

**MCRP 3-25.10A**

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**Low Altitude Air Defense  
(LAAD)  
Gunner's Handbook**

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**U.S. Marine Corps**

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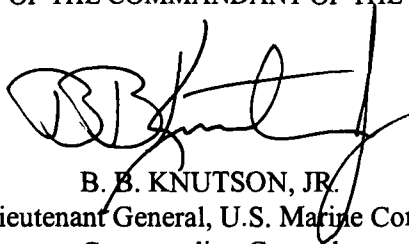
FOREWORD

Marine Corps Reference Publication (MCRP) 3-25.10A, *Low Altitude Air Defense (LAAD) Gunner's Handbook*, complements and expands on the information in MCWP 3-25.10, *LAAD Handbook*, by providing information on tactics, techniques and procedures and employment of the Stinger weapon system for the LAAD gunners.

MCRP 3.25.10A supersedes Fleet Marine Force Reference Publication (FMFRP) 5-53, *LAAD Gunner's Handbook*. This MCRP is designed as a pocket reference primarily for LAAD section, LAAD firing team, and the LAAD gunner (military occupational specialty [MOS] 7212).

Reviewed and approved this date.

BY DIRECTION OF THE COMMANDANT OF THE MARINE CORPS



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# Low Altitude Air Defense Gunner's Handbook

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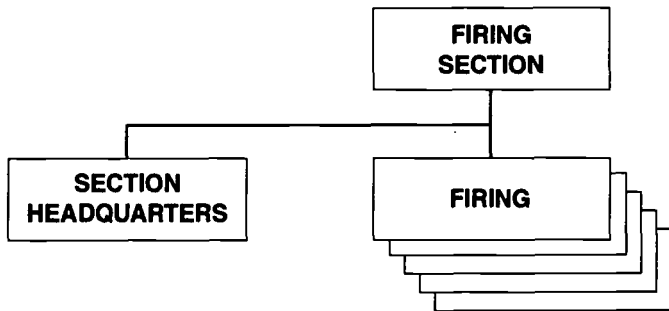
## Chapter 1

# Fundamentals

The mission of a low altitude air defense (LAAD) unit is to provide close-in, low altitude surface-to-air weapons (SAWs) fires in defense of forward combat areas, vital areas, and installations. It also provides SAW support for units engaged in special and independent operations. Each LAAD firing team has the mission to protect the supported unit from attack by aircraft. LAAD operations are provided by the LAAD battalion or battery under the Marine air control group within the Marine air wing. LAAD units are often task-organized to support the entire spectrum of Marine air-ground task force (MAGTF) contingencies.

### ORGANIZATION

The firing team is the LAAD battery's basic combat unit. (See fig. 1-1 on page 1-2) It consists of a team leader and assistant gunner/driver. Both team members are trained as gunners and in communications, target detection, and aircraft recognition. Normally, the assistant gunner/driver will fire the Stinger missile(s), allowing the team leader to evaluate targets and make engagement decisions. During periods of intense enemy air activity, both man-portable air defense (MANPAD) team members may act as gunners to increase their rate of fire. There are three variations of LAAD teams; their combat loads may be altered according to the mission.



**Figure 1-1. LAAD Firing Section and Team Organization.**

- **Avenger.** Each Avenger team carries a basic load of eight missile rounds and one gripstock container comprised of two gripstocks and eight battery coolant units.
- **MANPAD.** Each MANPAD team carries a basic load of four weapon rounds and two missile rounds.
- **Dismounted.** Dismounted teams normally carry a basic load of one weapon round.

## **COMMAND AND CONTROL**

The LAAD section leader commands and controls firing teams through established rules of engagement (ROE) and detailed procedures. Because teams are usually located far from the section leader's command post, direct and personal supervision is normally not possible. Team leaders must possess a strong sense of responsibility. Team members, once their position has been established, must realize the importance of providing section leaders with accurate site location information.

The link between the section leader and the team is a tactical very high frequency (VHF) radio net (Team Control). The section leader maneuvers teams and obtains status and location information over this net. The section leader also modifies their state of readiness by passing and updating air defense warning conditions, and controls their freedom to fire through weapon control status (WCS) and fire control orders. Further details on command and control and support relationships are found in Marine Corps Warfighting Publication (MCWP) 3-25.10, *Low Altitude Air Defense Handbook*.

LAAD units must effectively integrate with the Marine air command and control system (MACCS) to facilitate operation of an integrated air defense system (IADS). An understanding of LAAD integration and relationship with the tactical air operations center (TAOC) is essential. MCWP 3-22, *Antiair Warfare*; MCWP 3-25.10; and MCWP 3-25, *Control of Aircraft and Missiles* provide more information.

LAAD section leaders must know the location of their teams at all times and periodically provide the direct air support center (DASC) and/or the supported unit's fire support coordination center (FSCC) with position updates. Each team normally has a high-mobility multipurpose wheeled vehicle (HMMWV). The team may need to displace frequently to ensure its survivability and properly defend a maneuvering unit. These factors can make it difficult for the section leader to know team locations. However, the DASC and/or FSCC must be kept informed of the whereabouts of supporting and nearby LAAD units so that the teams do not unknowingly enter free-fire areas or position themselves so they are exposed to friendly fires. This is particularly important when LAAD units are assigned a general support (GS) mission, and their movement is not associated with the maneuver of any one particular unit or organization.



For their mission to succeed, team members must work together. Actions and decisions must be understood by all members before and during an engagement.

## **COMMAND RELATIONSHIPS**

Command relationships are relationships that establish authority, responsibility, and a chain of command. The relationship of a commander over his subordinates gives him full responsibility for those within his command. The purpose of a command relationship is to give commanders authority and assets to accomplish their assigned missions. A command relationship will specify the degree of authority one commander has over another commander and is used to allocate units or unit assets to commanders.

### **Operational Control**

Operational control (OPCON) is the command authority over assigned or attached forces, commands or military capabilities or forces to direct accomplishment of specific missions, usually limited by function, time or location. Inherent with operational control is the authority to exercise or delegate operational or tactical control of, establish support relationships for, and designate coordinating authorities to the attached or assigned units.

OPCON does not include authoritative direction for logistics or matters of administration, discipline, internal organization or unit training. It may include such authority when specified in the assignment or attachment order. The commander exercising OPCON has the authority to—

- Give direction to carry out the assigned mission.
- Prescribe the chain of command.

- Task-organize, as necessary, to carry out assigned missions.
- Employ tactically.
- Assign command functions.
- Plan for and coordinate the unit's actions.
- Suspend from duty and recommend reassignment of any officer.
- Establish an adequate system of control for local air defense or ground defense and delineate such areas of operation.
- Delineate a functional responsibility.

### **Tactical Control**

Tactical control (TACON) is the command authority over assigned or attached forces, commands or military capabilities or forces made available for tasking. TACON is limited to the detailed and usually local direction and control of movements or maneuvers necessary to accomplish assigned missions or tasks.

TACON is inherent in OPCON. The commander exercising TACON of a unit has the authority to control and direct the tactical movement of the unit and the application of the unit's organic weapons fires.

TACON does not provide organizational authority or authoritative direction for administrative and logistic support. The commander of the LAAD unit or the commander delegated administrative control (ADCON) continues to exercise command authorities unless otherwise specified in the attachment or assignment order.

## **Support**

Support is a command authority. A support relationship is established by a superior commander between subordinate commanders when one organization should aid, protect, complement or sustain another force while maintaining the normal chain of command. For example, the MAGTF commander may direct a LAAD unit to be in direct support (DS) of a Marine regiment. The LAAD unit commander can accomplish his mission and still maintain the normal chain of command within the battalion. The MAGTF commander approves or directs support relationships between the ground combat element (GCE) and the aviation combat element (ACE). The MAGTF commander also establishes MAGTF air defense priorities before any LAAD assets are given support missions. A support relationship does not necessarily imply that logistical or administrative support is automatically provided to the supporting LAAD unit. This responsibility is retained by the commander exercising ADCON. LAAD units can establish a support relationship with or without being assigned or attached to the supported unit. The two standard support relationships most used by LAAD units are GS and DS.

### **General Support**

GS is given to the supported force as a whole and not to any subdivision. The following are GS considerations.

- Air defense priorities are established based on the needs of the entire force.
- LAAD units are not associated with maneuvering of any particular element as this may leave a gap in air defense coverage.
- LAAD units maintain communications with the MACCS to ensure that critical information is disseminated to all levels

within the IADS. The coordination for LAAD units in GS should consist of security, coordination with adjacent units, dissemination of early warning information, and advising units on passive defense and small arms defense from air attack.

- Logistical needs—such as resupply of missiles, food, fuel, and maintenance support—are provided by the LAAD battalion or battery headquarters and services detachment via the chain of command. Timely resupply may be difficult, since LAAD sections are normally dispersed widely throughout the IADS. When possible, support is received from adjacent or supported units to ensure timely receipt of critical resupply.
- Security from ground attack is coordinated with the supported unit. The senior LAAD representative should conduct liaison with the commander in whose zone of action (ZOA) they are operating to ensure that units are aware that LAAD elements are moving through or operating within their ZOA.

### **Direct Support**

DS is given by one force to another force requiring the supporting force to answer directly to the supported unit commander's request for assistance. The following are DS considerations.

- The supporting LAAD unit is immediately responsive to the supported unit's requirements for air defense.
- The supported unit establishes local air defense priorities.
- LAAD elements operate within supported unit's ZOA or sector.
- The supporting LAAD elements accompany the supported unit to maintain coverage of the established air defense priorities.

- LAAD elements maintain communications with the supported unit to receive critical information such as modifications to ROE, early warning, cueing, and any essential intelligence or coordinating instructions.
- LAAD elements must coordinate local security requirements. Security is not always provided for in DS.
- LAAD elements may be directed to augment local security. The senior LAAD representative should brief the supported unit commander on possible diminished quality of air defense provided by an unrested crew. The supported unit commander should determine the priority for air defense versus perimeter security. This coordination should also provide LAAD units with proper procedures for maneuvering throughout the supported unit's ZOA.
- When LAAD elements are dispersed widely, the parent LAAD unit may find it difficult to provide logistical support even though they may retain ADCON. LAAD commanders in DS should coordinate logistical support through the supported unit when possible.
- LAAD units must maintain communications with the MACCS to operate as part of the IADS whenever possible to allow LAAD teams to receive early warning and cueing information.

### **Assignment and Attachment**

An assignment or attachment is a transfer of forces. A LAAD unit can be assigned or attached to another unit under an OPCON or TACON status.

### **Assignment**

An assignment is the placement of a unit or personnel into an organization outside the normal chain of command, where such placement is relatively permanent. A LAAD section deploying with a Marine expeditionary unit is an example of an assignment.

### **Attachment**

An attachment is the temporary placement of a unit or personnel into an organization outside the normal chain of command. For example, LAAD units would be used as an attachment in independent operations such as a Noncombatant Evacuation Operation (NEO), helicopterborne assault or raid.

### **Considerations**

- The degree of ADCON exercised over LAAD units will be specified in the assignment or attachment directive. This will determine who is responsible for the administrative and logistical needs of the LAAD unit.
- If possible, the attached LAAD unit will maintain communications with MACCS for cueing, early warning, and updated weapons conditions.
- Assignment or attachment directives will state the limits of authority in terms of establishing air defense control measures, when applicable.

### **Other Authorities**

In addition to command relationships, LAAD units can be placed under other areas of authority. These authorities are described in the following paragraphs.

## **Administrative Control**

ADCON is the direction or exercise of authority over subordinate or other organizations with respect to administration and support. This authority includes control of resources and equipment, organization, personnel management, unit logistics, individual and unit training, readiness, mobilization, demobilization and discipline, and other matters not included in the operational missions of the subordinate or other organizations. The degree of ADCON may be delegated by the MAGTF commander or parent unit commander and exercised at any echelon at or below the delegating authority.

## **Direct Liaison Authorized**

Direct liaison authorized (DIRLAUTH) is the authority granted by a commander (any level) to a subordinate to directly consult or coordinate an action with a command or agency within or outside of the granting command. DIRLAUTH, which is more applicable to planning than operations, carries the additional requirement of keeping the commander who granted DIRLAUTH informed. DIRLAUTH is a coordination relationship, not an authority through which command may be exercised.

## **Operations within a Zone of Action**

The commander of a sector or ZOA in which LAAD units are operating has some degree of authority over those LAAD units in regard to movement and security requirements, unless the LAAD unit commander is exempt from such authority. For LAAD elements to negotiate safely through or operate within a specific ZOA, the LAAD commander must first make liaison with that unit and any adjacent units. This will ensure deconfliction of any security procedures that will apply to the movement and placement of LAAD elements or firing of missiles within these ZOAs. In addition, LAAD

elements must make liaison in regards to their own personnel security requirements and address possible security requirements that they may have been tasked to provide for that ZOA.

## **MANEUVER WARFARE**

Marine Corps combat doctrine is based on maneuver warfare. Maneuver warfare is characterized by—

- Concentration of forces at a decisive time and place.
- Speed.
- Surprise.
- Boldness.
- Exploitation of vulnerability and opportunity.

The lightweight, highly mobile Stinger system, perhaps more than any other ground-based air defense weapon, enables LAAD units to support maneuver warfare. A LAAD unit's ability to task-organize, coupled with the Stinger's inherent mobility and flexibility, give the MAGTF a maneuver-oriented LAAD capability that can support all types of tactical operations.





## Chapter 2

# Stinger Weapon System

The basic Stinger weapon is a man-portable, shoulder-fired, infrared (IR) radiation homing (heat-seeking) guided missile system that requires no control from the gunner after firing. Stinger has an identification, friend or foe (IFF) subsystem that aids the gunner and team leader in identifying friendly aircraft. The re-programmable microprocessor (RMP) Stinger operates the same way as the basic Stinger except for its improved tracking ability and improved IR counter-counter measures (IRCCM). RMP Stinger tracks in either IR or ultraviolet (UV). Stinger provides short-range air defense (SHORAD) to counter high-speed, low-level, ground attack aircraft. It is a lethal weapon against helicopter, observation, and fixed-wing aircraft. Operations at night or in adverse weather conditions are aided with the forward looking infrared (FLIR) capability of the Avenger weapons system and the AN/PAS-18 wide angle Stinger pointer (WASP) thermal night sight which mounts directly to the shoulder-fired Stinger. Although these devices aid in target acquisition and identification, gunners must first be able to see a target; acquire the target; and, in specific weapons conditions, positively identify targets prior to the engagement process.

## MISSILE COMPONENTS

The Stinger missile has three main sections: guidance, warhead, and propulsion. Each section can be broken down into sub-components of the missile. (See fig. 2-1 on page 2-2.)

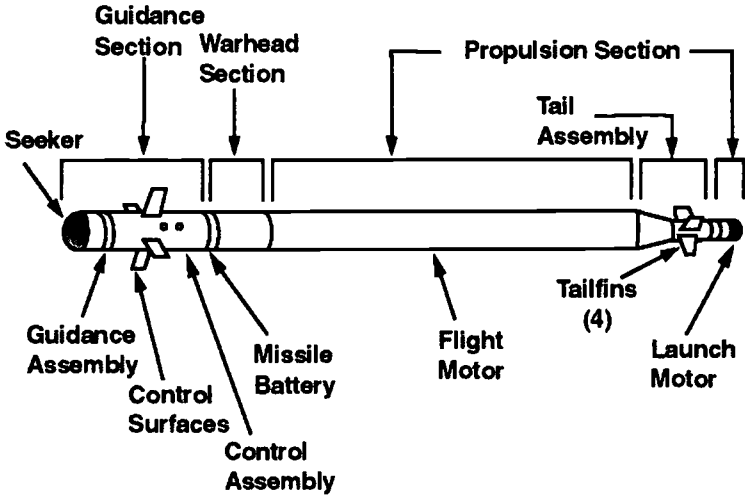


Figure 2-1. Stinger Missile.

## Guidance Section

The guidance section consists of a seeker assembly, guidance assembly, control assembly, missile battery, and four control surfaces (or wings) that provide in-flight maneuverability. The tail assembly, which is not located with the guidance section, provides stabilization, and the beveled leading edges impart roll. The guidance assembly processes target IR/UV and provides guidance commands for the missile during flight. The seeker tracks the IR or UV source automatically after the gyro is uncaged and during missile flight. The control assembly converts guidance commands into movement of control surfaces that direct missile flight. The missile battery provides in-flight power for the missile. Above 100° Fahrenheit (F), IR detector-cell cool down in the RMP Stinger may take up to 5 seconds. The seeker will attempt to reacquire the target through UV at this time.

## **Warhead Section**

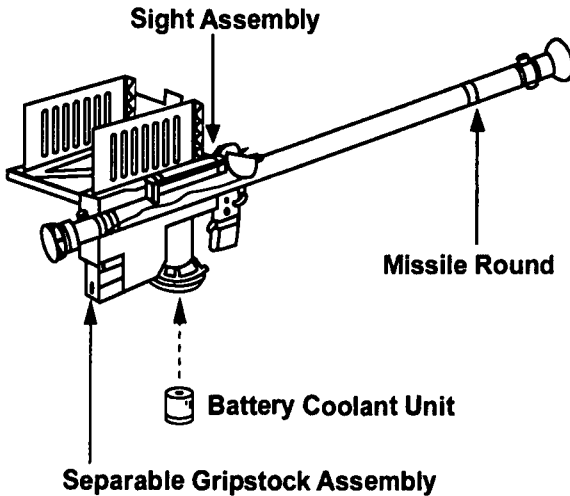
The warhead section consists of a fuze assembly and an equivalent of 1 pound of high explosives (.08 HTA-3) encased in a pyrophoric titanium cylinder. The fuze is extremely safe and makes the missile exempt from any hazards of electromagnetic radiation to ordnance conditions. Impacting the target, penetrating the target or self-destruction detonates the warhead. Self-destruction occurs within 15 to 19 seconds after launch. The additional safety features incorporated into the missile make it safe for shipping and handling.

## **Propulsion Section**

The propulsion section consists of a launch motor and a dual thrust flight motor. The launch motor ejects the missile from the launch tube. The missile coasts a safe distance (about 9 meters or 29 feet) from the gunner before the flight motor ignites and provides a sustained 22g's acceleration that arms the missile. A sustained flight phase maintains missile velocity until the propellant is consumed. Then the missile enters a free flight period or coast phase in which the motor has burned out, but the missile maintains a degree of maneuverability prior to intercept or self-destruction.

## **STINGER WEAPON ROUND**

The Stinger weapon round consists of a missile round, a separable gripstock, and a battery coolant unit (BCU). (See fig. 2-2 on page 2-4.) If the RMP Stinger weapon round is handled roughly after activation and the gyro is knocked off center, the gyro may take up to 15 seconds to realign.



**Figure 2-2. Stinger Weapon Round.**

## **Missile Round**

The missile round consists of a Stinger missile sealed in a launch tube with an attached sight assembly.

## **Launch Tube**

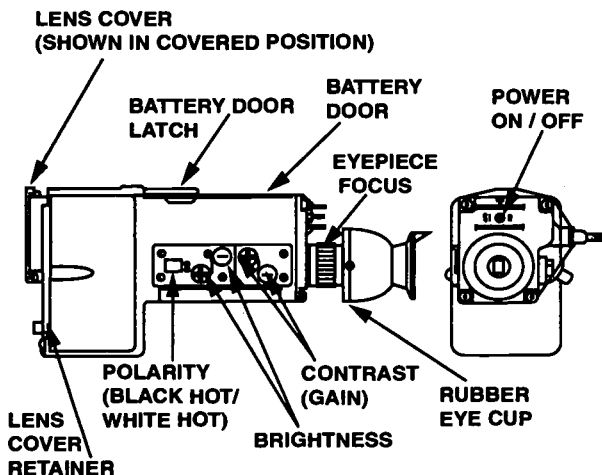
The fiberglass launch tube provides the main support for all parts of the launcher. Both ends of the launch tube are sealed with breakable disks. The IR window (front disk) is transparent to IR and opaque in color on the basic Stinger missile, whereas the RMP Stinger missile's IR window is clear and transparent to both IR and UV radiation. Both the IR window (front) and the blowout disk (rear) break when the missile is fired. A desiccant cartridge/humidity indicator on the launch tube indicates whether moisture has entered the tube. Green indicates the launch tube is moisture-free and safe to fire. Tan indicates possible exposure to moisture, and the missile should not be used. If the desiccant cartridge is tan, it must be replaced.

Twenty-four hours must pass before checking again for moisture contamination. If the desiccant cartridge turns tan again, the missile round must be returned to the missile re-supply point.

### Sight Assembly

The sight assembly allows the gunner to acquire, range, and track an aircraft. It is comprised of the following:

- **Acquisition indicators.** Two acquisition indicators are mounted on the sight assembly. A speaker allows the gunner to hear the IFF tones and IR acquisition signal. A bone transducer allows the gunner to “feel” the IR acquisition signal.
- **Eye shield.** A clear plastic shield attached to the sight assembly protects the gunner's left eye when the weapon is fired.
- **Open sight.** The open sight is used to aim the weapon and visually track the target. The open sight of the Stinger weapon consists of a front sight with range ring, a sight aperture with three open reticles, and a rear peepsight. The range ring is used to determine if the aircraft is in range and to visually track it. The rear sight reticles are used to insert super-elevation and lead. Super-elevation is an additional elevation angle that overcomes the effects of gravity on the missile. Lead is applied to assist the missile on its flight path to the target and is applied to all targets except directly incoming or outgoing fixed-wing aircraft. The peepsight is located at the rear of the sight. The gunner uses the peepsight to properly align the other elements of the sight.
- **AN/PAS-18 Thermal Night Sight.** The AN/PAS-18 WASP receiver, IR system (see fig. 2-3 on page 2-6) is a rugged, lightweight, thermal imaging sight that easily mounts on the Stinger missile round to provide 24-hour mission capability. The



**Figure 2-3. Thermal Night Sight (AN/PAS-18 WASP).**

AN/PAS-18 allows the Stinger MANPAD team to perform target acquisition and weapon firing during total darkness and under reduced visibility conditions due to fog, dust, and smoke. The AN/PAS-18 can track a fixed-wing target (tail-end aspect) in excess of 30 kilometers away from the Stinger team's position; in the worst-case scenario (nose-front aspect), 8 to 10 kilometers toward the Stinger team's position. Identification (ID) of aircraft with the AN/PAS-18 is difficult, and positive visual ID should not rely on the AN/PAS-18 receiver alone.

Differentiation between fixed-wing and rotary aircraft can be made between 3 to 5 kilometers. The AN/PAS-18 has a reticle electronically displayed on the image screen that matches the open sight assembly. The range ring is factory boresighted to match that of the weapon round. The range ring displayed within the AN/PAS-18 cannot, however, be used for range determination as with the open sight assembly.

The vertical lines on each side of the range ring can be used to make a launch decision on a crossing jet aircraft using the time count rule. The operator positions the sight slightly forward of a crossing jet image, then holds the weapon stationary. The gunner wait's until the jet's nose reaches the first vertical line. When it reaches this point, the gunner begins counting off in seconds (e.g., "one thousand, two thousand . . .") following travel horizontally to the opposite vertical line. If the jet's nose reaches the second vertical line before or at the correct time [NOTE: The correct time count is classified.] then the jet is within the missile's range. The gunner will either activate or launch missile (depending on the point in the engagement). If the jet takes longer than the specified time to travel between the two vertical lines, it is beyond the missile's range.

The primary power source is a disposable lithium battery (BA-5847/U) that will provide 12 hours of continuous power. The AN/PAS-18 is equipped with a low battery indicator located in the upper left corner of the display screen, the battery low icon flashes when the internal battery is approximately 15 minutes from depletion. For continuous 24-hour operations, the alternative power source is the vehicle power adapter (VPA). The VPA consists of a power converter with two connectors, one for power in and the other for power out. For further details, refer to TM 09688A-12&P, *Operation and Maintenance Instruction with Parts List AN/PAS-18, Receiver Infrared System*.

### **Gripstock**

The gripstock consists of the gripstock assembly and the IFF antenna assembly. The gripstock assembly contains all of the circuits and components required to prepare and launch the missile. After the missile is launched, the gripstock is removed from the launch tube for reuse. When the IFF antenna assembly is unfolded and the IFF interrogator is connected to the weapon, the gunner can interrogate aircraft and receive coded replies. The RMP missile



round can be used with a basic gripstock, but the resulting weapon round will function as a Stinger Post weapon round. A basic missile round with an RMP gripstock will function as a basic weapon round. The basic gripstock does not have a security classification, but it is considered a sensitive piece of equipment that must be secured when not under direct control. The RMP gripstock is classified as confidential when equipped with the reprogrammable microprocessor. It is engineered to function without failure a minimum of 25 times. The LAAD battalions will dictate proper usage and destruction procedures in accordance with unit standing operating procedures (SOPs).

## **Battery Coolant Unit**

The BCU contains a thermal battery that provides power for pre-flight system operations and a supply of argon gas to cool the IR detector in the missile seeker. Once activated, the BCU supplies electrical power and seeker coolant until the missile is launched or for a maximum of 45 seconds. The safety and actuator device must be in the SAFE position before the BCU is inserted. The Stinger weapon is shipped with a cap covering the BCU receptacle; the cap remains in place until just before BCU insertion. The receptacle cap is removed by turning it counterclockwise and then placing it in the BCU container (within the shipping and storage container) for future use.

Prior to inserting a BCU, the gunner should ensure the color of the heat sensitive indicator is pink. If not, the BCU is discarded and a new BCU inserted into the receptacle and turned clockwise until it locks in place. The BCU gets extremely hot (400°F) 3 to 5 minutes after activation. The gunner should grasp it only by the heat-insulated cap when removing it. The gunner should be made aware of additional safety precautions due to the purging of residual argon gas within the BCU upon removal. The BCU is removed immediately after firing.

## **TRANSPORTATION CONTAINERS**

### **Missile Round Container**

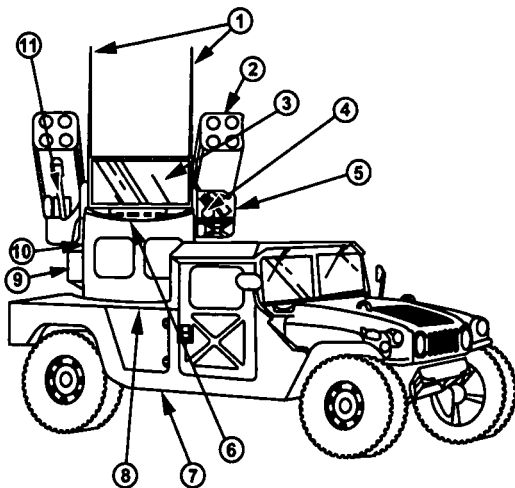
The missile round container (MRC) is a wooden box that provides adequate protection for one missile round and two or three BCUs during shipping and storage. It also contains a set of earplugs. These items are wrapped in a sealed barrier bag with desiccant for protection against the environment. A humidity indicator is enclosed in the bag to indicate moisture content. The bag is inside a fiberboard liner, which is inside the wooden box. As rounds are expended, the gunner simply opens an MRC, removes the missile round, mates the gripstock assembly from the expended round to the new missile round, and installs a BCU.

### **Weapon Round Container**

The weapon round container (WRC) is an aluminum box that provides environmental protection for one weapon round and three BCUs during shipping and storage. Inside each container is a set of earplugs. The container is equipped with four latches, handles for the two-man carry, a pressure relief valve, humidity indicator, and a BCU storage area. These containers can be reused.

## **AVENGER WEAPON SYSTEM**

The Avenger air defense weapon system (see fig. 2-4 on page 2-10) is a lightweight, day/night, limited adverse weather fire unit for countering the threat of low altitude, high-speed fixed-wing or rotary wing aircraft. The fire unit incorporates two standard vehicle mounted launcher (SVML) missile pods, a .50 caliber machine gun, FLIR, laser range finder (LRF) and IFF capability. The fully rotating, gyro-stabilized turret is mounted on the M1097 heavy high-



- |                       |                      |
|-----------------------|----------------------|
| 1. Radio Antenna      | 7. HMMWV             |
| 2. Missile Pod (SVML) | 8. Battery Box       |
| 3. Canopy             | 9. Ammunition Box    |
| 4. LRF                | 10. Ammunition Chute |
| 5. FLIR               | 11. Machine Gun      |
| 6. IFF Antenna        |                      |

**Figure 2-4. Location of Avenger's Major Components.**

mobility multipurpose wheeled vehicle (HMMWV). The fire unit can engage a target with missiles or the machine gun with a gunner in the turret or from a remote location using the remote control unit (RCU). On-board communication equipment provides for VHF radio and intercom operations.

### **Standard Vehicle Mounted Launcher**

There are two SVMLs mounted to the turret. Each holds up to four Stinger missiles and has an upper and lower access panel that is hinged or removed during missile reload. Each SVML contains two rechargeable argon bottles with pressure gauge indicators located in the rear of the bottle. When installed in the SVMLs, the pressure

gauge indicators can be viewed at the rear of the SVML. A fully charged argon bottle will read 6,000 pounds per square inch (psi); the minimum operating requirement is 3,500 psi.

### **M3P .50 Caliber Machine Gun**

The M3P .50 caliber machine gun is an air-cooled, spring-operated, remotely charged machine gun mounted on the right-hand side of the Avenger turret. It is used to provide coverage of the Stinger inner launch boundary and for Avenger self-protection against ground targets. The machine gun is capable of firing in the 25 round-burst mode (air/ground auto) or continuously (manual mode) until all ammunition is expended. The maximum .50 caliber ammunition upload consists of 285 rounds. Maximum sustained rate of fire is 1,100 round per minute. Maximum effective range is 1,850 meters. Maximum range is 6,500 meters. Refer to TM 9-1425-433-10, *Operator's Manual: Guided Missile Battery Control Central, Vehicle Mounted: AN/TWQ-1 Avenger Air Defense Weapon System*.

### **Forward Looking Infrared**

The forward looking infrared (FLIR) is an all-weather sensor that scans the light spectrum and converts detected infrared into video imagery. It is attached to the left launch beam, directly below the SVML and follows the elevation of the SVML. FLIR monitors are located in the gunner's console of the turret and on the RCU within the cab of the vehicle. The FLIR monitor displays the optical, sight-driven reticles and symbology as well as a tracking box. When in FLIR auto track mode, the tracking box will surround and shrink unto the target once it is detected. The Avenger control electronics component will automatically move the turret in azimuth and SVMLs in elevation until the engagement is completed or the FLIR auto track is deactivated. The Avenger has a second automatic tracking capability provided by the missile auto-tracker.

The FLIR has three fields of view (FOVs): wide (WFOV), narrow (NFOV), and rain (RFOV).

	<b>Magnification Level</b>	<b>FOV (degrees)</b>	<b>Elevation (degrees)</b>
<b>WFOV</b>	x1.8	21.1	14.2
<b>NFOV</b>	x7.2	5.3	3.5
<b>RFOV</b>	x3.1	12.6	8

Target search and acquisition are accomplished in WFOV mode. The gunner switches to NFOV mode using the left foot switch in the turret or a push button switch on the RCU to complete target acquisition. Switching to rain mode and increasing gain setting enhances the FLIR acquisition capability during inclement weather. The FLIR monitor also provides the gunner with the means of adjusting the quality of the imagery and the polarity of the IR heat signature displayed. This enhances the gunner's ability in the acquisition process and aids in the practice of light discipline during night operations. The FLIR has a range of approximately 10 kilometers. The FLIR requires a cool down period of approximately 5 minutes from standby to ready mode.

## **Laser Range Finder**

The LRF is a dual aperture CO<sub>2</sub> (Cat 1) eye safe laser that is mounted on the left launch beam below the SVML and beside the FLIR. The LRF is used to gather range information during the target engagement process and also provides a fire permit signal for missile and gun use that is displayed on both the FLIR monitor and combining glass. The LRF has a range capability of 0.5 to 10 kilometers and an accuracy measurement to + or - 10 meters.

## **Identification Friend or Foe**

IFF is provided by use of Stinger AN/PPX-3B Interrogator and Avenger IFF antenna mounted on the front of the turret. The AN/PPX-3A is not compatible with the Avenger weapon system because it will not seat properly in the area where the IFF belt pack is placed in the turret.

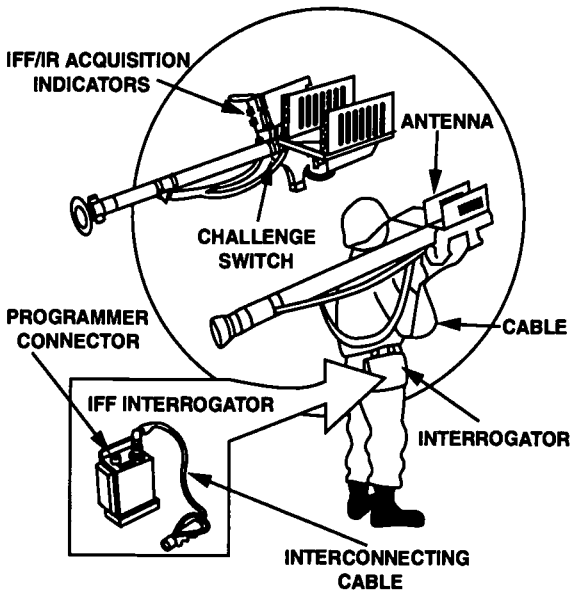
## **Communications Equipment**

The Avenger uses the AN/VRC-91, short-range and/or long-range radio system. The system incorporates two AN/PRC-119 single-channel ground and airborne radio system (SINCGARS) radios. The long-range receiver/transmitter (RT) is capable of voice transmissions up to 40 kilometers when using the vehicular power amplifier, vehicular antennas and radio frequency (RF) power selector switch in power amplifier (PA) mode. The two radios are divided into an "A" radio (bottom) and a "B" radio (top) that slide into a mounting adapter. A separate power amplifier provides 50 watts of RF power to the RT in position A. Radio A is used for the team control net, and the B radio is used to receive and transfer electronic data (ground-based data links [GBDLs], digital communications terminal [DCT]). The on-board communications system also provides for intercom operations (AN/VIC 1) using combat vehicle crewman (CVC) helmets.

## **IFF SUBSYSTEM**

The IFF subsystem aids in the identification of aircraft and classifies them as either friendly, possible friend or unknown. It does not identify hostile aircraft. (See fig. 2-5 on page 2-14.)

The gunner initiates the IFF sequence by pressing the IFF INTERROGATE switch on the gripstock assembly and—in the case of



**Figure 2-5. Stinger IFF Subsystem Components.**

Avenger teams—by pressing the IFF INT switch on the gunner's console in the turret or on the RCU while conducting remote engagements. Once the gunner issues a challenge, the rest of the sequence is automatic. The IFF interrogator sends a coded challenge (via an IFF antenna) to the aircraft. Aircraft with Mark X or Mark XII transponders will automatically decode if the interrogator is programmed with Modes 3 and 4. Mode 3 is built into the interrogator. If the Mode 4 position is used during programming, Mode 3 (Mark X) will not be challenged until the 2 or 4 days of Mode 4 codes have expired.

The aircraft's transponder then prepares and sends a coded reply. The reply is received by the IFF antenna and is routed to the interrogator for decoding. The interrogator converts the reply into an audi-

ble tone, which is then routed via the interconnecting cable to the gunner as a friendly tone.

If the aircraft's transponder sends an incorrect reply to the IFF challenge, the reply is processed by the IFF system into an unknown tone. Aircraft not equipped with the transponders will not reply to the challenge; this is also processed into an unknown tone. The gunner hears the friendly or unknown tone immediately after challenging the aircraft. The IFF challenge is coded in either a complex, crypto-secure Mode 4 form or a simpler Mode 3 form. All U.S. combat aircraft and helicopters have transponders to provide friendly Mode 4 and 3 replies. Some aircraft operating in the combat zone, including U.S. commercial aircraft and some aircraft belonging to our allies, are not Mode 4 capable; they are only Mode 3 capable. Since the Mode 4 is secure, a friendly Mode 4 reply is considered a "true friend" reply. A friendly Mode 3 reply is considered only as a "possible friend" reply.

IFF support equipment includes a programmer/battery charger AN/GSX-1A, interrogator computer KIR-1C, general purpose tape reader TSEC/KOI-18, electronic/digital transfer device (TSEC/KYK-13, TSEC/KYX-15, and AN/CYZ-10). The programmer/battery charger programs the IFF interrogator belt packs and charges the interrogator batteries. Functions may be done separately or simultaneously. (See the KAM-225C/TSEC for more detailed procedural information.) The computer, electronic transfer device, and the reply evaluator module within the interrogator (when set with classified code), are classified SECRET. They must be safeguarded as outlined in SECNAV 5510.30A, *Department of the Navy Personnel Security Program Regulation*; SECNAV 5510.36, *Department of the Navy Information Security Program Regulations*; and the CMS-1A, *Communications Security Material (CMS) System Policy and Procedures Manual*. The current CMS callout will contain the specific (AKAT) tape requirements and instructions.



## **BATTERY CHARGING**

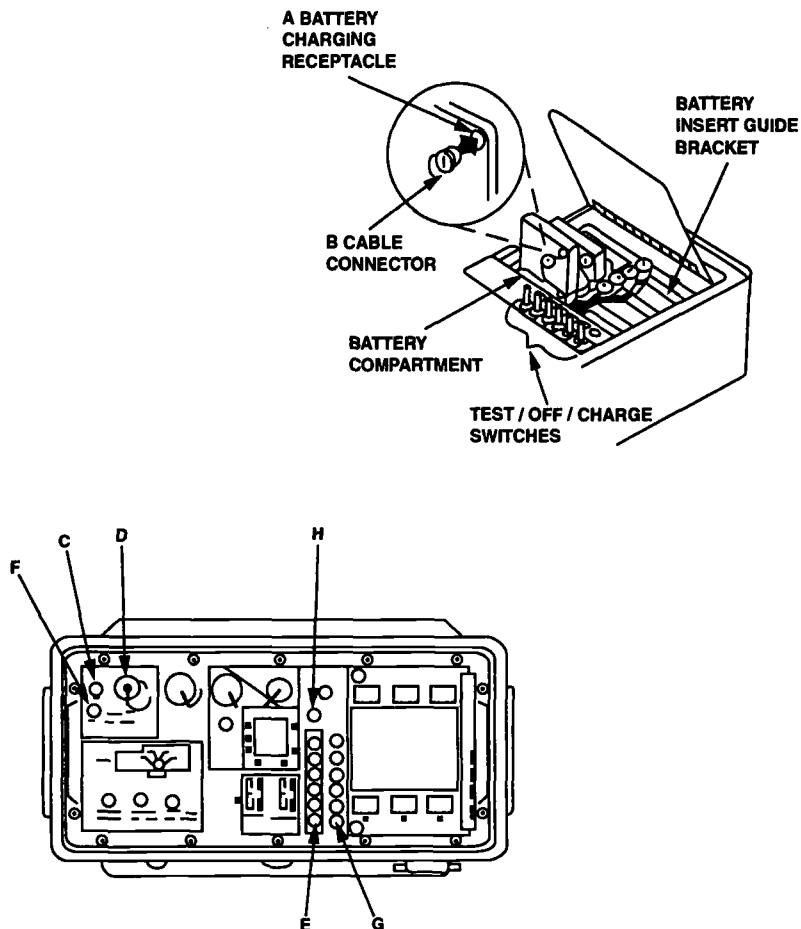
The IFF belt pack batteries are charged using the AN/GSX-1A programmer/battery charger. A minimum of 4 hours is needed to fully charge the batteries. Up to six batteries can be charged simultaneously. Six cable connectors are routed through the inside center bracket of the battery compartment. Each cable connector has an identification number that corresponds to the number alongside each of the six TEST/OFF/CHARGE switches. The brightness of each indicator lamp on the programmer may be adjusted by turning the lens assembly.

The battery compartment door remains open during the entire charging period unless ambient temperature or battery temperature is below freezing. If all battery charging indicators go out at once, the battery compartment maximum temperature has been exceeded and compartment will have to cool before charging will resume.

## **BATTERY INSTALLATION**

Install a freshly charged battery in the interrogator before programming. (See fig. 2-6.)

- Step 1: Open battery compartment lid. Insert batteries to be charged into battery receptacles (a).
- Step 2: Insert cable connector in battery charging receptacle (b).
- Step 3: Set POWER switch (c) to OFF. Connect power cable W2 to 115V 1 PH 50-400 Hz POWER CONNECTOR (4). Connect power cable to power source.
- Step 4: Set the six TEST OFF/CHARGE switches (e) to OFF (center) positions.



**Figure 2-6. Battery Charging.**

Step 5: Set POWER switch (c) to ON. POWER DC lamp (f) should illuminate. If POWER DC lamp (f) does not illuminate, press and hold lens assembly to check if indicator is operating.

- Step 6: Set appropriate TEST/OFF/CHARGE switches (e) corresponding to the batteries to CHARGE. Observe that appropriate lamp (g) lights. If a lamp does not light, be sure that appropriate battery is properly connected.
- Step 7: Let batteries charge for about 10 minutes. One at a time, hold appropriate TEST/OFF/CHARGE switches (e) to the TEST position. For each TEST position, BATTERY TEST lamp (h) will light, if battery is not defective.
- Step 8: Reset appropriate TEST/OFF/CHARGE switches (e) to CHARGE.
- Step 9: After 4 hours, set appropriate TEST/OFF/CHARGE switches (e) to OFF. Disconnect charging cable from battery. Remove charged batteries from their receptacles.

## **BATTERY CONDITIONING**

The test function is designed for one battery at a time. Testing or cold weather conditioning more than one battery at a time can damage the test-charge load resistor. Battery cold weather conditioning is required when the IFF Interrogator is used in temperatures below 0°F. To condition a battery for temperatures below -25°F and above -40°F, the battery must be discharged approximately 10 percent after being fully charged. The discharge is accomplished by holding the BATTERY TEST switch in the TEST position for about 1 minute. If the operating temperature is expected to be below -40°F, the discharge time is doubled to about 2 minutes. Dual control and indicator circuitry permits charging of the IFF batteries while programming the IFF interrogator.

## **INTERROGATOR PROGRAMMING**

### **Background**

After a charged battery is installed, the IFF interrogator (see fig. 2-7 on pages 2-20 and 2-21) is manually programmed for 4 days of operation. The appropriate fill device is used to insert the proper Mode 4 codes into the computer. (Mode 3 codes are built into the interrogator.) The programmer extracts the Mode 4 codes from the computer and inserts them into the interrogator.

One of two programs is selected by operating a function switch on the programmer. For either program, the programmer initiates an automatically timed 4-day countdown period in the interrogator. After 4 days, the interrogator switches to and continues in Mode 3 operation until the batteries are discharged or the interrogator is reprogrammed.

In the Mode 4/3 position (the normal setting used for programming), the interrogator is programmed to interrogate in Modes 4 and 3. Initial interrogation is made in Mode 4. If there is no Mode 4 reply by the aircraft or the reply is incorrect, the interrogator automatically switches to Mode 3 and interrogates again.

In Mode 4, the interrogator is programmed to interrogate in Mode 4 only. The interrogator will not automatically interrogate in Mode 3 after an incorrect Mode 4 reply. Certain situations may require that the interrogator be programmed for Mode 4 only operation.

The interrogators can be programmed every 2 to 3 days at section headquarters or at each team's location. Each team can exchange its interrogator for one that is programmed. The section leader is ultimately responsible for ensuring that each team's belt packs are reprogrammed before the Mode 4 codes expire. The programmer performs a self-check of the interrogator after data transfer.

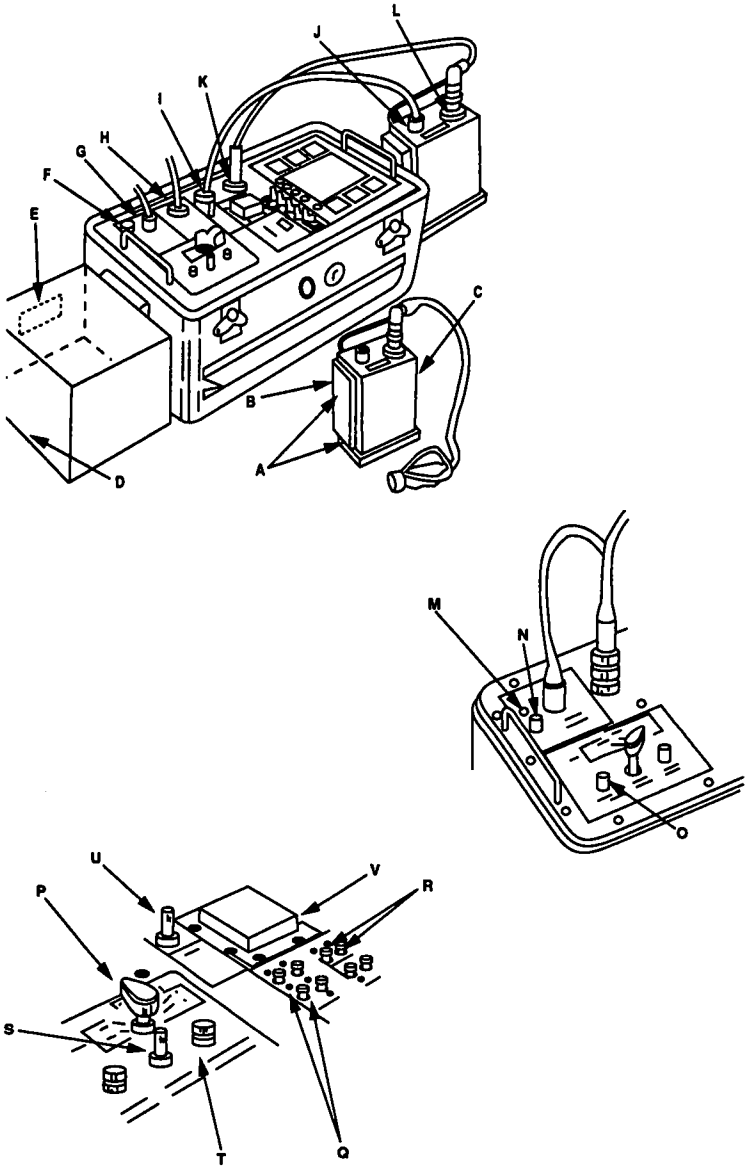


Figure 2-7. Interrogator Programming.

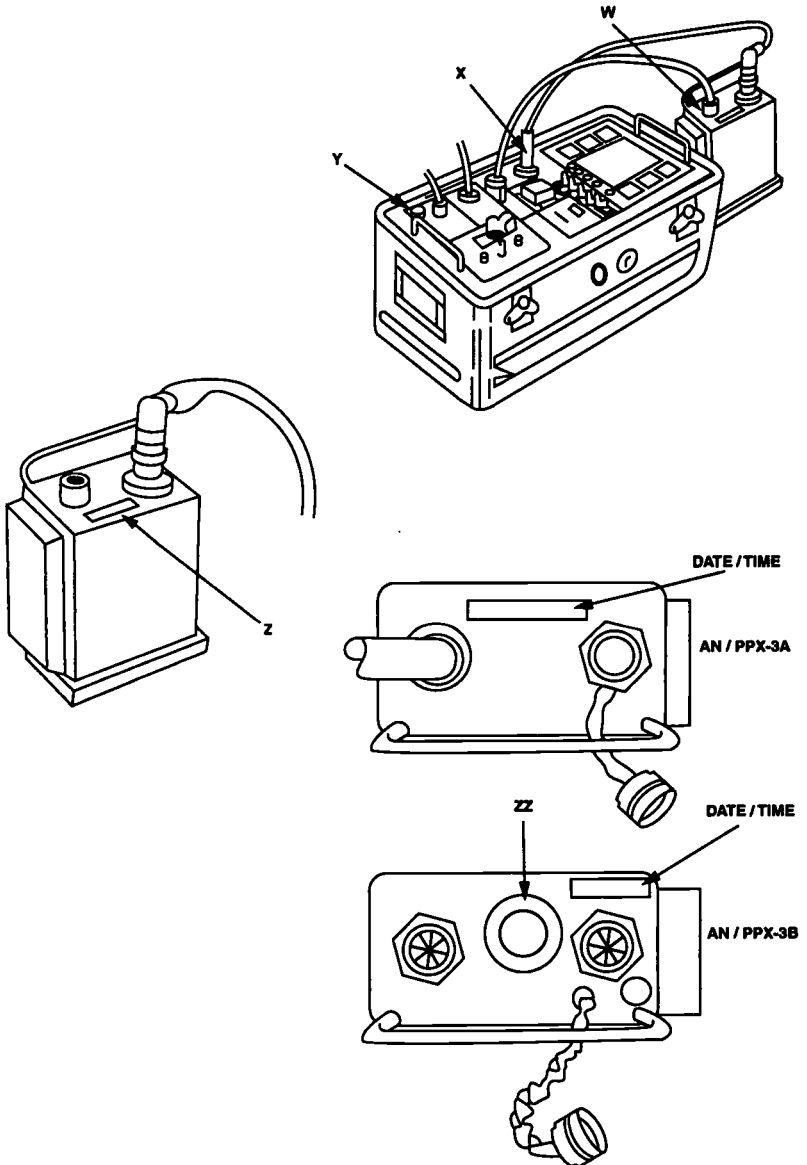


Figure 2-7. Interrogator Programming—Continued.

An audio signal confirms that the interrogator is operational, but the audio signal does not confirm the interrogator is properly programmed. The interrogator's Mode 4 codes are tested and verified with a known friendly aircraft (with operational and correctly coded Mode 4 transponder). The battery attached to the side of the IFF interrogator must be replaced with a charged battery before programming. (See fig. 2-6 on page 2-17.)

**[NOTE:** Prior to attempting to program, ensure all equipment has the appropriate batteries installed. The KIR-1C requires two BA-5567 batteries for memory storage capability. The KOI-18, KYK-13, and KYX-15 require one BA-5372 or BA-1372/U battery for operation. The AN/CYZ-10 requires three, 3-volt lithium batteries (BR-2/3 ASSP) or one DL123A for operation.]

The AN/PPX-3 B/A accepts and stores Mode 4 codes for up to 4 days. Each keytape is broken down into two segments, A and B. Segment A represents the IFF program for the actual date drawn, while segment B represents the following day. The KIR 1-C is capable of holding a single keytape of segments A and B. Both segments are required for the KIR 1-C to accept and distinguish the Mode 4 alarm lamp on the AN/GSX 1-A. Loading more than one keytape will overwrite previous IFF code, making the program invalid. Each AKAT canister consists of 34 consecutive key tapes. As previously stated, each key tape is further broken down into two segments, A and B, for a total of 68 individual tapes. The first 27 key tapes are numbered sequentially 1 through 27, the remaining key tapes are numbered F28, 28, F29, 29, F30, 30 and 31. The F-series key tapes are used to program the final day of the month.

**EXAMPLE:** There are 30 days in the month of November. When programming the last day of the month, the section leader will use the tape segment marked F30 vice using the tape segment marked 30. The F designates a keytape as a final day of the month IFF fill. F-series keytapes are used for months that end on the 28th, 29th, and 30th.





- POWER connector J1 (G) on programmer. Connect cable to power source.
- Step 3: Connect computer cable W3 to TSEC/KIR-1C connector J2 (H) on programmer. If dust cover is installed on computer connector, remove by loosening two screws. Attach other end of cable W3 to rear of computer.
- Step 4: Connect program cable W1 to INTERROGATOR PROGRAM connector J3 (I) on programmer and attach other end to J2 connector (J) on IFF interrogator.
- Step 5: Connect IFF interrogator interconnecting cable to INTERROGATOR TEST connector J4 (K) on programmer.
- Step 6: Set POWER ON/OFF switch (M) on programmer to ON. POWER DC (N) and MODE 4 ALARM (O) lamps will light. Press to test each lamp on programmer before operation. Mode 4 ALARM lamp remains lighted until code is entered into computer. Brightness of each indicator lamp on programmer may be adjusted by turning lens assembly.
- Step 7: Connect W2 fill cable to TSEC/KOI-18. Connect fill cable from TSEC/KOI-18 to faceplate of TSEC/KIR-1C.
- Step 8: Connect W3 cable from the AN/GSX-1A battery charger/programmer to the TSEC/KIR-1C.
- Step 9: Refer to the current CMS callout sheet for appropriate AKAT tape segment. Pull required day segment. The segment will include an A and a B portion. Both are required to program 1 day of IFF.
- Step 10: Insert tape leader in slot marked IN on the TSEC/KOI-18, lining up feed holes with white dots marked on the device,

and pull portion A of the required day segment slowly through the device once.

- Step 11: Disconnect fill cable from the TSEC/KIR-1C briefly, reconnect and then run portion B of the required day segment slowly through the TSEC/KOI-18. (If the fill cable is not disconnected briefly, the computer will treat segment A and segment B as one large segment.)
- Step 12: If the TSEC/KIR-1C accepts the codes, the green light display on the faceplate of the TSEC/KIR-1C will flash briefly. The light will only blink after both the A and B segments have been accepted into the computer. The Mode 4 ALARM lamp on the AN/GSX-1A will go out. Disconnect fill cable from the TSEC/KIR-1C. If the lamp remains lighted, check all cable connections, zeroize the KIR-1C, and then repeat steps 7 through 11.
- Step 13: Set CODE ENTRY SELECT switch (P) to desired SELECT M4/M3 or M4 position.
- Step 14: Set TIME ENTRY HOURS (Q) and MINUTES (R) push-button switches to enter ZULU time.
- Step 15: At ZULU time entered into TIME ENTRY switches, push forward and hold ENTER CODE TIME switch (S) until CODE/TIME ACCEPTED lamp (T) lights. This updates automatic 4-day clock in IFF interrogator.
- Step 16: Set CODE ENTRY SELECT switch (P) to DAY 1
- Step 17: Push forward and hold ENTER CODE/TIME SWITCH (S) until CODE/ TIME ACCEPTED lamp (T) lights.
- Step 18: Set CODE ENTRY SELECT switch (P) to DAY 2.

Step 19: Push forward and hold ENTRY CODE/TIME SWITCH (S) until CODE/TIME ACCEPTED lamp (T) lights.

Step 20: If programming additional IFF interrogators with day 1 and 2, perform substeps 20a through 20e, otherwise proceed to step 21.

[NOTE: Power switch must remain on while disconnecting program cable if TSEC/KIR-1C does not have memory batteries installed.]

Substep 20a: Disconnect previous IFF interrogator by disconnecting program cable W1 at J12 connector on interrogator. Disconnect cable at INTERROGATOR TEST connector J4 on programmer.

Substep 20b: Connect program cable W1 to J2 connector on next IFF interrogator to be programmed.

Substep 20c: Connect IFF interrogator interconnecting cable to INTERROGATOR TEST connector J4 on programmer.

Substep 20d: Insert day one and day two of IFF program by performing steps 16 through 19.

Substep 20e: Repeat substeps 20a through 20d for each additional IFF interrogator and/or belt pack, then continue with step 21.

Step 21: Disconnect the IFF interrogator by disconnecting program cable W1 at the J12 connector on interrogator. Disconnect the cable at the INTERROGATOR TEST connector J4 on the programmer.

Step 22: Push ZEORIZE BUTTON on face plate of TSEC/KIR-1C. Mode 4 ALARM lamp on AN/GSX-1A will light,

which confirms days 1 and 2 of IFF program has been successfully purged from TSEC/KIR-1C.

- Step 23:** Pull required day segment of AKAT, the segment will include an A and a B portion. Both are required to program 1 day of IFF.
- Step 24:** Reconnect fill cable from the TSEC/KOI-18 to the faceplate of the TSEC/KIR-1C.
- Step 25:** Pull portion A of the required day segment slowly through the KOI-18 once.
- Step 26:** Disconnect fill cable from the TSEC/KIR-1C briefly, reconnect and then run portion B of the required day segment slowly through the TSEC/KOI-18.
- Step 27:** If the TSEC/KIR-1C accepts the codes, the green light display on the faceplate of the TSEC/KIR-1C will flash briefly. The light will only blink after both the A and B portions of the AKAT segment have been accepted into the computer. The Mode 4 ALARM lamp on the AN/GSX-1A will go out. Disconnect fill cable from the TSEC/KIR-1C. If the lamp remains lighted, check all cable connections, then repeat steps 22 through 26.
- Step 28:** Set CODE ENTRY SELECT switch (P) to desired SELECT M4/M3 or M4 position.
- Step 29:** Set CODE ENTRY SELECT switch (P) to DAY 3.
- Step 30:** Push forward and hold ENTER CODE/TIME SWITCH until CODE/TIME ACCEPTED lamp (T) lights. Day 3 of IFF program has been successfully programmed.
- Step 31:** Set CODE ENTRY SELECT switch (P) to DAY 4.

Step 32: Push forward and hold ENTER CODE/TIME SWITCH s until CODE/TIME ACCEPTED lamp (T) lights. Day 4 of IFF program has been successfully programmed.

Step 33: Push forward and hold INTERROGATOR TEST switch (U) until test tone is heard from speaker (V), indicating IFF interrogator operational. If there is no tone, check cable connections and battery, reinitialize belt pack, and repeat steps 1 through 35. If still no tone, IFF interrogator belt back is non-functional.

Step 34: If programming additional IFF interrogators, perform substeps 34a through 34e, otherwise proceed to step 35.

[NOTE: Power and power switch must remain on while disconnecting program cable if TSEC/KIR-1C does not have memory batteries installed.]

Substep 34a: Disconnect previous IFF interrogator by disconnecting program cable W1 at J12 connector on interrogator. Disconnect cable at INTERROGATOR TEST connector J4 on programmer.

Substep 34b: Connect program cable W1 to J2 connector on next IFF interrogator to be programmed.

Substep 34c: Connect IFF interrogator interconnecting cable to INTERROGATOR TEST connector J4 on programmer.

Substep 34d: Insert IFF program days 3 and 4 by performing steps 28 through 33.

Substep 34e: Repeat above substeps 34a through 34d for each additional IFF interrogator, then continue with step 35.

- Step 35: Disconnect IFF interrogator by disconnecting program cable W1 at J12 connector on interrogator. Disconnect cable at INTERROGATOR TEST connector J4 on programmer.
- Step 36: Push ZEORIZE BUTTON on faceplate of TSEC/KIR-1C. Mode 4 ALARM lamp on AN/GSX-1A will light confirming day 3/4 of IFF program has been successfully purged from TSEC/KIR-1C.
- Step 37: Disconnect program cable W1 at J2 connector (W) on IFF interrogator. Disconnect cable at INTERROGATOR TEST connector J4 (X) on programmer.
- Step 38: Set POWER ON/OFF switch (Y) to OFF. Remove power cable W2 from power source and remove cables W1 and W3. Install all dust caps on cables. Return cables to compartment in lid and secure lid.

For the IFF interrogator date coding requirement, use china marking pencil and write the time expiration date (hours, day, and month) in area (Z) shown. Place strip of transparent tape over expiration date. The AN/PPX-3B has an light-emitting diode (LED) day code indicator (ZZ), but does not eliminate the necessity for time expiration date marking.

The IFF belt pack via the TSEC/KIR-1C can be programmed using alternate communications security (COMSEC) devices such as the AN/CYZ-10 Digital Transfer Device (DTD).

### **Loading the AN/CYZ-10 DTD with IFF Crypto—Method 1**

- Step 1: Press the ON/OFF button on the keypad to turn on the AN/CYZ-10; observe the on board screen, if the DTD does not default to main menu screen, user should manually select main menu from DTD keypad.

Step 2: Select application. Press ENTER.

Step 3: Select radio. Press ENTER.

Step 4: Select receive. Press ENTER.

Step 5: Select CFD (COMSEC Fill Device). Press ENTER.

Step 6: Select TSEC/KOI-18 (When the TSEC/KOI-18 is the CFD used to transfer fill). Press ENTER.

[NOTE: The user selects the specific COMSEC Fill Device to transfer the fill into the AN/CYZ-10.]

Step 7: Select traffic encryption key (TEK).

Step 8: Connect the TSEC/KOI-18 (or appropriate CFD) to the AN/CYZ-10 with fill cable (ON512424). Then press RECEIVE (RCV).

Step 9: When using the TSEC/KOI-18, load segment A of first required keytape:

Substep 9a: Release the latch on the TSEC/KOI-18 keytape slot cover.

Substep 9b: Inspect crypto keytape to determine the beginning of each segment to be loaded.

Substep 9c: Align the holes in the keytape with white dots on the TSEC/KOI-18.

Substep 9d: Insert keytape leader through slot.

Substep 9e: Pull one segment (segment A) completely through the reader.

Subset 9f: Disconnect the fill cable from the TSEC/KOI-18 after each segment is loaded. Then reconnect before loading segment B IFF fill. Proceed to step 10.

[NOTE: Failure to disconnect the fill cable may result in corrupted IFF crypto.]

Step 10: Select KEY TEX. Press ENTER. ID will display. Using the keypad of the AN/CYZ-10, label each fill entered into the AN/CYZ-10 by typing input via keypad. (i.e., IFF10JulA, IFF10JulB, IFF12JulA, IFF12JulB)

Step 11: Press Y on keypad to disregard tag sequence.

Step 12: Press Y on keypad to load additional fills. If no additional fills are required, select N on keypad and go to step 14.

Step 13: Repeat steps 6-12 until all additional keys are loaded.

Step 14: Once all fills are loaded, user should verify that all fills are stored within the AN/CYZ-10.

### ***Verifying IFF fills are Stored within the AN/CYZ-10 DTD***

Step 1: Turn on the AN/CYZ-10 by pressing the ON/OFF button on the keypad. If DTD does not default to main menu, user should manually select main menu from DTD keypad.

Step 2: Select application. Press ENTER.

Step 3: Select radio. Press ENTER.

Step 4: Select database. Press ENTER.

Step 5: Select display. Press ENTER.



Step 6: Select key. Press ENTER.

Step 7: Select TEK. Press ENTER. The DTD will show TEK fills. Using the up or down arrow keys or the page up/page down keys, user may scroll through to ensure all fills are loaded and stored by the name the user entered for each fill (i.e., IFF10JulA, scroll to next fill IFF10JulB, scroll to next fill IFF12JulA, scroll to next fill IFF12JulB).

Step 8: Select ABORT key (continuously) until back to main menu screen.

***To transfer IFF fills from the AN/CYZ-10 to the AN/GSX 1-A via the KIR-1C, ensure all required equipment is properly connected and powered.***

Step 1: Turn on AN/CYZ-10 by pressing the ON/OFF button on the keypad. If DTD does not default to main menu, user should manually select main menu from DTD keypad.

Step 2: Select application. Press ENTER.

Step 3: Select radio. Press ENTER.

Step 4: Select COMSEC. Press ENTER.

Step 5: Select load. Press ENTER.

Step 6: Select TEK. Press ENTER.

Step 7: Scroll to desired key fill. Press ENTER. (The key fill is identified by the label the user assigned to each fill at step 10 when Loading the AN/CYZ-10 with IFF Crypto.)

Step 8: Select quit. Press ENTER.

- Step 9: Press down arrow on AN/CYZ-10 keypad until menu displays PRESS LOAD ON RT.
- Step 10: Connect the fill cable between the AN/CYZ-10 and the TSEC/KIR-1C.
- Step 11: Press ENTER.
- Step 12: Disconnect the fill cable from the TSEC/KIR 1-C.
- Step 13: Repeat steps 2 through 11 to load segment B of required IFF fill.

**[NOTE: The TSEC/KIR 1C is capable of holding only 2 days IFF fill at a time (2 days IFF is defined as an single keytape of both segments A and B. When programming the belt packs, you must program days 1 and 2. Zeroize the IFF code from the TSEC/KIR 1-C. Then fill the TSEC/KIR 1-C with days 3 and 4 of IFF Code to be loaded into the belt packs.)]**

- Step 14: Upon acceptance of segment B, the TSEC/KIR 1-C green indicator light will again briefly flash. The Mode 4 alarm lamp on the AN/GSX 1-A will extinguish, indicating the MODE 4 IFF code has been accepted.
- Step 15: Program AN/PPX-3 B/A belt packs in accordance with the previously identified procedures.

### **Loading the AN/CYZ-10 DTD with IFF Crypto—Method 2**

To load the AN/CYZ-10 with AKAT \*\*\*\* IFF. Load fills within the FILL MENU vice RADIO MENU.

- Step 1: Turn on the AN/CYZ-10 by pressing the ON/OFF button on the keypad. If DTD does not default to main menu,

user should manually select main menu from DTD keypad.

**Step 2: From main menu, Select Appl. Press enter. The next screen will vary based on the UAS (User Application Setup) loaded within the DTD.**

**[NOTE: All boxed text represents the actual AN/CYZ-10 menu displayed.**

<b>Appl</b>	Date	Time	Setup
Util	Bit		{MAIN}

**Step 3: Select Fill. Press enter.**

JFILL	RDS	SOI	RADIO
<b>FILL</b>			{APPL}

Loading application will appear.  
Fill Ver 4.09 will appear.

**Step 4: Select Utility. Press enter.**

Xmit	Recv		{K13}
<b>Utility</b>			[ C ]

**Step 5: Select Setup. Press enter.**

<b>setup</b>	sTatus		
Check	Delete		{UTL}

**Step 6: Select Protocol. Press enter.**

Select setup option			{Set}
<b>Protocol</b>	Tag		

Step 7: Select Comsec Fill Device (Cfd). Press enter.

Select protocol	{SET}
<b>Cfd</b> D101 Lmd Stu Timeout	

Step 8: Select appropriate Comsec Fill Device. (K18 for KOI-18 when utilizing the KOI-18 to transfer tape fill segments.) Press enter.

Select K13 K15 <b>K18</b> {CFD}
Kemple K11c Ds 102 kW46

Step 9: Press abort key.

Step 10: Select Recv. Press enter. {K18} depicts when Comsec Fill Device is currently selected (K18 = KOI-18).

Xmit <b>Recv</b> {K18}
Utility [C]

Step 11: Connect the AN/CYZ-10 to the KOI-18. Select Receive. Press enter.

Connect to station and
press <b>RCV</b> / [ABORT]

Load in progress will appear.

Step 12: Draw segment (A) of AKAT tape through KOI-18. Enter Text Id will appear.

Step 13: Type in text Identifier for IFF tape. (I.e. IFF2A/APR)  
Press enter.

Appl	Date	Time	Setup
= >	????????????????		

Step 14: Type in the short title. AKAT \*\*\*\* (version on tape).  
Press enter.

Enter Short Title =>
????????????????

Step 15: Type in Edition. (E:? = edition on tape). Press enter.

Enter Edition
= > ????????????????

Step 16: Type in Segment Number. Press enter. [NOTE: CYZ-10 will not accept letters for segment identifier.]

Enter Segment Number
= > ????????????????

Step 17: Enter Registration number. (R:? = registration number on tape). Press enter.

Enter Reg Number
= > ????????????????

Step 18: Select Confidential. Press enter (or appropriate classification for fill).

Select Classification
Unclas <u>Confid</u> Sc   Topsec

Step 19: If loading additional IFF tape segments, ensure AN/CYZ-10 device is connected to KOI-18 via crypto cable then, Select Rcv. If not skip to step 21.

Connect to station and press [RCV] / [ABORT]
---

Loading in progress will appear.

Step 20: Pull tape through KOI-18.

Repeat steps 13 through 20 for all additional fills.

Step 21: If no additional fills are required select abort. Press enter.

Connect to station and press [RCV] / [ABORT]
---

Abort in progress; "Please standby" will appear. (Fill loading procedures complete.)

**To transfer IFF fills from the AN/CYZ-10 to the AN/GSX 1-A via the KIR-1C, ensure all required equipment is properly connected and powered:**

Step 1: Turn on the AN/CYZ-10 by pressing the ON/OFF button on the keypad. If DTD does not default to main menu, manually select main menu from DTD keypad.

Step 2: Select Appl. Press enter. **The next screen will vary based on the UAS (User Application Setup) loaded.**

Appl	Date	Time	Setup
Util	Bit		{MAIN}

[NOTE: All boxed text represents the actual AN/CYZ-10 menu displayed.]

Step 3: Select Fill. Press enter.

JFILL	RDS	SOI	RADIO
<b>FILL</b>			{APPL}

- a. Loading Application will appear.
- b. Fill Ver 4.09 will appear.

Step 4: Select Utility. Press enter. {K13} depicts Specific Comsec Fill Device currently selected (K13 = KY13).

Xmit	Recv	{K13}
<b>Utility</b>		[ C ]

Step 5: Select Setup. Press enter.

<b>setup</b>	sTatus	
Check	Delete	{UTL}

Step 6: Select Protocol. Press enter.

Select setup option	{Set}
<b>Protocol</b>	Tag

Step 7: Select Comsec Fill Device (Cfd). Press enter.

Select protocol	{SET}
<b>Cfd</b>	D101 Lmd Stu Timeout

Step 8: Select KI1c (Indicates KIR1C) Press enter.

Select	K13	K15	K18	{CFD}
Kemple	<b>KI1c</b>	Ds	102	kW46

Step 9: Press ABORT key on CYZ-10 keypad once below menu is shown.

<b>setup</b>	sTatus	
Check	Delete	{UTL}

Step 10: Select Xmit. Press enter.

<b>Xmit</b>	Recv	{KI1}
Utility		[C]

Step 11: Page down and find desired IFF Fill.

select	Find	sEnd	▼ {XMT}
IFF2A/APR			

IFF2A/APR indicates segment (A) of desired fill once found.

Step 12: Press enter when desired fill is found. (Segment A)

select	Find	sEnd	▼ {XMT}
IFF2AAPR			XMT

XMT will appear in lower right hand corner.



Step 13: Press page down to select the next desired fill. (Segment B) Once found press enter. XMT will once again appear in lower right hand corner.

select	Find	sEnd	↓ {XMT}
IFF2B/APR			XMT

IFF2B/APR indicates segment (B) of desired fill once found.

Step 14: Select Send. Press enter.

select	Find	sEnd	↓ {XMT}
IFF2B/APR			XMT

Step 15: Connect CYZ-10 to KIR 1-C. Press enter. (Do not press clear.)

Connect to Station	↓
Press [CLR]	

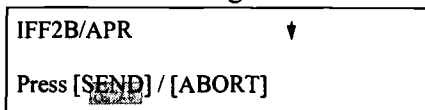
Step 16: Select Send. Press enter.

IFF2A/APR	↓
Press [SEND] / [ABORT]	

- Transfer in progress will appear.
- Processing please wait will appear.

[NOTE: When second fill window appears, disconnect crypto cable from KIR-1C, then reconnect to prevent initial crypto variable segment A from being corrupted.]

Step 17: Select send for second segment. Press enter.



- a. Transfer in progress will appear.
- b. Processing please wait will appear.
- c. 2 Keys Transferred will appear.
- d. MODE 4 Alarm lamp will distinguish. Programming AN/GSX1-A procedures complete.

Step 18: Program AN/PPX-3B/A's with days one (1) and two (2) of Mode III/IV IFF Code. Upon completion, zeroize KIR 1-C and refill with appropriate days three (3) and four (4) Mode III/IV IFF Code. Complete programming of all AN/PPX-3B/A's.

For further information on loading the TSEC/KIR 1-C computer, see limited maintenance manuals TSEC/KIR-1C/KAM-225C, IFF/DOD AIMS 86-100A Supplement 1, AN/CYZ-10/TM 11-5810-394-14&P.

## **STINGER HANDLING PROCEDURES**

When a Stinger weapon round is received from the missile resupply point, the Stinger is checked for firing suitability. The weapon is removed from the shipping and storage container and inspected in accordance with the services upon receipt checks found in technical manual TM 9-1425-429-12, *Operator's and Organizational Maintenance Manual: Avenger Stinger Air Defense Guided Missile System*. The markings on the container (case) are verified to ensure the proper weapon is within the container. Yellow squares on the container's two diagonally opposite corners and yellow data markings indicate the container contains a live round.

The Stinger weapon round and IFF interrogator containers are sealed to prevent environmental damage. Before either case is opened, the pressure relief valve must be pressed with the finger. When any rushing noise stops, the internal pressure of the case is the same as the pressure outside the case. The MRC does not have a pressure relief valve.

When out of its container, the weapon is carefully rested on its side. Do not stand the weapon on its end. If the launch tube does not have the proper color markings (four 1-inch yellow squares), the trainer is returned to the missile resupply point and exchanged it for another weapon round.

The gunner carries the weapon by placing the carrying sling over his shoulder when walking. The weapon is carried horizontally at a slight angle, sling tight enough to prevent weapon from swinging.

The gunner does not remove the weapon's protective covers (BCU receptacle, front end, and IFF connector caps) until preparing to fire or inspecting the weapon.

## **WEAPON CHECKS**

Although this publication does not cover preventive maintenance checks and services (PMCS), it contains an abbreviated set of weapon checks that may be made under field conditions when the time and tactical situation permit. When Stinger weapons are issued, and sufficient time is not available to perform all the checks listed in the TM, the team leader and gunner must, as a minimum, make the checks listed on the following pages. This does *not* mean that the other checks listed in TM 9-1425-429-12 should be overlooked if time permits performance.

## Full Checks

Full checks are made daily when time and the situation allow, and when the team is in a reduced state of alert. Full checks are especially important for weapons that have been out of their containers and exposed to bad weather. TM 9-1425-429-12 provides information on performing a full check.

## Critical Checks

A well-thought-out and organized procedure for checking the Stinger weapon round will ensure that it can be fired when it is needed. If any item listed is defective, then its entire component is considered not ready or available. (See fig. 2-8.)

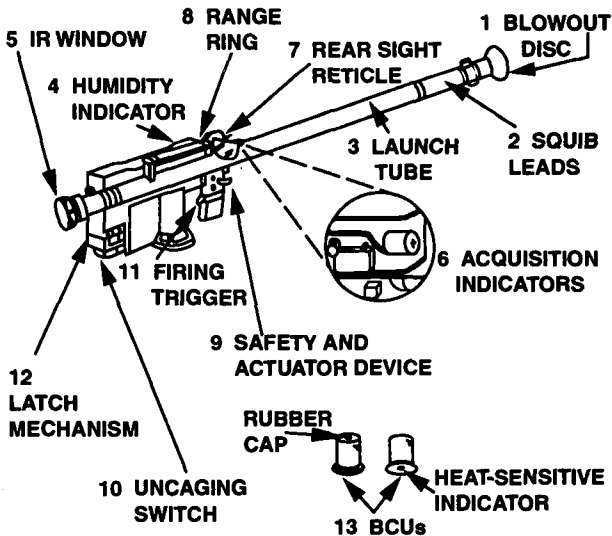


Figure 2-8. Checking Stinger Weapon Round Components.

## **Missile Round**

- Ensure Blowout disk (1) is *not* cracked or broken.
- Ensure launch motor igniter squib leads (2) are *not* damaged or broken. (Do *not* remove the adhesive cover; just run fingers along wires.)
- Ensure launch tube (3) is *not* cracked or broken.
- Verify color in humidity indicator (4) window. If tan, replace *at once* with green desiccant cartridge. Do *not* use launch tube for 24 hours. If indicator turns tan again within 24-hour period, too much moisture is in launch tube. Turn tube in to missile resupply point.
- Ensure IR window (5) is clean and *not* scratched, broken or cracked. If window needs cleaning, use lens cleaning tissue. (See para 3-5, TM 9-1425-429-12.)
- Ensure range ring (8) is *not* loose or defective.
- Ensure rear sight reticle (7) is *not* loose or defective.
- Ensure acquisition indicators (6) and wires are *not* damaged.

[NOTE: If the paint seals on screws holding the range ring or rear sight reticle to sight assembly are broken, assume they have been tampered with and do not use the launch tube until boresight has been verified.]

## **Gripstock Assembly**

[NOTE: Before performing gripstock assembly checks, ensure a BCU is not installed. If a BCU is installed, do *not* inspect the gripstock assembly and do *not* remove the BCU.]

- Safety and actuator device (9). Press and release lever. After click is heard, return lever to normal position.
- UNCAGING switch (10) in three positions: center and both ends. Press and release switch. A click should be heard each time. Return switch to caged position.
- Firing trigger (11). Squeeze and release trigger. After click is heard, return trigger to normal position.
- Latch mechanism (12). It holds gripstock assembly securely to the launch tube.

### Battery Coolant Unit

Check all BCUs (13). The color of the heat-sensitive indicator should be pink. If not, discard the BCU. Check the holes over the burst disc diaphragm. If the silver foil has been ruptured, discard the BCU. [NOTE: Do not remove an installed BCU to perform the following checks.]

- Rubber cap over needle. If the cap is punctured, use the BCU *only* in an emergency.
- Needle without removing rubber cap. Ensure *not* bent. Do *not* try to straighten bent needle. Discard BCU.
- BCU housing to ensure *not* cracked. If so, discard BCU.

Weapon mating procedures are outlined in TM 9-1425-429-12.

## **AVENGER MISSILE LOADING PROCEDURES**

The basic Stinger missile rounds and captive flight trainers (CFTs) contain a small amount of mercury thallium in the IR dome. If the IR dome breaks, do not touch the missile round or CFT in the vicinity of the seeker gyro. This material is toxic to unprotected skin. Avoid all contact with released material unless protective equipment—such as a respirator, gloves, and chemical goggles—is worn. If the skin or eyes are exposed to the released material, immediately flush with large amounts of water. Persons exposed to the released material should be promptly referred to a physician.

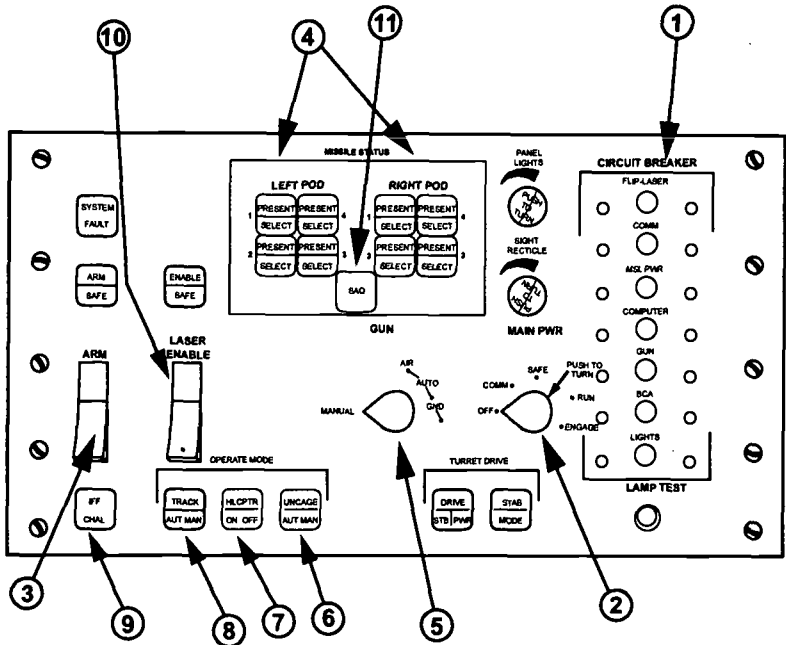
Do not upload or download missiles or CFTs with power applied to the missile system. Keep weapons system pointed in a safe direction away from personnel and equipment during loading or unloading procedures.

### **Loading Missile Pods**

Rotate the turret to 90 degrees or 270 degrees in azimuth and position missile pods to a maximum elevation of +68 degrees safely down range.

#### **Gunners Console (See Figure 2-9.)**

- Set MAIN POWER selector switch (2) to ENGAGE.
- Set ARM switch (3) on SAFE.
- Pull out missile power circuit breaker (1) CB3.



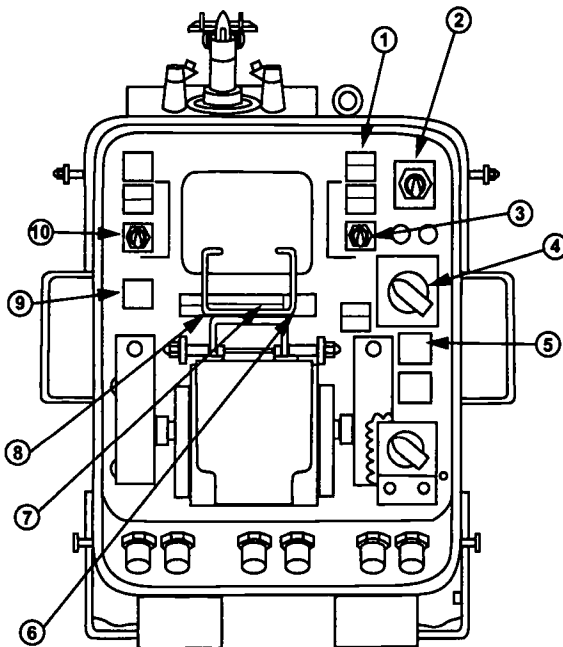
- |   |  |
|---|--|
| 1. Circuit Breakers                     | 7. Operate Mode Helicopter Switchlight |
| 2. Main Power Selector                  | 8. Operate Mode Track Switchlight      |
| 3. Arm Switch                           | 9. IFF Interrogator Switch             |
| 4. Missile Status Select/ Present Light | 10. Laser Enable Switch                |
| 5. Gun Mode Selector                    | 11. Missile Sequence Switchlight       |
| 6. Operate Mode Uncage Switchlight      |  |

Figure 2-9. Gunners Console.



**RCU (See Figure 2-10)**

- Set MAIN POWER switch (2) to ON.
- Press REMOTE ON/OK switchlight (1) to the ON position in order to initialize RCU. (RCU interface with fire unit computer is completed when white OK light and all other display lights come on.)



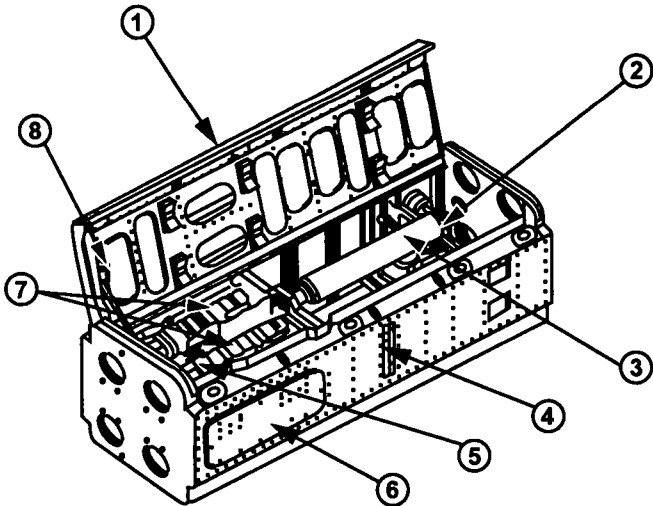
- |                             |                                  |
|-----------------------------|----------------------------------|
| 1. Remote ON/OK Switchlight | 6. Field of View Selector Switch |
| 2. Main Power Switch        | 7. Uncage Switchlight            |
| 3. Drive Interlock Switch   | 8. Helicopter Switchlight        |
| 4. Gun Mode Selector Switch | 9. Missile Sequence Switchlight  |
| 5. IFF Interrogator Switch  | 10. Weapons Arm/Save Switch      |

**Figure 2-10. Remote Control Unit.**

- Set DRIVE INTLK switch (3) to SAFE.

**Missile Pods (See Figure 2-11.)**

- Unlatch (4) and open upper missile pod access door (1).
- Unlatch (4) and remove lower missile pod access door.
- Inspect electrical auto mate connector (7) for burnt, bent or broken pins. If pins are damaged, notify maintenance. Do not install missile or CFT.
- Inspect argon gas receiver port for dirt, dust, moisture or damage.
- Ensure pressurized argon bottles (3) are installed and that the pressure gauge (2) indicates 3,500 PSI or greater. (SVML can be operated with only one argon bottle if necessary.)



- |                         |                            |
|-------------------------|----------------------------|
| 1. Access Door          | 5. Missile Release Latches |
| 2. Argon Pressure Gauge | 6. LEA Access Panel        |
| 3. Argon Bottle         | 7. Auto Mate Connectors    |
| 4. Access Door Latches  | 8. Access Door Stay Latch  |

**Figure 2-11. Standard Vehicle Missile Launcher.**

## **Missile Installation**

- Perform missile or CFT preventive maintenance checks. See TM 9-1425-429-12 or TM 9-6920-429-12, *Operator's and Organizational Maintenance Manual for Training Set, Stinger Guided Missile System, M134*.
- Remove lens cap cover.
- Place aft end of missile or CFT into recessed hole in aft end of missile pod (SVML).
- Check the alignment of argon gas and the electrical auto mate connectors.
- Latch missile or CFT into pod bracket (listen for click of latch). Check to ensure missile or CFT is securely latched into pod without exerting excessive force.

## **Completion Steps**

- Install and latch missile pod access doors (see figure 2-11).
- Push in MSL PWR circuit breaker (1) CB3 on gunner's console (see figure 2-9 on page 2-47).
- Verify that MISSILE STATUS SELECT/PRESENT light (4) illuminates on gunners console to indicate missile present for each missile loaded.
- Set DRIVE INTLK switch (3) on RCU to ENABLED (see figure 2-10 on page 2-48).
- Press REMOTE ON/OK (1) switchlight on RCU. (REMOTE ON/OK light will go out.)

- Set MAIN POWER switch (2) on gunners console to OFF. Missile upload complete.

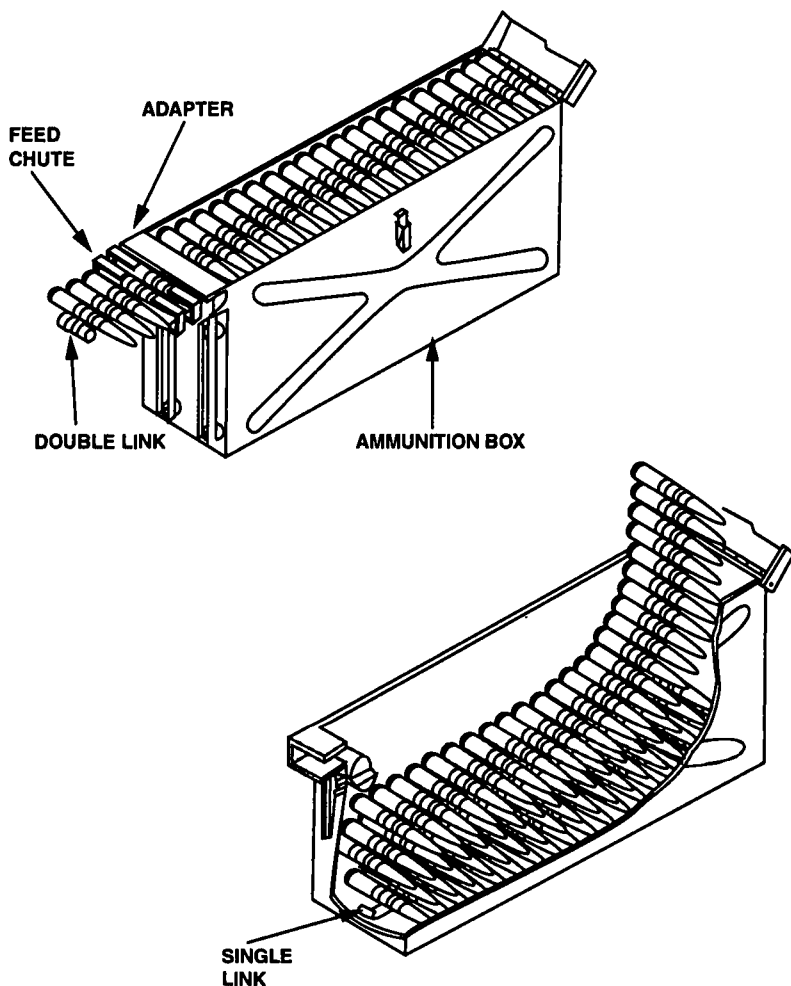
### AVENGER MACHINE GUN LOADING PROCEDURES

When loading the M3P .50 caliber machine gun, ensure the weapon remains pointed down range and in a safe direction away from personnel and equipment. Drive interlock switch on RCU will be kept in SAFE except when rotating turret or moving SVMLs. When using the gunner's console or RCU to perform machine gun loading procedures, ensure turret is positioned at 90 degrees azimuth and SVMLs are at 0 degrees elevation safely down range. Set controls on gunner's console (see fig. 2-9 on page 2-47) as follows:

- Set MAIN POWER selector switch (2) to ENGAGE.
- Set ARM switch (3) to SAFE.

When using RCU to perform machine gun loading procedures, set RCU (see fig. 2-10 on page 2-48.) controls as follows:

- Set MAIN POWER ON switch (2) to ON.
- Press REMOTE ON/OK switchlight (1) to ON. (RCU has interfaced with fire unit computer, when OK light and all other display lights come on.)
- Set DRIVE INTERLOCK switch (3) to SAFE. (If ARM switch on gunner's console is in the SAFE position, the weapon may be safed from the RCU.) Ensure gun is clear of ammo and links. Remove ammunition box and ammunition chute.
- Position linked ammunition into ammunition box (with ammunition box and chute removed from the Avenger) so a single loop link (see fig. 2-12 on page 2-52) is in the corner, and



**Figure 2-12. Ammunition Box Loading.**

the rough side of the links are facing up on the first row of rounds placed in the ammunition box. (When ammunition box is mounted on turret, rounds will point outward, away from Avenger turret.)

- Push ammunition up feed chute until three or four rounds come out other end of chute.
- Push first two rounds through the feed tray on gun. Do not open the feed cover of the machine gun. Verify no ammunition jams in chute.
- Set DRIVE INTERLOCK switch (3) on RCU to ENABLED (see figure 2-10 on page 2-48).
- Cycle ARM switch (3) on gunner's console to ARM, then SAFE, then ARM, to chamber a round. (Assistant gunner should watch ammunition belt for upward movement during this procedure.) Verify round has been chambered. Machine gun loading procedures are complete.

---

### **WARNING**

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**Keep hands clear of moving parts when machine gun is arming; failure to comply may result in injury to personnel.**

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## **MISSILE FIRING PROCEDURES (SHOULDER FIRED)**

See figure 2-13.

---

### **WARNING**

---

**When firing, gunner and assistant must hold their breath until trigger is released to avoid inhaling toxic fumes. If exhaust plume visibly persists at firing position, gunner and assistant must move away from plume before inhaling.**

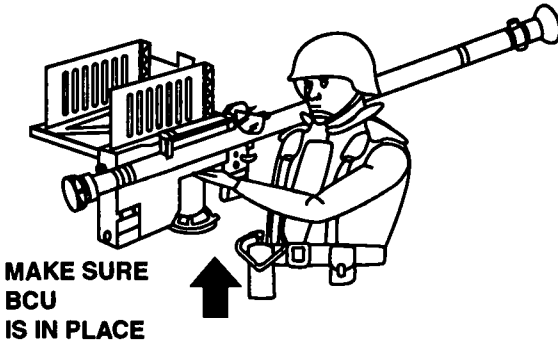
---

Step 1: Attach the IFF interrogator to the belt and the IFF clamp to the flak jacket.



**Figure 2-13. Firing Procedures.**

Step 2: Shoulder weapon.



**Figure 2-13. Firing Procedures—Continued.**

Step 3: Unfold antenna, pull up and release.

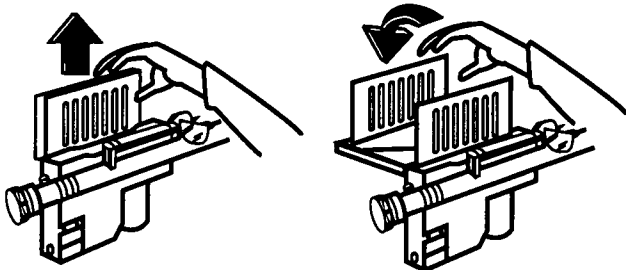


Figure 2-13. Firing Procedures—Continued.

Step 4: Remove cover.

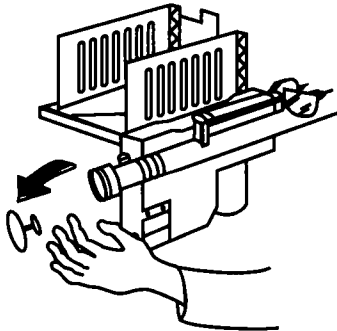


Figure 2-13. Firing Procedures—Continued.

Step 5: Raise sight assembly.

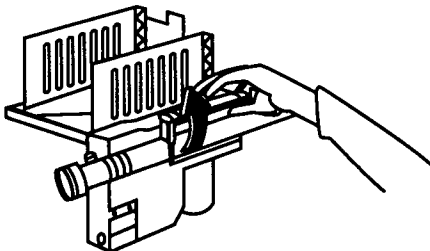
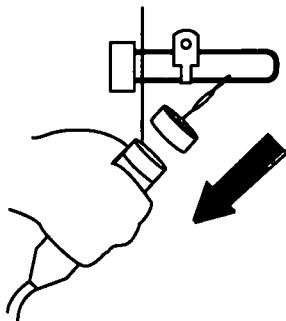


Figure 2-13. Firing Procedures—Continued.

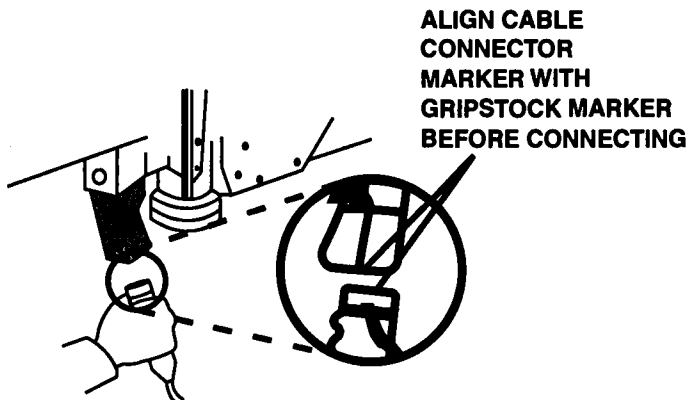


Step 6: Remove IFF connector from clamp assembly at the protective cover.



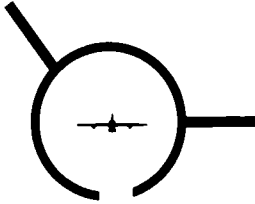
**Figure 2-13. Firing Procedures—Continued.**

Step 7: Remove gripstock protective cover and connect cable.



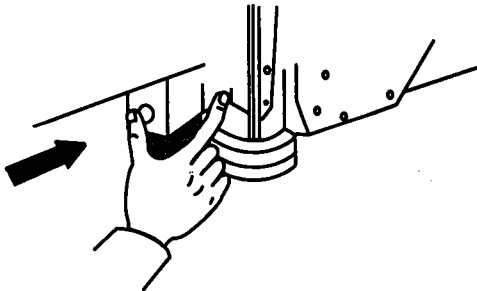
**Figure 2-13. Firing Procedures—Continued.**

Step 8: Point weapon at target and center target in range ring.



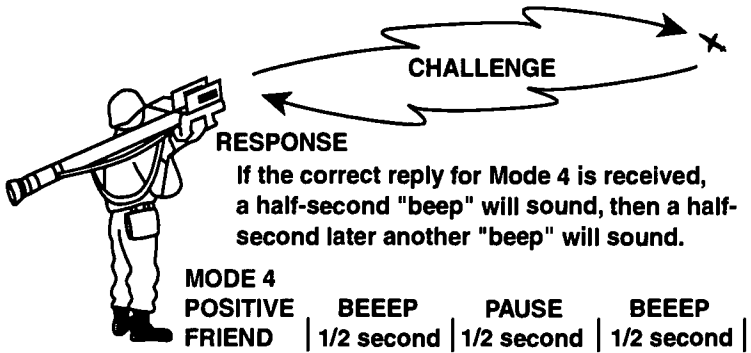
**Figure 2-13. Firing Procedures—Continued.**

Step 9: Press IFF interrogator switch. If target has already been identified, go step 11.



**Figure 2-13. Firing Procedures—Continued.**

Step 10: Listen for IFF response . . . .



**Figure 2-13. Firing Procedures—Continued.**

If the correct Mode 4 reply is not received, the interrogator automatically switches to Mode 3 when programmed using the Mode 4/3 setting and interrogates again.

If a Mode 3 reply is received, a 1 1/2-second BEEP will sound.

<b>MODE 3</b>	<b>BEEEEEEEEEEEEEEEEEEEEEEEP</b>
<b>POSSIBLE</b>	
<b>FRIEND</b>	<b>1 1/2 second</b>

If an incorrect reply or no reply is received, a string of short beeps will sound, meaning that the target identity is unknown.

<b>UNKNOWN</b>	<b>BEEP BEEP BEEP BEEP BEEP</b>
	<b>Short Beeps</b>

If no tone is heard when the IFF interrogator switch is pressed, the IFF system is either defective or the IFF interrogator is not connected to the weapon.

IFF  
SYSTEM  
NON-OPERATIONAL                      NO TONE

Step 11: Begin tracking and ranging target.

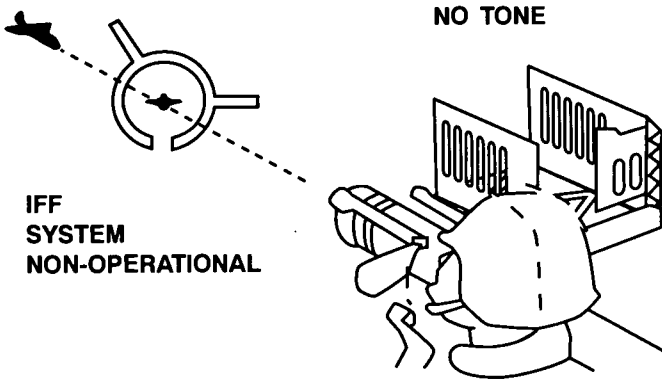
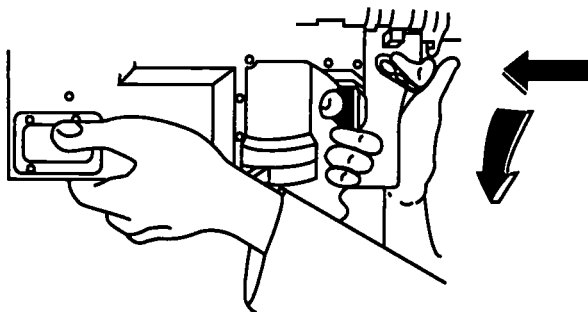


Figure 2-13. Firing Procedures—Continued.

Step 12: Wait until target is in range.

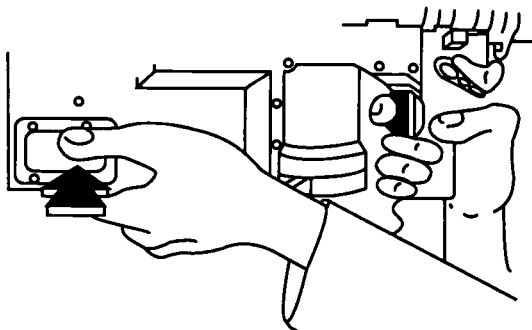


**Figure 2-13. Firing Procedures—Continued.**

Step 13: Operate safety and actuator device.

Step 14: Listen for distinct acquisition tone.

Step 15: Press and hold uncaging switch.

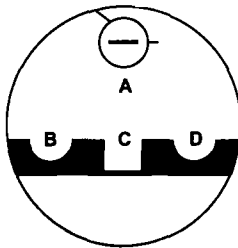


**Figure 2-13. Firing Procedures—Continued.**

Step 16: Positively identify aircraft and prosecute in accordance with current WCS and ROE.

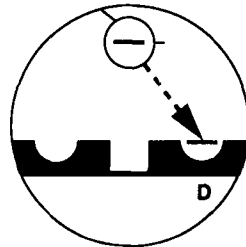
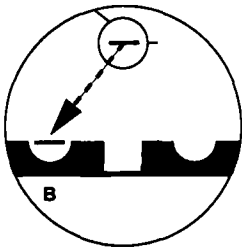
Step 17: Super-elevate weapon.

Step 18: Have one of these sight pictures (refer to fig. 2-13).



**Right Lead Induced (Fixed Wing)**

**Left Lead Induced (Fixed Wing)**

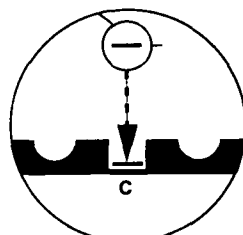
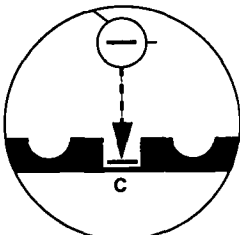


All fixed-wing aircraft and helicopters coming from the left, or slightly from the left, are placed in the left reticle B.

All fixed-wing aircraft and helicopters coming from the right, or slightly from the right, are placed in the right reticle D.

**Incoming/Outgoing (Fixed Wing)**

**Helicopters and Hovering VTOL Aircraft**



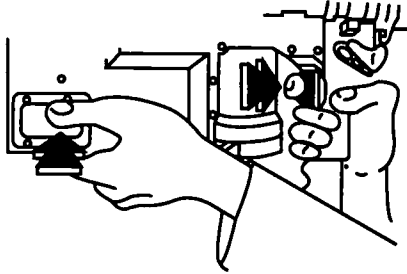
All fixed-wing aircraft directly incoming or outgoing are placed in the center of reticle C.

Hovering helicopters and hovering VTOL aircraft regardless of aspect are placed in the center of reticle C.

NOTE: When firing the RMP Stinger Missile, all helicopters and VSTOL aircraft regardless of aspect, are placed in the center reticle.

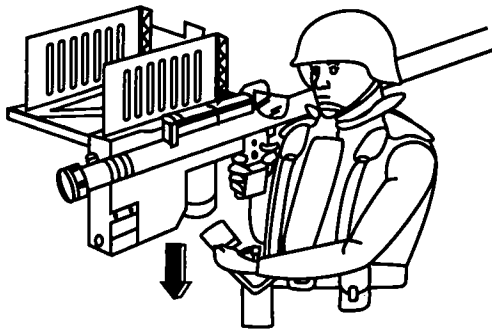
**Figure 2-13. Firing Procedures—Continued.**

Step 19: **FIRE!** Hold breath and continue tracking for 3 to 5 seconds.



**Figure 2-13. Firing Procedures—Continued.**

Step 20: Remove BCU within 3 minutes.



**Figure 2-13. Firing Procedures—Continued.**

## **POST FIRING PROCEDURES**

Remove the expended BCU from the gripstock within 3 minutes to prevent damage to the BCU receptacle. Remove the IFF cable by pulling straight down on the quick-release loop attached to the IFF cable connector.

Close the IFF antenna. Place the expended weapon on the ground (or back in its container with its sight and IFF assemblies closed). When the situation permits, remove the gripstock assembly from the expended launch tube. It can be reused on another missile round. Destroy the launch tube at a convenient time. Leave the firing site quickly to avoid fire from the enemy.

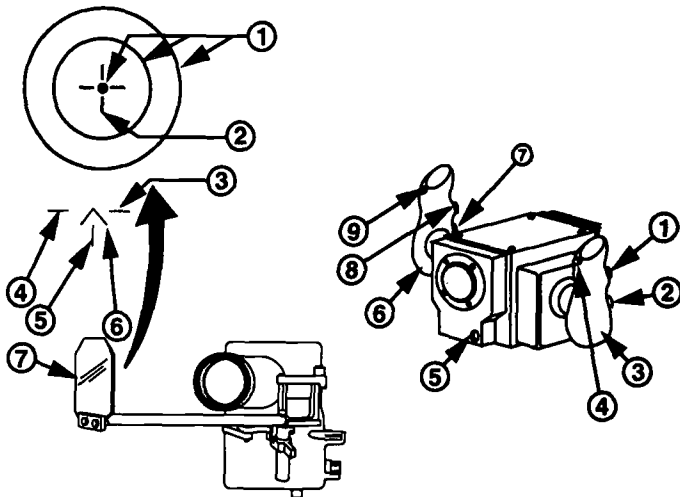
## **FIRING PROCEDURES (AVENGER)**

The Avenger weapons system fires Stinger missiles in the pedestal-mounted configuration using turret controls or the RCU. The Avenger unit may be quickly converted to the MANPAD role (if the fire unit is not capable of operating in the pedestal-mounted mode) by removing a Stinger missile round from the SVML, attaching a gripstock and IFF belt pack, and inserting a BCU into the battery well. Missile firing procedures are as follows:

- Select engage mode from MAIN POWER selector switch (2) and enable ARM switch (3) on gunner's console. (See fig. 2-9 on page 2-47.)
- Acquire target using FLIR (WFOV) and center in fixed reticle, fixed reticle symbology (+), and sight aiming point. At least one of the palm switches must remain depressed throughout engagement sequence.



- Acquire target, center, then change to NFOV (left-foot switch).
- The gunner may track the target manually or activate FLIR auto track (right-thumb button). Once activated, the tracking box will shrink onto target indicating FLIR auto track is activated. The box will flash on and off if no IR/UV source present within reticle view.
- Press IFF INTERROGATOR switch (9). Listen for IFF response. (See fig. 2-13, step 10, page 2-58.)
- Activate missile (depress left thumb button once). Missile activate symbol (^) will appear on FLIR monitors and combining glass. (See fig. 2-14.)
- Select operation mode (6). (Auto Uncage on gunner's console.) (See fig. 2-9 on page 2-47.)
- Uncage missile/fire laser range finder (left finger trigger-pull and hold). Missile uncage symbol (!) will appear under missile activate symbol on FLIR monitors and combining glass. The trigger must remain depressed from the point of uncaging through firing the missile.
- Verify fire permit symbology (-) has appeared to the left of the missile activate symbol on FLIR monitors and combining glass. (Listen for 1,200 cycle tone.) (See fig. 2-14.)
- Verify seeker tracking target. (Reticle will move with target.)
- Fire missile. (Pull and hold right finger trigger and continue to track.)
- Weapons system will automatically spin up and cool down next missile in firing sequence to prepare for firing.



- |   |                                 |
|---|---------------------------------|
| 1. Driven Reticles                      | 1. Right Trigger Switch         |
| 2. Wide Field of View Reticle           | 2. Right Palm Grip Switch       |
| 3. RSO Authorized Symbol                | 3. Right Palm Grip              |
| 4. Fire Permit Symbol                   | 4. Right Thumb Switch           |
| 5. Missile Uncage Verify Symbol         | 5. Drift Adjustment Push Button |
| 6. Missile Activate Symbol              | 6. Left Palm Grip               |
| 7. Combining Glass/Optical Display Unit | 7. Left Palm Grip Switch        |
|   | 8. Left Trigger Switch          |
|   | 9. Left Thumb Switch            |

**Figure 2-14. FLIR Symbology and Hand Station.**

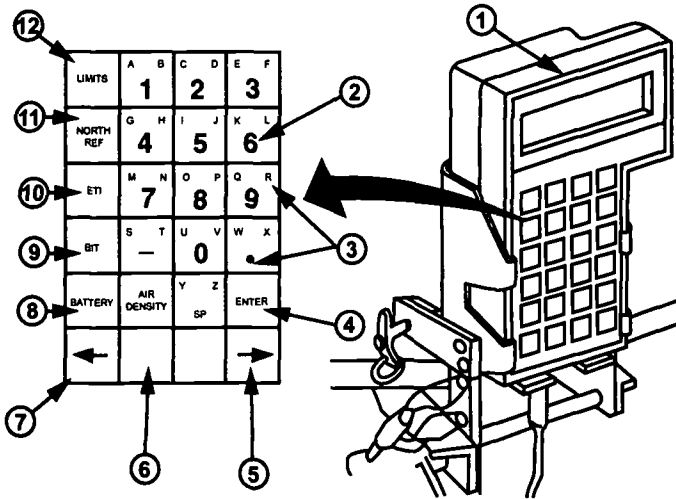
The M3P .50 caliber machine gun is used to provide coverage of the Stinger inner launch boundary and for Avenger self-protection against ground targets. To compensate for various temperature and altitude conditions for machine gun firing, it is necessary to enter temperature and altitude information into the control display terminal (CDT) prior to weapons firing for accurate aiming calculations to be made. Once the information is entered, the computer will

automatically insert proper lead and super elevation based on input data. To enter air density data—

- Set MAIN POWER selector switch (2) to COMM on gunner's console. (See fig. 2-9 on page 2-47.)
- Press AIR DENSITY KEY (6) on CDT, press ENTER (4).
- Enter approximate ambient temperature in degrees Fahrenheit, press ENTER (4).
- Enter current elevation of fire unit location in meters, press ENTER (4).
- Press the letters R V and then press ENTER (4) to view air density. (See fig. 2-15.)

The following are machine gun setup and engagement procedures.

- Select Engage on MAIN POWER selector switch (2) on gunner's console.
- Arm the ARM switch (3). (Remote charger will automatically chamber a round. If the ARM switch is put on SAFE, the remote charger will extract the round.)
- Enable laser range finder (10) on gunner's console.
- Activate FLIR auto track. (Depress right thumb button.)
- Press IFF interrogator switch (9). Listen for IFF response. (See fig. 2-13, step 10, page 2-58.)
- Select GUN MODE switch (5) (manual/auto gunner's console).



- |                                 |                         |
|---------------------------------|-------------------------|
| 1. CDT Display                  | 7. Left Arrow Key       |
| 2. Keyboard                     | 8. Battery Key          |
| 3. Character and Numerical Keys | 9. BIT Key              |
| 4. Enter Key                    | 10. ETI Key             |
| 5. Right Arrow Key              | 11. North Reference Key |
| 6. Air Density Key              | 12. Limits Key          |

**Figure 2-15. Avenger Control Display Terminal.**

- Fire laser range finder. (Depress left trigger switch and hold.)
- Fire machine gun. (Depress right trigger switch.)

## STINGER HANGFIRE, MISFIRE, AND DUD

A hangfire is a delay in the functioning of a weapon round. It can last up to several minutes. A misfire is a complete failure to fire. A dud is a missile whose flight motor does not ignite, the missile is ejected from the launch tube assembly, travels a short distance, then falls to the ground. Tactical situations determine how a hangfire or

misfire will be handled. Dud locations will be marked, then appropriate personnel will notify explosive ordnance disposal (EOD). All dud situations require the team or fire unit to move at least 1,200 feet away from the dud site location. Remember, the overall classification of the missile is considered SECRET. The missile must be held under secure storage or under surveillance until disposed of by EOD personnel. Local disposal is authorized and required.

If a MANPAD missile does not fire—

- Continue tracking target for 3 to 5 seconds longer, keeping firing trigger and UNCAGING switch depressed. If missile still has not ejected, release firing trigger and UNCAGING switch. Remove the BCU.
- Place weapon round on ground or in dud pit during annual service practice. Point safely down range and away from personnel. Front end should be elevated approximately 20 degrees. Leave firing site without passing in front of, over or behind the weapon.
- Mark defective weapon's location.
- Notify EOD unit.

If an Avenger missile does not fire, the missile present status indicator (4) on the gunner's console (see fig. 2-9 on page 2-47) will flash off and on.

If an Avenger missile does not fire—

- Continue to track target and attempt to fire missile if MISSILE STATUS SELECT/PRESENT light on gunner's console remains on.

- Release the left trigger switch and the right trigger switch on hand station. Ensure missile uncage symbol on combining glass and FLIR display go off. (In a tactical situation where the mission accomplishment is essential, press MISSILE STATUS SEQUENCE switch (11) to select another missile. MISSILE STATUS SELECT/PRESENT light comes on to identify next missile to be fired. Continue engagement.)
- Press and release left thumb switch on handstation. Missile activate symbol on combining glass and FLIR display will go off. MISSILE STATUS SELECT light on gunner's console will go off.
- Set ARM Switch to SAFE. ARM light will go off, SAFE light comes on. Position turret with both ends of missile pointed away from personnel. Elevate SVMLs +20°.
- Turn MAIN POWER selector switch to SAFE. Remain in turret for 10 minutes before exiting to the rear.
- Notify supporting EOD unit.

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### WARNING

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For hangfire, misfire or dud missile, evacuate area around missile launcher for distance of at least 366 meters (1,200 feet). Missile launcher should be guarded and kept under observation. It should not be approached for at least 60 minutes. Avenger fire units must remain loaded for 60 minutes after misfire before being unloaded for disposal. Death or injury may result. The front portion of a misfire missile may remain hot. Proper precautions should be taken in handling the missile round.

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## **MACHINE GUN MISFIRE, HANGFIRE, COOK-OFF, AND STOPPAGE**

A misfire is a failure of a chambered round to ignite when the firing mechanism is actuated. It can be due to an ammunition defect or faulty firing mechanism in the weapon. A misfire is not dangerous, but because it cannot be immediately distinguished from a hangfire, it should be handled with care. A hangfire is a delay in igniting of propellant charge after primer has been struck by firing pin. It is not easily distinguished from a misfire. A cook-off is the igniting of a round caused by the heat of a extremely hot barrel and not caused by actuating the firing mechanism. A stoppage is any interruption in the cycle of operation caused by faulty action of the machine gun or ammunition. Stoppages must be handled as a misfire. Information on hangfires, misfires, cook-off, and stoppages can be found in TM 9-1425-433-10.

If the machine gun malfunctions, the Avenger weapons system will automatically attempt to clear stoppages and prevent cook-offs. When firing the machine gun in ground-air auto, if 22 or more rounds are not fired within 2 to 3 seconds after the fire trigger is pressed then released, the CDT will display HANGFIRE. The system automatically ejects a round and chambers a new one. The gunner may continue operations under normal conditions.

When the machine gun sets to cool-down mode (displayed on the CDT), there is a 40-second delay before normal operations may continue. In tactical situations when necessary, the cool-down mode may be overridden by pressing the left trigger switch, normal operations may continue.

When firing in the manual mode and 52 or more rounds have been fired in less than 10 minutes, *the bolt is automatically safed* for 40 seconds after the last round burst and is then held open for 10 min-

utes. In tactical situations where the situation deems it necessary, this SAFETY feature may be overridden by pressing the left trigger switch, and normal operations may continue.

If a hangfire occurs, wait 10 minutes from the last round burst before approaching the machine gun and—

- Set ARM switch (3) on gunner's console to SAFE. (Bolt will retract and eject round.) (See fig. 2-9 on page 2-47.)
- Set ARM switch (3) to ARM. (Bolt will move forward and chamber new round.)
- Verify LASER ENABLE switch (10) is set to ENABLE, press and hold PALM switch, press and hold left trigger switch.
- Press right trigger switch to attempt to fire weapon. If the weapon still fails to fire, refer to troubleshooting section of TM 9-1425-433-10.

---

### WARNING

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**Because of the possibility of a cook-off, never attempt to remove a round that is chambered in a hot weapon by opening breech. All personnel should remain clear of the breech until weapon is cooled. Permanent deafness may result if personnel are exposed to weapons firing without proper hearing protection. Wear ear protectors, helmet, and flack jacket when firing. Personnel within 125 meters (about 400 feet) should also wear ear protectors.**

---

## NATURE OF INFRARED RADIATION

IR is the band of wavelengths in the electromagnetic frequency spectrum just below visible light. All substances radiate IR energy,



the amount depending largely on their temperature. IR energy has properties similar to light. It travels in a straight line and at the same speed as light. The missile senses IR emitted by a target by optically focusing this energy on the surface of an IR detector in the missile seeker system. The coolant in the BCU cools the detector cell. When the seeker acquires the IR energy emitted by a target, acquisition signals produced by the weapon inform the gunner that the target has been detected. Although sunlight normally will not cause damage to the seeker, an uncovered seeker should be pointed away from the sun.

## **ATMOSPHERIC CONDITIONS**

The atmosphere is not completely transparent to IR. Certain gases in the atmosphere, primarily carbon dioxide and water vapor, absorb energy in the IR frequency spectrum. Because the amount of carbon dioxide in the air is fairly constant, its effect on detection range is consistent and need not be considered by the gunner.

Water vapor content varies widely with geographic location and local weather conditions. The sun's IR is also reflected from objects, causing them to become secondary sources of background radiation (false targets). Typical secondary sources are bodies of water, bare hillsides, and white clouds. Some sources of secondary background radiation are shown in fig. 2-16.

The Stinger IR seeker can discriminate between radiation from a small point source such as the tailpipe of a jet and large background sources such as clouds and terrain. Except for the Sun, the engine exhaust or tailpipe of the target is usually the smallest and hottest object in the environment and will be tracked by the missile seeker.

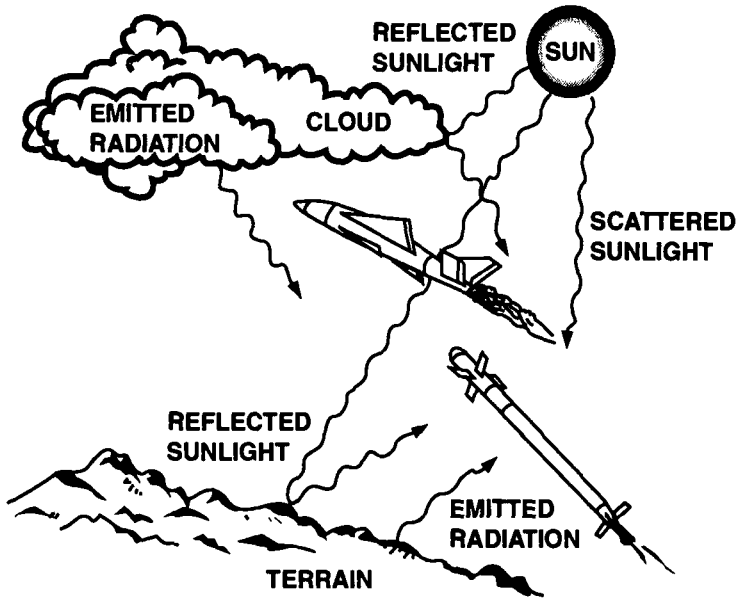


Figure 2-16. Background Radiations.

## DESTROYING THE STINGER AND AVENGER WEAPONS SYSTEMS

Stinger and Avenger weapons systems are destroyed when the team leader determines loss to the enemy is imminent. Destroying the weapon systems should guarantee it cannot be repaired with components from other weapons systems. This includes damaging all key components beyond repair. Every effort should be made to destroy the weapons system and components. If all key components cannot be destroyed, at a minimum, the seeker head on each Stinger, the FLIR, laser range finder, gunner's console, RCU, and RTU on the Avenger must be destroyed so that the enemy cannot reconstruct one complete weapon from several damaged ones. Firing is the best method of destroying the missile. When the Stinger

cannot be fired, it is destroyed by burning, demolition or small arms fire. Destroying the burning key components, make the Stinger inoperable. Follow the procedures listed below for the destruction of the Avenger weapons system and ancillary equipment. See chapter 3 for the destruction of communications equipment.

Whenever a Stinger team occupies a firing position, identify a suitable emergency destruction area at least 50 meters away. A shallow pit or berm built up with soil or logs can provide personnel protection from incendiary or explosives devices.

## **Burning**

The Stinger contains both a live rocket motor and a high explosive warhead that create an extreme hazard when burned. Use extreme caution. If time permits, dig a hole about 2 feet deep and long enough to hold the Stinger. Smash the seeker, the sight assembly, and the gripstock and place them in the hole. Place incendiary grenades around the Stinger or douse with flammable liquids. Cautiously ignite.

The Avenger weapons system contains many assemblies that must be destroyed. The FLIR, laser range finder, optical display unit (ODU), interface electronics assembly (IEA), Avenger control electronics component, electronic control assembly (ECA), remote terminal unit(s) (RTU), RCU, and gunner's console must be smashed and then burned. Place incendiary grenades atop the Avenger control electronics component, IEA, RCU, RTU, and gunner's console or douse with flammable liquids and cautiously ignite.

## **Demolition**

Use 7 1/2 pounds of C-4 explosive or equivalent per weapon. Place the charges lengthwise on top of the Stinger. C-4 charges should be placed inside the turret of the Avenger, located on the Avenger con-

trol electronics component, IEA, RCU, RTU, and gunner's console. Inside the cab, C-4 charges should be placed on the RCU.

Determine whether electrical blasting caps and wire or non-electric caps and a safety fuze are available for priming and detonating the charges. If non-electric blasting caps are used, crimp them to at least 2 meters (about 6.5 feet) of safety fuze.

Connect charges with detonating cord for simultaneous detonations if destroying more than one Stinger at a time. Dual-prime the charges to minimize chances of a hangfire or a misfire.

If charges are primed with non-electric blasting caps, initiate the safety fuzes and then immediately take cover. If primed with electric blasting caps, take cover before firing.

### **Small Arms Fire**

Use only if no other method is available. Smash the seeker of each Stinger, the ODU, FLIR, Avenger control electronics component, IEA, ECA, RTU, RCU, and gunner's console. Stack or pile the Stinger weapons and related equipment. Fire on the equipment from at least 50 meters (164 feet) with rifles, machine guns, rifle grenades or rockets. Some of the ancillary equipment associated with the Avenger weapons system is marked with red arrows indicating where to fire upon for maximum damage.

### **LAAD TEAM VEHICLE**

In addition to being able to shoot and communicate, LAAD units must also be able to move to accomplish their mission. LAAD teams should deploy with their organic HMMWVs if possible.

Although the HMMWV is not a component of the Stinger missile system, it is considered part of the weapon system for the MAN-PAD Stinger team. The HMMWV allows the LAAD team to—

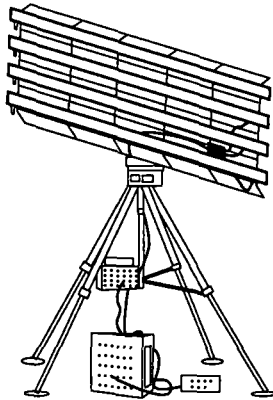
- Keep pace with rapidly moving ground forces they are supporting.
- Move rapidly to alternate positions.
- Reach missile resupply points.
- Carry its full, basic load of missiles.
- Carry ancillary equipment and supplies necessary to accomplish the team mission.

Situations that force the team to deploy without the HMMWV should be minimized. Without its vehicle, the LAAD team can fulfill only a portion of the mission for which it was designed and equipped. If the team is to be employed without the vehicle, extensive coordination and planning should be conducted to provide the logistical support necessary to continue the mission.

[NOTE: The HMMWV is considered organic to the Avenger weapons system.]

## **TACTICAL DEFENSE ALERT RADAR**

The AN/UPS-3 Tactical Defense Alert Radar (TDAR) is a transportable, lightweight air defense surveillance and cueing radar used for the detection of low-flying aircraft (fixed-wing helicopters or hovering helicopters). See figure 2-17. The minimum and maximum detection altitudes of the TDAR is from 0 to 10,000 feet +



**Figure 2-17. Tactical Defense Alert Radar.**

based on the adjustable antenna elevation setting of + or - 6 degrees. It is capable of detecting helicopters from 8 to 10 kilometers and fixed-wing aircraft from 20 kilometers at speeds ranging from 50 knots to 1.6 mach. The minimum target velocity for target detection is 70 knots for fixed-wing aircraft and 50 knots for rotary wing aircraft within 8 kilometers of the radar. Target detection accuracy is within 300 meters. The system can be remoted from the command post position from 2 kilometers when using the RTU external power source such as a generator and WF16 data wire.

[NOTE: WD1 (slash/field wire) has a greater resistance value than that of WF16 data wire. If WD1 slash wire is used the maximum remote distance is reduced to no greater than 50 feet before degradation and is not recommended for use.]

The AN/UPS-3 operates within the delta band of the (military) radar spectrum and has a selectable frequency range of 1.215 to 1.299 gigahertz (GHz), which is displayed on the transceiver as frequencies 00 through 07 as indicated.

Frequency indicator 00 = 1.215 GHz

Frequency indicator 01 = 1.224 GHz

Frequency indicator 02 = 1.242 GHz

Frequency indicator 03 = 1.251 GHz

Frequency indicator 04 = 1.269 GHz

Frequency indicator 05 = 1.278 GHz

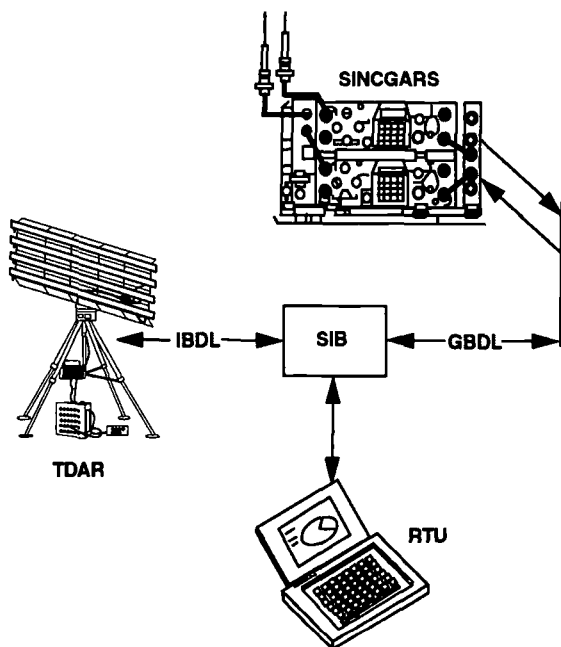
Frequency indicator 06 = 1.290 GHz

Frequency indicator 07 = 1.299 GHz

This modular system has three subsystems (see fig. 2-18): a detection device (sensor), a processing system, and a display terminal. It weighs approximately 237 pounds when assembled. Operating temperatures range from -25° to 140°F. The TDAR is also able to operate in winds gusting up to 60 knots and can be powered by a variety of sources, 24-volt (V) power from the HMMWV, 120V household power (U.S.) with the use of the supplied power converter or authorized generator.

The TDAR is packed in four reusable transport cases. The pressure relief valves on each case should be pressed to equalize internal case pressure before the case cover is opened. Equipment setup consists of quadripod setup, pedestal installation, antenna installation, antenna elevation adjustment, transceiver installation, pedestal and antenna alignment, cable connections, and remote terminal unit installation and setup.

Pedestal and antenna north reference alignment is accomplished by selecting the most distant terrain feature or stationary man-made object, referred to as the known reference point (KRP), then deter-



**Figure 2-18. Tactical Defense Alert Radar Components.**

mining the KRP's magnetic azimuth from the TDAR's position. Once the KRP's magnetic azimuth is known, apply the map local variation value to convert the known azimuth to a true north azimuth. Align the antenna sights with the KRP. Release the azimuth ring locking levers and rotate azimuth ring until the pedestal index marker is aligned with the adjusted KRP true north azimuth. Lock down azimuth ring levers. The pedestal is now aligned so that the zero degree indicator of the display unit is now also aligned to true north. See TM 09480A-12&P/1, *Display Unit AN/UPS-3*, for instructions.

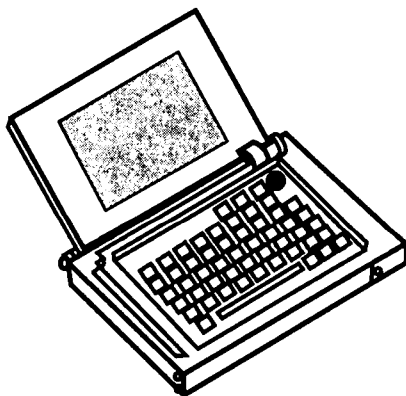
The TDAR is generally employed at the section leader's position but may be employed at any level that aids mission accomplish-



ment. Place the radar where it can best detect incoming aircraft. Proper site selection is the most critical part of radar employment since its performance will be directly related to site location.

## **REMOTE TERMINAL UNIT**

The RTU is a ruggedized, manportable EMI shielded laptop computer that displays received data information (GBDL) into a recognized air picture for cueing and early warning purposes. It is designed to be used in the field environment, capable of withstanding a 40G shock and operating temperatures that range from  $-40^{\circ}$  to  $160^{\circ}$ F. (See fig. 2-19.)



**Figure 2-19. Remote Terminal Unit.**

The RTU is powered by an internal replaceable, 6V nickel-cadmium (NiCd) battery pack. A fully charged NiCd battery pack will provide 3 to 4 hours of operating time in a moderate environment, when the backlight and keyboard are not used. Recharging the NiCd battery pack will take 5 to 6 hours. As an emergency backup to the NiCd battery pack, five D-sized alkaline cell batteries may be used with the 386 RTU. In addition, the RTU can be powered by

standard (U.S.) household 120V power using the power converter and cables provided or by 24V HMMWV power when using the P4 power cable.

Prior to activating the RTU, ensure that the RESET/RUN switch and STORE/RUN switch are both in the RUN position. Refer to TM-09480A-12&P/1 for detailed setup and interface procedures.

### Remote Terminal Unit Setup

Refer to TM 10296A-10/1-1, *Field Handbook Expeditionary Air Defense System (EADS) Director Unit*.

- Turn RTU on by pressing On/Off key. (It will take the system a few seconds to initialize.)
- Select EADS by pressing the appropriate number when the selection menu appears.
- SELECT A PROGRAM will appear. Select EADS TACTICAL by pressing the appropriate number. (System will take approximately 1 minute to boot.) EADS SYSTEM CONFIGURATION menu will appear.
- Select the appropriate item for the use of the RTU under MAJOR ITEMS.
  - MANPAD team, type M0 to select NONE.
  - Avenger team, type M4 to select Avenger.
  - Section leader, type M2 to select TDAR
- Type R1 under RADIO SUBMENU to select SINGGARS RADIO, select RECEIVE. (Select TRANSMIT and RECEIVE if forwarding data link from your position.)

- Type P1 AUTOMATIC POSITIONING to select precision lightweight global positioning system receiver (PLGR). (If not using the PLGR, leave blank.)
- Enter station address by pressing F1 key, type RTU address, and press ENTER.
- Enter Team call sign by pressing F2 key, type call sign, and press ENTER.
- Enter local time by pressing F3 key, type in local time, and press ENTER.
- Enter date by pressing F4 key, type date (e.g., 07-19-00), and press ENTER.
- Press ENTER to launch application, main screen will appear.

### **Inputting Emplacement Data**

- Press the shift key and emplacement data (F12) key. (Options menu will appear.)
- Select units of measure. Press ENTER.
  - Select DEGREES when azimuth is highlighted, using left or right arrows to scroll through options.
  - Press ENTER. Range will now be highlighted. Select nautical miles or kilometers.
  - Press ENTER. Velocity is now highlighted. Select KNOTS or meters per second (MPS).

- Press ENTER. Altitude is now highlighted. Select feet or meters as desired.
  - Press ENTER. Select the altitude reference as above ground level (AGL) for team configuration setup or mean sea level (MSL) for section leader or team with TDAR emplaced at their individual location.
  - Press ENTER.
  - Select coordinate system. Military grid reference system (MGRS).
  - Press ENTER.
  - Enter ZULU time configuration.
  - Press ENTER twice.
  - Select sectors/alerts when options menu appears, using up/down arrow keys.
    - Press ENTER. Start degree will be highlighted. Enter start degree as 0.
    - Press ENTER. Stop degree will be highlighted. Enter stop degree as 359.
    - Press ENTER.
- [NOTE: Teams should not input blanking sectors unless directed to do so by a higher authority.]**

- Turn system tones ON/OFF as desired.

- Press ENTER.
- Type desired IN RANGE distance.
- Press ENTER.
- Select Stinger missile zone.
- Press ENTER twice. Options menu will appear.
- Select emplacement data using the up or down arrows.
- Press ENTER. Datum will be highlighted. Using the left or right arrow keys, select WGD WGS 1984. Spheroid will be World Geodetic 1984. Press ENTER.
- Type in site location. Using 1:50,000 enter grid zone designator for map being used. Type 100,000 meter grid square identification. (The grid zone designator and 100,000 meter square identifier information can be found in marginal information area at the bottom of a map.) Type current location in 10-digit grid. (Example: 12S TB 2790008500). Press ENTER.
- Type in data link reference point (DLRP). Press ENTER.
- Type in current site altitude. Press ENTER. Type site number as required.
- Type in Cartesian coordinate reference point (CCRP). Press ENTER.
- Type in quadrant identifier for northwest (NW), northeast (NE), southwest (SW), and southeast (SE). (Use color or state, two-letter abbreviation). Press ENTER after each entry.

- Scroll down using down arrow to select CCRP. Using left or right arrow, select YES, press ENTER. Cartesian grid will be displayed with quadrant identifiers on main screen.
- Scroll down to GBDL SRC. Select YES. Press ENTER twice.
- Press emplacement data (F12) key. RTU is prepared for operation.

[NOTE: The SINCGARS radio must be set to the proper data rate for the RTU to function properly. Ensure the SINCGARS data rate is set at 2,400 BPS. To turn the RTU off, press ALT and OFF keys simultaneously. Stations transmitting GBDL should remain in the frequency hop master setting on the AN/PRC 119, this will enable receiving stations to maintain synchronization with the NCS. All receiving stations remain in frequency hops (FH) mode.]

[NOTE: The track box will appear on a team's RTU only when a section leader or other appropriate higher authority sends an engagement command over GBDL to a specific Avenger team, and that team then quick hooks the target and wilcos the engagement order.]

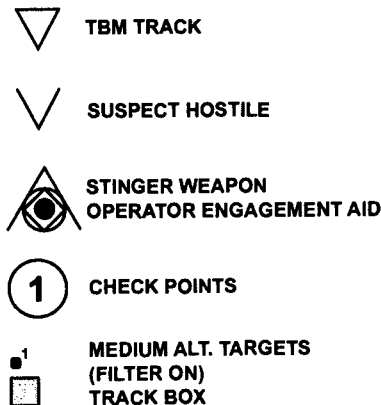















Figure 2-20. Remote Terminal Unit Symbology.

-  UNKNOWN HELICOPTER (LOW ALT.)
-  UNKNOWN (LOW ALT.)
-  UNKNOWN (MEDIUM ALT. )
-  HOSTILE (LOW ALT.)
-  HOSTILE (MEDIUM ALT.)
-  HOSTILE HELICOPTER (MEDIUM ALT.)
-  FRIENDLY (LOW ALT.)
-  FRIENDLY HELICOPTER (MEDIUM ALT.)
-  FRIENDLY (MEDIUM ALT.)
-  REMOTE ENGAGED/CUABLE  
TRACK (SHTU/HTU)
-  TBM TRACK WITH GIP AND PAIRING LINE
-  JAM STROBE
-  HIGHEST PRIORITY OR  
RECOMMENDED TARGET

**Figure 2-20. Remote Terminal Unit Symbology—Continued.**

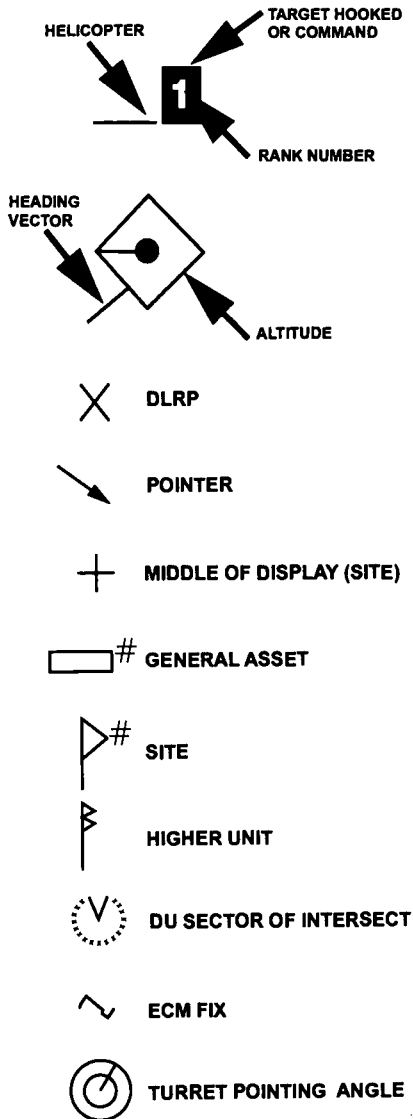


Figure 2-20. Remote Terminal Unit Symbology—Continued.



## SAFETY DISTANCES

During annual service practice firing for both the Avenger weapons system and the shoulder-fired Stinger missile, personnel should not be closer than 50 meters (164 feet) to a firing point. Under combat conditions, to prevent injury from flying glass and debris, personnel should not be closer than 15 meters (50 feet).

The team leader should be close to the gunner's side to ensure that he is not endangered by the weapon's backblast. Allow at least 5 meters (16 feet) safety distance from equipment. These safety distances for personnel and equipment may not always be feasible under combat conditions. Damage to radio equipment may result if it is within the backblast area. Always inform the supported unit of the noise and backblast safety hazards. (See fig. 2-21.)

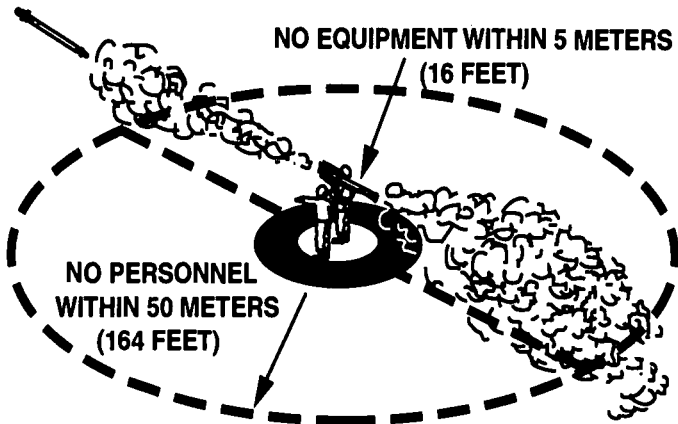


Figure 2-21. Safety Distance.

## SAFETY IN FIRING

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### WARNING

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Permanent deafness will result if personnel are exposed to more than two firings. Proper hearing protection must be worn! Fire only from standing position. Wear ear protectors, helmet, and flack jacket when firing. Personnel within 125 meters (about 400 feet) should also wear ear protectors.

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For shoulder-fired weapons—

- Use the plastic eye shield on the weapon sight.
- Do not fire at an angle greater than 65 degrees. The flying debris caused by the missile backblast presents a hazard to the gunner if this angle is exceeded, or if the launch tube is within 76 centimeters (30 inches) of the ground.
- Super-elevate. By super-elevating, you make use of a built-in, 10-degree angle that compensates for missile drop during the coast phase of the engagement.
- Do not discard a used BCU into dry brush, grass or near flammable materials.

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### WARNING

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BCU case gets extremely hot (+ 400°F) 3 to 5 minutes after activation. Grasp it only by heat-insulated cap when removing it. Do not point top of BCU toward skin, as high-pressure gas may still be escaping. Remove BCU immediately after firing, and do not handle it for at least 30 minutes.

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## **AVENGER GENERAL SAFETY PRECAUTIONS**

These general safety precautions are not all inclusive. Refer to TM 9-1425-433-10 for further guidance.

- Remove all jewelry before working on or operating equipment. Accidental contact with certain components can result in electrocution or severe burns.
- Clear area around fire unit of personnel to allow turret movement; failure to comply may result in injury to personnel.
- When firing missiles, ensure the canopy is closed and latched securely and the HMMWV cab doors and windows closed completely. Missile exhaust contains amounts of hydrogen chloride (HCl) gas, which may cause eye and throat irritation or exposure to potentially harmful concentrations of HCl from the exhaust plume.
- Maintain at least 30 inches between vehicular antenna and personnel. RF energy is present near the antenna during transmission.
- Do not stand on HMMWV cab or have canopy open during transmission.
- Do not step on SVMLs. Failure to comply may result in the missile engagement malfunction due to possible boresight offset.
- Do not step on, kick or apply weight to optical sight boom for any reason; failure to comply may result in damage to equipment or injury to personnel.
- Fasten seat belts within cab and turret when Avenger is in motion.

## Chapter 3

# Employment

Understanding the employment of LAAD assets first requires an understanding of the employment of air defense units as a whole. One of the first issues to address is the identification of the air defense priorities. A major challenge faced by MAGTF commanders is the proper use of the limited number of SAW resources for the protection of critical forces and facilities in the MAGTF area of operations. Two factors that impact directly on this problem are the inability of existing MAGTF SAW to provide adequate air defense protection to every MAGTF asset, and the lack of adequate air defense planning frequently provided to those defenses. Proper planning is a command responsibility that begins with the establishment of air defense priorities based on the MAGTF commander's intent and concept of operations. Air defense priorities must precede the employment of ground-based air defense units in the battlespace.

It is the responsibility of every LAAD gunner to be capable of giving competent advice to supported units and their commanders on the subject of LAAD and its employment.

To effectively employ Stinger, the LAAD section, team, and gunner must consider the air threat, firing team integrity and location, alerting and cueing, and target destruction. These aspects must be considered based on the established ROE, air defense warning conditions, states of alert (SOAs), weapons control status, and fire control orders. Effective return to force (RTF) procedures must be established. Communications provide the means to tie the entire effort together. The LAAD *team* should be evaluated and employed

based on mission, enemy, terrain and weather, troops and support available-time available (METT-T).

## **AIR DEFENSE PRIORITIES**

Air defense priorities are those selected MAGTF assets and areas that must be defended in priority order by supporting air defense systems. To determine these priorities, the MAGTF commander makes an evaluation of his force assets and areas and their need for air defense based on the following factors.

### **Criticality**

Criticality is the degree to which the asset is essential to the force commander's concept of the operation. Assets in decreasing criticality are categorized as those which, if damaged—

- Are capable of preventing the execution of the concept of operations and ultimately accomplishment of the mission.
- Will cause immediate and serious interference with the execution of the concept of operations.
- Can ultimately cause serious interference with the execution of the concept of operations.
- Can cause limited interference with the execution of the concept of operations.

### **Vulnerability**

Vulnerability is the degree to which the asset is susceptible to attack in the battlespace. Consideration should be given to the asset's hardness, its specific mission in the overall operation, the degree to

which it can provide its own air defense, the amount of engineer mobility and survivability support available, and the amount of protection afforded by passive air defense measures.

### **Recuperability**

Recuperability is the degree to which the asset can recover from inflicted damage. It is measured in terms of available manpower and the time and equipment necessary to repair or recoup the asset if it sustains damage from air attack.

### **Threat**

Threat assessment is based on the probability of an asset being targeted for attack by enemy air. Planners must assess this probability if they are to achieve economical allocation of air defense resources. Targeting information provided by intelligence estimates, enemy attack methods used in the past, and current enemy doctrine are all useful in determining which assets require active air defense protection.

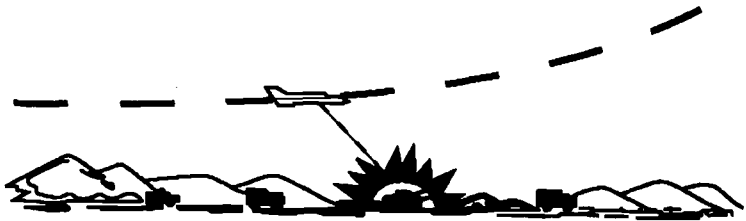
## **AIR THREAT FACING THE MAGTF**

### **Fixed-Wing Attacks**

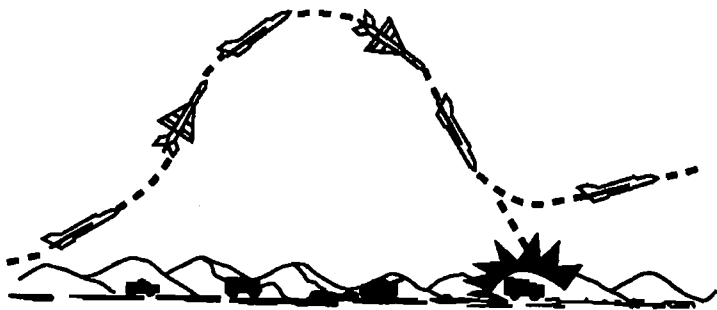
The enemy will likely employ fixed-wing aircraft against our forces. Enemy pilots will try to fly outside of Stinger's engagement envelope or approach their targets at altitudes under 1,000 feet and speeds of at least 450 knots. They will use IR countermeasures, including flares, chaff, and electronic jamming. They will use approach routes that increase background IR sources and minimize visual detection and recognition. They will approach the target from the direction of the sun or using glare off water, ice or snow. They will maximize use of low-level penetration routes that offer good terrain masking.

Due to high approach speeds, enemy pilots normally strike along the longest axis of their targets to give more time to inflict damage. If more than one pass is needed, different approach directions are used.

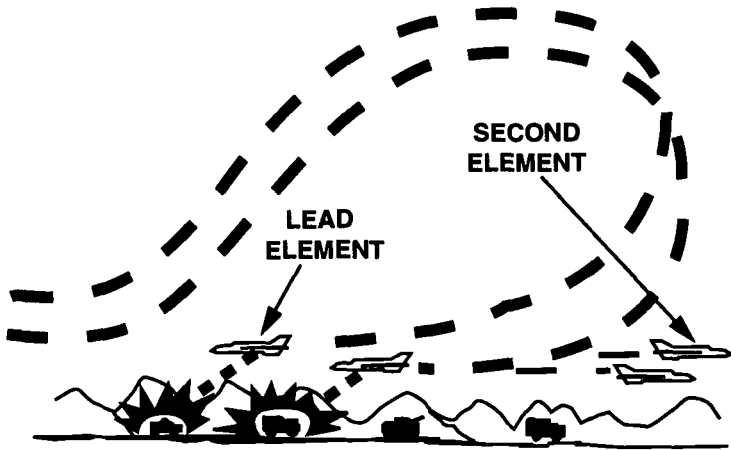
Fixed-wing aircraft use three basic ordnance delivery techniques against ground targets: the level laydown delivery (see fig. 3-1), the dive delivery (from pop-up or from altitude) (see figs. 3-2 and 3-3), and the loft delivery (see fig. 3-4).



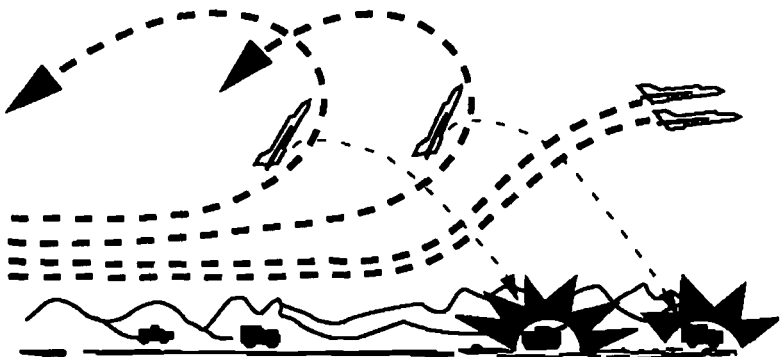
**Figure 3-1. Level Laydown Technique  
(High Speed [450–600 knots], Low Altitude [300 feet]).**



**Figure 3-2. Dive Delivery (Pop-Up Technique).**



**Figure 3-3. Dive Delivery (Altitude Technique)  
(Lead Element Executing Reversing Maneuver).**



**Figure 3-4. Loft Delivery Technique  
(Lead Element Executing Reversing Maneuver).**



## **Helicopter Attacks**

Helicopters pose a major air threat to friendly forces in contact with the enemy. Like our attack helicopters, enemy attack helicopters—

- Strike against preplanned and immediate targets and mechanized forces.
- Conduct armed reconnaissance.
- Provide fire support for ground attacks.
- Reinforce artillery fires.
- Provide rotary-wing close air support.

Although relatively slow, helicopters are very maneuverable and fly at low altitudes, they maximize cover and concealment by using buildings, vegetation, and terrain. Attack helicopters carry conventional ordnance, antitank guided missiles (ATGMs), air-to-surface rockets, machine guns, and nuclear, biological, and chemical (NBC) ordnance.

Using nap-of-the-earth (NOE) and “sneak-and-peek” techniques, attack helicopters can be used against armor and mechanized units using ATGMs from standoff ranges of more than 5,000 meters.

Pilots must expose their aircraft to aim and fire their weapons. For some ATGMs, pilots must also track both the missile and target or lase targets from fixed-wing aircraft throughout the missile’s or bomb’s time of flight (up to 30 seconds), long enough to conduct a Stinger engagement.

### LAAD FIRING TEAM INTEGRITY

A LAAD team is comprised of two Marines, the team leader and assistant gunner. In certain and extreme situations, the LAAD unit commander may choose to split teams into single gunner elements. Splitting a team increases each team member's workload significantly. Aircraft identification and firing decision will be in the hands of a busy gunner instead of a more experienced team leader who is not burdened with physically handling the Stinger weapon. Command and control (C2) is also degraded when teams are split. If teams must operate in this manner, the following "guidelines" are provided:

- Splitting the basic missile load.
- Understanding the current ROE and the correct identification of any aircraft engaged when separated from the team leader.
- Requesting personnel from supported units to assist team members in search and scan duties, communications, missile movement, etc.
- Maintaining communications between team members using voice, signal or wire. Each team member keeps the other informed of any air activity observed. The team leader should have access to the radio and relay C2 information to the gunner.

See Appendix A for information on team mount-out for deployment.

## **LAAD TEAM POSITIONS**

### **Primary Positions**

The team leader selects the best firing position within the area selected by his section leader or platoon commander. This site becomes the team's primary position. Terrain evaluation and orientation precedes selecting a position and is a continuous process. The team leader will make the final decision as to his team's exact location; however, he is also fully responsible for ensuring he can adequately cover his assigned sector of fire. A LAAD MANPAD team position should consist of firing positions for both the team leader and gunner. All team positions consist of a missile destruction pit, fighting hole, and a concealed position for the team vehicle. Alternate firing position(s) will be selected upon arrival at the primary firing position. When the current state of alert and weapons conditions allow, the alternate firing position will be prepared for operations.

### **Alternate Positions**

The Stinger's launch signature (backblast and exhaust trail) can be expected to reveal the team's position during an engagement. After an engagement in a forward area, the team must quickly move to an alternate position. In rear areas where the threat of enemy ground or artillery fire is remote, the need to move quickly to another position is not as great. Alternate positions need not and should not be far from the primary position; a distance between 500 and 1,000 meters is acceptable when tactically feasible. An alternate position should cover the same sector of fire as the primary position. When time permits, access and egress routes must be reconnoitered and selected. Routes between positions should be relatively secure.

### Initial Tasks

The individual experience of each team will vary, however the general guidelines for the tasks to be completed upon arrival at the teams primary position remain the same. It is the team leader's responsibility to ensure the tasks are assigned and completed in a timely manner. The initial tasks are meant to provide the initial focus of effort of the team site preparation and are not the only tasks to be completed. After arrival at the primary team position, the required tasks, procedures, and emplacement priorities are:

- Establish communications with section leader. Provide position information (by grid). Continuously monitor radio.
- Obtain current air defense weapons conditions (ADWCs), SOA, WCS, and all other pertinent information.
- Position two ready rounds at the primary firing site (MANPAD teams). Additional missiles will remain in the vehicle but accessible. The primary firing site should consist of two firing positions separated by 10 to 20 meters. During periods of observation, both positions are not required to be manned. However, having two positions will ensure readiness and safety when confronted with multiple aircraft raids.
- Using a compass, identify the team's sector of fire (after assignment by section leader) and primary target line (PTL); then apply sector stakes or terrain features. Avenger teams, position stern of the vehicle towards the PTL. The team leader will identify the direction of true north in relation to the firing position. The assistant gunner will orient the turret and set the true north reference to correlate with the weapons system. The team leader will construct a range card.

- Conduct a map study and choose an alternate firing site located between 500 and 1,000 meters from the primary firing site. The team leader will contact the section leader and provide this alternate firing site position.
- Begin surveillance, searching, and scanning for enemy aircraft and ground assault, in accordance with current SOA.
- Move the vehicle (MANPAD teams) with remaining missiles and supplies, emplace and camouflage the vehicle's position by taking advantage of natural foliage and terrain, and cover any tracks leading to the position. The vehicle should be at least 50 meters from firing position. Terrain will generally dictate vehicle location.
- Select a remote position 50 meters to the front of the vehicle and within the no-fire permit cutout for the .50 caliber machine for remote operations (Avenger teams). The use of the RCU will allow Avenger crews a larger degree of self-protection against attack while still covering their assigned search sector. If required, the team leader will direct the assistant gunner to set firing limits into the CDT. The fire unit will be camouflaged.
- Dig defensive positions that should be oriented against ground attack, and thus separate from missile firing positions. Missile destruction pit will be dug at least 50 meters from the firing position. The location of this pit should allow for the emplacement and destruction of misfire rounds and not interfere with coverage of the assigned sector and normal team operations.
- Commence team operations in accordance with the current WCS, ADWC, and SOA once all site preparations are completed. However, certain situations may dictate that operations commence prior to site preparations being completed. Camouflage, cover, and concealment are continuous.

[NOTE: There are “no-fire” permits built into the Avenger system to prevent the .50 caliber machine gun from accidental firing into the cab of the vehicle or the remote engagement position during RCU operations. The elevation cutouts are from -10 degrees to +10 degrees and azimuth cutouts are from 270 degrees to 20 degrees. The M3P .50 caliber machine gun will not fire within the cutout area, completely protecting the cab and front areas of the vehicle where the RCU should be placed during remote engagement operations.]

### AIR DEFENSE EMPLOYMENT PRINCIPLES

Ground-based air defense units employ four air defense employment principles. The balanced application of these principles to each tactical situation will enhance the effectiveness of each Stinger unit and increase its survivability. These four principles form the building blocks for the employment of air defense assets.

- **Mass** is the concentration of air defense combat power. The purpose of mass is to establish a favorable ratio of air defense units against threat attack aircraft. Ground-based air defense (GBAD) units employed in mass can place an effective, all-direction volume of fire on attacking aircraft. If GBAD units are not employed in mass, threat aircraft can destroy not only the defended asset but also the defending GBAD units.
- **Mix** is the balance between different GBAD units and/or GBAD units and air defense aircraft. Establishing a mix of air defense assets will offset the limitations of one system with the capabilities of another. Employing the mix principle forces the enemy to use tactics against an array of systems rather than just against a single system. With the divestiture of HAWK, it is increasingly important for LAAD units to mix with joint GBAD units within the area of operation. This will provide the maximum desired

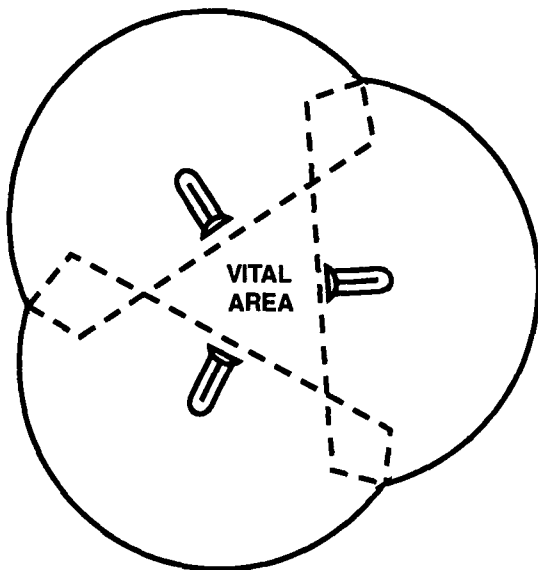
effect of available air defense assets. Mixing air defense weapon systems goes hand-in-hand with massing. If threat planners fail to plan tactics and force structure against a massed and mixed defense, the price of entry into the battle area will be high.

- **Mobility** means the dynamic nature of the battlefield requires GBAD units to be highly mobile. Principles of mass and mix can only be maximized through the effective use of mobility. Properly controlled movement ensures continuous coverage of the defended assets and reduces the enemy's capability to gain precise targeting information on defending GBAD unit locations, thereby improving unit effectiveness and survivability.
- **Integration**, vital to all operations in the air-land battle, occurs between air defense units as well as with the supported unit's ground scheme of maneuver. Integration requires effective C2 links capable of sustained operations in high-intensity NBC and EW environments. An air defense system that is not effectively integrating and maximizing each component's capabilities (including timely sharing of critical information) will be subject to destruction.

## **LAAD EMPLOYMENT GUIDELINES**

When LAAD unit commanders design a defense and select locations for their teams, certain general guidelines are considered. Understanding the how and why GBAD units are employed aids the gunner in understanding the overall mission and the commander's intent. The LAAD employment guidelines used are—

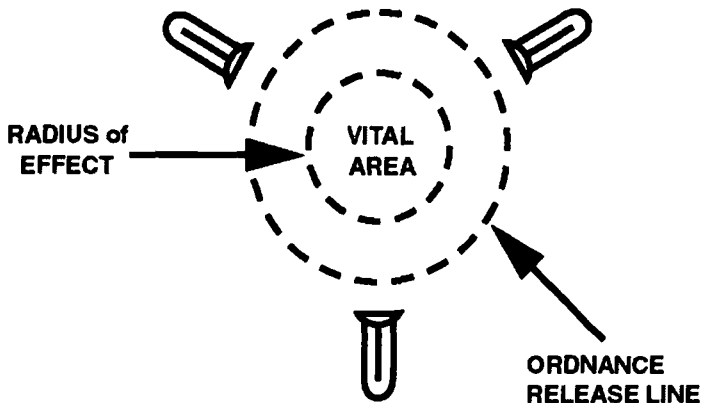
- **Balanced Fires.** Balanced fires (see fig. 3-5) are achieved by positioning LAAD units to permit approximately equal defensive fires in all directions. Balanced fires take on added importance when facing a 360 degree threat.



**Figure 3-5. LAAD Balanced Fires.**

- **Early Engagement.** LAAD teams should be positioned far enough out from the asset or unit being defended to permit the engagement of enemy aircraft before ordnance release (see fig. 3-6). The enemy's ordnance release line (ORL) will vary with the type of aircraft and ordnance employed. For planning purposes, 1.5 kilometers is the minimum ORL figure to use for low-altitude, pop-up attacks. In some cases, ordnance may be released in excess of 20 kilometers from the target. When developing air defense plans, actual threat tactics, flight profiles, and ordnance capabilities must be considered. Using unit internal assets to analyze threat capabilities will aid in determining employment.





**Figure 3-6. LAAD Early Engagement.**

- **Weighted Coverage.** Weighted coverage is achieved by concentrating teams toward known enemy locations, unprotected unit boundaries or likely enemy avenues of approach (see fig. 3-7).
- **Mutual Support.** Mutual support results from positioning individual assets so they deliver fires into dead zones that surround adjacent assets. Mutual support (see fig. 3-8) enhances defensive survivability. The required maximum distance between air defense units and assets to achieve mutual support varies depending on the type of air defense weapon and the speed and altitude of the threat.
- **Defense in Depth.** Defense in depth (see fig. 3-9 on page 3-16) is achieved by positioning air defense assets so that enemy aircraft encounter an ever-increasing volume of fire as they approach a defended asset or area. Integrating all air defense weapons used in the defense maximizes defense in depth.

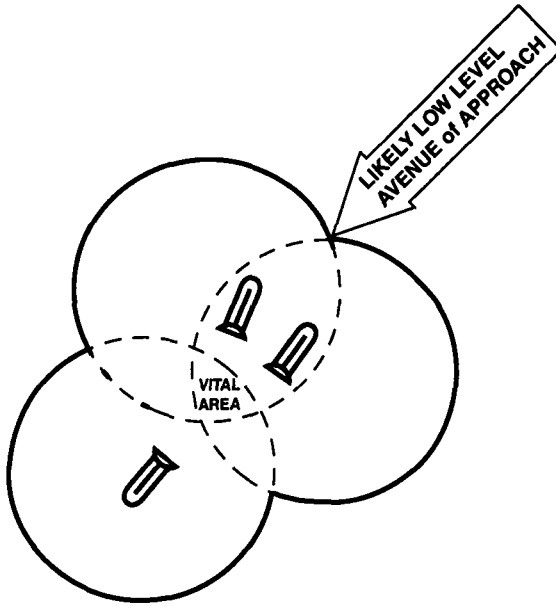


Figure 3-7. LAAD Weighted Coverage.

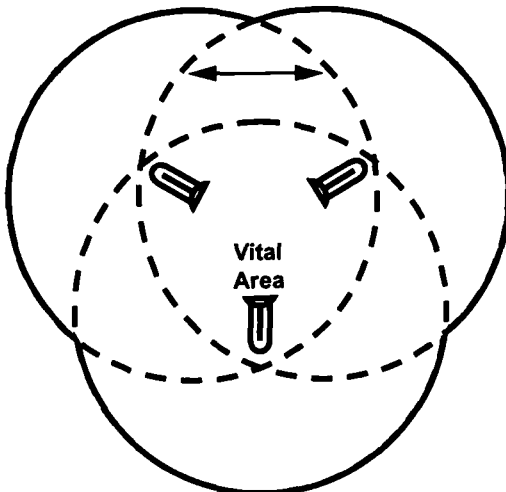
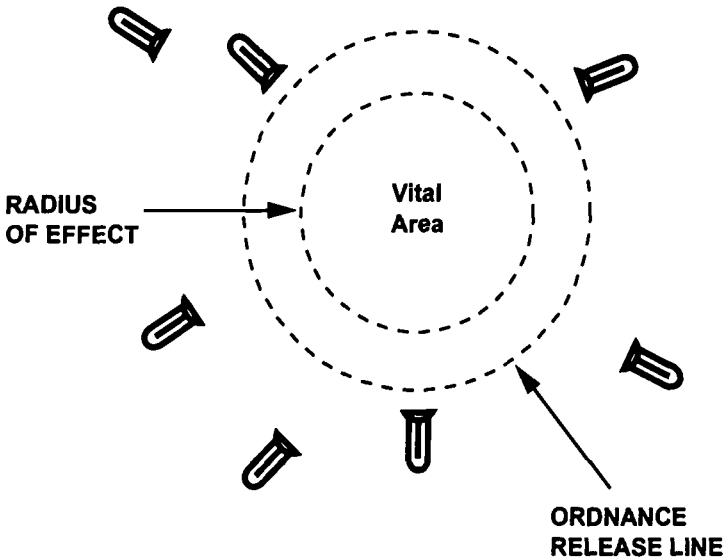


Figure 3-8. LAAD Mutual Support.

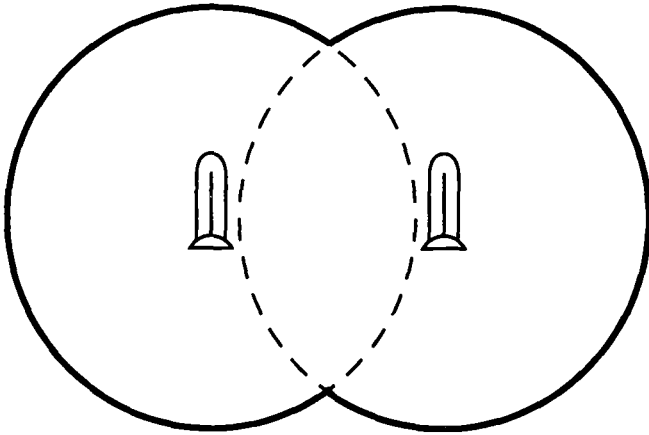


**Figure 3-9. LAAD Defense in Depth.**

- **Overlapping Fires.** Overlapping fires occur when individual air defense units' engagement zones overlap. Overlapping fires reduce the possibility of enemy aircraft slipping through the MAGTF's air defense without being engaged by at least one air defense unit (see fig. 3-10).

## **CONSIDERATIONS FOR LAAD TEAM POSITIONS**

Mission accomplishment is the prime consideration in site selection. When a choice of sites is available, cover, concealment, and camouflage are considered in tandem with LAAD employment guidelines (see figs. 3-5 through 3-10). Particular attention is given to unobstructed fields of fire, masking clearance, and backblast area.



**Figure 3-10. LAAD Overlapping Fires.**

Terrain features that present a masking problem for Stinger employment are evaluated for height, distance, and direction from the firing positions. The firing positions should offer good line-of-sight communications with the section leader. If the team cannot communicate from its position, the position is unsatisfactory.

### **Observation and Fields of Fire**

Optimally, a team's firing position should be selected to provide members with all-around visibility and allow them to fire the Stinger in any direction. The firing position must allow coverage of the team's assigned sector to allow earliest detection of low-flying aircraft, permitting engagement at the Stinger's maximum range. Firing positions should minimize masking effects of vegetation and terrain and maximize cover and concealment for team members and their equipment. The team may have to use separate, but closely linked positions for observation and firing.

## **Accessibility**

If time permits, routes into and out of these positions must be reconnoitered and selected. The routes should afford cover between positions. The advantages and disadvantages of each available position must be weighed. The firing positions (both primary and alternate) should provide ready access to the vehicle (normally a HMMWV) to allow mobility, survivability, and rapid displacement. The ultimate determining factor is how well the team can perform its mission.

## **Security from Ground Attack**

LAAD teams depend upon the supported unit for defense against ground attack. This generally requires that LAAD teams be positioned within, or very near, the supported unit's perimeter. Positioning LAAD teams too close to the supported unit can degrade their effectiveness. Stinger's launch signature can compromise the supported unit's location if LAAD teams are positioned too closely. A balance must be made between local security and mission capability.

## **Safety Requirements**

The LAAD gunner must stand in the open to fire the Stinger. The selected firing position should be clear of dry brush and other materials that may ignite when the weapon is fired. Backblast and hearing hazards to personnel exist whenever a Stinger is fired.

## **ALERTING AND CUEING**

Due to Stinger system reaction time and limited weapon firing envelope, LAAD units need the earliest possible notice (alerting) of potential air threats in their area. Providing LAAD units with specific threat location information (cueing) allows them to engage enemy aircraft as soon as they become visible in their areas. LAAD unit

leaders will extract threat information from all available sources. Integrating into accessible GBDLs or co-locating with other MACCS agencies, such as the Marine Air Control Squadron or an Air Traffic Control Detachment, will enhance alert and cueing capability. This approach will maximize dissemination of threat information over all available LAAD nets and optimize LAAD weapons employment. Proper employment of the TDAR enhances the ability of LAAD section leaders to provide their teams with organic alerting and cueing information, relieving them from total dependence on other MACCS agencies and visual airsearch.

The TDAR is especially useful during independent operations when no other MACCS radar are available. To successfully destroy an enemy aircraft, the LAAD team must effectively detect, identify, and engage the target.

LAAD teams receive GBDLs from radar-equipped units of the MACCS. The air picture developed by the radar is shared among air defense units through a network of data links. (For configuration and setup procedures, refer to TM 10296A-10/1.) Current MACCS radars capable of GBDL are—

- AN/TPS-59 (MACS).
- AN/MPQ-62 CWAR (MACS).
- AN/TPS-63 (MACS).
- AN/TPS-73 (Marine air traffic control [MATC]).
- AN/UPS-3 TDAR (Organic to LAAD).
- Other external GBDL sources.

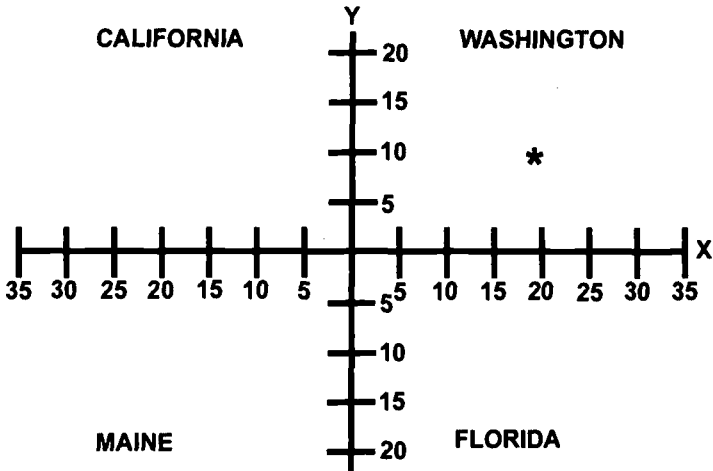
Information is extracted from available radar sources and transmitted to GBAD units by means of HF, VHF, ultrahigh frequency (UHF) or multichannel radio (MUX) communications nets. Currently, the AN/UPS-3 TDAR and AN/MPQ-62 CWAR interface with the RTU through the sensor interface box (SIB), however all other radar sources organic to the MACCS require the tactical interface module to field wire box (TIB). In addition to ground-based radar systems, limited U.S. Naval vessels of the LHA and LHD class have been retrofitted with required equipment to convert TADIL A data into GBDL for broadcast over VHF radio nets to GBAD phased ashore during amphibious operations.

For transmitting receiving stations of ground-based data, the Baud rate is set at 2,400 bits per second (bps). To minimize directional finding (DF) tactics the enemy may employ, LAAD elements forward deployed on a battlefield and transmitting GBDL should establish and maintain frequency hop nets to aid in countering DF threats.

For LAAD assets to coordinate surveillance and early warning, manual cross tell of air tracks must be established with the MACCS agencies. The three most common reference systems used for manual cross tell procedures are: Cartesian coordinate grid reference system, polar coordinate system, and polar grid system.

### **Cartesian Coordinate Grid**

The Cartesian coordinate grid reference system is a manual cross tell system that uses four quadrants delineated by an X and a Y axes (see fig. 3-11). The X-Y axes can either be oriented to true north, grid north, or magnetic north. The center of the grid, known as the Cartesian coordinate reference point or a KRP, is normally a geographic point that is compatible to all participating agencies. The reference point can be a common geographic point, a mountaintop or the location of the TAOC. Each rectangular quadrant of the grid system is assigned a name or is color coded so that the plot (target



**Figure 3-11. Cartesian Grid Reference System.**

or track) can be reported rapidly to other units. For ease of depiction, the X-Y axes lines are normally marked in increments of 5 kilometers, 5 nautical miles or 5 statute miles, but any common system of measurement could be used. Although the grid is commonly marked in increments of five, it is the responsibility of the individual reporting the track to extrapolate the target's location to the nearest single measurement. Track information is prepared for transmission by reading—

- Northwest quadrant (left and up)
- Southwest quadrant (left and down)
- Northeast quadrant (right and up)
- Southeast quadrant (right and down).

Figure 3-11 illustrates an aircraft or contact at Washington (20-10). For cueing purposes, the distance between hash marks should be estimated to the nearest single digit increment.

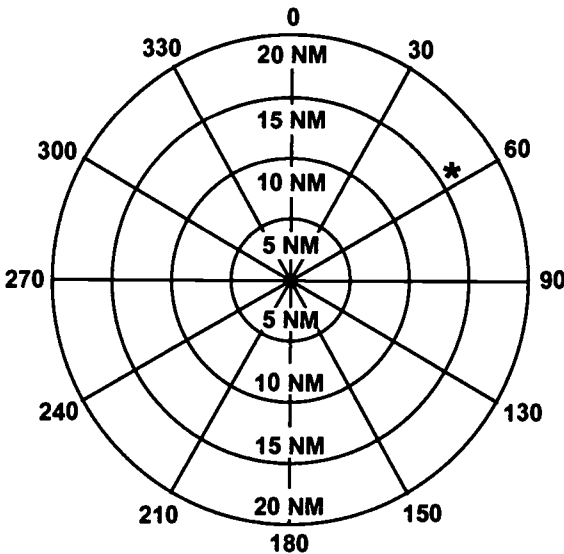


**WARNING**

Red, yellow, and white should not be used as quadrant reference colors. Air defense warning conditions are identified by these colors, and each has a specific meaning to an air defender. The use of these colors for both the ADWC and Cartesian quadrant reference may cause unnecessary confusion.

**Polar Coordinate Reference**

The polar coordinate system is a circular coordinate system that uses a known location from a KRP. Tracks are reported from the KRP at the center of grid map using only radials (magnetic degrees) and miles. The reference point can be a geographical point or a unit location such as the TAOC, as long as it is compatible to all participating agencies. The circular distances from the KRP can be in nau-



**Figure 3-12. Polar Coordinate Reference System.**

tical miles, kilometers or any other common system of measurement. Figure 3-12 shows a contact at approximately 60 degrees and 15 nautical miles from the KRP.

When using the polar coordinate system, the gunner must consider the information received in relation to the KRP. The cueing a gunner receives on an aircraft will usually be at a different azimuth and range than that of the team's actual position, unless the team is located at the known reference point.

### Polar Grid

The polar grid system is a circular coordinate system that uses magnetic bearing (in degrees) and distances (in nautical miles or kilometers) from a specified reference point. The polar grid system (see fig. 3-13) uses an easily recognizable feature (a tactical air naviga-

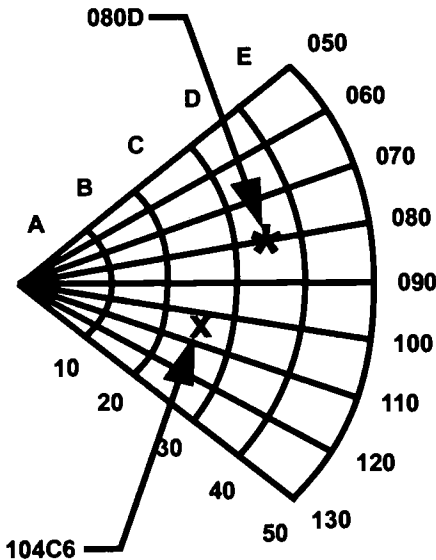


Figure 3-13. Polar Grid Reference System.

tion marker or other location specified in the air tasking order's special instructions) as its center and is aligned to magnetic north. The polar grid system is composed of 10-degree radials, which originate from the grid's center and are further divided into 10 nautical mile range bands. Each 10 nautical mile range band is given an alphabetic designator, beginning with "A" from the origin. Broad brush references can be made using only the radial (to the nearest 10 degrees) and the range band (to the nearest 10 nautical miles). More precise cross tell can be accomplished using the exact radial (to the nearest degree), the range band alphabetic, and the exact number of nautical miles within that range band.

An unknown aircraft detected in the vicinity of the \* in fig. 3-13 could be reported as "one bogey, 080D, heading west." As a precise reference example, two hostile aircraft detected at the X would be reported as "two bandits, 104C6, heading west." This report is derived from the exact magnetic radial (104 degrees) and the range (26 nautical miles) from the grid's origin, that places the hostile aircraft at 6 nautical miles into the C band of the grid.

## **VISUAL DETECTION OF THE TARGET**

The first step in the destruction of an enemy aircraft by Stinger is visual detection of the target by either member of the team. A LAAD team may be warned of approaching aircraft over one of the LAAD nets. The LAAD team can narrow its search sector to the general direction of approaching aircraft after receiving the warning. Terrain masking, aircraft characteristics, meteorological conditions, visual acuity, and search sector affect aircraft detection range.

### **Terrain Masking**

Terrain will influence the distance at which low altitude aircraft will unmask, i.e., not be hidden behind a hill or other feature.

### **Aircraft Characteristics**

An aircraft's size, color, speed, altitude, and tell-tale signature affect detection range.

#### **Size**

The larger the target, the farther away it can be detected. Apparent aircraft size varies with aircraft type and the aspect from which it is viewed. A fighter flying a course directly toward an observer shows a small profile and can get close to the observer before detection. The same aircraft on a crossing course has a much larger profile and can be detected at a greater range.

#### **Color**

An aircraft's color affects the degree that aircraft contrast with the background. Some jet aircraft have a smoke trail that aids in detection at long ranges.

#### **Speed**

Aircraft speed affects visual detection of aircraft. Detection range decreases as target speed increases.

#### **Altitude**

Aircraft flying at 150 to 1,200 feet (46 to 366 meters) above the ground are detected at longer ranges than those flying over 1,200 feet or below 150 feet.

#### **Tell-Tale Signatures**

Many aircraft have tell-tale signatures that can lead to early detection. LAAD teams should look for—

- Sun reflection from aircraft canopies or cockpit windows.
- Blade flash from rotating helicopter blades.

- Smoke or vapor trails from jet aircraft and missiles or rockets fired from aircraft.
- Dust or excessive movement of treetops and bushes in a particular area.
- Noise from helicopter blades or from jets breaking the sound barrier.

### **Meteorological Conditions**

Rain, snow, dust, fog, smoke, heat shimmer, and haze reduce visibility and the visual detection range of aircraft.

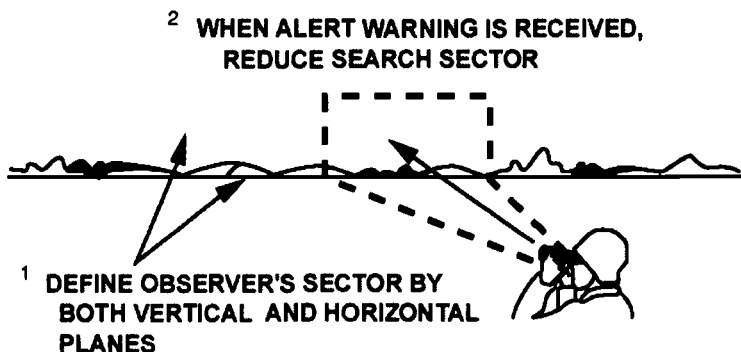
### **Visual Acuity**

Observers must detect, recognize, and identify small objects at long ranges. They must have good eyesight and should rest their eyes periodically (about every 15 minutes) to prevent fatigue and maintain alertness. Visual detection is first performed by the team leader with the naked eye utilizing various search patterns. Once detection of possible air threat is achieved, binoculars may be utilized to assist the team leader in earliest possible identification of the aircraft. This method reduces the time required to search a given area of space.

### **Search Sector**

Search sectors should be as small as possible while having good coverage to both sides of the expected avenues of target approach. The ability to detect aircraft increases as the size of the search sector assigned decreases. The observer may be assigned a large sector for general surveillance if an alert warning system is supporting the observer. After receiving a warning, the search sector is narrowed and centered on the aircraft's approach azimuth. Decreasing the sector size to less than 30 degrees is not advisable because the alert

warning system azimuth data may not be accurate. The search sector is defined in both horizontal and vertical planes (see fig. 3-14). Horizontal scanning and vertical scanning are the two systematic search methods.



**Figure 3-14. Sector Search.**

### **Horizontal Scanning**

The observer searches the horizon to about 20 degrees (356 mils) above the horizon by moving his eyes in short movements across the sky, working his way up and across. The observer continues the scan pattern to below the horizon to detect aircraft flying nap-of-the-earth (NOE). (See fig. 3-15 on page 3-28.)

Using the hand is a simple way to estimate how high above the horizon to search. Facing the PTL, the left or right arm and the fingers are fully extended. The tips of the thumb and little finger should form a line perpendicular to the ground. When the little finger is touching the horizon, the tip of the thumb is approximately 20 degrees above the horizon. (See fig. 3-16 on page 3-28.)

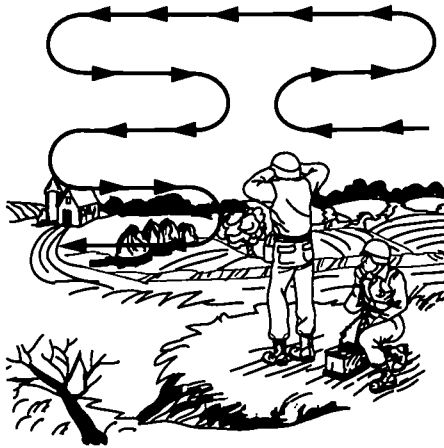


Figure 3-15. Horizontal Scanning.

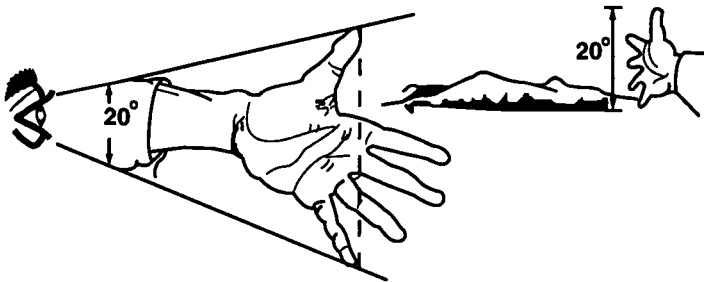
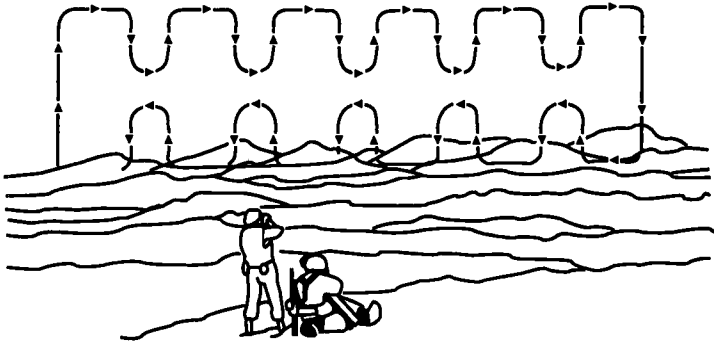


Figure 3-16. Estimating 20 Degrees.

### Vertical Scanning

The observer searches the sky using the horizon as a starting point and prominent terrain features as points of references. He moves his eyes in short movements up the sky, then back down, continuing

this movement across the terrain. He scans in the same pattern below the horizon to detect aircraft flying NOE (see fig. 3-17).



**Figure 3-17. Vertical Scanning.**

## **Nonsystematic Search Methods**

Observers with more experience and above average visual efficiency may use nonsystematic search methods, such as a combination of the two systematic methods, search of the horizon in an oval shape to about 20 degrees above the horizon, and general and/or random search of the horizon.

## **Scanning Tips**

The observer should frequently focus his eyes on a distant object such as a cloud or terrain feature to avoid eye relaxation and blurring of distant objects. The observer should squint his eyes if he has trouble focusing at long ranges to make distant objects come into focus. The area near the sun is searched by extending arm and hand as if to block out the sun's glare. Looking into the sun without shielding the eyes will cause blindness for a few seconds. The observer should keep his eyes on the aircraft once he sees it. If he has to look away, he should note the direction of the aircraft and



move his eyes away from it when the aircraft is near some object, such as a cloud or a terrain feature, that will guide his eyes back to it. Each team member should take turns searching for targets.

## **Where to Search**

A map reconnaissance of the supported unit's direction of movement or area of operation helps to pinpoint areas from which aircraft are most likely to attack the unit. Far sides of woodlines, ridgelines, and significant folds in the terrain are marked out to at least 3,000 to 5,000 meters (maximum range of attack helicopters' ATGMs). Restricting terrain (defiles and narrow valleys) are marked where the unit may be forced to pinch together, becoming lucrative targets for air attack. When accompanying maneuver units in contact with or moving to contact with the enemy, the team usually concentrates its search for aircraft in the general direction of the enemy ground forces and occasionally searches the entire horizon. The team leader marks the route of advance and monitors the radio for warnings of approaching aircraft.

## **Aircraft Interrogation Techniques**

The weapon system is aimed at the target and centered on the aircraft in the range ring (MANPAD) or centered in fixed reticle of FLIR monitor WFOV (Avenger). As soon as the target is in the range ring or fixed reticle, the challenge switch is pressed. The IFF operation is completely automatic after triggering.

## **Aircraft Identification**

Normally, the team leader is responsible for target identification. Identification must be completed before the team leader issues a command to engage. When operating as a split (MANPAD) team or if the team leader becomes a casualty, the gunner must assume identification responsibilities. After an aircraft has been detected, it

must be identified as friendly, hostile or unknown. Time for identification is limited. Identifying a fast-moving jet aircraft must be completed within approximately 5 to 15 seconds.

## **ENGAGEMENT PROCESS**

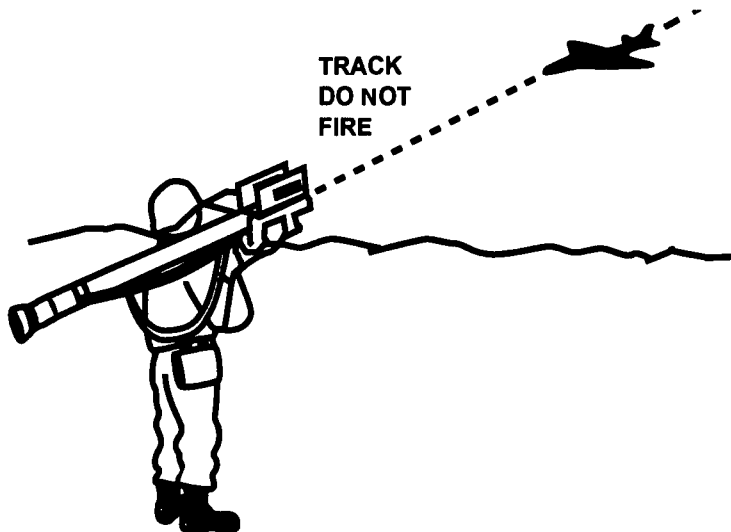
### **Decision**

When the team leader or gunner identifies a target as hostile or (under certain conditions) as unknown, and all other engagement requirements are met, the team leader makes the engagement decision. LAAD operational reports are required for all exercises, and standard formats for these reports are provided in appendix B.

The team leader makes the decision based on the current ROE and criteria received by the section leader. The team leader is also responsible for selecting the method of engagement and the specific target to be engaged. If the gunner is alone (MANPAD), he engages the most threatening target first. The situations illustrated in figs. 3-18 through 3-21 on pages 3-32 through 3-35 show how a LAAD team leader uses his ROE to reach an engagement decision.

### **Techniques of Fire**

Use of proper Stinger firing techniques are necessary to successfully engage aircraft. These techniques are applied relative to the aircraft's direction, threat, and range.



An aircraft approaches my position very fast and very low. The section leader announces a WCS of "WEAPONS TIGHT." I acquire the aircraft but can not visually identify it and decide to interrogate. I challenge and receive an unknown IFF response (BEEEP, BEEEP, BEEEP, BEEEP----).

**ACTION TAKEN**

I cannot engage the aircraft because it does not positively identify as hostile. I do not ignore it, but continue tracking the aircraft.

**REASON**

WEAPONS TIGHT requires that I make positive hostile identification before engaging. As the aircraft comes closer, I positively identify it as a MIG-23. It bears an enemy national insignia.

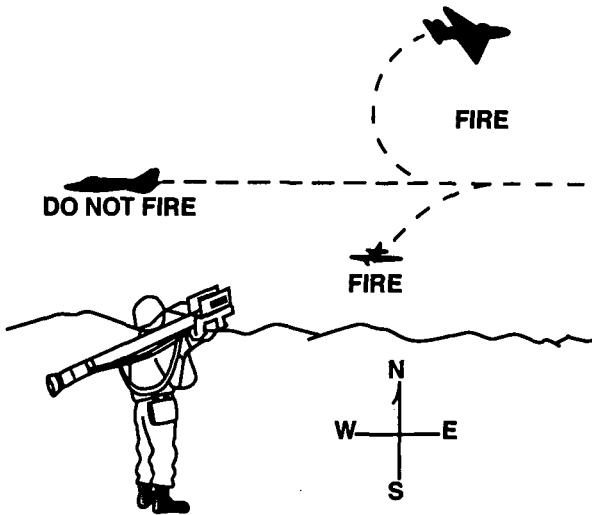
**ACTION TAKEN**

Engage.

**REASON**

I have positively identified the aircraft as hostile.

**Figure 3-18. Situation 1.**



At 1230, I receive a message from my section leader. He states, the current weapons condition is "WEAPONS HOLD on all jet aircraft flying westbound between 1300 and 1330. WEAPONS TIGHT for all other aircraft." At 1315, a jet aircraft I recognize as hostile approaches westbound. It is coming within range of my weapon.

**ACTION TAKEN**

I do not engage but continue to observe. I track the aircraft and wait to engage. I report the incident to my section leader. If the aircraft changes its heading so that it is no longer westbound, I will engage.

**REASON**

Under WEAPONS HOLD, I can not engage except in self-defense. If the aircraft changes its heading, I am then under WEAPONS TIGHT. Since I've already positively identified the aircraft as hostile, I can then engage. The aircraft continues on the same heading and fires two tactical air-to-surface missiles at the unit I am supporting.

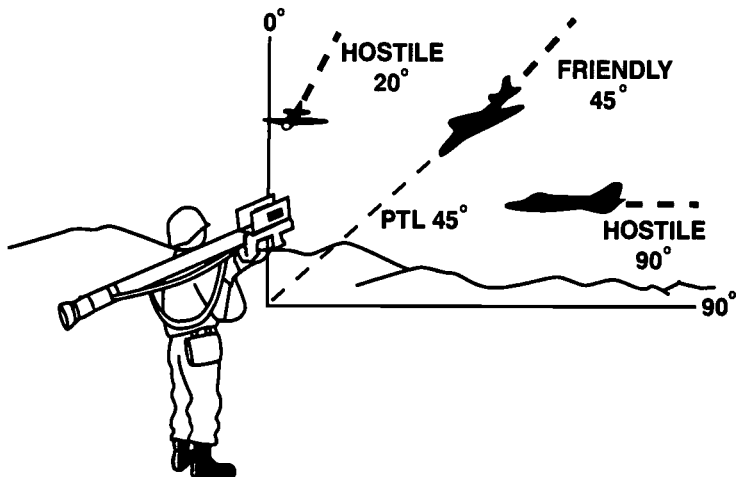
**ACTION TAKEN**

Engage.

**REASON**

I have the right to engage any aircraft in self-defense. This rule applies not only to an attack on my position, but to the unit I am supporting as well.

**Figure 3-19. Situation 2.**



At 1400 my section leader orders me to go to a new position to become part of a four team defense of a supply depot. Upon arrival, he assigns me a primary search sector of 0 degrees to 90 degrees and a primary target line at 45 degrees. The WCS is WEAPONS TIGHT. Three aircraft approach, one at 90 degrees, one at 45 degrees, and one at 20 degrees. All three are at the same range and appear to be moving at the same speed. I visually identify the aircraft at 45 degrees as friendly. I visually identify the aircraft at 20 degrees as hostile. I then turn my attention to the aircraft at 90 degrees. I also visually identify this aircraft as hostile.

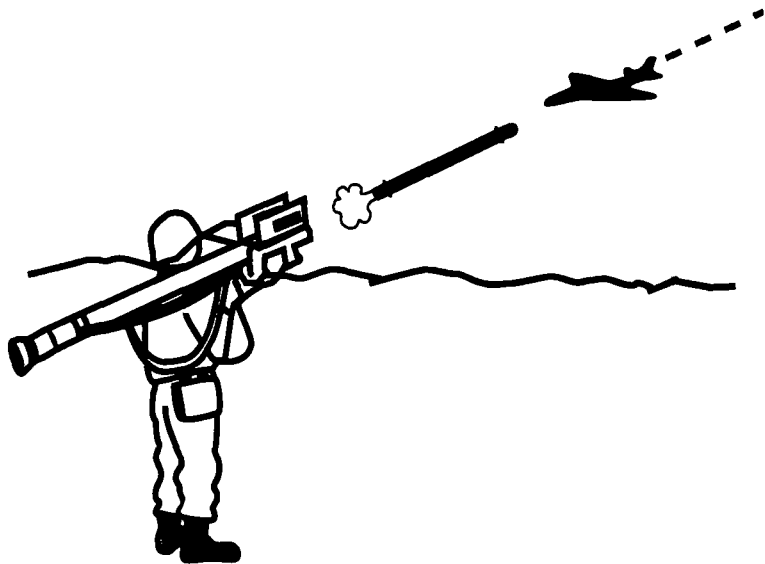
#### **ACTION TAKEN**

I engage the aircraft at 90 degrees. My assistant gunner picks up a second weapon round and engages the second hostile aircraft at 20 degrees.

#### **REASON**

Since all three aircraft are at the same range and speed, they present an equal threat to the defended asset. The aircraft at 45 degrees is on my PTL and is, therefore, the first aircraft I must look at. Since I positively identify it as friendly and there are other aircraft in the area, I ignore it and look at the second aircraft within my primary search sector and next closest to my PTL. I identify it as hostile. I then look at the third aircraft and identify it as hostile. Since this is a multiple aircraft raid, I engage the aircraft on the right. My assistant gunner picks up a second weapon round and engages the aircraft on the left at 20 degrees.

**Figure 3-20. Situation 3.**



I receive a message from my section leader changing the WCS to WEAPONS FREE. A jet aircraft approaches my position at a low altitude and high speed. I challenge the aircraft on detection and receive an unknown audible signal.

#### **ACTION TAKEN**

I continue my attempts to visually identify the aircraft while going through the engagement sequence, then I engage.

#### **REASON**

I was authorized to engage because WEAPONS FREE means I should engage all aircraft not positively identified as friendly. This, coupled with the fact that an unknown audible signal to our IFF challenge was received, and I was unable to positively identify the aircraft as friendly, provided sufficient grounds to launch under WEAPONS FREE. Had there been other aircraft in the area, the engagement sequence on the first aircraft would have continued while the assistant gunner directed his attention at the other aircraft and engaged if necessary. If he had identified the aircraft as friendly prior to launch, he would have called out "HOLD FIRE."

**Figure 3-21. Situation 4.**

**Aircraft Direction (MANPAD)**

Once the aircraft is detected, the weapon is sighted so the aircraft's image is aligned in the range ring of the weapon sight. Tracking the aircraft in the proper stance helps the gunner determine whether the aircraft is incoming, outgoing or crossing. The gunner assumes a proper stance by stepping directly toward the target with his left foot and leaning toward the target. If the gunner has any horizontal movement of his arms or upper body as he tracks the target, the target is considered crossing. If there is a lack of any substantial horizontal movement, the target should be considered incoming and/or outgoing. Also indicative of an incoming and/or outgoing aircraft is any vertical movement of the gunner's arms or upper body. Determination of crossover, i.e., the closest point the aircraft gets to the gunner, is important for applying aspect or activate decisions. Target size (getting larger or smaller) can assist the gunner in determining crossover or incoming and/or outgoing status.

**Aircraft Threat**

Upon detection, the team leader must immediately decide if the aircraft is a potential threat. If the aircraft's direction of flight indicates that it will penetrate the defended area, the gunner issues an IFF challenge. If the aircraft fails to respond correctly to the IFF challenge, it is considered a potential threat. The gunner may then activate his weapon.

**Aircraft Range**

The LAAD gunner must evaluate the target and determine if the target is within the Stinger missile's range. The type of aircraft (jet or propeller driven) and the flight path (incoming, crossing or outgoing) will determine what rule to follow while making the launch decision. By applying the correct rule for the type and flight path of the aircraft, the gunner can be assured that he will fire within the

effective range of the missile and withhold fire on targets out of his launch boundaries.

### Incoming and/or Outgoing Jet Aircraft

For incoming and/or outgoing jet aircraft, the launch and hold fire decision for MANPAD teams is based on a range ring measurement. The gunner moves the weapon so that the aircraft's image is within the range ring of the sight. He then evaluates the size of the aircraft image relative to the width of the range ring.

For example, if the aircraft's width within the range ring is approximately one-half the size of the range ring, then the aircraft is at one-half range ring. A helpful hint in estimating aircraft size within the range ring is to place the aircraft at the inner left (or right) edge of the range ring before making a size estimate.

The gap at the bottom of the range ring is also used to measure range ring size. This gap measures one-fifth the size of the range ring. When an aircraft fills this gap, it is at one-fifth range ring (see fig. 3-22). To determine when to activate, hold fire or launch the missile at an incoming or outgoing jet, the gunner tracks the jet and makes continuous size estimates. When the jet reaches a specified range ring size, it is considered to be within range of the missile. This is the earliest point at which the gunner may launch.

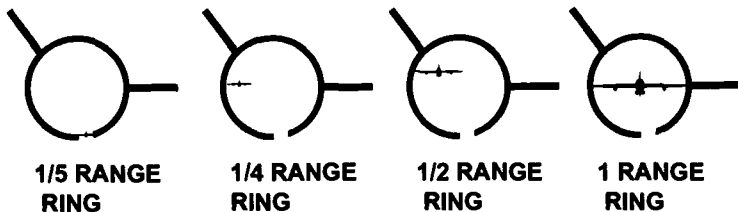


Figure 3-22. Incoming and/or Outgoing Jet Aircraft.



He is also given a second range ring measurement to indicate when he is to hold fire; a third for resume fire; and a fourth for cease fire. The range ring measurements used in determining when to launch are classified and are contained in Army Field Manual (FM) 44-1A, *U.S. Army Air Defense Artillery Operational Planning Data*.

There are two ranging capabilities on the Avenger, the LRF and manual range estimation. When the LRF is fired at a target, the gunner receives the range reading on the CDT display. With a 10 kilometer range, the LRF is the preferred method of determining range with the Stinger missile, since the missile range is well within the range of the laser. During an engagement, and when a missile is uncaged, the laser is continuously ranging the target. The ACE computer will determine the target is in range and a "fire permit" symbol will appear on the FLIR monitor and ODU. In cases where the fire permit symbology does not appear, gunners must determine if the range reading on the CDT is accurate and consistent with the type of aircraft being engaged. The ultimate firing decision remains with the team leader.

Manual range estimation is accomplished by acquiring the aircraft in the FLIR monitor or ODU fixed reticle and then determining the type of aircraft, fixed- or rotary-wing, and its aspect (incoming, crossing, outgoing). The aircraft's width in milliradians (mrads) is found using the FLIR monitor or ODU and centering the aircraft in the fixed reticle in either WFOV or NFOV (see fig. 3-23).

Once the target is acquired, the gunner selects the FOV the aircraft will fit into to determine the size of the aircraft in mrads. Table 3-1 lists range estimation procedures to identify when an aircraft is in missile range and may be fired upon in accordance with the determined size.

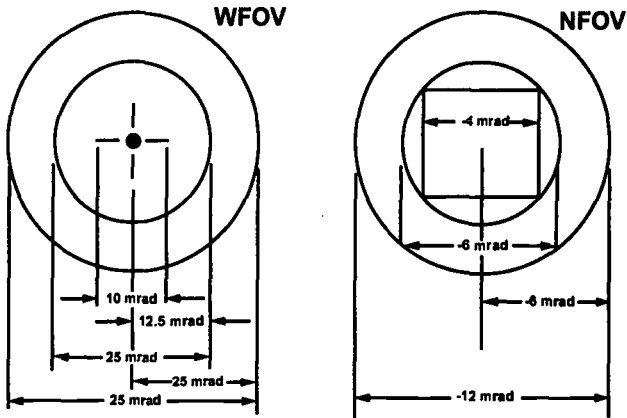


Figure 3-23. FLIR Milliradians—Size Symbology.

Table 3-1. Aircraft in Missile Range.

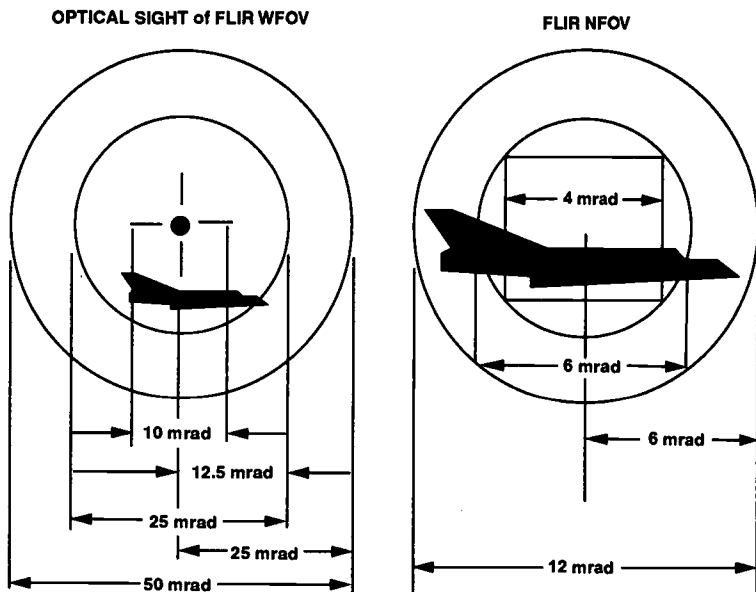
Aircraft Type	Incoming Size (mrads)	Crossing Size (mrads)	Outgoing Size (mrads)
Fixed-Wing	1.5	5	6
Rotary-Wing	0.5	3	0.5

The target is within range of the selected weapon system if an aircraft falls into one of the categories and meets the size parameters or is larger than the minimum size requirement given (Table 3-2).

Table 3-2. Aircraft in Machine Gun Range.

Aircraft Type	Incoming Size (mrads)	Crossing Size (mrads)	Outgoing Size (mrads)
Fixed-Wing	6	16	23.5
Rotary- Wing	1.5	15	3.5

The estimation rule in fig. 3-24 is applied as if it were the range ring profile on an open sight assembly. The size of the target in relation to the FLIR monitors symbology is ultimately determined by the FOV selected by the gunner and the actual size of the aircraft. The gunner's proficiency in aircraft identification (ACID) and knowledge of aircraft sizes will greatly enhance the range estimation process. The ranging procedures are only used when the LRF is disabled or not functioning.



**Figure 3-24. Missile Range Estimation Example.**

**Crossing Jet Aircraft**

For crossing jets, MANPAD team's launch decision is based on a time count rule. HOLD FIRE is based on a range ring measurement.

The gunner positions the weapon sight slightly forward of a crossing jet's image and holds the weapon stationary. When the jet's nose reaches a fixed point within the sight, the gunner counts off in seconds, "one thousand one, one thousand two . . .," as he watches the jet travel horizontally to another fixed point within the sight.

If the jet's nose reaches the second fixed point before or at the correct time, then the jet is within the MANPAD team's missile's range. The gunner can either activate or launch the missile, depending on the engagement stage. If the jet takes longer than the specified time to travel between points, it is beyond the missile's range and the gunner must not fire. (See fig. 3-25.) Refer to FM 44-1A for actual fixed points and number of seconds (time count rule) or size used to determine when to activate, hold fire or launch.

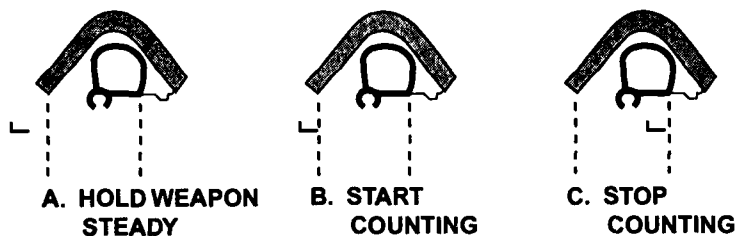


Figure 3-25. Crossing Jet Aircraft.

### Propeller Aircraft

For propeller aircraft (including helicopters), no time count or range ring measurements are used. The MANPAD gunner can launch the missile as soon as weapon activation, positive hostile ID, and IR acquisition lock-on.

### Launch Rules

For jet aircraft *only* (both incoming and outgoing), launch is made when the jet's image is the proper size within the range ring. The

same rules apply for crossing aircraft. Launch is made if the jet meets the time count criteria. For all other aircraft (propeller), launch is made when a positive hostile ID and IR acquisition lock-on are obtained. HOLD FIRE on all targets when the inner launch boundary dictates.

## **Methods of Engagement**

The number of enemy aircraft in a raid determines target engagement methods used by a LAAD team. Two or more aircraft flying the same course, at the same speed, less than 1,000 meters apart conduct multiple target raids. All other raids are single target raids.

### **Single Target Raids**

All single target raids are engaged using a SHOOT-LOOK-SHOOT method. The first missile is fired (SHOOT) as soon as engagement requirements are met. Next, the missile's success is evaluated (LOOK). If the first missile does not hit the target or does not achieve guided flight, a second missile is fired (SHOOT). After firing the first missile, the gunner immediately readies another weapon, regains visual track, and acquires the IR tone of the target. The gunner does not watch the missile's flight. The team leader observes the missile's flight, makes the kill evaluation and, if time permits, directs the gunner to launch another missile. Under certain circumstances, the team leader may launch a missile himself.

### **Multiple Target Raids**

Multiple target raids are engaged using a SHOOT-NEW TARGET-SHOOT method. As many missiles as possible are launched at successive aircraft in the raid. When practical, fire coordination within a team will be on voice command of the team leader. When faced with multiple targets of equal threat, both team members will engage targets. The team leader should direct the gunner to fire at the lead hostile target in the sector of fire. The team leader engages

the trailing hostile target. When deployed in an Avenger, the team leader will direct the gunner to engage subsequent targets.

### **Engagement Sequence**

The engagement sequence outlines a basic sequence of events in the order that they usually occur for a MANPAD team; however, it is not rigid. For example, determining aircraft type (jet or propeller driven) and identification may take place at any time before launch. After the aircraft has been detected and identified, the appropriate technique of fire should be applied based on aircraft type. Certain actions, such as tracking and determining whether aircraft is incoming or crossing, are done throughout the engagement sequence.

### **Shoulder the Weapon**

The gunner shoulders his weapon, folds the antenna, removes the front cover, raises the sight, and connects the IFF cable. He then moves the weapon so that the aircraft's image is placed within the range ring and begins tracking the target.

### **Interrogate the Aircraft**

The gunner interrogates the aircraft. The team leader considers an unknown reply, along with the aircraft's direction of flight, in determining whether the aircraft poses a threat to the defended area.

### **Activate the Weapon**

The gunner activates the weapon when the aircraft appears to be penetrating the defended area and fails to correctly respond to an IFF challenge. The gunner will not activate if he determines that he will be unable to engage the target successfully before it leaves the area. For RMP Stinger, only a low hum can be heard from the weapon round after activation and gyro spin up.

### **Continue Tracking**

If the signal is strong enough for seeker lock-on, the seeker is uncaged. The tone should become louder and steadier. If the tone is lost, the UNCAGING switch is released and retried.

If the target cannot be locked on, sweeping the target or performing the figure eight method is recommended. IR acquisition lock-on is necessary for all targets before firing. Ensure the acquisition tone is not from background or another IR source. For RMP Stinger, a slow, steady tracking motion is used in lieu of the sweeper or the figure eight method. When the target is acquired, a clear 1,200 cycle tone is heard. If acquisition is lost, the tone is lost.

### **Determine Range**

The proper launch rule is applied for an incoming or crossing jet to determine if the jet is within the Stinger missile's range (disregard if propeller aircraft). Determining the right moment to launch the Stinger is one of the most critical decisions made by a LAAD gunner. The gunner must evaluate the target and determine if the target is within the Stinger's range. This decision requires a knowledge of the type of target being engaged and the ability to range the target.

To aid the gunner in making his launch decision, range cards should be made for both primary and alternate firing positions. 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. The range card enables the LAAD gunner to have a ready reference to various ranges within view of his position. By knowing the capabilities and limitations of the Stinger weapon and the ranges of various landmarks and objects, the gunner can readily determine if a target can be engaged. Other aids for estimating ground distance to distant objects are binoculars, the naked eye, and

the gunner's hand. These aids supplement range data when maps are not available. The gunner may sight an object with binoculars or through the range ring on the Stinger's sight, and find the range of specific landmarks or temporary objects located on the ground within view of the position. See Fleet Marine Force Manual (FMFM) 6-5, *Marine Rifle Squad*, for more information on range estimation techniques.

### **Super-Elevation and Lead**

As the UNCAGING switch is pressed and held, the tone strengthens. Super elevation and lead are applied by placing the aircraft image in the proper super elevation and lead reticule. If the tone is lost, the UNCAGING switch is released and pressed again. If the target cannot be locked on, either sweeping the target or the figure eight method is performed. IR acquisition lock-on for all targets must occur prior to firing at them.

For RMP Stinger, after target acquisition: UNCAGE and continue to track for 2 seconds before super elevating. Sight on the nose of crossing jets in the appropriate lead reticle. Sight on incoming and/or outgoing jets in the center reticle. Sight on all helicopters and propeller aircraft in the center reticle. Do not offset during IRCCM. If the tone is lost anytime after uncaging, release the uncaging bar and reacquire target and tone.

### **Fire**

Squeeze the trigger while still holding the UNCAGING switch. Hold your breath for 3 seconds.

For RMP Stinger, if target acquisition is maintained (tone still present) after super elevating and leading the target, squeeze and hold trigger for 3 to 5 seconds. (See Appendix B for engagement report format.)



## **RULES OF ENGAGEMENT**

The ROE tell LAAD units what, when, and where they can shoot. At a minimum, the ROE will include—

- The right of self-defense.
- Target ID criteria.
- Weapons control statuses.

Some of these ROE, such as WCS, change frequently and are ordered into effect in specific areas at specific times. Intermediate commanders may make these rules more restrictive within their sectors or ZOAs if the tactical situation warrants, but may not make them less restrictive than those imposed by the MAGTF commander. Weapons-free zones may be established to give LAAD gunners the ability to maximize the potential of the Stinger system.

### **Right of Self-Defense**

Any aircraft observed attacking friendly forces within the LAAD unit's area of responsibility may be engaged with any weapons available. The right of self-defense is never denied.

### **Target ID Criteria**

The target ID criteria are provided as examples to aid the commander in planning his air defenses and should not be considered all-inclusive. Target ID criteria may be altered or changed at the commander's discretion.

### Friendly Aircraft

Aircraft are considered friendly under any one or a combination of the following situations:

- Visually identified as friendly.
- Declared friendly by an appropriate MACCS agency.
- Electronically identified as friendly via non-cooperative target recognition (NCTR).
- Transmitting an appropriate friendly Mode 4 IFF response.
- In proper correlation with flight plan or coordinated mission brief/operation order (OPORD) and within the restrictions of safe passage corridor with appropriate IFF response. For example: transiting a weapon engagement zone (WEZ) at the correct altitude and airspeed on an active minimum risk route (MRR); squawking proper Mode IV, III, or I within corridor; and properly performing identification turn, landing gear down.

### Hostile Aircraft ("Bandit")

Aircraft can be declared hostile if it meets one of the following criteria:

- Visually identified as hostile (based on military markings and/or aircraft configuration).
- Attacking friendly forces.
- Declared hostile by an appropriate MACCS agency.
- Performing any of the following acts over friendly troops or territory without prior coordination:

- Discharging smoke or spray.
- Discharging parachutists or unloading troops in excess of normal aircraft crew.
- Engaging in mine-laying operations.
- Clearly committing an offensive act; i.e., an act or maneuver posing a threat to friendly forces.
- Employing electronic attack (EA).
- Operating at prohibited speeds, altitudes or in prohibited directions.
- Outside safe passage corridors or flying under minimum altitude specified in the ROE and is inbound to friendly forces.
- Making unauthorized or improper entry into an area designated as restricted or prohibited. [NOTE: Care should be exercised in applying this criterion to avoid engaging a friendly aircraft that is damaged and is returning to its base. It may have inadvertently strayed into a restricted area due to a navigational error.]

### Unknown (“Bogey”)

Many air tracks are initially unidentified and are labeled as unknowns. Resolution of unknown status must be made rapidly, so that LAAD capabilities are not handicapped. The ROE should specify procedures for handling unknown aircraft. For instance, ROE may allow surface-to-air (SAM) intercepts of an unknown aircraft if it enters a missile engagement zone (MEZ) at high subsonic or supersonic airspeed, or if it is not transmitting correct IFF codes. The right of self-defense always applies. Unknown aircraft are

prosecuted in accordance with current weapons conditions and ROE. Unknown aircraft have—

- A negative Mode 4 response.
- Not been identified by appropriate higher authority as either friendly or hostile.
- Not been visually identified as friendly.

### Weapon Control Status

WCSs define restrictions on firing Stinger and other air defense weapons for a particular area and time period.

- **Weapons Free.** LAAD teams engage all aircraft not positively identified as friendly.
- **Weapons Tight.** LAAD teams engage any aircraft positively identified as hostile.
- **Weapons Hold.** Do not open fire or cease fire on aircraft currently engaged. Do not fire except in self-defense or in response to a formal fire control order.

In the event of lost communications, LAAD units will follow the WCS procedures detailed in the paragraph titled “Lost or Degraded Communications,” found on page 3-58.

### AIR DEFENSE WARNING CONDITIONS

Air defense warning conditions indicate probability of air attack. They are passed by the senior air control agency to all MAGTF elements. Warning conditions may differ from one area of the bat-

blespace to another due to the tactical situation and level of enemy air threat.

## **Red**

Attack by hostile aircraft and/or missiles is imminent or in progress. This means that hostile aircraft and/or missiles are within an air defense sector or are in the immediate vicinity of an air defense sector. The audio signal for warning condition red is one long, yelping blast lasting approximately one minute. A code word may be assigned to signify warning condition red as per the unit SOP.

## **Yellow**

Attack by hostile aircraft and/or missiles is probable. This means that hostile or unknown aircraft and/or missiles are en route or within an air defense sector. The audio signal for warning condition yellow is three yelping blasts, lasting approximately 2 seconds each. A code word may be assigned to signify warning condition yellow as per the unit SOP.

## **White**

Attack by hostile aircraft and/or missiles is improbable. The audio signal for warning condition white is verbal or data communications passed over established nets. A code word may be assigned to signify warning condition white as per the unit SOP.

## **AIR DEFENSE ALERT STATE**

Table 3-3 contains the alert state for all organizations including those not dedicated to air defense. The most difficult decision for commanders of dedicated air defense units is determining which weapons and personnel must be immediately ready to do battle, and

**Table 3-3. States of Alert.**

	<b>A Battle Stations</b>	<b>B 5-minute Alert</b>	<b>C 1-hour Alert</b>	<b>D 4-hour Alert</b>
<b>Surveillance</b>	Assigned sector and all visible avenues of approach	Assigned sector	Assigned sector	As directed
<b>Communications</b>	All nets	All nets	All nets	As directed
<b>Movement</b>	None	None	Mission essential within immediate vicinity of position	As required
<b>Maintenance</b>	None	None	Preventive	As required
<b>Resupply</b>	Delivered to team level only in critical circumstances	Delivered to team level only in critical circumstances	Mission essential routine distribution IAW section SOPs	Mission essential routine distribution IAW section SOPs
<b>Weapons</b>	2 missiles immediately ready to fire	2 missiles ready to fire within 10 seconds	2 missiles readily available	Basic load on hand
<b>Rest</b>	None	None	1 Marine as required	As required

which can be placed on a lesser alert to perform maintenance and crew rest to ensure operational readiness. States of alert define degrees of combat readiness more specific than, but in concert with, air defense warning conditions. SOAs increase or decrease readiness, allowing LAAD units to rest, move, perform maintenance,

resupply, etc. and, more importantly, establish the period of time in the air defense unit must be able to engage a target. The following are primary SOAs.

### **SOA A (Battle Stations)**

Marines are in their assigned firing positions. All communications nets are manned. At the team level, one member is scanning all visible avenues, while the other is searching the threat sector. Missiles are immediately ready to fire.

### **SOA B (5 Minutes)**

Marines will be in the immediate vicinity of their firing positions. No movement in or out of the team position will occur. All communications nets will be monitored. At the team level, both gunners will be alert. One team member will maintain surveillance over the team's assigned sector of fire at all times. At least two missiles will be readily available for immediate use. Units can assume that an air attack is probable and may occur within the next 5 minutes.

### **SOA C (1 Hour)**

Marines will be in the general vicinity of their positions. Only mission essential movement and resupply will take place. All communications nets will be monitored. One team member will maintain surveillance over the team's assigned sector of fire at all times. At least two missiles will be readily available. Units can assume that an air attack is probable and may occur within the next hour.

### **SOA D (4 Hours)**

Time to be used for movement, resupply, maintenance, improving positions, and rest. Communications nets are to be monitored as directed. Units can assume that an air attack is improbable within the next 4 hours.

## FIRE CONTROL ORDERS

Fire control orders are commands used to control air defense engagements on a case-by-case basis. Fire control orders may be issued regardless of the weapons control status in effect.

**ENGAGE** is used to direct or authorize units and/or weapon systems to fire on a designated target in air defense. This order cancels any previous fire control order that may have been given to a unit.

**CEASE ENGAGEMENT** is used to direct units to stop the firing sequence against a designated target in air defense. Guided missiles already in flight will continue to intercept. This order may be used to reallocate fire against a higher priority target. It may also be used to preclude undesired simultaneous engagements of a target by more than one weapons system.

**HOLD FIRE** is an emergency order to stop firing in air defense. Missiles already in flight must be prevented from intercepting, if technically possible. This order may be used to protect friendly aircraft or in the interests of safety. Stinger does not have the capability to be command destroyed after launch.

**RESUME FIRE** is the command given to terminate a **HOLD FIRE** order.

**CEASE FIRE** is a command given to air defense artillery units to refrain from firing on, but continue to track, an airborne object. Missiles already in flight will be permitted to continue to intercept. This order is primarily used to prevent simultaneous target engagements by different units or with different types of air defense units.

**COVER** is used to order a fire unit to assume a posture that allows immediate engagement of a target if directed. To carry out this order, SAW units with tracking radars achieve a radar lock on a



specific target. The COVER command can be used for targets that are presently being engaged by another fire unit or for targets that have not yet become a significant threat.

## **INGRESS, EGRESS, AND RTF CONTROL PROCEDURES**

Procedures must be established that allow friendly aircraft to safely move in, out, and through the MAGTF's airspace. The most difficult aspect of the air defense task is planning for friendly air operations to support the MAGTF while still protecting it from air attack. Control procedures must be thoroughly examined, especially for safe passage of friendly aircraft through restricted areas. Use of control procedures should maximize the safety of the defended area while minimizing the possibility of fratricide. MCWP 3-22, *Antiair Warfare*, contains a complete description of these procedures. Examples of ingress, egress, and RTF control procedures include use of—

- Ingress or egress corridors and routes for both helicopters and fixed-wing aircraft. Examples of these corridors and routes include low-level transit routes (LLTRs) and MRRs.
- Control points.
- Visual identification (VID).
- Tactical air navigation (TACAN) system.
- IFF equipment.
- Altitude and airspeed restrictions.

- Lame duck procedures (when aircraft have no communications, IFF, battle damage, etc.).
- Airspace coordination areas (ACAs).

## **LAAD COMMUNICATIONS**

LAAD units depend heavily on reliable communications to enable effective operations and aircraft engagements (see table 3-4). Due to wide dispersion and mobility of LAAD units, radio is the primary means of communications. Wire should be used where practical. The LAAD unit commander has the following responsibilities:

- Communications are established, maintained, controlled, coordinated, and employed per current doctrine and applicable directives issued by higher authority.

**Table 3-4. LAAD Communications Nets.**

<b>Net</b>	<b>Purpose</b>
LAAD battalion command (LBC) (HF)	Between bn HQ (net control) and subordinate batteries to coordinate tactical employment of LAAD batteries and to provide administrative and logistics support.
LAAD command (LC) (HF)	Between the battery (net control) and subordinate platoons for administrative and logistics support and coordination of employment of LAAD platoons.

Table 3-4. LAAD Communications Nets.

Net	Purpose
LAAD weapon control (LWC) (HF/VHF)	Between platoon commander (net control) and section leaders. Provides subordinate/senior elements current air defense warning conditions, WCSs, and information on hostile, unknown, and friendly aircraft. Also serves as a means to provide administrative and logistics support and coordinate tactical employment of LAAD sections. May require multiple nets.*
LAAD team control (LTC) (VHF)	For section leader (net control) to control teams and relay air defense warning conditions, WCSs, and information on hostile, unknown, and friendly aircraft. Used to pass aircraft sighting reports, engagements reports, position reports, status reports, and resupply requests to section leaders. Multiple nets, usually one per section, may be required.
ACE tactical air command (ACE TAC) (HF/VHF)	For ACE commander to task subordinate units or agencies. May require multiple nets.*
Antiaircraft intelligence (AAI) (HF/MUX)	Reports targets by LAAD UNITS. May be used by TAOC to pass early warning.
Antiaircraft control (AAC) net (HF)	For control of GBAD units. Types of information include target assignments, fire direction orders, weapons status commands, battery status reports, and engagement reports.*
Combat information detection (CID) (HF/MUX)	For reporting unidentified or hostile aircraft, initial contact reports, tracking, amplifying, and final dispositions reports.*
Command action (CA) (HF)	For command level coordination of antiair warfare (AAW) by exchanging information on SAM unit employment, assignment of air targets, and interceptor/missile coordination.*
Marine air control group command (MACG CMD) (HF)	For MACG commander for command, administrative, and logistics functions with subordinate units.*

**Table 3-4. LAAD Communications Nets.**

<b>Net</b>	<b>Purpose</b>
ACE command (ACE CMD) (HF/VHF)	For ACE commander for command, administrative, and logistics functions with subordinate units. May require multiple nets.*
Direct air support (DAS) (HF/MUX)	Provides a means for the DASC to request DAS aircraft from the Tactical Air Command Center (TACC)/TADC. Requests for DAS aircraft, aircraft stationing, fuel and ordnance states, and progress of DAS missions are passed on this net.
Tactical air request/ helicopter request (TAR/HAR) (HF)	Provides a means for forward ground combat elements to request immediate air support from the DASC. Intermediate ground combat echelons monitor the net and may approve, disapprove or modify the request. After the request is approved, the DASC uses the net to brief the requesting agency on the final details of the mission. Damage assessment reports are also passed on the net.
<i>*LAAD units may employ or monitor these nets as required.</i>	

- All personnel required to operate communications equipment are qualified.
- Alternative communication means are identified as needed.

In addition to communications between LAAD echelons, communications must be established between a LAAD unit and—

- The unit it is working for or supporting (as established by command and support relationships).
- The unit providing it with local security.
- MACCS agencies and ACE organizations.

The LAAD commander and the commanders of these units will determine the best means to establish communications; e.g., radio, wire or messenger. See Appendix C for information on communications assets

## **LOST OR DEGRADED COMMUNICATIONS**

All LAAD personnel should be aware of the following alternate communications nets. See MCWP 6-22, *Communications and Information Systems*, for more information.

- Infantry battalion or regimental Tactical Net (HF/VHF).
- Fire support coordination net (HF/VHF).
- Air operations control net (HF).
- Command action net (HF/VHF).

If a total loss of communications occurs, immediate action to reestablish communications must be taken by all affected units. Actions include—

- Attempt to relay through collocated MACCS agency or supported unit.
- Attempt to relay through adjacent LAAD elements.
- Change location if tactical situation allows.

- Send runner to most likely location that communications may be restored if no contact is made within 30 minutes. (It is the responsibility of the senior element to send the runner.)
- If loss of communications occurs after a frequency change, return to the last frequency used.

Until communications are restored, established ROE remain in effect during autonomous operations. Unless otherwise directed by OPORDS or local combat SOP, LAAD units will comply with the following WCS rules.

If communications were lost and the WCS was—

**WEAPONS TIGHT:** LAAD units maintain WEAPONS TIGHT.

**WEAPONS HOLD:** If a time limit was established, LAAD units maintain WEAPONS HOLD, then revert to WEAPONS TIGHT. If no time limit was established, LAAD units maintain WEAPONS HOLD for 30 minutes and then revert to WEAPONS TIGHT.

**WEAPONS FREE:** If a time limit was established, the same rule applies as in WEAPONS HOLD. If no time limit was established, LAAD units immediately revert to WEAPONS TIGHT.

In the case of suspected or actual jamming, the following actions should be initiated:

- Submit a frequency interference report (FIR) to higher headquarters immediately.
- Move stations closer together when tactically feasible, increase output power, shorten transmission bursts, relay through adjacent units, and use directional antennas.

**As a last resort**, the senior element should direct all subordinate elements to change to an alternate frequency.

## **COMMUNICATIONS SECURITY**

Proper procedures to safeguard classified information, equipment, and operational details should always be employed. COMSEC results from all measures designed to deny unauthorized persons information that might be derived from possession and study of communications. COMSEC includes physical, cryptographic, and transmission security. Maximum use of COMSEC capabilities and assets is paramount. In the interest of security, transmission by radio will be as short and concise as possible. Adherence to prescribed battalion (Bn) or battery (btry) SOPs is mandatory. Unauthorized departure and/or variations from prescribed procedures often creates confusion, reduces reliability and speed, and tends to nullify security precautions. Cryptographic security, the use of crypto-systems, physical security, the safe guarding of classified equipment, documents, and materials is also part of COMSEC.

## **AUTHENTICATION**

Authentication is a security aid designed to protect our communication against deception from fraudulent transmissions by unauthorized persons. Authentication is required whenever the identity of a station is in doubt. The Marine Corps is currently using the TRIAD Numerical Cipher/Authentication System. (See table 3-5.)

Table 3-5. Example Triad Numerical Cipher.

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CIPHER

	ABCD 0	EFG 1	HIJ 2	KLM 3	NO 4	PQR 5	ST 6	UV 7	WX 8	YZ 9
A	AYGZ	MWC	IQN	KPU	BV	TJR	HE	LS	DO	XF
B	HIBY	ZGN	CQF	AOW	DV	TEX	ML	RJ	UK	PS
C	MJBF	IDA	WEX	POT	UQ	HRS	GZ	LK	CY	NV
D	BNDV	UGE	HTR	FJC	QI	ZLK	MY	AW	XP	OS
E	YAMG	SUF	KIR	PVB	JX	EZO	HN	LQ	WD	TC
F	ACNS	WHI	UMV	LFP	TJ	YOD	BX	KR	EZ	GQ
G	KNEZ	QYX	JOV	DLW	HP	SFM	BU	CR	TI	AG
	ABCD 0	EFG 1	HIJ 2	KLM 3	NO 4	PQR 5	ST 6	UV 7	WX 8	YZ 9
H	HZNF	YBQ	PMT	UIC	DE	AVR	JG	XK	OL	SW
I	TCVK	FMZ	KXA	RWS	HO	UIP	QG	YN	DJ	EB
J	AFZG	MDL	YCE	NPO	JI	UKX	WQ	SV	HT	BR
K	SLUO	ZYM	JAP	IEP	QB	HVC	KW	GN	TD	XR
L	UTNM	RQO	BVA	YZH	SJ	FGC	KD	XI	WL	PE
M	GDPC	WTI	ZHS	XAV	KB	RQN	LM	FU	OJ	EY
	ABCD 0	EFG 1	HIJ 2	KLM 3	NO 4	PQR 5	ST 6	UV 7	WX 8	YZ 9
N	SQXT	VRF	LNP	DGC	UK	BEJ	YO	MI	WA	HZ
O	QZER	SLY	PWG	JNI	UC	AKM	XO	BV	FD	TH
P	YODG	XUI	VLT	CFP	WE	HKN	AZ	RM	SB	QJ
Q	HRYP	AIX	SBP	UGL	OE	MCJ	ZQ	TV	KF	WN
R	HYDW	BKC	SUF	AXE	OT	PML	IR	GJ	QN	ZV
S	YQLX	MWZ	BAV	TKD	IG	FHC	SE	PJ	RU	NO
	ABCD 0	EFG 1	HIJ 2	KLM 3	NO 4	PQR 5	ST 6	UV 7	WX 8	YZ 9
T	GAZS	MVE	JPL	CKD	FY	HIO	BU	QT	XR	WN
U	HSPJ	CUT	NIQ	BLA	DX	EYO	FM	RK	ZV	GW
V	FKQB	VNO	JRI	SPH	CL	MWX	AY	GT	EZ	UD
W	WFZS	PBL	YNG	DIH	CQ	VMX	KE	JR	TU	AO
X	WPXQ	CBF	RGV	YOT	NM	JUH	EK	IL	DS	ZA
Y	FSKD	LRX	CGN	HAJ	EI	MZO	WP	VB	QU	YT
Z	PHCR	NQS	AYI	FDW	ZB	EGJ	VM	LT	KU	OX

DAY 01-02

Identify the Encipher/Decipher Line

- Select three letters at random using table 3-5. These three letters are the random set indicator.

**NOTE:** Do not repeatedly use the same three letters; failure to comply will degrade and jeopardize the security of the system.



- Go to the line indicated by the first letter of the random set indicator. (Far left single column of letters in bold print indicates lines.)
- Read right on that line and locate the second letter of the random set indicator. Take the letter immediately to the right of that second letter and go to that line.

**NOTE:** If the letter you are directed to go to is the last letter in a line, go back to the first letter of the same line.

- Read right and locate the third letter of the random set indicator on the new line. Identify the letter to the right of that third letter. This letter will be the line indicator that identifies the encipher line. This line will be used to encipher or decipher any message.

**EXAMPLE:**

Use table 3-5. The random set indicator is "CXF." The initial letter is "C" locate line "C."

Locate the second letter of the Random Set Indicator "X" (within line "C,"), identify the letter to the immediate right of "X." You should have identified the letter "P."

Go to line "P," find the third letter "F" of the random set indicator.

Identify the letter to the immediate right of "F." You should have identified the letter "P." Line "P" will be the encipher/decipher line.

## Encipher Numbers

- Read right and find the numbered column that corresponds to the first digit of the number(s) to be enciphered using the encipher line.
- Substitute one letter on that column for the plain text number.
- Stay on this line and repeat this process for each digit to be enciphered. Each column has from two to four letters listed for each number. These letters are called Variants and should be chosen at random. Each variant from a column should be used before any letter is reused.

### EXAMPLE:

Use table 3-5. Encipher a six digit grid "142 497."

Go to encipher line, identified earlier as "P."

Read right to the numbered column that corresponds to the desired number. The first number of the six digit grid is "1." You should have found the corresponding letters for the number "1" on line "P" to have been "XUI."

Select a single letter to represent the number "1."

Repeat the above steps for subsequent numbers until all numbers are enciphered

## Transmit

When using this system, plain text can be mixed with cipher text. The words "I SET" must precede the enciphered message. This indicates that the next three letters will be the random set indicator.

Pause your communications transmission, then continue to indicate a space between the set indicator and enciphered numbers.

## **Decipher Numbers**

After receiving the enciphered message, identify the random set indicator. This will be the first three letters of the cipher text message following the words "I SET". Determine the appropriate decipher line, using the procedures listed above. Using this decipher line, read right on the line until you locate the first letter of the cipher text. Determine which number appears at the top of that column. Substitute that column number for the cipher text letter. This number is the first digit of the plain text message. Remain on that line and repeat this process for each letter of cipher text.

## **Authenticate**

The TRIAD system provides two methods of authentication: the challenge-and-reply authentication, and the transmission authentication. The challenge-and-reply method is the primary means of authentication for LAAD gunners.

Challenge-and-reply authentication should be used whenever possible to verify the authenticity of a station. The called party will always make the first challenge. The party calling may counter challenge after the initial exchange to verify authenticity. This procedure is usually carried out when the calling party suspects a bogus station is impersonating another station.

## **Challenge**

Select three letters at random. Random selection is essential for security reasons. **Do not** repeat challenges and **do not** use standard groups such as "ABC," "AAA," etc. Verify correct response prior to receiving answer from calling station.

## **Reply**

Using the three letters transmitted in the challenge, take the first letter and go to the line indicated by that letter. The far left single column of letters in bold print indicates lines. Move to the right on that line until you reach the second letter of the challenge. Take the letter directly below the second letter of the challenge and go to the line indicated by that letter. Move to the right on that line until you reach the third letter of the challenge. Take the letter directly below the third letter of the challenge. This is the reply letter.

**NOTE:** If directed to go to a letter below the Zulu line for authentication purposes, choose letter from the same column on line Alpha.

### **EXAMPLE:**

Use table 3-5 to authenticate "RLG."

Go to line "R," locate the second letter of the challenge "L," identify the letter directly below "L." You should have found the letter "C."

Go to line "C," locate the third letter of the challenge "G," identify the letter directly below "G." The authentication reply is "M."

## **DESTROYING COMMUNICATIONS EQUIPMENT**

### **Burning**

Within a general area, equipment is stacked in small piles and an incendiary grenade is placed in the center of each pile. The pins are pulled remotely or small arms are used to fire at the grenades. If that procedure is not possible, all the equipment is placed in a pile with

minimal separation between items. The pile is doused with flammable liquid and ignited with an incendiary grenade or a flare.

## **Removal and Destruction of Components**

If time does not allow for complete destruction of the communications equipment, the equipment is disassembled and removed, and components are destroyed or scattered. Applicable crystals, modules, tubes, and switches are removed and an axe or sledgehammer is used to render them inoperative and indistinguishable. If a heavy vehicle such as a tank or a large truck is available, the components can be placed in its path and driven over repeatedly.

## **Small Arms Fire**

This is the least desirable way to destroy equipment as the chance remains that the equipment could still be used with components from another set. If this method of destruction is selected, the equipment is placed such that the most exposed area is facing the designated firing team. The team is allowed to fire as many rounds as possible into each piece of equipment to ensure it is destroyed. This is accomplished by firing about 3 inches in from each corner of the equipment, as well as directly into the center of the gear.

## **Submerging**

The equipment's retaining screws on the equipment are loosened and the seals are cracked. The equipment is thrown overboard or into any nearby body of water.

## **BASE DEFENSE ZONE PROCEDURES**

The base defense zone (BDZ) is a destruction area established around an air facility or site or forward operating base to allow for

the launch and recovery of friendly aircraft while maintaining an air defense posture. BDZs are limited to the engagement envelope of the short-range air defense weapons systems defending that base. In the case of the MAGTF, LAAD assets employ at BDZs.

BDZs have specific entry and exit, as well as IFF procedures associated with their use. LAAD assets will integrate with the Marine air traffic control detachment operating at the airfield around which the BDZ has been established. Pre-planned BDZs are published in the airspace control plan, while requests for activation of BDZs are made to the ACE or MAGTF commander. Three critical elements are required to establish a BDZ: controlling agency (air traffic control, TAOC or a joint/multinational air traffic control system); radar; and weapon system.

### **MATC Detachment LAAD Integration**

The MATC detachment (Det) has the requisite doctrine, forces, equipment, and capabilities to effectively manage and control a BDZ. The success of the BDZ is predicated on integration of the SHORAD and MATC Det personnel.

The LAAD section leader responsible for supervising Stinger fires within the BDZ physically locates in the MATC Det's control and communications subsystem (CCS) at a control scope along with the approach controller. The approach controller monitors the assigned MATC Det airspace and provides cueing to the LAAD section leader. The LAAD section leader's control scope should depict the airspace, individual team positions, sectors of responsibility, and manual cross tell system. The approach controller provides the section leader with cueing on all air tracks within MATC Det airspace out to 60 nautical miles and 60,000 feet AGL. The section leader provides cueing and aircraft position updates to his LAAD teams. The detailed entry, exit, and IFF procedures, which are required for the launch and recovery of friendly aircraft within the BDZ, are

monitored by MATC Det tower, departure, approach, and radar controllers to ensure friendly aircraft are safely passed through the defenses. BDZ operations may be conducted 24 hours a day. The Avenger is the weapon of choice in BDZ operations due to the significant capabilities that the system possesses. The FLIR, the RTU, and the slew-to-cue capability aid in the defensive posture required of BDZ operations.

## **Command and Control**

The process of C2 within the BDZ is accomplished through the communication link (LAAD team control) between the section leader and the Stinger teams. The concept of the WCS is not applicable to the BDZ, which is a departure from traditional defenses. Aircraft are engaged based upon the classification of an aircraft by air traffic control, either through electronic means (IFF), the determination of non-compliance with pre-briefed approach procedures, lack of voice communication or visual identification by LAAD teams. The constant dialogue between section leader and approach controller provides LAAD teams with a steady flow of accurate friendly and threat air activity information within the BDZ.

Teams that lose communications with the section leader will immediately revert to WEAPONS TIGHT during daylight hours or WEAPONS HOLD at night and assume a point defense role until communications with the section leader can be restored. Likewise, if air traffic control radar and data links to the TAOC are inoperable or not providing a recognized air picture, all LAAD assets within the BDZ will revert to a point defense role.

Point defense allows LAAD gunners to prosecute engagements of hostile aircraft in accordance with the established ROE and WCS.

## **Ingress or Egress Control Procedures**

Procedures are established that allow friendly aircraft to transit safely in and out of the MAGTF's airspace. MCWP 3-22 contains a complete description of these procedures. Examples of ingress or egress control procedures include the use of—

- Ingress or egress corridors for both helicopters and fixed-wing aircraft.
- Checkpoints.
- The tactical air navigation system.
- Altitude and air speed restrictions.
- Lame duck procedures.
- Airspace coordination areas.





## **Chapter 4**

# **Training**

Marine leaders have the responsibility to establish and conduct technical and tactical training to enable Marines to successfully accomplish the unit's mission. The complexities of amphibious, joint, and multinational operations highlight the importance of individual and unit-level training for LAAD Marines.

### **INDIVIDUAL TRAINING**

Training requirements for employment of the Stinger weapon system are standardized by Marine Corps Order (MCO) P3500.19, *Aviation Training and Readiness (T&R) Manual, Volume V, Marine Air Command and Control System (MACCS)*. The T&R Manual specifies training events and position requirements necessary for these personnel to attain position designations. Follow-on formal training is available to Marines who demonstrate military occupational specialty (MOS) proficiency.

### **FORMAL SCHOOLS**

Entry-level training for antiair warfare officers and Stinger gunners is conducted at the U.S. Army Air Defense School, Fort Bliss, TX. The 3-week Stinger Officers Course focuses on training in aircraft identification, Stinger missile operating characteristics and employment, and the application of air defense principles. Opportunities are provided to track simulated targets in the moving

target simulator, conduct terrain analysis, and observe live tracking and live missile firing.

## **Stinger Gunners' Course**

This course provides enlisted gunners' initial training in Stinger and Avenger operation and maintenance. It emphasizes the engagement process, aircraft identification, and employment of the Stinger and Avenger missile system through lectures and tracking exercises in the moving target simulator. The course culminates with a live missile fire exercise.

## **On-the-Job Training**

The T&R Manual, volumes I and V, provides information on individual training and qualification criteria for MACCS personnel. Specific academic and practical application training standards for LAAD AAW officers and gunners are outlined in the T&R Manual, volume V. Officers and enlisted personnel complete separate training syllabi. A different syllabus is established for enlisted personnel functioning at the platoon sergeant or section leader position. Tracking of individual readiness is computed by the aviation training and readiness information management system. Refer to MCWP 3-25.3, *Marine Air Command and Control System Handbook*, for detailed discussion on levels of training.

## **Graduate-Level Training**

### **Weapons and Tactics Instructor Course**

AAW officers exhibiting requisite technical and tactical proficiency may be selected by their commands to attend the Weapons and Tactics Instructor course. The course is a 6-week graduate-level school, held at Marine Corps Air Station, Yuma, AZ. It provides advanced training and practical application regarding the planning and execution of the six functions of Marine aviation. Students

receive specific instruction in the areas of MACCS and air defense planning considerations. The weapons and tactics instructor course is geared toward the mid-level captain who would return to the LAAD battalion and assist in the training of personnel. Prerequisites for attendance include experience in Marine expeditionary force exercises and specific T&R syllabus events up to the battery level. Upon completion of the weapons and tactics instructor course, officers are eligible for the MOS 7277 designation, weapons, and tactics instructor.

### **LAAD Advanced Tactics and Employment Course**

This LAAD course is conducted simultaneously with the weapons and tactics instructor course. The course includes many of the same classes and provides an overview of the six functions of Marine aviation and the MACCS. Students plan and execute approximately 12 separate evolutions under the supervision of two enlisted instructors and the LAAD division head. Enlisted personnel from the DASC, TAOC, and MATCDET participate in many of the classes and in the flight phase of this course. The course provides a deeper understanding and appreciation for the complexities associated with employment of the MACCS.

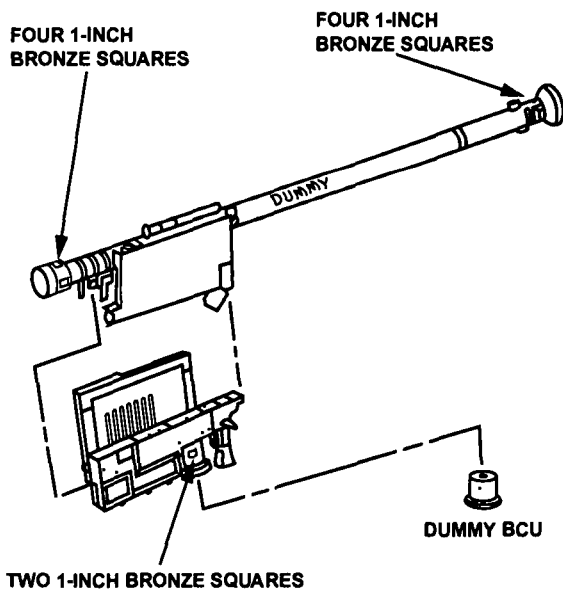
### **LAAD GUNNER INDIVIDUAL SKILLS**

Mastering individual skills is the beginning of an effective LAAD team. Proficiency in these tasks ensures that LAAD teams will be able to meet the challenge. Aircraft identification, weapon handling, decisionmaking, and evaluation of the gunner's skills are key factors in individual gunner training. Tasks are broken into two groups: common tasks that must be mastered by all individuals; and tasks required by duty positions or proficiency tasks. When individual standards are met, the LAAD team and section must function together where LAAD gunnery and tactics are combined.

Only after all LAAD personnel have been trained to perform these tasks at the required standards will teams be able to accomplish their mission on the battlefield effectively.

## **Field Handling Trainer**

The field handling trainer (see fig. 4-1.) has the same size, weight, and external appearance as the Stinger weapon round but is totally inert. Its controls and mechanical operation are also the same. Stinger gunners use the field handling trainer to practice the basic manual skills of weapon handling, operation, sighting, and ranging. Gunners can practice mating or removing the gripstock and inserting or removing the battery coolant unit. Unlike the Stinger weapons system, the field handling trainer does not provide gunners with indications of target acquisition and has no IFF capability.



**Figure 4-1. Field Handling Trainer.**

## Training Set Guided Missile (M134)

The training set guided missile M134 (see fig. 4-2) consists of a tracking head trainer, five rechargeable nickel cadmium (NICAD) batteries, an IFF simulator with cable, and a shipping and storage container. It is used to develop and maintain proficiency in tracking aircraft and firing the Stinger weapon. The tracking head trainer has the same appearance as the weapon round except for a performance indicator assembly strapped near the aft end of the launch tube. Weighing about 38 pounds, its rechargeable battery looks like the battery coolant unit except that it is approximately 3 inches longer and twice as heavy. A fully charged battery produces a minimum of 15 training missions of 47 seconds each. The IFF simulator provides the operator with random, simulated IFF interrogation

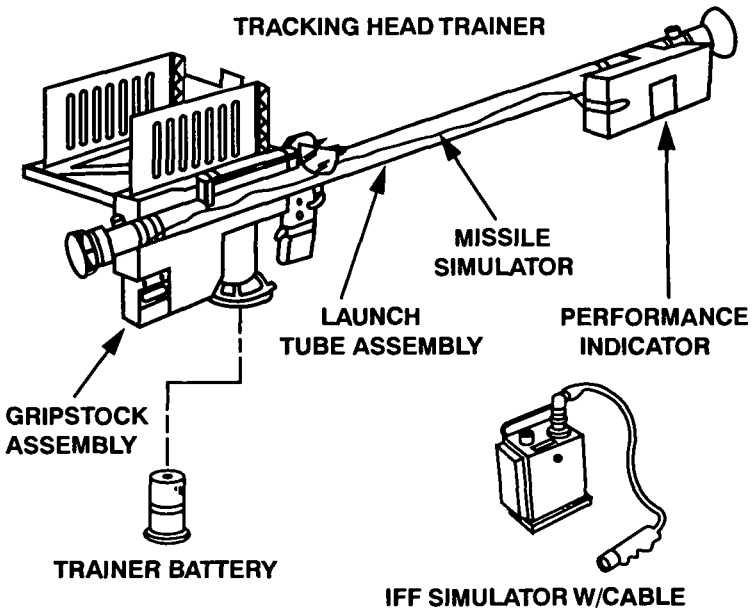


Figure 4-2. Training Set Guided Missile (M134).

responses. The performance indicator displays the gunner's progress during a simulated engagement. It provides indications that the gunner has—

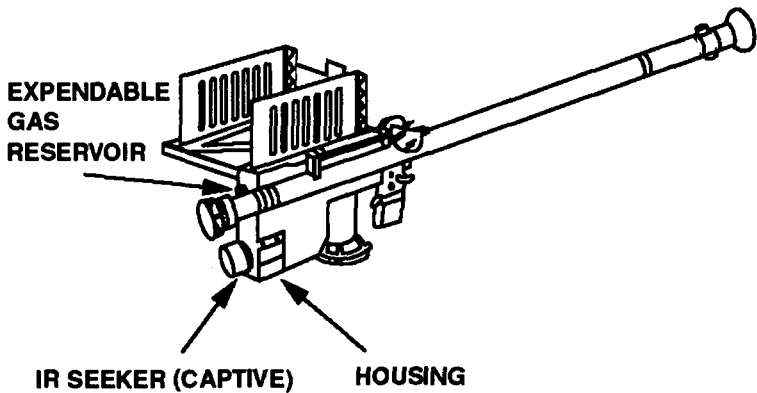
- Performed the engagement sequence correctly.
- Committed a correctable error (e.g., a procedural error that can be corrected before squeezing the firing trigger).
- Committed an uncorrectable error (e.g., squeezing the firing trigger out of sequence).
- Allowed 47-second timer to run down, which shuts down trainer.

### **Moving Target Simulator II**

The moving target simulator (MTS) II provides representative sights and sounds of aircraft expected to be encountered by Stinger gunners. One to three gunners can be trained simultaneously in the MTS II. Environmental realism is achieved by using a large 40-foot diameter, 360-degree display area that displays authentic aircraft presentation (with up to three active targets), selectable background scenery and weather conditions, and stereophonic sound. Accurate infrared signatures are computer-controlled to indicate target range, type, and altitude. Infrared countermeasures (in the form of flare drops) are also available. When a gunner scores a target kill, the target explodes. The missile's flight path is also shown. Each U.S.-based, active duty LAAD battalion has an MTS II.

### **Stinger Launch Simulator**

The Stinger launch simulator (see fig. 4-3) is a low cost, gunner proficiency training device. It is comprised of a standard Stinger launcher with an externally mounted captive seeker. All indications received by the gunner during training are identical to those for the



**Figure 4-3. Stinger Launch Simulator.**

tactical weapon round up to and including launch. The Stinger launch simulator uses an eject motor to launch an inert missile to a range of approximately 170 meters (557 feet) with a maximum altitude of 43 meters (141 feet). Normal range safety requirements and operating procedures for the Stinger launch simulator are detailed in TM 08319A-12, *Operator's and Organizational Maintenance Instructions: STLS (Stinger Launch Simulator)*.

### **Captive Flight Trainer**

The captive flight trainer is a training tracking device much the same as the tracking head trainer. It is modified for the standard Avenger vehicle-mounted launcher and may also be used with the light armored vehicle, air defense variant. It allows vehicle-mounted systems to track aircraft and conduct engagements in a training environment. Each captive flight trainer has an on-board storage capability for argon gas to cool the seeker head. These training devices are recharged by Stinger personnel who are specially trained in the operation of the single chamber unit that pressurizes the argon gas from a supply bottle into the captive flight trainer or the tracking head trainer.



## **Institutional Conduct of Fire Trainer**

Institutional conduct of fire trainer (ICOFT) is a self-contained training set that allows simulated Avenger engagements from a computer-based simulation program. Similar to the moving target simulator, the institutional conduct of fire trainer displays pre-programmed flight profiles on a monitor in front of the gunner. The gunner sits in the ICOFT, which is configured identical to an Avenger turret, and performs all actions required in an engagement. The gunner's actions are recorded by a computer that provides immediate feedback to the operator. The institutional conduct of fire trainer simulates the sounds of a battlefield and displays ground and air activity within the specific profile that is flown.

## **PLATOON, SECTION, AND TEAM TRAINING**

Platoon, section, and team training provides the means by which future LAAD battalion leaders are developed, and it should be incorporated into the daily routine and training plan. Small-unit training is designed to take a basically trained Marine, fine tune those skills, and develop an ability to handle increased responsibilities. Moreover, small-unit leadership training develops and reinforces procedures used by the battalion to accomplish its mission.

### **Platoon Training**

Platoon training should include field and garrison training for individual sections that are working together to become a synergistic force to fulfill platoon responsibilities. Platoon headquarters and communication exercises, and deployment and redeployment drills should be conducted on a regular basis in accordance with battalion SOPs and MOS-specific handbooks. Areas of focus in platoon training should include—

- 5-Paragraph Orders (issuing and receiving). (See appendix D for format.)
- Preventative and field maintenance of equipment.
- Convoy operations.
- Platoon-level tactical movement.
- Reporting procedures.
- Communications procedures.
- Integration training with other elements of the MACCS.

### **Section Training**

Sections are the smallest tactical element of Stinger assets and may be expected to perform their mission away from normal platoon-level employment. SOPs should be consistent, yet provide the ability for the section to operate away from the platoon headquarters. Section-level training should include developing or conducting the following:

- Delivery and receipt of detailed 5-Paragraph Orders. (See appendix D.)
- Convoy procedures.
- Tactical movement.
- Enhanced precision lightweight global positioning system (GPS) receiver. (See appendix E.)
- Reporting procedures.

- Lost communication procedures.
- Integration training.
- Preventative and field maintenance training.
- Communications procedures to include COMSEC.
- Operational security to include light discipline.

## **Team Training**

Team training cannot be over-emphasized. The team level is where LAAD Marines spend the majority of their time. A carefully cultivated relationship between the team leader and assistant gunner should exist. Each team member should know the strengths and weaknesses of the other and should strive to offset those weaknesses. Teams are dependent upon each other for survival on the battlefield and should possess a strong sense of loyalty. Each team should have a routine that is followed every time they deploy. Though it is not necessary to develop an SOP for each team, team members should have a clear understanding of the process to be followed each time they arrive at a position. Team members should attend tracking training in the MTS II individually and as a team. The team leader should be a mentor to the assistant gunner, developing skills and teaching sound practices for tactical employment. Elements of team training should include—

- Setting up the team.
- Selecting the team position.
- Tracking live and simulated aircraft.
- Reporting procedures.

- Using the enhanced precision lightweight GPS receiver. (See appendix E.)
- Engaging aircraft.
- Identifying aircraft.
- Developing the 5-Paragraph Order.

### **AIRCRAFT IDENTIFICATION TRAINING**

Effective and realistic aircraft identification training is difficult, challenging, and necessary. New aircraft and changing aircraft designs continually increase the list of aircraft to be identified. Individuals must be trained to identify aircraft quickly and accurately. Hostile, low-flying aircraft may appear suddenly from behind low hills, over trees, or through haze. High-speed aircraft are difficult to identify. Team members should be experts at identifying all friendly and potentially hostile aircraft expected to be operating at low altitudes in a specified combat zone.

Aircraft identification training is conducted using real-time video and picture images of the aircraft to be learned. Various aircraft identification systems are available. With current software and hardware upgrades, these systems are continually being upgraded. Two systems currently in use by the LAAD battalions are the Combat Visual Identification System CD-ROMs. In addition, the Visual Aircraft Recognition CD-ROMs, (CD-ROM 441-173). These systems are an interactive computer software program designed to increase aircraft recognition skills of the gunners. The program uses 3-D animations, 3-D views, photographs, video clips, and line drawings to enhance recognition skills for selected aircraft from around the world. These systems also contain a database for testing, scoring, and sorting aircraft for the theater of operation you

may be operating. Graphic training aids (GTAs), such as printed cards and charts, are useful supplements to the software if the CD-ROMs are unavailable. Current software CD-ROMs available are:

- Combat Visual Identification System (CVIS).
- Visual Aircraft Recognition CD-ROMs series 441-173.
- Jane's Ultimate Flight #3.

## **TRAINING DEVICES**

The training devices used for individual training are also used to augment team-, section-, and platoon-level training. Some devices are employed to support aircrew training; e.g., the Smokey SAM.

The Smokey SAM is a training device that helps aircrews visualize the backblast and smoke signature created when a short-range, SAM is fired at their aircraft. They are for non-tactical visual training and are employed solely for aircrews. Personnel who handle and launch Smokey SAMs may have any MOS; however, because the Smokey SAM igniter and rocket motor contain explosive material, personnel who operate them must have adequate operating, safety, and handling training. Marines who operate these training devices are normally part of the battlefield realism section of the Marine aircraft wing headquarters G-3.

## **UNIT TRAINING**

Unit training is required to prepare the LAAD battalion to perform its wartime mission. Unit training exercises include command post, simulated, and field training. During unit training, LAAD battalion

personnel are intimately involved in preparing training plans and coordinating with higher, adjacent, and subordinate command and control and support units. Command post and field training exercise evolutions are generally conducted at the Marine aircraft wing- or higher level. Unit participation in Marine air command and control-level training can be accomplished at low cost while maintaining an effective, stimulating forum geared toward MACCS integration training. Examples include the Marine aviation planning problem, MACCS integrated simulated training exercise, and joint service training exercises. Refer to MCWP 3-25.3 for a more detailed discussion of MACCS level training opportunities.

## EVALUATING TRAINING

The success of individual, crew, and unit training must be qualitatively measured to identify training deficiencies and create a baseline for designing future training. For unit training, identified needs should be stated as training objectives for upcoming exercises. The Marine Corps Combat readiness evaluation system (MCCRES) is a key evaluation tool used to identify unit training needs. MCCRES is a standardized evaluation program designed to measure a unit's warfighting readiness. The MCCRES specifies mission performance standards that agencies are expected to perform during their wartime mission. Though formal unit evaluations are usually performed every 2 years, units are encouraged to conduct informal MCCRES evaluations each time crew- or unit-level training is conducted. By employing MCCRES standards as a baseline for training, units can easily identify training needs and orient their training toward improving on previously identified training deficiencies.

## **TERRAIN WALK**

The terrain walk should be completed with leaders first. Then the leader takes the men on a tour (by foot or vehicle) over a predetermined route. The leader discusses applications of various tactical principles and techniques along the route. This gives the team members an appreciation for tactics or techniques in the employment of Stinger. An informal, two-way question and answer session is the most effective method. A well-conducted terrain walk is an excellent way to implant tactical concepts of LAAD team support to a unit.

## **TERRAIN MODEL EXERCISE**

Terrain model exercises reinforce classroom training of team members before undergoing a practical exercise in the field. Terrain model exercises are actually small tactical exercises where each team member sees how he fits into the whole picture. Terrain model exercises permit leaders to—

- Discuss the role of the supported unit, adjacent units, and other units connected with the field exercise.
- State the mission of the section and teams.
- Discuss unit SOPs for actions on contact, security, and occupying positions.
- Ask questions of each team member.

- Point out terrain features that attack helicopters can slip behind and then attack friendly armored vehicles.
- Answer questions and clear up any misconceptions.

### **CREW DRILLS**

Drills develop teamwork and automatic reaction in time-critical situations. Initially, team members should understand their individual actions and procedures and how they relate to those of the other team members. Next, team members should walk through the procedures with a trained and experienced team leader. During the walk through, team members rehearse the crew drill, pointing out equipment they will use and actions they will perform. These preliminary steps resolve questions and reinforce safety precautions applicable to the system. Stinger technical manuals list all safety requirements that must be understood and followed. Crew drills should include—

- Stinger engagements and procedures from the mounted position.
- Stinger engagement and procedures from the fighting position.
- Stinger engagement and procedures from foot-march position.
- Proper wear and procedures for NBC protective over garments. (See appendix F.)
- Proper decontamination procedures for individual equipment, personnel, and clothing.





## **Appendix A**

# **LAAD Team Mount-Out Guide**

This appendix includes information relative to administrative, operational, and logistical matters. It is not all-inclusive, but provides a starting point for a deployment or operation. The 5-Paragraph Order (see appendix D) provides a means to pass this information to team personnel. The team leader—

- Acquires and analyzes all information necessary to conduct LAAD operations as it relates to the team and its mission.
- Fully understands the supported unit's mission, commander's intent, and scheme of maneuver.
- Is thoroughly familiar with the supported unit commander's air defense requirements.
- Understands the team's relationship to the MACCS and communication links with appropriate units and agencies.
- Ensures the team is briefed on what he knows. Specific information requirements include—
  - Supported unit mission and team mission.
  - NBC threat information.
  - Supported unit scheme of maneuver.
  - Ground and/or air threat.

- Operation order and SOP.
- Maps and charts.
- Unit location or alternate location.
- Route or alternate route.
- Hostile criteria, ROE, and RTF procedures.
- Air defense warning condition, SOA, and WCS.
- Sector of fire and PTL.
- Manual cross tell procedures.
- Challenge and/or password.
- Call signs, communications nets, and frequencies.
- Lost communications procedures.
- Restoration of communications nets.
- Handling prisoners of war (POWs).
- MACCS agency(ies).
- Friendly troops in operating area or free fire zone.
- Rally points or loiter times.
- Release points.
- Weather report.

- TDAR employment.
- Emission control (EMCON) procedures.
- Retrograde procedures.
- Reporting procedures.
- Resupply (missiles and logistics).
- Medical support.
- BDZ procedures (as applicable).
- Appropriate operational and Service publications.
- Fire support coordination lines (FSCLs).

After acquiring all necessary information, the team determines the personal 782 gear and operational equipment required based on METT-T. Table A-1 contains specific equipment requirements. These requirements are not all-inclusive.

**Table A-1. Equipment Requirements.**

<b>Equipment</b>	<b>Quantity</b>
<b>Vehicles:</b> M998 HMMWV or M1097 Avenger SL-3/pioneer gear	1 1 set
<b>Armory:</b> M-16A2 w/bayonet M-9 w/kabar Compass Binoculars An/PVS-7B night vision goggles M3P .50 caliber machine gun	1 per gunner 1 per team leader 1 1 1 per team leader 1 per Avenger
<b>Supply:</b> MREs Cammie net (MANPAD) Cammie poles (MANPAD) Avenger cammie net Gripstock carrying case Alice pack BC-5 or team box 5-gallon water can 5-gallon gas can 782 gear	1 case per man 1 set 1 set 1 set per Avenger team 1 set per Avenger team 1 per man 1 1 per man 1 1 set per man

**Table A-1. Equipment Requirements.**

Equipment	Quantity
<b>Communications:</b> AN/PRC-119 SL-3 complete TA-312 AKAK-1553 BA-5590/BB-590 (3-day supply) BA-30 (3-day supply) BA-1372 (3-day supply) BA-3058/U AAs (3-day supply) BA-5847/U (3-day supply) LS6-BA BA-5800/U External antennas to include vehicular AN/PSN-11 (EPLGR) DR-8 roll (field wire)	2 1 set 1 3 12 2 4 per MANPAD team 1 4 1 1
<b>Administrative:</b> Record books, pens, paper, etc.	1 set
<b>NBC:</b> Chemical protective overgarment & mask M-11 vehicle decontamination apparatus M-291 personal decontamination kit Nerve agent antidote kit	2 per man 1 1 per man 3 per man
<b>Stinger:</b> AN/PPX-3 A/B belt pack (Avenger B) AN/PAS-18 Stinger night sight RTU	2 1 as assigned 1

Table A-1. Equipment Requirements.

Equipment	Quantity
<b>S-4:</b> Weapon rounds (FIM-92-C) Missile rounds (FIM-92C) Missile rounds (FIM-92C) RMP gripstocks Complete complement of ground ammo: AT-4s Mines/booby traps Hand grenades (WP/smoke/frag/CS/illum) M-16A2 ammunition M-9 ammunition	2 per MANPAD team 4 per MANPAD team 8 per Avenger team 2 per Avenger team 1 as assigned

## Appendix B

# LAAD Operational Reports

### A. LAAD Early Warning/Leaker Report.

Date Time Group of Report (Sent by RTU)

1. Number and Type of Aircraft.
2. Location and Heading.
3. Time (If not immediate).

FLASH REPORT, PASS VIA VOICE COMMUNICATIONS

### B. SALUTE Report.

Date Time Group of Report (Sent by RTU)

1. Size
  - (S) Squad
  - (P) Platoon
  - (C) Company
  - (B) Battalion
  - (O) Other Specify: \_\_\_\_\_.
2. Activity
  - (O) Offensive
  - (D) Defensive
  - (C) Convoy
  - (OT) Other Specify: \_\_\_\_\_.
3. Location \_\_\_\_\_.

MGRS  
LAT/LONG



4. Unit  
(M) Mechanized Infantry  
(DI) Dismounted Infantry
5. Time Seen \_\_\_\_\_.
6. Equipment  
(AC) Aircraft on deck.  
(S) Semi-Auto Machine gun  
(A) Anti-Tank Weapons  
(M) Mines  
(T) Tanks  
(ART) Artillery  
(TR) Trucks  
(B) Boats  
(O) Other \_\_\_\_\_.
7. Additional Comments \_\_\_\_\_.

**C. NBC 1 Report.**

Date Time Group of Report (Sent by RTU)

1. Type of Report  
(N) Nuclear  
(B) Biological  
(C) Chemical
2. Position of Observer \_\_\_\_\_, MGRS  
Direction of attack \_\_\_\_\_, (Relative to observers  
position)  
Direction: \_\_\_\_\_, (Degrees)
3. DTG attack began/ended \_\_\_\_\_ / \_\_\_\_\_.
4. Location of Attack \_\_\_\_\_, MGRS

5. Means of Delivery
  - (A) Aircraft
  - (ART) Artillery
  - (M) Missile
6. Type of Burst
  - (A) Air
  - (S) Surface
  - (SUB) Sub-Surface (SPR) Spray
7. Type of Agent
  - (N) Nerve
  - (B) Blister
  - (BL) Blood
  - (C) Choking
  - (I) Irritant
  - (U) Unknown
8. Additional Comments \_\_\_\_\_.

**D. Casualty Evacuation (CASEVAC) Request**

(see appendix G) (Team Leader Level)

Date Time Group of Report (Sent by RTU)

1. Call Sign of Requesting Party \_\_\_\_\_.
2. Number of Injured \_\_\_\_\_.
3. Type of Injury \_\_\_\_\_.
4. Status of Injured \_\_\_\_\_.
5. Location of Injured \_\_\_\_\_.

MGRS  
LAT/LONG

6. Amplifying Instructions or Comments \_\_\_\_\_.

**E. Engagement Report.**

Date Time Group of Report (Sent by RTU)

1. Unit call sign.

2. Number and type of aircraft engaged.
3. Time of engagement.
4. Location (as per the reference system used).

Polar Grid \_\_\_\_\_.  
Cartesian Grid \_\_\_\_\_.  
MGRS \_\_\_\_\_.  
LAT/LONG \_\_\_\_\_.

5. Number of missiles expended.
6. Result (kill, miss or damage).

**F. Air Defense Status Message.**

Date Time Group of Report (Sent by RTU)

1. Air Defense Warning Condition  
(W) White  
(Y) Yellow  
(R) Red
2. Weapons Control Status  
(F) Free  
(T) Tight  
(H) Hold
3. States of Alert  
(A) BATTLE STATION  
(B) 5 Minute Alert  
(C) 1 Hour Alert  
(D) 4 Hour Alert
4. Effective DTG

**G. Frequency Interference Report.**

Date Time Group of Report (Sent by RTU)

1. Type of Report
2. Unit Location and Time

3. Frequency Affected
4. Equipment Affected  
(FM) Radio/VHF  
(N) Navaid  
(S) SAT Comm.  
(AM) AM Radio/HF  
(R) Radar  
(O) Other Specify \_\_\_\_\_.
5. Strength of Interference  
(W) Weak  
(M) Medium  
(S) Strong
6. Comments or Amplifying Instructions \_\_\_\_\_.

**H. Movement Order.**

Date Time Group of Report (Sent by RTU)

1. Relocation Position Grid: \_\_\_\_\_.
2. Time Released from Current Mission/ \_\_\_\_\_.
3. Time to be Operational (DTG) \_\_\_\_\_.
4. Comments/Instructions \_\_\_\_\_.

**I. LAAD Status/Logistics Report.**

Date Time Group of Report (Sent by RTU)

1. Personnel \_\_\_\_\_
2. Missiles
  - a. Number Optional
  - b. Number Non-Operational
  - c. Number Needed
3. IFF
  - a. Number Operational
  - b. Number Non-Operational
  - c. Comments and Specific Problem
4. TDAR
  - a. Operational
  - b. Non-Operational
  - c. Comments and Specific Problems
5. RTU GBDL
  - a. Up
  - b. Down
  - c. Comments and Specific Problems
6. Vehicle
  - a. Up
  - b. Down
  - c. Comments and Specific Problems
7. Crypto Type\_\_\_\_\_
  - a. Up
  - b. Down
  - c. Comments and Specific Problems

8. POL Resupply
- a. Diesel \_\_\_\_\_ Gal
  - b. MOGAS\ \_\_\_\_\_ Gal
  - c. Oil \_\_\_\_\_ Gal
  - d. White Gas \_\_\_\_\_ Gal
  - e. Anti-Freeze \_\_\_\_\_ Gal
  - f. Brake Fluid \_\_\_\_\_ Gal
  - g. CLP \_\_\_\_\_
  - h. Other Specify \_\_\_\_\_

9. Water Resupply \_\_\_\_\_ Gal

10. Battery Resupply
- Type \_\_\_\_\_ Number Needed \_\_\_\_\_
  - Type \_\_\_\_\_ Number Needed \_\_\_\_\_
  - Type \_\_\_\_\_ Number Needed \_\_\_\_\_
  - Type \_\_\_\_\_ Number Needed \_\_\_\_\_
  - Type \_\_\_\_\_ Number Needed \_\_\_\_\_

11. Ammo Resupply
- Type \_\_\_\_\_ Amount Needed \_\_\_\_\_
  - Type \_\_\_\_\_ Amount Needed \_\_\_\_\_
  - Type \_\_\_\_\_ Amount Needed \_\_\_\_\_
  - Type \_\_\_\_\_ Amount Needed \_\_\_\_\_
  - Type \_\_\_\_\_ Amount Needed \_\_\_\_\_

12. Subsistence Cases of MREs

13. Location and Time for Resupply \_\_\_\_\_.

14. Comments and Special Instructions \_\_\_\_\_.

JOINT TACTICAL AIR STRIKE REQUEST		See Joint Pub 3-06 for preparation instructions.	
<b>SECTION I-MISSION REQUEST</b>			
1. UNIT CALLED	THIS IS	REQUEST NUMBER	DATE SENT TIME BY
PREPLANNED: <input type="checkbox"/> A	PRECEDENCE <input type="checkbox"/> B	PRIORITY	RECEIVED TIME BY
2. IMMEDIATE: <input type="checkbox"/> C	PRIORITY		
TARGET IS/NUMBER OF			
<input type="checkbox"/> A PERS IN OPEN	<input type="checkbox"/> B PERS DUG IN	<input type="checkbox"/> C WPNS/MG/RR/AT	<input type="checkbox"/> D MORTARS, ARTY
<input type="checkbox"/> E AAA ADA	<input type="checkbox"/> F RKTS MISSILE	<input type="checkbox"/> G ARMOR	<input type="checkbox"/> H VEHICLES
<input type="checkbox"/> I BLDGS	<input type="checkbox"/> J BRIDGES	<input type="checkbox"/> K PILLBOX, BUNKERS	<input type="checkbox"/> L SUPPLIES, EQUIP
<input type="checkbox"/> M CENTER (CP, COM)	<input type="checkbox"/> N AREA	<input type="checkbox"/> O ROUTE	<input type="checkbox"/> P MOVING N E S W
<input type="checkbox"/> Q REMARKS			
TARGET LOCATION IS			CHECKED
<input type="checkbox"/> A (COORDINATES)	<input type="checkbox"/> B (COORDINATES)	<input type="checkbox"/> C (COORDINATES)	<input type="checkbox"/> D (COORDINATES)
<input type="checkbox"/> E TGT ELEV	<input type="checkbox"/> F SHEET NO.	<input type="checkbox"/> G SERIES	<input type="checkbox"/> H CHART NO.
TARGET TIME/DATE			
<input type="checkbox"/> A ASAP	<input type="checkbox"/> B NLT	<input type="checkbox"/> C AT	<input type="checkbox"/> D TO
DESIRED ORD/RESULTS			
<input type="checkbox"/> B DESTROY	<input type="checkbox"/> C NEUTRALIZE	<input type="checkbox"/> A ORDNANCE	<input type="checkbox"/> D HARASS/INTERDICT
FINAL CONTROL			
<input type="checkbox"/> A FAC/RABFAC	<input type="checkbox"/> B CALL SIGN	<input type="checkbox"/> C FREQ	
<input type="checkbox"/> D CONT PT			
8. REMARKS			
1. IP	2. HDNG	3. DISTANCE	4. TGT ELEVATION
5. TGT DESCRIPTION	6. TGT LOCATION	7. MARK TYPE	8. FRIENDLIES
9. EGRESS	10. BCN-TGT	11. BCN-TGT	12. BCN ELEVATION
"MAG	"MAG	METERS	"MAG
OFFSET-L/R	BCN GRID	TGT GRID	FEET MSL
<b>SECTION II-COORDINATION</b>			
9. NGF	10. ARTY	11. AIO/G-2G-3	
12. REQUEST <input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED	13. BY	14. REASON FOR DISAPPROVAL	
15. AIRSPACE COORDINATION AREA <input type="checkbox"/> A IS NOT IN EFFECT <input type="checkbox"/> B NUMBER		16. IS IN EFFECT <input type="checkbox"/> A (FROM TIME) <input type="checkbox"/> B (TO TIME)	
17. LOCATION <input type="checkbox"/> A (FROM COORDINATES) <input type="checkbox"/> B (TO COORDINATES)		18. WIDTH (METERS)	19. ALTITUDE/VERTEX <input type="checkbox"/> A (MAXIMUM VERTEX) <input type="checkbox"/> B (MINIMUM)
<b>SECTION III-MISSION DATA</b>			
20. MISSION NUMBER	21. CALL SIGN	22. NO. AND TYPE AIRCRAFT	23. ORDNANCE
24. EST/ACT TAKEOFF	25. EST TOT	26. CONT PT(COORDS)	27. INITIAL CONTACT
28. FAC/FAC(A)TAC(A) CALL SIGN/ FREQ	29. AIRSPACE COORDINATION AREA	30. TGT DESCRIPTION	*31. TGT COORD/ELEV
32. BATTLE DAMAGE ASSESSMENT (BDA) REPORT (USMTF INFLTREP)			
LINE 1/CALL SIGN		LINE 4/LOCATION	
LINE 2/MSN NUMBER		LINE 5/TOT	
LINE 3/REQ NUMBER		LINE 6/RESULTS	
REMARKS			
* TRANSMIT AS APPROPRIATE			

DD Form 1972, (REVISED) 15 NOV 1994. Supersedes DD Form 1972, Apr 1975.

Figure B-1. Joint Tactical Air Strike Request.

## Appendix C

# Communications Assets

### **RADIO: AN/VRC-91A SINCGARS**

#### **Characteristics**

**Frequency range:** 30 to 87.975 MHz

**Range (using vehicular antennas):** Voice 5 to 10 km HI  
Voice 10 to 40 km PA  
Data 3 to 5 km HI  
Data 5 to 25 km PA

**Standard vehicle power source:** 27.5 VDC

**Secure device:** Integrated

**Antenna:** AS-3683/PRC (tape)  
AS-4266/PRC (whip)  
AS-3900/3916 (vehicle)

**Weight:** 58 lbs

**TAM#:** A2170

**NSN#:** 5820-01-267-9478

Long-range and/or short-range configuration of the ICOM SINCGARS comes with manpack accessories. Controllable output power with a maximum of 50 watts for RT using the power amplifier and a maximum output of 4 watts for remaining channels. Contains integrated COMSEC (ICOM) module for secure voice and data. Ranges shown are for planning purposes only. They are based upon line of sight communications and are averages



for normal conditions. Use of the OE-254 (not SL3 to the AN/VRC-91A) antenna increases ranges for both voice and data transmissions. Data range is based on 2,400 BPS.

## **RADIO: AN/PRC-104**

### **Characteristics**

**Frequency range:** 2 to 29.999 MHz

**Range:** 30 mi (portable)  
300 mi (with transportable antenna)

**Standard power source:** 20 to 32 VDC  
2 BA-5590 or 2 BB-590

*Note: Do not combine a rechargeable BB-590 battery with a BA-5590 in the same piece of equipment.*

**Battery life:** BA-5590, 22 to 26 hrs  
BB-590, 2 to 4 hrs

**Antenna:** AT-271A  
AB-1241

**Secure device:** TSEC/KY-99

**Weight:** 28 lbs

**TAM#:** A2065

**NSN#:** 5820-01-269-5603

Ranges shown are for planning purposes only. They are based upon line of sight communications and are averages for normal conditions. Use of the AS-2259 (not SL3 to the AN/PRC-104) antenna increases ranges for both voice and data transmissions. Transmit to receive ratio, output setting, and local ambient temperature can reduce battery life.

### **Operating Instructions**

Install batteries in battery pack.

Attach battery pack to receiver/exciter unit.

Attach whip antenna to shock mount.

Attach antenna assembly (whip antenna and shock mount) to antenna socket.

Connect handset.

Set MODE switch to V-TR.

Set ANT SEL switch to WHIP ANTENNA.

Set SB switch to USB.

Set frequency to 02221.2

Turn VOLUME switch to desired listening level.

Push PTT switch on handset and verify 1 kHz sidetone (terminates in less than 12 seconds).

Repeat above two steps for other test frequencies: 3334.3 LSB, 6665.6 USB, 8889.8 LSB, 15554.5 USB, and 27778.7 LSB.

Select a frequency from a time standard broadcast (5, 10, 15, 20, and 25 MHz). Monitor broadcast and switch sidebands to verify constant pitch of audible signals.

Set desired operational frequency.

Push PTT switch on handset and transmit to distant station.

## **RADIO: AN/PRC-113**

### **Characteristics**

**Frequency range:** VHF 116 to 149.975 MHz  
UHF 225 to 399.975 MHz

**Range:** 30 mi

**Standard power source:** 24 VDC  
2 BA-5590 or 2 BB-590

*Note: Do not combine a rechargeable BB-590 battery with a BA-5590 in the same piece of equipment.*

**Battery life:** BA-5590, 22 to 26 hrs  
BB-590, 2 to 4 hrs

**Antenna:** VHF/UHF

**Secure device:** TSEC/KY-99

**Weight:** 16.7 lbs

**TAM#:** A2069

**NSN#:** 5820-01-136-1519

## **RADIO: AN/PRC-119-A SINGARS**

### **Characteristics**

**Frequency range:** 30 to 87.975 MHz

**Range:** Voice 5 to 10 km HI  
Data 3 to 5 km HI

**Standard power source:** 12 VDC  
1 BA-5590

**Memory power source:** 1 BA-5372U

**Battery life:** 1 BA-5590 approx 22 to 26 hrs  
1 BA-5372U approx 6 months

**Antenna:** AS-3683/PRC (tape)  
AS-4266/PRC (whip)

**Secure device:** Integrated

**Weight:** 22 lbs

**TAM#:** A2070

**NSN#:** 5820-01-267-9482

MANPAD configuration of the ICOM SINCGARS: The operating mode include single channel, frequency hopping with internal ECCM module. Maximum output 4 watts. Number of channels 2320. Capable of preset frequency scanning. Ranges shown are for planning purposes only. They are based on line of sight communications and are averages for normal conditions. Use of the OE-254 (not SL3 to the AN/PRC-119) antenna will increase ranges for both voice and data transmissions. Transmit to receive ratio, output setting, and local ambient temperature can reduce battery life.

## **RADIO: AN/MRC-138**

### **Characteristics**

**Frequency range:** 2 to 29.999 MHz (HF)  
225 to 400 MHz (UHF)

**Range:** HF 2,000 mi

**Standard power source:** 22 to 30 VDC

**Antenna:** AT-1011

**Secure device:** HF TSEC/KY-99  
TSEC/KY-99  
UHF TSEC/KY-99

**Weight:** 7,700 lbs (includes HMMWV)

**TAM#:** A1935

**NSN#:** 5820-01-337-5294

### **Operating Instructions**

Ensure all cables are tightly and properly connected and all covers are in place.

Connect the antenna.

Ensure proper ground connection to mounting rack frame. ***Grounding is imperative.***

Ensure generator power source is grounded properly if used.

Ensure inlet and exhaust openings on power amplifier and coupler are unobstructed.

Connect handset.

Set MODE switch to V-TR.

Set ANT SEL switch to WHIP ANTENNA.

Set SB switch to USB.

Set frequency to 02221.2.

Set VOLUME switch to desired listening level.

Push PTT switch on handset and verify 1 kHz sidetone (terminates in less than 12 seconds).

Repeat above two steps for other test frequencies: 3334.3 LSB, 6665.6 USB, 8889.8 LSB, 15554.5 USB, and 27778.7 LSB.

Select frequency from a time standard broadcast (5, 10, 15, 20, 25 MHz)  
Monitor broadcast. Switch sidebands to verify constant pitch of audible signals.

Set desired operational frequency.

Push PTT switch on handset and transmit to distant station.

### **OTHER COMMUNICATIONS EQUIPMENT: AN/PSC-2 Digital Communications Terminal (DCT)**

#### **Characteristics**

**Standard power source:** 28 VDC  
115 VAC  
1 BA-5600

**Battery life:** 8 hrs

**Weight:** 5 lbs

**TAM#:** A4098

**NSN#:** 5895-01-339-8341

The AN/PSC-2 DCT is compatible with HF, VHF, UHF, and field wire. The MU-848/PSC-2 PED performs high speed load of programs and data into an AN/PSC-2. The MU-848 uses one BA-5600 (battery life 8 hrs).

**OTHER COMMUNICATIONS EQUIPMENT: AN/PSC-3  
UHF Tactical Satellite Communications Radio**

**Characteristics**

**Frequency range:** 225 to 399.995 MHz

**Standard power source:** 2 BA-5590 or 2 BB-590

*Note: Do not combine a rechargeable BB-590 battery with a BA-5590 in the same piece of equipment.*

**Antenna:** AS-3566 (whip)  
AS-3567 (medium gain)  
AS-3568 (high gain)

**Secure Device:** TSEC/KY-57 or 65

**Weight:** 16 lbs

**TAM#:** A0917

**NSN#:** 5820-01-145-4943

**OTHER COMMUNICATIONS EQUIPMENT:  
AN/PSQ-4 (MPU)/AN/VSQ-1 (SVU)  
Position Location Reporting System (PLRS)**

**Characteristics**

**Frequency range:** 420-450 MHz

**Range:** 30 mi  
300 mi (extended via airborne relays)

**Standard power source:** PSQ-4 MPU  
1 BA-5590 or 1 BB-590  
VSQ-1  
24 VDC

*Note: Do not combine a rechargeable BB-590 battery with a BA-5590 in the same piece of equipment.*

**Battery life:** BA-5590, 15 hrs  
BB-590, 3 hrs

**Antenna:** PSQ-4, AS-3448  
VSQ-1, AS-3449

**Secure device:** TSEC/KGV-6 (internal)

**Weight:** 23 lbs

**TAM#:** AN/PSQ-4: A2051  
AN/VSQ-1: A2151

**NSN#:** AN/PSQ-4: 5820-01-252-5420  
AN/VSQ-1: 5820-01-199-8625

## **OTHER COMMUNICATIONS EQUIPMENT: AN/PSN-11 PLGR**

**Standard power source:** BA-5800

**Memory power source:** LS6-BA

**Battery life:** BA-5800, 10 hrs  
LS6-BA, 1 yr

**Weight:** 4 lbs

**TAM#:** A1260

**NSN#:** 5825-01-374-6643



## **WIRE COMMUNICATIONS EQUIPMENT: AN/GRA-39**

### **Characteristics**

**Frequency compatibility:** UHF  
VHF  
HF

**Remoting range:** 2 mi maximum

**Standard power source:** 9 VDC  
6 BA-30 ea per C-2328 (remote)  
6 C-2329 (local)  
12 total per AN/GRA-39

**Battery life:** 24 hrs (C-2328)  
72 hrs (C-2329)

**Weight:** 23.4 lbs

**TAM#:** A1730

**NSN#:** AN/GRA-39A: 5820-00-082-3998  
AN/GRA-39B: 5820-00-949-9909

### **Operating Instructions**

Install batteries (6 BS-30s in C-2328, 6 BA-30s in C-2329).

Connect field wire to line binding posts of each unit.

Connect LOCAL connector to audio receptacle of radio.

Connect handset to each unit.

Turn POWER switch to ON on both local and remote units.

Establish telephone communications between units. Push PTT switch on handset and transmit to distant unit.

C-2328 remote: Set TEL-RAD-RAD/SPKR switch to TEL position. Set buzzer volume control.

C-2329 local: Set TEL-REMOTE-RADIO switch to TEL position (spring loaded switch). Set buzzer volume control.

Establish radio communications

C-2329 local: Set TEL-REMOTE-RADIO switch to RADIO position. Push PTT switch on handset and transmit to distant station. Change TEL-REMOTE-RADIO switch to REMOTE position.

C-2328 remote: Set TEL-RAD-RAD/SPKR switch to RAD or RAD/SPKR position. Push PTT switch on handset and transmit to distant station.

## **WIRE COMMUNICATIONS EQUIPMENT: TA-312/PT**

**Frequency range:** NA hardwire

**Standard power source:** 2 BA-30

**Battery life:** 168 hrs

**Weight:** 9.75 lbs

**TAM#:** H2443

**NSN#:** 5820-500-543-0012

## **COMMUNICATIONS SECURITY EQUIPMENT: KY-99**

### **Characteristics**

**Transmission medium:** HF  
UHF  
VHF

**Standard power source:** 1 BA-5372 or BA-1372/U  
1 BA-5590

**Battery life:** BA-5372, 6 mos  
BA 5590, 12 to 24 hrs

**Fill devices:** CYZ-10  
KYK-13  
KOI-18  
KYX-15

**Weight:** 4.5 lbs

**TAM#:** A8047

**NSN#:** 5810-01-391-0187

### **Operating Instructions**

Connect fill device to fill connection point of KY-99. Set mode control switch of the KY-99 to OFF line. Turn the KY-99 on.

Scroll through the off-line menu items until the display indicates keys. Press INIT button and scroll to load. Once load is displayed press INIT.

The display will indicate LOAD N with the N flashing. If using a KYK-13, turn it on. Using the arrow keys of the KY-99, select the location of the fill to be stored. If using KOI-18, insert tape. If using KYX-15, select the address toggle switch of the fill to be loaded and set to on.

If using a KYK-13, set the fill switch of the KYK-13 to the desired fill to be transferred. Press INIT on the KY-99, it will prompt the operator with a flashing LOAD N. Press the INIT on the KY-99 again. After a successful load, a pass tone will be heard. The display will read LOAD N with N flashing.

If using KYX-15, return address select toggle switch to OFF and switch to OFF/CK. If using KYK-13, set mode to OFF/CHECK. Set KY-99 to RK, CT, or PT. Disconnect fill cable.

To operate: Turn on the KY-99. Connect external HF/UHF/VHF radio cable. Set mode to CT. Press arrows until desired voice mode is displayed and proper data rate is displayed. Once proper modes and rates are set, press INIT and pass tone will be heard. Press the handset/headset PTT switch and transmit.

## **COMMUNICATIONS SECURITY EQUIPMENT: KYK-13 Electronic Transfer Device**

### **Characteristics**

**Standard power source:** 1 BA-1372/U or BA 5372

**Battery life:** 6 mos

**TAM#:** A8025

**NSN#:** 5810-01-026-9618

### **Operating Instructions**

To load a KYK-13: Connect to keying source. Turn MODE switch to ON. Turn ADDRESS switch to slot to be loaded. Press and release KYK-13 INITIATE button. Red light flashes if key has been received. Turn MODE switch to OFF/CHECK and check parity.

To load TSEC equipment from KYK-13: Connect to equipment or device. Turn MODE switch to ON. Turn ADDRESS switch to appropriate slot. Press and release button on equipment or device being loaded, as required. Red light on KYK-13 flashes if key has been transferred. Turn MODE switch to OFF/CHECK and check equipment or device to ensure it contains key.

To check parity: Turn MODE switch to OFF/CHECK. Turn ADDRESS switch to appropriate slot. Press and release KYK-13 INITIATE button. Red light flashes only if contents of storage register passes parity.

To zeroize: Turn SELECTOR switch to Z-ALL. Turn MODE switch to Z position and hold. Press and release INITIATE button. Turn MODE switch to OFF/CHECK. Turn SELECTOR switch to 1 through 6. Press INITIATE button to check parity.

## **COMMUNICATIONS SECURITY EQUIPMENT: KOI-18 Tape Reader**

### **Characteristics**

**Standard power source:** 1 BA-1372/U or BA-5372

**Battery life:** 6 mos

**TAM#:** A8024

**NSN#:** 5810-01-026-9620

### **Operating Instructions**

Connect to TSEC equipment with fill cable, if appropriate.

Insert tape leader into slot marked IN, lining up feed holes with white dots on device.

Press and release appropriate button on equipment being keyed, as required.

Pull tape through at a steady rate.

Ensure equipment is keyed; if not (constant tone when handset keyed or beeping during normal operations), repeat above procedure.

**COMMUNICATIONS SECURITY  
EQUIPMENT: AN/CYZ-10 Digital Transfer Device**

**Characteristics**

**Standard power source:** Three, BR-2/3ASSP or 1 DL123A

**Battery life:** 30 days

**Weight:** 1.5 lbs

**TAM#:** A80237

**NSN#:** 5810-01-343-1194

**COMMUNICATIONS SECURITY  
EQUIPMENT: TSEC/KYX-15 Net Control Device**

**Characteristics**

**Standard power source:** 1 BA-1372/U or BA-5372

**Battery life:** 6 mos

**Weight:** 3.2 lbs

**TAM#:** A80237

**NSN#:** 5810-01-343-1194

**ANTENNA: AS-2259/GR**

**Characteristics**

**Frequency range:** HF 2 to 30 MHz

**Range:** 300 mi

**Construction time:** 5 minutes by 2 men

**Height:** 15 ft

**Weight:** 14.7 lbs

**TAM#:** H2044

**NSN#:** 5895-00-106-6130

## **ANTENNA: OE-254**

**Frequency range:** VHF 30 to 87.975 MHz

**Range:** .1 to 30 mi

**Construction time:** 15 minutes by 2 men

**Height:** 37 to 41.5 ft

**Weight:** 45 lbs

**TAM#:** A0059

**NSN#:** 5985-01-063-1574

## **FIELD EXPEDIENT ANTENNAS**

Any radio system's capabilities are limited by the design of the system. The radio will only transmit a specified amount of power, but power alone is not necessarily the answer to establishing or maintaining a difficult radio circuit. Operator training, equipment maintenance, and employing the radio system to maximize its capabilities and minimize factors that negatively impact the radio's circuits determine success. The key to obtaining optimum performance from the systems used is to understand the basics of

how they work and how to improve them. The construction of an appropriate field expedient antenna is an ever-increasing necessity for mission accomplishment. Antennas can be constructed from any electrically conductive material (i.e., slash wire, barbed wire, metal pipe, rain gutter). Although any conductive material can be used, multi-strand copper wire of 18 gauge or better provides the best performance. The key to constructing an effective field expedient antenna is the proper usage of antenna wavelength formulas and the selection and construction of the appropriate antenna to accomplish the job.

Antenna selection is accomplished by considering what will affect the circuit or net, what negative effects can be minimized, and what positive characteristics can be used to enhance the circuit or net. Minimum considerations for selecting an antenna are—

- What directional characteristics are required?
- What, if any, obstructions are in the path to distant stations?
- Will the distant station be mobile?
- What is the transmit distance between stations?
- Are the materials required to build the antenna available?

All antennas have radiation patterns. Antenna directivity is classified according to how they radiate energy in the horizontal plane. The three classifications are—

- Omni-directional.
- Bi-directional.
- Uni-directional.



Omni-directional antennas radiate energy equally in all directions of the compass. Bi-directional antennas radiate energy in two main lobes in opposite directions. Uni-directional antennas radiate energy primarily in one direction.

### **Very High Frequency**

For Marine Corps purposes (30 to 87.975 MHz), VHF communications provide the primary means for ground-to-ground, short-range communications used by tactical units. VHF frequencies are *not* usable for sky-wave propagation, but do provide some surface wave and is usable for ground-wave communications. VHF communications provide circuits free from fading and is the primary ground radio frequency range.

### **High Frequency**

For Marine Corps purposes (2 to 29.999 MHz), HF communications provide sky-wave propagation in the lower portion of the band. HF also propagates in ground wave. A disadvantage of HF communications is high levels of interference. The HF spectrum is congested due to the large number of HF radio equipment currently in use and the long-range propagation of each HF frequency in use.

### **Antenna Wavelength Formulas**

Radio waves in free space travel at the speed of light. When RF energy is applied to an antenna, it travels through the material of the antenna and its speed changes. The following formulas are used to compute the optimal length of expedient antenna wires.

*Formula for a quarter wave length is:*

234 divided by the Frequency in MHz = 1/4 the wave length in feet.

Examples:

1/4 wave length for 3 MHz is;  $234 \div 3 = 78$  ft (wire length)

1/4 wave length for 30 MHz is;  $234 \div 30 = 7.8$  ft (wire length)

*Formula for a half wave length is:*

468 divided by the Frequency in MHz = 1/2 the wave length in feet.

Examples:

1/2 wave length for 3 MHz is;  $468 \div 3 = 156$  ft (wire length)

1/2 wave length for 30 MHz is;  $468 \div 30 = 15.6$  ft (wire length)

*Formula for a full wave length is:*

936 divided by the Frequency in MHz = 1 wave length in feet.

Examples:

1 wave length for 3 MHz is;  $936 \div 3 = 312$  ft (wire length)

1 wave length for 30 MHz is;  $936 \div 30 = 31.2$  ft (wire length)

The AN/PRC-104 reads in kHz. Move the decimal point to the left 3 spaces to convert to MHz ( $30,825.0$  kHz =  $30.8250$  MHz).

### **Horizontal/Vertical/Inverted V Dipole**

The horizontal dipole can be used for HF or VHF, but it is important to note the ground effects on the radiation pattern. The dimensions for the horizontal and vertical dipole are the same. The antenna consists of two independent, quarter wavelength wires placed in-line and end to end. The two near ends are as close as possible, but insulated from each other. Each of the independent wires is connected to different sides of the coax cable (i.e., one is connected to the center conductor and the other is connected to the braided ground conductor). The transmission line should be kept perpendicular to the antenna to the maximum extent possible.

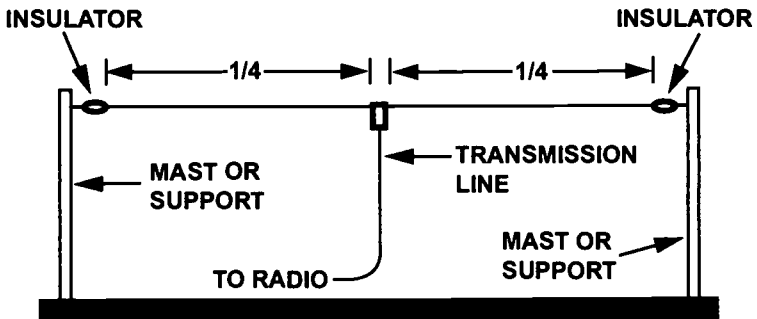
The vertical dipole does not use the ground as an image antenna, which is possible with a quarter wave or whip antenna using ground radials. Therefore, raising the antenna as high as possible will provide the best performance and increases the range of the system. The bottom of the antenna should be secured to the ground to keep the antenna orientated vertically. When the antenna is supported from a tree, tower, or metal mast, the antenna should be extended out from the support as far as possible and in the direction that maximum radiation is desired. See figures C-1 and C-2.

**Sloping V**

A sloping V antenna is essentially two sloping long wire antennas orientated so that the energy radiated from each leg reinforces the other. If terminating resistors are not used, the antenna is considered bi-directional. However, the required takeoff angles may not be achieved in order to communicate effectively in both directions. This antenna is considered an effective antenna for both HF and VHF communications. See figure C-3 on page C-22.

**Vertical Half Rhombic**

Vertical half rhombic antennas are high gain antennas and can enhance most communications circuits. Rhombic antennas are long



**Figure C-1. Horizontal Dipole.**

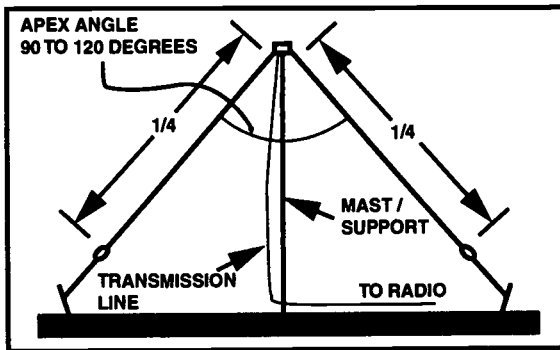
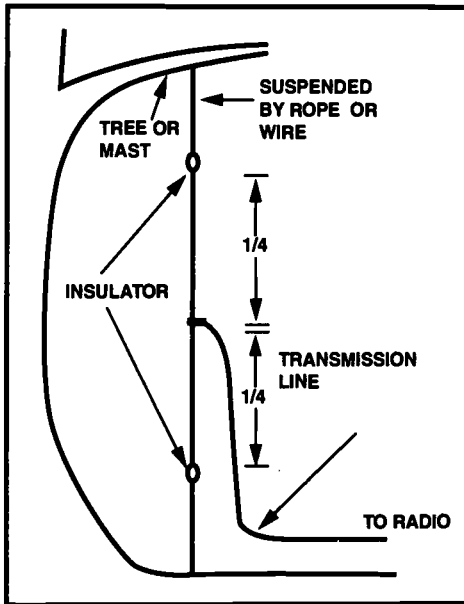


Figure C-2. Vertical Dipole and Inverted V or Drooping Dipole.

wire antennas, rather large in size. They can easily be used for VHF or HF circuits that require a low takeoff angle. Rhombic antennas are characteristically bi-directional or uni-directional if terminating

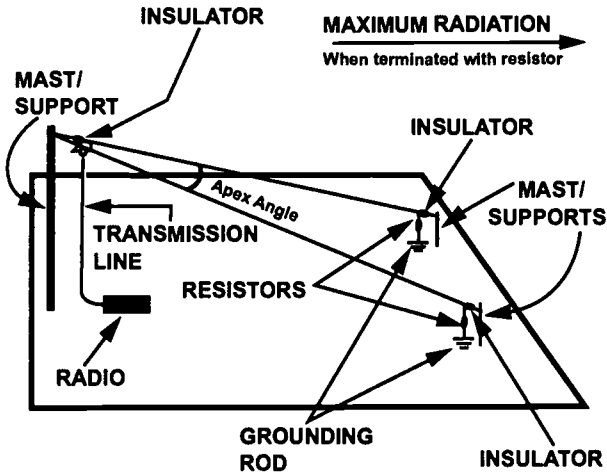


Figure C-3. Sloping V.

resistors are used. The vertical half rhombic is constructed from one piece of antenna wire, which is supported in the middle by a single mast. See figure C-4.

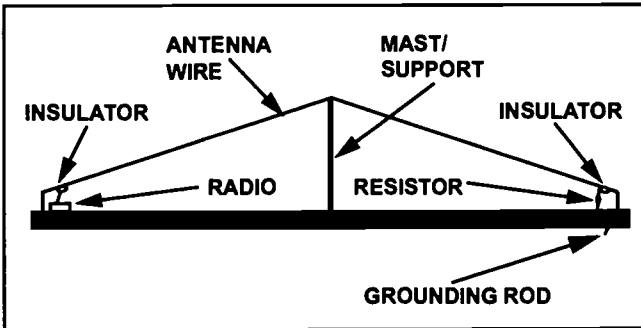


Figure C-4. Vertical Half Rhombic.

**Inverted L**

The inverted L antenna provides omni-directional, vertically polarized, ground-wave signal from the vertical section and a high takeoff angle horizontally polarized signal off of the horizontal portion. The radiation pattern of the inverted L antenna is dependent on the length of the vertical portion compared to the horizontal portion. The longer portion (vertical or horizontal) will radiate more energy than the shorter portion (vertical or horizontal). Both the vertical and horizontal portions of the inverted L are constructed from one piece of wire that is  $3/4$  wavelength in size. The radiation pattern is dependent on how much of the  $3/4$  wavelength wire is positioned vertically rather than horizontally. The insulator at the vertical and horizontal joint only insulates the antenna wire from the support mast. The entire antenna is one piece. The wire is connected to the center conductor of the radio antenna connector or secured underneath a component antenna base. A counter poise can be created to enhance the radiation from the horizontal element but is not required. See figure C-5.

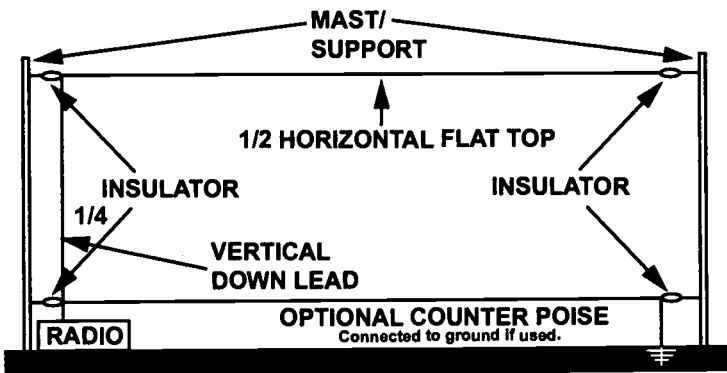


Figure C-5. Inverted L.



## Appendix D

# 5-PARAGRAPH ORDER

This appendix contains a sample format of a 5-paragraph order. It is not inclusive. The team leader should be familiar with the 5-paragraph order format and all essential information required to complete the mission. It is also the responsibility of the team leader to ensure his assistant gunner is informed on all aspects of the mission, ROE, and tasks to be accomplished and to acquaint subordinates with the operating area to include key terrain, site location, adjacent unit locations (tactical air command center [TACC], TAOC, DASC, forward operating bases [FOBs], etc.), and expected axes of attack.

### 1. ( ) Situation

a. ( ) General. Address current situation to include a big picture comparison of enemy versus friendly locations. Address MAGTF air defense priorities and current weather and its effects on operations.

b. ( ) Enemy Forces. Address enemy forces and capabilities with respect to friendly IADS capabilities.

(1) ( ) Ground forces disposition.

(2) ( ) Aircraft number and type (include unmanned aerial vehicles [UAVs]).

(3) ( ) Expected threat axis and likely avenues of approach.



- (4) ( ) Expected times of attack.
  - (5) ( ) Ordnance types/delivery techniques.
  - (6) ( ) EA and/or electronic warfare support (ES) capabilities.
  - (7) ( ) IRCCM capabilities.
  - (8) ( ) NBC capabilities.
  - (9) ( ) Night capabilities.
  - (10) ( ) Surface-to-surface threat.
  - (11) ( ) Special operations and/or terrorist threat.
  - (12) ( ) Most likely enemy course of action.
- c. ( ) Friendly Forces
- (1) ( ) Higher. Include battalion combat operations center (COC), early warning/control (EW/C), TAOC, TACC.
  - (2) ( ) Adjacent. Include ground combat element (GCE), combat service support element (CSSE), Stinger.
  - (3) ( ) Supporting. Address as appropriate.
- d. ( ) Attachments and Detachments
- e. ( ) Assumptions. Based upon operations plans.

2. ( ) Mission

3. ( ) Execution

a. ( ) Commander's Intent

b. ( ) Concept of Operations

c. ( ) Tasks

d. ( ) Reserve

e. ( ) Coordinating Instructions

(1) ( ) Time of departure/time to be operational.

(2) ( ) Initial air defense warning conditions, WCS, SOA.

(3) ( ) Initial mode of control (centralized, decentralized).

(4) ( ) Engagement direction authority (TAOC, airborne warning and control system [AWACS], airborne early warning [AEW], etc.).

(5) ( ) Autonomous operations.

(6) ( ) Visual combat air patrol (VISCAP), battle defense zone (BDZ), MEZ, fighter engagement zone (FEZ) locations.

(7) ( ) Surveillance gaps.

(8) ( ) Primary threat axes.

(9) ( ) RTF, MRRs, ROE, and ID criteria.

(10) ( ) Firing doctrine guidance (specific with respect to single targets, raids, jammers, and maneuvering and/or non maneuvering targets).

(11) ( ) Lane duck procedures.

(12) ( ) Self-defense criteria.

(13) ( ) Manual cross-tell procedures.

(14) ( ) Casualty plans.

(15) ( ) Liaison requirements.

(16) ( ) Alternate site locations.

(17) ( ) Consolidation points.

(18) ( ) NBC MOPP conditions and decontamination plans.

4. ( ) Administration and Logistics

a. ( ) Water and rations.

b. ( ) POL.

c. ( ) Missile resupply and/or ammunition (include initial missile loadout).

d. ( ) Location of corpsman and/or medical evacuation (MEDEVAC) procedures.

e. ( ) Handling of enemy prisoners of war (EPW).

f. ( ) Equipment maintenance.

5. ( ) Command and Signal

a. ( ) Command

- (1) ( ) Location and next higher unit leader's location.
- (2) ( ) Succession of command.

b. ( ) Signal

- (1) ( ) Current period for automated communications-electronics operating instructions (ACEOI).
- (2) ( ) Frequencies and/or call signs (PRI/ALT).
- (3) ( ) Required communications nets.
- (4) ( ) Prioritization and restoration of communications nets.
- (5) ( ) Data link reference points and battery address (including information for ground-based data link).
- (6) ( ) Lost or alternate communications procedures.
- (7) ( ) Required reports (times required).
- (8) ( ) Frequency, call sign, and/or crypto change-over times.
- (9) ( ) Challenge and/or password.
- (10) ( ) Brevity codes.
- (11) ( ) EMCON and/or electronic protection (EP) procedures.
- (12) ( ) Plan for air tasking order (ATO) distribution.

Time Hack



## Appendix E

# Enhanced Precision Lightweight Global Positioning System Receiver Operations

This appendix includes information for the basic setup of the EPLGR for a position fix and EPLGR operations with the remote terminal unit.

### Contents

#### Introduction

- Section 1 How to set up the PLGR.
- Section 2 How to obtain position time and tracking information.
- Section 3 How to initialize the PLGR.
- Section 4 Crypto variable operations.
- Section 5 How to enter a waypoint.  
How to enter coordinates for your waypoint
- Section 6 Marking waypoints.
- Section 7 How to navigate.
- Section 8 How to load global positioning system (GPS) time into a SINCGARS.
- Section 9 Setup of the EPLGR for RTU operations.

## **INTRODUCTION**

Before using the precision lightweight global receiver (PLGR), ensure the LAAD team has a common understanding of GPS operations. The NAVSTAR GPS is a space-based navigation and timing system. There are 24 satellites in 6 orbits, you can't see them; but there are usually 6 to 9 satellites in view to a GPS receiver at any given time. The PLGR needs only three satellites to give a 2D position (no elevation). To determine elevation, the PLGR requires four satellites. See figure E-1.

### **SECTION 1 HOW TO SET UP THE PLGR**

Setting up the operating parameters of the PLGR is critical. Consider the mission requirements before making all selections. Press the ON BRT key to turn the receiver on. A self-test begins immediately, and upon completion, the results are displayed. The NO FAULTS message indicates the unit is functioning properly. FIX and OLD will be displayed on the first line every time the set is turned on and is not connected to external or vehicle power. If connected to external or vehicle power the default will be CONT OLD. The position initially displayed is "OLD" information until the receiver collects and calculates satellite data and displays the current position known as the "First Fix."

<b>FIX</b>	<b>Old</b>
<b>11R</b>	<b>MGRS-New</b>
<b>EZ 12345e</b>	<b>67893n</b>
<b>ELh+00134ft</b>	<b>^P</b>

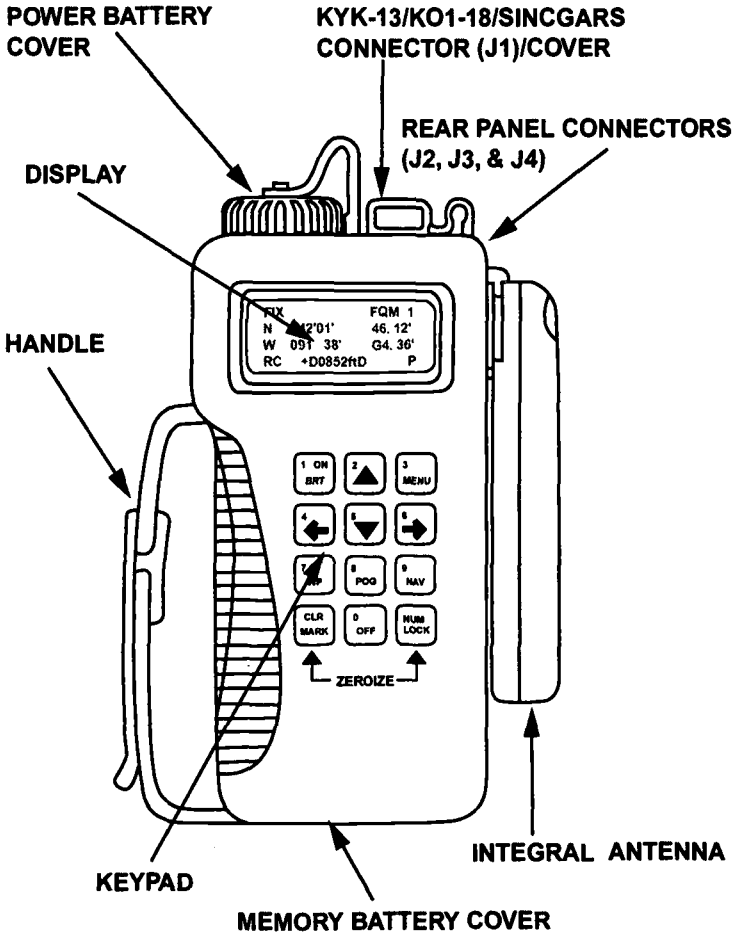


Figure E-1. Enhanced Precision Lightweight Global Positioning System Receiver.



## **Mode Selection**

Press the MENU key once.

<b>&lt;Move&gt;</b>	<b>^Select</b>
<b>STATUS</b>	<b>SETUP</b>
<b>INIT</b>	<b>TEST</b>
<b>HELP</b>	<b>&lt;more&gt;</b>

Use the right arrow key to move the flashing cursor to the SETUP field. Press the down arrow key to activate the SETUP function.

<b>SETUP MODE:</b>	<b>FIX</b>
<b>Quick POS FIX,</b>	
<b>then STBY</b>	
<b>SV-TYPE: all-Y</b>	<b>^P</b>

Line 1 will display SETUP MODE: FIX. Line 2 and 3 provide a brief explanation of each mode selected. Line 4 displays the satellite vehicle (SV) type. Press the right arrow key once to highlight the FIX mode of operation. Fix mode means the PLGR acquires satellites and determines the present position. Then automatically changes to standby (STBY) mode after the position is determined. Press the up arrow key to change the mode of operation to CONT. Press the right arrow key once to highlight SV-TYPE: all-Y.

<b>SETUP MODE: CONT</b>
<b>Continuous POS and</b>
<b>VEL update</b>
<b>SV-TYPE: all-Y ^P</b>

Press the right arrow key once to obtain the change page symbol (^) next to the P. All-Y tells the PLGR to track only Y-code signals

when crypto keys are loaded. Mixed allows the PLGR to track any type of satellite signal.

## **Unit Selection**

Press the down arrow key once to display the SETUP UNITS page.

<b>SETUP UNITS</b>	
<b>MGRS-New</b>	<b>Metric</b>
<b>Elev: feet</b>	<b>MSL</b>
<b>ANG: Deg</b>	<b>Mag^P</b>

This page allows you to select your coordinate format and the units you want the PLGR to display your measurement under. Press the right arrow key once to highlight the coordinate system on line 2. One of seven coordinate systems can be selected by pressing the down arrow key. Select MGRS-NEW if you are using a military map. For maritime and aviation charts, you may select L/L DM or L/L DMS.

Press the right arrow key to move to the distance and velocity field. You may choose one of three options by pressing the down arrow key. Select metric, which is normally used with military maps.

Press the right arrow key to highlight the elevation reference field. Select MSL, which is the standard option.

Press the right arrow key to highlight the angle field. Select Deg (degrees) which is the standard option.

Press the right arrow key to highlight the north reference. Press the down arrow key to select one of three options available. Select Mag when using the PLGR to determine bearings.

## **Magnetic Variation Selection**

Press the right arrow key once and then press the down arrow key once to display the SETUP MAGVAR page.

<b>SETUP</b>	<b>MAGVAR</b>
<b>TYPE:</b>	<b>Calc Deg</b>
	<b>WMM 1995</b>
	<b>^P</b>

This page is used to choose the source of the magnetic variation the east/west difference, in degrees or mils, between true and magnetic north. If a map is not available, select Calc Deg.

## **Elevation Hold and Time Zone Selection**

Press the down arrow key to display page 4 of SETUP. Page four of the setup display is used to customize the display, which includes options for elevation calculation, time format, and error display. Selecting AUTOMATIC for the elevation means it will be calculated each time a new present position is received. If the PLGR is tracking less than four satellites, elevation will be pulled from memory thereby allowing for continued navigation capabilities. Satellites transmit in ZULU time, however, by entering an offset value, local time can be displayed. Your selection of error display format applies to both position and time displays. Estimated position error can be displayed numerically as meters, yards or feet, depending on selection made. Another option is the figure of merit (FOM), which is relative value ranging from one to nine, nine being the least accurate.

## Datum Selection

Press the down arrow key to access the next page.

<b>SETUP</b>	<b>DTM: WGD</b>
<b>WGS-84</b>	
<b>AUTOMATIC</b>	<b>OFF</b>
<b>TIMER: off</b>	<b>^P</b>

Military maps are drawn using a system of common references called a datum. A datum is a surveyed line or point that ensures all maps within a series will correctly match when placed edge to edge. Fifty-two map datums sets are available within the PLGR. Maps have two associated datums: horizontal and vertical (altitude). When using the PLGR with the Avenger, the datum should be set as WGD/WGS-84 (World Geodetic System 1984), which should be used unless instructed to use specific datum for your theater of operations. When navigating with the PLGR, the datum of the map in which you are navigating with should be used. (Incorrect setup of datums can result in errors of up to 900 meters.)

When using the PLGR, line four on this display allows you to select the duration for the automatic off timer. This sets the amount of time the PLGR will stay on after a fixed position has been obtained. It is operational only when battery power is in use. Use the right arrow key to move the flashing cursor to a desired field and then press the down arrow key.

## **Setup In/Out Port**

Setup I/O page.

<b>SETUP</b>	<b>I/O</b>
<b>SERIAL:</b>	<b>Standard</b>
<b>HAVEQUICK</b>	<b>Off</b>
<b>1PPS: Off</b>	<b>^P</b>

This page allows you to control SERIAL communications, HAVEQUICK, and 1PPS Options. You may configure the J2 Serial I/O port to select one of two data port options: Standard or instrumentation. Select standard unless otherwise directed. Select HAVEQUICK: Off Select 1PPS: Off

## **Automatic Setup**

Press the down arrow key to activate the setup AutoMark page.

<b>SETUP</b>	<b>AUTOMARK</b>
<b>MODE: off</b>	<b>WP001</b>
<b>17-05-00</b>	<b>1337L</b>
<b>REPEAT 00h00m</b>	<b>^P</b>

The AutoMark feature commands the PLGR to periodically; Wake Up, Take a Position Fix, Store it as a waypoint, and Return to the mode of operation it was previously in.

The remaining pages for setup are for advance E-PLGR users.

## **Adjusting Display Back Light**

The display is backlighted for night viewing. Be aware that the PLGR draws more battery power with back lighting on. Hold the ON BRT key and press the up arrow key. This increases the display

back lighting. Hold the ON BRT key and press the down arrow key. This reduces the display back lighting. Press the ON BRT key, this toggles the display back lighting off and on.

## **SECTION 2**

### **HOW TO OBTAIN POSITION, TIME, AND TRACKING INFORMATION**

How to locate your current position. Press the POS key to display the position page. The position displayed is “old” information until the receiver collects and calculates satellite data and displays the current position known as the “First Fix.”

#### **Track and Search Information**

Press the POS key twice to obtain information on the satellite vehicle that the PLGR is tracking and searching.

<p><b>Track/Search</b> <b>06 12 07 23/19</b> <b>#VIS: 11 #GOOD: 11</b> <b>ALM AGE: 1 day ^P</b></p>
---

This display page contains the satellite tracking data and almanac age.

Line 1—Satellite Track/Search table Heading

Line 2—Satellite identifier for each satellite tracked or searched for. Ids to the left of the slash are Satellites tracked. Ids to the right of the slash are satellites searched for.

Line 3—Shows the number of visible satellites. The number of visible satellites that are in good health.

Line 4—Shows the age of the almanac. The age can be from 1 to 99 days. The almanac provides the PLGR with the location of the satellites. A 1-day almanac is the most current and preferred. The remaining pages of POS are for advanced PLGR users.

## SECTION 3

### HOW TO INITIALIZE THE PLGR

The PLGR has the ability to determine present position, time, date, track, and ground speed without any operator input and needs no initialization. Average time for “search-the-sky” (cold start) acquisition is 6 minutes or less; maximum is 15 minutes. Operator entry of initialization data may speed up acquisition time.

Press the MENU key once to access page 1 of the menu.

<move>	^select
STATUS	SETUP
INIT	TEST
HELP	<move>^P

Press the right arrow key to highlight the INIT field. Press the down arrow key to activate the INIT field. If the initialize position display is accessed after the PLGR has received a good position fix, the display shown on the left comes up.

POS	INIT POS	CLR
Known, init is	11R	MGRS-NEW
Not required	EZ	1234e 67890N
^P	EI 00123	^P

If the PLGR requires initialization the display shown on the right comes up. Press the right arrow key three times to highlight line 2

of the display. Press the up or down arrow key to enter the correct grid zone designation from the map. Press the up or down arrow key to enter the correct grid coordinates from a map. The entered position must be accurate within 1,000 meters for a P- or Y-code acquisition to be successful. Press the down arrow key to access page two of INIT. If the below display comes up, it is because the PLGR has acquired the time already.

<b>TIME</b> <b>Known, Init is</b> <b>Not required</b> <b>^P</b>
--

**The remaining pages of INIT is for advanced EPLGR users.**

## **SECTION 4**

### **CRYPTO VARIABLE OPERATIONS**

You cannot compensate for the selective availability errors without crypto keys. You cannot read the encrypted signals. There is no protection against spoofing. The receiver still operates but cannot be used for combat operations. Access the crypto menu page. Press the MENU key twice to access page 2 of menu. *If CRYPTO is displayed on line 4, your E-PLGR has been keyed.*

<b>DATA-XFR</b>	<b>SV-SEL</b>
<b>DOP-CALC</b>	<b>ALERTS</b>
<b>SINGARS</b>	<b>KOI-18</b>
<b>CRYPTO &lt;more&gt;</b>	<b>^P</b>

#### **Crypto Key Entry via AN/CYZ-10**

- Turn on the AN/CYZ-10, read, "Radio/SOI/SUPERVISOR."



- Enter Radio, read “SEND/RECEIVE/DATABASE/SETUP/COMSEC/TIME.”
- Enter COMSEC, read “VG/LD/RV/AK/MK/VU.”
- Enter LD, read, “Select TEK/KEK.”
- Enter TEK.
- Select the desired GPS key, then press ENTER.
- Enter QIT, read “Connect AN/CYZ-10 to RT”—(Do not comply).”
- Press, read “Press Load on RT”—(Do not comply).
- Turn on the E-PLGR, wait for self-test to complete.
- Connect AN/CYZ-10 to the J1 port on the PLGR GPS key transfer automatically.
- The AN/CYZ-10 reports: “Keys transferred.” The PLGR reports “Keys Loaded.”
- Bring up the CRYPTO pages from the system MENU. Verify the crypto key status.
- Enter the type loaded on the crypto key type display.
- Disconnect AN/CYZ-10 from the J-1 port on the PLGR.

The PLGR now has a key loaded, and you are receiving the secure code, which allows the set to reach a FOM 1. This takes about 15 minutes with a GUV key installed.

## SECTION 5 HOW TO ENTER A WAYPOINT

A waypoint is the location of a point on a desired course described by coordinates or a physical location. You can enter waypoints into the PLGR by map coordinates or by a known range, azimuth, and elevation from your present position. Press the WP key to access the waypoint menu page.

WP <move>	^ SEL
ENTER	EDIT COPY
SR-CALC	RNG-CALC
DIST	CLEAR ROUTE

Press the down arrow key to activate the waypoint enter field. You are now prepared to enter your first waypoint.

WP001	UNUSED001
11R	MGRS-New
EZ	00000e 00000n
No EL	CLR ^P

Press the right arrow key to highlight the waypoint number field in upper left corner. This field allows you to change the waypoint number, if necessary, in numeric order. Press the right arrow key, and the up and down arrow symbol immediately appears next to the waypoint name. This allows you to use the up and down arrow keys to change the waypoint name, in alphanumeric order. Press the right arrow key to highlight the waypoint label field. The waypoint label field allows you to name a waypoint up to ten characters.

## **How to Enter Coordinates for Your Waypoint**

Press the right arrow key to highlight the field to enter your grid zone designation in line 2 of the display. The grid zone designation is found in the map margin area (usually found in the center or lower left corner of your map). Enter the grid zone designator, then enter the 100,000 mile square identifier. At this time, it is easier to press the NUM LOCK key once to allow you to directly enter your grid via the keypad numbers. After entering your coordinate, press the NUM LOCK key once to change the PLGR back to the control mode, A P will be displayed in the lower right hand corner. Now press the right arrow key to move the cursor next to the page symbol. A ^ symbol will appear next to the letter P. You are now ready to store your waypoint data. Please observe the display as you perform the next step. Press the down arrow key and observe the display area. It reads "WAYPOINT STORED" and immediately defaults to page 2 of waypoint. This page allows you to change the DATUM, MAGVAR, and coordinate format, when necessary. If no changes are necessary, press the down arrow key to enter a second waypoint. Follow the procedures above for entering waypoints.

## **SECTION 6 MARKING WAYPOINTS**

The CLR/MARK key is used to store your present position as a waypoint. Press the MARK key once to bring up the mark display. Notice the display comes up with the cursor on the waypoint number. This indicates where the waypoint will be stored.

<b>MARK POS WP:001</b>
<b>MARK: saves</b>
<b>NAV: ManOverbrd</b>
<b>ON: cancels</b>

Press the MARK key again to save the waypoint to the number listed on line 1. Observe the display area upon doing this. It reads "WAYPOINT MARKED." Press ON to cancel the marking waypoint feature and return to the previous display. If all nine hundred ninety nine waypoints are already defined when the Mark key is pressed, the waypoint marked defaults to WP001. You may choose to overwrite this waypoint or select another one.

## **SECTION 7**

### **HOW TO NAVIGATE**

Navigating is using the PLGR to locate various points on a map relative to your current position. There are four navigating modes that may be accessed and selected. However, we will only discuss one, which is 2D FAST. This mode maybe used for land or sea navigation. Press the NAV key once to display the NAV menu page.

<b>SLOW DIRECT</b>
<b>WP001</b>
<b>TARGET</b>
<b>^P</b>

Press the right arrow key to the Nav mode of operation. Now use the down arrow key to select the various mode of operations (slow, 2D fast, 3D fast and custom). Please select 2D Fast. Press the right arrow key to highlight the Navigation method field of operation.

Now use the down arrow key to see the various methods of navigation (direct, CRSE to, CRS FROM). Please select DIRECT.

<b>2D FAST</b>
<b>DIRECT</b>
<b>WP 001    MARK001</b>
<b>          ^P</b>

Direct is used to navigate from your current position directly to the waypoint, not taking obstacles into consideration. Now press the right arrow key to highlight the waypoint number field. Use the up or down arrow key to select waypoint number 2. Now press the right arrow key twice. Press the down arrow key to change the waypoint page. There are no selective fields on this page. The information displayed is used for navigation only.

<b>WP002</b>	<b>30 m</b>
<b>TRK</b>	<b>020.5 m</b>
<b>AZ</b>	<b>210.0 m kph</b>
<b>STR&gt;</b>	<b>190.5    ^P</b>

*Note: Track, azimuth, and steering information will not be displayed unless traveling at 1.5 kilometers and above.*

Line 1 (left corner) is the waypoint number you are currently navigating to. Line 1 (right corner) is the position accuracy. Line 2 is your current heading in degrees. (TRK 020.5 Deg magnetic). Line 3 is the direct azimuth from your current position to the waypoint. Line 3 (right corner) is your ground speed. Line 4 is your left/right steering angle. The steering angle lets you know how much your heading is off from the azimuth. If your TRK (line 2) is within 10 degrees or less from the azimuth, you are on course. However, one must be outside and moving for this to be accurate.

Press the down arrow key. Press the down arrow key to access page 3 of navigation.

<b>RNG 60.0 m</b>
<b>TTG 0020:15</b>
<b>ELD +00003.0 m</b>
<b>MMD2 60.0 m ^P</b>

The third page includes: range, time to go, elevation difference, and minimum miss difference. No data is available (N/A) for time to go and minimum miss distance if you're not moving. Line 1 is the range to the waypoint. As you move toward the waypoint, the range should decrease. If not, you're going the wrong way. Line 2 represents the total time it will take you to reach the waypoint (hours, minutes, and seconds). Line 3 is the difference in elevation (current position minus waypoint altitude). Line 4 is the minimum miss difference (MMD). Normally it is identical to your range, providing you're on course.

In SLOW nav mode, the PLGR performs two-dimensional (2D) nav. Slow nav mode is used for land or sea nav, when the user can not maintain the minimum speed necessary (approximately 1.5 kph) for GPS to compute navigation parameters that depend on velocity.

## **SECTION 8**

### **HOW TO LOAD GPS TIME INTO SINGARS**

Connect the SINGARS cable to the data port (J1) on the PLGR. Connect the other end of this cable to the SINGARS radio data port. Pressing the MENU key twice accesses the SINGARS function. Press either the LEFT/Right arrow key to move the cursor over the SINGARS field. Press the down arrow key to activate the SINGARS time fill. Press the LOAD key on the SINGARS. The

PLGR display reads “time fill successful.” Disconnect the PLGR from the SINCGARS and continue the mission.

## **SECTION 9**

### **SETUP OF THE E-PLGR FOR RTU OPERATIONS**

Turn on the E-PLGR (the position screen will automatically appear). Push the menu key and select setup. If using internal battery power with the E-PLGR select, setup mode: FIX. If using vehicle power for the E-PLGR select, setup mode: CONT. If crypto is loaded in the PLGR, SV-TYPE should be set to all-Y. If crypto is not loaded, use mixed. In combat operations, crypto should always be loaded. On the second page of setup, the E-PLGR should be set to match the map you are using. For RTU operations, the standard datum is WGD/WGS-84. However, if you are navigating using the RTU/PLGR, the datum should match your map. The following is the standard settings:

**SETUP UNITS**  
MGRS-New Metric  
Elev.: meter MSL  
ANG: Deg Grid ^P

**SETUP MAGVAR**  
Type: Calc Deg  
WMM 1995

**SETUP**  
ELHold: automatic  
TIME:ZULU  
ERR:+-m

**SETUP DTM:WGD**  
**WGS-84**  
**AUTOMATIC OFF**  
**TIMER: off**

**SETUP I/O**  
**SERIAL: Standard**  
**HAVEQUICK: Off**  
**1PPS:Off**

**SETUP AutoMark**  
**MODE: off WP001**  
**00-00-98 0000Z**  
**REPEAT 00h00m**

## **RTU Setup for the E-PLGR**

Go to options menu of the RTU Select PLGR Control. Connect the RTU PLGR cable to the J2 Port of the E-PLGR. Reference for setting is described in detail in TM 10296A10/1-1. For detailed operational and maintenance procedures refer to TM 11-5825-291-13, *Operations and Maintenance Manual for Satellite Signals Navigation Sets AN/PSN-11 and AN/PSN-11 V-1*.





# **Appendix F**

## **NBC Operations**

### **NBC RESPONSIBILITIES**

#### **Stinger Teams**

Stinger teams notify section leader immediately upon being contaminated and take appropriate action. Teams continue the mission until given further direction. Stinger teams must be familiar with and able to pass the NBC-1 report (see para 7 and fig. F-2).

#### **Individual Marines**

Individual Marines will carry three nerve agent antidote kits (NAAK 1) when deployed. They are responsible for decontamination of themselves using the M 258 A1 kit and hasty decontamination of their personal equipment using the ABC-M 11 decontamination apparatus.

### **MISSION ORIENTED PROTECTIVE POSTURE**

Considerations for mission oriented protective posture (MOPP) levels are—

- MOPP-0. Before intelligence indicates possible use.
- MOPP-1. Before first use of chemical agents.

- MOPP-2. During all combat operations against a threat force capable of employing biological and chemical agents, including weather conditions favoring threat NBC use.
- MOPP-3. When non-persistent agents are detected and identified.
- MOPP-4. When chemical agent attack is imminent or in progress.

MOPP levels are depicted in table F-1.

**Table F-1. MOPP Levels.**

<b>MOPP LEVEL</b>	<b>OVER GARMENT</b>	<b>OVERBOOT</b>	<b>MASK/HOOD</b>	<b>GLOVES</b>
MOPP-0	Nearby	Nearby	Carried	Nearby
MOPP-1	Worn	Carried	Carried	Carried
MOPP-2	Worn*	Worn	Carried	Carried
MOPP-3	Worn*	Worn	Worn*	Carried
MOPP-4	Worn (closed)	Worn	Worn (closed)	Worn
*Worn open or closed depending on temperature/threat activity.				

## **IMMEDIATE ACTION**

When MOPP-2 or higher is set, each Stinger team should be put on rotating MOPP-4. (One Marine in each team goes to MOPP-4.) At the end of a 15-30 minute period, the other Marine goes to MOPP-4, while the first one resumes the set MOPP level.

If an aircraft is sighted that is spraying, the MOPP-4 Marine engages it while the other Marine goes to MOPP-4. After the aircraft is engaged and both Marines are in MOPP-4, they should sound the NBC alarm and take cover until the agent stops falling. The Stinger team then sends an NBC-1 report to the section leader.

### **SUBSEQUENT ACTION**

The team—

- Evaluates and treats casualties with NAAK, CANA, and M-258 kits.
- Conducts hasty decon with ABC-M 11.
- Conducts MOPP gear exchange as soon as tactically feasible (NLT 6 hours after attack).
- Moves to designated areas and conduct deliberate decontamination of personnel, vehicles, and equipment with adjacent or supported units as soon as tactically feasible.

### **NBC ALARMS**

Vocal and/or audible alarms are given in all cases as soon as a Marine has donned and cleared after an attack or hazard is detected. Due to distance between Stinger teams, the primary method of passing the NBC alarm is by radio.

Or by—

- Rapid and continuous beating on any metal object or any other object that produces a loud noise.
- A succession of very short blasts on a vehicle horn.
- A succession of short blasts or warbling of a hand cranked siren.

*Note: Stinger units located outside the battalion's immediate area must coordinate with the senior agency present/supported unit to ensure they are included in the NBC alert and reporting system for that area of operation.*

## **UNMASKING**

Stinger teams unmask when directed by section leaders or when supported unit unmask. If the alert area covers a large section of the MEZ, unmasking is directed by the section leader in a team by team sequence. This ensures that air defense coverage is maintained during the unmasking procedure.

## **NBC-1 REPORT**

Message containing NBC-1 report include precedence, date-time group (local or Zulu- state), and security classification. Include type of report (NBC-1 Nuclear, NBC-1 Chemical, NBC-1 Biological).

**Table F-2. NBC-1 Report.**

<b>LINE NUMBER</b>	<b>REMARKS</b>
Strike serial number	As assigned by reporting unit
Position of observer	Grid coordinates or place
Direction of attack from observer	Direction measured clockwise from grid north magnetic north (state which) in degrees or mils (state which)
Date-time group of detonation/start of attack	ZULU time
Illumination time (seconds) or date-time group of end of attack	ZULU time
Location of area attacked	Grid coordinates or place
Means of delivery	Artillery, mortars, rockets, missiles, bombs or spray
Type of burst/type of agent	Estimate height of burst. Specify air, surface or unknown for nuclear, state whether ground or air, or spray for chemical state type of agent or attack if known.

## CHEMICAL AGENT CHARACTERISTICS

Table F-3. Chemical Agent Characteristics.

Category	Symbol	Normal state when disseminated	Persistence	Effect	Time to incapacitation
Nerve agent	GB	Vapor or aerosol	A few minutes	Lethal on troops	Very short, death may occur in a few minutes if agent inhaled
Nerve agent	VX	Liquid	A few hours to 4 days	Lethal on troops, contamination of terrain and equipment	A few hours (delayed casualties)
Blister agent	HD	Liquid	Usually a few days, possibly a few weeks	Incapacitation of troops, contamination of terrain and equipment	A few hours delayed casualties
Blood agent	CX	Vapor or aerosol	A few minutes	Incapacitation of troops, contamination of terrain and equipment	Immediate
Choking agent	CK/AC	Vapor or aerosol	A few minutes	Incapacitation of troops, contamination of terrain and equipment	Immediate

## Appendix G

# MEDEVAC Request

MEDEVACs and CASEVACs will be requested using the assault support request (ASR) form per MCWP 3-24, *Assault Support*, and (see fig. G-1). The following portions of the ASR pertain to MEDEVACs. Sections II and III have intentionally been omitted.

<b>Block</b>	<b>Title and Elements</b>	<b>Explanation</b>
1	UNIT CALLED	Identifies the unit designation/call sign/preassigned number.
	THIS IS	Identifies the request originator by unit designator/call sign/preassigned number.
	REQUEST NUMBER	For preplanned missions, indicates the originator's request number in series. For immediate missions, this number is assigned by the DASC.
	SENT	Indicates the time and individual who transmitted the request.
2	REQUEST FOR	Indicates whether request is for helicopter or fixed-wing support.
3	MISSION CATEGORIES	



<b>Block</b>	<b>Title and Elements</b>	<b>Explanation</b>
	<b>IMMEDIATE</b> C. Priority	<p>For immediate requests, enter priority (block C). A precedence entry is not required for immediate requests because, by definition, all immediate requests are precedence #1.</p> <p>Use the numerical designation below to determine priority (e.g., define the tactical situation for preplanned (block B) or immediate (block C)).</p> <ol style="list-style-type: none"><li>1. <b>Emergency.</b> Missions which require immediate action and supersede all other categories of mission priority.</li><li>2. <b>Priority.</b> Missions which require immediate action and supersede routine missions. For medical evacuation (MEDEVAC), use this category for patients who require specialized treatment not available locally and who are liable to suffer unnecessary pain or disability unless evacuated with the least possible delay.</li><li>3. <b>Routine.</b> Missions which do not demand urgency in execution. For MEDEVAC, use this category for patients who can be treated locally, but whose prognosis would benefit by evacuation with the least possible delay</li><li>4. <b>Urgent.</b> (for MEDEVAC only). Evacuation of critically wounded, injured, or ill personnel whose immediate evacuation is a matter of life or death.</li></ol>
	<b>RECEIVED</b>	Indicates the time and individual who received the request
4	<b>TYPE MISSION</b>	Indicates whether the mission is tactical or administrative.
5	<b>MISSION IS</b>	Describes the mission to be performed. Check appropriate blocks 1 through 12 to identify the mission to be performed

<b>Block</b>	<b>Title and Elements</b>	<b>Explanation</b>
6	PAYLOAD IS	Describes the type and approximate amount of the payload to be transported. It is necessary to specify, even if a rough estimate, the number of troops. Other wise ACE planner cannot determine what force is required-aircraft type/number. For internal cargo, include the dimensions of the largest item to be moved. For MEDEVAC, indicate number of casualties in block 6A.
7	INSTRUCTIONS	Indicates the time/coordinates of the Pick up Zone (PZ) and Drop Zone (DZ).
8	LZ DESCRIPTION	Contains detailed information on the LZ. A. WIND DIRECTION/VELOCITY B. ELEVATION (FT MSL) C. SIZE D. OBSTACLES E. FRIENDLY POSITION (DIRECTION/DISTANCE) F. ENEMY POSITION (DIRECTION/DISTANCE) G. LAST FIRE RECEIVED TIME/TYPE (DIRECTION/DISTANCE)
9	LZ WILL BE A. UNMARKED B. MARKED	Indicates if the LZ will be unmarked or marked. If the LZ will be marked, indicate color.
10	LZ MARKED WITH	Identifies the type of LZ marking A. PANELS B. SMOKE C. FLARES D. MIRROR E. LIGHTS F. NAVAID G. OTHER
11	COMMUNICATIONS	Identifies the call sign and frequency of the PZ and DZ.

<b>Block</b>	<b>Title and Elements</b>	<b>Explanation</b>
12	REMARKS	<p>Allows the requestor to add other essential information not provided for in the request format. For MEDEVAC, include type casualties/wounds, litter, ambulatory status, medical attendant requirements, or any other special considerations. If possible, medical personnel should provide a medical regulating code (MRC):</p> <ul style="list-style-type: none"><li>MC Pediatrics</li><li>SS General Surgery</li><li>MM Internal Medicine</li><li>SSC Thoracic Surgery</li><li>NP Psychiatry</li><li>SSM Maxillofacial Surgery</li><li>SB Burns</li><li>SSN Neurosurgery</li><li>SC Spinal Cord Injury</li><li>SSO Opthamology</li><li>SG OB/GYN</li><li>SSU Urology</li><li>SO Orthopedic Surgery</li></ul>



## ASSAULT SUPPORT REQUEST FORM - CONTINUED

ASSAULT SUPPORT REQUEST FORM			
SECTION II — COORDINATION			
13. MSFS	14. ARTILLERY	15. AIO/G-2/G-3	
16. ESCORT/AERIAL REFUELING		A. <input type="checkbox"/> REQUESTED B. <input type="checkbox"/> ASSIGNED	
C. NO/TYPE A/C _____		D. CALL SIGN _____	
E. COMMUNICATIONS _____		F. ARMAMENT _____	
17. REQUEST <input type="checkbox"/> APPROVED <input type="checkbox"/> DISAPPROVED	18. BY _____	19. REASON FOR DISAPPROVAL _____	
20. RESTRICTIVE FIRE/AIR PLAN A. <input type="checkbox"/> IS NOT B. <input type="checkbox"/> NUMBER		21. IS IN EFFECT A. <input type="checkbox"/> FROM TIME _____ B. <input type="checkbox"/> TO TIME _____	
22. LOCATION A. <input type="checkbox"/> _____ B. <input type="checkbox"/> _____ (FROM COORDINATES) (TO COORDINATES)		23. WIDTH (METERS)	24. ALTITUDE/VERTEX A. <input type="checkbox"/> MAX/VERTEX _____ B. <input type="checkbox"/> MINIMUM _____
SECTION III — MISSION DATA			
25. MISSION NUMBER	26. CALL SIGN	27. NO/TYPE AIRCRAFT	
28. EST/ACT TAKEOFF		29. ETA/ATA	
30. MISSION CANCELLED/DIVERTED A. <input type="checkbox"/> CANCELLED B. <input type="checkbox"/> DIVERTED <input type="checkbox"/> BY _____			
31. TERMINATE REQUEST A. GO/NO-GO DTG _____ B. WHEN COMPLETED _____			
32. MISSION RESULTS			ACKNOWLEDGED
A. <input type="checkbox"/> COMPLETE			<input type="checkbox"/> TACC <input type="checkbox"/> TADC
B. <input type="checkbox"/> INCOMPLETE			<input type="checkbox"/> FSCC <input type="checkbox"/> SACC
C. <input type="checkbox"/> OTHER _____			<input type="checkbox"/> DASC <input type="checkbox"/> HDC
			<input type="checkbox"/> TACP <input type="checkbox"/> TACLOG

# Appendix H

## Glossary

### Section I. Acronyms and Abbreviations

#### A

AAC .....	antiaircraft control
AAI.....	antiaircraft intelligence
AAW .....	antiair warfare
ACA .....	airspace coordination area
ACE.....	aviation combat element
ACEOI.....	automated communications-electronics operating instructions
ACID .....	aircraft identification
ADCON.....	administrative control
ADWC.....	air defense weapons conditions
AEW.....	airborne early warning
AGL.....	above ground level
ASR.....	assault support request
ATGM .....	antitank guided missile
ATO.....	air tasking order
AUTO.....	automatic
AVT.....	automatic video tracker
AWACS .....	airborne warning and control system

**B**

BCU ..... battery/coolant unit  
BDZ ..... base defense zone  
bn ..... battalion  
bps ..... bits per second

**C**

C2 ..... command and control  
CA ..... command action  
CASEVAC ..... casualty evacuation  
CCRP ..... cartesian coordinate reference point  
CCS ..... control and communications subsystem  
CDT ..... control display terminal  
CFD ..... COMSEC fill device  
CFT ..... captive flight trainer  
CID ..... combat information detection  
CMD ..... command  
CMS ..... communications security material system  
COC ..... combat operations center  
COMM ..... communications  
COMSEC ..... communications security  
CONUS ..... continental United States  
CSSE ..... combat service support element  
CVC ..... combat vehicle crewman

**D**

DASC ..... direct air support center  
DCT ..... digital communications terminal  
Det ..... detachment  
DF ..... directional finding  
DIRLAUTH ..... direct liaison authorized  
DLRP ..... data link reference point  
DS ..... direct support  
DTD ..... digital transfer device  
DTG ..... date-time group  
DZ ..... drop zone

**E**

EA .....	electronic attack
ECA .....	electronic control assembly
EL .....	elevation
EMCON .....	emission control
EOD .....	explosive ordnance disposal
EP .....	electronic protection
EPW .....	enemy prisoner of war
ES .....	electronic warfare support
EW .....	electronic warfare
EW/C .....	early warning/control
EXT .....	external

**F**

F .....	Fahrenheit
FEZ .....	fighter engagement zone
FH .....	frequency hop
FHM .....	frequency hop master
FHT .....	field handling trainer
FIR .....	frequency interference report
FLIR .....	forward looking infrared
FM .....	field manual
FMFM .....	fleet marine force manual
FMFRP .....	fleet marine force reference publication
FOB .....	forward operating base
FOM .....	figure of merit
FOV .....	field of view
FREQ .....	frequency
FSCC .....	fire support coordination center
FSCL .....	fire support coordination lines
ft .....	feet
FTX .....	field training exercise
FU .....	fire unit



**G**

- G ..... unit of force equal to the gravity exerted on an object or a body at rest.
- G-3 ..... operations staff officer
- GBAD ..... ground-based air defense
- GBDL ..... ground-based data link
- GCE ..... ground combat element
- GHz..... gigahertz
- GOAR.....ground observer aircraft recognition
- GPS..... global positioning system
- GPU ..... gas pumping unit
- GS ..... general support
- GTA ..... graphic training aid

**H**

- HAR..... helicopter request
- HCl ..... hydrogen chloride
- HF ..... high frequency
- HI..... high power
- HMMWV.....high-mobility multipurpose wheeled vehicle
- H&S ..... headquarters and services
- Hz.....hertz

**I**

- IADS ..... integrated air defense system
- ICOFT..... institutional conduct of fire trainer
- ID ..... identification
- IEA..... interface electronics assembly
- IFF..... identification, friend or foe
- INT..... internal
- IR ..... infrared
- IRCCM ..... infrared counter-countermeasures

**J**

- JTASR..... joint tactical air strike request

**K**

KHz	..... kilohertz
km	..... kilometer
KRP	..... known reference point

**L**

LAAD	..... low altitude air defense
LBC	..... LAAD battalion command
lb	..... pound(s)
LC	..... LAAD command
LEA	..... launcher electronics assembly
LED	..... light-emitting diode
LLTR	..... low level transit route
LRF	..... laser range finder
LTC	..... LAAD team control
LWC	..... LAAD weapon control
LZ	..... landing zone

**M**

M	..... meters
MACCS	..... Marine air command and control system
MACG	..... Marine air control group
MAGTF	..... Marine air-ground task force
MANPADS	..... man portable air defense system
MATC	..... Marine air traffic control
MCCRES	..... Marine Corps combat readiness evaluation system
MCWP	..... Marine Corps Warfighting Publication
MEDEVAC	..... medical evacuation
MANPADS	..... man portable air defense system
METT-T	..... mission, enemy, terrain and weather, troops and support available- time available
MEZ	..... missile engagement zone
MGRS	..... military grid reference system
MHz	..... megahertz
MOPP	..... mission-oriented protective posture
MOS	..... military occupational specialty

MPS ..... meters per second  
mrad ..... milliradian  
MRC ..... missile round container  
MRE ..... meals ready to eat  
MRR ..... minimum risk route  
MSL ..... mean sea level  
MTS ..... moving target simulator  
MUX ..... multichannel radio

**N**

NAAK ..... nerve agent antidote kits  
NBC ..... nuclear, biological, and chemical  
NCTR ..... noncooperative target recognition  
NE ..... northeast  
NEO ..... noncombatant evacuation operation  
NFOV ..... narrow field of view  
NICAD ..... nickel cadmium  
NiCd ..... nickel cadmium  
NM ..... nautical mile  
NOE ..... nap-of-the-earth  
NUV ..... negative ultra violet  
NW ..... northwest  
NWP ..... naval warfare publication

**O**

ODU ..... optical display unit  
OH ..... operational handbook  
OPCON ..... operational control  
OPNAV ..... Office of the Chief of Naval Operations  
OPORD ..... operation order  
ORL ..... ordnance release line  
ORTT ..... operational readiness training test

**P**

PA ..... power amplifier  
PMCS ..... preventive maintenance checks and services

PMS..... pedestal mounted stinger  
POW..... prisoner of war  
PSI..... pounds per square inch  
PTL..... primary target line  
PWR..... power  
PZ..... pick up zone

**R**

RCMAT..... radio-controlled miniature aerial target  
RCU..... remote control unit  
RF..... radio frequency  
RFOV..... rain field of view  
RIB..... radio in a box  
RMP..... reprogrammable microprocessor  
ROE..... rules of engagement  
RT..... receiver/transmitter  
RTF..... return to force  
RTU..... remote terminal unit

**S**

SAM..... surface-to-air missile  
SAW..... surface-to-air weapon  
SE..... southeast  
SHORAD..... short-range air defense  
SIB..... sensor interface box  
SINGARS..... single-channel ground and airborne radio system  
SOA..... state of alert  
SOP..... standing operating procedure  
stby..... standby  
STLS..... Stinger launch simulator  
SV..... satellite vehicle  
SVML..... standard vehicle mounted launcher  
SW..... southwest

**T**

TAC..... tactical air command

TACAN..... tactical air navigation  
TACC..... tactical air command center  
TACON..... tactical control  
TADIL ..... tactical information link  
TAOC ..... tactical air operations center  
TAR ..... tactical air request  
TDAR ..... tactical defense alert radar  
TEK..... traffic encryption key  
THT..... tracking head trainer  
TIB..... tactical interface module to field wire box  
TM ..... technical manual  
T&R..... training and readiness  
TTP ..... tactics, techniques, and procedures

**U**

UAV..... unmanned aerial vehicle  
UHF ..... ultrahigh frequency  
UV..... ultraviolet

**V**

V ..... volt  
VDC..... volts DC  
VHF ..... very high frequency  
VID ..... visual identification  
VISCAP ..... visual combat air patrol  
VPA ..... vehicle power adapter

**W**

WASP..... wide-angle Stinger pointer  
WCS..... weapon control status  
WEZ..... weapon engagement zone  
WFOV..... wide field of view  
WGS ..... World Geodetic System  
WRC..... weapon round container

**Z**

ZOA..... zone of action

## Section II. Definitions

**active air defense**—Direct defensive action taken to nullify or reduce the effectiveness of hostile air action. It includes such measures as the use of aircraft, air defense weapons, weapons not used primarily in an air defense role, and electronic warfare.

**airborne early warning**—The detection of enemy air or surface units by radar or other equipment carried in an airborne vehicle and the transmitting of a warning to friendly units. (Joint Pub 1-02) Also called AEW.

**air defense**—All defensive measures designed to destroy attacking enemy aircraft or missiles in the earth's envelope of atmosphere, or to nullify or reduce the effectiveness of such attack. (Joint Pub 1-02)

**air defense (NATO)**—All measures designed to nullify or reduce the effectiveness of hostile air action. See also active air defense; passive air defense. (Joint Pub 1-02)

**air defense action area**—An area and the airspace above it within which friendly aircraft or surface-to-air weapons are normally given precedence in operations except under specified conditions. (Joint Pub 1-02)

**air defense area**—A specifically defined airspace for which air defense must be planned and provided. (Joint Pub 1-02, Part 1 of a 2-part definition.)

**air defense identification zone**—Airspace of defined dimensions within which the ready identification, location, and control of airborne vehicles are required. (Joint Pub 1-02) Also called ADIZ.

**air defense operations area**—An area and the airspace above it within which procedures are established to minimize mutual

interference between air defense and other operations; it may include designation of one or more of the following: air defense action area, air defense identification zone, and/or firepower umbrella. (Joint Pub 1-02)

**air defense region**—A geographical subdivision of an air defense area. (Joint Pub 1-02)

**air defense sector**—A geographical subdivision of an air defense region. (Joint Pub 1-02)

**air intercept zone**—A subdivided part of the destruction area in which it is planned to destroy or defeat the enemy airborne threat with interceptor aircraft. (Joint Pub 1-02) The AIZ may be divided into fighter engagement zones (FEZ).

**air superiority**—That degree of dominance in the airbattle of one force over another which permits the conduct of operations by the former and its related land, sea and air forces at a given time and place without prohibitive interference by the opposing force. (Joint Pub 1-02)

**air supremacy**—That degree of air superiority wherein the opposing air force is incapable of effective interference. (Joint Pub 1-02)

**air surveillance**—The systematic observation of air space by electronic, visual or other means, primarily for the purpose of identifying and determining the movements of aircraft and missiles, friendly and enemy, in the air space under observation. (Joint Pub 1-02)

**amphibious objective area**—A geographical area, delineated in the initiating directive, for purposes of command and control within which is located the objective(s) to be secured by the amphibious

task force. This area must be of sufficient size to ensure accomplishment of the amphibious task force's mission and must provide sufficient area for conducting necessary sea, air and land operations. (Joint Pub 1-02) Also called AOA.

**antiair warfare**—A US Navy/US Marine Corps term used to indicate that action required to destroy or reduce to an acceptable level the enemy air and missile threat. It includes such measures as the use of interceptors, bombers, antiaircraft guns, surface-to-air and air-to-air missiles, electronic countermeasures, and destruction of the air or missile threat both before and after it is launched. Other measures which are taken to minimize the effects of hostile air action are cover, concealment, dispersion, deception (including electronic), and mobility. (Joint Pub 1-02) Also called AAW.

**antiair warfare commander**—The antiair warfare commander is the antiair warfare agent of the commander, amphibious task force. He is responsible for AAW of the amphibious task force in a particular region, (the amphibious objective area), and during its movement to, and arrival in, the amphibious objective area. Also called AAWC.

**area air defense commander**—Within an overseas unified command, subordinate unified command, or joint task force, the commander will assign overall responsibility for air defense to a single commander. Normally, this will be the Air Force component commander. Representation from the other Service components involved will be provided, as appropriate, to the area air defense commander's headquarters. (Joint Pub 1-02) Proposed change to definition, per Joint Test Pub 3-52, as follows, "Normally this will be the component commander with the preponderance of air defense assets to be used and the ability to assume that responsibility." The remainder of the definition is the same as existing Joint Pub 1-02. Also called AADC.



**area of influence**—A geographical area wherein a commander is directly capable of influencing operations, by maneuver or fire support systems normally under his command or control. (Joint Pub 1-02)

**area of responsibility**—A defined area of land in which responsibility is specifically assigned to the commander of the area for the development and maintenance of installations, control of movement and the conduct of tactical operations involving troops under his control along with parallel authority to exercise these functions. (Joint Pub 1-02) Also called AOR.

## **B**

**bandit**—Known enemy aircraft.

**base defense zone**—An air defense zone established around an air base and limited to the engagement envelope of short range air defense weapon systems defending that base. Base defense zones have specific entry, exit, and IFF procedures established. (Joint Test Pub 3-52) Also called BDZ.

## **C**

**centralized control**—In air defense, the control mode whereby a higher echelon makes direct target assignments to fire units. See also decentralized control. (Joint Pub 1-02)

**combat air patrol**—An aircraft patrol provided over an objective area, over the force protected, over the critical area of a combat zone, or over an air defense area, for the purpose of intercepting and destroying hostile aircraft before they reach their target. (Joint Pub 1-02) Also called CAP.

**combat information center**—The agency in a ship or aircraft manned and equipped to collect, display, evaluate, and disseminate

tactical information for the use of the embarked flag officer, commanding officer, and certain control agencies. Certain control, assistance and coordination functions may be delegated by command to the combat information center. (Joint Pub 1-02) Also called CIC.

**combat operations center**—The primary operational agency required to control the tactical operations of a command that employs ground and aviation combat, combat support, and combat service support elements or portions thereof. The combat operations center continually monitors, records, and supervises operations in the name of the commander and includes the necessary personnel and communications to do the same. (FMFRP 0-14) Also called COC.

**command and control**—The exercise of authority and direction by a properly designated commander over assigned forces in the accomplishment of the mission. Command and control functions are performed through an arrangement of personnel, equipment, communications, facilities, and procedures employed by a commander in planning, directing, coordinating, and controlling forces and operations in the accomplishment of the mission. (Joint Pub 1-02) Also called C2.

**control of aircraft and missiles**—The coordinated employment of facilities, equipment, communications, procedures, and personnel which allows the ACE commander to plan, direct, and control the efforts of the ACE to support the accomplishment of the MAGTF's mission. (FMFM 5-60)

**coordinating altitude**—A procedural airspace control method to separate fixed- and rotary-wing aircraft by determining an altitude below which fixed-wing aircraft will normally not fly and above which rotary-wing aircraft normally will not fly. The coordinating altitude is normally specified in the Airspace Control Plan and may

include a buffer zone for small altitude deviations. (Joint Test Pub 3-52)

**counter air**—A US Air Force term for air operations conducted to attain and maintain a desired degree of air superiority by the destruction or neutralization of enemy forces. Both air offensive and air defensive actions are involved. The former range throughout enemy territory and are generally conducted at the initiative of the friendly forces. The latter are conducted near to or over friendly territory and are generally reactive to the initiative of the enemy air forces. (Joint Pub 1-02)

**crossover zone (crossover point)**—That range in the air warfare area at which a target ceases to be an air intercept target and becomes a surface-to-air missile target. (Joint Pub 1-02) Weapons systems making engagements in this zone will normally be under positive control of the TAOC, EW/C, or airborne early warning aircraft.

## **D**

**decentralized control**—In air defense, the normal mode whereby a higher echelon monitors unit actions, making direct target assignments to units only when necessary to ensure proper fire distribution or to prevent engagement of friendly aircraft. (Joint Pub 1-02)

**destruction area**—An area in which it is planned to destroy or defeat the enemy airborne threat. The area may be further subdivided into air intercept, missile (long-, medium-, and short-range), or anti-aircraft gun zones. (Joint Pub 1-02)

**detection**—In surveillance, the determination and transmission by a surveillance system that an event has occurred. (Joint Pub 1-02, Part 2 of a 3-part definition)

**direct air support center**—A subordinate operational component of a tactical air control system designed for control and direction of close air support and other tactical air support operations, and normally collocated with fire-support coordination elements. (Joint Pub 1-02) The principal air control agency of the U. S. Marine air command and control system responsible for the direction and control of air operations directly supporting the ground combat element. It processes requests for immediate air support and coordinates air missions requiring integration with ground forces and other supporting arms. It normally collocates with the senior fire support coordination center within the ground combat element and is subordinate to the tactical air command center. Also called DASC. (proposed modification to Joint Pub 1-02, FMFM 5-60)

### E

**electronic warfare**—Military action involving the use of electromagnetic and directed energy to control the electromagnetic spectrum or to attack the enemy. The three major subdivisions within electronic warfare are electronic attack, electronic protection, and electronic warfare support.

**a. electronic attack**—That division of electronic warfare involving the use of electromagnetic or directed energy to attack personnel, facilities, or equipment with the intent of degrading, neutralizing, or destroying enemy combat capability. Also called EA. EA includes: 1) actions taken to prevent or reduce an enemy's effective use of the electromagnetic spectrum, such as jamming and electromagnetic deception, and 2) employment of weapons that either use electromagnetic or directed energy as their primary destructive mechanism (lasers, RF weapons, particle beams).

**b. electronic protection**—That division of electronic warfare involving actions taken to protect personnel, facilities, and

equipment from any effects of friendly or enemy employment of electronic warfare that degrade, neutralize, or destroy friendly combat capability. Also called EP.

**c. electronic warfare support**—That division of electronic warfare involving actions tasked by, or under direct control of, an operational commander to search for, intercept, identify, and locate sources of radiated electromagnetic energy for the purpose of immediate threat recognition. Thus, electronic warfare support provides information required for immediate decisions involving electronic warfare operations and other tactical actions such as threat avoidance, targeting, and homing. Also called ES. Electronic warfare support data can be used to produce signals intelligence (SIGINT), both communications intelligence (COMINT) and electronics intelligence (ELINT). (approved for inclusion in Joint Pub 1-02)

**Note:** EA replaces electronic countermeasures (ECM); EP replaces electronic counter-countermeasures (ECCM); ES replaces electronic warfare support measures (ESM).

**emission control**—The selective and controlled use of electromagnetic, acoustic, or other emitters to optimize command and control capabilities while minimizing, for operations security (OPSEC), detection by enemy sensors; to minimize mutual interference among friendly systems; and/or to execute a military deception plan. (Joint Pub 1-02) Also called EMCON.

## F

**few (raid size)**—In air intercept usage, seven or fewer aircraft. (Joint Pub 1-02)

**fighter engagement zone**—The airspace of defined dimensions within which the responsibility for engagement rests with fighters.

(Joint Pub 1-02 under "Weapon Engagement Zone") (A type of Weapon Engagement Zone.) FEZs may be designated within the Air Intercept Zone (AIZ).

**fire support coordination center**—A single location in which are centralized communications facilities and personnel incident to the coordination of all forms of fire support. (Joint Pub 1-02) Also called FSCC.

**forward operating base**—An airfield used to support tactical operations without establishing full support facilities. The base may be used for an extended time period. Support by a main operating base will be required to provide backup support for a forward operating base. (FMFRP 0-14) Also called FOB.

## H

**hostile**—A contact positively identified as enemy. (Joint Pub 1-02)

## J

**joint engagement zone**—Airspace of defined dimensions within which multiple air defense weapon systems (SAMs and friendly fighters) of one or more Services are simultaneously employed and operated. (Joint Test Pub 3-52) Also called JEZ.

## L

**low altitude missile engagement zone**—Volume of airspace established for control of low- to medium- altitude surface-to-air missile engagements. A low altitude missile engagement zone will limit the volume of airspace within which these weapons may conduct engagements without specific direction of the area air defense commander. Subject to weapon system capabilities, the low altitude missile engagement zone will normally extend beyond the forward edge of the battle area. (Joint Test Pub 3-52) In air defense,

that airspace of defined dimensions within which the responsibility for engagement normally rests with low to medium altitude surface-to-air missiles. Also called LOMEZ. (proposed for inclusion in Joint Pub 1-02, FMFM 5-60)

**low level transit route**—A temporary corridor of defined dimensions which facilitates the low level passage of friendly aircraft through friendly air defenses and controlled or restricted airspace. (Joint Pub 1-02) Also called LLTR.

## M

**many (raid size)**—In air intercept usage, eight or more aircraft. (Joint Pub 1-02)

**Marine air command and control system**—A US Marine Corps tactical air command and control system which provides the tactical air commander with the means to command, coordinate, and control all air operations within an assigned sector and to coordinate air operations with other Services. It is composed of command and control agencies with communications-electronics equipment that incorporates a capability from manual through semiautomatic control. (Joint Pub 1-02) A US Marine Corps air command and control system which provides the aviation combat element commander with the means to command, coordinate, and control all air operations within an assigned sector and to coordinate air operations with other Services. It is composed of command and control agencies with communications-electronics equipment that incorporates a capability from manual through semiautomatic control. Also called MACCS. (proposed modification to Joint Pub 1-02)

**minimum risk route**—A temporary corridor of defined dimensions recommended for use by high-speed, fixed-wing aircraft that presents the minimum known hazards to low-flying

aircraft transiting the combat zone. (Joint Test Pub 3-52) Also called MRR.

**missile engagement zone**—The airspace of defined dimensions within which the responsibility for engagement normally rests with missiles. (Joint Pub 1-02 under "Weapon Engagement Zone") MEZs may be designated within the Missile Intercept Zone (MIZ).

**missile intercept zone**—That geographical division of the destruction area where surface-to-air missiles have primary responsibility for destruction of airborne objects. (Joint Pub 1-02) Also called MIZ.

## P

**passive air defense**—All measures, other than active air defense, taken to minimize the effectiveness of hostile air action. These measures include deception, dispersion and the use of protective construction. (Joint Pub 1-02)

## R

**rules of engagement**—Directives issued by competent military authority which delineate the circumstances and limitations under which United States forces will initiate and/or continue combat engagement with other forces encountered. (Joint Pub 1-02) Also called ROE.

## S

**short-range air defense engagement zone**—Areas of short-range air defense (SHORAD) deployment may fall within a low altitude engagement zone or high altitude engagement zone. Some areas might be solely defended by SHORAD assets. A SHORAD engagement zone can be established to define the airspace within which these assets will operate. Because centralized control over



the SHORAD weapons may not be possible, these areas must be clearly defined and disseminated so friendly aircraft can avoid them. (Joint Test Pub 3-52) In air defense, that airspace of defined dimensions within which the responsibility for engagement normally rests with short range air defense weapons. It may be established within a low altitude missile engagement zone or a high altitude missile engagement zone. Also called SHORADEZ. (proposed for inclusion in Joint Pub 1-02, FMFM 5-60)

**Stinger**—A lightweight, man-portable, shoulder-fired, air defense artillery missile weapon for low altitude air defense of forward area combat troops. Designated as FIM-92A-D. (Joint Pub 1-02)

**surface-to-air guided missile**—A surface-launched guided missile for use against air targets. (Joint Pub 1-02) Also called SAM.

**surface-to-air weapon**—A surface-launched weapon for use against airborne targets. Future developments in air defense systems may lead to the employment of weapons other than missiles. Examples include rockets, directed-energy weapons, and air defense guns. (FMFM 5-40) Also called SAW.

## T

**tactical air command center (Marine TACC)**—The principal US Marine Corps air operation installation from which aircraft and air warning functions of tactical air operations are directed. It is the senior agency of the Marine Corps Air Command and Control System from which the Marine Corps tactical air commander can direct and control tactical air operations and coordinate such air operations with other Services. (Joint Pub 1-02) The principal U. S. Marine Corps air command and control agency from which air operations and air defense warning functions are directed. It is the senior agency of the U. S. Marine air command and control system which serves as the operational command post of the aviation

combat element commander. It provides the facility from which the aviation combat element commander and his battlestaff plan, supervise, coordinate, and execute all current and future air operations in support of the Marine Air-Ground Task Force. The tactical air command center can provide integration, coordination and direction of joint and combined air operations. Also called Marine TACC. (proposed modification to Joint Pub 1-02, FMFM 5-60)

**tactical air control center**—The principal air operations installation (land or ship based) from which all aircraft and air warning functions of tactical air operations are controlled. (Joint Pub 1-02) US Navy only; US Air Force changed their TACC to AOC (air operations center.)

**tactical air direction center**—An air operations installation under the overall control of the tactical air control center (afloat)/tactical air command center, from which aircraft and air warning service functions of tactical air operations in an area of responsibility are directed. (Joint Pub 1-02) Also called TADC.

**tactical air operations center**—A subordinate operational component of the Marine air command and control system designed for direction and control of all en route air traffic and air defense operations, to include manned interceptors and surface-to-air weapons, in an assigned sector. It is under the operational control of the Tactical Air Command Center. (Joint Pub 1-02) The principal air control agency of the U. S. Marine air command and control system responsible for airspace control and management. It provides real time surveillance, direction, positive control and navigational assistance for friendly aircraft. It performs real time direction and control of all anti-air warfare operations, to include manned interceptors and surface-to-air weapons. It is subordinate to the tactical air command center. Also called TAOC. (proposed modification to Joint Pub 1-02, FMFM 5-60)

**U**

**unmanned aerial vehicle**—A powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload. Ballistic or semiballistic vehicles, cruise missiles, and artillery projectiles are not considered UAVs. (Joint Pub 3-55.1) Also called UAV.

**V**

**vital area**—A designated area or installation to be defended by air defense units. (Joint Pub 1-02)

**W**

**weapon engagement zone**—In air defense, airspace of defined dimensions within which the responsibility for engagement normally rests with a particular weapon system. Also called fighter engagement zone, missile engagement zone, short range air defense engagement zone. (Joint Pub 1-02) Also called WEZ.

# Appendix I

## References

### Joint Publication

1-02 Department of Defense Dictionary of Military and Associated Terms

### Secretary of the Navy (SECNAV) Instructions

5510.30A Department of the Navy Personnel Security Program

5510.36 Department of the Navy Information Security Program  
ISP Regulations

### Naval Warfare Publication

32 Anti-air Warfare

### Marine Corps Warfighting Publications

3-22 Anti-air Warfare

3-24 Assault Support

3-25 Control of Aircraft and Missiles

3-25.3 Marine Air Command and Control Handbook

3-25.10 Low Altitude Air Defense Handbook

6-22 Communication and Information Systems

## **Marine Corps Reference Publication**

5-12C Marine Corps Supplement to the Department of Defense Dictionary of Military and Associated Terms

## **Fleet Marine Force Manual**

6-5 Marine Rifle Squad

## **Marine Corps Order (MCO)**

P3500.19B Aviation Training and Readiness (T&R) Manual, Volume V, Marine Air Command and Control System (MACCS)

## **Technical Manuals**

08319A-12 Operator's and Organizational Maintenance Instructions: STLS (Stinger Launch Simulator)

09480A-12&P/1 Display Unit AN/UPS-3

09688A-12&P Operation and Maintenance Instruction with parts List AN/PAS-18, Receiver Infrared System

9-1425-429-12 Operator's and Organizational Maintenance Manual: Avenger Stinger Guided Missile System

9-1425-2525-14&P Unit, Direct Support, and General Support Maintenance Manual for Remote Terminal Unit (RTU) and Enhanced Remote Terminal Unit (RTU-E) HAWK Air Defense Guided Missile System

- 9-1425-433-10 Operator's Manual: Guided Missile Battery Control Central, Vehicle Mounted: AN/TWQ-1 Avenger Air Defense Weapon System
- 9-6920-429-12 Operator's and Organizational Maintenance Manual for Training Set, Stinger Guided Missile System, M134
- 10296A-10/1 Field Handbook Expeditionary Air Defense System (EADS) Director Unit
- 11-5825-291-13 Operations and Maintenance Manual for Satellite Signals Navigation Sets AN/PSN-11 and AN/PSN-11 (V) 1
- 2000-15/2B Principal Technical Characteristics of USMC Communications Electronics Equipment

### **Army Field Manuals (FMs)**

- 44-1A US Army Air Defense Artillery Operational Planning
- 44-1-2 Air Defense Artillery Reference Handbook
- 44-8 Combined Arms For Air Defense
- 44-18 Air Defense Artillery Employment: Stinger
- 44-18-1 Stinger Team Operations
- 44-44 Avenger Platoon, Section, and Squad Operations
- 44-48 Tactics, Techniques, and Procedures for the Sensor Platoon
- 44-80 Visual Aircraft Recognition
- 44-100 US Army Air Defense Operations

## **Related Publications**

TSEC/KIR-1C/KAM-225C, Limited Maintenance Manual for KIR/  
KIT-1A

IFF/DOD, AIMS 86-100A Mode 4 Handbook Identification Friend  
or Foe Supplement 1

CMS-1A, Communications Security Material System (CMS)  
Policy and Procedures Manual

AN/CYZ-10/11-5810-394-14&P

Combat Visual Identification System (CVIS)

Visual Aircraft Recognition CD-ROMs series 441-173

Jane's Ultimate Flight #3