one-hole lug from the launcher support assembly. When all these lugs are alined in position, a pin can be temporarily inserted to lock the housing assembly to the launcher support assembly.

Caution: **This locking pin must be removed before subsystem use.**

b. Adjustment of the nut and latch on the rear side of the housing assembly assures a snug mating of the launcher support and housing assemblies.

c. Mounted inside the housing assembly is—

(1) A jettison hook, which mechanically mates with a roll bar inside the launcher support assembly (para E–23).

(2) An electrical quick-disconnect, which is a part of the cable assembly (para E–21).

E–23. Launcher Support Assembly
(fig. E–12)

The launcher support assembly on each side of the helicopter is a hollow metal tube. Its flared inboard end contains a roll bar for the mechanical jettison hook (para E–22*c*(1)) and a 29-pin socket which mates with the cable assembly quick-disconnect (para E–21) inside the housing assembly. An internal wiring harness leads from the quick-disconnect plug to two cables. These cables extend through the three holes in the tube at each of the three fixed housing assembly mounting stations—one cable has a three-pin connector for the explosive bolt circuit and one cable has a seven-pin connector for the missile circuit.

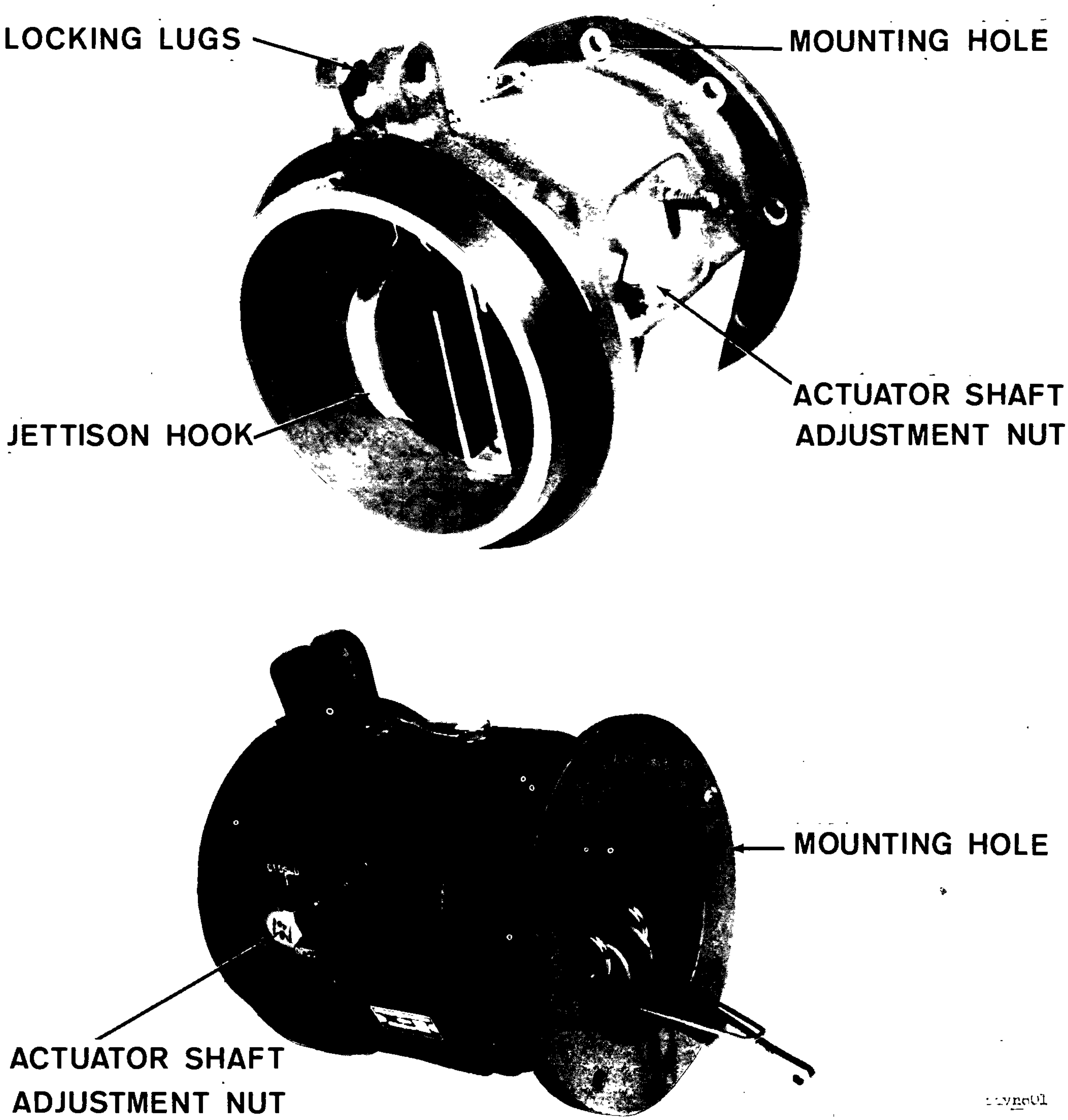

Figure E-11. Housing assembly.

E-24. Fixed Housings
(fig. E-13)

Each of the two launcher support assemblies has three fixed housings that support the launchers.

a. Each fixed housing is secured to its launcher support assembly by two U-bolts. Setting the elevation angle of the fixed housing determines initial elevation angle of the missile's flightpath. For a detailed description of the gunner's procedure in setting the elevation angle of the fixed housing and launcher, see TM 9-1400-461-20.

b. Between the two U-bolts, the fixed housing has an access hole for the two cables(C) from the launcher support assembly. A hinged cover on top of the housing(A) provides access to these connections and to the deep well mount (C) for the explosive bolt.

c. On the bottom of each fixed housing(B), there is a 15-pin electrical connector for the launcher. (Only seven of the 15 pins are used).

E–25. Launcher
(fig. E–14)

Each of the six launchers is fastened to a fixed housing assembly by an explosive bolt (para E–24*b*). This bolt is mounted in the fixed housing and protrudes through a hole in the launcher.

a. Locking Lever and Hook. While the helicopter is in flight, a spring-loaded hook on the forward end of the launcher locks the missile in place. During loading operations, the locking lever is used to actuate the hook. (See the locking lever on the side of the launcher (fig. E–14).

b. Explosive Cartridge. The explosive cartridge holds the locking hook in place. A receptacle with a female plug for the cartridge is located just forward of the locking lever.

c. Microswitch. When the locking hook is released, it depresses a microswitch which completes the electrical circuit between launcher and missile.

d. Vertical Plate Plug and Guillotine Lock. On the rear side of the launcher's vertical plate (hidden in fig. E–14) is the seven-pin female connector that mates with the 15-pin plug described in paragraph E–24*c*. Also located here is the guillotine lock which engages the junction box and, upon missile launch, holds the box in place.

e. Launcher Guide Rails. The launcher guide rails are in two sections on the bottom of the launcher on both sides (compare the side and bottom views of fig. E–14). These rails receive the four ears of the two missile mounting lugs. The forward rail section (corresponding to the forward mounting lug on the missile) is higher and wider than the rear rail section.

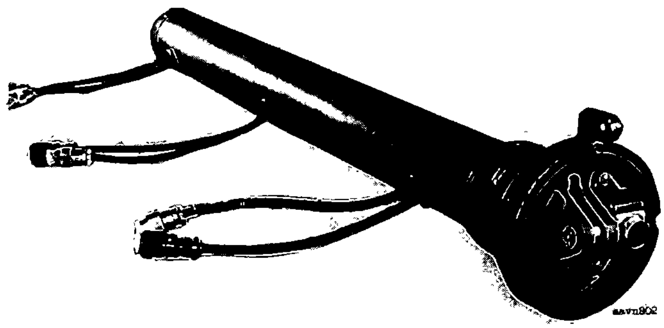

Figure E–12. Launcher support assembly.

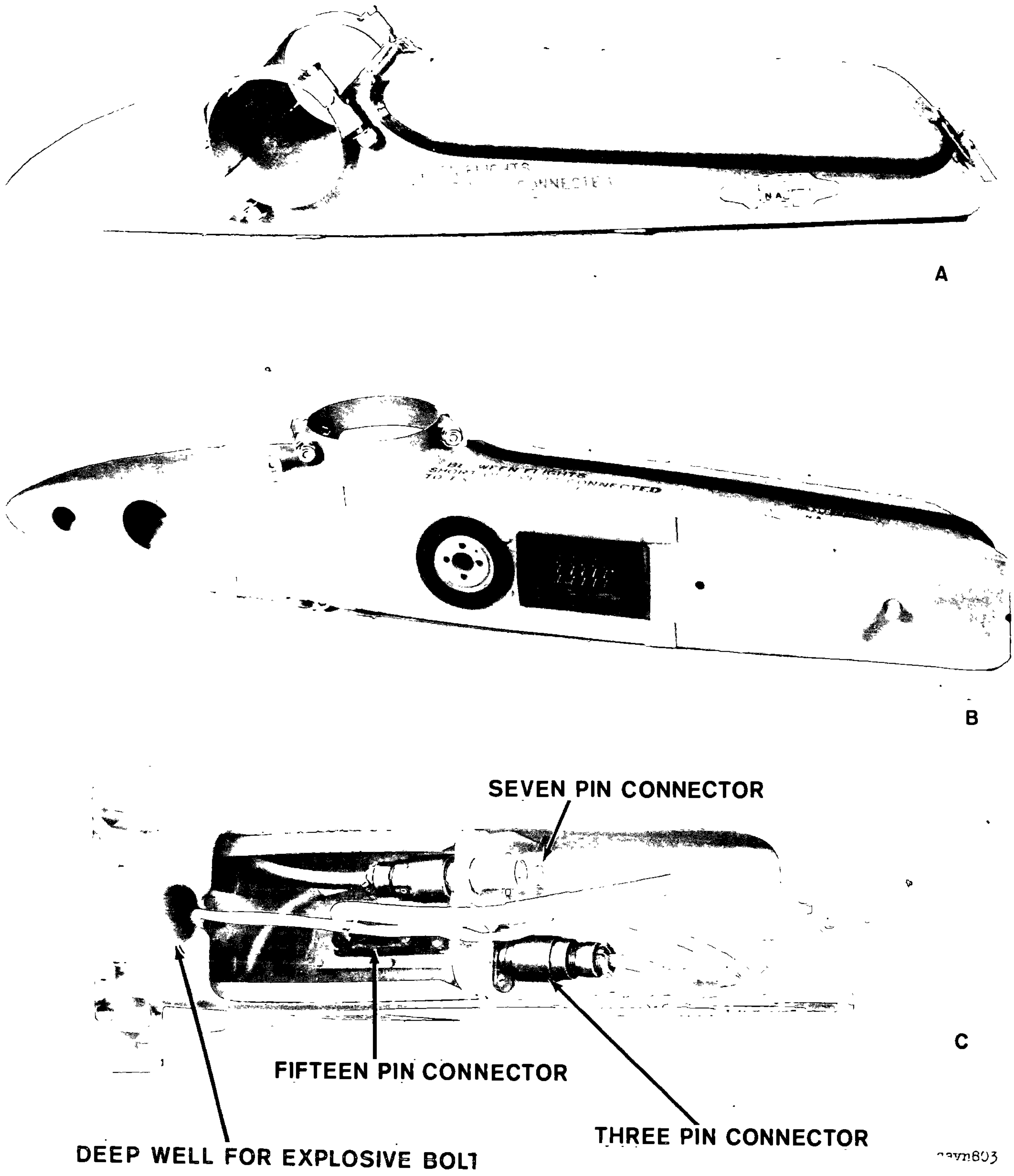

Figure E–13. Fixed housing.

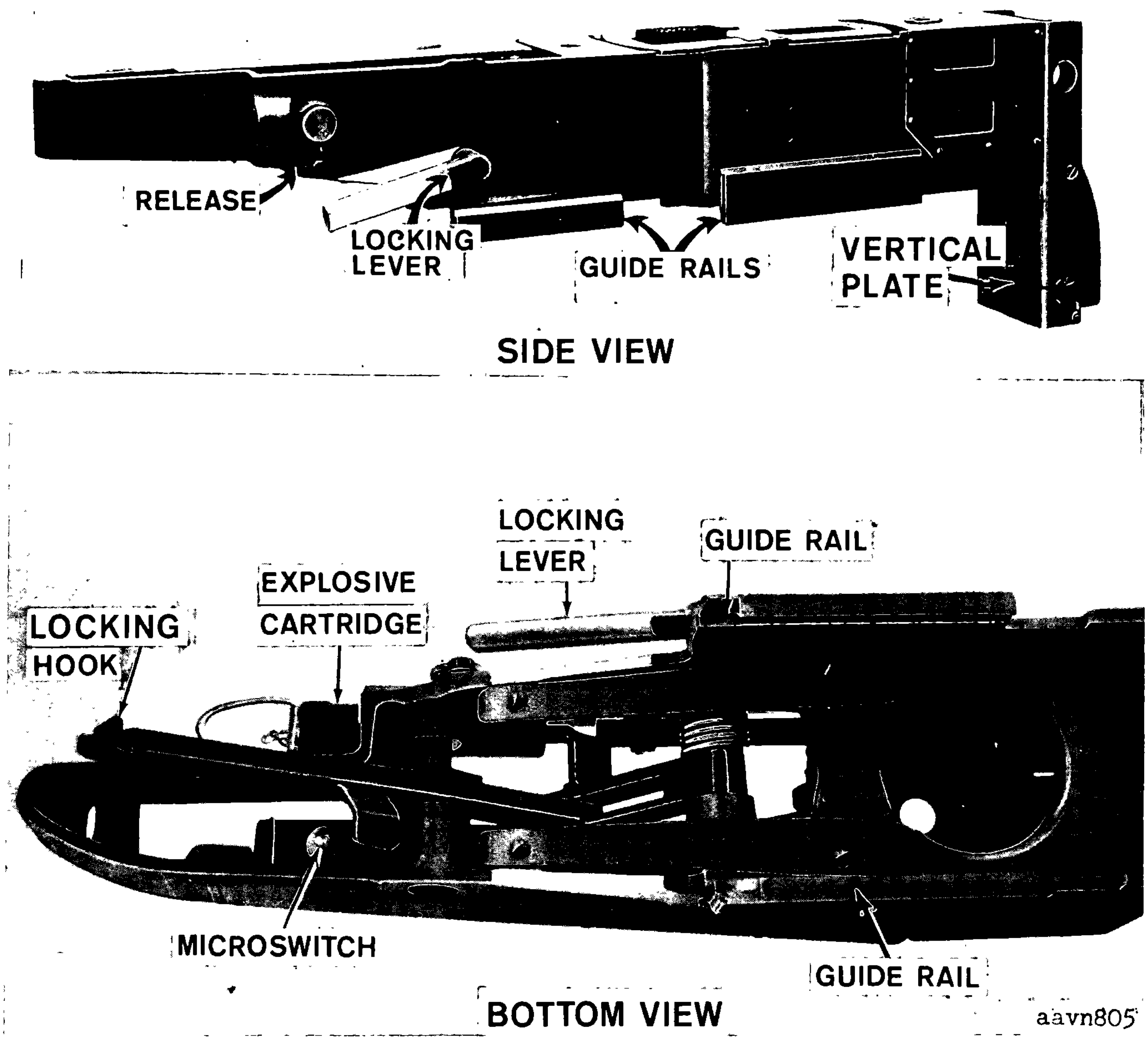

Figure E–14. Launcher.

Section IV. INTERNAL SUBSYSTEM COMPONENTS

E–26. General

The M22 subsystem components internal to the UH-1 are for missile selection, firing and control, and guidance. The electronics components are completely transistorized. For installation and boresighting procedures, see TM 9–1400–461–20. For equipment check and circuit tests, see paragraph E–46. For weights and dimensions of internal components, see table E–4.

E–27. Pilot's Sight
(fig. E–15)

The infinity reflex optical sight (Navy Mk 8) is mounted to the roof of the helicopter in front of the pilot. A locking clamp(1) on the mount locks the sight in the operating (vertical) position or the stowed (horizontal) position.

a. The target is viewed through a flat glass reflector plate(2). This plate adjusts 14° up and

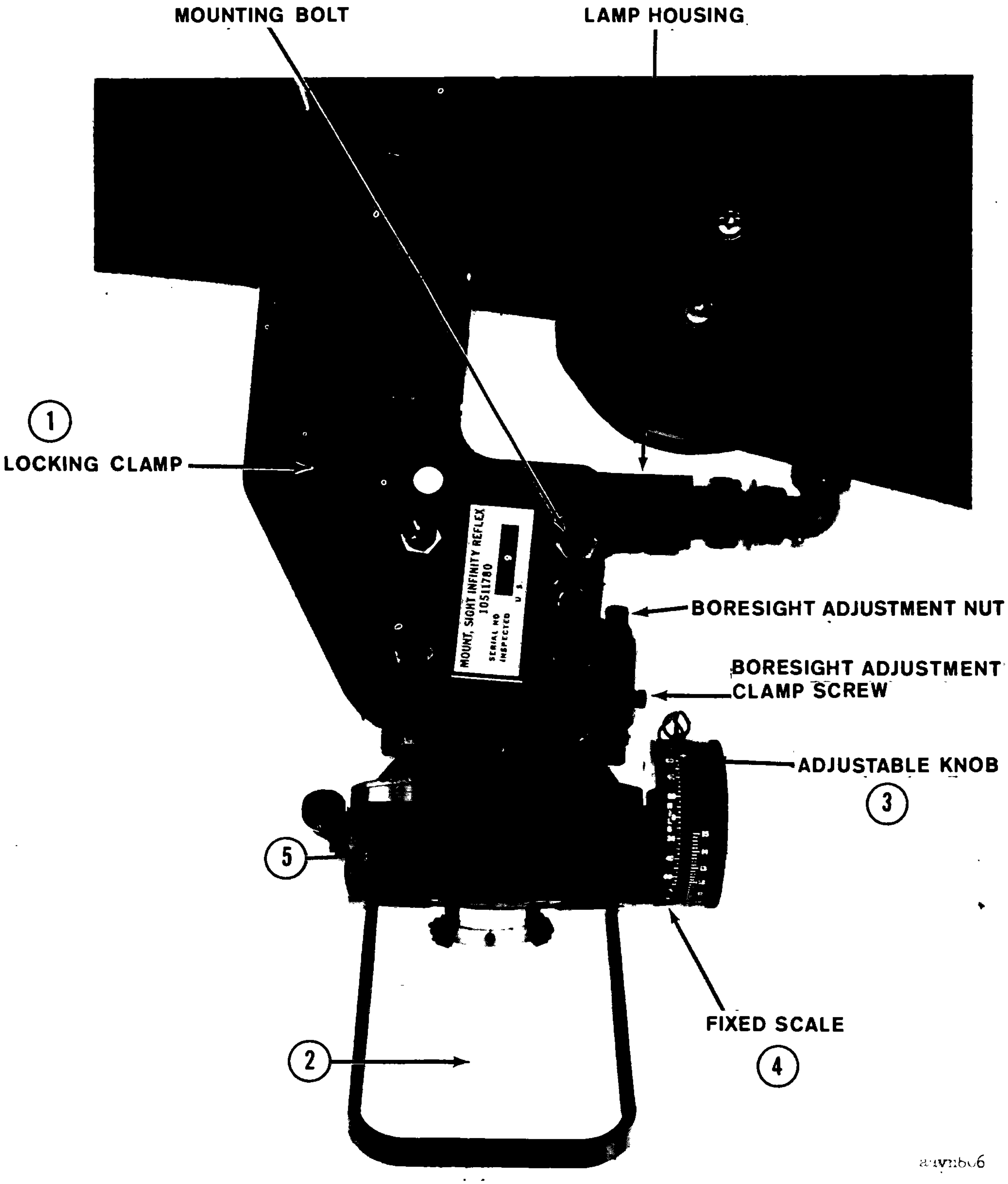

Figure E-15. Pilot's infinity reflex sight.

down from a zero reference point in making changes in range. The adjustment is by the knurled ring knob that has a degree scale inscribed on it. Next to the degree scale(3) is a fixed scale(4) graduated in mils. A spring brake holds the degree scale in the desired setting.

b. Inside the sight body(5) is a two-filament 28-volt bulb, a multiple ring reticle (inner ring with 100 mils value) with a 10-mil ladder image, and a lens.

Table E–4. Weights and Dimensions of Internal Components

Item	Length (In.)	Width (In.)	Height (In.)	Diameter (In.)	Weight (Lbs.)
Guidance Control Unit	12¼	5½	6	----	13
Missile Selection Box	10	5	4½	----	6½
Pilot's Sight (including mount)	18	----	----	----	10
Gunner's Sight M55 (including mount)	----	12	15	----	18½
Gunner's Sight XM58 (with control amplifier)	----	7	15	----	50
Control Stick	----	----	4	3¼	2
Adapter Kit	----	----	----	----	10

E–28. Gunner's Sight M55 (fig. E–16)

The M55 antioscillation sight is used by the gunner (copilot) to track the M22 missile after it is fired. The sight is mounted to the helicopter roof in front of the gunner's seat.

a. Mount. A locking clamp(1) on the mount allows positive vertical positioning of the sight for use and horizontal positioning when not in use. The thumb screw(2) is to adjust sight elevation, and the locking lever(3) to adjust sight azimuth.

b. Binocular. The Navy Mk 43 six-power binocular, modified to a fixed focus, is the major component of the sight. An eye lens, a control lens, and a field lens are mounted together. Two erecting prisms of each optical system are fastened to a shelf secured to the cover. The lenses are mounted in a double eccentric ring. This ring permits any adjustment necessary in a plane at right angles to the line of sight.

c. Gimbals. Two gimbals with double bearings permit the binocular to move vertically and hori-

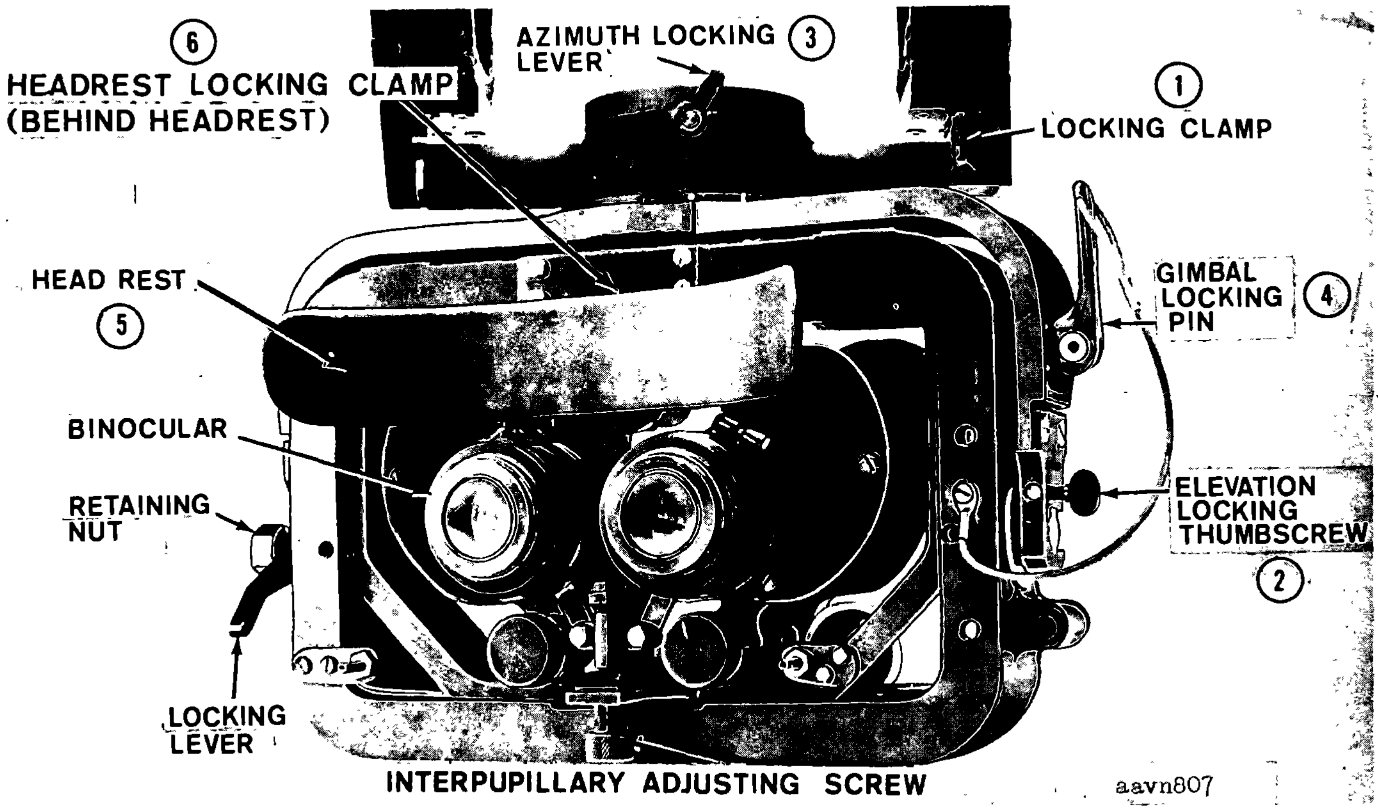

Figure E–16. M55 gunners antioscillation sight.

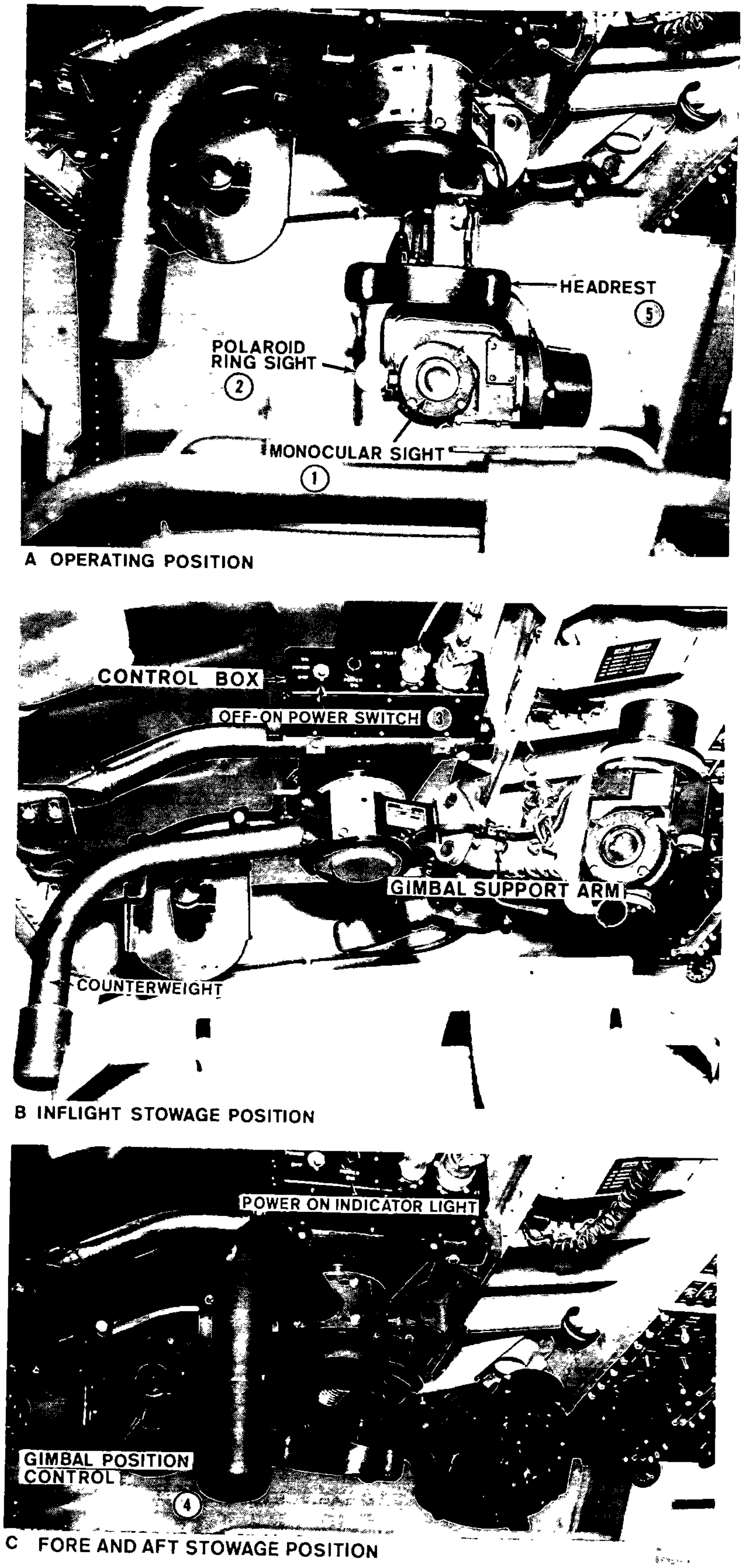

Figure E–17. XM58 sight.

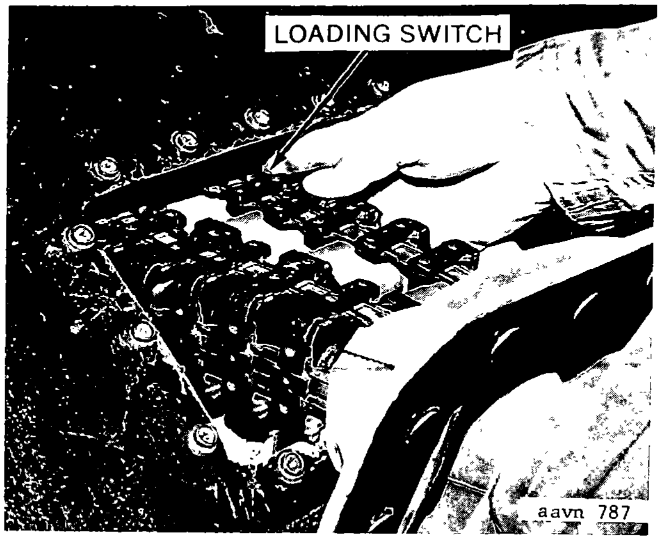

Figure F–5. Use of loading switch.

mounted next to the gunner in the lower left corner of the pedestal console. The panel is held in place by six turn-lock fasteners. The face of the panel is illuminated and contains the indicators and controls for applying subsystem power, for determining rounds remaining, and for selecting the gun elevation stow position. Electrical connections to the control panel are made beneath the panel from internal components.

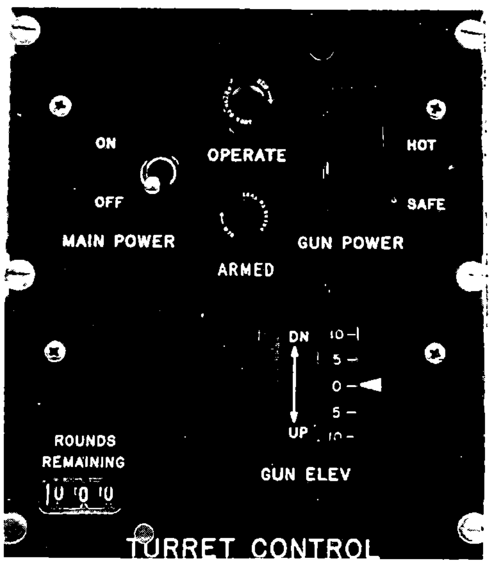

Figure F–6. Turret control panel assembly.

a. Controls and Indicators.

(1) *MAIN POWER switch.* Applies operating power to the M5 subsystem.

(2) *OPERATE indicator light.* Lights to indicate that operating power is applied to the subsystem.

(3) *GUN POWER switch.* This two-position switch has a toggle guard for safety. The switch permits firing the gun only when it is moved from the SAFE to the HOT position.

(4) *ARMED indicator light.* Red light indicates that the subsystem is armed and ready to fire.

(5) *GUN ELEV stow control.* Selects gun elevation or depression desired for stow position. The selector dial associated with the control is graduated in 5° increments from +15° to −35°.

(6) *ROUNDS REMAINING indicator.* Indicates the number of rounds of ammunition remaining to be fired. Pushing the cylindrical reset knob in and turning it clockwise permits the indicator to be set to the number of rounds loaded.

b. Internal Components.

(1) Control panel relay.

(2) Manual elevation transmitter synchro assembly (part of the gun stow position elevation control).

(3) A portion of the components and circuitry for dynamic braking (para F–20) of the gun motor.

(4) Wiring to connect the control panel assembly with other components of the subsystem.

(5) A portion of the lead compensation system.

F–9. Sight Mount Bracket Assembly

The sight mount bracket assembly (fig. F–7) is secured to a plate in an overhead position on the left (gunner's) side of the cabin of the helicopter.

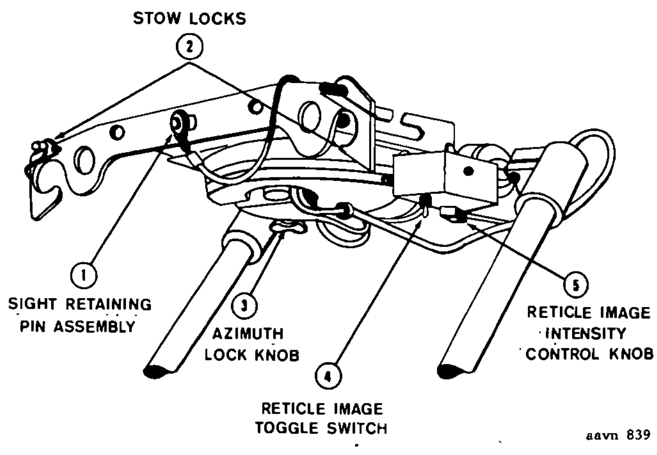

Figure F–7. Sight mount bracket assembly.

It mounts the hand control sight assembly. As the sight mount group is slid into the bracket assembly, an electrical connector mates with a receptacle in the bracket. Proper mating of the connector and receptacle is insured by an index pin on each side of the receptacle. A retaining pin assembly(1) inserted through the front of the bracket assembly locks the sight assembly into the bracket assembly. Two spring-loaded stow locks(2) at the ends of the bracket assembly support the sight assembly in the stow position.

a. Azimuth Lock Knob ((3), fig. F–7). This knob can be turned to lock the azimuth frame assembly in one position.

b. Reticle Image Toggle Switch ((4), fig. F–7). Moving this three-position toggle switch to either side of the center position lights the lamp that illuminates the sight reticle.

c. Reticle Image Intensity Control Knob ((5), fig. F–7). This knob is attached to a variable resistor in the bracket with the reticle image toggle switch. When the toggle switch is turned on, movement of the control knob brightens or dims the intensity of the reticle image.

F–10. Hand Control Sight Assembly

The hand control sight assembly permits the gunner to remotely aim and fire the gun. Throughout the field of fire, the sight assembly maintains a relationship between the gunner's line of sight and the line of fire of the gun. Sight movement must be steady and smooth to maintain coordination between sight and turret assembly. The hand control sight assembly consists of a—

a. Mount Group. The mount group slides into the sight mount bracket assembly and is secured by the sight retaining pin assembly (para F–9). The mount group contains an azimuth frame assembly attached to the mount assembly. The azimuth frame assembly rotates on ball bearings within azimuth limits set by stops. Setscrews on the stops provide for azimuth travel adjustment. Synchro and gear assemblies are mounted on the azimuth frame assembly and the mount assembly. When the sight assembly is energized and operated, movement in azimuth and/or elevation generates electrical impulses that are transmitted by the synchro and gear assemblies to the powered trunnion assemblies in the turret assembly. The azimuth frame assembly supports the suspension system through a tube mounted along the rear end of the frame. A spring mounted around the tube allows the sight to "float" in a neutral position in front of the gunner.

b. Suspension System. The suspension system consists of springtensioned telescoping tube assemblies that pivot on the azimuth frame assembly. When released, the tubes tend to return to the retracted position. The sight is mounted on the ends of the tube assemblies.

c. Sight. The sight consists of the—

(1) *Right- and left-hand support assemblies.* The support assemblies are attached to the ends of the tubes of the suspension system. The right-hand support assembly provides a bearing mount for the shaft that connects the guide with the controller grip assembly. The left-hand support assembly is also bearing mounted; this permits the guide to be easily rotated through the movement of the controller grip assembly. The left-hand support assembly contains the reticle housing assembly, reticle lamp, elevation transmitter synchro assembly, and a sight reticle range scale selector switch. The selector switch is located on the rear of the left-hand support assembly. This switch permits the gunner to select either the high or low range scale on the reticle by setting the switch to either the H or L position.

(2) *Guide.* The guide contains a glass reflector and spherical mirror housing assembly. It is open on both sides of the reflector to provide the gunner with a clear view of the target area. A sun filter can be lowered (B, fig. F–8) to permit the gunner to clearly see the target on bright sunny days. The reflector is mounted at an angle of 45° to the gunner's line of sight and slightly to the right of the centerline of the guide. The reflected collimated reticle image (fig. F–9) is displayed on the reflector. The gun cannot be fired when the reticle is flashing (also, the ARMED indicator light will not be illuminated on the turret control panel). A flashing reticle image indicates one (or more) of the following conditions—

(*a*) The turret is in an azimuth or elevation limit position.

(*b*) The position of the sight and turret is out of synchronization.

(*c*) There is an electrical malfunction in the subsystem.

(*d*) The turret control switch is not depressed.

(3) *Controller grip assembly.* The controller grip assembly contains the turret control switch, the gun trigger switch, and the elevation lock knob (B, fig. F–8).

(*a*) *Turret control switch.* *When de-*

zontally. The vertical gimbal is attached to the outer frame and holds the horizontal gimbal. A pin(4) locks the gimbals together when the gunner's sight is not being used, with a stowing position for the pin when the gunner is using the sight.

d. Dashpots. Two dashpots act in the vertical and horizontal axes to dampen shock. A control knob on each dashpot adjusts the travel limits of a rubber diaphragm. The diaphragm is clamped between the dashpot plate and cover. It and the mounting ring make up the antioscillation system. These two parts vibrate with respect to one another. The diaphragm moves back and forth, forcing air in and out through the openings in a small needle valve, thereby dampening vibrations.

e. Headrest. To prevent the gunner from coming in contact with the gimbals, a headrest(5) is rigidly mounted on the outer frame. It may be locked(6) in any of three positions by lifting the spring-loaded arm and sliding the headrest to the desired position.

E–29. Gunner's Sight XM58
(fig. E–17)

One half of a Navy Mk 43 six-power binocular, modified to a fixed focus, gives the gunner magnified vision with the right eye(1). A polaroid ring sight(2) with multicolored target rings is for the left eye. The XM58 is mounted to the roof in front of the gunner.

a. Mount. Bolted in existing holes in the helicopter roof, the mount holds the azimuth gimbal and the line-of-sight indicator pickoff synchro (*g* below), as well as the sighting system trim controls, control box, and the gimbal position control. DC power of 28 volts is brought into the system at the control box, through the OFF/ON power switch(3), which also acts as a circuit breaker.

b. Sights. The monocular sight consists of an eye lens, a control lens, and a field lens mounted together. The open polaroid ring sight adjusts optically with the monocular.

c. Gimbals.

(1) The balanced azimuth gimbal includes its housing, support arm, and counterweight. It has mechanical stops 45° on either side of the centerline of the helicopter.

(2) The elevation gimbal is fixed to a yoke on the azimuth gimbal support arm. This gimbal houses the monocular and ring sights, and two motion-sensing gyroscopes. The gimbal has mechanical stops 15° up or down from the centerline of the helicopter.

(3) The two gyroscopes, operating independently, sense helicopter motion electrically, then send signals to the control amplifier located on the floor of the helicopter just aft of the M22 guidance control unit. The amplifier then sends counteracting commands to the gimbal motors, which move the sight in direct motion opposite to that of the helicopter.

(4) The sight, once set, will stay on target during helicopter motion if the helicopter does not exceed the azimuth limits (45° right or left) or the elevation limits (15° up or down).

d. Gimbal Position Control. This control (C, fig. E–17) is a button-knob attached to the mount (4). It lets the gunner control the gimbal position both in azimuth and elevation, as much as 20° per second. This makes tracking a moving target possible, even with the sight stabilized. When the gunner gives the knob an azimuth change command, elevation of the sight is controlled by the motion sensing elevation gyro (*c* (2) and (3) above). If he gives the knob an elevation change command, the azimuth gyro stabilizes the sight. When the sight is moved by gimbal position control commands and then released, the sight stabilizes in the new position until moved again.

e. Headrest (5). The adjustable headrest mounted on the azimuth axis is independent of the gimbal. This allows the gunner a firm head and eye position without placing any loads or torque upon the gimbals.

f. Stowage. When the sight is not being used, the gimbal support arm is allowed to swing into the stowed (or horizontal) position by a locking lever and spring assembly. The headrest shaft is raised to engage with holes in the gimbal housing for a positive lock of the azimuth gimbal. There are two locking positions:

(1) *In-flight stowage position.* For in-flight stowage, the gimbal support arm is placed in a right horizontal position with the counterweight to the left (B, fig. E–17).

(2) *Fore and aft position.* For exiting the helicopter, the support arm and counterweight are placed fore and aft (C, fig. E–17).

g. Line-of-Sight Indicator. A line-of-sight indicator is provided for the pilot, and is mounted on the pilot's instrument panel. A transmitting pickoff synchro, geared to the azimuth axis, provides an indication of sight azimuth with respect to the helicopter axis. The indicator is an easy reference for the pilot, so that he can keep the helicopter nose within the 90° travel limits (in azimuth) of the sight (45° left or right of center).

E–30. Adapter Kit
(fig. E–18)

The UH–1 adapter kit for the M22 subsystem includes—

a. Base Plate. The L-shaped base plate(1) is attached left and rear of the console to the helicopter floor. It provides a mounting surface for the support assemblies of the arm rest(2), the guidance control unit(3), and the missile selection box(4).

b. Arm Rest Assembly. The arm rest assembly at the right side of the gunner is mounted on a tubular stand that can be adjusted for height. The horizontal part adjusts fore and aft, having the control stick clamp at the forward end and the mechanical firing switch(5) just behind this clamp. This switch has a spring and plunger cable assembly that leads to a tripping assembly(6).

c. Support Assembly. The support assembly of sheet metal is mounted on the base plate. It provides a mount and strap assembly(7) to secure the guidance control unit and a shelf for the missile selection box and its connector shield.

d. Pilot's Jettison Control Panel. (fig. E–19). This panel on the lower left of the console has a two-position lock switch. The pilot can jettison all missiles and launchers by pulling the switch out and pushing it up from the SAFE to the JETTISON position.

e. Pilot's Sight Control Panel. (fig. E–19). This panel just above the jettison panel has a two-position toggle switch on the left to select one of two bulb filaments and rheostat on the right to control the light intensity of the reticle in the pilot's sight.

f. Mechanical Jettison Lever and System. The mechanical jettison lever (fig. E–20) on the right side of the console has a sheet metal hood to prevent accidental raising of the lever to the jettison position. The mechanical jettison system

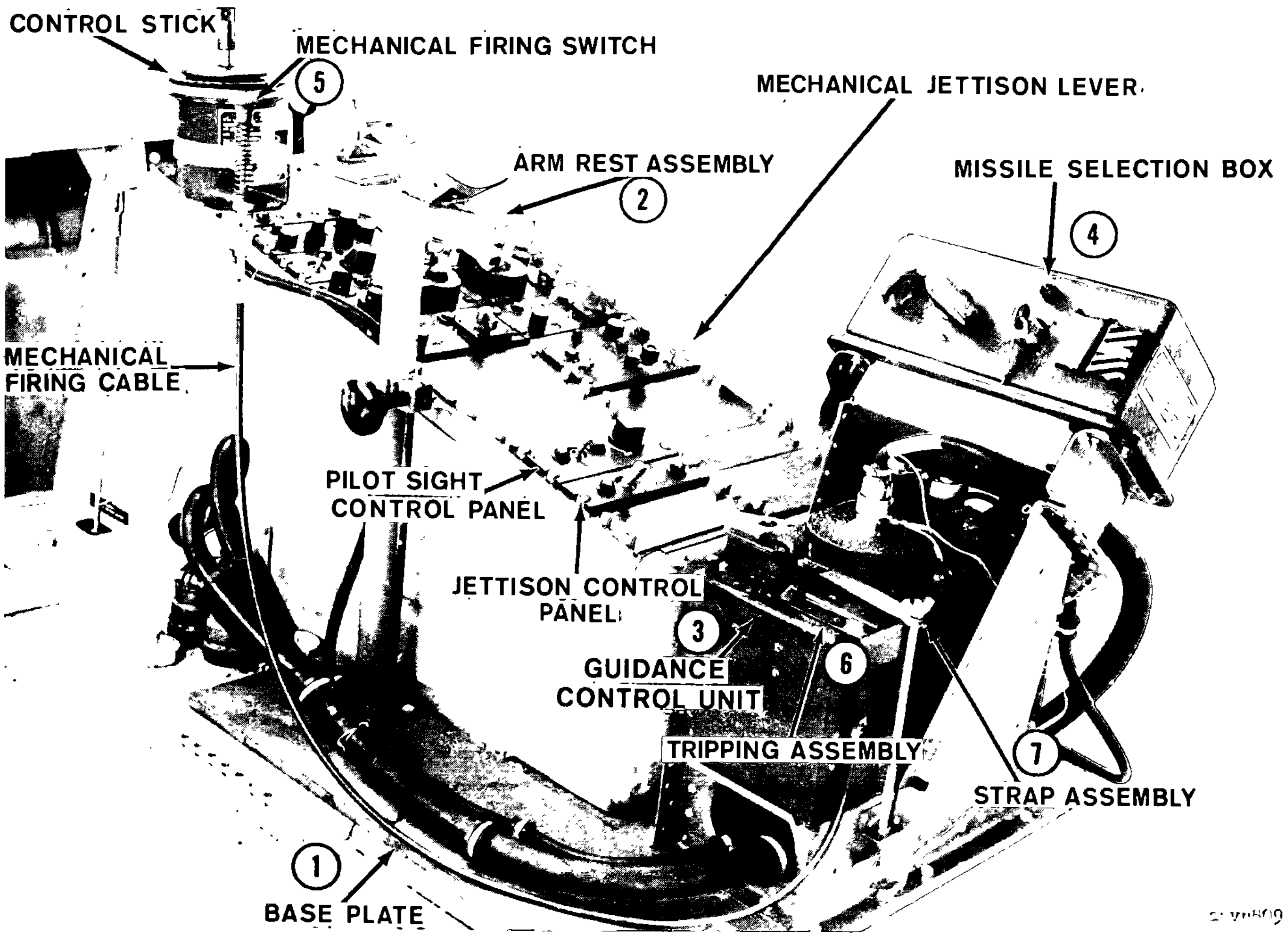

Figure E–18. Pedestal console—adapter kit installed.

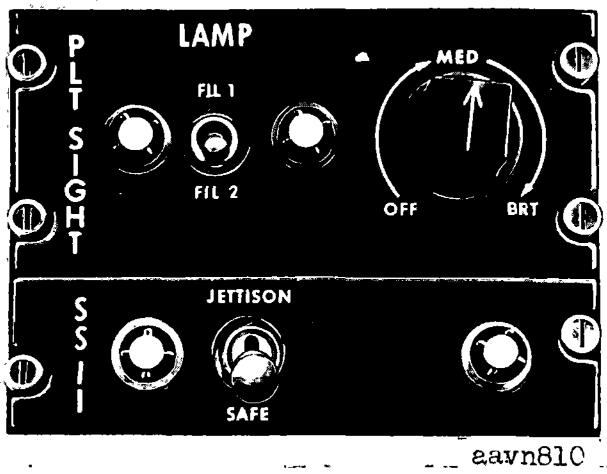

Figure E-19. Pilot's jettison and sight control panels.

(fig. E-21) includes five cables, a bellcrank, five trunbuckles, pulleys, and two quick disconnects. As can be seen by following the cable route in figure E-21—

(1) The forward cable leads from the pilot's jettison lever to the bellcrank under the floor.

(2) Two cables exit right and left from the bellcrank to quick disconnects on each side of the helicopter.

(3) Each quick disconnect attaches to a cable running through an access panel adjacent to the forward external stores mounting. These cables then lead through guard tubes to turnbuckles that connect to the final cable leading to the mechanical jettison hook in the housing assembly.

E-31. Control Stick

The control stick (fig. E-18) is held in the neutral position by a centering device and may be moved in all directions. Two variable resistors are inclosed in the base (one for pitch, one for yaw), with two sliding taps attached to the hand-operated lever. At the bottom of the base is a seven-pin plug for the cable that carries the resistor readings to the guidance control unit. Movement of the control stick generates and transmits guidance commands to the missile. Forward movement commands "down" for the missile, rearward movement commands "up," to the right commands "right," and to the left commands "left." Since the control stick can be moved diagonally, the gunner can combine "up-left," "up-right," "down-left," or "down-right" commands.

Note. To insure proper installation of the control stick, pull up on it and then fold it. When the stick is folded, it will point forward.

E-32. Guidance Control Unit
(fig. E-22)

The completely transistorized guidance control unit (GCU) is located to the right-rear of the gunner, behind the helicopter's center console. This unit contains the signal generator module that converts the control stick movements to missile guidance commands (signals).

a. Firing Switch. The firing switch(1) has a mechanical stop to hold it in the "O" position. To test the input voltage, and the pitch and yaw signal output of the coder, the switch is held counter clockwise in the "C" position In this position, the operational readiness can be determined by observing the voltmeter(2), yaw indicator light(3), and pitch indicator light(4). When firing switch is lifted over the mechanical stop and released, the spring mechanism in the firing switch pushes the switch through the IG, UG, FB, and "F" positions (para E-35).

b. Voltmeter. This meter indicates voltage input from helicopter electrical power supply.

c. Yaw Indicator Light. This orange light oscillates on and off to indicate yaw command output of the signal's coder when firing switch is held in "C" (test) position.

d. Pitch Indicator Light. This white light oscillates on and off to indicate pitch command output of the signal generator module when firing switch is held in "C" (test) position.

e. Ignition Indicator Light(5). This light glows red when the firing switch is lifted over the mechanical stop and is at the IG, UG ,or FB positions, indicating that power is being applied to the ignition circuits of the missiles and launchers.

f. Safety Indicator Light(6). This light glows green when the firing switch is at "F" position. It continues to glow until the switch is reset to the "O" position. The green light indicates that ignition and firing circuits are disconnected.

g. FF/VF Toggle Switch(7). This two-position switch allows a fixed frequency (FF) or a variable frequency (VF) output. At the VF position, the signal generator module produces a signal increasing from 10 to 16.5 cycles per second. The FF position is not normally used, but is recommended for all firings over 100 knots launching speed.

E-33. Missile Selection Box
(fig. E-23)

The missile selection box applies primary power to the armament subsystem from the helicopter power supply. The single and total jettison switches are separate circuits, unrelated to the key switch circuit. Output from the missile selection box is cabled to the electrical connectors of the UH–1 just below the rear doorsills outborad.

Note. Be careful not to lose the two keys supplied with the missile selection box. All keys don't fit all boxes.

a. Power Indicating Light(1). This light glows green when the key switch is turned on, indicating that voltage from the helicopter power supply is being applied to the missile subsystem.

b. Missile Selection Switch(2). This seven-position rotary switch connects firing, guidance wire-jettison, and individual jettison circuits to missiles and launchers and allows the gunner to select the missile to be fired. The O position is off; positions 1 through 6 correspond to missiles or launchers 1 through 6.

c. Key Switch(3). This switch connects voltage from the helicopter power supply to the missile subsystem.

d. Wire Jettison Switch (under green hood marked WIRES). This spring-loaded toggle switch applies voltage to wire-jettison cartridges in the missile junction box.

e. Single Jettison Switch (under red hood marked SIN). This spring-loaded pushbutton switch applies voltage to the explosive bolt of that launcher which is selected by the gunner on the missile selection switch.

f. Total Jettison Switch (under black and yellow "TOT" hood). This spring-loaded pushbutton switch applies voltage to all of the explosive bolts securing launchers to the fixed housings. All launchers are jettisoned simultaneously.

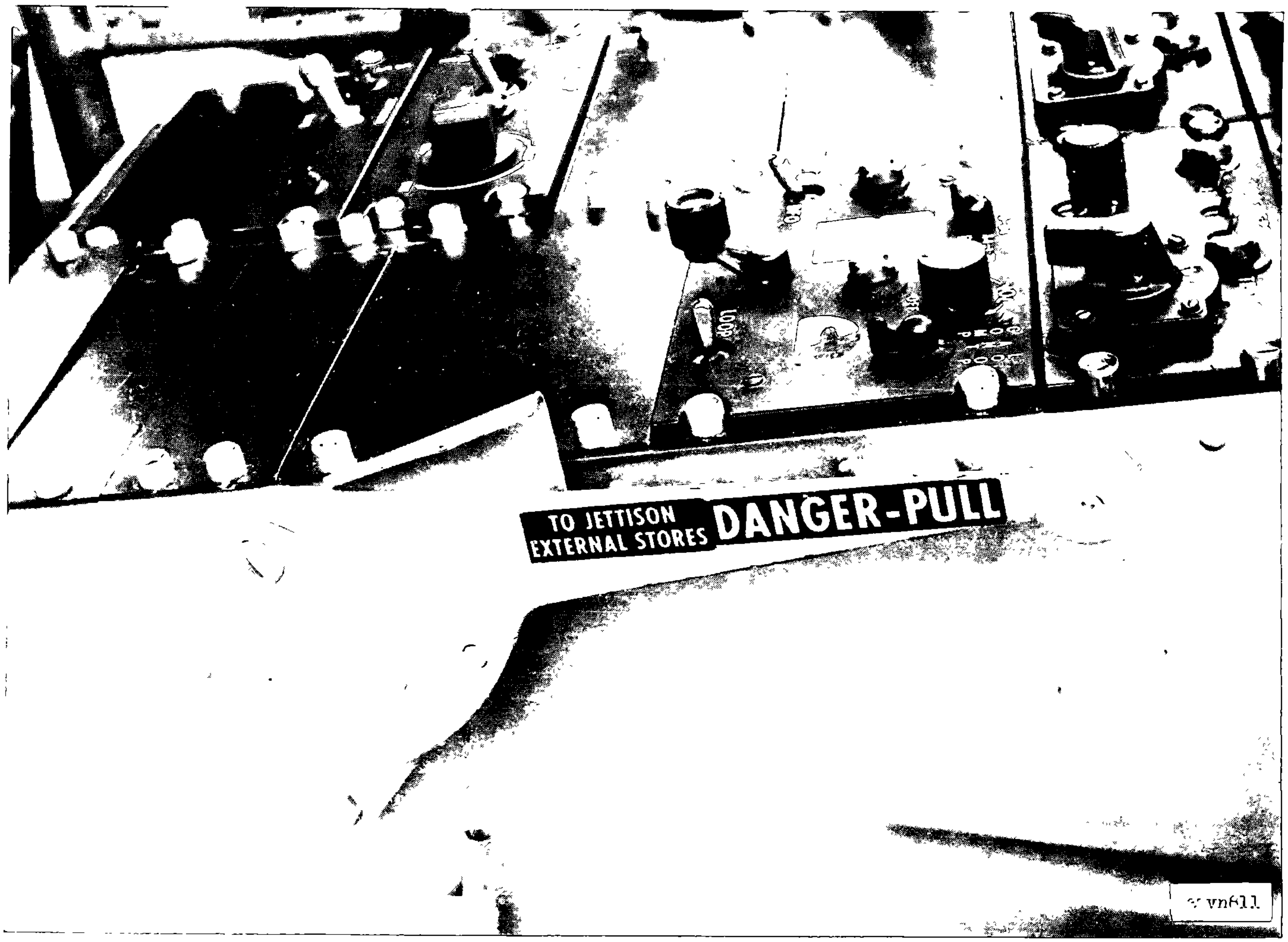

Figure E–20. Pilot's mechanical jettison lever.

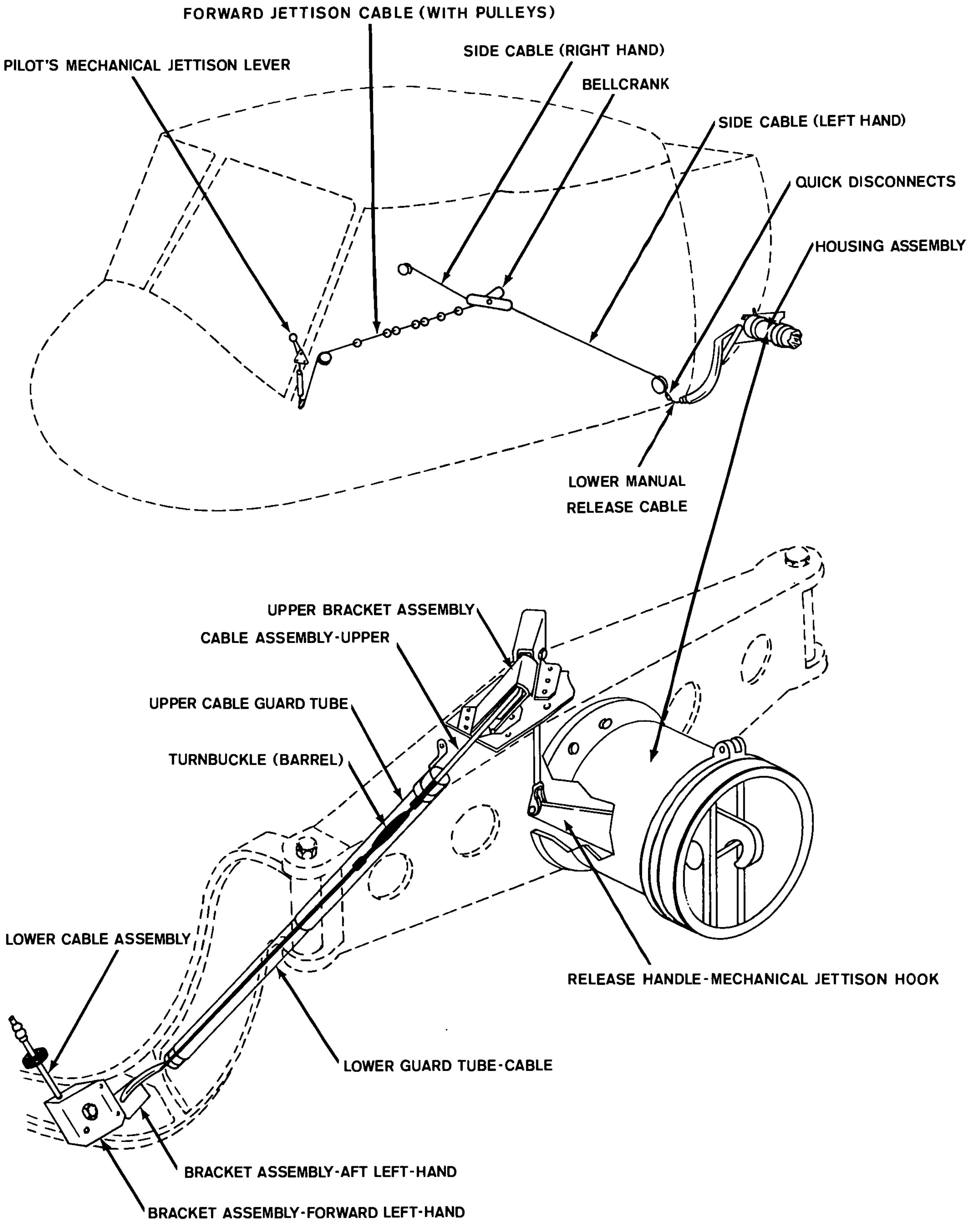

Figure E-21. Mechanical jettison system.

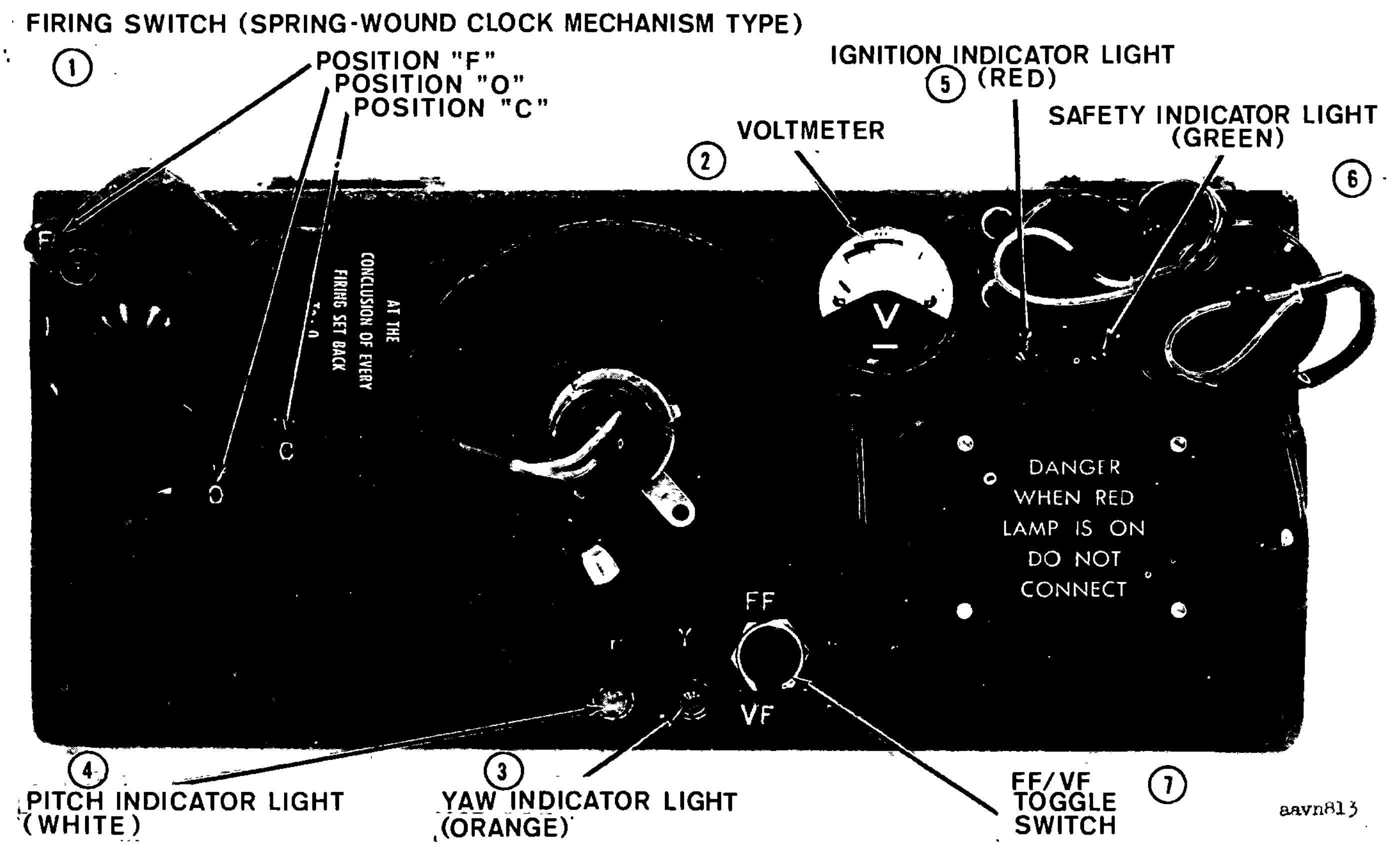

Figure E–22. Guidance control unit—controls and indicators.

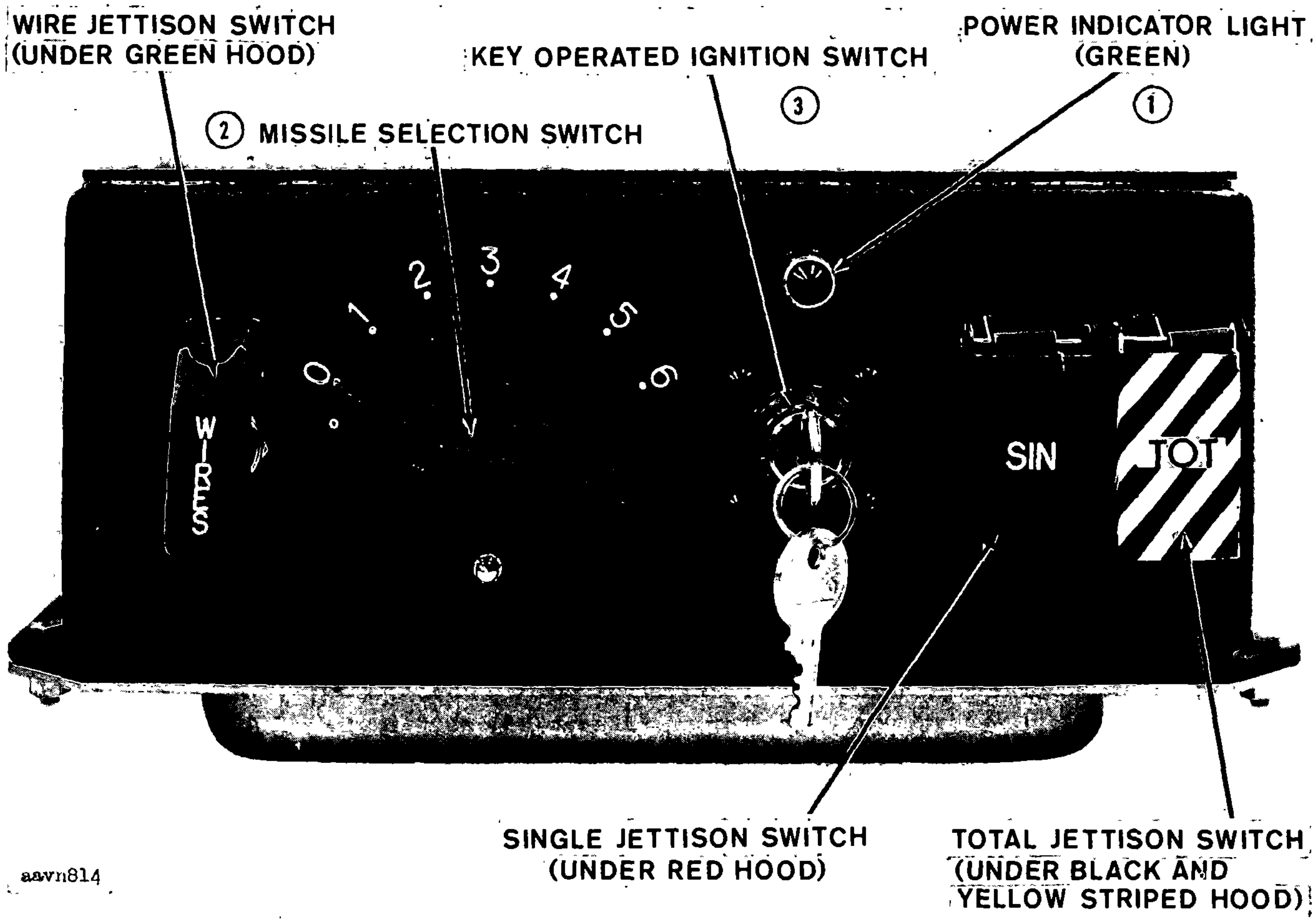

Figure E-23. Missile selection box—controls and indicators.

Table E–5. Firing Sequence and Table of Events

Event	Time interval (Seconds)	Time elapsed (Seconds)
1. Firing switch released from "O" position.		T + .0
2. Firing switch reaches IG position.	0.5	T + .5
a. Explosive cartridge is detonated, releasing locking hook.		
b. Locking hook disengages from missile body and depresses microswitch.		
c. Microswitch completes electrical circuit to missile and to gyro igniter filament.		
d. Gyro powder charge ignites, accelerating gyro to approximately 40,000 rpm in 0.15 second.		
3. Firing switch reaches UG position.	0.5	T + 1.0
a. Gyro uncaging solenoid energized.		
b. Caging arm releases gyro gimbals and closes missile battery switch.		
4. Firing switch reaches FB position.	0.5	T + 1.5
a. Two flares ignited, to burn for duration of missile flight.		
b. Booster motor ignited, generating 9 G's of thrust for 1.4 seconds.		
c. Delay squibs ignited, to burn for 0.6 second.		
d. Missile launches, after approximately 0.1 second of booster motor ignition.		
5. Firing switch reaches "F" position, completing command circuit to missle and disconnecting all firing circuits.	0.5	
6. Delay squibs burn out.	0.6	T + 2.1
a. Ball valves open, allowing hot gases to enter sustainer motor chamber.		
b. Sustainer motor ignites, generating 1.2 G's of thrust for 20 seconds.		
c. Ball valves close from sustainer motor gas pressure, and gunner gains control of missile.		
d. Warhead arms from sustainer motor gas pressure at about 300 meters from launch.	3.2	T + 5.3
7. Impact of missile (at any range up to a maximum of 3,500 meters).		
a. Weighted striker goes forwarded into detonator, causing ignition.		
b. Detonator ignition causes explosion of HEAT shaped charge.		
c. Gunner actuates WIRES switch; explosive charges in junction box are detonated, blowing the wires away from the helicopter.		
8. Firing switch is returned to "O" position, which disconnects the command circuit.		

Section V. SUBSYSTEM OPERATION

E–34. Mechanical and Electrical Functions

The overhead panel shown in figure E–24 contains these M22 circuit breakers:

a. MK VIII SIGHT PWR
b. XM58 SIGHT PWR (when installed)
c. SS–11 MISSILE JETTISON
d. SS–11 MISSILE POWER

After the two SS–11 circuit breakers are pushed in, primary power is applied to the subsystem by turning the ignition key and setting the missile selection switch to the desired postion. For sequence and time of events after release of the firing switch from the "O" position, see table E–5. The mechanical and electrical functions of the subsystem during a firing sequence are described below .

E–35. Initiating Firing Sequence (fig. E–25)

The firing switch can be seen on top of the guidance control unit (figs. E–18 and E–22). The switch is lifted over the mechanical stop at the "O" (off) position and released, directly by the gunner or remotely through the tripping assembly when he actuates the mechanical firing switch. When released, the spring mechanism pushes the switch clockwise through the IG, UG, FB, and "F" positions.

a. IG Position. When the firing switch reaches the IG position, positive and negative voltage is routed through the selection box to the explosive cartridge of the selected launcher. But the voltage to the gyro is blocked by the launcher's open microswitch.

(1) When the explosive cartridge detonates, the locking hook disengages from the missile body and leaves the missile free to launch when thrust is applied. The spring-loaded locking hook snaps up and depresses the microswitch, completing the circuit to the missile.

(2) The positive 24 volts through junction box plug pin 3 and microswitch, with the negative 24 volts through pin 5 and microswitch, deto-

nates the igniter filament in the gyro powder charge.

(3) Upon detonation, the igniter wires are retracted by a spring in the gyro case and the protective cocoon is blown away from the gyroscopic distributor. (The force of the charge accelerates the gyro to approximately 40,000 revolutions per minute in 0.15 second.)

b. UG Position. In the UG position, voltages reach pins 6 and 5 of the junction box in 0.5 second after gyro ignition (T + 1.0 second)*. This sequence drops the spring-loaded gyro locking arm and frees the gyro gimbals. Upon dropping, the arm locks the missile battery circuit switch in the closed position. This completes the circuit within the missile—from batteries to decoder to jetavator electromagnets.

c. FB Position. At 0.5 second after the gyro uncages (T+1.5 seconds), the voltage reaches pins 7 and 5 of the junction box. Pin 7 voltage (positive) goes through the 10-ohm resistors to the two flares and the booster motor.

(1) The resistors prevent igniter fusings. Such fusing would cause a short circuit drawing maximum voltage and burning out the missile circuitry.

(2) The two flares are ignited, and the plastic caps are blown off the ends of the flares. Also the booster motor is ignited, burning for about 1.4 secods and generating 9 G's (583 pounds) of thrust.

(3) The pellets sealing the chamber from moisture are blown out by gas pressure and thrust is channeled out the exhaust nozzles, initiating launch.

(4) Under booster thrust, the missile accelerates to a speed of about 195 miles per hour.

d. "F" Position. When the "F" position is reached, electric power to all circuits is cut off except that to the command circuit. The firing circuits remain deenergized until the firing switch is returned to the "O" (off) position.

E-36. Launch

The missile leaves the launcher almost instantly after booster motor ignition. Each spool of wire (3,300 meters) starts paying out from the two spool assemblies in the missile back to the fastened junction box end on the launcher. The missile wings provide lift and, being offset 48 minutes from the long axis of the missile, spin. The spin rate varies from 3 to 3 5/8 revolutions per second, according to the missile velocity.

*T=Time at which the firing switch actuates.

E-37. Sustainer Ignition

At the time of booster ignition, two delay squibs on ball valves are ignited. After 0.6 second (T+2.1 seconds), the squibs burn out and open the ball valves, allowing a small amount of the hot gases from the booster motor to enter the sustainer motor chamber. These hot gases ignite the ring charge ignition casing of the sustainer motor, and the motor burns forward from its rear face. When the gas pressure from the sustainer motor equals that of the booster motor, the ball valves close. The protective celluloid pellet is then blown out of the exhaust tube, with sustainer motor gases channeled out through the sustainer exhaust tube. The sustainer motor burns for about 20 seconds and provides 1.2 G's (77 pounds) of thrust. It continues the acceleration of the missile until it reaches a speed of about 425 miles per hour at maximum range.

Note. Since solid propellant combustion speed varies with temperature, the thrust of both the booster and sustainer motors will vary. Thus, missile speed and motor burnout time varies proportionally with temperature. The motor operating limits are −36° C. to +56° C., giving an operating guarantee for temperatures ranging from −30° C. to +50° C. On a cold day, thrust and missile speed reduce, while motor burnout time and, hence, missile flight time increase.

E-38. Missile Guidance

Up to this time, the missile has been in free flight, governed only by azimuth displacement of the helicopter's longitudinal axis at time of launch and the initial trajectory angle set into the fixed housing and launcher by the gunner. With the sustainer motor burning and providing exhaust for the jetavators to deflect, missile guidance is now possible.

a. Pitch and yaw commands are sensed by the taps on the control stick variable resistors and routed to the signal generator module in the guidance control unit to be coded. The coded command is then sent through the missile selection switch to pins 1 and 2 of the missile junction box (which has remained on the launcher). In voltage, the coded commands are as follows:

(1) *Pitch up*—large or small positive voltage.

(2) *Pitch down*—large or small negative voltage, or zero voltage (broken circuit).

(3) *Yaw left*—large positive or negative voltage.

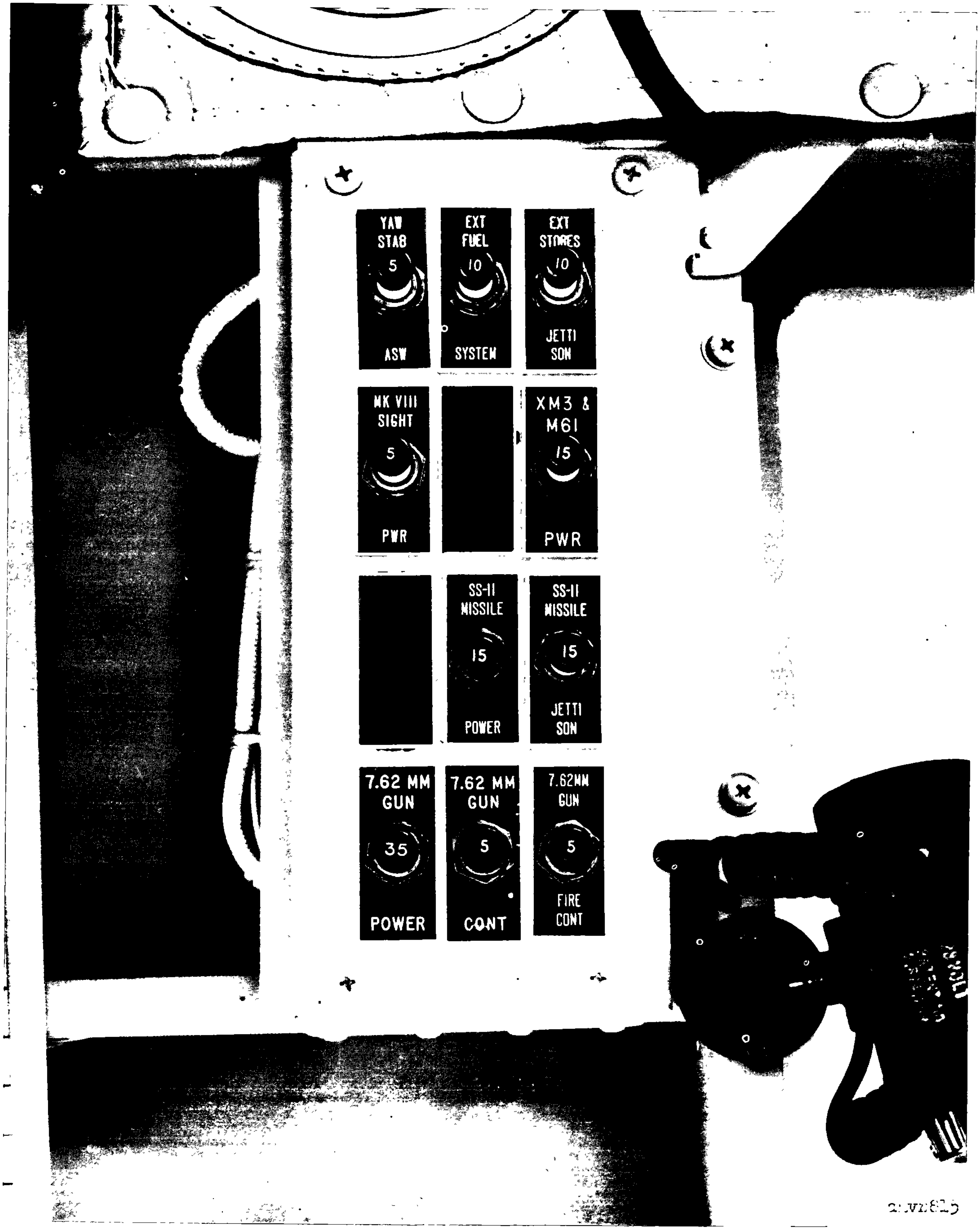

Figure E–24. Overhead circuit breaker panel.

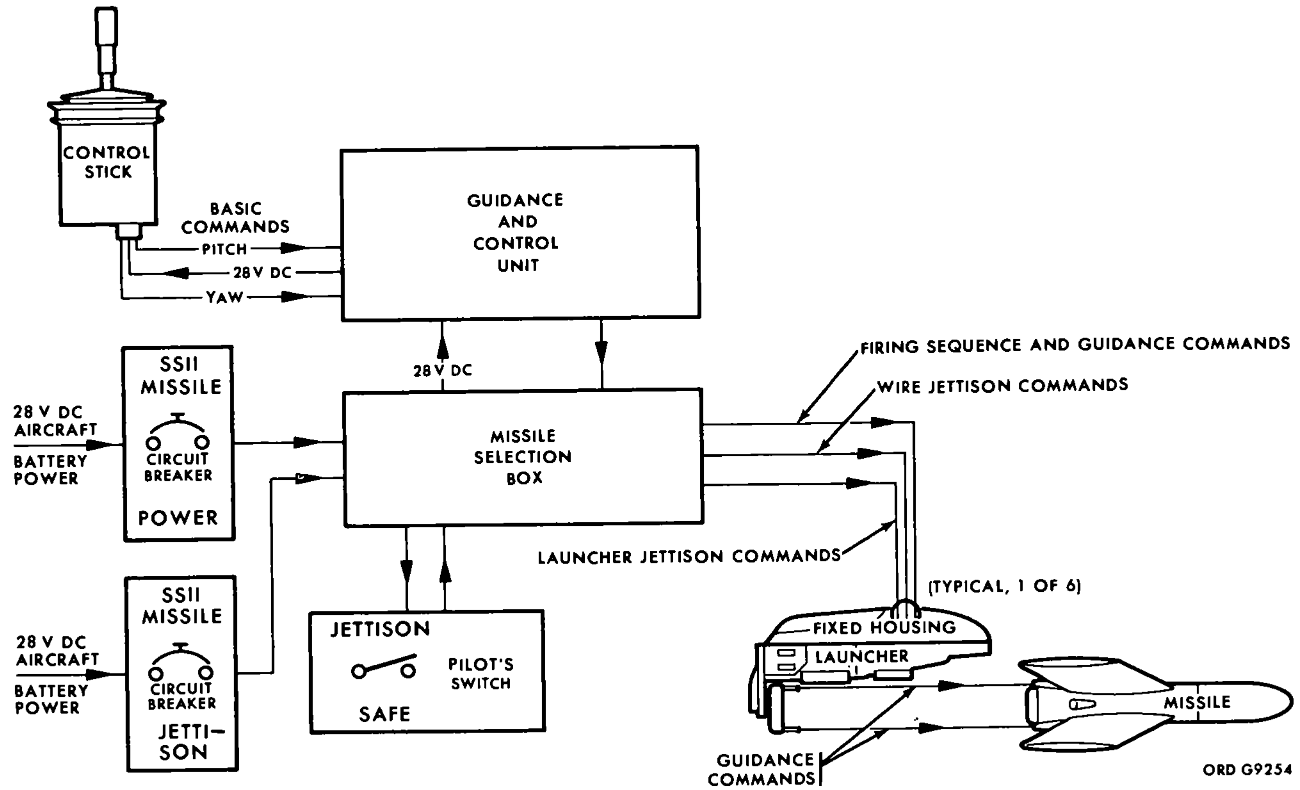

Figure E-25. M22 armament subsystem, block diagram.

(4) *Yaw right*—small positive or negative voltage, or zero voltage (broken circuit).

b. For voltages in *a* above, high voltage is 18.25 volts (+1.5 or −1.0). Low voltage is 6.25 volts (+0.5 or −0.5). The amount of command given by the gunner (100 percent left or "hard" left, 50 percent left, 25 percent left, etc.) is defined by the *length* of a square wave ((1), fig. E-26) sent by the guidance control unit. The voltage being applied is defined by the *height* (depth) ((2), fig. E-26) of the square wave in relation to a false zero line. With the control stick in a neutral position, a "35 percent up" command is being sent to the missile to overcome gravitational pull.

c. The command travels to the decoder over the two guidance wires paying out from the missile. The decoder separates "up," "down," "left," or "right" commands. Since either wire is positive and the other negative, the two wires from the junction box to the missile form a complete circuit. Thus, if one wire should break, the decoder would receive a zero signal (resulting in a "down and right" command) and the missile would destroy itself.

d. Each command from the decoder (fig. E-7) has its own positive lead connected to a wiper. These wipers are contacts for the slip rings on the gyroscopic distributor. The slip rings are wired internally to a particular segment of the four-segment commutator. The slip ring(s) being energized transmits the command impulse to the segment(s) of the commutator being energized.

e. A negative lead from missile batteries to all electromagnets of the deflector assembly has already been applied. Four wipers brushing each segment of the commutator then supply the positive lead to actuate the appropriate electromagnet. These electromagnets pull one jetavator into the sustainer exhaust and pull the opposing jetavator out. This is accomplished for each command given. The percentage of command given (25 percent, 50 percent, 75 percent, etc.) determines how long the electromagnets accomplishing this command will stay positive. (An electromagnet will stay positive 25 percent of the time for a 25 percent command, 50 percent of the time for a 50 percent command, etc., for as long as that command is held by the gunner.)

Note. Because of the segmented commutator, the command will be interrupted for the length of time it takes the wiper to go over the insulation between the segments.

f. As the missile rotates about the gyro, slip rings, and commutator, the eight wipers (four sending signals and four receiving signals) and

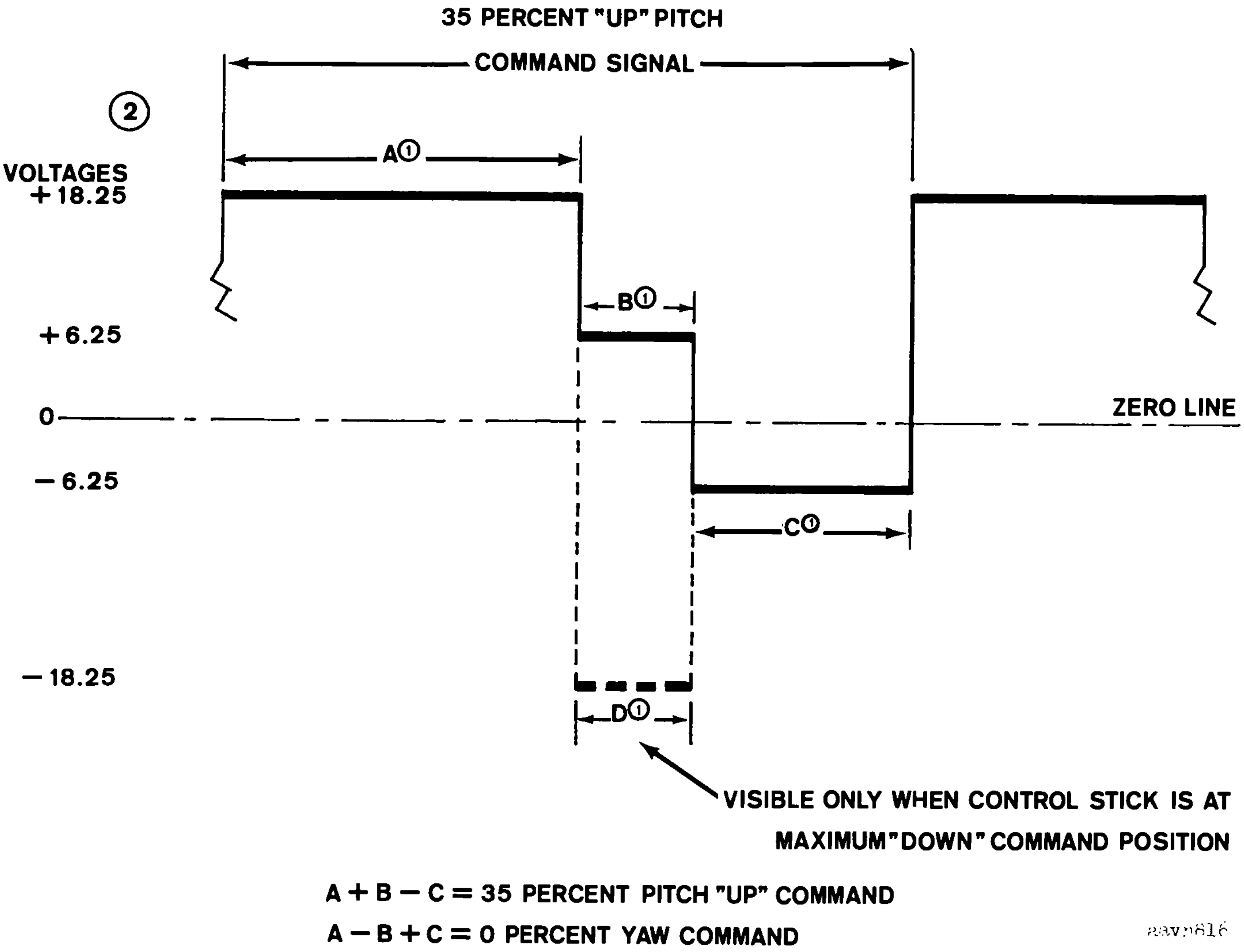

Figure E-26. Amount of command by gunner in relation to voltage.

the jetavators and their electromagnets also rotate. This missile rotation has no effect on transmission, but the receiving wipers are continually changing segments of the commutator. Since only one segment is positive for a given command, this changes the electromagnets receiving the command. In this manner, the electromagnets being actuated correspond directly to the missile roll rate, and the jetavators being moved in or out of the exhaust are in the proper position for any given command.

E-39. Arming of the Fuze Detonator Assembly

a. Aside from the sustainer motor gases for guidance control, a small portion enters the arming orifice of the fuze detonator assembly (A, fig. E-5) through the three small tubes molded into the motor. Gas pressure on a flexible sealed diaphragm breaks a shear pin on a plunger. This upward movement forces the red plastic piston out (B, fig. E-5) and lets the weighted firing pin striker rest against the detonator. A light coil spring holds the firing pin striker against the detonator until missile impact.

b. Arming of the fuze detonator occurs 3.2 seconds after sustainer motor ignition (T+5.3 seconds) or about 300 meters from the point of launch.

E-40. Warhead Detonation

At impact, the weighted firing pin (para E-39*a*) is driven forward against the detonator by inertia. The striker enters the detonator, it explodes, and the warhead detonates.

E-41. Wire Jettison

After missile impact, wire jettison is accomplished by activating the wire jettison switch on the missile selection box. This applies voltage through the selection switch to pin 4 of the junction box and to each of the two control wire attachment jacks. Explosive squibs cause ignition of a small powder charge in the jacks, blowing away the guidance wires (and a detachable portion of the jack) from the helicopter. Upon release, the spring-loaded jettison switch returns to the off position.

Section VI. MISSILE JETTISON EMERGENCY PROCEDURES

E–42. General

Helicopter malfunction may require a forced landing while loaded with tactical rounds (HEAT). The missiles should be jettisoned at least 50 feet above the terrain by use of the TOT jettison switch, the pilot's electrical jettison switch, or the pilot's mechanical jettison lever. If time allows (as when some of the missiles have been fired), individual missiles should be jettisoned with the SIN switch.

E–43. Simultaneous Jettison of All Missiles and Launchers

a. By Gunner. The gunner can electrically jettison all launchers and missiles by depressing the TOT jettison switch. Voltage is applied to all explosive bolts simultaneously.

b. By Pilot. The pilot can electrically jettison all launchers and missiles with the pilot's electrical jettison switch. Voltage is applied to all explosive bolts.

E–44. Single Launcher and Missile Jettison

In an emergency, the gunner may jettison a single launcher and missile. The missile to be jettisoned is selected and the SIN jettison switch depressed. Voltage is applied to the explosive bolt of the selected missile's fixed housing assembly.

E–45. Mechanical Jettison

The pilot can mechanically jettison the missiles by pulling up on the mechanical jettison lever (fig. E–20). This activates the jettison hooks in the housing assemblies on both sides of the helicopter. The launcher support assemblies, internal electrical cabling, fixed housing assemblies, launchers, and all missiles fall away from the helicopter.

Caution: **Mechanical jettison should not be attempted when the helicopter is loaded with tactical rounds (HEAT) unless the altitude is at least 50 feet above the terrain.**

Section VII. TEST EQUIPMENT, COMMON SUBSYSTEM MALFUNCTIONS AND CORRECTIVE ACTION

E–46. Test Equipment

The purpose of the M22 test equipment is to insure proper component performance prior to loading. It enables the crew to check the explosive cartridge circuit, ignition and firing circuits, wire jettison circuits, launcher jettison circuits, amplitude of control signals, percentage of the command signals, the command signal frequency, missile battery power, and launcher elevation. For functioning of this equipment, see TM 9–1400–461–20.

E–47 through E–56. Common Subsystem Malfunctions and Corrective Action

Malfunction	Probable cause	Corrective action
E–47. No ignition of explosive cartridge, flare, or booster.	SS–11 MISSILE POWER circuit breaker pulled out or selection box key switch off. Wrong setting on missile selection switch. Cables broken or not connected. Low voltage supply. Faulty selection box. Faulty guidance control unit.	Push in circuit breaker or turn key switch on. Select the next missile. *Note.* Upon return, circuits should be tested with circuit test equipment (para E–46).
E–48. Ignition of explosive cartridge, but no ignition of flares or booster.	Locking lever is not released: (1) Too much interference between missile and lever. (2) Faulty spring on lever.	Select the next missile. Remove unfired missile from launcher at first opportunity.

Malfunction	Probable cause	Corrective action
	Locking lever is released: (1) Faulty microswitch in launcher. (2) Faulty circuit. (3) Lever slow to come up (after switch passes 16).	Jettison the missile (from a height of at least 50 feet), using the SIN jettison switch on the missile selection box.
	Locking lever has delayed release: (1) Too much interference between missile and lever. (2) Foreign material in lever assembly.	Reset firing switch and again attempt to fire the same missile.
E–49. Ignition of explosive cartridge and flares, but no ignition of booster.	Faulty booster ignition circuit.	Jettison the missile (from a height of at least 50 feet, using the SIN jettison switch on the missile selection box.
E–50. Ignition of flares and booster, but no ignition of explosive cartridge; or, ignition of explosive cartridge, flares, and booster but missile does not leave the launcher.	Combination of several improbable malfunctions.	Jettison the missile (from a height of at least 50 feet, using the SIN jettison switch on the missile selection box. If this occurs with helicopter on the ground, the warhead will be armed (if HEAT.) Have all personnel evacuate the area and call EOD personnel. If inert round, wait 10 to 15 minutes and then remove missile.
E–51. Ballistic flight, with missile impacting 100 to 500 meters from point of launch.	Gyro ignited, but not uncaged. Missile power supply failure.	None required.
E–52. Spiraling flight, with missile impacting 100 to 500 meters from point of launch.	Gyro not ignited, but uncaged, because of faulty squib or lead wire in gyro.	None required.
E–53. Missile goes down and right.	Broken guidance wire. Low helicopter supply voltage.	None required.
E–54. Missile takes a maximum left or right path.	Broken or short-circuited potentiometer in control stick. Malfunction of yaw channel in missile decoder. Malfunction of GCU. Broken wire on control stick cable.	Give maximum down command on control stick. If this does not ground the missile, cut the power at the missile selection box.
E–55. Missile takes a maximum up or down path.	Broken or short-circuited potentiometer in control stick. Malfunction of pitch channel in missile decoder. Malfunction of GCU. Broken wire in control stick cable.	Guide the missile straight down range until impact. ***Warning:*** **Do not cut the power at the selection box unless the missile takes a maximum up and left path. If the malfunction is in the decoder pitch channel, the missle will take a maxmum up and right path if power is cut.**
E–56. Missile takes a maximum up and right (or left) path. (This should cause the missile to impact between 500 and 1,000 meters laterally from the launch point.)	Malfunction of GCU. Both potentiometers in control stick broken or short-circuited. Failure of both pitch and yaw channels in missile decoder.	Cut the power at the missile selection box.

Section VIII. MISSILE ASSEMBLY, INSTALLATION, AND DISSASSEMBLY

E–57. General Precautions

Warning: **All personnel must observe the following precautions when handling missiles.**

a. Remove all rings and jewelry from hands before assembling, installing, or disassembling missiles.

b. Do not install missiles on the helicopter until the daily operational checks have been successfully completed.

c. Do not mount missiles until the helicopter has been fueled, checked out, and is ready for flight.

d. For the person in charge of installing the missiles, be sure he has the missile selection box key in his possession.

e. Always approach or move away from missiles at a right (or left) angle to the line-of-fire.

f. Be sure that all persons not actively engaged in installing the missiles remain at least 100 meters from the launchers and clear of the flightpath.

g. Position helicopter in an open area with missiles pointing toward a safe, uninhabited area.

h. Mount missiles from the inside launcher to the outside, both left and right.

i. See that the explosive bolt cables are connected to their shorting plugs until just before helicopter takeoff.

j. Never assemble missiles within 300 meters of a radio or radar installation that has more than 100 kw of peak power.

E-58. Missile Assembly and Installation

a. Pilot.

(1) Check each fixed housing to make sure the explosive bolt cable is connected to the shorting plug. Leave fixed housing hinged cover open.

(2) Check front and rear guiderails on each launcher for damage.

b. Gunner.

(1) Check SS-11 MISSILE POWER and SS-11 MISSILE JETTISON circuit breakers on overhead panel and make sure they are in off (pulled out) position.

(2) At the helicopter pedestal console, insure that SS-11 JETTISON switch (fig. E-19) is set in SAFE position.

(3) Set missile selection switch on missile selection box at the O position.

(4) Make sure key switch is in off position and key is removed. Retain key until firing is to commence.

(5) Check firing switch on guidance control unit and make sure it is in "O" position.

c. Pilot.

(1) Press and turn the two turnlock fasteners securing the battery compartment cover on the missile shipping container and remove the special wrench inside.

(2) Remove the spring clips that hold the toggle fasteners and, using the special wrench, release the eight fasteners holding the container halves together.

(3) Lift the top half of the container and place it upside down on the ground.

d. Gunner.

(1) Using the missile battery tester, place the battery, rounded side forward, on the connector pins of the tester. The voltmeter should indicate between 12 and 15 volts.

(2) Press the toggle switch on the tester in either direction and hold. As soon as indication is read on meter, release the toggle switch. The voltmeter indication should not differ more than 1.5 volts from the indication obtained in (1) above, and total voltage should not be less than 12 volts.

(3) Repeat (1) and (2) above for second battery.

e. Pilot and Gunner.

(1) Inspect the condition of the detonator arming device, located in the front portion of the missile body. The top of the arming piston should not be seen protruding above the surface of the rim.

***Warning:* If the arming device is found to be armed, do not move the missile. Evacuate the area and call EOD personnel.**

(2) Remove the clamps that hold the missile body in the container, and, with the pilot at the front and gunner at the rear, lift the missile and place it on the launcher by carefully alining the top mounting lug ears with the launcher rails. DO NOT fully seat the missile.

Note. Two men are required to handle the missile. Do not grasp the junction box when mounting on the launcher.

(3) After the gunner removes the dust cover and clamps from the junction box connector plug, rearward pressure is exerted on the missile by the pilot while the gunner carefully alines the junction box connector plug with the launcher plug receptacle. Fully seat the missile body on the launcher, insuring that the guillotine lock on the launcher engages the prongs of the junction box.

f. Pilot.

(1) Remove the explosive cartridge from its receptacle in the missile shipping container.

(2) Remove the plastic shorting plug from the rear of the explosive catridge cap.

g. Gunner.

(1) Unscrew the protective plug from the missile battery circuit tester port.

(2) Short out the circuit by inserting a screwdriver into the port. If the batteries are

properly seated in the missile, the jet deflectors will make an audible clicking sound.

Note. If jet deflectors do not click, remove warhead as described in paragraph E-59 below (disassembly). Reseat the batteries and reinsert the screwdriver. If click is not heard, recheck batteries on battery tester and replace, if necessary. If, after again seating both batteries, no clicking is heard, follow remaining disassembly steps in paragraph E-59 below. If clicking sound is heard, reinstall the warhead as before and recheck the circuit.

h. Pilot.

(1) Grasping the launcher locking lever handle, pull up and at the same time exert downward pressure on the locking hook.

(2) After cartridge is seated, release both handle and hook so gunner may recheck seating.

i. Gunner.

(1) Take explosive cartridge and insert into launcher receptacle, making sure molded ridge on explosive cartridge cap is alined with painted tick mark on outside of receptacle.

(2) Make sure explosive cartridge locking pin on side of launcher receptacle is engaged.

(3) Check the cartridge to insure that it is properly seated by pulling out on it. It should not pull out.

(4) Cut the plastic bands around the igniter wires on the missile flares to insure that guidance wires do not become entangled in the flare caps upon missile launch.

j. Pilot.

(1) Remove the three retainer straps on the warhead, and remove from upper half of missile shipping container.

(2) Remove the plastic container inclosing the warhead, being careful in handling the high explosive head.

Note. The ATM-22B (inert) does not have the plastic container for the warhead.

k. Gunner.

(1) By hand, remove the detonator protective cap, being careful not to strike the detonator. If it cannot be removed by hand, use a wooden stick as a lever to loosen the cap.

(2) Place the two missile batteries in their proper clamps, making sure they are firmly seated.

(3) Take the warhead and screw it onto the missile body, taking care not to strike the detonator. Screw the head up tight, back it off one-quarter turn, and then give it a rapid twist to properly seat the warhead.

l. Pilot and Gunner. Repeat steps *c* through *k* above for each missile to be mounted.

m. Pilot.

(1) Hold outboard end of launcher support assembly while gunner removes locking pin, and then check for security.

(2) Assume pilot's duties.

n. Gunner.

(1) With one hand under inboard end of launcher support assembly, remove locking pin holding launcher support assembly to housing assembly. If there is "end play" in launcher support assembly, tighten actuator shaft.

(2) Record serial numbers of mounted missiles and the launcher upon which each missile is mounted.

(3) Just prior to helicopter takeoff, connect all explosive bolts to the system and secure hinged covers.

E-59. Missile Disassembly

a. Pilot.

(1) Insert locking pin in launcher support assembly/housing assembly.

(2) Check each fixed housing and connect all explosive bolts to their shorting plugs. Leave fixed housing hinged covers open.

b. Gunner. Take steps as outlined in paragraph E-58b.

c. Gunner.

(1) Unscrew the warhead from the missile body, being careful not to strike the detonator.

(2) Inspect the condition of detonator arming device.

Warning: **If found armed, evacuate the area and call EOD personnel.**

(3) Remove the two missile batteries.

(4) Replace the detonator protective cap.

d. Pilot.

(1) Replace warhead in plastic shell.

(2) Put warhead back into upper half of missile shipping container and secure with the three straps provided.

e. Pilot and Gunner. With the pilot pulling up on the launcher locking lever handle and out on the locking pin, the gunner pulls out the explosive cartridge.

f. Pilot.

(1) Replace the plastic shorting plug on the explosive cartridge cap and place the cartridge in its plastic container. Place the container in the missile shipping container receptacle, taking care that the serial number on the side of the shipping container matches that of the missile being disassembled.

(2) Prepare the shipping container to receive the missile body and warhead.

g. Pilot and Gunner. With the pilot at the front of the missile, the gunner will push up on the guillotine lock and forward on the junction box to disengage the connector plug. Avoid letting the missile go too far forward, since the mounting lugs could come out of the rails and the missile fall to the ground.

Note. If the missile is pushed or pulled forward without the junction box connector plug being disengaged, the junction box will separate from the missile and may render the missile unusable for future firings.

***Warning:* The junction box contains explosives, and if it separates from the missile and drops, the concussion could cause detonation.**

h. Gunner. Replace dust cover and clamps on the junction box connector plug.

i. Pilot and Gunner.

(1) Remove the missile from the launcher rails and place it in missile shipping container.

(2) Secure retainer clamps.

(3) Mate upper half of shipping container to lower half.

(4) Fasten the eight toggle fasteners on the missile shipping container, and insert the spring clips in the fasteners.

(5) Replace special wrench in container battery compartment.

j. Pilot and Gunner. Repeat c through *i* above for all missiles to be disassembled.

E–60. Disassembly of M22 External Hardware

a. Launcher.

(1) *Pilot.* Check to make sure explosive cartridge has been removed and inert tagged cartridge inserted in launcher explosive cartridge receptacle.

Note. Explosive cartridge is ammunition and should be handled as such. For proper storage, see TM 9-1300–206.

(2) *Gunner.* Check to make sure explosive bolt cable is connected to shorting plug.

(3) *Pilot.* Hold launcher in position.

(4) *Gunner.* Remove nut from explosive bolt and help pilot to remove launcher by moving it straight down, being careful not to damage explosive bolt or electrical connections.

(5) *Gunner.* Check launcher for cleanliness and proper lubrication at pivot of the locking hook, locking lever handle, and guiderails. If needed, lubricate using GL grease MIL–G–3278.

b. Fixed Housing.

(1) *Gunner.* Remove explosive bolt from fixed housing and shorting plug, if extra plug is not available. Check cable for frayed or broken shielding. Replace nut which was removed to take off launcher. Replace screws on bolt mounting (these are metric size and hard to obtain in the United States).

***Warning:* Explosive bolt is ammunition and should be treated as such. For proper handling and storage, refer to TM 9–1300–206.**

(2) *Pilot.* Disconnect cables leading from launcher support assembly and remove from fixed housing.

(3) *Pilot.* Hold fixed in position.

(4) *Gunner.* Remove U-bolts and help pilot to remove fixed housing. Replace U-bolts and inspect for cleanliness. Check wiring harness for frayed insulation.

c. Launcher Support Assembly.

(1) *Pilot.* Make sure locking pin is inserted on *both* sides of aircraft, and then move pilot's mechanical jettison lever to the full rear (unlocked) position.

(2) *Gunner.* Remove actuator shaft latch and turn actuator shaft clockwise until loose.

(3) *Pilot.* Secure outboard end of launcher support assembly.

(4) *Gunner.* After securing inboard end of launcher support assembly, pull locking pin out and disconnect cable from housing assembly. Check condition of wiring harness.

Section IX. TARGET ACQUISITION AND FIRING TECHNIQUE

E–61. General

The target may be engaged at any range between 500 and 3,500 meters (the maximum range dependent upon the mode in which the missile is fired). Tactical as well as terrain considerations will dicate at what range the attack will commence. The size and silhouette of the target will determine the angle of fire. The gunner's remaining consideration is use of the antioscillation sight.

E–62. Not Using the Sight

The difficulties of target acquisition and firing without use of the sight increase with range. The advantage of firing by naked eye is that the pilot need not remain on an inbound course after launch, but can take small evasive maneuvers in both the lateral and vertical planes. However, the gunner must keep the missile flares between him and the target. Evasive maneuvers, however small, increase the gunner's difficulty in accomplishing this task. This is because his angle of vision changes with every deviation from a collision course. A disadvantage of firing by naked eye is an unclear view of the target because of range. When the edges of the target are poorly defined, the center of mass is hard to determine and the gunner has trouble placing the missile flares in the middle of the target area. This often results in near misses, either laterally or vertically. Also, when firing at ranges in excess of 2,500 meters and without the benefit of a magnified view of the target and missile, the smoke from the missile sustainer motor may be enough be enough to obscure both the missile flares and the target. The method of firing is to—

a. Estimate the range to get an estimate of missile flight time. Below are approximate flight times for ranges given.

(1) 500 meters— 5 seconds
(2) 1,000 meters— 9 seconds
(3) 1,500 meters—12 seconds
(4) 2,000 meters—15 seconds
(5) 2,500 meters—18 seconds
(6) 3,000 meters—20 seconds
(7) 3,500 meters—22 seconds

b. Launch the missile, then initiate command control at the first opportunity to determine the individual missile's reaction to a given command; i.e., whether its reaction is normal, sensitive, or sluggish.

c. Bring the missile in a gentle arc over to the vertical centerline of the target (but not beyond), and approximately three target widths above the target. Stabilize the missile in this position.

d. With about 5 seconds remaining of missile flight time to target, lower the missile slowly on the vertical centerline to the target horizontal centerline, being careful not to go below that line.

e. Stabilize the missile on the center of mass and await impact.

E-63. Use of the M55 (Gunner's) Sight

The M55 sight can be used to great advantage while firing from a static position, or from any mode when the helicopter is equipped with yaw stabilization (AN/ASW-12). The obvious advantage in using the M55 sight is the magnified view of the target and missile. Poor visibility due to range or natural causes (fog, haze, light rain, etc.), or the smoke of the missile, is reduced. The M55 sight cannot be successfully employed in any mode other than static without yaw stabilization. This is due to the narrow field of vision inherent in the use of an instrument of magnification, which results in the inability to keep the target and missile in sight. Use of the sight is restricted to targets beyound 1,000 meters range. When the range of the target is less than 1,000 meters range. When the range of the target is less than 1,000 meters, the speed of the missile does not allow the average gunner time to stabilize the missile, transition to the sight, and guide it to the target. The method of firing is to—

a. Estimate range to get an estimate of missile flight time.

b. (Pilot) Establish the helicopter on a heading toward the target, with the target centered in the Mk 8 sight, and engage the AN/ASW-12 heading lock by pressing forward and releasing the beep switch on the cyclic control. This locks the helicopter on the precise heading on which it was established.

c. Same as paragraph E-62*b*.

d. Same as paragraph E-62c.

e. Transition to the binoculars, and upon firm sighting of the target and missile, lower the missile slowly on the vertical centerline to the target horizontal centerline, being careful not to go below that line. Stabilize the missile on the center of mass and await impact.

f. (Pilot) For a moving target, track, by use of the flat rate turn control dial and the AN/ASW-12 beep switch, being careful to keep the target centered in the Mk 8 sight.

E-64. Use of the XM58 (Gunner's) Sight

The XM58 sight eliminates the disadvantages of firing with the naked eye and firing using the M55 sight and combines their advantages. As long as evasive maneuvers are within 45° of centerline in azimuth and plus or minus 15° in elevation, the pilot may make evasive maneuvers while the gyro stabilization keeps the target and missile centered in the sight. However, evasive maneuvers increase the difficulties of the gunner using the XM58 sight, as similar maneuvers do when firing without a sight. Because of the unobstructed view of the left eye of the gunner, launch to impact can be observed without leaving the sight. Also because of the magnified monocular vision available to the right eye of the gunner, magnified view of the target is seen by the gunner at all times and at all ranges. The method of firing is—

a. Estimate range to get an estimate of missile flight time.

b. By the gimbal position control or by hand, establish sight on target in azimuth and elevation until sight is stabilized in the proper position.

c. Same as paragraph E-62*b*.

d. Same as paragraph E-62*c*.

e. Stabilize the missile on the center of mass and await impact.

f. (Pilot) Use the line-of-sight indicator on the instrument panel to keep the helicopter within the 45° azimuth limitations, and use the M k8 sight to keep within the 15° elevation limit.

g. (Gunner) Track a moving target with the gimbal position control.

APPENDIX F

M5 40MM RIFLED-BORE ARMAMENT SUBSYSTEM

Section I. GENERAL

F–1. Capabilities

a. The M5 helicopter armament subsystem (fig. F–1) launches 40mm antipersonnel fragmentation-type projectiles to provide a neutralization fire capability for UH–1B/C helicopters.

b. The maximum rate of fire is 220 shots per minute. The minimum burst is two rounds from a flexible or stow position. The subsystem can fire a single round by rapidly depressing and releasing the firing switch on either cyclic control stick.

c. Maximum employable range is 1,750 meters.

d. Maximum effective range is 1,200 meters.

e. Minimum safe range for firing the M384 cartridge during training is 300 meters; for combat firing, about 100 meters.

f. Ammunition capacity—

(1) If ammunition box fed, 150 rounds.

(2) If ammunition rotary drum fed, 300 rounds.

g. Maximum flexible limits of the mounted gun are—

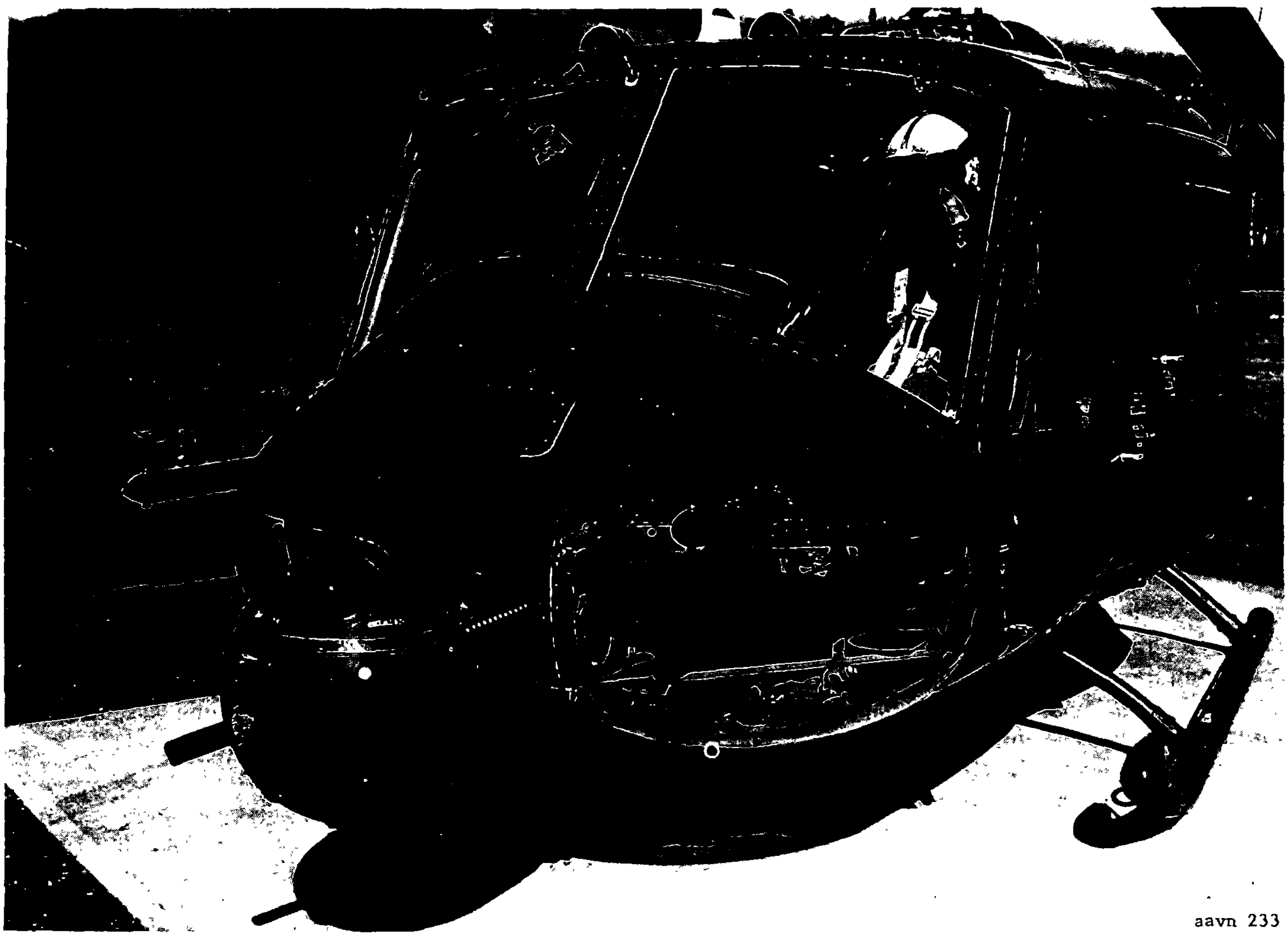

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Figure F–1. M5 armament subsystem.

(1) Azimuth: 60° right, 60° left. (For target lead corrections, see table F–1.)
F–2.)

(2) Elevation: +15°, −35°. (For a guide to slant range elevation adjustment, see table F–2.)

h. Daily rate of fire is limited only by ammunition resupply and possible time-compliance weapon parts change or maintenance.

Table F–1. Corrections to Target Azimuth (Degrees) to Compensate for Target Lead and Drift or Projectile Versus Aircraft Speed and Azimuth to Target

Aircraft speed (knots)	Azimuth to target (degrees)								
	−60	−45	−30	−15	0	+15	+30	+45	+60
0	−.5	−.5	−.5	−.5	−.5	−.5	−.5	−.5	−.5
60	−6.3	−5.3	−3.7	−2.0	−.4	+1.2	+2.9	+4.4	+5.5
90	−8.9	−7.3	−5.0	−2.6	−.4	+1.9	+4.3	+6.6	+8.1

Note. Minus (−) indicates an azimuth or correction to the left. Positive (+) indicates an azimuth or correction to the right.

F–2. Limitations

The M5 subsystem is vulnerable to all types of air defense fires, including small arms, and has the following limitations:

a. Effectiveness of operation is reduced at night and during periods of low visibility due to limitations in target acquisition and range estimation.

b. Engagement of targets is limited by the subsystem's flexible limits in relation to gun-target range, altitude, airspeed, and helicopter degree of bank.

Table F–2. Correct Angle of Quadrant Elevation for 90 Knots Airspeed by Slant Range and Altitude

Slant range (meters)	Absolute altitude (feet)		
	100	50	1,000
300	5		
400	19	−43	
500	33	−18	
600	47	4	−52
700	61	22	−25
800	75	43	−1
900	90	60	21
1,000	106	78	42
1,100	123	97	64
1,200	142	117	86
1,300	162	138	108
1,400	184	161	131
1,500	208	185	156
1,600	235	211	182
1,700	264	240	210
1,800		272	240
1,900			273

Correction factor (mils)

F–3. Safety

Normal safety precautions prescribed in TM 9–1300–206 for handling high-explosive ammunition apply to the M384 cartridge.

Warning: **Unexploded M384 projectiles fired from launchers WILL NOT BE HANDLED OR MOVED UNDER ANY CIRCUMSTANCES. They will be destroyed by explosive ordnance disposal personnel or other qualified personnel.**

Warning: **Troops moving into an area that has been subjected to fire from M384 cartridges must be warned that all unexploded projectiles are extremely dangerous and must not be touched or disturbed in any manner.**

Section II. DESCRIPTION AND FUNCTIONING

F–4. General

The M5 helicopter armament subsystem employs a 40mm gun mounted in a flexible power-operated turret on the nose of the helicopter. The gunner aims and fires the gun using a hand control sight assembly (para F–10). Within the physical travel limitations of the turret, gun control is independent of the helicopter's flight attitude. When the turret control switch (fig. F–8) is released by the gunner, the turret returns to a fixed forward attitude (stow position). Either the pilot or gunner can fire the gun in the stow position by depressing the firing switch located on either cyclic stick. The pilot can preset or control gun elevation in the stow position by adjusting a wheel on the turret control panel assembly. For subsystem weights, see table F–3.

F–5. Turret Assembly

The turret assembly mounts on three hard points outside the electronic equipment compartment on the helicopter nose. It contains the components which which mount, position, and fire the gun. The internal components are protected by both

Table F-3. M5 Subsystem Weights

Item	Weight (lbs.)	
	Unloaded	Loaded
M5 subsystem—		
Ammunition box fed	233	335 (150 rounds)
Ammunition rotary drum fed	223.5	459 (300 rounds)
Ammunition container—		
Ammunition box and cover assembly	16	80 (85 rounds)
Ammunition can and access cover assembly	32	220 (240 rounds)

top and forward turret enclosure assemblies. These assemblies are easily removed to provide access to the gun and turret assembly components. The forward enclosure assembly has a rectangular opening for the gun barrel. Closure brushes, mounted in the rectangular opening, prevent entry of dirt and foreign matter. An external boot assembly attaches to the top enclosure and to the electronic equipment door of the helicopter. It protects the front ammunition chute assembly and the electric cable assembly that connects the turret assembly components with the remainder of the subsystem. Major components of the turret assembly are the—

a. Gun Drive Assembly. The gun and drive motor are mounted in the saddle assembly. A gun drive assembly transmits mechanical power to the gun through a belt and universal joint. The saddle assembly rotates on the horizontal axis to provide gun elevation and depression.

b. Saddle Assembly. The saddle assembly is mounted in the gimbal assembly which rotates on the vertical axis to provide gun left and right azimuth.

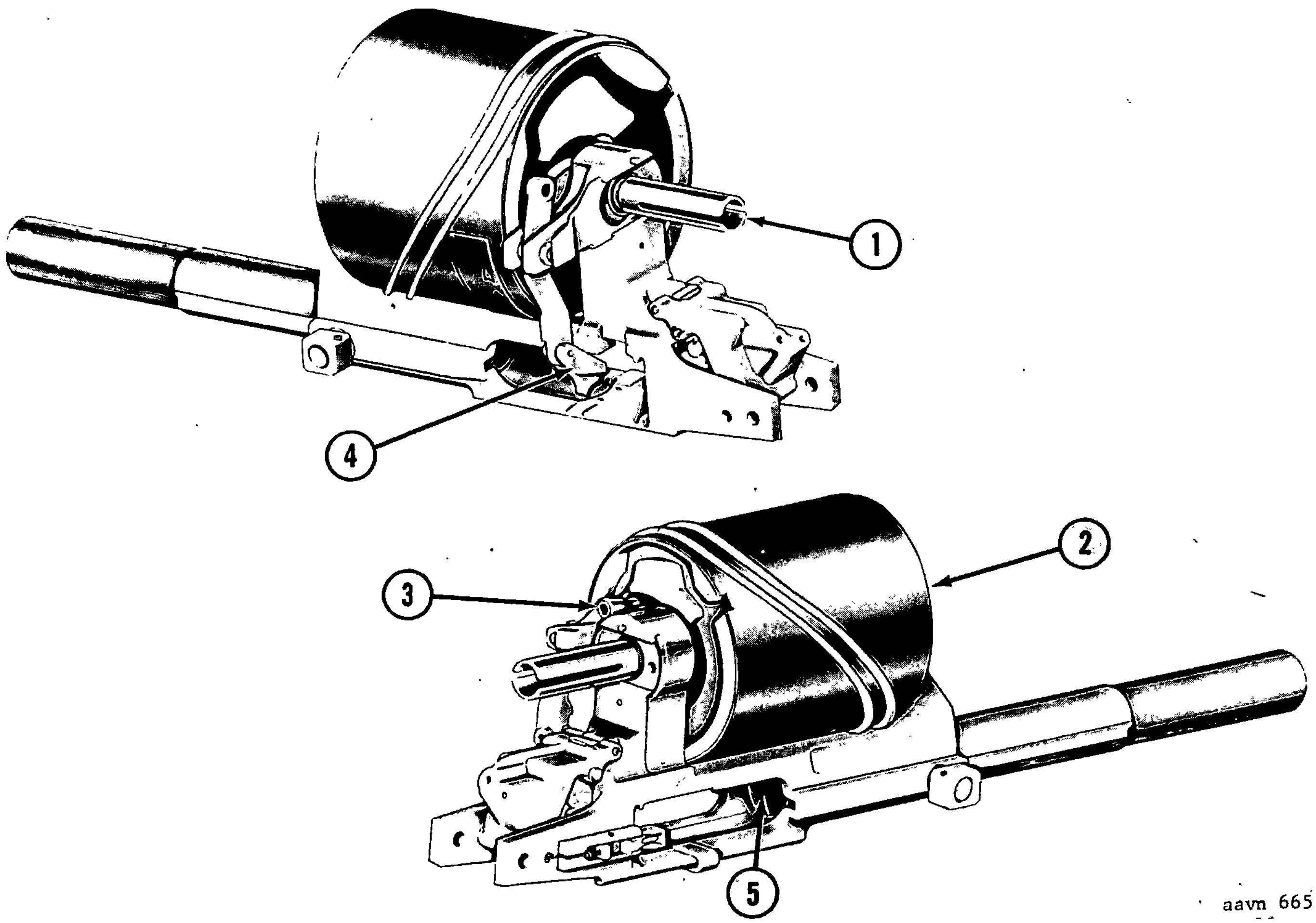


Figure F-2. Gun.

c. Elevation and Azimuth Powered Trunnion Assemblies. Elevation and azimuth movements of the gun are made by the elevation and azimuth powered trunnion assemblies. Each powered trunnion assembly contains a direct-current drive motor which is powered by its respective servoamplifier. The rotational travel of each powered trunnion assembly is limited by fixed mechanical stops and by adjustable limit switch actuators.

d. Ammunition Ejection Chute. An ejector chute assembly on the saddle assembly and an ejection hopper on the gimbal assembly form a continuous chute for ejecting spent cartridge cases and misfired cartridges from the turret assembly.

F-6. Gun
(fig. F-2)

The 40mm gun is an air-cooled, electrically powered, rapid-firing weapon. It is percussion fired and metallic link belt fed. An electric motor drives the gun through the entire operational cycle of feeding, chambering, cocking, locking, firing, unlocking, extracting, and ejecting. The gun has a reciprocating barrel, rotating cam and cover assembly, feed arm assembly, drive spindle assembly, hammer assembly, and receiver assembly.

a. When torque is applied to the drive spindle assembly,[1] the cam and cover assembly[2] rotates in a clockwise direction. As the cam and cover assembly rotates, the roller[3] of the feed arm assembly follows a path in the rear face of the cam and cover assembly. The feed arm assembly[4] turns on its pivot pin to secure a 40mm cartridge and push it into place in the receiver assembly.[5] The gun barrel roller follows the raised track on the cam and cover assembly, moving the barrel back over the cartridge and separating the cartridge link from the link of the next cartridge. The barrel movement also pushes the cocking rod to the rear, cocking the hammer assembly.

b. When the gun barrel is at its rearmost position, a barrel lock is cammed down to hold the barrel in position. Downward movement of the barrel lock pushes the sear release extension to the rear. The sear release extension actuates the hammer assembly and the hammer strikes the firing pin, firing the cartridge.

c. After the projectile has left the barrel, the barrel lock is retracted and the barrel is cammed forward. Feeding of the next cartridge pushes the spent cartridge case out of the receiver and into the ejector chute assembly of the turret assembly.

F-7. Ammunition Feed System

The ammunition feed system provides a path for the smooth flow of linked cartridges and assists in pulling the cartridges from the ammunition container and through the chute assemblies. The system consists of the following:

a. Ammunition Containers. There are two types of ammunition containers—the *ammunition can and access cover assembly* and the *ammunition box cover assembly.*

(1) *Ammunition can and access cover assembly* (A, fig. F-3). The rotary drum ammunition can is mounted directly below the main rotor mast. The ammunition is wound around a spool inside the can. The spool rotates within the can as the ammunition is pulled to the gun. A crank handle attached to the top of the spool can be turned manually to assist in loading ammunition.

(2) *Ammunition box and cover assembly* (B, fig. F-3). The ammunition box and cover assembly is located in the center of the helicopter under the passenger seat. It is held in place by toeplates in the deck and webbing assemblies which are attached by hook snaps to standard cargo tiedown points.

b. Ammunition Booster Assembly (fig. F-4). The ammunition booster assembly is positioned in the electronic compartment between the rear and forward ammunition chute assemblies. It assists the gun in pulling linked cartridges from the ammunition box. The ammunition booster assembly is powered by a direct-current motor which is energized simultaneously with the gunfiring circuit.

(1) *Loading switch.* Normally, the loading switch (figs. F-4 and F-5) is not used for loading or unloading procedures. However, the booster motor can be turned on independently for loading or unloading ammunition by pressing the loading switch. This switch can be used to energize the booster motor without moving the MAIN POWER switch on the turret control panel assembly to ON. The helicopter must have electrical power applied and the M5 GUN & BOOST MOTOR circuit breaker pushed in. When the GUN POWER switch on the turret control panel is moved from SAFE to HOT, operating power is removed from the loading switch as a safety measure.

(2) *Feed control switch* (fig. F-4). This switch provides for automatically controlling the speed of the booster motor.

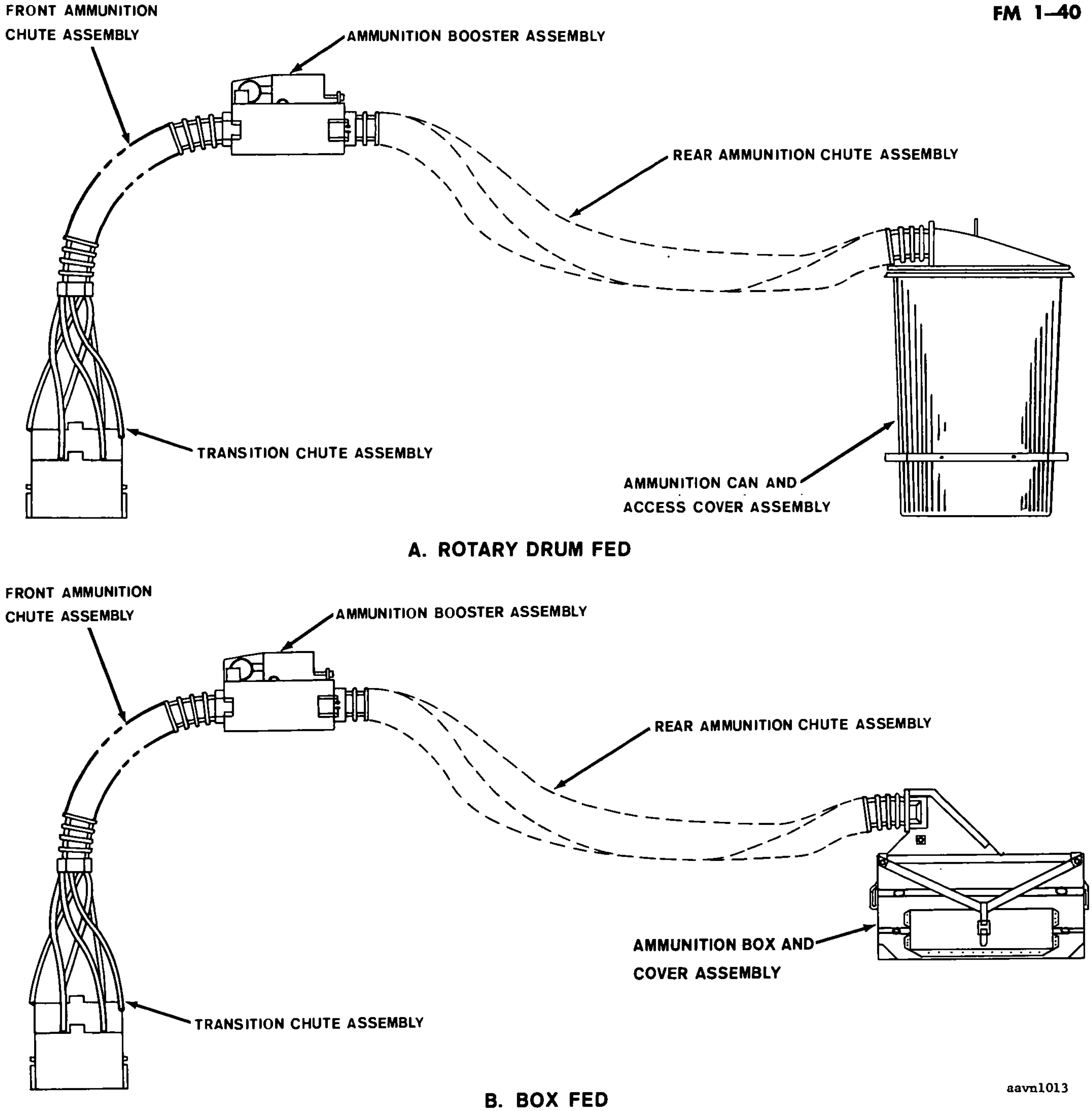


Figure F-3. Ammunition feed system.

(*a*) Through gears, the booster motor drives a shaft on which two drive sprockets are mounted.

(*b*) The sprockets pull the linked cartridges through the booster. A cover for the sprockets prevents jamming of loose objects and injury to personnel during ammunition loading.

(*c*) A regulator arm mounted on the sprocket shaft supports a lever which rides on the case portion of the linked cartridges as they flow through the ammunition booster assembly. The regulator arm also carries a machine bolt that is adjustable to proper height for contacting the feed control switch.

(*d*) When ammunition demand is low, the linked cartridges crowd together. This crowding forces the lever to ride up on the cartridges. The regulator arm machine bolt then contacts the pin in the bottom of the feed control switch, actuating the switch to reduce motor speed. Reduced

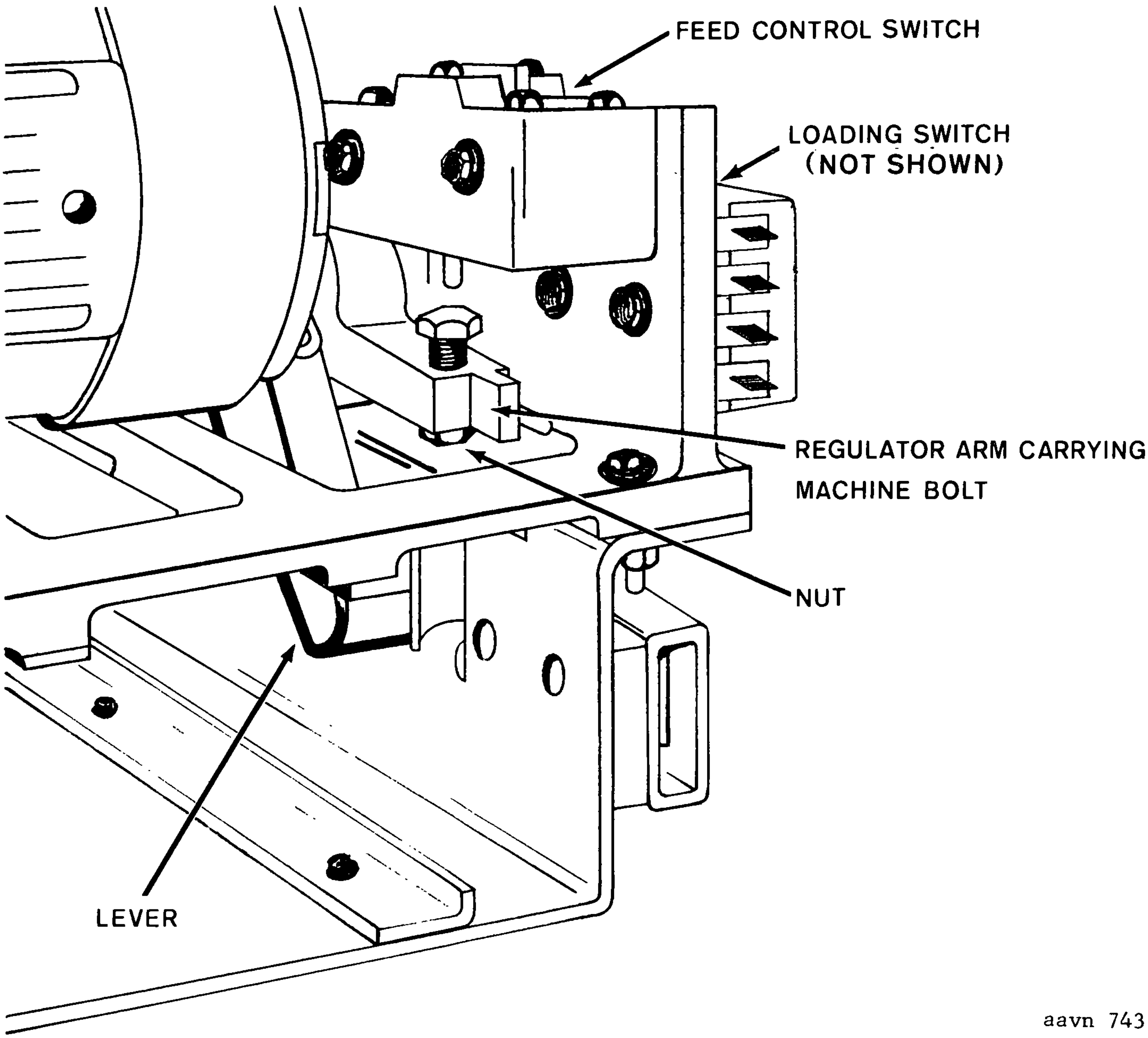


Figure F–4. Ammunition booster assembly.

motor speed is directly controlled by three resistors mounted to the underside of the sprocket cover.

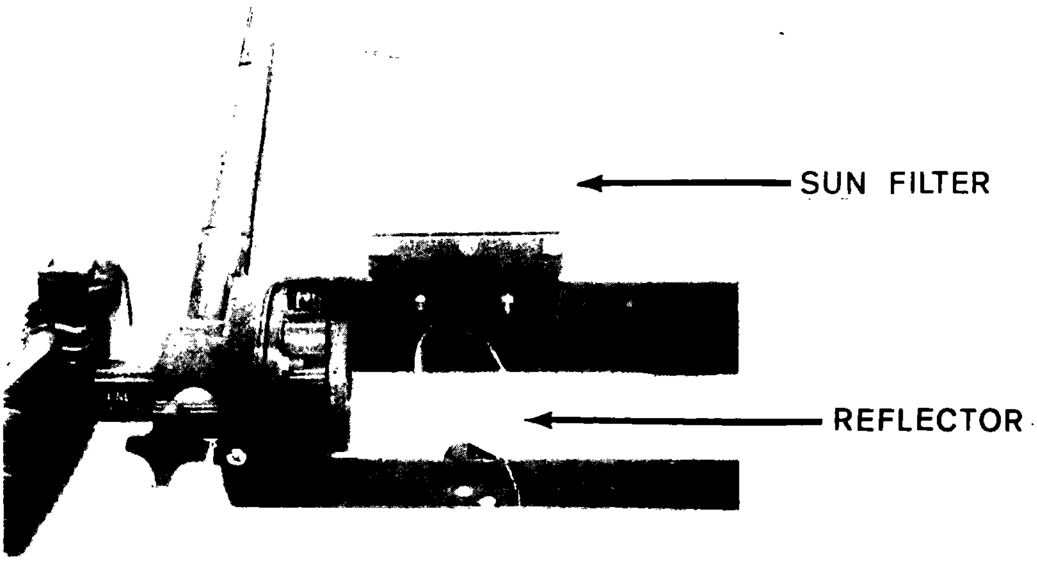
(*e*) When ammunition demand is high, the linked cartridges are properly spaced and the machine bolt on the arm no longer contacts the switch pin, thus deactuating the feed control switch.

c. Front and Rear Ammunition Chute Assemblies. The rear ammunition chute assembly fits into the metal aperture adapter, mounted on the firewall, and runs along the left side of the pedestal console and under the instrument panel to the ammunition booster assembly. The front ammunition chute assembly runs from the ammunition booster assembly to the transition chute assembly in the turret assembly. Altogether, the chuting holds about 75 rounds of ammunition.

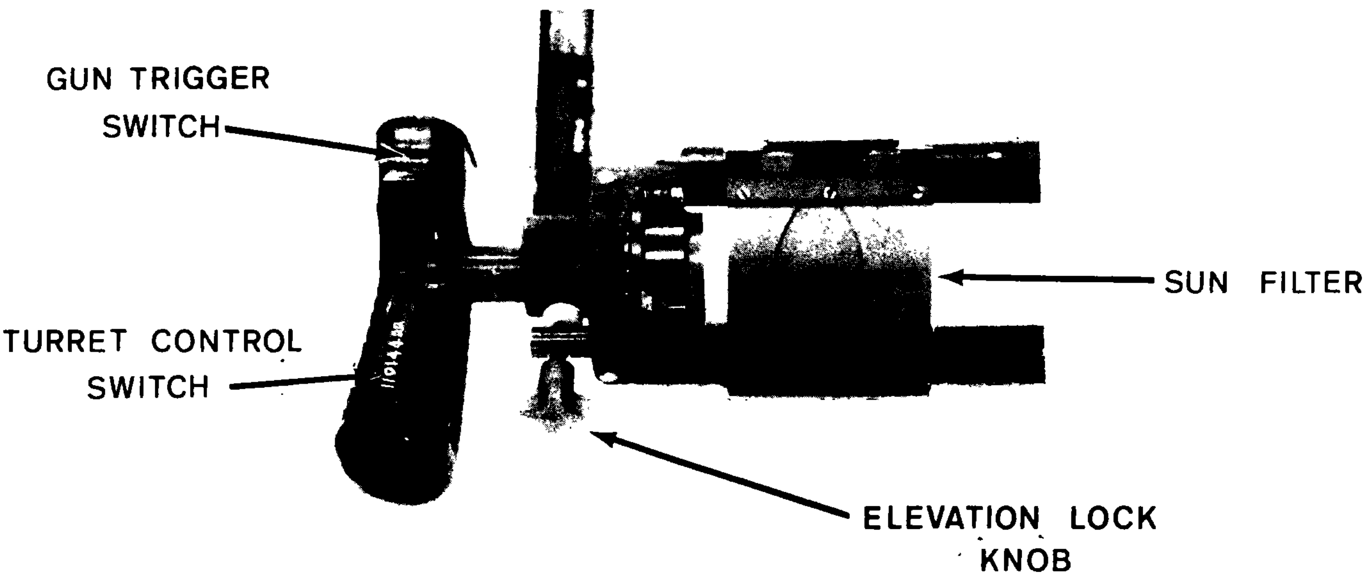
d. Transition Chute Assembly. The transition chute assembly connects the front ammunition chute assembly with the gun. It turns the linked cartridges through 90° so that the cartridges enter the gun with nose pointing forward.

F–8. Turret Control Panel Assembly

The turret control panel assembly (fig. F–6) is



A. SUN FILTER UP



B. SUN FILTER DOWN

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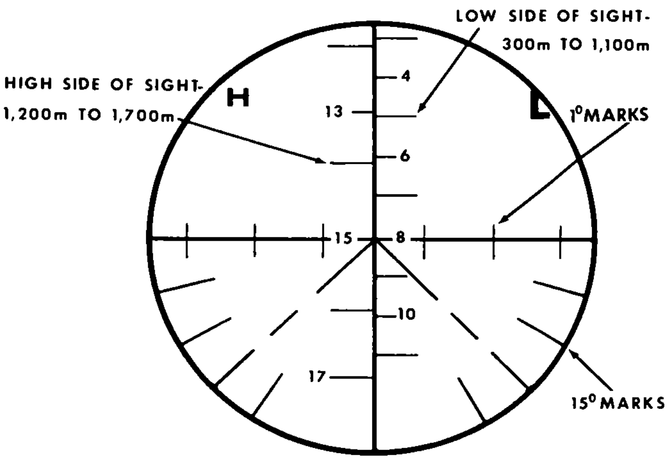
Figure F-8. Sight guide and controller grip assembly.



★*Figure F-9. Sight reticle image.*

pressed and held, this switch activates circuits which turn the turret assembly in azimuth and elevation, according to the electrical signals generated by movement of the sight in azimuth and elevation. Depressing this switch also permits firing the gun by depressing the gun trigger switch. Releasing the turret control switch returns the turret and gun to the stow position.

(*b*) *Gun trigger switch.* When the turret control switch and the gun trigger switch are both held depressed, the gun trigger switch closes the gun drive motor circuits and ammunition booster assembly circuits.

(*c*) *Elevation lock knob.* This knob can be turned to lock the sight assembly guide in one position.

F-11. Firing Switches

When the turret control switch is released and the turret is in the stow position, either the gunner or pilot can fire the gun by depressing the firing switch (fig. D-11) on either cyclic control stick.

F-12. Servo-Amplifier Junction Box Assembly

The servo-amplifier junction box assembly contains two servo-amplifier module assemblies, a control module, relay switching and control circuits for the subsystem, components of the automatic lead compensation device, and a switch to remove the compensation when desired for testing or instructional purposes. The servo-amplifier junction box assembly is located in the baggage compartment of the helicopter. Holes in the junction box assembly mounting brackets fit over studs on two channel beams in the helicopter. The cover assembly is secured by two tabs on one end and two turn-lock fasteners at the other end.

a. Cooling air circulation is supplied by an exhaust-type blower mounted on one side of the box. Test jacks, designated TP1 through TP18, are mounted on both sides of the blower to permit electrical troubleshooting tests without having to remove the cover assembly.

b. Five externally-mounted receptacles provide for subsystem electrical interconnection.

c. The two amplifier module assemblies are interchangeable and are secured in the junction box by a module retainer assembly.

d. The flashing reticle (para F-10*c*(2)) circuit is also contained in the junction box.

F-13. Preflight Checks

Warning: **Do not attempt to perform preflight checks with high explosive or practice ammunition loaded in the transition feed chute assembly or gun. If this ammunition is present, unload in accordance with paragraph F-15.**

a. Connect auxiliary power unit to the helicopter.

Caution: **If auxiliary power is used to operate the subsystem, only battery-type power units will be used.**

b. Push in the following circuit breakers and turn the indicated switches to the positions named:

(1) *AC circuit breaker panel* (fig. F-10).

(*a*) M-5 ARM (115 volts AC, synchronization, magnetic, amplifier, and stow).

(*b*) M-5 ARM (28 volts AC bias power).

(2) *DC circuit breaker panel* (fig. F-11).

(*a*) INVTR CONT.

(*b*) MAIN INVTR PWR.

(*c*) SPARE INVTR PWR.

(*d*) VOLT METER-NON-ESS-BUS.

(*e*) M5 GUN & BOOST MOTOR (35 amp gun drive and booster drive power).

(*f*) M5 AZ (7 amp, azimuth drive power).

(*g*) M5 EL (7 amp, elevation drive power).

(3) *Overhead console switches.*

(*a*) INVTR switch to SPARE ON.

(*b*) PHASE selector switch to AB (AC voltmeter indicates 115 volts).

(*c*) NON-ESS-BUS to manual ON.

(*d*) If no external power is used, turn BATT switch to ON.

Figure F–10. Pedestal (pilot's side) AC circuit breaker panel.

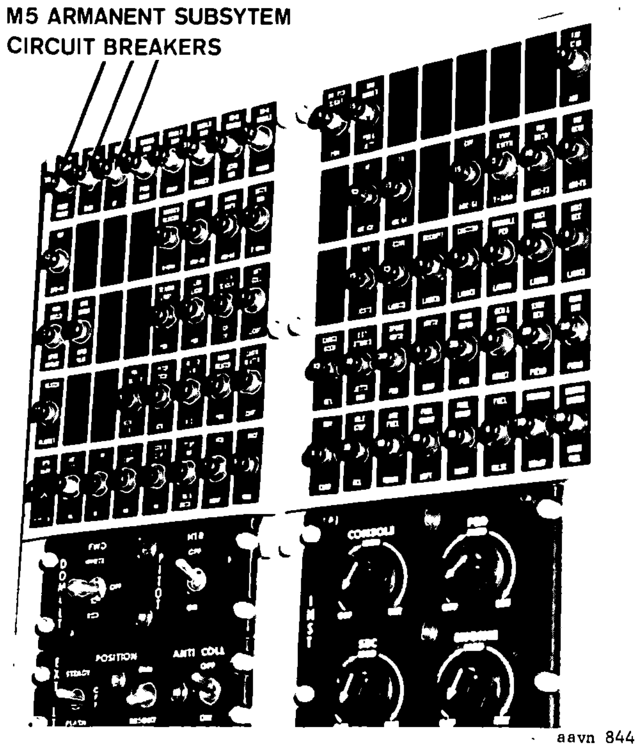


Figure F–11. Overhead DC circuit breaker panel.

c. On turret control panel (fig. F–6), set MAIN power switch to ON; the turret will move to the stow position (if its position has been moved from the stow position) and the OPERATE indicator will light.

d. On turret control panel (fig. F–6), move GUN ELEV stow control throughout its full travel. The turret should follow the movement of the control in elevation.

e. Release sight from stow position but do not depress turret control switch (B, fig. F–8). A flashing reticle image should be visible on the reflector.

f. Depress turret control switch. Reticle image should stop flashing and remain steady. The turret should assume the position of the sight.

g. Release turret control switch (turret reverts to —0° azimuth and elevation stow position). Set GUN POWER switch (fig. F-6) on turret control panel assembly to HOT (ARMED indicator light should illuminate).

h. With turret control switch (B, fig. F–8) depressed, move sight in azimuth to both the right and left limits. Reticle should flash when turret limits are reached.

i. Using dummy rounds to avoid breaking the firing pin, depress turret control switch and gun trigger switch (B, fig. F–8). The gun and booster should cycle while the gun trigger switch is depressed. The gun should continue to cycle for two or three rounds before stopping. Release turret control switch and gun trigger switch.

j. Using dummy rounds, press firing switch (fig. D–11) on each cyclic control stick. The gun and booster should cycle while each firing switch is pressed and stop after release of the trigger when two or three rounds have cycled.

k. Set GUN POWER switch (fig. F–6) to SAFE (ARMED indicator light should go out) and place sight in the stow position.

l. On turret control panel, set MAIN POWER switch to OFF; OPERATE indicator light should go out.

m. Pull out circuit breakers listed in *b* above, and disconnect auxiliary power unit from the helicopter.

n. Set ROUNDS REMAINING (fig. F–6) indicator to 150/300.

F–14. Loading Ammunition

★*Warning:* **Observe ammunition handling safety precautions. See TMs 9–1010–207–12, 9–1300–200, and 9–1300–206 for details on handling ammunition.**

a. Rotary Drum Fed Ammunition System.

(1) Disconnect aft chute from aperture adapter.

(2) Obtain ammunition complement consisting of six 50-round belts. Arrange and connect these belts to make one belt of 220 rounds and one belt of 80 rounds. If safety conditions warrant, attach one linked aluminum dummy round containing a rubber firing pin insert to connector end of last 50-round belt. This dummy round must be the last round of the 300 rounds to feed.

Caution: **Examine rounds for correct linking and position (figs. F–12 and F–13).**

(3) Grasp end of belt containing dummy round and place the dummy round end in the aperture opening on the firewall so that the nose of the round is pointing to the right of the helicopter. Feed the ammunition into the can until the last round of the belt can be engaged in the spool. Then rotate the spool by turning the manual crank on top of the ammunition can. This pulls

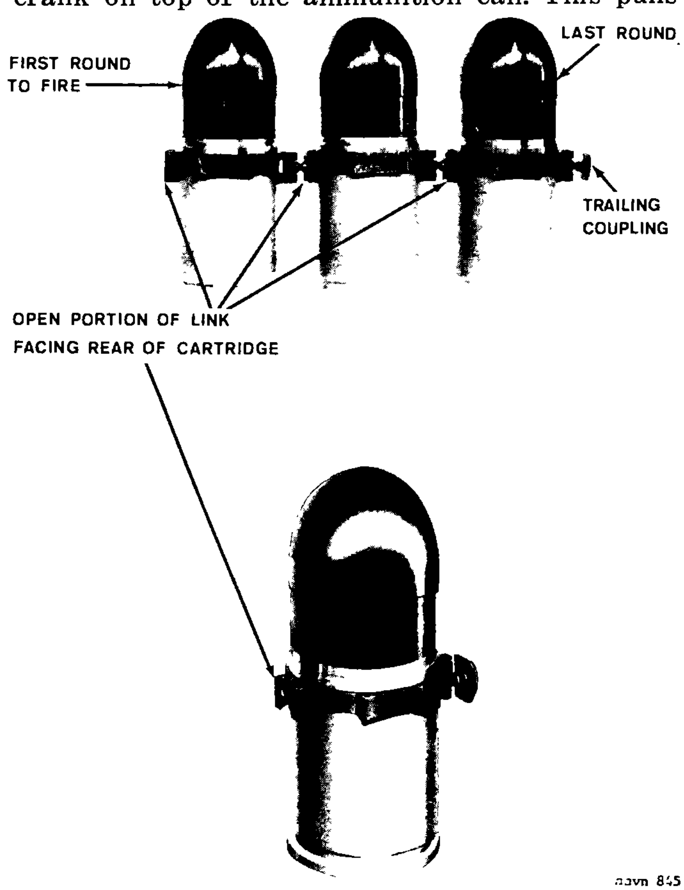


Figure F–12. Examples of correct linking.

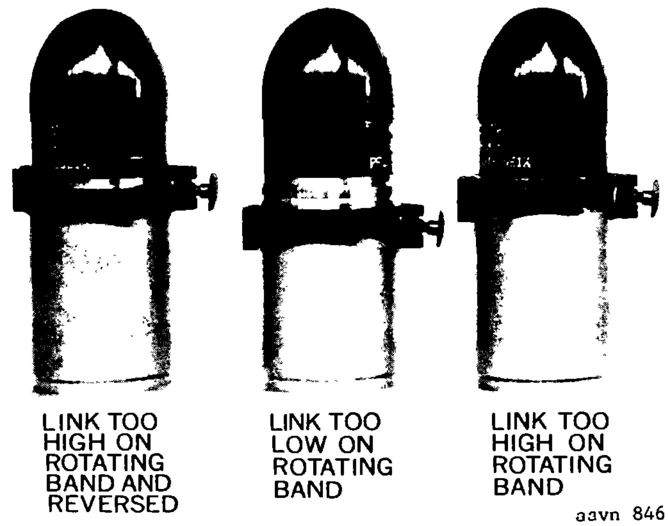


Figure F–13.—Examples of incorrect linking.

the remainder of the 220-round belt into the can, winding it around the spool.

(4) With approximately three rounds trailing from the aperture in the firewall, replace the access cover.

b. Box Fed Ammunition System.

(1) Remove access cover by releasing the hook snaps and removing the rear chute assembly.

(2) Obtain ammunition complement consisting of three 50-round belts. Arrange and connect these belts to make two belts of 75 rounds.

(3) Feed one 75-round belt into the box so that the nose of the round is pointing to the right of the helicopter.

(4) With approximately three rounds trailing, replace assembly cover.

Note. Subparagraphs *c* through *l* below apply to both of the above ammunition feed systems.

c. Remove top enclosure by releasing the strap and sliding the enclosure 1 inch to the right. Then slide enclosure, with boot attached, up toward center of forward flexible chute.

d. Disconnect forward flexible chuting from the transition chute assembly.

e. Insert hook end of loading cable through opening in forward chute and continue inserting cable until the hook emerges from the rear of the aft chute.

Note. Open portion of flexible chuting must face up.

f. Attach hook to end of remaining belt of ammunition so that *the nose of the rounds is pointing to the right* of the helicopter with the *link coupling always on the trailing side of the cartridge.*

Caution: **Examine rounds for correct linking and position (figs. F–12 and F–13).**

g. Pull ammunition through chutes and booster until five rounds are past the forward end of the front flexible chute. Remove hook from link.

h. Join the two belts of ammunition by using hand linker tool (fig. F–14).

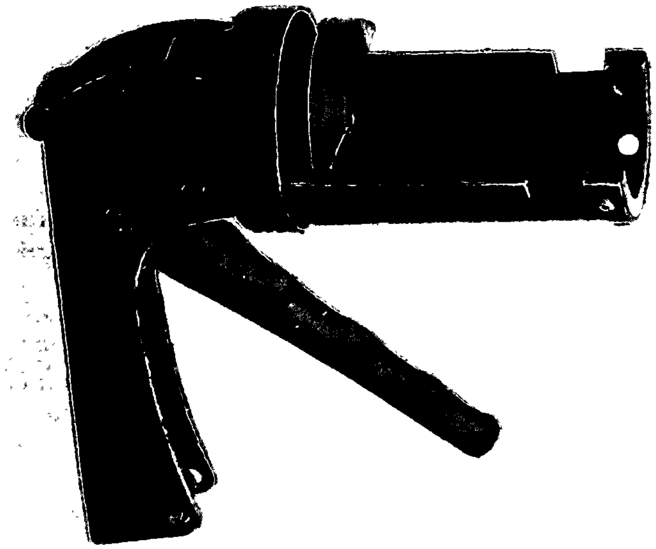


Figure F–14. Hand linker-delinker.

i. Connect end of aft chute to the aperture adapter, insuring that the latches are fully engaged on catches.

j. Insert the five rounds, hanging from the front ammunition chute, into the transition chute assembly. Press the first round past the belt-holding pawl on top of the transition chute assembly. Then continue pressing the first round until it is in line with the decal on the transition chute assembly (hidden in fig. F–15).

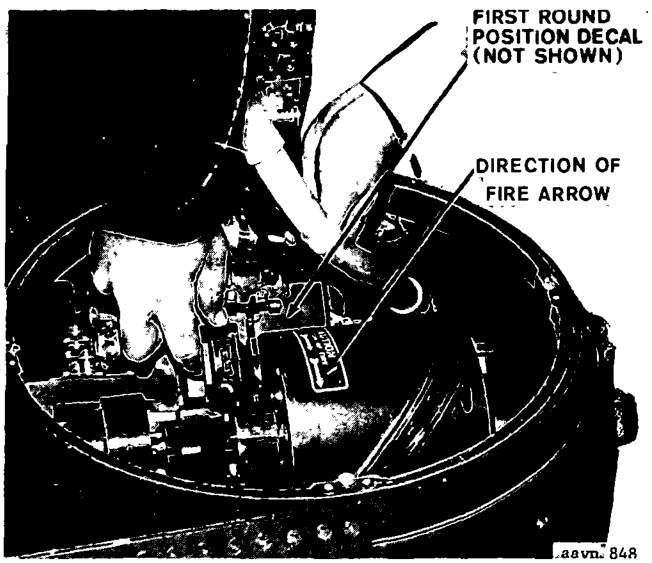


Figure F–15. Positioning the first round.

Warning: **Do not push the first round into the gun receiver.**

k. Place top enclosure on turret and secure.

l. Depress reset knob on turret control panel and rotate until the rounds remaining counter is set for the number of rounds loaded.

F–15. Clearing Gun and Unloading Ammunition

Warning: **Insure that the area forward of weapon is clear of personnel and equipmnt. Before performing clearing procedures, dete:mine that no unfired live cartridges are in the gun receiver assembly. Do not stand in front of gun. Observe ammunition handling safety precautions (TM 9–1010–207–12).**

a. Before proceeding, make certain the procedures in paragraph F–17*d*(3) have been accomplished.

b. Remove the top enclosure assembly from the turret and slide it and the ammunition chute external boot up the front ammunition chute.

c. Check the position of the gun barrel.

(1) If the barrel is forward, inspect the gun receiver assembly to determine whether the cartridge has been fired.

(*a*) If the cartridge has been fired, push the spent case out of the receiver assembly by hand.

(*b*) If a cartridge is in the receiver, has not been fired, and the link *has not* been stripped from the belt—

1. Carefully rotate the cam and cover assembly in the direction of the arrow on the caution instruction plate (fig. F–15) just enough to uncouple the link.

Caution: **Any further rotation of gun cam will start cocking action in the hammer assembly.**

2. Rotate the cam and cover assembly (2 fig. F–2) in the reverse direction until the barrel is fully forward. Manually depress the cartridge stop while pushing the round from the receiver.

Caution: **Catch the unfired cartridge as it drops from the ejection chute below the turret.**

(*c*) If the link *has* been stripped from the belt of the cartridge in the receiver assembly, push the cartridge from the gun, being careful to catch it (*2* above).

(2) If the barrel is to the rear and the cartridge has been stripped from its link, rotate the cam and cover assembly in the opposite direction of that shown by the arrow on the caution instruction plate to determine whether or not the cartridge has been fired. Remove the spent case or the unfired cartridge, as applicable.

Note. If the complete complement of cartridges has been fired, the gun barrel may stop over the plug and link assembly. Proceed as in (2) above and push the plug and link assembly out of the receiver assembly by hand.

d. Remove the exit and fitting of the front ammunition chute assembly from the transition chute assembly (fig. F–16).

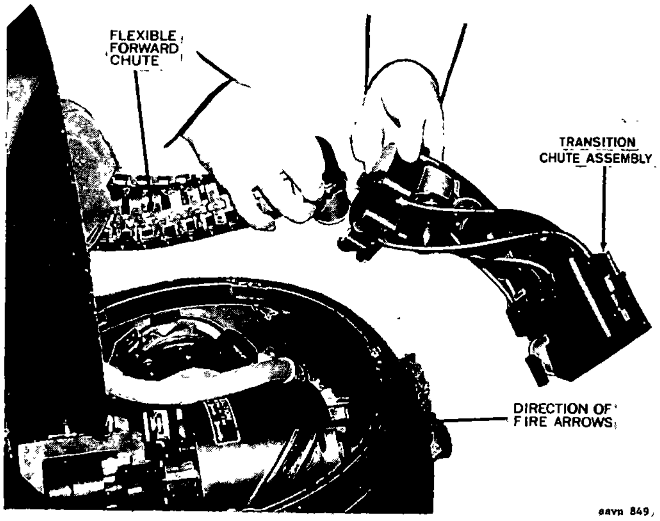


Figure F–16. Disconnecting transition chute assembly from flexible forward chute.

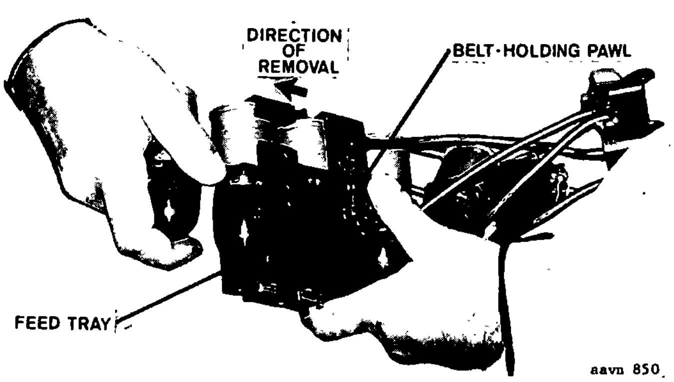


Figure F–17. Removal of ammunition from transition chute assembly.

e. Depress the belt holding pawl and remove the linked cartridges from the transition chute assembly (fig. F–17).

f. If the ammunition booster assembly is to be used to unload the subsystem—

(1) Remove the ammunition chute external boot assembly to gain access to the ammunition booster assembly.

(2) Energize the helicopter DC power control panel by moving the BAT switch to ON.

g. Withdraw the remaining linked cartridges from the free end of the front ammunition chute assembly manually or by pressing the ammunition booster assembly loading switch.

***Caution:* Avoid dropping unfired linked cartridges. Do not allow cartridge primers to strike any objects.**

h. Store all unfired linked cartridges in accordance with TM's 9–1010–207–12 and 9–1300–206.

i. Install the exit end fitting of the front ammunition chute assembly on the transition chute assembly and install the ammunition chute external boot assembly.

j. If the ammunition booster assembly was used to unload the subsystem, deenergize the helicopter DC power control panel by moving the BAT switch to OFF.

F–16. Harmonization (Boresight Procedure)

Two men are required to boresight the armament subsystem M5. The subsystem should be boresighted as necessary to assure accuracy in firing. Use the dimensions shown in figure F–18 to construct the boresighting target shown in figure F–19.

***Warning:* Do not attempt to boresight a subsystem when the gun is still hot from firing. Allow the gun barrel to cool before proceeding. Then do not stand in front of gun until transition chute assembly and gun receiver assembly have been inspected for ammunition (*c* below).**

a. Place the helicopter on level ground. Approximately 100 feet of level ground should be in front of the turret assembly.

b. Remove the top and forward enclosure assemblies from the turret assembly.

c. Inspect the gun receiver and transition chute assemblies for the presence of high explosive or practice ammunition. If either type is found, unload in accordance with paragraph F–15.

d. Manually rotate the cam and cover assembly of the gun until the gun barrel is in its rearmost position.

e. One operator should sit in the gunner's seat

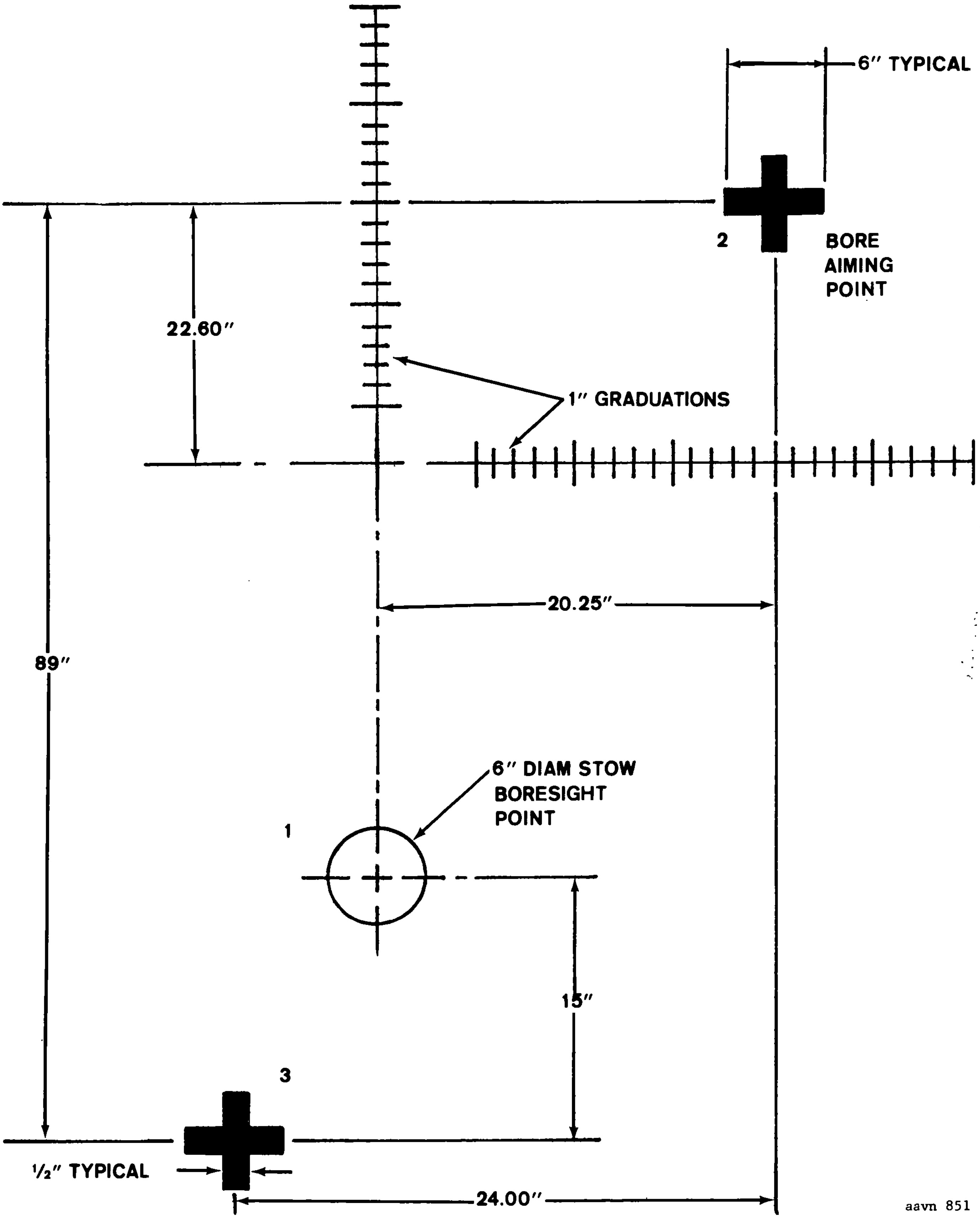


Figure F–18. Diagram for 700-meter boresighting target.

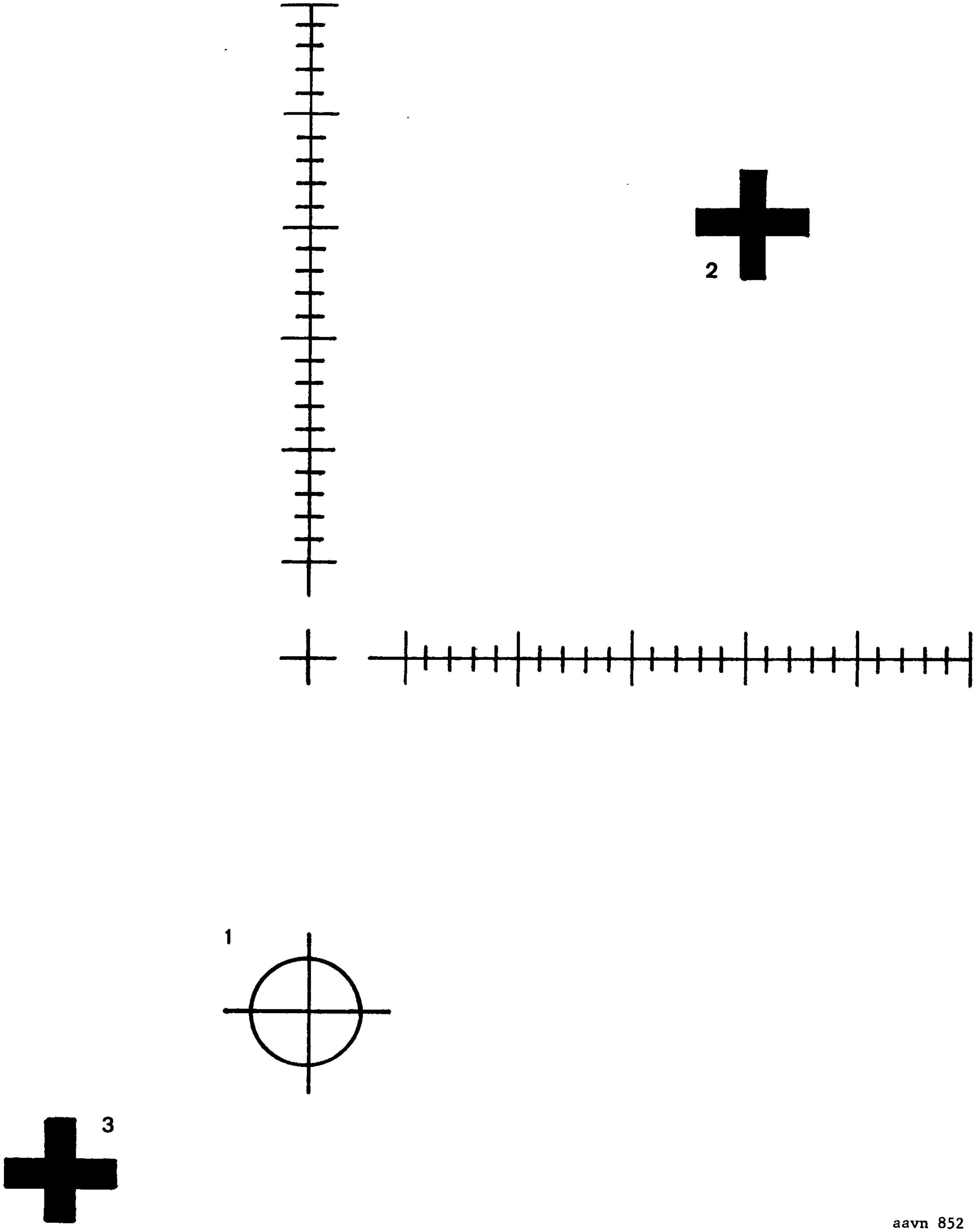


Figure F–19. 700-meter boresighting target.

in the helicopter and turn the selector dial of the stow position elevation control on the turret control panel assembly until the indicator dial is at 0°.

***Caution:* See that the GUN POWER toggle switch on the turret control panel assembly is on SAFE, with the toggle guard in the lowered position.**

f. Push in the following circuit breakers and turn the indicated switches to the positions named:

(1) *AC circuit breaker panel.*

(*a*) M–5 ARM (115 volts AC, sychronization, magnetic, amplifier, and stow).

(*b*) M–5 ARM (28 volts AC bias power).

(2) *DC circuit breaker panel.*

(*a*) INVTR CONT.

(*b*) MAIN INVTR PWR.

(*c*) SPARE INVTR PWR.

(*d*) VOLT METER-NON-ESS-BUS.

(*e*) M5 GUN & BOOST MOTOR (35 amp gun drive and booster drive power).

(*f*) M5 AZ (7 amp, azimuth drive power).

(*g*) M5 EL (7 amp, elevation drive power).

(3) *Overhead console switches.*

(*a*) INVTR switch to SPARE ON.

(*b*) PHASE selector switch to AB (AC voltmeter indicates 115 volts).

(4) *Turret control panel assembly.* Set MAIN POWER toggle switch to ON.

g. The OPERATE indicator light on the turret control panel assembly should now light.

h. See that the helicopter engine is off.

i. Insert the 40mm boresight adapter from the 40mm boresighting kit into the muzzle of the gun barrel until the adapter flange is up against the end of the barrel.

j. Insert the 40mm boresight telescope firmly in the adapter with the viewing piece vertical (fig. F–20).

k. Set the boresighting target (fig. F–19) 1,000 inches in front of the end of the gun barrel. Maneuver the target so that position 1 on the target is alined with the crosshairs of the viewing piece of the 40mm boresight telescope.

l. In the helicopter, release the sight assembly from the stow hooks on the sight mount bracket assembly. Depress and hold the turret control switch.

m. Move the sight assembly until the 700-meter rangemark coincides with the crossed lines at position 3 on the target.

n. At the turret assembly, look through the

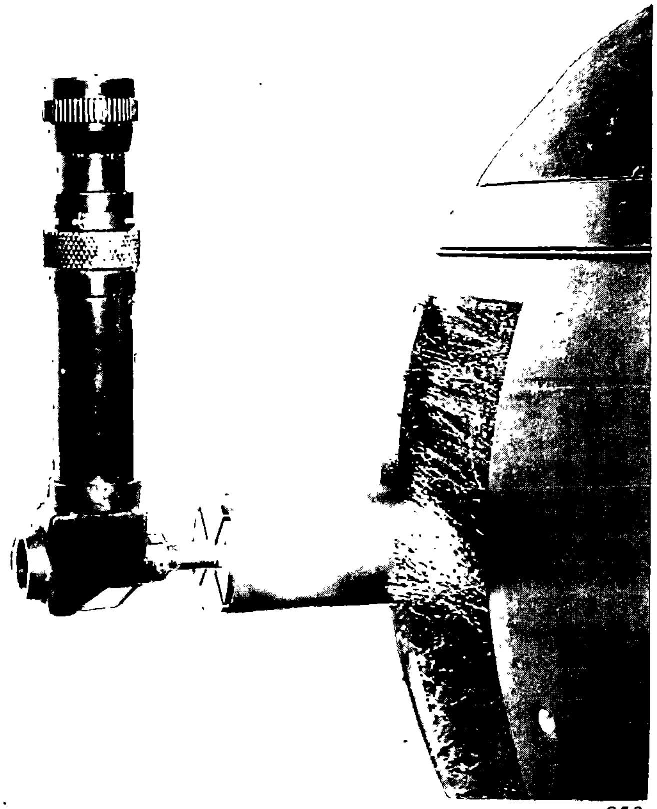


Figure F–20. 40mm boresight telescope in position.

boresight telescope and note the location of the crosshairs with relation to the crossed lines at position 2 on the target. If the telescope crosshairs do not coincide with the crossed lines, determine the amount of displacement of the crosshairs in elevation and azimuth by counting the 1-mil graduations on the target. Announce the displacement to the operator using the sight assembly.

Note. The elevation and azimuth adjusting screws on the sight assembly have raised portions on the heads for indicator points. The edges of the screw access holes are marked off with eight lines. When an adjusting screw is turned so that the indicator point moves from one line to another, the screw has moved the reticle image 1 mil at 700 meters, or 1 mil on the boresighting target. Turning the azimuth adjusting screw clockwise moves the reticle image to the right.

o. In the helicopter, release the turret control switch. Turn the azimuth and elevation adjusting screws clockwise or counterclockwise, according to the placement announced by the operator using the boresight telescope.

p. Again depress and hold the turret control switch and repeat *m*, *n*, and *o* above until the crosshairs of the boresight telescope are alined with position 2 on the target when the reticle 700-meter rangemark is held on position 3.

q. Push the sight assembly up to the bracket assembly until the stow hooks grasp the suspension system.

r. Turn off the switches (*f* (3) and (4) above) and pull out the circuit breakers listed in *f* (1) and (2) above.

s. Remove the boresight telescope and boresight adapter from the gun barrel and remove and store the boresighting target.

Note. If the subsystem is to be loaded with ammunition, follow procedures indicated in paragraphs F-13 and F-14 at this time.

t. Install the top and forward turret enclosure assemblies in the turret assembly.

Note. If the subsystem cannot be boresighted using the above procedures (the sight reaches the stops), minor adjustment of the mounting braces will normally bring the weapon into limits.

Section III. FIRING

F-17. Gunner's Checklist for Firing

a. Exterior Inspection.

(1) Turret assembly—SECURED.

(2) Top enclosure assembly—FASTENED.

(3) Forward enclosure assembly—FASTENED.

(4) Boot assembly—FASTENED.

b. On Entering the Helicopter.

(1) GUN POWER toggle switch guard—DOWN.

(2) MAIN POWER toggle switch—OFF.

(3) Armament AC and DC circuit breakers—IN.

(4) Sight assembly—STOWED.

(5) Ammunition—LOADED.

(6) ROUNDS REMAINING indicator set on number of rounds loaded.

c. In Flight.

(1) *Firing using hand control sight assembly.*

(*a*) MAIN POWER toggle switch—ON.

(*b*) GUN POWER toggle switch—HOT.

(*c*) ROUNDS REMAINING indicator—CHECK.

(*d*) Hand control sight assembly—released from STOWED POSITION.

(*e*) Turret control switch—DEPRESSED.

(*f*) Gun trigger switch—PRESS TO FIRE.

(2) *Stow firing position.*

(*a*) MAIN POWER toggle switch—ON.

(*b*) GUN POWER toggle switch—HOT.

(*c*) ROUNDS REMAINING indicator—CHECK.

(*d*) Firing switch on either cyclic control stick—PRESS TO FIRE.

d. After Firing.

(1) *Using hand control sight assembly.*

(*a*) Hand control sight assembly—STOW.

(*b*) GUN POWER toggle switch—SAFE.

(*c*) MAIN POWER toggle switch—OFF.

(2) *Stow firing position.*

(*a*) GUN POWER toggle switch—SAFE.

(*b*) MAIN POWER toggle switch —OFF.

(3) *Before leaving helicopter.*

(*a*) GUN POWER toggle switch—SAFE.

(*b*) MAIN POWER toggle switch—OFF.

(*c*) AC and DC ARM circuit breakers—OUT.

(*d*) Hand control sight assembly—STOWED.

F-18. Turning on Subsystem Electrical Power

After all preflight checks are made (para F-13), electrical power for the subsystem is obtained by—

a. Pushing in the FIVE M5 Subsystem Circuit Breakers.

(1) M-5 ARM (two circuit breakers).

(2) M5 GUN & BOOST MOTOR.

(3) M5 AZ.

(4) M5 EL.

b. Setting the Following Switches:

(1) MAIN POWER switch—ON.

(2) GUN POWER switch—HOT.

Note. The subsystem will not operate if a positional error of more than 35 mils exists between the turret and the input signals. Do not have the turret at either of the azimuth or elevation limits.

F-19. Flexible and Stow Firing Positions

When the subsystem is energized (para F-18), the turret will automatically be driven to the stow position and the OPERATE indicator will light. As soon as the GUN POWER switch is placed in the HOT position and the ARMED indicator light illuminates, the subsystem is ready for operation in either the flexible or stow position. In the flexible position, the gunner remotely directs and fires the gun by using the hand control sight assembly and sight mount bracket assembly. The mounting pivot axis system matches the azimuth elevation coordinate system used on the turret; thus, the correct relationship is maintained between the gunner's line of sight and the line of fire of the gun. Within the travel limits of the turret, gun control is independent of the helicopter's flight attitude. The subsystem is equipped with two azimuth and two elevation limit switches and an error circuit. Operation of any of the switches will deenergize the operate relay to prevent firing and extinguish the ARMED indicator light on the control panel assembly.

a. Flexible Firing Position. In firing from the flexible position, the gunner holds the turret control switch depressed and depresses the gun trigger switch. The turret assembly moves the gun with the movement of the sight. When the gunner attempts to acquire a target near the extremes of turret azimuth (60° right, 60° left) or when rapidly giving a large azimuth command signal, the turret may fall out of synchronization with the sight (drive in the opposite direction from that commanded). A flashing reticle display will indicate that the gun cannot be fired. To regain synchronization—

(1) Release turret control switch.
(2) Allow turret to assume stow position.
(3) Position sight near 0°.
(4) Depress turret control switch.
(5) Sight on target.

b. Stow Firing Position. When the turret control (fig. F–8) switch is released by the gunner, the turret returns to the stow position with the gun pointing forward at the elevation shown on the GUN ELEV stow control wheel. The turret can be stowed in positive 5° increments of elevation between +15° and −35°. When the sight assembly is not in use, either the gunner or pilot can fire the gun by depressing the firing switch on either cyclic stick.

***Warning:* Due to gun and subsystem design (para F–20*a*), one round will be fired after the gun trigger or cyclic stick firing switch is released (maximum time delay approximately 0.8 second). Therefore, disengagement from the target must be delayed until the trigger switch has been released and the next round fired.**

F–20. Dynamic Braking

To insure safe operation of the subsystem, the gunner must fully understand the function of dynamic braking of the gun drive motor. Dynamic braking is used to insure that the gun will always be stopped in a safe condition after each firing cycle.

a. Time Delay Relay Energized. When the trigger switch is released, a time delay relay will remain energized until the relay is opened by the recoil produced from firing a round. The time delay is incorporated in the circuitry to insure passing a misfired round through the weapon so that it will stop in a safe position. The time delay circuit is set to deenergize the time delay relay 0.8 second after release of the triger switch.

(1) When no recoil is produced after release of the trigger switch (e.g., when a firing pin is broken or ammunition is expended), the time delay circuit will permit the gun to move through two cycles before deenergizing the time delay relay.

(2) The time delay permits the gun to be driven through two or three misfires in succession before producing recoil by firing a good round. In a typical misfire, or a misfire at the instant of trigger release, the gun will eject the misfire, fire the next round and produce recoil, and then be stopped by dynamic braking (*b* below).

(3) The time delay normally allows firing of one round after release of the trigger switch.

b. Time Delay Relay Deenergized. When the time delay relay is deenergized, power is removed from the gun coil of the gun relay and applied to the braking coil. The contacts of the braking coil now reverse the connection of the motor field winding with respect to the armature, and the two windings in series are shorted. The motor now becomes a shorted series generator that produces torque in the opposite direction to brake the gun.

F–21. Emergency Operation

a. Malfunction in Azimuth and Elevation. If the subsystem fails to respond in azimuth and/or elevation, maneuver the helicopter to keep fire on the target.

b. Runaway Gun. If a runaway gun occurs, place the GUN POWER toggle switch in SAFE position and place MAIN POWER toggle switch in OFF position.

F–22. Maintenance and Troubleshooting Procedures

For maintenance and troubleshooting procedures, see TM 9–1010–207–12.

APPENDIX G

XM18 AND XM18E1 ARMAMENT PODS

Section I. DESCRIPTION AND DATA

G–1. Description

a. 7.62mm Machinegun Aircraft Armament Pod XM18 or XM18E1. The armament pod (fig. G–1) is a lightweight, completely integrated weapons system incorporated into an aerodynamic design which permits its use on aircraft with speeds up to Mach 1.2. The armament pod contains its own power source and the electrically-driven multibarrel M134 machinegun has a firing rate of 2,000 or 4,000 shots per minute. Ammunition is fed to the M134 machinegun from a 1,500 round capacity drum, through a single-ended linkless system which is gear-driven by the gun rotor. Suspension lugs permit the armament pod to be installed on helicopters or airplanes equipped with bomb racks.

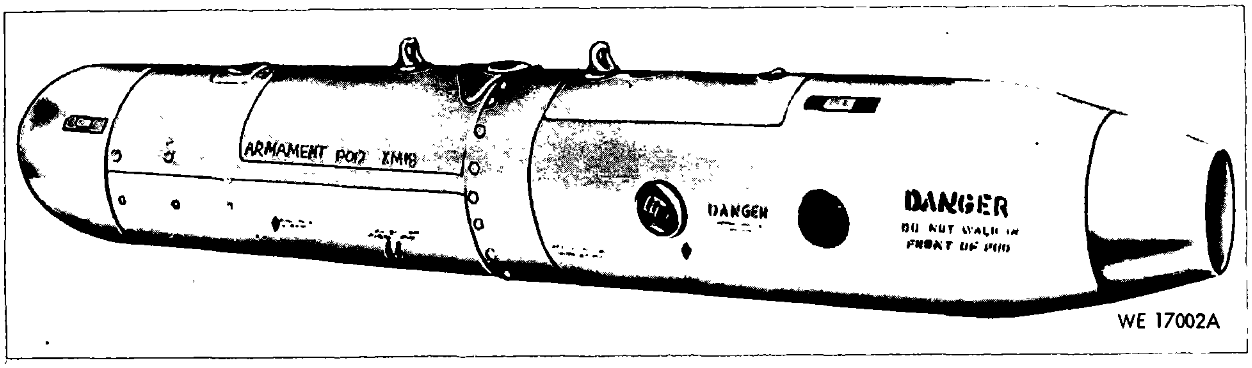


Figure G1. 7.62mm machinegun aircraft armament pod XM18 or XM18E1.

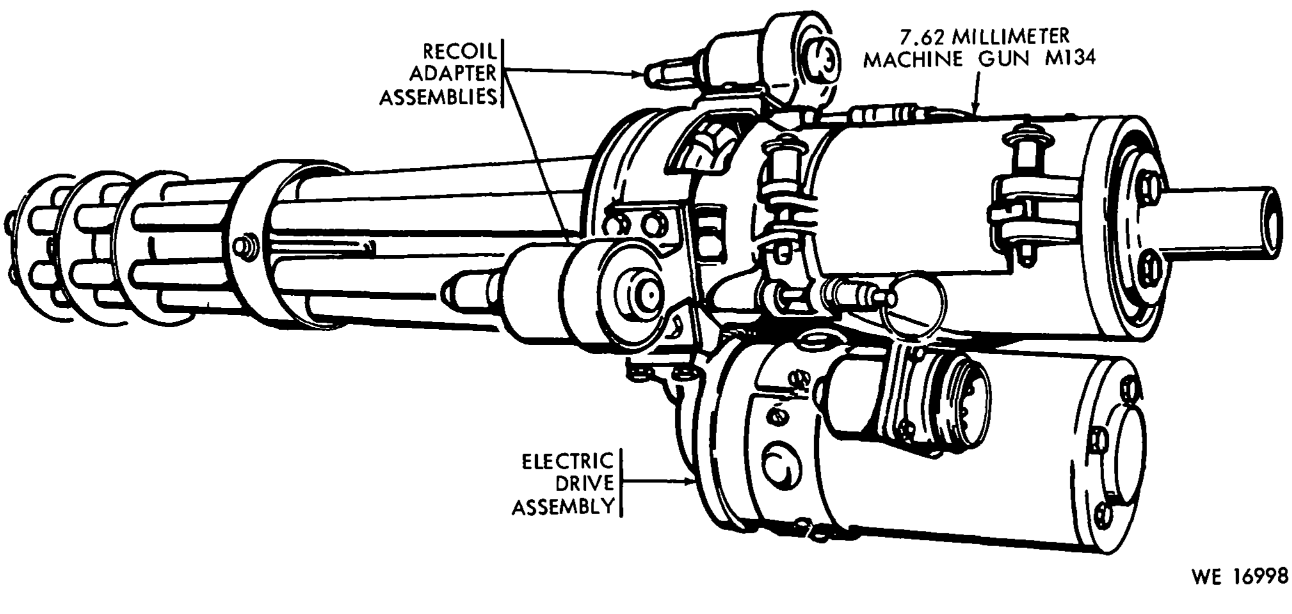


Figure G–2. Gun assembly components

b. Main Components. The following items are the main components and assemblies which make up the armament pod XM18 or XM18E1:

(1) *7.62mm M134 machinegun.* The M134 machinegun (fig. G–2) is a lightweight, air-cooled, six-barrel weapon which revolves during operation. As the rotor turns, each of the six bolt assemblies, in turn, picks up a cartridge from the feeder MAU–57A/A, chambers the round, actuates the firing pin, and ejects the spent cases after firing. Firing is accomplished when the barrel is in the 12 o'clock position.

(2) *Electric drive assembly* (fig. G–2). The gun drive consists of an electric motor and gears which turn the gun. Power is transmitted through a motor shaft spur gear and an idler gear to the front gear on the gun rotor assembly.

(3) *Recoil adapter assemblies* (fig. G–2). These spring loaded plunger-type assemblies reduce the intensity of recoil and counterrecoil during firing.

(4) *Automatic gun feeder MAU–57A/A.* The ammunition feeder MAU–57A/A (fig. G–3) conveys cartridges from the exit unit assembly into the M134 machinegun during firing periods. It is driven directly by the rear gear on the gun rotor; however, when the trigger is released, the solenoid-actuated clearing section automatically prevents transfer of any additional rounds into the gun rotor.

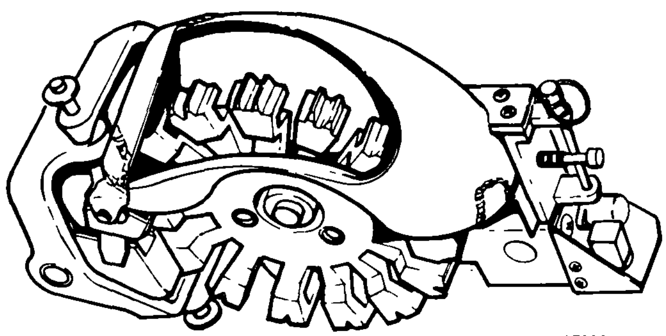


Figure G–3. Automatic gun feeder MAU–57A/A.

(5) *Gun pod front fairing assembly.* The front fairing assembly consists of a stainless steel nose cap joined to an aerodynamic aluminum structure (fig. G–4). The nose cap provides an opening through which the M134 machinegun is fired. A section at the top of the fairing assembly is cut away to accommodate the gun support assembly. Brackets in the lower section are used to store the ammunition loader assembly.

(6) *Loader assembly.* The loader assembly, operated by a handcrank, delinks belted ammunition, ejects the links, and transfers the cartridges through the exit unit assembly into the drum assembly for storage (fig. G–4).

(7) *Exit unit assembly.* The exit unit assembly consists of sprockets, shafts, and gears which remove the cartridge from the geared retainer partitions of the drum assembly and transfer them to the feeder MAU–57A/A (fig. G–3). It is gear-driven by the conveyor wheel of the feeder MAU–57A/A. The exit unit assembly works in reverse order during loading procedure and is then powered by the loader assembly.

(8) *Counter and drive assembly.* The rounds counter is a dual action drum-type recorder driven by a flexible shaft powered by the scoop disc ring gear of the drum assembly (fig. G–4). The reset portion indicates the number of rounds in the ammunition drum and is automatically reset as the armament pod is reloaded. The accumulative part records the total number of rounds fired.

(9) *Pod aft fairing assembly.* The aft fairing assembly is an aluminum structure which completes the streamline design of the armament pod (fig. G–4). It is secured by three latches which engage eyebolts in the outer drum structure and serves as a cover for the electrical system access area.

(10) *Battery and control assembly.* The control panel assembly and battery box assembly (fig. G–4) are mounted on retractable slides in the rear section of the drum. The electrical control system supplies power to the motor and provides pilot/copilot control of the gun operation by sequencing the electrical inputs to the motor and clearing solenoid during the firing cycle. The control system also supplies charge to the battery in use and maintains temperature control in the battery box.

(11) Gun support assembly. The gun support assembly is a beam and yoke which serves as a mount for the gun assembly (fig. G–4). A gun mount on the rear of the beam is on the centerline of the armament pod and provides the rear support for the M134 machinegun. The forward section of the beam contains two eyebolts which secure the front fairing assembly. The rounds counter is fastened to the underside of the beam. The forward suspension lug and an electrical receptacle are located on the exposed section of the beam. The yoke is attached to the beam by a lead screw mechanism, permitting elevation/depression adjustment of the M134 machinegun. The arms of the yoke receive and support the recoil adapter assemblies of the gun assembly. A

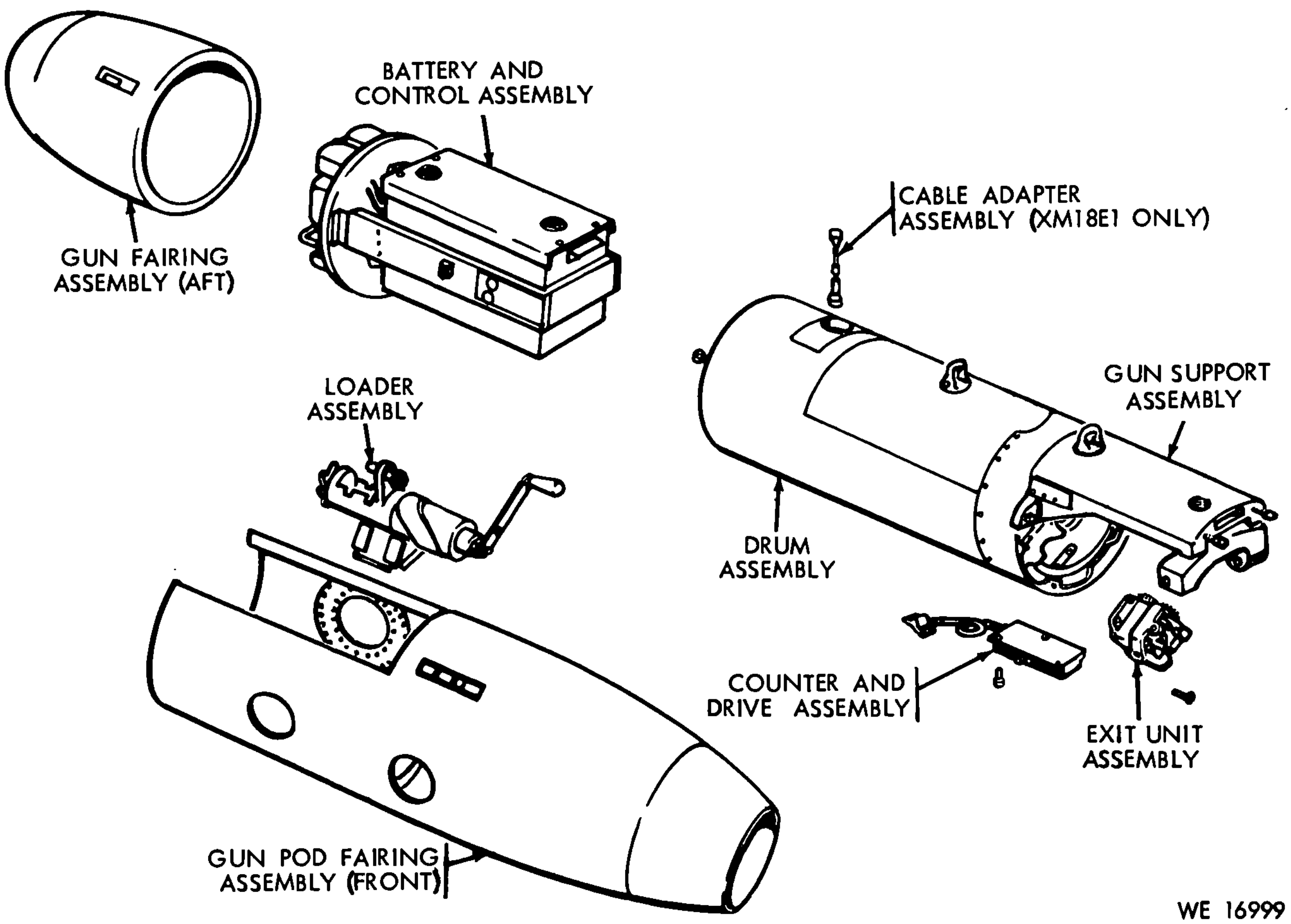


Figure G–4. Pod assembly—main components.

boresight block in the left arm of the yoke permits adjustment of the M134 machinegun in azimuth.

(12) *Drum assembly.* The drum assembly is the main structural component of the armament pod and forms the center section (fig. G–4). The partitions in the outer section provide storage facilities for ammunition which is moved in or out by fins of a rotating inner ammunition drum assembly. A scoop disc assembly is mounted on the ammunition drum assembly and acts to transfer the ammunition between the exit unit assembly and the drum assembly partitions. The drum cover assembly serves to support the ammunition drum assembly and provides mounting surface for the exit unit assembly and the rounds counter flexible shaft. The aft suspension lug and an alternate electrical outlet are located on the top of the drum assembly.

(13) *Cable adapter assembly.* This assembly adapts the electrical wiring of the armament pod XM18E1 to the aircraft-to-armament pod cable assembly (fig. G–4).

c. Difference in Models.

(1) Early production models of the armament pod XM18 had a fitting in the top of the drum assembly to accommodate a single (NATO) suspension lug.

(2) The first major change, armament pod XM18E1, uses auxiliary aircraft power for more starting torque; a deenergizing solenoid for better clearing of rounds at a low rate of fire; and circuitry which permits a dual rate of 2,000 or 4,000 shots per minute for aircraft equipped with a two-detent cyclic stick trigger, or, for aircraft with single control, a switch for preselection of either rate.

G–2. Tabulated Data

Armament Pod XM18 and XM18E1:	
Length	85 in.
Diameter	12 in.
Weight-loaded	320 lb.
Weight-empty	240 lb.
Suspension	14 in. on center
Capacity	1,500 rounds
Temperature range	−65° F to +165° F
Ignition	28 VDC

Links	M13 (for loading only)
Feed system	Single-ended linkless with rotary conveyor
Gun and feed system drive	Motor-battery
Gun	7.62mm M134 machigun
Weight	50 lb.
Length	31.5 in.
Rate of fire:	
Slow (XM18E1)	2,000 shots per minute
High	4,000 shots per minute
Burst length	3 seconds

Maximum burst	Full complement
Muzzle velocity	2,850 fps.
Cooling	Air
Barrel length	22 in.
Barrel weight	1 lb., 10 oz.
Rotation	Counterclockwise
Boresight adjustment:	
Elevation/depression	+1° 30′ to −1° 30′
Azimuth	+1° 30′ to −1° 30′

Section II. INSTALLATION/REMOVAL OF ARMAMENT POD

G–3. General

The following procedures are for installation of the armament pod to the aircraft. Unless otherwise indicated, removal is in reverse order of installation.

a. Remove front fairing assembly from armament pod (fig. G–5).

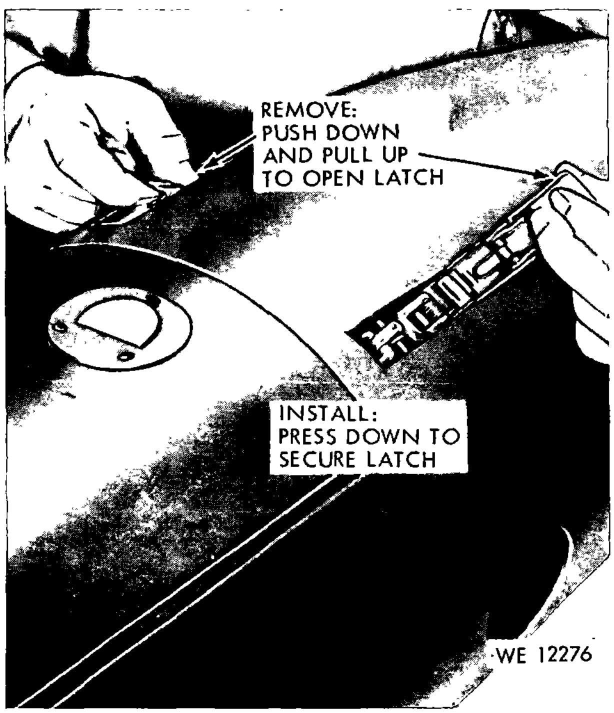


Figure G–5. Installing or removing front fairing assembly.

b. Check suspension lugs of armament pod to make sure they are properly and securely installed. A minimum of five threads must be engaged in lug fitting. Also remove quick-release pins from yoke of gun support assembly.

c. Loosen aircraft sway brace pads, lift armament pod to engage suspension lugs within hooks of bomb rack, and pull bomb rack cocking ring to secure armament pod in bomb rack.

Note. If no mechanical lift is available, it is recommended that three or four men be used to lift the armament pod.

d. Adjust front sway brace pads simultaneously, then both rear sway brace pads. Tighten jam nuts securely.

Note. Do not adjust both left or both right sway brace pads at the same time.

e. Assemble recoil adapter assemblies and electric drive assembly to the M134 machinegun. Install gun assembly in gun support assembly of armament pod as shown in figures G–6 and G–7. Secure with quick-release pins which were removed in *b* above.

f. Install feeder MAU–57A/A by positioning and securing as shown in figures G–8 and G–9.

Note. Before installing feeder MAU–57A/A to exit unit and gun assemblies, refer to table G–1 for timing instructions.

g. Connect drum assembly cable connectors P4 and P3 to connectors on gun drive motor and feeder solenoid.

h. Install front fairing assembly to armament pod (fig. G–5).

i. Connect aircraft-to-armament pod cable assembly to aircraft and to armament pod.

G–4. Timing

Timing pins (fig. G–6 and G–10) are provided on the drum cover assembly, exit unit assembly, feeder MAU–57A/A, and M134 machinegun. The pins are used to insure that these items are synchronous in operation when properly installed and timed as outlined in table G–1.

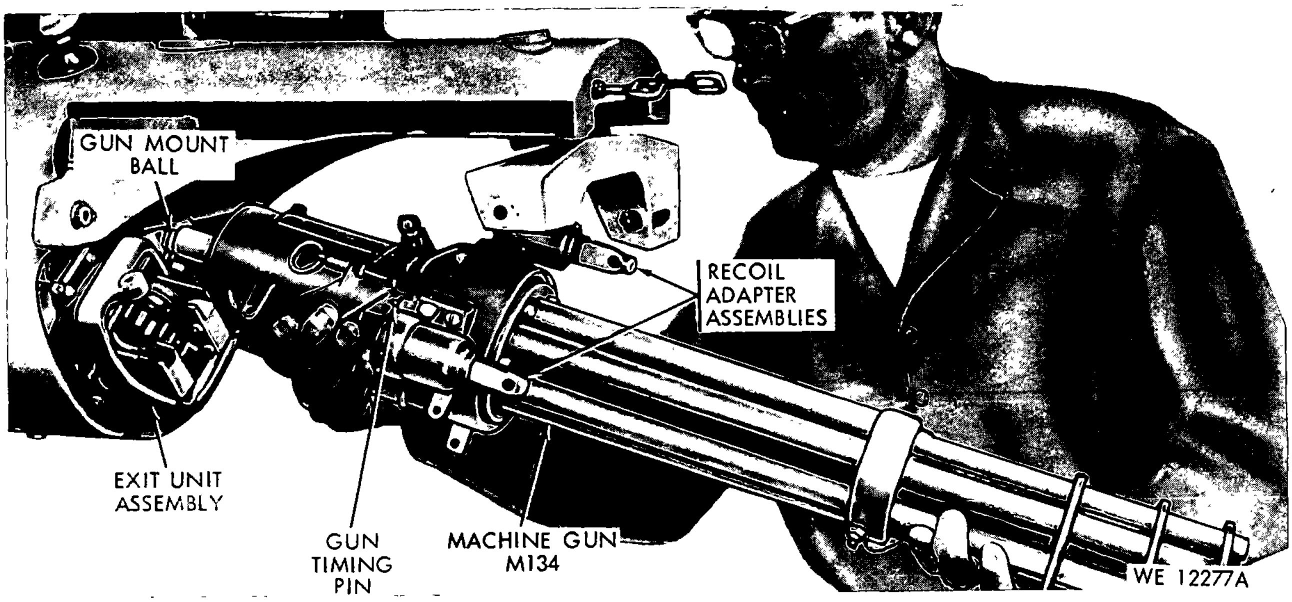


Figure G–6. Positioning rear gun support on gun mount ball.

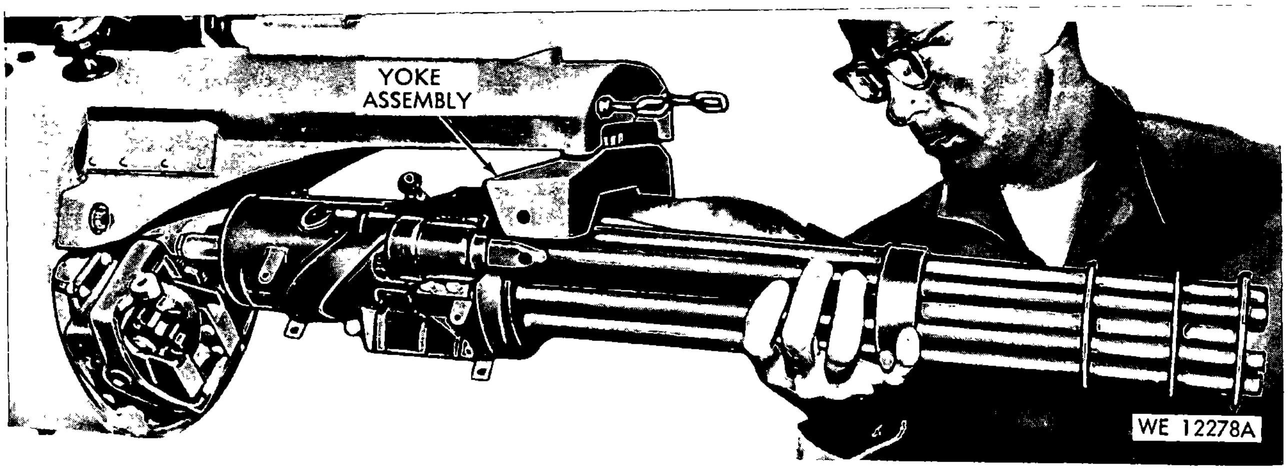


Figure G–7. Alining recoil adapter assemblies with mating holes in yoke assembly.

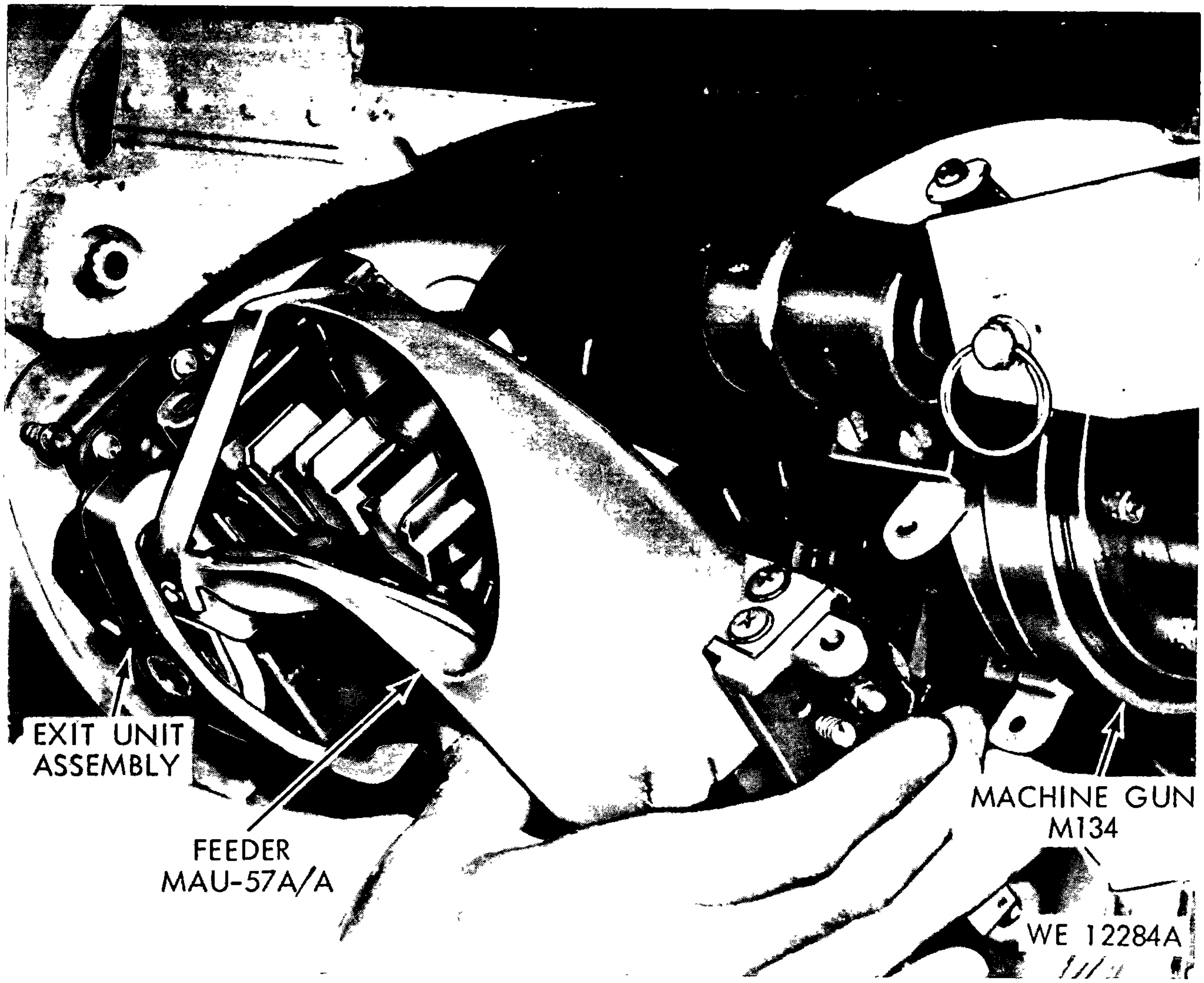


Figure G–8. Positioning feeder MAU–57A/A.

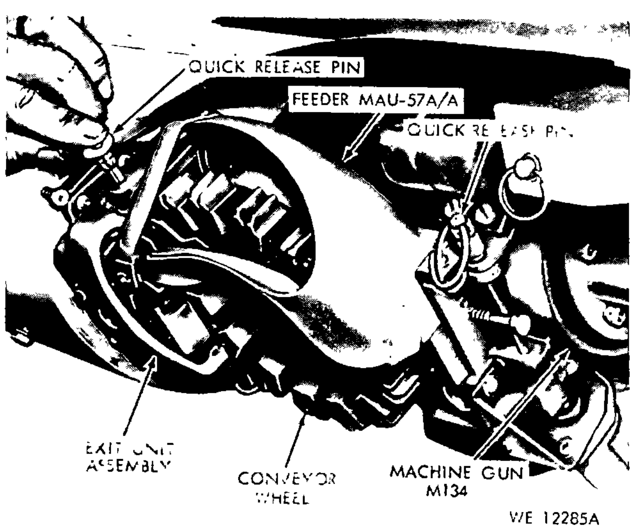


Figure G–9. Installing feeder MAU–57A/A.

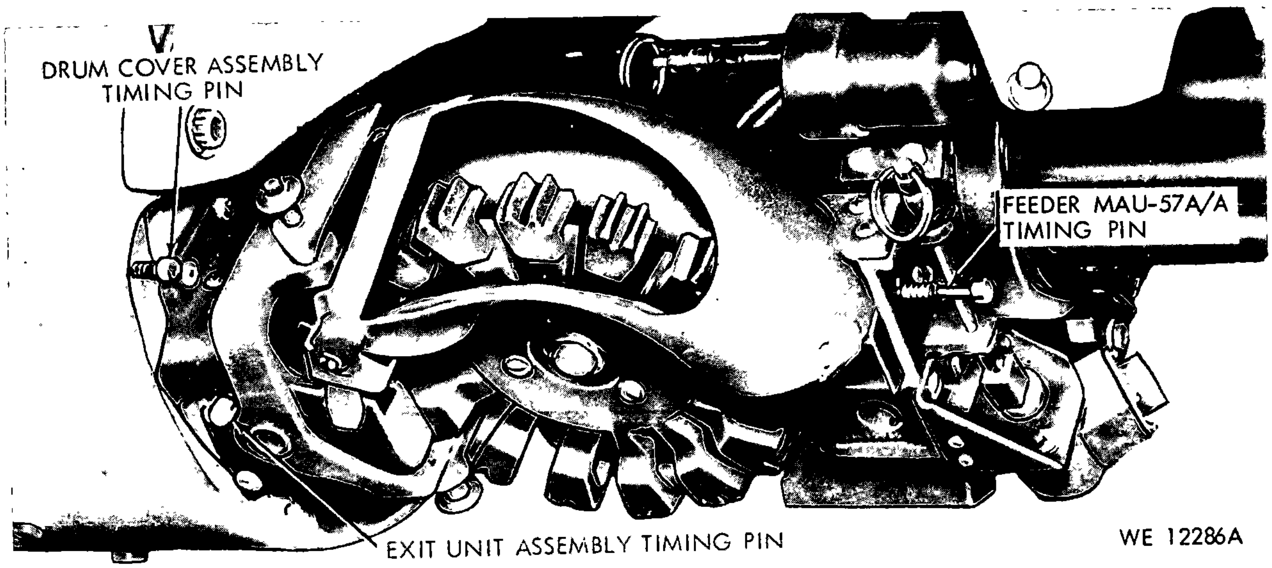


Figure G–10. Feeder MAU–57A/A, exit unit assembly, and drum cover assembly timing pins.

Section III. OPERATION

G–5. Controls and Instruments

a. Table G–2 describes the various controls and instruments and provides sufficient information to insure proper operation of the armament pod.

b. Controls for firing are located within the pilot's or gunner/copilot's compartment of the applicable aircraft. Refer to the operator's manual of the aircraft for description and operating instuctions of these controls.

Table G–1. Procedure for Timing M134 Machinegun and Armament Pod Assemblies

*Step	Timing procedure
1	Depress drum cover assembly timing pin and rotate ammunition drum assembly until timing pin can be fully depressed. With drum cover assembly pin fully depressed, determine that exit unit assembly timing pin can also be fully depressed. If exit unit assembly timing pin cannot be fully depressed within one complete rotation of the drum, rotate gears of exit unit assembly until its timing pin can be completely depressed.*
2	Depress gun timing pin and rotate gun barrels until gun timing pin can be fully depressed.*
3	Depress feeder timing pin and rotate feeder MAU–57A/A until timing pin can be fully depressed. Hold pin in fully depressed position and install feeder to exit unit and gun assemblies.
4	Check that all four timing pins—drum cover assembly, exit unit assembly, feeder MAU–57A/A, and M134 machinegun—can be fully depressed. Also make certain that all timing pins return to neutral (disengaged) position when released.

*After timing procedure is accomplished in each step, do not rotate items until after all four steps are completed.

Table G–2. Controls and Instructions

Control or instrument	Function	Reference
Timing pins	There are four timing pins used to establish the firing cycle of the M134 machinegun.	Table G–1; figs. G–6 and G–10
Safing sector	When safing sector is removed, bolt assemblies cannot be cammed into battery, or firing pins cocked and released by rotation of gun mechanism.	
Counter and drive assembly	The four-digit indicator (ROUNDS IN POD) shows the number of rounds in the armament pod. The six-digit indicator (TOTAL ROUNDS ON POD) shows the total rounds that have previously been fired from the armament pod. Reset knob is used to set the ROUNDS IN POD indicator to zero reading when loading armament pod.	Fig. G–11

Control or instrument	Function	Reference
Battery charger switch	A two-position (OFF-AUTO) toggle switch—located on lower portion of armament pod XM18 control panel and on upper portion of armament pod XM18E1 control panel—permits battery charging when placed in AUTO position.	
Battery heater switch	A two-position (OFF-AUTO) toggle switch—located on lower portion of armament pod XM18 control panel and on upper portion of armament pod XM18E1 control panel—permits heating the battery at zero degrees Fahrenheit when placed in AUTO position.	
Firing rate selector switch	A two-position (HIGH-LOW) toggle switch is located on the upper portion of the armament pod XM18E1 control panel assembly. Placed in LOW position, the gun fires at 2,000 shots per minute; in HIGH position, the gun fires at 4,000 shots per minute. If aircraft has high and low rate trigger switch capability, place firing rate selector switch of armament pod in the HIGH position; otherwise place switch in the desired rate position.	
Power start field switch	Two-position (ACFT-BAT) toggle switch on upper portion of armament pod XM18E1 control panel. When placed in BAT position, armament pod battery supplies the electric power for weapon operation. Placed in the ACFT position, the aircraft battery will supply a momentary surge of current to increase starting torque of weapon.	
Battery charged indicator light	Illuminates when battery charged switch is placed in AUTO position; at the time, battery becomes fully charged.	
Battery charging indicator light	Illuminates when battery charger switch is in AUTO position, indicating that battery is being charged.	
Azimuth adjusting knob (boresighting)	Permits firing barrel to be moved in azimuth 1.5° right and 1.5° left—total adjustment of 3°.	Fig. G-12
Elevation adjuster (boresighting)	Permits firing barrel to be elevated 1.5° and to be depressed 1.5°—total adjustment of 3°.	Fig. G-13

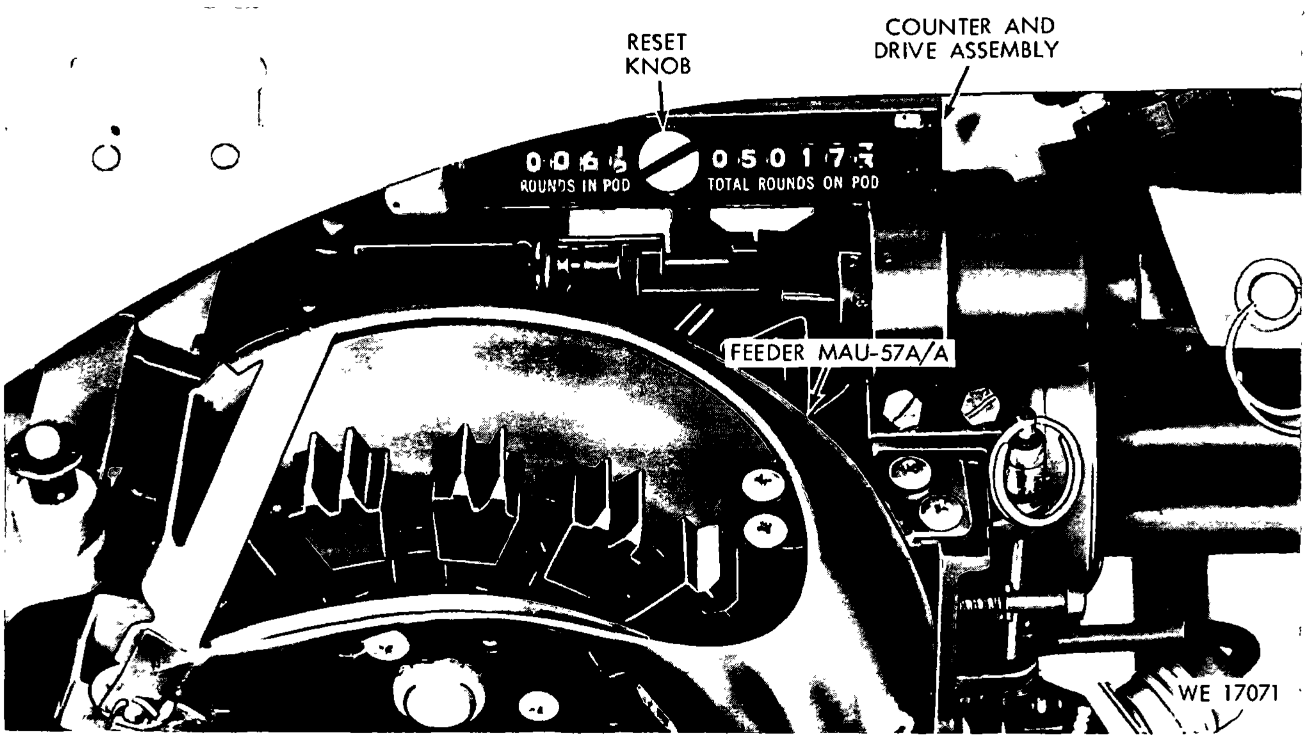


Figure G-11. Counter and drive assembly.

G–6. Operational Check

Warning: **Do not walk in front of the armament pod. Disconnect the aircraft-to-armament pod cable assembly at the receptacle of the armament pod.**

To determine if the armament pod is properly installed and serviceable—

a. Remove front fairing assembly from armament pod (fig. G–5).

Warning: **Do not perform operational check with live ammunition in any component of the armament pod. Refer to TM 9–1005–257–12 and unload any live ammunition.**

b. In accordance with loading instructions in TM 9–1005–257–12, load approximately 100 dummy rounds of ammunition into the drum assembly.

Caution: **Do not use corrugated case dummy cartridges. Make sure safing sector is installed.**

c. Manually rotate barrel cluster of M134 machinegun to feed dummy ammunition through exit unit assembly and into the feeder MAU–57A/A.

Note. Manually cycle a total of approximately 20 rounds through the components during the checks outlined in *d* through *e* below.

d. Manually hold down clearing solenoid of feeder MAU–57A/A and observe if the rounds enter the M134 machinegun smoothly.

e. Release feeder clearing solenoid and observe that rounds clear through the bottom of feeder MAU–57A/A.

f. Plug in aircraft-to-armament pod cable, activate electrical power circuits in aircraft, and depress trigger switch and release immediately. Gun barrels should rotate for approximately one-fourth second after trigger is released.

Caution: **Gun operation (dry firing) shall be held to a minimum to avoid damaging firing pins. Also the high speed obtained by an empty gun, when electrically driven, may damage moving parts.**

g. Deactivate electrical armament pod control in aircraft, disconnect aircraft-to-armament pod cable assembly from armament pod, and make sure all dummy ammunition has been removed from the armament pod.

Section IV. BORESIGHTING

G–7. General

This section contains the procedures required to obtain accuracy of fire by adjusting the axis of the bore of the weapons in relation to the aircraft sighting equipment.

G–8. Distant Aiming Point Method

Warning: **Clear the armament pod of all live ammunition.**

a. Select a well defined point target at least 1,000 meters distant and in line with centerline of helicopter.

b. Position helicopter and superimpose helicopter sighting equipment reticle on distant aiming point as instructed in pertinent aircraft or weapons system organizational maintenance manual.

c. Check that armament pod is properly secured in bomb rack and sway braces are properly adjusted and tightened.

d. Remove two quick release pins (fig. G–9) securing conveyor wheel support to exit unit assembly and move conveyor wheel to loading (forward) position.

e. Set elevation and azimuth boresight adjustments (figs. G–12 and G–13) to center point of adjustment limits.

f. Rotate barrel cluster until gun timing pin can be fully depressed.

g. Insert boresight adapter (fig. G–14) into muzzle of barrel which is in firing (12 o'clock) position and install boresight.

h. Adjust elevation and/or azimuth boresight adjustments until line of sight is on the point target.

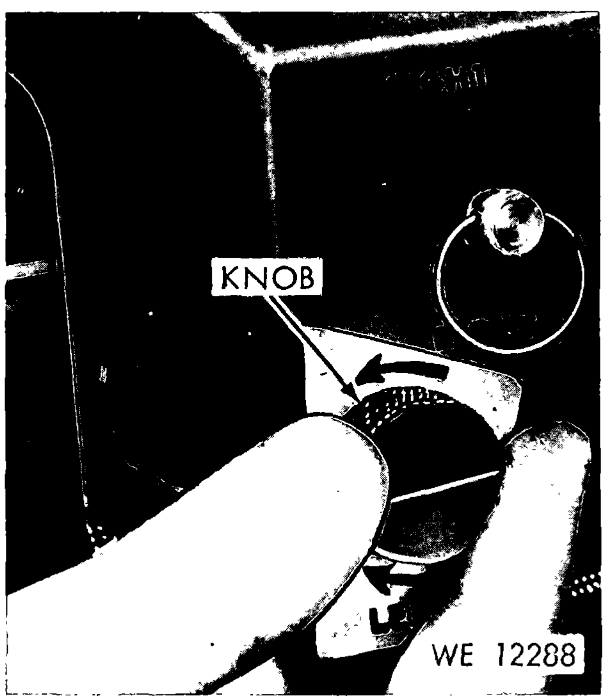


Figure G–12. Adjusting M134 machinegun in azimuth.

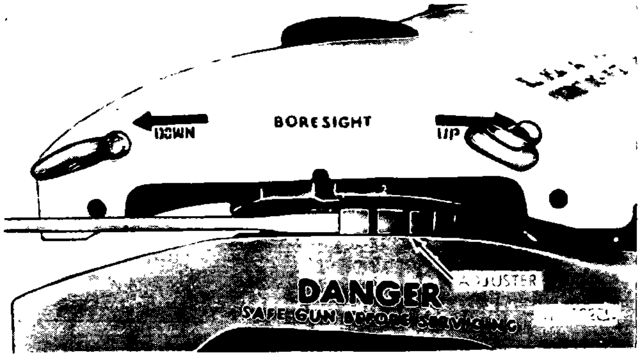


Figure G-13. Adjusting M134 machinegun in elevation.

i. Check that aircraft sighting equipment reticle is still superimposed on target.

j. Remove boresight and adapter from the gun barrel.

k. Time exit unit assembly and feeder MAU-57A/A (table G-1). Move conveyor wheel to firing (rearward) position and secure with two quick release pins.

G-9. Boresight Target Method

a. Place aircraft centerline mark of boresight target in line with centerline of aircraft and at distance recommended for applicable aircraft.

b. Repeat procedure in paragraphs G-8*c* through *g*.

c. Sight through boresight and adjust armament pod elevation and azimuth (figs. G-12 and G-13) until crosshairs of boresight coincide with gun mark on boresight target.

d. Repeat procedure in paragraphs G-8*i* through *k*.

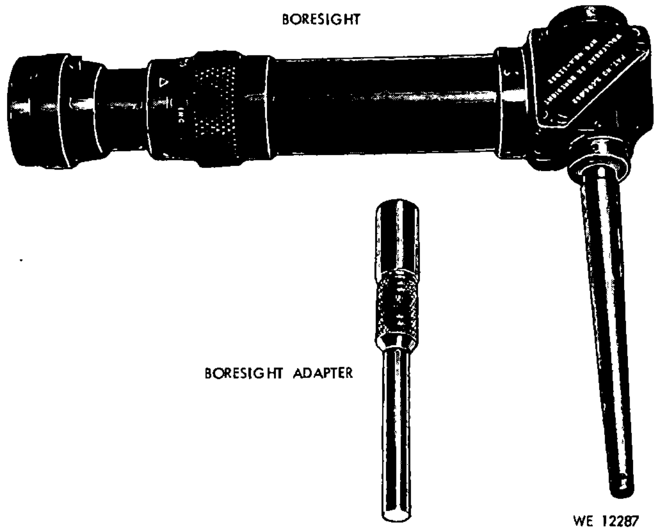


Figure G-14. Boresight and boresight adapter.

Section V. TROUBLESHOOTING

G-10. General

This section contains troubleshooting information for locating and correcting malfunctions which may develop in the armament pod.

G-11. Troubleshooting

Table G-3 is intended as a guide in troubleshooting. The table does not cover all possible malfunctions that may occur. Only the more common malfunctions are listed.

***Warning:* Do not attempt to troubleshoot an armament pod containing live ammunition. Clear gun and remove ammunition before proceeding.**

Table G-3. Troubleshooting

Malfunction	Probable cause	Corrective action
	GUN ASSEMBLY	
Fails to rotate or fire.	Loose or defective connection between electric cable assembly and electric drive assembly.	Check connection.
	Low or discharged battery.	Charge battery.
	Defective electric drive assembly.	Replace.
	Damaged cartridge in M134 machinegun.	Clear M134 machinegun and check ammunition for damaged cartridges.
	Foreign material in barrel chamber(s).	Remove material and clean barrel(s) and chamber(s).
	Damaged bolt assemblies.	Replace.
	Timing pin not released.	Check pin (also check those on drum assembly, exit unit assembly, and feeder).
	Improper timing between feeder MAU-57A/A, M134 machinegun, and exit unit assembly.	Check timing.

Malfunction	Probable cause	Corrective action
	Improperly adjusted or damaged counter and drive assembly.	Adjust. Notify direct support if repair is required.
Rotates but will not fire.	Damaged or unserviceable cartridges.	Clear M134 machinegun and check ammunition.
	Broken firing pin.	Replace.
	Broken firing pin spring.	Replace.
	Damaged bolt heads.	Replace.
	Burred firing pins or bolt heads.	Remove burs.
Fires but rate is low.	M134 machinegun dirty or not properly lubricated or both.	Clean and lubricate.
	Burred or damaged bolt assemblies.	Inspect and remove burs; repair or replace bolt assemblies.
	Burred or damaged camtracks in rotor assembly or housing.	Inspect and remove burs. Notify direct support, if damaged.
Stops firing.	Damaged cartridges.	Clear M134 machinegun.
	Bolt head separated from bolt assembly.	Remove bolt head and replace firing bolt head assembly.
	Damaged rotor assembly.	Replace M134 machinegun.
	Loose or defective connection between electric cable assembly and electric drive assembly.	Check connection.
Fails to feed.	Damaged or broken guide bar.	Replace.
	Bent or broken fingers on gun housing.	Notify direct support.
	Damaged or broken extractor on bolt head.	Replace firing bolt head assembly.
Fails to extract.	Damaged or broken extractor on bolt head.	Replace bolt head.
	Bent or broken guide bar allows round to feed ahead of bolt assembly.	Replace guide bar.
	Damaged rim on cartridge.	Clear M134 machinegun. Inspect for bent or damaged parts which would damage rim of cartridge.
Fails to eject.	Bent or broken guide bar.	Replace guide bar.
	Damaged gun housing assembly.	Notify direct support.
Excessive dispersion of bullets.	Barrels—heat warped or excessively worn rifling.	Replace.
	Loose barrel clamp assembly allows barrel movement.	Tighten barrel clamp.
	FEEDER	
Fails to rotate or feed.	Timing pin not released.	Check pin (also check those on drum assembly, exit unit assembly, and gun assembly).
	Improper timing between feeder MAU-57A/A, M134 machinegun, etc.	Check timing.
	Damaged cartridges.	Remove.
	Loose or defective connection in cable assembly of electrical (clearing solenoid.	Check connection.
	Defective clearing solenoid.	Replace.
Low firing rate.	Feeder MAU-57A/A not properly lubricated.	Clean and lubricate.
	Foreign matter in feeder MAU-57A/A.	Remove.
	Burred, bent, or damaged parts in feeder MAU-57A/A.	Repair or replace as required.
Firing stops.	Damaged parts in feeder MAU-57A/A.	Repair or replace.

Malfunction	Probable cause	Corrective action
	POD ASSEMBLY	
Firing stops.	Low or discharged battery.	Charge battery.
	Timing pins in exit unit assembly and drum assembly not released.	Check pin (also check feeder and gun timing pin).
	Damaged cartridges in drum assembly.	Remove.
	Defective timing, gun, or burst module assembly.	Replace.
	Damaged parts in exit unit assembly or drum assembly.	Repair.
Low rate of fire.	Low charge in battery.	Charge battery and/or replace cell(s) as required.
	Foreign matter in drum assembly.	Remove.
Excessive dispersion of bullets.	Timer module assembly defective.	Replace.
Fails to operate.	Defective power module.	Replace.

APPENDIX H

ATTACK HELICOPTER ARMAMENT SYSTEMS

Section I. XM28 ARMAMENT SUBSYSTEM ON THE AH-1G COBRA ATTACK HELICOPTER

H-1. Description and Operation

The XM28 armament subsystem (figs. H-1 through H-4) is an electrically controlled, hydraulically operated, dual weapon, that provides wide-angle coverage and rapid fire for the Cobra attack helicopter (AH-1G). It is gunner controlled as a fully flexible system and pilot controlled as a forward firing system with weapons stowed. The weapons may be installed in the XM28 armament subsystem using any one of the following combination of weapons: left—7.62mm M134 machinegun, right—40mm XM129 grenade launcher (fig. H-1); left—40mm XM129 grenade launcher, right—7.6mm M134 machinegun (fig. H-2); two 7.62mm M134 machineguns (fig. H-3); or two 40mm XM129 grenade launchers (fig. H-4). The XM28 armament subsystem consists essentially of the following major components: 7.62mm machinegun and accessory assemblies, and/or 40mm grenade launcher and accessory assemblies; turret assembly; chute separator assembly; weapons gun speed and launcher brake controller (left-hand and right-hand); intervalometer; electronic components assembly; differential pressure transducer; turret sighting station; stow bracket assembly; gunner's control panel; pilot's wing stores control panel; pilot's control panel; and reflex sight XM73. For subsys-

Table H-1. XM28 Subsystem Weight Data

Item	Weight (lb.)	
Turret assembly	116.80	
Chute separator assembly	0.80	
Weapons gun speed and launcher brake controller	20.00	
Intervalometer	2.50	
Electric components assembly	12.70	
Differential pressure transducer	0.88	
Turret sighting station	19.50	
Stow bracket assembly	0.50	
Gunner's control panel	3.10	
Pilot's wing stores control panel	1.50	(estimated)
Pilot's control panel	1.10	
Reflex sight XM73	6.50	
Subtotal	185.88	
One 7.62mm M134 machinegun, one 40mm grenade launcher XM129, and accessory assemblies—figs. H-1 and H-2	261.30	
Total weight empty	447.18	
Ammunition	450.00	
Gross weight	897.18	(estimated)
Two M134 7.62mm machineguns and accessory assemblies—fig. H-3	205.80	
Total weight empty	391.48	
Ammunition*	510.00	
Gross weight	901.48	(estimated)
Two 40mm grenade launchers XM129 and accessory assemblies—fig. H-4	304.60	
Total weight empty	490.48	
Ammunition*	390.00	
Gross weight	880.48	(estimated)

*Ammunition capacity per system is two boxes of 2,000 rounds of 7.62mm for each M134 machinegun and one magazine of 300 rounds of 40mm for each XM129 grenade launcher.

tem weight data, see table H–1. When using left and right 7.62mm machineguns, the guns are basically the same except for the use of different link ejection chute and cartridge case ejection chute assemblies mounted on the guns. When using left and right 40mm grenade launchers, the launchers are basically the same except for the use of different feed tray assemblies mounted on the launchers.

a. 7.62mm Machinegun and Accessory Assemblies. The 7.62mm machinegun and accessory assemblies (fig. H–5) consist primarily of the M134 machinegun, delinking feeder MAU–56/A drive assembly, two ammunition box assemblies, crossover assembly, ammunition drive shaft assembly, and the ammunition chute assembly.

(1) *7.62mm M134 machinegun.* The M134 machinegun is an electrically-driven, automatic,

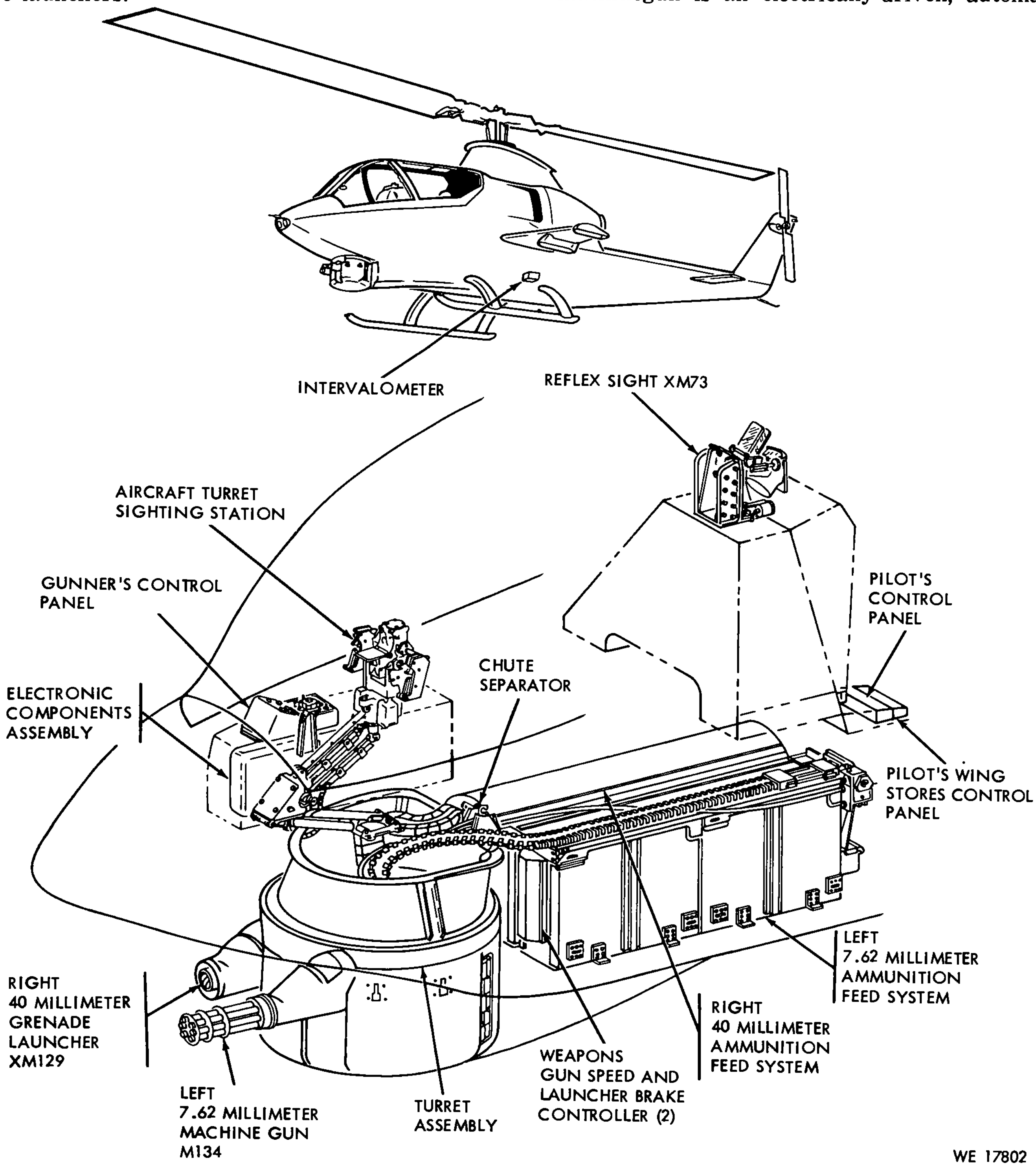
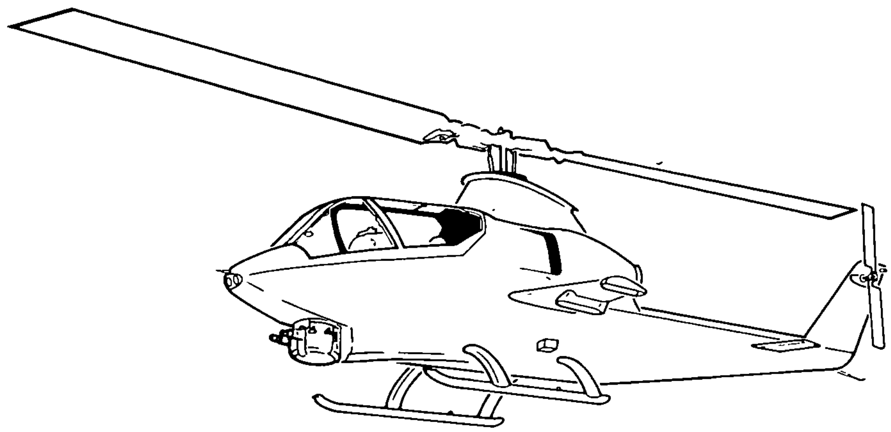


Figure H–1. XM28—left 7.62mm machinegun and right 40mm grenade launcher.



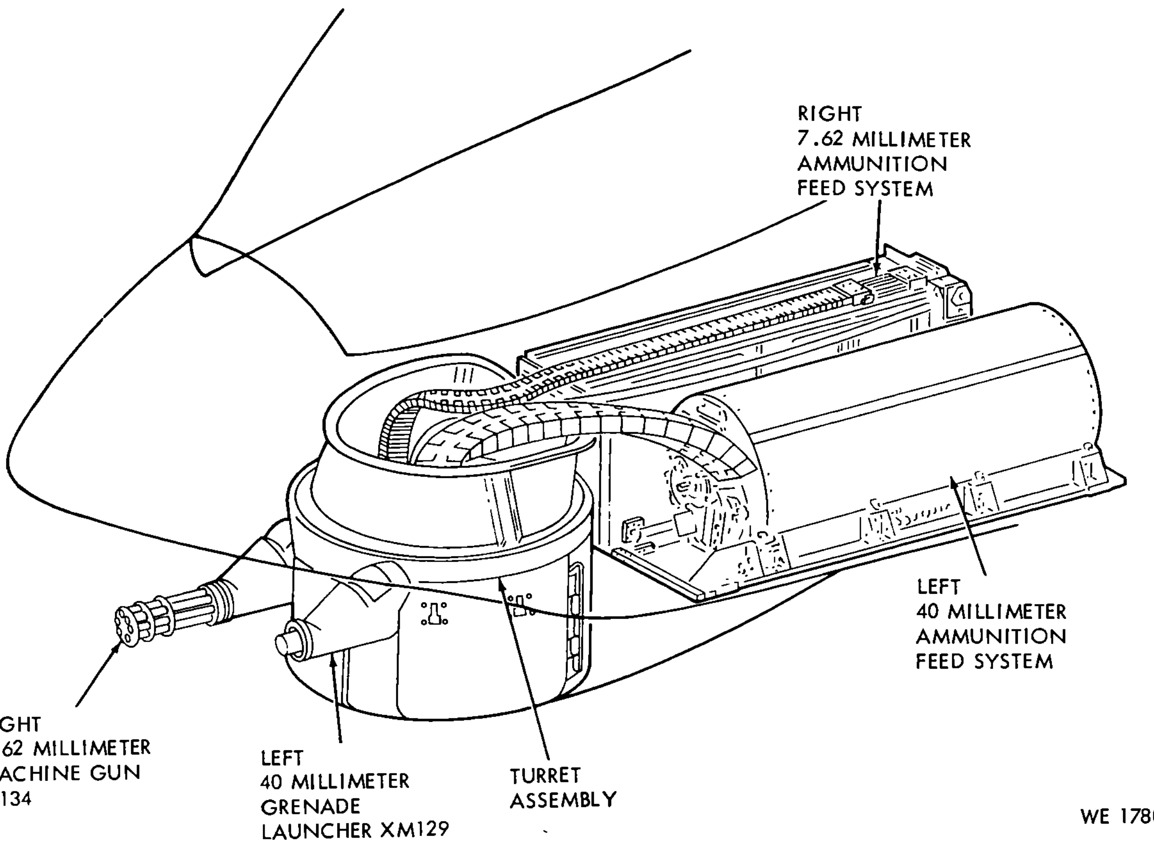


Figure H–2. XM28—left 40mm grenade launcher and right 7.62mm machinegun.

★air-cooled gun, incorporating six barrels and six bolt assemblies which revolve around the longitudinal axis of the weapon. The M134 machinegun weighs 35.1 pounds and is capable of firing 6-second burst at rates of 2,000 or 4,000 shots per minute.

(2) *Delinking feeder MAU–56/A.* The feeder MAU–56/A is gear driven through the M134 machinegun. The feeder removes the cartridges from the links and feeds them to the bolt and track assemblies in the machinegun rotor. The

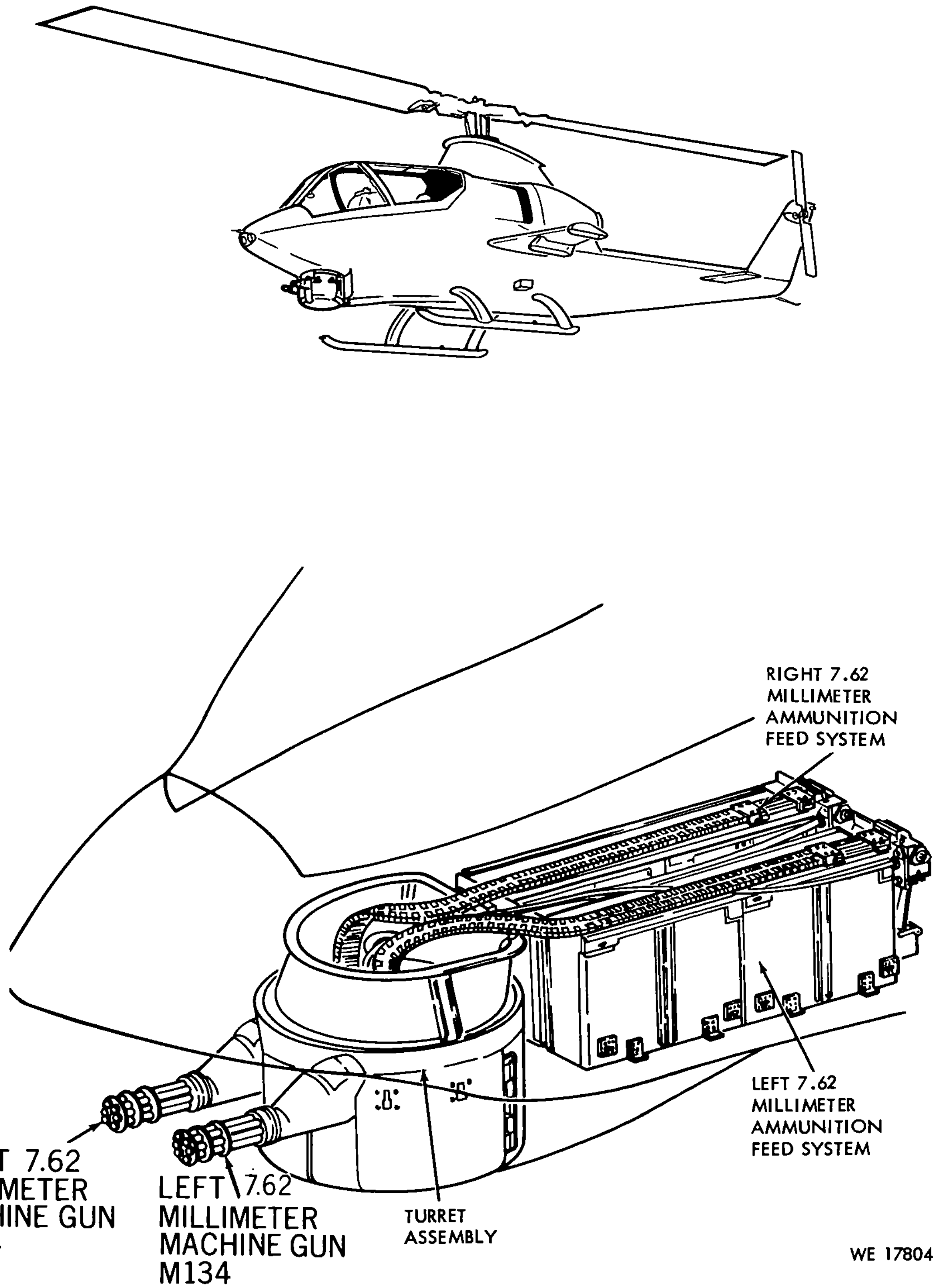
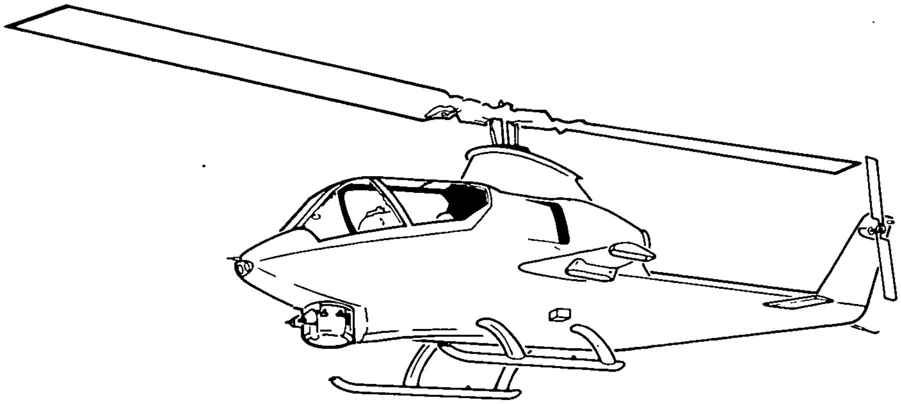


Figure H-3. XM28—two 7.62mm machineguns.

links are discarded through the link ejector chute attached to the feeder MAU-56/A.

(3) *Ammunition box assemblies.* The two ammunition box assemblies are located in the ammunition compartment aft of the turret. The ammunition box assemblies are locked together and have a capacity of 4,000 rounds of linked 7.62mm ammunition.

(4) *Crossover assembly.* The crossover assembly, mounted at the rear of the ammunition box assemblies, extracts the linked ammunition from each bay of the ammunition box assemblies in sequence and feeds the ammunition into the



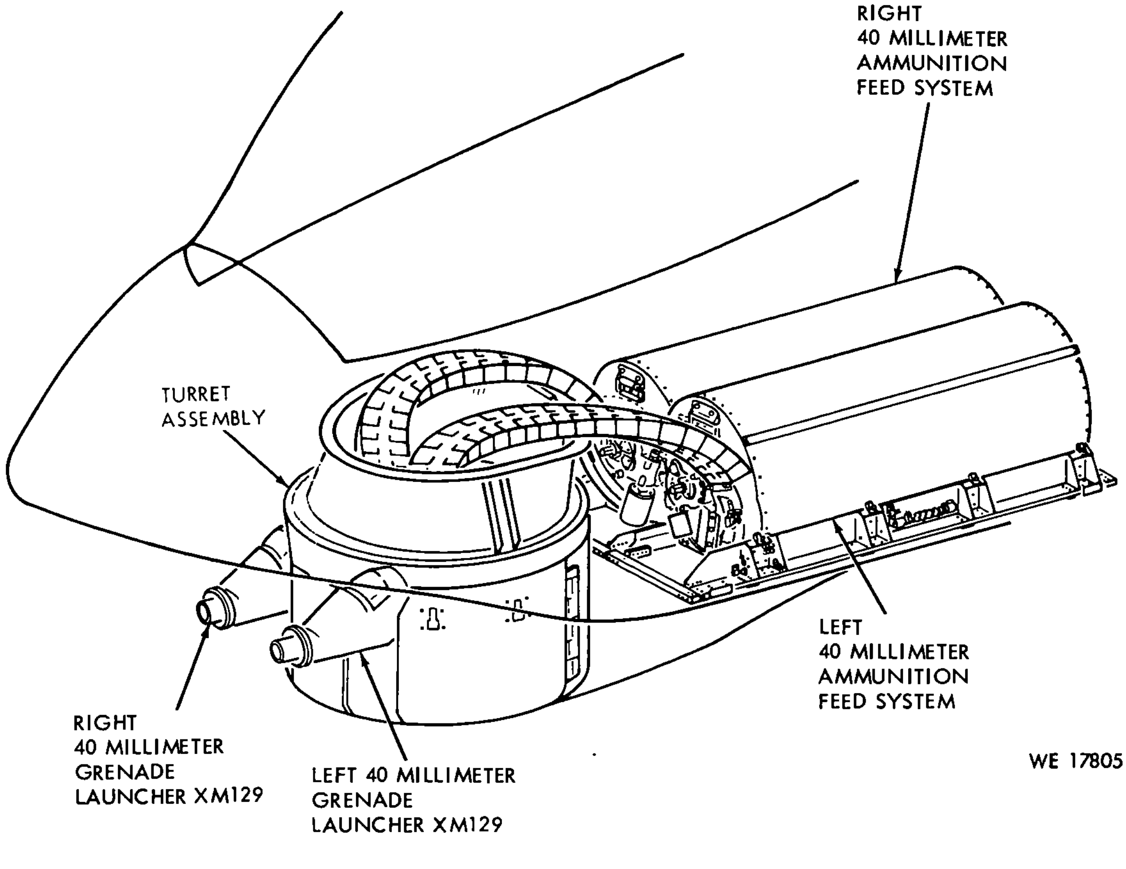


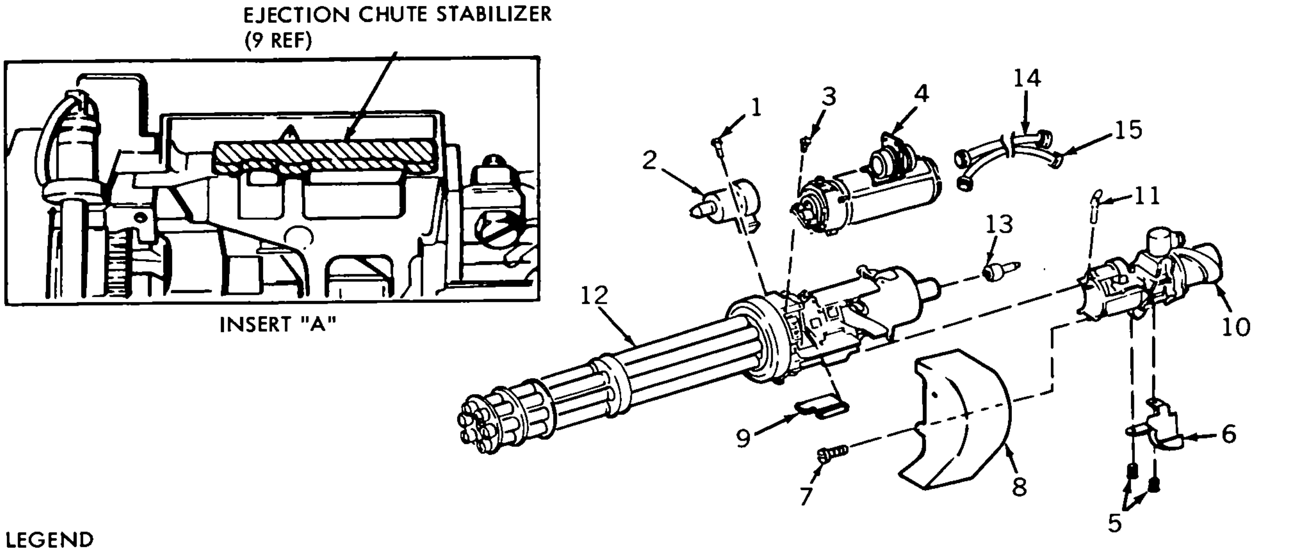
Figure H–4. XM28—two 40mm grenade launchers.

ammunition chute assembly.

(5) *Ammunition drive shaft assembly.* The ammunition drive shaft assembly is a flexible shaft, mechanically connecting the machinegun drive assembly to the crossover assembly.

(6) *Ammunition chute assembly.* The ammunition chute assembly is a flexible link channel which guides the 7.62mm ammunition from the crossover assembly to the feeder MAU–56/A, mounted on the M134 machinegun. Although the left and right ammunition chute assemblies are functionally the same, they are not physically interchangeable.

b. 40mm Grenade Launcher and Accessory Assemblies. The 40mm grenade launcher and accessory assemblies consist primarily of the launcher



LEGEND

1 - SCREW
2 - RECOIL ADAPTER
3 - SCREW
4 - MACHINE GUN DRIVE ASSEMBLY
5 - SCREW (PART OF DELINKING FEEDER)
6 - LINK EJECTOR CHUTE
7 - SCREW (PART OF DELINKING FEEDER)
8 - CARTRIDGE EJECTOR CHUTE
9 - EJECTION CHUTE STABILIZER ASSEMBLY
10 - DELINKING FEEDER
11 - QUICK RELEASE PIN
12 - MACHINE GUN M134
13 - SUPPORT EXTENSION
14 - ELECTRICAL CABLE ASSEMBLY
15 - ELECTRICAL CABLE ASSEMBLY

INSTALLATION

INSTALL FOUR SCREWS (1) SECURING EACH RECOIL ADAPTER (2) TO MACHINE GUN (12).

INSTALL THREE SCREWS (3) SECURING MACHINE GUN DRIVE ASSEMBLY (4) TO MACHINE GUN.

REMOVE TWO SCREWS (5) FROM DELINKING FEEDER (10). POSITION LINK EJECTOR CHUTE (6) ON DELINKING FEEDER AND SECURE WITH TWO SCREWS (5).

REMOVE THREE SCREWS (7) FROM DELINKING FEEDER. POSITION CARTRIDGE EJECTOR CHUTE (8) ON DELINKING FEEDER AND SECURE WITH THREE SCREWS (7).

INSTALL EJECTION CHUTE STABILIZER ASSEMBLY (9) IN MACHINE GUN CARTRIDGE EJECTION SLOT (SEE INSERT "A").

NOTE. PRIOR TO INSTALLATION, THE MACHINE GUN M134 AND THE DELINKING FEEDER MAU-56/A MUST BE TIMED TO INSURE PROPER OPERATION.

TIME THE MACHINE GUN M134 BY ROTATING THE BARRELS UNTIL THE TIMING PIN CAN BE DEPRESSED.
TIME THE DELINKING FEEDER MAU-56/A BY ROTATING THE DRIVE GEAR UNTIL THE TIMING PIN CAN BE DEPRESSED.

POSITION DELINKING FEEDER (10) (TIMING PINS DEPRESSED) ON MACHINE GUN AND SECURE WITH TWO QUICK RELEASE PINS (11).

REMOVAL

REMOVE TWO QUICK RELEASE PINS (11) SECURING DELINKING FEEDER (10) TO MACHINE GUN (12).

REMOVE EJECTION CHUTE STABILIZER ASSEMBLY (9) FROM MACHINE GUN CARTRIDGE EJECTION SLOT (SEE INSERT "A").

REMOVE THREE SCREWS (7) SECURING CARTRIDGE EJECTOR CHUTE (8) TO DELINKING FEEDER. REINSTALL SCREWS (7) IN DELINKING FEEDER.

REMOVE TWO SCREWS (5) SECURING LINK EJECTOR CHUTE (6) TO DELINKING FEEDER. REINSTALL SCREWS (5) IN DELINKING FEEDER.

REMOVE THREE SCREWS (3) SECURING MACHINE GUN DRIVE ASSEMBLY (4) TO MACHINE GUN.

REMOVE FOUR SCREWS (1) SECURING EACH RECOIL ADAPTER (2) TO MACHINE GUN.

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Figure H-5. Installation/removal of accessory assemblies on left—machinegun M134.

XM129, gun cradle assembly, turret assembly gun drive, gun drive shaft assembly, ammunition chute assembly, and magazine assembly.

(1) *40mm grenade launcher XM129.* The launcher XM129 is an electrically driven, rapid firing, air-cooled weapon. It is used to launch 40mm antipersonnel fragmentation-type projectiles. The single barrel launcher XM129 is cam operated, metallic link belt fed, and percussion fired. It weighs 43 pounds and is capable of firing

10-second bursts at 400 shots per minute. The grenade launcher is composed of a receiver assembly; lock and feed cam assembly; drum and cup assembly; barrel assembly; front plate and cup assembly; front support and block assembly; drive assembly; feed slide assembly; feed actuator assembly; feed tray assembly; and carrier, sear, and striker group. The grenade launcher can be assembled for left-hand (fig. H–6) or right-hand (fig. H–7) feed.

(*a*) When the proper clockwise torque is applied to the drive assembly, the lock and feed cam assembly and drum and cup assembly rotate together in a clockwise direction. During this rotation, the roller of the feed actuator assembly follows a track in the feed cam portion of the lock and feed cam assembly. The feed actuator assembly transmits driving motion to the feed slide assembly which moves out to the left to secure a 40mm cartridge. The feed slide assembly pushes the cartridge into the receiver where the cartridge stop and cartridge positioner locate the cartridge properly.

(*b*) The barrel assembly roller fits in the

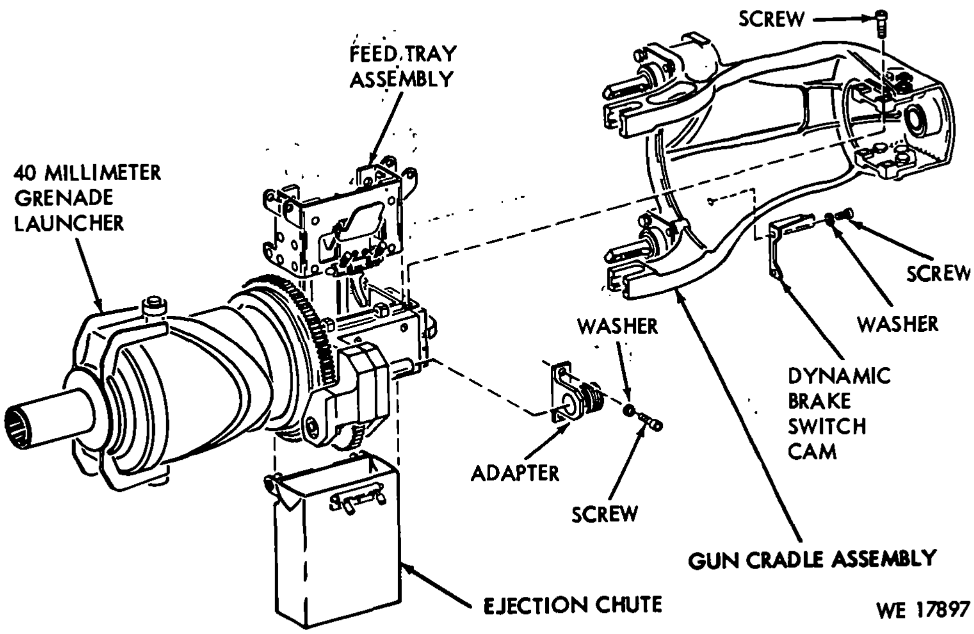


Figure H–6. Installation/removal of accessory assemblies on left—40mm grenade launcher XM129.

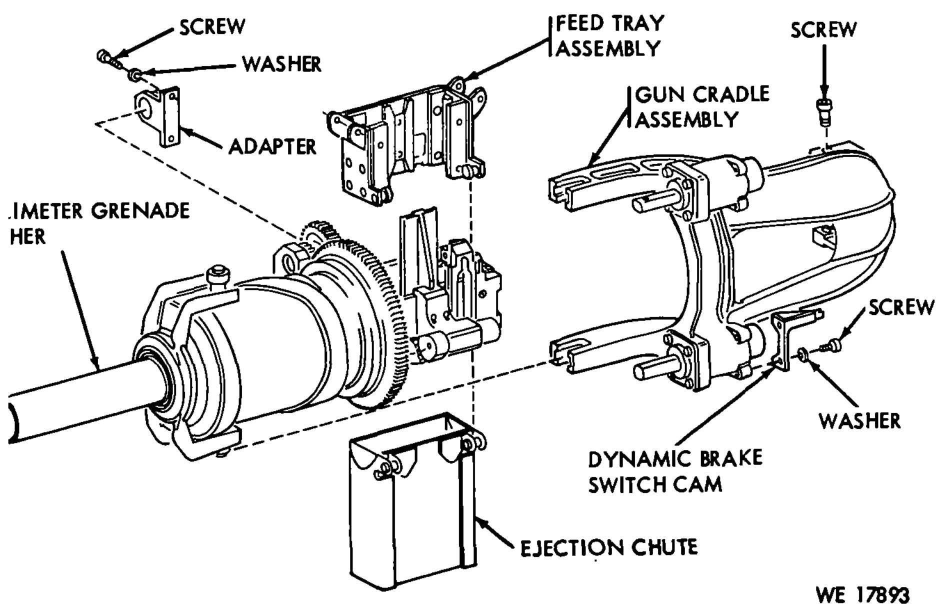


Figure H–7. Installation/removal of accessory assemblies on right—40mm grenade launcher XM129.

cam track on the inner surface of the drum and cup assembly. As the drum and cup assembly rotates, the barrel assembly is moved back over the positioned cartridge and the cartridge link is separated from the link of the next cartridge. When the barrel assembly is at the rearmost part of travel, the barrel lock assembly is cammed down to secure the barrel assembly during cartridge firing.

(*c*) Rearward movement of the barrel assembly also cocks the grenade launcher for firing. A segment of the lock cam groove presses down on one end of the sear release, allowing the sear to move forward and free the hammer block, which hits the striker. The striker in turn hits the firing pin assembly, driving it into the cartridge primer.

(*d*) After the projectile has left the barrel assembly, the barrel lock assembly is retracted and the barrel assembly is cammed forward. A new cartridge is fed into the receiver assembly and pushes out the spent cartridge case.

(2) *Gun cradle assembly.* The gun cradle assembly supports the launcher XM129 in the turret. Mounted on the launcher before installation, the cradle assembly is equipped with two recoil adapter assemblies which compensate for recoil of the launcher. Left and right gun cradles function in the same manner but cannot be interchanged.

(3) *Turret assembly gun drive.* The turret assembly gun drive is mounted on the left or right saddle (turret) when the launcher XM129 is installed. It consists of a direct current motor and gun drive adapter which operates the launcher XM129 by means of a flexible drive shaft.

(4) *Gun drive shaft assembly.* The shaft assembly is a flexible drive shaft connecting the turret assembly gun drive to the launcher drive assembly.

(5) *Ammunition chute assembly.* The ammunition chute assembly is a flexible link channel which guides the 40mm ammunition from the magazine assembly to the feed tray on the launcher XM129. Although the left and right ammunition chute assemblies function the same, they are not physically interchangable.

(6) *Magazine assembly.* The magazine assembly, located aft of the turret in the ammunition compartment, has a capacity of 300 rounds of linked 40mm ammunition. The magazine drum assembly is electrically driven by a motor mounted on the front of the magazine drum.

c. Turret Assembly. The hydraulically-driven turret assembly is mounted forward and below the gunner's station inside an aerodynamically designed fairing. The azimuth and elevation travel has electrical stop limitations. Weapon depression is 50° in all azimuth positions. Angular velocity of the turret is 80° per second for azimuth and 60° per second for elevation or depression. The turret can position the weapons 107.5° left or right of the forward position. Weapon elevation is variable from 12° to 17.5°, depending on the azimuth position of the turret.

Azimuth position (degrees)	*Elevation (degrees)*
0	17.5
71.5	17.5
80	16
90	14.5
100	13
107.5	12

d. Weapon Gun Speed and Launcher Brake Controller. The two controllers (fig. H-8) are mounted on the helicopter bulkhead aft of the turret assembly. The controllers are used to control the firing speed (high or low rate) of the M134 machinegun and control the drive and brake on the launcher XM129. One controller is required for each system, left and right. Each

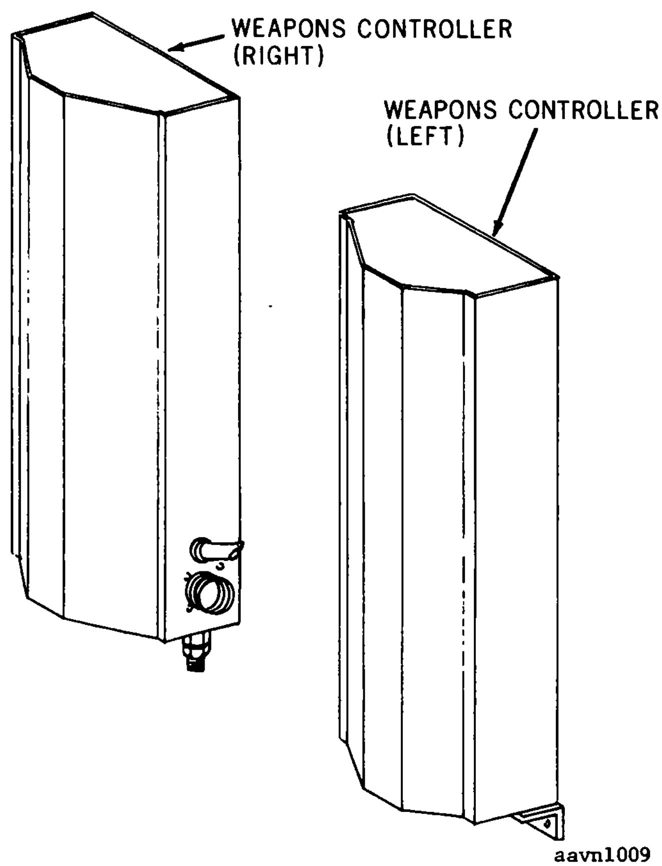


Figure H-8. Weapons controllers.

controller contains the required circuitry to control either a machinegun installation or a launcher installation, without change. The controllers function the same but cannot be interchanged between left and right sides.

e. *Intervalometer.* The intervalometers are located beneath the helicopter's rotor transmission and are accessible through apertures under the right and left wings. The right intervalometer controls the inboard and the left controls the outboard wing stores rocket pod installations. The intervalometer is designed to control group or ripple firing of a preselected number of pairs of rockets and to interrupt firing of turret armament when wing stores armament is fired.

f. *Electronic Components Assembly.* The electronic components assembly (fig. H–9) is located below the gunner's control panel and is accessible from the outside of the helicopter. It contains the azimuth and elevation amplifiers, power supplies, dither and coincidence circuits, and control circuits required to operate the armament subsystem XM28.

g. *Differential Pressure Transducer.* The differential pressure transducer is located forward of the gunner's left console and is connected to the helicopter's pitot-static system. Using the pitot-static pressure differential, the transducer feeds air speed data to the electronic components assembly

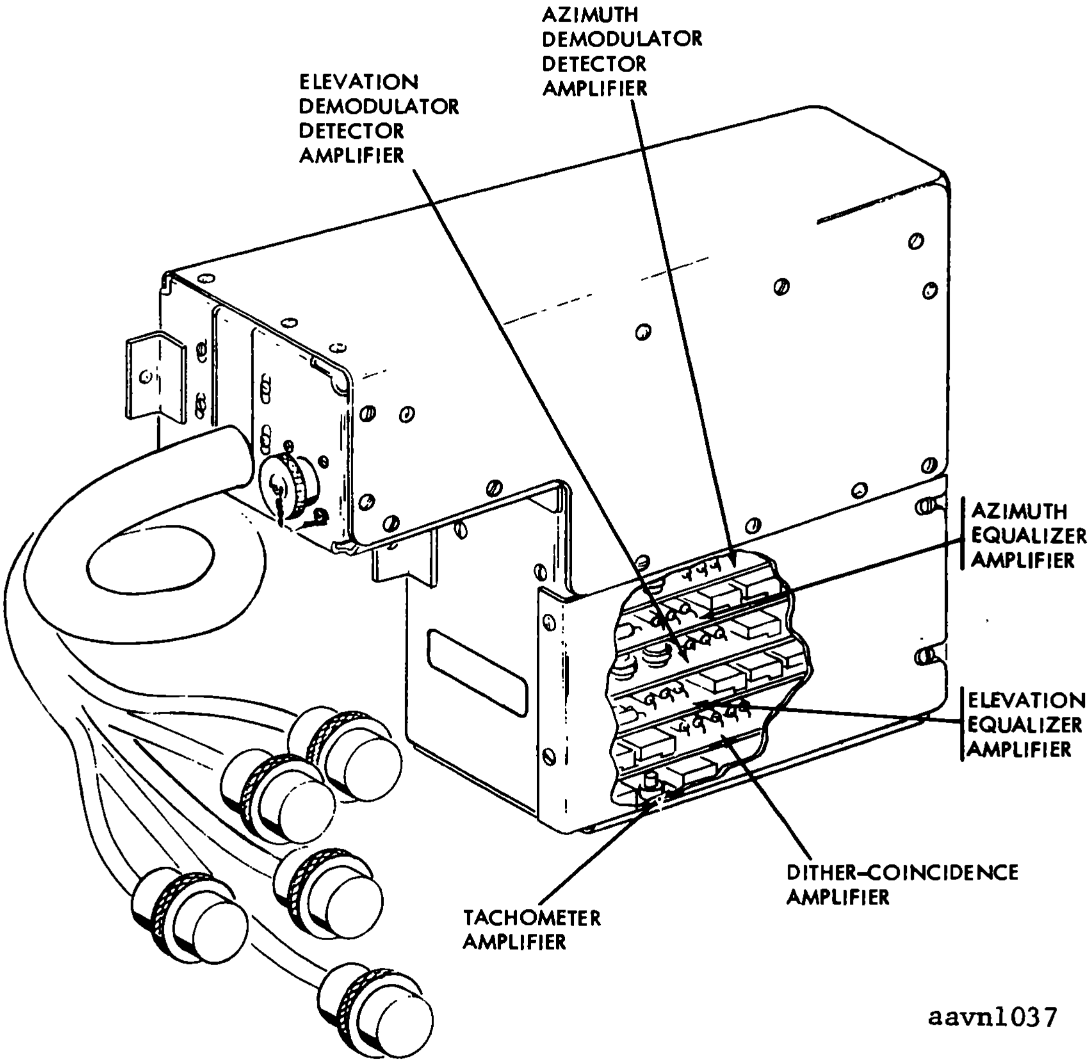


Figure H–9. Electronic components assembly.

h. *Turret Sighting Station.* The turret sighting station (fig. H–10) provides a line of sight for the gunner to aim and fire the weapons. Aiming is accomplished by superimposing a reticle image on the target. Airspeed and range data may be fed to the resolver and amplifier circuits to provide gun line correction.

(1) *Action switches.* The action switches are located on the lower forward side of the hand grips. Depressing either or both action switches

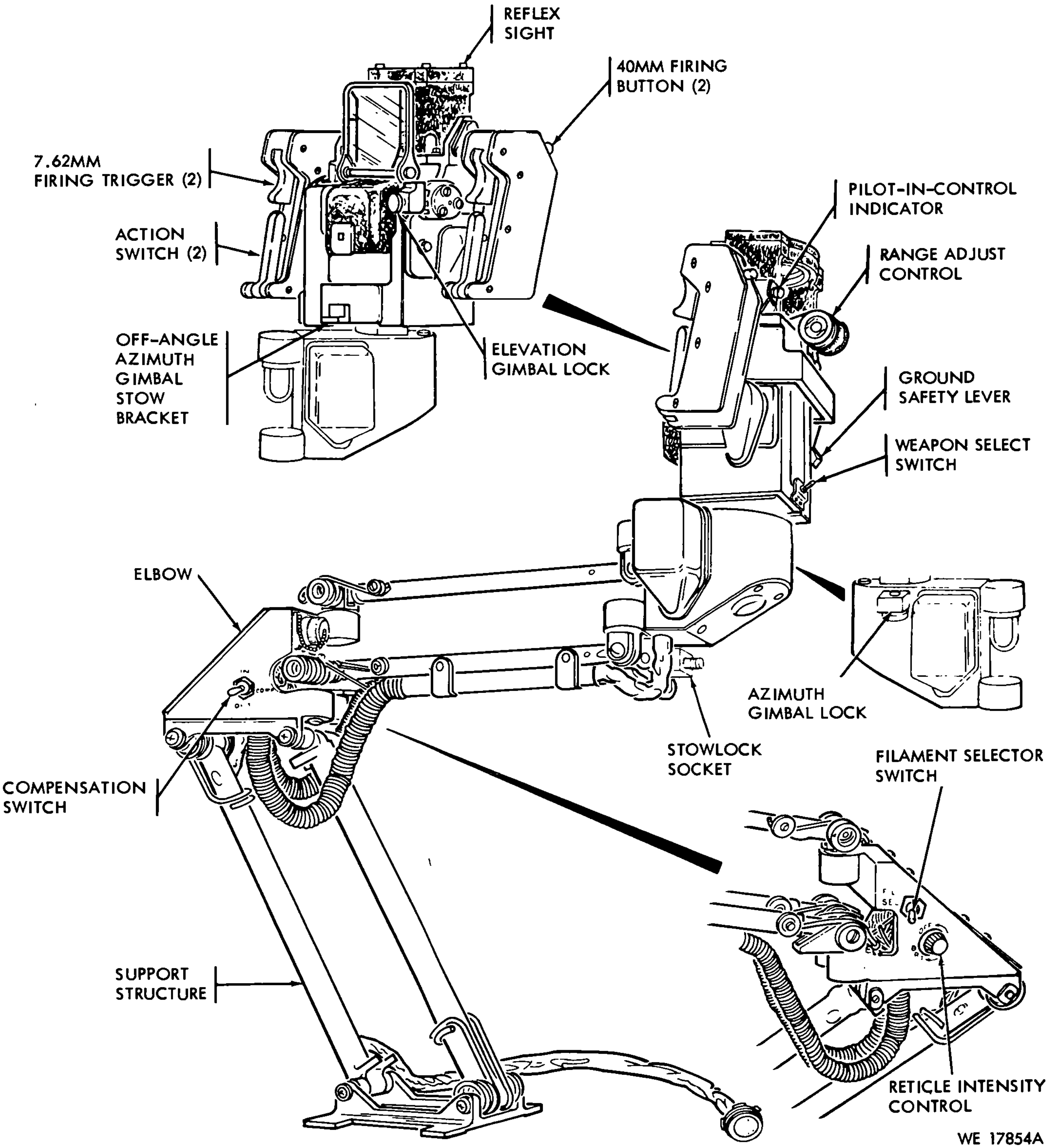


Figure H-10. Turret sighting station.

allows the gunner to position the turret. If the action switch is depressed and the infinity sight rotated at a speed greater than the turret assembly maximum angular velocity, the firing circuit is interrupted and the sight reticle blinks until the gun is coincident within 5° to the line of sight. Releasing the action switch(es) removes the signal applied to the gunner action relay and the turret returns to the stowed position.

(2) *Firing the M134 machinegun.* Firing the M134 machinegun is accomplished by placing the weapon select switch to the LEFT GUN,

RIGHT GUN, or BOTH position (depending upon which positions the M134 machinegun is mounted) and using either or both of the hand grips. Depressing the action switch and partially depressing the machinegun trigger switch on top of the grips will fire the gun at the low rate of approximately 2,000 shots per minute; then fully depressing the machinegun trigger switch will fire the gun at the high rate of approximately 4,000 shots per minute.

***Caution:* If a gun firing stoppage occurs, immediately release the trigger switches or extensive damage to the materiel may occur. Do not initiate further attempts to fire the machinegun until stoppage corrective action has been taken.**

(3) *Firing the XM129 grenade launcher.* Firing the XM129 grenade launcher is accomplished by placing the weapon select switch to the LEFT GUN, RIGHT GUN, or BOTH position (depending upon which positions the grenade launcher is mounted) and using either or both of the hand grips. Depressing the action switch and the grenade launcher firing button on the hand grips will fire the grenade launcher at a rate of approximately 400 shots per minute. When the firing button is released, the launcher stops firing.

***Warning:* At hover below 125 feet, do not fire the XM129 grenade launcher when the weapon is in the fully depressed position.**

***Caution:* If a launcher firing stoppage occurs, immediately release the trigger switches or extensive damage to the materiel may occur. Do not initiate further attempts to fire the launcher until stoppage corrective action has been taken.**

(4) *Compensation (COMP) switch.* When the conpensation switch is placed in the IN position, the compensation relay is energized and airspeed and range data are fed to the turret positioning circuits to provide gun line correction. When the compensation switch is in the OUT position, gun line correction is achieved manually by observing and adjusting the impact area.

(5) *Filament selector (FIL SEL) switch.* In the event one filament burns out, the filament selector switch is used to select an additional filament of the reticle incandescent lamp.

(6) *Reticle intensity control.* The reticle intensity control is a variable resistor mounted on the right side of the support structure elbow. This control adjusts the intensity of the sight reticle image.

(7) *Range adjust control.* The range adjust control is a variable resistor mounted above the right hand grip. The range adjust control knob is calibrated in meters. When the compensation (COMP) switch is in the IN position, the gunner can supply a range correction input to the turret positioning circuits. If the range adjust control is to be used for ranges, the gunner sets it to the estimated range and aims the weapons using the reticle center dot.

Note. The sighting station is provided with a graduated reticle which may be used for ranging in place of the range adjust control. To range using the graduated reticle, first position the range adjust control to 1,200 meters, then use the reticle graduations to aim the weapons.

(8) *Ground safety lever.* When placed in the up position, the ground safety lever prevents the sight head from being depressed more than 20° below horizontal. During ground firing, this lever prevents the sight head from being accidentally fully depressed, thereby preventing rounds from ricocheting into the helicopter.

(9) *Azimuth and elevation gimbal locks.* These locks provide mechanical locking of the sight gimbals at zero degree azimuth and elevation for boresighting and harmonization, and for stowing the sight when not in use.

(10) *Stowlock socket.* The stowlock socket allows the gunner to mechanically lock the sighting station to the stow bracket.

(11) *Off-angle stow bracket.* When the sighting station is stowed, the off-angle stow bracket engages with the azimuth gimbal lock to prevent sight head interference with the canopy.

(12) *Pilot-in-control indicator.* The pilot-in-control indicator is located adjacent to the left grip. The indicator illuminates (amber) when the GUNNER/PILOT CONTROL switch on the pilot's control panel is in the PILOT position, indicating that pilot has control of the system.

i. Gunner's Control Panel. The gunner's control panel (fig. H–11) contains the controls and indicators required by the gunner to operate and monitor the XM28 armament subsystem. Emergency provisions on control panel are available for the gunner to take command and fire the system in case the pilot is disabled.

(1) *Controls.*

(*a*) *PILOT OVERRIDE switch.* This (leverlock) switch is for emergency use by the gunner to take over command of the XM28 armament subsystem from the pilot. The ON position transfers control of the subsystem (stowed position) and the wing stores. Subsystem firing is by means of the trigger on the gunner's cyclic stick.

***Warning:* With PILOT OVERRIDE switch ON, the system is armed and may be fired. Before landing, place PILOT OVERRIDE switch in OFF position.**

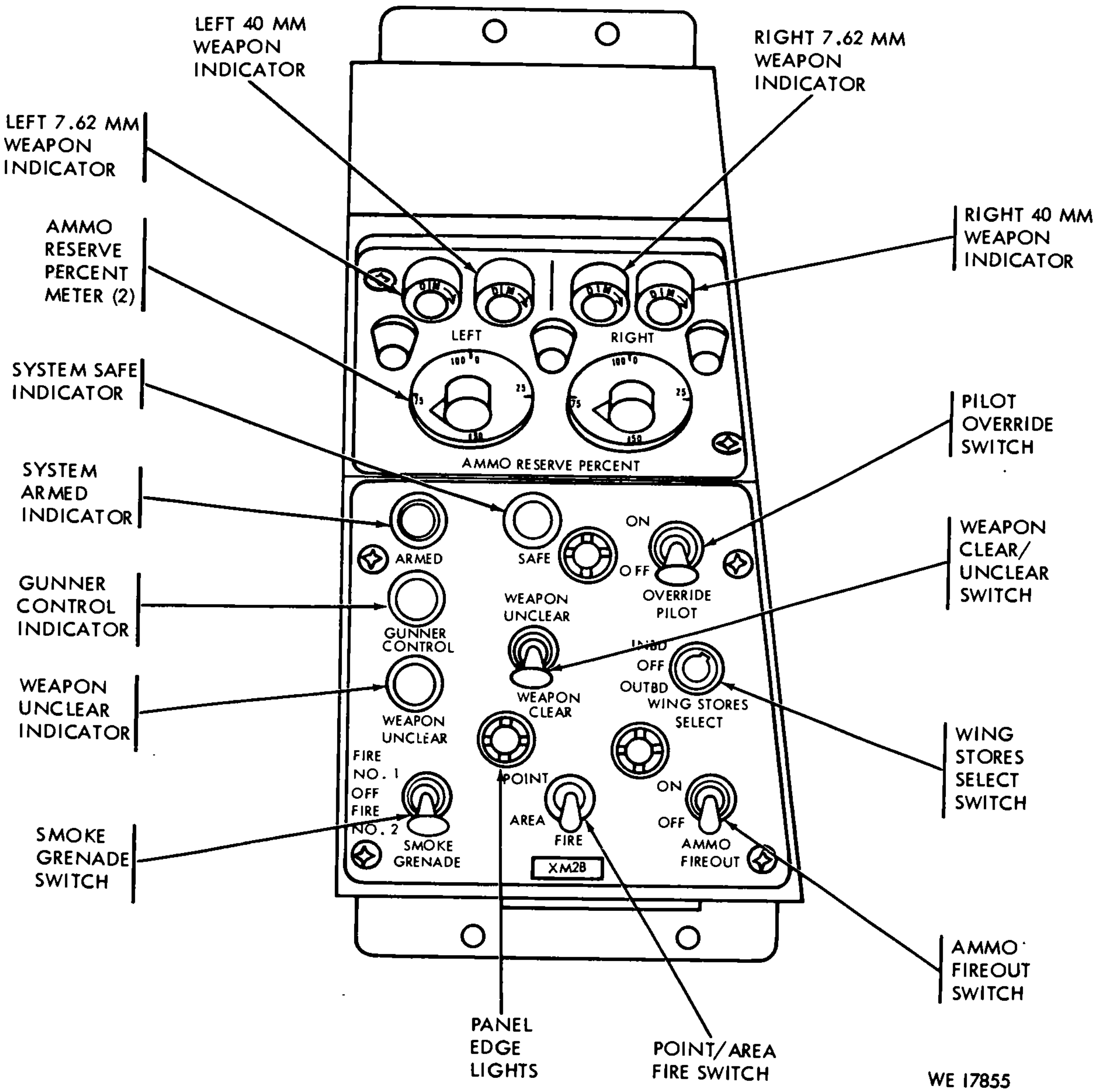


Figure H–11. Gunner's control panel.

(*b*) *WEAPON CLEAR/UNCLEAR* (*leverlock*) *switch.* The WEAPON CLEAR/UNCLEAR switch applies only to the 7.62mm machinegun M134. In the WEAPON CLEAR position at the end of the firing cycle, the machinegun rotates one full revolution after the delinking feeder gate is closed. This assures that the machinegun(s) is clear of live ammunition. In the WEAPON UNCLEAR position, the delinking feeder gate remains open during the last revolution of the machinegun. Since live ammunition remains chambered, this mode should be used only during combat. Its use conserves ammunition.

***Warning:* The UNCLEAR mode of fire raises the hazard of live round cook-off in the weapon from barrel heat. Proper precautions must be taken to protect personnel and property when using this mode.**

***Caution:* Use of the UNCLEAR mode of fire for the M134 machinegun may result in more frequent stoppage.**

Note. Placing the WEAPON CLEAR/UNCLEAR switch in the CLEAR position does not bring about normal clearing or jam clearing of the 7.62mm weapons but merely selects the next mode for firing.

(*c*) *WING STORES SELECT switch.* The WING STORES SELECT switch functions only when the PILOT OVERRIDE switch is in the forward (ON) position. This switch may be used to select either inboard or outboard wing stores for firing. Wing stores are fired with the wing stores button on the gunner's cyclic stick.

(*d*) *AMMO FIREOUT switch.* The electrical last-round switch opens when the last round of ammunition passes over it, thereby interrupting the signal to the gun drive. The round of ammunition remaining in the flexible chutes facilitates the reloading of ammunition, but in an emergency it may be fired by placing the AMMO FIREOUT switch in the ON position. This lets the electrical signal bypass the last-round switch, so that the remaining rounds are fired.

(*e*) *POINT/AREA switch.* When placed in the AREA position, the POINT/AREA FIRE switch energizes the dither circuit and applies a dither voltage to the azimuth servo valve. This causes the gun to oscillate 80 mils in azimuth about its trained position. Placing the switch in the POINT position removes the dither voltage from the azimuth servo valve and allows the gun to remain in its trained position.

(*f*) *SMOKE GRENADE switch (lever-lock momentary switch).* The SMOKE GRENADE switch provides FIRE No. 1 or FIRE No. 2 position, dropping colored smoke grenades from system No. 1 or No. 2. The OFF position deactivates both smoke grenade circuits.

(2) *Indicators.*

Note. The incandescent lamps in the indicators on the gunner's control panel may be tested by pressing the indicator lens. The lamp intensity may be varied by rotating the indicator lens.

(*a*) *System ARMED indicator.* This indicator glows amber when the pilot places his MASTER ARM switch in the ARMED position or when the gunner places his PILOT OVERRIDE switch in the ON position, indicating that the turret control system is energized.

(*b*) *GUNNER CONTROL indicator.* This indicator glows blue when the pilot places his switch in the GUNNER position or when the gunner places his PILOT OVERRIDE switch in the ON position, indicating the gunner has control of the system.

(*c*) *System SAFE indicator.* This indicator glows green to indicate that the XM28 subsystem (except the firing circuits) is energized. The pilot activates this indicator by placing the MASTER/PILOT CONTROL switch in the GUNNER or PILOT position and the MASTER ARM switch in the SAFE position.

(*d*) *WEAPON UNCLEAR indicator.* When the last firing was in the UNCLEAR mode, the WEAPON UNCLEAR indicator will illuminate and remain illuminated until the 7.62mm weapon is fired in the CLEAR mode.

Note. The WEAPON UNCLEAR indicator will go out when firing in the UNCLEAR mode and will illuminate when firing in the CLEAR mode. After the firing cycle, the indicator will illuminate or go out depending upon the position of the WEAPON CLEAR/UNCLEAR switch.

(*e*) *Weapons indicators.* When the XM28 armament subsystem is energized, a LEFT and RIGHT weapons indicator (left machinegun or grenade launcher, and right machinegun or grenade launcher) will illuminate, indicating the type of weapon mounted in position in each side of the turret.

(*f*) *AMMO RESERVE PERCENT meters.* The AMMO RESERVE PERCENT meters indicate the percentage of ammunition remaining in the left and right 7.62mm ammunition box assemblies or 40mm magazine assemblies.

(*g*) *PANEL EDGE lights.* The PANEL EDGE lights provide panel lighting and are illuminated when the aircraft INVTR switch is in the ON position.

j. Pilot's Wing Stores Control Panel. The pilot's wing stores control panel (fig. H–1) is located in the lower center area of the instrument panel. It contains the necessary controls to provide the pilot with primary control over selection and arming of wing stores armament, materiel jettison, and operation of the smoke grenade dispenser XM20.

k. Pilot's XM28 Turret Control Panel. The pilot's turret control panel (fig. H–12) contains the controls and indicators required by the pilot to arm and fire the armament subsystem XM28 with the weapon in the stowed position. All inputs from the pilot's station are received by the electronic components assembly and the gunner's control panel.

(1) *Controls.*

(*a*) *MASTER ARM switch.* This three-position switch includes the ARMED position to arm the basic weapon system, the SAFE position to energize only the control circuits, and the OFF position to deenergize the armament and control circuits.

(*b*) *GUNNER/PILOT CONTROL switch.* This two-position switch includes the GUNNER position for gunner control of the subsystem firing circuits and the PILOT position for pilot control of them.

(*c*) *POINT/AREA FIRE switch.* This two-position switch includes the POINT position to hold the guns stable in the trained position and

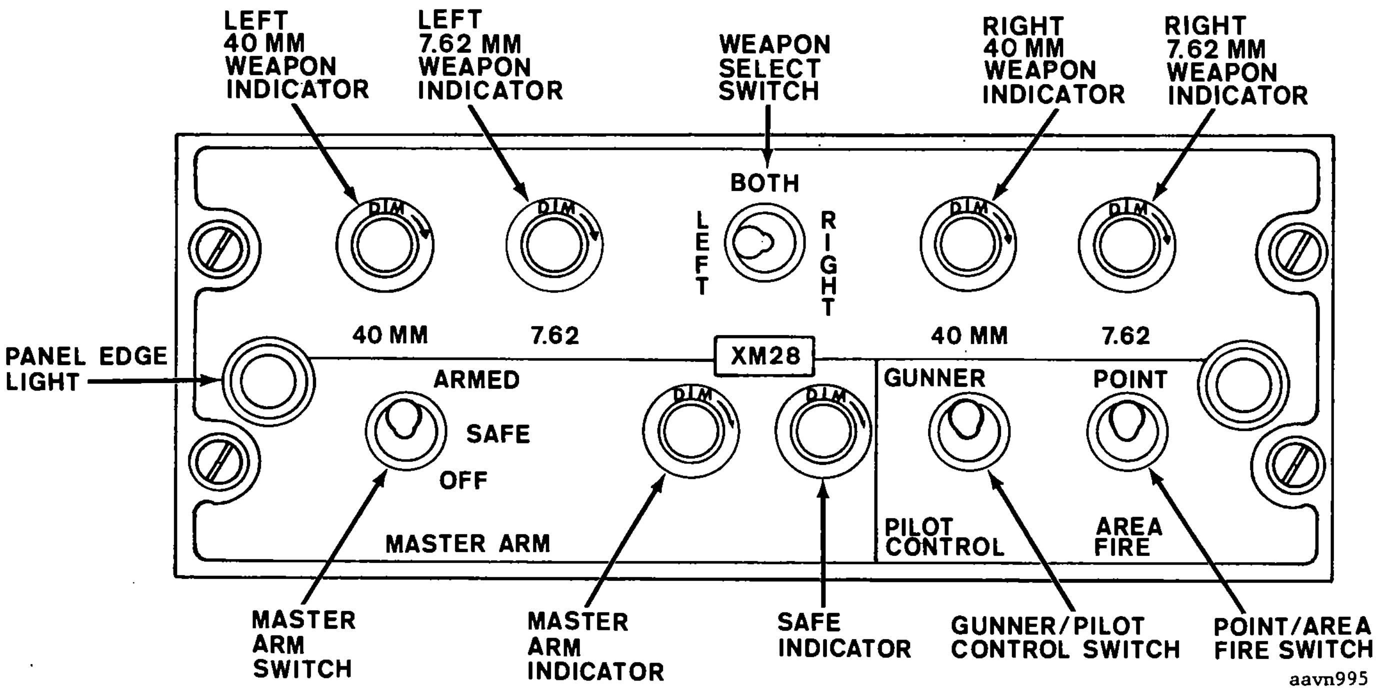


Figure H-12. Pilot's XM28 turret control panel.

the AREA position to allow the guns to oscillate 80 mils in azimuth about their trained positions.

(*d*) *Weapon select switch.* This three-position switch includes the LEFT position for left weapon firing, the RIGHT position for right weapon firing, and the BOTH position for both weapons (two M134 7.62mm machineguns or two 40mm XM129 grenade launchers) to fire simultaneously.

(1) *Indicators.*

Note. The incandescent lamps in the indicators on the pilot's turret control panel may be tested by pressing the indicator lens. The lamp intensity may be varied by rotating the indicator lens.

(*a*) *Left 40mm and 7.62mm weapons indicator.* When a left weapon indicator is illuminated, it indicates the type of weapon mounted in left side of turret.

(*b*) *Right 40mm and 7.62mm weapons indicator.* When a right weapon indicator is illuminated, it indicates the type of weapon mounted in right side of turret.

(*c*) *Safe indicator.* When the MASTER ARM switch is in the SAFE position, the system safe indicator illuminates green, indicating the XM28 subsystem (except for firing circuits) is energized.

(*d*) *MASTER ARM indicator.* This indicator glows amber to indicate that the MASTER ARM switch is in the ARMED position.

(*e*) *Panel edge lights.* The panel edge lights are illuminated when the aircraft INVTR switch is in the ON position.

l. Pilot's XM73 Reflex Sight. The XM73 reflex sight (fig. H-1) is adjustable to the pilot's eye level for firing the turret weapons in the forward (turret stowed) position and for firing the wing stores at selected targets. It includes—

(1) *Elevation/depression scale.* To vary the angle of the beamsplitter to adjust for range and airspeed.

(2) *Reticle intensity control.* To adjust the illumination intensity of the sight reticle image.

(3) *Inclinometer.* To indicate helicopter attitude.

(4) *Range potentiometer.* To apply an elevation correctional signal to the turret weapons.

(5) *Filament selector switch.* To select one of two filaments of the sight reticle lamp.

(6) *Panel lights.* To light the panel on the sight during operation.

(7) *Panel light intensity control.* To adjust the illumination intensity of the panel lights.

H-2. Electrical Circuits

a. Master Armed Circuit. The master armed circuit is energized when the aircraft INVERTER switch is in the ON position, the armament circuit breakers are on, and the MASTER ARM switch, located on the pilot's control panel (fig. H-12), is in the ON position. The PILOT OVERRIDE switch, located on the gunner's control panel, when placed in the override position, will energize the same circuits as the MASTER ARM switch. The PILOT OVERRIDE switch is for emergency use only. When the MASTER ARM switch is placed in the ON position, 28 volts DC is applied to the sighting station ACTION switches.

b. Control Circuits. The purpose of the control circuits is to position the turret in a line of sight corresponding to the line of sight of the sighting station. Positioning the turret is accomplished by the azimuth and elevation control circuits. The MASTER ARM switch must be in the ON position. The TURRET CONTROL switch must be in the GUNNER position, or the TURRET POWER switch in the ON position.

(1) The gunner manipulates the sighting station controller handle grips about the azimuth and elevation axes to position the sight reticle on the target. This creates an error signal (phase difference) between the sighting resolvers and the turret resolvers. The gunner then depresses either or both ACTION switches, which energizes the gunner action relay. The relay applies the voltage output of the sighting station resolvers to the electronic control subassembly amplifiers. Voltage amplification by the electronic control subassembly amplifiers is determined by the error signal (phase difference) between the sighting station resolvers and the turret resolvers. The amplified error signal is then applied to the turret servo valves. The servo valves respond to the error signal by porting the hydraulic pressure to the turret actuators.

(2) Direction of the turret movement is controlled by the magnitude and polarity of the error signal applied to the servo valves. The turret will move, rotating its resolvers, until the turret position corresponds with the sighting station resolvers. At this time, turret movement will stop since all resolvers are in coincidence without voltage difference.

c. Firing Circuits. The purpose of the firing circuits is to control the firing of the 7.62mm machinegun and the 40mm grenade launcher. The weapons may be fired from the sighting station or cyclic stick firing switches. The 7.62/40mm fire relay controls the voltage that will energize either the 7.62mm fire relays or the 40mm fire relays. The 7.62/40mm fire relay is energized by placing the weapon select switch (para H–1k(1)(*d*)) to the position for the weapon desired for firing.

(1) *Sighting station TRIGGER switches.* The sighting station handle grips incorporate a single TRIGGER switch, located above the action switches, on each handgrip.

(*a*) To fire the 7.62mm machinegun, the weapon select switch must be in a position for which a 7.62mm machinegun is installed.

(*b*) To fire at low rate, the gunner must first depress either or both ACTION switches, then partially depress either or both TRIGGER switches. This applies 28 volts DC from the TRIGGER switch, through the 7.62/40mm fire relay, to the 7.62mm low-speed relay. This applies the 28 volts DC to the 7.62mm machinegun.

(*c*) To fire the 7.62mm automatic gun at a high rate of fire, the gunner completely depresses either or both TRIGGER switches. This applies 28 volts DC from the TRIGGER switch, to the 7.62mm high-speed relay, and in turn to the 7.62mm automatic gun.

(*d*) To fire the 40mm grenade launcher, the weapon select switch must be in a position which has the 40mm grenade launcher installed. When the gunner depresses either or both ACTION switches and either or both TRIGGER switches, 28 volts DC is applied from the TRIGGER switch, through the energized 7.62/40mm fire relay, to the drive latch relay. This allows the 28 volts DC to energize the 40mm drive relay, then applies the voltage to the 40mm grenade launcher drive motor assembly. When the TRIGGER switch is released, the drive latch relay is deenergized. This allows 28 volts DC to energize the 40mm brake relay.

(2) *Cyclic stick trigger switch.* On the front of each cyclic stick handgrip is a trigger switch with a guard. The purpose of the guard is to prevent inadvertent firing of the turret gun. The guard must be moved forward to actuate the trigger switch. The pilot may fire the turret gun when it is in the stowed position. The pilot cannot fire the turret gun when it is in a flexible position. However, the pilot may override the gunner by moving the TURRET CONT switch to the PILOT position. The turret will then return to the stow position and the pilot will have control. The cyclic stick trigger switches energize the firing relays through the same circuits as the sighting station trigger switches ((1) above). Before firing, the pilot must place the weapon select switch in position. To fire—

(*a*) *7.62mm machinegun.* To fire at a low rate, the gunner/pilot partially depresses the trigger switch. To fire at a high rate, the gunner/pilot completely depresses the switch.

(*b*) *40mm grenade launcher.* To fire the grenade launcher (at approximately 400 shots per minute), the gunner/pilot completely depresses the trigger switch.

(3) *Cyclic stick wing stores switch.* The

cyclic stick wing stores switch (button) is on the left side of each cyclic stick handgrip. After presetting the WING STORES SELECT switch (para H–1*i*(1)(*c*)), the wing stores may be fired. When the wing stores button is depressed, an interrupter circuit interrupts turret firing and the wing stores are fired.

H–3. Hydraulic System

a. Hydraulic Supply. Hydraulic power for subsystem operation is supplied by the helicopter hydraulic system. The rate of flow is 5.5 gpm with a pressure of 1,500 psi. The hydraulic pressure is used to operate the turret azimuth and elevation actuators. The turret hydraulic system is connected to the helicopter hydraulic system by two quick-disconnect couplings. The hydraulic oil enters the turret hydraulic system through the forward manifold located in the turret.

b. Azimuth Drive Motor. Hydraulic pressure to drive the azimuth drive motor is controlled by the azimuth servo valve. When the azimuth servo valve is energized, oil flows through the servo valve, out the hydraulic ports to the azimuth drive motor. The direction and speed of the azimuth drive motor is dependent upon the polarity and magnitude of the electrical signal applied to the servo valve.

c. Elevation Cylinder. Hydraulic pressure to operate the elevation cyclinder is controlled by the elevation servo valve. When the elevation servo valve is energized, hydraulic oil flows through the servo valve to the elevation cyclinder. The direction and speed of the elevation cylinder is dependent upon the polarity and magnitude of the electrical signal applied to the servo valve. The elevation cylinder has an air bleed valve installed on the cylinder housing to bleed trapped air from the cylinder.

d. Elevation Stow Lock. The elevation stow lock assembly is a hydraulic, spring-operated, locking mechanism. The purpose of the stow lock assembly is to lock (spring pressure) the turret elevation gimbal in the stow position when aircraft hydraulic pressure is removed. When helicopter hydraulic pressure is applied, the stow lock assembly retracts and allows the turret to respond to elevation commands.

H–4. Boresighting and Troubleshooting

For boresighting and troubleshooting procedures, see TM 9–1090–203–12.

Section II. TAT–102A ARMAMENT SUBSYSTEM ON THE AH–1G COBRA ATTACK HELICOPTER

H–5. Description and Operation

The TAT–102A armament subsystem (fig. H–13) is a single gun, electrically controlled, hydraulically-operated system providing wide angular coverage and rapid fire for the Cobra attack helicopter (AH–1G). It is gunner controlled as a fully flexible system, and pilot controlled as a forward firing system with gun stowed. The subsystem consists essentially of five main subassemblies: *turret assembly, gunner's sighting station, gunner's armament control panel, electronic control subassembly,* and *ammunition feed system.* The reflex sight, pilot's turret control panel, pilot's wing stores control panel, wing stores armament, and intervalometer operate in conjunction with the TAT–102A armament subsystem.

a. Turret Assembly. The hydraulically-driven turret is housed inside an aerodynamically designed fairing located forward and below the gunner station. The turret mounts a 7.62mm M134 machinegun which is capable of short bursts or prolonged firing at rates of 1,300 or 4,000 shots per minute. The turret can position the weapon 115° left and right of the forward position. Gun elevation is variable from 15° to 25°, depending on the azimuth position of the turret. Gun depression is 50° at all azimuth positions.

Azimuth position (degrees)	*Elevation (degrees)*
0	20
25	23
35	24
45	25
60	24
90	19
115	15

b. Turret Sighting Station. The TAT–102A subsystem sighting station provides the means for the gunner to train and fire the turret gun. It is similar to the XM28 subsystem turret sighting station (para H–1*h*), except that there is no weapon select switch or pilot-in-control indicator.

(1) *Low rate firing triggers.* The low rate firing triggers are located on the top forward side of the hand grips. Depressing either or both action switches and low rate firing triggers causes the turret gun to be hydraulically driven to maintain a firing rate of 1,300 shots per minute.

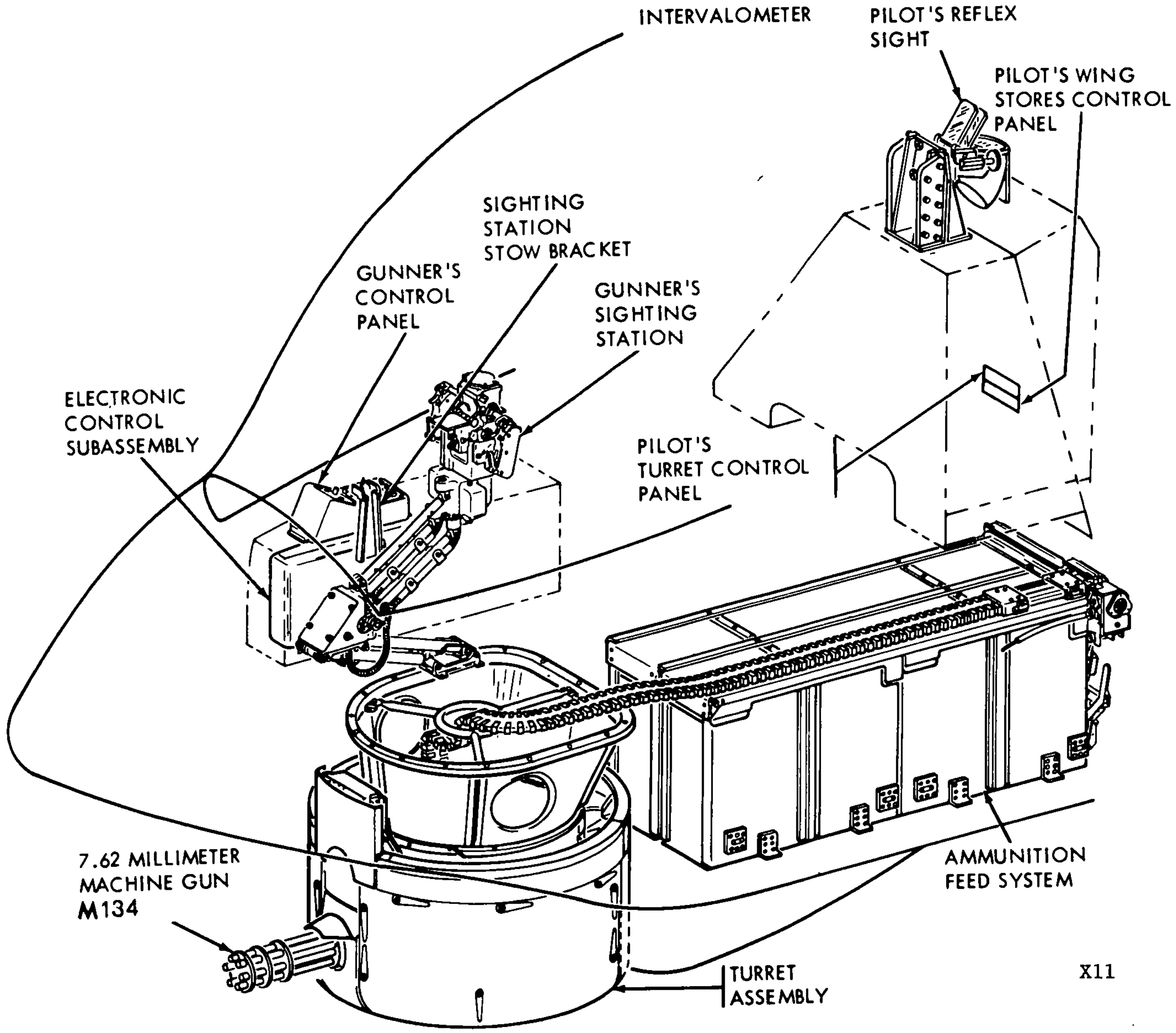


Figure H-13. TAT-102A armament subsystem.

(2) *High rate firing button.* The high rate buttons are located on the upper aft side of the hand grips. To fire the gun at the high rate, either or both action switches and low rate firing triggers are depressed. The high rate button should be depressed before the low rate trigger to prevent the speed from changing while actually firing. The high rate of fire is 4,000 shots per minute.

(3) *Compensation (COMP) switch.* The compensation switch is located on the left side of the support structure elbow. When the compensation switch is placed in the IN position, the compensation relay is energized and airspeed data and range correction data are fed to the turret positioning circuits. Also, the gunner can use the range adjust control to provide gross deflection corrections based on azimuth of fire and airspeed. When the compensation switch is OUT, the weapons are alined parallel to the sight reticle with any range and azimuth corrections provided manually by the gunner.

(4) *Range adjust control.* The range adjust control is a variable resistor, mounted above the right grip. The range adjust control knob is calibrated in meters. When the COMPensation switch is in the IN position, the control allows the gunner to supply a range correction input to the turret positioning circuits.

(5) *Ground safety lever.* When positioned horizontal detent, the ground safety lever mechanically prevents the sight elevation gimbal from being depressed more than 20° below horizontal. This assures that the gun will not be

driven into the ground during ground testing of the helicopter. During flight, the lever should be positioned vertical detent to allow full depression of the gun.

c. Gunner's Armament Control Panel. The gunner's armament control panel (fig. H-14) contains the controls and indicators necessary to operate and monitor the armament system. Emergency provisions on the control panel are available for the gunner to take command and fire the system in case the pilot is disabled.

(1) *Controls.*

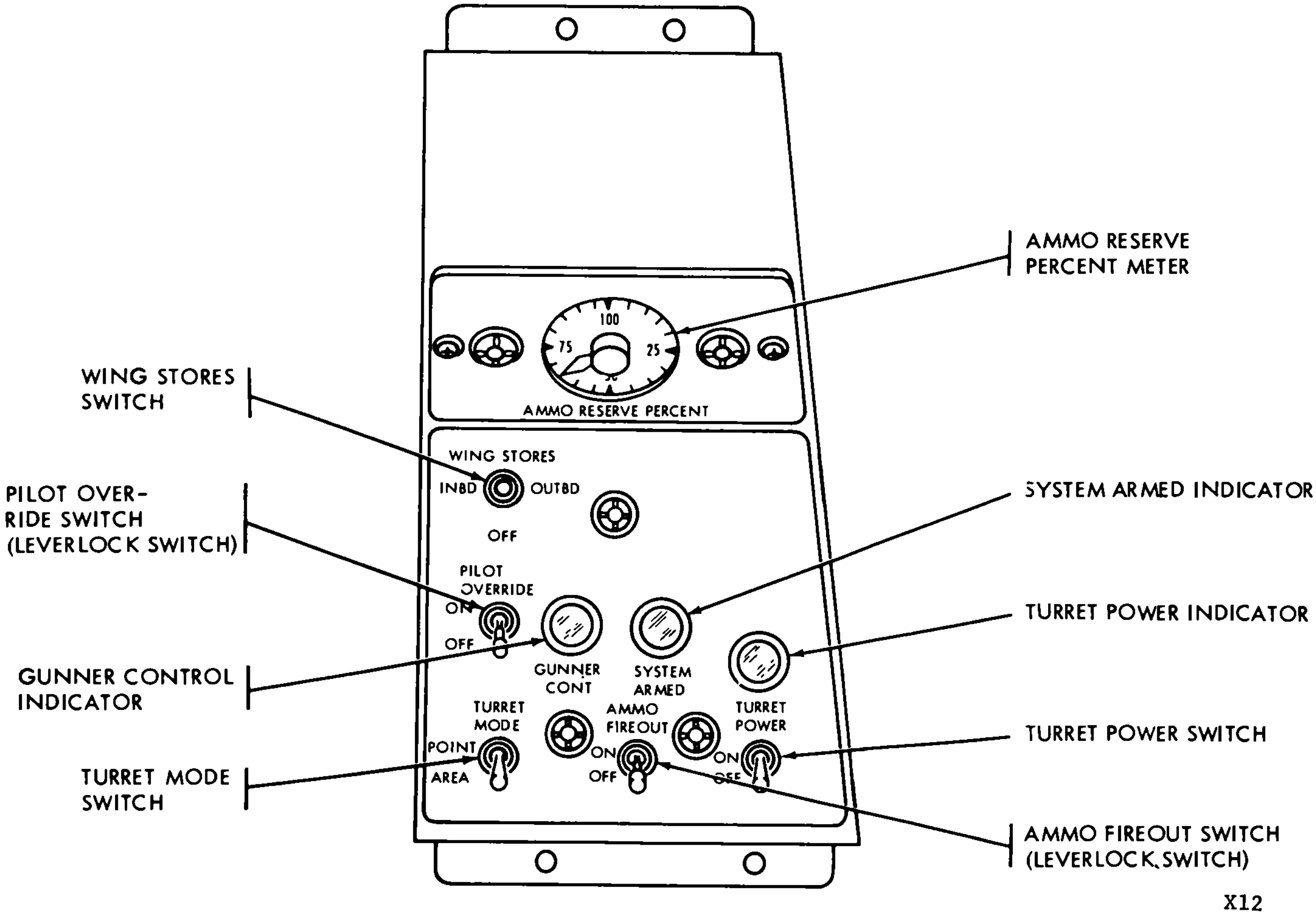


Figure H-14. Gunner's armament control panel (TAT-102A).

(a) *TURRET POWER* switch. When placed in the forward position, the TURRET POWER switch energizes the azimuth and elevation stow lock release solenoids which mechanically unstow the turret. The switch also energizes the turret power relay to provide plus 28 volts DC and minus 28 volts DC to the system and applies 28 volts DC to the contacts of the action and compensation switches in the sighting station. The SYSTEM ARMED indicator illuminates (green) when the TURRET POWER switch is placed in the ON position.

(*b*) *TURRET MODE switch.* When placed in the AREA position, the TURRET MODE switch energizes a dither circuit and applies a dither voltage to the azimuth servo valve causing the gun to oscillate 60 mils in azimuth about its trained position. Placing the switch in the POINT position removes the dither voltage from the azimuth servo valve and allows the gun to remain stable in its trained position.

(*c*) *AMMO FIREOUT switch.* The last-round switch in the ammunition box crossover assembly opens when the last round of ammunition passes over the switch, thereby interrupting the electrical signal to the gun drive control valve. The rounds remaining in the crossover and flexible chute facilitate the reloading of ammunition. In an emergency, the ammunition remaining in the crossover and flexible chute may be fired by placing the AMMO FIREOUT switch to the forward position. This permits the electrical signal to bypass the last round switch and allows the remaining rounds to be fired.

(*d*) *PILOT OVERRIDE switch.* The PILOT OVERRIDE switch is an emergency switch which permits the gunner to take command of the armament system when the pilot is incapacitated. Placing the switch in the forward position energizes the pilot override relay and transfers control of the armament system and the wing pods to the gunner. In this condition, the system is fired using the triggers on the gunner's cyclic control. The ARMED indicator illuminates (amber) when the switch is placed in the PILOT OVERRIDE (ON) position.

(*e*) *WING STORES switch.* If the PILOT OVERRIDE switch is in the forward position, the WING STORES switch may be used to select either inboard or outboard wing pods for firing. Pod stores are fired by using the thumb button on the gunner's cyclic control.

(2) *Indicators.*

Note. The incandescent lamps in the indicators on the gunner's control panel may be tested by pressing the indicator lens. The lamp intensity may be varied by rotating the indicator lens.

(*a*) *SYSTEM ARMED indicator.* The SYSTEM ARMED indicator illuminates (amber) when the pilot's MASTER ARMED switch is placed in the ON position or when the gunner's PILOT OVERRIDE switch is placed in the forward position, indicating that the turret control system is energized.

(*b*) *TURRET POWER (system on) indicator.* The TURRET POWER (system on) indicator illuminates (green) when the TURRET POWER switch is placed in the forward position.

(*c*) *GUNNER CONTrol indicator.* The GUNNER CONTrol indicator illuminates when the TURRET CONTrol switch on the pilot's control panel is in the GUNNER position, indicating that the gunner has control of the system.

(*d*) *AMMO RESERVE PERCENT meter.* The AMMO RESERVE PERCENT meter receives electrical impulses from the rounds counter switch in the ammunition crossover assembly and indicates the percent of ammunition remaining in the ammunition boxes.

d. Electronic Control Subassembly. The electronic control subassembly (fig. H-13) is located below the gunner's control panel in the gunner station and is accessible from outside the helicopter. The subassembly contains amplifiers, relays, and electronic components used by the control circuit, firing circuit, and master armed bus.

e. Ammunition Feed System.

(1) *Description.* The ammunition stowage and feed system (fig. H-13) is used to store 8,000 rounds of 7.62mm ammunition in standard metal links, and transports the ammunition to the gun. Each link is separated from the cartridge and is discarded by the delinking feeder prior to entry into the gun chamber. The ammunition feed system consists of the followinv items: four ammunition stowage boxes; a crossover assembly; a feed chute; and a flexible drive shaft assembly.

(*a*) *Ammunition stowage boxes.* Each ammunition stowage box is divided into two bays; each bay is divided into two compartments. Each ammunition box has two spring-loaded handles. A lid covers all four boxes.

(*b*) *Crossover assembly.* The crossover assembly is attached to the rear of the ammunition boxes. It connects each bay of ammunition and forms a continuous transportation path between adjacent stowage boxes. The crossover assembly contains four separately engaged sprockets which are driven by the synchronized cartridge drive assembly. Three idler rollers are located at the bottom of the crossover for guiding the ammunition through the crossover. Three detent switches are located above the rollers for engaging the sprocket clutches. The crossover mechanism also contains a last-round switch and a rounds counter switch.

(*c*) *Feed chute.* A flexible ammunition feed chute guides the ammunition from the exit of the crossover to the delinking feeder on the gun.

(*d*) *Flexible drive shaft assembly.* The flexible drive shaft connects the crossover assembly to the gun drive. This shaft synchronizes the extraction and transportation of cartridges to gun fire demand, ensuring no gun stoppage due to different acceleration or feed rates between separate cartridge drives and the gun.

(2) *Operation.* Ammunition is fed from the stowage boxes in the following manner.

(*a*) Cartridges are extracted from the ammunition box compartments in sequence. Cartridges in the successive compartments are immobile until all cartridges in the preceding compartment are depleted.

(*b*) Upon depletion of the first day, the tension on the idler roller in the crossover trips the detent switch and engages the clutch for the next bay sprocket drive. Ammunition flows over the extracting sprocket, around the lower (idler) roller, over the primary drive sprocket, through the feed chute to the gun until all boxes are emptied.

(*c*) As the last cartridge of the ammunition belt passes over the last round switch, gun firing and ammunition feed is automatically stopped and the cartridge belt is left in the feed chute with its last round accessible for joining to the cartridge in the reloaded box.

(*d*) A rounds counter switch electrically counts the number or rounds fired and relays the information to the AMMO RESERVE PERCENT meter.

H–6. Boresighting and Troubleshooting

For boresighting and troubleshooting procedures, see TM 9–1005–297–12.

APPENDIX I

OTHER AVAILABLE OR PROPOSED WEAPONS SUBSYSTEMS

Note. This appendix provides information on the capabilities, limitations, descriptions, and functioning of other available or proposed weapons subsystems. These subsystems are not standard; however, they may be made available to units on a requirement basis.

Section I. XM12 (20MM) ARMAMENT POD

I–1. Pod Characteristics

The XM12 armament pod employs the M61 Vulcan, electrically-fired, 20mm gun with a linkless feed system. Pod characteristics are—

a. Drive System—Ram air turbine.

b. Drive Power Input—Approximately 40 horsepower.

c. Electrical Power From Aircraft—208 volts AC, 400 cycle, three phase, 7 amperes.

d. Firing Rate—6,000 shots per minute.

e. Ammunition Capacity—1,200 rounds.

f. Pod Length—197 inches.

g. Pod Diameter—22 inches.

h. Pod Weight.

(1) With ammunition—1,615 pounds.

(2) Without ammunition—965 pounds.

i. Attachment to Aircraft—20-inch lugs.

j. Center of Gravity Shift When Ammunition is Expended—17 inches forward.

k. Maximum Burst Length—Full complement.

l. Ammunition Cook-Off Hazard—None.

m. Operational Capability—All attitudes and high "g" loads.

I–2. Gun Characteristics

The externally powered, six-barrel M61, 20mm, Vulcan gun is capable of firing up to 6,000 shots per minute. As only one barrel fires at a time, the six rotating barrels contribute to a long weapon life by reducing the problem of barrel erosion and heat generation. This method of operation eliminates erratic recoil associated with multiple gun installations. The weapon may be electrically, hydraulically, or ram-air turbine driven. The firing circuit requires 28 volts DC, 28 amperes. An endless conveyor belt picks up the live rounds from the exit end of the storage drum and delivers them to the gun. After firing, the gun ejects the spent cases. The M61 fires standard electrically-primed ammunition such as M53A1 (APL), M56AL (HEI), and M55A1 (ball). For a list of ammunition, see appendix K. Gun characteristics are—

a. Firing Rate—Variable, up to 6,000.

b. Weight—255 pounds.

c. Length—72 inches.

d. Number of Barrels—Six.

e. Muzzle Velocity—3,380 feet per second.

f. Average Recoil Force (firing rate multiplied by 0.57).

(1) *At 4,600 shots per minute*—82,661 pounds.

(2) *At 6,600 shots per minute*—3,818 pounds.

g. Maximum Recoil Travel—0.25 inches.

h. Time to Rated Fire—0.4 seconds.

i. Stopping Time—0.4 seconds.

j. Temperature Range—From −65° F. to +260° F.

k. Scheduled Maintenance—15,000 rounds.

l. Barrel Life—15,000 rounds.

m. Gun Life—100,000 rounds.

n. Power Required.

(1) *Firing circuit*—25 to 30 volts DC, 0.5 amperes.

(2) *Clearing cam*—28 volts DC, 28 amperes.

o. Steady-State Power Required.

(1) *At 4,000 shots per minute*—8 horsepower.

(2) *At 6,000 shots per minute*—20 horsepower.

Section II. XM25 (20MM) ARMAMENT POD

I–3. Pod Characteristics

The XM25 armament pod is a gas-operated version of the XM12 pod; it employes the gas-operated XM130 20mm gun. Pod characteristics are—

a. *Drive System*—Gun is gas operated.

b. *Drive Power Input*—About 40 horsepower.

c. *Electrical Power From Aircraft*—208 volts. AC, 400 cycle, three-phase, 10 amperes.

d. *Firing Rate*—6,000 shots per minute.

e. *Ammunition Capacity*—1,200 rounds.

f. *Pod Length*—197 inches.

g. *Pod Diameter*—22 inches.

h. *Pod Weight*.

(1) *With ammunition*—1,720 pounds.

(2) *Without ammunition*—1,045 pounds.

i. *Attachment to Aircraft*—30-inch lugs, per MIL–A–8591.

j. *Center of Gravity Shift When Ammunition is Expended*—17 inches forward.

k. *Maximum Burst Length*—Full complement.

l. *Ammunition Cook-Off Hazard*—None with automatic clearing.

I–4. Gun Characteristics

To provide for gas operation, the XM130 20mm aircraft gun is a redesigned M61 Vulcan gun. Four of the six barrels have small holes drilled in them which coincide with holes in the piston chamber. As gas from the barrels is released into the piston chamber, the pressure increase on the piston causes it to move forward. As it moves forward, so does the cam path on the piston shaft. This imparts a rotary motion to the barrel cluster. Initial rotation of the barrel cluster is provided by an inertia starter which disengages automatically when the weapon is accelerated to 5,400 shots per minute. A governor holds the weapon at 6,000 shots per minute. More than three consecutive misfires will stop the weapon. The feed system is the same as the XM12. Gun characteristics are—

a. *Firing Rate*—Variable up to 6,000 shots per minute.

b. *Weight*—276 pounds.

c. *Length*—72 inches.

d. *Number of Barrels*—Six.

e. *Muzzle Velocity*—3,380 feet per second.

f. *Average Recoil Force* (firing rate multiplied by 0.57).

(1) *At 4,000 shots per minute*—2,250 pounds.

(2) *At 6,000 shots per minute*—3,330 pounds.

g. *Maximum Recoil Travel*—0.25 inches.

h. *Time to Rated Fire*—0.2 to 0.4 seconds.

i. *Stopping Time*—0.2 to 0.4 seconds.

j. *Temperature Range*—From −65° F. to +260° F.

k. *Scheduled Maintenance*—15,000 rounds.

l. *Barrel Life*—15,000 rounds.

m. *Gun Life*—100,000 rounds.

n. *Power Required*.

(1) *Firing circuit*—25 to 30 volts DC, 0.5 amperes.

(2) *Clearing cam*—28 volts DC, 28 amperes.

(3) *Starting power*—10 amperes, three-phase, 400 cycle AC.

Section III. XM14 ARMAMENT SUBSYSTEM

I–5. Description

Two XM14 armament pods (one per side, fig. I–1) are mounted on standard Kellet pylons which are attached to the external stores support. Each pod encloses an M3, caliber. 50, automatic machinegun; 750 rounds of ammunition; an ammunition feed system with booster; and a pneumatic charging system. The pod is 16 inches in diameter and 118 inches long.

I–6. Sighting System

A Mk 8 sight is provided at the pilot's station; however, the system may be fired from either the pilot's or the gunner's cyclic stick. Firing may be accomplished from either or both pods simultaneously.

I–7. Ammunition

Each pod contains 750 rounds of caliber .50 ammunition. Firing rate is 1,200 shots per minute.

I–8. Weight

Installed kit weight is 592 pounds, including 1,500 rounds of ammunition. Ammunition weight is 225 pounds.

aavn999

Figure I–1. XM14 armament pod.

Section IV. XM26 (TOW) ARMAMENT SUBSYSTEM

I–9. Description

The purpose of the XM26 (TOW) helicopter armament subsystem (fig. I–2) is to provide the Army with a highly mobile, airborne, heavy point fire weapon system. This system uses the TOW (tube launched, optically tracked, wire command link) guided missile. The XM26 is designed to replace the M22 subsystem. It consists of the following major assemblies—

a. Stabilized Sight/Sensor. The stabilized sight/sensor (A, fig. I–2) mounted in the helicopter nose is the key to the XM26 subsystem. This gyro-stabilized sight enables the gunner to keep the crosshairs of his sight on the target, regardless of helicopter vibration and maneuvers. Through the sight, the gunner establishes and maintains the line of sight which the missile follows to the target.

Figure I–2. XM26 armament subsystem on UH–1.

b. Launchers. The missile container is attached to the helicopter bomb rack. There is a launcher containing three missiles (B, fig. I–2) on each side of the UH–1 helicopter. The launchers are trainable in elevation only by hydraulic actuation.

c. Electronics. The electronic assemblies contain necessary circuitry for the operation of all XM26 subsystem assemblies. The circuitry is built into three separate chassis—*servo electronics, auxiliary electronics,* and *command signal generator.*

d. Power Supply. Power for the subsystem is produced through an inverter located in the helicopter engine compartment. The inverter uses 24 volts DC from the helicopter emergency power and converts it into 115 volts AC 400 cycle, three-phase power for the XM26 subsystem. If emergency power is needed as helicopter prime power, the circuit is designed so that the XM26 subsystem can be switched out of the circuit.

e. Missile. The TOW missile round is launched directly from the missile container (fig. I–3), without an additional launch tube.

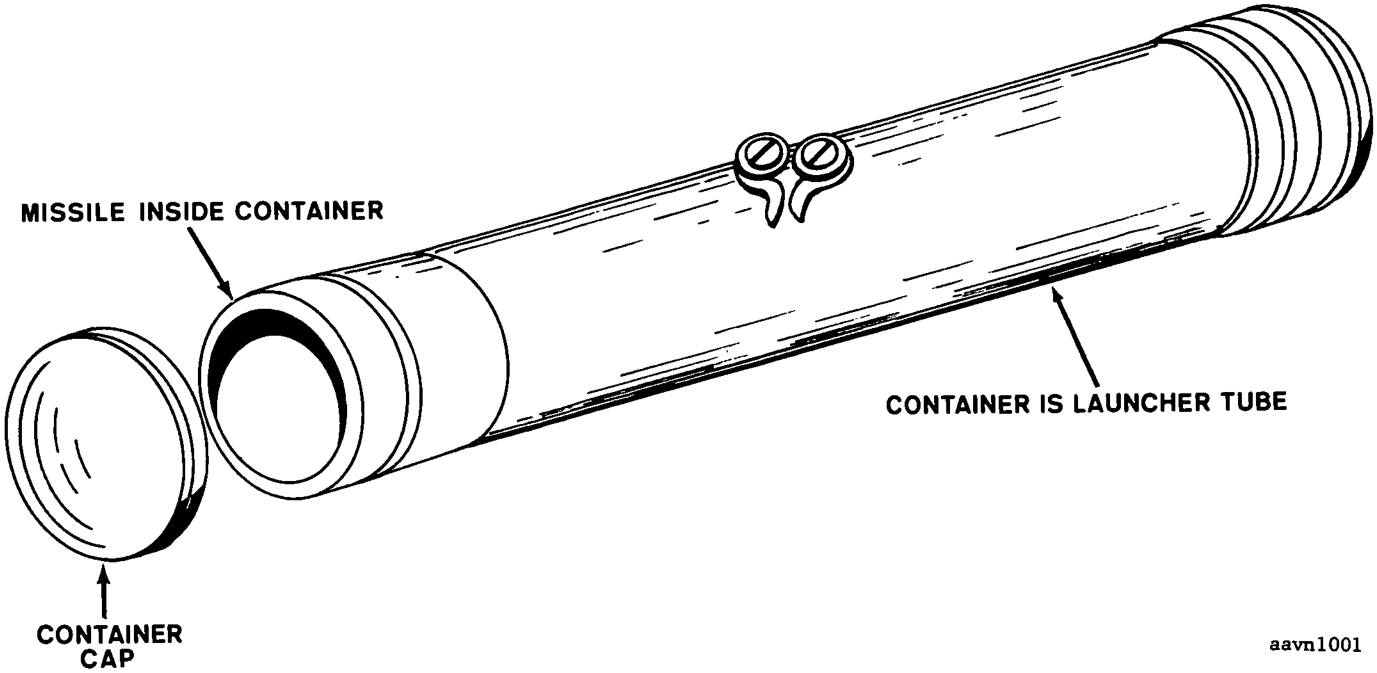


Figure I-3. Missile and container.

f. Cockpit Controls and Displays. The cockpit controls and displays located in the cockpit allow for ease of operation by the gunner and do not interfere with the flight controls of the helicopter. Figure I-4 shows cockpit controls and displays in a UH-1 helicopter; however, the XM26 subsystem is adaptable to the AH-1 attack helicopter. Power and armament controls are mounted on

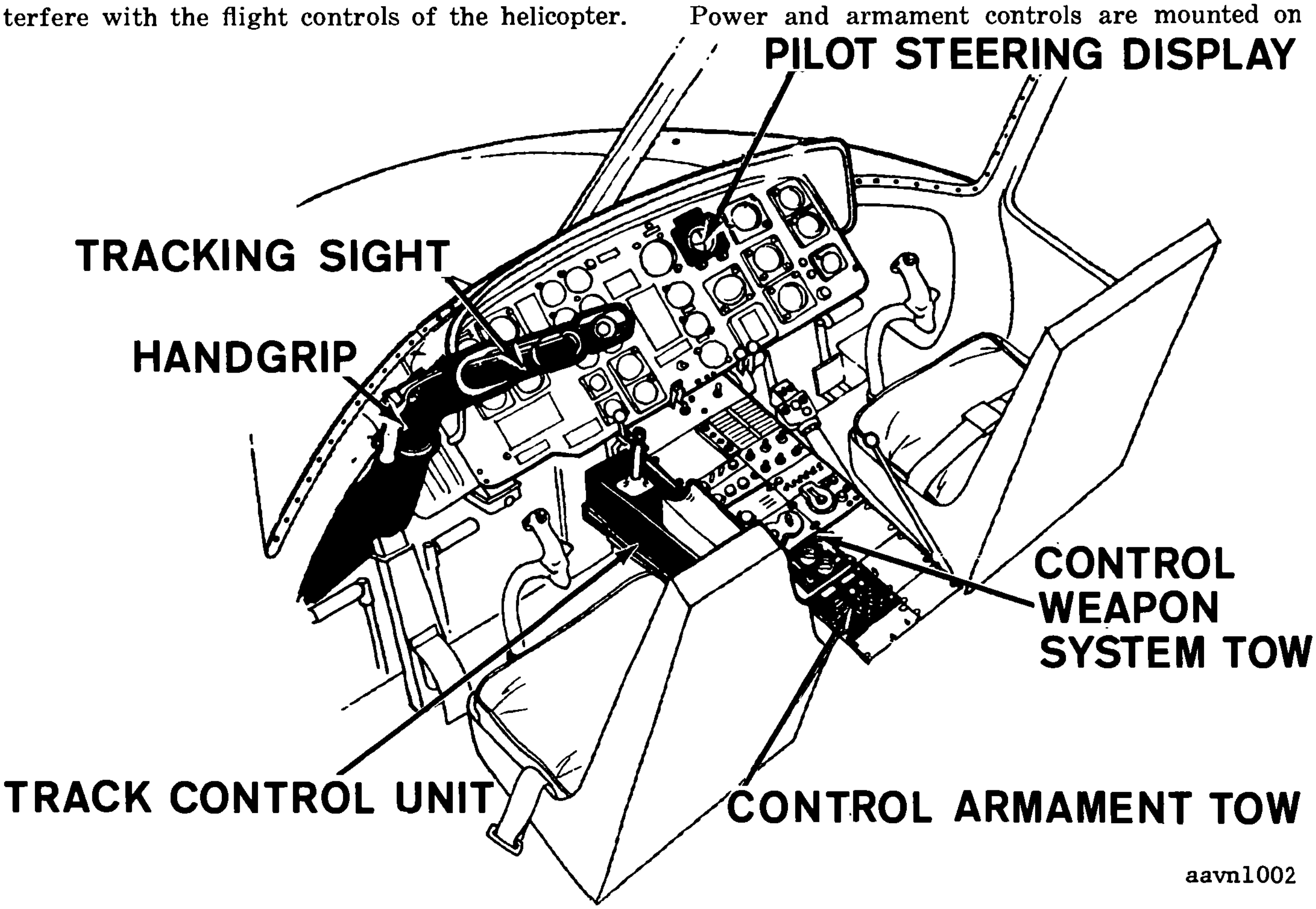


Figure I-4. Cockpit controls and displays in UH-1 helicopter.

the console between the pilot and gunner's seat. These are within easy reach of both pilot and gunner. Additional controls and displays are located on the sight extension tube, gunner's armrest, and the helicopter instrument panel.

(1) *Pilot steering display.* The pilot steering display (fig. I–5) provides attack status data and an azimuth steering signal for missile firing. So that the pilot will not exceed the gimbal angle limits during maneuvering flight, it indicates platform gimbal angles.

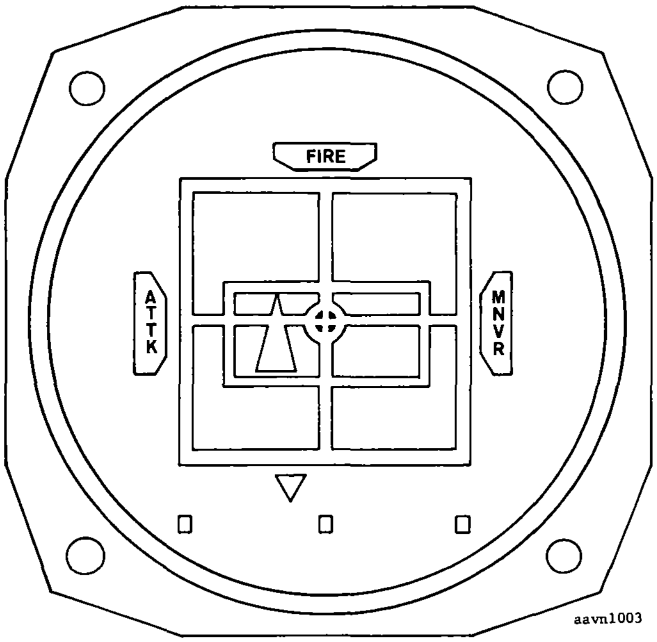


Figure I–5. Pilot steering display.

(2) *TOW armament subsystem control panel.* The TOW armament subsystem control panel (fig. I–6) has—

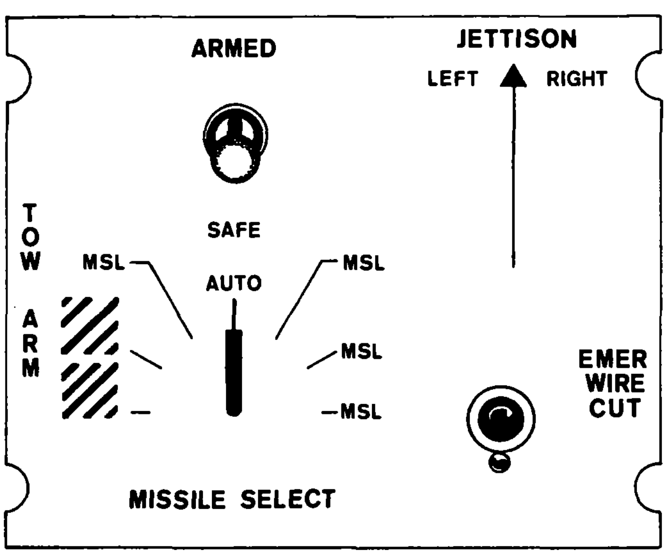


Figure I–6. TOW armament subsystem control panel.

(a) *SAFE/ARMED switch.* When this switch is placed in the SAFE position, a missile cannot be fired. When placed in the ARMED position, this switch completes the circuitry necessary for firing a missile.

(b) *MISSILE SELECT switch.* Missile selection can be manual or automatic by means of the MISSILE SELECT switch. When placed in the AUTO position, the system will select the next ready missile. Each position on the switch has a flag indicator that will indicate the presence (MSL), or absence (barber pole) of the selected missile.

(c) *JETTISON switches.* In an emergency, activation of the JETTISON switches jettisons the launcher assemblies to improve helicopter maneuverability.

(d) *EMERgency WIRE CUT.* In case of wire entanglement or failure of the automatic wire cutting device, the emergency wire cut control permits the gunner to cut the wire.

(3) *TOW weapon subsystem control panel.* The TOW weapon subsystem control panel (fig. I–7) has—

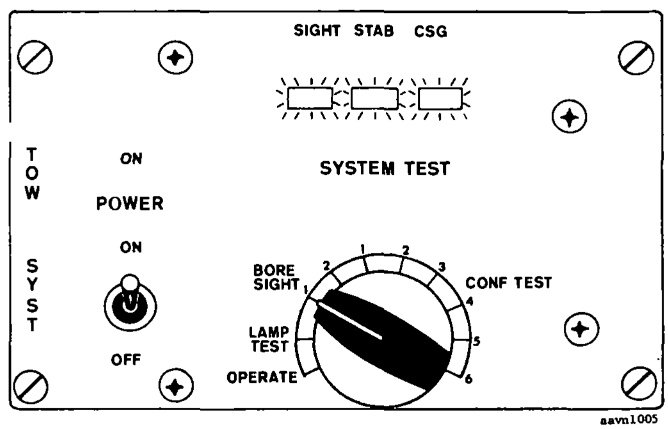


Figure I–7. TOW weapon subsystem control panel.

(a) *POWER ON/OFF switch.* In the ON position, full operating power is applied to the subsystem.

(b) *SYSTEM TEST switch.* This 10-position switch is used to determine the operational status of the weapon subsystem. The first position (OPERATE) switches out all system test circuitry; the switch must be in this position to fire a missile. The second position (LAMP Test) applies power to all indicator lamps. The next two positions (B1 and B2) are used in performing boresighting checks and alinement. The last six positions of the switch are used to perform system selftest. Results of the selftest are indicated on the three flag indicators above the switch. A GO indication will be displayed when a particular test has been satisfactorily completed. The three indicators used are—SIGHT, for the stabilized sight/sensor unit; STAB, for stabilization electronics; and CSG, for missile guidance electronics.

(4) *Track control unit.* The track control unit (FIG. I–8) is designed for right-handed operation by the gunner to provide control inputs to the TOW sight system for manual acquisition, tracking, and stow positioning of the sight. The tracking control stick and control switch have been designed into a small unit separate from the armrest. The position of the control unit may be adjusted to accommodate different sized gunners.

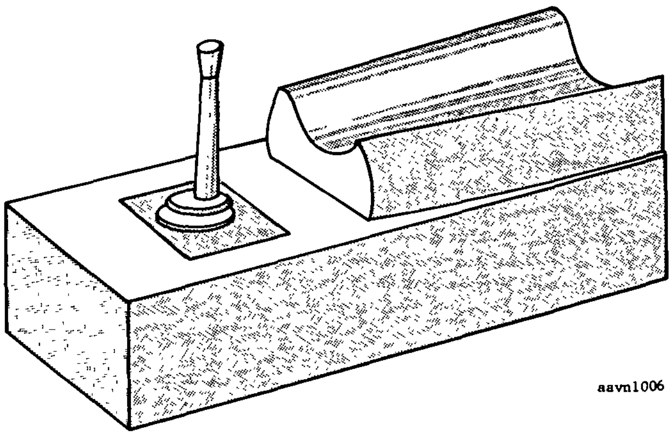


Figure I–8. Track control unit.

(5) *Gunner's handgrip.* The gunner's handgrip (fig. I–9) provides a means of stabilization for the gunner, switching function controls, and a designation pointer display. The handgrip is fixed to the left side of the sight unit relay column near the upper rotary joint. The switching functions are short or long range selection, high or low magnification selection, camera control, reticle brightness control, attack mode selection, and trigger. The trigger is a recessed, momentary, snap-action pushbutton. The designation pointer display is a small pencil-shaped pointer that indicates where the sight is pointing. It is used in the heads-up mode for gross positioning of the sight prior to headsdown acquisition. It is located over a moving card display that indicates the azimuth position of the sight relative to a fixed scale.

I–10. Operation

a. In combat, the helicopter gunner acquires and tracks a target through the stabilized sight/sensor. A display on the instrument panel (fig. I–5) will indicate to the pilot each phase of the engagement; e.g., attack, fire, and maneuver.

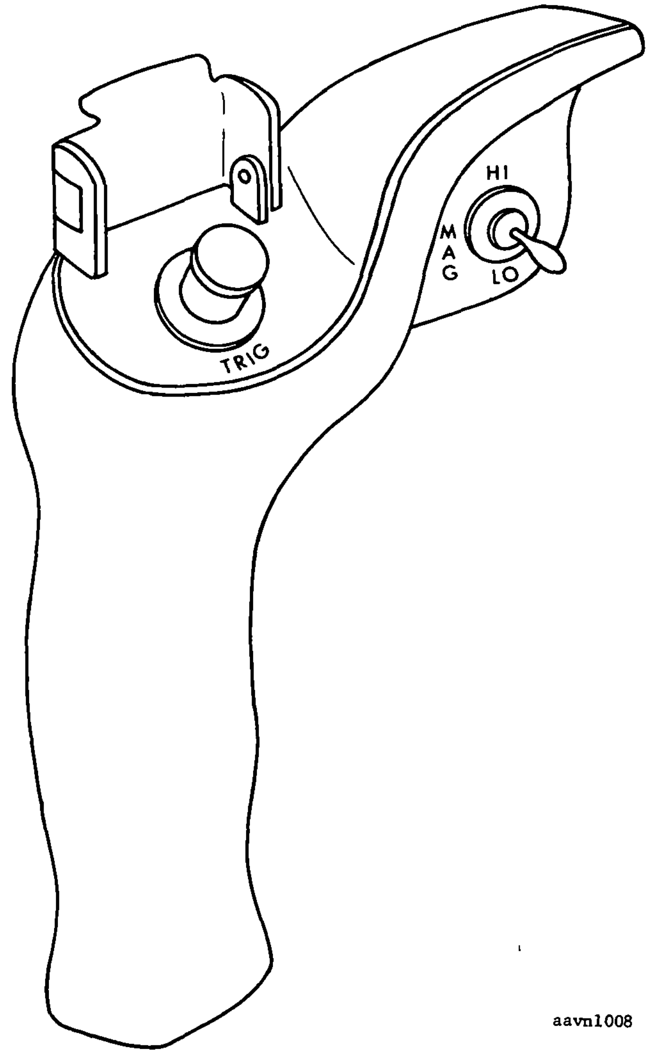


Figure I–9. Handgrip.

Also indicated are limitations of the evasive maneuvers that the pilot may perform.

b. Easily operated, viscous damped controls (fig. I–8) enable the gunner to maintain the sight/sensor pointing direction without regard to the angular motion or vibration of the helicopter.

c. The TOW missile is fired into the field of view of the stabilized sight/sensor. The stabilized sight/sensor "senses" missile flightpath deviation from the line of sight maintained by the gunner. These deviations are sent (in terms of electronic impulses) to the command signal generator, then converted into corrective commands and sent to the missile by thin wires that are payed out in flight. These corrective commands guide the missile back to the line of sight and on to the target (fig. I–10).

I–11. Logistical Support

TOW armament subsystem equipment will be de-

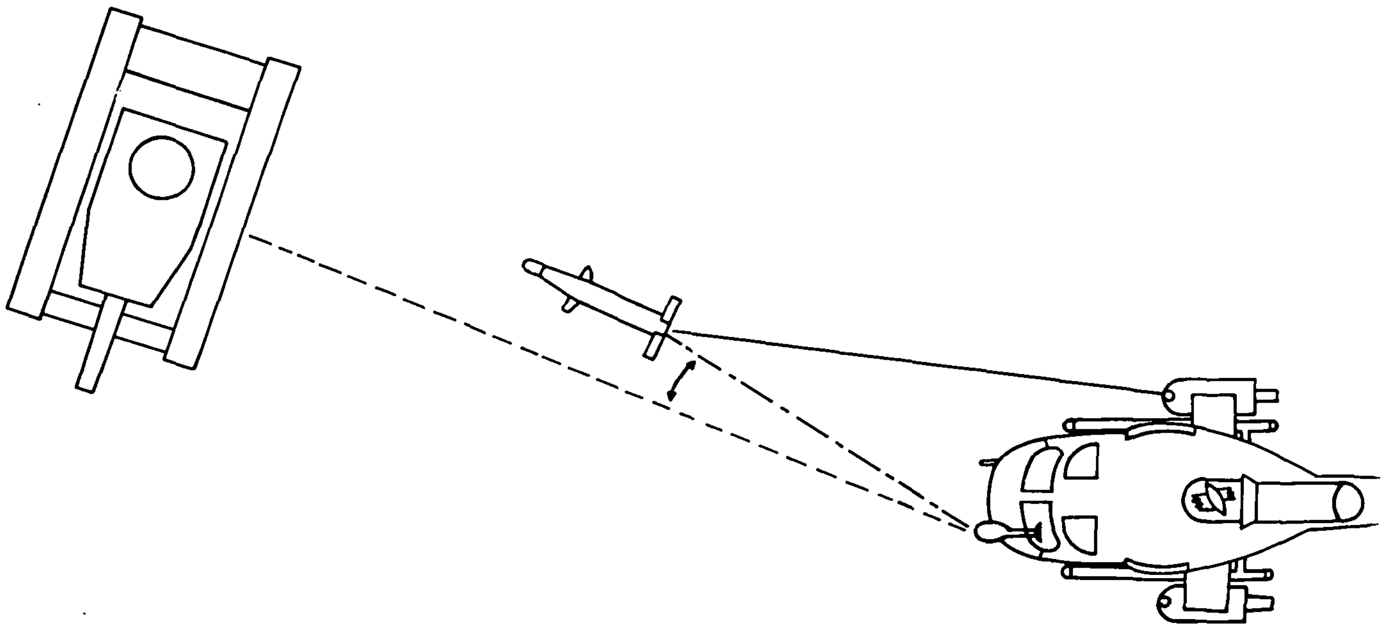


Figure I-10. Weapon concept.

signed to include a completely built-in selftest capability that will isolate faults down to a removable major assembly. Under the current planned concept, the aircraft armament repairman will remove and replace the defective assembly indicated by the built-in selftest.

APPENDIX J

DOOR/RAMP MOUNTED ARMAMENT SUBSYSTEMS

Caution: **To prevent rocket detonation during rocket firing, door gunners should not fire when 2.75-inch rockets are launched from the helicopter.**

J–1. General

Helicopter door/ramp guns provide attack helicopters with highly flexible fire to cover their own flanks and rear. For details on these armament subsystems, see TM 9–1005–262–15. Each of the methods below of mounting door/ramp guns has different capabilities and limitations.

J–2. "Free Gun" Door Gunner

"Free gun" door gunners provide flank fires by hand-holding a standard M60 7.62mm machinegun in each cargo door of the UH–1 helicopter. Ammunition (approximately 1,000 rounds per gun) is contained in locally fabricated wooden boxes placed on the cargo floor.

Warning: **Since there are no safety stops, extreme care is required when using the "free gun." Careless traversing fire can result in damage to the helicopter or injury to crewmembers.**

J–3. Bungee Cord for Use on UH–1 Helicopters

The bungee cord (a cloth-covered elastic cord, fig. J–1) is similar to that used at the back of the UH–1B/C pilot's seat. It is hung from the litter pole attaching point at the top of the cargo door and attaches to the handle of a standard M60 machinegun. The bungee cord was improvised for temporary use on UH–1B/C helicopters armed with the XM3, M5, M6, M16, or M21 armament subsystem. It is completely flexible and permits the gunner to traverse without limitations. When using this cord, emphasis should be placed on safety procedures.

Warning: **Extreme care is required when using the bungee cord since there are no safety stops. Careless traversing fire can result in damage to the helicopter or injury to crewmembers.**

J–4. M23 Armament Subsystem for UH–1D/H Helicopters

The M23 armament subsystem is used on UH–1D/H helicopters. It consists of two M60D 7.62mm machineguns, two mount assemblies, and two ejection control bags. The mount assembly includes an ammunition box and cover assembly and an ammunition chute assembly. One machinegun is mounted in each cargo doorway of the helicopter (fig. J–2).

a. Weight. Subsystem weight without ammunition is 66.0 pounds; subsystem weight with ammunition (600 rounds) is 104.4 pounds.

b. Traverse. Forward and aft traverse limits are 1,546 mils.

c. Depression and Elevation Limits.

Gun direction	Depression (mils)	Elevation (mils)
Maximum forward	1,457	61
Center	1,457	89
Maximum aft	1,386	115

J–5. M24 Armament Subsystem for CH–47A Helicopters

The M24 armament subsystem is used on the CH–47A helicopters. I consists of two M60D 7.62mm machineguns, two mount assemblies, two ejection control bags, and two ammunition can assemblies. One machinegun is mounted to the cabin doorway on the right side of the helicopter (fig. J–3) and one to the escape hatch on the left side of the helicopter.

a. Weight. Subsystem weight without ammunition is 42.5 pounds; subsystem weight with ammunition (200 rounds) is 55.7 pounds.

b. Traverse. Left side total traversing capability is 2,418 mils; right side total traversing capability is 2,596 mils.

c. Depression and Elevation Limits.

Gun direction	Right side		Left side	
	Depression (mils)	Elevation (mils)	Depression (mils)	Elevation (mils)
Maximum forward	436	61	559	52
Center	1,200	91	1,298	67
Maximum aft	545	136	877	130

Figure J-1. "Free gun" door gunner.

J-6. XM41 Armament Subsystem for CH-47A Helicopters

The XM41 armament subsystem is used on the CH-47A helicopter (fig. J-4). It consists of one M60D 7.62mm machinegun, one rear ramp mount assembly, one ammunition can assembly, and one ejection control bag. To provide rear fire, it is attached to the rear ramp of the helicopter.

a. Weight. Subsystem weight without ammunition is 41.8 pounds; subsystem weight with ammunition (200 rounds) is 55.0 pounds.

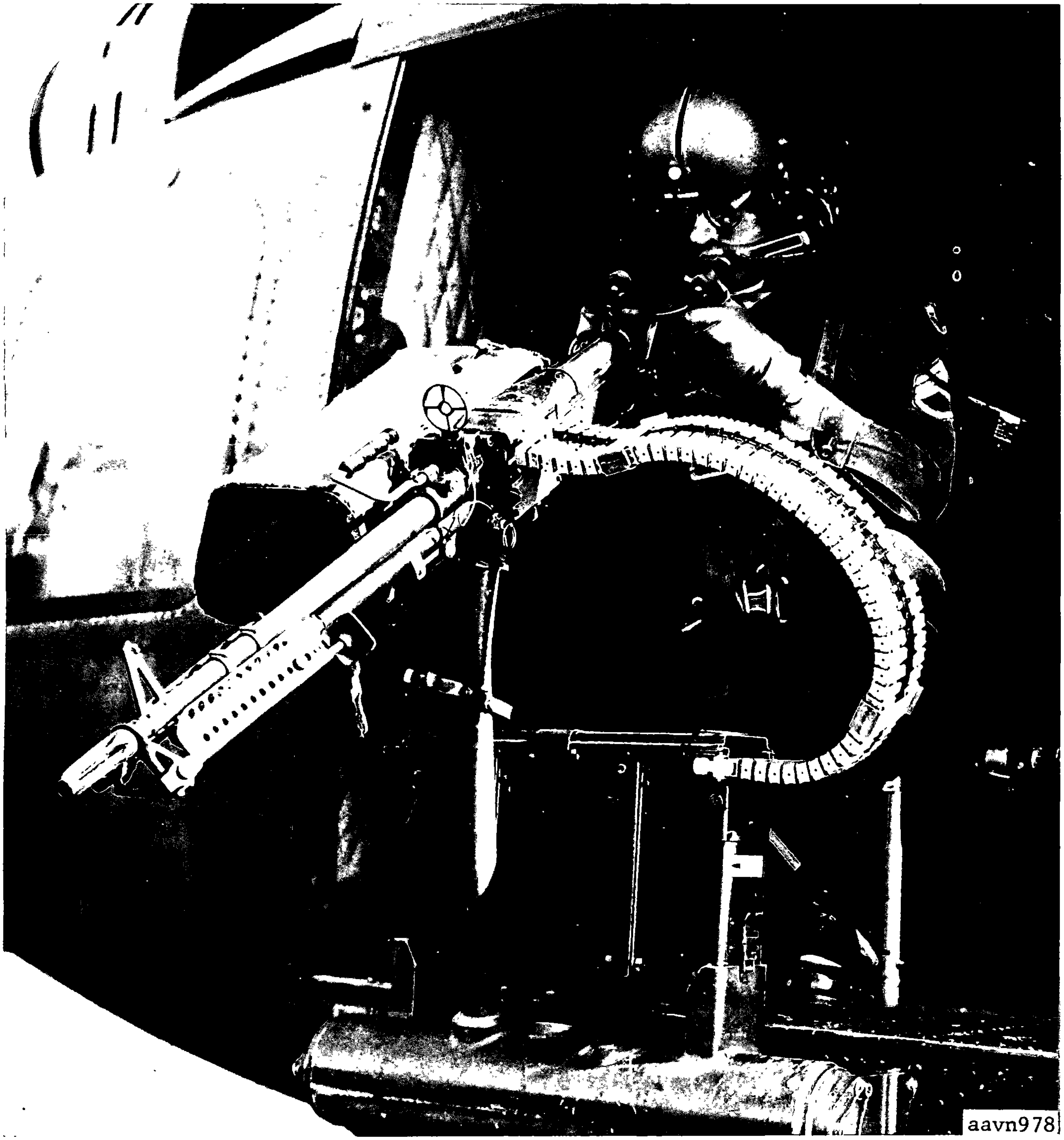


Figure J–2. M23 armament subsystem.

b. Traverse. Rear traverse capability is 1,671 mils.

c. Elevation. Rear elevation limit is 222 mils.

d. Depression. Rear depression limit is 1,227 mils.

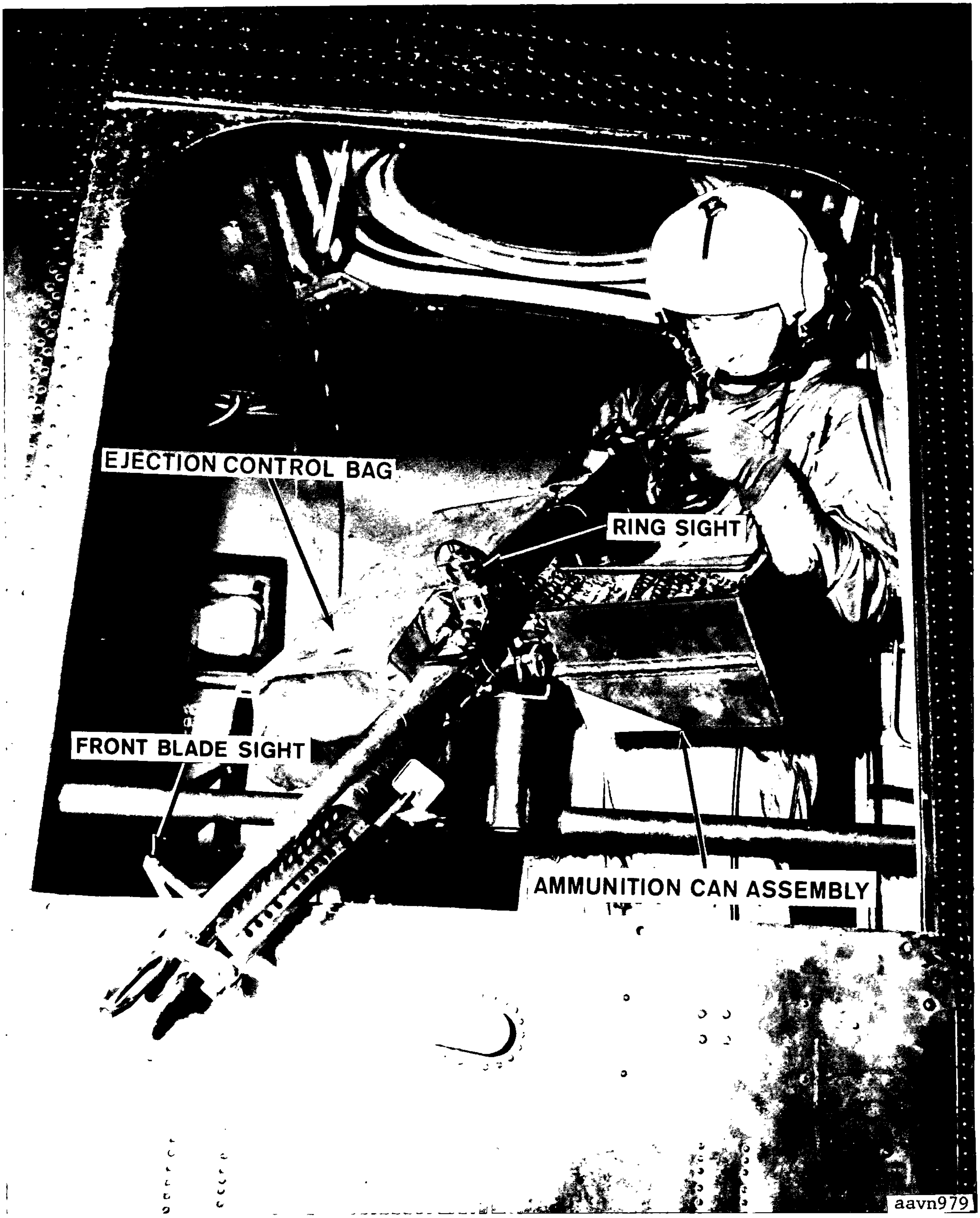


Figure J–3. M24 armament subsystem.

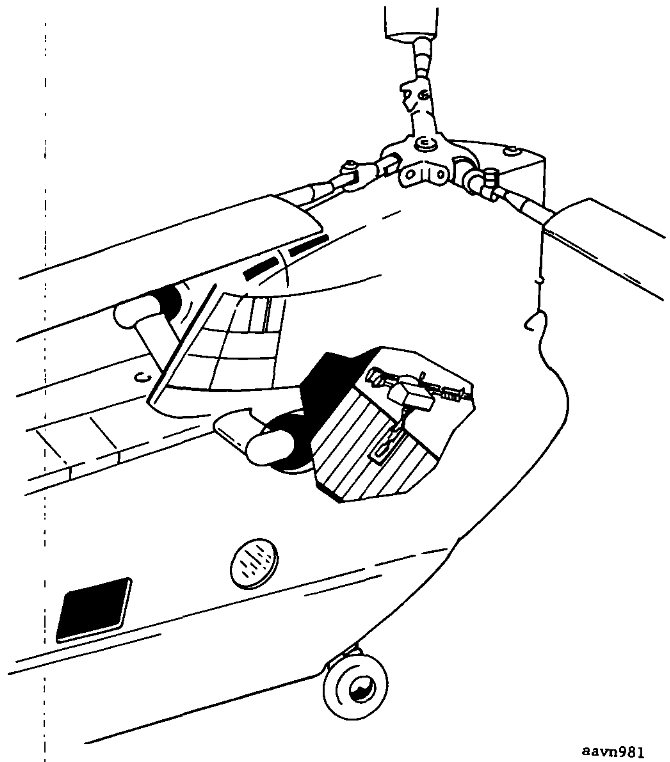


Figure J–4. XM41 armament subsystem installed on CH–47A helicopter.

APPENDIX K

HELICOPTER ARMAMENT AMMUNITION

K–1. General

Aircraft weapons subsystems require several types of standard and nonstandard munitions. For details concerning the munitions required for each subsystem, see the appropriate TM 9-series. This appendix lists munitions required for helicopter armament subsystems.

K–2. 7.62MM Ammunition

a. Commonly used 7.62mm (NATO) helicopter machinegun subsystem ammunition includes—

(1) M59 or M80—ball.

(2) M61—armor piercing (AP).

(3) M62—tracer.

b. Two additional types of 7.62mm ammunition not normally used in machinegun subsystems are —

(1) M63—dummy.

(2) M60—high-pressure, test.

K–3. Caliber .50 Ammunition

a. Numerous types of caliber .50 ammunition are used in helicopter armament subsystems including—

(1) M2—armor piercing.

(2) M8—armor piercing, incendiary.

(3) T49—armor piercing, incendiary.

(4) M20—armor piercing, incendiary, tracer.

(5) M33—ball.

(6) M1—incendiary.

(7) M23—incendiary.

(8) M1—tracer.

(9) M10—tracer.

(10) M17—tracer.

(11) M21—tracer.

b. Other caliber .50 ammunition available for training and testing includes—

(1) M1—blank.

(2) M2—dummy.

(3) M1—high-pressure, test.

K–4. 20MM Ammunition

Different types of 20mm guns are listed below with their ammunition type requirements.

a. M24A1, Gun, 20mm. Automatic, Single-Barrel.

(1) M95—armor piercing, tracer.

(2) M58—high explosive, incendiary.

(3) M97A1—high explosive, incendary.

(4) M96—incendiary.

(5) M99—target practice.

(6) M18—dummy.

b. Automatic 20mm Six-Barrel Gun: M61 and M61A1—Electric Drive; XM130—Gas Drive.

(1) T221E3—armor piercing, incendiary.

(2) M55A1—ball.

(3) M56A1 (T198E1)—high explosive, incendiary.

(4) M51 (T228)—dummy.

(5) M54 (T156)—high-pressure, test.

K–5. 30MM Ammunition

Ammunition for the XM140, gun 30mm, automatic (WECOM-30), single-barrel includes the XM552 cartridge, high explosive, dual purpose; the XM554, practice (spotter); and the XM639 (inert).

K–6. 40MM Ammunition

★*a*. The 40mm ammunition used in the M75 or XM129 launchers includes—

(1) M384—cartridge, high explosive.

(2) XM430—cartridge, high explosive dual purpose.

(3) XM574—cartridge, white phosphorous.

(4) XM596—cartridge, high explosive, proximity fuze.

b. To allow detonation at impact angles of from 90° to low graze angles of 5°, 40mm ammunition is provided with the M533 fuze.

K–7. 2.75-Inch Folding Fin Aerial Rockets (FFAR)

a. Launchers for the 2.75-inch FFAR include—

(1) XM141—seven tube, reloadable, reusable.

(2) XM157—seven tube, reloadable, reusable, not repairable.

(3) XM157B—seven tube, reloadable, reusable, extra long.

(4) XM158—seven tube, reloadable, resuable, repairable.

(5) XM159—19 tube reloadable, reusable, not repairable.

(6) XM159C—19 tube, reloadable, reusable.

★(7) XM200E1—19 tube, reloadable, reusable, repairable.

b. Warheads for the 2.75-inch FFAR are—

(1) Mk1—high explosive, 6 lb.

(2) Mk67—white phosphorous, 6 lb.

(3) M151—high explosive, 10 lb.

(4) XM152—high explosive, white phosphorous, red marker, 6 lb.

(5) XM153—high explosive, white phosphorous, yellow marker, 6 lb.

(6) M156—white phosphorous, 10 lb.

(7) XM157—smoke, red, 10 lb.

(8) XM158—smoke, yellow, 10 lb.

(9) XM229—high explosive, 17 lb.

(10) XM230—practice, 10 lb.

(11) XM232—practice, spotting, 10 lb.

(12) WDU—44/A—flechette, 10 lb.

c. Fuzes for the 2.75-inch FFAR include—

(1) M423E1—PD (graze sensitive).

(2) XM427—redesign of M423 to allow delayed arming.

(3) M429—proximity.

d. Types of 2.75-inch FFAR motors are—

(1) Mk4—high speed (unscarfed).

(2) Mk40—low speed (scarfed).

(3) Mk40—low speed (scarfed), redesign of Mk40.

K–8. M22 Missile Subsystem Ammunition

Ammunition for the M22 subsystem includes an AGM–22B guided missile with high explosive antitank warhead, an ATM–22B guided missile with inert warhead filled with a marking powder, and an ATM guided missile with completely inert warhead.

K–9. Munitions for Special Attack Helicopter Missions

The munitions listed below are not normally used in attack or limited attack helicopter roles and missions. However, they could be used on attack helicopters during special missions.

a. XM147—bomb, fragmentation (XM9).

b. XM142—bomb, antitank (XM9).

c. XM144—bomb fragmentation (XM25).

d. XM920E2—bomb, fuze and burster, CS in 55-gallon drum.

e. Mk24—flare, aircraft, parachute.

f. E158—50 lb. CS canister cluster.

g. E159—130 lb. CS canister cluster (two E/58 with strongback).

h. Helicopter trap weapon—to sanitize landing zones.

i. Fuel—air explosive, to sanitize landing zones.

j. E39R1—smoke tank (Kellet pylon).

k. XM52—smoke generator, exhaust stack mounted.

APPENDIX L
RECOMMENDED HELICOPTER RANGE FIRING AND SAFETY STANDING OPERATING PROCEDURES

Note. This recommended SOP provides guidance for unit commanders and staff officers in preparing their own SOP's. Each unit should develop range firing and safety SOP's applicable to their special situation.

Section I. GENERAL

L–1. Purpose

To establish range procedures and safety criteria for firing live ammunition from helicopter armament subsystems for training.

L–2. Scope

This SOP provides checklists, safety procedures, and range operating procedures for conducting helicopter range firing. For recommended door gunner range firing and safety standing operating procedures, see appendix M.

L–3. References

a. AR 385–63.

b. Local range safety regulations.

c. Local lesson plans for each armament subsystem.

d. Technical manuals (app A). (For details of safety procedures in loading and unloading ammunition, see appendixes C through J.)

L–4. Definitions

a. Diving fire—Fire delivered from a helicopter while descending in altitude toward the target.

b. Firing lane—The area of the range between the start-firing line and the cease-firing line.

c. Fixed or stowed weapons subsystem—A subsystem that is aimed at a target by the pilot alining the helicopter in heading and attitude with the target. A *fixed subsystem* (e.g., the M2 or XM3) does not have the capability of independent movement in relation to the helicopter. A *stowed subsystem* (e.g., the M6) is the emergency or standby status of a flexible weapons subsystem.

d. Flexible weapons subsystem—A subsystem that is aimed at a target (within design limits) independently of helicopter heading or attitude (e.g., the M5 or M6).

e. Hovering fire—Fire delivered from a helicopter at a stabilized altitude with zero groundspeed (hover).

f. Immediate action—The procedure applied to reduce any stoppage without attempting to determine its cause.

g. Loaded subsystem—Weapons subsystem condition when *any* ammunition is in the assembled subsystem and no positive physical action (e.g., gun barrels removed or firing circuit disconnected) is taken to prevent firing.

h. Malfunction—Any failure (stoppage) of the subsystem that cannot be remedied while in flight (e.g., partial ignition of missile and runaway gun).

i. Running fire—Fire delivered while helicopter is in level flight at any altitude.

j. Safety bridle—Any physical device to prevent a flexible weapons subsystem from moving past a desired deflection or elevation limit in the event of a subsystem malfunction.

k. Subsystem secured—All ammunition moved from the assembled subsystem, or components disassembled to positively prevent weapon loading.

l. Stoppage—The failure to fire due to an interruption in the cycle of operation (functioning) caused by the faulty action of a weapon or faulty ammunition.

m. Switches cold—Weapon subsystem loaded, arming switch in either the OFF or SAFE position, and no functioning possible.

n. Switches hot—Weapon subsystem loaded, arming switch in the ARMED position, and all components energized and ready for firing.

o. No-fly line—The line before which an aircraft must execute a turn to prevent penetrating a designated area (other range impact areas, restricted area, etc.).

L–5. Responsibilities

No live fire range may be operated without the range control officer being present. Personnel involved in attack helicopter range operation must maintain continuous surveillance over all aspects of range operation and report unsafe conditions to the officer in charge or to the range control officer. The proper loading, boresighting, stoppage clearance, and range firing procedures and safety precautions prescribed herein and contained in applicable references must be followed. Training is to be conducted as prescribed in the local lesson plan, insuring that all live ammunition is cleared from the helicopter at the end of the firing period.

a. Officer in Charge (OIC).

(1) Senior officer of participating unit using range.

(2) Responsible for overall supervision of range personnel, activities, firing, and safety.

b. Range Control Officer (RCO)/Safety Officer. A qualified officer assigned to the range must—

(1) Insure safe operation of the range.

(2) Be thoroughly familiar with range SOP and aircraft and armament emergency (preaccident) plan (para L–7).

c. Instructor Pilot. The instructor pilot must—

(1) Be thoroughly familiar with SOP, aircraft and armament emergency (preaccident) plan (para L–7), and local accident report form.

(2) Insure operation of assigned helicopter and weapons subsystem in accordance with prescribed procedures and applicable safety precautions.

(3) Be qualified in weapons subsystems.

(4) Be on board helicopter when training new individuals.

(5) Be familiar with the azimuth of range and sector azimuth limits.

(6) Direct arming and de-arming of weapons subsystem; de-arm subsystem when shooting results in impacts outside impact area.

(7) Insure conduct of training as prescribed in local lesson plan.

d. Radio Operator/Controller. The radio operator/controller must—

(1) Insure that radios are working properly.

(2) Open range upon order of RCO.

(3) Be thoroughly familiar with range SOP and aircraft and armament emergency (preaccident) plan (para L–7).

(4) Assist RCO as directed.

e. Senior Armorer. The senior armorer must insure—

(1) The control and proper use of enlisted personnel on the ground.

(2) That proper equipment and required personnel are at the range to conduct firing and give necessary ground support.

(3) That the proper amount and type of ammunition are on hand for range firing.

f. Noncommissioned Officer In Charge (NCOIC) of Ammunition Detail. The ammunition detail NCOIC must—

(1) Brief detail on—

(*a*) Safe handling of ammunition.

(*b*) Loading procedures.

(*c*) Safety measures for ammunition and helicopter.

(*d*) Vehicle and helicopter parking areas.

(2) Supervise detail at all times.

(3) Police area during and after firing.

(4) Control loose rounds. (Inspect personnel prior to releasing them.)

L–6. Checklists

a. Officer in Charge.

(1) Prior to firing—

(*a*) Obtain present and forecasted weather for the period of firing.

(*b*) Obtain helicopter tail numbers and assign them to instructor pilots.

(*c*) File flightplan for period of firing.

(*d*) Verify that required armament personnel and equipment are present.

(*e*) Verify ammunition loading by type and amount with senior armorer.

(*f*) Brief range control officer.

(*g*) Conduct gunner/pilot safety and range briefing as specified in local lesson plan.

(*h*) Prescribe helicopter formation for flight to the range.

(*i*) Monitor helicopter maintenance difficulties and coordinate any required maintenance.

(2) During firing—

(*a*) Supervise flight operations and safety procedures.

(*b*) Periodically observe and spot check ground operations.

(3) After firing—

(*a*) Verify completion of range closure and reports as required by the current range regulations.

(*b*) Debrief gunner/pilots as specified in local lesson plan.

(*c*) Report helicopter deficiencies, number of stoppages, and time lost as required.

(*d*) Supervise completion of reports and flight folders as prescribed by local range regulations.

b. Range Control Officer.

(1) *Prior to opening range for firing—*

(*a*) Obtain a range briefing from the post range officer as required by current local range regulations.

(*b*) Inspect firing line area, parking areas, ammunition loading areas, and area of range visible from control tower for safety hazards and proper positioning of vehicles, helicopters, and equipment.

(*c*) Brief crash-rescue team and—

1. Determine any firefighting vehicle or equipment deficiencies.

2. Determine if equipment has been fully checked out.

3. Check qualifications of emergency crew (minimum of two must be qualified crewmen).

4. Brief crew leader on—

(a) Desired standby location to insure immediate availability to control tower or vehicles.

(b) Helicopter range, orbit operating areas, and specific range activities for firing to be conducted each day.

(c) Knowledge of access routes to helicopter operating areas.

(d) Notification and dispatch of emergency crew (will only be by RCO or radio operator/controller).

(e) Methods of emergency clearing of armament subsystem in crash-rescue operations.

(f) General crash/emergency procedures as prescribed in aircraft and armament emergency (preaccident) plan (para L-7).

5. Brief ambulance driver on route to take to the hospital.

6. Check qualification of first aid man.

7. Determine deficiencies of ambulance vehicle or first aid equipment. The following equipment must be present:

(a) Two litters.

(b) One blanket set.

(c) One first aid kit.

(d) One splint set.

(e) One bottle of impregnated salt tablets (100).

(f) Two canteens filled with water.

(*d*) Brief senior armorer. Determine deficiencies of personnel and/or equipment. Prescribe vehicle parking area, and organization and operation of crew to service attack helicopters. Review the following safety precautions as required:

1. Approach attack helicopter from side only, staying clear of rotors and subsystems' flexible limits of movement.

2. Inspect each weapons subsystem for safety prior to loading for firing.

3. No smoking allowed within 50 feet of helicopters or ammunition.

4. Use available protective devices; i.e., ear plugs, dust goggles, etc.

5. Use containers for collection of ammunition and brass.

(*e*) Brief NCOIC of ammunition detail. Determine ammunition count and any equipment deficiencies. Check the organization and operation of the ammunition detail and review the following safety precautions as required:

1. Safe handling of ammunition.

2. Cleanliness of ammunition (freedom from sand, dirt, grease, etc.).

3. No smoking allowed within 50 feet of ammunition or helicopter.

4. Use of protective devices available; i.e., ear plugs, dust goggles, etc.

5. Control of loose rounds.

(*f*) Brief refueling personnel on helicopter refueling and vehicle parking areas and range safety. Refueling personnel must contact RCO for release from range.

(*g*) Contact range headquarters for clearance to fire; record name of person giving clearance and time.

(*h*) Before firing, insure that first aid man, ambulance, and ambulance driver are present; range flag is up; and range sweep by helicopter is complete.

(2) *During firing*—

(*a*) Maintain positive radio control of all helicopters operating on the range.

(*b*) From control tower observe all visible range activities for efficiency and safety.

(*c*) As helicopter control situation (proficiency of radio operator/controller) permits, report to official visitors and inspecting officers.

(*d*) Release POL vehicle when all scheduled refueling is completed.

(*e*) Maintain record by name of personnel aboard each helicopter.

(*f*) Maintain a record of the number of helicopter armament stoppages (by helicopter tail number and total time lost).

(3) *After firing*—

(*a*) Close range with range headquarters as required by range regulations and record time and name of person receiving report.

(*b*) Inspect range area to insure that—

1. Range flag has been lowered.

2. Building(s) and tower are secured.

3. Operating areas (firing line, tower, and parking areas) are policed.

4. Mutilated and live ammunition and expended brass are policed from firing line and placed in appropriate boxes for return to ammunition dump.

(*c*) Release armament detail.

(*d*) Notify crash-rescue team, ambulance, and civilian/military maintenance personnel that firing is completed. Depart only after last helicopter is airborne.

c. Instructor Pilot.

(1) Check for proper procedures and safety in loading, boresighting, test firing, and stoppage clearance by all personnel in the vicinity of the helicopter.

(2) Continually observe all aspects of range operation and report unsafe conditions to the OIC or RCO.

(3) Insure that firing is conducted only when—

(*a*) Helicopter is on course.

(*b*) All weapons are aimed at target.

(4) Insure that all live ammunition is cleared from the helicopter at the conclusion of the firing period.

d. Radio Operator/Controller.

(1) Put up range flag.

(2) Turn on range tower radios, and make sure they are working properly.

(3) Review range SOP.

(4) Open range upon order of RCO.

(5) Assist ROC in traffic control as per range SOP.

(6) Close range upon order of RCO.

(7) Turn off radios.

(8) Take down range flag.

e. Senior Armorer.

(1) *Prior to firing–*

(*a*) Check personnel and equipment.

(*b*) Obtain helicopter tail numbers and verify that ammunition loading is correct.

(*c*) Assign duties to crew (armorers to helicopter and driver to vehicle, etc.).

(*d*) Brief crew as follows:

1. Location of helicopter parking areas.

2. Location of vehicle parking areas.

3. Type of firing table, ammunition load, etc.

4. Review the following safety precautions as required:

(a) Approach and depart vicinity of helicopter from side only after visual recognition from instructor pilot in the helicopter.

(b) Last man to leave vicinity of helicopter will give "all clear" signal to instructor pilot.

(c) Remain to rear of loaded subsystem at all times.

(d) Secure subsystem before anyone enters or leaves the helicopter or as directed by instructor pilot.

(e) Remain clear of subsystem areas during boresighting, etc.

(f) Check subsystem only when arming switch is in "cold" position.

(g) Check proper installation of safety bridles.

(h) No smoking within 50 feet of ammunition or helicopter.

(i) Use available protective devices; i.e., ear protectors.

(j) Secure loose equipment in helicopter.

***Caution:* In case of emergency, stay at duty position until directed otherwise by officer or NCOIC.**

(*e*) Visually inspect range area on and behind firing line for safety.

(2) *During firing:* Supervise all armament crew activities for operation and safety.

(3) *After firing:*

(*a*) Police firing line for—

1. Live rounds in specified container for return to ammunition area.

2. Expended brass in specified container for turn in to ammunition area.

(*b*) Police range areas behind firing line (parking areas, in vicinity of tower, etc.).

(*c*) Check security of buildings and equipment on the range.

(*d*) Check security of buildings and equipment at classroom/briefing area.

f. NCOIC of Ammunition Detail.

(1) Brief detail as follows:

(*a*) Safe handling of ammunition.

(*b*) Loading procedures.

(*c*) Safety measures for ammunition and helicopter.

(*d*) Location of vehicle and helicopter parking areas.

(2) Supervise detail at all times.

(3) Police area during and after firing.

(4) Control loose rounds. (Inspect personnel prior to releasing them.)

Section II. EMERGENCY PLANS

L–7. Aircraft and Armament Emergency (Preaccident) Plan

a. Purpose. The aircraft and armament emergency (preaccident) plan prescribes the procedures to be followed in the event of an aircraft emergency (accident, incident, or inadvertent firing) during conduct of range firing.

b. RCO/Controller Checklist. Any emergency (*a* above) will be reported immediately by the RCO or any officer on the range as prescribed by local range regulations. The preaccident plan will be initiated upon receipt of this report.

(1) Report the following by radio or telephone:

(*a*) Location of accident.

(*b*) Time accident occurred.

(*c*) Type aircraft involved.

(*d*) Injuries to personnel, if any.

(*e*) Other pertinent facts available.

Note. Individuals involved in an accident will complete a report (on the local form provided) at the scene of the accident as soon as practical and turn it in to the unit safety officer.

(2) Dispatch ambulance and crash-rescue team to the site simultaneously with report ((1) above).

(3) Designate one helicopter to proceed to crash site to assist the ambulance and crash-rescue team and to establish radio communications at the crash site.

(4) Designate one helicopter to orbit crash site at 1,500 feet absolute altitude and guide rescue helicopter to the area by radio.

(5) Direct remaining helicopters to firing line or loading area to await further instructions.

(6) Notify post range officer by telephone. Request that other ranges cease fire until further notice, depending on the location of the crash.

(7) As soon thereafter as possible, report by telephone to *one* of the following—in this order:

(*a*) Immediate supervisor.

(*b*) Commander.

(*c*) Operations officer.

L–8. Crash-Rescue Plan

The crash-rescue plan—

a. Provides for a minimum of two helicopters on range for live firing.

b. Provides for an ambulance, as required by regulations.

c. Recommends crash-rescue team for range.

d. Defines responsibilities of helicopter crew while in the air.

e. Defines responsibilities of officers and NCO's while on the ground.

f. In order of priority, list names and telephone numbers of individuals to be notified in the event of a crash.

L–9. Malfunctions Involving Ammunition

a. Malfunctions include—

(1) Hangfires.

(2) Preinitiation.

(3) Duds.

b. In the event of such a malfunction—

(1) Attempt to jettison missiles in a safe area.

(2) Notify the range safety officer immediately of action taken or failure of missiles to jettison. If missiles fail to jettison, land helicopter as directed by the range safety officer at a location which will assure safety of personnel and facilities. Evacuate helicopter and await assistance.

(3) Explosive ordnance disposal personnel, if available on the range to support range firing, will render any assistance necessary to eliminate explosive hazards and make the situation safe.

(4) The range safety officer will immediately notify the post ammunition officer of the type, location, and nature of the ammunition malfunction. The ammunition officer will obtain the assistance of explosive ordnance disposal personnel, unless such personnel have been provided to support range operations, and will investigate malfunctions.

L–10. Safety Control Plan

A diagram will be made outlining each range. This diagram will show the location of range facilities, any appropriate range fan information, and flight routes to and from the firing lane. Examples of specific safety instructions include—

a. Minimum altitudes to be flown over adjacent areas.

b. Other range impact areas to be avoided.

c. Hazards to flight during low altitude runs on targets; e.g., high trees at the end of the firing lane. Pullups must be initiated in sufficient time to clear all obstacles.

d. Possible cautions for—

(1) Conducting nap-of-the-earth operations in the early morning or late afternoon if the range is oriented into the sun.

(2) Other aircraft operating in the vicinity.

(3) Operation in vicinity of a highway.

Section III. RANGE SAFETY

L–11. Range Facilities

Range flag(s), road guards, and range markers are as prescribed by local range regulations. Range facilities include the following:

a. Control Tower. A control tower is located on each firing range. Each tower is equipped with radios, telephones, and an emergency warning device. Positive control over all range activities is exercised from the control tower.

b. Markers.

(1) *Start-firing line.* The start-firing line on each range may consist of an asphalt or concrete pad, with parking spots marked for each helicopter. Approaches to and from the start-firing line will be kept clear of all vehicles, obstructions, and loose objects likely to interfere with helicopter operations.

(2) *Cease-fire line.*

(3) *No-fly line.*

c. Helicopter Parking and Refueling Areas. When available, helicopter parking and refueling areas are located adjacent to the start-firing line and are used by all helicopters not actively engaged in training. When separate parking and refueling areas are not available, parking and refueling areas may be located on or near the start-firing line (*b*(1) above). Helicopter landing areas should be protected from dust to prevent visibility hazards and damage to helicopter components.

d. Vehicle Parking Areas. When space is available, separate vehicle parking areas are located clear of all aircraft operations. If separate parking areas are not available, parking areas will be located near the control tower on the opposite side from the firing line. Whenever possible, military vehicles will be unloaded and parked in designated areas away from aircraft operations. Civilian vehicles will be parked in designated areas completely clear of all aircraft and military vehicle operations.

e. Ammunition Areas. When applicable, ammunition areas are located in an area separate from other activities and adjacent to the helicopter parking and refueling area. Whenever possible, ammunition preparation and loading activities should be shielded from blowing dust and dirt.

f. Communications.

(1) Two-way radio communications will be established and maintained with all helicopters operating on the range.

(2) Telephone communications with range headquarters will be established and maintained at all times while the range is in operation. In an emergency, radio communication to another range tower that has telephone communication is acceptable until emergency repairs are completed.

L–12. Air Safety

a. Weather.

(1) Minimum visibility for range firing is 1 nautical mile.

(2) Minimum ceiling for range firing is clear of clouds.

(3) Wind limitations depend on—

(*a*) Local flying regulations.

(*b*) Aircraft flight limitations.

(*c*) Judgment of the range officer in charge.

b. Helicopters.

(1) Operational helicopters must have a minimum of one radio for two-way communication with the control tower.

(2) Helicopters will not be operated with any unsecured equipment in the pilot and/or cargo compartment.

(3) Passengers or observers will not be carried in helicopters operating on the range unless individually approved by the range officer in charge.

(4) Armament subsystems must be "secured" en route to and from the firing range.

c. Routes. Low-level training flights will be restricted to previously reconnoitered routes. All hazards to low-level flight, especially wire hazards, will be appropriately marked on an up-to-date map overlay. Overlays will show flight routes to and from ranges, specified flight altitudes, and hours between which these flights may take place.

***Caution:* Helicopters with loaded weapons should not overfly inhabited areas.**

(1) *En route procedures.*

(*a*) To provide additional aviator training in formation flying, helicopters will fly in formation whenever practical. Minimum distance between helicopters is 1½-rotor diameters.

(*b*) Minimum en route altitude away from populated areas is 100 feet absolute altitude; nap-of-the-earth techniques (altitudes) will apply for range operation.

(*c*) Formation landings and takeoffs are authorized.

(2) *Return from the ranges and helicopter shutdown.*

(*a*) Prior to departure of helicopters for home station, subsystems will be secured and deactivated at the range.

(*b*) Following helicopter shutdown, all ammunition will be removed from the helicopter.

L-13. Ground Safety

a. All personnel (including helicopter crews) will avoid passing in front of loaded armament subsystems.

b. Personnel will approach the helicopter from the 90 side position and only after receiving visual recognition from the instructor in the helicopter.

c. All personnel will exercise extreme caution while walking under the main rotor arc or in the vicinity of the tail rotor.

d. Helicopter will not be moved until an armorer moves out of the main rotor arc at the 90° side position and signals "all clear."

e. Hand and arm signals between the instructor pilot/gunner and armorers will be standardized and reviewed in all safety meetings prior to range firing. For suggested hand and arm signals between instructor pilot/gunner and armorers, see figure L-1.

f. Only authorized personnel who have received training in range operating and safety procedures will perform armorer duties.

L-14. Armament Subsystem Safety

a. General.

(1) Whenever possible, armament subsystems will be pointed downrange or away from all populated areas during all range operations.

(2) Armament subsystems are considered safe for range traffic pattern operations under "switches cold" conditions.

(3) Armament subsystems will go "switches hot" only if *all* of the following conditions are satisfied:

(*a*) Helicopter is on or past the start-firing line and is pointed downrange in the firing lane.

(*b*) No other aircraft are downrange in the range danger zone. (Helicopters maintaining lateral positions to each other may be cleared by control tower to conduct formation firing and team training.)

(*c*) Clearance is received from control tower to go "switches hot."

(4) The operation and position of the arming switch is the responsibility of the instructor pilot or designated safety observer.

(5) The instructor pilot or designated safety observer is responsible for all required radio calls pertaining to range operations.

(6) Whenever possible and except when firing downrange or for practice runs within the maneuvering areas, helicopter will be flown at an altitude and over terrain where a forced landing could be safely completed.

b. M6 Quad Machinegun Subsystem.

(1) Safety bridles will be installed for all stowed position firing.

(2) Armorers will remain clear of guns until arming switch is in the SAFE or OFF position.

(3) Helicopter crewmembers will not depart helicopter until subsystem is secured by removing gun barrels. Pilot's or copilot's door will not be opened until guns are secured.

(4) Helicopter crewmembers will remain clear of open windows in copilot's and pilot's door during firing. Cargo doors will be closed during firing.

(5) To prevent collision with ricochets, minimum slant range to bullet impact is 100 meters.

c. M2 Twin Machinegun Subsystem.

(1) Armorers will remain clear of guns until arming switch is placed in the SAFE position.

(2) Top cover of machineguns will not be opened until barrel is removed.

(3) If runaway gun occurs, helicopter will be flown into impact area with the subsystem aimed downrange until ammunition is expended.

(4) When doors are removed, helicopter crewmembers will keep themselves completely inside the helicopter and clear of doorways.

(5) To prevent collision with ricochets, minimum slant range to bullet impact is 100 meters.

d. XM3 2.75-Inch Area Rocket Weapons Subsystem.

(1) To prevent collision with rocket fragments, minimum slant range to rocket impact is 300 meters.

(2) Helicopter crewmembers will not enter or leave rocket-loaded helicopter until the rocket subsystem is electrically disconnected from the helicopter.

(3) Cargo doors will be closed during firing.

(4) Rocket subsystem will not be energized until inbound on firing run; subsystem will go "switches hot" on or past the start-firing line.

(5) Misfire procedures.

(*a*) Attempt to fire subsystem rockets while helicopter remains pointed downrange on or past the start-firing line.

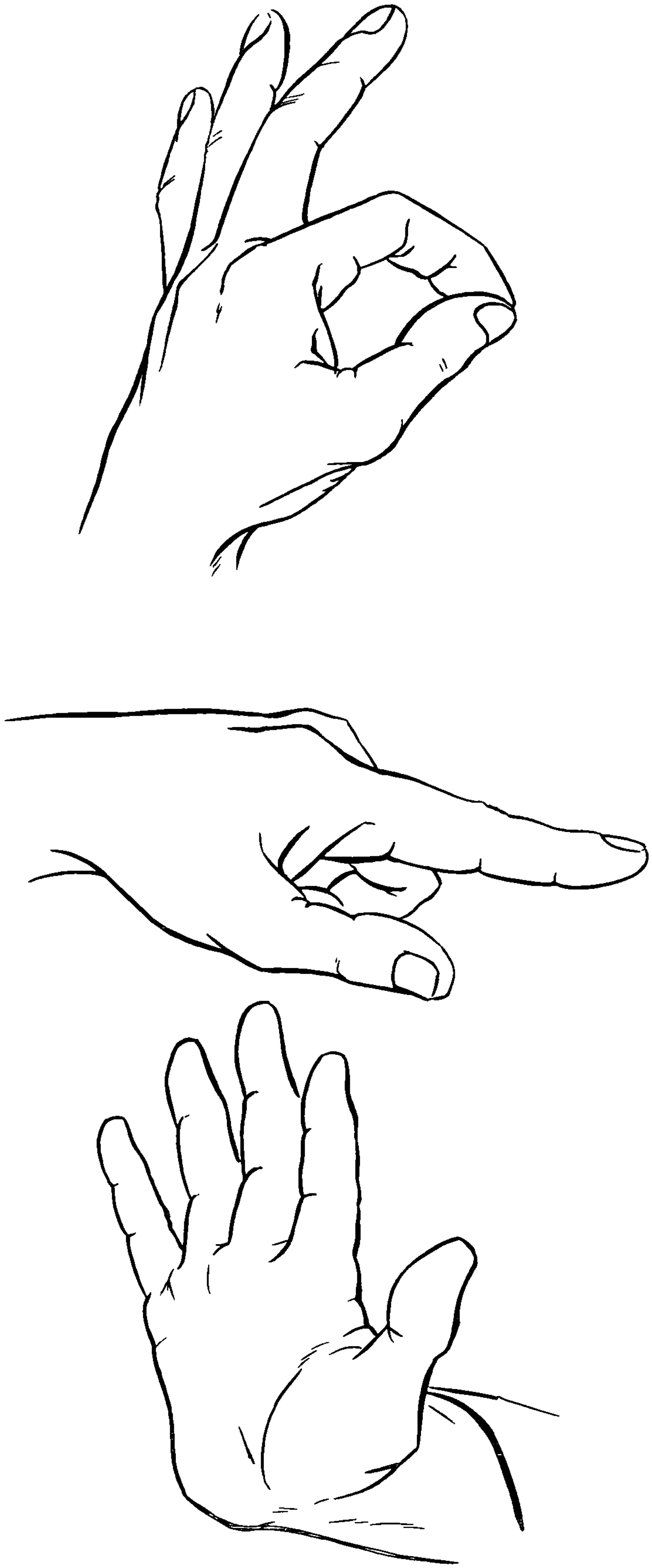
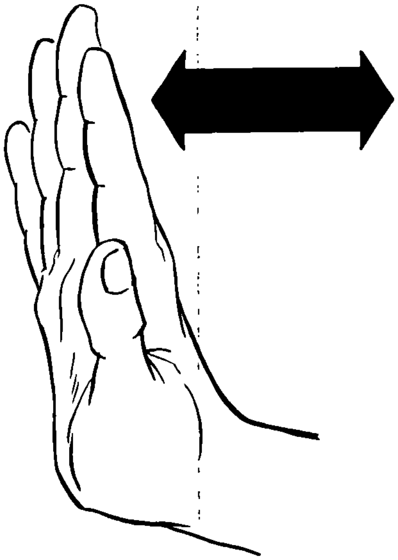
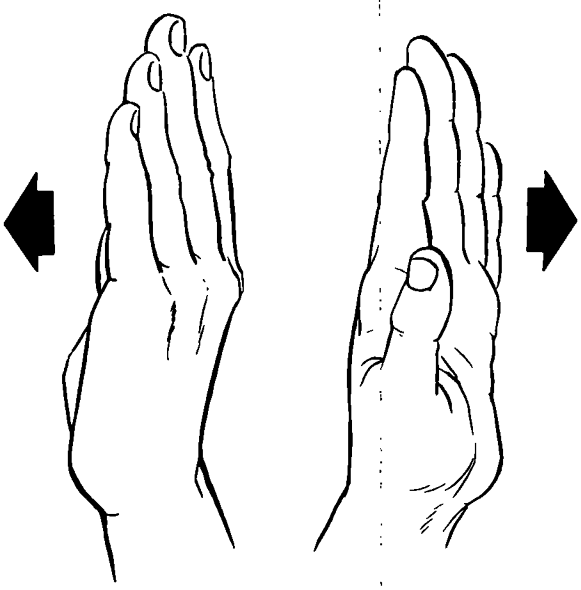


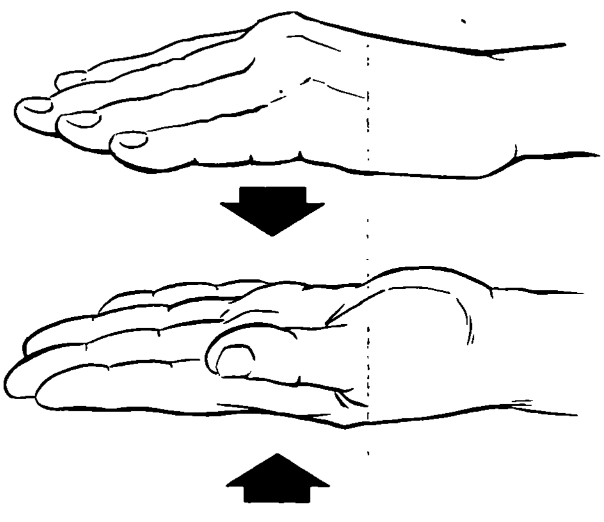
Figure L–1. Suggested hand signals for armorers and gunners.



D. CLEAR AIRCRAFT - MOVE CLEAR OF AIRCRAFT BY A DISTANCE OF 50 FEET.



E. AZIMUTH ADJUSTMENT - HAND UP, PALM TOWARD DIRECTION ADJUSTMENT DESIRED. MAGNITUDE OF MOVEMENT INDICATES RELATIVE AMOUNT OF ADJUSTMENT REQUIRED.



F. ELEVATION ADJUSTMENT - HAND OUT, PALM UP OR DOWN TO INDICATE ADJUSTMENT DESIRED.

aavn983

Figure L-1—Continued.

G. STOPPAGE OF BOTH GUNS.

H. UPPER STOPPAGE.

I. LOWER STOPPAGE.

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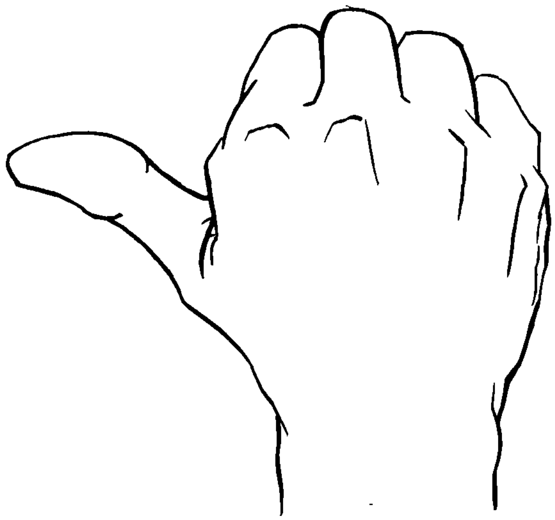
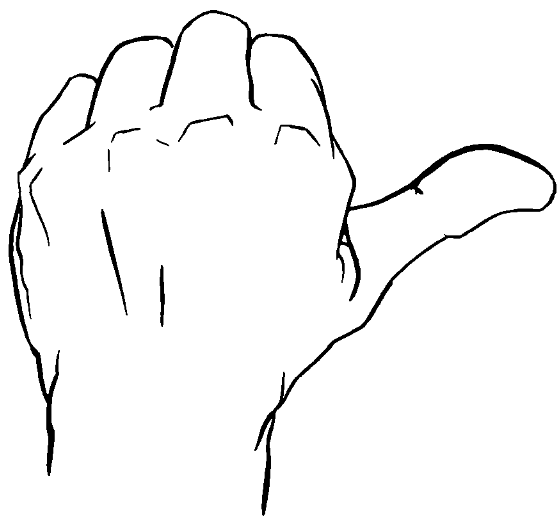
Figure L–1—Continued.



J. STOPPAGE ON LEFT SIDE.



K. STOPPAGE ON RIGHT SIDE.

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Figure L-1—Continued.

(*b*) Keep subsystem pointed downrange for 15 seconds after last attempt to fire.

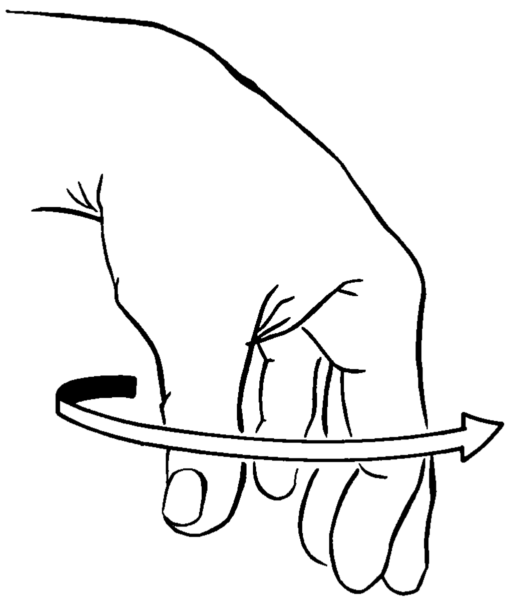
(*c*) Deenergize the subsystem; return to firing line, and land helicopter with subsystem pointing downrange.

(*d*) Ground helicopter, wait 15 seconds, and electrically disconnect the rocket subsystem and remove the misfires.

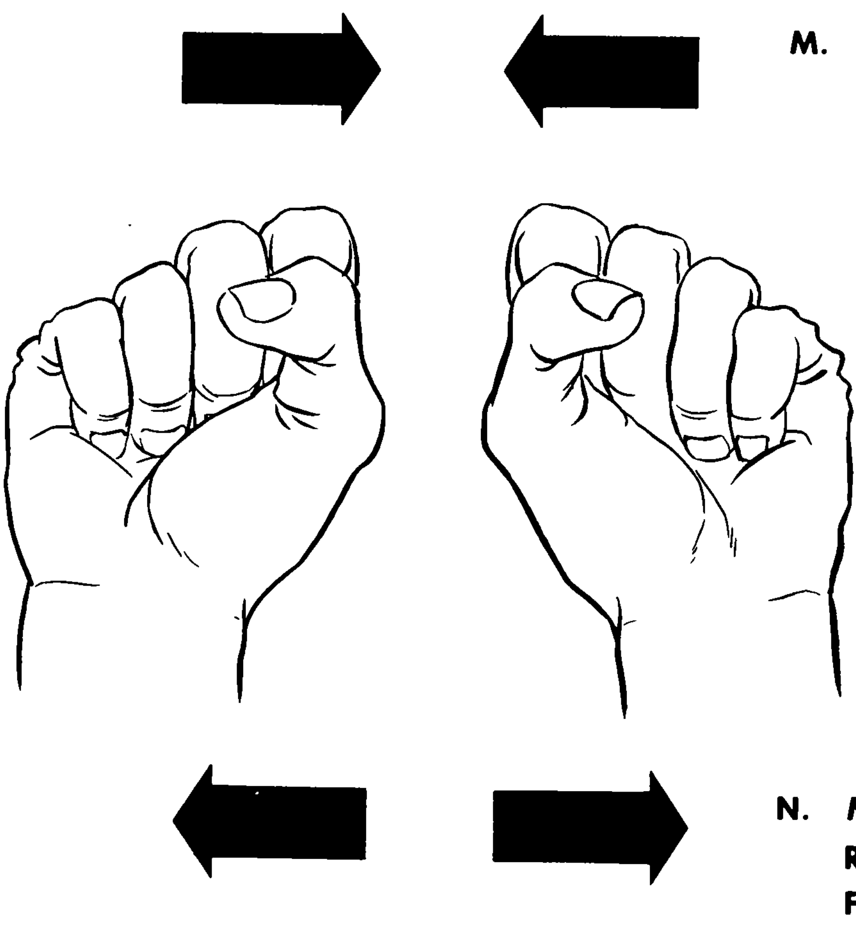
(*e*) Place the misfires in a defilade location well clear (approximately 100 meters) of all personnel and activities; notify explosive ordnance disposal (EOD).

e. M22 Guided Missile Launcher Helicopter Armament Subsystem. For details of M22 armament subsystem safety procedures, see appendix E.

f. M5 40mm Grenade Launcher. For details of



L. CONNECT CANNON PLUG ON ROCKET LAUNCHER - POINT TO SIDE TO BE CONNECTED.

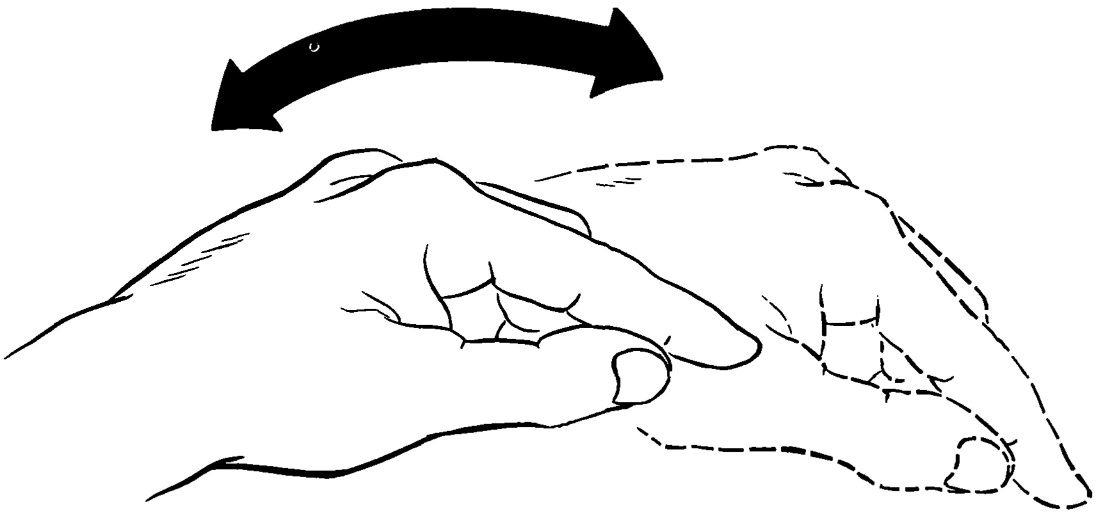


M. MOVE HANDS TOGETHER - PLACE BARRELS IN MACHINEGUNS.

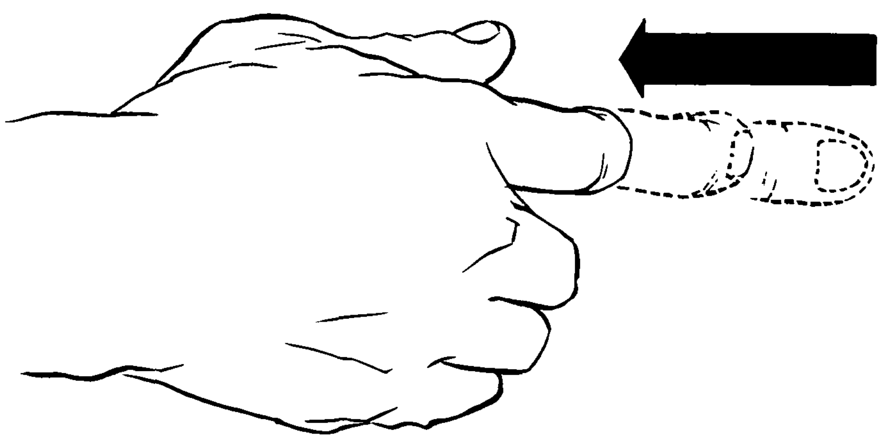
N. MOVE HANDS APART - REMOVE BARRELS FROM MACHINEGUNS.

aavn1047

Figure L-1—Continued.



O. SAFE - ARM. SIMULATED MOVEMENT OF SWITCH TO REAR INDICATES PLACE SWITCH SAFE. SIMULATED MOVEMENT OF SWITCH FORWARD INDICATES PLACE SWITCH ARMED.



P. DEPRESS ACTION SWITCH. MOVEMENT OF FINGER TO REAR INDICATES DEPRESS ACTION SWITCH.

aavn986

Figure L–1—Continued.

M5 armament subsystem safety procedures, see appendix F.

g. M16 Combination 7.62mm Machinegun and 2.75-Inch Rocket Subsystem. For subsystem safety procedures in *b* and *d* above apply.

h. M21 Combination High Rate 7.62mm Automatic Gun and 2.75-Inch Rocket Subsystem. For details of M21 armament subsystem safety procedures, see TM 9–1090–202–12.

Section IV. RANGE OPERATION

L–15. Range Preparation

a. Range Sweep. One or more helicopters will inspect the firing lane and adjacent range for areas on each side up to helicopter turn-around line for the presence of any personnel and privately- or Government-owned vehicles or equipment. Report range area clear to range control officer. Presence of range guards will be checked as directed.

b. Officer in Charge Tasks.

(1) Complete checklist (para L–6*a*).

(2) Establish radio communications with helicopters operating on this range.

(3) When all requirements are met, request permission from range headquarters to open fire on the range.

c. Landing on Firing Line. Helicopters will land on marked spots on the firing line with armament subsystem pointed downrange in the firing lane.

d. Range Control. Aircraft may be used for range control. Control aircraft—

(1) May not take part in firing.

(2) Must remain behind the start-firing line.

(3) Will remain above helicopters participating in range firing.

L–16. Loading, Boresighting, Harmonization, and Test Firing

a. Helicopters may be loaded and prepared for firing after arrival at the range.

b. Safety devices will be installed as required.

c. Gunners/instructor pilots will request permission from the RCO to fire from the firing line.

d. Standardized hand and arm signals between the instructor pilot/gunner and armorers will be used as required for boresighting, harmonization, test firing, and troubleshooting (fig. L–1).

e. Upon completion of loading, boresighting, harmonization, and test firing (as appropriate), the instructor pilot will declare "switches cold" and request to initiate a firing exercise, takeoff to maneuvering area, etc. All helicopter movement will be on or behind the firing line unless specifically approved for downrange operations.

f. All clearances from the control tower will include the specific action that is approved. For example, "Seven three cleared hot, test fire"; or, "Seven three cleared left, break to high orbit."

g. When appropriate, any helicopter pilot not reporting "switches cold" will be challenged immediately by control tower—"Check switches cold."

L–17. Traffic Patterns

a. Orbit-Maneuver Area.

(1) *Requirements.* The range should have an orbit-maneuver area when—

(*a*) Two or more helicopters are using the range.

(*b*) The density of other aircraft creates hazardous conditions.

(2) *Characteristics.*

(*a*) Orbit-maneuver area is approximately 3,000 meters square.

(*b*) It contains adequate areas for forced landing.

b. Operating Helicopters. The ideal number of helicopters using the range is three: one in firing lane (except when team firing is being conducted), one clear of danger zone and returning to orbit area, and one in orbit area waiting for clearance down range.

c. Control of Traffic Patterns.

(1) *Range area.* The range control officer has absolute control of helicopters operating on range. He must know where each helicopter is and what it is doing. Armed/attack helicopter pilots must report—

(*a*) Going "hot."

(*b*) Weapons subsystem safe.

(*c*) Clear of the range.

(2) *Firing.* When the helicopter has completed firing—

(*a*) Armament subsystems will be "cold."

(*b*) Helicopters will leave range as specified by SOP.

(3) *Orbit area.*

(*a*) As range firing helicopter leaves orbit area, the next helicopter to go on the range then descends to the lowest altitude.

(*b*) Other helicopters will orbit at high altitudes.

L-18. Conduct of Firing Exercises

a. Helicopter pilots will be cleared for firing runs as follows:

(1) From firing line—"Seven three cleared downrange, hot."

(2) In flight—"Seven three cleared inbound."

(3) When range is clear—"Seven three cleared hot at the firing line."

b. Helicopter pilots may request orbiting fire. Reports will be as follows:

(1) "Switches cold, orbit right" (left).

(2) "Switches hot" (when alined on target).

(3) After last orbit, "Switches cold, breaking right" (left).

c. Two or more helicopter pilots may be cleared to conduct hovering and bobbing fire simultaneously from lateral positions. Firing must be from the fixed or stowed position with safety bridles installed as appropriate. Lateral positions may be on the firing line or downrange in the firing lane, depending on the terrain.

d. Prior to reaching the cease-fire line, the OFF-SAFE-ARMED switch will be placed in the SAFE or OFF position, a turn short of the turnaround line initiated, and a report given as follows: "Switches cold, breaking right" (left).

e. After the helicopter pilot reports "Switches cold, breaking right" (left), the helicopter pilot will then clear the range surface danger zone by the most direct route having forced landing area available. Airspeed will be increased to the maximum practical safe limit to clear the range as soon as possible. Report "Clear of the range" upon passing a known terrain feature that is outside the surface danger area.

f. A helicopter pilot desiring to return to the firing line will so indicate upon breaking right (left). A helicopter pilot awaiting another firing run will enter high or low orbit in the maneuvering area or be cleared for another run.

g. A helicopter pilot in low orbit will plan his inbound approach to a firing run to cross the firing line as soon as possible after the downrange helicopter pilot reports clear at the range. Normally, this does not exceed 10 seconds.

h. When gunner/pilot training period on range firing is completed (ammunition expended), the helicopter pilot will report his fact to the control tower to allow remaining helicopter gunners/pilots to continue firing uninterruptedly.

Section V. PROGRAM OF INSTRUCTION FOR GUNNERY AND RANGE FIRING

L-19. Gunnery Training Program of Instruction

To qualify selected personnel in the techniques of aerial gunnery, training will be designed to meet the needs of each unit and gunner/aviator concerned. The training should emphasize techniques involving minimum altitude observation, target acquisition, navigation, and related subjects. Such training, however, should include as a minimum the subjects and time allocated below.

Subject	Hours	Type	Scope	References*
M21 introduction	1	Conference	Conference covering M21 armament subsystem used on UH-1B/C helicopters, to include all components and sighting systems. Describe characteristics, capabilities, and limitations of the subsystem, and its effect on operation of the helicopter.	Appendix D; TM 55-1520-219-10, 55-1520-220-10.
★M134 7.62mm machinegun disassembly, assembly, and troubleshooting.	1	Conference and practical exercise.	Conference and practical exercise covering detailed disassembly, assembly, and troubleshooting of the M134 7.62mm machinegun.	TM 9-1090-202-35.
Principles of aerial fire ballistics.	1	Conference	Conference on principles of aerial fire ballistics, including the three phases, with particular emphasis on aerial rocket ballistics.	Chapter 2.
★Aerial weapons; techniques of fire.	1	Conference	Conference on techniques used in aerial fire to include range estimation and target analysis. Emphasis is placed on aerial rocketry.	Section III, chapter 2; chapters 6 and 10; TM 9-1055-217-20.

*Unless otherwise noted, references are to this publication.

Subject	Hours	Type	Scope	References*
XM3, M16, and M21 alinement and boresighting procedures.	2	Conference	Conference and demonstration covering the procedures and techniques used in boresighting.	Appendix D; TM 9-1055-217-20, 9-1090-202-12, 9-1090-202-35.
★Ammunition and safety.	1	Conference	Conference and demonstration covering the various types of ammunition and proper loading, handling, and operating procedures.	Paragraphs 1-8, 1-9, 4-12, 10-10, 12-3, 12-7, 13-15, 13-18; appendix K; TM 9-1090-202-12, 9-1300-200, 9-1300-206.
★M16 and M21 operting loading, and emergency procedures.	2	Conference	Conference and practical exercise covering detailed description of procedures used in loading and operating the M16 and M21 subsystems including emergency procedures.	Appendix D; TM 9-1090-202-12.
XM3 introduction**	1	Conference	Conference covering the general characteristics of the XM3 subsystem, to include functioning, preflight check, and emergency procedures.	Appendix D.
M5 introduction**	1	Conference	Conference covering the general characteristics of the M5 armament subsystem (including sighting system), to include description, nomenclature, functioning, capabilities, and limitations of the subsystem, and its effect on the operation of the UH-1 helicopter.	Appendix F.
M6 introduction**	1	Conference	Conference covering the general characteristics of the M6 armament subsystem, to include description, nomenclature, functioning, capabilities, and limitations of the subsystem, and its effect on operation of the UH-1 helicopter.	Appendix C.
M16 introduction**	1	Conference	Conference covering M16 armament subsystem used on UH-1 helicopters, to include all components and sighting systems. Describe characteristics, capabilities, and limitations of the subsystem, and its effect on operation of the helicopter.	Appendix D.
M22 introduction**	2	Conference	Conference covering missile description, nomenclature, theory of operation, inspection, M22 control and guidance equipment, and functioning, nomenclature, and description of M55 and XM58 sights.	Appendix E.
★Armor and its employment.	3	Conference	Conference on armored vehicles to include description, antiaircraft capability, vulnerability, and traditional employment.	FM 17-1, 17-36, 17-37.
★Target recognition	2	Conference and practical exercise.	A conference on developing a systematic method of detecting and identifying targets found within the battle area to include basic characteristics, methods of detection, and recording and identifying targets; also a practical exercise on target recognition.	FM 1-80.

*Unless otherwise noted, references are to this publication.
**This training is not required for individuals already familiar with this armament subsystem.

Subject	Hours	Type	Scope	References*
Rotary wing aerial fire ranges.	2	Conference	A detailed discussion of the range requirements to support rotary wing aerial fire training on all approved weapons subsystems to include appropriate references, safety procedures, range fans, terrain requirements, range dimensions, target locations and materials, range marking, and supervisory responsibilities.	Chapter 13; AR 385–63.
Low-level navigation	3	Conference and practical exercises.	Advanced low-level flight, planning techniques, map selection and preparation, selection of route checkpoint and air control point, inflight procedures to include inflight change-of route procedures, and flight and radio discipline.	FM 21–26; TM 1–225.
Attack helicopter employment.	2	Conference	Conference covering tactical employment of attack helicopters to include considerations for target attacks, a summary of types of attack helicopter missions, and typical organization for combat.	Chapters 3, 4, 5, and 7; FM 1–100.
Range firing	10	Practical exercise	Practical exercise on air-to-ground firing techniques using all armament subsystems.	Appendixes L and M.

*Unless otherwise noted, references are to this publication.

L–20. Ranges

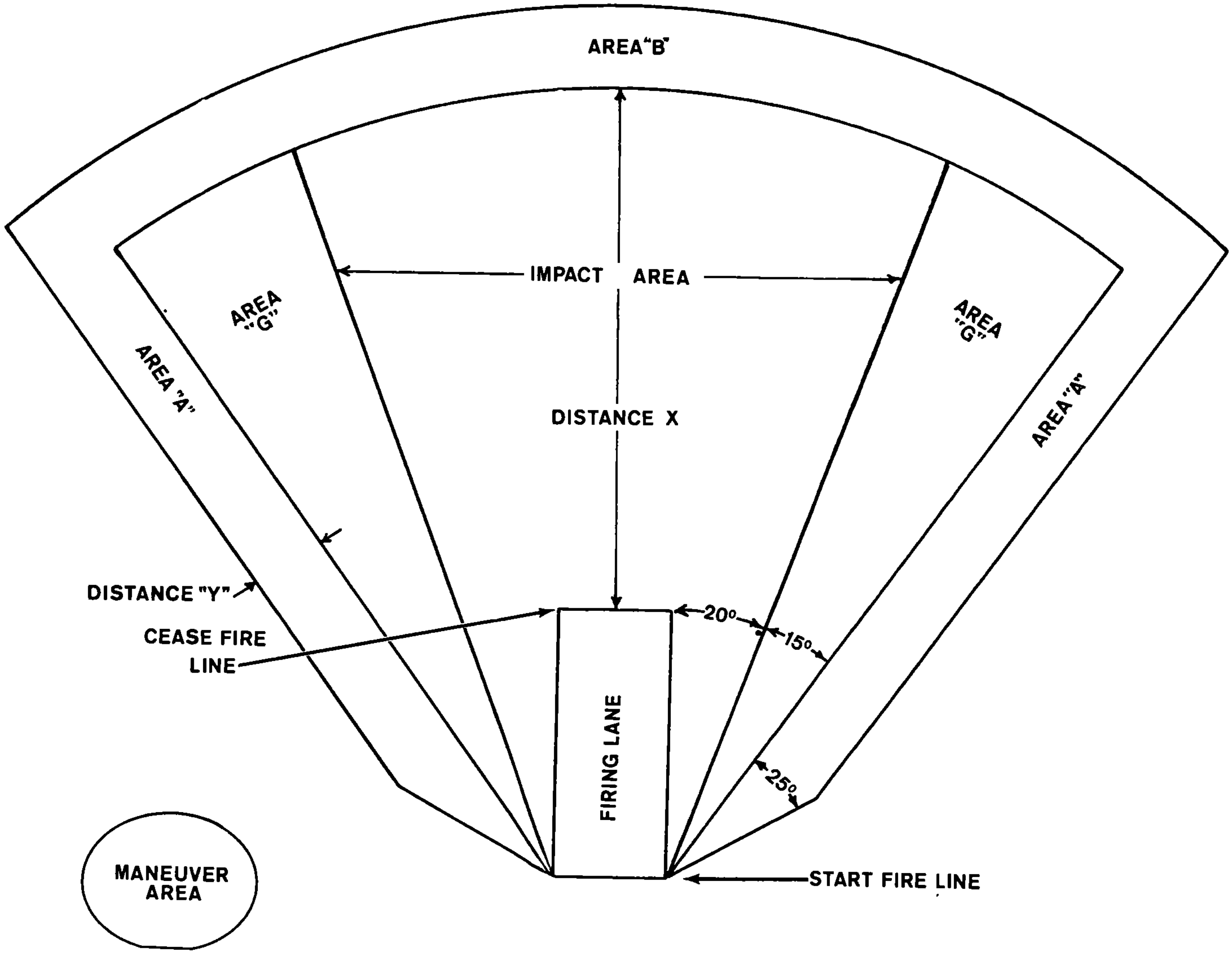
★*a. Recommended Range.* A recommended range for aviator firing exercises is shown in figure L–2. Range firing provides the gunner with training in identifying, acquiring, and shooting at targets. Helicopter flightpaths and firing lane must be clear of other range impact areas. Diagrams should be obtained to show adjacent aerial gunnery ranges, artillery ranges, and small arms ranges. Table L–1 contains recommended range dimensions for various weapons systems. Distance "Y" is the width of the buffer zone (areas "A" and "B"). Distance "X" is measured from the cease-fire line. Area "G" may be eliminated when, in the opinion of the range control officer, the aviator has demonstrated a continuing aptitude to retain all impacts within the prescribed impact area or when a qualified instructor pilot is on board. Written range safety regulations and range firing and safety standing operating procedure must be on hand at each installation.

b. Targets. All targets should be placed within

★*Table L–1. Surface Danger Area (Aerial Fire Ranges)*

Aircraft	Speed (knots)	Firing lane (meters)	Weapons	Distance "X"* (meters)	Distance "Y" (meters)	Minimum Safe Engagement Range (meters)
UH–1	Below 100	400 x 1,600 (all weapons)	7.62mm	3,800	100	100
			40mm	3,000	200	300
			2.75-inch	7,700	300	300
			Caliber .50	7,400	----	200
			20mm	----	200	200
			30mm	----	200	200
			Wire-guided missiles	4,900	1,000	500
AH–1G	Above 100	1,000 x 3,000 (all weapons)	7.62mm	3,800	100	200
			Caliber .50	7,400	----	400
			20mm	----	200	400
			30mm	----	200	400
			40mm	3,000	200	500
			2.75-inch	7,700	300	500
			Wire-guided missiles	----	----	Not applicable

*When a qualified instructor pilot is on board, distance "X" may be reduced 30 percent.



★*Figure L-2. Recommended range for aviator firing exercises.*

the firing lane or an extension of the firing lane. Available equipment and funds will determine the types of targets to be used. The three types of targets are—

(1) *Hard targets.* Hard targets, e.g., old car bodies and/or tank hulls, make very durable and good targets for initial training. These targets should be painted in different bright colors. One of each of these targets should be located at close, mid, and extreme ranges.

(2) *Silhouettes.* Silhouettes make very good training targets and add a degree of realism. They should be placed in normal combat formations at various ranges.

(3) *Panels.* Numbered or colored, 10-foot by 10-foot target cloth panels on 2-inch by 4-inch frames are the least desirable type of targets because they are very rapidly destroyed by rocket fire.

c. *Engagement.*

(1) *Switches.* Switches may not be placed in the ARMED position until the helicopter is at or past the startfire line and must be placed in the SAFE position upon reaching the cease-fire line.

(2) *Impacts.* All rounds must impact within the firing lane or impact area.

(3) *Targets.* Targets beyond the cease-fire line may be engaged, but all fire must cease at the cease-fire line.

(4) *Deflection.* It is permissible to engage targets at deflection angles up to 20° either side of the range centerline. To fire deflection shots at angles greater than 20°, the helicopter must be flown at a 90° angle to the centerline. For example, to fire a deflection shot of 110° to 70°, the helicopter must be flown perpendicular to the range centerline (fig. L–3).

L–21. Instruction Techniques

a. Because of the type of armament subsystem and the coordination involved in operating as a pilot/gunner team, both aviators should be trained together. This can be accomplished by positioning the instructor in the jump seat between the pilot/copilot seats (UH–1B/C).

b. The instructor will occupy an aviator's position only when required for a demonstration.

c. The instructor will critique the aviators on each flight.

d. To insure that safety limits are not exceeded, the instructor should always be positioned in the helicopter within easy reach of the OFF-SAFE-ARMED switch.

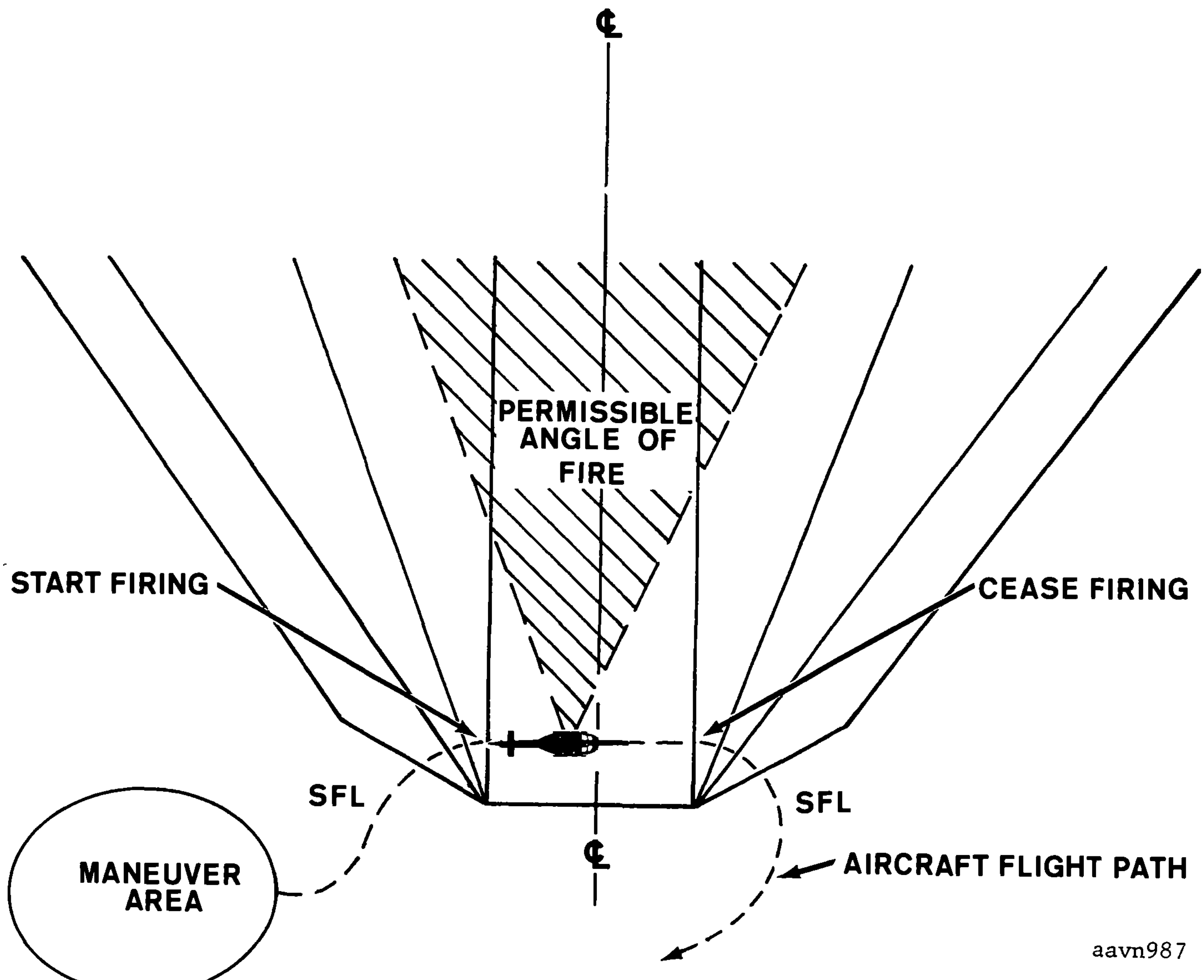


Figure L–3. Permissible angle of fire for deflection shots in excess of 20°.

L-22. Firing Tables

The firing tables (tables L-2 through L-10) are for training copilot and pilot gunners and are designed to qualify them in firing the XM3, M5, M16, and M21 or AH-1G subsystems in both the stowed and flexible positions. These tables include night firing and fire team tactical firing. Commanders may modify these tables to meet local training needs and range facilities. When scoring devices are not available, scoring will be based on the instructor's judgment of the accuracy of fire on target. Table L-11 is designed to familiarize aviators with the UH-1 weapons subsystems. Except for proficiency training of qualified aviators, all training for the M22 subsystem is conducted at the U.S. Army Aviation School and is not included in this manual.

Table L-2. Firing 7.62mm Ammunition From Flexible Position

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
1	Harmonization, hovering, and diving.	400-700	800	Hovering, 600-200	0-90	2-4	Aircraft heading varies 20° left and right (hovering)
2	Diving	400-750	400 [1]	600-200	60-90	3-5	
3	Running and racetrack.	300-1,000	400 [1]	50-100	60-90	4-8	Aircraft heading varies 20° left and right.
4	Diving to running.	400-750	400 [1]	600-50	60-90	4-8	Azimuth engagements to 70° left and right of aircraft centerline.

[1] Gun selector switch in All position.

Table L-3. Firing 40mm Ammunition From Flexible Position

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
5	Hovering and running.	500-1,000	3/1-2/3-4/30	Hovering, 3 runs at 100	0-90	1-2	Hovering, targets to be engaged at gun azimuth of 0°-50° left and right.
6	Running	500-1,200	3/1-3/3-4/30	1 run at 300 1 run at 600 1 run at 900	60-90	1-2	Target azimuth-0°.
7	Diving	500-1,750	4/2-4/3-4/45	900-50	60-90	1-2	Target azimuth 0°-20° left and right.
8	Diving to running.	500-1,500	4/2-4/3-4/45	600-50	60-90	1-3	Target azimuth 0°-30° left and right.

*Firing runs/burst per run/rounds per burst/total rounds.

Table L-4. Night Firing 40mm Ammunition From Flexible Position

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition*	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
9	Running	500-1,200	4/1-3/3-4/40	200	80-100	1-2	Target azimuth 0°. Flare illumination and blackout.
10	Running	500-1,500	4/1-3/3-4/40	2 runs at 400	80-100	1-2	Target azimuth 0°. Flare illumination and blackout.
11	Diving	500-1,750	4/1-3/3-4/40	900-200	80-100	1-2	Target azimuth 0°-20° Flare illumination and blackout.
12	Diving to running.	500-1,750	4/1-3/3-4/30	600-200	80-100	1-3	Target azimuth 0°-20°. Blackout.

*Firing runs/burst per run/rounds per burst/total rounds.

Table L-5. Firing 40mm Ammunition From Flexible Position

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition*	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
13	Running	500–1,200	4/1-3/3-4/45	2 runs at 100 2 runs at 50	80–100	1–2	Target azimuth 0°–30° left and right.
14	Running	500–1,500	4/1-3/3-4/45	2 runs at 600 2 runs at 900	80–100	1–2	Target azimuth 0°–45° left and right.
15	Running and diving.	500–1,750	4/1-3/3-4/30	2 runs at 1,500; 2 runs diving 1,500 to 50 race-track pattern.	80–100	1–2	Target azimuth 0°–45° left and right.
16	Diving to running	500–1,750	4/1-3/3-4/30	600–50	80–100	1–2	Target azimuth 0°–20° left and right. (Student will fire M5 in stowed position on one live run.)

*Firing runs/burst per run/rounds per burst/total rounds.

Table L-6. Firing 7.62mm Ammunition From Stowed Position

Exercise*	Type Fire	Target Range (meters)	Quantity of Ammunition	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
17	Harmonization, hovering, and diving.	300–750	800	600–50	0–90	1–2	
18	Diving and racetrack.	400–750	400	600–200	60–90	1–3	One orbit (racetrack) 20° left and right.
19	Running	400–750	400	50–100	60–90	3–4	Aircraft heading varies 20° left and right.
20	Diving to running racetrack.	400–750	400	600–50	60–90	3–5	20° left and right.

*Each exercise will require approximately four live runs.

Table L-7. Firing 2.75-Inch FFAR

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition*	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
21	Diving	700–2,000	8/1-3/14	600–50	60–90	1–3	Aircraft heading varies 20° left and right.
22	Running	700–2,000	7/1-3/14	50–100	60–90	1–3	Aircraft heading varies 20° left and right.
23	Diving to running	700–2,500	3/2-8/14 (4 pair salvo on last run)	600–50	60–90	1–2	Aircraft heading varies 20° left and right.

*Firing runs/rounds per run/total rounds.

Table L–8. Firing 2.75-Inch FFAR

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition*	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
24	Diving	1,000–2,500	5/1–4/14	3 runs at 600; 2 runs at 1,500	60–90 80–100	1–2	
25	Running	1,000–2,000	5/1–4/14	50–300	80–100	1–3	
26	Diving to running	1,000–2,500	4/2–6/14	3 runs at 1,000–50; 2 runs at 1,500–50, race-track pattern.	80–100	1–3	Aircraft heading varies 20° left and right.

*Firing runs/rounds per run/total rounds.

Table L–9. Night Firing 7.62mm and 2.75-Inch FFAR Ammunition From Stowed Position

Exercise	Type Fire	Target Range	Quantity of Ammunition*	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
27	Harmonization and diving.	700	7.62mm 3/200/600	600–200	60–90	2	Flare illumination and blackout.
28	Diving	700–1,500	2.75-inch FFAR 5/1–2/7	600–200	60–90	1–2	Flare illumination and blackout.
29	Running	700–1,500	7.62mm 1/200/200; 2.75-inch FFAR 3/2–3/7	200	60–90	2–3	Flare or search light illumination.
30	Diving to running	700–2,000	2.75-inch FFAR 3/4–6/14 (Demonstration of flexible fire by instructor pilot)	600–200	60–90	1–2	Blackout.

*Firing runs/rounds per run/total rounds.

Note. 50 percent more 7.62mm ammunition required when using M21.

Table L–10. Examination—Firing 7.62mm and 2.75-Inch FFAR Ammunition From Flexible and Stowed Positions

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition*	Altitude (feet)	Airspeed (knots)	Targets per Firing Run	Remarks
31	Diving to running (flexible).	300–800	7.62mm 4/200/800	1,000–50	80–100	1–4	Firing azimuth and heading varies 20° left and right.
32	Diving	500–2,000	7.62mm 2/100/200; 2.75-inch FFAR 5/1–3/7	1,000 initial 3 runs 600 2 runs 1,000	80–100 60–90 80–100	1–3	
33	Running	700–1,500	7.62mm 2/100/200; 2.75-inch FFAR 3/1–3/7	50–300	80–100	1–3	Variations in heading 20° left and right.
34	Diving to running	1,000–2,500	2.75-inch FFAR 3/4–6/14	1,500–50, race-track	80–100	1–3	

*Firing runs/rounds per run/total rounds.

Table L–11. Familiarization Firing

Exercise	Type fire	Target range (meters)	Quantity of ammunition	Altitude (feet)	Targets per firing run	Remarks
1	Harmonization, hovering, and diving.	500–1,000	750 (7.62mm)	Hovering, 1,000–200	2–4	Aircraft heading varies through flexible limits.
2	Running	500–1,000	750 (7.62mm)	Nap-of-the-earth.	2–4	Aircraft heading varies 20° left and right.
3	Harmonization, hovering, and diving.	500–1,200	4/20/75* (40mm)	1,000–200	4–6	
4	Running	500–1,200	4/20/75* (40mm)	Nap-of-the-earth.	4–6	Aircraft heading varies 20° left and right.
5	Diving	1,250	4/1/4* (2.75-inch rocket)	1,000–500	1	To obtain combat sight.
6	Diving	1,000–2,500	2–4/1–2/4* (2.75-inch rocket)	1,200–500	1–2	
7	Running	750–1,250	3/1/3* (2.75-inch rocket)	Nap-of-the-earth.	1	
8	Diving	1,000–1,500	1/4/4*	1,200–500	1	Salvo of four 2.75-inch FFAR.

*Firing runs/rounds per run/total rounds.

Note. Exercises 1 through 4 are gunner familiarization exercises and 5 through 8 are for aichaft commander familiarization firing.

★L–23. Ammunition Requirements

Authorized ammunition allowances for aerial gunnery training are contained in CTA 23–100–6. Commanders must insure that ammunition expended will not exceed the authorized allowances. Tables L–12 through L–14 are provided for guidance purposes only and do not restrict flexibility exercised by local commanders. Qualification on the M22 armament subsystem is conducted only at the US Army Aviation School. The ammunition requirements for annual proficiency firing of the M22 armament subsystem are given below.

Armament subsystem	Helicopter	Wire-guided missile ammunition (No. rounds per individual)	
		ATM–22B w/inert warhead	AGM–22B w/HEAT warhead
M22	UH–1B/C	5	1

★Table L–12. 7.62mm and 20mm Ammunition Requirements for Aerial Gunnery

Armament subsystem	Helicopter	Automatic gun	Machinegun	Ammunition (No. of rounds per individual)		
				Initial qualification	Annual proficiency	Familiarization
				Ctg ball, 7.62mm, TR 4-1, MLB	Ctg ball, 7.62mm, TR 4-1, MLB	Ctg ball, 7.62mm, TR 4-1, MLB
M2	OH–13		M60C	4,000	2,000	1,000
M6	UH–1B/C		M60C	6,000	3,000	2,000
M16	UH–1B/C		M60C	6,000	3,000	2,000
M21	UH–1B/C	M134		7,500	3,000	2,000
XM27E1	OH–6A, OH–58A	M134		8,000	4,000	1,500
XM28E1	AH–1G	M134		12,000	8,000	1,500
TAT–102A	AH–1G	M134		12,000	8,000	1,500
XM18E1 (Pod)	AH–1G	M134		9,000	6,000	3,000
				Ctg 20mm Tgt, Prac, MLB	Ctg 20mm Tgt, Prac, MLB	Ctg 20mm Tgt, Prac, MLB
XM35	AH–1G	XM195		950	475	475

★*Table L-13. 40mm Grenade Ammunition Requirements for Aerial Gunnery*

Armament subsystem	Helicopter	40mm grenade launcher	Ammunition (No. of rounds per individual)		
			Initial qualification	Annual proficiency	Familiarization
			CTG HE, 40mm grenade	CTG HE, 40mm grenade	CTG HE, 40mm grenade
XM28E1	AH-1G	XM129	600	150	150
M5	UH-1B/C	M75, XM129	450	150	150
XM8	OH-6A	XM129	450	150	150

★*Table L-14. 2.75-In, Rocket Ammunition Requirements for Aerial Gunnery*

Armament subsystem	Helicopter	2.75-in. rocket launcher	Ammunition (No. of rounds per individual)					
			Initial qualification		Annual proficiency		Familiarization	
			Rkt 2.75-in., practice	Rkt 2.75-in., HE	Rkt 2.75-in., practice	Rkt 2.75-in., HE	Rkt 2.75-in., practice	Rkt 2.75-in., HE
XM3	UH-1B/C	XM3E1	75	75	48	48	7	8
XM16	UH-1B/C	XM157, XM158	75	75	48	48	7	8
XM21	UH-1B/C	XM157, XM158	75	75	48	48	7	8
	UH-1B/C	XM157, XM157B, M158, M158A1, XM159C, XM200	75	75	48	48	7	8
	AH-1G	XM157B, M158A1, XM159C, XM200.	75	75	48	48	7	8

APPENDIX M

DOOR GUNNER RANGE FIRING

Section I. RECOMMENDED M60 MACHINEGUN GROUND RANGE FIRING AND FAMILIARIZATION STANDING OPERATING PROCEDURES

M-1. Purpose

To establish M60 machinegun range firing procedures and safety criteria for firing live ammunition from range towers.

M-2. Scope

This SOP provides specific procedures for conducting M60 machinegun firing exercises from range towers. It also includes guidance for student and assistant instructor behavior during these exercises.

M-3. References

a. Local range safety regulations.

b. AR 385-63.

M-4. Responsibilities of Personnel

a. Range Officer in Charge (OIC). The range officer in charge is responsible for supervision of all range personnel and activities.

b. Noncommissioned Officer in Charge (NCOIC). The NCOIC uses the range tower amplifier system to direct the actions of all gunners and assistant instructors during range firing; he also supervises all NCO's on the range.

c. Assistant Instructors (AI's). A qualified AI must be physically present in each firing tower during range firing and whenever student gunners are in the firing tower. The firing tower AI's responsibility is to teach the gunner how to fire effectively. They will assist the OIC and NCOIC in carrying out the following training procedures:

(1) Safe handling of ammunition.

(2) Correct procedures for loading and unloading ammunition and clearing machineguns.

(3) Fastening safety belts, removing brass and links from the floor of the range towers, and picking up the brass from under the towers after firing.

d. Ammunition NCO. The ammunition NCO will personally see that ammunition is properly placed and handled at all times. On order from the range tower, he will issue the ammunition to each student gunner and then will inspect the turned-in brass to verify that there are no live rounds present.

e. Equipment NCO. While the weapons are being cleaned, an AI designated by the NCOIC will be responsible for accounting for the equipment used on the firing line. He will report any missing equipment to the OIC.

M-5. Range Procedures

a. Tower Preparation. The NCOIC will assign a machinegun to the assistant instructor in each tower. The AI will tie the machinegun on the end of a rope and pull the weapon up into the firing tower where he hangs the weapon by means of a bungee cord. He will then secure the seat belts (if available) to the tower seats.

b. Introduction by OIC. All demonstration personnel will be at their posts before the class begins. The introduction will include standard range SOP's, runaway gun, a firing demonstration, a clearing the weapon demonstration, a loading demonstration, range facilities, and the rotation system.

(1) *Safety regulations.*

(*a*) No running on the range.

(*b*) No smoking near ammunition.

(*c*) All weapons pointing downrange at all times.

(*d*) All gunners will fire at targets in front of their towers.

(*e*) No rounds will land outside the range markers downrange.

(*f*) Students will not stand in the tower except when assuming positions or when changing stations. When removing brass from the towers, all personnel will remain seated until the tower has been declared clear by the range control OIC or range tower NCOIC.

(*g*) All students will wear steel helmets.

(*h*) When ammunition or other materials are hauled to the top of the towers by rope, or when there is a person on the ladder, all other personnel will stand clear of the ladder. There will be only one person on the ladder at one time.

(*i*) When firing is being conducted or the firing line is not considered clear, no personnel will go forward of the base of the firing tower. To go forward of the base of the firing tower, the OIC must first have ordered firing to cease and each weapon to be cleared with a safety block inserted into the feed slot between the bolt and the chamber.

(2) *Firing demonstration.* Before the class beings, two AI's will take the position of gunner and assist gunner in a tower. This demonstration will consist of firing several 6 to 8 round bursts at stationary targets and about seven 6 to 8 round bursts at target of opportunity. Bursts of 6 to 8 rounds are used to permit the gunner to gain maximum proficiency in adjusting fire with the number of rounds available. The remaining rounds in a 200-round belt will be fired to demonstrate incorrect techniques of fire (too-long or too-short bursts). These AI's will remain in the tower until the entire class has completed range firing.

(3) *Loading demonstration.* The OIC will assemble the entire class in front of the bleachers for the loading demonstration. Every student should be positioned so that he can see the M60 machinegun loading demonstration.

(4) *Clearing the weapon demonstration.* The weapon clearing procedure is—

(*a*) Pull back the cocking lever.

(*b*) Place the safety on SAFE.

(*c*) Open the feed tray cover and lift up the feed tray.

(*d*) Check to make sure the chamber is empty.

(*e*) Close the feed tray cover.

Caution: **Do not attempt to close the feed cover when the bolt is forward. If bolt is forward, pull the cocking lever handle to the rear. (For cooking lever handle (and bolt) to move to rear, safety must be in FIRE position.)**

(*f*) Holding the cocking lever rearward, place the safety in the FIRE position. Still holding the cocking lever rearward, pull the trigger and allow the bolt to ride forward slowly.

Caution: **When the gun is unloaded, do not allow the bolt to impact forward. In an unloaded gun, this action will damage the bolt, feed tray, and actuating cam roller.**

(5) *Rotation system.* After the introduction, the NCOIC will arrange the students in four equal ranks (orders). He will tell each concurrent station AI the number of students in each order. If any order reports to a station without the proper number of students, the AI on that station will report this to the NCOIC or OIC. The time allotted to each station should be about 50 minutes, after which the students take a 10-minute break and rotate to the next station.

M-6. Firing Techniques

a. Correct Sitting Position. When correctly seated, the gunner should be sitting on the very end of the appropriate* seat with his right (left) leg extending beyond the edge of the seat and pointing toward the target.

b. Holding the Gun. Steady hold is obtained by placing the front-hand guard of the M60 on the right (left) knee. The right (left) hand then holds the gun by the carrying handle, keeping it steady. Aiming is accomplished by pivoting the gun around this point.

c. Adjusting Fire. The gunner should adjust his fire by observing both bullet impact and the path of the tracers. Better effectiveness is also obtained by initially "walking" the strike of the bullets up to the target.

M-7. Conducting Range Firing

a. Hoisting Ammunition Into Firing Tower. On command from the range NCOIC in the tower, the students who are firing will proceed from the safety line to the ammunition point to receive 200 rounds each of 7.62mm linked ammunition (4 rounds of ball to 1 round of tracer). With the AI's aid, they will hoist the ammunition up to the tower.

b. Range Firing Procedures. One person at a time will climb up the ladder to the firing platform. Then—

(1) One student (the gunner) will be seated at the rear of the machinegun and will secure his safety belt. The other student will take a seat on the right and to the rear of the tower.

(2) When the gunner, assistant gunner, and AI are properly positioned in each tower and the gunner is properly briefed, the AI will signal the range tower NCOIC that all is ready.

(3) When all firing tower AI's have signaled ready, the range tower NCOIC will declare the firing line ready.

(4) On order from the NCOIC in the range

* The seat chosen depends upon the side of the helicopter from which the door gunner will fire.

tower, the gunners (assisted by the AI) will load the weapons.

(5) Each AI will notify the NCOIC in the range tower when each weapon is loaded and locked.

(6) On command from the range tower NCOIC, the gunners will commence firing at the proper targets of opportunity.

(7) Subsequent firing commands will be issued from the range tower NCOIC until all of the allotted ammunition has been expended.

(8) The gunner will clear the weapon. The weapon is considered clear when the bolt is forward, the cover is raised, all ammunition is removed from the weapon, and the safety is on SAFE position. After clearing the tower of brass and links, the AI will notify the NCOIC that the weapon is clear and that no loose brass or links are on the firing tower floor.

(9) The students will exchange places and (1) through (8) above will be repeated.

(10) When firing has been completed and the firing tower has been declared clear by the NCOIC, both students will proceed to the bottom of the firing tower and assist the AI in lowering the cleared machinegun to the ground.

(11) All students will pick up the brass and links around the base of each firing tower under the supervision of the AI.

(12) The OIC will inspect all weapons that have been fired.

(13) There will be a critique of the class session.

(14) The OIC will check each student for brass and ammunition.

Section II. RECOMMENDED DOOR GUNNER AERIAL RANGE FIRING AND SAFETY STANDING OPERATING PROCEDURES

Note. This recommended SOP provides guidance for unit commanders and staff officers in preparing their own SOP's. Each unit should develop range firing and safety SOP's applicable to its special situation.

M–8. Purpose

To establish range procedures and safety criteria for door gunner aerial machinegun training.

M–9. Scope

This SOP provides checklists, safety procedures, and range operating procedures for conducting aerial door gunner machinegun range firing. For recommended helicopter range firing and safety standing operating procedures, see appendix L.

M–10. References

a. Local range safety regulations.

b. Local lesson plans for each armament subsystem.

c. Technical manuals.

M–11. Definitions

a. Cook-off—The firing of a chambered round by heat from a hot barrel.

b. Hangfire—A temporary failure or delay in the action of the primer in a cartridge.

c. Misfire—A failure to fire.

d. Runaway gun—A gun which continues to fire after the trigger is released.

e. Weapon cold—The safety is on the SAFE position, preventing the weapon from firing. The weapon may or may not be loaded.

f. Weapon hot—Weapon is loaded with safety on FIRE position, ready to fire.

M–12. Range Facilities

Range flag(s), road guards, and range markers are as prescribed by local range regulations. Range facilities include the following:

a. Control Tower. A control tower is located on each firing range. Each tower is equipped with UHF radios, telephones, and an emergency warning device. Positive control over all range activities is exercised from the control tower.

b. Start-Firing Line and Cease-Firing Line Markers. For locations of start-firing line and cease-firing line markers, see figures M–5, M–6, and M–7. The start-firing line on each range may consist of an asphalt or concrete pad, with parking spots marked for each helicopter. Approaches to and from the start-firing line will be kept clear of all vehicles, obstructions, and loose objects likely to interfere with helicopter operations.

c. Helicopter Parking and Refueling Areas. When available, helicopter parking and refueling areas are located adjacent to the start-firing line and are used by all helicopters not actively engaged in training. When separate parking and refueling areas are not available, parking and refueling areas may be located on or near the start-firing line (*b* above). Helicopter landing areas should be protected from dust to prevent visibility hazards and damage to helicopter components.

d. Vehicle Parking Areas. Separate vehicle parking areas are located clear of all aircraft operations, whenever space is available. If separate parking areas are not available, parking areas will be located near control tower on the opposite side from the firing line. Whenever possible, military vehicles will be unloaded and parked in designated areas away from aircraft operations. Civilian vehicles will be parked in designated areas completely clear of all aircraft and military vehicle operations.

e. Ammunition Areas. When applicable, ammunition areas are located in an area separate from other activities and adjacent to helicopter parking and refueling area. Whenever possible, ammunition preparation and loading activities should be shielded from blowing dust and dirt.

f. Communications.

(1) Two-way radio communications will be established and maintained with all helicopters operating on the range.

(2) Telephone communication with range headquarters will be established and maintained at all times while the range is in operation. In an emergency, radio communication to another range tower that has telephone communication is acceptable until emergency repairs are completed.

M–13. Door Gunner Instructor Responsibilities

The instructor must—

a. Be thoroughly familiar with range SOP, to include azimuth of range and specific firing sector limits.

b. Insure that the student follows the techniques of fire outlined in the local lesson plan.

c. Direct the student gunner in loading and unloading weapon as directed by the pilot.

d. Be directly responsible for the status of the weapon (e.g., hot or cold) at all times.

e. Clear the machinegun when firing impacts outside of prescribed impact area or when a weapon malfunction creates a safety hazard.

f. At all times remain in a position where direct control and communication can be maintained with the student.

g. In the event of communication failure between the pilot and instructor or instructor and student, discontinue firing and immediately clear the weapon.

M–14. Door Gunner Instructor Checklist

a. Brief student gunner on range procedure and safety.

b. Insure that firing is conducted only when—

(1) Cleared to fire by pilot.

(2) Weapon is pointed at target.

c. Monitor all aspects of range operation and advise the pilot of any unsafe conditions.

d. Insure at all times that no ammunition is loaded into weapon until pilot gives clearance to go "weapon hot."

e. Check that all ammunition has been cleared from the helicopter at the conclusion of the firing period.

f. At the conclusion of the firing, debrief student gunners on individual performance as prescribed in local lesson plans.

Section III. DOOR GUNNER RANGE FIRING

M–15. Purpose

To qualify selected enlisted personnel in the techniques, skills, and duties of door gunners.

M–16. Recommended Program of Instruction

Training will be designed to meet the needs of each unit and door gunner concerned. It should emphasize techniques involving target acquisition, helicopter door-mounted aerial machinegun firing, and related subjects. Training should include (but not be limited to) the subjects and time allocated below.

Subject	Hours	Type	Scope	References*
Introduction to UH–1 and CH–47 helicopters.	4	Conference and demonstration.	Description of UH–1 and CH–47 helicopters including capabilities, airframe information, location of emergency equipment, exits and emergency procedures, and troop-cargo and casualty-carrying equipment.	TM 55–1520–209–10, TM 55–1520–210–10, TM 55–1520–218–10, TM 55–1520–219–10, and TM 55–1520–220–10.

* Unless otherwise noted, references are to this publication.

Subject	Hours	Type	Scope	References*
Introduction to helicopter door gunnery and duties of door gunner.	2	Conference	Orientation conference covering the purpose of training to include duties of door gunners, before-mission procedures, target marking, handling of brass, safety procedures, emergency landing procedures, and destruction of subsystems to prevent enemy use. Conference will also cover door gunner night firing, including range estimation and target engagement.	Paragraphs M-17 through M-29; FM 23-67; and TM 9-1005-262-15.
Introduction to XM3**	1	Conference	Conference on the components of the XM3 and their functions, the preflight check, and the emergency removal of the weapons subsystem.	Appendix D; TM 9-1055-217-20.
Introduction to M16**	2	Conference	Conference covering the general characteristics of the M16 armament subsystem, to include all components and the sighting system; and capabilities and limitations of the subsystem.	Appendix D.
2.75-inch FFAR ammunition and safety.	1	Conference	Conference and demonstration covering 2.75-inch rocket; the various types of warheads; and proper loading, handling, and storage procedures.	Appendix D.
Loading and unloading procedures for XM3, M16**, and M21.**	3	Demonstration and practical exercise.	A demonstration and practical exercise in the preparation, loading, and unloading of the subsystems to include assembly and disassembly of rockets.	Appendix D and appropriate TM.
Introduction of M5**	2	Conference and practical exercise.	A conference covering the M5 armament subsystem and a practical exercise on loading and unloading procedures.	Appendix F; TM 9-1010-207-12.
Aerial illumination	1	Conference	Conference on the various means available to illuminate an area and necessary operating and safety procedures.	FM 20-60 and TM 9-1370-200.
★Briefing on aircraft gas and employment of smoke grenades.	1/2	Conference	Conference on description, capabilities, limitations, nomenclature, and procedures for wearing the M24 aircraft gas mask; conference on description, nomenclature, functioning, capabilities, uses, and safety procedures for throwing a smoke grenade from aircraft.	Paragraph M-17*d*; TM 3-4240-219-14.
First aid	3	Conference	Conference on principles and techniques of emergency medical care aboard aircraft to include use of morphine and emergency in-flight first aid measures.	FM 21-11, FM 57-35; and TM 8-230.
Emergency landings procedures and emergency removal of helicopter equipment.	1	Conference	Conference on procedures used during different types of emergency landings and removal or destruction of equipment to prevent enemy use.	Paragraph M18 and Unit SOP.
★Survival, escape, and evasion.	2	Conference	Conference on principles and techniques of evading the enemy and surviving in tropical jungle terrain.	FM 21-76.
Principles of air-to-ground machinegun fire.	1	Conference	Conference on principles and techniques of aerial machinegun fire from helicopters to include fixed and moving gun ballistic problems, employment of dispersion, and the use of the M60D sight, if available.	Chapter 2 and paragraphs M-25 through M-29.
M60 machinegun familiarization firing.	5	Conference, demonstration, and practical exercise.	Introduction to M60 machinegun to include a practical exercise on firing the M60 from range towers and classes on machinegun assembly and disassembly, care and cleaning, and correcting stoppages and malfunctions.	Paragraphs M-30*a* and M-31. TM 9-1005-262-15; and FM 23-67.

*Unless otherwise noted, references are to this publication.
**This training required only when unit is equipped with armament subsystem.

Subject	Hours	Type	Scope	References*
Door gunner aerial machinegun firing range.	8	Practical exercise____	Practical exercise on door gunner air-to-ground machinegun firing techniques.	Paragraphs M-32 and M-33.

*Unless otherwise noted, references are to this publication.

M-17. Routine Duties of the Door Gunner

Each door gunner must have a knowledge of his own weapons, and be familiar with the helicopter and its armament subsystem and with special situations and duties he might encounter while in flight. A door gunner—

★*a. Assists in Preflight Check.* For preflight check procedures for UH-1B helicopters, see TM 55-1520-219-10; for UH-1C helicopters, see TM 55-1520-220-10; for UH-1D/H helicopters, see TM 55-1520-210-10; for CH-47 helicopters, see TM 55-1520-209-10. Before going on a mission, each door gunner must—

(1) Perform daily inspection of weapons subsystems as required by TM 9-1005-262-15 and other applicable operator's manuals, and immediately report any known maintenance deficiency which is beyond operator capability to organizational maintenance personnel for correction.

(2) Insure that prior to the mission, the proper amount and type of clean and serviceable ammunition (including right color and amount of smoke grenades) is on board helicopter.

(3) Check all armament subsystems for proper loading of ammunition.

b. Acts as Observer.

(1) Since the pilot and copilot fly the helicopter, each door gunner must act as an observer from his side of helicopter. The door gunner's primary area of observation is from 60° off the nose of the helicopter all the way to the rear. He observes for enemy activity and other aircraft. This observation includes hearing as well as seeing. Because of his position, each door gunner will often be able to hear fire that he could not observe visually. The door gunner's observation techniques will improve greatly with experience. For further details on observation techniques, see FM 1-80 and TM 1-380-series.

(2) Under field conditions and immediately before touchdown or takeoff, the door gunner also keeps a close watch for obstacles such as stumps, brush, or uneven ground.

c. Protects Helicopter. Normally, door gunners provide area neutralization fires when taking off, landing, and during target disengagement. Before firing, each door gunner must consider the location of friendly forces, location of other aircraft, and the ammunition available. The gunner's primary area of coverage is to the flanks and rear of the helicopter.

d. Marks Targets. When required, each door gunner marks enemy fire by machinegun tracers or smoke grenades. Smoke color for a mission is normally designated in the operation order or the SOI. However, smoke color may be designated just before throwing the smoke grenade. The spot report procedure for throwing a smoke grenade is —

(1) Select the correct color smoke grenade and throw it.

(2) Call "Smoke is out." If different color smokes are burning at the same time, give color of smoke.

(3) Report target, giving—

(*a*) Type of target.

(*b*) Distance from smoke to target.

(c) Either an azimuth heading from the smoke to the target (e.g., 090° from smoke) or an approximate directional reference (e.g., east of the smoke, southwest of the smoke).

Note. The directional gyro gives compass heading.

M–18. Emergency Landing Procedures

a. Unit SOP. The unit SOP should establish a drill for the crew to follow after an emergency landing in a hostile area.

(1) The drill should provide for immediately establishing security in the landing area.

(2) Radios and weapons should be removed from the helicopter to prevent enemy use. The unit SOP should designate the responsibility and priority for removing equipment.

b. Door Gunner's Duties. The door gunner must—

(1) Establish immediate security for the helicopter landing area.

(2) Know the procedures and techniques for removing radios and weapons from the helicopter.

(3) If capture is imminent, assist in destroying the helicopter armament subsystem and ammunition.

M–19. Fire Commands

Before departing on a mission, the helicopter commander orients his crew on the situation and the mission. His orientation will include the friendly situation, the enemy situation, rules of target engagement, marking of targets, possible target areas, fire commands, the location of emergency medical and survival equipment, and other available information essential to mission success. Fire commands the helicopter commander may give each door gunner are—

a. "On Order Gun." This permits each door gunner to fire only upon the pilot's command.

b. "Open Gun." This permits each door gunner to fire at any suitable target.

Section IV. SAFETY

M–20. Brass

The M23 and M24 armament subsystems provide ejection control bags to eliminate problems with ejected brass when it falls to the floor. It may make footing hazardous or jam helicopter controls; if blown out of the helicopter, it can damage the tail rotor system.

M–21. Seat Belt

Normally, the door gunner should remain safely strapped in his position by the door.

M–22. Safety Harness

The door gunner should always wear a safety harness to permit him to move safely inside the helicopter.

M–23. Body Armor

Many different types of body armor are now in use to provide chest and back protection. The situation will dictate when and what type of body armor is to be worn.

M–24. Other Light Equipment

Flying gloves and the APH–5 helmet equipped with a clear visor should be worn during flight. The visor should be lowered during firing runs to protect crewmember's eyes from the back blast of the rockets as they are fired.

Section V. AERIAL ADJUSTMENT OF FIRES

M–25. Using the M60D Machinegun Sight

The M60D machinegun has a conventional front blade sight and a ring sight (fig. J–3) mounted in place of the conventional bead sight. This sight is used by placing the top of the front blade in line with the horizontal cross hair of the sight ring.

a. Correction for Bullet Drop. Placing the horizontal cross hair and sight blade on line with the target automatically corrects for bullet drop at range up to 600 meters. The gunner must aim higher at ranges beyond 600 meters.

b. Correction for Lead Effect. To lead a target properly, the gunner must aline the target, front blade sight, and the appropriate point on the horizontal cross hair. However, this alinement is only approximate since the rapidly changing conditions will make accurate aiming impossible. When firing out of the right side of the helicopter, the gunner will use the right side of the appropriate ring (where it intersects the horizontal cross hair); when firing out of the left side, he will use the left side of the appropriate ring. The gunner should first try to slightly overlead the target and then let the helicopter's forward flight carry his beaten zone across the target. For lead corrections with M60D sight, see table M–1.

M–26. Firing the M60 Machinegun Without Using the Sight

a. Aside from the sight, tracers are the only

Table M–1. Lead Corrections Using M60D Ring and Blade Sight

Target Angle (with flight direction of 12 o'clock)	Helicopter Speed	
	25 knots	80 knots
Small (1, 5, 7, or 11 o'cclock)	Aline inner ring with front sight blade and fire long bursts.	Aline inner ring with front sight blade and target.
Large (3 or 9 o'clock)	Aline inner ring with front sight blade and target.	Aline outer ring with front sight blade and target.

help that the gunner will have to hit the target. However, occasionally he will be able to observe bullet strikes to help adjust his fire. Without the help of a sight, the door gunner should fire long bursts, adjusting his fire to "walk" the strike of his bullets into the target. If the flight path is nearly parallel to the target, a good procedure is to spray the target in an up and down direction and let the helicopter's forward flight sweep the beaten zone across the target.

Caution: **The machinegun has a tendency to climb when firing. The barrel must not be allowed to rise to an angle where other aircraft and/or the main rotor blade might be hit. If there is difficulty in controlling the weapon, the gunner should cease firing until he regains complete control.**

b. When firing the M60 from a bungee cord out of the left door, there is a tendency for the weapon to jam. This is caused by the relative wind preventing the gun from ejecting the empty cartridges. Since the machinegun ejects brass to the right of the gunner, the left machinegun ejects the brass into the helicopter unless the gun is equipped with an ejection control bag. Jamming of the M60 can be prevented by placing a plate to deflect the cartridge down, turning the gun upside down, or turning the gun on its right side and mounting a C ration can on the bandolier holder latch to act as a guide for the ammu-

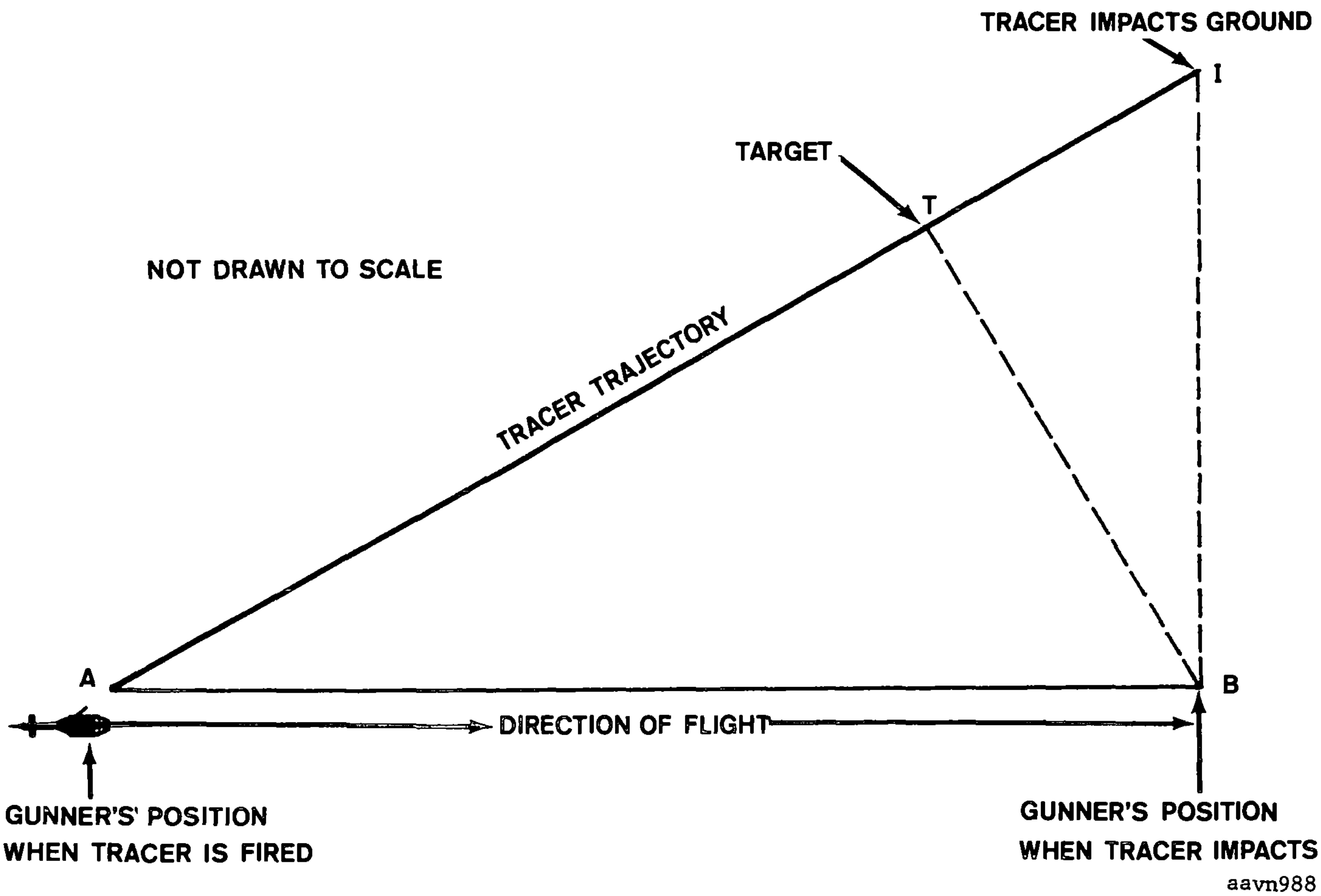


Figure M–1. Observer shift effect when bullet strike is beyond target.

nition. These field expedients also prevent brass from working its way into the controls.

M–27. Advantages of Using Tracers to Adjust Fire

Firing tracer ammunition permits the gunner to observe the trajectory of fire for a distance of 750 to 900 meters, thus permitting rapid adjustment of fire.

M–28. Disadvantages of Using Tracers to Adjust Fire

At long ranges, helicopter air-to-ground tracer fire may become deceptive. For example—

a. In figure M–1, a gunner at point A fires a round at target T at 700 meters range but aims slightly high so that the tracer impacts at point I. By that time, the gunner has moved to point B and observes his apparent miss. Because of his change of position, he is led to believe that he has aimed high *and to the right.* This effect is called *observer shift.* It occurs primarily at great ranges and is more pronounced with either increased aircraft speed or longer flight time of the bullet.

b. Observer shift is also deceptive when the gunner is firing at a target that is beyond tracer burnout range (fig. M–2). For example, the gunner with perfect aim fires a tracer from point A at target T. However, since target T happens to be beyond tracer burnout range, the tracer disappears at point D. At tracer burnout time the gunner has moved to point B. He sees the tracer disappear at point D and concludes (incorrectly) that he has aimed low and to the left; meanwhile, the bullet strikes the target.

M–29. Compensation for Effects of Observer Shift

It is possible for the gunner to compensate for the effects of observer shift; experienced gunners usually do this automatically. Awareness of the problem can greatly increase his ability to learn to correct for the deception. If the gunner can ob-

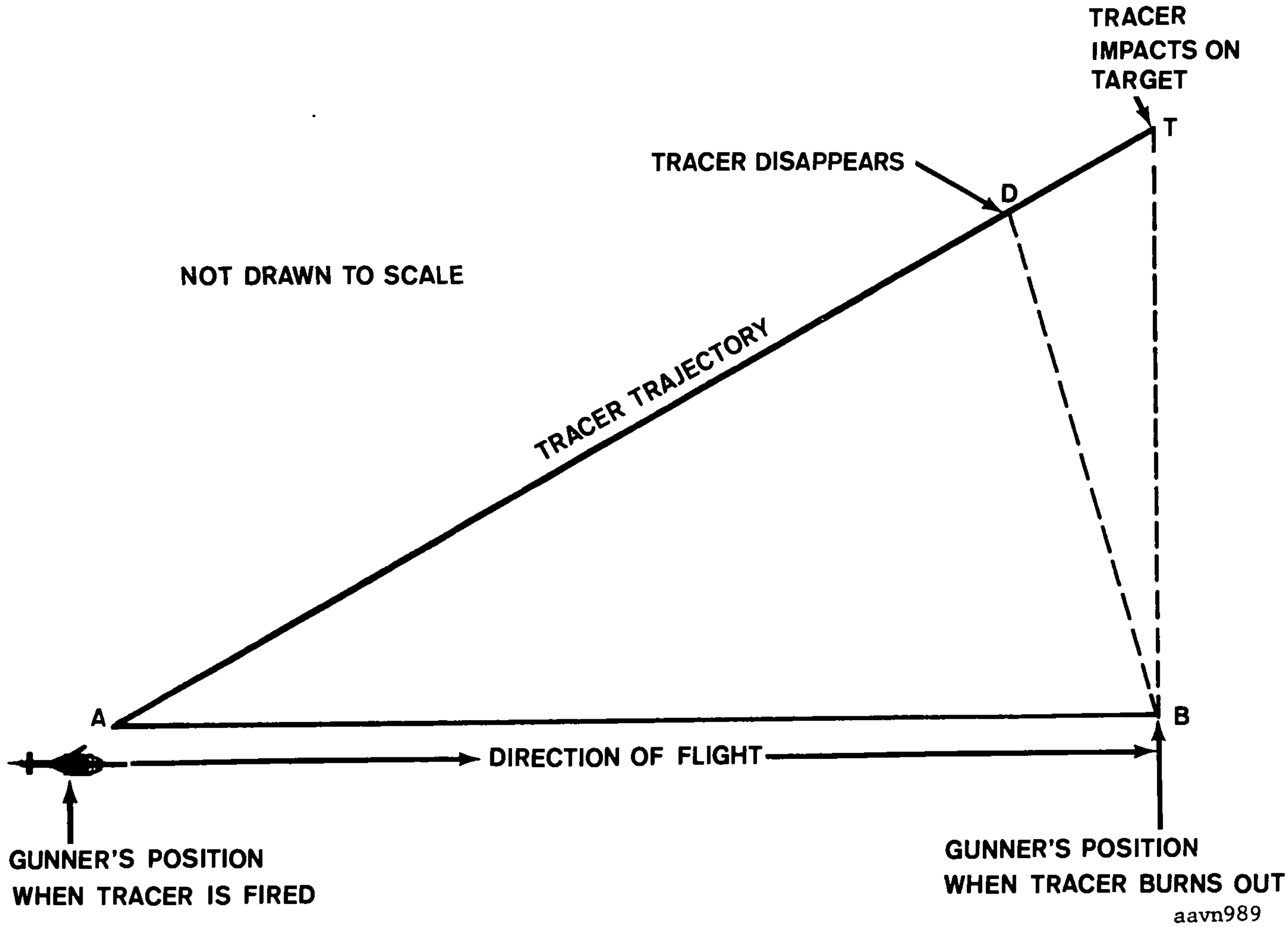


Figure M–2. Observer shift effect at tracer burnout (apparent impact point).

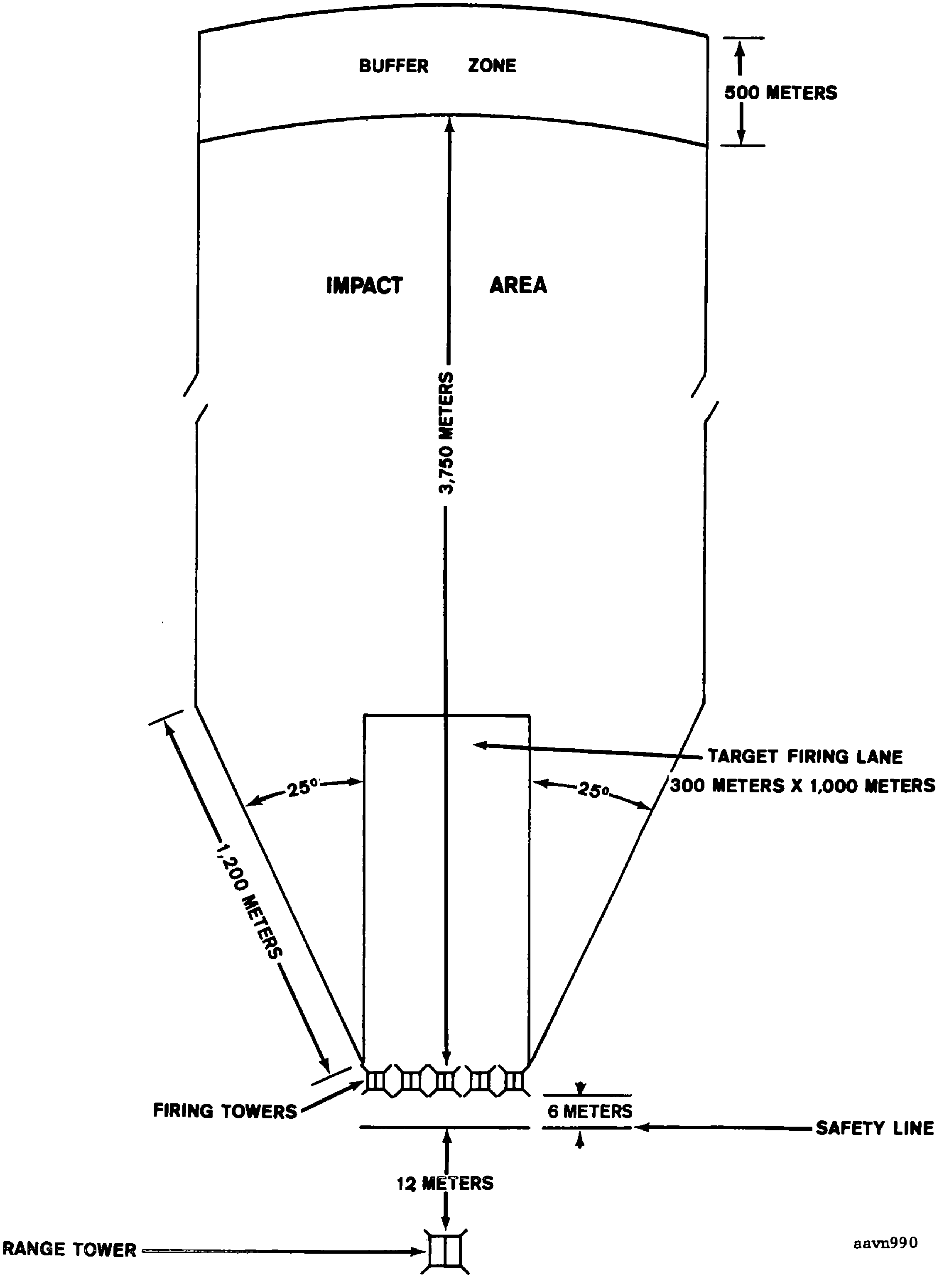


Figure M-3. Recommended ground-firing machinegun range.

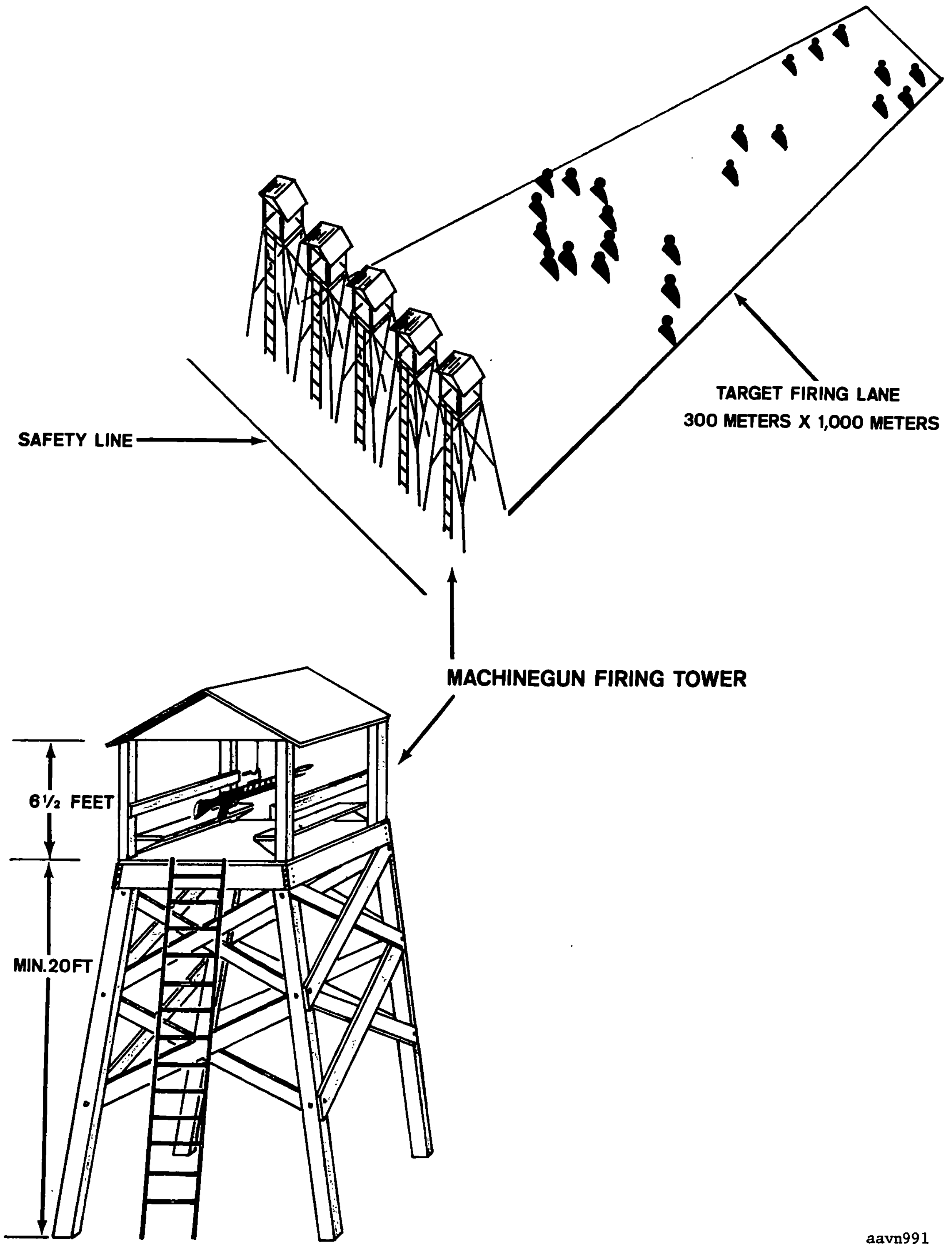


Figure M-4. Suggested machinegun firing towers—placement and construction.

serve bullet strike, he can use that as a guide. This technique is especially valuable if the target is beyond tracer burnout range. When a usable sight is available, the gunner should use both the sight and tracers.

Section VI. SUGGESTED DOOR GUNNER RANGES

M–30. Ranges for Door Gunner Training

a. Ground-Firing Range for M60 Machinegun Firing. A recommended range for door gunner machinegun ground firing is shown in figure M–3. This range will meet the minimum requirement of familiarizing the door gunner with his weapon.

(1) *Suggested firing towers.* Firing towers (fig. M–4) permit door gunners to be taught the proper sitting position and the procedures for handling and firing machineguns. A fixed-mount machinegun may be used, if available. To simulate firing from either helicopter door, the door gunner and instructor may switch seats during firing exercises.

(2) *Targets.* Targets for target engagement are placed within and beyond M60 machinegun tracer burnout range. Target engagement beyond tracer burnout range will give the gunner practical experience in adjusting his fire by observing bullet strike/impact.

(*a*) *Silhouettes.* Silhouettes make very good training targets and add a degree of realism. Silhouettes should be placed in normal combat formations and at various ranges (fig. M–4).

(*b*) *Popup targets.* Popup targets are only used on ground-firing ranges. They increase the gunner's ability to acquire new targets at various ranges.

(*c*) *Target placement.* The contour of the available terrain will dictate target placement. During target placement, every effort should be made to provide realistic ranges.

(*d*) *Target engagement.* On ground-firing ranges, target engagement is limited to targets in front of and downrange from the firing point or tower.

b. Aerial Door Gunner Firing Ranges. The pur-

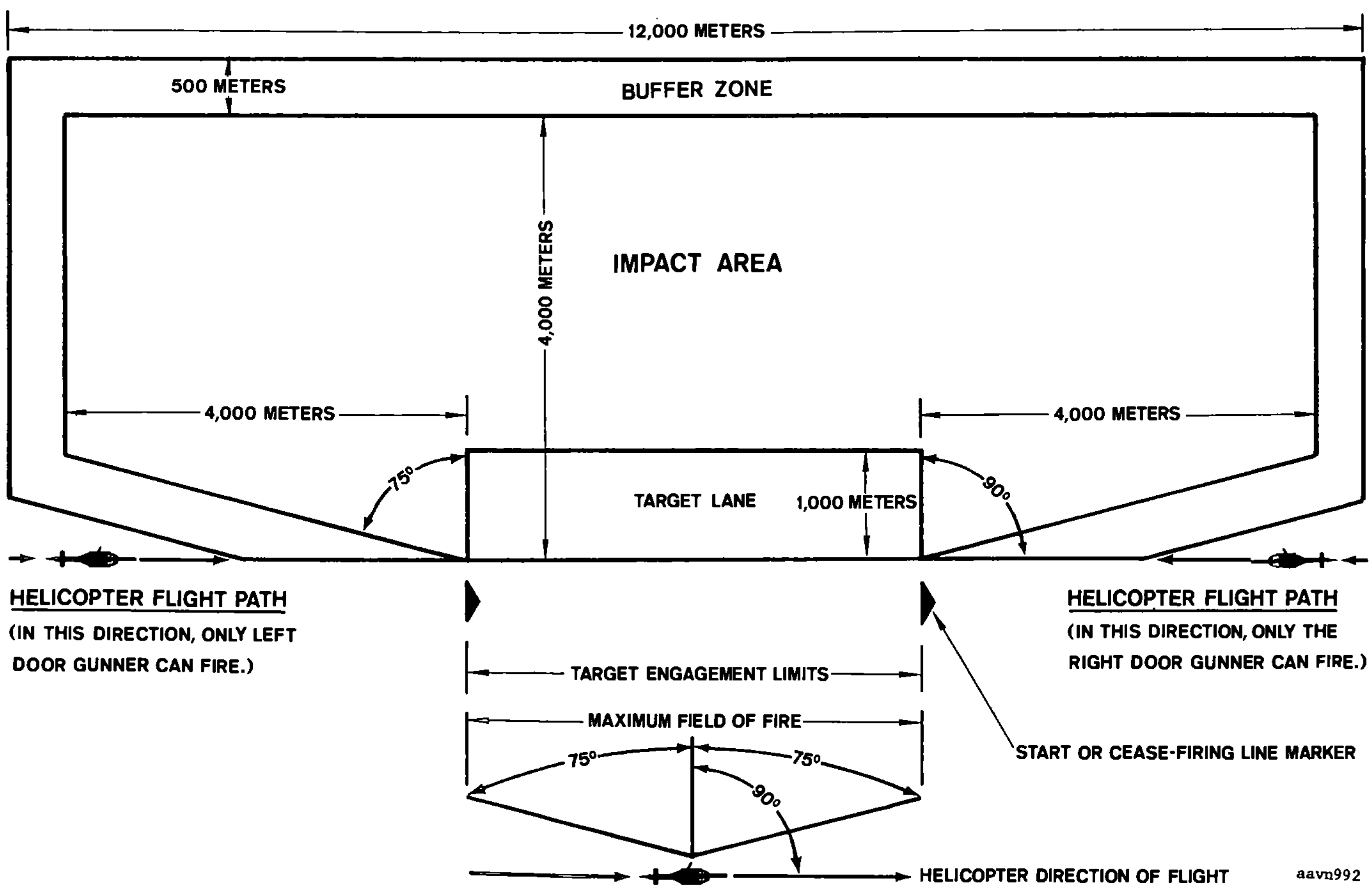


Figure M–5. Suggested aerial door gunner firing range for firing from helicopter door facing range.

pose of aerial door gunnery training is to teach the door gunner how to make the proper lead correction when engaging a target from a helicopter in flight. For details on targets, see *a*(2) above. Target engagement on aerial fire ranges will be restricted to within the angular limits of impact areas. Suggested aerial door gunner firing ranges are as follows:

(1) *For firing from only one helicopter door.* Figure M–5 shows a range suggested for door gunner firing from only one door, depending on which side of the helicopter is facing down the door gunner firing range.

(2) *For firing simultaneously from both helicopter doors.* Figure M–6 shows a range suggested for both door gunners to fire simulta-

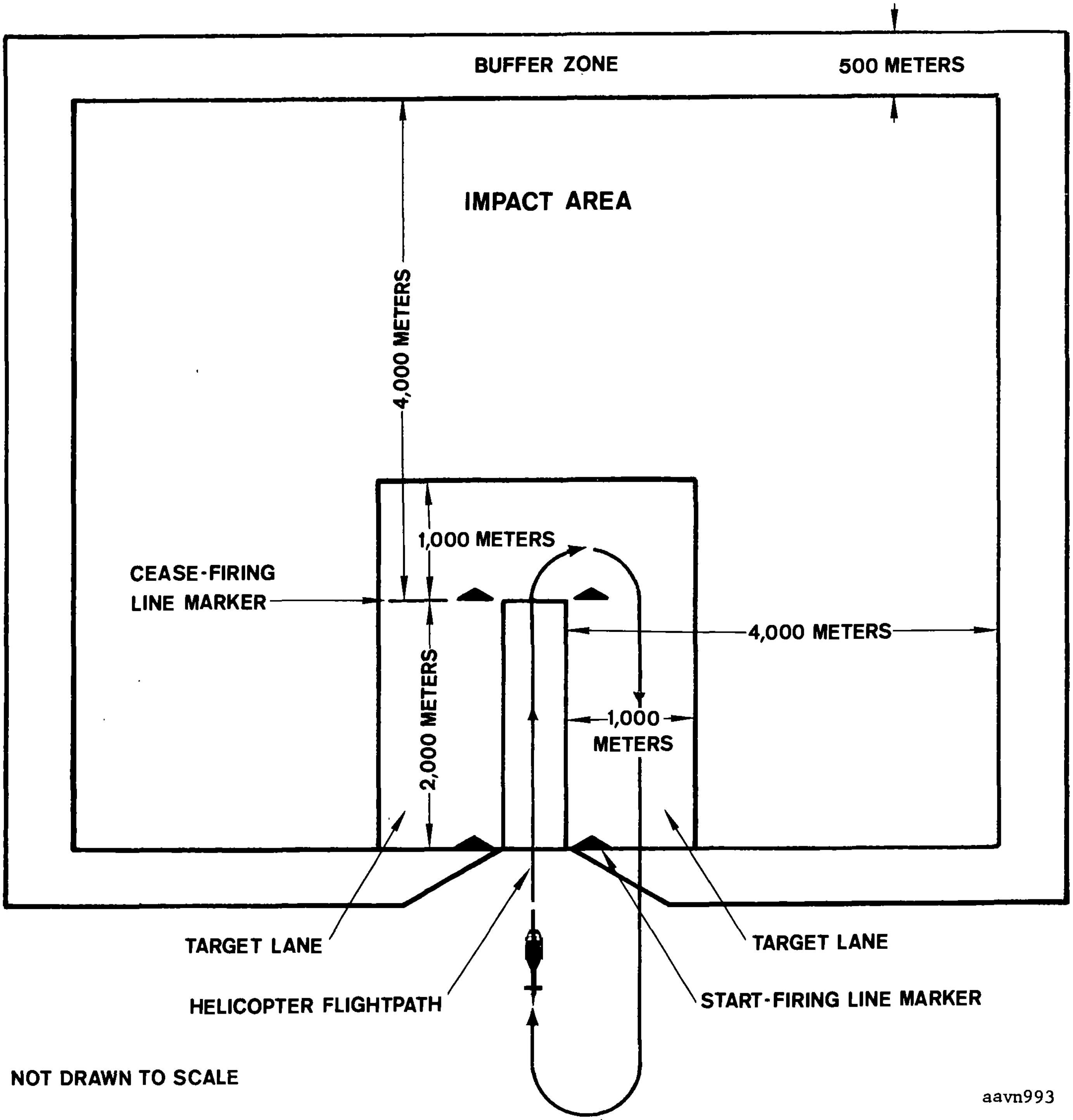


Figure M–6. Suggested aerial door gunner firing range for simultaneous firing from both helicopter doors.

neously from each helicopter cargo door. When the helicopter turns to depart from this range, the door gunner on the outside of the turn may continue to engage targets as long as he shoots within the range impact area limits.

(3) *M6 subsystem quad machinegun range for aerial door gunner training range.* If existing facilities (impact areas) do not provide sufficient area to accommodate the suggested aerial firing ranges (figs. M–5 and M–6), the typical helicopter aerial gunnery range for the M6 quad machinegun subsystem can be used. This range (fig. M–7) will allow door gunner firing from the helicopter as it breaks from the range. Firing must be limited to the right door in a left break and the left door in a right break. Door gunners must restrict their firing to the door gunner impact area (fig. M–7). If experienced door gunners are being trained, area "G" (fig. 13–1) may be eliminated.

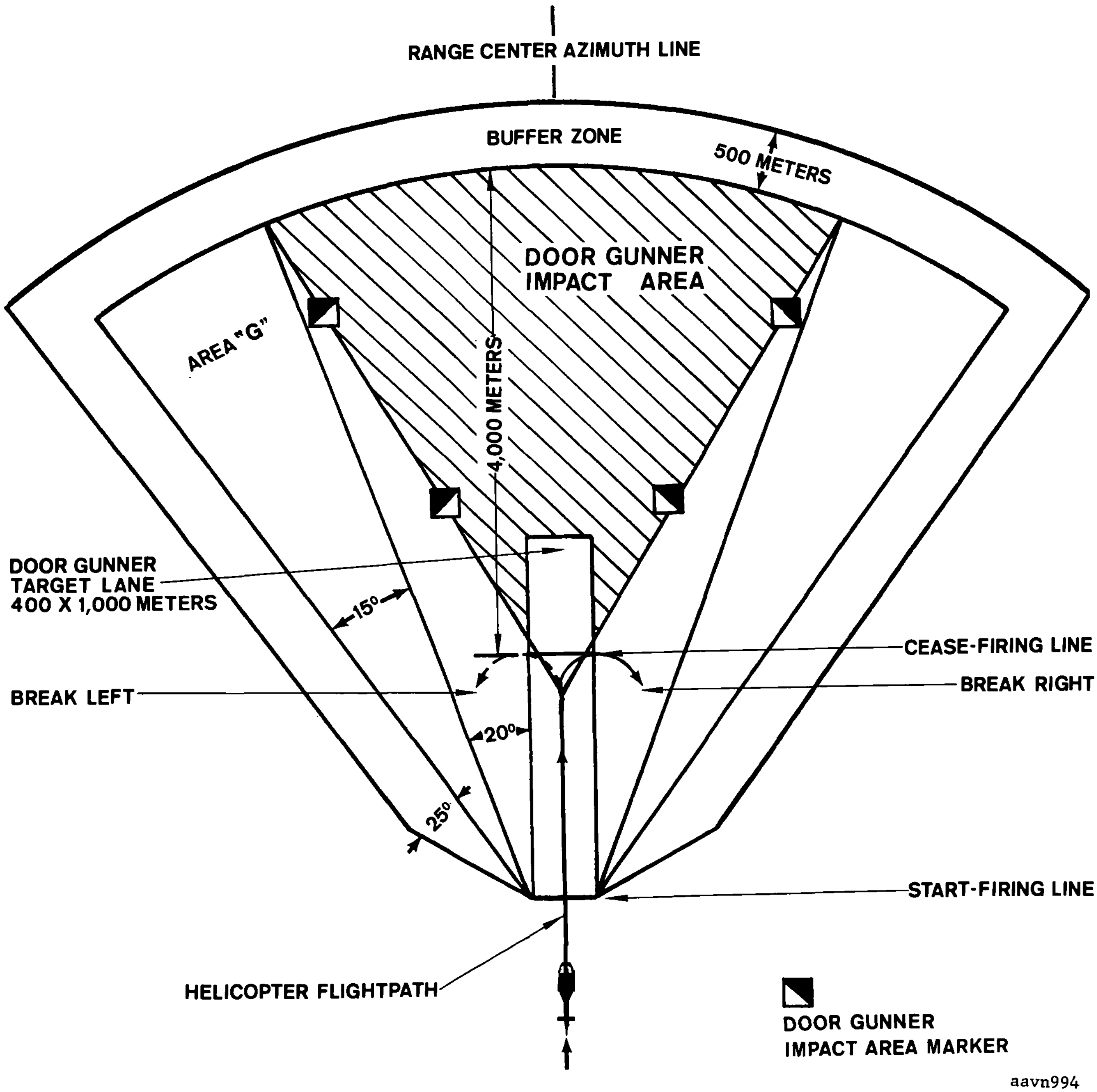


Figure M–7. Using an M6 quad machinegun range for door gunner training.

M–31. Ground Range Firing

All ground door gunner firing exercises must be conducted under the direction of a range control officer. Each gunner should fire about 200 rounds of 7.62mm linked ammunition (four rounds of ball to one round of tracer). The unit commander should determine the exact number of rounds required for training. While M60 machinegun firing is being conducted from towers on the range, M60 machinegun familiarization training can be conducted concurrently at three training stations.

★M–32. Aerial Range Firing

All aerial door gunner firing must be conducted under the direction of a range control officer. This officer must be located either on the ground or in a control tower that has complete visibility of all aerial firing. To control range firing, the range control officer must have radio communications with all helicopters using the range. The aerial range firing phase of instruction is designed to teach the door gunner the fundamental principles of air-to-ground machinegun fire. The door gunner should fire a sufficient number of rounds of 7.62mm linked ammunition (four rounds of ball to one round of tracer) to demonstrate the gunnery proficiency desired by the unit commander. He should be allowed to fire during all flight maneuvers, i.e., climbing, descending, shallow and steep turns, and nap-of-the-earth.

M–33. Scoring

Although no standard scoring system or qualification has been developed, scoring will be based on the instructor's judgment of the accuracy of fire on target.

★M–34. Ammunition Requirements

For aerial door gunner ammunition requirements, see table M–2. This table is for guidance purposes only and does not restrict flexibility exercised by local commanders. However, unit commanders must insure that ammunition expended will not exceed authorized allowance in CTA 23–100–6.

★*Table M–2. Door Gunner Aerial Gunnery Ammunition Requirements*

Helicopter	Armament subsystem	Machinegun	Ammunition, ctg ball, 7.62mm (No. of rounds per individual)					
			Initial qualification		Annual proficiency		Familiarization	
			TR 4-1, MLB	TR, MLB	TR 4-1, MLB	TR, MLB	TR 4-1, MLB	TR, MLB
UH-1D/H	M23	M60D	500	1,500	500	500	500	500
CH-47A	M24	M60D	500	1,500	500	500	500	500
CH-47A	XM41	M60D	500	1,500	500	500	500	500

APPENDIX N

CHECKLISTS, REPORTS, AND SEQUENTIAL OPERATION ORDER

Section I. CHECKLISTS

Note. The sample checklists included herein may be modified to meet individual unit requirements.

N-1. Premission Coordination Checklist

(To be used for coordination between the supported ground unit and the attack helicopter force.)

a. Situation.

(1) Unit being supported.

(2) Coordinating personnel.

(*a*) Supported.

(*b*) Others.

(3) Supporting fires in area.

(*a*) Mortars/artillery.

(*b*) Naval gunfire.

(*c*) Tactical air.

(4) Enemy estimated in area.

(*a*) Strength and disposition.

(*b*) Weapons and capabilities.

(5) Tactical air support plan.

b. Mission.

(1) Date and time of operation.

(2) Location of operation.

c. Execution.

(1) Concept of operation.

(2) Task of subordinate elements.

(3) Task of attached elements.

(4) Coorinating instructions.

(*a*) Formations.

(*b*) Routes.

(*c*) Altitudes.

(*d*) Starting and takeoff time.

d. Administration.

(1) Escape and evasion.

(2) POL, ammunition, rations.

(3) Medical evacuation.

(4) Recovery instructions for downed aircraft.

(5) Maintenance and armament support.

e. Command and signal.

(1) Frequencies and call signs.

(2) Alternate means of communications.

(3) Chain of command.

(4) Command post and commander's location.

f. Special instructions.

(1) Ground security forces for servicing area.

(2) Defense plans for refuel area.

N-2. Mission Planning Checklist

a. Operational time schedule.

b. Staging area (location and parking plan, if necessary).

c. Weather.

d. En route altitudes.

e. Approach and take off directions in landing zone.

f. Airspeed en route.

g. Flight routes.

h. Flight formations.

i. Use of phase lines and checkpoints.

j. Prestrike requirements.

k. Areas of suspected targets (priority); e.g., antiaircraft areas in route of flight.

l. Target designation procedures.

m. Emergency procedures for downed aircraft.

n. Medical evacuation procedures.

o. Use of USAF support and/or artillery.

p. Observers.

q. Class III support.

(1) Type refueling procedures.

(2) Proposed refueling time.

r. Radio frequencies and call signs.

s. Class V support.

(1) Ammunition prestocked.

(2) Ammunition to be delivered.

N-3. Mission Checklist

a. Premission.

(1) Crews alerted.

(2) Crews briefed.

(3) Readiness of aircraft and equipment.

(4) Preflight and runup.

(*a*) Radio.

(*b*) Armament.

(5) En route formation (to staging area).

(6) Radio discipline.
(7) Parking (in staging area).
(8) Logistics.
(*a*) Classes I, III(A), V(A).
(*b*) Special equipment.
1. Survival.
2. Maintenance.
(*c*) Support equipment.
(9) Final briefing on tactical situation.

b. During Mission.
(1) Supervision of—
(*a*) Tatical formations.
(*b*) Escort procedures.
(*c*) Reconnaissance.
(*d*) Radio procedures.
(*e*) Reports (Code and SOI, etc.).
(2) Evaluation of—
(*a*) Battle damage and possible repair.
(*b*) Collection and dissemination of latest enemy intelligence.
(c) Redistribution of personnel and equipment.
(*d*) Reports to and from checkpoint.
(*e*) Preparation for next lift or strike.
(*f*) Additional resupply when required.

c. Postmission.
(1) Operational status—damage assessment.
(2) Resupply.
(3) Debriefing:
(*a*) Intelligence.
(*b*) Operational.
1. Unit and individual performance.
2. Lessons learned.
(4) Postflight and maintenance:
(*a*) Aircraft.
(*b*) Weapons.

N–4. Debriefing Checklist

a. Estimate of mission results (degree to which mission was accomplished).

b. Enemy activity encountered or observed during mission. Report in following sequence:

(1) *Line A*—WHO made the sighting or observation (aircraft number, mission number, patrol, etc.).

(2) *Line B*—WHAT was observed (enemy, unknown, or friendly forces; strength and type of target—tanks, infantry, patrol, bivouac area; include number of items observed and what they were doing—halted, digging in, moving (if moving, include directions of movement)).

(3) *Line C*—WHERE the activity was sighted (universal transverse mercator (grid) (UTM) coordinates or cardinal point from geographic location in the clear if the report is of enemy activity) and WHEN (time sighted and/or reported).

(4) *Line D*—WHERE spot (hot) reports were made and to whom (if applicable).

(5) *Line E*—DAMAGE reports (if applicable).

c. Debrief individual flightcrews.
(1) Aircraft hits.
(2) En route fire received.
(3) Targets engaged.
(4) Estimated killed in action (KIA).
(5) Estimated wounded in action (WIA).
(6) Ammunition expended.
(*a*) 2.75-inch FFAR.
(*b*) 7.62mm.
(*c*) 40mm.
(*d*) M22 ATGM.
(*e*) Small arms.
(7) Weapons status.

d. Estimate of aviation portion of mission.

(1) Conduct of operation in the PZ: As planned? Problems?

(2) Flight route and checkpoints: Adequate? Easily identified?

(3) Formation and altitude: Most suitable?

(4) Activity in the landing zone (LZ): As planned? Alternate?

(5) Communications: Adequate? Excessive?
(*a*) Air-to-air.
(*b*) Air-to-ground.
(*c*) SOI-SSI.

e. Aircraft damage and personnel casualties KIA's and WIAs'.

(1) Personnel casualties.

(2) Aircraft damage. What? When? Where? How?

f. Refueling and maintenance problems.

g. Mission command.

(1) Was the concept of the operation carried out as planned?
(*a*) Flight routes.
(*b*) Flight altitudes.
(*c*) Flight formation.
(*d*) Time schedules.
(*e*) Communications.
(*f*) Other.

(2) Were the enemy and friendly situations valid as received at the briefing?

(3) Were there any delays or confusion which could have been eliminated?

(4) Lessons learned.
(*a*) Ground units.
(*b*) Aviation units.

(5) Actions taken for correction.

N-5. Duties of Aircraft Commander

a. Briefs entire crew on—

(1) Mission.

(2) Friendly and enemy situation.

(3) Restrictions to fire.

(4) Weather.

(5) All other available information pertaining to the mission.

b. Commands aircraft, regardless of who is at controls.

c. Makes radio check per unit SOP.

d. To keep aircraft within gross weight limitations, determines that only mission-essential equipment is aboard and operational.

e. Is responsible during mission for actions of all crewmembers.

f. Personally supervises rearming and refueling of aircraft. If he must be absent, directs that the copilot supervise and/or assist in rearming and refueling.

g. Keeps sharp lookout for other aircraft.

h. Debriefs crew after mission.

i. Trains the crew in unit procedures applicable to the area of operation.

j. If aircraft commander of lead ship, personally completes mission reports for his flight.

N-6. Duties of Pilot

a. Obtains necessary equipment from unit operations.

b. Preflights aircraft and armament system.

c. Insures that all required equipment is aboard and operational.

d. Insures that all required protective and survival equipment is aboard and serviceable.

e. Tunes radios and makes frequency changes as directed by aircraft commander.

f. Monitors all radio frequencies not being monitored by aircraft commander.

g. Records all pertinent information, received on radio and from other crewmembers, that has bearing on mission.

h. Records coordinates and times of all strikes and areas from which fire is received.

i. Arms and de-arms armament subsystem.

j. Monitors aircraft instruments during flight and notifies aircraft commander when fuel remaining is 400 pounds.

k. Assists with rearming and refueling.

l. Clears aircraft for turns to the left.

m. Assists aircraft commander as directed by aircraft commander.

n. Keeps crew chief and gunner up to date on tactical situation.

o. Keeps sharp lookout for other aircraft.

p. Checks SOI for familiarity with necessary call signs and posts schedule code for quick use.

q. Navigates and maintains general aircraft location on the map at all times.

N-7. Duties of Crew Chief (UH-1)

a. Completes daily inspection prior to arrival of pilot for preflight.

b. Insures standard loading of weapons, ammunition, and survival equipment.

c. Informs pilot as to condition of helicopter and any special characteristics or deficiencies in helicopter.

d. Assists aircraft commander in adjusting seat and closes door, unless directed otherwise.

e. Arms the M5 subsystem and the weapons system on right side of helicopter.

f. Clears helicopter in parking area and for turns to right while in flight.

g. Throws smoke grenade and calls "Fire" when fire is received.

h. Lays down protective fire while helicopter disengages. Fires under disengaging helicopter on all breaks and under the trailing helicopter after 180° breaks.

i. Monitors fire mission commands and insures that he has sufficient ammunition to provide fire if required.

j. Keeps pilot informed as to armament status and amount of ammunition remaining.

k. Refuels helicopter.

l. Rearms helicopter with assistance of pilot and door gunner.

m. Maintains accurate records on helicopter and armament.

n. Repairs and maintains helicopter as authorized.

o. Supervises and assisst door gunner in cleaning and reassembling machineguns if time permits.

p. Supervises training of door gunner.

q. Knows first aid procedure and how to administer morphine.

r. Insures that rations and water are aboard helicopter.

s. Keeps sharp lookout for other aircraft from 6 o'clock position to 1 o'clock position.

t. Informs pilot of any movement on the ground in mission area.

u. Acknowledges all instructions from pilot and aircraft commander.

N–8. Duties of Door Gunner (Utility and Cargo Helicopters Only)

a. Draws required weapons and equipment and places it on the helicopter.

b. Insures that standard M14, M79, and M60 reserve ammunition is aboard in bandoliers or assault packs as required by loding SOP.

c. Assists pilot with preflight.

d. Assists crew chief with daily inspection.

e. Assists pilot with adjusting seat and closes door, unless directed otherwise.

f. Clears helicopter on left side in parking area and for turns to left while in flight.

g. Keeps sharp lookout for other aircraft from 6 o'clock position to 11 o'clock position.

h. Arms weapons system on left side of helicopter.

i. Monitors fire mission commands and insures that he has sufficient ammunition to provide fire on break if required.

j. Throws smoke grenade and calls "Fire" when fire is received.

k. Lays down protective fire while helicopter disengages. Fires under disengaging helicopter on all breaks and under the trailing helicopter after 180° breaks.

l. Assists pilot and crew chief in rearming and refueling helicopter.

m. Cleans rifle and machineguns with assistance of crew chief.

n. Informs pilot of any movement in the mission area which has not been previously observed.

o. Knows first aid procedures and how to administer morphine.

p. Acknowledges all instructions by pilot and aircraft commander.

q. Insures that all weapons aboard helicopter are cleared at end of flight.

r. Assists crew chief in maintenance of helicopter if time permits.

N–9. Sample Standard Loading List (UH–1 W/M16 Subsystem)

1. Two barrel racks with four barrels each, one rack attached to each pilot's seat.
2. Two M60 door guns attached to the barrel racks; 1,000 rounds ammunition plus two assault packs per door gun.
3. One M14 rifle attached to the copilot's seat; 15 loaded M14 magazines in bandoliers attached to the copilot's seat.
4. One M16 rifle attached to the pilot's seat; five loaded M16 magazines attached to pilot's seat.
5. One M79 grenade launcher attached to the pilot's seat; 18 rounds in bandoliers attached to the pilot's seat.
6. One URC–4 emergency radio attached to the copilot's seat.
7. One headset (101–U) stored in door post compartment.
8. Five lifevests stored in door posts (if required in area of operation).
9. One 10-pound toolbox with flashlight attached to floor aft of console.
10. One 10-pound gun parts box attached to floor aft of console.
11. One 2-gallon water can attached to floor in center of crew chief/gunner's seat.
12. Six thousand seven hundred rounds of 7.62mm ammunition for the machinegun system (1,500 rounds per gun plus 700 in chutes).
13. Smoke grenades, attached to firewall above crew chief/gunner's seat (total 32–20 white).
14. Four chest protectors stored on seats.
15. "C" rations (minimum of four meals) stored in baggage compartment.
16. One quart MIL 7808 oil, stored in baggage compartment.
17. One quart MIL 5606 hydraulic fluid, stored in baggage compartment.
18. Machinegun covers stored in baggage compartments.
19. Fifty feet of ½-inch rope secured to barrel rack on pilot's seat.

N–10. Individual Survival Kit, Crewmember

a. Listed below are the minimum required items of survival equipment to be placed in the standard combat pack issued to each individual.

(1) Two-part emergency survival kit.
(2) Signal mirror.
(3) Hand-held mayday flares.
(4) Multilingual request for assistance.
(5) Snakebite kit.
(6) Insect repellent.
(7) Matches.
(8) Pocket knife.
(9) Survival compass.
(10) Flashlight.

b. Minimum survival items required to be secured to the individual crewmember's webbelt are—

(1) Canteen with fresh water.
(2) Survival pack.
(3) Machete knife or jungle axe.
(4) First aid packet.
(5) Individual weapon if applicable.

N–11. Required Items of Uniform

The items of clothing and equipment listed below will be worn by air crewmembers during aerial flight.

a. Fatigues or fire retardant clothing with sleeves rolled down.

b. Combat boots.

c. Flak vest with survival knife affixed to left side (optional).

d. Chest protector.

e. Groin protector (optional).

f. APH-5 helmet w/clear visor.

g. Flying gloves (gauntlet type).

h. Sun glasses (optional).

i. Identification tags with chain.

j. Protective mask (optional).

Section II. REPORTS AND SEQUENTIAL OPERATION ORDER

N–12. Airmobile Operation Message Format

a. Abbreviated orders and plans may be transmitted using the Ground-Air Plan (GAP) format. Items are numbered or lettered to allow the message to be transmitted using a line item key. Only the required information need be given. Abbreviations used are—

(1) Ambl—airmobile.
(2) AMTF—airmobile task force.
(3) CCP—communications checkpoint.
(4) C&C—command and control.
(5) Comd—commander.
(6) Dep—depart/departing/departed.
(7) GAP—ground-air plan.
(8) LFT—light fire team.
(9) LRP—landing zone release point.
(10) PF—pathfinders.
(11) PIREP—pilot report.
(12) PRP—pickup zone release point.
(13) P/u—pickup.
(14) PZ—pickup zone.
(15) Sec—second(s).

b. Liaison officers will use the Ground-Air Plan (GAP) format for assembling the information required by aviation elements involved in the operation.

c. Radio transmissions will be preceded by the phrase, "This is a GAP message." This will be followed by the message text in the following form: "One Alpha—Red one, one Bravo—ACF 6428, one Charlie—071030R, etc."

SAMPLE GROUND-AIR PLAN (GAP) MESSAGE FORMAT

1. a. Supported Ground Unit ______(Call word, Channel, Size)
   b. Supporting Aviation Unit ______
2. a. Obj ______ b. H-Hour ______
3. a. Trp Hel Plan Plat ______ b. Co ______ c. Bn ______
4. a. Mdm Hel Plan Plat ______ b. Co ______ c. Bn ______
5. a. Atk Hel Plan ______ b. Prep ______ c. Tgt Coord ______
   d. Join Column at ______ e. Orbit Area ______
6. a. 105-How Plan ______ b. Tgt Coord ______
   c. Length of Prep ______ d. Fire Control (Call word, Channel) ______
7. AF Spt: a. Orbit Area ______ b. No. Preplans ______
8. Cav Plan: ______

9. PZ (Name and Coord)	10. Formation	11. Load Type	12. Acft Rqr
a. ______	a. ______	a. ______	a. ______
b. ______	b. ______	b. ______	b. ______
c. ______	c. ______	c. ______	c. ______
d. ______	d. ______	d. ______	d. ______

13. LZ (Name and Coord)
   a. ______ b. ______
   c. ______ d. ______
   e. ______ f. ______
14. Formation
   a. ______ b. ______
   c. ______ d. ______
   e. ______ f. ______

15. Prim Flt Route
    a. IP ____________Time:____ b. Acft Con Pt _____Time:____
    c. Con Check Pt _____Time:____ d. Acft Con Pt _____Time:____
    e. Release Pt ______Time:____
16. Alternate Flight Route
    a. IP ____________Time:____ b. Acft Con Pt _____Time:____
    c. Con Check Pt _____Time:____ d. Acft Con Pt _____Time:____
    e. Release Pt ______Time:____

SAMPLE GROUND-AIR PLAN (GAP) MESSAGE FORMAT
(continued)

17. UHF Air Con Channel ______________________________
18. Fire Con (Call word, Channel) ______________________
19. PF ____
20. REMARKS: ____

N–13. After Action Report

a. Statement of Mission.

(1) Staging area.

(2) How mission was accomplished.

(3) Designation of aviation unit supported.

(4) Designation of unit supported.

b. Conduct of the Operation.

(1) Departure and arrival time of individual lifts.

(2) Enemy location.

(3) Location of hostile fire.

(4) Coordinates of friendly fire delivered.

(5) Unusual incidents and delays.

(6) Location of landing zone.

c. Conclusion. Was the mission completed satisfactorily?

d. Recommendations.

(1) Lessons learned.

(2) New ideas or concepts.

(3) Unsatisfactory techniques.

e. Remarks.

(1) Training or equipment needed.

(2) Coordination required with other units.

N–14. Fire Report

a. General. Radio discipline is mandatory to prevent undue confusion in battle. Excessive radio communications block out necessary transmissions, create undue confusion, and give the enemy more time to locate frequencies for jamming and/or injecting false information. For these reasons, a fire report transmitted to the mission leader from the aircraft observing or receiving enemy fire must be clear, complete, and brief. The report need contain only the identity of the aircraft making the report, the type of fire, location (using clock system of reference and range estimation), the word "smoke" (indicating that a smoke grenade has been dropped), and the location of source of fire in relation to smoke grenade.

b. Factors and Considerations.

(1) Crews must be trained to use a brief fire report.

(2) Crews must be trained to drop smoke immediately upon receiving fire.

(3) Team leaders and mission leader must know the location for their subordinate elements at all times.

c. Sample Fire Report.

(1) Dragon (aircraft identification).

(2) Automatic weapons fire (type of fire).

(3) 3 o'clock, 400 meters (direction and range).

(4) Smoke (indicating that as base of reference, smoke has been dropped).

N–15. Aircraft, Crew, Weapons, and In-Flight Status Report

In order for the mission leader to estimate the combat power and immediate capabilities of his unit at all times, he must receive timely reports from subordinate leaders giving the status of their aircraft, personnel, and weapons. After each major target attack (e.g., a landing zone, point target, etc.), individual aircraft should transmit a status report to the mission leader. This report should cover whether aircraft are flyable, whether casualties were suffered, and the status of aircraft weapons systems. It is recommended that such reports be given in code words to confuse listening stations (e.g., "Scorpions 1" could mean that only one machinegun is operating). A short, clear report is desirable. These in-flight reports should be given without request, and negative reports should *not* be transmitted.

Below is an example of an in-flight aircraft, crew, and weapons report in the clear:

a. Dragon (aircraft identification).

b. FM out, flyable (aircraft status).

c. Gunner lightly wounded (crew status).

d. Two machineguns out (weapons status).

N–16. Sample Format for Spot, Site, and Pilot Reports

(Use format by reading down under each type report. Use only those items which apply.)

TIME RECEIVED		CONTROL NO.	
	SPOT	SITE	PIREP
ALPHA:	OBSERVER	OBSERVER	OBSERVER
BRAVO:	WHAT (enemy)	WHAT (LZ, PZ)	WHAT (Visibility (Wea))
CHARLIE:	WHERE (Coordinates-clear)	WHERE (Coordinates-encode)	WHERE (Coordinates-encode)
DELTA: (Convoy, Troops Moving)	ACTIVITY	SIZE (plt, co)	ACTIVITY (Stationary, T)
ECHO:	YOUR ACTION (contact)	BEST NO WIND LNDG DIRECTION	WIND DIRECTION
REMARKS:			

N–17. Sample Sequential Operation Order

(The Sequential Operation Order can be used to simplify the issuance of necessary orders for an airmobile operation. It also simplifies the annotating of changes after the order has been published.)

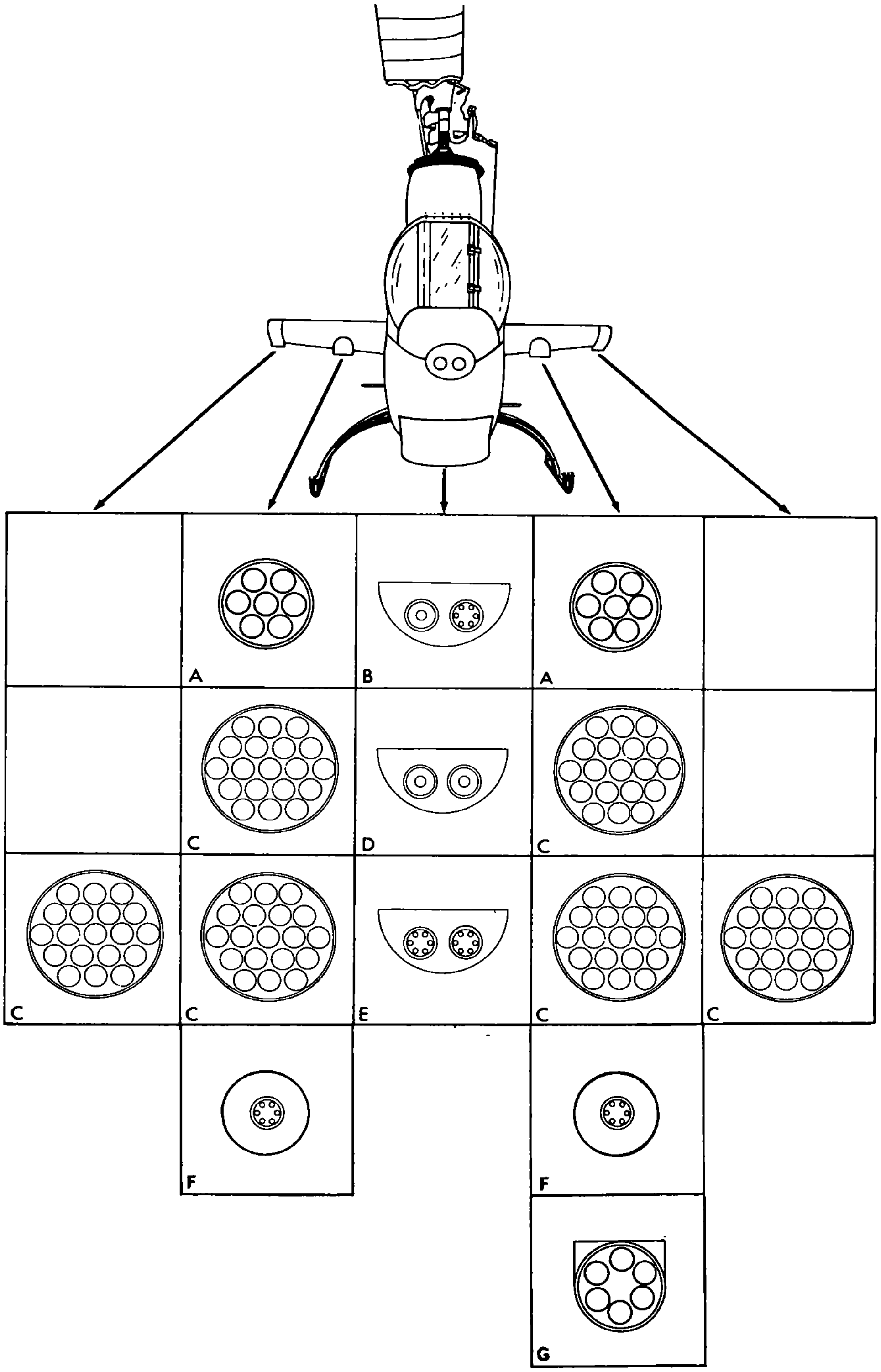
ITEM	TIME	ACTION	OTHER INFORMATION
1	0730–1000	162d w/attach conducts ambl aslt w/½ Inf from QUAN LOI to LZ RED (XT645689) ; 25 sorties 2 lifts. (1)	Flt #1, 1st plat 162d 5 UH–1D; Flt #2, 2d plat 162d 5 UH–1D; Flt #3, 173d 5 UH–1D. 1 LFT Copperheads, 1 LFT Crossbows.
2	0730	Station time QUAN LOI; line up NW side runaway; final briefing. Contact QUAN LOI Twr 5 min out for landing instr. (2)	Chalk plates & No. Flt #1 Yellow 1–5 Flt #2 White 1–5 Flt #3 Green 1–5
3	0745	Copperheads & Crossbows dep for LZ RED. Gunships prep 3 min prior to arrival of slicks; Copperheads mark LZ w/yellow smoke. (3)	Copperheads E; Crossbows W side of LZ. No prep fires by arty or TAC air.
4	0748	Flt #1, #2, #3 dep QUAN LOI for LZ RED. (4)	En route & landing formation Heavy Right; Flt route as briefed; 30 sec sep between flts; 1500′/80k. Normal rules of engagement en route.
5	0800	Flt #1 arr LZ RED. Followed by Flt #2, #3. (5)	Landing az 030; suppressive fire by door gunners Flt #1 only. Use only outboard guns. All flts rpt arr & dep LZ to C&C.
6	0813	Flt #1 & #2 arr QUAN LOI; P/u 2d lift; dep immed for LZ RED. Flt #3 refuel and standby QUAN LOI. (6)	POL avail QUAN LOI. Rearm at HON QUAN. Aid sta loc QUAN LOI. Dust Off avail on call.
7	0826	Flt #1 & #2 arr LZ RED: return QUAN LOI, refuel & standby. Copperhead & Crossbows return to QUAN LOI on order C&C; standby QUAN LOI. (7)	AMTF Comd: Co, ½ Inf (Dasher 6) Mission Comd: Co, 162d (Vulture 6) Alt Mission Comd: Vulture Lead.
8	1000	All flts released to parent unit control. (8)	Prim UHF: 248.6 Alt: 360.4 Prim FM: 66.30 Alt: 60.2 Gunships VHF: 122.5 QUAN LOI Twr: 47.3 Dust Off: 45.7

APPENDIX O

★ARMAMENT DATA

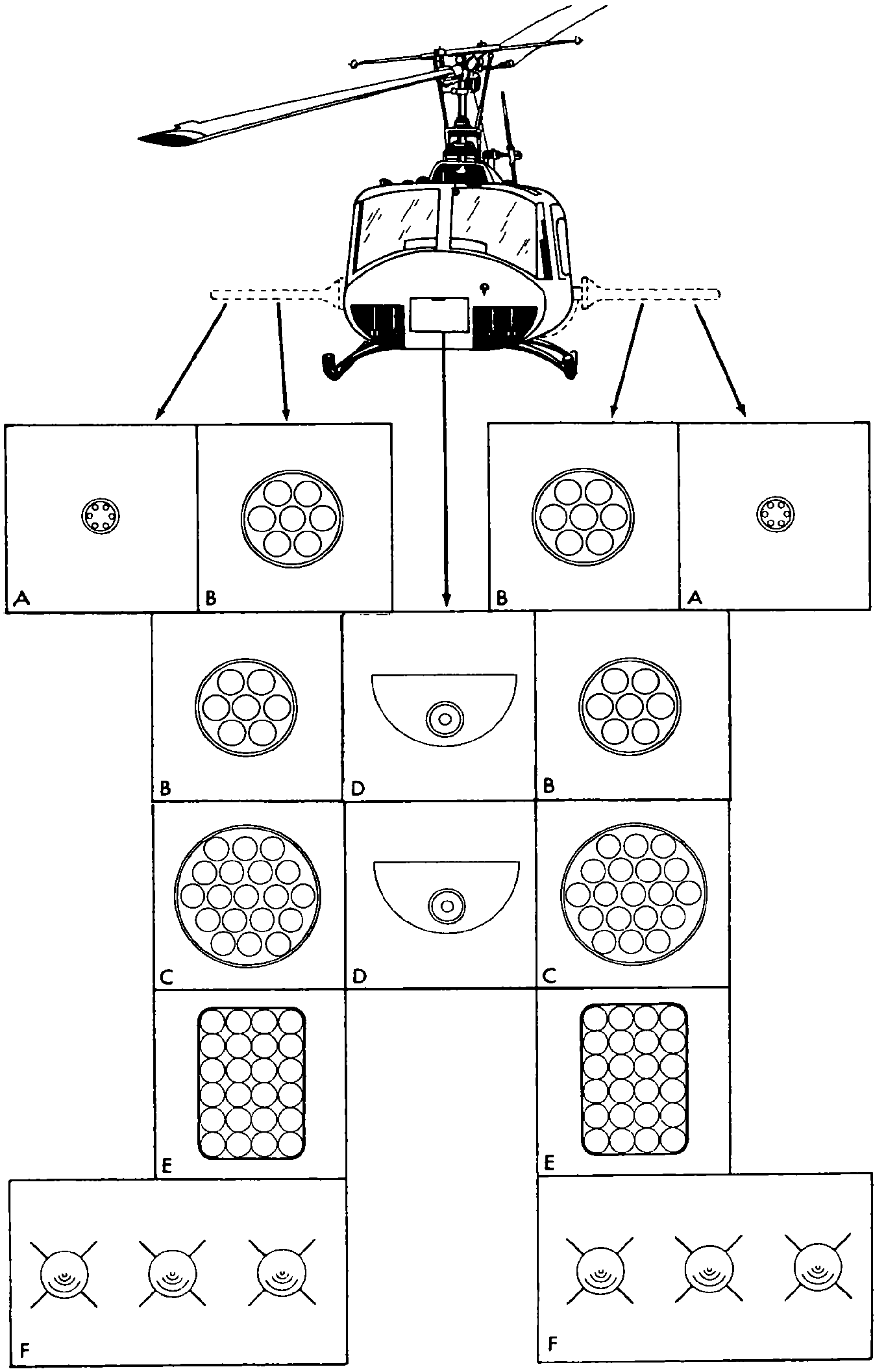
O–1. Armament Subsystem Performance

Various armament configurations for the AH–1B and UH–1B/C attack helicopters are shown in figures O–1 and O–2. All possible combinations are not shown. For AH–1G and UH–1B/C armament subsystem performance data, see tables O–1 and O–2.



A XM157B OR M158A1: SEVEN-TUBE, 2.75-INCH ROCKET LAUNCHER.
B XM28 SUBSYSTEM: 7.62MM HIGH RATE AUTOMATIC GUN AND 40MM GRENADE LAUNCHER.
C XM159C OR XM200: 19—TUBE, 2.75—INCH ROCKET LAUNCHER.
D XM28 SUBSYSTEM: TWO 40MM GRENADE LAUNCHERS.
E XM28 SUBSYSTEM: TWO 7.62MM HIGH RATE AUTOMATIC GUNS.
F XM18E1: ARMAMENT POD, 7.62MM HIGH RATE AUTOMATIC GUN
G XM35 SUBSYSTEM: 20MM HIGH RATE AUTOMATIC GUN.

Figure O–1. AH–1G armament configurations.



A M134: 7.62MM, HIGH RATE AUTOMATIC GUN.
B XM157B OR M158A1: SEVEN-TUBE, 2.75-INCH ROCKET LAUNCHER.
C XM159C OR XM200: 19–TUBE, 2.75–INCH ROCKET LAUNCHER.
D M5 SUBSYSTEM: 40MM GRENADE LAUNCHER.
E XM3 SUBSYSTEM: 24-TUBE, 2.75-INCH ROCKET LAUNCHER.
F M22 SUBSYSTEM: WIRE-GUIDED MISSILE.

Figure O–2. UH–1B/C armament configurations.

Table 0-1. AH-1G Armament Subsystem Performance Data

Item	XM28 [a]		XM18E1	XM35	M158A1	XM159C	XM200
Ammunition type	7.62mm	40mm [b]	7.62mm	20mm	2.75-in [b]	2.75-in [b]	2.75-in [b]
Ammunition capacity (rounds)	4,000	300	1,500	1,000	7	19	19
Range (meters):							
Maximum	3,200	2,000	3,200	3,750	9,300	9,300	9,300
★Effective	1,000	1,200	1,000	3,000	2,500	2,500	2,500
Minimum	100	300	100	300	300	300	300
Rate of fire:							
★Shots per minute (guns)	2,000/4,000	400	2,000/4,000	750			
Pairs per second (rockets)					6	6	6
Flexible limits:							
Elevated	+20%	+20°					
Depressed	−50°	−50°					
Horizontal, right and left	110°	110°					
Weight (lb):							
Loaded	449	434	325	1,239	202	604	629
Unloaded	205	206	245	559	52	113	138

[a] One M129 and one M134, two M129's or two M134's.
[b] Burst radius—10 meters.

Table 0–2. UH–1B/C Armament Subsystem Performance Data

Item	XM3	M5	M6	M16		M21		M22	XM27
Ammunition type	2.75-in. [a b]	40mm [a]	7.62mm	7.62mm	2.75-in. [a b]	7.62mm	2.75-in. [a b]	AGM-22B [c]	7.62mm
★*Ammunition capacity (rounds)*	48	300	6,700	6,700	14	6,400	14	6	2,000
Range (meters):									
Maximum	9,300	1,750	3,200	3,200	9,300	3,200	9,300	3,500	3,100
Effective	2,500	1,200	750	750	2,500	1,000	2,500	3,500	1,000
Minimum	300	300	100	100	300	100	300	500	100
Rate of fire:									
Shots per minute (guns)	—	220	2,200	2,200	—	4,000/4,800	—	—	2,000/4,000
Pairs per second (rockets)	6	—	—	—	6	—	6	—	—
Flexible limits:									
Elevated	—	+15°	+15°	+15°	—	+10°	—	—	+10°
Depressed	—	−35°	−60°	−60°	—	−85°	—	—	−24°
Horizontal, outboard	—	—	70°	70°	—	70°	—	—	—
Horizontal, inboard	—	—	12°	12°	—	12°	—	—	—
Horizontal, right and left	—	60°	—	—	—	—	—	—	—
Weight (lb):									
Loaded	1,439	335	830	1,294		1,346		682	276
Unloaded	452	233	428	604		674		249	96

[a] Burst radius—10 meters.
[b] 2.75-inch rocket fires from fixed position.
[c] Wire-guided missile.

O–2. Attack Helicopter Performance Data

For attack helicopter performance data utilizing various ammunition loads, see table O–3.

Table O-3. Attack Helicopter Flight Limitations

Helicopter designation	Limitation [a]				Ammunition capacity (rounds)			AGM-22B missiles
	Gross weight (lb)	Fuel (lb)	Range (nautical miles)	Flight time on station (hr+min)	7.62mm	40mm	2.75-in.[b]	
AH-1G	8,593	1,600	369	02+35	4,000	300	14	
	8,234	1,600	370	02+35	7,000	300		
	9,194	1,600	360	02+30	4,000	300	38	
	9,323	1,600	355	02+30	7,000	300	14	
	9,500	1,176	256	01+50	7,000	300	38	
	9,500	1,418	305	02+10	4,000	300	52	
	9.500	914	196	01+25	6.000		76	
UH-1B	8,297	1,000	166	01+45	6,000		14	
	8,380	1,000	166	01+45			48	
	7,974	1,000	185	01+50		150	14	
	7,548	1,000	190	01+54		315		
	8,308	1,000	166	01+45			38	
	7,766	1,000	176	01+45				6
UH-1C	8,500	900	163	01+28	6,000		14	
	8,500	816	145	01+20			48	
	7,878	1,000	189	01+40		150	14	
	7,852	1,000	189	01+40		315		
	8,500	900	163	01+28			38	
	8,070	1,000	187	01+40				6

[a] Ranges and station times are based on standard day 2,000-foot pressure altitude using cruise power chart in applicable TM 55-series-10. Runup, climb, and reserve fuel not considered in computations.

[b] Computed with MK 151 warheads on 2.75-inch rockets.

INDEX

By Order of the Secretary of the Army:

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S/S ch 2

FIELD MANUAL
No. 1-40

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *20 June 1969*

ATTACK HELICOPTER GUNNERY

***This manual supersedes TC 1-24, 27 July 1967; TC 1-25, 27 August 1964; TC 1-30, 6 September 1966, including all changes; and TC 1-33, 27 July 1967.**

PART ONE

GENERAL

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1–1. Purpose and Scope

★*a.* This manual explains helicopter gunnery including practical applications of the science of ballistics and other procedures essential for the timely and accurate delivery of fire by attack helicopters. It includes techniques and procedures for the employment of attack helicopters (1-series TOE only) in support of ground tactical operations.

★*b.* This manual is a guide for attack helicopter unit personnel, aviation staff officers, and commanders of supported tactical units. It does not cover all helicopter gunnery situations. Local modifications of the methods and techniques described herein may be necessary but should be made only when based upon firsthand knowledge and experience of the aircraft commander as measured against the state of training of his personnel. Any such modification should result in a gain in either accuracy or speed of response, or both. Modifications which might result in a degradation of accuracy or speed of response should be seriously questioned.

c. The scope of this manual includes—

(1) Characteristics and capabilities of weapons and ammunition.

(2) Fundamentals of ballistics.

(3) The helicopter gunnery problems.

(4) Techniques of fire.

(5) Fire control.

★(6) Miscellaneous employment information.

d. The material presented herein is applicable to both nuclear and nonnuclear warfare, except as otherwise noted.

★1–2. Recommended Changes

Users of this manual are encouraged to submit recommended changes and comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commandant, United States Aviation School, ATTN: ATSAV–DL–L, Fort Rucker, Alabama 36360.

★1–3. Armed Helicopter Categories and Missions

An armed helicopter is any helicopter that has a mounted weapon system intended primarily for offensive use (e.g., UH–1 armed with M23 armament subsystem).

a. Attack Helicopter. An attack helicopter is an armed helicopter modified or designed to search out and engage enemy targets or to supplement the fires of ground-based weapons (e.g., UH–1 armed with M21 armament subsystem or AH–1G). Attack helicopters perform three basic missions—*direct aerial fire support, aerial escort,* and *reconnaissance and security.* These missions may occasionally be performed concurrently. The attack helicopter aircraft commander or fire team leader must be prepared to perform any one or all of them with a short notice. Only direct aerial fire support missions are discussed in detail in this text. For information on aerial escort, see FM 1–100; and for information on reconnaissance and security, see FM 17-37. For information on the employment of attack helicopters by aerial field artillery, see FM 6-102.

b. Scout Helicopter. A scout helicopter is an armed helicopter designed primarily to conduct reconnaissance, including reconnaissance by fire (e.g., OH-6 armed with XM27 armament subsystem).

1-4. References

For details on each armament subsystem, preventive maintenance procedures, and ammunition required for each subsystem, see applicable 9-series TM (app A). For the characteristics and capabilities of each helicopter, see the appropriate aircraft operator's manual (TM 55-series-10).

★1-4.1 Concept of Employment

a. The Army airmobile concept, employing organic Army aircraft, dictates a requirement for immediate, responsive direct aerial fire support during airmobile operations. The attack helicopter has proven to be a suitable platform which can accommodate a variety of weapons responsive to the fire support requirements of the ground commander. By providing accompanying and readily available direct aerial fire support, the attack helicopter increases the number of possibilities available to the ground commander to more effectively apply his combat power. Missions requiring movement into enemy-held terrain can be undertaken with greater probability of success when attack helicopters are an integral element of the airmobile force.

b. The concept of using attack helicopters in a fire support role visualizes their employment to supplement and extend the firepower available to the ground commander from ground-based weapons and close air support. As the Army's capabilities for combat mobility are expanded through the use of organic aircraft, the ability to provide direct aerial fire support will also expand. Using appropriate tactics, the attack helicopter contributes greatly to mission accomplishment through its ability to operate in the same environment as the ground force. In addition, it is capable of delivering effective neutralization fire in the objective area at a crucial point in airmobile operations. The number of attack helicopters used on a particular mission will depend upon the airmobile capability allocated to the ground commander and the responsive fire support required.

c. Attack helicopters play an essential role in augmenting the ground commander's capability for mobile and nuclear warfare. This role is emphasized in those instances where great dispersion of ground forces is required. The close and quick-reacting direct aerial fire support that the attack helicopter can provide the ground or troop lift commander permits him the widest possible latitude in the assignment of missions to the airmobile force.

★1-5. Attack Helicopter Element (Team)

a. Mission. The attack helicopter element (team) consists of two or three helicopters and has the primary mission of delivering coordinated *direct aerial fire support* for the ground commander. To provide immediate responsiveness to the requirements of the ground force, coordination of attack helicopter fires will normally be effected directly with the supported force commander or his tactical operations center. Procedures to accomplish the tasks involved in the coordination of fire will vary with the headquarters, the amount and type of fire support available, and the type of operation; however, every effort must be made to establish the attack helicopter unit in the lowest echelon which can effect complete coordination of the fire support mission.

b. Organization. Normally, the basic attack helicopter element is the fire team consisting of two helicopters. When circumstances require and resources permit, a heavy fire team consisting of three attack helicopters may be employed. The helicopters are mutually supporting by both fire and observation. The aircraft commanders of the fire team are—

(1) *Fire team leader.* Normally, the fire team leader is the aircraft commander of the lead helicopter. His primary responsibility is to insure mission accomplishment. He controls all the fires of the fire team as necessary to accomplish the mission. He should be proficient in the techniques of properly employing attack helicopters. He is the requesting unit commander's immediate advisor for attack helicopter employment.

(2) *Wingman.* The wingman controls all fires of his crew, and his primary responsibility is to support the fire team leader. This support is typically accomplished by the wingman (and, in a heavy fire team, the third attack helicopter) augmenting the leader's fire or by providing fire for the leader. In an emergency, the wingman is capable of assuming the duties of the fire team leader.

★1–6. Fundamentals of Employment of Attack Helicopters

Successful employment of attack helicopters demands responsive and accurate delivery of fires to meet the requirements of supported ground forces. Consideration of the fundamentals of surprise, flexibility, mobility, and fire and maneuver will enable the commander of an attack helicopter unit to recommend the best utilization of his unit in the support of the plan of action. For a detailed discussion of the fundamentals of employment, see FM 1–100.

Section II. TYPES OF ARMAMENT

1–7. General

Attack helicopters normally carry a wide variety of armament (fig. 1–1) in order to have the widest possible mission profile on each sortie. For information on armament subsystems now in use or planned for use, see appendixes B through J; for a list of ammunition see appendix K.

1–8. Rifled-Bore Weapons

a. Ammunition. Ammunition for rifled-bore weapons varies from 5.56mm through 40mm. At present, most of this ammunition is percussion fired, with the propellant charge housed in brass casings. The current 20mm ammunition is electrically fired.

b. Firing Mode. Rifled-bore weapons may be mounted and fired in either the flexible or fixed mode. The flexible mode allows the gunner to shift his fire rapidly in any flight attitude or altitude.

c. Projectiles. Rifled-bore weapons projectiles vary from simple impact to high explosive and chemical. Fuzes for the high explosive and chemical projectiles may be point detonating (PD) or proximity type.

1–9. Rockets, Missiles, Warheads, and Fuzes

The rocket/missiles of weapons subsystems provide the standoff capability for attack helicopters.

a. Rockets. Because of their size and ballistic properties, rockets are launched in a fixed for-

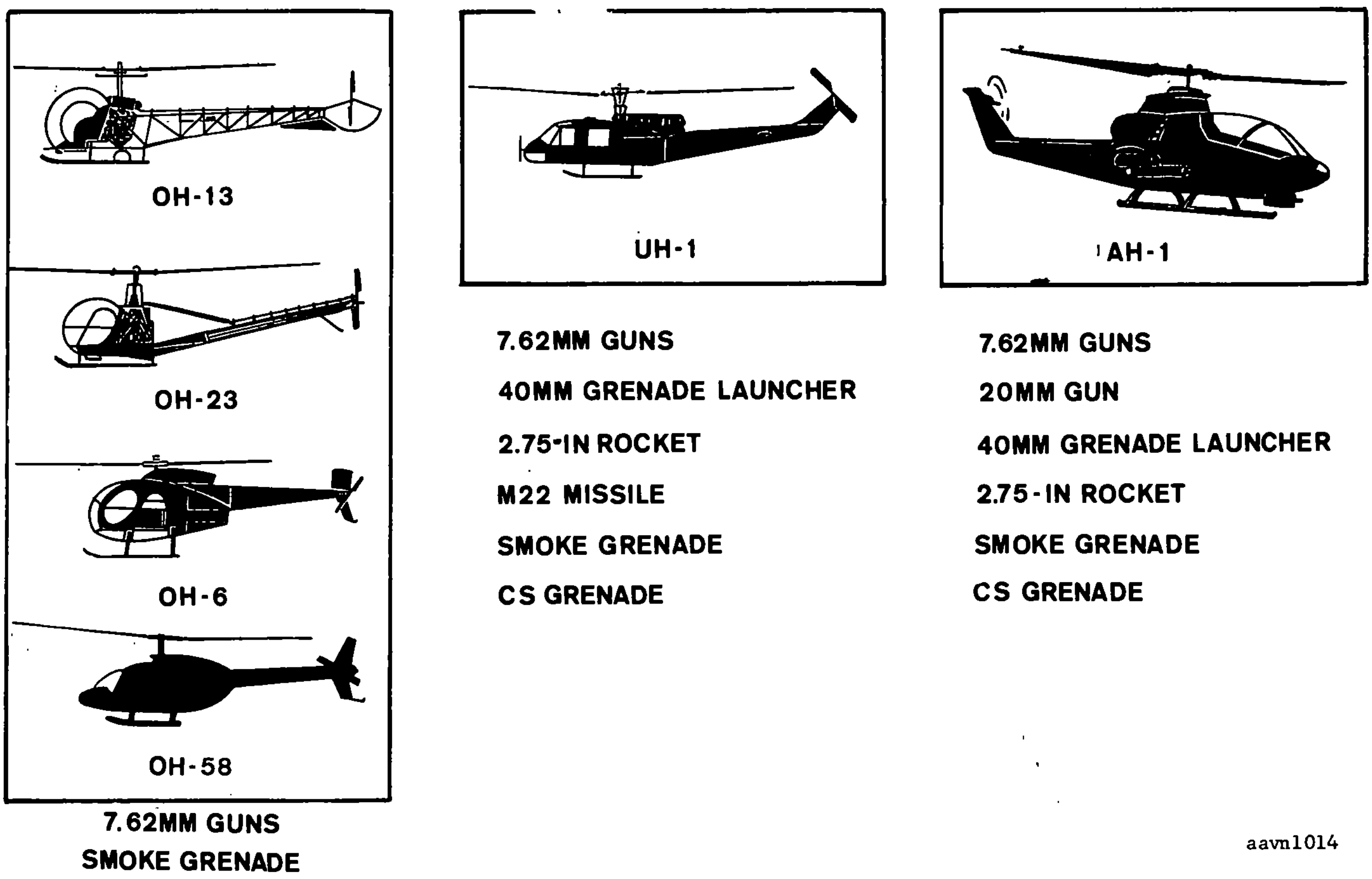


Figure 1–1. Helicopter armament.

ward firing mode. They provide the fire required for attack helicopter engagement of area targets.

b. Missiles. Guided missiles provide attack helicopters the capability of engaging point targets (armor, bunkers, gun positions, etc.) with an extremely high probability of first-round hits.

c. Warheads. Guided missiles are capable of carrying a variety of warheads. However, existing stocks contain only practice and high explosive antitank (HEAT) warheads. Warheads for rockets include various chemical and high explosive (HE) and special purpose munitions in different sizes. Future warheads will be ballistically matched so that mixed loads may be carried and fired with a selectivity system.

★*d. Fuzes.* The proper fuze must be used with each type warhead to cause the projectile to function at the time and place desired. Fuzes are classified according to the method of functioning—*time, impact, or proximity*. Impact fuzes are classified according to their position on the projectile—base-detonating (BD) or point-detonating (PD). At present, all guided missile fuzes are PD, but rocket warheads (app K) have a variety of fuzes.

★(1) Time (T) and mechanical time (MT) fuzes contain a graduated time element in the form of a compressed powder train or a gear train (as in a clock) that may be set, prior to firing, to a predetermined time.

(2) Impact fuzes function when projectiles strike a solid object. Impact fuzes are further classified according to the speed of action after impact as *superquick, quick, nondelay* (base detonating only) and *delay*.

★(3) Proximity (VT)[1] fuzes function when they approach any object which will reflect, with sufficient strength, the signal radiated from the fuze.

1-10. Free-Fall Stores

Delivery of free-fall stores reduces the effectiveness of attack helicopters because of the elimination of one or more weapon systems to accommodate the stores. Although the attack helicopter is not normally employed as the delivery aircraft, the tactical situation may necessitate responsive delivery of droppable munitions to include modified mortar projectiles, cluster bomb units, mines, chemical agents, or flares. Commanders must evaluate the advantages and disadvantages of employing the attack helicopter in this role and integrate their use into the ground unit's plan of action. Such use must be preplanned to insure effectiveness.

★[1] Variable time.

PART TWO

ATTACK HELICOPTER PROCEDURES AND TECHNIQUES

CHAPTER 3

ATTACK HELICOPTER DIRECT AERIAL FIRE SUPPORT MISSIONS

Section I. GENERAL

3–1. Direct Aerial Fire Support

Direct aerial fire support is fire support delivered by aircraft organic to ground forces against surface targets and in support of land operations. Coordination by the attack helicopter commander and the ground commander allows helicopter fires to supplement and be integrated into the committed firepower of the ground force.

★3–1.1. Command and Control

a. General. To fully exploit the advantages of the versatile attack helicopter weapons system, attack helicopter command and control must be simple and direct. When not an integral part of the operation, aerial escort attack helicopters will normally be requested through fire support request channels. However, when the attack helicopters are acting in an aerial escort role at the time of request for direct aerial fire support, the force commander establishes direct communications with the attack helicopter element and assigns the mission. The initial requestor, who is located in the combat area where the target has appeared, then advises the attack helicopter commander in the actual execution of the aerial attack. This insures that the requested aerial fire support is available in the minimum amount of time and also provides the supported force commander with immediate control of a direct aerial fire support system that can be integrated closely with the overall fire support effort.

b. Rules of Engagement. Since uncontrolled aerial helicopter fire is ineffective and dangerous, attack helicopter aircraft commanders must have positive control of their crews at all times. Crews only fire if permission has been granted by prearrangement or by requesting and receiving clearance as targets of opportunity occur. Prearrangement may include mission briefings, establishment of no-fire areas, or defining rules of engagement for a particular mission. When firing in close support of friendly forces, all firing must be closely coordinated. Before targets of opportunity acquired in an unexpected area may be engaged, they must be cleared by the commander responsible for that area. All attack helicopter personnel must know and observe the following rules of engagements. Attack helicopters will fire only when—

(1) Under positive control and in direct radio communication with the designated control agency.

(2) The target or target marks can be readily identified.

(3) Friendly and civilian positions are positively identified.

(4) They are defending themselves against ground fire and—

(*a*) The source can be visually identified.

(*b*) The strike can be positively oriented against the source.

(*c*) The intensity of fire warrants counteraction.

3–2. Types of Attack Helicopter Fires

The three general types of attack helicopter fires are *neutralization fires, destruction fires,* and *combined fires.* The distinction between these types depends upon results desired, weapons selected, and slant range to the target.

★*a. Neutralization Fires.* To maintain fire on target, neutralization fires are often first delivered with heavy intensity and then followed by subsequent fires of lesser intensity. These fires are delivered for the purpose of reducing the combat efficiency of the enemy by—

(1) Hampering or interrupting the fire of his weapons.

(2) Reducing his freedom of action.

(3) Reducing his ability to inflict casualties on friendly troops.

(4) Severely restricting his movement within an area.

b. Destruction Fires. Destruction fires are those delivered for the sole purpose of destroying enemy troops and equipment.

Note. With all destruction fires, poststrike analysis is an assumed task requirement.

c. Combined Fires. Since attack helicopters can carry more than one type of ammunition and armament, fires may be combined. For example, neutralization fires may be used to protect the helicopter while it is engaged in destroying a point target.

3–3. Categories of Weapons

Weapons are categorized as *area target weapons, point target weapons,* or *dual-purpose weapons.* The category of each weapons system is determined by the inherent accuracy of the weapons system, the terminal ballistic characteristics of its projectile, and the volume of fire delivered.

a. Area Target Weapons. Because of inherent inaccuracies of area target weapons systems, they have a low probability of first-round hits. Included in this category are 7.62mm machineguns, 40mm grenade launchers, and 2.75-inch FFAR's. The terminal ballistics of these weapons vary from a single 2.75-inch FFAR warhead with hundreds of fragments, to the impact of thousands of bullets fired from the automatic gun.

b. Point Target Weapons. Point target weapons require a high probability of first-round hits. Normally, point target weapons use a shaped-charge warhead capable of penetrating armor plating. Point fire is delivered by the wire-guided missile system.

c. Dual-Purpose Weapons. Dual-purpose weapons, such as the 30mm automatic gun and 2.75-inch FFAR, fire ammunition that is designed to be effective against personnel and light-armor materiel.

★3–3.1. Attack Helicopter Employment

The types of targets best suited for attack helicopters are those that are relatively soft, small, lightly defended by antiaircraft weapons, difficult to detect, transitory, or very close to friendly troops.

a. Attack helicopters are the preferred system of aerial attack when—

(1) Friendly troops are less than 200 meters from the target.

(2) Targets are appearing in a changing and fast-moving situation requiring rapid response time, multiple target acquisition or tracking, direct communications, and close coordination.

(3) The target dictates that reaction to the ground commander's desires be immediate, closely integrated with the direct and indirect fires employed by the ground unit, and coordinated with the unit maneuver plan.

(4) Fixed wing attack aircraft cannot be used because of lack of immediate responsiveness and airspeed limitations.

(5) Discrete fires of minimum destruction are required for combat in populated areas.

(6) The enemy is well-dispersed and concealed.

(7) Preparation fires are needed on landing zones while transport helicopters are on final approach.

(8) Fire support is needed during the insertion or extraction of long range patrols.

(9) Neutralization fire is required to permit friendly maneuvers.

(10) Reconnoitering of the local battle area is required.

(11) Enemy action effectively closes runways required for fixed wing attack aircraft.

(12) Neutralization fire is needed on heavily fortified positions pending arrival of heavier fire support.

(13) Tactical chemical agent irritant (CS) fires are required. CS munitions are also effective against targets cited in (1) through (3), (6) through (10), and (12) above.

b. The attack helicopter is the superior system for the escort mission.

Section II. PREPLANNED DIRECT AERIAL FIRE SUPPORT

3-4. Preplanned Fire Support

Preplanned fires are those that are planned for delivery in advance of takeoff. These fires are closely coordinated with the ground force commander and his fire support coordinator to insure support of the ground tactical plan. Planning normally includes target location, type and amount of weapons and ammunition, time of delivery, technique of delivery (chap 6) and method of adjustment (chap 10).

3-5. Target Acquisition and Control

Targets are acquired by all available means. Targets acquired by the ground element are engaged and controlled under the direction of the ground force commander to support his ground tactical plan. Engagement of targets acquired by other means will be in accordance with existing directives or policies of the supported headquarters.

3-6. Methods of Preplanned Support

Preplanned target fires, as with other supporting fires, are normally conducted to support a ground maneuver plan. Common preplanned direct aerial fire support methods are—

★*a. Preparation Fires.* Before and during the initiation of an assault, a heavy volume of preparation fire is delivered on a suspected or known enemy position. Various types of ammunition may be used in firing preparations for airmobile, amphibious, and airborne assaults; ground offensives; or raids.

★*b. Diversionary.* Diversionary fires are delivered into an area to draw attention to it, with the intent that enemy forces may be drawn away from that principal area of operation. Diversionary fires may be used as an economy-of-force measure or in conjunction with ground offensive, defensive, or retrograde operations. The type ammunition to use is determined by the situation.

c. Harassing. Harassing fires are those delivered into an area for the purpose of disturbing the rest, curtailing the movement, and lowering the morale of enemy troops by the threat of casualties or losses in materiel.

★*d. Interdicting.* Interdicting fires are those delivered into a designated area to deny the unrestricted use of that area to the enemy or to prevent the unimpeded withdrawal of the enemy from the combat area. Interdicting fires may be on-call or fired at random to provide a harassing effect in support of offensive, defensive, or retrograde operations.

e. Counterpreparation. Counterpreparation fire may be preselected area fire for targets of opportunity. Counterpreparation is the delivery of fire into the enemy's prepared fire support positions to deny the enemy a base of fire. Counterpreparation fires may be used against enemy mortar, artillery, armor, or other fire support weapons.

3-7. Preplanned Fires on Designated Point Targets

Preplanned fires on designated points are delivered with the intent of inflicting high losses to enemy personnel or equipment. Weapons should be those which insure a high probability of first-round hits; however, any type of weapon may be used. Normally, the high volume of fire required for area fire weapons to insure hits limits their use for point targets.

Section III. IMMEDIATE DIRECT AERIAL FIRE SUPPORT

3-8. Target Acquisition and Fire Control

The requirement for *immediate fires* arises from targets of opportunity or changes in the tactical situation. Immediate fire targets may be acquired by any individual or element in the battle area; however, within his area the ground commander is responsible for the control of these fires. All immediate fires require close coordination of the fire team leader and the ground commander or his fire support coordinator.

3-9. Methods of Immediate Support

The common methods of immediate area target fire support are—

a. Preparation. A change in the forecasted tactical situation may require the firing of preparation fires into an area other than where originally planned. The rapid-reaction capability of attack helicopters permits their recall from a lower priority mission to fire preparation for an assault.

b. Base of Fire. In the fluid, fast-moving situations found in unconventional warfare, attack helicopters, without previous planning, may provide a base of fire for maneuvering elements.

c. Interdicting. As the tactical situation develops, immediate interdicting fires in support of the ground force may become necessary. To achieve good timing and target location and to locate friendly elements, interdicting fire delivery must be closely coordinated with the ground commander.

d. Targets of Opportunity. Targets of opportunity are those targets that randomly appear within the battle area and for which neutralization or destruction is desired. They should be engaged only when the engagement does not interfere with the primary tactical mission.

e. Countermeasure. Area countermeasure fires are those fires required for the defenes of the aircraft against either an area-type hostile position or an all-hostile position within a determined quadrant. Generally these will be high volume, short duration fires allowing contact to be broken. The type of ammunition used will depend on the type target, as follows:

(1) *Soft.* Soft (i.e., lightly armored or bunkered) point targets will require high volume, short duration fires using all available weapons.

(2) *Hard.* Hard (i.e., heavily armored or bunkered) point targets place a different requirement on the pilot if he is to break contact successfully. Hard targets require larger caliber weapons, which presently are fired from the stowed mode. This requires that the pilot maneuver the helicopter to engage the target straight on.

(3) *Hostile aircraft.* Countermeasure fire against hostile aircraft allows the use of almost any type of weapon presently in the inventory. Some weapons systems require a high volume of fire to saturate the flightpath of the hostile aircraft. Other types of weapons are sufficiently accurate and responsive to allow a small expenditure of ammunition with a high probability of first-round hits.

f. Destruction Fires. Effective point target engagement normally requires that the target be clearly discernible at relatively greater ranges than for area targets; generally, the point target is acquired by the ground unit. The advantages of engaging these targets at maximum standoff distance are—

(1) Attacking helicopters have a high probability of first-round hits beyond the effective range of enemy small arms fire.

(2) Attack helicopters engaging targets several thousand meters in front of friendly positions provide friendly ground units reaction time and space to maneuver.

CHAPTER 5

TARGET ACQUISITION AND FIRE REQUESTS

Section I. AERIAL ACQUISITION

5–1. General

Using either visual means or airborne surveillance equipment, targets may result from aerial reconnaissance performed by the attack helicopter or by other aircraft. Before engaging a known target or a target of opportunity, the task of the attack helicopter crew is to locate the target on the ground. The success of attack helicopter fire support depends upon this ability of the crew to locate the target.

5–2. Target Acquisition

a. Reconnaissance. Target acquisition always involves some type of reconnaissance. Reconnaissance is a continuous effort by the entire crew of an attack helicopter. A specific mission may or may not be stated as a reconnaissance task, but reconnaissance is a part of every mission. A thorough reconnaissance is necessary for either a known target location or for targets of opportunity.

(1) *Known target.*

(*a*) The known target is detected by some type of aerial surveillance or method of ground surveillance. The mission is given to the attack helicopter team. Their task is to pinpoint the target specifically before attacking it. To accomplish their task, the factors of METT and the established rules (chap 4) of attack helicopter employment must be considered. Based on this analysis of the target, the attack element then performs a reconnaissance of the target area by flying at the best altitude for observation, depending upon the terrain, vegetation, and enemy situation. The attack helicopter element must find a position from which to best determine exactly *what the target is, what it looks like, and where it is located.* Once this has been determined, the leader of the element can form his plan of attack and issue his fire command.

(*b*) Before sending the helicopter element to attack a known target, aerial photography can be helpful in locating it. Aerial photography often gives the first indication that a target is in the area. If possible, a visual reconnaissance should be made before attacking a target identified by a photograph.

(2) *Targets of opportunity.* "Pop-up" or surprise targets which the attack helicopter element reconnaissance happens to locate are targets of opportunity. They may be spotted visually by the crew, or they may disclose their positions as a result of enemy fire directed toward the attack helicopter element.

(*a*) Targets spotted by the crew may be picked up by movement, fresh digging, trails, smoke from campfires, poorly camouflaged huts, fortifications, and many other clues which can arouse suspicion in the search area.

(*b*) Reconnaissance by fire is another method of locating targets. This leads a poorly disciplined enemy to move or to return fire and thus give away his position.

(*c*) Targets may be located by drawing enemy fire, even when not employing reconnaissance by fire. This is frequently the case when conducting a reconnaissance mission or escorting troop-lift helicopters en route. In either situation, some method of pinpointing the location must be used.

(*d*) Often the enemy fire will pinpoint the target; but if tracers, smoke, muzzle flash, or other motion is not detected, some sort of search of the general area must be conducted to locate it. Conduct of this search must be determined by and based on the factors of METT. Normally, the commander of the attack element must request permission from the ground commander or higher headquarters to engage the target. He will already be cleared when he is sent into the area of known targets, but he may have to verify friendly element locations before determining how to engage the target. Care must be taken to insure that targets of opportunity have been confirmed as the enemy.

b. Night Acquisition. At night or during periods of low visibility, target acquisition becomes more difficult and crew responsibilities take on added importance. Proper crew training and knowledge of techniques available can turn the operation into an advantage for the attack helicopter element. Aids to night target acquisition include—

(1) *Artificial illumination.* Night target illumination may be accomplished by aircraft flares, artillery illuminating rounds, and ground or helicopter-mounted searchlights (chap 7). When using artillery illumination, radio contact must be maintained between the fire team leader and the artillery unit firing the rounds. When using these artificial means of illumination, care must be taken to avoid being blinded and/or entangled with parachutes of flares that have burned out but are still aloft.

(2) *Infrared devices and starlight scopes.* Infrared devices and starlight scopes may be used effectively to locate targets at night; but even then, it is often difficult to identify the target location for other helicopters in the attack helicopter team. One method that is effective is to use the infrared device with an automatic rifle loaded with full tracer ammunition to mark the target. Another method of identifying the target is by illuminating it with an aircraft flare (chap 7), after locating it with the surveillance device. Still another method is to have the searchlight operator use the starlight scope to locate the target, then illuminate it with the searchlight.

(3) *Radar.* Ground radar units can vector the attack helicopter element to the target. Another method is to have observation aircraft using airborne surveillance equipment vector the attack helicopter to the target.

(4) *Aerial photographs.* Especially in unfamiliar areas, aerial photographs will help pilots find targets at night. The photographs will show terrain features such as canal lines, tree lines, and ridge lines which may be visible at night, making it easier to navigate to a known target.

(5) *Enemy fire.* By spotting muzzle flashes or tracers (para 8–1*a*), enemy fire may often be spotted from the air. However, the observer must rapidly pinpoint the muzzle flash or tracer location before it disappears and is lost.

★*c. Spot Reports.* In many situations, the attack helicopter element commander must request permission in accordance with existing directives to attack a specific target. The spot report can be used to make the request. This report enables the ground commander or higher headquarters to keep abreast of the situation, determine the importance of the target in relation to the mission, and advise the attack helicopter element of situational changes in the target area, such as friendly movements. This type of report must include the following information—

(1) *Observer identification.* Identify yourself.

(2) *Description of target.* Identify target.

(3) *Location of target.* Give target coordinates.

(4) *Activity.* What is the target doing (e.g., moving convoy, troops moving, etc)?

(5) *Requested action.* What action you desire to take against the target.

Section II. TARGETS ACQUIRED BY GROUND OBSERVERS

5–3. General

Ground elements acquire many targets for attack helicopters. Transmitting target information from the ground element to the attack helicopter element causes special problems. These problems are compounded during night operations or periods of low visibility. A simplified fire request system must be used by the ground observer to minimize the difficulties of calling for attack helicopter support. Usually this is accomplished by FM radio as a result of an exchange of SOI between the ground element and the attack helicopter element.

★5–4. Employment Considerations

a. To effectively employ the available direct aerial fire support, the supported force commander must consider—

(1) *Nearness to friendly forces.* Several factors that determine how near aerial fires may be delivered to friendly forces are the enemy situation, nature of threat, amount of casualty risk acceptable to friendly forces, type of aerial fires, type of ammunition used, and disposition of friendly forces. Also, effective employment of the available aerial fire support often depends on the battlefield situation. The following employment

distances are for planning purposes only. They should be used with discretion and adjusted as appropriate. Normally—

(*a*) Daytime machinegun and cannon fire may be brought to within 50 meters of friendly forces (25 meters in an emergency).

(*b*) Daytime rocket and grenade fire may be employed to within 75 meters (50 meters in an emergency). Depending on type of fuze and warhead (para K–7), employment distance for rockets may be greater.

(*c*) Night employment distances are generally greater than daytime distances due to the hazards of night flight close to the ground. However, accuracy and effectiveness of night fire support may depend on crew experience.

(2) *Response time.* The time required for the attack helicopter to reach the target area depends for the most part upon the proximity of the helicopter staging area to the target area. As a general rule, normal time for attack helicopter response has been found to be 15 to 20 minutes from receipt of mission until arrival on station.

(3) *Adverse weather.* For effectice AH–1G daylight employment, ceiling should be at least 800 feet and visibility 1 mile (UH–1, 400 feet and 1 mile). For nighttime AH–1G employment, ceiling should be at least 1,500 feet and visibility 2 miles (UH–1, 800 feet and 2 miles). Ceiling and visibility requirements will increase in unfavorable terrain, e.g., mountains.

b. Prior to the execution of a particular mission, the supported force commander must determine the requirements for attack helicopter support. This support will be integrated into the overall plan of action.

5–5. Actions of Attack Helicopter Team

When under direction of a ground observer, the attack helicopter team must insure that—

a. Friendly positions are identified.

b. The ground observer's position is known.

c. If mark is used, it can be identified.

d. If mark is used, direction from the mark to the target is clearly understood by both the ground observer and the attack helicopter team.

e. If close-in fire is required to support friendly troops, a marking round or burst is fired into the target to insure positive identification and obtain any adjustment.

★5–6. Direction to Target by Ground Observers

a. Friendly Elements Position. The ground observer and the attack helicopter commander must be sure that the attack helicopter element knows the location of the friendly elements on the ground. Two methods that may be used to insure that no mistake is made are—

(1) Using colored smoke or colored panels which can be seen from the air, mark the friendly positions indicating the right, left, and forward boundaries.

(2) Using normally encoded coordinates, give friendly positions. (In premission briefings, it is necessary to insure that both elements are using the same code.)

b. Marking Target. The ground observer can mark or reference the target using any means which can be identified from the air; e.g., grenades, colored smoke, etc.

c. Directing to Target. If it is impossible to mark the target, the ground observer may elect to use smoke or panels to mark a position or use a prominent terrain feature. He will then measure or estimate the direction and distance to the target. This may be done using the clock method; however, the attack helicopter commander must know which direction the ground observer is using as his 12 o'clock position. This can be set up during premission coordination. A preferred method is to give a magnetic azimuth from the mark (colored smoke) to the target. Range from the mark or friendly position should be as accurate as possible. This can be measured on the map or estimated.

d. Describing Target. Care must be taken to describe the target, using a means which can be identified from the air and the ground. The ground observer should inform the attack helicopter commander of the type and intensity of enemy fires existing or suspected in the target area.

e. Type of Weapon Desired. If he has a preference, the ground observer should let the attack helicopter commander know what type weapon he desires—

(1) Rifle-bored weapons only (7.62mm, 20mm, 30mm, or 40mm).

(2) Rockets only.

(3) Missiles only.

(4) Any combination of weapons.

f. Adjustment by Ground Observer. The ground observer must be prepared to adjust initial fires of the attack helicopter using the observer-target line.

★5–7. Night Operations

Night operations make it especially difficult for a ground observer to convey what he sees to the attack helicopter team. Several methods may be used to assist fire direction and target identification from the ground at night.

a. Illumination. Use of illumination is similar to that used for artificial night target illumination (para 5–2*b*(1)).

b. Radar. Ground radar units can vector the attack helicopter to the target (para 5–2*b*(3)).

c. Marking. Marking a target or friendly position at night by the ground observer is especially critical and requires close coordination. Flare pots or some other light system may be used instead of smoke; e.g., lights arranged in the shape of an arrow pointing in the direction of the target. Artillery or mortar fire may also be used to mark a target. Additional means of marking include strobe lights, railroad flares, trip flares, and tracers.

★5–8. Fire Request Format

Use of the fire request enables the ground observer to call for attack helicopter support in much the same way as he would for artillery support. This procedure cuts down on the fire request formats that he must remember and keeps radio transmissions to a minimum.

a. Elements of a Fire Request. Following are the elements of a fire request in the sequence in which they are transmitted:

(1) *Identification of observer.* This element consists of the call sign or code to identify the observer.

(2) *Warning order.* The warning, "Helicopter fire mission," is sent by the observer to achieve communication priority and to alert the crews of the attack helicopter element.

(3) *Location of target.* Normally, one or more of the following methods of target location are used:

(*a*) The coordinate system.

(*b*) Mark the target.

(*c*) Mark the observer's position and give direction and range.

(4) *Description of target.* When restrictions exist or friendly artillery is impacting near the target, the observer may recommend the direction of the attack.

(6) *Methods of control.* The following phrases are used by the observer to announce the method of control:

(*a*) *Fire for mark.* The ground observer will adjust from the initial rocket or burst.

(*b*) *Fire for effect.* The observer is ready to observe and the attack helicopter team may fire for effect when ready.

(*c*) *At my command.* The attack helicopters are not cleared to attack the target until the ground commander is ready and gives the command to fire.

(*d*) *Cannot observe.* The observer cannot observe fire and is unable to adjust it; however, he has reason to believe that a target exists at the given location.

b. Example of Ground Observe Fire Request.

Sequence Number	Element of Request	Example
1	Identification and warning order.	"Dragon 33, this is Blackhorse 26; helicopter fire mission, over."
2	Reply.	"This is Dragon 33, send your mission, over."
3	Target location and description.	"From the fire arrow, 300 meters, troops dug in, with small arms automatic weapons."
4	Direction of attack.	"Recommend engagement from south."
5	Method of fire control.	"Will adjust, over."
6	Acknowledgment.	"This is Dragon 33, Roger, out."

CHAPTER 7

NIGHT ATTACK HELICOPTER SUPPORT

Section I. GENERAL

7–1. Direct Aerial Fire Support

Attack helicopters normally will be expected to provide the same quality and types of direct aerial fire support at night as they provide during daylight hours. To provide this support requires highly motivated, well-trained crews who are aware of their capabilities and limitations.

7–2. Factors Affecting Employment

The factors of METT and the cardinal rules apply equally well to night operations when it is understood that the visibility at night could work to the advantage of the attack helicopter team. For example, the limits of the "deadman" zone are sharply reduced. Attack helicopters can operate at altitudes and ranges which optimize accuracy using the cover of darkness to limit observation.

7–3. Night Vision

Light passes through the lens of the eye and then falls on the retina, which has two types of photoreceptors—rods and cones. The cones are effective only when illumination is abundant, while the rods are sensitive for night vision or low illumination. The rods provide peripheral (side) vision. However, bright light can impair the function of the rods for over one-half an hour. For the crew to prevent complete loss of night vision due to artificial illumination, one crewmember should, when possible, direct his eyes within the cockpit. Also, it is usually desirable to close one eye momentarily when firing an aircraft weapons system at night. This will permit at least partial night vision during the other critical portions of the attack.

7–4. Planning

Planning for night target attacks requires considerable care and coordination. Even with experienced crews, a detailed premission briefing is required. Included in the briefing area—

a. Location, call sigh, and frequency of support unit.

b. Target location and method of identification.

c. Time schedule (i.e., takeoff, en route, on station, off station, etc.).

d. Call sign and frequencies of en route and target area artillery.

e. Call sign and frequency of radar control facility.

f. Call sign and frequency of tactical air support.

g. Downed crew and other emergency procedures (unit SOP).

h. Procedures upon receipt of hostile fire.

i. Formations and altitudes to be used.

★7–4.1. Control Measures

a. Orbit Point. Several orbit or rallying points may be established in the vicinity of the battle area so that helicopters can be quickly assembled at any time during or after the attack. These points should be readily identifiable by a navigation fix or by relative position to prominent terrain features such as rivers and towns.

b. Altitude. Night operations by attack helicopters are initiated from higher flight altitudes than daylight operations. Normally, it is not feasible to make nap-of-the-earth firing runs at night without illumination or special visual aids. Termination of firing runs should also be completed at a higher altitude, especially in uneven, hilly, or mountainous terrain.

c. Attack Headings. The attack helicopter commander or a control aircraft situated overhead can give attack headings to be flown for the firing runs. Vectoring aids control and reduces confusion in the target area.

d. Troop Safety Buffer Zone. A larger troop safety buffer zone must be established for night operations to preclude attack helicopters firing into friendly positions. Its location should be defined by easily identifiable terrain features or lighting devices.

e. Formations. Night formations will require greater separation between helicopters. Minimum lighting of a type to preclude observation from the ground should be used during formation flying over hostile areas. For details on night formation flying, see TM 1–260.

★7–4.2. Helicopter Lighting

a. Cockpit. The panel lights should be as dim as possible during all phases of night operations to preclude canopy glare and yet allow the instruments to be adequately illuminated. Flashlights with red lens covers should be used only when necessary for map scrutiny, and then as briefly as possible.

b. Exterior. If the helicopter is not equipped with special night lighting devices, the following guidance should be followed:

(1) Only those lights essential to the successful conduct of the mission should be used. The bottom half of the navigation lights should be masked.

(2) In an emergency, additional exterior lighting should be used to aid other aircraft in locating a particular helicopter. If an aircraft is forced down in a hostile area, lights should be used only as necessary until its location has been determined.

(3) The searchlight and landing light should be in the extended position so that they can be quickly used if the helicopter is forced down.

★7–4.3. Effect of Enemy Searchlights

Enemy searchlights focused directly on attacking helicopters produce a serious problem. Evasive action must be initiated immediately. A new approach angle and attack direction should be selected that will restrict the capability of the enemy searchlight. When feasible, the searchlight should be destroyed by fire.

★7–4.4 Helicopter Servicing

a. Approach and Landing. Helicopters will make approaches to a lighted servicing area, and ground personnel will guide the helicopter to preselected parking locations within the area. If possible, the attack helicopters should approach and land at the preselected parking locations, thereby eliminating hovering and movement in the servicing area.

b. Rearming and Refueling. The helicopter may be refueled and rearmed with the engine running provided positive control is exercised and appropriate safety precautions are observed. Colored lights and ground guides should be used to direct the helicopter crews to the parking areas where ammunition is stacked and fuel is stored. Personnel used to rearm and refuel during the hours of darkness must be well trained and must have performed like functions numerous times during daylight hours.

Section II. NATURAL ILLUMINATION

7–5. General

Target attacks using natural lighting at night provide certain advantages which are not possible when using flare or lighting system (e.g., Firefly) illumination.

a. Advantages.

(1) The element of surprise is maintained longer.

(2) Night vision is conserved.

(3) All helicopters in the team maintain the security provided by the darkness.

(4) Ground fire is more readily seen.

b. Disadvantages.

(1) Target area and targets are more difficult to identify.

(2) Range is more difficult to determine.

(3) Even after initially identified, target locations are more difficult to maintain.

7–6. Target Identification

Target identification under natural light conditions at night may be difficult. As with daylight attacks, friendly positions must be positively known before commencing the attack. Positive radio contact is essential before the friendly positions are marked. Commanders must caution friendly troops not to mark their positions by firing tracers into the air. Several satisfactory methods of marking friendly positions and target locations are to—

PART THREE

FIRE CONTROL

CHAPTER 9

ATTACK HELICOPTER FIRE COMMANDS AND EXECUTION

9–1. General

Fire commands allow the aircraft commander to begin, conduct, and end all aerial fires. The timely and accurate fires of the team are dependent upon complete understanding of commands by every member in the team.

9–2. Fire Command Sequence

To insure complete understanding, the elements of the fire command are given in the following sequence:

Sequence number	Element of command	Example
1	Identification and warning order.	"Dragon 34 this is Dragon 33; fire mission * * *."
2	Reply.	"This is Dragon 34; send your mission * * *."
3	Target location and description.	"At my 10 o'clock, troops due in on the tree line * * *."
4	Attack direction.	"From NE to SW (225°)."
5	Attack formation.	"Racetrack" (when applicable).
6	Weapons to use.	"Machineguns only."
7	Amount to expand.	"Expend five-zero percent (one-half)."
8	Direction of break.	"Break left."
9	Special restrictions.	"Keep all fires north of canal line."
10	Acknowledgment.	"This is Dragon 34, Roger."

9–3. Elements of Fire Command

Paragraphs 9–34 through 9–13 explain each element of the fire command. Some of the elements listed are used only under special circumstances and are not announced when they have no application. When the attack requires more than one firing pass, an abbreviated command should be given for each pass.

9–4. Identification and Warning Order

During the course of any mission, several radio transmissions will pass from fire team leader to wingman. The words "Fire mission" warn the wingman that this transmission is of the highest priority and requires his fullest attention. This transmission will normally not be required on subsequent firing passes during the same attack.

9–5. Reply

The wingman replies so that the fire team leader knows he is alerted and ready to recieve the mission. Reply is not required unless a *warning* is given.

9–6. Target Location and Description

This element of the command should be as concise as possible but not so consise as to preclude absolute understanding of the target and its location by all members of the team.

a. Location. Target location, especially in situations where the target is obscure, is perhaps the most important element of the command. An accurate description of the target location is necessary to insure that the first rounds are close to the target. Location may be described by coordinates, polar plot (range and direction), or by adjusting from previous rounds or smoke.

b. Description. To prevent engaging the wrong target, the target description must be clear and stated in terms understood by all. Target descritption normally will provide the basis for weapon selection.

9–7. Attack Direction

When the fire team leader specifies the attack direction, he allows the wingman time to move into position to provide protective fires as well as prepare for his firing pass on the target. When determining the attack heading, the fire team leader will take into account those principles of target attack discussed in chapter 4. Attack direction or heading is given in general terms (i.e., northwest, southeast, north, south, etc.) to allow the wingman the widest possible latitude in order to provide protective fires for the leader and still be in position to initiate his firing pass. This element of the command will usually be required for each subsequent pass.

9–8. Attack Formation

To position each element in the team at the proper location during the attack, the formation to be used in the attack will be given in the fire command. Unless otherwise specified, the free cruise formtion technique will be used. For attack patterns and attack formations, see paragraph 6–11. Unless changed, this element of the command need not be repeated for subsequent passes.

9–9. Weapons

This element of the fire command is used by the fire team leader to control the type of fire delivered on the target. Unless specified otherwise, it applies only to those weapons to be used on the target. Weapons for selfprotection, such as machineguns, may be employed at the discretion of each aircraft commander to protect himself, regardless of the weapons used on the target. This element of the command will usually be required for each firing pass.

9–10. Amount of Ammunition to Expend

The fire team leader uses this element to control the *maximum* amount of ammunition that will be expended on the target. Of the total amount of ammunition specified, only the amount sufficient to obtain the desired results is expended. Normally, this element of the fire command applies only to that ammunition to be used on the target. Each aircraft commander is responsible to control any countermeasure fire required for selfprotection during the firing pass. This element normally will be required for subsequent fire commands.

9–11. Direction of Break

The fire team leader calls the direction of break so that the wingman can position himself to take advantave of the break. For example, if the break is to the left, the wingman normally will be on the leader's right side so that he can commence his firing pass as soon as the leader breaks without having to wait while the leader clears his line of fire. The direction of break will be governed by those principles of target attack discussed in chapter 4, and will be required for each fire command.

9–12. Special Restrictions

The fire team leader uses the ninth element to limit the identification and warning order (para 9–4) with special restrictions that may apply. For example, attack helicopter fires will be directed away from areas occupied by friendly troops.

9–13. Acknowledgment

All elements of the attack helicopter force must "Roger" the fire command to signify that they have received and understand the transmission. If any portion of the fire command is not understood, the recipient should request a clarification (i.e., "Say again, direction of break"). All subsequent fire commands must be acknowledge by each element.

CHAPTER 10

ATTACK HELICOPTER TARGETS AND FIRE ADJUSTMENT

Section I. TARGETS

10-1. Types of Targets

Generally, an attack helicopter will engage two types of targets—targets that are *positively identifiable* and those that are *not positively identifiable.* For both types of targets, the location of any friendly troops in the area must be determined. A positively identifiable target could be a house or group of houses, a small clump of bushes, or a group of enemy troops in the open; a target that is not positively identifiable is normally located in some form of vegetation which limits observation.

10-2. Target Acquisition

a. Day. Normally day acquisition will be by visual detection; it may also be by radar or specialized equipment.

b. Night. Night target acquisition may be by radar, specialized equipment, or artificial illumination (para 7-9).

10-3. Locating Targets

a. Day. Day location of targets may be by—

(1) Polar coordinates.
(2) Radar.
(3) Grid coordinates.

b. Night. Night location of targets may be by—

(1) Radar.
(2) Polar coordinates.
(3) Grid coordinates.
(4) Use of ground searchlights.
(5) Flares.
(6) Helicopter searchlights.
(7) Airborne lighting systems (e.g., Firefly).

Section II. FIRE ADJUSTMENT

10-4. Fire Support

Attack helicopter fire does not replace but augments the other types of fire support. It may be included in either the offensive or defensive fire support plan.

a. Offensive Fire Support Plan. Fires include but are not limited to—

(1) Preparation.
(2) Base of fire.

b. Defensive Fire Support Plan. Fires include but are not limited to—

(1) Interdicting.
(2) Counterpreparation.
(3) Countermeasure.

10-5. Fire Adjustment

a. A positively identifiable target may be attacked with all available firepower on the initial attack, if this is decided upon by the fire team leader.

b. If the target is located in proximity to friendly troops or is not positively identifiable, it may be best to fire only one rocket (or one pair) and then continue firing into the target area. For this method, it is necessary to have an individual on the ground or an aerial observer to adjust the fire. If the friendly troops are close, a good technique is to start fire on the enemy side of the target and then move the fire toward the friendly troops until delivered fire is on target. The adjustments can be made in much the same manner as artillery adjustment (observer target line). The corrections would be given as *left, right, add,* or *drop,* with a corresponding distance.

c. Since a forward observer (FO) will not always be present when a profitable target appears, the crewmembers of attack helicopters must be prepared to call for and adjust the firepower available in the area of operations.

10-6. Adjustment by Forward Air Controller (FAC)

The forward air controller serves the same purpose during the conduct of an airstrike as the forward observer serves during the conduct of an artillery fire mission. That is, he controls the conduct of the strike by relaying adjustments to the strike aircraft and recommending the type of delivery and fire support to be delivered. Although it is sometimes necessary for the attack helicopter crew to communicate directly with the strike aircraft, it is normally desirable for communications to be relayed through the FAC. In an emergency if no FAC is available, the attack helicopter commander will use the same procedures the FAC would use.

10–7. Frequencies and Call Signs

Normally, the aircraft commander or fire team leader will be responsible for obtaining the frequencies and call signs of available firepower from the unit operations section prior to departing on any mission.

10–8. Control

a. The initial request and control of an airstrike is normally made through the air liaison officer (ALO) by the Army aviation commander or the supported ground commander in the area of operations.

(1) When communications is established with the strike aircraft, the observer will be notified of the number of aircraft taking part in the strike and the type ammunition being carried. As the strike aircraft arrive on station, the observer should mark the target for positive identification by strike aircraft. If friendly troops are in the near vicinity, their position must be positively identified.

(2) Since the attack heading will normally remain oriented in the same direction throughout the strike, adjustments by the observer can be made with reference to the burst location.

b. When the strike has been completed, the observer should make an immediate poststrike damage analysis if the situation permits. The analysis should include—

(1) The percentage of ordnance in the target area.

(2) The percentage of target area covered.

(3) Any specific destruction (i.e., huts or bunkers destroyed, KIA's, etc.).

c. The immediate poststrike damage analysis is relayed to the strike aircraft.

d. A report should also be submitted to the operations section to include—

(1) Target location.

(2) Number and type of strike aircraft.

(3) Type ordnance delivered.

(4) Time on target.

(5) Time off target.

(6) Percentage of ammunition expended in target area.

(7) Percentage of target area covered.

(8) Any specific destruction.

10–9. Observation of Artillery and Naval Gunfire

a. The initial and subsequent requests for artillery and naval gunfire are basically the same. All aviators must know how to request and adjust artillery fire; however, only the target location portion of the initial request will be discussed here.

(1) From a stationary observation post, the observer would give the azimuth from his location to the target as a basis for his adjustments. Since the azimuth from an aircraft to the target is constantly changing, this method is not considered practical for aerial adjustment. The selection of a reference line as a basis for sensings and corrections is a prime consideration for the aerial observer. A reference line may be defined as an imaginary line on the ground which enables the observer to determine direction. The line and its direction must be known by the fire direction center (FDC); also, it may be used when adjusting either artillery or naval gunfire. It is essential for the observer to immediately select the correct type of line for use in the adjustment of fire. The three types of reference lines are—

(*a*) *Gun-target line.* The gun-target line is an imaginary line extending from the artillery location through the target. When using this reference line, the observer would make adjustments as though looking at the target from the gun position. If the artillery location is not known, the observer may request that two rounds be fired at different ranges but at the same deflection setting. By observing the burst of these rounds, the observer determines the gun-target line. The gun-target reference line is perhaps the easiest and quickest of the three methods to use. The omission of a reference line in the initial fire request indicates to the FDC that the gun-target line will be used.

(*b*) *Line of known direction.* The observer may select a line formed by a road, railroad, canal, or any series of objects. Prior to flight, the observer selects the line and determines its direction and advices the FDC that corrections will be based on this line. The observer mentally superimposes a line on the ground parallel to the road, canal, etc., which passes through the target.

When he decides to use a line of known direction as the reference line, it must be identified in the initial fire request, and is transmitted to the FDC in conjunction with the target location; e.g., GRID 105857, REFERENCE LINE ALPHA.

(*c*) *Convenient reference line.* The convenient reference line is the same as the line of known direction except that it is selected while in flight, and the line of known direction is selected and coordinated prior to flight. This reference line must be fully identified in the initial fire request; e.g., GRID 105857, REFERENCE LINE CANAL RUNNING NE FROM GRID 087843 TO GRID 101862.

(2) Upon completion of the fire mission, the attack helicopter commander should make a poststrike reconnaissance or damage assessment to determine if the target results are those desired.

b. Each helicopter unit SOP should require that all helicopter crews show current artillery locations on maps and know current frequencies and call signs of these units.

10–10. Integration of Fire Support

The main principle to be observed when integrating available fire support is never to allow one type of fire to interfere with or duplicate another. Therefore, the integration of fires, in theory and practice, depends directly upon the attack helicopter commander's knowledge of the characteristics and capabilities of the various types of fire support and correct fire support coordination procedures and his ingenuity and resourcefulness in their use. Because of the rapid reaction capability of attack helicopters, they can provide continuous fire support. These fires should be integrated with other fire support to—

a. Provide immediate close support for ground troops.

b. Fill gaps in the fire support plan which cannot be filled by other means.

c. Contain enemy forces for destruction by other fire support, to include the use of attack helicopters as a base of fire for ground maneuver elements.

voltage" check prior to each loading, but it is advisable to do so before each day's firing to insure that the circuitry is functioning properly. For testing procedures, see TM 9–1055–217–20 or –35. Remove static cover and/or grounding wire, and load in accordance with the appropriate TM for the launcher being used.

e. Unloading. If the rockets are not fired and it is necessary to unload the launcher, perform the preloading check (circuit breakers "out," etc.) prior to attempting to unload. Then release the detent and push the rocket out the front of the tube.

f. Disassembly. When practical, the rocket should be disassembled and stored in its original container. To disassemble, remove the warhead and replace the rubber gasket, support assembly, spacers, and ground wire/static cover. If it is not practical to disassemble the rocket, store it with the grounding wire and/or static cover in place. For additional information on the care, handling, and storage of rocket ammunition, see TM 9–1300–206, TM 9–1950, and TM 9–1300–200.

12–7. Guided Missiles

a. Storage. Guided missile ammunition requires no maintenance at the user level. Stacks will be limited to five rounds.

b. Handling. Guided missile ammunition should be handled only by trained personnel. Rough handling can cause ammunition malfunction, to include propellant explosion when ignited. For detailed handling instructions, see appropriate 9-series TM (app A).

c. Safety. Personnel engaged in handling, assembly, and loading of guided missile ammunition will observe the following precautions:

(1) The flightcrew must remove all rings and jewelry from their hands before assembling, installing, or disassembling missiles.

(2) Missiles will not be installed on the helicopter until the daily operational checks have been successfully completed.

(3) Missiles will not be mounted until the helicopter has been fueled, checked out, and is ready for flight.

(4) To approach or move away from missiles, personnel should move at a right angle to the line of fire.

(5) All persons not actively engaged in installing the missiles will remain at least 100 meters from the launchers and clear of the flightpath.

(6) The helicopter should be in an open area and positioned so that the missiles are pointing toward a safe, uninhabited area.

(7) Missiles should be mounted from the inside launcher to the outside, both left and right.

(8) Until just before helicopter takeoff, the explosive bolt cables will be connected to their shorting plugs.

(9) Never assemble missiles within 300 meters of a radio or radar installation that has more than 100 kilowatts of peak power.

d. Assembly, Loading, Unloading, and Disassembly. Guided missile ammunition will come from the ammunition supply point assembled and ready to load. Only qualified personnel will assemble, load, unload, and disassemble guided missile ammunition. For assembly, loading, unloading, and detailed disassembly instructions, see appropriate 9-series TM (app A).

APPENDIX A

REFERENCES

A–1. Publication Indexes

Department of the Army Pamphlets of the 310-series should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

A–2. Army Regulations (AR)

95-series	Aviation
220–58	Organization and Training for Chemical, Biological, and Radiological (CBR) Operations.
310-series	Military Publications.
310–25	Dictionary of United States Army Terms.
310–50	Authorized Abbreviations and Brevity Codes.
350–1	Army Training.
380–5	Safeguarding Defense Information.
385–40	Accident Reporting and Records.
385–62	Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat.
385–63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
622–5	Qualification and Familiarization.
750–5	Organization, Policies, and Responsibilities for Maintenance Operations.
750–8	Command Maintenance Management Inspections (CMMI).

A–3. Department of the Army Pamphlets (DA Pam)

(O)30–51	Handbook of the Chinese Communist Army.(U)
108–1	Index of Army Motion Pictures and Related Audio-Visual Aids.
310-series	Military Publications Indexes.
750–1	Preventive Maintenance Guide for Commanders.

★A–4. Field Manuals (FM)

1–5	Aviation Company.
1–15	Aviation Battalion, Group, and Brigade.
1–80	Aerial Observer Techniques and Procedures.
1–100	Army Aviation Utilization.
1–105	Army Aviation Techniques and Procedures.
3–10	Employment of Chemical and Biological Agents.
3–12	Operational Aspect of Radiological Defense.
5–15	Field Fortifications.
5–20	Camouflage.
5–25	Explosives and Demolitions.
5–34	Engineer Field Data.
5–36	Route Reconnaissance and Classification.
6–40	Field Artillery Cannon Gunnery.
6–102	Field Artillery Battalion, Aerial Field Artillery.

9–6	Ammunition Service in the Theater of Operations.
10–8	Airdrop of Supplies and Equipment in the Theater of Operations.
17–1	Armor Operations.
17–12	Tank Gunnery.
17–36	Divisional Armored and Air Cavalry Units.
17–37	Air Cavalry Squadron.
20–60	Battlefield Illumination.
21–5	Military Training Management.
21–6	Techniques of Military Instruction.
21–11	First Aid for Soldiers.
21–26	Map Reading.
21–40	Chemical, Biological, Radiological and Nuclear Defense.
21–60	Visual Signals.
21–76	Survival, Evasion, and Escape.
22–100	Military Leadership.
23–67	Machinegun 7.62MM, M60.
24–1	Tactical Communications Doctrine.
24–18	Field Radio Techniques.
29–22	Maintenance Battalion and Company Operations (Nondivisional).
29–30	Maintenance Battalion and Company Operation in Divisions and Separate Brigades.
30–5	Combat Intelligence.
31–16	Counterguerrilla Operations.
31–20	Special Forces Operational Techniques.
31–21	Special Forces Operations—U.S. Army Doctrine.
31–50	Combat in Fortified and Built-Up Areas.
31–71	Northern Operations.
31–72	Mountain Operations.
33–1	Psychological Operations—U.S. Army Doctrine.
33–5	Psychological Operations—Techniques and Procedures.
57–35	Airmobile Operations.
101–5	Staff Officers' Field Manual: Staff Organization and Procedure.

★A–5. Training Circulars (TC)

1–16	Employment of Aircraft Flares From Army Aircraft.
3–16	Employment of Riot Control Agents, Flame, Smoke, Antiplant Agents and Personnel Detectors in Counterguerrilla Operations.

★A–6. Technical Manuals (TM)

1–215	Attitude Instruments Flying.
1–225	Navigation for Army Aviation.
1–250	Fixed Wing Flight.
1–260	Rotary Wing Flight.
1–380-series	Aerial Observer Programed Texts.
3–210	Fallout Prediction.
3–4240–219–15	Organizational, DS, GS, and Depot Maintenance Manual: Mask, Protective, Aircraft, M24.
5–330	Planning and Design of Roads, Airbases, and Heliports in the Theater of Operations.
8–230	Medical Corpsman and Medical Specialist.
9–1005–243–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool List): Armament Subsystem Helicopter, 7.62-MM Machine Gun, Quad, M6 (XM6E3) (Used on UH–1B Helicopters).

9–1005–247–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem Helicopter 7.62-MM Machine Gun Twin, M2 (Used on OH–13 (Series) and OH–23 (Series) Helicopters).
9–1005–257–12	Operator and Organizational Maintenance Manual: Armament Pod, Aircraft, 7.62-Millimeter Machine Gun: XM18 and XM18E1.
9–1005–262–15	Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Door Mounted, Lightweight, M23 (1005–907–0720) (Used on UH–1D Helicopters); Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Door Mounted, Lightweight, M24 (1005–763–1404) (Used on CH–47A Helicopters); and Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Ramp Mounted Lightweight, XM41 (1005–087–2046) (Used on CH–47A Helicopters).
9–1005–281–15	Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tools List) Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun: XM27 (Used on OH–6A Helicopters).
9–1005–297–12	Operator and Organizational Maintenance Manual for Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun: High Rate TAT–102A (1005–933–4710) (Used on AH–1G Helicopters).
9–1005–298–12	Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62-MM Machine Gun High Rate, XM27E1 (1005–933–6242) (Used on the OH–6A Helicopter).
9–1010–207–12	Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 40 Millimeter Grenade Laucher: M5 (Used on UH–1B Helicopters).
9–1055–217–20	Organizational Maintenance Manual: Helicopter Armament Subsystem 2.75-Inch Rocket Launcher XM3 (Used on UH–1B Helicopter).
9–1055–217–35	DS, GS, and Depot Maintenance Manual: Helicopter Armament Subsystem 2.75-Inch Rocket Launcher XM3 (Used on UH–1B Helicopter).
9–1090–201–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists) Armament Subsystem, Helicopter 7.62-MM Machine Gun—2.75-Inch Rocket Launcher: XM16 (Used on UH–1B Helicopters).
9–1090–202–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—2.75-Inch Rocket Launcher: Twin, High Rate, XM21 (Used on UH–1B Helicopters).
9–1090–202–35	Direct and General Support and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists) Armament Subsystem, Helicopter, 7.62 MM Machine Gun—2.75-Inch Rocket Launcher: Twin, High Rate, XM21 (Used on UH–1B Helicopters).
9–1090–203–12	Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—40 Millimeter Grenade Launcher: XM28 (1090–933–6701) (Used on AH–1G Helicopters).
9–1090–204–12	Operator and Organizational Maintenance Manual: Mount, Multiarmament, Helicopter: XM156 (1090–930–5018) (Used on UH–1B or UH–1C Helicopters).
9–1300–200	Ammunition, General.
9–1300–206	Care, Handling, Preservation, and Destruction of Ammunition.
9–1305–200	Small-Arms Ammunition.
9–1330–202–25	Organizational, DS, GS, and Depot Maintenance Manual (Including Repair Parts and Special Tools List) Dispenser, Grenade, Smoke XM20.

9–1370–200	Military Pyrotechnics.
9–1400–461–20	Organizational Maintenance Manual: Guided Missile Launcher, Helicopter Armament Subsystem M22 (Used on UH–1B Helicopter).
9–1950	Rockets.
55–1520–209–10	Operator's Manual: Army Model CH–47A Helicopter.
55–1520–210–10	Operator's Manual: Army Model UH–1D/H Helicopter.
55–1520–218–10	Operator's Manual: Army Model UH–1A Helicopter.
55–1520–219–10	Operator's Manual: Army Model UH–1B Helicopter.
55–1520–220–10	Operator's Manual: Army Model UH–1C/M Helicopter.
55–1520–221–10	Operator's Manual: Army Model AH–1G Helicopter.

★A–7. Common Type Tables of Allowances (CTA)

23–100–6	Ammunition, Rockets, and Missiles for Unit Training—Active Army and Reserve Components.

APPENDIX B

HELICOPTER ARMAMENT MODEL NUMBERS AND DEFINITIONS

★B–1. Model Numbers Applicable to the Aircraft Armament Program

The prefix "X" indicates incomplete development or that standard A classification will not be awarded.

a. Helicopter Armament Subsystems. The following list of helicopter armament subsystems is a guide to all armament subsystems, past and present. While not all of the systems listed are applicable to attack helicopters, they are included here to provide all gunnery information applicable to attack helicopters.

XM1, XM1E1 (LP)	Caliber .30 machinegun; twin gun (used on OH-13 series helicopters).
M2	7.62mm M60C machinegun; twin gun (used on OH–13-series and OH–23-series helicopters).
XM3	2.75-inch rocket launcher, 48-tube (used on UH–1B/C only; will not be standardized).
XM3E1	Improved XM3 2.75-inch rocket launcher. Subsystem launch tubes are 4 inches longer.
XM4	2.75-inch rocket launcher subsystem for the CH–34.
M5	40mm M75 grenade launcher nose-mounted on UH–1B/C.
M6	Quad 7.62mm M60C machinegun on UH–1B/C (formerly the XM–153 used on CH–21).
M6E1	Same as above, but on CH–34.
XM6E2	Same as above, but on UH–1B/C at station 69.
XM6E3 (M6)	Same as above, but on UH–1B/C at station 136 (now standard A and designated M6).
XM7	7.62mm machinegun; twin gun (the 7.62mm subsystem on the OH–6A; development suspended).
XM8	40mm grenade launcher (the XM129 on the OH–6A).
XM10	Development cancelled.
M16	Quad 7.62mm M60C machinegun; 2.75-inch, seven-tube rocket launcher (used on UH–1B/C helicopters; M6 modified to incorporate rocket capability).
XM17	2.75-inch rocket launcher 19-tube, reloadable, reusable, not repairable (used on UH–1B/C; two XM159 rocket pods on Kellet pylons).
M21	7.62mm high rate M134 machinegun; 2.75-inch rocket launcher XM158 (M16 modified by replacing four M60C machineguns with two M134 machineguns).
M22	Antitank guided missile subsystem for UH–1B/C using AGM–22B missile (formerly SS–11B1).
M23	7.62mm M60D machinegun; door pintle-mounted on UH–1D/H.
M24	7.62mm M60D machinegun; pintle-mounted on CH–47.
XM26 (TOW)	TOW (Tube launched, Optically tracked, Wire guided) missile, for UH–1B/C.
XM27	7.62mm machinegun—high rate; one M134 machinegun side-mounted on OH–6A.
XM27E1	Improved XM27 armament subsystem.
XM28	Two 7.62mm M134 machineguns; two 40mm XM129, grenade launchers; or one M134 machinegun and one XM129, turret-mounted on the nose of AH–1G.

XM29	One 7.62mm M6 OD machinegun; pintle-mounted on UH–1B/C (cannot be used if external weapons subsystems are mounted).
XM30	30mm automatic gun XM140 on UH–1B/C.
XM31	20mm automatic gun; one pod-mounted M24A1 gun on each side of UH–1B/C.
XM32	Caliber .50 or 7.62mm machinegun mounted one on each side of CH–47A.
XM33	Caliber .50 machinegun ramp-mounted in rear of CH–47A.
XM34	Dual 20mm M24A1 guns mounted one on each side of the CH–47A.
XM35	20mm subsystem for the AH–1G.
XM41	One 7.62mm M60D machinegun; ramp-mounted on CH–47A.
Tactical Armament Turret—TAT–102A	Chin turret mounting one 7.62mm M134 machinegun on the nose of AH–1G.

b. Weapons Used in Helicopter Armament Subsystems.

M60C	Machinegun, 7.62mm, electrically fired.
M60D	Machinegun, 7.62mm, spade grip with thumb triggers.
M61	Gun, three-barrel, 20mm cannon, Gatling-type; electrically driven, Vulcan, barrel length 60 inches.
M61A1	Same as M61 except barrel length is 40 inches.
M75	Launcher, grenade, 40mm.
XM129	Launcher, grenade, 40mm (redesign of M75).
XM130	Gun, 20mm, automatic (redesign of M61 to provide gas drive).
XM133	Gun, 7.62mm, high cyclic rate machinegun w/gas drive.
M134	Gun, 7.62mm, high cyclic rate machinegun w/electric drive.
XM140	Gun, 30mm, automatic, single barrel.
XM141	Launcher, 2.75-inch rocket, seven-tube reusable.
XM157	Launcher, 2.75-inch FFAR, seven-tube reusable, not repairable (LP).
XM158	Launcher, 2.75-inch rocket, seven-tube reusable, repairable (LP).
XM159	Launcher, 2.75-inch FFAR, 19-tube reusable, not repairable (LP).
XM200	Launcher, 2.75-inch FFAR, 19-tube, reusable, repairable.

c. Multiarmament Helicopter Mount.

XM156	Mount, multiarmament, used on UH–1B/C having M16 subsystem internal wiring (for XM157, XM158, and XM-159 2.75-inch rocket launchers).

d. Sights for Helicopter Armament Subsystems.

XM58	Sight, antioscillation, for M22 subsystem.
XM60	Sight, infinity, helicopter (pilot sight for M16 and M21).
XM70	Sight, infinity, helicopter (used with XM27 on OH–6A).

e. Aircraft Armament Pods.

XM12	20mm automatic gun—turbine driven (uses M61 gun) (SUU–16/A, AF).
XM13	40mm grenade launcher (uses M75 launcher).
XM14	Caliber .50 machinegun (uses M3 machinegun) (LP).
XM18	7.62mm high rate M134 machinegun (SUU–11A/A, AF) (LP).
XM19	7.62mm machinegun; twin gun (uses M60C machinegun).
XM25	20mm automatic gun—gas driven (SUU–11A, AF).

f. Aircraft Dispensers.

XM3	Dispenser, antipersonnel, mine (see XM47 mine dispersing subsystem).
XM9	Dispenser, bomb (modified SUU 7 for UH–1B/C, see SUU 14/A).
XM15	Dispenser for XM165 aircraft flares.
XM18	Dispenser for XM54 grenades and XM170 aircraft flares.

XM19	Dispenser for XM170 aircraft flares.
XM20	Smoke grenade dispenser for AH–1G.
XM25	Dispenser, bomb, aircraft (XM18 dispenser and XM144 frag bombs).
XM27	Dispenser, grenade, aircraft (XM18 dispenser and XM54 grenade).
XM47	Mine dispersing subsystem (XM3 dispenser and XM27 mines).

g. Mines.

XM27	Mines, antipersonnel (see XM47 mine dispersing subsystem).

h. Canisters.

XM15	50-pound cluster of eight modules of XM16 CS canisters.
XM165	130-pound cluster of two XM15 CS canisters.

B–2. Definitions

a. Clockwise Rotation—When an armament system is viewed from the rear, rotation in the direction of the hands of a clock.

b. Gunner—The copilot-gunner.

c. Gatling—Machinegun operation where barrels rotate through a loading, firing, and ejecting cycle.

d. Pod—An externally mounted armament subsystem that is contained within a fairing.

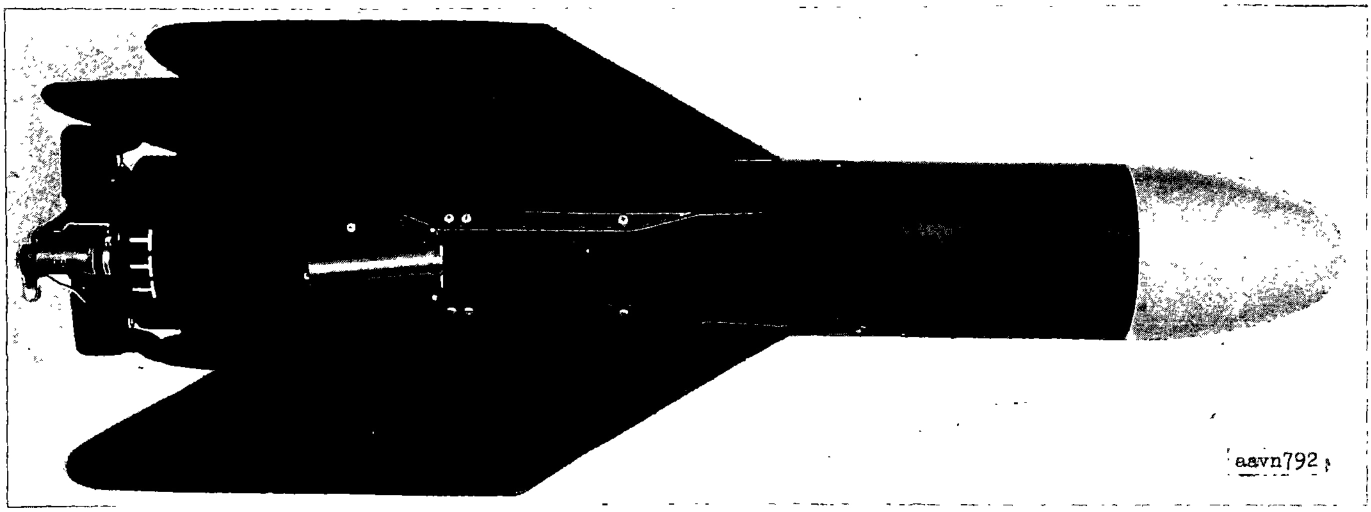


Figure E–3. M22 missile.

Table E–2. Missile Components

Item	Length (In.)	Diameter (In.)	Weight (Lbs.)	Material	See Fig. No.
Warhead	16	6.5	17.5		E–4, at A[1]
Missile Body	32	6.5	46.5	Magnesium casting	E–4, at A–D
Battery Holders	----	----	-----	Stamped steel	E–4, at D
Fuze Detonator Assembly	----	----	-----	Duralumin	E–5
Booster Motor and Exhaust Nozzles	----	----	-----	---------------	E–4, at C–D
Sustainer Motor and Exhaust Tubes	----	----	-----	---------------	E–4, at A, D
Decoder	----	----	-----	---------------	E–4, at B
Gyroscopic Distributor	----	----	-----	---------------	E–6, E–7
Deflector Assembly	----	----	-----	Molybdenum arm	E–4, at C; E–8
Wing Assembly	----	----	-----	Aluminum skin Balsa wood filler	E–4, at B
Spool Assemblies	----	----	-----	---------------	E–4, at A, C
Juntion Box	----	----	-----	---------------	E–4, at A, C
Batteries	----	----	-----	---------------	E–9
Rear Cover and Tracer Flares	----	----	-----	---------------	E–4, at C
Mounting Lugs	----	----	-----	Steel	E–4, at C
Missile Circuit Test Socket	----	----	-----	---------------	E–4, at A

rear edge of the warhead enters the front end of the missile body (D, fig. E–4) when the missile is completely assembled.

a. The AGM–22B missile has a 140mm shaped charge HEAT** warhead.

b. The ATM–22B*** training missile has an inert warhead. It contains a red, nonexplosive marking powder as well as the weights needed for ballast.

Caution: **Although alike except for color coding, the warheads cannot be interchanged on AGM and ATM missiles. The tactical round has a fuze and detonator in the missile body, but the training round does not have a detonator.**

** *HEAT* (*h*igh *e*xplosive *a*nti*t*ank).
** *ATM* (inert warhead).

E–5. Missile Body
(fig. E–4)

a. The missile body houses—
(1) Battery holders
(2) Fuze detonator assembly
(3) Sustainer motor and exhaust nozzle
(4) Booster motor and exhaust nozzles
(5) Decoder
(6) Gyroscopic distributor
(7) Deflector assembly

b. The body also provides the mounting surface for—

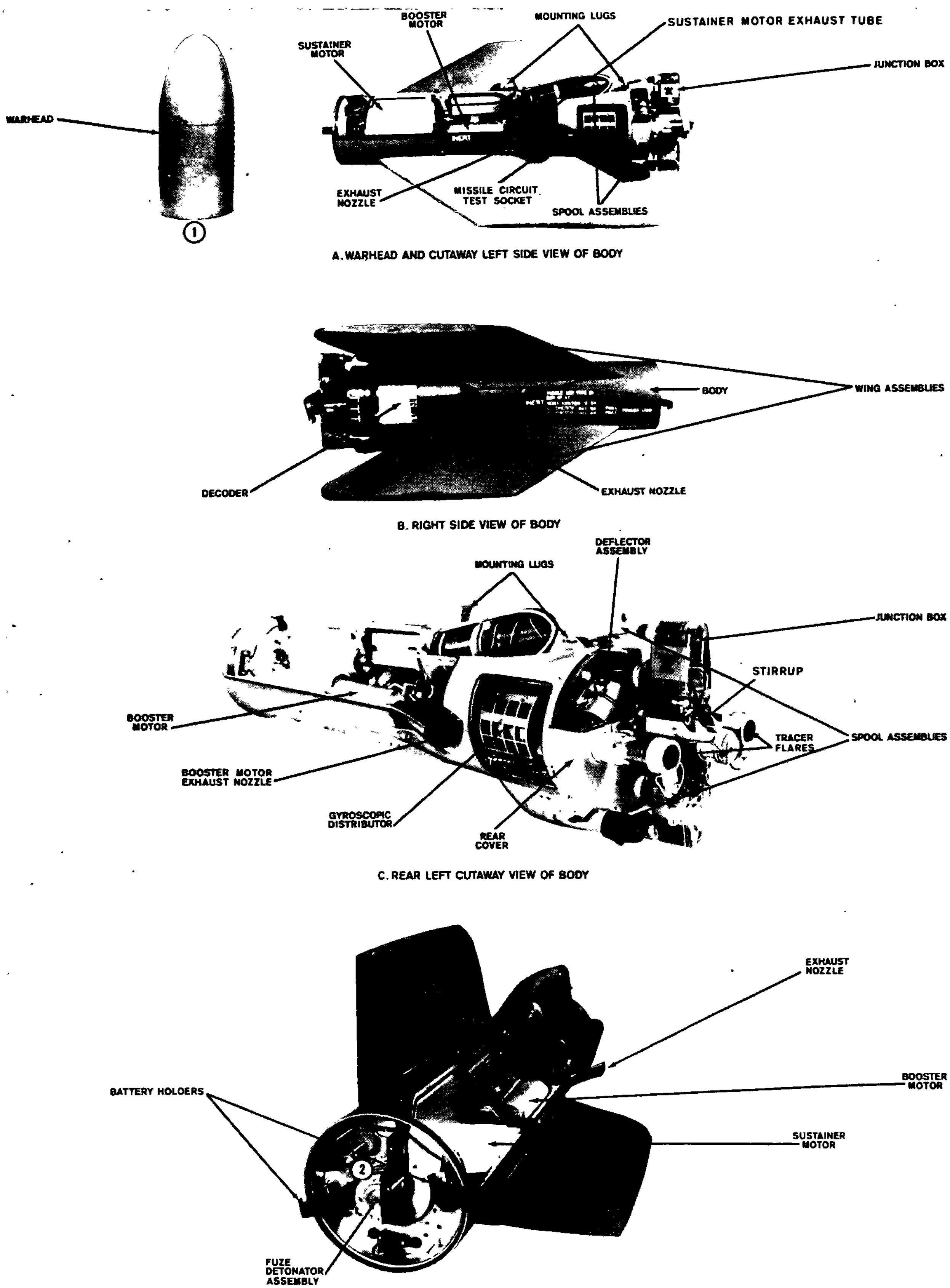


Figure E–4. Missile components.

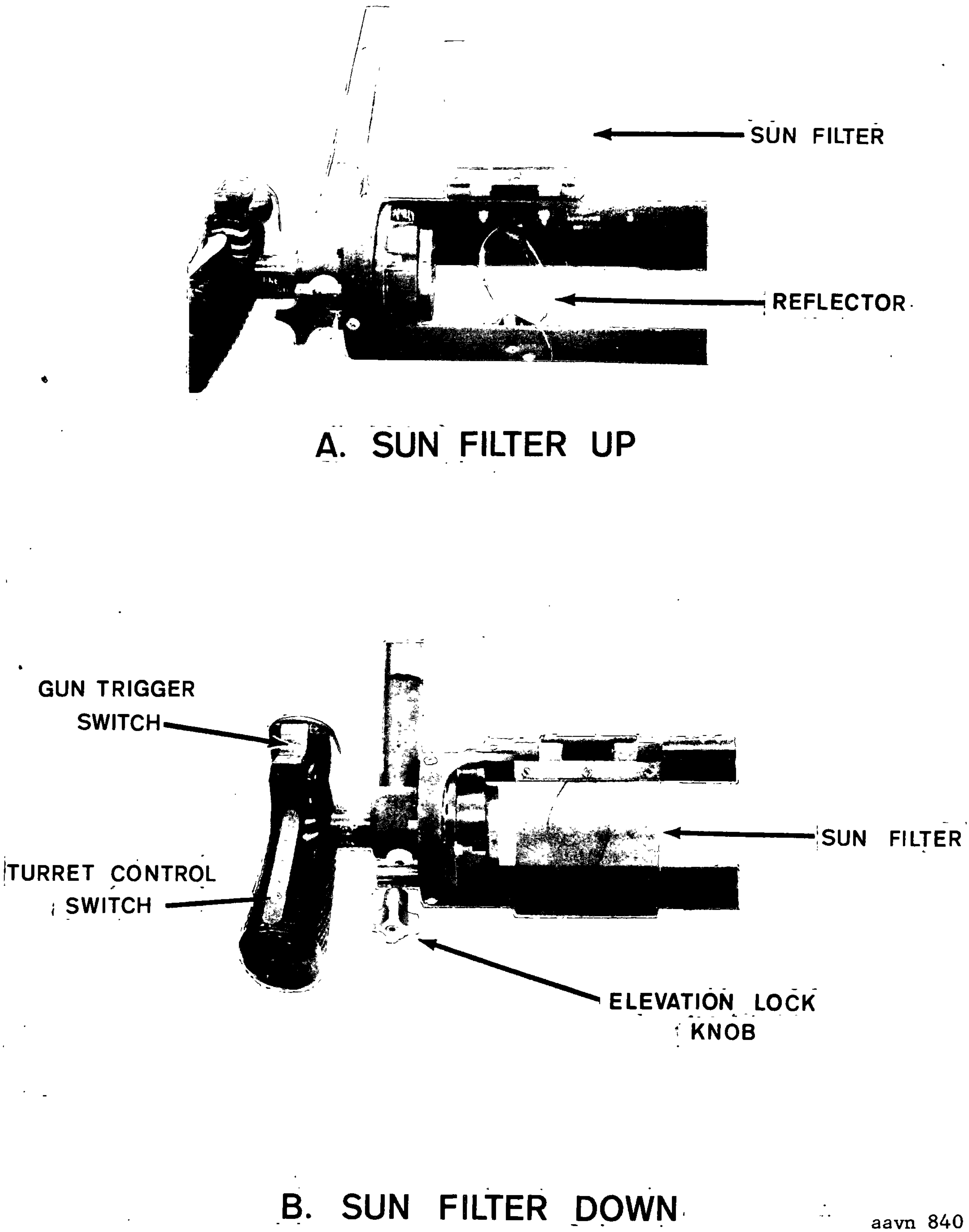


Figure F-8. Sight guide and controller grip assembly

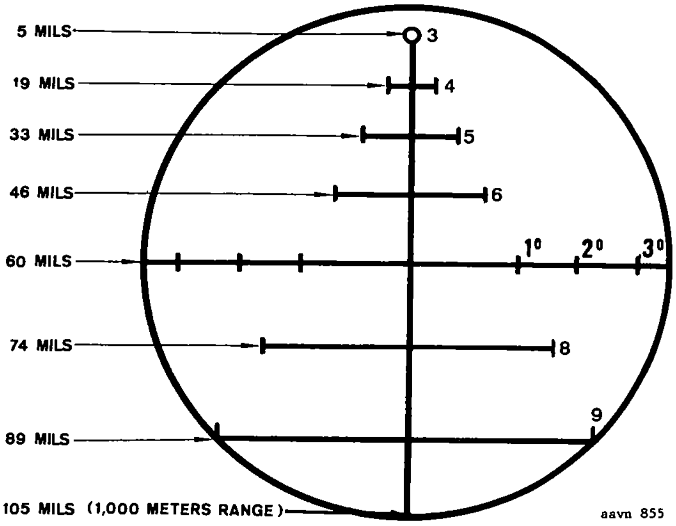


Figure F–9. Sight reticle image.

pressed and held, this switch activates circuits which turn the turret assembly in azimuth and elevation, according to the electrical signals generated by movement of the sight in azimuth and elevation. Depressing this switch also permits firing the gun by depressing the gun trigger switch. Releasing the turret control switch returns the turret and gun to the stow position.

(*b*) *Gun trigger switch.* When the turret control switch and the gun trigger switch are both held depressed, the gun trigger switch closes the gun drive motor circuits and ammunition booster assembly circuits.

(*c*) *Elevation lock knob.* This knob can be turned to lock the sight assembly guide in one position.

F–11. Firing Switches

When the turret control switch is released and the turret is in the stow position, either the gunner or pilot can fire the gun by depressing the firing switch (fig. D–11) on either cyclic control stick.

F–12. Servo-Amplifier Junction Box Assembly

The servo-amplifier junction box assembly contains two servo-amplifier module assemblies, a control module, relay switching and control circuits for the subsystem, components of the automatic lead compensation device, and a switch to remove the compensation when desired for testing or instructional purposes. The servo-amplifier junction box assembly is located in the baggage compartment of the helicopter. Holes in the junction box assembly mounting brackets fit over studs on two channel beams in the helicopter. The cover assembly is secured by two tabs on one end and two turn-lock fasteners at the other end.

a. Cooling air circulation is supplied by an exhaust-type blower mounted on one side of the box. Test jacks, designated TP1 through TP18, are mounted on both sides of the blower to permit electrical troubleshooting tests without having to remove the cover assembly.

b. Five externally-mounted receptacles provide for subsystem electrical interconnection.

c. The two amplifier module assemblies are interchangeable and are secured in the junction box by a module retainer assembly.

d. The flashing reticle (para F–10*c*(2)) circuit is also contained in the junction box.

F–13. Preflight Checks

Warning: **Do not attempt to perform preflight checks with high explosive or practice ammunition loaded in the transition feed chute assembly or gun. If this ammunition is present, unload in accordance with paragraph F–15.**

a. Connect auxiliary power unit to the helicopter.

Caution: **If auxiliary power is used to operate the subsystem, only battery-type power units will be used.**

b. Push in the following circuit breakers and turn the indicated switches to the positions named:

(1) *AC circuit breaker panel* (fig. F–10).

(*a*) M–5 ARM (115 volts AC, sychronization, magnetic, amplifier, and stow).

(*b*) M–5 ARM (28 volts AC bias power).

(2) *DC circuit breaker panel* (fig. F–11).

(*a*) INVTR CONT.

(*b*) MAIN INVTR PWR.

(*c*) SPARE INVTR PWR.

(*d*) VOLT METER-NON-ESS-BUS

(*d*) VOLT METER-NON-ESS-BUS.

(*e*) M5 GUN & BOOST MOTOR (35 amp gun drive and booster drive power).

(*f*) M5 AZ (7 amp, azimuth drive power).

(*g*) M5 EL (7 amp, elevation drive power).

(3) *Overhead console switches.*

(*a*) INVTR switch to SPARE ON.

(*b*) PHASE selector switch to AB (AC voltmeter indicates 115 volts).

(*c*) NON-ESS-BUS to manual ON.

(*d*) If no external power is used, turn BATT switch to ON.

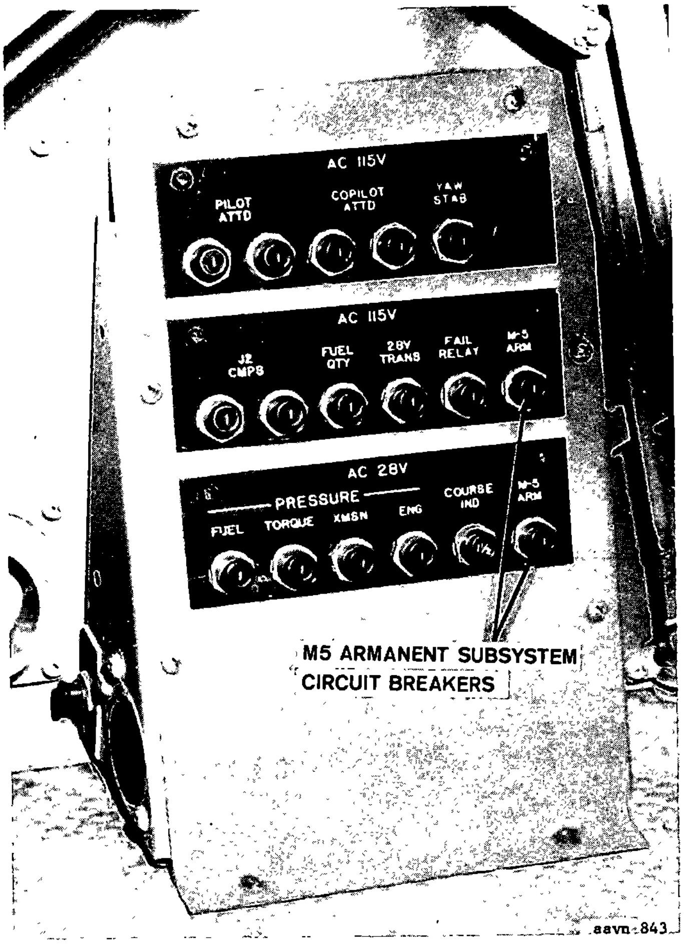


Figure F–10. Pedestal (pilot's side) AC circuit breaker panel.

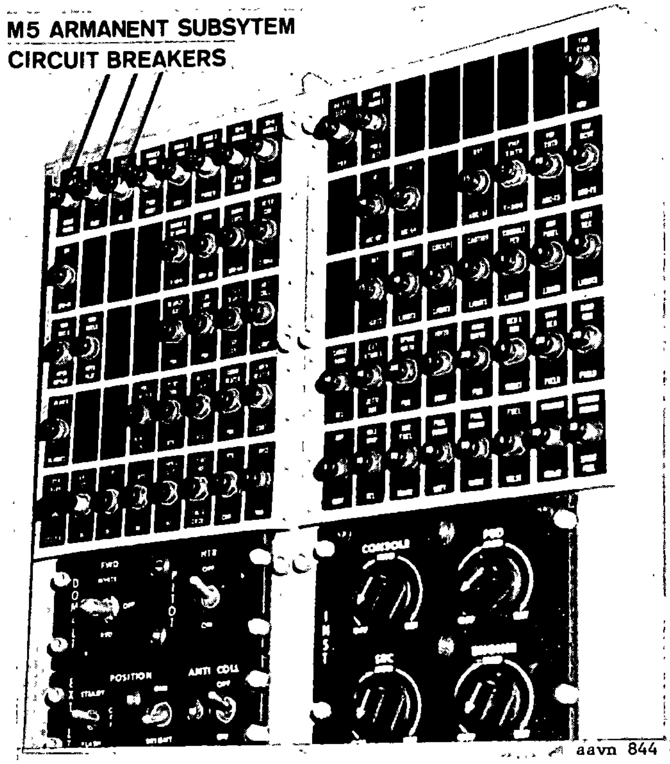


Figure F–11. Overhead DC circuit breaker panel.

c. On turret control panel (fig. F–6), set MAIN POWER switch to ON; the turret will move to the stow position (if its position has been moved from the stow position) and the OPERATE indicator will light.

d. On turret control panel (fig. F–6), move GUN ELEV stow control throughout its full travel. The turret should follow the movement of the control in elevation.

e. Release sight from stow position but do not depress turret control switch (B, fig. F–8). A flashing reticle image should be visible on the reflector.

f. Depress turret control switch. Reticle image should stop flashing and remain steady. The turret should assume the position of the sight.

g. Release turret control switch (turret reverts to −0° azimuth and elevation stow position). Set GUN POWER switch (fig. F–6) on turret control panel assembly to HOT (ARMED indicator light should illuminate.

h. With turret control switch (B, fig. F–8) depressed, move sight in azimuth to both the right and left limits. Reticle should flash when turret limits are reached.

i. Using dummy rounds to avoid breaking the firing pin, depress turret control switch and gun trigger switch (B, fig. F–8). The gun and booster should cycle while the gun trigger switch is depressed. The gun should continue to cycle for two or three rounds before stopping. Release turret control switch and gun trigger switch.

j. Using dummy rounds, press firing switch (fig. D–11) on each cyclic control stick. The gun and booster should cycle while each firing switch is pressed and stop after release of the trigger when two or three rounds have cycled.

k. Set GUN POWER switch (fig. F–6) to SAFE (ARMED indicator light should go out) and place sight in the stow position.

l. On turret control panel, set MAIN POWER switch to OFF; OPERATE indicator light should go out.

m. Pull out circuit breakers listed in *b* above, and disconnect auxiliary power unit from the helicopter.

n. Set ROUNDS REMAINING (fig. F–6) indicator to 150/300.

F-14. Loading Ammunition

Warning: **Observe ammunition handling safety precautions. See TM's 9-1010-207-12, 9-1300-206, and 9-1900 for details on handling ammunition.**

a. Rotary Drum Fed Ammunition System.

(1) Disconnect aft chute from aperture adapter.

(2) Obtain ammunition complement consisting of six 50-round belts. Arrange and connect these belts to make one belt of 220 rounds and one belt of 80 rounds. If safety conditions warrant, attach one linked aluminum dummy round containing a rubber firing pin insert to connector end of last 50-round belt. This dummy round must be the last round of the 300 rounds to feed.

Caution: **Examine rounds for correct linking and position (figs. F-12 and F-13).**

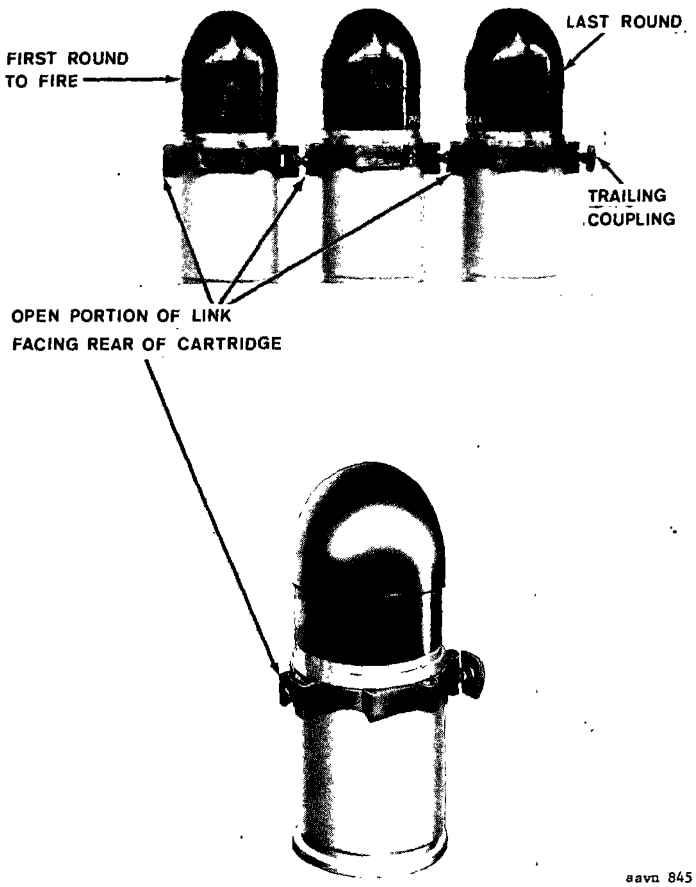


Figure F-12. Examples of correct linking.

(3) Grasp end of belt containing dummy round and place the dummy round end in the aperture opening on the firewall so that the nose of the round is pointing to the right of the helicopter. Feed the ammunition into the can until the last round of the belt can be engaged in the spool. Then rotate the spool by turning the manual crank on top of the ammunition can. This pulls

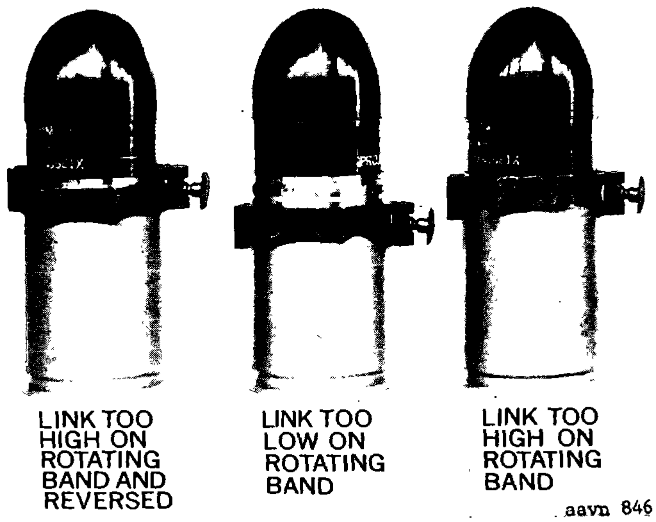


Figure F-13. Examples of incorrect linking.

the remainder of the 220-round belt into the can, winding it around the spool.

(4) With approximately three rounds trailing from the aperture in the firewall, replace the access cover.

b. Box Fed Ammunition System.

(1) Remove access cover by releasing the hook snaps and removing the rear chute assembly.

(2) Obtain ammunition complement consisting of three 50-round belts. Arrange and connect these belts to make two belts of 75 rounds.

(3) Feed one 75-round belt into the box so that the nose of the round is pointing to the right of the helicopter.

(4) With approximately three rounds trailing, replace assembly cover.

Note. Subparagraphs c through *l* below apply to both of the above ammunition feed systems.

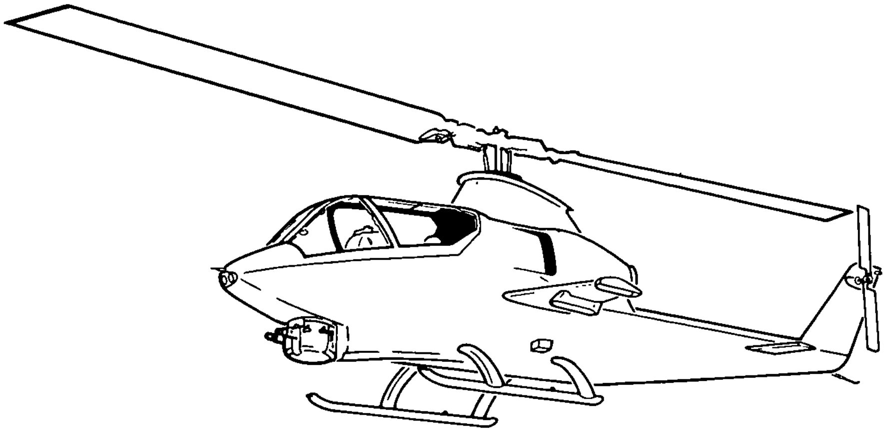
c. Remove top enclosure by releasing the strap and sliding the enclosure 1 inch to the right. Then slide enclosure, with boot attached, up toward center of forward flexible chute.

d. Disconnect forward flexible chuting from the transition chute assembly.

e. Insert hook end of loading cable through opening in forward chute and continue inserting cable until the hook emerges from the rear of the aft chute.

Note. Open portion of flexible chuting must face up.

f. Attach hook to end of remaining belt of ammunition so that *the nose of the rounds is pointing to the right* of the helicopter with the *link coupling always on the trailing side of the cartridge.*



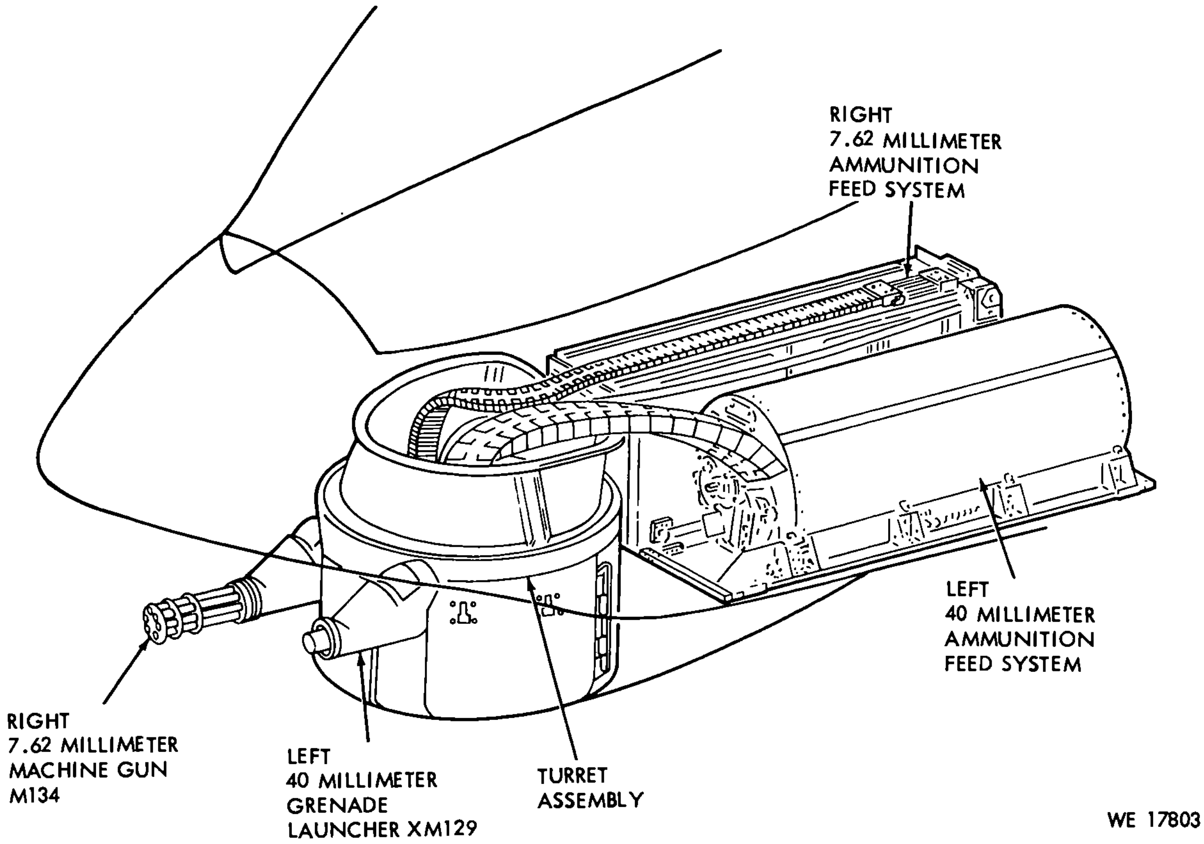


Figure H-2. XM28—left 40mm grenade launcher and right 7.62mm machinegun.

air-cooled gun, incorporating six barrels and six bolt assemblies which revolve around the longitudinal axis of the weapon. The M134 machinegun weighs 35.1 pounds and is capable of firing 6-second bursts at rates of 2,000 or 4,000 shots per minute. For detailed description, operation, and maintenance of the 7.62mm M134 machinegun, see TM 9-1005-265-15.

(2) *Delinking feeder MAU-56/A.* The feeder MAU-56/A is gear driven through the M134 machinegun. The feeder removes the cartridges from the links and feeds them to the bolt

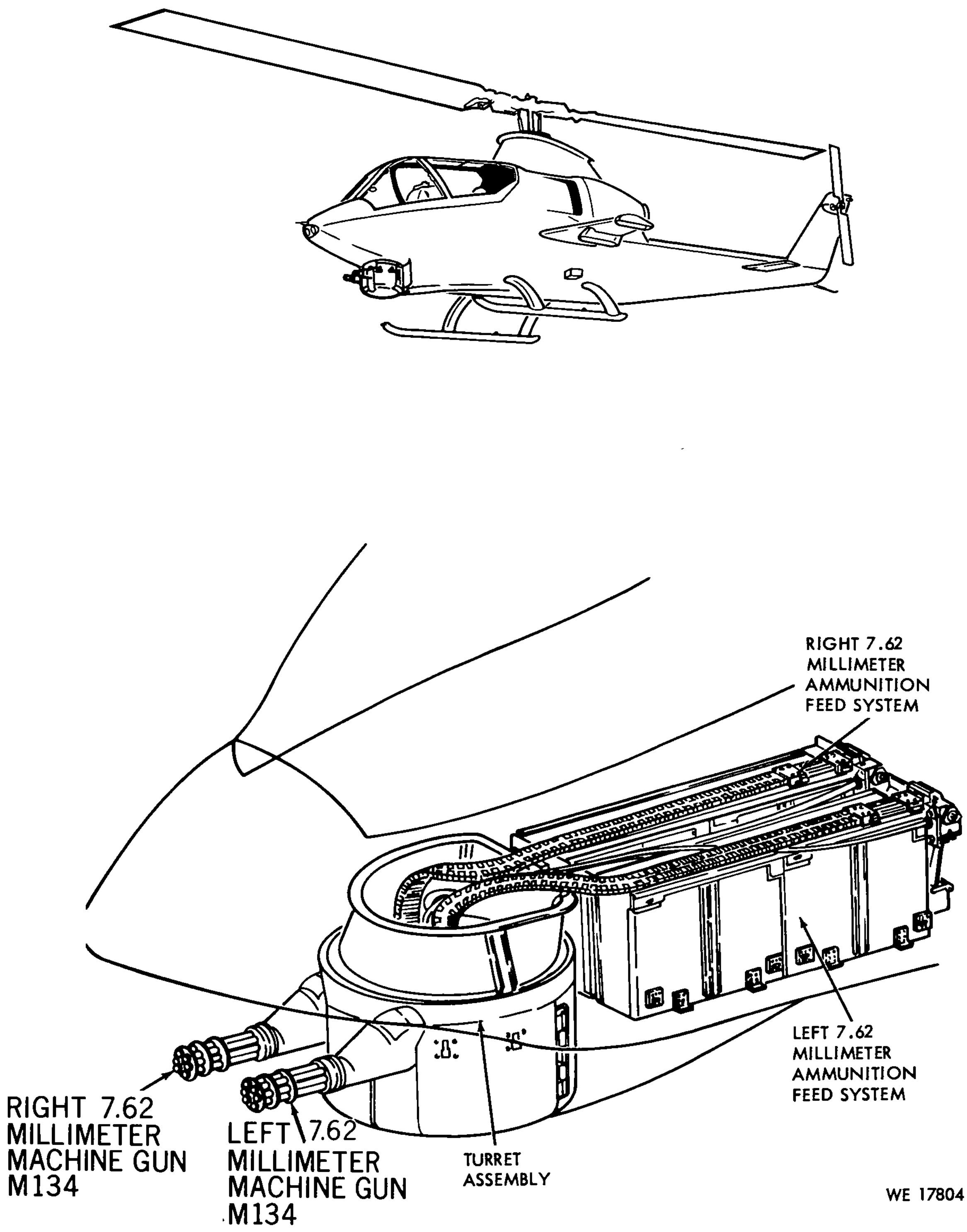


Figure H–3. XM28—two 7.62mm machineguns.

and track assemblies in the machinegun rotor. The links are discarded through the link ejector chute attached to the feeder MAU–56/A.

(3) *Ammunition box assemblies.* The two ammunition box assemblies are located in the ammunition compartment aft of the turret. The ammunition box assemblies are locked together and have a capacity of 4,000 rounds of linked 7.62mm ammunition.

(4) *Crossover assembly.* The crossover assembly, mounted at the rear of the ammunition box assemblies, extracts the linked ammunition from each bay of the ammunition box assemblies in sequence and feeds the ammunition into the

APPENDIX K

HELICOPTER ARMAMENT AMMUNITION

K–1. General

Aircraft weapons subsystems require several types of standard and nonstandard munitions. For details concerning the munitions required for each subsystem, see the appropriate TM 9-series. This appendix lists munitions required for helicopter armament subsystems.

K–2. 7.62MM Ammunition

a. Commonly used 7.62mm (NATO) helicopter machinegun subsystem ammunition includes—

(1) M59 or M80—ball.
(2) M61—armor piercing (AP).
(3) M62—tracer.

b. Two additional types of 7.62mm ammunition not normally used in machinegun subsystems are—

(1) M63—dummy.
(2) M60—high-pressure, test.

K–3. Caliber .50 Ammunition

a. Numerous types of caliber .50 ammunition are used in helicopter armament subsystems including—

(1) M2—armor piercing.
(2) M8—armor piercing, incendiary.
(3) T49—armor piercing, incendiary.
(4) M20—armor piercing, incendiary, tracer.
(5) M33—ball.
(6) M1—incendiary.
(7) M23—incendiary.
(8) M1—tracer.
(9) M10—tracer.
(10) M17—tracer.
(11) M21—tracer.

b. Other caliber .50 ammunition available for training and testing includes—

(1) M1—blank.
(2) M2—dummy.
(3) M1—high-pressure, test.

K–4. 20MM Ammunition

Different types of 20mm guns are listed below with their ammunition type requirements.

a. M24A1, Gun, 20mm, Automatic, Single-Barrel.

(1) M95—armor piercing, tracer.
(2) M58—high explosive, incendiary.
(3) M97A1—high explosive, incendiary.
(4) M96—incendiary.
(5) M99—target practice.
(6) M18—dummy.

b. Automatic 20mm Six-Barrel Gun: M61 and M61A1—Electric Drive; XM130—Gas Drive.

(1) T221E3—armor piercing, incendiary.
(2) M55A1—ball.
(3) M56A1 (T198E1)—high explosive, incendiary.
(4) M51 (T228)—dummy.
(5) M54 (T156)—high-pessure, test.

K–5. 30MM Ammunition

Ammunition for the XM140, gun 30mm, automatic (WECOM–30), single-barrel includes the XM552 cartridge, high explosive, dual purpose; the XM554, practice (spotter); and the XM639 (inert).

K–6. 40MM Ammunition

a. The 40mm ammunition used in the M75 or XM129 launchers includes—

(1) M384—cartridge, high explosive.
(2) M385—cartridge, practice.
(3) XM428E1—cartridge, practice (spotting).
(4) XM430—cartridge, high explosive dual purpose.
(5) XM574—cartridge, white phosphorous.

b. To allow detonation at impact angles of from 90° to low graze angles of 5°, 40mm ammunition is provided with the M533 fuze.

K–7. 2.75-Inch Folding Fin Aerial Rockets (FFAR)

a. Launchers for the 2.75-inch FFAR include—

(1) XM141—seven tube, reloadable, reusable.

(2) XM157—seven tube, reloadable, reusable, not repairable.

(3) XM157B—seven tube, reloadable, reusable, extra long.

(4) XM158—seven tube, reloadable, reusable, repairable.

(5) XM159—19 tube, reloadable, reusable, not repairable.

(6) XM159C—19 tube, reloadable, reusable.

b. Warheads for the 2.75-inch FFAR are—

(1) Mk1—high explosive, 6 lb.

(2) Mk67—white phosphorous, 6 lb.

(3) M151—high explosive, 10 lb.

(4) XM152—high explosive, white phosphorous, red marker, 6 lb.

(5) XM153—high explosive, white phosphorous, yellow marker, 6 lb.

(6) M156—white phosphorous, 10 lb.

(7) XM157—smoke, red, 10 lb.

(8) XM158—smoke, yellow, 10 lb.

(9) XM229—high explosive, 17 lb.

(10) XM230—practice, 10 lb.

(11) XM232—practice, spotting, 10 lb.

(12) WDU–44/A—flechette, 10 lb.

c. Fuzes for the 2.75-inch FFAR include—

(1) M423E1—PD (graze sensitive).

(2) XM427—redesign of M423 to allow delayed arming.

★(3) M429—proximity.

d. Types of 2.75-inch FFAR motors are—

(1) Mk4—high speed (unscarfed).

(2) Mk40—low speed (scarfed).

(3) Mk40—low speed (scarfed), redesign of Mk40.

K–8. M22 Missile Subsystem Ammunition

Ammunition for the M22 subsystem includes an AGM–22B guided missile with high explosive antitank warhead, an ATM–22B guided missile with inert warhead filled with a marking powder, and an ATM guided missile with completely inert warhead.

K–9. Munitions for Special Attack Helicopter Missions

The munitions listed below are not normally used in attack or limited attack helicopter roles and missions. However, they could be used on attack helicopters during special missions.

a. XM147—bomb, fragmentation (XM9).

b. XM142—bomb, antitank (XM9).

c. XM144—bomb fragmentation (XM25).

d. XM920E2—bomb, fuze and burster, CS in 55-gallon drum.

e. Mk24—flare, aircraft, parachute.

f. E158—50 lb. CS canister cluster.

g. E159—130 lb. CS canister cluster (two E/58 with strongback).

h. Helicopter trap weapon—to sanitize landing zones.

i. Fuel—air explosive, to sanitize landing zones.

j. E39R1—smoke tank (Kellet pylon).

k. XM52—smoke generator, exhaust stack mounted.

L–18. Conduct of Firing Exercises

a. Helicopter pilots will be cleared for firing runs as follows:

(1) From firing line—"Seven three cleared downrange, hot."

(2) In flight—"Seven three cleared inbound."

(3) When range is clear—"Seven three cleared hot at the firing line."

b. Helicopter pilots may request orbiting fire. Reports will be as follows:

(1) "Switches cold, orbit right" (left).

(2) "Switches hot" (when alined on target).

(3) After last orbit, "Switches cold, breaking right" (left).

c. Two or more helicopter pilots may be cleared to conduct hovering and bobbing fire simultaneously from lateral positions. Firing must be from the fixed or stowed position with safety bridles installed as appropriate. Lateral positions may be on the firing line or downrange in the firing lane, depending on the terrain.

d. Prior to reaching the cease-fire line, the OFF-SAFE-ARMED switch will be placed in the SAFE or OFF position, a turn short of the turn-around line initiated, and a report given as follows: "Switches cold, breaking right" (left).

e. After the helicopter pilot reports "Switches cold, breaking right" (left), the helicopter pilot will then clear the range surface danger zone by the most direct route having forced landing area available. Airspeed will be increased to the maximum practical safe limit to clear the range as soon as possible. Report "Clear of the range" upon passing a known terrain feature that is outside the surface danger area.

f. A helicopter pilot desiring to return to the firing line will so indicate upon breaking right (left). A helicopter pilot awaiting another firing run will enter high or low orbit in the maneuvering area or be cleared for another run.

g. A helicopter pilot in low orbit will plan his inbound approach to a firing run to cross the firing line as soon as possible after the downrange helicopter pilot reports clear at the range. Normally, this does not exceed 10 seconds.

h. When gunner/pilot training period on range firing is completed (ammunition expended), the helicopter pilot will report his fact to the control tower to allow remaining helicopter gunners/pilots to continue firing uninterruptedly.

Section V. PROGRAM OF INSTRUCTION FOR GUNNERY AND RANGE FIRING

L–19. Gunnery Training Program of Instruction

To qualify selected personnel in the techniques of aerial gunnery, training will be designed to meet the needs of each unit and gunner/aviator concerned. The training should emphasize techniques involving minimum altitude observation, target acquisition, navigation, and related subjects. Such training, however, should include as a minimum the subjects and time allocated below.

Subject	Hours	Type	Scope	References*
M21 introduction	1	Conference	Conference covering M21 armament subsystem used on UH–1B/C helicopters, to include all components and sighting systems. Describe characteristics, capabilities, and limitations of the subsystem, and its effect on operation of the helicopter.	Appendix D; TM's 9–1090–202–12, 55–1520–219–10, 55–1520–220–10.
M134 7.62mm machinegun disassembly, assembly, and troubleshooting.	1	Conference and practical exercise.	Conference and practical exercise covering detailed disassembly, assembly, and troubleshooting of the M134 7.62mm machinegun.	TM 9–1090–202–12, TM 9–1090–202–35.
Principles of aerial fire ballistics.	1	Conference	Conference on principles of aerial fire ballistics, including the three phases, with particular emphasis on aerial rocket ballistics.	Chapter 2.
Aerial weapons; techniques of fire.	1	Conference	Conference on techniques used in aerial fire to include range estimation and target analysis. Emphasis is placed on aerial rocketry.	Section III, chapter 2; chapters 6 and 9; TM 9–1055–217–20.

*Unless otherwise noted, references are to this publication.

Subject	Hours	Type	Scope	References*
XM3, M16, and M21 alinement and boresighting procedures.	2	Conference	Conference and demonstration covering the procedures and techniques used in boresighting.	Appendix D; TM's 9–1055–217–20, 9–1090–201–12, 9–1090–202–12, 9–1090–202–35.
Ammunition and safety	1	Conference	Conference and demonstration covering the various types of ammunition and proper loading, handling, and operating procedures.	Paragraphs 1–8, 1–9, 4–12, 9–10, 12–3, 12–7, 13–15, 13–18; appendix K; TM's 9–1090–202–12, 9–1300–206, 9–1900, 9–1950.
M16 and M21 operating loading, and emergency procedures.	2	Conference	Conference and practical exercise covering detailed description of procedures used in loading and operating the M16 and M21 subsystems including emergency procedures.	Appendix D; TM 9–1090–202–12.
XM3 introduction **	1	Conference	Conference covering the general characteristics of the XM3 subsystem, to include functioning, preflight check, and emergency procedures.	Appendix D.
M5 introduction **	1	Conference	Conference covering the general characteristics of the M5 armament subsystem (including sighting system), to include description, nomenclature, functioning, capabilities, and limitations of the subsystem, and its effect on the operation of the UH–1 helicopter.	Appendix F.
M6 introduction **	1	Conference	Conference covering the general characteristics of the M6 armament subsystem, to include description, nomenclature, functioning, capabilities, and limitations of the subsystem, and its effect on operation of the UH–1 helicopter.	Appendix C.
M16 introduction **	1	Conference	Conference covering M16 armament subsystem used on UH–1 helicopters, to include all components and sighting systems. Describe characteristics, capabilities, and limitations of the subsystem, and its effect on operation of the helicopter.	Appendix D.
M22 introduction **	2	Conference	Conference covering missile description, nomenclature, theory of operation, inspection, M22 control and guidance equipment, and functioning, nomenclature, and description of M55 and XM58 sights.	Appendix E.
Armor and its employment.	3	Conference	Conference on armored vehicles to include description, antiaircraft capability, vulnerability, and traditional employment.	DA Pam 30–50–1, DA Pam 30–51.
Target recognition.	2	Conference and practical exercise.	A conference on developing a systematic method of detecting and identifying targets found within the battle area to include basic characteristics, methods of detection, and recording and identifying targets; also a practical exercise on target recognition.	DA Pam 30–50–1, DA Pam 30–51; FM 1–80.

*Unless otherwise noted, references are to this publication.
**This training is not required for individuals already familiar with this armament subsystem.

Table L–11. Familiarization Firing

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition	Altitude (feet)	Targets per Firing Run	Remarks
1	Harmonization, hovering, and diving.	500–1,000	750 (7.62mm)	Hovering, 1,000–200	2–4	Aircraft heading varies through flexible limits.
2	Running	500–1,000	750 (7.62mm)	Nap-of-the-earth	2–4	Aircraft heading varies 20° left and right.
3	Harmonization, hovering, and diving.	500–1,200	4/20/75* (40mm)	1,000–200	4–6	
4	Running	500–1,200	4/20/75* (40mm)	Nap-of-the-earth	4–6	Aircraft heading varies 20° left and right.
5	Diving	1,250	4/1/4* (2.75-inch rocket)	1,000–500	1	To obtain combat sight.
6	Diving	1,000–2,500	2–4/1–2/4* (2.75-inch rocket)	1,200–500	1–2	
7	Running	750–1,250	3/1/3* (2.75-inch rocket)	Nap-of-the-earth	1	
8	Diving	1,000–1,500	1/4/4*	1,200–500	1	Salvo of four 2.75-inch FFAR's.

*Firing runs/rounds per run/total rounds.

Note. Exercises 1 through 4 are gunner familiarization exercises and 5 through 8 are for aircraft commander familiarization firing.

★L–23. Ammunition Requirements

For helicopter aerial gunnery training ammunition requirements, see table L–12. This table is for guidance purposes only and does not restrict flexibility exercised by local commanders. However, unit commanders must insure that ammunition expended will not exceed authorized allowance in CTA 23–100–6.

★*Table L–12.. Aerial Gunnery Ammunition Requirements*

Armament Subsystem	Helicopter	Weapon: Machinegun	Weapon: 40MM grenade launcher	Weapon: 2.75-in rocket launcher	Weapon: Wire-guided missile	Ammunition (No. of rounds per individual): Initial Qualification		Annual Proficiency		Familiarization	
		M60C M134				Ctg ball, 7.62mm TR 4–1, MLB	Ctg TR, 7.62mm MLB	Ctg ball, 7.62mm TR 4–1, MLB	Ctg TR 7.62mm MLB	Ctg ball, 7.62mm TR 4–1, MLB	Ctg TR, 7.62mm MLB
M2	OH–13	M60C				4,100	1,900	4,000		600	900
M6	UH–1B/C	M60C				4,000	6,000	2,000	3,000	600	900
M16	UH–1B/C	M60C				4,000	6,000	2,000	3,000	600	900
M21	UH–1B/C	M134				6,000	9,000	4,000	6,000	900	1,350
XM27	OH–6A, OH–58A	M134				6,000	9,000	4,000	6,000	900	1,350
XM28	AH–1G	M134				6,000	9,000	4,000	6,000	900	1,350
TAT–102A	AH–1G	M134				6,000	9,000	4,000	6,000	900	1,350
XM18 (Pod)	AH–1G	M134				6,000	9,000	4,000	6,000	900	1,350
			XM129			Ctg HE, 40mm Gren	Ctg Prac, 40mm Gren	Ctg HE, 40mm Gren	Ctg Prac, 40mm Gren	Ctg HE, 40mm Gren	Ctg Prac, 40mm Gren
XM28	AH–1G		XM129			150	300	75	75	75	75
M5	UH–1B/C		[1]M75 XM129			150	300	75	75	75	75
XM8	OH–6A		XM129			150	300	75	75	75	75
				[2]XM3E1		Rocket 2.75-in Prac	Rocket 2.75-in HE	Rocket 2.75-in Prac	Rocket 2.75-in HE	Rocket 2.75-in Prac	Rocket 2.75-in HE
XM3	UH–1B/C			XM3E1		75	75	48	48	7	8
XM16	UH–1B/C			XM157, M158		75	75	48	48	7	8
XM21	UH–1B/C			XM157, M158		75	75	48	48	7	8
	UH–1B/C			[2](—)		75	75	48	48	7	8
	AH–1G			[3](—)		75	75	48	48	7	8
					ATM–22B			ATM–22B Prac	ATM–22B HE		
M22	UH–1B/C				ATM–22B			5	1		

[1] As M75's wear out, will be replaced by XM129.

[2] Includes XM157, XM157B, M158, M158A1, XM159C, and XM200 2.75-inch rocket launchers.

[3] Includes XM157B, M158A1, XM159C, and XM200 2.75-inch rocket launchers.

Subject	Hours	Type	Scope	References*
Introduction to helicopter door gunnery and duties of door gunner.	2	Conference	Orientation conference covering the purpose of training to include duties of door gunners, before-mission procedures, target marking, handling of brass, safety procedures, emergency landing procedures, and destruction of subsystems to prevent enemy use. Conference will also cover door gunner night firing, including range estimation and target engagement.	Paragraphs M–17 through M–29; FM 23–67; and TM 9–1005–262–15.
Introduction to XM3**	1	Conference	Conference on the components of the XM3 and their functions, the preflight check, and the emergency removal of the weapons subsystem.	Appendix D; TM 9–1055–217–20.
Introduction to M16**	2	Conference	Conference covering the general characteristics of the M16 armament subsystem, to include all components and the sighting system; and capabilities and limitations of the subsystem.	Appendix D; TM 9–1090–201–12.
2.75-inch FFAR ammunition and safety.	1	Conference	Conference and demonstration covering 2.75-inch rocket; the various types of warheads; and proper loading, handling, and storage procedures.	Appendix D.
Loading and unloading procedures for XM3, M16**, and M21.**	3	Demonstration and practical exercise.	A demonstration and practical exercise in the preparation, loading, and unloading of the subsystems to include assembly and disassembly of rockets.	Appendix D and appropriate TM.
Introduction of M5**	2	Conference and practical exercise.	A conference covering the M5 armament subsystem and a practical exercise on loading and unloading procedures.	Appendix F; TM 9–1010–207–12.
Aerial illumination	1	Conference	Conference on the various means available to illuminate an area and necessary operating and safety procedures.	FM 20–60 and TM 9–1370–200.
Briefing on aircraft gas mask and employment of smoke grenades.	1/2	Conference	Conference on description, capabilities, limitations, nomenclature, and procedures for wearing the M24 aircraft gas mask; conference on description, nomenclature, functioning, capabilities, uses, and safety procedures for throwing a smoke grenade from aircraft.	Paragraph M–17*d*; FM 1–110; and TM 3–4240–219–15.
First aid	3	Conference	Conference on principles and techniques of emergency medical care aboard aircraft to include use of morphine and emergency in-flight first aid measures.	FM 21–11, FM 57–35; and TM 8–230.
Emergency landings procedures and emergency removal of helicopter equipment.	1	Conference	Conference on procedures used during different types of emergency landings and removal or destruction of equipment to prevent enemy use.	Paragraph M18 and Unit SOP.
Survival, escape, and evasion.	2	Conference	Conference on principles and techniques of evading the enemy and surviving in tropical jungle terrain.	FM 21–77.

* Unless otherwise noted, references are to this publication.
** This training required only when unit is equipped with armament subsystem.

Subject	Hours	Type	Scope	References*
Principles of air-to-ground machinegun fire.	1	Conference	Conference on principles and techniques of aerial machinegun fire from helicopters to include fixed and moving gun ballistic problems, employment of dispersion, and the use of the M60D sight, if available.	Chapter 2 and paragraphs M–25 through M–29.
M60 machinegun familiarization firing.	5	Conference, demonstration, and practical exercise.	Introduction to M60 machinegun to include a practical exercise on firing the M60 from range towers and classes on machinegun assembly and disassembly, care and cleaning, and correcting stoppages and malfunctions.	Paragraphs M–30*a* and M–31. TM 9–1005–262–15; and FM 23–67.
Door gunner aerial machinegun firing range.	8	Practical exercise	Practical exercise on door gunner air-to-ground machinegun firing techniques.	Paragraphs M–32 and M–33.

* Unless otherwise noted, references are to this publication.

M–17. Routine Duties of the Door Gunner

Each door gunner must have a knowledge of his own weapons, and be familiar with the helicopter and its armament subsystem and with special situations and duties he might encounter while in flight. A door gunner—

a. Assists in Preflight Check. For preflight check procedures for UH–1B helicopters, see TM 55–1520–219–20; for UH–1C helicopters, see TM 55–1520–220–10; for UH–1D/H helicopters, see TM 55–1520–210–10; for CH–47 helicopters, see TM 55–1520–209–10. Before going on a mission, each door gunner must—

(1) Perform daily inspection of weapons subsystems as required by TM 9–1005–262–15 and other applicable operator's manuals, and immediately report any known maintenance deficiency which is beyond operator capability to organizational maintenance personnel for correction.

(2) Insure that prior to the mission, the proper amount and type of clean and serviceable ammunition (including right color and amount of smoke grenades) is on board helicopter.

(3) Check all armament subsystems for proper loading of ammunition.

b. Acts as Observer.

(1) Since the pilot and copilot fly the helicopter, each door gunner must act as an observer from his side of the helicopter. The door gunner's primary area of observation is from 60° off the nose of the helicopter all the way to the rear. He observes for enemy activity and other aircraft. This observation includes hearing as well as seeing. Because of his position, each door gunner will often be able to hear fire that he could not observe visually. The door gunner's observation techniques will improve greatly with experience. For further details on observation techniques, see FM 1–80 and TM 1–380-series.

(2) Under field conditions and immediately before touchdown or takeoff, the door gunner also keeps a close watch for obstacles such as stumps, brush, or uneven ground.

c. Protects Helicopter. Normally, door gunners provide area neutralization fires when taking off, landing, and during target disengagement. Before firing, each door gunner must consider the location of friendly forces, location of other aircraft, and the ammunition available. The gunner's primary area of coverage is to the flanks and rear of the helicopter.

d. Marks Targets. When required, each door gunner marks enemy fire by machinegun tracers or smoke grenades. Smoke color for a mission is normally designated in the operation order or the SOI. However, smoke color may be designated just before throwing the smoke grenade. The spot report procedure for throwing a smoke grenade is—

(1) Select the correct color smoke grenade and throw it.

(2) Call "Smoke is out." If different color smokes are burning at the same time, give color of smoke.

(3) Report target, giving—

(*a*) Type of target.

(*b*) Distance from smoke to target.

(*c*) Either an azimuth heading from the smoke to the target (e.g., 090° from smoke) or an approximate directional reference (e.g., east of the smoke, southwest of the smoke).

Note. The directional gyro gives compass heading.

M–31. Ground Range Firing

All ground door gunner firing exercises must be conducted under the direction of a range control officer. Each gunner should fire about 200 rounds of 7.62mm linked ammunition (four rounds of ball to one round of tracer). The unit commander should determine the exact number of rounds required for training. While M60 machinegun firing is being conducted from towers on the range, M60 machinegun familiarization training can be conducted concurrently at three training stations.

M–32. Aerial Range Firing

All aerial door gunner firing must be conducted under the direction of a range control officer. This officer must be located either on the ground or in a control tower that has complete visibility of all aerial firing. To control range firing, the range control officer must have radio communications with all helicopters using the range. The aerial range firing phase of instruction is designed to teach the door gunner the fundamental principles of air-to-ground machinegun fire. The door gunner should fire a sufficient number of rounds of 7.62mm linked ammunition (four rounds of ball to one round of tracer) to demonstrate the gunnery proficiency desired by the unit commander. He should be allowed to fire during all flight maneuvers, i.e., climping, descending, shallow and steep turns, and nap-of-the-earth.

M–33. Scoring

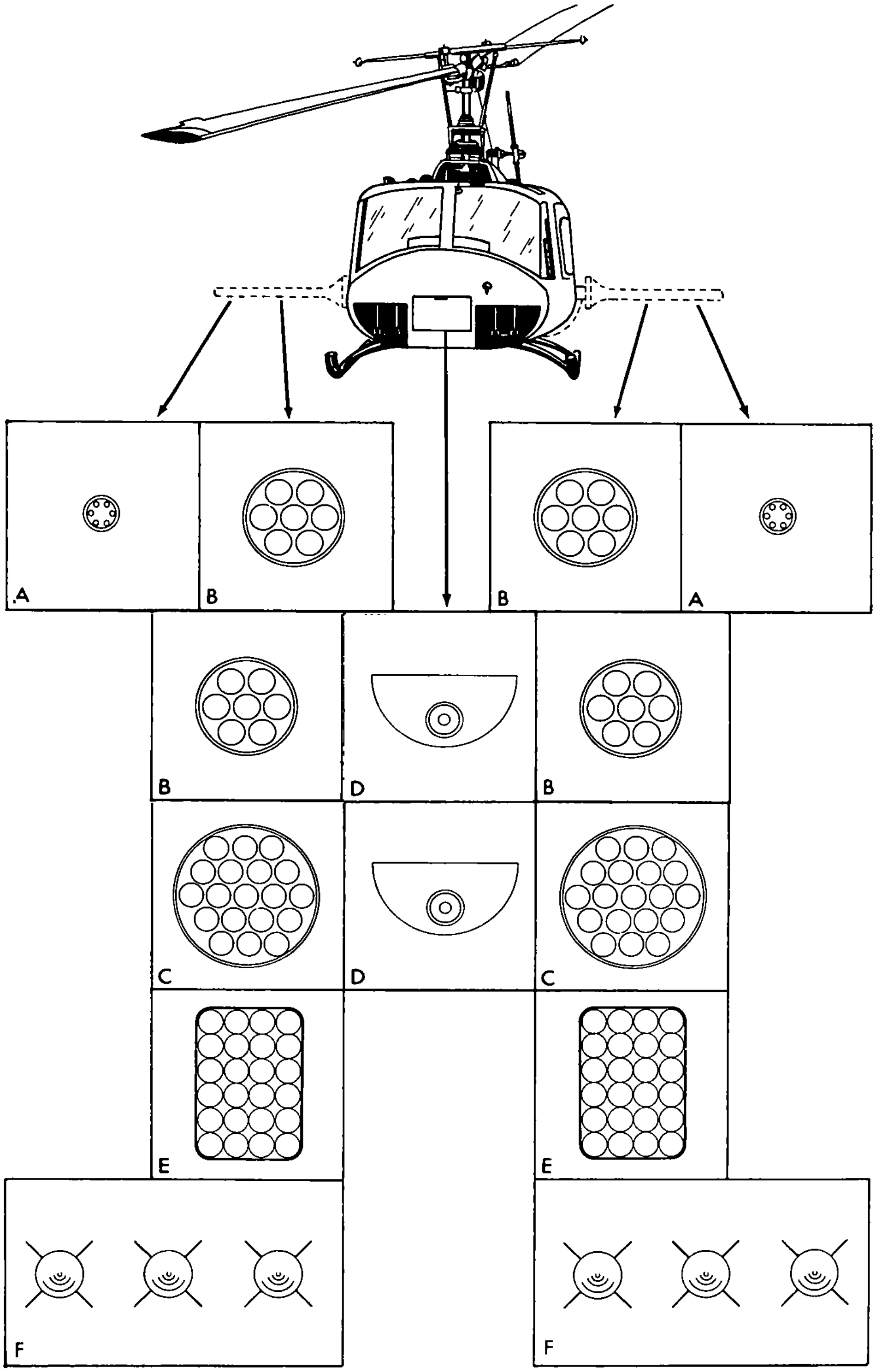
Although no standard scoring system or qualification has been developed, scoring will be based on the instructor's judgment of the accuracy of fire on target.

★M–34. Ammunition Requirements

For aerial door gunner ammunition requirements, see table M–2. This table is for guidance purposes only and does not restrict flexibility exercised by local commanders. However, unit commanders must insure that ammunition expended will not exceed authorized allowance in CTA 23–100–16.

★*Table M–2. Door Gunner Aerial Gunnery Ammunition Requirements*

Helicopter	Armament Subsystem	Machinegun	Ammunition (No. of rounds per individual)					
			Initial qualification		Annual proficiency		Familiarization	
			Ctg Ball, 7.62mm TR 4–1, MLB	Ctg TR, 7.62mm MLB	Ctg Ball, 7.62mm TR 4–1, MLB	Cgt TR, 7.62mm MLB	Ctg Ball, 7.62mm TR 4–1, MLB	Ctg Ball, 7.62mm MLB
UH–1D/H	M23	M60D	2,000	3,000	1,000	1,500	1,000	1,500
CH–47A	M24	M60D	2,000	3,000	1,000	1,500	1,000	1,500
CH–47A	XM61	M60D	2,000	3,000	1,000	1,500	1,000	1,500



A M134: 7.62MM, HIGH RATE AUTOMATIC GUN.
B XM157B OR M158A1: SEVEN-TUBE, 2.75-INCH ROCKET LAUNCHER.
C XM159C OR XM200: 19—TUBE, 2.75—INCH ROCKET LAUNCHER.
D M5 SUBSYSTEM: 40MM GRENADE LAUNCHER.
E XM3 SUBSYSTEM: 24-TUBE, 2.75-INCH ROCKET LAUNCHER.
F M22 SUBSYSTEM: WIRE-GUIDED MISSILE.

Figure O–2. UH–1B/C armament configurations.

Table 0-1. AH-1G Armament Subsystem Performance Data

Item	XM28[a]		XM18E1	XM35	M158A1	XM159C	XM200
Ammunition type	7.62mm	40mm[b]	7.62mm	20mm	2.75-in.[b]	2.75-in.[b]	2.75-in.[b]
Ammunition capacity (rounds)	4,000	300	1,500	1,000	7	19	19
Range (meters):							
Maximum	3,200	2,000	3,200	3,750	9,300	9,300	9,300
Effective	1,000	1,200	1,000	3,000	3,000	3,000	3,000
Minimum	100	300	100	300	300	300	300
Rate of fire:							
Shots per minute (guns)	2,000/4,000	400	2,000/4,000	800			
Pairs per second (rockets)					6	6	6
Flexible limits:							
Elevated	+20°	+20°					
Depressed	−50°	−50°					
Horizontal, right and left	110°	110°					
Weight (lb):							
Loaded	449	434	325	1,239	202	604	629
Unloaded	205	206	245	559	52	113	138

[a] One M129 and one M134, two M129's or two M134's.

[b] Burst radius—10 meters.

Table 0–2. *UH–1B/C Armament Subsystem Performance Data*

Item	XM3	M5	M6	M16		M21		M22	XM27
Ammunition type	2.75-in.[a,b]	40mm[a]	7.62mm	7.62mm	2.75-in.[a,b]	7.62mm	2.75-in.[a,b]	AGM–22B[c]	7.62mm
Ammunition capacity (rounds)	48	150	6,700	6,700	14	6,400	14	6	2,000
Range (meters):									
Maximum	9,300	1,750	3,200	3,200	9,300	3,200	9,300	3,500	3,100
Effective	2,500	1,200	750	750	2,500	1,000	2,500	3,500	1,000
Minimum	300	300	100	100	300	100	300	500	100
Rate of fire:									
Shots per minute (guns)		220	2,200	2,200		4,000/4,800			2,000/4,000
Pairs per second (rockets)	6				6		6		
Flexible limits:									
Elevated		+15°	+15°	+15°		+10°			+10°
Depressed		−35°	−60°	−60°		−85°			−24°
Horizontal, outboard			70°	70°		70°			
Horizontal, inboard			12°	12°		12°			
Horizontal, right and left		60°							
Weight (lb):									
Loaded	1,439	335	830	1,294		1,346		682	276
Unloaded	452	233	428	604		674		249	96

[a] Burst radius—10 meters.

[b] 2.75-inch rocket fires from fixed position.

[c] Wire-guided missile.

O–2. Attack Helicopter Performance Data

For attack helicopter performance data utilizing various ammunition loads, see table O–3.

Table O–3. Attack Helicopter Flight Limitations

Helicopter designation	Limitation[a]				Ammunition capacity (rounds)			
	Gross Weight (lb)	Fuel (lb)	Range (nautical miles)	Flight time on station (hr+min)	7.62mm	40mm	2.75-in.[b]	AGM–22B missiles
AH–1G	8,593	1,600	369	02+35	4,000	300	14	
	8,234	1,600	370	02+35	7,000	300		
	9,194	1,600	360	02+30	4,000	300	38	
	9,323	1,600	355	02+30	7,000	300	14	
	9,500	1,176	256	01+50	7,000	300	38	
	9,500	1,418	305	02+10	4,000	300	52	
	9,500	914	196	01+25	6,000		76	
UH–1B	8,297	1,000	166	01+45	6,000		14	
	8,380	1,000	166	01+45			48	
	7,974	1,000	185	01+50		150	14	
	7,548	1,000	190	01+54		315		
	8,308	1,000	166	01+45			38	
	7,766	1,000	176	01+45				6
UH–1C	8,500	900	163	01+28	6,000		14	
	8,500	816	145	01+20			48	
	7,878	1,000	189	01+40		150	14	
	7,852	1,000	189	01+40		315		
	8,500	900	163	01+28			38	
	8,070	1,000	187	01+40				6

[a] Ranges and station times are based on standard day 2,000-foot pressure altitude using cruise power chart in applicable TM 55-series–10. Runup, climb, and reserve fuel not considered in computations.

[b] Computed with MK 151 warheads on 2.75-inch rockets.

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S/S ch 1

FIELD MANUAL
No. 1-40

HEADQUARTERS
DEPARTMENT OF THE ARMY
WASHINGTON, D.C., *20 June, 1969*

ATTACK HELICOPTER GUNNERY

*This manual supersedes TC 1-24, 27 July 1967; TC 1-25, 27 August 1964; TC 1-30, 6 September 1966, including all changes; and TC 1-33, 27 July 1967.

PART ONE

GENERAL

CHAPTER 1

INTRODUCTION

Section I. GENERAL

1–1. Purpose and Scope

a. This manual explains helicopter gunnery including practical applications of the science of ballistics and other procedures essential for the timely and accurate delivery of fire by attack helicopters. It includes techniques of employing attack helicopters, techniques of fire control, and training requirements.

b. This manual is a guide for attack helicopter commanders and pilots and does not cover all helicopter gunnery situations. Local modifications of the methods and techniques described herein may be necessary but should be made only when based upon firsthand knowledge and experience of the aircraft commander as measured against the state of training of his personnel. Any such modification should result in a gain in either accuracy or speed of response, or both. Modifications which might result in a degradation of accuracy or speed of response should be seriously questioned.

c. The scope of this manual includes—

(1) Characteristics and capabilities of weapons and ammunition.

(2) Fundamentals of ballistics.

(3) The helicopter gunnery problems.

(4) Techniques of fire.

(5) Fire control.

(6) Miscellaneous gunnery information.

d. The material presented herein is applicable to both nuclear and nonnuclear warfare, except as otherwise noted.

1–2. Recommended Changes

Users of this manual are encouraged to submit recommended changes or comments to improve the manual. Comments should be keyed to the specific page, paragraph, and line of the text in which the change is recommended. Reasons should be provided for each comment to insure understanding and complete evaluation. Comments should be prepared using DA Form 2028 (Recommended Changes to Publications) and forwarded direct to the Commandant, United States Army Aviation School, ATTN: AASPI, Fort Rucker, Alabama 36360.

1–3. Helicopter Classification and Missions

a. Helicopters are classified according to their intended use:

(1) Observation Helicopter (e.g., OH–6).

(2) Utility Helicopter (e.g., UH–1).

(3) Cargo Helicopter (e.g., CH–47).

(4) Attack Helicopter (e.g., AH–1G).

b. Although the attack helicopters are the only Army aircraft specifically designed to attack and destroy enemy targets, most helicopters in a combat zone will be armed with one or more weapons systems. When adequately armed, utility and cargo helicopters may have a limited attack helicopter capability.

c. Attack helicopters perform three basic missions—direct aerial fire support, escort, and reconnaissance and security. These missions may occasionally be performed concurrently. The attack helicopter aircraft commander or fire team leader must be prepared to perform any one or all of them with a short notice. Only the direct aerial fire support mission is discussed in this text; for information on the other two basic missions, see FM 1–100 and FM 1–110.

1–4. References

For details on each armament subsystem, preventive maintenance procedures, and ammunition required for each subsystem, see applicable 9-series TM (app A). For the characteristics and capabilities of each helicopter, see the appropriate aircraft operator's manual (TM 55-series-10).

1-5. Attack Helicopter Element (Team)

a. Mission. The attack helicopter element (team*) consists of two or three helicopters and has the primary mission of delivering coordinated *direct aerial fire support* for the ground commander. To provide immediate responsiveness to the requirements of the ground force, coordination of attack helicopter fires will normally be effected directly with the supported force commander or his tactical operations center. Procedures to accomplish the tasks involved in the coordination of fire will vary with the headquarters, the amount and type of fire support available, and the type of operation; however, every effort must be made to establish the attack helicopter unit in the lowest echelon which can effect complete coordination of the fire support mission.

b. Organization. The basic tactical element is the two-helicopter fire team. This team may be augmented (reinforced) by another helicopter. Addition of one helicopter to the basic team results in a "heavy" fire team. Larger tactical units are made up of multiple fire teams. The two-helicopter fire team must be interconnected by a communications system; the two helicopters are mutually supporting by both fire and observation. The aircraft commanders of the two-helicopter fire team are—

(1) *Fire team leader.* Normally the fire team leader is the aircraft commander of the lead helicopter. His primary responsibility is to insure mission accomplishment. He controls all the fires of the fire team as necessary to accomplish the mission. He should be proficient in the techniques of properly employing attack helicopters and is the requesting unit commander's immediate advisor for attack helicopter employment.

(2) *Wingman.* The wingman controls all fires of his crew, and his primary responsibility is to support the fire team leader. This is typically accomplished by augmenting the leader's fire or by providing protective fire for the leader. When necessary, he is capable of assuming the duties of the fire team leader.

1-6. Fundamentals of Employment of Attack Helicopters

Successful employment of attack helicopters demands responsive and accurate delivery of fires to meet the requirements of supported ground forces. Consideration of the fundamentals of surprise, flexibility, mobility, and fire and maneuver will enable the commander of an attack helicopter unit to recommend the best utilization of his unit in the support of the plan of action. For a detailed discussion of the fundamentals of employment, see FM 1-100 and FM 1-110.

Section II. TYPES OF ARMAMENT

1-7. General

Attack helicopters normally carry a wide variety of armament (fig. 1-1) in order to have the widest possible mission profile on each sortie. For information on armament subsystems now in use or planned for use, see appendixes B through J; for a list of ammunition see appendix K.

1-8. Rifled-Bore Weapons

a. Ammunition. Ammunition for rifled-bore weapons varies from 5.56mm through 40mm. At present, most of this ammunition is percussion fired, with the propellant charge housed in brass casings. The current 20mm ammunition is electrically fired.

b. Firing Mode. Rifled-bore weapons may be mounted and fired in either the flexible or fixed mode. The flexible mode allows the gunner to shift his fire rapidly in any flight attitude or altitude.

c. Projectiles. Rifled-bore weapons projectiles vary from simple impact to high explosive and chemical. Fuzes for the high explosive and chemical projectiles may be point detonating (PD) or proximity type.

1-9. Rockets, Missiles, Warheads, and Fuzes

The rocket/missiles of weapons subsystems provide the standoff capability for attack helicopters.

a. Rockets. Because of their size and ballistic properties, rockets are launched in a fixed forward firing mode. They provide the fire required for attack helicopter engagement of area targets.

b. Missiles. Guided missiles provide attack helicopters the capability of engaging point targets

*Aerial artillery units refer to their teams as sections. See FM 6-102.

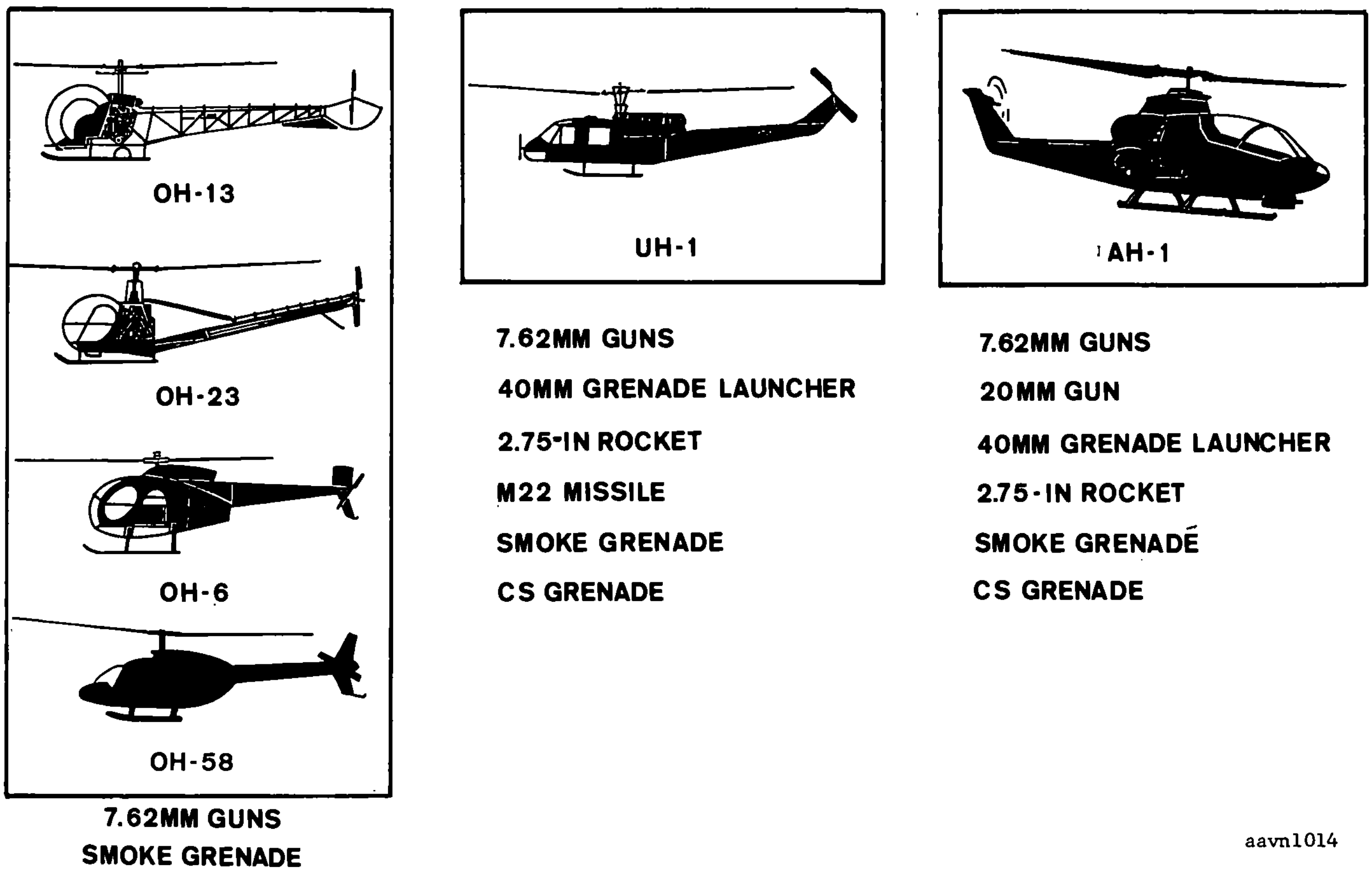

Figure 1–1. Helicopter armament.

(armor, bunkers, gun positions, etc.) with an extremely high probability of first-round hits.

c. Warheads. Guided missiles are capable of carrying a variety of warheads. However, existing stocks contain only practice and high explosive antitank (HEAT) warheads. Warheads for rockets include various chemical and high explosive (HE) and special purpose munitions in different sizes. Future warheads will be ballistically matched so that mixed loads may be carried and fired with a selectivity system.

d. Fuzes. The proper fuze must be used with each type warhead to cause the projectile to function at the time and place desired. Fuzes are classified according to the method of functioning—*time, impact,* or *proximity.* Impact fuzes are classified according to their position on the projectile-base-detonating (BD) or point-detonating (PD). At present, all guided missile fuzes are PD, but rocket warheads (app K) have a variety of fuzes.

(1) Time (T) (MT)[1] fuzes contain a graduated time element in the form of a compressed powder train or a gear train (as in a clock) that may be set, prior to firing, to a predetermined time.

(2) Impact fuzes function when projectiles strike a solid object. Impact fuzes are further classified according to the speed of action after impact as *superquick, quick, nondelay* (base detonating only) and *delay.*

(3) Proximity (VT)[2] fuzes function when they approach any object which will reflect, with sufficient strength, the signal radiated from the fuze.

1–10. Free-Fall Stores

Delivery of free-fall stores reduces the effectiveness of attack helicopters because of the elimination of one or more weapon systems to accomodate the stores. Although the attack helicopter is not normally employed as the delivery aircraft, the tactical situation may necessitate responsive delivery of droppable munitions to include modified mortar projectiles, cluster bomb units, mines,

[1] Mechanical time.

[2] Variable time.

chemical agents, or flares. Commanders must evaluate the advantages and disadvantages of employing the attack helicopter in this role and integrate their use into the ground unit's plan of action. Such use must be preplanned to insure effectiveness.

PART TWO

ATTACK HELICOPTER PROCEDURES AND TECHNIQUES

CHAPTER 3

ATTACK HELICOPTER DIRECT AERIAL FIRE SUPPORT MISSIONS

Section I. GENERAL

3–1. Direct Aerial Fire Support

Direct aerial fire support is fire support delivered by aircraft organic to ground forces against surface targets and in support of land operations. Coordination by the attack helicopter commander and the ground commander allows helicopter fires to supplement and be integrated into the committed firepower of the ground force.

3–2. Types of Attack Helicopter Fires

The three general types of attack helicopter fires are *neutralization fires, destruction fires,* and *combined fires.* The distinction between these types depends upon results desired, weapons selected, and slant range to the target.

a. Neutralization Fires. To maintain fire on target, neutralization by subsequent fires of lesser intensity. These fires are delivered for the purpose of reducing the combat efficiency of the enemy by—

(1) Hampering or interrupting the fire of his weapons.

(2) Reducing his freedom of action.

(3) Reducing his ability to inflict casualties on friendly troops.

(4) Severely restricting his movement within an area.

b. Destruction Fires. Destruction fires are those delivered for the sole purpose of destroying enemy troops and equipment.

Note. With all destruction fires, poststrike analysis is an assumed task requirement.

c. Combined Fires. Since attack helicopters can carry more than one type of ammunition and armament, fires may be combined. For example, neutralization fires may be used to protect the helicopter while it is engaged in destroying a point traget.

3–3. Categories of Weapons

Weapons are categorized as *area target weapons, point target weapons,* or *dual-purpose weapons.* The category of each weapons system is determined by the inherent accuracy of the weapons system, the terminal ballistic characteristics of its projectile, and the volume of fire delivered.

a. Area Target Weapons. Because of inherent inaccuracies of area target weapons systems, they have a low probability of first-round hits. Included in this category are 7.62mm machineguns, 40mm grenade launchers, and 2.75-inch FFAR's. The terminal ballistics of these weapons vary from a single 2.75-inch FFAR warhead with hundreds of fragments, to the impact of thousands of bullets fired from the automatic gun.

b. Point Target Weapons. Point target weapons require a high probability of first-round hits. Normally, point target weapons use a shaped-charge warhead capable of penetrating armor plating. Point fire is delivered by the wire-guided missile system.

c. Dual-Purpose Weapons. Dual-purpose weapons, such as the 30mm automatic gun and 2.75-inch FFAR, fire ammunition that is designed to be effective against personnel and light-armor materiel.

Section II. PREPLANNED DIRECT AERIAL FIRE SUPPORT

3–4. Preplanned Fire Support

Preplanned fires are those that are planned for delivery in advance of takeoff. These fires are closely coordinated with the ground force commander and his fire support coordinator to insure support of the ground tactical plan. Planning normally includes target location, type and amount of weapons and ammunition, time of delivery, technique of delivery (chap 6) and method of adjustment (chap 10).

3–5. Target Acquisition and Control

Targets are acquired by all available means. Targets acquired by the ground element are engaged and controlled under the direction of the ground force commander to support his ground tactical plan. Engagement of targets acquired by other means will be in accordance with existing directives or policies of the supported headquarters.

3–6. Methods of Preplanned Support

Preplanned target fires, as with other supporting fires, are normally conducted to support a ground maneuver plan. Common preplanned direct aerial fire support methods are—

a. Preparation Fires. Before the during the initiation of an assault, a heavy volume of preparation fire is delivered on a suspected or known enemy position. Various types of ammunition may be used in firing preparations for airmobile, amphibious, and airborne assaults; ground offensives; or raids.

b. Diversionary. Diversionary fires are delivered into an area to draw attention to it, with the intent that enemy forces may be drawn away from thet principal area of operaton. Diversionary fires may be used as an economy-of-force measure or in conjunction with ground offensive, defensive, or retrograde operations. The type ammunition to use is determined by the situation.

c. Harassing. Harassing fires are those delivered into an area for the purpose of disturbing the rest, curtailing the movement, and lowering the morale of enemy troops by the threat of casualties or losses in materiel.

d. Interdicting. Interdicting fires are those delivered into a designated area to deny the unrestricted use of that area to the enemy or to prevent the unimpended withdrawal of the enemy from the combat area. Interdicting fires may be on-call or fired at random to provide a harassing effect in support of offensive, defensive, or retrograde operations.

e. Counterpreparation. Counterpreparation fire may be preselected area fire for targets of opportunity. Counterpreparation is the delivery of fire into the enemy's prepared fire support positions to deny the enemy a base of fire. Counterpreparation fires may be used against enemy mortar, artillery, armor, or other fire support weapons.

3–7. Preplanned Fires on Designated Point Targets

Preplanned fires on designated points are delivered with the intent of inflicting high losses to enemy personnel or equipment. Weapons should be those which insure a high probability of first-round hits; however, any type of weapon may be used. Normally, the high volume of fire required for area fire weapons to insure hits limits their use for point targets.

Section III. IMMEDIATE DIRECT AERIAL FIRE SUPPORT

3–8. Target Acquisition and Fire Control

The requirement for *immediate fires* arises from targets of opportunity or changes in the tactical situation. Immediate fire targets may be acquired by any individual or element in the battle area; however, within his area the ground commander is responsible for the control of these fires. All immediate fires require close coordination of the fire team leader and the ground commander or his fire support coordinator.

3–9. Methods of Immediate Support

The common methods of immediate area target fire support are—

a. Preparation. A change in the forecasted tactical situation may require the firing of preparation fires into an area other than where originally planned. The rapid-reaction capability of attack helicopters permits their recall from a lower priority mission to fire preparation for an assault.

b. Base of Fire. In the fluid, fast-moving situations found in unconventional warfare, attack helicopters, without previous planning, may provide a base of fire for maneuvering elements.

c. Interdicting. As the tactical situation develops, immediate interdicting fires in support of the ground force may become necessary. To achieve good timing and target location and to locate friendly elements, interdicting fire delivery must be closely coordinated with the ground commander.

CHAPTER 5

TARGET ACQUISITION AND FIRE REQUESTS

Section I. AERIAL ACQUISITION

5–1. General

Using either visual means or airborne surveillance equipment, targets may result from aerial reconnaissance performed by the attack helicopter or by other aircraft. Before engaging a known target or a target of opportunity, the task of the attack helicopter crew is to locate the target on the ground. The success of attack helicopter fire support depends upon this ability of the crew to locate the target.

5–2. Target Acquisition

a. Reconnaissance. Target acquisition always involves some type of reconnaissance. Reconnaissance is a continuous effort by the entire crew of an attack helicopter. A specific mission may or may not be stated as a reconnaissance task, but reconnaissance is a part of every mission. A thorough reconnaissance is necessary for either a known target location or for targets of opportunity.

(1) *Known target.*

(*a*) The known target is detected by some type of aerial surveillance or method of ground surveillance. The mission is given to the attack helicopter team. Their task is to pinpoint the target specifically before attacking it. To accomplish their task, the factors of METT and the established rules (chap 4) of attack helicopter employment must be considered. Based on this analysis of the target, the attack element then performs a reconnaissance of the target area by flying at the best altitude for observation, depending upon the terrain, vegetation, and enemy situation. The attack helicopter element must find a position from which to best determine exactly *what the target is, what it looks like,* and *where it is located.* Once this has been determined, the leader of the element can form his plan of attack and issue his fire command.

(*b*) Before sending the helicopter element to attack a known target, aerial photography can be helpful in locating it. Aerial photography often gives the first indication that a target is in the area. If possible, a visual reconnaissance should be made before attacking a target identified by a photograph.

(2) *Targets of opportunity.* "Pop-up" or surprise targets which the attack helicopter element reconnaissance happens to locate are targets of opportunity. They may be spotted visually by the crew, or they may disclose their positions as a result of enemy fire directed toward the attack helicopter element.

(*a*) Targets spotted by the crew may be picked up by movement, fresh digging, trails, smoke from campfires, poorly camouflaged huts, fortifications, and many other clues which can arouse suspicion in the search area.

(*b*) Reconnaissance by fire is another method of locating targets. This leads a poorly disciplined enemy to move or to return fire and thus give away his position.

(*c*) Targets may be located by drawing enemy fire, even when not employing reconnaissance by fire. This is frequently the case when conducting a reconnaissance mission or escorting troop-lift helicopters en route. In either situation, some method of pinpointing the location must be used.

(*d*) Often the enemy fire will pinpoint the target; but if tracers, smoke, muzzle flash, or other motion is not detected, some sort of search of the general area must be conducted to locate it. Conduct of this search must be determined by and based on the factors of METT. Normally, the commander of the attack element must request permission from the ground commander or higher headquarters to engage the target. He will already be cleared when he is sent into the area of known targets, but he may have to verify friendly element locations before determining how to engage the target. Care must be taken to insure that targets of opportunity have been confirmed as the enemy.

b. Night Acquisition. At night or during periods of low visibility, target acquisition becomes more difficult and crew responsibilities take on added importance. Proper crew training and knowledge of techniques available can turn the operation into an advantage for the attack helicopter element. Aids to night target acquisition include—

(1) *Artificial illumination.* Night target illumination may be accomplished by aircraft flares, artillery illuminating rounds, and ground or helicopter-mounted searchlights (chap 7). When using artillery illumination, radio contact must be maintained between the fire team leader and the artillery unit firing the rounds. When using these artificial means of illumination, care must be taken to avoid being blinded and/or entangled with parachutes of flares that have burned out but are still aloft.

(2) *Infrared devices and starlight scopes.* Infrared devices and starlight scopes may be used effectively to locate targets at night; but even then, it is often difficult to identify the target location for other helicopters in the attack helicopter team. One method that is effective is to use the infrared device with an automatic rifle loaded with full tracer ammunition to mark the target. Another method of identifying the target is by illuminating it with an aircraft flare (chap 7), after locating it with the surveillance device. Still another method is to have the searchlight operator used the starlight scope to locate the target, then illuminate it with the searchlight.

(3) *Radar.* Ground radar units can vector the attack helicopter element to the target. Another method is to have observation aircraft using airborne surveillance equipment vector the attack helicopter to the target.

(4) *Aerial photographs.* Especially in unfamiliar areas, aerial photographs will help pilots find targets at night. The photographs will show terrain features such as canal lines, tree lines, and ridge lines which may be visible at night, making it easier to navigate to a known target.

(5) *Enemy fire.* By spotting muzzle flashes or tracers (para 8-1*a*), enemy fire may often be spotted from the air. However, the observer must rapidly pinpoint the muzzle flash or tracer location before it disappears and is lost.

c. Spot Reports. In many situations, the attack helicopter element commander must request permission in accordance with existing directives to attack a specific target. The spot report can be used to make the request. This report enables the ground commander or higher headquarters to keep abreast of the situation, determine the importance of the target in relation to the mission, and advise the attack helicopter element of situational changes in the traget area, such as friendly movements. This type of report must include the following information—

(1) *Observer identification.* Identify yourself.

(2) *Description of target.* Identify target.

(3) *Location of target.* Give target coordinates.

(4) *Activity.* What is the target doing (e.g., moving convoy, troops moving, etc.)?

(5) *Requested action.* What action you desire to take against the target.

Section II. TARGETS ACQUIRED BY GROUND OBSERVERS

5-3. General

Ground elements acquire many targets for attack helicopters. Transmitting target information from the ground element to the attack helicopter element causes special problems. These problems are compounded during night operations or periods of low visibility. A simplified fire request system must be used by the ground observer to minimize the difficulties of calling for attack helicopter support. Usually this is accomplished by FM radio as a result of an exchange of SOI between the ground element and the attack helicopter element.

5-4. Direction to Target by Ground Observers

a. Friendly Elements Position. The ground observer and the attack helicopter commander must be sure that the attack helicopter element knows the location of the friendly elements on the ground. Two methods that may be used to insure that no mistake is made are—

(1) Using colored smoke or colored panels which can be seen from the air, mark the friendly positions indicating the right, left, and forward boundaries.

(2) Using normally encoded coordinates, give friendly positions. (In premission briefings, it is necessary to insure that both elements are using the same code.)

b. Marking Target. The ground observer can mark or reference the target using any means which can be identified from the air; e.g., grenades, colored smoke, etc.

c. Directing to Target. If it is impossible to mark the target, the ground observer may elect to use smoke or panels to mark a position or use a prominent terrain feature. He will then measure or estimate the direction and distance to the target. This may be done using the clock method; however, the attack helicopter commander must know which direction the ground observer is using as his 12 o'clock position. This can be set up during premission coordination. A preferred method is to give a magnetic azimuth from the mark (colored smoke) to the target. Range from the mark or friendly position should be as accurate as possible. This can be measured on the map or estimated.

d. Describing Target. Care must be taken to describe the target, using a means which can be identified from the air and the ground. The ground observer should inform the attack helicopter commander of the type and intensity of enemy fires existing or suspected in the target area.

e. Type of Weapon Desired. If he has a preference, the ground observer should let the attack helicopter commander know what type weapon he desires—

(1) Rifle-bored weapons only (7.62mm, 20mm, 30mm, or 40mm).

(2) Rockets only.

(3) Missiles only.

(4) Any combination of weapons.

f. Adjustment by Ground Observer. The ground observer must be prepared to adjust initial fires of the attack helicopter using the observer-target line.

5–5. Actions of Attack Helicopter Team

When under direction of a ground obserber, the attack helicopter team must insure that—

a. Friendly positions are identified.

b. The ground observer's position is known.

c. If mark is used, it can be identified.

d. If mark is used, direction from the mark to the target is clearly understood by both the ground observer and the attack helicopter team.

e. If close-in fire is required to support friendly troops, a marking round or burst is fired into the target to insure positive identification and obtain any adjustment.

5–6. Night Operations

Night operations make it especially difficult for a ground observer to convey what he sees to the attack helicopter team. Several methods may be used to assist fire direction and target identification from the ground at night.

a. Illunination. Use of illunination is similar to that used for artificial night target illunination (para 5–2*b* (1)).

b. Radar. Ground radar units can vector the attack helicopter to the target (para 5–2*b*(3)).

c. Marking. Marking a target or friendly position at night by the ground observer is especially critical and requires close coordination. Flare pots or some other light system may be used instead of smoke; e.g., lights arranged in the shape of an arrow pointing in the direction of the target. Artillery or mortar fire may also be used to mark a target. Additional means of marking include strobe lights, railroad flares, trip flares, and tracers.

5–7. Fire Request Format

Use of the fire request enables the ground observer to call for attack helicopter support in much the same way as he would for artillery support. This procedure cuts down on the fire request formats that he must remember and keeps radio transmissions to a minimum.

a. Elements of a Fire Request. Following are the elements of a fire request in the sequence in which they are transmitted:

(1) *Identification of observer.* This element consists of the call sign or code to identify the observer.

(2) *Warning order.* The warning, "Helicopter fire mission," is sent by the observer to achieve communication priority and to alert the crews of the attack helicopter element.

(3) *Location of target.* Normally, one or more of the following methods of target location are used:

(*a*) The coordinate system.

(*b*) Mark the target.

(*c*) Mark the observer's position and give direction and range.

(4) *Description of target.* This is a brief, informative description of the target.

(5) *Direction of attack.* When restrictions exist or friendly artillery is impacting near the target, the observer may recommend the direction of the attack.

(6) *Methods of control.* The following phrases are used by the observer to announce the method of control:

(*a*) *Fire for mark.* The ground observer will adjust from the initial rocket or burst.

(*b*) *Fire for effect.* The observer is ready to observe and the attack helicopter team may fire for effect when ready.

(*c*) *At my command.* The attack helicopters are not cleared to attack the target until the ground commander is ready and gives the command to fire.

(*d*) *Cannot observe.* The observer cannot observe fire and is unable to adjust it; however, he has reason to believe that a target exists at the given location.

b. Example of Ground Observer Fire Request.

Sequence Number	Element of Request	Example
1	Identification and warning order.	"Dragon 33, this is Blackhorse 26; helicopter fire mission, over."
2	Reply.	"This is Dragon 33, send your mission, over."
3	Target location and description.	"From the fire arrow, 300 meters, troops dug in, with small arms automatic weapons."
4	Direction of attack.	"Recommend engagement from south."
5	Method of fire control.	"Will adjust, over."
6	Acknowledgment.	"This is Dragon 33, Roger, out."

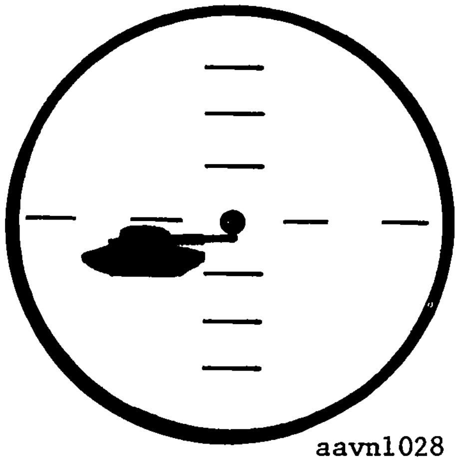
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Figure 6-1. Combat sight method—corrected for a crosswind from the right.

(1) *High muzzle velocity.* Weapons with a high muzzle velocity have a relatively flat trajectory and are not affected by those ballistic factors associated with flexible weapons (chap 2) as much as low muzzle velocity weapons. This, in combination with the high rate of fire of flexible systems, eliminates the requirement for mil values on the sight reticle image. The procedures given below should be followed:

(*a*) Harmonize these weapons at their maximum effective range. Maximum effective range is dependent upon tracer burnout, volume of fire, and type of sight.

(*b*) Place the pipper on the target. Fire and observe tracer impact. Adjust weapons so tracers impact on the target. Due to the high volume of fire and the relatively simple sighting techniques, fire from this type of weapons is relatively accurate.

(2) *Low muzzle velocity.* Weapons systems with a low muzzle velocity (less than 2,000 fps) have a relatively higher angle of fire and are affected considerably by the ballistic factors discussed in chapter 2. These weapons have a relatively slow rate of fire and may not have a tracer element. Sights for these systems require mil value/range lines and/or a complex lead-compensating sighting system. These systems are boresighted for one altitude and airspeed, and offset correction is required if these conditions are not met. For example, current 40mm subsystems are boresighted for 90 knots airspeed, 10 feet absolute altitude, and 700 meters range. As absolute altitude or airspeed is increased, the gunner must decrease range settings on the sight (aim short of the target). The same correction applies conversely: as absolute altitude or airspeed is decreased, the gunner must increase range settings on the sight (aim over the target). Deflection shots at other than boresight altitude and airspeed are very difficult as the lead and lag values are not easily determined. When employing this system, accurate range estimation is required, coupled with accurate application of lead or lag values. Due to the longer time-of-flight of the rounds, it is usually not possible to "walk" the rounds onto the target. Proper sighting techniques for this type system are to—

(*a*) Estimate range and altitude above the target and note airspeed.

(*b*) Apply factors for these conditions to the sight, including lead for deflection.

(*c*) Fire a short burst and note the impact.

(*d*) Make sighting adjustments on succeeding bursts, compensating for range closure.

Note. For the gunner to be accurate with low muzzle velocity weapons, sighting techniques require considerable training.

Section II. ENGAGEMENT TECHNIQUES

Note. Since the techniques for engaging targets using either the *pipper intersection* method or the *aircraft placard* method are seldom used, only the *combat sight* method is discussed below.

6-6. Establishing the Combat Sight

To better understand why the combat sight method of engaging targets is more widely used than other methods, it is helpful to understand the procedure for establishing the combat sight. Following is an example using the combat sight with the 2.75-inch FFAR; it is equally applicable to any fixed fire system.

a. Boresight the system in accordance with appendix D.

b. Select a target at 1,250 meters slant range. This range is one-half the maximum effective range of the weapon; however, the selected range will be that range from which the majority of all targets are engaged. This selected range may be made according to individual preference or unit SOP.

c. At a tactical altitude and airspeed and with the pipper on the target, fire one round. Note the impact of the round and rotate the knurled ring (elevation-depression) to put the *pipper on the burst.*

d. Repeat *c* above until the rounds are consistently hitting on the pipper. Usually three rounds will be sufficient to obtain the combat sight setting. This setting may be established at any range. Midrange allows the widest possible latitude for engaging targets. Using this method, targets may be engaged from 300 meters (minimum safe slant range) to 2,500 meters (maximum effective range), and the proper sight setting will still fall within the sight reticle (80 mils for the XM60 sight).

Note. The combat sight setting for machineguns is normally accomplished at slightly less than maximum effective range. Targets beyond maximum effective range may be engaged with an acceptable dispersion pattern. This is accomplished by adjusting the fire so that tracer burnout appears to occur just above the target.

6–7. Using the Combat Sight Setting

a. At the altitude and airspeed chosen for obtaining the setting, the rounds will impact at the pipper at the selected range. Therefore, it is necessary to use this altitude, airspeed, and range, or to compensate for any changes. Changes in range are accomplished by aiming 4 mils high for each 100 meters beyond the range chosen for the setting, and 4 mils low for each 100 meters less (fig. 6–2). If the combat sight setting is made at 1,250 meters, the proper setting required to engage a target at 2,500 meters is to hold the pipper a 50 mils (4 × 12.5 = 50) above the target. If the target is at 300 meters, hold the pipper a 38 mils (4 × 9.5 = 38) below the target.

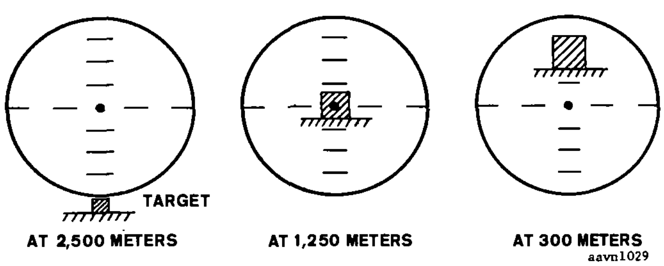


Figure 6–2. Using the combat sight setting.

b. Once an entry altitude and airspeed have been selected, a constant power setting must be maintained and the same selected entry altitude and airspeed used in each pass at the target. For example, if the setting were obtained using 91 percent N_1 (gas producer speed) in the helicopter, this setting would result in nearly the same trajectory every time if the helicopter weight remains relatively constant.

c. Considering the factors in *a* and *b* above, one way to use the combat sight setting is to—

(1) Initiate the roll-in on the target run.

(2) Check the power setting and helicopter trim and adjust as necessary to maintain a trim condition.

(3) Estimate the slant range to the target and apply the compensation factors.

(4) Obtain the proper sight picture by flying the helicopter using only the cyclic control stick.

(5) While the helicopter is in its most stable flight, fire as soon as the proper sight picture is obtained. The helicopter becomes more unstable as the dive progresses and airspeed builds up.

(6) Use "burst on target" for subsequent adjustments.

6–8. Slant Range Estimation

Slant range (fig. 2–13) applies to aerial weapons systems. It is the distance along the line of sight from the weapon to the target. At the altitude and attack angles used by attack helicopters, slant range is slightly greater than horizontal distance to the target. The methods of determining slant range are *estimation by eye, sight mil values, tracer burnout, maps and photomaps,* and *electronic ranging devices.*

a. Estimation By Eye. The most common method used for determining range is estimation by eye. Normally this method is most accurate when the range is compared to known ranges; i.e., the number of 100-meter segments there are in the range. While this method is the most rapid, it is also the least accurate. Some reasons for this inherent inaccuracy are—

(1) *Nature of the target.*

(*a*) A target in contrast to its background appears closer.

(*b*) A target that blends with its background appears more distant.

(*c*) A target that is partially hidden appears more distant.

(2) *Nature of the terrain.*

(*a*) Over smooth terrain, the eye tends to underestimate the range.

(*b*) Over rough terrain, the eye tends to overestimate the range.

(3) *Visibility.*

(*a*) A target seen in full sunlight appears closer than one observed through haze or fog.

(*b*) When the sun is behind the target, the target appears more distant than it actually is. When the sun is behind the observer, the target appears closer.

b. Sight Mil Values. Because of sight vibration caused by aircraft flight, reading the mil value of target width in the sight is difficult or sometimes impossible. However, if this value can be found and the actual target width is known, the mil value for target width can easily be converted to the range. At a range of 1,000 meters, 1 mil equals 1 meter; therefore, if target width is known, range can be found by using the following formula—

$$R = \frac{W}{m} \times 1{,}000 \text{ meters}$$

where
R = range (meters)
W = known target width (meters)
m = mil value of target width (meters)

For example, a tank known to be 15 meters long covers 20 mils of reticle width (fig. 6–3)—

$$R = \frac{15 \text{ meters}}{20 \text{ mils (meters)}} \times 1{,}000 \text{ meters} = 750 \text{ meters}$$

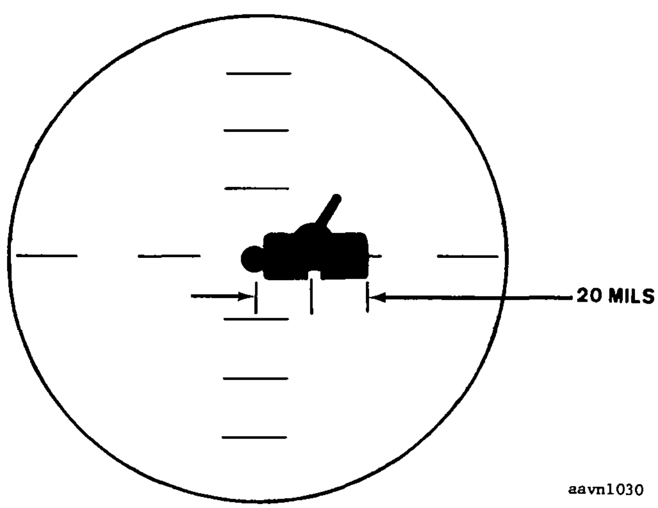


Figure 6–3. Reading sight mil value of target.

c. Tracer Burnout. Because the 7.62mm (NATO) round of tracer ammunition burns out at a range of approximately 750 meters, the gunner can use tracer burnout to make a range estimate. If the tracers burn out before reaching the target, he can compare the 750 meter tracer burnout distance to the total distance to the target. His range estimate is based on this comparison. For example, the gunner fires a burst of tracer ammunition from his machineguns that burns out halfway to the target. Thus he estimates that the range to the target is 1,500 meters.

d. Maps and Photomaps. Prior to the mission, ranges from prominent terrain feaures to the target area may be determined from maps and photomaps. This permits comparison of actual ranges with ranges estimated by eye and is very useful in teaching aviators to correctly estimate ranges by eye.

e. Electronic Ranging Devices. Fire control systems for some attack helicopters (e.g., AH–56) have electronic laser ranging devices to accurately determine the range to targets. Such systems solve many of the problems in aerial gunnery.

6–9. Flight Techniques

Before accuracy with aerial fire weapons can be expected, the aviator must be able to fly the helicopter without actually concentrating on the art of flying. However, to assure weapons accuracy, coordinated flight must be maintained by using smooth control pressures.

a. Coordination. Coordinated flight is especially important in aerial rocketry. An "out-of-trim" condition creates unacceptable dispersion in rocket fire (para 2–3*b*(2)(*e*)). Emphasis must be placed on flying in the helicopter to the proper sight picture. A common tendency is to cross-control using the antitorque pedals to get the proper sight picture.

b. Control Touch. Control touch affects both fixed and flexible firing modes. Since rough and abrupt control movements result in unacceptable dispersion patterns, smooth control pressures must be applied.

c. Spot Weld. For most aviators, the "spot weld" consists of bracing their right elbow on their right thigh. This braced position allows the proper muscle response for positive smooth control movements and permits the proper sight picture to be obtained in a much shorter time without the unnecessary movements which result in "chasing the pipper around the target."

6–10. Turning Error

Firing while in a bank affects both fixed and flexible weapons fire. To compensate for ballistic factors, the boreline axes of all weapons systems are elevated above the horizontal. If the weapon is fired while the helicopter is in a bank, this elevation becomes deflection (fig. 6–4). Firing results in rounds impacting short and inside the turn. To compensate for turning error, it is necessary to aim high and opposite to the direction of the bank. In addition, a range estimation and power setting adjustment are necessary. Since this complicated technique makes accuracy nearly impossible, it should only be attempted in emergency situations.

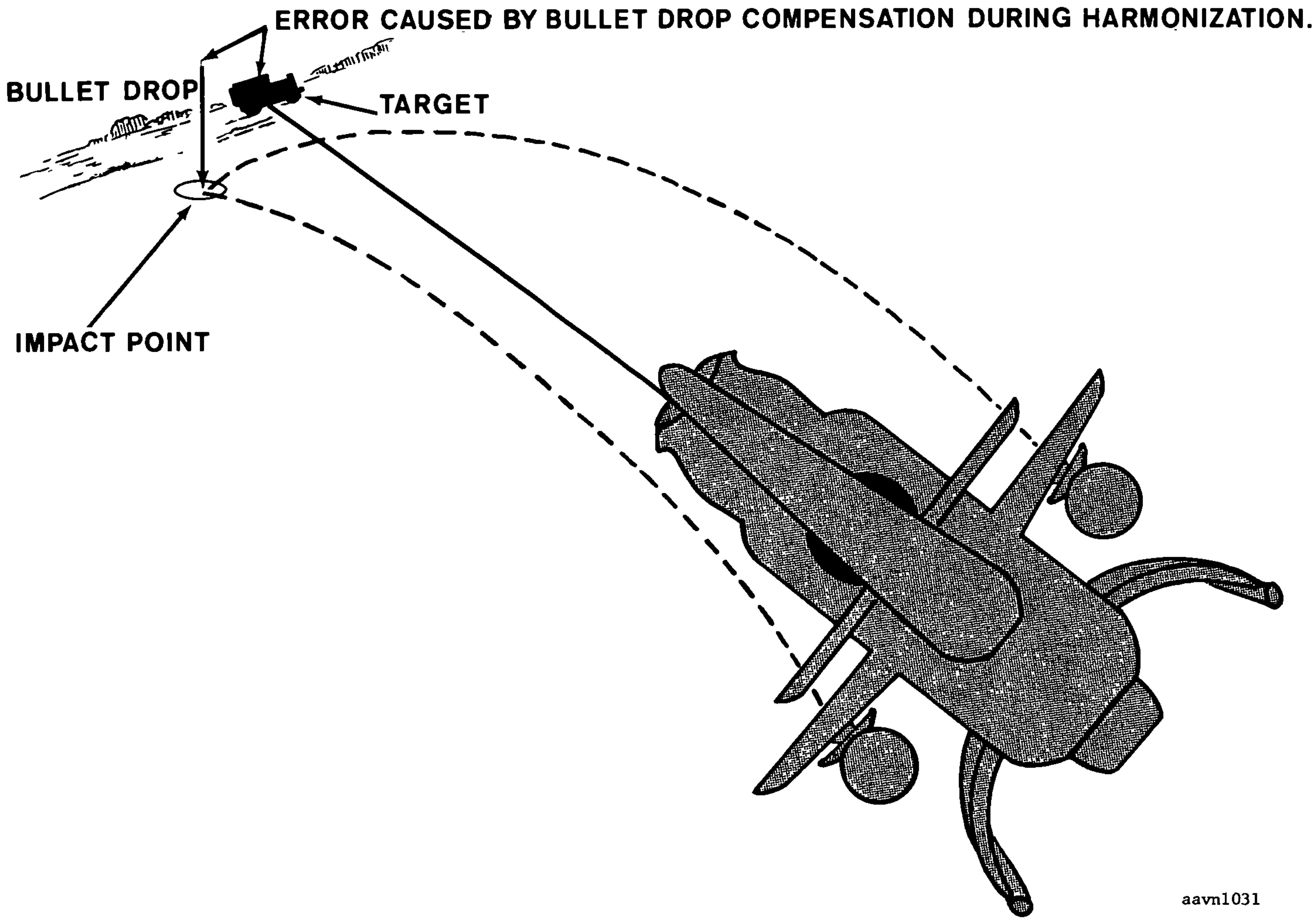


Figure 6–4. Turning error.

6–11. Attack Patterns and Formations

a. General. Normally specific attack patterns cannot be preplanned; however, certain considerations apply to all patterns. The mission commander will adjust each attack to take advantage of the terrain and weather, exploit enemy weaknesses, and employ his combat elements to gain the maximum advantage. Important considerations in the selection of an attack pattern include the number of attacking elements, the target characteristics, weapons capabilities, friendly forces in the immediate area, the disposition of enemy defenses, and the requirement for a change in direction of subsequent attack passes.

b. Racetrack Pattern. The racetrack pattern (fig. 6–5) is the basic attack pattern from which the others are derived. This pattern may be used on any mission or may be modified as the situation dictates.

(1) *Advantages.*

(*a*) Any number of helicopters may be used in the pattern.

(*b*) The helicopters are mutually supporting by fire and observation.

(*c*) Continuous fire may be placed on the target.

(*d*) Engagement range, disengagement range, and timing are flexible.

(*e*) The mission commander has good control over the attack.

(2) *Disadvantages.*

(*a*) Target is covered from only one direction at a time.

(*b*) Enemy is able to place enfilade fire on the entire attack formation from one position.

(*c*) Direction of break is fixed.

(*d*) Only one helicopter can engage the target at a time.

CHAPTER 7

NIGHT ATTACK HELICOPTER SUPPORT

Section I. GENERAL

7–1. Direct Aerial Fire Support

Attack helicopters normally will be expected to provide the same quality and types of direct aerial fire support at night as they provide during daylight hours. To provide this support requires highly motivated, well-trained crews who are aware of their capabilities and limitations.

7–2. Factors Affecting Employment

The factors of METT and the cardinal rules apply equally well to night operations when it is understood that the visibility at night could work to the advantage of the attack helicopter team. For example, the limits of the "deadman" zone are sharply reduced. Attack helicopters can operate at altitudes and ranges which optimize accuracy using the cover of darkness to limit observation.

7–3. Night Vision

Light passes through the lens of the eye and then falls on the retina, which has two types of photoreceptors—rods and cones. The cones are effective only when illumination is abundant, while the rods are sensitive for night vision or low illumination. The rods provide peripheral (side) vision. However, bright light can impair the function of the rods for over one-half an hour. For the crew to prevent complete loss of night vision due to artificial illumination, one crewmember should, when possible, direct his eyes within the cockpit. Also, it is usually desirable to close one eye momentarily when firing an aircraft weapons system at night. This will permit at least partial night vision during the other critical portions of the attack.

7–4. Planning

Planning for night target attacks requires considerable care and coordination. Even with experienced crews, a detailed premission briefing is required. Included in the briefing are—

a. Location, call sign, and frequency of support unit.

b. Target location and method of identification.

c. Time schedule (i.e., takeoff, en route, on station, off station, etc.).

d. Call sign and frequencies of en route and target area artillery.

e. Call sign and frequency of radar control facility.

f. Call sign and frequency of tactical air support.

g. Downed crew and other emergency procedures (unit SOP).

h. Procedures upon receipt of hostile fire.

i. Formations and altitudes to be used.

Section II. NATURAL ILLUMINATION

7–5. General

Target attacks using natural lighting at night provide certain advantages which are not possible when using flare or lighting system (e.g., Firefly) illumination.

a. Advantages.

(1) The element of surprise is maintained longer.

(2) Night vision is conserved.

(3) All helicopters in the team maintain the security provided by the darkness.

(4) Ground fire is more readily seen.

b. Disadvantages.

(1) Target area and targets are more difficult to identify.

(2) Range is more difficult to determine.

(3) Even after initially identified, target locations are more difficult to maintain.

7–6. Target Identification

Target identification under natural light conditions at night may be difficult. As with daylight attacks, friendly positions must be positively known before commencing the attack. Positive radio contact is essential before the friendly positions are marked. Commanders must caution friendly troops not to mark their positions by firing tracers into the air. Several satisfactory methods of marking friendly positions and target locations are to—

a. Have friendly flank positions fire tracers into the target area.

b. For fortified positions, use the "flaming arrow" technique (fig. 7–1). The arrow is made of wood mounted on a pivot. The flames are made by flare pots attached to the arrow. The distance from the arrow to the target can be provided by radio communication from the ground observer to the attack helicopter crew.

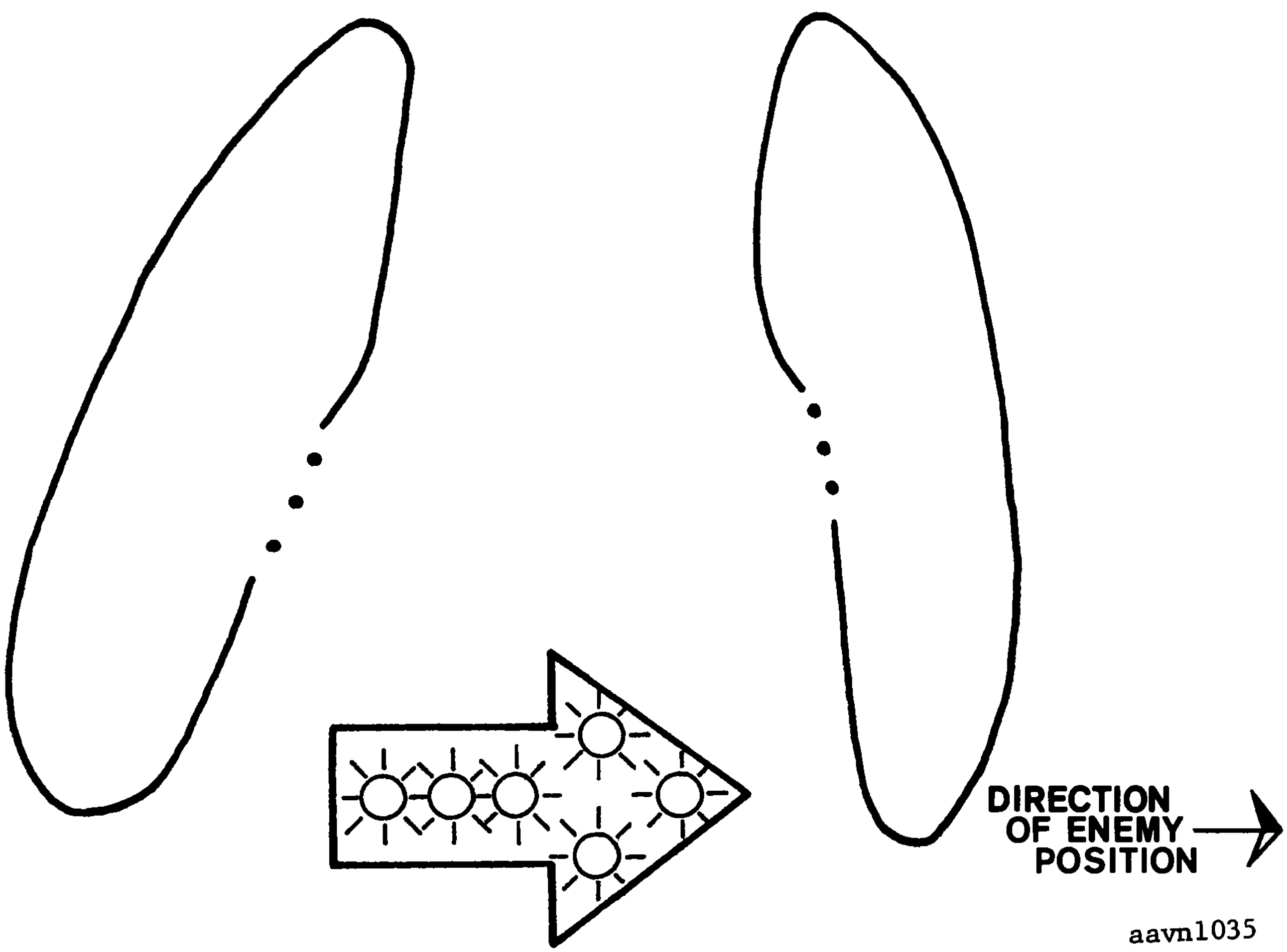


Figure 7–1. Marking target with a flaming arrow.

c. Have friendly troops mark their position with strobe lights and give range and azimuth to the target. Use of codes or voice scrambler radios will add to security and prevent disclosure of friendly positions.

7–7. Attack Formation

Because of the danger of midair collision, the wingman will normally fly at least 100 feet higher than the fire team leader. The prescribed formation must be rigidly adhered to at night, since everyone in the formation must know the location of the others. Standard procedure may be to assign airspace limitations in which each helicopter must operate unless given permission to deviate. For example, the lead helicopter will operate below 800 feet indicated altitude, the second helicopter between 800 and 1,000 feet, and the third helicopter (in a heavy fire team) above 1,000 feet indicated altitude.

7–8. Attack Patterns

The attack pattern most commonly used at night is the racetrack (fig. 6–5). Because of the degree of control required for more advanced or intricate patterns, they are not suitable for night at-

PART FOUR

ATTACK HELICOPTER TRAINING

CHAPTER 11

AIRCREW TRAINING

11–1. Crew Duties

The training process for aircrews is never complete. Every crewmember has duties for which he alone is responsible, as well as other duties in which the responsibility is shared. By constant practice, every member of the crew must maintain proficiency in both his *primary* and *secondary* duties and, as time is available, cross train in the primary duties of another member of the crew. The following paragraphs discuss the duties of each member of the attack helicopter aircrew.

a. Aircraft Commander. The aircraft commander is in command of the helicopter and all personnel aboard. He is responsible for the employment and training of the aircrew. The aircraft commander of an attack helicopter will also be either the fire team leader or wingman in a fire team (for these primary duties, see para 1–4*b*(1) and (2)). Also, the aircraft commander usually pilots his aircraft, fires the towed weapons systems, and controls the fires of the other crewmembers.

b. Gunner/Copilot. The primary duty of the gunner/copilot is to fire those weapons systems for which he is responsible. En route he acts as navigator, maintains spatial orientation, observes to keep the helicopter clear from hazards, monitors instruments, and, when required, makes radio transmissions and flies the helicopter.

c. Crew Chief. The primary duty of the crew chief is to perform operator and limited organizational maintenance on the helicopter. In certain types of attack helicopters, he may be required to accompany the helicopter on combat operations as a door gunner. In this situation, he will—

(1) Observe to keep the helicopter clear of hazards.

(2) Provide surveillance within his zone of observation.

(3) Throw smoke grenades to mark targets or positions.

(4) On command of the aircraft commander, fire his weapon.

(5) When required, give first aid to other crewmembers.

11–2. Familiarization and Qualification Training

The type of training to be given to the individual flight crewmember depends upon the state of proficiency required for him to accomplish his mission. The two basic types of training given to flight crewmembers for gunnery are familiarization and qualification. Any crewmember must meet certain prerequisites prior to receiving weapons training. For example, pilot gunners must first be qualified to pilot the helicopter.

a. Familiarization. Familiarization training is given to an individual when the only required proficiency is the ability to start, aim, fire, stop, and safety the system. This training is less expensive and time consuming than qualification training (*b* below). If appropriate training devices are available, "live" fire is not necessary for this training.

b. Qualification. Ground commanders may be hesitant to use available attack helicopter support because of a lack of confidence from previous experience with untrained, unqualified teams. So that the ground commander can have confidence in the attack helicopter team's ability to provide the desired support, the attack helicopter unit commander should never commit unqualified personnel on combat operations. He should make every effort to conduct the training required to assure their initial qualification and to maintain their proficiency.

(1) For recommended firing tables for qualification training, see appendix L. Qualification

training is also covered by appropriate ATP's and ASubjScd's.

(2) Commander should not rely on individual effort alone in the conduct of training, but should establish an orderly logical training program for their units.

CHAPTER 12

SUPPORT CREW TRAINING

Section I. GENERAL

12-1. Personnel

The support crew consists of maintenance personnel, armorers, ammunition handlers, POL handlers, and other related aircraft support personnel. In general, it consists of all personnel, excepting the flight crew, required to support an aircraft on its mission.

12-2. Training and Motivation

For the attack helicopter team to provide responsive, accurate fires, proficiency and motivation of the support crew must be maintained at a high level. For each member of the support crew to do his job in a safe, expeditious manner, he must be instilled with a sense of importance of his contribution to the combat effort. Commanders at all levels should establish training programs to insure the safe, efficient, and complete performance of duties by all support personnel.

Section II. CARE AND HANDLING OF AMMUNITION

12-3. General

Training support personnel in the care and handling of ammunition should be a continuous process at unit level. All ammunition storage, handling, and basic safety procedures should be in accordance with TM 9-1300-206 and TM 9-1305-200, unit SOP, and applicable AR. For ammunition characteristics, see appropriate 9-series TM (app A).

12-4. 7.62MM Ammunition

a. Storage. Ammunition should be—

(1) Stored in areas designated for ammunition storage.

(2) Rotated constantly to prevent a buildup of old ammunition.

b. Safety. Unit SOP's will dictate specific safety procedures to be followed locally.

c. Loading. All loading and unloading procedures will be conducted according to the specific technical manual instructions on the individual weapons systems.

12-5. 20MM, 30MM, and 40MM Ammunition

a. Storage. Storage of ammunition should be in specified areas. Whenever possible, munitions should be stored in the original containers until ready for firing.

b. Handling. Munitions must not be handled roughly or dropped. The warheads are not "bore-safe" and accidental detonation can occur.

c. Loading. For loading and unloading procedures for 40mm HE cartridges, see TM 9-1010-207-12.

12-6. 2.75-Inch FFAR Ammunition

a. Storage. At present, 2.75-inch FFAR's are packed in a wooden box containing four motors and four warheads. Future packing methods will take advantage of advances in packaging techniques and materials. Rockets should be stored in their containers until ready for firing. Storage areas should be dry, bunkered, and maintained within the temperature limits of −65° Fahrenheit to 150° Fahrenheit (as stenciled on containers).

(1) If the ammunition must be stored in an open area, raise it on dunnage at least 6 inches and cover it with a double thickness of tarpaulin.

(2) If rockets are prepared for firing but are not fired, they should be disassembled and returned to their original containers. Rocket motors should be stored pointed toward the area that poses the least hazard to personnel and equipment.

b. Handling. When possible, rockets should be handled while in the container. In any event, rockets must not be thrown, rolled, dragged, or handled roughly in any manner. If the motors are handled roughly, the propellant is likely to crack. (Cracking occurs more frequently at temperatures below 40° Fahrenheit.) Prior to loading, rockets should be kept free of sand, ice, snow, mud, grease, and other foreign matter.

c. Assembly. Prior to assembling the warhead and the motor, the spacer and rubber gasket are removed from the warhead. To tighten the warhead to the motor, a torque wrench should be used to apply 55 foot-pounds of torque to the warhead.

***Caution:* Do not remove the static cover or grounding wire from the aft end of the rocket motor until ready to load the complete rocket into a launcher.**

d. Loading. Prior to loading, ascertain that the system is "cold"; the circuit breakers are "out"; and the helicopter is grounded and, if possible, oriented in a direction away from personnel and equipment. It is not necessary to make a "stray voltage" check prior to each loading, but it is advisable to do so before each day's firing to insure that the circuitry is functioning properly. For testing procedures, see TM 9–1055–217–20 or –35. Remove static cover and/or grounding wire, and load in accordance with the appropriate TM for the launcher being used.

e. Unloading. If the rockets are not fired and it is necessary to unload the launcher, perform the preloading check (circuit breakers "out," etc.) prior to attempting to unload. Then release the detent and push the rocket out the front of the tube.

f. Disassembly. When practical, the rocket should be disassembled and stored in its original container. To disassemble, remove the warhead and replace the rubber gasket, support assembly, spacers, and ground wire/static cover. If it is not practical to disassemble the rocket, store it with the grounding wire and/or static cover in place. For additional information on the care, handling, and storage of rocket ammunition, see TM 9–1300–206, TM 9–1900, and TM 9–1950.

12–7. Guided Missiles

a. Storage. Guided missile ammunition requires no maintenance at the user level. Stacks will be limited to five rounds.

b. Handling. Guided missile ammunition should be handled only by trained personnel. Rough handling can cause ammunition malfunction, to include propellant explosion when ignited. For detailed handling instructions, see appropriate 9-series TM (app A).

c. Safety. Personnel engaged in handling, assembly, and loading of guided missile ammunition will observe the following precautions:

(1) The flightcrew must remove all rings and jewelry from their hands before assembling, installing, or disassembling missiles.

(2) Missiles will not be installed on the helicopter until the daily operational checks have been successfully completed.

(3) Missiles will not be mounted until the helicopter has been fueled, checked out, and is ready for flight.

(4) To approach or move away from missiles, personnel should move at a right angle to the line of fire.

(5) All persons not actively engaged in installing the missiles will remain at least 100 meters from the launchers and clear of the flightpath.

(6) The helicopter should be in an open area and positioned so that the missiles are pointing toward a safe, uninhabited area.

(7) Missiles should be mounted from the inside launcher to the outside, both left and right.

(8) Until just before helicopter takeoff, the explosive bolt cables will be connected to their shorting plugs.

(9) Never assemble missiles within 300 meters of a radio or radar installation that has more than 100 kilowatts of peak power.

d. Assembly, Loading, Unloading, and Disassembly. Guided missile ammunition will come from the ammunition supply point assembled and ready to load. Only qualified personnel will assemble, load, unload, and disassemble guided missile ammunition. For assembly, loading, unloading, and detailed disassembly instructions, see appropriate 9-series TM (app A).

CHAPTER 13

RANGE FIRING

Section I. RANGE OPERATION

13–1. Range Requirements

Range requirements are established by the United States Army Materiel Command (USAMC). The range requirements depend on the types of aircraft and weapons subsystems to be used on the range, the purpose of the range (i.e., qualification or familiarization), and whether qualified instructor pilots are used aboard each aircraft to control the firing.

13–2. Surface Danger Area

Basic guidance for surface danger areas is shown in figure 13–1. With proper justification to the United States Army Materiel Command, these requirements may be altered to fit local conditions. Each surface danger area is divided into the following major components:

a. Firing Lane. The helicopter must be in the firing lane when firing. The firing lane has lateral boundaries extending perpendicularly from each end of the start-fire line (SFL) to each end of the cease-fire line (CFL). Targets may be engaged beyond the CFL but firing must cease at the CFL. To permit target engagement at maximum effective range, the target lane (part of the firing lane) extends beyond the CFL.

b. Impact Area. All rounds must impact into the impact area. The impact area begins at each end of the SFL, includes the fan-shaped area that is swept out by a 20° angle on each side of the firing lane, and extends downrange a distance of "X" meters (fig. 13–1)

c. Area "G." Area "G" is required when one qualified aviator (not an instructor pilot) is giving another aviator familiarization weapon training (Plan 1, fig. 13–1). Beginning at each end of the SFL, area "G" sweeps out at a 15° angle from each side of the impact area and extends downrange the same distance as the impact area. This area may not be required when qualified instructor pilots are controlling the fires from each helicopter (Plan 2, fig. 13–1).

d. Buffer Zone(Areas "A" and "B"). The buffer zone surrounds the impact area to provide a margin for error. It also begins at each end of the SFL and sweeps out at a 25° angle from the impact area (or area "G," if required) until it reaches the width specified for the type ammunition in use. This width then parallels the end of the impact area (fig. 13–1).

13–3. Range SOP and/or Checklists

The safe and efficient use of available ranges depends upon establishing detailed range and crash/rescue SOP's and duties checklists; all personnel concerned must be familiar with the provisions of the appropriate SOP and/or checklist. For a sample SOP, see appendix L.

13–4. Range Officer

The range officer is the installation commander's representative for operation and control of the range facilities. He is responsible for conducting training for range personnel, establishing the range SOP, insuring that the safety precautions are met, preparing and maintaining the ranges, posting warning signs, and placing barriers. Normally, he will also be responsible for scheduling range guards, ambulances and first aid personnel, crash/rescue equipment and operating personnel, and tower operations.

13–5. Officer in Charge (OIC)

The officer in charge supervises the range personnel and through the range officer, he is responsible for—

a. Opening the range for training.

b. Range safety.

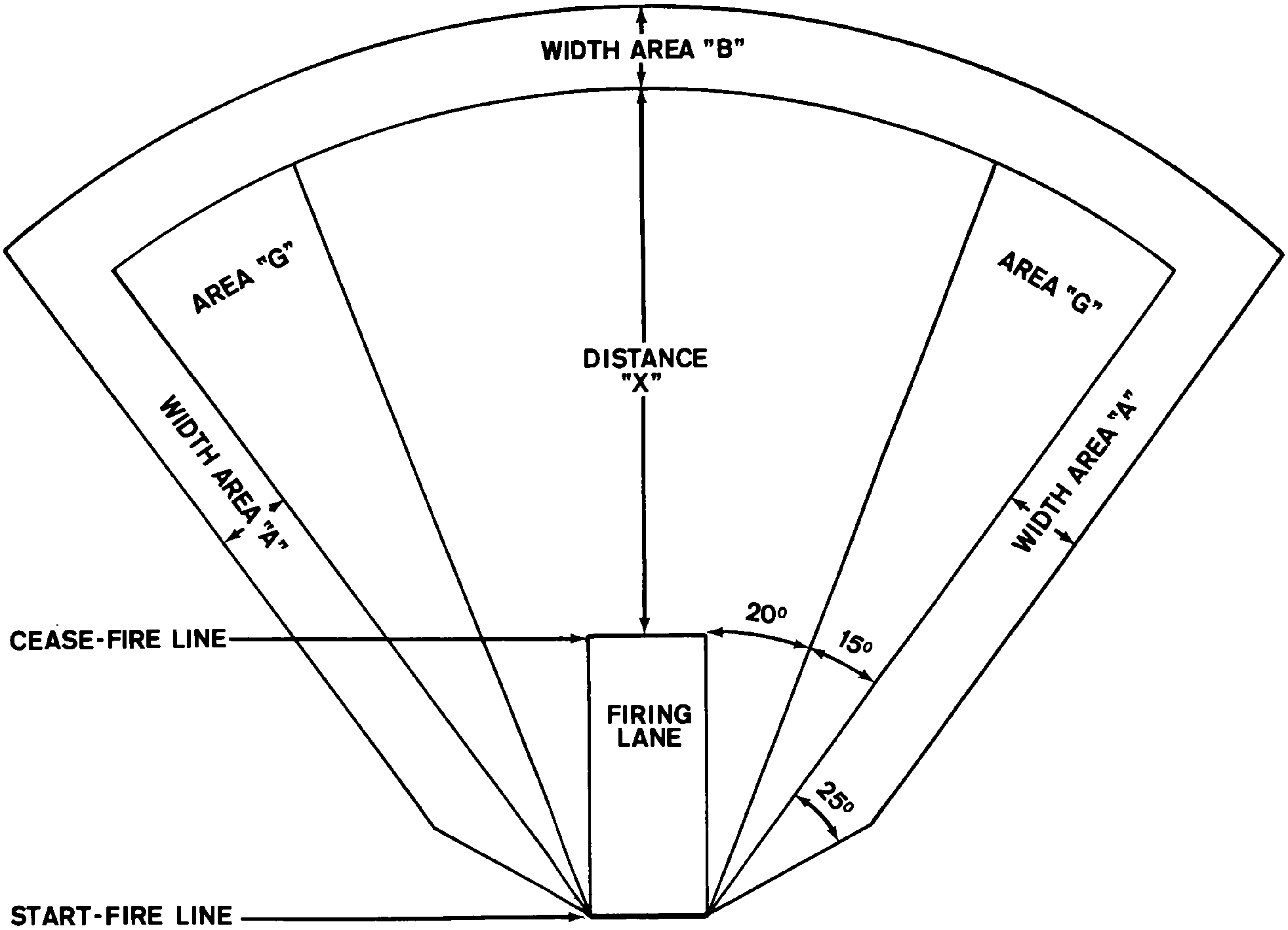
c. Conducting all training that requires the firing of live ammunition.

d. Monitoring the loading of weapons.

e. Aircraft and weapons maintenance.

f. Flight operations.

g. After firing has been completed, verifying range closing and completing required reports.



CALIBER	WIDTH AREA "A" METERS	WIDTH AREA "B" METERS	DISTANCE "X" METERS	
			PLAN 1	PLAN 2
7.62MM	100	100	3,800	2,700
2.75-INCH (ROCKET)	300	300	7,700	5,400
40MM (M75)	200	200	3,000	2,100

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Figure 13–1. Surface danger area.

13–6. Range Control Officer (RCO)

The safety officer at the firing point is the RCO, who represents the OIC. Orders issued by the RCO which prohibit or restrict firing must be obeyed and can only be rescinded by the OIC. The RCO has operational control of the range noncommissioned officer in charge (NCOIC), the ammunition NCOIC, crash/rescue team, ambulance crew, and control tower personnel. In the discharge of his duties, the RCO should interfere as little as possible with training, provided that safety precautions are not violated. In addition, the RCO should not be assigned responsibilities to assist in training but should be free to monitor safety.

13–7. Range NCOIC

The range NCOIC, under RCO control, supervises all range support personnel operations and safety. Normally, the range NCOIC is permanently assigned to the range and is thoroughly familiar with the facilities and operations of the range.

APPENDIX A

REFERENCES

A–1. Publication Indexes

Department of the Army Pamphlets of the 310-series should be consulted frequently for latest changes or revisions of references given in this appendix and for new publications relating to material covered in this manual.

A–2. Army Regulations (AR)

95-series	Aviation.
220–58	Organization and Training for Chemical, Biological, and Radiological (CBR) Operations.
310-series	Military Publications.
310–25	Dictionary of United States Army Terms.
320–50	Authorized Abbreviations and Brevity Codes.
350–1	Army Training.
380–5	Safeguarding Defense Information.
385–40	Accident Reporting and Records.
385–62	Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat.
385–63	Regulations for Firing Ammunition for Training, Target Practice, and Combat.
622–5	Qualification and Familiarization.
750–5	Organization, Policies, and Responsibilities for Maintenance Operations.
750–8	Command Maintenance Management Inspections (CMMI).

A–3. Department of Army Pamphlets (DA Pam)

30–50–1	Handbook on the Soviet Army.
(0)30–51	Handbook of the Chinese Communist Army.(U)
108–1	Index of Army Motion Pictures and Related Audio-Visual Aids.
310-series	Military Publications Indexes.
750–1	Preventive Maintenance Guide for Commanders.

A–4. Field Manuals (FM)

1–5	Aviation Company.
1–15	Divisional Aviation Battalion and Group.
1–80	Aerial Observer Techniques and Procedures.
1–100	Army Aviation Utilization.
1–105	Army Aviation Techniques and Procedures.
1–110	Armed Helicopter Employment.
3–10	Employment of Chemical and Biological Agents.
3–12	Operational Aspects of Radiological Defense.
5–15	Field Fortifications.
5–20	Camouflage.
5–25	Explosives and Demolitions.
5–34	Engineer Field Data.

5–36	Route Reconnaissance and Classification.
6–40	Field Artillery Cannon Gunnery.
6–102	Field Artillery Battalion, Aerial Artillery.
9–6	Ammunition Service in the Theater of Operations.
10–8	Air Delivery of Supplies and Equipment in the Field Army.
17–1	Armor Operations.
17–12	Tank Gunnery.
17–36	Divisional Armored and Air Cavalry Units.
20–60	Battlefield Illumination.
21–5	Military Training Management.
21–6	Techniques of Military Instruction.
21–11	First Aid for Soldiers.
21–26	Map Reading.
21–40	Chemical, Biological, Radiological and Nuclear Defense.
21–60	Visual Signals.
21–76	Survival.
21–77	Evasion and Escape.
22–100	Military Leadership.
23–67	Machinegun 7.62MM, M60.
24–1	Tactical Communications Doctrine.
24–18	Field Radio Techniques.
29–22	Maintenance Battalion and Company Operations (Nondivisional).
29–30	Maintenance Battalion and Company Operations in Divisions and Separate Brigades.
30–5	Combat Intelligence.
31–16	Counterguerrilla Operations.
31–20	Special Forces Operational Techniques.
31–21	Special Forces Operations—U.S. Army Doctrine.
31–50	Combat in Fortified and Built-Up Areas.
31–71	Northern Operations.
31–72	Mountain Operations.
33–1	Psychological Operations—U.S. Army Doctrine.
33–5	Psychological Operations—Techniques and Procedures.
57–35	Airmobile Operations.
101–5	Staff Officers' Field Manual: Staff Organization and Procedure.

A–5. Training Circulars (TC)

1–16	Employment of Aircraft Flares From Army Aircraft.
3–16	Employment of Riot Control Agents, Flame, Smoke, Anti-Plant Agents and Personnel Detectors in Counterguerrilla Operations.
6–1	Field Artillery Observation.

A–6. Technical Manuals (TM)

1–215	Attitude Instrument Flying.
1–225	Navigation for Army Aviation.
1–250	Fixed Wing Flight.
1–260	Rotary Wing Flight.
1–380-series	Aerial Observer Programmed Texts.
3–210	Fallout Prediction.
3–4240–219–15	Organizational, DS, GS, and Depot Maintenance Manual: Mask, Protective, Aircraft, M24.

5–330	Planning and Design of Roads, Airbases, and Heliports in the Theater of Operations.
8–230	Medical Corpsman and Medical Specialist.
9–1005–243–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool List): Armament Subsystem Helicopter, 7.62-MM Machine Gun, Quad, M6 (XM6E3) (Used on UH–1B Helicopters).
9–1005–247–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem Helicopter 7.62-MM Machine Gun Twin, M2 (Used on OH–13 (Series) and OH–23 (Series) Helicopters).
9–1005–257–12	Operator and Organizational Maintenance Manual: Armament Pod, Aircraft, 7.62-Millimeter Machine Gun: XM18 and XM18E1.
9–1005–262–15	Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Door Mounted, Lightweight, M23 (1005–907–0720) (Used on UH–1D Helicopters); Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Door Mounted, Lightweight, M24 (1005–763–1404) (Used on CH–47A Helicopters); and Armament Subsystem, Helicopter, 7.62-Millimeter Machine Gun: Ramp Mounted Lightweight, XM41 (1005–087–2046) (Used on CH–47A Helicopters).
9–1005–281–15	Operator, Organizational, Direct Support, General Support, and Depot Maintenance Manual (Including Repair Parts and Special Tools List) Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun: XM27 (Used on OH–6A Helicopters).
9–1005–297–12	Operator and Organizational Maintenance Manual for Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun: High Rate TAT–102A (1005–933–4710) (Used on AH–1G Helicopters).
9–1005–298–12	Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62-MM Machine Gun High Rate, XM27E1 (1005–933–6242) (Used on OH–6A Helicopter).
9–1010–207–12	Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 40 Millimeter Grenade Laucher: M5 (Used on UH–1B Helicopters).
9–1055–217–20	Organizational Maintenance Manual: Helicopter Armament Subsystem 2.75-Inch Rocket Launcher XM3 (Used on UH–1B Helicopter).
9–1055–217–35	DS, GS, and Depot Maintenance Manual: Helicopter Armament Subsystem 2.75-Inch Rocket Launcher XM3 (Used on UH–1B Helicopter).
9–1090–201–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists) Armament Subsystem, Helicopter 7.62-MM Machine Gun—2.75-Inch Rocket Launcher: XM16 (Used on UH–1B Helicopters).
9–1090–202–12	Operator and Organizational Maintenance Manual (Including Repair Parts and Special Tool Lists): Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—2.75-Inch Rocket Launcher: Twin, High Rate, XM21 (Used on UH–1B Helicopters).
9–1090–202–35	Direct and General Support and Depot Maintenance Manual (Including Repair Parts and Special Tool Lists) Armament Subsystem, Helicopter, 7.62 MM Machine Gun—2.75-Inch Rocket Launcher: Twin, High Rate, XM21 (Used on UH–1B Helicopters).

9–1090–203–12	Operator and Organizational Maintenance Manual: Armament Subsystem, Helicopter, 7.62 Millimeter Machine Gun—40 Millimeter Grenade Launcher: XM28 (1090–933–6701) (Used on AH–1G Helicopters).
9–1090–204–12	Operator and Organizational Maintenance Manual: Mount, Multiarmament, Helicopter: XM156 (1090–930–5018) (Used on UH–1B or UH–1C Helicopters).
9–1300–206	Care, Handling, Preservation, and Destruction of Ammunition.
9–1305–200	Small-Arms Ammunition.
9–1330–202–25	Organizational, DS, GS, and Depot Maintenance Manual (Including Repair Parts and Special Tools List) Dispenser, Grenade, Smoke XM20.
9–1370–200	Military Pyrotechnics.
9–1400–461–20	Organizational Maintenance Manual: Guided Missile Launcher Helicopter Armament Subsystem M22 (Used on UH–1B Helicopter).
9–1900	Ammunition, General.
9–1950	Rockets.
55–1520–209–10	Operator's Manual: Army Models CH–47A Helicopter.
55–1520–210–10	Operator's Manual: Army Model UH–1D/H Helicopter.
55–1520–218–10	Operator's Manual: Army Model UH–1A Helicopter.
55–1520–219–10	Operator's Manual: Army Model UH–1B Helicopter.
55–1520–220–10	Operator's Manual: Army Model UH–1C Helicopter.
55–1520–221–10	Operator's Manual: Army Model AH–1G Helicopter.

APPENDIX B

HELICOPTER ARMAMENT MODEL NUMBERS AND DEFINITIONS

B–1. Model Numbers Applicable to the Army Aircraft Armament Program

The prefix "X" indicates incomplete development or that standard A classification will not be awarded.

a. Helicopter Armament Subsystems. The following list of helicopter armament subsystems is a guide to all armament subsystems, past and present. While not all of the systems listed are applicable to attack helicopters, they are included here to provide all gunnery information applicable to attack helicopters.

XM1, XM1E1 (LP)	Caliber .30 machinegun; twin gun (used on OH–13 series helicopters).
M2	7.62mm M60C machinegun; twin gun used on OH–13-series and OH–23-series helicopters).
XM3	2.75-inch rocket launcher, 48-tube (used on UH–1B/C only; will not be standardized).
XM3E1	Improved XM3 2.75-inch rocket launcher. Subsystem launch tubes are 4 inches longer.
XM4	2.75-inch rocket launcher subsystem for the CH–34.
M5	40mm M75 grenade launcher nose-mounted on UH–1B/C.
M6	Quad 7.62mm M60C machinegun on UH–1B/1C (formerly the XM-153 used on CH–21).
M6E1	Same as above, but on CH–34.
XM6E2	Same as above, but on UH–1B/C at station 69.
XM6E3 (M6)	Same as above, but on UH–1B/C at station 136 (now standard A and designated M6).
XM7	7.62mm machinegun; twin gun (the 7.62mm subsystem on the OH–6A; development suspended).
XM8	40mm grenade launcher (the XM129 on the OH–6A; development deferred).
XM10	Development cancelled.
XM11	Not assigned.
M16	Quad 7.62mm M60C machinegun; 2.75-inch, seven-tube rocket laucher (used on UH–1B/C helicopters; M6 modified to incorporate rocket capability).
XM17	2.75-inch rocket launcher 19-tube, reloadable, reusable, not repairable (used on UH–1B/C; two XM159 rocket pods on Kellet pylons).
M21	7.62mm high rate M134 machinegun; 2.75-inch rocket launcher XM-158 (M16 modified by replacing four M60C machineguns with two M134 machineguns).
M22	Antitank guided missile subsystem for UH-1B/C using AGM–22B missile (formerly SS-11B1).
M23	7.62mm M60D machinegun; door pintle mounted on UH–1D/H.

M24	7.62mm M60D machinegun; pintle-mounted on CH–47.
XM26 (TOW)	TOW (Tube launched, Optically tracked, Wire guided) missile, for UH–1B/C.
XM27	7.62mm machinegun—high rate; one M134 machinegun side-mounted on OH–6A.
XM27E1	Improved XM27 armament subsystem.
XM28	Two 7.62mm M134 machineguns; two 40mm XM129, grenade launchers; or one M134 machinegun and one XM129, turret-mounted on the nose of AH–1G.
XM29	One 7.62mm M6 OD machinegun; pintle-mounted on UH–1B/C (cannot be used if external weapons subsystems are mounted).
XM30	30mm automatic gun XM140 on UH–1B/C.
XM31	20mm automatic gun; one pod-mounted M24-A1 gun on each side of UH–1B/C.
XM32	Caliber .50 or 7.62mm machinegun mounted one on each side of CH–47A.
XM33	Caliber .50 machinegun ramp-mounted in rear of CH–47A.
XM34	Dual 20mm M24A1 guns mounted one on each side of the CH–47A.
XM35	20mm subsystem for the AH–1G.
XM41	One 7.62mm M60D machinegun; ramp-mounted on CH–47A.
Tactical Armament Turret—TAT–102A	Chin turret mounting one 7.62mm M134 machinegun on the nose of AH–1G.

b. Weapons Used in Helicopter Armament Subsystems.

M60C	Machinegun, 7.62mm, electrically fired.
M60D	Machinegun, 7.62mm, spade grip with thumb triggers.
M61	Gun, three-barrel, 20mm cannon, Gatling-type; electrically driven, Vulcan, barrel length 60 inches.
M61A1	Same as M61 except barrel length is 40 inches.
M75	Launcher, grenade, 40mm.
XM129	Launcher, grenade, 40mm (redesign of M75).
XM130	Gun, 20mm, automatic (redesign of M61 to provide gas drive).
XM133	Gun, 7.62mm, high cyclic rate machinegun w/ gas drive.
M134	Gun, 7.62mm, high cyclic rate machinegun w/ electric drive.
XM140	Gun, 30mm, automatic, single barrel.
XM141	Launcher, 2.75-inch rocket, seven-tube reloadable, reusable.
XM157	Launcher, 2.75-inch FFAR, seven-tube reloadable, reusable, not repairable (LP).
XM158	Launcher, 2.75-inch rocket, seven-tube reloadable, reusable, repairable (LP).
XM159	Launcher, 2.75-inch FFAR, 19-tube reloadable, reusable, not repairable (LP).

c. Multiarmament Helicopter Mount.

XM156	Mount, multiarmament, used on UH–1B/C having M16 subsystem internal wiring (for XM-157, XM158, and XM-

159 2.75-inch rocket launchers).

d. Sights for Helicopter Armament Subsystems.

XM58 Sight, antioscillation, for M22 subsystem.

XM60 Sight, infinity, helicopter (pilot sight for M16 and M21).

XM70 Sight, infinity, helicopter (used with XM27 on OH–6A).

e. Aircraft Armament Pods.

XM12 20mm automatic gun—turbine driven (uses M61 gun) (SUU–16/A, AF).

XM13 40mm grenade launcher (uses M75 launcher).

XM14 Caliber .50 machinegun (uses M3 machinegun (LP).

XM18 7.62mm high rate M134 machinegun (SUU–11A/A, AF) (LP).

XM19 7.62mm machinegun; twin gun (uses M60C machinegun).

XM25 20mm automatic gun—gas driven (SUU–11A, AF).

f. Aircraft Dispensers.

XM3 Dispenser, antipersonnel, mine (see XM47 mine dispersing subsystem).

XM9 Dispenser, bomb (modified SUU 7 for UH–1B/C, see SUU 14/A).

XM15 Dispenser for XM165 aircraft flares.

XM19 Dispenser for XM170 aircraft flares.

XM20 Smoke grenade dispenser for AH–1G.

XM25 Dispenser, bomb, aircraft (XM18 dispenser and XM144 frag bombs.

XM27 Dispenser, grenade, aircraft (XM18 dispenser and XM54 grenade).

XM47 Mine dispersing subsystem (XM3 dispenser and XM27 mines).

g. Mines.

XM27 Mines, antipersonnel (see XM47 mine dispersing subsystem).

B–2. Definitions

a. Clockwise Rotation—When an armament system is viewed from the rear, rotation in the direction of the hands of a clock.

b. Gunner—The copilot-gunner.

c. Gatling—Machinegun operation where barrels rotate through a loading, firing, and ejecting cycle.

d. Pod—An externally mounted armament subsystem that is contained within a fairing.

APPENDIX C

7.62MM RIFLED-BORE ARMAMENT SUBSYSTEMS

Section I. M2 ARMAMENT SUBSYSTEM

C-1. Capabilities

The twin calliber 7.62mm machinegun helicopter armament subsystem M2 (figs. C-1, C-2, and C-3) is designed for use on the OH-13 and OH-23 series helicopters. As a normal reconnaissance function, the M2 helicopter armament subsystem is used in a neutralization fire role. It is most effective against area type soft targets; however, other types of targets may be engaged to develop reconnaissance information (reconnaissance by fire).

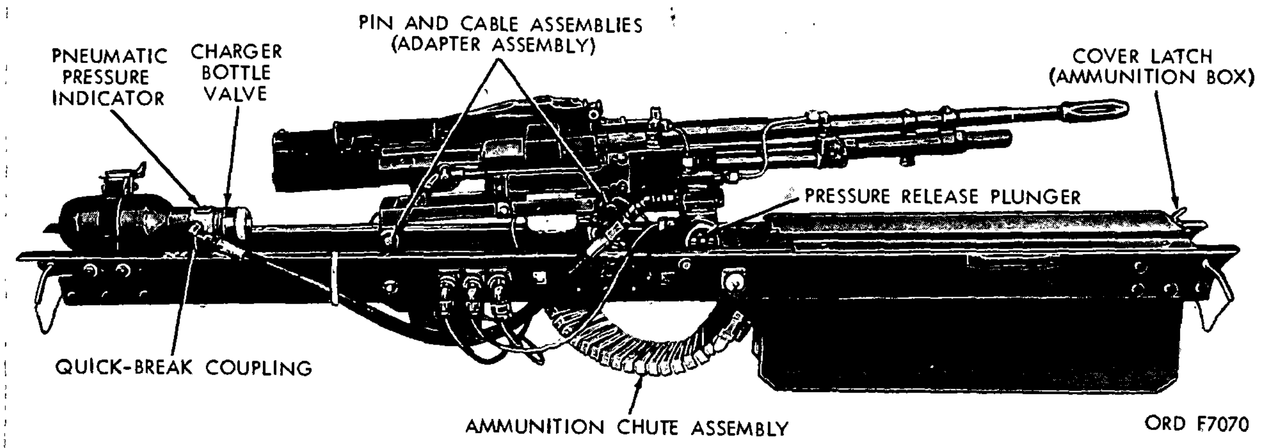

Figure C-1. Helicopter armament subsystem M2—right side view.

C-2. Limitations

The M2 helicopter armament subsystem is not effective for use at night or during periods of low visibility and it is vulnerable to small arms and other types of air defense fires.

C-3. Description

The M2 armament subsystem is lightweight, simple in construction, requires little maintenance, and can be readily installed with only minor modification of the helicopter. Weight, size, and operating characteristics are—

a. Fixed Cal 7.62mm Machinegun, M60C.

(1) Type .... Fixed machinegun.

(2) Weight (two machineguns) ..... 42.0 lb.

(3) Rate of fire (combined) .... 1,100 shots per minute (approx.)

b. Ammunition.

(1) 7.62mm .... All types.

(2) Weight (1,100 rounds: four rounds of ball to one round of tracer, linked) .... 74.0 lb.

c. Mount, M2.

(1) Weight (two mount assemblies 88.55 lb.

(2) Overall length .... 65.8 in.

(3) Overall height .... 15.6 in.

(4) Overall width .... 7.25 in.

(5) Distance between guns .... 70.55 in.

(6) Ground clearance OH-13H ...... 9.5 in.

(7) Elevation range .... 9°.

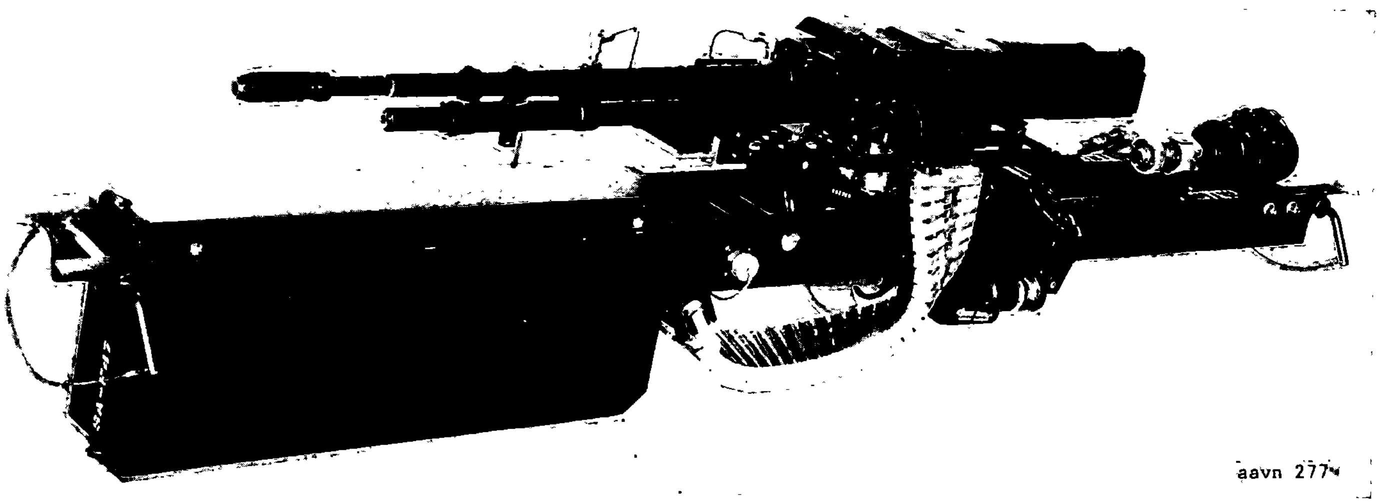

Figure C-2. Helicopter armament subsystem M2—left side view.

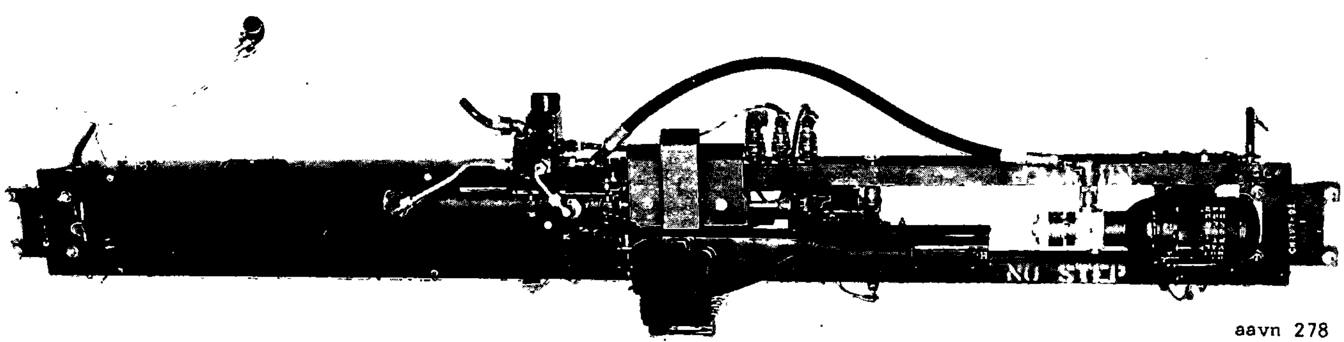

Figure C-3. Helicopter armament subsystem M2—top view.

(8) Elevation rate ..6° per second (approx.)
(9) Depression rate .9° per second (approx.)
(10) Elevation drive .... Electric.
(11) Charging and safetying mechanism .... Pneumatic.
(12) Charger supply cylinder volume ....30 cu. in.
(13) Charger supply pressure .... 2,000 to 3,000 psi.
(14) Charging cycles per cylinder ...22 to 25.
(15) Charger line pressure ....350 psi.
(16) Charging time ......1 second (approxi)
(17) Total ammo capacity ....1,150 rd.
(On each side: Ammunition box—550 (approx), chute—25 (approx).)

d. Center of Gravity (CG) Limits.

(1) Forward ....81.5 in.
(2) Aft ....89 in.

e. Boresighting. The machineguns are boresighted in the azimuth plane for the rounds to coverage at 500 meters.

C-4. Fire Control and Operation

Since there is no sight for this subsystem, the aviator can provide his own sight reference which can be a 4-inch vertical line and short horizontal lines spaced at one-half inch intervals, made with a grease pencil on the helicopter bubble. Arming, charging, safetying, elevating, and firing operations are remotely controlled by the aviator, who can perform these operations without releasing the collective or cyclic controls. Controls for operating the subsystem are installed on the cyclic and collective controls and on the console. The subsystem consists of two M60C (7.62mm) machineguns (left-hand feed), the

(1) *Deflection boresight adjustments.*

(*a*) Check machineguns to make sure they are securely attached to the mount assemblies by grasping the barrels firmly and, applying moderate pressure, attempt to move the guns in elevation and deflection.

(*b*) Using a piece of tape, tape down the action switch on the lower portion of the control handle.

(*c*) Remove alinement pin from its stowage clamp on the elbow assembly of sighting station. Aline hole in the controller housing beneath the sunshade on the front of the sighting station with hole in sight shaft; insert pin until fully shouldered. This prevents any movement of the sighting station on the deflection axis.

(*d*) Place the OFF-SAFE-ARMED switch in the ARMED position.

(*e*) Turn on the sight reticle lamp switch by moving the toggle handle to either side of the center OFF position. Move the sight reticle lamp variable resistor as necessary to adjust reticle brightness.

(*f*) Hold sighting station in normal sighting position. Place center dot of sight reticle on sight point on target in elevation-depression axis. The groundman will then physically position helicopter left or right in a horizontal plane until center dot of sight reticle is on sight point on target in the deflection axis.

(*g*) Sight through barrels of upper guns. The sight point on target should appear centered in the machinegun bores.

(*h*) Should the sight point be outside the field of view through the barrels in a vertical direction, i.e., up or down, the sight may be moved in elevation, thus moving the sight reticle dot slightly above or below the sight point.

(*i*) Should the sight point not appear centered in the gun bores in deflection when sighting through the barrels, alter the position of the deflection variable resistor as follows:

1. Using a screwdriver, turn adjusting screw at base of deflection variable resistor clockwise or counterclockwise, as required, to center sight point in deflection (fig. C–16).

2. Stand clear of mount assemblies and guns. Request cockpit operator to remove alinement pin from front of sighting station and move sight slowly in its deflection axis several times across the sight point and return it to its original position, i.e., reticle dot on sight point.

3. Observe sight point through gun barrels. Sight point should be centered in deflection.

(2) *Elevation boresight adjustments.* Using the same target and with electrical and hydraulic power supplied to subsystem, check the elevation axis of the subsystem in the following manner:

(*a*) Using a piece of tape, tape down the action switch on the lower portion of the control handle.

(*b*) Insert alinement pin as outlined in (1)(*c*) above.

(*c*) Place the OFF-SAFE-ARMED switch in the ARMED position.

(*d*) Turn on sight reticle lamp.

(*e*) Hold sighting station in normal sighting position. Place center dot of sight reticle on sight point on target in elevation and deflection axis.

(*f*) Sight through barrels of upper guns. The sight point on target should appear centered in the machinegun bores.

(*g*) Should the sight point not be centered in the gun bores, alter the position of the elevation variable resistor in the following manner:

1. Place OFF-SAFE-ARMED switch in the OFF position.

2. Remove the elevation variable resistor plug located on each mount assembly (fig. C–17). This plug is labeled "Elev. Cal."

3. Insert a 3/16-inch socket-head screw key into hole vacated by the variable resistor plug. When key is seated in the top of the socket-head screw which rotates the elevation variable resistor, place OFF-SAFE-ARMED switch in the ARMED position.

4. Recheck sight reticle as outlined in (*f*) above.

5. While observing sight point through gun bore, adjust the elevation variable resistor by slowly rotating socket-head screw key clockwise or counterclockwise to center the sight point in the gun bore (fig. C–18).

6. Groundman: stand clear of mount assemblies and guns.

7. Cockpit operator: move sighting station in its elevation axis several times above and below the sight point and return to its original position, i.e., reticle dot on aiming point.

8. Observe sight point through gun barrels. Sight point should be centered in elevation.

9. Install variable resistor plug (fig. C–17).

10. Remove tape from action switch.

11. Remove and stow alinement pin.

e. Boresighting for stow position can now be accomplished. The purpose of boresighting the subsystem M6 series in the stow position is to compensate for the helicopter's position (nose down) when flying at speeds between 80 to 100 knots.

(1) Select a target with clearly defined right angles (90°) at 700 meters ± 20 meters. A building or a natural object, such as a tree, are adequate targets. Select a reference point at least 10 but not over 30 feet from the ground.

(2) Using a screwdriver, open the door on the control box panel by turning "dzus" fastener counterclockwise.

(3) Sight through barrels of upper guns. The sight point should appear centered in the machinegun bores.

(4) Should the sight point be outside the field of view through the barrel in a deflection or vertical direction, alter the position of the stow variable resistors located in the control box panel.

(5) Groundman: observe target through barrels of guns and give cockpit operator directional signals to correct for deflection/elevation errors.

(6) Cockpit operator: adjust mount assemblies by turning the screw adjustment on any or all variable resistors with jeweler's screwdriver 5120–180–0728 clockwise or counterclockwise, whichever is applicable (fig. C–31). The stow position variable resistors are marked "LE" (left elevation), "LD" (left deflection), "RE" (right elevation), and "RD" (right deflection). They are adjusted in elevation/deflection in the following manner:

(*a*) Clockwise movement of "LE" adjustment—depresses left-hand guns.

(*b*) Counterclockwise movement of "LE" adjustment—elevates left-hand guns.

(*c*) Clockwise movement of "LD" adjustment—traverses left-hand guns to right.

(*d*) Counterclockwise movement of "LD" adjustment—traverses left-hand guns to left.

(*e*) Clockwise movement of "RE" adjustment—elevates right-hand guns.

(*f*) Counterclockwise movement of "RE" adjustment—depresses right-hand guns.

(*g*) Clockwise movement of "RD" adjustment—traverses right-hand guns to left.

(*h*) Counterclockwise movement of "RD" adjustment—traverses right-hand guns to right.

(7) Place OFF-SAFE-ARMED switch in OFF position.

f. After boresighting has been completed, check to see that the firing interrupter switch is properly adjusted. Perform any adjustment required as outlined in TM 9–1005–243–12.

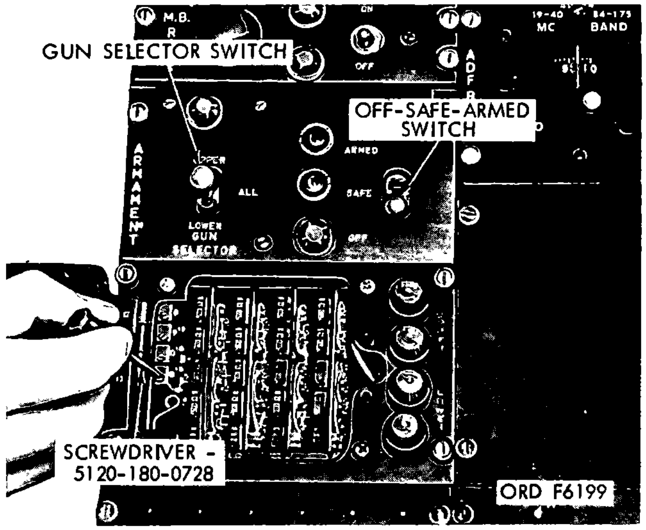

Figure C–31. Adjusting deflection/elevation stow variable resistor.

C–23. Harmonization Procedures

a. Flexible Mode.

(1) Armorer/crewchief adjusts deflection and elevation variable resistors as described in paragraph C–19*b*(4) and (5).

(2) Gunner depresses action switch, places the pip on target, and fires short bursts. Then armorer adjusts resistors ((1) above) until rounds are hitting the target. Gunner keeps action switch depressed and pip on target throughout harmonization.

(3) Once harmonization is established at a known distance, pip holdover or under (Kentucky windage) must be used for greater or lesser ranges.

b. Stowed Position. Adjustment of the guns in the stowed position is accomplished by turning the screw adjustment on each stowed position variable resistor utilizing a jeweler's type screwdriver. The stowed position variable resistors are marked LE, LD, RE, RD (para C–22*e*(6)).

(1) The gunner fires a short burst prior to each adjustment.

(2) Armorer/crewchief adjusts variable resistors until the rounds are hitting the target.

Section III. XM27 ARMAMENT SUBSYSTEM

C–24. Description and Capabilities

The high rate, 7.62mm, air-cooled machinegun helicopter armament subsystem XM27 is mounted on the left side of the OH–6A helicopter. It may be fired by the pilot's or copilot's firing switch on each cyclic control stick. The subsystem is designed for use as a direct fire area weapon against troops and soft material targets. It provides an immediately responsive and highly mobile means of delivering volume area nonnuclear fire in support of ground maneuver elements. General data describing the XM27 armament subsystem is given in table C–1.

Note. The XM27E1 armament subsystem is an improved XM27 subsystem. The ammunition boxes are more compact and there are differences in the fairing assembly, mount assembly, and the reflex sight assembly. The XM27E1 also has an improved gun drive assembly and a ram air induction system for the delinking feeder. For details on the XM27E1 subsystem, see TM 9–1005–298–12.

a. The subsystem has a low rate of fire of 2,000 shots per minute or a high rate of fire of 4,000 shots per minute.

b. Maximum employable range is 3,100 meters.

c. Maximum effective range is 1,000 meters (based on tracer burnout, volume of fire, and sight).

d. Minimum safe slant range is 100 meters.

Table C–1. XM27 Armament Subsystem Data

Item	Length (In.)	Width (In.)	Height (In.)	Weight (Lbs.)
Armament Subsystem With Ammunition				245
Armament Subsystem Without Ammunition				117
Automatic Gun M134	29.5			35
Delinking Feeder MAU–56/A	10.75	6.5	5.0	8
Gun Drive Assembly	7.75	3.05	5.2	7⅜
Helicopter Reflex Sight XM70	17	20 (extened 8.5 (stowed)	8.5	5 (w/mount)

e. Ammunition capacity is 2,000 rounds.

f. The guns are fired from a fixed azimuth position. The subsystem's elevation limit is +10° and its depression limit is – 24°.

C–25. Limitations

The XM27 subsystem mounted on the OH–6A helicopter is vulnerable to all types of air defense fires including small arms. Effectiveness of night and low visibility operations is reduced by limitations in target acquisition and range estimation. Daily rate of fire is limited only ammunition resupply and necessary maintenance. Also, target engagement is limited by the subsystem's flexible limits.

C–26. External Components

a. Guns. The M134 high rate automatic gun is capable of firing at rates up to 6,000 shots per minute, depending upon the gun drive assembly used. Because the weapon is driven by external power, dud rounds are cycled through the weapon and it does not require a gun charger system. Ammunition muzzle velocity is 2,850 feet per second. Gun firing life is a minimum of 100,000 rounds.

b. Gun Drive Assembly. The gun drive assembly provides a drive ratio of 6.1 to 1. It consists of—

(1) *Drive motor.* During steady state firing, the electric drive motor draws 70 amperes of current. It operates on 28 volts DC and belt pull is 20 pounds.

(2) *Gear reduction assembly.* The gear reduction assembly has an electric solenoid-operated clutch that permits the rate of fire to be selected at 2,000 or 4,000 shots per minute (spm).

c. Delinking Feeder. The MAU–56/A delinking feeder requires ammunition belted with the M13 link; it strips the links from the round and feeds the round into the gun. The delinking feeder consists of the following subassemblies:

(1) *Housing.* The housing has rear portion of feeder and contains bearing and elliptical cam groove in which seven push rods and rollers operate.

(2) *Push rods and rollers.* The push rods and rollers push rounds forward and out of link and into sprocket.

(3) *Gear and guide group.* The gear and guide group drives the feeder and guides push rods.

(4) *Delinking feeder group.* The delinking feeder group is the rear attaching point on the gun for the timing assembly, incoming rounds guides, and gun feed solenoid.

(5) *Guide.* The guide insures that rounds are parallel as they enter the feeder.

(6) *Nose guide.* The nose guide insures the correct alinement for rounds.

(7) *Gun feed solenoid.* When electrical power is sent to the gun feed solenoid, it closes gates to allow rounds to be fed into gun. Without power, gates are open and rounds are fed overboard. This is a fail-safe system: unless power is applied, live rounds do not enter the gun.

(8) *Gun-cleared sensor* (*XM27E1 only*). The gun-cleared sensor is a microswitch that is connected to the GUN CLEAR light on the fire control panel; it is held open by a round and closes when the gun is clear.

(9) *Sprocket.* The sprocket is attached to the gear and guide group. It picks up a round from a push rod and feeds it into the gun. (A loose sprocket allows misalinement of rounds with gun rotor.)

(10) *Plate.* The plate contains the front bearing and is the front point for attaching the delinking feeder to the gun.

d. Recoil Adapter Assemblies. The two recoil adapter assemblies are cylindrical spring-loaded plunger-type assemblies designed to reduce recoil and counterrecoil forces during firing of the gun. Recoil forces average 300 pounds.

e. Fairing. The two-piece gun fairing assembly controls air flow around the gun for cooling and the ejection of links and brass.

f. Gun Support. The gun support is bolted to the left end of the tube assembly (fig. C-37). The two recoil adapter assemblies mount the gun in the gun support, thus mounting the gun to the tube assembly.

C-27. Internal Components

a. Mount. The mount (figs. C-32, C-33, and C-34) consists of the following main components:

(1) *Housing assembly.* The housing assem-

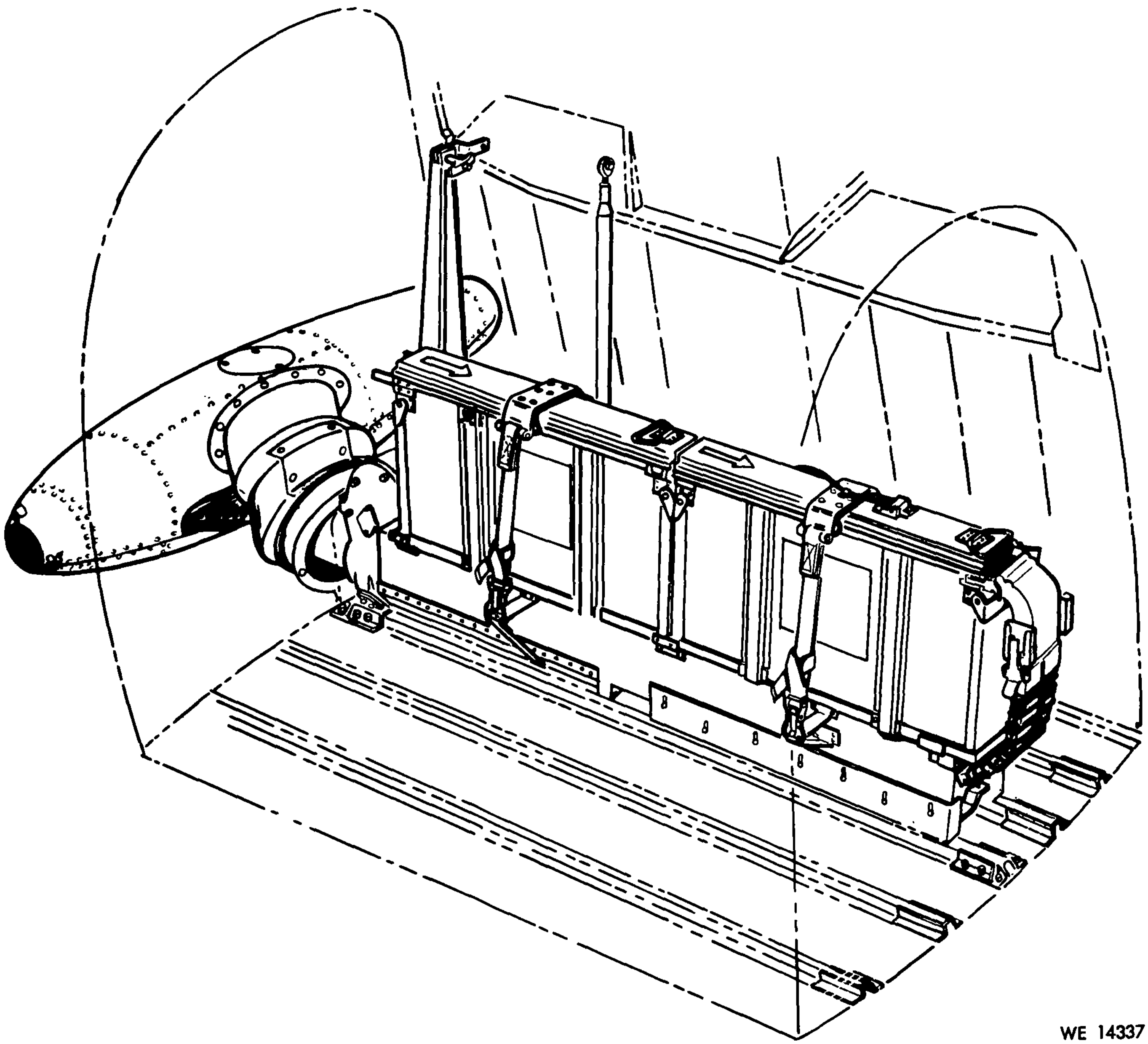

Figure C-32. High rate 7.62mm gun mount installed in helicopter—right rear view.

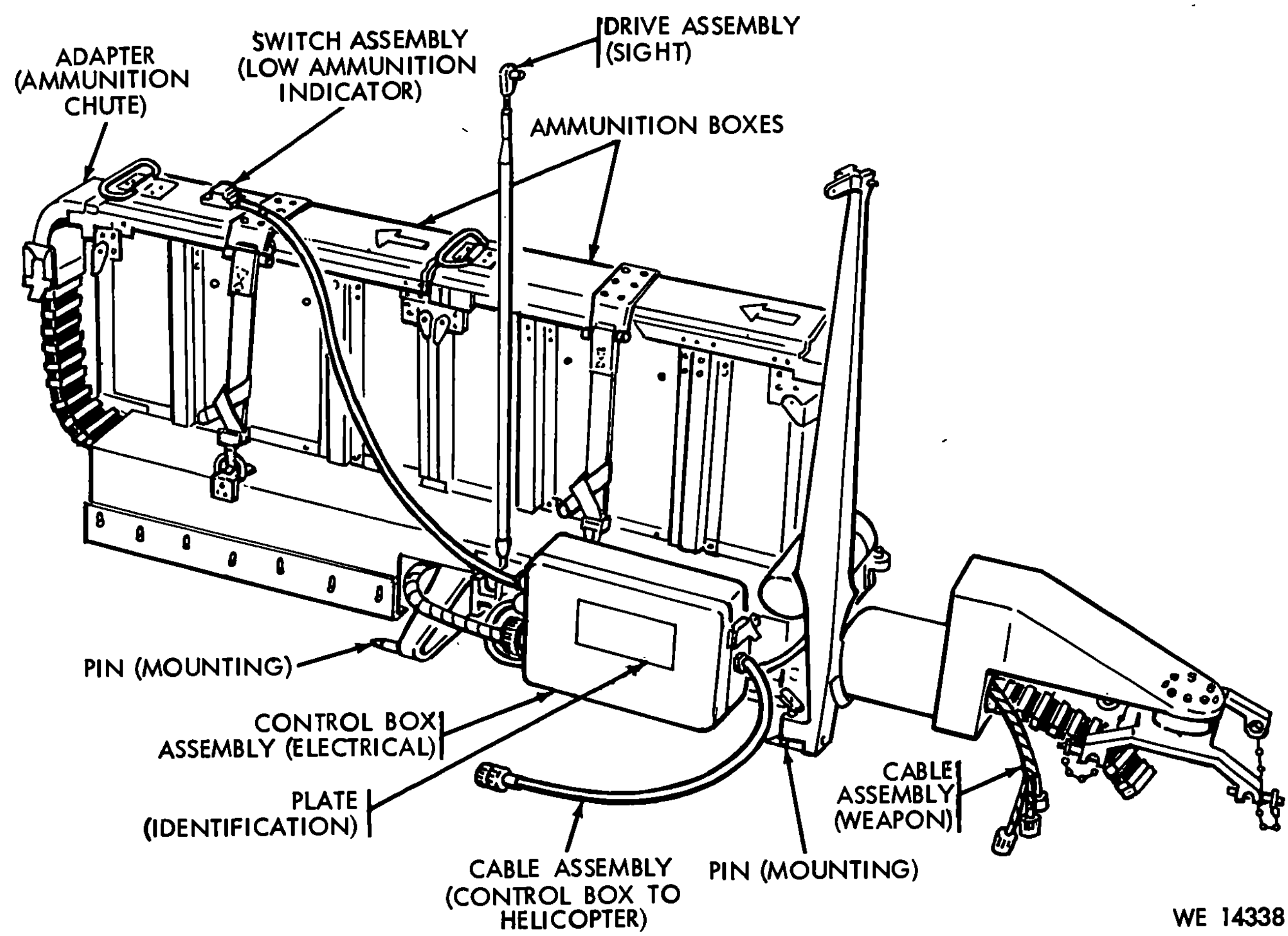

Figure C–33. High rate 7.62mm gun mount (partially assembled) fairings removed—left front view.

bly is rectangular in shape and accepts the tube assembly through a circular opening at the left end. It is secured to the helicopter at three points —at the upper and lower end of the left arm-like bracket and at lower front side of the right bracket of the housing assembly. The housing is provided with bearings which contact a bearing surface around the tube assembly. Rotation of the tube within the housing provides the elevation and depression for the weapon. This is accomplished by an electric, motor-driven clutch and worm gear mating with a gear segment on the tube assembly. Stops are provided in the cone gear to limit elevation to 10° and depression to 24°. A bracket assembly near the right end of the tube assembly accepts the reflex sight link assembly, permitting the sight to follow the tube assembly in elevation and depression. Extending from the left end of the tube assembly is an arm-like support to which the gun cradle support is attached.

(2) *Control box assembly.* The electrical control box assembly is mounted to the front side of the housing and tube assembly. It controls the electric motor which elevates and depresses the gun; the fire to clear and fire normal circuits; the gun drive motor and delinking feeder solenoid; switching and time delay relays; and serves as a junction point for all circuits between the helicopter, sight, and the subsystem.

(3) *Ammunition box assemblies and low ammunition indicator switch assembly.* Two 1,000 round ammunition box assemblies are joined end to end and are secured to the housing and tube assembly by strap assemblies. At installation of the subsystem, a low ammunition indicator switch assembly must be installed to one of the covers. The cover with the indicator switch assembly will be installed on the ammunition box and positioned on the right-hand side of the housing and tube assembly.

(4) *Ammunition chute assembly and chute adapter assembly.* The chute adapter assembly is installed to the right end of the ammunition box

and accepts the ammunition chute assembly. The ammunition chute has 111 links, plus the two end fittings.

c. Helicopter Reflex Sight XM70. The helicopter reflex sight (figs. C–35 and C–36) is an optical sighting instrument synchronized with the movement of the weapon in elevation and depression by a parallelogram linkage system. The sight is fixed in azimuth. The sight mount provides the means of adjusting the sight to a height

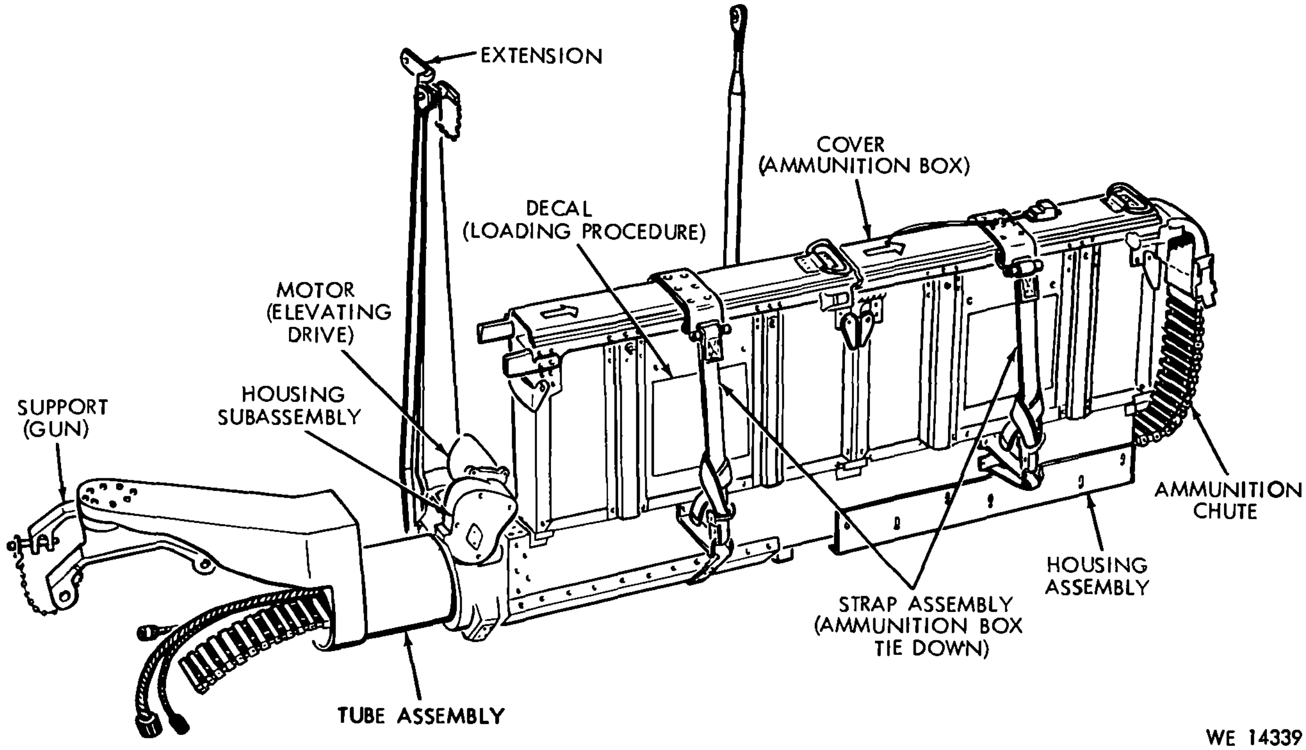

Figure C–34. High rate 7.62mm gun mount (partially assembled) fairings removed—left rear view.

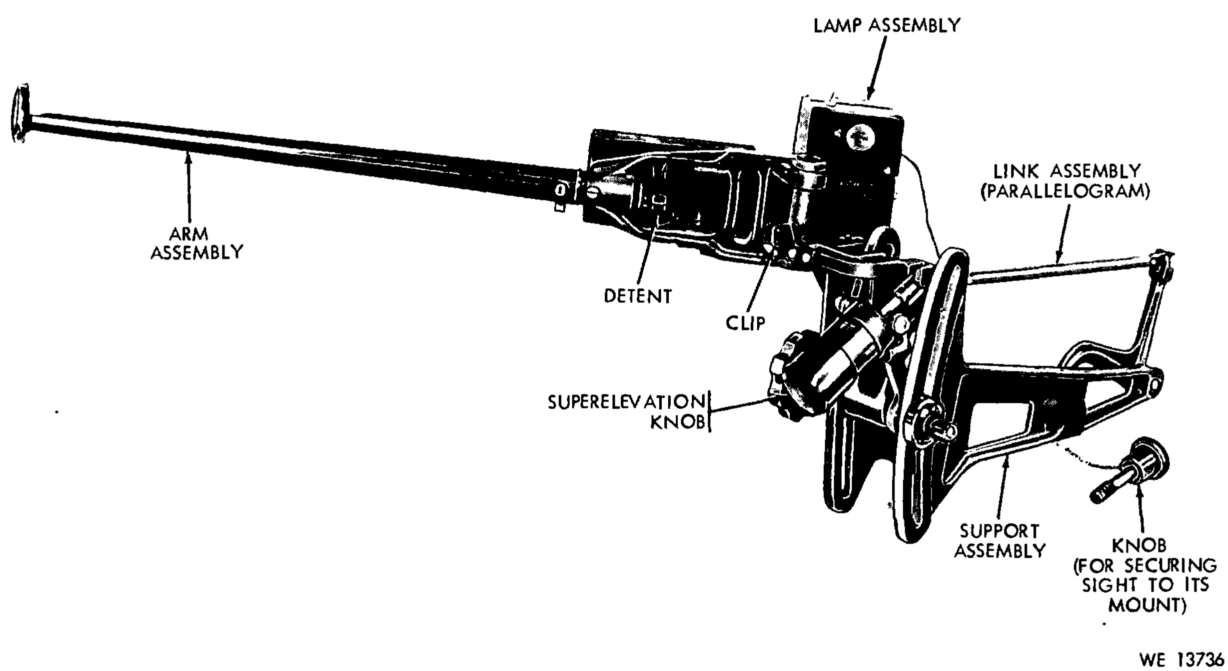

Figure C–35. Helicopter reflex sight SM70—left side view.

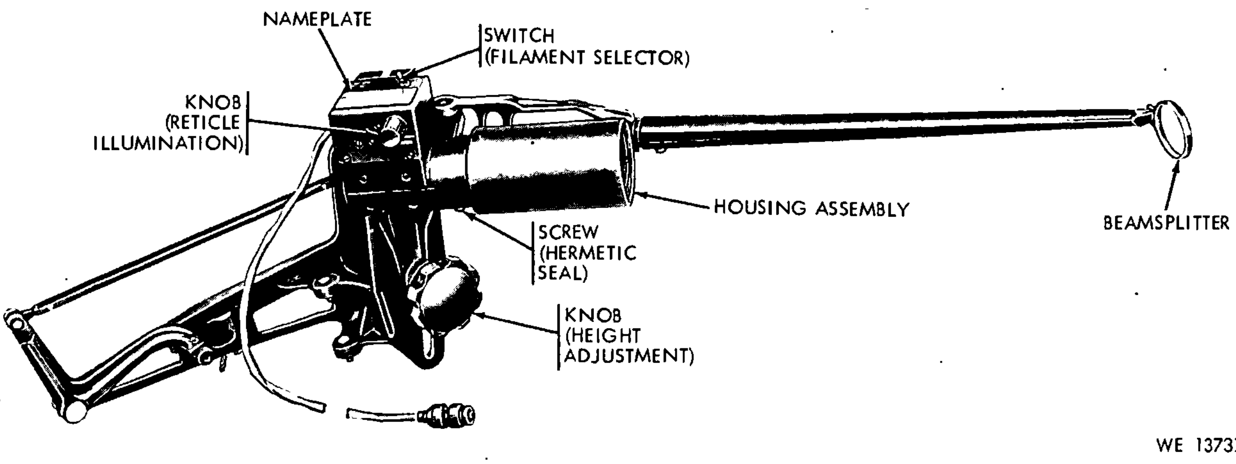

Figure C–36. Helicopter reflex sight XM70—right side view.

convenient to the user. The required electrical power is supplied through a two-conductor cable connected to the weapon's electrical system. A reticle pattern is projected on the beamsplitter plate which is superimposed on the image of the target as viewed by the user. A stowed position is provided to remove the extended beamsplitter from the user's line of sight when not in use.

(1) *Optical characteristics.*
 (*a*) Field of view ....174 mils.
 (*b*) Clear aperture..1.375 (beamsplitter).
 (*c*) Objective effective focal length ...... 4.0 inches

(2) *Electrical characteristics.*
 (*a*) Operating voltage ...20–28 volts DC.
 (*b*) Lamp ..0.68 amps (each filament).

(3) *Elevation range.*
 (*a*) Elevation ....15° (maximum).
 (*b*) Depression ....30° (maximum).

(4) *Temperature range.*
 (*a*) Operable ....40° F. to 125° F.
 (*b*) Storage ....80° F. to 160° F.

C–28. Boresighting

Note. A 3° azimuth adjustment (boresight adjustment screws (fig. C–37)) is provided at the mounting point between the gun cradle support and tube support. Prior to boresighting, loosen the six nuts and bolts securing gun cradle support to tube support.

a. Select a well defined point target at a distance greater than 1,000 meters.

b. Depress gun timing pin (fig. C–41), rotate barrels counterclockwise until pin is fully de-

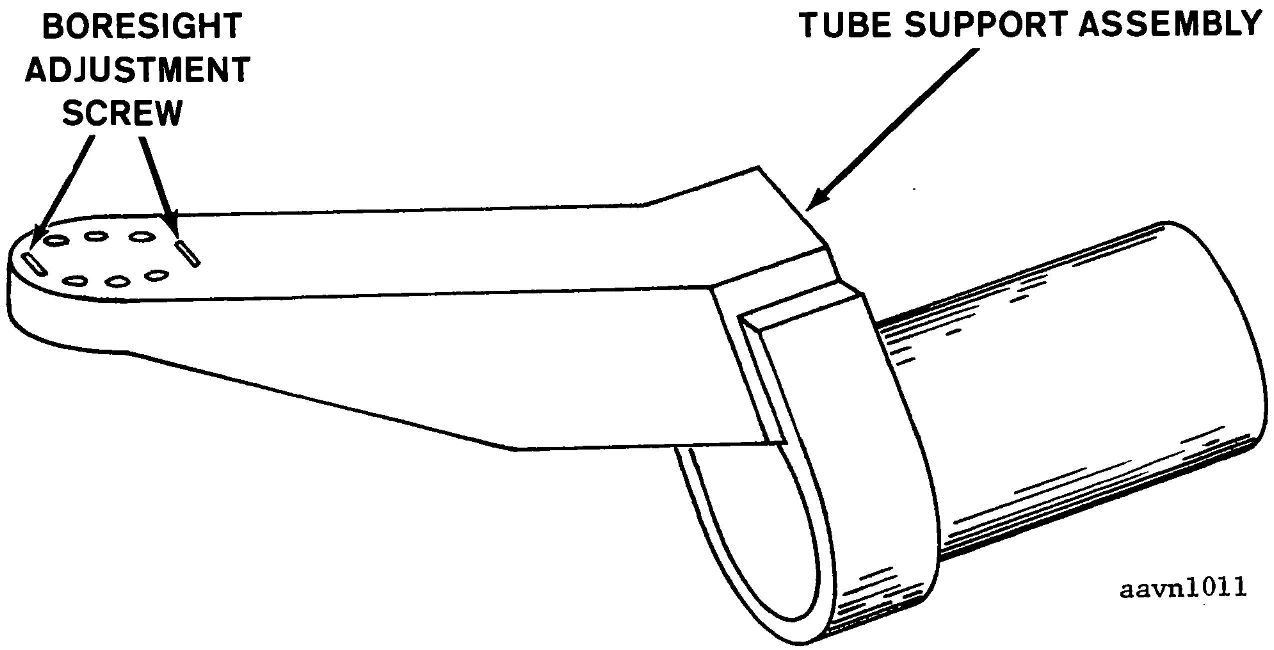

Figure C–37. Boresight adjustment screws.

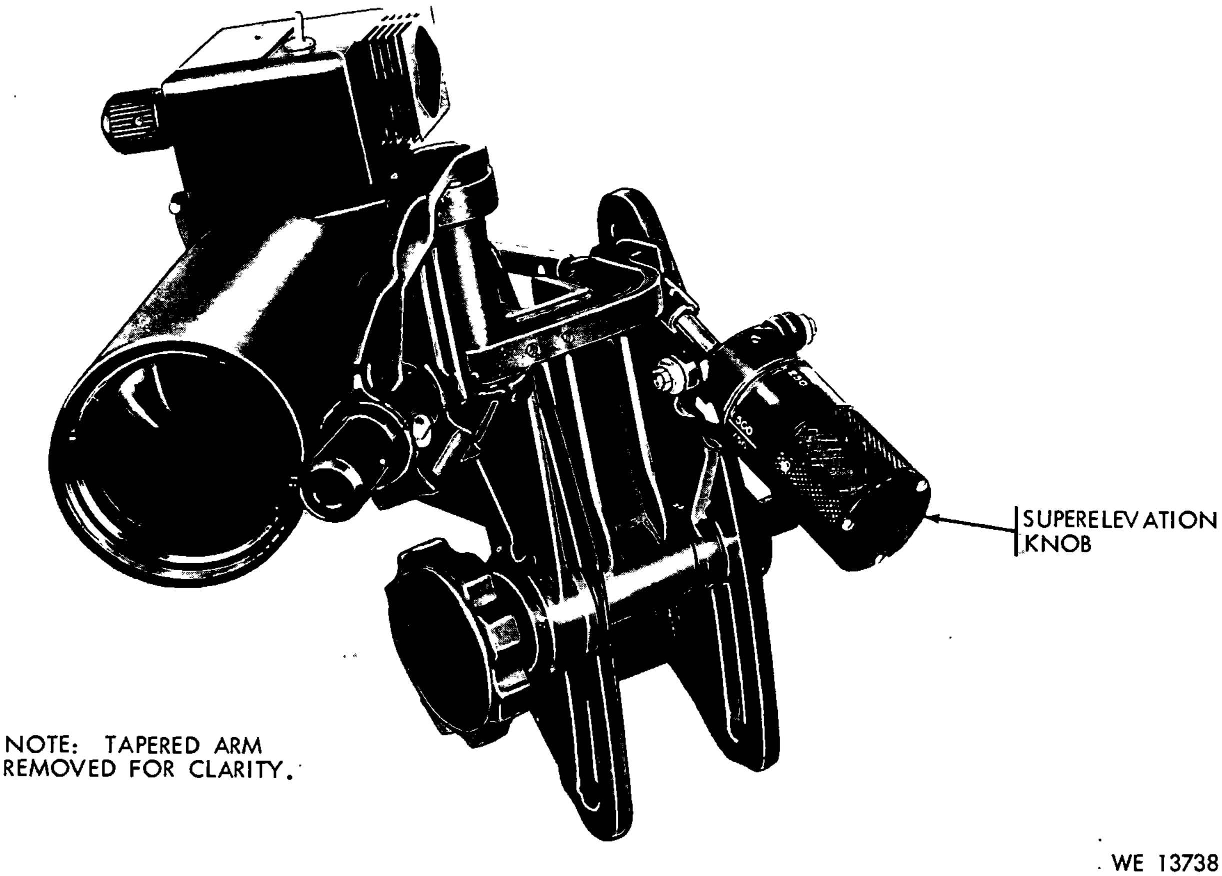

Figure C–38. Zero boresight position set into reflex sight XM70.

pressed, and install boresight in upper barrel (12 o'clock position).

c. Sight through boresight, and position helicopter so that line of sight is on the point target.

Note. Helicopter leveling is not required but cant should be as small as possible. Weapon elevation position is not critical and can be at any elevation angle required to acquire the point target.

d. Aline red line on superelevation knob with arrow (fig. C–38). The sight is now in zero boresight position.

e. Position sight in approximate center of height adjustment.

f. Turn power ON to illuminate reticle pattern.

g. Manually adjust sight/weapon drive arm until center of reticle pattern corresponds with same horizontal position on the point target as the weapon position in *c* above. The sight and weapon now have the same effective elevation angle with respect to the helicopter.

h. Check the line of sight of both the reflex sight and gun boresight, to make certain they intersect on the point target. If necessary, adjust boresight adjustment screws (fig. C–37) until line of sight of gun and reflex sight intersects.

i. Remove gun from cradle support, turn power off on pilot's console, and tighten nuts and bolts securing gun cradle support to tube support.

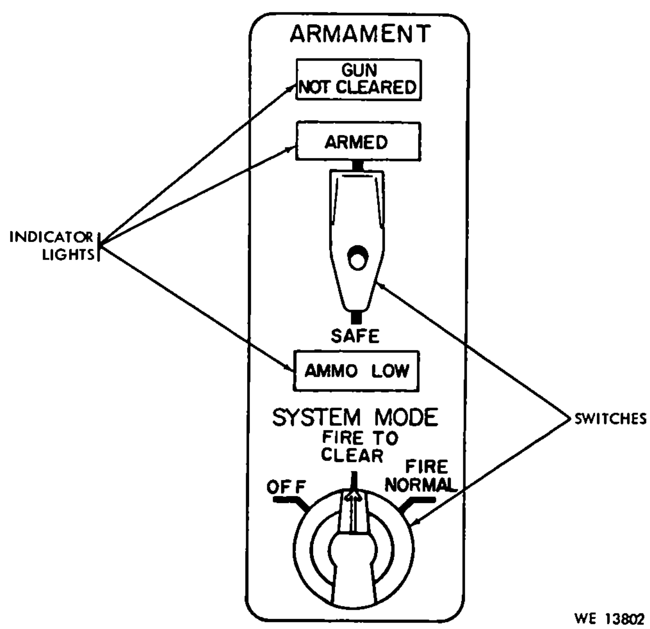

Figure C–39. Helicopter armament control panel—controls.

C–29. Operational Checks, Troubleshooting, and Preventive Maintenance

a. Operational Checks. For operational checks, refer to table C–2 and figures C–36 and C–39.

***Warning:* Do not attempt to perform operational checks with a loaded gun.**

Note. Make sure helicopter 28 volt DC supply is ON and armament circuit breaker is depressed.

b. Troubleshooting. For troubleshooting procedures, see table C–3.

c. Preventive Maintenance. Preventive maintenance will be in accordance with TM 9–1005–281–15.

C–30. Loading and Unloading

a. Loading Instructions.

(1) Prior to loading or unloading the gun, check to make sure the following exist:

(*a*) Helicopter master battery switch is OFF.

(*b*) Armament SYSTEM MODE switch is OFF and ARMED/SAFE switch in SAFE position.

(*c*) Warning lights out.

Table C–2. Operational Checks

Check sequence	Control	Operation and check
1	ARMED/SAFE switch	Place in SAFE position.
2	SYSTEM MODE switch	Place in OFF position. GUN NOT CLEARED, ARMED, and AMMO LOW lights should be out.
3	SYSTEM MODE switch	Place in FIRE TO CLEAR position. AMMO LOW light comes on. GUN NOT CLEARED and ARMED lights are out.
4	ARMED/SAFE switch	Raise switch guard and place switch in ARMED position. ARMED light comes on.
5	Cyclic stick trigger switch	Press switch to fire, either 2,000 or 4,000 shots per minute position. Gun rotates for approximately 3 seconds.
6	SYSTEM MODE switch	Place in FIRE NORMAL position.
7	Cyclic stick trigger switch	Press switch to fire. GUN NOT CLEARED lights comes on. Gun rotates for approximately 3 seconds.
8	SYSTEM MODE switch	Place in FIRE TO CLEAR position.
9	Cycle stick trigger switch	Press switch to fire. GUN NOT CLEARED light goes out. Gun rotates approximately 3 seconds.
10	ARMED/SAFE switch	Place in SAFE position.
11	SYSTEM MODE switch	Place in either FIRE TO CLEAR or FIRE NORMAL position.
12	Reflex sight filament selector switch	Place in either filament position. Reticle lamp comes on. Switch to other filament position. Reticle lamp comes on.
13	Reflex sight reticle illumination	Rotate knob. Intensity of light should increase when turning clockwise.
14	Reflex sight filament selector switch	Place in opposite position.
15	Cyclic stick elevation/depression switch	Push up on switch—weapon elevates. Push down on switch—weapon depresses.
16	Low ammunition indicator	Remove cover from right hand ammunition box and raise activator. AMMO LOW light should go out. (If adjustment is necessary, turn adjusting screw in until switch opens and back out one full turn.)
17	SYSTEM MODE switch	Place in OFF position. *Note.* Turn off helicopter 28 volts DC supply and pull out armament circuit breaker.

Table C–3. Troubleshooting

Malfunction	Probable cause	Corrective action
	7.62 MILLIMETER AUTOMATIC GUN M134	
Ammunition belt separation.	Defective relay (K6—high current).	Voltage check at K1. Replace relay if necessary.
Fails to rotate or fire.	Defective wiring.	Check continuity. Repair as necessary.
	Defective mode control switch in control panel.	Replace switch or control panel.
	Defective firing relay contacts K1.	Replace firing relay.
	Defective CR5 diode.	Test for forward conductance. Replace if necessary.
	F1 (5A) fuse blown.	Replace.
	Defective SAFE-ARMED switch.	Replace switch or control panel.
	Arming circuit breaker open.	Reset. Repeated failure; replace control box assembly.
	Defective drive motor.	Replace.
	Damaged cartridges in gun.	Clear gun and check ammunition for damaged cartridges.
	Foreign material in barrel chamber(s).	Remove material and clean barrel(s) and chamber(s).
	Damaged bolt assemblies.	Replace as required.
	Loose cable connections.	Tighten.
	Damaged delinking feeder.	Repair.
Rotates but will not fire.	Damaged or unserviceable cartridges.	Clear gun and check ammunition lot.
	Linked cartridges separated.	Link cartridges or replace defective links.
	Broken firing pin.	Replace.
	Broken firing pin spring.	Replace.
	Damaged bolt heads.	Replace.
	Burred firing pins or bolt heads.	Remove burs.
	Loose or damaged electrical connections to delinking feeder.	Tighten electrical connector or replace delinking feeder.
Fires but rate is low.	Gun dirty or not properly lubricated or both.	Clean and lubricate.
	Burred or damaged bolt assemblies.	Inspect and remove burs; repair or replace bolt assemblies.
	Burred or damaged cam tracks in rotor assembly or housing.	Inspect and remove burs; repair or replace as required.
Stops firing.	Damaged cartridge.	Clear gun.
	Bolt head separated from bolt assembly.	Remove bolt head and replace firing bolt head assembly.
	Damaged rotor assembly.	Replace gun.
Fails to feed.	Damaged or broken guide bar.	Replace.
	Bent or broken fingers on gun housing.	Repair or replace housing.
	Damaged or broken extractor on bolt head.	Replace firing bolt head assembly.
Fails to extract.	Damaged or broken extractor on bolt head.	Replace firing bolt head assembly.
	Bent or broken guide bar allows round to feed ahead of bolt assembly.	Replace guide bar.
	Damaged rim on cartridge.	Clear gun. Inspect for bent or damaged parts which would damage rim on cartridge.

Table C-3. Troubleshooting—Continued

Malfunction	Probable cause	Corrective action
Fails to eject.	Bent or broken guide bar.	Replace guide bar.
	Damaged gun housing assembly.	Replace.
Excessive dispersion of bullets.	Barrels—heat warped or excessively worn rifling.	Replace barrels.
	Loose barrel clamp allows barrel	Tighten barrel clamp.
Gun continues to fire after trigger is released (fire-out).	Defective switch in cyclic stick.	Check continuity; if switch is defective, notify avionics repairman.
	Defective components in control box.	Check continuity; replace defective components.
Gun does not clear.	Defective mode control switch.	Replace switch or control panel.
	Defective wiring.	Check continuity; repair as necessary.
	Defective M2 or K5 relays.	Replace.
Gun drives at low rate only.	Defective trigger switch.	Replace switch.
	Defective wiring.	Check continuity; repair as necessary.
	Defective M1 gun start time delay.	Replace time delay module.
	7.62 MILLIMETER GUN MOUNT	
Mount will not elevate or depress.	Bent or defective housing and tube assembly.	Repair or replace.
	Defective control box.	Check continuity; replace defective components.
	Worm and gear run into mechanical stop.	Turn off the stop by hand.
	Defective switch in cyclic stick.	Check continuity; if switch is defective, notify avionics repairman.
	Defective drive motor.	Replace.
	Defective wiring.	Check continuity. Repair as necessary.
	Defective gearhead clutch assembly.	Replace housing and tube assembly. Return to higher echelon for repair.
	Torque tube binds in housing.	Replace housing and tube assembly.
Mount will elevate but not depress.	Defective depress relay K2.	Replace.
	Cyclic stick "elevation/depression"/ switch defective.	Replace.
	Defective control box.	Check continuity; replace defective components.
Mount will depress but not elevate.	Defective elevation relay K3.	Replace.
	Cyclic stick "elevation/depression" switch defective.	Replace.
Mount runs to elevation or depression limit when switch is pressed and released.	Defective switch in cyclic stick.	Check continuity; if switch is defective, notify avionics repairman.
	Defective control box.	Check continuity; replace defective components.
	REFLEX SIGHT XM70	
No light visible in reticle projector.	Power switch OFF.	Place switch in ON position.
	Light intensity too low.	Turn reticle illumination knob in clockwise direction.
	One filament burned out.	Switch filament selector to opposite position.
	Loose or poor electrical connection.	Check plug connections in receptacle. Check cable for visible breaks.

Table C–3. Troubleshooting—Continued

Malfunction	Probable cause	Corrective action
	Defective switch or wiring.	Notify DS maintenance.
Lamp does not reach full brightness.	Lamp positioned incorrectly.	Remove and insert lamp with frosted area adjacent to lenses.
	Defective rheostat.	Notify DS maintenance.
No reticle pattern on beamsplitter.	No light in reticle projector.	Notify DS maintenance.
	Support arm improperly positioned.	Insure that arm assembly is locked in operating position.
Reticle pattern not sharp or clear.	Optical elements may be dirty, wet or fogged.	Clean with lens tissue.
	Optical elements not positioned properly.	Notify depot maintenance.
Superelevation knob binds.	Improper lubrication.	Notify DS maintenance.
	Bent shaft.	Notify DS maintenance.
Looseness between fitted parts.	Excessive wear.	Notify DS maintenance.
	Screws not secure.	Notify DS maintenance.

(2) Fold ammunition belt into ammunition boxes and work it through ammunition chute to the delinking feeder as shown in figure C–40.

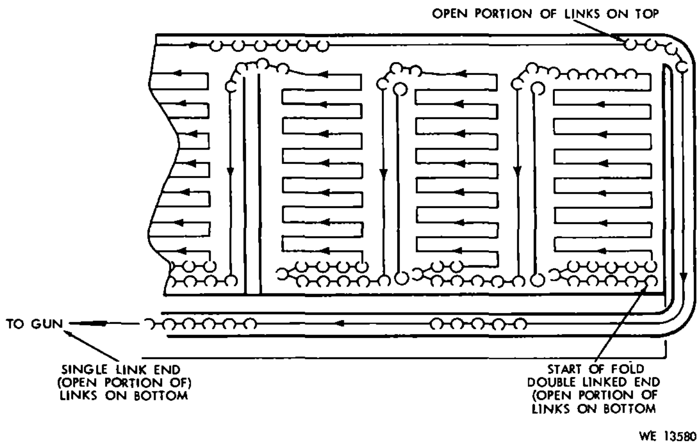

Figure C–40. Schematic drawing of ammunition belt "folded" into ammunition box assemblies.

(3) Remove safing sector and housing cover of gun.

(4) Work ammunition belt into delinking feeder as shown in figure C–41.

(5) With gun slightly depressed, rotate gun barrels counter-clockwise (as viewed from rear of gun) until a round drops from the delinking feeder.

(6) Install safing sector and housing cover to gun; and cover assemblies to ammunition boxes.

b. Unloading Instructions.

(1) Repeat instructions contained in *a*(1) above.

Warning: **A firing pin may be cocked and ready to be released. Before removing safing sector and housing cover, rotate barrels clockwise (opposite firing direction) to prevent firing.**

(2) Remove safing sector and housing cover from the gun.

(3) Release ammunition chute from delinking feeder and remove one cartridge from the linked cartridges.

(4) Manually rotate barrels counterclockwise (firing direction) until remaining cartridges are cleared from delinking feeder and the gun.

(5) Remove covers from ammunition box assemblies and pull linked ammunition into ammunition box.

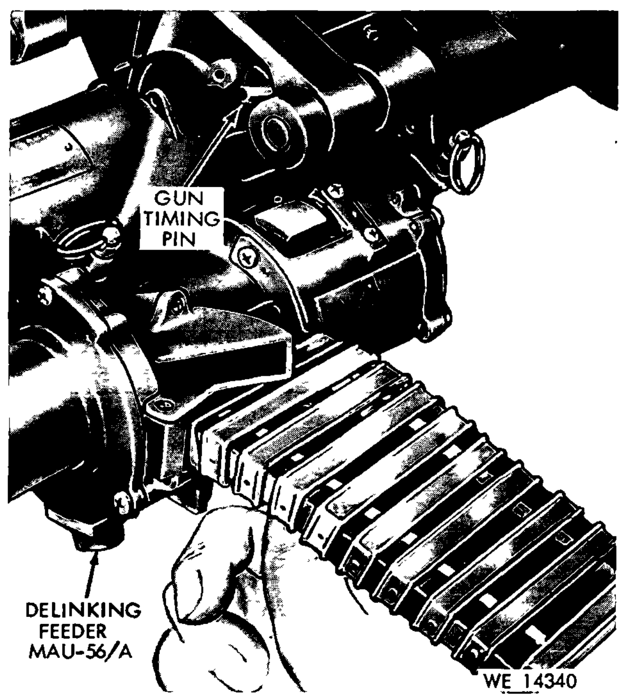

Figure C–41. Working ammunition into delinking feeder.

APPENDIX K
HELICOPTER ARMAMENT AMMUNITION

K–1. General

Aircraft weapons subsystems require several types of standard and nonstandard munitions. For details concerning the munitions required for each subsystem, see the appropriate TM 9-series. This appendix lists munitions required for helicopter armament subsystems.

K–2. 7.62MM Ammunition

a. Commonly used 7.62mm (NATO) helicopter machinegun subsystem ammunition includes—

(1) M59 or M80—ball.
(2) M61—armor piercing (AP).
(3) M62—tracer.

b. Two additional types of 7.62mm ammunition not normally used in machinegun subsystems are—

(1) M63—dummy.
(2) M60—high-pressure, test.

K–3. Caliber .50 Ammunition

a. Numerous types of caliber .50 ammunition are used in helicopter armament subsystems including—

(1) M2—armor piercing.
(2) M8—armor piercing, incendiary.
(3) T49—armor piercing, incendiary.
(4) M20—armor piercing, incendiary, tracer.
(5) M33—ball.
(6) M1—incendiary.
(7) M23—incendiary.
(8) M1—tracer.
(9) M10—tracer.
(10) M17—tracer.
(11) M21—tracer.

b. Other caliber .50 ammunition available for training and testing includes—

(1) M1—blank.
(2) M2—dummy.
(3) M1—high-pressure, test.

K–4. 20MM Ammunition

Different types of 20mm guns are listed below with their ammunition type requirements.

a. M24A1, Gun, 20mm, Automatic, Single-Barrel.

(1) M95—armor piercing, tracer.
(2) M58—high explosive, incendiary.
(3) M97A1—high explosive, incendiary.
(4) M96—incendiary.
(5) M99—target practice.
(6) M18—dummy.

b. Automatic 20mm Six-Barrel Gun: M61 and M61A1—Electric Drive; XM130—Gas Drive.

(1) T221E3—armor piercing, incendiary.
(2) M55A1—ball.
(3) M56A1 (T198E1)—high explosive, incendiary.
(4) M51 (T228)—dummy.
(5) M54 (T156)—high-pressure, test.

K–5. 30MM Ammunition

Ammunition for the XM140, gun 30mm, automatic (WECOM–30), single-barrel includes the XM552 cartridge, high explosive, dual purpose; the XM554, practice (spotter); and the XM639 (inert).

K–6. 40MM Ammunition

a. The 40mm ammunition used in the M75 or XM129 launchers includes—

(1) M384—cartridge, high explosive.
(2) M385—cartridge, practice.
(3) XM428E1—cartridge, practice (spotting).
(4) XM430—cartridge, high explosive, dual purpose.
(5) XM574—cartridge, white phosphorous.

b. To allow detonation at impact angles of from 90° to low graze angles of 5°, 40mm ammunition is provided with the M533 fuze.

K–7. 2.75-Inch Folding Fin Aerial Rockets (FFAR)

a. Launchers for the 2.75-inch FFAR include— for the 2.75-inch FFAR include—

(1) XM141—seven tube, reloadable, reusable.
(2) XM157—seven tube, reloadable, reusable, not repairable.

(3) XM157B—seven tube, reloadable, reusable, extra long.

(4) XM158—seven tube, reloadable, reusable, repairable.

(5) XM159—19 tube, reloadable, reusable, not repairable.

(6) XM159C—19 tube, reloadable, reusable.

b. Warheads for the 2.75-inch FFAR are—

(1) Mk1—high explosive, 6 lb.

(2) Mk67—white phosphorous, 6 lb.

(3) M151—high explosive, 10 lb.

(4) XM152—high explosive, white phosphorous, red marker, 6 lb.

(5) XM153—high explosive, white phosphorous, yellow marker, 6 lb.

(6) M156—white phosphorous, 10 lb.

(7) XM157—smoke, red, 10 lb.

(8) XM158—smoke, yellow, 10 lb.

(9) XM229—high explosive, 17 lb.

(10) XM230—practice, 10 lb.

(11) XM232—practice, spotting, 10 lb.

(12) WDU-44/A—flechette, 10 lb.

c. Fuzes for the 2.75-inch FFAR include—

(1) M423E1—PD (graze sensitive).

(2) XM427—redesign of M423 to allow delayed arming.

(3) XM29—proximity.

d. Types of 2.75-inch FFAR motors are—

(1) Mk4—high speed (unscarfed).

(2) Mk40—low speed (scarfed).

(3) Mk40—low speed (scarfed), redesign of Mk40.

K–8. M22 Missile Subsystem Ammunition

Ammunition for the M22 subsystem includes an AGM–22B guided missile with high explosive antitank warhead, an ATM–22B guided missile with inert warhead filled with a marking powder, and an ATM guided missile with completely inert warhead.

K–9. Munitions for Special Attack Helicopter Missions

The munitions listed below are not normally used in attack or limited attack helicopter roles and missions. However, they could be used on attack helicopters during special missions.

a. XM147—bomb, fragmentation (XM9).

b. XM142—bomb, antitank (XM9).

c. XM144—bomb fragmentation (XM25).

d. XM920E2—bomb, fuze and burster, CS in 55-gallon drum.

e. Mk24—flare, aircraft, parachute.

f. E158—50 lb. CS canister cluster.

g. E159—130 lb. CS canister cluster (two E/58 with strongback).

h. Helicopter trap weapon—to sanitize landing zones.

i. Fuel—air explosive, to sanitize landing zones.

j. E39R1—smoke tank (Kellet pylon).

k. XM52—smoke generator, exhaust stack mounted.

Subject	Hours	Type	Scope	References*
Rotary wing aerial fire ranges.	2	Conference	A detailed discussion of the range requirements to support rotary wing aerial fire training on all approved weapons subsystems to include appropriate references, safety procedures, range fans, terrain requirements, range dimensions, target locations and materials, range marking, and supervisory responsibilities.	Chapter 13; AR 385–63.
Low-level navigation	3	Conference and practical exercises.	Advanced low-level flight, planning techniques, map selection and preparation, selection of route checkpoint and air control point, in-flight procedures to include inflight change-of route procedures, and flight and radio discipline.	FM 21–26; TM 1–225.
Attack helicopter employment.	2	Conference	Conference covering tactical employment of attack helicopters to include considerations for target attacks, a summary of types of attack helicopter missions, and typical organization for combat.	Chapters 3, 4, 5, and 7; FM 1–110.
Range firing	10	Practical exercise.	Practical exercise on air-to-ground firing techniques using all armament subsystems.	Appendixes L and M.

*Unless otherwise noted, references are to this publication.

L–20. Ranges

a. Recommended Range. A recommended range for aviator firing exercises is shown in figure L–2. Range firing provides the gunner with training in identifying, acquiring, and shooting at targets. Helicopter flightpaths and firing lane must be clear of other range impact areas. Diagrams should be obtained to show adjacent aerial gunnery ranges, artillery ranges, and small arms ranges. Tables L–1 contains recommended range dimensions for various weapons systems. Area "A" is the ricochet area, area "B" is the buffer zone. Distance "X" is measured from the cease-fire line. Area "G" may be eliminated when, in the opinion of the range control officer, the aviator has demonstrated a continuing aptitude to retain all impacts within the prescribed impact area or when a qualified instructor pilot is on board. Written range safety regulations and range firing and safety standing operating procedure must be on hand at each installation.

b. Targets. All targets should be placed within

Aircraft	Speed (knots)	Firing lane (meters)	Weapons	Distance "X"*	Distance "Y"	Minimum Safe Engagement Range
				(meters)		
UH–1	Below 100 ..	400 x 1,600 (all weapons)	7.62mm	3,800	100	100
			40mm	3,000	200	300
			2.75-inch	7,700	300	300
			Caliber .50	7,400	----	200
			20mm	----	200	200
			30mm	----	200	200
			Wire-guided missiles	4,900	1,000	500
AH–1G	Above 100 ...	1,000 x 3,000 (all weapons)	7.62mm	3,800	100	200
			Caliber .50	7,400	----	400
			20mm	----	200	400
			30mm	----	200	400
			40mm	3,000	200	500
			2.75-inch	7,700	300	500
			Wire-guided missiles	----	----	Not applicable

*When a qualified instructor pilot is on board, distance "X" may be reduced 30 percent.

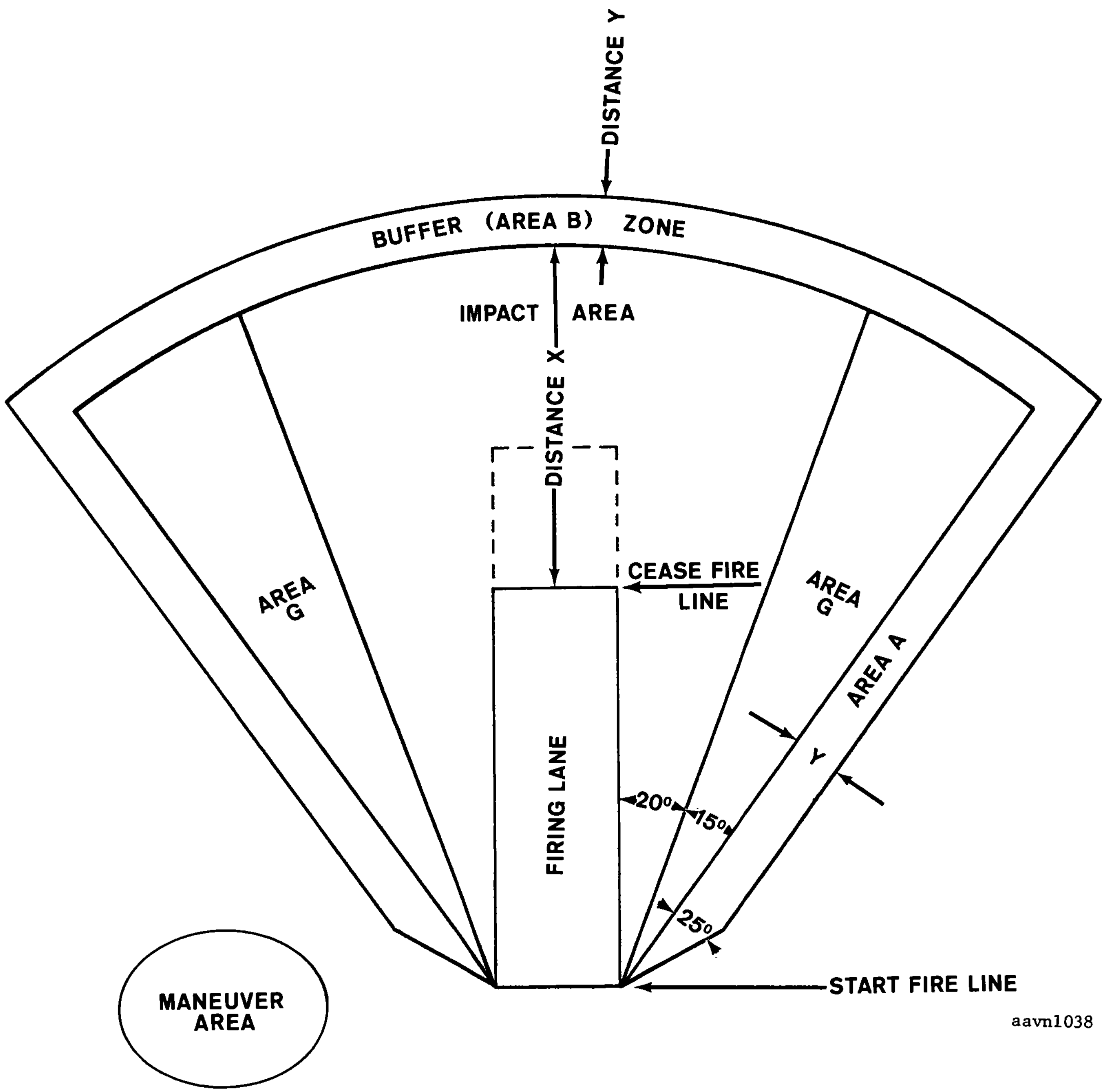

Figure L–2. Recommended range for aviator firing exercises.

the firing lane or an extension of the firing lane. Available equipment and funds will determine the types of targets to be used. The three types of targets are—

(1) *Hard targets.* Hard targets, e.g., old car bodies and/or tank hulls, make very durable and good targets for initial training. These targets should be painted in different bright colors. One of each of these targets should be located at close, mid, and extreme ranges.

(2) *Silhouettes.* Silhouettes make very good training targets and add a degree of realism. They should be placed in normal combat formations at various ranges.

(3) *Panels.* Numbered or colored, 10-foot by 10-foot target cloth panels on 2-inch by 4-inch frames are the least desirable type of targets because they are very rapidly destroyed by rocket fire.

c. Engagement.

Table L–11. Familiarization Firing

Exercise	Type Fire	Target Range (meters)	Quantity of Ammunition	Altitude (feet)	Targets per Firing Run	Remarks
1	Harmonization, hovering, and diving.	500–1,000	750 (7.62mm)	Hovering, 1,000–200	2–4	Aircraft heading varies through flexible limits.
2	Running	500–1,000	750 (7.62mm)	Nap-of-the-earth	2–4	Aircraft heading varies 20° left and right.
3	Harmonization, hovering, and diving.	500–1,200	4/20/75* (40mm)	1,000–200	4–6	
4	Running	500–1,200	4/20/75* (40mm)	Nap-of-the-earth	4–6	Aircraft heading varies 20° left and right.
5	Diving	1,250	4/1/4* (2.75-inch rocket)	1,000–500	1	To obtain combat sight.
6	Diving	1,000–2,500	2–4/1–2/4* (2.75-inch rocket)	1,200–500	1–2	
7	Running	750–1,250	3/1/3* (2.75-inch rocket)	Nap-of-the-earth	1	
8	Diving	1,000–1,500	1/4/4*	1,200–500	1	Salvo of four 2.75-inch FFAR's.

*Firing runs/rounds per run/total rounds.

Note. Exercises 1 through 4 are gunner familiarization exercises and 5 through 8 are for aircraft commander familiarization firing.

M–31. Ground Range Firing

All ground door gunner firing exercises must be conducted under the direction of a range control officer. Each gunner should fire about 200 rounds of 7.62mm linked ammunition (four rounds of ball to one round of tracer). The unit commander should determine the exact number of rounds required for training. While M60 machinegun firing is being conducted from towers on the range, M60 machinegun familiarization training can be conducted concurrently at three training stations.

M–32. Aerial Range Firing

All aerial door gunner firing must be conducted under the direction of a range control officer. This officer must be located either on the ground or in a control tower that has complete visibility of all aerial firing. To control range firing, the range control officer must have radio communications with all helicopters using the range. The aerial range firing phase of instruction is designed to teach the door gunner the fundamental principles of air-to-ground machinegun fire. The door gunner should fire a sufficient number of rounds of 7.62mm linked ammunition (four rounds of ball to one round of tracer) to demonstrate the gunnery proficiency desired by the unit commander. He should be allowed to fire during all flight maneuvers, i.e., climbing, descending, shallow and steep turns, and nap-of-the-earth.

M–33. Scoring

Although no standard scoring system or qualification has been developed, scoring will be based on the instructor's judgment of the accuracy of fire on target.

APPENDIX O
FIRING DATA

(To be published)

INDEX

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