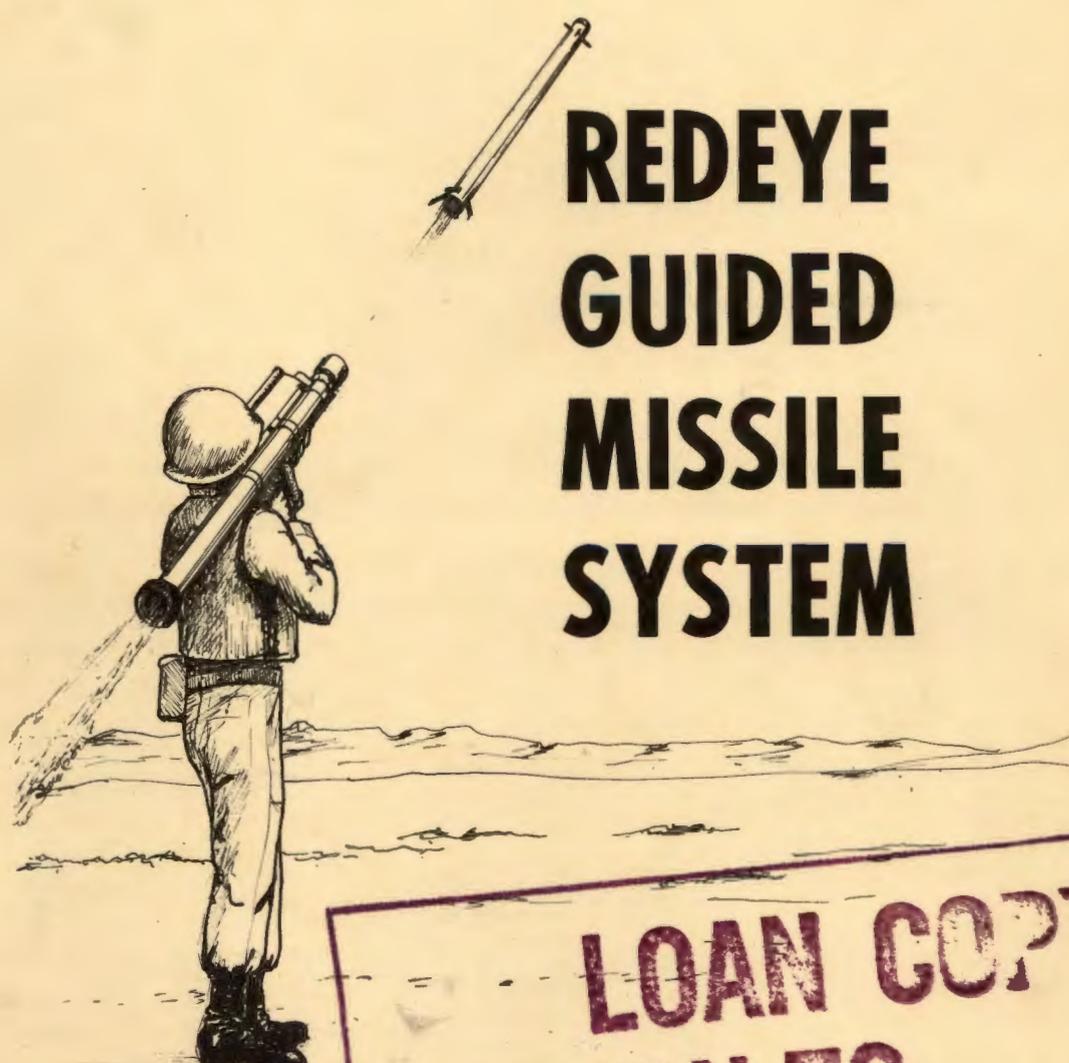


FIELD MANUAL



REDEYE GUIDED MISSILE SYSTEM

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HEADQUARTERS, DEPARTMENT OF THE ARMY

OCTOBER 1971

FIELD MANUAL }
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REDEYE GUIDED MISSILE SYSTEM

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PART ONE
SYSTEM DESCRIPTION

CHAPTER 1
INTRODUCTION

1-1. Purpose and Scope

a. This manual provides guidance for Redeye defense section personnel and others concerned with Redeye training and operations. Part one encompasses system description and operation; gunner operating procedures; target engagement procedures; system maintenance; decontamination and destruction of materiel; and shipment, storage, and security. Part two contains guidance for air defense leaders and other personnel on mission, organization, responsibilities, and equipment; fundamentals of employment; command and control; communications; reconnaissance, selection, and occupation of position; survivability; and Redeye combat operations. Part three contains information to assist personnel concerned with Redeye training and includes section and team drill, guided missile training set M76, moving target simulator, Redeye training procedures, and range firing.

b. The material contained herein is applicable without modification to both nuclear and non-nuclear warfare.

c. The techniques and procedures described herein are primarily for guidance and are adaptable to various combat situations. Commanders may modify them as required by local conditions. Instructors will find that this manual, together with FM 23-17A, FM 44-1A, ASubjScd 23-17, and ATT 44-3, provides a basis for the conduct of Redeye training.

d. This manual is restricted to the presentation of unclassified data on the Redeye system. Classified information can be found in supplementary manuals, FM 23-17A and FM 44-1A.

1-2. Recommended Changes and Comments

Users of this publication are encouraged to submit recommended changes or comments to improve the publication. Comments should be keyed to the specific page, paragraph, and line of 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 Commandant, US Army Air Defense School, ATTN: ATSAD-DL, Fort Bliss, Texas 79916.

1-3. References

Publications used as references for this manual and those offering further technical information on subjects included herein are listed in appendix A. Redeye employment doctrine for specific military branches is included in FM 6-140, FM 7-10, FM 7-20, and FM 17-1.

1-4. Abbreviations

Abbreviations are defined the first time they are used in this manual. For a list of military abbreviations, see AR 310-50.

CHAPTER 2

SYSTEM DESCRIPTION AND OPERATION

Section I. GENERAL

2-1. Introduction

Reye is a man-portable, shoulder-fired, air defense guided missile system designed to provide combat units with the capability of destroying low-altitude hostile aircraft. Because it is man-portable, it can be deployed easily and flexibly throughout the forward area. The Redeye weapon can be employed to provide protection for critical areas or to cover probable enemy air approaches. It moves with the troops, providing continuous and responsive air defense. Redeye can destroy a wide variety of aerial targets, including jet and propeller aircraft, helicopters, and reconnaissance drones. Redeye, when employed

by well-trained gunners, is an effective air defense weapon.

2-2. System Description

The Redeye guided missile system (intercept-aerial guided missile system) (fig 2-1) is composed of five basic items: Redeye weapon (a missile, launcher, and battery/coolant unit combination); shipping and storage container (monopak M571 or unipak XM585); guided missile test set AN/TSM-82 (XO-1); and two training devices; field handling trainer (intercept-aerial guided missile system M46A2) and training set M76. For Redeye guided missile system data, refer to table 2-1.

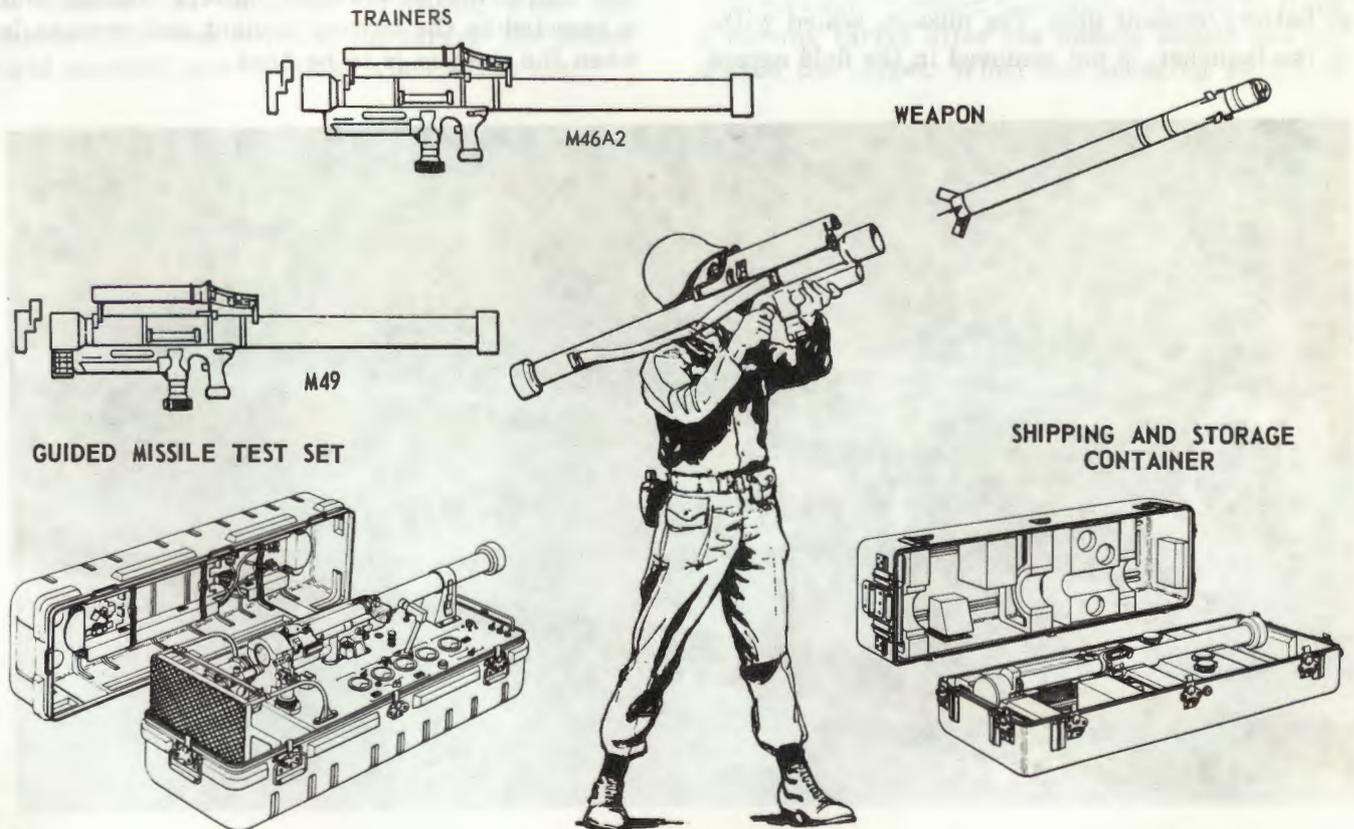


Figure 2-1. Redeye guided missile system.

Table 2-1. Redeye Guided Missile System Data

Item	Length (inches)	Width (inches)	Height (inches)	Diameter (inches)	Weight (pounds)
Redeye weapon (complete with cover and launcher battery/coolant unit) M41	50.5	4.7 (sight folded)	10.9 (sight folded)	---	28.9
Missile	47.5	---	---	2.75	18.0
Launcher (without cover, sling, and launcher battery/coolant unit (BCU))	29.7	---	---	3.61	8.5
Launcher BCU (M41)	6.0	---	---	1.86	1.2
Receptacle cap (M41)	3.9	---	---	1.9	0.09
Shipping and storage container (monopak) (M571)	56.5	15.5	12.5	---	42.5 (empty) 75.0 (full)
(Unipak) (XM585)	56.5	10.0	15.5	---	19.0 (empty) 50.0 (full)

Section II. DESCRIPTION OF PRINCIPAL COMPONENTS

2-3. Redeye Weapon

The Redeye weapon (fig 2-2) consists of three major components—launcher, missile, and launcher battery/coolant unit. The missile, sealed within the launcher, is not removed in the field except

by firing. The launcher houses the missile prior to firing and provides the controls and power and coolant channels necessary for target acquisition and firing. A launcher battery/coolant unit is inserted in the battery/coolant unit receptacle when the weapon is to be fired.

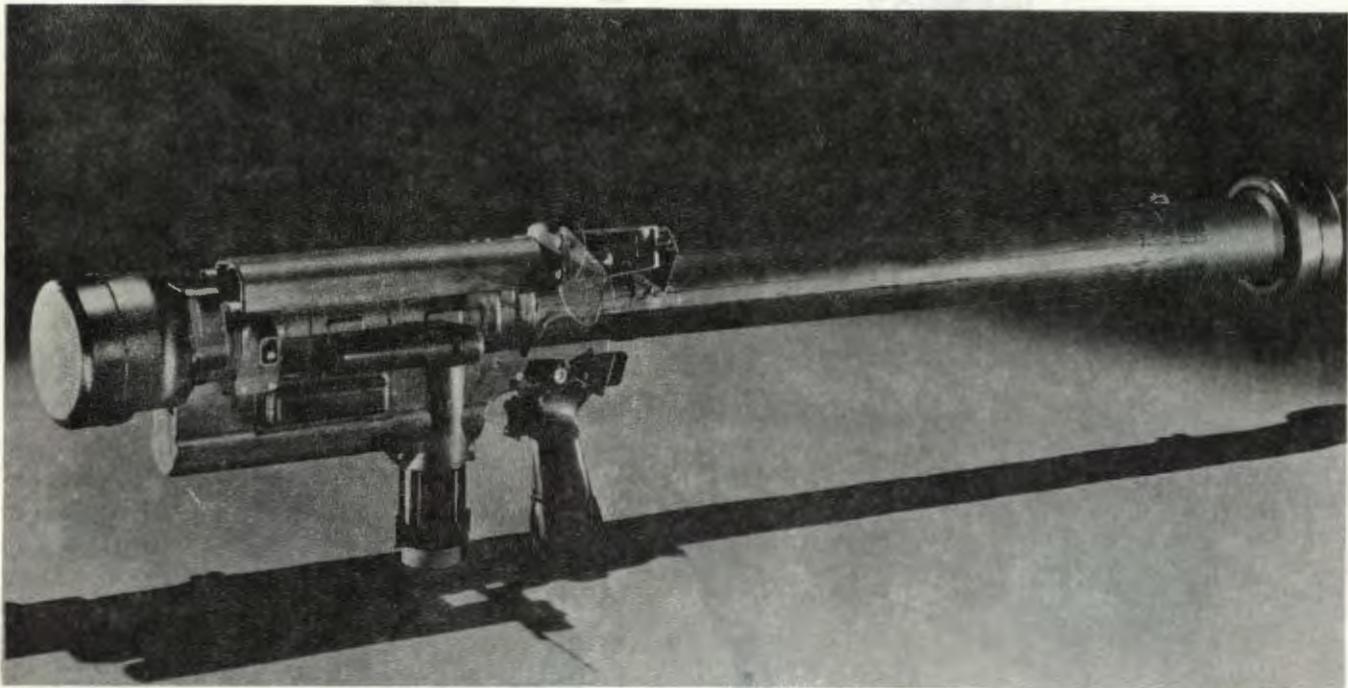


Figure 2-2. Redeye weapon.

a. *Launcher.* The Redeye launcher (fig 2-3) has three main sections—launch tube, open sight assembly, and gripstock. It provides the means for transporting, aiming, and firing the missile. The electrical connection between launcher and missile is made through a retractable launcher-to-missile connector (umbilical assembly). The launcher is discarded after the missile is fired.

(1) *Launch tube.* The launch tube, a cylindrical container which houses the missile, is the main support for all other parts of the launcher. Both ends of the launch tube are sealed with breakable disks. The purpose of these disks is to seal the missile in a low-humidity environment. The front disk is transparent to infrared (IR) radiation and allows the missile to sense the target without breaking the seal. Both disks break when the missile is fired.

(2) *Open sight assembly.* The Redeye weapon has an open sight assembly (fig 2-4) which provides the means to aim the weapon, track the target, perform range estimation, and insert superelevation and lead. The sight provides reticles for ranging and for the insertion of superelevation and lead. The sight assembly has an acquisition indicator mounted to the rear of the sight cover. This device provides the gunner with an audible and vibratory indication when the missile seeker has acquired the target. The entire sight assembly can be folded when not in use.

(3) *Gripstock.* The launcher gripstock assembly is attached to the lower forward end of the launch tube. It contains the controls and power and coolant channels necessary to launch the missile. The pistol grip, near the center of balance, is the natural right-hand hold point of the weapon. Located forward of the pistol grip is the battery/coolant unit receptacle which has a receptacle cap installed when the weapon is not in use.

(a) *Controls.* The controls consist of the safety and actuator device, uncaging switch, and firing trigger.

1. *Safety and actuator device.* The safety and actuator device is a manually operated mechanism located on the left side of the gripstock assembly (fig 2-3). When locked, the device prevents inadvertent activation of the thermal battery in the launcher battery/coolant unit. Manual operation of the device activates the thermal battery to furnish power for the missile and launcher electrical systems and release the coolant gas to cool the seeker detector cell in the missile.

2. *Uncaging switch.* The uncaging switch is a manually operated switch located on the left side of the gripstock assembly (fig 2-3). It is manually pressed to uncage the gyro to track a moving target after the missile seeker has acquired the target. When the uncaging switch is

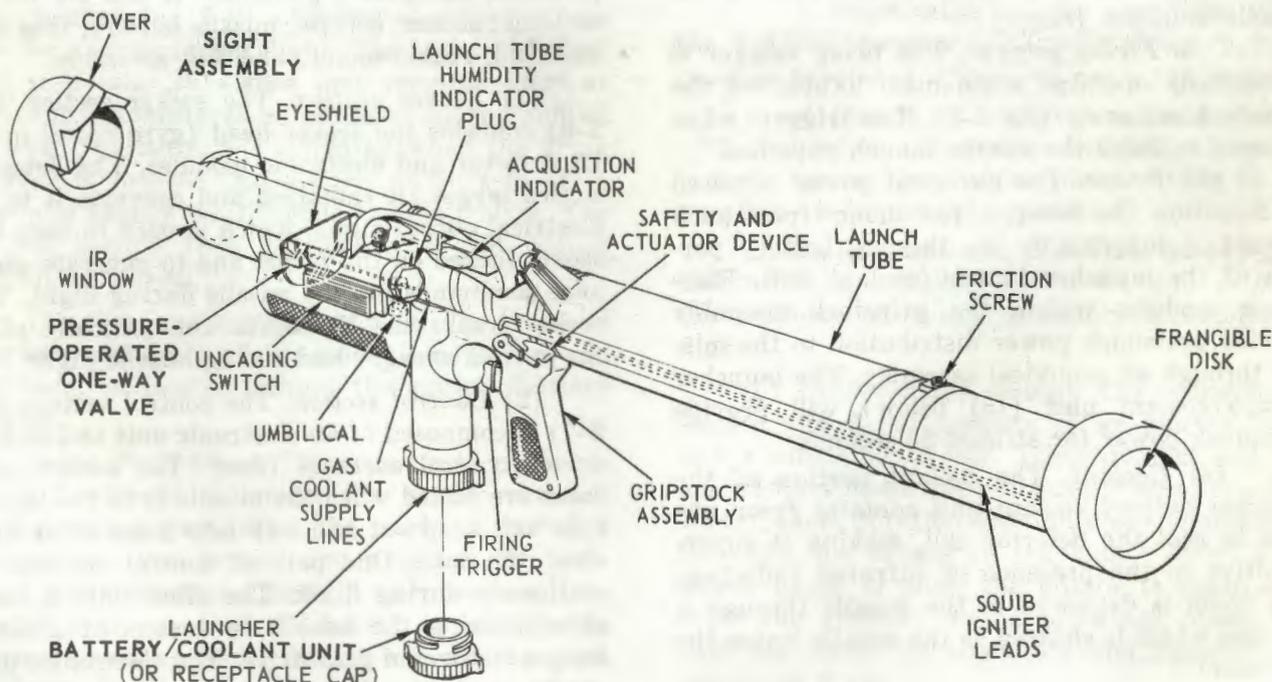


Figure 2-3. Redeye launcher (exploded view).

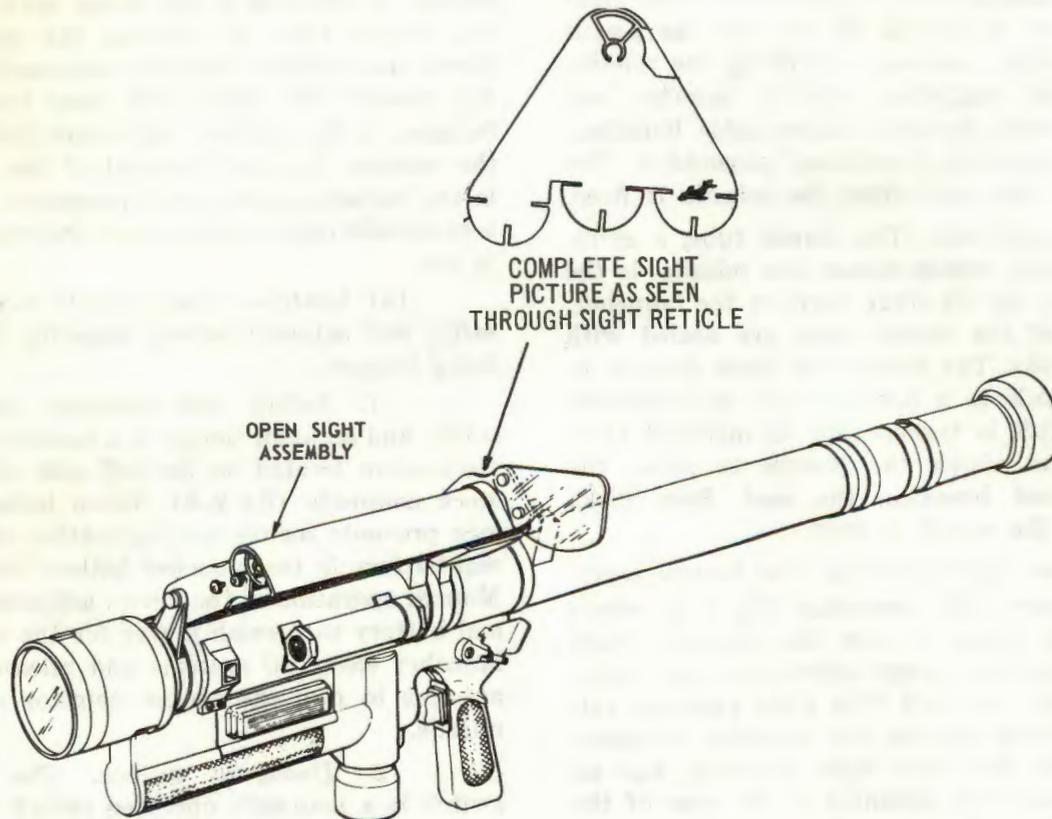


Figure 2-4. Open sight assembly.

released, the gyro is electrically locked and held in alignment with the longitudinal axis of the missile/launcher (caged).

3. *Firing trigger.* The firing trigger is a manually operated mechanism located on the gripstock assembly (fig 2-3). The trigger, when pressed, initiates the missile launch sequence.

(b) *Power.* The electrical power required to condition the weapon for firing (prelaunch power) is supplied by the thermal battery portion of the launcher battery/coolant unit. Electronic modules within the gripstock assembly provide prelaunch power distribution to the missile through an umbilical assembly. The launcher battery/coolant unit ((c) below) will provide prelaunch power for at least 30 seconds.

(c) *Coolant.* The coolant portion of the launcher battery/coolant unit contains freon gas used to cool the detector cell, making it super-sensitive to the presence of infrared radiation. The freon is delivered to the missile through a gas line which is sheared as the missile leaves the launcher.

b. *Redeye Missile.* The Redeye guided missile (fig 2-5) is a supersonic, surface-to-air missile

using passive infrared (IR) homing and proportional navigation guidance. It has six major sections: seeker, control, missile battery, fuze and warhead, rocket-motor, and tail assembly.

(1) *Seeker section.* The seeker section (fig 2-6) contains the seeker head (gyro optics unit) IR detector and electronic modules. The detector senses target IR radiation and converts it to an electrical output signal which is used to keep the seeker locked on the target and to generate guidance commands for the missile during flight. The seeker tracks the IR source automatically after the gyro is uncaged and during missile flight.

(2) *Control section.* The control section (fig 2-7) is composed of an electronic unit and motor-driven control surfaces (fins). The control surfaces are folded when the missile is in the launch tube and snap out and lock into place after they clear the tube. One pair of control surfaces is stationary during flight. The other pair is movable, steering the missile by means of a servo torque motor and gear drive. The electronics unit senses error signals generated by the seeker section and sends amplified electronic signals to the steering motor. The amplified error signals are

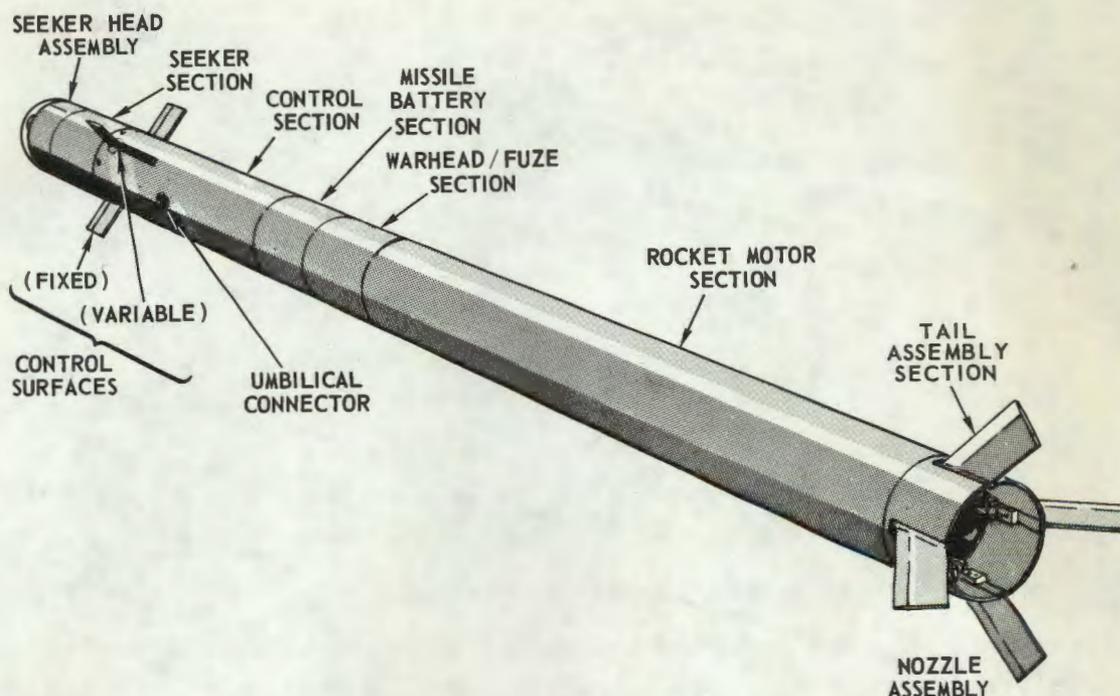


Figure 2-5. Redeye missile.

converted to steering commands which direct the missile to the target. During prelaunch, electrical power for the operation of the control section is provided by the launcher battery/coolant unit through an umbilical assembly.

(3) *Missile battery section.* The missile battery section (fig 2-8) provides electrical power for the missile during flight. The battery electrolyte is a solid substance that remains inert at ambient temperatures encountered by the unfired missile. The battery is activated when the firing trigger is pressed. An electric squib sets off a thermite charge which melts the electrolyte. The missile battery then develops a 40-volt output within 0.5 second.

(4) *Fuze and warhead section.* The fuze and warhead section (fig 2-9), consisting of a fuze and warhead, is located behind the missile battery section.

(a) *Fuze timer.* The fuze timer performs three functions: it ignites the sustainer motor at the proper time, arms the warhead during a subsequent time period, and prepares the warhead for detonation. Safety features are included to insure that the missile is safe during normal shipping and handling movements prior to firing. Further details on time sequence functions are explained in paragraphs 2-15—2-19.

(b) *Warhead.* The warhead performs two functions: it provides the explosive force to destroy the target and, if the missile fails to hit the target, destroys the missile after a set time of flight. The warhead, when armed, can be detonated in any one of three ways.

1. *Penetration impulse generator.* When the warhead penetrates a metal object, a firing pulse is generated which detonates the warhead.

2. *Inertia sensing device.* To further insure detonation, an inertia sensing device detonates the warhead upon deceleration of the missile as it impacts the target.

3. *Self-destruct.* Should a missile miss the target, a self-destruct circuit will detonate the warhead after approximately 15 seconds of flight.

(5) *Rocket-motor section.* The rocket-motor section (fig 2-10) consists of an ejector motor and a sustainer motor. Three distinct and separate rocket-motor performance phases are a high thrust, short duration ejection phase to accelerate and spin the missile in the launch tube; a no-power phase to allow the missile to coast away from the gunner; and a sustainer phase that provides thrust to accelerate and maintain the missile in flight.

(a) *Ejector motor.* The ejector motor pro-

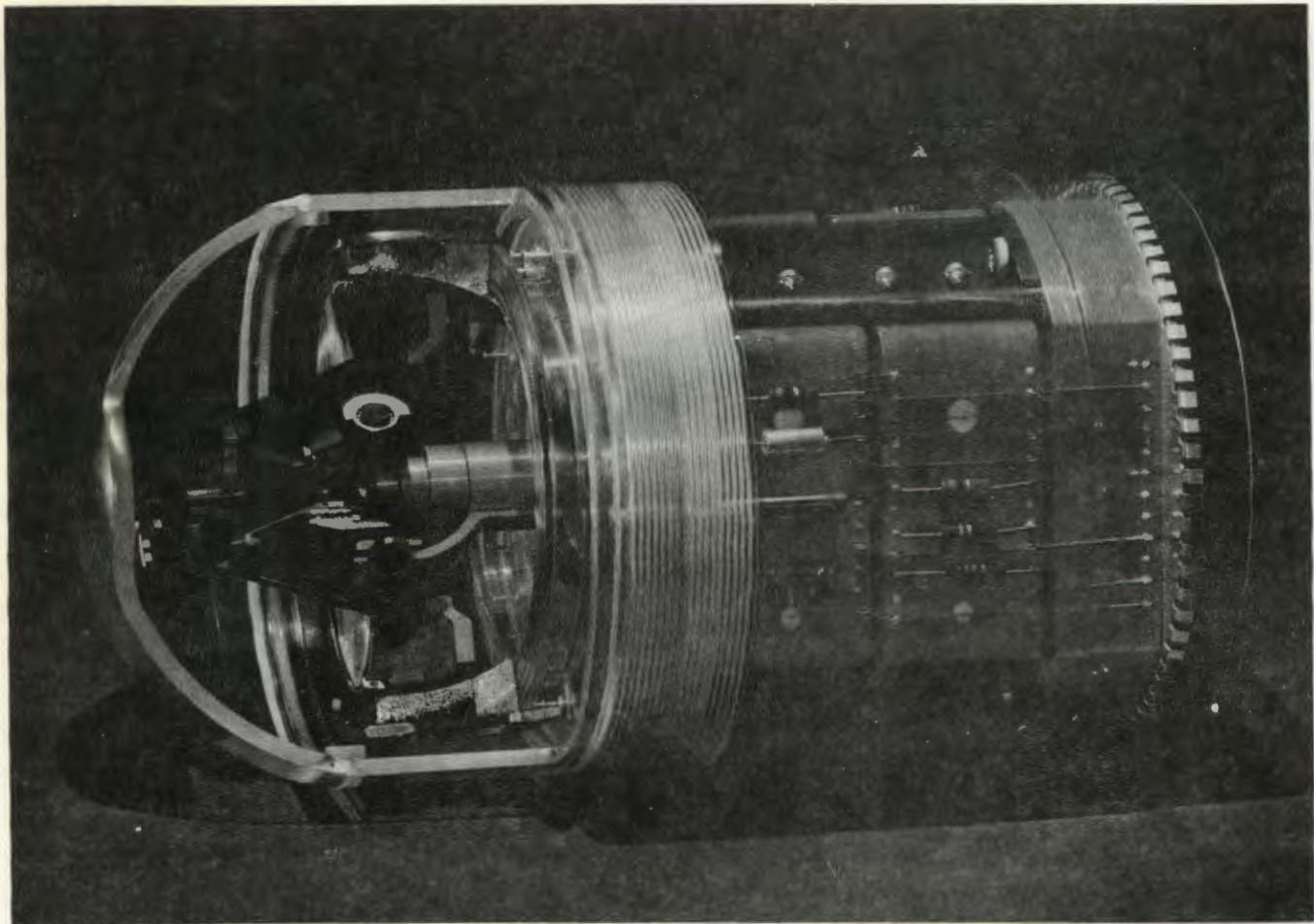


Figure 2-6. Seeker section.

vides the thrust to eject the missile from the launch tube. When the trigger is pressed, the missile battery activates and retracts the umbilical. Retraction of the umbilical causes the eject motor to fire. The propellant is expended before the missile leaves the launch tube. The missile, during ejection, is caused to spin by the action of the propellant gases on the folded tail fins ((6) below). The missile then coasts for approximately 7 meters before the fuze timer fires the sustainer motor, thereby providing gunner safety from sustainer motor backblast.

(b) *Sustainer motor.* The sustainer motor contains a rapid-burning, solid propellant which provides the thrust to accelerate the missile and maintain its flight attitude.

(6) *Tail assembly section.* The tail assembly section (fig 2-11) consists of four stabilizing fins that are in a folded position while the missile is in the launch tube. When the missile is fired, the ejector motor exhaust (gases) strikes the tail fins which are canted. The resultant reaction

causes the missile to spin counterclockwise (viewed from the rear) as it moves forward in the launch tube. After the missile is ejected from the launch tube, the tail fins unfold and lock in flight position. These airfoil-shaped fins then react against the atmosphere and maintain the roll rate required to stabilize the longitudinal axis of the missile throughout its flight. The tail fins do not provide any guidance action.

c. *Launcher Battery/Coolant Unit.* The launcher battery/coolant unit (BCU) (fig 2-12) consists of a thermal battery which energizes the launcher electrical circuits during the prelaunch sequence and a gas coolant supply unit which cools the infrared detector in the missile seeker to the required operational temperature. The BCU is inserted in its receptacle in the launcher prior to activation of the weapon. The unit is activated when the safety and actuator device on the launcher is pressed forward. Once activated, the battery will supply power for a minimum of 30 seconds, after which it is discarded. If the firing

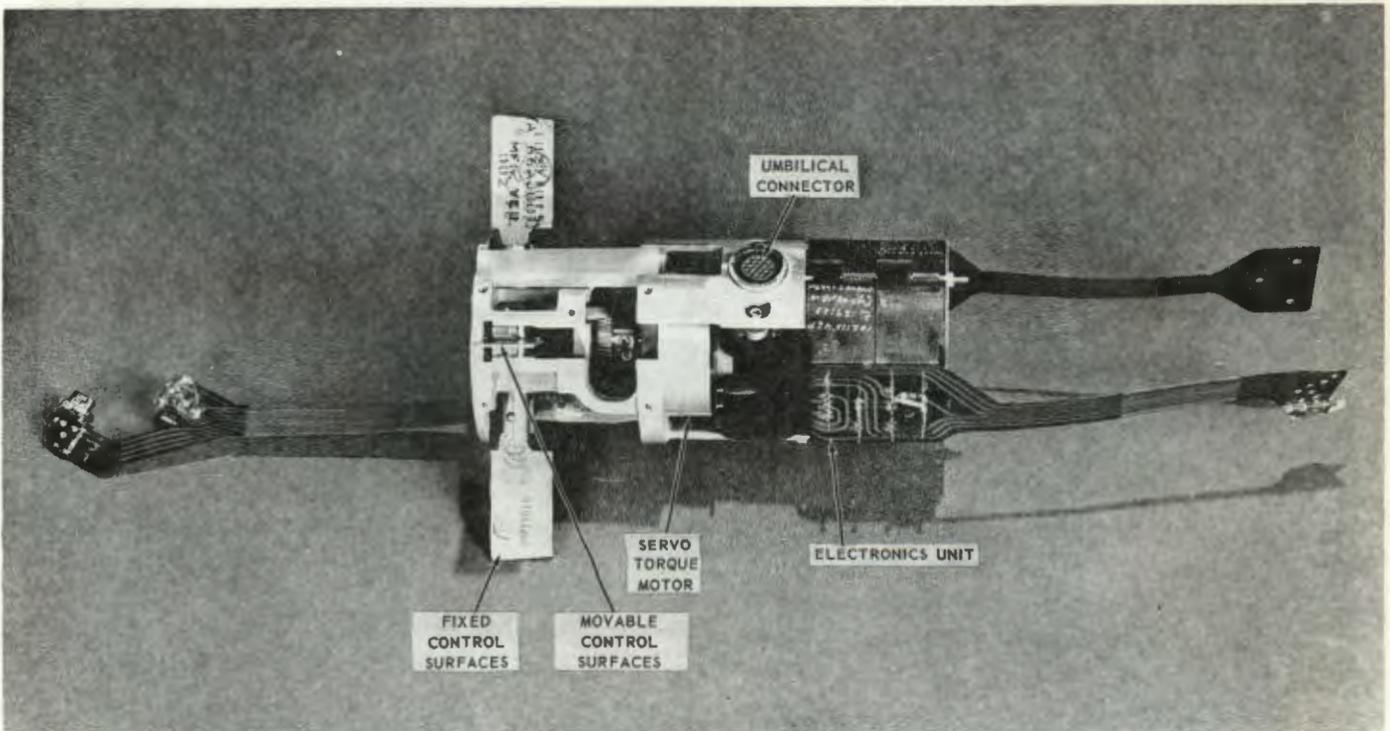


Figure 2-7. Control section.



Figure 2-8. Missile battery section.



Figure 2-9. Fuze and warhead section.

sequence is discontinued any time after the battery is activated and before the missile is fired, the BCU must be replaced. Three BCU are issued with each weapon.

2-4. Shipping and Storage Container

a. *Monopak.* The monopak shipping and stor-

age container M571 (fig 2-13) is a two-piece aluminum shell with a capacity of one Redeye weapon and three battery/coolant units. The container is fungus- and moisture-resistant. Protection is provided against shock and vibration expected to be encountered during all modes of transportation. Saddle-type padded supports hold

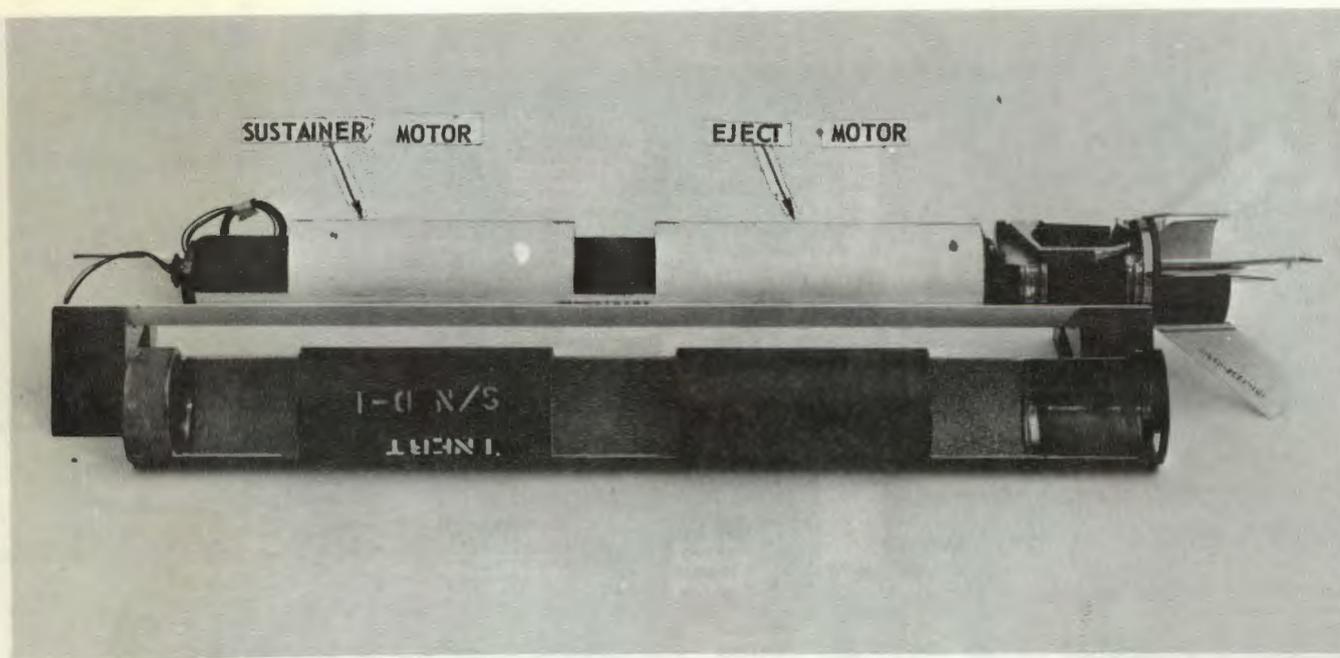


Figure 2-10. Rocket-motor section.

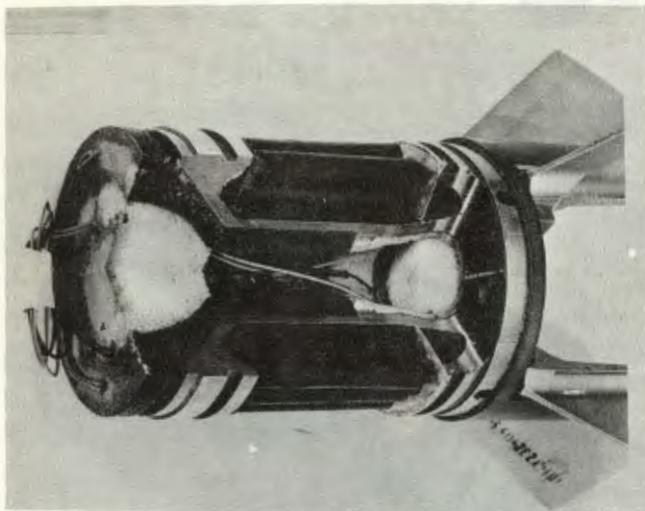


Figure 2-11. Tail assembly section.

the weapon firm within the container. The battery/coolant units are held firm in formfitting holes. The container cover is secured with 10 twist-lock steel latches. Handles are positioned to allow two men to transport and load the container on a vehicle.

b. *Unipak*. The unipak shipping and storage container XM585 (fig 2-14) is a molded flame-retardant polystyrene container with foam cushioning and saddles. A moisture vapor barrier bag

(fig 2-15) encloses the weapon for long-term storage and is removed at the ammunition supply point at the time of issue but remains with the weapon system. The unipak container provides physical and environmental protection to one weapon and three BCU during handling, shipping, and storage conditions encountered in field army use. The unipak container is an expendable item.

c. *Usage of Containers*. The monopak containers are issued for the command stocks of the unit. The unipak containers are issued from the supply points with the basic load for each team. In CONUS the basic load may be issued to teams in monopak containers. The monopak containers can be carried in the trailer M416 or truck, M37-B1; however, they do not form as compact a load as the unipak containers. Both containers provide the required protection for the weapon and either one may be used in any combat environment. When the Redeye in a unipak is transported by helicopter, the Redeye weapon must be inclosed in a moisture vapor barrier bag to provide adequate electrostatic protection.

2-5. Test Set

The guided missile test set (GMTS) AN/TSM-82 (fig 2-1) is used to test the Redeye guided missile system M41. The test set is used by direct

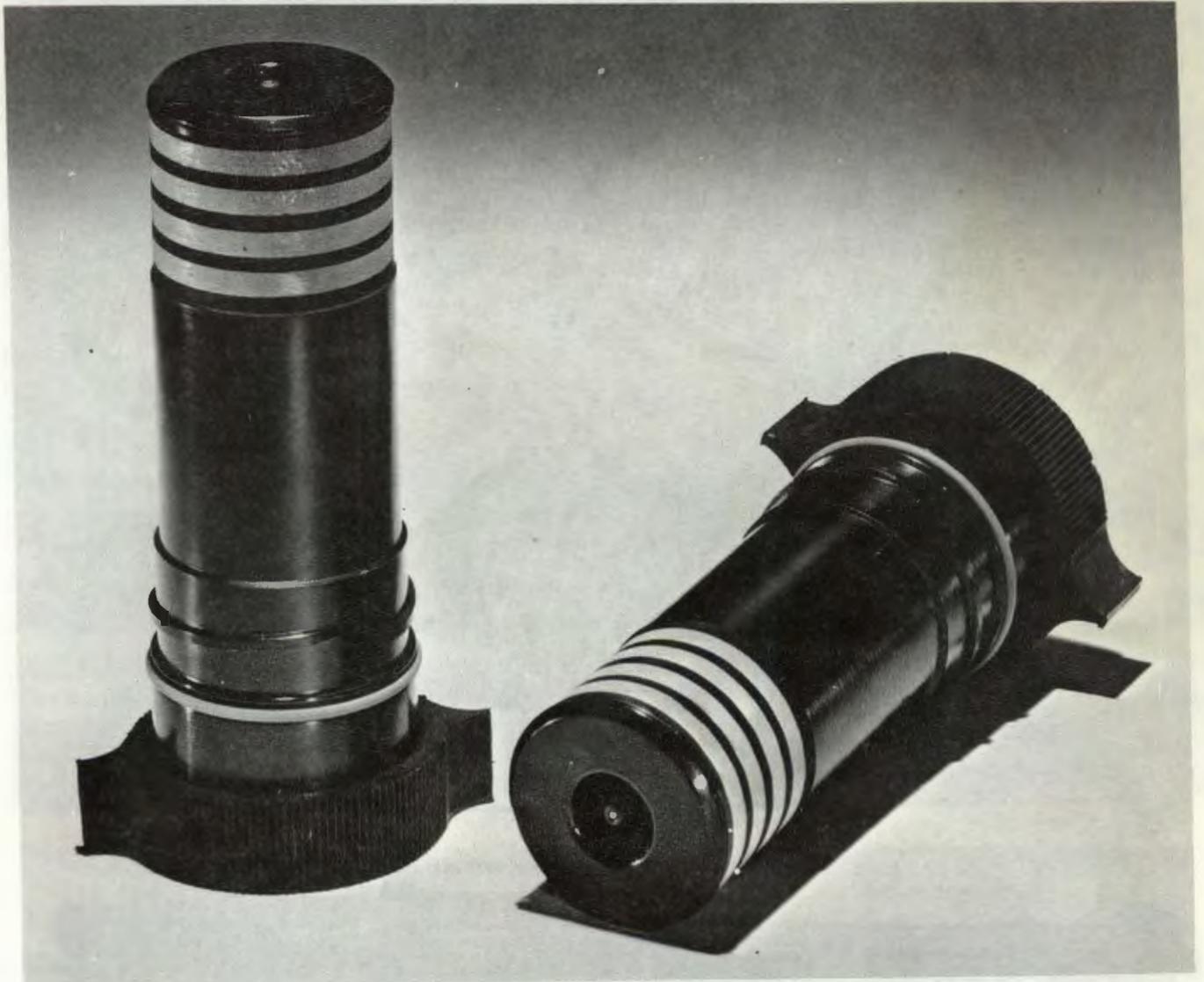


Figure 2-12. Launcher battery/coolant unit.

and general support personnel to perform functional checks on Redeye weapons before they are issued, and at 12-month intervals thereafter. The GMTS provides electrical power and coolant to the weapon and an IR source to test the operation of the seeker. Switches and meters are provided on the GMTS to provide observation of the functions of the Redeye weapon under test. The test set is usually located at the ammunition supply point (ASP). The test set is issued to TOE and TDA units in support of Redeye and these units will provide direct and general support to ASP and the user. (For details on the GMTS, see TM 9-1400-425-35.)

2-6. Field Handling Trainer

The field handling trainer M46A2 (fig 2-16) consists of a full-scale weapon launcher which has been ballasted to simulate the weight and feel of the tactical weapon. The trainer is identical in external appearance to the Redeye weapon. The trainer is a rugged, inexpensive device designed to provide the gunner practice in the basic skills of Redeye weapon handling, operation, sighting, and ranging. Because the trainer does not have an infrared radiation acquisition capability, indications of target acquisition are not provided. Controls and mechanical operations are the same

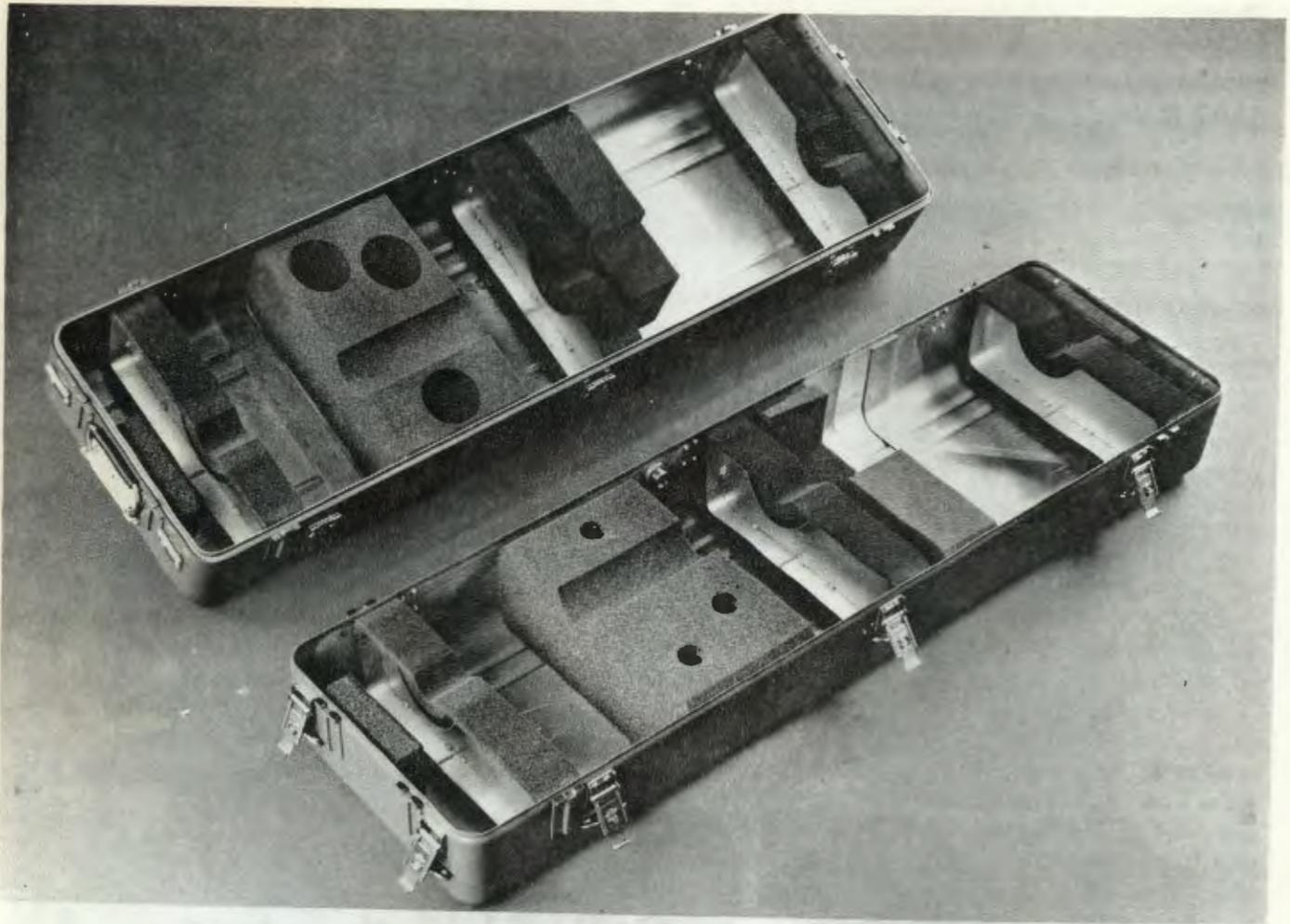


Figure 2-13. Monopak shipping and storage container M571.

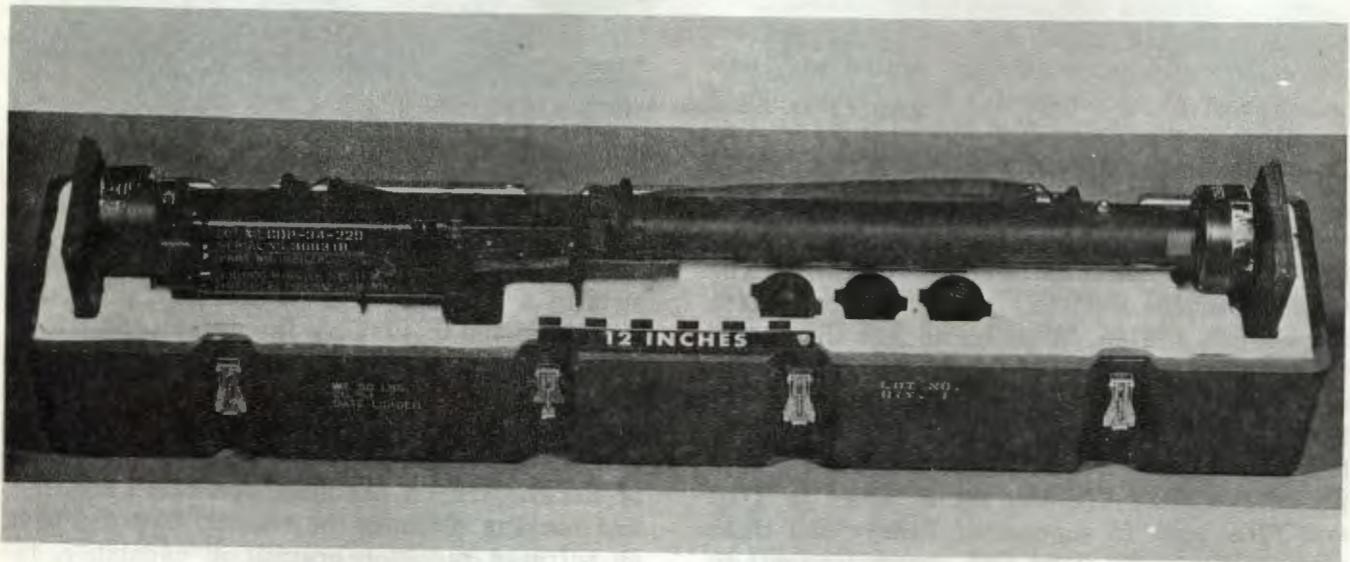


Figure 2-14. Unipak shipping and storage container XM585.

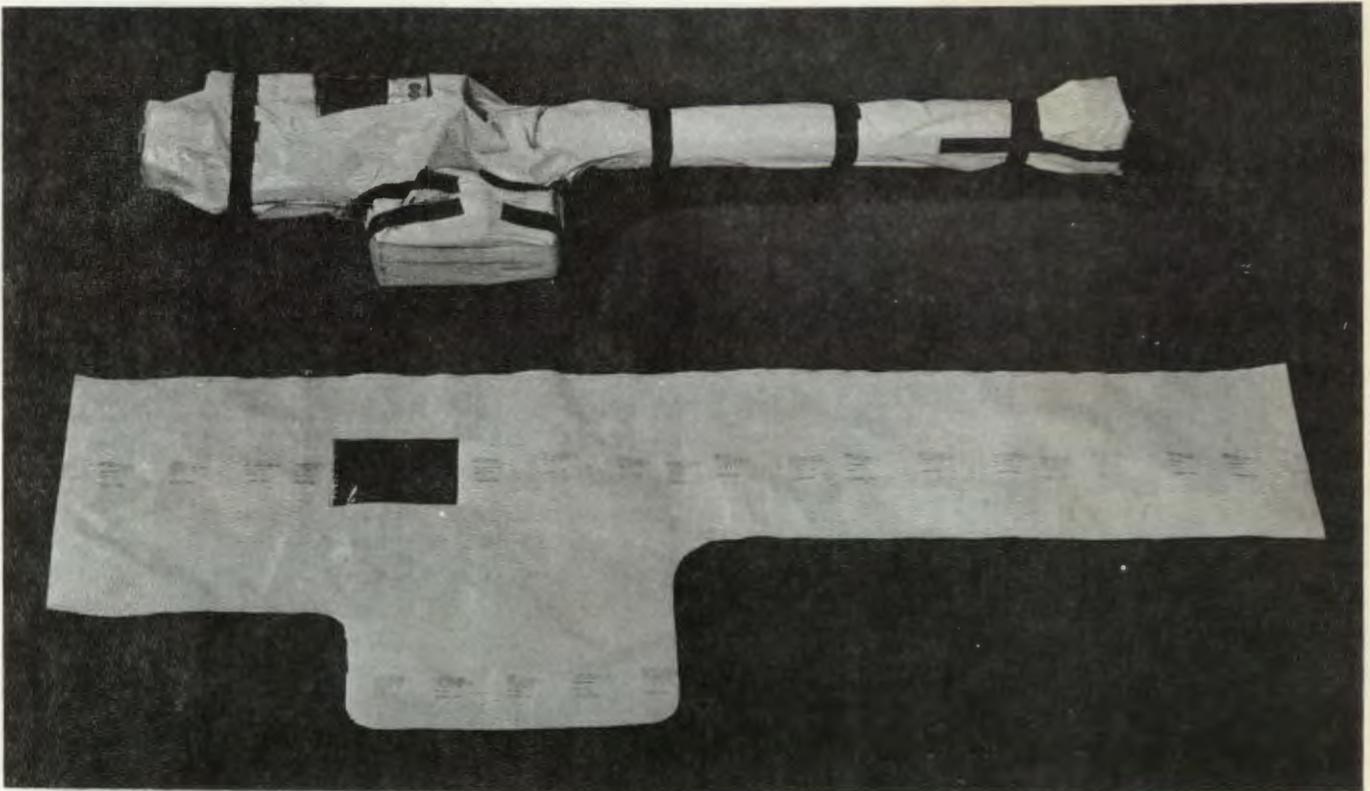


Figure 2-15. Redeye weapon in moisture vapor barrier bag.



Figure 2-16. Field handling trainer M46A2.

as that of the rear weapon. The trainer contains no operational electronic equipment. Each Redeye team is issued a trainer. (For further information, see TM 9-1400-425-12.)

2-7. Guided Missile Training Set

The guided missile training set M76 consists of tracking head trainer M49, four dry batteries

BA-523/PSQ, battery charger PP6118/PSQ, and shipping and storage container M590 (fig 2-17). Description, operating instructions, and procedures for evaluating Redeye gunners on this training set are found in chapter 16. (A complete description of training set M76 and operator and organizational maintenance procedures are found in TM 9-6920-428-12.)

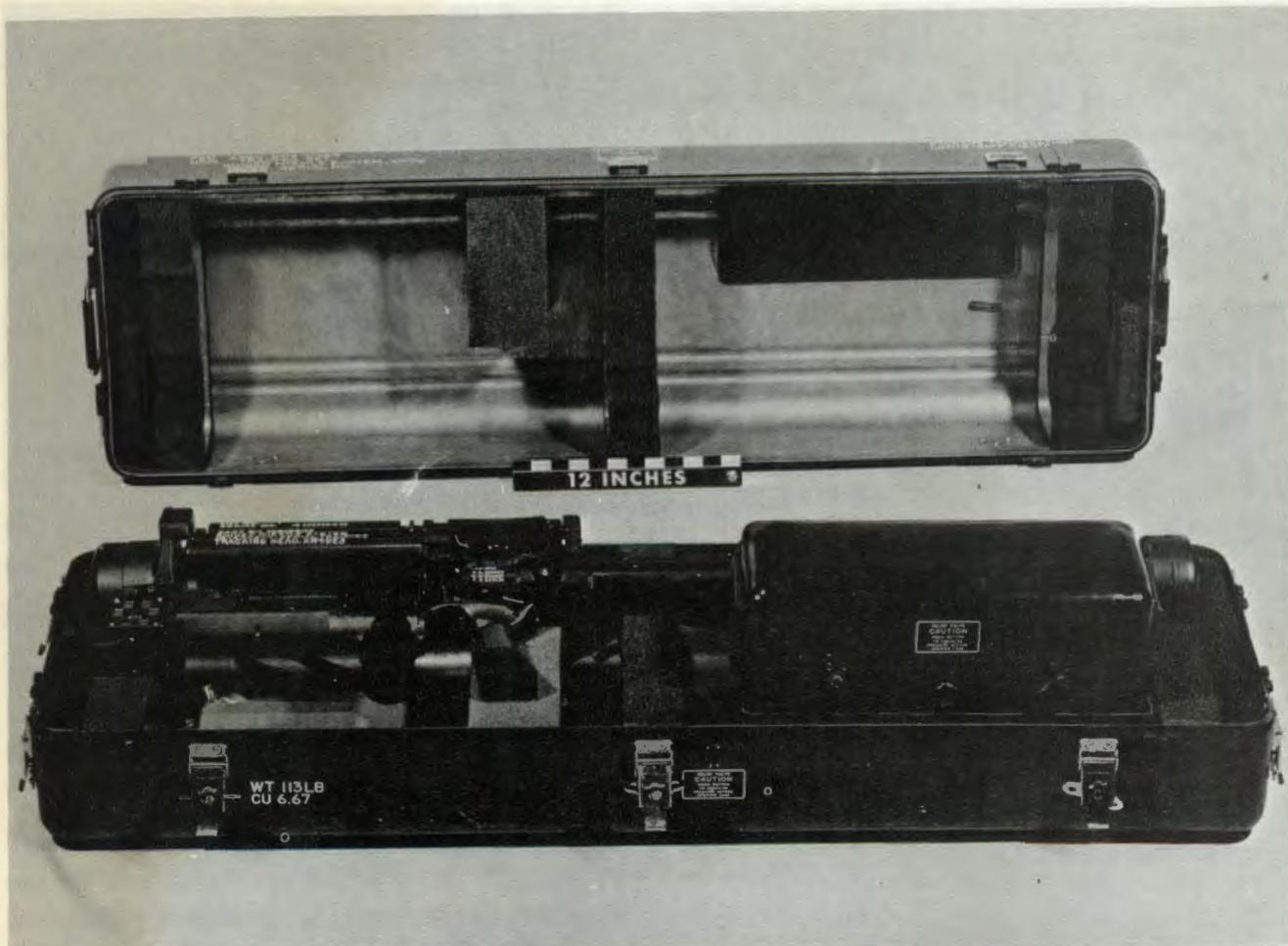


Figure 2-17. Training set M76.

Section III. SYSTEM OPERATION

2-8. General

The Redeye missile is an infrared radiation seeking, passive homing missile; i.e., the missile responds to target radiations in the infrared frequency spectrum and uses these radiations to guide itself to target intercept. The nature of infrared radiation and the sequence of operation of the Redeye missile from activation through warhead detonation are described in this section.

2-9. Nature of Infrared Radiation

a. Infrared (IR) radiation is the band of electromagnetic wavelengths in the infrared frequency spectrum just below visible light. All substances radiate IR energy, the amount depending largely on their temperature. IR energy has pro-

perties similar to light; i.e., it travels in a straight line and at the same speed as light.

b. The missile senses IR radiation emitted by a target by optically focusing this energy on the surface of an infrared detector in the missile seeker system. Optimum sensitivity for the detector cell is obtained at a temperature of approximately -100° F.; the cell is cooled to this temperature by the coolant in the BCU. When the seeker acquires the IR energy emitted by a target, acquisition signals are produced by the weapon which inform the gunner that the target has been acquired.

2-10. Redeye Weapon Operation

Redeye weapon operation begins when a potential target has been sighted and a tentative engage-

ment decision made. The steps in this operation of the Redeye weapon, when fired, consist of internal weapon functions and manual operations performed by the gunner. The steps are described sequentially in paragraphs 2-11-2-19.

2-11. Weapon Activation and Warmup

Weapon activation occurs when the gunner operates the safety and actuator device. This activates the launcher BCU (para 2-3a(3) (a)1). Warmup occurs within a period of 3 to 5 seconds during which certain components are brought up to the mechanical and electrical condition required for system operation. This time lapse and limited BCU life make it necessary to delay weapon activation until the target is at the correct range, and then to fire the weapon within approximately 30 seconds after activation. The following events occur during activation and warmup (fig 2-18).

a. Launcher Battery/Coolant Unit Activated.

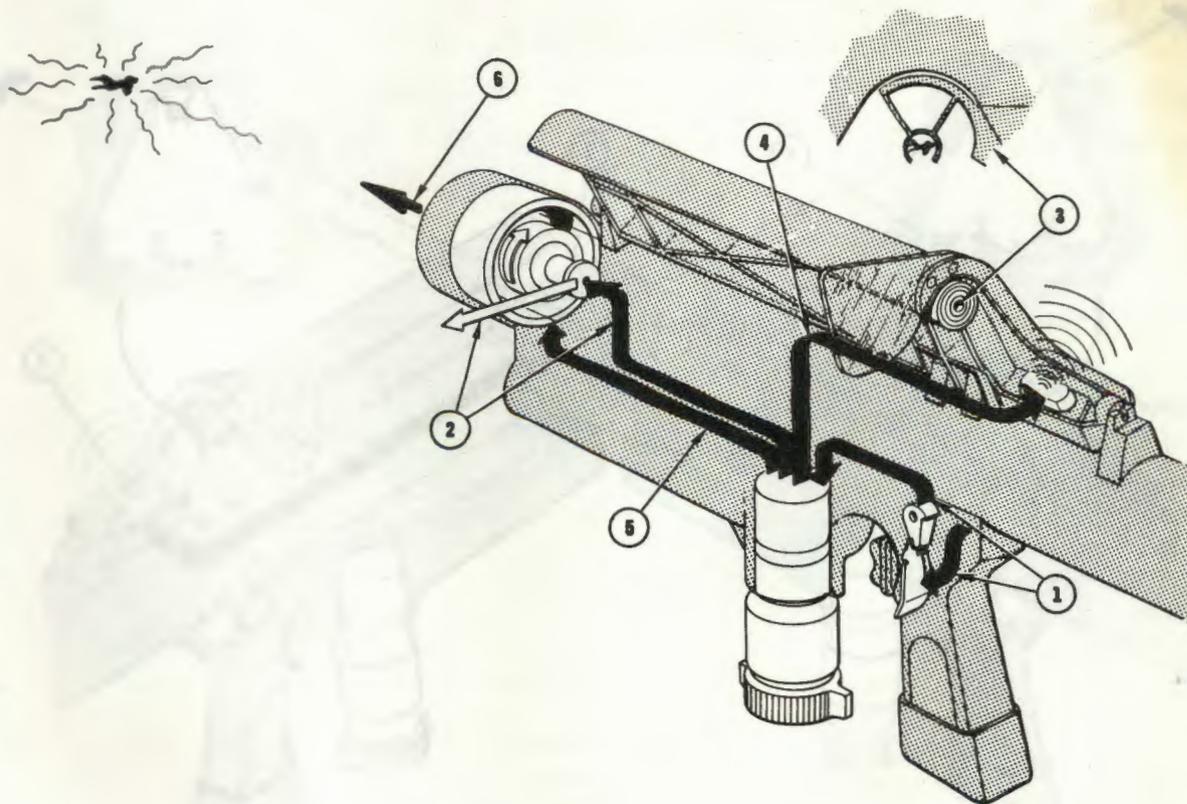
Operating the safety and actuator device activates the BCU to provide electrical power for the missile and launcher and start the coolant gas flow (fig 2-18(1)).

b. *Gas Coolant Flow.* Freon gas flows from the BCU to the seeker, expands to cool the IR detector cell to -100°F . within about 3 to 5 seconds, and then exhausts to the atmosphere (fig 2-18(2)).

c. *Weapon Aimed.* The Redeye weapon is aimed so that the target image appears in the center of the sight range ring (fig 2-18(3)).

d. *Acquisition Indicator Circuits Energized.* When sufficient target radiation is received to enable seeker tracking, an audible tone will be generated from the gunner to indicate the IR seeker has acquired the target (fig 2-18(4)).

e. *Gyro Spin Motor Energized.* The gyro motor is energized by the launcher BCU and starts to spin the gyro up to full speed. The acquisition



- 1 Launcher BCU activated.
- 2 Coolant gas flow.
- 3 Redeye weapon aimed.

- 4 Acquisition indicator circuits energized.

- 5 Gyro spin motor energized.
- 6 Gyro caged.

Figure 2-18. Events during warmup.

indicator provides an audible signal indicating gyro spinup (fig 2-18(5)).

f. *Gyro Caged.* The launcher battery energizes the gyro cage circuit so that the gyro is electrically caged along the gunner's line of sight (fig 2-18(6)).

2-12. Acquisition

When the target provides sufficient IR energy to the seeker, audible and vibratory signals are generated by the acquisition indicator circuits. This informs the gunner that the target has been acquired. If the gunner aims away from the target when the gyro is caged the signal will change tone or cease. The following steps occur during target acquisition (fig 2-19).

a. *Seeker Senses Target.* Infrared detector cell in seeker senses infrared energy and converts it to an electrical output which is applied to the acquisition indicator circuit (fig 2-19(1)).

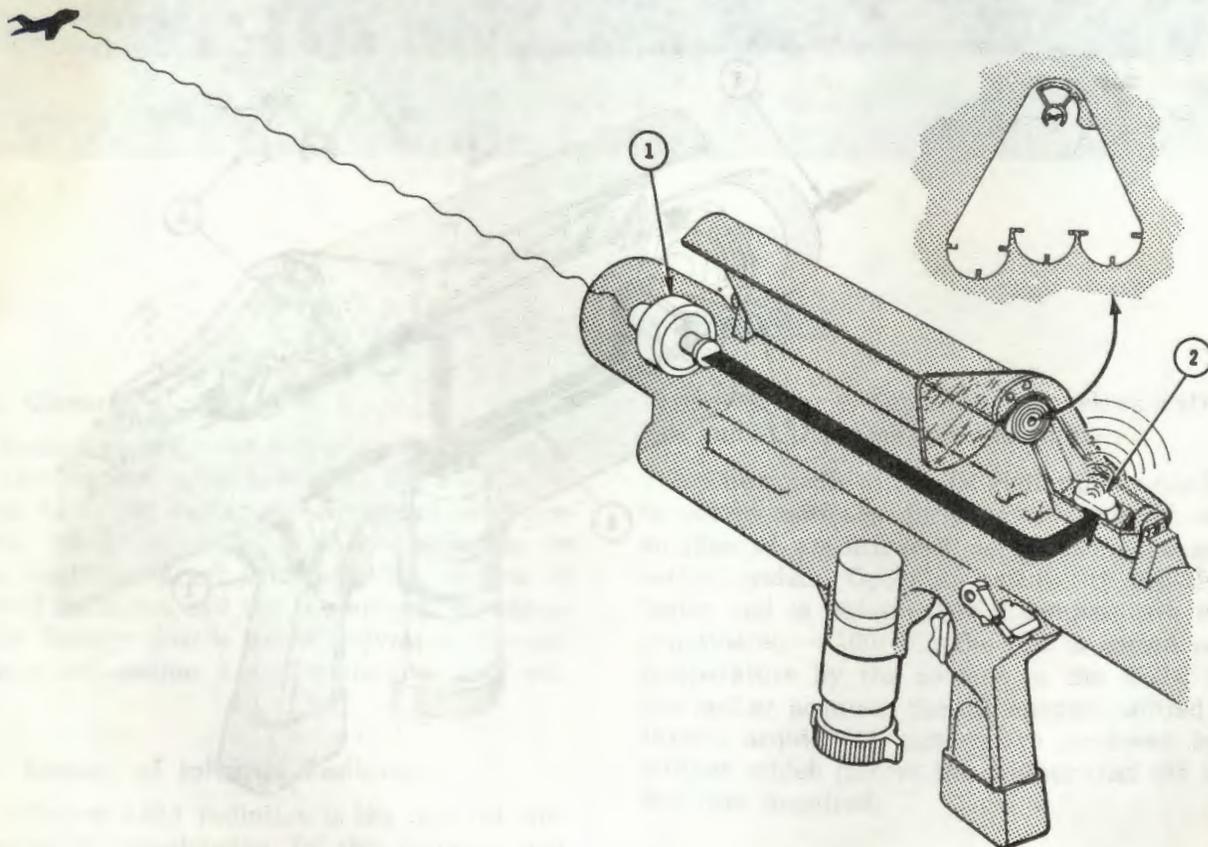
b. *Acquisition Indicator Sounds.* An audible

signal indicates that infrared radiation from the target is detected (fig 2-19(2)).

2-13. Uncaging Gyro and Inserting Superelevation and Lead

a. *Uncaging Switch.* The seeker, when caged, is locked in alinement with the sight range ring and must be uncaged (released) to automatically track a moving target. When acquisition signals are obtained, the gunner presses and holds the uncaging switch. Operation of the uncaging switch (fig 2-20(1)) uncages the gyro and frees the seeker to automatically track the target while the gunner inserts superelevation and lead.

b. *Superelevation and Lead.* Superelevation is the elevation angle added to the missile-target line of sight to compensate for the effects of gravity on the missile after it is ejected and prior to sustainer motor ignition (fig 2-20(2)). Superelevation also prevents the missile from hitting the ground when it is fired at low-flying targets.



1 Seeker senses target.

2 Acquisition indicator sounds.

Figure 2-19. Acquisition.

For incoming or outgoing targets (fig 2-21), the gunner moves his line of sight to the target from the range ring down to the 15° superelevation reticle (fig 2-21(A)) with no lead. For right-to-left crossing courses, the gunner moves his line of sight to the target down 15° from the range ring and laterally 10° (fig 2-21(B)). For left-to-right crossing courses, the gunner inserts 18° superelevation and 10° lead (fig 2-21(C)). The extra 3° superelevation are added because of missile tip-off caused by missile rotation.

2-14. Firing

The firing trigger must remain pressed (fig 2-22), the uncaging switch must be held down, and the gunner must keep tracking the target until missile ejection occurs. There is no recoil when firing the Redeye weapon, only a change in the weight of the launcher as the missile ejects.

a. Missile Battery Activated. Pressing the firing trigger activates the missile battery (fig 2-22(1)).

b. Umbilical Retracted. The umbilical is retracted from the missile 0.25 to 0.5 seconds after the trigger is pressed, depending on the output of the missile battery (fig 2-22(2)).

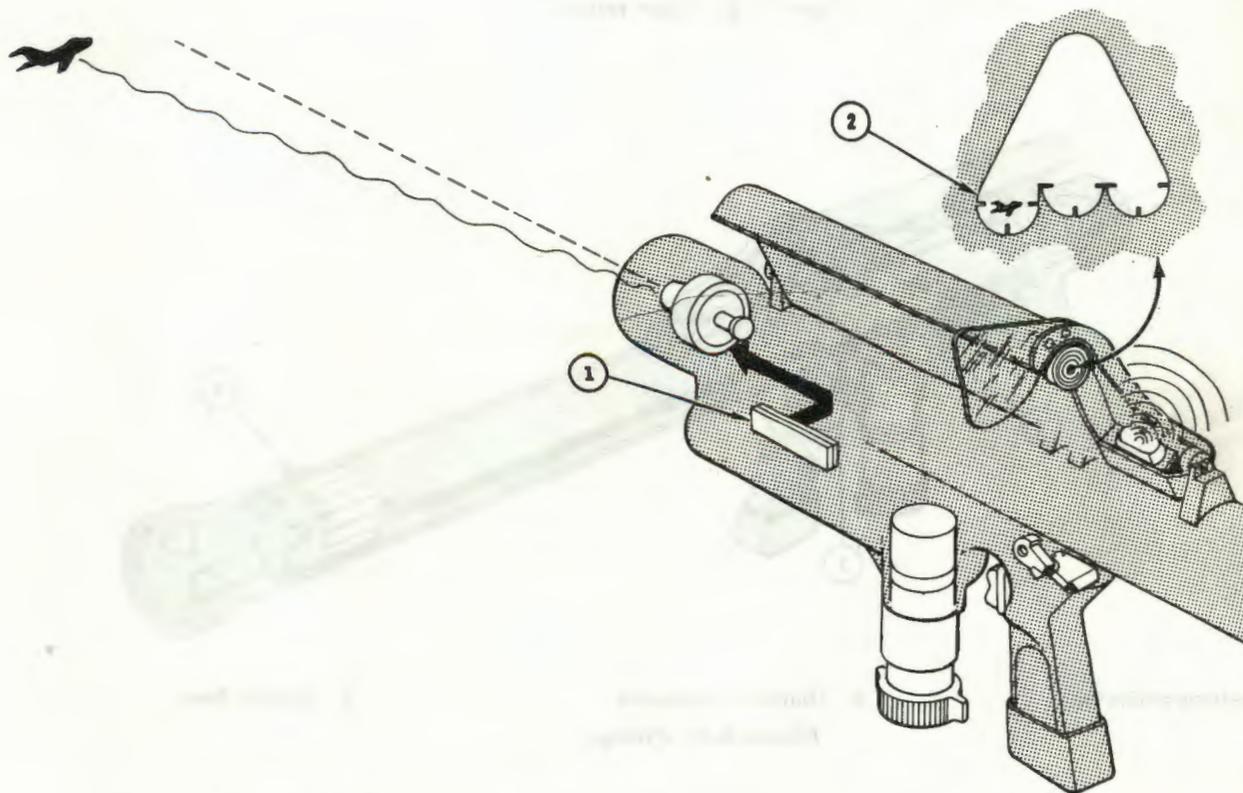
c. Ejector Fires. Retraction of the umbilical causes the ejector in the launch tube to be fired (fig 2-22(3)).

2-15. Missile Ejection

Shortly after the firing trigger is pressed, the missile ejector motor ignites and generates the thrust required to eject the missile from the launcher (fig 2-23).

a. Missile Spin. Before it leaves the launch tube, the missile is spinning at the full flight rate by the force of the ejector exhaust against the still-folded tail fins (fig 2-23(1)).

b. Fuze Timer Starts. When the ejector produces a missile acceleration of 28g, an inertial switch in the fuze timer closes and the fuze timer starts (fig 2-23(2)).



1 Gyro uncaging switch operated.

2 Superelevation and lead inserted.

Figure 2-20. Gyro uncaged; superelevation and lead inserted.

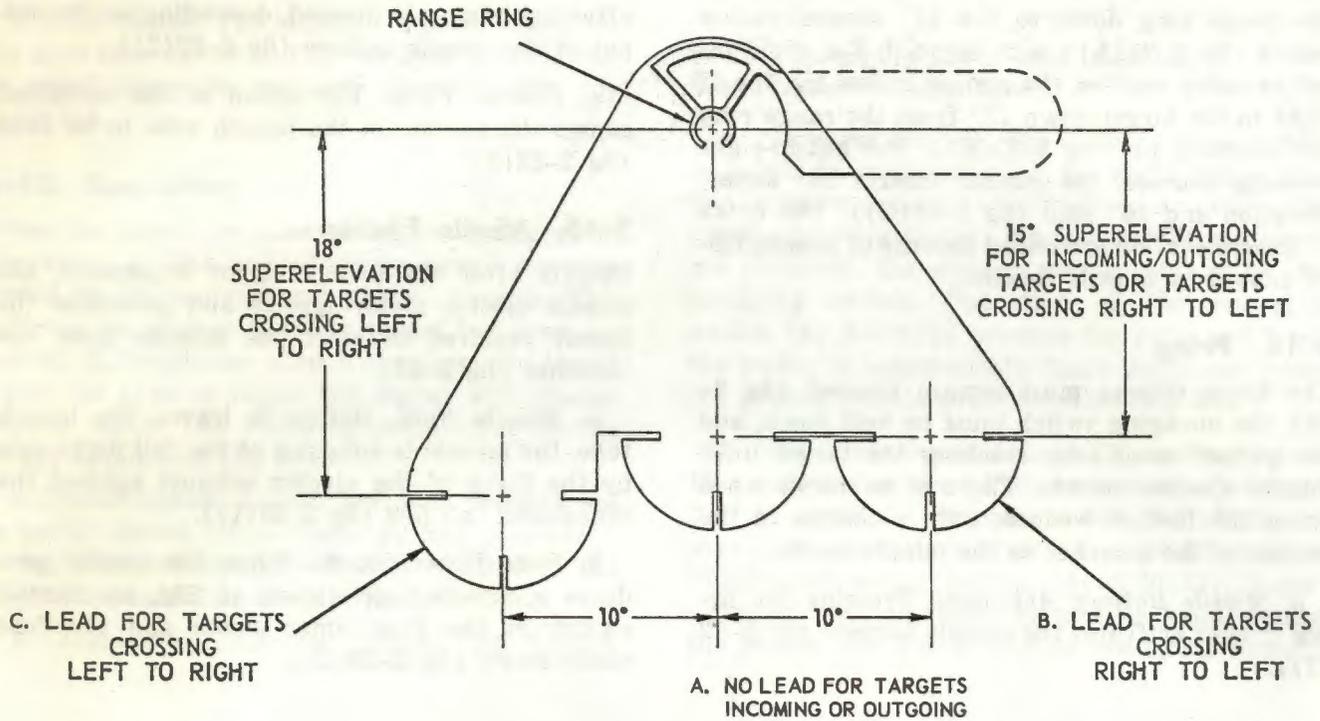
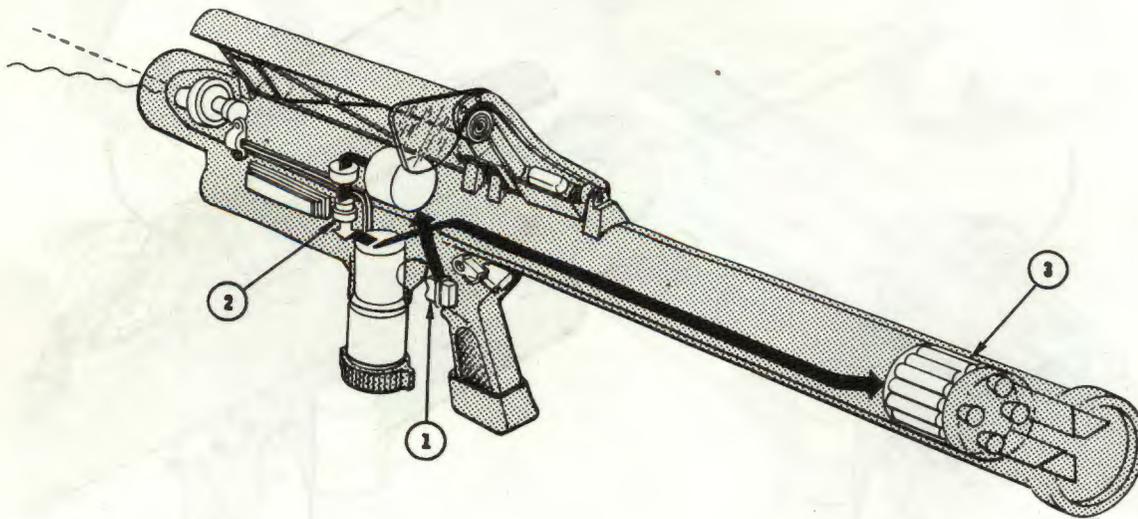


Figure 2-21. Sight reticle.



1 Missile battery activated.

2 Umbilical retracted.

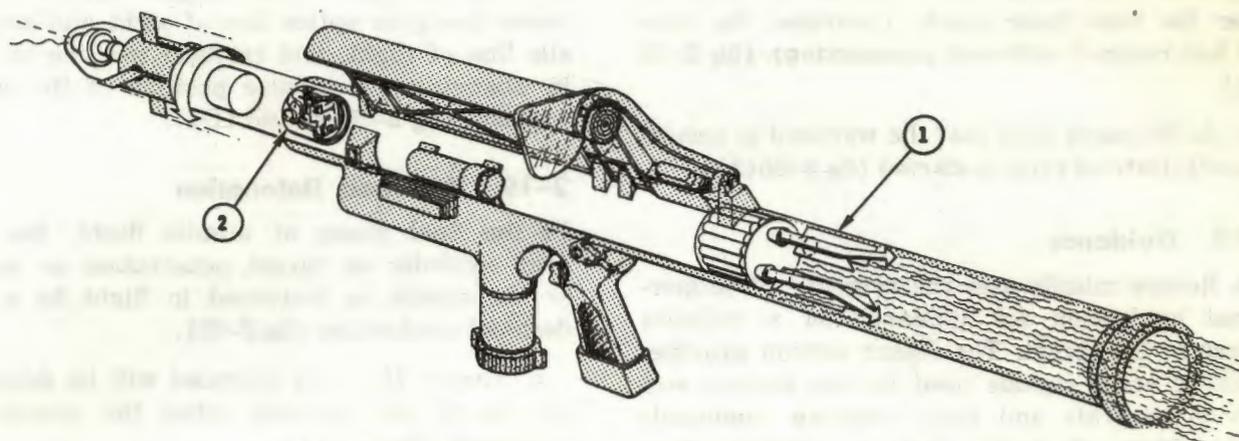
3 Ejector fires.

Figure 2-22. Firing.

2-16. Missile Coast

Under the force imparted to it by the ejector and after clearing the launcher, the missile

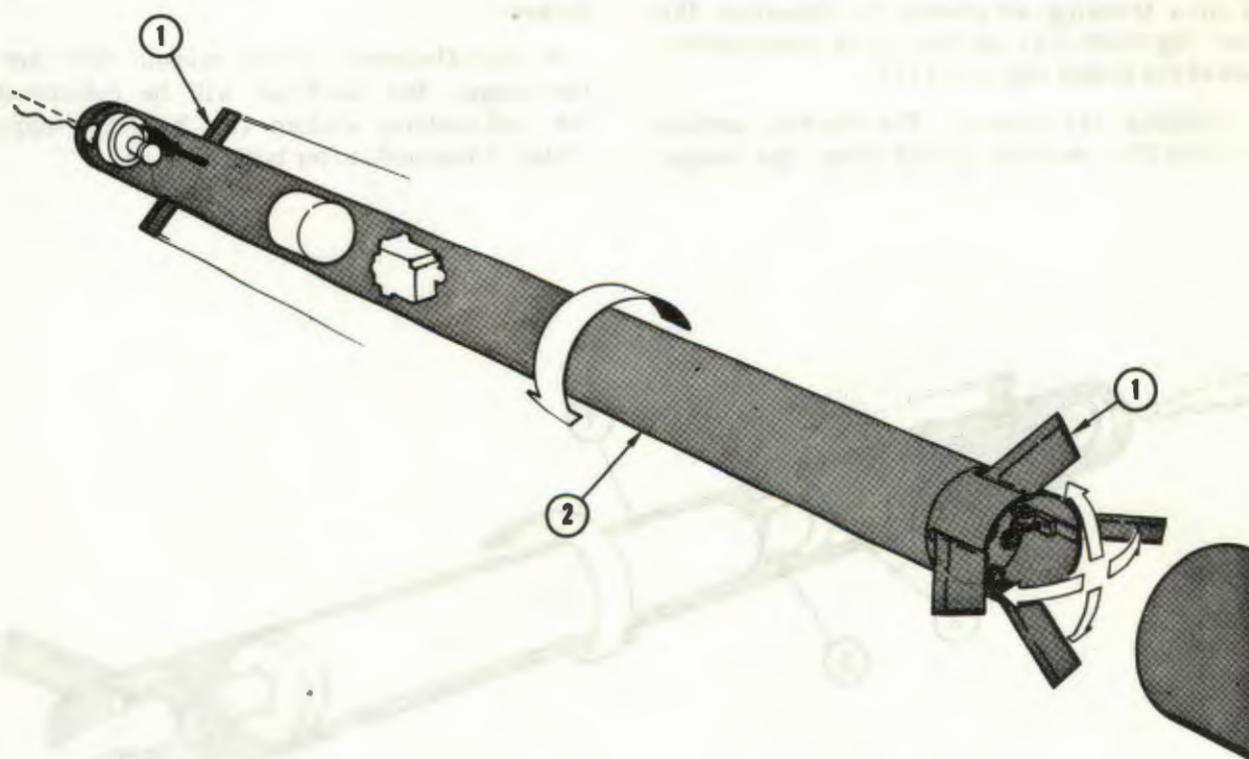
coasts approximately 7 meters before the sustainer motor fires (fig 2-24). As the control surfaces and tail fins clear the launch tube, they snap out and lock in place (fig 2-24(1)). The



1 Missile spin.

2 Fuze timer starts.

Figure 2-23. Missile ejection.



1 Control surfaces and tail fins.

2 Missile coast.

Figure 2-24. Missile coast.

ejector is completely expended before the missile is entirely out of the launch tube (fig 2-24(2)).

2-17. Sustainer Motor Ignition (fig 2-25)

a. A fuze activates the sustainer motor firing

circuit 0.31 second after the missile is ejected (fig 2-25(1)). At this time the missile is approximately 7 meters from the gunner. This delay insures that the missile is sufficiently clear of the gunner before the sustainer motor ignites.

b. The fuze arms the warhead 1.6 seconds after the fuze timer starts (provided the missile has reached sufficient acceleration) (fig 2-25 (2)).

c. At the same time that the warhead is armed, the self-destruct cycle is started (fig 2-25(3)).

2-18. Guidance

The Redeye missile uses the principle of proportional navigation for guidance on a collision course to the target. The seeker section provides tracking error signals used by the control section to generate and apply steering commands during flight (fig 2-26). Guidance actions are as follows:

a. *Tracking the Target.* The seeker section (fig 2-26(A)) detects any difference between the seeker (gyro) line of sight and the source of IR energy. This tracking error signal is then used in a tracking servo-loop to reposition the seeker (fig 2-26(B)) so that it is continuously aimed at the target (fig 2-26(1)).

b. *Guiding the Missile.* The control section (fig 2-26(C)) receives inputs from the seeker

section, enabling it to compute the error between the gyro optics line of sight and the missile line of flight, and corrects the line of flight by changing the angular position of the control surfaces (fig 2-26(2) and (D)).

2-19. Warhead Detonation

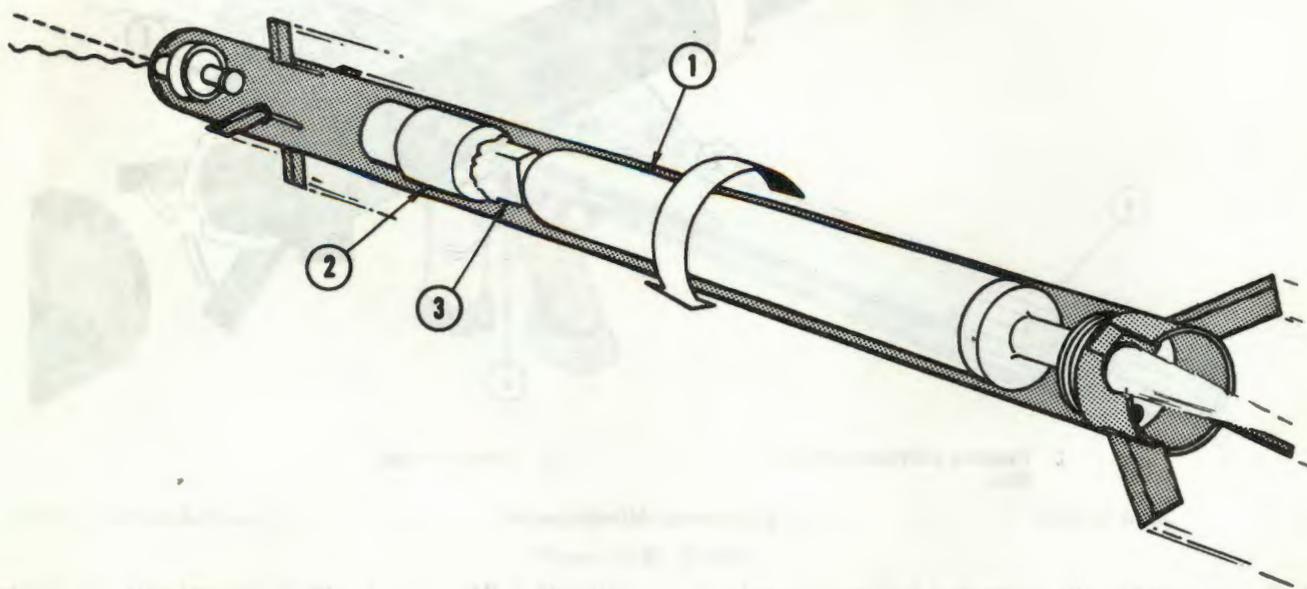
In the final phase of missile flight, the warhead explodes on target penetration or impact, or the missile is destroyed in flight by a self-destruct mechanism (fig 2-27).

a. *Target Hit.* The warhead will be detonated by one of two methods when the missile hits the target (fig 2-27(1)).

(1) The penetration impulse generator will detonate the warhead as the missile body penetrates the metal skin of the target.

(2) The impact switch will detonate the warhead if the missile impacts a solid portion of the target.

b. *Self-Destruct.* If the missile does not hit the target, the warhead will be detonated by the self-destruct system (fig 2-27(2)) approximately 15 seconds after launch.

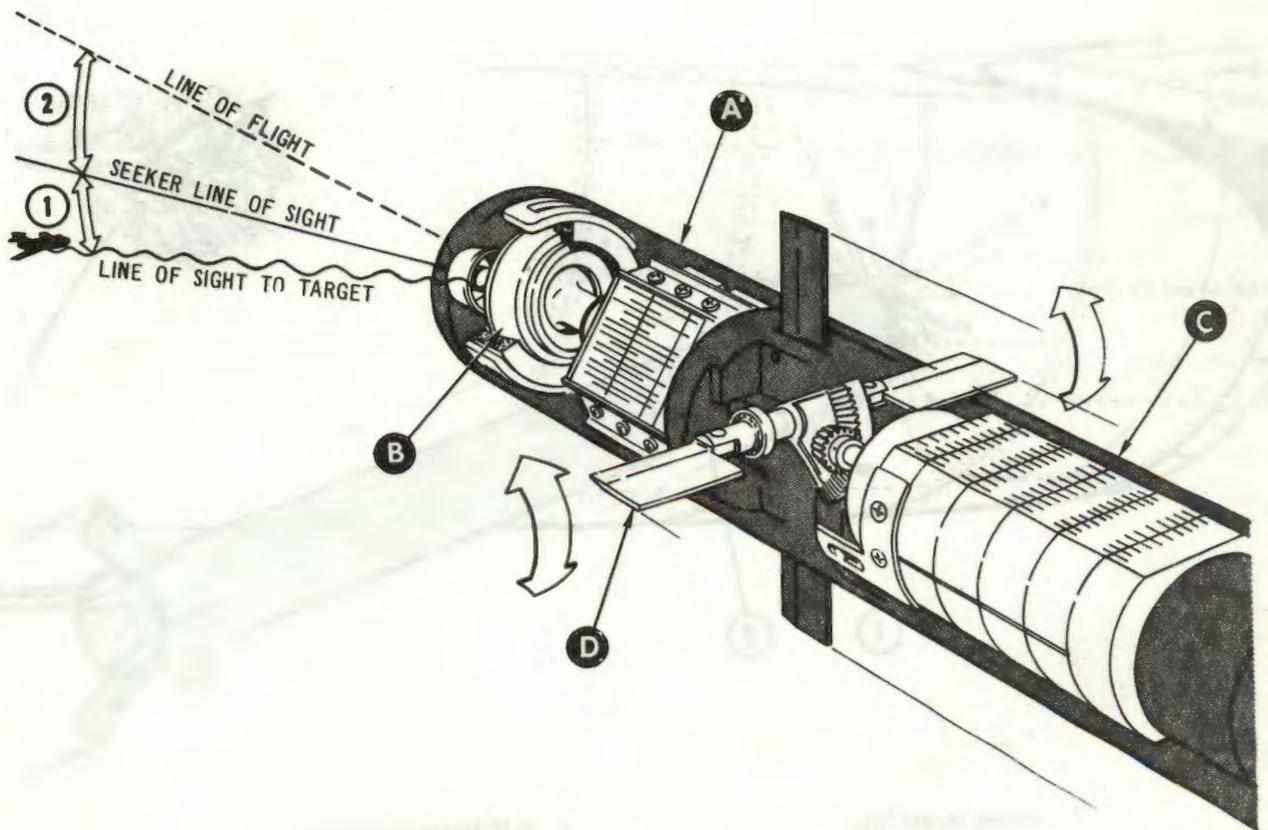


1 Sustainer fires.

2 Warhead armed.

3 Self-destruct cycle begins.

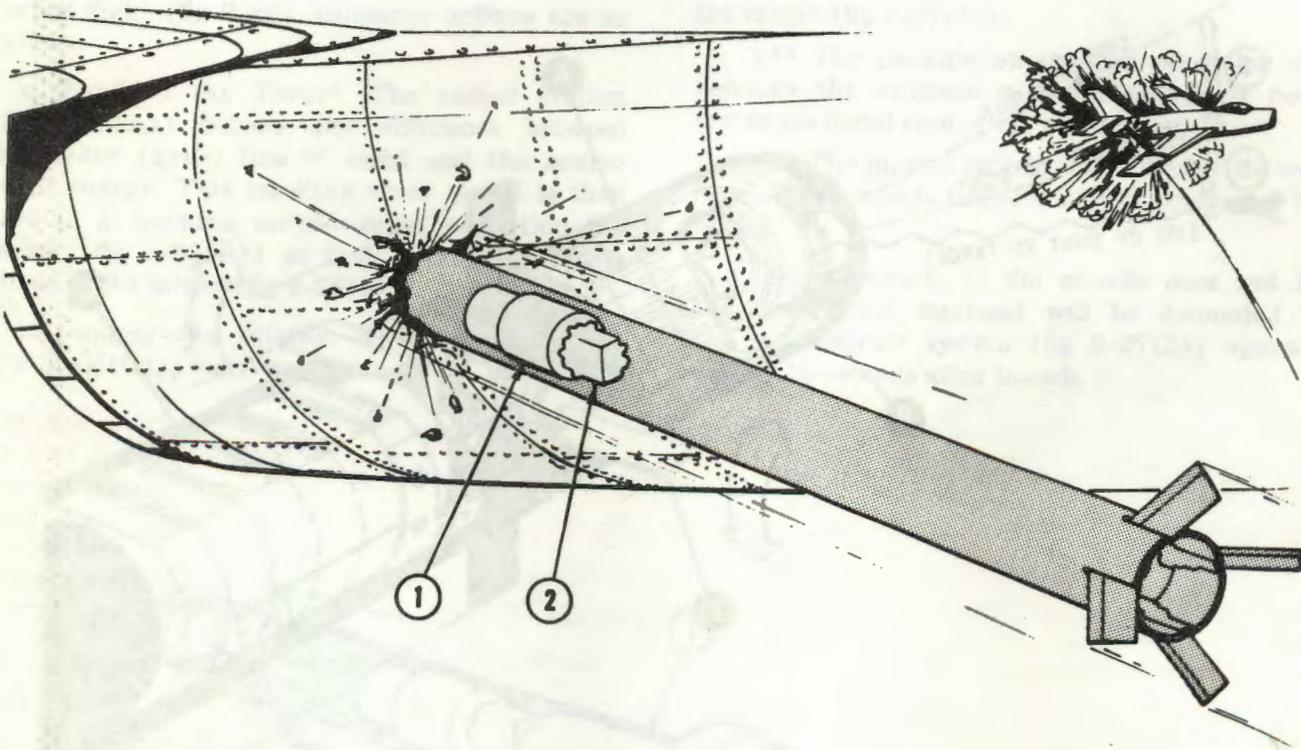
Figure 2-25. Sustainer motor ignition and warhead arming.



1 Tracking the target.

2 Guiding the missile.

Figure 2-26. Guidance.



1 Senses target hit.

2 Self-destruct system.

Figure 2-27. Warhead detonation.

CHAPTER 3

GUNNER OPERATING PROCEDURES

Section I. PREOPERATIONAL INSPECTION AND HANDLING PROCEDURES

3-1. Identification Markings

Both the shipping and storage container and Redeye weapon bear colored markings to distinguish between tactical and inert weapons. Markings must be checked to insure that the Redeye item chosen is the type the gunner has been directed to use. Figures 3-1 and 3-2 show the storage container markings; figure 3-3 shows the Redeye weapon and field handling trainer markings. The identification markings of the guided missile system training set M76 are discussed in chapter 16.

a. Shipping and Storage Container. The identification markings for the container are on two diagonal corners of the container top. A container with a tactical Redeye weapon is marked with yellow squares. Colors are not required for identifying a container housing a Redeye trainer.

b. Weapon Markings. Four 1-inch squares are painted on the front and rear of the tactical weapons as indicated below.

(1) *Front of weapon.* Yellow squares indicate a tactical weapon.

(2) *Rear of weapon.* Brown squares indicate a tactical or telemetry weapon. The word INERT in 2-inch white letters indicates a trainer.

3-2. Preoperational Inspection Procedures

After the Redeye weapon is removed from the shipping and storage container, the weapon should be inspected in accordance with the proce-

dures stated in table 3-1. This table includes the "service upon receipt" inspection.

3-3. Handling Procedures

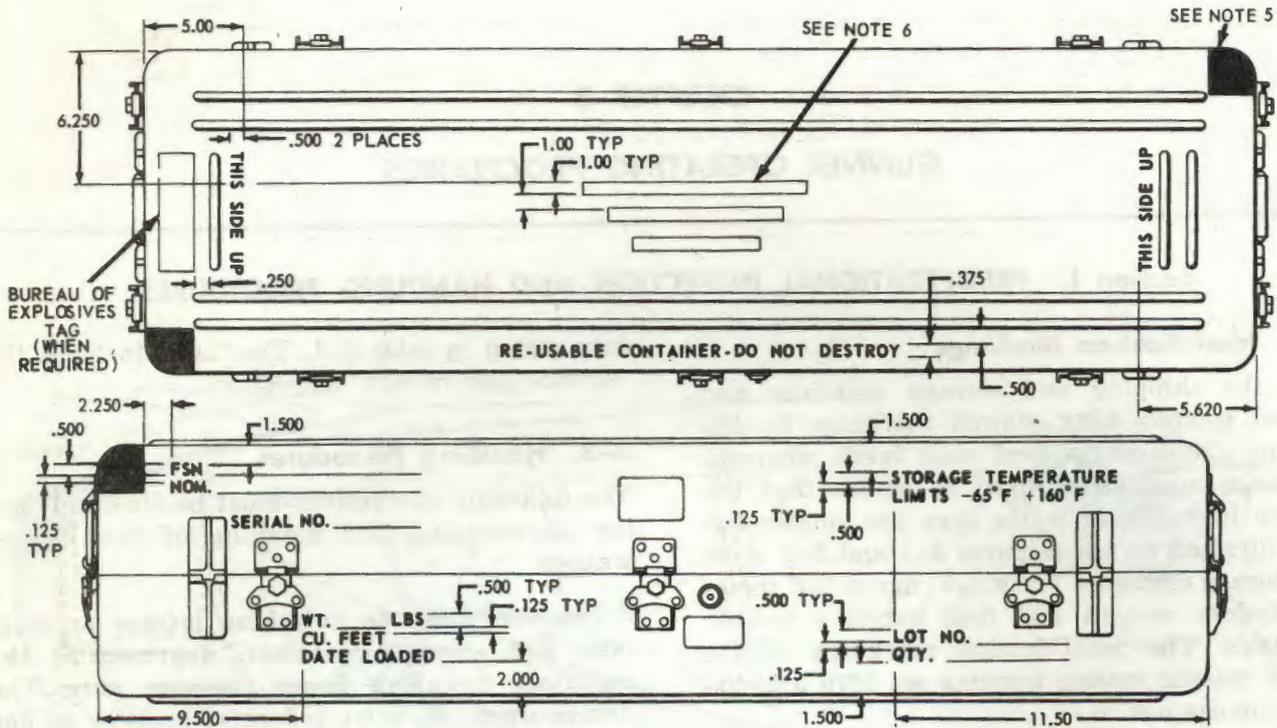
The following precautions must be observed during unpackaging and handling of the Redeye weapon.

Caution: Prior to unlocking latches on shipping and storage container, depressurize the container by using finger pressure only. The depressurization valve is located midway on one side of bottom half of container (fig 2-13).

a. When removing the weapon from the storage container, care must be exercised not to damage the rocket-motor squib wires which are encapsulated on the outside of the launch tube. When removing the weapon from the unipak container, remove platens prior to lifting weapon out of container.

b. The weapon always must be rested on its right side. Do not stand the weapon on its end.

c. While the gunner is walking, he should carry the weapon by placing the carrying sling around his shoulder. The seeker end of the weapon should point upward. The sling should be adjusted tight enough to prevent the weapon from swinging excessively. Improper handling of the weapon can result in misalignment of the sight or damage to electrical and mechanical parts. The protective covers should not be removed until preparing to fire the weapon.



- NOTES:**
1. ALL COLORS TO BE IN ACCORDANCE WITH FED STD -595.
 2. FED. STOCK NUMBER APPLIES TO MISSILE WEAPONS SYSTEM AND CONTAINER AS A UNIT OF ISSUE.
 3. BASIC COLOR OF CONTAINER EXTERIOR SHALL BE ENAMEL PER TT -E -529, OLIVE DRAB COLOR NO. X24087.
 4. ALL DATA MARKINGS SHALL BE PER COLOR CODES IN ACCORDANCE WITH CHART I, USING ENAMEL PER TT -E -529.
 5. 2½ INCH COLOR SQUARES SHALL BE PER COLOR CODES IN ACCORDANCE WITH CHART I.
 6. DOT MARKINGS SHALL BE IN ACCORDANCE WITH CHART I.
 7. DOT MARKING, FWD, AFT, THIS SIDE UP AND RE-USABLE CONTAINER DO NOT DESTROY SHALL BE CENTERED ON CONTAINER, DIMENSION AS SHOWN.

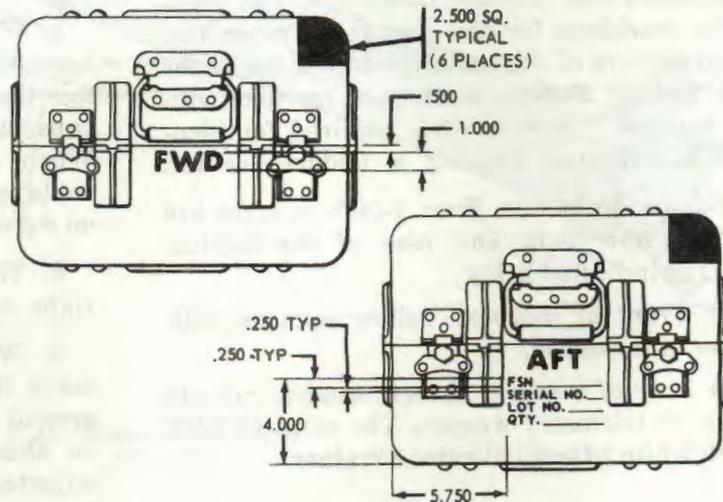
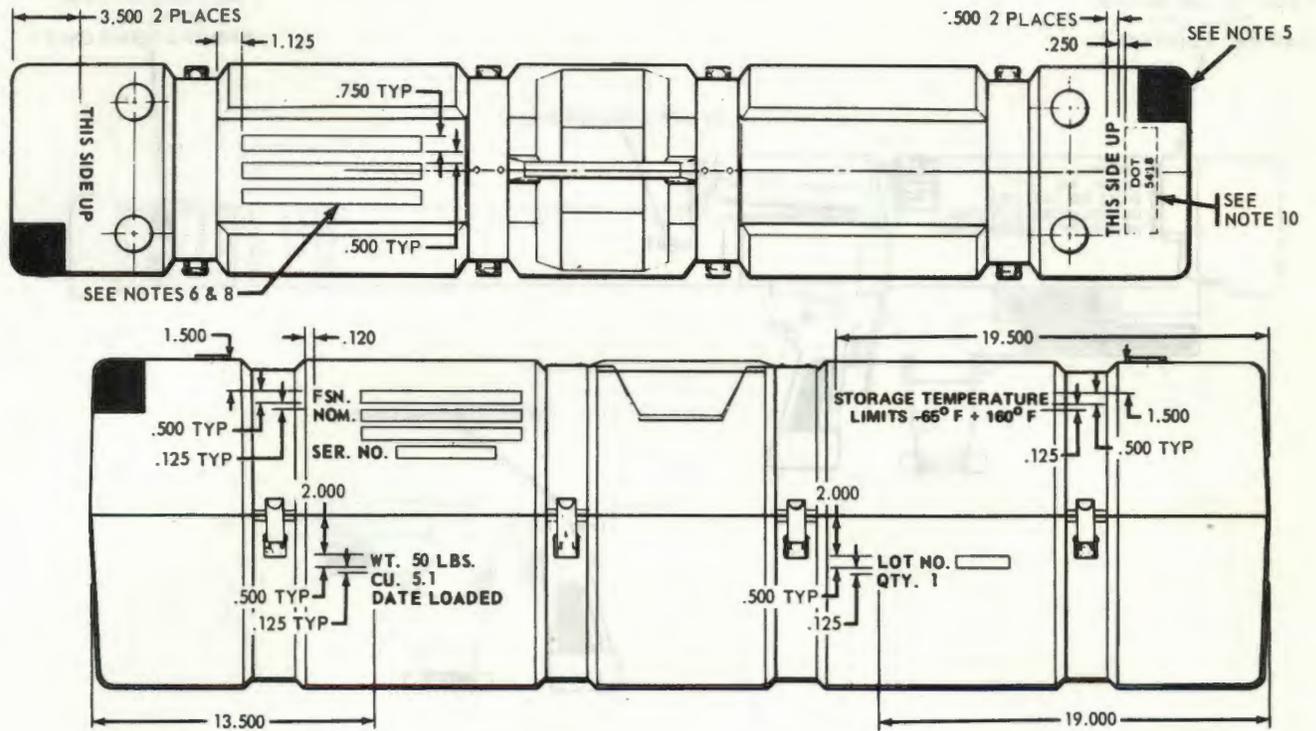


CHART I
COLOR CODES PER MIL-STD-709

ARMY PART NUMBER	NOMENCLATURE	FEDERAL STOCK NUMBER	2½ INCH COLOR SQUARES	DATA MARKING COLOR	DOT MARKING REQUIRED
10398952	GUIDED MISSILE SYSTEM, INTERCEPT -AERIAL, M41	1425-930-9923	YELLOW 23538	YELLOW 23538	ROCKET AMMUNITION WITH EXPLOSIVE PROJECTILE
10214925	GUIDED MISSILE SYSTEM, INTERCEPT -AERIAL, TRAINING: M46A2	1425-933-5352		WHITE 27875	INERT
	GUIDED MISSILE SYSTEM, INTERCEPT -AERIAL, INERT			WHITE 27875	INERT

Figure 3-1. Shipping and storage container (monopak) identification markings.



NOTES:

1. ALL COLORS TO BE IN ACCORDANCE WITH FED-STD-595.
2. FED STOCK NUMBER APPLIES TO MISSILE WEAPONS SYSTEM.
3. BASIC COLOR OF CONTAINER EXTERIOR SHALL BE PAINT LATEX - BASE PER TT-P-0033, OLIVE DRAB COLOR NO. X34087.
4. ALL DATA MARKINGS SHALL BE PER COLOR CODES IN ACCORDANCE WITH CHART 1, USING PAINT LATEX - BASE PER TT-P-0033.
5. 2 1/2 INCH COLOR SQUARES SHALL BE PER COLOR CODES IN ACCORDANCE WITH CHART 1.
6. DOT MARKINGS SHALL BE IN ACCORDANCE WITH CHART 1.
7. ALL MARKINGS ARE TO BE APPLIED WITH STENCILS, USING STENCIL BOARD PER UU-P-534, TYPE II USING STANDARD STENCIL CUTTING MACHINES. AN ALTERNATE METHOD USING A SILK SCREENING PROCESS, UTILIZING STANDARD BLOCK LETTERS, MAY BE USED.
8. DOT MARKING, FWD, AFT AND THIS SIDE UP, SHALL BE CENTERED ON CONTAINER, DIMENSIONS AS SHOWN.
9. WORD FWD WILL BE STENCILED ON CONTAINER END TO INDICATE LOCATION OF MISSILE NOSE IN CONTAINER.
10. DEPARTMENT OF TRANSPORTATION PERMIT SHALL BE STENCILED IN (1/2 IN. HIGH LETTERS) THIS AREA AT TIME OF LOADING CONTAINER.

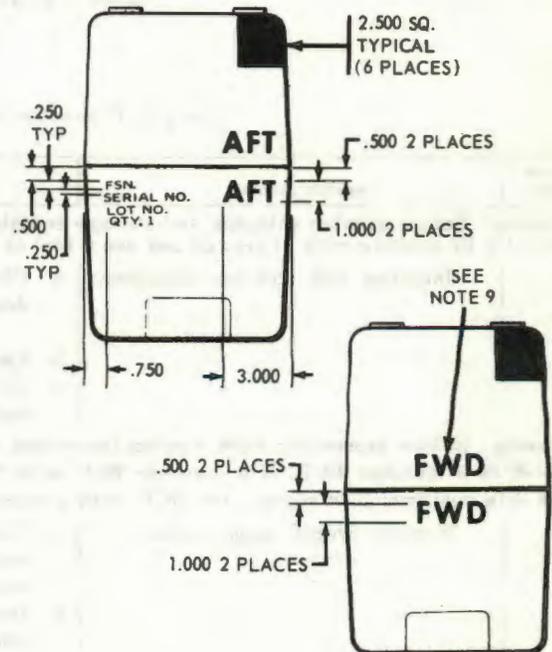


CHART 1
COLOR CODES PER MIL-STD-709

ARMY PART NUMBER	NOMENCLATURE	FEDERAL STOCK NUMBER	2 1/2 INCH COLOR SQUARES	DATA MARKING COLOR	DOT MARKING REQUIRED
10398951	GUIDED MISSILE SYSTEM, INTERCEPT - AERIAL: M41	1425-183-5990	YELLOW 23538	YELLOW 23538	ROCKET AMMUNITION WITH EXPLOSIVE PROJECTILE
	GUIDED MISSILE SYSTEM, INTERCEPT - AERIAL: INERT			WHITE 27875	INERT

Figure 3-2. Shipping and storage container (unipak) identification markings.

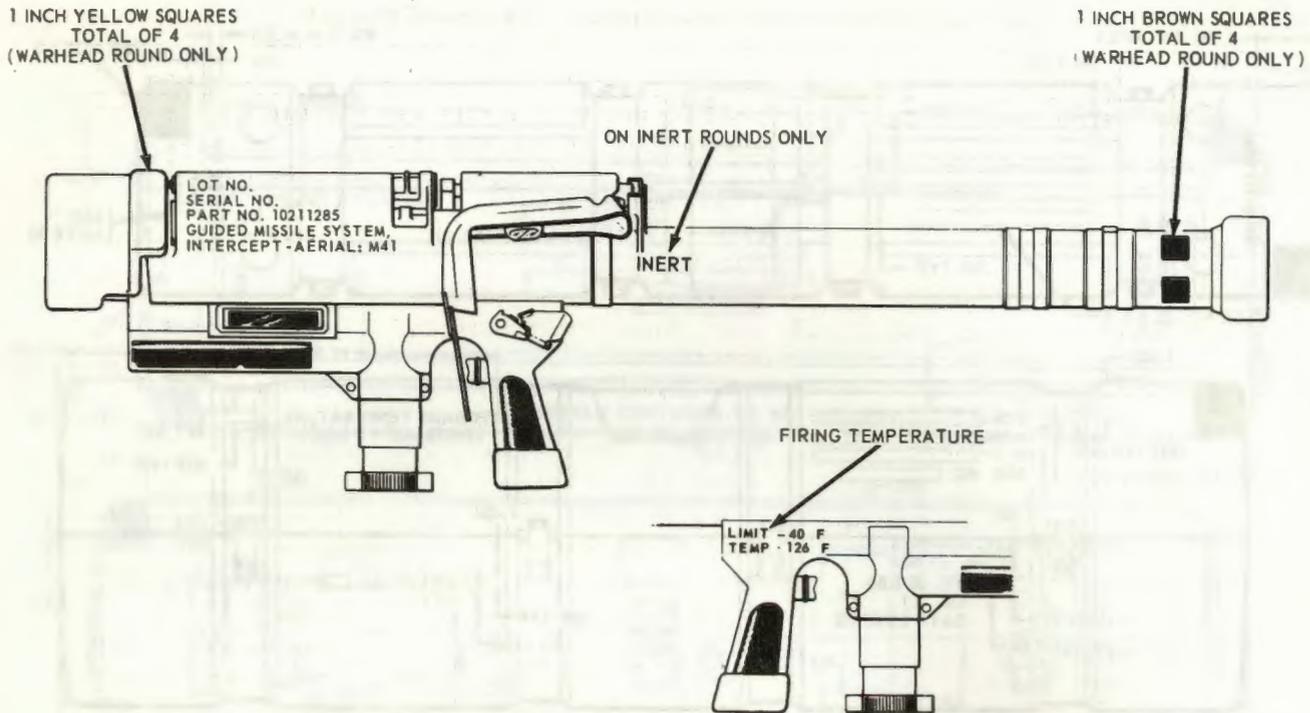


Figure 3-3. Redeye weapon identification markings.

Table 3-1. Preventive Maintenance Checks and Services

Sequence number	Inspection point	Procedure	Corrective action
<p>Warning: Before opening shipping and storage container, push depressurization valve in to allow all air to escape. Operate valve by pushing with finger; do not use a tool or other object.</p>			
1	Shipping and storage container.	<p>a. Check for external and internal damage.</p> <p>b. Check for proper closure.</p> <p>c. Check for water and foreign matter.</p>	<p>Return container and weapon to ammunition supply point (ASP).</p> <p>Return container to ASP.</p> <p>Return container to ASP.</p>
<p>Warning: Before proceeding with weapon inspection, make certain that a receptacle cap is in the launcher BCU receptacle—NOT a launcher BCU. If a launcher BCU is in the receptacle, make certain that the safety and actuator device is in the safe position; then replace the BCU with a receptacle cap.</p>			
2	Weapon overall appearance.	<p>a. Visually check for evidence that weapon has been dropped or otherwise mishandled.</p> <p>b. Inspect for presence of dirt, oil, or other foreign matter.</p> <p>c. Check for evidence of water contamination.</p>	<p>Return container to ASP.</p> <p>Clean.</p> <p>Return weapon to ASP.</p>
3	Launch tube.	Check for visible damage or evidence of water in launch tube.	Return weapon to ASP.
4	Gripstock.	<p>a. Check gripstock for visible damage.</p> <p>b. Inspect gripstock butt bumper for damage or looseness.</p>	<p>Return weapon to ASP.</p> <p>Return weapon to ASP.</p>
5	Sling assembly.	<p>a. Check condition of webbing.</p> <p>b. Check condition of adjuster.</p> <p>c. Check security of launcher sling swivels.</p>	<p>Replace.</p> <p>Replace.</p> <p>Return weapon to ASP.</p>

Table 3-1. Preventive Maintenance Checks and Services—Continued

Sequence number	Inspection point	Procedure	Corrective action
6	Cover (launch tube).	a. Check for snug fit; it must be easy to remove, but not loose enough to fall off. b. Inspect for breakage. c. Check for moisture and foreign matter.	Replace. Replace. Clean.
7	Retainer window assembly (launch tube forward end).	a. Inspect window for cleanliness. b. Inspect window for breakage and/or scratches. c. Inspect nylon ring for damage.	Clean. Return weapon to ASP. Return weapon to ASP.
8	Protective shock ring and disk (launch tube rear end).	a. Inspect for evidence of damage. b. Inspect for cleanliness. Ring must be free of dirt and ice.	Return weapon to ASP. Clean.
9	Eject motor squib igniter leads (on outside of launch tube).	Check that material covering wires is intact and unbroken.	Return weapon to ASP.
10	Sight.	Check for damage (broken sight).	Return weapon to ASP.
11	Eyeshield.	Check for damage or breakage.	Replace.
12	Sight bracket cushion.	Check for cracks and tears.	Return weapon to ASP.
13	Sight frame cushion.	Check for cracks and tears.	Return weapon to ASP.
14	Face guard.	Check for cracks and tears.	Return weapon to ASP.
15	Acquisition indicator.	Check for visible damage.	Return weapon to ASP.
16	Launch tube humidity indicator plug (cap assembly).	a. Check color of indicator. b. Check condition of preformed packing (O-ring).	If lighter than lavender guide on humidity indicator in cap, replace humidity indicator and dessicant cartridge. Hand tighten. Replace O-ring.
17	Receptacle cap.	Check condition of preformed packing (O-ring).	Replace O-ring.
18	Launcher BCU receptacle.	Check interior for foreign matter and clean contacts.	Clean.
19	Launcher BCU.	a. Verify that there are three units for each weapon. b. Check color of heat-sensitive indicator. c. Check contact rings and needle on top of unit for cleanliness. d. Verify that bond between head-insulated cap and case is secure. e. Check condition of preformed packing (O-ring).	Requisition additional unit(s). If indicator is black, requisition replacement unit. Clean. Requisition replacement unit. Replace O-ring.
<p>Warning: The following steps require operation of safety and actuator device and firing trigger. Make certain that the component in the launcher receptacle is a receptacle cap—NOT a launcher BCU.</p>			
20	Safety and actuator device.	Press safety and actuator device and rotate it out and forward to limit of its travel. A click should be heard. When released, device should return to the safe position and lock in place.	Return weapon to ASP.
21	Firing trigger.	a. Pull firing trigger to limit of its travel. A click should be heard. When released, trigger should return to original position. b. Inspect sealing boot for cracks and tears. Seal should be airtight.	Return weapon to ASP. Return weapon to ASP.

Table 3-1. Preventive Maintenance Checks and Services—Continued

Sequence number	Inspection point	Procedure	Corrective action
22	Uncaging switch.	<p>a. Alternately press uncaging switch at each end and in the middle position of the switch. A click should be heard each time switch is pressed. When released, switch should return to original position.</p> <p>b. Inspect sealing boot for cracks and tears.</p>	<p>Return weapon to ASP.</p> <p>Return weapon to ASP.</p>

Section II. FIRING PROCEDURES

3-4. Precautions Prior to Firing

a. *Safety Precautions.* Safety precautions which must be observed prior to firing are—

(1) Insure that the area behind the weapon is clear of personnel and equipment to a distance of 13 meters (fig 3-4).

(2) Do not fire with the launcher elevated more than 65° nor less than 15°.

(3) Fire only from a standing position.

(4) Wear ear protectors in addition to the helmet when firing under nontactical conditions.

(5) Use the plastic eyeshield on the weapon sight.

b. Prefire Weapon Check.

(1) Check battery receptacle contacts.

(2) Check operation of safety and actuator device, uncaging switch and firing trigger (table 3-1).

(3) Check front and rear disks.

(4) Check sight assembly.

(5) Check eject motor squib igniter leads.

(6) Check physical condition of entire weapon.

c. Launcher Battery/Coolant Unit Placement.

Warning: Before inserting the BCU, make cer-

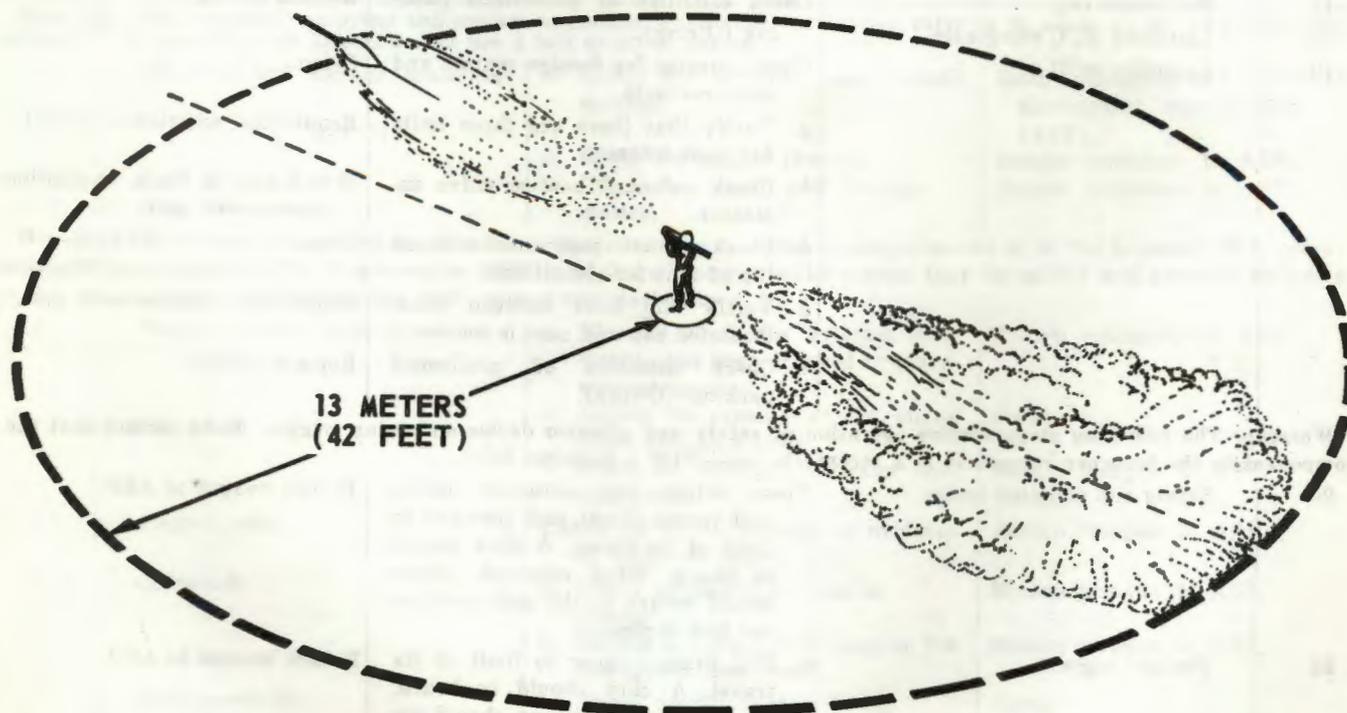


Figure 3-4. Firing area safety diagram.

tain that the safety and actuator device is in the safe position. The Redeye weapon is shipped with a cap covering the launcher BCU receptacle. The cap should be kept in place until a BCU is inserted. Remove the receptacle cap by turning it counterclockwise. Insert a BCU in the receptacle and turn it clockwise until it locks in place (fig 3-5).

d. Launcher Battery/Coolant Unit Replacement.

Warning: Parts of the launcher BCU get extremely hot (400° F.) when activated and remains too hot to touch for approximately 15 minutes. Do not touch the case of a newly-fired BCU when removing it from the BCU receptacle. To remove the BCU, grasp the heat-insulated cap (fig 3-5) and turn it counterclockwise. After use, it may be discarded. Replace the BCU as explained in *c* above.

3-5. Weapon Ready Procedures

Prior to target engagement the Redeye weapon is readied for action. To ready the weapon for action the gunner—



Figure 3-5. Placement and safe method of removing launcher BCU.

a. Removes the launch tube cover, locks the sight assembly into position, and places the weapon on right shoulder (fig 3-6).

b. Inserts the launcher BCU into the weapon, positions the right hand around pistol grip of the launcher gripstock, and positions the left hand on forward part of gripstock, cradling weapon between thumb and fingers (fig 3-7).

3-6. Target Detection, Tracking, and Ranging

When the target is visually detected, the gunner determines target direction (fig 3-8). He then looks into the peep sight, positions the target image into the center of the range ring, and keeps tracking the target. He determines target type and determines if the target is engageable by ranging the target. Initial target ranging occurs prior to weapon activation but subsequent range estimates are made during the firing engagement (see chapter 4).

3-7. Weapon Activation and Warmup

When the target is within the activate zone (as determined by range ring profiles), the gunner continues to track the target while he presses the safety and actuator device (fig 3-9) and rotates it forward until a click is felt and/or heard. The gunner releases the safety and actuator device and continues tracking the target. The location of the activate zone varies with the type of target, its velocity, and its flight path.

3-8. Target Acquisition

When IR radiation is acquired and audible steady target acquisition signals are received, the gunner continues to track the target (fig 3-10). Two conditions are required for the missile seeker to acquire target IR radiation.

a. The weapon must be activated and pointed at the target.

b. The IR radiation from the target must be sufficiently strong.

3-9. Uncaging Switch

The gunner presses and holds the uncaging switch (fig 3-11) as soon as he receives an acquisition tone. The audible signal should increase in intensity and clarity, indicating the missile seeker is tracking the target. If the audible signal is not obtained or is lost, the gunner recages the gyro (releases the uncaging switch) and con-



*Figure 3-6. Step 1. Remove launch tube cover and lock the sight assembly.
Step 2. Place weapon on shoulder.*

tinues to track the target in the range ring until he has reacquired the target. The gunner again uncages the gyro and proceeds with the firing sequence.

3-10. Superelevation and Lead

When the target is within the launch zone, as specified in FM 23-17A, the gunner estimates target range and, if the target is positively identified as hostile, positions the target in one of the three lower semicircular positions to introduce superelevation (and lead as required) (fig 3-12) and proceeds with this step as previously stated in paragraph 2-13b. *An easy way for the gunner to remember how to insert correct lead is to aim*

the weapon so that the target appears to fly from the left or right superelevation position toward the center superelevation position.

3-11. Interrupting the Firing Sequence

The gunner may interrupt the firing sequence at any time before pressing the firing trigger. When the firing sequence is interrupted after the safety and actuator device has been operated, the BCU may have to be replaced before continuing the engagement. Replacement of the BCU is dependent on whether sufficient time remains to complete the firing sequence (minimum of 30 seconds). If insufficient time remains to complete the sequence, the BCU is replaced, and



*Figure 3-7. Step 3. Insert launcher BCU.
Step 4. Position right hand.
Step 5. Position left hand.*

the gunner commences a new firing sequence to complete the engagement if the target is still in range.

3-12. Firing Trigger Pressed

While the target remains in range and the seeker is tracking (para 3-9), and immediately after

insertion of superelevation and lead, the gunner presses and holds the firing trigger. He continues to track the target until the missile ejects (fig 3-13). When the target moves out of range before the gunner completes the engagement sequence, he releases the uncaging switch and removes the BCU (cease fire).



Figure 3-8. Step 6. Commence visual acquisition of target.



*Figure 3-9. Step 7. Activate; push safety and actuator device forward, out, and press down.
Step 8. Release safety and actuator device and continue tracking target.*



Figure 3-10. Step 9. Audible signals indicate target IR acquisition.

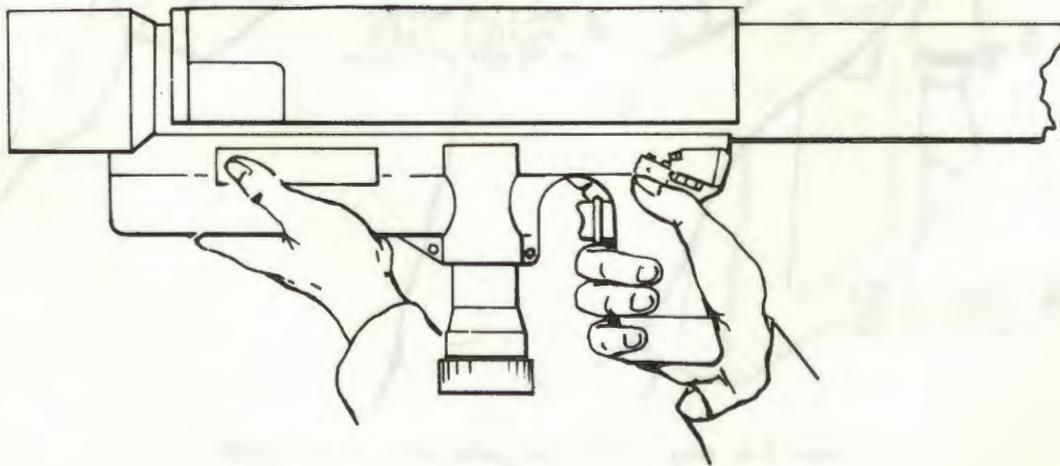
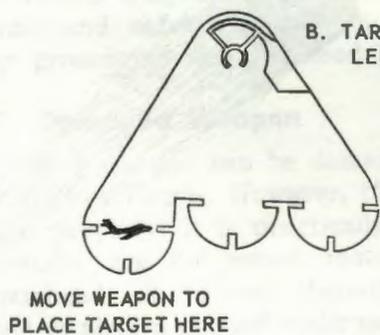


Figure 3-11. Step 10. Uncage gyro and check seeker tracking.

A. INCOMING AND OUTGOING TARGETS
(NO LEAD INSERTED)



B. TARGETS CROSSING
LEFT TO RIGHT



C. TARGETS CROSSING
RIGHT TO LEFT

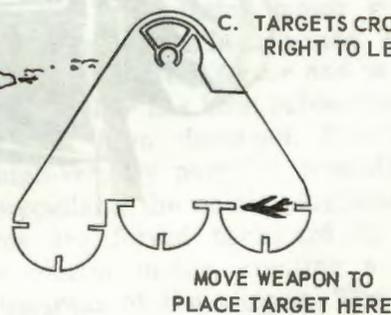


Figure 3-12. Step 11. Determine target is in launch zone, apply superelevation and lead, and recheck seeker tracking.



Figure 3-13. Step 12. Press and hold firing trigger and continue tracking target.

Section III. WEAPON MALFUNCTIONS AND CORRECTIVE ACTIONS

3-13. Hangfire

A hangfire is a delay in functioning of either electronic or explosive components caused by loose electrical connections, damaged propellant, or misalignment of components. The delay may last from a split second to several minutes. If the missile fails to fire, always assume it is a hangfire and proceed as follows:

a. Continue to track the target for at least 3 seconds, keeping the firing trigger pressed and uncaging switch held.

b. If the missile has not ejected after at least 3 seconds, release both the firing trigger and uncaging switch. Remove the launcher BCU and place weapon on stand or ground, keeping the launcher aimed in a safe launch position (pre-selected safe azimuth and minimum elevation of 20°) for 30 minutes. Leave the firing site so as not to pass in front of or behind the weapon.

c. In a training situation, disposal of the unfired weapon is accomplished by responsible ordnance personnel in accordance with TM 9-1385-215.

d. In a combat environment, the gunner continues tracking the target until at least 3 seconds have elapsed. The weapon then is placed on the ground and pointed in a direction which will not endanger friendly troops. The area should be marked with appropriate signs and the weapon should be destroyed by one of the means described in chapter 6.

3-14. Misfire

A misfire is a complete failure to fire because of faulty electronic or explosive components. Although a misfire is not dangerous, it cannot be immediately distinguished from a hangfire. Misfires, therefore, are treated as hangfires until this possibility is eliminated by qualified personnel.

3-16. General

This section discusses safety hazards peculiar to the Redeye guided missile system. Topics include Redeye weapon care and handling, weapon hazards, and safety in weapon firing. Range safety procedures are discussed in chapter 19.

3-17. Damaged Weapon

The Redeye weapon can be damaged if dropped or handled carelessly. However, if the weapon is handled properly, it is practically impossible to accidentally fire the rocket motor or detonate the warhead. To prevent damage, the Redeye weapon is always carried seeker end up, or kept in the shipping and storage container when not in use. Any of the following conditions will warrant immediate turning in of the weapon to the ammunition supply point for inspection and testing by ordnance personnel:

a. A weapon in the shipping and storage container is dropped more than 5 feet onto a hard surface.

b. A weapon is removed from a container that has damaged supports.

c. A weapon shows exterior damage indicating rough handling.

3-18. Redeye Weapon Hazards

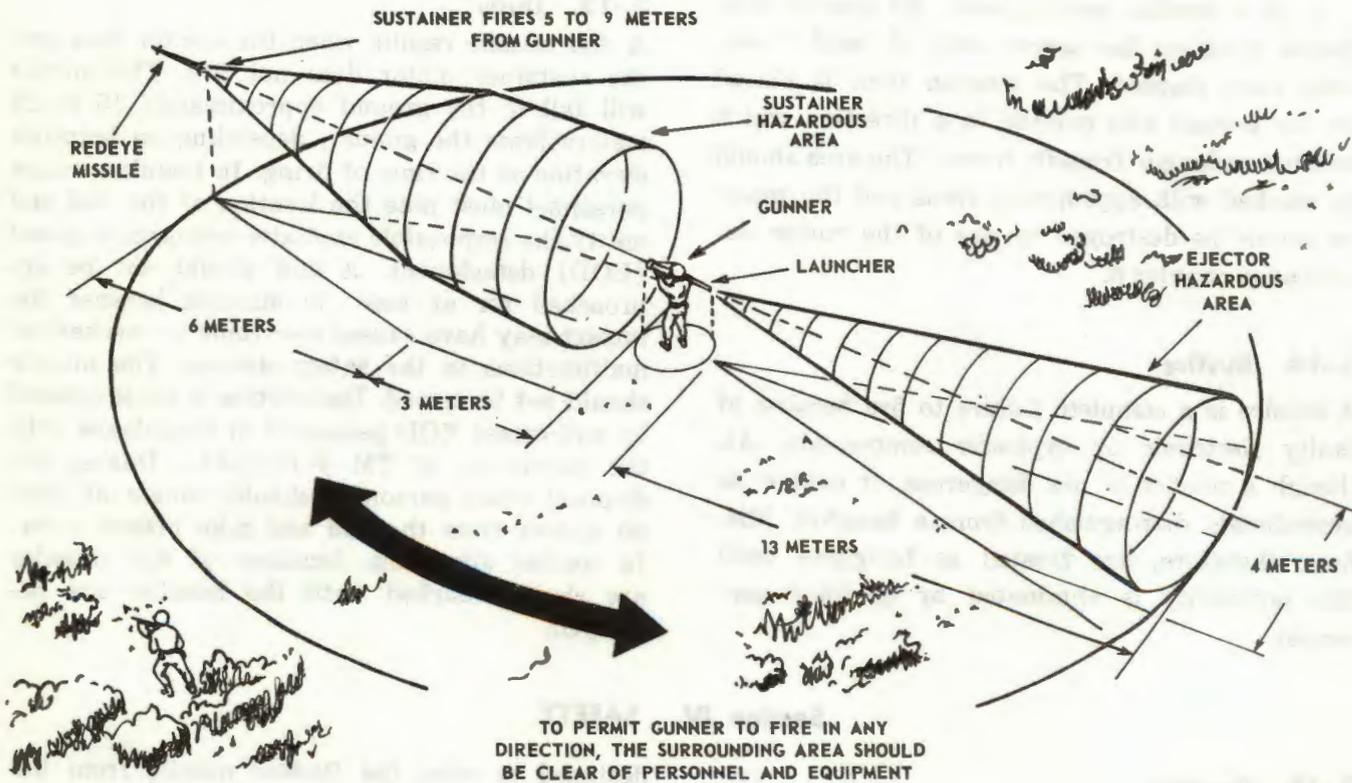
a. *Rocket Motors.* The small ejector motor is

3-15. Duds

A dud missile results when the ejector fires and the sustainer motor does not fire. The missile will fall to the ground approximately 15 to 23 meters from the gunner, depending on launcher elevation at the time of firing. In training, range personnel must note the location of the dud and notify the responsible explosive ordnance disposal (EOD) detachment. A dud should *not* be approached for at least 30 minutes because the impact may have caused electronic or mechanical malfunctions to the safety devices. The missile should not be moved. Destruction is accomplished by authorized EOD personnel in accordance with the provisions of TM 9-1385-215. During the disposal other personnel should remain at least 50 meters from the dud and take proper cover. In combat situations, locations of dud missiles are clearly marked until the missiles are destroyed.

Section IV. SAFETY

designed to eject the Redeye missile from the launcher with sufficient velocity to propel the missile from the gunner to a safe distance before the sustainer motor ignites. Ejector motor burn-out occurs before the missile leaves the launcher. When burning, the ejector motor generates a high pressure inside the launch tube. The ejector casing has a high safety factor and is no hazard unless the launcher has been subject to excessive shock or has been damaged. During missile launch, high-velocity particles consisting of unburned propellant, the nozzle plug, and the ignition wires are forced backward by the blast from the ejector motor, creating a hazardous area to the rear of the weapon. The hazardous area is a 15° cone, having its center directly to the rear of the launcher (fig 3-14). Another hazard to the gunner is secondary debris, such as particles of the forward disk (infrared window) which is shattered when the missile leaves the launcher, and other particles moved by the motor exhaust. Flying debris is a hazard to the gunner during firing if the launcher breech is closer than 1 meter to the ground or an obstacle is directly to the rear of the gunner. Debris from sustainer ignition at the end of the coast phase does not endanger the gunner in any way if proper eye protection is used. In addition to his helmet, the gunner is required to use the plastic eyeshield installed on the weapon sight, and to use earplugs under nontactical conditions.



TO PERMIT GUNNER TO FIRE IN ANY DIRECTION, THE SURROUNDING AREA SHOULD BE CLEAR OF PERSONNEL AND EQUIPMENT

Figure 3-14. Redeye position safety diagram.

b. *Blast Pressures.* Blast overpressure could damage eardrums and lungs if personnel stand close to the side and near the rear of the launcher when the weapon is fired. However, blast overpressure rapidly decreases and areas more than 2 meters to the side of the launcher are safe. The gunner is not affected by blast overpressure during sustainer motor ignition which occurs at a minimum distance of 5 meters in front of the gunner.

c. *Acoustic Energy.* The peak noise levels generated by firing the ejector and sustainer motors average 157 decibels (db). The Army Surgeon General's Office requires the use of approved ear protection under nontactical conditions when peak noise levels of 140 db or more are expected (TB MED 251 and AR 40-5). Earplugs are available through medical channels for use by the gunner when not in combat.

d. *Warhead Safety.* The probability of accidental detonation of the warhead by static electricity or radiofrequency energy is extremely small.

e. *Battery Safety.* It is highly unlikely that the thermal battery inside the launcher could be accidentally activated. However, to insure high

safety standards, the batteries should not be exposed to high-power radiofrequency energy or stored near inflammable materials.

3-19. Firing Angle Limitations

Warning: Never fire the Redeye weapon from a kneeling or prone position. Fire only from the standing position and never from a foxhole.

a. *Maximum Firing Elevation Angle.* The weapon should never be fired at a launcher elevation angle greater than 65° (fig 3-15). If firing is done at an elevation angle greater than 65°, the blast from the ejector motor may cause earth and stone particles to fly upward and cause injury to the legs and body of the gunner.

b. *Minimum Firing Elevation Angle.* The Redeye missile loses altitude during the coast phase; therefore, the launcher must be elevated to a minimum angle of 15° or 18° before firing on level or near-level terrain (fig 3-15). This angle is provided when the gunner inserts superelevation. Whenever possible, the firing position should be on elevated terrain to reduce the possibility of the missile hitting the ground when fired at a low-altitude aircraft.

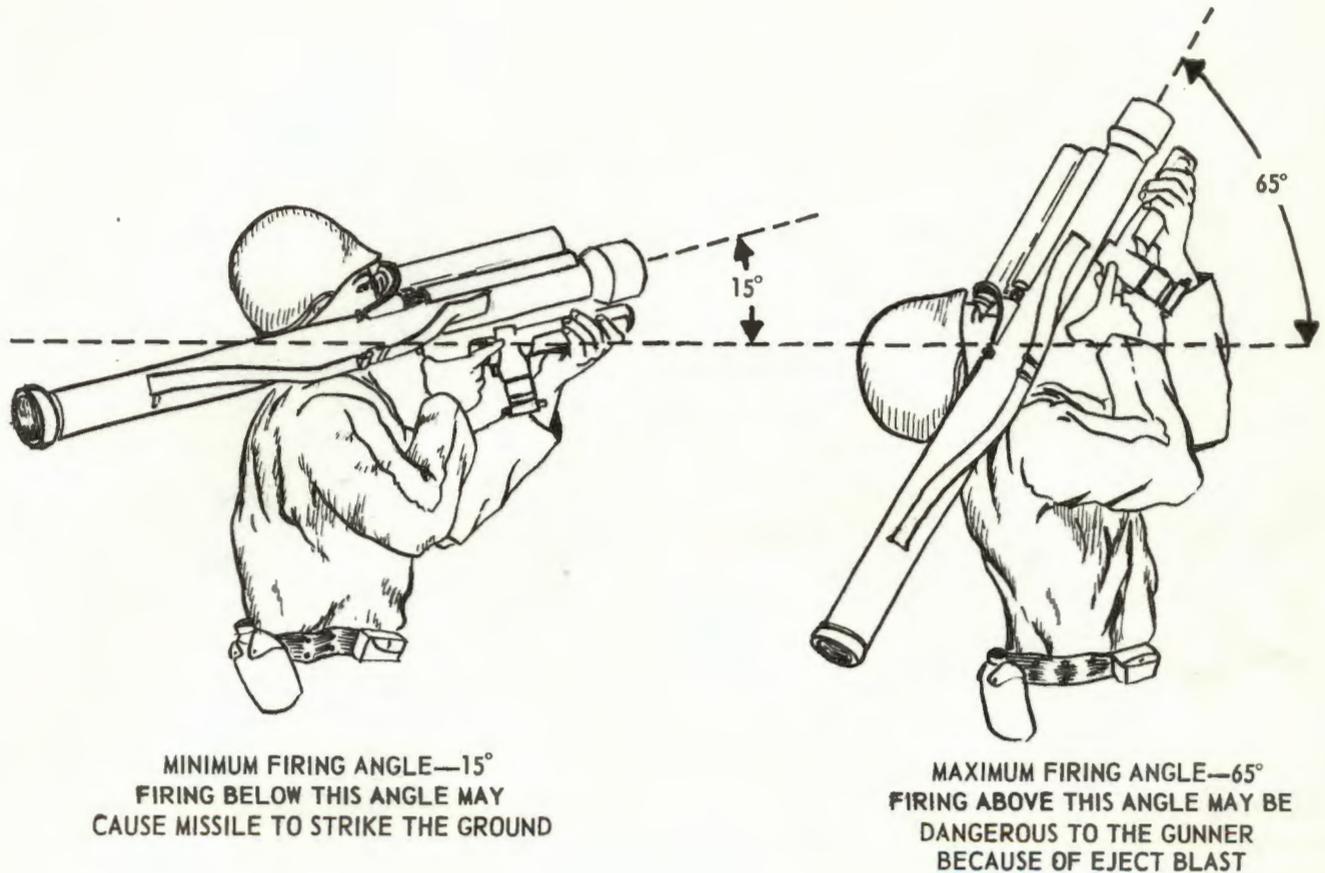


Figure 3-15. Maximum and minimum firing elevation angles.

3-20. Firing From Vehicles

Redeye can be fired from ground or from stable vehicular positions; e.g., the turret of a tank or the deck of an armored personnel carrier when personnel hatches are closed, all parts of the Red-

eye are outside the vehicle, and no personnel or combustible or frangible material are in the backblast area. Redeye can be fired at very low aircraft with little likelihood of endangering ground elements.

CHAPTER 4

TARGET ENGAGEMENT PROCEDURES

Section I. GENERAL

4-1. Introduction

The successful engagement of targets by Redeye requires performing an ordered sequence of specific steps and the application of specific rules and criteria to each engagement. These steps require visual detection of the target, target identification, target acquisition (IR), sighting procedures, and conduct of fire. The order of accomplishment of the steps is usually as listed

except that target identification may occur at any time, but must *always* occur before firing.

4-2. Scope

This chapter is divided into six sections with sections II through VI each describing one of the five sequential steps of an engagement. Factors that influence the successful accomplishment of the five steps in the engagement sequence are also discussed.

Section II. VISUAL DETECTION OF AERIAL TARGETS

4-3. General

The first step in the Redeye engagement sequence is to detect the target. Both team members act as observers, therefore, target detection may be by either team member. Redeye effectiveness is increased and target identification is facilitated by early visual detection of hostile aircraft.

usually detected are its size, color and exhaust smoke, speed and motion, altitude, and heading.

4-4. Factors Affecting Visual Detection

Major factors that influence detection are terrain mask; target characteristics, including size of profile, speed, altitude, heading, and color; environmental characteristics; and observer characteristics, including visual acuity, search sector size, and alertness.

(1) *Size.* Visual detection range increases with an increase in target size. Apparent target size varies with the type of target and the aspect from which the aircraft is viewed. A jet fighter flying a course directly toward or away from an observer presents a small profile and can approach quite close to the observer before being detected. The same aircraft flying a crossing course presents a much larger profile to the observer and thus can be detected at much greater ranges.

a. Terrain Masking. Terrain masking results from the existence of mountains, hills, trees, and buildings between the gunner and the target. The local terrain profile will influence the distance at which low-altitude targets will be unmasked; i.e., not be hidden behind a hill or other terrain features. Terrain masking is a primary consideration in establishing a Redeye air defense, and its effect can be minimized by proper site selection.

(2) *Color and exhaust smoke.* The color of an aircraft influences detection range because color affects the degree with which the aircraft contrasts with the background against which it must be detected. An aircraft that contrasts with its background is visible at greater distances than one that is camouflaged to blend with its background. The contrast ratio of most aircraft is reduced when the aircraft is viewed against a mountain background. The background in the direction from which targets are expected to approach should be considered in selecting observer positions. Many jet aircraft leave a dark smoke trail that can be used as an aid in detection at long ranges.

b. Target Characteristics. The major characteristics of an aircraft that influence the maximum distance at which the aircraft can be vis-

(3) *Speed and motion.* Target speed also affects the range of visual detection of aircraft.

In general, detection range decreases as target speed increases; however, motion, such as changing course, serves to enhance detection.

(4) *Altitude and heading.* Both the altitude and heading of aircraft influence visual detection range. Targets flying at altitudes between 150 and 1,200 feet are detected at longer ranges than targets flying either higher or lower. The heading of the aircraft affects the size of the profile presented to the observer and thereby affects detection range as explained in (1) above.

c. Environmental Characteristics. The major environmental characteristic that affects the range of visual detection of aircraft is meteorological visibility. Environmental elements, such as rain, snow, dust, fog, and haze, tend to reduce the range of visual detection of aircraft.

d. Observer Characteristics. The observer is the human link in the detection process, and his effectiveness will vary from moment to moment as a result of his personal motivation, state of training, and events taking place in his field of view that may distract his attention. These factors can be compensated for by assigning overlapping sectors of search to observers whenever possible. Two major factors must be considered in selecting personnel for duty as observers and in the assignment of observer sectors of search. These factors are the visual acuity required of observers and the size of the assigned search sector.

(1) *Visual acuity.* Observers are required to visually detect, recognize, and identify small objects at long range; therefore, observers are required to have good visual acuity. Visual acuity is man's capability to perceive an object based on minimum target size, shape, and contrast ratio. Binoculars have little effect in increasing detection ranges because they have narrow fields of view and consequently increase the time required to search a given area of space. However, binoculars may be helpful in identifying a target.

(2) *Search sector size.* In general, the range of visual aircraft detection increases with a decrease in the size of the search sector assigned an observer. Search sectors should be as small as possible, (but not less than 30°) and still provide good coverage to both sides of the expected avenues of target approach. Upon receiving an alert of the target approach, the search sector should be reduced and directed toward the direction of expected target approach.

(3) *Observer alertness.* Long periods of observer duty may degrade visual search performance. Observer duties should be rotated as often as possible. Warning of the expected approach of an aircraft tends to increase alertness of observers and can result in detection ranges considerably greater than in the case of unwarned observers.

4-5. Visual Search and Scan Procedures

The probability of visually detecting targets at long ranges is increased if systematic search procedures are followed by observer personnel. The procedure suggested here is called *scanning*. Two methods of scanning are suggested, one for use in flat terrain and the other for use in hilly terrain. In both methods, the observer should focus his eyes on a distant object, cloud, or terrain feature every few seconds so that his eyes remain focused for distant vision. If this is not done, his eyes will relax and distant objects will become blurred.

a. Flat Terrain. To discern detail, an observer's eyes must stop and focus on an object. When moving the line of vision rapidly across flat terrain, the observer will see almost no detail. When an observer moves his line of vision in short steps from point to point, he is more likely to see detail. When observing over flat terrain, use the scanning technique illustrated in figure 4-1.

b. Hilly Terrain. When observing over hilly terrain, use the horizon as a starting point and scan as illustrated in figure 4-2. Use prominent terrain features as reference points to insure complete and systematic coverage of the assigned search sector. The observer should focus his eyes on the selected starting point and scan slowly across the search sector, using an up-and-down scanning technique. After a small portion of the sector has been scanned, the observer should refocus his eyes and then continue scanning across the search sector. The search must be systematic so that no area escapes inspection. The area between the horizon and the observer should also be searched to detect low-altitude aircraft between the observer and the mask.

4-6. Search and Scan Duties

Alternating search and scan duty will reduce fatigue on both team members. One member searches for aircraft while the other member performs other team duties. Observers should not

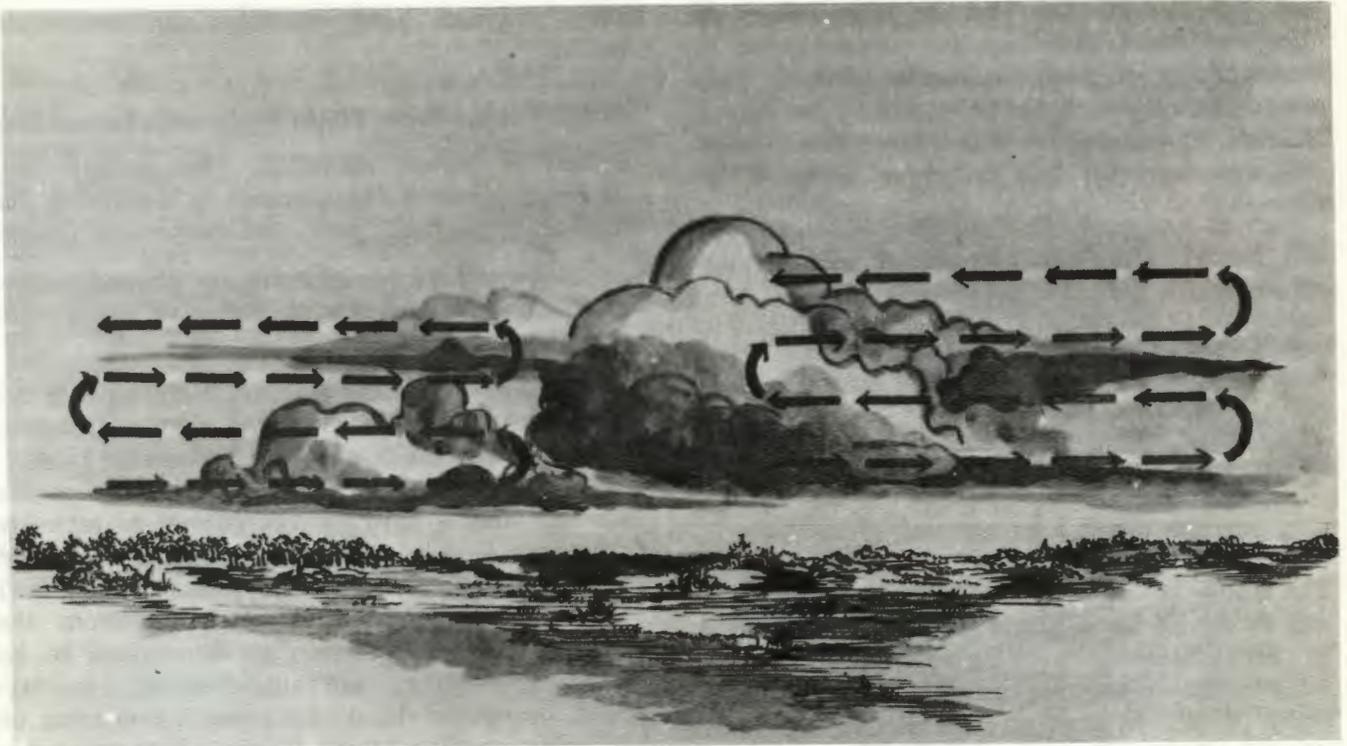


Figure 4-1. Search and scan technique in flat terrain.

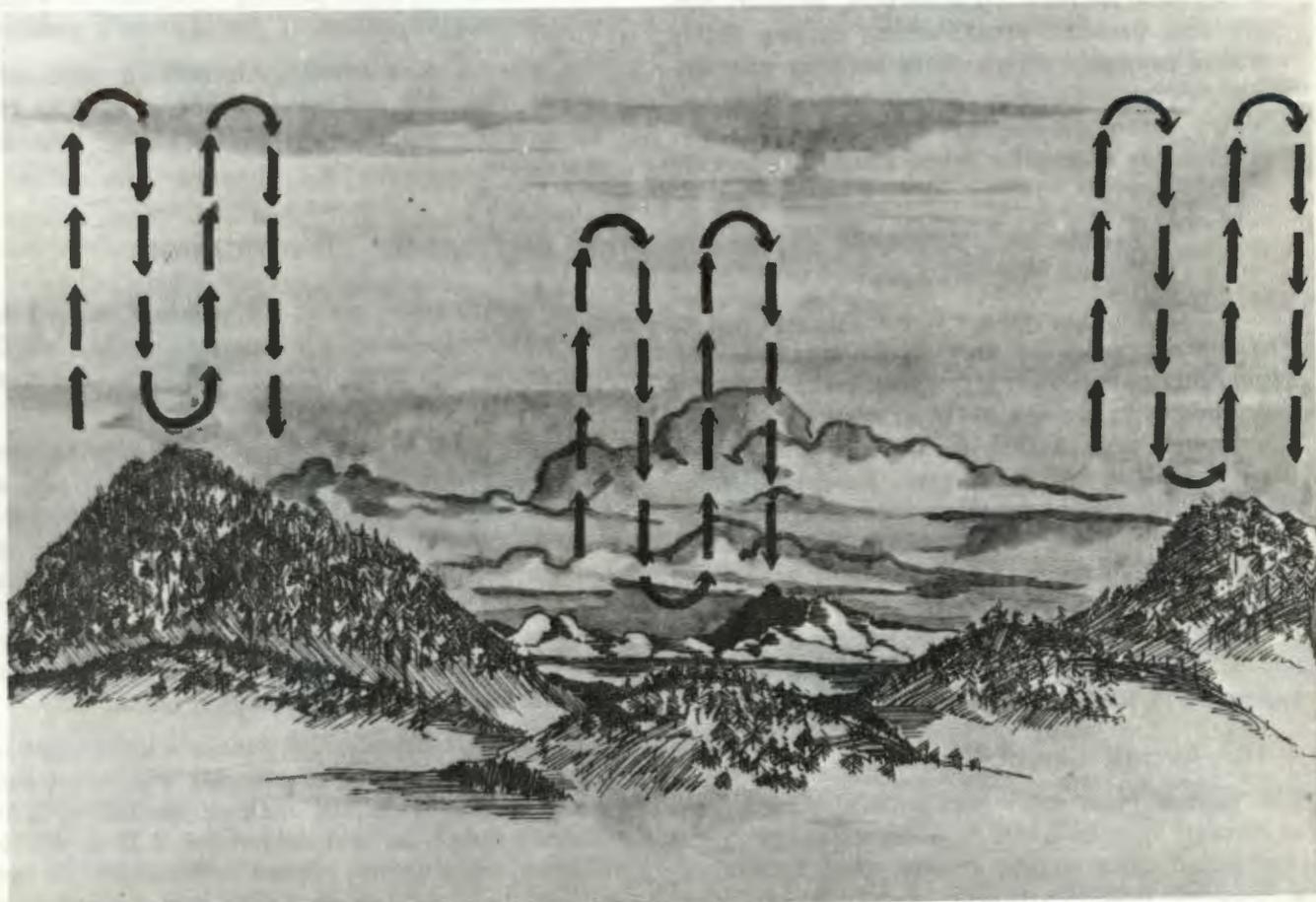


Figure 4-2. Search and scan technique in hilly terrain.

look for aircraft for periods longer than 40 minutes. Unless the team has been alerted to the approach of potential hostile aircraft, only one team member should be searching for enemy aircraft. Procedures for surveillance when a specific search sector has not been assigned include—

- a. Search all likely avenues of aircraft approach to the defended position.
- b. Divert attention occasionally to other sectors to prevent surprise by hostile aircraft.
- c. Search the entire horizon (360°) periodically.

4-7. Early Warning

The ability of the Redeye team to visually detect and recognize low-altitude aircraft is facilitated by adequate early warning. Early warning is information concerning possible enemy air activity to include location, direction of approach, number of aircraft, and other data disseminated to all air defense artillery (ADA) units. Early warning information is gathered from many sources, such as forward observers, friendly aircraft, and forward area alerting radars. Early warning communications facilities may give advance warning from a few seconds to a few minutes before an aircraft is sighted. The detection range is greater when there is adequate

early warning, good visibility, and no terrain masks.

4-8. Target Type, Flight Path, and Target Size

Following visual detection, the gunner continues to observe the aircraft to determine the aircraft type, flight path, and target size profile.

a. *Aircraft Type.* Aircraft are classed in two categories, jet and nonjet. Refer to paragraphs 4-9 and 4-10.

b. *Flight Path.* The aircraft flight path is the target course as viewed by the gunner. Determination of the flight path is particularly important during engagement of a high-performance aircraft and is used by the gunner to estimate crossover. Crossover is the midpoint of the target flight path (90° aspect to gunner's position) which is at minimum slant range from the weapon. Target direction is determined to be incoming-crossing, outgoing-crossing, in-overhead, or out-overhead. An incoming-crossing or outgoing-crossing target is one which will cross the gunner's position more than 500 meters off range. An in-overhead or out-overhead target is one which will cross directly overhead or within 500 meters off range of the gunner's position.

c. *Target Size Profile.* Aircraft in both categories (i.e., jet and nonjet) are classed in two sizes, large and small. Refer to paragraphs 4-9 and 4-10.

Section III. AIRCRAFT CHARACTERISTICS AND TARGET IDENTIFICATION

4-9. General

The gunner must be able to differentiate between enemy and friendly aircraft that operate over the forward area. A knowledge of aircraft characteristics is a prerequisite for gunner determination of aircraft type. Target engagement is a sequential function (sighting, ranging, tracking, and firing) by gunners that depends on the positive recognition of friend or foe as determined by a responsible person. Identification is an integral part of the recognition process and is essential to the rapid and accurate engagement of hostile targets.

4-10. Aircraft Characteristics

The gunner must know the general dimensions of aircraft to enable him to estimate range. This does not imply that the gunner must remember a mass of data concerning each aircraft. The

vital information about an aircraft needed by the gunner includes wingspan, fuselage, length, approximate normal operating speed, and type of engine(s) (jet or reciprocating).

a. *Aircraft Dimensions.* For fixed-wing aircraft, the important dimensions are wingspan and fuselage length. For helicopters, the important dimensions are cabin width and fuselage length. The dimensions are stated in meters and have been rounded off to simplify the gunner's task. Aircraft dimensions are grouped into specific categories for solving the ranging problem and are described in paragraph *d* below.

b. *Aircraft Speed.* The gunner's knowledge of the speed capabilities of aircraft will assist him in an engagement. By making an estimate of aircraft speed, he can determine if it is within weapon capabilities. Speed estimation is not critical because gunner firing criteria has been

optimized for broad speed requirements. However, knowledge of operating speeds is useful during some close air support missions. Aircraft flying close air support missions may be expected to fly at altitudes ranging from treetop level to several thousand feet and at speeds which would permit engagement by Redeye. A typical jet fighter, when delivering ordnance, as a ground speed of 300 to 400 knots. The attack speed of a jet fighter during close-in ground support is a function of the aircraft characteristics, target obscuration, weapon mix to be delivered, topography, and pilot skill. Speeds of aircraft are further grouped into specific categories to help solve the gunner ranging problem. A nonjet aircraft in the low/medium-performance category has a speed range of 0-300 knots. A jet aircraft in the high-performance category has a speed range of 300 knots or more.

Note. To convert knots to approximate meters per second, divide the number of knots by 2. For example, a 100-knot target flies at a speed of approximately 50 meters per second.

c. Type of Engine. Engine type information is useful to the gunner because the aircraft engine affects IR acquisition. Most propeller-driven aircraft can be acquired at a head-on aspect, but jet aircraft IR radiation is masked by the aircraft body in most cases and the gunner will normally achieve acquisition later in the flight path as compared to propeller-driven aircraft.

d. Categories of Aircraft. Redeye may be fired at two categories of aircraft based on speed and IR radiation characteristics. These categories are low/medium and high-performance aircraft.

(1) *Low/medium-performance aircraft.* This category consists primarily of observation and reconnaissance propeller-driven aircraft and helicopters.

(a) *Small propeller-driven aircraft.* Small propeller-driven aircraft (fig 4-3) have a 10-meter wingspan and a 10-meter fuselage length.

(b) *Helicopters.* Light helicopters (fig 4-4) have a 1- to 3-meter cabin (bubble) width and a 10-meter fuselage length. Medium/large helicopters (fig 4-5) have a 3- to 6-meter cabin width and a 20-meter fuselage length.

(c) *Other aircraft.* In the low/medium category are also propeller-driven transports and cargo aircraft which will not be engaged often by Redeye gunners. Representative aircraft (fig 4-6) have a wingspan of 30 meters and a fuselage length of 25 meters.

(2) *High-performance aircraft.* This category consists of all jet fighter and fighter-bomber aircraft (fig 4-7 and 4-8). The smaller jet fighter has a 10-meter wingspan and a 15-meter fuselage length. The larger fighter-bomber or attack bomber has a 25-meter wingspan and a 30-meter fuselage length.

4-11. Aircraft Recognition

Correct aircraft recognition depends upon knowledge of aircraft appearances. Recognition of aircraft by all external features is referred to as the "total form" concept. This can be achieved only by continuous study augmented by training aids and practical exercises. Aircraft must be studied to recognize the distinguishing features of their particular shapes; however, two problems must be considered:

a. Minor aircraft details should not be emphasized because they are not likely to be visible at long ranges.

b. In studying aircraft parts do not forget the overall configuration or total form. Each element should be examined as an integral part of the overall aircraft design, not as a recognition feature in itself. (See FM 44-30 for a more complete discussion of recognition training and methods of training.)

4-12. Special Considerations

a. Recognition skill is acquired only by practice. Gunners are never considered sufficiently trained and constant review is essential as long as a proficiency must be maintained.

b. Redeye team personnel should have 20-20 minimum vision (corrected) and a hearing loss no greater than 15 db between 500 and 2000 Hz, or 40 db at 4000 Hz (AR 40-501).

c. Visual recognition of aircraft aids are:

(1) Binoculars.

(2) Early warning communications.

d. During Redeye weapon training, the gunner is taught procedures of aircraft recognition. The Redeye team should continue aircraft recognition training in the particular theater where assigned. A minimum proficiency level of 90 percent correct identification, using ATT 44-3 as a standard, is required.

4-13. Responsibility for Identification

At the earliest possible time in the engagement sequence the Redeye team chief must visually



DIMENSIONS:

LENGTH OF FUSELAGE - 10 METERS

WING SPAN - 10 METERS

Figure 4-3. Typical low-performance, liaison-observation aircraft.

identify the aircraft. Immediately upon *detecting* the aircraft, the team chief should make a preliminary (tentative) aircraft identification. Tentative identification can be made by either the team chief or the gunner. Positive identification is made by the team chief if team members are together. However, during an engagement,

if the team chief and gunner are deployed separately, the gunner becomes the senior gunner or team chief at his position and assumes the duties and responsibilities accordingly. The identification process continues through the entire engagement. When the target is tentatively identified as hostile, the gunner should proceed with the

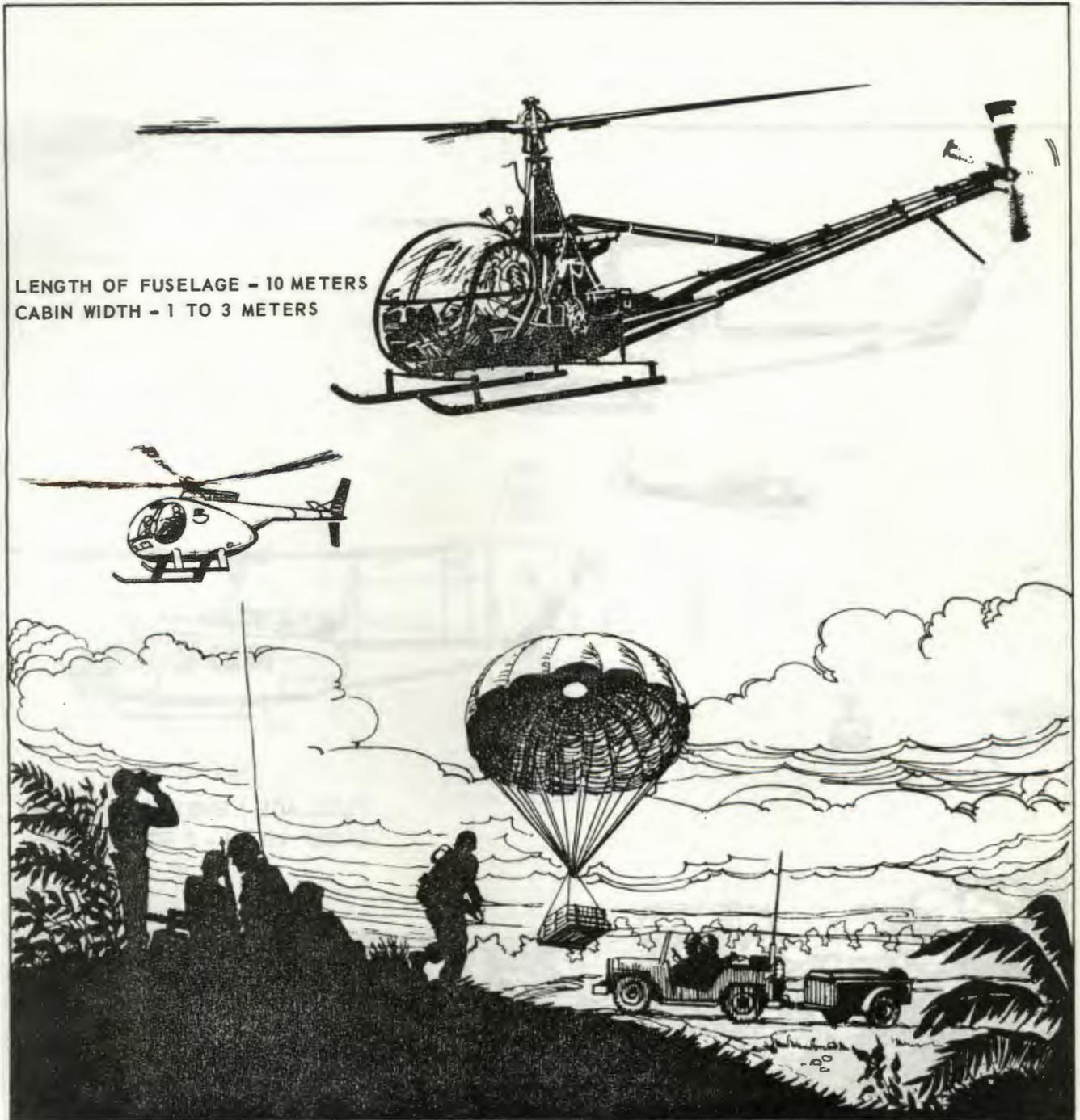


Figure 4-4. Typical light helicopter.

engagement sequence. In every case, the gunner should establish visual track and abandon it only when the aircraft is identified as friendly. If tentative identification is friendly, the team chief continues to observe the aircraft to resolve any doubt but continues to watch for other aircraft during this time. While destruction of enemy aircraft is of prime importance, the protection of friendly aircraft from inadvertent engagement

by Redeye is also a prime consideration. Since rules for engagement require that a visual, positive hostile identification be made in accordance with hostile criteria before the gunner fires, tentative hostile identification will be further verified or changed, as necessary, prior to the moment of firing. If the identification as hostile is not positive, the rules for engagement normally require that the gunner withhold fire.



DIMENSIONS

FUSELAGE LENGTH - 20 METERS

CABIN WIDTH - 3 TO 6 METERS

Figure 4-5. Typical medium helicopter.

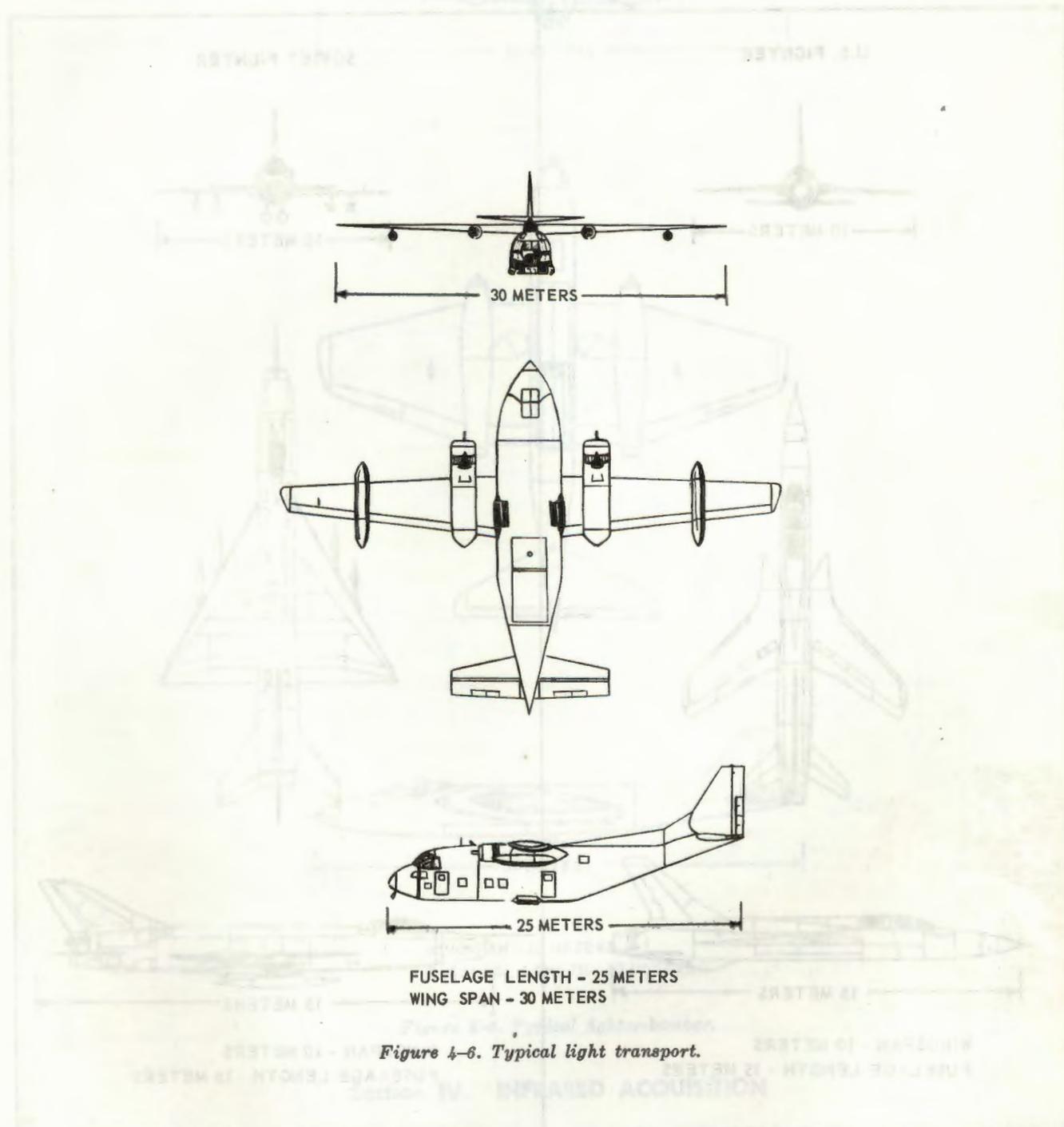


Figure 4-6. Typical light transport.

4-14. General

In the direct engagement system, the target is identified by a type of infrared acquisition. As previously mentioned, this acquisition is essential for a successful engagement. Infrared acquisition requires the operator to have a knowledge of target characteristics, including IR radiation, as well as

4-15. Infrared Acquisition Principles

The target must be within sensor acquisition range. The maximum range of infrared acquisition is called the IR acquisition boundary. It is

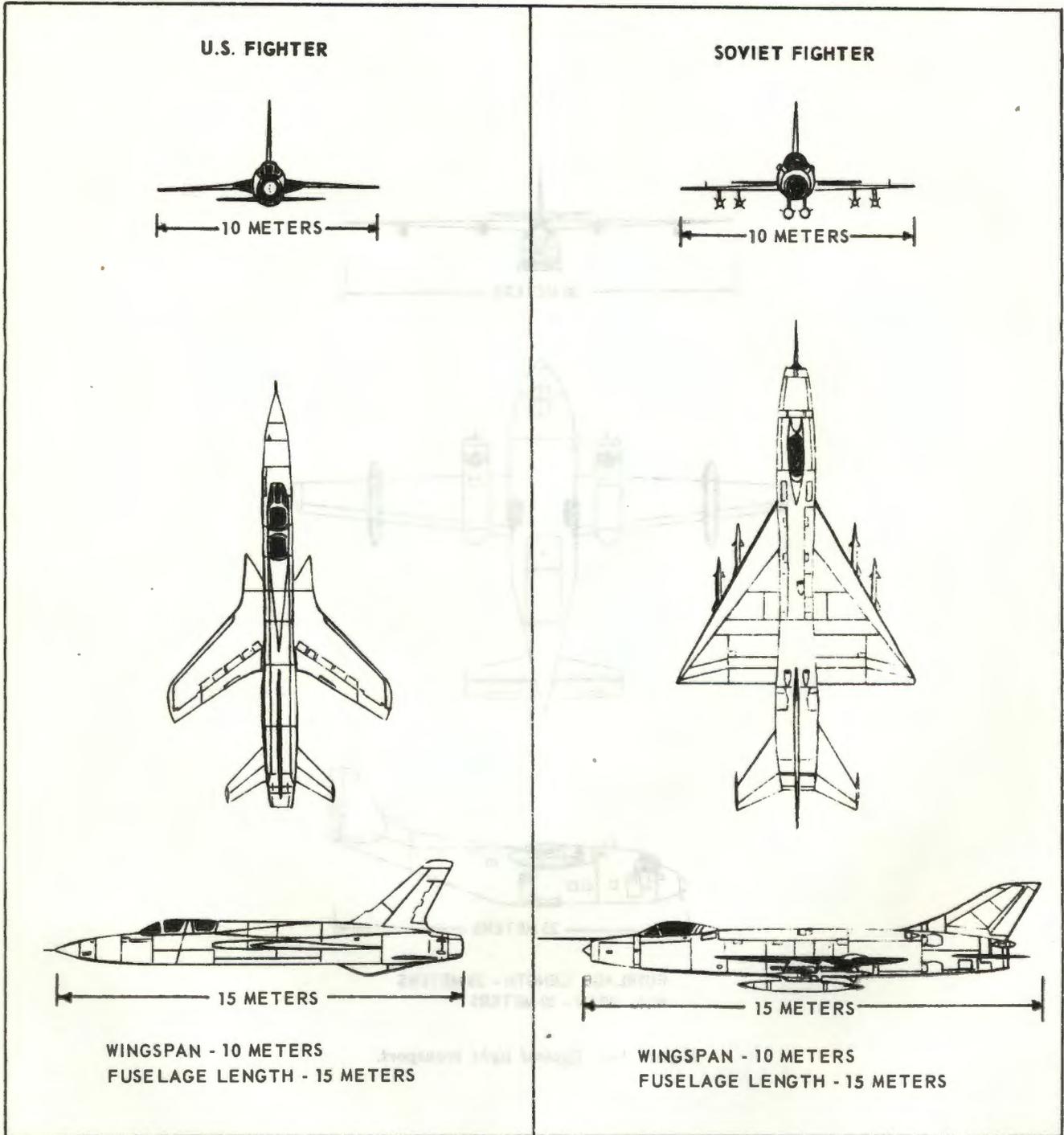


Figure 4-7. Typical jet fighters.

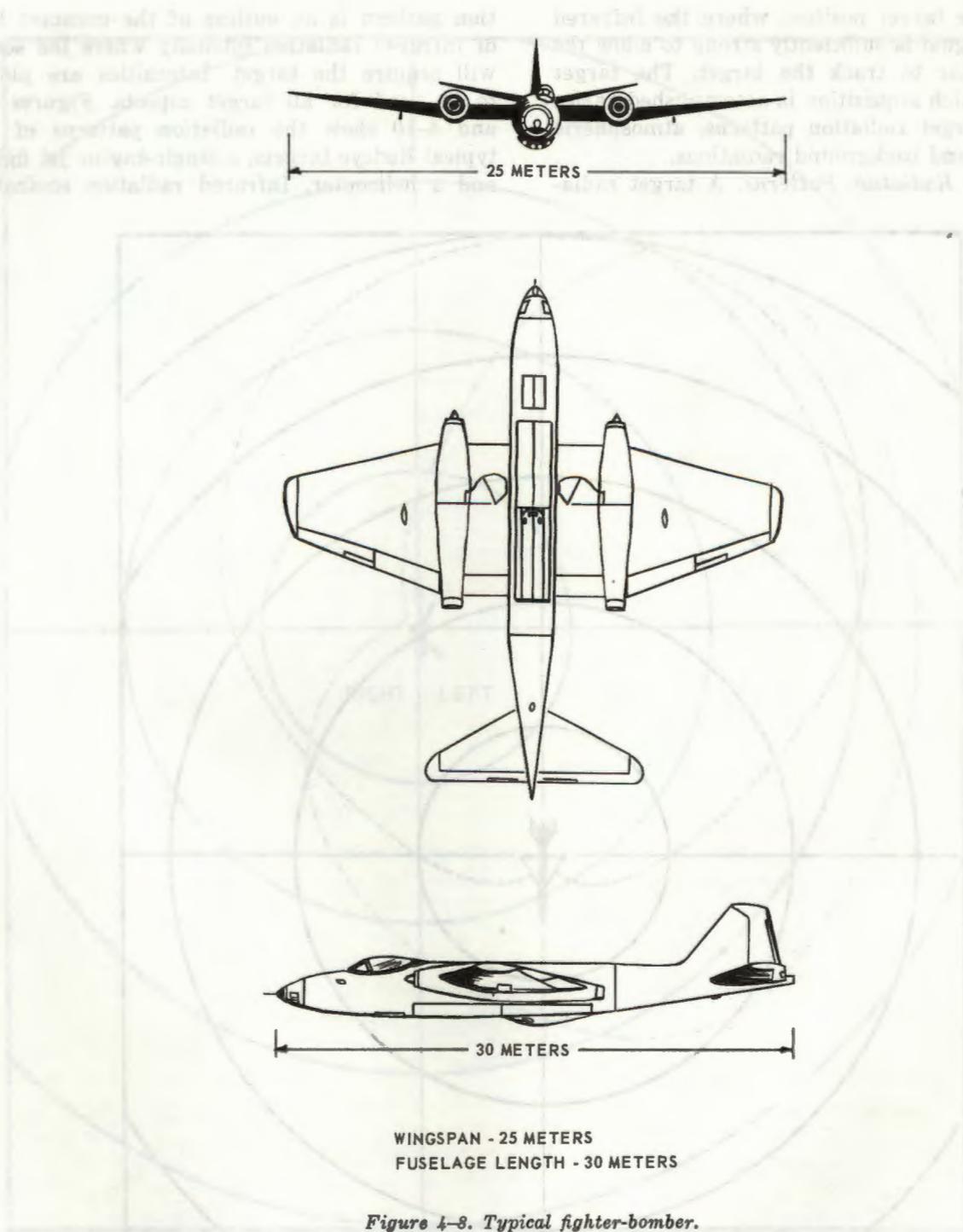


Figure 4-8. Typical fighter-bomber.

Section IV. INFRARED ACQUISITION

4-14. General

In the Redeye engagement sequence, the seeker acquires the target by infrared acquisition. As previously discussed, this acquisition is essential for a successful engagement. Redeye gunnery requires the gunner to have a knowledge of target characteristics, including IR radiation, so he can

intelligently decide when to warm up the weapon, acquire, and fire.

4-15. Infrared Acquisition Boundaries

The target must be within seeker acquisition range. The maximum range of infrared acquisition, called the IR acquisition boundary, is lo-

cated at the target position where the infrared radiation signal is sufficiently strong to allow the missile seeker to track the target. The target range at which acquisition is accomplished varies with the target radiation patterns, atmospheric conditions, and background radiations.

a. *Target Radiation Patterns.* A target radiation

pattern is an outline of the constant level of infrared radiation intensity where the seeker will acquire the target. Intensities are plotted to be used for all target aspects. Figures 4-9 and 4-10 show the radiation patterns of two typical Redeye targets, a single-engine jet fighter and a helicopter. Infrared radiation emanating

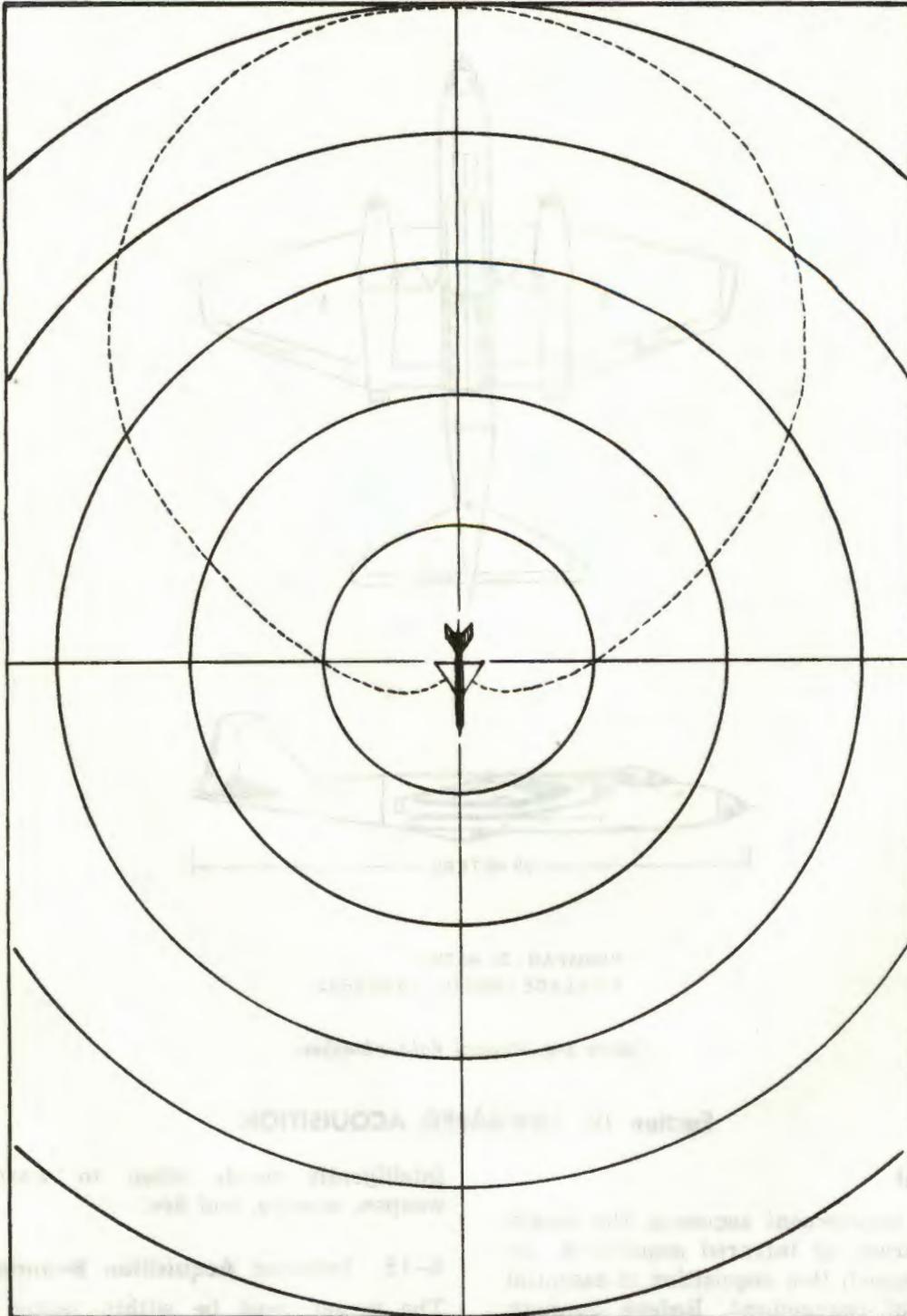


Figure 4-9. Radiation pattern of typical jet fighter.

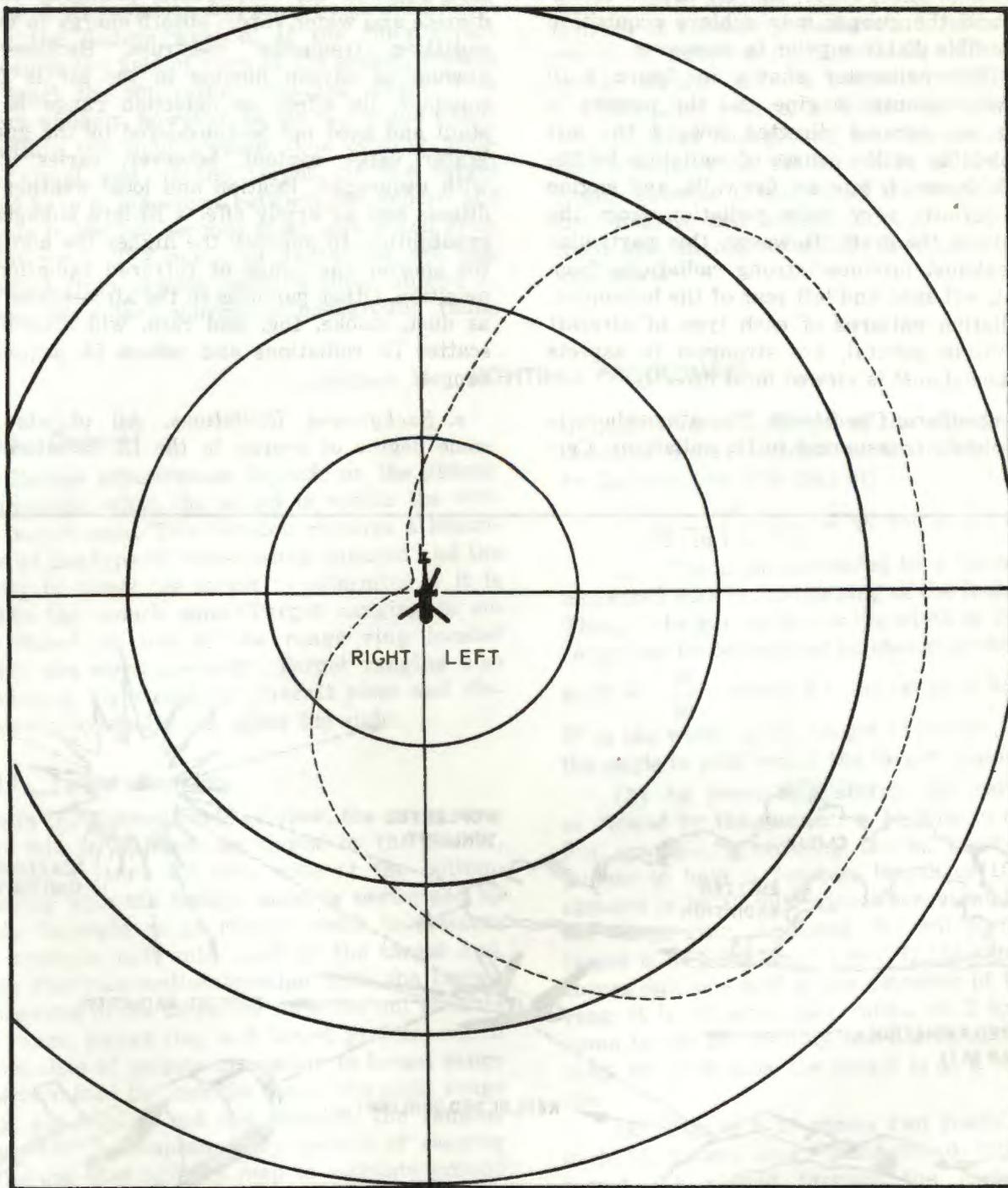


Figure 4-10. Radiation pattern of helicopter with exhaust on left side.

from an aircraft has many sources, but the primary source is the hot metal parts of the engine exhaust system.

(1) The jet fighter shown in figure 4-9 produces a radiation intensity that is strongest from a rear aspect and becomes weak as the nose aspect is approached because the exhaust is directed to the rear of the aircraft. Maximum

radiation is present from the rear aspect, but is masked to the Redeye seeker in the nose aspect by the fuselage and wing structure. Because of the shape of the radiation pattern of a jet fighter, IR acquisition may occur just prior to crossover for a directly incoming jet aircraft and just at crossover or beyond for other jet aircraft. However, as a target's offset distance increases,

in relation to the gunner, the IR source is unmasked and the gunner may achieve acquisition a considerable distance prior to crossover.

(2) The helicopter shown in figure 4-10 has a front-mounted engine and the pattern is based on an exhaust directed toward the left rear. Shielding of the source of radiation by the aircraft's fuselage, interior firewalls, and engine mounts permits very little radiation from the right side of the craft. However, this particular engine exhaust produces strong radiations from the front, left side, and left rear of the helicopter. The radiation patterns of each type of aircraft differ but, in general, are strongest in aspects where the exhaust is viewed most directly.

b. Atmospheric Conditions. The atmosphere is not completely transparent to IR radiations. Cer-

tain gases in the atmosphere, primarily carbon dioxide and water vapor, absorb energy in the IR radiation frequency spectrum. Because the amount of carbon dioxide in the air is fairly constant, its effect on detection range is constant and need not be considered by the gunner. Water vapor content, however, varies widely with geographic location and local weather conditions and adversely affects Redeye engagement capabilities. In general, the higher the humidity, the shorter the range of infrared radiation acquisition. Other particles in the atmosphere, such as dust, smoke, fog, and rain, will absorb and scatter IR radiations and reduce IR acquisition ranges.

c. Background Radiations. All objects emit some degree of energy in the IR radiation fre-

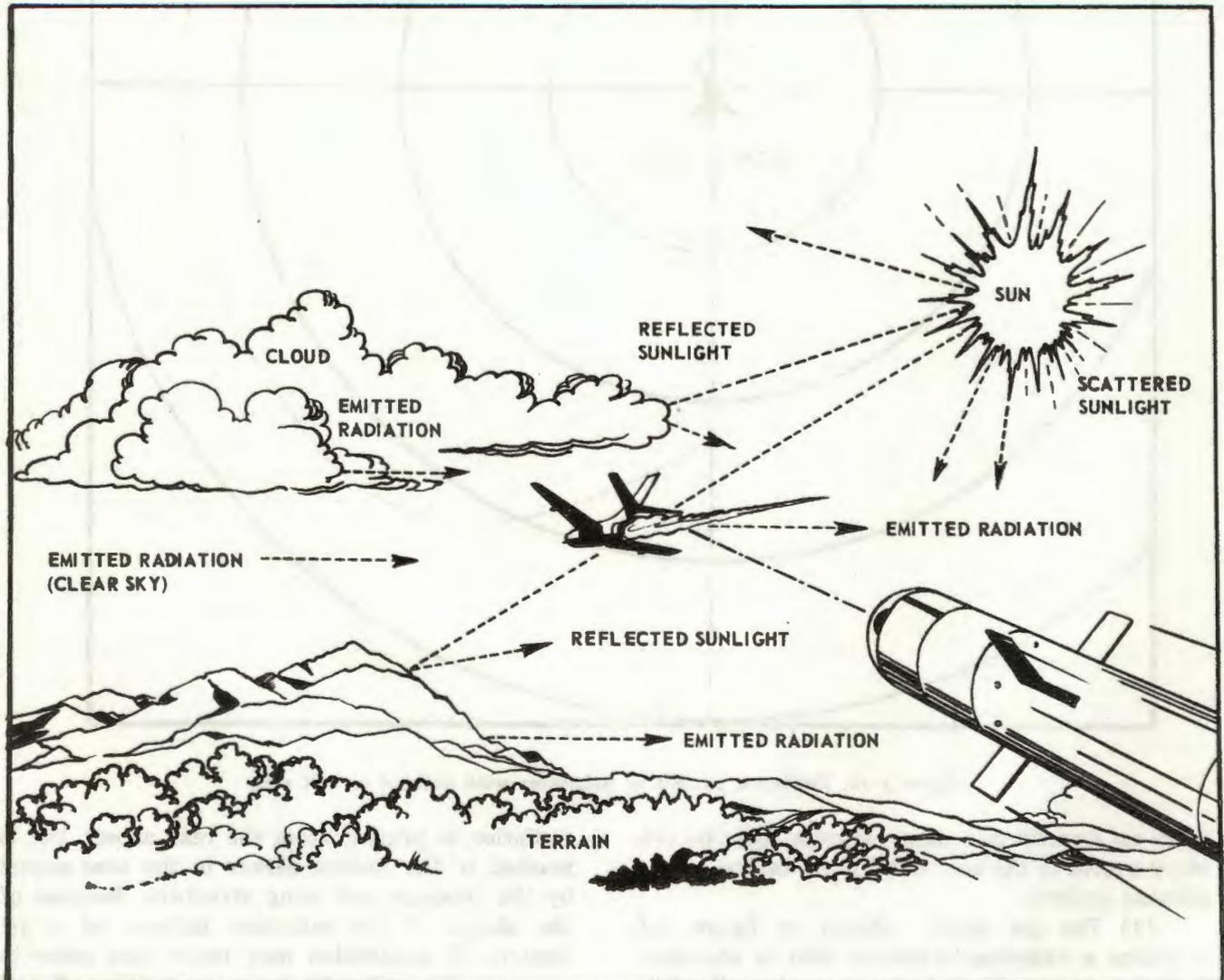


Figure 4-11. Background radiations.

quency spectrum. The sun is an extremely strong source of IR radiation and must be avoided when firing the Redeye weapon. If the sun's direct rays enter the field of view of the seeker, Redeye will track the sun rather than the target. This is very unlikely, however, as the sun would either be within the sight picture, thus causing probable visual loss of the target, or the target would have to maneuver between the Redeye and the sun in the few seconds after launch and prior to intercept. The sun's IR radiations are also reflected from objects, causing these objects to become secondary sources of background radia-

tions. Typical secondary sources are bodies of water, bare hillsides, and white clouds. Some sources of secondary background radiations are shown in figure 4-11. The Redeye IR radiation seeker can discriminate between radiations from a small point source, such as the tailpipe of a jet, and large background sources, such as clouds and terrain. With the exception of the sun, the engine exhaust or tailpipe of the target is usually the smallest and hottest object in the environment and, therefore, will be tracked by the missile seeker.

Section V. SIGHTING PROCEDURES

4-16. General

The Redeye effectiveness depends on the gunner determining when the target is within the missile launch zone. This decision requires a knowledge of the type of target being engaged and the ability to range the target to determine if it is within the launch zone. Target ranging is accomplished by use of the range ring located within the sight assembly. Target ranging also requires a knowledge of aircraft sizes and distance-size relationships, using the sight.

4-17. Target Ranging

Within the gunner's field of view, the range ring is 10 mils in diameter, as viewed by the gunner, and has a notch 2.5 mils wide at the bottom. Ranging with the Redeye sight is performed by using the sight range ring or notch to measure the angle in mils subtended by the target and, using this information together with the known dimensions of the target, to solve the mil formula for range. Range ring and target profiles, which depict sizes of targets in relation to target range as determined through the use of the sight range ring, are used to aid and simplify the ranging procedure. A complementary method of ranging is the use of a military map to estimate ground distance. The data obtained through estimation of ground distance obtained from a military map, compass, and binoculars may be used in making a range card as explained in *d* below. With a prepared range card the gunner can readily determine, through practice, when aircraft should or should not be engaged.

a. Use of Mil Formula.

(1) The mil formula can be related to the memory aid of WORM or the Width of an object

in units Over the Range of the object (in thousands of units) is equal to the angle subtended by the object in Mils (μ) or:

$$\frac{W}{R \text{ (in 1,000's)}} = \mu \text{ (fig 4-12).}$$

(2) The angle subtended by a target can be measured with the range ring of the Redeye sight. Then, if the gunner knows the width of the target, range can be determined by changing the formula

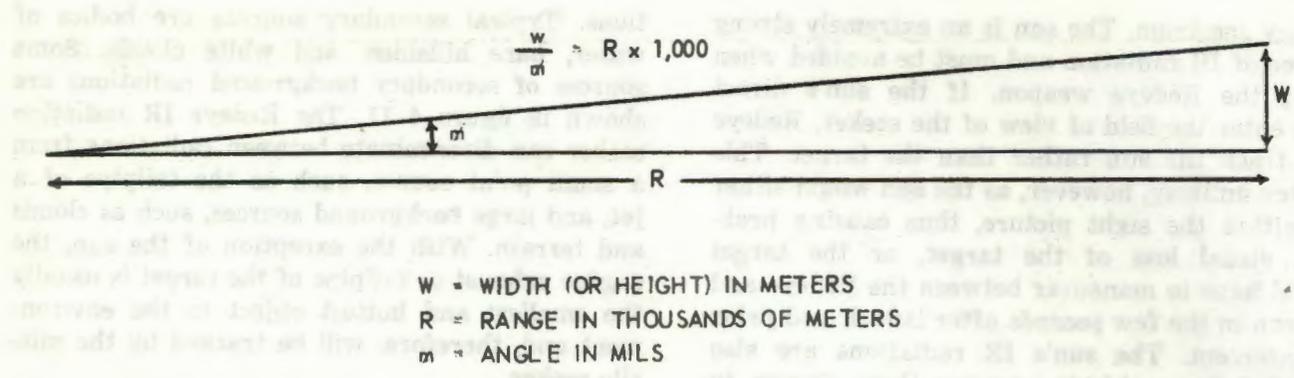
to $R = \frac{W}{\mu}$, where R is the range in kilometers,

W is the width of the target in meters, and μ is the angle in mils which the target subtends.

(3) As previously stated, the range ring, as viewed by the gunner, is 10 mils in diameter. For example, a crossing target, known to the gunner to have a fuselage length of 10 meters, appears to be 10 mils wide when viewed through the range ring. Applying the mil formula, the target is at a range of 1 km. If the same target covers only one-half of the diameter of the range ring, it is at twice that range, or 2 km. If the same target covers only one-fourth of the range ring, or 2 1/2 mils, the target is at a range of 4 km.

(4) Figure 4-13 shows two roadside signs, each 15 meters long, which could represent a target. As viewed through the Redeye sight range ring, the sign close to the viewer just fills the 10-mil diameter of the range ring, thus is at a distance of 1.5 km. The other sign, which is farther from the viewer, covers only 5 mils of the range ring. Since the second sign appears to be only one-half as wide as the range ring, it is 3 km from the viewer.

(5) The aircraft in figure 4-14 is a jet fighter. The average fuselage length of this type of aircraft is about 15 meters. Its angular width ac-



W = WIDTH (OR HEIGHT) IN METERS
 R = RANGE IN THOUSANDS OF METERS
 m = ANGLE IN MILS

SECTION V SIGHTING PROCEDURES

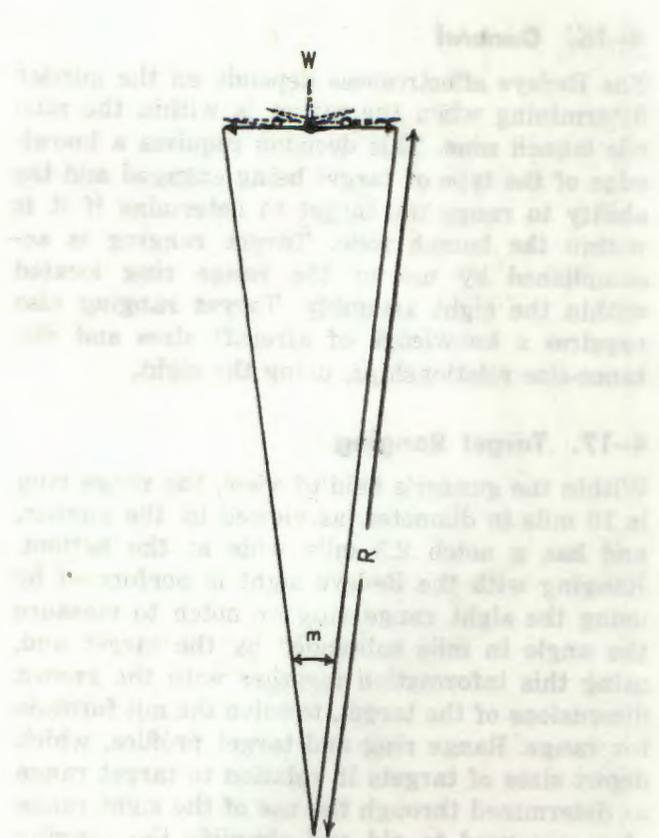
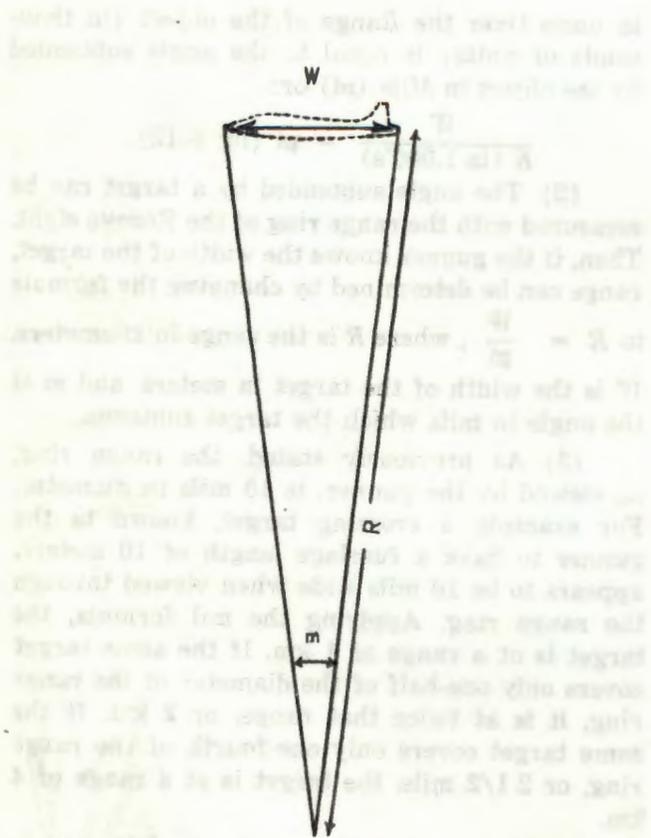


Figure 4-12. Mil formula.

According to the figure is 10 mils. Its range is $R \times 1000 = \frac{W}{m} = \frac{15}{10} = 1.5 \text{ km.}$

(6) The jet fighter shown in figure 4-15 is about 5 mils wide and has an average length of 15 meters. The range of this target is $\frac{15}{5} = 3 \text{ km.}$

(7) The jet fighter shown in figure 4-16 is about 2 1/2 mils wide and has an average fuselage

length of 15 meters. The range of this target is $\frac{15}{2.5} = 6 \text{ km.}$

b. *Practical Target Ranging.* When the target image is superimposed on the sight range ring, the target image size will change correspondingly as the range to the target increases or decreases. The target size as seen by the gunner through the range ring, therefore, is related to

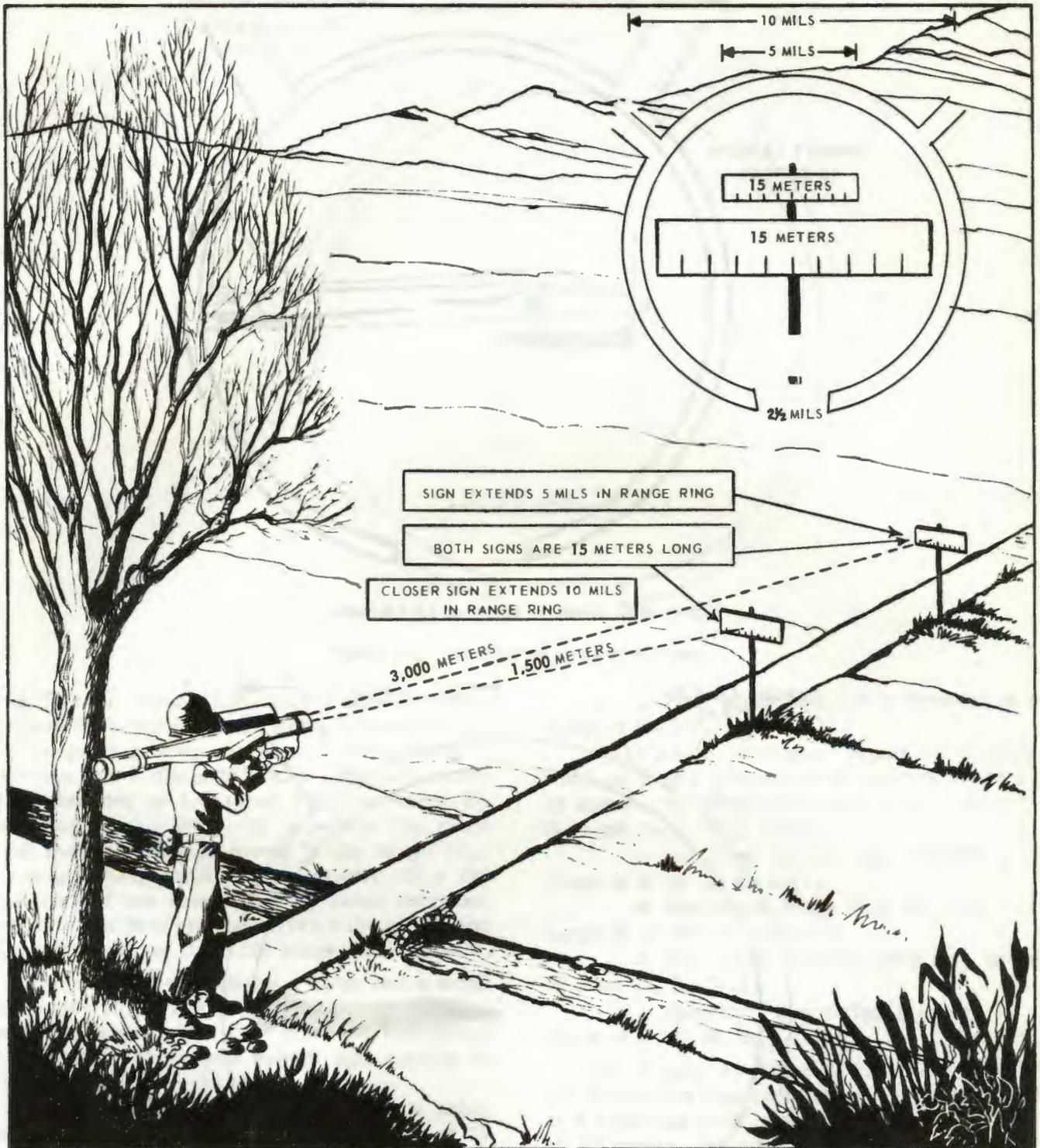


Figure 4-13. Gunner estimating range.

target range. The gunner forms a mental profile picture of one of the various representative low/medium- and high-performance aircraft previously described. From memory, the gunner applies this profile to the range ring to solve the

ranging problem. The use of the range ring and target profiles simplifies the ranging procedure because the gunner does not have to apply the mil formula and work out mathematical computations during an engagement.

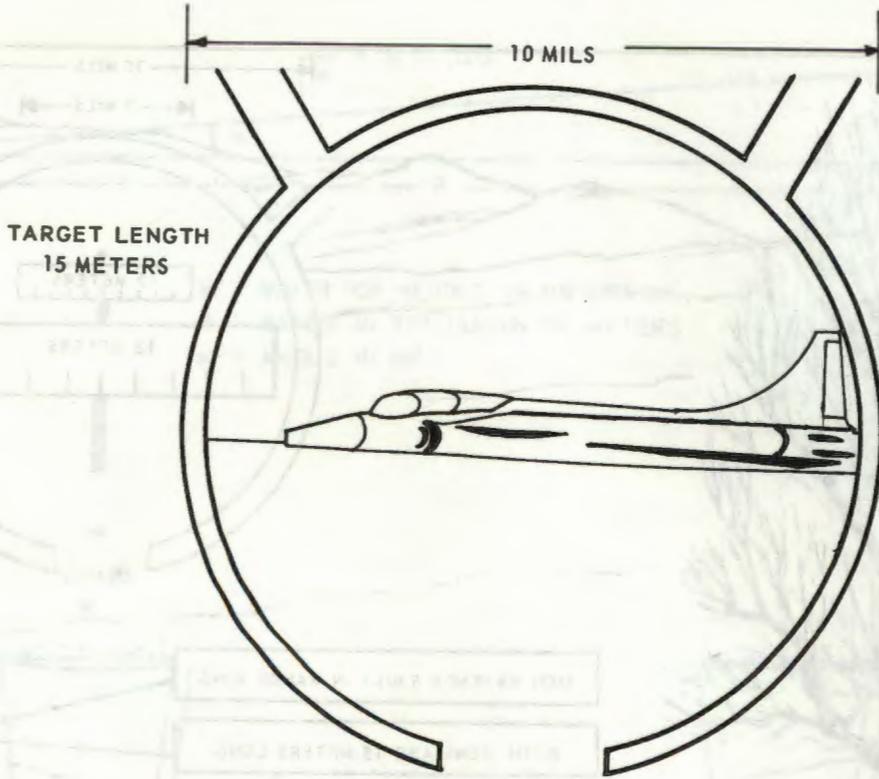


Figure 4-14. 15-meter target at 1.5-km range.

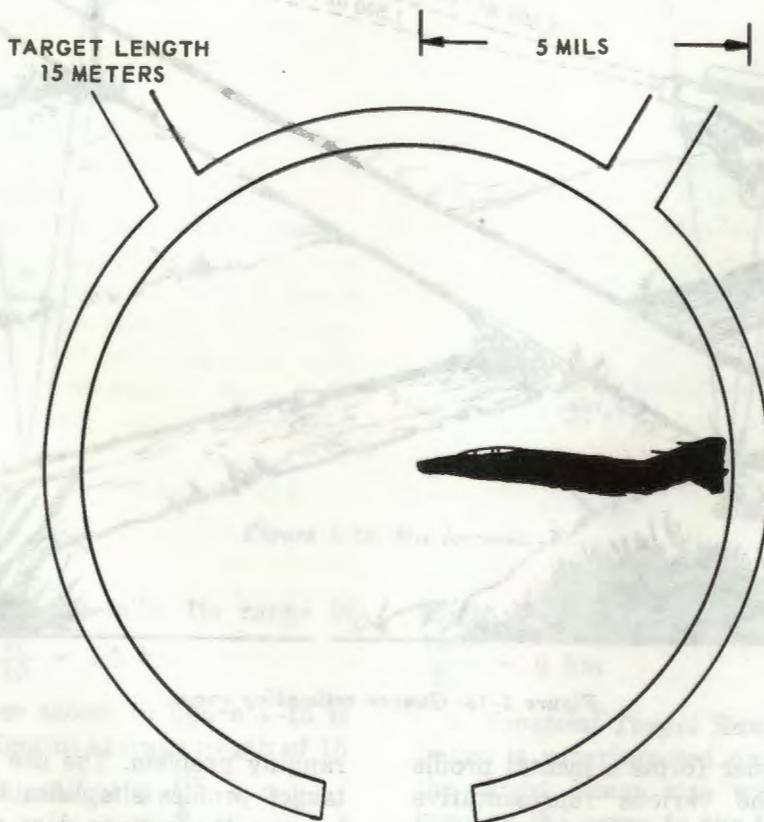


Figure 4-15. 15-meter target at 3-km range.

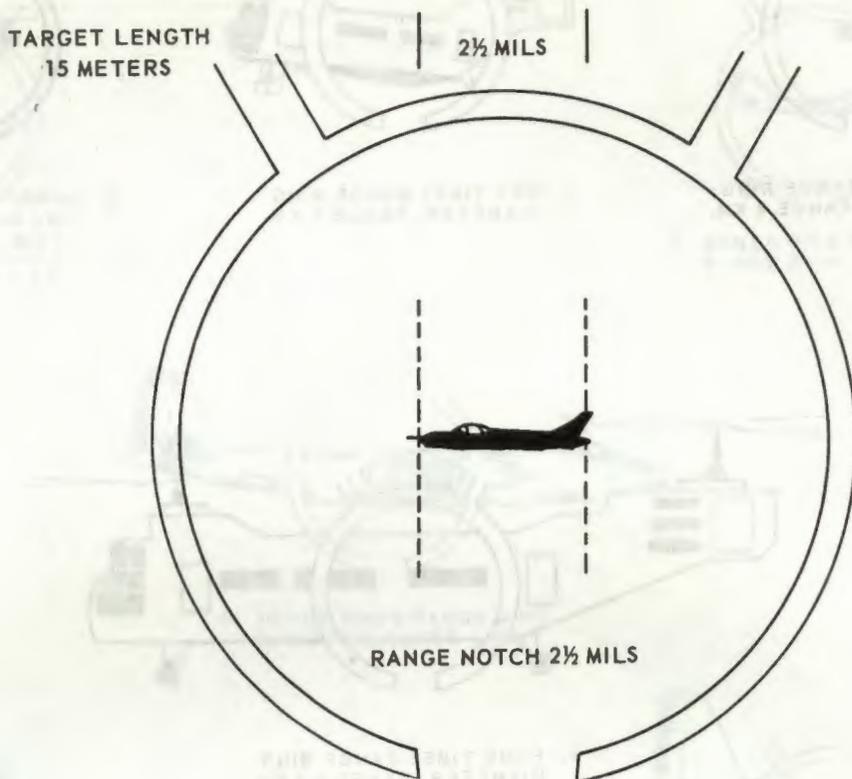


Figure 4-16. 15-meter target at 6-km range.

c. Use of Range Ring and Target Profiles. Instead of the target image width as seen through the range ring being expressed in mils, the gunner can use a simplified term (e.g., $1/2$ range ring diameter or $1/3$ range ring diameter). By this method, he need only determine the space that the target image covers in the range ring. A target image will appear greater than the diameter of the range ring as range decreases and this can be expressed as twice the range ring diameter or three times the range ring diameter.

(1) Figure 4-17 shows a large and a small helicopter which are in the low/medium-performance category. The two types of helicopters are depicted at various ranges and aspects as seen through the sight ring.

(a) *Large helicopter.* Based on a cabin width of 6 meters and a fuselage length of 20 meters, the large helicopter as seen through the sight range ring covers—

1. One-half range ring diameter at a range of 4 km (1, fig 4-17).
2. Two times range ring diameter at a range of 1 km (2, fig 4-17).
3. Three-fourths range ring diameter at a range of 2.7 km (3, fig 4-17).

4. Four times range ring diameter at a range of 0.5 km (4, fig 4-17).

(b) *Small helicopter.* Based on a cabin width of 1 to 3 meters and a fuselage length of 10 meters, the small helicopter as seen through the sight range ring covers—

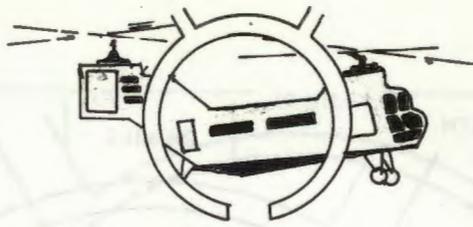
1. One-third range ring diameter at a range of 3 km (5, fig 4-17).
2. Two times range ring diameter at a range of 0.5 km (6, fig 4-17).
3. Full range ring diameter at a range of 1 km (7, fig 4-17).
4. One-third range ring diameter at a range of 3 km (8, fig 4-17).

(2) Figure 4-18 shows an attack bomber which is in the high-performance category. Based on a wingspan of 25 meters and a fuselage length of 30 meters, the aircraft as seen through the sight range ring (1-5, fig 4-18) covers—

- (a) Three-fourth range ring diameter at a range of 4 km (1, fig 4-18).
- (b) Full range ring diameter at a range of 3 km (2, fig 4-18).
- (c) Three times range ring diameter at a range of 1 km (3, fig 4-18).



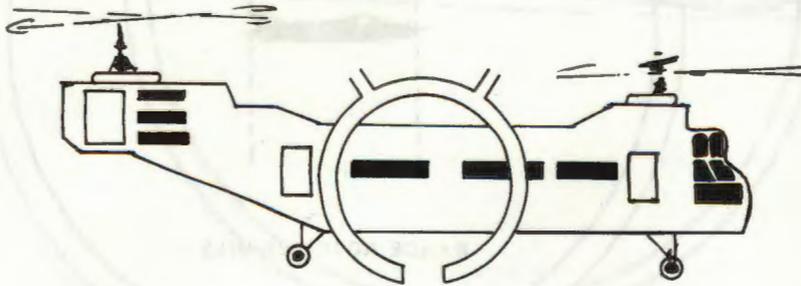
1. ONE-HALF RANGE RING DIAMETER, RANGE 4 KM.



2. TWO TIMES RANGE RING DIAMETER, RANGE 1 KM.



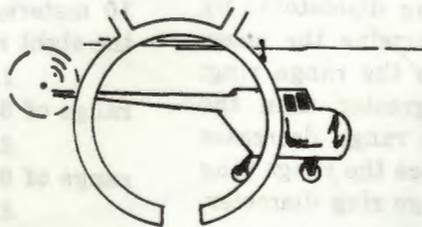
3. THREE-FOURTHS RANGE RING DIAMETER, RANGE 2.7 KM.



4. FOUR TIMES RANGE RING DIAMETER, RANGE 0.5 KM.



5. ONE-THIRD RANGE RING DIAMETER, RANGE 3.0 KM.



6. TWO TIMES RANGE RING DIAMETER, RANGE 0.5 KM.



7. RANGE RING DIAMETER, RANGE 1 KM.



8. ONE-THIRD RANGE RING DIAMETER, RANGE 3.0 KM.

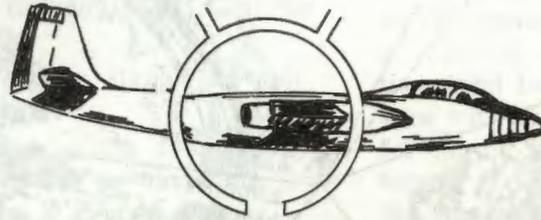
Figure 4-17. Range ring and target profiles of helicopters.



1. THREE-FOURTHS RANGE RING DIAMETER, RANGE 4 KM.



2. RANGE RING DIAMETER, RANGE 3 KM.



3. THREE TIMES RANGE RING DIAMETER, RANGE 1 KM.



4. RANGE RING DIAMETER, RANGE 3 KM.



5. THREE TIMES RANGE RING DIAMETER, RANGE 1 KM.

Figure 4-18. Range ring and target profiles of attack bomber.

(d) Full range ring diameter at a range of 3 km (4, fig 4-18).

(e) Three times range ring diameter at a range of 1 km (5, fig 4-18).

d. Complementary Aids Used in Target Ranging.

(1) *Map.* A military map can be used for determining distance. The map is used to plot distances to various landmarks or terrain features. When team personnel are oriented with a military map and know approximate distances to various landmarks, it is a simple matter to construct a range card.

(2) *Range card.* The team chief normally makes a range card (fig 4-19) for the Redeye position. By transposing information from the map to the range card, he establishes ranges to various landmarks or objects that he can see.

Many areas may contain few or no usable landmarks; therefore, other temporary objects, such as a vehicle, mortar position, or temporary bridge may be used to supplement more permanent objects when making a range card. The purpose of the range card is to enable the team chief and gunner to have a ready reference to various ranges within view of the position. By knowing the capabilities and limitations of the weapon and the ranges of various landmarks and objects, the gunner can readily determine if a target can be engaged. Targets to be engaged by Redeye teams generally will be operating at low altitudes; therefore, the slant range (line-of-sight distance) to these targets will be only slightly greater than the horizontal range (the distance to a point in the horizontal plane directly below the target). This difference for the Redeye problem is not considered consequential.

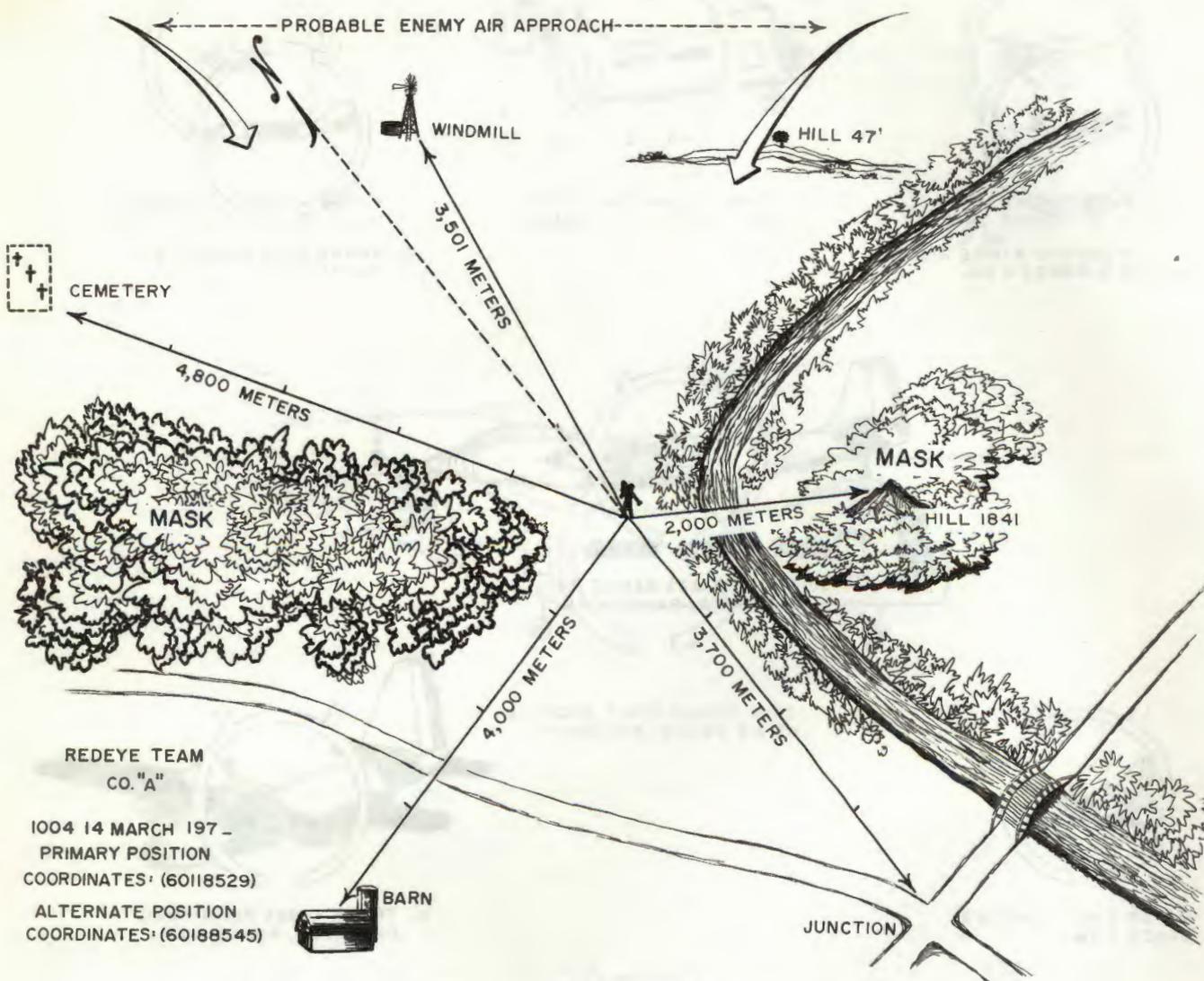


Figure 4-19. Typical range card.

(3) *Other aids.* Other aids to use when estimating ground distance to distant objects are binoculars, Redeye weapon range ring, and/or the gunner's hand. These aids are used to supplement data obtained more easily from maps, but maps may not always be available. The gunner may sight an object with binoculars or through the range ring of the weapon and, by using the

mil relationship previously described, find the range to specific landmarks or temporary objects located on the ground and within view of the position. The use of the hand, fingers, or thumb may also be used with the mil relationship formula to estimate range. FM 6-135 describes this process.

Section VI. CONDUCT OF FIRE

4-18. General

This section covers the steps in the Redeye engagement procedures. The gunner must know general target characteristics and effective weapon employment techniques to properly use the Redeye weapon. The gunner should study this

section along with FM 23-17A to understand Redeye engagement techniques.

a. *Gunner Skills.* Gunner skills must be developed by systematic training in the proper employment of the Redeye weapon. The gunner should be given every opportunity to practice

these skills during the training period. His progress should be measured periodically to insure that training objectives are being met. The required gunner skills include:

- (1) Visual identification of aircraft.
- (2) Target evaluation and engagement probability considering target type, direction, speed, range, altitude, and IR radiation pattern.
- (3) Preparation for firing.
- (4) Pointing the weapon toward expected acquisition area, and using range estimation factor, which influences the decision to activate the weapon at the proper time.
- (5) Recognition of proper signals to indicate acquisition of the target.
- (6) Pressing uncaging switch followed by checking of seeker tracking by listening to changed audible output from the weapon.
- (7) Alternate procedures; i.e., if IR radiation is lost between uncaging the gyro and pressing the firing trigger, to recage and reestablish IR acquisition.
- (8) Procedures to determine proper firing time based on range ring profiles.
- (9) Procedures to insert superelevation and lead based on aircraft course, speed, and range.
- (10) Procedures for firing.
- (11) Procedures for deenergizing the weapon.

b. Activate. The activate zone encompasses the entire area within which the target must be when the gunner activates the weapon. Determination of the activate zone by the gunner is important for effective firing because the activate zone has to be established and time allowed for weapon warmup prior to launch. (For detailed explanation of activate zones, see FM 23-17A.) The gunner can determine the activate zone for a specific engagement after he knows the target type and direction of flight. He determines when to activate by using the simplified target ranging technique (applying range ring profile). When engaging a low/medium- or high-performance target, the gunner activates the weapon as soon as he determines the target to be within the activate zone. If the weapon is activated too soon and BCU life is exceeded, the engagement can be continued by inserting a new BCU.

c. Launch. The missile launch zone is that volume of space within which the target must be for a successful engagement. The launch zone is defined by the missile performance boundaries, and seeker IR radiation acquisition capabilities.

Launch zones with respect to the gunner will vary with target type, speed, and altitude. *Launch may take place as soon as the target is within the determined launch limits and IR acquisition has occurred.* The gunner determines when to launch by application of range ring profile. Launch for low/medium-performance aircraft may take place as soon as the target is within the determined launch limits and IR acquisition has occurred. The optimum time for missile launch for high-performance aircraft is a function of the crossover point and IR acquisition. If IR acquisition occurs prior to crossover, the gunner will uncage the gyro, insert superelevation (and lead if required), and fire in accordance with the applicable engagement procedures for an incoming-crossing or incoming-overhead target. If IR acquisition occurs after crossover, the gunner will then perform the firing sequence as quickly as possible if the target is within the launch boundaries. The gunner's determination as to when to hold fire and resume fire are functions of weapon capabilities and limitations and are described in the techniques of fire rules found in FM 23-17A.

d. Cease Fire. The gunner should cease fire when he estimates the target to be outside the launch zone. The gunner's estimate is based on the target range as determined by target size in relation to range ring.

4-19. Firing Technique for Engaging Low/Medium-Performance Aircraft

a. Typical Low/Medium-Performance Aircraft Characteristics. The identifying characteristics of typical low/medium-performance aircraft include:

- (1) Dimensions:
 - (a) *Propeller-driven (small):*
 1. Wingspan 10 meters.
 2. Length of fuselage 10 meters.
 - (b) *Propeller-driven (large):*
 1. Wingspan 30 meters.
 2. Length of fuselage 25 meters.
 - (c) *Small helicopter:*
 1. Cabin width 1-3 meters.
 2. Length of fuselage 10 meters.
 - (d) *Large helicopter:*
 1. Cabin width 3-6 meters.
 2. Length of fuselage 20 meters.
- (2) Cruising speed 0-300 knots.
- (3) IR characteristics incoming, outgoing, and crossing.

b. Technique of Fire Rules. For engagement of this type of target, the gunner should refer

to technique of fire rules and performance capability described in FM 23-17A.

c. Engagement Sequence. Figure 4-20 shows the sequence for engagement of a low/medium-performance aircraft. The engagement proceeds as follows:

(1) *Visual detection.* Gunner scans for aircraft. When an aircraft is detected, gunner visually tracks aircraft and readies weapon.

Notes. 1. If weapon is not in ready condition, launch tube cover is removed and BCU inserted in weapon prior to engagement. Weapon-readying procedures are described in Redeye team drill, chapter 15.

2. Tentative identification of aircraft as hostile is made by the team chief or gunner and the identification process continues throughout the entire firing sequence.

(2) *Determination of aircraft and flight path.* When the gunner determines that an aircraft is a low/medium type, he also determines the size of aircraft (large or small). Flight path is determined to be incoming-crossing, outgoing-crossing, incoming-overhead, or outgoing-overhead.

(3) *Acquisition of target in sight range ring.* When the gunner visually acquires the target, he shoulders the weapon, points it at the target, and visually acquires the target in the sight range ring. He tracks and ranges the target (using the methods described in paragraph 4-16 and the criteria given in FM 23-17A) to determine if the target is in the activate zone. When an incoming target is estimated to be beyond the activate zone, the gunner waits until the target is within the activate zone before proceeding to activate the weapon. When target is outgoing and not expected to enter the activate zone, the gunner abandons that target.

(4) *Activation.* When a target is within the activate zone, the gunner activates the weapon. Most low/medium-performance aircraft have IR radiation patterns which permit acquisition from either an incoming or outgoing direction and, therefore, will allow an engagement in either the incoming or outgoing direction. During the 3- to 5-second warmup period, the gunner continues to track the target, using the range ring. During this time, the gyro is caged so that it is pointed in alignment with the sight.

(5) *IR acquisition.* When IR radiation is acquired, the gyro is uncaged as soon as possible by pressing and holding the uncaging switch. The gunner then checks seeker tracking and, if audible tone is good, continues to track the target.

If seeker tracking is not obtained or is lost, the gunner recages the gyro (releases the uncaging switch) and continues to track the target. When IR radiation is acquired, he again uncages the gyro and checks for seeker tracking.

(6) *Verification of flight path.* The gunner notes the latest target direction to determine whether the target is on the same course or has altered its initial course.

(7) *Range estimation.* The gunner continues to range the target to determine whether the target is in or out of the launch zone. The gunner must know the range ring profile of the target in relation to the launch zone.

(a) *Incoming.* If the aircraft is incoming and the gunner determines that it is in the launch zone, he proceeds with the engagement firing sequence. If the gunner determines it is outside the launch zone and inside the inner launch boundary, he waits until the target passes the inner launch boundary and reenters the launch zone and then proceeds with the firing sequence.

(b) *Outgoing.* If the aircraft is outgoing and the gunner determines that it is in the launch zone, he proceeds with the firing sequence. If the gunner determines the outgoing target to be beyond launch zone, he ceases engagement.

(8) *Positive identification.* Final positive identification must occur prior to firing (refer to para 4-13).

(9) *Superelevation, lead, and fire.* When the gunner determines the target is within the launch zone, superelevation, and lead if necessary, are inserted. The acquisition tone is checked and, if good, the gunner presses and holds the firing trigger and continues to track the target until the missile ejects.

4-20. Firing Technique for Engaging High-Performance Aircraft

a. Typical High-Performance Aircraft Characteristics. The identifying characteristics of typical high-performance aircraft include—

- (1) Dimensions:
- (a) *Small jet fighter:*
- | | |
|-----------------------------|------------|
| 1. Wingspan | 10 meters. |
| 2. Length of fuselage | 15 meters. |
- (b) *Large jet attack bomber:*
- | | |
|-----------------------------|------------|
| 1. Wingspan | 25 meters. |
| 2. Length of fuselage | 30 meters. |
- (2) Ground attack speed during close-in ground support
- | | |
|--|---------------------------------|
| | Above 300 knots
(150 m/sec). |
|--|---------------------------------|
- (3) IR characteristics
- | | |
|--|---------------------------------|
| | Incoming-crossing;
outgoing. |
|--|---------------------------------|

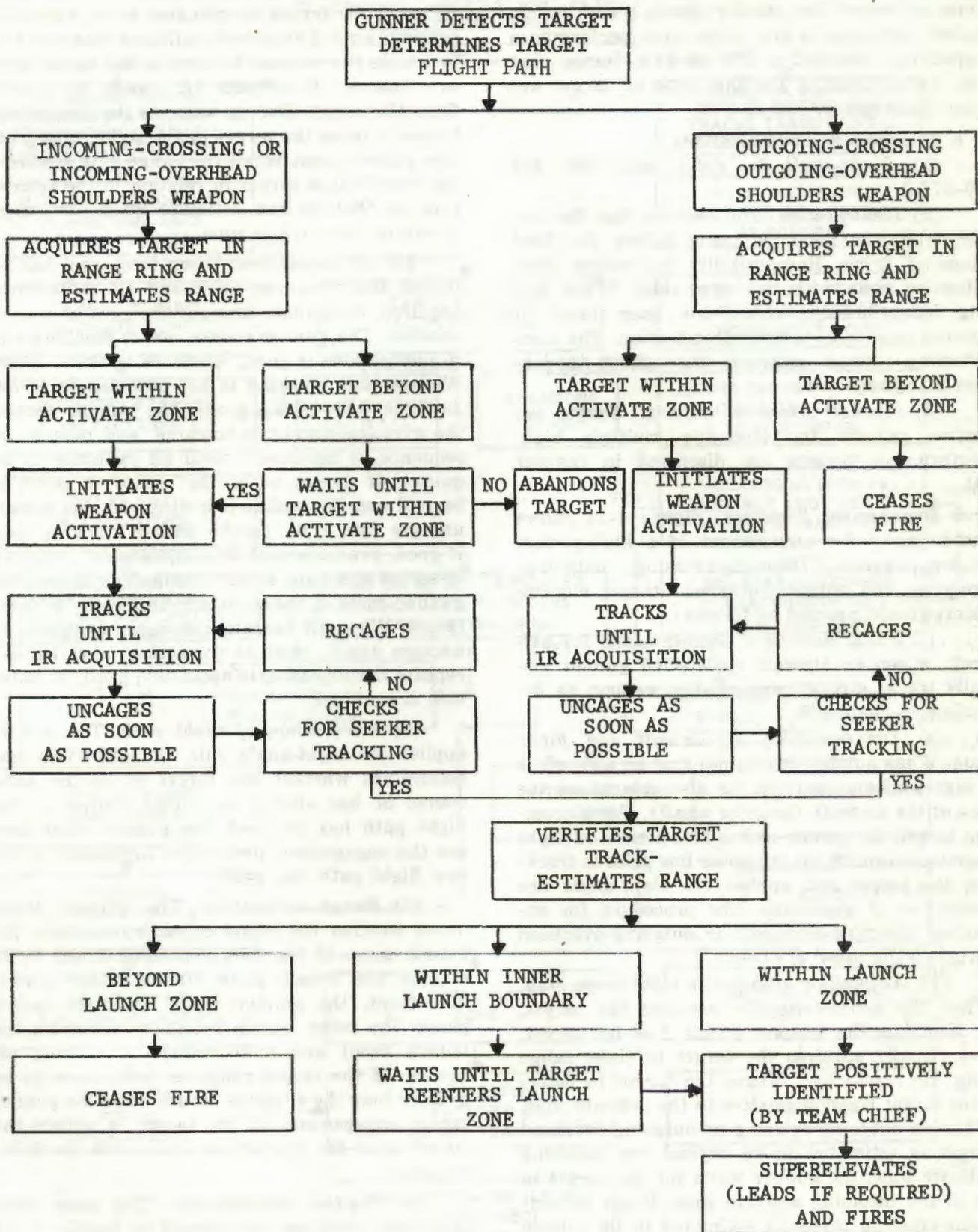


Figure 4-20. Engagement procedures for low/medium-performance aircraft.

b. *Technique-of-Fire Rules.* To engage this type of target the gunner should refer to detailed technique-of-fire rules and performance capability described in FM 23-17A. Range ring and target profiles for this type of target are also illustrated in FM 23-17A.

c. *Engagement Considerations.*

(1) *Right-angle fire delay rule.* (See FM 23-17A.)

(2) *Identification.* The decision that the target is hostile must be made before the final stage of firing. Responsibility for target identification rests with the team chief. When acting independently, either the team chief or gunner may make target identification. The identification process continues throughout the entire firing sequence.

(3) *Target selection criteria.* Target selection criteria for engaging multiple high-performance targets are discussed in chapter 10.

d. *Engagement Sequence.* Figure 4-21 shows the sequence for engagement of a high-performance aircraft. Incoming-crossing, outgoing-crossing, and outgoing-overhead target engagements should proceed as follows:

(1) *Visual detection.* Gunner scans for aircraft. When an aircraft is detected gunner visually tracks aircraft and readies weapon as described in chapter 3.

(2) *Determination of aircraft and flight path.* When gunner determines that an aircraft is a high-performance type, he also determines the size of the aircraft (large or small). For a crossing target, the gunner makes an estimate of flight path to determine the crossover line prior to tracking the target and applies the right-angle fire delay rule if applicable. The procedure for engaging incoming-overhead or outgoing-overhead targets is discussed in e below.

(3) *Acquisition of target in sight range ring.* When the gunner visually acquires the target, he shoulders the weapon, points it at the target, and visually acquires the target in sight range ring. He tracks and ranges the target to determine target position relative to the activate zone. When an outgoing-crossing or outgoing-overhead target is estimated to be beyond the incoming activate zone, the gunner waits for the target to be in the incoming activate zone. When an outgoing-crossing target is estimated to be outside the outgoing activate zone, the gunner abandons target. When the target is within the outgoing activate zone, he activates the weapon.

(4) *Activation.* Gunner activates the weapon when the target is estimated to be within the activate zone. This allows sufficient warmup time to enable the weapon to acquire the target prior to crossover if sufficient IR energy is radiated from the target. During warmup the gunner continues to track the target in the sight range ring. The gunner must recall the range ring profile of the specific type target in relation to the activate zone so that he can estimate when the target is within the activate zone.

(5) *IR acquisition.* When the target has not passed the crossover point and IR radiation is acquired, the gunner uncages the gyro as soon as possible. The gunner checks seeker tracking and, if audible tone is good, continues to track target. When seeker tracking is not obtained or is lost (audible tone is not good), the gunner recages the gyro, reestablishes tracking, and repeats the sequence, if necessary, until IR radiation is acquired. If target is at the crossover point or beyond and IR radiation is acquired, the gunner uncages the gyro, checks seeker tracking and, if good, proceeds with the engagement sequence. If seeker tracking is not obtained or is lost, the gunner recages the gyro and continues to track target. When IR radiation is again acquired, he uncages again, rechecks for seeker tracking, and repeats the sequence, if necessary, until IR radiation is acquired.

(6) *Verification of flight path.* The gunner applies the right-angle rule (FM 23-17A) and determines whether the target is on the same course or has altered its initial course. If the flight path has changed, the gunner must then use the engagement procedures applicable to the new flight path (fig 4-21).

(7) *Range estimation.* The gunner determines whether the target is inside or outside the launch zone. If the target is determined to be outside the launch zone (inside inner launch boundary), the gunner waits until the target passes the inner launch boundary (reenters the launch zone) and then resumes the firing sequence. If the target range is determined to be greater than the effective launch zone, the gunner ceases engagement. If the target is within the launch zone, the gunner continues with the firing sequence.

(8) *Positive identification.* The team chief positively identifies the aircraft as hostile if not previously determined and notifies the gunner. Final positive identification must take place prior to the firing stage.

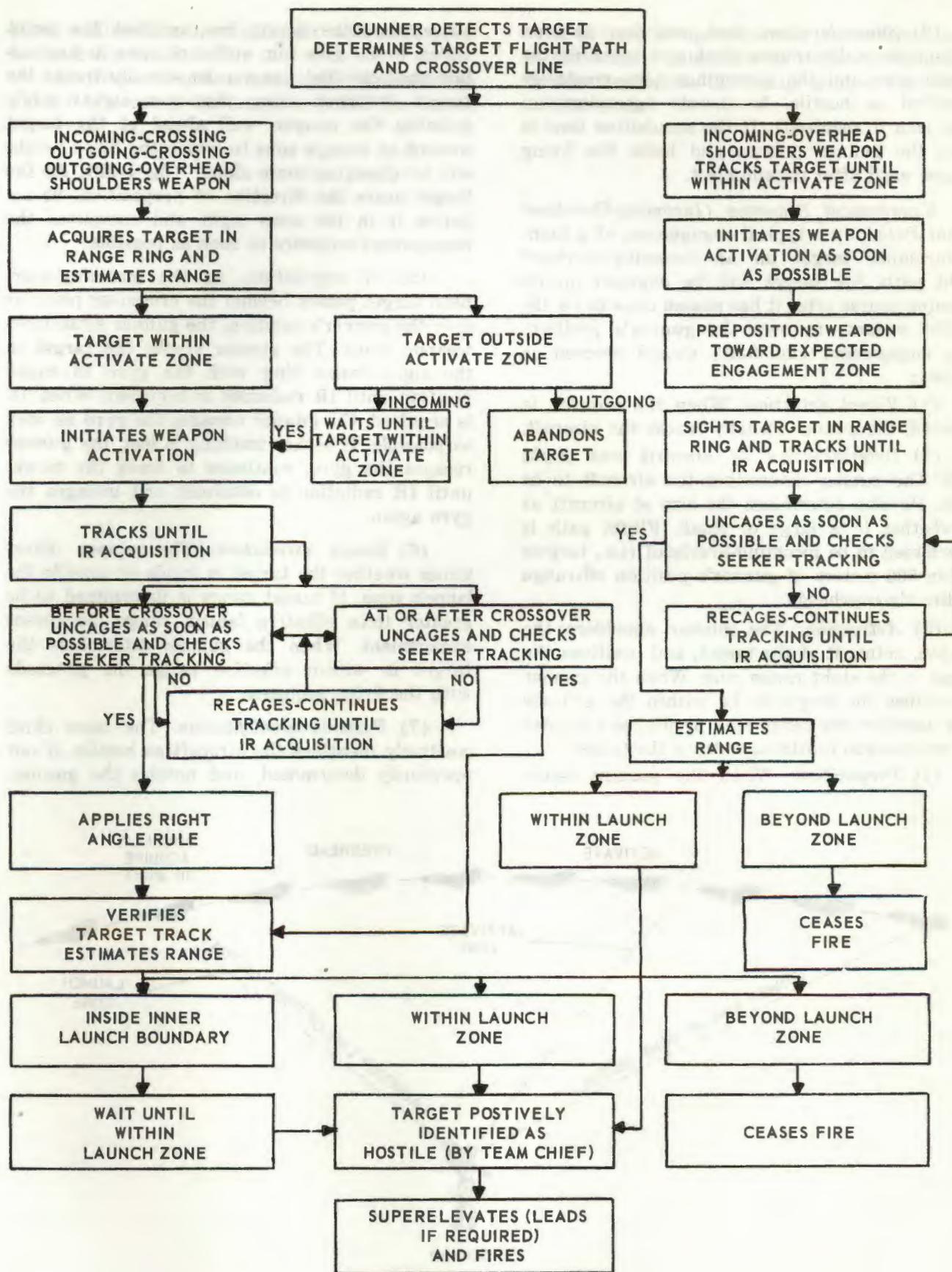


Figure 4-21. Engagement procedures for high-performance aircraft.

(9) *Superelevation, lead, and fire.* As soon as the gunner determines the target is within the launch zone and the target has been positively identified as hostile, he inserts superelevation (and lead if required). If the acquisition tone is good, the gunner presses and holds the firing trigger until after missile eject.

e. Engagement Sequence (Incoming-Overhead Flight Path). In a typical engagement of a high-performance target on an incoming-overhead flight path, the target will be engaged on its outgoing course after it has passed close to (within 500 meters) or over the gunner's position. This engagement (fig 4-21) should proceed as follows:

(1) *Visual detection.* When the aircraft is detected, the gunner visually tracks the aircraft.

(2) *Determination of aircraft and flight path.* The gunner determines the aircraft to be a jet. He also determines the size of aircraft as to whether it is large or small. Flight path is determined to be incoming-overhead (i.e., targets within 500 meters of gunner's position off-range or directly overhead).

(3) *Activation.* The gunner shoulders the weapon, points it at the target, and positions the target in the sight range ring. When the gunner determines the target to be within the activate zone based on the range ring profile, he activates the weapon and continues to track the target.

(4) *Preposition.* When the gunner deter-

mines that the target has reached the point which would give him sufficient time to preposition the activated weapon, he visually tracks the target (without using the open sight) while pointing the weapon well ahead of the target toward an engage zone in which the line of sight will be changing more slowly (fig 4-22). As the target nears the direction of preposition, he acquires it in the open sight and completes the engagement sequence as soon as possible.

(5) *IR acquisition.* As the incoming-overhead target passes beyond the crossover point or over the gunner's position, the gunner establishes weapon track. The gunner tracks the target in the sight range ring with the gyro in caged position until IR radiation is acquired. When IR is acquired, the gunner uncages the gyro as soon as possible. If seeker tracking is lost, the gunner recages the gyro, continues to track the target until IR radiation is obtained, and uncages the gyro again.

(6) *Range estimation.* The gunner determines whether the target is inside or outside the launch zone. If target range is determined to be greater than effective launch range, he ceases engagement. When the gunner determines the target is within effective range, he proceeds with the firing sequence.

(7) *Positive identification.* The team chief positively identifies the aircraft as hostile, if not previously determined, and notifies the gunner.

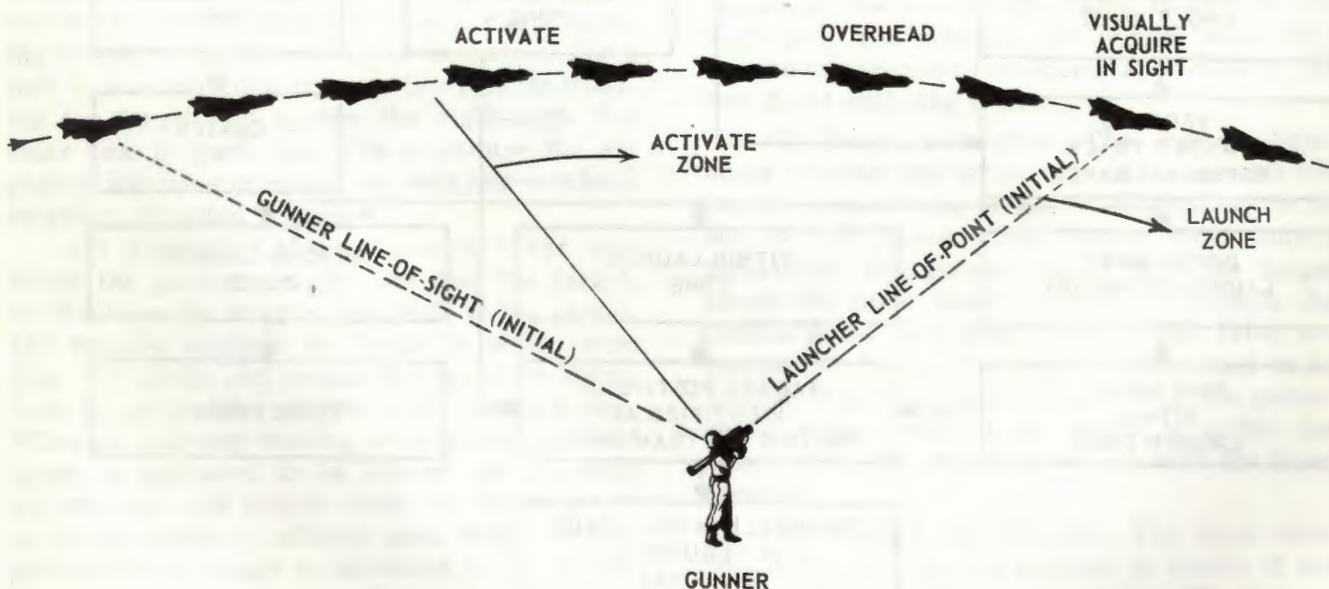


Figure 4-22. Preposition technique for incoming-overhead, high-performance aircraft.

Final positive identification must take place prior to the firing stage.

(8) *Superelevation, lead, and fire.* When the gunner determines the target is within the launch

zone, he inserts superelevation (no lead required). If the seeker tracking tone is good, the gunner presses and holds the firing trigger until after missile eject.

CHAPTER 5

SYSTEM MAINTENANCE

5-1. Maintenance Concept

The maintenance concept for the Redeye missile system is based on the high degree of reliability of the weapon. The weapon is handled essentially as a round of ammunition. Levels of maintenance as outlined in AR 710-1 are fully applicable to the Redeye system. The maintenance levels consist of organizational, direct support, general support, and depot maintenance.

5-2. Organizational Maintenance

Organizational maintenance, the responsibility of the commander of the using units, is performed by the Redeye teams. Defective weapons will be turned in to the ammunition supply point (ASP) on a direct exchange basis for a new weapon. (For further information pertaining to maintenance of Redeye equipment, refer to maintenance manuals TM 9-1400-425-12, TM 9-1400-425-35, TM 9-6920-428-12, and TM 9-6920-428-34.)

5-3. Preventive Maintenance Services

Warning: Cleaning solvents must be used only in a well-ventilated area and under proper supervision. Contaminated cloths or rags used with cleaning solvents must be disposed of as specified by TM 9-1300-206.

Caution: Do not allow cleaning solvent to contact plastic components, as it may melt them or possibly loosen the adhesive bond.

a. General Cleaning Instructions. Clean the exterior of the weapon and M46A1 or M46A2 field handling trainer as necessary. If any dirt is found that cannot be removed with a dry, clean cloth or brush, wipe with a cloth moistened with degreaser solvent. Wipe the cleaned area thoroughly dry.

b. Special Cleaning of Optical Parts. Use lens cleaning tissue FSN 6640-285-4694 or 7920-721-8884 to clean the optical surfaces of the seeker head window. To remove oil or grease, apply optical cleaning compound 6850-392-9751

sparingly with lens cleaning tissue. Wipe the cleaned area thoroughly dry.

c. Care of Earplugs. Wash earplugs with soap and cold or lukewarm water. Do not use hot water. Dry them thoroughly before replacing in container.

d. General Painting Instructions. Small areas of damaged paint may be touched up as part of user preventive maintenance. Do not paint the launch tube front window, cover, safety and actuator device, battery/coolant unit receptacle, identification plates, or any of the rubber boots.

5-4. Preventive Maintenance

a. Preventive maintenance services to be performed on the weapon by the using organization, including the service upon receipt inspection, are shown in table 3-1. This table contains all necessary preventive maintenance information, including the point of inspection and preventive maintenance required. The inspection interval may be extended to 6 months if the container has not been opened during that period.

b. A weapon readiness check will be scheduled annually with the supporting DS unit where a sample lot will be checked, using guided missile test set AN/TSM-82.

c. The butt bumper and sealing boots for the uncaging switch and firing trigger are secured without screws on weapons with serial numbers 302557 through 306519. Although the sight cushions and face guards are not identical on all weapons, the preventive maintenance checks specified in table 3-1 are applicable for all weapons.

d. The field handling trainer may also be checked, using table 3-1 as a guide, by omitting steps 7b, 8, 9, 15, and 16.

5-5. Weapon Corrective Maintenance

The Redeye weapon corrective maintenance procedures are found in TM 9-1400-425-12, chap-

ter 3. The maintenance allocation chart shown in appendix II of the same publication is the guide for corrective maintenance functions to be performed on the Redeye weapon and field handling trainer.

5-6. Direct and General Support Maintenance

a. Direct Support Maintenance.

(1) Division. The Redeye guided missile systems are provided direct support maintenance by missile direct support/general support companies, platoons, or detachments. These units may be assigned to the corps or division, depending on support requirements. Contact teams from these units may be attached to the division

maintenance support unit to provide responsible contact support to combat units.

(2) Separate brigades. Direct support for Redeye systems are provided by contact teams or organic missile support units assigned to the brigade support battalion.

b. General Support Maintenance. General support is not an organic capability of divisions and separate brigades. It is provided by units in corps, army service, and communications zone areas.

c. Missile Maintenance Concept. The missile maintenance concept and the organization for direct and general support maintenance for divisions and separate brigades are found in FM 9-59.

CHAPTER 6

DECONTAMINATION AND DESTRUCTION

Section I. DECONTAMINATION

6-1. General

Redeye teams must develop and maintain a capability for successful accomplishment of the mission while subject to chemical, biological, or radiological (CBR) attacks. This chapter describes procedures that the Redeye team must take to decontaminate its equipment following a CBR attack. It also describes procedures that the Redeye team must take to destroy Redeye equipment if subject to imminent capture.

6-2. Decontamination Principles

a. Decontamination is accomplished by removal, absorption, neutralization, destruction, or burial of toxic agents.

b. In all decontamination operations the first responsibility is for the soldier to avoid personal contamination.

c. Materials used in rubbing or blotting contamination agents should be burned, buried, or otherwise destroyed.

d. Materials used to remove radioactive contamination should be buried.

e. When protective ointment is used for emergency decontamination of personal equipment, the soldier must be careful to save enough ointment for personal use.

f. After decontamination of equipment, the adequacy of treatment should be tested to avoid later hazard. After an hour, or longer, equipment should be rechecked with a detection device.

6-3. Protection of Equipment

a. Keep the Redeye weapon in its container as long as possible.

b. Redeye weapons will be covered with tarpaulins or placed under other cover when possible.

6-4. Decontamination Procedures

a. Decontamination procedures described in FM 21-40 will be followed.

b. Redeye system equipment contaminated with chemicals other than blister agents (V- and G-series) is decontaminated by airing. For faster decontamination, apply DS-2 decontaminating agent.

c. Redeye system equipment contaminated with blister agents (V- and G-series) is decontaminated as follows:

(1) Remove all dust, dirt, grease, and oil.

(2) Expose all components to air.

(3) Decontaminate all equipment with DS-2 decontaminating agent. Hot soapy water is also an effective cleaner.

(4) Use protective ointment M5 for emergency decontamination.

(5) Test with detector kit to determine if decontamination is complete.

(6) Bury (or burn) all rags or wiping materials. Exercise caution to protect personnel against vapors created by burning.

Section II. DESTRUCTION

6-5. General

a. Destruction of the Redeye weapon or its components, when subject to imminent capture in the combat zone, is performed by the Redeye team. This action is taken when, in the judg-

ment of the unit commander, the tactical situation warrants it and when it is necessary in accordance with orders or policy established by the Army commander.

b. The missile can be destroyed best by firing

the weapon. When the Redeye weapon cannot be fired, destruction by other means is required. The information that follows is for guidance only. Certain procedures outlined require the use of explosives and incendiary grenades which may not be authorized items for the Redeye system. The issue of these and related materials, and the conditions under which destruction will be effected, are command decisions in each case. The final decision is based on the tactical situation. The most applicable means of destruction are:

(1) *Burning.* Destruction by burning requires gasoline, oil, incendiary grenades, or other flammables.

(2) *Demolition.* Destruction by demolition requires suitable explosives or ammunition.

(3) *Gunfire.* Destruction by gunfire includes artillery, rifles using grenades, or launchers using antitank rockets. Under some circumstances handgrenades may be used.

c. In general, destruction of essential parts, followed by burning, will usually be sufficient to render the weapon useless. However, selection of the particular method of destruction requires imagination and resourcefulness in the use of facilities at hand under existing conditions. Time is usually critical.

d. The weapon must be so badly damaged that it cannot be restored to a usable condition in the combat zone by repair cannibalization. Adequate destruction requires that all parts essential to the weapon operation be destroyed or damaged beyond repair. However, when lack of time and personnel prevent destruction of all essential parts, priority is given to those parts most difficult to replace. The guided missile must receive top priority in destruction. Equally important, the same parts must be destroyed on all like materiel so that the enemy cannot construct one complete unit from several damaged ones.

e. If destruction is directed, due consideration should be given to:

(1) Selecting a point of destruction that will cause the greatest obstruction to enemy movement and not create a hazard to friendly troops.

(2) Observing appropriate safety precautions.

f. The trainer may also be destroyed by mechanical means, such as an ax, pick, mallet, sledge, crowbar, or similar implement.

6-6. Destruction by Burning

Warning: The weapon contains both a live rocket motor and a high-explosive (HE) warhead. This creates an extreme hazard to personnel when a weapon is destroyed by burning.

Note. Heap all material to be burned if time or conditions permit.

a. Slash the rocket-motor squib igniter leads on the outside of the launch tube.

b. If available, place a sufficient number of incendiary grenades about the weapon(s).

Warning: To prevent serious injury or burns to personnel, care must be taken in the handling of highly volatile liquids.

c. Douse the weapon(s) with gasoline, oil, or other flammable liquids.

d. Using incendiary grenades fired from a safe distance, bursts from a flame thrower, combustible train, or other appropriate means, ignite the equipment and immediately take cover. Elapsed time is about 7 minutes.

6-7. Destruction by Demolition

Note. For successful destruction of the weapon by explosives, all concerned personnel will be thoroughly familiar with the pertinent provisions of FM 5-25. Training and careful planning are essential.

a. If sufficient time permits, all guided missiles should be destroyed first by firing them in a manner that will cause the greatest obstruction to enemy movement, but will not inflict damage upon friendly troops. Otherwise the guided missiles may be destroyed by explosives.

b. Using sufficient amount of TNT or equivalent, prepare and strategically place charges of explosives about the weapon(s) to assure detonation of the warhead (see TM 9-1385-215).

c. Determine whether electrical blasting caps and wire, or nonelectric blasting caps and safety fuzes, will be used for priming and detonating the explosive charges. If nonelectric caps are used, they must be crimped to at least 5 feet of safety fuze.

Note. Safety fuze burns at the rate of 1 foot in 30 to 40 seconds; cut off and test a portion of the fuze before using.

Caution: Safety fuze, which contains black powder, and blasting caps must be protected from moisture at all times.

d. Connect the charges with detonating cord

as required to effect their simultaneous detonation. Dual-prime the charges to minimize the possibility of a misfire.

Warning: Blasting caps, detonating cord, and safety fuzes must be kept separate from the charges until actually required for use.

e. If the charges are primed with nonelectric blasting caps, ignite the safety fuzes and take cover without delay. If the charges are primed with electric blasting caps, take cover before firing. Elapsed time is about 15 minutes.

6-8. Destruction by Gunfire

This method cannot be relied upon to destroy the same parts on like equipment nor to produce the same degree of destruction. If conditions disallow destruction by burning and/or demolition, destroy the weapon(s) by gunfire in accordance with the following:

Warning: The presence of live rocket motors and HE warheads present an extreme hazard to personnel firing at the weapon from a distance of less than 500 yards. If possible, the guided missile should be destroyed in accordance with paragraph 6-7a above.

a. Slash the rocket-motor squib igniter leads on the launch tube.

b. Is possible, stack or pile the weapon(s) and related equipment.

c. Fire on the equipment from a safe distance with rifles using rifle grenades, with launcher using antitank rockets, or with artillery. Elapsed time is about 5 minutes.

Note. Although one well-placed hit may render the weapon temporarily useless, several hits are usually required for its complete destruction unless an intense fire is started in which case the material may be considered destroyed.

CHAPTER 7

SHIPMENT, STORAGE, AND SECURITY

7-1. Shipment and Security

a. General. When the Redeye weapon is to be stored or shipped, remove the BCU, insure that the receptacle cap is installed in the BCU receptacle, replace the launch tube cover, and return the weapon to the shipping and storage container.

b. Shipping Name and Classification. The Interstate Commerce Commission (ICC) shipping name for the weapon is "Rocket Ammunition with Explosive Projectile." Shipping hazard classification (ICC) is Class A. Motor vehicles transporting weapons over public highways must have "EXPLOSIVE" placards, with letters at least 8 inches high, on the front, rear, and sides of the vehicle.

c. Quantity-Distance and Limited Storage.

(1) Storage of weapons by the using organization is normally limited to the basic load issued to the unit. Storage separation distances are the same whether the weapons are in unbarri-caded areas or stored on vehicles. To comply with quantity-distance regulations for unbarri-caded ammunition storage specified by TM 9-1300-206, each vehicle should be separated from other vehicles containing ammunition or explosives by at least 300 feet, and from inhabited areas by at least 1,200 feet. The quantity-dis-tance class for the tactical weapon is class 7, based on the 7.3 total pounds of warhead high explosive and propellants. The storage compati-bility group is F. No separation distance is to be less than that required by TM 9-1300-206 for class 5 ammunition.

(2) Stored weapons, whether on vehicles, in magazines, or in open storage, should be posi-tioned with the forward ends of the missiles all facing in the same direction and in a direction that would cause the least damage in case of accidental ignition.

(3) When stored in the open, shipping and storage containers are placed on heavy dunnage and protected with a canvas cover. The cover

should not rest on the containers, but must be raised enough to allow at least 12 inches of air-space around the stacks. The containers should be protected from the weather as much as possi-ble.

d. Storage Temperature Limit. The storage temperature limit for the weapon, as marked on the shipping and storage container, is -65° F. to $+165^{\circ}$ F. Weapons exposed to temperatures outside this range must not be fired. Use DA Form 2415, as required by TM 38-750, to report them to the ASP for disposition and provide full details for the reason for turn-in.

7-2. Weapon Security

The Redeye weapon is a complete guided missile system which can be put into a ready-to-fire condition simply by insertion of a BCU. Con-tinuous safeguarding of the weapon is of para-mount importance. The complete assembled weap-on is classified CONFIDENTIAL. The sensitivity of the Redeye weapon due to physical security cannot be overemphasized. The weapon can be easily concealed and fired. Physical security of Redeye is in addition to the minimum require-ments for security control of classified items established by TB 9-380-101. Personnel discov-ering a loss, theft, or other surreptitious action involving Redeye weapons will notify the ap-propriate commander immediately. The com-mander will take action as prescribed in AR 190-11 and AR 210-10.

7-3. Safeguarding Redeye Weapons

a. The Redeye weapon is safeguarded in ac-cordance with AR 380-5.

b. Physical and surveillance control is main-tained at all time in areas where Redeye systems are located.

7-4. Personnel Clearance

a. Granting of security clearances to personnel for access to Redeye weapons will be accom-plished in accordance with AR 604-5.

b. Limited access to classified or sensitive areas will be established by responsible commanders, also in accordance with AR 604-5.

7-5. Transportation Security

Transportation security pertaining to Redeye discussed in this manual refers only to transportation by Government vehicle (surface). Shipment by air (military and commercial), water, and rail are covered in appropriate Army regulations. Shipments made by Government vehicle must be under full control of qualified, properly cleared US military or civilian personnel to assure that constant surveillance is maintained throughout the transportation movement.

7-6. Issue and Control

a. The Redeye custodian will issue Redeye weapons only on order of the responsible officer to an officer authorized to receipt for the weapons.

b. The authorized receiving officer will keep the weapons under positive control until fired or returned to the custodian.

c. The receiving officer will provide cleared armed guards as necessary to insure against unauthorized launch or compromise of classified materiel.

4. Storage Requirements. The storage requirements for the weapon are outlined in the following and storage containers are to be used. The weapon must be stored in the container provided for the weapon and provided for the weapon for transport.

7-2. Weapon Security. The Redeye weapon is a complex, highly sensitive system which can be used as a self-defense weapon only by personnel who are properly trained and authorized. The weapon is classified CONFIDENTIAL. The security of the Redeye weapon and its physical location cannot be overemphasized. The weapon and its parts are to be stored in a secure, locked container. In addition to the constant surveillance for security control of classified materiel, the Redeye weapon is to be stored in a secure container. The Redeye weapon is to be stored in a secure container. The Redeye weapon is to be stored in a secure container. The Redeye weapon is to be stored in a secure container.

7-3. Transporting Redeye Weapons. The Redeye weapon is transported in a secure container. The Redeye weapon is transported in a secure container. The Redeye weapon is transported in a secure container. The Redeye weapon is transported in a secure container.

7-4. Personnel Clearance. Personnel who are authorized to handle the Redeye weapon must be properly cleared. Personnel who are authorized to handle the Redeye weapon must be properly cleared. Personnel who are authorized to handle the Redeye weapon must be properly cleared.

5. Shipping Form and Container. The Redeye weapon is shipped in a secure container. The Redeye weapon is shipped in a secure container. The Redeye weapon is shipped in a secure container. The Redeye weapon is shipped in a secure container.

6. Loading, Unloading and Limited Storage. The Redeye weapon is loaded and unloaded by the receiving officer. The Redeye weapon is loaded and unloaded by the receiving officer. The Redeye weapon is loaded and unloaded by the receiving officer. The Redeye weapon is loaded and unloaded by the receiving officer.

7. Short Storage. Short storage of the Redeye weapon is permitted. Short storage of the Redeye weapon is permitted. Short storage of the Redeye weapon is permitted. Short storage of the Redeye weapon is permitted.

8. When Stored in the Open. The Redeye weapon is stored in the open.

PART TWO
OPERATIONAL TECHNIQUES
CHAPTER 8
MISSION, ORGANIZATION, RESPONSIBILITIES, AND EQUIPMENT

Section I. MISSION AND ORGANIZATION

8-1. Mission

The mission of Redeye is to provide small combat units in the forward battle area with a self-defense capability against attack by aircraft operating at low altitudes. Redeye may also be employed to provide low-altitude air defense for small vital areas.

8-2. Organization

a. Divisional Units. Redeye is organic to battalions or squadrons of armored, airborne, air-mobile, infantry, and mechanized infantry divisions of the field army. The military organization for command, control, and employment of Redeye is referred to in this manual as the air defense section (Redeye). Air defense sections are assigned to the headquarters or combat support company of each combat maneuver battalion within a division. Each air defense section consists of a headquarters element and three to six Redeye teams (fig 8-1). Redeye teams are usually allocated on the basis of one team per company-size unit within the battalion. The air defense section normally collocates with, and operates under the supervision of, the battalion S3 or S3 air.

b. Nondivisional Units. Redeye is also assigned to separate brigades, armored cavalry regiments, nondivisional artillery battalions, and selected

separate battalions. The air defense section organization is the same as the divisional Redeye air defense section.

c. Air Defense Section.

(1) The air defense section headquarters is composed of a section leader (first lieutenant), a section sergeant (E-6), and a radio operator (E-3). The lieutenant commands the air defense section and is also the battalion special staff officer for air defense.

(2) Each Redeye team (fig 8-2) consists of a team chief (E-5) and a gunner (E4).

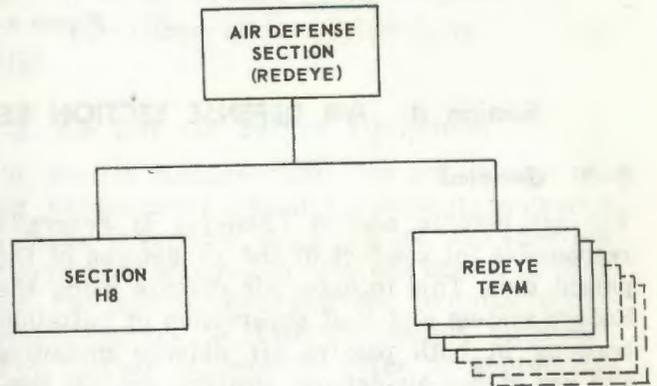


Figure 8-1. Air defense section (Redeye).



Figure 8-2. Redeye team.

Section II. AIR DEFENSE SECTION RESPONSIBILITIES, DUTIES, AND EQUIPMENT

8-3. General

The air defense section (Redeye) is generally responsible for conduct of the air defense of the parent unit. This includes air defense using the Redeye system and staff supervision of battalion training in both passive air defense measures and use of non-air-defense weapons against hostile aircraft. A derivative responsibility is that of training and indoctrinating parent unit personnel in other air defense matters.

8-4. Specific Duties and Responsibilities

a. Section Leader. The air defense section leader commands the air defense section and has special staff duties as battalion air defense officer. In this capacity he will:

(1) Command the section headquarters and assigned and attached Redeye teams.

(2) Plan and conduct the air defense of the battalion in accordance with priorities determined by the battalion commander.

(3) Advise the battalion commander and staff and subordinate unit commanders on air defense matters.

(4) Prepare and maintain the battalion air defense SOP.

(5) Provide an air defense input to battalion operation plans and orders.

(6) Establish and maintain coordination with the division Chaparral/Vulcan battalion in support of the battalion as directed.

(7) Maintain Redeye team and FAAR posi-

tion plots on the battalion situation overlay. Obtain and inform Redeye teams of appropriate FAAR radiofrequencies.

(8) Acquire and maintain a record of friendly air movement data and inform deployed Redeye teams as appropriate.

(9) Insure that states of air defense warning, weapon control status, and hostile criteria are current and are made known to Redeye teams.

(10) Maintain a journal of events to include mission assignment; changes in weapon control status, team location, and operational status; missiles on hand; missiles expended; and engagement results.

(11) Plan and supervise section and team training in accordance with appropriate technical manuals, field manuals, and command directives.

(12) Select Redeye team general position areas and approve position changes when required.

(13) Assist the battalion S3 in planning and supervising training in passive air defense and use of non-air-defense weapons against hostile aircraft.

b. Section Sergeant. The section sergeant is the senior noncommissioned officer assigned to the air defense section and is responsible to the section leader for—

(1) Assisting the section leader in planning and conducting the defense of the battalion against low-altitude air attack.

(2) Supervising the Redeye teams.

(3) Conducting and evaluating training of the Redeye teams.

(4) Establishing and maintaining communications with Redeye teams when deployed to tactical positions.

(5) Supervising and training the section radio operator.

(6) Supervising maintenance of equipment issued to the air defense section headquarters and Redeye teams.

(7) Training and evaluating gunners, using the moving target simulator (chap 17).

(8) Performing other duties assigned by the section leader.

c. Radio Operator. The radio operator is responsible to the section leader and—

(1) Establishes and maintains radio and/or wire communications with the Redeye teams and designated higher headquarters.

(2) Operates and maintains the section vehicle.

(3) Performs other duties assigned by the section sergeant.

d. Redeye Teams. The Redeye teams furnish the firing capability that enables the air defense section to accomplish its mission. Duties of team members are as follows:

(1) *Team chief.* The team chief is responsible to the section leader for—

(a) Delivery of effective fire on hostile aircraft.

(b) Supervision of the Redeye team.

(c) Selection of final team position on the ground and recommendation of team position changes.

(d) Maintenance of team equipment.

(e) Other duties assigned by the section sergeant.

(2) *Gunner.* The gunner is responsible to the team chief for—

(a) Delivery of effective fire on hostile targets as directed by the team chief.

(b) Operation and maintenance of assigned team vehicular and communications equipment.

(c) Operator and organizational maintenance of the team's basic load of weapons.

(d) Other duties assigned by the team chief.

8-5. Air Defense Section Equipment

a. Section Headquarters. The air defense section headquarters contains sufficient equipment to enable it to move, communicate, and effectively control its assigned or attached teams. In addition the section headquarters contains equipment necessary to train the section personnel. (For further information refer to appropriate tables of organization and equipment.)

b. Redeye Teams. Redeye teams are equipped with sufficient equipment to enable them to move, communicate, and fire at hostile targets. (For further information refer to appropriate tables of organization and equipment.)

c. Basic Load. In addition to TOE equipment, a basic load of six Redeye weapons is carried by each team during combat operations.



Figure 8-3. Battery/coolant unit carry case.

8-6. Recently Fielded Equipment

Tables of organization and equipment and other recent Army publications reflect items of equipment being issued to Redeye units which have not been described in previous editions of this manual. Because the Redeye guided missile system has been recently fielded, new and developmental items of equipment have been added to the section headquarters and each Redeye team. These equipment items and their use are described in applicable chapters of this manual. Included are the following:

a. Battery/Coolant Unit Carry Case (fig 8-3). The battery/coolant unit carry case provides the Redeye gunner with a means for carrying the three BCU issued with each Redeye weapon. The BCU carry case is a nylon bag with a polystyrene insert. It is 9 3/8 inches long, 3 7/8

inches wide, 7 inches high, and weighs 3 pounds, 10.72 ounces, with three BCU inserted. It is attached to the pistol belt.

b. Unirack Mounting Kit. The unirack mounting kit (fig 8-4) consists of the top half of unipak shipping and storage container mounted across the rear of the vehicle M151A1 with two plastic supports and seat belts holding a single weapon in a combat-ready condition. The mounting kit is secured to the vehicle by the seat belts.

8-7. Target Alert Data Display Set (TADDS)

a. The target alert data display set (TADDS) (fig 8-5), an ancillary item to the Redeye communications system, provides the team with a display of coarse target location and tentative target identification. Its source of information is

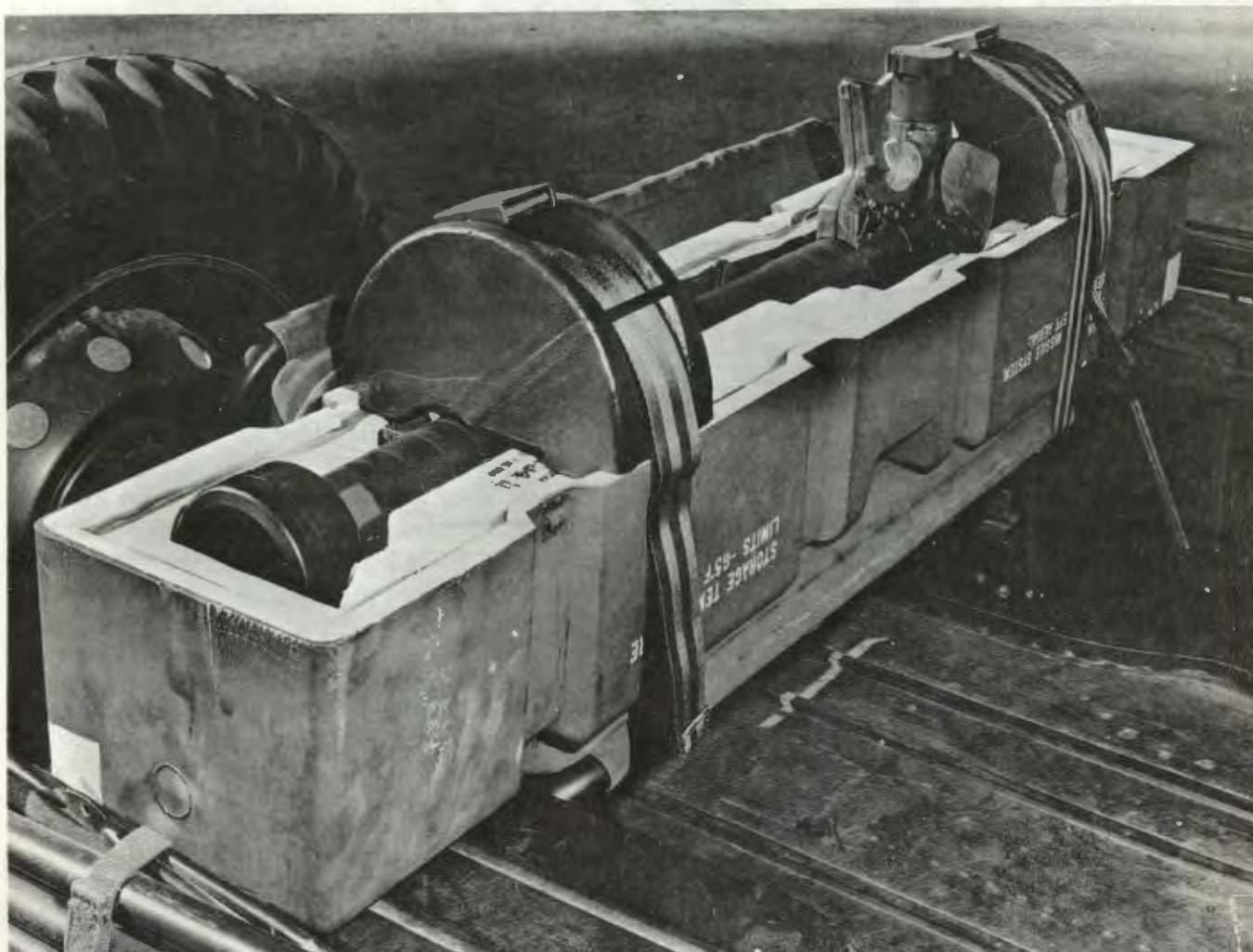


Figure 8-4. Unirack installation.

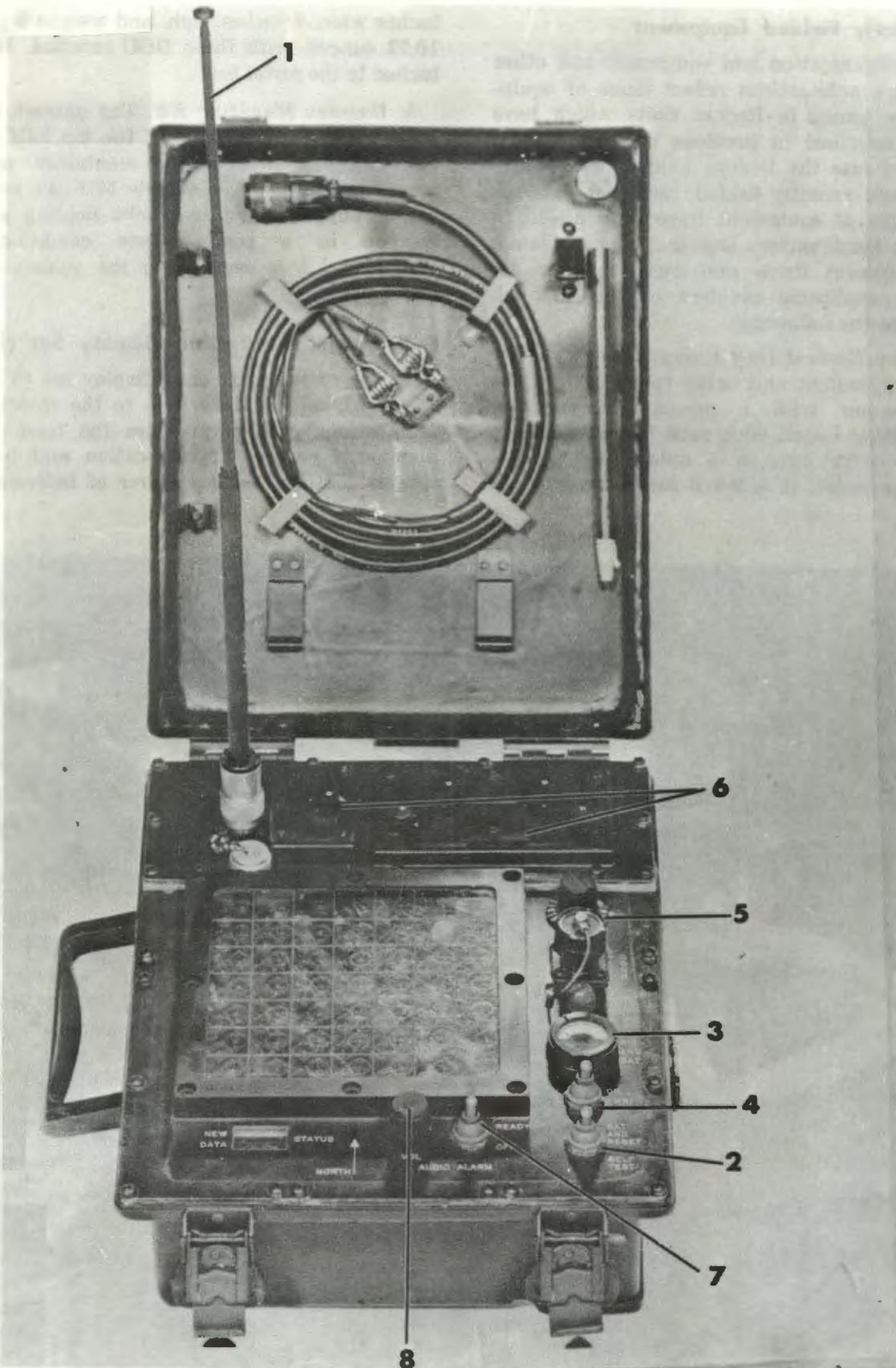


Figure 8-5. Target alert data display set (TADDS).

the forward area alerting radar (FAAR) organic to Chaparral/Vulcan units. Targets information generated by the FAAR is transmitted by radio-frequency data link (RFDL) to the TADDS for display. The TADDS is also capable of receiving voice transmissions in place of the display described in b(1) below.

b. The TADDS consists of a radio receiver circuit, display matrix, magnetic compass, radiofrequency (RF) field strength meter, telescoping antenna, and rechargeable battery-pack power supply.

(1) The display consists of a matrix of grid lines forming 49 squares (7 squares x 7 squares) with each square containing two target indicators. The indicators are two-color disks (green-black and red-black) that indicate targets by exposing a green side for a friendly target or a red side for a target of unknown identity. If no target is within the area of a square, the indicators display only the black sides of the two-color disks. The unit has the capability of displaying 49 friendly and 49 unknown targets simultaneously, a friendly and an unknown target in each of the 49 squares. The FAAR, as the source of data, is represented as being located at the exact center of the display. Target position is displayed with respect to the location of the FAAR. The location of the Redeye site with respect to the FAAR is plotted and marked on the display by the TADDS operator. Target location with respect to the Redeye site may then be read directly from the display. The Redeye position must be marked on the display matrix with a china marking pencil.

(2) A telescoping antenna attaches to the TADDS by means of an insulated mount on the unit front panel. When not in use, the antenna is removed and stored in the front cover.

(3) An RF field-strength meter mounted in the unit front panel provides an indication of the strength of the received signal. The meter is useful in emplacing the TADDS for the best data reception.

(4) A standard compass is mounted on the unit cover for the purpose of orienting the unit

to magnetic north. Orientation to magnetic north is necessary to align the display matrix with the FAAR display.

(5) An audible alarm is provided to alert the operator that a change has taken place in the data display. When a change occurs, a pulsating audible tone is generated; if a loss of signal occurs, a steady tone is generated.

(6) An indicator for remaining battery life is provided on the set. A cable and receptacle are also provided so that the battery can be charged from the electrical system of any Army vehicle. A fully charged battery-pack provides sufficient power for 24 hours operation.

c. *Operation of Target Alert Data Display Set.* The team leader is responsible for emplacing and operating the target alert data display set (TADDS). (For detailed operation of the TADDS refer to TM 9-1430-589-12.)

Note. Refer to key numbers on figure 8-5 for location of controls and indicators.

(1) Emplace the TADDS, using a map and the compass. The compass is in the cover of TADDS.

(2) Remove the antenna (1) from the TADDS cover and install as shown in figure 8-5.

(3) Set the BAT AND RESET/SELF TEST switch (2) at BAT AND RESET. The S-METER (3) will indicate the battery strength. Reset the switch to midposition.

(4) Set the PWR switch (4) at ON.

(5) Adjust the ADDRESS CONTROL (5) to set the number of the FAAR used to furnish the TADDS information.

(6) Select either BAND A or BAND B (6) to receive the RFDL transmissions.

(7) Set the READY/OFF switch (7) at READY.

(8) Adjust the VOL control (8) for a rushing sound over the speaker.

Note. Operating frequencies for band A or band B will be in the unit communications-electronics operating instructions (CEOI) (formerly SOI).

CHAPTER 9

FUNDAMENTALS OF REDEYE EMPLOYMENT

Section I. GENERAL

9-1. Introduction

This chapter presents guidance for the Redeye air defense section leader in planning and designing the air defense of battalion assets. The principles and guidelines provided are based on fundamentals of employment of air defense weapons contained in FM 44-1, FM 44-1A, FM 44-1-1, and FM 44-3, and on the mission and organization normal to Redeye as presently deployed in the field army.

9-2. Employment Considerations

a. Basic Steps. Four basic steps should be taken in establishing a Redeye defense.

- (1) Determine defense priorities.
- (2) Determine available means.
- (3) Design the defense.
- (4) Evaluate the defense.

b. Determination of Priorities. The battalion commander, in consultation with his staff and in consideration of the tactical operation being conducted, establishes air defense priorities. The Redeye air defense section leader obtains these priorities and uses them as the basis of his air defense plan.

c. Determination of Available Means. Generally, the air defense means available to the section leader are fixed by TOE and consist of three to six two-man Redeye teams. The section leader will employ these resources in the manner which best meets the commander's requirements. Critical considerations are the established priorities; nature, location, and size of the defended assets;

expected threat; and quantity of available resources. These considerations will determine the type of defense to be used (e.g., an area defense, point defense, or moving column defense) and the method of employment (e.g., general support, direct support, attached, or a combination of these methods). Further, the considerations will provide an indication as to how available resources must be allocated. In determining air defense means available, consideration should be given to the feasibility of splitting teams to increase coverage.

d. Defense Design. Having determined defense priorities and available Redeye teams, the section leader must design the defense to best accomplish the commander's requirements. In designing the defense, the principles of balance, mutual support, overlapping fires, early engagement, depth, and weighting toward likely avenues of approach must be considered. These principles are most important in the design of area and point-type defenses. Little in the way of formal design can be done in the case of moving column defenses except to apply the principle of early engagement when selecting stations for Redeye teams moving with the column.

e. Defense Evaluation. Having completed the preliminary design of the defense, the section leader should evaluate his design to determine if it meets established requirements. If the evaluation shows that the preliminary design cannot meet requirements, inefficient use of resources, or unacceptable holes in coverage, the defense should be redesigned and reevaluated until it meets the requirements in the best possible manner.

Section II. ESTABLISHMENT OF REDEYE DEFENSES

9-3. Principles Influencing Air Defense Design

a. General. Five basic principles should be considered in designing an air defense. The

principles of air defense design are discussed in *b* through *f* below. Factors such as air threat; terrain; number of available teams; and the size,

CHAPTER 9

FUNDAMENTALS OF REDEYE EMPLOYMENT

Section I. GENERAL

9-1. Introduction

This chapter presents guidance for the Redeye air defense section leader in planning and designing the air defense of battalion assets. The principles and guidelines provided are based on fundamentals of employment of air defense weapons contained in FM 44-1, FM 44-1A, FM 44-1-1, and FM 44-3, and on the mission and organization normal to Redeye as presently deployed in the field army.

9-2. Employment Considerations

a. Basic Steps. Four basic steps should be taken in establishing a Redeye defense.

- (1) Determine defense priorities.
- (2) Determine available means.
- (3) Design the defense.
- (4) Evaluate the defense.

b. Determination of Priorities. The battalion commander, in consultation with his staff and in consideration of the tactical operation being conducted, establishes air defense priorities. The Redeye air defense section leader obtains these priorities and uses them as the basis of his air defense plan.

c. Determination of Available Means. Generally, the air defense means available to the section leader are fixed by TOE and consist of three to six two-man Redeye teams. The section leader will employ these resources in the manner which best meets the commander's requirements. Critical considerations are the established priorities; nature, location, and size of the defended assets;

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d. Defense Design. Having determined defense priorities and available Redeye teams, the section leader must design the defense to best accomplish the commander's requirements. In designing the defense, the principles of balance, mutual support, overlapping fires, early engagement, depth, and weighting toward likely avenues of approach must be considered. These principles are most important in the design of area and point-type defenses. Little in the way of formal design can be done in the case of moving column defenses except to apply the principle of early engagement when selecting stations for Redeye teams moving with the column.

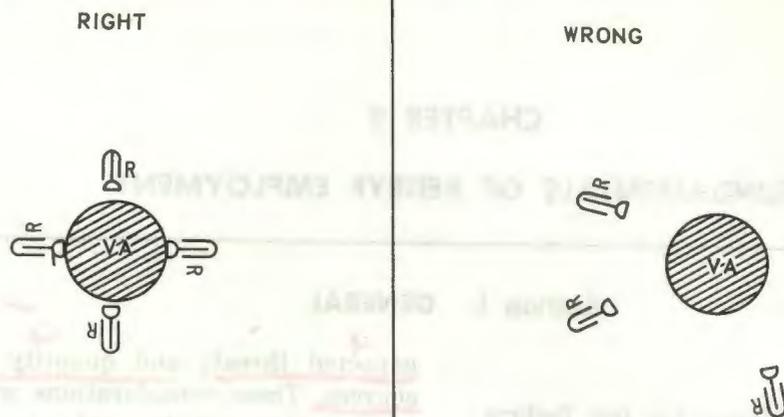
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principles of air defense design are discussed in *b* through *f* below. Factors such as air threat; terrain; number of available teams; and the size,



Note. No forced avenue or probable avenue of approach.

Figure 9-1. Balanced defense.

shape, and nature of the defended area tend to arrange these principles in an order of priority of application.

b. Balance. In general, enemy aircraft are capable of attacking from any direction. The enemy will seek the most favorable direction of attack and will attempt to exploit any weakness in the defense. Therefore, the defense should be balanced (fig 9-1) to cope with attacks from any direction with approximately the same volume of fire. Exceptions arise in cases where attack along certain avenues of approach is forced or probable during defense of march columns or in an area defense.

c. Mutual Support. Mutual support between Redeye teams is desired and can be obtained under most tactical conditions. The principle of mutual support is applied by positioning each Redeye team so that the system's dead zone is within the engagement capability of at least one adjacent team. This increases the volume of fire possible in the space mutually covered. To remain mutually supporting, Redeye teams should not be separated by more than 1,500 meters. Teams must be capable of visually detecting targets at maximum distances if they are to provide mutual support. Space that is masked to one team should be covered by another. A masking problem can sometimes be overcome by splitting teams. When mutual support cannot be obtained, the teams should be positioned to provide over-

lapping fires. Overlapping coverage or fires for Redeye requires the placement of Redeye teams so that the area covered by one team can extend over the area of one or more adjacent teams. Overlapping coverage is desired to prevent gaps in the defense. Team positions may have to be staggered to attain overlapping fires.

d. Early Engagement. The object of early engagement (fig 9-2) is to engage and destroy hostile aircraft prior to the aircraft releasing its ordnance. Since the enemy has such a wide choice of aircraft, ordnance, and attack variations, specific rules for the emplacement of teams to maximize the principle of early engagement cannot be formulated except by placing teams along most likely avenues of approach. In area defense, Redeye teams should be positioned well in front to provide early destruction along the low-altitude avenues of approach. Redeye may also be employed with security forces forward of the FEBA, for example, to provide air defense of the brigade combat outpost (COP) or division general outpost (GOP). Redeye teams employed with security forces contribute to air defense of the forward units and implement the principle of early engagement and defense in depth.

e. Weighted Area Coverage. When deploying Redeye teams in area defense, an effort should be made to provide weighted area coverage (fig 9-3) to the front of the FEBA and toward exposed boundaries. Weighting of Redeye toward

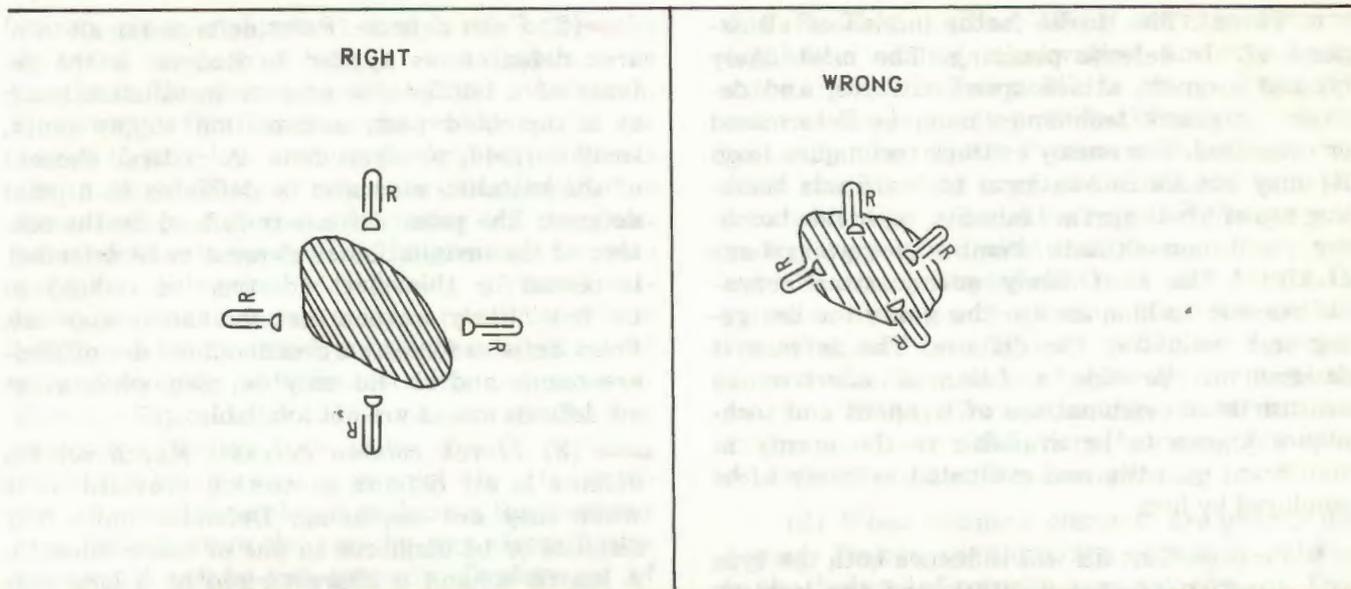


Figure 9-2. Early engagement.

the front of the battalion serves two purposes; it destroys many attackers before they can reach their intended targets and it also provides coverage for avenues of approach not adequately covered by other air defense means. Redeye teams should be positioned along the flanks of the low-altitude avenues of approach to take advantage of inherent weapon characteristics.

f. Defense in Depth. Once engaged, the enemy should be given no relief. The aircraft should

be engaged from the moment it comes within range until it is destroyed or out of range. The volume of fire to which an aircraft is exposed should increase as it closes with the defended target.

9-4. Factors Influencing Air Defense Design

The air defense section leader must consider a number of factors that influence application of the principles already discussed.

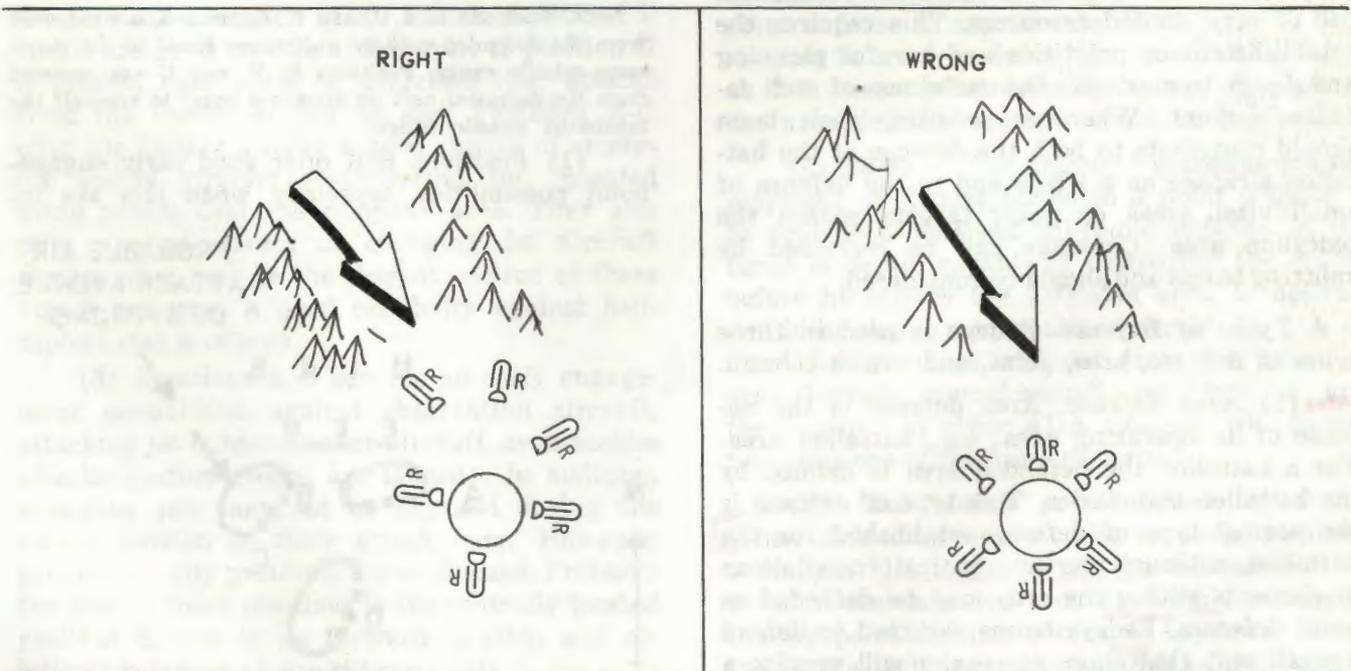


Figure 9-3. Weighted defense.

a. *Threat.* The threat factor influences all aspects of air defense planning. The most likely type of aircraft, attack speed, altitude, and delivery or attack techniques must be determined or estimated. The enemy's attack techniques (app B) may include conventional high-altitude bombing, use of air-to-surface missiles, lay-down bombing, and low-altitude bomb aiming systems (LABS). The most likely enemy attack capabilities and techniques are the guide for designing and evaluating the defense. The defense is designed to provide a balanced effectiveness against those combinations of weapons and techniques known to be available to the enemy in significant quantity and evaluated as likely to be employed by him.

b. *Terrain.* Terrain will influence both the type and direction of enemy attack and the location of Redeye team positions. Since Redeye weapons are visually directed, the terrain should afford maximum observation and unrestricted fields of fire. Terrain may limit the number of suitable positions available without adversely affecting the enemy, or it may compel the enemy to approach the target from specific directions.

c. *Economy of Resources.* The task of the air defense planner involves determining the number of Redeye teams needed to provide a specific degree of protection to a small unit, installation, or area of tactical importance. Since the number of teams available is usually fixed by TOE, the planner is concerned with the most economical use of very limited resources. This requires the establishment of priorities and careful planning and design to maximize the usefulness of each defense element. Wherever possible, each team should contribute to both the defense of the battalion airspace as a whole and to the defense of small vital areas or point targets within the battalion area. Coverage can be increased by splitting teams and should be considered.

d. *Types of Defense.* Redeye is used in three types of defense, area, point, and march column.

(1) *Area defense.* Area defense is the defense of an operating area; e.g., battalion area. For a battalion the defended area is defined by the battalion boundaries. This type of defense is the normal type of defense established for the battalion, although certain critical installations or elements within the area may be defended as point defenses. Redeye teams assigned to defend a small unit (battalion, company) will provide a local air defense capability specifically responsive to the small unit.

(2) *Point defense.* Point defense (small vital area defense), as applied to Redeye, is the defense of a limited-size area or installation, such as a command post, ammunition supply point, small airfield, or drop zone. A critical element of the battalion may also be defended as a point defense. The point defense is defined by the contour of the installation or element to be defended, increased by the effect (destructive radius) of the most likely weapon that the enemy may use. Point defense forces an uneconomical use of Redeye teams and should only be used when other air defense means are not available.

(3) *March column defense.* March column defense is air defense protection provided units while they are displacing. Defended units may displace or be displaced in one or more echelons. A march column is characterized by a long axis of moving vehicles which can present a lucrative target to hostile aircraft.

9-5. Deployment Guidelines

a. *Area Defense.* In addition to the principles and considerations stated in paragraphs 9-3 and 9-4, selection of a Redeye position favorably located with regard to the defended unit position is important. Figure 9-4 illustrates a company layout and possible Redeye positions (A-K), all of which are assumed to meet the technical requirements of a Redeye position; i.e., good fields of view, prominent terrain, and safety considerations which are covered in chapter 12.

Note. Positions H, I, J, and K, figure 9-4, are removed from the defended unit by a distance equal to the maximum missile range. Positions E, F, and G are removed from the defended unit by distances equal to one-half the maximum missile range.

(1) Positions H-K offer good early engagement possibilities, especially when jets are in-

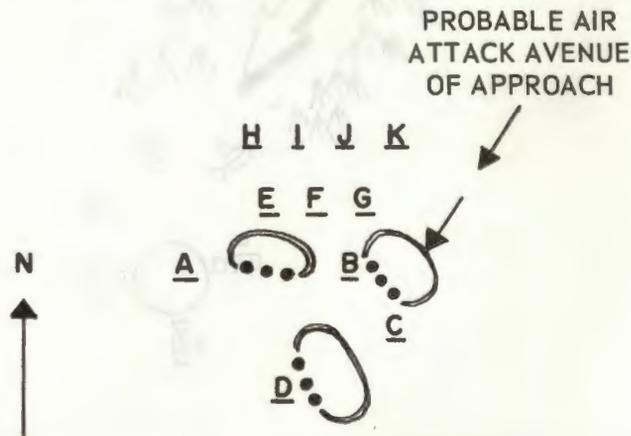


Figure 9-4. Type position defenses.

volved, since engagement may occur before the defended company is struck; also jets may be caught in the slower portion of the attack run. Deployment this far forward would not be required if only low/medium-performance aircraft are involved. These positions are best insofar as discouraging airborne observation of the company position is concerned. The positions are also good for disruption of incoming airmobile attacks before the enemy troops are landed. These positions have the disadvantage, besides increased ground security problems, of being unduly sensitive to change in direction of air attack. For example, a Redeye team at position K probably would not be able to engage a jet aircraft traveling a northwest-southeast path over the company area. Attack from the rear by any aircraft type also would not be met properly. Deployment of single teams this far forward is suitable only when—

(a) Ground security is not a major problem.

(b) Defense by a single team against all directions of attack is not required, due either to the situation or to the favorable placement of adjacent teams.

(2) Positions E-G offer less early engagement possibilities than positions H-K, but provide fewer ground security problems and are less sensitive to direction of attack. Position E would be the least preferred position due to its reduced coverage against jet aircraft approaching from the probable direction of air attack. Positions F and G are good positions; however, if position G is chosen, care must be exercised that attacks from the northwest can be met. Positions E-G offer the Redeye gunner a good chance of engaging enemy aircraft maneuvering for repeated firing passes over the company area. They also offer a good chance of engaging jet aircraft during what may be the slowest portion of these attack patterns. A good capability against helicopters also is offered.

(3) Positions A-D provide no early engagement possibilities against observation aircraft, attacking jet fighter-bomber aircraft, or airmobile attacks (before troops are landed). In addition, attacking jets may not be engaged during the slower portion of their attack runs. However, ground security problems are minimized. Probably the best of these positions is the centrally located position B, due to its forward location and relatively balanced all-around capability.

(4) The position affording the best technical relation between Redeye and unit location is posi-

tion F. This position offers early engagement capability against observation and reconnaissance aircraft and airmobile forces operating forward of the company position. It provides an opportunity for repeated engagement of jet aircraft maneuvering over and about the company area while they are making repeated firing passes (a Redeye position within the company area may not allow such engagement). It also favors the probable direction of attack while retaining all-round capability and may not pose a serious ground security problem (especially for units not on the FEBA). Ground security or terrain and environmental considerations, however, may make selection of position B necessary.

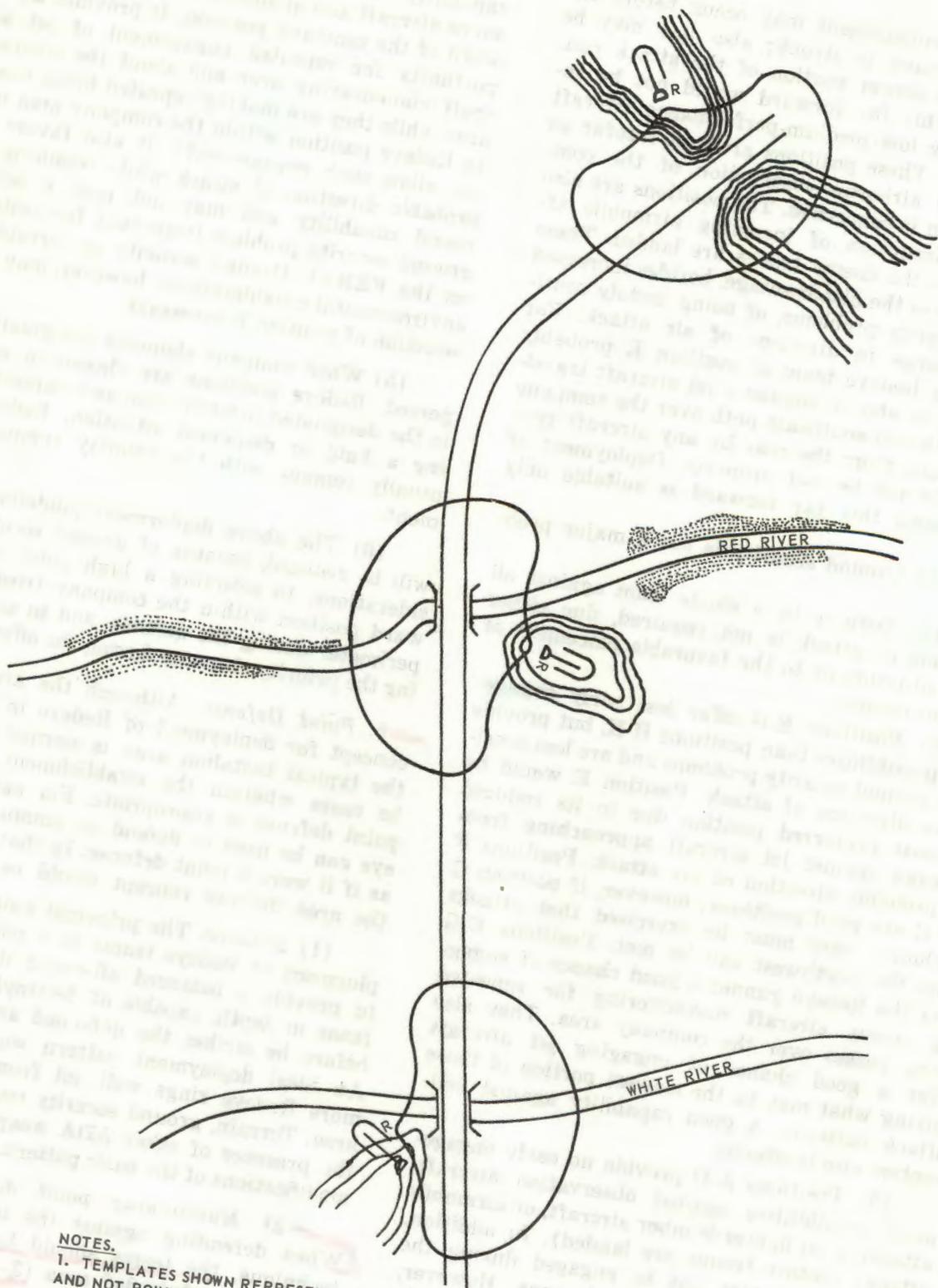
(5) When company elements are greatly dispersed, Redeye positions are chosen in relation to the designated priority company element. During a fluid or dispersed situation, Redeye will usually remain with the priority company element.

(6) The above deployment guidelines often will be reduced, because of ground security considerations, to selecting a high point in a forward position within the company/troop/battery perimeter during the defense, and to accompanying the priority elements during the offense.

b. Point Defense. Although the area defense concept for deployment of Redeye in defense of the typical battalion area is normal, there will be cases wherein the establishment of Redeye point defense is appropriate. For example, Redeye can be used to defend an ammunition dump as if it were a point defense. In that case, use of the area defense concept would be impractical.

(1) *Balance.* The principal guideline for deployment of Redeye teams in a point defense is to provide a balanced all-round defense. A defense in depth, capable of destroying the enemy before he strikes the defended area, is desired. An ideal deployment pattern would be one or more Redeye rings well out from the defended area. Terrain, ground security requirements; and the presence of other ADA weapons will dictate modifications of the basic pattern.

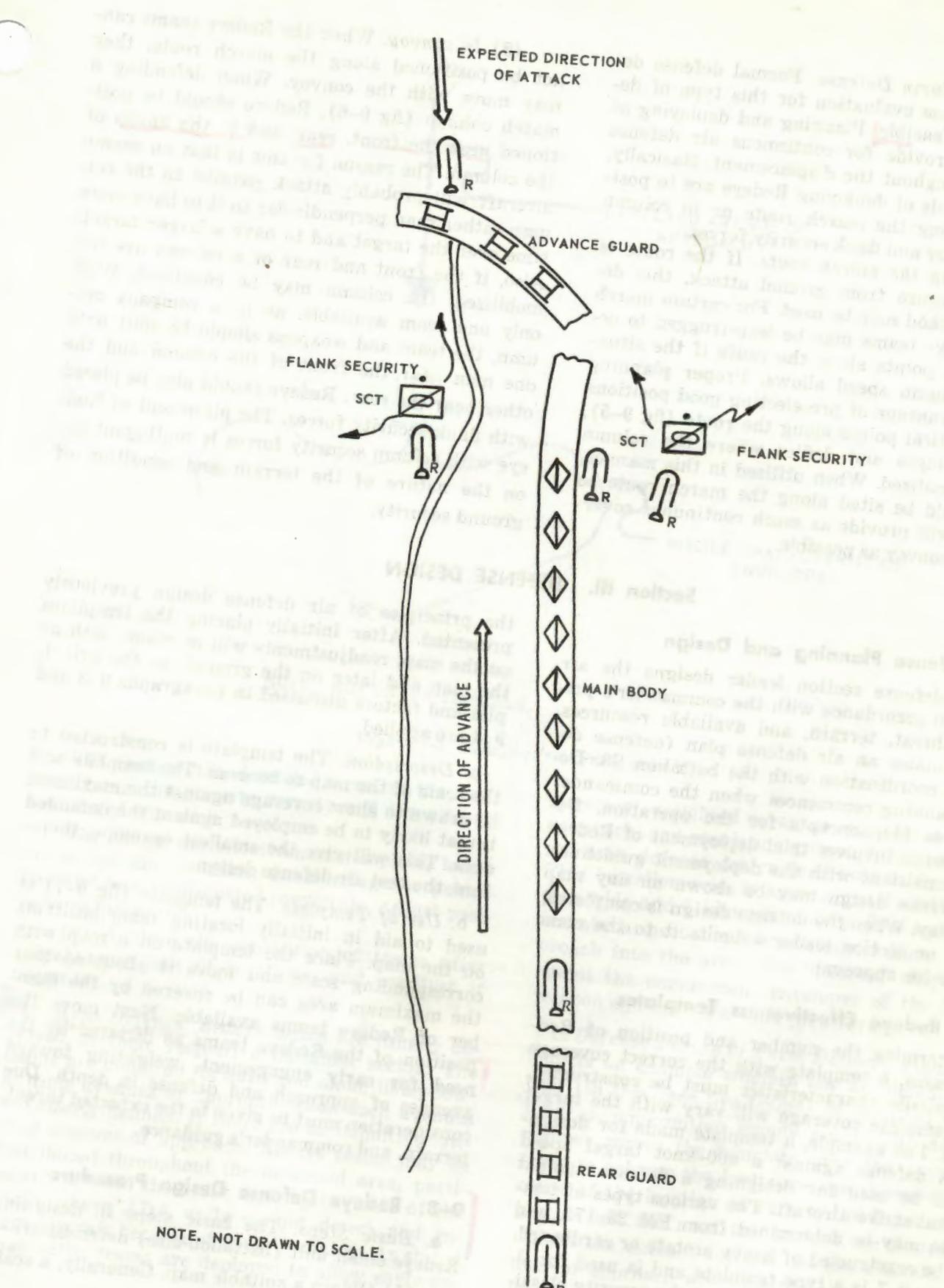
(2) *Maintaining point defense coverage.* When defending against the laydown bombing technique, the teams should be located well in front of the defended area (3-4 km), yet maintaining point defense coverage. Laydown bombing is the technique wherein delay-fuzed bombs are used to allow the attacker to escape their effects.



NOTES.

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2. NOT DRAWN TO SCALE.

Figure 9-5. Redeye positioned along the march route.



NOTE. NOT DRAWN TO SCALE.

Figure 9-6. March column defense in convoy.

c. *March Column Defense.* Formal defense design and defense evaluation for this type of defense are not feasible. Planning and deploying of teams must provide for continuous air defense coverage throughout the displacement. Basically, the two methods of deploying Redeye are to position them along the march route or in column with the convoy and flank security forces.

(1) *Along the march route.* If the route is sufficiently secure from ground attack, this deployment method may be used. For certain march routes, Redeye teams may be leap-frogged to occupy critical points along the route if the situation and column speed allows. Proper planning can take advantage of preselecting good positions to cover critical points along the route (fig 9-5), such as bridges and defiles where the column could be canalized. When utilized in this manner, teams should be sited along the march route so that they will provide as much continuous coverage to the convoy as possible.

(2) *In convoy.* When the Redeye teams cannot be positioned along the march route, they may move with the convoy. When defending a march column (fig 9-6), Redeye should be positioned near the front, rear, and to the flanks of the column. The reason for this is that an enemy aircraft will probably attack parallel to the column rather than perpendicular to it to have more time over the target and to have a larger target. Also, if the front and rear of a column are immobilized, the column may be canalized. With only one team available, as in a company column, the team and weapons should be split with one man near the front of the column and the other near the rear. Redeye should also be placed with flank security forces. The placement of Redeye with column security forces is contingent upon the nature of the terrain and condition of ground security.

Section III. DEFENSE DESIGN

9-6. Defense Planning and Design

The air defense section leader designs the air defense in accordance with the commander's priorities, threat, terrain, and available resources. He formulates an air defense plan (defense design) in coordination with the battalion S3. Defense planning commences when the commander announces his concepts for the operation. Defense design involves trial deployment of Redeye teams consistent with the deployment guidelines. The defense design may be shown on any map or overlay. When the defense design is completed, the S3 or section leader submits it to the commander for approval.

9-7. Redeye Effectiveness Templates

To determine the number and position of Redeye teams, a template with the correct coverage and missile characteristics must be constructed. The template coverage will vary with the target speed. For example, a template made for designing a defense against a 400-knot target speed would be used for designing a defense against tactical strike aircraft. The various types of templates may be determined from FM 23-17A and can be constructed of heavy acetate or cardboard. Figure 9-7 is a type template and is used for illustrative purposes because of the security classification of specific Redeye missile performance data. Redeye teams are placed so as to conform to

the principles of air defense design previously presented. After initially placing the templates on the map, readjustments will be made, both on the map and later on the ground, as the principles and factors discussed in paragraphs 9-3 and 9-4 are applied.

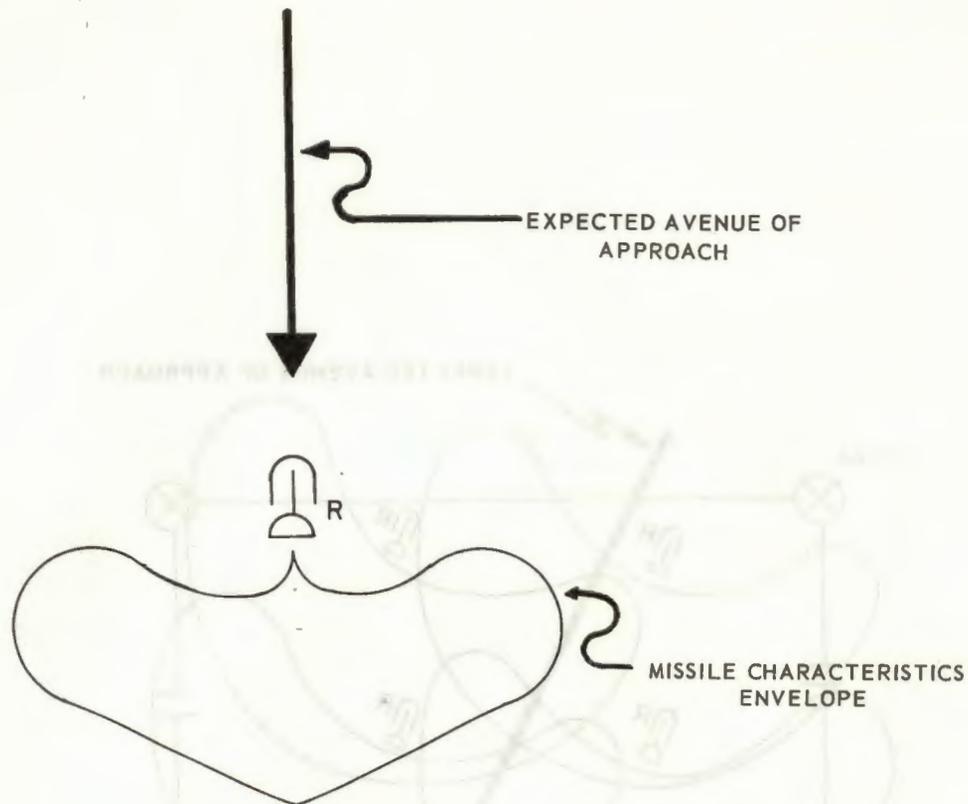
a. *Description.* The template is constructed to the scale of the map to be used. The template will be drawn to show coverage against the maximum threat likely to be employed against the defended area. This will give the smallest envelope, therefore, the best air defense design.

b. *Use of Template.* The template (fig 9-7) is used to aid in initially locating team positions on the map. Place the template on a map with corresponding scale and move it about so that the maximum area can be covered by the number of Redeye teams available. Next move the position of the Redeye teams as dictated by the need for early engagement, weighting toward avenues of approach and defense in depth. Due consideration must be given to the expected threat, terrain, and commander's guidance.

9-8. Redeye Defense Design Procedure

a. *Basic Steps.* The basic steps in designing Redeye small unit (battalion-size) defenses are—

(1) Obtain a suitable map. Generally, a scale of 1:50,000 is best.



NOTE. NOT DRAWN TO SCALE.

Figure 9-7. Redeye effectiveness template.

(2) Outline the defended area on the map, identifying the priority targets and low-altitude avenues of approach.

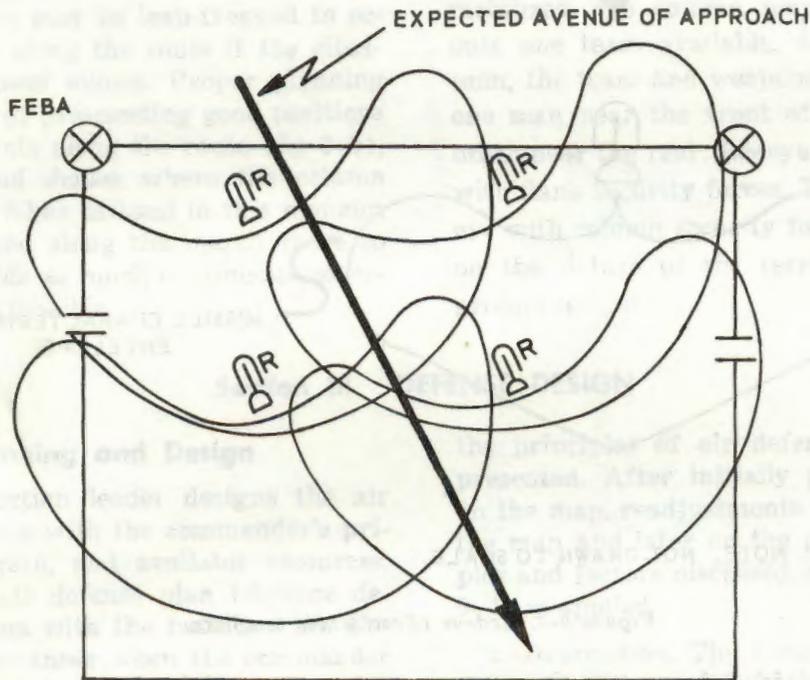
(3) Using the effectiveness template, locate initial weapon positions. Considering the principles and factors discussed previously, adjust positions as necessary.

(4) Analyze the disposition of teams after actual occupation of positions, and readjust if necessary.

b. Area Defense. Redeye teams are usually deployed in their respective battalion sector. The teams are deployed forward and along likely low-altitude avenues of approach when such avenues are clearly defined. If there are no definitive low-level avenues of approach, Redeye teams may be distributed throughout the defended area, particularly toward the front and in the folds of the earth where ADA units cannot detect and engage aircraft because of radar masking. As stated previously, teams are deployed to allow early en-

gagement, weighted coverage along the avenue of approach, and overlapping fires. A typical battalion area defense design is shown in figure 9-8. This battalion area is approximately 3.5 kilometers wide and 3 kilometers deep. The arrow represents a probable low-altitude avenue of approach into the area. The "peanut" shapes represent the engagement envelopes of the Redeye weapon against a 450-knot jet aircraft.

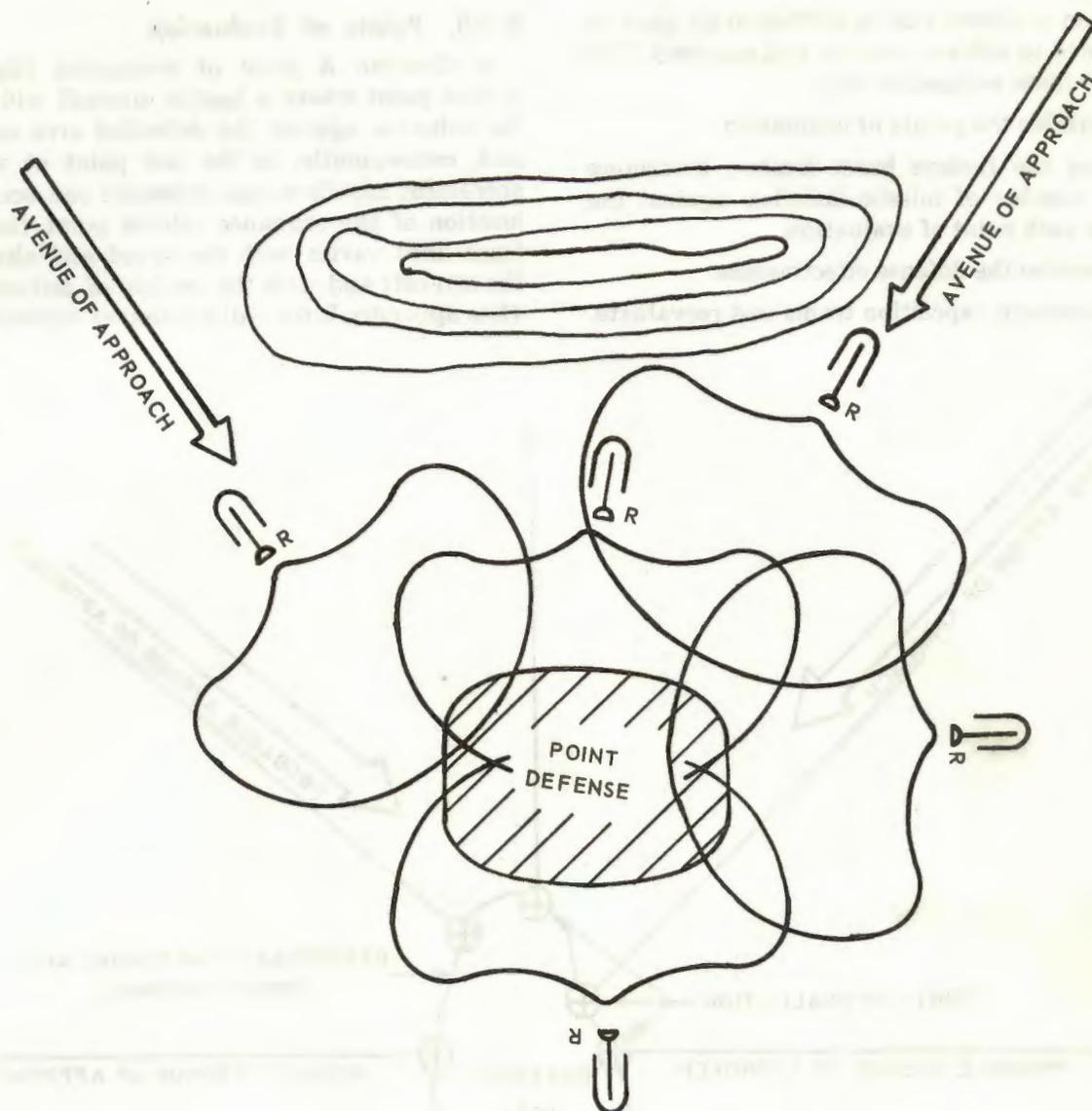
c. Defense Design of Point Defense. Figure 9-9 depicts an example wherein one air defense section (in this case five teams) is deployed to defend an ammunition supply point. The defense planner moves the template over the point defense to achieve the best coverage. However, because of the location of expected avenues of approach and the need for balance, he decides to weight the defense toward the low-altitude avenues of approach while maintaining some degree of balance.



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Figure 9-8. Type battalion area defense design.



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2. NOT DRAWN TO SCALE.

Figure 9-9. Designing a point defense.

Section IV. EVALUATION OF REDEYE DEFENSES

9-9. General

The fourth step in establishing a Redeye defense is evaluation of the proposed deployment of forces to determine its effectiveness against the anticipated threat. Evaluation can be accomplished by

using a Redeye burst locator as an analyzing device to measure the number of missiles each team can deliver on target prior to the target releasing its ordnance. If evaluation, using the burst locator, shows holes in the defense or overkill in some

areas, team positions can be shifted to fill gaps or repositioned to achieve balance and economy. The steps in defense evaluation are:

- a. Determine the points of evaluation.
- b. Using the Redeye burst locator, determine the total number of missile launches against the target for each point of evaluation.
- c. Determine the defense effectiveness.
- d. If necessary, reposition teams and reevaluate.

9-10. Points of Evaluation

a. *General.* A point of evaluation (fig 9-10) is that point where a hostile aircraft will release its ordnance against the defended area or target and, consequently, is the last point at which a successful missile-target intercept can occur. The location of the ordnance release point (bomb release line) varies with the speed and altitude of the aircraft and with the method of delivery used. (See appendix B for a discussion of delivery meth-

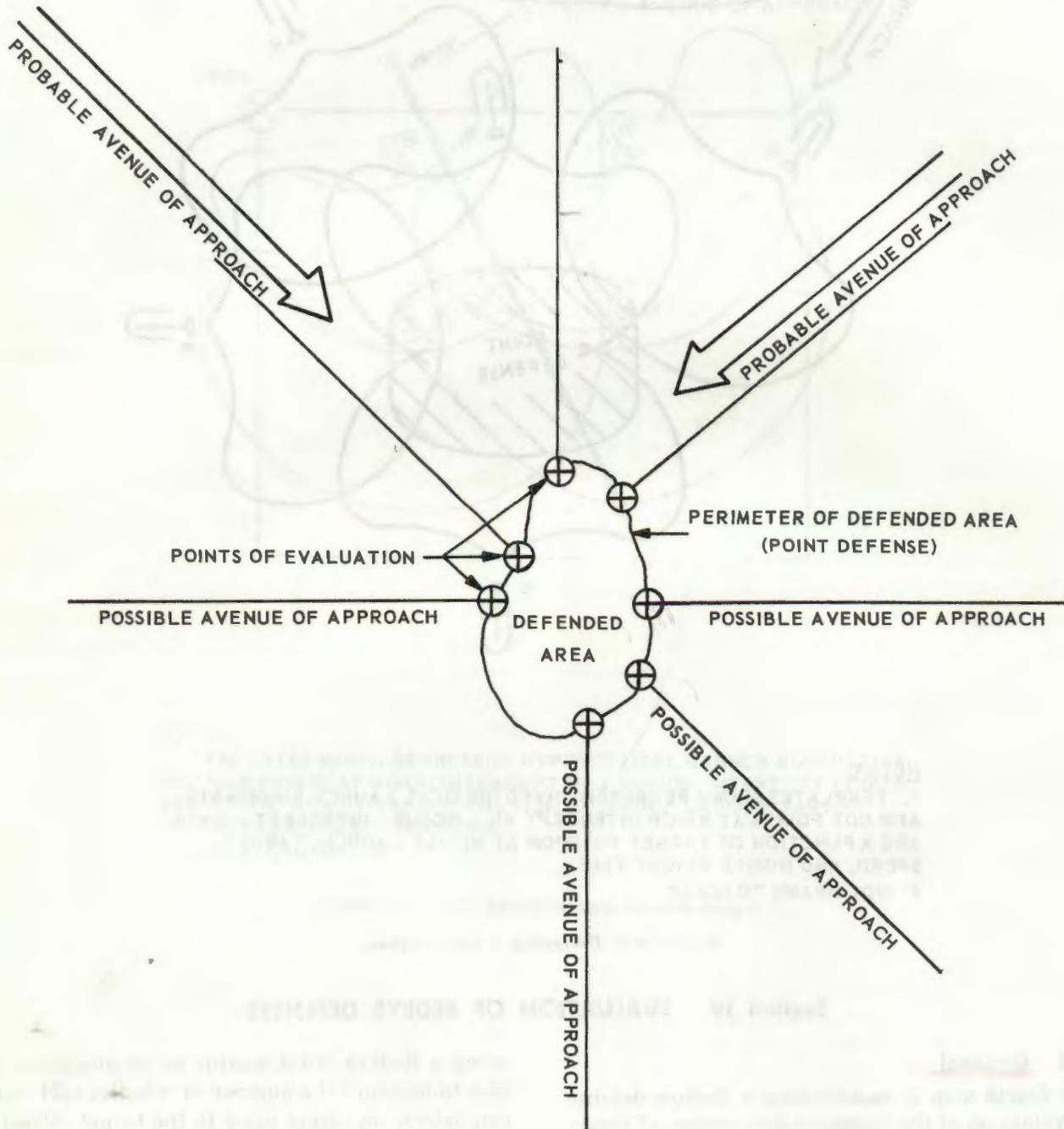


Figure 9-10. Points of evaluation.

ods.) Direction-of-attack lines are lines drawn along probable and possible avenues of attack.

b. Establishing Points of Evaluation.

TALK (1) Point or vital area defense. For Redeye point or vital area defense, points of evaluation are established (drawn) at the intersection of each direction-of-attack line leading into the defended area and a line defining the outer perimeter of the defended area. Direction-of-attack lines are drawn along each probable and possible low-altitude avenues of approach as shown in figure 9-10. In sectors where strength is relatively low, move teams closer to that direction-of-attack line. In sectors where strength is relatively high, move teams away from that direction of attack. In cases where terrain is relatively flat and hostile aircraft may approach from any direction, draw an equidistant number of radial direction-of-attack lines at equal angles apart through the center of the defended area. For a point defense, check the balance to see if the defense has approximately the same strength along each direction of attack. In addition to being balanced, the defense must be capable of achieving adequate firepower along each direction-of-attack line.

(2) *Area defense.* For the purpose of evaluating a battalion area-type defense, points of evaluation are established at the intersection of the direction-of-attack line and the forward edge of the battle area or exposed boundary. In this case, Redeye teams will not be able to achieve any bursts at the point of evaluation unless they are positioned well forward of the FEBA.

9-11. Redeye Burst Locator

a. Description. The Redeye burst locator (fig 9-11) is a graphic portrayal of the effectiveness envelope (fig 9-12) of the Redeye system against a specific threat and shows the number of missiles which can intercept the target as it passes through the envelope. The burst locator shown in figure 9-11 is for illustrative purposes only and does not reflect the true capabilities of the Redeye system. Note that the direction-of-flight arrow is drawn on the rear of the locator. Burst locators based on actual system capabilities against various threats are described in FM 23-17A. The completely inclosed area of the burst locator represents the system's effectiveness against a specific threat. The smooth contour line at the rear of the burst locator represents maximum effective horizontal range of the mis-

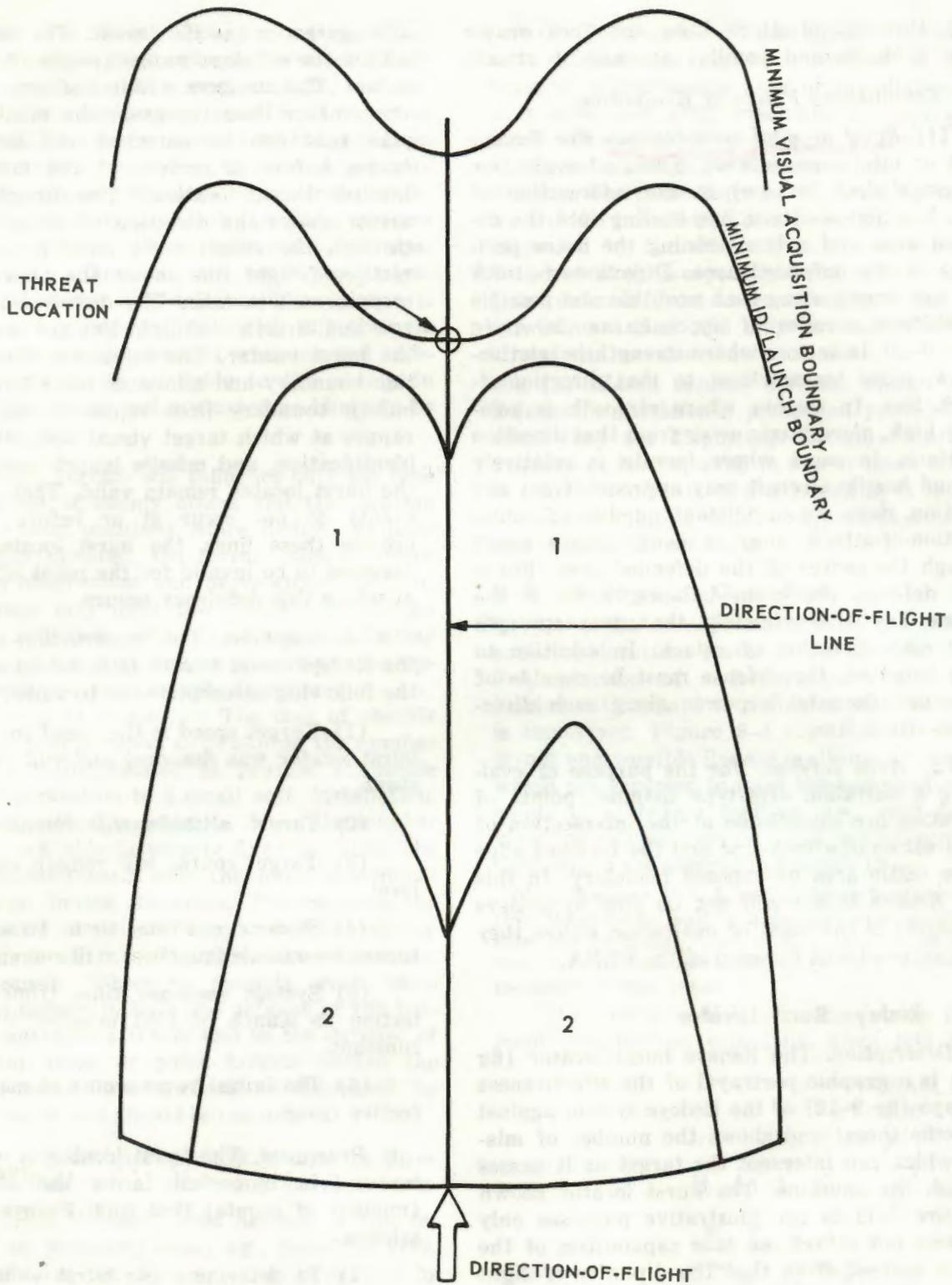
sile against a specific threat. The contour lines within the envelope connect points of equal burst values. The numbers within the area inclosed by the contour lines represent the number of missiles that can be launched and intercept the target before it arrives at the crossed circle labeled "threat location." The direction-of-flight arrow shows the direction of target movement through the effectiveness envelope and the direction-of-flight line shows the path the target is presumed to take. The direction-of-flight arrow and direction-of-flight line are used to orient the burst locator. The minimum visual acquisition boundary and minimum identification (ID)/launch boundary lines represent the minimum ranges at which target visual acquisition, target identification, and missile launch can occur and the burst locator remain valid. That is, if these events do not occur at or before the target crosses these lines, the burst locator must be assumed to be invalid for the point of evaluation at which this deficiency occurs.

b. Assumptions. The construction and use of the Redeye burst locator is based on considering the following assumptions to be valid:

- (1) Target speed is the speed for which the burst locator was designed and will remain constant.
- (2) Target altitude will remain constant.
- (3) Target course will remain straight and level.
- (4) System reaction time (time between successive missile launches) will remain constant.
- (5) System response time (time from detection to launch of first missile) will remain constant.
- (6) The initial burst occurs at maximum effective range.

c. Procedure. The burst locator is used to determine in numerical terms the effectiveness (number of bursts) that each Redeye team can achieve.

(1) To determine the burst value of each team, plot the outline of the defended area on a 1:50,000 map, if available, and indicate the location of each Redeye team. Draw direction-of-attack lines along probable and possible avenues of approach so that the lines intersect the boundary of the defended area. Each intersection is a point of evaluation. Place the threat location (crossed circle) over the point of evaluation (fig



LEGEND:

TYPE SYSTEM:

SCALE:

TARGET SPEED:

TARGET ALTITUDE:

METHOD OF FIRE:

Figure 9-11. Type Redeye burst locator.

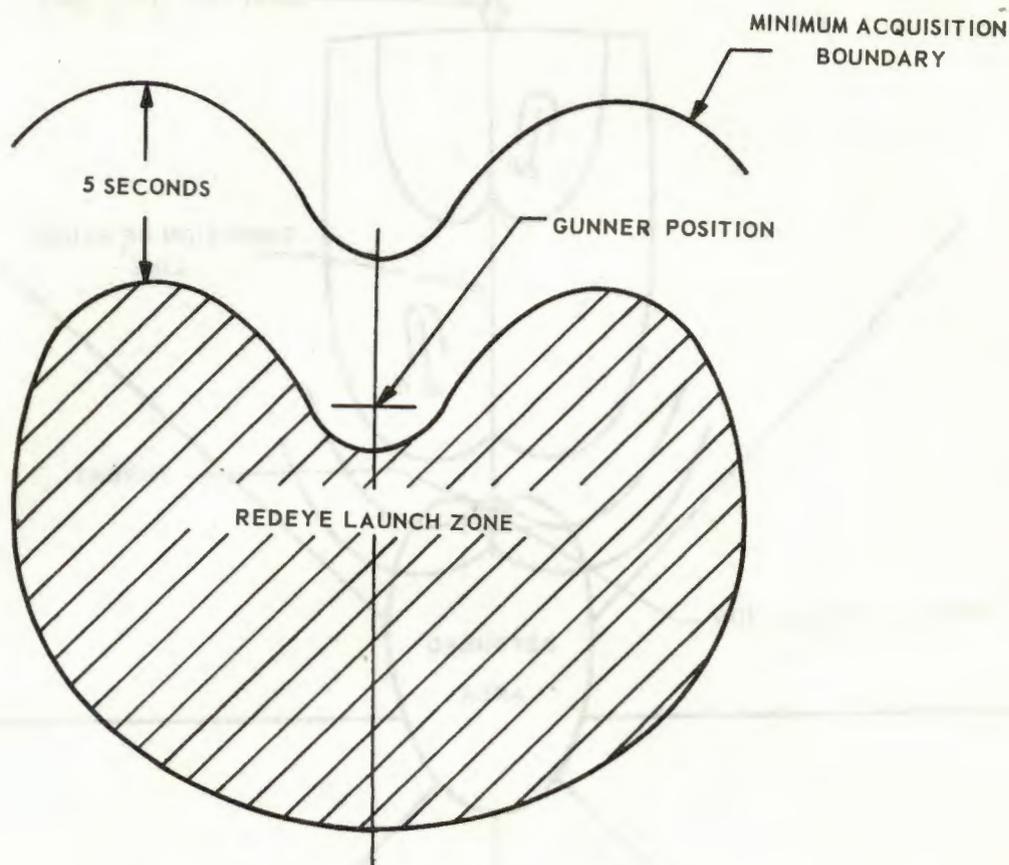


Figure 9-12. Type Redeye effectiveness envelope.

9-13) and orient the burst locator so that the direction-of-flight line and direction-of-attack line are coincident and the direction-of-flight arrow is pointing in the direction of target movement. Note the location of each Redeye team with respect to the burst contour lines of the burst locator. If the team is located within the burst contour having a value of 2, it means that this team can fire two missiles on the target prior to its reaching the point of evaluation. If a team is located within the contour having a burst value of 1, the team can fire only one successful missile at the target. Teams located outside the area of the burst locator (except teams located to the rear of the burst locator and toward direction of approach) are beyond effective range and have a burst value of 0. Teams located to the rear of the burst locator have been within range; therefore, the point is given a value by extending a line parallel to the direction-of-flight line from the team position to the rear of the burst locator (fig 9-14(A)) and reading the missile value at that point.

(2) In figure 9-13 it can be seen that, with

the burst locator oriented properly, one Redeye team achieves two bursts while the other team achieves one burst. If Redeye teams are deployed well-forward along low-altitude avenues of approach leading into a point defense, mark the avenue of approach on the defense overlay and move the burst locator in along the avenue recording the missile burst values. In figure 9-14 it can be seen that each team achieves two bursts against the threat.

9-12. Evaluating Defense Effectiveness

a. *Initial Team Positioning.* In evaluating the effectiveness of a typical Redeye defense, it can be seen in figure 9-15 that the defense planner has initially deployed his Redeye teams in a defense which is partially faulty. Using five teams and available intelligence concerning the threat and information pertaining to the terrain and area to be defended, the defense planner has positioned the teams to cover the defense as shown. The two low-altitude avenues of approach to the defended area are labeled X-RAY and ZEBRA. Two Redeye teams have been positioned

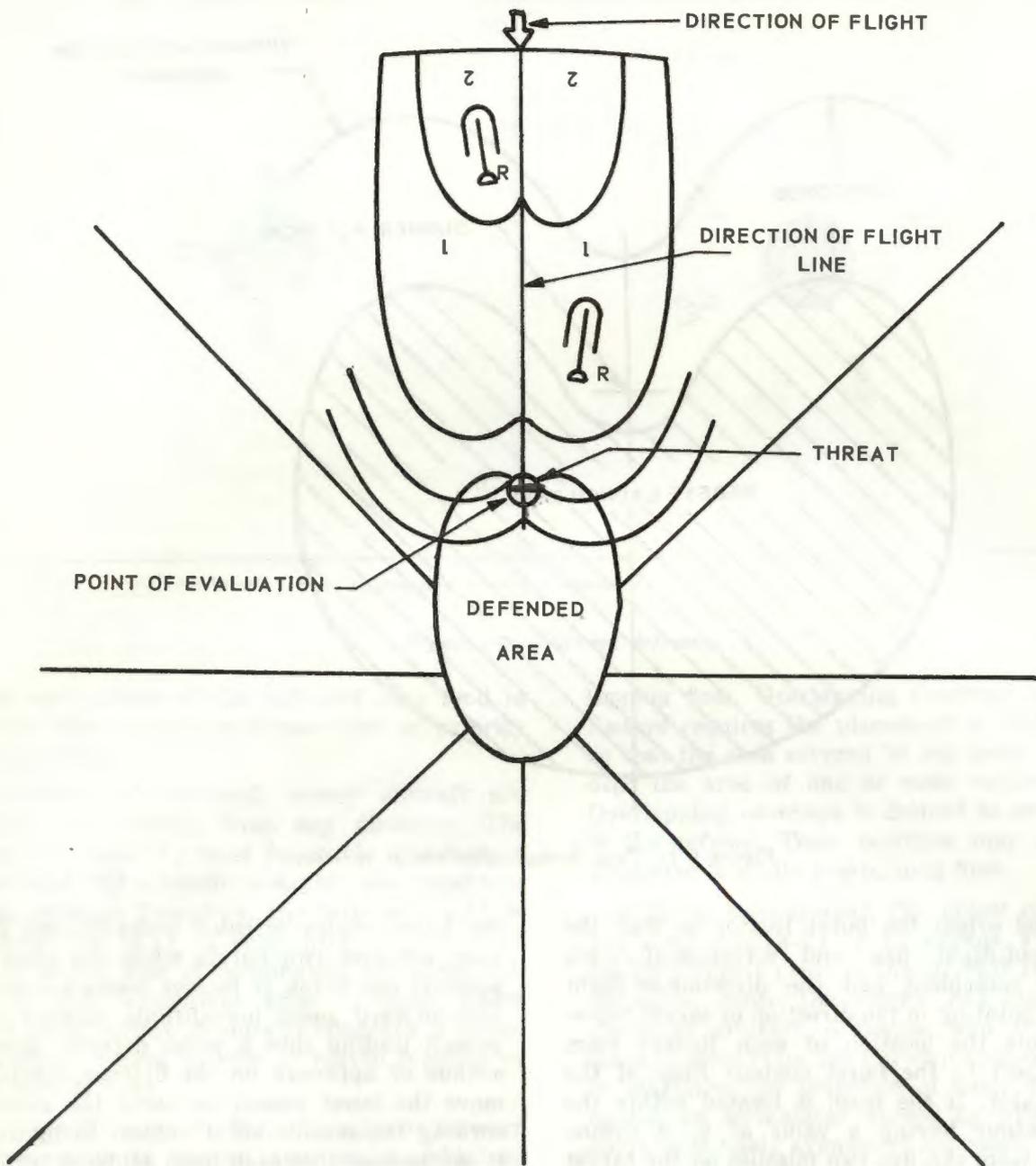


Figure 9-13. Burst locator use in point defense.

to cover route X-RAY and will be evaluated at point A. One team has been positioned to cover route ZEBRA and will be evaluated at point B. The remaining two teams are positioned to achieve additional balance to the defense and will be evaluated at point D as shown.

b. Effectiveness Formula. To evaluate the Redeye defense, the defense planner needs to know the system effectiveness (SE) and specified engagement effectiveness (EE).

(1) System effectiveness is defined as the

probability, expressed as a percentage, that a Redeye team will acquire a single target within system design capability, deliver a single round that will burst within system design accuracy, and achieve the desired degree of target destruction (See FM 23-17A, change 1, for actual SE percentage.)

(2) Engagement effectiveness is defined as the kill probability of the defense, expressed as a percentage, against each aircraft in a particular raid size. The commander specifies the de-

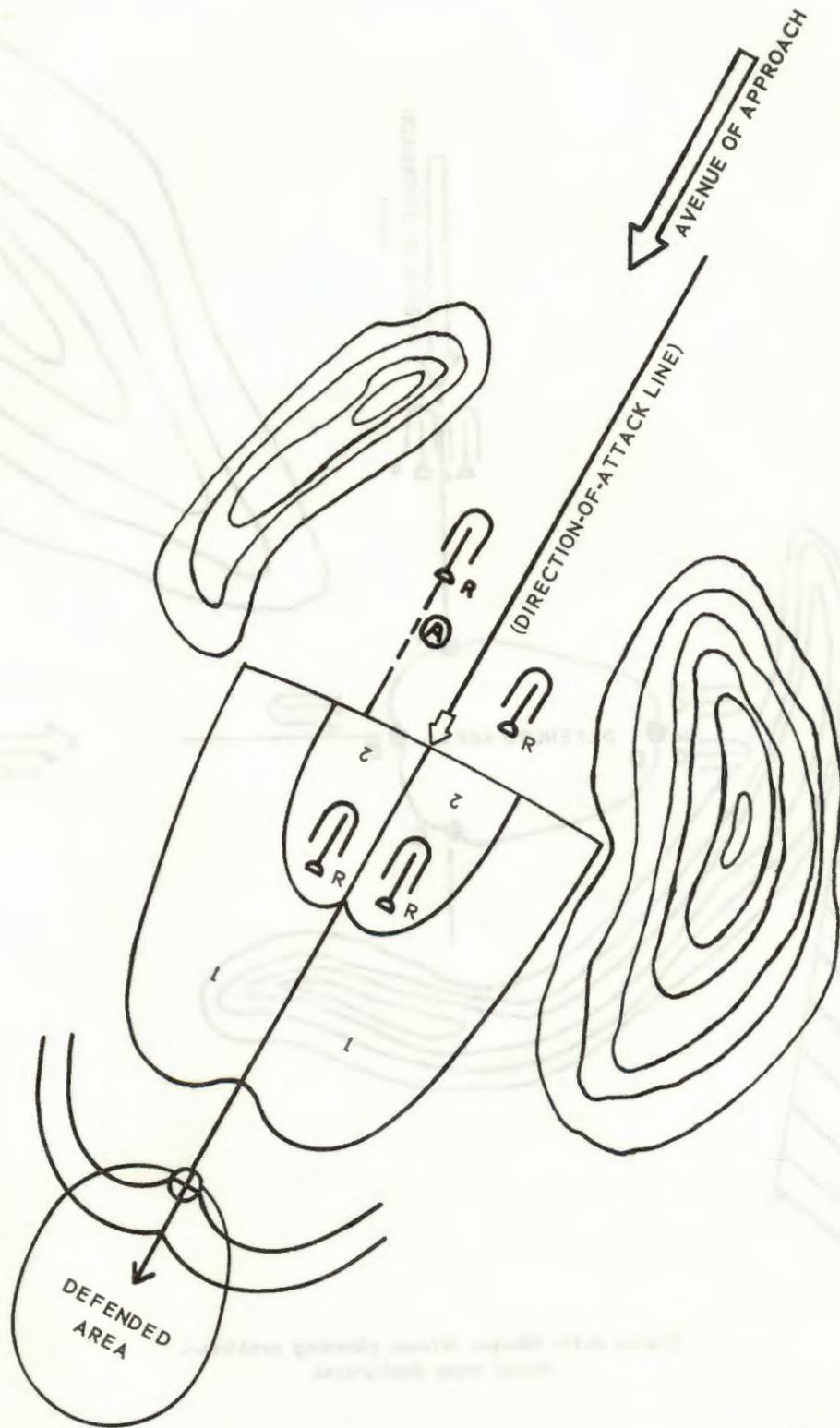


Figure 9-14. Burst locator use with Redeye teams well forward.

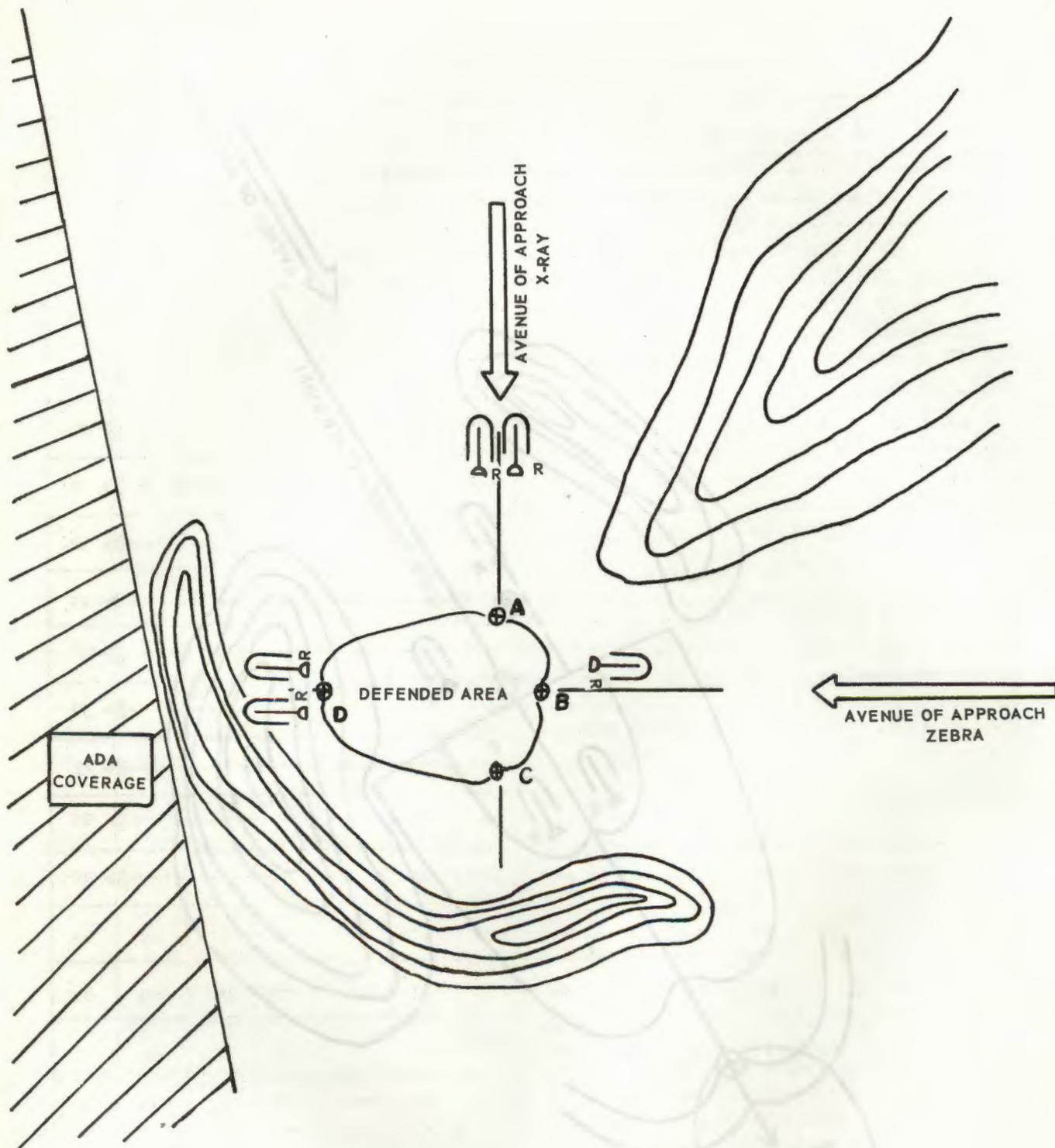


Figure 9-15. Sample defense planning problem—initial team deployment.

gree of protection for each area in terms of engagement effectiveness.

(3) The next step is to determine the maximum raid size the defense can cope with in ac-

cordance with the specified engagement effectiveness, using the effectiveness formula:

$$n = \frac{M_t}{m} \text{ where}$$

ATTEMPTED MISSILE LAUNCHES REQUIRED PER TARGET

SE	1	2	3	4	5	6	7	8	9	10	11	12	13
99	99												99
95	95	99											99
90	90	99											99
85	85	97	99										99
80	80	96	99										99
75	75	93	98	99									99
70	70	91	97	99									99
65	65	87	95	98	99								99
60	60	84	93	97	99								99
55	55	79	90	95	98	99							99
50	50	75	87	93	96	98	99						99
45	45	69	83	90	94	97	98	99					99
40	40	64	78	87	92	95	97	98	99				99
35	35	57	72	82	88	92	95	96	97	98	99	99	99
30	30	51	65	76	83	88	91	94	96	97	98	99	99
25	25	43	57	68	76	82	86	89	92	94	95	96	97
20	20	36	48	59	67	73	79	83	86	89	91	93	94
15	15	27	38	47	55	62	67	72	76	80	83	85	87
10	10	19	27	34	40	46	52	57	61	65	68	71	74

Figure 9-16. Engagement effectiveness expressed as a percentage.

n = Kill capability (maximum number of aircraft against which the defense can achieve the given EE as specified by the commander).

M_t = Total number of missiles that can be launched against aircraft flying a specific avenue of approach (as measured by burst locator).

m = Missile launches per target required to achieve desired EE (obtained from fig 9-16).

c. Determining Engagement Effectiveness.

(1) To evaluate the defense at point A (fig 9-17), the defense planner positions the Redeye burst locator at point A, orients the device, and determines that each Redeye team can achieve two bursts. To determine the n (kill capability) for point A, the defense planner refers to percentages listed in figure 9-16. For example, if the SE is 45 percent, he reads upward in the left column to 45; then uses the commander's guidance as to EE (in this case 90 percent) and determines the m by reading across to EE of 90 percent, then upward to the m which has a value of 4. By use of the burst locator he knows that the two teams at point A can achieve a total of four missile bursts (M_t). He then uses the effectiveness formula

$n = \frac{M_t}{m}$ to determine the kill capability of the Redeye defense.

$$n = \frac{M_t}{m} = \frac{4}{4} = 1$$

The defense, therefore, is capable of destroying one aircraft under these conditions of SE, EE, and M_t . If the specified EE is 69 percent, for example, the same defense can destroy two aircraft.

$$n = \frac{M_t}{m} = \frac{4}{2} = 2$$

(2) At point B, the defense planner determines that the one Redeye team can achieve one burst. Again, using an SE of 45 percent and the same evaluation procedure described above, he determines that no aircraft can be destroyed with a 90 percent EE; however, with an EE of 45 percent one aircraft can be destroyed.

(3) At point C it has been determined that no teams are needed because of the terrain and also because of adjacent ADA coverage which could destroy any hostile aircraft approaching from that direction.

(4) At point D two teams have been positioned so that each team can achieve two missile bursts. Again, using the procedure described in a-c above and an EE of 90 percent, one aircraft can be destroyed.

d. Reevaluation of Defense Effectiveness. After initial evaluation of the defense, the air defense section leader determines that point B needs additional coverage. Therefore, he redeploys one team from point D to point B, to achieve two bursts, then repositions the team at point B so that it can also achieve two bursts (fig 9-18). The engagement effectiveness at point B can now be increased to 90 percent and n (kill capability), therefore, is raised to one aircraft. Although engagement effectiveness for point B is increased at the expense of point D, the decision to weight the additional coverage for route ZEBRA is correct.

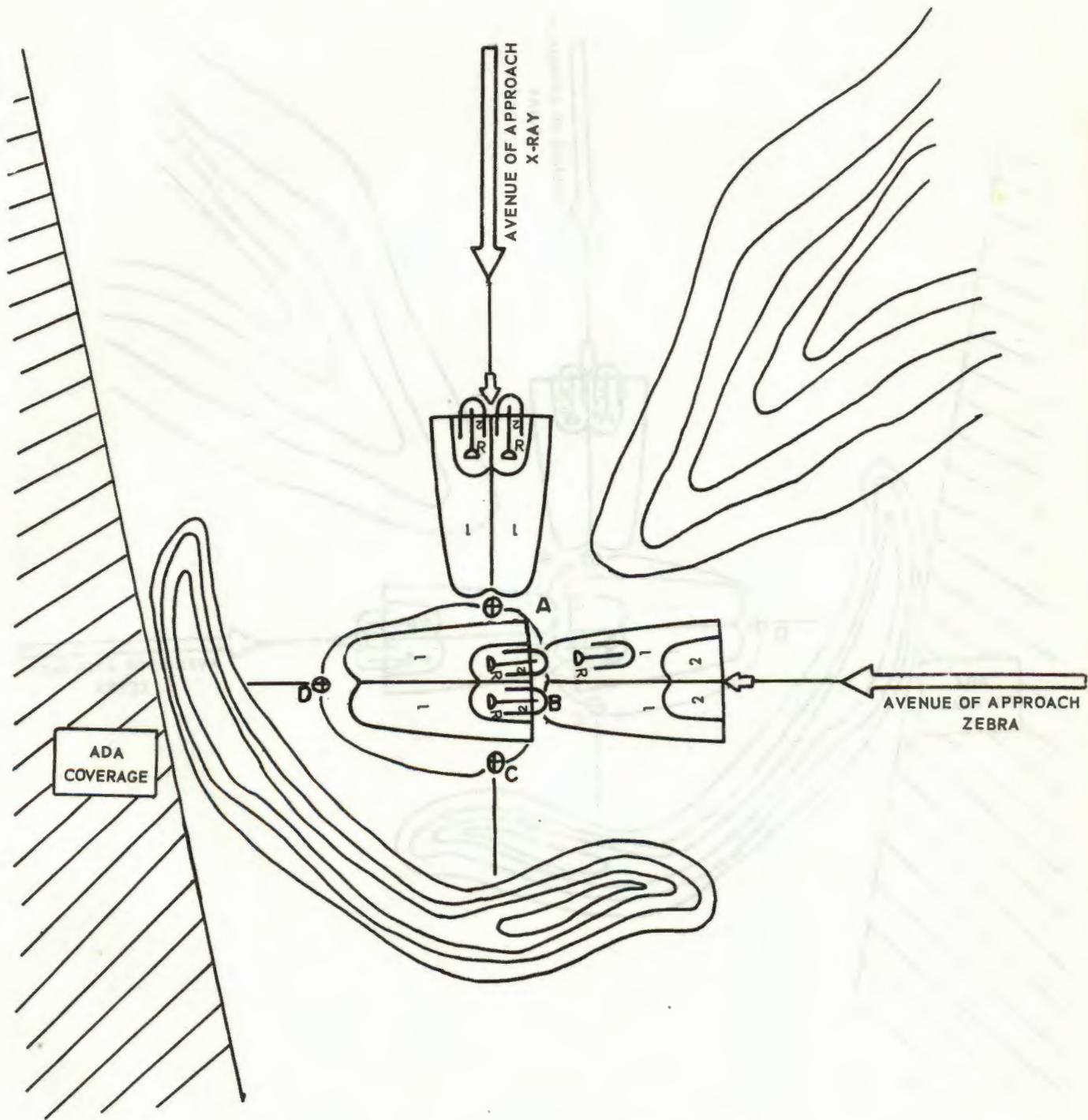


Figure 9-17. Determining defense effectiveness at point A.

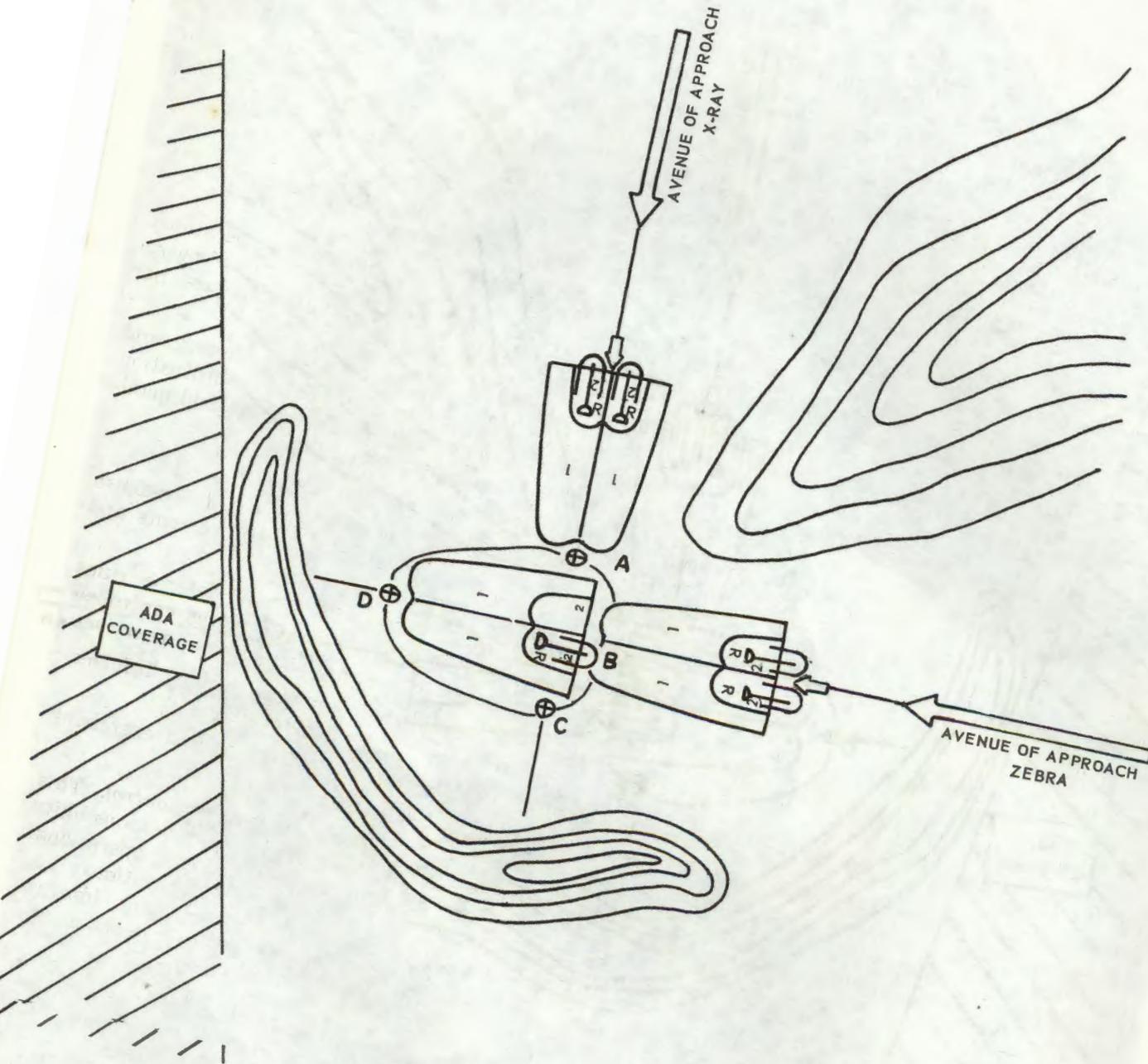


Figure 9-18. Corrected defended area coverage.

CHAPTER 10

COMMAND AND CONTROL

Section I. GENERAL

10-1. Introduction

Command and control is an arrangement of personnel, facilities, and the means of information acquisition, processing, and dissemination employed by a commander in planning, directing, and controlling operations. The functions of command and control of the air defense section (Redeye) within a division are presented in this chapter. The principles of command and control of higher air defense operations are covered in FM 44-1.

10-2. Definition of Terms

The following terms are commonly used to describe the degree of command and control/authority/responsibility to be exercised by the air defense section leader.

a. Operational Control. Operational control is the authority granted to a subordinate commander to enable him to accomplish his assigned mission. The Redeye air defense section leader exercises operational control within the limits and guidelines specified by higher authority in plans, policies, rules, directives, and SOP. The air defense section leader's responsibility of establishment and maintenance of air defense for supported units includes the following activities:

- (1) Operational planning.
- (2) Designation of missions and priorities based on the threat to be encountered.
- (3) Allocation of resources for mission accomplishment.
- (4) Organization for combat (excludes internal organization).
- (5) Assignment of tactical missions (e.g., direct support, general support).
- (6) Delegation of control authority in whole or in part.

(7) Designation of geographical boundaries or responsibilities.

(8) Control of unit positioning and repositioning (deployment control).

(9) Control of fires. The term "operational control" should not be used when only "control of fires" is intended since the terms are not synonymous.

(10) Coordination with higher, lower, and adjacent echelons for purposes of coordination of operations to minimize interference and maximize complementary effectiveness.

(11) Evaluation of the situation.

(12) Advising all echelons on air defense matters to include air defense requirements and situation.

(13) Insuring established air defense rules and procedures binding on all forces controlled are in compliance with higher level directives.

(14) Establishing communications, information, and reporting requirements.

(15) Monitoring all activities and exercising central override as required.

b. Command Less Operational Control. This term provides for authority and responsibility in all matters *not included* in the operational missions of the subordinate organizations; i.e., logistics, administration, unit training, internal organization, and health, welfare, morale, and discipline matters.

c. Command. Command authority and responsibility is the summation of those terms specified in operational control (*a* above). This is the air defense section leader's normal degree of authority over his teams.

d. Support. In Redeye air defense the term defines the case where a Redeye team is obliged to render a degree of responsive air defense to a specified force element (e.g., an infantry rifle

company), but remains under the command (c above) of the air defense section leader. Redeye units receive clear definitions of the degree of support to be provided through receipt of the tactical missions of direct support, general support, and deployment control described in chapter 14.

e. Coordination. Coordination requires that the participating elements integrate their operations to the degree permitted by their individual missions to minimize interference and maximize complementary effectiveness. Command or operational control authority is not implied.

10-3. Delineation of Basic Responsibilities

Figure 10-1 shows a division-type command structure for air defense, employing the terms defined above. The figure shows a portion of the structure from division commander level to Redeye section leader level. (Further discussion is presented in FM 44-1.)

a. Battalion/Squadron Commander. Battalion

and squadron commanders are responsible for the proper employment of Redeye as well as organic automatic weapons and small arms used in the air defense role.

b. Battalion S3 or S3 Air.

(1) Supervises the overall establishment of the required battalion air defense procedures and primary and alternate communications channels for control of battalion air defense operations.

(2) Relays weapon control status orders, forward area alerting radar (FAAR) location/data link frequency, friendly air movement information, and other pertinent information received from the battalion commander or authorized external sources to the air defense section headquarters and, when so advised by the Redeye section leader, to the company/battery/troop commanders.

(3) For the battalion commander, imposes Redeye weapon hold status on an area/time/class of aircraft basis; e.g., for known friendly aircraft overflights and penetrations.

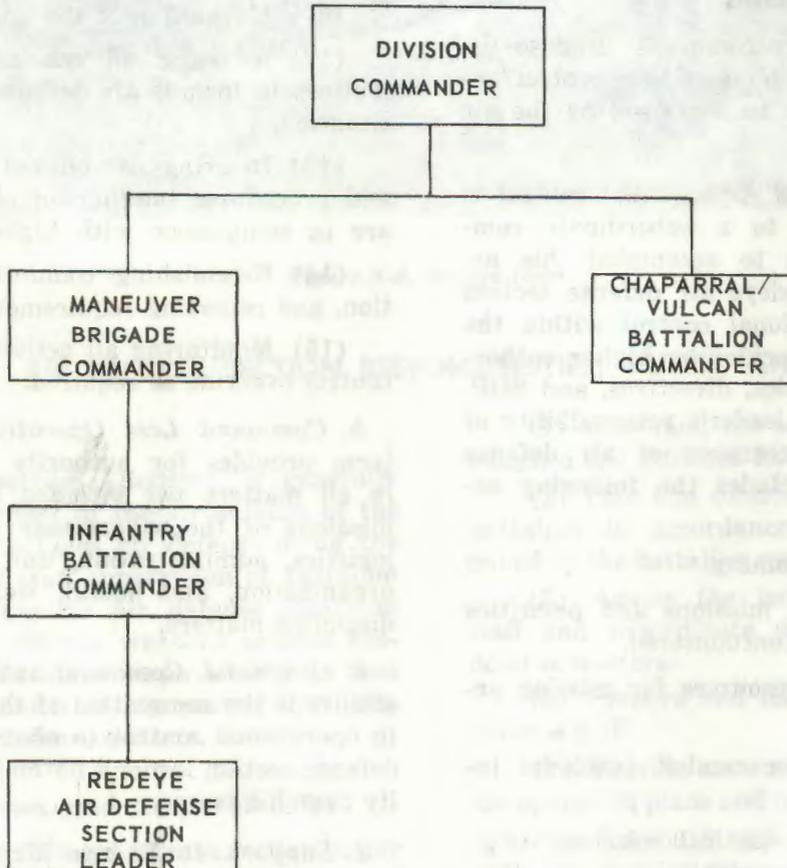


Figure 10-1. Type command structure for wartime air defense as applied to air defense section within division.

c. *Air Defense Section Leader.* (Refer to para 8-3.)

d. *Company/Battery/Troop Commanders.*

(1) Support Redeye teams that are in direct support or general support as directed. This pertains to messing facilities, supply, etc.

(2) Command attached Redeye teams with operational control exercised in compliance with the SOP.

(3) Supervise the employment of non-air-defense weapons against attacking enemy aircraft.

Section II. CONTROL FACILITIES AND DOCUMENTATION

10-4. Control Facilities

The key control facilities relevant to Army air defense operations, and coordination thereof, are discussed below.

a. *Army Air Defense Command Post.*

(1) An Army air defense command post (AADCP) is established by each air defense artillery (ADA) battalion, group, and brigade. An AADCP is the tactical headquarters of an Army air defense commander where he and his staff insure continuous and efficient control of tactical operations by subordinate ADA forces (FM 44-1).

(2) The divisional Chaparral/Vulcan (C/V) ADA battalion AADCP is an entirely "manual" post. The AADCP is supervised by the battalion S3 and manned on each shift by personnel from the battalion operations and intelligence section. The AADCP is manned and equipped to permit control and monitoring of all activities of the battalion except for detailed engagement control and detailed friendly and/or hostile aircraft flight information.

b. *Tactical Operations Centers.* A tactical operations center (TOC) is established at each echelon from division (sometimes brigade) to field army for the purpose of coordinating current combat and combat support operations. Each TOC includes the necessary coordinating elements, one of which is an airspace coordination element (ACE). The ACE performs coordination (but not minute-to-minute control) of division airspace usage during operations. Army aviation and air defense artillery personnel man the ACE.

c. *Airspace Coordination Element.* The primary purpose of the ACE is to coordinate all airspace management functions among Army airspace users and with other services. The element also provides information on the current status of air defense artillery and Army aviation capabilities. The ACE—

(1) *Coordinates use of airspace.* In compliance with directives of higher headquarters and the commander's concept for use of airspace by organic forces, the ACE coordinates airspace requirements and issues airspace clearance based on SOP, orders, data displays, knowledge of the situation, and information from the fire support element (FSE), AADCP, Army aviation, and other services. To facilitate coordination of the use of airspace, the ACE—

(a) Maintains airspace utilization displays, including airspace utilization map and airspace utilization board, which show information regarding preplanned and immediate air activity, Army air traffic control, and standing and temporary restrictive measures.

(b) Provides airspace utilization advice and information to other TOC elements as required.

(c) Issues or relays supplementary instructions to airspace users as required by the situation.

(d) Recommends changes to SOP's, plans, orders, policies, and directives.

(2) *Provides information on aviation status and recommends allocation and reallocation of Army aviation resources.* The ACE provides information to the TOC on the status of aviation resources controlled by the command. Based on the command mission, requests of subordinate commanders, and missions assigned to subordinate commanders, the chief of the ACE recommends the allocation of aviation resources.

(3) *Coordinates Army ADA operations.* The ACE coordinates current air defense artillery operations with combat and other combat support operations. To accomplish this, the ACE—

(a) Maintains air defense displays and provides information and advice to other TOC elements as required. Typical displays include the air defense situation map and the air defense status board. These display ADA unit locations; type, designation, and states of alert; ammuni-

tion levels; and the prevailing conditions of readiness, states of air defense warning, weapon control status, and weapon control case.

(b) Makes a continuous estimate of the air defense situation.

(c) Coordinates ADA operations with combat and other combat support operations.

(d) Coordinates ADA operations with higher, lower, and adjacent commands.

(e) Disseminates FAAR location and data link frequency information to the division's Redeye users (brigades, cavalry squadrons, division artillery).

(4) *Coordinates Army air traffic.* The ACE determines prohibited or restricted air defense areas possibly imposed on air traffic by the commander or higher headquarters.

(5) *Provides intelligence obtained through air defense channels.* The ACE received intelligence information through its link with the AADCP and Air Force command and control facilities. (Detailed information on the functions of the ACE is found in FM 44-1 and FM 101-5.)

10-5. Air Defense Plan, SOP, and Rules and Procedures

Formal documentation of the air defense plans, policies, directives, responsibilities, and procedures takes place at each appropriate echelon in the form of the three key documents discussed in the following paragraphs.

a. Air Defense Plan. The air defense plan indicates to all users the method or scheme for air defense support of the force. As such, it is the force air defense commander's proposal to carry out the air defense portion of the force commander's concept of the operation. When approved and ordered to be implemented, it is the air defense annex of the *operation order*. The

division air defense plan is prepared by the division air defense officer (normally a Chaparral/Vulcan battalion commander) and the maneuver battalion/field artillery battalion/squadron air defense plan is prepared by the battalion's air defense officer (normally the air defense section (Redeye) leader). The G3/S3 at each echelon exercises general staff supervision and, in headquarters not employing an air defense officer, actually prepares the plan. The plan is thoroughly coordinated, checked for compliance with higher echelon plans, and published as an annex to the force plan. The standard FM 101-5 format is used providing coverage of references cited, time zone, task organization, situation, mission, execution, service support, and command and signal.

b. Air Defense SOP. The air defense SOP's at each force echelon and within the air defense section reduce the number, frequency, and length of other plans/orders by establishing regular procedures to be followed in the absence of specific instructions. Preparation responsibilities are the same as for the air defense plan (a above). The SOP is prepared in standard FM 101-5 format, using the standard headings of general, intelligence, operations, service support, and command and signal. Appendix C to this manual provides a sample infantry battalion air defense SOP annex considered suitable for field adaptation.

c. Air Defense Rules and Procedures. The overall air defense rules and procedures normally are published by the regional (higher than division level) air defense commander(s), following coordination with the field army commander(s) concerned. Relevant portions are extracted by each force commander concerned for inclusion in the air defense plans/orders and SOP.

Section III. CONTROL MEASURES

10-6. General

The basic measures used to control ADA elements, including Redeye, are control of unit allocations, mission assignment, maneuver, and fires. Control is exercised through dissemination of detailed unit SOP based on theater air defense policies and procedures and by employment of liaison and organic communications.

10-7. Fire Control

a. General. Air defense fires are controlled to—

(1) Insure efficient engagement of hostile aircraft.

(2) Prevent engagement of friendly aircraft.

(3) Prevent air defense and aviation mission interference.

(4) Prevent incidents prior to an outbreak of hostilities.

b. Basic Concept. The Army concept for control of fires (engagement control) of Army air defense artillery units is based on the principle of centralized direction and decentralized execution and this is equally true for Redeye units. The concept emphasizes use of techniques rather than hardware. The degree of dependence on SOP varies with weapon mission and type, being the greatest for Redeye and non-air-defense weapons in the air defense role.

c. Fire Control SOP. The fire control concept depends on both SOP and communications. Communications are covered in chapter 11. The fire control SOP items are covered separately.

d. Conditions of Readiness. Conditions of readiness are the means used by the higher air defense echelons to maintain the air defenses at a state of preparedness compatible with the real or apparent imminence of attack. The terms, *defense readiness condition* (DEFCON) and *defense readiness posture* (DEFREP), are frequently used in relation to conditions of readiness. In response to each condition of readiness, the appropriate Army air defense commander prescribes a required *state of alert* for each subordinate ADA unit. The divisional air defense units normally maintain a degree of preparedness, in peace or war, equal to that of the division or as specified by the division. Defense readiness conditions may be announced by divisional unit commanders to their air defense units.

e. States of Alert. States of alert are prescribed by Army air defense unit commanders and specify the required readiness of each subordinate unit. They are the air defense unit commander's response to the defense readiness conditions prescribed by the controlling headquarters. A typical state of alert might be "Battle Stations." This means that some of the Redeye teams ordered to battle stations would be fully manned, in tactical position, searching prescribed sectors, communicating, and would have all missile containers opened with BCU inserted in two weapons.

f. Air Defense Warnings. Air defense warnings are normally issued after the air defense units have reached their highest condition of readi-

ness. The air defense warnings represent the air defense commander's evaluation of the probability of air attack. Typical air defense warnings are: RED—attack imminent or in progress; YELLOW—attack probable; and WHITE—attack not probable. The RED, YELLOW, and WHITE air defense warnings originate in air defense channels and are normally disseminated via the channels shown in figure 10-2.

g. Rules of Engagement.

(1) The air defense rules of engagement are the means by which the commander of the unified command governs the fire of air defense weapons. The rules should be formulated, disseminated, and exercised prior to the beginning of hostilities and must provide for a logical transition from peacetime to wartime conditions. Following are rules of engagement considered typical for air defense operations during conditions short of war and during wartime.

(a) During conditions short of war, engagements are conducted only in self-defense or as ordered by designated commanders. The right of individual and collective self-defense is not denied.

(b) During wartime, engagements are conducted in accordance with the prevailing weapon control status (*h* below) and hostile criteria (*i* below). The right of individual and collective self-defense is not denied.

(2) The rules of engagement and routine changes thereto are published and disseminated through command channels.

h. Weapon Control Status.

(1) Each weapon control status indicates the degree of fire control imposed upon the Army units including Redeye air defense sections in the combat zone. A "normal" wartime status for each ADA weapon type should be specified in the air defense rules and procedures. Authority to change or modify weapon control status, if any, should also be specified. The weapon control status terms defined and discussed below may be combined to give, for example, more freedom to fire at fixed-wing aircraft and less freedom to fire at helicopters.

(a) *Weapons free.* "Fire at any aircraft not identified as friendly." Under this status aircraft of unknown or doubtful identification may be engaged. This status permits greatest air defense effectiveness, but its frequent implementation demands close coordination between air defense and aviation units.

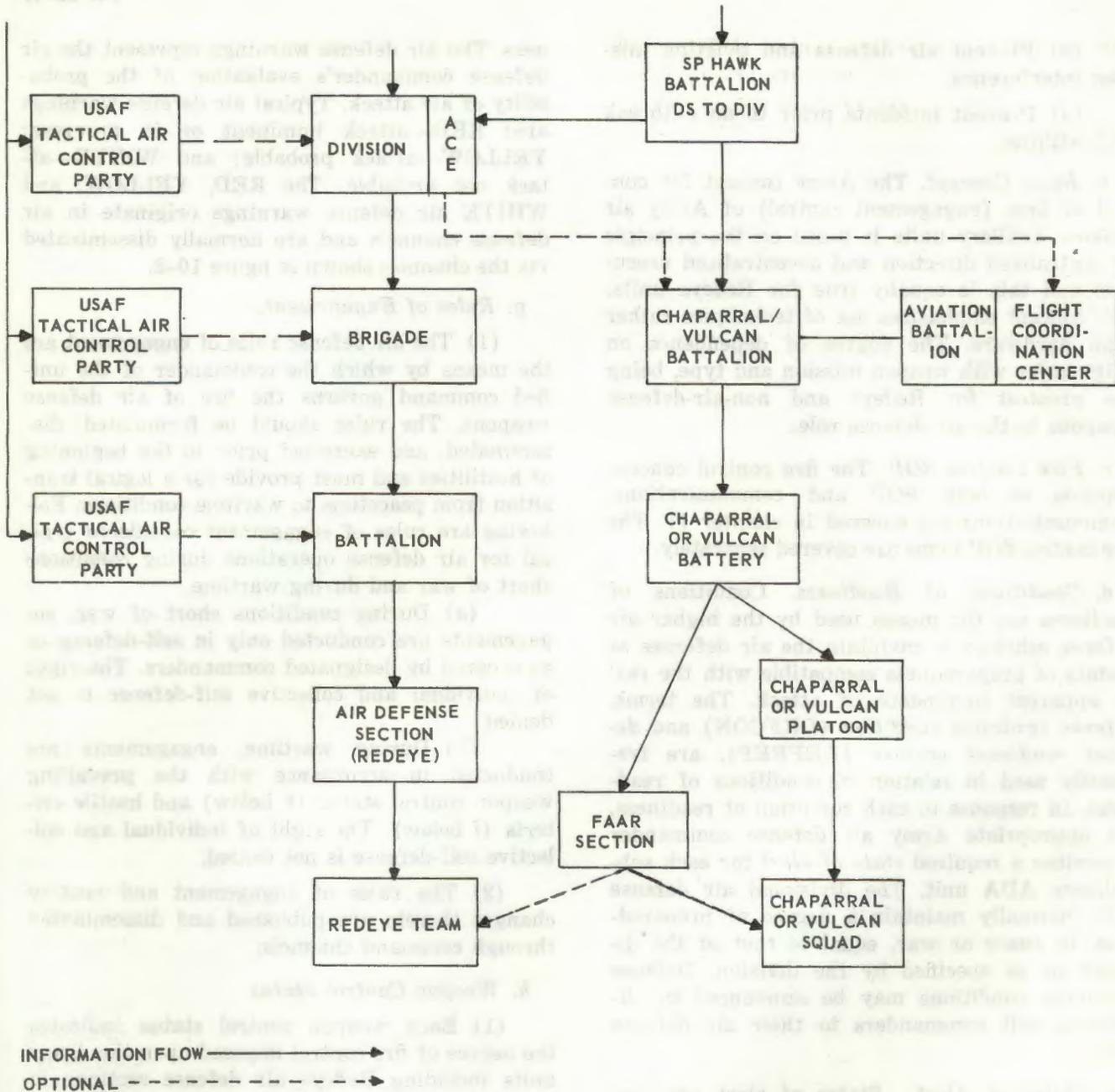


Figure 10-2. Information flow; air defense warnings (RED, YELLOW, WHITE) and emergency changes to rules of engagement, weapon control status, and hostile criteria.

(b) *Weapons tight.* "Fire only at aircraft positively identified as hostile in accordance with the hostile criteria." This should be the normal wartime status imposed on Redeye teams. Examples of hostile criteria are presented in *i* below. This status requires Redeye team proficiency in visual aircraft recognition (chap 4).

(c) *Weapons hold.* "Do not fire." (The right of self-defense is not denied in peace or

war.) The weapons hold status is normally time, area, and unit limited; and may be further limited as to class of aircraft protected.

(2) Weapon control status definitions, normal applications, and changes are published and disseminated through command channels. Emergency changes to weapon control status (fig 10-2) can follow a variety of parallel paths as for the rules of engagement. A typical change originated by

the control and reporting center (CRC) might be "Weapons free authorized against all jets in division airspace." A typical change originated at division might be "Redeye weapons hold, area AH, 1400-1500, helicopters."

i. Hostile Criteria. The theater rules of engagement will refer to or include criteria by which an aircraft may be designated hostile. Hostile criteria must be quickly and accurately understandable by forward area ADA fire unit crewmen, Redeye gunners, and aircraft pilots. For example, SOP may provide fire units the authority to classify as hostile any aircraft which is meeting one, or a combination, of the following criteria:

- (1) Attacking friendly elements.
- (2) Responding improperly to electronic identification, friend or foe (IFF), interrogation. (Since current division air defense fire units are not IFF-equipped, the criteria is not of direct use to them. However, the FAAR's are IFF-equipped.)
- (3) Discharging smoke or spray over friendly elements without prior coordination.
- (4) Dropping flares at night over friendly territory without prior coordination.
- (5) Discharging parachutists without prior coordination.
- (6) Engaging in mine-laying operations without prior coordination.
- (7) Operating at prohibited speeds, altitudes, or directions. (Current division air defense fire units cannot reliably recognize violation of these criteria.)
- (8) Improperly entering an area designated as restricted, prohibited, or as an ADA "battle zone."
- (9) Improperly departing from a zone, route, or corridor designated as "safe."
- (10) Employing electronic countermeasure devices; e.g., dropping chaff and reflectors over friendly territory without prior coordination.
- (11) Maneuvering in a manner clearly indicating imminent attack.
- (12) Bearing the military insignia or having the configuration of an aircraft employed by a known enemy nation.

j. Methods of Control. The rules of engagement specify the level at which the fires of air defense weapons are supervised in a particular defense.

The unit SOP may specify or imply use of either the decentralized or centralized method of engagement control. Other conditions (e.g., loss of communications) may force autonomous operation. Redeye, to be effective, *must* operate under the decentralized method of engagement control.

(1) Under the decentralized method of control, engagement decisions are made at team level based on rules of engagement, SOP, and temporary engagement restrictions imposed by higher headquarters.

(2) Under the centralized method of control, Redeye teams conduct engagements only upon receipt of specific orders or permission from a designated higher air defense echelon.

k. Fire Coordination. Fire coordination is the planning and executing of fire so that targets are adequately covered by a suitable weapon or group of weapons. Fire coordination rules are developed to conserve ammunition and to prevent unopposed hostile penetrations. A certain amount of fire coordination is inherent in a well-designed defense. Coordination of division air defense weapon fires is accomplished primarily by SOP. Fire coordination between Redeye teams is accomplished through use of proper target selection procedures and designation of sectors of responsibility. The rules for target selection provide the gunner with instructions as to which target to select from a group of attackers. These rules would be prepared by each division if not included in the area air defense SOP. They should be changed infrequently. Some of the more common rules for target selection are—

(1) Engage the greatest threat first. This rule may require simplification; e.g., when faced with multiple targets, the gunner should select the lead or right aircraft while the team chief should select the trailing or left aircraft.

(2) Engage at maximum range.

(3) Continue to engage until the attacker breaks off his attack, is destroyed, or is out of range. (If Redeye teams can force an attacker into the areas of the integrated air defense coverage, they have accomplished their mission.)

(4) Fire will be withheld if friendly and hostile aircraft are closely intermixed.

(5) A Shoot (one missile)—Look—Shoot method of fire is employed against low/medium-performance targets (below 100 meters per second). This method involves a hasty kill assessment at the time of smoke clearance. If, after smoke

clearance from the previous launch, the target has not been destroyed, another missile will be launched immediately (provided the target is still within range).

(6) Against high-performance targets (targets speeds above 100 meters per second) a Shoot—Shoot method of fire is employed. Both Redeye team members fire at the maximum rate of fire with no kill assessment being made until the target has been destroyed or has escaped.

l. Friendly Aircraft Protection. Information on friendly air traffic is provided each Redeye team to protect friendly aircraft (para 10-4b). The three weapon control statuses discussed in *h* above generally indicate the degree of importance attached to friendly aircraft protection in each situation, with the degree of importance following the progression: “weapons free”—least importance, “weapons tight”—important, and “weapons hold”—overriding importance. Within this context, the weapons tight situation imposes the most stringent demands on the Redeye teams because they must positively identify an aircraft as hostile before engagement and conversely are permitted no mistaken engagements of friendly aircraft. Careful use of the SOP items discussed above provides only a part of the solution to the friendly aircraft protection problem. Timely transfer of information from the ACE at DTOC via the communications system described in chapter 11 provides another contribution to problem solution. However, in the final analysis, all of these are of lesser importance if the Redeye teams cannot recognize hostile and friendly aircraft using their own resources.

m. Warnings. Air defense warnings—RED, YELLOW, and WHITE—are covered in *f* above. This paragraph pertains to three more specific types of warnings.

(1) *Alert warning.* This is the nearly real-time warning of ongoing air activity provided by the FAAR's within the division and within units linked by electronic control and coordination systems external to the division. Paths are shown in figure 10-2. It is readily apparent that the line-of-sight communications required between the 8 FAAR's and the approximately 105 air defense fire units in an average division area will not always be available. Failure of fire units to receive FAAR data will be frequent in fast-moving situations.

(2) *Early warning/raid notification.* This is the long-range advance notice of incoming hostile aircraft. Paths are shown in figure 10-2.

When originated by USAF and long-range ADA, the data are termed “early warning.” When originated by forward units employing short-range radars or visual observation, the data are termed “raid notification.” Figure 10-2 shows that transmission rearward of raid notification originated by Redeye teams, FAAR's, and Chaparral or Vulcan squads involves several retransmissions.

(3) *Nuclear, CBR, or ground attack warning.* Warnings of these activities are exchanged by all units via the same channels as (2) above.

10-8. Redeye Concept

a. Level of Control. The level of control for Redeye is normally battalion/squadron (air defense headquarters) in compliance with theater and division rules pertaining to Redeye. Emergency control orders, as specified in SOP, may be received from the DTOC or the Chaparral/Vulcan battalion.

b. Concept. The basic concept for control of Redeye fires is by SOP, plus orders/information received over simple communications system.

c. SOP.

(1) *Elements.* Rules of engagement, hostile criteria, weapon control status.

(a) *Rules of engagement.* During peacetime, Redeye operations are rigidly restricted. During wartime, Redeye operates in accordance with prevailing weapon control status and hostile criteria.

(b) *Hostile criteria.* Hostile criteria is based on visual recognition of hostile acts or hostile character.

(c) *Weapon control status.* The weapon control status for Redeye is normally “weapons tight” in wartime. This requires positive identification by the Redeye team chief in accordance with hostile criteria.

(2) *Level of firing decision.* The firing decision is made by the Redeye team chief in accordance with SOP and control/orders information.

(3) *TADDS input.* Alerting and tentative identification input for Redeye teams is from specified FAAR.

(4) *Fire control communications.* Fire control information is received over the Redeye section command net and “shared” use of division and Chaparral/Vulcan nets. This minimum specialized communications does not permit centralized engagement control.

CHAPTER 11

COMMUNICATIONS

11-1. Introduction

Radio and wire communications are used by the air defense section to facilitate command and control. Because Redeye teams are widely dispersed and because of frequent and rapid moves, radio is the primary means of communication. Radio nets are supplemented and paralleled by wire nets as feasible. Wire should be used as a backup means of communications because of its greater degree of dependability and security; however, this means generally is used only in defensive operations. Other means of communication include voice commands and arm and hand signals. Due to the importance of communications to effective employment of the Redeye weapon, each member of the air defense section must understand communications operations and maintenance.

11-2. Radiotelephone Procedure

a. All section personnel must be thoroughly familiar with proper radiotelephone procedure and comply with instructions contained in unit communications-electronics operation instructions (CEOI) (formerly SOI) and communications-electronics standing instructions (CESI) (formerly SSI).

b. Unnecessary and improper transmission must be avoided to prevent the enemy from obtaining information. Effective transmission security requires constant supervision by commanders and a high state of training on the part of user personnel. Communications security is discussed further in chapter 14 as a survivability measure.

11-3. Radio

a. Capabilities.

(1) Radio sets are readily portable, can be placed in operation quickly, and can be operated from moving vehicles.

(2) No physical circuits are required between stations.

(3) Radio is a readily available means of long-range communications.

b. Limitations.

(1) Radio equipment is complex and fragile. It requires skilled operators and effective maintenance.

(2) Operating and maintenance personnel require specialized individual training.

(3) Radio messages are easily intercepted by the enemy.

(4) Radio is subject to jamming and affords the enemy information on the location of transmitters, command posts, and other installations.

(5) Radios available (FM) have limited range and require line of sight to operate.

c. Communications to Air Defense Section Headquarters or Higher Headquarters.

(1) *Warning (ground and air).* The Redeye team must have communications facilities with which to transmit early warning information to air defense section headquarters or higher headquarters.

(2) *Missile resupply requests.* Requests by Redeye teams for more weapons are forwarded through the organizational communications facilities.

(3) *Assistance requests.* Forwarded as required.

(4) *Status reports.* As directed by SOP.

d. Communications from Air Defense Section Headquarters or High Headquarters.

(1) Early warning.

(2) Changes in weapon control status. The Redeye team must receive timely and accurate information as to the current status.

(3) Movement orders.

(4) Command information.

(5) Special flight information.

(6) Clearance for special operations (e.g., spraying smoke).

11-4. Radio Nets

a. Radio stations are organized in nets defined as two or more radio stations operating together on a common frequency. The net control station (NCS) is responsible for the overall operation of the radio net.

b. The air defense section headquarters will be the NCS for the air defense section command net, using the organic radio set.

c. The Redeye team chief will operate in the air defense section command net when providing general or direct support, in the designated company/battery/troop command net when attached, or as directed.

d. The duties of the NCS include opening and closing the net, maintaining circuit discipline, controlling the flow of traffic, and watching for and correcting security and procedure violations.

11-5. External Radio Nets

Each Redeye air defense section is equipped to operate in the command net of any divisional

unit it may be required to support. The air defense section leader will monitor the battalion command net, using the organic radio set. Redeye teams may be attached to companies/batteries/troops or placed under their operational control. In such cases, the team enters the company/battery/troop command net, breaking its FM radio link to the section leader. Any section leader influence on Redeye team operations is then via the battalion/squadron command net. SOP would normally limit this to coordination and transfer of emergency fire control information. A typical attachment net for Redeye teams is shown in figure 11-1.

Note. This arrangement is only for use when section level control is impractical. An especially high state of communications discipline is required since all Redeye traffic is carried over the unit command nets.

11-6. Internal Radio Nets

a. *Air Defense Section Command Net.* The air defense section (Redeye) headquarters operates in the air defense section command net, a two-way net between the air defense section head-

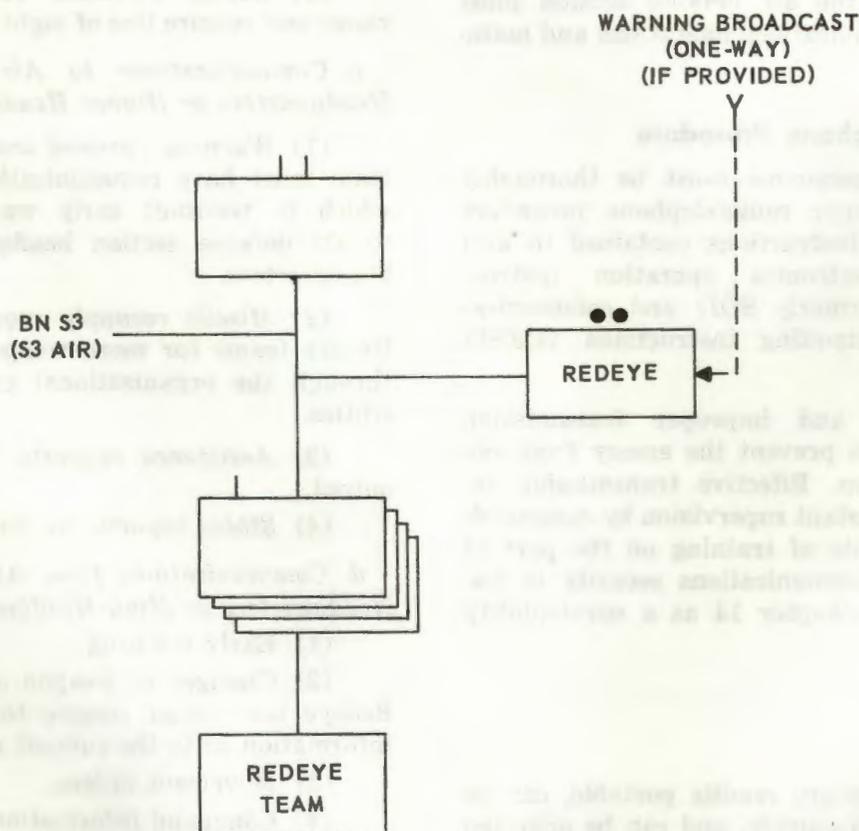
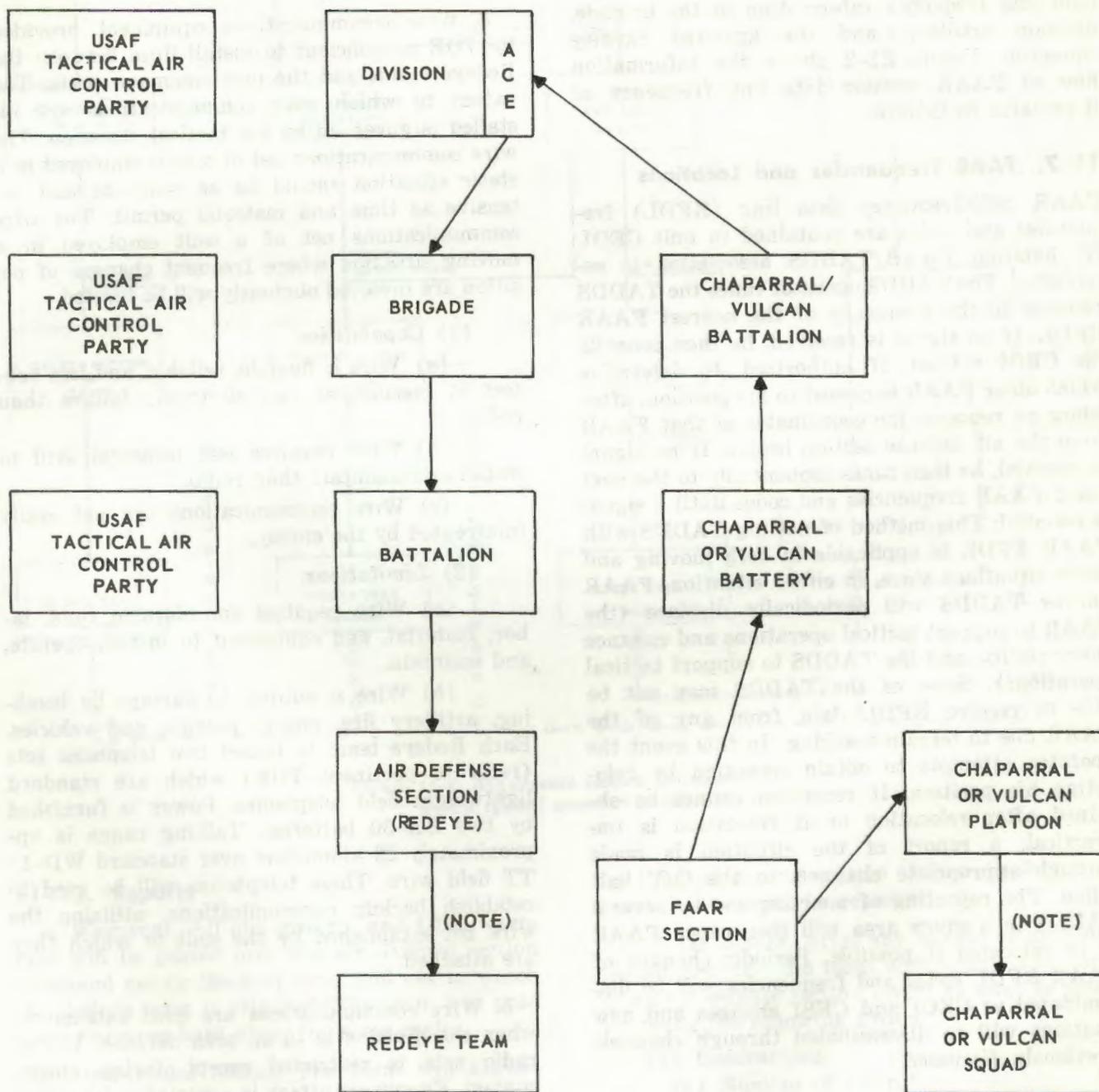


Figure 11-1. Typical attachment net for Redeye teams.

quarters and the Redeye teams. The air defense section headquarters will be the NCS for this net, using the organic two-way FM radio set. Each air defense team will operate in the section command net, using the two-way FM radio set authorized by its equipment tables. Based on information/instructions received from the elements with which collocated, the air defense section

leader transmits warning, control, and movement data to his teams. Transmission is by the section command net or existing unit nets, depending on the method used.

b. *Target Alert Data Display Set (TADDS)*. This is a one-way digital data link from the C/V battalion/battery FAAR teams to the Chaparral,



NOTE: FAAR/FIRE UNIT "PAIRING"

Figure 11-2. Information flow, FAAR location/ data link frequency.

Vulcan, and Redeye sections previously discussed in chapter 8. Dissemination of FAAR locations and frequencies are made by DTOC through channels to the Redeye section leaders so they can establish the required FAAR fire unit (ADA) "pairing." "Pairing" refers to the assignment of a team to monitor a specified FAAR. The ACE originates or relays Redeye weapon control and warning information and FAAR location and data link frequency information to the brigade, division artillery, and the armored cavalry squadron. Figure 11-2 shows the information flow of FAAR location/data link frequency as it pertains to Redeye.

11-7. FAAR Frequencies and Locations

FAAR radiofrequency data link (RFDL) frequencies and codes are contained in unit CEOI. No habitual FAAR/TADDS association is established. The TADDS operator tunes the TADDS receiver to the frequency of the nearest FAAR RFDL. If no signal is received, he then consults the CEOI extract, if authorized, to determine which other FAAR is closest to his position, after which he requests the coordinates of that FAAR from the air defense section leader. If no signal is received, he then tunes sequentially to the next listed FAAR frequencies and codes until a signal is received. This method of netting TADDS with FAAR RFDL is applicable in both moving and static situations since, in either situation, FAAR and/or TADDS will periodically displace (the FAAR to support tactical operations and enhance survivability, and the TADDS to support tactical operations). Some of the TADDS may not be able to receive RFDL data from any of the FAAR due to terrain masking. In this event the operator attempts to obtain reception by relocating his position. If reception cannot be obtained after relocation or if relocation is impractical, a report of the situation is made through appropriate channels to the C/V battalion. The reporting of nonreception by several TADDS in a given area will then cause FAAR to be relocated if possible. Periodic changes of FAAR RFDL codes and frequencies will be disseminated as CEOI and CESI changes and new locations will be disseminated through channels previously discussed.

11-8. Type Armored Division Redeye Nets

Figure 11-3 shows air defense command nets of a portion of a type armored division represented by a tank battalion, field artillery battalion, and

an armored cavalry squadron which are organic to the division. Only one Redeye team of the air defense section is depicted in each Redeye section command net; however, the radio nets affecting the air defense section and Redeye team are shown.

11-9. Wire

a. Wire communications equipment provided by TOE is sufficient to install lines between the Redeye teams and the unit command posts. The extent to which wire communications are installed is governed by the tactical situation. The wire communications net of a unit employed in a static situation should be as complete and extensive as time and materiel permit. The wire communications net of a unit employed in a moving situation where frequent changes of position are involved obviously will be limited.

(1) Capabilities.

(a) Wire is flexible, reliable, and less subject to mechanical and electronic failure than radio.

(b) Wire requires less technical skill to install and maintain than radio.

(c) Wire communications are not easily intercepted by the enemy.

(2) Limitations.

(a) Wire requires considerable time, labor, material, and equipment to install, operate, and maintain.

(b) Wire is subject to damage by bombing, artillery fire, enemy patrols, and vehicles. Each Redeye team is issued two telephone sets (refer to pertinent TOE) which are standard lightweight field telephones. Power is furnished by two BA-30 batteries. Talking range is approximately 23 kilometers over standard WD-1/TT field wire. These telephones will be used to establish backup communications, utilizing the wire net established by the unit to which they are attached.

b. Wire communications are used extensively when the division is in an area defense. Use of radio nets is restricted except during enemy contact. Enemy air attack is assumed to be enemy contact and air defense radio nets could be used at that time. Before contact, air defense units, including Redeye, must rely on wire or messenger communications, the air defense SOP, and a "listening watch" on all radio nets.

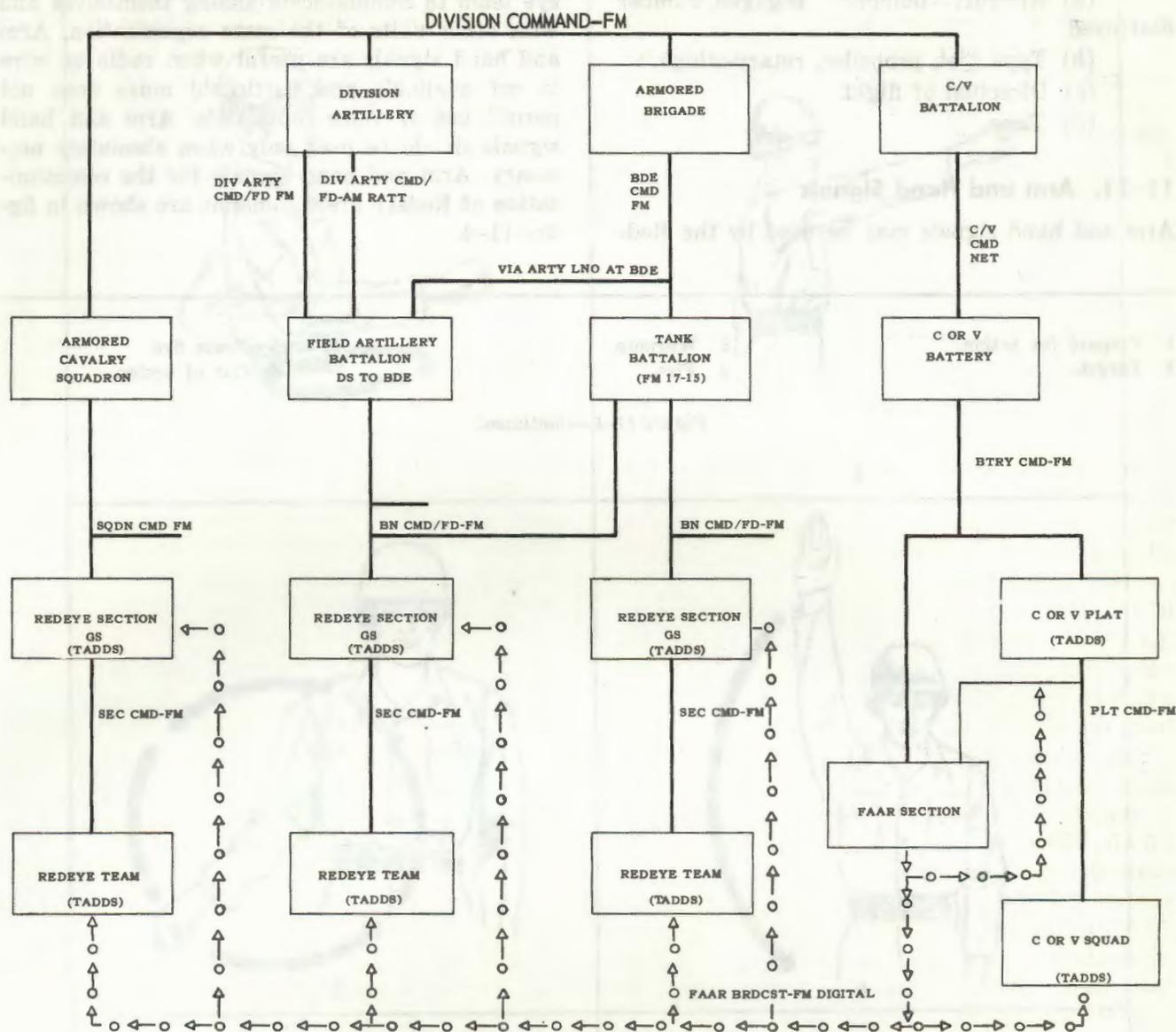


Figure 11-3. Air defense section command nets within typical armored division.

11-10. Reports

a. *Warnings.* All air, ground, and CBR warnings will be passed over the air defense section command net or the unit command net to which the Redeye team is attached. The team will pass their warnings back along the same chain.

b. *Operational Status.* The team will always report its operational status, state of readiness, and times of assuming weapon control status.

c. *Position.* The team will report its location by coordinates to the air defense section leader upon establishing each new position. In addition,

the time of closing station before displacing to a new position will be reported.

d. *After Action.* After any hostile or unidentified air activity, the team will report such facts to the air defense section leader as soon as possible, using the following format:

- (1) *Unidentified.*
 - (a) Number of aircraft.
 - (b) Direction of flight.
 - (c) Type (jet, propeller, rotary-wing).
 - (d) Time.
- (2) *Engagement (hostile).*

- (a) Aircraft—number engaged/number destroyed.
- (b) Type (jet, propeller, rotary-wing).
- (c) Direction of flight.
- (d) Time.

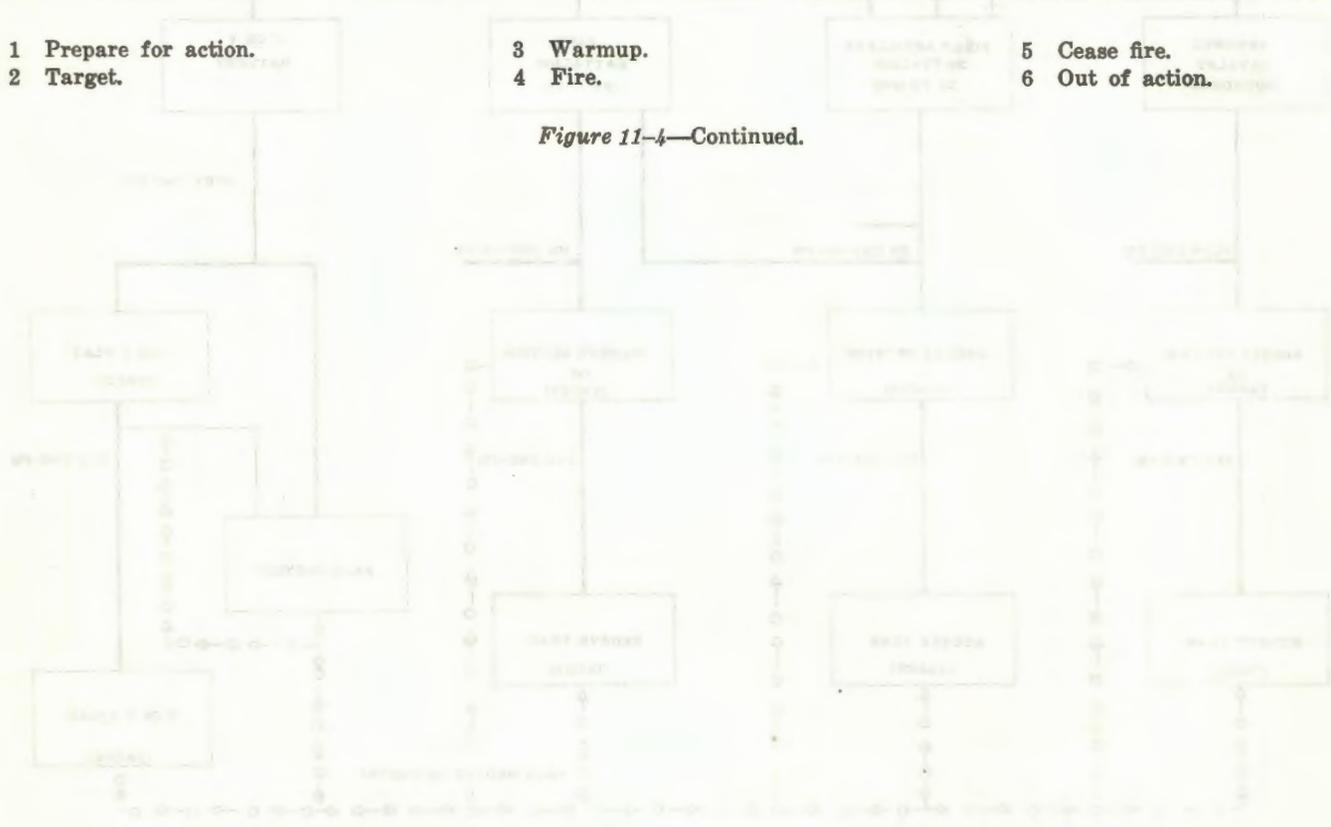
eye team to communicate among themselves and with other units of the same organization. Arm and hand signals are useful when radio or wire is not available and battlefield noise does not permit use of voice commands. Arm and hand signals should be used only when absolutely necessary. Arm and hand signals for the communication of Redeye fire commands are shown in figure 11-4.

11-11. Arm and Hand Signals

Arm and hand signals may be used by the Red-

- 1 Prepare for action.
- 2 Target.
- 3 Warmup.
- 4 Fire.
- 5 Cease fire.
- 6 Out of action.

Figure 11-4—Continued.



the time of closing station before dispatch to a new position will be reported.

4. After Action. After any battle or unit has had air activity, the team will report such facts to the air defense section leader as soon as possible using the following format:

- (1) Engagement location.
- (a) Number of aircraft.
- (b) Direction of flight.
- (c) Type (jet, propeller, rotary-wing).
- (d) Time.
- (2) Engagement location.

11-10. Reports

a. Warmup. All air ground and CTR war-logs will be passed over the air defense section command net or the goal command net in which the Redeye team is attached. The team will pass their warlogs back along the same chain.

b. Operational Status. The team will always report the operational status, state of readiness, and time of assuming weapon control status.

c. Position. The team will report the location or coordinates to the air defense section leader upon establishing each new position. In addition,

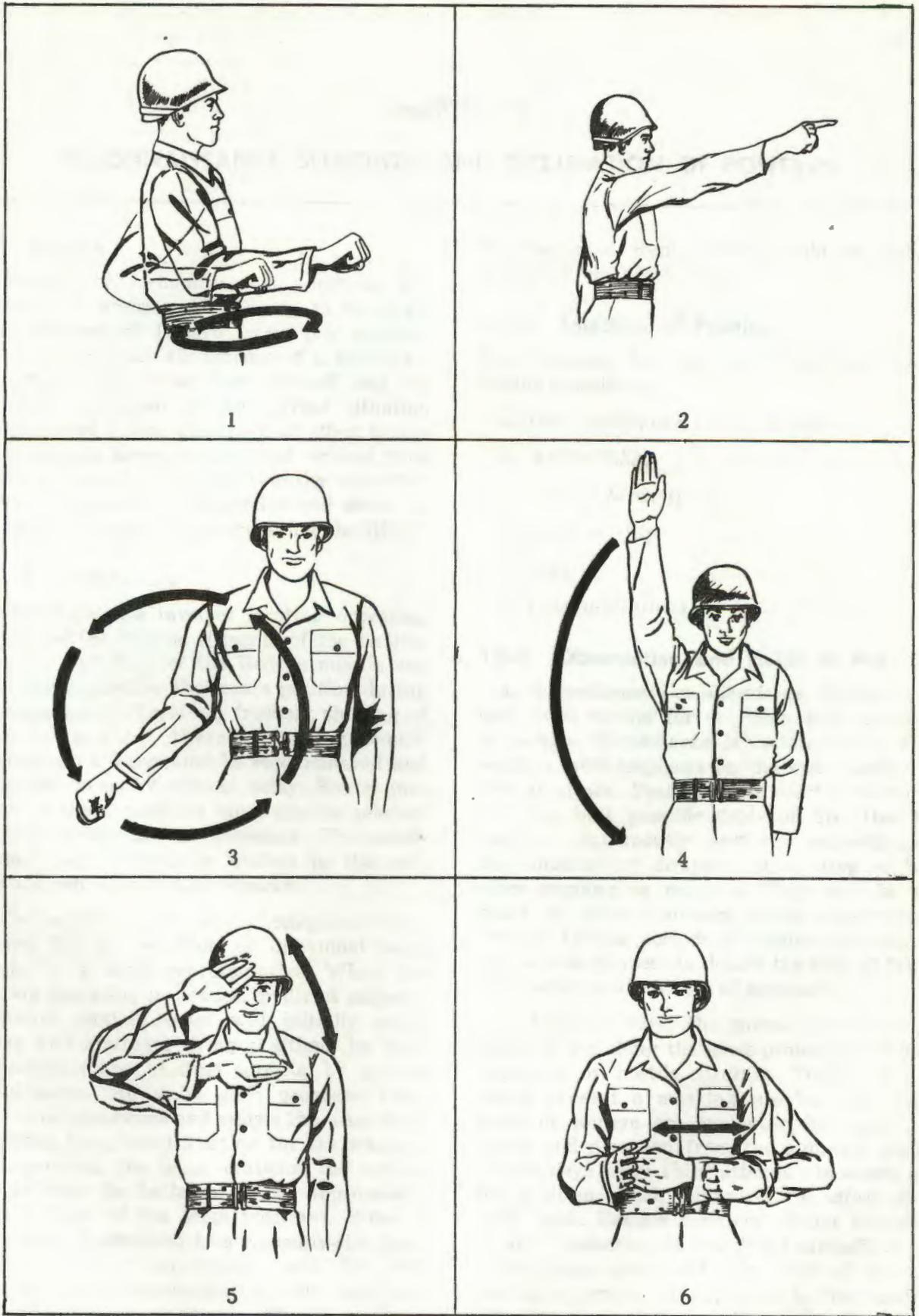


Figure 11-4. Arm and hand signals used with Rodeye teams.

CHAPTER 12

RECONNAISSANCE, SELECTION, AND OCCUPATION OF POSITION

12-1. Purpose

The purpose of reconnaissance, selection, and occupation of position (RSOP) is to facilitate rapid movement of Redeye teams into position when establishing an air defense of a new area. The section leader must keep himself and his team chiefs informed of the current situation and anticipated future operations to effect timely RSOP. Position areas, routes, and critical time elements are usually received from the supported battalion or company commander and serve as the basis for planning and conducting the RSOP.

12-2. Reconnaissance

a. Reconnaissance involves locating operating positions for the various elements of the section. The smoke signature of the Redeye missile can be expected to disclose the team's position during each engagement; therefore, frequent shifting of position is required. Alternate and supplementary positions always must be reconnoitered and selected for occupancy without delay. Routes into and out of these positions must also be selected and prepared for use as necessary. The reconnaissance party should be limited to the personnel and vehicles actually required.

b. The section leader usually delegates reconnaissance for the selection of individual team positions to a team representative. When the teams are operating in general or direct support, the Redeye section leader will initially select primary and alternate firing positions by map reconnaissance and, if time permits, by ground reconnaissance. He visits each proposed team position and supervises and assists the team chief in selecting the ground location for the weapon. After approving the team locations, the section leader informs the battalion S3, as appropriate, of the location of the team positions. When a Redeye team is attached to a company-size unit, the team chief, in conjunction with the unit commander or his representative, will select primary and alternate positions. After a position has been selected, an alternate position should

be designated. Range cards should be made for both positions (fig 4-19).

12-3. Selection of Position

The following features are considered when selecting a position:

- a. *Observation and Fields of Fire.*
- b. *Accessibility.*
- c. *Ground Security.*
- d. *Survivability.*
- e. *Safety.*
- f. *Communications.*

12-4. Observation and Fields of Fire

a. *Surveillance Considerations.* Redeye teams use visual means for detection and recognition of targets. Surveillance is maintained in all directions with emphasis on the most likely direction of attack. Positions are selected which provide the best possible fields of fire. One team member continuously performs surveillance of the surrounding airspace, alternating with the other member as required. They may be separated by short distances where observation is limited. During periods of intense activity, both may act as gunners to double the rate of fire and cover additional avenues of approach.

b. *Fields of Fire.* The gunner must have good fields of fire along the most probable avenues of approach of hostile aircraft. Terrain features which present a masking problem for employment of Redeye are evaluated for height, distance, and direction from the gunner's position. The Redeye team chief attempts to select a firing position which minimizes the effect of terrain mask. Redeye positions should be selected to allow detection of low-flying aircraft at least 5 kilometers away and clear fields of fire along probable avenues of approach to the maximum effective range of the missile system. Terrain and vegetation obstacles should not limit detection

and engagement ranges; e.g., a gunner located on the edge of a forest may have a good detection capability forward but little or none to engage targets over the forest. The Redeye team may deploy in flat terrain with little cover, or in rugged terrain where the team is forced to use less favorable sites to cover the air approach corridor.

c. Location in Regard to Sun. Firing positions should be selected so as to minimize direct or reflective effects of the sun.

12-5. Accessibility

The position should be accessible for the team vehicle where possible. Team personnel should have ready access to the basic load of Redeye weapons, radio, and other equipment carried on the team vehicle. Ideally, firing positions should be accessible by vehicle to maintain mobility and facilitate resupply.

12-6. Ground Security

a. Firing positions should not be selected beyond the protection of friendly troops unless provision is made to provide ground security for the team.

b. When the Redeye teams are used in general or direct support, the section leader is responsible for coordinating ground defense of all teams.

c. The unit commander whose unit the Redeye team is defending must assist in providing local security for the Redeye team. At night, the team should withdraw within the company/battery/troop area. The team chief is responsible for contacting the unit to insure that security is provided for his team. The SOP of the defended unit should include those actions necessary to accomplish the required security of the Redeye teams.

12-7. Cover, Concealment, and Camouflage

While mission accomplishment is the prime consideration in site selection, cover, concealment, and camouflage should also be considered when a choice of sites is available. Survivability considerations include screening the team from observation by enemy ground and aerial forces and

protection of personnel and equipment from artillery, mortar, and aerial attack. Cover, concealment, camouflage, and other survivability measures are discussed in chapter 13.

12-8. Safety

Missile backblast requires that, if practical, the Redeye weapon be fired from an open position and that gunner positions be separated by a safe distance. Gunner positions should be clear of excess dry brush, tall grass, and other materials which may ignite when the weapon is fired. If possible, a circular zone, 13 meters in radius around the firing position, should be kept clear to permit the team to fire in any direction (para 3-4).

12-9. Communications

The section leader exercises command and control of the Redeye team by FM radio. If radio contact with section headquarters cannot be established, the site normally should be considered unsatisfactory. Large terrain masks may greatly influence the ability to establish and maintain radio communications. Wherever possible, direct line of sight for section communications must be obtained.

12-10. Occupation

During the reconnaissance and selection of position, the section leader must formulate a plan for occupying the positions selected. This plan must be coordinated with the plan for the occupation of parent unit positions. The air defense section leader must consider the time that the section headquarters and teams are required to be operational in the new positions, routes and travel time from the old positions, communications, and security during the move and occupation. Once the plan is formulated, the section leader issues the orders necessary for its execution. The displacement and occupation should be accomplished as rapidly as possible to minimize the time that the teams are out of action or in a reduced state of action. When all teams have occupied their positions and are in a ready-for-action status, the section leader will so report his section.

CHAPTER 13

SURVIVABILITY (STANAG 2047)

13-1. General

All reasonable measures which do not degrade system effectiveness or interfere with the accomplishment of the assigned mission should be employed by Redeye teams to enhance survivability. These survivability measures fall into two general groupings, local security and supplementary measures.

a. Local security measures (active and passive) are taken by Redeye teams, in conjunction with supported or defended units, to enhance the survivability of the Redeye teams. These measures utilize organic resources and, wherever possible, should be integrated with security plans of adjacent teams. An example of this is the improvement of positions and camouflage.

b. Supplementary measures are those which require support of, or coordination with, higher echelons and integration into the overall concept of ground operations. An example of this is movement to avoid targeting.

13-2. Relationship of Mission to Survivability

When the defended unit is subjected to ground attack, Redeye teams may be required to suspend the air defense mission temporarily to defend against the ground attack. Redeye team members can defend themselves only with their individual weapons.

13-3. Local Security of Redeye Positions

An SOP for local security is necessary for every Redeye team. It must be part of the unit plan and be thoroughly understood by both team members. It will include the following:

a. Establishment of air observation and listening posts.

b. An alert plan for preparing the Redeye weapon for action.

c. A plan for establishing and executing immediate local security upon occupation of position.

d. Alert signals.

e. A plan for primary and individual weapon resupply.

f. A plan for defense against CBR attack.

13-4. Active Self-Defense Measures

All available non-air-defense weapons are sited so as to achieve maximum effectiveness against air attack. An effective active defense requires the consideration of unit mission, terrain, resources, enemy threat, and time available. The Redeye teams should be positioned near, and the defense forces integrated with, the local defenses of other units. The sole Redeye mission is active air defense. Non-air-defense weapons will be used for active air defense against attacking aircraft on order of platoon and higher commanders. Concentrated automatic weapons fire will be exploited. The use of non-air-defense weapons against air attack is covered in paragraph 13-7.

13-5. Passive Self-Defense Measures

a. General. Passive defense (local security) includes all defensive measures other than the employment of weapons taken by the Redeye team to protect itself against direct enemy action. The passive defense plan is made by the parent unit before moving into a position and is implemented and improved upon while the unit remains in the position. The passive defense plan may be in the form of a unit SOP for local security. It may be part of the company, battery, or troop passive defense plan. Passive security measures include cover, concealment, dispersion, field fortifications, camouflage, and communications security. Other important passive defense measures are noise prevention, light discipline, and adequate training in security measures.

b. Cover. Cover is natural or artificial protection from the fire of enemy weapons. Natural cover (ravines, hollows, reverse slopes) and

artificial cover (foxholes, trenches, walls) provide protection from low-angle fires and effects of nuclear explosions. Requirements for concealment usually conflict with the requirements for field fortifications necessary for protection of personnel and materiel against enemy fire. The problem of digging shelters without violating camouflage discipline is extremely difficult. As time permits, the Redeye team organizes its position by digging in. This operation should follow a prepared plan which insures that camouflage discipline is not violated at any time. Digging should be done during darkness or under camouflage. The camouflage plan must provide for disposal of spoil and elimination of tracks. The possibility of both aerial observation and photography must be considered.

c. Concealment. Concealment is protection from enemy observation.

(1) Natural concealment is provided by the surroundings, with no change involved. Examples of natural concealment are bushes, grass, and shadows.

(2) Artificial concealment is made from materials, such as burlap or garnished nets, or from natural materials, such as bushes, leaves, and grass moved from their original location.

(3) During marches, vehicles and other equipment which are peculiar to this team should be concealed to the maximum extent possible. Camouflage nets, canvas covers, and other field expedients should be used.

(4) In most positions, concealment is obtained by the use of camouflage nets supplemented by available natural concealment.

d. Camouflage.

(1) Redeye personnel will be located in or near the main battle position in proximity to other troops. Because of the battlefield position, the following basic principles of camouflage must be observed: choice of position, camouflage discipline, and camouflage construction. In choosing a position, the Redeye team selects a background that will absorb the visual elements of the position. The appearance of the background must not be changed by the presence of individuals, weapons, or equipment. The position selected must not hinder the accomplishment of the mission. Within the limits of camouflage requirements, a natural position is located. A natural position is one that can be used almost as it is, such as natural cover or a defilade. Isolated land-

marks that command attention, such as individual trees, haystacks, or a house, should be avoided.

(2) Because the Redeye teams do not have bulky equipment, the task of camouflage is relatively simple. The vehicle and the foxhole (or hasty slit trench for personal safety) are the main items to camouflage. Shipping and storage containers (off-loaded) should be concealed or camouflaged.

(3) Camouflage discipline is the avoidance of activity that changes the appearance of an area. Tracks, spoil, and debris are the most common signs of military activity that indicate concealed objects. Existing tracks, paths, roads, or natural lines in the terrain are to be used. Exposed routes should not end at a position, but extend to another logical termination. If practical, exposed tracks are camouflaged by brushing, covering with material, or planting local vegetation (when time permits). Camouflage discipline is important because the enemy readily can detect breaches of discipline on aerial photographs. (Detailed camouflage techniques are found in FM 5-20.)

e. Alert Signals. Unit SOP prescribes specific warning signals for ground, air, airmobile, and CBR attacks. The signals must be understood by all personnel. Personnel must be made aware of the actions to be taken in each instance. Periodic rehearsals and drills are conducted to insure that the signals are understood and that the methods of dissemination are adequate to provide unit personnel sufficient warning time to take action. *Redeye personnel must understand all warning signals as prescribed in unit SOP.* To provide a standard method of disseminating emergency warnings within NATO forces operating on land, the United States Armed Forces, together with other NATO armed forces, have concurred in the provisions of STANAG 2047 (Emergency Warnings of Hazard on Attack). Details of STANAG 2047 are contained in table 13-1.

f. Combat Readiness. The battalion commander, based on the air defense section leader's recommendation, may prescribe the number of teams to be ready for action. A ready-for-action team—

(1) Has its radio manned and operating in the required net.

(2) Is actively performing airspace surveillance.

Table 13-1. Warning Signals

Hazard	Sound Signal	Visual Signal
Nuclear, Biological, Chemical (NBC).	A rapid and continuous beating on any metal object which produces a loud noise. A horn or siren signal of three short blasts followed by 2 seconds of silence and repeated for 1 minute. Shout "Gas" or "Spray" prior to donning protective mask. Automatic alarms should replace above warning signals insofar as possible.	Donning of protective mask and equipment IAW SOP.
Air Attack.	Continuous series of short blasts on a vehicle horn, whistle, bugle, or other wind instrument; long warbling blast on a siren.	Rapid crossing and uncrossing of arms fully extended above head.
Ground Attack.	Series of long blasts on vehicle horn, whistle, bugle, or other wind instrument.	IAW SOP.
Friendly Nuclear Strike.	Per SOP.	IAW SOP.
All Clear.	Orally or continuous sustained blast on vehicle horn, whistle, bugle, or other wind instrument. Continuous steady blast on siren for 1 minute.	IAW SOP.

Notes. 1. If an air or ground attack is determined to be a nuclear, biological, or chemical hazard, the appropriate NBC hazard alarm should replace or immediately follow the air or ground attack alarm as appropriate.
2. The spoken word (vocal alarm) remains the most effective means of informing troops in an emergency.

- (3) Is able to accompany the defended unit.
- (4) Has its basic load of weapons available, with batteries inserted in at least two unpacked rounds (batteries normally will not be inserted during peacetime).
- (5) Meets all prescribed proficiency standards.

g. Blackout. The commander must insure strict adherence to blackout principles and regulations. Problem areas include vehicle running lights, smoking, gun flashes, flashlights, and carelessness in entering or leaving shelters or vans where illumination is being used.

h. Movement. Redeye is singly deployed throughout the area and should displace after each engagement to prevent targeting. At night and during foul weather, Redeye should displace into prepared positions within the defense perimeter of the defended, supported, or collocated unit.

i. Communications Security. Excessive and careless use of radio communications should be avoided. CEOI and other directives concerning the use of communications must be rigidly enforced. When time permits, wire should be laid and concealed. Additional measures which contribute to effective communications security include—

- (1) Physical security of CEOI, CESI, and cryptographic materiel.

- (2) Emergency destruction plans for all classified literature and materiel.
- (3) Remedial action to eliminate violations of communications security.
- (4) Training of communications personnel in security procedures.
- (5) Programed change of radio frequencies.
- (6) Avoiding long or easily associated messages.
- (7) Alertness of operators to recognize irregularities in procedures.
- (8) Transmitting messages whenever possible without requiring acknowledgement of receipt.
- (9) Use of authentication procedures by radio operators.

j. Chemical, Biological, and Radiological (CBR) Defense.

(1) *General.* The continued effectiveness of Redeye teams during CBR attack is dependent on the degree of CBR training and availability and proper use of protective equipment. It is imperative that all personnel be thoroughly trained in all aspects of CBR defense. The nature of CBR operations may cause untrained soldiers to panic at the first sign of CBR attack and cause units to become ineffective.

- (2) *References.* Detailed information concerning CBR operations, defense, and training

is contained in FM 3-10, FM 3-12, FM 6-140, FM 7-10, FM 7-20, FM 17-1, FM 21-11, FM 21-40, FM 21-41, and FM 21-48.

13-6. Supplementary Measures

Redeye positions primarily in the forward combat area lend themselves to detection and observation by hostile forces especially during the period when a target is engaged. The longer their positions are occupied, the greater the probability that they will be subjected to artillery, mortar, or air attack. To reduce this danger, teams should displace at irregular intervals to alternate positions. These alternate positions should be so selected that, when occupied, no measureable degradation will result in the overall defense.

13-7. Use of Non-Air-Defense Weapons Against Air Attack

a. Concept.

(1) The substantial low-altitude air threat faced by units in the combat theater may be partially countered by aggressive use of the large volume of fire which non-air-defense weapons can place against this threat.

(2) Exercise of the individual and collective right of self-defense against hostile aircraft must be emphasized. Hostile aircraft includes all attacking aircraft and those positively identified enemy aircraft which pose a threat to the unit. Large volumes of fire from non-air-defense weapons have proven capable of destroying both low- and high-speed aircraft or disrupting their attack. Exercise of this right of self-defense does not demand specialized use of communications and is in consonance with paragraph 306, JCS Pub. 8, *Doctrine for Air Defense from Oversea Land Areas*.

(3) Indiscriminate use of non-air-defense weapons must be prevented due to the resulting danger to friendly aircraft and troops and the requirement to place in proper perspective the technique of withholding fire to preclude disclosure of positions. Effective and safe employment of these weapons necessitates Army-wide training. Engagement of hostile aircraft in immediate self-defense will be most frequent and training emphasis should reflect this.

(4) Situations may arise wherein the exercise of the right of self-defense should be temporarily suppressed, or when more freedom in the use of non-air-defense weapons against aircraft should be encouraged. The former case in-

volves a local decision that prevention of position disclosure is paramount. Notice of such restriction is disseminated through command channels. The latter case should be based on a theater-level decision.

b. *Rules for Engagement.* In the absence of orders to the contrary, individual weapon operators will engage attacking aircraft; engagement of all other hostile aircraft will be on orders issued through the unit chain of command and will be supervised by unit leaders. Nothing in this rule is to be taken as requiring actions prejudicial to accomplishment of the primary mission of the unit.

c. *Techniques.* The following techniques should maximize the destructive and/or deterrent effect against aircraft. Aircraft may be divided into two categories, low- and high-speed. Low-speed aircraft include helicopters and liaison, reconnaissance, and observation fixed-wing propeller aircraft. High-speed aircraft include all other propeller aircraft and all jet fixed-wing aircraft. This distinction will result in simplified engagement procedures.

(1) *Engagement of low-speed aircraft.* In accordance with the rules for engagement, low-speed enemy aircraft are engaged with aimed fire, employing the maximum weapon rate of fire. Aerial gunnery techniques (less lead) generally applicable to all small arms and automatic weapons are presented in FM 23-12, FM 23-65, and FM 23-67.

(2) *Engagement of high-speed aircraft.* In accordance with the rules for engagement, high-speed enemy aircraft are engaged with maximum fire aimed well in front of the aircraft, and above its flight path, to force it to fly through a pattern of fire. This technique is not unaimed "barrage" fire, but requires a degree of aimed fire. It does not, however, call for careful estimation of aircraft speed and required lead.

(3) *Use of tracer ammunition.* Automatic weapons should utilize the highest practical proportion of tracer ammunition to enhance the deterrent or disruptive effect.

(4) *Massed fire.* Units should employ a massed fire technique when using small arms and automatic weapons in an air defense role.

d. *SOP Items.* Unit-level SOP should cover, but not be limited to, the following items relevant to engagement of aircraft with non-air-defense weapons.

(1) *Applicability.* (Include operators of designated weapons.)

(2) *Relation to primary mission.* (Primary mission is never prejudiced.)

(3) *Relation to passive air defense.* (The necessity for aggressively engaging hostile aircraft is balanced with the requirement to place in proper perspective the tactic of withholding fire to preclude disclosure of position.)

(4) *Authority to engage.* (Authority to engage attacking aircraft delegated to individual weapon operators and to engage all other hostile aircraft on orders through the unit chain of command, subject to the rules for engagement and rules for withholding fire.)

(5) *Rules for engagement.* (Normally, self-defense only against all attacking aircraft and

those positively identified enemy aircraft which pose a threat to the unit.)

(6) *Rules for withholding fire.* (When ordered. When not positive that aircraft are actually attacking or otherwise hostile. When friendly aircraft or troops are endangered.)

(7) *Position selection.* (See FM 44-1. Applicable only to weapons specifically assigned an air defense role; e.g., designated single-barrel, caliber .50 machineguns.)

(8) *Firing techniques.* (Lead and super-elevation. Massed fire. Maximum rate of fire. Maximum use of tracer ammunition.)

(9) *Unit training requirements.* (Motivation and discipline. Gunnery. Aircraft recognition.)

CHAPTER 14

REDEYE COMBAT OPERATIONS

Section I. ORGANIZATION FOR COMBAT

14-1. Introduction

The mission of the battalion air defense section is to provide air defense for maneuver elements and other priority targets in the battalion area. The available Redeye resources are organized for combat to maximize air defense effectiveness in supporting mission accomplishment. The commander's priorities for air defense; the scheme of maneuver; and the mission, situation, and composition of forces will each influence the required Redeye organization for combat. The commander exercising operational control may assign air defense tactical missions in the operation order. Although additional implementing instructions may be received by the section, the mission statement in the operation order should be sufficient for the section leader to plan and execute the air defense of the battalion.

14-2. Principles of Redeye Organization for Combat

a. Redeye teams are normally retained under section control in a battalion general support mission or a company direct support mission. This retains the advantages of centralized direction while providing the required degree of close and continuous air defense support. Centralized direction provides significant advantages in planning and maintaining both the overall defense integrity and combat service support.

b. Redeye air defense sections are responsive to common doctrine prescribed by the division air defense officer. Common doctrine includes conditions of readiness, air defense warnings, rules of engagement, hostile criteria, weapon control status, and reporting requirements. The organization for combat should insure clear lines of authority for prescribing common operating doctrine and changes thereto. This assures that attached Redeye teams are also responsive to prescribed common doctrine.

c. The battalion commander exercises only that control over Redeye necessary to insure coordinated action and permit rapid response to changes in the local situation. Engagement control of Redeye should remain decentralized to the maximum extent possible with the authority to make engagement decisions resting with the Redeye team chief.

14-3. Commander's Organizational Options

In organizing for combat, the air defense section leader has three basic organizational options for recommendation to the battalion commander. He may recommend that the air defense section be assigned the tactical mission of general support (GS) of the battalion as a whole, a direct support (DS) mission, or the attachment of teams to battalion maneuver elements.

14-4. General Support

In a general support mission the air defense section leader deploys his Redeye teams so as to best defend the battalion as a whole. Emphasis will be placed on maintenance of overlapping fires and on coverage of low-altitude air attack routes threatening the battalion priority units/installations as specified by the battalion commander. The air defense section leader will maintain command and control of all teams so deployed. This does not preclude team tie-in to nearby units for purposes of coordinating team security and administrative support. The general support tactical mission is most effective during semistatic conditions when optimum firing positions can be occupied and adequately secured. General support is the normal tactical mission of Redeye sections when the defended unit is in an area defense posture. The operation order assigning a tactical mission to an air defense section headquarters may designate certain of its subordinate teams for accomplishment of other tactical missions.

14-5. Direct Support

In a direct support mission the air defense section leader deploys his teams so as to best defend the specified battalion maneuver elements to receive direct support. The air defense section assigned the tactical mission of direct support (DS) provides close and continuous air defense for a designated force element and must coordinate its operation with this element. Teams move with the supported units as required for mission accomplishment, but otherwise remain under Redeye section leader command and control. Team tie-in to the supported unit will be as required for coordination of team positioning, security, and mess. The direct support mission

is most frequently used to place a Redeye team in support of a company.

14-6. Attachment

Redeye teams may be detached from the air defense section and attached to specified companies when battalion-level control is impractical. The company receiving the team(s) will exercise command, with operational control subject to compliance with battalion air defense SOP. Redeye teams should only be detached from the section when the general or direct support methods are impractical; e.g., when the battalion dispersion precludes maintenance of direct section-team communication, or when a company is detached from the battalion.

Section II. CONDUCT OF OPERATIONS

14-7. General

Redeye air defense section employment is basically the same in offensive, defensive, retrograde, and special operations. The primary differences are changes in priority required by the changing importance of various elements of the defended unit. During combat operations the battalion commander assigns missions to the air defense section. The assigned missions remain in effect until priorities change. If the defended unit or installation moves, the Redeye teams move with it. When air defense priorities for a combat operation have been established, the air defense section leader coordinates his air defense plan with the defended force commander. The air defense section leader must insure that the Redeye elements provide continuous air defense protection to the defended unit throughout all phases of the operation. The air defense section leader must be familiar with the various tactical maneuvers associated with offensive, defensive, and retrograde operations described in the appropriate combat arms manuals.

14-8. Support of Battalion in Offense

a. Actions of Section Leader. The Redeye section leader normally receives a battalion warning order for the attack which permits early planning. The warning order is usually fragmentary and may contain information such as the time of attack, mission, objectives, administrative instructions, and employment plans for battalion elements (including Redeye). The section leader then normally issues a warning order to his

subordinates giving them any information he has received concerning the attack.

b. Redeye Attack Planning. Based on the commander's decision and concepts, the air defense section leader, in conjunction with the battalion S3, develops plans for implementing air defense of the battalion during the attack. In general, the Redeye team(s) remain close enough to the attack elements to provide defense against enemy air attack. Air defense for maneuvering elements is provided as long as possible from positions along the line of departure (LD). These positions usually permit engagement of aircraft attacking the maneuver elements during the advance to, assault on, and occupation of the objective. Preselected positions beyond the LD should be occupied as soon as possible to support the attack.

c. Actions of Team Chief. During reconnaissance the team chief selects firing positions according to the section leader's instructions. He pays particular attention to masks, low-altitude avenues of approach and routes the maneuver element will take to the objectives and supporting positions. RSOP procedures are covered in chapter 11.

d. Preparation for Attack. Steps in preparing for the attack by the Redeye team are basically the same as with any other weapon system. Vehicles, weapons, and communications equipment should be checked to insure proper functioning. Map and ground reconnaissance will be made with particular attention given to selection of firing positions and to identifying aircraft

approach corridors along the planned route of advance. Procedures must be established for resupplying the Redeye team with weapons. Section leader will brief the teams on the situation, plan of attack, communications procedures, messing arrangements, logistical support, and special instructions concerning friendly aircraft.

14-9. Redeye Team in the Attack

a. Mounted Operations. In the attack the Redeye team is most effective when the team is using organic transportation. In addition to carrying the basic load of Redeye weapons and communications equipment, the truck allows the team to accompany the fast-moving troops and provide the necessary air defense. In fast-moving situations the Redeye team must choose positions from which the attacking unit can be supported and at the same time not be masked by prominent terrain features or subject to small-arms fire. When Redeye teams are to accompany the most forward elements of rapidly moving armored or mechanized columns, mobility requirements can be met by providing them with tracked transportation on a share-the-ride basis. Support of the mounted attack or exploitation involves Redeye deployment with little opportunity for occupation of optimum firing positions. In this case the gunner may not have time to satisfy all the technical position requirements. He must, however, occupy a position far enough from the other elements to assure safety from weapon backblast.

b. Dismounted Operations.

(1) At times the Redeye team must dismount to accompany and defend the infantry during operations in difficult terrain and during the assault.

(2) As a general rule the two team members should remain together and operate as a team during dismounted operations. The team, with its radio and one to three weapons, should accompany the defended unit and be prepared to deploy as necessary to defend against air attack. Assistance from the defended unit should be sought in carrying additional weapons, if deemed necessary, and in caring for the team vehicle and other equipment left behind. The team should cover the final assault from preselected positions offering the best chance for team survivability consistent with the team mission of providing maximum air defense coverage of the assault forces.

14-10. Support of Battalion in Defense

a. General. Employment of an air defense section in support of the battalion, in general, is more centralized and controlled at the section level than in the support of offensive operations. In planning the battalion air defense, consideration must be given to low-altitude avenues of approach, such as valleys and passes leading into the area. In addition to close support by attack aircraft, the air threat will include the probability of airmobile and airborne attacks. Therefore, consideration must be given to the probable locations of airdrop and landing zones within the battalion's defensive positions. The low-altitude avenues of approach into the battalion area, used by aircraft in support of the enemy's air assault operation, may be quite different from the approaches that may be used by high-performance aircraft. Slower helicopters used in airmobile operations may use approaches over heavy forest if the forest is not overlooked by terrain nearby which would offer good weapon positions.

b. Planning. In planning the air defense of the battalion, the section leader considers the mission, enemy situation, terrain, weather, available forces, and fundamentals of defense. The two fundamental forms of defense used by the battalion are mobile defense and area defense. In the mobile defense ground security of Redeye teams is more of a problem than when the battalion is conducting an area defense. In the mobile defense Redeye teams should be within the perimeter of the defending forces. Less than optimum positions will often have to be selected. Artillery preparation and close-support air attacks may precede enemy ground attacks. The section leader, in conjunction with the battalion S3, develops the battalion air defense plan employing the principles and factors of air defense design discussed in chapter 9.

c. Preparation. Preparing for defense by the Redeye team is basically the same as with any weapon system. Troop-leading steps taken by the section leader and team chief are covered in combat arms manuals and in DA Pam 350-13. The most important consideration for employment of Redeye is team selection and occupation of positions that will provide the required air defense coverage. The section leader determines the priority of tasks to be performed by the team. As many tasks as possible are accomplished simultaneously. The normal sequence of tasks is as follows:

(1) Assume a ready-for-action status immediately upon arriving at the designated position area.

(2) Make any further detailed ground reconnaissance required to select final Redeye firing positions.

(3) Establish security; make contact with other friendly elements in the area.

(4) Prepare individual positions.

(5) Select and prepare alternate and supplementary positions.

(6) Prepare and forward a Redeye position sketch to the section leader indicating gunner location(s) and zone of coverage.

(7) Improve primary position.

(8) Provide wire communications.

d. Operations. Redeye teams will be combat-ready during RED and YELLOW air defense warnings. Early warning of all air attacks is highly improbable; therefore, team personnel will continuously search and scan for hostile aircraft. Redeye teams will exchange alert information by the fastest means available (voice, visual/audio signals, telephone). The gunner prepares to engage hostile aircraft that are approaching or within the team's sector of responsibility. The engagement decision is made by the team chief and the engagement proceeds as prescribed for team drill in chapter 15. An after-action report will be sent to the section leader as soon as possible.

14-11. Conduct of March Column Defense

During movement of a unit, Redeye teams should be positioned as explained in chapter 9. Based on recommendations of the Redeye section leader, the column commander places the teams within the column. The section leader assigns appropriate primary and secondary zones of responsibility assuring all-round observation. Some weapons should be unpacked and ready, and gunners should be able to quickly assume firing positions. In certain cases the requirement for mobility may be such that temporarily dropping the organic vehicle trailer and carrying a reduced load of weapons in the truck is justified.

14-12. Reaction Capabilities to Early Warning

The reaction capabilities of units vary with respect to their mission and tactical postures. These factors and the type of unit determine the

degree of active and passive air defense measures that will be employed.

a. Infantry. An infantry unit in an area defense is characteristically dug in and camouflaged. The units are deployed to meet a ground attack so that weapons are optimally sited for this purpose and observation and listening posts are established. *The Redeye team also serves as an additional air guard.* The receipt of early warning causes little change in unit activity except to alert the Redeye team and emphasize passive air defense measures. Notification of impending air attack in the vicinity of the unit should cause surveillance to be focused in the direction of attack, and preparation of Redeye and organic non-air-defense weapons.

b. Armor. An armored unit, even though detected, can capitalize an armor and mobility for passive air defense. The receipt of early warning serves primarily to increase the awareness of personnel as to the probability of air attack and, if the tactical situation permits, may cause unit personnel to disperse and take cover. Notification of impending air attack, however, should result in the same response as stated in *a* above. Each weapon/vehicle should have one individual designated as an air guard.

c. Mechanized. A mechanized unit can respond in the same general manner to warnings as can armor units. However, mechanized units not moving at the time of the attack should dismount personnel to bring more individual weapons to bear on the aircraft and should employ passive air defense measures where practical. Each weapon/vehicle should have one individual designated as an air guard.

d. Field Artillery. Field artillery units respond generally in the same manner as their supported unit and according to the type of unit; i.e., self-propelled or towed. Self-propelled units respond similarly to mechanized units and towed units respond similarly to infantry units. Each weapon/vehicle should have one individual designated as an air guard.

e. Airmobile and Airborne. Airmobile and airborne units are most vulnerable to attack during the initial stages of the ground operation; therefore, the maximum utilization of firepower is required to destroy or drive away an air attack. The use of natural and artificial camouflage and cover, where available, limits equipment damage and casualties among personnel. The dis-

tance of either operation from other friendly forces may prevent a significant degree of early warning.

14-13. Night Operations

Night combat is an integral part of all operations. Principles are the same as for daylight operations; however, the limited visibility offers added opportunities for concealment and complicates the problems of control and coordination.

a. Night operations pose two particular problems for Redeye teams:

- (1) Aircraft detection and identification.
- (2) Manning.

b. Redeye is classed as a visually directed system and, as such, has a limited air defense capability at night. Given a "weapons free" status, the weapons can be used at night. Night vision devices can provide the gunner with a capability of aircraft detection and identification.

c. Manning poses a special problem. Being users of visually aimed air defense weapons with an implied 12- to 16-hour combat day, the Redeye section TOE was not designed to provide sustained 24-hour air defense. Non-Redeye-trained personnel will be required from the supported unit to assist Redeye personnel at night as additional air guards. They will not be employed as Redeye gunners, but will alert the team upon detection of aircraft or receipt of early warning. The air defense section leader will arrange for this augmentation when deemed necessary.

Section III. SPECIAL OPERATIONS

14-14. River-Crossing Operations

a. *General.* The physical characteristics of river obstacles influence the air defense of river-crossing operations in that rivers restrict the movements of attacking ground forces and provide natural avenues for low-altitude air attack. Redeye team positions should be weighted toward the natural avenues of approach and displaced from the crossing site by a distance that will insure a target kill probability prior to the release of ordnance. Basic concepts, doctrine, and detailed procedure for the conduct of river-crossing operations are presented in FM 31-60.

b. *Concepts.* Redeye teams should be employed with the troops approaching the river obstacle and establishing the bridgehead. Redeye may be employed in a general support role to provide air defense of assembly areas and also to defend engineer bridging equipment. Redeye teams should accompany assault echelons to provide air defense protection of the crossing site. Redeye teams should be sent across as soon as the battalion bridgehead has been secured and should deploy to preselected positions immediately.

14-15. Airmobile/Airborne Operations

a. Airlift limitations and assault force priorities frequently dictate employment of only fighter-interceptors and Redeye teams for air defense during the early and critical phases of an airmobile/airborne operation. Therefore, in this type of special operation, Redeye teams may have two roles, the normal small-unit defense and

temporarily defending initial base buildup until the base defense can be assumed by other ADA weapons. If sufficient ADA weapons are airlifted in during the initial phase of base buildup, Redeye teams that are deployed with the assault infantry will provide a "bonus" base defense. The Redeye base defense can be accomplished either by integrating Redeye deployments with the base security plan or by detaching teams from reserve elements and placing them under direct control of a designated Redeye base defense officer. Under either concept the designated Redeye base defense officer is responsible for Redeye base defense planning and management. Redeye employment for base defense will be for short periods.

b. Reliance is placed on helicopters for team transport and man-portable FM radios are required at both section and team level. The Redeye elements depend on other divisional elements for combat support to include most transportation.

14-16. Base Defense

a. *Command and Control.*

(1) Redeye command and control concepts vary with the role assigned, base defense or all-arms.

(2) The command and control measures described in chapter 10 apply although a higher degree of centralized control is feasible and frequently desirable in the base defense application.

(3) The base defense mission may be as-

signed to selected teams by the assault force commander.

b. *Control of Redeye Fires.* Control of Redeye fires is exercised as explained in chapter 10. If an officer is designated for direct control of the Redeye base defense, he should operate from the base air traffic control facility and should gather, screen, and transmit appropriate information to the base defense teams as necessary to alert them of friendly and enemy air and ground activity. He also transmits weapon control status as required.

14-17. Airlifted Assault Phase

a. The airmobile force may seize single or multiple base areas in the objective area. Division air defense will defend the base areas, in designated priority, using the vital area defense pattern of deployment.

b. An AADCP should be established in the

objective area as soon as possible. Prior to that time, fire units may operate autonomously.

c. Redeye may be the only Army air defense means accompanying the assault echelons. As the assault force builds up, towed Vulcan may be brought in. At that time, the towed Vulcan platoons and the Redeye sections of the uncommitted forces may be formed into a composite Redeye-Vulcan defense of the key elements of the base area. Later the heavier ADA units can be brought in.

d. The assault commander is responsible for air traffic control and, when provided the means, for low-altitude air defense. Radio is the primary means of communication.

e. The airborne division in the assault and linkup concepts and techniques is similar to the airmobile division. General concepts are found in FM 44-1 and FM 61-100.

PART THREE
REDEYE TRAINING
CHAPTER 15
SECTION AND TEAM DRILL

Section I. SECTION DRILL

15-1. General

The objective of section drill is to attain a high degree of proficiency, speed, and teamwork in performing the duties and operations required to employ the Redeye system. To be effective, section drill should be:

- a. Conducted with only necessary commands and reports.
- b. Repeated until reactions are automatic and efficient.
- c. Supervised to discover and correct mistakes.
- d. Conducted with all section personnel present.

15-2. Formation for Drill

a. Section drill is conducted in response to section sergeant commands. Before conducting section drill, the section sergeant briefs the teams on how the drill will be conducted, specifies the assembly area, assigns team firing positions, specifies team equipment, and assigns communications call signs and frequencies.

b. After the briefing, team chiefs and gunners return to their vehicles, assemble equipment, and move with vehicles and equipment into formation at the assembly area. The section headquarters radio operator is briefed by the section sergeant and moves the section vehicle into formation at the specified time.

c. Vehicles, with required equipment aboard, are formed at the assembly area as follows:

(1) *Team A.* Team A moves into the assembly area and stops its vehicle on the spot designated by the section sergeant.

(2) *Other teams.* Follow team A, in turn, into the assembly area and halt vehicles beside, on line with, and 5 meters to the left of last team vehicle.

(3) *Section headquarters.* Follows last team into the assembly area and halts vehicle beside, on line with, and 5 meters to the left of last team vehicle.

15-3. FALL IN

After the section is assembled, the section sergeant moves to a position 5 meters in front of, and centered on, the formation, faces the section and commands, **FALL IN**. The section responds as follows:

a. *Team A.*

(1) *Team chief.* Dismounts from right side of vehicle and falls in 2 meters in front of the vehicle right front wheel, facing the section sergeant.

(2) *Gunner.* Dismounts from left side of vehicle and falls in 2 meters in front of the vehicle left front wheel, and dresses on the team chief.

b. *Other Teams.* The other teams fall in, in front of their respective vehicles, as described in a above and dress on team A.

c. *Section Headquarters.* Section headquarters radio operator dismounts from left side of vehicle and falls in 2 meters in front of the vehicle left front wheel and dresses on line with last team.

15-4. COUNT OFF

After all team members have formed in front

of their respective vehicles, the section sergeant commands, **COUNT OFF**. Team members respond as follows:

a. Team A.

(1) *Team chief.* Counts off, **ONE**.

(2) *Gunner.* Executes eyes right on the command of execution and, following the team chief, counts off, **TWO**, simultaneously returning to eyes front.

b. Other Teams. All team members execute eyes right on the command of execution and count off, **THREE, FOUR, FIVE, SIX**, etc., in turn. Each man returns to eyes front as he counts off.

c. Section Headquarters. Section headquarters radio operator executes eyes right on the command of execution, counts off in turn, and returns to eyes front as he counts off.

15-5. CALL OFF

After section personnel count off, the section sergeant may command, **CALL OFF**. Team members respond as follows:

a. Team chief, team A, calls off, **CHIEF, TEAM A**.

b. Gunner, team A, calls off, **GUNNER, TEAM A**.

c. Teams B, C, D, etc., call off as described for team A.

d. Section headquarters radio operator calls off, **RADIO OPERATOR**.

15-6. EXAMINE EQUIPMENT

After personnel have called off, the section sergeant commands, **EXAMINE EQUIPMENT**.

Note. The "examine equipment" drill is a short version of the inspection procedure detailed in TM 9-1400-425-12 and chapter 3.

a. Team Chief.

(1) Checks telephones and binoculars.

(2) Assisted by the gunner, removes shipping and storage containers from the vehicle and examines the outside of each container for evidence of damage to locks and body.

(3) Assisted by the gunner, examines Red-eye weapon in unirack for evidence of damage or breakage and insures that there are three BCU for the ready weapon. The sight is checked for

cleanliness. *When a BCU is already inserted in the weapon, no further checks are made to check the operation of the safety and actuator device and uncaging switch.*

(4) Assisted by the gunner, opens each container of the basic load and checks that there are three BCU for each Redeye weapon. Examines each Redeye weapon for evidence of damage or breakage.

Note. To preclude excessive handling of weapons within containers, the "examine equipment" drill may be simulated.

(5) Each weapon, after it is inspected, is returned to the container. At completion of inspection and with assistance of the gunner, the containers are returned to the vehicle and secured. The team chief returns to the formation in front of his vehicle.

b. Gunner.

(1) Assists the team chief in the checks outlined in *a*(2) through (5) above.

(2) Performs necessary vehicle checks and starts engine.

(3) Checks the team radio. (Refer to appropriate technical manual for radio check procedures.)

(4) After the inspection, returns to the formation.

c. Section Headquarters Radiotelephone Operator.

(1) Performs necessary vehicle checks and starts vehicle engine. After warmup, the operator checks for visual and audible indications that the vehicle is operational.

(2) Performs necessary radio checks.

(3) After the inspection, stops engine and returns to the formation.

15-7. PREPARE TO MOVE OUT

At the command, **PREPARE TO MOVE OUT**, by the section sergeant, section personnel respond as follows:

a. Section Headquarters.

(1) *Section sergeant.* Commands, **START ENGINE**, and, **TURN ON RADIO AND OPEN NET**.

(2) *Radio operator.* Radio operator/driver starts vehicle engine, turns on vehicle-mounted radio, and opens net control station (NCS). In-

forms section sergeant when all stations have reported in.

b. Team A.

(1) *Team chief.* Team chief commands, START ENGINE, and TURN ON RADIO. After the NCS is open, enters Redeye section command net, using team A call sign.

(2) *Gunner.* Gunner starts engine and turns on vehicle-mounted radio.

c. Other Teams. Other teams respond accord-

ingly except that each team uses its team call sign.

15-8. MOVE OUT

At the command, MOVE OUT, by the section sergeant, team chiefs direct gunners to move out in sequence, starting with team A. Team chiefs follow prescribed routes to the predesignated team tactical positions for continuation of the drill. The section sergeant may stay at the assembly area or may inspect team positions and drill as the training progresses.

Section II. TEAM DRILL

15-9. General

Engagement of aircraft requires coordination of both Redeye team members and each has specific functions to perform. Team drill, normally conducted as a part of section drill, is controlled by the team chief. This drill outlines team member duties and prescribes a formal procedure to be used in training each member in the performance of these duties. Team drill is useful during combat as well as in a training environment. During training, the field handling trainer is substituted for the actual weapon and the drill is changed accordingly. The team chief, when in position, conducts action drill in a training environment on receipt of simulated early warning information from the air defense section command net or from team-generated aircraft sightings. Action drill develops teamwork, precision, and speed in placing the Redeye system in action. The commands used are flexible and may be changed or modified as necessary. During an engagement, team chief commands are repeated by the gunner to prevent misunderstanding. *The team chief is responsible for making the final decision as to the identity of a target unless the team members are deployed independently (para 4-13).*

15-10. Preparation for Action

a. Establishing Position. Upon arrival of the team at the designated position, the team chief notifies the air defense section headquarters through the established radio net that his team has arrived at the predesignated location. The team chief readies his team for immediate action:

<i>Team chief</i>	Commands, UNLOAD
<i>(TC).</i>	EQUIPMENT; takes binoculars, compass, and one

Redeye weapon with cap and cover removed and BCU inserted, from vehicle rack to the position and assists the gunner in unpacking and unloading additional weapons as required. Prepares position range cards.

Gunner (G).

Gunner responds by taking binoculars and one Redeye weapon with cap and cover removed and BCU inserted to the team position. Gunner unpacks and unloads additional weapons and BCU's, but does not insert BCU's in weapons until needed. If the vehicle and position are separated, the gunner removes portable radio set and sets it up for operation close to firing position.

Notes. 1. Usage of radio equipment is dependent upon equipment authorized in unit TOE.

2. In training environment, the team may not have actual basic load of weapons and the drill may be modified, using the field handling trainer when necessary, in consonance with unit SOP.

3. Site selection and occupation of position are described in chapter 12.

b. Search and Scan. When the equipment is unloaded, the team chief takes immediate measures to guard against surprise aerial attack.

TC. Commands, SEARCH AND SCAN, and designates search sector.

G. Responds, SEARCH AND SCAN; proceeds to search and scan, using procedures described in chapter 4.

Notes. 1. The clock system may be used if a suitable reference point is established.

2. Early warning may or may not be received. The Redeye team must always guard against surprise air attack and will constantly have one member maintaining surveillance of airspace within sectors of responsibility. A 40-minute search cycle is recommended.

3. The tactical situation may dictate that search and scan procedures be in effect prior to unloading equipment.

4. Binoculars are not used during surveillance of airspace.

c. Alert. Upon being alerted as a result of team surveillance or through any of the available early warning systems, the Redeye team prepares to engage hostile aircraft.

TC. Commands, PREPARE FOR ACTION; readies binoculars; and assists gunner in searching and scanning. Ascertains that ready weapons are close. Refers to range card for reference in map and range orientation. Keeps within listening distance of the team radio and assures that equipment will not be in the backblast area of any weapons.

G. Responds, PREPARE FOR ACTION, and continues to search and scan.

15-11. Target Detection and Engagement

a. Visual Detection. When a possible hostile target is detected, either member of the team may call out, TARGET(S)—PREPARE TO ENGAGE. The aircraft is immediately pointed out to the other member.

TC or G. Calls out, TARGET(S)—PREPARE TO ENGAGE,

and points out target to the other team member. If a potential target appears before the command, PREPARE FOR ACTION, has been given, calls out, TARGET(S)—PREPARE TO ENGAGE.

TC or G. Responds, TARGET(S)—PREPARE TO ENGAGE.

G. Shoulders the weapon.

b. Tentative Recognition. The team chief makes a determination as to target type and number and attempts to make an identification as rapidly as possible while the gunner is tracking the target.

Note. During tactical motor marches, when a possible target is sighted by either member of the team, he calls out, TARGET, and designates it by pointing. The team chief directs the driver of the vehicle to move out of the traffic and stop as quickly as possible. Team chief hands weapon from unrack to the gunner. Gunner dismounts, moves about 13 meters from the vehicle, if time permits, and engages target as described during engagement from a position.

c. Engagement Decision. The team chief determines whether or not to engage the target based on target course, elevation, aspect, range, and nationality. When the aircraft is determined to be approaching or is within the team's sector of responsibility, the gunner prepares to engage the target. *The team chief may also prepare to engage the target(s) once positive identification is accomplished* if the target is other than a single low/medium-performance aircraft.

d. Track and Range. Gunner continues to visually track and range the target. If the target is a high-performance aircraft, the gunner estimates the crossover point prior to establishing target track and prepositions the weapon if necessary.

e. Multiple Targets. During a multiple attack when both team members are simultaneously acting as gunners, the team chief assigns a target to the gunner as follows.

TC. Commands, LEAD OR RIGHT, and tracks the aircraft with binoculars to establish positive identification. If potential hostile aircraft are positively identified, the team chief

- G.** engages the trailing or left target.
- G.** Responds, LEAD or RIGHT, and tracks the indicated target.

Note. The gunner activates the weapon when appropriate, based on engagement procedures shown for various target types in figures 4-20 and 4-21.

f. Fire When Ready. When the team chief has positively identified the aircraft as hostile, he gives the command, FIRE WHEN READY. The command is permissive and does not *imply* that the gunner must fire at the time of issuance. In case of a doubtful target identity, the team chief may allow the gunner to continue with the engagement until the target is identified, but will not permit the engagement to proceed to the firing stage without positive identification.

- TC.** Commands, FIRE WHEN READY, and continues to observe the target. If a high-performance target is hostile, both the team chief and gunner engage the target, but the team chief must first determine whether the target is hostile. During a multiple attack, the team chief engages the trailing or left target. The team chief employs engagement procedures for specific type targets as shown in figures 4-20 and 4-21.

- G.** Responds, FIRE WHEN READY, and employs engagement procedures for specific type targets as shown in figures 4-20 and 4-21.

g. Termination of Engagement.

(1) *Cease fire.* The command, CEASE FIRE, may be given at any time during the engagement by either team member when aircraft is determined to be friendly, cannot be engaged, or when it is not safe to fire. The command may be overridden by the team chief. Either team member should cease fire when it is determined that the target has passed the outer launch limits.

- TC.** Command, CEASE FIRE, releases uncaging switch,

and discards the expended weapon when engagement is complete. Takes a weapon from nearby container and prepares to engage new target (s). (If the mission was aborted for any reason, team chief discards old BCU and replaces it with a new one.) Assesses damage to target and reports results to higher headquarters. Commands gunner to search and scan for new target (s).

- G.** Responds, CEASE FIRE, releases uncaging switch, and discards the expended weapon upon termination of engagement. Takes a weapon from nearby container, removes cover and cap, inserts BCU, and prepares to engage new target (s). If the mission was aborted for any reason, gunner discards old BCU, replaces it with a new one, and prepares to engage new target (s). Continues to search and scan.

(2) *Out of action.* The Redeye team may report or call itself out of action if mechanical or personnel difficulties prevent it from performing its mission. Examples could include total expenditure of batteries or the basic load of missiles, or injury to team members.

- TC or G.** Reports, OUT OF ACTION. Team chief and/or gunner proceed to bring the Redeye team back to an operational status.

15-12. Abbreviated Action Commands and Drill

a. Abbreviated action commands as a method of controlling Redeye firing, as shown in the following example, is the normal method of control in combat. With both members of the team firing the weapon when engaging jet targets, safe distances are desired between gunners. After initial training in action commands and drills, team members should be taught to react to action commands in situations such as the one cited in *b* below.

b. The team chief sights a target committing hostile acts and approaching the Redeye team's area. He commands by voice, TARGET, PREPARE TO ENGAGE. The gunner commences the engagement sequence against the enemy aircraft. Upon positive identification of the aircraft as hostile, the team chief commands, FIRE WHEN READY. The team chief joins the gunner in the engagement if the aircraft is a high-performance aircraft or there are multiple targets. The team chief may continue to observe the aircraft being engaged in the case of a single low/medium-performance target. Abbreviated action commands may be employed in fast-moving situations during combat.

15-13. After-Action Reports

Upon termination of team engagement(s), the team chief informs air defense section headquarters, or the headquarters to which the team is

attached, of damage results to hostile or simulated hostile aircraft, amount of weapons expended, and any other information deemed necessary.

15-14. Termination of Drill

The section leader terminates the drill by ordering team chiefs to secure (load) equipment, mount up, prepare to move out, and return to the assembly area at the specified time, using the same drill procedures outlined in paragraphs 15-7 and 15-8. The NCS closes when the teams reach the assembly area. Teams reassemble at designated point and are alined in the same manner as explained in paragraph 15-4. The section chief orders the teams to dismount, fall in, and report. Immediately after the termination of the drill, a critique is conducted by the section leader. The section leader either dismisses the section or orders the section sergeant to assume command of the section.

CHAPTER 16

GUIDED MISSILE SYSTEM TRAINING SET M76

Section I. GENERAL

16-1. Introduction

The successful engagement of aerial targets with Redeye requires that the gunner be skilled in the handling and operation of the Redeye weapon and in making correct judgments that will result in a missile launch at the optimum time. The acquisition and retention of these skills requires continuing practice by every gunner. The high cost of Redeye missiles precludes firing the weapon to maintain gunner proficiency, but the training requirement has been met with the development of tracking head and field handling

trainers. These training devices provide a means of simulating all steps of the firing procedure except actual launch of a missile. The field handling trainer is described in chapter 2.

16-2. Scope

The chapter is divided into four sections. Section II describes the overall system equipment, section III describes the operator procedures, and section IV contains the Redeye testing program used to determine individual gunner proficiency.

Section II. SYSTEM DESCRIPTION

16-3. Guided Missile Training Set M76

a. The training set M76 (fig 16-1) consists of the M49 tracking head trainer, battery charger, four batteries (normally stored in the battery receptacles of the battery charger), and shipping and storage container. The trainer requires one charged battery to conduct a training mission.

b. The tracking head trainer M49 (fig 16-2) is made up of a launcher simulator and missile simulator. The missile simulator is contained within the launch tube of the launcher simulator. The trainer is similar in appearance to the Redeye weapon M41 except for a compressor actuator assembly (gas pump handle) mounted on the launch tube, two gas pressure gages (high pressure and low pressure) visible through a plastic window in the forward launch tube, a performance indicator assembly fitted under the gyro activator coils, a battery-voltage indicator mounted in the left half of the gripstock, a gas fill port located just above the desiccant holder, a thermometer installed inside the desiccant holder, and a rubber bumper (disk assembly) fitted to the rear protective shock ring. If Freon

gas pressure is excessive, it will rupture a safety relief disk and vent through the rubber bumper.

c. The four batteries (fig 16-1) are similar in shape to the BCU used with the Redeye weapon but are about 3 inches longer and weigh 2 pounds more. A battery is capable of providing power for at least fifteen 31-second training missions without recharging. Each battery contains a plastic shield over the ring contacts to protect the battery from accidentally discharging. The plastic shield is removed from the ring contacts only when the battery is in use during a training mission or when being recharged. This shield remains in place when transporting or storing the batteries either in or out of the battery charger.

d. The battery charger (fig 16-1) is a compact, solid-state, trickle-type charger housed in a metal container with a hinged lid secured with two turn-key latches. All components are supported by the front panel. For servicing, the panel and attached components can be withdrawn as a unit by removing the screws that secure the panel to the container. Spare fuses and lamps are located in the container top under a cover plate

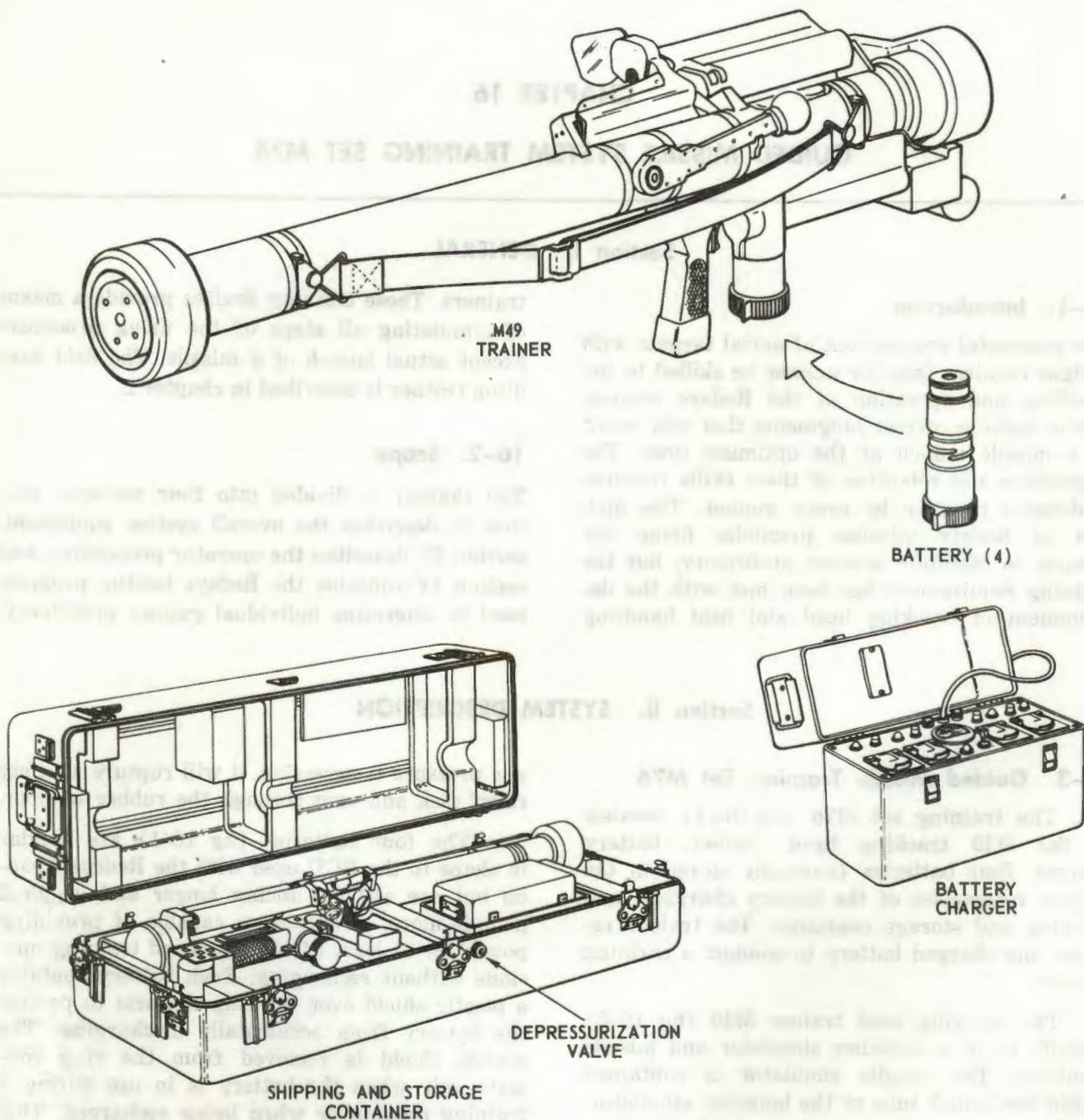


Figure 16-1. Guided missile training set M76.

attached by two thumbscrews. The battery charger is capable of charging one to four batteries at a time. Four independent receptacles receive the batteries, so charging of one is not affected by the others.

e. The shipping and storage container (fig 16-1) is an aluminum, two-piece shell with capacity for the trainer M49 and the battery charger with four batteries stored in the charger battery

receptacles. A depressurization valve is provided to equalize internal pressure with the atmosphere before the container is opened.

f. The trainer has a closed-loop coolant system that recirculates Freon to cool the seeker. A manually operated pump is used to obtain the necessary pressures required for operation. Under normal conditions at least nine training se-

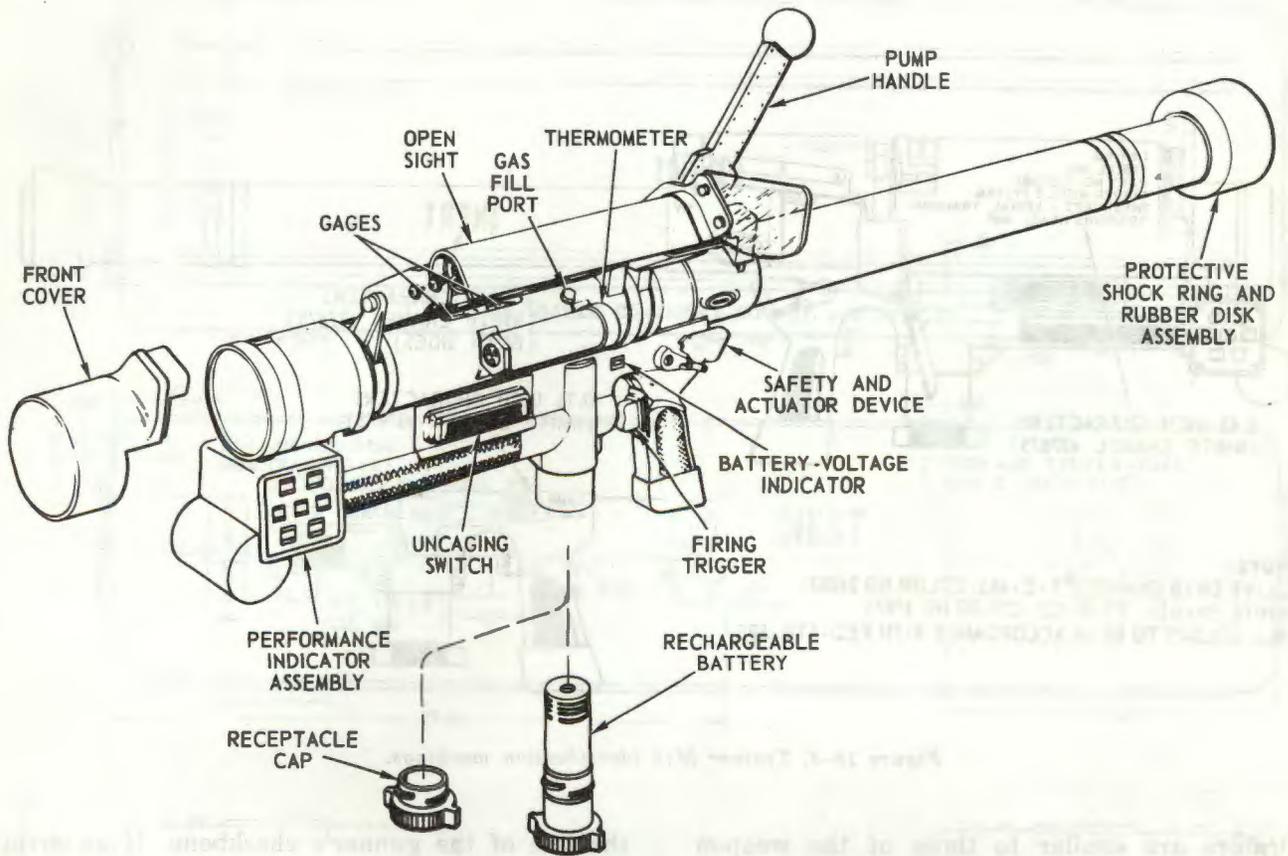


Figure 16-2. Tracking head trainer M49—principal components.

quences can be accomplished when the cooling system is properly pressurized.

g. The physical dimensions, including weight of the items which make up the training set M76, are given in table 16-1.

h. For further information refer to chapter 17 and TM 9-6920-428-12.

i. Figure 16-3 shows the identification mark-

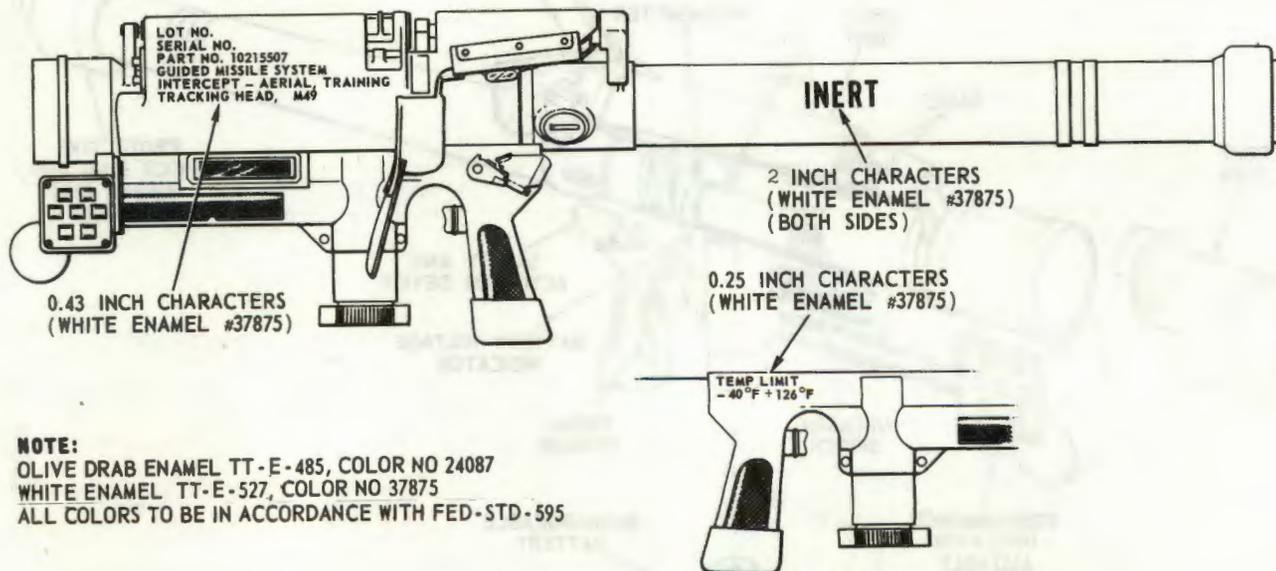
ings for the trainer M49. Figure 16-4 shows the markings for the shipping and storage container.

16-4. Controls and Indicators

The tracking head trainer M49 (fig 16-5), part of guided missile training set M76, is a full-scale model similar in weight, size, operation of controls, the prelaunch operating characteristics to the Redeye weapon. Some of the controls and

Table 16-1. Training Set M76 Tabulated Data

Item	Length (inches)	Width (inches)	Height (inches)	Weight (pounds)
Trainer M49.	49.45	--	14.13	32.0
Dry battery BA-523/PSQ.	9.06	--	--	2.88
Battery charger PP-6118/PSQ.	15.75	7.0	10.5	27.5
Log book.	9	6	1	1.3
Shipping and storage container M590.	56	17	12.6	47.0
				(empty)
				115.1
				(full)



NOTE:
 OLIVE DRAB ENAMEL TT-E-485, COLOR NO 24087
 WHITE ENAMEL TT-E-527, COLOR NO 37875
 ALL COLORS TO BE IN ACCORDANCE WITH FED-STD-595

Figure 16-3. Trainer M49 identification markings.

indicators are similar to those of the weapon and some have no counterpart on the weapon itself. Trainer controls and indicators are illustrated in figure 16-6.

16-5. Use of Trainer Controls

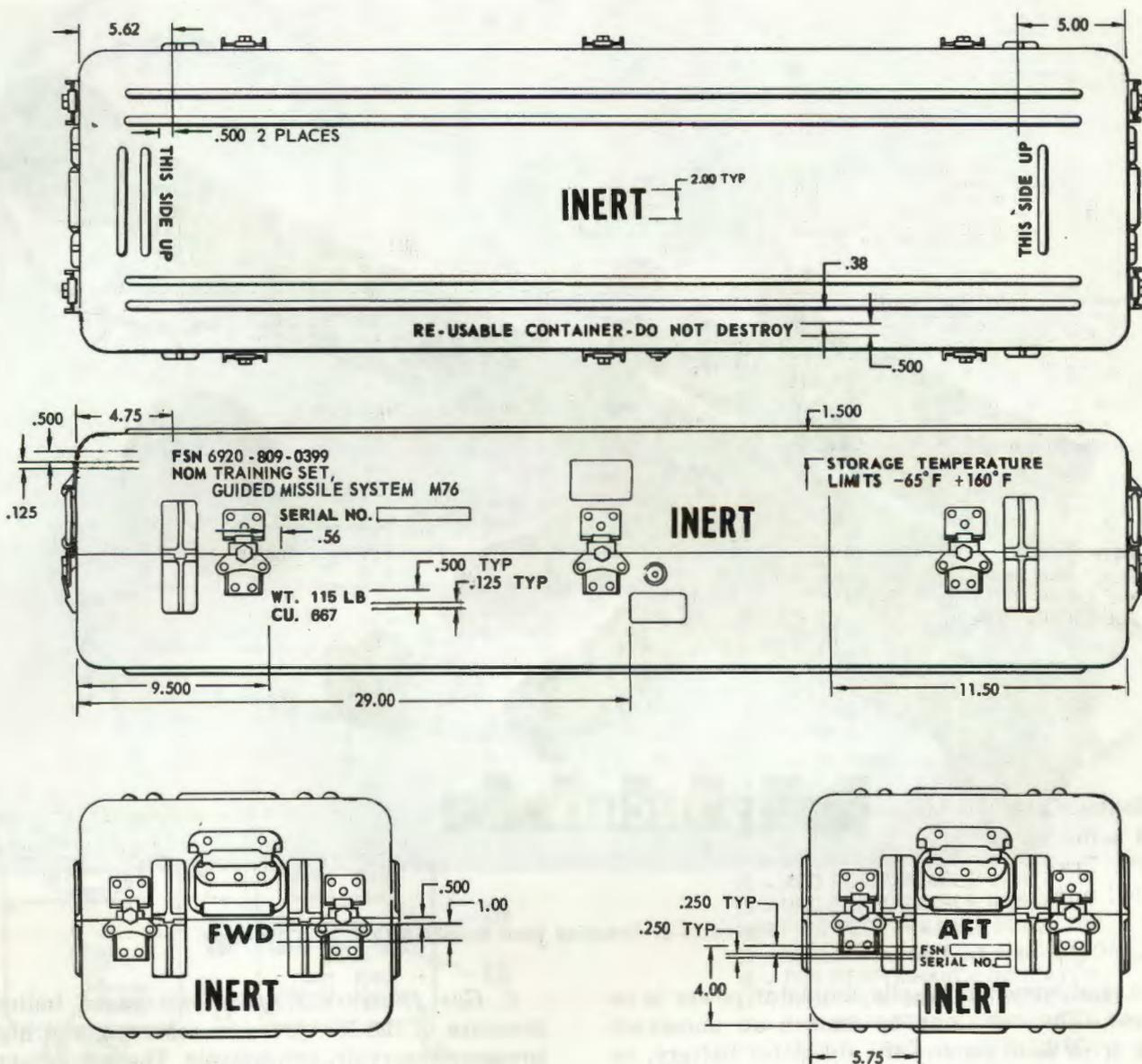
a. Open Sight. The open sight (fig 16-6(1)) is identical to the weapon sight and the gunner uses it to perform the same function of aiming and target ranging.

b. Safety and Actuator Device. The safety and actuator device (fig 16-6(7)), when operated, activates an impulse generator which energizes the power circuits and starts the training mission sequence.

c. Acquisition Indicator. The acquisition indicator (fig 16-6(5)) is a vibrating transducer which puts out an audible signal. With the target centered in the sight range ring, the gunner operates the safety and actuator device to apply power to the simulator. Gyro spinup noise can be heard first on the acquisition indicator as a low hum. When the missile simulator is locked on a target, the acquisition signal is heard as a distinct tone or felt as a steady vibration along

the line of the gunner's cheekbone. If an error occurs, the error tone is heard as a continuous beeping tone, higher pitched than the acquisition signal. A launch tone is heard as one short beep on the acquisition indicator at the end of a successful training mission.

d. Gyro Uncaging Switch. This switch (fig 16-6(11)) uncages the gyro after the missile simulator seeker has acquired the target. The seeker is electrically locked (caged) in the same direction as the open sight for acquiring the target, but it must be released to track the moving target before superelevation and lead angle are inserted. The gyro uncaging switch also acts as an interlock for the firing trigger. In the tactical weapon this is a safety feature, preventing the missile from being fired before the uncaging switch is pressed. In the tracking simulator, inserting superelevation and lead before the uncaging switch is pressed results in a sequence error. This type of error can be corrected by re-acquiring the target in the range ring, pressing the uncaging switch, then inserting superelevation and lead angle. If the uncaging switch is not pressed—or has been released—when the firing trigger is pulled, an uncorrectable error oc-



NOTES:

1. ALL COLORS TO BE IN ACCORDANCE WITH FED-STD-595.
2. BASIC COLOR OF CONTAINER EXTERIOR SHALL BE ENAMEL PER TT-E-529, OLIVE DRAB COLOR NO. X24087.
3. ALL DATA MARKINGS SHALL BE PER COLOR CODES IN ACCORDANCE WITH CHART I, USING ENAMEL PER TT-E-529.

CHART I
COLOR CODES PER MIL-STD-709

NOMENCLATURE	FEDERAL STOCK NUMBER	DATA MARKING COLOR
TRAINING SET, GUIDED MISSILE SYSTEM M76	6920-809-0399	WHITE 27875

Figure 16-4. Shipping and storage container identification markings.



Figure 16-5. Tracking head trainer M49.

curs, and launcher/missile simulator power is removed. The only way to remove an uncorrectable error is to remove the simulator battery, reinsert it, and start a new mission sequence.

e. Firing Trigger. With the gyro uncaging switch pressed and held, and superelevation and lead inserted, the firing trigger (fig 16-6(8)) is pulled and held for a minimum of 0.4 second. This time period is required to achieve a satisfactory launch sequence. In the tactical weapon, this represents the time required for the missile battery to reach its nominal operating voltage before launcher power is removed and the missile is ejected. When the firing trigger is pulled without successfully having completed acquisition, uncage, track, and superelevation/lead, an uncorrectable error occurs, and launcher/missile simulator power is removed. To start a new mission sequence, remove and reinsert the battery in the launcher simulator.

f. Gas Pressure Gages. Two gages indicate pressure in the low-pressure reservoir and high-pressure reservoir, respectively. The low-pressure gage indicates 0 to 100 psi, and the gage scale is color-coded in yellow (0 to 20 psi), green (20 to 60 psi), and red (60 to 100 psi) (fig 16-6(2)). The high-pressure gage indicates 0 to 3,000 psi, and the gage scale is color-coded in red and green for ambient temperatures from -40° F. to 140° F. (fig 16-6(3)). The green area indicates the pressure range which will provide the maximum number of training sequences at the ambient temperature. To prepare for a training session, operate the gas pump handle (fig 16-6(6)) as required to produce a low-pressure gage indication in the yellow band (20 psi or less), and a high-pressure gage indication in the green area for the ambient temperature. Training sequences may then be conducted without repressurizing so long as the low-pressure

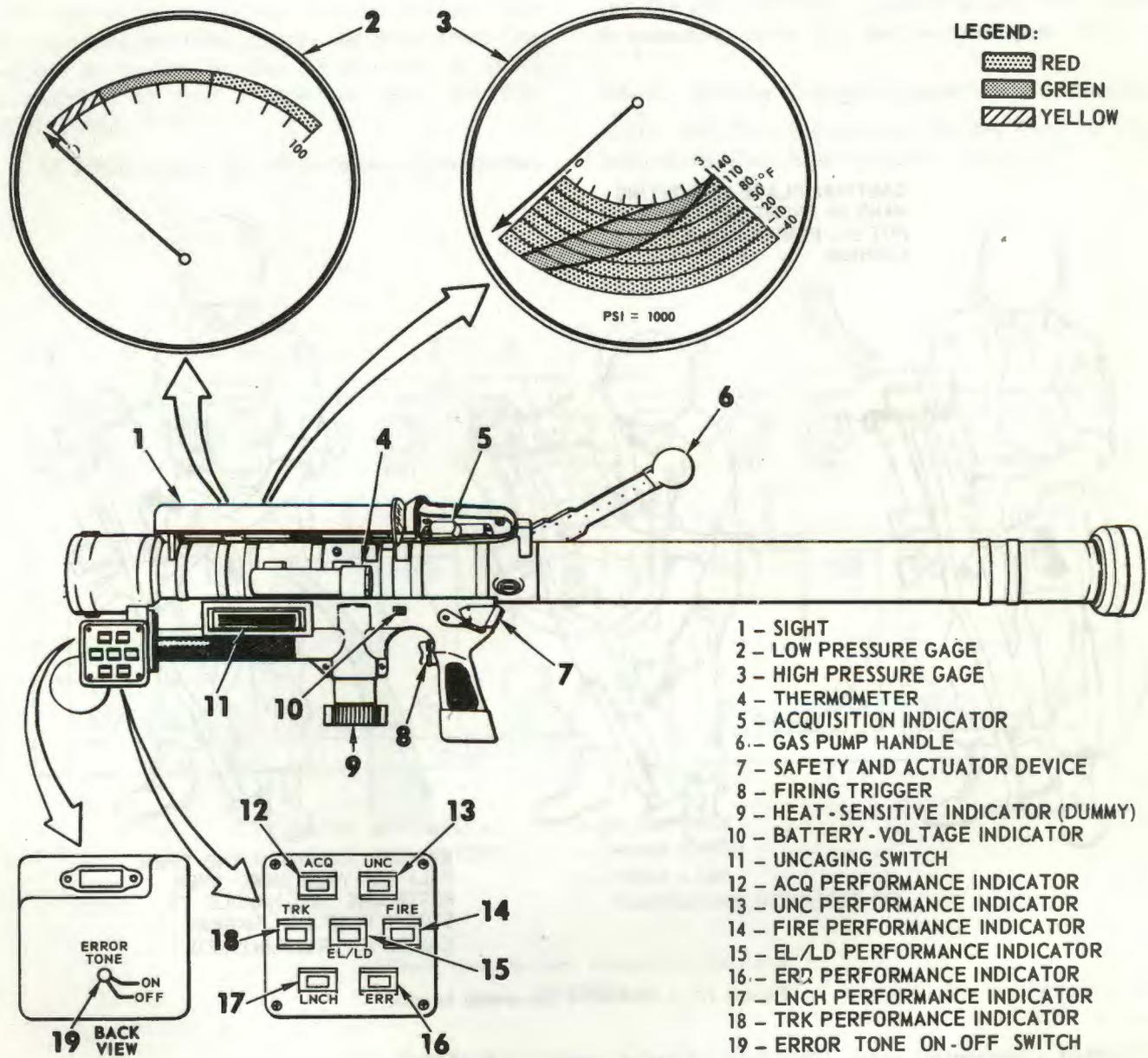


Figure 16-6. Trainer M49 controls and indicators.

gauge continues to indicate in the yellow or green bands (less than 60 psi). Under average temperature conditions, at least nine training sequences will be completed before repressurizing is required.

g. Thermometer. The thermometer (fig 16-6 (4)) shows ambient temperature from -40° F. to 160° F. and is used in conjunction with the high- and low-pressure gages to indicate when the gas system is sufficiently pressurized to perform the maximum number of training missions.

h. Gas Pump Handle. The gas pump handle

(fig 16-6(6)) is used to repressurize the closed-loop system when the requirement is indicated by the thermometer and the pressure gages. Figure 16-7 shows the proper stance for operating the pump handle.

i. Performance Indicators. The performance indicators (flags) (fig 16-6(12-18)) provide a visual indication of sequential errors made by the operator. Errors may be considered as two types, correctable or uncorrectable. A correctable (or revocable) error occurs when the operator has not yet pulled the firing trigger but has

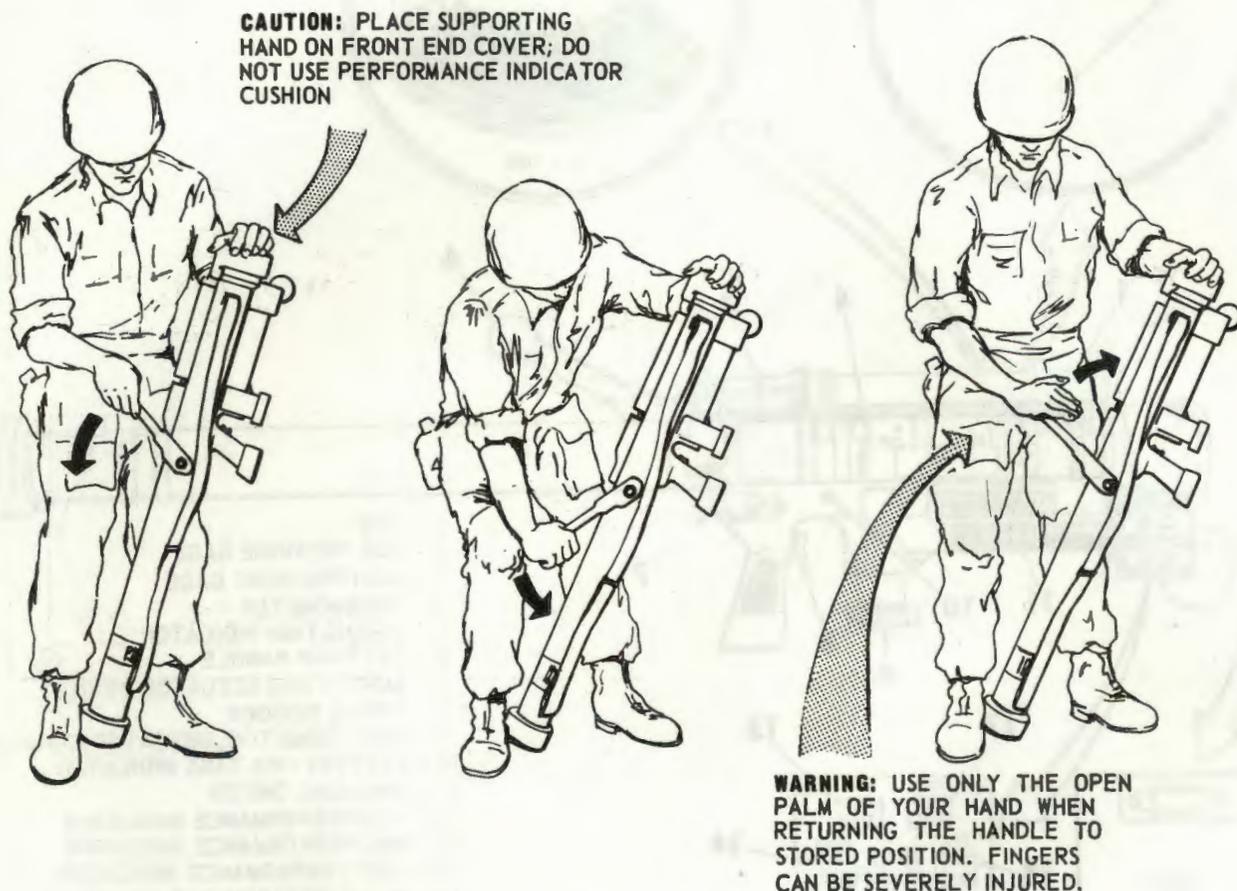


Figure 16-7. Operating gas pump handle.

committed a sequential error. This type of error is correctable and does not prevent the possibility of a successful launch. An ERR indication occurs when the gunner holds the uncaging switch, inserts superelevation and lead, but does not have target acquisition. An uncorrectable (or irrevocable) error occurs when the firing trigger is pulled with an error present. The firing sequence is terminated by this action and cannot be reinitiated immediately. These performance indicators are magnetic indicators which flip over from black to white (ERR indicator from black to orange). They indicate to the instructor the student gunner's progress in a simulated firing mission. The seven indicators (flags) are as follows:

(1) ACQ—acquisition.

- (2) UNC—uncage.
- (3) TRK—track.
- (4) EL/LD—elevation/lead.
- (5) FIRE—fire.
- (6) LNCH—launch.
- (7) ERR—error.

j. Battery Voltage Indicator. This is the same basic type of indicator (fig 16-6(10)) as the performance indicators. When the battery voltage falls below 35.4 volts, the indicator flips from black to white, and the battery should be replaced with a fully charged battery.

k. Error Tone Switch. The error tone switch (fig 16-6(19)) provides the instructor with an option of disabling the error tone. However, he

may elect to let the gunner become familiar with the sequence and then remove the error tone. The switch is located in the A8 module. A small screwdriver is used to open or close the ERROR TONE switch.

CAUTION: Care should be taken when operat-

ing the ERROR TONE switch as only 15° travel is necessary from the "on" to "off" position.

16-6. Battery Charger Controls and Indicators

Table 16-2 lists the battery charger controls and indicators illustrated in figure 16-8.

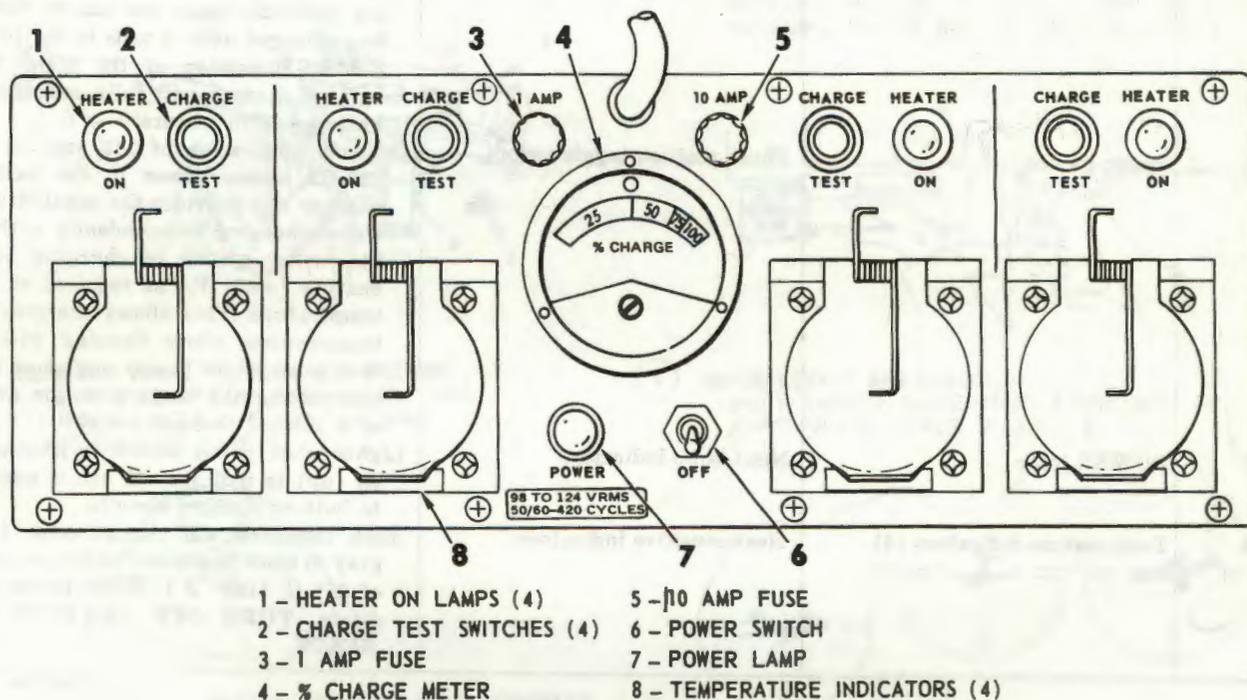


Figure 16-8. Battery charger controls and indicators.

Table 16-2. Battery Charger Controls and Indicators

Key (fig. 16-8)	Control or indicator	Type	Function
1	HEATER ON lamps (4)	Neon-lamp indicators.	Light when associated battery heaters are energized. When a battery is heated above 16° C. (60° F.), its heater de-energizes and the associated HEATER ON lamp goes out.
2	CHARGE TEST switches (4)	Momentary push-button switches.	When pressed, charging current is interrupted, the battery output is applied to a test circuit, and the charged condition is read on the % CHARGE meter. (Test circuit disconnects after 1 second.)
3	1 AMP fuse	115 vac, 1-ampere, cartridge fuse.	Overload protection for battery charging circuit.
4	10 AMP fuse	115 vac, 10-ampere, cartridge fuse.	Overload protection for battery heater circuit.
5	% CHARGE meter	0 to 100% CHARGE meter.	Indicates charged condition of a bat-

Table 16-2. Battery Charger Controls and Indicators—Continued

Key (fig. 16-8)	Control or indicator	Type	Function
6	Power switch	Three-position toggle switch.	<p>tery under charge when associated CHARGE TEST switch is pressed. The colored scales are:</p> <p>a. RED. Battery must be recharged before use.</p> <p>b. WHITE. Battery is less than 75 percent charged but will operate the trainer. Should be recharged for a full training session.</p> <p>c. GREEN. Battery is usable for about 15 training sequences. However, for maximum usage the battery should be recharged until it tests in the 100% CHARGE portion of the scale. The battery charger will fully recharge a battery within 5 hours.</p> <p>Controls application of 115 vac, 50- to 420-Hz source power to the battery charger and provides the capability of either charging independently without the heater system or charging after heating (+60° F.) as required at low temperature. This allows charging at temperatures above freezing without the danger of the heater coming on and overheating the battery in the event of a shorted thermal switch.</p>
7	POWER lamp	Neon-lamp indicator.	Lights when power switch is positioned on (up) to indicate 115 vac is applied to battery charger circuits.
8	Temperature indicators (4)	Heat-sensitive indicators.	Each indicator will change color from gray to black if exposed to temperature of 85° C. (180° F.). White letters indicate, TURN OFF CHARGER IF BLACK.

Section III. OPERATING PROCEDURES

16-7. Operation

The operating procedures which the gunner employs to engage a simulated target with the tracking head trainer are identical to the firing procedures of the Redeye weapon described in chapter 3.

a. *Firing Limitations.* For the trainer seeker to acquire a target, the target must be centered in the sight range ring, and the infrared radiation from the target must be strong enough for the seeker to lock on the target. Effective range of the Redeye weapon is limited by the flight time of the missile, target speed, and the time it takes the missile to attain the speed required for maneuverability. The gunner uses the open sight range ring as an aid to determine when a target can be engaged. If a target is too close for a missile launch to be simulated effectively,

the gunner should continue tracking the target until it passes beyond the minimum range before firing.

b. *Activate Zone.* To allow for gyro spinup time and seeker cooling, the gunner should activate the trainer at least 5 seconds before the missile launch can be simulated effectively. The location of the activate zone varies with the type of target, its speed, and its flight path.

c. *Preposition.* Ordinary tracking procedures apply to most jet targets. In tracking a fast-moving jet passing close-in or overhead, however, the gunner would swing the trainer so rapidly that the seeker line of sight would lag behind the launcher line of point (fig 4-22). To prevent this, the gunner employs a preposition technique against such targets. The gunner detects the target, determines target type, and ac-

FIRING INSTRUCTIONS

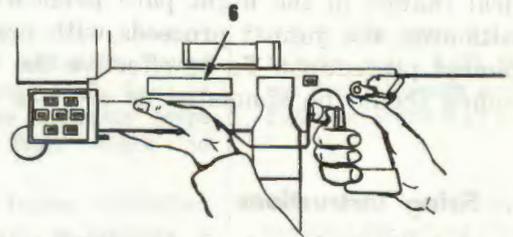
THE FIRING INSTRUCTIONS FOR THE TRAINER AND THE WEAPON ARE IDENTICAL. SPECIAL INDICATIONS AND OPERATIONS PROVIDED BY THE TRAINER ARE UNDERLINED.

NOTE: SPECIAL PRECAUTIONS ARE MANDATORY DURING FIRING OF THE ACTUAL WEAPON. REFER TO TM9-1400-425-12 FOR FAMILIARIZATION.

- 1 STANDBY**
REMOVE COVER 1, RAISE SIGHT 2, REMOVE BATTERY RECEPTACLE CAP 3, AND INSERT BATTERY 4.



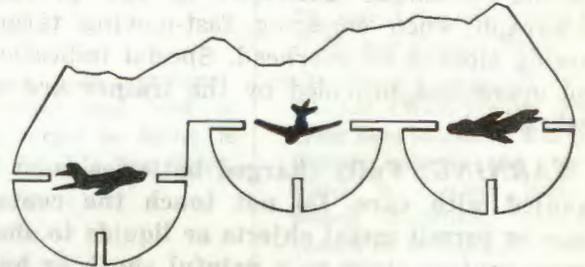
- 5 UNCAGE GYRO**
STILL TRACKING TARGET, PRESS AND HOLD UNCAGING SWITCH 6. A PURER TONE INDICATES SEEKER TRACKING. IF TONE IS LOST, RELEASE UNCAGING SWITCH AND GO BACK TO STEP 4.



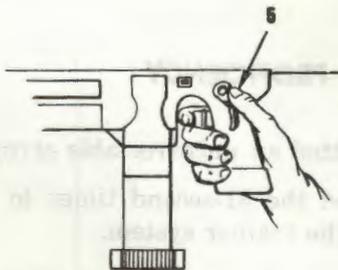
- 2 COMMENCE VISUAL TRACKING AND RANGING**
CENTER TARGET IN SIGHT RANGE RING (UPPER CIRCLE). BEGIN TRACKING AND RANGING TARGET.



- 6 SUPERELEVATE AND LEAD**
SHIFT TARGET IMAGE FROM RANGE RING TO APPROPRIATE LOWER SEMICIRCLE.



- 3 ACTIVATE**
WHEN TARGET ENTERS ACTIVATE ZONE, OPERATE AND RELEASE SAFETY AND ACTUATOR DEVICE 5, AND CONTINUE TRACKING. GYRO-SPINUP NOISE INDICATES POWER ON.



- 7 CHECK SEEKER TRACKING**
IF ACQUISITION SIGNAL IS LOST, OR AN ERROR TONE IS HEARD, RELEASE UNCAGING SWITCH, SHIFT TARGET IMAGE TO RANGE RING, AND GO BACK TO STEP 4.

- 8 FIRE**
STILL HOLDING UNCAGING SWITCH, SQUEEZE AND HOLD FIRING TRIGGER 7. KEEP TRACKING TARGET FOR APPROX. 1 SECOND.



NOTE: IF NO GYRO NOISE IS HEARD, CHECK BATTERY VOLTAGE INDICATOR. IF WHITE, REPLACE BATTERY.

- 4 IR ACQUISITION**
WHEN A DISTINCT TONE IS HEARD FROM ACQUISITION INDICATOR, YOU HAVE ACQUIRED A TARGET.

CAUTION: AFTER COMPLETING THE FIRING SEQUENCE, RELEASE THE UNCAGING SWITCH AND WAIT AT LEAST 1.5 MINUTES TO ALLOW THE GYRO TO SPIN DOWN BEFORE MOVING THE TRAINER. REMOVE THE BATTERY WITHIN 1 MINUTE AFTER OPERATING THE SAFETY AND ACTUATOR DEVICE. WAIT 3 MINUTES BEFORE STARTING A SUBSEQUENT MISSION.
CAUTION: BCU GETS EXTREMELY HOT WHEN FIRED. GRIP IT BY HEAT-INSULATED CAP WHEN REMOVING IT. DO NOT TOUCH THE HOT CASE FOR AT LEAST 15 MINUTES.
NOTE: IF THE 31-SECOND TIMER RUNS OUT OR THE FIRING TRIGGER IS PULLED OUT OF SEQUENCE, THE MISSION STOPS AUTOMATICALLY.

Figure 16-9. Firing instructions for tracking head trainer.

quires the target through the sight range ring. When the target reaches the activate zone, the gunner activates the trainer and continues to track the target in the range ring. When the gunner determines that the target has reached the point which would give him sufficient time to preposition the activated trainer, he visually tracks the target (without using the open sight) while pointing the trainer well ahead of the target toward an engage zone in which the line of sight will be changing more slowly. As the target nears the direction of preposition, he acquires it in the open sight and completes the training mission sequence. If the aircraft makes a radical change in the flight path prior to his prepositioning, the gunner proceeds with normal engagement procedures. To be effective the missile launch should be simulated as soon as possible.

16-8. Firing Instructions

Figure 16-9 illustrates a typical training mission performed with the trainer M49. Modify this procedure to include the instructions for preposition technique described in the previous paragraph when engaging fast-moving targets passing close-in or overhead. Special indications and operations provided by the trainer are underlined.

WARNING: Fully charged batteries must be handled with care. Do not touch the contact rings or permit metal objects or liquids to short across contact rings as a painful shock or burn can result.

Notes. 1. When an uncorrectable error occurs, or when

a successful launch sequence is carried out, launcher/missile (L/M) power is removed at once, but indicator power remains until the battery is removed. To conserve the battery for the maximum number of missions before recharging, the battery should be removed within 30 seconds after L/M power is removed.

2. Check the pressure reading on the low-pressure gas gage before beginning the missions. The reading must be below 60 psi to run a complete mission. If the reading is too high, repressurize the system by operating the pump handle.

WARNING: Use only the open palm of your hand to return the gas pump handle to the stored position (fig 16-7).

a. Remove the cover, raise sight, remove battery receptacle cap, and insert battery.

b. Commence visual tracking and range estimations.

c. Activate the trainer as the target enters the activate zone by pressing and releasing safety and actuator device.

d. Continue to visually track the target.

e. Acquire the target by aiming the trainer and noting proper acquisition signals.

f. Uncage the gyro by pressing and holding the gyro uncaging switch.

g. Apply the superelevation (and lead as required) by moving the trainer to establish the correct sight picture.

h. Check seeker tracking.

i. Fire the trainer by pressing and holding the firing trigger.

Section IV. EVALUATION OF GUNNER PROFICIENCY

16-9. Procedural Sequence Indicators

The instructor has several tools which he can use to evaluate gunner proficiency with the trainer. The tracking head trainer provides a performance indicator assembly (fig 16-6) which displays the actual sequence of gunner and trainer operation as each major step occurs. The performance indicator assembly provides information that the gunner has—

a. Correctly performed the operational engagement sequence.

b. Committed a correctable error.

c. Committed an uncorrectable error.

d. Allowed the 31-second timer to expire and shut down the trainer system.

16-10. Complete Operational Engagement Sequence

A complete target engagement exercise with the tracking head trainer is shown in table 16-3. The event or action starts from target detection through launch and describes gunner response through each event. The correct indication which the gunner should receive with the resulting indication if an error should occur are also de-

scribed in the table. An explanation of the indication(s) is also listed for each error indication. Gunners and training personnel should

study and become thoroughly familiar with visual indicators and audio cues to evaluate student gunner proficiency.

Table 16-3. Procedures for Use of M49 Trainer

Action	Response	Correct indication	Error indication and corrective action
1. Detect target.	Gunner prepares weapon and tracks target visually to determine target classification and time to activate in accordance with range ring profile (RRP).	Gunner visually follows target and uses sight to determine RRP.	
2. Activate decision.	Gunner operates safety and actuator device.	Gyro spin-up sound is heard in acquisition indicator.	
3. Track target with target centered in sight range ring.	Gunner evaluates output of acquisition indicator for valid IR.	When IR is received by seeker, acquisition indicator sound changes and ACQ flag on performance indicator drops (changes from black to white).	If IR is less than 2:1, signal-to-noise ratio ACQ flag will not drop although acquisition indicator sound may be heard.
4. Decision to uncage.	Gunner presses uncaging switch.	When seeker tracks, acquisition tone becomes or remains a relatively clear 1200-Hz tone even when sight is moved off target. UNC flag and TRK flag drops.	If IR signal is less than that required for seeker track, tone does not clarify and/or seeker does not track target. Gunner recages and continues to track target and repeats action 4. If IR signal is less than 2:1, UNC flag remain black.
5. Decision target is within launch zone.	Gunner inserts superelevation and appropriate lead in preparation for next step to follow immediately.	Seeker track tone continues. Superelevation and lead in direction target is flying is inserted; EL/LD flag drops.	Seeker track tone is lost during EL/LD. (With present design error tone sounds at EL/LD.) Gunner recages and repeats action 3. Gunner leads in wrong direction, evaluator (coach or instructor) corrects or scores errors on gunner.
6. Gunner decision to launch.	Gunner presses fire trigger and holds until launch.	Seeker track tone continues until launch tone.	Launch tone is not heard. Error tone is heard at fire. Gunner or evaluator determines from performance indicator where error occurred. Indications of error include the orange ERR flag showing at least one of the following groups: a. ACQ flag white. TRK flag black. UNC flag white. EL/LD flag white. FIRE flag white. LCH flag black. (IR radiation from target was lost between uncage and fire.) b. ACQ flag white. UNC flag white. TRK flag white. FIRE flag white. EL/LD flag black. LCH flag black. (Insufficient elevation inserted prior to fire.)

Table 16-3. Procedures for Use of M49 Trainer—Continued

Action		Response					Correct indication	Error indication and corrective action
								c. ACQ flag black. UNC flag black. TRK flag black. LCH flag black. EL/LD flag black. FIRE flag white. (*Fire without uncaging.) d. ACQ flag black. TRK flag black. UNC flag white. EL/LD flag white. FIRE flag white. LCH flag black. (Sequence performed without sufficient IR signal at uncage or subsequently.)
ACQ	UNC	TRK	EL/LD	FIRE	LCH	ERR	Completion of firing sequence	
1.						x	Normal sequence.	
2.	x				x		Insufficient IR signal at uncage or subsequent (without revocable error tone at EL/LD).	
3.		x			x		Loss of IR signal subsequent to uncage and prior to fire.	
4.	x	x	x		x		Fire without uncage (not possible in weapon).	
5.			x	x	x		Insufficient elevation inserted prior to fire.	
Firing sequence not completed								
1.	x		x	x	x	x	Insufficient IR signal prior to uncage.	
2.		x	x	x	x	x	Loss of IR signal after uncage prior to EL/LD or EL/LD insufficient.	
3.		x		x	x		Loss of IR signal after uncage before fire EL/LD inserted.	
4.	x	x	x	x	x	x	No change prior to EL/LD.	

*Not possible with weapon.
 x denotes black flag.

16-11. Visual Displays and Audible Cues

The instructor observes the performance indicators (flags) as the gunner performs the engagement sequences. The flags are color-coded to indicate the step functions of performance (fig 16-6).

a. Correctable Errors. A correctable (revocable) error, as stated previously, is a gunner operational procedural error committed prior to actuating the firing trigger. The gunner operational procedural error is not considered critical to the total weapon system as the missile has not been launched; therefore, the gunner has the capability to recage the seeker system and once again properly engage the target. This action enables the gunner to recover from his error without committing the missile to a launch which would result in a miss.

b. Uncorrectable Error. The uncorrectable (irrevocable) error by the gunner is a nonrecover-

able error. The gunner has either committed an operational error or made an improper decision regarding the IR signal and has pressed the firing trigger. The error would be correctable (revocable) if the firing trigger has not been activated. When the gunner presses the firing trigger out of proper sequence or without the necessary operational functions, the trainer operationally shuts down and the performance indicator locks the flags in their existing conditions. The gunner cannot continue with the engagement against that particular target unless the trainer is reset to start a new sequence by removing and replacing the trainer battery.

c. Audible Cues. The gunner is presented with audible cues which indicate the correct or incorrect procedures during target engagement. The gunner first hears gyro spinup as background noise which indicated the weapon is operational. He then monitors an audible IR signal to determine when he has achieved target ac-

quisition. A change in the IR signal will indicate uncage. At launch a single pulse tone will indicate successful launch or an intermittent tone will signal when the gunner has committed an uncorrectable sequential error.

16-12. Timer Expiration Conditions

The Redeye trainer M49 has a 31-second timer which is activated during operation of the trainer. When the trainer has been activated for 31 seconds, the timing device will shut down the system and lock all indicators in the existing status. During the engagement of slow non-jet targets, the gunner may encounter difficulty in performing the complete operational sequences prior to the 31-second timer expiration. However, the potential target may remain within range of the Redeye weapon after timer expiration. The gunner should remove the battery and reinsert the battery (to simulate insertion of a new BCU), thus reactivating the trainer to allow completion of the operational sequence within the target engagement boundaries.

16-13. Evaluation Checklist

Another tool which may be used by the instructor to evaluate gunner performance with the trainer M49 is the gunner evaluation checklist (table 16-4). The checklist should be used by the coach/instructor to determine gunner proficiency during the engagement sequence. It may be used during actual or simulated target engagement. Each required action will be rated as a satisfactory or unsatisfactory performance. Each task requirement shall be checked by the evaluator relative to the actual performance of the gunner/trainee. The coach/instructor should familiarize himself with the checklist prior to an exercise and, as the gunner proceeds through the engagement sequence, observe all incorrect actions and record them on the checklist. At the completion of the exercise the coach/instructor should present a short critique to the gunner/trainee, specifically pointing out the errors and good points.

Table 16-4. Gunner Evaluation Checklist

	Gunner	Coach	Satisfactory	Unsatisfactory
I. PREPARATION FOR FIRING				
a. Shoulders the weapon.				
b. Removes end cap.				
c. Raises sight into proper position.				
d. Inserts BCU adequately in launcher.				
e. Proper position (hands-elbows-feet).				
II. VISUAL TARGET ACQUISITION				
a. Acquires target at maximum range.				
b. Properly classifies target by type.				
c. Oversights.				
d. Correlates target profile in range ring with gunner actions; i.e., activates at proper time.				
e. Determines target trajectory (flight path) and positions body accordingly (incoming/crossing R/L, outgoing/crossing L/R, incoming, outgoing).				
III. INITIAL PROCEDURES				
a. Activates properly and at correct time.				
b. Tracks smoothly and steadily.				
c. Determines presence of IR acquisition.				
d. Uncages as soon as possible.				
e. Recognizes "seeker track" versus "IR acquisition."				
IV. FIRING PROCEDURES				
a. Determines if target is within launch boundaries or in hold fire status.				

Table 16-4. Evaluation Checklist—Continued

	Gunner	Coach		
			Satisfactory	Unsatisfactory
<p>b. Determines crossover (jet targets only).</p> <p>c. Inserts proper superelevation (and lead if necessary) prior to firing.</p> <p>d. Fires at proper time with respect to range ring profile.</p> <p>e. Holds trigger and uncaging switch and continues to track for at least 3 seconds after firing.</p>				

PENALTY POINTS. Penalty points are assessed against student gunners by evaluator, using the following list of common and critical errors.

1. Fails to grip weapon properly for shouldering (left hand on forward pistol grip; right hand on launch tube, rear of pistol grip).
2. Fails to oversight.
3. Cants weapon on shoulder.
4. Hand, wrist, or arm against BCU.
5. Finger on trigger prior to firing.
6. Fails to track smoothly or exceeds tracking rate.
7. Elbows away from sides of body.
8. Exceeds maximum or minimum safety elevation angle.
9. Releases firing trigger too soon after firing.
10. Fails to continue to track.

CHAPTER 17

MOVING TARGET SIMULATOR M87

Section I. DESCRIPTION

17-1. Introduction

The moving target simulator M87 (figs 17-1 and 17-2) is a device which will present realistic target images with flight pattern and maneuvers representative of those expected to be encountered by Redeye gunners. Targets are projected on a simulated sky background extending 180° in azimuth and 90° in elevation. Target sound effects and a painted background scene

from horizon level to -10° provides added realism. An invisible infrared spot coincident with target position provides the means for proper operation of the Redeye infrared seeker. The Redeye moving target simulator (MTS), when used in conjunction with the Redeye tracking head trainer M49 described in chapter 16, can be used to realistically train and evaluate the Redeye gunner. Simulated firing engagements can be conducted against low-, medium-, and

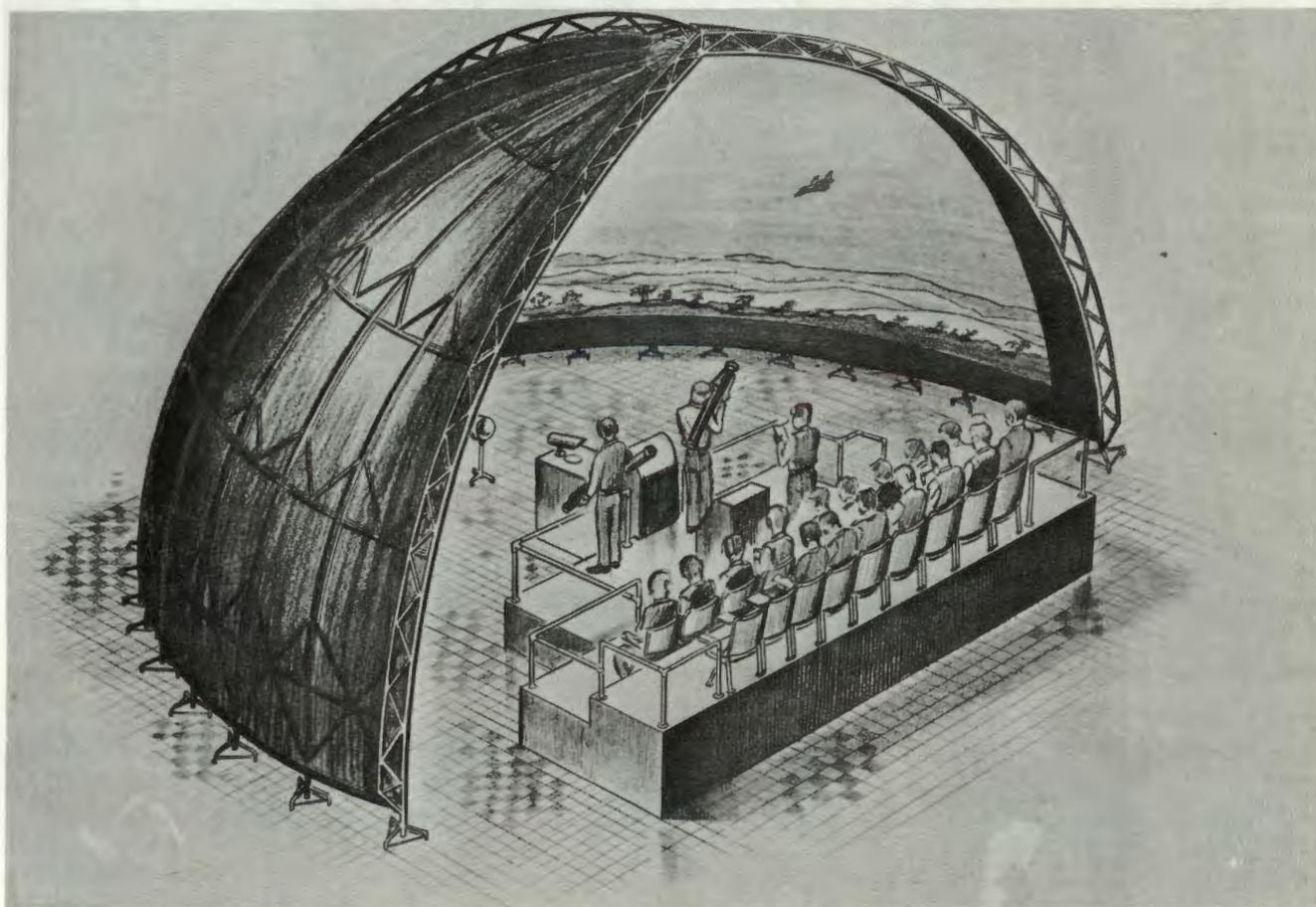


Figure 17-1. Training set moving target simulator M87.

high-performance targets without the necessity of expending live weapons, target drones, or aircraft missions. The moving target simulator is an effective training device which can be used by a commander to train his gunners and evaluate their state of proficiency.

17-2. Purpose

The purpose of the Redeye moving target simulator (MTS) is to provide economical and realistic targets for training and evaluating Redeye gunners. Aircraft images are projected on a spherical screen with realistic sound effects and IR characteristics similar to actual aircraft. In addition to training economy, the MTS provides a high degree of training stimuli to a Redeye gunner. It enables him to "engage" an assortment of aircraft types with varying target

course, speed, maneuver, and range which would not be encountered except under actual combat conditions. Moving target simulators are expected to be provided at major installations in CONUS and overseas.

17-3. Description of Major Components

The training device comprises the following major components, firing platform, observer platform, target projection console, projection screen assembly, loudspeakers, trainer control console, 16 mm motion picture films, background scenery lighting system, and a power supply. (For detailed information on the MTS, see *TM 9-6920-427-12.)

a. Firing Platform. The firing platform is

*To be published.

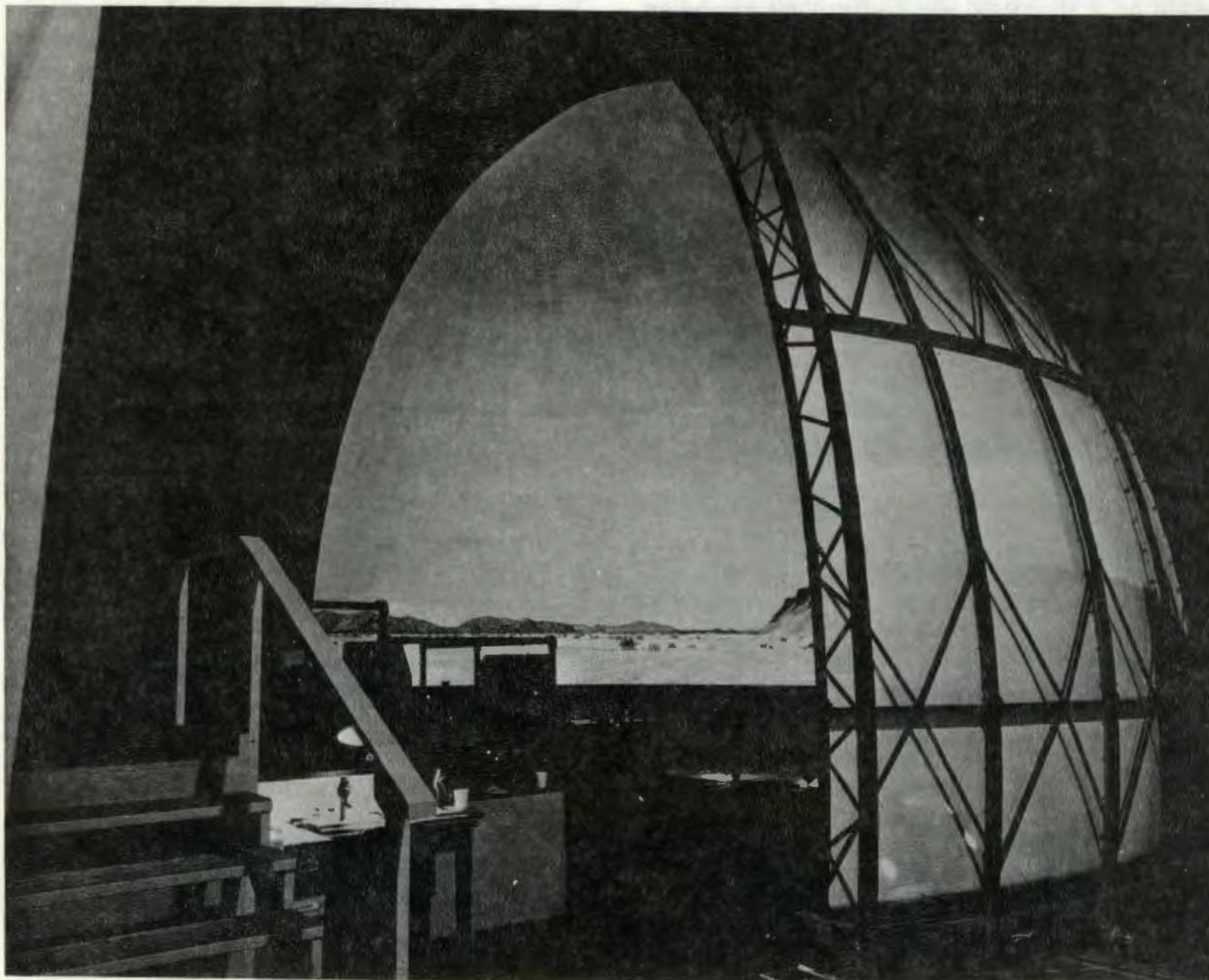


Figure 17-2. Side view of moving target simulator.

located to the rear of the target projection console and consists of four sections each 2 feet high, with the firing positions located slightly behind and to the side of the projection console. The firing platform is surrounded by a metal safety railing which does not interfere with the gunner's view of the screen.

b. Observer Platform. The observer platform is located behind the firing platform and has two rows of seats arranged in tiers. The observer platform is near the firing area so that observers can hear the instructor's comments while observing the gunner/trainee performance. The platform, consisting of six sections is enclosed by a metal safety railing.

c. Target Projection Console. The target projection console (fig 17-3) provides the means to project the target image on the screen. The con-

sole includes the target image projector, infrared emission projector (IR lamp assembly), power supplies, amplifiers, gimballed mirror assembly, and logic rack. The purpose of the target projection system is to combine the visible target image from the target image projector and the IR source from the IR lamp assembly into one beam. The combined target image and IR beam is reflected to the desired azimuth and elevation onto the screen by the movable gimballed mirror.

(1) *Target image projector.* The outputs from the 16 mm target image projector include a visual target aircraft image, binary data for gimballed mirror positioning, IR and image projector on/off control, launch boundary indication, and audio for reproduction of aircraft sounds and other required data. The target image projector projects the target image onto the screen through

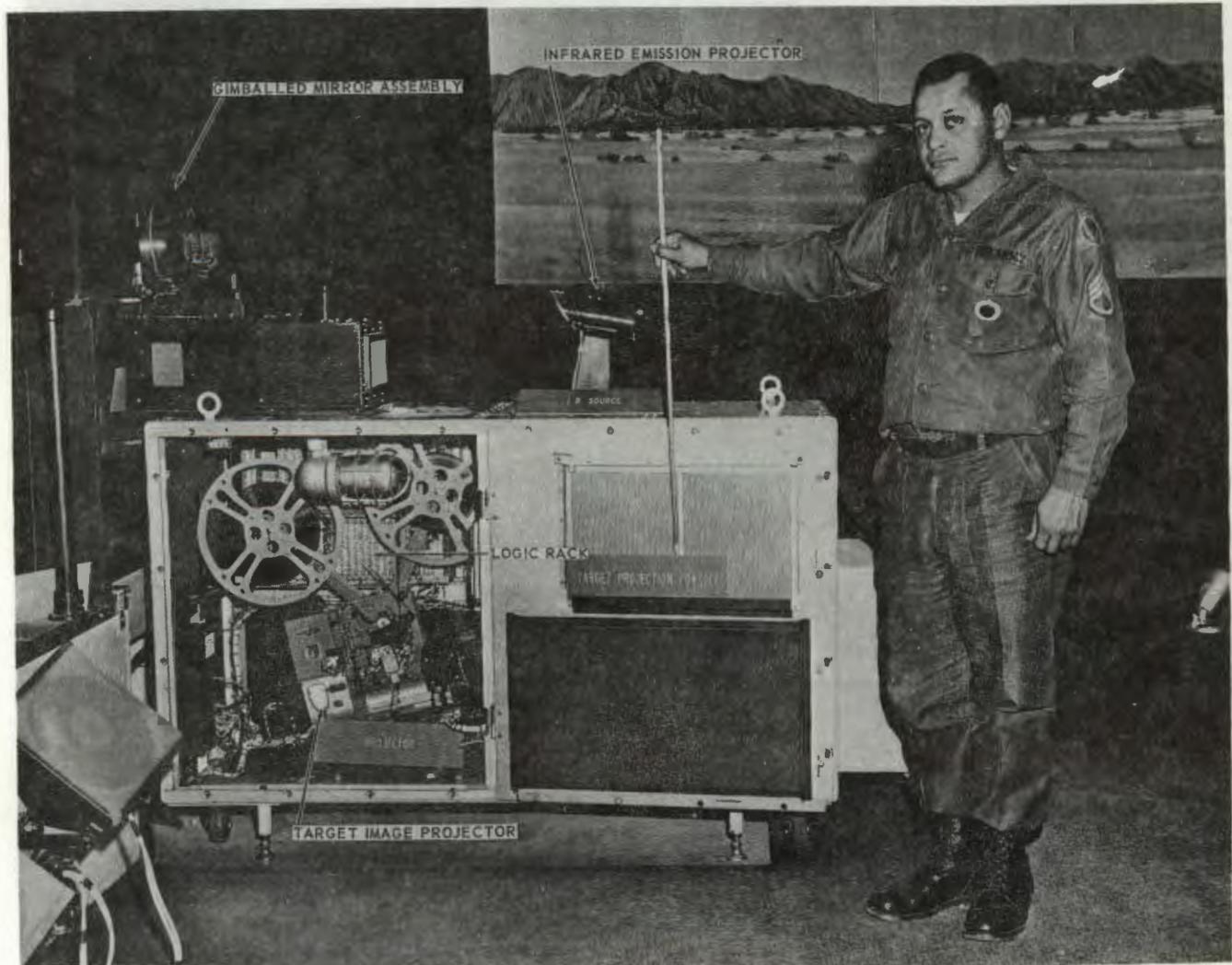


Figure 17-3. Target projection console.

a transfer optics system consisting of three fixed mirrors and the gimbaled mirror. The gimbaled mirror directs the target image to the projection screen, creating the illusion of aircraft motion across the gunner's field of view.

(2) *Infrared emission projector (lamp assembly)*. The lamp assembly (IR source) is mounted on the front of the target projection console and aimed directly at the IR pedestal. An incandescent lamp, variable in brightness and IR output, provides the source of IR energy. The IR energy passes through a filter at the front of the source and is collected by the mirror mounted in the IR pedestal. The filter removes all visible light from the IR beam. The IR pedestal in front of the target projection console contains a curved mirror which reflects the IR

to the gimbaled mirror and focuses the IR beam into a 3/4-inch spot on the screen. The IR beam is thus coincident with the target image and remains superimposed on the target image. Since the target IR emission is turned on only when the simulated target is within normal IR acquisition range of the Redeye weapon, proper responses are obtained from the tracking head trainer M49.

d. *Projection Screen Assembly*. The spherical 40-foot screen assembly (fig 17-4) is constructed of perforated aluminum panels supported on an aluminum frame. The entire structure is assembled from sections small enough to pass through a 60- by 78-inch doorway.

e. *Loudspeakers*. Three loudspeakers provide

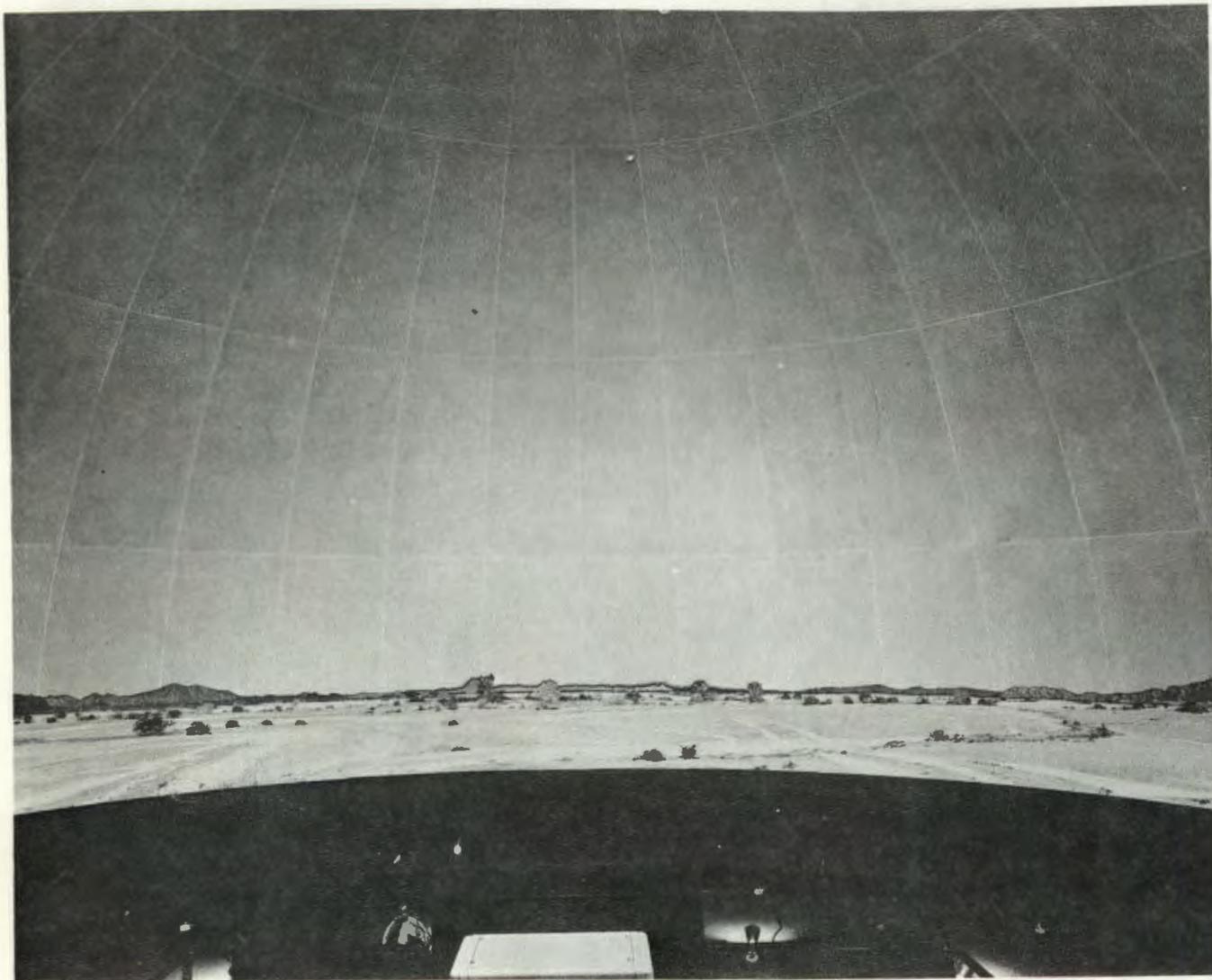


Figure 17-4. Projection screen assembly.



Figure 17-5. Trainer control console.

sound effects from the rear of the projection screen. A speaker is located at the vertical center near each end of the screen and one at the screen center.

f. Trainer Control Console. The trainer control console (fig 17-5) enables the operator/instructor to operate the training device. The trainer control console is movable but is usually located at the rear of the firing area platform. The trainer control panel is mounted in the top of the console and contains all controls necessary for operation of the trainer. This panel also provides the operator/instructor with visible status of IR and launch boundary.

g. Motion Picture Films. The 16 mm motion picture films contain the target images used for projection. Target sound effects and electronic control signals (similar to ordinary tape recorder/player) are also on the recorded section of the film to control the target image projection system for each target trajectory (target flight path). The audio signals are applied to three loudspeakers where the output is varied between

them so that the apparent sound location coincides with the location of the target. The electronic control signals are processed and used to switch on and off the target IR source in accordance with the target program. The films supplied with the trainer contain exercises and problems ranging from simple to difficult. Each film reel contains 20 individual target trajectories.

h. Background Scenery Lighting System. The background scenery lighting system consists of 4 background lights and 11 footlights. Two background lights are mounted at the base of each platform facing the projection screen assembly and two on the forward portion of the projection console. Eleven footlights are spaced inside the perimeter of the projection screen assembly. The brightness of the sky (background lights) and scenery (footlights) is controlled from the trainer control console.

i. Power. Power for operation of the trainer is derived from a conventional 115-volt, 60-hertz source.

Section II. TARGET FILM PROGRAMS AND TRAINING OBJECTIVES

17-4. Target Film Programs

Existing target programs consist of 11 reels of film, each containing 20 target courses (runs). Twenty different types of aircraft are presented in five general classes including jet-fighter, fighter-bomber, helicopter, cargo-transport, and propeller utility. The programs and training objectives are arranged in a sequence designed to develop mental and physical proficiencies in a progressive order of difficulty. Target engagement problems are structured to increase student performance demands by varying factors of target course, speed, maneuver, and range.

a. Target Course Data. A trained instructor operates the MTS console and coordinates the film program presentations with the required training. A manual is provided for the instructor so that he has ready information for each target course.

b. Target Reel Data. Included within the data sheet for each reel are the run number and reel number which identify each target presentation. Coded "type" of aircraft are referenced to aircraft type whose NATO designation is shown on the run analysis sheet. Entry of aircraft on screen (first appearance) is shown using azi-

muth, ground range, and altitude. Azimuth is expressed in degrees and ground range in kilometers is measured from the gunner with north (0° or 360°) at top center of the graphic representations. North on the MTS is at the center of the screen (equidistant from the screen edge). Altitude is expressed in meters. Aircraft course is expressed in degrees relative to north, representing the aircraft heading. Change of aircraft course in g's indicates the radius of the turn relative to speed; a high-g turn having the smaller radius for a given speed and the higher speeds having a larger radius for a given g. Speed is expressed in knots and time of run in seconds. Aircraft exit data (last appearance) is also shown, using azimuth, ground range, altitude, and speed.

c. Target Run Analysis Sheets. There are 20 target run analysis sheets per reel. Target run data scaled to 1 inch per kilometer is provided on each target run sheet. The instructor is given crossover slant range, activate, IR radiation, launch boundary, hold fire, and cease fire data which are keyed in time to assist in evaluation of the student gunner response. Definition of special annotations found on each sheet refer to the following terms:

(1) NIR—No IR emission available for the trainer M49 after passing this point until otherwise noted.

(2) IR—IR radiation acquisition of target possible past this point until otherwise noted.

(3) A—Target crosses or enters activate boundary.

(4) L—Target crosses the launch boundary.

(5) XO—Target is at crossover.

(6) CF—Target crosses cease fire boundary.

(7) HF—Target crosses or enters hold fire boundary.

17-5. Prerequisites for MTS Training

Prior to commencement of training exercises on the MTS, the student must receive certain preparatory training to be able to participate in the MTS training program. Specific prerequisites for the training program and the proficiency code key are listed in chapter 18.

17-6. Training Objectives

Training objectives are included with each film program (reel) to assist the instructor in accomplishing the teaching points designated specifically for that reel. Objectives should be stated at the beginning of the instruction. Objectives are outlined for each reel as follows:

a. Reel No. 1.

(1) To familiarize the students with the training equipment, method of target presentation, and the procedures to be followed during the training period with the moving target simulator.

(2) To train the student in determination of the proper time to activate, launch zone for incoming targets, hold-fire periods, launch zone for outgoing targets, cease-fire points, and target crossover events for typical target flight conditions based on weapon range ring profiles.

b. Reel No. 2. To train the student in engagement procedures through fire and launch against targets flying straight and level courses at speeds not exceeding 200 knots and crossing at ranges less than 2 kilometers.

c. Reel No. 3. To train the student in engagement procedures against maneuvering targets which include turns not exceeding 90° or 1g. Crossing ranges will be less than 2.5 km and will completely familiarize the student with the hold-

fire zones for low-speed targets. A second launcher battery will be required for some engagements, decision to use second battery will be assisted by instructor commands.

d. Reel No. 4. To train the student in engagement procedures against maneuvering low-speed jet aircraft with the exception of run No. 11 which is a low-speed nonjet. Target speeds are not in excess of 250 knots and include turns not exceeding 90°. This reel will allow the student to familiarize himself with the hold-fire rule against jet aircraft after crossover. The technique-of-fire rule for jet aircraft (above 400 knots) will apply to this exercise. The lower speeds will allow the student more time to complete the mission at this early stage of training.

e. Reel No. 5. To train the student in engagement procedures against maneuvering high- and low-speed targets. Jet speeds will be 300 knots and other categories will be at proportionate speeds. All targets will appear at 500 meters altitude. Targets will perform 0.5_g to 1_g turns up to 180°. All technique-of-fire rules will be employed by the student in accordance with the aircraft category.

f. Reel No. 6. To evaluate the student on engagement procedures and proficiency against maneuvering targets of all categories. Target speeds will range from 80 to 300 knots and altitudes from 150 to 300 meters. Maneuver will include turns up to 90° at rates from 0.5_g to 1_g.

g. Reel No. 7. To evaluate the student on engagement procedures and proficiency against maneuvering high-speed targets of mixed categories. Target speeds will vary from 300 to 400 knots and altitudes from 150 to 2,000 meters. Maneuvers will include high-speed turns up to 180° from 2_g to 3_g and will also include target altitude changes.

h. Reel No. 8. To evaluate the student on engagement procedures against maneuvering high-altitude targets with speeds up to 400 knots. Targets will generally be at ranges near the outer launch zone. Students will be tested on ability to rapidly perform procedural sequences and discriminate launch and cease-fire boundaries.

i. Reel No. 9. To evaluate students against high- and low-altitude, predominantly high-speed, maneuvering targets. Runs will include aircraft paths which present relatively high elevation angles at crossover (approximately 45°). Occasional targets will exceed 400 knots. Maneuvers

will require change in lead angle during the firing sequence. Student will be evaluated on ability to rapidly perform the procedural sequence including emphasis on correct lead angle, and to discriminate launch and cease-fire zones.

j. Reel No. 10. To examine the student on previously learned knowledges and skills. Targets presented will include a selected mix from previous reels. Presentations are in groups of four selected to minimize variance of student performance requirements. Reel evaluation sheets should

include all errors of performance coded in previous reels.

k. Reel No. 11. To examine the student on previously learned knowledges and skills. Targets presented will include a selected mix from previous reels. Presentations are in groups of four selected to minimize variance of student performance requirements. Reel evaluation sheets should include all errors of performance coded in previous reels.

Section III. USE OF TRACKING HEAD TRAINER WITH MOVING TARGET SIMULATOR

17-7. Instructor Procedures

Specific information for instructor use is included with each reel to provide guidance on conduct of training. Information on conditions, standards, orders, criterion, and scoring for each reel assists him in instruction. The instructor may also use special training procedures.

a. Conditions. Prescribed conditions pertain to certain gunner environmental situations; e.g., the tracking head trainer is on the student's shoulder with battery in battery receptacle at start of the exercise (fig 17-6).

b. Standards. Standards prescribe what the student should be able to accomplish within the time period allocated.

c. Orders. Assigning student gunners to a firing order places them in a definite grouping for simplicity of scheduling their sequence. Each order trains on four target runs. To allow sufficient changeover time between orders at the completion of the fourth run, the instructor presses the STOP AFTER RUN switch on the trainer control panel. The switch may be pressed at any time during the run and the projector will stop the film presentation automatically at the end of the run. When the new student is ready, the instructor presses the START switch and continues the training.

d. Criterion. Information is provided the instructor as to the required performance of the student gunner.

e. Scoring. Information is provided the instructor on how to score the student gunner on a reel evaluation sheet.

f. Special Training. Special training may be employed by the instructor to train on unusual

conditions which Redeye gunners may be expected to encounter. To accomplish these effects, additional suggested modes of operation may include:

(1) Aircraft sounds may be eliminated (volume control off) to prevent alerting the student to the aircraft position and allow practice in search and scan procedures.

(2) IR override can be momentarily used during the run to turn off IR at a critical time in the sequence of operations; e.g., after uncage, to train the student in reacquisition procedures.

17-8. Procedure for Use of Trainer M49

a. A recommended procedure is to use trainer M49 at each training position as follows:

(1) Student finishes the run with trainer No. 1 and hands the trainer to assistant.

(2) Student picks up recycled trainer No. 2 from rack at appropriate time.

(3) Assistant waits 30 seconds, resets trainer No. 1 by removing battery and reinserting another battery and inspects the performance indicator to ascertain ACQ flag is not white. Assistant may also repump gas during the 30-second waiting period prior to placing trainer in rack.

b. A recharged battery is inserted into the trainer battery receptacle at the end of each two reels.

c. Trainer responses and performance indicator conditions for each procedural action for both correct and incorrect student performance are shown in table 16-4.

17-9. Use of Range Ring Profiles

Application of the range ring rules by the student

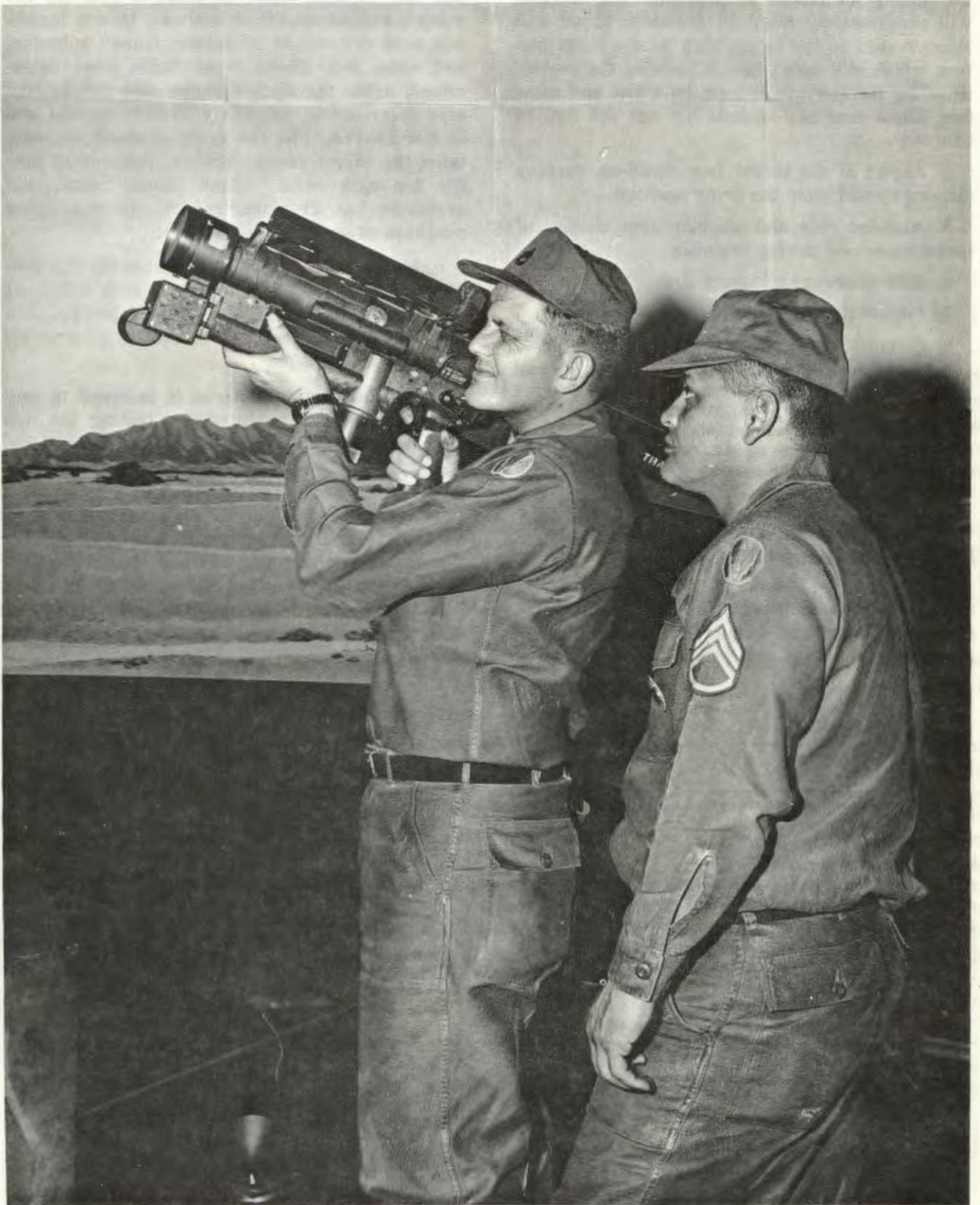


Figure 17-6. Gunner training on MTS.

should be reinforced or corrected by the instructor during all phases of training. The student will progressively learn to associate visual and sensory cues to the range ring profile sight picture which will assist him in making the correct decisions for activate, launch, hold fire, and cease fire. These cues will include but are not limited to:

- a. Aspect of the target (e.g., head-on, turning etc.) as viewed from the firing position.
- b. Angular rate and angular rate change of target as sensed during training.
- c. Rate of change of target size.
- d. Perceivable target detail.
- e. Aircraft engine sounds.

Note. The forward disk on trainer M49 is replaced with special focusing lens specifically designed for use with the MTS. The trainer will not operate properly with the MTS unless the focusing lens is used. The lens is designed to compensate for IR defocusing within the seeker due to the short ranges (20 feet) involved in the MTS.

17-10. Criteria for Determining Student Performance Using MTS Programs

a. The training standards, when used with the run analysis sheets, provide the means to evaluate student performance based on "expected" performance. The run analysis sheet contains a

scaled target trajectory with time (in seconds) and film footage, based on start of run, for the weapon-related events of activate, launch incoming, hold fire, target crossover, launch outgoing, and cease fire. These event times were determined, using the Redeye range ring profile concept described in chapter 4 of this manual and in FM 23-17A. The run analysis sheet also contains the target characteristics, range ring profile for each event, target speed, range, and evaluation at crossover which the instructor monitors to evaluate the student.

b. Expected tolerance data standards are provided in table 17-1. The weapon events called out on the run analysis sheet and the tolerance data are used by instructors to determine student errors and progression.

c. The instruction materiel is designed to provide the means of training and testing the student in all types of target engagement situations. The student will act at all times under the Redeye team concept. The instructor will act as team chief, providing the gunner with commands; e.g., SEARCH and PREPARE FOR ENGAGEMENT. The instructor will also call out "target hostile" information. This method of instruction will prepare the student to act under a tactical situation with the effectiveness necessary to achieve success.

Table 17-1. Tolerance Standards

	Time (Seconds)		
	Best	Average	Worst
1. *"Prepare to engage" to ready to activate.			
a. Weapon ready on shoulder.	No data	5	No data
b. Weapon on ready rack.	No data	7	No data
2. Activate to uncage (with IR).	5	8	12
3. IR to uncage (at least 4 sec after activate).	1	3	8
4. Uncage to launch (*target hostile).	3	3	5
5. *"Target hostile" to launch.	4	4	5
6. Activate to launch (with IR and *hostile).	8	10	17
7. With new battery insertion during exercise.			
a. 1st activate to 2d activate.	No data	40	No data
b. 1st activate to uncage (with IR).	**45	48	**52
c. 1st activate to launch (with IR and *hostile).	48	50	57

*Team chief command.

**Estimated, based on 0-second battery change.

CHAPTER 18

REDEYE TRAINING PROCEDURES

Section I. GENERAL

18-1. Purpose and Scope

This chapter discusses Redeye training procedures and resources and provides uniform guidance in the conduct of Redeye training in all components of the Army. It includes general information on the conduct of training, training aids, Redeye gunner job requirements, and tracking range instructional procedures.

18-2. Training Objectives

The objectives of the training program are to—

- a. Qualify the individual to perform the functions of a Redeye team chief and gunner in a combat unit.
- b. Assist in producing a Redeye team qualified to perform its operational mission.

18-3. Training References

A complete list of references is shown in appendix A. Some of these references may become obsolete. The instructor should refer to the appropriate index of military publications (DA Pam 310-series), check indicated references, and present the instruction accordingly.

18-4. Minimum Training Schedule

Army Subject Schedule 23-17 is intended for use throughout the Army and should be integrated into the training of the parent unit by modifying

the training time to match that in the applicable Army training program. The time allotted in the subject schedule is considered to be the minimum necessary to achieve an acceptable level of performance.

a. *Redeye Gunner Training.* The Redeye gunner qualification (specialized individual training) is the technical training presented to the Redeye gunner by Army training centers or by other training commands as directed by United States Continental Army Command. This 120-hour training program may also be given on an annual basis to Redeye gunners who have received initial training and are still serving as Redeye gunners in TOE units. The program is a repeat of the basic gunner program, plus 44 hours of aircraft recognition as prescribed in Army Subject Schedule 44-2. Subjects to be stressed include visual aircraft recognition, techniques of fire, and engagement of targets.

b. *Air Defense Section Training.* The air defense section training outlined in ASubjScd 23-17 (417 hours) provides guidance for conduct of training of Redeye sections in all components of the Army. The training program is given Redeye gunners who have received initial training and are assigned in air defense sections to TOE units. The training covers Redeye-peculiar training subjects and presents more training time to critical subjects, such as command and control, communications, visual aircraft recognition, techniques of fire, and team tactical employment.

Section II. CONDUCT OF TRAINING

18-5. Advice to Instructors

- a. Training will be conducted in accordance with the principles specified in FM 21-5.
- b. The application of prior instruction to current training must be emphasized. The goal of training should be the standards set forth for

the Redeye gunner in AR 611-201, this chapter, and appropriate Army training programs of the combat arms.

c. Individual training is conducted by non-commissioned officers as far as practicable. Officers are responsible for preparing training

plans, conducting section training, and supervising and testing individual training.

d. It is recommended that certain Redeye-peculiar training be centralized for economical use of training resources. Training officers may incorporate Redeye training, such as tactical employment, RSOP, and field exercises, into the parent unit's field exercises for more realistic training and application of Redeye sections and teams. Every opportunity to train Redeye gunners to simulate engagements of live aircraft should be used.

e. Commanders and training officers should endeavor to integrate Redeye team training into the unit's daily training activities when in garrison and when the team is not undergoing centralized training under the section leader. This will assure that Redeye personnel are properly employed by the commander, not only in garrison, but also during tactical exercises and combat operations. It is not intended that all Redeye training be centralized. Subjects included in ASubjScd 23-17 which may be integrated with the unit training include map reading, communications, RSOP, active and passive defense measures, tactical employment, command and control, destruction of equipment, maintenance of equipment, and engagement of targets.

f. The proportion of time spent on the tracking range, where the gunner practices the basic fundamentals of handling and operating the weapon (trainer), must not be lessened in favor of classroom instruction.

18-6. Training in Aircraft Recognition

a. Current methods of visual aircraft recognition training can produce reasonably satisfactory results. Because of the importance of this problem, improved training aids and training instructions are undergoing final development by the US Army Air Defense School. The new visual aids and instructions will replace equivalent material included in the SL-ARK No. 1 35 mm aircraft recognition slide kit now available at audio-visual support centers at most installations. (The SL-ARK kit No. 1 is *not* a TOE issue item. It must be obtained through audio-visual channels, or may be shared with other units.) The new material is currently identified as the *Ground Observer Aircraft Recognition (GOAR) Kit*. The GOAR slides are designed to teach aircraft recognition by presenting realistic and tactical flight aspects. The GOAR slides are more difficult to identify than the SL-ARK slides, but produce the desired results in the field. The new slides are shown during training in 5- to 8-second exposures, there being no tactical requirement for the "instant recognition" approach of years ago. Nationality insignia are taught as a subject separate from aircraft recognition since insignia vary (e.g., the F-100 is used by 12 countries) and often may not be visible from the field. Slides alone, no matter how modern, are of little value unless presented as part of a properly designed training program. A modern training program that can be administered by a junior officer or noncommissioned officer is shown in table 18-1.

Table 18-1. Aircraft Recognition Training Program

What	When	Why	How
Supplemental training	Throughout	Review and supplement	Self-study. Use card decks or substitutes. (Card decks under development at Fort Bliss.)
Goal setting	1st stage	Inform and motivate	Set 95 percent class accuracy goal per aircraft per hour. (Achievable—ATT 44-3 sets 90 percent minimum.)
Nomenclature familiarization	2d stage	Develop standard language	Standard pattern of recognition features. Simple terms. Use slides.
Aircraft familiarization	3d stage	Define the problem	Introduce theater tactical aircraft and their recognition features. Keep number of aircraft low. Use slides.
Recognition practices and comparisons	4th stage and as needed	Discriminate between aircraft	Stress "look-alike." Stress individual performance. Use slides with 5- to 8-second exposures. Informal tests and reviews. Class average to be 90 percent before proceeding.

Table 18-1. Aircraft Recognition Training Program—Continued

What	When	Why	How
Achievement testing	5th stage and as needed	Expose problem areas	Formal test. Vary tests. Use test slides.
Remedial training	6th stage and as needed	Solve problems exposed	Variable, depending on whether problem is with an individual or the class, or with a single aircraft or a pair/group.

b. The specific techniques used during stages 4, 5, and 6 (table 18-1) offer the most improvement over older methods. In these stages individual problems are clearly brought out and methodically solved. It is not enough that the class aircraft recognition average is good—each man must be good. Such a program is not a one-time effort, but rather is updated and repeated as necessary to maintain peak proficiency. The method is described in FM 44-30 which should be available down to section level. Even a 96 percent correct identification capability is not good enough when you consider the requirement to clear the sky of hostile aircraft while avoiding shooting down friendly aircraft. If a friendly aircraft passes in range of a large number of Redeye gunners, each with a 96 percent identification accuracy record, the aircraft's chance of making it through without getting mistakenly shot at by at least one gunner is not as good as it should be. Of course, even one percentage point in identification makes a great difference. But until the goal of perfect identification capability is reached, efforts to reduce the possibility of friendly aircraft being exposed to gunner error must be continued. This is where pilot cooperation, the command and control system, and the battalion forward area alerting radars (FAAR) come into the picture. Pilots cooperate by adhering to air traffic control procedures designed to minimize unnecessary exposure to friendly Army air defenses. The Army's command and control system, through warning of forthcoming friendly air activity and/or through imposition of temporary "hold fire" orders, complements the gunner's identification capabilities. FAAR provides timely warning and tentative identification of many aircraft; thus, the combination of well-trained gunners, air traffic control procedures, the Army's command and control system, and the FAAR insure that Redeye provides maximum danger for enemy aircraft while not unduly endangering friendly aircraft.

18-7. Tracking Range Instruction

Tracking range instruction applies to that training conducted on a tracking range or suitable

training area where aircraft are used to provide Redeye gunners with experience in tracking and simulated engagement of aircraft targets. Tracking aircraft should be scheduled for specific periods of time for proper utilization of training time. Tracking range instruction provided Redeye gunners should be carefully planned. Assignment to the tracking range of well-trained and motivated instructors and assistant instructors/coaches who effectively use leadership, training time, and training resources available will greatly increase the ability of Redeye gunners to function properly. A tracking range SOP and lesson plans should be prepared. Frequent but short demonstrations and conferences should emphasize correct methods of employing trainers and engaging targets. Uncorrected errors will cause the gunner to lose confidence in his ability to function properly. A short informal critique should be conducted immediately following each simulated engagement. Coaches should be observant and alert to detect gunner error because of the short engagement time, particularly with jet targets.

18-8. Army Training Test

Checklists for testing the battalion/squadron air defense section (ATT 44-3) are designed to test the ability of the section to perform its mission under simulated combat conditions. The checklists follow the general outline of an Army training test and are administered in conjunction with the parent unit's training test. The checklist includes a tactical phase and a firing phase, the latter including an aircraft recognition test. The tactical phase tests the air defense section's ability to perform its tactical mission. The firing phase tests each team member on his firing ability, using the tracking head trainer. The aircraft recognition test determines the ability of each team member to recognize and identify tactical aircraft under simulated combat conditions.

18-9. Qualification Program for Redeye Gunners

Appendix D contains the qualification program for Redeye gunners.

18-10. Redeye Gunner Task Inventory

In accordance with current Army concepts for training development, the true objectives of a training course should be derived from, or revised in accordance with, the actual job requirements. The major and critical tasks required of the Redeye gunner are listed in table 18-2. The task inventory was derived from the Redeye task analysis, gunner technique-of-fire chart, and moving target simulator gunner prerequisites. At the completion of the gunner's training course, the gunner should be able to perform the tasks listed in the table at the knowledge and performance levels indicated. Higher levels should be achievable after further training and experience in the

unit. The job requirement is a presentation of the gunner's major procedures and procedural sequences required to engage a tactical target. The task inventory list denotes the subjects, knowledge, and performance levels essential to total system effectiveness. A subject knowledge (SK) scale value is used to define a level of knowledge for a subject not related to a specific task, or for a common subject related to several tasks. A task knowledge (TK) scale value is used to define a level of knowledge for a specific task. A task performance (TP) scale value is used to refer to actual practical exercise or task performance.

Table 18-2. Redeye Gunner Task Inventory

PROFICIENCY CODE KEY*Task performance (TP) levels.*

- 1—Can do simple parts of the task. Needs to be told or shown how to do most of the task. (EXTREMELY LIMITED)
- 2—Can do most parts of the task. Needs help only on most difficult parts. May not meet local demands for speed or accuracy. (PARTIALLY PROFICIENT)
- 3—Can do all parts of the task. Needs only a spot check of completed work. Meets minimum local demands for speed and accuracy. (COMPETENT)
- 4—Can do the complete task quickly and accurately. Can tell or show others how to do the task. (HIGHLY PROFICIENT)

Task knowledge (TK) levels.

- 1—Can name parts, tools, and simple facts about the task. (NOMENCLATURE)
- 2—Can name the steps in doing the task and tell how each is done. (PROCEDURES)
- 3—Can explain why and when the task must be done and why each step is needed. (OPERATING PRINCIPLES)
- 4—Can predict, identify, and resolve problems about the task. (COMPLETE THEORY)

Subject knowledge (SK) levels.

- 1—Can identify basic facts and terms about the subject. (FACTS)
- 2—Can explain relationship of basic facts and state general principles about the subject. (PRINCIPLES)
- 3—Can analyze facts and principles and draw conclusions about the subject. (ANALYSIS)
- 4—Can evaluate conditions and make proper decisions about the subject. (EVALUATION)

Task function	Subject	Knowledge and performance level		
		Subject knowledge (SK)	Task knowledge (TK)	Task performance (TP)
Weapon ready	1. Monopak or Unipak	1	2	2
	Practical exercise			2
	2. Weapon.	1		
	a. Components			
	(1) Launcher			
	(a) Launch tube.			
	(b) Grip stock area.			
	(c) Frangible disks.			
	(d) End caps.			
	(e) Sight.			
(2) Missile	2			
(a) Seeker.				
(b) Guidance.				

Table 18-2. Redeye Gunner Task Inventory—Continued

Task function	Subject	Knowledge and performance level		
		Subject knowledge (SK)	Task knowledge (TK)	Task performance (TP)
	(c) Arming.			
	(d) Warhead.			
	(e) Rocket motors.			
	(f) Sustainer.			
	(g) Ejector.			
	(3) BCU -----	2		
	<i>b. Functional Components.</i>			
	(1) Safety and actuator device -----		1	
	(a) Purpose -----	2		
	(b) Operation -----		2	2
	(2) Uncaging switch -----		1	
	(a) Purpose -----	2		
	(b) Operation -----		2	2
	(3) Firing trigger -----		1	
	(a) Purpose -----	2		
	(b) Operation -----		2	2
	(4) BCU and receptacle -----		1	
	(a) Purpose -----	2		
	(b) Operation -----		2	2
	(5) Sight -----		1	
	(a) Purpose -----	2		
	(b) Utilization -----		2	2
	<i>c. Unirack</i> -----	1	2	
	(1) Installation -----		2	
	(2) Utilization -----		2	2
	<i>d. Safety and Hazards.</i>			
	(1) Blast area -----		2	
	(2) Eject only -----		2	
	(3) Hangfires -----		2	
	(4) Rocket motors.			
	(a) Db levels -----	2		
	(b) Gunner ear protection -----		2	
	(c) Eye protector -----		2	
	(5) Weapon inspection -----		2	2
Target detection	Search and Scan -----	2	2	2
	<i>a. Terrain</i> -----	1		
	(1) Desert.			
	(2) Hills.			
	(3) Ocean.			
	<i>b. Backgrounds</i> -----	1		
	(1) Sky.			
	(2) Clouds.			
	(3) Sun.			
	(4) Foliage.			
	(5) Structures.			
	<i>c. Masking</i> -----	2		
	(1) Background.			
	(2) Sun glint.			
	(3) Clouds.			
	<i>d. Target Visual Cues</i> -----	2		
	(1) Size and shape.			
	(2) Illumination.			
	(a) Bright surface.			
	(b) Dark objects.			
	(3) Contrast.			
	(a) Polished aluminum.			
	(b) Camouflage.			

Table 18-2. Redeye Gunner Task Inventory—Continued

Task function	Subject	Knowledge and performance level		
		Subject knowledge (SK)	Task knowledge (TK)	Task performance (TP)
	<i>b. IR Patterns</i> -----		2	
	(1) Jet.			
	(2) Propeller.			
	(3) Helicopter.			
	2. Tactical Target Tactics -----	2	2	
	<i>a. Jet</i> -----	2	2	
	(1) Small.			
	(a) Interdiction and penetration.			
	(b) Strafing.			
	(c) Bombing.			
	1. LABS.			
	2. Toss.			
	(d) Napalm.			
	(e) Rockets.			
	(2) Large -----	2	2	
	(a) Penetration.			
	(b) Bombing.			
	(c) Strafing.			
	<i>b. Nonjet</i> -----	2	2	
	(1) Prop—turbo prop -----	2	2	
	(a) Small -----	2	2	
	1. Penetration—observation.			
	2. Support drop.			
	3. Strafing.			
	4. Rockets.			
	(b) Large -----	2	2	
	1. Penetration.			
	2. Support drop.			
	3. Strafing.			
	(2) Helicopters -----	2	2	
	(a) Small -----	2	2	
	1. Penetration—observation.			
	2. Strafing.			
	3. Rockets.			
	(b) Large -----	2	2	
	1. Penetration.			
	2. Support-drop-retrieving.			
Weapon activation	Techniques of Fire; Ranging Techniques -----		2	2
	<i>a. Nonjet</i> -----		1	
	(1) Gunner tasks -----		2	
	(2) Engagement procedures -----		2	2
	(3) Ranging profiles -----		2	2
	(4) Procedural sequence -----		2	2
	(5) Nonmaneuvering -----			2
	(a) Incoming/crossing -----			2
	(b) Incoming/outgoing -----			2
	(6) Maneuvering -----			2
	<i>b. Jet.</i> -----			
	(1) Gunner tasks -----		2	
	(2) Engagement procedures -----		2	2
	(3) Range ring profiles -----		2	2
	(4) Procedural sequence -----		2	2
	(5) Nonmaneuvering -----			2
	(a) Incoming/crossing -----			2
	(b) Incoming/outgoing -----			2
	(6) Maneuvering—tactical trajectories.			2
IR acquisition	1. Simplified IR Patterns -----		2	2

Table 18-2. Redeye Gunner Task Inventory—Continued

Task function	Subject	Knowledge and performance level		
		Subject knowledge (SK)	Task knowledge (TK)	Task performance (TP)
	2. IR Acquisition Signals -----		2	
	a. Nonjet -----		2	2
	(1) Nonmaneuvering -----			2
	(a) Incoming/crossing -----			2
	(b) Incoming/outgoing -----			2
	(2) Maneuvering -----			2
	b. Jet -----		2	2
	(1) Nonmaneuvering -----			2
	(a) Incoming/crossing -----			2
	(b) Incoming/outgoing -----			2
	(2) Maneuvering—tactical targets -----			2
Uncaging weapon seeker	Engagement Procedure -----		2	2
	a. Uncaging as Soon as Possible -----			2
	(1) Clarify IR signal -----			2
	(2) Insure seeker track -----			2
	b. Procedural Sequence -----			2
Target identification (positive)	1. Target Characteristics -----	2		
	a. Structure.			
	b. Type Power Plant.			
	2. IR Characteristics -----		2	
	3. Operational Roll -----		2	
	4. Typical Delivery Capabilities -----		2	
	5. Target ID Procedures -----			2
	a. Early Warning.			
	b. TADDS.			
	c. Redeye Team.			
Target crossover (Jet targets only)	Crossover -----		2	2
	a. Target Aspect -----		2	
	b. Nonmaneuvering -----			2
	(1) Incoming/crossing.			
	(2) Incoming/outgoing.			
	c. Maneuvering—Tactical Trajectories -----			2
Superelevation and lead (S/L)	1. Target Trajectory -----		2	2
	2. Procedures -----		2	
	a. Crossing -----		2	2
	(1) Left to right.			
	(2) Right to left.			
	b. Outgoing—Center Reticle -----		2	2
	c. Maneuvering -----		2	
	3. IR Signal -----		2	2
	4. Procedural Sequence -----			2
Firing missile	1. Technique of Fire Procedure -----		2	2
	a. IR Signal -----			2
	b. Uncage -----			2
	c. Superelevate and Lead -----			2
	d. Seeker Tracking -----			2
	e. Fire -----			2
	2. Procedural Sequence -----			2
Redeye deployment	Field Exercises -----			2

CHAPTER 19

RANGE FIRING

Section I. RANGE ORGANIZATION

19-1. General

a. An officer in charge (OIC) is designated for the Redeye firing range. Range firing is conducted in accordance with AR 385-62, local range SOP, local directives, and appropriate field and technical manuals.

b. Responsibilities of personnel are as prescribed in current range and safety regulations, directives, and local SOP's.

c. The purpose of this chapter is to aid personnel in conducting Redeye range firing. Some of the considerations apply to local installation/range operation requirements. Duties of personnel and considerations peculiar to Redeye are discussed as well as some of the normal range requirements.

d. A sample Redeye range SOP which may be used for conducting range firing is in appendix E.

19-2. Planning Requirements

The OIC prepares a plan for the conduct of range firing. Items included in planning requirements are discussed in *a* through *h* below.

a. Redeye Weapons. Coordination with unit S3/S4 to insure availability of weapons (rounds) as authorized by CTA 23-100-6.

b. Targets and Courses.

(1) IR-augmented drone aircraft, towed targets or ballistic targets may be used during range firing. (Refer to section IV for further information on target drone requirements.)

(2) Within range safety limitations, aerial target courses should—

(a) Intersect the launch envelope within Redeye system capabilities (FM 23-17A).

(b) Require the system to be exercised at or near optimum capability.

(c) Provide combat realism by varying

target range, altitude, and speed from course to course.

c. Weapon Checkout. Coordination with the local installation to provide for guided missile test set (GMTS) checkout of Redeye weapons 24 hours prior to firing and to have technically qualified personnel and test equipment available during the range firing. In tactical situations the weapon does not have to be checked out on the GMTS prior to firing.

d. Transportation. Redeye weapons are transported as described in chapter 7. Coordination is affected with the unit S4 or support personnel to insure that weapons arrive on the range at the scheduled time. The authorized receiving officer keeps the weapons under positive control until authorized launch or return to the custodian. The receiving officer provides cleared, armed guards, as necessary, to insure against unauthorized launch or compromise of design data.

e. Storage of Weapons. Redeye weapons are stored in compliance with standards established in TM 9-1300-206 in the designated storage building.

f. Medical Support. A qualified medical aid man must be present at the firing range or checkout site. In addition, a vehicle capable of transporting a litter patient and first aid equipment must be present on the range. Helicopter evacuation is available at many posts in the event a serious injury occurs. The procedure for requesting helicopter evacuation is stated in post and/or range regulations. Medical support is normally arranged through the unit S4 or battalion/squadron medical section.

g. Range Surveillance. Surveillance of the endangered airspace by radar or patrol aircraft must be provided. Visual surveillance of the firing area is mandatory at all times during firing.

h. Personnel and Duties.

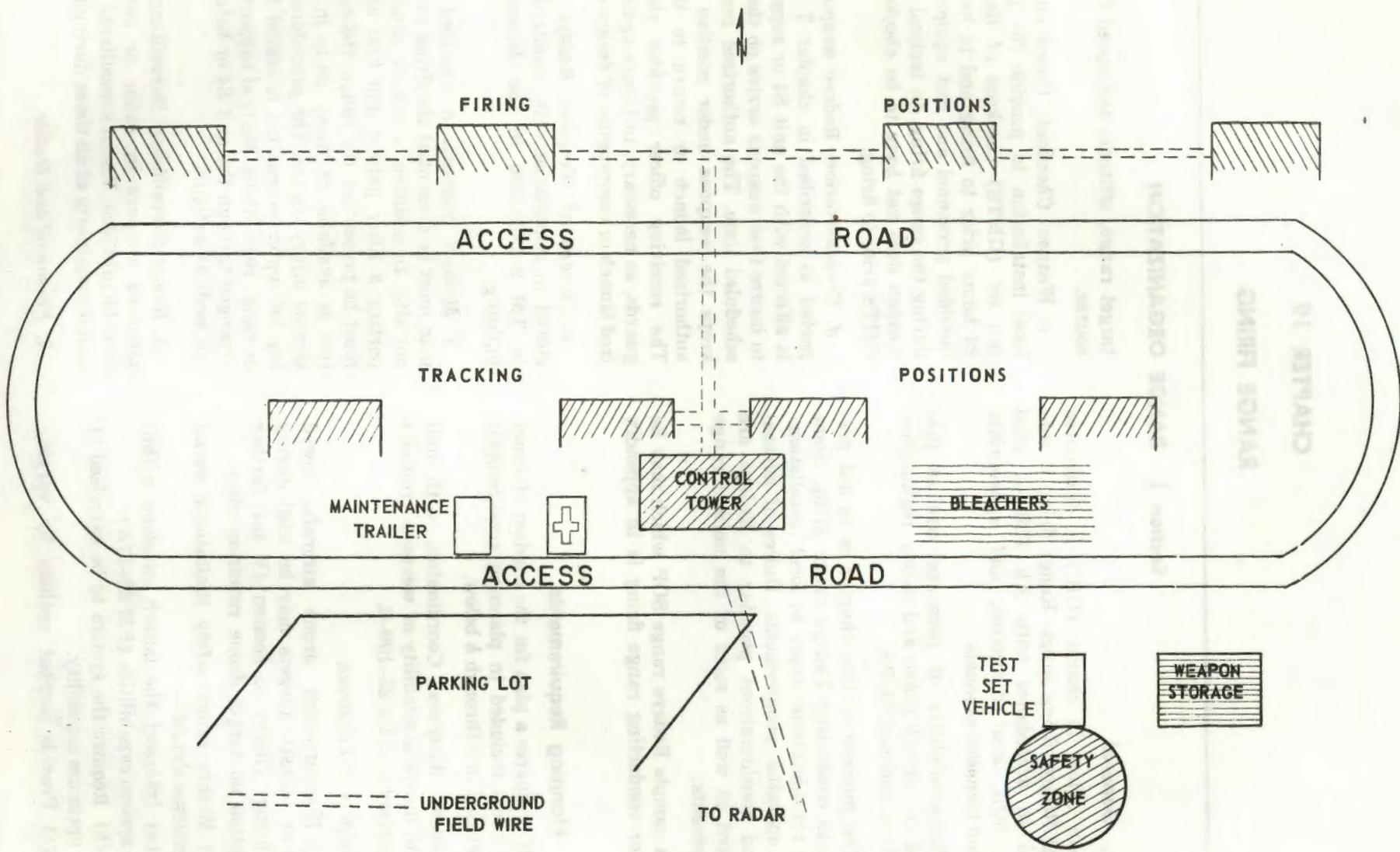


Figure 19-1. Suggested layout of Redeye range.

(1) *Safety officer.* (See para 19-5 below.)

(2) *Noncommissioned officer in charge.* The noncommissioned officer in charge (NCOIC) supervises the various details connected with range firing. He assists the OIC in carrying out his duties. Personnel are normally moved between the firing stations and tracking stations under his supervision.

(3) *Firing station NCO (coaches).* A firing station NCO is designated to coach each gunner on the firing line (station). His primary duty is to insure that safety precautions are observed, to coach the gunner, and correct all errors made or about to be made during firing.

(4) *Ammunition NCO.* This NCO assists the responsible officer who received the Redeye weapon to insure adequate security for the weapons (d above). He assures that weapons are properly unloaded and placed at the range. After completion of firing, he assists the receiving officer to turn in expended and unexpended weapons, if any, in accordance with installation supply procedures.

19-3. Range Layout

The OIC prepares a tentative plan for the conduct of firing; however, before the plan is finalized, he inspects the range to insure that the range facilities will support the firing. Figure 19-1 shows a sample layout for a range which could be used for Redeye firing. The range is organized as explained in a through e below.

a. *Firing Positions.* The firing positions (sta-

tions) on the firing line are concrete or sandbagged barricades designed to protect gunners during conduct of firing. Nonfiring personnel designated to assist or observe the gunner during firing, including the coach, will be within the barricade with the gunner. They must exercise caution and remain clear of the backblast area. No personnel should be in the open space (50 meters) between firing and tracking positions during firings.

b. *Tracking Positions.* The tracking positions are concrete or sandbagged barricades also designed to protect Redeye gunners awaiting their turn on the firing line. Gunners at tracking positions practice target engagement of the same target being fired on by gunners at the firing line. Tracking head trainers M49 are used for practice engagements in lieu of live Redeye weapons.

c. *Ammunition Points.* The weapon storage area should be at least 100 meters from the firing line and away from spectators/observers.

d. *Concurrent Training Station.* A concurrent training station may be set up in the vicinity of the bleachers. Concurrent training suggested for nonfiring gunners consists of technique-of-fire training, engagement of targets, and observation of firing.

e. *Weapon Test Area.* The weapon test area should be a safe distance from personnel and only authorized personnel are allowed in its vicinity. The weapons can be checked out in a designated area of the ASP or at the firing range prior to the day of firing.

Section II. SAFETY PRECAUTIONS

19-4. General

A safety officer normally is detailed to assist the OIC in fulfilling his safety responsibilities. The safety officer's duty is to prevent any normally safe condition or procedure from deteriorating into an unsafe act whenever he sees such a possibility. The safety officer assists the OIC in planning and conducting the firing. He may be from the same unit as the OIC.

19-5. Duties of Safety Officer

The safety officer must be thoroughly knowledgeable with safety regulations, range SOP, and safety aspects of the Redeye weapon. He is the direct representative of the OIC of firing and is

not assigned other duties while acting in this capacity. During the range reconnaissance, the safety officer may assist the OIC by checking the misfire bunker (dud pit), control tower, pole for the red streamer, and any other item specified by the OIC. The safety officer normally operates from the tower. From this position, he has overall observation of the firing line and impact area. Additionally, at the control tower, the safety officer has several means of communication available to him; therefore, he can immediately correct personnel who may become careless on the firing line. The duties of the safety officer may include, but are not limited to, the following:

a. Displaying the red streamer when the OIC gives permission to fire.

b. Insuring that Redeye weapons are handled correctly.

c. Insuring that weapon misfire procedures are established and conducted in accordance with TM 9-1385-215. Refer also to paragraphs 3-13 and 3-14.

d. Assuring that weapons are pointed into the impact area at all times and are not fired below minimum elevation.

e. Assuring that all range regulations are enforced.

19-6. Safety Precautions

Redeye range safety precautions include, but are not limited to, the following:

a. Redeye weapons are removed from the firing positions only by order of the OIC.

b. Redeye weapons are stored in the shipping and storage container when not in use. When returning a weapon to the container, check that the receptacle cap is in place.

c. When it seems probable that lightning may occur, missiles will be stored in containers and firing positions vacated.

d. A noncommissioned officer is designated to take charge of dud missiles occurring when a sustainer motor fails to fire. Destruction of duds will be conducted according to AR 385-62 and TM 9-1385-215 or rendered *safe* by qualified technical personnel.

e. If the Redeye missile fails to fire, appropriate safety measures will be taken as specified in AR 385-62 and pertinent technical and field manuals.

f. Drone safety requirements will be followed as outlined in range regulations.

g. Firefighting equipment and personnel should be available or on call.

h. Air guards (air observers) are posted to provide 360° surveillance to prevent firing during overflight.

19-7. Surface Danger Zone

The surface danger zone for any Redeye firing range is generally composed of a firing area, target area, and impact and danger areas surrounding these locations. The surface danger zone for the Redeye missile is based on its maximum ballistic range capability since the trajectory safety officer has no capability to destroy the missile. The OIC uses the surface danger area diagram to insure that the firing position is marked and azimuth limit markers are positioned properly. Normally, both ends of the firing line are marked with poles driven into the ground. The limits of the impact area are defined by azimuth limit markers. If the safety markers are missing, range control must be notified. The minimum safety dimensions for a Redeye firing range are shown in figure 5, AR 385-62.

Section III. RANGE PROCEDURES

19-8. General

a. All personnel to fire are given a detailed briefing by the OIC. The OIC discusses the purpose, objective, standards, and firing procedures to be followed. The OIC reviews the Redeye gunnery techniques applicable to the type of firing conducted.

b. Prior to conducting live firing exercises, gunners will track drone targets on both left-to-right and right-to-left crossing courses using training sets M76. During the firing exercises they will not fire except on orders from the noncommissioned officer assigned to coach each gunner. Gunners on the tracking positions (in barricades) will track and simulate engagements on the same targets assigned to gunners at the firing

positions. Coaches (noncommissioned officers) will make necessary corrections to gunners on both firing and tracking positions.

19-9. Firing Commands

a. On command from the OIC, the gunners proceed to the firing line, draw a Redeye weapon, and go to the designated firing point. The coach (NCO) takes position to the left of the gunner and assures that all safety measures are complied with. He is able to communicate with the OIC/safety officer in the tower.

b. Three commands will be relayed to gunners.

(1) *ACTIVATE*. This command means that the drone target is coming within range and will

be in a position for engagement. If all safety precautions are met, the range safety officer gives permission to proceed with the firing.

(2) **WEAPONS FREE.** This command signifies that the gunner is free to engage the target when ready.

(3) **CEASE FIRE.** Refrain from firing.

c. **CROSSOVER** is announced when the target drone is at crossover to assist the gunner in performing the firing sequence, particularly in the case of high-speed courses (when the gunner fires after crossover).

19-10. Range Firing Time Sequence

The firing sequence time and event schedule (table 19-1) is presented as a guide for Redeye firing range personnel. The time sequence breakdown is particularly useful for control personnel and gunners during engagement of high-speed drone targets. The host installation will coordinate drone control, test activities involving range, radar, test personnel, and instrumentation, and guided missile test set checkout of weapons prior to range firing. Range operation personnel will record times of events as shown in table 19-1.

Table 19-1. Range Firing Sequence Time and Event Schedule

Time	Event
T - xx hours	Local installation will coordinate drone, weapons, range, equipment and personnel requirements. For example: <ol style="list-style-type: none"> 1. Coordination of test activities involving range, radar, drone control, test personnel, and instrumentation. 2. Selection of firing trajectories. 3. Review of range safety precautions.
T - 24 hours	Local installation will perform guided missile test set (GMTS) checkout of weapons to be fired.
T - 3 hours	Transport firing controller, weapons, gunners, and equipment to firing site.
T - 1 hour	Place weapons and BSU's in firing area.
T - x hours	At drone facility: check of JATO's drones, IR target sources, smoke, etc.
T - 30 minutes	Range operation personnel will be prepared to record: <ol style="list-style-type: none"> 1. Crossover time. 2. Spotting of drone; check of IR source illumination. 3. Camera coverage. 4. Audio (tape recorder coverage). 5. Time of launch and time of flight. 6. Weapon serial number, BCU serial number, and gunner's name.
T - 30 minutes	Firing controller will check readiness of drones, radar, gunners, communications, and will verify conduct of firing test. <ol style="list-style-type: none"> 1. Drone launch. 2. Gunner and coach deployed to firing position.
T - 5 minutes	<ol style="list-style-type: none"> 1. All instrumentation to "On"—verify. 2. Confirm target trajectory. 3. Identify target position when in northern or southern most portion of its turn. 4. Target/trajectory data.
T - 2 minutes	BCU insertion in weapon. <ol style="list-style-type: none"> 1. Advise that target is inbound. 2. Confirm that target is on course by drone control. 3. Confirmation of IR augmentation.
T - 1 minute	<ol style="list-style-type: none"> 1. Target approaching gunner's position. 2. Weapons free (time determined by applicable trajectory).
T - 30 seconds	<ol style="list-style-type: none"> 1. All cameras to "On"—verify. 2. IR confirmed—verify.
T - 15 seconds	Crossover. <ol style="list-style-type: none"> 1. Fire. 2. Cease fire at crossover plus x seconds.
T - 5 seconds	<ol style="list-style-type: none"> 1. Time of missile flight and missile firing recorded. 2. Crossover time recorded. 3. Firing results and comments on self-destruct recorded.
T - x seconds	Next gunner sent to firing position as required. Previous drone, if available, will be used as repeat target or next drone will be launched. Recycle to T-2 minute firing sequence.
T - 0 seconds	All firing data required to describe firing including weather tabulated. Gather raw data, radar plots, weapon serial number, and BCU serial number.
T + —	Firing bulletin prepared describing results in detail.
Subsequent firings	
T + 1 hour	
T + 8 hours	

Section IV. TARGETS AND SCORING

19-11. General

Redeye range firing requires targets capable of infrared emissions in a specific range (see FM 23-17A). The advent of Redeye and other Army heat-seeking missiles has increased emphasis on the development of infrared sources to augment target systems. Current target systems employ three types of infrared sources, infrared flares, thermal pots, and propane burners. All current infrared sources can be ignited on command of a ground controller. The information presented in this section is designed to familiarize Redeye personnel with the characteristics and capabilities of Redeye target systems.

19-12. Target IR Sources

a. Short Endurance Sources.

(1) *Infrared flares.* IR flares burn for approximately 1 minute. Flares are characterized by erratic IR emissions and varying intensities resulting from changes in target speed. In general, IR flares are unsatisfactory for most IR target applications.

(2) *Thermal pots.* The thermal pot, essentially a carbon crucible which glows when the thermite mixture is ignited, burns for an average of 90 seconds. The most popular thermal pots are rated 40, 90, and 190 watts/steradian. The emission rate of thermal pots is a function of time; however, emission intensity is very consistent. Intensities also vary as a function of speed. The basic disadvantage of thermal pots, as well as flares, is the short emission time.

b. *Long Endurance Source.* The long-burning IR source, basically a propane burner within a porous steel mesh housing, will emit for approximately 30 minutes. A wind deflector minimizes the cooling of the radiating mesh surface. The wind deflector also increases the differential across the mesh which makes possible the high temperatures (approximately 2,000° F.) required for intensity levels of 200-250 watts/steradian. Unlike IR flares and thermal pots, emission rates and intensity levels of the propane burner do not vary as a function of speed. Another advantage is the ability of the propane burner to duplicate the intensity and emission characteristics of potential enemy aircraft.

19-13. Aerial Targets

Several target systems are briefly described in this section. Basic considerations in the selection

of a proper target system include firing range limits, cost per target presentation, and desired mission objectives. In general, targets should be selected which will require the weapon system to use its maximum capability. The following target systems have been utilized in support of Redeye range firing.

a. *MQM-34D Firebee.* The MQM-34D Firebee (figs 19-2 and 19-3) is a jet-powered, remotely controlled aerial target, closely resembling an actual jet aircraft in shape and flight characteristics. Speed is variable between 200 and 600 knots. The target, of midwing construction, has a flight-ready weight of approximately 2,300 pounds. All normal maneuvers of a jet aircraft can be performed with the Firebee. The target is controlled from the ground and is recovered by parachute. Recovery of the Firebee is commanded by the ground controller, or automatically initiated upon loss of power or control signal.

b. *MQM-34D Firebee Tow Systems.* The MQM-34D Firebee has been designed to pull a variety of tow targets for air defense missile and automatic weapon firings. In support of Redeye firings, the MQM-34D Firebee pulls the TA8-IRE (Towbee) long-endurance, propane burning, tow target (fig 19-4). Up to four of these infrared tows can be carried on the Firebee. Each Towbee is individually ignited and launched on command of the ground controller. The Towbee follows the Firebee at the end of a 100-foot steel cable. The Towbee can be equipped with a miss-distance indicator to score Redeye miss distances. Due to its small size the Towbee is not readily visible through the Redeye sight. The Redeye gunner will sight on the Firebee drone; however, the Redeye missile seeker will lock on the Towbee, which is producing the larger infrared source. The Towbee radiates at 250 watts/steradian while the jet engine of the Firebee produces only 40 watts/steradian.

c. *MQM-61A Cardinal.* The MQM-61A Cardinal (fig 19-5) has been used as a target for testing and training on every major Army surface-to-air weapon system program since it was adopted by the US Army Missile Command more than a decade ago. It has been launched, flown, and recovered successfully in all climates from the Arctic to the tropics and is completely air-transportable.

(1) For mobility, the MQM-61A is launched



Figure 19-2. MQM-34D Firebee.

from a zero-length launcher (fig 19-6) mounted on a target transport dolly making it a go-anywhere missile target. It may be launched without regard to wind direction or wind speed up to 20 knots.

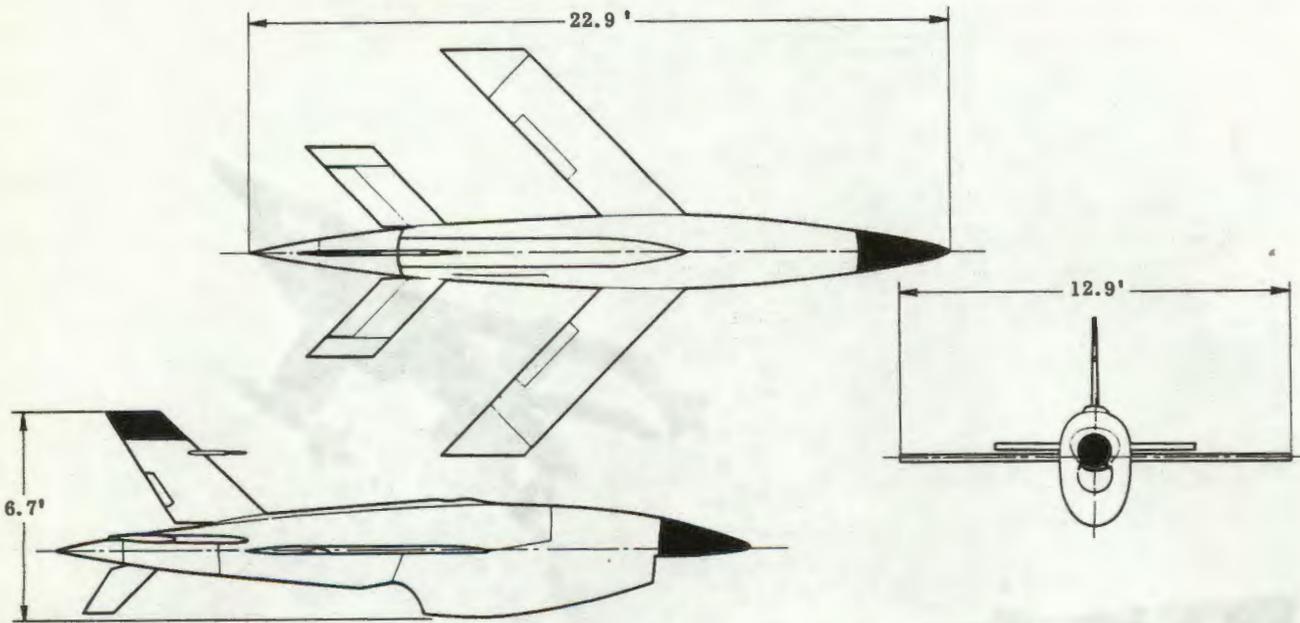
(2) It is of conventional aluminum stringer and skin construction. Its wing spread is 155.5 inches; height is 39.9 inches. It is powered by the TC-6150-J-3 engine rated at 125 brake horsepower, with an all-metal, constant-speed propeller. Speed is controllable from a maximum of 300 knots to a minimum of approximately 140 knots. It has altitude capabilities from 50 feet above terrain to 43,000 feet. An autopilot keeps the target in stable flight; its maneuvers are controlled by remote digital radio commands. For easy visual acquisition the MQM-61A contains an integral smoke oil system which produces a dense white smoke train. Colored smoke is ob-

tained from pods containing flares mounted on each wingtip (fig 19-7).

(3) Four tubular fiberglass tow targets containing the antenna portion of a missile scoring system are mounted under the wings. For IR-seeking missiles, a molten metal IR augmentor is mounted on each tow target (fig 19-8). Each tow target is released from the MQM-61A as required by ground command and is towed on a 20- to 150-foot cable. Two or three IR augmentors can be mounted on the keel and on each wingtip. The ground controller may ignite one augmentor at a time as desired. This allows the target to make multiple passes until each tow targets is hit or until its fuel supply is exhausted.

d. Ballistic Aerial Target System (BATS).

(1) A ballistic target (fig 19-9) has been developed for use with forward area air defense systems. The ballistic aerial target system



WING	Area 36.0 Sq. Ft. Aspect Ratio 4.632	GROSS WEIGHT . . .	2500 Lb. (BASIC)
HORIZONTAL . . .	Area 16.69 Sq. Ft. STABILIZER Aspect Ratio 3.30	POWER PLANT . . .	J-69-T-29, Continental
VERTICAL	Area 11.28 Sq. Ft. STABILIZER Aspect Ratio 1.5	RATED THRUST . .	.1700 Lb. S. L. S.
VENTRAL	Area 1.43 Sq. Ft. STABILIZER Aspect Ratio 1.6	WIDTH12.9 Ft.
		LENGTH22.9 Ft.
		HEIGHT	6.7 Ft.

Figure 19-3. Firebee general arrangement.

(BATS) is a low-cost, booster-propelled, gunnery target that provides realistic 300- to 450-knot targets for training Chaparral/Vulcan crewmen, Redeye gunners, and gunners/crewmen of future forward area air defense weapon systems.

(2) The range of the system varies from 5,000 to 12,000 feet when flown at altitudes between 300 feet and 2,400 feet.

(3) The target is capable of being launched from a ground-emplaced launcher, can be transported on a 2 1/2-ton standard military vehicle, and can be emplaced, using semiskilled labor, in 2 hours or less with common handtools. The BATS can be remotely launched up to 2 miles from the launcher. Electrical connections between launcher and fire control box are standard field wire.

(4) The target has a broadside area of 20 square feet and presents IR sources compatible

with those systems for which the target is used. The target, less propulsion system, has a shelf life of 5 years and a probability of at least 95 percent of meeting all essential launch and flight characteristics.

(5) Detailed firing tables and charts are included in *TM 9-1340-418-12.

19-14. Scoring System

a. An electromagnetic miss-distance indicator (MDI) is used to provide a reliable low-cost scoring system for use in Redeye weapon system training and Redeye system evaluation. The 800 B-4 model is a completely integrated MDI. It consists of an integrated and encapsulated RF transmitter-receiver and telemetry unit, self-contained and packaged, to be installed in one of

*To be published.

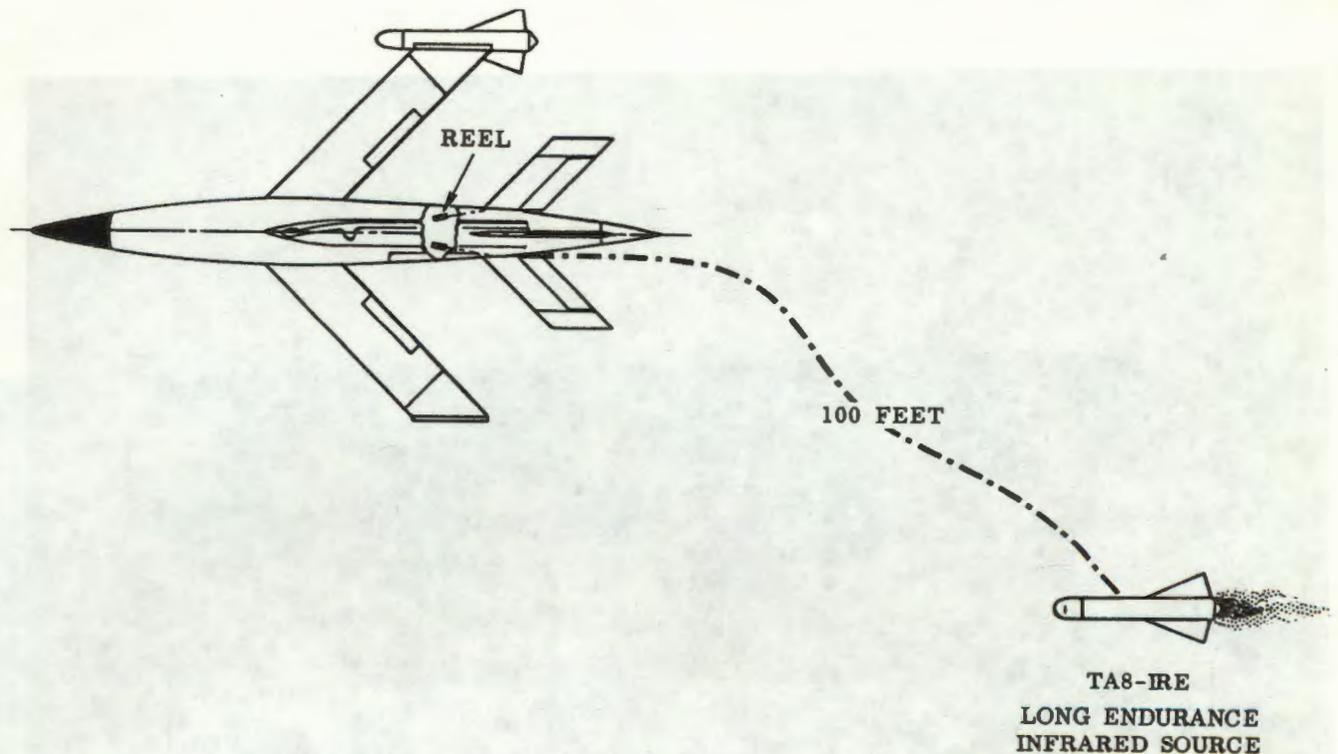


Figure 19-4. Firebee/Towbee tow target system.

the fin assemblies of the Towbee target towed by the Firebee (figs 19-11 and 19-12).

b. The MDI sensor (detector) mounted in the airborne target uses step-keyed RF radiation to create an electromagnetic sphere of influence around the sensor antenna at the rear of the Towbee fin assembly. As the Redeye missile enters this sphere, the sensor produces a signal that is transmitted to the ground station (fig 19-13). Miss distance is derived by comparing the reflected doppler cycles to a predetermined range/wavelength reference. The size of the sphere of influence is predetermined and factory

set, but may be varied between 5 and 25 feet for Redeye range firings or service practice if authorized. The sensor operates at 1740 MHz and scoring data is transmitted to the ground station, using an integrated FM telemetry device.

c. The ground receiving/recording station (fig 19-11) is used to receive, record, and reproduce the scoring data by means of an oscillograph direct readout. The miss distance is determined by visually counting the number of doppler cycles on the oscillograph readout that were produced by the missile passing through the predetermined electromagnetic sphere of influence.

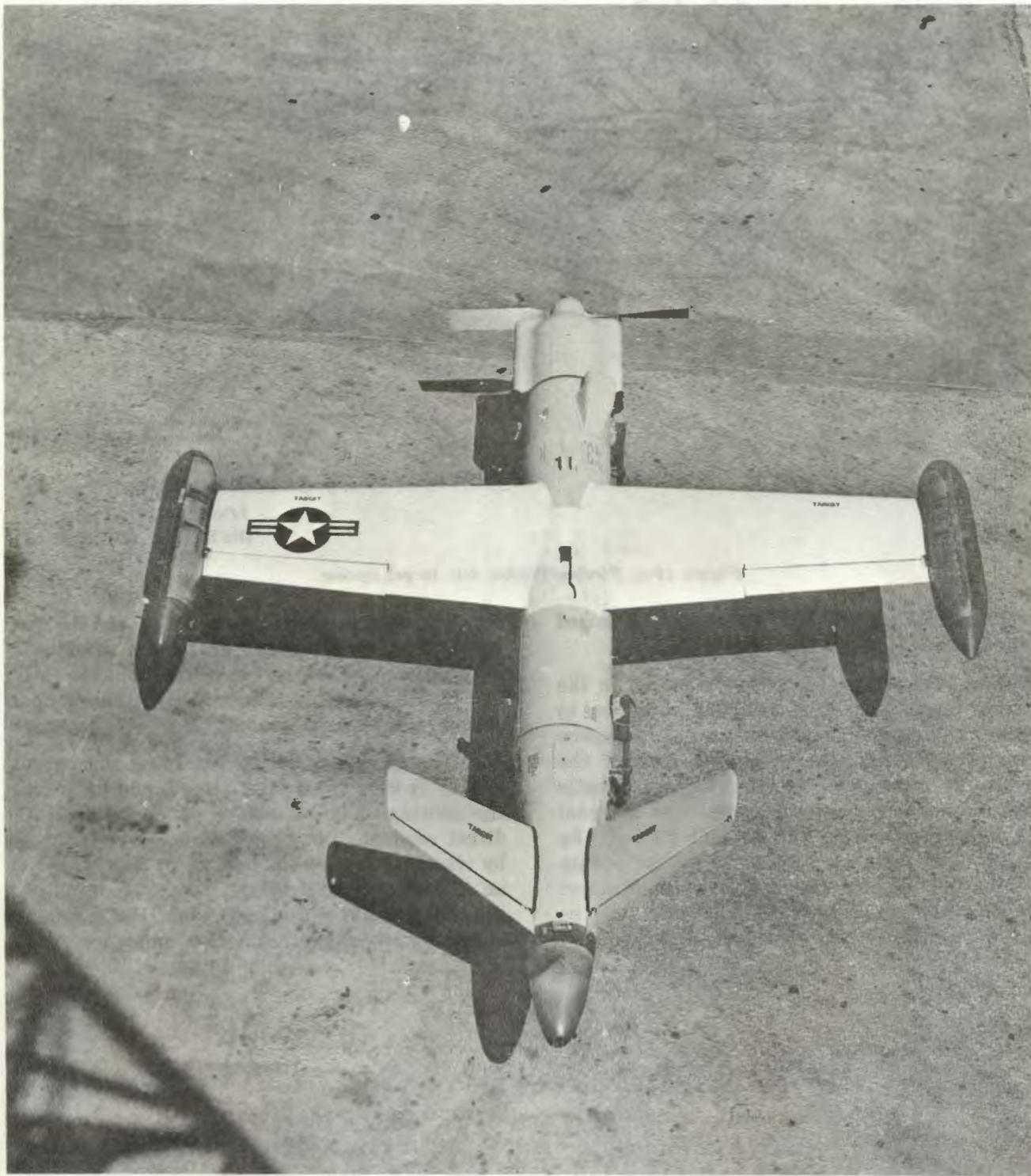


Figure 19-5. MQM-61A Cardinal.



Figure 19-6. MQM-61A on zero-length launcher.



Figure 19-7. MQM-61A (front view).



Figure 19-8. MQM-61A with tow targets.

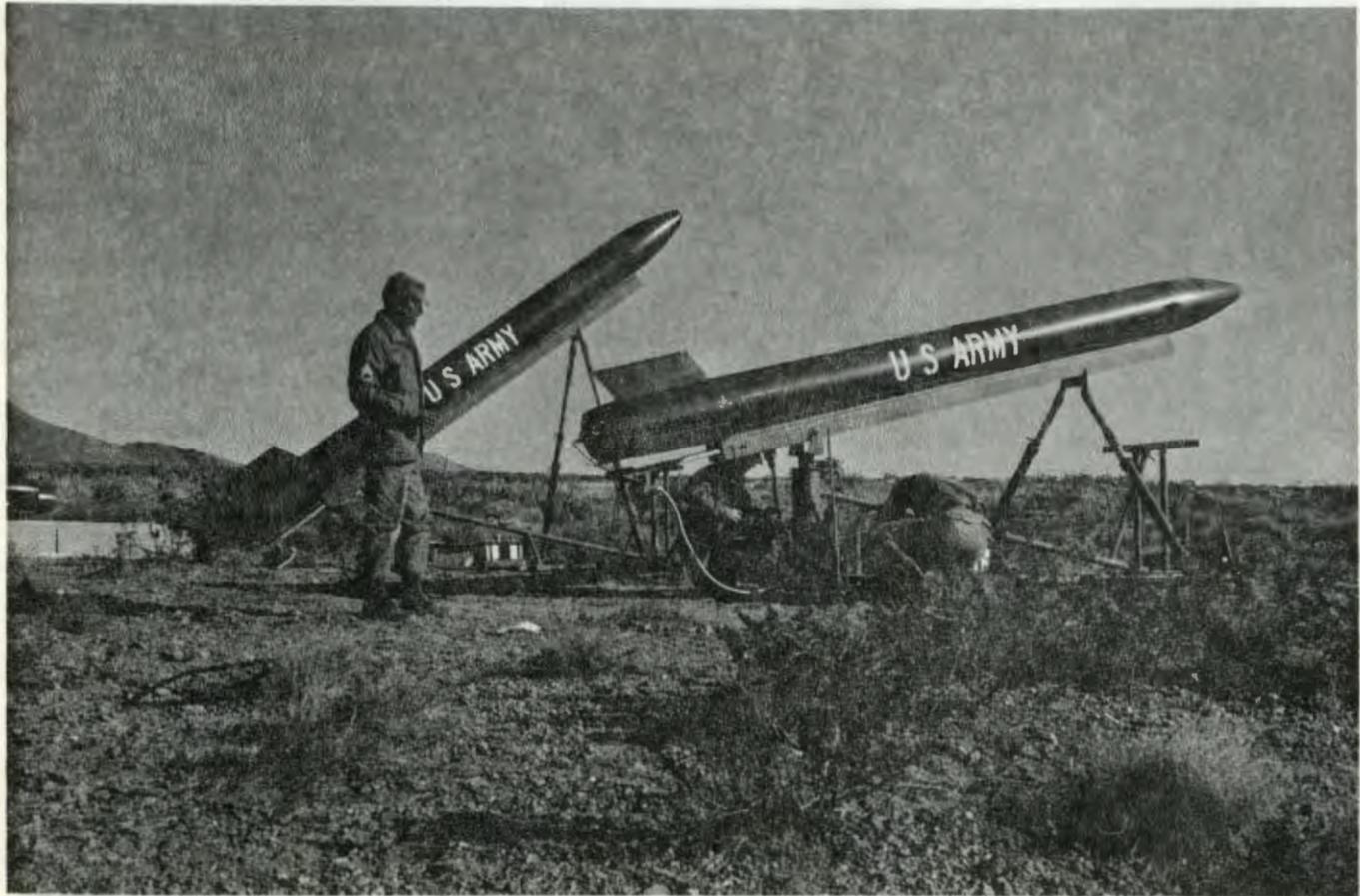


Figure 19-9. Ballistic aerial target system (BATS).

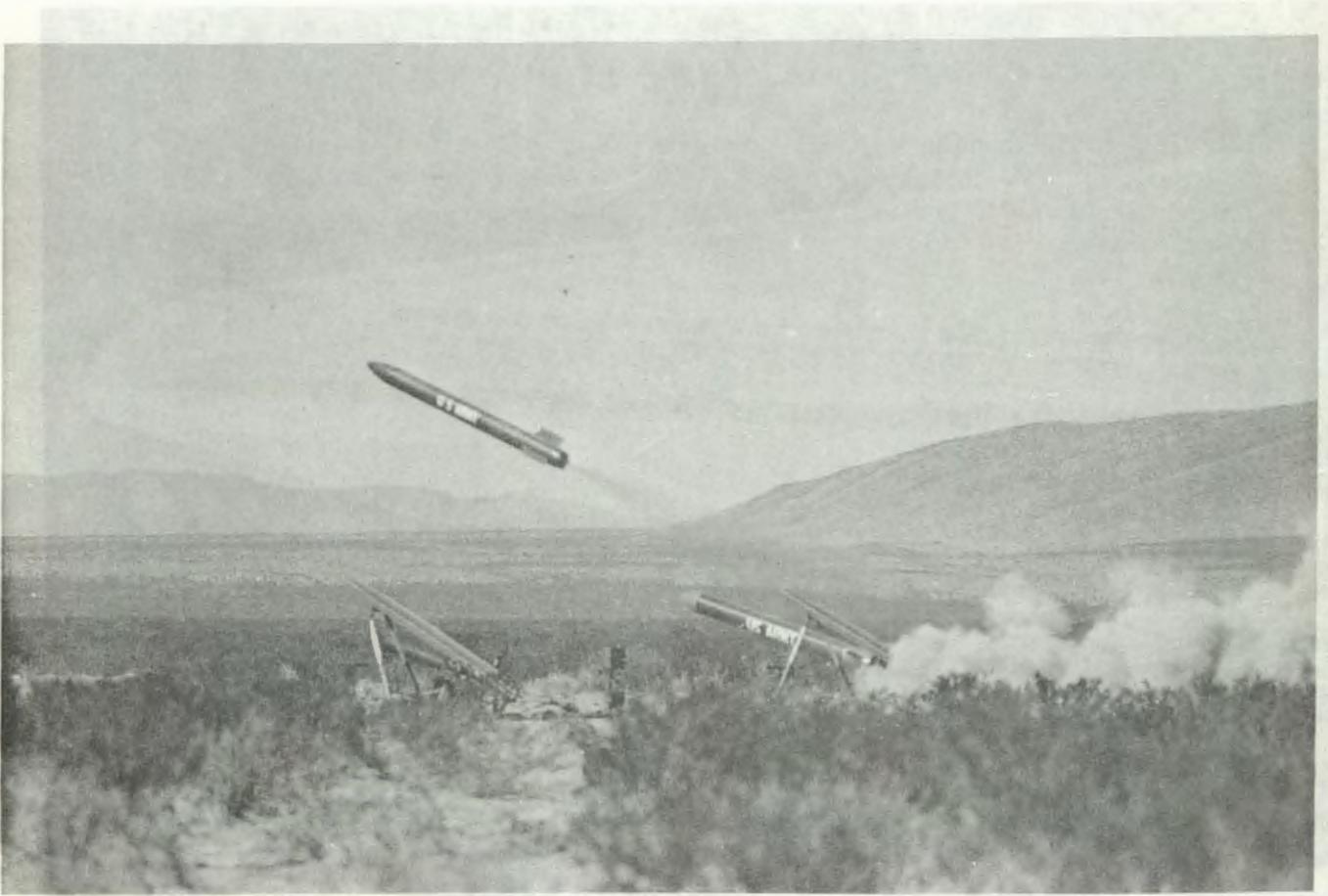


Figure 19-10. BATS being launched.

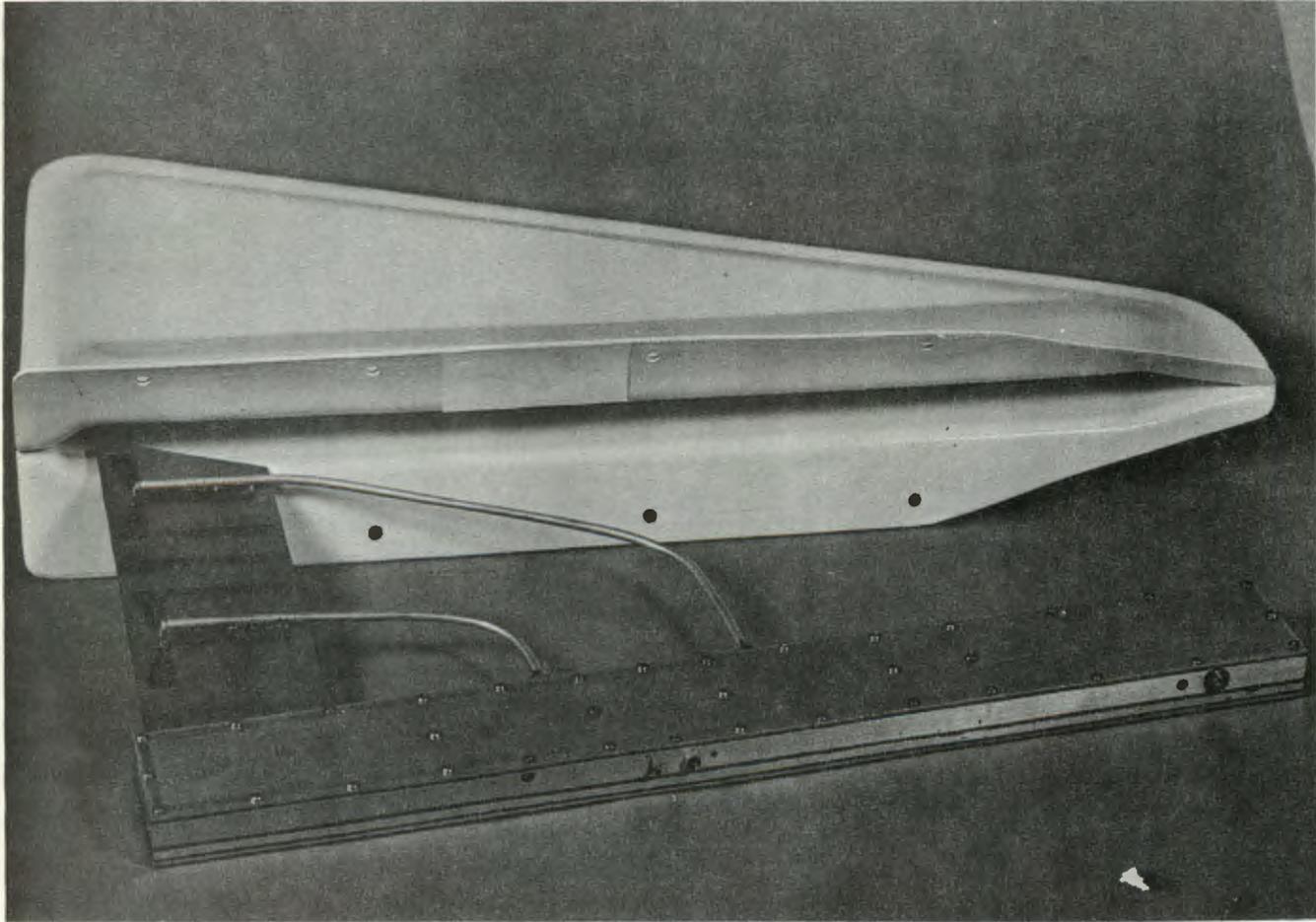


Figure 19-11. Scoring system prior to assembly in target wing.



Figure 19-12. Towbee with scoring system prior to assembly in target wing.

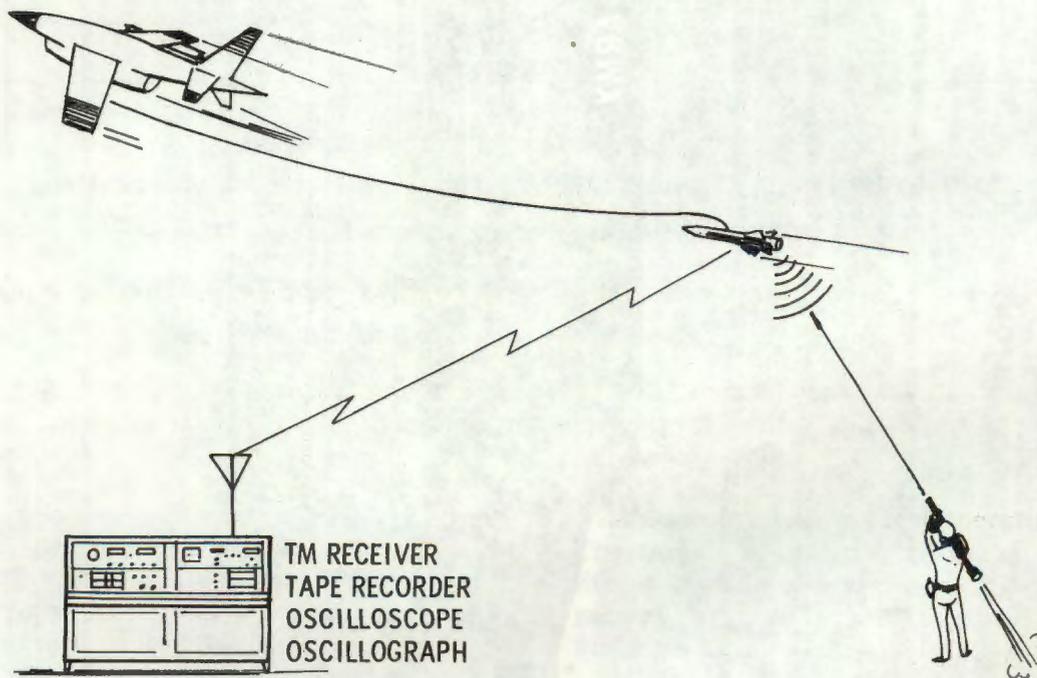


Figure 19-13. System concept.

APPENDIX A

REFERENCES

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

A-1. Army Regulations (AR)

40-5	Preventive Medicine.
40-501	Standards of Medical Fitness.
75-1	Malfunctions Involving Ammunition and Explosives.
190-11	Physical Security of Weapons, Ammunition, and Explosives.
210-10	Administration.
310-25	Dictionary of United States Army Terms.
310-50	Authorized Abbreviations and Brevity Codes.
350-1	Army Training.
380-5	Safeguarding Defense Information.
380-20	Restricted Areas.
385-10	Army Safety Program.
385-62	Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat.
604-5	Clearance of Personnel for Access to Classified Defense Information and Material.
611-201	Enlisted Military Occupational Specialties.
700-58	Report of Packaging and Handling Deficiencies.
746-1	Color, Marking, and Preparation of Equipment for shipment.
750-1	Maintenance Concepts.

A-2. Department of the Army Pamphlets (DA Pam)

310-series	Indexes of military publications.
350-13	Guide for Platoon Sergeants.

A-3. Field Manuals (FM)

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.
6-135	Adjustment of Artillery Fire by the Combat Soldier.
6-140	Field Artillery Cannon Battalions and Batteries.
7-10	The Rifle Company, Platoons, and Squads.
7-20	The Infantry Battalions.
9-59	Missile Support Unit Operations.
17-1	Armor Operations.
19-30	Physical Security.
21-5	Military Training Management.
21-6	Techniques of Military Instruction.

21-11	First Aid for Soldiers.
21-40	Chemical, Biological, Radiological, and Nuclear Defense.
21-41	Soldier's Handbook for Defense Against Chemical and Biological Operations and Nuclear Warfare.
21-48	Chemical, Biological, and Radiological (CBR) and Nuclear Defense Training Exercises.
21-60	Visual Signals.
21-75	Combat Training of the Individual Soldier and Patrolling.
23-12	Technique of Fire of the Rifle Squad and Tactical Application.
(C) 23-17A	Redeye Guided Missile System (U).
23-67	Machinegun, 7.62 mm, M60.
24-18	Field Radio Techniques.
24-20	Field Wire and Field Cable Techniques.
31-60	River Crossing Operations.
(C) 32-5	Signal Security (SIGSEC) (U).
44-1	US Army Air Defense Artillery Employment.
(S) 44-1A	US Army Air Defense Artillery Employment (U).
44-1-1	US Army Air Defense Artillery Operations.
44-3	Air Defense Artillery Employment, Chaparral/Vulcan.
44-30	Visual Aircraft Recognition.
61-100	The Division.

A-4. Army Subject Schedules (ASubjScd)

23-17	Redeye Gunner and Air Defense Section Training.
44-2	Visual Aircraft Recognition.

A-5. Allied Communications Publication (ACP)

(C) 122	Communications Instructions—Security (U).
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A-6. Joint Chiefs of Staff Publication (JCS Pub.)

8	Doctrine for Air Defense from Oversea Land Areas.
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A-7. Technical Manuals (TM)

9-207	Operation and Maintenance of Army Materiel in Extreme Cold Weather, 0° to -65°.
9-1300-206	Care, Handling, Preservation, and Destruction of Ammunition.
*9-1340-418-12	Operator and Organizational Maintenance Manual for Ballistic Aerial Target System (BATS).
(C) 9-1385-215	EOD Procedures for Intercept-Aerial, Guided Missile Systems, XM41E1 and XM41E2 (Redeye Air Defense Guided Missile System) (U).
9-1400-425-12	Operation and Organizational Maintenance Manual: Intercept-Aerial Guided Missile System XM41E2 and Training Intercept-Aerial-Guided Missile System M46A1 and M46A2 (Redeye Air Defense Guided Missile System).
9-1400-425-20P	Organizational Maintenance Repair Parts and Special Tools List for Guided Missile System, Intercept-Aerial XM41; Guided Missile System, Intercept-Aerial Training M46A2 (Block III) (Redeye Air Defense Guided Missile System).
9-1400-425-35	DS, GS, and Depot Maintenance Manual: Intercept-Aerial Guided Missile System XM41E2; Training Intercept-Aerial Guided Missile System M46A1 and M46A2, and Guided Missile Test Set AN/TSM-82 (Redeye Air Defense Guided Missile System).

*To be published.

9-1400-426-12	Operator and Organizational Maintenance Manual, Including Repair Parts and Special Tools List: Intercept-Aerial Guided Missile Systems XM-41E1, and Field Handling Trainer XM46 (Blocks I and II) (Redeye Air Defense Guided Missile System).
*9-1430-589-12	Operator and Organizational Maintenance Manual: Target Alert Data Display Set, AN/GSQ-137 (XO-1).
*9-6920-427-12	Operator and Organizational Maintenance for Redeye Moving Target Simulator Device XM87.
9-6920-428-12	Operator and Organizational Maintenance Manual: Guided Missile System Training Set XM76 (Redeye Air Defense Guided Missile System).
9-6920-428-34	DS and GS Maintenance Manual: Guided Missile System Training Set XM76 (Redeye Air Defense Guided Missile System).
11-666	Antennas and Radio Propagation.
38-750	The Army Maintenance Management System.

A-8. Technical Bulletins (TB)

MED 251	Noise and Conservation of Hearing.
9-380-101	Security Classification of Missile and Large Rocket Systems and Components.

A-9. Common Table of Allowances (CTA)

23-100-6	Ammunition, Rockets, and Missiles for Unit Training—Active Army and Reserve Components.
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A-10. Army Training Test (ATT)

44-3	Air Defense Section (Redeye).
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*To be published.

APPENDIX B

THREAT CHARACTERISTICS

B-1. Enemy Capability

The enemy capability is a factor affecting the employment of Redeye. A thorough study capabilities as a prelude to optimum defense design should be conducted by the battalion air defense section leader. Of necessity, a major portion of this study is based on intelligence. Intelligence can determine with considerable accuracy the number of airborne objects in the enemy inventory and their operational characteristics, size, and probable employment tactics.

B-2. Speed and Altitude

Knowing the operational characteristics of enemy targets, the optimum speed and altitude of attack can be determined with reasonable accuracy. The defense design is based on this optimum speed and altitude. This is particularly true for manned aircraft because these two factors greatly affect determination of the bomb release line (BRL).

B-3. Weapons and Delivery Means

Intelligence can determine the optimum enemy weapon that would be used against a particular target. The defense must also be designed for the delivery means that the enemy has in operational status and in sufficient numbers. The carriers employed by the enemy will vary with the numbers available, payload, weather conditions, and launching-base-to-target considerations. The attack technique will be closely associated with the characteristics of the carrier, launching base, and target area.

B-4. Attack Techniques

The enemy may employ any of a number of attack techniques as discussed in *a* through *g* below.

a. Basis for Tactics. A basic fighter aircraft tactic is to attack at maximum speed and minimum altitude. This will compress the time that the ground defenders will have to acquire, identify, and engage the attacking aircraft. This

shortened exposure time is an important factor in aircraft survivability.

b. Short Exposure Time. Attack speeds may vary from 400 to 800 knots, depending on aircraft type and cargo. However, to enhance attack accuracy, the aircraft must slow to an approximate speed of 300-450 knots. Actual speed will depend on ordnance load, fuel requirements, visibility, and the pilot's familiarity with the terrain. An increase in speed during the final approach further decreases the time available in which to engage the target. Final approaches at 100 feet or less altitude may be employed. Aircraft currently in operation can attack effectively at this minimum altitude. Attacks at these high speeds and low altitudes will delay or preclude target acquisition until the aircraft has been maneuvered to acquire the final attack heading and angle. The total time the aircraft is vulnerable is greatly reduced by attacks at minimum altitudes and high speeds. Table B-1 provides a conversion table which enables Redeye personnel to estimate the speed of attacking aircraft.

Table B-1. Attack Speed Data

Mach No.	Knots	Miles/Min	Km/Min	Ft/Sec
.9	600	11.5	18.5	1,020
1.2	800	15.4	24.7	1,350
2.1	1,400	26.9	43.2	2,360

Note. Mach 0.75 = 500 knots at sea level.

c. Low-Altitude Approach Techniques. Low-altitude approach techniques which may be used prior to executing basic attacks are shown in figure B-1.

d. Basic Low-Altitude Tactics. The enemy is assumed to employ tactics similar to those used by the US Air Force (fig B-2).

For these tactics, the aircraft is flown at minimum altitude and high speed and is pulled up abruptly into a climbing altitude 1 to 4 1/2 miles before reaching the target. This climb will provide sufficient altitude to maneuver for the final

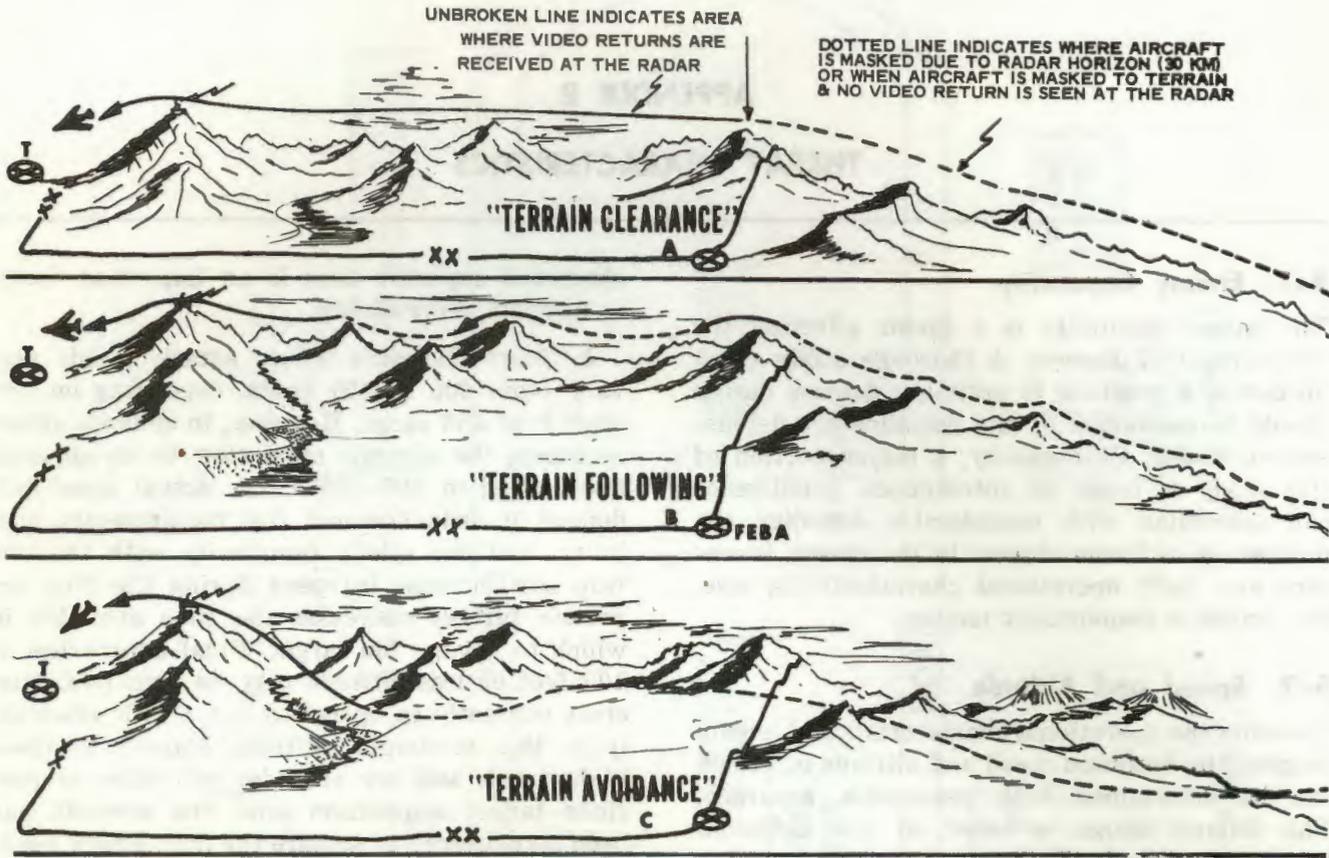


Figure B-1. Low-altitude approach techniques.

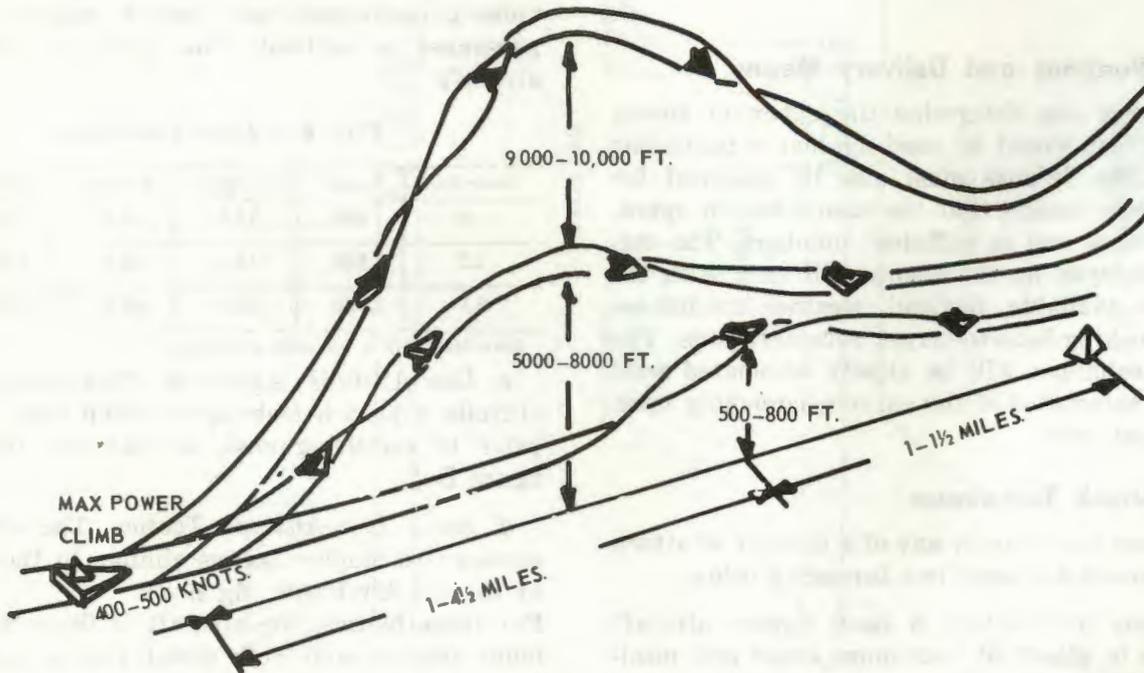


Figure B-2. Basic tactical maneuvers.

attack. The distance from the target at which the pullup is executed depends on the approach speed and type of run; e.g., strafing, rocket, or dive-bomb runs. This pullup and climb are executed at the maximum power of the aircraft. Each type of run requires a different attack angle which determines the maximum altitude of the maneuver. In the case of rocket and dive-bomb runs, the pullup angle and attack angle are approximately equal. The speeds in the illustration are specific for the example shown but may be varied in combat. Specific details of the three types of runs are—

(1) *Low-angle strafe* (fig B-3). The pilot flies the aircraft at an altitude of 30 to 100 feet at a speed of 400 to 500 knots. He abruptly pulls up the aircraft to a climbing altitude of less than

30° at 1 to 1 1/2 miles from the target. After climbing to an altitude of 500 to 800 feet, the pilot maneuvers to attain the attack angle of 5° to 6°. The speed when on target is about 400 knots.

(2) *Rocket run* (fig B-4). The pilot flies the aircraft at an altitude of 30 to 100 feet at a speed of 400 to 500 knots. He abruptly pulls up the aircraft to a climbing attitude of 30° to 35° approximately 3 miles from the target. After climbing to an altitude of 5,000 to 7,000 feet, the pilot maneuvers to attain the attack angle of 30°. The final speed when on target is about 400 knots. Approach and final speeds may vary, causing the pullup distance from the target to change accordingly.

(3) *Dive-bomb* (fig B-5). The aircraft ap-

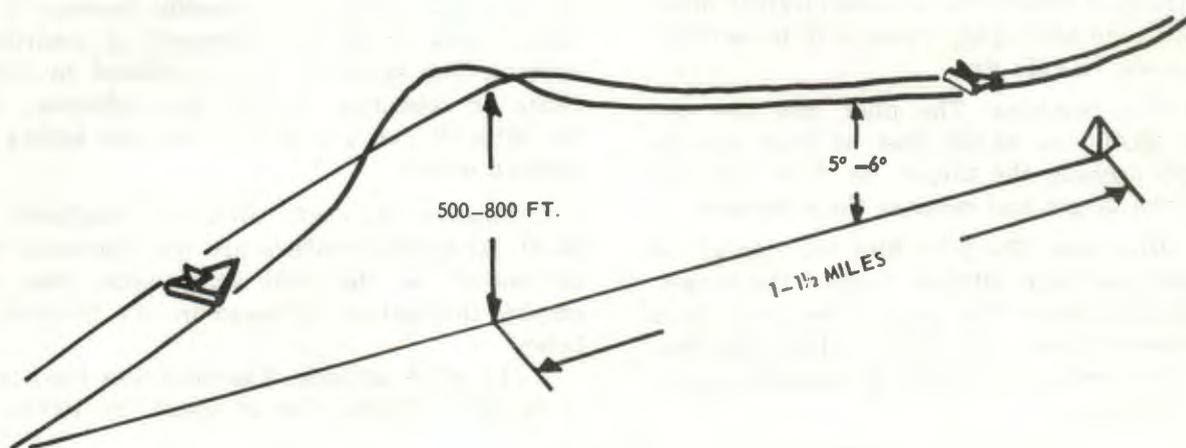


Figure B-3. Low-angle strafe.

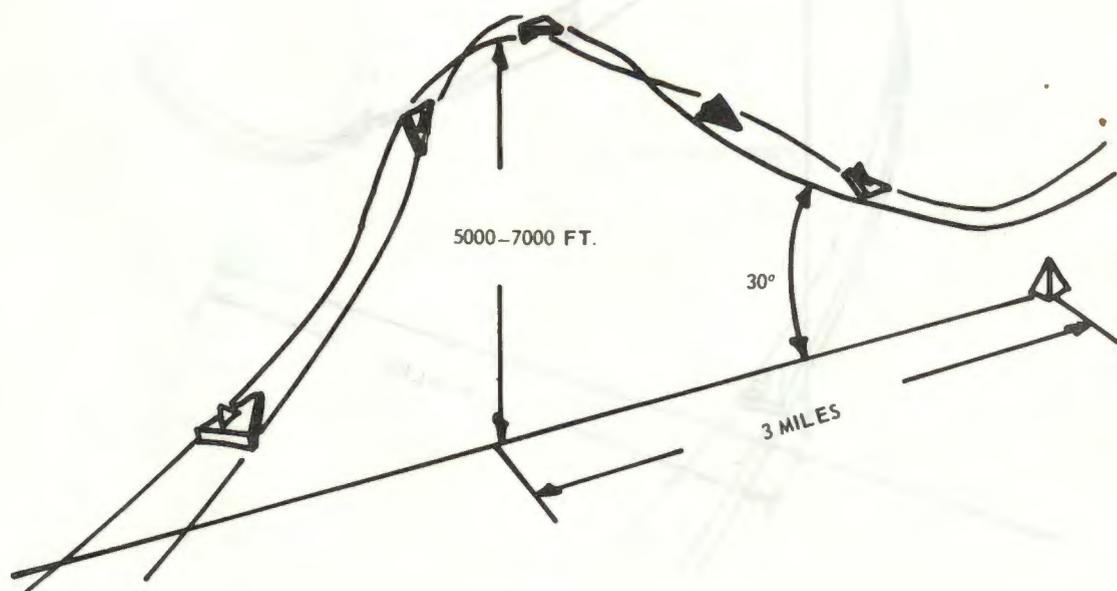


Figure B-4. Rocket run.

proaches the target at an altitude of 30 to 100 feet with the target off the wingtip at a distance of 2 to 2 1/2 miles. With a speed of 400 to 500 knots, the pilot pulls up the aircraft into a climbing attitude of 40° to 45°. Upon reaching an altitude of 9,000 to 10,000 feet, the pilot turns the aircraft toward the target and maneuvers it to attain the attack angle of 45°. At the top of the maneuver, the speed has dissipated to approximately 250 knots. The final speed when on target is about 400 knots.

e. Fighter Aircraft Delivery Methods (fig B-6).

(1) *High altitude.* The pilot flies the aircraft at extreme altitude, from 30,000 to 50,000 feet, and at high speed. The ordnance falls by gravity after release. This method of delivery is uncommon in the field army area because aircraft flown at this altitude are highly vulnerable to surface-to-air missile (SAM) fire.

(2) *Dive-bombing.* The pilot flies the aircraft at 30,000 to 45,000 feet at high speeds. Upon approaching the target, he dives the aircraft on the target and releases the ordnance.

(3) *Dive-toss.* The pilot flies the aircraft at high speed and high altitude toward the target. After diving toward the target, the pilot pulls up the aircraft into a climbing attitude; he then releases the ordnance which is literally tossed toward the target.

(4) *Low-altitude bomb aiming systems (LABS).* The pilot flies the aircraft between 100 and 1,000 feet above the terrain at a speed of 400 to 750 knots. On approaching the target, at a predetermined point the pilot pulls up the aircraft into a climbing attitude. The pilot then releases the ordnance and reverses his direction of flight.

(5) *Lay-down.* This method is most frequently used by fighter aircraft to deliver ordnance on targets in the field army area. The pilot flies the aircraft about 300 feet above ground level at speeds of 400 to 900 knots. The target course is over the target area. At the proper time, the pilot releases the ordnance and flies over the target without changing altitude. High speed and low altitude enhance the success of the mission. The ability to release ordnance at such low altitudes is possible because of advance made in the development of retardation devices. The speed of fall is reduced by drogue chute or retarding fins on the ordnance; thus, the aircraft can get out of the way before detonation occurs.

f. Bomber Aircraft Delivery Methods (fig B-7). Although bombers are not commonly used on targets in the field army area, they may employ the tactics discussed in (1) through (3) below.

(1) *High altitude.* The pilot flies the bomber at 35,000 to 60,000 feet at speeds of 400 to 600

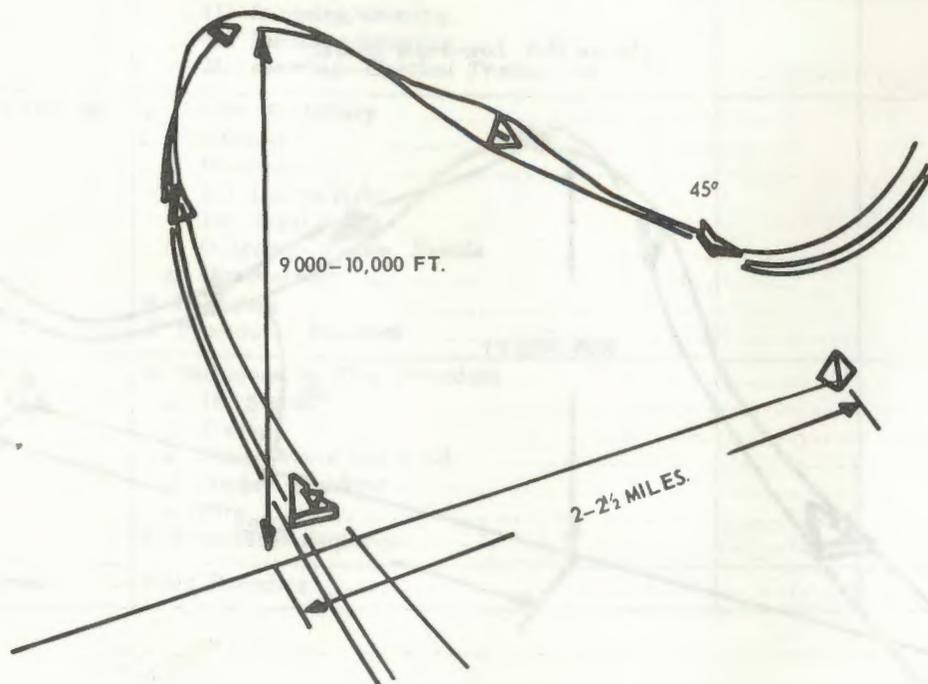


Figure B-5. Dive-bomb.

knots. The ordnance falls by gravity after release.

(2) *Air-to surface missile (ASM)*. Air-to-surface missiles have a range of 90 to more than 500 nautical miles. With this range, the bombers can often be kept out of range of air defense artillery surface-to-air missiles (SAM). The pilot flies the bomber at any desired altitude because there is no fixed altitude requirement for release of the ASM.

(3) *Lay-down*. The bomber can also use the lay-down method in the same manner as the fighter.

g. Low-altitude Bomb Aiming Systems (LABS).

(1) *Basic principles*. The basic principles of LABS (fig B-8) are—

(a) An initial point, which can easily be identified on the ground, is selected before the attack. In figure B-8, the initial point is a bridge.

(b) After arriving at the initial point, the pilot flies a stated time-distance factor. Upon completion of this time-distance flight, the pilot pulls the aircraft up into a climbing attitude of 45°. Electronic devices release the ordnance of the proper time to insure maximum hit probability.

(c) Immediately after the ordnance release, the pilot continues the flight maneuver by putting the aircraft into a loop and reversing his direction of flight.

(d) The LABS would be used primarily with nuclear weapons, although it may be used with conventional bombs.

(2) *Variation of LABS*. Over-the-shoulder delivery is a variation of LABS (fig B-9). The nature of the terrain, weather conditions, or failure of the pilot to pick up the initial point may result in the pilot finding himself over the target area. When this happens, the pilot will continue on course and fly past the target, pulling the aircraft up past the vertical. At about 90° to 120°, the ordnance is released automatically. The ordnance will continue upward; the pilot will loop the aircraft at the top and maneuver it into a half-roll to get out of the way of the falling ordnance.

B-5. Maximizing Defense Capabilities

The optimum enemy capabilities and attack techniques will be selected as a guide in maximizing defense capabilities. This does not imply that the defense will be designed against the fastest

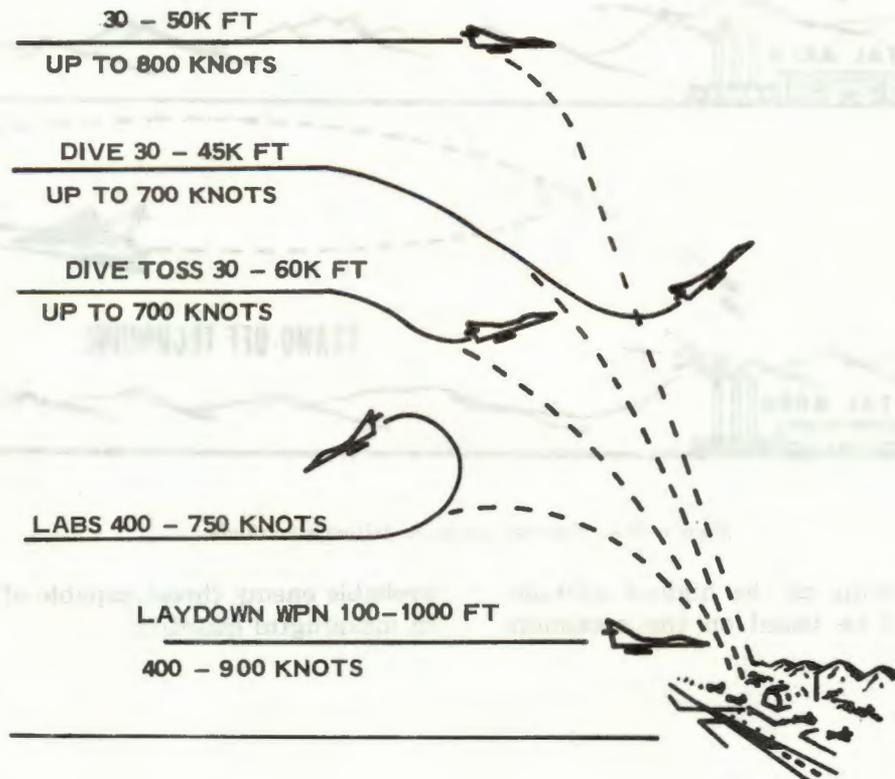


Figure B-6. Fighter aircraft delivery methods.

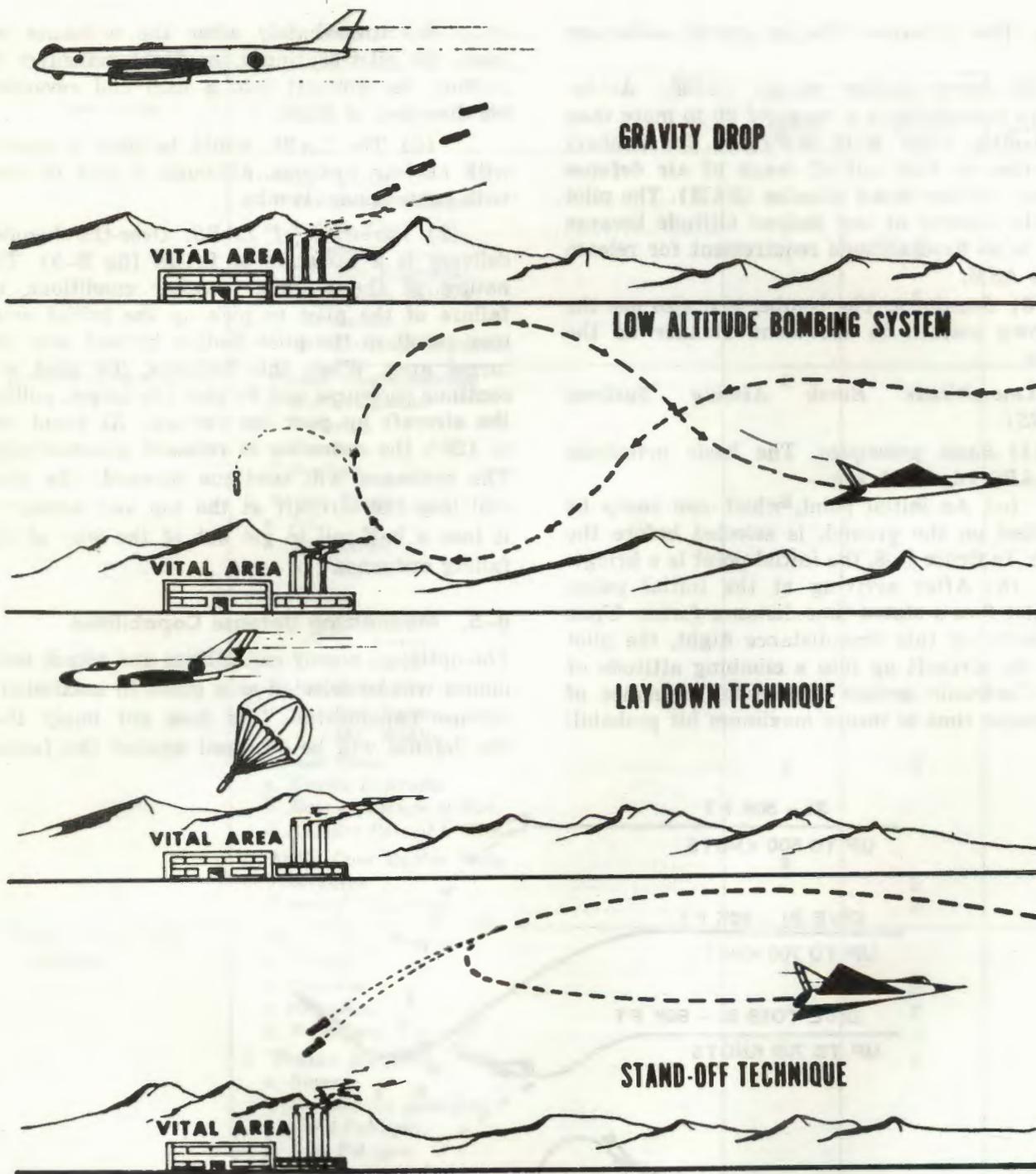


Figure B-7. Bomber aircraft delivery methods.

target or one operating at the highest altitude. Defense design will be based on the maximum

probable enemy threat capable of being employed in meaningful quantity.

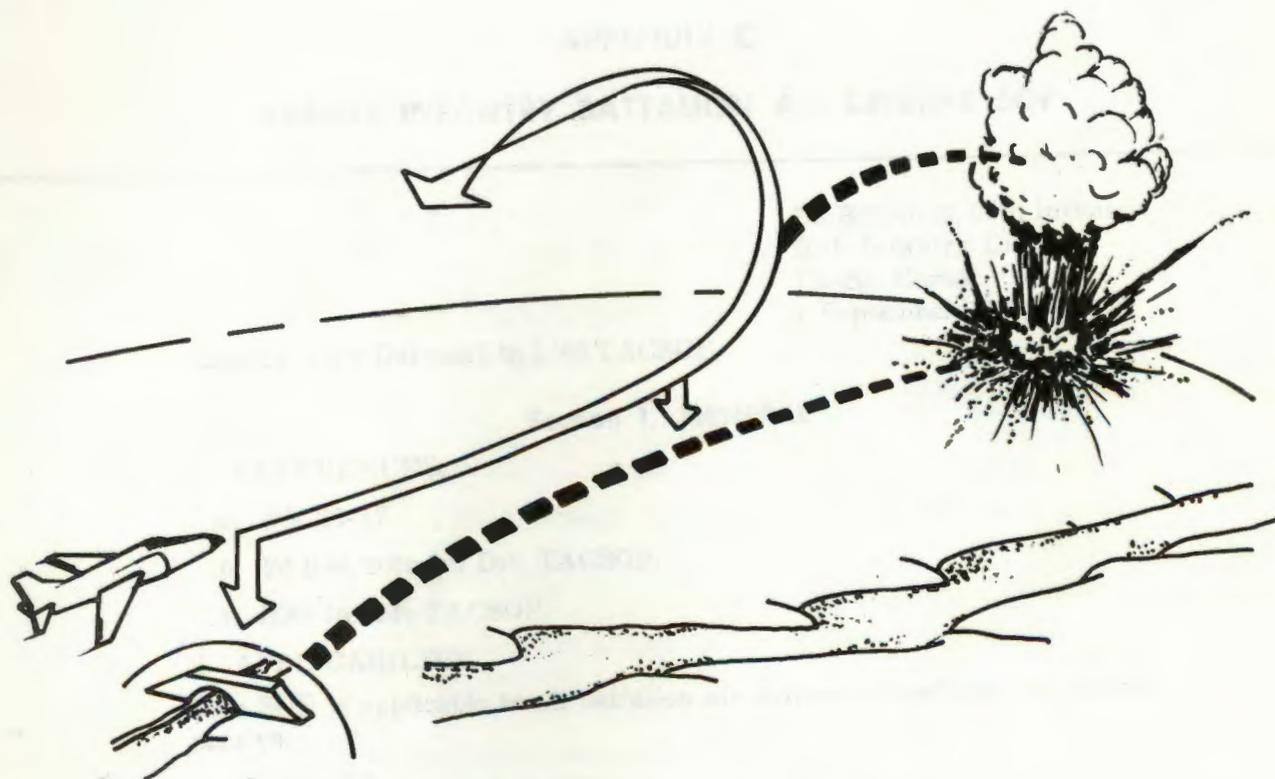


Figure B-8. Low-altitude bomb aiming system.

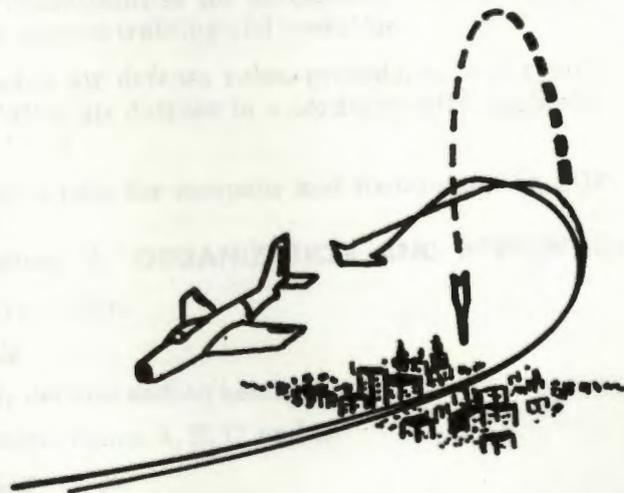


Figure B-9. LABS variation (over-the-shoulder delivery).

APPENDIX C

SAMPLE INFANTRY BATTALION AIR DEFENSE SOP

1st Battalion, 66th Infantry
20th Infantry Division
Taegu, Korea
1 September 1970

Annex E (Air Defense) to 1/66 TACSOP

Section I. GENERAL

1. REFERENCES.

- a. FM 23-17.
- b. 2d Bde, 20th Inf Div, TACSOP.
- c. 20th Inf Div TACSOP.

2. APPLICABILITY.

This SOP is applicable to all battalion air defense operations, active and passive.

3. PURPOSE.

This SOP—

- a. Fixes responsibilities for development, execution, and supervision of battalion air defense training and operations.
- b. Establishes air defense rules, procedures, and communications channels for battalion air defense in accordance with applicable directives (see paragraphs 1b, c).
- c. Provides a base for company and Redeye section SOP.

Section II. ORGANIZATION AND RESPONSIBILITIES

4. ORGANIZATION.

a. Organic.

- (1) Air defense section headquarters.
- (2) Redeye teams A, B, C, and D.

b. Attached.

- (1) Additional Redeye teams may be attached to the air defense section when required.
- (2) Vulcan ADA units may be attached to the battalion when required for direct fire support.

c. Organization for Combat (para 11).

5. RESPONSIBILITIES

- a. *Battalion Commander.* (See paragraphs 1b, c.)

b. Battalion S3.

(1) Supervise the overall establishment of the required battalion air defense procedures and primary and alternate channels for control of battalion air defense operations.

(2) Relay weapon control status orders, FAAR location/data link frequency, friendly air movement information, and other pertinent information received from the battalion commander or authorized external sources (para 1b and 1c) to the air defense section headquarters and, when so advised by the Redeye section leader, to the company commanders.

(3) For the battalion commander, impose Redeye weapons hold (para 13c) on an area/time/class of aircraft on a limited basis when deemed appropriate for the situation.

(4) Controls issue of Redeye BCU's (peacetime).

(5) Exercise staff supervision over the battalion air defense officer (air defense section leader).

c. Air Defense Section Leader. The air defense section leader is a commander and also the battalion air defense officer. He will:

(1) Command organic and attached Redeye teams not further attached to other units.

(2) Maintain the battalion air defense SOP.

(3) Provide air defense input to battalion plans.

(4) Maintain Redeye team and FAAR position plots on the battalion situation overlay.

(5) In conjunction with S3 Air, maintain friendly air movement data, using available materials, such as colored string and thumbtacks, to display time-annotated preplanned and immediate air activity of future or immediate interest to the battalion's Redeye teams.

(6) Maintain a journal of Redeye weapon control status orders received, team location changes, operational status change, missiles on hand, and engagement results.

(7) Advise the battalion commander and staff on employment and coordination of organic and attached air defense means, if any, and recommend air defense priorities in conjunction with the commander of attached ADA units. The command relationship of the air defense section leader and a commander of attached ADA (employed in air defense role) will be specified by the battalion commander.

(8) Plan and supervise section and team training in accordance with appropriate technical manuals, field manuals, and command directives.

(9) Plan and exercise staff supervision of battalion training in passive air defense measures and use of non-air-defense weapons against hostile aircraft.

(10) Maintain NCS for battalion air defense section command net.

(11) Assign sector of responsibility to Redeye teams employed in general or direct support roles.

d. Company Commanders.

(1) Support Redeye teams in direct support or general support as directed.

(2) Command attached Redeye teams, with operational control exercised in compliance with this SOP.

(3) Supervise the employment of non-air-defense weapons against attacking enemy aircraft (para 13b and 15).

(4) Consider air defense positions when positioning caliber .50 machineguns.

e. Section Sergeant. (See paragraphs 1a, b.)

f. Section Driver/Radio Operator. (See paragraphs 1a, b.)

g. Team Chief. (See paragraphs 1a, b.)

h. Gunner. (See paragraphs 1a, b.)

Section III. INTELLIGENCE

6. AIR DEFENSE WARNING (RED/YELLOW/WHITE).

a. See paragraph 1c.

b. Redeye teams will be combat ready (para 14) during RED and YELLOW air defense warnings.

7. EARLY WARNING.

a. See paragraph 1c.

b. Early warning of the approach of hostile aircraft is originated external to the division and is broadcast over available warning nets (para 26a). Early warning of all air attacks is highly improbable.

8. ALERTING.

a. See paragraph 1c.

b. The division forward area alerting radars (FAAR) will provide local alert information directly to the Redeye teams via data link to the team's target alert data display set (TADDS). The section leader will accomplish FAAR-team "pairing" based on FAAR location/data link frequency received from the S3 and section leader knowledge of team locations.

c. All units, including Redeye teams, will exchange alert information by the fastest means available (voice, visual/audio signals, telephone).

9. FRIENDLY AIR MOVEMENT.

Available friendly air movement information (reference 1c), will be transmitted by the S3 to the air defense section leader who will relay it to the Redeye teams when appropriate. Time in effect will be specified. This information is transmitted to warn Redeye teams when friendly aircraft are to be in the area. The team will not assume that all friendly flights will be preceded by friendly air movement information. Also see paragraph 5c(5).

Section IV. OPERATIONS

10. CONCEPT.

a. The objective of the Redeye air defense section is to limit the effectiveness of enemy air offensive and reconnaissance efforts to a level permitting freedom of action to the 1st Bn, 66th Inf. A secondary objective is to contribute to the air defense of the 20th Inf Div as a whole. Redeye has no ground fire support capability.

b. All operations of air-defense-capable weapons have the secondary

mission of aggressively engaging by fire all aircraft attacking their units unless otherwise ordered by unit leaders.

11. ORGANIZATION FOR COMBAT.

a. Redeye teams are normally retained under battalion (air defense section) control. One of two tactical missions may then be assigned.

(1) *General support.* The air defense section leader deploys his Redeye team so as to best defend the battalion as a whole. Emphasis will be placed on maintenance of overlapping fires and on coverage of avenues of low-altitude air attack threatening the battalion priority units/facilities specified by the battalion commander. The section leader will arrange for team tie-in to nearby units for purposes of coordinating security and mess. The general support tactical mission is most effective during semistatic conditions when optimum firing positions can be occupied and adequately secured.

(2) *Direct support.* The air defense section leader deploys his Redeye teams so as to best defend the companies specified to receive direct support. Teams move with the supported units as required for mission accomplishment, but otherwise remain under Redeye section leader command and control. Team tie-in to the supported unit will be as required for coordination of team positioning, security, and mess. This method is normal in the 1st Bn, 66th Inf. During this tactical mission, team A will normally defend company A, team B will normally defend company B, etc.

b. Redeye teams may be attached to companies when battalion level control is impractical, as determined by the battalion commander, based on air defense section leader's recommendation. Also, see paragraphs 5b2) and 5d(2). When attachment is required, the same team-company pairings will normally be made as in direct support (a(2) above).

12. DEPLOYMENT CONTROL.

Redeye team general position areas will be selected by the commander (air defense section leader or company commanders) exercising operational control. Redeye team chiefs accomplish final position selection and report coordinates to section leader. Reference 1a provides criteria.

13. FIRE CONTROL.

a. See paragraphs 1b, c.

b. After declaration of hostilities, Redeye engagements will be in accordance with the prescribed weapon control status (c below) and hostile criteria (d below). Other air defense-capable weapons will be employed against aircraft only in self-defense.

c. Redeye teams will be placed by the battalion commander, through S3, under any one or a mixture of the three weapon control statuses listed below. A "mixture" involves application of a particular status against a particular aircraft class only (e.g., helicopter).

(1) *Weapons free.* Under this status, Redeye teams will engage all aircraft not identified as friendly. Aircraft of unknown or doubtful identity may be engaged; however, every reasonable effort will be made to achieve a positive identity prior to the firing decision. Authority to declare this status rests above the battalion level; however, commanders may place Redeye teams authorized this status in a more restrictive status ((2) and (3) below).

(2) *Weapons tight*. This is the normal wartime status for 1st Bn, 66th Inf, Redeye teams. Under this status, Redeye teams engage aircraft that they positively identify as hostile (*e* below). Aircraft of unknown or doubtful identity will not be engaged. The commander is authorized to revert to this status from a weapons free status. He can also place teams authorized this status in a more restrictive status ((3) below).

(3) *Weapons hold*. Under this status, Redeye teams will not engage aircraft, except that the right of self-defense is not denied. The S3 and commanders of attached Redeye teams are delegated weapons hold authority. The S3 will respond positively to air liaison officer (ALO)-originated weapons hold requests whenever possible. Use of this status will be for limited periods as necessary to prevent premature disclosure of positions or to protect special friendly aircraft flights.

d. Aircraft are identified as hostile when they are:

- (1) Attacking friendly troops or installations.
- (2) Bearing the insignia or having the configuration of an enemy aircraft.
- (3) Dropping flares over friendly territory without prior coordination.
- (4) Discharging parachutists or unloading troops in numbers in excess of the normal aircraft crew (six) without prior coordination.
- (5) Engaging in mine-laying operations without prior coordination.
- (6) Discharging smoke or spray over friendly elements without prior coordination.
- (7) Employing ECM devices over friendly territory without prior coordination (e.g., chaff, corner reflectors, or decoys).

e. Aircraft identification by Redeye teams will be by visual means. Identification received from external sources will be considered tentative until verified by team visual means. When the team is operating under the weapon control status of weapons tight, the team chief is responsible for positive identification of an aircraft as hostile prior to engagement and will declare weapons hold on those aircraft not so identified. Binoculars will be used to the degree feasible during the identification process. When the Redeye team members are acting independently, both are considered team chiefs and may identify aircraft.

f. Redeye teams suffering *total* loss of communications will assume a weapons tight status as soon as the loss is discovered unless a weapons hold, with a specific time limit, is in effect. In this case weapons hold will be observed until the time limit, then the team reverts to weapons tight (para 26f).

14. COMBAT READINESS.

a. See paragraph 6b.

b. A combat-ready Redeye team—

- (1) Has its radio manned and operating in the required net.
- (2) Is actively performing airspace surveillance.
- (3) Is able to accompany the defended unit.
- (4) Has its basic load of weapons readily available, with batteries inserted in at least two unpacked rounds.
- (5) Meets all proficiency standards.

15. ACTIVE AIR DEFENSE.

a. See paragraphs 1a through c.

b. The sole Redeye mission is active air defense. Non-air-defense weapons will be used for active air defense against attacking aircraft on order of platoon and higher commanders. Concentrated automatic weapons fire will be exploited. Enemy helicopter landing zones will be covered by grenade launcher and mortar fire.

16. PASSIVE AIR DEFENSE.

a. See paragraphs 1a through c.

b. The passive air defense measures of camouflage, cover, concealment, and dispersion will be habitually practiced.

17. GUNNERY.

a. *Fire Coordination.* When practical, fire coordination within a team will be on voice command of the team chief. Fire coordination between teams is accomplished through use of proper target selection procedures (b below), and through designation of sectors of responsibility (para 19).

b. *Rules for Target Selection.* The target which presents the most immediate threat to the defended area or installation will be engaged first. When faced with multiple targets of equal threat, the gunner should select the lead or right hostile aircraft in the primary sector of responsibility. The team chief should select the trailing or left hostile aircraft. If no aircraft is attacking in the primary sector, or if no primary sector is assigned, the gunner should select the leading aircraft or the one on the right of the formation, and the team chief should select the second aircraft trailing or on the left of the formation. The team chief may designate targets by voice command. Fire will be withheld if friendly and hostile aircraft are closely intermixed.

c. *Number of Missiles to Fire.*

(1) Single, low-medium-performance, hostile aircraft. Fire one missile, assess results, and fire again if necessary.

(2) Single, hostile, jet aircraft. When possible, team chief and gunner each fire one missile.

(3) Multiple hostile aircraft. Team chief and gunner will continue firing one round per aircraft as long as the threat is within weapon capabilities. The team chief will make a positive hostile identification prior to each engagement unless the team is deployed independently.

18. SURVEILLANCE PROCEDURES.

The sector of search is 360°, with emphasis on the sector of responsibility (para 19) if assigned. Team members should alternate surveillance duties every 40 minutes if practical. (See FM 23-17.)

19. SECTORS OF RESPONSIBILITY.

Teams providing general and direct support normally will be assigned a sector responsibility by the air defense section leader. The commander of attached Redeye teams may assign sectors of responsibility. The sector of responsibility influences surveillance procedures and procedures for target selection. An assigned sector of responsibility will normally encompass 30° to 180°. If none is assigned, the sector of responsibility is 360°.

20. MOVEMENT.

a. *Vehicle Loading.* (See unit SOP.)

b. *Foot Movement.* Teams moving on foot will:

- (1) Maintain radio or alternate communications.
- (2) Request assistance in carrying basic load of weapons.
- (3) Insure that weapons left behind are properly guarded.

c. *Section Headquarters Displacement.* The air defense section headquarters will normally displace with the battalion operations section. When the air defense section headquarters is required to displace independently to maintain the required degree of control over the teams, the section sergeant will normally remain as liaison with the battalion operations section while the section leader and radio operator/driver displace.

21. POSITION SELECTION.

a. *Maximum Observation and Fields of Fire.* Redeye firing positions should be selected as far forward as practical (*f below*), on commanding terrain affording a minimum detection range of 5 kilometers, and with unobstructed fields of fire along the most probable low-altitude avenues of hostile aircraft approach. These positions should cover avenues of approach into the battalion area not otherwise defended by divisioned air defense artillery units.

b. *Mutual Support/overlapping Fires.* Teams should be positioned so that they provide maximum coverage of adjacent team's dead zones (FM 23-17A) with mutually supporting/overlapping fires along probable enemy air avenues of approach. This criteria is most applicable when teams are deployed in a general support role.

c. *Defense in Depth.* When sufficient teams are available, they should be deployed in depth to provide an increasing density of fire as the threat approaches the defended area.

d. *Accessibility.* Ideally, firing positions should be accessible by vehicle to maintain mobility and facilitate resupply. The Redeye team can operate on foot when required.

e. *Location in Regard to Sun.* Firing positions should be selected so as to minimize reflective and direct effects of the sun.

f. *Ground Security.* Firing positions should not be selected beyond the protection of friendly troops unless provision is made to provide ground security for the team.

g. *Safety.* To preclude the possibility of burns or injury to other troops, a circular zone 13 meters in radius around the firing positions should be kept clear where possible to permit the team to fire in all directions.

22. SAFETY.

a. *Hangfires, Duds, and Misfires.* (See FM 23-17.)

b. *Required Clear Areas.* (See FM 23-17.) The requirement for 13-meter gunner separation applies only to range firing.

Section V. SERVICE SUPPORT

23. ADMINISTRATION/LOGISTICS.

Annex H, 1st Bn, 66th Inf, TACSOP.

24. REPORTS.

Air defense section leader will report daily or as ordered to S3 as to section status and engagement results.

Section VI. COMMAND AND SIGNAL

25. COMMAND.

Current operation order.

26. COMMUNICATIONS.

a. The air defense section leader, if collocated with the battalion S3, will monitor the Chaparral/Vulcan command net.

b. The air defense section leader will monitor the battalion command net, using the organic AN/VRC-47 radio set. Collocation of the air defense section leader with the S3 or S3 Air is considered normal and will reduce the need for section transmission in the battalion command net.

c. The air defense section leader will act as the net control station (NCS) for the Redeye section net, using the organic AN/VRC-47 radio set.

d. The Redeye team chief will operate in the Redeye section net when providing general or direct support, and in the designated company command net when attached to the unit, or as directed.

e. The Redeye team chief will use voice, team telephone, or other designated means to maintain contact within the team and with nearby or designated companies as required.

f. Redeye elements experiencing loss of primary communications will utilize all available alternate means (see CEOI).

g. The air defense section leader will send hourly notices to teams under his control for purposes of checking communications and time standardization. An exception is during mandatory periods of radio silence.

h. The air defense section leader will assign TADDS frequencies to his Redeye teams (para 8b).

i. Communications discipline and security will be enforced. (See CEOI and CESI.)

MUNROE
LTC

Distribution: A

Official:
/s/Doughtie
DOUGHTIE
S3

APPENDIX D

QUALIFICATION PROGRAM FOR REDEYE GUNNERS

Section I. GENERAL

D-1. Purpose and Scope

a. This appendix outlines and standardizes the scopes of examination for qualification of personnel armed with the Redeye weapon system. Encouraging and training personnel to qualify in these examinations develops an advanced training program which tends to insure a high level of technical proficiency on the part of the individual armed with Redeye and thereby directly contributes to the effectiveness of the battalion/squadron air defense.

b. These examinations are designed to test the ability of the soldier in those skills and techniques directly related to employment and operation of the Redeye weapon system. They cover subjects considered to be essential to the professional development and advancement of enlisted personnel charged with the conduct of the air defense of units of all arms operating in the forward battle area. Training in preparation for these examinations will assist in the development of Redeye gunners and air defense sections (Redeye) and will prepare them to accomplish their assigned missions.

D-2. Classification of Examinations

The examinations are classified in order of increasing difficulty corresponding to the knowledge and skills required of second-class, first-class, and expert Redeye missilemen. The second-class examination is planned at the level of knowledge and skill required of individuals serving as basic Redeye gunners. The first-class examination is

planned at the Redeye team chief level and the expert examination is designed to test the soldier's overall knowledge of the Redeye weapon system, his ability in employing Redeye tactically while operating as the battalion/squadron air defense section sergeant, and his ability as an instructor.

D-3. Description of Examinations

The examinations presented in this appendix have been prepared in sufficient detail to serve as a guide to examining boards as to the scope of knowledge and skill required at each qualification level without negating the board's prerogative to tailor the examination to meet the particular tactical requirements of the parent unit. In this respect, provision has been made for the inclusion of questions based on locally generated standing operating procedures and emergency or alert plans. Where appropriate, the examiner has been given a choice of test procedures and questions to permit flexibility in administration of the examination and to minimize the possibility of compromise. Solutions or answers have not been included because the examination requirements for the most part consist of practical application of the required skills and knowledge. This approach precludes the learning of answers to stock questions but allows the appendix to be used by the soldier in preparing himself for a particular examination by indicating the scope of the material in which he is expected to be proficient.

Section II. ADMINISTRATION

D-4. Examining Boards

The examinations will be conducted by boards of officers appointed by the commanding officer of the next higher headquarters (or higher) in the chain of command of the unit to which the air

defense section (Redeye) is organic. The boards will be composed of a minimum of three officers who, if practicable, are not members of the unit whose personnel are being examined. Officers appointed as board members should be knowledge-

able in matters concerning Redeye system tactics, employment, organization for combat, command and control, maintenance and support, and communications. Examining boards will be convened at the discretion of the appointing authority.

D-5. Preparation of Examinations

a. The examining board prepares all examinations. In preparing examinations, boards *should use this appendix as a guide* to insure adequate depth of coverage and to insure a reasonable degree of uniformity between the examinations conducted by different boards. *All subject areas in this appendix will be covered in each examination prepared and each area will be given the scoring weight indicated herein.* Questions and procedures, however, should not follow the exact wording given in this appendix but should be varied in wording and content to prevent compromise and to prevent a passing grade by learning the examination only. The board will take positive precautions to prevent disclosure of examination content to candidates prior to conducting the examination.

b. If an examination item becomes obsolete or inappropriate due to modification of material or changes in tactics or doctrine, questions with the same weight based on the new material, tactics, or doctrine will be prepared and substituted for the obsolete item.

c. The examining board is responsible for making the necessary administrative arrangements for conduct of the tests.

D-6. Conduct of Examinations

a. To the maximum extent possible, examinations will be conducted in a manner that requires the practical demonstration of the required knowledge and skills by the candidate. Oral and/or written portions of the examination will be restricted to those subject areas where the candidate is required to demonstrate possession of factual data concerning the weapon system and its ancillary equipment or to express himself verbally, as when acting as an instructor.

b. Training devices, such as the field handling trainer and tracking head trainer, may be used instead of the Redeye weapon for the demonstration of proficiency in weapon handling, tracking and target acquisition, range estimation, and the techniques of target acquisition, range estimation, and the techniques of target engagement.

The SL-ARK No. 1 or GOAR kits may be used in examining candidates for proficiency in aircraft recognition.

c. Examining boards will exercise care in both preparing and administering examinations to insure validity. Success or failure of a candidate should depend solely on possession or lack of the required knowledge or skill.

D-7. Eligibility

a. Any person who has satisfactorily completed the Redeye gunner's qualification course and has been awarded the additional skill identifier R6 to his basic MOS (AR 611-201) is eligible to take these examinations. The examining board is responsible for verifying the eligibility of each candidate.

b. A candidate for the second-class examination must meet the basic eligibility requirement in *a* above. A candidate for the first-class examination must be currently qualified as a second-class missileman (Redeye) at the time he takes the examination. A candidate applying for the expert examination must be currently qualified as a first-class missileman (Redeye) at the time he takes the examination.

D-8. Qualification

Each examination is assigned a total weight of 100 points. The minimum score required for qualification in any of the three classifications is 75 points.

D-9. Requalification

a. *Expert Missileman (Redeye)*. Requalification as expert missileman is required every 3 years until three successive qualifications are attained. No further requalification is then required.

b. *First-Class Missileman (Redeye)*. Requalification at the first-class level is required every 2 years until the soldier qualifies at the expert missileman level. After two successful qualifications at the first-class level, the soldier must attempt to qualify at the expert level. Failure to qualify as expert missileman will invalidate the soldier's existing first-class missileman classification and require reexamination at the first-class level.

c. *Second-Class Missileman (Redeye)*. Requalification as second-class missileman is required yearly until the soldier qualifies at the next higher

level. The soldier must attempt to qualify at the first-class level after two successive second-class missileman awards. Failure to qualify at the first-class level will result in invalidating the soldier's existing second-class classification and require reexamination at the second-class level.

D-10. Reports and Records

The examining boards will report the results of the examinations to the appointing authority who will issue appropriate orders announcing the qualification badge awards. Records of qualifying candidates will reflect qualification badge awards in accordance with current regulations.

D-11. Qualification Badges

Qualification badges are of three classes: *Expert*, *Sharpshooter*, and *Marksman*. When used to designate qualification level with the Redeye weapon system, these badges correspond to *expert*, *first-class*, or *second-class* missileman (Redeye), respectively. A component bar, inscribed MISSILE, is worn attached to the qualification badge.

D-12. Responsibility of Commanders

a. Air Defense Section Leaders. Air defense section leaders are responsible for training their section personnel so that they will be adequately

qualified in the subject areas covered in these examinations. This training and subsequent qualification of personnel will improve the technical proficiency and morale of both the individual and the unit. The section leader will actively encourage all section personnel to strive toward ultimate qualification at the expert level. The section leader will maintain informal records of the qualification status of each Redeye gunner and will provide training opportunities for the individual designed to further his technical proficiency and prepare him for qualification at successively higher levels.

b. Battalion/Squadron Commander. Commanders of units having organic air defense sections (Redeye) are responsible for supervising the training of the air defense section personnel, integrating the training of the section into the unit's overall training program, and actively encouraging section personnel to qualify under these examinations.

c. Higher Unit Commanders. Higher unit commanders, who are appointing authorities for the examining boards, are responsible that board members are competent in the Redeye field, impartial, and well-acquainted with the duties of air defense section personnel. Supervision of examinations is the responsibility of the appointing authority.

Section III. SECOND-CLASS MISSILEMAN (REDEYE) EXAMINATION

D-13. General

This section provides guidance in preparation of the second-class missileman (Redeye) qualification tests. The questions listed are intended to define the scope and depth of knowledge of skill required of the candidate and do not constitute the actual examination. Examining boards should draw up questions of similar scope and depth. The scoring weight assigned each major subject area will be as indicated after each paragraph heading. The exact number of questions used in each subject area may be determined by individual boards and will be the number the board considers the minimum necessary to require the candidate to demonstrate the required level of knowledge and skill.

D-14. Communications (Weight 10)

Questions on communications should be confined to the communications equipment assigned by TOE to the Redeye team and should explore the

candidate's knowledge of basic radiotelephone procedures, Redeye section command net, communications security, and equipment operation and maintenance. The following questions suggest the scope and depth of the examination:

a. Recite the letters of the phonetic alphabet and the numbers 0 through 9.

b. Point out, name, and describe the use of the communications equipment issued to the Redeye team.

c. Perform operator maintenance on the team radio equipment.

d. Energize the team radio and enter the Redeye section command net.

e. Write a complete message for radio transmission, using the correct format.

f. Transmit a message to the Redeye net control station over the team radio, using correct radiotelephone procedure.

g. Receive, authenticate, and acknowledge a message from the air defense section headquarters.

h. Act as a radio relay between the net control station and another Redeye team.

i. Establish wire communications to a nearby defended unit (company/battery/troop).

D-15. Technique of Fire (Weight 10)

Questions on technique of fire should test the candidate's ability to apply this knowledge to an engagement situation. The technique-of-fire rules reduce target range and speed determinations required by the Redeye gunner during the engagement sequence. Typical examination questions are as follows:

a. *Low/Medium-Performance Targets.* State and explain the following rules for engaging low/medium-performance targets:

- (1) Activation.
- (2) Uncaging.
- (3) Fire.
- (4) Hold fire.
- (5) Cease fire.

b. *High-Performance Targets.* State and explain the following rules for engaging high-performance targets:

- (1) Activation.
- (2) Uncaging.
- (3) Right-angle delay.
- (4) Hold fire.
- (5) Fire.
- (6) Cease fire.

D-16. Map Reading (Weight 10)

Questions on map reading should test the candidate's ability to read and use a military map to the extent of moving to a tactical position designated by map coordinates and preparing a range card at the position. The following questions are typical:

a. By inspection, locate your present position on a map.

b. Locate on the map the point designated by the following coordinates: _____, _____.

c. Using the map, select the best route of

travel to a designated point and measure the road distance to that point.

d. Using the team vehicle, move to the designated area and occupy the position.

e. Using the map and a compass, prepare a range card showing the azimuth and distance of prominent objects or terrain features with respect to the position.

f. From the map, determine the elevation of the position.

D-17. Command and Control (Weight 15)

The candidate should have extensive knowledge of command and control at the team level as prescribed in the Redeye annex to the unit SOP. Typical examination questions are as follows:

a. Explain the meaning of the statement: *the right of self-defense is not denied.*

b. Explain each of the hostile criteria listed in the Redeye SOP.

c. Explain the meaning of the three ADA weapon control statuses and describe the targets that may be engaged under each status.

d. From a hypothetical multiple attack situation presented by the examiner, select the target to be engaged first.

e. Explain the action to be taken and the weapon control status to be assumed in the event of complete loss of communications.

D-18. Aircraft Identification (Weight 30)

A high level of proficiency in aircraft identification is vital in the employment of Redeye and failure to attain the required accuracy will automatically disqualify the candidate. The test will be conducted in a classroom environment, using a slide projector and either the SL-ARK No. 1 or GOAR aircraft recognition kits. The examiner will select and display 100 slides of currently operational aircraft. To qualify for the second-class missileman badge, the candidate must correctly identify at least 92 of the slides presented. This will result in the award of 30 points to the candidate. The examiner may award an additional point for each aircraft above 92 correctly identified up to a maximum of five bonus points. These bonus points will not be computed in the overall test score of a candidate who would qualify without them, but may be used to pass a candidate who otherwise would not qualify.

D-19. Weapon System Characteristics (Weight 10)

The candidate should know the major physical and technical characteristics of the Redeye weapon system. Typical examination questions are as follows:

a. State 11 of the following characteristics of the Redeye weapon:

- (1) Weight of missile and launcher.
- (2) Maximum launcher elevation angle in degrees at fire.
- (3) Superelevation angle in degrees for right-to-left and left-to-right courses.
- (4) Size of the safety zone surrounding the Redeye launch site.
- (5) Maximum missile velocity during flight.
- (6) Maximum time of flight until self-destruct occurs.
- (7) Missile spin rate during flight.
- (8) Infrared seeker field of view.
- (9) Maximum seeker look angle.
- (10) Maximum seeker tracking rate.

Section IV. FIRST-CLASS MISSILEMAN (REDEYE) EXAMINATION**D-21. General**

This section provides guidance in preparing test elements for qualifying candidates as first-class missilemen (Redeye). The examination is prepared as explained in section II but should be of greater scope and depth. Items from the second-class examination may be included in this examination if combined with additional items of increased complexity and difficulty. Additional subject areas should also be tested. Major subject areas to be tested, scoring weights, and typical questions are presented in paragraphs D-22 through D-29.

D-22. Communications (Weight 10)

a. Draw a sketch of the Redeye section command net.

b. Act as net control station and:

- (1) Open the Redeye section command net.
- (2) Require each Redeye team to report into the net.

(11) Minimum battery/coolant unit life after activation.

b. Describe the sequence of events necessary to arm the Redeye warhead.

c. Describe the range ring profile of a specific aircraft.

D-20. Weapon Handling and Target Engagement (Weight 15)

The candidate should demonstrate proficiency in weapon handling and in engaging targets by simulating at least three complete engagement sequences, using tracking head trainer M49. Targets of opportunity may be used or, if aircraft are available, preset courses may be flown. Each engagement must require the candidate to detect the aircraft, make an identification, range the aircraft using the Redeye sight, and complete the weapon handling sequence through fire. The examiner must base his judgment of proficiency on close observation of the candidate's skill, speed, and precision in detecting, ranging, acquiring, and firing at the target. Any hesitation or incorrect action should be assessed against the candidate. Each complete course may be awarded a maximum of five points.

(3) Establish a log and make the appropriate entries.

(4) Transmit at least 10 messages to the teams, requiring each message to be authenticated, receipted for, and read back for an accuracy check.

c. Lay field wire between two points designated by the examiner. The line should require that at least one splice and one overhead road crossing be made.

D-23. Map Reading and Selection of Firing Positions (Weight 10)

a. Explain how the third division of the GEOREF system is determined and how much area is covered.

b. State the point of origin of the GEOREF system.

c. State the basic principles by which positions are selected.

d. Name the factors which are considered in selection of individual team firing positions.

e. State the advantages and disadvantages of selected Redeye positions in relation to unit position.

f. Describe occupation of position by the team, stating the sequence in which various operations should be performed.

g. Explain the aids found on the lensatic compass to assist in maintaining orientation when traveling at night.

D-24. Security, Storage, and Destruction (Weight 5)

a. State the publication which contains classification data for the Redeye weapon system.

b. List the action to be taken by the user unit for security of the basic load of Redeye weapons.

c. Define the term, "exclusion area."

d. State the classification of the missile seeker section.

e. State the quantity-distance regarding inhabited areas for five Redeye weapons (unbarri-caded).

f. State the storage temperature limit.

g. State the burn time of safety fuze.

h. List the material needed to effect destruction by demolition (nonelectric method).

D-25. Command and Control (Weight 10)

a. Explain rules for target selection applicable to the Redeye system as defined in Redeye tactical standing operating procedures.

b. Explain the terms:

- (1) Weapon control status.
- (2) Special flight information.
- (3) Passive defense.
- (4) Air defense warning.

c. State and define the terms, general support, direct support, and attachment, and give an example of each.

d. Discuss factors affecting accomplishment of the Redeye mission to include tactics of the enemy, vital areas, and terrain.

D-26. Aircraft Identification (Weight 30)

The examiner will conduct the test as explained in paragraph D-18. To qualify for the first-class

missileman badge the candidate must correctly identify at least 95 of the 100 slides presented. This will result in the award of 30 points to the candidate. The examiner may award an additional point for each aircraft above 95 correctly identified up to a maximum of three bonus points. The bonus points will not be computed in the overall test score of a candidate who would qualify without them, but may be used to pass a candidate who otherwise would not qualify.

D-27. Weapon System Characteristics (Weight 15)

a. Briefly describe the functional sequence of the Redeye weapon during firing from warmup to warhead detonation.

b. Describe the effects of minimum target elevation angle (MTEA) for crossing targets.

c. Illustrate the approximate launch zone for a high-performance aircraft.

d. Illustrate the approximate launch zone for a low/medium-performance aircraft.

e. Describe the effects of atmospheric conditions on IR radiation acquisition.

f. Describe how the inner performance boundary is established for all targets.

g. Illustrate the IR radiation pattern of a typical high-performance jet aircraft.

D-28. Section Drill (Weight 10)

a. *Section Drill in Assembly Area.* Conduct section drill, using all section personnel. Include all commands given to personnel and responses to commands. Explain the actions taken by the section sergeant, team chief, gunner, and section headquarters radio operator for each of the following commands:

- (1) COUNT OFF.
- (2) CALL OFF.
- (3) EXAMINE EQUIPMENT.
- (4) REPORT.
- (5) PREPARE TO MOVE OUT.

b. *Action Drill at Redeye Position.* Explain the actions taken by the team chief and gunner, using the tracking head trainer, for each of the following commands (include the indications on the tracking head trainer):

- (1) PREPARE FOR ACTION.
- (2) TARGET—PREPARE TO ENGAGE.
- (3) FIRE WHEN READY.
- (4) CEASE FIRE.

Section V. EXPERT MISSILEMAN (REDEYE) EXAMINATION

D-30. General

This section provides guidance in preparing test elements for qualifying candidates as expert missilemen (Redeye). The examination is prepared as explained in sections II and IV but should be of greater scope and depth. Examination items from the first-class examination may be included in the examination if they are combined with additional items of increased complexity and difficulty. Major subject areas to be tested, scoring weights, and typical questions are presented in paragraphs D-31 through D-35.

D-31. Map Reading (Weight 20)

a. Make a sample log and plot for land navigation by dead reckoning, using a motor vehicle.

b. Determine one of the following:

(1) The slope (or grade) between two points on a road on the map.

(2) The direction of flow of a stream or river on a map or aerial photograph.

(3) Whether an observer at one point on the map would be able to see another point.

c. Discuss situation maps maintained by brigade and battalion and post a simulated acetate-covered situation map with various symbols, designated by the examiner, based on data posted on a chalkboard.

d. Given a magnetic azimuth, determine the corresponding grid azimuth, using the declination diagram on the map corrected for annual change.

e. Explain the difference between a strip map and a panoramic sketch.

f. Explain the method of locating an unknown point on the ground by using—

- (1) Resection.
- (2) Intersection.

D-32. Tactics of Enemy Aircraft (Weight 10)

The candidate should have some knowledge of

D-29. Instructional Ability (Weight 10)

Conduct a 20- to 30-minute period of instruction on a subject relating to Redeye employment, command and control, or SOP.

tactics which may be employed against the team. Typical questions of this nature include the following:

a. Explain or illustrate the following methods of delivery:

(1) Dive-bombing.

(2) Dive toss bombing.

(3) Low-altitude bomb aiming system (LABS).

(4) Air-to-surface missile.

b. Explain the air attack variations which may be employed against Redeye.

c. State typical tactical high-performance aircraft characteristics to include—

(1) Dimensions of fuselage and wingspan in meters.

(2) Approximate attack speed.

(3) Approximate detection distances in meters.

d. State the typical low/medium-performance aircraft characteristics to include—

(1) Dimensions of fuselage and wingspan in meters.

(2) Approximate attack speed.

(3) Approximate detection distances in meters.

e. Describe the aircraft national markings of the following, using two out of three choices:

(1) Four NATO countries (air forces only).

(2) US Air Force, Army and Navy.

(3) Four Communist-block countries.

f. Define close air support.

D-33. Tactics (Weight 20)

a. State the rules for engagement given in the unit tactical SOP and discuss their application to the Redeye team.

b. Outline the organization of the infantry,

mechanized infantry, armored, and airmobile/airborne divisions and discuss the need of the major components thereof for air defense.

c. Discuss the basic considerations for siting Redeye units to perform the air defense mission.

d. Conduct a map reconnaissance for selection of a Redeye position and justify the position selected.

e. State the relationship of Redeye to air defense artillery units employed with or near front-line units.

f. Answer selected question(s) concerning the provisions for local security prescribed in the unit alert plan or Redeye SOP.

g. Explain how the Redeye teams are employed during dismounted operations.

h. Explain how Redeye teams are employed during defense of a unit march column.

i. Explain the principles and factors influencing Redeye defense design.

j. Demonstrate Redeye defense design procedure.

k. Discuss the division tactical operations center to include the airspace coordination element (ACE) mission and personnel.

l. Prepare an overlay-type operation order.

D-34. Tactical Control Ability (Weight 20)

For this portion of the examination, the candidate will assume tactical control of an air defense section headquarters prior to and during a simulated attack by hostile aircraft. He will perform all necessary procedures in accordance with the unit Redeye tactical SOP. The examiner will make advance arrangements for realistic simulated hostile target information to be transmitted to the teams over the Redeye net. The candidate will be graded on his adherence to SOP and exercise of sound judgment including timely dissemination of appropriate conditions of readiness and intelligence.

D-35. Instructional Ability (Weight 30)

Conduct a 45-minute period of instruction on a subject relating to Redeye defense planning.

APPENDIX E

SAMPLE SOP FOR REDEYE RANGE FIRING

G3 RANGE DIVISION

Fort _____

SOP

REDEYE MISSILE FIRING

Contents

- Section I. General
- II. Drone Requirements
- III. Range Safety and Redeye Missile Firings

Section I. GENERAL

1. PURPOSE.

- a. To set forth procedures for units engaged in Redeye missile firing on Fort _____ range facilities.
- b. Establish safety procedures for units utilizing the Fort _____ range.

2. GENERAL.

This SOP applies to all Redeye weapon firing on the Fort _____ range.

- a. Current AR's, TM's, FM's and Fort _____ regulations, where applicable, remain in effect.
- b. Reproduction of this SOP is authorized.
- c. Range requests. See Fort _____ Regulation _____.
- d. Observers/spectators.
 - (1) Will be no closer than 50 meters to the rear of the firing point.
 - (2) Will remain outside of the surface danger area during firing.
 - (3) Will not be permitted within 100 feet to the side or 200 feet to the rear of drone launch area (FM 44-120).

Section II. DRONE REQUIREMENTS

3. PURPOSE.

To establish policies and prescribe procedures under which radio-controlled aerial targets are utilized and controlled.

4. RESPONSIBILITIES.

- a. *Range Office.* Prescribing flight pattern and launch position area for all target drones flown on Fort _____ range facilities.

b. Requesting Unit/Agency.

(1) Providing personnel and equipment necessary for maintenance, launch, flight control, recovery of target drones, and necessary security.

(2) Exercise operational control over all target drones flown over the Fort _____ range.

(3) Provide radar coverage of entire flight pattern.

c. Drone Controller. The drone controller must be designated as drone control safety officer to insure drone flight safety.

5. DUTIES OF DRONE CONTROL SAFETY OFFICER.

The drone control safety officer will:

a. Insure that all safety requirements pertaining to the flight of target drones are followed.

b. Exercise personal radio control of target drone flights.

c. Insure that the target drone remains within prescribed limits and is launched only with permission of the OIC.

d. Direct the transmittal of parachute command followed by maximum dive command to drones lost by the radar.

e. Insure that a hazardous area 100 feet to side and 200 feet behind the drone launcher position is established and only authorized personnel admitted.

f. Cause a search of the airspace by radar where a target drone is lost to ascertain whether it reacted to the parachute or dive command.

g. Report to the range office the status of any uncontrolled target drones, giving continuous reports until the drone is lost by radar or visual contact. These reports will be of two types:

(1) A "certain" uncontrolled drone is a drone which is still being tracked by surveillance radar or visual observation but will not execute steering or parachute commands.

(2) A "probable" uncontrolled drone is a drone which has been lost by the surveillance radar. Procedures will be taken as outlined in *d* above. Reports will be made to the range office as to whether the radar could detect the lost drone.

h. Insure that all reports of uncontrolled drones have been rendered, and that last known coordinates, altitude, speed, direction of travel, amount of flying time remaining, time that control was lost, and information that parachute command or maximum dive command had been given.

i. Insure that target drones are never flown over personnel or equipment nor closer than 500 meters ground range except in launching and recovering procedures.

j. Insure that the drone contains the minimum fuel necessary to accomplish its mission; JATO bottles may be jettisoned within the authorized flight pattern.

k. Insure a system of notification exists for warning personnel when a drone is out of control. Minimum requirement is directed telephone between the drone controller and the OIC.

6. UTILIZATION.

a. Permission to launch drones will be obtained from OIC.

b. The requesting unit/agency will furnish a vehicle, equipped with grappling hook and fire extinguisher, for the removal of damaged drones from the vicinity of weapons or ammunition.

7. COURSES.

All flights will be conducted within the flight pattern designated by the range office.

8. RECOVERY.

Target drone recovery will be performed by the requesting unit/agency with the assistance of EOD personnel.

Section III. RANGE SAFETY AND REDEYE MISSILE FIRINGS

9. PURPOSE.

To establish safety procedures for Redeye firings on this installation.

10. RESPONSIBILITIES.

Responsibilities as outlined in Fort _____ Reg _____ will apply. Additional responsibilities are as follows:

a. The requesting unit/agency will designate an officer in charge (OIC) of firing.

b. The OIC will be responsible for the conduct of all phases of Redeye range firing.

c. A qualified safety officer will be designated by the requesting unit/agency during all live firing and surveillance tests of the Redeye weapon. He will be responsible for the administration of all safety aspects involving personnel and equipment associated with conduct of the tests. He will be assigned no other duties while acting as safety officer.

d. Each individual participating in the firing is responsible for knowing and practicing current safety procedures. Any doubts as to correct safety procedures will be referred to the OIC or safety officer for clarification.

e. The requesting unit/agency will insure radar coverage of entire surface danger area and restricted airspace.

f. The safety officer will insure only outgoing targets are fired on.

11. MEDICAL SERVICE.

Firing or missile prefiring checkouts will not be conducted unless at least one ambulance, one qualified medical aid man, and first aid equipment are present at the firing range or range control tower.

12. RANGE FIRES.

See Fort _____ Reg _____.

13. SAFETY LIMITS.

a. As prescribed by range safety cards.

b. Azimuth limit markers will be utilized and be readily identifiable by the safety officer.

c. G3 Range Division will insure that all access roads leading into the area covered by the Redeye weapon surface danger area overlay are blocked. (See chapter 19, FM 23-17.)

14. CLASSIFICATION OF COMPLETE WEAPON (TM 9-1400-426-12).

a. Quantity-distance classification: Class 7 (explosive content to be based on HE in warhead plus propellant).

b. Storage compatibility group: Group F.

c. ICC classification: Explosive A (rocket ammunition with explosive projectile).

15. STORAGE OF WEAPONS.

In compliance with standards established in TM 9-1300-206, Redeye weapons will be stored in the post ammunition storage area when they are not being tested or fired.

16. ISSUE OF MISSILES.

Requesting unit/agency will submit DA Form 581 for issue in accordance with established ammunition request requirements.

17. TRANSPORTATION OF MISSILES.

The Redeye missile will be transported in accordance with CON Reg 380-3.

18. SECURITY.

a. A complete missile is classified CONFIDENTIAL.

b. Security precautions will be taken in accordance with applicable security regulations and CON Reg 380-3.

19. SAFETY INVOLVING TEST SET.

a. The missile test will be accomplished prior to launch time in an area to be specified by the OIC.

b. The safety officer will verify that the area is safe prior to external weapon and telemetry power being applied.

20. FIRING PERSONNEL SAFETY.

a. All personnel will be behind barricades from start of countdown until cleared by the safety officer.

b. The safety officer will not look in the direction of missile flight until after sustainer ignition.

c. The weapon round will not be fired at elevation angles greater than 65° or less than 15° or from positions which restrict rearward passage of exhaust gases.

21. PERSONNEL AND WEAPONS AUTHORIZED IN FIRING BARRICADE.

a. No personnel other than the gunner and safety officer will be within 50 meters of the firing barricade at the time of firing.

b. Only one weapon will be within the firing barricade.

22. CLOTHING AND EQUIPMENT FOR GUNNER AND SAFETY OFFICER.

The gunner and safety officer will wear the following:

a. Eye protection (available on the weapon round).

b. Body armor.

c. Steel helmet.

23. COMMUNICATIONS.

a. The requesting unit/agency will establish and be responsible for the necessary communications.

b. The safety officer will have direct communications with the OIC.

c. Requesting unit/agency will establish wire communication between the radar site and OIC.

d. A cease-fire command will be given any time that communications are lost. The safety officer will resume firing only when communications are reestablished.

24. INSERTION OF LAUNCHER BATTERY/COOLANT UNIT (BCU).

a. The launcher BCU will be out of the launcher except just prior to firing.

b. The safety officer will notify the OIC when the gunner inserts the launcher BCU.

25. REMOVAL OF EXPENDED LAUNCHER BATTERY.

a. The launcher BCU reaches an external temperature of 400° F., when fired, making the case unsafe to touch for approximately 15 minutes.

b. The BCU must be removed from the Redeye launcher by grasping it by the heat-insulated cap.

26. CEASE FIRE.

a. Cease-fire command may be given by the following personnel:

(1) Range officer.

(2) Gunner.

(3) Telemeter monitor.

(4) OIC.

(5) Safety officer.

(6) Drone NCO.

(7) Any other personnel observing an unsafe condition.

b. If the cease-fire command is given prior to launcher battery activation, the gunner will continue to train the weapon downrange and remove the battery from the launcher. The gunner will then set the launcher securely on top of the barricade and await further instructions.

27. MISFIRES.

a. If a misfire occurs, the gunner will:

(1) Attempt to fire the missile by relocating and resqueezing the firing trigger, providing the gunner has acquisition and the target is within the safety limits.

(2) After the gunner is given the cease-fire command as a result of a misfire, he will cage the gyro and immediately remove the launcher BCU from its receptacle and place the weapon on the ground or in a dud pit area, keeping the launcher pointed downrange at all times.

(3) The gunner will then move away from the weapon in a direction perpendicular to the launcher longitudinal axis.

(4) The weapon will be left in place for 30 minutes, after which

time qualified personnel will short the rocket-motor ignition leads, thus allowing safe handling.

b. If the missile only ejects, the weapon will be left in place for 30 minutes and then destroyed by qualified explosive ordnance demolition personnel. The safety officer will notify the OIC.

28. DUDS.

a. Location of duds will be reported to the OIC.

b. The OIC will report the location of duds to the range office which will notify EOD personnel.

c. Under no circumstances will persons other than trained and authorized EOD personnel handle duds.

29. ACCIDENTS.

See Fort _____ Reg _____

30. DEFECTIVE WEAPON.

The following defects are causes for disqualifying a weapon for firing (Weapons so disqualified will be returned to post ammunition storage area.):

- a. Front disk in the front of the launch tube has been broken.
- b. Dents, cracks, severe abrasion of the launch tube exterior, or other evidence of mishandling.
- c. Cracked or broken grip stock assembly.
- d. Aft shock ring holding aft seal has been pushed forward along launch tube.
- e. Rattling noises in launch assembly discovered by shaking weapon.
- f. Flattened sling mounting brackets.
- g. Aft launcher breakable disk broken.
- h. Mud, ice, or other impediment on aft seal.
- i. Weapon will not track.

APPENDIX F
REDEYE WEAPON SYSTEM ITEMS

Nomenclature	Part No.	Type designator	FSN
Guided Missile System, Intercept-Aerial, Monopak	10398952	M41	1425-930-9923
Guided Missile System, Intercept-Aerial, Unipak	10398951	XM41E2	1425-183-5990
Guided Missile System, Intercept-Aerial, Telemetry	10211286	XM44E2	1425-930-9922
Guided Missile System, Intercept-Aerial, Training	10214925	M46A2	1425-933-5352
Shipping and Storage Container, Guided Missile System (Monopak)	10215052	M571	8140-937-1340
Shipping and Storage Container, Guided Missile System (Unipak)	10226996	XM585	8140-880-7285
Training Set, Guided Missile System	10216026	M76	6920-809-0399
Guided Missile System, Intercept-Aerial, Training	10215507	M49	1425-089-5675
Battery Charger, Guided Missile System, Training	10215774	NA	6130-089-5677
Battery, Guided Missile System, Training	10215788	NA	6135-878-6504
Shipping and Storage Container, Guided Missile System, Training	10215787	M590	8140-878-6479
Moving Target Simulator	10228800	M87	6920-179-7343
Mounting Kit, Vehicle, Guided Missile System			
a. Upper Section Shipping and Storage Container Assembly	8035599	NA	8140-403-5754
b. Harness Assembly	10662242	NA	1450-936-7936
Battery/Collant Unit Carry Case	8035348	NA	1440-809-2683
Adapter, Freon Filling, M49E3	10662120	NA	6920-179-7292

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By Order of the Secretary of the Army:

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