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*FM1-140

Field Manual
1-140

Headquarters
Department of the Army
Washington, DC, 29 March 1996

FM 1-140

HELICOPTER GUNNERY

Table of Contents

PREFACE
CHAPTER 1. INTRODUCTION
- **Training Strategy**
- **Gunnery Standards**
- **Gunnery Tables**
- **Readiness Reporting**
- **Master Gunner Program**
- **Weapons Training Standards**

CHAPTER 2. HELICOPTER GUNNERY TRAINING STRATEGY
- **Section 1. Training Assesment and Planning**
  - **The Commander's Assesment**
  - **Planning the Training**
  - **Effective Assesment and Training**
- **Section 2. Pregunnery Training**
  - **Subject Areas and Techniques**
  - **Table V**
- **Section 3. Helicopter Gunnery Range Training**
  - **Qualification Gates**
  - **Individual Gates**
  - **Crew Simulator/Ground Training Gates**
  - **Crew Live-Fire Gates**
  - **Engagement Scoring System**
  - **Scoring Criteria**
  - **Engagement Scoring**
  - **Scoring Moving Engagements**
  - **Scoring Hellfire Engagements with the VRS and AVTR**

Remote Hellfire Engagement Scoring
Section 4. Posttraining Assesment
After-Action Review
Required Documents
Range Score Sheet
CHAPTER 3. RANGES FOR HELICOPTER GUNNERY TRAINING
Section 1. Range Requirements
Range Considerations
Realistic Training
Operational Requirements
Range Scheduling
Section 2. Personnel Responsibilites and Duties
Officer in Charge
Range Safety Officer
Master Gunner
Laser Range Safety Officer or NCO
Radio Operators
Class III/V OIC or NCOIC
Section 3. Helicopter Gunnery Range Safety
Ground Safety
Firing Safety
Aircraft Emergency Plan
Section 4. Range Layout
Considerations
Multipurpose Range Complex
Aerial Weapons Scoring System
Attack Helicopter Gunnery Range
Section 5. Successful Training
Guides to Successful Training
CHAPTER 4. BALLISTICS
Interior Ballistics
Exterior Ballistics
Aerial Ballistics
Terminal Ballistics
Dispersion
CHAPTER 5. MUNITIONS FOR HELICOPTER WEAPON SYSTEMS
Section 1. Linked Ammunition
7.62 Millimeter for M60/M60d Machine Gun
.50 Caliber for OH-58D Kiowa Warrior
20-Millimeter for AH-1E/F
30 Millimeter forthe AH-64 M230 Cannon

Section 2. Rockets
2.75 Inch Rockets
Rocket Warheads (Tactical and Training)
Fuzes
Section 3. Missiles
Missile Configurations
Missile Performance Capabilities
Missile Performance Distracters
TOW Missile
Air-To-Air Stinger
CHAPTER 6. CREW WARFIGHTING
Section 1. Fratricide Prevention
Situational Awareness
Contributing Factors
Fratricide Prevention
Section 2. Target Aquisition
Acquisition Defined
Target Acquisition Process
Crew Search
Aerial Search Techniques
Techniques for Crew Search
Target Detection
Target Detection Challenges
Target Location
Target Classification
Confirmation
Section 3. Range Determination
Range Determination
Aircraft Mil Values
Laser-off Operations
Section 4. Crew Communications
Crew Communications
Fire Commands
Lines of Communications
Phraseology
Remote Hellfire Missile Firing
Remote Call for Fire
Call for Fire Description
Example of Call for Fire, One Missile, Two AHs
Example of Call for Fire, Two Missiles, Ripple Fire, Two AHs
Autonomous Fire Mission to Apache

Section 5. Precombat Checks
Precombat Checks
Before Mission Receipt Checks
Upon Mission Receipt
Preparing for the Mission
Final Checks
Crew Checks
Run-up Checks
Communications Checks
Conclusion
CHAPTER 7. ENGAGEMENT TECHNIQUES
Section 1. Modes and Types of Fire
Types of Fire
Modes of Fire
Target Effect Standards
Section 2. Terminology and Information on Weapons
Effective Range
2.75 inch Rocket
Boresighting and Dynamic Harmonization
Section 3. Crew Techniques
Firing Techniques
TTP for the Modes of Fire
Section 4. Night Gunnery for Non-C-NITE AH-1
AH-1 Night Firing
Issues with Night AH-1 Gunnery
Section 5. Air Combat Weaponeering
Weapon Systems Engagement Ranges
Target Engagement Factors

APPENDIX A. HELICOPTER DOOR GUNNERY
APPENDIX B. HELICOPTER GUNNERY TABLES
APPENDIX C. ENGAGEMENT TIME POINT CALCULATION SHEETS
GLOSSARY
REFERENCES
AUTHENTICATION

DISTRIBUTION RESTRICTION: Approved for public release; distribution is unlimited.

This publication supersedes TC 1-140, 30 September 1991.

PREFACE

This manual describes the helicopter gunnery training and qualification portion of Army Aviation's Aircrew Training Program. It provides tactics, techniques, and procedures for crews, teams, platoons, companies, and battalions to engage and destroy enemy targets efficiently in combat.

This manual is written for commanders, staffs, aircrews, and instructors. It is for use in coordinating, planning, executing, and teaching helicopter gunnery training and qualification. Through the Aircrew Training Program, it links the training and qualifications of helicopter weapons systems to the doctrinal employment of Army Aviation. In addition, FM 1-140 outlines a standardized, progressive program to train weapon system proficiency through the conduct of helicopter gunnery tables.

Ammunition resources in this manual reflect authorizations contained in DA Pamphlet 350-38.

All Aviation units are encouraged to recommend ideas to upgrade the tasks, conditions, and standards in this manual. The proponent of this publication is HQ TRADOC. Send comments and recommendations on DA Form 2028 (Recommended Changes to Publications and Blank Forms) to Commander, United States Army Aviation Center and Fort Rucker, ATTN ATZQ-TDS (Helicopter Gunnery), Fort Rucker, AL 36362-5000.

This publication implements the following international agreement: STANAG 3117 (Edition Five) Aircraft Marshalling Signals (Air Sdt 44/42A)

This publication has been reviewed for operations security considerations.

Unless this publication states otherwise, masculine nouns and pronouns do not refer exclusively to men.

CHAPTER 1

INTRODUCTION

The Army must prepare its soldiers, leaders, and units to deploy, fight, and win in combat at any intensity level, anywhere, anytime. Therefore, our training is top priority, and the focus of training is on our wartime mission. An important part of the wartime mission for units equipped with armed helicopters is helicopter gunnery. Every training program, including helicopter gunnery, must be carefully planned, aggressively executed, and thoroughly assessed.

1-1. TRAINING STRATEGY

The helicopter gunnery program begins with individual qualification on aircraft weapon systems and progresses through crew qualification to unit collective training. The unit training strategy must build on the skills learned by individual crew members during the aircraft qualification course. It must include and balance individual, gunnery, tactical, and maintenance training for both aviators and support personnel. The unit gunnery program must be progressive and continuous. It must emphasize training that allows integration of new personnel while maintaining qualified crews. This manual provides commanders with the information and guidance needed to develop and incorporate gunnery training into the Aircrew Training Program while meeting the standards in DA Pamphlet 350-38, Chapter 7. This program is focused on building warfighting units that can engage and destroy the enemy.

a. Helicopter gunnery range training is a training event where individuals, crews, teams, and companies show proficiency and validate the operational readiness of the helicopter weapon systems. Crew qualification on Table VIII is the cornerstone of this gunnery program. Table VIII qualification is a live-fire event and an annual requirement. Once crews qualify, units can begin work on the advanced tables that focus on collective training.

b. The unit's mission essential task list and mission training plan enable the commander to focus helicopter gunnery training on the unit's primary mission. This procedure allows the commander to exercise command, control, and communication functions while conducting gunnery. Commanders can use training devices like the MILES/AGES to enhance the collective training program so that the unit can train as it fights. Commanders tailor the advanced tables (Tables IX through XII) to meet their particular unit's mission and training requirements.

1-2. GUNNERY STANDARDS

The goal of Army training is a combat ready force that can deploy on short notice, fight, and win. To achieve this goal, commanders must have a common set of weapons and weapon systems qualification standards. They also must have an objective way to judge those standards. Army Aviation's gunnery program standards are discussed below.

a. The Aerial Weapon Scoring System or comparable DA approved objective scoring system is the standard for objective scoring of cannon and rocket fires with no subjective upgrades.

b. A target hit within the effective range of the system is the standard for cannon and machine gun engagements.

c. A target hit also is the standard for Hellfire, TOW, and Stinger missile engagements.

d. Target neutralization is the standard for rocket engagements. Because rockets are most effective when fired in mass, the rocket training strategy is to train crews for neutralization engagements.

(1) Target neutralization is an engagement that causes 10-percent casualties and/or destruction of materiel in the target effect area. It should be a deliberate engagement in which the crew fires a minimum of two pairs of adjustment rockets, senses the impacts, makes adjustments, and fires at least five pairs of rockets for effect.

(2) During the conduct of basic and intermediate gunnery tables, crews will train and show proficiency in adjusting rockets onto a target without completing a fire for effect.

1-3. GUNNERY TABLES

The gunnery tables in this manual provide the framework for the unit to execute its gunnery program. They are designed to train and evaluate the crew's ability to engage targets with the helicopter's weapon systems at short, medium, and long ranges. These gunnery tables are progressive; they must be fired in order. Except for Tables III and IV, these tables cannot be accomplished in a compatible simulator. Commanders may modify the engagement sequences, conditions, and target arrays within the tables to meet mission training requirements or to fit resource constraints such as range layout. However, modified tables must be no less demanding than those in this manual. Because modifications to tables are temporary, commanders must work with installation or regional range authorities to upgrade and improve helicopter gunnery ranges so the unit can fire the tables as stated in this manual.

a. ***Basic Tables.***

(1) Tables I and II are used for initial weapons qualification. Fire them according to USAAVNC or NGB AH-64, AH-1, and OH-58D Kiowa Warrior programs of instruction.

(2) Tables III and IV are used for prequalification training and the commander's evaluation of newly assigned crew members. Units may use these tables to evaluate unit trainers or to conduct refresher training for qualified aviators. Tables III and IV are individual tables evaluated by a unit instructor pilot.

b. ***Intermediate Tables.***

(1) Table V is the commander's pregunnery range assessment of unit helicopter

gunnery readiness. This table allows evaluation of the crew's knowledge and gunnery skills before the crew progresses to live-fire gunnery. Table V is a gate to live-fire training; crews must complete this table before attempting live-fire gunnery.

(2) Table VI is the calibration and verification table. This table includes ammunition for units to calibrate and test-fire weapon systems before qualification range training. An aircraft must meet the Table VI standards before it can be used for qualification on Tables VII and VIII.

(3) Table VII is a training table. Table VIII is a crew qualification table and is a gate to the advanced tables.

c. *Advanced Tables*. Tables IX through XII are the advanced tables. These tables orient on tactical scenarios and multi-helicopter employment. They allow the commander to focus the unit on collective live-fire training. The unit MTP and METL will dictate tactical scenarios, task organization, and weapons mix.

1-4. READINESS REPORTING

a. *Unit Status Report.* DA Form 2715-R (Unit Status Report) is an assessment of a unit's combat readiness. The commander assesses training for the USR by developing a training level or T-level. The primary purpose of the T-level is to show the unit's current ability to perform its assigned wartime missions. The standard for measuring the unit's training status is its METL.

(1) The commander decides the unit's training level by evaluating how well the unit accomplishes mission essential tasks. He considers all available factual data in making the determination. The training level determines how much time is needed to train the unit to do its mission essential tasks.

(2) Many factors affect the unit's T-level. AR 220-1 states that proficiency is measured in terms of the unit's demonstrated ability to do its mission essential tasks. The unit also must perform enabling tasks not specified in the METL but necessary for performance of mission essential tasks. An example of an enabling task is crew gunnery. Proficiency is judged on performance of tasks to standard. Therefore, gunnery proficiency is judged on the performance of gunnery tasks to standards in this manual, which has a direct impact on the unit USR. AR 220-1 also states that the availability of aviation training resources (flying hours, training ammunition, simulation devices, fuel) must be considered in the T-level.

b. *Helicopter Gunnery Impact.*

(1) TC 1-210 mandates the consideration of gunnery performance when determining the readiness levels of aviators. This objective assessment is derived from Table 7-1, TC 1-210 and is recorded on the USR in Block 18, TRAINDAT SET.

(2) However, proper reporting of helicopter gunnery problems and successes on the

unit status report is also important. The Army's leadership must receive an accurate assessment of unit gunnery. Such assessment will aid in preserving and improving helicopter live-fire gunnery. Refer to AR 220-1, paragraph 1-6d, for additional information.

(3) Maintenance of aircraft weapon systems is a critically important component of a successful helicopter gunnery training program. A shortage of maintainers will affect any training program involving aircraft.

c. ***Unit Actions.***

(1) The unit commander will consider the unit's helicopter gunnery qualification rate when determining the overall T-level. DA Pamphlet 350-38 specifies crew gunnery qualification requirements for helicopter crews.

(2) Section B, TRAINDAT SET is the place to record concerns about training resources. Problems that can be noted may include the following:

(a) Improper ammunition received for qualification range; that is, issued MK40 rocket motors instead of the required MK66.

(b) Not enough range time received for proper qualification on Tables VI through VIII and the advanced tables.

(c) The AWSS was unavailable for the qualification range.

(d) The home station range was unsuitable for proper helicopter gunnery qualification.

(e) A shortage of soldiers in critical MOSs (armament mechanics, POL handlers, aircraft electricians) exists.

(3) The resource constraints experienced by the unit should be explained in Section D, TRRAT GENTEXT and can include helicopter gunnery issues.

1-5. MASTER GUNNER PROGRAM

a. The battalion or squadron S3 and master gunner manage, develop, and implement the unit helicopter gunnery program. The master gunner is the commander's primary representative for helicopter gunnery. His primary duty is to help maintain the continuity and focus of the commander's helicopter gunnery training program.

b. The commander will designate a master gunner. He should be warrant officer rated and experienced in the unit's primary attack aircraft.

c. The master gunner's responsibilities include the following:

(1) Assist the commander and S3 in developing and implementing the unit helicopter gunnery training program.

(2) Assist the S3 in forecasting and allocating helicopter ammunition.

(3) Monitor simulator and TSTT (if applicable) gunnery training, scheduling, and use.

(4) Develop realistic target arrays in coordination with local range control officials.

(5) Serve as the primary scorer/evaluator on unit live-fire ranges.

(6) Work with the armament officer to ensure the readiness of the unit's helicopter armament.

(7) Serve as a member of the unit standardization committee.

1-6. WEAPONS TRAINING STANDARDS

a. DA Pamphlet 350-38 (also known as the STRAC manual) shows the quantities and types of ammunition required for weapons proficiency training and qualification. Ammunition authorizations prescribed by STRAC are the maximum amounts authorized for each airframe. These authorizations are based on the training readiness condition assigned to each unit by the STRAC executive director.

b. Unit commanders will make every effort to conduct live-fire gunnery training with the authorized ammunition. Turned-back or turned-in ammunition does not strengthen the helicopter gunnery training program.

c. Ammunition authorizations by STRAC are made on an annual basis. Tables VI through VIII, Table X, and Table XII are designed to be fired annually using live ammunition.

CHAPTER 2

HELICOPTER GUNNERY TRAINING STRATEGY

This chapter provides a framework for developing a helicopter gunnery training program in four phases. To make helicopter crews and units work together as a team, the commander must execute a well-planned, realistic, and consistent training program. This chapter describes a strategy structured for training that progresses from basic through intermediate and advanced gunnery tables to combined arms exercises, focusing on the warfighting skills of individuals, crews, and units.

Section I. Training Assessment and Planning

2-1. THE COMMANDER'S ASSESSMENT

a. The unit commander's training assessment and planning are essential to the success of unit level gunnery training programs. It is the first phase and will continue throughout the program. Commanders may repeat phases on different levels of training throughout the training year to sustain the helicopter gunnery training program. They may compress the phases into an intensified gunnery training program when necessary--for example, to meet mobilization requirements. The goal of this training is to maximize combat ready crews. The commander determines the unit's current proficiency level in helicopter gunnery by--

(1) Analyzing the experience level of the helicopter crews in the unit. For example, how much experience do the crews have in the aircraft? Are the crews crew-coordination trained? How many crews are in the unit?

(2) Analyzing the results of previous helicopter gunnery ranges. For example, were any trends noted during the last qualification range (low rocket qualification rates, excessive engagement times, etc.)?

(3) Analyzing the total training level of the unit and its personnel assignment stability. This analysis includes the number of RL1 aviators, nonrated crew members, maintenance personnel, and other key personnel.

(4) Conducting diagnostic testing to determine the unit's current proficiency. These tests may include a diagnostic HGST, a no-notice Table VI for randomly selected crews, or past results of the unit no-notice program.

(5) Determining the maintenance status of aircraft weapon systems. This determination may include performing Table VI on a regular basis.

b. By using the standards in this FM, TC 1-210, and DA PAM 350-38, the commander

will decide what training is necessary to meet required training standards. The commander will chart the course to his desired training end state by--

(1) Comparing results of the analysis of the unit's current level of proficiency with the required training standard.

(2) Placing the unit, or individuals, into the appropriate level of the training program.

c. The amount of time available for training crews and units to standard will vary. The commander determines how much time is available to achieve the required training standards by--

(1) Examining the unit's mission requirements and other obligations from the unit training calendars.

(2) Deciding whether a sustaining program or an intensified program is required. The primary difference between a sustaining and intensified program is the time required to execute it.

NOTE: For planning purposes, an average attack helicopter battalion requires a gunnery period of 2 weeks on the range to complete the live-fire helicopter gunnery tables.

d. The commander determines what resources are required to conduct training by--

(1) Referring to the logistic and administrative requirements in this document.

(2) Reviewing previous training experiences of the unit, as documented in the required detailed after-action review.

e. The commander determines what resources are available to conduct training by--

(1) Inventorying unit personnel and equipment.

(2) Determining what assistance is available from supporting units and higher headquarters.

(3) Examining training facilities.

(4) Determining the number of flight hours and ammunition available for basic, intermediate, and advanced gunnery tables.

(5) Determining the availability of the aerial weapons scoring system.

f. The commander reconciles all considerations. For example, differences between resources required and resources available will affect both the times required to conduct the training and the unit's ability to meet the required standards. The commander should adjust differences to meet the goal of producing the maximum number of combat ready crews.

2-2. PLANNING THE TRAINING

In the assessment process, the commander begins outlining his helicopter gunnery training program. To construct a detailed plan for implementing the program, the commander may follow these steps:

a. Develop a unit program of instruction for pregunnery training. Use the S3 and master gunner.

(1) Plan the conduct of academic training.

(2) Plan the conduct of hands-on training, based on the commander's assessment.

(3) Plan the conduct of nonaircrew training (FARP personnel, armament personnel, etc.)

b. Plan the conduct of Table V. Emphasize the importance of assessment prior to the gunnery range.

c. Plan the conduct of the intermediate table live-fire.

d. Plan the conduct of advanced table training.

2-3. EFFECTIVE ASSESSMENT AND TRAINING

An effective program for unit level helicopter gunnery is the result of good assessment and planning. To ensure successful training use the following principles:

a. *Set Standards*. Set and enforce tough, but achievable standards. Tough standards will generate tough training. Crews must know when they do well. Insist on repetition to achieve a high level of proficiency in required tasks.

b. *Start Early*. All aspects of the training program must be thoroughly coordinated. Forecast and request resources and maintenance assistance long before they are needed.

c. *Be Thorough*. Avoid wasting resources and training opportunities. Give leaders at all levels the guidance and assets needed to train. Focus the unit on accomplishing the commander's desired end state.

d. *Be Flexible*. Be prepared to adjust the training program to the changing needs of the unit. Once assessment, training, and planning stop, the training program stagnates and loses its effectiveness.

e. *Train Continually*. Train at every opportunity, not just during an intensified program to get ready for helicopter gunnery qualification tables. Intensified programs should be used only to bring a unit up to a desired proficiency level. Once accomplished, train continually to maintain that level.

Section II. Pregunnery Training

Pregunnery training prepares members of the unit to perform all tasks required by the helicopter gunnery tables. To ensure that desired levels of proficiency are reached at the time they are required, units must carefully integrate pregunnery training into the overall training program. Some areas that should be part of pregunnery training and suggestions for their implementation are discussed below. Other subjects requiring special attention may be discovered during the commander's training assessment and planning.

2-4. SUBJECT AREAS AND TECHNIQUES

a. ***Flight Proficiency*****.** Normally conducted at the company, platoon, and crew levels, flight proficiency training is critical for gunnery training. The battalion or squadron standardization officer must advise the commander on the unit's level of proficiency.

b. ***Map Reading, Navigation, and Terrain Analysis*****.** Navigating and proper terrain flight techniques are critical to mission accomplishment and aircrew survival. In the classroom, the instructor may use 35mm slides of terrain and terrain boards or sand tables to link map reading to terrain analysis and utilization. Terrain walks and ground vehicle navigation courses are a technique for training crews. Competitive navigation exercises are used to increase awareness and interest in navigation. The training program should include--

- Basic map reading and operational graphics.
- Map reconnaissance.
- Terrain utilization.
- Low altitude navigation, including Doppler navigation.

c. Armament. Knowledge and skill in operating and working with helicopter armament systems are important factors in gunnery performance. Pilots **should** participate regularly in armament maintenance operations. To establish and maintain proficiency, aircrews must conduct armament preflight and operational checks during every flight, to include boresighting. Armament training should include--

- Operation of armament controls.
- Preflight inspection of armament subsystems.
- Operational checks of armament subsystems.
- Aircrew level maintenance of armament subsystems.
- Correction of armament subsystem malfunctions.
- Loading and unloading armament subsystems.
- Clearing armament subsystems.

- Capabilities and limitations of armament subsystems.

d. *Ammunition.* Ammunition training goes hand-in-hand with armament training. Conduct practical exercises in garrison using dummy ammunition. Conduct concurrent training exercises on ranges and simulation exercises in the classroom. This training should include--

- Identification and inspection of ammunition.
- Care and handling of ammunition.
- Target effects of ammunition, including selection of ammunition for various targets.
- Ballistic characteristics of ammunition.
- Selection of ammunition for various targets.

e. *Crew Duties*. The crew duties training program must include all pilot skills required to attack and destroy a target. Refer to the crew warfighting chapter and the ATM for standard phraseology. Crew duties training includes--

- Principles of helicopter gunnery.
- Target handover procedures.
- Unit fire commands.
- Crew fire commands.
- Fire distribution and target attack techniques.

Training exercises should include as much audiovisual simulation as possible. Record target handovers and fire commands on audio tape. Target attacks can be recorded on audio tape and videotape, and can be simulated on terrain boards. Cockpit drills can be dry run on the ground using a portable tape recorder to present a realistic scenario. Complete and train dry-fire crew and team or company scenarios regularly.

f. *Target Acquisition And Identification.* The ability to acquire and identify battlefield targets is one of the most difficult and most often neglected skill areas of helicopter gunnery training. Classroom training with slides and photographs of vehicles in various terrain is the first step in target acquisition. Do not confuse this training with vehicle identification training. The purpose of this training is to help crews acquire targets and to prevent fratricide. Units may use the six-step technique in the vehicle identification in Chapter 6 to train crews to systematically identify targets. This training must include--

- Observation techniques.
- Target acquisition.
- Target identification.

- Threat capabilities and limitations.

g. *Mission Planning.* Every pilot must be able to plan and conduct a complete mission. Mission planning training teaches the pilot to receive and assimilate all the information he will need to conduct a mission successfully and relate the results of that mission to other pilots and ground personnel. This training must include--

- Operations and intelligence briefings.
- Mission planning and rehearsals.
- Mission debriefing.

Beyond basic classroom instruction, extensive practice, integrated with other areas of training such as target acquisition and land navigation courses, is required. Every training exercise presents an opportunity for briefing, planning, and debriefing.

h. *Range Operation And Safety.* The complexity of a realistically run helicopter gunnery range requires that every participating crew member has a comprehensive understanding of the operational and safety procedures required. Training must include--

- Range safety.
- Administrative procedures.
- Conduct of helicopter gunnery tables.

Terrain boards and models should be used to simulate the conduct of the range and to train pilots in range operations before beginning range firing. A visit to the range, or videotapes of the range recorded by the unit, will aid in range orientation and identify operational and safety issues.

2-5. TABLE V

Pregunnery training prepares aircrews for range training. Table V tests their proficiency level to ensure they are ready to advance to range training. Table V is the commander's assessment tool to ensure crews are ready for live-fire gunnery tables.

Section III. Helicopter Gunnery Range Training

2-6. QUALIFICATION GATES

A helicopter gunnery gate is a task or tasks grouped in a training event that a soldier or unit must perform to standard before progressing to more complex tasks or events. Gates allow commanders to evaluate the effectiveness of training and assess whether the unit is ready for

more complex training. The gunnery gates are listed in the Table 2-1.

Table 2-1. Helicopter Gunnery Training Gates

GATE #	INDIVIDUAL	CREW	UNIT	TABLES	REMARKS
1	X			I,II	APPROVED POI FOR AQC OR INITIAL QUALIFICATION
2	X			III,IV	COMMANDER'S EVAL, UNIT
3		X		V	HGST, ANNUAL REQUIREMENT
4		X		VI	AIRCRAFT MUST BE CERTIFIED ON TABLE PRIOR TO USE ON INTERMEDIATE TABLES
5		X		VIII	CREW MUST QUALIFY TO PROGRESS TO ADVANCED TABLES
6			X	X	PLATOONS MUST PASS TABLE X PRIOR TO TABLE XII

(See appendix A for specific requirements for door gunners.)

2-7. INDIVIDUAL GATES

a. ***Gate 1: Tables I and II.*** Tables I and II are conducted during the aircraft qualification course. They are individual gunnery tables and represent individual gunnery qualification for the aviator.

b. ***Gate 2: Tables III and IV*****.** Table III and IV are conducted with RL progression by the unit commander. These tables evaluate a crew member's proficiency in the duties associated with each crew position and give the commander the means and flexibility to make effective crew assignments.

c. ***Aircraft Survivability Equipment Trainer.*** Before proceeding to Table V, the aviator will be integrated into the ASET II program if assigned to the pilot's crew station. The intent is for the crew to complete and pass ASET II testing before proceeding to the advanced table gunnery.

d. *TADS Selected Task Trainer.* Complete TSTT testing if assigned to the front seat crew station (AH-64 units only). The exercise is based on a 100-point system, with 70 points the minimum for passing. Exercises for testing are found in the TSTT "ATAC Situations" menu. Conduct the test as follows:

(1) *Advanced switchology.* Use the advanced switchology (No LDNS) quiz (20 percent).

(2) *Hover situations.* Select hover situations from the menu. Four similar variations are available in the software. Any of the variations are acceptable for testing (20 percent).

(3) *Fly-to situations.* Select the built-in fly-to exercise. Four similar variations are available in the software. Any of the variations are acceptable for testing (20 percent).

(4) *Multiple targets, rapid fire.* This test has two exercises--the close formation exercise and the spread formation exercise. The two exercises are worth 10 points each. These exercises are located under the multiple target menus (20 percent).

(5) *Multiple targets, ripple fire.* Use the built-in ripple fire target engagement exercise found in the ATAC Situations "More Situations" menu. Three similar variations are available in the software. Any of the variations are acceptable for testing (20 percent).

(6) *Bonus--thumb force tracking test.* Award 5 points for 8,000 points or more on this exercise.

2-8. CREW SIMULATOR/GROUND TRAINING GATES

a. *Gate 3: Table V.* Table V is used to allow the commander to assess his unit's gunnery readiness before starting the live-fire gunnery tables. To complete Table V, crews will, at a minimum--

(1) Score 70 percent on the Helicopter Gunnery Skills Test. The skills test is a written examination with at least 50 gunnery-specific questions. Crews must complete the test no earlier than 180 days prior to the range.

(2) Complete crew conduct of fire training in their compatible simulator.

b. *C-COFT.* The CMS/FWS-based C-COFT is a standard, objectively scored training event for AH-64 and AH-1 attack helicopter crews. The master gunner will implement the C-COFT. The C-COFT will evaluate the crew's ability to engage targets and work as a team. This training is critical to assess the attack helicopter crew's skills before progressing to live-fire tables. The C-COFT setup will include--

(1) Short, medium, and long engagements for all weapons systems. Ranges are defined in Table 2-2.

Table 2-2. Engagement ranges in kilometers			
	Short	Medium	Long
Hellfire	<2	2 to 4	>4
Rockets	<3	3 to 4	>4
Cannon	<1	1 to 1.5	>1.5
TOW	1.5	1.5 to 3	>3

(2) Tactical scenarios for both day and night exercises.

(3) Multiple, progressively more difficult training levels.

NOTE: The C-COFT is part of Table V. It will not replace live-fire gunnery training.

c. Not all units have access to a compatible simulator. For those units, the master gunner may, with the concurrence of the battalion or squadron commander, develop a C-COFT type exercise for use in the aircraft. The intent is to evaluate the crew's skills in a progressive manner.

d. When a crew satisfactorily meets all requirements for the individual and crew simulator/ground training gates, they will progress to live-fire tables.

e. The commander may make Table V more rigorous. He should determine the level of detail required to assess aircrew readiness.

2-9. CREW LIVE-FIRE GATES

Tables VI and VII are live-fire training tables. Commanders must decide whether a crew can progress to the next table based on their demonstrated performance. Commanders retain the ability to deny crews further live-fire training if they fail to meet training standards.

a. ***Live-Fire Rules.*** Some rules applying to live-fire ranges are discussed below.

(1) If a crew fails to qualify on Table VIII because of failed tasks, the commander may allow the crew to reshoot the tasks that were failed if ammunition is available.

(2) If a crew has to reshoot tasks on Table VIII to qualify, their table is called a "Q2," or "qualification on second attempt." If a crew's table is scored a Q2, then the maximum score they can achieve is 700 points. If a crew does not qualify after the second pass, the commander must decide whether or not to commit resources to allow the crew to try for a "Q3."

(3) Although the tables are progressive, Table VIII day may be fired after Table VII day without firing Table VII night. In addition, Table VIII night may be fired directly after Table VII night.

(4) If the crew is assigned to an aircraft that has a night qualification requirement, they must successfully pass both the day and night portions of Table VIII for qualification. For validation, the crew must successfully pass both the day and night portions of Table VII.

b. ***Target Range and Engagement Time*****.** The live-fire tables represent more than a chance to expend ammunition. They represent a training standard. The range to targets and engagement time have been revised for this manual.

(1) The engagement ranges in the tables were developed as a function of the effective range of the weapon and the limitations of training ammunition. Sensing the impacts of training ammunition can be difficult.

(2) The engagement time standards were developed to ensure that crews could place fires on targets quickly and accurately. The time standards are based on target acquisition time, munition time of flight, and time to adjust rounds on target.

c. ***Gate 4: Table VI*****.** The first live-fire training table the crew will fire is Table VI. This table allows the crew to determine if their assigned helicopter weapon systems are working properly. Table VI will be accomplished to standard before progressing to Table VII.

(1) The intent of Table VI is to certify the helicopter weapon systems and will be fired under the supervision of the unit armament or maintenance officer. If the aircraft weapons do not function to standard, the aircraft will not be used for qualification.

(2) This table allows the crew to fire live munitions without the fear of failing because of time constraints. Table VI may be the first live-fire training for unit crews in a year. Table VI allows crews to become reacquainted with firing live munitions before progressing to Table VII.

d. ***Table VII*****.** Live-fire of Table VII is required before progressing to Table VIII. However, crews can validate on Table VII and skip Table VIII. Validation is the process of ensuring the gunnery crew can still meet the Table VIII standard, thus "validating" the results of the last range.

(1) With the concurrence of the commander, crew members may validate on table VII if --

- The crew members occupy the same crew station as the previous gunnery in which he/she qualified, unless dual-seat designated by the commander.
- The crew qualified Table VIII during the preceding 12 months on an objectively scored qualification range.
- Crew is Q1 on validation table.

(2) The minimum standard for validation is 7 of 10 qualified engagements and 700 points. If the standard is met, the crew can, at the discretion of the commander, progress to advanced tables without firing Table VIII. In effect, their Table VII performance becomes their Table VIII qualification.

(3) Crews who fail to meet the standard on Table VII will be evaluated by the commander before progression to Table VIII. If required, crews will be given additional training in deficient areas before progression.

(4) STRAC provides ammunition for Table VII as a live-fire table. Use of the simulator does not satisfy the requirement for progression to Table VIII.

e. ***Gate 5: Table VIII.*** This table is an annual requirement. Annual is once every 12 months, based on the last date of crew qualification. Table VIII is only valid if it is conducted live-fire.

(1) For crews that do not validate on Table VII, live firing this table is a requirement. This table determines crew qualification. Scoring standards are the same as Table VII. A crew cannot progress to advanced table gunnery without qualifying on Table VIII.

(2) Successful qualification will be annotated on DA Form 759 (Individual Flight Record and Flight Certificate - Army) and appropriate entries made in the crew member's individual aircrew training folder according to TC 1-210.

(3) Due to limited range time, weather, and other factors, units cannot always complete the required tables during a single gunnery range training period. Because of these factors, a crew's Table VII (validation) or Table VIII might be interrupted. However, a crew must complete all tasks of Table VII (validation) or Table VIII within 180 days of starting the table. Failure to complete all tasks within 180 days will require the crew to start the table over and complete all Table VIII tasks at the next available opportunity.

f. ***Advanced Tables.***

(1) The advanced level of gunnery training consists of four tables--Tables IX, X, XI, and XII. The battalion/squadron commander uses these tables to train and assess his unit's collective gunnery skills. These tables emphasize the command and control aspects of the unit's fire distribution plan, target acquisition, engagement priorities, and other control measures. Tables X and XII contain training ammunition resources to conduct live-fire by platoons and company/troops, respectively, and will be fired if sufficient ammunition is available after the conduct of intermediate tables. These are not qualification tables but collective training tables. Evaluation of these tables are based on tasks, conditions, and standards found in the unit's MTP.

(2) Table IX is a dry-fire training table for a team or platoon. This table is oriented on the basic fighting elements of a company/troop. The commander uses this table to train his unit in the coordination skills needed for multiple aircraft to engage targets. Unlike Table VIII that trains a crew to effectively "place steel on target," Table IX allows the commander to train multiple aircraft operations, placing primary emphasis

on fire distribution and control measures.

(3) Gate 6, Table X is the live-fire version of Table IX. The training emphasis is focused on the coordination between multiple aircraft for joint target engagements. This table provides the framework for conducting team or platoon gunnery training. Thorough and accurate coordination between elements, as well as accurate ordnance delivery, will determine the unit's success on this table.

(4) Tables XI and XII are company/troop training tables. These tables provide examples of training tasks the company commander may use to evaluate his unit's proficiency in collective training tasks. The commander's ultimate gunnery training goal is to train his unit to fight in the combined arms environment. Table XI is a dry-fire training table, designed to exercise the company-level command and control. The primary training emphasis is placed on the unit's fire distribution, target engagement priorities, and control measures. Table XII is the live-fire culmination of the company/troop's gunnery training program. This table emphasizes the same areas as Table XI, but under live-fire, tactical conditions. Evaluation of unit command and control is the primary objective of this table. However, Table XII is also an opportunity for the commander to evaluate the unit maintenance and rearm/refuel capability during multihelicopter operations.

(5) Combined arms live-fire exercises are not advanced tables. FM 25-101 defines CALFEXs as "high-cost, resource-intensive exercises in which player units move or maneuver and employ organic and supporting weapons systems using full-service ammunition with attendant integration of all combat, CS, and CSS functions." In addition, live-fire exercises conducted at Combined Training Centers are not advanced tables, but live-fire exercises.

2-10. ENGAGEMENT SCORING SYSTEM

This paragraph provides aviation units with a standardized, objective system to evaluate gunnery proficiency.

a. ***Missile Scoring.***

(1) ***Hellfire missile*****.** Score engagements using the Apache's onboard video recorder subsystem or the Kiowa Warrior's airborne video tape recorder. Missile engagements may also be scored with DA-approved objective scoring systems, if available.

(2) ***TOW missile*****.** STRAC resources live-fire for TOW missile qualification. Scoring will be as described in FM 1-140.

(3) ***Air-to-air Stinger*****.** No live missiles are resourced. Captive flight trainer engagements will be scored.

b. ***Cannon and Rocket Scoring*****.** The standard for scoring cannon and rocket engagements is the aerial weapons scoring system or comparable, DA-approved objective

scoring system.

c. *Target Handovers*. All target handovers will be transmitted from the range tower or a similar fixed-base for Tables VII and VIII. Units should develop scripts for the handover readers to provide standardized handovers for all crews.

d. *Target Hits*. When firing on a multipurpose range complex, target hits will be recorded on the RETS range computers along with the AWSS.

2-11. SCORING CRITERIA

Using the appropriate gunnery tables, aviation units will make an objective evaluation of their crews. The following are commonly used terms relating to the scoring process.

a. *Target Effect*. Target effect means the target is hit or the required number of rounds impact in the target effect area. For missile (Hellfire, TOW, and Stinger) and cannon engagements, the target must be hit to achieve target effect.

b. *Engagement Time*. Engagement time is the total time required for the engagement. The two basic target types are controlled presentation targets and fixed, uncontrolled targets. Start and stop times are defined as follows:

(1) *Start*.

• Controlled Presentation (Pop-ups). Engagement time starts when the target is in the full upright position.

• Uncontrolled Presentation (Fixed). Engagement time starts when the firing crew accepts the target handover.

(2) *Stop*. For all ranges the stop time is when target effect is achieved or the crew calls "mission complete." "Mission complete" is the point in time when the last rounds fired impact in the TEA or target effect is achieved (for example, the target falls). If the personnel operating the range observe target effect, they will announce "target cease fire" to let the crew know to stop firing.

2-12. ENGAGEMENT SCORING

a. Each engagement in a firing table is worth 100 points. Target effect is graded on a qualified/unqualified standard, with the score derived from engagement time tables. A qualified engagement is an engagement where the target effect standard as expressed in the table is achieved.

b. Crew duties and time of flight figures are integrated into the engagement time tables. The criteria for each table are in the table annex. For example, the rockets tables for the AH-64 and AH-1 are built for pairs of rockets, not for rockets fired singly.

c. The minimum table qualification requires the crew to qualify on 7 of 10 engagements, and accrue at least 700 of the 1,000 points possible on the table. In addition, a crew must achieve at least one qualified engagement per evaluated weapon system to receive a "go" on the table. For example, an AH-64 crew must qualify on 7 of 10 engagements, with a minimum of one qualified engagement for each evaluated weapon system (cannon, rockets, and Hellfire missile).

d. Upon qualification, crews will be rated by the following standard:

(1) ***DISTINGUISHED***-- 900-1,000 points on the qualification table.

(2) ***SUPERIOR***--800-899 points on the qualification table.

(3) ***QUALIFIED***--700-799 points on the qualification table.

(4) ***UNQUALIFIED***--699 points or less on the qualification table.

2-13. SCORING MOVING ENGAGEMENTS

a. Moving engagements are defined as engagements in which the helicopter is deliberately moving between designated start-fire and stop-fire points while firing at targets.

b. Running fire engagements are defined as engagements in which the helicopter is deliberately moving **forward** between designated start-fire and stop-fire points while firing at targets.

c. Experience has shown that it is more difficult to place accurate fires on a target with the aircraft at a hover than while moving or running, particularly with rockets. The challenge for training is to give the crew adequate maneuver space to fire and observe the impacts.

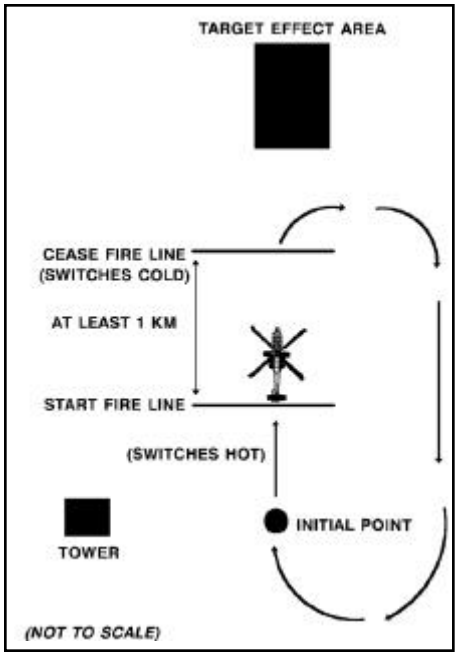
d. The master gunner must accurately and objectively score the moving engagement. The objective is to design the target array to give the crew the maximum time to observe munitions impacts on the target. Figure 2-1 shows a range layout.

e. When designing the moving engagement--

(1) Master gunners have the option to start engagement time at the start-fire line and stop engagement time at the stop-fire line.

(2) The range to target decreases as the helicopter flies toward the target. When an aircraft is traveling at 30 knots, it will cover approximately 1 kilometer in 1 minute.

(3) Select a start-fire line and stop-fire line that will keep the aircraft firing within the range fan and in an engagement time window. Refer to figure 2-1. If the start-fire line is 4,000 meters from the target, and the stop-fire line is 3,000 meters from the target, the engagement can be scored using the 3,001-4,000 meter engagement time scoring table.



(4) The amount of maneuver room available will dictate the speed of the aircraft during the engagement.

(5) If the aircraft cannot complete all shots between the start-fire and stop-fire line, time each pass separately. Time will start at the start-fire line and stop at the stop-fire line. Add the engagement times for each pass together to get the total engagement time.

2-14. SCORING HELLFIRE ENGAGEMENTS WITH THE VRS AND AVTR

The Apache's VRS and the Kiowa Warrior's AVTR are the current standard for scoring Hellfire missile engagements. Whether using live or training missiles, the tape recorded by the VRS or AVTR provides feedback on switchology, crew coordination, and proper employment techniques. Videotape is a useful resource for crew training, but is **not** an approved method for scoring cannon and rocket engagements. The master gunner is encouraged to maintain a library of videotapes containing both good and bad Hellfire engagement techniques. This library is an excellent way to preserve continuity in the gunnery program and is useful for reinforcing gunnery instruction and combat readiness.

a. Target hit is the standard for Hellfire missile engagements. The score for the engagement is derived from the engagement time scoring tables. Review of the crew's tape of the engagement is the method for determining target effect and confirming engagement time. For autonomous Hellfire engagements, engagement time starts as in paragraph 2-11 and ends with the simulated missile impacting the target. As a technique, crews may announce "splash" to the tower over the radio to stop engagement time.

b. When a crew finishes its gunnery table, the master gunner or his representative will view the tape and determine target effect. At a minimum, the tape must reflect that the--

(1) Target is within range of the Hellfire missile (adjusted for selected delivery mode).

(2) Aircraft is within constraints to launch a missile.

(3) Line of sight and laser energy is on target for the required length of time for the engagement.

(4) Proper grid is keyed in the DEK for remote engagements.

(5) Missile and LRF/D are on same code for autonomous designation. The AH-64 alphanumeric display may be displayed on the high action display and videotaped to confirm this data.

c. The master gunner can also determine proficiency of the Apache crew from reviewing the VRS tape. Target tracking technique, crew coordination, and proper designation technique can be evaluated. This scoring technique will also be used with the OH-58D Kiowa Warrior.

2-15 REMOTE HELLFIRE ENGAGEMENT SCORING

Remote Hellfire engagements are scored in the same manner as an autonomous Hellfire engagement.

a. The standards for engagement time start and stop are as follows:

(1) START ENGAGEMENT. Target handover complete. (Transmission acknowledged by the shooting crew).

(2) STOP ENGAGEMENT. Crew announces "Shot, over."

b. The Hellfire remote engagement has the following evaluation standards:

(1) The evaluated crew will fire the training missile.

(2) The target handover will be sent from the range tower or similar fixed-base.

(3) The target handover will use the FM 1-140 standard format including an 8-digit grid coordinate of the target.

(4) The master gunner will determine proper crew procedures from review of the VRS tape.

Section IV. Posttraining Assessment

2-16. AFTER-ACTION REVIEW

After the live-fire gunnery exercise is complete, a comprehensive after-action review will be completed. The after-action review should focus on all facets of the gunnery program leading up to, and including, the live-fire exercise. The AAR process will produce a written document outlining the issues encountered in the conduct of the unit gunnery program. There are several reasons for this process including the following:

a. Allows the commander to assess unit strengths and weaknesses in helicopter gunnery training and evaluation, as well as the unit standardization program.

b. Allows the unit to design the next gunnery training program based on demonstrated unit proficiency.

c. Provides continuity during periods of personnel turnover. Allows the entire unit to capture the good and the bad of the program.

d. Provides objective data on gunnery to solicit changes or modifications to this manual.

2-17. REQUIRED DOCUMENTS

Besides the written AAR, the following documents and training records will be kept for reference by each unit:

a. Range MOI and duty logs.

b. Individual crew score sheets for each crew.

c. AWSS and RETS printouts of all engagements.

d. A memorandum containing the names of the crews that fired on the range, their scores, and whether they were Q2, Q3, or unqualified. The memorandum will include the tail number of the aircraft they used for firing.

e. A comment slip in each IATF showing the gunnery qualification date and the crew station from which the crew member qualified.

f. A memorandum containing an in-depth assessment of the unit helicopter gunnery training program. It also will provide data for the unit to negotiate for increased resources. It should contain the following information:

(1) The names, ranks, and position of the key unit personnel serving as range staff. For example, name and rank of the officer in charge.

(2) Specific problems, if any, with the scoring system. Cite examples.

(3) Lot numbers of the ammunition fired and any problems encountered with the ammunition.

(4) A roll-up of engagements by table with--

- Range to target for each task.
- Total number of rounds fired.
- Total number of bullet hits and total number of rockets scored in the TEA by task.

2-18. RANGE SCORE SHEET

a. Figure 2-2 is a suggested format for a blank score sheet. The score sheet allows the master gunner to use a standardized score sheet for scoring the tables. Figure 2-3 shows an example of a completed score sheet used during range training.

b. This score sheet is not mandatory. However, if units develop their own score sheet, it will contain the same information as the example score sheet.

RANGE SCORE SHEET									
PILOT				CPG/CPO					
AIRCRAFT NUMBER				UNIT					
TABLE: DAY NIGHT				DATE					
TEMPERATURE: VISIBILITY: CEILING: CONDITIONS:									
START TIME				END TIME			Q1	Q2	Q3
Engagement And Task	Weapon	Flight Mode	Range To Target	Weapons Effect Standard	Crew Weapons Effect	Engagement Time Standard	Crew Engagement Time	Crew Score	Qualify? Y/N
TABLE TOTALS: QUALIFIED ENGAGEMENTS: TOTAL SCORE:									
QUALIFIED TABLE YES NO									
SCORER									
REMARKS									

Figure 2-2. Suggested format blank score sheet

RANGE SCORE SHEET

PILOT PIEPER | CPG/CPO WILLIAMS

AIRCRAFT NUMBER 267 | UNIT C Co.

TABLE: 8 (DAY) NIGHT | DATE 17 AUG 94

TEMPERATURE: 68°F VISIBILITY: 7 CEILING: 25K CONDITIONS: CLEAR

START TIME 1400 | END TIME 1500 | (Q1) Q2 Q3

Engagement And Task	Weapon	Flight Mode	Range To Target	Weapons Effect Standard	Crew Weapons Effect	Engagement Time Standard	Crew Engagement Time	Crew Score	Qualify? Y/N
1/1	HF	HOVER	2000	HIT	HIT	22	20	80	Y
2/2	ROCKETS	HOVER	2500	3/8	4/8	105	100	75	Y
3/4	HF	HOVER	4500	HIT	HIT	40	32	90	Y
4/3	CANNON	HOVER	1100	HIT	HIT	60	32	98	Y
5/5	ROCKETS	HOVER	3500	3/8	3/8	123	111	80	Y
6/6	HF	HOVER	3100	HIT	HIT	33	30	80	Y
7/7	HF	HOVER	REMOTE	HIT	HIT	60	59	70	Y
8/8	CANNON	HOVER	800	HIT	HIT	60	42	88	Y
9/9	CANNON	MOVING	1200	HIT	HIT	60	70	50	Y
10/10	ROCKETS	HOVER	4500	2/6	NONE	116	150	Ø	N
—	—	LAST		ENTRY	—	—			

TABLE TOTALS: QUALIFIED ENGAGEMENTS: 9/10 TOTAL SCORE: 711

QUALIFIED TABLE (YES) NO

SCORER CW2 SMITH

REMARKS GOOD RUN

Figure 2-3. Example of a completed score sheet

CHAPTER 3

RANGES FOR HELICOPTER GUNNERY TRAINING

A complete helicopter gunnery training program includes range firing and uses training areas or dry-fire ranges to run tactical courses. Tactical training should be integrated with gunnery training when possible, to provide a more realistic training environment. This chapter highlights procedures, duties, and responsibilities for establishing and operating helicopter gunnery ranges (see AR 385-63). It also includes administrative and logistic requirements necessary to support range firing.

Section I. Range Requirements

3-1. RANGE CONSIDERATIONS

Proper preparation is essential to conduct helicopter gunnery tables. This preparation includes everything from the normal preparations for field training (such as mess and individual equipment) to the basics (such as aircraft, weapons, range facilities, and ammunition).

a. Resources required for gunnery training, such as ammunition and range time, are expensive and limited. To ensure a successful training event, commanders must use these resources fully during every exercise.

b. Each unit should develop a range firing SOP or annex to the local range SOP. Range safety should be included in the unit safety SOP.

c. Effective range administration and operation are crucial to any firing exercise. Planning should be continuous throughout the training year. However, once the range training date is set, the S3 will examine the commander's objectives and work closely with the master gunner and staff to identify all requirements. The S3 will give particular attention to external requirements.

d. To maximize training, the unit should dry fire a table on the assigned range before live fire.

(1) Dry-fire training is most effective when conducted shortly before and during live-fire gunnery. Control measures peculiar to the range can be identified by dry firing an abbreviated crew table and by becoming familiar with the training scenario. Dry-fire training will improve the crews' concentration on the gunnery tasks during live qualification firing. It will also reduce their concerns about positioning, range orientation, and range fans. A thorough dry-fire practice will also help the crews acquire targets. The master gunner should conduct several dry runs in an aircraft to fine-tune the evaluation strategy and ensure targets are in place before live firing begins.

(2) Do not use the actual table VII and VIII target arrays for dry firing. If crews know exactly where targets are located, their proficiency in target acquisition cannot be evaluated.

3-2. REALISTIC TRAINING

a. Realism is the most important factor in gunnery training. Realistic gunnery training can be accomplished by training tough, realistic target acquisition and engagement situations.

b. Scenarios may be incorporated in all gunnery tables. Each scenario should be tailored to the table. For example, Tables III and IV may require only a general threat situation and the assignment of individual aircraft firing positions. Advanced tables may be executed by using a detailed battalion-level OPORD and tactical scenario. Company-level OPORDs may be developed to incorporate all aspects of tactical operations at the company level. The incorporation of tactical scenarios into all gunnery events also increases the value of training. This training may include crews sending spot reports and BDA after each task.

c. Administrative control measures should be kept to the absolute minimum required for safety. Tactical measures should be substituted for administrative measures, where appropriate. For example, a lateral boundary of a range facility could be briefed as a lateral divisional boundary that may not be crossed. The barrier to flight still exists, but some artificiality has been removed. The only necessary administrative control measures may be the verification of the firing aircraft's position and the orientation of weapons before firing.

d. The final step to ensure realistic training is the most important. With the training tables in this FM, the master gunner can design the target array and scenario for the course. The target handover and briefed threat situation provide the information required for crews to conduct a realistic attack.

(1) Firing tables fulfill minimum training requirements; safety regulations fulfill minimum safety requirements.

(2) NOE hover-fire routes can be established around the impact area. These routes may also be used as a target identification range. A target array based on the unit's MTP can assist the crew in target identification and detection. Friendly vehicles may be integrated into the target area during advanced table training to provide aircraft with realistic vehicle identification as part of fratricide prevention training.

(3) Targets to be engaged from the various firing points should vary in range and type. These targets facilitate training the crew in weapon and ammunition characteristics and ballistics. Silhouettes should be constructed to full size. Targets must have a thermal signature when they are engaged during night-firing exercises by attack helicopters with thermal sights/target acquisition systems and devices. Hard targets should be artificially heated. Plywood silhouettes mounted on target lifters should have the standard Army thermal signature devices.

3-3. OPERATIONAL REQUIREMENTS

Some operational requirements require advanced planning. They include--

- Training objectives. What is the desired training end state for the unit crews?
- Ammunition ordered and ammunition available. This ammunition includes rockets and cannon ammunition and return-fire simulators such as ATWESS and Hoffman charges.
- Combined arms integration. Integration of field artillery, armor, and CAS should be considered for advanced table training.
- Threat. Incorporation of TRTG equipment for advanced tables should be considered.
- Detailed manpower. Tasked labor force requirements internal and external to the unit must be identified.
- Briefings. Prerange briefings on range administration, ammunition handling, and range safety are needed.
- Aerial weapons scoring system. Is the system available during our scheduled range density? Has the range been surveyed for AWSS installation?

3-4. RANGE SCHEDULING

a. Most installations hold a G3 range conference annually to schedule range time. Representatives from all units using the range facilities will attend and compete for range time. Based on the long range calendar the units use (division, corps, or National Guard Training Center), the G3 personnel in charge of the conference provide information such as when units will be deployed and in the field. These conferences schedule range time for the installation range and unit representatives can meet range schedulers from the different units using the range. Maintaining a point of contact in the range scheduler's office may be important if a short-notice range requirement occurs, and your unit must trade with the occupying unit.

b. When scheduling a range, take into account the amount of time needed to conduct the required training. Table 3-1 shows an example time sequence for a range density. This example has dead-time built into it, and your unit may be able to make up time as the range progresses. Units should try to schedule extra days for maintenance and weather make-ups. Fourteen days is the minimum to run a gunnery density that includes advanced table training, not including AWSS set-up time. This example is based on a 24-helicopter AH-64 battalion.

Table 3-1. Example time sequence for a range density			
DAY	TABLE	COMPANY	REMARKS
1,2	AWSS Set-up		
3	VI	A Company	A Co. completes Table VI, B Co. starts Table VI
4	VI	B Company	B Co. completes Table VI, C Co. starts Table VI
5	VI	C Company	C Co. completes Table VI, Table VI complete
6	VI VII DAY	Makeup A Company	Table VI makeup, A Co. ready for VII
7	VII DAY VII NIGHT	B Company A Company	B Co. first-up, A Co. completes Table VII
8	VII DAY VII NIGHT	C Company B Company	C Co. first-up, B Co. completes Table VII
9	VIII DAY VII NIGHT	A Company C Company	A Co. first-up, C Co. finishes Table VII
10	VIII DAY VIII NIGHT	B Company A Company	B Co. first-up, A Co. completes Table VIII
11	VIII DAY VIII NIGHT	C Company B Company	C Co. first-up, B Co. completes Table VIII
12	X (2X) VIII NIGHT	A Company C Company	A Company Table X, C Co. completes Table VIII
13	X (2X) XII	B Company A Company	B Co. X in A.M. A Co. XII in P.M.
14	X (2X) XII	C Company B Company	C Co. X in A.M. B Co. XII in P.M.
15	XII Make-up/WX	C Company	
16	AWSS Tear-down and range turn-in		

b. ***Maneuver Area.*** A maneuver area is required to conduct dry-fire crew and team or company tables. Its purpose is two-fold. Without tying up valuable range space, it allows the firing elements to practice tactics, techniques, and procedures, short of actual live firing, required for gunnery training. Many impact areas will not accommodate firing lanes and surface danger zones large enough for large scale advanced table training. Companies waiting for their turn to fire on the range can conduct dry-fire training tables away from the range complex.

c. ***Facilities Requirements.***

(1) ***Preplanning.*** A list of range facility requirements includes all of the permanent and semipermanent fixtures required in the range areas. To avoid last minute problems, consider facil-ities requirements early, at least 6 months before the projected training. Give primary attention to--

(a) Alternate emergency airstrips.

(b) Rearm points.

(c) Ammunition holding and storage areas.

(d) Control towers.

(e) Target arrays.

(f) Boresight and harmonization pads and targets.

(g) Emergency safing areas for weapons.

(h) Jettison areas.

(i) Maintenance areas.

(j) Refuel points.

(2) ***Construction.*** Some facilities may be constructed by engineers, and some may be prepared or improved by the unit. For example, engineers may be able to install concrete rearm pads for use by helicopter units. In addition, range control may install target arrays tailored specifically for helicopter gunnery.

d. ***Equipment Requirements.***

(1) ***Preparation.*** Consider equipment requirements during the planning and preparation stage**.** Things to consider include--

(a) Number of firing aircraft.

(b) Number of crews to qualify.

(c) Command and control radio nets.

(d) Range control communication nets.

(e) Crash rescue equipment.

(f) Medical evacuation.

(2) ***Adaptation.*** This list may be expanded. Depending on the installation, available fixed facilities will vary. Some equipment must come from outside unit resources. Plan early to avoid problems.

e. ***Personnel Requirements.***

(1) ***Initial requirements.*** Filling personnel requirements is as important as filling facilities and equipment requirements. The gunnery training program must be integrated with the rest of the unit training calendar to ensure a coordinated effort by the unit. The following are key personnel required to conduct the live-fire range that will require additional preparation:

(a) Range officer in charge.

(b) Range safety officer.

(c) Laser range safety officer.

(d) Master gunner, chief of scoring.

(e) III/V platoon personnel.

(f) AVUM company and attached maintenance personnel.

These preparations are in addition to normal unit functions. For example, the III/V platoon and the AVUM company conduct operations similar to those found on live-fire ranges during field exercises. However, the fast tempo of the live-fire range may require more command, control, and communications functions than these elements normally employ.

(2) ***Training.*** The positions listed above are important to the unit's ability to perform the range mission. These personnel may require specialized training prior to the range. This training may include a rehearsal of the conduct of the tables at the range. In addition, all unit personnel should be briefed in detail on their specific responsibilities.

f. ***Logistic Requirements.*** Long-range forecasting and budgeting are required to ensure the availability of logistical support during the desired training period. Specifically, POL, ammunition, and armament repair parts require long-term planning and preparation. Special attention should be paid to budgeting for Class IX Air.

g. ***Range Operation.*** Effective range administration and operation is crucial to any firing exercise. To conduct effective gunnery ranges, the unit must make a coordinated effort to organize and operate a gunnery range efficiently.

(1) ***Range administration*****.** Begin organizing a helicopter gunnery range by identifying an officer in charge. The commander will appoint the OIC. The OIC must be a knowledgeable, responsible officer who can implement safety and training guidance during the operation of the range. The OIC must be familiar with the local range SOP and safety requirements. Most ranges are governed by a range control agency, and appropriate range limitations and directives can usually be obtained from that element.

(2) ***Range logistics*****.** An effective range requires a great deal of support. Most logistical support functions should be coordinated through the S4 in coordination with the Class III/V platoon leader. These functions must include medical support, mess support, ammunition, maintenance, and transportation for personnel around the range facility.

(3) ***Range communications*****.** A minimum of three radio nets are required to operate a helicopter gunnery range: one net for range operation, one for air traffic control, and a range control net. Additionally, it is recommended that VHF and UHF radio nets be used in controlling and evaluating the firing exercise. Land lines can be used effectively at the ammunition points, maintenance points, and other facilities on the range. The S3 section, along with communications personnel, are responsible for communications on the range.

(4) ***Range organization*****.** The final step in preparing a range for firing is to organize the assets already mentioned. Take care to ensure that all resources are placed so that each functions smoothly. **NOTE:** You cannot afford to have time on the range with no aircraft firing. You must have good communication with the rearm area and the assembly area. Rehearse the flow of aircraft prior to the range.

Section II. Personnel Responsibilities And Duties

3-5. OFFICER IN CHARGE

A range will not be operated without an OIC. The OIC is responsible for all range operations. He supervises range personnel and enforces range safety. Officers in charge should come from the firing unit's chain of command and operate according to AR 385-63. Most major range complexes dictate OIC responsibilities and operate under strict SOPs.

NOTE: The OIC is not the unit commander. He is the commander's representative. Units may appoint an alternate OIC to relieve the OIC during rest periods. This is especially important during heavy day and night firing schedules.

a. Before firing, the OIC--

(1) Obtains a range briefing from the installation range officer as required by local range regulations.

(2) Obtains clearance to fire from range headquarters and records the time and the name of the person giving the clearance.

(3) Ensures that medical support required by the range SOP is present; the range flag is up; and the range sweep is completed.

(4) Verifies that required personnel and equipment are present.

(5) Verifies with the FARP ammunition loading by type and amount.

(6) Checks communications and makes sure backup communications are available for live-fire.

b. During firing, the OIC--

(1) Enforces table standards.

(2) Maintains positive communications with ground elements and helicopters on the range.

(3) Supervises flight operations and safety procedures.

(4) Observes all range activities to ensure safety and efficiency.

(5) Observes and spot-checks ground operations.

(6) Maintains a duty log.

c. After firing, the OIC--

(1) Closes the range with headquarters.

(2) Verifies that the range is closed and completes reports as required.

(3) Ensures that the flag is removed, the buildings and tower are secure, and all operating areas are policed.

(4) Releases tasked labor details to supervisors when firing is completed, the last helicopter has departed the range, and work is complete.

3-6. RANGE SAFETY OFFICER

The RSO ensures safe operation of the range and assists the OIC. He is familiar with the range SOP and the aircraft and armament emergency plan. He is also aware of proper storing, handling, and loading of ammunition and fuel and knows the duties of all range personnel. RSO prerequisites are contained in AR 385-63. The RSO--

a. Observes range operation and reports unsafe conditions to the OIC.

b. Conducts the safety portion of the range briefing for all range personnel including

aircrews, Class III/V personnel, and maintenance personnel, as specified in the unit lesson plan.

c. Inspects the firing line and parking and ammunition-loading areas.

d. Ensures that vehicles, equipment, and aircraft are properly positioned for safety.

e. Provides input on the vehicle parking area and the organization and operation of the refuel/rearm areas.

f. Observes safety procedures during firing and ground operations.

g. Inspects crash and rescue equipment and reports any deficiencies in equipment or personnel training.

h. Ensures that a preaccident plan is in effect and all affected personnel are aware of it. Ensures that range control has a copy of the preaccident plan.

i. Observes safety procedures of POL and armament personnel and checks for any deficiencies in equipment or personnel.

j. Maintains watch for foreign objects in the parking area or FARP.

k. Ensures that knowledgeable EOD personnel are available.

l. Ensures that a diagram is displayed at the central control point showing the location of all range facilities, range fan information and flight routes, minimum altitudes, other impact areas, low-level hazards to flight, and possible caution areas.

3-7. MASTER GUNNER

The master gunner is familiar with the unit range SOP, aircraft and armament emergency procedures, and the local accident reporting procedures. He ensures that assigned helicopter weapon systems are operated using the prescribed procedures and applicable safety precautions. He is familiar with the azimuth, range, and sector azimuth limits of the range. He knows the standards and is the commander's primary scorer for the gunnery tables. The master gunner--

a. Observes the operation of the range, reports unsafe conditions to the OIC or RSO. Captures observations on range operation for the after-action review.

b. Ensures along with the OIC that the helicopters fire the approved scenario within range limits.

c. Ensures that the range is conducted to FM 1-140 standards.

d. Coordinates an evaluation cell to score gunnery tables. Completes required reports and produces required documents.

3-8. LASER RANGE SAFETY OFFICER OR NCO

For all laser range operations, unit commanders must designate, train, and certify LRSOs or LRSNCOs. The LRSO or LRSNCO will--

a. Be familiar with Chapter 19 and Appendix B, AR 385-63, and the FM and TM applicable to the laser devices used.

b. Brief unit personnel who work with laser devices on laser-related hazards, safety devices, and malfunction procedures.

c. Know the range fans, including elevations, firing position, and target to be used.

d. Ensure that protective eye wear is used when required.

e. Ensure compliance with unit and range SOPs regarding laser operations and training.

f. Maintain continuous communications with personnel on the range and stop lasing immediately if communications are lost.

3-9. RADIO OPERATORS

The radio operators ensure that radios used in the conduct of the range are working properly. They must be familiar with the range SOP and aircraft and armament emergency plan.

3-10. CLASS III/V OIC OR NCOIC

Early in the planning process, the Class III/V OIC or NCOIC coordinates resource requirements to ensure that adequate fuel and ammunition are available for training. Fuel requirements are based on the estimate of OPTEMPO by the commander and S3. Ammunition requirements are from DA Pamphlet 350-38.

a. In addition, they conduct classes in coordination with the master gunner to educate the unit air and ground crews on identifying and properly loading ammunition. These classes can be held both before and during range operations.

b. The Class III/V platoon establishes the FARP and coordinates the drawing, transportation, storage, and dispersal of ammunition and explosive devices on the range. The platoon leader ensures that each aircraft receives the prescribed load of ammunition. The platoon leader also develops a plan for disposal of nonfunctional ammunition and ensures that restricted or suspended lots are not used in training. The Class III/V platoon leader or platoon sergeant reviews and enforces the following safety precautions:

(1) Personnel must approach and depart the vicinity of the helicopter from the side and only after visual approval from the pilot in the helicopter.

(2) The last person to leave the vicinity of the helicopter gives an "all clear" signal to

the pilot.

(3) Personnel remain clear of loaded weapon danger areas at all times.

(4) The weapon system is secured before anyone enters or leaves the helicopter or as directed by the pilot.

(5) Personnel remain clear of weapon system areas during boresighting.

(6) The weapon systems are checked only when the master arm switch is in the SAFE position as directed in the appropriate TM.

(7) Smoking is not allowed within 50 feet of ammunition or the helicopter.

(8) Personnel use available protective devices such as hearing protectors.

(9) Loose equipment near the arming pads are secure before helicopter take-off or landing.

(10) Ammunition casings and dunnage are policed and turned in.

(11) Class III/V accounts are closed out, and the FARP is cleared as required.

NOTE: FARP operations are covered in FMs 1-104, 1-112, 1-114, 1-116, and 1-117.

Section III. Helicopter Gunnery Range Safety

3-11. GROUND SAFETY

Ground support personnel must be constantly aware of the dangers involved in live-fire training. The training of support personnel in ammunition care and handling is a continuous process at the unit level. All ammunition storage, handling, and basic safety procedures will follow guidelines found in ARs 385-62, 385-63, and 385-64; local regulations and/or the range SOP; and the unit SOP. Ammunition characteristics are described in Chapter 5. Ground personnel must also be trained in the procedures for working near operating helicopters. Ammunition loading areas **may** be separate from refueling areas. In addition, support personnel should be drilled on emergency situations related to their duties. The rules for ground safety are as follows:

a. Personnel must avoid main and tail rotors, turret weapon systems, and wing store fore and aft blast areas during aircraft operation.

b. Personnel will approach the helicopter from the 90-degree side position only after receiving visual approval from the aircrew.

c. The helicopter will not be moved until an armorer moves out of the main rotor arc at the 90-degree side position and signals "all clear."

d. Before departing the arming or dearming area for the home station, support personnel will

remove all ammunition from the helicopter, and it will be checked by the aircraft pilot-in-command.

e. The helicopter must be grounded before any maintenance is performed and before the aircrew enters or exits the helicopter.

f. All personnel working on or near the helicopter will have their sleeves rolled down.

g. All personnel will use proper hearing protection.

h. During night operations, ground personnel will carry a flashlight or similar lighted device when working near the helicopter.

i. To maintain communications between the aircrew and armorers servicing the armament subsystems, personnel should use the intercom system and practice common hand signals. Figures 3-1 and 3-2 show ground hand signals.

3-12. FIRING SAFETY

Range safety requirements for firing helicopter weapon systems are contained in ARs 385-62 and 385-63.

a. Safety requirements for firing are as follows:

(1) Individual weapons are properly inspected.

(2) Clearance is received from the OIC or his representative before arming weapons.

(3) Weapons are pointed downrange and within range fan limits.

(4) Ground personnel are not in front of the weapons or in the backblast area.

(5) No other aircraft are within the surface danger area.

(6) Weapons are not fired closer than the minimum safe slant range.

(7) Laser range finders and designators are considered and controlled as weapons.

b. The rules for firing safety are as follows:

(1) During range operations, armament subsystems will be pointed downrange or away from populated areas, whenever possible.

(2) Armament subsystems are considered safe for range traffic pattern operations under safe or standby conditions. (See NOTE below.)

(3) Armament subsystems may be placed in the ARM position if the helicopter is pointed downrange at the firing point and no other aircraft are in the surface danger zone. (Laterally parked helicopters may be cleared for formation firing and team training.)

(4) Operating and positioning the arming switch is the PC's responsibility.

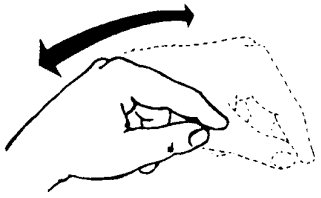
NOTE: Refer to the appropriate aircraft operator's manual for proper aircraft weapons safing techniques. Instances may occur when the master arm switch is in the safe position, but the weapon may still be functional and dangerous to ground crews.



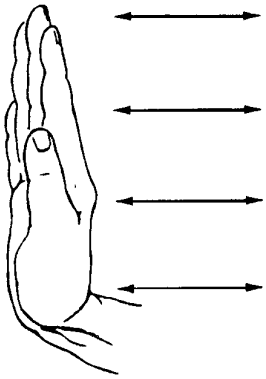
STOP! HOLD POSITION



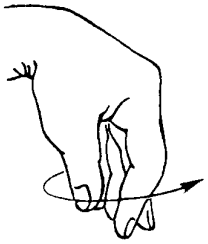
STOPPAGE OF BOTH GUNS:
POINT TO SIDE ON WHICH STOPPAGE OCCURS



SAFE ARM: SIMULATED MOVEMENT OF SWITCH TO REAR INDICATES PLACE SWITCH SAFE; SIMULATED MOVEMENT OF SWITCH FORWARD INDICATES PLACE SWITCH ARMED



CLEAR AIRCRAFT: MOVE CLEAR OF AIRCRAFT BY A DISTANCE OF 50 FT



CONNECT CANNON PLUG ON ROCKET LAUNCHER:
POINT TO SIDE TO BE CONNECTED

Figure 3-1. Ground hand signals

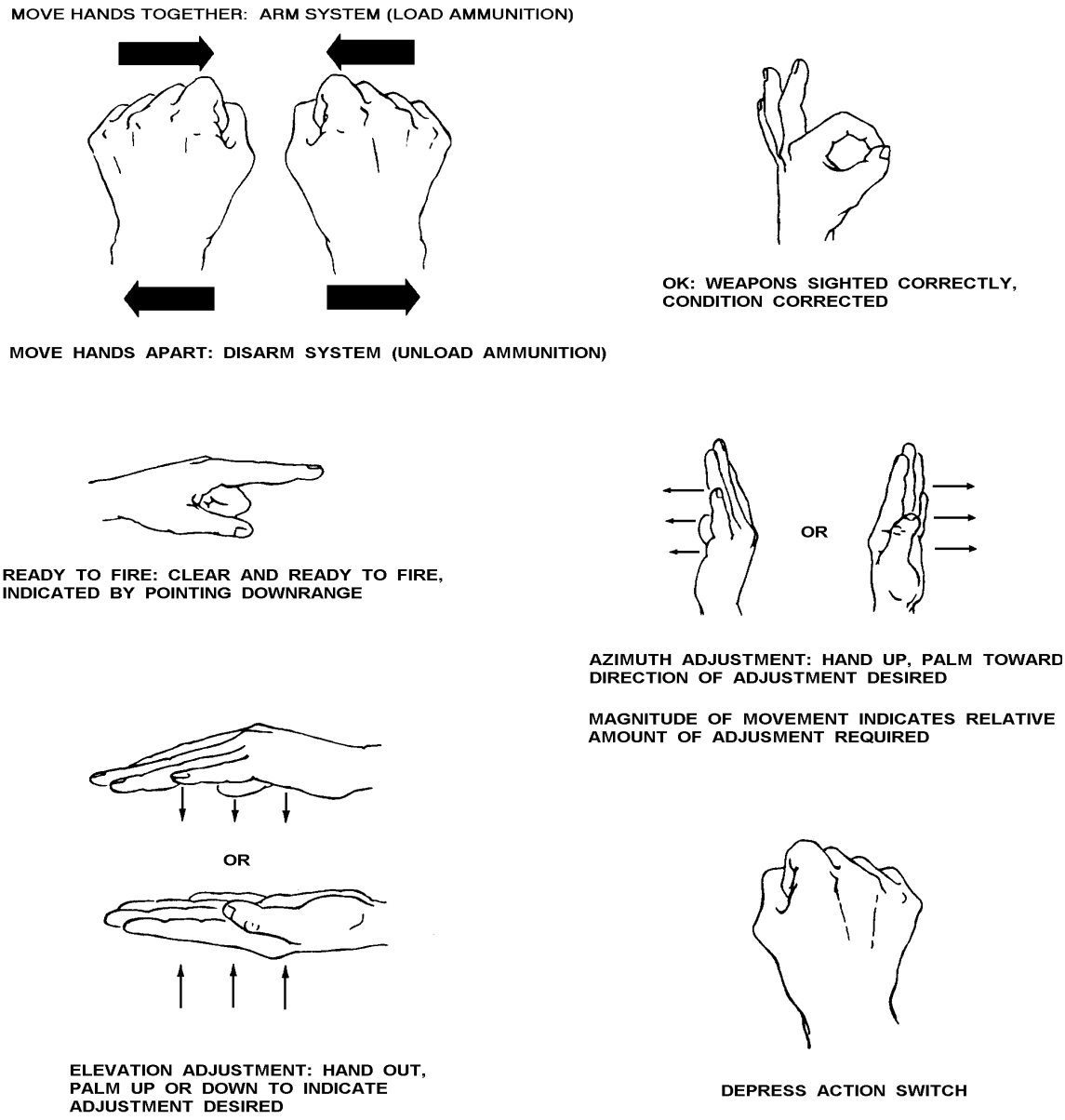


Figure 3-2. Ground hand signals (continued)

3-13. AIRCRAFT EMERGENCY PLAN

The aircraft emergency plan prescribes the procedures to be followed if an aircraft emergency (accident, incident, or inadvertent firing) occurs during range firing. The aircraft emergency plan should provide for immediate accident notification to the OIC and RSO. The range OIC will ensure that mishaps are reported according to local policies.

Section IV. Range Layout

3-14. CONSIDERATIONS

a. Construct firing lanes so targets are clear of obstructions and clearly visible to aircrews. To facilitate boresighting and emergency situations, the first 500 meters of a firing lane should be clear and relatively flat.

b. The start-fire line must be clearly marked and visible from the air. For control purposes, the start-fire line should be visible from the range tower or control point. Landing pads on the firing line should be clearly marked for both day and night landings. In addition, range limits must be clearly visual to aircrews and controllers.

c. Specifications for suitable helicopter gunnery range targets are contained in TC 25-8. By referring to the gunnery tables, the proper target silhouettes for each engagement can be manufactured and placed on the range. Do not settle for targets that are not full scale. Reduced scale targets degrade target acquisition by the aircrew.

3-15. MULTIPURPOSE RANGE COMPLEX

Multipurpose ranges are fully automated and instrumented with state-of-the-art targets and controlling devices. MPRCs are primarily designed for armored and mechanized infantry, but they can accommodate helicopter gunnery. Commanders should plan their gunnery programs to integrate helicopter gunnery into combined arms training. TC 25-8 contains more information on training in a multipurpose range complex.

a. The MPRC consists of an area approximately 1,000 meters by 4,500 meters. It employs remote target systems and stationary and moving targets.

b. Helicopters are restricted to specific firing points, altitudes, and ranges.

c. If live-fire, non-dud-producing ammunition, and MILES/AGES laser engagements are used, the MPRC can support training as outlined in AR 350-1 and FM 25-100.

3-18. AERIAL WEAPONS SCORING SYSTEM

a. The aerial weapon scoring system is a system of computer controlled sensors that can accurately score cannon and rocket engagements. These systems are owned by the Army and are contractor operated.

b. The AWSS is controlled by the Army Training Support Center, Fort Eustis, Virginia. FORSCOM, USARPAC, USAR units request the AWSS through FORSCOM J3-Training Support, Ranges. ARNG units request the AWSS through the FORSCOM National Guard Liaison. Units in Germany do not have to request the AWSS. The AWSS in USAREUR is semipermanently based at Grafenwoehr Training Area.

c. If your unit has not used the AWSS before, ensure that the range has been surveyed. Conduct the survey at least 60 to 90 days before the training. Normally, the contractor surveys a range only once unless new targets are installed.

d. The AWSS consists of a ballistic scoring subsystem, rocket scoring subsystem, and control subsystem.

(1) ***Ballistic scoring subsystem*****.** The BSS consists of doppler radar sensors located adjacent to the target. These sensors count 7.62-mm, 20-mm, 30-mm, and .50-caliber hits and transmit hit information to the control subsystem.

(2) ***Detonation (Rocket) scoring subsystem*****.** The DSS consists of acoustical sensors located at surveyed points on or adjacent to the range. The sensors detect detonations of training rockets and rocket submunitions and locate their points of impact in the target effect area. This information is transmitted to the control subsystem for processing. The DSS come in two variations to score PD and MPSM rockets.

(3) ***Computer scoring subsystem*****.** The CSS consists of a processor and monitor located in a mobile unit near the control tower. The scoring system receives information from the ballistics and rocket scoring subsystems, processes that information, and displays the results visually or as hard copy or both.

e. The crew must be aware of some characteristics of the AWSS. These characteristics include the following:

(1) The minimum range for scoring rocket engagements with the AWSS is 2,500 meters.

(2) Crews must allow rockets to impact in the target effect area before firing the next pair of rockets. Reports indicate that crews are shooting multiple pairs of rockets in rapid succession at AWSS targets. Not only does this have little training value (fewer trigger pulls), it confuses the AWSS and may cause the rocket score to be erroneous. Remember, crews have to observe the rocket's impact before an adjustment can be made.

(3) Do not fire PD and MPSM rockets at the same target effect area unless the target effect area is "dual augmented," or sensors are arrayed to score both types of rockets. The MPSM mode for the TEA plots the centroid of the submunitions. The PD mode plots single impacts.

(4) The AWSS is not compatible with high-explosive service ammunition. Only training munitions may be used with the AWSS.

3-19. ATTACK HELICOPTER GUNNERY RANGE

a. The AHGR is designed to allow an attack helicopter battalion or cavalry squadron to conduct company-level helicopter gunnery operations. While this range complex does not currently exist, it is being reviewed for possible future construction. An example attack

helicopter gunnery range is shown in Figure 3-3.

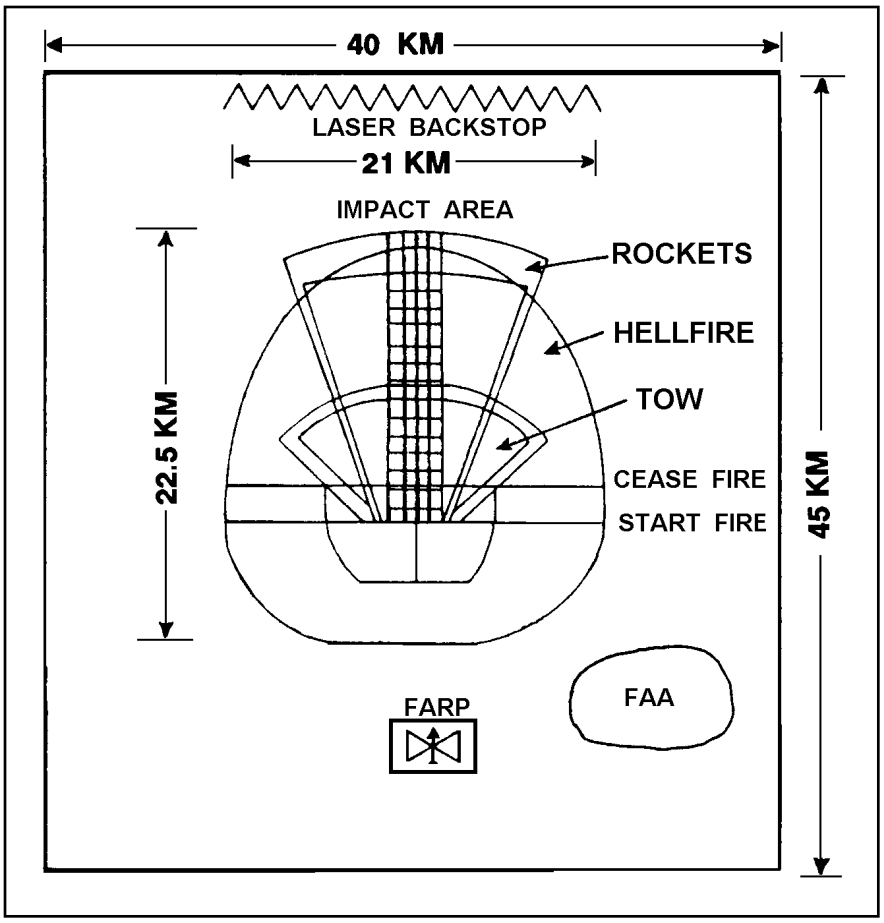


Figure 3-3. Attack helicopter gunnery range

b. The proposed maneuver and firing box for the AHGR is 3,000 meters wide by 2,000 meters long. The adjacent target area is 3,000 meters wide by 10,000 meters long. The purpose of a firing area this size is to allow an entire attack company or air cavalry troop to navigate, maneuver, and conduct live-fire training. The AHGR will allow crews to shoot current munitions at maximum ranges.

c. The purpose of the AHGR is for units to deploy to the training area and be objectively evaluated on helicopter gunnery proficiency on the fully instrumented AHGR.

Section V. Successful Training

3-20. GUIDES TO SUCCESSFUL TRAINING

a. ***Brief Key Personnel.*** Before moving to the training site, the S3 and master gunner should brief key personnel in setting up the site and on how to react to problems that may occur

during setup.

b. ***Start on Time***. The training site should be ready and the communications set up early so that crews can begin firing on time. Plan operations for no interruptions of training for maintenance on the range until a prearranged time or normal shutdown time. Sufficient targets must be available to complete all scheduled training before the scheduled break. Short breaks to replace damaged targets are unavoidable. Try to minimize down-time. Range control must have plenty of backup targets ready for use.

c. ***Keep a Log*****.** The OIC will maintain an accurate log or staff journal. A log will help keep the OIC better informed of dry- and live-firing times and other important events. As a minimum, the log should contain the following entries:

(1) When the unit occupied the range.

(2) When permission was received from range control for live-fire.

(3) The name of the person at range control granting permission to fire.

(4) When the range was in a cease-fire status and the reason for cease-fire.

(5) When the range was reopened.

(6) Locations and times of stray impacts.

(7) Crew identification and table fired--start and stop times. (It is critical that the OIC keep track of which crews have fired.)

(8) Reason for incomplete tables such as maintenance, unexploded ordnance, and weather.

(9) When the unit cleared and departed the range.

(10) Shift changes.

(11) VIPs or senior officers visiting the range.

d. ***Change Guards*****.** Prepare plan to check and change guards frequently. Make sure that each guard is briefed on his job and its importance. Ensure the guard understands the instructions.

e. ***Control Fires*****.** During the dry season, a danger of grass and brush fires exists. Be prepared to quickly control fires and have a plan to evacuate aircraft, if fires spread.

f. ***Police Continuously*****.** Keep your range area clean at all times. Police the range area continuously to avoid lengthy cleanup during range turn-in.

g. ***Brief Visitors*****.** Senior officers may arrive on the range unannounced. Have a plan for briefing visitors on the range operation. Designate a briefing officer or NCO.

(1) Build a professional, concise range briefing book. It should contain the following

information:

(a) Names and ranks of the unit chain of command and key range personnel.

(b) Training objectives for the range.

(c) Schedule for range training.

(d) A short memo outlining the objectives and standards for the training.

(e) MOI for the range.

(f) Diagrams of the firing points.

(g) A copy of FM 1-140.

(2) Ensure the briefing officer or NCO knows what actions to take with the visitor.

h. *Plan Aircraft Evacuation*. The AVUM commander must have a plan to evacuate disabled or damaged aircraft from the range and the rearm/refuel area. A precautionary landing on the range or in the FARP can stop firing for a long time unless a plan is in place to remove the aircraft.

CHAPTER 4

BALLISTICS

Ballistics is the science of the motion of projectiles and the conditions that influence that motion. The four types of ballistics influencing helicopter fired weapons are **interior**, **exterior**, **aerial**, and **terminal**. Each type produces **dispersion**, which is the degree that projectiles vary in range and deflection about a target.

4-1. INTERIOR BALLISTICS

Interior ballistics deal with characteristics that affect projectile motion inside the barrel or rocket tube. It also includes effects of propellant charges and rocket motor combustion. These characteristics affect the accuracy of all aerial-fired weapons. Aircrews cannot compensate for these characteristics when firing free-flight projectiles. The characteristics of interior ballistics are discussed below.

a. ***Barrel Wear.*** Gaseous action, propellant residue, and projectile motion wear away the barrel's inner surface or cause deposits to build up. These conditions result in lower muzzle velocity, a decrease in accuracy, or both.

b. ***Propellant Charges.*** Production variances can cause differences in muzzle velocity and projectile trajectory. Temperature and moisture in the storage environment can also affect the way propellants burn.

c. ***Projectile Weight.*** The weight of projectiles of the same caliber may vary. The variance is most noticeable in linked-ball projectiles. These variations do not significantly influence trajectory.

d. ***Launcher Tube Alignment.*** Individual rocket launcher tubes are aligned by the rocket launcher's internal or end bulkhead. However, the precise alignment of each tube may vary. Because of variances in alignment, the launcher boresight also varies from tube to tube. Proper boresighting of the launcher should include checking the boresight of several tubes and selecting the one that best represents the alignment of the entire launcher.

e. ***Thrust Misalignment.***

(1) A perfectly thrust-aligned free-flight rocket has thrust control that passes directly through its center of gravity during motor burn. In reality, free-flight rockets have an inherent thrust misalignment, which is the greatest cause of error in free flight. Spinning the rocket during motor burn reduces the effect of thrust misalignment.

(2) Firing rockets at a forward airspeed above ETL provides a favorable relative wind, which helps to counteract thrust misalignment. When a rocket is fired from a hovering helicopter, the favorable relative wind is replaced by an unfavorable and

turbulent wind caused by rotor downwash. This unfavorable relative wind results in a maximum thrust misalignment and a larger dispersion of rockets.

(3) Rockets spin to counteract thrust misalignment. Rockets with MK66 motors exhibit less dispersion in the target effect area than those with MK40 motors according to data provided by Rock Island Arsenal.

4-2. EXTERIOR BALLISTICS

Exterior ballistics deal with characteristics that influence the motion of the projectile as it moves along its trajectory. The trajectory is the flight path of the projectile as it flies from the muzzle of the weapon to the point of impact. Aerial-fired weapons have all the exterior ballistic characteristics associated with ground-fired weapons. They also have other characteristics unique to helicopters. The characteristics of exterior ballistics are discussed below.

a. *Air Resistance*. Air resistance, or drag, is caused by friction between the air and the projectile. Drag is proportional to the cross-section area of the projectile and its velocity. The bigger and faster a projectile is, the more drag it produces.

b. *Gravity*. The projectile's loss of altitude because of gravity is directly related to range. As range increases, the amount of gravity drop increases. This drop is proportional to time of flight (distance) and inversely proportional to the velocity of the projectile. Crew members that fire weapons without FCC solutions must correct for gravity drop. Table 4-1 shows gravity drop for different projectiles.

c. *Yaw*. Yaw is the angle between the centerline of the projectile and the trajectory. Yaw causes the projectile's trajectory to change and drag to increase. The direction of the yaw constantly changes in a spinning projectile. Yaw maximizes near the muzzle and gradually subsides as the projectile stabilizes.

d. *Projectile Drift.*

(1) When viewed from the rear, most projectiles spin in a clockwise direction. Spinning projectiles act like a gyroscope and exhibit gyroscopic precession. This effect causes the projectile to move to the right, which is called the **horizontal plane gyroscopic effect**. As the range to target increases, projectile drift increases.

Table 4-1. Gravity drop			
Projectile	Approximate Muzzle Velocity (feet per second)	Range (meters)	Approximate Gravity Drop (mils)
7.62 mm	2,800	1,000	7
.50 cal	2,900	1,000/1,500	9/18
20 mm	3,380	1,000/1,500	9/21
30 mm	2,640	1,000/2,000	15/60
40 mm	795	1,000	87

(2) To compensate for this effect in aircraft without FCC solutions, the gunner increases any correction, such as elevation, depression, or deflection, to hit the target. To compensate for projectile drift, the gunner establishes combat sight settings or adjusts rounds toward the target. This compensation is known as using "burst on target." Figure 4-1 shows projectile drift.

e. ***Wind Drift.*** The effect of wind on a projectile in flight is called wind drift. The amount of drift depends on the projectile's time of flight and the wind speed acting on the cross-sectional area of the projectile. Time of flight depends on the range to the target and the average velocity of the projectile. When firing into a crosswind, the gunner must aim upwind so that the wind drifts the projectile back to the target. Firing into the wind or downwind requires no compensation in azimuth but will require range adjustment.

4-3. AERIAL BALLISTICS

a. ***Common Characteristics*****.** Characteristics of aerial-fired weapons depend on whether the projectiles are spin-stabilized or fin-stabilized and whether they are fired from the fixed mode or the flexible mode. Some characteristics of aerial-fired weapons are discussed below.

(1) ***Rotor downwash error*****.** Rotor downwash acts on the projectile as it leaves the barrel or launcher. This downwash causes the projectile's trajectory to change. A noticeable change in trajectory normally occurs when the helicopter is operating below effective translational lift.

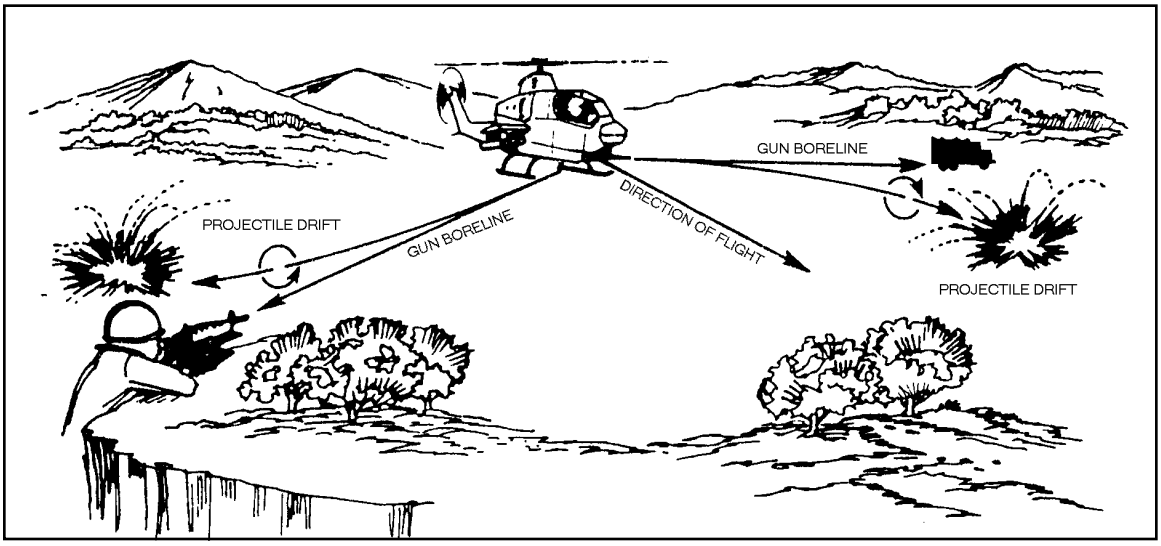


Figure 4-1. Projectile drift

(a) Although rotor downwash influences the accuracy of all weapon systems, it most affects the rockets. Maximum error is induced by rotor downwash when the weapon system is fired from an aircraft hovering IGE, as shown in Figure 4-2. Air flows downward through the rotor system and causes the rocket to pitch up as it leaves the launcher.

(b) When the rocket passes beyond the rotor disk, air flows upward and causes the rocket to wobble. This air flow causes both lateral (azimuth) and linear (range) errors.

(c) When the aircraft is hovering OGE (Figure 4-2) the relative wind strikes the rocket only from above after it leaves the launcher. This condition decreases the lateral error. However, the velocity of the rotor downwash increases because of the additional power required to maintain OGE hover, which may increase linear dispersion.

(d) High-density altitudes and heavily loaded aircraft further increase linear dispersion. During IGE and OGE hovering flight, the true airspeed vector of the helicopter affects the position of rotor downwash and the speed of the downwash at the rocket launchers. For example, holding a position over the ground during a right crosswind results in a true airspeed vector to the right and a shift of the downwash to the left. This shift affects the left rocket for a longer time during launch than the right rocket. The left rocket also will pitch up to a higher quadrant elevation and go farther than the right rocket. Detailed system testing has not shown that differences of QE are required for right versus left launchers during hover fire.

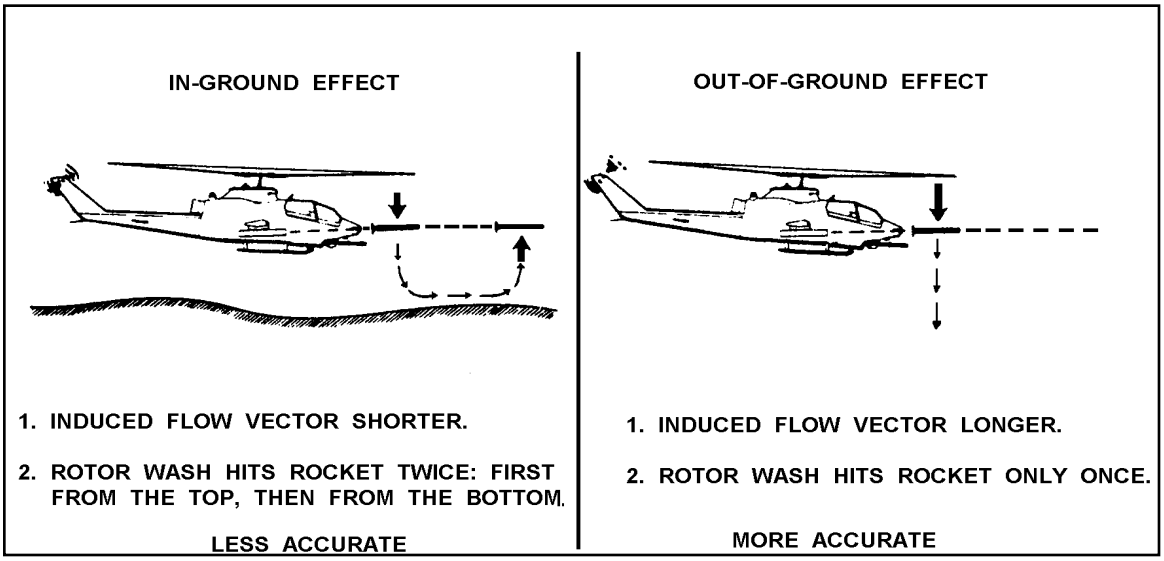


Figure 4-2. Rotor downwash error

(e) To prevent a divergence of trajectories, the aircraft can drift with the wind if the terrain allows. Drifting with the wind allows the aircraft to remain stable and provides a more consistent rotor downwash for both launchers.

(2) ***Angular rate error.***

(a) Angular rate error is caused by the motion of the helicopter as the projectile leaves the weapon. It affects most weapon systems. The exceptions are TOW, Hellfire, and Stinger missiles. For example, a pilot using the running-fire delivery technique to engage a target with rockets at 5,000 meters may have to pitch the nose of the helicopter up to place the reticle on the target. When the weapon is fired, the movement of the helicopter imparts an upward motion to the rocket. The amount of error induced depends on the range to the target, the rate of motion, and the airspeed of the helicopter when the weapon is fired.

(b) Angular rate error occurs when aircrews fire rockets from a hover using the pitch-up delivery technique. Anytime a pitch-down motion is required to achieve the desired sight picture, the effect of angular rate error causes the projectile to land short of the target.

b. ***Spin-Stabilized Projectiles.*** Certain exterior ballistic characteristics are peculiar to spin-stabilized projectiles fired from weapons with rifled barrels. These weapons include the .50-caliber and 7.62-mm machine guns, and the 20- and 30-mm cannons. When fired in the fixed mode (straight ahead of the helicopter), the projectiles generally have the same ballistic characteristics as ground-fired weapons. However, relative wind changes and the velocity of the helicopter increase or decrease the velocity of the projectile. Ballistic characteristics influencing spin-stabilized projectiles fired from positions other than a stabilized hover are discussed below.

(1) ***Trajectory shift.*** When the boreline axis of the weapon differs from the flight path

of the helicopter, the movement of the helicopter changes the trajectory of the projectile. For off-axis shots within ±90 degrees of the helicopter's heading, trajectory shift causes the round to hit left or right of the target. To correct for trajectory shift, the gunner leads the target. To lead the target, the gunner places fire on the near side of the target as the helicopter approaches. The amount of lead depends on the airspeed of the helicopter, angle of deflection, velocity of the projectile, and range of the target. Figure 4-3 shows trajectory shift. Table 4-2 shows some examples of how to compensate for trajectory shift.

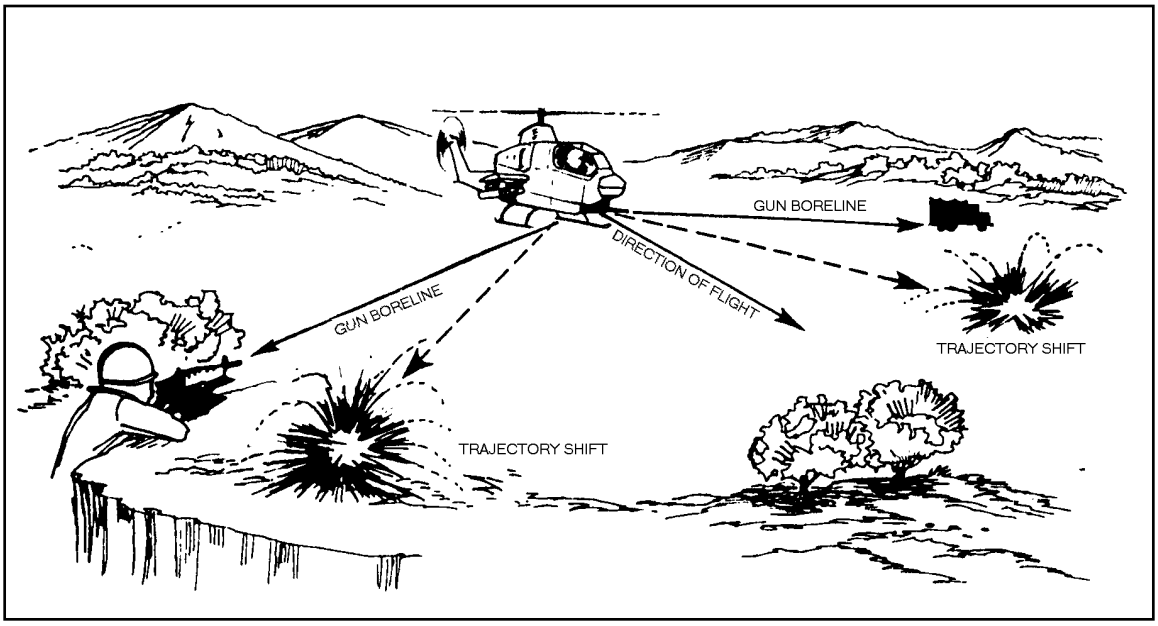


Figure 4-3. Trajectory shift

Table 4-2. Typical lead angles for a 60-degree deflection shot at 1,000 meters

Projectile	Approximate Muzzle Velocity (feet per second)	Helicopter Velocity (knots)	Lead Angle (mils)
7.62 mm	2,800	100	51
.50 cal	2,900	100	49
20 mm	3,380	100	47
30 mm	2,640	100	64
40 mm	795	100	182

(2) ***Port-starboard effect.*** Trajectory shift and projectile drift combine to constitute the port-starboard effect. When targets are on the left, the effects of drift and shift compound each other; both cause the round to move right. To hit the target, the gunner must correct for both ballistic effects by firing to the left of the target. When targets are on the right, the effect of projectile drift (round moves right) tends to

cancel the effect of trajectory shift (round moves left). Therefore, firing requires less compensation. The range and airspeed at which a target is engaged determine which effect is greater. For example, at ranges less than 1,000 meters, trajectory shift is greater. The gunner must fire to the right of the target. At ranges beyond 1,000 meters, the effect of projectile drift is greater and tends to cancel the effect of trajectory shift.

(3) ***Projectile jump (vertical plane gyroscopic effect).***

(a) When a crew fires a weapon from a helicopter in flight and the weapon's muzzle is pointing in any direction other than into the helicopter's relative wind, the projectile will experience projectile jump. Projectile jump begins when the projectile experiences an initial yaw as it leaves the muzzle. The yaw is in the same direction as the projectile's direction of rotation. The jump occurs because of the precession (change in axis of rotation) induced by crosswind.

(b) The amount a projectile jumps is proportional to its initial yaw. Firing to the right produces a downward jump; firing to the left produces an upward jump. To compensate the gunner must aim slightly above a target on the right of a helicopter and slightly below a target on the left. The amount of compensation required increases as helicopter speed and angular deflection of the weapon increase. Compensation for projectile jump is not required when firing from a hover.

c. ***Fin-Stabilized Projectiles.*** The exterior ballistic characteristics affecting fin-stabilized projectiles are important. They include--

(1) ***Propellant force.*** A bullet reaches its maximum velocity at or near the weapon's muzzle. However, a rocket continues to accelerate until motor burnout occurs. As the rocket reaches its greatest velocity, the kinetic energy in the rocket tends to overcome other forces and causes the rocket to travel in a flatter trajectory.

(2) ***Center of gravity.*** Unlike a bullet, the CG of a rocket is in front of the center of pressure. As the rocket propellant burns, the CG moves farther forward. The rocket's fins cause the center of pressure to follow the CG.

(3) ***Relative wind effect.*** When a helicopter is flown out of trim, either horizontally, vertically, or both, the change in the crosswind component deflects the rocket as it leaves the launcher. Because the rocket is accelerating as it leaves the launcher, the force acting upon the fins causes the nose to turn into the wind.

(a) A horizontal out-of-trim condition results when a pilot tries to align the sight on the target during a crosswind by cross-controlling, or slipping, the helicopter. For example, a pilot flies at 100 knots and maintains 10 degrees out of trim with a quartering crosswind component of 10 knots. This condition causes the rocket to turn into the relative wind after leaving the tube. As the velocity of the rocket increases and the motor burns out, the crosswind component decreases. After the motor burns out, the rocket drifts with the air

mass (real wind). If the pilot is unable to align the helicopter into the wind, the gunsight must be corrected upwind. While firing from a hover or during slow flight, the pilot must make a downwind correction because the rocket will turn into the wind.

(b) A vertical out-of-trim condition results from an improper power setting. This condition creates a vertical relative wind on the rocket during launch, causing the rocket to turn into the wind. If the pilot fires the rocket while applying power (as in a climb), the relative wind will be from above. The relative wind will cause the rocket to hit beyond the aiming point. To maintain a vertical trim condition, the pilot must maintain a constant power setting that will produce the desired airspeed and altitude.

4-4. TERMINAL BALLISTICS

Terminal ballistics describes the characteristics and effects of the projectiles at the target. Projectile functioning, including blast, heat, and fragmentation, is influenced as described below.

a. ***Impact Fuzes.*** Impact fuzes activate surface and subsurface bursts of the warhead. The type of target engaged and its protective cover determine the best fuze for the engagement. Engage targets on open terrain with a superquick fuze that causes the warhead to detonate upon contact. Engage targets with overhead protection, such as fortified positions or heavy vegetation, with either a delay or forest penetration fuze. As shown in Figure 4-4 these fuzes detonate the warhead after it penetrates the protective cover.

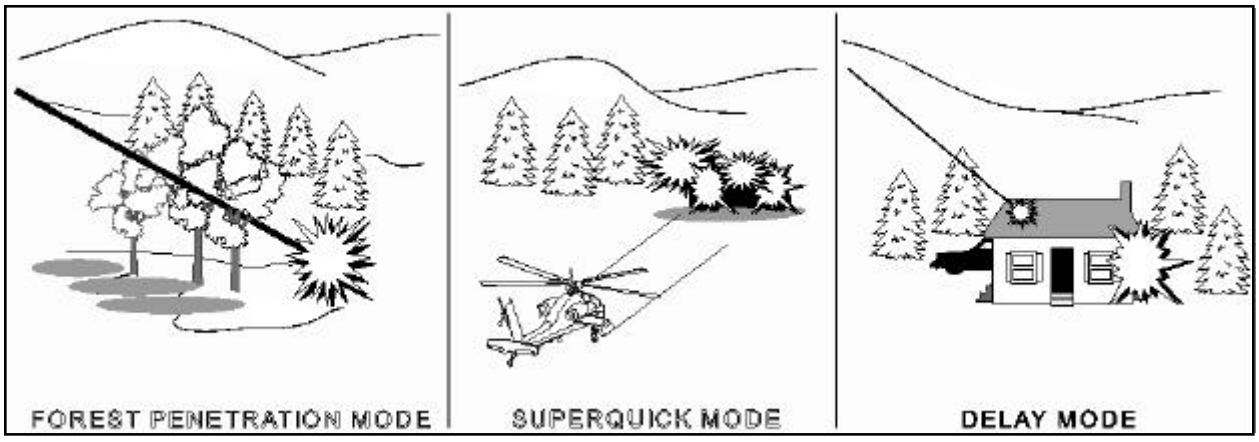


Figure 4-4. M433 multioption fuze/2.75-inch high-explosive warhead

b. ***Remote Set or Variable Time Fuzes.*** Timed fuzes produce airbursts and are most effective against targets with no overhead protection. Flechette, smoke, and illumination warheads incorporate a timed fuze, which depends on motor burnout. The range for this type of fuze is fixed. Remote range-set fuzes are in use for high explosive, multipurpose submunition, smoke, illumination, and chaff warheads. The range is variable for this type of fuze and can be set by the crew in the AH-1E/F, AH-64, and OH-58D (KW).

c. *Wall-In-Space Fuze.*

(1) Multipurpose submunition warheads provide a large increase in target effectiveness over standard unitary warheads. The MPSM warhead helps to eliminate range-to-target errors because of variations in launcher/helicopter pitch angles during launch. The M439 fuze is remotely set from the aircraft with range (time) to the target data.

(2) Once fired, the initial forward motion of the rocket begins fuze time. At the computer-determined time (a point slightly before and above the target area), the M439 fuze initiates the expulsion charge. The submunitions eject and each ram air decelerator inflates. Inflation of the RAD separates the submunitions, starts the arming sequence, and causes each submunition to enter a near vertical descent into the target area. Figure 4-5 shows the wall-in-space concept.

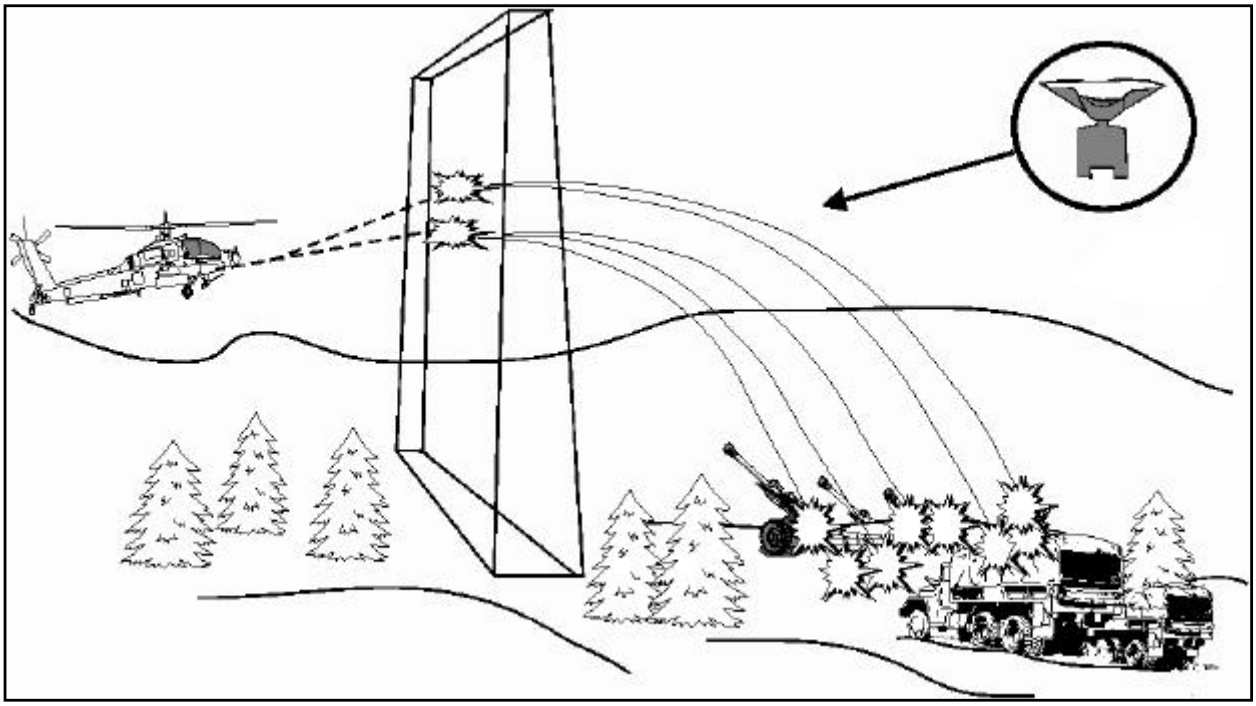


Figure 4-5. Wall-in-space concept

d. *Surface Conditions*. The surface of the target area (such as sand, rocks, or vegetation) affects the lethality of the projectile. If superquick fuzes are used against targets covered by heavy foliage, they will function high in the tree canopy but will be ineffective at ground level. However, the same fuze would be effective against a target area with a sandy surface. To get maximum effectiveness from the warhead, use the proper fuze for the surface condition.

e. *Warheads*. The type of target to be engaged determines which warhead to use. A large variety of warheads are available. The factors of METT-T help determine the proper mix of warheads for the particular mission.

f. ***Angle of Impact.*** The altitude from which the projectile is fired and the range to the target determine the angle of impact and fragmentation pattern. Weapons fired with a high angle of impact produce fragmentation patterns that are close together. A projectile fired from NOE altitudes at the midrange of the weapon forms an elongated pattern with the projectile impacting at shallow angles. As the range increases, the impact angle of the projectile increases. The length of the fragmentation pattern decreases while the width increases. Figure 4-6 shows the angle of impact.

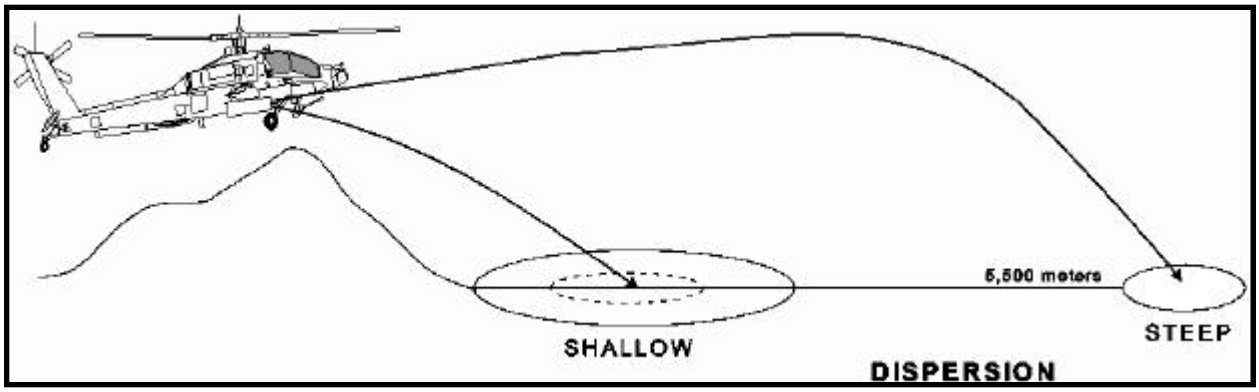


Figure 4-6. Angle of impact

4-5. DISPERSION

If several projectiles are fired from the same weapon with the same settings in elevation and deflection, their points of impact will be scattered about the mean point of impact of the group of rounds. The degree of scatter (range and azimuth) of these rounds is called dispersion. The mean point of impact with respect to the target center, or intended air point, is an indication of the weapon's accuracy. Both dispersion and accuracy determine whether a particular weapon can hit an intended target. Firing rockets at maximum ranges decreases range dispersion and normally increases accuracy. The reverse is true with other weapon systems; that is, as range increases, dispersion increases and accuracy decreases. Dispersion is caused by errors inherent in firing projectiles. These errors are influenced, in part, by the factors discussed in the ballistics paragraphs. In addition, they may be influenced by the vibrations in the mount and condition of the sighting systems.

a. ***Vibrations.*** Because mounts for weapons are fixed to the helicopter, vibrations in the helicopter transmit through the mounts. These vibrations affect azimuth and elevation.

b. ***Sights.*** The condition of the sights and the accuracy of their alignment with the bore axes of the weapons cause a displacement of the dispersion pattern of the projectiles.

c. ***Boresigh*****t.** Proper boresighting of aircraft weapons is critical to accurate fires. Improper boresighting is a factor in dispersion differences between like aircraft.

CHAPTER 5

MUNITIONS FOR HELICOPTER WEAPON SYSTEMS

The training munitions discussed in this chapter should be available through the logistical system. Combat, or service munitions, may not be found in a particular theater of operations. The theater command or, in some cases, a specific geographical area may require different types of munitions and/or different packaging configurations. Some Department of Defense ammunition codes are listed with the munitions that are described. Additional identification codes may be necessary to distinguish the type of munitions, series, warhead and fuze combinations, grouping sequence, packaging, package quantity, and availability. Any munitions that cannot be positively identified will not be loaded onto an aircraft, into a weapon, or into the feed system. All munitions must be identified at the ammunition supply or transfer point before receipt and distribution to the unit.

Section I. Linked Ammunition

5-1. 7.62 MILLIMETER FOR M60/M60D MACHINE GUN

a. The 7.62 mm ammunition is percussion-primed; chamber pressure is 50,000 psi for both the ball and the tracer. Projectile weight varies from 142 grains (.32 ounce) for the tracer to 150 grains (.34 ounce) for the ball. Muzzle velocity averages 2,750 feet per second. Figure 5-1 shows all 7.62mm service and training ammunition described below.

(1) ***Ball (M80 or M59).*** The M80 or M59 ball is intended for use against personnel and unarmored targets.

(2) ***Tracer (M62).*** The M62 tracer permits observation of the projectile's trajectory to the point of tracer burnout or to the point of impact. It is also used for incendiary effect and signaling. Tracer burnout occurs at approximately 900 meters.

(3) ***Armor piercing (M61).*** The M61 armor piercing projectile is used against light armor, concrete shelters, and similar bullet resistant targets. It is not intended for use in a training environment.

(4) ***Frangible ball (M160).*** The M160 frangible ball can be used during initial training on the M60 machine gun. It can be fired on indoor ranges if the range is ventilated to prevent buildup of toxic "bullet dust".

(5) ***Blank (M82).*** The M82 blank is used for training exercises in weapons equipped with blank firing adapters.

(6) ***Dummy (M172).*** The M172 dummy is used for weapon loading practice and for

testing the weapon mechanism.

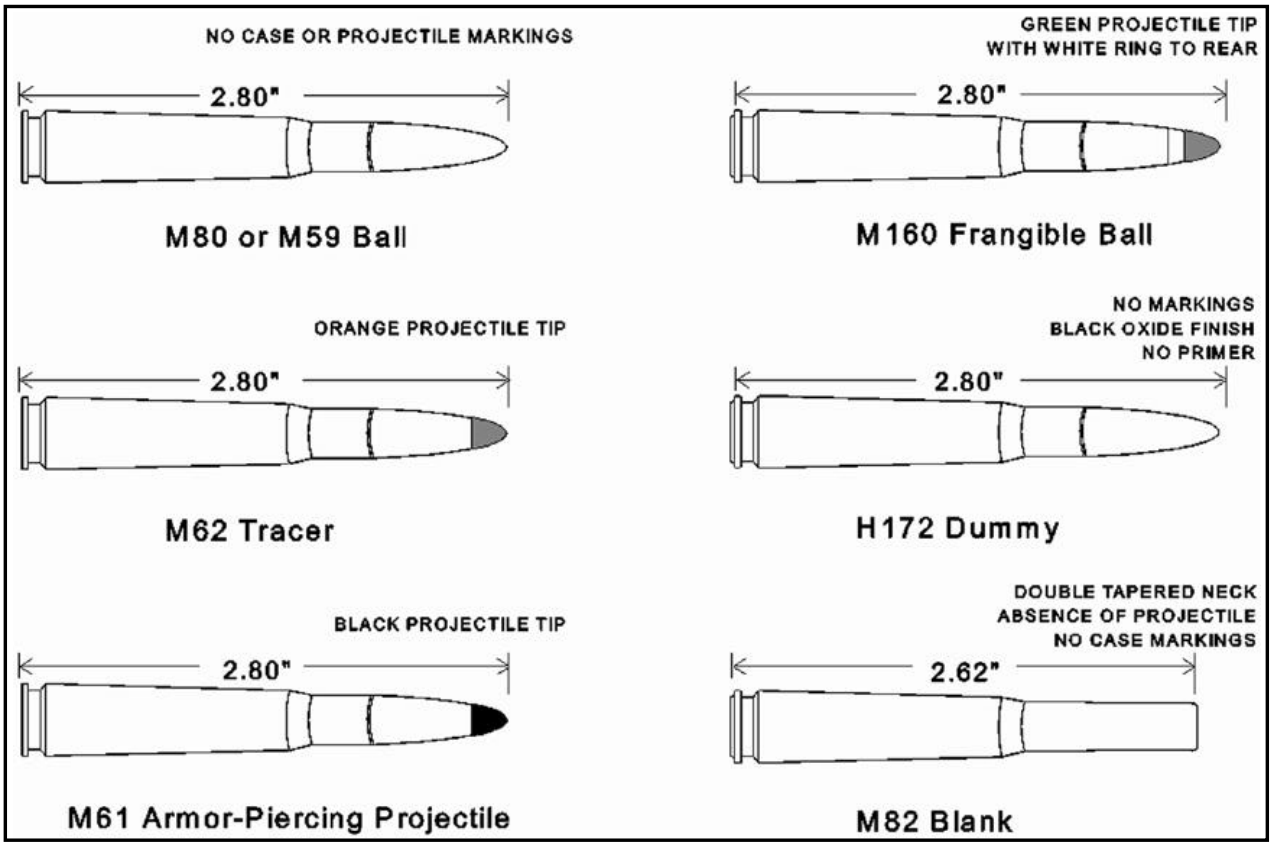


Figure 5-1. 7.62mm munitions

b. ***DODACs for 7.62 mm.*** DODACs of linked ammunition for the M60 and M60D machine guns are shown below. TM 43-0001-27 lists only one type of metallic link (M13) for all 7.62mm linked ammunition.

- 1305-A143 M80 Ball, l00/linked belt.
- 1305-A146 M62 Tracer, 100/linked belt
- 1305-A131 M80 Ball and M62 tracer (4 to l mix), l00/ linked belt.
- 1305-A147 M160 Ball, frangible, l00/linked belt.
- 1305-A159 M172 Dummy, 100/linked belt.
- 1305-A111 M82 Blank, l00/linked belt.

5-2. .50 CALIBER FOR OH-58D KIOWA WARRIOR

a. The .50 caliber ammunition is percussion primed; chamber pressure is 52,000 psi for the tracer and 59,000 psi for armor piercing ammunition. Projectile weight varies from 619

grains (1.36 ounces) for the AP to 662 grains (1.45 ounces) for the ball. Muzzle velocities vary from 2,700 feet per second for the M1 tracer to 3,400 feet per second for the M23 incendiary. Neither armor piercing nor incendiary ammunition is intended for use in a training environment. Table 5-1 shows the approximate time of flight and approximate ballistic drop with the M33 ball. Figure 5-2 shows .50 caliber service and training ammunition described below.

Table 5-1. M33 projectile ballistic data

Range to Target (meters)	Time of Flight (seconds)	Ballistic Drop (mils)
1,000	1.5	9
1,500	2.7	18
2,000	4.3	33

(1) ***Ball (M2 and M33).*** The M2 ball and the M33 ball are intended for use against personnel and unarmored targets. Muzzle velocity of the M33 is approximately 2,910 feet per second; the M2 is 2,810 feet per second.

(2) ***Tracer (M1, M10, and M17).*** The M1, M10, and M17 tracers permit visible observation of the in-flight path or trajectory to the point of impact. The M1 is limited to training use in CONUS. The M10 exhibits a trace from approximately 100 meters from the muzzle to approximately 1,600 meters from the muzzle.

(3) ***Armor piercing (M2).*** M2 armor piercing ammunition is used against lightly armored or unarmored targets, concrete shelters, and similar bullet resistant targets.

(4) ***Incendiary (M1 and M23).*** Impact with a hardened or armored target will cause incendiary composition to burst into flame and ignite flammable material. The incendiary charge of M1 is 34 grains; the M23 is 90 grains.

(5) ***Armor piercing incendiary (M8*****).** M8 armor piercing incendiary ammunition combines the function of the AP and incendiary bullet. The incendiary charge of the M8 is 15 grains.

(6) ***Armor piercing incendiary tracer (M20).*** The M20 combines the functions of the AP and the incendiary and adds a tracer element. The incendiary charge is 27 grains.

(7) ***Dummy (M2).*** The M2 dummy is used to practice loading and test the weapon's ammunition feed system and mechanical function.

(8) ***Blank (M1 and M1A1).*** The M1 and M1A1 blanks are used to simulate firing in training exercises. The M1A1 is used with the M2 machine gun and the M19 blank firing adapter.

(9) ***Target practice ball (M858) and plastic tracer (M860).*** The M858 ball and tracer

are intended for scaled range training with the M2 machine gun. The maximum range of this ammunition is 700 meters. The tracer round provides trace from 20 to 150 meters. This target-practice ball and tracer round is constructed of molded, high density polyethylene plastic.

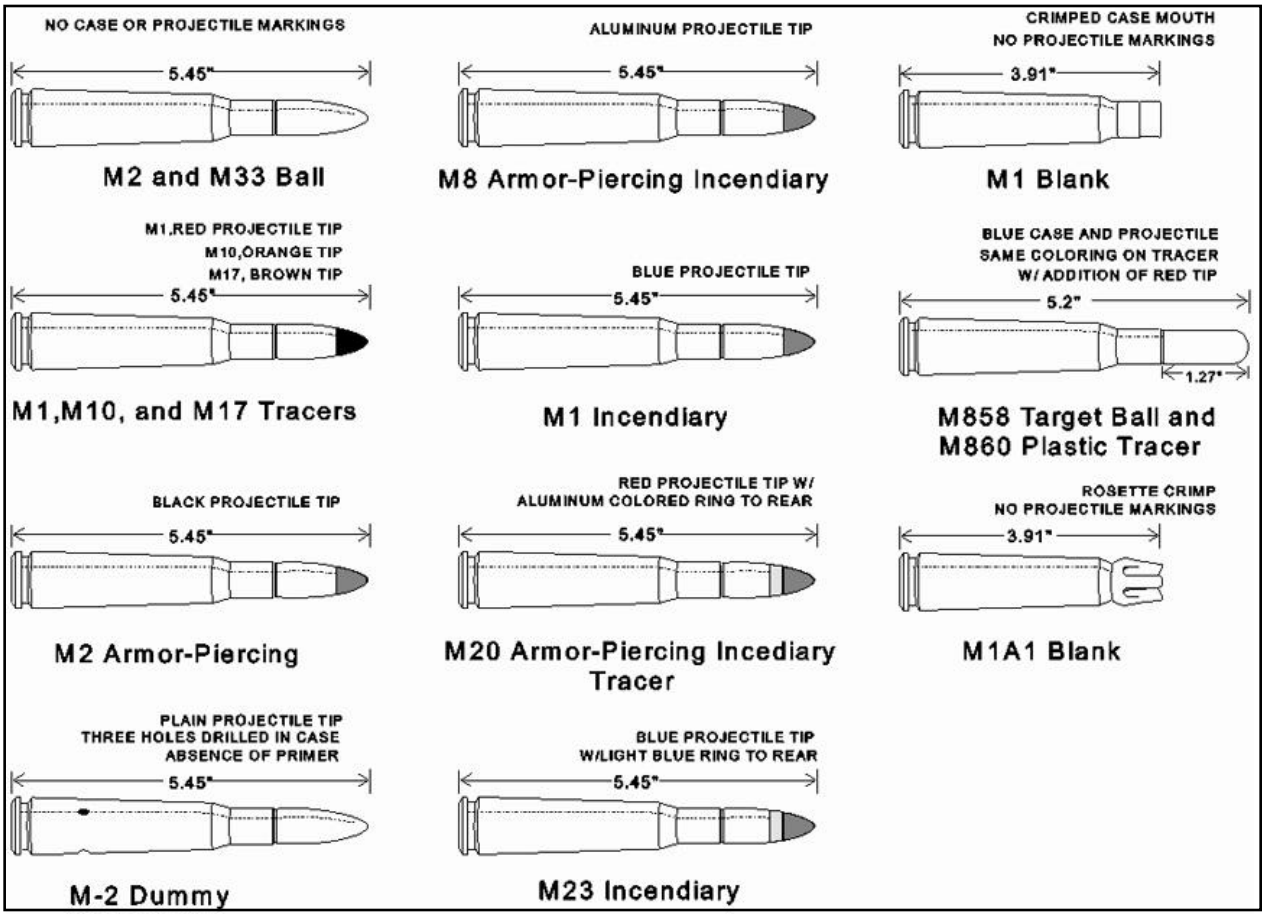


Figure 5-2. .50-caliber munitions

b. DODACs for .50 caliber. DODACs for linked .50-caliber ammunition for the M2 machine gun are as follows:

- 1305-A555 M33 Ball, 100/linked belt.
- 1305-A572 M17 Tracer, 100/linked belt.
- 1305-A557 M33 Ball / M17 Tracer (4 to 1 mix), 100/linked belt.
- 1305-A576 M8 API / M20API-T (4 to l mix), l00/linked belt.
- 1305-A543 M20 API-T, l00/linked belt.
- 1305-A598 M1A1 Blank, 100/linked belt.
- 1305-A602 M858 TP / M860 TP-T (4 to 1 mix), 100/linked belt.

NOTE: Only M2 and/or M9 closed loop links are used with the M2 machine gun.

5-3. 20-MILLIMETER FOR AH-1E/F

a. Twenty millimeter ammunition is electrically primed; chamber pressure varies from 60,500 to 61,500 psi. Projectile weight of the M56 HEI round is 1,543 grains (3.5 ounces); other 20mm projectiles are of comparable weight. Muzzle velocity for the types of 20mm ammunition discussed below averages 3,380 feet per second. Types of 20mm munitions available are discussed below and shown in Figure 5-3.

(1) ***Target practice M55A2.*** M55A2 TP ammunition is used for gunnery training and test firing in lieu of the service round. It has a hollow cavity projectile body without a fuze (inert). The nose of the round is constructed of aluminum and is swaged to the projectile body.

(2) ***Target practice tracer M220.*** Except for the addition of a tracer element, the M220 TPT is very similar physically and ballistically to the M55A2. Tracer burnout usually occurs at a range of approximately 1,500 meters (±100 meters).

(3) ***High explosive incendiary M56A3/A4.*** Functioning with both explosive and incendiary effect, the M56A3/A4 HEI is intended for use against ground targets, including lightly armored vehicles. This thin walled, steel projectile can produce casualties to exposed personnel within 2-meter radius. It has a base plate that prevents ignition of the incendiary mixture by propellant gases. The M56A3/A4 is assembled with a single action M505A3 point detonating fuze. The explosive charge is 165 grains (.37 ounce); the incendiary charge is 20 grains. The HE mix and the incendiary mix are combined into one pellet in the A3 HEI.

(4) ***Armor piercing incendiary M53.*** The M53 API is intended for use against lightly armored targets. It functions with a combined incendiary and has a penetrating effect. The body of the projectile is constructed of solid steel; the nose is constructed of an aluminum alloy. The incendiary charge is 65 grains (.14 ounce).

(5) ***High explosive incendiary with tracer and self-destruct feature (M246/M246A1).*** The M246/M246A1 HEI-T-SD is intended for use against aerial targets. It has an HEI charge, a self-destruct relay charge, and a tracer element. It is assembled with an M505A3 point detonating fuze. The tracer burns for about 5 seconds whereupon the relay charge ignites and detonates the HEI charge. If impact with the target occurs before self-destruction, the PD fuze causes the HEI charge to detonate. The M246 has the HE and incendiary mix combined as one pellet; the M246A1 has the HE and incendiary charge loaded as separate pellets.

(6) ***Dummy (M51A2/XM254).*** The M51A2 is an inert round of solid metal construction and is used for nonfiring system loading and system checkout. The XM254 is constructed of plastic. As with the M51A2, the M254 also reduces wear on gun components and feed mechanisms.

b. Twenty millimeter fuze functioning and penetration are affected by velocity and angle of impact at all ranges, particularly at ranges in the upper one third of the 2,000 meter value. However, this depends on the type of target that is engaged. Rounds with an R50 value, a 50-percent chance penetrating rolled homogeneous armor at the given condition and range, are as follows:

- M56 HEI: .25 inch (6.3 mm), RHA at 60 degrees, obliquity at 221 meters; .50 inch (12.5 mm), RHA at 0 degrees, obliquity at 104 meters.

- M53 API: .25 inch (6.3 mm), RHA at 0 degrees, obliquity at 1,000 meters.

- M940 MPT-SD: .25 inch (6.3 mm), RHA at 60 degrees, obliquity at 940 meters; .50 inch (12.5 mm), RHA at 0 degrees, obliquity at 518 meters.

For comparison, Table 5-2 shows the hull and turret thickness of some common armored vehicles.

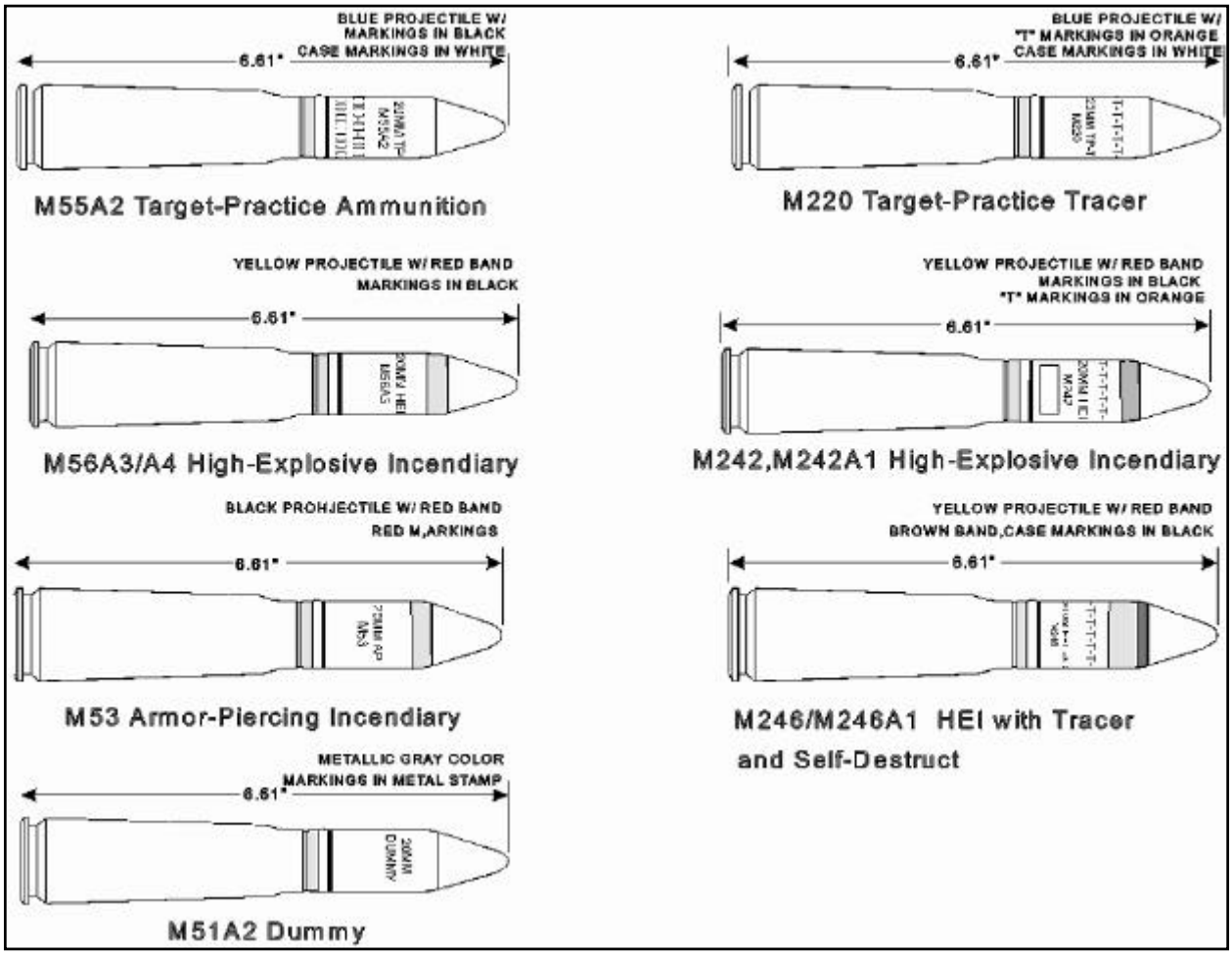


Figure 5-3. 20mm munitions

Table 5-2. Hull and turret thickness of selected vehicles

Vehicle	Thickness of Hull		Thickness of Turret	
BTR-70	.40 inches	10 mm	.28 inches	7 mm
BRDM 2	.56 inches	14 mm	.28 inches	7 mm
BMP	.76 inches	19 mm	.92 inches	23 mm
BMD	.60 inches	15 mm	1.0 inch	25 mm
ZSU 23-4	.37 inches	9 mm	.35 inches	9 mm

NOTE: Rechambering live ammunition is prohibited. The chambering action could loosen the projectile in the cartridge case and break the waterproof seal. A broken seal could contaminate the propellant and primer and cause a misfire or hangfire.

c. Table 5-3 shows the approximate time of flight and approximate ballistic drop with 20mm ammunition.

Table 5-3. Approximate time of flight/ballistic drop 20mm,

M56 HEI fired from hover.

Range to Target (meters)	Time of Flight (seconds)	Ballistic drop (mils)
1,000	1.5	9
1,500	3	21
2,000	5	42

d. **DODACs FOR 20mm.** DODACs for linked 20mm ammunition for the M197 cannon are as follows:

- 1305-A896 M55A2/M220 TP/TP-T (4 to 1 mix), 100/linked belt.
- 1305-A652 M220 TP-T, 100/linked belt.
- 1305-A918 M53 API, 100/linked belt.
- 1305-A563 M56/M220 HEI/TP-T (4 to 1 mix), 100/ linked belt.
- 1305-A655 M56/M220 HEI/TP-T (7 to 1 mix), 100/ linked belt.
- 1305-A792 M246A1 HEI-T-SD, 100/linked belt.
- 1305-A919 M56A4 HEI, 100/linked belt.
- 1305-A781 M51A2 Dummy, 100/linked belt.

NOTE: The M197 cannon and feed system requires M14A2 linked 20mm ammunition.

5-4. 30 MILLIMETER FOR THE AH-64 M230 CANNON

The 30mm ammunition for the M230 cannon is electrically primed; chamber pressure has been measured at 40,600 to 44,950 psi. Muzzle velocity is 2,640 feet per second for both the TP and HEDP. Table 5-4 shows the approximate times of flight and approximate ballistic drop of the 30mm projectile. Types of 30mm munitions available are discussed below and shown in Figure 5-4.

a. ***Target Practice M788.*** The M788 TP is an inert projectile without a fuze and is used for gunnery training in lieu of service ammunition. Its three-piece assembly consists of a steel body with a cavity, a rotating band, and an aluminum nose. The cartridge case is aluminum. This round serves no other purpose than for target impact or penetration.

b. ***High Explosive, Dual Purpose M789.*** The M789 HEDP is an antimateriel and antipersonnel round. The projectile body is steel and is loaded with a 340 grain (.76 ounce) explosive charge and a spin compensated shaped charge liner that has a PD (M759) fuze. The cartridge case is aluminum. The fuze arms while the projectile is in flight and initiates the projectile's explosive filler upon impact. The shaped charge liner collapses with detonation that creates an armor piercing jet. Fragmentation of the projectile body also occurs that can produce antipersonnel effects within a 4-meter radius. Estimated penetration performance was interpolated from a graph contained in a gun system effectiveness report. This report reflected penetration in excess of 2.0 inches (50 mm) RHA at 2,500 meters.

c. ***Dummy (M848).*** The M848 dummy is used for function checks of the weapon mechanism and to test the linking and delinking operations. It is an inert cartridge with an anodized aluminum case and a modified TP projectile. The primer and the propellant are replaced on the M848 with a threaded steel bolt to maintain the same weight as the TP round.

Table 5-4. Approximate time for flight and approximate ballistic drop for 30mm ammunition (HE fired from hover)

Range to Target (meters)	Time of Flight (seconds)	Ballistic drop (mils)
1,000	2	15
1,500	3.7	32
2,000	5.8	60
2,500	8.6	100
3,000	12.2	160

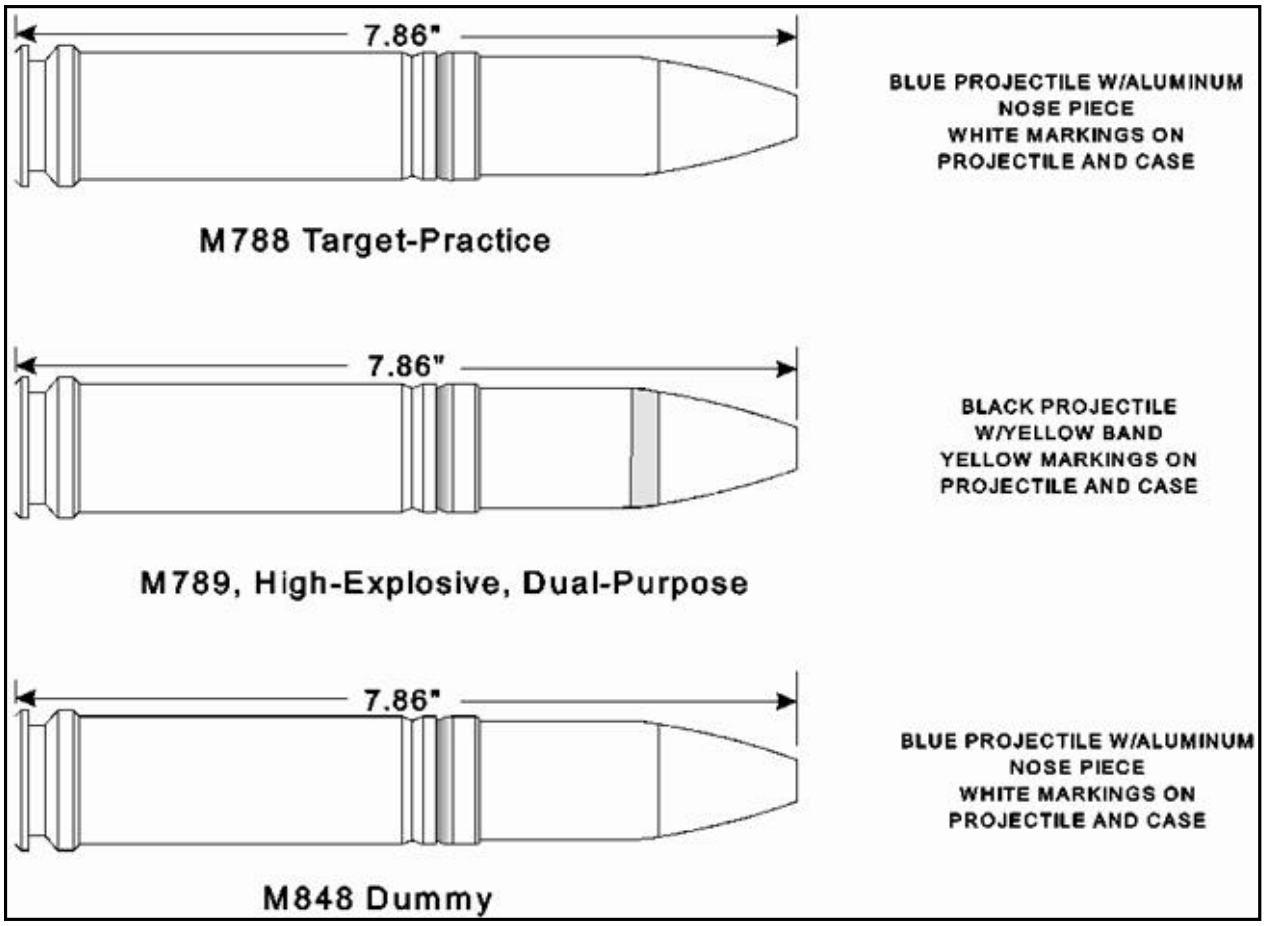


Figure 5-4. 30mm munitions

d. ***DODACs for 30mm.*** DODACs for linked 30mm ammunition for the M230 cannon are as follows:

- 1305-B120 M788 TP, 72 rounds linked.
- 1305-B118 M788 TP, 11 round carton pack.
- 1305-B130 M789 HEDP, 72 rounds linked.
- 1305-B129 M789 HEDP, 11 round carton pack.
- 1305-B134 M848 Dummy, 72 rounds linked.
- 1305-B133 M848 Dummy, 11 round carton pack.

Section II. Rockets

5-5. 2.75-INCH ROCKETS

a. Hydra 70 is the name associated with the family of 2.75-inch (70 millimeter) rockets. Hydra 70 refers to the Mark 66 rocket motor with any warhead/fuze combination. The MK 66 rocket motor was designed to provide a common 2.75-inch rocket for helicopters and high-performance aircraft. Compared to the MK 40 motor, it has a longer tube, an improved double base solid propellant, and a different nozzle and fin assembly. Increased velocity and spin provide improved trajectory stability for better accuracy. The launch signature and smoke trail have been significantly reduced. The MK 66 Mod 1 is not hazards of electromagnetic radiation to ordnance safe. It can be inadvertently ignited by electromagnetic radiation, especially by radio frequencies found aboard Navy ships. Both the Mod 2 and Mod 3 have HERO filters, and the Mod 2 filter may prevent the AH-1 rocket management system from inventorying. The Mod 1 is the standard motor for Army use as will be the Mod 3 when it is fielded. Figure 5-5 shows the M66 rocket motor.

b. MK 40 rocket motors are no longer produced for the Army. Inventories for training were expected to be exhausted in FY 93. An unknown quantity are held in war reserve stockage. Table 5-5 shows rocket motor comparison data extracted from TM 43-0001-30.

c. M260 and M261 launchers are required to fire the MK 66 rocket. They have reduced system weight and provide remote set fuze interface capabilities. The M158A1 and M200 launchers are not compatible with the MK 66 rocket motor.

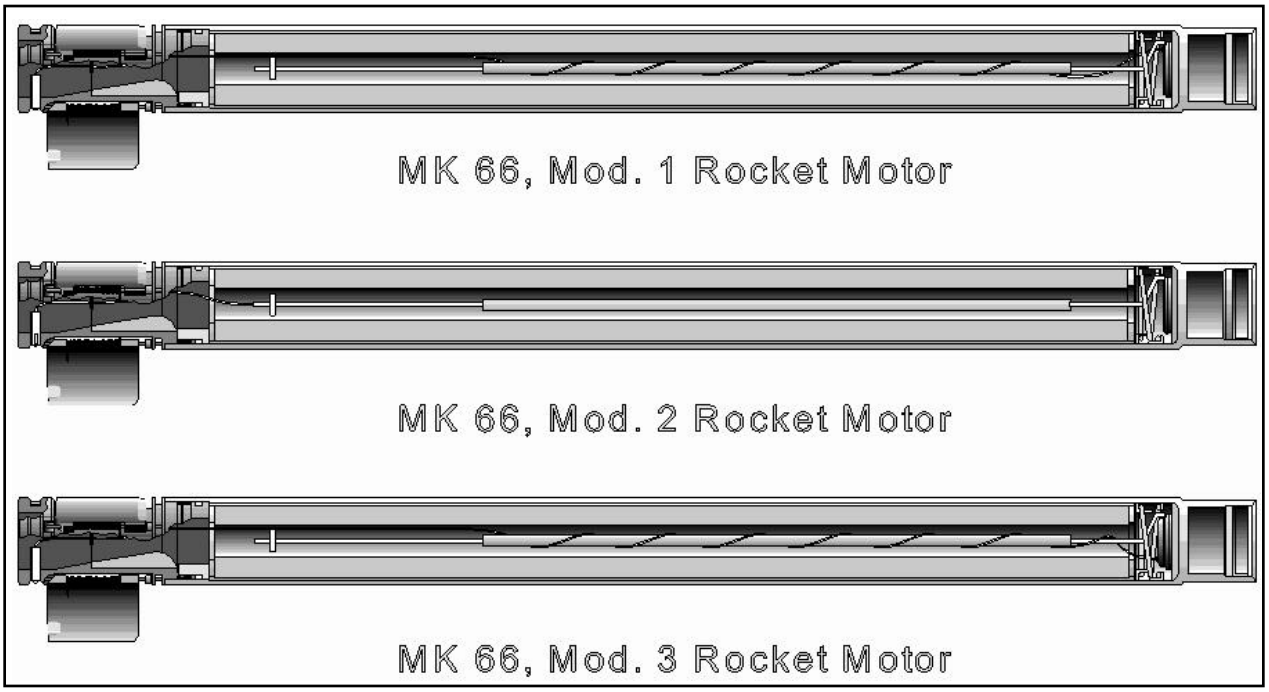


Figure 5-5. MK 66 rocket motors

Table 5-5. Rocket motor comparison data

CHARACTERISTIC	MK 66	MK 40
Length without warhead	41.7 inches	39.3 inches
Weight before firing	13.6 lbs.	11.0 lbs
Motor burn time (77F)	1.05 - 1.1 sec.	1.55 - 1.69 sec.
Average thrust	1,300-1370 lbs.	720 lbs.
Average spin rate	9 - 10 rps	1 rps
Motor burn out	1280 feet (397 m)	1460 feet (445 m)
Velocity at motor burnout	2425 fps	1965 fps
Maximum range at QE 43 degrees (MPSM warhead ground launch)	10,425 meters	8,080 meters

5-6. ROCKET WARHEADS (TACTICAL AND TRAINING)

a. ***M151 High Explosive*****.** The M151 HE is an antipersonnel, antimateriel warhead and is traditionally referred to as the "10 Pounder." The bursting radius is 10 meters; however, high velocity fragments can produce a lethality radius in excess of 50 meters. The nose section is constructed of malleable cast iron that is threaded to receive the fuze. The base section is constructed of steel or cast iron and is threaded so that it can be attached to the rocket motor. The base section and the nose section are welded (brazed) together. Total weight of the loaded, unfuzed, warhead is 8.7 pounds, of which 2.3 pounds is composition B4. The M151 can be used M423, M429, and M433 fuzes.

b. ***M274 Smoke Signature (Training)*****.** This training rocket provides a ballistic match for the M151 HE warhead. The casing is a modified WTU-1/B with vent holes or blowout plugs. A modified M423 fuze mechanism is integral to the warhead. A cylindrical cartridge assembly is in the forward section of the casing; it contains approximately 2 ounces of potassium perchlorate and aluminum powder that provides a "flash, bang, and smoke" signature. The M274 weighs 9.3 pounds.

c. ***M261 High-Explosive Multipurpose Submunition.***

(1) The MPSM warhead provides improved lethality against light armor, wheeled vehicles, materiel, and personnel. It has a plastic nose cone assembly, an aluminum warhead case, an integral fuze, an expulsion charge, and nine M73 submunitions. The primary warhead fuze, M439, is remotely set with the ARCS, MFD, or RMS to provide range settings (time of flight) from 500 meters to approximately 7,000

meters. On the AH-1, the RMS is programmable only from 700 meters to 6,900 meters.

(2) Initial forward motion of the rocket fuze timing. The expulsion charge is initiated at a point before and above the target, approximately 150 meters, depending on the launch angle. The submunitions are separated by ejection, and arming occurs when the ram air declarator deploys. The RAD virtually stops forward velocity and stabilizes the descent of the submunition. An M230 omnidirectional fuze with an M55 detonator is used on each submunition and is designed to function regardless of the impact angle.

(3) Each submunition has a steel body that has a 3.2-ounce shaped charge of composition B for armor penetration. The submunition is internally scored to optimize fragments against personnel and materiel. Upon detonation, the shaped charge penetrates in line with its axis and the submunition body explodes into high velocity fragments (approximately 195 at 10 grains each up to 5,000 feet per second) to defeat soft targets. The fuzed weight of the M261 is 13.6 pounds.

(a) ***Approximate target area coverage.*** Figure 5-6 shows the approximate target area coverage of one M261 warhead. At shorter ranges, the RAD takes longer to overcome momentum, increasing dispersion. As range increases, the rocket loses momentum, increasing the effectiveness of the RAD. This increased effectiveness reduces submunition drift and ground dispersion. Forestation, other vegetation, and natural or man-made structures within the target area may cause the submunition to detonate or land in a dispersion pattern other than the one shown in Figure 5-6.

(b) ***Probability of impact angle.*** Aerodynamic forces affecting submunitions during vertical descent may prevent them from landing upright (0 degrees off center). Sixty-six percent of the time a submunition will land 5 degrees off center; 33 percent of the time a submunition will land 30 degrees off center.

(c) ***MPSM lethality potential.*** Each M73 HE submunition has a shaped charge that can penetrate in excess of 4 inches of armor. A submunition that lands 5 degrees off center has a 90-percent probability of producing casualties against prone, exposed personnel, within a 20-meter radius. A submunition landing 30 degrees off center has a 90-percent probability of producing casualties within a 5 meter radius.

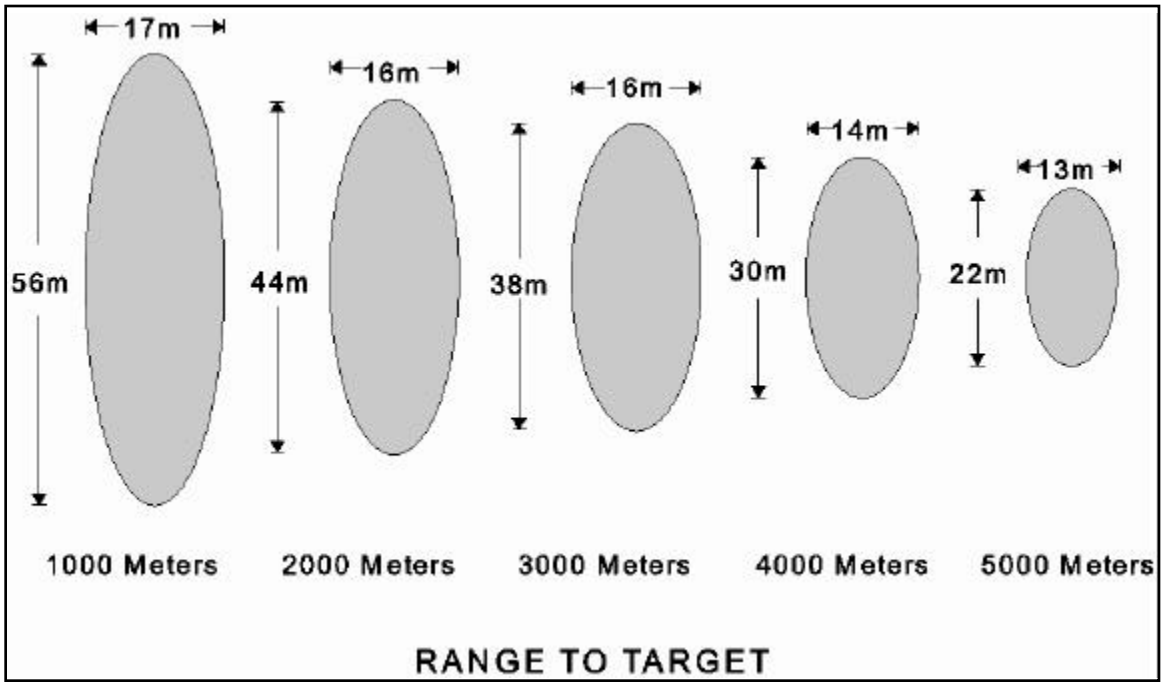


Figure 5-6. Approximate target coverage of one M261 warhead

d. ***M267 MPSM Smoke Signature (Training).*** The M267 MPSM training warhead operationally, physically, and ballistically matches the M261. Three M75 practice submunitions and six inert submunition load simulators take the place of the nine HE submunitions in the M261 warhead. Each practice submunition contains approximately 1 ounce of pyrotechnic powder. An M231 fuze with an M55 detonator is used with practice submunitions.

e. ***M257 Illumination.*** The M257 illumination warhead provides one million candlepower for 100 seconds or more. It can illuminate an area in excess of 1 square kilometer at optimum height. A deployed main parachute descent is approximately 15 feet per second. An M442 integral fuze provides a standoff range of approximately 3,000 meters with the MK 40 motor and approximately 3,500 meters with the MK 66 motor. The weight of the M257 is 10.8 pounds, of which 5.4 pounds is magnesium sodium nitrate.

f. ***M229 High-Explosive.*** The M229 HE warhead is currently in the inventory. An elongated version of the M151, it is commonly referred to as the "17 Pounder." The M229 filler consists of 4.8 pounds of composition B4 and has the same fuzes as the M151. Its unfuzed weight is 16.4 pounds.

g. ***M156 White Phosphorous (Smoke).*** The M156 is primarily used for target marking and incendiary purposes. It ballistically matches the M151 and is of similar construction. Filler for the M156 is 2.2 pounds of WP with a .12-pound bursting charge of composition B. The approximate weight of the fuzed warhead is 9.7 pounds. The M156 uses M423 and M429 fuzes.

h. ***M247 High-Explosive*****.** The M247 is no longer in production; however, some of these warheads may still be found in war reserve stockage. With a shape charge for an antiarmor capability, the M247 employs a cone shaped charge like that of the M72 LAW. The point initiated detonating fuze (M438) is an integral part of the warhead. The weight of the M247 is 8.8 pounds, of which 2.0 pounds is composition B.

i. ***M255E1 Flechette*****.** The M255E1 flechette warhead, which contains approximately 1,180 60-grain hardened steel flechettes, is in limited production. It is designed for use with the M439 fuze and has possible air-to-air as well as air-to-ground application. Figure 5-7 shows all current production warheads.

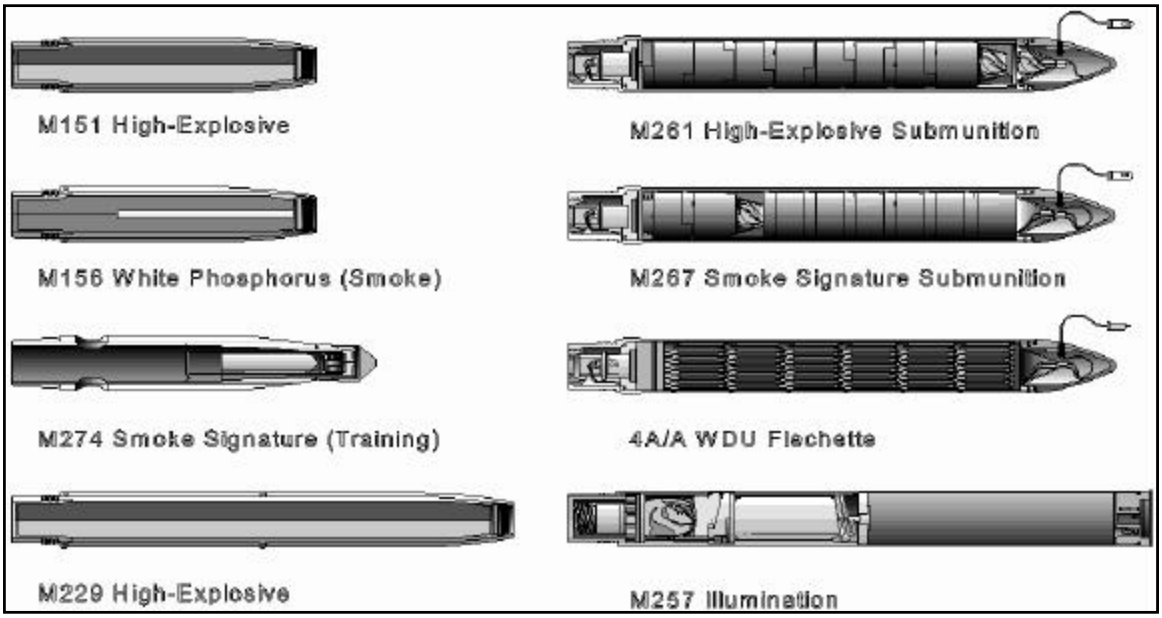


Figure 5-7. 70mm warheads in production

5-7. FUZES

a. ***M423 Point Detonating*****.** The M423 PD is an oblique sensitive, point-detonating, superquick fuze used as a common component with the M151. The safety and arming device forward of the booster housing (explosive charge) contains an unbalanced rotor. Upon acceleration of the rocket at firing, a weight setback occurs in the unbalanced rotor assembly which houses the primer and detonator. This setback places the fuze into an armed condition when the rocket has traveled approximately 43 to 92 meters from the launcher.

b. ***M429 Proximity*****.** Currently in inventory, the M429 proximity fuze is a transistorized, continuous wave, doppler device that provides air burst functioning for improved antipersonnel effectiveness. The arming mechanism of the M429 is similar to the one in the M423 except that it has been modified to include a battery and an electric detonator. Once it is armed and the reflected signals reach a specific intensity, the firing circuit is initiated through a capacitor to the electric detonator that provides the air burst function. A superquick impact switch serves as a backup to the air burst electronics. (**WARNING:** Multiple firing of

rockets with this fuze is not permitted [no pairs, no salvos, or ripple fire]. Fire in single rocket mode only. Radio frequency interference between fuzes can cause premature functioning.)

c. ***M433 Resistance Capacitance*****.** The M433 RC is a nose mounted, multioption, time delay fuze with selectable functioning modes. A superquick setting is used for open terrain; a forest penetration mode permits a selectable time delay range (10 to 45 meters in 5-meter increments) set for the height of the forest canopy. After first contact with the forest canopy, a delay timer is activated to provide warhead functioning. The bunker or building penetration mode provides up to 10 feet of penetration before detonation. The target penetration RC timer is activated by a point mounted probe switch that is initiated by target contact. An umbilical assembly is positioned on the nose of the fuze for interface through the launcher and RMS or ARCS and the aircraft. When the trigger is pulled, aircraft voltage is supplied to the fuze and the time delay is initiated as selected by the pilot.

d. ***M439 Resistance Capacitance*****.** The M439 RC is a base mounted, electronic variable, time delay fuze with an RC delay circuit. Designed for cargo and flechette warheads, the M439 allows the pilot to remotely set the fuze for air burst functioning at the desired range from 500 to 7,200 meters. A fuze capacitor is charged by the RMS, ARCS, or MFD through an umbilical assembly. The fuze has no internal battery, and the required voltage is supplied by the aircraft through the remote set fuze subsystem. When the rocket is fired and normal acceleration occurs, the fuze is armed and timing starts. If the fuze is set but the rocket motor fails to fire, the rocket should not be loaded into another tube and fired. When the fuze is set a second time, it will function longer than the set time and should not be used for accurate measurement until 10 days has elapsed before resetting it. The detonator is initiated electrically, depending on the range setting (time of flight), and ignites the expelling charge. Figure 5-8 shows production fuzes.

e. ***M422/M446 Fuzes*****.** The M442 and M446 fuzes are base mounted, air burst, motor burnout delayed fuzes. They are integral fuzes used with the M257 illumination and M259 WP smoke rockets, respectively.

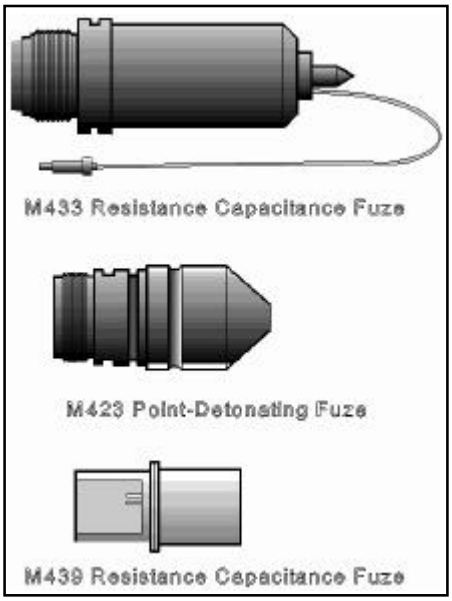


Figure 5-8. 70mm fuzes

f. ***DODACs for Rockets***. DODACs for rockets (complete round with MK 66 motors) are listed in Table 5-6 :

Table 5-6. DODIC/NSN cross reference for select HYDRA-70,

2.75-inch rocket items

COMPLETE ROUNDS DODIC	NSN	CONFIGURATION	PACK
H154	1340-01-371-8611	M278/M442/MK66-2	6
H165	1340-01-269-1447	M261/M439/MK66-3	4
H181	1340=01-249-7721	M257/M442/MK66-1	3
H182	1340-01-249-7720	M257/M442/MK66-2	3
H183	1340-01-268-7175	M257/M442/MK66-3	3
H184	1340-01-289-4719	M264/M439/MK66-3	4
H462	1340-01-309-5799	M255/M439/MK66-3	4
H463	1340-01-108-8849	M267/M439/MK66-1	4
H464	1340-01-108-8850	M261/M439/MK66-1	4
H582	1340-01-269-9122	M151/M433/MK66-3	4
H583	1340-01-269-9123	M151/M423/MK66-3	4
H642	1340-01-309-8300	M229/M423/MK66-2	4
H973	1340-01-238-2068	M274/ N/A /MK66-2	4
H972	1340-01-238-2067	M274/ N/A /MK66-1	4
H974	1340-01-268-7174	M267/M439/MK66-3	4
H975	1340-01-269-1446	M274/ N/A /MK66-3	4
H163	1340-01-108-8851	M151/M423/MK66-1	4
H164	1340-01-110-2672	M151/M433/MK66-1	4

NOTE: Due to the various models of rockets, warheads, and fuze combinations possible and the number of those that are undergoing classification or awaiting production contracts, a comprehensive list is not possible. TM 43-0001-30 gives additional information on rockets and rocket systems, fuzes, and motors. To obtain additional information about the Hydra 70, 2.75-inch rocket, write the US Army Armament, Munitions, and Chemical Command, ATTN:

AMSMC-ASH, Rock Island, IL 61299-6000.

Section III. Missiles

5-8. MISSILE CONFIGURATIONS

The Hellfire surface attack guided missile is currently available in three configurations: dummy, training, and tactical. All Hellfire missiles are 7 inches in diameter, and have a wingspan of 13 inches. The missile weighs 99.5 pounds and is 64 inches long except for the AGM-114F that is 7 pounds heavier and 7 inches longer. Color codes and data markings for the Hellfire missile are as follows:

- The basic color of missile is black.
- Data markings are olive drab.
- Markings on the aft end are four brown 3-inch squares 90 degrees apart (brown means solid propellent).
- Markings on the end of the warhead are four yellow 3-inch squares 90 degrees apart (yellow means HE).
- The basic color of container is olive drab.

a. *Dummy Missiles*. The M34 dummy missile has the same physical characteristics as the tactical missile. It is used to train armament personnel in loading and unloading and to simulate aircraft missile loads for training flights.

b. *Training Missiles*. The M36 training missile is used for captive flight training and cannot be launched. It has an operational laser seeker that can search for and lock on laser energy. The M36 has the same physical characteristics as the tactical missile but contains no explosives. It requires the same handling as a live tactical missile.

NOTE: If a training missile is on a launcher rail, live missiles cannot be launched.

c. *Tactical Missiles*.

(1) The AGM-114A tactical missile, DODAC number 1410-PA79, is the originally designed Hellfire missile, which will no longer be purchased by the Army. AGM-114As in the inventory are released for live-fire training when they are replaced with AGM-114Cs.

(2) The AGM-114C missile, DODAC number 1410-PD68, has an improved semiactive laser seeker with an improved low visibility capability. The AGM-114C has a low smoke motor and a lower trajectory than the 114A. Army missiles should be marked with either the A or C designation just behind the seeker.

(3) The AGM-114B, DODAC number 1410-PC9l, although primarily designed for Navy use, can be fired from Army aircraft. This missile has an additional electronic arm/safety device required for shipboard use.

(4) The AGM-114F missile features two warheads, a seeker and an autopilot similar to the C-model missile. The 114F is designed to defeat vehicles equipped with reactive armor.

(5) The AGM-114K missile features dual warheads for defeating reactive armor, electro-optical countermeasures hardening, semiactive laser seeker, and a programmable autopilot for trajectory shaping. The AGM-114K missile is capable of operating with either pulsed radar frequency or A-Code laser codes for those aircraft equipped with dual code capability.

NOTE: When A-Code is used with the AGM-114K, the missile counter-counter measure switch should remain OFF for both electronic counter measure and non-ECM environments. This procedure is not applicable if PRF coding is used.

(6) For antiarmor roles, the AGM-114 missile has a conical shaped charge warhead with a copper liner cone that forms the jet that provides armor penetration. This high explosive, antitank warhead is effective against various types of armor including appliqué and reactive. Actual penetration performance is classified. It can also be employed against concrete bunkers and similar fortifications.

(7) The tactical missiles are propelled by a single stage, single thrust, solid propellant motor. When thrust exceeds 500 to 600 pounds, the missile leaves the rail. Based on a 10g acceleration parameter, arming occurs between 150 to 300 meters after launch. Maximum velocity of the missile is 950 miles per hour. Figure 5-9 shows the Hellfire missile profile.

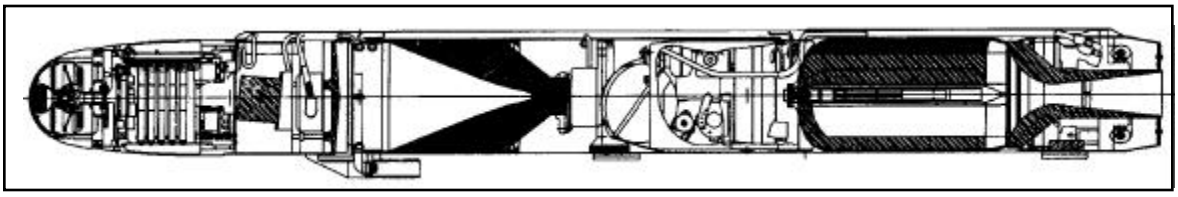


Figure 5-9. Hellfire profile

5-9. MISSILE PERFORMANCE CAPABILITIES

a. ***Maximum Standoff Range.*** Maximum standoff range is a function of missile performance, launch platform altitude versus target altitude, visibility and cloud cover. The effects of minimum cloud ceilings on maximum standoff ranges for all lock on before launch shots are shown in Figure 5-10. The minimum cloud ceiling on lock on after launch modes are shown in Figure 5-11.

(1) ***Autonomous.*** The target should be designated by the launching aircraft when the aircraft can fire from a position close enough to the target to ensure accurate

designation without extensive exposure of the launching aircraft to the enemy threat. On a clear day, target designation is limited by the capability of the designator to maintain the total laser spot on the target. Table 5-7 shows Hellfire laser designation times.

Table 5-7. HELLFIRE Designation Times

Range (meters)	Max Delay Time (sec)	Offset Lasing Time (sec)	Transition Time (sec)	On Target Time (sec)	Total Lasing Time (sec)	Temp (^{O}C) and Approximate TOF (sec)		
						-32^{O}	$+21^{O}$	$+52^{O}$
2000	2*	0	0	4	4	7	6	6
3000	2*	0	2	6	8	11	10	10
4000	5	1	2	6	9	15	14	13
5000	7	3	2	6	11	21	18	17
6000	10	5	2	6	13	28	23	22
7000	12	8	2	7	17	36	29	27
8000**	15	12	2	8	22	45	37	34

All times are from missile separation. Add an additional second for time from trigger pull.

* This is also the minimum time.

** Indirect only.

(2) *Remote*. Remote designation allows the launch aircraft to stand off at greater distances from the target. This standoff range can be out to the maximum missile effective engagement range. Remote designation also allows the launch aircraft to be masked from the target using the LOAL-LO or LOAL-HI launch mode (Figure 5-12). Remote designation also allows a single aircraft to provide the weapons for several designators. Remote designators may include another aircraft, a ground or vehicle laser locator designator, or one of the various designators of other services or foreign allies. Remote designators must be within their maximum designation range from the target, as determined by their laser beam divergence and aiming errors (jitter and boresight). Range to target can vary from one type of designator to another.

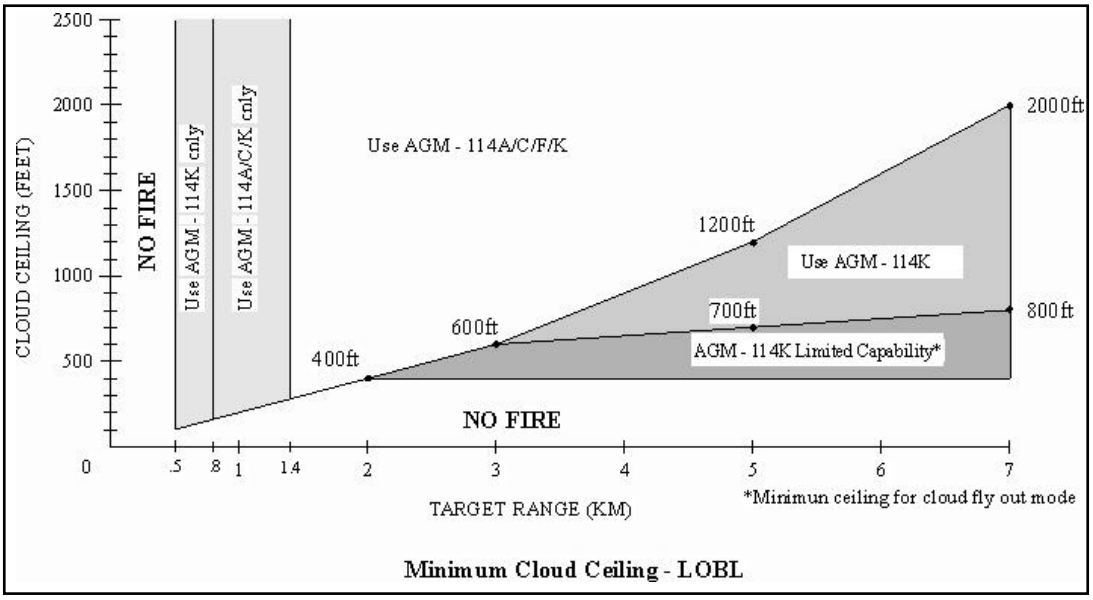


Figure 5-10. Minimum Cloud Ceiling - LOBL

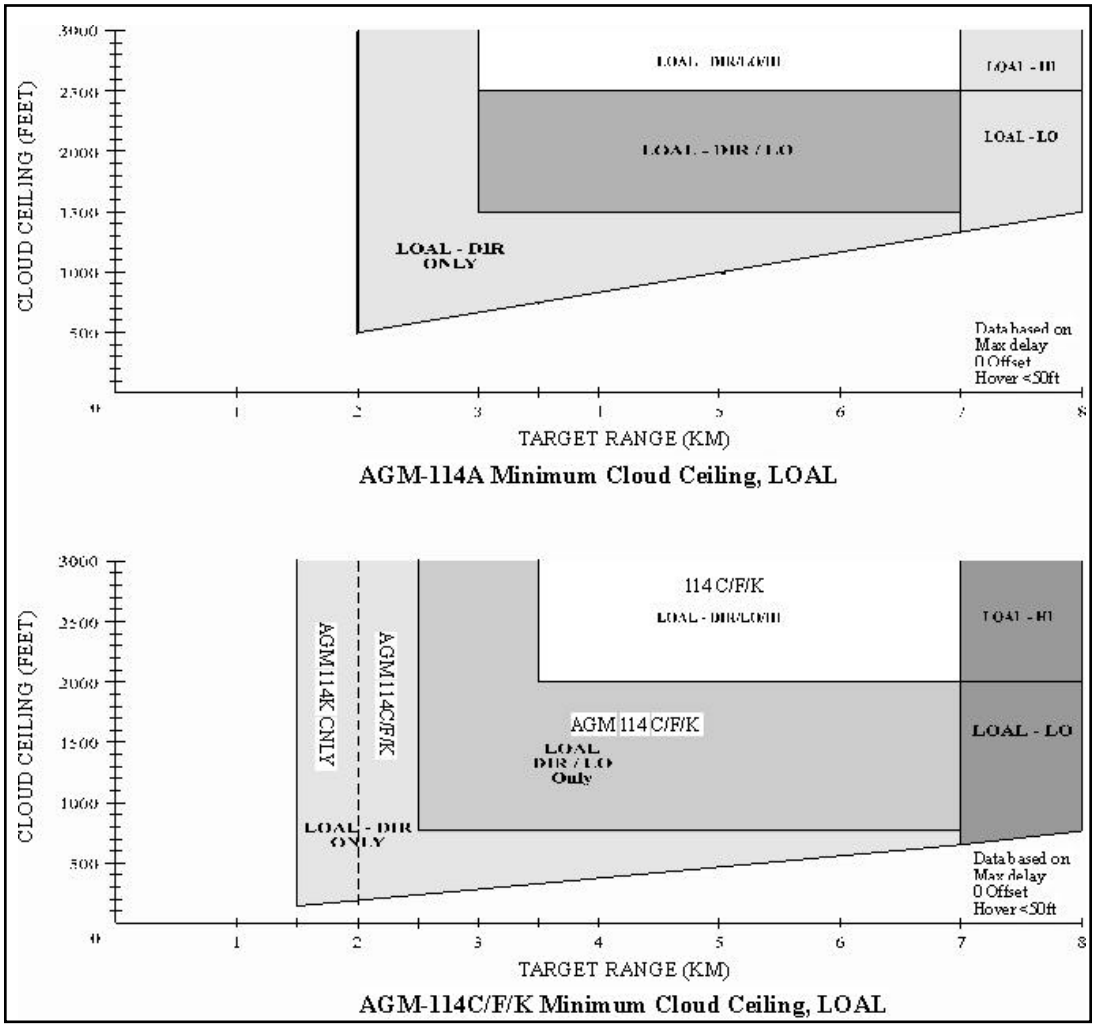


Figure 5-11. Minimum Cloud Ceiling - LOAL

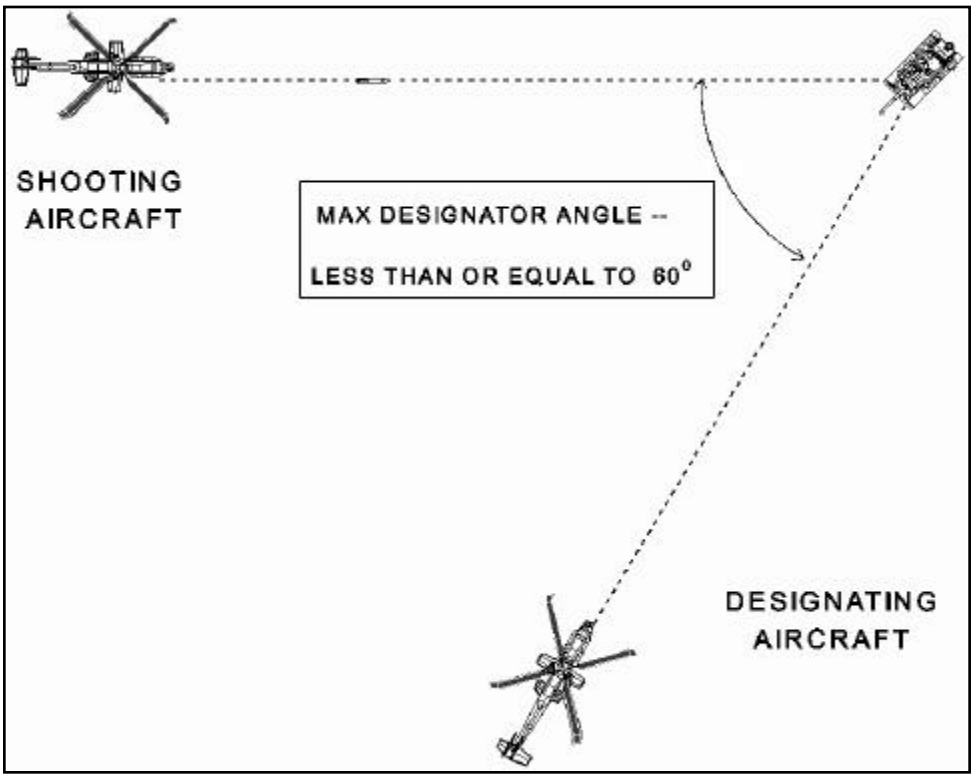


Figure 5-12. Maximum Designator Offset Angle

b. ***Remote Designator Location Offset***. When the remote designator is located in an offset position in azimuth from the launch aircraft, care must be taken to ensure that the laser spot is on a section of the target that is visible to the missile. The remote designator should not be displaced more than ±60 degrees in azimuth from the launch aircraft to the target line.

c. ***Remote Designator Safety Zone***. The remote designator should ensure that the designation position is not inside the 20 degrees designator avoidance area (Figure 5-13). If the designating aircraft is unable to designate outside of the avoidance area, the minimum laser delay time must be accurately computed and utilized. The difference in time of flight for a missile launched form the designator's position and the launching platform site is the minimum delay that must be adhered to. Follow the guidelines shown in Figure 5-13.

d. ***Minimum Engagement Range.*** Due to the Hellfire missile's trajectory shaping and seeker scan pattern during LOAL mode, it will be necessary to increase the minimum engagement ranges as the launch altitude increases above the target altitude. As launch altitude increases the missiles ability to see the target at shorter ranges decreases. The minimum LOAL engagement ranges shown in Table 5-8 are for launch altitudes less than 50 feet above target altitude. Increase these minimum ranges by 0.5 KM for altitudes of 50-400 feet and by 1.0 KM for altitudes 401-800 feet above the target. Minimum LOBL target engagement ranges are shown in Table 5-9. Maximum missile altitude is shown in Table 5-10.

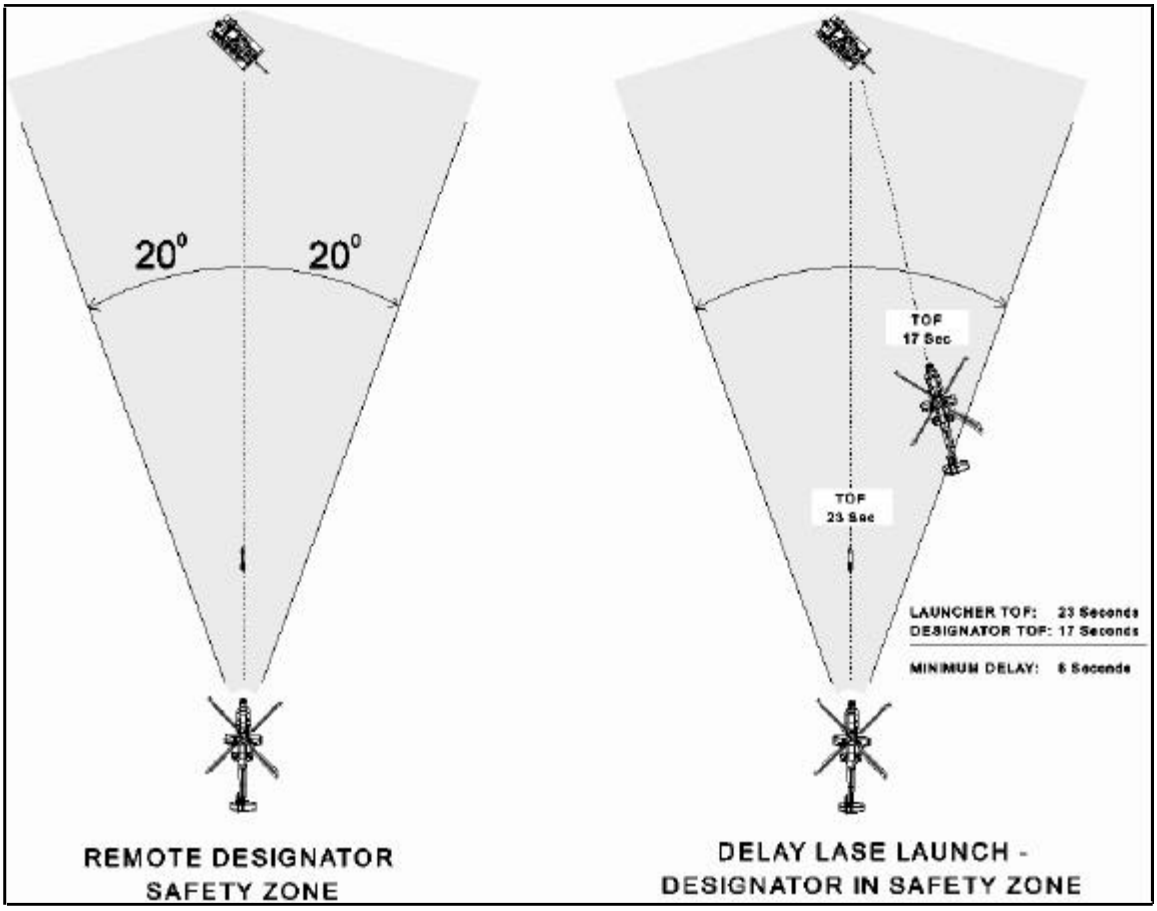


Figure 5-13. Designator avoidance area

Table 5-8. Minimum LOAL target engagement range

MISSILE	AZIMUTH TARGET OFFSET (degrees)	MINIMUM LOAL ENGAGEMENT RANGE (KM) LAUNCH ALTITUDE < 50' ABOVE TARGET ALTITUDE		
		LOAL - DIR LOAL - HI	LOAL - LO	
AGM-114A	0^O	2.0	2.0	3.5
	7.5^O	2.5	3.0	4.5
AGM-114C	0^O	2.0	2.0	3.5
	7.5^O	2.5	3.0	4.5
AGM-114F	0^O	2.0	2.5	3.5
	7.5^O	2.5	3.5	4.5
AGM-114K	0^O	1.5	2.0	3.5
	7.5^O	1.7	2.5	3.5
50' - 400' Increase minimum range by 0.5 KM.				
401' - 800' Increase minimum range by 1.0 KM.				

Table 5-9. Minimum LOBL target engagement range.

MISSILE	MINIMUM RANGE (KM) 0^O Target Offset in Azimuth	MINIMUM RANGE (KM) 20^O Target Offset in Azimuth
AGM-114A	0.8	1.2
AGM-114C	0.8	1.2
AGM-114F	1.4	1.5
AGM-114K	0.5	0.7

Table 5-10. Maximum Missile Altitude

MODE	LOBL			LOAL-DIR		LOAL-LO		LOAL-HI	
TARGET RANGE (KM)	3	5	7	7		8		8	
LASER DELAY (SEC)	0	0	0	2	12	4	15	4	15
MISSILE TYPE	MAXIMUM MISSILE ALTITUDE INCLUDING RANDOM TRAJECTORY (FEET)								
AGM-114A	400	1000	1700	1700	1000	1900	1400	2300	2200
AGM-114C	500	1100	1800	1200	500	1500	900	1800	1500
AGM-114F	400	1000	1700	1200	300	1300	700	1600	1300
AGM-114K	400	600	700	600	500	900	800	1500	1500

5-10. MISSILE PERFORMANCE DISTRACTERS

a. ***Backscatter*** Backscatter is a term that applies to a portion of the laser beam energy reflected off atmospheric particles in the laser path back towards the designator while the remainder of the laser energy penetrates toward the target. Backscatter occurs even in clear weather so the operator must rely upon LOBL constraints box to know if the seeker is tracking backscatter. Obscurants in the laser-to-target line of sight can also cause backscatter (fog, haze, snow, smoke, dust, etc.). If a target return is not detected then the seeker may track the backscatter return. If the seeker is tracking backscatter, the seeker LOS and the designator LOS will differ by more than 2 degrees and the LOBL constraints box will be dashed.

(1) If an obscurant is between the designator and the target, it is possible for the seeker to lock on the reflected laser energy from the obscurant and "walk up" the laser beam toward the aircraft. When the seeker LOS is 2 degrees from the designator LOS and the seeker is locked on the autonomous laser spot, the symbology will indicate "OUT OF CONSTRAINTS."

NOTE: This symbology is only correct in this case if the aircraft is pointing directly at the target.

(2) Backscatter is best controlled by maintaining the true target in the seeker's instantaneous field-of-view. The seeker generally does not track backscatter after track has been established on the true target. Backscatter tracking is more likely to occur with autonomous lasing than with remote lasing because of the proximity of the seeker to the laser beam on the launch aircraft. Backscatter affects LOBL autonomous but can also affect LOAL autonomous if the designation commences before the missile has time to climb above and away from the laser beam.

b. ***Backscatter Avoidance Techniques*****.**

(1) To eliminate a backscatter lock-on, lasing the target should be discontinued for a short period of time and the target redesignated. If a backscatter problem still exists, it may be necessary to discontinue lasing, move to another position, and redesignate the target.

(2) If the launching aircraft is designating the target and autonomous operation is properly set up, one seeker will be slaved to the designator LOS, such as pointed at the target when designator is tracking the target. This condition will generally result in proper seeker lock-on to the target. However, under some conditions that fail to produce a detectable target return, the seeker will lock onto the laser backscatter close to the aircraft. Generally, backcatter is caused by poor target reflectivity, collocated obscurants, or excessive designation ranges. If backscatter occurs, the seeker LOS will diverge from the designator LOS by two or more degrees, the LOBL constraints symbology will indicate "OUT-OF-CONSTRAINTS" and the missile should not be launched.

NOTE: If primary channel track is achieved and the symbology indicates "OUT-OF-CONSTRAINTS", the missile cannot be launched by pulling the trigger to the first detent but can be launched by pulling the trigger to the second detent. The missile should not be launched by pulling the trigger to the second detent when "OUT-OF-CONSTRAINTS" is indicated, because it will result in a low probability of hitting the target. If the LOBL constraints box is intermittently switching "in-and-out" of constraints, then a marginal target condition exists and the missile should not be launched.

(3) To eliminate a backscatter lock-on, stop lasing the target. Switch to LOAL-Direct and use a minimum of 2 seconds of delayed designation from separation (3 seconds from trigger pull).

(4) If time permits, an attempt to improve the target return could be made by reducing engagement range, improving aim point or employing offset designation onto the higher reflective terrain near the target. **The laser must be turned off before the reengagement of any target to allow the seeker to unlock from the backscatter.**

(5) It is possible for the seeker to switch to tracking backscatter during the first second after missile separation in the LOBL autonomous mode if the target return is lost before the missile has climbed above the laser beam. This condition can be created by image auto track break lock due to motor smoke in the TADS LOS. The aircraft should be rotated 3 - 5 degrees in the direction of the missile to be launched to ensure that the missile does not fly across the TADS LOS and create an IAT breaklock or degrade the TADS imagery.

c. ***Rules for Operation in Obscurants***. Performance is reduced when obscurants degrade the seeker's lock-on range. The following rules indicate how to determine if the situation supports a missile launch.

(1) The designator operator must have a clear enough image of the target for accurate placement of the laser spot on the target without overspill or underspill.

(2) When the launch aircraft has a line-of-sight to the target, it must have a sufficient image in its day television or forward looking infared so that the general shape of the target is recognizable. If the launch aircraft is masked, the designating aircraft must have a sufficient image in its DTV or FLIR for the aircrew to recognize the general shape of the target. Otherwise, the seeker will probably not achieve a lock-on, even after launch.

(3) Laser range finder readings should be taken by the designating aircraft and the missile not launched until steady, plausible range readings are indicated. Erratic range readings are generally caused by smoke or dust near the target. The same erratic readings could also be caused by overspill or underspill onto foreground or background objects. If accurate designation does not fix the problem, then the only solution is to change to a different designator, a different target, or relocate the designator aircraft.

(4) For LOBL autonomous launches, constraints symbology must show "in constraints." Otherwise, the seeker is not tracking the true target.

d. Target Illumination.

(1) Only the target is illuminated by the laser spot. When the missile is in its last few seconds of flight before impact, the entire laser spot must be placed on the target. During the final few seconds of flight, even a momentary placement of laser energy on adjacent terrain can prevent the missile from hitting the target. Once the seeker is tracking, the designator should not be turned off before all in-flight missiles have impacted. The seeker will not initiate box scan once the laser energy is lost.

(2) The portion of the target that is illuminated must be "seen" by the missile. This requirement imposes a 60-degree limit on the angle between the gun target line and the remote designator-to-target line. The probability of killing a target depends on missile flight path at impact and target attack azimuth but generally is maximized if the laser spot can be held stable on the base of the tank turret.

(a) ***Boresight error***. Boresight error occurs when the laser spot is not properly aligned with the TADS reticle, which produces an error in the location of the spot on the target.

(b) ***Spot jitter***. Spot jitter is the result of motion of the designator or the beam developed by the designator around the intended aim point. Spot jitter can give the laser spot a bouncing movement on the target, which will increase with designator distance from the target.

(c) ***Beam divergence***. The further the laser designator is from the target, the wider the spot will be on the target. The amount of beam divergence will vary between different types of designators.

(d) ***Attenuation***. Attenuation is a portion of the laser beam that is "scattered" by obscurants along the laser-to-target LOS and the missile-to-target LOS resulting in a reduced target pulse to the seeker. Also, low visibility attenuates

the target return to the seeker. If the attenuation is severe, the seeker will not detect the laser energy from the target.

(e) ***Overspill***. Overspill is caused by placing the laser spot too high on the target so that beam divergence and jitter cause the spot or a portion of the spot to spill over onto the object or the terrain behind the target. Overspill can cause intermittent background false targets, which become more severe at long designation ranges.

(f) ***Underspill***. Underspill is caused by placing the laser spot too low on the target so that the spot or a portion of the spot spills onto the foreground. Underspill can cause foreground false targets, which become more severe at long designation ranges.

NOTE: Even a small number of overspilled or underspilled laser pulses can cause the missile to follow false signals. If either of these conditions occur just before missile impact, the probability of hit is seriously degraded.

(3) The missile can operate with several different designators and operating modes to assure that a designator is available that can meet the above illumination requirements. The selection of designator equipment and the mode must be based on the specific mission, enemy, troops, terrain, and time factors for the particular engagement. The following are suggested guidelines.

5-11. TOW MISSILE

a. The TOW surface attack guided missile is an antitank weapon that may also be used against bunkers and similar fortifications, depending on the tactical situation.

(1) When the trigger is pulled, three batteries are activated that provide power to the electronics, the Xenon or thermal beacon, and the actuator subsystem. When the missile is fired, the launch motor develops initial thrust to accelerate the missile to approximately 250 feet per second when it exits the tube. The wings on the missile extend as it exits the tube and completes the circuit to activate the flight motor about 7 meters from the launcher. The warhead becomes armed between 30 and 65 meters from the launcher. Acceleration provides peak velocity at approximately 350 meters.

(2) Upon capture, the TOW missile becomes a closed loop system. The Xenon beacon and thermal beacon (TOW 2/TOW 2A) are installed in the rear of the missiles and are detected by the Xenon detector or thermal tracker located in the telescopic sight unit. Two wire dispensers are mounted on the rear of the missile at the 90- and 270-degree positions. These dispensers contain 3,750 meters of single strand wire. Control surface flippers respond to signals from this wire command link. Helium powers the control actuators; the attitude gyro, which limits yaw and roll, is driven by nitrogen.

(3) Once the missiles are launched, the I-TOW, TOW 2, and TOW 2A have

extensible probes that provide standoff detonation. The TOW 2A also has a small warhead in the probe that detonates the explosives in a tank's reactive armor. The warhead consists of an aluminum shell, an ogive crush switch, a safety device, electrical wiring, and an explosive filler. Impact and detonation of the conical shape filler concentrate the force of the explosive into a hot jet at approximately 25,000 feet per second, which can penetrate more than 17 inches of RHA.

(4) At the maximum range, the missile slows to one third of its peak velocity. The nose high position of the missile at this range may not produce the best impact angle of the warhead. Basic characteristics of the TOW missile family are shown in Table 5-11. Table 5-12 shows the color codes of the encased TOW missiles.

Table 5-11. Characteristics of the TOW missile family

CHARACTERISTICS	BASIC TOW	I-TOW	TOW 2	TOW 2A	TOW 2B
Missile weight (lb)	41.5	42	47.3	49.9	49.8
Weight in container (lb)	56.3	56.5	61.8	64	64
Prelaunch length (in)	45.8	45.8	45.9	45.9	46
Standoff probe (in)	NA	14.6	17.4	17.4	NA
Max velocity (fps/mps)	981/299	970/296	1079/329	1079/ 329	1010/309
Warhead diameter (in)	5	5	6	5	5(2x)
Explosive filler (lb)	5.4	4.6	6.9	6.9	-
Max range (m)	3000	3750	3750	3750	3750

Table 5-12. Encased missile color codes

	HE (BGM)	Training (BTM)
Basic color	Olive drab	Olive drab
Data markings	White	White
Code on aft end	Four brown 2 inch squares 90 apart or 2 inch brown stripes	Same as HE
Code on warhead end	Four yellow 2 inch squares 90 apart or 2 inch yellow stripes	Four blue 2 inch squares 90 apart or 2 inch blue stripes

(5) The TOW 2 and TOW 2A have an improved propellant in the flight motors, and the guidance links have been hardened with a thermal beacon which improves operations in dust, smoke, and other obscurants. The thermal beacon is compatible with aircraft with the C-NITE system.

(6) The TOW 2B is the newest version of the TOW missile. The TOW 2B entered production in late 1991. The TOW 2B was designed to attack targets from the top. The missile's trajectory places the missile slightly above the target when its two warheads explode downward. Figure 5-14 shows the TOW velocity, time, and range profile.

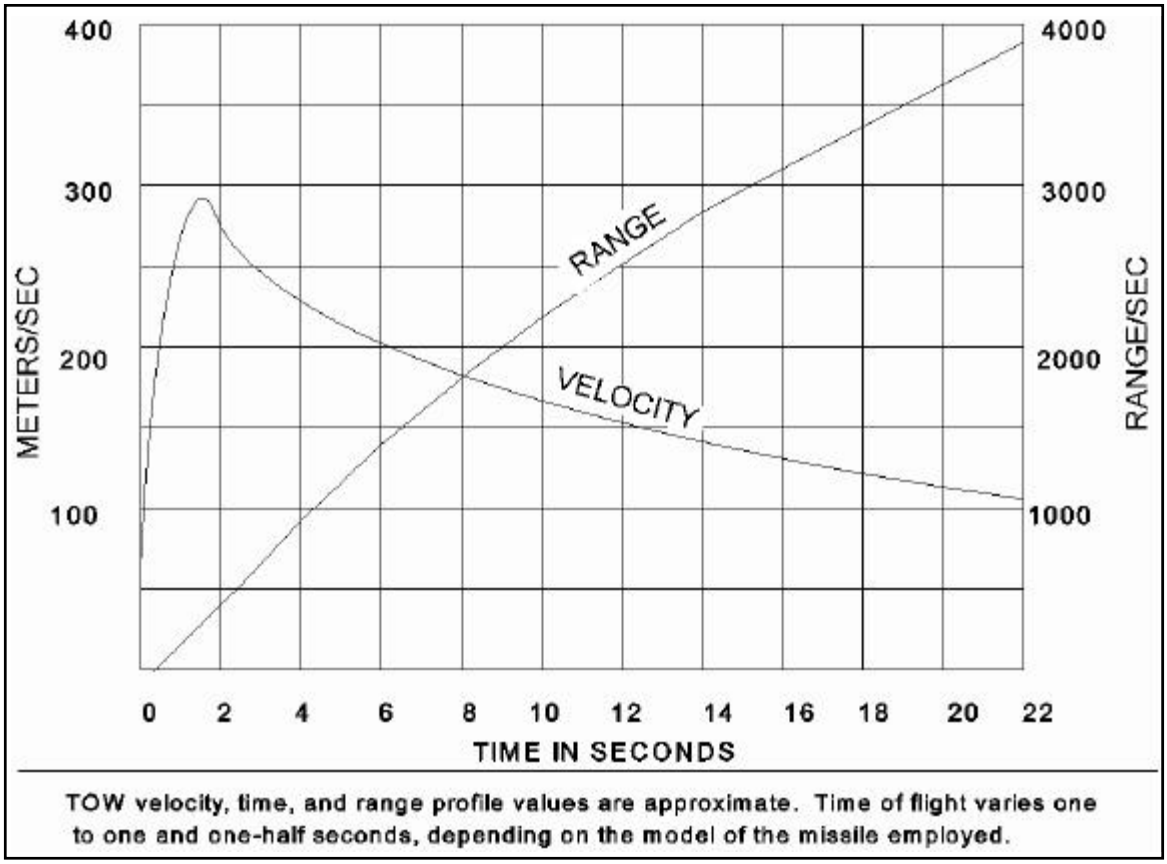


Figure 5-14. TOW Missile Flight Profile

b. Approximately 30 different TOW missiles are listed in the conventional ammunition substitutability and interchangeability list published by the U.S. Army Armament, Munitions, and Chemical Command, Rock Island, IL 61299-6000. Your parent command ammunition logistics managers should have a current DODAC listing of TOW missiles.

5-12. AIR-TO-AIR STINGER

a. The ATAS uses infrared (heat sensitive) homing and an overpressure blast with some fragmentation for lethality. The ATAS can accept and function with the unmodified basic Stinger and the Stinger-RMP (Reprogramable Micro Processor).

b. The Stinger is 59 inches long and weighs 22.4 pounds. The warhead case is titanium with a 2.25-pound explosive filler of HTA-3 (HMX--49 percent, TNT--29 percent, and aluminum flake powder--22 percent). The impact fuze has a self-destruct feature. If the missile does not impact and detonate, it automatically explodes 17 seconds after it is launched. Range is

predicted upon target identification and acquisition and environmental conditions. The demonstrated range capability within favorable conditions is classified.

c. When the Stinger is fired, the launch motor begins missile movement within the launch tube. Before the missile exits the tube, the launch motor is expended and separation sequence is initiated. At a safe distance from the launcher, the launch motor falls from the missile. During this sequence, flight motor ignition takes place. Peak velocity of the Stinger is in excess of Mach 2. Table 5-13 gives the basic characteristics of the Stinger missile.

Table 5-13. Characteristics of the Stinger missile

	Basic Color	**1 Inch Squares**	**Data Markings**	**2 1/2 Inch Squares**
Shipping and storage container	Forest green		Yellow	Yellow
Missile round	Olive drab	Yellow		
Field-handler trainer	Forest green		White	Bronze

CHAPTER 6

CREW WARFIGHTING

Warfighting is the mission of Army Aviation aircrews. The purpose of this chapter is to provide information and tactics techniques, and procedures for attack and armed-reconnaissance helicopter crews.

Section I. Fratricide Prevention

> "Fratricide is the employment of friendly weapons and munitions with the intent to kill the enemy or destroy his equipment or facilities, which results in unforeseen and unintentional death or injury to friendly personnel."
>
> - TRADOC Fratricide Action Plan

Fratricide is a fact in combat operations. Historically, fratricide incidents are most likely to occur in the early stages of combat, during reduced visibility, or along shared unit boundaries. Each one of us share the responsibility to stop fratricide. However, we must avoid the reluctance to employ, integrate, and synchronize all battlefield operating systems due to fear of fratricide. On the modern battlefield, the extreme range capability of the attack helicopter's direct fire weapons exceed the ability of the helicopter's sights to positively identify targets. Therefore, the decision to fire is based considerably on SITUATIONAL AWARENESS.

6-1. SITUATIONAL AWARENESS

Situational awareness is the real-time accurate knowledge of one's own location and orientation, as well as the locations of friendly forces, enemy forces, and noncombatants. Situational awareness includes awareness of the METT-T conditions that impact the operation. A breakdown in situational awareness is illustrated most frequently in the following ways:

a. ***Inadequate Fire and Maneuver Control.*** Units fail to disseminate the minimum necessary maneuver and fire support control measures to coordinate operations. Units fail to tie control measures to recognizable terrain features.

b. ***Direct Fire Control Failures.*** Units fail to designate easily recognizable and understandable target reference points, engagement areas, and engagement priorities.

c. ***Navigation Failures.*** Navigation problems can cause individual helicopters and units to stray out of sector, report wrong locations, become disoriented, or employ fire support weapons from wrong locations. As a result, friendly units may collide unexpectedly or engage each other erroneously.

d. ***Reporting, Crosstalk, and Battle Tracking Failures.*** Commanders and leaders at all levels

often do not generate timely, accurate, and complete reports or track subordinates as locations and the tactical situation change. This erroneous information permits erroneous clearance of fires.

e. ***Known Battlefield Hazards.*** Unexploded ordnance, unmarked and unrecorded minefields, FASCAM, and booby traps litter the battlefield.

f. ***Combat Identification Failures.*** The inability or failure of the attack crew to positively identify the target.

6-2. CONTRIBUTING FACTORS

There are numerous contributing factors (or preconditions) to fratricide. These factors are crucial in the commander's fratricide risk assessment prior to combat. They include, based on METT-T:

a. ***Mission and C^2.***

- High vehicle or weapons density.
- Commander's intent unclear or complex.
- Poor flank coordination.
- Crosstalk lacking.
- No habitual relationships between units.

b. ***Enemy.***

- Weak intelligence or reconnaissance.
- Intermingled with friendly forces.
- Similar or same equipment as friendly forces.

c. ***Terrain and Environmental Conditions.***

- Day versus night (unit training level).
- Obscuration or poor visibility.
- Extreme engagement ranges.
- Navigation difficulties.
- Absence of recognizable features.
- NBC environment.
- Battlefield hazards (such as minefields and submunitions).

d. ***Troops and Equipment.***

- High weapon's lethality.
- Unseasoned leaders or troops.
- Poor fire control SOPs.
- Incomplete rules of engagement.
- Anxiety, confusion, or fear.
- Failure to adhere to SOPs.
- Low unit manning level.
- Communication's effectiveness.
- Weapon's errors.
- Availability of navigation and positioning equipment.

e. ***Time.***

- Soldier and leader fatigue.
- Inadequate rehearsals.
- Short planning cycle.

f. The effects of a fratricide incident can be devastating to a unit. They include:

- Hesitation to conduct limited visibility operations.
- Loss of confidence in the unit's leadership.
- Increase of leader self-doubt.
- Hesitation to use supporting combat systems (FA).
- Oversupervision of units.
- Loss of initiative.
- Loss of aggressiveness during fire and maneuver.
- Disrupted operations.
- Needless loss of combat power.
- General degradation of cohesion and morale.

6-3. FRATRICIDE PREVENTION

Aviation units must practice antifratricide tactics, techniques, and procedures during all training. Unit SOPs must reflect a thorough understanding of fratricide and must focus on those TTP the soldiers understand, innovate and refine themselves, and practice frequently. The following initiatives can help establish and refine unit SOPs.

a. ***Doctrine/Tactics, Techniques, and Procedures*****.**

(1) ***Direct Fire weapons control measures*****.**

(a) ***Physically mark target reference points*****.** Use ground-burning illumination, WP, beacons, colored smoke, strobes with IR filters, and identifiable engagement areas to orient maneuver and fires.

(b) ***Weapons control status for direct fires*****.** Use a weapons control status similar to Air Defense. Weapons HOLD, TIGHT, and FREE would indicate the necessity of an external verification of the fire command or call for fire.

(c) ***Rules of engagement.*** Use detailed ROE to establish engagement criteria for various conditions crews may face. Establish a tie-in between visibility, FLIR conditions, and weapon engagement ranges.

(d) ***Control measures*****.** Establish control measures that provide spacial separation between adjacent units. For example, an AH-64 battalion may establish a free-fire area in which, in coordination with their higher and adjacent units, the crews can have a high confidence that elements found within the area are not friendly. Buffer zones can also be established around ground units for close combat. Before control measures can be effective, they have to be accurately plotted on crew member's maps and fully understood.

(2) ***Indirect fire control measures*****.** (Rockets and Field Artillery)

(a) Establish and practice routine positive controls (permissive controls to those who can see; restrictive measures protect those who are exposed).

(b) Establish simplified procedures for external clearance of fires. For example, an attack battalion clears all fire missions through their fire support officer.

(c) Incorporate fire support members in liaison teams for detailed flank coordination.

(d) Anticipate special controls needed for mixed voice-digital environments.

(3) ***Reconnaissance priorities*****.**

(a) Consider priority intelligence requirements relating to the feasibility of the routes, navigation, and maneuver plan.

(b) Consider allocation of some reconnaissance to flank observation and

reporting.

(c) Accurately track movement of ground forces in sector by radio net surveillance, visual observation, and tie-in with higher headquarters.

(4) ***Rehearsals.*** Benefits of rehearsals include:

(a) Well-understood fire control measures are established.

(b) Maneuver element locations and actions are well known.

(c) Information down to every crew member.

(d) Feedback to leaders result in refinements in the plan.

(e) Fratricide prevention measures are determined.

(f) Problems are identified and corrected.

(g) Increased crew member confidence and aggressiveness.

(h) Sense of partnership or ownership in the plan.

b. ***Training*****.**

(1) ***Control measures and graphics training*****.**

(a) Each crew member must be trained on the different types of control measures used and their graphic portrayal.

(b) Crews must ensure that they copy and plot graphics and control measures accurately on their maps. A 1- or 2-kilometer error could be the difference between life and death.

(2) ***Combat vehicle identification training*****.**

(a) Don't key on vehicle details that the gunner could not realistically discern, such as bore evacuator position. Key on chassis shape, turret shape and position, and relative length of gun tube.

(b) Don't push for moving CVI Training. Studies show it is not critical in CVI training.

(c) Use "black-hot" as the normal thermal polarity setting for target identification, particularly at longer ranges. Make it a habit to shift polarities regularly in FLIR/TIS.

(d) Use training in assembly areas for vehicle ID. The tactical assembly area is a good place to train as it allows the crews to key in on the prevailing terrain of the area.

(3) ***Crew training*****.**

(a) Crew training is focused on collective situational awareness, particularly at night. It includes training and assessment of the crew's ability to maintain awareness of their aircraft's heading and location in relation to both friendly and enemy forces.

(b) TASCs have training tapes available from the U.S. Army Armor Center and the Night Vision Laboratories, Fort Belvoir, showing thermal signatures of different vehicles, friendly and threat.

(c) ***Simulators***. A situational training exercise in a compatible simulator can be an excellent building block threat for reliable identification. Intermingling threat and friendly vehicles on training scenarios may build crew confidence.

(d) Placing friendly vehicles in target arrays on the range for Tables IX-XII for situational awareness training is suggested by the US Army Combined Arms Center, Fort Leavenworth.

(e) After action reviews following ALL training events.

(4) ***Advanced table training/live-fire.***

(a) Allows leaders to track aircraft and ground force orientation in a "go to war" OPTEMPO.

(b) Uncovers weaknesses in unit's level of understanding of mission and combined arms operations.

(c) Uncovers weaknesses in unit leadership and planning.

(d) Builds confidence in unit's ability to conduct multiship warfighting missions.

(e) Focus on situational awareness from crew to battalion level.

c. ***Organization.*** Liaison officers and liaison parties are normally located in the Tactical Operations Center of the higher headquarters. A liaison party normally includes an assistant S3 officer, fire support officer, and a communication's specialist (enlisted). Primary duties are to--

(1) Make sure the scheme of maneuver and the intent of the ground commander is understood by the aviation element.

(2) Exchange information throughout the operation, not just on the front-end.

(3) Standardize graphic control measures.

(4) Establish and maintain communications between the aviation element and the ground element.

d. ***Materiel Solutions.*** Although many technical solutions to fratricide are being investigated, currently there are no materiel solutions to the fratricide problem.

(1) During "Operation Desert Storm", deployed units painted an inverted "V" on vehicles to denote friendlies. This symbol was understood by coalition forces, as the inverted V is the number 8 in Arabic. Some units also used IR reflective tape on vehicles to aid in vehicle recognition. The drawback was that to be visible at 2,000 meters, the symbol had to be at least 2 x 2 feet in size. Also, it was "directional", meaning that if the symbol was on the back of the vehicle, it was not visible when viewing the vehicle from the front.

(2) Although an Army standard for marking vehicles is established, it is very difficult to discern these markings at the standoff ranges of attack helicopters. Aviation units must not allow their training to focus solely on identifying vehicles by their markings.

e. ***Leader and Soldier Development.***

(1) ***After-action reviews.***

(a) All AARs should address fratricide whether or not it occurs.

(b) Highlight near-fratricidal incidents and fire control successes.

(c) Discuss and capture techniques for fratricide reduction.

(2) ***Field discipline.***

(a) Mistakes with weapons and explosives, both friendly and enemy, historically account for a large number of casualties during conflict, many self-inflicted. Ensure all soldiers understand the command policies relating to the handling of live munitions.

(b) Commander's must enforce strict rules of engagement on use of booby traps, weapons on safe, employment of mines and explosives, and use of hand grenades to help prevent fratricide.

Section II. Target Acquisition

6-4. ACQUISITION DEFINED

Target acquisition is the timely detection, location, and identification of targets in sufficient detail to permit attack by either direct or indirect-fire weapons. Effective target acquisition requires the combined effort of the crew. This section describes the target acquisition process, discusses methods for acquiring and classifying targets, and relates target acquisition confirmation to conduct of fire.

6-5. TARGET ACQUISITION PROCESS

The target acquisition process is a series of progressive and interdependent steps or actions with which an aircrew acquires enemy targets for destruction. It is a continuing requirement for all aircrew members, whether in the offense or defense, moving or stationary. **Crew Search** is the crew's collective efforts, using both the unaided eye and aircraft optics, within assigned sectors of observation, to explore the area of operations visually for enemy presence. The acquisition process consists of the following elements:

a. ***Detection*** is the discovery, by any means available (sight, sound, smell) of any phenomena (personnel, equipment, objects) of potential military significance.

b. ***Identification*** is the friendly or hostile character of a detected potential target determined by its physical traits, such as size, shape, or functional characteristics.

(1) ***Classification*** is the categorizing of a potential target by the relative level of danger it represents.

(2) Confirmation is the rapid verification of a target in terms of the initial identification and classification. During the engagement, the crew must confirm that the target is properly identified and classified before engaging.

c. ***Location*** is the determination (by direction, reference point, or grid) of where a potential military target is on the battlefield (air or ground).

d. ***Reporting*****.** Spot reports provide commanders with critical information during the conduct of missions. The method of sending or transmitting spot reports is specified by the requesting agency. Reports of no enemy sighting are frequently just as important as actual enemy sightings.

6-6. CREW SEARCH

Crew search, or observation, is the act of carefully viewing or watching the area of operation, using search and scanning techniques and sectors of observation, to acquire targets. Sectors of observation are areas assigned to each crew member for search and target acquisition. Crew members must know their assigned sectors of observation to ensure thorough coverage of the battlefield. When operating in larger groups (team, platoon, company), each helicopter's coverage will create overlapping fields of observation.

6-7. AERIAL SEARCH TECHNIQUES

Crew members will scan their areas of observation at all times to detect targets or possible target signatures. Three search techniques enable crew members to locate targets quickly: **Side-scan**, **motive**, and **stationary**. Crews must divide duties during deliberate search--someone must fly the helicopter. All three techniques may be employed using the aided or unaided eye or aircraft optics under both day and night conditions.

a. *Side-Scan Technique*. This technique normally is used when the aircraft is operating at an altitude of 100 feet AGL or higher at cruise airspeed. The crew is looking for readily visible or obvious sightings. Over most terrain, the CPG/CPO systematically --

(1) Looks out approximately 1,000 meters and searches in toward the aircraft.

(2) Looks out one-half the distance (500 meters) and searches in toward the aircraft.

(3) Looks out one-fourth the distance (250 meters) and searches in toward the aircraft.

(4) The CPG/CPO repeats the procedure.

b. *Motive Technique.* This technique is used when the aircraft is operating at terrain flight altitudes and at airspeeds of 10 KIAS or greater. The entire area on either side of the aircraft is divided into two major sectors: the **nonobservation sector** and the **observation work sector**. The nonobservation sector is the area where the aircrew's field of vision is restricted by the physical configuration of the aircraft. The observation work sector is that portion of the field of vision to which search activity is confined. The observation work sector is subdivided into two smaller sectors--

(1) The **acquisition sector** is the forward 45-degree area of the observation work sector. This area is the primary area of search.

(2) The **recognition sector** is the remainder of the observation work sector. In using the motive technique, the CPG/CPO looks forward of the aircraft and through the center of the acquisition sector for obvious sightings. He then scans through the acquisition sector, gradually working back toward the aircraft.

c. *Stationary Technique*. This technique is used at NOE altitudes with the aircraft hovering in a concealed position. When using the stationary technique, the crew makes a quick, overall search for sightings, unnatural colors, outlines, or movements. They start scanning to the immediate front, searching and area approximately 50 meters in depth. The crew continues to scan outward from the aircraft, increasing the depth of the search area by overlapping 50-meter intervals until they have covered the entire search area.

d. If no targets are found using the motive, side-scan, or stationary techniques and if time permits, crews may use their optics to make a careful, deliberate search of specific areas in their sector. This method is also used to search, in detail, small areas or locations with likely or suspected enemy activity.

(1) Concentrate on one specific area or location and study it intensely.

(2) Look for direct or indirect target signatures in a clockwise sweep around the focal point (key terrain feature) of the area.

(3) Some examples of signatures to look for are:

- Dust created by movement or firing.
- Diesel exhaust.

- Track or tire marks on the ground.
- Reflection from glass or metal.
- Angular object that does not blend in with the surroundings.
- Vegetation that seems out of place.
- Radical movement of vegetation.
- Flash or smoke from a firing gun or missile.
- Entrenchments or earthworks.

6-8. TECHNIQUES FOR CREW SEARCH

a. Search for targets in FLIR (if available) wide field of view, both day and night. You can select a narrower field of view when you have a target acquired. **Note:** You should start with wide fields of view and when the target is acquired, select a narrower field. When firing at a target, select a wider field of view to observe munitions impacts. Many times attack crews will select a narrow field of view and maintain it through munitions impact. The crew will not be able to adjust the weapons on target if they do not see the impacts.

b. Use the laser range finder to determine how far you are looking. Crews normally use the laser range finder only to find ranges to an acquired target. The laser range finder can help ensure overlapping sectors of observation.

c. On qualification ranges, use the laser range finder to bracket a target before it pops up. For example, if you know a target is between 2,000 and 2,500 meters on a general azimuth from the firing point, use your laser to pick a point to observe at about 2,300 meters. When the target pops up, you will be looking in the general area, and target acquisition will be easier.

d. Switching between black and white hot on FLIR during a search will sometimes cause a target to appear. A well optimized FLIR, coupled with frequently reversing polarities, will help the crew acquire targets.

e. AH-64 and OH-58D KW crews should use their onboard video recorder during deliberate search. Playback of the videotape may reveal targets unseen during search.

6-9. TARGET DETECTION

Target detection is the discovery of objects (personnel, vehicles, equipment) of potential military significance on the battlefield. It is the first phase of target acquisition. Target detection occurs during crew search as a direct result of observing target signatures.

a. ***Target Signatures.***

(1) Target signatures are telltale indicators or clues that help an observer detect potential targets on the battlefield. Most weapons and vehicles have identifiable signatures. These distinguishing characteristics may be the result of equipment design or the environment in which the equipment is used. For example, firing a tank main gun will produce blast, flash, dust, smoke, and noise.

(2) Look for targets where they are most likely to be employed. Look for track vehicle signatures in open areas and rolling terrain. Look for helicopters on the back side of woodlines, ridgelines, and significant folds in the terrain. Crews must be familiar with where enemy positions, both vehicular and dismounted, will likely be located. Some examples follow.

b. ***Examples of Target Signatures*****.**

(1) ***Soldier signatures*****.**

• Foxholes.

• Broken vegetation.

• Footprints.

• Camp fires.

• Cleared fields of fire.

(2) ***Track vehicle signatures.***

• Vehicle track on ground.

• Dust clouds from movement.

• Weapon's firing report and smoke.

• Bright white flash at night.

• Thermal signatures --

• Suspension and exhaust systems will be more visible than the rest of the vehicle and surrounding area.

• A gun tube that has just fired will appear much brighter than a tube that has not.

• Normally the vehicle is more visible than the surrounding area and is readily visible when weather conditions permit.

(3) ***General signatures*****.**

• Sun glint from canopies, windshields, etc.

• Vapor trails from shoulder fired missiles.

• Dust and movement of foliage.

6-10. TARGET DETECTION CHALLENGES

Some targets are more difficult to detect than others. Increased crew sustainment training and greater concentration are needed to detect and locate them. Some examples of these more difficult targets and detection challenges are as follows:

a. Targets on the extreme edge of the field of view.

b. Targets that are camouflaged or in shadows.

c. Small, single targets such as a lone, dismounted ATGM or shoulder fired antiaircraft missile position.

d. Natural obstacles, such as weather and terrain.

e. Man-made obstacles, such as smoke and battlefield clutter.

f. Crew fatigue.

6-11. TARGET LOCATION

Target location is the determination of where a potential target is on the battlefield. Locating a target occurs as a result of observation and detection during crew search. The purpose of target location is to allow a crew member to fix or locate a target for their other crew member(s). For example, a pilot locating a target for his copilot/gunner. The most common target location methods are described below.

a. *Clock Method*. The clock method and sector methods are the fastest methods used to get the gunner on target. The crew bases 12 o'clock on the direction of helicopter movement while travelling, and on aircraft orientation, or the nose of the aircraft, when stationary. Example: "BMP, nine o'clock."

b. *Sector Method*. Similar in concept to the clock method, the sector method is quicker. It is best used to indicate a direction from the aircraft's direction of movement or orientation. Center sector is always to the direct front. Example: "BMP, left front."

c. *Wheel Method*. The wheel method is a relatively quick method. It is used primarily by the pilot to get the gunner on target. Example: "Turn left - stop turn - hold."

NOTE: When handing a target over to another aircraft, use a **magnetic heading**. The above stated methods may not be relevant to another crew due to their position.

6-12. TARGET CLASSIFICATION

Target classification is the grouping of potential targets by the relative level of danger they represent. It is determined by the aircrew after target acquisition has been completed. To defeat the many enemy targets that will appear on the battlefield, the crew must rapidly decide which targets present the greatest danger. Targets are classified as **most dangerous, dangerous, or least dangerous.** Estimate of the threat array, target by target, leads to a priority-of-engagement decision. The crew further analyzes the targets in terms of hard (tank) versus soft (truck), and single (tank) versus multiple (troops) to determine the proper ammunition (MPSM or PD rockets) and weapon system to use in the engagement.

a. ***Most Dangerous.*** When the crew observes an enemy target with air defense capabilities that appears to be preparing to engage them, the target is classified as **most dangerous**. This type of target is the greatest threat and must be engaged immediately. If more than one target is encountered, engage the closest one first.

b. ***Dangerous.*** When a crew sees a target with air defense capabilities, but that target is not preparing to engage them, the target is classified **dangerous**. This type of target should be engaged after all **most dangerous** targets have been destroyed, unless otherwise specified by the priority of engagements. Multiple dangerous targets are engaged the same as most dangerous targets--the closest one first.

c. ***Least Dangerous.*** A target that does not have an air defense capability, but can report you to one that does, is classified **least dangerous**. Engage this type of target after all most dangerous and dangerous targets have been destroyed, unless certain least dangerous targets have a high priority of engagement as in the case of command and control vehicles.

6-13. CONFIRMATION

Target confirmation is the rapid verification of the initial identification and classification of the target. Confirmation takes place after the crew has completed the fire commands except the execution command. The crew may complete the evaluation of the target based on the 6-step method. This technique may be used at the discretion of the commander. It provides a deliberate method for crews to classify a target. If the crew determines the target is enemy, they continue the engagement. However, if a crew answers unknown to the following questions, they probably should seek out assistance from other crews in the area unless they are taking fire.

Answer yes, no, or unknown for the following questions:

LINE 1: **Is the vehicle located in a briefed enemy sector?**

(Situational awareness--a yes response does not necessarily mean it is enemy.)

LINE 2: **Is the vehicle oriented toward friendly positions?**

(Situational awareness--a yes response does not necessarily mean it is enemy.)

LINE 3: **Is the vehicle tracked?**

(Categorizes the vehicle based on the briefed enemy situation. If it is not tracked, assume it is wheeled.)

LINE 4: **Does the vehicle have a gun?**

(Categorizes the vehicles as a potential threat. May distinguish the vehicle between tank and an APC.)

LINE 5: **Does the vehicle have a turret?**

(Further refines LINE 3. Also shifts attention to the turret, where the shape may help identify the vehicle.)

LINE 6: **Does the vehicle have other equipment mounted on it?**

(For example: radar, missiles. smoke generators, etc. May help identify an ADA system.)

Section III. Range Determination

6-14. RANGE DETERMINATION

The laser range finder is the primary method of determining range in attack helicopters. LRF malfunctions, environmental conditions, battlefield obscurant, or target size may force the crew to use alternate methods. This chapter explains how to determine range without the LRF.

a. ***Recognition Method.***

(1) Range determination by recognition is simple and accurate when practiced. The target must be visible with the unaided eye. The principle of this method is that when the crew sees a target, they can determine the range according to what they recognize. For example, if a target can be recognized with the unaided eye as a tank, it is probably within 1,500 meters. Table 6-1 shows what the average person can identify with the naked eye at various ranges. The ranges shown are the maximum range for identification.

Table 6-1. Identification ranges

TARGET	UNAIDED EYE
Tank crew, troops, machine gun, antitank gun, mortar	500 meters
Tank, armored personnel carrier, truck--by model (i.e. T-72)	1,000 meters
Tank, howitzer, APC, truck--generic	1,500 meters
Armored vehicle, wheeled vehicle.	2,000 meters

(2) When using the recognition method, the size and clarity of the target in relation to its background must be considered. Some light and terrain conditions make a target seem closer; others make it seem farther away. The conditions outlined below may cause an error in estimating range by the recognition method.

(a) ***Seems closer*****--**

- Bright, clear day.
- Sun in front of target.
- Targets at higher elevations.
- Bright colors.
- Contrast.
- Looking across ravines, hollows, rivers, depressions.
- Desert.
- At sea.

(b) ***Seems farther*****--**

- Fog, rain, hazy.
- Sun behind target.
- Targets at lower elevations.
- Small targets.
- Dark colors.
- Camouflaged targets.

b. ***Map Method.*** A map can be used to determine range to target. The CPG/CPO finds position of his aircraft on the map using doppler (or other navigation system) coordinates or terrain positioning. He then determines the position of the target. Once the position of the aircraft and the target are determined, he measures the distance between the two to determine range. All aircrews must carry maps even if their aircraft has electronic navigation devices.

c. ***Known Ranges.*** Using battle position cards or similar techniques, the aircrew can overcome a laser range finder failure. When positioned in the battle position, the BPC allows the crew to determine ranges from the battle position to center of mass of the engagement area.

d. ***Mil Relationship Method.*** The mil relation method is useful in deliberate range determination. To use this method, the width, length, or height of the target must be known. Measure the width, length, or height with the helicopter's optics; substitute the

mil relation; and compute the range. Accuracy depends on knowledge of target dimensions and the ability of the individual to make measurements with the helicopter's displays, and the ability to make the relations between the measurement and the actual target range.

(1) There are approximately 18 mils in one degree. The mil is a unit of angular measurement equal to 1/6400 of circle. One mil equals a width (or height) of 1 meter at a range of 1,000 meters. The relationship of the angle, the length of the sides of the angle, and the width (height) between the sides remain constant.

(2) Table 6-2 can help aircrews determine range to target when the helicopter's LRF is not working. Aircrews can use this chart for training deliberate range determination.

Table 6-2. Mil/range table, tank, and APC

AVERAGE THREAT TANK														
VEHICLE	**MIL ANGLE AND RANGE IN METERS**													
DIMENSION	0.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
Length 6.7 meters	13400	6700	4467	3350	2680	2233	1914	1675	1489	1340	1218	1117	1031	957
Width 3.4 meters	6800	3400	2267	1700	1360	1133	971	850	756	680	618	567	523	486
Full height 2.3 meters	4600	2300	1533	1150	920	767	657	575	511	460	418	383	354	329
Turret height 1 meter	2000	1000	667	500	400	333	286	250	222	200	182	167	154	143

AVERAGE THREAT ARMORED PERSONNEL CARRIER														
VEHICLE	**MIL ANGLE AND RANGE IN METERS**													
DIMENSION	.5	1	1.5	2	2.5	3	3.5	4	4.5	5	5.5	6	6.5	7
Length 6.4 meters	12800	6400	4267	3200	2560	2133	1829	1600	1422	1280	1164	1067	985	914
Width 2.6 meters	5200	2600	1733	1300	1040	867	743	650	578	520	473	433	400	371
Full height 2.1 meters	4200	2100	1400	1050	840	700	600	525	467	420	382	350	323	300

e. ***The Mil Relation*****.** The relationship of the angle in mils (m), the length of the sides (or range) in thousands of meters (R), and the width between the ends of the sides in meters (W) is expressed as the mil relation of:

$$\frac{W}{R} = m$$

Because the mil relation is constant, other units of measurement such as yards, feet, or inches may be substituted for meters in expressing width or range. However, the relation holds true only if both W and R are expressed in the same unit. For example, if the sides of a 1 mil angle are extended to 1,000 yards, the width between the ends of the sides is 1 yard. Computations are difficult in a busy cockpit. The following formula is the easiest to use and is preferred for quick range computations.

RANGE TO TARGET = (WIDTH OF TARGET/MIL) X 1,000

NOTE: Remember -- Width refers to the measurement of width, length, or height of the vehicle.

Using this formula, divide the width of the target by the determined mil measurement and multiply by 1,000. If you round the mil values to a whole number and memorize a mil value for each of one or two fields of view in your helicopter's optics, practice will produce accurate, quick range determinations. Table 6-3 shows some average measurements (in meters) to use in the above formula.

Table 6-3. Average measurements in meters

TYPE VEHICLE	LENGTH	WIDTH	HEIGHT	TURRET
TANK	7m	3m	2m	1m
APC	6m	3m	2m	

6-15. AIRCRAFT MIL VALUES

The key to determining range with the mil method is that the aircrew must remember mil values that relate to their particular aircraft. The training program should focus on using one or two selected mil values that can be easily remembered by the aircrew. Focusing on a few values can speed up the process and produce ranges consistently.

a. ***Mil Determination for the AH-64*****.**

(1) ***Pilot's display - PNVS***

• Center of LOS reticle to the ends of the horizontal and vertical lines: **33.3 mils.**

• Each of the four lines of the LOS reticle represents **27.7 mils.**

• When fixed gun is used, the cued LOS reticle represents the same mil value as the LOS reticle.

Tip to tip **66.6** mils

Center to tip **33.3** mils

Center space **22.2** mils

(2) ***HDU and ORT displays (HDU, HOD, HDD).*** These displays are used by the CPG and provide him with a 50-degree field of view down to .45 degrees depending on the sensor and field of view selected. Table 6-4 shows the mil values for FLIR and DTV fields of view and reticles. It also shows the mil values for the AH-64's LOS in various fields of view. Round numbers are used in range formula.

Table 6-4. Mil values for the AH-64

SENSOR	FOV	HFOV	VFOV	HRET	VRET	HGAP	VGAP
TV	W	56.9	42.7	11.7	8.8	1.4	.9
TV	N	12.8	9.6	2.6	2.0	.3	.2
TV	Z	6.4	4.8	1.3	1.0	.2	.1
FLIR	W	711.2	533.4	145.8	110.2	17.8	10.7
FLIR	M	145.1	108.3	29.7	22.5	3.6	2.2
FLIR	N	44.1	33.1	9.0	6.8	1.1	.7
FLIR	Z	22.0	16.5	4.5	3.4	.6	.3

KEY:

1. SENSOR: Day TV or FLIR
2. FOV: Field of View
3. HFOV: Horizontal field of view
4. VFOV: Vertical field of view
5. HRET: Horizontal LOS reticle, outside tip to outside tip
6. VRET: Vertical LOS reticle, outside tip to outside tip
7. HGAP: Gap in center of LOS reticle, measured horizontally
8. VGAP: Gap in center of LOS reticle, measured vertically

b. ***Mil determination for the AH-1.***

(1) ***Pilot/gunner HSS.***

• Center circle: **20 mil** diameter.

• Horizontal and vertical gap: **10 mils**.

• Crosshair width: **1.5 mil.**

(2) ***TSU reticle--HIGH MAG*****.**

• 4 inboard hash marks: **1 mil** from center.

• 4 outboard hash marks: **5 mils** from center.

(3) ***Stadiametric reticle--HUD*****.** The dots on the sight are positioned as follows from center:

• 1 DOT = 23.8 mils above.

• 2 DOTS = 4.5 mils above.

• 3 DOTS = 27.9 mils below.

• 4 DOTS = 77.4 mils below.

• 5 DOTS = 149.4 mils below.

c. ***Mil Determination for the OH-58D (KW)*****.** Table 6-5 shows the mil values for the KW MFD.

Table 6-5. Mil values for the Kiowa Warrior

SENSOR	FOV	RAS/WT	RAS/HT	MMS LOS/ R/A/G	MMS LOS/HF	GPC	GPCL/ H-V
TV	W	.6	20.2	2.9	4.2	10.2	19.2
TV	N	.4	5.0	.7	1.0	2.6	4.8
TIS	W	2.0	25.2	3.6	5.2	12.8	24
TIS	W 2x	1.0	12.6	1.8	2.6	6.4	12
TIS	N	.6	7.6	1.1	1.6	3.8	7.2
TIS	N 2x	.3	3.8	.5	.8	1.9	3.6

KEY:

1. RAS/WT: Rocket Aiming Symbol, Width
2. RAS/HT: Rocket Aiming Symbol, Height
3. MMS LOS/R/A/G: MMS Line of sight, Rockets, ATAS, Gun
4. MMS LOS/ HF: MMS Line of sight, Hellfire
5. GPC: Gun Pitch Cue, Solid Ring
6. GPCL/H-V: Gun Pitch Cue Lines, Horizontal and Vertical

6-16. LASER-OFF OPERATIONS

a. Laser range finders can fail. Always have a back-up plan.

b. Very few units can use their laser range finders during routine home-station training. Use the mil determination methods to send spot reports, target-handovers, and battle damage assessments. In addition, units may set up a training program on the ground using M22 binoculars. These binoculars have mil scales and are useful in reinforcing the methods of mil-based range determination before execution in the aircraft.

Section IV. Crew Communication

6-17. CREW COMMUNICATION

a. The attack helicopter's cockpit is very busy during an engagement. Review of videotapes of actual weapons engagements from recent conflicts shows that communication between crew members lacks standardization and is often confusing. Because the sequence of communication is unknown, crew members become confused in the busy cockpit. Crew members sometimes become irritated with their fellow crew member because of a communication breakdown.

(1) Rote memorization of words by crews is not the intent of this section. The intent is for the phrases to make sense, and become part of the crew vocabulary through training. The TCs 1-209, 1-213, and 1-214 discuss crew coordination and establishes a list of standardized phrases.

(2) The purpose of this section is to define the process of cockpit communication and outline the steps necessary to implement standard fire commands.

b. Some reasons why crews should use a standard fire commands during engagements are as follows:

(1) ***Crew turnover.*** When crew turnover occurs either in combat or peacetime, the commander may have to cross-level crews quickly to meet missions. Crews must use standard sequences during target acquisition and engagement to avoid confusion between newly assigned crew members.

(2) ***Time sequence.*** Testing shows standard sequences during target acquisition and engagement significantly reduce the time required to employ the helicopter's weapons systems.

(3) ***Focus.*** Standard sequences helps the crew to stay focused during demanding engagements. A demonstrated positive habit transfer between training exercises and actual employment of the weapons exists when all crew members are drilled in the proper communication sequence.

c. Crew communication and crew coordination are terms describing interaction between crew members. Listed below are the essential elements of this interaction:

(1) ***Communicate positively*****.** Communication is positive when the sender directs, announces, requests, or offers. The receiver acknowledges the sender. Positive communication--

(a) Is quickly and clearly understood.

(b) Permits timely actions.

(c) Uses a limited vocabulary to improve understanding in a work-intensive cockpit.

(2) ***Direct assistance*****.** Direct assistance is necessary when one crew member cannot reasonably be expected to know what or when assistance is needed by the other crew member. An example is communication during an aircraft emergency procedure.

(3) ***Announce actions*****.** Each crew member will announce actions that effect the other crew member.

(4) ***Offer assistance.*** A crew member will offer assistance when he sees the other crew member needs help.

(5) ***Acknowledge actions*****.** Crew members must understand directives and announcements from other crew members. Acknowledgements must be short and positively indicate that the message was received and understood.

(6) ***Be explicit.*** Crew members should use clear terms and phrases and positively acknowledge critical information.

6-18. FIRE COMMANDS

a. The following outlines the elements of standard fire commands. All target engagements or use of weapons systems can use standard fire commands.

- Alert.
- Target location.
- Movement commands.
- Target identification..
- Weapon selection.
- Weapon engagement.
- Weapon effect.

• Adjust fire command.

b. The following is an explanation of each element of the standard fire command. For this explanation, target refers to ground targets and air targets.

(1) ***Alert.*** This is notification of the other crew member that a target has been spotted.

(2) ***Target location*****.** The crew member who observed the target tells the other crew member its location.

(3) ***Movement commands*****.** Command to the crew member flying the aircraft. Explains how to maneuver the aircraft to engage the target.

(4) ***Target identification*****.** Crew determines what the target is. If not readily apparent, the crew uses deliberate action to classify the target.

(5) ***Weapon selection*****.** Crew determines appropriate weapon for engagement. If a missile is to be fired, gunner will announce which side of the aircraft the missile will be launched from.

(6) ***Weapon engagement.*** Crew member firing will announce "Shot" prior to trigger pull for missiles or rockets, or "Firing" for cannon.

(7) ***Weapon effect.*** Firing crew member reports target effect for BDA.

(8) ***Adjust fire command.*** This command adjusts the fire of weapons on target. It is primarily used for engagement with rockets. It is similar to shift commands for artillery.

6-19. LINES OF COMMUNICATIONS

Lines of communications must be established or communicated during each step of the engagement. The following example contains the information that should be passed between the crew members.

a. ***Alert.***

PILOT: "Gunner, target."

• Indicates the pilot sees a target and he wants to hand the target over to the CPG for identification

COPILOT: "Tally."

• Tells the pilot that the copilot sees the target.

b. ***Target Location.***

COPILOT: "240 degrees, 3,200 meters."

• Tells the pilot the location of the target.

c. *Movement Command*.

COPILOT: "Turn right to 240 degrees."

PILOT: "Turning right to 240 degrees."

• Copilot tells pilot to turn aircraft. Pilot repeats command for confirmation.

d. *Target Identification*.

COPILOT: "BMP, 3,200 meters."

• Copilot identifies target and states range.

e. *Weapons Selection.*

COPILOT: "One Hellfire ready, left side. Designating." (Denotes missile will be launched from left side of aircraft).

• Copilot states weapon of choice for engagement and declares laser status. Pilot maneuvers aircraft into constraints.

PILOT: "Turning right, in constraints."

f. Weapon Engagement.

COPILOT: "Shot."

• Indicates trigger pull for weapon.

g. *Weapons Effect.*

COPILOT: "Target destroyed."

• Tells pilot target is destroyed.

h. *Weapon Adjust.* Used primarily for rocket engagements.

• Not applicable for this example.

6-20. PHRASEOLOGY

The most important aspect of crew coordination is the sequence. The following phrases are used to conduct crew coordination.

a. *Alert Terminology*.

(1) *Target.* A groundborne target has been spotted.

(2) *Bogey*. An unidentified airborne target has been spotted.

(3) *Bandit.* An identified hostile airborne target has been spotted.

(4) *Gunner, target.* The pilot wants to hand a target over to the copilot/gunner or door gunner.

(5) *Pilot, target.* The gunner wants to hand a target over to the pilot.

NOTE: "Bogey" or "bandit" may be substituted for "target" in (4) and (5) above.

(6) *Multiple targets.* Alert that more than one groundborne target has been spotted.

(7) *Multiple bandits (Bogeys)*. Alerts that more than one airborne target has been spotted.

b. *Target Location*.

(1) Identification of target (if known).

(2) Magnetic heading to the target, for example, "090 degrees." Heading is stated from nose of aircraft.

(3) Range to target. Estimated range or laser range to target.

c. *Movement Commands (If Required)*.

(1) *Break*. Immediate action command to perform a maneuver to deviate from present ground track. It will be followed by the word "right" or "left."

(2) *Hold*.

(a) *At hover*. Maintain present hover altitude and heading.

(b) *In flight.* Maintain airspeed, altitude, and heading.

(3) *Slide*. Horizontal movement of aircraft followed by a direction, "left, right, forward, or back."

(4) *Stop*. Go no further; halt present action.

(5) *Turn*.

(a) *At hover*. Perform pedal turn right or left.

(b) *In flight.* Turn right or left from current ground track.

(6) *Stop Turn*. Terminates turn. Pilot holds heading/altitude present at stop turn command.

d. *Target Identification*. Self-explanatory. The crew states the identity of the target.

e. *Weapons Selection*. Self-explanatory. Engaging crew member will announce the

weapon of choice for target engagement.

f. ***Weapons Engagement.***

(1) ***Ready.*** Used by the pilot or gunner during engagements. Tells the other crew member that the selected weapon is ready to fire.

(2) ***Shot.*** Announced at trigger pull for rocket or missile engagements.

(3) ***Firing.*** Announced at trigger pull for cannon engagements.

(4) ***Searching.*** Indicates that the gunner is actively searching for targets or that he has selected a wider field of view and is observing the target area for munitions impacts.

(5) ***Match and shoot.*** Cooperative rocket engagement in AH-64. Tells the pilot that the CPG is ready, range is in FCC, and that the pilot can line-up symbology to fire rockets.

g. ***Weapons Effec*****t.**

(1) ***Hit.*** Rounds complete and target was hit.

(2) ***Destroyed.*** Rounds complete and target was killed.

(3) ***Miss.*** Rounds complete and target was not hit.

(4) ***Adjusting.*** Command from gunner that a miss has occurred and rounds are being adjusted to target.

(5) ***Bad missile.*** Indicates an apparent missile malfunction has occurred based on suspect flight path.

h. ***Adjust Fire Commands.***

(1) ***Range adjustments.***

(a) ***Long.*** Impact is behind the target.

(b) ***Short.*** Impact is in front of the target.

(2) ***Azimuth adjustments.***

(a) ***Line.*** Azimuth is correct.

(b) ***Left.*** Impact is to left of the target.

(c) ***Right.*** Impact is to right of the target.

(3) ***Examples of adjust fire commands.***

(a) ***Short, line.*** Impact is in front of the target, but the azimuth is correct.

(b) ***Long, left.*** Impact is to the left and behind the target.

(c) ***Short, right.*** Impact is to the right and in front of the target.

i. ***Miscellaneous*****.**

(1) ***Cease fire*****.** Command to stop firing but continue to track.

(2) ***Heads down*****.** Indicates the gunner is in a weapons mode. The gunner's attention is primarily focused inside the aircraft.

(3) ***Heads up*****.** Indicates the gunner is not in a weapons mode. The gunner's attention is primarily focused outside the aircraft.

(4) ***Strobe*****.** Indication by the pilot that the aircraft is being tracked by a radar. It will be followed by a heading direction and an identification of the radar, if possible.

(5) ***Spot.*** Laser target designation energy is being received.

(6) ***Tally*****.** I can see the traffic, obstacle, or target.

(7) ***Drifting*****.** An alert to the unintentional or uncommanded movement of the aircraft.

(8) ***Looking*****.** Traffic, obstacle, or target is being acquired.

(9) ***No joy*****.** Traffic, obstacle, or target not seen or identified.

(10) ***Traffic*****.** Refers to friendly aircraft that may present a hazard to the current route of flight of your aircraft. Will be followed by an approximate clock position, altitude, and distance.

(11) ***Visual.*** Contact is established visually.

6-21. REMOTE HELLFIRE MISSILE FIRING

A remote Hellfire missile call for fire is a concise message initiated by the laser designator. It contains all information the designator and launch aircraft need to effect an engagement with the exception of the exact positioning of the two aircraft. Because of the specific parameters that are required to safely and successfully fire remote Hellfire missiles, the engagements are usually preplanned or part of unit SOPs. The remote designator will ensure the proper constraints are met when positioning is in question. For example, if more than 60 degrees exist between the designating and firing aircraft's laser-target line, the designating aircraft has the responsibility to move.

6-22. REMOTE CALL FOR FIRE

The call for fire is transmitted in four parts consisting of seven elements.

a. The four parts are as follows:

(1) Designator identification and warning order.

(2) Number of missiles, target location, and control.

(3) Ready call with time of flight of missile, if known.

(4) Execution call.

b. The seven elements of the call for fire are as follows:

(1) Designator identification.

(2) Warning order.

(3) Number of missiles requested with requested code.

(4) Targeting information and laser target line.

(5) Ready call with time of flight.

(6) Execution call.

(7) Battle damage assessment.

6-23. CALL FOR FIRE DESCRIPTION

a. ***Designator Identification.*** The designator identification call tells the launch aircraft who is calling for the missiles, and it clears the net for the mission.

b. ***Warning Order.*** The warning order alerts the launch crew of the upcoming mission request.

c. ***Number Of Missiles Requested.*** Self-explanatory. Missiles are always launched on the designator's designated code. For multiple missiles, unless specified, launch aircraft will launch missiles with 15-second separation. Also, unless specified, launch crew will select LOAL-L or LOAL-H depending on terrain masks, cloud ceiling, and target range.

NOTE: The designating crew assumes that the launch crew accepts the mission if they acknowledge the warning order transmission. If the launch crew cannot accept the mission, they alert the designating crew at this time and give the reason for not accepting the mission. For example, the launch crew responds "Blue 6, mission denied, out of missiles."

d. ***Targeting Information.*** This information allows the launch aircraft to launch the missile on the proper heading, laser target line, and within range constraints. The target location can be a grid coordinate (6 or 8 digit) or a preplotted target reference point. Designating aircraft will announce "Call when ready," "Fire when ready," or "At my command." If available, target altitude should also be included in this transmission.

e. ***Ready Call and Time of Flight.*** The launch aircraft calls the designator when he is ready to fire and provides the missile time of flight.

f. ***Execution Call.*** The designator initiates the missile launch by transmitting "Fire, over" if he specified "At my command." The launch aircraft responds with "Shot, over" when the missile is launched. The designator responds with "Shot, out."

(1) For multiple launches, the launch aircraft will announce "Shot one, over," 15 second delay, "Shot two, over."

(2) The designating aircraft may also specify "Fire when ready." When this command is given, the firing aircraft fires the missile when ready. The firing aircraft announces "Shot, over" when the missile is fired.

g. *BDA*. The designating aircraft will send BDA to the launch aircraft.

6-24. EXAMPLE OF CALL FOR FIRE, ONE MISSILE, TWO AHs

NOTE: The numbers in parentheses denote the sequence of radio transmissions.

DESIGNATING AIRCRAFT - BLUE 6	**LAUNCH AIRCRAFT - BLUE 4**
(1) *BLUE 4, THIS IS BLUE 6, ONE ALPHA, OVER.*	
	(2) *BLUE 6, THIS IS BLUE 4 ONE ALPHA, OUT.(Denotes mission acceptance)*
(3) *GRID AA 12345678, ALTITUDE 1078,LTL 160, CALL READY, OVER.*	
	(4) *GRID AA 12345678,ALTITUDE 1078, LTL 160, ROGER, OUT.*
	(5) *READY, TIME OF FLIGHT 20 SECONDS*
(6) *TOF 20 SECONDS (STANDBY OR FIRE) FIRE, OVER.*	
	(7) *SHOT, OVER*
(8) *SHOT, OUT*	
(9) *BDA: 1 T-72 DESTROYED, GRID AA 12345678, TIME: 2115.*	
	(10) *BDA: 1 T-72 DESTROYED, GRID: AA 12345678 TIME: 2115.*

6-25. EXAMPLE OF CALL FOR FIRE, TWO MISSILES, RIPPLE FIRE, TWO AHs

NOTE: The numbers in parentheses denote the sequence of radio transmissions.

DESIGNATING AIRCRAFT - BLUE 6	***LAUNCH AIRCRAFT - BLUE 4***
(1) *BLUE 4, THIS IS BLUE 6, ONE ALPHA, ONE BRAVO, RIPPLE, OVER.*	
	(2) *BLUE 6, THIS IS BLUE 4 ONE ALPHA, ONE BRAVO, RIPPLE, OUT.*
(3) *GRID AA 12345678, LTL 160, CALL READY, OVER.*	
	(4) *GRID AA 12345678, LTL 160, ROGER, OUT.*
	(5) *READY, TIME OF FLIGHT 20 SECONDS*
(6) *TOF 20 SECONDS (STANDBY OR FIRE) FIRE, OVER.*	
	(7) *SHOT ONE, OVER*
(8) *SHOT ONE, OUT*	
	(9) *SHOT TWO, OVER*
(10) *SHOT TWO, OUT*	
(11) *BDA: 2 T-72s DESTROYED, GRID AA 12345678, TIME: 2115.*	
	(12) *BDA: 2 T-72s DESTROYED, GRID: AA 12345678, TIME: 2115.*

6-26. AUTONOMOUS FIRE MISSION TO APACHE

NOTE: The numbers in parentheses denote the sequence of ratio transmissions.

CALLING AIRCRAFT - BLUE 6	SHOOTING AIRCRAFT - BLUE 4
(1) *BLUE 4, THIS IS BLUE 6, FIRE MISSION, (GUN, ROCKETS, HELLFIRE), OVER.*	
	(2) *BLUE 6, THIS IS BLUE 4, FIRE MISSION, HELLFIRE, OUT.*
(3) *ONE T-72, (POLAR, SHIFT FROM KNOWN POINT, OR GRID) GRID AA 12345678, 1078 FT., ALPHA SPOT ON, OVER.*	
	(4) *ONE T-72, GRID AA 12345678, 1078 FT, TALLY ALPHA SPOT, OUT.*
(5) *CALL SPOT (OR FIRING), OVER.*	
	(6) *FIRING, OVER*
(7) *BDA: 1 T-72 DESTROYED, GRID: AA 12345678, TIME: 2115.*	
	(8) *ROGER, END OF MISSION, OUT.*

NOTE: On transmission #3, the calling aircraft may use the following for handover:

- **(**Polar: 360 degrees, 4,000 meters from my location.
- Shift from known point: 2 kilometers south of TRP 5, EA CAT.
- Grid: AA 12345678, 1,078 feet (altitude).

Laser spot tracker operations are recommended for this procedure.

Section V. Precombat Checks

6-27. PRECOMBAT CHECKS

a. Commanders conduct precombat checks to ensure the unit is prepared for the mission. Aircrews and aircraft require extensive precombat checks to ensure mission readiness.

b. Precombat checks are a part of all missions and are included in this manual to increase the probability of successful helicopter gunnery operations. The following paragraphs contain a suggested format for the aircrew precombat checks.

6-28. BEFORE MISSION RECEIPT CHECKS

a. Preflight the aircraft per appropriate checklist with PPC in progress. Place aircraft logbook in a known location, preferably in the aircraft.

b. Refuel the aircraft and load it with ammunition (if applicable). Compute weight and balance for the aircraft load.

c. Place aircrews on appropriate crew rest schedule. Crew rest should be tracked by the commander and ASO.

6-29. UPON MISSION RECEIPT

The commander and company planning cells provide the following information to the crews: (This information is gathered from the various unit staff sections.)

a. Navigation/air route planning according to posted A^2C^2 plan.

***b.** Communications card or SOIs.

***c.** COMSEC/IFF codes for aircraft.

***d.** Mission graphics.

e. Fire support and fire distribution on the objective.

***f.** Weather and light data and fuel requirements.

g. Tactical flight plan preparation and filing.

h. Risk assessment.

***i.** Assessment of enemy capability.

***j.** Actions on contact.

NOTE: Much of this information may be developed concurrently with the staff. The items marked with the asterisks contain information that can be continually tracked and updated prior to mission receipt.

6-30. PREPARING FOR THE MISSION

Following receipt of the mission briefing (either written or oral), the mission unit executes the following:

a. The commander conducts a briefing to cover more detailed flight and tactical procedures for the mission aircrews. The crew briefing contained in FM 1-112 is recommended.

b. The planning cells receive updates from the staff, continually updating the friendly and enemy situation, as well as weather and environmental considerations.

c. By backward planning, the commander and planning cells determine the mission's time sequence.

d. A flight plan or field strip is filed at flight operations with a current risk assessment for the mission.

6-31. FINAL CHECKS

Before the crews move to the aircraft, the following checks will take place:

a. *Graphics*. Check mission graphics for completeness and accuracy. The commander or a designated platoon leader will inspect the mission graphics of the mission crews. Use a known, properly prepared map as the baseline. This technique can be ongoing through the planning process, but a quick check before the mission is critical.

b. *Communications Card*. If the crews copy their own frequencies and callsigns, designate a crew member to read the card aloud to the crews to check accuracy. Ensure crews know the proper frequencies to conduct communications check.

c. *Mission Statement and Commander's Intent*. The commander will read the mission statement and the commander's intent to the crews.

d. *Chain of Command*. Restate the chain of command and reiterate the downed pilot points and the SERE plan at this time. Ask for questions and send the crews to their aircraft.

6-32. CREW CHECKS

Crews will check the following items before getting into the aircraft:

a. Crew members within limits of crew endurance policy.

b. Aircraft ignition key is present.

c. Aviation life support equipment, both personal and crew, present.

d. Checklist, -10 manual, and all mission-related publications available.

e. Special mission equipment (such as NVGs, sidearms) available and function check complete.

f. COMSEC and IFF codes loaded in appropriate equipment.

6-33. RUN-UP CHECKS

a. Complete start sequence according to the appropriate -10 checklist.

b. Crews are required to complete weapons system initialization according to the appropriate aircraft ATM. For armed helicopters, weapons checks and boresights are considered one of the most critical precombat checks.

6-34. COMMUNICATIONS CHECK

For brevity, complete the communications check in the following manner. Techniques for communications checks may not be compatible with all communications packages in armed helicopters. The commander may use this technique for SOP development.

a. Chalk 1 starts the check on FM, selects UHF and transmits, and then selects VHF and transmits. For example, "THIS IS (callsign) ON 1 (FM internal frequency, nonsecure), 2 (UHF internal frequency), and 3 (VHF internal frequency)."

b. This process continues through the chalk order until all aircraft in the flight have checked. All aircraft will monitor to determine which radios work on which aircraft.

c. Chalk 1 announces "THIS IS (callsign), GO SECURE ON 1." This call instructs the flight to select the secure mode for their FM radio. The check progresses as listed in paragraph 6-34a, but only the FM is used.

d. Once FM secure is checked, the flight can go active on HAVE QUICK, with a designated aircraft in the flight sending the time.

(1) If crews use this procedure during all training missions, communications checks become quick and routine. The commander may need to readjust radio nets due to nonfunctioning radios in the flight. It is very important to let all crews know which radios the nets are on prior to takeoff.

(2) Once all checks are complete and the commander is satisfied the flight can communicate, he will call "EXECUTE CARD." This command will tell the crews to tune their radios to the predetermined nets for the mission, and it probably will be the

last radio transmission until takeoff.

6-35. CONCLUSION

When the commander or AMC calls for takeoff, he must assume that the crews in his flight have conducted all weapons system checks. Units should practice precombat checks before all training missions. When practiced regularly, these checks will become routine and easily accomplished.

CHAPTER 7

ENGAGEMENT TECHNIQUES

Attack helicopters can be extremely effective if aircrews understand the techniques and standards associated with the employment of their weapons systems. This chapter discusses the terminology, procedures, and standards for helicopter fired weapons.

Section I. Modes and Types of Fire

7-1. TYPES OF FIRE

The two types of fire are **direct** and **indirect**. FM 101-5-1 defines direct and indirect fire as follows:

a. Direct fire is "fire directed at a target that is visible to the aimer or firing unit."

b. Indirect fire is "fire delivered on a target which cannot be seen by the firing unit."

7-2. MODES OF FIRE

Armed helicopters use three modes of fire--**hover fire**, **running fire**, and **diving fire**. Hover fire may be stationary or moving.

a. *Hover Fire*. Hover fire is defined as any engagement conducted below ETL. For objectively scored gunnery ranges, hover fire is broken into two subgroups. When hover is specified on a gunnery task, the crew will conduct the task from a stationary hover. This definition is not intended to conflict with aircraft ATMs.

(1) *Stationary*. Hover engagements occur with the aircraft at stationary hover. Both direct and indirect fires can be delivered during hover fire.

(2) *Moving fire*. Moving fire is an engagement from a moving helicopter below effective translational lift. Horizontal movement may be in any direction, but some deliberate movement is present. Both direct and indirect fires can be delivered during moving fire.

b. *Running Fire*. Running fire is an engagement from a moving helicopter above ETL. Both direct and indirect fires can be delivered during running fire. The forward airspeed adds stability to the helicopter and increases the delivery accuracy of weapon systems, particularly rockets.

c. *Diving Fire*. Diving fire is a direct fire engagement from a helicopter that is in a diving flight profile according to the aircraft ATM. The airspeed and altitude of the aircraft improve the accuracy of engagements, particularly for rockets. The advantages of diving fire are as follows:

- Decreased vulnerability to small arms fire.
- Increased armament loads because of decreased power requirements.
- Increased accuracy due to less rotor downwash effects on munitions and a more stable launch platform.
- A smaller beaten zone in the target effect area.

7-3. TARGET EFFECT STANDARDS

The three target effect standards for armed helicopter engagements are **suppression**, **neutralization**, and **destruction**.

a. *Suppression*. Popular definitions of suppression include--

- "Shoot enough to get their heads down."
- "Make those tanks button-up."
- "Shoot enough to cover my break."

(1) However, FM 101-5-1 defines suppression as, "direct and indirect fires, electronic countermeasures, or smoke brought to bear on enemy personnel, weapons, or equipment to prevent effective fire on friendly forces."

(2) Suppression for the individual aircraft is normally unplanned, is defensive in nature, and executed as a self-defense engagement. A suppression engagement is a hasty engagement to prevent, modify, or stop an enemy engagement. Aircrews should use suppression to break contact and gain maneuver time and space.

(3) Suppression is not a decisive engagement. FM 101-5-1 defines a decisive engagement as, "an engagement in which a unit is considered fully committed and cannot maneuver or extricate itself. In the absence of outside assistance, the action must be fought to a conclusion and either won or lost with the forces at hand."

(4) The crew firing the suppression engagement may not be able to observe target effect.

(5) Aircrews may attempt suppression against virtually any target for self-defense. For example, a crew may have to engage an armored target with cannon at close range to gain time and situational awareness for egress.

(6) Training suppression on live-fire gunnery ranges provides limited training value.

The amount of ammunition required to suppress a target is not definable. In addition, all weapons mounted on armed helicopters have the capability to suppress targets.

b. *Neutralization*. Neutralization knocks a target out of action temporarily. Neutralization of a target occurs when it suffers 10 percent or more casualties or damage.

(1) Neutralization is the standard for rocket engagements. Neutralization is a deliberate engagement in which the crew fires a minimum of two pairs of adjustment rockets, senses the impacts, makes adjustments, and fires for effect with at least five pairs of rockets. This standard applies to both MPSM and PD rockets.

(2) The crew selects a central aimpoint for multiple targets covering a large area and adjusts the aimpoint on observed impacts. Crews must observe the impacts of the sensing rockets to adjust for the fire for effect.

(3) Rockets are most effective when fired in mass. For neutralization training, resource constraints do not allow aircrews to fire rockets in mass for fire for effect. The training strategy for neutralization is to teach and evaluate crews on their ability to select a central aimpoint (target center-of-mass) and adjust rockets onto the target without completing a decisive fire for effect.

(4) The optimal solution for training and evaluating neutralization is for units to set-up an assembly area complete with tents and vehicles in the range impact area and allow the crews to engage the area with rockets. When a crew completes the engagement, the master gunner goes to the target area and counts impacts. While it would be interesting to watch, this level of targetry is totally impractical. Because of this, the neutralization standard for training is to use single (may be several) silhouettes on the range as central aimpoints. The crew adjusts the rockets onto the individual targets. The limits of the target effect area is defined by the AWSS.

(5) All aircrews will train to the neutralization standard. Although commanders may consider suppression a more relevant rocket mission for his unit, neutralization will provide the maximum training value per trigger pull for basic and intermediate gunnery training.

(6) Paragraph 7-5 contains more information on the employment of 2.75-inch rockets.

c. *Destruction*. Destruction puts a target out of action permanently. Direct hits with high-explosive munitions are required to destroy hard materiel targets. Do not confuse destroying a tank with a destruction mission. Destruction often requires large expenditures of ammunition.

(1) Destruction is a deliberate engagement.

(2) Precision guided missiles are used against hard targets during destruction missions. While other weapons may be used for destruction, mission planning will normally focus on the standoff capability of TOW and Hellfire missiles.

Section II. Terminology and Information on Weapons

7-4. EFFECTIVE RANGE

FM 101-5-1 defines effective range as, "That range at which a weapon or weapons system has a 50 percent probability of hitting a target."

a. A weapon's effective range extends from the minimum effective range to the maximum effective range. **Maximum effective range** is the longest range at which a weapon has a 50-percent probability of hitting a target.

b. The standard target used in determining effective range for cannon are 3 x 3 meter plywood silhouettes. It is a "vehicle sized" target.

c. The training tables contained in this manual require aircrews to engage targets within the effective range of the weapon with target-practice ammunition. However, crews may have to shoot long range engagements in combat using service ammunition.

7-5. 2.75-INCH ROCKETS

Whether fired from an AH-64, AH-1, or OH-58D (KW), the 2.75-inch rocket system displays similar characteristics. The intent of the following paragraphs is to provide general information applicable to all armed helicopters.

a. The rocket system mounted on attack helicopters is a unique weapon system. Rockets fired from an attack helicopter possess characteristics of both direct and indirect fire weapons. Like indirect artillery fire, 2.75-inch rockets are most effective when fired in mass. In addition, helicopter crews can fire rockets in the direct fire and indirect fire mode.

b. Crews can expect 7 to 12 mils of dispersion from rockets fired from helicopters. The MK 66 rocket motor spins clockwise up to 30 revolutions per second to motor burnout due to the flutes on the motor nozzle. As the motor burns out the rocket's clockwise rotation zeroes out and the wrap-around fins cause the rocket to begin a rapid counterclockwise rotation. Engineers designed this reversal of rotation for the following reasons:

(1) The rocket's high rate of rotation may keep the warhead's set-back fuze from arming due to the centrifugal force of the spinning rocket.

(2) The MPSM warhead's submunition ejection pattern is disrupted by high rates of rotation. The pattern of submunition impacts is inconsistent and provides poor target coverage without proper submunition ejection.

c. Live-fire testing shows that rockets are most effective between 3,000 and 5,000 meters. These test results apply to both MPSM and unitary warhead rockets.

d. Crews must select the proper weapon for the target to be engaged. The targets most suited for rockets are large target areas with high concentrations of enemy personnel and

materiel. Figure 7-1 shows an example of a rocket target. The targets best suited for neutralization with rockets include--

(1) Troops in the open.

(2) Tactical assembly areas.

(3) Command, control, and communications facilities.

(4) Motor parks and vehicle marshalling area.

(5) Convoys of thin-skinned vehicles.

(6) River crossing sites.

(7) Deployed artillery or air defense sites.

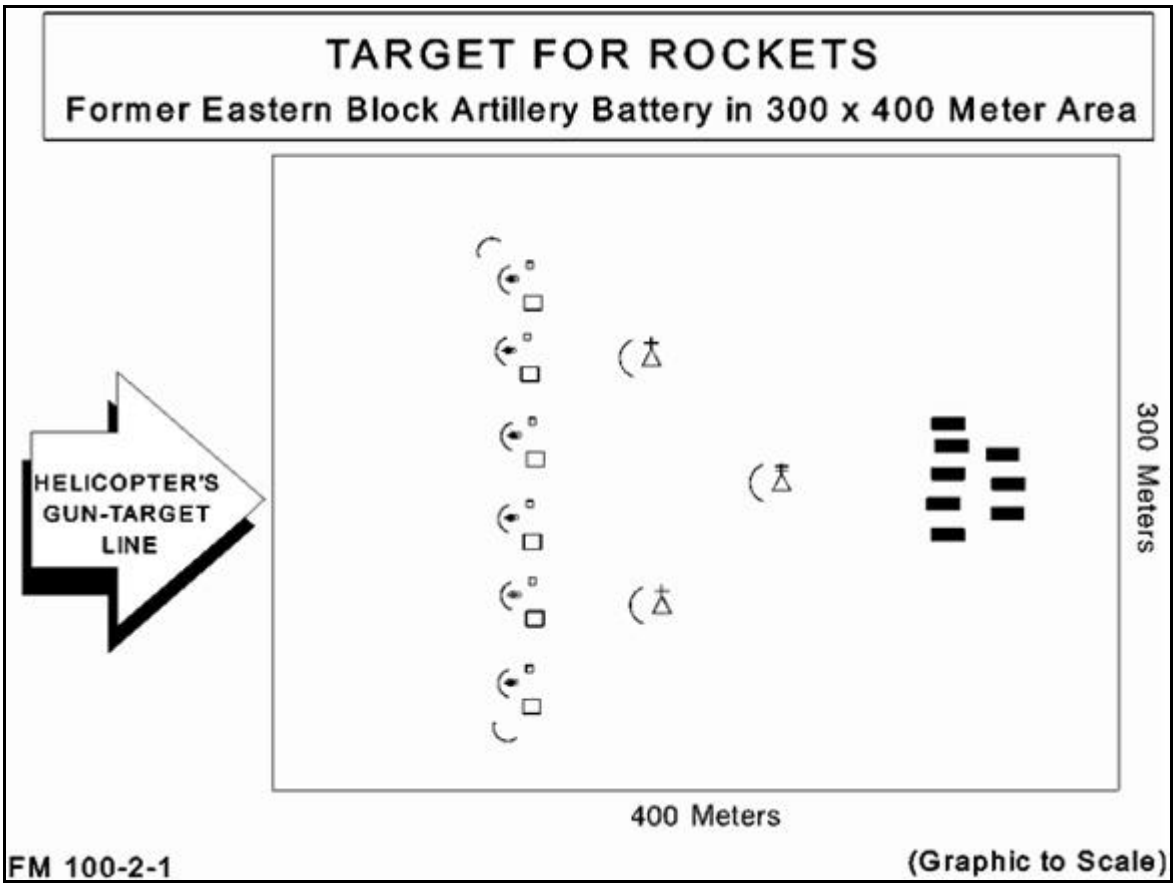


Figure 7-1. Example rocket range

7-6. BORESIGHTING AND DYNAMIC HARMONIZATION

a. Armament personnel and aircrews must adjust each weapon system to ensure that the aiming point and impact point of the projectile are the same. Boresighting is the first step in

this process. It involves adjusting the boreline axis of the weapon and the optical axis of the sight. Boresighting does not compensate for deviations caused by the ballistic characteristics discussed in Chapter 4.

b. Normally, armament personnel are responsible for boresighting prior to range training. However, aircrews should be knowledgeable in the procedures for boresighting weapon systems. The publications in the references section describe boresighting procedures for specific helicopters and weapon subsystems. Table VI shows the ammunition for weapons calibration and verification.

c. The dynamic harmonization procedure is for AH-64 units only. It is conducted during Table VI and greatly improves the accuracy of the 30mm cannon. This procedure in conjunction with the improved pylon and rocket launcher boresight procedure will greatly enhance the accuracy of the Apache's weapon systems. Unit crews must know the proper procedures for each task before attempting them.

d. The range specified by the dynamic harmonization procedure, 1,000 meters, is selected to negate impact of environmental conditions. Additionally, the FOV diagrams and the correctors are scaled to that range.

NOTE: This procedure is not a replacement for the CBHK ground procedure.

Section III. Crew Techniques

7-7. FIRING TECHNIQUES

Firing helicopter weapons systems requires a great deal of skill by the pilot and CPG/CPO. These skills require development and sustainment. They include aircraft control and burst on target.

a. *Aircraft Control*. Aircraft control is most critical when engaging targets with rockets. Rockets are affected by changes in pitch attitude and relative wind as they leave the launcher. Regardless of the engagement technique used, aircrews should use a consistent sequence. This sequence is known as the 4 Ts (target, torque, trim, target). The use of this sequence, regardless of your aircraft type, will assure a consistent launch. The following is a description of the sequence.

(1) *Target.* Verify that the correct target is being engaged. Verify the correct azimuth. The pilot may select key terrain to assist in lining up on the target.

(2) *Torque*. Verify that the torque required to maintain altitude and DO NOT CHANGE IT. Any torque changes during the firing sequence will

affect the distance the rockets fly based on the changed induced flow from the rotor system.

(3) ***Trim.*** The trim of the aircraft includes both horizontal and vertical trim. During hovering fire, the pitch attitude (vertical trim) should be verified for the range and adjusted with the cyclic. During running fire the trim of the aircraft (horizontal trim) should be verified and adjusted for with the pedals prior to firing. An out of trim condition will cause a deflection of the rockets on the opposite side the trim error occurs.

(4) Target. Finally, reverify the correct target and azimuth prior to firing.

b. ***Burst on Target.*** BOT is the technique used to adjust fires on target. This technique requires the crew member firing the weapon to sense the impacts of his engagement and use proper technique to adjust the rounds on target. BOT is used with cannon, machine gun, and rocket engagements. There are several techniques for applying BOT. They include--

(1) ***Laser range finder method.***

(a) Select a narrow field of view on the helicopter's optics. Lase the target. Note the range to the target.

(b) Fire a burst of cannon fire at the target.

(c) Immediately select a wider field of view on the optics.

(d) Note the impacts of the bullets.

• Lase the impact. Note the range to the impacts. The difference between the laser range to target and the laser range to the center of the bullet impacts is the range error.

• Note the azimuth to the impact. If impacts were right or left of target, make minor corrections in the aimpoint to the opposite side of the target to adjust bullets on the target.

(e) Change the range.

• Add/subtract the range error to the original range to target and manually entering the corrected range into the aircraft.

• Add/subtract the range error from the original range to target and lasing either short or long of the target to get the corrected range.

(f) Continue the engagement.

(2) ***Mil relation method.***

(a) Select a narrow field of view on the helicopter's optics. Estimate the range to the target using mil values. Input or adjust the range manually, noting the range to the target.

(b) Fire a burst of cannon fire at the target.

(c) Immediately select a wider field of view on the optics.

(d) Note the impacts of the bullets. Measure the distance between the impacts and the target using the symbology in the helicopter's optics. Using the mil values in Section III, Chapter 6, determine the distance (both in range and azimuth) from the target the impact occurred.

(e) Change the range by adding or subtracting the range error to the original range to target and manually entering the corrected range.

(f) Continue the engagement.

(3) ***Recognition method.*** The recognition method is also known as "Kentucky Windage." This technique's effectiveness is directly proportional to the experience of the crew member making the corrections. To use this method, the crew member fires a burst, senses its impact, and estimates the amount of correction needed to adjust rounds on target. He adds or subtracts the adjustment from the original range and continues firing.

7-8. TTP FOR THE MODES OF FIRE

a. ***Hover Fire.*** Hover fire is fire delivered when the helicopter is below effective translational lift, either in ground effect or out of ground effect. It may be stationary or moving, but movement during hover fire is always below ETL airspeed.

(1) The "4 Ts" from paragraph 7-7 above apply to hover fire. Vertical and horizontal trim are important when engaging from a hover. Depending on the environmental conditions, many aircraft hover OGE very near their maximum torque available limit. The narrow power margin held by a

loaded aircraft makes smooth, deliberate pilot inputs critical.

(2) When firing at a hover, verify proper torque control by setting the collective and verifying that the vertical speed indicator is steady. Pitch of the aircraft should be confirmed with the attitude indicator or pilot symbology. Keep the aircraft stable for the most accurate shots. Drift with the wind if the threat situation and terrain permits.

(3) AH-64 and AH-1F pilots can check the speed of the real wind around the aircraft. If a crew is shooting rockets on a windy day, a technique is to watch the true airspeed display and let it become stable, or "constant" prior to firing the rockets.

(4) When firing from a hover, the attitude of the aircraft may prevent the pilot from seeing directly over the nose of the AH-1 and AH-64 aircraft. The pilot should select reference points identifiable from the aircraft to maintain aircraft alignment and position over the ground during the engagement.

b. ***Running Fire*****.**

(1) The crew selects an initial point about 8 to 10 kilometers from the target. The IP should be an identifiable terrain feature. The IP is selected primarily as a function of the desired route to the target.

(2) The aircraft departs the IP toward the target flying contour, using terrain to mask the approach.

(3) Approximately 6 km from the target, the pilot starts a climb to achieve intervisibility with the target. Once the crew acquires the target, the pilot levels the aircraft.

(4) At 5 km (rockets) or 1500 m (cannon) from the target, the pilot starts a shallow 3-to 5-degree dive angle and the crew begins engaging the target.

(5) At 3 km (rockets) or 1 km (cannon) from the target, the pilot begins his break and uses terrain to cover his departure from the target area.

(6) The crew returns for an immediate reattack on the target or returns to the IP and holds.

NOTE: The crew does not fly over the target in running fire.

c. *Diving Fire*. Figure 7-2 shows diving fire. Use diving fire when--

• Line of sight to target from hover is obstructed and direct fire is required on target for destruction or neutralization mission.

• High volume of accurate rocket and cannon fire is required on the target and there is minimal air defense threat.

• High gross weight or environmental conditions prevent hover fire.

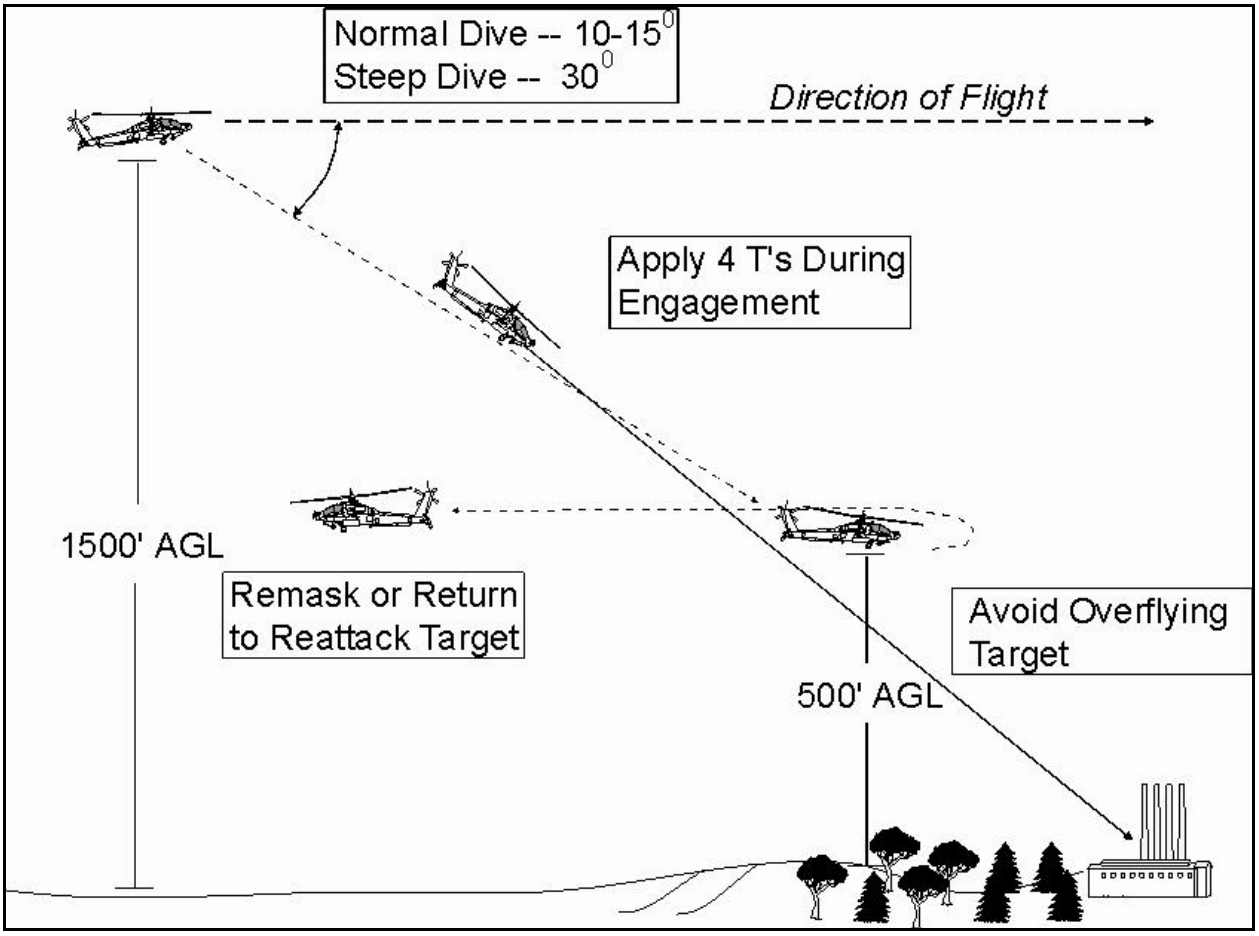


Figure 7-2. Diving fire

(1) Both the AH-1 and AH-64 ATM address diving flight. TC 1-213 (Task 2069) and TC 1-214 (Task 2069) give specific performance standards for diving flight.

(2) Techniques for firing weapons during diving flight are discussed below.

(a) Use the 4 Ts in paragraph 7-7a (target, torque, trim, target).

Proper aircraft control will greatly enhance the accuracy of the aircraft weapon systems, primarily with rockets.

(b) Engage targets with rockets and cannon similar to techniques used in running fire. Use rockets employing point detonating fuses and used "fixed gun" for cannons during the engagement.

(c) Use a careful cross-check because target fixation may cause the pilot to fly the aircraft into the ground. The pilot should complete the recovery from the dive no lower than 500 feet AGL for training.

(d) Be aware that pitch cone coupling in the AH-1 and transient torque are more pronounced during diving fire and must be recognized by the pilot. Pilots must monitor rate of closure, rate of descent, and torque.

(e) Understand that high rates of descent coupled with high flight path speeds require that the pilot closely monitor rate of closure and terrain features. The pilot must plan the dive recovery in time to avoid abrupt recovery maneuvers. If an abrupt recovery is attempted at high airspeed, "mushing" may occur. When the pilot tries to recover from a dive, the high rate of descent and high power setting cause the controls of the helicopter to become less responsive. Mushing may prevent the pilot from recovering the aircraft from the dive.

NOTE: The crew should avoid flying over the target in diving fire.

Section IV. Night Gunnery for Non-C-NITE AH-1

7-9. AH-1 NIGHT FIRING

a. USAAVNC's position on AH-1 night gunnery is that only C-NITE equipped Cobras have a night gunnery qualification requirement. This was a Command Group decision made in 1989 based on the following facts concerning non C-NITE Cobras:

- Night vision goggles are not compatible with artificial illumination.
- AH-1 telescopic sight unit is not compatible with NVGs.

• Maximum range of the NVGs is approximately 800 meters, which restricts operational employment. This includes target acquisition and direct fire engagements.

• AH-1 units are not funded for illumination, neither internal with illumination rockets nor external with artillery or mortar illumination.

b. The requirement to conduct AH-1 night gunnery should be based on the unit's METL. Considerations for firing the 20mm, 2.75-inch FFAR, and TOW missile while wearing NVGs are addressed in TC 1-204. Additionally, the new TC 1-213 requires aviators to perform gunnery tasks as part of NVG qualification and annual evaluation. The tasks, conditions, and standards outlined in the ATM gunnery tasks apply to NVGs as well. Night firing tactics, techniques, and procedures with illumination are similar to day-firing techniques.

c. If an AH-1 equipped unit has the mission to fight at night, then the command that the unit belongs to has the responsibility to provide the resources and training for night fighting.

7-10. ISSUES WITH NIGHT AH-1 GUNNERY

a. Because of the range limitations of the NVGs, indirect rockets are the only rocket engagements considered reliable with NVGs.

b. NVGs mounted on the HSS helmet provide the AH-1F crew with the capability to place cannon fires on short range targets. When the cannon is not in coincidence with the pilot's or gunner's HSS, firing voltage is inhibited to the cannon. However, a trigger pull will dump live 20mm rounds overboard. Great care should be exercised with this technique. Based on the limitations of the NVGs, this technique is most useful at ranges between 300 and 800 meters.

c. Suppression is a viable mission for the AH-1 not using artificial illumination. For example, using cannon to break contact during a night movement.

d. Non-C-NITE AH-1 units have ammunition allocated for night sustainment gunnery, not qualification.

Section V. Air Combat Weaponeering

The purpose of this section is to provide information on helicopter weapons and

their employment against airborne targets. The objective of air combat weaponeering techniques is to increase the survivability of the aviation force.

NOTE: When discussing sighting systems for air-to-air firing, the pilot needs to understand that it is far more important to know where the bullet is in relation to the sight at different ranges than it is to know how far the bullet can go.

7-11. WEAPON SYSTEMS ENGAGEMENT RANGES

a. *20mm Cannon, AH-1F*.

(1) When fired FIXED GUN using the HUD sighting system, the 20mm cannon is boresighted to cause the bullet to pass through the center of the sight reticle at 1,351 meters and has a TOF of 2.41 seconds.

(2) Recommended range switch setting is SHORT (1,000 meters). Elevation mil corrections for air combat engagement from 500 to 1,500 meters is minimal. Therefore, Kentucky Windage adjustments are easier and faster than range switch adjustment.

(3) When using the range switch to set range to target and the target is closer or farther away than the range set, use Table 7-1 to improve accuracy for elevation.

Table 7-1. Range switch setting 20mm cannon

SWITCH SET	RANGE TO TARGET	MILS
SHORT	500	-25.53
SHORT	1000	0.00
SHORT	1500	+16.78
SHORT	2000	+38.04

(4) Since the speed of the bullet is greatly reduced beyond 1,500 meters, detonation of HEI and/or API rounds are not guaranteed. Therefore, engagements beyond 1,500 meters using these rounds are not recommended.

(5) Variations in altitude have a much greater effect on bullet deceleration than does the shooter's true airspeed. Projectile speed decay

is directly proportional to air density. If you are shooting at an altitude above 6,000 feet MSL, the speed of the bullet would not decay as fast, resulting in slightly less drop of the bullet compared to a bullet shot at sea level.

(6) By the time a 20mm projectile is 500 feet in front of the muzzle, it has effectively stabilized from all pitch and yaw moments.

b. ***30mm Cannon, AH-64*****.**

(1) The 30mm cannon when fired FIXED GUN has a bullet impact at 1,575 meters and a TOF of 3.9 seconds.

(2) Recommended range setting is 1,000 meters. Elevation mil corrections for air combat engagement from 500 to 1,500 meters is minimal. Therefore, Kentucky Windage adjustments are easier and faster than readjustment for range. Use the information below to adjust your aim for elevation.

Table 7-2. Range adjustment for 30mm cannon

RANGE	AIM ADJUSTMENT
500	-29.0
1000	0.0
1500	+23.3

c. ***TOW Missile System, AH-1*****.**

(1) Due to tracking limitations of the TOW missile system (35 mils per second), the minimum standoff range required to allow the missile to track its target increases as the speed of the target increases. Table 7-3 shows the minimum and maximum ranges required to engage a target at varying speed with an aspect of 90 degrees.

Table 7-3. Minimum and maximum ranges for TOW engagement

TARGET SPEED (KNOTS)	MIN RANGE IN METERS	MAX RANGE IN METERS
34	500	3750
68	1000	3750
102	1500	3750
136	2000	3750
170	2500	3750
204	3000	3750
238	3500	3750
255	3750	3750

(2) When using the TOW missile to engage an aerial target, the amount of distance the target will travel during the missile's time of flight becomes very important. Table 7-4 shows the relationship between the target speed, range to target, and distance the target travels.

Table 7-4. Aerial target, TOW engagement

TARGET SPEED (KNOTS)	RANGE TO TARGET		DISTANCE TARGET TRAVELED (IN METERS)	
34	500	3750	35	359
68	1000	3750	137	718
136	2000	3750	602	1435
204	3000	3750	1554	2153
255	3750	3750	2691	2691

d. *2.75-Inch Rockets.*

(1) The MK 66 rocket motor reaches its maximum velocity within 400 meters after launch. For the purpose of air combat, the rocket warhead of choice is the flechette, followed by the MPSM and HE-PD.

(2) The flechette warhead detonates 150 meters before the predetermined range set by the rocket management system. After detonation of the warhead, the flechettes are deployed at a 12-degree angle and create a flechette cloud that becomes a cylinder after 150 meters. The size of this cylinder is 15.7 meters (49.7 feet) in diameter.

(3) Analysis of the firing characteristics of the flechette warhead indicates that firing three pairs of rockets at a range of 2,000 to 2,500 meters will result in a 75 to 82 percent probability of hit.

(4) Table 7-5 shows range, TOF and velocity for the flechette and MPSM MK66 rockets for air combat engagements.

Table 7-5. Air combat engagement with rockets

RANGE (METERS)	TIME OF FLIGHT (SECONDS)	VELOCITY (METERS PER SECOND)
1000	1.96	510
2000	4.38	413
3000	7.41	330
4000	11.0	278
5000	15.17	240
6000	19.93	210
7000	25.06	195

e. *Hellfire Missile*. The maximum effective range of the Hellfire missile is over 8,000 meters. With an onboard laser designator, aircrews can engage targets at ranges up to the maximum effective range. Ideally, aircrews should engage enemy helicopters indirectly with the Hellfire. The target can be designated by OH-58D or ground lasers. This designation capability enables aircrews to fire the missile from concealed positions behind masking terrain.

f. *Stinger Missile*. The Air-to-Air Stinger should be used at or near maximum range before the enemy can detect the friendly aircraft. In extended range firing where the friendly aircraft has not been detected, the aircrew should be aware that the ATAS has a detectable smoke signature under certain atmospheric conditions. The ATAS may be used in short-range firings of less than 1,000 meters. However, the minimum arming range may affect its lethality.

7-12. TARGET ENGAGEMENT FACTORS

a. *Range*. Inaccurate range estimation results in rounds missing the target and reduces the element of surprise by alerting the enemy to an impending attack. Therefore, aircrews must train to estimate the range accurately. The following methods are recommended:

- Visual range estimation.
- Tracer burnout.
- Maps and photomaps.
- Electronic devices.
- Sight mil values.

Laser range finders are the most accurate of all of these methods.

b. *Target Motion*. If a target is not stationary, it becomes necessary to aim the gun ahead of the target to compensate for motion. The lead requirements for a target's motion occurs because the target has a velocity and sometimes an acceleration.

(1) The lead component compensating for the target's velocity is generally 85 to 90 percent of the total lead requirement and is a function of the target's true airspeed and aspect. The lead component compensation for target acceleration comprises the remaining 10 to 15 percent of the total lead requirement.

(2) The lead for target velocity is a function of the target's TAS and aspect. The velocity of the target is not nearly as important as the LOS motion rate that it creates. The magnitude of that LOS rate is a function of the magnitude of the target rate of motion and distance. At longer ranges, a smaller LOS rate is required to match the target's rate of movement. As the range decreases, LOS rate will proportionally increase. To determine the amount of lead required to compensate for target velocity--

- Determine the amount of target movement in degrees per second, then multiply that number by 17.45. This number will give you the rate of target movement in mils per second.

• Multiply this number by the TOF of the bullet to the target. The result is the amount of velocity lead required. For example, if your aircraft is turning at 10 degrees/second (10 degrees x 1,745 = 174.5 mils/sec) to match (track) the target's velocity normal to the LOS, and the apparent TOF of the bullet is 0.5 seconds, the required velocity lead would be:

Velocity lead = (174.5 mils/sec) x (0.5 sec) = 87.25 mils

c. ***Target Acceleration*** **(compensation for target acceleration during tail chase engagement).** The targets acceleration does not actually increase the target's LOS before firing the bullet. What is required, however, is an additional lead component to compensate for the change in the target's motion path during the TOF of the bullet. The additional lead component compensates for a turning situation where the target is turning after the bullet is fired. A miss distance has been generated due to the target turning after the bullet left the gun. The magnitude of acceleration is a function of the total "Gs" (crew station "G" force) that the target aircraft is generating. Gun control theory assumes that over the short TOF of the bullet, the target's speed remains constant. The amount of correction will depend on the amount of "Gs" pulled by the target aircraft and TOF of the bullet. (This amount would not be greater that 50 mils in most cases.)

d. ***Lead Angle*****.**

(1) Shooting at a moving target is easy. Placing a killing burst on it requires a great deal of skill. One of the biggest problems to solve is how much to lead the target. Without a fire control computer that is capable of computing lead angles, the pilot and gunner have an increased workload.

(2) "Lead the speed" refers to leading the target aircraft by the number of mils equal to the aircraft's maximum speed. For example if an aircraft's maximum speed is 120 knots, lead the aircraft by 120 mils in an engagement. The following are a few rules of thumb for tracking airborne targets and engaging them. This technique will get the bullets going in the right direction, but will probably require adjustment by the pilot or gunner.

(a) 7.62mm: Lead the speed.

(b) 20mm Cannon: Lead the speed minus 20 percent.

(c) 30mm Cannon: Lead the speed.

(d) Rockets: Lead the speed plus 10 percent.

(e) TOW/Hellfire: Track the target.

(f) ATAS: Track the target.

e. *Weapons Guide*. Table 7-7 shows the recommended weapon system to use for air combat at various ranges to target.

Table 7-7. Recommended weapon system for air combat

RANGE TO TARGET (METERS)	WEAPON SYSTEM
0 - 1250	7.62mm
0 - 1500	20mm or 30mm
700 - 2500	2.75" Rockets
2000 - 3750	TOW Missile
2000 - 8000	Hellfire Missile
1000 - 8000	Air-to-Air Stinger

f. *Sight Reference*. Mil values for sights are contained in the Chapter 6.

APPENDIX A

HELICOPTER DOOR GUNNERY

This appendix contains the tactics, techniques, and procedures required for training and employing door gunners for utility and cargo helicopters.

Section I. Door Gunnery Training Strategy

A-1. DOOR GUNNERY OVERVIEW

MISSION. Utility and cargo helicopter units will conduct annual live-fire door gunnery qualification according to this appendix on range facilities where target hits can be objectively scored.

a. Door gunners on utility and cargo helicopters are concerned with threats to the helicopter and crew on board, whether the helicopter is in the air or on the ground. Door gunners must be able to acquire and engage a wide variety of targets from many different flight profiles. Evaluation of door gunners includes a time standard to acquire, engage, and hit the target.

b. Door gunners are normally helicopter crew chiefs. They may also be soldiers from within or outside the unit. Crew coordination is critical between the door gunners and the helicopter's pilots. The door gunners and pilots maintain communication and work as a team to acquire targets, as well as safely fly the helicopter.

c. The door gunner's primary weapon is the 7.62mm M60D machine gun. The M60D is a direct fire weapon system. The configuration of the M60D is similar for all cargo and utility helicopters and differs mainly in the helicopter gun mount and auxiliary equipment.

A-2. DOOR GUNNER DUTIES

a. Door gunners provide direct fire as protection for the aircraft and crew. To effectively employ their weapon, door gunners must:

- Thoroughly understand weapon system's functional characteristics and operation, as well as its capabilities and limitations.
- Have a thorough knowledge of tactical helicopter employment.
- Be prepared to act independently, based on the threat, and engage targets without a specific command from the pilot.
- Act as observers to assist the pilot and copilot in safe operation of the helicopter.

b. The door gunner will perform the inspections of their weapons and weapon subsystem(s) on the aircraft unless specified otherwise by unit SOP or directives.

(1) The door gunner will perform operator level maintenance on the aircraft weapon

system. The door gunner is responsible for ensuring that the correct type and amount of clean and serviceable ammunition is on board the aircraft for the mission.

(2) The door gunner will normally assist in the daily inspection, preflight, postflight and other maintenance operations involved with the aircraft. Additional duties and/or aviation specific duties required of the door gunner (not crew chief) should be specified by the unit SOP.

c. Door gunners must act as observers to help the pilot and copilot operate the aircraft safely.

(1) During flight and ground operations, door gunners will maintain a watch for hazards and obstructions to flight. These obstructions may vary from high tension wires and other aircraft along the flight path to obstacles such as tree stumps in the landing zone.

(2) Reporting potential or actual targets to the pilot/copilot is a specified task of the door gunner. From the gunners side of the aircraft, the primary observation sector is normally 60 degrees off the nose of the helicopter all the way to the rear.

(3) During both combat operations and training, door gunners must maintain situational awareness. They must know the location of friendly troops, the location of other aircraft in their formation (including escorting attack helicopters), and the classification and location of the target(s) to be engaged. A door gunner may also be required to mark a ground location with smoke grenades or tracers.

(4) The unit SOP should have procedures for crews to follow during an emergency landing. The door gunners must know the procedures for removing weapons, electronic equipment (radios, COMSEC devices), or other sensitive equipment or items (such as maps and SOIs) from the helicopter. The gunner must know how to destroy or assist in the destruction of sensitive equipment, if necessary, to prevent capture.

A-3. DOOR GUNNER TRAINING PROGRAM

This program is progressive and has training gates similar to the gates found in the attack helicopter qualification program. The purpose of this training program is to give the door gunner the skills necessary to perform door gunner duties in a crew. The training program consists of 10 training tables. These tables progress in numerical order from individual marksmanship training to multiship live-fire. The training tables support the commander's METL and the unit's MTP. The door gunnery training tables are as follows:

a. ***Basic Gunnery*****.** Tables I-IV are the initial M60 ground qualification.

- Table I - 10 meter practice fire.
- Table II - 10 meter record fire.
- Table III - Transition practice fire.

• Table IV - Transition record fire.

(1) Tables I-IV qualify the door gunner on the ground M60 machine gun according to FM 23-67. The philosophy of ground qualification is to instill confidence in the door gunner and also in the soldiers transported in the helicopter. Soldiers flown into combat by the assault or cargo helicopter crew will know that the door gunners are not only qualified to the Army standard on the ground M60, but are also trained on the M60D. Door gunners are capable of placing direct fire on threats while in the air or on the landing zone.

(2) The ground M60 tasks in FM 23-67 require that the weapon be fired from both the tripod and bipod. If standard M60s cannot be used during Tables I-IV, the tasks that normally require firing the weapon from a tripod must be modified for the M60D with bipod firing substituted for tripod firing.

(3) If standard M60s are not available in the unit, the unit has the option to arrange with another unit in the battalion/squadron or brigade to use their M60s for initial weapons training. "Piggy backing" door gunners on ranges with other units that conduct M60 machine gun training is also recommended.

(4) When newly assigned to a unit, the door gunner candidate must complete ground qualification according to FM 23-67 prior to progressing to air qualification and full door gunner qualification. Ground qualification is a training gate. During his assignment to a specific unit (battalion or separate company), the door gunner must ground qualify only once. However, if 12 months pass and the door gunner has not fired an M60D from an aircraft on a qualification range as a trainee, he must requalify on the ground M60 before progressing to air qualification.

(5) Before firing the basic tables, the door gunner candidate will receive premarksmanship instruction on the M60 machine gun. Figure A-1 shows the minimum instruction required for Tables I-IV.

(6) Units may conduct live-fire training from helicopter cabin mock-up during basic gunnery. Many units build helicopter cabin mock-up for training their door gunners. They approximate the dimensions of the immediate area of door gunner's station in the helicopter's cabin and allow the door gunner trainee to fire his weapon using a sight picture very similar to that used in the actual aircraft. These "simulators" range in complexity from simple 20-foot towers to those mounted on 2 1/2-ton trucks, simulating aircraft movement during engagements. While there is currently no standard design, units may develop their own design for enhancing door gunnery training.

b. ***Intermediate Gunnery.***

(1) ***Table V.*** Table V is the Door Gunnery Skills Training and Test table. During this table, the door gunner will learn skills needed to execute his duties. The commander will use this table for assessing the readiness of the door gunners prior to Table VI.

(a) ***Training program.***

• Table V program contains two parts--training and assessment. The training program prepares the door gunner for Intermediate live-fire tables. To fill both door gunner positions, the commander may designate a noncrew chief. If this is the case, Table V training must include instruction on the basics of the aircraft.

• At a minimum, Table V will include academic instruction on the subjects outlined in Figure A-2 and a Door Gunnery Skills Test of at least 50 questions. Subject areas for the questions will be selected by the commander, but will include questions on the academic instruction with emphasis on weapon function, ballistics, target acquisition, and aircraft procedures. Door gunners will score at least 70 percent on the DGST. Door gunners must complete the DGST within 180 days prior to starting intermediate gunnery.

(b) Aircraft orientation is applicable only to door gunners who are not crew chiefs or who are not familiar with the unit aircraft.

(c) This program is intended to be ongoing, which the reason the tactical subjects are included in the training program. A good gunnery program does not start just prior to the qualification range.

(2) ***Table VI*****.** If the door gunner successfully completes Table V to standard, he will progress to Table VI. Table VI is the initial aircraft live-fire table. During this table, the door gunner will fire the M60D from the aircraft for the first time.

(a) The table consists of 5-day tasks, of which one is an NBC task.

(b) The tables serves to verify the function of the door gunner's assigned weapons.

Training Objective: To provide initial M60 qualification for personnel assigned to door gunnery positions.		
SUBJECT	**DESCRIPTION**	**REFERENCE**
Operation and Function of the M60	Class to provide the basic knowledge of how the components of the M60 function during operation	FM 23-67, TM 9-1005-224-10
Assembly, Disassembly, and Nomenclature of the M60	Demonstration and practical exercise on the general and detailed assembly, disassembly, and nomenclature of the M60 machine gun.	FM 23-67, TM 9-1005-224-10
Malfunctions, Immediate Action, and Maintenance	Class to provide information concerning abnormal operation, corrective action, and maintenance.	FM 23-67, TM 9-1005-224-10
Range Estimation	Class and practical exercise to provide information on methods of determining the distance between gunner and target.	FM 23-67, FM 1-140, TM 9-1005-224-10
Fire Control/ Fire Commands	Class to provide information on the methods used in controlling and delivering fires.	FM 23-67
M60 Machine Gun Practice and Record Fire	Briefing on the conduct and standards of Tables I-IV.	Unit SOP, Range SOP, FM 23-67

Figure A-1. Basic weapon qualification

Training Objective: Door gunner qualification		
SUBJECT	**DESCRIPTION**	**REFERENCE**
Duties of the Door Gunner	Class on the duties of door gunners	Unit SOP, Appendix A, FM 1-140
Aircraft Orientation	Class and practical exercise to familiarize the student with the capabilities and limitations of the unit's aircraft	Appropriate aircraft operator's manual
Techniques of Fire and Employment	Class on principles and techniques of helicopter machine gun firing	Appendix A, FM 1-140, FM 23-67
Ballistics	Aerial ballistics for spin stabilized projectiles	Chap 4, FM 1-140, Chap 7, FM 23-67
Armament System Introduction	Class and practical exercise on the M60D to include safety procedures, and operator maintenance	TM 9-1005-262-13
Aviation Battlefield Survivability	Class to provide an overview of Threat defense systems that aircrews may face	Bde/Bn S2 brief
Visual Search and Target Detection	Class on techniques of visual search, to include limitations and procedures of target detection	FM 1-116, Chapter 6, FM 1-140
Crew Member Emergency Procedures	Class and demonstration of duties and actions taken by the door gunner during in-flight and forced landing emergencies	Aircraft operator's manual and unit SOP
Night Gunnery	Class on techniques and procedures of night firing	TC 1-204, Range SOP
First Aid Training	Class on principles of first aid	FM 1-301, FM 21-11
Protective Mask	Class and practical exercise on the description, characteristics, and procedures for wearing the protective mask during engagements	TM 3-4240-280-10
Door Gunnery Qualification	Briefing on the conduct and standards of Tables VI-VIII.	Range SOP, TM 9-1005-224-10, TM 9-1005-262-13

Figure A-2. Table V, intermediate gunnery training

(c) The NBC task is fired in mask and gloves only. This task has no requirement for a MOPP suit.

(3) ***Table VII*****.** Table VII is a day/night practice table for Table VIII. The table consists of 8 tasks (5 day/3 night) of which one is an NBC task. The table is completed from the aircraft in a variety of flight modes.

(4) ***Table VIII*****.** Table VIII is the qualification table. The table consists of the same number of tasks as Table VII. Table VIII contains both day and night tasks, and is the gate for advanced table gunnery.

c. ***Advanced Gunnery*****.**

(1) ***Table IX*****.** Table IX is multiship gunnery using MILES/AGES and blanks with the M60D. This table will give the door gunners that successfully completed intermediate gunnery qualification the first opportunity to participate in training with more than one aircraft.

(2) Table X. Table X is multiship live-fire gunnery. The intent of Table X is for units to fire the table at CTCs or large range complexes. The large surface danger zone of two M60D prohibits multidoor gunner gunnery at most installations. The maximum recommended number of aircraft participating in Table X gunnery is five.

A-4. UNIT TRAINING STRATEGY

a. Commanders will designate in writing a door gunnery unit trainer. The door gunnery unit trainer should be a senior noncommissioned officer with considerable experience in door gunnery. The UT is the commander's point of contact and subject matter expert on door gunnery. The UT is responsible for training new personnel and conducting sustainment training for personnel already qualified. The UT will--

- Be a qualified door gunner.
- Organize all training in coordination with the S3.
- Supervise the preparation and execution of all instruction.
- Supervise initial qualification and annual qualification from the aircraft.
- Evaluate qualification tables.
- Maintain qualification records on all door gunners according to Chapter 2, FM 1-140.

Assistant UTs may be designated by the commander. The UT will work closely with the commander and the S3 to administer and evaluate the unit door gunner training program.

b. After designating a UT, the commander will complete, in conjunction with the UT, a unit training assessment according to Chapter 2 of this manual.

c. Once the assessment is complete, the commander will outline his objectives for the

door gunnery training program. His guidance must include the desired training end state for the program. For example, "two qualified door gunners per UH-60 in A Company." This requirement is based in large part on available resources.

d. Once the objectives for the gunnery are clear, the S3 and UT will begin planning the conduct of the training program. It is recommended that door gunner training be incorporated into the unit training plan as a continual program.

e. Door gunnery training should be incorporated into a written program with clear objectives and training goals throughout the training year. Door gunnery subjects are relevant for "Sergeants Time" or "Prime Time" training programs common to most active Army units.

f. Door gunners will be designated in writing by the unit commander. The commander will accomplish this with a memorandum similar to standard additional duty appointment orders.

g. The door gunnery section of this appendix defines the requirements for conducting and evaluating live-fire door gunnery tables. Units that have night missions as part of their METL will complete the night tasks. The door gunners will use NVGs while firing from the aircraft.

h. Once the intermediate gunnery is complete, the UT will document the training and maintain records for a minimum of 24 months, according to Chapter 2, FM 1-140.

NOTE: Door gunners should be allowed to fire from both sides of the aircraft for familiarization if resources are available. However, some range controls have specific instructions for door gunnery. For example, firing is allowed from the right side of the aircraft only.

A-5. CREW COORDINATION

Crew coordination is critical for door gunnery because of the personnel turnover and turbulence in utility and cargo helicopter units. Crew chiefs stay with their aircraft, but they are an integral part of the crew. The crews and crew chiefs should maintain a habitual flying relationship. Because of personnel turnover and maintenance, the pilot and copilot may not always fly the same aircraft or fly with the same crew chief. Training will focus on standardization of cockpit communication and procedures.

A-6. WEAPONS CONTROL AND FIRE COMMANDS

Before departure on a mission, the pilot in command of the aircraft will brief the crew on the situation and mission. The briefing is mission dependant, but will normally include the friendly situation, enemy situation, rules of engagement, possible target areas, marking of targets, mission specific fire commands, and other mission specific information. Loading ammunition in the aircraft weapons systems should be dictated by the unit SOP or parent unit operating procedures or directives.

a. ***Standard Weapon Control Measures.***

(1) The following are the standard weapon control measures:

• ***Weapons hold.*** The door gunner's weapons will remain in a stowed position. Enemy contact is not likely or is an administrative measure by the PC.

• ***Weapons tight.*** The door gunner's weapon would be placed in a position to fire. However, firing would only be executed on order of the PC. Enemy contact is possible.

• ***Weapons free.*** Door gunners make the decision to fire. Based on the mission brief where enemy contact is expected.

(2) The door gunner will acknowledge the weapon control status to the PC. If the weapon status is in other than "hold", the gunner will announce that the weapon is in a condition and position to fire. The door gunner will report "GUN READY."

b. ***Crew Weapon Sequence.*** A standard sequence for engagements is important (See Chapter 6). The following is the standard weapon sequence for utility/cargo crews. The intent of the sequence is for it to follow a logical progression for the crew member. If the pilot, copilot, or other crew members acquire a target, the observing crew member will alert the other crew members. The standard weapon sequence is:

• **Which crew member should know?** (Left/Right Gunner, Pilot.)

• **What is it?** (Target, Bandit.)

• **Where is it?** (Clock position and range.)

• **Who is it?** (Target type.)

• **Action.** (What are you doing or what should the other crew members be doing?)

(1) The following is a typical weapon sequence:

"Left Gunner, target, eleven o'clock, six hundred meters, soldiers in treeline, engage."

The right side door gunner, upon acquisition, would announce:

"Tally, firing."

(2) Chapter 6 lists standard phrases for crew communication. The following are phrases specifically for door gunnery.

• **Open fire.** Instructs the gunners to start firing at an obvious threat to the aircraft. May also apply to a specific gunner. For example, "right gunner, open fire."

• **Cease fire.** Instructs the gunners to stop firing. May also apply to a specific gunner. For example, "right gunner, cease fire."

• **Ready.** Indicates guns are ready to fire.

• **Right gun/left gun jam.** Indicates a gun is jammed and cannot fire. Right/left indicates which side the gun is on.

• **Right gun/left gun out.** Indicates the door gunner is out of ammunition. Right/left indicates which side the gun is on.

NOTE: "Back gunner" or "back gun" indicates the rear door gunner and will be used on CH-47s with the third door gunner.

A-7. SAFETY CONSIDERATIONS

a. ***Flight Equipment.*** ALSE (such as flight helmet, Nomex flight suit, gloves) and other pieces of equipment specified by regulations and/or directives will be worn by door gunners during flight operations. The commander may direct that additional hearing protection be worn due to the increased sound pressure levels generated during weapons firing. For increased eye protection, lower helmet visors during any firing operations.

b. ***Seat Belt/Safety Harness.*** The door gunner should remain strapped in his seat during normal aircraft operations. A safety harness ("Monkey strap") will permit additional movement inside the aircraft, particularly during engagements.

c. ***Ejected Brass.*** Spent brass that collects on the floor of the aircraft can make footing hazardous. Ejected brass from a firing weapon can be carried by the aircraft's slipstream into the aircraft, causing damage. Ejection control bags ("Brass catchers") control spent brass and should be used.

d. ***Barrel Change*****.** The airflow around a helicopter in flight helps to cool the machine gun barrel. However, a barrel change may still be necessary, depending on the rate of fire. A barrel change is normally a team effort (gunner and assistant gunner) on a standard M60. However, on board an aircraft a barrel change will more than likely be performed by the individual door gunner. Although barrel removal and replacement is relatively simple, safety dictates that additional emphasis be placed on standardization of the procedure. The unit SOP should specify when, where, and how an extra barrel will be carried and secured and how to accomplish barrel changes. FM 23-67 recommends barrel change based on the following rates of fire:

• **Sustained (100 rounds per minute):** Change barrel every 10 minutes.

• **Rapid (200 rounds per minute):** Change barrel every 2 minutes.

• **Cyclic (550 rounds per minute):** Change barrel every minute.

A-8. AMMUNITION

DA Pamphlet 350-38 allocates ammunition to train one door gunner per aircraft. This ammunition is an important consideration and will be an important factor when determining the number of door gunners to train. Chapter 7, DA Pamphlet 350-38 states, "Current authorizations fill one gunner position per aircraft. Total rounds per aircraft will double when second gunner position is authorized." Ammunition for the M60D is standard 7.62mm mix. Units may have success drawing additional ammunition. However, the initial planning must be for the DA

Pamphlet 350-38 allocation. Figure A-3 shows the ammunition allocation per table.

A-9. GUNNERY TABLES

Figures A-4 through A-8 (gunnery tables VI, VII and VIII) provide the framework for the door gunnery training program. Commanders may vary the engagement sequences, conditions, and target arrays within the tables to meet mission training requirements or to fit resource constraints such as range layout. Modified tables must be no less demanding than those in the manual, and such modifications will be temporary. Commanders must work continuously with installation or regional range authorities to upgrade and improve gunnery ranges. Commanders may allocate additional ammunition to Table VI for weapons calibration, if available.

a. Tables VII and VIII are based on eight tasks. Five tasks must be qualified, and a minimum of 350 points must be scored on Table VIII for the door gunner to be qualified. You may use the score sheet in Chapter 2 to help score the engagements.

GUNNERY TABLES		# ROUNDS TRC A / C
I	10 meter practice fire	117 / 117 ball
II	10 meter record fire	119 / 119 ball
III	Transition range practice fire	182 / 182 mix
IV	Transition range record fire	154 / 154 mix
V	Door gunner training and assessment	
VI	Aircraft transition/weapons calibration	150 / 150 mix
VII	Aircraft practice	240 / 240 mix
VIII	Aircraft qualification	240 / 240 mix
IX	Section/platoon training (MILES)	200 / 200 blank
X	Section/platoon training	200 / 0 mix
TOTALS:	7.62mm Ball: 236/236 7.62mm Mix: 1,166 (TRC A) 966 (TRC C) 7.62mm Blank: 200/200	

NOTES:

1. Refer to DA Pamphlet 350-38 for current ammunition authorizations.

2. The unit METL and MTP determine whether night training and qualification tables are conducted. Night door gunnery is designed for door gunners and crew to use NVGs.

Figure A-3. Annual ammunition allocation per gunnery table

TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE (METERS)	TARGET	TARGET EFFECT	AMMO
1	Engage stationary target, NBC	Ground	300-500	Troops	1 Hit	30
2	Engage stationary target	Take off	300-500	Troops	1 Hit	30
3	Engage moving target	Hover	400-600	Vehicle	3 Hits	30
4	Engage moving target	Moving	400-500	Vehicle	3 Hits	30
5	Engage stationary target	Running	800-300	Vehicle	3 Hits	30

Figure A-4. Table VI. Door gunner transition course

TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE (METERS)	TARGET	TARGET EFFECT	AMMO
1	Engage stationary target, NBC	Ground	300-500	Troops	1 Hit	30
2	Engage stationary target	Take off	300-500	Troops	1 Hit	30
3	Engage moving target	Hover	400-600	Vehicle	3 Hits	30
4	Engage stationary target	Moving	400-500	Vehicle	3 Hits	30
5	Engage stationary target	Running	800-300	Vehicle	3 Hits	30

Figure A-5. Table VII. Day door gunner practice course

TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE (METERS)	TARGET	TARGET EFFECT	AMMO
1	Engage stationary target	Ground	250-350	Troops	1 Hit	30
2	Engage stationary target	Hover	400-500	Vehicle	3 Hits	30
3	Engage stationary target	Moving	400-600	Vehicle	3 Hits	30

Figure A-6. Table VII. Night door gunner practice course

TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE (METERS)	TARGET	TARGET EFFECT	AMMO
1	Engage stationary target, NBC	Ground	300-500	Troops	1 Hit	30
2	Engage stationary target	Take off	300-500	Troops	1 Hit	30
3	Engage moving target	Hover	400-600	Vehicle	3 Hits	30
4	Engage stationary target	Moving	400-500	Vehicle	3 Hits	30
5	Engage stationary target	Running	800-300	Vehicle	3 Hits	30

Figure A-7. Table VIII. Day door gunner qualification course

TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE (METERS)	TARGET	TARGET EFFECT	AMMO
1	Engage stationary target	Ground	250-350	Troops	1 Hit	30
2	Engage stationary target	Hover	400-500	Vehicle	3 Hits	30
3	Engage stationary target	Moving	400-600	Vehicle	3 Hits	30

Figure A-8. Table VIII. Night door gunner qualification course

b. ***Engagement Time Standards.*** Using the point calculation table below, scorers can determine a numerical score for each engagement. To use Table A-1:

- Time the engagement using the methods outlined in Chapter 2 of this manual.
- Find the time of the engagement in the "Time" column below. Read down to the "Points" column to determine score.
- If the engagement time is exactly halfway between two times, figure the number in between the two scores the engagement time falls between. For example, if the engagement time is 10.5 seconds, the score is 95 points.
- Always round down to get the score. For example, if the engagement time is 11.7 seconds, the score is 93. (Rounded down to 11.5 seconds).

Table A-1. Point calculation for Tables VII and Table VIII

Time	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	24	27	30
Points	100	98	96	94	92	90	88	86	84	82	80	78	76	74	72	70	50	30
NOTE: A full-size version of this point calculation table is located in Appendix C.																		

Section II. Tactics, Techniques, and Procedures

A-10. FIRE CONTROL FUNDAMENTALS

Fire control is the name given to the observations, calculations, and actions involved in firing a weapon. Fire control is the method of directing munitions so they will **hit the target** with a minimum expenditure of ammunition.

a. Most gun systems contain the same basic elements. The line of sight is the direction from the gun to the target. The line of aim is offset from the LOS by an amount determined by the following:

- Target motion.
- Helicopter motion.
- Range to target.
- Projectile drop.
- Wind effects.
- Projectile and gun characteristics.

b. The muzzle of the weapon must be aimed so that when the weapon is fired, the projectile will hit the target. The gunner must estimate all the factors that determine the amount of compensation required. He estimates range and lead for an initial burst and corrects for elevation and deflection by adjusting the rounds on target. This techniques is known as applying "burst on target". The ballistic factors for door guns (flexible mode) are covered in Chapter 4 of this manual.

A-11. RANGE ESTIMATION

Range estimation is covered in Chapter 6. Door gunners will normally use the recognition method for range estimation. When the door gunner uses the recognition method, the following factors effect the accuracy of the range estimation process.

a. Objects seem closer when:

- Viewed from altitude.
- Looking down a straight road or railroad track.
- Objects are in bright light.
- Looking over smooth terrain.
- Color of object contrasts sharply with color of background.

b. Objects seem farther away when:

- Looking from low altitude to higher terrain.
- Looking over rough terrain.
- There is poor light or fog.
- Only a small part of the object can be seen.

A-12. WEAPON ENGAGEMENT RANGE

a. The maximum range of the M60 machine gun with the 7.62mm round is 3,725 meters. Maximum range means that, with the necessary elevation applied to the weapon with standard ball ammunition over "flat earth," the projectile should travel 3,725 meters.

b. The maximum effective range of the M60D is published as 1,100 meters. The planning maximum effective range is 900 meters, based on probabilities of hit and tracer burnout.

A-13. FIRING TECHNIQUES

a. The door gunner must understand the challenges of firing a machine gun from a helicopter in flight. These challenges include variable airspeeds, ranges, firing angles, and ballistics. Some of these complexities, as compared to a ground gunner, are explained below.

(1) The door gunner's firing platform is normally moving; the ground gunner usually fires from a stationary platform.

(2) The door gunner normally has only his eyes to estimate range. The ground gunner can use range finders, maps, or known ground reference points to more easily determine range.

(3) The door gunner is usually autonomous regarding fire control and ammunition conservation. The ground gunner receives fire control instructions from his section leader and ammunition conservation assistance from the assistant gunner.

b. Range estimation is the door gunner's first consideration when preparing to fire at a target. Door gunners must be able to estimate range quickly and accurately and should practice range estimation throughout their training.

c. Proper aim points for target engagement from a moving helicopter vary with airspeed, altitude, bank angle, and rate of turn.

(1) As a rule of thumb, the point of aim is to the near side of the target (the side of the target closest to the firer). Aim point is, in part, due to the motion of the aircraft and the effects of projectile drift that carry the bullet forward.

(2) Another accepted method of initial target engagement is to aim low when firing from the left side of the aircraft and to aim high when firing from the right side. Bank angles, approach angles, turns, and other aircraft motion will also be factors in aiming the weapon and placing effective fire on a target (see Figure A-9).

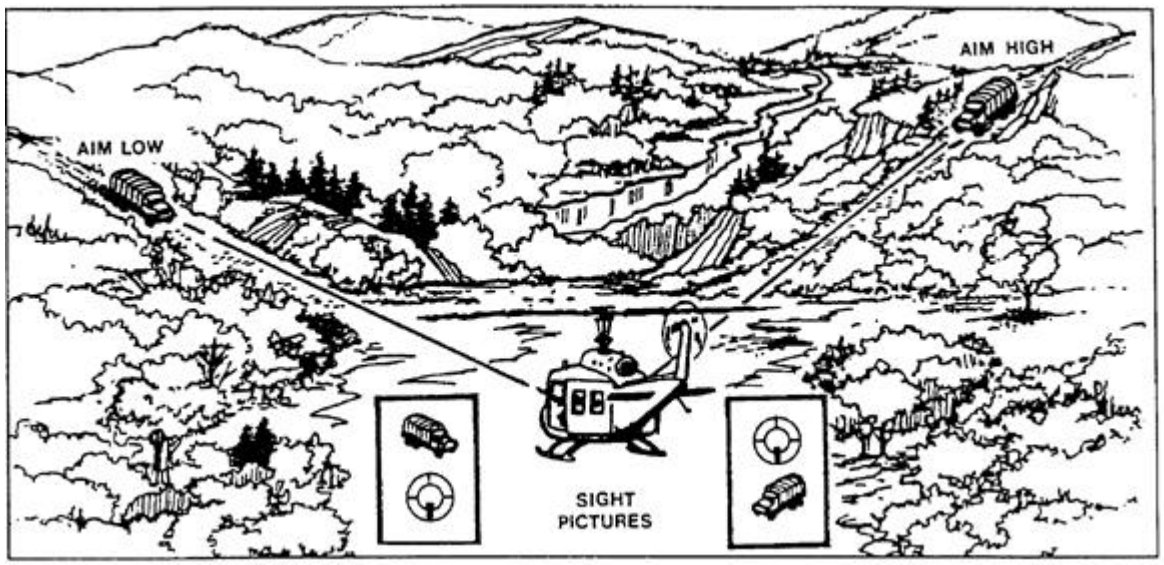


Figure A-9. Aiming points

A-14. FIRE ADJUSTMENT

a. Observation and adjustment of fire must be continuous throughout the engagement. Initial delivery of long bursts will normally help the gunner adjust the subsequent bursts.

b. For moving targets or targets that are likely to move (vehicles or personnel) the gunner must try to anticipate movement (or quickly react to the movement) and shift fire in the direction of the movement.

c. The use of 4 to 1 (ball/tracer) ammunition will normally provide enough tracers for positive adjustment of fire. At engagement ranges beyond tracer burnout, other factors must be considered. Tracer burnout of 7.62 mm ammunition is approximately 900 meters. At ranges beyond 900 meters, the firer could observe tracer burnout and believe that he aimed low when, in reality, the projectile continued along its trajectory and struck beyond the target.

d. The M60D machine gun has a tendency to climb when firing. Caution must be exercised to prevent this tendency. A climbing muzzle could reach an angle where other aircraft, or even the main rotor blades of the firing aircraft, could be hit.

e. When firing with the M60D, placing the horizontal cross hair and front sight blade on line with the target corrects for bullet drop at ranges up to 750 meters. The weapon must be aimed higher at ranges beyond 750 meters.

f. When correcting for lead effect, the gunner must align the target, front sight blade, and the approximate point on the horizontal cross hair. This alignment is only an estimated point of aim since aircraft speed and/or movement will make accurate aiming difficult. When firing from the right side of the helicopter, the gunner will use the right hand section of the sighting rings according to target location and aircraft speed. When firing from the left side of the helicopter the gunner will use the left side of the sighting rings. Refer to Figures A-10 and A-11 for more information on the lead effect.

A-15. OVERVIEW

a. This section describes the tactics, techniques and procedures for planning and conducting multihelicopter door gunnery operations. It is designed for use in establishing M60D multihelicopter door gunnery training programs in aviation units assigned utility or cargo helicopters.

b. This section is applicable to commanders, platoon leaders, crew members, and nonrated crew members of aviation units who conduct air movement and air assault missions. It is not intended to replace aviation unit door gunnery training manuals or SOPs. It provides planning and training requirements for aerial door gunnery that are not in doctrinal publications or ATMs.

c. The TTP applies to the UH-1, UH-60, and CH-47 helicopters. However, these principles are applicable to all aviation units that conduct multihelicopter air movement and air assault operations.

A-16. MULTIHELICOPTER DOOR GUNNERY

Multihelicopter door gunnery consists of the techniques used to acquire and engage targets from helicopters flying in formation at terrain flight altitudes.

a. Aircrews and door gunners in the formation must use effective crew coordination procedures to visually acquire, identify and engage targets. Both aircraft and passengers are vulnerable to attack during air movement operations and throughout all phases of air assault operations. Therefore, it is imperative that door gunners respond by delivering direct and indirect fires on these targets. This section discusses crew coordination procedures, gunner employment, and firing techniques to be used during multihelicopter operations.

b. ***Prerequisites.*** Before conducting multihelicopter door gunnery, the aircrews and door gunners must be qualified in the techniques and skills of basic door gunnery and they must complete crew qualification, Table VIII, according to this appendix.

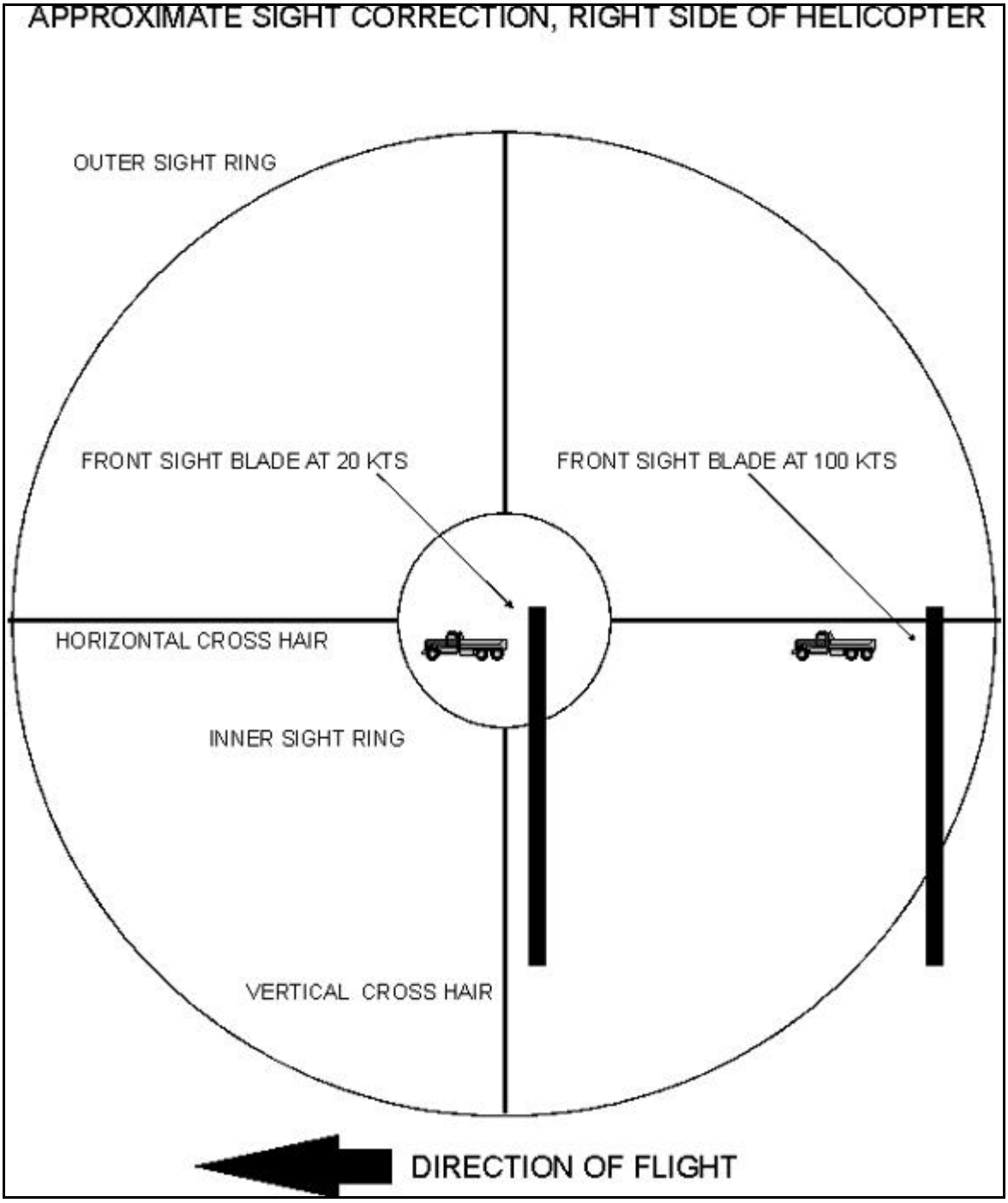


Figure A-10. Sight picture, right side of aircraft

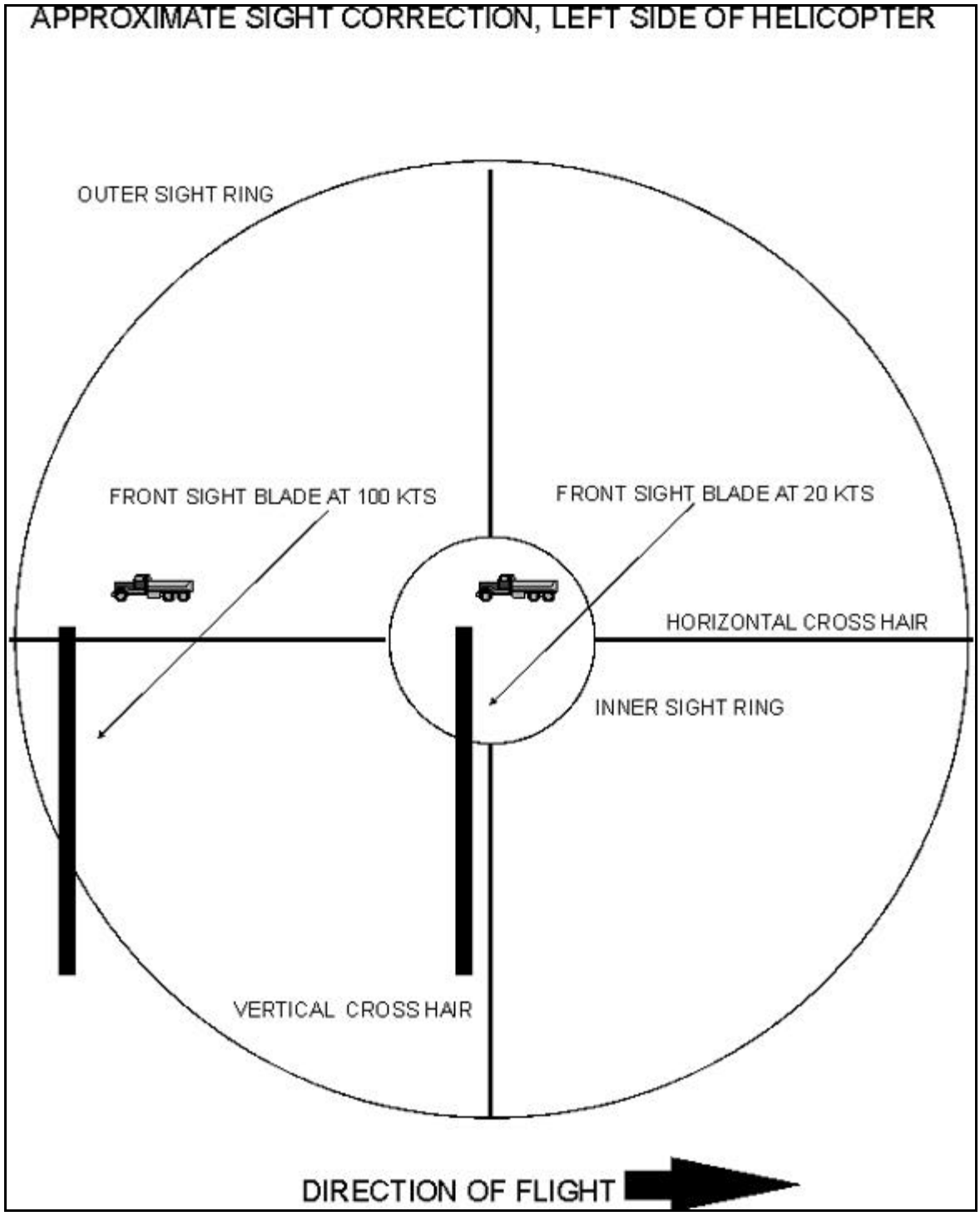


Figure A-11. Sight picture, left side of aircraft

Section III. Advanced Table Tactics, Techniques, and Procedures

A-17. CREW COORDINATION

a. ***Aircrew Duties*****.** Before departing on a mission, the pilot-in-command must orient his crew on the situation and the mission. This orientation will include the friendly situation, rules of engagement, possible target areas, fire commands, the location of emergency medical and survival equipment, and other available information essential to mission success.

b. ***Coordination Between Aircraft.*** Detailed procedures for communicating during live-fire (training and combat) will be standardized and specified by the unit SOP. Crew members must clearly understand one another. In addition, positive communication between aircrews must specify commence fire and cease fire procedures and firing azimuths of overlapping or sector fires for the flight. For example, lead calls formation "cease fire" upon landing in LZ.

A-18. DOOR GUNNER EMPLOYMENT IN FORMATION

a. ***Sectors of Fire*****.** A sector of fire is an area to be covered by fire that is assigned to an individual, a weapon, an aircraft, or a unit. Door gunners are normally assigned two sectors of fire: a primary sector and a secondary sector. Door gunners must know the traversing limits and the definitions that apply when calculating sectors of fire in formation. Traversing limits are addressed in the aircraft operators manual.

b. ***Definitions*****.**

(1) ***Inboard gunner*****.** Gunner whose position is on the inboard side of a formation and usually has another aircraft in his field of fire. Figures A-12 through A-16 show examples of inboard gunner positions.

(2) ***Outboard gunner*****.** Gunner whose position is on the outboard side of a formation that does not have another aircraft in his field of fire. Figure A-12 through A-16 show examples of outboard gunner positions.

(3) ***The safety limit.*** An imaginary line from the gunner's position to a point in space that is no closer than two rotor diameters (day) and three rotor diameters (night) from another aircraft.

(4) ***Permissible sector of fire*****.** The sector of fire of the door gunner that is limited by the traversing limits of the weapon system or by the amount of deflection he can traverse based upon the safety limit or any other factors (such as friendly troops or equipment) that prevent him from firing toward another aircraft in the formation. For safety reasons, the door gunner should not fire any closer than a lateral distance of two rotor diameters (day safety limit) and three rotor diameters (night safety limit) from another aircraft. This distance will be determined by the gunner. However, the figures in this section show the approximate angles for the sectors of fire for different aircraft when allowing for the safety limit. The permissible sectors of fire will

constantly change due to changes in position of aircraft during formation flying.

A-19. FORMATION CONSIDERATIONS

a. Multihelicopter door gunnery training operations should be performed with a minimum of two aircraft and maximum of five aircraft in formation.

b. Aircrews conducting formation flight must do so with an extreme sense of responsibility and with constant vigilance. The employment of door gunners in formation adds another responsibility to the entire aircrew. In addition to being concerned with separation from other aircraft they must concentrate on permissible sectors of fire and when firing can commence and when it must cease. Any aspect of formation flying while employing door gunners can be fatal if principles are violated.

(1) ***Aerodynamic interference*****.** Aircrews, especially door gunners, should anticipate aerodynamic interference between helicopters during formation flight. Aircrews flying trailing aircraft may encounter wake turbulence if they permit their aircraft to get below leading aircraft. Flight in the turbulent air may result in rapid attitude (pitch), roll, and yaw changes. Power may also have to be increased to maintain a proper position in a formation. Door gunners must be aware of the possibility of aerodynamic interference.

(2) ***Aircraft separation*****.** The distance between helicopters or formations of helicopters can be greatly increased to fit the tactical situation. At higher altitude, helicopters should be positioned far enough apart to prevent a burst of antiaircraft fire from destroying the entire flight. At terrain flight altitudes, aircraft may be spread out to take advantage of the terrain. Additionally, flying loose and extended formations are less fatiguing to the pilot than flying close formations. Door gunners must be familiar with the techniques for maintaining proper aircraft separation. Understanding these techniques will aid door gunners in determining their permissible sectors of fire while in formation.

(3) ***Aircraft maneuvering*****.** An aircraft is normally maneuvered with primary reference to only one other aircraft in the formation. The constant effort required to detect any change in altitude, airspeed, or heading of the reference aircraft precludes watching aircraft other than the reference aircraft. If all aircraft guide correctly to their reference aircraft, then all aircraft have adequate distance and altitude separation for safe operation of the flight as well as door gunner employment. In those formations requiring a relative position to more than one aircraft (staggered trail), the aviator must use peripheral vision to the maximum, while concentrating on his reference aircraft. The pilots must also keep a constant mental picture of his door gunners' permissible sectors of fire as well as keeping track of locations of other aircraft in the formation. Gunners will also play a role in determining when they do and do not have permissible sectors of fire. It is possible for a gunner on one side of the aircraft to have a permissible sector of fire when the gunner(s) in another position(s) do not and vice versa.

(4) ***Maneuvers*****.** Aircrews that will be conducting formation flight must also be

familiar with the many different maneuvers normally associated with multihelicopter operations. They must be aware of how those maneuvers could change the permissible sectors of fire or in some cases restrict the gunners' fire altogether. Maneuvers they must be familiar with include:

- Formation takeoff.
- Formation turns.
- Formation changes en route.
- Rendezvous and join up.
- Tactical formation breakup.
- Formation landing.
- Night formation landing.
- Evasive actions.

The procedures for these maneuvers are explained in TC 1-201. The tasks, conditions and standards for some of the maneuvers, particularly evasive maneuvers, are found in the appropriate ATM for each aircraft.

(5) Listed below are commonly used formations and their permissible sectors of fire.

(a) ***Echelon left/right.*** This formation allows rapid deployment of the flank and allows unrestricted fires by outboard gunners in the lead and trail aircraft. It somewhat restricts suppressive fire by inboard gunners of lead and trail aircraft as well as the inboard and outboard gunners of other aircraft within the formation. Figure A-12 shows echelon left. Figure A-13 shows echelon right.

(b) ***Trail.*** Allows rapid deployment of forces to the flank; somewhat restricts fires by all gunners. Separation is two rotor disks during day and three rotor disks at night. Figures A-14 and A-15 show trail formations for day and night.

(c) ***Tactical free cruise.*** Free cruise is a technique that permits the wingman in a two-ship section or greater to freely maneuver in the zone extending 45 degrees on either side and to the rear of the leader's tail. Within the zone, the wingman may vary vertical separation, airspeed, and distance from the leader. The distance the wingman trails the leader varies and depends upon visibility and terrain. The wingman must maintain visual contact with the leader. However, he must exercise caution not to overtake the leader. The flexibility of free cruise enables the wingman to change his position behind the leader at will without radio communication. The wingman is able to choose his own flight path to avoid obstacles, use terrain to the maximum advantage, or to provide fires against known or suspected enemy positions. Free cruise is best

suited for tactical situations. This formation causes continuous changes in the permissible sectors of fire. Depending upon aircraft position in the flight, it sometimes allows unrestricted fires of gunners while restricting fires of other gunners within the formation. Figure A-16 shows tactical free cruise sectors of fire.

NOTE: Tactical free cruise is the most challenging formation for controlling fires from door gunners. Because of the constant change involved in the formation, employment of door gunners during free cruise requires a great deal of training and command and control.

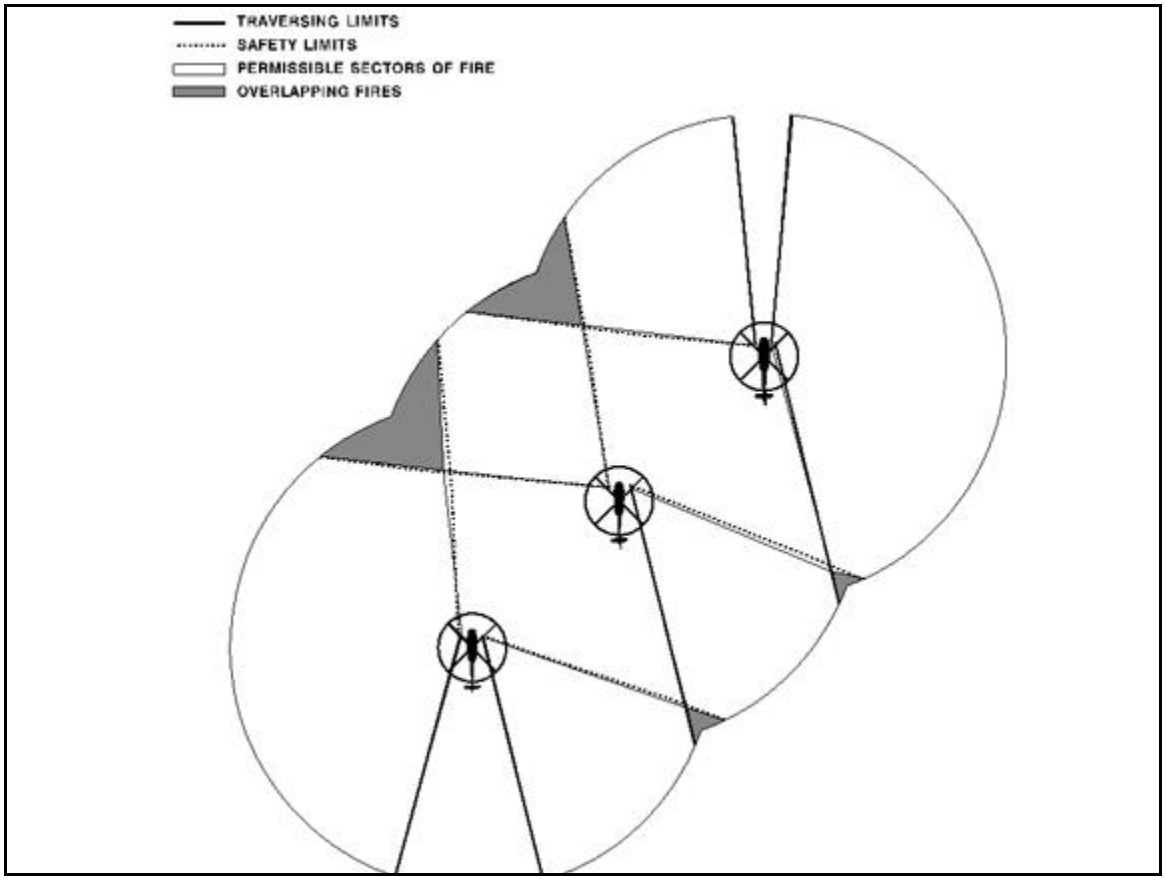


Figure A-12. Sectors of fire, echelon left

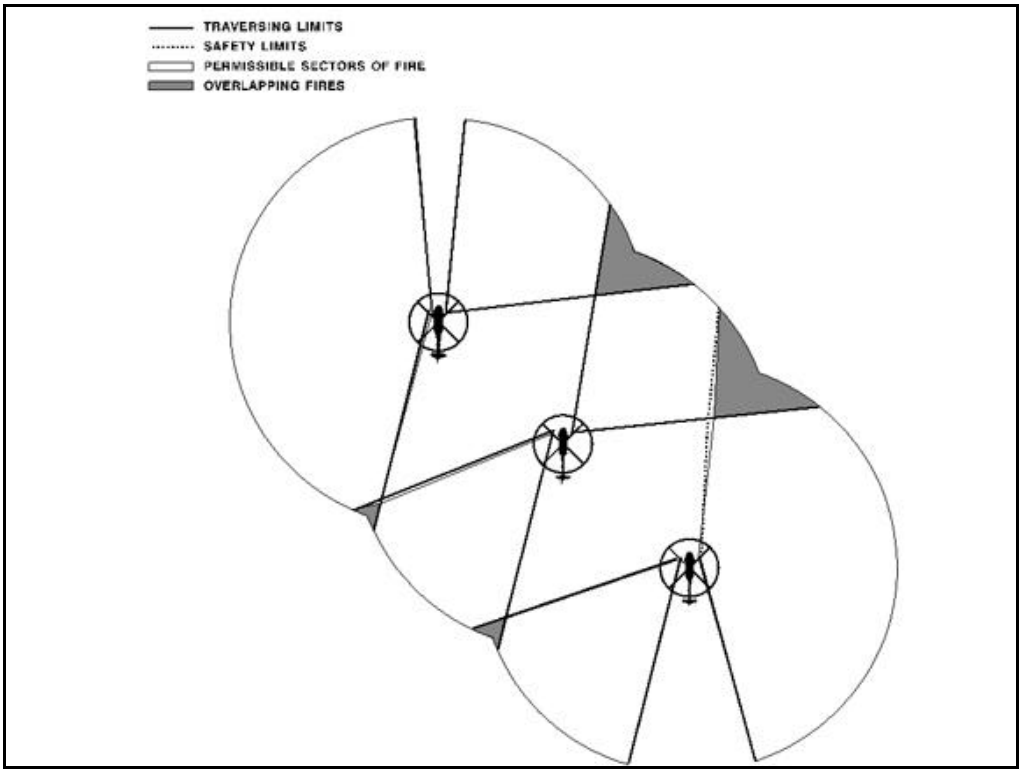


Figure A-13. Sectors of fire, echelon right

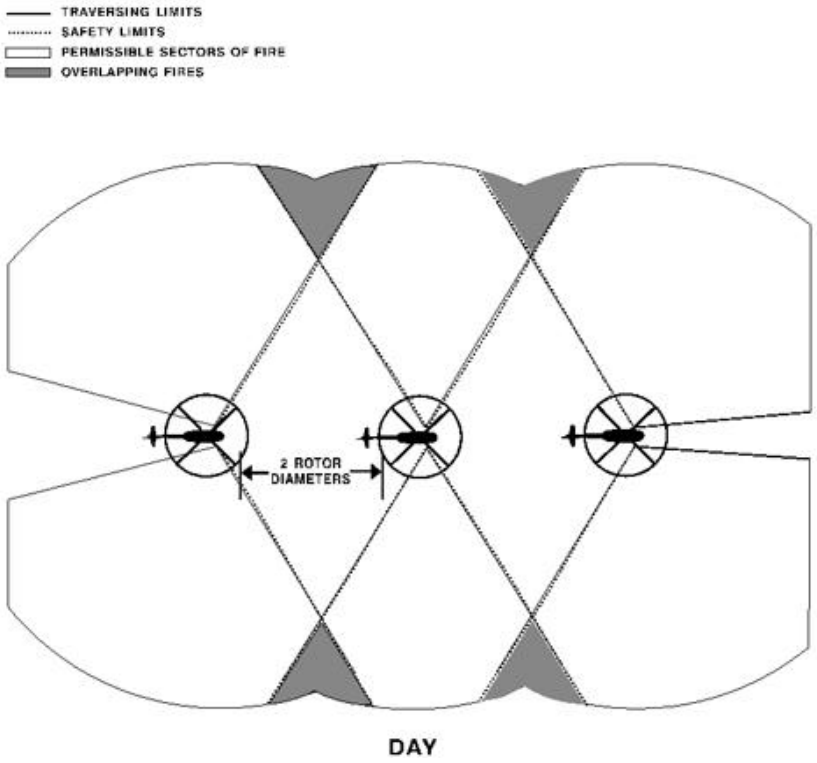


Figure A-14. Trail formation, day

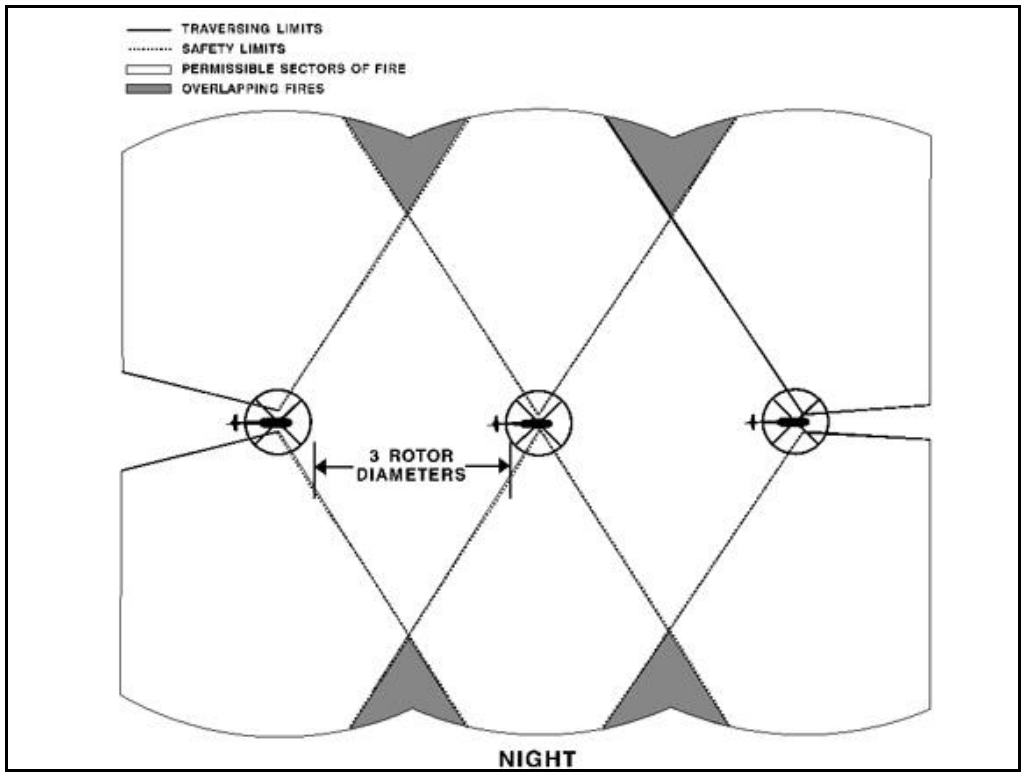


Figure A-15. Trail formation, night

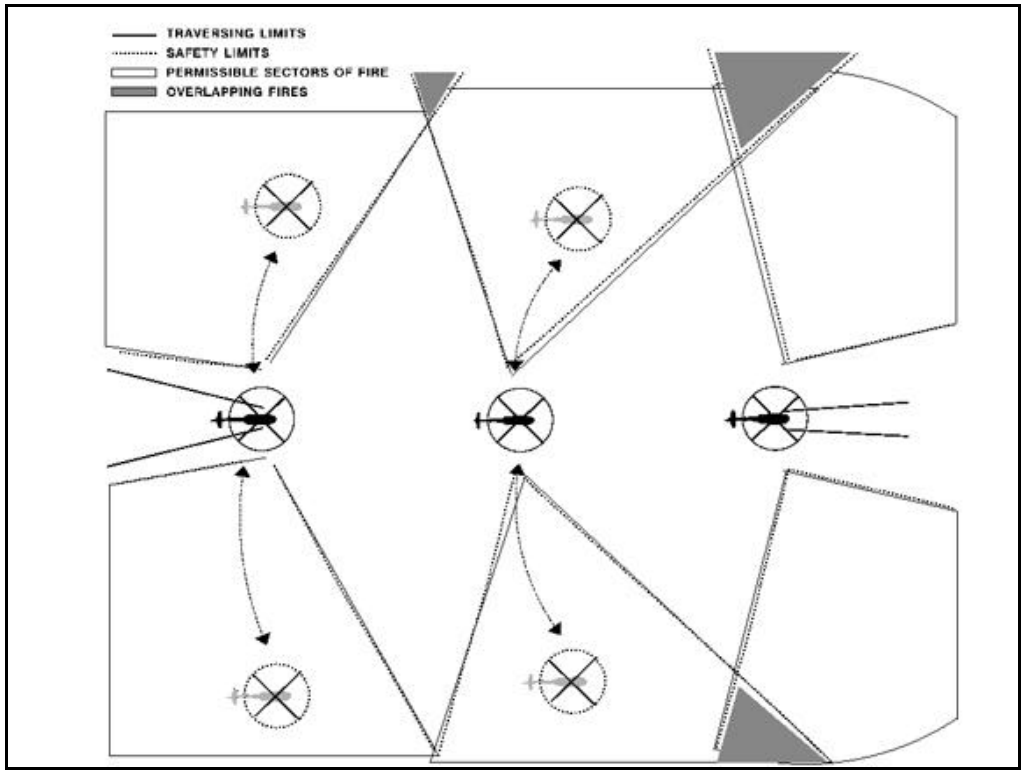


Figure A-16. Tactical free cruise

A-20. FIRING TECHNIQUES.

a. ***Fire Control Requirements.*** Fire control includes all actions of the aircrews in planning, preparing and actually applying fire on a target. These actions include:

- The ability to select and designate targets.
- Open fire at the instant desired.
- Adjust fire and regulate the rate of fire.
- Shift from one target to another.
- Overlap fires with other gunners.
- Cease fire.

Failure to exercise fire control results in ineffective employment of the weapon systems and can result in danger to friendly troops or aircraft. It also results in an inability to engage a threatening target; loss of surprise; premature disclosure of positions, fire on unimportant targets, loss of time in adjusting fire, and wasted ammunition

b. ***Target of Opportunity.*** The requirement for immediate fires arises from targets of opportunity or changes in the tactical situation. Immediate fire targets may be acquired by any door gunner(s) in the formation. However, all immediate fires require close coordination between other aircraft in the formation and, if the situation dictates, with the ground commander or his fire support coordinator.

c. ***Target Acquisition.*** Targets are acquired by all available means. Targets acquired by the aircrews are engaged and controlled under the direction of the pilot-in-command, pilot, air mission commander or with the ground commander to support the ground tactical plan. Engagement of targets acquired by other means will be according to existing directives or policies of the supported headquarters.

(1) Target identification under natural light conditions at night may be difficult. The factors of METT-T and the tactical situation (such as cross-FLOT) also apply to night operations. As with all operations, friendly positions must be positively known before commencing firing.

(2) ***Night acquisition.*** At night or during periods of low visibility, target acquisition becomes more difficult and crew responsibilities take on added importance. Proper crew training and knowledge of techniques available can turn the operation into an advantage for the door gunners. Aids to night target acquisition include--

(a) Artificial illumination.

(b) Night vision devices.

(c) ***Enemy fire.*** By spotting muzzle flashes or tracers, enemy fire may often be spotted from the air. However, the observer must rapidly pinpoint the muzzle flash or tracer location before it disappears.

d. *Principles of Application of Fire*. Application of fire consists of the methods crews use to get complete and effective coverage of a target area. Training in the methods of applying fire can be accomplished only after the aircrews and door gunners have learned to recognize the different types of targets they may find in combat, how to properly distribute, overlap and concentrate their fire, and how to maintain the proper rate of fire.

• ***Airspeeds 80 to 120 knots*.** Airspeeds en route should not exceed 120 knots if door gunners are to be employed. Airspeeds exceeding 120 knots can cause the M60D machine gun to be ineffective.

• ***Targets*.** The door gunner may have to engage a wide variety of targets during a mission. Suppression is a self-defense engagement and is intended to allow friendly helicopters to bypass the threat. Door gunners do not shoot at targets they do not intend to hit. Therefore, coordinated fires from all aircraft in the formation will enhance the probability of destroying the target.

• ***Overlapping fires.*** Gunners should initiate overlapping fires to provide the maximum fire available to destroy or suppress targets encountered en route.

(1) *Fires en route.* Techniques and procedures for engaging targets (for example, SA-14 team, observation post, small arms fire) en route will be specified by the unit to enhance mission security. Targets identified en route will be visible for a short duration therefore door gunners must be prepared to respond immediately to this threat.

(2) *Approach to landing*. Aircrews and troops are most vulnerable during landing. Therefore, procedures for gunners to coordinate and employ simultaneous fires must be developed.

(3) *On the ground*. Door gunners must fire without delay or continue firing to suppress or destroy targets while troops disembark.

(a) *During troop egress*. Procedures for gunners firing within the aft 75 degrees (UH-60) fan must be carefully developed to prevent fratricide. Situations may occur that require continued suppression while troops egress. Soldiers will have to egress toward the aft part of the helicopter and immediately take the prone position. This technique is potentially very dangerous. It takes a great deal of training and should be practiced during Table IX training.

(b) *Overlapping or sector fire*. After landing, enemy fires may be expected from any direction. Therefore, door gunners must use their discretion regarding fire control. To provide the most effective engagements techniques gunners should use overlapping fires or sector fires.

(4) *Departure*. Gunners must be trained according to FM 90-4 in troop dismounting and movement procedures from all aircraft landing formations. The gunner's ability to suppress targets is dependent upon troop actions and movements from aircraft in different formations. Depending on the threat in the

landing zone, door gunners may be required to continue suppression to assist the inserted soldiers while they organize their actions during the ground tactical plan.

Section IV. Advanced Tables and Range Training

A-21. TABLE IX

Table IX is the first opportunity for door gunners to participate in multiship door gunnery. Units will use Table IX to train the TTP necessary to progress to multiship live-fire. The commander selects the specific tasks he wants to train during Table IX. This table is the commanders training and assessment event prior to live-fire multiship door gunnery. Follow these guidelines when firing Table IX.

a. A maximum of 5 aircraft should participate in multiship door gunnery formations. The S3 and UT should select a route for the flight on which the door gunners can engage targets en route and in the LZ.

b. OPFOR should be available to engage the aircraft and provide targets for the door gunner. The OPFOR should be soldiers with infantry MILES equipment. The OPFOR must have weapons capable of engaging the aircraft.

c. The crews involved in exercise will be thoroughly briefed and will rehearse the mission.

d. Because the door gunners will not be shooting live mix ammunition, adjusting fires onto the targets may be difficult. This situation is unavoidable. The training value is in rehearsing formations and fire commands.

e. The objectives of the training are to--

(1) Allow units to refine fire discipline.

(2) Expose door gunners to multiship door gunnery.

(3) Exercise command and control with blanks.

(4) Train gunners to place fires on target.

(5) Uncover multiship door gunnery weaknesses within the unit.

A-22. TABLE X

Commanders conduct Table X at Combined Training Centers. Table X is the live-fire "graduation exercise" for unit door gunnery training.

a. The primary reason for firing Table X at a CTC is that the surface danger

area for a helicopter with two door gunners firing is almost 6,500 meters wide. Because of this fact, most units cannot conduct this training on their home station range. However, if commanders have the resources and adequate range facilities they can fire Table X at their home station.

b. Commanders will use the same premission planning procedures, with additional emphasis on safety, for Table X as for Table IX.

c. The CTC will dictate the scenario, but it will have the following characteristics:

(1) OPFOR en route and in the LZ.

(2) No troops onboard the aircraft--crew only.

(3) Maximum of five aircraft in the formation.

(4) For initial live-fire, trail is the mandated formation

d. Table IX must be completed no earlier than 180 days prior to the conduct of Table X.

e. The unit commander must decide whether his unit is ready for live-fire. A thorough risk assessment must be completed prior to the exercise.

A-23. GUIDES FOR SUCCESSFUL TRAINING

Units must thoroughly prepare for door gunner qualification ranges. The following are recommendations for range training:

a. Pilots must practice the flight profiles required by the tables prior to the range. Running fire and takeoff will present the greatest challenge to the pilot. In addition, the helicopter should hover only high enough to give the door gunner intervisibility with the target. Extremely high hovers present unrealistic training for the door gunner.

b. Engagement timing is very important. To make the timing objective:

(1) Make sure the pilot of the firing aircraft is ready prior to target presentation.

(2) Make sure the soldiers timing the engagements practice the calls to the firing aircrew and timing sequences to ensure uniform scoring.

(3) Make sure the pilots understand the required flight profile for the

engagement.

c. Refer to the running fire diagram in Chapter 2. Adopt this method to door gunner running fire. The running fire engagement must start and stop at the same point for all qualifying door gunners. In addition, the door gunner must have intervisibility with the target during the running engagement.

d. The AWSS may be used in the near future for door gunnery scoring. At the time of publication of this manual, the AWSS is undergoing testing to determine its ability to score door gunnery. Until the AWSS is the standard for door gunnery, door gunners must qualify on MPRCs or other ranges that can objectively score target effect.

e. Targets.

(1) Door gunners must engage both troop and vehicle targets during qualification. The recommended vehicle targets are BMP silhouettes. For troop targets, units have several options.

(2) Figures A-17 and A-18 show the proper use of 3D and "E" silhouettes on the door gunnery range. TC 25-8 contains the dimensions of the targets.

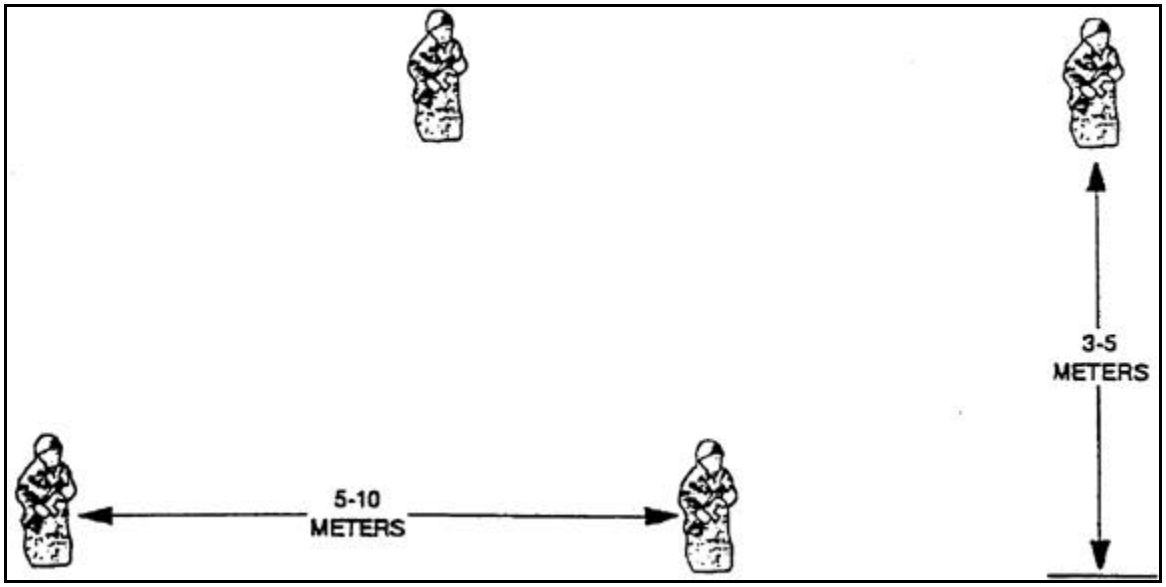


Figure A-17. Troop target with 3D silhouettes

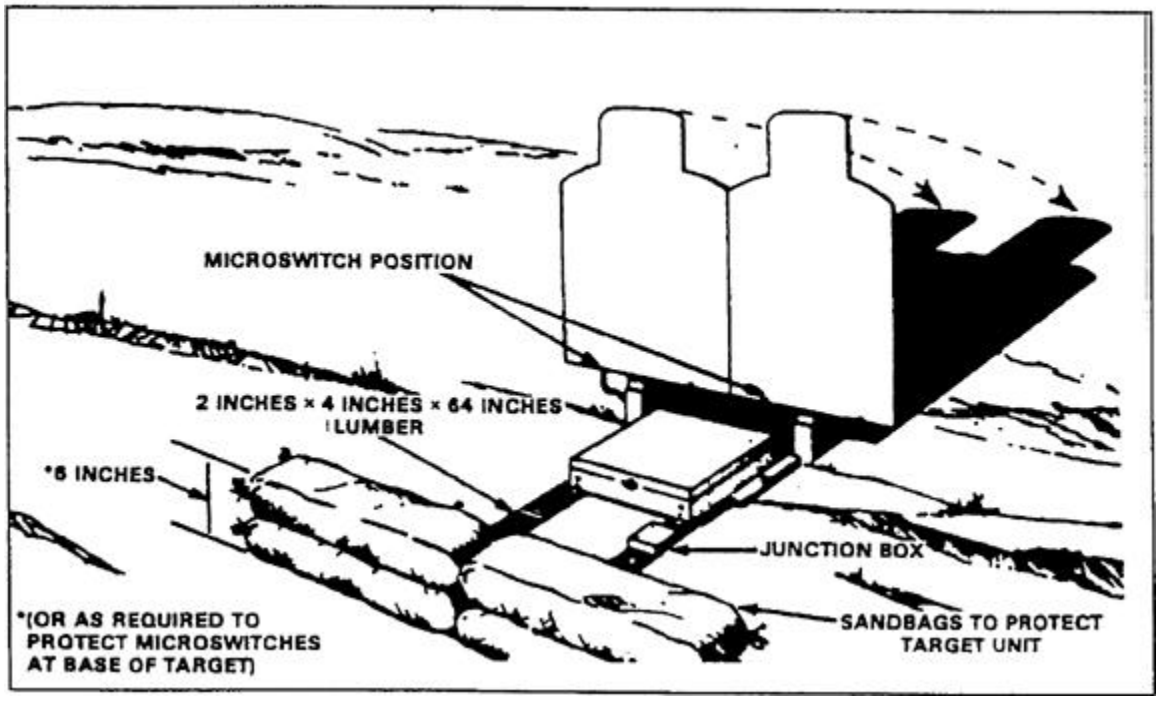


Figure A-18. Target lifter with troop silhouettes

APPENDIX B

HELICOPTER GUNNERY TABLES

Section I. Gunnery Table Overview

B-1. INTRODUCTION

a. The gunnery tables in this appendix provide the framework for helicopter gunnery range training and evaluation. They are designed to develop and test the proficiency of individual, crew, and unit gunnery techniques at the basic, intermediate, and advanced levels. Commanders may vary the engagement sequences, conditions, and target arrays within the tables to meet mission training requirements or to fit resource constraints such as range layout.

b. Modified tables must be no less demanding than those in this appendix, and such modifications will be temporary. Commanders must work continuously with installation or regional range authorities to upgrade and improve gunnery ranges so the tables can be conducted as prescribed.

c. Commanders may modify the engagement task modes to fit unit METL. However, a minimum of five engagements per table should be conducted from a hover.

B-2. TARGETS

a. The tables in this appendix specify the targets suitable for each engagement task. These targets include heavy armor, light armor, wheeled vehicles, and troops.

b. TC 25-8 depicts standard target silhouettes for range training. The following are the approved targets for the tables in this appendix.

(1) ***Heavy armor*****.** T-72 front or flank target.

(2) ***Light armo*****r.** BMP 1981, BRDM, ZSU 23-4, BMD, or BTR-series targets (front or flank profiles).

(3) ***Wheeled vehicle*****.** U-375 truck front or flank target.

(4) ***Troops*****.** E-type or 3D personnel silhouettes. Three to four personnel silhouettes can be attached to a single target board or lifter for scoring. In addition, Section IV, Appendix A shows other options for personnel target scoring.

c. The commander will decide whether to use flank or frontal target silhouettes. This decision will most likely depend on target intervisibility, target lifters used, and range layout.

d. ***Rockets*****.** The condition for each rocket task specifies a target silhouette for the engagement. Portray the rocket TEA as a notional large target area (for example, an

assembly area) with the target silhouette located in the center, serving as the crew's aimpoint. The TEA is oriented with its long axis parallel to the firing helicopter's gun-target line.

B-3. TARGET ENGAGEMENTS

a. The target engagement ranges on the tables in this appendix are within the effective range of the weapons specified by the task.

b. Commanders may combine single table tasks into multiple engagements. Each individual task within a multiple task must be evaluated by its individual standard. For example, when combining single Hellfire and cannon engagement tasks, each task must be scored and timed separately, even though they may be occurring at the same time. No engagement time tables are available for multiple engagements, only single engagements.

B-4. AMMUNITION

a. Ammunition conservation is not evaluated, but is an implied task. In addition to stating the task, conditions, and standards for engagements, each Table VII and VIII task has a specific type and quantity of ammunition allocated. Commanders will insure that the proper type and quantity of ammunition is available for the conduct of tables.

b. The ammunition used to execute the crew's first attempt at Table VII or VIII will not exceed the total table allocation. Crews must manage their ammunition carefully to ensure they have enough ammunition for each task.

c. Crews are allowed to exceed the ammunition allocation for a task, but are not given additional ammunition to make up for that ammunition. If a crew uses more than the allocated ammunition on a task and does not have enough ammunition to execute the remaining tasks, no credit will be given for the nonfired tasks. Incomplete or nonfired tasks will be executed during the rerun or refire portion of that crew's training.

d. For example, an AH-64 crew is authorized a total of 100 30mm rounds for the three 30mm tasks in Table VIII Day. If the crew only used a total of 20 rounds to qualify on their first two 30mm tasks, they could use the remaining 80 rounds for their last 30mm engagement. While the crew could shoot their remaining rounds during their last engagement, the time standard would not increase, and would remain the same as if they had only the 40 rounds prescribed by the task to fire.

e. The ammunition allocations serve as planning factors for the conduct of the gunnery tables. They allow the commander to assess resources required for each gunnery table. In addition, the allocations show individual crews the maximum amount of ammunition available for them to engage the table's targets. In addition, the ammunition allocation serves as a guide for Q2 and Q3 engagements when crews must reshoot a specific task.

B-5. TABLE VI

a. Execute Table VI during daylight hours.

b. Check all systems, shooting and sighting, on the helicopter.

c. Execute this table under the supervision of the unit armament and maintenance officers.

B-6. EVALUATION

a. There are no degraded mode gunnery tasks on tables VI, VII, or VIII. The commander should mandate the use of the most accurate sighting system on the helicopter for intermediate gunnery tables unless otherwise specified.

b. Score the tables according to the guidance in chapter 2 of this manual.

c. ***AH-64.***

(1) Table VII Day/Night and VIII Day/Night consist of 10 engagement tasks each.

(2) Swing Tasks.

(a) A "swing task" is one that can be fired day or night. Tables VII and VIII include two rocket swing tasks. These two engagements are a long-range MPSM rocket engagement and a medium-range PD rocket engagement. The commander has the latitude to choose which table, day or night, will include the MPSM engagement. The PD engagement will be added to the other table, giving each day and night table three rocket engagements each.

(b) For example, the commander decides that, due to environmental conditions, the Table VII long-range MPSM engagement should be fired during daylight hours. The three Table VII Day rocket engagements would include a short- and medium-range PD rocket engagement, and a long-range MPSM rocket engagement. Because the commander chose the MPSM engagement for the day table, Table VII Night would include one short-range PD rocket engagement and two medium-range PD rocket engagement.

(c) Commanders should maintain consistency between Tables VII and VIII. If the MPSM engagement is chosen for Table VII Day, the MPSM engagement for Table VIII should be fired during the daylight portion of the table.

(2) Combined Engagements. Tables VII and VIII feature a combined Hellfire missile and cannon engagement. This engagement is designed to evaluate the coordination of the crew during a simultaneous engagement. The standard for the conduct of the table is for the CPG to conduct the remote missile engagement, and the pilot to conduct the cannon engagement using IHADSS as the sight.

(3) Dynamic Harmonization. The dynamic harmonization procedure is included for units not equipped with upgraded FCC software featuring built-in harmonization capability.

d. ***AH-1.***

(1) Diving fire is not mandated for evaluation in Tables VII or VIII. Commanders may include diving fire in these tables based on unit METL. If not included in the evaluation strategy, diving fire tasks should be included for sustainment training only.

(2) Only one TOW missile is resourced per AH-1 for Tables I-XII. This live fire TOW missile is for Table VIII qualification. For other TOW engagements in the tables, evaluate crew TOW proficiency in the FWS if missiles for the tasks are unavailable. If the FWS is unavailable, delete the engagement from the table. If the unresourced TOW engagement is deleted, score the table on the following basis: to qualify, 6 of 9 engagements must be "GOs" and 630 points is the minimum number of points.

B-7. ALIBI FIRES

a. The unit commander or his designated representative is the deciding authority for alibis. Any aircraft system or subsystem malfunction not detectable by the crew before the engagement that adversely affects the performance of the selected weapon system will constitute an alibi. Malfunctions induced by crew error will not constitute an alibi.

b. TOW missile alibis may be fired in the FWS. The TOW missile is the only weapon in which the simulator can be used to complete an alibi.

B-8. ADVANCED TABLES

The advanced tables in this appendix are examples. The commander may modify them to support the unit METL and MTP. Each section includes advanced tables with both attack and cavalry scenarios.

a. Advanced tables are the commander's tables. Units progress to advanced tables once they have completed intermediate tables. **(Note:** Crews who fail Table VIII will not progress to advanced table training). Advanced tables allow the commander to evaluate his unit's ability to distribute fires and engage targets as a unit in a tactical scenario. Advanced tables are to platoons and companies what intermediate tables are to crews--training and evaluation.

b. The commander determines the tasks he wants to accomplish. The scenario should be built as a STX according to TC 1-210, and should support the unit METL and battle tasks. The scenario should evaluate all aspects of the firing unit and should not be merely an OE^2.

c. The S3 and master gunner must consider the physical dimensions of the assigned range complex when designing the scenario for advanced table live-fire. Providing realistic target arrays and tactical spacing between helicopters firing simultaneously will provide a planning challenge. The following is an example flow for a company Table XII.

(1) The evaluation starts at the assembly area. The crews receive an OPORD from the battalion staff and plan the mission. The company continues its planning process as it would during normal collective training missions. When the company planning is complete, the company conducts a rehearsal and briefback to the commander.

(2) When rehearsals and brief-backs are complete, the company starts the mission. The company moves along briefed air routes to the FARP, rearms/refuels, and continues to the battle position.

(3) Figure B-1 shows the initial occupation of the BP and engagement of long-range targets with missiles. The initial engagements are accomplished with missiles to simulate a deliberate attack. The standard is to hit all targets. Scoring is with onboard videotape or hits with live missiles.

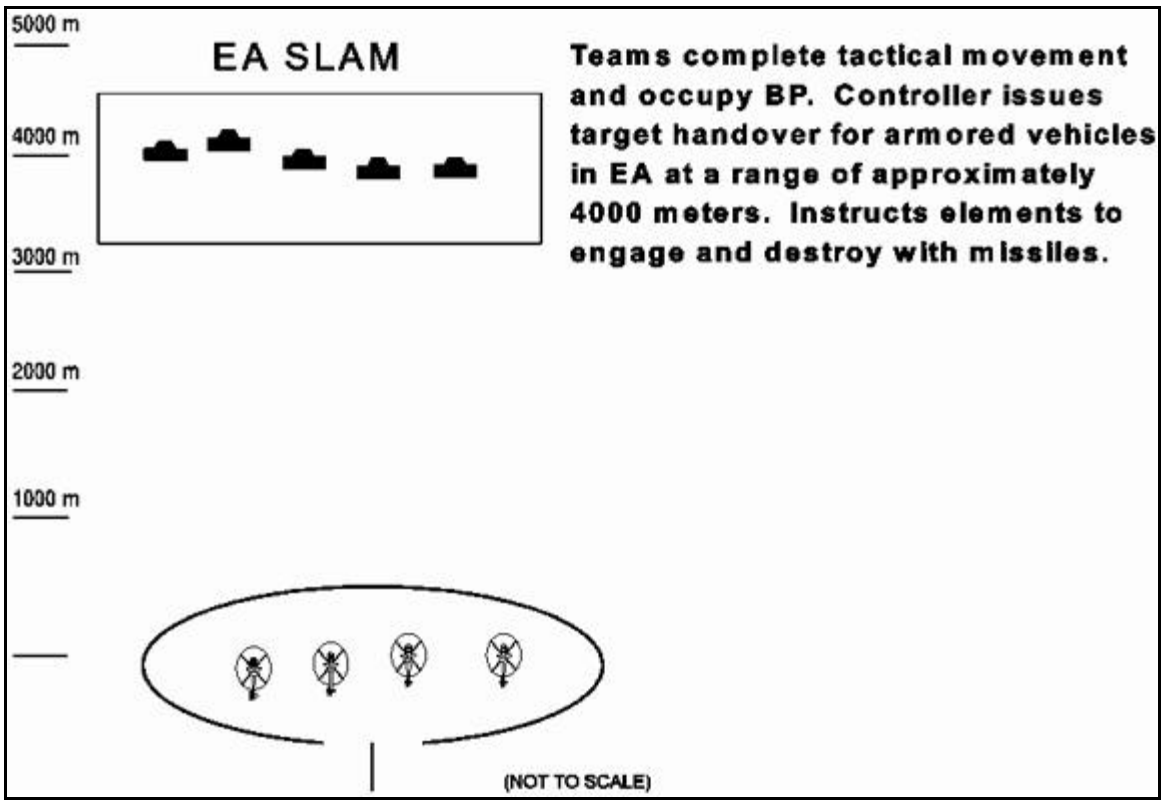


Figure B-1. Occupation of battle position

(4) Figure B-2 shows the company engaging short range cannon targets. Three to five minutes after the initial target handover for the missile engagements, present pop-up targets at approximately 1,000 meters. The standard is to hit all targets. Present at least two targets per aircraft.

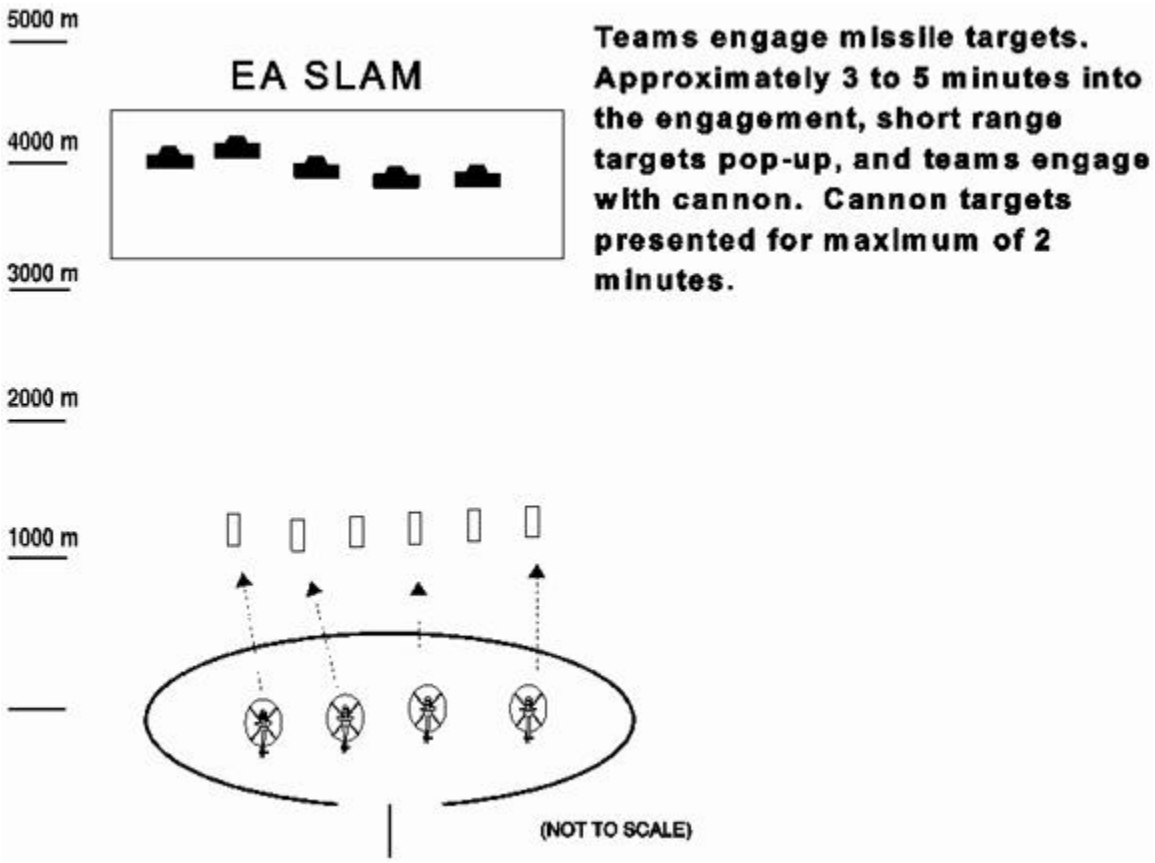


Figure B-2. Short range cannon engagements

(5) As depicted in Figure B-3, a simulated artillery battery opens fire during the cannon engagements. Use Hoffman charges to simulate the artillery battery. The teams will engage the target with rockets. Neutralization is the standard for this engagement.

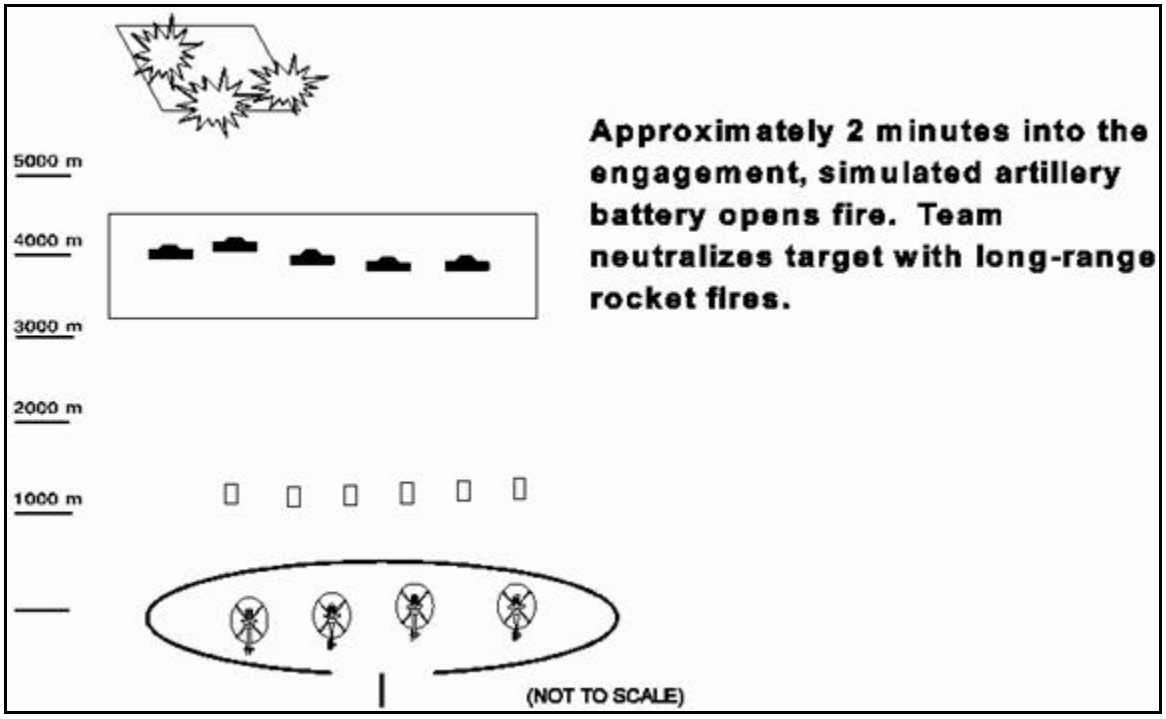


Figure B-3. Neutralization of artillery battery

(6) Once the rocket engagement is complete, the company departs the BP and returns to the FARP. Figure B-4 shows the company departing the BP.

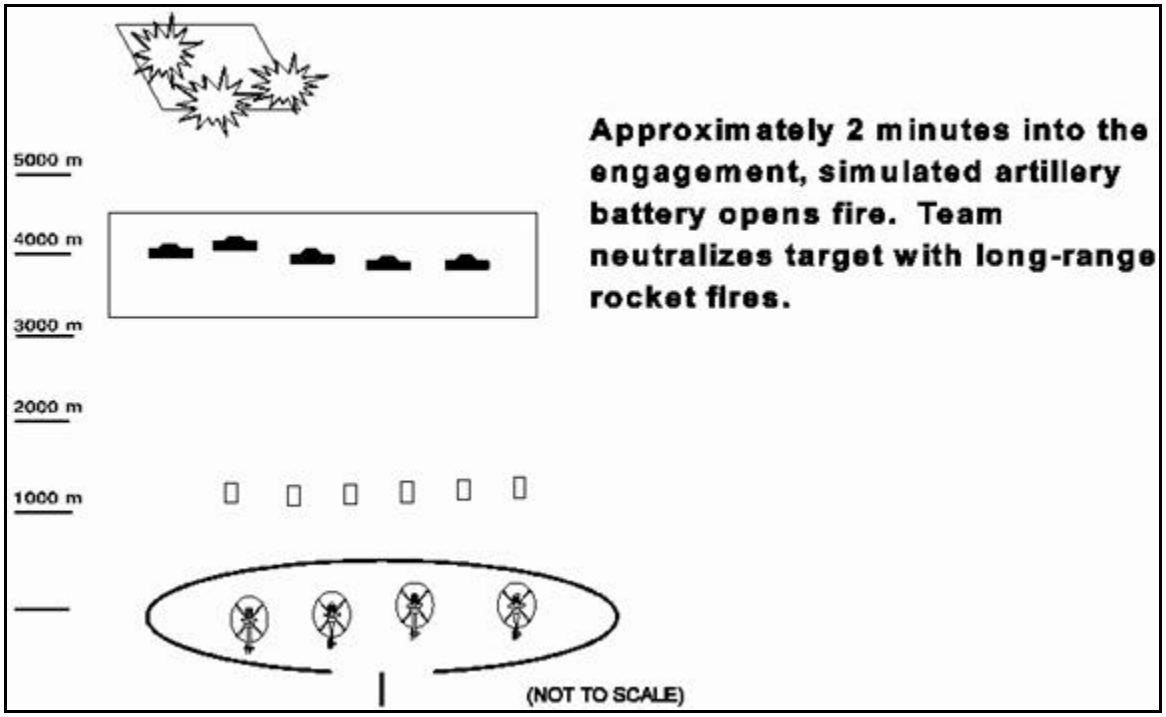


Figure B-4. Mission complete, depart BP

d. The performance of the units should be judged against each other. The standard should include fire distribution, target effect for each of the weapons, and movement techniques.

Section II. AH-64 Gunnery Tables

Units assigned AH-64 aircraft will use the gunnery tables in this section.

TABLE I. DAY AH-64 INITIAL TRANSITION/QUALIFICATION (PILOT)						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE I. NIGHT AH-64 INITIAL TRANSITION/QUALIFICATION (PILOT)						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE II. DAY AH-64 INITIAL TRANSITION/QUALIFICATION (CPG)						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE II. NIGHT AH-64 INITIAL TRANSITION/QUALIFICATION (CPG)						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE III. DAY AH-64 COMMANDER'S EVALUATION TABLE (PILOT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	LIGHT ARMOR	2 RKTS IN 300 X 400m TEA	6 RKTS M274.
2	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
3	ENGAGE MOVING TARGET W/CANNON	HOVER	1000-1500m	WHEELED VEHICLE	HIT	30 RNDS
4	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
5	ENGAGE STATIONARY TARGET W/HELLFIRE	MOVING/ RUNNING	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
6	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	LIGHT ARMOR	HIT	30 RNDS
7	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	40 RNDS
9	ENGAGE MOVING TARGET W/HELLFIRE	MOVING/ RUNNING	<2000m	HEAVY ARMOR	HIT	1 HELLFIRE
10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	2 RKTS IN 300 X 400m TEA	6 RKTS M274

NOTES:
1. Table III is designed for use by unit IP/SP to determine individual proficiency and readiness level.
2. All rocket engagements will be fired as pairs.
3. Table is not resourced IAW DA PAM 350-38. Conduct in the CMS.

TABLE III. NIGHT AH-64 COMMANDER'S EVALUATION TABLE (PILOT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	LIGHT ARMOR	2 RKTS IN 300 X 400m TEA	6 RKTS M274
2	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
3	ENGAGE MOVING TARGET W/CANNON	HOVER	1000-1500m	WHEELED VEHICLE	HIT	30 RNDS
4	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
5	ENGAGE STATIONARY TARGET W/HELLFIRE	MOVING/ RUNNING	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
6	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	LIGHT ARMOR	HIT	30 RNDS
7	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	40 RNDS
9	ENGAGE MOVING TARGET W/HELLFIRE	MOVING/ RUNNING	<2000m	HEAVY ARMOR	HIT	1 HELLFIRE
10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	2 RKTS IN 300 X 400m TEA	6 RKTS M274

NOTES:

1. Table III is designed for use by unit IP/SP to determine individual proficiency and readiness level.
2. All rocket engagements will be fired as pairs.
3. Table is not resourced IAW DA PAM 350-38. Conduct in the CMS.

TABLE IV. DAY AH-64 COMMANDER'S EVALUATION TABLE (CPG)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	LIGHT ARMOR	2 RKTS IN 300 X 400m TEA	6 RKTS M274
2	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
3	ENGAGE MOVING TARGET W/CANNON	HOVER	1000-1500m	WHEELED VEHICLE	HIT	30 RNDS
4	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
5	ENGAGE STATIONARY TARGET W/HELLFIRE	MOVING/ RUNNING	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
6	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	LIGHT ARMOR	HIT	30 RNDS
7	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	40 RNDS
9	ENGAGE MOVING TARGET W/HELLFIRE	MOVING/ RUNNING	<2000m	HEAVY ARMOR	HIT	1 HELLFIRE
10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	2 RKTS IN 300 X 400m TEA	6 RKTS M274

NOTES:
1. Table IV is designed for use by unit IP/SP to determine individual proficiency and readiness level.
2. All rocket engagements will be fired as pairs.
3. Table is not resourced IAW DA PAM 350-38. Conduct in the CMS.

TABLE IV. NIGHT AH-64 COMMANDER'S EVALUATION TABLE (CPG)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	LIGHT ARMOR	2 RKTS IN 300 X 400m TEA	6 RKTS M274
2	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
3	ENGAGE MOVING TARGET W/CANNON	HOVER	1000-1500m	WHEELED VEHICLE	HIT	30 RNDS
4	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
5	ENGAGE STATIONARY TARGET W/HELLFIRE	MOVING/ RUNNING	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
6	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	LIGHT ARMOR	HIT	30 RNDS
7	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	40 RNDS
9	ENGAGE MOVING TARGET W/HELLFIRE	MOVING/ RUNNING	<2000m	HEAVY ARMOR	HIT	1 HELLFIRE
10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	2 RKTS IN 300 X 400m TEA	6 RKTS M274

NOTES:
1. Table IV is designed for use by unit IP/SP to determine individual proficiency and readiness level.
2. All rocket engagements will be fired as pairs.
3. Table is not resourced IAW DA PAM 350-38. Conduct in the CMS.

TABLE V. HELICOPTER GUNNERY SKILLS TEST		
TASK	**CONDITION**	**STANDARD**
Written test consisting of a minimum of 50 questions from the following subject areas: • Weapon Systems Operation/Firing Characteristics. • Ballistics • Delivery Techniques • Munitions: Identification/Function/Operation	Without reference to publications.	Minimum 70% correct.
Perform relevant tasks from the following areas: • Armament/Weapon Systems Preflight • Armament/Weapon Systems Switchology • Procedures for Hangfire/Misfire/Emergency Conditions Involving Armament Systems • Munitions Handling, Uploading/ Downloading	Demonstrate ability to perform or explain selected subject areas: Aircraft Simulator or Aircraft Simulator or Aircraft Aircraft with Training or Live Munitions	Overall GO/NO-GO is based on scorer's assessment.
Other requirements per Chapter 2, FM 1-140.		
NOTE: Some hands-on tasks are also ATM tasks. However, conduct these tasks as part of the HGST to confirm crew proficiency prior to live fire training/qualification.		

TABLE VI. AH-64 WEAPONS CALIBRATION/VERIFICATION

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**SIGHT**	**TGT EFFECT**	**AMMO**
1	CONDUCT AWS DYNAMIC HARMONIZATION	HOVER	1000m	TADS	REFER TO HARMONIZATION PROCEDURE	60 RNDS
2	OPERATE CANNON WITH TADS/LASER	HOVER	1000-1500m	TADS	HIT	30 RNDS
3	OPERATE CANNON WITH IHADSS (P)	HOVER	<1000m	IHADSS (P)	HIT	30 RNDS
4	OPERATE CANNON WITH IHADSS (G)	HOVER	<1000m	IHADSS (G)	HIT	30 RNDS
5	OPERATE ARCS	HOVER	3000-4000m	COOP	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	OPERATE ARCS	HOVER	>4000m	COOP	2 RKTS IN 300 X 400m TEA	6 RKTS M274
7	OPERATE PTWS	HOVER	2000-4000m	TADS	PROPER PRE/ POSTLAUNCH SYMBOLOGY	1 TRAINING MISSILE

NOTE:
This table is designed to verify weapon systems operation.

AMMUNITION:
12 RKTS M274
150 RNDS 30mm

TABLE VII. DAY AH-64 CREW TRAINING COURSE

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE MOVING TARGET W/HELLFIRE	HOVER	<2000m	HEAVY ARMOR	HIT	1 HELLFIRE
2	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	TROOPS	2 RKTS IN 300 X 400m TEA	6 RKTS M274
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000-1500m	LIGHT ARMOR	HIT	30 RNDS
4	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	ENGAGE MOVING TARGET W/ HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
7	ENGAGE STATIONARY TARGET W/HELLFIRE (REMOTE)	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	TROOPS	HIT	40 RNDS
9	ENGAGE MOVING TARGET W/CANNON	MOVING/ RUNNING	1000-1500m	WHEELED VEHICLE	HIT	30 RNDS
*10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	3 RKTS IN 300 X 400m TEA	8 RKTS M274
*10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	3 RKTS IN 300 X 400m TEA	8 RKTS M267

STANDARD:
Crew must achieve a GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table.

AMMUNITION:
12 RKTS M274
100 RNDS 30mm
Swing Tasks:
8 RKTS M274 or
8 RKTS M267

NOTES:
1. Engagements in Task 10 are "swing tasks." The commander may select one of the rocket engagements to fire on Table VII Day. The remaining task will be fired during Table VII Night.
2. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
3. Tasks 7 and 8 are combined to form a single engagement. The handover for 8 will be given immediately following the engagement 7 handover.
4. All rocket engagements will be fired as pairs.
5. Missiles in this table are not resourced IAW DA PAM 350-38. Training missiles should be used.

TABLE VII. NIGHT AH-64 CREW TRAINING COURSE

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE MOVING TARGET W/HELLFIRE	HOVER	<2000m	HEAVY ARMOR	HIT	1 HELLFIRE
2	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	TROOPS	2 RKTS IN 300 X 400m TEA	6 RKTS M274
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000-1500m	LIGHT ARMOR	HIT	40 RNDS
4	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	ENGAGE MOVING TARGET W/ HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
7	ENGAGE STATIONARY TARGET W/HELLFIRE (REMOTE)	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	TROOPS	HIT	30 RNDS
9	ENGAGE MOVING TARGET W/CANNON	MOVING/ RUNNING	1000-1500m	WHEELED VEHICLE	HIT	30 RNDS
*10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	3 RKTS IN 300 X 400m TEA	8 RKTS M274
*10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	3 RKTS IN 300 X 400m TEA	8 RKTS M267

STANDARD:
Crew must achieve a GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table.

AMMUNITION:
12 RKTS M274
100 RNDS 30mm
Swing Tasks:
8 RKTS M274 or
8 RKTS M267

NOTES:
1. Engagements in Task 10 are "swing tasks." The commander may select one of the rocket engagements to fire on Table VII Day. The remaining task will be fired during Table VII Night.
2. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
3. Tasks 7 and 8 are combined to form a single engagement. The handover for 8 will be given immediately following the engagement 7 handover.
4. All rocket engagements will be fired as pairs.
5. Missiles in this table are not resourced IAW DA PAM 350-38. Training missiles should be used.

TABLE VIII. DAY AH-64 CREW QUALIFICATION COURSE

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE MOVING TARGET W/HELLFIRE	HOVER	<2000m	HEAVY ARMOR	HIT	1 HELLFIRE
2	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	TROOPS	2 RKTS IN 300 X 400m TEA	6 RKTS M274
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000-1500m	LIGHT ARMOR	HIT	30 RNDS
4	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	ENGAGE MOVING TARGET W/ HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
7	ENGAGE STATIONARY TARGET W/HELLFIRE (REMOTE)	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	TROOPS	HIT	40 RNDS
9	ENGAGE MOVING TARGET W/CANNON	MOVING/ RUNNING	1000-1500m	WHEELED VEHICLE	HIT	30 RNDS
*10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	3 RKTS IN 300 X 400m TEA	8 RKTS M274
*10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	3 RKTS IN 300 X 400m TEA	8 RKTS M267

STANDARD:
Crew must achieve a GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table.

AMMUNITION:
12 RKTS M274
100 RNDS 30mm
Swing Tasks:
8 RKTS M274 or
8 RKTS M267

NOTES:
1. Engagements in Task 10 are "swing tasks." The commander may select one of the rocket engagements to fire on Table VIII Day. The remaining task will be fired during Table VIII Night.
2. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
3. Tasks 7 and 8 are combined to form a single engagement. The handover for 8 will be given immediately following the engagement 7 handover.
4. All rocket engagements will be fired as pairs.
5. Missiles in this table are not resourced IAW DA PAM 350-38. Training missiles should be used.

TABLE VIII. NIGHT AH-64 CREW QUALIFICATION COURSE

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE MOVING TARGET W/HELLFIRE	HOVER	<2000m	HEAVY ARMOR	HIT	1 HELLFIRE
2	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	TROOPS	2 RKTS IN 300 X 400m TEA	6 RKTS M274
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000-1500m	LIGHT ARMOR	HIT	30 RNDS
4	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	ENGAGE MOVING TARGET W/ HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
7	ENGAGE STATIONARY TARGET W/HELLFIRE (REMOTE)	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	TROOPS	HIT	40 RNDS
9	ENGAGE MOVING TARGET W/CANNON	MOVING/ RUNNING	1000-1500m	WHEELED VEHICLE	HIT	30 RNDS
*10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	3 RKTS IN 300 X 400m TEA	8 RKTS M274
*10	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	3 RKTS IN 300 X 400m TEA	8 RKTS M267

STANDARD:
Crew must achieve a GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table.

AMMUNITION:
12 RKTS M274
100 RNDS 30mm
Swing Tasks:
8 RKTS M274 or
8 RKTS M267

NOTES:
1. Engagements in Task 10 are "swing tasks." The commander may select one of the rocket engagements to fire on Table VIII Day. The remaining task will be fired during Table VIII Night.
2. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
3. Tasks 7 and 8 are combined to form a single engagement. The handover for 8 will be given immediately following the engagement 7 handover.
4. All rocket engagements will be fired as pairs.
5. Missiles in this table are not resourced IAW DA PAM 350-38. Training missiles should be used.

TABLE IX. DAY/NIGHT AH-64 ADVANCED TRAINING COURSE (TEAM/PLT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ACFT 1 ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
	ACFT 2 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS M274
2	ACFT 1 ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	TROOPS	HIT	30 RNDS
	ACFT 2 ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000- 1500m	WHEELED VEHICLE	HIT	30 RNDS
3	ACFT 1 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS M274
	ACFT 2 ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
4	ACFT 1 ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000- 1500m	WHEELED VEHICLE	HIT	30 RNDS
	ACFT 2 ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	TROOPS	HIT	30 RNDS
5	ACFT 1 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000- 4000m	WHEELED VEHICLE	1 RKTS IN 300 X 400m TEA	4 RKTS M274
	ACFT 2 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000- 4000m	WHEELED VEHICLE	1 RKTS IN 300 X 400m TEA	4 RKTS M274

STANDARD:
Acft 1 and 2 must achieve a combined GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table.

AMMUNITION PER A/C:
8 RKTS M274
60 RNDS 30mm

NOTES:
1. Commanders may modify this table in order to tailor the gunnery tasks more closely to those required by the unit's METL and/or MTP.
2. Engagement points for each task are based on applying engagement time to the appropriate calculation sheet.
3. This table is not resourced IAW DA Pam 350-38.
4. All rockets fired as pairs.

TABLE X. DAY/NIGHT AH-64 ADVANCED TRAINING COURSE (TEAM/PLT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ACFT 1 ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
	ACFT 2 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS M274
2	ACFT 1 ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	TROOPS	HIT	30 RNDS
	ACFT 2 ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000- 1500m	WHEELED VEHICLE	HIT	30 RNDS
3	ACFT 1 ENGAGE STATIONARY TARGETW/ROCKETS	HOVER	>4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS M274
	ACFT 2 ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000m	HEAVY ARMOR	HIT	1 HELLFIRE
4	ACFT 1 ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000- 1500m	WHEELED VEHICLE	HIT	30 RNDS
	ACFT 2 ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	TROOPS	HIT	30 RNDS
5	ACFT 1 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000- 4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS M274
	ACFT 2 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000- 4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS M274

STANDARD:
Acft 1 and 2 must achieve a combined GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table.

AMMUNITION PER A/C:
8 RKTS M274
60 RNDS 30mm

NOTES:
1. Commanders can modify this table in order to tailor the gunnery tasks more closely to those required by the unit's METL and/or MTP.
2. Engagement points for each task are based on applying engagement time to the appropriate calculation sheet.
3. Consult DA Pam 350-38 for ammunition resourcing.
4. All rockets fired as pairs.

TABLE XI. DAY/NIGHT AH-64 ADVANCED TRAINING COURSE (COMPANY)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order deliberate attack mission. Enemy is two to three hours from decision point. Operations overlay includes lateral boundaries, phase lines, air routes, and engagement area.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct air movement	Commander receives order to execute mission. Unit departs TAA en route to BP per briefed time schedule.	Unit complies with A^2C^2 plan. Coordinates with ground elements in vicinity of HA and BP. Meets times for crossing SP, ACPs, CCPs, and RP.
Conduct battle position operations	Unit occupies BP per SOP. SITREP from S2 indicates enemy is near the planned engagement area.	Unit occupies BP along briefed routes. Unit establishes security in BP. Unit prepares to engage IAW briefed schedule.
Engage multiple targets	Multiple targets in EA. Unit engages targets with long range missile fires.	Direct fire distribution per SOP. Unit will fire and maneuver per commander's guidance.
Detect and react to OPFOR	During missile engagements unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and troops supported by artillery. Unit engages with cannon at short to medium ranges and rockets at medium to long ranges.	Fire distribution per SOP. Unit will fire and maneuver. Engages troops and vehicles with cannon and neutralizes artillery with rockets. Sends reports to higher HQ.
Conduct FARP operations	Upon completing briefed mission, unit rallies at HA and returns along briefed air route to FARP.	Commander consolidates BDA and FARM. Reports to higher command. Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed air routes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. The purpose of this table is to exercise command and control of the live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. This table is not resourced IAW DA 350-38.

TABLE XI. DAY/NIGHT AH-64 ADVANCED TRAINING COURSE (TROOP)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order zone recon mission. Enemy situation is unknown. Operations overlay includes lateral boundaries, LD, and objective.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct movement to LD	Commander receives order to execute mission. Unit departs TAA en route LD.	Unit complies with A^2C^2 plan. Coordinates with ground elements for LD passage.
Conduct zone reconnaissance	Enemy contact is likely. Unit uses bounding overwatch to conduct reconnaissance.	Unit recons assigned zone IAW time constraints in OPORD.
Detect and react to OPFOR	Unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and dismounted troops.	Unit engages OPFOR and breaks contact. The engagement is not decisive. Reports to higher HQ.
Conduct FARP operations	Unit rallies, conducts battle handover, and returns along briefed air routes to FARP.	Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP.
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed air routes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. The purpose of this table is to exercise command and control of the troop live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Accomplish tasks according to standards in applicable MTP.
4. This table is not resourced IAW DA 350-38.

TABLE XI. DAY/NIGHT AH-64 ADVANCED TRAINING COURSE (COMPANY)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order deliberate attack mission. Enemy is two to three hours from decision point. Operations overlay includes lateral boundaries, phase lines, air routes, and engagement area.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct air movement	Commander receives order to execute mission. Unit departs TAA en route to BP per briefed time schedule.	Unit complies with A^2C^2 plan. Coordinates with ground elements in vicinity of HA and BP. Meets times for crossing SP, ACPs, CCPs, and RP.
Conduct battle position operations	Unit occupies BP per SOP. SITREP from S2 indicates enemy is near the planned engagement area.	Unit occupies BP along briefed routes. Unit establishes security in BP. Unit prepares to engage IAW briefed schedule.
Engage multiple targets	Multiple targets in EA. Unit engages targets with long range missile fires.	Direct fire distribution per SOP. Unit will fire and maneuver per commander's guidance.
Detect and react to OPFOR	During missile engagements unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and troops supported by artillery. Unit engages with cannon at short to medium ranges and rockets at medium to long ranges.	Fire distribution per SOP. Unit will fire and maneuver. Engages troops and vehicles with cannon and neutralizes artillery with rockets. Sends reports to higher HQ.
Conduct FARP operations	Upon completing briefed mission, unit rallies at HA and returns along briefed air route to FARP.	Commander consolidates BDA and FARM. Reports to higher command. Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed air routes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. The purpose of this table is to exercise command and control of the live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. This table is not resourced IAW DA 350-38.

TABLE XII. DAY/NIGHT AH-64 ADVANCED TRAINING COURSE (TROOP)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order zone recon mission. Enemy situation is unknown. Operations overlay includes lateral boundaries, LD, and objective.	Commander will ensure precombat checks are complete. Commander briefs mission to air- crews. Unit conducts mission planning and rehearsal.
Conduct movement to LD	Commander receives order to execute mission. Unit departs TAA en route LD.	Unit complies with A^2C^2 plan. Coordinates with ground elements for LD passage.
Conduct zone reconnaissance	Enemy contact is likely. Unit uses bounding overwatch to conduct reconnaissance.	Unit recons assigned zone IAW time constraints in OPORD.
Detect and react to OPFOR	Unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and dismounted troops.	Unit engages OPFOR and breaks contact. The engagement is not decisive. Reports to higher HQ.
Conduct FARP operations	Unit rallies, conducts battle handover, and returns along briefed air routes to FARP.	Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP.
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed air routes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. The purpose of this table is to exercise command and control of the troop live fire.
2. Commanders can modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Consult DA Pamphlet 350-38 for ammunition resourcing.

Section III. AH-1E/F Gunnery Tables

Units assigned AH-1E/F aircraft will use the gunnery tables in this section.

TABLE I. DAY AH-1E/F INITIAL TRANSITION/QUALIFICATION (PILOT)						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE I. NIGHT AH-1E/F INITIAL TRANSITION/QUALIFICATION (PILOT)						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE II. DAY AH-1E/F INITIAL TRANSITION/QUALIFICATION (CPG)						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE II. NIGHT AH-1E/F INITIAL TRANSITION/QUALIFICATION (CPG)						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE III. DAY AH-1E/F COMMANDER'S EVALUATION (PILOT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	WHEELED VEHICLE	HIT	48 RNDS
2	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	LIGHT ARMOR	HIT	48 RNDS
3	ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	<3000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS M274
4	ENGAGE STATIONARY TARGETS W/ROCKETS	DIVING	<3000m	TROOPS	1 RKT IN 300 X 400m TEA	4 RKTS M274
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS M267
6	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M267

NOTES:
1. Table III is designed for use by unit IP/SP to determine individual proficiency, readiness level and aircraft station for crew qualification.
2. This table is not resourced IAW DA Pamphlet 350-38. Conduct in the FWS.

TABLE III. NIGHT AH-1E/F COMMANDER'S EVALUATION (PILOT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	WHEELED VEHICLE	HIT	48 RNDS
2	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	LIGHT ARMOR	HIT	48 RNDS
3	ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	<3000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS M274
4	ENGAGE STATIONARY TARGETS W/ROCKETS	DIVING	<3000m	TROOPS	1 RKT IN 300 X 400m TEA	4 RKTS M274
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS M267
6	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M267

NOTES:
1. Table III is designed for use by unit IP/SP to determine individual proficiency, readiness level and aircraft station for crew qualification.
2. This table is not resourced IAW DA Pamphlet 350-38. Conduct in the FWS.

TABLE IV. DAY AH-1E/F COMMANDER'S EVALUATION (GUNNER)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	WHEELED VEHICLE	HIT	48 RNDS
2	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	LIGHT ARMOR	HIT	48 RNDS
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000-1500m	WHEELED VEHICLE	HIT	48 RNDS
4	ENGAGE STATIONARY TARGETS W/TOW	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 TOW
5	ENGAGE MOVING TARGET W/TOW	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 TOW

NOTES:
1. Table IV is designed for use by unit IP/SP to determine individual proficiency, readiness level, and aircraft station for crew qualification.
2. This table is not resourced IAW DA Pamphlet 350-38. Conduct in the FWS.

TABLE IV. NIGHT AH-1E/F COMMANDER'S EVALUATION (GUNNER)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	WHEELED VEHICLE	HIT	48 RNDS
2	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	LIGHT ARMOR	HIT	48 RNDS
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000-1500m	WHEELED VEHICLE	HIT	48 RNDS

NOTES:
1. Table IV is designed for use by unit IP/SP to determine individual proficiency, readiness level, and aircraft station for crew qualification.
2. This table is not resourced IAW DA Pamphlet 350-38. Conduct in the FWS.

TABLE V. HELICOPTER GUNNERY SKILLS TEST		
TASK	**CONDITION**	**STANDARD**
Written test consisting of a minimum of 50 questions from the following subject areas: • Weapon Systems Operation/Firing Characteristics. • Ballistics • Delivery Techniques • Munitions: Identification/ Function/Operation	Without reference to publications.	Minimum 70% correct.
Perform relevant tasks from the following areas: • Armament/Weapon Systems Preflight • Armament/Weapon Systems Switchology • Procedures for Hangfire/Misfire/Emergency Conditions Involving Armament Systems • Munitions Handling, Uploading/Downloading	Demonstrate ability to perform or explain selected subject areas: Aircraft Simulator or Aircraft Simulator or Aircraft Aircraft with Training or Live Munitions	Overall GO/NO-GO is based on scorer's assessment.
Other requirements per Chapter 2, FM 1-140.		
NOTE: Some hands-on tasks are also ATM tasks. However, conduct these tasks as part of the HGST to confirm crew proficiency prior to live fire training/qualification.		

TABLE VI. AH-1E/F WEAPONS CALIBRATION/VERIFICATION

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**SIGHT**	**TGT EFFECT**	**AMMO**
1	OPERATE 20MM WITH GHSS	HOVER	<1000m	GHSS	HIT	32 RNDS
2	OPERATE 20MM WITH PHSS	HOVER	<1000m	PHSS	HIT	32 RNDS
3	OPERATE 20MM, TSU/GUN WITH LASER	HOVER	500-1500m	TSU	HIT	32 RNDS
4	OPERATE 20MM IN FIXED GUN MODE	HOVER	500-1500m	AS REQUIRED	HIT	32 RNDS
5	OPERATE RMS	HOVER	<3000m	AS REQUIRED	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	OPERATE TMS	HOVER	N/A	AS REQUIRED	PROPER PRE/ POSTLAUNCH SYMBOLOGY	TSGMS

AMMUNITION:
6 RKTS M274
128 RNDS 20mm

TABLE VII. DAY AH-1E/F CREW TRAINING COURSE

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	WHEELED VEHICLE	HIT	80 RNDS
2	ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	3000-4000m	TROOPS	2 RKTS IN 300 X 400m TEA	6 RKTS M274
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	LIGHT ARMOR	HIT	80 RNDS
4	ENGAGE MOVING TARGET W/TOW	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 MSL
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000-1500m	LIGHT ARMOR	HIT	80 RNDS
7	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
8	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	TROOPS	3 RKTS IN 300 X 400m TEA	8 RKTS M267
9	ENGAGE MOVING TARGET W/CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	80 RNDS
10	ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	3000-4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
*11	ENGAGE STATIONARY TARGET W/ROCKETS	DIVING	<3000m	TROOPS	2 RKTS IN 300 X 400m TEA	6 RKTS M274
*12	ENGAGE STATIONARY TARGET W/CANNON	DIVING	>1000m	LIGHT ARMOR	HIT	30 RNDS

STANDARD:
Crew must achieve a GO rating on 7 of 10 scored tasks and 700 of 1000 points to receive an overall GO for this table

AMMUNITION:
8 RKTS M267
24 RKTS M274
350 RNDS 20mm

NOTES:
1. Engagement points for each task are based on applying engagement times to the appropriate point calculation sheet.
2. All rocket engagements will be fired as pairs.
3. The missile in this table is not resourced IAW DA Pamphlet 350-38.
4. Task 11 may be substituted for a short or medium range rocket task.
5. Tasks 12 is fired for sustainment. No score is assigned to this task.

TABLE VII. NIGHT AH-1E/F CREW TRAINING COURSE

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	48 RNDS
2	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	LIGHT ARMOR	HIT	48 RNDS
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	LIGHT ARMOR	HIT	64 RNDS
4	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS M274
6	ENGAGE STATIONARY TARGET W/TOW	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 MSL

STANDARD:
With C-NITE aircraft, crew must achieve a GO rating on 4 of 6 scored tasks and 420 of 600 points to receive an overall GO for this table.

AMMUNITION:
10 RKTS M274
160 RNDS 20mm

NOTES:
1. Engagement points for each task are based on applying engagement times to the appropriate point calculation sheet.
2. All rocket engagements will be fired as pairs.
3. The missile in this table is not resourced IAW DA Pamphlet 350-38.
4. This table is scored for C-NITE equipped units, all others complete as sustainment.

TABLE VIII. DAY AH-1E/F CREW QUALIFICATION COURSE

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/CANNON	MOVING/ RUNNING	<1000m	WHEELED VEHICLE	HIT	80 RNDS
2	ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	3000-4000m	TROOPS	2 RKTS IN 300 X 400m TEA	6 RKTS M274
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	LIGHT ARMOR	HIT	80 RNDS
4	ENGAGE MOVING TARGET W/TOW	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 MSL
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	ENGAGE STATIONARY TARGET W/CANNON	HOVER	1000-1500m	LIGHT ARMOR	HIT	80 RNDS
7	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
8	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	TROOPS	3 RKTS IN 300 X 400m TEA	8 RKTS M267
9	ENGAGE MOVING TARGET W/CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	80 RNDS
10	ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	3000-4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
*11	ENGAGE STATIONARY TARGET W/ROCKETS	DIVING	<3000m	TROOPS	2 RKTS IN 300 X 400m TEA	6 RKTS M274
*12	ENGAGE STATIONARY TARGET W/CANNON	DIVING	>1000m	LIGHT ARMOR	HIT	30 RNDS

STANDARD:
Crew must achieve a GO rating on 7 of 10 scored tasks and 700 of 1000 points to receive an overall GO for this table

AMMUNITION:
8 RKTS M267
24 RKTS M274
350 RNDS 20mm

NOTES:
1. Engagement points for each task are based on applying engagement times to the appropriate point calculation sheet.
2. All rocket engagements will be fired as pairs.
3. Units equipped with C-NITE will fire TOW during Table VIII Night.
4. Task 11 may be substituted for a short or medium range rocket task.
5. Task 12 is fired for sustainment. No score is assigned to this task.

TABLE VIII. NIGHT AH-1E/F CREW QUALIFICATION COURSE

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	48 RNDS
2	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	LIGHT ARMOR	HIT	48 RNDS
3	ENGAGE STATIONARY TARGET W/CANNON	HOVER	<1000m	LIGHT ARMOR	HIT	64 RNDS
4	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS M274
6	ENGAGE STATIONARY TARGET W/TOW	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 MSL

STANDARD:
With C-NITE aircraft, crew must achieve a GO rating on 4 of 6 scored tasks and 420 of 600 points to receive an overall GO for this table.

AMMUNITION:
10 RKTS M274
160 RNDS 20mm

NOTES:
1. Engagement points for each task are based on applying engagement times to the appropriate point calculation sheet.
2. All rocket engagements will be fired as pairs.
3. This table is scored for C-NITE equipped units, all others complete as sustainment.

TABLE IX. DAY/NIGHT AH-1E/F ADVANCED TRAINING COURSE (TEAM/PLT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ACFT 1: ENGAGE STATIONARY TARGET W/20mm CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	32 RNDS
	ACFT 2: ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS
2	ACFT 1: ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	TROOPS	1 RKT IN 300 X 400m TEA	4 RKTS
	ACFT 2: ENGAGE STATIONARY TARGET W/20mm CANNON	HOVER	<1000m	LIGHT ARMOR	HIT	32 RNDS
3	ACFT 1: ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	4 RKTS
	ACFT 2: ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS
4	ACFT 1: ENGAGE STATIONARY TARGET W/20mm CANNON	HOVER	>1000m	WHEELED VEHICLE	HIT	32 RNDS
	ACFT 2: ENGAGE STATIONARY TARGET W/20mm CANNON	HOVER	>1000m	WHEELED VEHICLE	HIT	32 RNDS
5	ACFT 1: ENGAGE MOVING TARGET W/TOW MISSILE	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 MSL
	ACFT 2: ENGAGE MOVING TARGET W/TOW MISSILE	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 MSL

STANDARD:
Acft 1 and 2 must achieve a combined GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table.

AMMUNITION PER A/C:
8 RKTS M274
64 RNDS 20mm

NOTES:
1. Commanders may modify this table in order to tailor the gunnery tasks more closely to those required by the unit's METL and/or MTP.
2. Engagement points for each task are based on applying engagement time to the appropriate calculation sheet.
3. This table is not resourced IAW DA Pam 350-38.
4. All rockets fired as pairs.

TABLE X. DAY/NIGHT AH-1E/F ADVANCED TRAINING COURSE (TEAM/PLT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ACFT 1: ENGAGE STATIONARY TARGET W/20mm CANNON	HOVER	<1000m	WHEELED VEHICLE	HIT	32 RNDS
	ACFT 2: ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	1 RKT IN 300 x 400m TEA	4 RKTS
2	ACFT 1: ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	TROOPS	1 RKT IN 300 x 400m TEA	4 RKTS
	ACFT 2: ENGAGE STATIONARY TARGET W/20mm CANNON	HOVER	<1000m	LIGHT ARMOR	HIT	32 RNDS
3	ACFT 1: ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	1 RKT IN 300 x 400m TEA	4 RKTS
	ACFT 2: ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	1 RKT IN 300 x 400m TEA	4 RKTS
4	ACFT 1: ENGAGE STATIONARY TARGET W/20mm CANNON	HOVER	>1000m	WHEELED VEHICLE	HIT	32 RNDS
	ACFT 2: ENGAGE STATIONARY TARGET W/20mm CANNON	HOVER	>1000m	WHEELED VEHICLE	HIT	32 RNDS
5	ACFT 1: ENGAGE MOVING TARGET W/TOW MISSILE	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 MSL
	ACFT 2: ENGAGE MOVING TARGET W/TOW MISSILE	HOVER	1500-3500m	HEAVY ARMOR	HIT	1 MSL

STANDARD:
Acft 1 and 2 must achieve a combined GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table.

AMMUNITION PER A/C:
8 RKTS M274
64 RNDS 20mm

NOTES:
1. Commanders may modify this table in order to tailor the gunnery tasks more closely to those required by the unit's METL and/or MTP.
2. Engagement points for each task are based on applying engagement time to the appropriate calculation sheet.
3. This table is not resourced IAW DA Pam 350-38.
4. All rockets fired as pairs.

TABLE XI. DAY/NIGHT AH-1E/F ADVANCED TRAINING COURSE (COMPANY)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order deliberate attack mission. Enemy is two to three hours from decision point. Operations overlay includes lateral boundaries, phase lines, air routes, and engagement area.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct air movement	Commander receives order to execute mission. Unit departs TAA en route to BP per briefed time schedule.	Unit complies with A^2C^2 plan. Coordinates with ground elements in vicinity of HA and BP. Meets times for crossing SP, ACPs, CCPs, and RP.
Conduct battle position operations	Unit occupies BP per SOP. SITREP from S2 indicates enemy is near the planned engagement area.	Unit occupies BP along briefed routes. Unit establishes security in BP. Unit prepares to engage IAW briefed schedule.
Engage multiple targets	Multiple targets in EA. Unit engages targets with long range missile fires.	Direct fire distribution per SOP. Unit will fire and maneuver per commander's guidance.
Detect and react to OPFOR	During missile engagements unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and troops supported by artillery. Unit engages with cannon at short to medium ranges and rockets at medium to long ranges.	Fire distribution per SOP. Unit will fire and maneuver. Engages troops and vehicles with cannon and neutralizes artillery with rockets. Sends reports to higher HQ.
Conduct FARP operations	Upon completing briefed mission, unit rallies at HA and returns along briefed air route to FARP.	Commander consolidates BDA and FARM. Reports to higher command. Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed air routes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. The purpose of this table is to exercise command and control of the live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. This table is not resourced IAW DA 350-38.

TABLE XII. DAY/NIGHT AH-1E/F ADVANCED TRAINING COURSE (COMPANY)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order deliberate attack mission. Enemy is two to three hours from decision point. Operations overlay includes lateral boundaries, phase lines, air routes, and engagement area.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct air movement	Commander receives order to execute mission. Unit departs TAA en route to BP per briefed time schedule.	Unit complies with A^2C^2 plan. Coordinates with ground elements in vicinity of HA and BP. Meets times for crossing SP, ACPs, CCPs, and RP.
Conduct battle position operations	Unit occupies BP per SOP. SITREP from S2 indicates enemy is near the planned engagement area.	Unit occupies BP along briefed routes. Unit establishes security in BP. Unit prepares to engage IAW briefed schedule.
Engage multiple targets	Multiple targets in EA. Unit engages targets with long range missile fires.	Direct fire distribution per SOP. Unit will fire and maneuver per commander's guidance.
Detect and react to OPFOR	During missile engagements unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and troops supported by artillery. Unit engages with cannon at short to medium ranges and rockets at medium to long ranges.	Fire distribution per SOP. Unit will fire and maneuver. Engages troops and vehicles with cannon and neutralizes artillery with rockets. Sends reports to higher HQ.
Conduct FARP operations	Upon completing briefed mission, unit rallies at HA and returns along briefed air route to FARP.	Commander consolidates BDA and FARM. Reports to higher command. Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed air routes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. The purpose of this table is to exercise command and control of the live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Consult DA 350-38 for ammunition resourcing.

TABLE XI. DAY/NIGHT AH-1E/F ADVANCED TRAINING COURSE (TROOP)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order zone recon mission. Enemy situation is unknown. Operations overlay includes lateral boundaries, LD, and objective.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct movement to LD	Commander receives order to execute mission. Unit departs TAA en route LD.	Unit complies with A^2C^2 plan. Coordinates with ground elements for LD passage.
Conduct zone reconnaissance	Enemy contact is likely. Unit uses bounding overwatch to conduct reconnaissance.	Unit recons assigned zone IAW time constraints in OPORD.
Detect and react to OPFOR	Unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and dismounted troops.	Unit engages OPFOR and breaks contact. The engagement is not decisive. Reports to higher HQ.
Conduct FARP operations	Unit rallies, conducts battle handover, and returns along briefed air routes to FARP.	Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP.
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed air routes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. Purpose of this table is to exercise command and control of the troop live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Accomplish tasks according to standards in applicable MTP.
4. This table is not resourced IAW DA 350-38.

TABLE XII. DAY/NIGHT AH-1E/F ADVANCED TRAINING COURSE (TROOP)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order zone recon mission. Enemy situation is unknown. Operations overlay includes lateral boundaries, LD, and objective.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct movement to LD	Commander receives order to execute mission. Unit departs TAA en route LD.	Unit complies with A^2C^2 plan. Coordinates with ground elements for LD passage.
Conduct zone reconnaissance	Enemy contact is likely. Unit uses bounding overwatch to conduct reconnaissance.	Unit recons assigned zone IAW time constraints in OPORD.
Detect and react to OPFOR	Unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and dismounted troops.	Unit engages OPFOR and breaks contact. The engagement is not decisive. Reports to higher HQ.
Conduct FARP operations	Unit rallies, conducts battle handover, and returns along briefed air routes to FARP.	Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP.
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed air routes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. Purpose of this table is to evaluate command and control of the live fire.
2. Commanders can modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Consult DA Pamphlet 350-38 for ammunition resourcing.

Section IV. OH-58D(I) Gunnery Tables

Units assigned OH-58D (I) aircraft will use the gunnery tables in this section.

TABLE I. DAY OH-58D (I) INITIAL TRANSITION/QUALIFICATION (PILOT)

TASK		CONDITION			STANDARD	
NO	DESCRIPTIONS	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE I. NIGHT OH-58D (I) INITIAL TRANSITION/QUALIFICATION (PILOT)

TASK		CONDITION			STANDARD	
NO	DESCRIPTIONS	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE II. DAY OH-58D (I) INITIAL TRANSITION/QUALIFICATION (CPO)

TASK		CONDITION			STANDARD	
NO	DESCRIPTIONS	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE II. DAY OH-58D (I) INITIAL TRANSITION/QUALIFICATION (CPO)

TASK		CONDITION			STANDARD	
NO	DESCRIPTIONS	MODE	RANGE	TARGET	TGT EFFECT	AMMO
IAW USAAVNC or NGB approved POI.						

TABLE III. DAY OH-58D (I) COMMANDER'S EVALUATION (PILOT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	500-800m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
2	ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/RUNNING	800-1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
3	ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/RUNNING	3000-4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	3 RKTS M274
4	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS M267
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	LIGHT ARMOR	3 RKTS IN 300 X 400m TEA	7 RKTS M274

AMMUNITION:
4 RKTS M267
10 RKTS M274
160 RNDS .50 CAL

TABLE IV. NIGHT OH-58D (I) COMMANDER'S EVALUATION (PILOT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	500-800m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 X 36m TEA	80 RNDS
2	ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/RUNNING	800-1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 X 36m TEA	80 RNDS
3	ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/RUNNING	3000-4000m	WHEELED VEHICLE	1 RKT IN 300 X 400m TEA	3 RKTS M274
4	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS M267
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	LIGHT ARMOR	3 RKTS IN 300 X 400m TEA	7 RKTS M274

AMMUNITION:
4 RKTS M267
10 RKTS M274
160 RNDS .50 CAL

TABLE V. HELICOPTER GUNNERY SKILLS TEST		
TASK	**CONDITION**	**STANDARD**
Written test consisting of a minimum of 50 questions from the following subject areas: • Weapon Systems Operation/Firing Characteristics. • Ballistics • Delivery Techniques • Munitions: Identification/Function/Operation	Without reference to publications.	Minimum 70% correct.
Perform relevant tasks from the following areas: • Armament/Weapon Systems Preflight • Armament/Weapon Systems Switchology • Procedures for Hangfire/Misfire/Emergency Conditions Involving Armament Systems • Munitions Handling, Uploading/Downloading	Demonstrate ability to perform or explain selected subject areas: Aircraft Simulator or Aircraft Simulator or Aircraft Aircraft with Training or Live Munitions	Overall GO/NO-GO is based on scorer's assessment.
Other requirements per Chapter 2, FM 1-140.		
NOTE: Some hands-on tasks are also ATM tasks. However, conduct these tasks as part of the HGST to confirm crew proficiency prior to live fire training/qualification.		

TABLE VI. OH-58D (I) WEAPONS CALIBRATION/VERIFICATION						
TASK		CONDITION			STANDARD	
NO	DESCRIPTION	MODE	RANGE	SIGHT	TGT EFFECT	AMMO
1	OPERATE .50 CAL MACHINE GUN	HOVER	800-1200m	AS REQUIRED	HIT OR 10% OF RNDS IN 36 X 36m TEA	40 RNDS
2	OPERATE 2.75-INCH ROCKET SYSTEM	HOVER	<3000m	AS REQUIRED	3 RKTS IN 300 X 400m TEA	7 RKTS M274
3	OPERATE HELLFIRE MISSILE SYSTEM WITH LASER	HOVER	2000-3000m	AS REQUIRED	PROPER PRE/POST LAUNCH SYMBOLOGY	
4	OPERATE STINGER MISSILE SYSTEM	HOVER	2000-4000m	AS REQUIRED	PROPER PRE/POST LAUNCH SYMBOLOGY	
AMMUNITION: 7 RKTS M274 40 RNDS .50 CAL						

TABLE VII. DAY OH-58D (I) INTERMEDIATE TRAINING COURSE (CREW)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/RUNNING	800-1200m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 X 36m TEA	80 RNDS
2	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	TROOPS	1 RKT IN 300 X 400m TEA	3 RKTS M274
3	ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	>1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 X 36m TEA	120 RNDS
4	ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	500-800m	TROOPS	HIT OR 10% OF RNDS IN 36 X 36m TEA	80 RNDS
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	3 RKTS IN 300 X 400m TEA	7 RKTS M274
6	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS M267
7	ENGAGE MOVING TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000	HEAVY ARMOR	HIT	1 HELLFIRE
9	ENGAGE MOVING TARGET W/STINGER	HOVER	>4000m	F/W ACFT >500 FEET AGL	HIT	1 STINGER
10	ENGAGE STATIONARY TARGET W/STINGER	HOVER	2000-4000m	R/W ACFT AT NOE ALTITUDE	HIT	1 STINGER

STANDARD:
Crew must achieve a GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table

AMMUNITION:
10 RKTS M274
4 RKTS M267
280 RNDS .50 CAL

NOTES:
1. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
2. The HELLFIRE and STINGER missiles in this table are not resourced IAW DA Pamphlet 350-38. Training missiles should be used.

TABLE VII. NIGHT OH-58D (I) INTERMEDIATE TRAINING COURSE (CREW)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/RUNNING	800-1200m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 X 36m TEA	80 RNDS
2	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	TROOPS	1 RKT IN 300 X 400m TEA	3 RKTS M274
3	ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	>1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 X 36m TEA	120 RNDS
4	ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	500-800m	TROOPS	HIT OR 10% OF RNDS IN 36 X 36m TEA	80 RNDS
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	WHEELED VEHICLE	2 RKTS IN 300 X 400m TEA	6 RKTS M274
6	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	3 RKTS M267
7	ENGAGE MOVING TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	>4000	HEAVY ARMOR	HIT	1 HELLFIRE
9	ENGAGE MOVING TARGET W/STINGER	HOVER	>4000m	F/W ACFT >500 FEET AGL	HIT	1 STINGER
10	ENGAGE STATIONARY TARGET W/STINGER	HOVER	2000-4000m	R/W ACFT AT NOE ALTITUDE	HIT	1 STINGER

STANDARD:
Crew must achieve a GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table

AMMUNITION:
9 RKTS M274
3 RKTS M267
280 RNDS .50 CAL

NOTES:
1. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
2. The HELLFIRE and STINGER missiles in this table are not resourced IAW DA Pamphlet 350-38. Training missiles should be used.

TABLE VIII. DAY OH-58D (I) INTERMEDIATE QUALIFICATION COURSE (CREW)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/ RUNNING	800-1200m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
2	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	TROOPS	1 RKT IN 300 x 400m TEA	3 RKTS M274
3	ENGAGE STATIONARY TARGET W/MACHINEGUN	HOVER	>1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 x 36m TEA	120 RNDS
4	ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	500-800m	TROOPS	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	WHEELED VEHICLE	3 RKTS IN 300 x 400m TEA	7 RKTS M274
6	ENGAGE STATIONARY TARGET w/ROCKETS	HOVER	>4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	4 RKTS M267
7	ENGAGE MOVING TARGET w/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE MOVING TARGET w/HELLFIRE	HOVER	>4000	HEAVY ARMOR	HIT	1 HELLFIRE
9	ENGAGE MOVING TARGET w/STINGER	HOVER	>4000m	F/W ACFT >500 FEET AGL	HIT	1 STINGER
10	ENGAGE STATIONARY TARGET w/STINGER	HOVER	2000-4000m	R/W ACFT AT NOE ALTITUDE	HIT	1 STINGER

STANDARD:
Crew must achieve a GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table

AMMUNITION:
10 RKTS M274
4 RKTS M267
280 RNDS .50 CAL

NOTES:
1. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
2. The HELLFIRE and STINGER missiles in this table are not resourced IAW DA Pamphlet 350-38. Training missiles should be used.

TABLE VIII. NIGHT OH-58D (I) INTERMEDIATE QUALIFICATION COURSE (CREW)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/ RUNNING	800-1200m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
2	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	<3000m	TROOPS	1 RKT IN 300 x 400m TEA	3 RKTS M274
3	ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	>1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 x 36m TEA	120 RNDS
4	ENGAGE STATIONARY TARGET W/MACHINEGUN	HOVER	500-800m	TROOPS	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
5	ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	WHEELED VEHICLE	2 RKTS IN 300 x 400m TEA	6 RKTS M274
6	ENGAGE STATIONARY TARGET w/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	1 RKT IN 300 X 400m TEA	3 RKTS M267
7	ENGAGE MOVING TARGET w/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
8	ENGAGE MOVING TARGET w/HELLFIRE	HOVER	>4000	HEAVY ARMOR	HIT	1 HELLFIRE
9	ENGAGE MOVING TARGET w/STINGER	HOVER	>4000m	F/W ACFT >500 FEET AGL	HIT	1 STINGER
10	ENGAGE STATIONARY TARGET w/STINGER	HOVER	2000-4000m	R/W ACFT AT NOE ALTITUDE	HIT	1 STINGER

STANDARD:
Crew must achieve a GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO for this table

AMMUNITION:
9 RKTS M274
3 RKTS M267
280 RNDS .50 CAL

NOTES:
1. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
2. The HELLFIRE and STINGER missiles in this table are not resourced IAW DA Pamphlet 350-38. Training missiles should be used.

TABLE IX. DAY/NIGHT OH-58D (I) ADVANCED TRAINING COURSE (TEAM/PLT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ACFT 1 ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/ RUNNING	800-1200m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
	ACFT 2 ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	<3000m	TROOPS	3 RKTS IN 300 x 400m TEA	7 RKTS M274
2	ACFT 1 ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	<3000m	TROOPS	3 RKTS IN 300 x 400m TEA	7 RKTS M274
	ACFT 2 ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/ RUNNING	800-1200m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
3	ACFT 1 ENGAGE STATIONARY TARGET W/MACHINEGUN	HOVER	>1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 x 36m TEA	160 RNDS
	ACFT 2 ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	>1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 x 36m TEA	160 RNDS
4	ACFT 1 ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
	ACFT 2 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	3 RKTS IN 300 x 400m TEA	7 RKTS M274
5	ACFT 1 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	3 RKTS IN 300 X 400m TEA	7 RKTS M274
	ACFT 2 ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE

STANDARD:
Aircraft 1 and 2 must achieve a combined GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO rating on this table.

AMMUNITION PER A/C:
14 **RKTS** M274
250 RNDS .50 CAL

NOTES:
1. Commanders may modify this table as required by the unit METL and/or MTP.
2. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
3. This table is not resourced IAW DA Pamphlet 350-38.

TABLE X. DAY/NIGHT OH-58D (I) ADVANCED TRAINING COURSE (TEAM/ PLT)

TASK		CONDITION			STANDARD	
NO	**DESCRIPTION**	**MODE**	**RANGE**	**TARGET**	**TGT EFFECT**	**AMMO**
1	ACFT 1 ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/ RUNNING	800-1200m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
	ACFT 2 ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	<3000m	TROOPS	3 RKTS IN 300 x 400m TEA	7 RKTS M274
2	ACFT 1 ENGAGE STATIONARY TARGET W/ROCKETS	MOVING/ RUNNING	<3000m	TROOPS	3 RKTS IN 300 x 400m TEA	7 RKTS M274
	ACFT 2 ENGAGE STATIONARY TARGET W/MACHINE GUN	MOVING/ RUNNING	800-1200m	WHEELED VEHICLE	HIT OR 10% OF RNDS IN 36 x 36m TEA	80 RNDS
3	ACFT 1 ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	>1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 x 36m TEA	160 RNDS
	ACFT 2 ENGAGE STATIONARY TARGET W/MACHINE GUN	HOVER	>1200m	LIGHT ARMOR	HIT OR 10% OF RNDS IN 36 x 36m TEA	160 RNDS
4	ACFT 1 ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE
	ACFT 2 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	>4000m	LIGHT ARMOR	3 RKTS IN 300 x 400m TEA	7 RKTS M274
5	ACFT 1 ENGAGE STATIONARY TARGET W/ROCKETS	HOVER	3000-4000m	LIGHT ARMOR	3 RKTS IN 300 X 400m TEA	7 RKTS M274
	ACFT 2 ENGAGE STATIONARY TARGET W/HELLFIRE	HOVER	2000-4000m	HEAVY ARMOR	HIT	1 HELLFIRE

STANDARD:
Aircraft 1 and 2 must achieve a combined GO rating on 7 of 10 tasks and 700 of 1000 points to receive an overall GO rating on this table.

AMMUNITION PER A/C:
14 RKTS M274
250 RNDS .50 CAL

NOTES:
1. Commanders may modify this table as required by the unit METL and/or MTP.
2. Engagement points for each task are based on applying engagement time to the appropriate point calculation sheet.
3. Consult DA Pamphlet 350-38 for ammunition resourcing.

TABLE XI DAY/NIGHT OH-58D (I) ADVANCED TRAINING COURSE (COMPANY)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order deliberate attack mission. Enemy is two to three hours from decision point. Operations overlay includes lateral boundaries, phase lines, air routes, and engagement area.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct air movement	Commander receives order to execute mission. Unit departs TAA en route to BP per briefed time schedule.	Unit complies with A^2C^2 plan. Coordinates with ground elements in vicinity of HA and BP. Meets times for crossing SP, ACPs, CCPs, and RP.
Conduct battle position operations	Unit occupies BP per SOP. SITREP from S2 indicates enemy is near the planned engagement area.	Unit occupies BP along briefed routes. Unit establishes security in BP. Unit prepares to engage IAW briefed schedule.
Engage multiple targets	Multiple targets in EA. Unit engages targets with long range missile fires.	Direct fire distribution per SOP. Unit will fire and maneuver per commander's guidance.
Detect and react to OPFOR	During missile engagements unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and troops supported by artillery. Unit engages with machine gun at short to medium ranges and rockets at medium to long ranges.	Fire distribution per SOP. Unit will fire and maneuver. Engages troops and vehicles with MACHINEGUN and neutralizes artillery with rockets. Sends reports to higher HQ.
Conduct FARP operations	Upon completing briefed mission, unit rallies at HA and returns along briefed air route to FARP.	Commander consolidates BDA and FARM. Reports to higher command. Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed airroutes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. Purpose of this table is to exercise command and control of the troop live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Accomplish tasks according to standards in applicable MTP.
4. This table is not resourced IAW DA Pamphlet 350-38D.

TABLE XI. DAY/NIGHT OH-58D (I) ADVANCED TRAINING COURSE (TROOP)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order zone recon mission. Enemy situation is unknown. Operations overlay includes lateral boundaries, LD, and objective.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct movement to LD	Commander receives order to execute mission. Unit departs TAA en route LD.	Unit complies with A^2C^2 plan. Coordinates with ground elements for LD passage.
Conduct zone reconnaissance	Enemy contact is likely. Unit uses bounding overwatch to conduct reconnaissance.	Unit recons assigned zone IAW time constraints in OPORD.
Detect and react to OPFOR	Unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and dismounted troops.	Unit engages OPFOR and breaks contact. The engagement is not decisive. Reports to higher HQ.
Conduct FARP operations	Unit rallies, conducts battle handover, and returns along briefed airroutes to FARP.	Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP.
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed airroutes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. Purpose of this table is to exercise command and control of the troop live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Accomplish tasks according to standards in applicable MTP.
4. This table is not resourced IAW DA Pamphlet 350-38.

TABLE XII DAY/NIGHT OH-58D(I) ADVANCED TRAINING COURSE (COMPANY)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order deliberate attack mission. Enemy is two to three hours from decision point. Operations overlay includes lateral boundaries, phase lines, airroutes, and engagement area.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct air movement	Commander receives order to execute mission. Unit departs TAA en route to BP per briefed time schedule.	Unit complies with A^2C^2 plan. Coordinates with ground elements in vicinity of HA and BP. Meets times for crossing SP, ACPs, CCPs, and RP.
Conduct battle position operations	Unit occupies BP per SOP. SITREP from S2 indicates enemy is near the planned engagement area.	Unit occupies BP along briefed routes. Unit establishes security in BP. Unit prepares to engage IAW briefed schedule.
Engage multiple targets	Multiple targets in EA. Unit engages targets with long range missile fires.	Direct fire distribution per SOP. Unit will fire and maneuver per commander's guidance.
Detect and react to OPFOR	During missile engagements unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and troops supported by artillery. Unit engages with machine gun at short to medium ranges and rockets at medium to long ranges.	Fire distribution per SOP. Unit will fire and maneuver. Engages troops and vehicles with machinegun and neutralizes artillery with rockets. Sends reports to higher HQ.
Conduct FARP operations	Upon completing briefed mission, unit rallies at HA and returns along briefed airroute to FARP.	Commander consolidates BDA and FARM. Reports to higher command. Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed airroutes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. Purpose of this table is to exercise command and control of the troop live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Accomplish tasks according to standards in applicable MTP.
4. Consult DA Pamphlet 350-38 for ammunition resourcing.

TABLE XII. DAY/NIGHT OH-58D (I) ADVANCED TRAINING COURSE (TROOP)		
TASK	**CONDITION**	**STANDARD**
Receive mission, conduct mission planning	Commander receives on order zone recon mission. Enemy situation is unknown. Operations overlay includes lateral boundaries, LD, and objective.	Commander will ensure precombat checks are complete. Commander briefs mission to aircrews. Unit conducts mission planning and rehearsal.
Conduct movement to LD	Commander receives order to execute mission. Unit departs TAA en route LD.	Unit complies with A^2C^2 plan. Coordinates with ground elements for LD passage.
Conduct zone reconnaissance	Enemy contact is likely. Unit uses bounding overwatch to conduct reconnaissance.	Unit recons assigned zone IAW time constraints in OPORD.
Detect and react to OPFOR	Unit makes contact with lead elements of the OPFOR. OPFOR is recon element with lightly armored vehicles and dismounted troops.	Unit engages OPFOR and breaks contact. The engagement is not decisive. Reports to higher HQ.
Conduct FARP operations	Unit rallies, conducts battle handover, and returns along briefed airroutes to FARP.	Commander determines proper weapons load for aircraft. Aircraft sequence into FARP and refuel per SOP.
Return to TAA and prepare for future operations	Commander orders the unit to depart the FARP and return to the TAA along briefed airroutes.	Unit complies with A^2C^2 plan. Conducts AAR, prepares for future operations and completes precombat checks.

NOTES:
1. Purpose of this table is to exercise command and control of the troop live fire.
2. Commanders may modify this table and develop a tactical scenario to support the unit METL and/or MTP.
3. Accomplish tasks according to standards in applicable MTP.
4. Consult DA Pamphlet 350-38 for ammunition resourcing.

APPENDIX C

ENGAGEMENT TIME POINT CALCULATION SHEETS

C-1. GENERAL

The point calculation sheets in this appendix (Figures C-1 through C-12) allow the assessing of points for each engagement. The times are based on weapon system characteristics, times of flight, and crew coordination. All engagement times are measured in seconds.

C-2. USING THE POINT CALCULATION SHEETS

a. To determine engagement time scores, select the applicable table for the engagement. For example, "MPSM rockets, four pair." Determine range to the target on top row, and read down to the engagement time, which is expressed in seconds. After finding the correct engagement time, read the left-most column to determine the score.

b. Cannons (20 and 30mm) and Hellfire remote engagements have entries for even numbered seconds. For odd numbered times, subtract 1 second. The rule is round down. To determine a score, move across to the time the target was hit. The point value is under that time.

c. For ranges with masking terrain, commanders may elect to add 10 seconds to engagement times to allow crews to unmask and acquire targets.

d. For specific instructions on how to time engagements, refer to Chapter 2.

SECONDS	30	32	34	36	38	40	42	44	46	48	50	52	54	56	58	60	70	80
POINTS	100	98	96	94	92	90	88	86	84	82	80	78	76	74	72	70	50	30

Figure C-1. Point calculation sheet, Tables VII and VIII, 20mm and 30mm cannon tasks

RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	15 or less	19 or less	23 or less	28 or less	34 or less	39 or less	46 or less
95	15.1 - 17	19.1 - 20	23.1 - 25	28.1 - 30	34.1 - 36	39.1 - 42	46.1 - 50
90	17.1 - 18	20.1 - 22	25.1 - 26	30.1 - 32	36.1 - 38	42.1 - 45	50.1 - 53
85	18.1 - 19	22.1 - 23	26.1 - 28	32.1 - 34	38.1 - 41	45.1 - 48	53.1 - 56
80	19.1 - 20	23.1 - 24	28.1 - 30	34.1 - 36	41.1 - 43	48.1 - 50	56.1 - 59
75	20.1 - 21	24.1 - 26	30.1 - 31	36.1 - 38	43.1 - 46	50.1 - 53	59.1 - 63
70	21.1 - 22	26.1 - 27	31.1 - 33	38.1 - 40	46.1 - 48	53.1 - 56	63.1 - 66
50	22.1 - 24	27.1 - 30	33.1 - 36	40.1 - 44	48.1 - 53	56.1 - 62	66.1 - 73
30	24.1 - 25	30.1 - 31	36.1 - 38	44.1 - 46	53.1 - 55	62.1 - 64	73.1 - 76
0	> 25	> 31	> 38	> 46	> 55	> 64	> 76

Figure C-2. Point calculation sheet, Tables VII and VIII, autonomous Hellfire engagement tasks

Seconds	40	42	44	46	48	50	52	54	56	58	60	62	64	66	68	70	76	80
POINTS	100	98	96	94	92	90	88	86	84	82	80	78	76	74	72	70	50	30

Figure C-3. Point calculation sheet, Tables VII and VIII, Hellfire remote engagement tasks

RANGE IN METERS	<1000	1000-1500	1501-2000	2001-2500	2501-3000	3001-3500	>3500
POINTS	**Engagement Time In Seconds**						
100	14 or less	17 or less	20 or less	23 or less	27 or less	30 or less	36 or less
95	14.1 - 15	17.1 - 18	20.1 - 22	23.1 - 25	27.1 - 29	30.1 - 32	36.1 - 39
90	15.1 - 16	18.1 - 19	22.1 - 23	25.1 - 26	29.1 - 30	32.1 - 34	39.1 - 42
85	16.1 - 17	19.1 - 20	23.1 - 25	26.1 - 28	30.1 - 32	34.1 - 37	42.1 - 44
80	17.1 - 18	20.1 - 22	25.1 - 26	28.1 - 30	32.1 - 34	37.1 - 39	44.1 - 47
75	18.1 - 19	22.1 - 23	26.1 - 28	30.1 - 31	34.1 - 36	39.1 - 41	47.1 - 49
70	19.1 - 20	23.1 - 24	28.1 - 29	31.1 - 33	36.1 - 38	41.1 - 43	49.1 - 52
50	20.1 - 22	24.1 - 26	29.1 - 32	33.1 - 36	38.1 - 42	43.1 - 47	52.1 - 57
30	22.1 - 23	26.1 - 28	32.1 - 33	36.1 - 38	42.1 - 44	47.1 - 49	57.1 - 60
0	> 23	> 28	> 33	> 38	> 44	> 49	> 60

Figure C-4. Point calculation sheet, Tables VII and VIII, TOW engagement tasks

4 PAIRS							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	92 or less	102 or less	111 or less	127 or less	139 or less	155 or less	173 or less
95	92.1 - 98	102.1 - 109	111.1 - 119	127.1 - 136	139.1 - 149	155.1 - 166	173.1 - 185
90	98.1 - 105	109.1 - 116	119.1 - 127	136.1 - 145	149.1 - 159	166.1 - 177	185.1 - 198
85	105.1 - 111	116.1 - 123	127.1 - 135	145.1 - 154	159.1 - 169	177.1 - 188	198.1 - 210
80	111.1 - 118	123.1 - 131	135.1 - 143	154.1 - 163	169.1 - 179	188.1 - 199	210.1 - 222
75	118.1 - 124	131.1 - 138	143.1 - 151	163.1 - 172	179.1 - 189	199.1 - 210	222.1 - 235
70	124.1 - 131	138.1 - 145	151.1 - 159	172.1 - 181	189.1 - 199	210.1 - 221	235.1 - 247
50	131.1 - 144	145.1 - 160	159.1 - 175	181.1 - 199	199.1 - 219	221.1 - 243	247.1 - 272
30	144.1 - 151	160.1 - 167	175.1 - 183	199.1 - 208	219.1 - 229	243.1 - 254	272.1 - 284
0	> 151	> 167	> 183	> 208	> 229	> 254	> 284
3 PAIRS							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	54 or less	62 or less	69 or less	81 or less	91 or less	103 or less	117 or less
95	54.1 - 58	62.1 - 66	69.1 - 74	81.1 - 87	91.1 - 98	103.1 - 110	117.1 - 125
90	58.1 - 62	66.1 - 70	74.1 - 79	87.1 - 93	98.1 - 104	110.1 - 118	125.1 - 134
85	62.1 - 65	70.1 - 75	79.1 - 84	93.1 - 99	104.1 - 111	118.1 - 125	134.1 - 142
80	65.1 - 69	75.1 - 79	84.1 - 89	99.1 - 104	111.1 - 117	125.1 - 132	142.1 - 150
75	69.1 - 73	79.1 - 84	89.1 - 94	104.1 - 110	117.1 - 124	132.1 - 140	150.1 - 159
70	73.1 - 77	84.1 - 88	94.1 - 99	110.1 - 116	124.1 - 130	140.1 - 147	159.1 - 167
50	77.1 - 85	88.1 - 97	99.1 - 109	116.1 - 128	130.1 - 143	147.1 - 162	167.1 - 184
30	85.1 - 89	97.1 - 101	109.1 - 114	128.1 - 133	143.1 - 150	162.1 - 169	184.1 - 192
0	> 89	> 101	> 114	> 133	> 150	> 169	> 1926

Figure C-5. Point calculation sheet, Tables VII and VIII, MPSM rocket engagement tasks

2 PAIRS							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	37 or less	43 or less	48 or less	57 or less	64 or less	72 or less	82 or less
95	37.1 - 40	43.1 - 46	48.1 - 52	57.1 - 61	64.1 - 68	72.1 - 77	82.1 - 88
90	40.1 - 42	46.1 - 49	52.1 - 55	61.1 - 65	68.1 - 73	77.1 - 82	88.1 - 94
85	42.1 - 45	49.1 - 52	55.1 - 59	65.1 - 69	73.1 - 77	82.1 - 88	94.1 - 99
80	45.1 - 48	52.1 - 55	59.1 - 62	69.1 - 73	77.1 - 82	88.1 - 93	99.1 - 105
75	48.1 - 50	55.1 - 58	62.1 - 66	73.1 - 77	82.1 - 86	93.1 - 98	105.1 - 111
70	50.1 - 53	58.1 - 61	66.1 - 69	77.1 - 81	86.1 - 91	98.1 - 103	111.1 - 117
50	53.1 - 58	61.1 - 67	69.1 - 76	81.1 - 89	91.1 - 100	103.1 - 113	117.1 - 129
30	58.1 - 61	67.1 - 70	76.1 - 79	89.1 - 93	100.1 - 105	113.1 - 118	129.1 - 135
0	> 61	> 70	> 79	> 93	> 105	> 118	> 135
1 PAIR							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	20 or less	24 or less	27 or less	32 or less	36 or less	41 or less	47 or less
95	20.1 - 22	24.1 - 26	27.1 - 29	32.1 - 35	36.1 - 39	41.1 - 44	47.1 - 50
90	22.1 - 23	26.1 - 27	29.1 - 31	35.1 - 37	39.1 - 42	44.1 - 47	50.1 - 54
85	23.1 - 25	27.1 - 29	31.1 - 33	37.1 - 39	42.1 - 44	47.1 - 50	54.1 - 57
80	25.1 - 26	29.1 - 31	33.1 - 35	39.1 - 41	44.1 - 47	50.1 - 53	57.1 - 60
75	26.1 - 28	31.1 - 32	35.1 - 37	41.1 - 44	47.1 - 49	53.1 - 56	60.1 - 64
70	28.1 - 29	32.1 - 34	37.1 - 39	44.1 - 46	49.1 - 52	56.1 - 59	64.1 - 67
50	29.1 - 32	34.1 - 37	39.1 - 43	46.1 - 51	52.1 - 57	59.1 - 65	67.1 - 74
30	32.1 - 33	37.1 - 39	43.1 - 45	51.1 - 53	57.1 - 60	65.1 - 68	74.1 - 77
0	> 33	> 39	> 45	> 53	> 60	> 68	> 77

Figure C-6. Point calculation sheet, Tables VII and VIII, MPSM rocket engagement tasks (concluded)

4 PAIRS							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	43 or less	53 or less	65 or less	78 or less	96 or less	120 or less	138 or less
95	43.1 - 46	53.1 - 56	65.1 - 70	78.1 - 83	96.1 - 103	120.1 - 128	138.1 - 148
90	46.1 - 49	56.1 - 60	70.1 - 74	83.1 - 89	103.1 - 110	128.1 - 137	148.1 - 158
85	49.1 - 52	60.1 - 64	74.1 - 79	89.1 - 94	110.1 - 116	137.1 - 145	158.1 - 167
80	52.1 - 55	64.1 - 68	79.1 - 84	94.1 - 100	116.1 - 123	145.1 - 154	167.1 - 177
75	55.1 - 58	68.1 - 71	84.1 - 88	100.1 - 105	123.1 - 130	154.1 - 162	177.1 - 187
70	58.1 - 61	71.1 - 75	88.1 - 93	105.1 - 111	130.1 - 137	162.1 - 171	187.1 - 197
50	61.1 - 67	75.1 - 83	93.1 - 102	111.1 - 122	137.1 - 151	171.1 - 188	197.1 - 217
30	67.1 - 70	83.1 - 86	102.1 - 107	122.1 - 128	151.1 - 158	188.1 - 197	217.1 - 227
0	> 70	> 86	> 107	> 128	> 158	> 197	> 227
3 PAIRS							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	33 or less	41 or less	50 or less	60 or less	74 or less	92 or less	106 or less
95	33.1 - 35	41.1 - 44	50.1 - 54	60.1 - 65	74.1 - 80	92.1 - 99	106.1 - 114
90	35.1 - 38	44.1 - 46	54.1 - 58	65.1 - 69	80.1 - 85	99.1 - 106	114.1 - 122
85	38.1 - 40	46.1 - 49	58.1 - 61	69.1 - 73	85.1 - 90	106.1 - 112	122.1 - 129
80	40.1 - 42	49.1 - 52	61.1 - 65	73.1 - 77	90.1 - 95	112.1 - 119	129.1 - 137
75	42.1 - 45	52.1 - 55	65.1 - 68	77.1 - 82	95.1 - 101	119.1 - 125	137.1 - 144
70	45.1 - 47	55.1 - 58	68.1 - 72	82.1 - 86	101.1 - 106	125.1 - 132	144.1 - 152
50	47.1 - 52	58.1 - 64	72.1 - 79	86.1 - 95	106.1 - 117	132.1 - 145	152.1 - 167
30	52.1 - 54	64.1 - 67	79.1 - 83	95.1 - 99	117.1 - 122	145.1 - 152	167.1 - 175
0	> 54	> 67	> 83	> 99	> 122	> 152	> 175

Figure C-7. Point calculation sheet, Tables VII and VIII, PD rocket engagement tasks

2 PAIRS							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	23 or less	29 or less	36 or less	43 or less	53 or less	65 or less	75 or less
95	23.1 - 25	29.1 - 31	36.1 - 38	43.1 - 46	53.1 - 56	65.1 - 70	75.1 - 80
90	25.1 - 26	31.1 - 33	38.1 - 41	46.1 - 49	56.1 - 60	70.1 - 74	80.1 - 86
85	26.1 - 28	33.1 - 35	41.1 - 43	49.1 - 52	60.1 - 64	74.1 - 79	86.1 - 91
80	28.1 - 30	35.1 - 37	43.1 - 46	52.1 - 55	64.1 - 68	79.1 - 84	91.1 - 96
75	30.1 - 31	37.1 - 39	46.1 - 48	55.1 - 58	68.1 - 71	84.1 - 88	96.1 - 102
70	31.1 - 33	39.1 - 41	48.1 - 51	58.1 - 61	71.1 - 75	88.1 - 93	102.1 - 107
50	33.1 - 36	41.1 - 45	51.1 - 56	61.1 - 67	75.1 - 83	93.1 - 102	107.1 - 118
30	36.1 - 38	45.1 - 47	56.1 - 59	67.1 - 70	83.1 - 86	102.1 - 107	118.1 - 123
0	> 38	> 47	> 59	> 70	> 86	> 107	> 123
1 PAIR							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	13 or less	17 or less	21 or less	25 or less	31 or less	38 or less	43 or less
95	13.1 - 14	17.1 - 18	21.1 - 23	25.1 - 27	31.1 - 33	38.1 - 41	43.1 - 47
90	14.1 - 15	18.1 - 19	23.1 - 24	27.1 - 29	33.1 - 35	41.1 - 43	47.1 - 50
85	15.1 - 16	19.1 - 20	24.1 - 26	29.1 - 31	35.1 - 37	43.1 - 46	50.1 - 53
80	16.1 - 17	20.1 - 22	26.1 - 27	31.1 - 32	37.1 - 40	46.1 - 49	53.1 - 56
75	17.1 - 18	22.1 - 23	27.1 - 29	32.1 - 34	40.1 - 42	49.1 - 51	56.1 - 59
70	18.1 - 19	23.1 - 24	29.1 - 30	34.1 - 36	42.1 - 44	51.1 - 54	59.1 - 62
50	19.1 - 21	24.1 - 26	30.1 - 33	36.1 - 40	44.1 - 48	54.1 - 59	62.1 - 68
30	21.1 - 22	26.1 - 28	33.1 - 35	40.1 - 41	48.1 - 51	59.1 - 62	68.1 - 71
0	> 22	> 28	> 35	> 41	> 51	> 62	> 71

Figure C-8. Point calculation sheet, Tables VII and VIII, PD rocket engagement tasks (concluded)

MPSM							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	121 or less	137 or less	153 or less	179 or less	200 or less	226 or less	257 or less
95	121.1 - 130	137.1 - 147	153.1 - 164	179.1 - 192	200.1 - 215	226.1 - 242	257.1 - 275
90	130.1 - 138	147.1 - 157	164.1 - 175	192.1 - 205	215.1 - 229	242.1 - 258	275.1 - 294
85	138.1 - 147	157.1 - 167	175.1 - 186	205.1 - 218	229.1 - 243	258.1 - 275	294.1 - 312
80	147.1 - 156	167.1 - 176	186.1 - 197	218.1 - 230	243.1 - 257	275.1 - 291	312.1 - 330
75	156.1 - 164	176.1 - 186	197.1 - 208	230.1 - 243	257.1 - 272	291.1 - 307	330.1 - 349
70	164.1 - 173	186.1 - 196	208.1 - 219	243.1 - 256	272.1 - 286	307.1 - 323	349.1 - 367
50	173.1 - 190	196.1 - 216	219.1 - 241	256.1 - 282	286.1 - 315	323.1 - 355	367.1 - 404
30	190.1 - 199	216.1 - 225	241.1 - 252	282.1 - 294	315.1 - 329	355.1 - 371	404.1 - 422
0	> 199	> 225	> 252	> 294	> 329	> 371	> 422
PD							
RANGE IN METERS	1000-2000	2001-3000	3001-4000	4001-5000	5001-6000	6001-7000	7001-8000
POINTS	**Engagement Time In Seconds**						
100	72 or less	88 or less	109 or less	130 or less	161 or less	202 or less	232 or less
95	72.1 - 77	88.1 - 95	109.1 - 117	130.1 - 140	161.1 - 173	202.1 - 216	232.1 - 249
90	77.1 - 82	95.1 - 101	117.1 - 125	140.1 - 149	173.1 - 184	216.1 - 230	249.1 - 266
85	82.1 - 88	101.1 - 107	125.1 - 133	149.1 - 158	184.1 - 196	230.1 - 245	266.1 - 282
80	88.1 - 93	107.1 - 113	133.1 - 140	158.1 - 167	196.1 - 207	245.1 - 259	282.1 - 299
75	93.1 - 98	113.1 - 120	140.1 - 148	167.1 - 177	207.1 - 219	259.1 - 274	299.1 - 315
70	98.1 - 103	120.1 - 126	148.1 - 156	177.1 - 186	219.1 - 230	274.1 - 288	315.1 - 332
50	103.1 - 113	126.1 - 139	156.1 - 172	186.1 - 205	230.1 - 253	288.1 - 317	332.1 - 365
30	113.1 - 118	139.1 - 145	172.1 - 179	205.1 - 214	253.1 - 265	317.1 - 331	365.1 - 382
0	> 118	> 145	> 179	> 214	> 265	> 331	> 382

Figure C-9. Point calculation sheet, Tables VII and VIII, 7 rocket engagement tasks, OH-58D (KW)

RANGE IN METERS	<1000	1000-1500	1501-2000
POINTS	**Engagement Time In Seconds**		
100	81 or less	102 or less	123 or less
95	81.1 - 86	102.1 - 109	123.1 - 131
90	86.1 - 92	109.1 - 116	131.1 - 140
85	92.1 - 98	116.1 - 123	140.1 - 149
80	98.1 - 104	123.1 - 131	149.1 - 158
75	104.1 - 109	131.1 - 138	158.1 - 166
70	109.1 - 115	138.1 - 145	166.1 - 175
50	115.1 - 127	145.1 - 160	175.1 - 193
30	127.1 - 132	160.1 - 167	193.1 - 201
0	> 132	> 167	> 201

Figure C-10. Point calculation sheet, Tables VII and VIII, .50 cal MG engagement tasks, 120 rounds

RANGE IN METERS	<1000	1000-1500	1501-2000
POINTS	**Engagement Time In Seconds**		
100	52 or less	63 or less	74 or less
95	52.1 - 56	63.1 - 68	74.1 - 80
90	56.1 - 59	68.1 - 72	80.1 - 85
85	59.1 - 63	72.1 - 77	85.1 - 90
80	63.1 - 67	77.1 - 81	90.1 - 95
75	67.1 - 70	81.1 - 86	95.1 - 101
70	70.1 - 74	86.1 - 90	101.1 - 106
50	74.1 - 81	90.1 - 99	106.1 - 117
30	81.1 - 85	99.1 - 104	117.1 - 122
0	> 85	> 104	> 122

Figure C-11. Point Calculation sheet, Tables VII and VIII, .50 cal MG engagement tasks, 80 rounds

SECONDS	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	24	27	30
POINTS	100	98	96	94	92	90	88	86	84	82	80	78	76	74	72	70	50	30

Figure C-12. Point calculation sheet, Tables VII and VIII, door gunnery tasks

GLOSSARY

ACRONYMS AND ABBREVIATIONS

A^2C^2 - Army airspace command and control
A - attack
AADS - airspeed and direction sensor
AAR - after action review
ABCS - airfield battlefield countermeasures and survivability
AC - alternating current
acft - aircraft
ACP - air control point
ACQ - acquire
ADA - air defense artillery
ADI - attitude direction indicator
ADS - air data subsystem
ADSS - air data sensor subsystem
ADV - advance
AF - adjust fire
AGES - air-ground engagement system
AGL - above ground level
AGM - antitank guided missile
AH - attack helicopter
AH1FWS - AH-1 flight weapons simulator
AHGR - attack helicopter gunnery range
AL - Alabama
ALCA - aircraft loader control assembly
ALFGL - automatic low frequency gain limiting
ALSE - aviation life support equipment
ALT - airborne laser tracker
AMC - air mission commander
AMCCOM - US Army Armament, Munitions, and Chemical Command
AMC ORD - at my command ordnance
AMC TGT - at my command target
ammo - ammunition
AND - alphanumeric display
AP - armor piercing
APC - armored personnel carrier
API - armor-piercing incendiary
API-T - armor-piercing incendiary--tracer
APU - auxiliary power unit
AQC - aviator qualification course
AR - Army regulation
ARCP - aerial rocket control panel

ARCS - aerial rocket control system
ARI - Army restructuring initiative
ARM - antiradiation missile
ARMD - armed
ARNG - Army National Guard
ARTEP - Army Training and Evaluation Program
ASE - aircraft survivability equipment
ASET - aircraft survivability equipment trainer
ASO - aviation safety officer
assy - assembly
ATAC - air-to-air combat
ATAS - air-to-air Stinger
ATGM - antitank guided missile
ATHS - automatic target handover system
atk - attack
ATM - aircrew training manual
ATS - acquire-track-stow
attk - attack
attn - attention
ATWESS - antitank weapons effects signature simulator
AUTO - automatic
AVIM - aviation intermediate maintenance
AVTR - airborne video tape recorder
AVUM - aviation unit maintenance
AWS - area weapon system
AWSS - area weapons scoring system
az - azimuth

BBC - backup bus controller
BDA - battle damage assessment
BIT - built-in test
BMD - Russian combat vehicle, airborne
BMP - Soviet personnel carrier
BOT - burst on target
BP - battle position
BPC - battle position card
BRDM - Russian combat reconnaissance patrol vehicle
BRSIT - boresight
BRT - bright
BSS - ballistics scoring subsystem
BTM - battalion training model
BTR - Soviet personnel carrier
btry - battery
B/W - black on white

C^2 - command and control

C - centigrade
CALFEX - combined arms live-fire exercise
CAS - close air support
CB - circuit breaker
CBHK - captive boresight harmonization kit
CDS - control display subsystem
CDU - computer display unit
CCIP - continuously computed impact point
CCM - counter-countermeasure
C-COFT - crew conduct of fire training
CCP - communication check point
CFT - captive flight trainer
CG - center of gravity
CGUN - copilot gun
CH - cargo helicopter
CHAN - channel
CHANLS - channels
CL - checklist
CMS - combat mission simulator
CMSL - copilot missile
COMP - compensation
COMSEC - communications security
CONT - control
CONVERG - convergence
CONUS - continental United States
coop - cooperative
CPG - copilot/gunner
CPO - copilot/observer
CRT - Cathode ray tube
CSS - computer scoring system
CTC - combined training center
CTT - combined training center
CVI - combat vehicle identification
C/W - caution warning
CWEPT - cockpit weapon and emergency procedures trainer

DA - Department of the Army
DASE - digital automatic stabilization equipment
DC - direct current
deg - degree
DEK - data entry keyboard
DELVRY - delivery
DGST - door gunnery skills test
DIG - digital generation imagery
dir - direct
DODAC - Department of Defense Ammunition Codes

DODIC - Department of Defense Identification Code
DP - dual purpose
DS - direct support
DSS - detonation scoring subsystem
DTTP - doctrine and tactics training plan
DTV - day television
DVO - direct view optics

EA - engagement area
ECAS - enhanced Cobra armament system
ECM - electronic counter measure
EL - elevation
ELEC - electrical
EMR - electromagnetic radiation
ENG - engagement
EOD - explosive ordnance disposal
EPS - electronic power supply
EPU - electronics processor unit
ETL - effective translational lift

FA - Field Artillery
FAA - forward assembly area
FAB - forward avionics bay
FAIL - failure
FARM - fuel, ammunition, cannon, rockets, missiles
FARP - forward arming and refueling point
FCC - fire control computer
FCP - fire control panel
FCR - fire control reticle
FDC - fire direction center
FD/LS - fault detection/location system
FFAR - folding fin aerial rocket
FFE - fire for effect
FHT - field handling trainer
flex - flexible
FLIR - forward looking infrared radar
FLOT - forward line of own troops
FLTR - filter
FM - field manual or frequency modulated
FOC - focus
FORSCOM - Forces Command
FOV - field of view
FP - firing point
fps - feet per second
ft - feet
FTX - field training exercise

FXD - fixed
FWS - flight weapon simulator
FY - fiscal year

GEN - generator
GHSS - gunner's helmet sight subsystem
GND - ground
GPU - ground power unit
G/VLLD - ground or vehicular laser locator designator
GZN - grid zone

HA - holding area
HAD - high action display
HARS - heading and altitude reference system
HDD - heads-down display
HDM - Hellfire dummy missile
HDU - helmet display unit
HE - high explosive
HEAT - high-explosive antitank
HEDP - high-explosive dual-purpose
HEI - high-explosive incendiary
HEI-T - high-explosive incendiary-tracer
HEI-T-SD - high-explosive incendiary with tracer and self-destruct feature
Hellfire - Hellfire laser air defense suppression and fire-and-forget guided missile
HE-PD - high-explosive point detonating
HERO - hazard of electronic radiation to ordnance
HF - Hellfire
HFOV - horizontal field of view
HGST - Helicopter gunnery skills test
HI - high
HIMAG - high magnification
HMMWV - high mobility multipurpose wheeled vehicle
HOD - heads-out display
HMD - helmet-mounted display
HQ - headquarters
HSI - horizontal situation indicator
HSS - helmet sight subsystem
HTM - Hellfire training missile
HUD - heads-up display

IAT - image autotracking
IATF - individual aircrew training folder
IAW - in accordance with
ID - identification
IEA - IMUX electronic assembly
IERW - initial entry rotary wing

IFF - identification friend and foe
IGE - in-ground effect
IHADSS - integrated helmet and display sight system
IL - illumination
ill - illumination
ILS - instrument landing system
IMUX - interface multiplexer
in - inch
INBD - inboard
ind - indicator
inf - infantry
IO - instructor operator
IP - instructor pilot or initial point
IR - infrared
IRCCM - infrared counter-countermeasures
IRIS - infrared imaging seeker
ISP - integrated systems processor

JAAT - joint air attack team
JATO - jet-assisted takeoff

KIAS - knots indicated airspeed
km - kilometer
kt - knot
KVA - kilovolt ampere
KW - Kiowa Warrior

LAI - low airspeed indicator
LAT - latitude
LAW - light antitank weapon
lb - pound
LD - line of departure
LEU - laser electronics unit
LFX - live-fire exercises
LH - left hand
LHG - left hand grip
LMC - linear motion compensator
LNCH - launch
LNDS - Lightweight Doppler Navigation Set
LO - low
LOAL - lock-on after launch
LOBL - lock-on before launch
LO MAG - low magnification
LOS - line of sight
LP - listening post
LRF - laser range finder

LRF/D - laser range finder/designator
LRSNCO - laser range safety noncommissioned officer
LRSO - laser range safety officer
LRU - line replaceable unit
LST - laser spot tracker
LSR - laser
LTL - laser target line
LTU - laser transceiver unit
LWR - lower
LZ - landing zone

m - meter
M - missile or mil
MACOM - major Army command
MAG - magnification
MALF LT - malfunction light
MAN - manual
MANL - manual
MANPADS - man-portable air defense system
MAN TRK - manual tracker
max - maximum
MED - medium
MEDEVAC - medical evacuation
MEM LT - memory light
METL - mission essential task list
METT-T - mission, enemy, terrain, troops, and time available
MFD - multifunction display
MILES - multiple integrated laser engagement system
min - minute or minimum
MK - mark
mm - millimeter
MMS - mast-mounted sight
MOI - methods of instruction
MOPP - mission-oriented protective posture
MOS - military occupational specialty
MP - multipurpose
mps - meters per second
MPRC - multipurpose range complex
MPSM - multipurpose submunition
MPT-SD - multipurpose tracer-self destruct
MRE - meal, ready-to-eat
MRT - minimum resolvable temperature
MRTU - multiplex remote terminal unit
MSL - missile or mean sea level
MSP - mast sight processor
MTOE - modified table(s) of organization and equipment

MTP - mission training plan
MUX - multiplex
MV - magnetic variation
MWO - modification work order

N - narrow
NATO - North Atlantic Treaty Organization
NAV - navigation
NBC - nuclear, biological, chemical
NCO - noncommissioned officer
NCOIC - noncommissioned officer in charge
NFOV - narrow field of view
NG - National Guard
NGB - National Guard Bureau
no - number
NOE - nap-of-the-earth
NORM - normal
NSN - national stock number
NVD - night vision devices
NVG - night vision goggles
NVS - night vision system

OC - observer controller
OE^2 - ordnance expenditure exercise
OFS - offset
OGE - out-of-ground effect
OH - observation helicopter
OIC - officer in charge
OP - observation post
OPFOR - opposing forces
OPORD - operation order
OPTEMPO - operational tempo
ORIDE - override
ORT - optical relay tube
OSET - offset
OUTBD - outboard
OVRD - override

PC - pilot in command
PD - point detonating
PDU - pilot display unit
PEN - penetrate
PEN-M - penetration in meters
PFR - pulse radar frequency
PH - probability of hit
PHS - pilot helmet sight

PHSS - pilot helmet sighting system
PL - precautionary landing or phase line
plt - platoon
PLT/GNR - pilot to gunner
PMI - premarksmanship instruction
PMSL - pilot missile
P/N - part number
PNVS - pilot night vision system
POI - program of instruction
POL - petroleum, oils, and lubricants
POST - passive optical seeker tracking
PPC - performance planning card
PRI - primary
PRKT - pilot rocket
prs - pairs
PSI - pilot's steering indicator
PTWS - point target weapon system
PWR ON - power on

qad - quadruple
QE - quadrant elevation
QTY - quantity

R - ready or range
RAD - ram air decelerator
RAI - remote attitude indicator
RC - remote control
RCD - recorder
RCO - range control officer
RCPU - rocket control panel unit
RDY - ready
recon - reconnaissance
REM - remaining
reqd - required
RETS - remote target system
RF - radio frequency
RFD - range finding designator
RH - right hand
RHE - remote Hellfire electronics
RHA - rolled homogenous armor
RIPL - ripple
rkt - rocket
RL - readiness level
RMI - radio magnetic indicator
RMP - radio magnetic pulse
RMP (Stinger) - reprogamable microprocessor

RMS - rocket management system
RND REM - rounds remaining
rnds - rounds
RNG - range
RNG-KM - range-kilometers
ROE - rules of engagement
RP - release point
rpl - ripple
rps - revolutions per second
RRU - rocket remote unit
RSO - range safety officer

S3 - Operations and Training Officer (US Army)
S4 - Supply Officer (US Army)
SAM - send a message or surface-to-air missile
sec - second, also section
SEL - select
SERE - survival, evasion, resistance, and escape
SEU - sight electronics unit
SIGHT SEL - sight selection switch
SIM - simulated
SITREP - situation report
SK - smoke screen
SKR - seeker
SM - submunition
sng - single
SOI - signal operation instructions
SOP - standing operating procedure
SP - standardization instructor pilot or start point
SPH - spheroid
squad - squadron
SSN - social security number
SSU - sight survey units
ST - store
STAB - stabilator
stad - stadiametric
STANAG - Standardization Agreement
STBY - standby
std - standard
STRAC - Standards in Training Commission
STX - situational training exercise
SYM - symbology
sys - system

TAA - tactical assembly area
TADS - target acquisition and designation system

TAS - true airspeed
TASC - training aids support center
TC - training circular
TCB - turret control box
TCP - TOW control panel
TEA - target effect area
temp - temperature
TEU - TADS electronic unit
tgt - target
TGT/NAV - target/navigation
TIS - thermal imaging system
TKR - tracker
TM - technical manual
TOC - tactical operations center
TOE - table(s) of organization and equipment
TOF - time of flight
TOW - tube-launched, optically-tracked, wire-guided missile
TP - target practice
TPT - target practice- racer
TRADOC - US Army Training and Doctrine Command
TRC - training readiness condition
TRK - track
TRTG - tactical radar threat generator
trans - transition
TRC - training readiness condition
TSEM - TOW system evaluation missile
TSGMS - test set guided missile system
TSR - TOW sight reticle
TSTT - TADS selected task trainer
TSU - telescopic sight unit
TTP - tactics, techniques and procedures
TV - television
TVS - television sensor

UH - utility helicopter
UHF - ultra high frequency
UPDT/ST - update/store
UPR - upper
US - United States (of America)
USA - United States Army
USAAVNC - United States Army Aviation Center
USAR - United States Army Reserve
USAREUR - United States Army Europe
USARPAC - United States Army Pacific
USR - unit status report
UT - unit trainer

UTS - universal turret subsystem

VAC - volts, alternating current
VDC - volts, direct current
VDU - video display unit
VHF - very high frequency
VID - video
vis - visibility
VRS - video recorder subsystem
VSD - vertical situation display

w - with
W - width
WAS - weapons action switch
W/B - white on black
W/E - with equipment
WESTCOM - United States Army Western Command
WFOV - wide field of view
WP - white phosphorous
wpn - weapon
WR - when ready
WR ORD - when ready ordnance
WRM - width, range, mil
WR TGT - when ready target
WSS - weapons select switch

XMSN - transmission

ZFOV - zoom field of view
ZSU - Soviet self-propelled antiaircraft gun

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These documents must be available to the intended users of this publication.

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TM 9-1300-206. Ammunition and Explosives Standards. 30 August 1973.

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FM 1-140
29 MARCH 1996

By Order of the Secretary of the Army:

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01492

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