

**Army Regulation 385–63
MCO 3570.1D**

Safety

Range Safety

**Headquarters
Department of the Army
and the U.S. Marine Corps
Washington, DC
23 May 2025**

UNCLASSIFIED

SUMMARY of CHANGE

AR 385–63/MCO 3570.1D

Range Safety

This major revision, dated 23 May 2025—

- o Combines AR 385–63/MCO 3570.1D and DA Pam 385–63 into one publication (throughout).
- o Supersedes and cancels DA Pam 385–63 (throughout).
- o Makes administrative changes (throughout).

Headquarters
Department of the Army
and the U.S. Marine Corps
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***Army Regulation 385–63
MCO 3570.1D**

Effective 23 June 2025

Safety Range Safety

By Order of the Secretary of the Army:

RANDY A. GEORGE
*General, United States Army
Chief of Staff*

Official:


MARK F. AVERILL
*Administrative Assistant
to the Secretary of the Army*

By Order of the Commandant of the Marine Corps:


BENJAMIN T. WATSON
*Commanding General
Training and Education Command*

History. This publication is a major revision. The portions affected by this major revision are listed in the summary of change.

Summary. This regulation/order provides range safety policy for the Army and Marine Corps.

Applicability. This regulation/order applies to the Regular Army, the Army National Guard/Army National Guard of the United States, and the U.S. Army Reserve, unless otherwise stated. It also applies to the following: the United States Military Academy; Departments of the Army and the Navy civilian employees and contractors; Reserve Officers' Training Corps students training on Army or Marine Corps-controlled ranges; the Marine Corps Total Force; any person or organization using armor Marine Corps-controlled real estate or operational ranges; operational range training and target practice activities; military real estate areas that are being or have been used as bombing ranges; artillery impact areas or target areas; all areas designated for live-fire weapons firing; recreational ranges and rod and gun club ranges located on Army or Marine Corps real property controlled by the Army or the Marine Corps; personnel training outside the continental United States; and operational training

conducted on test and evaluation ranges (it does not apply to testing and evaluation conducted on such ranges). This regulation/order is advisory for deployed units engaged in combat operations. Army or Marine Corps commanders will apply the provisions of this regulation/order and host nation agreements as appropriate. Local standard operating procedures and range policies will reinforce this regulation/order. Service-specific policies that are more restrictive will apply regardless of the installation being used. Except for airspace and water traffic safety requirements, these provisions do not apply to development, proof, and function test ranges or laboratories. However, Army commands, Army service component commands, direct reporting units, and Marine Corps installations having such ranges and laboratories are required to develop and apply alternate standards that are appropriate to the mission and that ensure the preservation of life and property. Contracts for work on Army and Marine Corps ranges will comply with applicable provisions of this regulation/order. During contingency operations, chapters and policies contained in this regulation/order may be modified by the Assistant Secretary of the Army for Installations, Energy and Environment or Commandant of the Marine Corps.

Proponent and exception authority.

The Army proponent of this regulation/order is the Assistant Secretary of the Army for Installations, Energy and Environment. The proponent has the authority to approve exceptions or waivers to this regulation/order that are consistent with controlling laws and regulations. The proponent may delegate this approval authority, in writing, to a division chief within the proponent agency or its direct reporting unit or field operating agency, in the grade of colonel or the civilian equivalent. Activities may request a waiver to this regulation/order by providing justification that includes a full analysis of the expected benefits and must include formal review by the activity's senior legal officer. All waiver requests will be endorsed by the commander or senior leader of the requesting activity and forwarded through their higher headquarters to the policy proponent. Refer to AR 25–30 for specific requirements. The Army's consultant for surface danger zones and weapon danger zones is the Commanding General, U.S. Army Training and Doctrine Command (ATIC–TCT). The Marine Corps proponent of this order is the Commandant of the Marine Corps. The proponent has the authority to approve changes to this order that are consistent with controlling laws and regulations. The proponent has

*This publication supersedes AR 385-63/MCO 3570.1C, dated 30 January 2012 and DA Pam 385-63, dated 16 April 2014.

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delegated approval authority to the Commanding General, Marine Corps Training and Education Command (C 465). The Marine Corps technical advisor for range management is the Commanding General, Training and Education Command (C 465). Army/Marine Corps Range Safety Working Group members are direct representatives of the Service proponents and will ensure changes to this regulation/order follow Army policy and regulation, such as AR 25–30, and will ensure that any changes are consistent with controlling law and regulations.

Army internal control process. This regulation contains internal control provisions in accordance with AR 11–2 and identifies key internal controls that must be evaluated (see appendix B).

Supplementation. Supplementation of this regulation and establishment of agency, command, and installation forms are prohibited without prior approval

from the Assistant Secretary of the Army for Installations, Energy and Environment, 110 Army Pentagon, Washington, DC 20310–0110.

Suggested improvements. Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) directly to the Assistant Secretary of the Army for Installations, Energy and Environment at usarmy.pentagon.hqda-asahsa.mbx.esohsaco@army.mil. Marine Corps users are invited to submit comments and suggested improvements to the Commanding General, Marine Corps Training and Education Command (C 465), 2007 Elliot Rd, Quantico, VA 22134.

Committee management. AR 15–39 requires the proponent to justify establishing/continuing committee(s), coordinate draft publications, and coordinate changes

in committee status with the Office of the Administrative Assistant to the Secretary of the Army, Special Programs Directorate at usarmy.pentagon.hqda-hsa.mbx.committee-management@army.mil. Further, if it is determined that an established “group” identified within this regulation later takes on the characteristics of a committee as found in AR 15–39, then the proponent will follow AR 15–39 requirements for establishing and continuing the group as a committee.

Distribution. This publication is available in electronic media only and is intended for the Regular Army, the Army National Guard/Army National Guard of the United States, and the U.S. Army Reserve. Publication and distribution to authorized users within the Marine Corps are indicated in the table of allowance for publications.

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Glossary

Chapter 1

Introduction

Section I

General

1–1. Purpose

This regulation/order prescribes the policies and related administrative procedures governing range safety operations and requirements for the Army's and Marine Corps' Range Safety Programs. This regulation also establishes standards and procedures for the safe firing of ammunition, demolitions, lasers, guided missiles, and rockets; and the delivery of bombs for training, target practice, and to the extent practicable, combat. For Army and Marine Corps users, prescribed range safety standards and procedures exist within this publication. When standards in this regulation/order conflict with standards of other military Services or Federal agencies, the standards providing the higher degree of safety apply. For operational ranges outside the United States that a non-Department of Defense (DoD) Component owns, Department of Defense Directive (DoDD) 4715.12 applies subject to the terms of any agreement with the owner for the leasing or operation of the range.

1–2. References and forms

See appendix A.

1–3. Explanation of abbreviations and terms

See the glossary.

1–4. Responsibilities

See section II of this chapter.

1–5. Records management (recordkeeping) requirements

a. The records management requirement for all record numbers, associated forms, and reports required by this publication are addressed in the Records Retention Schedule–Army (RRS–A). Detailed information for all related record numbers, forms, and reports are located in Army Records Information Management System (ARIMS)/RRS–A at <https://www.arims.army.mil>. If any record numbers, forms, and reports are not current, addressed, and/or published correctly in ARIMS/RRS–A, see DA Pam 25–403 for guidance.

b. For the Marine Corps, any misuse or unauthorized disclosure of personally identifiable information (PII) may result in both civil and criminal penalties. DoD recognizes that the privacy of an individual is a personal and fundamental right that shall be respected and protected. DoD's need to collect, use, maintain, or disseminate PII about individuals for purposes of discharging its statutory responsibilities will be balanced against the individuals' right to be protected against unwarranted invasion of privacy. All collection, use, maintenance, or dissemination of PII will be in accordance with the Privacy Act of 1974, as amended (5 USC 552a) and implemented per Department of Defense Instruction (DoDI) 5400.11.

1–6. Range safety programs

a. Range safety programs will be established for all ranges in accordance with this regulation/order, Army Regulation (AR) 350–19, Marine Corps Order (MCO) 3550.9A, and MCO 3550.10 and must—

- (1) Enhance safe and realistic live-fire training, enabling the Army and Marine Corps to train as they fight.
- (2) Protect personnel and property while improving combat readiness training and helping prevent fratricide in combat.
- (3) Protect civilian and military populations who live and work near live-fire operational ranges.
- (4) Minimize, to the extent practical through the design and management of ranges, impacts on human health and the environment.
- (5) Prevent injuries and property damage by introducing risk management (RM) into the range operations process to enhance combat readiness.
- (6) Enhance the sustainability of operational ranges through the implementation of effective range clearance programs, in accordance with DoDI 3200.16.

(7) Establish range safety training and certification programs for range safety professionals and other personnel, as appropriate.

b. Army personnel who handle or manage waste military munitions, will be trained on the Military Munitions Rule (62 FR 6622) course available in the Army Training Requirements and Resources System Self Development Center at <https://www.atrrs.army.mil/selfdevctr> and in accordance with other applicable Federal, State, interstate, and local waste military munitions management requirements (for example, waste military munitions transporters must be trained on applicable provisions of the Defense Transportation Regulation 4500.9–R, Part II).

1–7. Requirements for range safety certification programs

a. Range safety certification programs will be used to train and qualify personnel in the duties of officer in charge (OIC) and range safety officer (RSO) for firing exercises and maneuver operations. Army certification programs are normally conducted at the unit level in accordance with an established range safety certification program. Marine Corps OIC and RSO certifications will be conducted at the installation level only. Prior to attendance, Marine Corps personnel must complete the Range Safety (Basic) Distance Learning Course. The Marine Corps certificate is valid for 3 years. Government civilian personnel may serve as OIC or RSO in accordance with the guidance in table 1–1. Contractors may serve as RSO, but in accordance with DoDI 1100.22 Enclosure 5 paragraph 2.d(3)(b) and Federal Acquisition Regulation 7.503(a) and 7.503(c) contractors may not serve as OIC.

b. Range safety certification programs will be integrated into organizational training.

c. Once satisfied through training and testing that individuals are qualified to perform the duties of OIC and RSO of the firing unit, battalion or squadron commanders will forward the names of trained OIC’s and RSO’s to range operations (Army) or range control (Marine Corps) for appropriate action.

d. The range management authority (RMA) (Army) and range control (Marine Corps) will provide personnel designated as OICs and RSOs a range safety briefing on the use of the training complex as part of certification.

e. The installation RMA (Army), range control officer (RCO) (Marine Corps), and the garrison or mission safety staff (Army) will monitor the effectiveness of range safety certification programs for OICs and RSOs.

f. For the Army, a locally devised “range safety card” program may be employed in lieu of unit-generated rosters of certified personnel, if approved by the installation senior commander.

g. The senior commander (Army) and installation commander (Marine Corps) may reduce the OIC and RSO grade requirements in table 1–1 by not more than one grade, with the following exceptions:

(1) The OIC of battalion or larger combined arms live-fire exercise ((CALFEX) Army) or combined arms exercise ((CAX) Marine Corps) will be a field grade commissioned officer. Exercise RSO of battalion or larger CALFEX or CAX will be an E–7 or above. Warrant Officers will not be assigned as OIC’s for battalion or larger CALFEX or CAX (Marine Corps).

(2) Marine Corps explosive ordnance disposal (EOD) units are exempt from OIC and RSO requirements when conducting EOD proficiency training on a Department of Defense Explosives Safety Board (DDESB) sited range. However, when EOD units are conducting operational training on any operational training range, the OIC and RSO requirements in table 1–1 apply. EOD units conducting EOD operations will supervise demolition and disposal operations following the guidance contained in NAVSEA OP 5, NAVSEA SW060–AA–MMA–010, and Explosive Ordnance Disposal Bulletin (EODB)/Technical Manual (TM) 60–series publications. Marine Corps EOD units conducting disassembly and inerting will assign a qualified EOD technician as an RSO. Commanding officers may designate in non-emergency standard operating procedures (SOPs) other instances that require EOD units to use an RSO. The RSO may be an E–5 or above if they are currently qualified as an EOD officer or technician military occupational specialty (MOS) 2305/2336.

Table 1–1
Officer in charge and range control officer appointment requirements

| Weapon system | Officer in charge ¹ | | | Range control officer ¹ | | |
|--|--------------------------------|-----------------|-------------------------|------------------------------------|-----------------|--------------------------|
| | Officer | Warrant officer | Noncommissioned officer | Officer | Warrant officer | Non-commissioned officer |
| Practice hand grenades; 40 millimeters (mm) practice, illumination (IL), and signaling; sub-caliber training devices; laser devices; firing devices; | X | X | E–6 | X | X | E–5 |

Table 1–1
Officer in charge and range control officer appointment requirements—Continued

| Weapon system | Officer in charge ¹ | | | Range control officer ¹ | | |
|---|--------------------------------|-----------------|-----------------------------|------------------------------------|-----------------|-----------------------------|
| | Officer | Warrant officer | Noncommissioned officer | Officer | Warrant officer | Non-commissioned officer |
| simulators; trip flares, non-lethal munitions; small arms and machine guns | | | | | | |
| Chemical agents ² , riot control ² , and smoke | X | X | E–6 ² | X | X | E–5 ² |
| Aerial gunnery and air defense weapons; live grenades, grenade launchers, and grenade machine guns; live mines and demolitions; tank and fighting vehicle cannons | X | X | E–7 | X | X | E–6 |
| Field artillery ³ | X | X | E–7 ³ | X | X | E–6 ³ |
| Mortars ⁴ | X | X | E–6 | X | X | E–6 ⁴ |
| Air defense artillery rockets and guided missiles ⁵ | X | X | Not authorized ⁵ | X | X ⁵ | Not authorized ⁵ |
| Direct-fire anti-tank rockets and missiles | X | X | E–7 | X | X | E–6 |
| Live-fire exercises using organic weapons, squad through company, battery, and troop ⁶ | X | X | E–7 ⁶ | X | X | E–6 ⁶ |
| CALFEX or CAX using outside fire support, troop, battery, squad, platoon, company; or battalion and larger ⁷ | X | X | E–7 ⁷ | X | X | E–6 ⁷ |

Notes.

¹ Civilians in the grade of general schedule (GS)–07 and above, or equivalent, may act as OIC; GS–05 and above, or equivalent, may act as RSO.

² For the Marine Corps, OIC or RSO must be E–4 and above and be chemical, biological, radiological, and nuclear (CBRN) MOS 5702/5711 when conducting CBRN or smoke training. For the Army, OIC and RSO must be CBRN qualified when conducting CBRN or smoke training.

³ Use of E–7s as OICs is authorized only when approved by the senior commander (Army) or installation commander (Marine Corps). Duties of the RSO are normally performed by either the battery executive officer or the platoon leader.

⁴ RSO for Marine Corps can be an E–5 for mortar training activities.

⁵ Senior range safety officer (SRSO) will be a chief warrant officer four or higher or a Civilian in the grade of GS–12 or above.

⁶ For the Army, when conducting maneuver or shoothouse training using force-on-force training ammunition Ultimate Training Munitions or close combat mission capability kit (CCMCK) only, OIC will be E–6 or above and RSO will be E–5 or above.

⁷ For battalion or larger CALFEX or CAX, OIC will be a field grade commissioned officer; exercise RSO will be E–7 or above.

Section II

Responsibilities

1–8. Chief of Staff, Army

The CSA, through the CG, U.S. Army Combat Readiness Center will—

- a. Administer the Army range safety program.
- b. Assist the Assistant Secretary of the Army (Installations, Energy and Environment) (ASA (IE&E)) with the planning, programming, and evaluation of an effective Army range safety program. This includes integrating range safety and RM into Army range operations, policies, and procedures and identifying and resolving range operations safety issues that affect training and readiness of the Army.
- c. Assist the ASA (IE&E) with developing and implementing range safety policy.
- d. Advise the Deputy Chief of Staff (DCS), G–3/5/7 on the establishment and management of range operating procedures.

- e.* Provide key range safety personnel data on mishaps and incidents occurring on Army and Marine Corps ranges and training areas in a timely manner.
- f.* Establish, in coordination with the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health, the DCS, G-3/5/7, and the DCS, G-4, the Army risk assessment and deviation approval process for improved conventional munitions (ICMs) and sub-munition clearance activities.
- g.* Serve as Department of the Army focal point to coordinate and integrate range safety policy matters within Headquarters, Department of the Army, ASA IE&E and with the Commanding General (CG), Marine Corps Training and Education Command (TECOM) (C 465) and other agencies as appropriate.
- h.* Assist ASA (IE&E) with evaluating the effectiveness and efficiency of range safety policies and publish changes to this regulation/order, and required or needed.
- i.* Oversee publication of Army range safety messages/memoranda (ARSMM) to provide updates and other technical information to Army commands (ACOMs), Army service component commands (ASCCs), direct reporting units (DRUs), and the Marine Corps (CG, TECOM (C 465)).
- j.* Serve as a co-chair of the Army/Marine Corps Range Safety Working Group.

1-9. Assistant Secretary of the Army (Acquisition, Logistics and Technology)

The ASA (ALT) will—

- a.* Ensure range safety data specifications are incorporated into research, development, and acquisition strategies and test programs for new weapon systems and ammunition items.
- b.* Ensure appropriate danger zones (in accordance with this regulation/order) for weapon and ammunition and explosives (AE) safety characteristics are available prior to materiel release.
- c.* Ensure project managers develop or provide required danger zones in accordance with this regulation/order in support of equipment and materiel fielding. The Army will conduct a quarterly Aviation Range Safety Working Group, which includes munition material developers, associated laboratories, and appropriate safety agencies, to ensure requisite coordination, validation and verification, correct data utilization, and proper weapon danger zone (WDZ) functionality for fielded and emerging weapon systems.
- d.* Monitor the research, development, test, evaluation, distribution, and fielding of Army EOD equipment.
- e.* Procure all Army EOD specific equipment and ammunition.

1-10. Assistant Secretary of the Army (Installations, Energy and Environment)

The ASA (IE&E) is the proponent for all Army safety policy publications and is authorized to approve exceptions and waivers to all Army safety publications that are consistent with controlling laws and regulations. The ASA (IE&E) will—

- a.* Serve as the Army's Designated Agency Safety Health Organization in accordance with Section 6, Part 1960, Title 29, Code of Federal Regulations (29 CFR 1960.6) and Department of the Army General Orders 2020-01 and represent the Secretary of the Army in the management and administration of the Army Safety and Occupational Health Program (ASOHP).
- b.* Develop and oversee ASOHP policies and provide strategic planning, direction, and advocacy for ASOHP by setting strategic goals, objectives, and metrics.
- c.* Ensure that safety and health officials are designated at each appropriate level with sufficient authority and funds in accordance with DoDI 6055.01.
- d.* Provide oversight of Army wide safety and occupational health.
- e.* Through the Deputy Assistant Secretary of the Army for Environment, Safety, and Occupational Health, serve as the functional advisor for safety and occupational health management of installations career field.
- f.* Synchronize safety and occupational health direction and initiatives across the Army and with the Secretary of Defense.
- g.* Act on the Secretary of the Army's behalf as executive agent responsible for emergency response with the responsibilities, functions, and authorities specified in DoDD 6055.09E for emergency response to transportation mishaps involving DoD military munitions. Coordinate, after an initial emergency response, required responses to transportation incidents or mishaps involving DoD military munitions (for example, mechanical breakdowns that may require reloading, transloading, securing, or storing the DoD military munitions).
- h.* Appoint, in consultation with the Director of Army Safety (DASAF) and the CG, U.S. Army Materiel Command (AMC), an Executive Director of Explosives Safety. Assist the Executive Director of Explosives Safety with Army Explosives Safety Management Program responsibilities per this regulation/order.

i. Serve as approval authority or recommending authority (for DoD requests) for all requests to deviate from DoD and Army explosives safety standards for construction of new potential explosive site or exposed site when such construction is properly supported by a Secretarial certification.

j. In accordance with DoDI 6055.01, report to the Deputy Under Secretary of Defense (Environmental Security) any situation resulting from compliance with procedures in this regulation/order that could impair the defense mission or adversely affect national security.

1–11. Chief, National Guard Bureau

The CNGB and Director, Army National Guard Bureau, if so delegated, will—

a. Ensure resources are provided to review range design plans (to include support structures and facilities) to ensure that safety requirements are adequately addressed prior to new construction or modification or renovation of firing ranges and weapons training facilities.

b. Maintain the central registry for deviations throughout the Army National Guard (ARNG).

c. Ensure resources are provided to establish and maintain the Range Safety Program throughout the ARNG, in accordance with applicable directives.

d. Provide range safety training upon request to ARNG installations, units, and others as required.

e. Ensure designated range safety training instructors and course materials are certified by the proponent for range safety training prior to initial delivery and annually thereafter.

f. Ensure that ARNG will coordinate scheduling of range safety courses with the range safety training proponent to prevent duplication of effort and to capitalize on opportunities to meet Armywide range safety training requirements.

1–12. Deputy Chief of Staff, G–1

The DCS, G–1 will ensure that the Manpower and Personnel Integration Program takes into consideration personnel requirements in the materiel development and acquisition phases for weapon systems and related components.

1–13. Deputy Chief of Staff, G–3/5/7

On behalf of DCS, G–3/5/7, the Assistant DCS, G–37 Director of Training will—

a. Ensure that range safety standards within this regulation/order are incorporated into the standardization and modernization of ranges.

b. Ensure adequate range safety training for range operations personnel.

c. Validate requirements for the use of nonstandard AE.

d. Approve Army ammunition procurement funds to purchase nonstandard AE after validation of the requirement and appropriate range safety data has been obtained.

e. Serve as a co-chair of the Army/Marine Corps Range Safety Working Group.

1–14. Deputy Chief of Staff, G–4

The DCS, G–4 will—

a. Establish procedures with the DCS, G–9 for life cycle munitions management to ensure compliance with DoDD 4715.11 and DoDD 4715.12.

b. Publish safety of use messages (SOUMs) and ground precautionary messages pertinent to weapons and munitions worldwide in accordance with AR 750–6.

c. Provide representation on the Army/Marine Corps Range Safety Working Group.

1–15. Deputy Chief of Staff, G–9

The DCS, G–9 will ensure compliance with environmental laws and regulations for real property containing ordnance and explosives.

1–16. Chief of Engineers (U.S. Army Corps of Engineers)

The COE (U.S. Army Corps of Engineers (USACE)) will—

a. Ensure that the design of ranges meets the standards prescribed in AR 350–19 and Training Circular (TC) 25–8 and is consistent with Defense Explosives Safety Regulation (DESR) 6055.09, Edition 1.

b. Negotiate and conclude agreements for real property on behalf of the Army.

1–17. The Surgeon General

TSG will—

a. Provide policies, guidance, and technical assistance to the ACOM, ASCC, DRU, and the Marine Corps organic occupational health protection support staffs, with all Army resource expenditures fully reimbursed by the Marine Corps, as appropriate, for occupational health protection regarding electromagnetic radiation, laser, visible light, radar, combustion by-products, lead, and noise and eye hazards on outdoor and indoor operational ranges and associated work areas.

b. Provide ACOM, ASCC, DRU, and the Marine Corps occupational health protection support staffs technical assistance in evaluating and certifying laser ranges upon request.

c. Evaluate and certify all Army tactical laser devices prior to fielding.

1–18. Commanding General, U.S. Army Training and Doctrine Command

The CG, TRADOC will—

a. Provide advice on range safety policies, procedures, and standards for the Army.

b. Ensure TRADOC Schools and Centers of Excellence provide required technical information on weapons and munitions development to the Army Training Support Center (ATIC–LTR–O).

c. Through the Director, Army Training Support Center, U.S. Army Training and Doctrine Command Proponent Office (TPO) Live, TPO Ranges, designate a technical consultant for Army range safety matters. The technical consultant will—

(1) Provide advice on range safety policies, procedures, and standards for the Army.

(2) Serve as a subject matter expert (SME) for revisions or changes to this regulation/order.

(3) Analyze range safety technical data, such as munitions data and ballistic characteristics validated by AMC or other sources, and recommend resultant regulatory changes.

(4) Review all danger zone policies for Army weapon systems.

(5) Approve new danger zones and changes to existing danger zones based on recommendations from the CG, AMC and others, as appropriate.

(6) Assist in providing technical guidance to ACOMs; ASCCs; DRUs; Federal, State, and local agencies; and other organizations on range safety issues.

(7) Assist in monitoring Army range safety operations and procedures worldwide.

(8) Serve as lead developer for Army range safety training and coordinate range safety instruction.

(9) Publish ARSMM to provide updates and other appropriate technical information to ACOMs, ASCCs, DRUs, and the Marine Corps (CG, TECOM (C 465)).

(10) Ensure required range safety training for range operations personnel through the Range Operations Professional Development program.

(11) Coordinate, publish, and update a range safety pocket guide for use by Army personnel.

(12) Coordinate, publish, and update WZDs for rotary wing-delivered and Army delivered ordnance.

(13) Serve as the Army's range safety technical center for advice on standardization and integration of safety and operations to support training objectives.

(14) Approve requirements for nonstandard AE.

1–19. Commanding General, U.S. Army Materiel Command

The CG, AMC will—

a. Establish danger zone development criteria based on weapon, munition capabilities, and user requirements.

b. Provide weapon system danger zones and range safety mitigations for the maintenance and update of this regulation/order to the CG, TRADOC (ATIC–LTR–O).

c. Provide appropriate danger zone dimensions and supporting technical data prior to materiel release of new munitions or weapon systems to TPO Ranges (ATIC–LTR–O) and the Sustainable Range Program-Mandatory Center of Expertise, Huntsville, Alabama, in accordance with AR 385–10 and DA Pam 385–10.

d. Ensure munitions data and ballistic characteristics are included in materiel development and acquisition life cycle management phases.

e. Establish a program to validate or amend existing danger zones and provide recommendations to TPO Ranges (ATIC–LTR–O), as required.

f. Provide, upon request, milestone schedules for munitions and weapon systems danger zone development to TPO Ranges (ATIC–LTR–O).

1–20. Commanding General, U.S. Army Special Operations Command

The CG, USASOC will designate a technical consultant to TRADOC for close quarters combat (CQC), advanced military operations in urban terrain (AMOUT), and other USASOC-unique range safety matters. The technical consultant will—

- a.* Recommend CQC and AMOUT range safety policies, procedures, and standards for Army special operations forces (ARSOFF), to include requirements for conducting ARSOFF CQC and AMOUT training and operations.
- b.* Provide a USASOC SME on ARSOFF CQC and AMOUT to develop proposed updates and revisions to AR 385–63/MCO 3570.1D and submit through TPO Ranges (ATIC–LTR–O).
- c.* Analyze USASOC range safety technical data, such as nonstandard munitions data and ballistic characteristics provided by AMC or other sources, and recommend changes to the DASAF (DACS–SF).
- d.* Prepare and recommend surface danger zone (SDZ) standards for nonstandard weapons and munitions systems used in CQC and AMOUT training and operations to CG, TRADOC.
- e.* Coordinate USASOC range safety matters and, in coordination with the DASAF, provide USASOC technical range safety assistance to ACOMs, ASCCs, DRUs, Federal agencies, and other Services.
- f.* Provide technical assistance on CQC and AMOUT and other USASOC-unique range safety matters to other Federal, State, national, and international organizations and so forth, as appropriate.
- g.* Monitor and review USASOC CQC and AMOUT ARSOFF range safety operations and procedures worldwide to ensure the adequacy of CQC and AMOUT range safety practices.

1–21. Commanders of Army commands, Army service component commands, and direct reporting units

The commanders of ACOMs, ASCCs, and DRUs will ensure adequate range safety training for appropriate personnel.

1–22. The Army Range Safety Working Group

Commanders of ACOMs, ASCCs and DRU's will conduct the Army Range Safety Working Group. Membership will consist of ACOM, ASCC, and DRU representatives who are SMEs on operational range safety and training requirements pertinent to safe range operations and system developers related to integrating safety in range operations. The Army Range Safety Work Group will—

- a.* Review and coordinate Army range safety policy and procedures for operational ranges.
- b.* Review, discuss, and make recommendations for worldwide Army range safety issues.
- c.* Review new weapon systems to ensure operational range safety requirements are identified and promulgated prior to weapon fielding.
- d.* Report to the Army Safety and Occupational Health Synchronization Oversight Council all range safety issues that impact senior Army leadership.
- e.* Command representatives at the ACOM, ASCC, DRU level will establish a charter recognizing procedures and members of the working group.

1–23. Marine Corps

The Commandant of the Marine Corps (CMC) (Safety Division) establishes overall Marine Corps safety and occupational health policies. The Deputy Commandant, Installations and Logistics (I&L) establishes environmental program policy.

a. The CG, TECOM (C 465) administers and directs the Marine Corps Range Safety Program in support of the Marine Corps Range and Training Area (RTA) Program as specified in applicable regulations. The CG, TECOM (C 465) serves as the central point of contact for all Marine Corps RTA issues, to include the dissemination of policy guidance. The CG, TECOM (C 465) is the CMC agent for RTA validation in the requirements determination process. The CG, TECOM (C 465) will—

- (1) Maintain this publication with associated pamphlets and update as required.
- (2) Prioritize training resources, submit training program objective memorandum initiatives, and identify present and future RTA requirements.
- (3) Establish an RTA investment strategy program.
- (4) Serve as coordinator of all RTA issues and act as the Marine Corps RTA safety representative.
- (5) Receive and review requirements documents, integrated logistics support plans, and materiel fielding plans relating to RTAs.
- (6) Coordinate enhancement efforts with installations managing existing RTAs.
- (7) Coordinate with installation efforts for effective scheduling and utilization of military special use airspace (SUA).

(8) Coordinate with other Services; appropriate Marine Corps staff offices; and regional Marine Corps installation, base, and station commanders on range management information systems.

(9) Ensure that range safety standards within this regulation/order are incorporated into the standardization and modernization of ranges.

(10) Ensure required range safety training for range operations personnel through the Range Operations Professional Development program.

(11) In conjunction with Marine Corps regional installation, base, and station commanders, initiate military construction programs in support of force structure and training area enhancement.

(12) Coordinate with the Deputy Commandant, I&L (Land Use and Military Construction Branch) to maintain an accurate inventory of RTAs.

(13) Ensure management plans developed by the bases and stations include management procedures to maintain long-term sustainable range use.

(14) Coordinate with the Deputy Commandant, I&L to establish and implement procedures to assess the potential environmental impacts of munitions use on RTAs.

(15) Establish procedures for range clearance operations to permit the sustainable use of RTAs. These procedures will include the frequency and scope of range clearance operations based on safety hazards associated with the clearance operations, the range's intended use, and quantity and type of munitions expended on the range.

(16) Publish SOUMs and precautionary messages pertinent to weapons and munitions worldwide.

(17) Provide key range safety personnel with timely data on mishaps and incidents occurring on Army and Marine Corps RTAs.

(18) Coordinate, publish, and distribute a range safety pocket guide for use by Marine Corps personnel.

(19) Coordinate, publish, and update WDCs for aviation-delivered ordnance.

(20) Serve as a co-chair of the Army/Marine Corps Range Safety Working Group.

b. The Commander, Marine Corps Systems Command (MARCORSYSCOM) will—

(1) Provide CG, TECOM (C 465) hazard assessment and recommendations regarding AE to be used on operational ranges.

(2) For Marine Corps developed or sponsored items, ensure that approved danger zones and weapons and ammunition safety characteristics are available prior to fielding and that data are forwarded to TPO Ranges (ATIC-LTR-O) and CG, TECOM (C 465).

(3) Serve as the proponent for munitions logistics (for example, storage, transportation, and demilitarization).

(4) Provide representation on the Army/Marine Corps Range Safety Working Group, as required.

c. The CG, Marine Corps Warfighting Laboratory will provide all appropriate technical data on nonstandard ammunition, explosive items, and weapon systems to be used on operational ranges to CG, TECOM (C 465).

1–24. Army and Marine Corps

The following applies to Army and Marine Corps:

a. ACOM, ASCC, and DRU commanders and Army senior commanders; the Adjutants General of the States, territories, and District of Columbia; Commander, Marine Corps Forces Reserve (COMMARFORRES); Commander, Marine Corps Installations Command (MCICOM); and the regional commanders of Marine Corps installations with RTA complexes will—

(1) Establish range safety programs in accordance with the provisions of this regulation/order; AR 350–19; AR 385–10; and current guidance published in this regulation/order, MCO 3550.9A, and MCO 3550.10 (Marine Corps).

(2) Establish review and approval procedures for conducting RM in accordance with established doctrine.

(3) Maintain a central register of deviations from the standards of this publication within the command.

(4) Review range design plans (to include support structures and facilities) to ensure that safety requirements are adequately addressed prior to new construction and modification or renovation of firing ranges and weapons training facilities.

(5) Conduct final safety acceptance surveys of all firing ranges, weapons training facilities, and related structures following new construction, modification, or renovation.

(6) Ensure proper use of both SUA and airspace outside SUA used for live-fire training.

(7) Take appropriate actions, including closure, to control hazards on ranges determined to be unsafe.

(8) Ensure RM is performed in accordance with Army Techniques Publication (ATP) 5–19 (Army) or MCO 5100.29C (Marine Corps).

(9) Comply with the prohibitions prescribed in paragraph 2–8 of this regulation/order.

b. Commanders of ACOMs, ASCCs, DRUs, the Marine Corps Forces Reserve, and MCICOM and regional commanders of Marine Corps installations with RTA complexes are authorized to approve the use of foreign nation

technical data on foreign nation weapon systems not in the U.S. inventory when used by U.S. forces after appropriate coordination with TPO Ranges (Army) or CG, TECOM (C 465) (Marine Corps). The use of danger zones developed for U.S. weapon systems and ammunition is authorized for those weapon systems sold through foreign military sales as long as the weapon platform and ammunition have not changed.

c. The Army/Marine Corps Range Safety Working Group membership consists of Army and Marine Corps representatives who are SMEs on operational range safety and the training requirements pertinent to safe range operations. The Army/Marine Corps Range Safety Working Group will—

- (1) Develop and coordinate Army and Marine Corps range safety policy and procedures for operational ranges.
- (2) Coordinate with and provide technical expertise to weapon and ammunition program managers before and during weapon systems development, to include training simulators.
- (3) Review each weapon system to ensure operational range safety requirements are identified and stated prior to weapon fielding.
- (4) Develop, coordinate, and execute Army and Marine Corps range safety training curricula as part of the Range Operations Professional Development Program.
- (5) Coordinate with DoD laboratories to obtain technical data upon which to establish danger zones and other range safety measures.
- (6) Coordinate changes and revisions to this regulation/order and associated pamphlets.

d. Senior commanders (Army) and installation commanders (Marine Corps) will—

- (1) Be responsible for ensuring the safe conduct of military personnel, and civilians employed by DoD or DoD components involved in training operations.
 - (2) Establish a range safety program that meets the requirements of paragraphs 1–6 and 1–7.
 - (3) Assign the installation RMA (Army) and RCO (Marine Corps) in writing.
 - (4) Ensure essential personnel involved with oversight to live-fire training receive appropriate range safety training such as the Army/Marine Corps Inter-Service Range Safety Course (Intermediate) which provides policies and techniques necessary for safe and efficient range operations.
 - (5) Implement a certification program for installation range OIC and RSO.
 - (6) Establish a range clearance program in accordance with DoDI 3200.16 (Army) or MCO 3550.12A (Marine Corps) that balances training requirements and high-tempo operations with the need to ensure safe and sustainable ranges.
 - (7) Comply with DoDI 6055.15, MIL–HDBK–828C, Technical Bulletin Medical (TB MED) 524, and this regulation/order in establishing firing ranges, training facilities, and maneuver areas for laser use within the installation training complex. For medical surveillance of recurrent laser workers exposed to Class 3b and Class 4 lasers and laser systems at these facilities, consult DoDM 6055.05.
 - (8) Appoint an SRSO for air defense artillery (ADA) guided missile and large rocket firing exercises.
 - (9) Establish and maintain a proactive Recognize, Retreat, Report (3Rs) Explosive Safety Education Program for assigned and on- and off-post personnel, particularly schoolchildren (kindergarten through 12th grade).
 - (10) Ensure the command's public affairs office's community relations section participates in planning for and the execution of the command's explosives safety program.
 - (11) Develop procedures to ensure all release of information to the public news media is made through the installation's public affairs office and in accordance with AR 360–1 and Secretary of the Navy Instruction (SECNAVINST) 5720.44C.
 - (12) Ensure warnings are issued at least 24 hours in advance through the installation public affairs officer to the public news media before training operations that may involve possible hazards or concerns to the general public.
 - (13) Prohibit use of alcohol and controlled substances in the training complex and any individual under the influence of alcohol or controlled substance entrance into the training complex.
 - (14) Ensure AE not expended during training are returned to the ammunition supply point (ASP), in the original packaging, when firing is completed or as directed by local policy.
 - (15) Ensure the use of the Range Facility Management Support System (RFMSS) for the range and training facility scheduling and management functions, daily operation of the Fire Desk to manage all phases of unit training, reporting of utilization data, and recording of activation and deactivation of SUA.
- e. The garrison safety manager (Army) and installation range operations director (Marine Corps) will—
- (1) Provide oversight responsibility for all range safety matters (Army) and be responsible for all range safety matters (Marine Corps).
 - (2) Evaluate the overall effectiveness of the installation range safety program annually to ensure the range safety program is being implemented in accordance with this regulation/order and installation range regulations and procedures.

(3) Inspect the installation training complex semiannually and high-risk training operations quarterly (Army) or as required (Marine Corps) to support safety in training missions.

(4) Review proposed local range safety policies and procedures.

(5) Review and comment on all high-risk or extremely high-risk assessments for training and operations on installation-owned facilities and units and others as directed by the commander.

(6) Assist the installation RMA (Army), RCO (Marine Corps), public affairs officer, and EOD officer as required in developing and implementing a proactive 3Rs Explosive Safety Education Program for assigned and on- and off-post personnel, particularly schoolchildren (kindergarten through 12th grade).

(7) Investigate or ensure range mishaps occurring within or originating from the installation training complex are investigated by the appropriate command level in accordance with AR 385–10, DA Pam 385–10, AR 15–6, or MCO 5100.29C, as appropriate.

(8) Review all range modification and construction proposals, designs, and plans.

(9) Participate in final range acceptance inspections following construction, renovation, or modification of facilities prior to any firing on the range.

(10) Review all nonstandard range and training activities, to include the user-provided RM documentation for those activities with high or extremely high residual risk.

(11) Review and make recommendations regarding the conduct of overhead fire.

(12) Monitor installation OIC and RSO training program effectiveness. For the Marine Corps, OIC and RSO must complete the Range Safety Course (Basic) Distance Learning Course prior to attendance at installation OIC and RSO training.

f. The installation RMA (Army) and RCO (Marine Corps) will—

(1) Serve as the central point for control and coordination for all activities conducted within the installation training complex to ensure safety and unified operations.

(2) Coordinate safety issues with appropriate installation staff including the garrison safety manager (Army). Coordinate range safety issues with appropriate installation staff offices (Marine Corps).

(3) Ensure all live-fire range incidents are reported to TPO Ranges (Army) and Range and Training Area Management (RTAM) (Marine Corps) by the RMA (Army) and RCO (Marine Corps).

(4) If authorized in writing by the senior commander or installation commander, withdraw or suspend installation training complex privileges from any person, organization, agency, or club that willfully violates the policies in this publication or local range regulations and procedures; or from any person whose ability or conduct is incompatible with the safe use of Government range structures and facilities. A written justification for the suspension will be provided to the unit commander for awareness and appropriate action.

(5) Maintain and update RFMSS files of current and historical usage data on the installation training complex, to include known hazards, and clearance status of temporary, dedicated, and high-hazard impact areas where available. For the Army, use of the Total Ammunition Management Information System (TAMIS) is the authoritative data source for the type of AE expended on each range, dud accumulation, and disposal records, and firing units will record all expenditures via TAMIS or DA Form 581 (Request for Issue and Turn-in of Ammunition) to the installation garrison staff.

Note. For the Army, audio recording of firing desk operation is encouraged at the installation level for the purpose of safety, AR 15–6 administrative investigation purposes, and historical tracking of incidents on the range complex.

(6) Maintain original records of current and historical danger zones, weapon system safety data, firing limitations, and survey data for firing points and impact areas within the installation training complex boundaries.

(7) Approve, control, and monitor personnel access into the installation RTA complex for both training and administrative activities. All visitors to RTAs will be approved by the RMA (Army) or RCO (Marine Corps). The RMA (Army) and RCO (Marine Corps) will be included in all range scheduling activities. If empowered by the senior commander or installation commander, the RMA (Army) or RCO (Marine Corps) is the final authority regarding the use of training facilities and will authorize live-fire and laser operations.

(8) For the Army, before personnel who have an operational requirement are granted access to range impact areas, determine whether ICM or sub-munitions are known or suspected to be present. The RMA (Army) or RCO (Marine Corps), in coordination with garrison safety (Army) or installation safety (Marine Corps) and EOD representatives, determines whether it is safe to permit access and, if required, establishes prerequisite precautions, including escort by EOD or unexploded ordnance (UXO)-qualified personnel. Personnel permitted access to any area known or suspected to contain ICM or sub-munitions will be fully appraised of the potential dangers and the safeguards to be exercised (see para 2–21 for additional actions required for operational ranges and other areas where ICM or sub-munitions are known or suspected to be present).

(9) Maintain current maps and overlays of training complex impact area boundaries, danger zone diagrams, and ground hazards for dissemination of information to installation training complex users.

(10) Establish, maintain, and document safety certification procedures for unit range OIC and RSO. For artillery units, the commander provides the installation RMA (Army) or RCO (Marine Corps) a list of personnel who have successfully completed the unit certification program. The installation RMA (Army) or RCO (Marine Corps) ensures that all OICs and RSOs have received baseline education addressing the use of installation training complex facilities (for example, installation procedures for opening and closing facilities, communications requirements, and medical evacuation procedures).

(11) Perform administrative and investigative duties related to the safe operation of ranges, training areas, and airspace.

(12) Assist the garrison safety (Army), installation safety (Marine Corps) office, and public affairs officer in establishing and implementing a proactive 3Rs Explosive Safety Education Program for assigned and on- and off-post personnel, particularly schoolchildren (kindergarten through 12th grade).

(13) Exercise oversight of unit range OIC and RSO training programs and serve as the authority on suspension or termination of OIC and RSO certification (Army). Installation RMA (Army) or RCO (Marine Corps) will conduct all OIC and RSO certifications and serve as the authority on suspension or termination of those certifications (Marine Corps).

(14) Exercise approval authority for the conduct of overhead fires when authorized by the installation commander or senior commander. Approval is based on considering unit RM documentation, maneuver plans, and the garrison safety manager's (Army) or RCO's (Marine Corps) recommendation.

(15) Coordinate, as required, with installation facilities engineers for maintenance of ranges and training facilities to provide safe operating conditions.

(16) Participate as a member of the installation range mishap investigation team, providing weapons and munitions information, scenario input and time-line data, and SME input to the garrison safety (Army) or installation safety (Marine Corps) manager.

(17) Coordinate with local EOD, environmental, garrison safety, and other involved staff organizations for clearance of specific UXO on a case-by-case basis as dictated by mission requirements (Army). Coordinate with appropriate staff offices for the clearance of specific UXO on a case-by-case basis as dictated by mission requirements (Marine Corps). This unscheduled UXO clearance is in addition to the recurring operational range clearance requirements in DoDI 3200.16. Maintain a working register of all known RTA facts, circumstances, and information concerning UXO within the installation RTAs. This data must be maintained as a critical historical record and be made available to those installation staff elements that may employ the information to reduce the risk of UXO-related incidents (for example, Department of Public Works, safety office, provost marshal, public affairs office, or fire department). For the Marine Corps, EOD does not have the mission for range clearance operations. Marine Corps range clearance operations will be conducted in accordance with MCO 3550.12A.

(18) Develop and publish an installation or garrison SOP or range regulation.

(19) Ensure that appropriate explosives safety site plans are submitted for permanent ammunition and explosive storage facilities, except for 1.4 small caliber ammunition, on ranges. There is no requirement for a site plan unless the storage or distribution facility is improved and is used on a recurring basis, such as a building or a covered concrete pad.

(20) Designate ranges and areas that are not known or suspected to contain UXO for hunting and other recreational activities. Control the movement of personnel so as not to interfere with operational range training.

(21) Prohibit unnecessary access (for example, livestock grazing and recreational uses, such as hunting and hiking) and take appropriate action to deter unauthorized access to areas known or suspected to contain UXO or other munitions that have experienced abnormal environments.

(22) For the Army, successfully complete the Inter-Service Range Safety Course (Intermediate) or the Range Safety Course Level II. For the Marine Corps, successfully complete the Inter-Service Range Safety Course (Intermediate).

(23) Ensure that range maintenance, construction, renovation, or modification programs within operational range areas that may contain UXO that involve ground disturbing or intrusive activities use construction support or, if required, are conducted in a manner that includes the explosives safety criteria applicable to a munitions response.

(24) For the Army, ensure all units training on the installation receive a brief of specific hazards within the training area and all hazards related to vehicle rollovers and vehicle mishaps.

g. RMA RSO (Army) will—

(1) Assist the RMA with interpreting, adapting, development, and execution of program policies and objectives pertaining to weapons, explosives, and training facilities on an installation.

(2) Assist RMA with safety and RM proposals and packets on multipurpose ranges used by different weapon systems and different unit types to meet the continually changing training requirements.

(3) Assist in the coordination of large, complex training events within the mission areas of range scheduling, operations, and real-time range operations.

(4) Review all SDZs, laser surface danger zones (LSDZs), and WDZs for firing on an installation developed, reviewed, and approved by the RMA RSO.

(5) Review deviation packets required for training.

h. Quality assurance specialist, ammunition surveillance (Army) will—

(1) Ensure only ammunition certified and cleared in accordance with TB 9–1300–385 or NAVSUP P–801 is issued for overhead fire of unprotected personnel.

(2) Ensure ammunition is stored, handled, and transported in accordance with applicable regulations, standards, and policies.

(3) Investigate and forward malfunction reports in accordance with AR 75–1 and DA Pam 385–40, as appropriate. Act as installation’s coordinator for ammunition malfunctions, explosive mishaps, and ammunition investigations.

(4) Provide using units with technical assistance concerning all aspects of AE.

(5) Provide ammunition liaison with range operations office, garrison safety (Army) installation safety (Marine Corps) office, logistics assistance office, EOD personnel, and training units.

i. Battalion and squadron commanders will—

(1) Comply with the installation procedures for the certification of OICs, RSOs, and laser RSOs. Once satisfied through training and testing that individuals are qualified to perform the duties of OIC, RSO, and laser RSO, forward their names to the RMA (Army) or range control (Marine Corps) for appropriate action.

(2) For commanders of Army field artillery battalions and larger field artillery units, establish and maintain an artillery safety training and certification program to train and qualify personnel in safety procedures for their specific areas of responsibility.

(3) Ensure personnel who have not completed training and certification are not appointed as an OIC or RSO. For the Marine Corps, commanders of field artillery and tank battalions will establish and maintain weapon safety and certification programs to train and qualify personnel on their respective weapon systems. Personnel must complete this training prior to being nominated by their commanders as OIC and RSO in the installation’s range safety certification program.

(4) Integrate RM into all range operations.

(5) For personnel who are at or over the action level for exposure to occupational hazards including electromagnetic radiation, laser, visible light, radar, combustion by-products (Lead), noise, and eye hazards on outdoor and indoor operational ranges and associated work areas, ensure an appropriate medical surveillance program is established and performed.

j. Unit commanders will—

(1) Ensure compliance with this publication, applicable TMs, field manuals (FMs), doctrinal publications (Marine Corps), installation range guidance, and applicable SOPs for safe training and firing for each weapon system within the command.

(2) Ensure all personnel within the command are briefed on and comply with installation range procedures and safety requirements, including required personal protective equipment (PPE).

(3) Designate an OIC and an RSO for each firing exercise or maneuver in accordance with OIC and RSO appointment requirements in table 1–1. Except as designated in paragraph 1–24I, the RSO may have no additional duties during the firing exercise.

(4) Ensure personnel performing duties of OIC and RSO are certified in accordance with established installation range safety certification program.

(5) Comply with range safety certification program requirements in paragraph 1–7 for OIC and RSO to ensure they are—

(a) Competent and properly instructed in the performance of their duties.

(b) Knowledgeable or qualified in the weapon systems for which they are held responsible and in safe ammunition handling and use procedures.

(6) Develop SOPs for laser operations, to include provision for immediate medical attention for personnel who incur eye or other overexposure to laser energy and reporting laser overexposure incidents in accordance with AR 385–10, DA Pam 385–40, TB MED 524, MIL–HDBK–828C, and MCO 5104.1C.

(7) Apply RM and develop controls and procedures for all phases of training events.

(8) Follow the requirements of the battalion or squadron commander’s program for medical surveillance of unit personnel who are at or over the action level for exposure to occupational hazards.

k. OIC qualifications and duties.

(1) *Qualifications.* The OIC must meet the following qualifications.

(a) The OIC must be a commissioned officer, warrant officer, or noncommissioned officer (NCO) (Army) or staff noncommissioned officer (SNCO) (Marine Corps) or civilian equivalent. NCOs serving as OICs will be in the grade as shown for OIC and RSO appointment requirements in table 1-1 at a minimum.

(b) The OIC will be knowledgeable in the weapon systems for which they are responsible. For weapon systems equipped or dependent on lasers, the OIC will be knowledgeable of laser hazards and proper employment. The OIC holds responsibility and accountability for the conduct of the activity and the adherence to governing regulations and guidance. They must be able to fully influence the conduct of the event. The range OIC will not (Army) or should not (Marine Corps) participate in training events for which they are responsible nor will they serve in any other capacity during those range events.

(c) The OIC must provide proof of satisfactory completion of unit (Army) or installation (Marine Corps) range safety certification program.

(2) *Duties.* The OIC must—

(a) Ensure the overall safe conduct of training and proper use of the installation training complex.

(b) Receive a range safety briefing from installation range operations (Army) or range control (Marine Corps) on use of the RTA complex.

(c) Ensure the using unit is on the correct range, firing point, or firing area as assigned by the range operations (Army) or range control (Marine Corps) and has the weapons and munitions approved for use on the range.

(d) Ensure the RSO is physically present at the training site.

(e) Determine when it is safe to fire in accordance with applicable regulations and installation range requirements.

(f) Ensure receipt of final clearance to fire from range operations (Army) or range control (Marine Corps).

(g) Ensure proper supervision of personnel performing misfire, hang fire, and cook-off procedures.

(h) Ensure required communications are established and maintained.

(i) Ensure safe laser operations.

(j) Ensure that, at a minimum, one qualified medical person is in support of live-fire training events. Qualified medical personnel will not be assigned other duties while providing medical support and will have adequate medical equipment on site for the training activity. For the Marine Corps, a qualified medical person is a military graduate from the Medical Education and Training Campus at the DoD Healthcare Education Facility, Joint Base San Antonio, Texas (for example, a Navy Corpsman or an Army medic), or a Civilian possessing a current emergency medical technician or higher certification from an approved United States Department of Transportation National Emergency Medical Services Education Standards Curricula, which is current and recognized in the State of residence.

(k) Ensure AE are properly handled, transported, stored, and accounted for within the training complex from the time of receipt to the time of expenditure or turn-in.

(l) Ensure a written log is maintained of pertinent safety and control data concerning the operation of firing ranges, weapons training facilities, maneuver areas, authorized operating times, impact areas (entries and exits), and cease-fire authorizations.

(m) Ensure plans for firing exercises and maneuvers are coordinated with range operations (Army) or range control (Marine Corps).

(n) Ensure that unit conducts rehearsals for all live-fire training evolutions.

(o) Ensure control of target areas to prohibit entry by unauthorized personnel.

(p) Ensure all ammunition malfunctions and mishaps are reported to the RMA (Army) or range control (Marine Corps) in accordance with AR 75-1 and DA Pam 385-40 (Army) or MCO 5100.29C and MCO 8025.1E (Marine Corps).

(q) Ensure coordination and approval has been gained from range operations (Army) or range control (Marine Corps) for all civilian and contractor personnel who will be entering the training site.

(r) Brief the RSO on the duties to be performed in support of the training event. Clearly establish the requirement for the RSO to brief the OIC on the safety of the facility and unit and the readiness to commence live-fire operations prior to the start of firing.

(s) Implement RM in all phases of the training events.

(t) When conducting night live-fire training, ensure that safety personnel and targets are not marked or illuminated in the same manner.

l. RSO qualifications and duties.

(1) *Qualifications.* The RSO must meet the following qualifications:

(a) *Commissioned officer, warrant officer, staff noncommissioned officer (Marine Corps), noncommissioned officer, or civilian equivalent.* Civilian contractors may act as RSO when approved by the senior commander or

installation commander. For field artillery applications, the position commander or OIC may assume RSO duties. Grade requirements will be in accordance with OIC and RSO appointment requirements in table 1–1. Personnel assigned as RSO will have no other duties during that period of training, except for aviation weapons systems training where instructor pilots, standardization instructors, or flight instructors may assume RSO duties.

(b) *Weapon system qualified.* Weapon system qualified means qualified by the OIC on the individual weapon system being fired either through preliminary marksmanship instructions, weapons qualification, or new equipment training within the last year. For CALFEXs (Army) and CAXs (Marine Corps), an exercise RSO will be assigned who may not be weapon system qualified on all weapons used during the training exercise. The exercise RSO will supervise and coordinate the activities of weapon system RSOs who are qualified on those systems. The exercise RSO grade requirements are in accordance with OIC and RSO appointment requirements in table 1–1.

(c) *Satisfactory completion.* The RSO must provide proof of satisfactory completion of unit (Army) or installation (Marine Corps) range safety certification program.

(2) *Duties.* The RSO is responsible for ensuring that the assistant range safety officers (ARSOs) fully understand their duties, including receiving range safety briefing from the installation range operations (Army) or range control (Marine Corps) on use of the RTAs. The RSO, before granting clearance to fire, ensures—

(a) ARSOs that have been appointed by the unit commander, OIC, or RSO, as required, are given a separate safety brief pertaining to the ARSO's specific responsibilities. The ARSO should be weapons system qualified and thoroughly familiar with the weapons systems they are directed to supervise. ARSOs will be in a position to directly influence the portion of the training activity to which they are responsible to enforce proper weapons handling and employment procedures.

(b) The unit is on the correct range, firing point, or firing area as assigned by the range operations (Army) or range control (Marine Corps).

(c) Weapons and personnel are properly positioned.

(d) Authorized AE, to include proper charge, fuze, and fuze settings, are used.

(e) Applicable ammunition information notice precautionary measures are incorporated into the range safety brief.

(f) Firing settings and weapons systems are within prescribed safety limits and verified.

(g) Danger zone is clear of all unauthorized personnel.

(h) Proper hearing protection is worn by personnel within noise hazard areas.

(i) Proper eye protection is worn by personnel within eye hazard areas.

(j) Permission is received from range operations (Army) or range control (Marine Corps) to commence training and live-fire operations.

(k) Compliance with responsibilities listed in local SOPs.

(3) *Final coordination.* Prior to commencing live-fire operations, the RSO will conduct final coordination with the OIC. This coordination will include a summary of checks, inspections, and actions that the RSO has completed; verification that required communications have been established; and a "hot status" has been received from range operations (Army) or range control (Marine Corps). The RSO will—

(a) Order immediate cease-fire or check-fire when any unsafe condition occurs.

(b) Be physically present at the training site.

(c) Report all mishaps and ammunition malfunctions to the range OIC.

(d) Verify, upon completion of firing or firing order, to the OIC that all weapons and weapons systems are clear and safe before allowing the removal of weapons from the firing area.

(4) *Laser operations.* During laser operations, the RSO will—

(a) Ensure unit personnel employing lasers receive thorough safety briefings, to include explanations of specific laser-related hazards, safety equipment, and detailed range safety procedures.

(b) Ensure unit personnel comply with procedures in this regulation/order.

(c) Know and observe horizontal and vertical safety limits of the laser range.

(d) Follow unit SOPs for laser operations and training exercises.

(e) Ensure all personnel engaged in laser operations, to include personnel in target areas, maintain continuous communications.

(f) Cease laser operations immediately if communications or positive control of the laser beam is lost.

(g) Allow the laser RSO, as required, to serve as the RSO.

(5) *Air Defense Artillery.* During ADA range firing with crew-served guided missiles and rockets, the RSO will—

(a) Receive missile and rocket firing advisory information from the senior RSO and advise the OIC accordingly.

(b) Ensure the entire range is clear of unauthorized personnel and equipment prior to firing and maintain clearance throughout the entire firing sequence.

m. An SRSO is required for ADA guided missile and rocket firing. In addition to requirements outlined in paragraph 1–24I personnel assigned as SRSOs must meet the following qualifications and be responsible for the duties below:

(1) Qualifications.

(a) Field grade officer, chief warrant officer 4 or chief warrant officer 5 (Army), or Civilian in the grade of GS–12 or above.

(b) Weapon system qualified.

(2) Duties.

(a) Ensure the safe conduct of all ADA crew-served guided missile and rocket firings.

(b) Enforce strict compliance with range safety standards and SOPs.

(c) Ensure RSOs comply with responsibilities listed in paragraph 1–24I of this regulation/order.

(d) Comply with the restrictions, requirements, and procedures listed in local SOPs (Marine Corps RSOs (Stinger)).

n. In addition to qualifications and responsibilities outlined in paragraph 1–24I, personnel assigned as trajectory safety officers must meet the following qualifications and be responsible for the duties below:

(1) Qualifications.

(a) Officer, warrant officer, or Civilian in the grade of GS–09 or above.

(b) Weapon system qualified.

(c) Appointed by the SRSO based on experience with ADA crew-served guided missile and large rocket firings.

(d) Technical knowledge and experience to adequately discharge trajectory safety officer responsibilities.

(e) Satisfactory completion of range safety certification program.

(2) Duties.

(a) Assist the SRSO.

(b) Observe the trajectory of ADA crew-served guided missiles and large rockets (or free ballistic rockets when provided with controllable destruct systems) to ensure missile or rocket containment within the boundaries of the SDZ.

Chapter 2

Ranges

2–1. General

a. Army indoor firing ranges will be designed, operated, maintained, inspected, and decontaminated in accordance with DA Pam 40–503 and AR 11–34.

b. Marine Corps indoor firing ranges will be designed by the Naval Facilities Engineering Systems Command (NAVFAC), inspected in accordance with Bureau of Medicine instructions, and certified in accordance with MCO 3550.9A.

c. Marine Corps ranges will be certified in accordance with MCO 3550.9A.

d. Army installations will conduct self-assessments of ranges in accordance with AR 385–10, this publication, and TB MED 524.

2–2. Restricting access to and activities on impact areas

a. Unauthorized persons are prohibited from entering the installation training complex. When empowered by the commander responsible for range operations at the Garrison level, the installation RMA (Army) or RCO (Marine Corps) is the approval authority for entry onto ranges and maneuver areas and into any impact area (temporary, dedicated, or high-hazard).

b. Unauthorized persons are prohibited from entering impact areas and other areas known or suspected to contain UXO by use of positive controls, to include fencing and posting of UXO hazard warning signs. Responsible commanders will ensure appropriate measures are used to restrict access to areas known or suspected to contain UXO. The commander will use RM to determine the type and extent of marking and fencing required. Primary factors to consider in making this risk decision are accessibility of the public to restricted locations and the level of UXO hazards in the area.

c. Where practical, positive means of excluding livestock (such as fences or gates) must be established unless a written agreement negating this requirement is in effect with livestock owners.

d. The installation RMA (Army), RCO (Marine Corps), a designated representative, or EOD personnel will brief personnel who have an operational requirement and are authorized access to an operational range's impact area on the hazards associated with UXO and other hazards.

e. Access into temporary or dedicated impact areas will be strictly controlled. Those portions of temporary and dedicated impact areas authorized for training or other authorized purposes will be surface-cleared of UXO before

access is permitted. Cleared areas that become contaminated during live-fire exercises will be cleared when the exercise has been completed. Firing munitions into a UXO contaminated area for the purpose of clearing the area of UXO is not authorized. Training events that include firing mine-clearing line charges (MCLICs) or other similar munitions are not considered UXO clearing activities. Controlled burn activities to reduce ground cover to mitigate risks prior to a surface-clearing operation or contamination survey must be coordinated with appropriate installation staff offices. Fire will not be used to clear UXO.

f. Access to high-hazard impact areas will be limited to qualified EOD personnel, range operations (Army), range control (Marine Corps), range maintenance, and safety personnel designated by the installation RMA (Army) or RCO (Marine Corps).

g. High-hazard impact areas that have ICM or sub-munition duds are permanently contaminated and will not be cleared by Army personnel or entered by Army range personnel for range maintenance. Marine Corps EOD personnel, operational range clearance contractors, and supporting Marine Corps personnel of any MOS are authorized access into ICM-contaminated impact areas to conduct range clearance operations and MOS proficiency training. Marine Corps EOD personnel will accompany the Marine Corps supporting personnel at all times while in the ICM-contaminated area.

h. Entry into high-explosive (HE) dud contaminated areas to extinguish fires may be an extremely high-risk operation that requires a thorough risk assessment and approval at the appropriate level of command.

i. Digging entrenchments, foxholes, slit trenches, or any other activities that disturb earth within an impact area is not permitted unless authorized by the installation RMA (Army) or RCO (Marine Corps). Maneuvers within a temporary impact area that include bivouac must prevent disturbing earth by driving poles, pegs, and so forth into the ground; trenching around tents; or any activity that could disturb a UXO located just beneath the ground surface. Open fires will not be permitted.

j. Unauthorized personnel are prohibited from handling UXO and munitions or removing them from the training complex. Procedures (for example, amnesty boxes) will be established for turn-in of AE items.

k. All normal vehicular and foot traffic approaches to ranges and impact areas will be guarded by range guards properly instructed in their duties, or closed off by appropriate barriers, as determined by the installation RMA (Army) or RCO (Marine Corps). When barriers are used, appropriate signs will be posted.

l. Aeronautical charts limit aerial access to ranges within restricted areas.

2–3. Posting danger, warning, and caution signs, markers, and flags

a. Warning signs should comply with 29 CFR 1926.200 and AR 385–10. Such signage should include a signal word (such as “Danger” or “Warning”), safety symbols that identify the hazard and hazard avoidance (such as a pictogram of an explosion and “Do Not Enter” symbol), and a text message (such as “Explosive Hazard, Keep Out”) (see AR 385–10).

Note. New signage, if constructed locally, will be at least 33 centimeters (cm) by 43.5 cm in overall size and of weather-resistant materials.

b. The sign will state “Unexploded Ordnance Do Not Enter” in two lines of red, sans-serif capital letters in the lower white section of the sign. Lettering will be at least 5 cm high and of weather-resistant materials or as dictated by the host nation. Signs should be constructed with non-reflective paint to enable the use of lasers. Warning signs will be posted around the installation training complex to warn and prohibit entry by unauthorized persons and to alert authorized personnel entering a hazard area (see fig 2–1).

c. Signs at entry points to the training complex will prohibit trespassing and removal of items under penalties provided by law. Signs will also emphasize the dangers associated with unlawful entry and handling of dud ammunition. Where appropriate, signs will be in both English and the foreign language applicable to the native language when in a foreign country.

d. Warning signs will be placed to ensure they are visible to individuals attempting to enter training complex live-fire areas at any point around its perimeter. They will be placed at 200 meter (m) intervals or less, if practicable, or in a way that will ensure that a person cannot enter the range without seeing at least one sign within a legible distance.

e. Commanders will ensure UXO hazard signs are posted at a maximum of 200 m intervals around all UXO locations.

f. Safety (danger, warning, and caution) signs and signals will be used to warn personnel approaching a firing area. Scarlet danger flags supplemented by blinking red lights at night or during reduced visibility will be displayed from a prominent point, normally at the range entrance.

g. Signs warning personnel of the danger from projectiles, bombs, lasers, and UXO will be posted near the firing area at all times.

h. Limit-of-fire markers will be placed to denote right and left limits of fire. Internal markers are used for controlling the geometry of fires of individual lanes of a range and external markers are the limits of fire markers for the entire range. For the Army, internal and external limit-of-fire markers will be placed on direct-fire ranges only (see TC 25–8 for limit-of-fire design requirements). When required, limit-of-fire markers will be illuminated to ensure proper target area identification at times of limited visibility. Limit-of-fire markers should be thermalized when thermal weapons sights are used. In accordance with AR 385–10, appropriate hearing protection, eye protection, and laser warning signs will be posted at each range and firing line.

i. Individual vehicles, tanks, fighting vehicles, and armored personnel carriers may display flags to show the vehicle's weapon status in accordance with the appropriate FM (see para 9–5 for more information).



Figure 2–1. Sample warning signs

2-4. Ammunition and explosive items

a. Standard ammunition and explosive items. Standard ammunition and explosive items have been type classified for use by the U.S. military and have a Department of Defense identification code (DoDIC) and national stock number. Ammunition and explosive items may not be modified nor altered to change their characteristics or intended functions and still be considered standard. If modified, this modification or alteration renders them nonstandard and subject to the policies and requirements of this regulation/order (see AR 385-10, DA Pam 385-64 (Army), or NAVSEA OP 5 (Marine Corps) for safety policies and procedures for standard ammunition and explosive items).

b. Nonstandard ammunition and explosive items. Nonstandard ammunition and explosive items have not been type classified for use by the U.S. military nor are standard demolitions or munitions that have been altered to change their characteristics to do an essentially different function from that which they were intended and manufactured and then used as initially intended. Examples of this are adding excess increments to mortar or artillery ammunition, jamming variable-timed fuzes, increasing the propellant in small arms cartridges, or assembly of explosives components to inert rounds.

(1) Army. The DCS, G-3/5/7 validates the requirement for nonstandard AE. The final approval authority for their use on operational ranges rests with the senior commander or Adjutants General of States, territories, and the District of Columbia for the National Guard. The CG, USASOC will validate the requirement and authorize the use of nonstandard ammunitions by USASOC personnel. Installation senior commanders or Adjutants General of States, Territories, and the District of Columbia will be the approval authority for the use of USASOC nonstandard ammunition on their ranges.

(2) Marine Corps. Use of nonstandard ammunition and explosive items is prohibited on Marine Corps operational ranges without explicit approval of the CG, TECOM (C 465). The CG, TECOM (C 465) will request and consider a technical review of nonstandard ammunition and explosive items from the CG, MARCORSYSCOM as required. Once the use of nonstandard AE has been authorized by the CG, TECOM (C 465), the base or station commander has final approval authority for their use on operational ranges. The Commander, Marine Corps Special Operations Command (MARSOC) will validate the need and authorize the use of nonstandard ammunition by MARSOC personnel. Installation commanders will be the approval authority for the use of MARSOC nonstandard ammunition on their ranges. Authorization to store nonstandard ammunition must be requested from Naval Ordnance Safety and Security Activity via the CG, MARCORSYSCOM in accordance with MCO 5100.29C, Volume 8.

2-5. Ammunition and explosive items on ranges

Procedures for transporting, storage, handling, and security of AE are available in DA Pam 385-64 or NAVSEA OP 5 and in applicable FM's or TM's. In addition, the following instructions, with relevant references, pertain to operational ranges.

a. Positioning and issuing of ammunition and explosives. Positioning and issuing of AE, to include explosive safety quantity-distance determinations, will be in accordance with DA Pam 385-64 or NAVSEA OP 5. The Range Managers Toolkit (RMTK) may be used to plan for positioning and issuing of AE on operational ranges.

(1) Operational ranges require that AE be placed at various locations (for example, firing points) that are inherent to a training exercise or temporary or transient by nature. These locations do not require a site plan approved by the DDESB. However, permanent structures on ranges used for administrative storage or issuance of AE must be sited and approved by the Director, U.S. Army Technical Center for Explosives Safety (USATCES) for the Army and subsequently by the DDESB, and the CG, MARCORSYSCOM.

(2) Distribution of AE to personnel will occur only in areas (for example, ready lines, firing lines, attack positions, assembly areas, and defilade positions) designated for that purpose. Force-on-force and live-fire AE will not be stored in or issued from the same location at the same time.

(a) Fuel storage areas will be located at separation distances from ammunition storage areas based on the amount of fuel.

1. Fuel quantities up to 500 gallons will be separated from each potential explosion site by at least 50 feet (ft).
2. Fuel quantities between 500 to 5,000 gallons will be separated from each potential explosion site by at least 100 ft.
3. For fuel quantities greater than 5,000 gallons, see DA Pam 385-64 (Army) or NAVSEA OP 5 (Marine Corps).

(b) Forward arming and refueling point operations and separation distances for fuel, ready ammunition storage areas, and basic load storage areas will be in accordance with ATP 3-04.17 and Naval Air Systems Command (NAVAIR) 00-80T-109.

1. The quantity of ammunition unpacked for training will be kept to the minimum quantity needed for live-fire training or an exercise. Packaging material, propelling increments, and fuzes will be retained until completion of the

live-fire portion of the training or exercise. Units will not burn or bury wooden containers or indiscriminately use or dispose of ammunition to preclude its return to a storage facility.

Note. GTR-18 Smokey Sam rockets are issued by the case with a quantity of 12 rockets and 12 igniter rods. Planning use of these pyrotechnics requires careful consideration of the effects of moisture on unpacked items. Unpacked rockets must be expended and only full, unbroken cases returned to the ASP. Broken or unserviceable increments (powder bags) will be handled in accordance with installation range SOPs.

2. Guided missiles, rockets, and components, such as fuels, propellants, oxidizers, and explosives, in ready storage or at the firing location will be positioned to minimize the possibility of ignition or detonation by motor exhaust or by a mishap involving the firing of a missile or rocket. Such military AE will be stored in dry locations, protected from direct rays of the sun, and adequately ventilated. Marine Corps Smokey Sams, Smokey Guns, and pyrotechnics will be stored as outlined in appropriate Marine Corps TMs, or NAVAIR technical publications.

3. During pre-fire preparation, guided missiles, rockets, and components will be handled and assembled in a manner consistent with this regulation/order, local range SOPs, and appropriate FMs and TMs. Any alteration to guided missiles or rockets and their associated equipment is prohibited except as authorized by official publications or by the CG, AMC.

4. AE unpacked for use but not used will be repackaged into its original packing configuration prior to return to the ASP. AE that are easily degraded by short-term exposure to moisture (for example, propelling charges, pyrotechnic signals, and simulators) will be unpacked only for the minimum amount of time consistent with mission requirements.

(c) Requests for current status of AE not listed in Naval Supply Systems Command (NAVSUP) P-801 will be sent to Navy Operational Logistics Support Center, Mechanicsburg, Pennsylvania, Defense Switched Network (DSN) 430-2107/commercial (717) 605-2107 (Marine Corps).

(d) Defective AE will be reported in accordance with MCO 8025.1E (Marine Corps).

b. *Suspension or disposition of ammunition and explosives involved in malfunctions and mishaps.* The suspension or disposition of AE involved in malfunctions and mishaps will be in accordance with AR 75-1, DA Pam 385-40, MCO 8025.1E, and MCO 5100.29C. Firing suspensions are published in Technical Bulletin (TB) 9-1300-385, NAVSUP P-801, and appropriate TMs.

(1) Any AE suspended and listed in TB 9-1300-385 or NAVSUP P-801 and their supplements will not be fired in training.

(2) Firing of restricted AE listed in TB-9-1300-385 or NAVSUP P-801 and their supplements will be conducted in accordance with the restriction requirements.

(3) AE determined to be defective will not be fired. Defective AE will be reported to the installation quality assurance specialist, ammunition surveillance office or the explosives safety office via the RMA (Army) or RCO (Marine Corps). Examples of defects include—

(a) Fuzes or fuzed rounds that are inadequately tightened, insecurely staked, or missing safety devices.

(b) Safe and arming mechanisms, if so equipped, in an armed position.

(c) AE showing deterioration or corrosion.

(d) AE showing evidence of defects in material or assembly.

(e) AE and unopened AE packaging that shows evidence of tampering. In this case, it will not be issued until cleared by competent explosives safety authority.

c. *Unexploded ordnance and misfire procedures and reporting.*

(1) The range OIC will report all UXO to the installation RMA (Army) or RCO (Marine Corps). In the case of grenades or other AE that may be immediately hazardous to personnel (for example, bursting radius), firing will be halted until qualified EOD personnel clear the dud. In other cases, firing need not be halted. Duds not cleared by EOD personnel before the unit departs the training complex will be reported in writing to the installation RMA (Army) or RCO (Marine Corps) for determination of clearance scope.

(2) Misfire procedures in training manuals and current operating manuals for the appropriate weapon system will be followed. Misfires that present an immediate hazard to personnel or require an immediate cease-fire will be reported to the range operations firing desk (Army) or range control (Marine Corps).

(3) AE malfunctions or defects will be reported in accordance with AR 75-1 (Army) or MCO 8025.1E (Marine Corps).

(4) Range clearance and destruction of UXO on operational ranges will be in accordance with DoDI 3200.16 and approved Service procedures.

2-6. Blank ammunition

The following precautions will be observed during the use of blank ammunition.

- a. Blank and live-fire AE will not be stored in or issued from the same location at the same time.
- b. The blank-firing adapter (BFA) is a necessary component for operational safety. Weapon systems for which approved BFAs are manufactured will not be fired without the proper BFA. The distance at which weapons can be safely fired at unprotected troops without causing injury is somewhat reduced with the BFA. However, 5 m safe separation distance will not be reduced. This distance, with a dispersion angle of 10 degrees left and right of the gun target line (GTL), does not exclude possible injury to the unprotected eye.
- c. Army combat uniform and Marine Corps combat utility uniforms offer skin protection and should be worn at all times. For Army, eye protection will be used. For Marine Corps, eye protection should be used. A violation of the safe separation distance could result in serious injury and, within 1 m, may cause fatal injuries. Hearing protection (ear plugs) should be worn while firing blank ammunition.
- d. See table 5–2 for SDZ data for all small arms blank ammunition with blank-firing adaptor.
- e. When firing the Close Combat Blank System (CCBS) for either the 5.56mm or 7.62mm weapons systems, a BFA is not required but does require the CCMCK conversion kit to function. The minimum safe distance (MSD) for this munition is 18 inches (see table 5–2 for SDZ data). This munition is for Special Operation Forces only.
- f. Nine mm blank (DoDIC AC07) cartridges are fired from a special barrel kit without a BFA. This is a non-toxic cartridge that consists of a half-brass and half-plastic 9mm casing with a reduced, cleaner-burning propellant. When using this cartridge, a MSD of 5 m must be maintained and hearing and eye protection worn (PPE Level 0). This cartridge will not be used for force-on-force training.
- g. The following conditions, and safety measures previously stated, must be met when Marine Corps personnel and Government civilians and contractors acting as role players in support of training are using Katmai Avtomat Kalashnikova (AK)-47 7.62x39mm blank-firing only weapon system on operational training ranges or Advancia AK-47 blank-fire-only weapon system with internal and external BFAs:
 - (1) The weapon system must fire only blank ammunition. If a live round can be chambered, it cannot exit the barrel and, if subsequent attempts are made to fire live rounds, the weapon must render itself inoperable.
 - (2) All operators must be trained on the safe handling and employment of the systems.
 - (3) The contracted agency is responsible for the inspection, safe operation, maintenance, functionality, and serviceability of the weapon systems with BFAs and assumes all responsibility for blank ammunition transportation, storage, and use during training.
 - (4) Limited technical inspections and pre-fire inspections will be conducted on all weapons in accordance with weapon TMs. Prior to the training, the contracted agency will provide copies of the completed inspection checklists to the exercise OIC.
 - (5) The OIC or RSO will inspect all personnel, magazines, and equipment prior to and immediately following all training in accordance with this order.
 - (6) The OIC or RSO will conduct a safety brief, so that all participants (including contractors) understand the safety requirements prior to participation in the training.
 - (7) Any safety or blank-fire weapons anomalies that may occur during training with these systems will be reported to the installation RCO.
 - (8) Specific safety precautions will be used for the following training scenarios:
 - a) Contracted weapons. Ammunition is restricted to blank full flash cartridges for outdoor training and blank quarter flash cartridges for indoor training.
 - b) Katmai AK-47. Ammunition is restricted to full-charge blank 7.62x39mm DoD cartridges (DoDIC A103) or contractor-supplied 7.62x39 mm full-charge blank cartridges for both indoor and outdoor training. There are no special facility requirements associated with these cartridges.
 - c) Advancia AK-47. Ammunition is restricted to Advancia full-charge 7.62x39mm blank ammunition. Advancia full-charge blank ammunition will only be used during outdoor training. Indoor training with this ammunition is prohibited.

2–7. Use of non-Department of Defense property

- a. The use of non-DoD property (property not under jurisdiction, custody, or control of the Secretary of Defense) for live-fire exercises requires the approval of ACOM, ASCC, or DRU commanders; COMMARFORRES; Commander, MCICOM; or the regional commanders of Marine Corps installations with RTA complexes. AR 405–10 and NAVFAC P–73 provide mandatory guidance regarding acquisition of real property interest and the necessary approval requirements.
- b. The danger zones for non-DoD training areas must meet the requirements of the facility. This regulation/order will be followed to the extent possible. Danger zones must meet applicable environmental and local regulations. A legal review is required for any formal agreement with the owners of the non-DoD property. For Army organizations,

use agreements will be submitted to the ACOM, ASCC, or DRU safety manager for coordination with USACE. The USACE is the approval authority for the Army.

c. Specific guidelines for use agreements include—

- (1) Weapons and ammunition intended for use.
- (2) Procedures for range operations, to include ammunition accountability.
- (3) Agreement outlining the scope of accountability and liability in the event of property damage or injury to military or non-military personnel as a result of Army or Marine Corps operations.
- (4) Airspace requirements, as required by the Federal Aviation Administration (FAA).
- (5) Operational procedures to notify the public of training operations.
- (6) RM plan showing residual risk level for the operation (approved by the appropriate command level), control, and supervision measures.
- (7) Specify positive control measures for access to the training areas by authorized personnel and for excluding unauthorized personnel.
- (8) Specific procedures for decontaminating training areas prior to release from Army or Marine Corps control if required.

2–8. Risk management

The RM process, described in ATP 5–19; DA Pam 385–30; and MCO 5100.29C, Volume 2, with Erratum will be used to manage risks during all live fire. The RM process will be used to identify range hazards and implement appropriate controls in the development of installation range regulations and SOPs.

2–9. Military operations outside the United States

Standards and procedures in this regulation/order apply to range operations conducted by Army and Marine Corps units training outside of the United States.

a. Range operations in countries with a permanent U.S. military presence (for example, Germany, South Korea, and Japan) will be conducted according to this regulation/order and host nation regulations as required by the provisions of the status of forces agreement. Normally the stricter regulations will apply.

b. Range operations in countries without a permanent U.S. military presence (for example, a bilateral military exercise) will be conducted according to this regulation/order and host nation regulations as required by the provisions of the visiting forces agreement. Normally the stricter regulations will apply.

c. For range operations conducted on host nation installations that would require a deviation on a U.S. installation—

(1) If range safety responsibility is designated as the responsibility of the host nation in accordance with the terms of the status of forces agreement or visiting forces agreement, the designated approving authority must authorize, in writing, the training event.

(2) If range safety responsibility is not designated to the host nation, a general officer with deviation authority in accordance with chapter 4 of this regulation/order in the chain of command must authorize, in writing, the training event after coordination with the host nation.

2–10. Controlling other range usage

a. When the installation training complex is authorized for use by non-military organizations, such as schools; county, municipal, State, or Federal agencies; organized clubs (including rod and gun clubs); or civic associations, the following requirements apply:

(1) The organization or agency will comply with requirements and procedures established within this regulation/order and local range regulations and SOPs.

(2) Requests for use will be coordinated with the installation RMA (Army) or RCO (Marine Corps), appropriate safety offices, servicing legal office, and submitted to the senior commander (Army) or installation commander (Marine Corps) for approval.

(3) Requests will identify if non-DoD associated minors will be involved in live-fire activities. If so, the activity must be an approved course of marksmanship training, unless otherwise approved by the senior commander (Army) or installation commander (Marine Corps).

(4) A written agreement must be completed between the installation and the non-military organization, detailing all rights and responsibilities of each party, liabilities, procedures, and regulatory and procedural requirements. For the Army, this agreement will be incorporated into the report of availability as required by AR 405–80.

(5) For live-fire events, non-military organizations will designate an OIC and RSO. Personnel designated as OICs and RSOs will complete a pistol and rifle course approved by the National Rifle Association or equivalent (for example, U.S. Pistol Shooters Association). The senior commander (Army) or installation commander (Marine Corps),

based on input from the RMA (Army) or RCO (Marine Corps), garrison safety office, servicing legal office, and other staff agencies, as appropriate, will determine the equivalency. For the Marine Corps, OICs and RSOs must complete the Range Safety (Basic) Distance Learning Course.

(6) The installation RMA (Army) or RCO (Marine Corps) will ensure designated OICs and RSOs are briefed on their duties and responsibilities.

b. Military Family members engaging in authorized live-fire activities, such as marksmanship training, or participating in activities involving weapons firing, such as organizational or family days, will comply with this regulation/order, installation range regulations, and SOPs. Requests for these activities will specify if minors will be involved. Unit will maintain a roster of all Family members for tracking and identification purposes.

c. Civilian personnel, such as military Family members and local populace, must receive authorization from the installation RMA (Army) or RCO (Marine Corps) to enter the training complex to participate in or observe capabilities exercises, fire power demonstrations, training courses, competitions, or other types of live-fire exercises. Such personnel will remain in designated safe areas as determined by the installation RMA (Army) or RCO (Marine Corps).

d. Inspection team members or other official observers required to be on the firing line, firing position, or firing area will position themselves in safe areas as determined by the installation RMA (Army) or RCO (Marine Corps). These personnel must wear appropriate safety equipment as specified by the local range regulations and the installation RMA (Army) or RCO (Marine Corps).

e. Civilians, to include Family members and DoD civilians, must have approval from the installation RMA (Army) or RCO (Marine Corps) to fire weapons within the installation training complex. For Marine Corps, civilian visitors to participate in exercises or training events, commands must submit requests to the Deputy Commandant for Plans, Policies and Operations in the following manner:

(1) Make requests via formal message format through the appropriate chain of command to the Deputy Commandant for Plans, Policies and Operations. Requests will be submitted at least 2 weeks in advance of the training and include the following: the unit conducting the event, organization and background of civilian visitor participants, type of event in which the civilian visitors will participate, date and time the event will take place, location of event, purpose the event will serve, and reason the civilian visitors are participating.

(2) Civilian visitor participants will sign a waiver of liability before the event. The term “participate” means “to have or to take part or to share in the execution of the exercise or training event.” This does not include observation from a designated viewing area or handling of items properly cleared for a static display. This does include those accompanying a unit as observers within a designated exercise area.

2–11. Coordinating use of special use airspace

a. Hazardous activities. Any activity considered hazardous to nonparticipating aircraft or requiring SUA to segregate it from other users of the National Airspace System or in the airspace of host countries will not be conducted until appropriate SUA has been designated and activated for that purpose.

b. Types of activities that may require special use airspace. Types of activities that may require SUA include artillery fire, mortars, missiles and rockets, air-to-ground and ground-to-air weapon systems, aerial target practice, laser operations, demolition and explosive devices, electronic warfare devices, remotely piloted and unmanned aerial systems, conducting hazardous activities, small arms ranges, and any other activity considered to be hazardous or non-compatible with other users of the airspace. SUA is required to be designated and activated prior to conducting any activity over 45 m (150 ft) above ground level (AGL) (to include ricochets) that would be hazardous to aircraft. When determining requirements for any type of new SUA to support planned training, a risk assessment will be performed that identifies the degree of risk posed by hazards to existing airspace users from planned live-fire events.

c. Installation range management authority (Army) and range control officer (Marine Corps) special use airspace. The installation’s RMA (Army) or RCO (Marine Corps) will be involved in all SUA matters. For the Army, SUA will be established and managed in accordance with appropriate FAA regulations, applicable host nation rules and procedures, and AR 95–2. The installation air traffic and airspace (AT&A) officer is the focal point for SUA actions. For additional information and guidance, contact the appropriate ACOM, ASCC, DRU, AT&A officer, or Department of the Army representative (DAR). For the Marine Corps, SUA will be established and managed in accordance with appropriate FAA regulations or International Civil Aviation Organization rules, applicable host nation rules and procedures, OPNAVINST 3770.2L, MCO 3550.10, local SOPs, and range control procedures. Formal communications with the FAA must be in accordance with OPNAVINST 3770.2L.

d. Types of special use airspace. Types of SUA that may be established include—

(1) *Restricted areas.* Airspace identified by an area on the surface of the earth within which the flight of aircraft, while not wholly prohibited, is subject to restrictions. Restricted areas will be designated when determined necessary

to confine or segregate activities considered to be hazardous to nonparticipating aircraft. Examples of those activities include artillery, aerial gunnery, or guided missile firing.

(2) *Warning areas.* Airspace of defined dimensions that contains activity that may be hazardous to nonparticipating aircraft. The purpose of such warning areas is to warn nonparticipating pilots of the potential danger. A warning area may be located over domestic or international waters or both.

(3) *Military operations area.* Airspace of defined vertical and lateral limits established for the purpose of containing certain military training activities that include air combat tactics, air intercepts, acrobatics, formation flying, and low-altitude tactics in airspace as free as possible from nonparticipating aircraft.

(4) *Controlled firing area.* A controlled firing area is established to contain activities that, if not conducted in a controlled environment, would be hazardous to nonparticipating aircraft. The distinguishing feature of a controlled firing area, as compared to other SUA, is that its activities are suspended immediately when spotter aircraft, radar, or ground lookout positions indicate an aircraft might be approaching the area. Examples of controlled firing areas are small arms or EOD ranges.

e. Display of special use airspace. SUA will be shown on installation maps and overlays, as appropriate.

2-12. Small arms range safety area (Army)

For the Army, small arms range safety areas (SARSAs) are areas the garrison commander establishes to contain small arms range activities that could be hazardous to non-participating aircraft. SARSAs are not SUA. Garrison commanders will ensure that users of Army small arms ranges that are located outside restricted airspace or controlled firing areas follow the SARSA policy established in paragraphs 2-12a through 2-12g.

a. To protect aircraft, the garrison commander or designated representative (normally the installation range manager) will establish or abolish SARSAs at each small arms range not located within SUA as required by this regulation/order. Unless otherwise identified in this regulation/order, the data in tables 5-1 through 5-32 will be used as the basic vertical component for each weapon system used on the range. When determining SARSA altitude boundaries, 152 m (500 ft) will be added to that value and rounded up to the next 152 m increment of altitude as a safety buffer. Garrison commanders will take appropriate action to ensure that airspace above and adjacent to small arms ranges is adequately monitored to preclude endangering aircraft operations. Garrison commanders will also consider maximum ordinate (Max Ord) and highest altitude of fire where the specific range operations call for it.

b. The garrison commander or designated AT&A officer will coordinate with the appropriate senior commander's AT&A officer and DAR for development of SARSA proposals and letters of agreement with local air traffic control facility personnel to assist in the early detection and notification of approaching aircraft. Garrison commanders will coordinate SARSA proposals through the U.S. Army Aeronautical Services Agency for areas not covered by the DAR. SARSA proposal requests will include—

- (1) Activity for which approval is being requested.
- (2) Specific location and boundaries.
- (3) Altitudes.
- (4) Name, address, and phone number of the originator of the request.
- (5) Proposed times of use.
- (6) Desired effective date.
- (7) Proposed safety precautions, including visibility requirements, ceiling (cloud height) requirements, safety observers, communication links, and any other factors that enhance range safety.
- (8) Instructions, if applicable, for the installation range OIC to notify the owner or manager of airports that might be affected by the SARSA.
- (9) Risk assessment and map with SDZ and 5 miles of buffer depicted and air traffic control letter of agreement (if applicable).

c. Upon receipt of SARSA proposal, the DAR—

- (1) Reviews the garrison commander's proposal to determine if the proposed SARSA presents conflict with the requirements of other airspace users.
- (2) Encourages the proponent to explore the feasibility of conducting the activity in an existing restricted area where possible.
- (3) Assists the AT&A officer in coordination with local air traffic control for letters of agreement (if applicable) and reviews prior to signature.
- (4) Prior to the establishment of the SARSA, reviews the proposal and informs the garrison commander of any recommendations by formal correspondence for proposal feasibility.

d. The following precautionary measures are mandatory requirements for all small arms ranges, as applicable:

(1) The ceiling (cloud height) will be at least 305 m (1,000 ft) above the ricochet height. The garrison commander or their designated representative should also consider highest altitude of fire and Max Ord in addition to ricochet height as a part of risk assessment.

(2) Visibility will be sufficient to detect nonparticipating aircraft and then establish a cease-fire before penetration of the aircraft into the SDZ.

(3) The garrison commander may elect, based on risk analysis, to substitute radar surveillance for the ceiling and visibility requirements. This provision is contingent on the adequacy and availability of the radar service and the necessary communication links to the range OIC.

e. The garrison commander or designated representative will establish procedures that designate a responsible officer (normally the range OIC) for the surveillance of the airspace in the SARSA. Safety observers and radar should be able to monitor airspace inclusive of a border extending 5 miles from the boundaries of the SDZ of the SARSA. Safety observers will maintain positive, immediate communication with the range OIC or range operations firing desk (Army) or range control (Marine Corps) at all times. Safety observers will be thoroughly briefed on their duties and responsibilities. Range operations (Army) and range control (Marine Corps) must have an adequate plan in place to support the range OIC in this effort.

f. Firing activities within the SARSA must cease upon notification of impending or actual incursion of the SARSA by nonparticipating aircraft.

g. For assistance on SARSA matters, contact—

(1) Garrison commander's AT&A officer.

(2) Senior commander's AT&A officer.

(3) The DAR responsible for your geographic area (see AR 95–2 for DAR contact information).

(4) U.S. Army Aeronautical Services Agency.

2–13. Coordinating use of navigable waterways

a. USACE maintains notices of the restricted danger zones published in 33 CFR 334. USACE is the only entity authorized to waive water traffic requirements that apply to the live-fire of military munitions over navigable waters, to include intercoastal waterways. Senior commanders (Army) and installation commanders (Marine Corps) will notify the USACE division or district commanders and the applicable U.S. Coast Guard District Office of—

(1) Waterway involved.

(2) Operations to be conducted.

(3) Sector of waterway needed for closure.

b. Federal laws that protect water traffic on navigable waterways authorize the Secretary of the Army to prescribe regulations for use and navigation of waterways endangered or likely to be endangered by firings and target practice. USACE will publish a notice of the restricted danger zone under 33 CFR 334.

c. The senior commander (Army) or installation commander (Marine Corps) will not authorize firing until notice of the restricted danger zone is published in 33 CFR 334 and navigation maps have been revised. Additionally, the senior commander (Army) and installation commander (Marine Corps) will enforce closed waterways by radar or surface vessel surveillance. Firing will not commence until the U.S. Coast Guard has marked the restricted danger zone with buoys.

d. Military munitions containing phosphorous, including guided missiles or rockets, will not be fired or dropped into any inland waterway, lake, bay, wetlands, or other bodies of water.

e. Firing over navigable waters in overseas areas, to include intercoastal waterways, will be performed within parameters of status of forces agreements, visiting forces agreements, and appropriate host nation requirements.

2–14. Army safety requirements for indoor firing ranges and shoothouses

This paragraph provides Army requirements for the safe operation and maintenance of indoor firing ranges and shoothouses.

a. *Lead exposure.*

(1) Commanders will ensure that Soldiers and maintenance personnel who operate in urban combat live-fire facilities understand the potential hazards of lead poisoning and the controls, based upon an individual's level of exposure, required to mitigate this hazard. Therefore, facility SOPs will address the industrial hygiene survey controls developed for the facility and facility personnel, and unit SOPs will address lead hazard communication training, to include safety precautions, hygienic standards, "do's and don'ts" on the range, methods to limit exposure, and so forth.

(2) Commanders will brief the following precautions prior to the conduct of live-fire exercises in indoor or semi-enclosed shooting facilities:

(a) Maintain good hygiene. Wash hands and face after completion of training.

- (b) Do not use tobacco products of any kind on the range.
 - (c) Wash hands and face prior to consuming food products and liquids on the range.
 - (d) Do not collect spent brass casings in personal headgear.
 - (e) Do not use dry sweeping to clean lead-contaminated areas. Use high efficiency particulate air (filter) vacuums to limit exposure.
 - (f) Change clothing and footwear before returning to the unit area or going home (children are more susceptible to lead poisoning).
 - (g) Take steps to remove residual lead dust from hands and clothing to avoid cross-contamination of other personnel.
- (3) Indoor firing ranges and shoothouse must comply with Occupational Safety and Health Administration standards (29 CFR 1910.1025), USASOC Regulation 40–8 (for USASOC organizations), DA Pam 40–503, and DoD medical surveillance requirements outlined in DoDM 6055.05.
- (4) The criteria in table 2–1 were developed to control intermittent lead exposure and establish maximum hours of exposure based on the airborne lead concentration and the number of days firing per year. These criteria are to be used as interim control measures only. Maximum effort will be made to reduce the airborne lead levels to 0.03 milligrams per cubic meter (mg/m³) or less.
- (5) Lead exposures for personnel are determined by a sampling strategy that employs general area and breathing zone samples (see para 2–14b for guidance on air sampling). The Industrial Hygiene Department of the U.S. Army Public Health Center will conduct the airborne lead sampling and provide the analysis and recommend the maximum allowable hours of exposure to be used as indicated table 2–1. Once an airborne lead concentration is determined, use table 2–1 to set maximum allowable hours of exposure for each category of range user. Other potential lead exposures, including off-duty firing, may contribute to an individual’s overall exposure and should be considered in establishing maximum allowable exposure time.
- (6) The command safety manager, RMA, industrial hygienist, and medical authority will make recommendations to the appropriate risk decision authority to determine the need for medical surveillance. Medical surveillance is not required for intermittent users if the maximum allowable exposure hours from table 2–1 are enforced.

Table 2–1
Breathing zone exposure limits for intermittent atmospheric lead exposures (Army)

| Concentrations (in mg/m ³) ¹ | Maximum hours of allowable exposure per day | | |
|--|---|---|--------------------------------------|
| | Soldiers exposed fewer than 30 days per year | Soldiers in marksmanship teams or sol- diers exposed more than 30 days per year and all nonmilitary personnel | Range users under 17 years of age |
| 0.000 to 0.029 | 8.00 | 8.00 | 4 |
| 0.030 to 0.039 | 8.00 | 6.00 | 3 |
| 0.040 to 0.049 | 8.00 | 4.50 | 2 |
| Limited-use ranges | | | |
| 0.050 to 0.059 | 6.50 | 4.00 | 2 |
| 0.060 to 0.079 | 5.00 | 3.00 | 1 |
| 0.080 to 0.099 | 4.00 | 2.25 | 1 |
| 0.100 to 0.149 | 2.50 | 1.60 | 0 |
| 0.150 to 0.199 | 2.00 | 1.20 | 0 |
| 0.200 to 0.299 | 1.25 | 0.75 | 0 |
| 0.300 to 0.399 | 1.00 | 0.60 | 0 |
| 0.400 to 0.499 | 0.75 | 0.45 | 0 |
| 0.500 to 0.749 | 0.50 | 0.30 | 0 |
| 0.750 to 0.999 | 0.35 | 0.24 | 0 |
| 1.000 or above | 0.00 | 0.00 | 0 |

Note.

¹ These values are the actual concentrations measured over the sampling period and are not 8-hour, time-weighted averages.

b. Air sampling.

(1) Collect all lead samples on cellulose ester filters meeting the following specifications: pore size of 0.8 microns, 37mm in diameter, three-piece preloaded cassette, and closed face. Sampling rate should be 1 to 4 liters per minute for a minimum volume of 500 liters.

(2) In indoor firing ranges, sample on the firing line, 3 m behind the firing line, and in adjacent areas (for example, range office, supply room, and hallways). In small ranges (fewer than six firing positions), samples should be taken at each firing position on and off line. In larger ranges (six or more firing positions), breathing zone and general area samples should be taken in every other firing position and off line. In shoothouses, sample at each doorway and other locations where personnel may pause. Permanently assigned range personnel may be evaluated using data obtained from general area and breathing zone samples, if applicable. Take at least one air sample for lead in an area adjacent to the facility defined in table 2–1 during each monitoring period. The sample should indicate whether or not lead contamination is confined to the facility.

(3) The following actions are critical to proper evaluation:

(a) Sample during periods of maximum use.

(b) If firing is over an extended period of time, allow time for possible buildup of airborne concentrations before sampling.

(c) Sample during the use of higher-caliber ammunition if more than one type of ammunition is used.

(4) Calibrate all pumps before and after use by a method traceable to a primary standard (for example, bubble and burette).

c. Ventilation (when required).

(1) Contaminants are byproducts of firing (for example, lead, carbon monoxide, and aldehydes) and must be removed from the facility through a well-designed ventilation system. The maximum concentration of lead acceptable for an 8-hour daily exposure (time-weighted average) is 0.05 mg/m³.

(2) Optimal ventilation systems in indoor firing ranges should distribute, deliver, or supply make-up air behind the firing line and exhaust air at the target line or bullet trap.

(3) Down-range (DR) air velocity can be measured or approximated by using a 30-second smoke candle and stopwatch. Ignite the smoke candle behind the firing line and time the smoke from the moment the first plume crosses the firing line until it reaches the bullet trap. Calculate the air velocity in meters per second (m/s) by dividing the range distance or length from firing line to bullet trap by time, or distance/time=m/s. A minimum of 0.381 m/s is required. This is equal to 0.02286 cubic meters per second per square meter of cross-sectional area. During the smoke evaluation, observe the range for any “dead spots” (swirling of smoke up range) or other turbulent airflow motions that may allow for increased exposure at or behind the firing line.

(4) Ensure proper disposal of contaminated waste (for example, filters).

d. Army requirements for inspection of indoor firing ranges and shoothouses. These facilities require periodic inspections by industrial hygiene to ensure compliance with current health and safety standards and DA Pam 40–503. The types of periodic inspections are initial, detailed, and annual.

(1) Initial inspections are one-time inspections made by qualified and competent safety or engineer personnel. The purpose of the initial inspection is to classify the authorized level of use of the facility. Based on the findings of the initial inspection, the facility will be classified as safe, limited, or unsafe. DA Form 5687 (Initial Inspection Checklist for Indoor Ranges) will be used to record the initial indoor firing range inspection. Criteria for initial inspection of shoothouses will be developed by the RMA, appropriate safety office, industrial hygiene office, and appropriate medical authority based on local conditions. A copy of the initial inspection will be maintained at the range and available for review.

(a) A facility classified as “safe” permits authorized firing for military and civilian use.

(b) A facility classified as “limited” permits only limited use under controlled conditions. The personnel exposure limits for intermittent atmospheric lead exposure will be used for limited operation of the facility.

(c) A facility classified as unsafe is not authorized for use under any conditions.

(2) Detailed inspections will be made by the support installation team composed of safety, facility engineer, and supporting industrial hygiene office. Detailed inspections are in addition to the initial inspection. DA Form 5688 (Detailed Inspection Checklist for Indoor Ranges) will be used as a minimum for conducting the indoor firing range inspection. Criteria for detailed inspection of shoothouses will be developed locally as in paragraph 2–14d(1). Findings from the detailed inspection will determine complete facility retrofit requirements. For new facilities, a detailed inspection will be made within 120 days of the initial inspection. It is important that appropriate safety, industrial hygienist, and range authority representatives participate in the planning, preparation, and execution stages of design and construction of all ranges.

(3) Annual inspections will be made by safety specialist (GS-0018 series) or safety engineer (GS-0803 series) personnel to ensure safety standards and procedures are maintained in the operation of the facility. The annual inspection will be made within 45 days of the anniversary date of the last annual inspection.

e. Disposition of Army inspection and evaluation results.

(1) Inspection and evaluation results will be provided to the next higher headquarters for action as appropriate. Supporting installation safety managers will maintain an information copy.

(2) The supporting facility coordinator will maintain a record of each inspection. Subsequent inspections will be made as a follow-up check against previous inspection results to assure required corrective actions noted have been accomplished and that there are not adverse changes to the building envelope, environmental conditions, or safe operating procedures.

f. Range safety inquiries. ACOMs, ASCCs, and DRUs may address inquiries pertaining to indoor range safety to TPO Ranges, Fort Eustis, VA 23604-5700.

g. Industrial hygiene inquiries. Inquiries pertaining to ventilation, air sampling, and other industrial hygiene issues should be directed to TSG U.S. Army Medical Command DCS for Public Health.

h. Unauthorized ammunition. The use of armor-piercing (AP) and tracer ammunition is not authorized for use in shoothouses and indoor or outdoor baffled ranges. These rounds have the potential of creating a fire or penetrating the walls and bullet traps.

i. Indoor and outdoor baffled ranges.

(1) Indoor and outdoor baffle ranges must have overhead baffles constructed with a minimum of 3/8-inch AR500 rated steel placed at an angle of 15 degrees to deflect errant rounds towards ground.

(2) For indoor ranges constructed with deceleration chambers, bullet impacts should not be concentrated into opening or throat of the deceleration chamber. Rounds should impact on steel ramps above or below the throat at an angle of 15 degrees or less leading into the throat. When firing M855A1 and M80A1 firers must be at the 25 m firing line to maintain the 15-degree impact angle onto ramps.

(3) These type ranges support the use of 5.56mm (M855 and M855A1) and 7.62mm (M80 and M80A1) or other less powerful small arms ammunition.

(4) Inspections should be conducted regularly to observe for dimpling or deformation of steel depending on usage (for example, high usage should be inspected quarterly at a minimum and low usage should be inspected annually at a minimum).

j. Shoothouses with 16-inch sand or gravel-filled walls.

(1) These type ranges support the use of 5.56mm (M855 and M855A1) or other less powerful small arms ammunition. Firing Short-Range Training Ammunition (SRTA) does not require bullet traps.

(2) Bullet traps are mandatory when firing M855 and M855A1.

(3) Inspect the shoothouse after each use to ensure no rounds penetrated the walls and that walls are filled to the recommended height with sand or pea gravel.

k. Shoothouses with 3/8-inch or 1/2-inch AR500 steel covered with 2-inch ballistic rubber.

(1) This configuration supports firing directly on the wall with 5.56mm SRTA, M1037, 7.62mm (M973), and frangible small arms ammunition only.

(2) Bullet traps are mandatory when firing 5.56mm (M855 and M855A1).

(3) Periodic inspections will be conducted to observe for any dimpling or deformation of steel depending on usage (for example, high usage should be inspected quarterly at a minimum and low usage should be inspected annually at a minimum).

l. Shoothouses with 3/8-inch or 1/2-inch AR500 steel covered with 2-inch and 12-inch ballistic rubber (14-inch total "hot wall").

(1) These configurations support firing directly on the wall with 5.56mm (M855 and M855A1) and 7.62mm (M80 and M80A1). Bullet traps are not required.

(2) This configuration supports simultaneous room clearing.

(3) Periodic inspections will be conducted to observe for any dimpling or deformation of steel depending on usage (for example, high usage should be inspected quarterly at a minimum and low usage should be inspected annually at a minimum).

2-15. Marine Corps safety requirements for indoor and outdoor firing ranges

This paragraph provides Marine Corps requirements for the safe operation and maintenance of indoor firing ranges.

a. Indoor firing ranges will comply with the information listed within UFC 4-179-02 and NEHC-TM 6290.99-10.

b. Marine Corps inquiries regarding indoor firing ranges will be directed to RTAM Branch, TECOM, 2007 Elliot Road, Quantico, VA 22134-5010.

- c. Indoor firing ranges will be certified and recertified in accordance with MCO 3550.9A.
- d. The use of AP and tracer ammunition is not authorized for use in shoothouses or indoor or outdoor baffled ranges. These rounds have the potential of creating a fire or penetrating the walls and bullet traps.
- e. For known distance ranges, ensure red safety line criteria is in accordance with figure 2–2 and figure 2–3.
- (1) To calculate the red line location, measure the height from the base of the target carriage to the top of the berm (Distance A in figure 2–2 and figure 2–3). Multiply the height of the berm (Distance A) by 0.7. This will establish the distance to the near edge of the red line (Distance B in figure 2–2 and figure 2–3), measured from the catwalk or berm as shown.
- (2) If a red line has been established that is closer than required by paragraph 2–15e(1), leave the existing line in place or reestablish it in accordance with that paragraph.
- (3) If a red line has been established that is further than required by paragraph 2–15e(1), then reestablish the red line at the distance calculated in accordance with that paragraph.
- (4) Commanders of organizations training on known distance rifle ranges not located on Marine Corps installations should identify the red line distance requirement to range operations. If range operators fail to apply red lines in the pit area paragraph 2–15e(1), commanders should coordinate the use of field expedient measures, such as engineer tape or sandbags, to identify the edge of the safety zone, in accordance with the calculation mentioned in paragraph 2–15e(1).

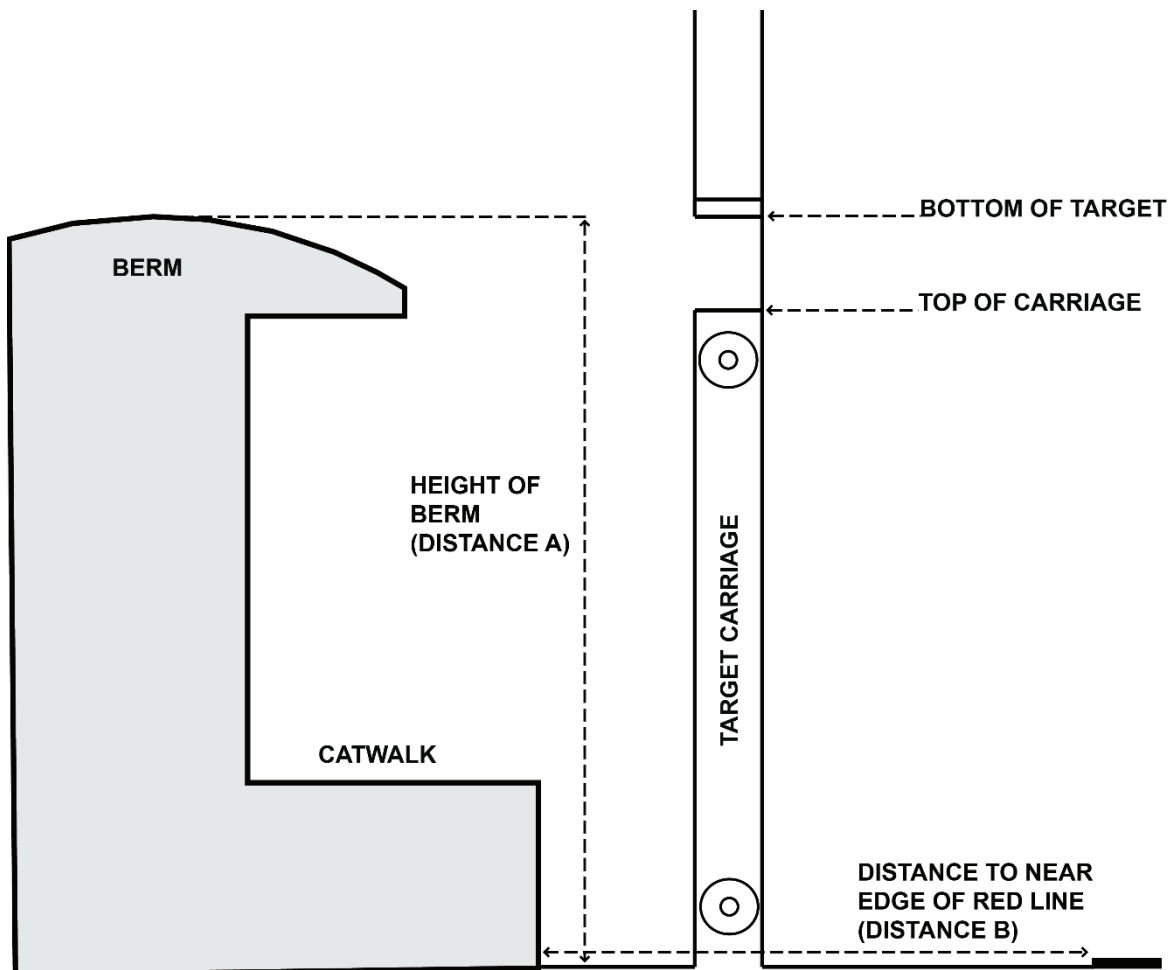


Figure 2–2. Red line for outdoor known distance target carriage pit area

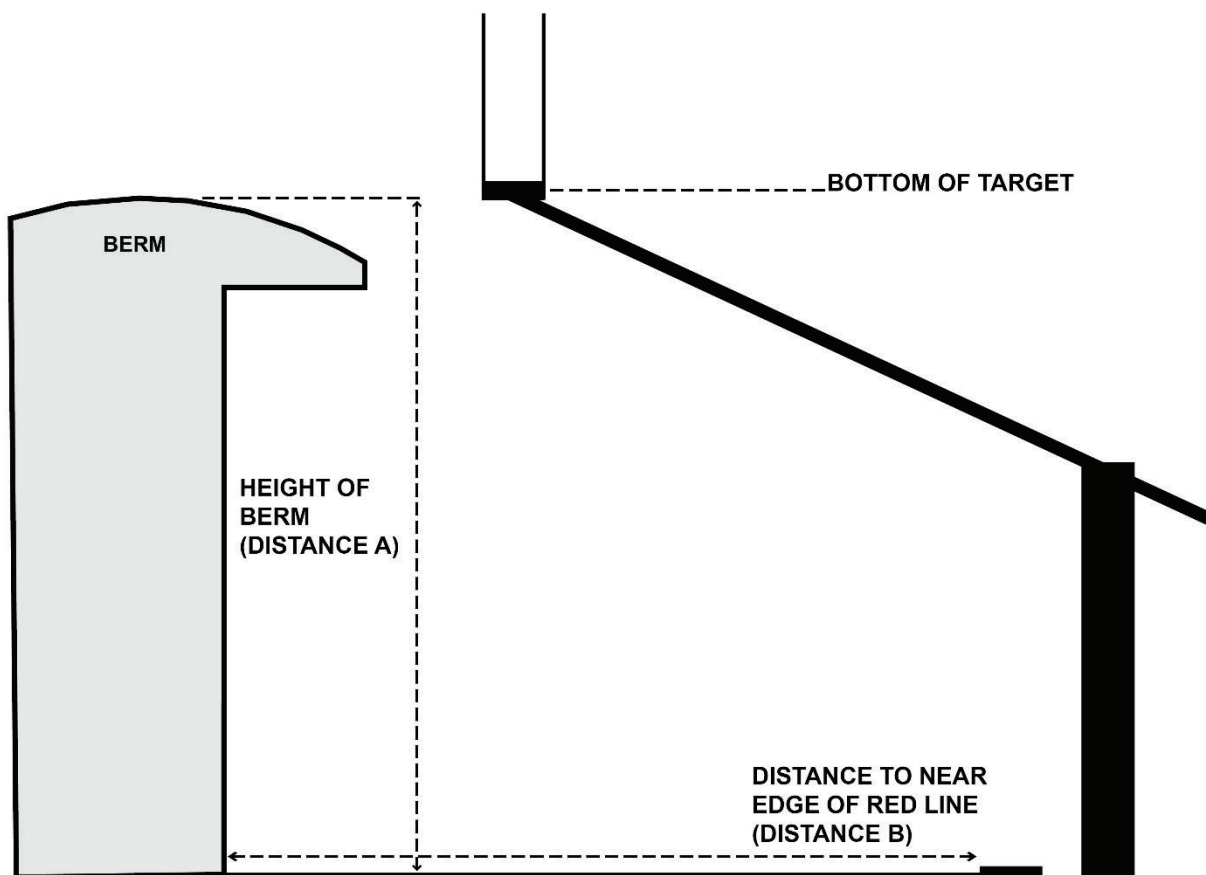


Figure 2–3. Red line for outdoor known distance target cantilever pit area

2–16. Use of ballistic concrete and shock-absorbent concrete

a. Ballistic concrete and shock-absorbent concrete (SACON) are ballistically comparable and patching materials and procedures for the two materials are interchangeable. Both materials require 28 days cure time to reach their full density.

b. Use of bullet traps or 12-inch SACON repair blocks can be used in front of SACON walls to reduce wear on the walls. This will reduce wear on the first floor of two-story structures that would require significant maintenance efforts to replace wall blocks on the first floor.

c. Concrete spall from all impacts should be considered during the risk mitigation process.

d. SACON will be a minimum 24-inch thickness.

e. Use of 9mm and .45 caliber ammunition are authorized for use in both SACON and ballistic concrete facilities. Ensure proper implementation of control measures to protect personnel and reduce the probability of ricochets. Ricochets from SACON and ballistic concrete are likely at angles less than 20 degrees with Service pistols.

f. Use of 5.56mm M855A1 ammunition is authorized in both SACON and ballistic concrete facilities. The effects of this ammunition should be monitored and damage repaired in a timely manner.

g. Use of 7.62mm ammunition, including M80A1, is authorized in both SACON and ballistic concrete facilities. Effects of the larger caliber with regard to increased damage and accelerated deterioration of the concrete should be considered.

- h. Use of .300 Win Mag, .338, and .50 caliber munition are not authorized in ballistic concrete or SACON facilities due to its unpredictability and deep penetration when those facilities are used to contain those munitions.
- i. Use of .300 Win Mag, .338, and .50 caliber munitions are authorized to fire at ballistic concrete or SACON buildings that are designated as targets or objectives; however, live-fire room clearing within these same buildings is not authorized.

2–17. Requirements for steel reactive target engagements

Proper steel hardness and target placement must be strictly adhered to in order to maintain a safe training environment on steel reactive targets (SRTs).

a. Only SRTs with a certified Brinell hardness rating (BHN) of AR (BHN) 500 to AR (BHN) 550 will be used for training.

(1) Manufacturers (commercial or organizational) of SRTs must provide a certificate of hardness to ensure the steel targets meet the minimum hardness rating of AR (BHN) 500. The certificate must remain on file as long as the targets are being utilized by the installation. Steel with an abrasion-resistant coating coupled with AR (BHN) 550 steel is considered optimum for safety and longevity of use. Only SRTs that are 3/8 inches or thicker are authorized for use.

(2) Angle of deflection is the angle of travel of bullet fragments relative to the plane of the target surface towards the shooter. When a shooter is shooting directly at a target, the bullet splatter will angle off the target up to 20 degrees in all directions from the point of impact and travel up to 45 m. The majority of all bullet fragments will exit the target within the 20-degree backslash area as shown in figures 2–4 and 2–5. A stationary target with a 20-degree forward cant (head forward of the body) produces the best angle of deflection with the most fragment consistency.

(3) SRTs that are not flat and smooth will cause unpredictable splatter effects. SRTs that are warped, cracked, or have holes burrowed through them are considered unserviceable and must be replaced. Targets with dimples (slight surface depressions) that are 1/32 inches deep or greater into the steel are considered unserviceable.

(4) Some types of SRTA will create projectile buildup, therefore, targets need to be scraped after their use with SRTA.

(5) Mounting bolts on the target face will have a rounded head. The rounded head end of the mounting bolt must be oriented to the shooter. Mounting bolts that are damaged must be replaced.

(6) Homemade or unit-constructed targets must meet a minimum of an AR (BHN) 500 rating.

(7) PPE Level 0 and, for the Army, use of authorized protective eyewear list (available at <https://www.peosoldier.army.mil/equipment/approved-eyewear-qpl/>) is required for all personnel on the range within 50m of the firing line.

(8) Automatic fire is not authorized on SRTs that are designed to flip, swing, or fall.

(9) Applying grease or oil (slicking) to the target face is not authorized.

(10) Enhanced Performance Round (EPR) ammunition will damage steel targets faster than other service ammunition.

(11) AP ammunition will not be used to engage SRTs.

(12) Shotgun engagements closer than 10 m for “00” buckshot and birdshot are prohibited.

(13) Twelve-gauge slug ammunition will not be fired at SRT distances of 45 m or closer.

(14) Engagement distances for .300 Win Mag, .338, and .50 caliber ammunition closer than 375 m are prohibited.

(15) Duties of the RSO will be addressed in the installation SOP. This listing is not to be considered all-inclusive.

b. Before firing, the RSO must ensure that all SRTs have the correct BHN.

(1) Ensure that only Army and Marine Corps procured ammunition with a DoDIC are used on SRTs for military training.

(2) Place targets on soft sandy-type soil or place an absorbing material, such as a sand box (minimum 30 inches x 30 inches), in front of the target to absorb the splatter and prevent projectiles from ricocheting off the ground. If more than one portable target is to be used, the targets will be set in a fashion so that the splatter from one target will not affect adjacent shooters. Each target must be placed with the direction of fire and the angle of deflection taken into consideration.

(3) Careful consideration of the 20-degree backslash area must be taken into account when multiple stationary SRTs are in a line. The number of shooters on the firing line must be limited at closer distances to keep all personnel out of the 20-degree backslash area (see figs 2–4 and 2–5).

(4) Targets that are intended to flip, swing, or rotate must move freely and operate as intended.

(5) Ensure all targets are adjusted to fall with minimal bullet impact.

c. The RSO will observe and maintain control of the firing line to ensure shooters do not inadvertently move past the 20-degree backslash area.

(1) Ensure all personnel remain clear of the 20-degree backslash area.

- (2) Ensure portable SRTs are prevented from moving (laterally, rotationally, or down range) from set-up position during training which would change the 20-degree backsplash areas of the targets.
- (3) Ensure that a minimum safe engagement distance from the muzzle to the SRT is established and maintained for each weapon system used.
- (4) Ensure the SRT remains adjusted to operate properly upon impact.
 - d.* After firing, lubricate all moving parts and mechanisms and inspect for wear and serviceability.
 - e.* Lead abatement must be considered when handling steel target that have been shot.
- (1) SRTs will be thoroughly cleaned prior to cutting, welding, or braising to avoid hazardous gases created by embedded or coated bullet fragments in accordance with local lead monitoring programs.
- (2) Personnel will wash hands immediately following the handling of SRTs. To reduce exposure, it is recommended that personnel use nitrile gloves.
- (3) For the Army, the minimum engagement distances for SRTs—
 - (a)* Pistol (9mm or above) minimum of 7 m.
 - (b)* Rifle (5.56mm) minimum of 25 m.
 - (c)* Rifle (7.62mm) minimum of 100 m.
- (4) For the Marine Corps—
 - (a)* SRT pistol engagements closer than 7 m are prohibited.
 - (b)* SRT engagements at distances closer than 69 m using 5.56mm ammunition with penetrators are prohibited.
 - (c)* SRT engagements at distances closer than 23 m with soft core 5.56mm ammunition or 5.56mm ammunition that has a solid copper alloy metal projectile are prohibited.
 - (d)* SRT engagements at distances closer than 150 m with 7.62mm ammunition are prohibited.
 - (e)* SRTs that are unserviceable may be used for engagements exceeding the minimum distance for both 5.56mm and 7.62mm.

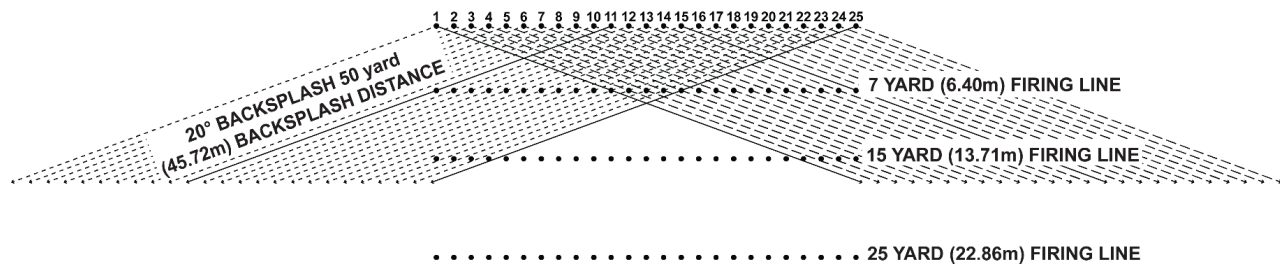
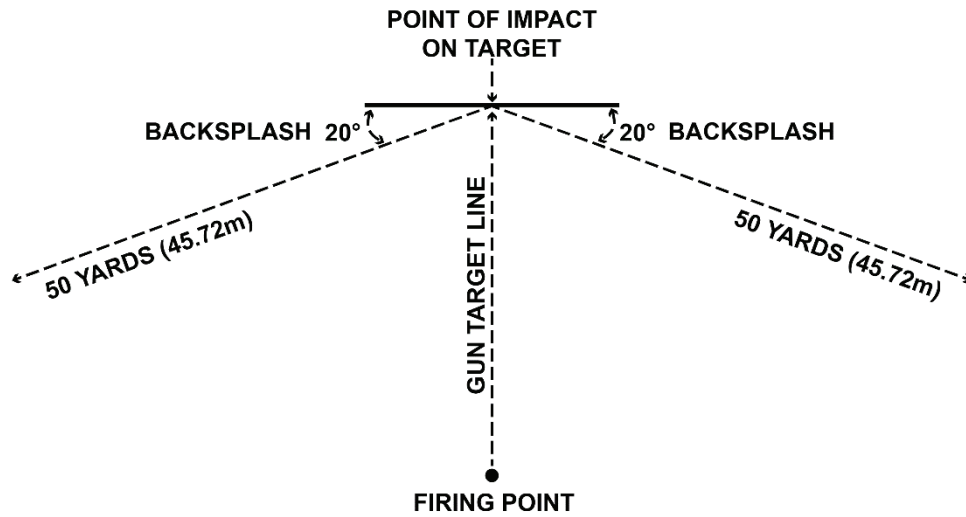


Figure 2–4. Multiple stationary steel reactive targets

TOP VIEW



SIDE VIEW

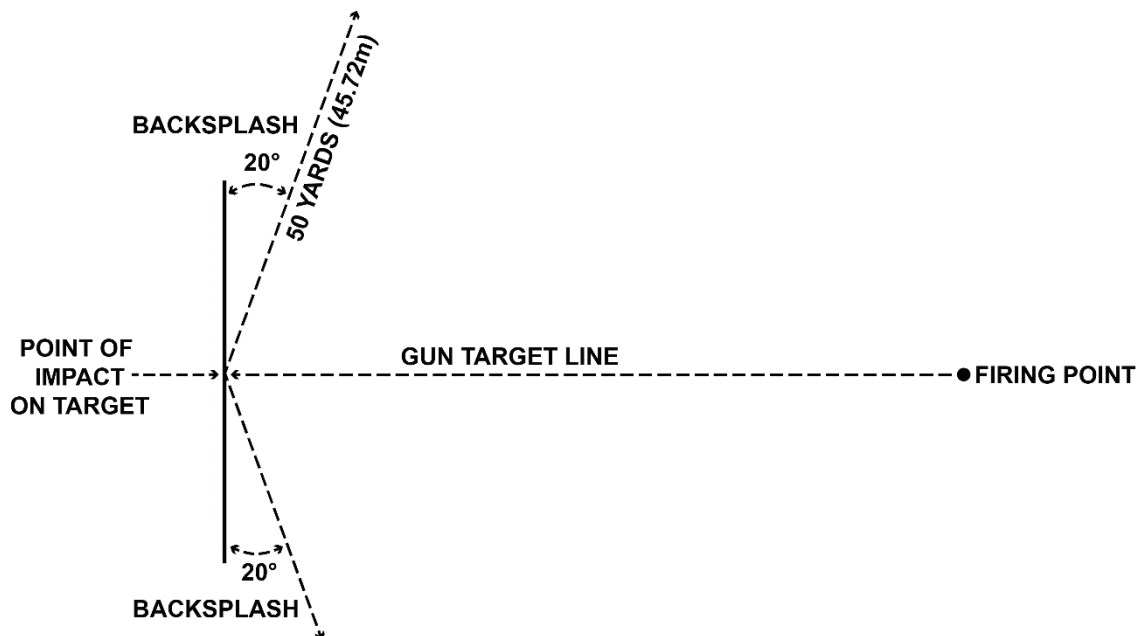


Figure 2–5. Single steel reactive target

2–18. Marine Corps safety requirements for trackless mobile infantry targets

- a. Trackless mobile infantry targets (TMITs) can be programmed for engagements at pre-set locations but also move in a random mode which engagements are unpredictable.
- b. The following considerations must be considered for mitigation practices.
 - (1) A detailed risk assessment must be completed for the ranges allowing the use of TMITs.
 - (2) OIC will verify with the target operator the established maneuver box and associated engagement measures not limited to lateral limits; minimum engagement distance; or firing points, lines, or box.
 - (3) The RSO and ARSO will monitor GTLs and impacts and order an immediate cease-fire or check-fire if an unsafe action is identified or unsafe conditions are presented.
 - (4) Target operators will have positive control of all TMITs throughout the training event and maintain verbal or radio communication with RSO.
 - (5) Target plans must be approved by RCO.
 - (6) TMITs will not be engaged any closer than 1 m.

2–19. Recreational ranges

- a. Procedures in this regulation/order apply to recreational ranges located on Government property. Recreational activity on ranges must be approved by the installation commander on a case-by-case basis. Formal memorandums of agreement must be established with approved organizations participating in recreational range activity. Memorandums of agreement at a minimum must address the following:
 - (1) Liability for both safety and environmental National Environment Protection Action compliance.
 - (2) Emergency response requirements and responsibilities.
 - (3) Responsibilities for maintenance and best management practices of the range.
 - (4) Operating cost and consumables.
- b. Archery target ranges will follow range designs included in TM 5–803–10. Other designs including three-dimensional archery ranges or field ranges simulating hunting scenarios must have a positive backstop. Additional guidance is available from the National Field Archery Association.
- c. Shotgun (skeet or trap) ranges will follow range designs included in TM 5–803–10. The shotfall danger zone will be a minimum of 275 m (300 yards) in accordance with TM 5–803–10 and the ranges must be limited to shot sizes 7.5, 8, 8.5, and 9 shot. Additional guidance is available from the National Skeet Shooting Association and the National Sporting Clays Association. Military training with shotguns (not on a recreational skeet or trap range) will be in accordance with SDZ requirements in chapter 5. Marine Corps shotgun ranges will be certified in accordance with MCO 3550.9A.

2–20. Range personal protective equipment requirements

- a. Training casualties on operational ranges must be minimized through the use of appropriate PPE. This regulation/order provides recommendations for the level of PPE to be used with specific weapon systems (see table 2–2 for PPE levels).

Note. When protective plates are required, they will be serviceable in accordance with applicable military department inspection requirements. Ultimately, the commander must decide the appropriate level of PPE based on a thorough risk assessment.

- b. All personnel within the hearing hazard zone will wear appropriate hearing protection in accordance with DA Pam 40–501 (Army) or MCO 6260.3A (Marine Corps). The size of the hazard zone varies with the weapon. For mixed-use ranges, it is usually convenient to establish the zone based on the loudest weapon used. For administrative convenience, the size of the hearing protection zones can be increased to encompass areas within convenient access or demarcation points. The Marine Corps requires that all personnel exposed to gunfire or artillery or missile firing, under any circumstances, wear hearing protective devices. The following list of distances to the hazard contours for common military weapons is conservative:
 - (1) 0.50 caliber: 55 m to the side; 12 m to the rear.
 - (2) 0.45 caliber: 12 m to the side; 4.5 m to the rear.
 - (3) 9mm: 9 m to the side; 6 m to the rear.
 - (4) 7.62mm: 20 m to the side; 8 m to the rear.
 - (5) 5.56mm: 24 m to the side; 6 m to the rear.
- c. Approved eye protection (ballistic) will be used, especially during force-on-force training maneuvers or scenarios by personnel undergoing training, and those in close proximity (for example, evaluators, observers, and very important persons). Based on risk assessment, the senior commander (Army) or unit commander (Marine Corps O–5) may reduce or eliminate the requirement for eye protection if the decision is made that reduced vision created by use

of eye protection outweighs its value. For the Army, to prevent serious eye injury, the only approved eye protection for use with CCMCK is the standard-issue sun, wind, and dust goggles (national stock number 8465-01-328-8268), which must be worn until all training has ceased. Alternate face masks with integrated goggles may be used only if listed in TM 9-6920-3700-10.

d. The discharge of weapons creates hazardous impulsive noise levels greater than 140 decibels peak pressure (dBp). On both static and maneuver ranges, impulsive noise may reflect off hard surfaces, directing the hazard back toward the Soldier, causing additional exposure. Exposure to impulsive noise greater than 140 dBp can cause significant hearing loss. All personnel exposed to impulsive noise greater than 140 dBp will be enrolled in the Army Hearing Program in accordance with DA Pam 40-501.

e. For the Army, USASOC personnel will comply with USASOC Regulation 385-1 for PPE requirements.

Table 2-2

Personal protective equipment

| Personal protective level | Personal protection required |
|---------------------------|---|
| 0 ¹ | Army combat uniform or standard utility uniform, hearing and eye protection |
| 1 ¹ | Body armor and helmet, hearing and eye protection |
| 2 ¹ | Body armor with front and back enhanced small arms protective insert plates and helmet, hearing and eye protection |
| 3 | Body armor with front, back, and side enhanced small arms protective insert plates and helmet, hearing and eye protection |

Note.

¹ Eye protection is encouraged. Based on risk assessment, the unit commander may require ballistic or laser eye protection.

2-21. Army requirements for areas known to contain improved conventional munitions and sub-munitions

This section prescribes Army controls to address hazards associated with maintenance, characterization, clearance, or removal actions at ranges and other areas known to contain ICMs and sub-munitions.

a. Applicability.

(1) Activities that involve ICM or sub-munitions undertaken by Regular Army, ARNG, or U.S. Army Reserve personnel; Army Civilian employees; Army contractors; and other DoD components.

(2) Operational and former ranges and other areas owned or controlled by the U.S. Army, both in the United States and overseas.

(3) Activities conducted by other Services on Army-owned or Army-controlled property.

(4) Does not apply to the following:

(a) Research, development, test, or evaluation.

(b) Acceptance or proof testing.

(c) Practice sub-munitions.

(d) World War II-era bomblets (for example, M83 butterfly bombs and M54 series incendiary bomblets).

(e) Formerly used defense sites.

b. Functions.

(1) The DASAF, in coordination with the DCS, G-3/5/7; DCS, G-4; and Deputy Assistant Secretary of the Army for Environment, Safety and Occupational Health, provide safety oversight and risk assessment criteria for range clearance activities (for example, target maintenance, environmental sampling, and clearance) that may involve ICM or sub-munitions.

(2) The Judge Advocate General is responsible for providing advice on applicable statutory and regulatory requirements affecting activities that involve ICM and sub-munitions.

(3) The Director, USATCES will—

(a) Provide, upon request, comments on requests for DA Forms 7632 (Deviation Approval and Risk Acceptance Document) for range clearance activities for areas known or suspected to contain ICMs and sub-munitions.

(b) Maintain an inventory of Army operational and former ranges and other properties where ICMs and sub-munitions are known or suspected to be present.

(4) Commanders will—

(a) Ensure that the DCS, G-3/5/7; DASAF; DCS, G-4; and Director, USATCES are informed of any ranges or other areas known to contain ICMs or sub-munitions.

(b) Ensure ranges or other areas known to contain ICMs or sub-munitions are clearly marked and entry to these areas is restricted with access controlled.

(c) Prohibit range clearance activities on operational ranges and removal actions on former ranges, training facilities, or maneuver areas known or suspected to contain ICMs or sub-munitions, unless a Deviation Approval and Risk Acceptance Document (DARAD) is submitted and approved in accordance with DA Pam 385–30.

(d) Have authority to approve DARADs in accordance with DA Pam 385–30.

c. *Mandatory requirements.* Mandatory requirements for operational ranges, training facilities, or maneuver areas known or suspected to contain ICM and sub-munitions.

(1) Ranges, training facilities, or maneuver areas known or suspected to contain ICMs or sub-munitions will be clearly marked, both physically and on the installation's master plans, to identify the hazard. Entry to such areas is prohibited with any authorized access to be strictly controlled.

(2) Before access is granted to an operational range, training facility, or maneuver area, the installation RMA will determine whether ICM or sub-munitions are known or suspected to be present. The RMA, in coordination with installation safety and EOD representatives, will determine if it is safe to authorize access and establish prerequisite precautions. Personnel authorized access to areas known or suspected to contain ICMs or sub-munitions will be fully advised of the potential dangers and safeguards to be followed and escorted by EOD or UXO-qualified personnel.

(3) If an ICM or sub-munition is found on a range, training facility, or maneuver area that is not known to contain ICM or sub-munitions, use of the range will be suspended until the installation range operations conducts the procedures in paragraphs 2–21c(1) and 2–21c(2). The expeditious destruction of any ICM or sub-munitions encountered is authorized.

(4) Range operations or safety personnel will ensure that previously unreported areas known or suspected to contain ICM or sub-munitions are reported immediately through command channels to the DCS, G–3/5/7; DASAF; DCS, G–4; and Director, USATCES. At a minimum, the report will include the location, the type of ICM or sub-munition, the boundaries (by coordinates) of the area, the suspected source (for example, weapon system and event in which the ICM or sub-munitions were most likely used), the date of discovery, a point of contact, and, if available, digital pictures of the discovered item. The location should be marked on the installation master plan and local supporting EOD units should be notified.

d. *Deviation Approval and Risk Acceptance Document.*

(1) A DARAD (DA Form 7632) is required prior to the conduct of clearance activities or a removal action in an area where ICMs or sub-munitions are known or suspected to be present.

(2) A DARAD will be developed and approved in accordance with DA Pam 385–30.

(3) Copies of approved DARADs will be electronically forwarded to DASAF, with copies furnished to DCS, G–3/5/7, Director of Training; Director, Munitions and Chemical Matters Directorate, Office of the Deputy Assistant Secretary of the Army (Environment, Safety and Occupational Health); DCS, G–4; and Director, USATCES.

(4) An amended DARAD will be submitted for any condition that increases the level of explosive safety risk.

e. *Hazard control requirements.*

(1) Operations will be conducted in a manner that exposes the minimum number of people to the smallest quantity of explosives for the shortest period of time.

(2) All work activities will be coordinated with and have the approval of all appropriate levels of command and all organizations or Services involved.

(3) All work activities will be conducted in accordance with controls outlined in approved planning documents (for example, work plans, explosives safety risk assessments, hazard analyses, and site safety and health plans).

(4) Only EOD or UXO-qualified personnel may conduct clearance or removal actions in areas known or suspected to contain ICMs or sub-munitions. Qualifications for UXO personnel are in DDESB Technical Paper 18.

(5) The final disposition of UXO that are ICMs or sub-munitions will be in accordance with EOD-approved procedures. When possible, such military munitions will be blown in place. Prior to destruction of the UXO, all personnel will be removed beyond the specified safe separation distance.

(6) Should an explosive-related incident involving injury to personnel occur—

(a) It will be reported in accordance with AR 385–10.

(b) All activities will be stopped until a review and validation of procedures have been completed and approved by the commander with responsibility for the activities.

2–22. Other military Services and agencies

Military Services, other than the Army and the Marine Corps; and local, State, and Federal agencies may use Army or Marine Corps-controlled ranges at the discretion of the senior commander (Army) or installation commander (Marine Corps). Agencies wishing to use Army or Marine Corps-controlled ranges must comply with the provisions of

this regulation/order. Requests for range use will include all technical data regarding munitions and weapons systems so the RM process can be applied and a determination made regarding the adequacy of the range for the proposed operation.

2–23. Prohibitions

Prohibitions pertain to activities on operational ranges that will only be conducted when authorized by the individuals designated below.

a. Army.

(1) Unless specifically approved by the DCS, G–3/5/7 and DCS, G–9, Army organizations are prohibited from training with or conducting demonstrations using ICM or sub-munitions. This approval authority will not be delegated to the ACOM, ASCC, DRU, or ARNG.

(2) Unless approved by ACOM, ASCC, or DRU commanders (lieutenant general and above) or the next general officer in the chain of command for ACOMs, ASCCs, and DRUs not commanded by a lieutenant general and above or the ASA (IE&E), overhead fire above unprotected personnel with AE is prohibited unless specifically authorized in this regulation/order.

(3) Unless approved by the DCS, G–3/5/7 and DCS, G–9, firing ammunitions or explosives over any ammunition storage area is prohibited unless specifically authorized in this regulation/order.

b. Marine Corps. Unless approved by the CG, TECOM, the following activities are prohibited:

(1) Firing ICM into dedicated impact areas where troops are permitted to maneuver. If an ICM round exits an approved ICM area, firing of that munition and weapon will cease until the cause of the round out of impact has been determined. Range control authorities and EOD units should be immediately notified of the event and the area identified as a possible ICM area until an explosive ordnance reconnaissance can confirm the area safe for use. If firing occurred with an approved range safety deviation and if the investigation determines all controls required by the deviation were in place, the deviation will be rescinded immediately.

(2) Overhead fire above unprotected personnel with ammunition, pyrotechnics, missiles, and rockets unless specifically authorized in this regulation/order.

(3) Firing ammunition, pyrotechnics, missiles, and rockets over ASPs, field ASPs, or any ammunition storage area with ammunition not approved for overhead fire. Firing over ASPs, field ASPs, or any ammunition storage area with ammunition approved for overhead fire will only be authorized through the deviation process outlined in chapter 4 of this regulation/order.

c. Army and Marine Corps. Unless approved by the DCS, G–3/5/7 and DCS, G–9, or the CMC, the following activities are prohibited:

(1) Firing depleted uranium ammunition on operational ranges. The exceptions are those ranges specifically designated Nuclear Regulatory Commission-licensed target or impact areas. For the Army, the approving authority must have visibility of all of the implications of firing depleted uranium; weigh the costs and benefits from the Army perspective; and be in a position to commit the Army to dealing with the regulatory requirements, environmental remediation, and potential negative publicity.

(2) The use of ranges, impact areas, buffer zones, or live-fire training areas that contain or may contain UXO for hunting or other recreational purposes.

(3) Burying live mines for training purposes.

(4) Trip wires, booby traps, or tilt rods used separately or collectively with live mines in training.

(5) Live-mine and practice-mine training taking place concurrently at the same location.

(6) Disarming or arming live mines more than 25 iterations per mine.

(7) Training with non-self-destructing antipersonnel land mines except as authorized by the National Command Authority. When training with non-self-destructing antipersonnel land mines is authorized, the following training is prohibited:

(a) Training with live M14 mines.

(b) Training with the M16 antipersonnel mine without the positive safety pin remaining in the M605 fuse.

(8) Live-fire and blank firing taking place concurrently at the same location supervised by the same OIC or RSO.

(9) In addition to actual operation of military vessels, aircraft, vehicles, and crew-served weapons systems, civilian visitor participation in the following activities is prohibited:

(a) Throwing live hand grenades.

(b) Using diversionary devices (for example, flash bangs and pyrotechnics).

(c) Participating in live firing in a shooting house (for example, close quarters battle).

(d) Participating in live firing on maneuver ranges while units are maneuvering.

(e) Fast rope, rappelling from helicopters, and special purpose insertion extraction rigging.

- (f) Parachuting.
- (g) Other activities, as determined by a commander, that could cause increased safety risks.

Chapter 3

Danger Zones

3–1. General

a. Danger zones will be created for every weapon system and the munitions associated with each system used on operational ranges. The danger zones in this regulation/order represent minimum safety requirements. They are adequate only when employed with properly functioning safety equipment and devices and when trained and competent personnel follow published firing procedures. They are three-dimensional areas derived from computer modeling or laboratory data. Danger zone size and shape are dependent on the performance characteristics of the weapon system, ammunition, training requirements, geographical location, and environmental conditions. They should not account for human error.

b. The goal of SDZs is to depict munitions and hazardous fragments with a probability of escapement from the danger zone not to exceed 1:1,000,000.

c. The goal of WDZs is to contain all munition fragments, broaches, ricochets, and debris with a probability of containment of 99.9999 percent (1:1,000,000 probability of escapement).

d. Danger zones will be prepared and updated as appropriate in accordance with this regulation/order for all munitions and laser systems. Hazardous laser systems (such as class 3B and 4 lasers) will not be fired or employed on operational ranges except within the confines of approved LSDZs. Deviations from this policy will be in accordance with the provisions of deviations of this regulation/order.

e. Only those personnel authorized in paragraph 3–3 will be allowed within the danger zone.

f. If a round exits an approved danger zone, firing or delivery of that munition and weapon will cease locally until the cause of the round out of impact has been determined.

(1) If firing occurred with an approved range safety deviation and if the investigation determines all controls required by the deviation were in place, the deviation will be rescinded immediately.

(2) If firing occurred without any deviations from this regulation/order or if the investigation determines all required controls are in place and there was no ammunition malfunction, the senior commander or a designated representative will report the incident to the weapon system manager and the ACOM, ASCC, or DRU safety office. The ACOM, ASCC, or DRU safety office will report the incident in accordance with AR 750–6. Marine Corps organizations will report incidents to the CMC Safety Division through the installation RCO and safety office, with an information copy provided to CG, TECOM (C 465).

g. Baffled firing ranges providing containment of projectiles, fragments, and ricochets designed and maintained in accordance with host nation design requirements or approved Corps of Engineers designs may not require application of danger zone restrictions outside of the baffled area. The approving authorities for this type of range are the Army ACOM, ASCC, and DRU commanders. Marine Corps organizations will use guidance from MCO 3550.9A and CG, TECOM (C 465).

h. For the Army, the creation of new or the expansion of existing impact areas that contain UXO must be validated in accordance with AR 350–19. For the Marine Corps, the areas must be approved by CG, TECOM (C 465), in conjunction with the Deputy Commandant, I&L and other Headquarters, Marine Corps agencies. Existing dedicated impact areas will be used to the maximum extent feasible during live-fire training with military munitions that may not function as intended.

i. Military munitions that land off an operational range and are not rendered safe and recovered become waste military munitions in accordance with DoDM 4715.26.

j. Danger zones can be constructed manually or by using geospatial data and the RMTK in either a desktop, web-based, or mobile environment (Marine Corps only). Danger zones created using the RMTK must be developed using the current approved version of the RMTK. The RMTK can be downloaded (desktop) and accessed (web-based) at <https://srp2.army.mil> (Army) or <https://rtam.tecom.usmc.mil> (Marine Corps).

3–2. Types of danger zones

There are three types of danger zones:

a. *Laser surface danger zone (air-to-ground and ground-to-ground).* An LSDZ consists of the target area and horizontal and vertical buffer zones. It reflects the minimum land and air requirement, to include terrain mitigation, needed to safely employ a given laser. The LSDZ accounts for direct hazards (main beam) and indirect hazards (reflections). The boundaries of the LSDZ depend on which of the two overlapping zones, direct or indirect, are larger.

If there are no specular reflectors on the range and the laser does not present a diffuse reflection hazard, there will not be an indirect hazard zone. LSDZs must accommodate stationary firing points (fixed positions) and mobile firing positions, in addition to fixed and moving targets (fig 3–1 for the basic elements of an LSDZ).

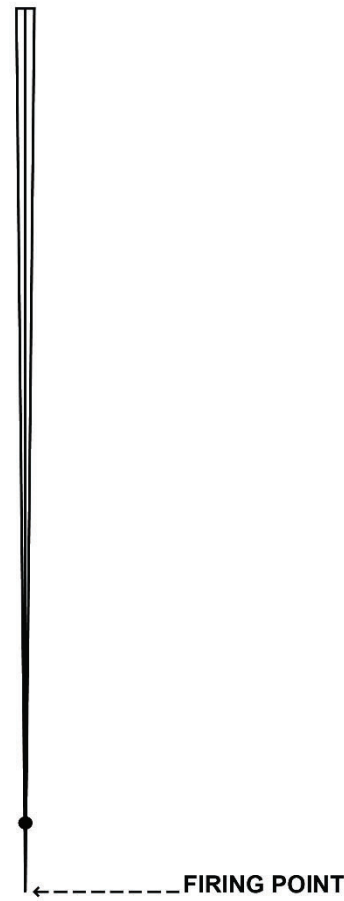


Figure 3–1. Basic elements of a laser surface danger zone

b. Surface danger zone (ground-to-ground). An SDZ delineates that portion of the earth and the air above in which personnel and equipment may be endangered by ground weapons firing or demolition activities. These SDZs are designed to make the probability of hazardous fragment or round escapement from installation boundaries unlikely and minimize the danger to the public, installation personnel, facilities, equipment, property, and the environment. The two basic SDZs are the cone and the batwing. The batwing SDZ provides for greater containment of ricochets. Figures 3–2 and 3–3 show cone and batwing SDZs for small arms direct-fire weapons without explosive projectiles. Figures 3–4 and 3–5 are cone and batwing SDZs for small arms direct-fire weapons with explosive projectiles. Figures 3–6 and 3–7 are SDZs for mortars and field artillery cannon in the indirect-fire mode. Certain weapons (for example, tube-launched, optically-tracked, wire-guided (TOW) and FGM–148 Javelin missiles) have unique SDZs. They will be addressed in the appropriate chapter.

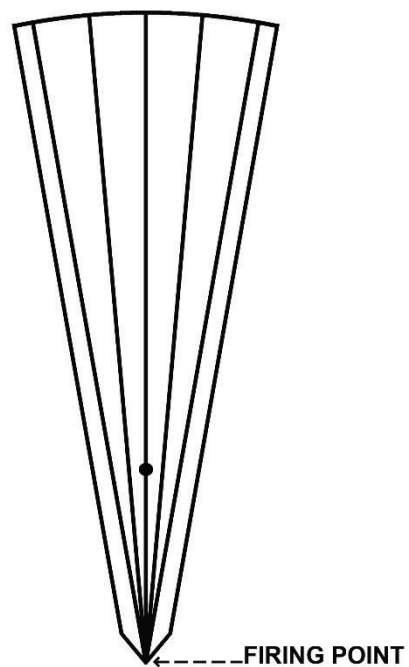


Figure 3–2. Cone surface danger zone for small arms direct-fire weapons without explosive projectiles

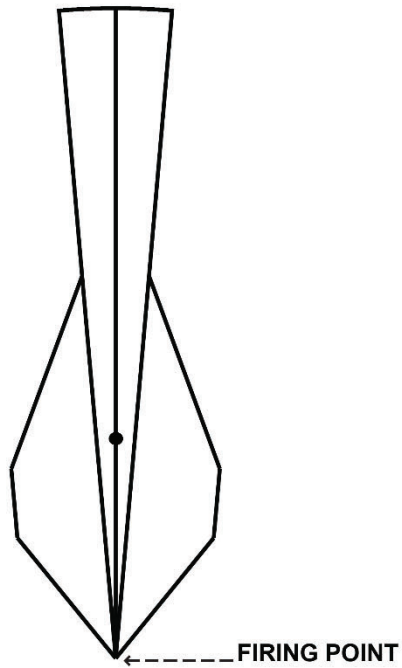


Figure 3–3. Batwing surface danger zone for small arms direct-fire weapons without explosive projectiles

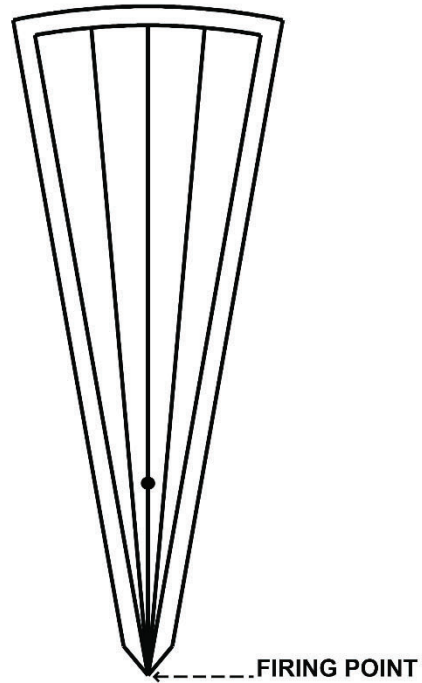


Figure 3–4. Cone surface danger zone for small arms direct-fire weapons with explosive projectiles

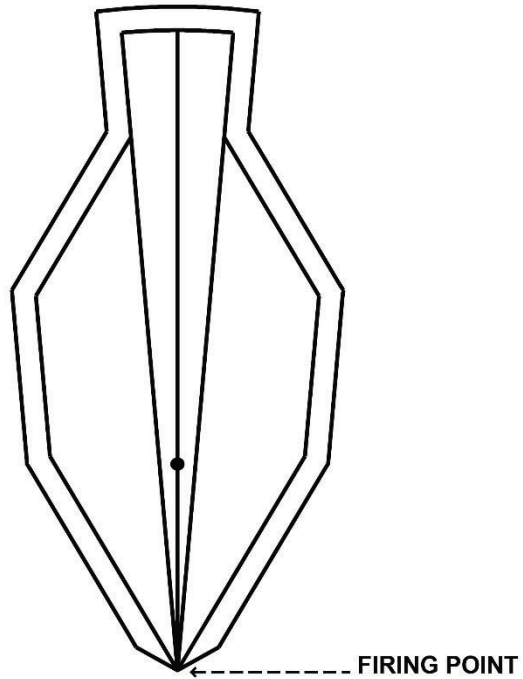


Figure 3–5. Batwing surface danger zone for small arms direct-fire weapons with explosive projectiles

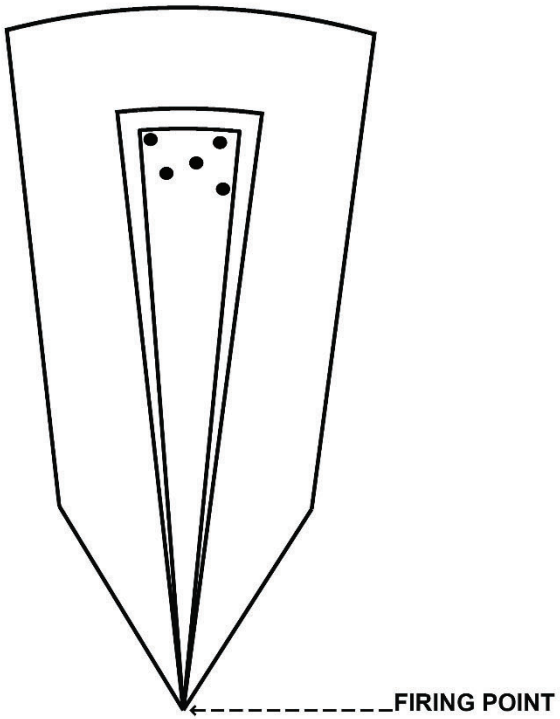


Figure 3–6. Surface danger zone for indirect fire, mortars

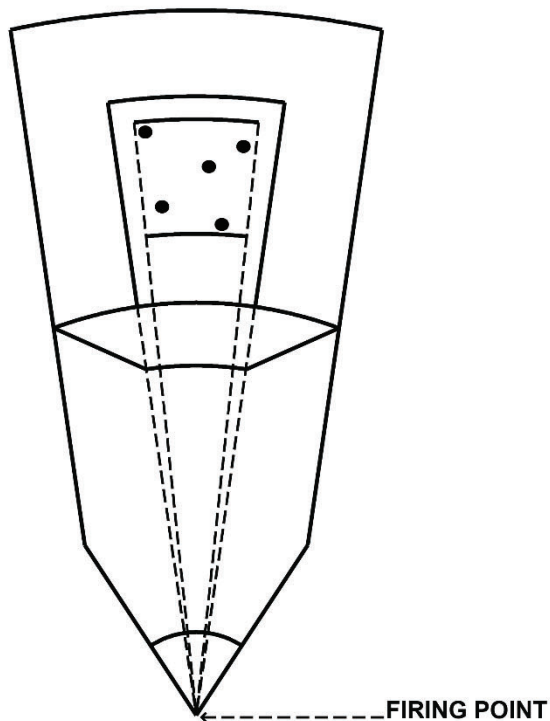


Figure 3–7. Surface danger zone for indirect fire, field artillery cannon

(1) *Multiple firing point and target surface danger zones.* A single SDZ for a particular weapon system may be expanded to accommodate multiple firing positions or targets for that weapon system. Figure 3–8 shows a SDZ for multiple fixed firing positions and multiple fixed targets. Figure 3–9 shows an SDZ for multiple fixed firing points and multiple fixed or moving targets. Figure 3–10 shows an SDZ with single fixed firing point and multiple fixed targets. Figure 3–11 shows an SDZ with multiple fixed firing points and single target or fixed or moving targets.

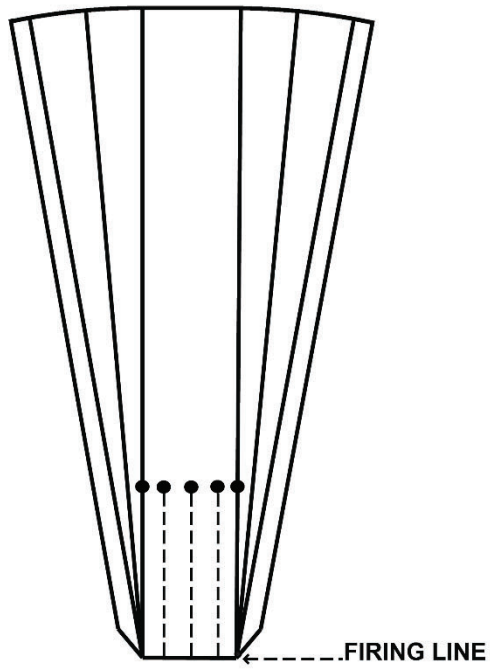


Figure 3–8. Multiple surface danger zone; multiple fixed firing points and multiple fixed targets

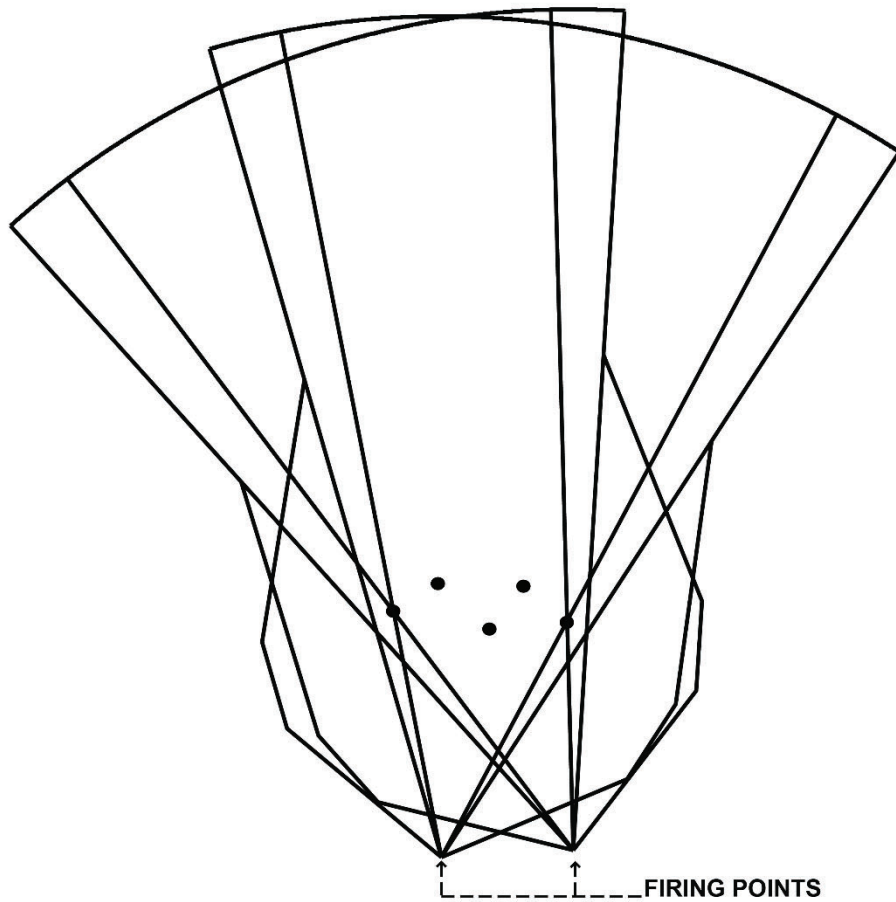


Figure 3–9. Multiple surface danger zone; multiple fixed firing points and multiple fixed or moving targets

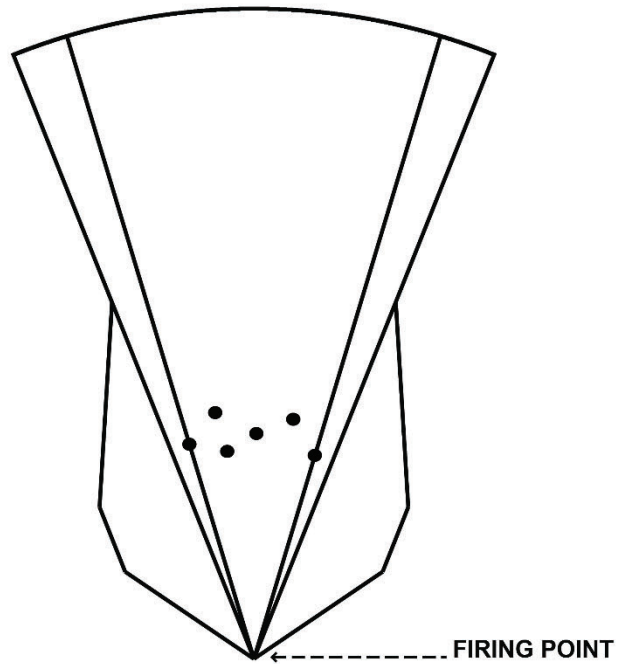


Figure 3-10. Multiple surface danger zone; single fixed firing point, multiple fixed targets

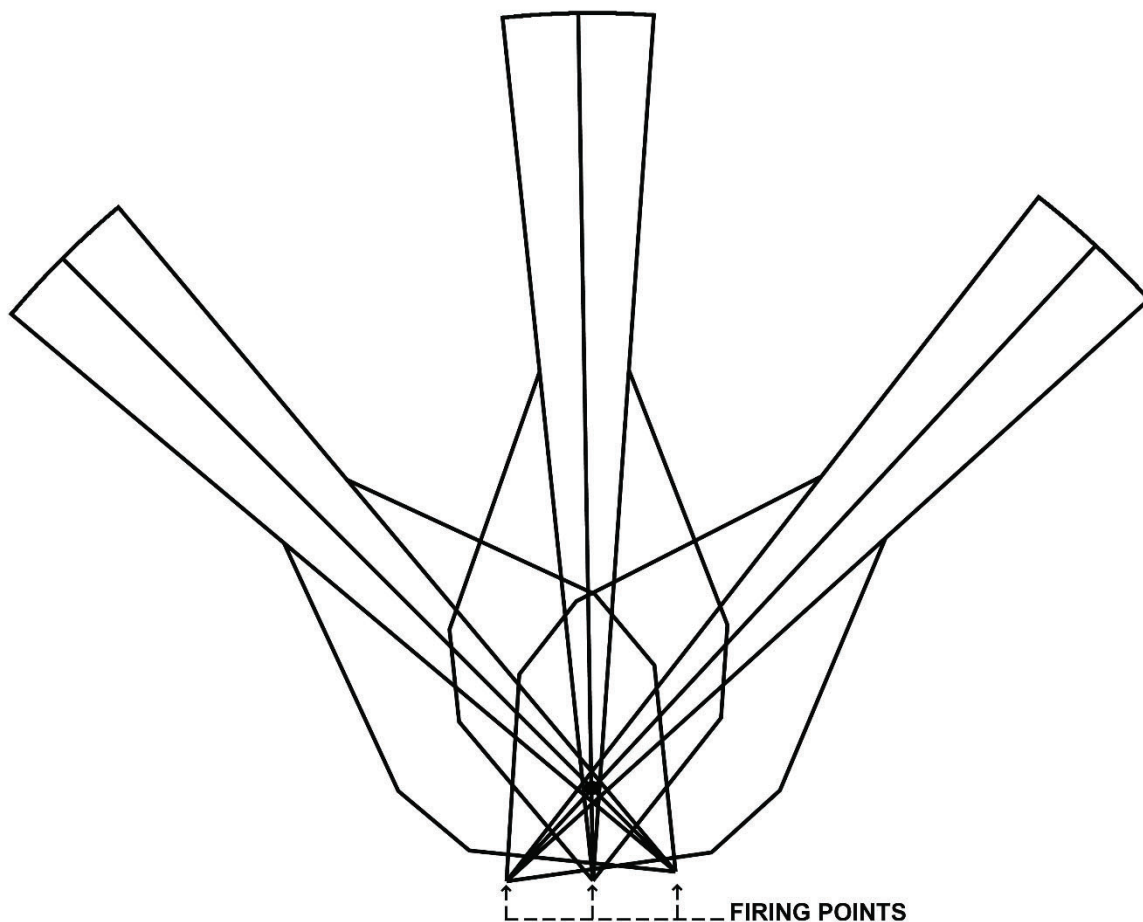


Figure 3–11. Multiple surface danger zone; multiple firing points; single target, fixed or moving targets

(2) *Movement box.* A movement box is designed to accommodate movement to an objective. Shooters move within the designated box and may engage multiple targets or moving targets down range. For the Marine Corps, movement boxes for live-fire maneuver and movement exercises will use the batwing SDZ. For the Army, the batwing SDZ will be considered for movement boxes for live-fire maneuver and movement exercises. Figure 3–12 shows a movement box with the batwing SDZ. Target engagement scenarios must ensure fires remain within the established SDZ.

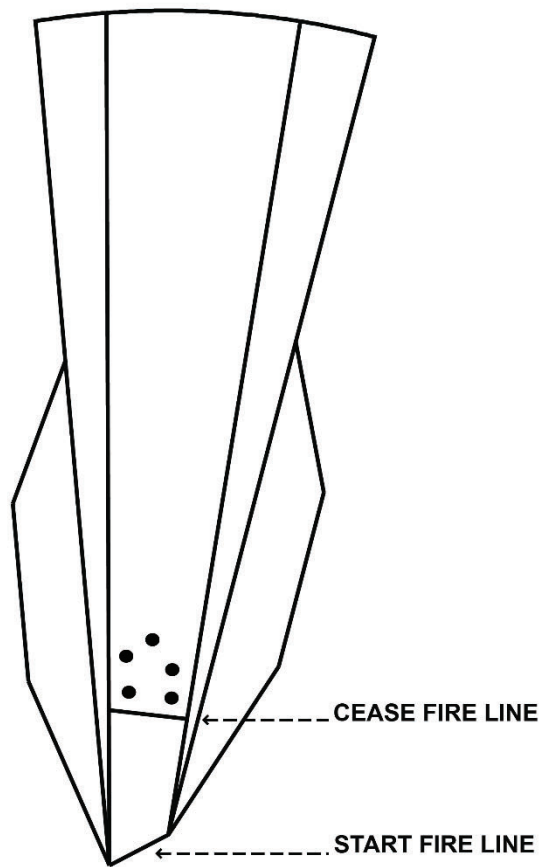


Figure 3–12. Movement box surface danger zone; multiple firing points, fixed or moving targets

c. Weapons danger zone (air-to-ground). A WDZ encompasses the ground and airspace for lateral and vertical containment of projectiles, fragments, debris, and components resulting from the firing, launching, and detonation of aviation-delivered ordnance. It reflects the minimum land and air requirement, to include terrain mitigation, needed to safely employ a given weapon. The WDZ accounts for inaccuracy, failures, ricochets, and broaching or porpoising of a specific weapon or munition type delivered by a specific aircraft type. The WDZ is based on weapon characteristics, type of delivery being executed, platform (aircraft) delivering the ordnance, target and soil characteristics, terrain, and level of containment acceptable to the senior commander (Army) or installation commander (Marine Corps) (see fig 3–13 for the basic elements of a WDZ).

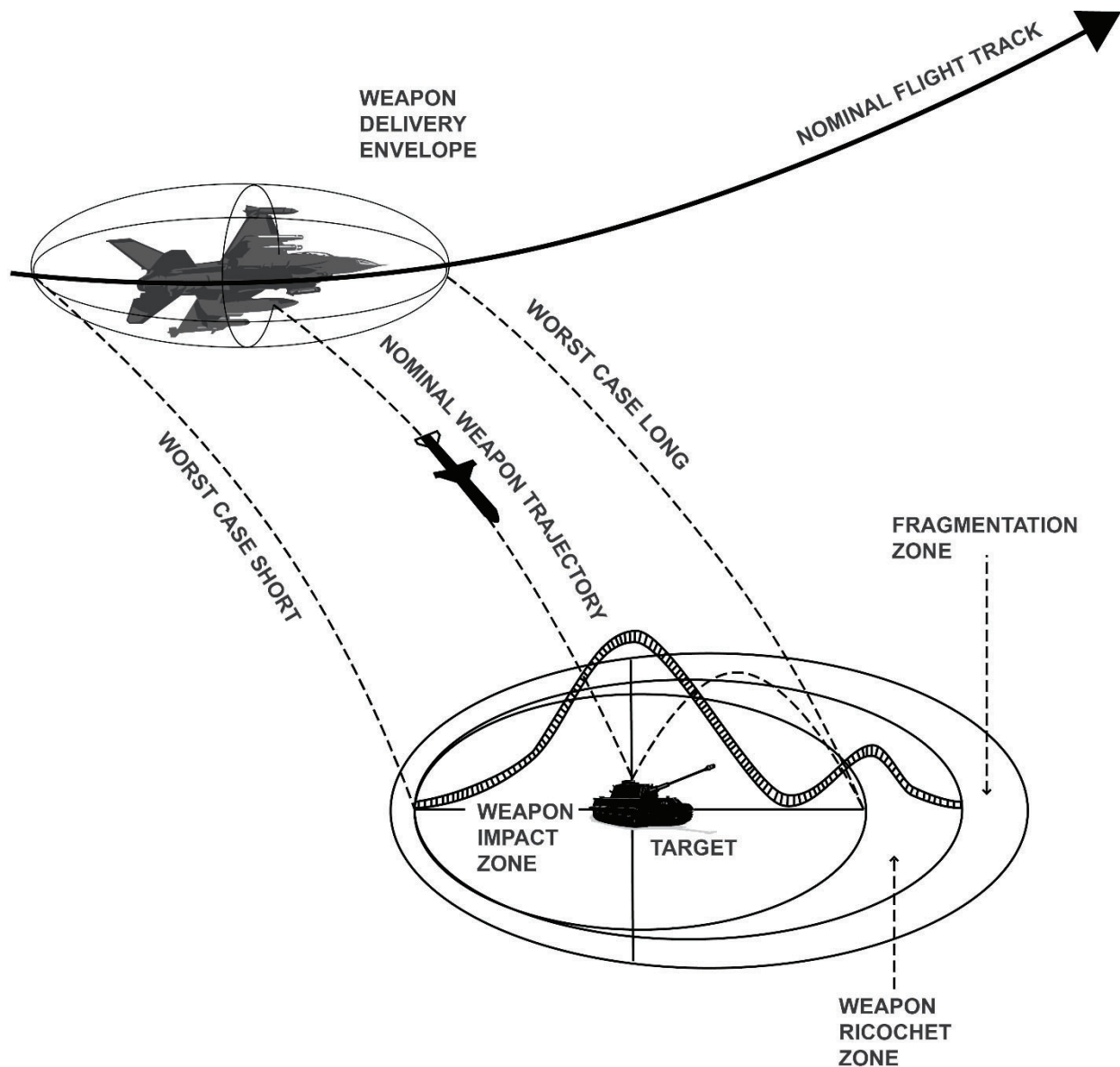


Figure 3–13. Basic weapon danger zone profile

d. Composite danger zones.

(1) CALFEXs (Army) and CAXs (Marine Corps) involve combined arms teams conducting coordinated fire and maneuver training in executing the assault, seizure, and defense of appropriate objectives. Tactical air support may be included with appropriate WDZs. Combining multiple danger zones for a CALFEX or CAX scenario is the definitive application of danger zones. Regardless of the number and types of danger zones a CALFEX or CAX requires, a systematic approach will result in successful definition of each LSDZ, SDZ, or WDZ and allow training to be safely accomplished.

(2) Danger zones of multiple weapon systems in a CALFEX or CAX scenario result in a composite LSDZ, SDZ, or WDZ. The composite LSDZ, SDZ, or WDZ identifies total real estate requirements at a given sequence or phase

of the exercise. Numerous sequenced or time-phased composite danger zones may exist depending on the complexity of a particular CALFEX or CAX. Figure 3–14 is a composite SDZ.

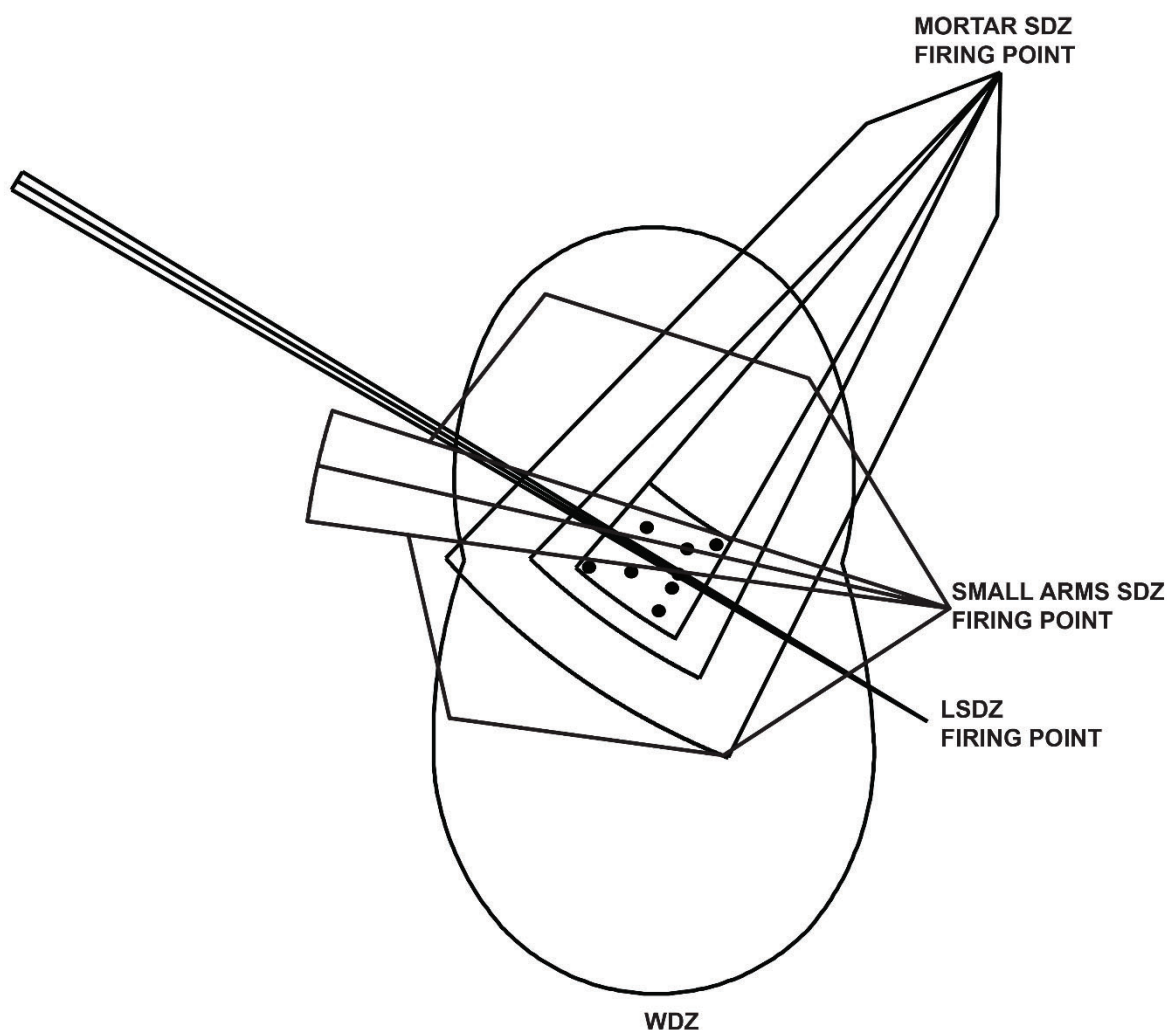


Figure 3–14. Composite surface danger zone

3–3. Authorization for personnel within danger zones

a. The personnel listed in paragraphs 3–3a(1) through 3–3a(9) and those personnel conducting live-fire are authorized to be within a danger zone. This authorization is subject to applicable restrictions in this regulation/order and the senior commander's (Army) or installation commander's (Marine Corps) approval based on a risk assessment.

- (1) Crews directly involved in the firing of a weapon system or munition.
- (2) Tactical air control party or joint terminal attack controllers (JTACs) controlling live-fire from aviation assets.
- (3) Aircrews operating within danger zones as part of an exercise.
- (4) During indirect field artillery, firing personnel may be in Areas A through E subject to the restrictions in chapter 11.
- (5) Designator operators (laser) during Air-to-Ground Missile (AGM)–114 Heliborne, Laser, Fire and Forget Missile (HELLFIRE) anti-tank guided missile operations.
- (6) Personnel down range when approved overhead small arms ammunition is fired.
- (7) Personnel wearing approved laser eye protection within the LSDZ.
- (8) Personnel down range when supporting training on known distance firing ranges, when protection is provided.

- (9) Designated mission-essential personnel (MEP).
- b. Authorization of any other personnel within danger zones requires deviation approval in accordance with this regulation/order.

Chapter 4

Deviations

4–1. Deviation from range standards and procedures

- a. A deviation, as discussed in this regulation/order, is the temporary departure from established range standards and procedures. An example would be reducing SDZ dimensions when terrain, artificial barriers, or other compensating factors mitigate risks to make smaller SDZs safe.
- b. Army senior commanders in the grade of O–7 and above may authorize deviations. This authority will not be further delegated.
- c. For the ARNG, the Adjutant General of the respective State or territory is the approval authority for all deviations within their State or territory. This authority will not be further delegated.
- d. For the Marine Corps, COMMARFORRES; Commander, MCICOM; or the regional commanders of Marine Corps installations with RTA complexes may authorize deviations.
- e. The first general officer (O–7 or above) in the exercise chain of command in non-enduring locations may authorize deviations for that exercise.
- f. For the Army, the CG, USASOC is the approval authority for all ARSOF deviations, to include nonstandard munitions, maneuver, overhead fires, and combined or joint foreign special operations forces training events. If ARSOF deviations affect installation deviations or have effects on outside units or facilities, then they must be approved by senior commander.
- g. The commanders listed in paragraphs 4–1b through 4–1f do not have authority to grant exceptions to the prohibitions in paragraph 2–23 of this regulation/order.

4–2. Delegation of deviation authority

- a. The Commander, MCICOM and regional commanders of Marine Corps installations with RTA complexes may delegate deviation authority to base and station commanders with the rank of colonel (O–6).
- b. For the Marine Corps, forward deployed commanders (O–6) are authorized to approve deviations, provided the deviations do not violate host nation agreements.
- c. This authority will not be further delegated.

4–3. Deviation limitations

- a. Deviations from range standards or procedures in this regulation/order may be granted based on critical mission requirements. RM will be integrated into the deviation process. Deviations are limited to—
 - (1) Reducing SDZ, LSDZ, and WDZ dimensions when terrain, artificial barriers, or other compensating factors make smaller danger zones safe.
 - (a) Deviations applied to danger zones extending beyond authorized range impact areas and installation boundaries must be based on the ability to sufficiently contain projectiles, hazardous fragments, laser beams, and both vertical and horizontal ricochets within the authorized range impact areas and installation boundaries and areas under military control (for example, leased land or training areas acquired through memorandum of agreement or memorandum of understanding).
 - (b) For the Army, deviations extending beyond the installation boundaries must be validated by U.S. Army TRADOC TPO Ranges, Range Operations, 1900 Jackson Ave., Fort Eustis, VA 23604, using the Probabilistic SDZ Tool. Probabilistic SDZ analysis is good for 2 years and does not require additional deviations.
 - (c) For the Marine Corps, deviations for danger zones extending beyond the installation boundaries must be validated by CG, TECOM, RTAM Branch, 2007 Elliot Rd., Quantico, VA 22134, using the Probabilistic SDZ Tool.
 - (2) Modifying prescribed firing procedures to increase training realism (such as accepting increased risk when the risks have been incorporated into an approved danger zone) as appropriate for the proficiency of participants.
 - (3) Allowing personnel not authorized within the danger zone, unless prohibited.
- b. At a minimum, all deviation authorizations will contain the following, as appropriate:
 - (1) Statement citing chapter, paragraph, and subparagraph of the specific condition requiring deviation and the name and number of the operational range, training facility, or maneuver area involved.
 - (2) Description of the existing condition and anticipated hazards, subsequent hazard analysis, and risk analysis.

- (3) Statement on why a deviation is necessary and impact on training if not granted.
- (4) Control measures taken to mitigate hazards or minimize risk and residual risk level.
- (5) Installation and unit SOPs governing the specific operational range, training facility, or maneuver area for which the deviation applies.
- (6) Scaled topographical map depicting SDZ and requested deviation.
- (7) Map coordinates of the firing positions, target location, and quadrant or elevation of fire, if required. The firing positions, direction of fire, and danger zones will be plotted on the scaled map with distances shown in meters.
- (8) Computer-generated danger zones and terrain profiles created using the RMTK may be submitted with deviation requests in lieu of developing them through manual means, if deemed appropriate by the senior commander (Army) or installation commander (Marine Corps). These computer-generated danger zones and terrain profiles must be developed using the current approved version of the RMTK. Danger zones and terrain profiles must depict the GTL, the left and right limits of fire, the relative elevation of the weapon system being fired, the target, and the natural terrain backstop or artificial barrier, as appropriate. RM principles will be applied in determining if alternate danger zones are applicable.
- c.* Requests for deviation will originate from the unit or activity conducting the event or the installation RMA (Army) or RCO (Marine Corps). The installation RMA (Army) or RCO (Marine Corps) makes the initial judgment regarding the suitability of a proposed deviation prior to submission to the approving authority. Requests will be coordinated through the appropriate chain of command. For the Army, coordination will include both garrison and mission safety offices, legal review, environmental, and public affairs offices, as appropriate.
- d.* Deviations will not be applied to other Federal agency directives or regulations, such as airspace or water traffic requirements.
- e.* Approved deviations will be effective for 1 year or less.
 - (1) Expired deviations may be renewed by the respective approval authority, provided conditions cited in the original deviation have not changed.
 - (2) The need to incorporate conditions, requirements, controls, and so forth in approved deviations into range development plans will be addressed at each installation range development plan meeting as required by AR 350–19, MCO 3550.9A, and MCO 3550.10.
- f.* Any mishap or incident occurring under an approved deviation will cause automatic termination of the deviation until an investigation is completed and the deviation revalidated by the respective approving authority.
- g.* Conflicts regarding level of risk determination will be resolved by the commander holding the deviation authority for the highest level of risk deemed in conflict.
- h.* For live-fire training operations conducted under an approved deviation by nonresident units, the host installation commander or senior commander must approve training at a host installation.
- i.* ACOMs, ASCCs, and DRUs communicate directly with the TPO Ranges for technical information and guidance on RM. Marine Corps organizations may communicate directly with TECOM, RTAM Branch (C 465) for technical information and guidance.

Chapter 5

Small Arms

5–1. Firing conditions

- a.* For the purpose of this regulation/order, small arms are man-portable, individual, and crew-served weapon systems of .50 caliber or less used primarily against personnel and lightly armored or unarmored equipment. Small arms SDZ diagrams and tables provided in this chapter are the standard for the proper construction of small arms direct-fire SDZs with or without exploding projectiles.
- b.* The cone SDZ may be applied when designing or conducting training on static or known distance style ranges that do not involve fire and movement or fire and maneuver. Figure 5–1 is a cone SDZ for firing small arms direct-fire weapons without exploding projectiles. Figure 5–2 is a cone SDZ for firing small arms direct-fire weapons with exploding projectiles.
- c.* The batwing SDZ provides for greater containment of all ricochets.
 - (1) For the Army, the batwing will be applied when designing ranges that involve fire and movement, fire and maneuver, or flanking fire or when ricochet hazards outside the range boundary may endanger nonparticipating personnel. Deviation for use of a cone SDZ will be based on level of risk and approval of appropriate command risk acceptance authority in accordance with DA Pam 385–30.
 - (2) For the Marine Corps, the batwing will be applied when designing or conducting training on ranges that involve fire and movement, fire and maneuver, or flanking fire or when ricochet hazards outside the range boundary may

endanger nonparticipating personnel. Figures 5–3 and 5–4 are batwing SDZs for firing small arms direct-fire weapons without exploding projectiles. Figure 5–5 is a batwing SDZ for firing small arms direct-fire weapons with exploding projectiles.

d. When firing small arms with or without exploding projectiles on small arms ranges with known distance and unknown distances involving hand-held and shoulder-fired weapons or weapons firing from ground or vehicle-mounted platforms, the standard 5-degree dispersion area for the SDZ may be reduced to 2 degrees when—

(1) Conducting static (no live-fire and movement/maneuver) training on known distance and unknown distance small arms ranges with hand-held or shoulder-fired weapons when firing from fixed or stationary positions.

(2) Training on ranges involving personnel conducting precision fires from stationary positions.

(3) Ground-mounted weapons conducting static (no-live-fire and movement/maneuver) training on known distance and unknown distance small arms ranges that are mounted on appropriate tripods. The traversing and elevation mechanism for that weapon system will be used for all fires.

(4) Vehicle-mounted weapons conducting static (non-fire and movement/maneuver) training on known distance and unknown distance small arms ranges are mounted on appropriate vehicle mounts. The traversing and elevation mechanism for that weapon system will be used and locked in place for all fires.

(5) RM process documentation for the unit conducting training has been approved by the installation RMA (Army) or RCO (Marine Corps) or other appropriate approving authority. Training events in which the SDZ dispersion area has been reduced from 5 to 2 degrees will be specifically addressed in the risk assessment worksheet.

e. When firing small arms on static ranges when the land area will not support the use of Distance X, the application of Distance Y as the maximum distance of an SDZ is authorized, as long as the following circumstances are met:

(1) Conducting static (no live-fire and movement/maneuver) training on known and unknown distance small arms (30mm or less) ranges with hand-held or shoulder-fired weapons from fixed or stationary positions.

(2) Training on ranges involving personnel conducting precision, target-centric fires from stationary positions.

(3) Conducting static (no live-fire and movement/maneuver) training on known and unknown distance small arms ranges with tripod-mounted weapons. Traversing and elevation mechanisms must be used. Firing weapons in a free gun condition requires SDZs with Distance X.

(4) During CAXs, the use of Distance Y as the maximum distance is authorized, except during live-fire and movement/maneuver.

(5) A cone SDZ may be applied with Distance Y as the maximum distance of a munition when designing or conducting training on static, known, or unknown distance ranges that do not involve fire and maneuver or fire and movement. A batwing SDZ is required when crew-served weapons are employed or anytime weapons are fired in an automatic or burst fire mode.

(6) RM process documentation for the unit conducting training has been approved by the installation RMA (Army) or RCO (Marine Corps) or other appropriate approving authority. Training events in which the SDZ dispersion area has been reduced from 5 to 2 degrees will be specifically addressed in the RM worksheet.

(7) The use of Distance Y in an SDZ for the purpose of containing the maximum distance of projectiles within an installation boundary is prohibited.

f. The .50 caliber MK211 cartridge will not be fired on known distance qualification ranges with earthen berms due to improper impact media and range safety and operational range clearance concerns. Firing this cartridge into dedicated impact areas may be authorized when access is controlled and maintenance activity that could cause a projectile that has malfunctioned to function (for example, grass cutting or sustainment or serviceability maintenance with equipment) is not permitted (see fig 5–6 for SDZ for .50 caliber Saboted Light Armor Penetrator (SLAP) and Saboted Light Armor Penetrator-Tracer (SLAP–T)).

5–2. Surface danger zones

a. See tables 5–1 through 5–35 for SDZ data for small arms.

b. Q and P are angles, and W is the width distance between the dispersion area limit and the ricochet area limit. The following definitions apply to all related instances:

(1) *Distance D.* Distance along specific angle, measured from the weapon target line, at the firing position down range for selected direct-fire weapons. Distance D defines maximum projectile distance along this line.

(2) *Distance W.* The maximum lateral distance a projectile will ricochet after impacting within the dispersion area. Distance W defines the maximum lateral edge of the ricochet area.

(3) *Distance Y.* The maximum distance down range at which a lateral ricochet is expected to occur when a projectile is fired at a given quadrant elevation (QE).

(4) *Angle P.* The angle beginning at the firing point, located to the left and right of the dispersion area, which defines the area which contains projectiles after making initial contact with the target medium.

(5) *Angle Q*. The angle beginning at Distance Y, located to the left and right of the dispersion area, which defines the area which contains projectiles after making initial contact with the impact medium.

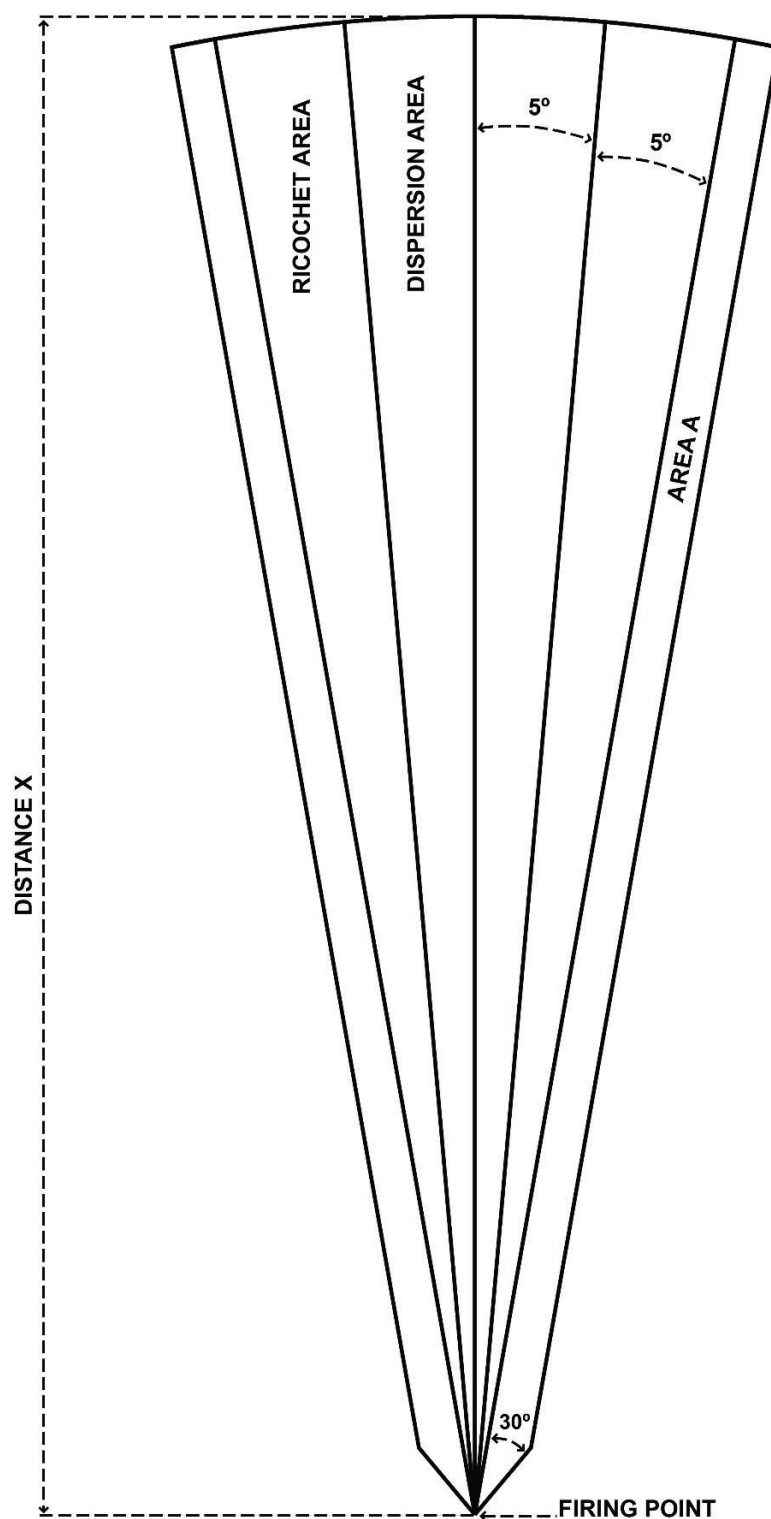


Figure 5–1. Cone surface danger zone for firing small arms direct-fire weapons without exploding projectiles

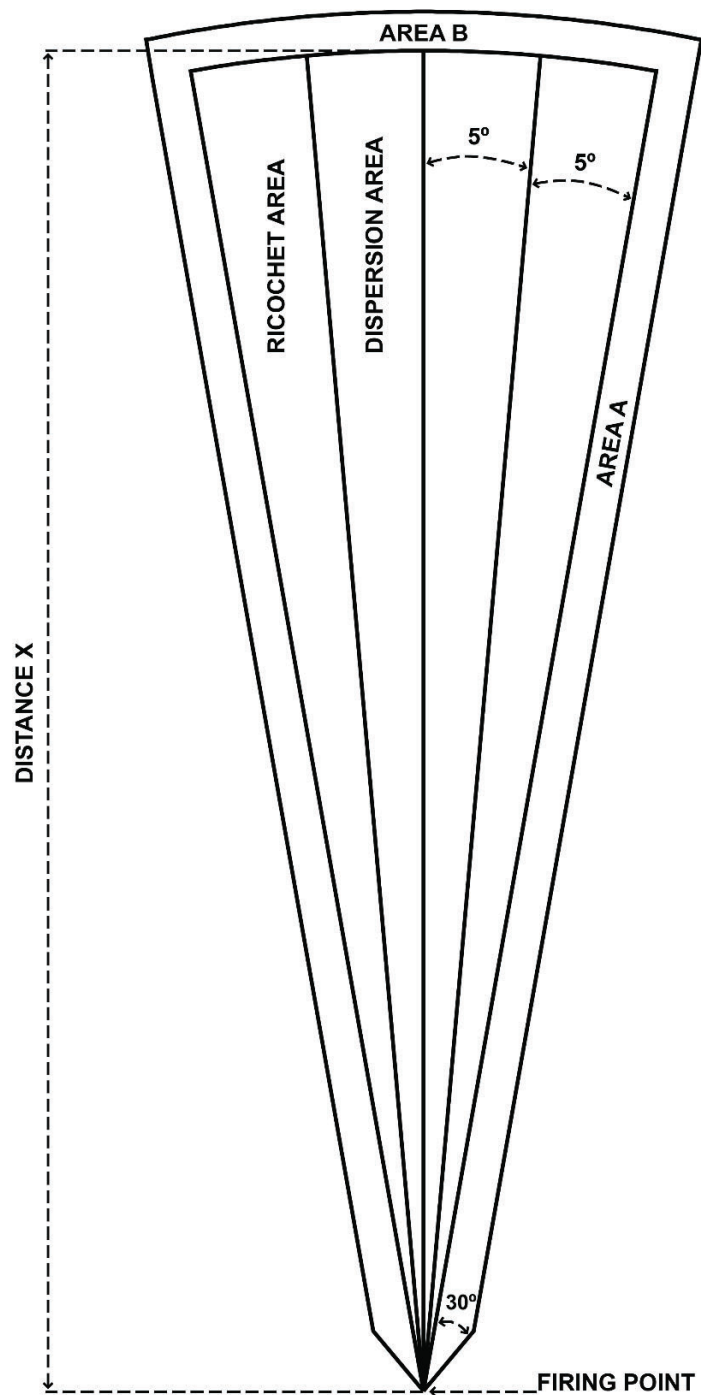


Figure 5-2. Cone surface danger zone for firing small arms direct-fire weapons with exploding projectiles

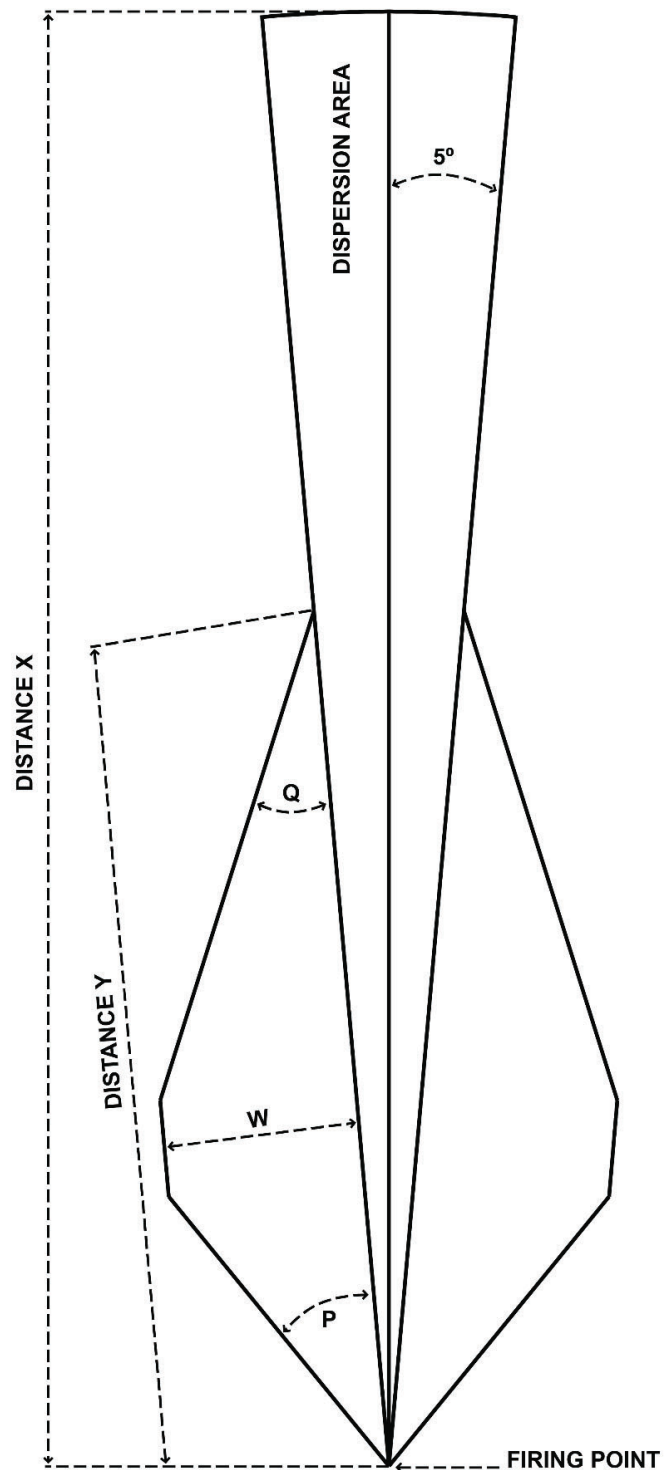


Figure 5–3. Batwing surface danger zone for small arms direct-fire weapons without exploding projectiles, except 5.56mm M1037 Short-Range Training Ammunition, 7.62mm M793 Short-Range Training Ammunition Ball, and M794 Short-Range Training Ammunition Tracer

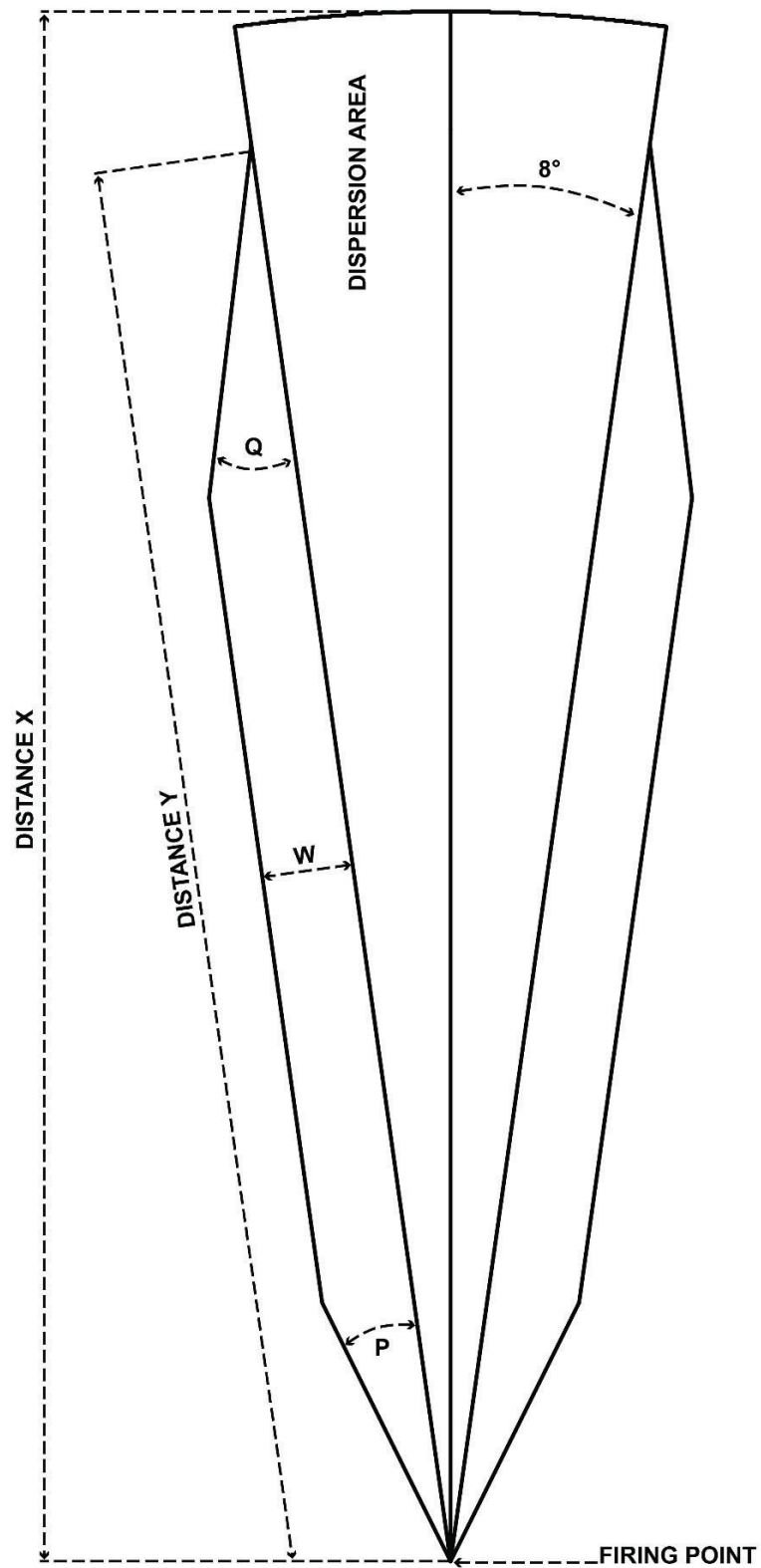


Figure 5-4. Batwing surface danger zone for Short-Range Training Ammunition

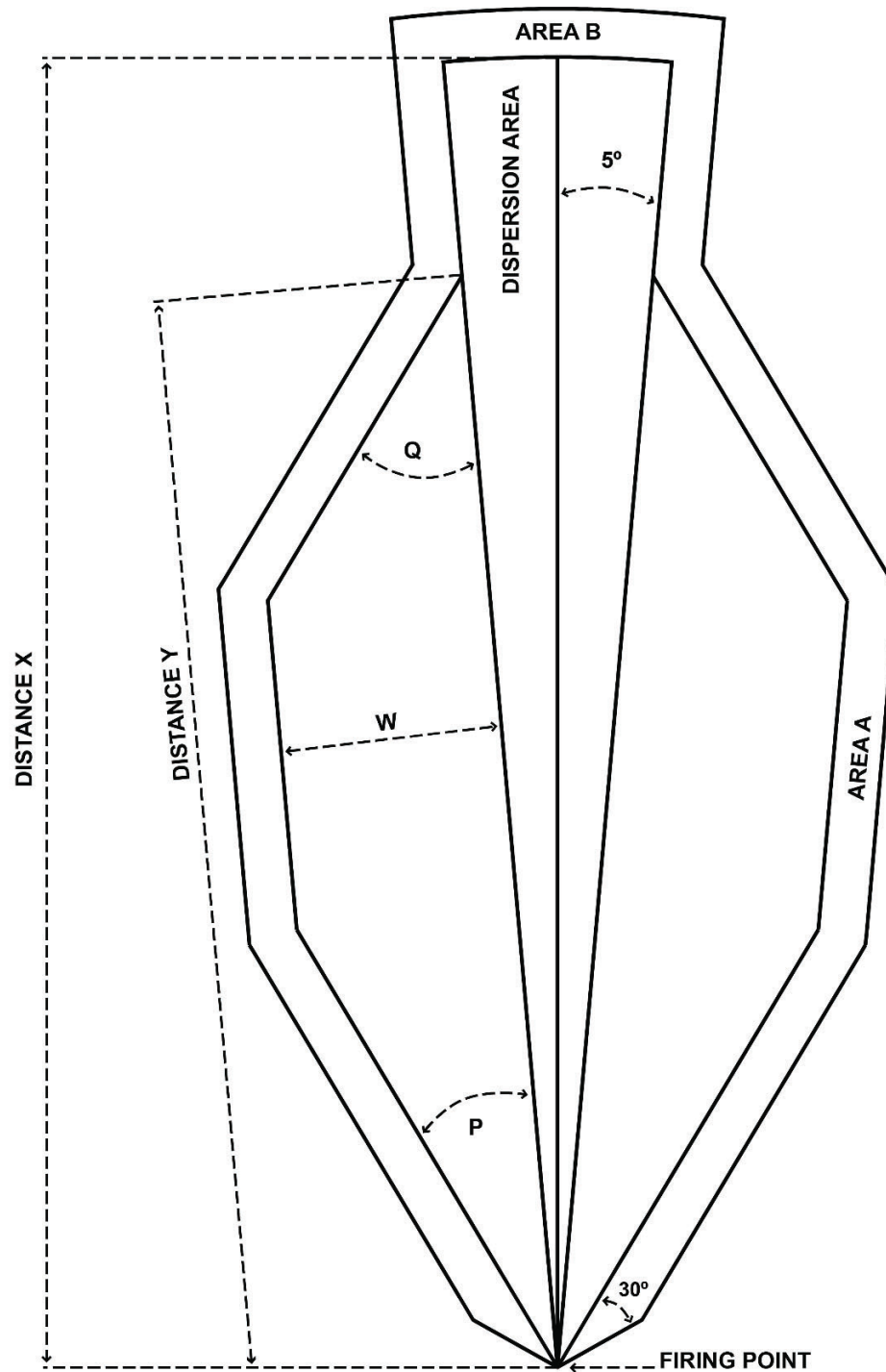


Figure 5–5. Batwing surface danger zone for small arms direct-fire weapons with exploding projectiles

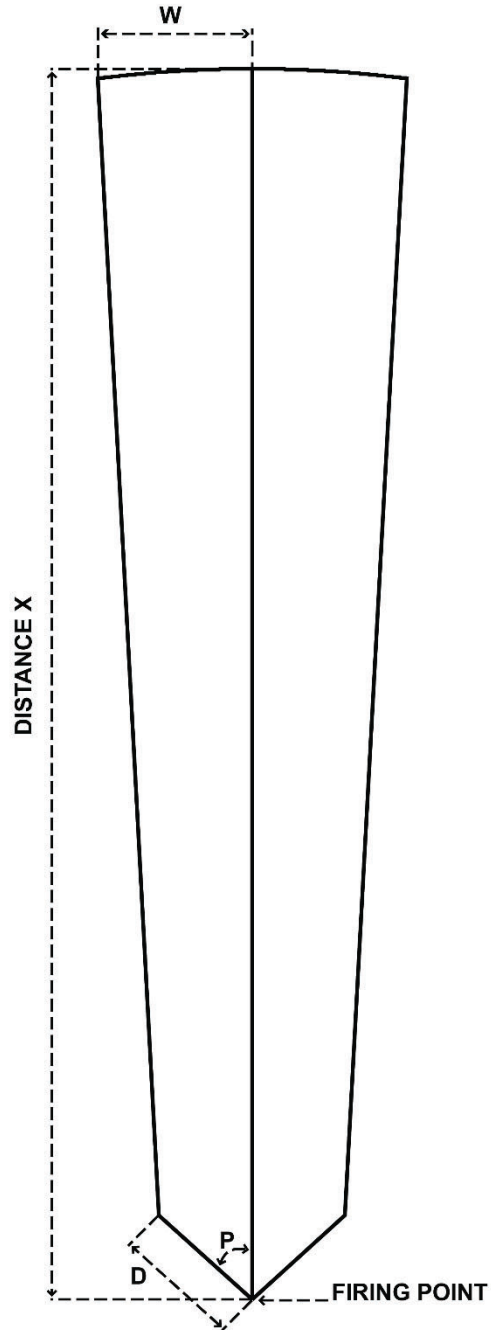


Figure 5–6. Surface danger zone for .50 caliber Saboted Light Armor Penetrator and Saboted Light Armor Penetrator-Tracer

c. Figure 5–7 is the .50 caliber M903 SLAP and M962 SLAP–T sabot discard area.

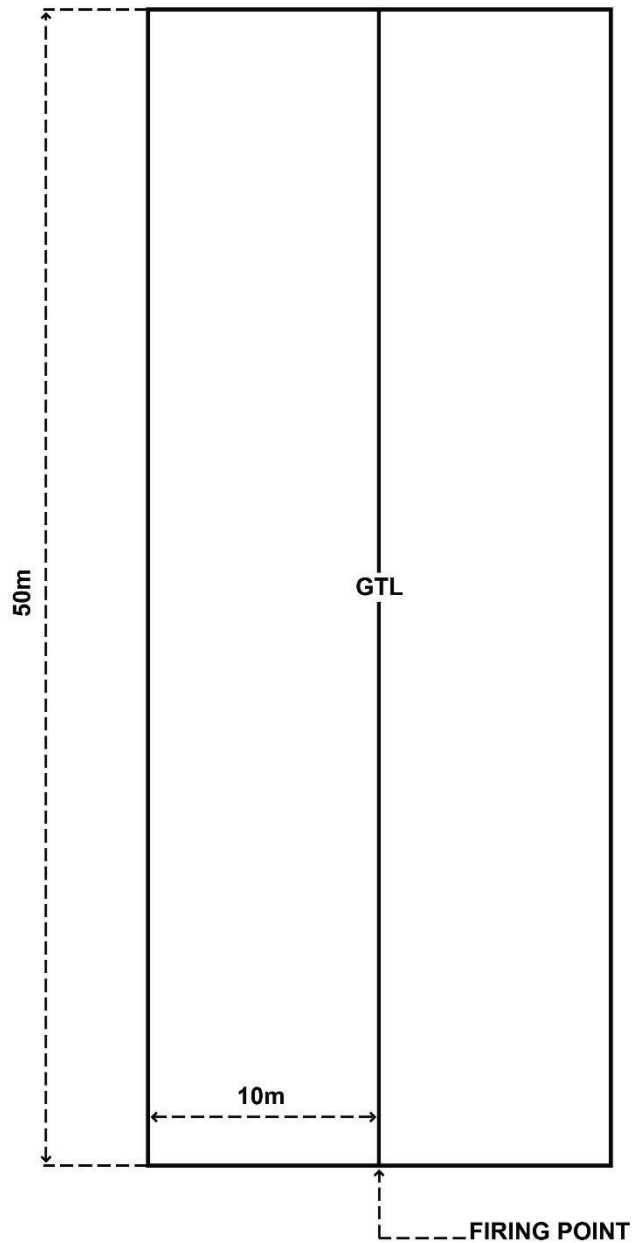


Figure 5-7. Surface danger zone for .50 caliber Saboted Light Armor Penetrator sabot discard area

d. When firing the 12-gauge shotgun with 7.5, 8, and 9 shot, use the SDZ shotfall data provided in figure 5–8 for trap ranges and figure 5–9 for skeet ranges. For the XM1030 12-gauge breaching round, use the SDZ data provided in figure 5–10 and table 5–1. All other 12-gauge buckshot, slug, or other shot larger than 7.5 shot will use data provided in figures 5–1 and 5–3 and table 5–1.

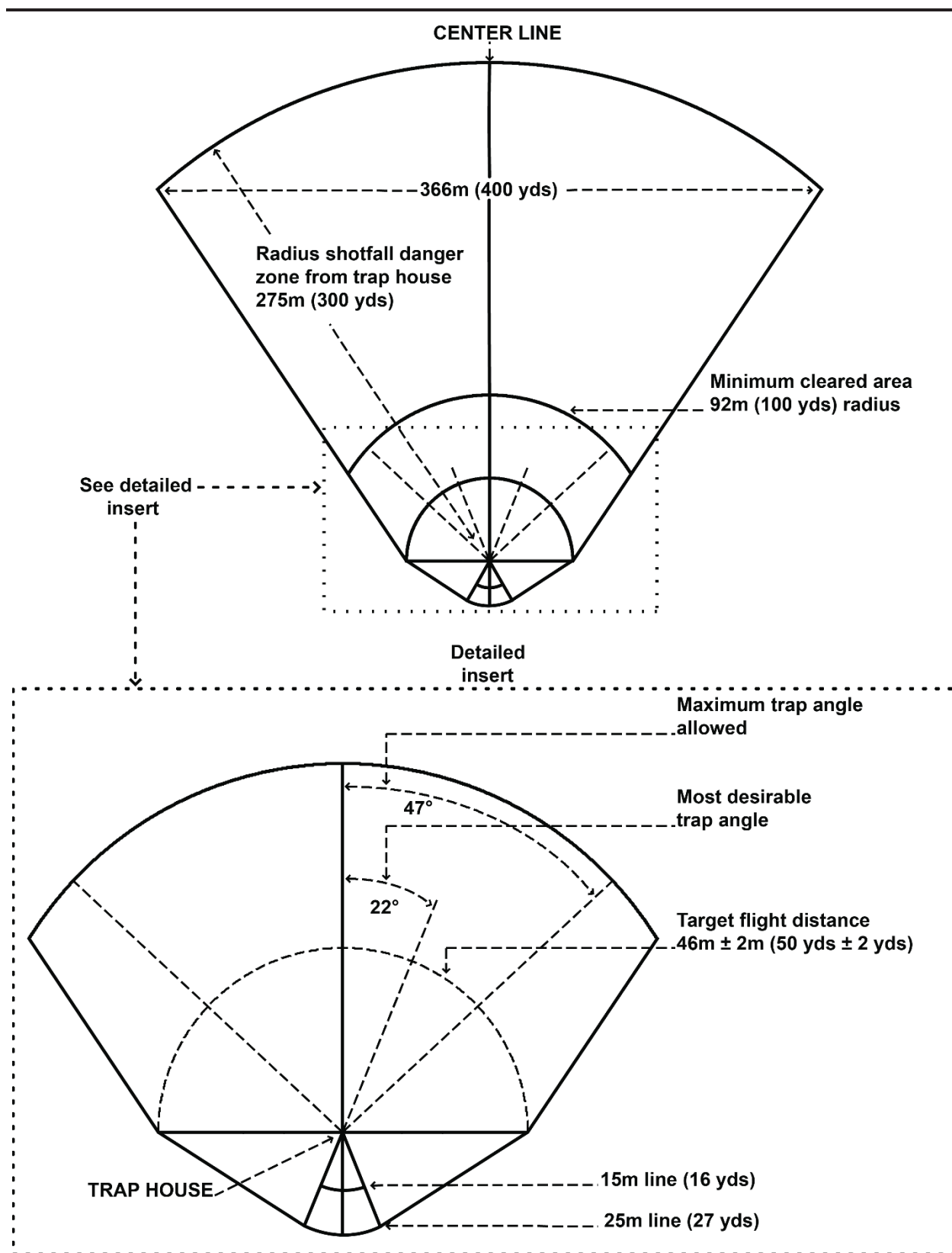


Figure 5-8. Surface danger zone, shotfall for trap ranges

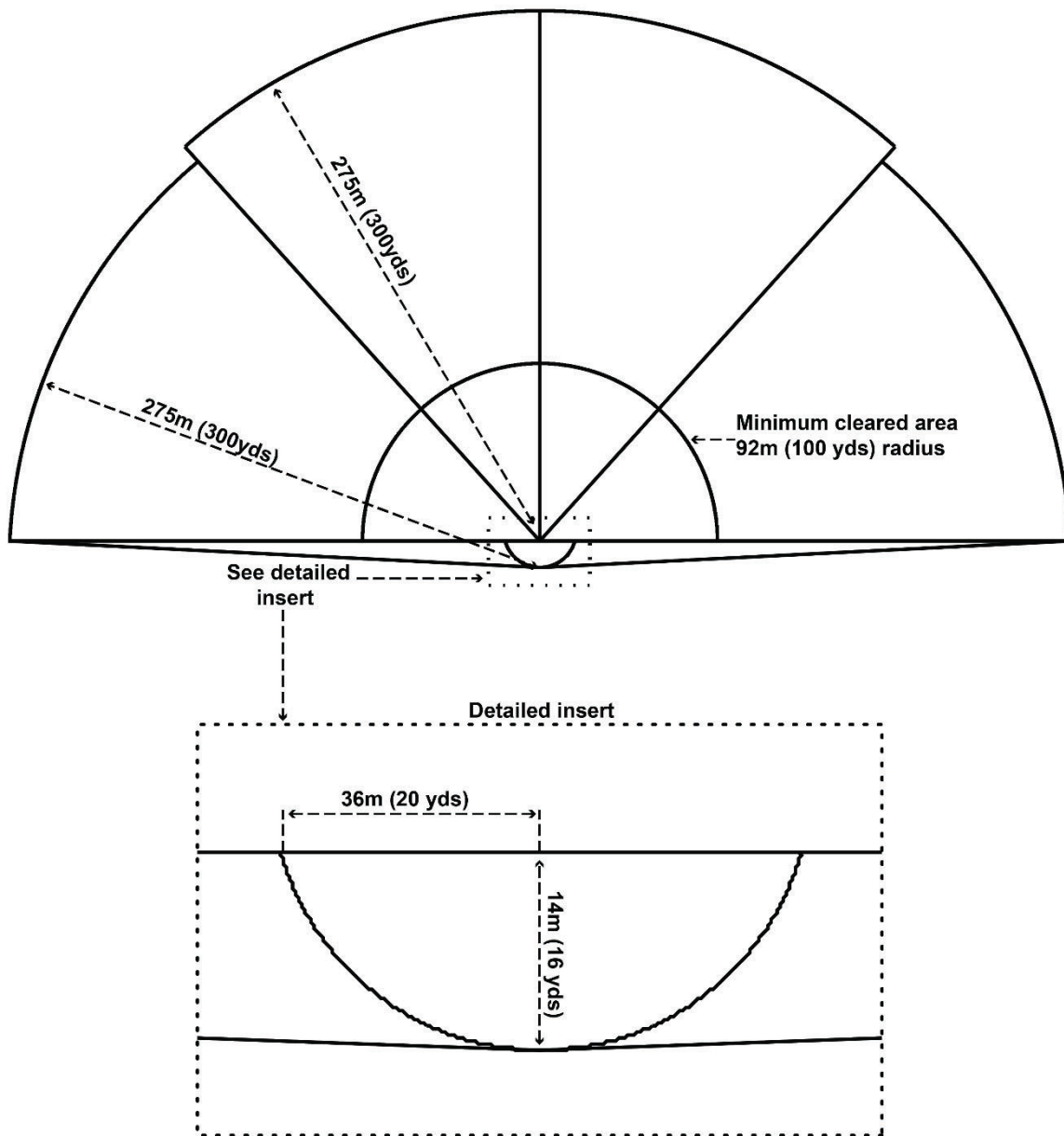


Figure 5–9. Surface danger zone, shotfall for skeet ranges

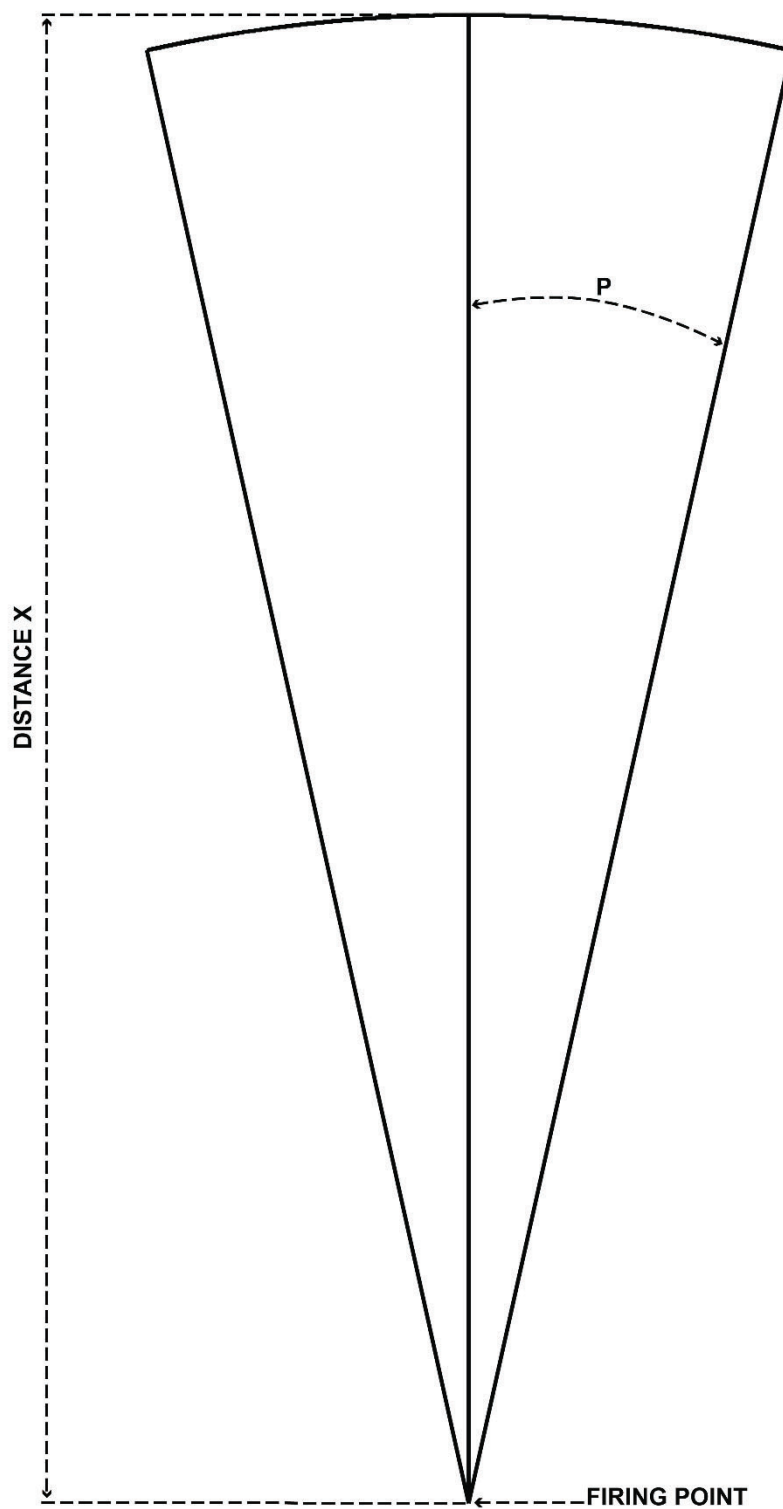


Figure 5–10. Surface danger zone for 12-gauge XM1030 breaching round

e. Table 5–1 contains SDZ data for 12-gauge shotguns.

Table 5–1
Surface danger zone data for 12-gauge shotgun

| Ammunition 12-gauge | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|--|---------------------------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 12-gauge slug, shot size larger than 7.5 | Earth/ water Steel/ concrete | 1,073 | 710 | 125 | 100 | NR | 21.96 | 33.34 | 136 |
| | | 1,073 | 830 | 287 | 100 | NR | 56.91 | 40.17 | 197 |
| 12-gauge 7.5, 8, and 9 shot | Earth/ water Steel/ concrete | 275 | NR | NR | NR | NR | NR | NR | NR |
| | | 275 | NR | NR | NR | NR | NR | NR | NR |
| 12-gauge XM1030 Breaching | Earth/ water Steel/ concrete | 375 | NR | NR | NR | NR | 12.50 | NR | NR |
| | | 375 | NR | NR | NR | NR | 12.50 | NR | NR |

Legend:
NR=not required

Note.
¹ Area A applies to cone SDZ only.

f. Table 5–2 contains SDZ data for blank ammunition with BFA.

Table 5–2
Surface danger zone data for all small arms blank ammunition with blank-firing adapter¹

| Ammunition blank | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------------------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 5.56mm 7.62mm .50 caliber | NR | 5 | NR | NR | NR | NR | NR | NR | NR |
| 5.56mm 7.62mm CCBS ² | NR | 0.5 | NR | NR | NR | NR | NR | NR | NR |

Legend:
NR=not required

Notes.
¹ The dispersion and ricochet area for all small arms blank ammunition is 10 degrees.
² The CCBS used only by Special Operations requires the CCMCK.

g. Table 5–3 contains SDZ data for .22 caliber ammunition, small arms direct-fire weapons.

Table 5–3
Surface danger zone data for .22 caliber weapons—Continued

| Ammunition .22 caliber | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------------------|---------------------------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| Ball LR | Earth/ water steel/ concrete | 1,400 | 1,033 | 155 | 100 | NR | 24.00 | 15.90 | 96 |
| | | 1,400 | 1,125 | 386 | 100 | NR | 63.40 | 30.30 | 245 |

Legend:
LR=long rifle
NR=not required

Note.
¹ Area A applies to cone SDZ only.

h. Table 5–4 contains SDZ data for 9mm small arms direct-fire weapons.

Table 5–4
Surface danger zone data for 9mm weapons

| Ammunition 9mm ¹ | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|--------------------------------|---------------------------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| Ball M882, M1, Subsonic | Earth/ water steel/ concrete | 1,800 | 1,077 | 158 | 100 | NR | 23.10 | 15.80 | 93 |
| | | 1,800 | 1,211 | 399 | 100 | NR | 61.10 | 30.40 | 253 |

Legend:
NR=not required

Notes.
¹ See chapter 14 for SDZ data for Special Effects Small Arms Marking System (SESAMS) and CCMCK ammunition.
² Area A applies to cone SDZ only.

i. Table 5–5 contains SDZ information for 9mm M1152.

Table 5–5
Surface danger zone data for 9mm M1152 Modular Handgun System¹

| Altitude (ft) | Impact media | Dist X ¹ (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P ³ (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|-------------------------------|------------------|------------------|-------------------------------|------------------|----------------------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 1,684 | 1,438 | 356 | NR | NR | 55.60 | 71.90 | 254 |
| | | 1,684 | 1,506 | 295 | NR | NR | 43.00 | 60.10 | 203 |
| 1,000 | Earth Armor | 1,729 | 1,472 | 367 | NR | NR | 56.00 | 71.55 | 261 |
| | | 1,729 | 1,544 | 304 | NR | NR | 43.15 | 60.00 | 208 |
| 2,000 | Earth Armor | 1,776 | 1,506 | 378 | NR | NR | 56.40 | 71.20 | 268 |
| | | 1,776 | 1,582 | 313 | NR | NR | 43.30 | 59.90 | 214 |
| 3,000 | Earth Armor | 1,824 | 1,540 | 389 | NR | NR | 56.80 | 70.85 | 275 |
| | | 1,824 | 1,620 | 322 | NR | NR | 43.45 | 59.80 | 220 |
| 4,000 | Earth Armor | 1,874 | 1,574 | 400 | NR | NR | 57.20 | 70.50 | 283 |
| | | 1,874 | 1,658 | 331 | NR | NR | 43.60 | 59.70 | 226 |

Table 5–5
Surface danger zone data for 9mm M1152 Modular Handgun System¹

| Altitude (ft) | Impact media | Dist X ¹ (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P ³ (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|-------------------------------|------------------|------------------|-------------------------------|------------------|----------------------------------|---------------------|---------------------------------------|
| 5,000 | Earth Armor | 1,925 | 1,608 | 411 | NR | NR | 57.60 | 70.15 | 290 |
| | | 1,925 | 1,696 | 340 | NR | NR | 43.75 | 59.60 | 232 |
| 6,000 | Earth Armor | 1,978 | 1,642 | 422 | NR | NR | 58.00 | 69.80 | 298 |
| | | 1,978 | 1,734 | 349 | NR | NR | 43.90 | 59.50 | 238 |
| 7,000 | Earth Armor | 2,032 | 1,676 | 433 | NR | NR | 58.40 | 69.45 | 306 |
| | | 2,032 | 1,772 | 358 | NR | NR | 44.05 | 59.40 | 245 |

Legend:
NR=not required

Notes.

¹To correct for tailwinds, Distance X must increase by 21 m per m/s or 11 m per knot of tailwind measured along the line of fire. To correct for cross-range (CR) winds, the dispersion angle must increase by 0.43 degrees per m/s or 0.22 degrees per knot of crosswind measured perpendicular to the line of fire.

²Area A applies to cone SDZ only.

³Ricochet angle P is measured from the dispersion angle. To correct for CR winds, the 5 deg dispersion angle must increase by 0.43 deg per m/s or 0.22 deg per knot of CR wind measured perpendicular to line of fire.

j. Table 5–6 contains SDZ information for 9mm M1153.

Table 5–6
Surface danger zone data for 9mm M1153 Modular Handgun System¹

| Altitude (ft) | Impact media | Dist X ¹ (m) | Dist Y (m) | Dist W ² (m) | Area A ² (m) | Area B (m) | Angle P ³ (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|-------------------------------|------------------|-------------------------------|-------------------------------|------------------|----------------------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 1,987 | 1,375 | 258 | NR | NR | 45.40 | 74.80 | 263 |
| | | 1,987 | 1,395 | 266 | NR | NR | 45.70 | 69.80 | 200 |
| 1,000 | Earth Armor | 2,037 | 1,410 | 264 | NR | NR | 45.50 | 72.80 | 269 |
| | | 2,037 | 1,428 | 274 | NR | NR | 45.90 | 67.30 | 206 |
| 2,000 | Earth Armor | 2,088 | 1,445 | 270 | NR | NR | 45.60 | 70.80 | 275 |
| | | 2,088 | 1,461 | 282 | NR | NR | 46.10 | 64.80 | 211 |
| 3,000 | Earth Armor | 2,140 | 1,480 | 276 | NR | NR | 45.70 | 68.80 | 281 |
| | | 2,140 | 1,494 | 290 | NR | NR | 46.30 | 62.30 | 217 |
| 4,000 | Earth Armor | 2,194 | 1,515 | 282 | NR | NR | 45.80 | 66.80 | 287 |
| | | 2,194 | 1,527 | 298 | NR | NR | 46.50 | 59.80 | 222 |
| 5,000 | Earth Armor | 2,249 | 1,550 | 288 | NR | NR | 45.90 | 64.80 | 294 |
| | | 2,249 | 1,560 | 306 | NR | NR | 46.70 | 57.30 | 228 |
| 6,000 | Earth Armor | 2,306 | 1,585 | 294 | NR | NR | 46.00 | 62.80 | 301 |
| | | 2,306 | 1,593 | 314 | NR | NR | 46.90 | 54.80 | 234 |
| 7,000 | Earth Armor | 2,364 | 1,620 | 300 | NR | NR | 46.10 | 60.80 | 308 |
| | | 2,364 | 1,626 | 322 | NR | NR | 47.10 | 52.30 | 241 |

Legend:
NR=not required

Notes.

¹To correct for tailwinds, Distance X must increase by 21 m per m/s or 11 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.43 degrees per m/s or 0.22 degrees per knot of crosswind measured perpendicular to the line of fire.

²Area A applies to cone SDZ only.

Table 5–6
Surface danger zone data for 9mm M1153 Modular Handgun System¹

| Altitude (ft) | Impact media | Dist X ¹ (m) | Dist Y (m) | Dist W ² (m) | Area A ² (m) | Area B (m) | Angle P ³ (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|-------------------------------|------------------|-------------------------------|-------------------------------|------------------|----------------------------------|---------------------|---------------------------------------|
|------------------|-----------------|-------------------------------|------------------|-------------------------------|-------------------------------|------------------|----------------------------------|---------------------|---------------------------------------|

³ Ricochet angle P is measured from the dispersion angle. To correct for CR winds, the 5 deg dispersion angle must increase by 0.34 deg per m/s or 0.17 deg per knot of CR wind measured perpendicular to line of fire.

k. Table 5–7 contains SDZ information for 9mm Gold Dot G2.

Table 5–7
Surface danger zone data for 9mm Gold Dot G2 for Special Operations units only¹

| Altitude (ft) | Impact media | Dist X ¹ (m) | Dist Y (m) | Dist W ² (m) | Area A ² (m) | Area B (m) | Angle P ³ (deg) | Angle Q (deg) | Ricochet vertical hazard ⁴ (m) |
|------------------|-----------------|-------------------------------|------------------|-------------------------------|-------------------------------|------------------|----------------------------------|---------------------|--|
| 0 | Earth Armor | 1,575 | 1,300 | 290 | 100 | NR | 56.50 | 57.00 | 262 |
| | | 1,575 | 1,310 | 390 | 100 | NR | 54.00 | 70.00 | 261 |
| 1,000 | Earth Armor | 1,615 | 1,324 | 297 | 100 | NR | 56.85 | 58.50 | 269 |
| | | 1,615 | 1,340 | 403 | 100 | NR | 54.50 | 70.50 | 268 |
| 2,000 | Earth Armor | 1,656 | 1,348 | 304 | 100 | NR | 57.20 | 60.00 | 276 |
| | | 1,656 | 1,370 | 416 | 100 | NR | 55.00 | 71.00 | 274 |
| 3,000 | Earth Armor | 1,698 | 1,372 | 311 | 100 | NR | 57.55 | 61.50 | 284 |
| | | 1,698 | 1,400 | 429 | 100 | NR | 55.50 | 71.50 | 281 |
| 4,000 | Earth Armor | 1,742 | 1,396 | 318 | 100 | NR | 57.90 | 63.00 | 291 |
| | | 1,742 | 1,430 | 442 | 100 | NR | 56.00 | 72.00 | 287 |
| 5,000 | Earth Armor | 1,786 | 1,420 | 325 | 100 | NR | 58.25 | 64.50 | 299 |
| | | 1,786 | 1,460 | 455 | 100 | NR | 56.50 | 72.50 | 294 |
| 6,000 | Earth Armor | 1,832 | 1,444 | 332 | 100 | NR | 58.60 | 66.00 | 307 |
| | | 1,832 | 1,490 | 468 | 100 | NR | 57.00 | 73.00 | 301 |
| 7,000 | Earth Armor | 1,878 | 1,468 | 339 | 100 | NR | 58.95 | 67.50 | 316 |
| | | 1,878 | 1,520 | 481 | 100 | NR | 57.50 | 73.50 | 309 |

Legend:

NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 21 m per m/s or 11 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.43 degrees per m/s or 0.22 degrees per knot of crosswind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

³ Ricochet angle P is measured from the dispersion angle. To correct for CR winds, the 5 deg dispersion angle must increase by 0.45 deg per m/s or 0.25 deg per knot of CR wind measured perpendicular to line of fire.

⁴ Vertical ricochet hazard is AGL.

l. Table 5–8 contains SDZ information for .38 caliber weapons.

Table 5–8
Surface danger zone data for .38 caliber weapons

| Ammunition .38 caliber | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 38 caliber | Earth/ water | 1,806 | 1,110 | 153 | 100 | NR | 22.57 | 16.07 | 89 |

Table 5–8
Surface danger zone data for .38 caliber weapons

| Ammunition .38 caliber | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------------------------|--------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| Spec Ball M41, .38 Wadcutter | steel/ concrete | 1,806 | 1,258 | 389 | 100 | NR | 60.59 | 35.36 | 245 |

Legend:
NR=not required

Note.

¹ Area A applies to cone SDZ only.

m. Table 5–9 contains SDZ information for .40 caliber weapons.

Table 5–9
Surface danger zone data for .40 caliber weapons

| Ammunition .40 caliber | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------------------|--------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| MK308 MOD 0 | Earth/ water | 1,796 | NR | NR | 100 | NR | NR | NR | 464 |
| | Steel/ concrete | 1,796 | NR | NR | 100 | NR | NR | NR | 464 |
| MK309 MOD 0 | Earth/ water | 1,973 | NR | NR | 100 | NR | NR | NR | 452 |
| | Steel/ concrete | 1,973 | NR | NR | 100 | NR | NR | NR | 452 |
| MK326 MOD 0 | Earth/ water | 1,702 | NR | NR | 100 | NR | NR | NR | 476 |
| | Steel/ concrete | 1,702 | NR | NR | 100 | NR | NR | NR | 476 |

Legend:
NR=not required

Note.

¹ Area A applies to cone SDZ only.

n. Table 5–10 contains SDZ information for .45 caliber weapons.

Table 5–10
Surface danger zone data for .45 caliber weapons

| Ammunition .45 caliber | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|--------------------------------------|--------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| Ball, Tracer, Wadcutter, Match | Earth/ water | 1,690 | 1,016 | 117 | 100 | NR | 21.11 | 16.69 | 100 |
| | Steel/ concrete | 1,690 | 1,111 | 290 | 100 | NR | 54.74 | 30.77 | 186 |

Legend:
NR=not required

Table 5–10
Surface danger zone data for .45 caliber weapons

| Ammunition .45 caliber | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
|---------------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|

Note.

¹ Area A applies to cone SDZ only.

o. Table 5–11 contains SDZ data for 5.56mm weapons.

Table 5–11
Surface danger zone data for 5.56mm weapons

| Ammunition 5.56mm ¹ | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|--|--------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| M193 Ball | Earth/ water | 3,100 | 2,004 | 458 | 100 | NR | 35.20 | 23.10 | 319 |
| | Steel/ concrete | 3,100 | 1,666 | 323 | 100 | NR | 19.00 | 26.90 | 219 |
| M196 Tracer | Earth/ water | 3,100 | 2,066 | 362 | 100 | NR | 35.10 | 26.80 | 355 |
| | Steel/ concrete | 3,100 | 2,023 | 243 | 100 | NR | 19.20 | 22.80 | 243 |
| M856 Tracer | Earth/ water | 3,089 | 1,607 | 355 | 100 | NR | 32.80 | 23.20 | 261 |
| | Steel/ concrete | 3,089 | 1,592 | 277 | 100 | NR | 18.60 | 21.00 | 261 |
| M862A1 Plastic Short Range | Earth/ water | 250 | 165 | 24 | 100 | NR | 15.40 | 20.00 | 16 |
| | Steel/ concrete | 250 | 136 | 5 | 100 | NR | 3.30 | 7.30 | 4 |
| MK255 Reduced Ricochet Limited Penetration | Earth Armor | 2,683 2,683 | NR | NR | 100 100 | NR | NR | NR | 827 827 |

Legend:

NR=not required

Notes.

¹ See chapter 14 for SDZ data for CCMCK ammunition.

² Area A applies to cone SDZ only.

p. Table 5–12 contains SDZ data for 5.56mm M855 Ball.

Table 5–12
Surface danger zone data for 5.56mm M855 Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth | 2,958 | 2,450 | 215 | 100 | NR | 34.00 | 15.00 | 158 |
| | Armor | 2,958 | 2,275 | 95 | 100 | NR | 13.00 | 7.50 | 96 |

Table 5–12
Surface danger zone data for 5.56mm M855 Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 1,000 | Earth Armor | 3,049 3,049 | 2,515 2,343 | 222 99 | 100 100 | NR NR | 34.25 13.25 | 15.70 7.90 | 163 99 |
| 2,000 | Earth Armor | 3,143 3,143 | 2,580 2,411 | 229 103 | 100 100 | NR NR | 34.50 13.50 | 16.40 8.30 | 168 103 |
| 3,000 | Earth Armor | 3,240 3,240 | 2,645 2,479 | 236 107 | 100 100 | NR NR | 34.75 13.75 | 17.10 8.70 | 174 106 |
| 4,000 | Earth Armor | 3,341 3,341 | 2,710 2,547 | 243 111 | 100 100 | NR NR | 35.00 14.00 | 17.80 9.10 | 179 109 |
| 5,000 | Earth Armor | 3,446 3,446 | 2,775 2,615 | 250 115 | 100 100 | NR NR | 35.25 14.25 | 18.50 9.50 | 184 113 |
| 6,000 | Earth Armor | 3,554 3,554 | 2,840 2,683 | 257 119 | 100 100 | NR NR | 35.50 14.50 | 19.20 9.90 | 190 116 |
| 7,000 | Earth Armor | 3,668 3,668 | 2,905 2,751 | 264 123 | 100 100 | NR NR | 35.75 14.75 | 19.90 10.30 | 196 120 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 27 m per m/s or 13.90 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.37 degrees per m/s or 0.19 degrees per knot of crosswind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

q. Table 5–13 contains SDZ data for 5.56mm M855A1 EPR Ball ammunition.

Table 5–13
Surface danger zone data for 5.56mm M855A1 Enhanced Performance Round Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 3,521 3,521 | 3,100 3,050 | 400 360 | 100 100 | NR NR | 60.00 45.00 | 15.00 14.00 | 295 272 |
| 1,000 | Earth Armor | 3,630 3,630 | 3,200 3,150 | 420 370 | 100 100 | NR NR | 60.00 45.00 | 15.00 14.00 | 305 280 |
| 2,000 | Earth Armor | 3,743 3,743 | 3,300 3,250 | 430 390 | 100 100 | NR NR | 60.00 45.00 | 15.00 14.00 | 314 288 |
| 3,000 | Earth Armor | 3,859 3,859 | 3,400 3,350 | 440 400 | 100 100 | NR NR | 60.00 45.00 | 15.00 14.00 | 324 297 |
| 4,000 | Earth Armor | 3,980 3,980 | 3,500 3,450 | 450 420 | 100 100 | NR NR | 60.00 45.00 | 15.00 14.00 | 334 306 |
| 5,000 | Earth Armor | 4,105 4,105 | 3,600 3,550 | 460 430 | 100 100 | NR NR | 60.00 45.00 | 15.00 14.00 | 344 315 |
| 6,000 | Earth Armor | 4,234 4,234 | 3,700 3,650 | 470 440 | 100 100 | NR NR | 60.00 45.00 | 15.00 14.00 | 354 324 |
| 7,000 | Earth Armor | 4,369 4,369 | 3,800 3,750 | 490 450 | 100 100 | NR NR | 60.00 45.00 | 15.00 14.00 | 365 333 |

Table 5–13
Surface danger zone data for 5.56mm M855A1 Enhanced Performance Round Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 29 m per m/s or 15 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.40 degrees per m/s or 0.20 degrees per knot of crosswind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

r. Table 5–14 contains SDZ data for 5.56mm M856A1 EPR Tracer.

Table 5–14
Surface danger zone data for 5.56mm M856A1 Enhanced Performance Round Tracer¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 2,574 | 1,625 | 190 | 100 | NR | 58.00 | 19.00 | 162 |
| | | 2,574 | 1,900 | 210 | 100 | NR | 48.00 | 15.00 | 171 |
| 1,000 | Earth Armor | 2,657 | 1,679 | 197 | 100 | NR | 58.30 | 19.15 | 166 |
| | | 2,657 | 1,958 | 217 | 100 | NR | 48.15 | 15.15 | 177 |
| 2,000 | Earth Armor | 2,742 | 1,733 | 204 | 100 | NR | 58.60 | 19.30 | 171 |
| | | 2,742 | 2,016 | 224 | 100 | NR | 48.30 | 15.30 | 183 |
| 3,000 | Earth Armor | 2,831 | 1,787 | 211 | 100 | NR | 58.90 | 19.45 | 177 |
| | | 2,831 | 2,074 | 231 | 100 | NR | 48.45 | 15.45 | 188 |
| 4,000 | Earth Armor | 2,924 | 1,841 | 218 | 100 | NR | 59.20 | 19.60 | 182 |
| | | 2,924 | 2,132 | 238 | 100 | NR | 48.60 | 15.60 | 194 |
| 5,000 | Earth Armor | 3,020 | 1,895 | 225 | 100 | NR | 59.50 | 19.75 | 189 |
| | | 3,020 | 2,190 | 245 | 100 | NR | 48.75 | 15.75 | 201 |
| 6,000 | Earth Armor | 3,120 | 1,949 | 232 | 100 | NR | 59.80 | 19.90 | 195 |
| | | 3,120 | 2,248 | 252 | 100 | NR | 48.90 | 15.90 | 207 |
| 7,000 | Earth Armor | 3,224 | 2,003 | 239 | 100 | NR | 60.10 | 20.05 | 201 |
| | | 3,224 | 2,306 | 259 | 100 | NR | 49.05 | 16.05 | 214 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 25 m per m/s or 13 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.45 degree per m/s or 0.23 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

s. Table 5–15 contains SDZ data for 5.56mm MK301 Dim Tracer.

Table 5–15
Surface danger zone data for 5.56mm MK301 Dim Tracer¹—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 2,324 | 1,920 | 190 | 100 | NR | 51.30 | 13.75 | 158 |
| | | 2,324 | 1,655 | 145 | 100 | NR | 41.70 | 11.75 | 100 |
| 1,000 | Earth Armor | 2,396 | 1,973 | 196 | 100 | NR | 51.15 | 13.85 | 164 |
| | | 2,396 | 1,708 | 149 | 100 | NR | 41.60 | 11.85 | 104 |
| 2,000 | Earth Armor | 2,472 | 2,026 | 202 | 100 | NR | 51.00 | 13.95 | 170 |
| | | 2,472 | 1,761 | 153 | 100 | NR | 41.50 | 11.95 | 108 |
| 3,000 | Earth Armor | 2,550 | 2,079 | 208 | 100 | NR | 50.85 | 14.05 | 176 |
| | | 2,550 | 1,814 | 157 | 100 | NR | 41.40 | 12.05 | 112 |
| 4,000 | Earth Armor | 2,632 | 2,132 | 214 | 100 | NR | 50.70 | 14.15 | 182 |
| | | 2,632 | 1,867 | 161 | 100 | NR | 41.30 | 12.15 | 116 |
| 5,000 | Earth Armor | 2,716 | 2,185 | 220 | 100 | NR | 50.55 | 14.25 | 188 |
| | | 2,716 | 1,920 | 165 | 100 | NR | 41.20 | 12.25 | 120 |
| 6,000 | Earth Armor | 2,804 | 2,238 | 226 | 100 | NR | 50.40 | 14.35 | 194 |
| | | 2,804 | 1,973 | 169 | 100 | NR | 41.10 | 12.35 | 124 |
| 7,000 | Earth Armor | 2,896 | 2,291 | 232 | 100 | NR | 50.25 | 14.45 | 200 |
| | | 2,896 | 2,026 | 173 | 100 | NR | 41.00 | 12.45 | 128 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 24 m per m/s or 12.50 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.50 degree per m/s or 0.26 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

t. Table 5–16 contains SDZ data for 5.56mm MK318 MOD 0 Ball.

Table 5–16
Surface danger zone data for 5.56mm MK318 MOD 0 Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 2,816 | 2,600 | 310 | 100 | NR | 59.50 | 14.00 | 235 |
| | | 2,816 | 2,525 | 290 | 100 | NR | 44.50 | 16.00 | 218 |
| 1,000 | Earth Armor | 2,903 | 2,670 | 321 | 100 | NR | 59.40 | 14.15 | 242 |
| | | 2,903 | 2,595 | 299 | 100 | NR | 44.30 | 16.10 | 224 |
| 2,000 | Earth Armor | 2,992 | 2,740 | 332 | 100 | NR | 59.30 | 14.30 | 250 |
| | | 2,992 | 2,665 | 308 | 100 | NR | 44.10 | 16.20 | 231 |
| 3,000 | Earth Armor | 3,085 | 2,810 | 343 | 100 | NR | 59.20 | 14.45 | 258 |
| | | 3,085 | 2,735 | 317 | 100 | NR | 43.90 | 16.30 | 238 |
| 4,000 | Earth Armor | 3,181 | 2,880 | 354 | 100 | NR | 59.10 | 14.60 | 266 |
| | | 3,181 | 2,805 | 326 | 100 | NR | 43.70 | 16.40 | 245 |
| 5,000 | Earth Armor | 3,281 | 2,950 | 365 | 100 | NR | 59.00 | 14.75 | 274 |
| | | 3,281 | 2,875 | 335 | 100 | NR | 43.50 | 16.50 | 252 |
| 6,000 | Earth Armor | 3,385 | 3,020 | 376 | 100 | NR | 58.90 | 14.90 | 282 |
| | | 3,385 | 2,945 | 344 | 100 | NR | 43.30 | 16.60 | 259 |

Table 5–16
Surface danger zone data for 5.56mm MK318 MOD 0 Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 7,000 | Earth Armor | 3,493 | 3,090 | 387 | 100 | NR | 58.80 | 15.05 | 291 |
| | | 3,493 | 3,015 | 353 | 100 | NR | 43.10 | 16.70 | 267 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 26.50 m per m/s or 13.50 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.39 degree per m/s or 0.20 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

u. Table 5–17 contains SDZ data for 5.56mm M1037 SRTA.

Table 5–17
Surface danger zone data for 5.56mm M1037 Short-Range Training Ammunition¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 370 | 345 | 22 | 100 | NR | 16.90 | 13.00 | 16 |
| | | 370 | 345 | 9 | 100 | NR | 6.20 | 3.90 | 9 |
| 1,000 | Earth Armor | 381 | 355 | 23 | 100 | NR | 16.90 | 13.30 | 17 |
| | | 381 | 355 | 9 | 100 | NR | 6.20 | 3.90 | 9 |
| 2,000 | Earth Armor | 393 | 365 | 24 | 100 | NR | 16.90 | 13.60 | 17 |
| | | 393 | 365 | 10 | 100 | NR | 6.20 | 3.90 | 9 |
| 3,000 | Earth Armor | 405 | 385 | 25 | 100 | NR | 17.80 | 13.80 | 18 |
| | | 405 | 385 | 10 | 100 | NR | 6.30 | 3.90 | 10 |
| 4,000 | Earth Armor | 418 | 395 | 25 | 100 | NR | 18.00 | 14.00 | 18 |
| | | 418 | 395 | 10 | 100 | NR | 6.30 | 3.90 | 10 |
| 5,000 | Earth Armor | 431 | 405 | 27 | 100 | NR | 18.40 | 14.20 | 19 |
| | | 431 | 405 | 10 | 100 | NR | 6.40 | 3.90 | 10 |
| 6,000 | Earth Armor | 445 | 414 | 27 | 100 | NR | 18.40 | 14.50 | 20 |
| | | 445 | 414 | 10 | 100 | NR | 6.40 | 3.90 | 11 |
| 7,000 | Earth Armor | 459 | 424 | 27 | 100 | NR | 18.40 | 14.80 | 20 |
| | | 459 | 424 | 10 | 100 | NR | 6.50 | 3.90 | 11 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 10 m per m/s or 5 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 1.10 degree per m/s or 0.55 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

v. Table 5–18 contains SDZ data for 7.62mm ammunition.

Table 5–18
Surface danger zone data for 7.62mm weapons—Continued

| Ammunition 7.62mm | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---|--------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| M59 Ball | Earth/ water | 4,100 | 4,073 | 1,461 | 100 | NR | 43.54 | 38.90 | 706 |
| | Steel/ concrete | 4,100 | 4,053 | 861 | 100 | NR | 20.04 | 75.54 | 447 |
| 7.62mm x 39mm A102 ¹ intermediate designed for AK series, SKS, RPK | Earth/ water | 4,100 | 4,073 | 1,461 | 100 | NR | 43.54 | 38.90 | 706 |
| | Steel/ concrete | 4,100 | 4,053 | 861 | 100 | NR | 20.04 | 75.54 | 447 |
| M118 Spec Ball, M85, MK316 MOD 0 | Earth/ water | 5,288 | 4,800 | 1,545 | 100 | NR | 43.81 | 38.73 | 752 |
| | Steel/ concrete | 5,288 | 5,137 | 990 | 100 | NR | 20.17 | 41.29 | 490 |

Legend:
NR=not required

Notes.

¹ For the 7.62mm x 39mm (AK), the only authorized standard DoDIC to be used is A102.

² Area A applies to cone SDZ only.

w. Table 5–19 contains SDZ data for 7.62mm M62 Tracer.

Table 5–19
Surface danger zone data for 7.62mm M62 Tracer¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 4,501 | 3,310 | 341 | 100 | NR | 29.00 | 47.00 | 256 |
| | | 4,501 | 3,135 | 170 | 100 | NR | 20.00 | 19.00 | 114 |
| 1,000 | Earth Armor | 4,629 | 3,392 | 352 | 100 | NR | 29.10 | 47.15 | 263 |
| | | 4,629 | 3,207 | 176 | 100 | NR | 20.10 | 19.60 | 118 |
| 2,000 | Earth Armor | 4,761 | 3,437 | 363 | 100 | NR | 29.20 | 47.30 | 270 |
| | | 4,761 | 3,279 | 182 | 100 | NR | 20.20 | 20.20 | 122 |
| 3,000 | Earth Armor | 4,899 | 3,556 | 374 | 100 | NR | 29.30 | 47.45 | 277 |
| | | 4,899 | 3,351 | 188 | 100 | NR | 20.30 | 20.80 | 125 |
| 4,000 | Earth Armor | 5,040 | 3,638 | 385 | 100 | NR | 29.40 | 47.60 | 285 |
| | | 5,040 | 3,423 | 194 | 100 | NR | 20.40 | 21.40 | 129 |
| 5,000 | Earth Armor | 5,187 | 3,720 | 396 | 100 | NR | 29.50 | 47.75 | 293 |
| | | 5,187 | 3,495 | 200 | 100 | NR | 20.50 | 22.00 | 133 |
| 6,000 | Earth Armor | 5,388 | 3,802 | 407 | 100 | NR | 29.60 | 47.90 | 302 |
| | | 5,388 | 3,567 | 206 | 100 | NR | 20.60 | 22.60 | 137 |
| 7,000 | Earth Armor | 5,495 | 3,884 | 418 | 100 | NR | 29.70 | 48.05 | 311 |
| | | 5,495 | 3,639 | 212 | 100 | NR | 20.70 | 23.20 | 141 |

Legend:
NR=not required

Table 5–19
Surface danger zone data for 7.62mm M62 Tracer¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|

Notes.

¹ To correct for tailwinds, Distance X must increase by 29 m per m/s or 14.9 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.31 degree per m/s or 0.16 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

x. Table 5–20 contains SDZ data for 7.62mm M80 Ball.

Table 5–20
Surface danger zone data for 7.62mm M80 Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 3,662 | 2,875 | 315 | 100 | NR | 45.60 | 35.20 | 271 |
| | | 3,662 | 2,775 | 115 | 100 | NR | 13.00 | 7.00 | 126 |
| 1,000 | Earth Armor | 3,777 | 2,952 | 328 | 100 | NR | 45.70 | 34.60 | 279 |
| | | 3,777 | 2,848 | 118 | 100 | NR | 13.10 | 7.70 | 130 |
| 2,000 | Earth Armor | 3,897 | 3,029 | 341 | 100 | NR | 45.80 | 34.00 | 288 |
| | | 3,897 | 2,921 | 121 | 100 | NR | 13.20 | 8.40 | 134 |
| 3,000 | Earth Armor | 4,022 | 3,106 | 354 | 100 | NR | 45.90 | 33.40 | 297 |
| | | 4,022 | 2,994 | 124 | 100 | NR | 13.30 | 9.10 | 139 |
| 4,000 | Earth Armor | 4,150 | 3,183 | 367 | 100 | NR | 46.00 | 32.80 | 307 |
| | | 4,150 | 3,067 | 127 | 100 | NR | 13.40 | 9.80 | 143 |
| 5,000 | Earth Armor | 4,284 | 3,260 | 380 | 100 | NR | 46.10 | 32.20 | 317 |
| | | 4,284 | 3,140 | 130 | 100 | NR | 13.50 | 10.50 | 147 |
| 6,000 | Earth Armor | 4,423 | 3,337 | 393 | 100 | NR | 46.20 | 31.60 | 327 |
| | | 4,423 | 3,213 | 133 | 100 | NR | 13.60 | 11.20 | 152 |
| 7,000 | Earth Armor | 4,569 | 3,414 | 406 | 100 | NR | 46.30 | 31.00 | 338 |
| | | 4,569 | 3,286 | 136 | 100 | NR | 13.70 | 11.90 | 156 |

Legend:

NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 29 m per m/s or 14.9 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.31 degree per m/s or 0.16 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

y. Table 5–21 contains SDZ data for 7.62mm M80A1 Ball.

Table 5–21
Surface danger zone data for 7.62mm M80A1 Enhanced Performance Round Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 3,951 | 3,460 | 650 | 100 | NR | 46.00 | 73.00 | 473 |
| | | 3,951 | 3,105 | 335 | 100 | NR | 18.00 | 52.00 | 368 |

Table 5–21
Surface danger zone data for 7.62mm M80A1 Enhanced Performance Round Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 1,000 | Earth Armor | 4,066 | 3,560 | 668 | 100 | NR | 45.80 | 72.00 | 486 |
| | | 4,066 | 3,185 | 346 | 100 | NR | 18.20 | 57.00 | 379 |
| 2,000 | Earth Armor | 4,185 | 3,660 | 686 | 100 | NR | 45.60 | 71.00 | 499 |
| | | 4,185 | 3,265 | 357 | 100 | NR | 18.40 | 62.00 | 390 |
| 3,000 | Earth Armor | 4,308 | 3,760 | 704 | 100 | NR | 45.40 | 70.00 | 512 |
| | | 4,308 | 3,345 | 368 | 100 | NR | 18.60 | 67.00 | 399 |
| 4,000 | Earth Armor | 4,435 | 3,860 | 722 | 100 | NR | 45.20 | 69.00 | 526 |
| | | 4,435 | 3,425 | 379 | 100 | NR | 18.80 | 72.00 | 410 |
| 5,000 | Earth Armor | 4,567 | 3,960 | 740 | 100 | NR | 45.00 | 68.00 | 541 |
| | | 4,567 | 3,505 | 390 | 100 | NR | 19.00 | 77.00 | 423 |
| 6,000 | Earth Armor | 4,703 | 4,060 | 758 | 100 | NR | 44.80 | 67.00 | 555 |
| | | 4,703 | 3,585 | 401 | 100 | NR | 19.20 | 82.00 | 436 |
| 7,000 | Earth Armor | 4,845 | 4,160 | 776 | 100 | NR | 44.60 | 66.00 | 570 |
| | | 4,845 | 3,665 | 412 | 100 | NR | 19.40 | 87.00 | 448 |

Legend:

NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 29 m per m/s or 14.90 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.31 degrees per m/s or 0.16 degrees per knot of crosswind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

z. Table 5–22 contains SDZ data for 7.62mm M62A1 EPR Tracer.

Table 5–22
Surface danger zone data for 7.62mm M62A1 Enhanced Performance Round Tracer¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 3,298 | 2,825 | 625 | 100 | NR | 51.00 | 68.00 | 510 |
| | | 3,298 | 2,680 | 275 | 100 | NR | 14.50 | 26.50 | 191 |
| 1,000 | Earth Armor | 3,400 | 2,910 | 647 | 100 | NR | 51.20 | 68.40 | 524 |
| | | 3,400 | 2,765 | 283 | 100 | NR | 14.60 | 26.60 | 196 |
| 2,000 | Earth Armor | 3,505 | 2,995 | 669 | 100 | NR | 51.40 | 68.80 | 538 |
| | | 3,505 | 2,850 | 291 | 100 | NR | 14.70 | 26.70 | 202 |
| 3,000 | Earth Armor | 3,615 | 3,080 | 691 | 100 | NR | 51.60 | 69.20 | 553 |
| | | 3,615 | 2,935 | 299 | 100 | NR | 14.80 | 26.80 | 207 |
| 4,000 | Earth Armor | 3,729 | 3,165 | 713 | 100 | NR | 51.80 | 69.60 | 569 |
| | | 3,729 | 3,020 | 307 | 100 | NR | 14.90 | 26.90 | 213 |
| 5,000 | Earth Armor | 3,847 | 3,250 | 735 | 100 | NR | 52.00 | 70.00 | 585 |
| | | 3,847 | 3,105 | 315 | 100 | NR | 15.00 | 27.00 | 218 |
| 6,000 | Earth Armor | 3,970 | 3,335 | 757 | 100 | NR | 52.20 | 70.40 | 601 |
| | | 3,970 | 3,190 | 323 | 100 | NR | 15.10 | 27.10 | 224 |
| 7,000 | Earth | 4,098 | 3,420 | 779 | 100 | NR | 52.40 | 70.80 | 618 |
| | | | | | | | | | |

Table 5–22
Surface danger zone data for 7.62mm M62A1 Enhanced Performance Round Tracer¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| | Armor | 4,098 | 3,275 | 331 | 100 | NR | 15.20 | 27.20 | 231 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 29 m per m/s or 15 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.35 degree per m/s or 0.18 degree per knot of CR wind.

² Area A applies to cone SDZ only.

aa. Table 5–23 contains SDZ data for 7.62mm M993 AP ammunition.

Table 5–23
Surface danger zone data for 7.62mm M993 Armor-Piercing

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth | 4,100 | 4,084 | 330 | 100 | NR | 33.32 | 5.97 | 224 |
| | Armor | 4,100 | 4,084 | 330 | 100 | NR | 33.32 | 5.97 | 224 |
| 1,000 | Earth | 4,195 | 4,179 | 338 | 100 | NR | 33.51 | 6.00 | 229 |
| | Armor | 4,195 | 4,179 | 338 | 100 | NR | 33.51 | 6.00 | 229 |
| 2,000 | Earth | 4,290 | 4,274 | 346 | 100 | NR | 33.69 | 6.03 | 234 |
| | Armor | 4,290 | 4,274 | 346 | 100 | NR | 33.69 | 6.03 | 234 |
| 3,000 | Earth | 4,385 | 4,368 | 354 | 100 | NR | 33.87 | 6.06 | 239 |
| | Armor | 4,385 | 4,368 | 354 | 100 | NR | 33.87 | 6.06 | 239 |
| 4,000 | Earth | 4,480 | 4,463 | 362 | 100 | NR | 34.04 | 6.09 | 244 |
| | Armor | 4,480 | 4,463 | 362 | 100 | NR | 34.04 | 6.09 | 244 |
| 5,000 | Earth | 4,575 | 4,558 | 370 | 100 | NR | 34.20 | 6.12 | 249 |
| | Armor | 4,575 | 4,558 | 370 | 100 | NR | 34.20 | 6.12 | 249 |
| 6,000 | Earth | 4,670 | 4,652 | 378 | 100 | NR | 34.36 | 6.14 | 254 |
| | Armor | 4,670 | 4,652 | 378 | 100 | NR | 34.36 | 6.14 | 254 |
| 7,000 | Earth | 4,765 | 4,747 | 386 | 100 | NR | 34.51 | 6.17 | 259 |
| | Armor | 4,765 | 4,747 | 386 | 100 | NR | 34.51 | 6.17 | 259 |

Legend:
NR=not required
Note.
¹Area A applies to cone SDZ only.

bb. Table 5–24 contains SDZ data for 7.62mm M1158 AP ammunition.

Table 5–24
Surface danger zone data for 7.62mm M1158 Armor-Piercing¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P ³ (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|----------------------------------|---------------------|---------------------------------------|
| 0 | Earth | 3,766 | 3,380 | 690 | 100 | NR | 63.00 | 52.50 | 559 |

Table 5–24
Surface danger zone data for 7.62mm M1158 Armor-Piercing¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P ³ (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|----------------------------------|---------------------|---------------------------------------|
| | Armor | 3,766 | 3,270 | 560 | 100 | NR | 41.40 | 60.00 | 663 |
| 1,000 | Earth Armor | 3,875 3,875 | 3,470 3,370 | 713 580 | 100 100 | NR NR | 63.50 41.50 | 52.60 59.50 | 575 682 |
| 2,000 | Earth Armor | 3,988 3,988 | 3,560 3,470 | 736 600 | 100 100 | NR NR | 64.00 41.60 | 52.70 59.00 | 590 704 |
| 3,000 | Earth Armor | 4,105 4,105 | 3,650 3,570 | 759 620 | 100 100 | NR NR | 64.50 41.70 | 52.80 58.50 | 606 725 |
| 4,000 | Earth Armor | 4,226 4,226 | 3,740 3,670 | 782 640 | 100 100 | NR NR | 65.00 41.80 | 52.90 58.00 | 623 746 |
| 5,000 | Earth Armor | 4,351 4,351 | 3,830 3,770 | 805 660 | 100 100 | NR NR | 65.50 41.90 | 53.00 57.50 | 640 766 |
| 6,000 | Earth Armor | 4,481 4,481 | 3,920 3,870 | 828 680 | 100 100 | NR NR | 66.00 42.00 | 53.10 57.00 | 658 788 |
| 7,000 | Earth Armor | 4,615 4,615 | 4,010 3,970 | 851 700 | 100 100 | NR NR | 66.50 42.10 | 53.20 56.50 | 676 814 |

Legend:
 NR=not required

Notes.

¹ Distance X is for firing elevations up to maximum range and considers both free flight and ricochet trajectories. To correct for tailwinds, Distance X must increase by 31 m per m/s or 16 m per knot of tailwind measured along the line of fire.

² Area A applies to cone SDZ only.

³ Ricochet angle P is measured from the dispersion angle. To correct for CR winds, the 5 deg dispersion angle must increase by 0.37 deg per m/s or 0.19 deg per knot of CR wind measured perpendicular to line of fire.

cc. Table 5–25 contains SDZ data for 7.62mm M276 Dim Tracer.

Table 5–25
Surface danger zone data for 7.62mm M276 Dim Tracer¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 2,932 2,932 | 1,118 2,192 | 106 234 | 100 100 | NR NR | 22.00 44.30 | 15.30 11.00 | 83 165 |
| 1,000 | Earth Armor | 3,032 3,032 | 1,238 2,242 | 114 238 | 100 100 | NR NR | 22.20 44.20 | 15.00 10.90 | 84 170 |
| 2,000 | Earth Armor | 3,132 3,132 | 1,242 2,342 | 116 244 | 100 100 | NR NR | 22.30 44.10 | 14.80 10.90 | 86 175 |
| 3,000 | Earth Armor | 3,232 3,232 | 1,287 2,392 | 118 248 | 100 100 | NR NR | 22.50 44.00 | 14.50 10.80 | 88 180 |
| 4,000 | Earth Armor | 3,332 3,332 | 1,330 2,492 | 122 258 | 100 100 | NR NR | 22.70 44.00 | 14.20 10.80 | 90 186 |
| 5,000 | Earth Armor | 3,432 3,432 | 1,382 2,542 | 134 266 | 100 100 | NR NR | 22.90 43.90 | 13.90 10.70 | 92 192 |
| 6,000 | Earth | 3,557 | 1,436 | 239 | 100 | NR | 23.00 | 13.70 | 94 |

Table 5–25
Surface danger zone data for 7.62mm M276 Dim Tracer¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| | Armor | 3,557 | 2,642 | 276 | 100 | NR | 43.80 | 10.70 | 198 |
| 7,000 | Earth | 3,677 | 1,485 | 144 | 100 | NR | 23.20 | 13.40 | 96 |
| | Armor | 3,677 | 2,742 | 286 | 100 | NR | 43.70 | 10.60 | 204 |

Legend:
 NR=not required

Notes.

¹ To correct for tailwind, Distance X is increased by 36 m per m/s or 18.50 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must be increased by 0.30 degree per m/s or 0.16 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

dd. Table 5–26 contains SDZ data for 7.62mm MK319 MOD 0 Ball.

Table 5–26
Surface danger zone data for 7.62mm Barrier MK319 MOD 0 Ball¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth | 2,788 | 2,590 | 305 | 100 | NR | 61.00 | 13.50 | 232 |
| | Armor | 2,788 | 2,510 | 285 | 100 | NR | 44.50 | 18.00 | 215 |
| 1,000 | Earth | 2,874 | 2,665 | 315 | 100 | NR | 61.10 | 13.65 | 239 |
| | Armor | 2,874 | 2,575 | 294 | 100 | NR | 44.40 | 18.10 | 221 |
| 2,000 | Earth | 2,963 | 2,740 | 325 | 100 | NR | 61.20 | 13.80 | 246 |
| | Armor | 2,963 | 2,640 | 303 | 100 | NR | 44.30 | 18.20 | 228 |
| 3,000 | Earth | 3,055 | 2,815 | 335 | 100 | NR | 61.30 | 13.95 | 254 |
| | Armor | 3,055 | 2,705 | 312 | 100 | NR | 44.20 | 18.30 | 235 |
| 4,000 | Earth | 3,151 | 2,890 | 345 | 100 | NR | 61.40 | 14.10 | 262 |
| | Armor | 3,151 | 2,770 | 321 | 100 | NR | 44.10 | 18.40 | 242 |
| 5,000 | Earth | 3,250 | 2,965 | 355 | 100 | NR | 61.50 | 14.25 | 270 |
| | Armor | 3,250 | 2,835 | 330 | 100 | NR | 44.00 | 18.50 | 249 |
| 6,000 | Earth | 3,353 | 3,040 | 365 | 100 | NR | 61.60 | 14.40 | 278 |
| | Armor | 3,353 | 2,900 | 339 | 100 | NR | 43.90 | 18.60 | 257 |
| 7,000 | Earth | 3,461 | 3,115 | 375 | 100 | NR | 61.70 | 14.55 | 287 |
| | Armor | 3,461 | 2,965 | 348 | 100 | NR | 43.80 | 18.70 | 264 |

Legend:
 NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 26.50 m per m/s or 13.50 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.39 degrees per m/s or 0.20 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

ee. Table 5–27 contains SDZ data for M973 Ball and M974 Tracer 7.62mm SRTA. These rounds are designed to be ballistically comparable to 7.62mm M80 Ball and M62 Tracer service ammunition out to 100 m.

Table 5–27**Surface danger zone data for 7.62mm M973 Short Range Training Ball and M974 Short Range Training Tracer^{1,2}—Continued**

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ³ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 540 | 500 | 105 | 100 | NR | 38.00 | 45.00 | 178 |
| | | 540 | 500 | 30 | 100 | NR | 10.00 | 20.00 | 178 |
| 1,000 | Earth Armor | 565 | 520 | 110 | 100 | NR | 38.00 | 45.00 | 184 |
| | | 565 | 520 | 32 | 100 | NR | 10.00 | 20.00 | 184 |
| 2,000 | Earth Armor | 590 | 540 | 115 | 100 | NR | 38.00 | 45.00 | 190 |
| | | 590 | 540 | 34 | 100 | NR | 10.00 | 20.00 | 190 |
| 3,000 | Earth Armor | 615 | 560 | 120 | 100 | NR | 38.00 | 45.00 | 196 |
| | | 615 | 560 | 36 | 100 | NR | 10.00 | 20.00 | 196 |
| 4,000 | Earth Armor | 640 | 580 | 125 | 100 | NR | 38.00 | 45.00 | 202 |
| | | 640 | 580 | 38 | 100 | NR | 10.00 | 20.00 | 202 |
| 5,000 | Earth Armor | 665 | 600 | 130 | 100 | NR | 38.00 | 45.00 | 208 |
| | | 665 | 600 | 40 | 100 | NR | 10.00 | 20.00 | 208 |
| 6,000 | Earth Armor | 690 | 620 | 135 | 100 | NR | 38.00 | 45.00 | 214 |
| | | 690 | 620 | 42 | 100 | NR | 10.00 | 20.00 | 214 |
| 7,000 | Earth Armor | 715 | 640 | 140 | 100 | NR | 38.00 | 45.00 | 220 |
| | | 715 | 640 | 44 | 100 | NR | 10.00 | 20.00 | 220 |

Legend:

NR=not required

Notes.

¹ For SDZ construction use figure 4–4, with the following change: use a dispersion angle of 12 degrees.² To correct for crosswind, the dispersion angle must increase by 0.80 degree per m/s or 0.40 degree per knot of crosswind measured perpendicular to the line of fire.³ Area A applies to cone SDZ only.*ff.* Table 5–28 contains SDZ data for MK 248 MOD 0.300 caliber Winchester Magnum ammunition.**Table 5–28****Surface danger zone data for .300 caliber Winchester Magnum MK 248 MOD 0¹**

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 5,919 | 4,200 | 390 | 100 | NR | 40.00 | 10.00 | 322 |
| | | 5,919 | 2,300 | 180 | 100 | NR | 28.00 | 12.00 | 128 |
| 1,000 | Earth Armor | 6,078 | 4,336 | 399 | 100 | NR | 40.45 | 10.30 | 340 |
| | | 6,078 | 2,358 | 187 | 100 | NR | 27.75 | 12.15 | 138 |
| 2,000 | Earth Armor | 6,242 | 4,472 | 408 | 100 | NR | 40.90 | 10.60 | 358 |
| | | 6,242 | 2,416 | 194 | 100 | NR | 27.50 | 12.30 | 150 |
| 3,000 | Earth Armor | 6,411 | 4,608 | 417 | 100 | NR | 41.35 | 10.90 | 382 |
| | | 6,411 | 2,474 | 201 | 100 | NR | 27.25 | 12.45 | 160 |
| 4,000 | Earth Armor | 6,584 | 4,744 | 426 | 100 | NR | 41.80 | 11.20 | 410 |
| | | 6,584 | 2,532 | 208 | 100 | NR | 27.00 | 12.60 | 165 |
| 5,000 | Earth Armor | 6,763 | 4,880 | 435 | 100 | NR | 42.25 | 11.50 | 433 |
| | | 6,763 | 2,590 | 215 | 100 | NR | 26.75 | 12.75 | 180 |
| 6,000 | Earth | 6,947 | 5,016 | 444 | 100 | NR | 42.70 | 11.80 | 457 |
| | | | | | | | | | |

Table 5–28
Surface danger zone data for .300 caliber Winchester Magnum MK 248 MOD 0¹—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| | Armor | 6,947 | 2,648 | 222 | 100 | NR | 26.50 | 12.90 | 194 |
| 7,000 | Earth Armor | 7,137 7,137 | 5,152 2,706 | 453 229 | 100 100 | NR NR | 43.15 26.25 | 12.10 13.05 | 484 208 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 37 m per m/s or 19 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.28 degree per m/s or 0.15 degree per knot of crosswind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

gg. Table 5–29 contains SDZ data for .300 caliber Winchester Magnum MK 248 MOD 1 ammunition.

Table 5–29
Surface danger zone data for .300 caliber Winchester Magnum, MK 248 MOD 1¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 6,294 6,294 | 4,600 3,800 | 390 220 | 100 100 | NR NR | 39.00 24.00 | 14.00 10.00 | 350 146 |
| 1,000 | Earth Armor | 6,462 6,462 | 4,675 3,858 | 402 227 | 100 100 | NR NR | 39.15 23.75 | 14.60 10.15 | 372 155 |
| 2,000 | Earth Armor | 6,635 6,635 | 4,750 3,916 | 414 234 | 100 100 | NR NR | 39.30 23.50 | 15.20 10.30 | 397 165 |
| 3,000 | Earth Armor | 6,814 6,814 | 4,825 3,974 | 426 241 | 100 100 | NR NR | 39.45 23.25 | 15.80 10.45 | 424 175 |
| 4,000 | Earth Armor | 6,998 6,998 | 4,900 4,032 | 438 248 | 100 100 | NR NR | 39.60 23.00 | 16.40 10.60 | 440 187 |
| 5,000 | Earth Armor | 7,188 7,188 | 4,975 4,090 | 450 255 | 100 100 | NR NR | 39.75 22.75 | 17.00 10.75 | 468 198 |
| 6,000 | Earth Armor | 7,384 7,384 | 5,050 4,148 | 462 262 | 100 100 | NR NR | 39.90 22.50 | 17.60 10.90 | 500 211 |
| 7,000 | Earth Armor | 7,587 7,587 | 5,125 4,206 | 474 269 | 100 100 | NR NR | 40.05 22.25 | 18.20 11.05 | 533 223 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 40 m per m/s or 21 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.28 degree per m/s or 0.15 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

hh. Table 5–30 contains SDZ data for .338 caliber Lapua Magnum MK330 (300 grain).

Table 5–30
Surface danger zone data for .338 caliber Lapua Magnum MK 330 (300 grain)¹—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ² (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 6,833 | 3,950 | 220 | 100 | NR | 41.00 | 52.00 | 329 |
| | | 6,833 | 4,050 | 165 | 100 | NR | 15.00 | 18.00 | 188 |
| 1,000 | Earth Armor | 7,015 | 4,035 | 228 | 100 | NR | 41.25 | 52.50 | 341 |
| | | 7,015 | 4,135 | 172 | 100 | NR | 15.30 | 19.80 | 193 |
| 2,000 | Earth Armor | 7,201 | 4,120 | 236 | 100 | NR | 41.50 | 53.00 | 353 |
| | | 7,201 | 4,220 | 179 | 100 | NR | 15.60 | 21.60 | 199 |
| 3,000 | Earth Armor | 7,395 | 4,205 | 244 | 100 | NR | 41.75 | 53.50 | 366 |
| | | 7,395 | 4,305 | 186 | 100 | NR | 15.90 | 23.40 | 203 |
| 4,000 | Earth Armor | 7,593 | 4,290 | 252 | 100 | NR | 42.00 | 54.00 | 378 |
| | | 7,593 | 4,390 | 193 | 100 | NR | 16.20 | 25.20 | 208 |
| 5,000 | Earth Armor | 7,798 | 4,375 | 260 | 100 | NR | 42.25 | 54.50 | 391 |
| | | 7,798 | 4,475 | 200 | 100 | NR | 16.50 | 27.00 | 213 |
| 6,000 | Earth Armor | 8,008 | 4,460 | 268 | 100 | NR | 42.50 | 55.00 | 402 |
| | | 8,008 | 4,560 | 207 | 100 | NR | 16.80 | 28.80 | 217 |
| 7,000 | Earth Armor | 8,227 | 4,545 | 276 | 100 | NR | 42.75 | 55.50 | 414 |
| | | 8,227 | 4,645 | 214 | 100 | NR | 17.10 | 30.60 | 223 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 42 m per m/s or 22 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.24 degree per m/s or 0.12 degree per knot of CR wind measured perpendicular to the line of fire.

² Area A applies to cone SDZ only.

ii. Table 5–31 contains SDZ data for .50 caliber weapons.

Table 5–31
Surface danger zone data for .50 caliber weapons

| Ammunition .50 caliber | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|--|---------------------------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| M8 API, M2 AP, M20, M1 | Earth/ water Steel/ concrete | 6,100 | 5,142 | 1,659 | 100 | NR | 40.80 | 69.60 | 904 |
| | | 6,100 | 4,300 | 718 | 100 | NR | 16.30 | 33.10 | 462 |
| M33 Ball, M2 Ball, M17, M10, M17, Spotter Tracer | Earth/ water Steel/ concrete | 6,500 | 5,211 | 1,652 | 100 | NR | 38.19 | 63.35 | 901 |
| | | 6,500 | 4,147 | 714 | 100 | NR | 16.03 | 44.13 | 478 |
| M858 Ball Plastic, M860 Tracer Plastic | Earth/ water Steel/ concrete | 700 | 398 | 20 | 100 | NR | 4.28 | 9.16 | 41 |
| | | 700 | 415 | 53 | 100 | NR | 11.65 | 21.14 | 41 |
| MK322/1 MK322 | Earth/ water | 3,500 | 3,500 | 1,659 | 100 | NR | 40.80 | 69.60 | 904 |

Table 5–31
Surface danger zone data for .50 caliber weapons

| Ammunition .50 caliber | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ¹ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------------------|--------------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| RRA | Steel/ concrete | 3,500 | 3,500 | 1,659 | 100 | NR | 40.80 | 69.60 | 904 |
| M1183 SRTA ² | Earth | 705 | 705 | 260 | 100 | NR | 48.0 | 58.0 | 210 |
| | Armor | 705 | 705 | 205 | 100 | NR | 40.0 | 55.0 | 185 |

Legend:

AP=Armor-Piercing

API=Armor-Piercing Incendiary

RRA=Reduced Range Ammunition

NR=not required

SRTA=Short-Range Training Ammunition

Notes.

¹ Area A applies to cone SDZ only.

² For Special Operations use only.

jj. Table 5–32 contains SDZ data for M903.50 caliber SLAP ammunition.

Table 5–32
Surface danger zone data for .50 caliber M903 Saboted Light Armor Penetrator

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Dist D (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Sand/steel | 8,625 | 1,130 | 1,074 | NR | NR | 47.34 | NR | 1,130 |
| 1,000 | Sand/steel | 8,885 | 1,155 | 1,101 | NR | NR | 47.34 | NR | 1,155 |
| 2,000 | Sand/steel | 9,145 | 1,180 | 1,128 | NR | NR | 47.38 | NR | 1,180 |
| 3,000 | Sand/steel | 9,405 | 1,205 | 1,155 | NR | NR | 47.39 | NR | 1,205 |
| 4,000 | Sand/steel | 9,665 | 1,230 | 1,182 | NR | NR | 47.40 | NR | 1,230 |
| 5,000 | Sand/steel | 9,925 | 1,255 | 1,209 | NR | NR | 47.42 | NR | 1,255 |
| 6,000 | Sand/steel | 10,185 | 1,280 | 1,236 | NR | NR | 47.43 | NR | 1,280 |
| 7,000 | Sand/steel | 10,445 | 1,305 | 1,263 | NR | NR | 47.44 | NR | 1,305 |

Legend:

NR=not required

kk. Table 5–33 contains SDZ data for M962.50 caliber SLAP–T ammunition.

Table 5–33
Surface danger zone data for .50 caliber M962 Saboted Light Armor Penetrator-Tracer

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Dist D (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Sand/steel | 9,560 | 1,240 | 1,001 | NR | NR | 48.00 | NR | 1,240 |
| 1,000 | Sand/steel | 9,870 | 1,270 | 1,025 | NR | NR | 48.00 | NR | 1,270 |
| 2,000 | Sand/steel | 10,180 | 1,300 | 1,049 | NR | NR | 48.01 | NR | 1,300 |

Table 5–33
Surface danger zone data for .50 caliber M962 Saboted Light Armor Penetrator-Tracer

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Dist D (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 3,000 | Sand/steel | 10,490 | 1,330 | 1,073 | NR | NR | 48.02 | NR | 1,330 |
| 4,000 | Sand/steel | 10,800 | 1,360 | 1,098 | NR | NR | 48.03 | NR | 1,360 |
| 5,000 | Sand/steel | 11,110 | 1,390 | 1,122 | NR | NR | 48.04 | NR | 1,390 |
| 6,000 | Sand/steel | 11,420 | 1,420 | 1,146 | NR | NR | 48.04 | NR | 1,420 |
| 7,000 | Sand/steel | 11,730 | 1,450 | 1,170 | NR | NR | 48.04 | NR | 1,450 |

Legend:
NR=not required

ll. Table 5–34 contains SDZ data for .50 caliber MK211 MOD 0 and MK211 MOD 1 API small ammunition.

Table 5–34
Surface danger zone data for .50 caliber MK211 MOD 0, MK211 MOD 1 Armor-Piercing-Incendiary MK211 Multipurpose^{1,2}

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ³ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 7,463 | 4,700 | 700 | 100 | NR | 58.00 | 47.25 | 508 |
| | | 7,463 | 4,750 | 460 | 100 | NR | 32.00 | 28.75 | 412 |
| 1,000 | Earth Armor | 7,648 | 4,810 | 725 | 100 | NR | 58.35 | 46.25 | 521 |
| | | 7,648 | 4,850 | 475 | 100 | NR | 32.05 | 29.75 | 433 |
| 2,000 | Earth Armor | 7,837 | 4,920 | 750 | 100 | NR | 58.70 | 45.25 | 534 |
| | | 7,837 | 4,950 | 490 | 100 | NR | 32.10 | 30.75 | 453 |
| 3,000 | Earth Armor | 8,032 | 5,030 | 775 | 100 | NR | 59.05 | 44.25 | 548 |
| | | 8,032 | 5,050 | 505 | 100 | NR | 32.15 | 31.75 | 471 |
| 4,000 | Earth Armor | 8,232 | 5,140 | 800 | 100 | NR | 59.40 | 43.25 | 562 |
| | | 8,232 | 5,150 | 520 | 100 | NR | 32.20 | 32.75 | 486 |
| 5,000 | Earth Armor | 8,438 | 5,250 | 825 | 100 | NR | 59.75 | 42.25 | 577 |
| | | 8,438 | 5,250 | 535 | 100 | NR | 32.25 | 33.75 | 499 |
| 6,000 | Earth Armor | 8,650 | 5,360 | 850 | 100 | NR | 60.10 | 41.25 | 592 |
| | | 8,650 | 5,350 | 550 | 100 | NR | 32.30 | 34.75 | 511 |
| 7,000 | Earth Armor | 8,869 | 5,470 | 875 | 100 | NR | 60.40 | 40.25 | 607 |
| | | 8,869 | 5,450 | 565 | 100 | NR | 32.35 | 35.75 | 524 |

Legend:
NR=not required

Notes.

¹ To correct for tailwinds, Distance X must increase by 43 m per m/s or 22 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.22 degree per m/s or 0.11 degree per knot of wind measured perpendicular to the line of fire

² Warning is issued when engaging hard target less than or equal to 350 m. The potential for hazardous fragments to impact near the weapon area may exist.

³ Area A applies to cone SDZ only.

mm. Table 5–35 contains SDZ data for .50 caliber MK257 MOD 0 AP Incendiary-Dim Tracer.

Table 5–35

Surface danger zone data for .50 caliber MK257 MOD 0 Armor-Piercing Incendiary-Dim Tracer^{1,2}—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A ³ (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|-------------------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor | 6,666 6,666 | 4,450 4,500 | 575 360 | 100 100 | NR NR | 57.80 34.00 | 35.00 24.00 | 428 335 |
| 1,000 | Earth Armor | 6,843 6,843 | 4,585 4,605 | 590 374 | 100 100 | NR NR | 58.40 34.15 | 33.50 24.75 | 439 351 |
| 2,000 | Earth Armor | 7,026 7,026 | 4,720 4,710 | 605 388 | 100 100 | NR NR | 59.00 34.30 | 32.00 25.50 | 450 368 |
| 3,000 | Earth Armor | 7,216 7,216 | 4,855 4,815 | 620 402 | 100 100 | NR NR | 59.60 34.45 | 30.50 26.25 | 462 385 |
| 4,000 | Earth Armor | 7,411 7,411 | 4,990 4,920 | 635 416 | 100 100 | NR NR | 60.20 34.60 | 29.00 27.00 | 475 398 |
| 5,000 | Earth Armor | 7,612 7,612 | 5,125 5,025 | 650 430 | 100 100 | NR NR | 60.80 34.75 | 27.50 27.75 | 488 409 |
| 6,000 | Earth Armor | 7,819 7,819 | 5,260 5,130 | 665 444 | 100 100 | NR NR | 61.40 34.90 | 26.00 28.50 | 501 418 |
| 7,000 | Earth Armor | 8,035 8,035 | 5,395 5,235 | 680 458 | 100 100 | NR NR | 62.00 35.05 | 24.50 29.25 | 515 429 |

Legend:

NR=not required

Notes.

¹To correct for tailwinds, Distance X must increase by 42 m per m/s or 22 m per knot of tailwind measured along the line of fire. To correct for CR winds the dispersion angle must increase by 0.24 degree per m/s or 0.12 degree per knot of CR wind measured perpendicular to the line of fire.

² Warning is issued when engaging hard target less than or equal to 350 m. The potential for hazardous fragments to impact near the weapon area may exist.

³ Area A applies to cone SDZ only.

5–3. Small caliber dummy, drill, and inert ammunition

The dummy, drill, and inert (DDI) cartridges are designed to aid in easy identification of inert ammunition to prevent injury caused by any mix-up with live service ammunition during training. The DDI are completely nickel-plated with the 9mm DDI having two holes drilled in the cartridge case, while the 5.56mm, 7.62mm, and .50 caliber DDI have fluted cartridge cases to aid tactile identification in darkness. For the Army, the nickel-plated DDI will be the only DDI inert small caliber cartridges authorized for classroom training and weapon cycling functioning for weapon maintenance or other situations when inert cartridges are needed.

Chapter 6 Grenades and Grenade Launchers

6–1. Hand grenades

a. High-explosive loaded type grenades. These munitions contain explosive charges that detonate after a short delay (3 to 5 seconds). Every precaution will be taken to prevent injury from blast, concussion, and fragment. For training purposes, fragmentation and offensive hand grenades will be thrown from a trench or barrier equivalent to a screen of sandbags 0.5 m (1.65 ft) thick. When throwing bays are used for protection, they will be built to a minimum height of 1.5 m (5 ft) high and 2.7 m (8.8 ft) wide or enough to accommodate one thrower and one ARSO. Bay height may be reduced to less than 1.5 m if approved by the installation commander. However, it must provide positive protection against high-velocity, low-angle fragments (see TC 3–23.30 and TC 25–8 for other dimensions and additional information). Throwing bays will be separated from adjacent bays by a distance of 20 m. If this requirement cannot be met, then throwing bays may be separated from one another by physical barriers (earthen berms, concrete walls, or wooden revetments) long and high enough to attenuate high-velocity, low-angle fragments. If the grenade

throwing position contains a grenade sump, RSO will ensure the sump is clear of obstructions prior to throwing live grenades. It is recommended that all throwing pits for live grenade training have knee walls at the rear of the bay. Knee walls provide the quickest and safest means of reacting to a dropped grenade. Knee walls should be 0.6 m (2 ft) high.

b. Firing conditions for fragmentation and offensive grenades.

(1) Personnel within the 150 m danger area when casualty-producing hand grenades are thrown will wear, at a minimum, PPE Level 1 (see table 2–2). Approved single-hearing protection is required for all participating personnel when throwing bays are used. Approved single-hearing protection is recommended for all personnel participating in tactical exercises.

(2) Safety clips on fragmentation and practice grenades will not be removed until immediately before the safety pin is removed. Once the safety pin has been pulled, the grenade will be thrown. No attempt will be made to reinsert the safety pin or tape the safety lever (spoon). The safety lever will not be released for any reason on HE grenades until the grenade exits the throwing hand.

(3) Personnel must be proficient in the safety precautions for handling and throwing grenades before live grenade training begins. Successful completion of practice grenade training (usually referred to as mock-bay, these pits will replicate the physical layout of live-bay pits) is mandatory the same day as live grenade training.

(4) OICs, RSOs, and live-bay ARSOs for live grenade training events must be certified to perform these duties. Certification will include training detailing actions in the event of a dropped grenade, short throw, grenade thrown other than down range, SDZ, control of observers, misfire or dud grenade procedures, arming, throwing techniques, and pre-live bay requirements. Marine Corps battalion and squadron commanders are responsible for establishing and maintaining a certification program for their OICs and RSOs commensurate to the assigned duties and responsibilities. RSOs and ARSOs must be qualified with the hand grenade prior to assuming their duties.

(5) HE grenades that fail to function (dud) will not be approached except by EOD personnel. During training, if a grenade fails to explode, the throwing of live grenades in any bay within the uninterrupted fragmentation radius of the dud grenade will cease. Dud grenades will be destroyed by EOD personnel only. Unauthorized personnel will not approach, move, touch, or handle dud grenades. All duds will be reported by the OIC to the range operations office (Army) or range control office (Marine Corps).

(6) During demonstrations, fragmentation and blast or concussion type grenades will be thrown from a barricaded position so grenades burst at least 150 m from unprotected personnel (see fig 6–1).

(7) When direct viewing of hand grenade detonations within the 150 m danger area is required, the following information is provided:

(a) Viewing positions will be constructed to provide positive protection from high-velocity, low-angle fragments and low-velocity high-angle fragments.

(b) Composite (laminated) viewing ports will be constructed using the following criteria or equivalent:

1. 10mm (0.40 inch) glass (outside).
2. 7mm (0.28 inch) polycarbonate.
3. 6mm (0.24 inch) glass.
4. 6mm (0.24 inch) polycarbonate.
5. 6mm (0.24 inch) glass.
6. 6mm (0.24 inch) polycarbonate.

(c) Alternatives.

1. Provide a single pane of UL 752 Level 1-, Level 2-, or Level 3 rated bullet-resisting laminated glass glazing (with a minimum total thickness of at least 1–3/16 inches). Also, as an alternative, two panes of other UL 752 Level 1-, Level 2-, or Level 3 rated bullet-resisting glazing types may be used, provided each pane contains a minimum of 30 percent glass by thickness. In cases where the protected side of the glazing is made of a glass layer, the interior surface should have a spall shield or film applied to that surface by the manufacturer.

2. These criteria provide minimum essential one-time protection against worst-case fragmentation detonated within 6 m of the viewing port. Additionally, 12.7mm (0.50 inch) or equivalent exterior polycarbonate protective sheet (scar shield) should be installed in front of the viewing port. The shield absorbs the majority of damage and is more easily replaced than the entire viewing port.

(8) Live grenades will not be thrown into standing water, deep snow, or dense vegetation which would obscure the grenade (for example, deeper than 5 cm (2 inches)).

(9) When training with live grenades in a tire house, trench line, or like environment and a dud grenade is experienced, all activities within the structure or danger area will stop. Personnel will remain within a safe area for a minimum of 5 minutes and then evacuate the structure or area until EOD clears the dud.

(10) Range cadre and commanders are cautioned that multiple employment of grenades in a training scenario significantly increases the difficulty of determining the actual number of grenades that detonated. Dud grenades may be activated by subsequent training, generating an unplanned detonation.

(11) Simultaneous employment of multiple fragmentation grenades into a single impact point is prohibited, as a live grenade could be propelled into the safe area by the detonation of another grenade (Marine Corps).

(12) The use of hand grenades during live-fire exercises will conform to the provisions provided by chapter 18.

c. Firing conditions for hand grenades with chemical and incendiary fills.

(1) Chemical grenades will not be held in the hand after the safety lever is released. The incendiary hand grenade may be taped (do not tape safety lever or safety pin, in accordance with TC 3–23.30) or tied in place if the incendiary effect is desired at a specified location. In this case, safety pins will not be pulled from the grenade until the desired time of functioning. Remote safety pin removal is preferred.

(2) Burning type grenades (riot control, smoke, IL, and incendiary) are ignited by pulling the safety pin and releasing the safety lever. After the safety pin has been pulled, the safety lever will not be released until the grenade exits the throwing hand. Once the safety lever is released, there is no way to stop the grenade from functioning. When the burning type grenade is fired in place, the firer will keep their face turned away from the grenade. After releasing the safety lever, the firer will quickly move at least 10 m away to avoid contact with incendiary particles and fumes emitted during burning.

(3) Personnel will be instructed on the proper method of holding the M25 bursting type, riot control grenade before commencing training exercises. The arming sleeve will remain depressed until the grenade is thrown. M25 grenades will not be thrown closer than 25 m to unprotected personnel.

(4) Burning type grenades burn oxygen. Standard protective masks filter particles but will not supply oxygen. Therefore, burning grenades will not be used in enclosed or confined spaces (such as occupied tunnels) or in other confined spaces into which personnel will enter until those spaces are ventilated (see TM 9–1330–200–12 and TM 43–0001–29 for specific fuse burning delay times and functioning characteristics).

(5) Burning type o-chlorobenzylidene malononitrile (CS) grenades will not be fired closer than 10 m to other personnel or 50 m to spectators upwind.

(6) Hexachloroethane (HC) smoke grenade restrictions are the same as those for HC smoke pots. These grenades will ignite combustible materials and cause burns. A separation distance of at least 10 m should be maintained from burning grenades. Personnel will wear protective respirators or masks before exposure to any concentration of smoke produced by HC smoke grenades (see chap 14 for detailed information concerning smoke hazards).

(7) Burning particles of white phosphorous (WP) are frequently projected from the M15 and M34 grenades to a distance of 40 m from the bursting point. Therefore, M15 and M34 WP grenades should be thrown only on standard live grenade ranges during training as prescribed in TC 3–23.30. Trainers should consider the use of protective cover when using the M15 and M34. WP particles cause serious, painful, slow-healing burns (see TC 4–02.1 for appropriate first aid measures).

(8) Direct viewing of thermite grenades will not be conducted due to the high potential of permanent eye damage.

d. M84 stun grenade. Regarding hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on noise hazard controls (NHCs) and allowable number of rounds (ANOR) per weapon system.

e. Scalable offensive hand grenade. The MK 21 MOD 0 was designed to incapacitate through concussive effects and allows for three different levels of noise hazard.

(1) Scalable offensive hand grenades will not be used in an enclosed structure. This munition is authorized for use in structures with no ceilings or overhead cover.

(2) Operator must deploy the munition from behind a barrier, such as a throwing bay, wall, or pit, to be protected from blast overpressure and debris.

(3) PPE Level 0 plus single-hearing protection is required for all personnel training with the grenade and those observing this training within the 140-decibel (dB) noise hazard contours (see fig 6–2). Regarding hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.

(4) PPE Level 0 plus double-hearing protection is required for all personnel training with the grenade and those observing this training within the 165-dB noise hazard contours (see fig 6–3). Regarding hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.

f. Diversionary hand grenade, 6 Bang, MK 24 MOD 0. The diversionary grenade M106 SOD-Vr is a bursting smoke hand grenade used for screening and concealment. When using M106 SOD-Vr, throw the grenade immediately

after pulling the pin. This smoke grenade has a Flash Bang Grenade type fuze with a 1.0 to 2.3-second time delay but can function as early as 0.7 seconds after the safety lever has been released.

g. Surface danger zones.

- (1) See figure 6–1 for SDZ requirements for hand grenades.
- (2) When developing a hand grenade range, the Army will use TC 25–8 for planning guidance.

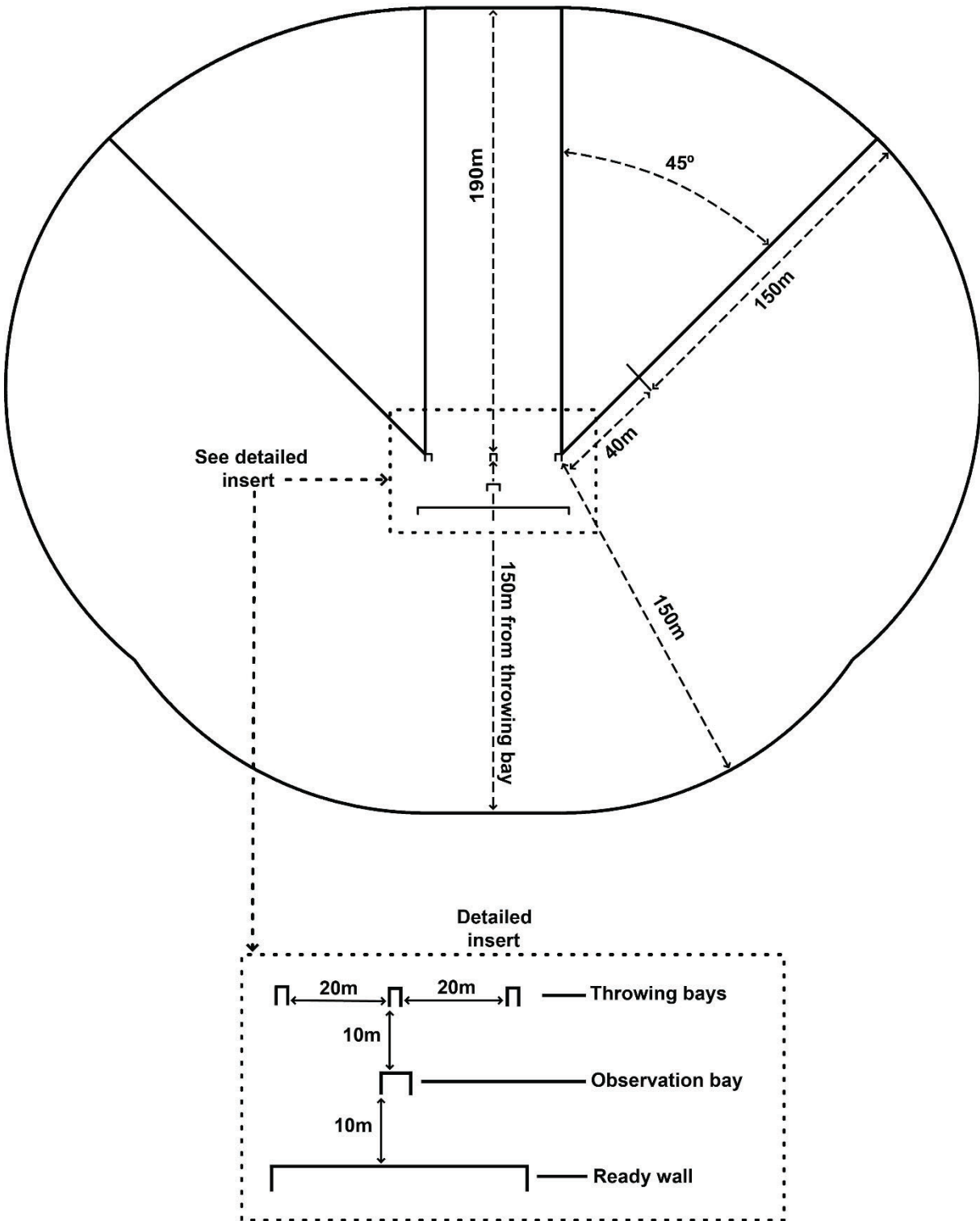


Figure 6-1. Surface danger zone for fragmentation and offensive hand grenade

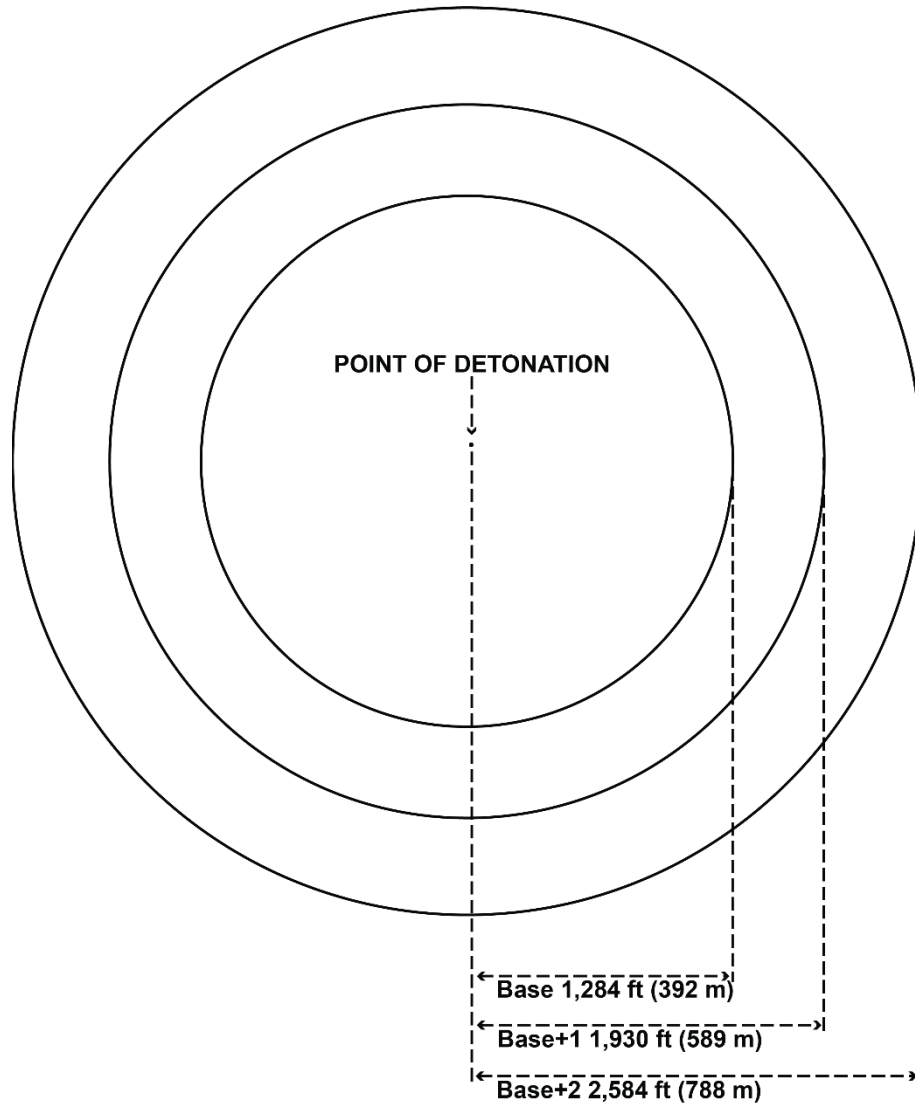


Figure 6-2. 140-decibel noise contours

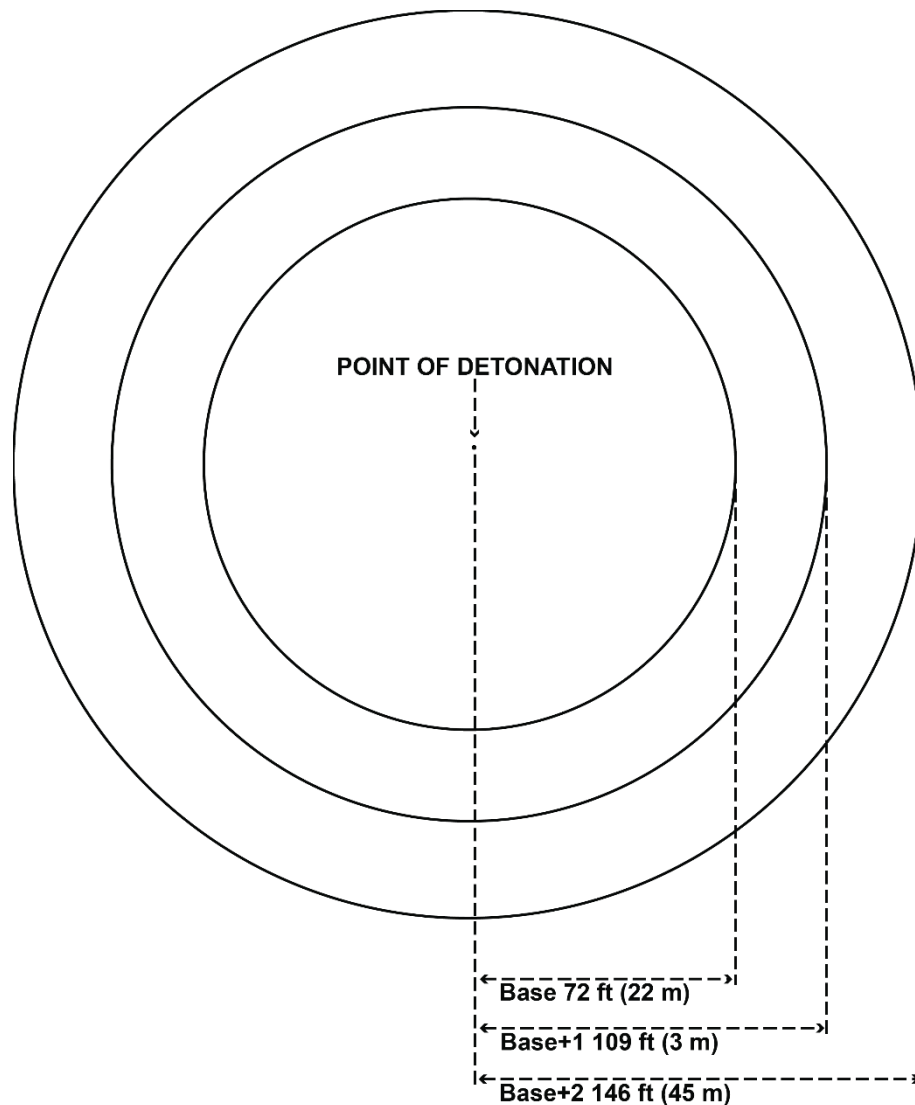


Figure 6–3. 165-decibel noise contours

6–2. Grenade launchers and grenade machine guns

a. General firing conditions.

(1) Personnel will be instructed in the proper use of grenade launchers and grenade machine guns and applicable safety precautions before firing with live ammunition.

(2) PPE Level 1 will be worn when firing HE ammunition. Requirement for eye protection will be determined by the commander as part of the RM process (see table 2–2).

(a) Hazardous fragmentation from HE grenade ammunition may be experienced up to 165 m from the point of detonation. Appropriate HE no-fire lines will be established.

(b) Although the MK32, M79, M203, and M320 40mm grenade launchers are designed to prevent accidental chambering of 40mm high-velocity ammunition, OICs and RSOs will ensure only low-velocity grenade cartridges are fired from MK32, M79, M203, and M320 grenade launchers.

(c) Single-hearing protection will be worn within 2 m of firing these grenade launchers.

(d) Snow depth of 10 cm (4 inches) or more and standing water will increase the potential of 40mm duds. These conditions must be considered prior to firing.

(e) Minimum target engagement for MK32, M79, M203, and M320 grenade launchers firing HE ammunition is 130 m or 165 m, depending on type of ammunition.

(f) For the Marine Corps, minimum target engagement for MK312 Mod 0 infrared (IR) ammunition is 15 m.

(3) All duds will be reported by the OIC to the range operations firing desk (Army) or range control office (Marine Corps). For the Army, when fired or launched, HE grenades cannot be cleared from an impact area, which must be designated as a dedicated, high-hazard impact area.

b. General firing precautions for the MK19 MOD 3 grenade machine gun.

- (1) Targets will be engaged only at ranges greater than 75 m with training practice (TP) ammunition.
- (2) Targets will be engaged only at ranges greater than or equal to 310 m with HE ammunition.
- (3) Firing through obstructions will be avoided.
- (4) Prohibit cross-line firing when using multiple firing points.
- (5) Gunners, crew members, and other personnel at the firing position will be in PPE Level 1 at all times when firing HE ammunition (see table 2–2).

(6) Range firing procedures and physical setup must be adequate to prevent HE rounds from impacting closer than 310 m from the firing position, firing vehicle, other vehicles, or personnel.

(7) Firing over open vehicle hatches is not authorized. Serious injury can result from burns caused by weapon flash or by expended or ejected cartridge cases striking personnel.

(8) Approved single-hearing protection and eye protection is required for all personnel within the noise hazard contour of a 20-m radius of the weapon system (see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system).

(9) Regarding hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.

(10) Army personnel recovering dud M918 40mm TP projectiles will follow the procedures outlined in TB 9–1310–251–10. The use of protective goggles or face shield, gloves, and tongs while handling M918 TP rounds is mandatory. Marine Corps EOD personnel recovering the same munitions will follow procedures outlined in EODB 60 series publications.

c. Static firing restrictions for vehicle-mounted machine gun. Static firing restrictions for vehicle-mounted machine gun, MK19 MOD 3 grenade machine gun are as follows:

(1) A gunner's quadrant or MK64, MOD 7 mount depression stop will be used to keep the minimum elevation above 30 mils when firing.

(2) M998 High-Mobility Multipurpose Wheeled Vehicle (HMMWV) interim squad carrier.

(a) Soft tops must be installed over the driver and passenger compartments for safe operation of the vehicle when firing the MK19.

(b) Visual and physical inspection of the adaptive engineering team collar-mounting bolts must be performed prior to, during, and after firing operations. All bolts must be present with nuts firmly tightened prior to firing.

(3) M113 and M106 series armored carriers.

(a) Firing over open hatches is prohibited.

(b) Driver's hatch must be closed when firing off the left side, forward, or off the right side of the vehicle or when personnel or objects in hatch areas are forward of the weapon muzzle.

(4) M88A1 Heavy Equipment Recovery Combat Utility Lift and Evacuation System (HERCULES) medium-tracked recovery vehicle.

(a) Operator and mechanic hatches must be closed when firing off the left side, forward, or off the right side of the vehicle.

(b) Personnel doors on the vehicle sides may remain open during firing forward or to the rear but will be closed when firing to the left or right side of the vehicle.

d. Moving firing restrictions for machine gun. Moving firing restrictions for the MK19 MOD 3 grenade machine gun, to preclude unintentional impacts of HE and high-explosive dual-purpose (HEDP) ammunition at ranges less than 310 m are as follows:

(1) Restrict speeds to not greater than 20 kilometer (km) per hour (12 miles per hour (mph)) when firing from the M1025/1026 HMMWV armament carrier and the M998T interim squad carrier over paved and improved roads that are in good condition and not greater than 10 km per hour (6 mph) over rough roads, trails, and cross-country.

(2) Restrict speeds to not greater than 20 km per hour (12 mph) when firing from the M113 and M106 family of armored carriers and the M88A1 tracked recovery vehicle over roads, trails, and cross-country.

e. Surface danger zone.

(1) See table 6–1 and figures 6–4 and 6–5 for SDZ requirements for MK32, M79, M203, and M320 grenade launchers. A minimum 6 m separation distance is required between firing positions when firing HE munitions.

Cartridge M433 requires an Area A and B of 165 m. All other MK32, M79, M203, and M320 HE cartridges require 130 m as shown in figure 6–4.

(2) See table 6–1 and figure 6–4 for SDZ criteria for the M781E1 Target Practice-Day Night Thermal (TP–DNT), low-velocity grenade when constructing a SDZ.

(3) See table 6–3 and figure 6–6 for SDZ criteria for the M918E1 TP–DNT, high-velocity grenade when constructing a SDZ.

(4) See table 6–2 and figure 6–6 for SDZ criteria for the MK19 MOD 3 grenade machine gun. Minimum target engagement range for HE cartridges is 310 m.

Table 6–1
Surface danger zone data for 40mm grenade launchers (low-velocity) MK32, M79, M203, and M320

| Cartridge | Impact media | Dist X (m) | Minimum target engagement (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------------------------|----------------|------------|-------------------------------|------------|------------|------------|---------------|---------------|------------------------------|
| M381 HE | Earth Armor | 470 | 130 | NR | 130 | 130 | NR | NR | 216 |
| | | 470 | 130 | NR | 130 | 130 | NR | NR | 216 |
| M433 HEDP | Earth Armor | 470 | 165 | NR | 165 | 165 | NR | NR | 216 |
| | | 470 | 165 | NR | 165 | 165 | NR | NR | 216 |
| M781, M407A1 TP | Earth Armor | 470 | 75 | NR | NR | NR | NR | NR | 216 |
| | | 470 | 75 | NR | NR | NR | NR | NR | 216 |
| M576 Multi Projectile | Earth Armor | 85 | NR | NR | NR | NR | NR | NR | 75 |
| | | 85 | NR | NR | NR | NR | NR | NR | 75 |
| M713, M715, M716 Smoke | Earth Armor | 470 | 130 | NR | NR | NR | NR | NR | 216 |
| | | 470 | 130 | NR | NR | NR | NR | NR | 216 |
| M651E1 CS ¹ | Earth Armor | 470 | 130 | NR | NR | NR | NR | NR | 216 |
| | | 470 | 130 | NR | NR | NR | NR | NR | 216 |
| M661, M662, M583A1, M992 IL, MK325 | NA | 470 | 130 | NR | NR | NR | NR | NR | NR |
| MK312 Mod 0 (IR) | NA | 500 | 15 | NR | NR | NR | NR | NR | NR |
| M781E1 TP–DNT ² | Earth Armor | 447 | 350 | 64 | NR | NR | 35.50 | 57 | 55 |
| | | 447 | 435 | 82 | NR | NR | 23 | 60 | 60 |

Legend:

HE=high-explosive

HEDP=high-explosive dual-purpose

IR=infrared

NA=not applicable

NR=not required

TP=target practice

DNT=day night thermal

Notes.

¹ See chapter 14 for the use of CS.

² To correct for tailwinds, Distance X must increase by 16 m per m/s or 8 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.25 degrees per m/s or 0.13 degrees per knot of crosswind measured perpendicular to the line of fire.

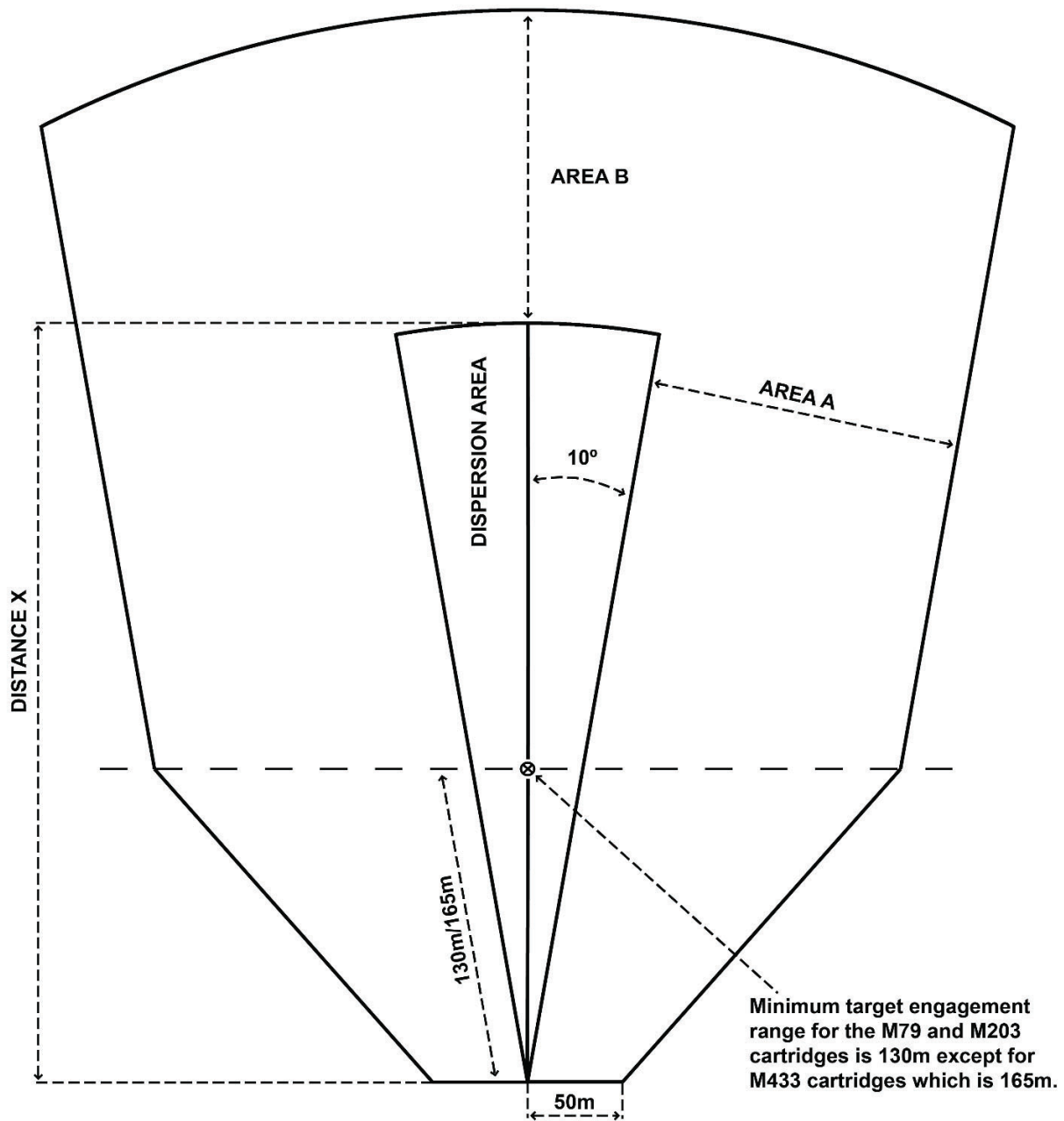


Figure 6-4. Surface danger zone for M79, M203, and M320 low-velocity grenade launchers

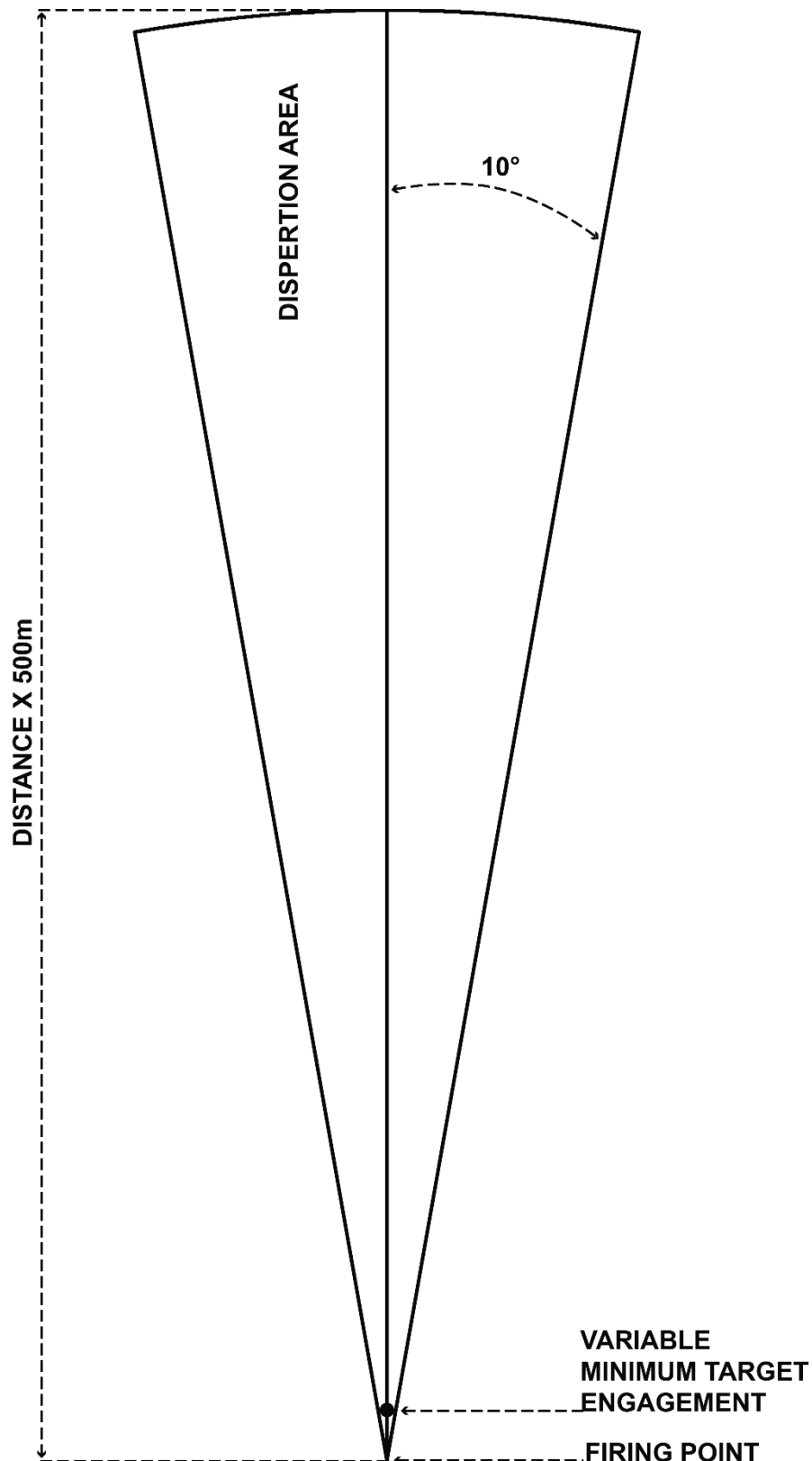


Figure 6–5. Surface danger zone for M781, M407A1, MK312 MOD 0, M576, M713, M715, M716, M661, M662, M583A1, M992, MK325, and M651E1 40mm low-velocity ammunition

Table 6–2
Surface danger zone data for 40mm grenade machine gun (high-velocity) MK19 MOD3

| Cartridge | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|--------------------|----------------|----------------|----------------|------------|------------|------------|---------------|---------------|--|
| M383 HE | Earth Armor | 2,095 2,095 | 1,250 1,250 | 167 471 | 310 310 | 310 310 | 23 60 | 15 28 | See note ¹ See note ¹ |
| M385A1 TP | Earth Armor | 1,984 1,984 | 1,250 1,250 | 167 471 | NR NR | NR NR | 23 60 | 15 28 | See note ¹ See note ¹ |
| M430 HEDP | Earth Armor | 2,037 2,037 | 1,250 1,250 | 167 471 | 310 310 | 310 310 | 23 60 | 15 28 | See note ¹ See note ¹ |
| M918 TP | Earth Armor | 2,095 2,095 | 1,250 1,250 | 167 471 | NR NR | NR NR | 23 60 | 15 28 | See note ¹ See note ¹ |
| MK281 MOD 0 TP | Earth Armor | 2,200 2,200 | 1,250 1,250 | 167 471 | NR NR | NR NR | 23 60 | 15 28 | See note ¹ See note ¹ |
| XM1001 Canister | Earth Armor | 1,750 1,750 | 1,743 1,743 | 370 370 | NR NR | NR NR | 35 35 | 25 25 | See note ¹ See note ¹ |

Legend:

HE=high-explosive

HEDP=high-explosive dual-purpose

NR=not required

TP=target practice

Note.

¹ Use the sum of the values of Distance W and Area A (if applicable) until validated test data is available.

Table 6–3
Surface danger zone data for 40mm grenade machine gun (high-velocity) MK19 MOD3 M918E1 Target Practice-Day Night Thermal¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------|----------------|----------------|----------------|------------|------------|------------|----------------|---------------|------------------------------|
| 0 | Earth Armor | 2,223 2,223 | 1,725 1,825 | 175 225 | NR NR | NR NR | 26 22 | 31 26 | 279 182 |
| 1,000 | Earth Armor | 2,267 2,267 | 1,750 1,850 | 180 232 | NR NR | NR NR | 25.90 22.10 | 33 28 | 285 186 |
| 2,000 | Earth Armor | 2,311 2,311 | 1,775 1,875 | 185 239 | NR NR | NR NR | 25.80 22.20 | 35 30 | 291 190 |
| 3,000 | Earth Armor | 2,356 2,356 | 1,800 1,900 | 190 246 | NR NR | NR NR | 25.70 22.30 | 37 32 | 297 194 |
| 4,000 | Earth Armor | 2,402 2,402 | 1,825 1,925 | 195 253 | NR NR | NR NR | 25.60 22.40 | 39 34 | 303 198 |
| 5,000 | Earth Armor | 2,448 2,448 | 1,850 1,950 | 200 260 | NR NR | NR NR | 25.50 22.50 | 41 36 | 310 302 |
| 6,000 | Earth Armor | 2,495 2,495 | 1,875 1,975 | 205 267 | NR NR | NR NR | 25.40 22.60 | 43 38 | 316 206 |
| 7,000 | Earth Armor | 2,543 2,543 | 1,900 2,000 | 210 274 | NR NR | NR NR | 25.30 22.70 | 45 40 | 322 211 |

Legend:

NR=not required

Table 6–3
Surface danger zone data for 40mm grenade machine gun (high-velocity) MK19 MOD3 M918E1 Target Practice-Day Night Thermal¹

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|------------------------------------|
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|------------------------------------|

Note.

¹ To correct for tailwinds, Distance X must increase by 15 m per m/s or 8 m per knot of tailwind measured along the line of fire. To correct for CR winds, the dispersion angle must increase by 0.22 degrees per m/s or 0.12 degrees per knot of crosswind measured perpendicular to the line of fire.

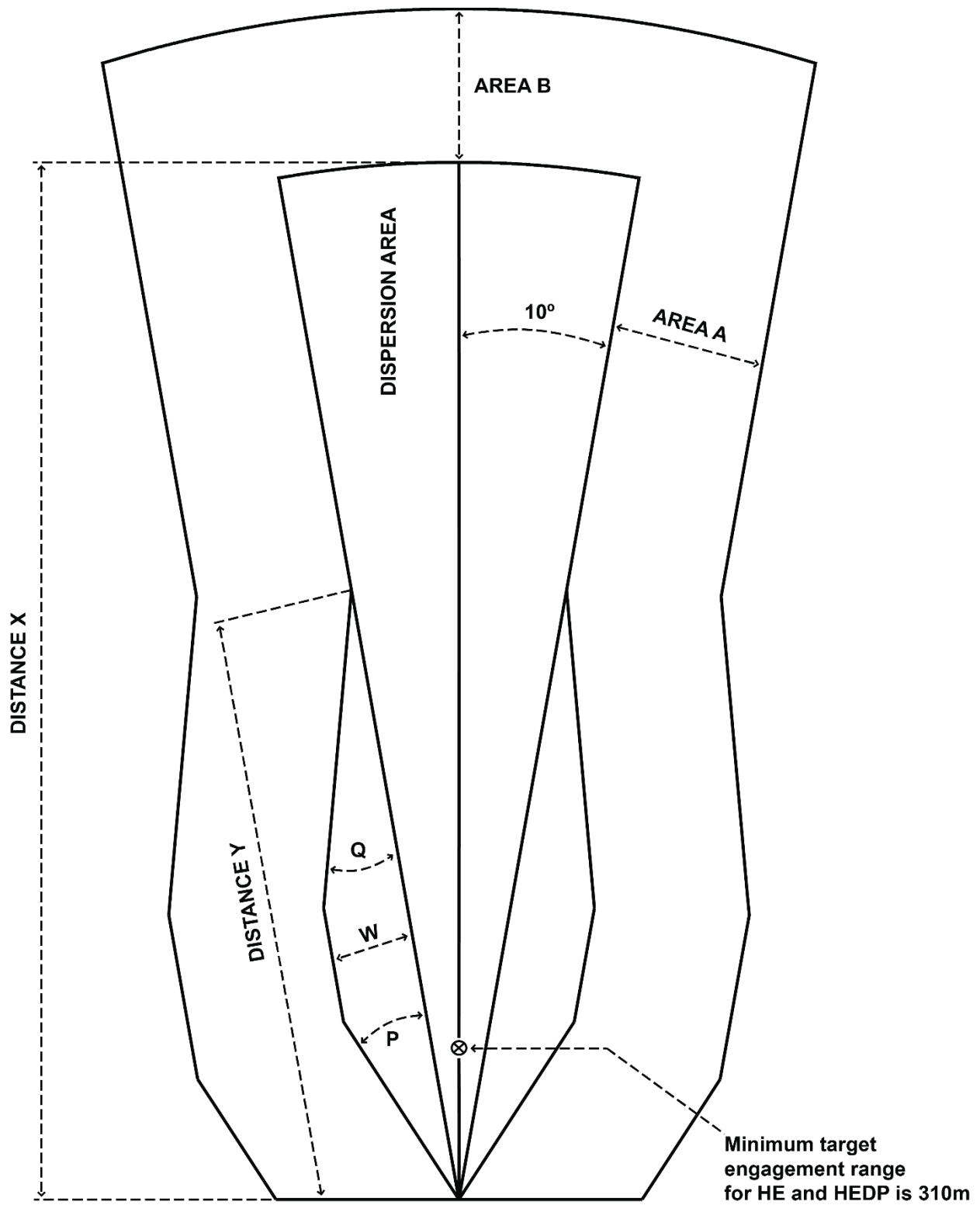


Figure 6-6. Surface danger zone for 40mm machinegun, MK19, MOD3

Chapter 7

Anti-Tank Rockets

7-1. Firing conditions

a. General.

(1) All loading and unloading for separate loading rockets (for example, 35mm TP rocket and 66mm M74 incendiary rockets) will be on the firing line or point with the muzzle pointed down range. Procedures and precautions in TM 3-23.25 and appropriate TMs will be observed in all preparation and firing operations.

(2) Personnel will not stand or have any portion of the body directly in front of or behind a loaded rocket launcher.

(3) Before firing, the SDZ to the rear of the launcher (Area F) will be cleared of personnel, materiel (including expended cartridge cases), and readily combustible vegetation. Area F for anti-tank rockets is a cone with the apex at the breech and radius corresponding with a rearward extension of the rocket target line.

(4) The use of manned target vehicles is prohibited when firing HE or high-explosive anti-tank (HEAT) ammunition. Moving target vehicles must be operated by remote control. Unprotected operating personnel will be located outside the SDZ.

(5) Approved single-hearing protection will be worn by personnel within 390 m of the firing point when firing anti-tank rockets. Approved single-hearing protection will be worn by personnel within 460 m of the firing point when firing HE, HEAT, TP, smoke, and IL from the Multi-Role Anti-Armor Anti-Personnel Weapons System (MAAWS). The gunner and all other personnel within a 25 m radius of the MAAWS must wear properly inserted earplugs and properly fitting earmuffs (double-hearing protection). If available, recommend fit testing of single-hearing protection to ensure a personal attenuation rating of at least 29 dB is achieved prior to fitting of noise muffs.

(6) Gunners and other personnel within 20 m will at a minimum wear PPE Level 1 (see table 2-2). Eye protection is encouraged when firing shoulder-launched multipurpose assault weapons (SMAW).

(7) During training with the SMAW, regarding gunner and assistant gunner hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.

(8) All personnel are required to wear appropriate hearing protection when firing the M72AS light anti-tank weapon (LAW) training system. Regarding hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.

b. Special firing conditions.

(1) SMAW-common practice round (CPR) HX-07 Areas A and B are not required.

(2) All personnel within 100 m of the SMAW launcher will wear, at a minimum, PPE Level 1. Eye protection is encouraged (see table 2-2).

(3) For MK80 Shoulder-Launched Multipurpose Assault Weapon Novel-Explosive (SMAW-NE) (DoDIC HA34), SMAW-MK6 High-Explosive Anti-Armor Assault (HEAA) (DoDIC HX06), SMAW-MK3 HEDP (DoDIC HX05), and SMAW-MK7 CPR (SMAW) (DoDIC HX07), danger zone occupation could result in fatalities or serious casualties including severe burns, eye damage, or permanent hearing loss. The hazards are base plate fragments, debris, fireball, high noise levels, and overpressure.

(4) When the M72 LAW is fired in temperatures below freezing, all back-blast areas (Area F) will be doubled. Operating personnel should wear approved face protection during firing.

(5) Extending the M72 weapon system too slowly can result in a failure to cock the weapon.

(6) All M72AS 21mm training system weapons will be visually inspected for damage before firing. Damaged weapons will be destroyed in accordance with standard EOD procedures.

(7) Rockets, except for AT4CS-TW munition, will not be fired from within buildings unless fired within 50 m of a vertical or nearly vertical backstop, barrier, or obstacle due to the risk of debris ricochets.

(8) Prone or foxhole firing of HE AT4 (M136) is not authorized. In training, an individual may fire one round from the sitting position or three rounds from the standing or kneeling positions in a 24-hour period.

(9) When firing the AT4CS-TW, the shooter is limited to firing from the prone, kneeling, or standing position and centered in a window that is positioned in the center of the room. Foxhole firing is prohibited (see table 7-4 and figures 7-4 and 7-5 for SDZ data).

(10) For the Army, prone and sitting positions when firing of IL ammunition in the MAAWS are not authorized due to burn hazards.

(11) For the Marine Corps, only the standing positing is authorized when firing of IL ammunition in the MAAWS due to burn hazards.

(12) The firing of anti-tank rockets over unprotected troops from a moving vehicle or aircraft is not authorized.

(13) For HE ammunitions, limit the number of daily firings by any individual (gunner or personnel within 20 m) to four. There is no limit for the M72AS 21mm LAW training system.

7-2. Surface danger zone

a. General.

(1) Danger area occupation could result in fatalities or serious casualties, including severe burns or permanent hearing loss. The hazards are base plate fragments, debris, fireball, high noise levels, and overpressure.

(2) Caution area is an extension of the primary danger zone. Occupation of this area could also result in severe casualties due to back-blast, debris, high noise levels, eye injuries, and possible base plate fragments.

b. *Anti-tank rockets.* See tables 7-1 and 7-2 and figures 7-1 and 7-2 for SDZ requirements including minimum target engagement distances for LAW anti-tank rockets. Distance X may be reduced if there is steeply rising terrain behind the target or overhead baffles and positive controls are used to limit elevation of the launcher at the firing position. A formal deviation must be approved to reduce Distance X (see table 7-2 for the 35mm M73). Minimum range to impact (minimum target distance) may be reduced 60 percent when firing non-explosive warhead from unprotected positions or explosive warhead from protected positions. Area F is a 70-degree angle (35 degrees left and right) of rearward extension of launcher target line. When firing from the prone position, the gunner's lower body will be 45 degrees away from the back-blast area. Area F extends rearward of the launcher firing point at 90 degrees (45 degrees left and right) for the M72A2 and 70 degrees (35 degrees left and right) for M72A 4, 5, 6, and 7. Area F consists of two primary areas known as danger area and caution area (except for the M72AS, which has only a danger area). The vertical hazard of 950 m will be used when firing all HE anti-tank rockets.

Table 7-1
Surface danger zone data for light anti-tank weapon

| Weapon | Dist X (m) | Minimum target engagement (m) | Ricochet angle (deg) | Area A (m) | Area B (m) | Area F primary danger area (m) | Area F caution area (m) |
|-------------------------------------|------------|-------------------------------|----------------------|------------|------------|--------------------------------|-------------------------|
| 66mm HEAT, M72A2 | 1,000 | 75 | 13 | 250 | 250 | 40 | 25 |
| 66mm Trainer M72AS 21mm sub-caliber | 1,000 | 75 | 13 | NR | NR | 50 | NR |
| 66mm HEAT M72A 4,5,6,7, and 9 | 1,400 | 75 | 13 | 250 | 250 | 40 | 30 |
| 66mm incendiary, M74 | 1,000 | 50 | 13 | 100 | 100 | 40 | 38 |
| 35mm sub-caliber, M73 | 1,150 | 50 | 13 | 100 | 100 | 40 | 25 |

Legend:

HEAT=high-explosive anti-tank

NR=not required

Table 7-2
Maximum ranges at various quadrant elevations for the 35mm M73 practice rocket

| Elevation (deg) | Range (m) | Max Ord (m) |
|-----------------|-----------|-------------|
| 5 | 343 | 8 |
| 10 | 591 | 30 |
| 15 | 776 | 62 |
| 30 | 1,082 | 203 |

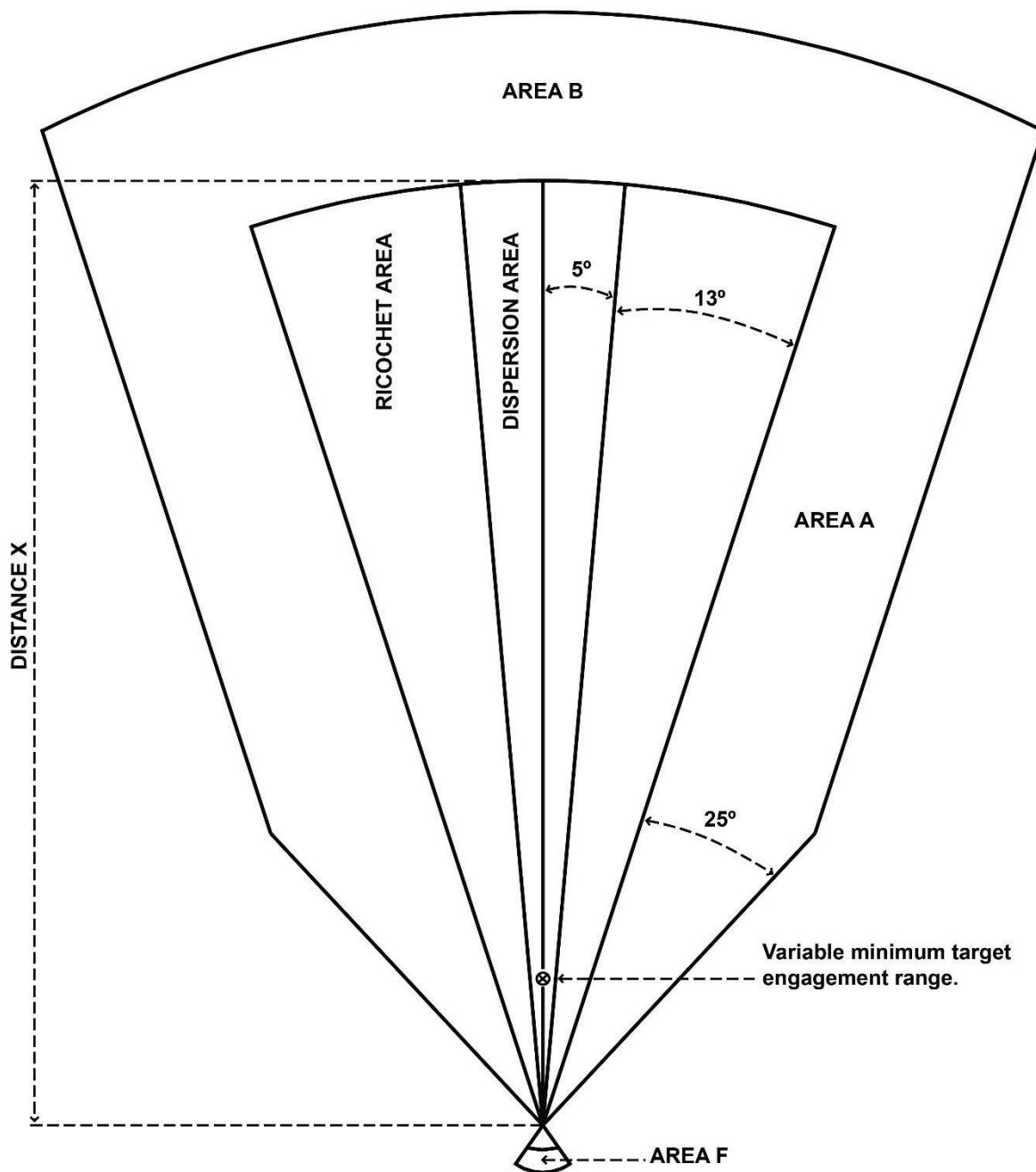


Figure 7-1. Surface danger zone for light anti-tank weapon

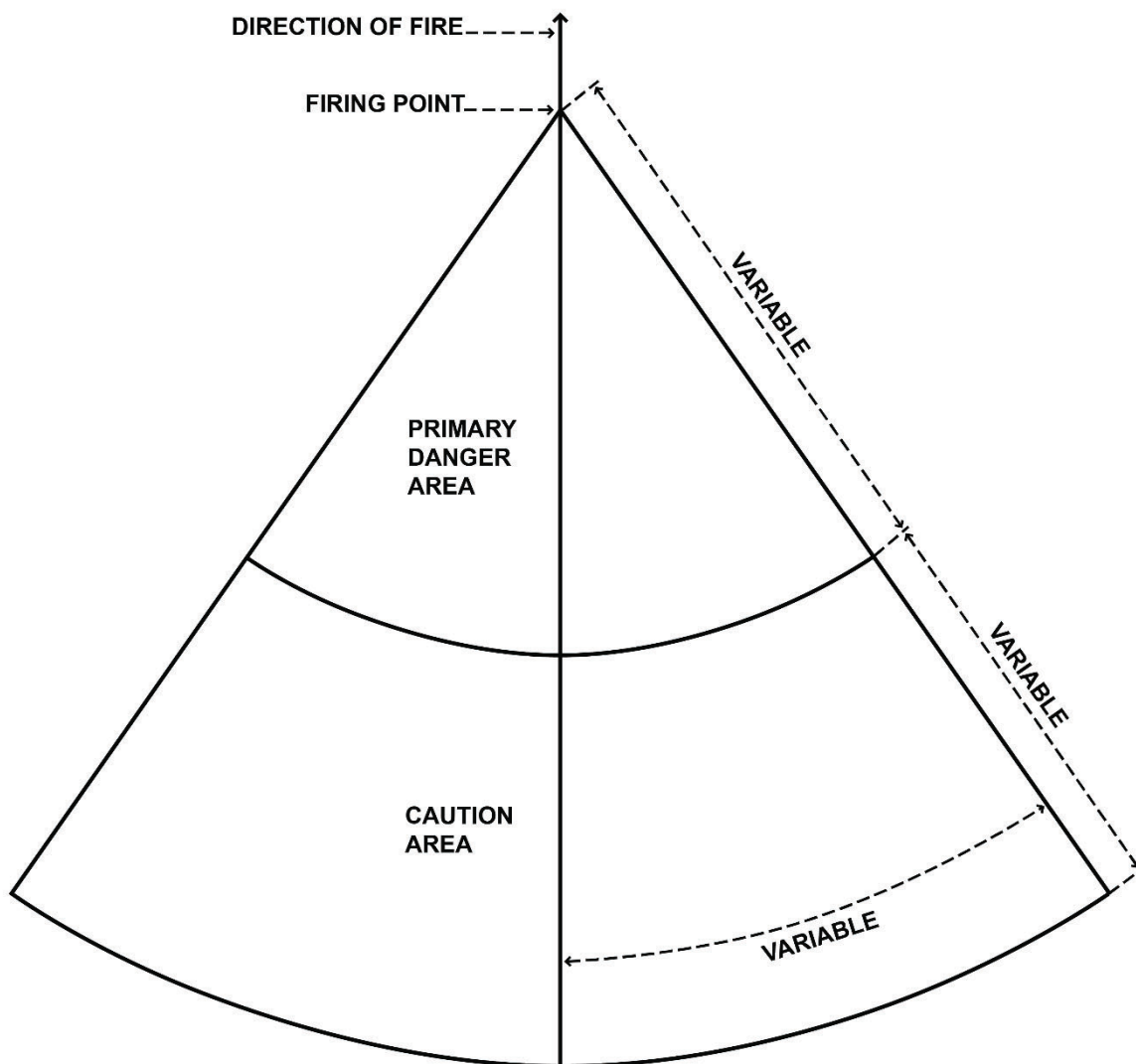


Figure 7-2. Surface danger zone, Area F, for all anti-tank rockets

c. See table 7-3 and figures 7-2 and 7-3 for SDZ requirements for MAAWS. Area F is a 90-degree angle (45 degrees left and right) of rearward extension of launcher target line.

Table 7–3
Surface danger zone data for Multi-Role Anti-Armor Anti-Personnel Weapons Systems—Continued

| Munition Type | Dist X (m) | Minimum target engagement (m) | Dispersion Angle | Ricochet angle (deg) | Area A (m) | Area B (m) | Area F primary danger area (m) | Area F caution area (m) |
|-----------------------------|------------|-------------------------------|------------------|----------------------|------------|------------|--------------------------------|-------------------------|
| HE (441B, 441D RS) | 2,600 | 250 | 5 | 13 | 400 | 400 | 40 | 60 |
| HEAT (551, 551 IM, 551C RS) | 3,200 | 85 | 5 | 38 | 150 | 150 | 40 | 60 |
| HEDP (502) | 2,000 | 150 | 5 | 12 | 330 | 330 | 40 | 60 |
| HEDP 502 RS | 2,000 | 50 | 5 | 12 | 330 | 330 | 40 | 60 |
| TP (552) | 3,200 | 85 | 5 | 13 | 100 | 100 | 40 | 60 |
| TPT (141) | 1,650 | 50 | 5 | 20 | 150 | 150 | 40 | 60 |
| Smoke (469B) | 2,600 | 150 | 5 | 13 | 150 | 150 | 40 | 60 |
| Illumination (545C) | 2,900 | 150 | 5 | NR | 100 | 100 | 40 | 60 |
| MT (756) | 2,600 | 300 | 5 | 40 | 420 | 420 | 40 | 60 |
| 7.62mm ¹ | 4,100 | NR | 5 | 5 | 100 | NR | NR | NR |
| 20mm (CCTS) | 2,000 | 20 | 5 | 45 | 200 | 200 | 40 | 60 |
| ASM 509 | 1,610 | 250 | 5 | 13 | 200 | 200 | 40 | 60 |
| ADM 401 | 925 | 50 | 11.4 | 25 | 100 | 100 | 40 | 60 |
| ADM 401B | 740 | 50 | 10 | 26 | 100 | 100 | 40 | 60 |

Legend:

ASM=anti-structure munition
ADM=area deterrent munition
CCTS=Cannon Caliber Training System
HE=high-explosive
HEAT=high-explosive anti-tank
HEDP=high-explosive dual-purpose
MT=multi-target
IM=insensitive munition
NR=not required
RS=reduced sensitivity
TP=target practice
TPT=target practice-tracer

Note.

¹ For SDZ construction, see figure 5–1.

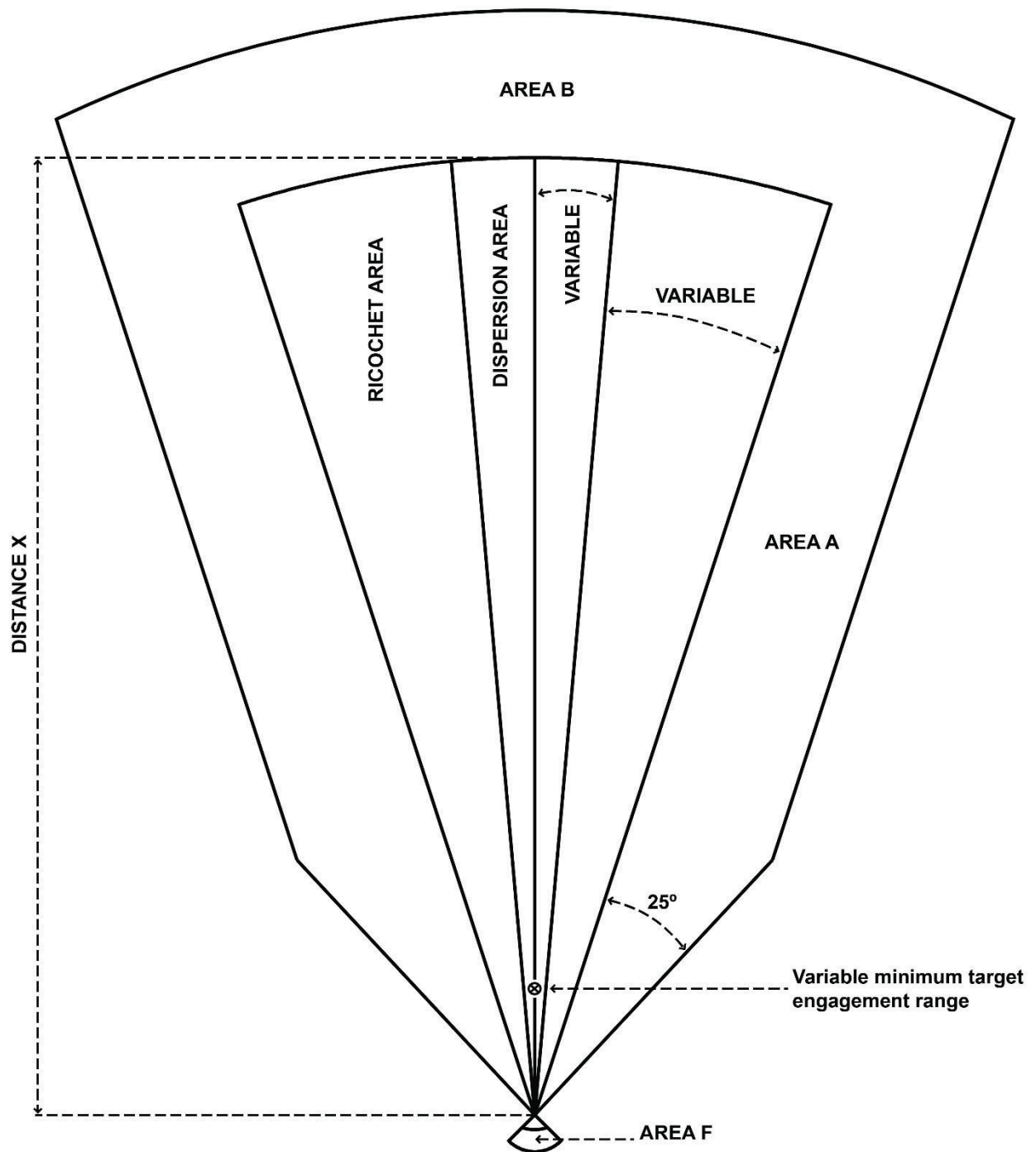


Figure 7–3. Surface danger zone for Multi-role Anti-armor Antipersonnel Weapons System

d. See table 7–4 and figures 7–2 and 7–4 for SDZ requirements for the M136 AT4. Area F is a 90-degree angle (45 degrees left and right) of rearward extension of launcher target line. Increased dud rates may occur when firing HEAT (M136) at impact angles of 10 degrees or less. For construction of AT4CS–TW Area F, use figure 7–5.

Table 7–4
Surface danger zone data for AT4

| Weapon | Dist X (m) | Minimum target engagement (m) ¹ | Ricochet angle (deg) | Area A (m) | Area B (m) | Area F primary danger area (m) | Area F caution area (m) |
|--------------------------|------------------|---|----------------------------|------------------|------------------|---|---|
| 84mm HEAT M136 | 2,100 | 50 | 13 | 227 | 488 | 5 | 95 |
| AT4CS–TW Open Space | 1,300 | 15/62/160 | 20 | 185 | 230 | 50 | NR |
| 9mmTrainer, M939 | 1,600 | NR | 13 | NR | NR | NR | NR |
| | | | | | | Area F² primary danger area width (m) | Area F² primary danger area depth (m) |
| AT4CS–TW Closed Space | 1,300 | 15/62/160 | 20 | 185 | 230 | 3.7 | 4.6 |

Legend:
CS=confined space
HEAT=high-explosive anti-tank
NR=not required
TW=Tandem Warhead

Notes. Vertical ricochet hazard is 500 m for all rounds.

¹ Minimum target engagement for the AT4CS–TW is 62 m for non-armored targets and 160 m for armored targets. Acceptance of a serious risk level safety risk assessment reduce the minimum range to 15 m for Special Operations units only.

² Additional requirements for the confined space and firing procedure can be found in the technical or operator manual.

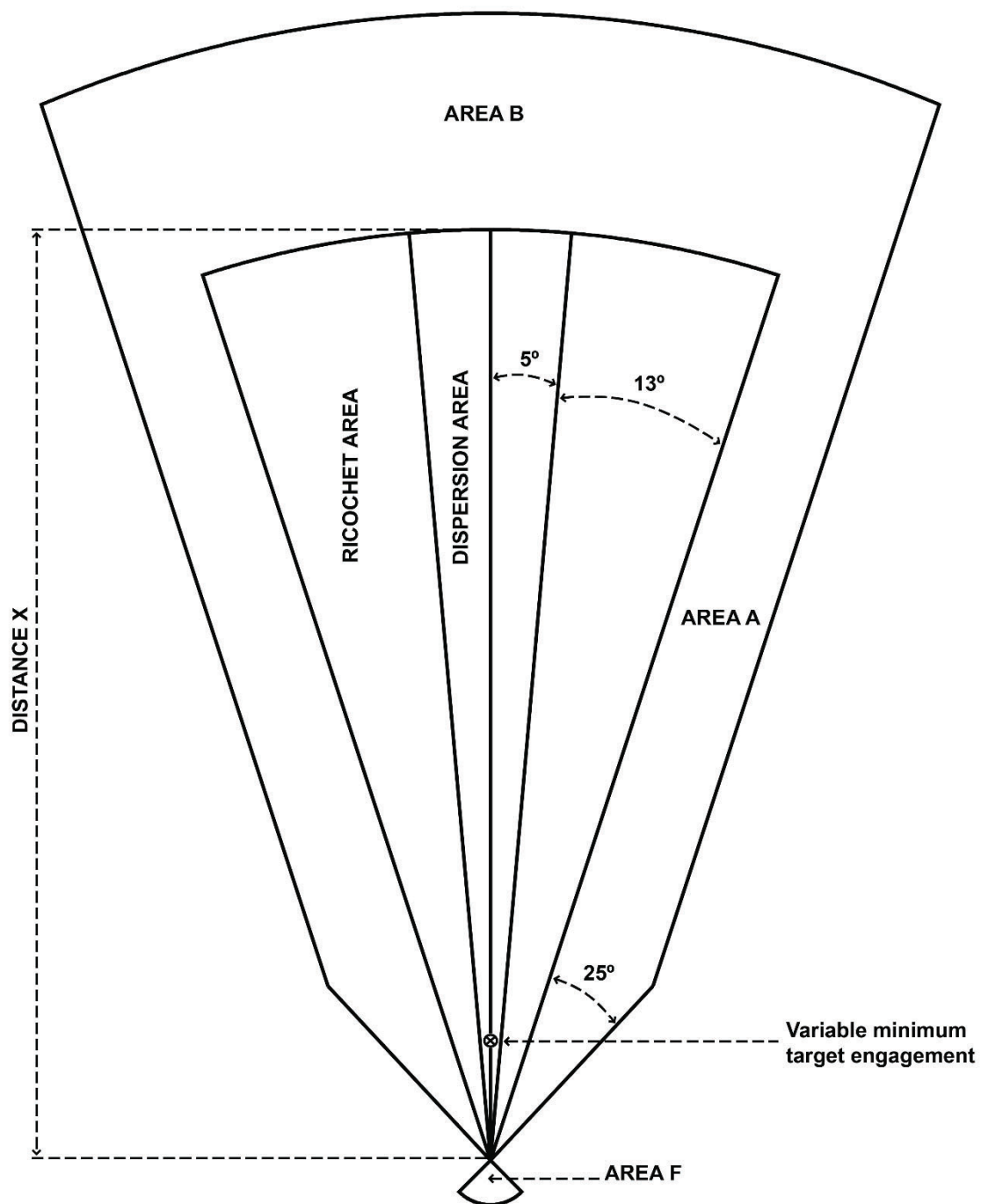


Figure 7-4. Surface danger zone for AT4

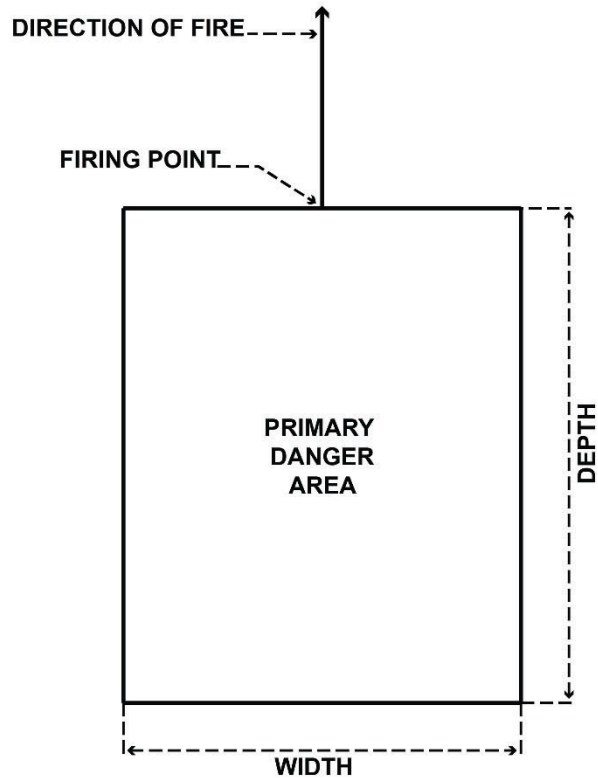


Figure 7–5. Surface danger zone Area F, AT4 Confined Space-Tandem Warhead

e. See table 7–5 and figures 7–2 and 7–6 SDZ requirements for SMAW–NE. See table 7–5 and figures 7–2 and 7–7 for SDZ requirements for Shoulder-Launched Multipurpose Assault Weapon-High-Explosive Anti-Tank Assault (SMAW–HEAA), SMAW–HEDP, and the SMAW–CPR. Area F for the SMAW is a 60-degree angle (30 degrees left and right) of rearward extension of launcher target line (see fig 7–6 for SDZ for MK80 SMAW–NE).

Table 7–5
Surface danger zone data for Shoulder-Launched Multipurpose Assault Weapon Shoulder-Launched Multipurpose Assault Weapon Novel-Explosive

| Munition type | Dist X (m) | Minimum target engagement (m) | Ricochet angle (deg) | Area A (m) | Area B (m) | Area F primary danger area (m) | Area F caution area (m) |
|----------------|------------|-------------------------------|----------------------|------------|------------|--------------------------------|-------------------------|
| SMAW–NE HA34 | 2,460 | 100 | 4 | 250 | 250 | 30 | 70 |
| SMAW–HEAA HX06 | 2,500 | 100 | 13 | 500 | 500 | 30 | 60 |
| SMAW–HEDP HX05 | 2,500 | 100 | 13 | 250 | 250 | 30 | 60 |
| SMAW–CPR HX07 | 2,500 | 100 | 13 | NR | NR | 30 | 60 |

Legend:

Table 7–5**Surface danger zone data for Shoulder-Launched Multipurpose Assault Weapon Shoulder-Launched Multipurpose Assault Weapon Novel-Explosive—Continued**

| Munition type | Dist X (m) | Minimum target engagement (m) | Ricochet angle (deg) | Area A (m) | Area B (m) | Area F primary danger area (m) | Area F caution area (m) |
|----------------------|-------------------|--------------------------------------|-----------------------------|-------------------|-------------------|---------------------------------------|--------------------------------|
|----------------------|-------------------|--------------------------------------|-----------------------------|-------------------|-------------------|---------------------------------------|--------------------------------|

CPR=common practice round

HEAA=high-explosive anti-tank assault

HEDP=high-explosive dual-purpose

NE=novel-explosive

NR=not required

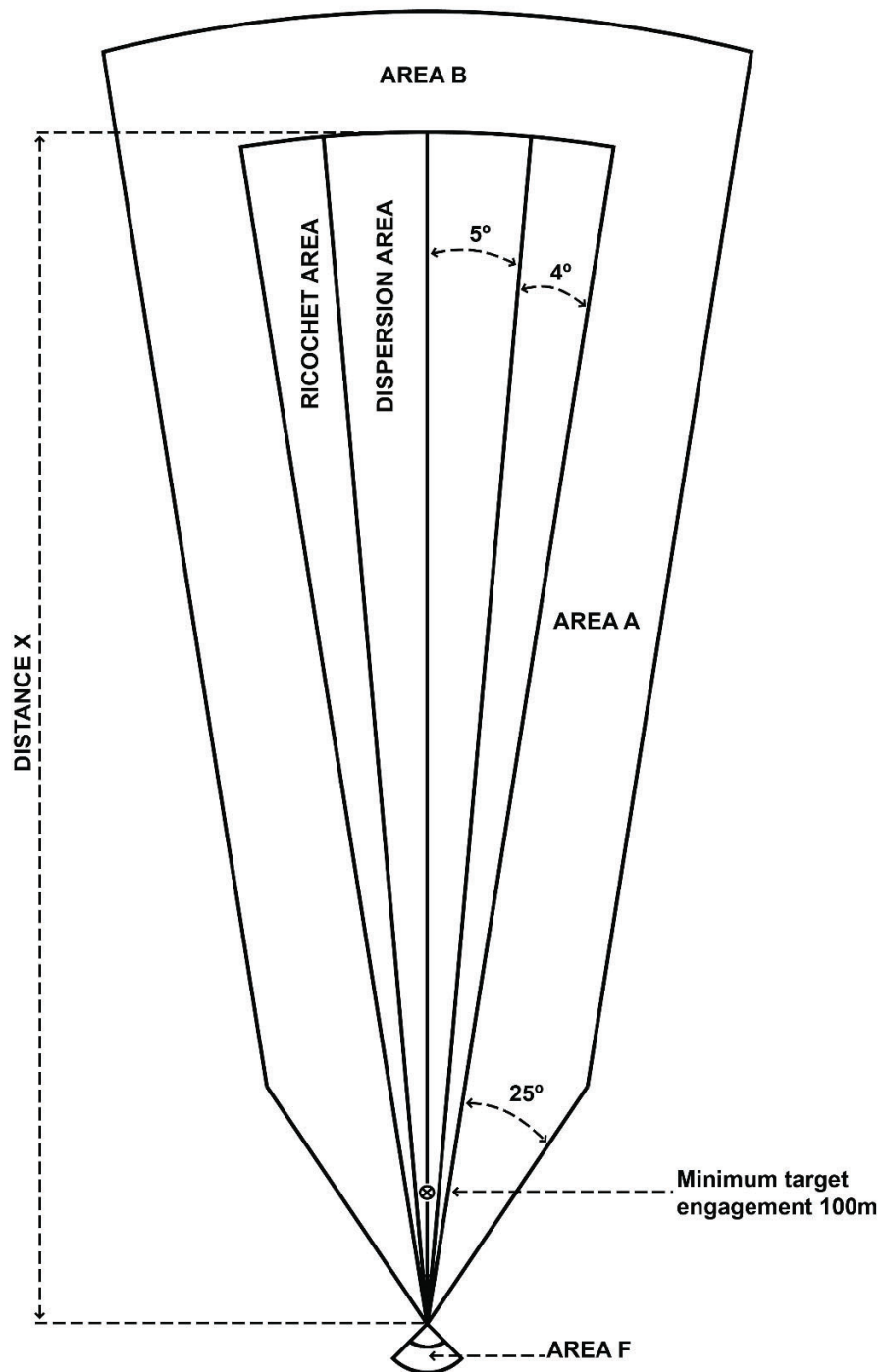


Figure 7-6. Surface danger zone for MK80 Shoulder-Launched Multipurpose Assault Weapon Novel-Explosive

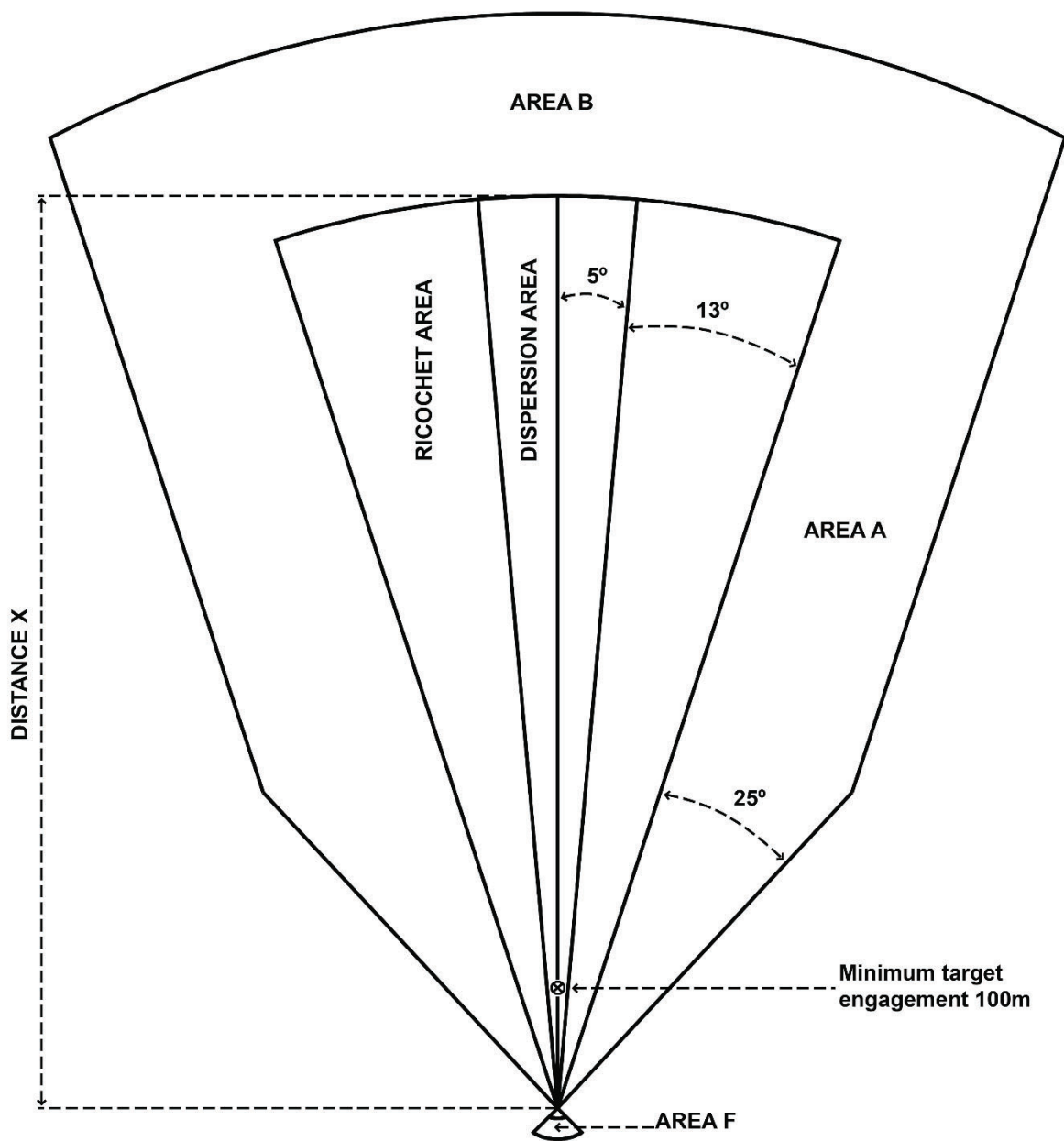


Figure 7–7. Surface danger zone for Shoulder-Launched Multipurpose Assault Weapon High-Explosive Anti-Tank Assault High-Explosive Dual-Purpose Common Practice Round

Chapter 8

Anti-Tank Guided Missiles

8-1. FGM-148 Javelin guided missile

The Javelin is a shoulder-launched, man-portable, anti-armor weapon system. It fires a passive-imaging IR missile with a lock-on before launch (LOBL) guidance system. The Javelin (FGM-148A, B, C, or D) anti-tank missile is the baseline variant. The Javelin FGM-148E anti-tank missile has extended range capability, enhanced software, and improved warhead. The Javelin FGM-148F is an upgrade to the Javelin FGM-148E and contains a modernized Control Actuator System hardware and software, new missile software, and new multipurpose warhead and precursor warhead, both designed to improve insensitive munitions performance and performance against non-armor targets.

a. Firing conditions.

(1) Before firing any Javelin missile, the entire SDZ will be cleared of non-participating personnel. Only those participating personnel specified in appropriate FMs and TMs will be permitted in any part of the SDZ.

(2) Javelin missile firings will be accomplished within predetermined boundaries. Installation RMAs (Army) and RCOs (Marine Corps) will ensure that an adequate SDZ exists along the missile target line (MTL) from each anticipated launch position within the predetermined boundaries.

(3) See applicable FMs and TMs for preparation and firing operations.

(4) Personnel will neither stand nor permit any part of their body to be directly behind or in front of the Javelin launcher.

(5) Personnel engaged in firing or supervising Javelin missile training will wear a minimum of PPE Level 1 (see table 2-2 for further guidance).

(6) Javelin missile firings during training exercises should be at targets located not less than 500 m from the launch position. If targets closer than 600 m are being engaged, an additional circular SDZ of 600 m from the target should be observed and the gunner and assistant gunner should be in a protected firing position (for example, sandbags) or an enclosure.

b. Surface danger zone construction for the Javelin anti-tank missile.

(1) See figure 8-1 for the SDZ for firing the Javelin missile variants at a fixed target.

(2) The Javelin SDZ boundary starts as a specified fan angle (Angle P) extending down range to a point at which it changes into a CR (Distance W) boundary, which extends to the maximum kinetic range of the missile (Distance X).

(3) Area A is drawn 600 m perpendicular to the 1 in 1 million (10^{-6}) impact fan boundary line for both HE warhead rounds and inert rounds. The remaining down-range portion of Area A is a constant 500 m width (FGM-148A-E) and 225 m width (FGM-148-F) for HE warhead-equipped rounds at the maximum range (see table 8-1 for Area A values for both HEAT and inert rounds). Area A will contain missile and warhead debris from impacts on the boundary selected fly-out line or trajectory limit and portions of the missile that remain attached to the propulsion section that may continue to be propelled until flight motor burnout.

(4) Area B contains the debris scatter associated with the missile landing at the forward edge of the impact area. This area depth is driven by the fragmentation distance and the width is driven by the maximum CR of Area A. The depth of Area B is 500 m (FGM-148A-E) and 225 m (FGM-148F) for HE warhead-equipped rounds at the maximum range (see table 8-1 for Area B values for both HEAT and inert rounds).

(5) The launcher danger zone, Area F, is the zone aft of the launcher tube (see fig 8-2) and consists of the primary danger area and cautions areas 1, 2, and 3.

(a) The primary danger area is a 60-degree angle (30 degrees either side of the rearward extension of the MTL) with the apex at the aft end of the missile launch motor. This area has a 25-m radius. Additionally, the primary danger area is extended forward to the firing line from a distance of 1 to 5 m left and right of the MTL (see fig 8-3).

(b) Caution Area 1 is an extension of the 25-m primary danger area arc forward to the firing line on each side of the launcher. Serious hearing impairment or damage from frequent exposure could occur to personnel in this area during firings. Personnel in this area must wear approved hearing and eye protection.

(c) Caution Area 2 is an extension to the rear of the primary danger area, 10 m beyond the primary danger area. Personnel in this area must wear approved hearing and eye protection.

(d) Caution Area 3 is an extension to the rear of the primary danger area within the 60-degree sector with a 100-m radius. This area is affected by the activation of the flight motor pressure relief system. Personnel in this area must wear approved hearing and eye protection.

Table 8–1
Surface danger zone data for Javelin missiles—Continued

| Javelin missile | Dist X (m) | Minimum target engagement distance (m) | Area A (m) | Area B (m) | Vertical ricochet hazard (m) | Angle P (deg) | Dist W (m) |
|-------------------------|------------------|--|------------------|------------------|---------------------------------------|---------------------|------------------|
| FGM–148A, B, C, D HEAT | 4,300 | 600 | 600–500 | 500 | 660 | 41 | 740 |
| FGM–148A, B, C, D Inert | 4,300 | 600 | 600–500 | 200 | 660 | 41 | 740 |
| FGM–148E HEAT | 6,100 | 600 | 600–500 | 500 | 660 | 37 | 1,040 |
| FGM–148E Inert | 6,100 | 600 | 600–200 | 200 | 660 | 37 | 1,040 |
| FGM–148F HEAT | 6,000 | 600 | 600–225 | 225 | 660 | 36 | 1,060 |
| FGM–148F Inert | 6,000 | 600 | 600–100 | 100 | 660 | 36 | 1,060 |

Legend:
HEAT=high-explosive anti-tank

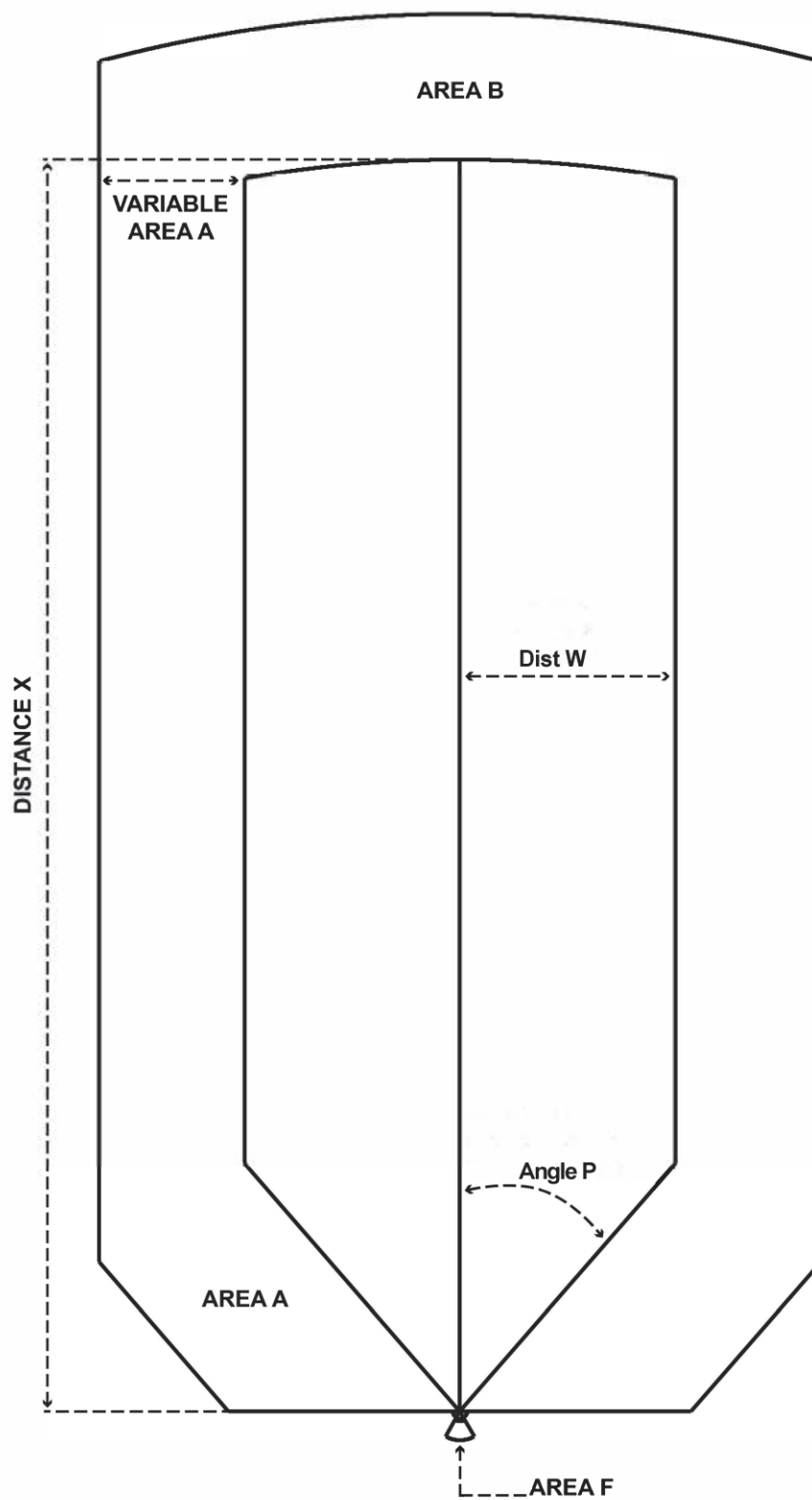


Figure 8–1. Surface danger zone for Javelin missiles

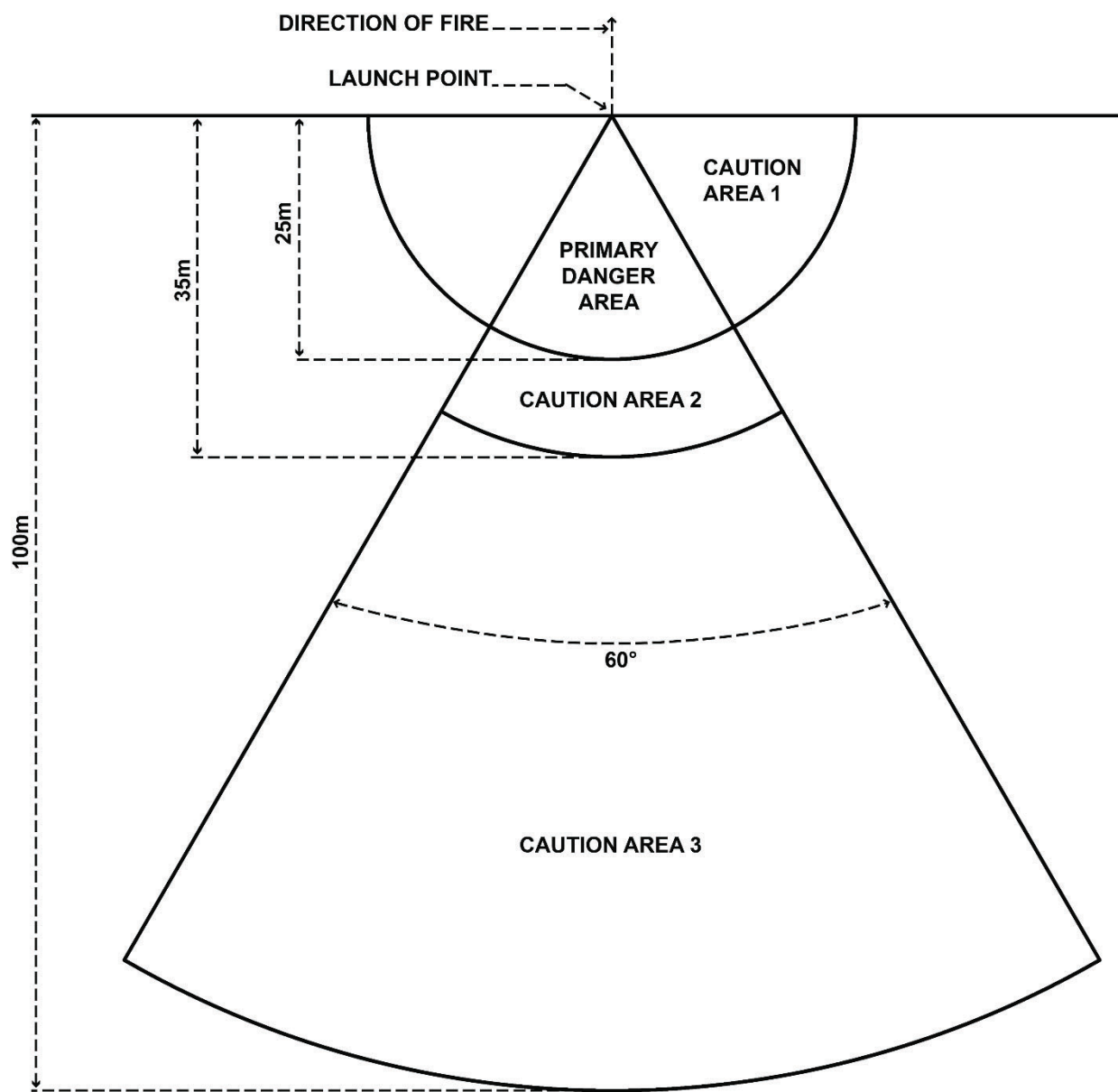


Figure 8–2. Surface danger zone Area F, for Javelin missiles

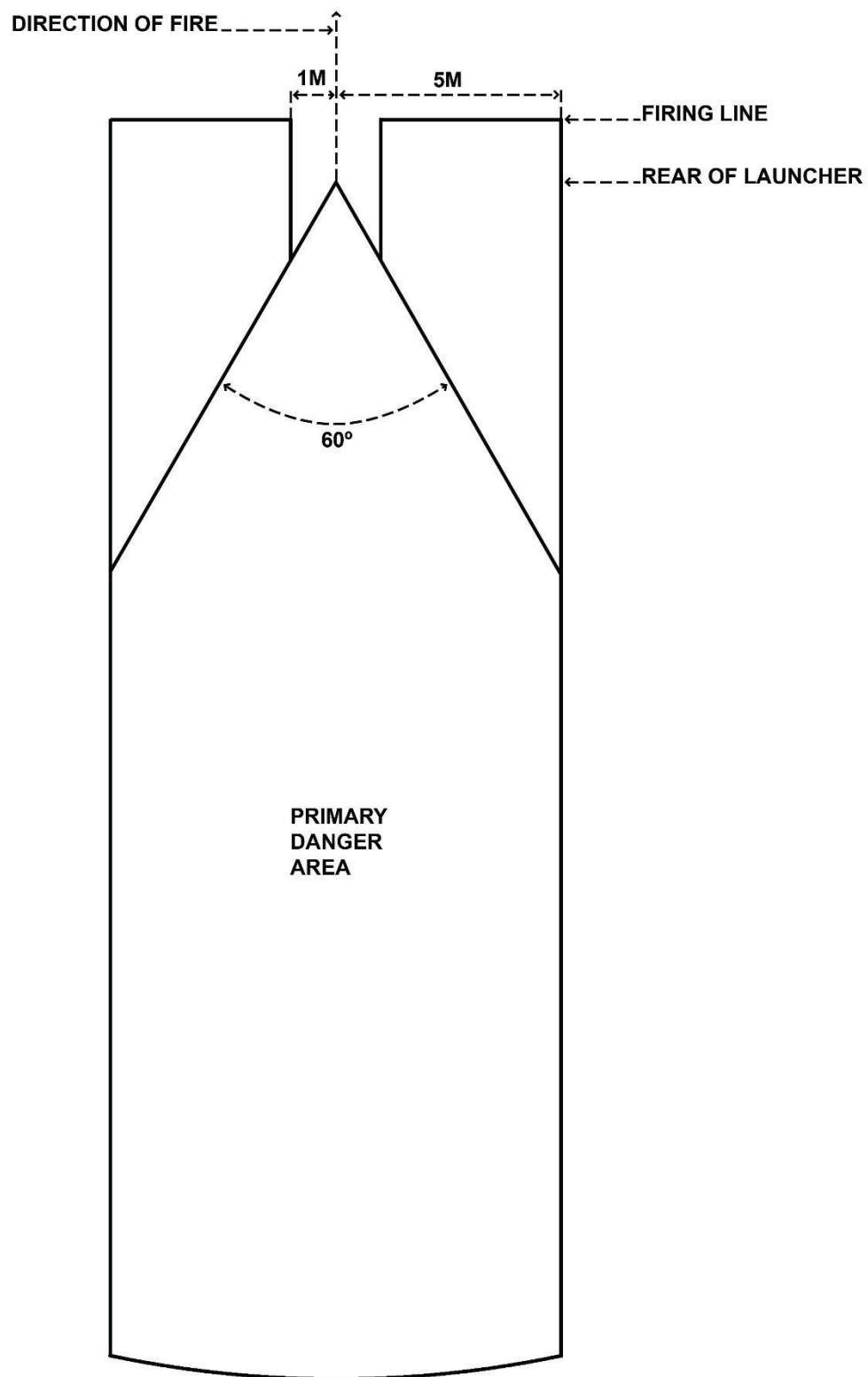


Figure 8–3. Surface danger zone Area F extension for activation of the Javelin missile flight motor pressure relief system

8-2. BGM-71 and BTM-71 series tube-launched, optically-tracked, wire-guided and wireless; tube-launched, optically-tracked, wire-guided and wireless radio frequency missiles

a. Firing conditions.

- (1) Before firing any TOW missile, the entire SDZ will be cleared of all non-participating personnel.
- (2) TOW missile firings must be accomplished within predetermined boundaries. The installation RMA (Army) or RCO (Marine Corps) will ensure that an adequate SDZ exists along the MTL from each anticipated launch position within the predetermined boundaries.
- (3) Procedures and precautions in appropriate FMs and TMs will be observed in all preparation and firing operations.
- (4) Only those personnel actively engaged in firing and controlling TOW missiles as specified in appropriate FMs and TMs will be permitted in the SDZ. Participating personnel directly associated with but not actively engaged in the firing of TOW missiles may be located at protected sites within Area H, such as behind earthen berms.
- (5) Personnel will neither stand nor permit any part of their body to be directly behind or in front of the TOW launcher while a missile is in the launch tube.
- (6) TOW missiles should not be fired from any position that will permit the guidance wire to contact electrical power lines or the high power portion of electrically-operated targetry. Commanders may deem it mission-essential to fire at electrically powered targets where guidance wires may come in contact with the high powered portion of electrically-operated targets. However, the firing commander must first apply a thorough RM process and have it approved by the installation RMA (Army) or RCO (Marine Corps) prior to firing.
- (7) For moving targets, TOW missiles should be launched within the left and right limits established by the movement of the target. Missile impact should be as near to the original missile-to-target-line as possible. Large deflection divergences during flight should be avoided.
- (8) TOW missiles will not be fired from within buildings or within 100 m of any vertical or nearly vertical backstop.
- (9) The range will be inspected after TOW firing activities to ensure, to the maximum extent possible, that all guidance wires are removed from the training complex unless approval is granted from installation RMA (Army) or RCO (Marine Corps) to abandon wires in place. Recovery of guidance wires will be made by ground personnel. Aircraft will not be used to remove guidance wires. The senior commander (Army) or installation commander (Marine Corps) will determine whether guidance wires will be recovered from dedicated and high-hazard impact areas. Access to installation training complexes where command link guidance wires are used will be at the authorization of the installation RMA (Army) or RCO (Marine Corps).
- (10) Modification of Area I is not authorized. Occupation of Area I by unprotected personnel is prohibited.
- (11) All missiles should be tested using the missile test set as part of the overall system pre-fire checks. This will identify the majority of missiles with a potential for operational failures.
- (12) For the Marine Corps, participating personnel not in Area F but within a rectangle 100 m to either side and 200 m to the rear of the TOW firing point will wear a minimum of PPE Level 1, as referenced in table 2-2.

b. Surface danger zone.

- (1) See figures 8-4 and 8-5 and table 8-2 for the SDZs for basic TOW, practice TOW, improved TOW, TOW 2, TOW 2A, TOW 2B, TOW 2B Aero, and TOW 2BB (Bunker Buster) missiles firing at fixed and moving targets.
- (2) See figure 8-6 and table 8-3 for the SDZ for TOW radio frequency (RF) family of missiles, including TOW 2B Aero RF, TOW 2A RF, TOW 2A RF Practice Missile, and TOW BB RF missiles firing at fixed and moving targets.
- (3) The SDZs are based on the maximum ballistic range for TOW-RF variants since there is no provision for command destruct.
- (4) Area F is the danger area extending to the rear of the launcher (see fig 8-7). For ground firings, Area F is divided into a primary danger area and two caution areas.
 - (a) The primary danger area is a 90-degree included angular cone (45 degrees on each side of the rear of the bore axis with a radius of 50 m) and with the apex of the cone centered at the rear of the missile launcher. Serious casualties or fatalities are likely to occur to any personnel in the primary danger area during firing. The hazards are launch motor blast, high noise levels, overpressure, and debris.
 - (b) Caution Area 1 is an area extending radially from each side of the primary danger area to the firing line with a radius of 50 m. Permanent hearing damage could occur to personnel in this area during firing. Appropriate hearing protection will be worn by all personnel occupying this area. The hazards are high noise levels and overpressure.
 - (c) Caution Area 2 is an extension of the primary danger area with the same associated hazards and personnel protection required. The radius of this area is 75 m.
 - (d) For the Army, at least single-hearing protection will be worn by all personnel within the rectangle 100 m to either side and 200 m to the rear of the TOW firing point.

(5) Area H, a circular sector to the rear of the launch position, is established as an additional buffer zone to protect personnel from the hazards of high-velocity fragments and missile debris resulting from detonation of the HE warhead during an eject only event (ballistic trajectory upon failure of the flight motor to ignite once the missile has exited the launcher). Each eject only event for TOW, improved TOW, TOW 2, TOW 2A, TOW 2B Aero, and TOW BB is expected to produce about 100 fragments with a maximum range of 1,300 m and one slug with a maximum range of 3,200 m. The maximum fly-back range for TOW 2B is expected to be 1,000 m, and one slug is expected to travel 1,600 m. Modification of Area H is authorized by deviation. For the Army, Area H is not required for inert warheads or for HE warheads equipped with Missile Ordnance Inhibit Circuits (MOICs) identified by the U.S. Army Aviation and Missile Command, as these circuits are designed to prevent eject only detonations. These missiles will encompass all MOIC, MOIC Enhancement, Improved Missile Ordnance Inhibit Circuit (IMOIC), and Digital MOIC circuitry. For the Marine Corps, Area H is not required for any TOW missile equipped with MOIC.

(6) Area I is a circular sector immediately in front of the launcher position. It is constructed by drawing an arc between the left and right lateral limits of the impact area with a radius of 800 m and centered at the launch position.

c. Surface danger zone adjustments.

(1) For ground-launched mode, if any point on the edge of the impact area is lower than the elevation of the launch position by more than 30 m, extend the impact area at that point by 1 m for every meter of drop in elevation greater than 30 m (for example, if a point of the SDZ at the edge of the impact area is 65 m below the launch position, extend only that portion of the impact area 35 m (65 m–30 m = 35 m) parallel with the edge of the impact area) (see fig 8–8).

(2) When engaging moving or multiple targets, bisect figure 8–6 longitudinally and expand the MTL to accommodate the target array. This will establish the left and right limits of fire.

Table 8–2
Surface danger zone data for tube-launched, optically-tracked, wire-guided missiles

| DoDIC | Marine Corps and Army inventory asset | Warhead flight motor safety device | Dist X (m) | Dist D (m) | Area A (m) | Area B (m) | Area H (m) | Max ord AGL (m) |
|-------------------------------------|---------------------------------------|------------------------------------|------------|------------|------------|------------|--------------------|-----------------|
| Basic TOW Practice (3,750 m) | | | | | | | | |
| PB99 | MC | MOIC | 5,000 | 3,800 | 100 | 100 | NR | 1,832 |
| Basic TOW HEAT (3,750 m) | | | | | | | | |
| WF10 | MC | IMOIC | 5,000 | 3,800 | 750 | 750 | NR | 1,832 |
| TOW 2 Practice (3,750 m) | | | | | | | | |
| PV02 | A | | 5,000 | 3,800 | 100 | 100 | NR | 1,832 |
| WH06 | MC | IMOIC | 5,000 | 3,800 | 100 | 100 | NR | 1,832 |
| TOW 2A HEAT (3,750 m) | | | | | | | | |
| PD62 | A/MC | | 5,000 | 3,800 | 750 | 750 | 3,200 ¹ | 1,832 |
| PE96 | A/MC | | 5,000 | 3,800 | 750 | 750 | 3,200 ¹ | 1,832 |
| WH03 | MC | IMOIC | 5,000 | 3,800 | 750 | 750 | NR | 1,832 |
| PV47 | A/MC | | 5,000 | 3,800 | 750 | 750 | 3,200 ¹ | 1,832 |
| PV83 | A | | 5,000 | 3,800 | 750 | 750 | 3,200 ¹ | 1,832 |
| PU16 | MC | | 5,000 | 3,800 | 750 | 750 | 3,200 ¹ | 1,832 |
| PU08 | MC | | 5,000 | 3,800 | 750 | 750 | 3,200 ¹ | 1,832 |
| WH04 | A | IMOIC | 5,000 | 3,800 | 750 | 750 | NR | 1,832 |
| TOW 2A Practice (3,750 m) | | | | | | | | |
| WH05 | MC | IMOIC | 5,000 | 3,800 | 100 | 100 | NR | 1,832 |
| PU09 | MC | | 5,000 | 3,800 | 100 | 100 | NR | 1,832 |
| PV84 | A | | 5,000 | 3,800 | 100 | 100 | NR | 1,832 |
| TOW BB (3,750 m) | | | | | | | | |

Table 8–2

Surface danger zone data for tube-launched, optically-tracked, wire-guided missiles—Continued

| DoDIC | Marine Corps and Army inventory asset | Warhead flight motor safety device | Dist X (m) | Dist D (m) | Area A (m) | Area B (m) | Area H (m) | Max ord AGL (m) |
|-----------------------------------|---------------------------------------|------------------------------------|------------|------------|------------|------------|--------------------|-----------------|
| WH82 | A | | 5,000 | 3,800 | 750 | 750 | 3,200 ¹ | 1,832 |
| WH50 | A/MC | | 5,000 | 3,800 | 750 | 750 | 3,200 ¹ | 1,832 |
| TOW 2B HEAT (3,750 m) | | | | | | | | |
| PV18 | A/MC | | 4,400 | 3,400 | 600 | 600 | 1,600 ¹ | 1,773 |
| PV82 | A/MC | | 4,400 | 3,400 | 600 | 600 | 1,600 ¹ | 1,773 |
| WF37 | A | | 4,400 | 3,400 | 600 | 600 | 1,600 ¹ | 1,773 |
| TOW 2B Aero HEAT (4,500 m) | | | | | | | | |
| WF93 | A | | 5,100 | 3,950 | 600 | 600 | 1,600 ¹ | 1,773 |
| WF94 | A | | 5,100 | 3,950 | 600 | 600 | 1,600 ¹ | 1,773 |
| WF95 | A | | 5,100 | 3,950 | 600 | 600 | 1,600 ¹ | 1,773 |
| WG02 | A/MC | | 5,100 | 3,950 | 600 | 600 | 1,600 ¹ | 1,773 |

Legend:

A=Army

DoDIC=Department of Defense identification code

HEAT=high-explosive anti-tank

MC=Marine Corps

MOIC=Missile Ordnance Inhibit Circuit

IMOIC=Improved Missile Ordnance Inhibit Circuit

NR=not required

Note.

¹ Area H not required for United States Marine Corps.

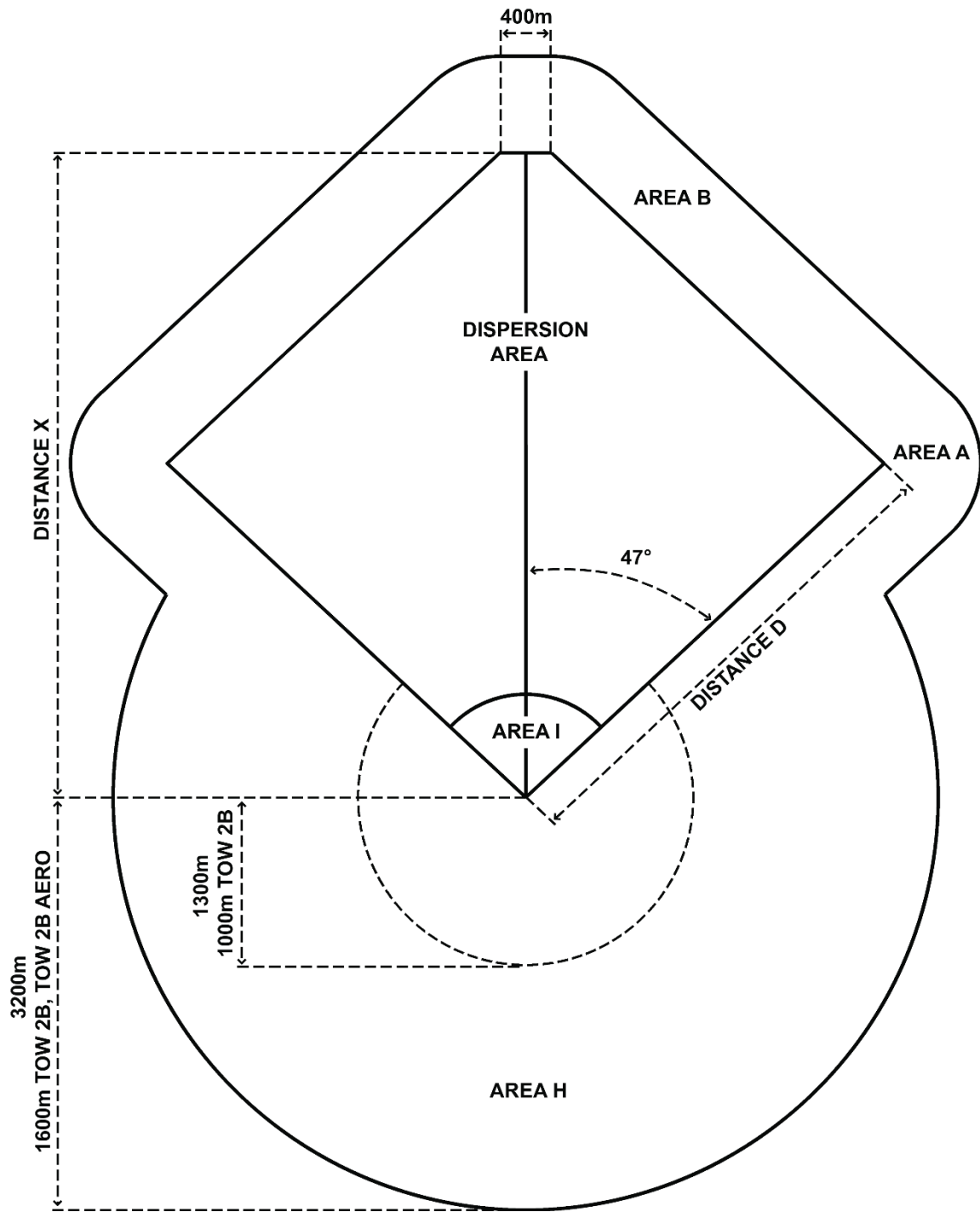


Figure 8-4. Surface danger zone for tube-launched, optically-tracked, wire-guided missiles with Area H Army

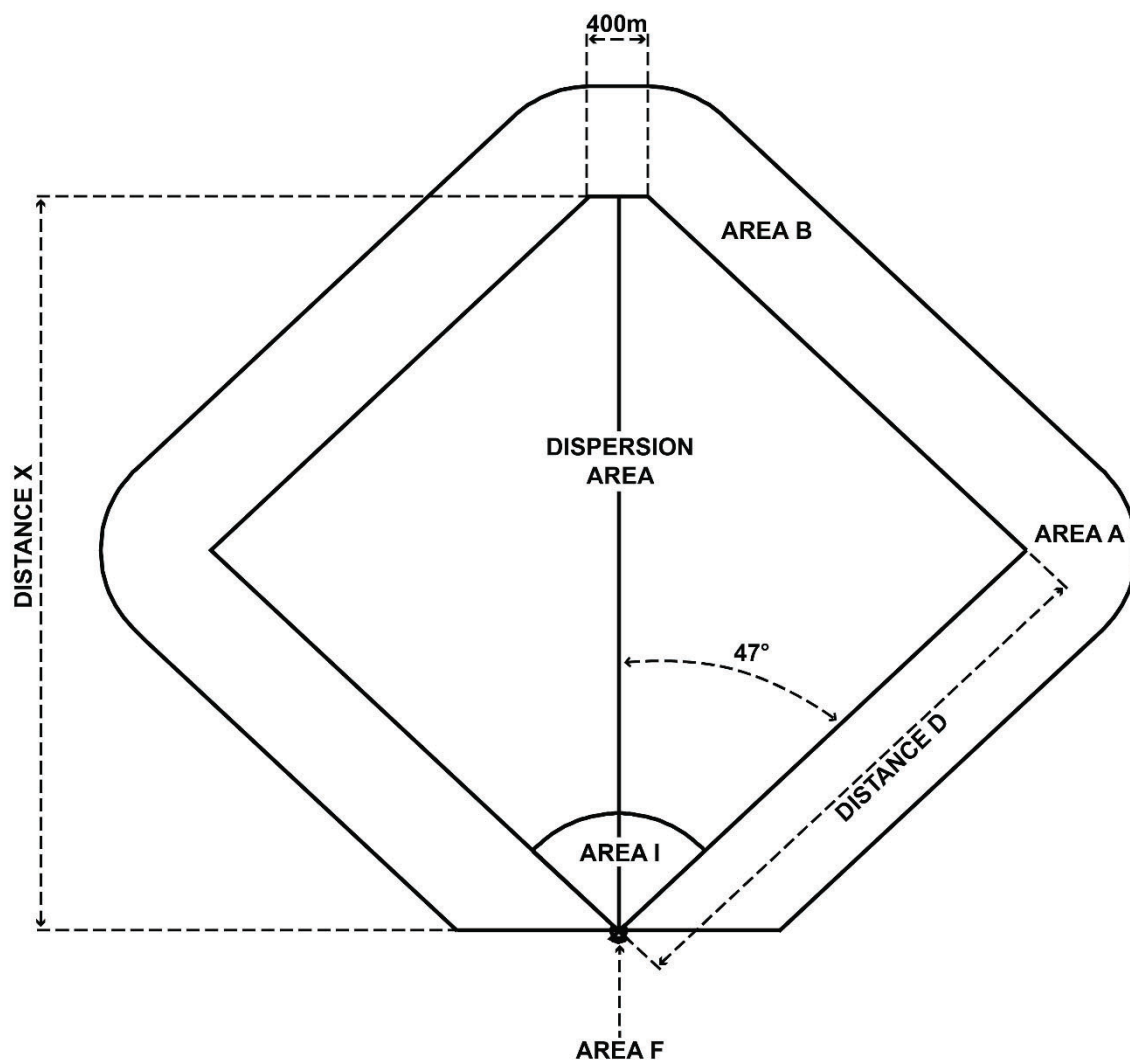


Figure 8–5. Surface danger zone for tube-launched, optically-tracked, wire-guided missiles without Area H United States Marine Corps

Table 8–3

Surface danger zone data for tube-launched, optically-tracked, wireless radio frequency missiles—Continued

| DoDIC | Marine Corps and Army inventory asset | Warhead flight motor safety device | Dist X (m) | Area A (m) | Area B (m) | Max ord AGL (m) |
|----------------------------|---|---------------------------------------|------------------|------------------|------------------|-----------------------|
| TOW 2A RF HEAT | | | | | | |
| WH54 | A | RFMOIC | 6,700 | 750 | 750 | 1,855 |
| TOW 2A RF Practice | | | | | | |
| WH56 | A | RFMOIC | 6,700 | 100 | 100 | 1,832 |
| TOW BB RF | | | | | | |
| WH51 | A/MC | RFMOIC | 6,700 | 750 | 750 | 1,888 |
| TOW 2B Aero RF HEAT | | | | | | |
| WH53 | A/MC | RFMOIC | 6,700 | 600 | 600 | 1,773 |
| WJ53 | A/MC | RFMOIC | 6,700 | 600 | 600 | 1,773 |
| WH52 | A | RFMOIC | 6,700 | 600 | 600 | 1,773 |

Legend:

A=Army

DoDIC=Department of Defense identification code

MC=Marine Corps

HEAT=high-explosive anti-tank

RFMOIC=Radio Frequency Missile Ordnance Inhibit Circuit

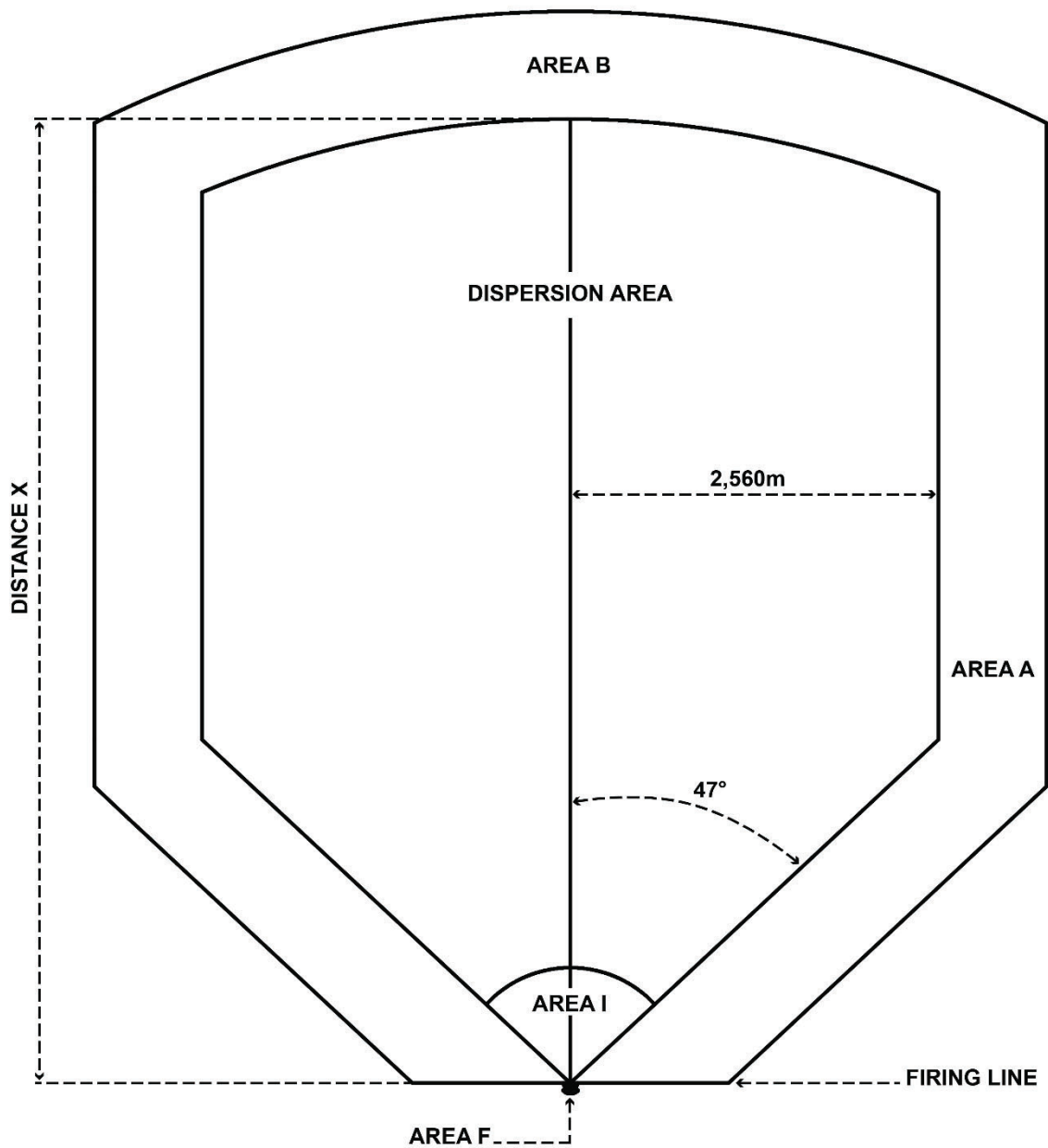


Figure 8–6. Surface danger zone for tube-launched, optically-tracked, wireless radio frequency missiles

d. *Multiple integrated laser engagement system training.* The TOW missile uses the anti-tank weapons effect signature simulator (ATWESS) device for a noise simulator. Use the SDZ in figure 8–4 to determine safe limits of use. ATWESS devices must never be armed until ready to fire. A severe jolt to the ATWESS may cause the device to function. Approved single-hearing protection is required.

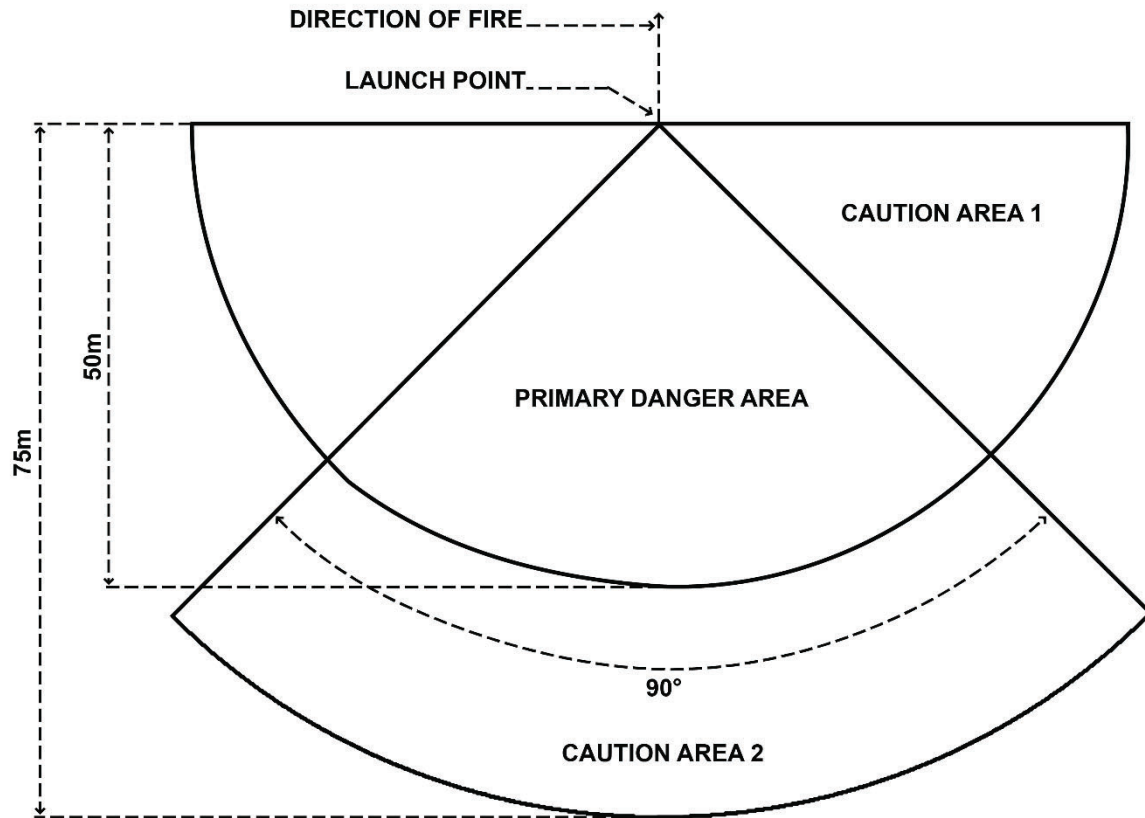


Figure 8–7. Surface danger zone, Area F, for tube-launched, optically-tracked, wire-guided; and tube-launched, optically-tracked, wireless radio frequency missiles

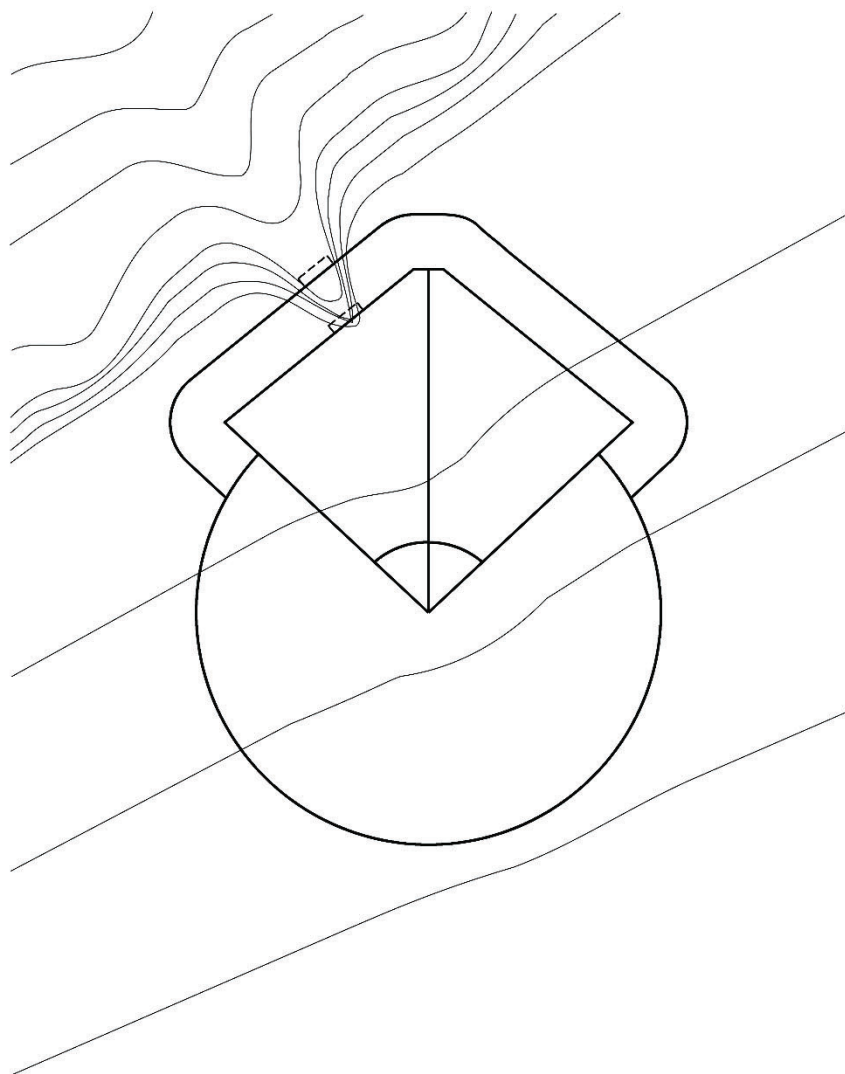


Figure 8–8. Surface danger zone adjustments for firing tube-launched, optically-tracked, wire-guided; and tube-launched, optically-tracked, wireless radio frequency missiles

Chapter 9

Tank and Fighting Vehicle Gunnery

9–1. Tank and fighting vehicle firing conditions

a. Tank and fighting vehicle weapon system will not be fired above 5 degrees (89 mils) QE from the firing position to the target (unless otherwise stated in this regulation/order). The following procedures will be employed.

(1) Unit master gunners, in conjunction with range operations (Army) or range control (Marine Corps) personnel, will ensure that targets are placed at or less than 5 degrees QE. Tank commanders will ensure that all weapon systems in a firing condition are pointed toward the impact area at or less than 5 degrees QE.

(2) Non-stabilized tank armament will not be fired while the tank or fighting vehicle is moving. This does not include machine guns.

b. When firing on ranges and weapons training facilities with less than the prescribed safety limits, existing compensatory terrain features and offsetting control measures will be thoroughly evaluated. An approved deviation is required before firing on reduced SDZs.

c. Hard or soft targetry may be used.

d. CR firing of weapon systems from firing positions at targets or target arrays on the opposite side of the range is permitted if the SDZ falls within allowable limits, and the risk of damage to target systems has been accepted by the RMA (Army) or RCO (Marine Corps). Limits of fire, combined dispersion, ricochet areas, and Areas A and B (when required) must be adjusted to compensate for and accommodate such CR firing. On ranges that do not permit CR firing, internal (inside the range area) left and right limit-of-fire markers, with both visual and thermal signature, will be used in addition to the left and right external range limit markers.

e. Environmental containment materials (spill kits) will be available on all mounted ranges, during all refuel operations, and whenever the vehicles involved in the training event are on the range.

9-2. Surface danger zones

Tank and fighting vehicle SDZs for direct fire at fixed or moving ground targets from stationary or moving firing positions are as follows:

a. The dispersion area for tank and fighting vehicle SDZs is 2 degrees with a stabilized weapon system. The dispersion area for tank and fighting vehicle SDZs utilizing non-stabilized weapon systems is 5 degrees.

b. When firing the M950 and M1198 the dispersion must be increased from 5 degrees to 8 degrees.

c. Areas A and B are not required when firing inert or non-HE projectiles at soft targets, except spotting charges or frangible projectiles that may eject a hazardous fragment.

d. When engaging armor targets, use the impact media that has the greater value due to the possibility of missing the target. For fighting vehicles, the Distance X (maximum range) may be reduced to ricochet range when engaging ground targets at ranges up to 3,500 m from stationary firing positions. For fighting vehicles, when firing from a moving vehicle over level terrain at ground targets up to 3,500 m, use the 15 degrees QE range. When firing on the move over rough terrain, use Distance X.

e. For fighting vehicles, when firing at aerial targets and the gun elevation is greater than 15 degrees QE, the ricochet area, as defined by Distance W and Angle P, is not required.

f. See chapter 4 (small arms criteria) and figure 9-5 for SDZ requirements for firing port weapon systems. Firing port weapon systems may be fired selectively or as part of a course provided—

(1) Sufficient terrain is available to accommodate the weapon system's SDZ fired at its extreme elevation and limits of traverse.

(2) An established impact area exists with targets or target arrays.

g. See table 9-1 and figure 9-1 for the SDZ data for M1040 105mm and M1028 120mm anti-personnel (APERS) canisters. See table 9-1 and figure 9-1 for SDZ data for M494 105mm Anti-personnel-Tracer (APERS -T). See figure 9-3 for the flechette dispersion pattern for the M494.

h. A deviation is required for standard non-petal producing munitions and requires a separate risk assessment tied to an event.

i. For sabot munitions, no personnel will be allowed within the SDZ.

j. For select tank cannon cartridges, use tables 9-1 and 9-2 and figure 9-1.

Table 9-1
Surface danger zone data for select tank cannon cartridges

| Ammunition | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|----------------|--------------|------------|------------|------------|------------|---------------|------------------------------|
| 105mm | | | | | | | |
| M393A1 TP-T | Earth | 5,474 | 1,225 | NR | NR | 24 | 1,090 |
| | Steel | 5,474 | 1,125 | NR | NR | 24 | 1,090 |
| M393A1/2 HEP-T | Earth | 5,474 | 1,225 | 615 | 615 | 24 | 1,090 |
| | Steel | 5,474 | 1,125 | 615 | 615 | 24 | 1,090 |
| M393A3 HEP-T | Earth | 8,175 | 1,225 | 300 | 300 | 24 | 962 |
| | Steel | 7,600 | 1,125 | 300 | 300 | 20 | 1,090 |
| M456 HEAT-T | Earth | 6,436 | 1,080 | 615 | 615 | 17 | See note 1 |
| | Steel | 6,436 | 600 | 615 | 615 | 12 | See note 1 |
| M467A1 TP-T | Earth | 8,175 | 1,225 | NR | NR | 24 | 962 |
| | Steel | 7,600 | 1,125 | NR | NR | 20 | 1,090 |

Table 9–1
Surface danger zone data for select tank cannon cartridges—Continued

| Ammunition | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|-----------------|----------------|------------------|----------------|------------|------------|---------------|------------------------------|
| M490 TP–T | Earth Steel | 6,445 6,445 | 1,080 600 | NR NR | NR NR | 17 12 | See note 1 See note 1 |
| M494 APERS–T | Earth Steel | 4,400 4,400 | 550 850 | NR NR | NR NR | 40 50 | 415 820 |
| M724 TPDS–T | Earth Steel | 11,343 11,343 | 1,110 1,900 | NR NR | NR NR | 13 11 | See note 1 See note 1 |
| M724A1E1 TPDS–T | Earth Steel | 7,234 7,234 | 450 1,400 | NR NR | NR NR | 12 16 | See note 1 See Note 1 |
| M735 APFSDS–T | Earth Steel | 22,846 22,846 | 1,100 1,400 | NR NR | NR NR | 14 16 | See note 1 See note 1 |
| M1040 Canister | Earth Steel | 1,300 1,300 | 550 850 | NR NR | NR NR | 40 50 | 415 820 |

120mm

| | | | | | | | |
|------------------|----------------|------------------|----------------|----------------|----------------|----------|--------------------------|
| M830 HEAT–MP–T | Earth Steel | 6,589 6,589 | 1,080 600 | 1,125 1,125 | 1,125 1,125 | 17 12 | See note 1 See note 1 |
| M830A1 HEAT–MP–T | Earth Steel | 10,069 10,069 | 1,239 1,061 | 1,377 1,377 | 1,377 1,377 | 22 20 | See note 1 See note 1 |
| M831 TP–T | Earth Steel | 6,589 6,589 | 1,080 600 | NR NR | NR NR | 17 12 | See note 1 See note 1 |
| M865 TPCSDS–T | Earth Steel | 7,234 7,234 | 450 1,400 | NR NR | NR NR | 12 16 | See note 1 See note |
| M908 HE–OR–T | Earth Steel | 10,069 10,069 | 1,239 1,061 | 1,377 1,377 | 1,377 1,377 | 22 20 | See note 1 See note 1 |
| M1028 Canister | Earth Steel | 1,650 1,650 | 550 850 | NR NR | NR NR | 30 55 | 550 1,050 |

Legend:

APFSDS–T=Armor-Piercing, Fin-Stabilized Discarding Sabot-Tracer

HE=high-explosive

HEAT=high-explosive anti-tank

HEP=high-explosive plastic

HEP–T=High-Explosive Plastic-Tracer

MP=multipurpose

NR=not required

OR=obstacle reduction

T=Tracer

TP–T=Target Practice-Tracer

TPDS–T=Target Practice Discarding Sabot-Tracer

TPCSDS–T=Target Practice, Cone-Stabilized Discarding Sabot-Tracer

Note.

¹ Use the sum of the values of Distance W and Area A (if applicable) until validated test data is available.

Table 9–2
Surface danger zone data for 120mm M1002 Target Practice Multipurpose-Tracer¹—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|---------------------|---------------------------------------|
| 0 | Earth | 7,200 | 975 | NR | NR | 30 | 1,252 |
| | Steel | 7,200 | 550 | NR | NR | 22 | 816 |
| 1,000 | Earth | 7,425 | 1,010 | NR | NR | 30 | 1,288 |
| | Steel | 7,425 | 575 | NR | NR | 22 | 842 |
| 2,000 | Earth | 7,650 | 1,045 | NR | NR | 30 | 1,325 |
| | Steel | 7,650 | 600 | NR | NR | 22 | 868 |
| 3,000 | Earth | 7,875 | 1,080 | NR | NR | 30 | 1,363 |
| | Steel | 7,875 | 625 | NR | NR | 22 | 869 |
| 4,000 | Earth | 8,100 | 1,115 | NR | NR | 30 | 1,402 |
| | Steel | 8,100 | 650 | NR | NR | 22 | 924 |
| 5,000 | Earth | 8,325 | 1,150 | NR | NR | 30 | 1,444 |
| | Steel | 8,325 | 675 | NR | NR | 22 | 954 |
| 6,000 | Earth | 8,550 | 1,185 | NR | NR | 30 | 1,486 |
| | Steel | 8,550 | 700 | NR | NR | 22 | 985 |
| 7,000 | Earth | 8,775 | 1,220 | NR | NR | 30 | 1,530 |
| | Steel | 8,775 | 725 | NR | NR | 22 | 1,017 |

Legend:
NR=not required

Note.

¹ To correct for crosswind, dispersion angle is increased by 0.15 degree per m/s or 0.075 degree per knot.

k. For cartridges M865 and M1002 sabot discard hazard, use table 9–3 and figure 9–2.

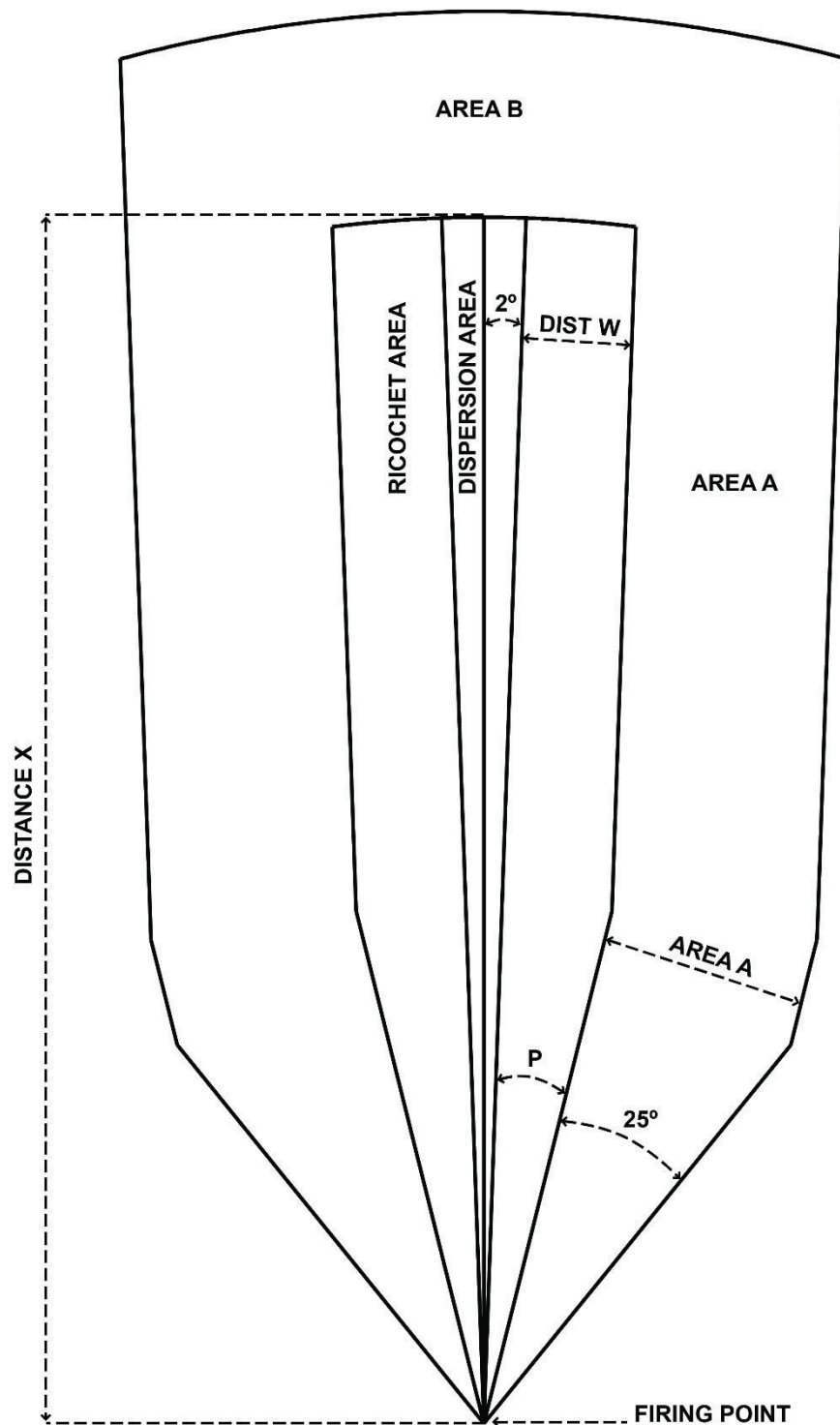


Figure 9-1. Surface danger zone for select tank cannon cartridges

Table 9–3
Surface danger zone data for 105mm and 120mm sabot petal discard area¹

| Ammunition | Dist X (m) | Dist Y (m) | Dist W (m) | Area R width (m) | Area R depth (m) |
|----------------------------------|---------------------------|---------------------------|---------------------------|---------------------------------|---------------------------------|
| M865 TPCSDS–T M724A1E1 TPDS–T | 1,300 | 200 | 300 | 140 | NR |
| M1002 MPAT–TP–T | 750 | 75 | 250 | 140 | NR |

Legend:

TPCSDS–T=Target Practice, Cone-Stabilized Discarding Sabot-Tracer

TPDS–T=Target Practice Discarding Sabot-Tracer

MPAT–TP–T=Multipurpose Anti-Tank Target Practice-Tracer

NR=not required

Note.

¹ SDZ holds for constant winds up to 12.5 m/s or 25 knots.

l. For cartridge M968, 35mm tank or fighting vehicle precision gunnery in bore device, use table 9–4 and figure 9–1.

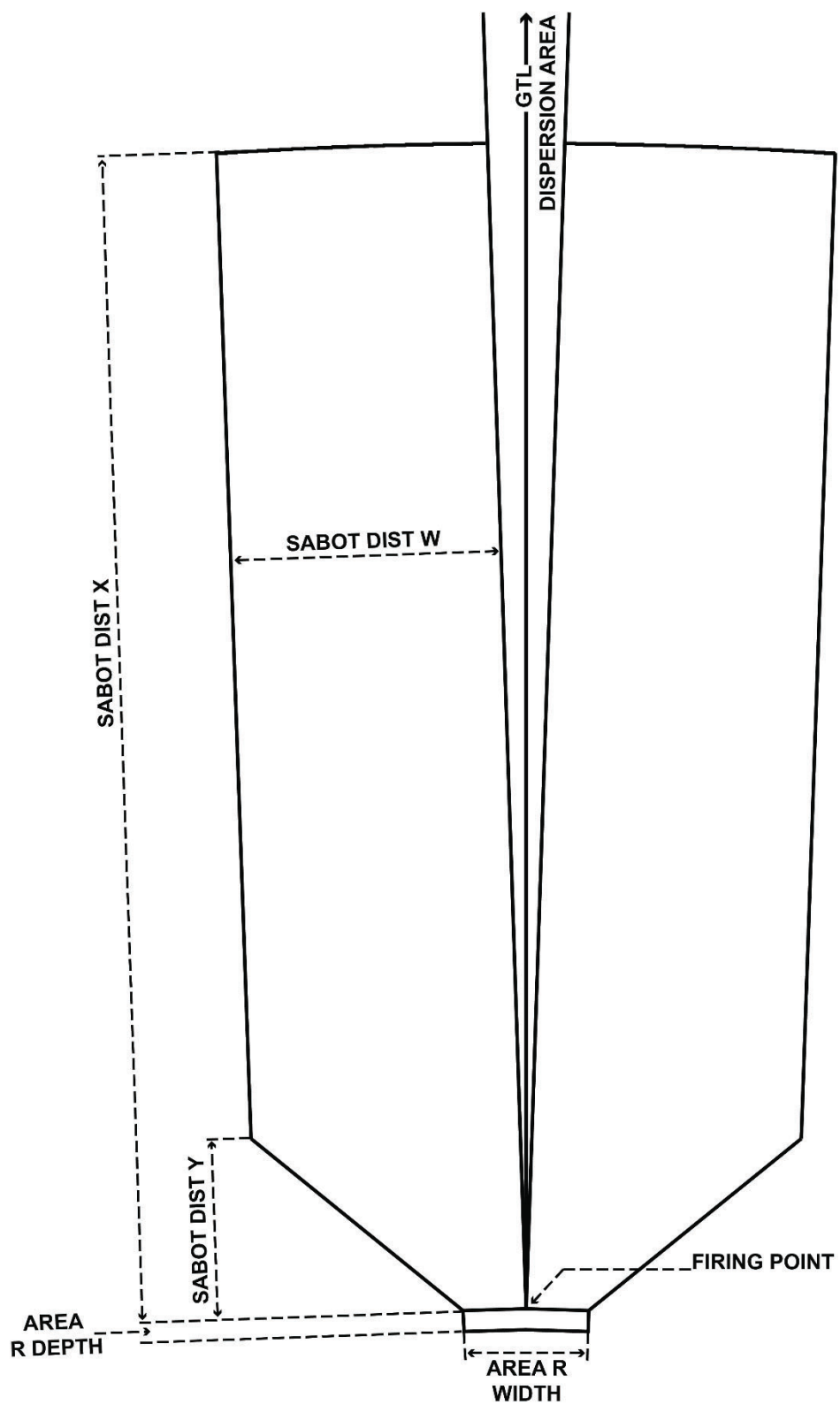


Figure 9–2. Surface danger zone for M865 and M1002 sabot petal discard area

Table 9–4

Surface danger zone data for 35mm M968 tank precision gunnery inbore device cartridge corresponding to target ranges

| Target range (m) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|------------------|--------------|------------|------------|------------|------------|---------------|------------------------------|
| 100 | Earth | 5,799 | 1,786 | NR | NR | 27 | 642 |
| | Water | 5,722 | 1,559 | NR | NR | 30 | 642 |
| | Concrete | 6,051 | 2,023 | NR | NR | 37 | 974 |
| | Steel | 5,750 | 2,301 | NR | NR | 42 | 1,133 |
| 500 | Earth | 5,902 | 1,844 | NR | NR | 24 | 622 |
| | Water | 5,944 | 1,528 | NR | NR | 22 | 605 |
| | Concrete | 6,261 | 2,068 | NR | NR | 30 | 916 |
| | Steel | 6,991 | 2,078 | NR | NR | 35 | 1,068 |
| 1,000 | Earth | 6,150 | 1,752 | NR | NR | 20 | 565 |
| | Water | 6,195 | 1,495 | NR | NR | 20 | 557 |
| | Concrete | 6,797 | 1,961 | NR | NR | 27 | 840 |
| | Steel | 6,230 | 2,191 | NR | NR | 29 | 980 |
| 1,500 | Earth | 6,752 | 1,225 | NR | NR | 17 | 505 |
| | Water | 6,771 | 1,487 | NR | NR | 17 | 504 |
| | Concrete | 6,476 | 1,180 | NR | NR | 26 | 760 |
| | Steel | 7,237 | 2,245 | NR | NR | 26 | 876 |
| 2,000 | Earth | 6,995 | 1,165 | NR | NR | 14 | 444 |
| | Water | 6,889 | 1,458 | NR | NR | 15 | 437 |
| | Concrete | 6,613 | 1,649 | NR | NR | 20 | 671 |
| | Steel | 6,776 | 2,067 | NR | NR | 23 | 775 |
| 2,500 | Earth | 7,005 | 1,211 | NR | NR | 13 | 354 |
| | Water | 6,934 | 1,393 | NR | NR | 13 | 362 |
| | Concrete | 7,144 | 1,548 | NR | NR | 17 | 546 |
| | Steel | 7,557 | 1,735 | NR | NR | 19 | 670 |
| 3,000 | Earth | 7,914 | 1,020 | NR | NR | 10 | 279 |
| | Water | 7,633 | 1,268 | NR | NR | 11 | 273 |
| | Concrete | 7,530 | 1,298 | NR | NR | 14 | 442 |
| | Steel | 7,453 | 1,732 | NR | NR | 17 | 527 |
| 3,500 | Earth | 7,713 | 980 | NR | NR | 10 | 193 |
| | Water | 8,114 | 847 | NR | NR | 9 | 188 |
| | Concrete | 7,816 | 1,190 | NR | NR | 11 | 318 |
| | Steel | 7,779 | 1,600 | NR | NR | 14 | 384 |
| 4,000 | Earth | 7,752 | 748 | NR | NR | 8 | 165 |
| | Water | 7,380 | 591 | NR | NR | 6 | 162 |
| | Concrete | 8,864 | 1,100 | NR | NR | 11 | 217 |
| | Steel | 8,190 | 1,101 | NR | NR | 10 | 272 |
| 4,500 | Earth | 7,365 | 658 | NR | NR | 6 | 132 |
| | Water | 7,360 | 495 | NR | NR | 5 | 130 |
| | Concrete | 8,327 | 883 | NR | NR | 8 | 160 |
| | Steel | 8,585 | 1,126 | NR | NR | 10 | 197 |
| 5,000 | Earth | 7,590 | 434 | NR | NR | 6 | 130 |
| | Water | 8,299 | 328 | NR | NR | 3 | 98 |
| | Concrete | 8,096 | 670 | NR | NR | 6 | 139 |
| | Steel | 9,076 | 995 | NR | NR | 8 | 150 |
| 5,500 | Earth | 7,745 | 307 | NR | NR | 3 | 188 |

Table 9–4
Surface danger zone data for 35mm M968 tank precision gunnery inbore device cartridge corresponding to target ranges—Continued

| Target range (m) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|---------------------|-----------------|------------------|------------------|------------------|------------------|---------------------|---------------------------------------|
| 6,000 | Water | 7,047 | 166 | NR | NR | 2 | 51 |
| | Concrete | 8,238 | 751 | NR | NR | 6 | 188 |
| | Steel | 8,620 | 629 | NR | NR | 7 | 188 |
| | Earth | 7,257 | 68 | NR | NR | 1 | 262 |
| | Water | 7,027 | 70 | NR | NR | 1 | 29 |
| | Concrete | 8,243 | 405 | NR | NR | 4 | 262 |
| | Steel | 8,556 | 622 | NR | NR | 5 | 262 |

Legend:
NR=not required

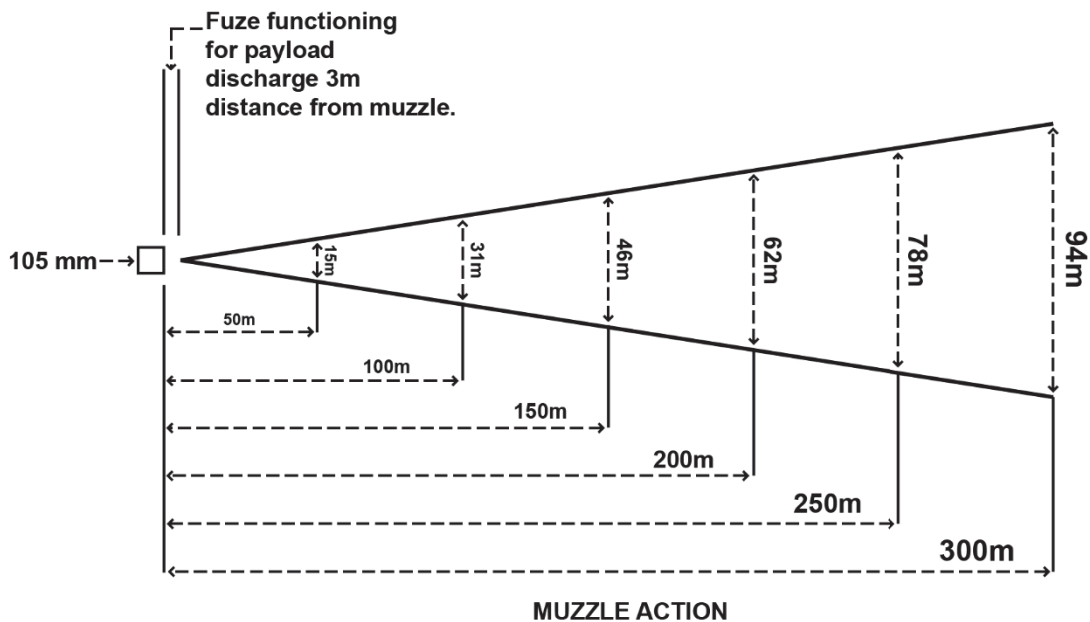
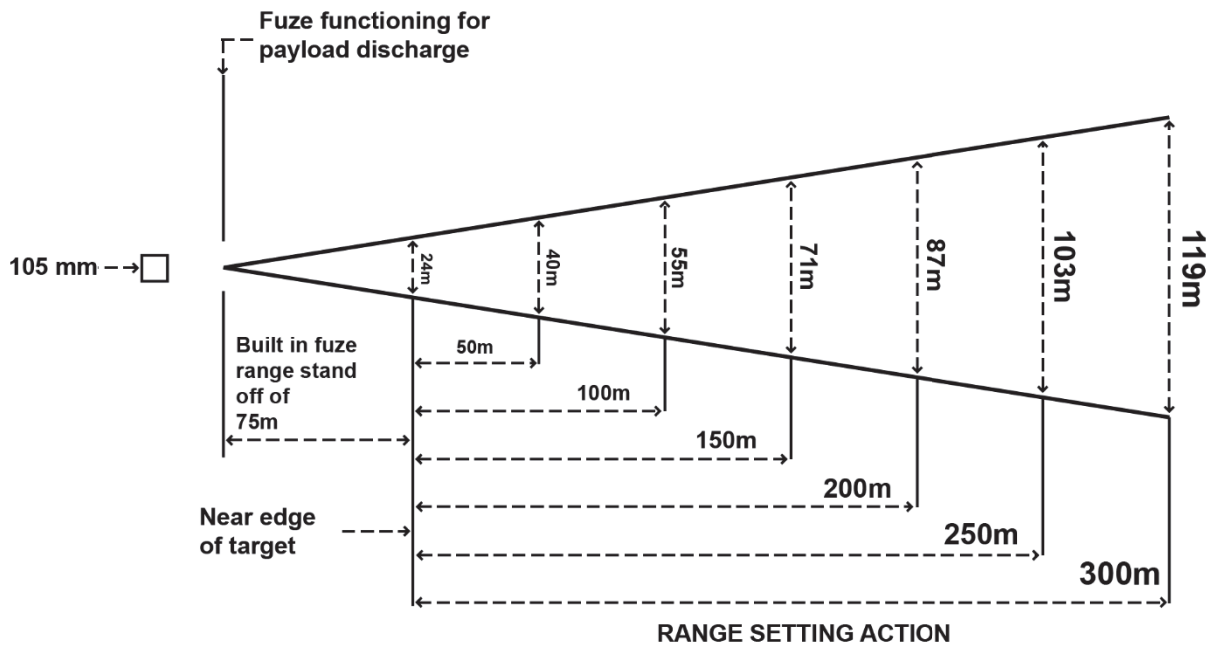


Figure 9-3. Flechette dispersion pattern for 105mm M494 Anti-personnel-Tracer

9-3. Fighting vehicles

See table 9-5 and figure 9-4 for SDZ requirements for the M242 Bushmaster 25mm cannon.

Table 9–5
Surface danger zone data for 25mm weapons—Continued

| Ammunition | Impact media | Dist X (m) | Dist W (m) | Ricochet Range (m) | 15-degree elevation range (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|-------------|--------------|------------|------------|--------------------|-------------------------------|---------------|------------------------------|
| M791 APDS–T | Earth | 14,572 | 1,466 | 7,402 | 11,561 | 18 | See note 1 |
| | Water | 14,572 | 263 | 5,665 | 11,561 | 6 | See note 1 |
| | Concrete | 14,572 | 2,208 | 7,622 | 11,561 | 34 | See note 1 |
| | Steel | 14,572 | 1,510 | 7,294 | 11,561 | 24 | See note 1 |
| M792 HEI–T | Earth | 6,379 | 908 | 4,792 | 5,249 | 19 | See note 1 |
| | Water | 6,379 | 1,047 | 4,823 | 5,249 | 19 | See note 1 |
| | Concrete | 6,379 | 1,290 | 5,071 | 5,249 | 27 | See note 1 |
| | Steel | 6,379 | 1,373 | 5,265 | 5,249 | 28 | See note 1 |
| M793 TP–T | Earth | 6,047 | 908 | 4,792 | 5,114 | 19 | See note 1 |
| | Water | 6,047 | 1,047 | 4,823 | 5,114 | 19 | See note 1 |
| | Concrete | 6,047 | 1,290 | 5,071 | 5,114 | 27 | See note 1 |
| | Steel | 6,047 | 1,373 | 5,265 | 5,114 | 28 | See note 1 |
| M910 TPDS–T | Earth | 6,404 | 734 | 4,592 | 5,868 | 15 | See note 1 |
| | Water | 6,404 | 148 | 3,724 | 5,868 | 4 | See note 1 |
| | Concrete | 6,404 | 1,143 | 4,643 | 5,868 | 27 | See note 1 |
| | Steel | 6,404 | 799 | 4,472 | 5,868 | 20 | See note 1 |

Legend:

APDS–T=Armor-Piercing, Discarding Sabot-Tracer

APFSDS–T=Armor-Piercing, Fin-Stabilized Discarding Sabot-Tracer

HEI–T=High-Explosive Incendiary-Tracer

NR=not required

TP–T=Target Practice-Tracer

TPDS–T=Target Practice, Discarding Sabot-Tracer

Note.

¹ Use the sum of values of Distance W and Area A (if applicable) until validated test data is available.

9–4. All types of 30mm

See tables 9–6 through 9–21.

Table 9–6
Surface danger zone data for 30mm MK239 Target Practice-Tracer (Fighting Vehicle–Elevation Restriction)

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|---------------|--------------|------------|------------|------------|------------|---------------|------------------------------|
| 0 | Earth | 6,000 | 575 | NR | NR | 8 | 570 |
| | Armor Plate | 6,000 | 750 | NR | NR | 17 | 575 |
| 1,000 | Earth | 6,140 | 590 | NR | NR | 8 | 585 |
| | Armor Plate | 6,140 | 765 | NR | NR | 17 | 590 |
| 2,000 | Earth | 6,280 | 605 | NR | NR | 8 | 600 |
| | Armor Plate | 6,280 | 780 | NR | NR | 17 | 605 |
| 3,000 | Earth | 6,420 | 620 | NR | NR | 8 | 615 |
| | Armor Plate | 6,420 | 795 | NR | NR | 17 | 620 |
| 4,000 | Earth | 6,590 | 640 | NR | NR | 8 | 631 |
| | Armor Plate | 6,590 | 825 | NR | NR | 17 | 636 |
| 5,000 | Earth | 6,760 | 660 | NR | NR | 8 | 647 |
| | Armor Plate | 6,760 | 855 | NR | NR | 17 | 652 |

Table 9–6
Surface danger zone data for 30mm MK239 Target Practice-Tracer (Fighting Vehicle–Elevation Restriction)—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|------------------|--------------|------------------|------------------|------------------|------------------|---------------------|---------------------------------------|
| 6,000 | Earth | 6,930 | 680 | NR | NR | 8 | 663 |
| | Armor Plate | 6,930 | 885 | NR | NR | 17 | 668 |
| 7,000 | Earth | 7,100 | 700 | NR | NR | 8 | 680 |
| | Armor Plate | 7,100 | 915 | NR | NR | 17 | 685 |

Legend:
NR=not required

a. When conducting fighting vehicle training with elevation limitations, use the SDZ template in figure 9–4 and the found in tables 9–7 through 9–16. For free gun training, use the batwing SDZ template in chapter 5 with the data in tables 9–12 through 9–16. To correct for CR wind, the dispersion angle of 2 degrees must be increased by 0.1 degree per m/s or 0.05 degree per knot of CR wind.

(1) For free gun training, to correct for CR wind, the dispersion angle of 5 degrees must be increased by 0.25 degree per m/s or 0.13 degree per knot of CR wind.

(2) For elevation restriction (5 degrees), to correct for CR wind, the dispersion angle is increased by 0.1 degree per m/s or 0.05 degree per knot of CR wind (see table 9–22 for SDZ data for sub-caliber devices).

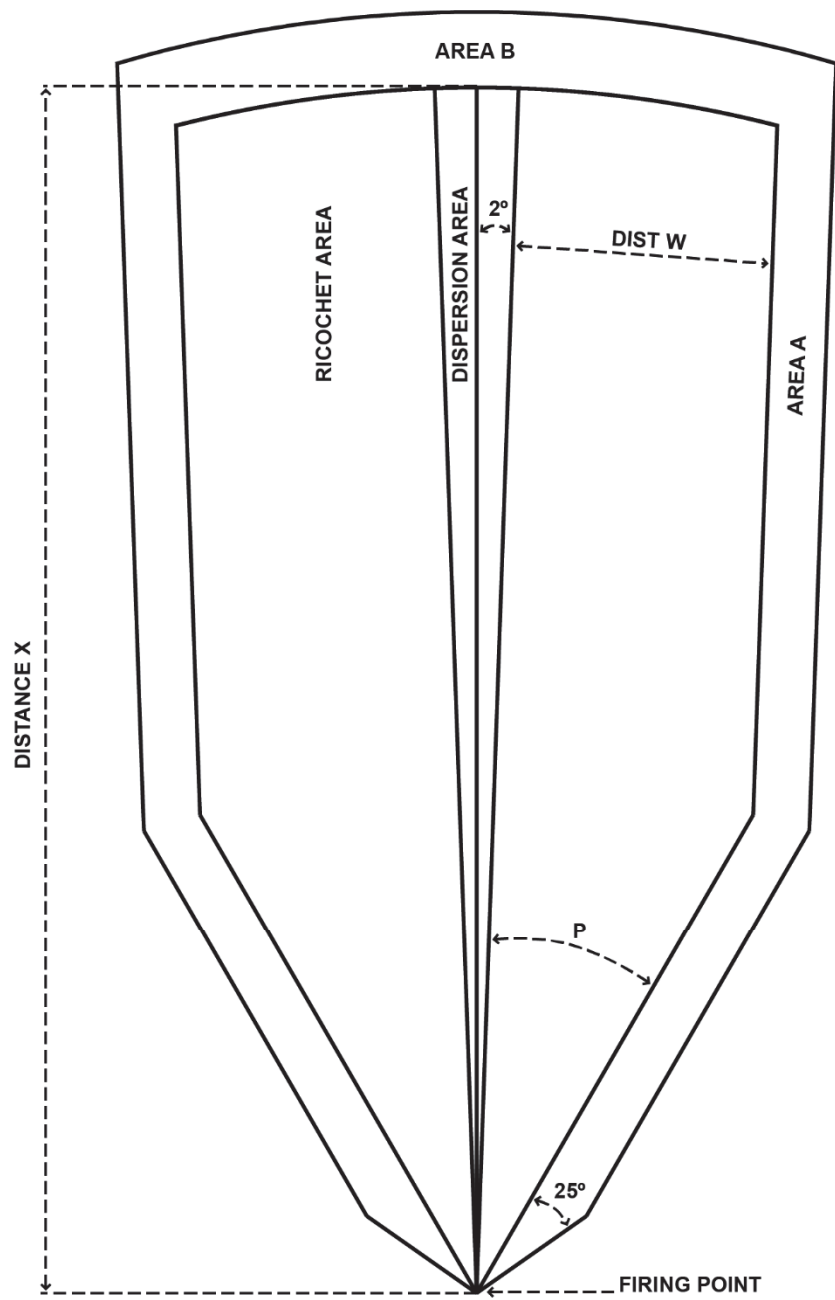


Figure 9-4. Surface danger zone for 25mm, 30mm, and 35mm cannons

Table 9–7
Surface danger zone data for 30mm MK238 MOD 1 High-Explosive Incendiary-Tracer and MK266 MOD 1 High-Explosive Incendiary-Tracer (Fighting Vehicle–Elevation Restriction)—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 6,000 | 575 | 175 | 175 | 8 | 570 |
| | | 6,000 | 750 | 175 | 175 | 17 | 575 |
| 1,000 | Earth Armor Plate | 6,140 | 590 | 175 | 175 | 8 | 585 |
| | | 6,140 | 765 | 175 | 175 | 17 | 590 |
| 2,000 | Earth Armor Plate | 6,280 | 605 | 175 | 175 | 8 | 600 |
| | | 6,280 | 780 | 175 | 175 | 17 | 605 |
| 3,000 | Earth Armor Plate | 6,420 | 620 | 175 | 175 | 8 | 615 |
| | | 6,420 | 795 | 175 | 175 | 17 | 620 |
| 4,000 | Earth Armor Plate | 6,590 | 640 | 175 | 175 | 8 | 631 |
| | | 6,590 | 825 | 175 | 175 | 17 | 636 |
| 5,000 | Earth Armor Plate | 6,760 | 660 | 175 | 175 | 8 | 647 |
| | | 6,760 | 855 | 175 | 175 | 17 | 652 |
| 6,000 | Earth Armor Plate | 6,930 | 680 | 175 | 175 | 8 | 663 |
| | | 6,930 | 885 | 175 | 175 | 17 | 668 |
| 7,000 | Earth Armor Plate | 7,100 | 700 | 175 | 175 | 8 | 680 |
| | | 7,100 | 915 | 175 | 175 | 17 | 685 |

Table 9–8
Surface danger zone data for 30mm MK264 Multipurpose Low Drag-Tracer (Fighting Vehicle–Elevation Restriction)

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 6,000 | 575 | 240 | 240 | 8 | 570 |
| | | 6,000 | 750 | 240 | 240 | 17 | 575 |
| 1,000 | Earth Armor Plate | 6,140 | 590 | 240 | 240 | 8 | 585 |
| | | 6,140 | 765 | 240 | 240 | 17 | 590 |
| 2,000 | Earth Armor Plate | 6,280 | 620 | 240 | 240 | 8 | 615 |
| | | 6,280 | 780 | 240 | 240 | 17 | 605 |
| 3,000 | Earth Armor Plate | 6,420 | 620 | 240 | 240 | 8 | 615 |
| | | 6,420 | 795 | 240 | 240 | 17 | 620 |
| 4,000 | Earth Armor Plate | 6,590 | 640 | 240 | 240 | 8 | 631 |
| | | 6,590 | 825 | 240 | 240 | 17 | 636 |
| 5,000 | Earth Armor Plate | 6,760 | 660 | 240 | 240 | 8 | 647 |
| | | 6,760 | 855 | 240 | 240 | 17 | 652 |
| 6,000 | Earth Armor Plate | 6,930 | 680 | 240 | 240 | 8 | 663 |
| | | 6,930 | 885 | 240 | 240 | 17 | 668 |
| 7,000 | Earth Armor Plate | 7,100 | 700 | 240 | 240 | 8 | 680 |
| | | 7,100 | 915 | 240 | 240 | 17 | 685 |

Table 9–9
Surface danger zone data for 30mm MK310 Programmable Air Burst Munition-Tracer (Fighting Vehicle–Elevation Restriction)—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 6,000 | 575 | 150 | 150 | 8 | 575 |
| | | 6,000 | 750 | 150 | 150 | 17 | 570 |
| 1,000 | Earth Armor Plate | 6,140 | 590 | 150 | 150 | 8 | 585 |
| | | 6,140 | 765 | 150 | 150 | 17 | 590 |
| 2,000 | Earth Armor Plate | 6,280 | 605 | 150 | 150 | 8 | 600 |
| | | 6,280 | 780 | 150 | 150 | 17 | 605 |
| 3,000 | Earth Armor Plate | 6,420 | 620 | 150 | 150 | 8 | 615 |
| | | 6,420 | 795 | 150 | 150 | 17 | 620 |
| 4,000 | Earth Armor Plate | 6,590 | 640 | 150 | 150 | 8 | 631 |
| | | 6,590 | 825 | 150 | 150 | 17 | 636 |
| 5,000 | Earth Armor Plate | 6,760 | 660 | 150 | 150 | 8 | 647 |
| | | 6,760 | 855 | 150 | 150 | 17 | 652 |
| 6,000 | Earth Armor Plate | 6,930 | 680 | 150 | 150 | 8 | 663 |
| | | 6,930 | 885 | 150 | 150 | 17 | 668 |
| 7,000 | Earth Armor Plate | 7,100 | 700 | 150 | 150 | 8 | 680 |
| | | 7,100 | 915 | 150 | 150 | 17 | 685 |

Table 9–10
Surface danger zone data for 30mm MK258, MK268 Armor-Piercing Fin-Stabilized Discarding Sabot-Tracer (Fighting Vehicle–Elevation Restriction)

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 13,300 | 390 | NR | NR | 30 | 445 |
| | | 13,450 | 375 | NR | NR | 17 | 445 |
| 1,000 | Earth Armor Plate | 13,700 | 405 | NR | NR | 30 | 452 |
| | | 13,850 | 392 | NR | NR | 17 | 452 |
| 2,000 | Earth Armor Plate | 14,100 | 420 | NR | NR | 30 | 458 |
| | | 14,250 | 409 | NR | NR | 17 | 458 |
| 3,000 | Earth Armor Plate | 14,500 | 440 | NR | NR | 30 | 465 |
| | | 14,650 | 425 | NR | NR | 17 | 465 |
| 4,000 | Earth Armor Plate | 14,875 | 455 | NR | NR | 30 | 471 |
| | | 15,025 | 438 | NR | NR | 17 | 471 |
| 5,000 | Earth Armor Plate | 15,250 | 470 | NR | NR | 30 | 478 |
| | | 15,400 | 451 | NR | NR | 17 | 478 |
| 6,000 | Earth Armor Plate | 15,625 | 485 | NR | NR | 30 | 484 |
| | | 15,775 | 464 | NR | NR | 17 | 484 |
| 7,000 | Earth Armor Plate | 16,000 | 500 | NR | NR | 30 | 490 |
| | | 16,150 | 475 | NR | NR | 17 | 490 |

Legend:
NR=not required

Table 9–11**Surface danger zone data for 30mm MK239 Target Practice-Tracer (free gun no elevation restriction)**

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 8,600 | 6,000 | 575 | NR | NR | 8 | 65 | 2,700 |
| | | 8,600 | 6,000 | 750 | NR | NR | 17 | 65 | 2,700 |
| 1,000 | Earth Armor Plate | 8,870 | 6,140 | 590 | NR | NR | 8 | 65 | 2,770 |
| | | 8,870 | 6,140 | 765 | NR | NR | 17 | 65 | 2,770 |
| 2,000 | Earth Armor Plate | 9,140 | 6,280 | 605 | NR | NR | 8 | 65 | 2,840 |
| | | 9,140 | 6,280 | 780 | NR | NR | 17 | 65 | 2,840 |
| 3,000 | Earth Armor Plate | 9,410 | 6,420 | 620 | NR | NR | 8 | 65 | 2,910 |
| | | 9,410 | 6,420 | 795 | NR | NR | 17 | 65 | 2,910 |
| 4,000 | Earth Armor Plate | 9,710 | 6,590 | 640 | NR | NR | 8 | 65 | 2,985 |
| | | 9,710 | 6,590 | 825 | NR | NR | 17 | 65 | 2,985 |
| 5,000 | Earth Armor Plate | 10,010 | 6,760 | 660 | NR | NR | 8 | 65 | 3,060 |
| | | 10,010 | 6,760 | 855 | NR | NR | 17 | 65 | 3,060 |
| 6,000 | Earth Armor Plate | 10,310 | 6,930 | 680 | NR | NR | 8 | 65 | 3,135 |
| | | 10,310 | 6,930 | 885 | NR | NR | 17 | 65 | 3,135 |
| 7,000 | Earth Armor Plate | 10,610 | 7,100 | 700 | NR | NR | 8 | 65 | 3,210 |
| | | 10,610 | 7,100 | 915 | NR | NR | 17 | 65 | 3,210 |

Legend:

NR=not required

Table 9–12**Surface danger zone data for 30mm MK238 MOD 1 High-Explosive Incendiary-Tracer and MK266 MOD 1 High-Explosive Incendiary-Tracer (free gun–no elevation restriction)**

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 8,600 | 6,000 | 575 | 175 | 175 | 8 | 65 | 2,700 |
| | | 8,600 | 6,000 | 750 | 175 | 175 | 17 | 65 | 2,700 |
| 1,000 | Earth Armor Plate | 8,870 | 6,140 | 590 | 175 | 175 | 8 | 65 | 2,770 |
| | | 8,870 | 6,140 | 765 | 175 | 175 | 17 | 65 | 2,770 |
| 2,000 | Earth Armor Plate | 9,140 | 6,280 | 605 | 175 | 175 | 8 | 65 | 2,840 |
| | | 9,140 | 6,280 | 780 | 175 | 175 | 17 | 65 | 2,840 |
| 3,000 | Earth Armor Plate | 9,410 | 6,420 | 620 | 175 | 175 | 8 | 65 | 2,910 |
| | | 9,410 | 6,420 | 795 | 175 | 175 | 17 | 65 | 2,910 |
| 4,000 | Earth Armor Plate | 9,710 | 6,590 | 640 | 175 | 175 | 8 | 65 | 2,985 |
| | | 9,710 | 6,590 | 825 | 175 | 175 | 17 | 65 | 2,985 |
| 5,000 | Earth Armor Plate | 10,010 | 6,760 | 660 | 175 | 175 | 8 | 65 | 3,060 |
| | | 10,010 | 6,760 | 855 | 175 | 175 | 17 | 65 | 3,060 |
| 6,000 | Earth Armor Plate | 10,310 | 6,930 | 680 | 175 | 175 | 8 | 65 | 3,135 |
| | | 10,310 | 6,930 | 885 | 175 | 175 | 17 | 65 | 3,135 |
| 7,000 | Earth Armor Plate | 10,610 | 7,100 | 700 | 175 | 175 | 8 | 65 | 3,210 |
| | | 10,610 | 7,100 | 915 | 175 | 175 | 17 | 65 | 3,210 |

Table 9–13**Surface danger zone data for 30mm MK264 Multipurpose Low Drag-Tracer (free gun–no elevation restriction)**

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 8,600 8,600 | 6,000 6,000 | 575 750 | 240 240 | 240 240 | 8 17 | 65 65 | 2,700 2,700 |
| 1,000 | Earth Armor Plate | 8,870 8,870 | 6,140 6,140 | 590 765 | 240 240 | 240 240 | 8 17 | 65 65 | 2,770 2,770 |
| 2,000 | Earth Armor Plate | 9,140 9,140 | 6,280 6,280 | 605 780 | 240 240 | 240 240 | 8 17 | 65 65 | 2,840 2,840 |
| 3,000 | Earth Armor Plate | 9,410 9,410 | 6,420 6,420 | 620 795 | 240 240 | 240 240 | 8 17 | 65 65 | 2,910 2,910 |
| 4,000 | Earth Armor Plate | 9,710 9,710 | 6,590 6,590 | 640 825 | 240 240 | 240 240 | 8 17 | 65 65 | 2,985 2,985 |
| 5,000 | Earth Armor Plate | 10,010 10,010 | 6,760 6,760 | 660 855 | 240 240 | 240 240 | 8 17 | 65 65 | 3,060 3,060 |
| 6,000 | Earth Armor Plate | 10,310 10,310 | 6,930 6,930 | 680 885 | 240 240 | 240 240 | 8 17 | 65 65 | 3,135 3,135 |
| 7,000 | Earth Armor Plate | 10,610 10,610 | 7,100 7,100 | 700 915 | 240 240 | 240 240 | 8 17 | 65 65 | 3,210 3,210 |

Table 9–14**Surface danger zone data for 30mm MK310 Programmable Air Burst Munition-Tracer (free gun–no elevation restriction)**

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 8,600 8,600 | 6,000 6,000 | 575 750 | 150 150 | 150 150 | 8 17 | 65 65 | 2,700 2,700 |
| 1,000 | Earth Armor Plate | 8,870 8,870 | 6,140 6,140 | 590 765 | 150 150 | 150 150 | 8 17 | 65 65 | 2,770 2,770 |
| 2,000 | Earth Armor Plate | 9,140 9,140 | 6,280 6,280 | 605 780 | 150 150 | 150 150 | 8 17 | 65 65 | 2,840 2,840 |
| 3,000 | Earth Armor Plate | 9,410 9,410 | 6,420 6,420 | 620 795 | 150 150 | 150 150 | 8 17 | 65 65 | 2,910 2,910 |
| 4,000 | Earth Armor Plate | 9,710 9,710 | 6,590 6,590 | 640 825 | 150 150 | 150 150 | 8 17 | 65 65 | 2,985 2,985 |
| 5,000 | Earth Armor Plate | 10,010 10,010 | 6,760 6,760 | 660 855 | 150 150 | 150 150 | 8 17 | 65 65 | 3,060 3,060 |
| 6,000 | Earth Armor Plate | 10,310 10,310 | 6,930 6,930 | 680 885 | 150 150 | 150 150 | 8 17 | 65 65 | 3,135 3,135 |
| 7,000 | Earth Armor Plate | 10,610 10,610 | 7,100 7,100 | 700 915 | 150 150 | 150 150 | 8 17 | 65 65 | 3,210 3,210 |

Table 9–15

Surface danger zone data for 30mm MK258 Armor-Piercing Fin-Stabilized Discarding Sabot-Tracer and MK268 Armor-Piercing Fin-Stabilized Discarding Sabot-Tracer (free gun–no elevation restriction)—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------|
| 0 | Earth Armor Plate | 30,800 | 18,500 | 390 | NR | NR | 30 | 15 | 18,705 |
| | | 30,800 | 18,500 | 375 | NR | NR | 17 | 15 | 18,705 |
| 1,000 | Earth Armor Plate | 32,965 | 18,665 | 405 | NR | NR | 30 | 15 | 19,625 |
| | | 32,965 | 18,665 | 392 | NR | NR | 17 | 15 | 19,625 |
| 2,000 | Earth Armor Plate | 35,130 | 18,830 | 420 | NR | NR | 30 | 15 | 20,545 |
| | | 35,130 | 18,830 | 409 | NR | NR | 17 | 15 | 20,545 |
| 3,000 | Earth Armor Plate | 37,300 | 19,000 | 440 | NR | NR | 30 | 15 | 21,465 |
| | | 37,300 | 19,000 | 425 | NR | NR | 17 | 15 | 21,465 |
| 4,000 | Earth Armor Plate | 39,925 | 19,250 | 455 | NR | NR | 30 | 15 | 22,530 |
| | | 39,925 | 19,250 | 438 | NR | NR | 17 | 15 | 22,530 |
| 5,000 | Earth Armor Plate | 42,550 | 19,500 | 470 | NR | NR | 30 | 15 | 23,595 |
| | | 42,550 | 19,500 | 451 | NR | NR | 17 | 15 | 23,595 |
| 6,000 | Earth Armor Plate | 45,175 | 19,750 | 485 | NR | NR | 30 | 15 | 24,660 |
| | | 45,175 | 19,750 | 464 | NR | NR | 17 | 15 | 24,660 |
| 7,000 | Earth Armor Plate | 47,800 | 20,000 | 500 | NR | NR | 30 | 15 | 25,730 |
| | | 47,800 | 20,000 | 475 | NR | NR | 17 | 15 | 25,730 |

Legend:

NR=not required

Table 9–16

Surface danger zone data for 30mm MK 258 Armor-Piercing Fin-Stabilized Discarding Sabot-Tracer and MK268 Armor-Piercing Fin-Stabilized Discarding Sabot-Tracer sabot discard area (all firing conditions)

| Item | Dist Y (m) | Dist W (m) | Angle P (deg) | Angle Q (deg) |
|-------|------------------|------------------|---------------------|---------------------|
| MK258 | 250 | 30 | 15 | 90 |
| MK268 | 175 | 40 | 30 | 90 |

Table 9–17

Surface danger zone data for 30mm MK317, Target Practice Frangible Discarding Sabot-Tracer¹

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|------------------|----------------------|------------------|------------------|------------------|------------------|---------------------|---------------------------------------|
| 0 | Earth Armor Plate | 5,925 | 320 | NR | NR | 22 | 290 |
| | | 6,100 | 600 | NR | NR | 21 | 480 |
| 1,000 | Earth Armor Plate | 6,092 | 330 | NR | NR | 22 | 300 |
| | | 6,275 | 617 | NR | NR | 21 | 495 |
| 2,000 | Earth Armor Plate | 6,259 | 340 | NR | NR | 22 | 310 |
| | | 6,450 | 634 | NR | NR | 21 | 510 |
| 3,000 | Earth Armor Plate | 6,425 | 350 | NR | NR | 22 | 320 |
| | | 6,625 | 650 | NR | NR | 21 | 525 |
| 4,000 | Earth | 6,613 | 360 | NR | NR | 22 | 330 |

Table 9–17
Surface danger zone data for 30mm MK317, Target Practice Frangible Discarding Sabot-Tracer¹—Continued

| Altitude (ft) | Impact media | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Ricochet vertical hazard (m) |
|---------------|----------------------|----------------|------------|------------|------------|---------------|------------------------------|
| | Armor Plate | 6,825 | 670 | NR | NR | 21 | 541 |
| 5,000 | Earth Armor Plate | 6,801 7,025 | 370 690 | NR NR | NR NR | 22 21 | 340 558 |
| 6,000 | Earth Armor Plate | 6,989 7,225 | 380 710 | NR NR | NR NR | 22 21 | 350 574 |
| 7,000 | Earth Armor Plate | 7,175 7,425 | 390 730 | NR NR | NR NR | 22 21 | 360 590 |

Legend:

NR=not required

Note.

¹To correct for CR winds, the dispersion angle is increased by 0.10 degree per m/s or 0.05 degree per knot of crosswind.

Table 9–18
Surface danger zone data for 30mm M1198 High-Explosive Dual-Purpose Discarding Sabot^{1,2} fired from the vehicle-mounted XM914E1 Chain-gun

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|---------------|----------------|----------------|----------------|----------------|------------|------------|----------------|----------------|------------------------------|
| 0 | Earth Steel | 5,310 5,310 | 5,200 5,200 | 875 1,095 | 275 275 | 275 275 | 20 20 | 32 40 | 2,320 2,320 |
| 1,000 | Earth Steel | 5,455 5,455 | 5,345 5,345 | 900 1,120 | 275 275 | 275 275 | 20.50 20.50 | 31.50 39.50 | 2,356 2,356 |
| 2,000 | Earth Steel | 5,605 5,605 | 5,495 5,495 | 925 1,145 | 275 275 | 275 275 | 21 21 | 31 39 | 2,393 2,393 |
| 3,000 | Earth Steel | 5,760 5,760 | 5,650 5,650 | 950 1,170 | 275 275 | 275 275 | 21.50 21.50 | 30.50 38.50 | 2,430 2,430 |
| 4,000 | Earth Steel | 5,915 5,915 | 5,805 5,805 | 975 1,195 | 275 275 | 275 275 | 22 22 | 30 38 | 2,465 2,465 |
| 5,000 | Earth Steel | 6,080 6,080 | 5,970 5,970 | 1,000 1,220 | 275 275 | 275 275 | 22.50 22.50 | 29.50 37.50 | 2,502 2,502 |
| 6,000 | Earth Steel | 6,250 6,250 | 6,140 6,140 | 1,025 1,245 | 275 275 | 275 275 | 23 23 | 29 37 | 2,538 2,538 |
| 7,000 | Earth Steel | 6,425 6,425 | 6,315 6,315 | 1,050 1,270 | 275 275 | 275 275 | 23.50 23.50 | 28.50 36.50 | 2,575 2,575 |

Notes.

¹ Dispersion angle for the 30mm M1198 HEDP Sabot Discarding round is eight degrees.

² For SDZ construction, see figure 5–5.

Table 9–19**Surface danger zone data for 30mm M950 Target Practice^{1,2} when fired from the vehicle-mounted XM914E1 Chain-gun—Continued**

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth | 5,310 | 5,200 | 875 | NR | NR | 20 | 32 | 2,320 |
| | Steel | 5,310 | 5,200 | 1,095 | NR | NR | 20 | 40 | 2,320 |
| 1,000 | Earth | 5,455 | 5,345 | 900 | NR | NR | 20.50 | 31.50 | 2,356 |
| | Steel | 5,455 | 5,345 | 1,120 | NR | NR | 20.50 | 39.50 | 2,356 |
| 2,000 | Earth | 5,605 | 5,495 | 925 | NR | NR | 21 | 31 | 2,393 |
| | Steel | 5,605 | 5,495 | 1,145 | NR | NR | 21 | 39 | 2,393 |
| 3,000 | Earth | 5,760 | 5,650 | 950 | NR | NR | 21.50 | 30.50 | 2,430 |
| | Steel | 5,760 | 5,650 | 1,170 | NR | NR | 21.50 | 38.50 | 2,430 |
| 4,000 | Earth | 5,915 | 5,805 | 975 | NR | NR | 22 | 30 | 2,465 |
| | Steel | 5,915 | 5,805 | 1,195 | NR | NR | 22 | 38 | 2,465 |
| 5,000 | Earth | 6,080 | 5,970 | 1,000 | NR | NR | 22.50 | 29.50 | 2,502 |
| | Steel | 6,080 | 5,970 | 1,220 | NR | NR | 22.50 | 37.50 | 2,502 |
| 6,000 | Earth | 6,250 | 6,140 | 1,025 | NR | NR | 23 | 29 | 2,538 |
| | Steel | 6,250 | 6,140 | 1,245 | NR | NR | 23 | 37 | 2,538 |
| 7,000 | Earth | 6,425 | 6,315 | 1,050 | NR | NR | 23.50 | 28.50 | 2,575 |
| | Steel | 6,425 | 6,315 | 1,270 | NR | NR | 23.50 | 36.50 | 2,575 |

Legend: NR=not required

Notes.

¹ Dispersion angle for the 30mm M950 TP round is 8 degrees.² For SDZ construction, see figure 5–3.**Table 9–20****Surface danger zone data for 30mm Lightweight M788 Target Practice fired from the 30mm XM914E1 Chain-gun^{1,2}**

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth | 5,310 | 5,200 | 875 | NR | NR | 20 | 32 | 2,320 |
| | Steel | 5,310 | 5,200 | 1,095 | NR | NR | 20 | 40 | 2,320 |
| 1,000 | Earth | 5,455 | 5,345 | 900 | NR | NR | 20.50 | 31.50 | 2,356 |
| | Steel | 5,455 | 5,345 | 1,120 | NR | NR | 20.50 | 39.50 | 2,356 |
| 2,000 | Earth | 5,605 | 5,495 | 925 | NR | NR | 21 | 31 | 2,393 |
| | Steel | 5,605 | 5,495 | 1,145 | NR | NR | 21 | 39 | 2,393 |
| 3,000 | Earth | 5,760 | 5,650 | 950 | NR | NR | 21.50 | 30.50 | 2,430 |
| | Steel | 5,760 | 5,650 | 1,170 | NR | NR | 21.50 | 38.50 | 2,430 |
| 4,000 | Earth | 5,915 | 5,805 | 975 | NR | NR | 22 | 30 | 2,465 |
| | Steel | 5,915 | 5,805 | 1,195 | NR | NR | 22 | 38 | 2,465 |
| 5,000 | Earth | 6,080 | 5,970 | 1,000 | NR | NR | 22.50 | 29.50 | 2,502 |
| | Steel | 6,080 | 5,970 | 1,220 | NR | NR | 22.50 | 37.50 | 2,502 |
| 6,000 | Earth | 6,250 | 6,140 | 1,025 | NR | NR | 23 | 29 | 2,538 |
| | Steel | 6,250 | 6,140 | 1,245 | NR | NR | 23 | 37 | 2,538 |
| 7,000 | Earth | 6,425 | 6,315 | 1,050 | NR | NR | 23.50 | 28.50 | 2,575 |
| | Steel | 6,425 | 6,315 | 1,270 | NR | NR | 23.50 | 36.50 | 2,575 |

Table 9–20
Surface danger zone data for 30mm Lightweight M788 Target Practice fired from the 30mm XM914E1 Chain-
gun^{1,2}

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|

Legend: NR=not required

Notes.

¹ Dispersion angle for the 30mm Lightweight (LW) M788 TP round is eight degrees.

² For SDZ construction, see figure 5–3.

Table 9–21
Surface danger zone data for 30mm Lightweight M789 High-Explosive Dual-Purpose fired from the 30mm XM914E1 Chain-
gun^{1,2}

| Altitude (ft) | Impact media | Dist X (m) | Dist Y (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) | Angle Q (deg) | Ricochet vertical hazard (m) |
|------------------|-----------------|------------------|------------------|------------------|------------------|------------------|---------------------|---------------------|---------------------------------------|
| 0 | Earth | 5,310 | 5,200 | 875 | 275 | 275 | 20 | 32 | 2,320 |
| | Steel | 5,310 | 5,200 | 1,095 | 275 | 275 | 20 | 40 | 2,320 |
| 1,000 | Earth | 5,455 | 5,345 | 900 | 275 | 275 | 20.50 | 31.50 | 2,356 |
| | Steel | 5,455 | 5,345 | 1,120 | 275 | 275 | 20.50 | 39.50 | 2,356 |
| 2,000 | Earth | 5,605 | 5,495 | 925 | 275 | 275 | 21 | 31 | 2,393 |
| | Steel | 5,605 | 5,495 | 1,145 | 275 | 275 | 21 | 39 | 2,393 |
| 3,000 | Earth | 5,760 | 5,650 | 950 | 275 | 275 | 21.50 | 30.50 | 2,430 |
| | Steel | 5,760 | 5,650 | 1,170 | 275 | 275 | 21.50 | 38.50 | 2,430 |
| 4,000 | Earth | 5,915 | 5,805 | 975 | 275 | 275 | 22 | 30 | 2,465 |
| | Steel | 5,915 | 5,805 | 1,195 | 275 | 275 | 22 | 38 | 2,465 |
| 5,000 | Earth | 6,080 | 5,970 | 1,000 | 275 | 275 | 22.50 | 29.50 | 2,502 |
| | Steel | 6,080 | 5,970 | 1,220 | 275 | 275 | 22.50 | 37.50 | 2,502 |
| 6,000 | Earth | 6,250 | 6,140 | 1,025 | 275 | 275 | 23 | 29 | 2,538 |
| | Steel | 6,250 | 6,140 | 1,245 | 275 | 275 | 23 | 37 | 2,538 |
| 7,000 | Earth | 6,425 | 6,315 | 1,050 | 275 | 275 | 23.50 | 28.50 | 2,575 |
| | Steel | 6,425 | 6,315 | 1,270 | 275 | 275 | 23.50 | 36.50 | 2,575 |

Legend:

NR=not required

Notes.

¹ Dispersion angle for the 30mm LW M789 HEDP round is eight degrees.

² For SDZ construction, see figure 5–5.

Table 9–22
Surface danger zone data for sub-caliber devices—Continued

| Ammunition/device | Impact media | Dist X at 10 degrees or less (m) | Dist W (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|---|-------------------------------|----------------------------------|----------------|------------|------------|------------------------------|
| .22 caliber LR DVC–D17–53 caliber.22 in-bore | Earth/water Concrete/steel | 1,073 1,073 | 155 386 | NR NR | NR NR | 96 245 |
| 5.56mm M856 Tracer Brewster DVC–D17–87 | Earth/water Concrete/steel | 2,250 2,250 | 260 202 | NR NR | NR NR | 261 261 |
| 7.62mm M80 Ball DVC–D17–87 (Brewster single shot) | Earth/water Concrete/steel | 3,100 3,100 | 1,461 861 | NR NR | NR NR | 706 447 |
| .50 caliber M2 Ball, MK211 | Earth/water Concrete/steel | 4,400 4,400 | 1,652 714 | NR NR | NR NR | 901 478 |
| .50 caliber SLAP M962 120mm in-bore AIMTEST ¹ | Earth/water Concrete/steel | 6,069 6,069 | 1,149 1,149 | NR NR | NR NR | See note 2 See note 2 |

Legend:

NR=not required

Notes.

¹ Data based on 7,000 ft mean sea level (MSL).

² Use value of Distance W until validated test data is available.

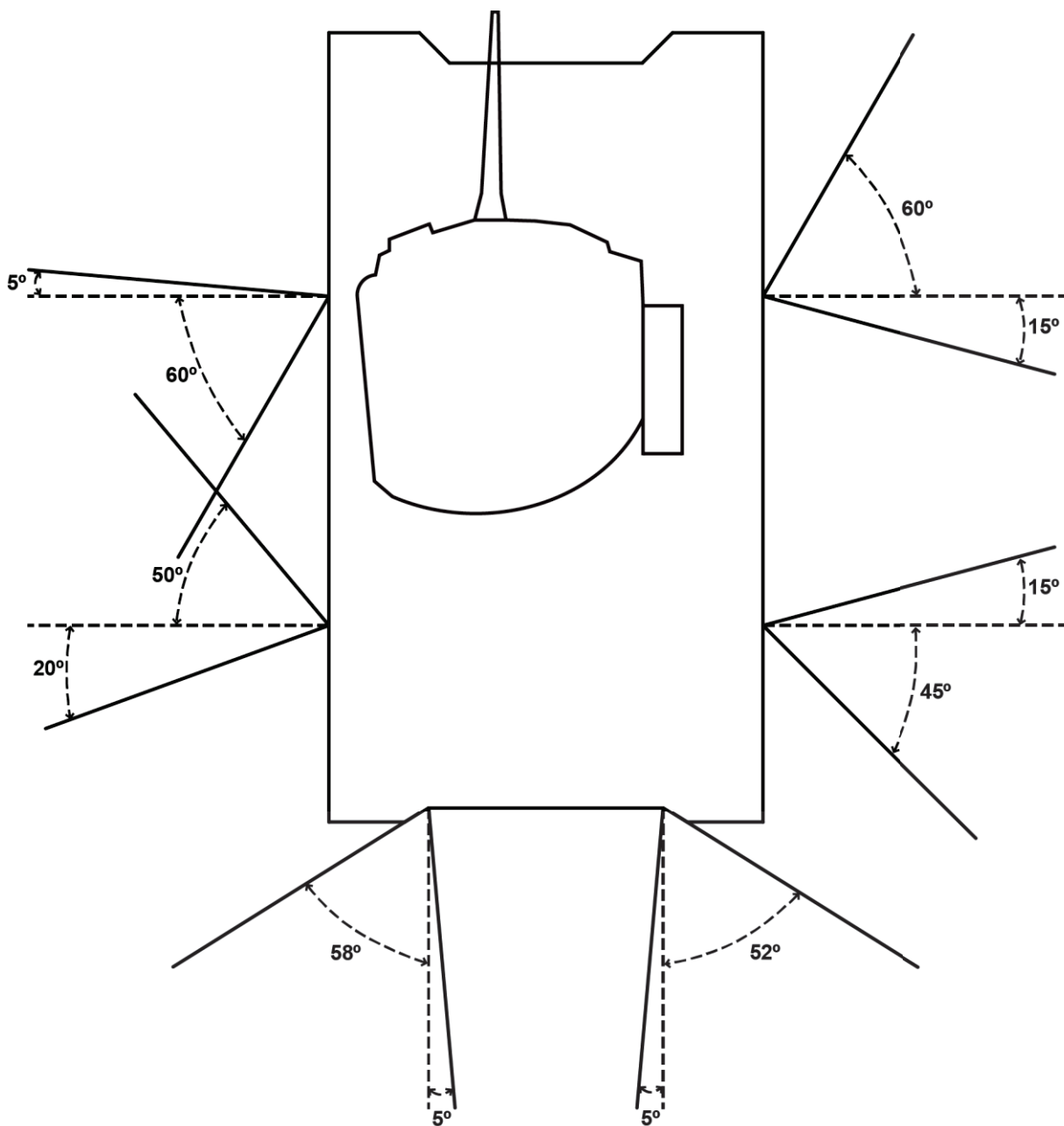
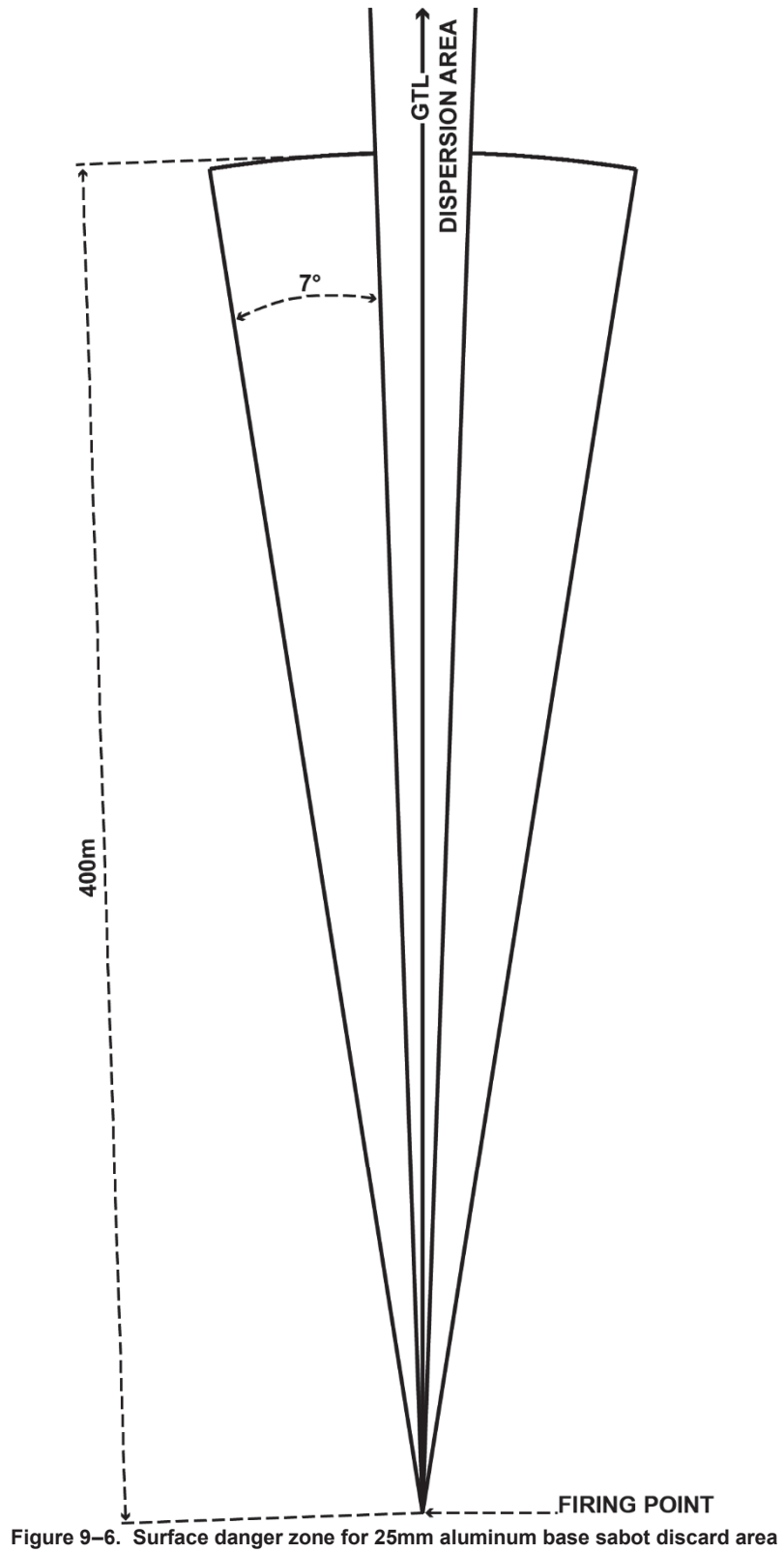


Figure 9–5. Surface danger zone for fighting vehicle firing port weapon systems

b. See table 9–16 and figures 9–6 through 9–8 for 25mm and 30mm aluminum and plastic base Sabot discard hazard area information.



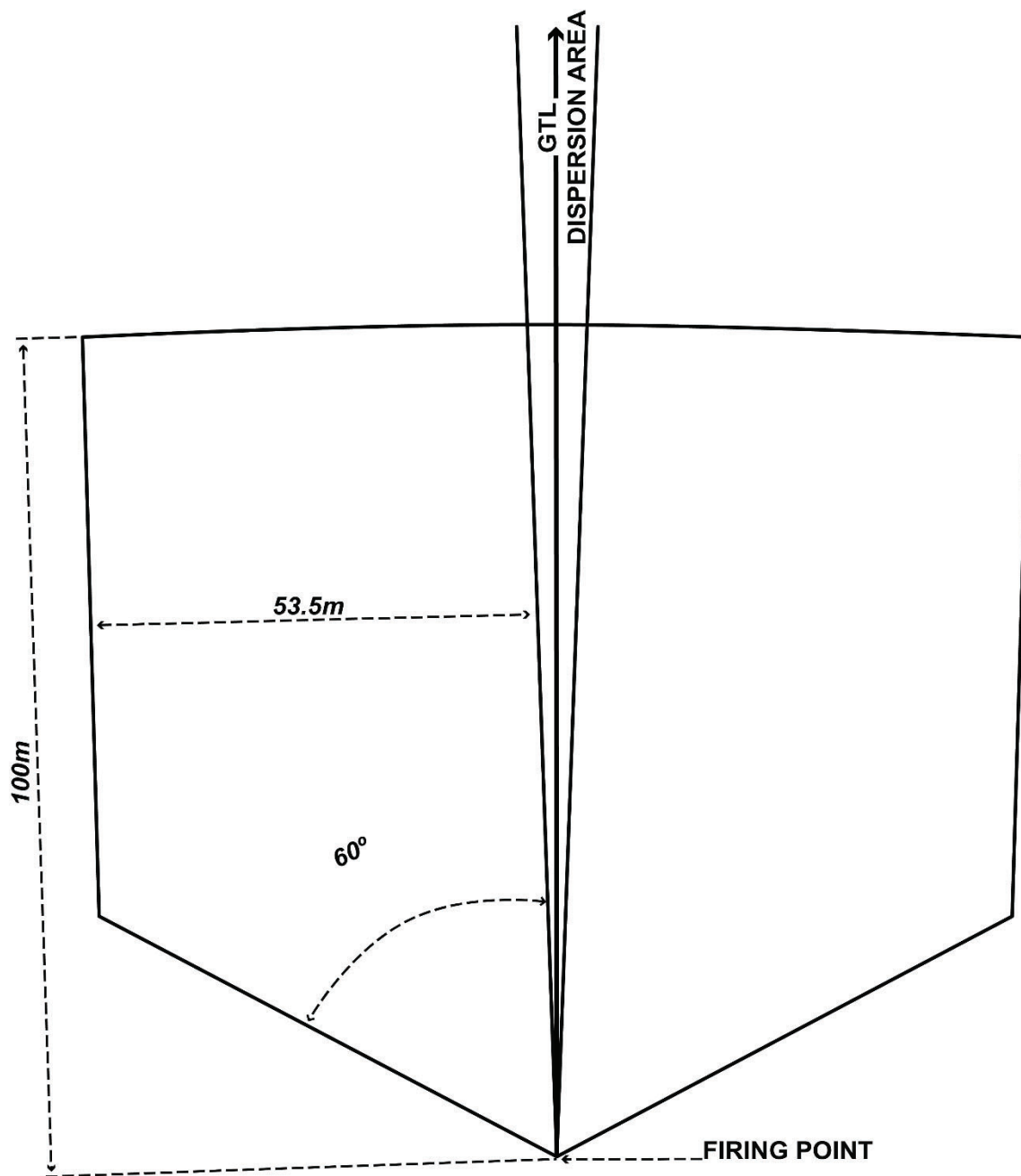


Figure 9–7. Surface danger zone for 25mm plastic base sabot discard area

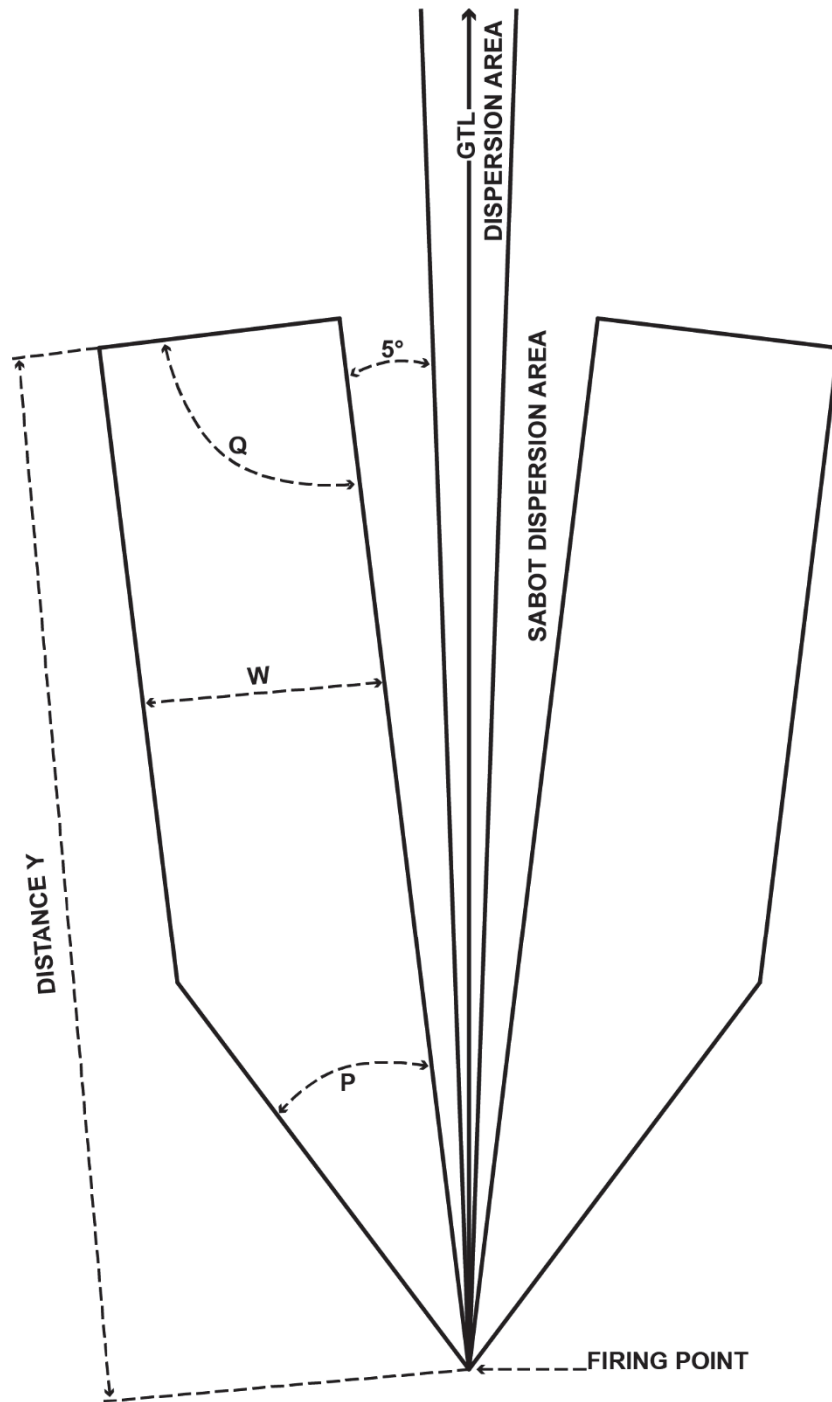


Figure 9-8. Surface danger zone for 30mm discard area

9-5. Firing vehicle status designations

a. Safety precautions for firing vehicle status designations will be determined by appropriate risk authority based on risk assessment and training objectives. Use of flags and lights is an alternative safety precaution to reduce risk of accidental losses during training operations. The following color scheme is recommended when flags or lights are used:

- (1) Yellow: vehicle has malfunction. Yellow is used only in conjunction with red or green.

(2) Red and green: vehicle is preparing to fire or the crew is performing a non-firing exercise. Weapon systems are clear but not elevated.

(3) Red and yellow: vehicle has a malfunction or misfire. Weapon systems are not clear and are pointed down range.

(4) Green and yellow: vehicle has a malfunction. Weapon systems are clear.

(5) Red: vehicle engaged in firing. Weapons must be pointed at the target area.

(6) Green: all vehicles' weapon systems are clear and elevated. Any live ammunition in the vehicle is properly stowed.

b. Once a firing vehicle begins a battle run and passes the start-fire line, all weapon systems, including laser systems, are considered to be loaded and ready to fire. Senior commanders (Army) or installation commanders (Marine Corps) may require vehicles on a battle run to display status flags or lights or other control measure based on a risk assessment.

c. When the firing vehicle completes a battle run, the tank or fighting vehicle commander will ensure the weapon systems have been cleared. Before the vehicle moves off the firing line, out of the maneuver box, or out of a battle position to a designated position, the vehicle commander, RSO, or ARSO will mount the vehicle and verify weapon systems clearance, to include laser systems. Proper flags or lights may be displayed to identify the status of the weapons.

d. Tank and fighting vehicle commanders or RSOs will ensure the weapon systems are aligned within the envelope of the vehicle's width when traveling off-range onto roadways or tank or fighting vehicle trails, unless previously coordinated with range operations (Army) or range control (Marine Corps) for purposes of tactical road marches.

9-6. Sub-caliber tank and fighting vehicle gunnery devices

a. SDZ will be constructed as shown in figure 9-1.

b. The dimensions in table 9-22 will be used based on munition caliber.

9-7. Grenade launchers

a. *Firing conditions.*

(1) SDZ occupation by unprotected personnel in the open is prohibited.

(2) Grenades will not be fired into strong head winds (19 km per hour (12 mph) and greater).

(3) PPE Level 1 is recommended with hand protection for personnel within the SDZ (see table 2-2).

(4) Clothing will fit snugly to prevent red phosphorous fragments from getting inside clothing, particularly around the neck, ends of sleeves, and pockets.

b. *Surface danger zone.*

(1) The L8A1 and L8A3 grenades are designed to launch out 30 m from the vehicle before functioning (see figure 9-9 for SDZ requirements for firing the L8A1 and L8A3 smoke grenades). Hazard distances of 125 m from the vehicle in the direction of fire and 50 m to the rear will be applied in accordance with figure 9-9.

(2) See figure 9-10 for SDZ requirements for the M176, M226, and M239 grenade launchers. Dimensions shown in figure 9-10 are for illustrative purposes only.

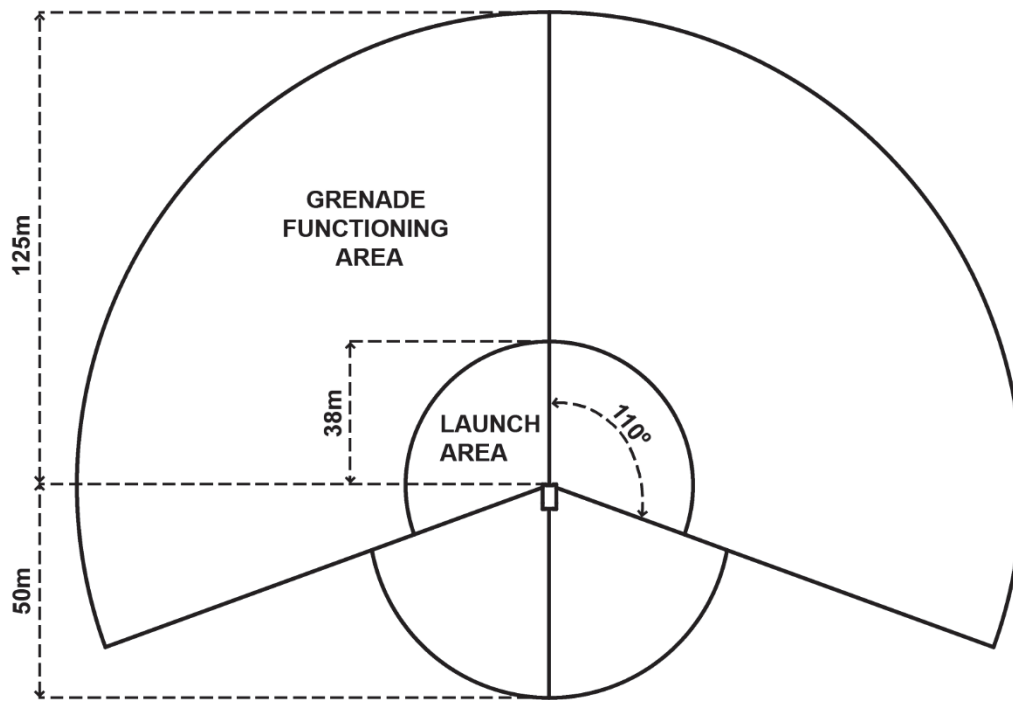


Figure 9-9. Surface danger zone for L8A1 and A3 smoke grenades on armored vehicles

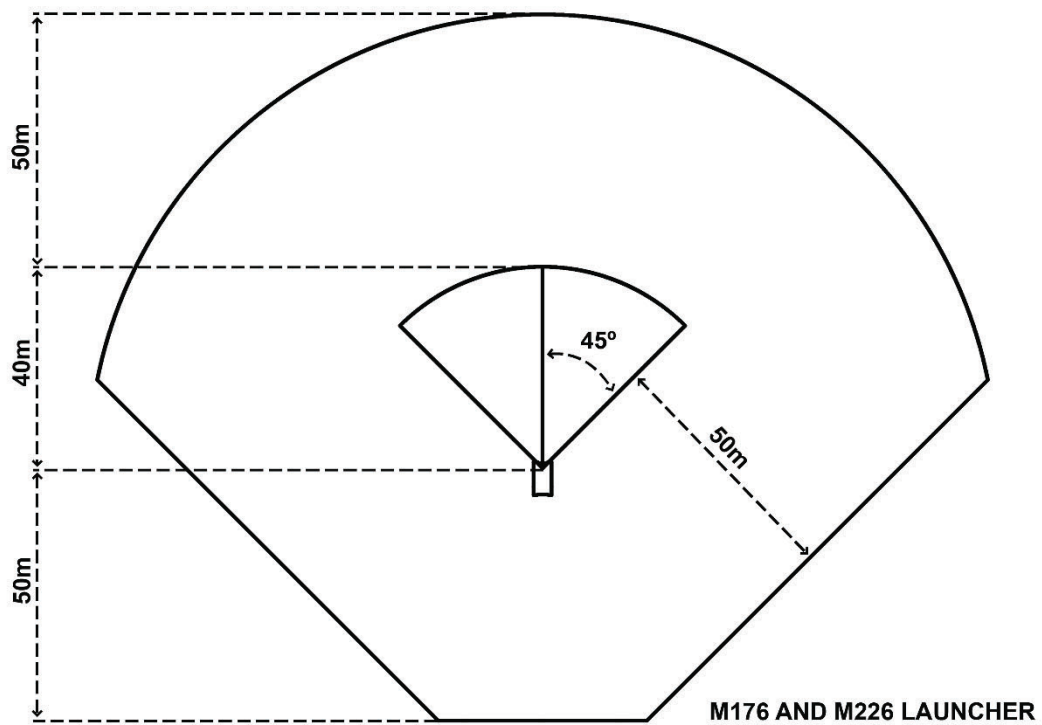
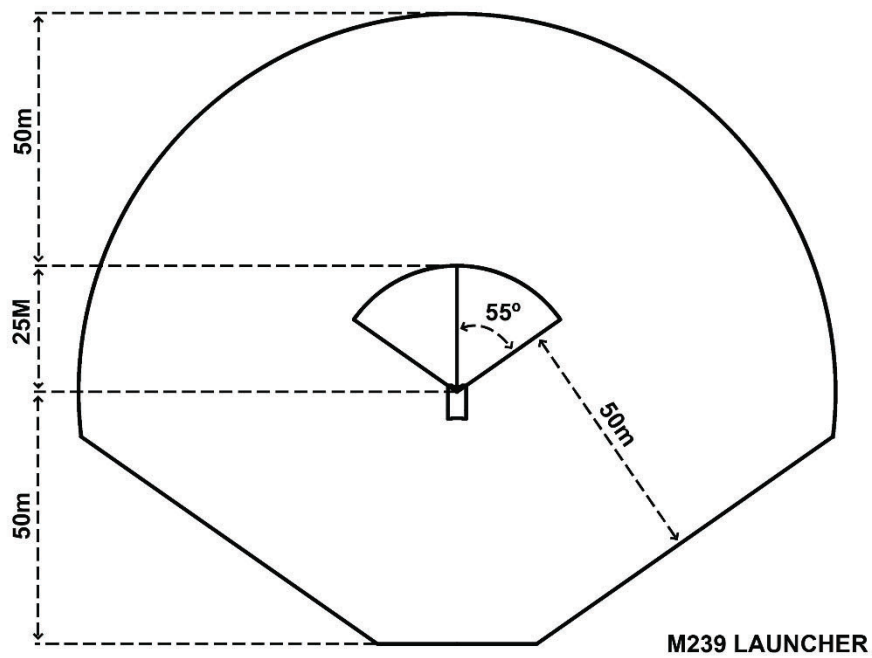


Figure 9–10. Surface danger zone for grenades from M176, M226, and M239 grenade launchers on armored vehicles

(3) See figure 9–11 for SDZ requirements for firing M81 grenades.

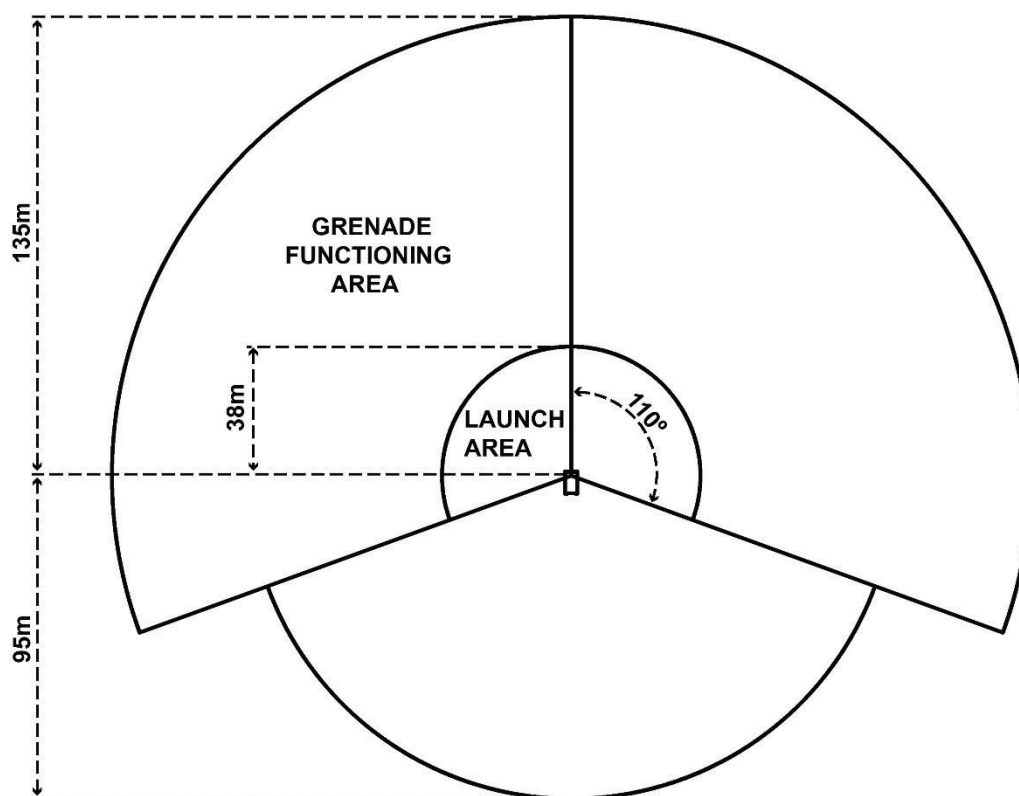


Figure 9–11. Surface danger zone for M81 grenade using standard 66mm launchers on armored vehicles

(4) See figure 9–12 for SDZ requirements for firing M82 grenades.

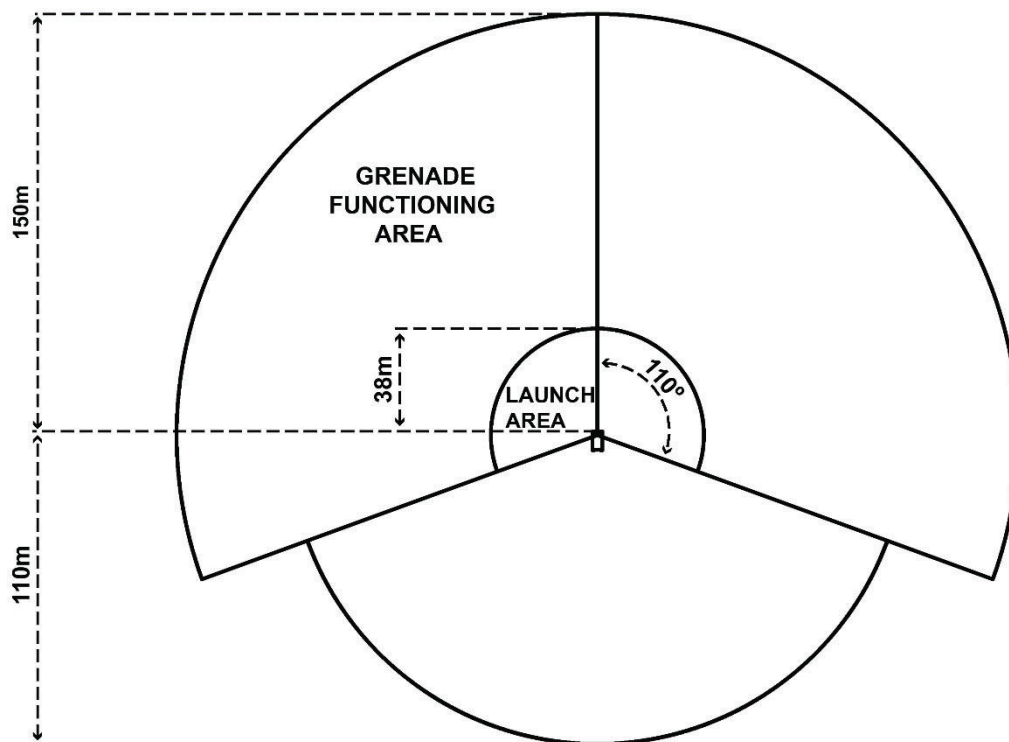


Figure 9–12. Surface danger zone for M82 grenade from 66mm launcher on armored vehicles

9–8. Close support of ground personnel

- Firing over the heads of unprotected personnel by tank and fighting vehicle main guns is prohibited.
- Tank and fighting vehicle weapons systems may be used to provide flanking fire if unprotected personnel remain out of the SDZ.
- Only personnel wearing approved single-hearing protection will be allowed within 140-dB peak level contour zones during tank and fighting vehicle main gun firings.
- Nonparticipating personnel will be restricted from areas 10 m to the sides and from all areas forward of tanks and fighting vehicles.

9–9. Weapons effect signature simulator

- Personnel within 25 m of the weapons effect signature simulator (WESS) will wear approved single-hearing protection.
- Eye protection will be worn.

9–10. Hazardous impulse noise exposure

- See table 9–23 for exposure limits to impulse noise when firing the 105mm main gun.

Table 9–23
Exposure limits to hazardous impulse noise from 105mm main gun cartridge (per 24 hours)

| Cartridge caliber | Cartridge type | Commander exposed | Gunner exposed | Examiner exposed | Commander adjacent tank |
|-------------------|----------------|-------------------|----------------|------------------|-------------------------|
| 105mm | M490A1 | 10 | 10 | 0 | 20 |

b. The driver's hatch must be closed tight at all times when the main weapon is fired. Exposure limits and contour distances to hazardous impulse noise in excess of 140 dBP from various 105mm and 120mm tank cannon cartridges are based on health hazard assessment reports (see table 9–24 for exposure limits for tank and fighting vehicle main gun firings).

Table 9–24
Exposure limits to hazardous impulse noise from 120mm tank main gun for selected cartridges (per 24 hours)

| Cartridge type | Firing condition | Single-hearing protection ¹ | Double-hearing protection ² |
|----------------|--|--|--|
| | | Maximum rounds per day | |
| M831 TP–T | Exposed commander | 16 | 320 |
| M831 TP–T | Exposed leader or evaluator | 11 | 220 |
| M831 TP–T | Rear deck | 95 | NPL |
| M831 TP–T | Interior commander (hatch open) | NPL | NPL |
| M831 TP–T | Interior driver (commander or leader hatch open) | NPL | NPL |
| M831 TP–T | Exposed commander adjacent tank | 15 | 300 |
| M831 TP–T | Exposed leader adjacent tank | 15 | 300 |
| M831A1 TP–T | Exposed commander | 45 | 894 |
| M831A1 TP–T | Exposed leader or evaluator | 20 | 400 |
| M831A1 TP–T | Rear deck | 52 | NPL |
| M831A1 TP–T | Interior commander (hatch open) | 215 | NPL |
| M831A1 TP–T | Interior driver (leader or evaluator hatch open) | 73 | NPL |
| M831A1 TP–T | Exposed commander adjacent tank | 65 | NPL |
| M831A1 TP–T | Exposed leader adjacent tank | 66 | NPL |
| M865 TPCSDS–T | Exposed commander | 0 | 0 |
| M865 TPCSDS–T | Exposed leader/evaluator | 0 | 0 |
| M865 TPCSDS–T | Rear deck | 13 | 260 |
| M865 TPCSDS–T | Interior commander (hatch open) | 27 | 549 |
| M865 TPCSDS–T | Interior driver (leader or evaluator hatch open) | NDA | NDA |
| M865 TPCSDS–T | Exposed leader or evaluator adjacent tank | ENA | 0 |
| M865 TPCSDS–T | Exposed leader adjacent tank | 0 | 0 |

Legend:

ENA=exposure not allowed

NDA=no data available

NPL=no practical limit

TP–T=Target Practice-Tracer

TPCSDS–T=Target Practice, Cone-Stabilized Discarding Sabot-Tracer

Notes.

¹ Single-hearing protection includes approved earplugs, earmuffs, combat vehicle crewman helmet, or headset.

² Double-hearing protection includes use approved earplugs in combination with combat vehicle crewman helmet, or headset.

³ Regarding hearing conservation, see <https://ph.health.mil/Pages/Products-Services.aspx> or <https://www.milsuite.mil/book/communty/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.

c. Do not allow tank or fighting vehicle crew examiners or other personnel on the outside of a firing tank or fighting vehicle.

d. Numerous health hazard assessment reports define hazardous impulse noise contours for various tank and fighting vehicle main gun and secondary armament cartridges exceeding 140 dBP. Table 9–25 summarizes these contour requirements and figure 9–13 shows the hazardous impulse noise contours in relation to the GTL. Double-

hearing protection must be worn when exposure is expected to be in excess of the daily exposure limit. Use of double-hearing protection increases the daily exposure limits as determined by TSG. Loader may not have their head protruding above the open hatch while firing the main gun. Data for locations forward of tank and fighting vehicle weapon systems are not available. Impulse noise levels in front of tank systems are expected to be higher than to the sides and rear.

Table 9–25
Hazardous impulse noise contours for various tank and vehicle cannon cartridge

| Caliber | Cartridge | Distance to 140 dBP contours (m) | | |
|---------|-----------|----------------------------------|-------------|-------------|
| | | 90 degrees | 135 degrees | 180 degrees |
| 105mm | M490 | 501 | NDA | NDA |
| 105mm | M490A1 | 400 | NDA | 200 |
| 120mm | M831 | 444 | 314 | 152 |
| 120mm | M865 | 501 | 355 | NDA |
| 35mm | M968 | 130 | NDA | NDA |
| .50 cal | All | 32 | 16 | NDA |
| 7.62mm | All | 15 | 7 | NDA |

Legend:
NDA=no data available

Notes.

¹ Regarding hearing conservation, see <https://ph.health.mil/Pages/Products-Services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.

Notes.

¹ Regarding hearing conservation, see <https://ph.health.mil/Pages/Products-Services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.

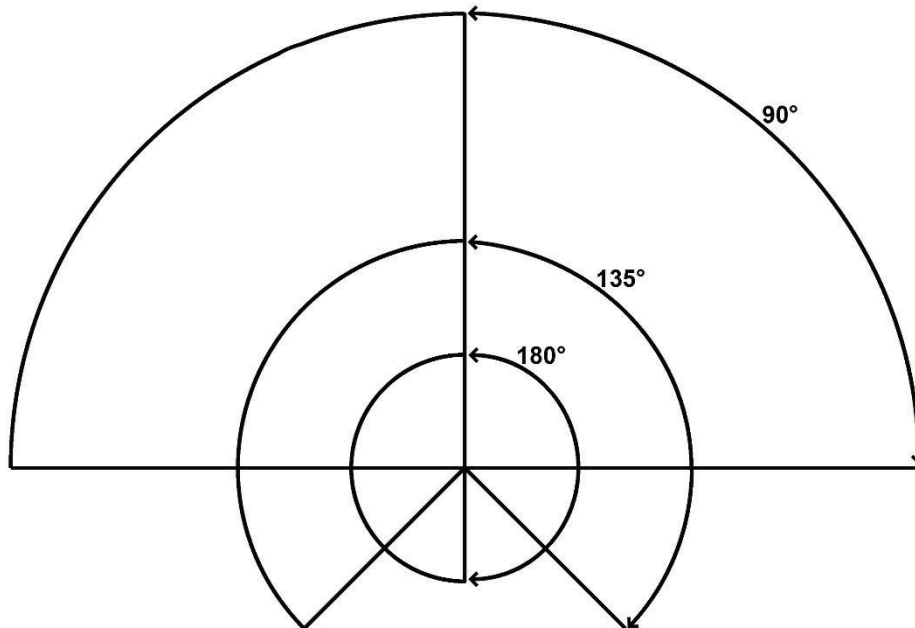


Figure 9-13. Hazardous impulse noise 140 decibels peak contour zones

Chapter 10 Mortars

10-1. Firing conditions

a. Firing mortars over the heads of unprotected troops by Army units is not authorized. The senior commander may approve overhead fire of unprotected troops with a deviation based on acceptable level of risk. Procedural controls to prevent human error (for example, dedicated observer-controllers with the unprotected troops and firing mortars with dedicated communications) will be included in the RM process.

b. For the Marine Corps, when firing HE munitions, mortars must be fired at the edge of a high-hazard impact area. IL and practice rounds may be fired into a dedicated impact area.

c. Firing mortars over the heads of troops by Marine Corps units is not authorized.

d. Overhead fire is allowed when participating personnel are in tanks and fighting vehicles with hatches closed 100 m or more from the line of fire.

e. All personnel who take part in mortar firing will require PPE Level 1 (see table 2-2). At the commander's discretion, the gunner may remove their protective helmet while sighting the mortar. All personnel within the hearing hazard zone for the mortar, cartridge, or charge increment used will wear approved single-hearing protection. The hearing hazard zone is usually defined in the manuals for the mortar or cartridges. If the hearing hazard zone information cannot be determined, single-hearing protection will be required within 200 m.

f. Propellant increments removed from rounds before firing will be placed in metal or wooden covered (waterproofed) containers located outside the firing vehicle or positioned a distance of at least 25 m from the firing point when firing dismounted. Unused propellant increments must be safeguarded and handled in accordance with installation range, environmental regulations and applicable TMs.

g. M720, M721, M722, and M888 cartridges will not be fired above propellant charge 2 in the M2/M19 (60mm) mortar.

h. No mortar cartridges will be fired in the hand-held mode with a charge greater than charge 1.

- i. No 800 series cartridges may be fired in the M29 (81mm) mortar except the M880 short-range target practice round. This also applies when using the M303 insert.
- j. When firing the 120mm mortar from the carrier, all crew members and personnel inside the carrier must wear double-hearing protection. Double-hearing protection is required regardless of the carrier ramp position (opened or closed). Double-hearing protection is defined as any approved earplugs plus either a combat vehicle crewman helmet or a communication aural protective system or artillery communication aural protective system with personnel armored system for ground troops helmet. Personnel outside the carrier within 200 m must wear single-hearing protection.
- k. Crew members and all personnel within 5 m of the 120mm mortar must wear double-hearing protection when firing.
- l. When firing the 120mm ground mount and carrier mount configuration, using the M933E1 HE cartridge, all personnel within 5 m of the mortar are required to wear double-hearing protection. Regarding hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/commnity/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.
- m. Firing restrictions and limitations in TM 43-0001-28 apply to all cartridges and fuzes. Marine Corps fires will observe restrictions in TM 08655B-10A for light armored vehicle-mortar variants.
- n. The target engagement distance will not be less than the distance required for Area B of the respective caliber of mortar to be fired, unless fired from protected positions.
- o. Full Range Practice Cartridges M769, M879, and M931 are required to be fired on ranges with full SDZs, to include SUA restrictions. Recovery of full range practice cartridge by mortar crews is not authorized. Only EOD personnel or properly trained range clearance personnel are authorized to recover these cartridges.

10-2. Surface danger zones

- a. See tables 10-1 and 10-2 and figure 10-1 for SDZ requirements for 60mm, 81mm, and 120mm mortars. For firing the cartridge, 120mm, high-explosive, guided, XM395, Accelerated Precision Mortar Initiative (APMI), use table 10-3 and figure 10-2.
- b. Dimensions of Areas A and B may be reduced by 50 percent when firing IL cartridges. Cartridges without HE filler do not require Areas A or B.
- c. Basic dimensions of the impact area will be computed as specified in table 10-1.
- d. Firing table probable errors (PEs) corresponding to the maximum range of charge employed will be used for this computation. These basic dimensions are based on standard conditions. They do not compensate for errors or non-standard conditions.
- e. To compute the PEs in range and deflection, multiply the constant (see table 10-1 and fig 10-1) by the data found in the tabular firing tables. These data are drawn in meters from the down-range edge of the target area for deflection probable errors (PE_Ds) and from Distance X for range probable errors (PE_Rs). For the XM395 APMI, PEs are not specified as part of the SDZ template, as the impact area as shown in figure 10-2 includes PEs for both range and deflection.
- f. The variable Area A angle is 25 degrees but must be increased to 70 degrees when firing HE ammunition at ranges equal to or less than 600 m for 60mm mortars; 940 m for 81mm mortars; and 1,500 m for 120mm mortars. Only the personnel required to fire the mortar system are authorized to be within this area.
- g. Only the mortar crew is authorized to be in Area A.
- h. QE limits must be modified to take into account the distance to the minimum and maximum limits of the impact area. After registration, corrections must be applied to the deflection QE limits.

Table 10-1
Mortar basic impact area dimensions

| Limits | Dimensions |
|----------|---|
| Left | 8 PE _D from the left limit of target area |
| Right | 8 PE _D from the right limit of target area |
| Far edge | 8 PE _R down range from Distance X |

Legend:
PE_D=deflection probable errors
PE_R=range probable errors

Table 10–2
Surface danger zone data for mortars

| Caliber | Area A (m) | Area B (m) |
|-------------------|------------|------------|
| 60mm M1061 | 380 | 405 |
| 60mm (all others) | 250 | 300 |
| 81mm | 400 | 400 |
| 81mm (M821A4) | 470 | 470 |
| 120mm | 600 | 600 |

Table 10–3
Surface danger zone data for 120mm XM395 Accelerated Precision Mortar Initiative

| Zone | Dist X (m) | Min target engagement (m) | Variable cross range (m) | Variable impact angle (m) | Variable frag angle (m) | Area A (m) | Area B (m) | Vertical hazard (m) |
|------|------------|---------------------------|--------------------------|---------------------------|-------------------------|------------|------------|---------------------|
| 2 | 4,801 | 1,000 | 496 | 20.71 | 47.68 | 600 | 600 | 4,154 |
| 3 | 6,604 | 1,140 | 662 | 30.20 | 44.48 | 600 | 600 | 4,634 |
| 4 | 8,288 | 1,300 | 804 | 39.27 | 38.86 | 600 | 600 | 5,107 |

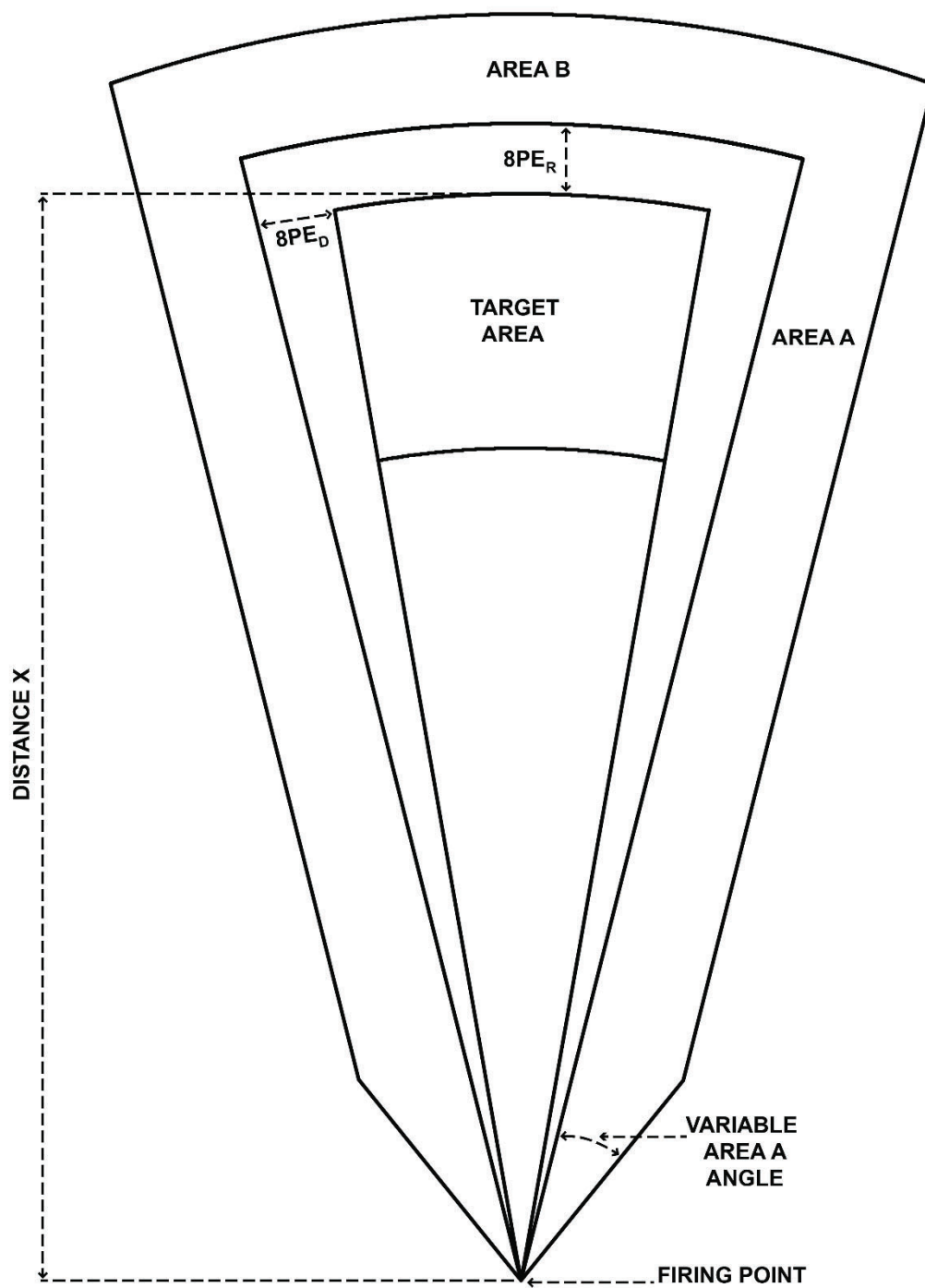


Figure 10–1. Surface danger zone for mortars

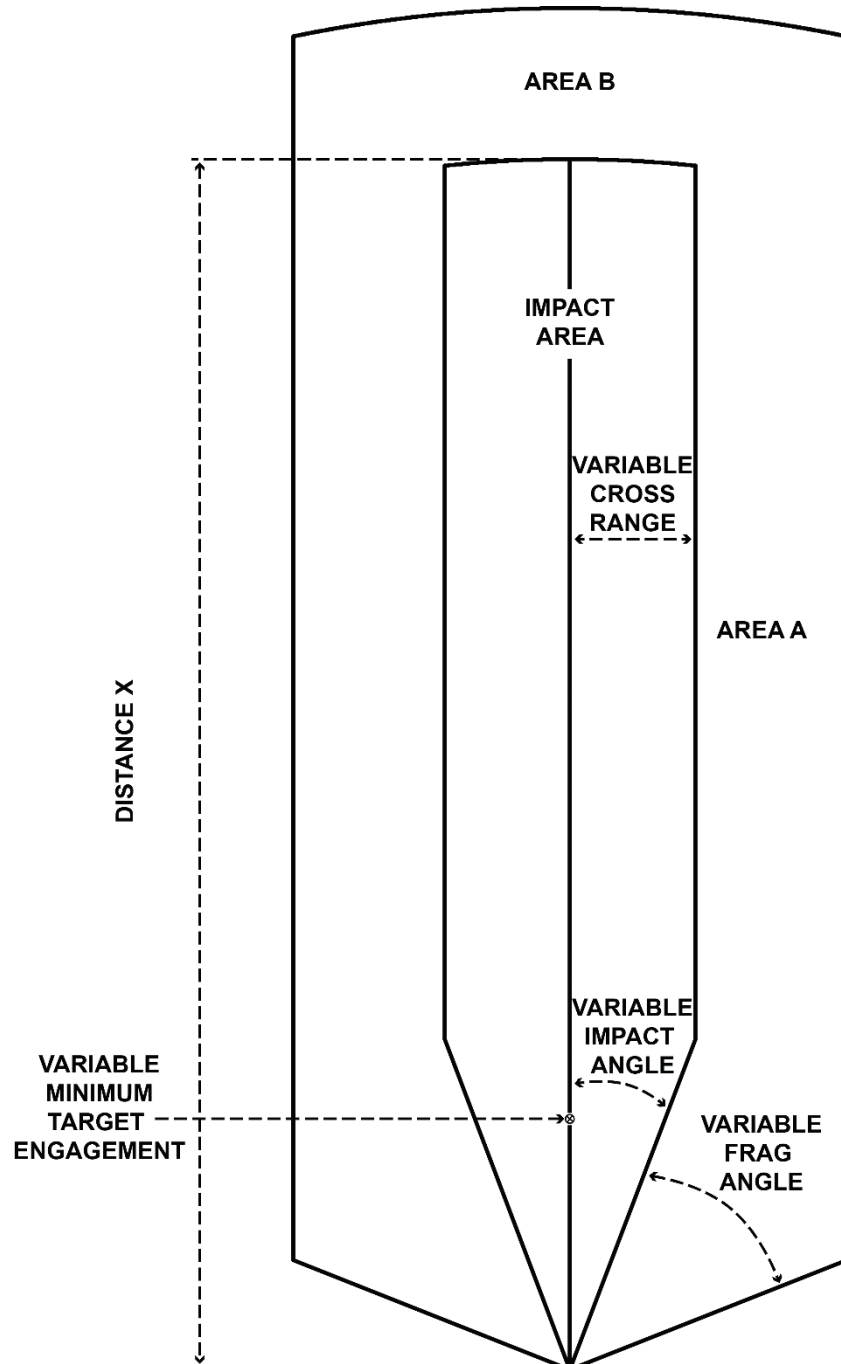


Figure 10–2. Surface danger zone for 120mm XM395 Accelerated Precision Mortar Initiative

Chapter 11 Field Artillery

11–1. Procedures and precautions

This chapter contains procedures and precautions required to fire cannon and rocket field artillery.

11-2. Safety certification program

a. Commanders of field artillery units, battalion and above, will establish and maintain an artillery safety training and annual certification program.

b. Field artillery commanders will determine, select, train, and safety certify personnel necessary to assist them in discharging this responsibility. These personnel will include the firing battery commander, executive officer or platoon leader, fire direction officer, chief of firing battery or platoon sergeant, gunnery sergeant, chief fire direction center computer, and howitzer or launcher chief of the section. These positions will be filled by command safety certified individuals. Their duties will be as described in the appropriate FMs and TCs.

c. A separate battery safety officer is not required during the firing of field artillery, but commanders may appoint one.

11-3. Field artillery cannons

a. Firing conditions.

(1) Procedures will be established for weapon systems producing blast overpressure hazards to reduce the risk to artillery crews from auditory and internal injury caused by blast overpressure from specific charges. Individuals who experience shortness of breath, chest discomfort, bleeding from mouth, nose, or ears, or excessive shakiness (tremors) when exposed to weapon system firings may be suffering from a blast overpressure injury. Individuals with any of these symptoms will be instructed to lie down and remain quiet and immobile. Injured personnel will be transported to the nearest medical facility for immediate evaluation and treatment. Firing procedures for specific weapon systems can be found in appropriate TMs.

(2) Lanyards will not be attached to the firing mechanism of field artillery cannons that use separate loading ammunition until directed by the section chief.

(3) Unused powder increments must be safeguarded and handled in accordance with appropriate TMs and installation range regulations.

(4) All personnel immediately engaged in artillery operations will wear a minimum of PPE Level 1, as referenced in table 2-2.

b. Fuzes.

(1) Alteration of fuzes is not authorized unless authorized by the CG, AMC and supervised by a qualified AMC commissioned officer, warrant officer, or civilian. For the Marine Corps, alteration of fuzes is not authorized unless authorized by Marine Corps System Command.

(2) Protect points of fuzes from blows or damage when handling ammunition because the closing cap may be sufficiently deformed and may activate the percussion primer in the fuze. Personnel inserting rounds of ammunition into cannons will be cautioned to keep each projectile away from the path of cannon recoil until recoil from the previous projectile is complete.

(3) Screw the fuze down by hand and firmly seat with the fuze wrench.

(4) Projectiles removed from cannons with ramming staffs will not be reused.

(5) All projectiles fired during training will be fuzed with bore safe fuzes.

(6) Fuzed projectiles fired during training exercises will be of the type that precludes close-in premature bursts that would present a fragment and debris hazard to the firing crew. Other type fuzes require all personnel within Area A distance from the firing position to be provided positive protection against premature bursts. When only WP ammunition is involved, this distance may be reduced to 200 m for positive protection from premature bursts. Positive protection at the weapon system position will meet the minimum requirements of four thicknesses of sandbags filled with dry, sifted sand stacked high enough for protection against all calibers of ammunition, or trenches deep enough to provide complete protection, or concrete walls 0.30 m thick, or tanks with hatches closed.

(7) Firing projectiles without fuzes is unauthorized.

(8) XM1156 Precision Guidance Kit (PGK).

(a) The XM1156 PGK fuze uses global positioning system (GPS) and control surfaces to guide the projectile to the target. The PGK is compatible with the M795 and M549A1 155mm projectiles fired from the M777A2 and M109A6 howitzers.

(b) Steering is carried out by a fixed angle canard section that is spun post-launch in the opposite direction from the projectile body. There is a design constraint within the PGK fuze to preclude arming and subsequent functioning if the round impacts more than 150 m from the intended aim point or target.

(c) RSO or ARSO will ensure that all PGK fuzes are inspected prior to firing to ensure that canards spin freely with slight resistance by turning canard assembly one full turn (revolution) in each direction. Fuzes should not be used if the canard cannot be spun freely by hand.

c. Malfunctions.

(1) Malfunctions that occur during firing of ammunition will be investigated in accordance with AR 75–1 or MCO 8025.1E.

(2) Procedures to be followed when a misfire or hang fire occurs or when the potential for a cookoff exists are in the appropriate weapon system TMs.

(3) All dud projectiles and their location will be reported to the installation RMA (Army) or RCO (Marine Corps).

d. Loading or firing ammunition. Do not load or fire ammunition at bore temperatures higher or lower than the safe limit of firing. After loading, fire the weapon system, or in case of a cease-fire, immediately remove the projectile. If the projectile cannot be removed from the weapon system within 5 minutes, evacuate all personnel to a distance equivalent to Area A for the munitions (see TM 43–0001–28 and appropriate weapon system TMs).

e. Authorized propellant charge. Use only authorized propellant charges for the specific projectile and weapon system to be fired. Never use more charges than those comprising the full authorized charge.

f. White phosphorous impregnated felt wedges from the M825 and M825A1 155mm projectiles. These may not be totally consumed when the WP burns. Crushing or moving unburned felt wedges would reignite residual WP, posing a burn hazard. Personnel will not disturb unburned felt wedges. Personnel discovering unburned felt wedges will notify the range operations firing desk (Army) or range control (Marine Corps).

g. Rocket assisted projectiles. Rocket-on firings require a clear zone short of the target area in case the rocket motor fails to function. Rocket-off firings also require a clear zone beyond the target area to allow for accidental (unintended) initiation of the rocket motor. One hundred five mm rocket assisted projectiles require a clear zone of 5,000 m short of the target for rocket-on firing and 5,000 m beyond the target for rocket-off firing. One hundred fifty-five mm rocket assisted projectiles require a 7,000 m clear zone short of the target for rocket-on firing and 7,000 m beyond the target for rocket-off firing.

h. Salute (blank) firing of 75mm and 105mm projectiles. DoDICs B550, B650, C025, and C440 produce hazards from muzzle debris and noise. Muzzle closure debris can be expelled 92 m forward of the weapon and 10 degrees either side of the bore axis. Hazardous noise levels (140 dB) are 77 m along the bore axis, 49 m at 30 degrees each side of the bore axis, 31 m at 60 degrees each side of the bore axis, 21 m at 90 degrees each side of the bore axis, 14 m at 120 degrees each side of the bore axis, 10 m at 150 degrees each side of the bore axis, and 10 m directly behind the weapon.

i. Hearing protection. All personnel within the hearing hazard zone will wear approved single-hearing protection. The hearing hazard zone is usually defined in the manuals for the cannon, propellant charges, or cartridge. If the hearing hazard zone information cannot be determined, hearing protection will be required within 800 m.

11–4. Field artillery cannon surface danger zones

a. See tables 11–1 through 11–4 and figures 11–1 through 11–3 for the SDZ requirements for all field artillery cannons firing conventional ammunition (excluding APERS and beehive projectiles).

b. Tactical fire control measures may be substituted for SDZs, provided they correspond to figures 11–1, 11–2, or 11–3 as applicable.

c. Installation RMAs (Army) or RCOs (Marine Corps) will determine target area boundaries. Left and right limits of the target area determine the left and right limits of fire. The maximum range line (arc) will be the far edge (down range) of the target area, and the minimum range line (arc) will be the near edge (up-range) of the target area. Unprotected personnel are not authorized in the target and associated hazard areas (Areas A, B, C, and E) during firing.

d. Projectile ricochets and empty carrier projectile bodies and debris found outside the target area in or beyond Area A and Area B and their locations will be reported to the installation RMA (Army) or RCO (Marine Corps).

e. Basic dimensions of the impact area will be computed as specified in table 11–1.

f. Firing table PEs corresponding to the range for the center of the target area will be used for this computation. These basic dimensions are based on standard conditions. They do not compensate for errors or nonstandard conditions.

g. When firing the M825 155mm WP smoke projectiles—

(1) Areas A and B may be reduced to 350 m.

(2) When firing the M825 projectile at target distances with firing solutions less than 800 mils, the information provided in table 11–5 and figure 11–4 will be utilized. The ricochet danger area from table 11–5 will be added to the max range arc of the artillery SDZ. A 10-degree ricochet angle is added to the artillery SDZ from the down-range arc of area C and outboard of the left and right PEs in deflection.

h. The PGK control authority maximum divert (CAMDV) area is the danger area immediately surrounding the PEs and accounts for GPS and control surface inaccuracies. The SDZ parameters showing the CAMDV area distance, in tables 11–3 and 11–4, are applied to all sides of the impact area as shown in figure 11–3. Area G is located between

the CAMDV area and Area C, and accounts for the possibility of a locked PGK canard resulting in a short round. Use figure 11–3 and tables 11–1 through 11–4 to draw the SDZ for firing rounds with PGK fuzes.

Table 11–1
Basic impact area dimensions for field artillery cannons

| Limits | Dimensions |
|-----------|---|
| Left | 8 PE _D from the left limit of target area |
| Right | 8 PE _D from the right limit of target area |
| Far edge | 8 PE _R down range from Distance X |
| Near edge | 12 PE _R from the up-range edge of target area. |

Legend:
PE_D=deflection probable errors
PE_R=range probable errors

Table 11–2
Surface danger zone data for field artillery cannons

| Caliber | Area A (m) | Area B (m) | Area C low angle ¹ (m) | Area C high angle, time, VT ^{2,3} (m) | Area E (m) | Direct-fire mode ⁴ (m) |
|----------------|------------|------------|-----------------------------------|--|------------|-----------------------------------|
| 105mm howitzer | 550 | 550 | 300 | 350 | 550 | 650 |
| 155mm howitzer | 725 | 725 | 350 | 550 | 725 | 750 |

Legend:
VT=variable time

Notes.

¹ When the headings of more than one column above relate in some way to the type of firing to be conducted, the column giving the larger value of Area C will be used.

² When using fuze multi-option, XM1156, area C is required to be 550 m.

³ Distances in this column represent minimum target engagement distances when personnel at the firing position are unprotected. When using fuze, multi-option, XM1156, direct-fire mode will not be used.

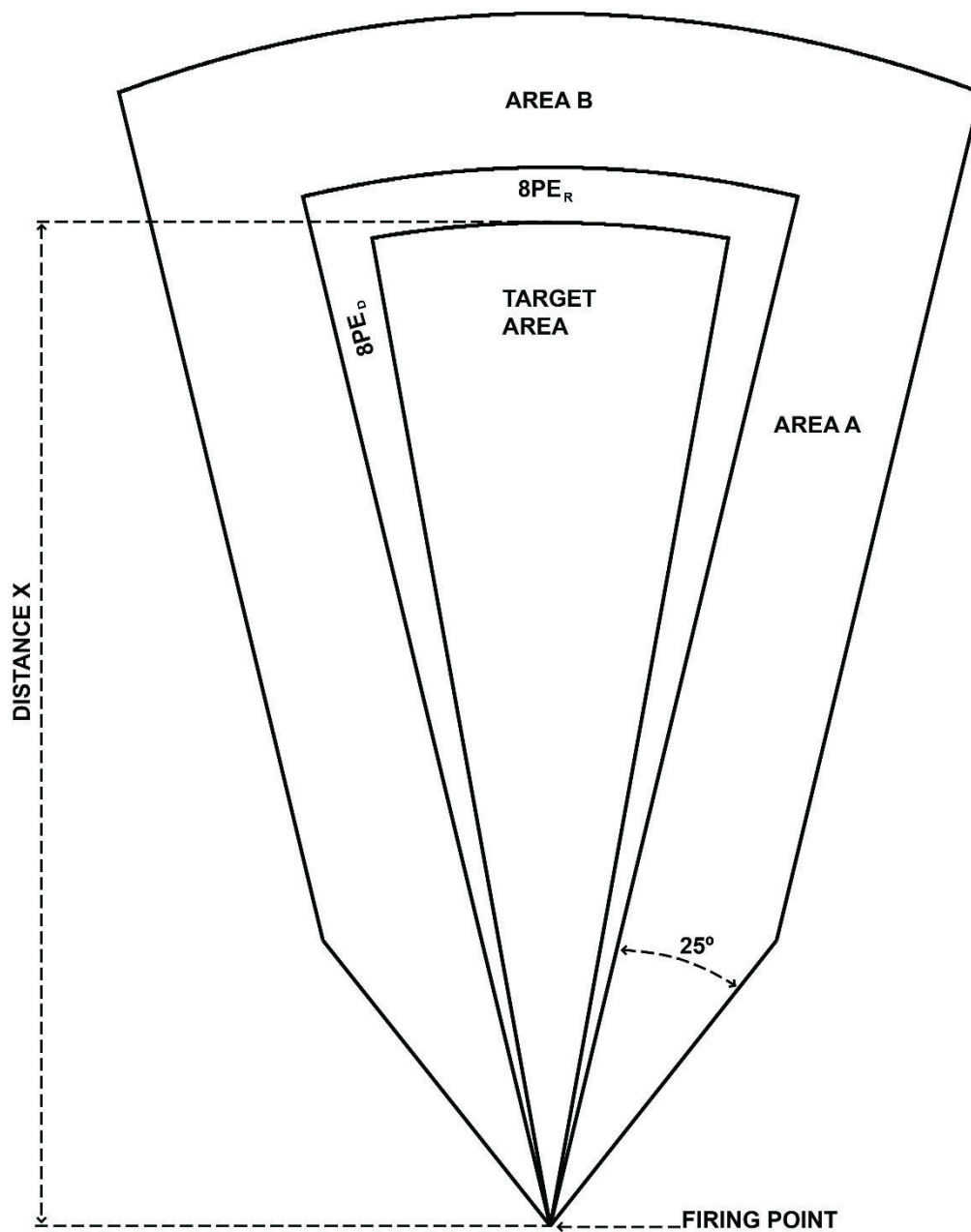


Figure 11–2. Surface danger zone for field artillery cannon firing in the direct mode at ground, fixed, or moving targets

Table 11–3

Surface danger zone data for 155mm High-Explosive M795 fired from M777A2 and M109A6 weapon platforms using fuze, multi-option, XM1156 Precision Guidance Kit zones 1L, 2L, 3H, 7R, 4H, 8S, and 5H

| QE (mils) | Zone 1L CAMDV (m) | Zone 1L Area G (m) | Zone 2L CAMDV (m) | Zone 2L Area G (m) | Zone 3H CAMDV (m) | Zone 3H Area G (m) | Zones 7R, 4H CAMDV (m) | Zones 7R, 4H Area G (m) | Zones 8S, 5H CAMDV (m) | Zones 8S, 5H Area G (m) |
|--------------|----------------------------|--------------------------------|----------------------------|--------------------------------|----------------------------|--------------------------------|---------------------------------|-------------------------------------|---------------------------------|-------------------------------------|
| 200 | 0 | 1,025 | 25 | 1,840 | 175 | 3,090 | 200 | 4,170 | 225 | 4,529 |
| 300 | 10 | 1,650 | 75 | 2,910 | 250 | 4,465 | 325 | 5,680 | 375 | 6,172 |
| 400 | 25 | 2,260 | 75 | 3,915 | 275 | 5,705 | 350 | 7,130 | 450 | 7,721 |
| 500 | 25 | 2,770 | 75 | 4,800 | 250 | 6,860 | 375 | 8,395 | 475 | 9,115 |
| 600 | 50 | 3,150 | 100 | 5,440 | 225 | 7,770 | 375 | 9,445 | 500 | 10,235 |
| 700 | 75 | 3,370 | 75 | 6,000 | 250 | 8,460 | 375 | 10,290 | 575 | 11,015 |
| 800 | 50 | 3,455 | 100 | 6,180 | 175 | 8,830 | 375 | 10,780 | 600 | 11,560 |
| 900 | 50 | 3,480 | 100 | 6,145 | 225 | 8,830 | 375 | 10,840 | 575 | 11,810 |
| 1,000 | 50 | 3,285 | 100 | 5,870 | 225 | 8,395 | 400 | 10,370 | 550 | 11,541 |
| 1,100 | 50 | 2,875 | 100 | 5,340 | 200 | 7,680 | 400 | 9,470 | 550 | 10,548 |
| 1,200 | 50 | 2,455 | 75 | 4,570 | 200 | 6,490 | 425 | 7,915 | 575 | 8,799 |

Table 11–4

Surface danger zone data for 155mm High-Explosive M549A1 fired from M777A2 and M109A6 weapon platforms using fuze, multi-option, XM1156 Precision Guidance Kit zones 3H–R, 7R–R, 4H–R, 8S–R, and 5H–R

| QE (mils) | Zone 3H–R CAMDV (m) | Zone 3H–R Area G (m) | Zones 7R–R, 4H–R CAMDV (m) | Zones 7R–R, 4H–R Area G (m) | Zones 8S–R, 5H–R CAMDV (m) | Zones 8S–R, 5H–R Area G (m) |
|--------------|------------------------------|----------------------------------|-------------------------------------|---|-------------------------------------|---|
| 200 | 275 | 4,865 | 325 | 6,465 | 425 | 7468 |
| 300 | 425 | 6,865 | 525 | 8,725 | 650 | 10,096 |
| 400 | 525 | 8,520 | 625 | 10,800 | 775 | 12,300 |
| 500 | 525 | 10,095 | 700 | 12,475 | 850 | 14,300 |
| 600 | 500 | 11,570 | 775 | 13,980 | 1,025 | 15,880 |
| 700 | 575 | 12,580 | 900 | 15,125 | 1,250 | 17,140 |
| 800 | 650 | 13,255 | 1,000 | 15,915 | 1,500 | 17,910 |
| 900 | 700 | 13,305 | 1,125 | 15,955 | 1,675 | 18,465 |
| 1,000 | 750 | 12,990 | 1,150 | 15,585 | 1,775 | 18,543 |
| 1,100 | 700 | 12,045 | 1,125 | 14,495 | 1,800 | 17,619 |
| 1,200 | 675 | 10,400 | 1,175 | 12,530 | 1,875 | 15,342 |

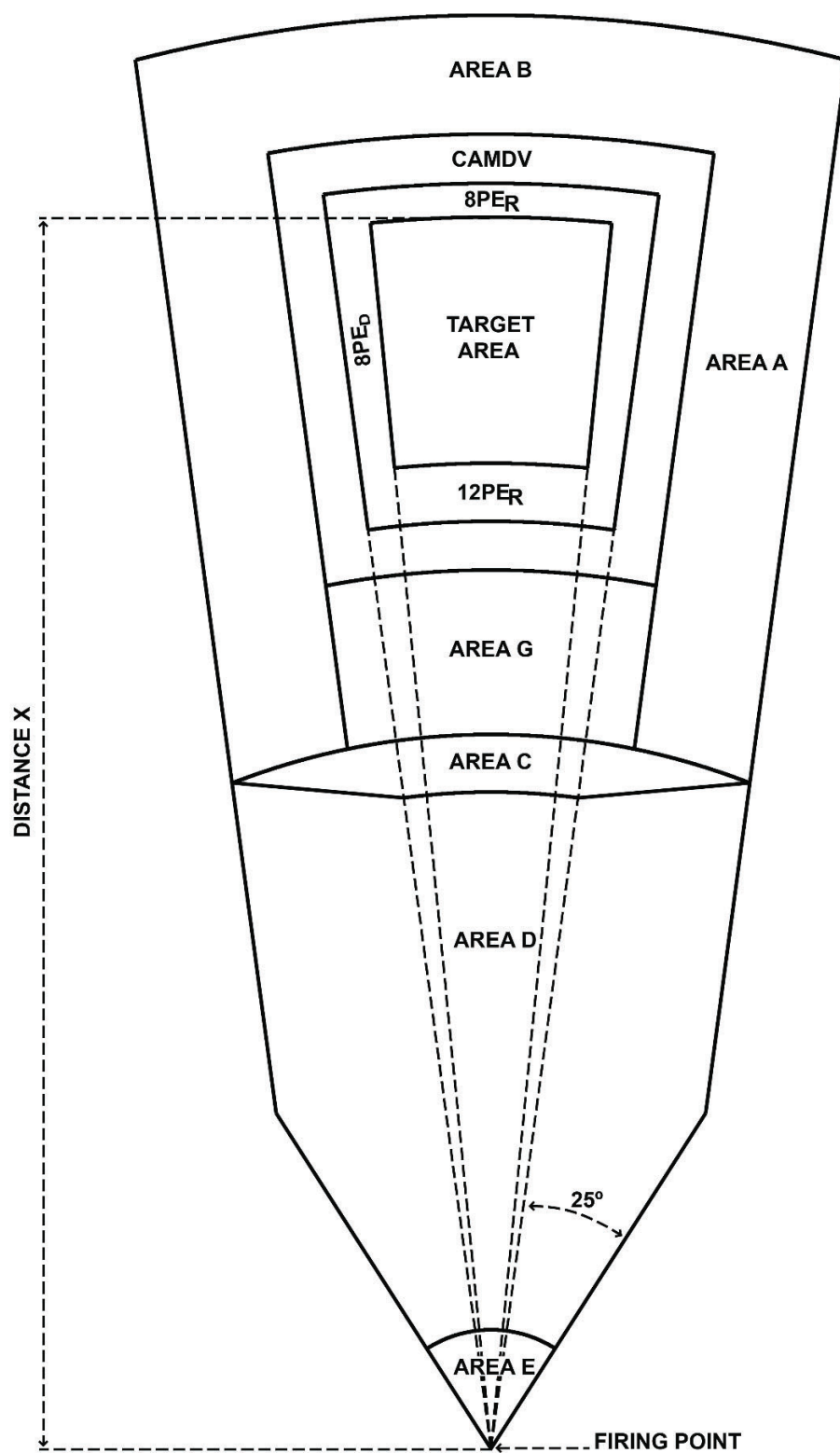


Figure 11-3. Surface danger zone for 155mm High-Explosive M795 fired from M777A2 and M109A6 weapon platforms using fuze, multi-option, XM1156 Precision Guidance Kit zones 1L, 2L, 3H, 7R, 4H, 8S, 5H, 3H-R, 7R-R, 4H-R, 8S-R, and 5H-R

Table 11–5
Ricochet danger area data for 155mm M825 and M1122 series projectiles

| Projectile | Propelling charge/zone | Dist X (m) |
|-------------|------------------------|------------|
| M825, M1122 | M231 (DA12)–1L | 7,100 |
| M825, M1122 | M231 (DA12)–2L | 11,100 |
| M825, M1122 | M232 (DA13)–3H | 15,100 |
| M825, M1122 | M232 (DA13)–4H | 18,200 |
| M825, M1122 | M232 (DA13)–5H | 21,800 |
| M825, M1122 | M119 (D533)–7R | 17,600 |
| M825, M1122 | M203 (D532)–8s | 21,700 |

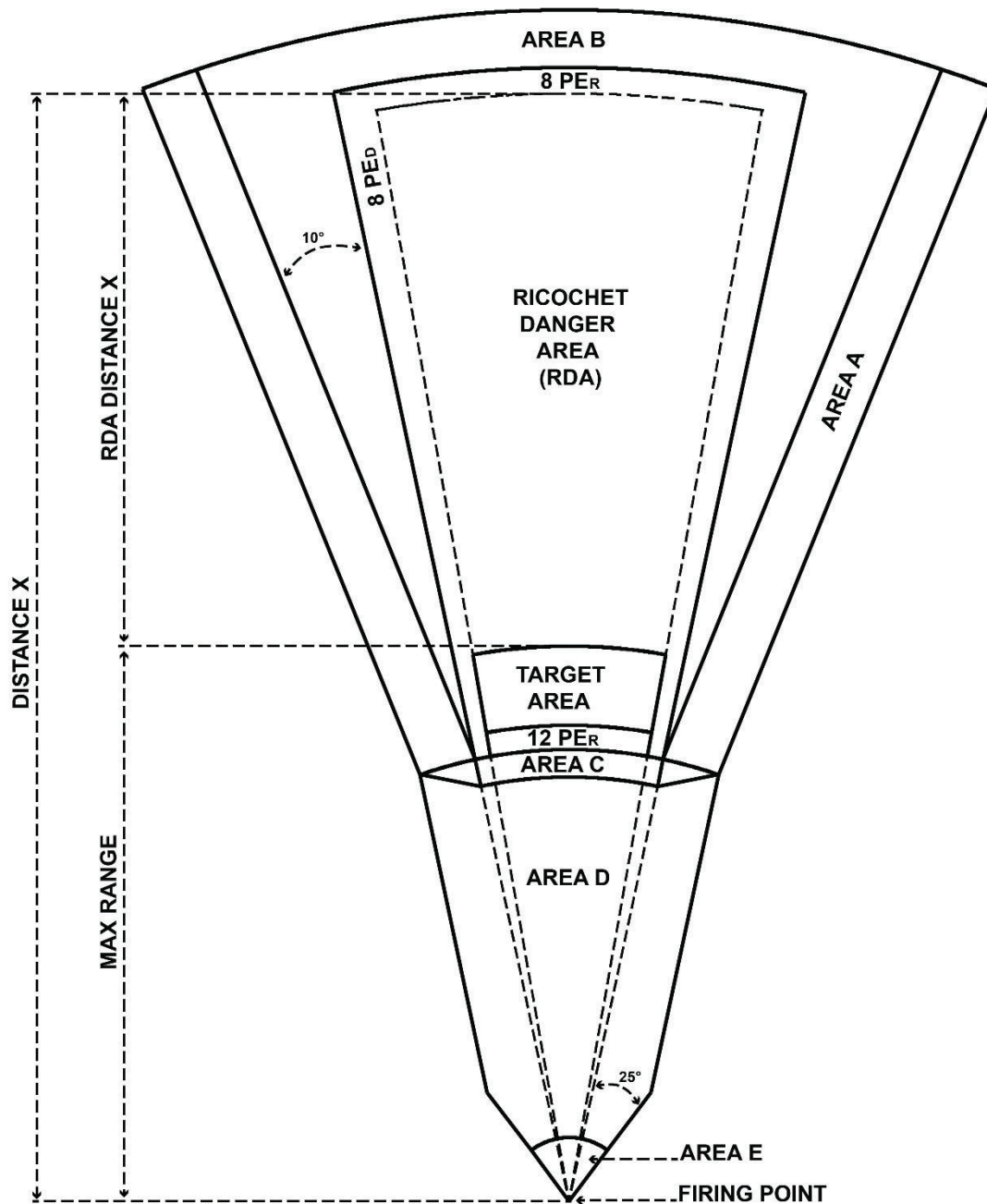


Figure 11–4. Ricochet danger area for 155mm M825 series and M1122 projectiles

- i. Weapon system crews firing from approved tactical configurations are authorized access to Area E. Operational and range operations (Army) or range control (Marine Corps) personnel involved in firing exercises with a valid need to enter Area E may do so at the approval of the installation RMA (Army) or RCO (Marine Corps).
- j. When firing in the direct mode, Distance X will not be less than the range of the weapon system corresponding to a QE of 15 degrees for a given charge.
- k. Area C is increased to 2,400 m when firing 155mm (M107) HE ammunitions filled with trinitrotoluene (TNT).

11-5. Bunkers and fighting vehicles

- a. Light field artillery fire, up to and including 105mm howitzer, may impact no closer than 100 m to occupied bunkers. Medium and heavy field artillery fire above 105mm may impact no closer than 200 m to occupied bunkers. Ammunition certified for overhead fire must be used. Bunkers must have been constructed and approved to protect personnel from a direct hit by the ammunition being fired. Constant communication must be maintained between the firing position and bunkers. Observation from bunkers will be by indirect viewing, such as periscopes, unless an approved design for direct viewing has been provided.
- b. Bunkers to be used in accordance with paragraph 11-5a will be designed and constructed using specifications provided by the facility engineer. The installation engineer will review designs before final approval to ensure that structural integrity is maintained against direct hits and penetrating fragments. Direct viewing methods will be designed and constructed according to specifications provided by the facility engineer.
- c. Personnel occupation of Areas A, B, and C is not authorized except when bunkers are constructed in accordance with paragraph 11-5a. Personnel access to Area C is not authorized unless protective cover exists that is designed in accordance with paragraph 11-5a for positive protection against a direct hit. Tanks and fighting vehicles with hatches closed are permitted in Area C when field artillery ammunition is fired overhead with variable time (VT) or time fuzes. Height of burst data in table 11-6 will be used to provide an adequate degree of safety to protect personnel and materiel from ammunition fired with VT or time fuzes. The following procedures apply when firing over tanks and fighting vehicles:
 - (1) Use sufficient QE so that if the time element of the fuze fails to function, the projectile will land beyond the tank or fighting vehicle at a distance equal to the predicted height of burst plus four PE_{RS}.
 - (2) Only cleared ammunition (projectiles, propellant, and fuzes) will be fired over the heads of unprotected personnel.

Table 11-6
Heights of burst above occupied fighting vehicles

| Vehicle | Distance 105mm (m) | Above vehicle 155mm (m) |
|--------------------------------|--------------------|-------------------------|
| Fighting vehicles ¹ | 125 | 150 |
| M1/M1A1 Tank | 40 | 55 |

Note.

¹ Fighting vehicles include the M106, M109, M113, M125, M577, M2, M3, Stryker, Light Armored Vehicle, and Amphibious Assault Vehicle.

11-6. Overhead fire

- a. Overhead fire of unprotected personnel located in Area D is authorized during training provided cleared ammunition for overhead fire (projectile, propellant, and fuze) is used. Senior commanders (Army) or installation commanders (Marine Corps) may authorize nonparticipating personnel access to Area D during indirect field artillery firing. When public highways pass through Area D, coordination with appropriate Government officials (Federal, State, and local) and landowners is required. When public roadways and railways pass through Area D, the following precautions apply:
 - (1) Projectile trajectories must clear unprotected personnel or objects by at least 5 m plus two forks. If the minimum range line (arc) is greater than the distance to the near edge of the target area, use the computed minimum range line (arc) for the near edge of the target area.
 - (2) Unless personnel are provided cover designed to withstand a direct hit, the minimum arming time of the proximity (VT) fuze establishes the near edge of the impact area. The minimum arming time of the proximity (VT) fuze will be the time set on the fuze corresponding to the range to the near limit of the impact area or computed minimum range line, whichever is greater, plus 5.5 seconds.
 - (3) Forward movement of personnel within Area D requires that the SDZ advance according to the distance and direction of the personnel. If proximity or VT fuzes with adjustable arming times are used, forward movement of

personnel is possible. VT fuze time settings will correspond to the range to the near limit of the impact area plus 5.5 seconds.

(4) Warnings that field artillery projectiles may be fired at any time of the day will be posted on public roadways approved for overhead fire that pass through an installation or community.

b. If rocket assisted projectiles will be fired over the heads of unprotected troops during training exercises, ensure compliance with provisions of paragraph 11–3g.

11–7. Anti-personnel ammunition (Army)

a. Firing conditions.

(1) APERS ammunition is available for 105mm cannon artillery. It is designed for use against personnel in direct-fire, muzzle action, or direct-fire missions with a time setting.

(2) APERS ammunition will not be fired over the heads of unprotected personnel. Hardware discarded by functioning of APERS projectiles presents a potential hazard to personnel to the side and rear of the weapon.

b. Surface danger zone.

(1) See table 11–7 and figure 11–5 for SDZ requirements for APERS ammunition.

(2) Distance X is based on the range at 15 degrees QE.

(3) For other than muzzle action functioning, begin APERS SDZ construction down range at a distance equal to the time of fuze setting.

(4) Warning hardware discarded by the functioning of the projectile presents a potential hazard to unprotected personnel located to the side and rear of weapon.

(5) For Distance X and Distance D, see table 11–7.

(6) Distance is 2,000 m or 1.41D, whichever is greater.

Table 11–7
Anti-personnel ammunition surface danger zone criteria

| Caliber | Distance X (m) | Distance D (m) |
|---------------------------------|---------------------------|---------------------------|
| 105mm howitzer M102, M119, M546 | 7,900 | 1,100 |

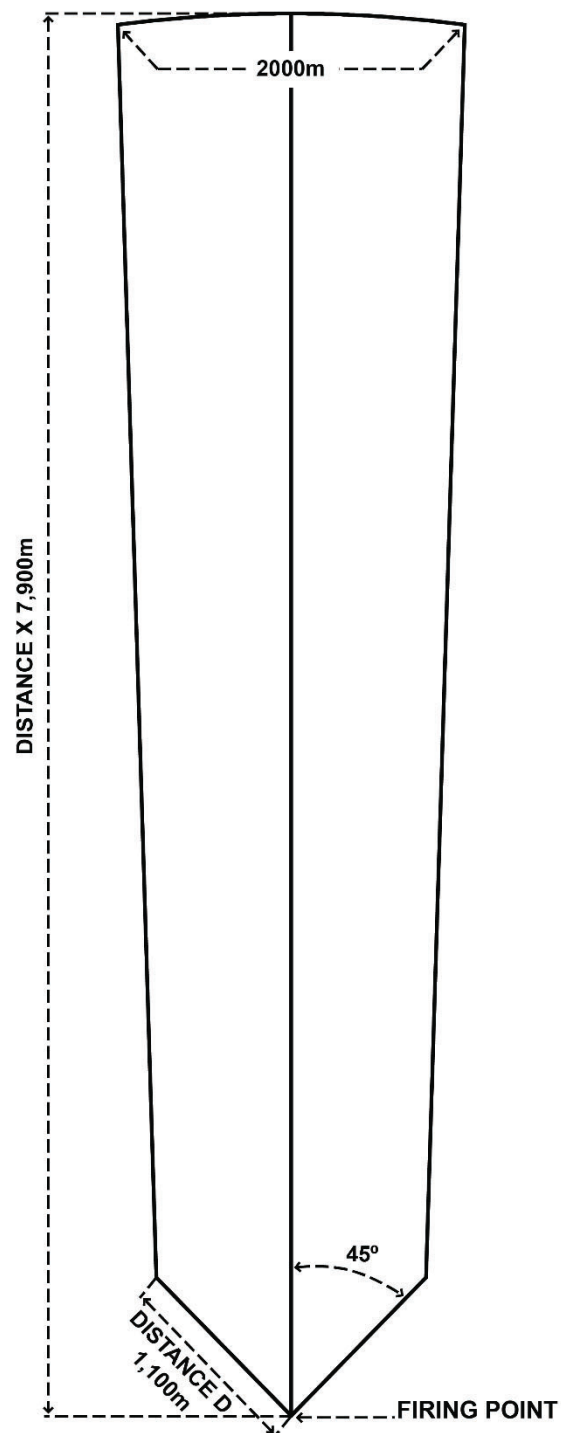


Figure 11–5. Surface danger zone for 105mm howitzer M102, M119, and M546 field artillery cannon with anti-personnel ammunition in the direct-fire mode at fixed or moving targets

11-8. Flight corridors

Flight corridors are created to vertically and laterally separate aircraft from surface fires (see chap 12 for aviation range safety). Aircraft may operate within or pass through artillery cannon danger zones, provided—

a. They are established where the maximum altitude of the aircraft will be below the ordinate corresponding to the minimum QE of the ammunition being fired above the flight corridor and corrected for density altitude. Flight corridors may provide access only through Area D (see figs 11-1 and 11-6). Altitudes in flight corridors will be indicated in MSL.

b. Permanent aircraft flight corridors are established under firing corridors. Corridors will be through Area D and outside Areas C and E. Altitude restrictions will be in accordance with paragraph 11-8*a*. Corridors will follow easily identifiable markers and routes. Flight control points will be established and aircrews briefed on flight navigation procedures. Maps of flight corridors (see fig 11-7) will be made available at installation range operations (Army), range control (Marine Corps), facilities base operations, and other locations deemed appropriate by the installation RMA (Army) or RCO (Marine Corps).

c. Communications will be maintained among the designated aircraft, range operations firing desk (Army), range control (Marine Corps), and the firing unit on a common communications network. Aircraft will report entry and exit of specific vertical danger zones. This is not applicable to aircraft operating as part of tactical exercises with firing elements provided communication is maintained between participants. A communications failure with aircraft in a flight corridor requires an immediate cease-fire. These procedures will be established by local SOP.

d. Participating aircraft operating within SDZs as part of an exercise will remain a minimum of 500 m from GTLs and outside of Areas C and E.

e. Only ammunition certified for overhead fire will be used when aircraft are operating in or passing over SDZs.

f. Uncontrolled flights within SDZs are not authorized.

g. Computing the stay above (SA) and stay below (SB) distances (for feet AGL) you must—

- (1) Determine the GTL and the firing unit range to target.
- (2) Determine the munitions type and charge being fired.
- (3) Determine the vertical interval (VI) ($VI = \text{target altitude} - \text{firing unit altitude}$ in meters).
- (4) Determine where the final attack heading (FAH) or cone crosses the GTL and the gun target range at those points.
- (5) See the appropriate trajectory chart by munitions or charge and determine the arc corresponding to range to target.

(6) Determine the altitude (in meters) corresponding to the ranges where the final attack cone crosses the GTL by tracing the arc to those ranges.

(*a*) $\text{Highest altitude} + VI = \text{ALT 1}$. Multiply by 3.3 to convert to feet.

Note. If the final attack cone straddles the summit of the trajectory, use the Max Ord for ALT 1.

(*b*) $\text{Lowest altitude} + VI = \text{ALT 1}$. Multiply by 3.3 to convert to feet.

(7) Incorporate a 1,000 ft buffer for all nonstandard conditions.

(*a*) $\text{ALT 1} + 1,000 \text{ ft} = \text{SA}$ (expressed to the next highest 100 ft AGL).

(*b*) $\text{ALT 1} - 1,000 \text{ ft} = \text{SB}$ (expressed safe to the next lowest 100 ft AGL).

h. Computing the SA and SB distances (for feet MSL)—

- (1) Determine the range to target in meters.
- (2) Determine the projectile and charge trajectory.
- (3) Determine target altitude in meters.
- (4) Plot FAH from intersecting point (IP) 1 to IP 2 in degrees magnetic.
- (5) Determine where FAH intersects GTL at IP 1 and IP 2.
- (6) Determine chart ordinate in meters at IP 1 and IP 2.
- (7) Add target altitude to IP 1 and IP 2.
- (8) Convert to feet (IP 1) $\times 3.3$ and (IP 2) $\times 3.3$.
- (9) Add 1,000 ft to IP 1 and subtract 1,000 ft from IP 2.

i. When computing SA or SB, the general rule is that, if the FAH straddles the Max Ord, compute SA and SB against the Max Ord plus or minus 1,000 ft.

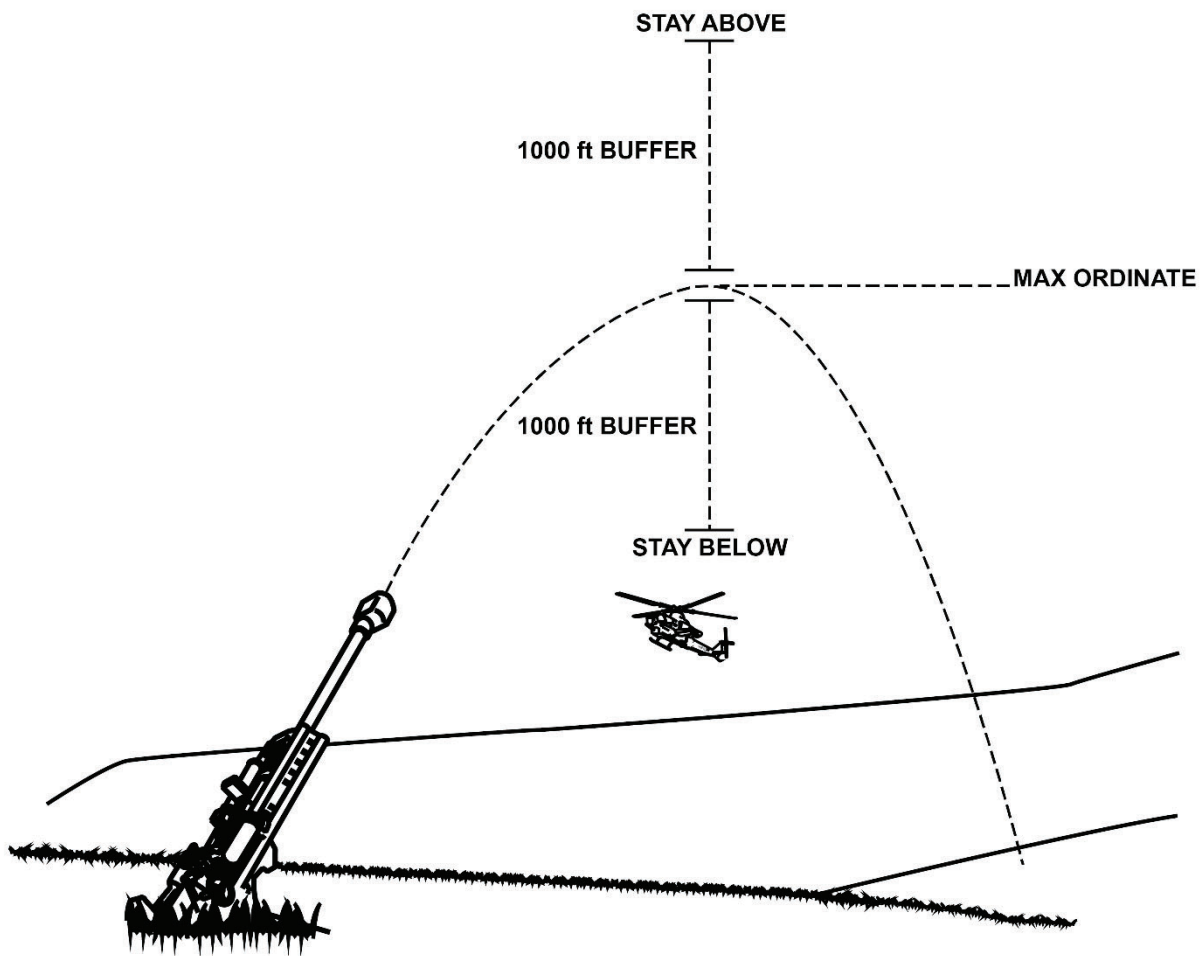


Figure 11–6. Flight corridor for field artillery cannon firing over aircraft

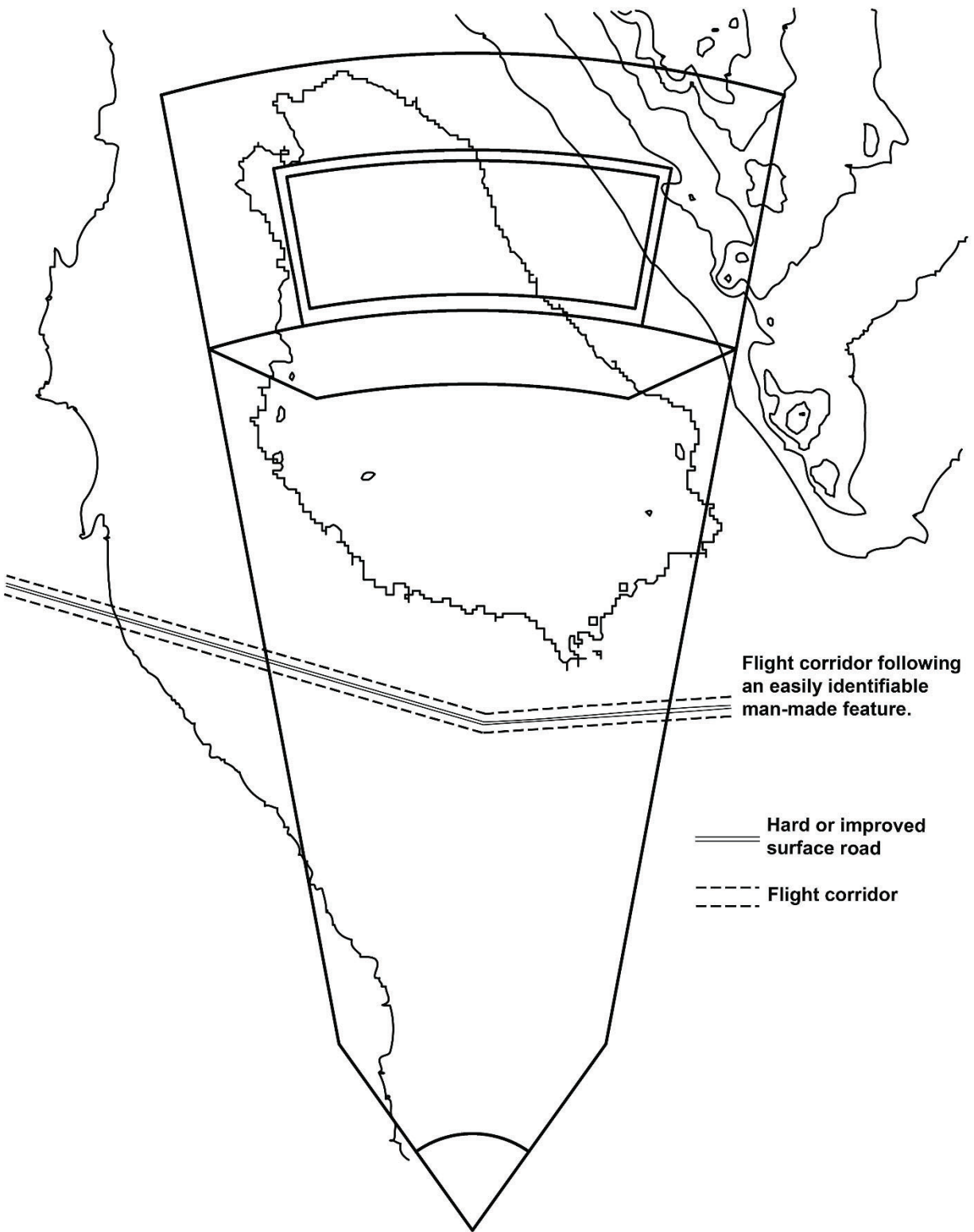


Figure 11-7. An example of an established flight corridor

11–9. Improved conventional munitions

a. Firing conditions.

(1) The firing of live ICM projectiles and dropping of aircraft-delivered live sub-munitions on Army ranges in training are prohibited.

(2) For the Marine Corps, the firing of dual-purpose ICMs is authorized in accordance with MCO 8011.5B. Local range SOPs will dictate the specific conditions under which dual-purpose ICMs may be employed in training.

(3) ICM projectiles will not be fired over the heads of troops in training exercises.

(4) When ICM carriers fail to function and impact on hard surfaces, up-range and lateral ricochets of up to 500 m may occur.

b. Surface danger zone.

(1) See figure 11–1 for requirements for field artillery cannon fired ICM. Conventional ballistic tabular firing table data for the particular caliber projectile and weapon system combination will be used to determine maximum range when firing ICM projectiles (see table 11–8).

(2) The impact area should be relatively flat and free from heavy vegetation.

(3) Danger Areas A and B will be observed for all firings of ICM projectiles (see table 11–9 for the data necessary to determine each of these).

(4) The special design of ICM projectiles subjects them to the effects of wind velocity more than standard conventional projectiles. Sub-missile drift factors listed in table 11–10 may be added to or subtracted from the basic trajectory distances presented in respective ballistic tabular firing tables. For example, if the wind is blowing at 50 knots from the gun position toward the target and the gun is being fired at 600 mils (33.75 degrees), the maximum range from the firing table will be increased by 150 m. If the wind is coming perpendicular (left to right) to the GTL, the right deflection will be increased 160 m and the left deflection will be decreased 160 m.

Table 11–8
Maximum range data sources for improved conventional munitions

| Model number | Reference |
|--------------|--|
| M444 | Standard 105mm firing tables for M1 |
| M449 | Standard 155mm firing tables for M107 w/FT–155–ADD–I–2 |
| M483 | Firing tables FT 155–AN–2 w/C–1 |

Table 11–9
Surface danger zone data for improved conventional munitions areas A, B, and C

| Cartridge | Areas A, B, C ¹ (m) |
|------------|--------------------------------|
| M444 | 440 |
| M449 | 480 |
| M404 | 485 |
| M483, M915 | 650 |

Note.

¹ Values for Areas A, B, and C include a maximum wind sub-missile drift of 250 m in a 50 knot wind.

Table 11–10
Sub-missile drift factors for improved conventional munitions

| Wind velocity (knots) | Elevation (mils) | Maximum range drift (m) | Maximum deflection (m) |
|-----------------------|------------------|-------------------------|------------------------|
| 50 | 300 | 250 | 250 |
| 50 | 600 | 150 | 160 |
| 50 | 1,150 | 100 | 100 |
| 10 | 300 | 50 | 50 |
| 10 | 600 | 40 | 30 |

Table 11–10
Sub-missile drift factors for improved conventional munitions—Continued

| Wind velocity (knots) | Elevation (mils) | Maximum range drift (m) | Maximum deflection (m) |
|--------------------------|---------------------|----------------------------|---------------------------|
| 10 | 1,150 | 20 | 20 |

11–10. Multiple Launch Rocket System and High-Mobility Artillery Rocket System

a. Firing conditions.

- (1) All non-MEP will be cleared from the SDZ.
- (2) Meteorological data in use at the fire control system will not be more than 4 hours old.
- (3) The weapon system navigation unit must be verified as correct. Ensure that the launcher is properly calibrated (M270 only) and updated with a verified survey control point, if not using GPS navigation, and that startup data is correct.
- (4) Fire control system internal tests must be successfully completed.
- (5) Firings will not be conducted if—
 - (a) There is any question of proper operation of the launcher.
 - (b) The winds have changed dramatically since meteorological data was taken.
 - (c) Any other sign of abnormal operation is evident.
- (6) Safe separation distance between Multiple Launch Rocket System (MLRS) and High-Mobility Artillery Rocket System (HIMARS) launchers firing simultaneously is 55 m.

b. Surface danger zone.

- (1) See ATP 3–09.60 for MLRS and HIMARS safety computations. Values for Distance W and Distance X in ATP 3–09.60 have danger Areas A and B included in their values.
- (2) See table 11–11 and figures 11–8 and 11–9 for MLRS and HIMARS SDZ requirements for practice and tactical (for combat only with M77 grenade payload) warheads. Dimensions of the SDZ vary according to range to target and launcher height above MSL. The SDZ consists of an impact area; Areas A, B, and F; and exclusion Areas I, II, and III forming a rectangle around the target with a corresponding flight corridor back toward the launcher.
- (3) See table 11–12 for Guided Multiple Launch Rocket System (GMLRS) variants. See table 11–13 and figures 11–8 and 11–9 for SDZ requirements for GMLRS warheads.
- (4) The rectangular impact area extends X meters beyond the target, Distance W to the left and right of the target, and 2,200 m from the target toward the launcher (Distance Y). The construction of the SDZ is completed by connecting the near left and right corners of the rectangle to respective points 350 m to the left and right of the launcher. The impact area is designed to contain fragments and debris (payload, warhead skin, and rocket motor) from normal functioning rockets. Distance X is adequate to contain rockets when the fuze fails to function.
- (5) Area A is 320 m.
- (6) Area B is 1,300 m.
- (7) Exclusion Area I is the 4,700-m area that extends forward of the launcher. It is endangered by premature fuze function or failure of the rocket motor during boost phase. Exclusion Area I may be reduced to not less than 1,000 m by deviation.
- (8) Exclusion Area II is the remaining area located between Exclusion Areas I and III once these areas are constructed. Occupation of Exclusion Area II by unprotected personnel is authorized only under an approved deviation. Length of Exclusion Area II varies with range to target.
- (9) Exclusion Area III is an area 1,800 m on the up-range side of the impact area and parallel to Area B. This area is designed to contain fragments and debris from early functioning warheads at the near edge of the impact area.
- (10) Area F is the area immediately to the rear of the launcher directly exposed to blast overpressure, fragments, and debris from rocket launch. Area F consists of two parts: the launcher danger area (LDA) and the noise hazard area. The LDA extends 415 m to each side of the launcher and 415 m to the rear. Personnel are not authorized to occupy the LDA during firing. The noise hazard area extends an additional 485 m past the LDA and may only be occupied by participating personnel wearing appropriate hearing protection.
- (11) Fin release failure impact area is required only for tactical rockets. This area is a sector with an origin at the launcher with a radius of 12,500 m. It includes a total angular measurement of 114 degrees centered about the azimuth of fire.

Table 11–11
Surface danger zone data for Multiple Launch Rocket System, High-Mobility Artillery Rocket System tactical and M28 practice rockets—Continued

| Range to target (m) | Dist X ² (m) | Dist W (m) |
|---------------------|-------------------------|------------|
| Min to 11,500 | See note 2 | 840 |
| 11,501 to 15,000 | 5,000+H ¹ | 1,000 |
| 15,001 to 20,000 | 3,700+H ¹ | 1,300 |
| 20,001 to 23,000 | 1,900+H ¹ | 1,500 |
| 23,001 to 27,000 | 2,300+H ¹ | 1,900 |
| 27,001 to Max | 2,700+H ¹ | 2,900 |

Notes.

¹ H is the height of launcher above MSL in meters.

² For targets less than 11,500 m from the launcher, Distance X will vary so that the distance from the launcher to the far edge of the impact area will be 16,700 + H meters. Adding Area B results in a minimum required distance of 18,000 + H for short shots.

Table 11–12
Guided Multiple Launch Rocket System variants

| Munition | Designator | Warhead |
|------------------------------------|------------|--|
| Guided MLRS Rocket | M30 | M85 DPICM Bomblets, steel case motor |
| Guided MLRS with Alternate Warhead | M30A1 | Unitary, PBXN–110, Tungsten spheres, steel-case rocket motor |
| Guided MLRS with Alternate Warhead | M30A2 | Unitary, PBXN–110, Tungsten spheres, IMPS rocket motor |
| Guided Unitary | M31 | Unitary, PBXN–109, helical-grooved steel skin |
| Guided Unitary with Tri-Mode Fuze | M31A1 | Unitary, PBXN–109, helical-grooved steel skin, steel-case rocket motor |
| Guided Unitary with Tri-Mode Fuze | M31A2 | Unitary, PBXN–109, helical-grooved, steel skin, IMPS rocket motor |

Table 11–13
Surface danger zone data for M30, M30A1, M30A2, M31, M31A1, and, M31A2 Guided Multiple Launch Rocket
System—Continued

| Range to target (m) | Dist X (m) | Dist W ² (m) |
|------------------------|-----------------------|----------------------------|
| 15,000 | 60,000+H ¹ | 15,000 |
| 20,000 | 70,000+H ¹ | 22,000 |
| 25,000 | 65,000+H ¹ | 22,000 |
| 30,000 | 60,000+H ¹ | 22,000 |
| 35,000 | 60,000+H ¹ | 22,000 |
| 40,000 | 55,000+H ¹ | 22,000 |
| 45,000 | 55,000+H ¹ | 22,000 |
| 50,000 | 45,000+H ¹ | 22,000 |
| 55,000 | 45,000+H ¹ | 22,000 |
| 60,000 | 40,000+H ¹ | 22,000 |
| 65,000 | 40,000+H ¹ | 22,000 |
| 70,000 | 40,000+H ¹ | 22,000 |
| 75,000 | 40,000+H ¹ | 22,000 |
| 80,000 | 40,000+H ¹ | 22,000 |
| 85,000 | 40,000+H ¹ | 22,000 |
| 90,000 | 40,000+H ¹ | 22,000 |
| 95,000 | 35,000+H ¹ | 22,000 |
| 100,000 | 35,000+H ¹ | 22,000 |

Notes.

¹ H is the height of launcher above MSL in meters.

² Values for X and W include Safe Zone and Safe Zone B.

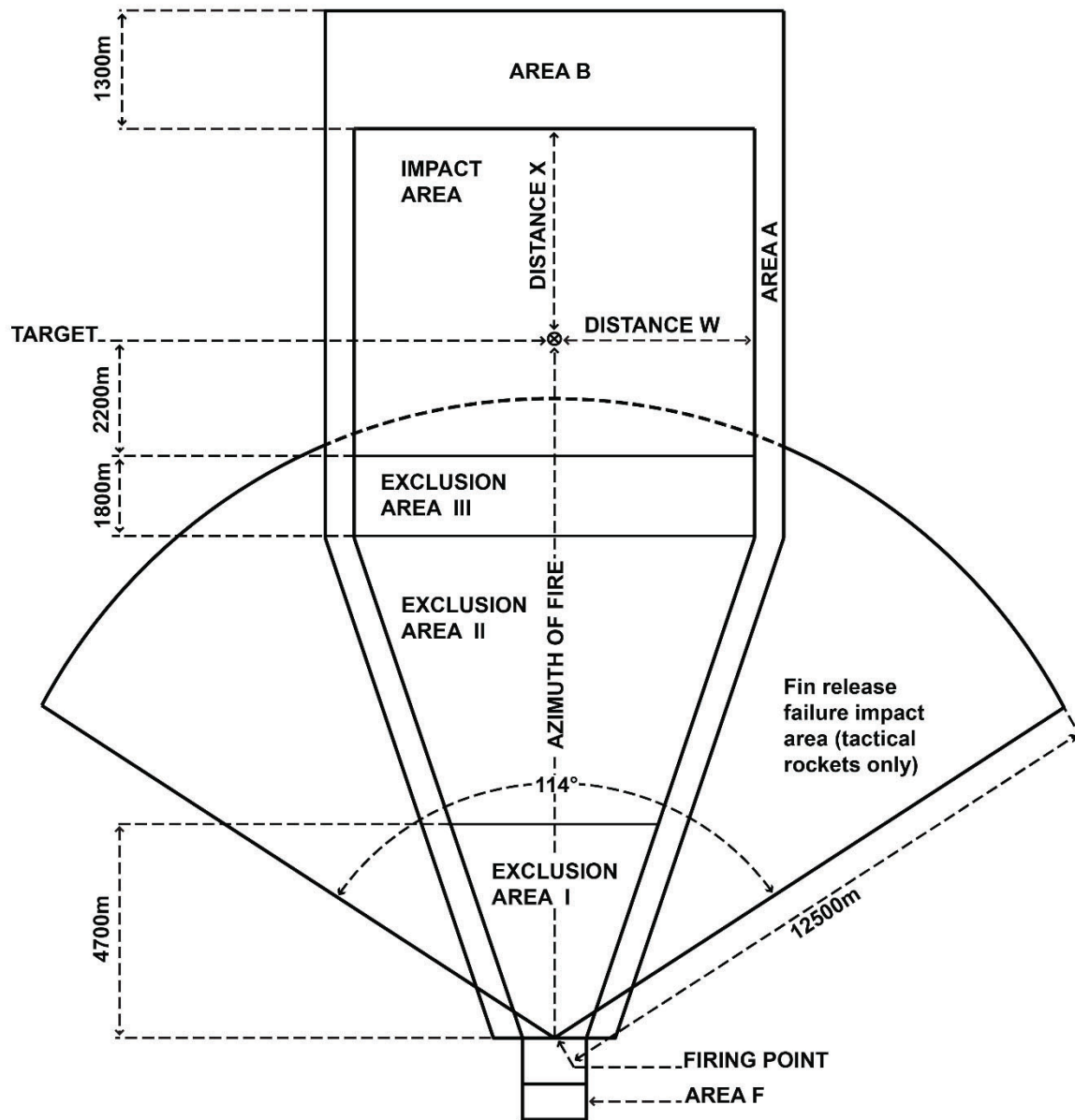


Figure 11–8. Surface danger zone for Multiple Launch Rocket System, High-Mobility Artillery Rocket System, and Guided Multiple Launch Rocket System

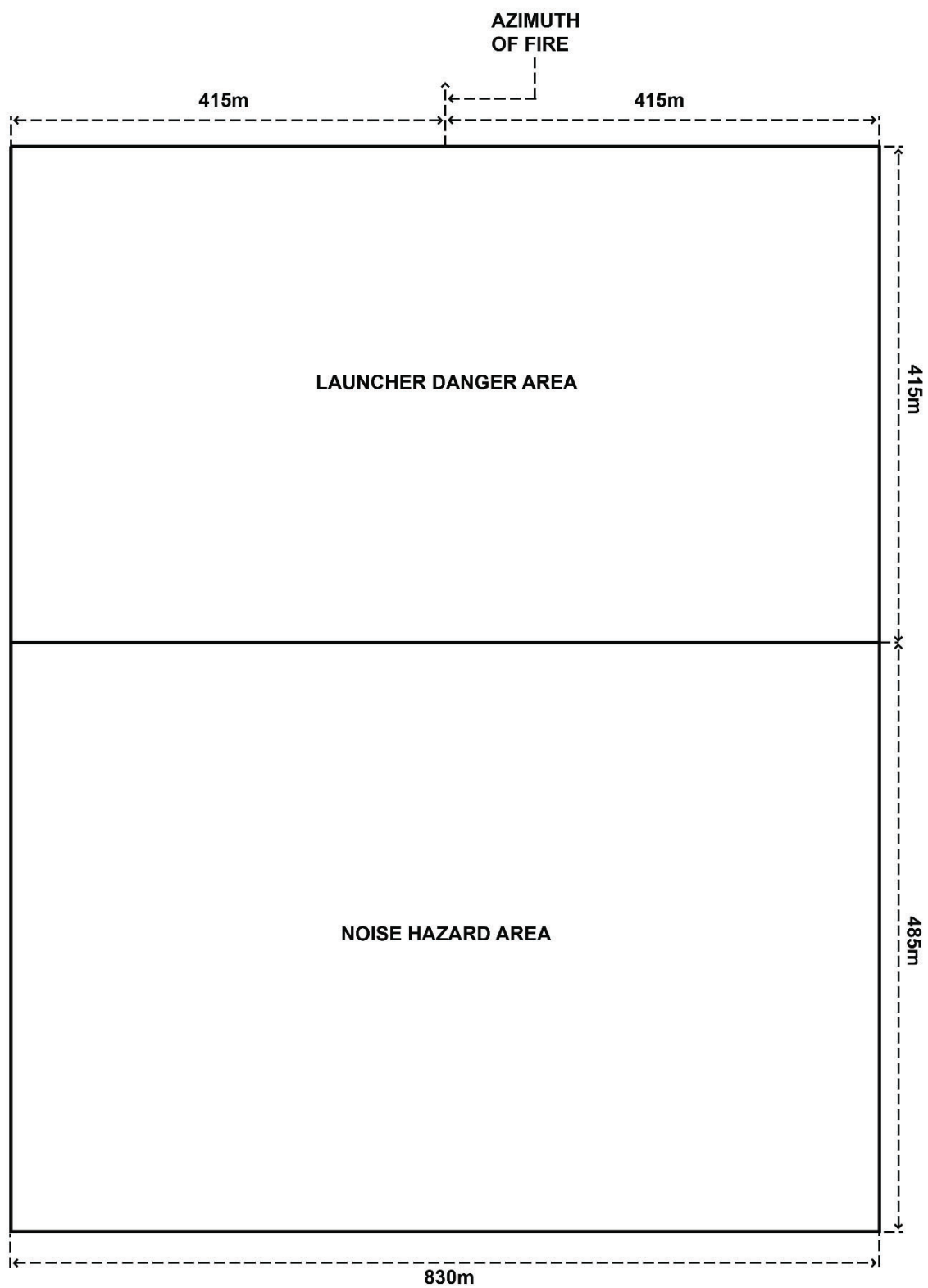


Figure 11–9. Surface danger zone, Area F, for Multiple Launch Rocket System, High-Mobility Artillery Rocket System, and Guided Multiple Launch Rocket System

11–11. Multiple Launch Rocket System and High-Mobility Artillery Rocket System reduced range practice rocket

a. Multiple Launch Rocket System and High-Mobility Artillery Rocket System. Firing conditions for MLRS and HIMARS reduced range practice rocket (RRPR) are the same as for standard MLRS and HIMARS (see para 11–10a).

b. Surface danger zone.

(1) See table 11–14 and figures 11–10 through 11–14 for RRPR SDZ requirements.

(2) The SDZ consists of an impact area, a target area or target point, a safety fan for firing point-to-point and operational area (OPAREA) SDZs only, flight corridors, Exclusion Areas I and II, and Area F.

(3) The SDZ impact area is the rectangular area that will contain all but one in one million normally functioning rockets and debris. It is perpendicular to and bisected by the azimuth of fire.

(4) Distances W, X, and Y are buffer distances accounting for debris distribution. Applied inward to determine target areas or outward from a single point, these buffers ensure that less than one in one million normally functioning rockets impact outside prescribed safety limits. For the azimuth of fire, Distance X is beyond the target, Distance Y is short of the target, and Distance W is to the flanks of the target.

(5) For the point-to-point method, the target box is determined by applying the values found in table 11–12, up range, down range, and laterally from the target location.

(6) The safety fan is defined by range and lateral limits within the target area.

(7) The flight corridors are areas parallel to the limits of the safety fan that extend from the forward corners of Area F to the far edge of the SDZ impact area.

(8) Exclusion Area I is the danger area directly in front of the firing point or OPAREA. This area extends 2,500 m toward the impact area (1:10,000 probability of injury). Based on risk estimates, Exclusion Area I may be reduced, by deviation, to not less than 1,000 m (1:1,000 probability of injury) (see figs 11–11 and 11–12).

(9) Exclusion Area II is the danger area between the forward limit of Exclusion Area I and the SDZ impact area. Exclusion Area II may be occupied by deviation only, in accordance with the criteria for overhead fire described in paragraph 11–11c.

(10) Area F is the area immediately to the rear of the launcher or OPAREA. Personnel may be exposed to blast overpressure, fragments, and debris from rocket launch. Area F extends 350 m to each side of the launcher and 400 m to the rear for point-to-point or firing point safety methods. It extends 400 m to each side of the OPAREA and 40 m to the rear of the OPAREA for OPAREA firing method. Personnel are not authorized to occupy Area F during firing. The noise hazard area extends an additional 300 m past Area F and may only be occupied by MEP wearing appropriate hearing protection.

(11) The target selection box (firing point and OPAREA SDZ only) is the set of all points from which a unit may select targets that will generate safe data regardless of where the launcher is within the OPAREA.

c. Overhead fire.

(1) The RRPR contains the same rocket motor failure potential as the basic rocket. However, because the RRPR does not have an explosive warhead event, the risk of firing over the heads of personnel authorized to occupy the SDZ is less than with the basic practice rocket.

(2) To calculate the risk of injury to personnel during overhead fire of RRPR under deviation, use a short round probability of 1 per 10,000 (0.0001) firing when a 2,500 m Exclusion Area I is used. If a 1,000 m Exclusion Area I is used, a short round probability of 1 per 1,000 firings should be used. This information should be used in conjunction with personnel density and areas occupied to calculate risk to personnel on a per-shot basis.

(3) An evaluation of the RRPR flight corridor is necessary to ensure accurate risk assessment and provide options for improved training and firing flexibility. Two options for assessing probability are as follows:

(a) If a 2,500 m Exclusion Area I in front of the launcher is used, a short round probability of 1 per 10,000 firings should be applied.

(b) If a 1,000 m Exclusion Area I in front of the launcher is used, a short round probability of 1 per 1,000 firings should be applied.

(4) For both options, the short round hazardous debris area to be used for ranges up to 12 km is 300 x 100 m. For ranges from 12.1 km to 15 km, use 100 x 50 m.

(5) The calculations in figure 11–15 are provided to assist in determining risk of RRPR overhead fire and should be chosen based on the training mission requirements.

(6) These calculations provide for the ability to estimate a reasonable probability of injury or vehicle damage. They are estimates and assume a certain level of randomness and uniformity. The probabilities are established so that, although grouping of troops could result in multiple injuries, this grouping would also realistically result in a lower overall probability of injury.

(7) See ATP 3–09.60 for MLRS and HIMARS safety computations.

Table 11–14
Surface danger zone data for Multiple Launch Rocket System and High-Mobility Artillery Rocket System M28A1 and M28A2
Reduced Range Practice Rocket

| Range to target (m) | Dist X (m) | Dist W (m) | Dist Y (m) | Target box dementions ¹ (m) |
|------------------------|------------------|------------------|------------------|--|
| 8,000 to 9,000 | 2,525 | 770 | 1,905 | 218 |
| 9,001 to 10,000 | 2,155 | 855 | 1,635 | 240 |
| 10,001 to 11,000 | 1,795 | 945 | 1,440 | 264 |
| 11,001 to 12,000 | 1,485 | 1,045 | 1,290 | 288 |
| 12,001 to 13,000 | 1,220 | 1,155 | 1,185 | 312 |
| 13,001 to 14,000 | 1,175 | 1,290 | 1,115 | 336 |
| 14,001 to 15,000 | 1,275 | 1,475 | 1,075 | 360 |

Note.

¹Target box dimensions are applied to point-to-point method only.

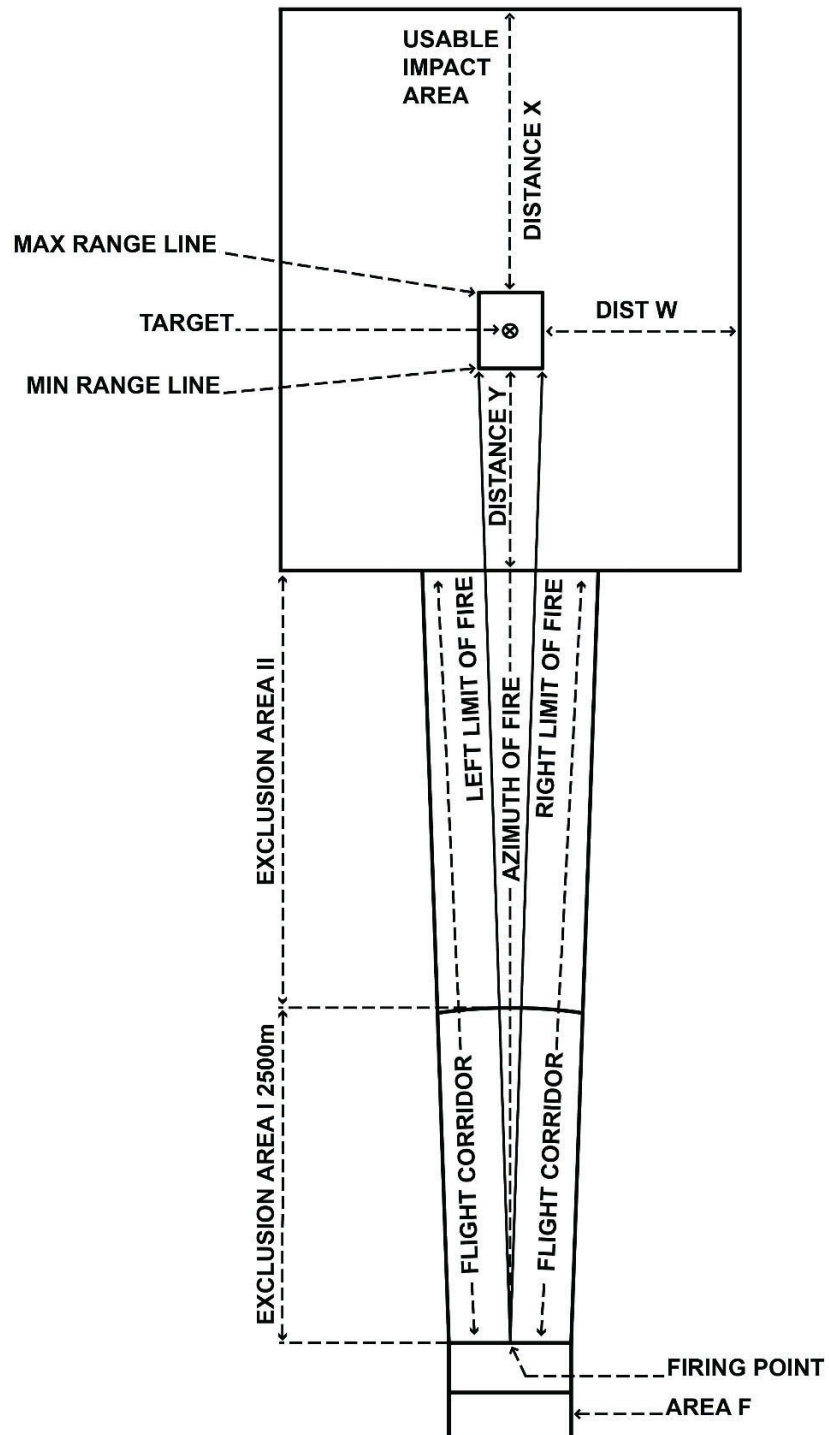


Figure 11-10. Surface danger zone for Reduced Range Practice Rocket point-to-point



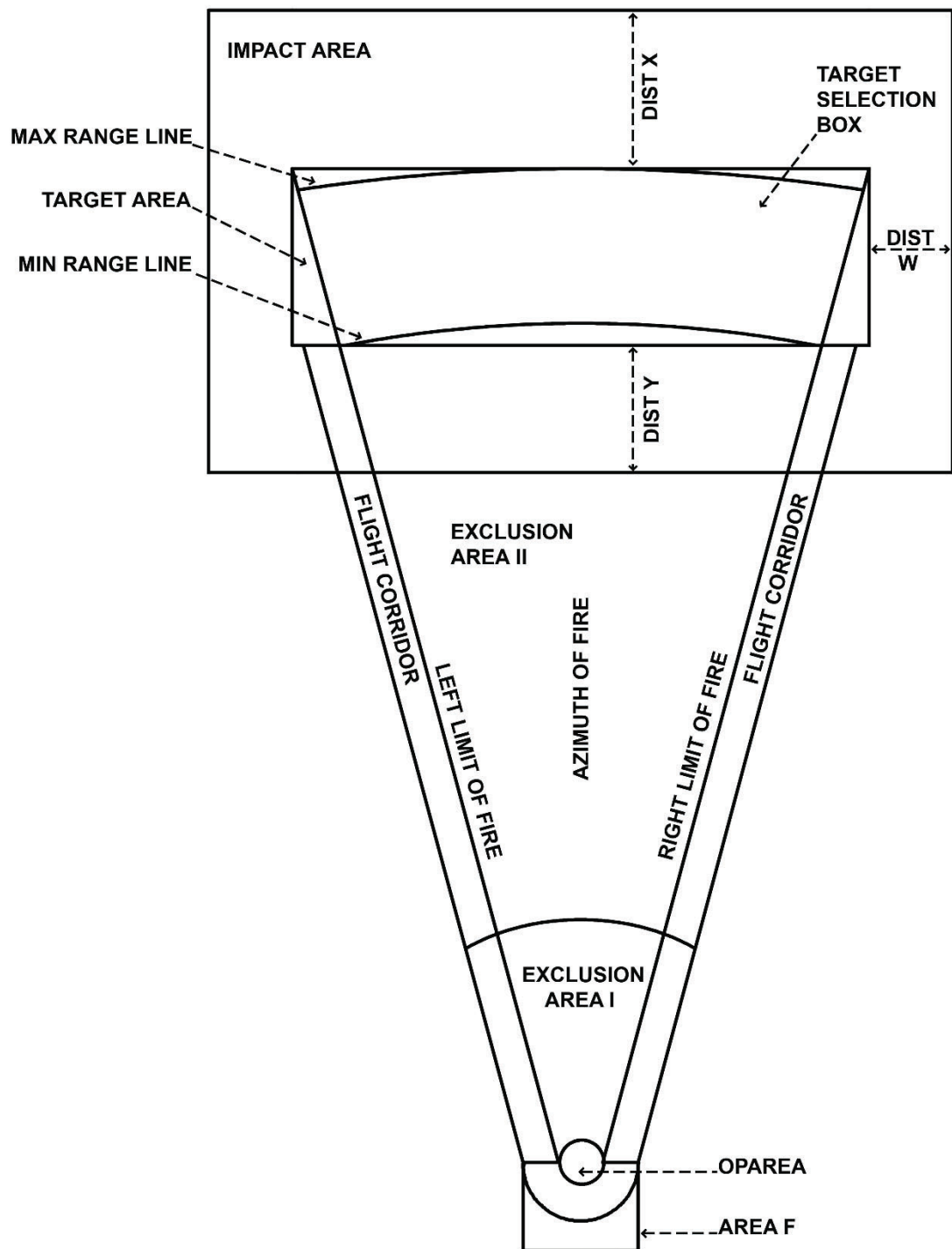


Figure 11–12. Surface danger zone for Reduced Range Practice Rocket operations area

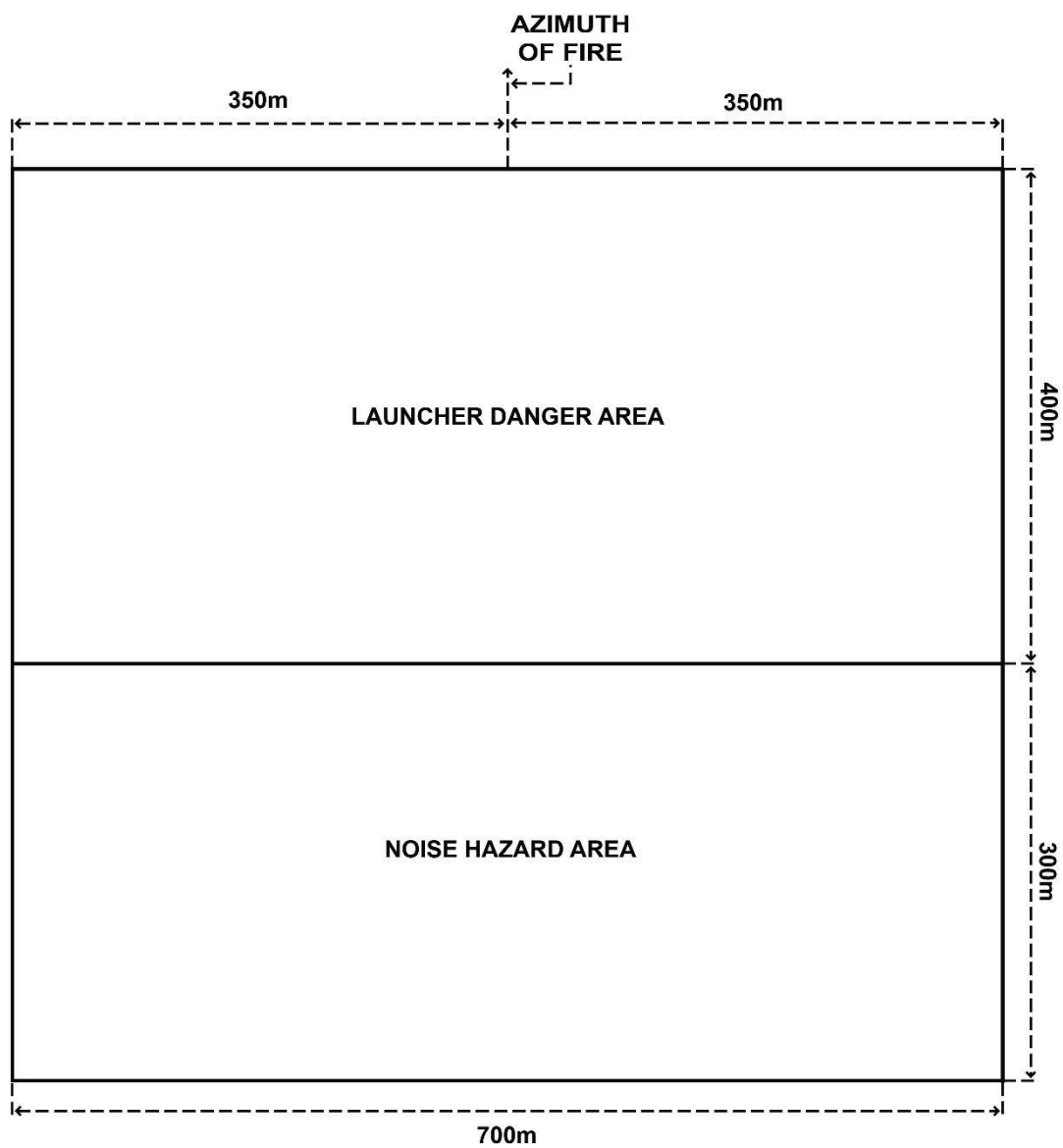


Figure 11–13. Surface danger zone, Area F, for Reduced Range Practice Rocket point-to-point and point-to-area

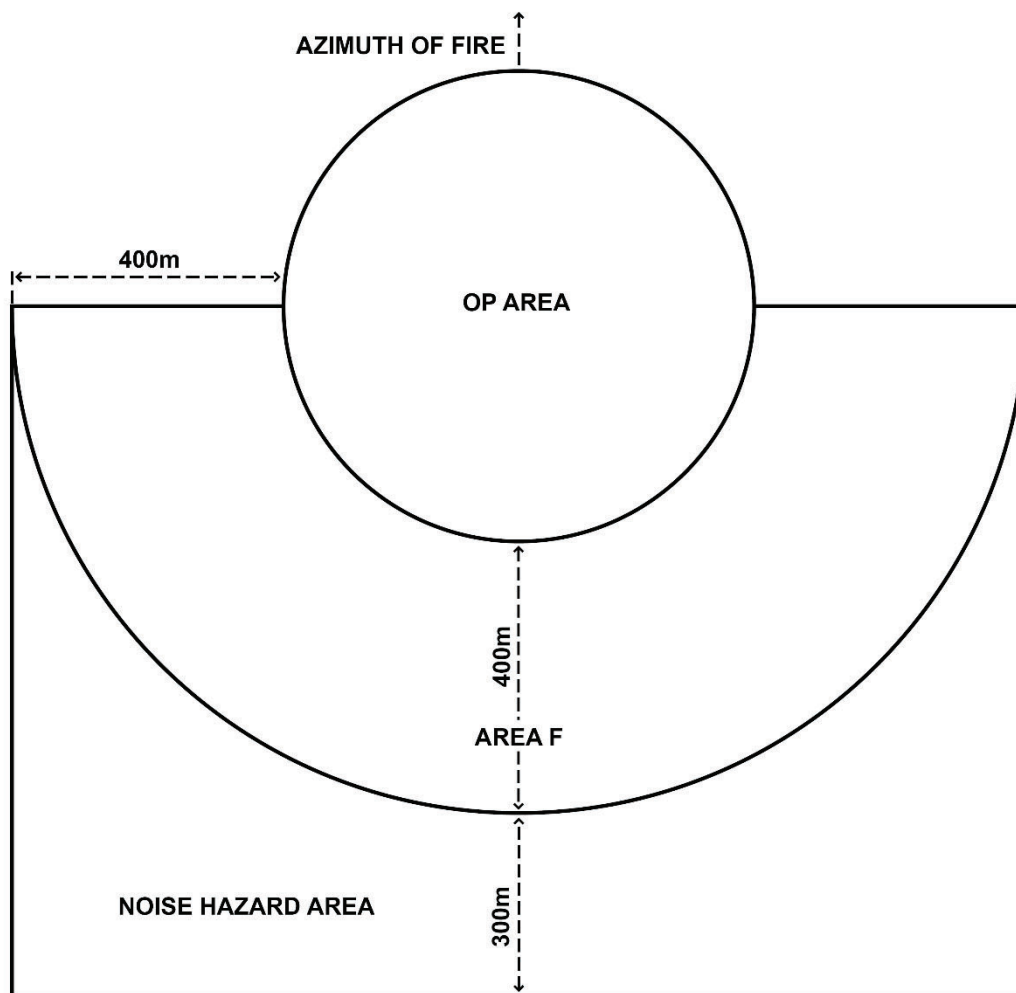


Figure 11–14. Surface danger zone, Area F, for Reduced Range Practice Rocket operations area

Probability of injury(ies) = $ABC(E/D)$

Probability of injury(ies) = $AB(F/D)$

Probability of vehicle damage = $ABG(E/D)$

Probability of injury(ies)/vehicle damage(s) = $AB(H/I)$

A = Probability of short round

B = Number of rockets fired

C = Number of personnel exposed

D = Size of occupiable corridor (based on target distance, in m^2)

E = Estimate of short round impact debris area (300m x 100m or 100m x 50m)

F = Area occupied by tank trail, road, site, etc. (when exact number of personnel/vehicles not known) in m^2 .

G = Number of vehicles exposed

H = (Length of short round impact debris area) + (width of trail/road), in meters

I = Length of occupiable corridor, in meters.

Figure 11–15. Formulas for determining risk during overhead fire using Multiple Launch Rocket System and High-Mobility Artillery Rocket System Reduced Range Practice Rockets overhead fire

11–12. Excalibur, 155mm High-Explosive M982

a. General.

(1) The Excalibur can be fired from the M777A2 Howitzer or the M109A6 Paladin.

(2) Currently fielded variants are the 1A1 (XM982), 1A2 (M982), and 1B (M982A1). The 1A1 variant has two operational flight software (OFS) configurations: 9.15.1.01 and 9.17.1d.01.

(3) Excalibur utilizes a 3-pound (lbs) hood to protect the base during transportation, handling, and gun firing. After exiting the muzzle brake, the hood falls free from the projectile. Death or serious injury can occur from impact of this hood. There is a potential hazard for the gun crew and others in the immediate vicinity that could lead to potentially catastrophic injuries.

b. Surface danger zone.

(1) If the Excalibur SDZ is too large to fit on a particular range, contact TPO Ranges (Army) or CG, TECOM (C 465) (Marine Corps) to obtain a unique SDZ tailored to fit on the allowable real estate of the range. The tailored SDZ is produced by restricting firing parameters, such as charge levels and gun elevations.

(2) The SDZ for the Excalibur is dependent on the Modular Artillery Charge System (MACS) charge zone. Figures 11–16 through 11–19 show the SDZs for MACS charge zones 3, 4, and 5, and are used with tables 11–15 through 11–18.

(3) The SDZ incorporates the base separation and hood impact hazard areas. These areas are depicted in figure 11–19 and table 11–18, which are valid for surface winds up to 30 m/s (67 mph).

Table 11–15

Surface danger zone data for Excalibur 1A1 XM982 Modular Artillery Charge System 3 and 4—Continued

| MACS | Dist EX1 (m) | Dist EX2 (m) | Dist EXR (m) | Dist EW1 (m) | Dist EW2 (m) | Dist EWR (m) |
|--------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|-----------------------------|
| 3 (OFS 9.15.1.01) | 30,000 | 7,500 | 6,250 | 15,500 | 12,000 | 3,500 |
| 4 (OFS 9.15.1.01) | 44,500 | 16,000 | 8,000 | 24,750 | 16,000 | 6,500 |
| 3 (OFS 9.17.1d.01) | 30,000 | 10,000 | 1,500 | 15,500 | 5,000 | 3,000 |
| 4 (OFS 9.17.1d.01) | 44,000 | 16,000 | 3,300 | 24,250 | 13,500 | 8,000 |

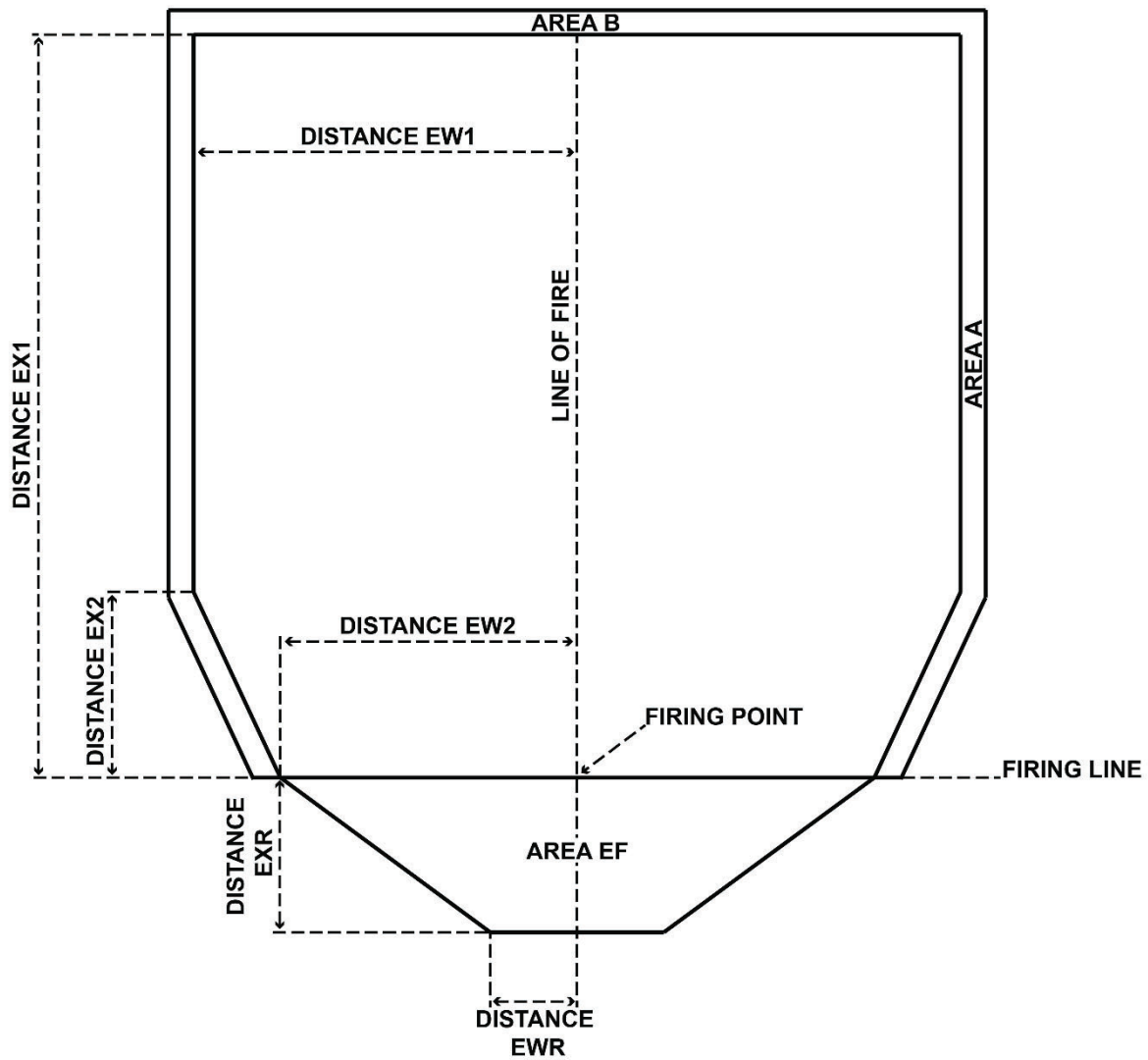


Figure 11–16. Surface danger zone for Excalibur 1A1 XM982 Modular Artillery Charge System 3 and 4

Table 11–16**Surface danger zone data for Excalibur 1A2 M982 Modular Artillery Charge System 3, 4, and 5**

| MACS | Dist EX1 ¹ (m) | Dist EX2 ² (m) | Dist EX3 ³ (m) | Dist EXR ⁴ (m) | Dist EW1 ⁵ (m) | Dist EW2 ⁶ (m) | Dist EW3 ⁷ (m) | Dist EWR ⁸ (m) | Min Target Dist (m) | Max Target Dist (m) |
|------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------|------------------------|
| 3 | 33,000 | 11,000 | NR | 1,400 | 14,000 | 4,200 | NR | 3,000 | 5,800 | 26,000 |
| 4 | 46,000 | 20,000 | 400 | 370 | 21,500 | 7,000 | 850 | 350 | 8,250 | 38,000 |
| 5 | 59,000 | 29,000 | 1,000 | 370 | 28,500 | 11,000 | 850 | 350 | 12,500 | 50,100 |

Legend:

MACS=Modular Artillery Charge System

NR=not required

Notes.

¹ Distance EX1 is the maximum distance Excalibur projectile can impact when fired or launched at a given QE with a given charge or propulsion system.² Distance EX2 is the minimum distance Excalibur projectile can impact with a lateral distance equivalent to distance EW1.³ Distance EX3 is the minimum distance Excalibur projectile can impact forward of the firing line.⁴ Distance EXR is the maximum distance Excalibur projectile, hood, or base can impact behind the firing at a given charge or propellant system.⁵ Distance EW1 is the maximum lateral distance from the line of fire that Excalibur projectile can impact between distance EX1 and EX2.⁶ Distance EW2 is the minimum lateral distance from the line of fire that Excalibur projectile can impact forward of the firing line.⁷ Distance EW3 is the maximum lateral distance from the line of fire that Excalibur projectile can impact forward of the firing line.⁸ Distance EWR is the maximum lateral distance from the line of fire Excalibur projectile or hood can impact at a distance EXR behind the firing line.**Table 11–17****Surface danger zone data for Excalibur 1B M982A1 Modular Artillery Charge System 3, 4, and 5**

| MACS | Dist EX1 ¹ (m) | Dist EX2 ² (m) | Dist EX3 ³ (m) | Dist EXR ⁴ (m) | Dist EW1 ⁵ (m) | Dist EW2 ⁶ (m) | Dist EW3 ⁷ (m) | Dist EWR ⁸ (m) | Min Target Dist (m) | Max Target Dist (m) |
|------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------------|------------------------|------------------------|
| 3 | 33,000 | 10,000 | NR | 950 | 16,100 | 4,600 | NR | 2,000 | 5,800 | 26,000 |
| 4 | 49,000 | 22,000 | NR | 370 | 23,800 | 6,300 | NR | 2,500 | 8,250 | 38,000 |
| 5 | 61,000 | 19,000 | 2,000 | 370 | 29,000 | 8,500 | 850 | 350 | 12,500 | 50,100 |

Legend:

MACS=Modular Artillery Charge System

NR=not required

Notes.

¹ Distance EX1 is the maximum distance Excalibur projectile can impact when fired or launched at a given QE with a given charge or propulsion system.² Distance EX2 is the minimum distance Excalibur projectile can impact with a lateral distance equivalent to distance EW1.³ Distance EX3 is the minimum distance Excalibur projectile can impact forward of the firing line.⁴ Distance EXR is the maximum distance Excalibur projectile, hood, or base can impact behind the firing at a given charge or propellant system.⁵ Distance EW1 is the maximum lateral distance from the line of fire that Excalibur projectile can impact between distance EX1 and EX2.⁶ Distance EW2 is the minimum lateral distance from the line of fire that Excalibur projectile can impact forward of the firing line.⁷ Distance EW3 is the maximum lateral distance from the line of fire that Excalibur projectile can impact forward of the firing line.⁸ Distance EWR is the maximum lateral distance from the line of fire Excalibur projectile or hood can impact at a distance EXR behind the firing line.

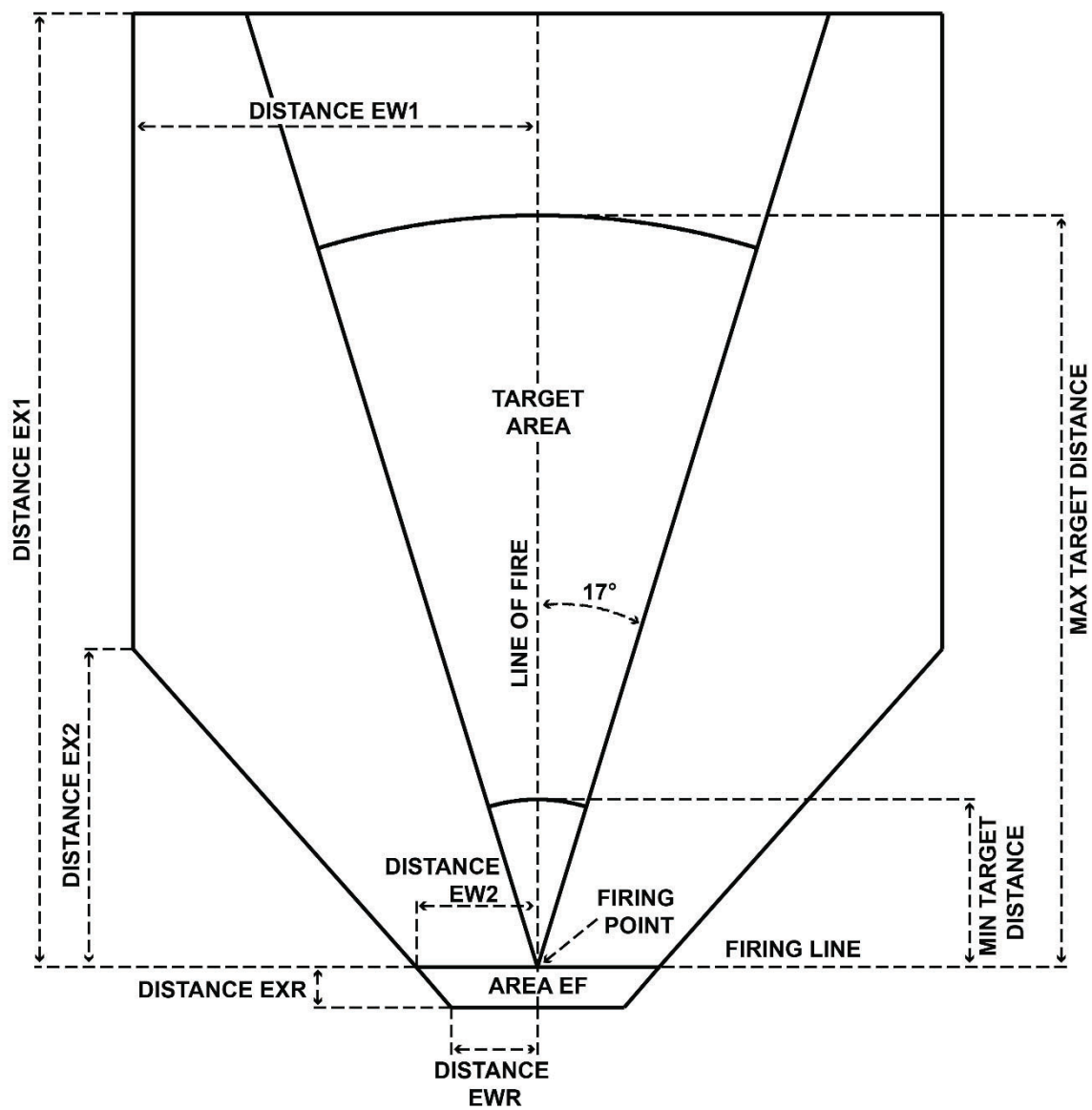


Figure 11–17. Surface danger zone for Excalibur 1A2 M982 Modular Artillery Charge System 3 and 1B M982A1 MACS 3 and 4

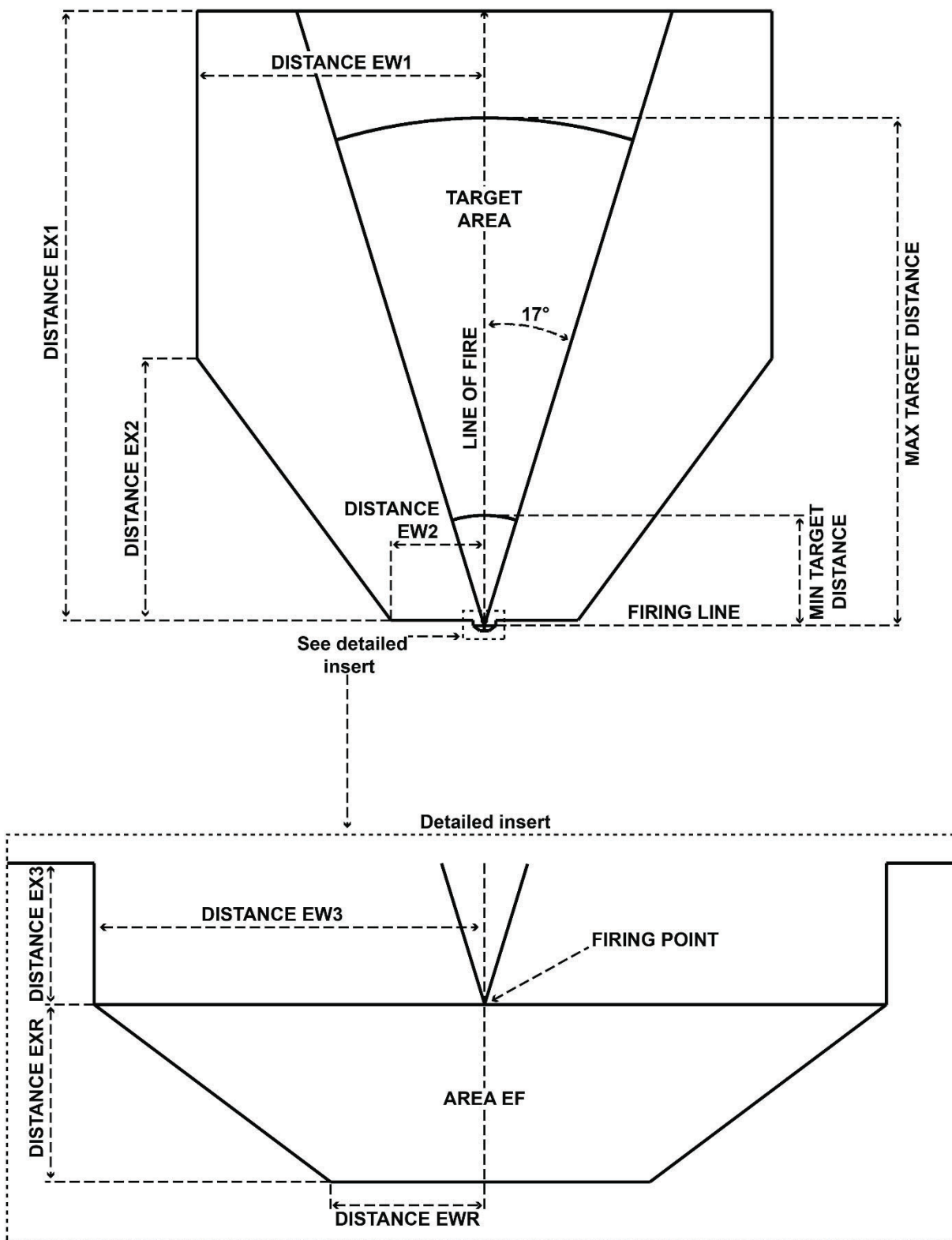


Figure 11–18. Surface danger zone for Excalibur 1A2 M982 Modular Artillery Charge System 4 and 5 and 1B M982A1 MACS 5

Table 11–18
Surface danger zone data for Excalibur 1A1 XM982, 1A2 M982, and 1B M982A1 Modular Artillery Charge System 3, 4, and 5
hood impact and base separation area

| Variant | Event | MACS zone | Dist EXH ¹ (m) | Dist EXR ² (m) | Dist EWH ³ (m) | Dist EWR ⁴ (m) |
|---------|-----------------------------|-----------|---------------------------|---------------------------|---------------------------|---------------------------|
| All | Hood impact area | All | 1,230 | 370 | 850 | 350 |
| All | Base separation impact area | 3 | 4,380 | 410 | 1,070 | 870 |

Legend:

MACS=Modular Artillery Charge System

Notes.

¹ Distance EXH is the maximum distance hazards, to include hood, base, or projectile body, can impact at a given charge or propellant system.

² Distance EXR is the maximum distance Excalibur projectile, hood, or base can impact behind the firing at a given charge or propellant system.

³ Distance EWH is the maximum lateral distance from the line of fire hazards, to include hood, base, or projectile body, can impact at a given charge or propellant system.

⁴ Distance EWR is the maximum lateral distance from the line of fire Excalibur projectile or hood can impact at a distance EXR behind the firing line.

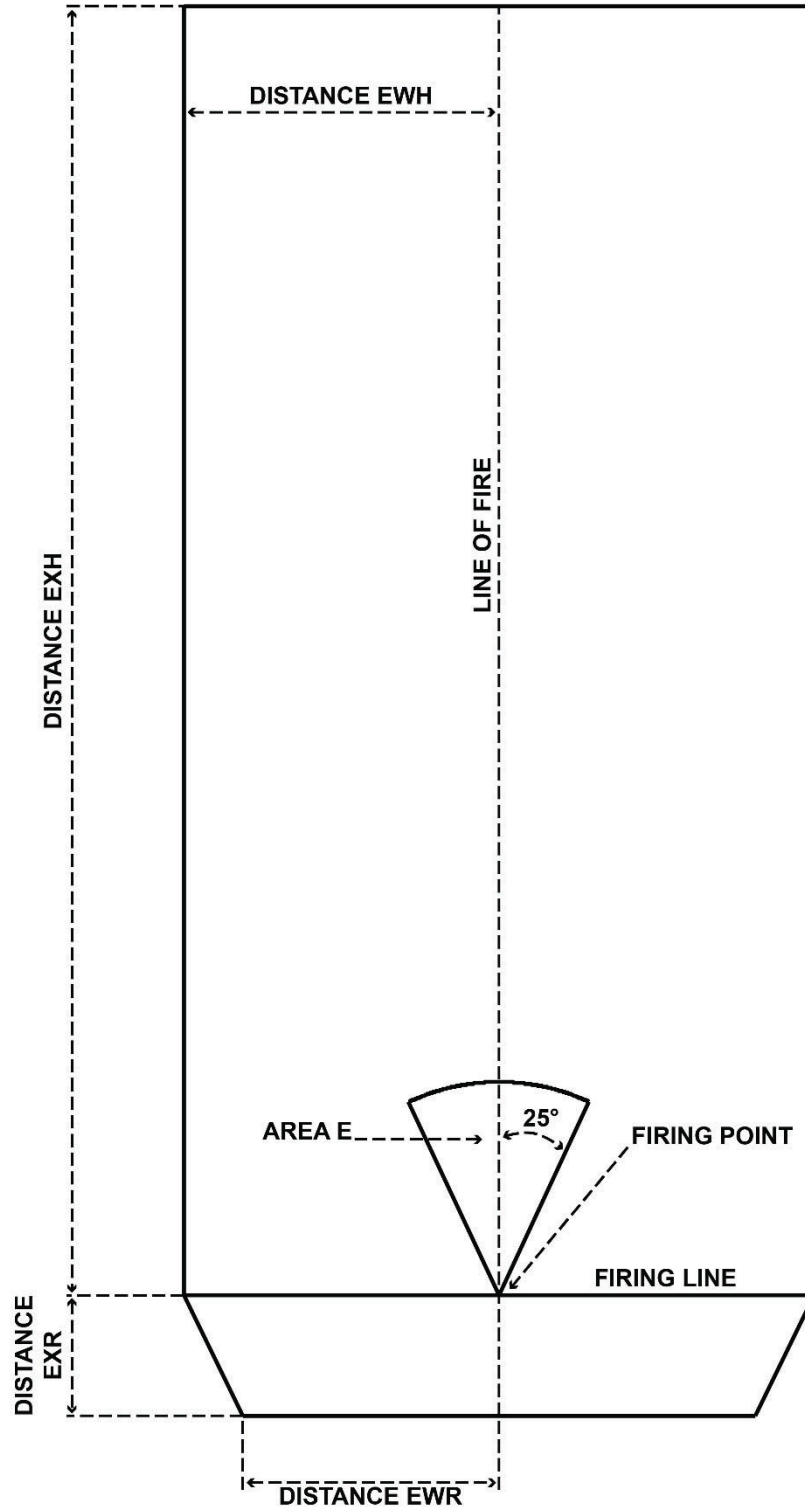


Figure 11–19. Surface danger zone for Excalibur 1A1 XM982, 1A2 M982 and 1B M982A1, Modular Artillery Charge System 3, 4, and 5 hood impact and base separation area

Chapter 12

Aviation Range Safety

12-1. General

a. Aircrew requirements.

(1) All aircrews operating within a range or training airspace complex will participate in a range safety brief and understand installation range regulations prior to operating within the complex.

(2) Aircrews will take all measures necessary to ensure they conduct training within assigned SUA or other authorized operating areas and that all effects are contained within range complex boundaries.

b. Scheduling.

(1) All aviation operations conducted within a range or SUA will be scheduled with the scheduling activity.

(2) SUA will be scheduled via the RFMSS when available and designated or activated in accordance with paragraph 2-4 of this regulation/order for all air-to-ground operations.

c. Communications.

(1) Two-way communication will be maintained between the OIC and the installation range operations firing desk (Army) or range control (Marine Corps).

(2) Range operations firing desk (Army) or range control (Marine Corps) must be able to maintain radio contact with all aircraft operating on the range. Communication relays are authorized as long as the RMA (Army) or RCO (Marine Corps) has a method (for example, tunable radio) to contact aircraft immediately in the event of an imminent situation.

(3) All aircraft utilizing ranges will monitor the guard frequency. RMA will have the capability to transmit and receive on the guard frequency (121.5 very high frequency (VHF) or 243.0 ultra high frequency (UHF)).

d. Weather.

(1) All aviation training will be conducted in visual meteorological conditions unless otherwise approved by the OIC and coordinated with range operations (Army) or range control (Marine Corps).

(2) The local weather detachment or command post must advise the OIC or RMA (Army) or RCO (Marine Corps) of any sudden adverse weather changes (watches, warnings, or advisories) that might impact range operations or safety.

(3) The OIC will monitor weather conditions (such as altimeter, wind direction and velocity, and ceiling) and provide general safety and weather updates during range operations as required.

e. Paradrops.

(1) The unit using the drop zone (DZ) is required to survey the DZ 24 hours prior to use.

(2) Parachute aircrew and DZ personnel will maintain communications with the range operations firing desk (Army) or range control (Marine Corps).

(3) DZs will be confirmed clear before commencement of parachute or parachute operations.

(4) Joint Precision Airdrop System (JPADS).

(a) The unit dropping the load is responsible for using JPADS mission planning software before they fly the mission.

(b) Range operations (Army) or range control (Marine Corps) will approve Improved-Container Delivery System deliveries only if the Precision Airdrop System-Mission Planner derived point of impact, the 3-sigma footprint for chute failure, and the guidance failure footprint overlay on Government-owned, leased, or otherwise controlled land with no unauthorized personnel present and a collateral damage estimate is acceptable to the RMA (Army) or RCO (Marine Corps).

(c) Equipment, facilities, and participating personnel are permitted within the 3-sigma success, chute failure, and the guidance failure footprints as long as RMA has conducted and approved an operational risk assessment.

(d) RMAs (Army) and RCOs (Marine Corps) should note that JPADS users may desire to update weather observations by dropping a sonde (foot-long metal wind sensor) for wind updates to revise footprint analyses up until the time of delivery.

(f) *Countermeasures.* The use of chaff and flares will comply with local range regulations, SOPs, and FAA requirements and in accordance with aircraft TMs.

12-2. Firing operations-general requirements

a. Weapon danger zones.

(1) Air-to-ground delivery of munitions can be accomplished from a variety of platforms, to include fixed wing (FW), rotary-wing (RW), tilt wing (TW), and unmanned aircraft systems (UAS). Danger zones with approved WDZ data will be generated through the use of the RMTK WDZ Tool. Munitions that do not have a developed WDZ may

use an SDZ if available. The WDZ is modeled to represent the distribution of impacts, ricochets or broaches, and the vertical hazard associated with fragmentation and the ricochets (see para 12–6).

(2) The three-dimensional aspect of munitions delivery can present many challenges when determining the safe location of personnel and facilities operating on the ground. The WDZ Tool enables RMAs (Army) and RCOs (Marine Corps) to reduce risks to personnel and facilities involved with aviation operations.

(3) RMAs (Army) and RCOs (Marine Corps) must employ safe management practices that provide the visibility and control required for the integration of both air and ground operations. The use of the WDZ Tool supplemented with an aggressive risk mitigation program will help reduce the complications and dangers associated with this training.

b. Aircrew currency qualifications for aviation weapons delivery.

(1) *Army.*

(a) During firing, qualified standardization instructor pilots or instructor pilots having immediate access to positive control of the aircraft and weapon systems being fired will accompany pilots and gunners who are not current and qualified in the aircraft.

(b) Qualified non-rated crew member flight instructors or nonrated crew member unit trainers having immediate access to the weapons systems being fired will accompany door gunners who are not current and qualified.

(2) *Marine Corps.* Marine pilot and aerial gunners will demonstrate flight and weapons system proficiency in accordance with the appropriate TMs and training and readiness manuals.

c. Aircrew weapons qualifications for aviation weapons delivery.

(1) Pilots and gunners will successfully complete an approved qualification course or qualification or transition training in accordance with an approved program of instruction.

(2) Pilots and gunners will demonstrate flight and weapon systems proficiency in accordance with TC 3–04.11, TC 3–04.3, or the appropriate aircrew training manuals.

d. Communications.

(1) All firing elements must maintain positive two-way communications with the OIC.

(2) Firing will be suspended immediately upon loss of communications with the range operations firing desk (Army), range control (Marine Corps), the OIC, or firing elements.

(3) Command and control aircraft may be used at the commander's discretion.

e. Night operations.

(1) Night range operations present unique challenges to both the aircrew and the OIC. Visual cues are greatly reduced, even with the use of night vision devices (NVDs).

(2) OICs should use NVDs during night operations and at a minimum have access to Generation III NVDs.

12–3. Firing conditions-general procedures

a. General.

(1) Pilots and gunners will be familiar with the impact area, firing limits, and safety regulations for the range on which they will expend munitions.

(2) The aircraft pilot in command will ensure the aircraft is safely oriented with the proper target prior to engagement.

(3) For FW operations, if the OIC cannot positively determine that the aircraft can release safely, the OIC will delegate munitions release clearance to a qualified flight lead, individual pilot, forward air controller, or other briefed person. The OIC will maintain overall authority on the range for the training event and can abort the release or direct a cease-fire at any time. In all cases, the pilot assumes sole responsibility for the safe release of munitions and confirmation of the approved target.

(4) For UAS operations, the mission commander will maintain the responsibility for the safe operation of payload and platform.

(5) All live-fire training must be observed.

b. Armament safety procedures.

(1) Aircraft weapon systems will be loaded or unloaded only in approved areas. Selection of these areas will ensure total containment in the event of accidental discharge. Use of natural or manmade barriers is encouraged.

(2) Airspace routing used by RW aircraft flying from the ammunition loading site to and from the firing range will be plotted on a map or chart and maintained by both the using unit and the installation range operations office (Army) or range control office (Marine Corps). This course will be selected so that accidental firing at any point on the course will minimize risk to life and property; however, aircraft weapon systems will be maintained in a safe condition until within the range boundary or authorized SUA. RW aircraft routing from the ammunition loading site to the firing range will be published in local SOPs.

(3) For FW aircraft, the WDZ must be contained within the SUA appropriate with the release conditions during transit of the munition until within the range boundary.

(4) When training requirements dictate, commanders (battalion, squadron, or higher) will direct the loading and unloading of ammunition from aircraft while the engines are running. Such operations are authorized when a thorough risk assessment has been conducted, control measures implemented, and residual risks identified and accepted by the appropriate commander.

(5) A dry pass or range sweep for the entire range, focusing on the target area, will be accomplished to ensure personnel and equipment are clear from hazardous effects. Aircraft, to include UAS, may use onboard sensors (such as advance targeting pods, sniper, lightning pod, or cameras) in lieu of a dry pass. Terminal controllers observing the target area may waive the dry pass.

(6) Prior to first weapons release or firing for each pass, final switch configuration will not be accomplished until the aircraft is in such a position that accidental activation or release will be contained within the range and not represent a danger to ground personnel.

(7) Aircraft will be a minimum of one switch position (excluding trigger) away from weapons release or firing when not oriented toward the target area unless approved by range operations (Army) or range control (Marine Corps). Switch manipulation will not occur until after safe recovery of weapons release or firing. RW and TW aircraft will be in a safe condition prior to departing an aerial release or firing area unless otherwise directed.

(8) Prior to leaving a range area, FW aircraft will conduct a hung munition check. If hung munition remains on board the aircraft, ensure compliance with local restrictions to avoid undue risk for the return flight. For RW and TW aircraft, the pilot in command will ensure that all weapon systems are clear of ammunition prior to departing the range. Upon completion of training, aircraft weapon systems will be safed in accordance with aircraft TMs before leaving the range.

(9) Crash rescue personnel will be knowledgeable of safety precautions associated with armed aircraft and impact areas and the hazards associated with burned aircraft (for example, radioactive and advanced composite materials).

c. Hung munitions and jettison areas.

(1) Range operations (Army) and range control (Marine Corps) will ensure all aircraft report munitions expended, hung munitions, and UXO locations to the range operations firing desk (Army) or range control (Marine Corps) prior to departing the range.

(2) Installation SOPs and range directives will designate munitions jettison and emergency landing areas for use by aircraft experiencing weapons malfunctions or in-flight emergencies.

(3) Jettison areas will be located such that maximum protection is provided to personnel and range facilities in case the jettisoned munition detonates.

(4) Fuel spill materials (spill kits) will be available at forward arming and refueling points. Fuel tankers used to refuel aircraft will be equipped with sufficient absorbent material to handle small to moderate spills.

d. Commanders responsibilities.

(1) Commanders will develop and implement an aggressive program to ensure crew coordination and combat identification procedures concurrent with the gunnery training program. Combat identification training will be conducted in accordance with TC 25–8, TC 3–04.11, TC 3–04.3, or appropriate aircrew training manuals.

(2) Range operations (Army) and range control (Marine Corps) personnel will publish air-to-ground munition delivery regulations for each target in the range SOP, specifying munitions permitted and any restrictions (dive angle, airspeed, and run-in heading) associated with that target or specific training event.

(3) Proper target analysis will include the following:

(a) Approved munition for the range target.

(b) Type of deliveries allowed.

(c) Run-in restriction if required for a specific weapon or delivery.

(d) Approved containment boundary.

(e) Weather minimums if more restrictive than standard visual flight rules operating requirements.

(f) Minimum Safe Lasing Altitude if class 3B or 4 lasers will be used.

(g) Any other constraints or restrictions required to allow weapons delivery on the identified target.

(h) For deliveries not contained within the SOP, the using unit may submit proposed WDZs and LSDZs as appropriate to the range operations office (Army) or range control office (Marine Corps) for consideration.

(i) WDZs will be developed and tested as new weapons, aircraft, and delivery parameters are produced and enter the operational inventory or as new testing and lab data becomes available. Appropriate higher headquarters will ensure WDZs are available prior to levying new weapons training requirements or introducing new aircraft and weapons into the DoD inventory.

12-4. Weapon danger zone program methodology

a. WDZs identify the minimum area necessary to contain munitions and hazardous fragments within the installation or range boundary that result from air-to-ground munition delivery operations.

b. The principle objective of the WDZ program is to assist range operations (Army) and range control (Marine Corps) in executing safe range operations. WDZ program methodology identifies weapon impact point probabilities from a variety of platforms and parameters, thus providing them with a scientific basis for making sound range planning decisions and to facilitate training readiness. It enables range personnel to—

- (1) Contain munition and fragmentation within range boundaries.
- (2) Identify appropriate containment levels and risk associated with the areas identified as needing specific risk analysis or the area of critical concern.
- (3) Identify possible or improved target locations.
- (4) Modify allowable delivery ground tracks to eliminate or reduce hazards.
- (5) Identify the best locations for participating personnel, range modifications, or improvements.
- (6) Design a new target area or range.

c. The methodology is based on a combination of weapon modeling and simulation data and actual impact data. Each WDZ incorporates a probability distribution function that provides the information necessary to perform a quantitative risk assessment to evaluate the relative risk of an identified profile, based on the size and location within the WDZ.

d. All developed air-to-ground aviation munitions will have a WDZ. This WDZ is calculated based on the type of aircraft delivering the weapon (for example, F/A-18 Hornet aircraft or AH-64 helicopter), the delivery parameters of the aircraft (for example, dive angle, airspeed, and altitude), the type of munitions being delivered (for example, MK-82 bomb or AGM-114 HELLFIRE missile), the target and terrain type, and the level of containment desired. Legacy weapon systems that do not have a developed WDZ may still use an SDZ.

e. WDZs may be further affected by terrain, artificial barriers, or other compensating factors, such as target type (wood or metal) and soil hardness.

f. See chapter 3 for representative examples and descriptions of WDZs.

12-5. Range Managers Toolkit Weapon Danger Zone Tool

a. WDZs for FW, RW, TW, and UAS are generated with the WDZ Tool as part of the RMTK suite of tools. The WDZ Tool is a geographic information system-based application that is available to operational planners and RMAs (Army) in desktop version and to RCOs (Marine Corps) in desktop, web-based, and mobile versions.

b. The WDZ Tool will lead the user through the WDZ generation process. It will help range managers determine aircraft type, munitions, and delivery parameters that are permissible for each target.

c. The WDZ (electronic or hard copy) for each target engaged during the training evolution will be maintained at range operations (Army) and range control (Marine Corps). The WDZ manager (library software function) may be used to meet this requirement.

12-6. Applying the weapon danger zone tool

a. Containment.

(1) The containment of a weapon system's performance envelope, impact footprint, and associated debris fields require the surface area (land or sea) to be protected by purchase, lease, or other restriction to exclude personnel from that area. This general policy ensures safety will be maximized and consistent with mission requirements.

(2) The WDZ Tool allows selectable levels for weapons containment based on service policy ranging from 1:10,000 probability to a 1:1,000,000 probability of a munition or munition component escaping the containment area (for inert munition) or a live weapon's fragment escaping the containment area (for live munition).

(3) The WDZ safety standard for Army and Marine Corps ranges is 1:1,000,000 (99.9999 percent) containment.

(4) For the Army, if the selected containment level is too restrictive to support necessary operations, a less restrictive containment level may be accepted with the completion of an appropriate risk analysis and deviation process in chapter 4 and ATP 5-19. For the Marine Corps, if the selected containment level is too large to support necessary operations, contact CG, TECOM, RTAM (C 465), 3300 Russell Road, Quantico, VA 22134-5001 for assistance in development of the appropriate risk analysis and deviation process referenced in ATP 5-19 and MCO 5100.29C.

(5) WDZs extending beyond installation boundaries must be based on the ability to contain projectiles, hazardous fragments, laser beams, and both vertical and horizontal ricochets sufficiently within the installation boundaries and the area under military control (such as leased land or training areas and facilities acquired through memorandum of understanding or memorandum of agreement) in coordination with TPO Ranges (Army) or CG, TECOM C 465

(Marine Corps). Probability of hazardous fragment escapement must not present a greater than 1:1,000,000 hazard to the public.

b. Mission-essential personnel.

(1) Placement of MEP within a WDZ may be authorized by the RMA (Army) or RCO (Marine Corps) or the operational commander of the training or exercise.

(2) MEP are those personnel directly related to the employment of live or inert munition (air, surface, or sea fires) in an exercise or evaluation on a training range in a training or evaluation scenario (all those people who are receiving or giving the training or receiving or giving the evaluation). This would include JTACs, tactical air control parties, maneuver elements, fires elements (air, land, and sea), and instructors and evaluators.

c. Risk analysis.

(1) The WDZ Tool risk analysis function can show the probability of impacts within a selectable, defined area of the WDZ. This function will help define the risk associated with a specific location within the WDZ, dependent upon the weapons system employed and the size of the area at risk or area of critical concern. Risk is determined by the WDZ tool for unprotected personnel in the open. An area of critical concern analysis using the WDZ tool must be performed anytime that participating personnel are located within a WDZ.

(2) Areas of critical concern may involve the placement of MEP (such as JTAC or tactical air control parties) or the location of towers or other facilities within the WDZ. For areas of critical concern that contain MEP, the RMA (Army), RCO (Marine Corps), or the OIC will use the WDZ Tool Risk Analysis function and will not accept greater risk than the safety standard of 1:1,000,000 unless a thorough risk assessment or RM process has been completed in accordance with ATP 5-19 and MCO 5100.29C.

(3) Risk may be mitigated by moving the location of the personnel or decreasing their vulnerability through the use of terrain features or bunkers.

(4) Non-participating personnel must be outside the WDZ at all times.

12-7. Rotary-wing surface danger zones

a. General.

(1) SDZs in this chapter will be used for RW aircraft when WDZ generation is not available.

(2) For firing from a hover, SDZs will be superimposed over the GTL at each firing point. On running fire courses, SDZs will be superimposed over each anticipated firing position along the course. These SDZs will begin at the start-fire line and move along the course to each anticipated firing point to the cease-fire line. SDZs should anticipate that firing may occur across the entire width of the running fire lane.

(3) A range may contain several different hover fire points or running fire courses where multiple aircraft can fire at the same time. The resultant SDZ will be a composite formed by individual SDZs. When multiple aircraft are firing at the same time, controls will be established to ensure the safety of all participating aircraft.

(4) The lateral limits of the target area determine the left and right limits of fire, which will begin at any point beyond the start-fire line, provided the MSD (see fig 12-1 ricochet area and areas A and B) for the weapon system being fired is maintained from the aircraft to the point of impact. For running fire, Distance X will be measured from the cease-fire line.

b. Guns and cannons. The WDZ Tool provides for safe firing of 5.56mm, 7.62mm, and .50 caliber machine guns and 20mm and 30mm cannons from RW aircraft.

c. Rockets.

(1) SDZ requirements for the safe firing of the 2.75-inch folding fin aerial rocket weapon systems from RW aircraft are in tables 12-1 through 12-8 for hover and running fire, tables 12-9 through 12-14 for diving fire, and figures 12-1 and 12-2 and are the basis for constructing the SDZ.

(2) Normal vertical danger zones with the parameters of tables 12-1 through 12-14 are 5,000 ft AGL. The length and width of the firing lane will be determined by the RMA (Army) or OIC (Marine Corps). Minimum recommended width is 50 m.

(3) The maneuver holding area is not required to be connected to the running fire lane and is not required to be any particular shape or size, except that it must be of sufficient space to accommodate aircraft waiting to enter the running fire lane without impeding aircraft entering the lane.

(4) Areas A and B are not required for inert or training munitions. For HE warhead-equipped rockets, Areas A and B are 300 m wide. For flechette warhead-equipped rockets, Area A is 300 m wide and Area B is 400 m wide.

(5) For mixed loads, Distance X is based off the rocket having the greatest range for the highest expected launch angle.

Table 12–1
Surface danger zone data for M274 Training Practice with MK66 altitude greater than 201 feet above ground level, hover and running fire—Continued

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|------------------|----------------|------------|------------|------------------------------|
| 0 | All | Hover 90 KTAS | 4,642 4,644 | NR NR | NR NR | 1,524 1,524 |
| 2 | All | Hover 90 KTAS | 5,035 5,087 | NR NR | NR NR | 1,524 1,524 |
| 4 | All | Hover 90 KTAS | 5,461 5,534 | NR NR | NR NR | 1,524 1,524 |
| 6 | All | Hover 90 KTAS | 5,828 5,919 | NR NR | NR NR | 1,524 1,524 |
| 8 | All | Hover 90 KTAS | 6,159 6,292 | NR NR | NR NR | 1,524 1,524 |
| 12 | All | Hover 90 KTAS | 6,797 6,956 | NR NR | NR NR | 1,524 1,524 |
| 16 | All | Hover 90 KTAS | 7,327 7,525 | NR NR | NR NR | 1,524 1,524 |

Legend:
KTAS=knots true airspeed
NR=not required
TP=training practice

Table 12–2
Surface danger zone data for M274 Training Practice with MK66 altitude greater than 1,001 feet above ground level, hover and running fire

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|------------------|----------------|------------|------------|------------------------------|
| 0 | All | Hover 90 KTAS | 5,242 5,298 | NR NR | NR NR | 1,524 1,524 |
| 2 | All | Hover 90 KTAS | 5,604 5,675 | NR NR | NR NR | 1,524 1,524 |
| 4 | All | Hover 90 KTAS | 5,960 6,063 | NR NR | NR NR | 1,524 1,524 |
| 6 | All | Hover 90 KTAS | 6,271 6,390 | NR NR | NR NR | 1,524 1,524 |
| 8 | All | Hover 90 KTAS | 6,606 6,737 | NR NR | NR NR | 1,524 1,524 |
| 12 | All | Hover 90 KTAS | 7,197 7,371 | NR NR | NR NR | 1,524 1,524 |
| 16 | All | Hover 90 KTAS | 7,670 7,878 | NR NR | NR NR | 1,524 1,524 |

Legend:
KTAS=knots true airspeed
NR=not required
TP=training practice

Table 12–3
Surface danger zone data for M151 High-Explosive with MK66 altitude greater than 201 feet above ground level, hover and running fire

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|------------------|----------------|------------|------------|------------------------------|
| 0 | All | Hover 90 KTAS | 4,642 4,644 | 300 300 | 300 300 | 1,524 1,524 |
| 2 | All | Hover 90 KTAS | 5,035 5,087 | 300 300 | 300 300 | 1,524 1,524 |
| 4 | All | Hover 90 KTAS | 5,461 5,534 | 300 300 | 300 300 | 1,524 1,524 |
| 6 | All | Hover 90 KTAS | 5,828 5,919 | 300 300 | 300 300 | 1,524 1,524 |
| 8 | All | Hover 90 KTAS | 6,159 6,292 | 300 300 | 300 300 | 1,524 1,524 |
| 12 | All | Hover 90 KTAS | 6,797 6,956 | 300 300 | 300 300 | 1,524 1,524 |
| 16 | All | Hover 90 KTAS | 7,327 7,525 | 300 300 | 300 300 | 1,524 1,524 |

Legend:
HE=high-explosive
KTAS=knots true airspeed

Table 12–4
Surface danger zone data for M151 High-Explosive with MK66 altitude greater than 1,001 feet above ground level, hover and running fire

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|------------------|----------------|------------|------------|------------------------------|
| 0 | All | Hover 90 KTAS | 5,242 5,298 | 300 300 | 300 300 | 1,524 1,524 |
| 2 | All | Hover 90 KTAS | 5,604 5,675 | 300 300 | 300 300 | 1,524 1,524 |
| 4 | All | Hover 90 KTAS | 5,960 6,063 | 300 300 | 300 300 | 1,524 1,524 |
| 6 | All | Hover 90 KTAS | 6,271 6,390 | 300 300 | 300 300 | 1,524 1,524 |
| 8 | All | Hover 90 KTAS | 6,606 6,737 | 300 300 | 300 300 | 1,524 1,524 |
| 12 | All | Hover 90 KTAS | 7,197 7,371 | 300 300 | 300 300 | 1,524 1,524 |
| 16 | All | Hover 90 KTAS | 7,670 7,878 | 300 300 | 300 300 | 1,524 1,524 |

Legend:
HE=high-explosive
KTAS=knots true airspeed

Table 12–5

Surface danger zone data for M255 Flechette with MK66 altitude greater than 201 feet above ground level, hover and running fire

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|------------------|------------|------------|------------|------------------------------|
| 0 | All | Hover 90 KTAS | 4,286 | 300 | 400 | 1,524 |
| | | | 4,383 | 300 | 400 | 1,524 |
| 2 | All | Hover 90 KTAS | 4,828 | 300 | 400 | 1,524 |
| | | | 4,975 | 300 | 400 | 1,524 |
| 4 | All | Hover 90 KTAS | 5,304 | 300 | 400 | 1,524 |
| | | | 5,509 | 300 | 400 | 1,524 |
| 6 | All | Hover 90 KTAS | 5,779 | 300 | 400 | 1,524 |
| | | | 6,019 | 300 | 400 | 1,524 |
| 8 | All | Hover 90 KTAS | 6,192 | 300 | 400 | 1,524 |
| | | | 6,461 | 300 | 400 | 1,524 |
| 12 | All | Hover 90 KTAS | 6,966 | 300 | 400 | 1,524 |
| | | | 7,284 | 300 | 400 | 1,524 |
| 16 | All | Hover 90 KTAS | 7,670 | 300 | 400 | 1,524 |
| | | | 8,031 | 300 | 400 | 1,524 |

Legend:

FL=flechette

KTAS=knots true airspeed

Table 12–6

Surface danger zone data for M255 Flechette with MK66 altitude greater than 1,001 feet above ground level, hover and running fire

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|------------------|------------|------------|------------|------------------------------|
| 0 | All | Hover 90 KTAS | 5,062 | 300 | 400 | 1,524 |
| | | | 5,232 | 300 | 400 | 1,524 |
| 2 | All | Hover 90 KTAS | 5,494 | 300 | 400 | 1,524 |
| | | | 5,686 | 300 | 400 | 1,524 |
| 4 | All | Hover 90 KTAS | 5,905 | 300 | 400 | 1,524 |
| | | | 6,130 | 300 | 400 | 1,524 |
| 6 | All | Hover 90 KTAS | 6,319 | 300 | 400 | 1,524 |
| | | | 6,567 | 300 | 400 | 1,524 |
| 8 | All | Hover 90 KTAS | 6,707 | 300 | 400 | 1,524 |
| | | | 6,989 | 300 | 400 | 1,524 |
| 12 | All | Hover 90 KTAS | 7,426 | 300 | 400 | 1,524 |
| | | | 7,749 | 300 | 400 | 1,524 |
| 16 | All | Hover 90 KTAS | 8,080 | 300 | 400 | 1,524 |
| | | | 8,451 | 300 | 400 | 1,524 |

Legend:

FL=flechette

KTAS=knots true airspeed

Table 12–7
Surface danger zone data for M278 Illumination with MK66 altitude greater than 201 feet above ground level, hover and running fire

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|-----------------|------------|------------|------------|------------------------------|
| 10 | NR | 80 KTAS | 4,423 | NR | NR | 1,524 |
| 12 | NR | 80 KTAS | 4,620 | NR | NR | 1,524 |
| 14 | NR | 80 KTAS | 4,790 | NR | NR | 1,524 |
| 16 | NR | 80 KTAS | 4,937 | NR | NR | 1,524 |
| 18 | NR | 80 KTAS | 5,064 | NR | NR | 1,524 |
| 20 | NR | 80 KTAS | 5,172 | NR | NR | 1,524 |
| 22 | NR | 80 KTAS | 5,263 | NR | NR | 1,524 |
| 24 | NR | 80 KTAS | 5,338 | NR | NR | 1,524 |
| 26 | NR | 80 KTAS | 5,397 | NR | NR | 1,524 |

Legend:
 IL=illumination
 KTAS=knots true airspeed
 NR=not required

Table 12–8
Surface danger zone data for M278 Illumination with MK66 altitude greater than 1,001 feet above ground level, hover and running fire

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|-----------------|------------|------------|------------|------------------------------|
| 10 | NR | 80 KTAS | 4,800 | NR | NR | 1,524 |
| 12 | NR | 80 KTAS | 4,959 | NR | NR | 1,524 |
| 14 | NR | 80 KTAS | 5,100 | NR | NR | 1,524 |
| 16 | NR | 80 KTAS | 5,223 | NR | NR | 1,524 |
| 18 | NR | 80 KTAS | 5,330 | NR | NR | 1,524 |
| 20 | NR | 80 KTAS | 5,421 | NR | NR | 1,524 |
| 22 | NR | 80 KTAS | 5,498 | NR | NR | 1,524 |
| 24 | NR | 80 KTAS | 5,561 | NR | NR | 1,524 |
| 26 | NR | 80 KTAS | 5,611 | NR | NR | 1,524 |

Legend:
 IL=illumination
 KTAS=knots true airspeed
 NR=not required

Table 12–9**Surface danger zone data for M274 Training Practice with MK66 altitude 500 feet above ground level, diving fire—Continued**

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|-----------------|----------------|------------|------------|------------------------------|
| -5 | All | 60 120 | 3,779 3,840 | NR NR | NR NR | 1,524 1,524 |
| -10 | All | 60 120 | 2,887 2,924 | NR NR | NR NR | 1,524 1,524 |
| -15 | All | 60 120 | 2,216 2,231 | NR NR | NR NR | 1,524 1,524 |
| -20 | All | 60 120 | 1,696 1,711 | NR NR | NR NR | 1,524 1,524 |
| -25 | All | 60 120 | 1,356 1,357 | NR NR | NR NR | 1,524 1,524 |
| -30 | All | 60 120 | 1,067 1,055 | NR NR | NR NR | 1,524 1,524 |

Legend:

KTAS=knots true airspeed

NR=not required

TP=training practice

Table 12–10**Surface danger zone data for M274 Training Practice with MK66 altitude 1,000 feet above ground level, diving fire**

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|-----------------|----------------|------------|------------|------------------------------|
| -5 | All | 60 120 | 4,241 4,305 | NR NR | NR NR | 1,524 1,524 |
| -10 | All | 60 120 | 3,315 3,358 | NR NR | NR NR | 1,524 1,524 |
| -15 | All | 60 120 | 2,578 2,605 | NR NR | NR NR | 1,524 1,524 |
| -20 | All | 60 120 | 2,016 2,031 | NR NR | NR NR | 1,524 1,524 |
| -25 | All | 60 120 | 1,640 1,656 | NR NR | NR NR | 1,524 1,524 |
| -30 | All | 60 120 | 1,335 1,345 | NR NR | NR NR | 1,524 1,524 |

Legend:

KTAS=knots true airspeed

NR=not required

TP=training practice

Table 12–11

Surface danger zone data for M274 Training Practice with MK66 altitude 1,500 feet above ground level, diving fire—Continued

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|-----------------|----------------|------------|------------|------------------------------|
| -5 | All | 60 120 | 4,621 4,708 | NR NR | NR NR | 1,524 1,524 |
| -10 | All | 60 120 | 3,703 3,750 | NR NR | NR NR | 1,524 1,524 |
| -15 | All | 60 120 | 2,932 2,953 | NR NR | NR NR | 1,524 1,524 |
| -20 | All | 60 120 | 2,342 2,349 | NR NR | NR NR | 1,524 1,524 |
| -25 | All | 60 120 | 1,907 1,913 | NR NR | NR NR | 1,524 1,524 |
| -30 | All | 60 120 | 1,575 1,575 | NR NR | NR NR | 1,524 1,524 |

Legend:

KTAS=knots true airspeed

NR=not required

TP=training practice

Table 12–12

Surface danger zone data for M151 High-Explosive with MK66 altitude 500 feet above ground level, diving fire

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|-----------------|----------------|------------|------------|------------------------------|
| -5 | All | 60 120 | 3,779 3,840 | 300 300 | 300 300 | 1,524 1,524 |
| -10 | All | 60 120 | 2,887 2,924 | 300 300 | 300 300 | 1,524 1,524 |
| -15 | All | 60 120 | 2,216 2,231 | 300 300 | 300 300 | 1,524 1,524 |
| -20 | All | 60 120 | 1,696 1,711 | 300 300 | 300 300 | 1,524 1,524 |
| -25 | All | 60 120 | 1,356 1,357 | 300 300 | 300 300 | 1,524 1,524 |
| -30 | All | 60 120 | 1,067 1,055 | 300 300 | 300 300 | 1,524 1,524 |

Legend:

HE=high-explosive

KTAS=knots true airspeed

Table 12–13**Surface danger zone data for M151 High-Explosive with MK66 altitude 1,000 feet above ground level, diving fire—Continued**

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|-----------------|----------------|------------|------------|------------------------------|
| -5 | All | 60 120 | 4,241 4,305 | 300 300 | 300 300 | 1,524 1,524 |
| -10 | All | 60 120 | 3,315 3,358 | 300 300 | 300 300 | 1,524 1,524 |
| -15 | All | 60 120 | 2,578 2,605 | 300 300 | 300 300 | 1,524 1,524 |
| -20 | All | 60 120 | 2,016 2,031 | 300 300 | 300 300 | 1,524 1,524 |
| -25 | All | 60 120 | 1,640 1,656 | 300 300 | 300 300 | 1,524 1,524 |
| -30 | All | 60 120 | 1,335 1,345 | 300 300 | 300 300 | 1,524 1,524 |

Legend:

HE=high-explosive

KTAS=knots true airspeed

Table 12–14**Surface danger zone data for M151 High-Explosive with MK66 altitude 1,500 feet above ground level, diving fire**

| Launch angle (deg) | Impact media | Airspeed (KTAS) | Dist X (m) | Area A (m) | Area B (m) | Ricochet vertical hazard (m) |
|--------------------|--------------|-----------------|----------------|------------|------------|------------------------------|
| -5 | All | 60 120 | 4,621 4,708 | 300 300 | 300 300 | 1,524 1,524 |
| -10 | All | 60 120 | 3,703 3,750 | 300 300 | 300 300 | 1,524 1,524 |
| -15 | All | 60 120 | 2,932 2,953 | 300 300 | 300 300 | 1,524 1,524 |
| -20 | All | 60 120 | 2,342 2,349 | 300 300 | 300 300 | 1,524 1,524 |
| -25 | All | 60 120 | 1,907 1,913 | 300 300 | 300 300 | 1,524 1,524 |
| -30 | All | 60 120 | 1,575 1,575 | 300 300 | 300 300 | 1,524 1,524 |

Legend:

HE=high-explosive

KTAS=knots true airspeed

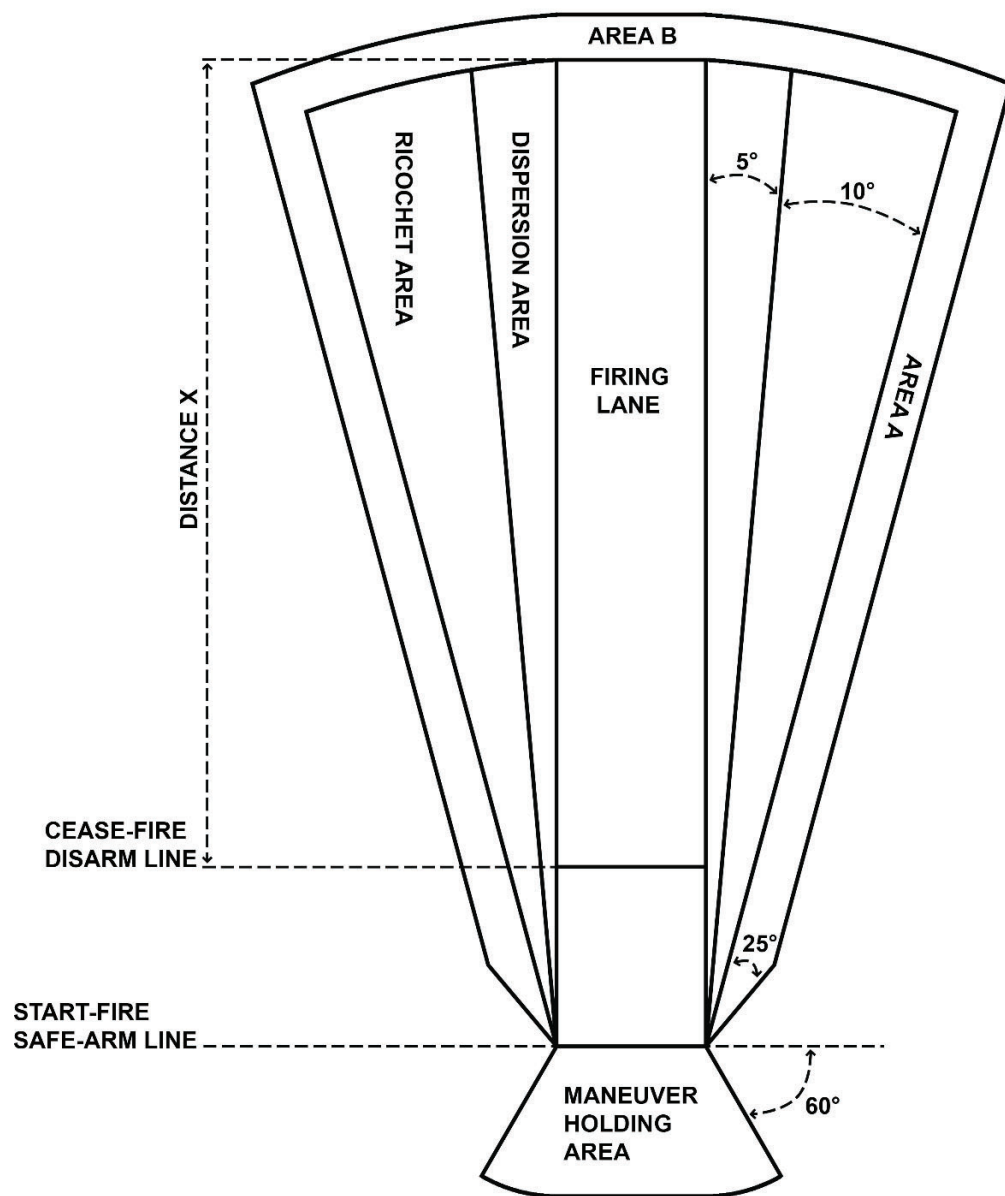


Figure 12-1. Surface danger zone for aerial rocketry at ground targets

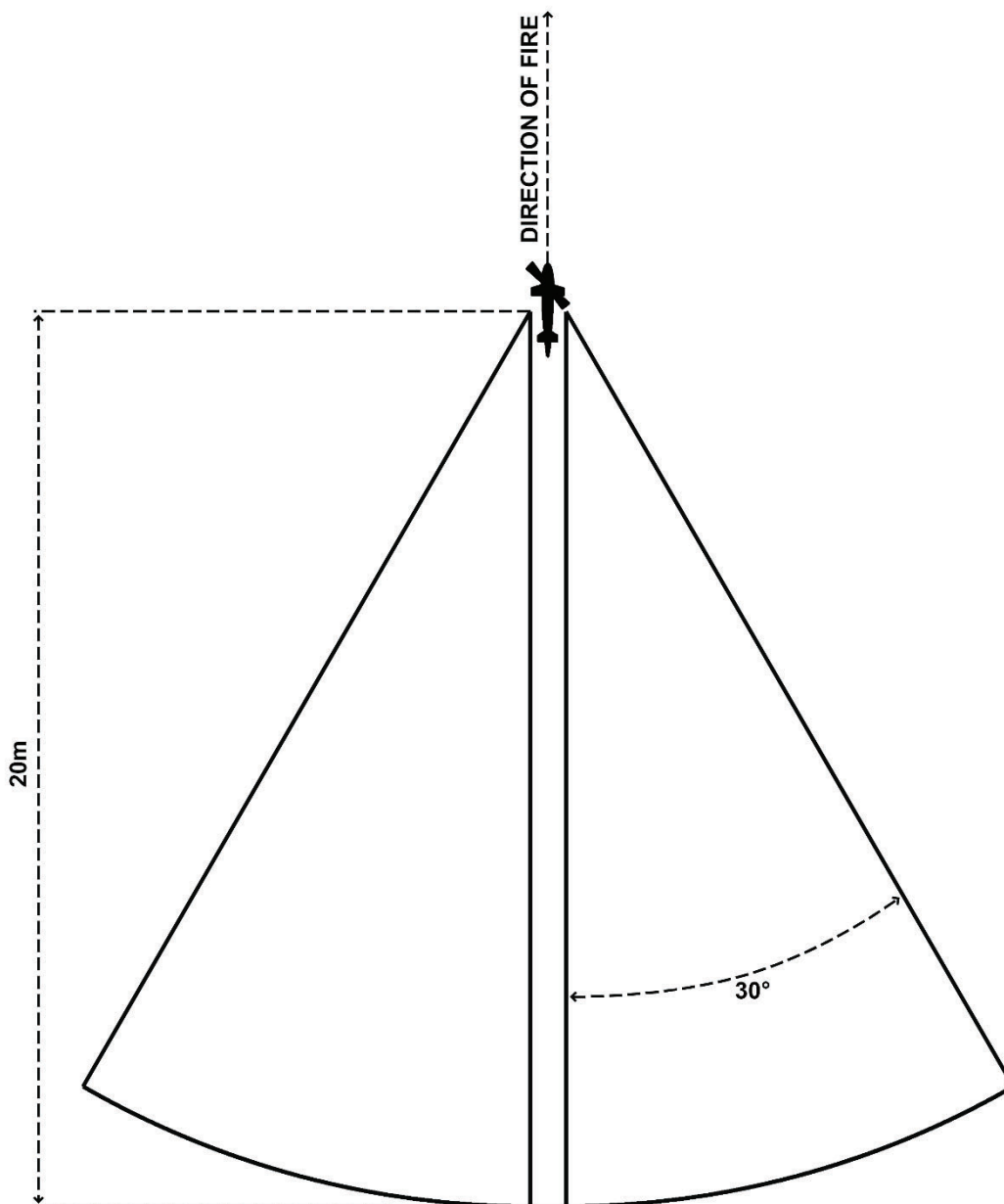


Figure 12–2. Surface danger zone, Area F, rear back-blast area for hover firing, loading and unloading aerial rockets

a. Running fire. When conducting running fire, cockpit-displayed graphics, ground markers, or prominent terrain will be used to mark start and cease-fire lines.

b. Hover fire. When conducting hover fire, cockpit-displayed graphics, ground markers, or prominent terrain will be used to mark the firing position. If possible, hover fire should be conducted over level terrain free of flight hazards (for example, dust, brush, trees, and blowing debris). Natural or manmade features will be used to aid in the establishment of range boundaries and control measures.

c. Markers. When used, markers will be illuminated or thermalized when thermal weapons sights are used to ensure proper target area identification at times of limited visibility when required. Additional ground markings will be used at the discretion of the commander or the range OIC. Adjacent ranges within a range complex that support aviation live-fire should be marked or lighted to facilitate aircrew identification of their assigned range.

(1) RW gun and rocket weapon systems may be used to provide flanking fire, as shown in figure 12-3 when a minimum lateral distance of 100 m or 15 degrees, whichever is more restrictive, between exposed troops and firing aircraft GTL is maintained. Additionally, non-participating troops must be positioned outside the WDG or SDZ.

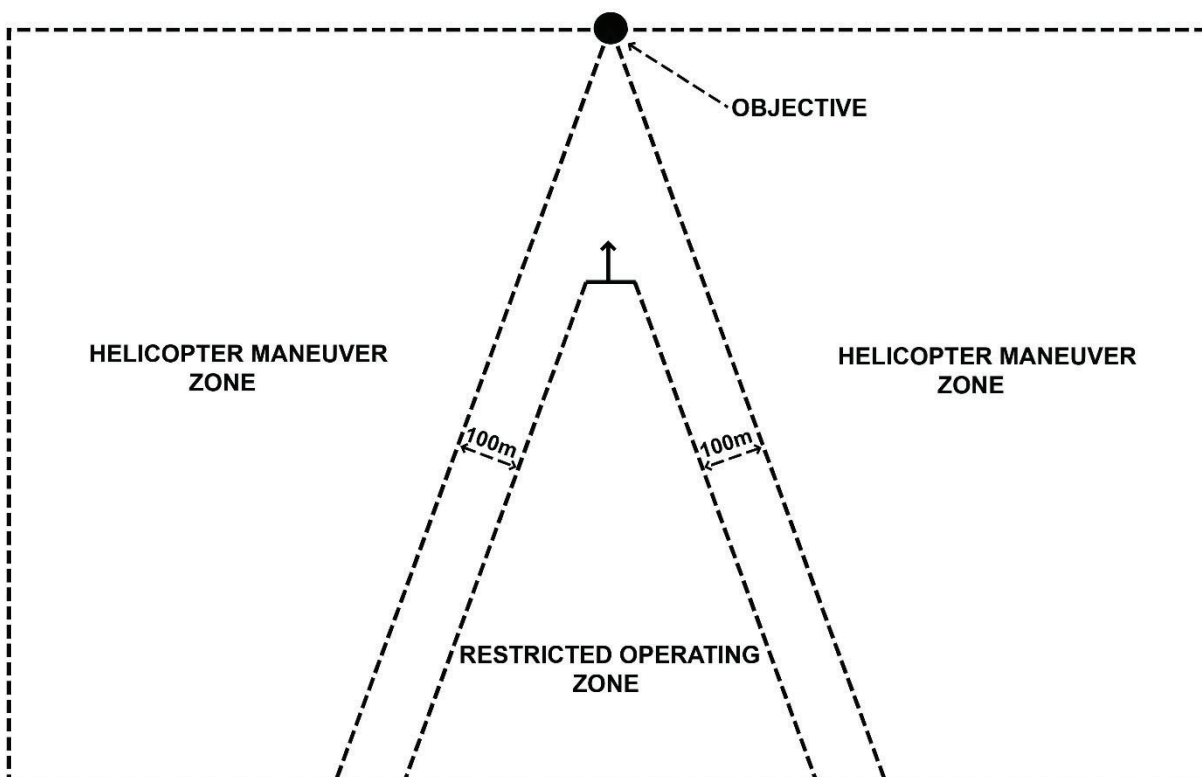


Figure 12–3. Rotary-wing gun and rocket flanking fire restrictions

(2) Positive means will be employed to ensure that the firing unit knows the location of the maneuver units while fire support is being provided.

(3) Only non-explosive projectiles will be used for RW flanking fire.

(4) The route and location of maneuver units and the firing aircraft providing flanking fire support will be described and briefed in detail. The use of cockpit-displayed graphics, recognizable natural or manmade terrain features, and other means of friendly position marking in accordance with table 12-15 will be used by exposed troops.

Table 12–15
Friendly position marking requirements

| Method | Day | Night | Night vision goggles | Night vision systems |
|------------------------------|-----|-------|----------------------|----------------------|
| Smoke | X | | | |
| IR Smoke | X | | | |
| Signal mirror | X | | | |
| IR laser | | | X | |
| Glint tape | | | X | |
| Combat identification panels | X | | | X |
| Strobe | | X | X | |
| IR strobe | | | X | |
| IR panel | | | | X |
| Chemlight | | X | X | |
| AN/PAQ–4 | | | X | |
| VS–17 panel | X | | | |
| Spot light | | X | X | |
| Meal Ready to Eat heater | | | | X |
| AN/PEQ–2 | | | X | |

(5) Firing aircraft must positively identify the front line trace of exposed troops prior to engagement.

e. Rotary-wing and tilt wing door gunnery operations.

(1) Door gunnery operations will be conducted according to the appropriate gunnery manuals. The Army will use TC 3–04.3. Marine Corps units will follow the procedures established in the Marine Aviation Weapons and Tactics Squadron One (MAWTS–1) Aerial Gunnery Manual and appropriate tactical manuals for the specific type aircraft.

(2) All personnel on the aircraft will wear at least single-hearing protection when firing weapons.

f. Rockets.

(1) *Training operations.* Training operations conducted in conjunction with aerial rocket firing must be suspended if winds or gusts exceed 30 knots.

(2) *Rotary-wing aerial rockets.* The launch angle in degrees equals launcher QE in mils divided by 17.7 plus the aircraft pitch in degrees. For articulating launchers, use the maximum articulated QE possible plus the aircraft pitch in degrees.

(a) Firing of the M267 multipurpose sub-munition practice rocket is prohibited if crosswinds exceed 20 knots. The M75 practice sub-munition may be either inert or have an explosive spotting charge. Inert M75 sub-munitions are painted blue and have no ram air decelerator. M75 sub-munitions with explosive spotting charges are painted blue with a brown band and have bright yellow ram air decelerator. A dud M75 has a clean underside. A functioned M75 has soot and burn marks on the underside of the sub-munition body. An armed M231 fuze for the M75 is identified by a slider that sticks out from the sub-munition body about 1.3 cm. This slider has a red tip and a “V” notch. Do not use the color as the only means of identification as the colors may change or not be apparent after weathering.

(b) For the Army, firing of the M261 HE multipurpose sub-munition rocket is prohibited in training by units and on Army ranges.

(c) Units using the 2.75-inch (70mm) aerial rocket are authorized to fire the M255A1 Flechette service munition on range complexes (such as a multipurpose range complex, multipurpose training range, digital multipurpose range complex, digital multipurpose training range, or digital air or ground integration range) that support the WDZ or SDZ. There is no requirement to limit firing of the M255 Flechette into permanently duded impact areas. The M255A1 presents a hazard similar to the M267 training rocket and, if functioned correctly, is not a hazard. Flechette rockets that fail to function should be marked upon discovery and referred to EOD personnel for removal. Prudent safety measures and operational practices can minimize risks and burdens to range personnel. RMAs (Army) and RCOs (Marine Corps) should identify specific moving and stationary targets for flechette engagements. Aviation crews will

typically engage while conducting running fire and close to a range of 1,500 m to launch the munition. Selected targets should be in the most down-range third of the range complex. This will minimize expended flechette damage to vehicle tires and risks to range personnel. RMAs (Army) and RCOs (Marine Corps) may employ magnetic sweepers to clear expended flechettes from highly travelled service roads.

(3) *Restrictions.* The following restrictions apply when firing the 2.75-inch folding fin aerial rocket with the M278 Infrared illumination warhead.

(a) The pilot or gunner will ensure that the M278 IR IL warhead deployment occurs at least 1,500 ft AGL on training areas. Deployment of the flare below 1,500 ft AGL significantly increases the risk of ground fires.

(b) The pilot or gunner will mitigate the hazard of spent rocket motor impact. The spent rocket motor impact point can be approximately 700 m to 1,200 m beyond the point of flare deployment.

(c) When the rocket with the M278 warhead is fired in the vicinity of friendly troops and personnel in an uncovered position, ground personnel are required to be in PPE Level 1.

(d) Pilots must exercise extreme caution when operating in the vicinity of IR IL flares. Once the flare burns out, the flare container and parachute may not be visible during its descent.

g. *Precision-guided munitions.*

(1) Some precision-guided munitions, such as Guided Bomb Unit (GBU)–38 joint direct attack munition, GBU–44 Viper Strike, or Griffin small tactical munition, employ organic navigational systems as an aid to acquire target location.

(2) Aircraft employing GPS munitions will adhere to the following when using the WDS tool prior to release:

(a) Aircrew will confirm the accuracy of the aircraft navigation and weapon delivery systems via three independent methods (triple check) to confirm GPS accuracy. For the Marine Corps, aircrew will confirm aircraft health and weapon health and coordinate in accordance with current MAWTS–1 publications or weapon school technical training procedures.

(b) Aircrew will ensure accurate receipt and entry of target coordinates and that they come from a valid target source. Aircrew will use all means available to verify accuracy of target coordinates or elevation and that the coordinates are within the anticipated target area. Examples of available means include forward looking IR radar; synthetic radar aperture map; heads-up display cueing; other aircraft sensors; terrain pointer; map plots; data links; radio communications; and talk-ons with JTACs, RMAs (Army), RCOs (Marine Corps), and other aircrew members.

(c) Aircrew will confirm and adhere to published range operating procedures and restrictions.

h. *Guided Bomb Unit–44 Viper Strike, Griffin.* Both the Viper Strike and Griffin weapon systems have post-launch debris that will fall to the ground after the weapon is launched from the aircraft. This includes aft-launch tube covers, support brackets, and parachutes (Viper Strike). Although the probability of someone being injured by these lightweight items is low, it is recommended that the area below the launch point be cleared of personnel for a radius of 2,000 m.

i. *Air-to-Ground Missile–114 HELLFIRE missiles.* AGM–114 HELLFIRE missiles will not be fired if there are tailwinds in excess of 20 knots (see paras 12–10 through 12–14 for further restrictions for HELLFIRE missiles).

12–9. Unmanned aircraft systems considerations

a. *Operator and air mission commander requirements.*

(1) All operators who control UAS platforms or payloads within range complex training airspace will participate in a range safety brief and become familiar with installation range regulations prior to operating within the complex.

(2) Air mission commanders who oversee UAS operations or training within range complex training airspace will participate in a range safety brief and become familiar with installation range regulations and range features and boundaries prior to conducting operations within the complex.

(3) Air mission commanders will take all measures necessary to ensure training and operations are conducted within assigned SUA or other authorized operating area and that UAS and all effects (for example, munitions and laser) are contained within assigned boundaries.

(4) UAS operational unit commanders will ensure that all UAS performance, air worthiness, and related requirements meet system safety standards prior to operating unmanned aerial systems within assigned range space.

b. *Operator qualifications for platform and payload operations, aviation weapons delivery, and terminal guidance.*

(1) *Army.*

(a) Operators will successfully complete an approved qualification course or qualification or transition training in accordance with an approved program of instruction.

(b) Operators will demonstrate platform, payload, and weapon systems proficiency in accordance with TC 3–04.62 and TC 3–04.3.

(2) *Marine Corps.* Marine operators will demonstrate proficiency in accordance with the appropriate Training Management System training and readiness manual.

c. Fielded systems.

(1) Ensure range operations (Army) and range control (Marine Corps) personnel are familiar with the flight characteristics of UAS involved in range aviation operations.

(2) Ensure all UAS operations are scheduled and approved by range operations (Army) or range control (Marine Corps). Include the coordination radio frequencies, loss of contact procedures, climb and descent corridors, operating altitudes, and proximity to other aircraft and personnel.

(3) UAS operators will maintain radio contact with the range operations firing desk (Army), range control (Marine Corps), or the OIC at all times.

(4) Unless accomplished during initial coordination, request and receive clearance from the range operations firing desk (Army), range control (Marine Corps), or control agency personnel before changing UAS assigned position, altitude, or route. If UAS loses uplink for a short period of time, the aircraft will automatically execute return home procedures so that the uplink can be reacquired.

(5) When munitions are loaded on the UAS, operate UAS in visual meteorological conditions and when the weather is forecast to remain visual meteorological conditions throughout the flight.

(6) If operating with weapons and munitions for delivery only when the aircraft is within the SUA and in a position from which, if released, the munitions will remain within the designated impact area, the UAS operator will notify the range operations firing desk (Army) or range control (Marine Corps) and the range OIC when the UAS has completed munition delivery, when departing the range, and if any range incidents occur (for example, misfires, hung munition, lost communications, lost UAS, or inadvertent or out-of-impact-area firing).

(7) The mission commander will maintain the responsibility for the safe operation of payload and platform.

d. Developmental and experimental unmanned aircraft systems. If the UAS has not yet been fielded, provide range operations (Army) or range control (Marine Corps) personnel current reliability information and a worst-case depiction of potential range, direction, and SUA point of departure for developmental or experimental UAS in the event that loss of contact procedures fail.

e. Unmanned aircraft systems operations conducted outside restricted areas and warning areas. UAS operations conducted outside restricted areas or warning areas will comply with the provisions of applicable FAA guidance, DoDDs, notices, and current certificates of authorization or waiver.

f. Loss of communications. Firing will be suspended immediately upon loss of communications with the range operations firing desk (Army), range control (Marine Corps), the OIC, or firing elements.

g. Loss of link. For systems with preprogrammed lost link loiter capability, the UAS operator will provide range safety with the location and flight profile of the loiter pattern.

12–10. HELLFIRE missile (semi-active laser) designation criteria

a. Due to the large size of the HELLFIRE WDZ or SDZ and the limited range of the designators, it may be necessary to place designator operators within HELLFIRE WDZs or SDZs during training operations. Remote laser designation will take place from a ground position at least 1,000 m or 1,400 m (see figs 12–4 through 12–7) laterally from the launch aircraft along the target line, while adhering to the designator zone requirements. Three designator zones have been established within the WDZ or SDZ and are shown in figures 12–4 through 12–7 (for A through F models only).

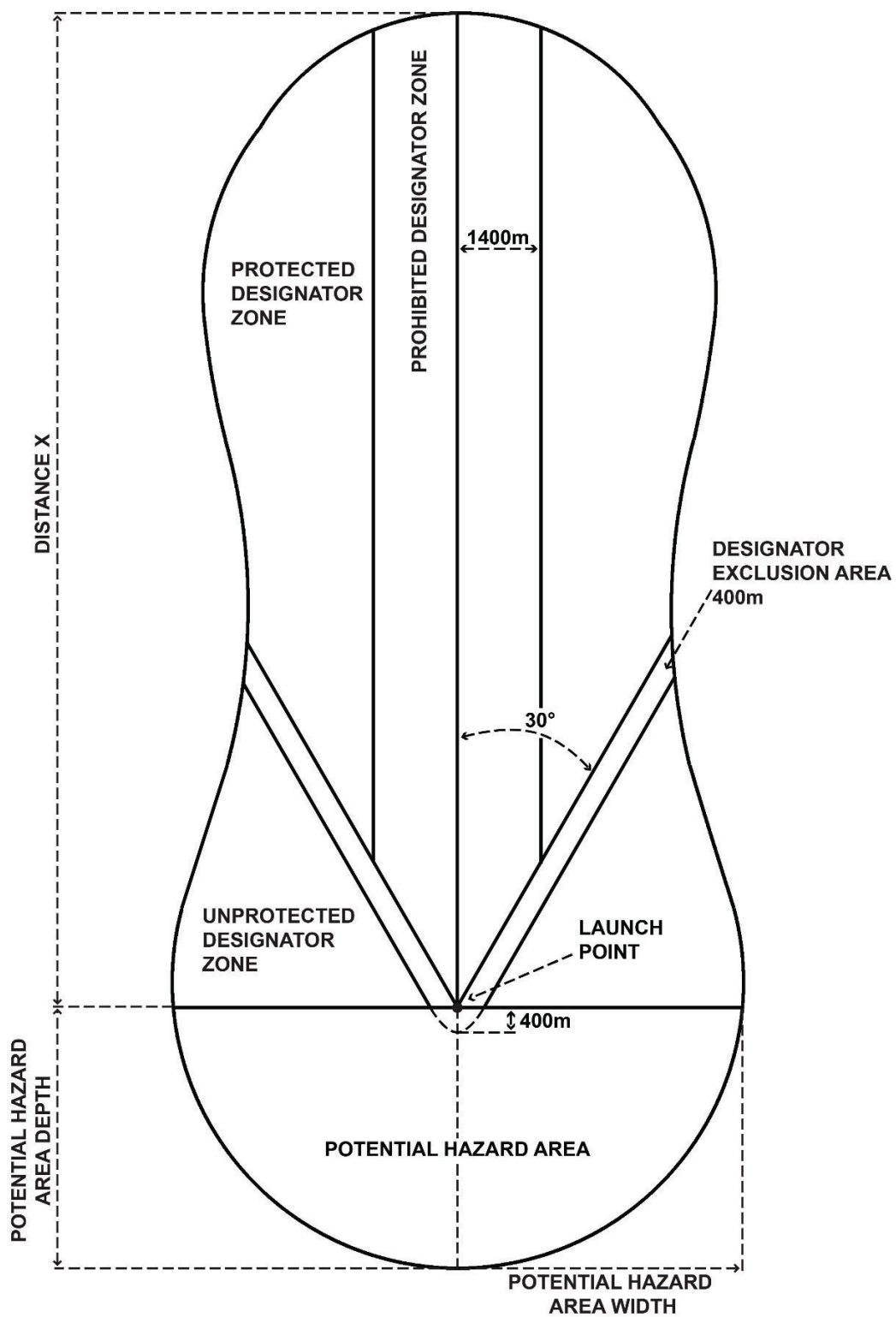


Figure 12-4. Surface danger zone for HELLFIRE direct-fire A through F models

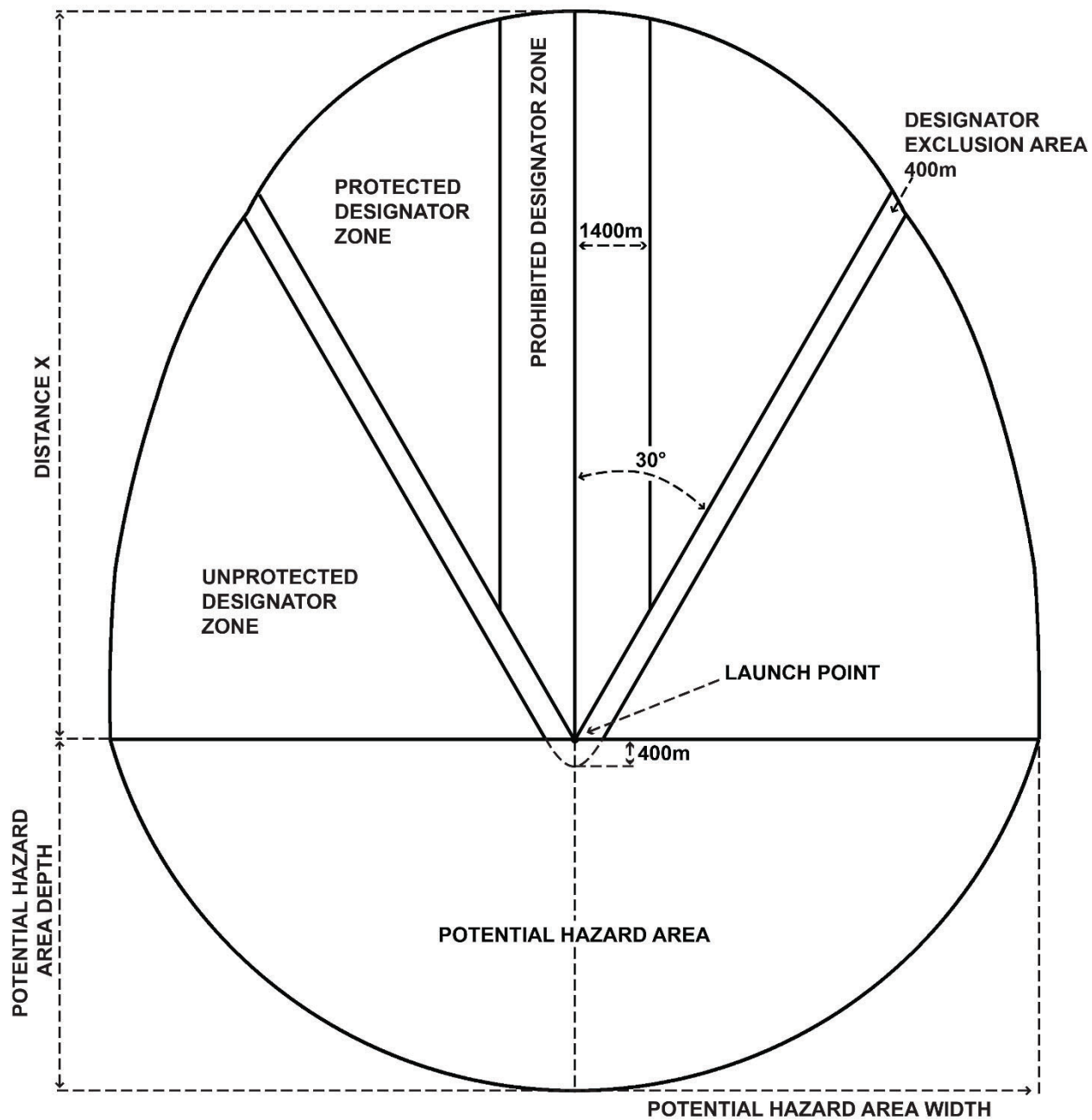


Figure 12-5. Surface danger zone for HELLFIRE indirect fire

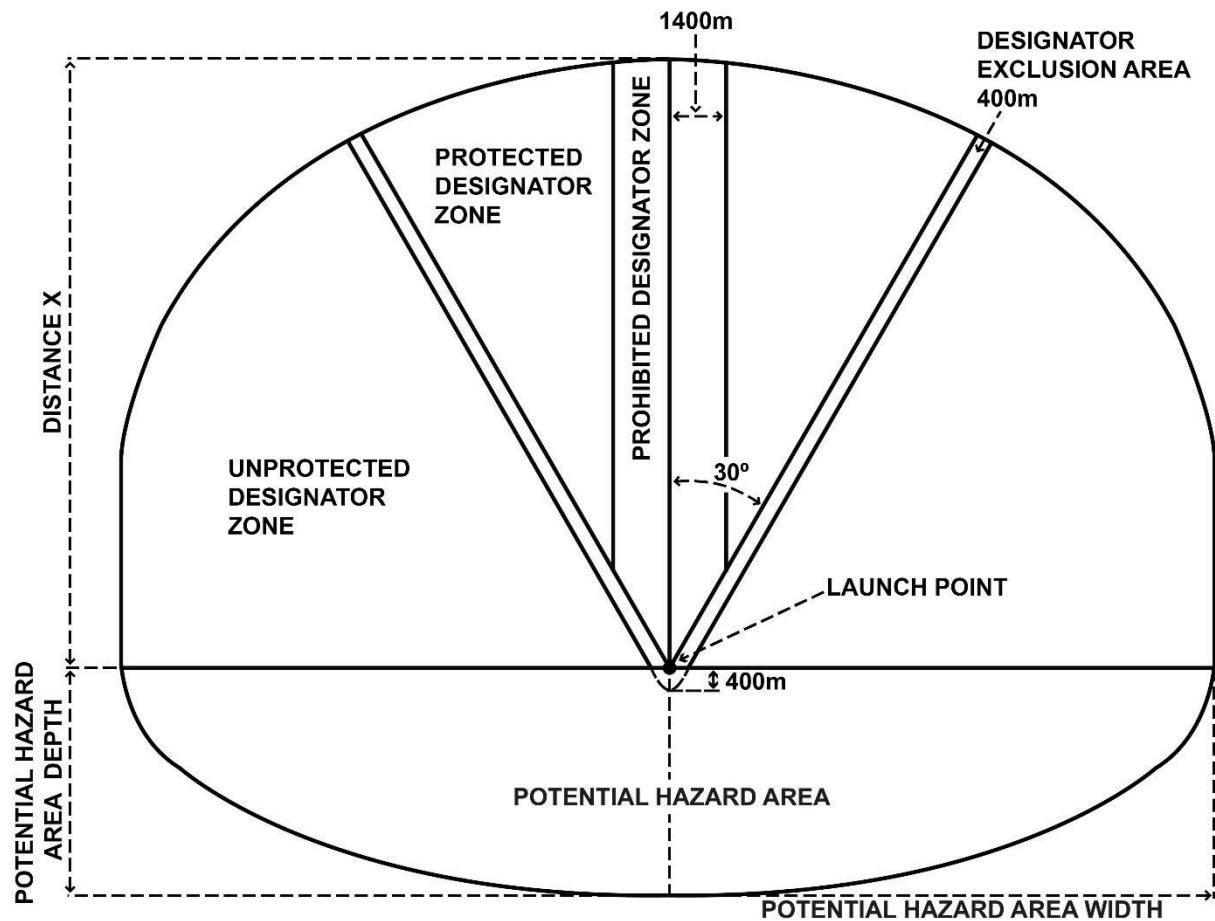


Figure 12-6. Surface danger zone for HELLFIRE expanded direct fire

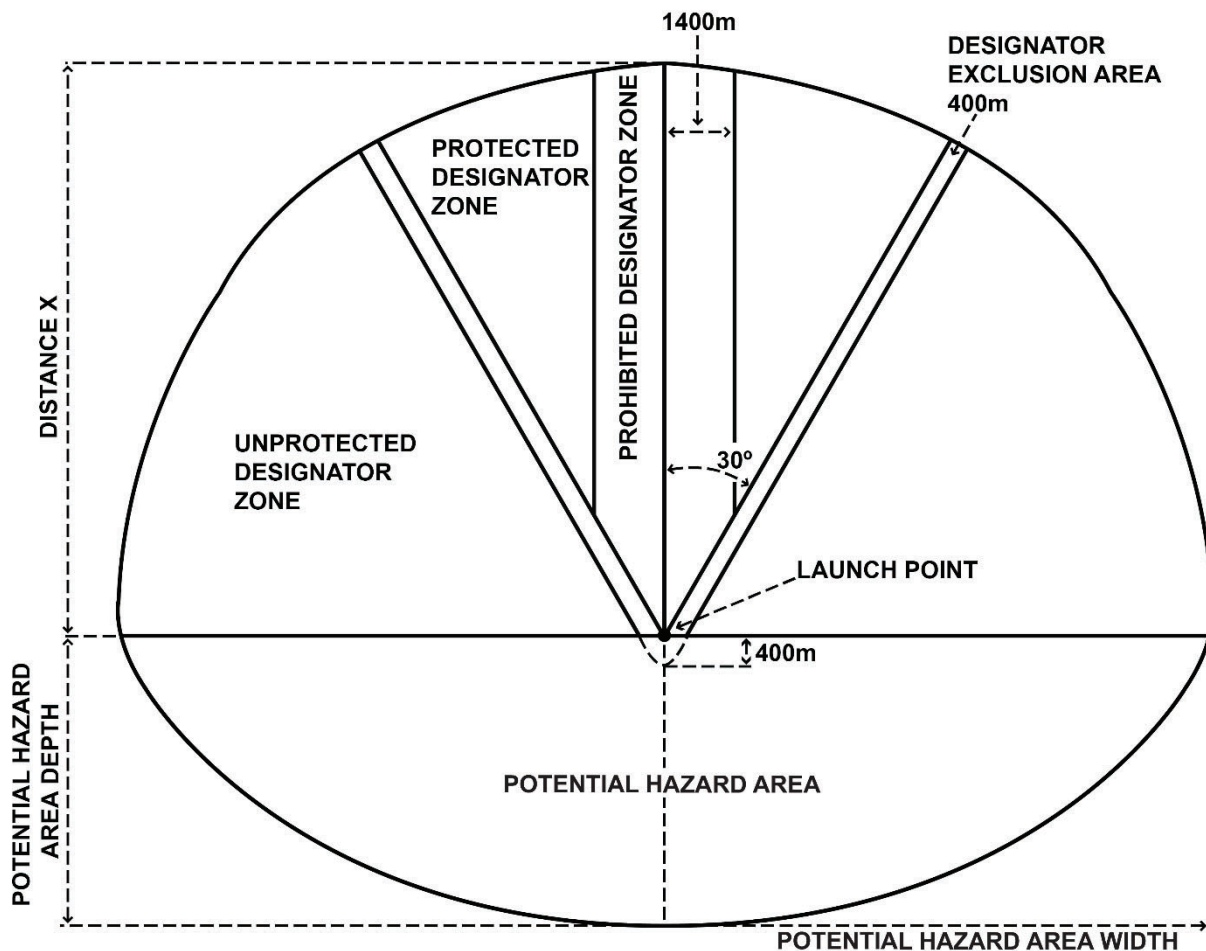


Figure 12–7. Surface danger zone for HELLFIRE expanded indirect fire

(1) *Prohibited designator zone.* No designator operators are allowed in this zone because of the unacceptable probabilities associated with the following hazards:

(a) The missile seeker can track the laser backscatter energy at the exit aperture of the designator or along the path of the laser beam.

(b) The probability of random missile engagement errors is the highest within this zone.

(2) *Protected designator zone.* Designator operators are not vulnerable to a normally functioning missile tracking the laser backscatter energy in this zone. However, there is a possibility that the missile will track and impact an obstruction such as trees, grass, or hills near the designator operator if it is accidentally illuminated by the laser beam. There is a possibility of a random missile failure impacting at or near the designator operator in this zone. Therefore, the number of personnel in this area must be kept to a minimum consistent with mission requirements.

(a) Only ground designator operators will occupy the protected designator zone. Ground designator operators will be in PPE Level 1 and be located in protected positions, such as surrounded by sandbags that enclose the designator operator.

(b) The designator will have a clear, unobstructed line of sight to the target. Ensure designator line of sight is unobstructed across the entire path of a moving target during the time of missile flight to impact.

(c) Ground designator operators must ensure that they do not inadvertently lase through battlefield obscurants, such as smoke, obstacles, or dust caused by other personnel, vehicles, and so forth.

(3) *Unprotected designator zone.* Although designator operators are not vulnerable to a normally functioning missile tracking backscatter or false targets in this zone, there is still a possibility of being injured by a random missile failure.

(a) As a minimum, ground designator operators will be in PPE Level 1 and laser eye protection. Unprotected ground designators will maintain at least 400 m outside of the protected designator zone.

(b) Airborne designator operators must ensure that they are either over ground conditions that do not create dust or are at an altitude where rotor downwash does not create dust.

(c) Ensure designator line of sight is unobstructed across the entire path of a moving target during the time of missile flight to impact.

b. When firing a semi-active laser-guided HELLFIRE in remote-designation engagements, the designating platform must conform to the HELLFIRE designator exclusion zone to remain protected from inadvertently becoming the target for friendly laser-guided weapons. Operations outside of this zone ensure that the designator is not within the HELLFIRE's field of regard (laser seeker field of view combined with seeker search pattern footprint). Each HELLFIRE variant's total designator exclusion zone is made up of the intersection of its vertical component above the shooter-to-designator line (see fig 12-8) and a horizontal component that extends outwards from the gunner-shot-line (GSL) (see figs 12-9 through 12-11). Designator must obey either the horizontal or the vertical exclusion zone guideline to prevent being detected by the seeker; that is, if the designator is in violation of the horizontal exclusion zone, it must be above the vertical exclusion zone line.

(1) HELLFIRE-II is an umbrella term covering HELLFIRE semi-active laser variants K, M, N, and P, and variants P+ and R when launched from a platform unable to provide target location via the R09 message.

(2) The HELLFIRE "FA" variant denotes an "F" variant with a fragmentation sleeve.

(3) For HF-I (Basic HF, including A-F, FA), the designator exclusion zone is made up of the 40-degree vertical exclusion zone and the 43-degree horizontal exclusion zone either side the GSL, both of which originate at the firing aircraft, extending outward to the maximum range of the missile.

(4) For HF-II and Romeo in Legacy Mode (no R09 message available), the designator exclusion zone is made up of the 34-degree vertical exclusion zone and the 43-degree horizontal exclusion zone either side the GSL.

(5) For HELLFIRE Romeo in Enhanced Mode (R09 message available to allow expanded offsets), the designator exclusion zone is made up of the 34-degree vertical exclusion zone and the target-offset-dependent horizontal exclusion zone. When lasing from the target side of the firing aircraft's GSL, the horizontal exclusion zone extends outward 30 degrees beyond the GTL, for a total exclusion zone beyond the GSL of 30 degrees plus target offset. When remote designator is lasing from the non-target side of the aircraft, the horizontal exclusion zone is 30 degrees beyond the GSL for all target offsets (see fig 12-11).

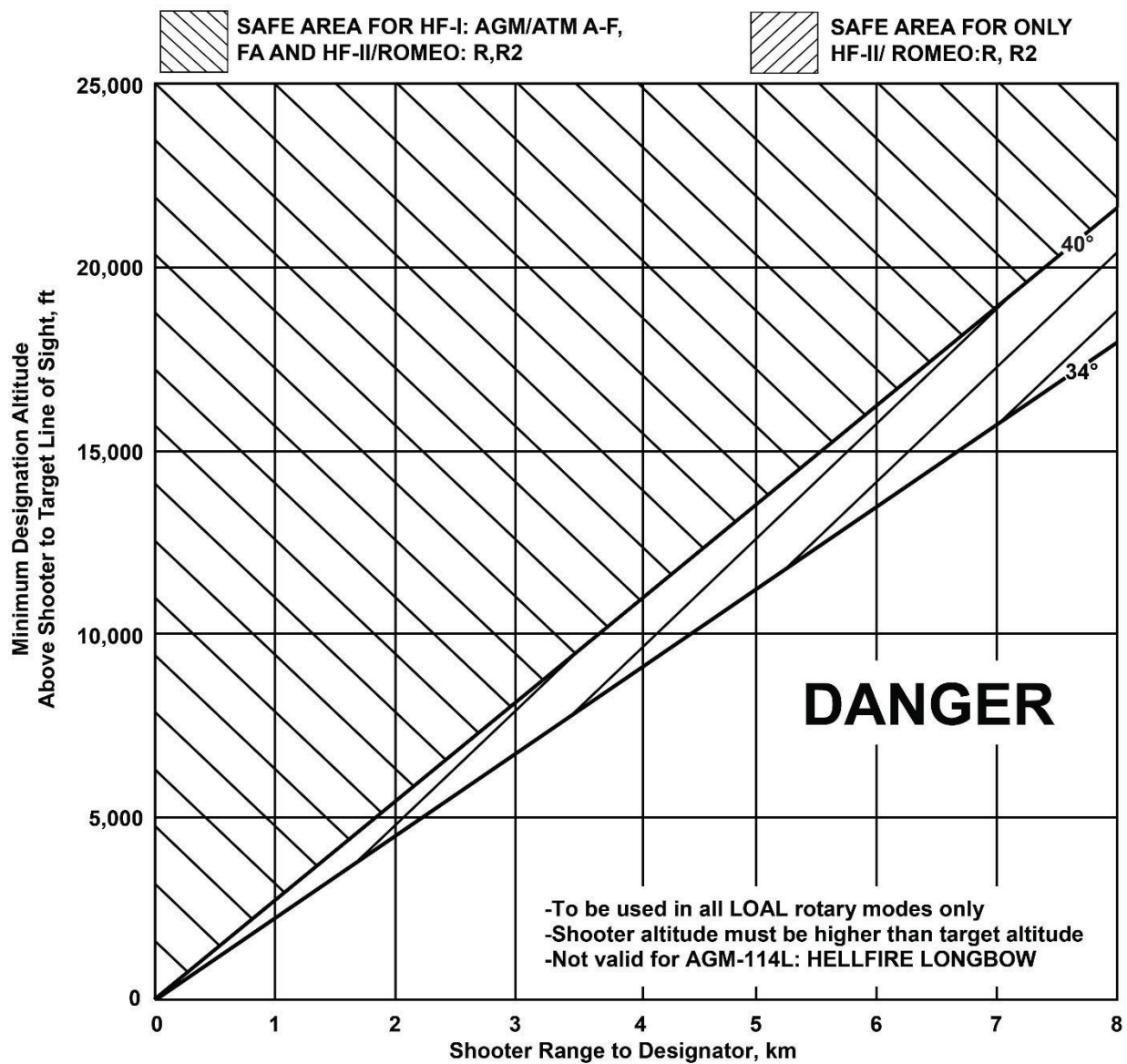


Figure 12-8. Vertical designator exclusion zone for HELLFIRE Semi-Active Laser in remote-designation engagements

c. In addition to abiding by the vertical and horizontal designator exclusion zones, the angle between the designator target line and the GTL, known as the designator offset angle, must be within the maximum designator inclusion angle of 60 degrees (preferably within 45 degrees) for the missile to acquire the target (see figs 12-9, 12-10, and 12-12).

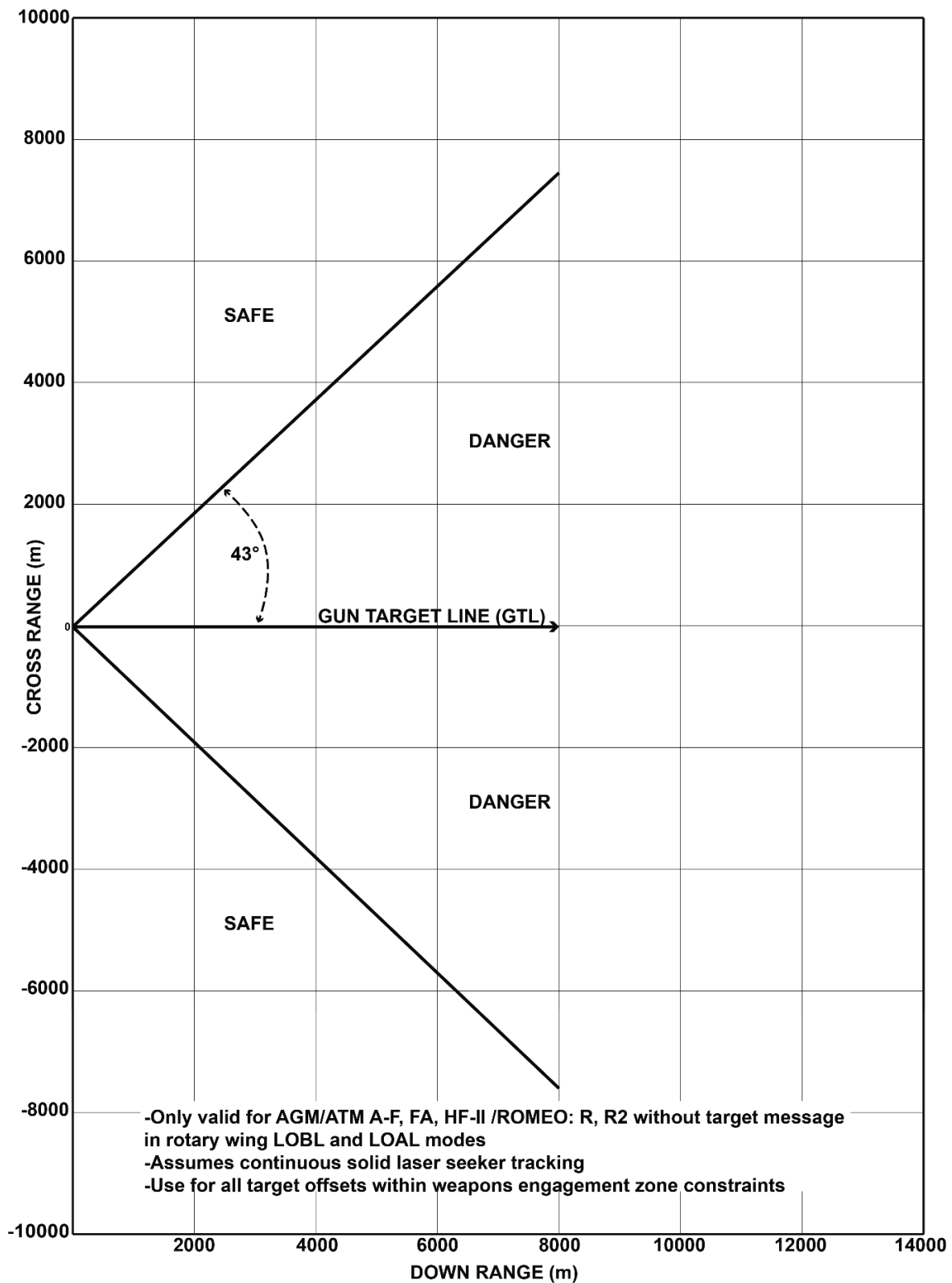
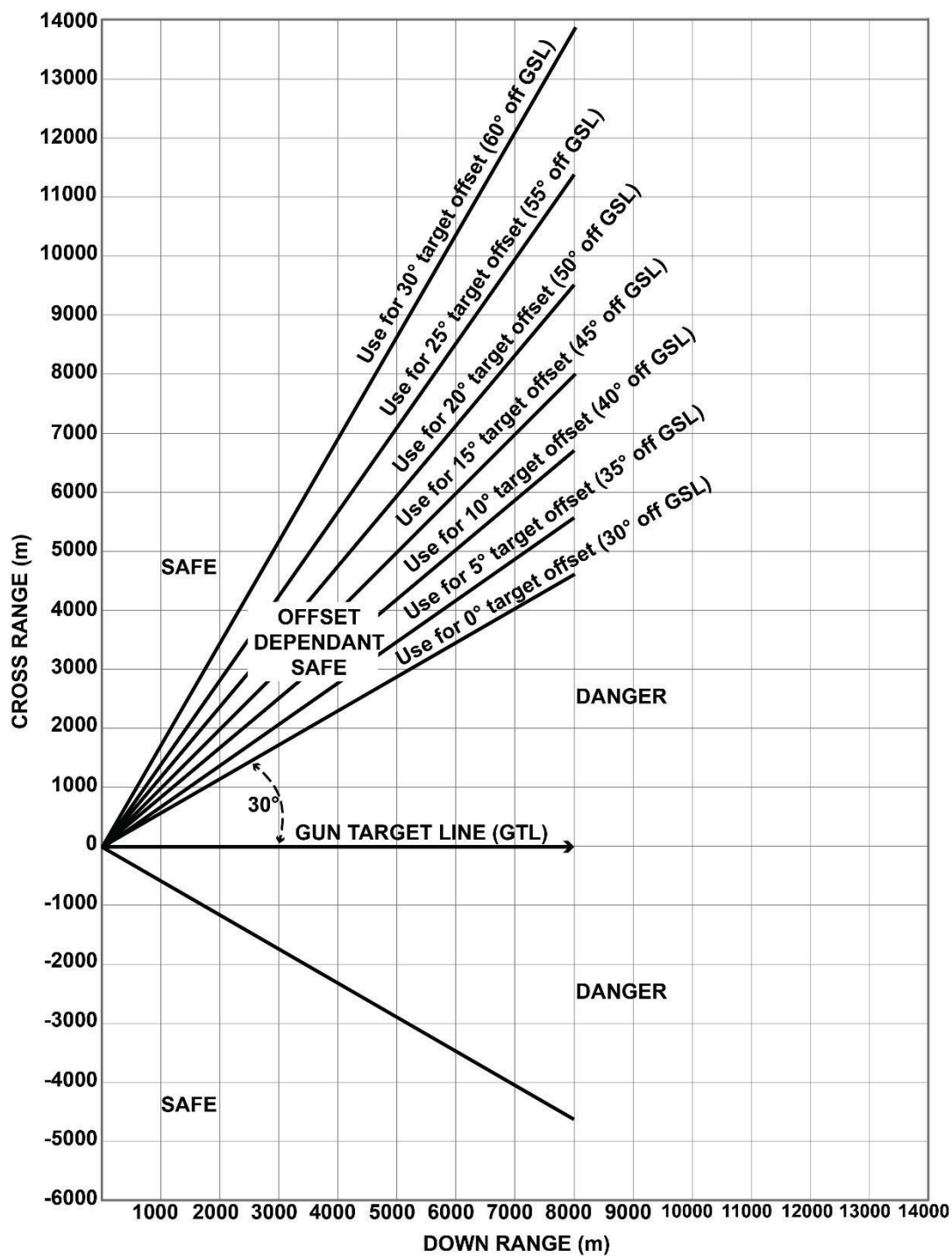


Figure 12-9. Romeo Horizontal Designator Exclusion Zone for HELLFIRE Romeo in remote-designation engagements



-Only valid for HELLFIRE SAL Romeo: R, R2 with target message
 in rotary wing LOBL and LOAL modes
 -Assumes continuous solid laser seeker tracking
 -Use for target offset as defined by graphic

Figure 12-10. Designator zone for HELLFIRE in remote-designation engagements (to scale)

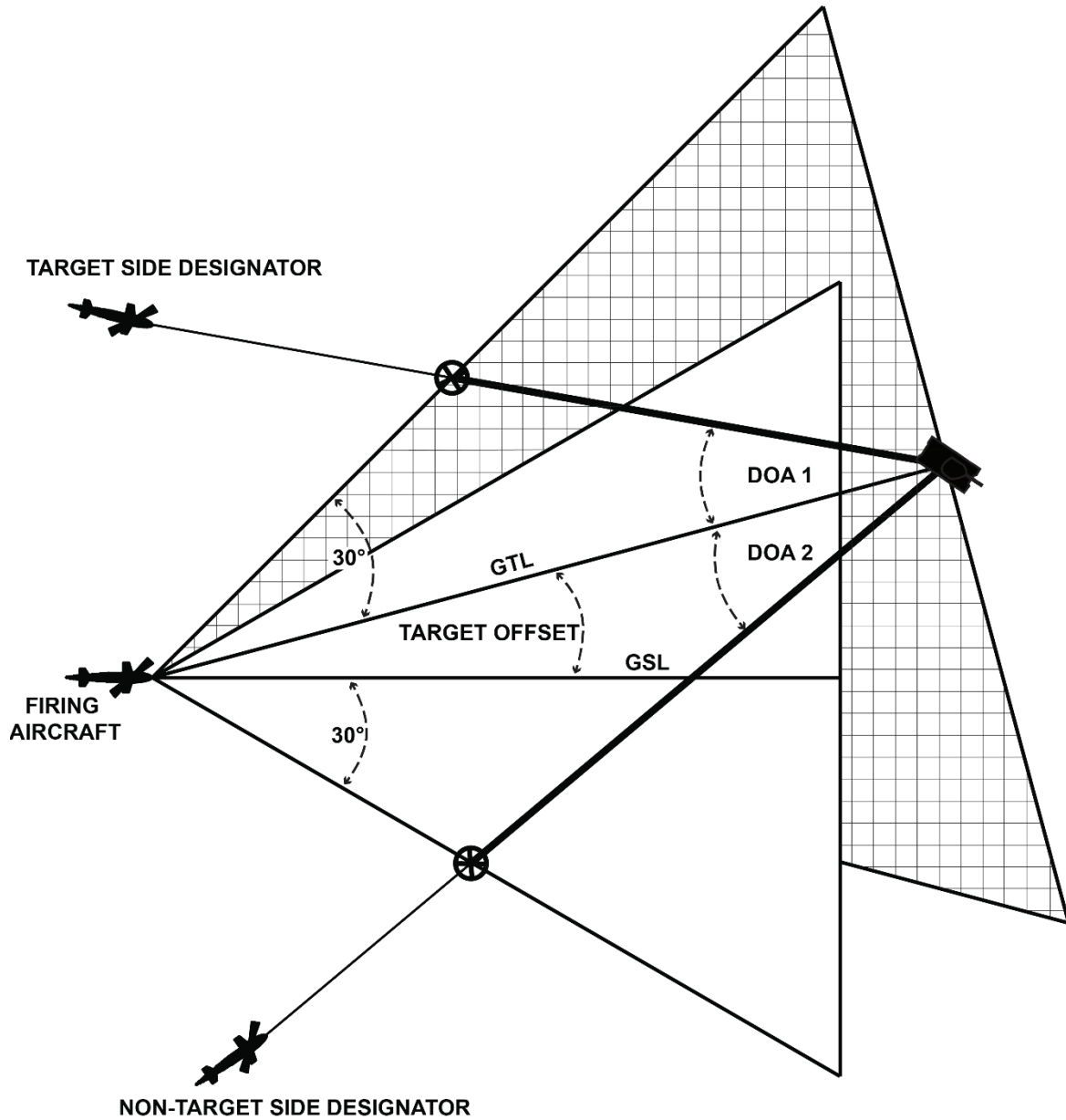


Figure 12–11. Two-part horizontal designator exclusion zone for HELLFIRE Romeo in remote-designation engagements target side versus non-target side designation

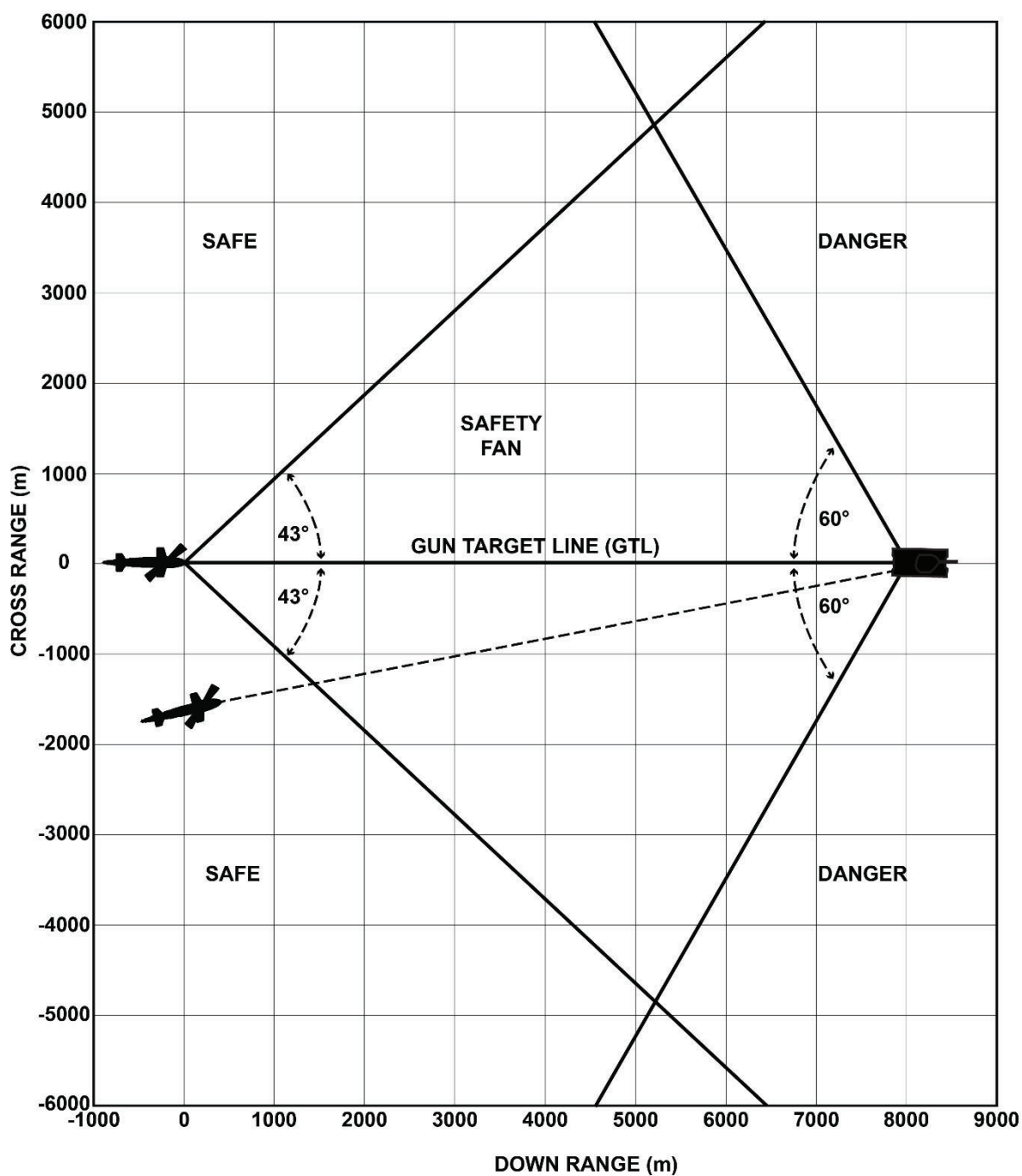


Figure 12-12. Maximum designator offset angle for Air-to-Ground Missile-114 HELLFIRE missile laser designators

d. Compliance with the HELLFIRE designator exclusion zones, as described in Joint Publication (JP) 3–09, is required to preclude the designating platform from being targeted by the missile. All HELLFIRE gunnery participants, including UAS operators, must be aware of and comply with JP 3–09’s HELLFIRE exclusion zone guidance. Pilots in command are responsible for ensuring missiles are not launched while a designator is in the exclusion zone. UAS pilots must also ensure that cooperative designation engagements comply with their Service’s tactics, techniques, and procedures, along with overarching JP 3–09 guidance.

e. Ground designator rain hood and port covers must always be used when supplied as a system option to reduce clear air laser energy backscatter (reflected laser energy) emitted from the designator toward the missile.

f. If the missile appears to fly straight up (errant missile), stop lasing.

g. Potential hazard areas depicted in applicable SOUMs and Army Range Safety Message/Memorandums (ARSMM) identify missile fly-out zones of greater than 1:1,000,000 (99.9999 percent) probability.

h. All non-MEP will be located outside HELLFIRE missile WDZs and SDZs.

i. LSDZ parameters outlined in MIL–HDBK–828C apply to designators being used with HELLFIRE missiles (see para 17–2b for use of MIL–HDBK–828C).

12–11. Air-to-Ground Missile–114 A, B, C, F, K, M, N models HELLFIRE missile weapon danger zones and surface danger zones

a. *Direct and indirect HELLFIRE missile weapon danger zones and surface danger zones.* The direct and indirect WDZs and SDZs support the AGM–114 A, B, C, F, and for K, M, N Indirect only for firing at fixed targets for both Army and Marine Corps RW aircraft. These WDZs and SDZs include the effects of HE warhead functioning at the edge of the impact area.

b. *Drawing HELLFIRE weapon danger zones and surface danger zones.* See tables 12–16 through 12–19 for selection criteria and restrictions if a HELLFIRE SDZ is to be constructed. Because of the unique shape and size of the SDZs, the actual scaled safety fans must be created using the WDZ Tool or tables 12–20 through 12–27 using the X–Y coordinates. Depending on the HELLFIRE variant, the appropriate warhead hazard distance (Area A) has been added to the hazard area dimensions of tables 12–16 through 12–19 (see tables 12–20 through 12–27 for the appropriate hazard distance for a specific HELLFIRE missile model). The alternative is to draw a rectangle using distances provided in tables 12–16 through 12–19 if the training area supports the increased space.

Table 12–16
Surface danger zone data for HELLFIRE Direct surface danger zone^{1,2,3,4}

| Ammuni- tion | Restrictions | Configured restriction defined by SOUM | Launch mode | SDZ | Dist X (m) | Potential hazard area depth (m) | Potential hazard area width (m) |
|-----------------------------------|---|--|--|-------------|------------------|--|--|
| AGM–114 A | Min 3 sec, max 10 secs; designation delay is calculated for range to target after missile separation, add 1 sec when counting from trigger pull | AH–64 A/D Apache: yes AH–6 Little Bird: yes UH–60 IDAP Short Wing Black Hawk: no | LOBL (with remote designation only) LOAL–D (with remote designation or autonomous with proper designation delays) | Figure 12–4 | 11,450 | 3,150 | 3,450 |
| AGM–114 B, C, F (except FA) | Min 3 sec, max 5 secs; designation delay is calculated for range to target after missile separation, add 1 sec when counting from trigger pull | AH–64 A/D Apache: yes AH–6 Little Bird: yes UH–60 IDAP Short Wing Black Hawk: no | LOBL (with remote designation only) LOAL–D (with remote designation or autonomous with proper designation delays) | Figure 12–4 | 11,450 | 3,150 | 3,450 |

Legend:
AGM=air-to-ground missile

Table 12–16
Surface danger zone data for HELLFIRE Direct surface danger zone^{1,2,3,4}

| Ammuni- tion | Restrictions | Configured restriction defined by SOUN | Launch mode | SDZ | Dist X (m) | Potential hazard area depth (m) | Potential hazard area width (m) |
|-----------------|--------------|---|----------------|-----|------------------|--|--|
|-----------------|--------------|---|----------------|-----|------------------|--|--|

IDAP=Integrated Defensive Armed Penetrator

LOAL=lock-on after launch

LOBL=lock-on before launch

SOUN=safety of use message

Notes.

¹ Tailwinds not to exceed 20 knots.

² Launch altitude of 300 feet AGL; use larger SDZ for altitudes greater than 300 feet AGL.

³ AGM–114 FA is for operational use only.

⁴ Minimum clearance airspace 20,000 feet about launch altitude.

Table 12–17
Surface danger zone data for HELLFIRE Expanded Direct surface danger zone^{1,2,3,4}

| Ammuni- tion | Restrictions | Configured restriction defined by SOUN | Launch mode | SDZ | Dist X (m) | Potential hazard area depth (m) | Potential hazard area width (m) |
|-----------------------------------|---|---|--|-------------|------------------|--|--|
| AGM–114 A | Min 3 sec, max 10 secs; designation delay is calculated for range to target after missile separation, add 1 sec when counting from trigger pull | All Army platforms (to include Army aircraft not defined in SOUN) | LOBL (with remote designation only) LOAL–D (with remote designation or autonomous with proper designation delays) | Figure 12–5 | 12,650 | 4,900 | 11,400 |
| AGM–114 B, C, F (except FA) | Min 3 sec, max 5 secs; designation delay is calculated for range to target after missile separation, add 1 sec when counting from trigger pull | All Army platforms (to include Army aircraft not defined in SOUN) | LOBL (with remote designation only) LOAL–D (with remote designation or autonomous with proper designation delays) | Figure 12–5 | 12,650 | 4,900 | 11,400 |

Legend:

AGM=air-to-ground missile

LOAL=lock-on after launch

LOBL=lock-on before launch

SOUN=safety of use message

Notes.

¹ Tailwinds not to exceed 20 knots.

² Launch altitude of 300 feet AGL; use larger SDZ for altitudes greater than 300 feet AGL.

³ AGM–114 FA is for operational use only.

⁴ Minimum clearance airspace 20,000 feet about launch altitude.

Table 12–18
Surface danger zone data for HELLFIRE Indirect surface danger zone^{1,2,3,4}—Continued

| Ammuni- tion | Restrictions | Configured restriction defined by SOUN | Launch mode | SDZ | Dist X (m) | Potential hazard area depth (m) | Potential hazard area width (m) |
|--|---|--|--|----------------|------------------|--|--|
| AGM–114 A, B, C, F (Except FA) AGM–114 K/K2 | LOBL autono- mous 3 to 5-de- gree target offset toward the side of the missile be- ing fired | AH–64 A/D Apache: yes AH–6 Little Bird: yes UH-60 IDAP Short Wing Black Hawk: no | LOBL (with re- mote designation or autonomous designation use defined target off- sets) All LOAL (with re- mote or autono- mous designation) | Figure 12–6 | 13,150 | 6,650 | 8,650 |
| AGM–114 KA/K2A AGM–114 M/N/N5 (except M6/N4/N6) | LOBL Autono- mous 3to 5-de- gree target offset toward the side of the missile be- ing fired | AH–64 A/D Apache: yes AH–6 Little Bird: yes UH-60 IDAP Short Wing Black Hawk: no | LOBL (with re- mote designation or autonomous designation use defined target off- sets) All LOAL (with re- mote or autono- mous designation) | Figure 12–6 | 13,400 | 6,900 | 8,900 |

Legend:

AGM=air-to-ground missile

IDAP=Integrated Defensive Armed Penetrator

LOAL=lock-on after launch

LOBL=lock-on before launch

SOUN=safety of use message

Notes.

¹ Tailwinds not to exceed 20 knots.

² Launch altitude of 300 feet AGL; use larger SDZ for altitudes greater than 300 feet AGL.

³ AGM–114 FA is for operational use only.

⁴ Minimum clearance airspace 20,000 feet about launch altitude.

Table 12–19
Surface danger zone data for HELLFIRE Expanded Indirect surface danger zone^{1,2,3,4}

| Ammuni- tion | Restrictions | Configured restriction defined by SOUN | Launch mode | SDZ | Dist X (m) | Potential hazard area depth (m) | Potential hazard area width (m) |
|---|--|---|--|----------------|------------------|--|--|
| AGM–114 A, B, C, F (except FA) AGM–114 K/K2 | LOBL autono- mous 3to 5-de- gree target off- set toward the side of the mis- sile being fired | All Army plat- forms (to include Army aircraft not defined in SOUN) | LOBL (with re- mote designation or autonomous designation use defined target off- sets) All LOAL (with re- mote or autono- mous designation) | Figure 12–7 | 13,150 | 6,650 | 12,480 |
| AGM–114 KA/K2A AGM–114 M/N/N5 | LOBL Autono- mous 3to 5-de- gree target off- set toward the | All Army Plat- forms (to include Army aircraft not defined in SOUN) | LOBL (with re- mote designation or autonomous designation use | | | | |

Table 12–19**Surface danger zone data for HELLFIRE Expanded Indirect surface danger zone^{1,2,3,4}**

| Ammuni- tion | Restrictions | Configured restriction defined by SOUM | Launch mode | SDZ | Dist X (m) | Potential hazard area depth (m) | Potential hazard area width (m) |
|----------------------|--------------------------------------|---|--|----------------|------------------|--|--|
| (except M6/N4/N6) | side of the mis- sile being fired | | defined target off- sets) All LOAL (with re- mote or autono- mous designation) | Figure 12–7 | 13,400 | 6,900 | 12,730 |

Legend:

AGM=air-to-ground missile

LOAL=lock-on after launch

LOBL=lock-on before launch

SOUM=safety of use message

Notes.

¹ Tailwinds not to exceed 20 knots.² Launch altitude of 300 feet AGL; use larger SDZ for altitudes greater than 300 feet AGL.³ AGM–114 FA is for operational use only.⁴ Minimum clearance airspace 20,000 feet about launch altitude.**Table 12–20****Surface danger zone data for Army rotary-wing HELLFIRE, direct and indirect, cross-range and down-range point plots when fired 300 feet above the target¹**

| Direct 300 ft 150 m CR (m) | Direct 300 ft 150 m DR (m) | Direct 300 ft 400 m CR (m) | Direct 300 ft 400 m DR (m) | Indirect 300 ft 150 m CR (m) | Indirect 300 ft 150 m DR (m) | Indirect 300 ft 400 m CR (m) | Indirect 300 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 0 | -3,153 | 0 | -3,409 | 0 | -6,651 | 0 | -6,902 |
| 830 | -2,975 | 889 | -3,218 | 1,819 | -6,485 | 1,869 | -6,732 |
| 1,654 | -2,752 | 1,762 | -2,982 | 3,638 | -5,907 | 3,737 | -6,138 |
| 2,495 | -2,164 | 2,678 | -2,341 | 5,461 | -4,914 | 5,614 | -5,115 |
| 3,322 | -916 | 3,556 | -1,015 | 7,278 | -3,016 | 7,479 | -3,168 |
| 3,429 | -420 | 3,678 | -453 | 8,137 | -1,563 | 8,366 | -1,667 |
| 3,451 | 10 | 3,702 | 27 | 8,651 | -22 | 8,902 | -58 |
| 3,228 | 890 | 3,533 | 941 | 8,560 | 2,644 | 8,809 | 2,673 |
| 3,088 | 1,753 | 3,332 | 1,809 | 8,018 | 5,294 | 8,259 | 5,363 |
| 2,889 | 2,612 | 3,133 | 2,668 | 7,024 | 7,947 | 7,249 | 8,060 |
| 2,691 | 3,471 | 2,935 | 3,527 | 5,304 | 10,604 | 5,496 | 10,768 |
| 2,500 | 4,297 | 2,757 | 4,297 | 3,581 | 12,128 | 3,717 | 12,342 |
| 2,690 | 5,119 | 2,933 | 5,057 | 1,831 | 12,883 | 1,900 | 13,126 |
| 2,929 | 5,981 | 3,173 | 5,925 | 0 | 13,152 | 0 | 13,404 |
| 3,092 | 6,861 | 3,342 | 6,838 | -1,831 | 12,883 | -1,900 | 13,126 |
| 3,092 | 7,744 | 3,342 | 7,762 | -3,581 | 12,128 | -3,717 | 12,342 |
| 2,971 | 8,620 | 3,217 | 8,666 | -5,304 | 10,604 | -5,496 | 10,768 |
| 2,764 | 9,514 | 2,996 | 9,617 | -7,024 | 7,947 | -7,249 | 8,060 |
| 2,140 | 10,414 | 2,326 | 10,585 | -8,018 | 5,294 | -8,259 | 5,363 |

Table 12–20

Surface danger zone data for Army rotary-wing HELLFIRE, direct and indirect, cross-range and down-range point plots when fired 300 feet above the target¹

| Direct 300 ft 150 m CR (m) | Direct 300 ft 150 m DR (m) | Direct 300 ft 400 m CR (m) | Direct 300 ft 400 m DR (m) | Indirect 300 ft 150 m CR (m) | Indirect 300 ft 150 m DR (m) | Indirect 300 ft 400 m CR (m) | Indirect 300 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 1,587 | 10,873 | 1,732 | 11,078 | -8,560 | 2,644 | -8,809 | 2,673 |
| 847 | 11,314 | 934 | 11,554 | -8,651 | -22 | -8,902 | -58 |
| 0 | 11,452 | 0 | 11,705 | -8,137 | -1,563 | -8,366 | -1,667 |
| -847 | 11,314 | -934 | 11,554 | -7,278 | -3,016 | -7,479 | -3,168 |
| -1,587 | 10,873 | -1,732 | 11,078 | -5,461 | -4,914 | -5,614 | -5,115 |
| -2,140 | 10,414 | -2,326 | 10,585 | -3,638 | -5,907 | -3,737 | -6,138 |
| -2,764 | 9,514 | -2,996 | 9,617 | -1,819 | -6,485 | -1,869 | -6,732 |
| -2,971 | 8,620 | -3,217 | 8,666 | 0 | -6,651 | 0 | -6,902 |
| -3,092 | 7,744 | -3,342 | 7,762 | | | | |
| -3,092 | 6,861 | -3,342 | 6,838 | | | | |
| -2,929 | 5,981 | -3,173 | 5,925 | | | | |
| -2,690 | 5,119 | -2,933 | 5,057 | | | | |
| -2,500 | 4,297 | -2,757 | 4,297 | | | | |
| -2,691 | 3,471 | -2,935 | 3,527 | | | | |
| -2,889 | 2,612 | -3,133 | 2,668 | | | | |
| -3,088 | 1,753 | -3,332 | 1,809 | | | | |
| -3,288 | 890 | -3,533 | 941 | | | | |
| -3,451 | 10 | -3,702 | 27 | | | | |
| -3,429 | -420 | -3,678 | -453 | | | | |
| -3,322 | -916 | -3,556 | -1,015 | | | | |
| -2,495 | -2,164 | -2,678 | -2,341 | | | | |
| -1,654 | -2,752 | -1,762 | -2,982 | | | | |
| -830 | -2,975 | -889 | -3,218 | | | | |
| 0 | -3,153 | 0 | -3,409 | | | | |

Note.

¹ Use 150 m columns for AGM–114 A, B, C, F, K, K2, and 400 m columns for AGM–114 FA, KA, K2A, M, N, and N5.

Table 12–21

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 300 feet above the target¹

| Expanded direct 300 ft 150 m CR (m) | Expanded direct 300 ft 150 m DR (m) | Expanded direct 300 ft 400 m CR (m) | Expanded direct 300 ft 400 m DR (m) | Expanded indirect 300 ft 150 m CR (m) | Expanded indirect 300 ft 150 m DR (m) | Expanded indirect 300 ft 400 m CR (m) | Expanded indirect 300 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 0 | -4,900 | 0 | -5,150 | 0 | -6,650 | 0 | -6,901 |
| 2,312 | -4,800 | 2,333 | -5,049 | 2,611 | -6,489 | 2,645 | -6,737 |

Table 12–21

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 300 feet above the target¹

| Expanded direct 300 ft 150 m CR (m) | Expanded direct 300 ft 150 m DR (m) | Expanded direct 300 ft 400 m CR (m) | Expanded direct 300 ft 400 m DR (m) | Expanded indirect 300 ft 150 m CR (m) | Expanded indirect 300 ft 150 m DR (m) | Expanded indirect 300 ft 400 m CR (m) | Expanded indirect 300 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| 3,953 | -4,598 | 3,991 | -4,846 | 5,233 | -5,914 | 5,304 | -6,154 |
| 5,053 | -4,396 | 5,107 | -4,641 | 7,851 | -4,923 | 7,970 | -5,146 |
| 6,958 | -3,892 | 7,038 | -4,130 | 10,482 | -3,041 | 10,653 | -3,227 |
| 8,791 | -3,133 | 8,910 | -3,354 | 11,727 | -1,583 | 11,937 | -1,721 |
| 10,303 | -2,112 | 10,474 | -2,297 | 12,482 | -31 | 12,735 | -83 |
| 11,138 | -1,068 | 11,367 | -1,182 | 12,349 | 2,655 | 12,597 | 2,698 |
| 11,400 | -18 | 11,650 | -49 | 11,559 | 5,308 | 11,791 | 5,404 |
| 11,400 | 4,006 | 11,650 | 4,016 | 10,113 | 7,969 | 10,317 | 8,116 |
| 11,319 | 5,024 | 11,566 | 5,063 | 7,615 | 10,627 | 7,775 | 10,823 |
| 11,073 | 6,046 | 11,312 | 6,122 | 5,141 | 12,138 | 5,244 | 12,369 |
| 10,665 | 7,067 | 10,889 | 7,178 | 2,619 | 12,888 | 2,668 | 13,134 |
| 10,053 | 8,087 | 10,257 | 8,232 | 0 | 13,151 | 0 | 13,402 |
| 9,208 | 9,105 | 9,388 | 9,279 | -2,619 | 12,888 | -2,668 | 13,134 |
| 8,060 | 10,120 | 8,211 | 10,321 | -5,141 | 12,138 | -5,244 | 12,369 |
| 6,452 | 11,132 | 6,571 | 11,353 | -7,615 | 10,627 | -7,775 | 10,823 |
| 5,345 | 11,640 | 5,437 | 11,872 | -10,113 | 7,969 | -10,317 | 8,116 |
| 3,841 | 12,144 | 3,910 | 12,385 | -11,559 | 5,308 | -11,791 | 5,404 |
| 2,989 | 12,347 | 3,038 | 12,593 | -12,349 | 2,655 | -12,597 | 2,698 |
| 1,736 | 12,549 | 1,764 | 12,798 | -12,482 | -31 | -12,735 | -83 |
| 0 | 12,650 | 0 | 12,901 | -11,727 | -1,583 | -11,937 | -1,721 |
| -1,736 | 12,549 | -1,764 | 12,798 | -10,482 | -3,041 | -10,653 | -3,227 |
| -2,989 | 12,347 | -3,038 | 12,593 | -7,851 | -4,923 | -7,970 | -5,146 |
| -3,841 | 12,144 | -3,910 | 12,385 | -5,233 | -5,914 | -5,304 | -6,154 |
| -5,345 | 11,640 | -5,437 | 11,872 | -2,611 | -6,489 | -2,645 | -6,737 |
| -6,452 | 11,132 | -6,571 | 11,353 | 0 | -6,650 | 0 | -6,901 |
| -8,060 | 10,120 | -8,211 | 10,321 | | | | |
| -9,208 | 9,105 | -9,388 | 9,279 | | | | |
| -10,053 | 8,087 | -10,257 | 8,232 | | | | |
| -10,665 | 7,067 | -10,889 | 7,178 | | | | |
| -11,073 | 6,046 | -11,312 | 6,122 | | | | |
| -11,319 | 5,024 | -11,566 | 5,063 | | | | |
| -11,400 | 4,006 | -11,650 | 4,016 | | | | |
| -11,400 | -18 | -11,650 | -49 | | | | |
| -11,138 | -1,068 | -11,367 | -1,182 | | | | |
| -10,303 | -2,112 | -10,474 | -2,297 | | | | |

Table 12–21

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 300 feet above the target¹

| Expanded direct 300 ft 150 m CR (m) | Expanded direct 300 ft 150 m DR (m) | Expanded direct 300 ft 400 m CR (m) | Expanded direct 300 ft 400 m DR (m) | Expanded indirect 300 ft 150 m CR (m) | Expanded indirect 300 ft 150 m DR (m) | Expanded indirect 300 ft 400 m CR (m) | Expanded indirect 300 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| -8,791 | -3,133 | -8,910 | -3,354 | | | | |
| -6,958 | -3,892 | -7,038 | -4,130 | | | | |
| -5,053 | -4,396 | -5,107 | -4,641 | | | | |
| -3,953 | -4,598 | -3,991 | -4,846 | | | | |
| -2,312 | -4,800 | -2,333 | -5,049 | | | | |
| 0 | -4,900 | 0 | -5,150 | | | | |

Note.

¹ Use 150 m columns for AGM–114 A, B, C, F, K, K2, and 400 m columns for AGM–114 FA, KA, K2A, M, N, and N5.

Table 12–22

Surface danger zone data for Army rotary-wing HELLFIRE, direct and indirect, cross-range and down-range point plots when fired 1,000 feet above the target¹—Continued

| Direct 1,000 ft 150 m CR (m) | Direct 1,000 ft 150 m DR (m) | Direct 1,000 ft 400 m CR (m) | Direct 1,000 ft 400 m DR (m) | Indirect 1,000 ft 150 m CR (m) | Indirect 1,000 ft 150 m DR (m) | Indirect 1,000 ft 400 m CR (m) | Indirect 1,000 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 0 | -3,869 | 0 | -4,125 | 0 | -7,353 | 0 | -7,605 |
| 995 | -3,655 | 1,054 | -3,898 | 1,959 | -7,176 | 2,008 | -7,422 |
| 1,955 | -3,396 | 2,063 | -3,626 | 3,914 | -6,554 | 4,013 | -6,785 |
| 3,006 | -2,661 | 3,188 | -2,839 | 5,891 | -5,477 | 6,045 | -5,678 |
| 3,978 | -1,193 | 4,212 | -1,292 | 7,840 | -3,442 | 8,040 | -3,594 |
| 4,125 | -512 | 4,374 | -545 | 8,778 | -1,855 | 9,007 | -1,959 |
| 4,154 | 57 | 4,405 | 74 | 9,355 | -124 | 9,606 | -160 |
| 3,973 | 1,032 | 4,218 | 1,083 | 9,258 | 2,727 | 9,507 | 2,756 |
| 3,770 | 1,911 | 4,014 | 1,967 | 8,693 | 5,488 | 8,934 | 5,558 |
| 3,571 | 2,769 | 3,815 | 2,826 | 7,653 | 8,263 | 7,878 | 8,376 |
| 3,373 | 3,628 | 3,617 | 3,685 | 5,840 | 11,065 | 6,031 | 11,229 |
| 3,218 | 4,297 | 3,475 | 4,297 | 3,961 | 12,727 | 4,097 | 12,940 |
| 3,369 | 4,947 | 3,611 | 4,885 | 2,023 | 13,562 | 2,092 | 13,805 |
| 3,612 | 5,824 | 3,856 | 5,768 | 0 | 13,859 | 0 | 14,112 |
| 3,792 | 6,797 | 4,042 | 6,774 | -2,023 | 13,562 | -2,092 | 13,805 |
| 3,792 | 7,793 | 4,042 | 7,810 | -3,961 | 12,727 | -4,097 | 12,940 |
| 3,660 | 8,748 | 3,906 | 8,793 | -5,840 | 11,065 | -6,031 | 11,229 |
| 3,415 | 9,802 | 3,648 | 9,905 | -7,653 | 8,263 | -7,878 | 8,376 |
| 2,660 | 10,892 | 2,846 | 11,062 | -8,693 | 5,488 | -8,934 | 5,558 |
| 1,992 | 11,446 | 2,137 | 11,651 | -9,258 | 2,727 | -9,507 | 2,756 |

Table 12–22

Surface danger zone data for Army rotary-wing HELLFIRE, direct and indirect, cross-range and down-range point plots when fired 1,000 feet above the target¹—Continued

| Direct 1,000 ft 150 m CR (m) | Direct 1,000 ft 150 m DR (m) | Direct 1,000 ft 400 m CR (m) | Direct 1,000 ft 400 m DR (m) | Indirect 1,000 ft 150 m CR (m) | Indirect 1,000 ft 150 m DR (m) | Indirect 1,000 ft 400 m CR (m) | Indirect 1,000 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 1,091 | 11,984 | 1,179 | 12,223 | -9,355 | -124 | -9,606 | -160 |
| 0 | 12,161 | 0 | 12,414 | -8,778 | -1,855 | -9,007 | -1,959 |
| -1,091 | 11,984 | -1,179 | 12,223 | -7,840 | -3,442 | -8,040 | -3,594 |
| -1,992 | 11,446 | -2,137 | 11,651 | -5,891 | -5,477 | -6,045 | -5,678 |
| -2,660 | 10,892 | -2,846 | 11,062 | -3,914 | -6,554 | -4,013 | -6,785 |
| -3,415 | 9,802 | -3,648 | 9,905 | -1,959 | -7,176 | -2,008 | -7,422 |
| -3,660 | 8,748 | -3,906 | 8,793 | 0 | -7,353 | 0 | -7,605 |
| -3,792 | 7,793 | -4,042 | 7,810 | | | | |
| -3,792 | 6,797 | -4,042 | 6,774 | | | | |
| -3,612 | 5,824 | -3,856 | 5,768 | | | | |
| -3,369 | 4,947 | -3,611 | 4,885 | | | | |
| -3,218 | 4,297 | -3,475 | 4,297 | | | | |
| -3,373 | 3,628 | -3,617 | 3,685 | | | | |
| -3,571 | 2,769 | -3,815 | 2,826 | | | | |
| -3,770 | 1,911 | -4,014 | 1,967 | | | | |
| -3,973 | 1,032 | -4,218 | 1,083 | | | | |
| -4,154 | 57 | -4,405 | 74 | | | | |
| -4,125 | -512 | -4,374 | -545 | | | | |
| -3,978 | -1,193 | -4,212 | -1,292 | | | | |
| -3,006 | -2,661 | -3,188 | -2,839 | | | | |
| -1,955 | -3,396 | -2,063 | -3,626 | | | | |
| -995 | -3,655 | -1,054 | -3,898 | | | | |
| 0, | -3,869 | 0 | -4,125 | | | | |

Note.

¹ Use 150 m columns for AGM–114 A, B, C, F, K, K2, and 400 m columns for AGM–114 FA, KA, K2A, M, N, and N5.

Table 12–23

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 1,000 feet above the target¹

| Expanded direct 1,000 ft 150 m CR (m) | Expanded direct 1,000 ft 150 m DR (m) | Expanded direct 1,000 ft 400 m CR (m) | Expanded direct 1,000 ft 400 m DR (m) | Expanded indirect 1,000 ft 150 m CR (m) | Expanded indirect 1,000 ft 150 m DR (m) | Expanded indirect 1,000 ft 400 m CR (m) | Expanded indirect 1,000 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 0 | -5,601 | 0 | -5,851 | 0 | -7,352 | 0 | -7,602 |
| 2,370 | -5,498 | 2,391 | -5,747 | 2,708 | -7,184 | 2,743 | -7,433 |
| 4,059 | -5,291 | 4,096 | -5,538 | 5,433 | -6,587 | 5,504 | -6,827 |

Table 12–23

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 1,000 feet above the target¹

| Expanded direct 1,000 ft 150 m CR (m) | Expanded direct 1,000 ft 150 m DR (m) | Expanded direct 1,000 ft 400 m CR (m) | Expanded direct 1,000 ft 400 m DR (m) | Expanded indirect 1,000 ft 150 m CR (m) | Expanded indirect 1,000 ft 150 m DR (m) | Expanded indirect 1,000 ft 400 m CR (m) | Expanded indirect 1,000 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| 5,206 | -5,080 | 5,260 | -5,324 | 8,184 | -5,546 | 8,303 | -5,768 |
| 7,183 | -4,557 | 7,263 | -4,795 | 10,959 | -3,561 | 11,129 | -3,746 |
| 9,125 | -3,752 | 9,244 | -3,974 | 12,317 | -1,969 | 12,528 | -2,107 |
| 10,783 | -2,632 | 10,954 | -2,818 | 13,190 | -176 | 13,443 | -228 |
| 11,780 | -1,386 | 12,009 | -1,500 | 13,044 | 2,774 | 13,292 | 2,817 |
| 12,100 | -105 | 12,350 | -135 | 12,209 | 5,578 | 12,441 | 5,674 |
| 12,100 | 4,034 | 12,350 | 4,044 | 10,684 | 8,382 | 10,889 | 8,530 |
| 12,012 | 5,134 | 12,260 | 5,173 | 8,061 | 11,176 | 8,220 | 11,371 |
| 11,742 | 6,258 | 11,981 | 6,334 | 5,428 | 12,783 | 5,531 | 13,014 |
| 11,294 | 7,379 | 11,519 | 7,490 | 2,755 | 13,578 | 2,804 | 13,824 |
| 10,625 | 8,493 | 10,830 | 8,638 | 0 | 13,854 | 0 | 14,106 |
| 9,712 | 9,593 | 9,892 | 9,768 | -2,755 | 13,578 | -2,804 | 13,824 |
| 8,481 | 10,683 | 8,632 | 10,883 | -5,428 | 12,783 | -5,531 | 13,014 |
| 6,785 | 11,749 | 6,904 | 11,970 | -8,061 | 11,176 | -8,220 | 11,371 |
| 5,603 | 12,291 | 5,695 | 12,524 | -10,684 | 8,382 | -10,889 | 8,530 |
| 4,034 | 12,818 | 4,103 | 13,059 | -12,209 | 5,578 | -12,441 | 5,674 |
| 3,126 | 13,034 | 3,175 | 13,279 | -13,044 | 2,774 | -13,292 | 2,817 |
| 1,813 | 13,246 | 1,840 | 13,495 | -13,190 | -176 | -13,443 | -228 |
| 0 | 13,351 | 0 | 13,602 | -12,317 | -1,969 | -12,528 | -2,107 |
| -1,813 | 13,246 | -1,840 | 13,495 | -10,959 | -3,561 | -11,129 | -3,746 |
| -3,126 | 13,034 | -3,175 | 13,279 | -8,184 | -5,546 | -8,303 | -5,768 |
| -4,034 | 12,818 | -4,103 | 13,059 | -5,433 | -6,587 | -5,504 | -6,827 |
| -5,603 | 12,291 | -5,695 | 12,524 | -2,708 | -7,184 | -2,743 | -7,433 |
| -6,785 | 11,749 | -6,904 | 11,970 | 0 | -7,352 | 0 | -7,602 |
| -8,481 | 10,683 | -8,632 | 10,883 | | | | |
| -9,712 | 9,593 | -9,892 | 9,768 | | | | |
| -10,625 | 8,493 | -10,830 | 8,638 | | | | |
| -11,294 | 7,379 | -11,519 | 7,490 | | | | |
| -11,742 | 6,258 | -11,981 | 6,334 | | | | |
| -12,012 | 5,134 | -12,260 | 5,173 | | | | |
| -12,100 | 4,034 | -12,350 | 4,044 | | | | |
| -12,100 | -105 | -12,350 | -135 | | | | |
| -11,780 | -1,386 | -12,009 | -1,500 | | | | |
| -10,783 | -2,632 | -10,954 | -2,818 | | | | |
| -9,125 | -3,752 | -9,244 | -3,974 | | | | |

Table 12–23

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 1,000 feet above the target¹

| Expanded direct 1,000 ft 150 m CR (m) | Expanded direct 1,000 ft 150 m DR (m) | Expanded direct 1,000 ft 400 m CR (m) | Expanded direct 1,000 ft 400 m DR (m) | Expanded indirect 1,000 ft 150 m CR (m) | Expanded indirect 1,000 ft 150 m DR (m) | Expanded indirect 1,000 ft 400 m CR (m) | Expanded indirect 1,000 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| -7,183 | -4,557 | -7,263 | -4,795 | | | | |
| -5,206 | -5,080 | -5,260 | -5,324 | | | | |
| -4,059 | -5,291 | -4,096 | -5,538 | | | | |
| -2,370 | -5,498 | -2,391 | -5,747 | | | | |
| 0 | -5,601 | 0 | -5,851 | | | | |

Note.

¹ Use 150 m columns for AGM–114 A, B, C, F, K, K2, and 400 m columns for AGM–114 FA, KA, K2A, M, N, and N5.

Table 12–24

Surface danger zone data for Army rotary-wing HELLFIRE, direct and indirect, cross-range and down-range point plots when fired 5,000 feet above the target¹

| Direct 5,000 ft 150 m CR (m) | Direct 5,000 ft 150 m DR (m) | Direct 5,000 ft 400 m CR (m) | Direct 5,000 ft 400 m DR (m) | Indirect 5,000 ft 150 m CR (m) | Indirect 5,000 ft 150 m DR (m) | Indirect 5,000 ft 400 m CR (m) | Indirect 5,000 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 0 | -7,961 | 0 | -8,217 | 0 | -11,370 | 0 | -11,621 |
| 1,939 | -7,544 | 1,998 | -7,787 | 2,755 | -11,120 | 2,804 | -11,366 |
| 3,675 | -7,074 | 3,783 | -7,304 | 5,491 | -10,250 | 5,590 | -10,481 |
| 5,921 | -5,503 | 6,103 | -5,681 | 8,350 | -8,692 | 8,504 | -8,893 |
| 7,728 | -2,775 | 7,962 | -2,874 | 11,048 | -5,875 | 11,249 | -6,027 |
| 8,104 | -1,039 | 8,353 | -1,072 | 12,438 | -3,523 | 12,667 | -3,628 |
| 8,172 | 325 | 8,423 | 341 | 13,377 | -706 | 13,628 | -743 |
| 7,890 | 1,848 | 8,135 | 1,898 | 13,244 | 3,198 | 13,493 | 3,228 |
| 7,667 | 2,813 | 7,911 | 2,869 | 12,549 | 6,597 | 12,790 | 6,667 |
| 7,468 | 3,670 | 7,712 | 3,726 | 11,247 | 10,073 | 11,471 | 10,186 |
| 7,324 | 4,296 | 7,581 | 4,296 | 8,900 | 13,698 | 9,092 | 13,862 |
| 7,324 | 4,296 | 7,581 | 4,296 | 6,133 | 16,147 | 6,268 | 16,360 |
| 7,324 | 4,296 | 7,581 | 4,296 | 3,124 | 17,443 | 3,193 | 17,686 |
| 7,514 | 4,925 | 7,757 | 4,868 | 0 | 17,902 | 0 | 18,155 |
| 7,792 | 6,430 | 8,042 | 6,408 | -3,124 | 17,443 | -3,193 | 17,686 |
| 7,792 | 8,068 | 8,042 | 8,086 | -6,133 | 16,147 | -6,268 | 16,360 |
| 7,597 | 9,475 | 7,843 | 9,520 | -8,900 | 13,698 | -9,092 | 13,862 |
| 7,139 | 11,451 | 7,372 | 11,554 | -11,247 | 10,073 | -11,471 | 10,186 |
| 5,636 | 13,621 | 5,822 | 13,791 | -12,549 | 6,597 | -12,790 | 6,667 |
| 4,308 | 14,722 | 4,453 | 14,927 | -13,244 | 3,198 | -13,493 | 3,228 |
| 2,486 | 15,810 | 2,573 | 16,049 | -13,377 | -706 | -13,628 | -743 |

Table 12–24

Surface danger zone data for Army rotary-wing HELLFIRE, direct and indirect, cross-range and down-range point plots when fired 5,000 feet above the target¹

| Direct 5,000 ft 150 m CR (m) | Direct 5,000 ft 150 m DR (m) | Direct 5,000 ft 400 m CR (m) | Direct 5,000 ft 400 m DR (m) | Indirect 5,000 ft 150 m CR (m) | Indirect 5,000 ft 150 m DR (m) | Indirect 5,000 ft 400 m CR (m) | Indirect 5,000 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 0 | 16,213 | 0 | 16,467 | -12,438 | -3,523 | -12,667 | -3,628 |
| -2,486 | 15,810 | -2,573 | 16,049 | -11,048 | -5,875 | -11,249 | -6,027 |
| -4,308 | 14,722 | -4,453 | 14,927 | -8,350 | -8,692 | -8,504 | -8,893 |
| -5,636 | 13,621 | -5,822 | 13,791 | | | | |
| -7,139 | 11,451 | -7,372 | 11,554 | | | | |
| -7,597 | 9,475 | -7,843 | 9,520 | | | | |
| -7,792 | 8,068 | -8,042 | 8,086 | | | | |
| -7,792 | 6,430 | -8,042 | 6,408 | | | | |
| -7,514 | 4,925 | -7,757 | 4,868 | | | | |
| -7,324 | 4,296 | -7,581 | 4,296 | | | | |
| -7,324 | 4,296 | -7,581 | 4,296 | | | | |
| -7,324 | 4,296 | -7,581 | 4,296 | | | | |
| -7,468 | 3,670 | -7,712 | 3,726 | | | | |
| -7,667 | 2,813 | -7,911 | 2,869 | | | | |
| -7,890 | 1,848 | -8,135 | 1,898 | | | | |
| -8,172 | 325 | -8,423 | 341 | | | | |
| -8,104 | -1,039 | -8,353 | -1,072 | | | | |
| -7,728 | -2,775 | -7,962 | -2,874 | | | | |
| -5,921 | -5,503 | -6,103 | -5,681 | | | | |
| -3,675 | -7,074 | -3,783 | -7,304 | | | | |
| -1,939 | -7,544 | -1,998 | -7,787 | | | | |
| 0 | -7,961 | 0 | -8,217 | | | | |

Note.

¹ Use 150 m columns for AGM–114 A, B, C, F, K, K2, and 400 m columns for AGM–114 FA, KA, K2A, M, N, and N5.

Table 12–25

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 5,000 feet above the target¹

| Expanded direct 5,000 ft 150 m CR (m) | Expanded direct 5,000 ft 150 m DR (m) | Expanded direct 5,000 ft 400 m CR (m) | Expanded direct 5,000 ft 400 m DR (m) | Expanded indirect 5,000 ft 150 m CR (m) | Expanded indirect 5,000 ft 150 m DR (m) | Expanded indirect 5,000 ft 400 m CR (m) | Expanded indirect 5,000 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 0 | -9,605 | 0 | -9,855 | 0 | -11,359 | 0 | -11,610 |
| 2,701 | -9,487 | 2,722 | -9,736 | 3,263 | -11,158 | 3,297 | -11,406 |
| 4,664 | -9,246 | 4,701 | -9,494 | 6,575 | -10,432 | 6,646 | -10,672 |
| 6,079 | -8,987 | 6,134 | -9,231 | 10,088 | -9,102 | 10,207 | -9,325 |

Table 12–25

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 5,000 feet above the target¹

| Expanded direct 5,000 ft 150 m CR (m) | Expanded direct 5,000 ft 150 m DR (m) | Expanded direct 5,000 ft 400 m CR (m) | Expanded direct 5,000 ft 400 m DR (m) | Expanded indirect 5,000 ft 150 m CR (m) | Expanded indirect 5,000 ft 150 m DR (m) | Expanded indirect 5,000 ft 400 m CR (m) | Expanded indirect 5,000 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| 8,465 | -8,355 | 8,546 | -8,593 | 13,685 | -6,529 | 13,855 | -6,715 |
| 11,029 | -7,293 | 11,148 | -7,514 | 15,691 | -4,178 | 15,901 | -4,316 |
| 13,526 | -5,606 | 13,698 | -5,792 | 17,236 | -1,003 | 17,488 | -1,055 |
| 15,448 | -3,203 | 15,678 | -3,317 | 17,015 | 3,453 | 17,263 | 3,496 |
| 16,100 | -597 | 16,350 | -628 | 15,923 | 7,121 | 16,156 | 7,217 |
| 16,100 | 4,194 | 16,350 | 4,204 | 13,953 | 10,745 | 14,157 | 10,893 |
| 15,974 | 5,764 | 16,222 | 5,803 | 10,607 | 14,308 | 10,766 | 14,504 |
| 15,564 | 7,474 | 15,803 | 7,550 | 7,068 | 16,469 | 7,170 | 16,699 |
| 14,889 | 9,162 | 15,113 | 9,274 | 3,531 | 17,520 | 3,580 | 17,766 |
| 13,898 | 10,813 | 14,103 | 10,958 | 0 | 17,874 | 0 | 18,126 |
| 12,594 | 12,385 | 12,774 | 12,559 | -3,531 | 17,520 | -3,580 | 17,766 |
| 10,887 | 13,895 | 11,038 | 14,095 | -7,068 | 16,469 | -7,170 | 16,699 |
| 8,692 | 15,275 | 8,811 | 15,496 | -10,607 | 14,308 | -10,766 | 14,504 |
| 7,078 | 16,016 | 7,170 | 16,249 | -13,953 | 10,745 | -14,157 | 10,893 |
| 5,136 | 16,668 | 5,205 | 16,908 | -15,923 | 7,121 | -16,156 | 7,217 |
| 3,909 | 16,960 | 3,958 | 17,205 | -17,015 | 3,453 | -17,263 | 3,496 |
| 2,248 | 17,227 | 2,275 | 17,476 | -17,236 | -1,003 | -17,488 | -1,055 |
| 0 | 17,358 | 0 | 17,609 | -15,691 | -4,178 | -15,901 | -4,316 |
| -2,248 | 17,227 | -2,275 | 17,476 | -13,685 | -6,529 | -13,855 | -6,715 |
| -3,909 | 16,960 | -3,958 | 17,205 | -10,088 | -9,102 | -10,207 | -9,325 |
| -5,136 | 16,668 | -5,205 | 16,908 | | | | |
| -7,078 | 16,016 | -7,170 | 16,249 | | | | |
| -8,692 | 15,275 | -8,811 | 15,496 | | | | |
| -10,887 | 13,895 | -11,038 | 14,095 | | | | |
| -12,594 | 12,385 | -12,774 | 12,559 | | | | |
| -13,898 | 10,813 | -14,103 | 10,958 | | | | |
| -14,889 | 9,162 | -15,113 | 9,274 | | | | |
| -15,564 | 7,474 | -15,803 | 7,550 | | | | |
| -15,974 | 5,764 | -16,222 | 5,803 | | | | |
| -16,100 | 4,194 | -16,350 | 4,204 | | | | |
| -16,100 | -597 | -16,350 | -628 | | | | |
| -15,448 | -3,203 | -15,678 | -3,317 | | | | |
| -13,526 | -5,606 | -13,698 | -5,792 | | | | |
| -11,029 | -7,293 | -11,148 | -7,514 | | | | |
| -8,465 | -8,355 | -8,546 | -8,593 | | | | |

Table 12–25

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 5,000 feet above the target¹

| Expanded direct 5,000 ft 150 m CR (m) | Expanded direct 5,000 ft 150 m DR (m) | Expanded direct 5,000 ft 400 m CR (m) | Expanded direct 5,000 ft 400 m DR (m) | Expanded indirect 5,000 ft 150 m CR (m) | Expanded indirect 5,000 ft 150 m DR (m) | Expanded indirect 5,000 ft 400 m CR (m) | Expanded indirect 5,000 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| -6,079 | -8,987 | -6,134 | -9,231 | | | | |
| -4,664 | -9,246 | -4,701 | -9,494 | | | | |
| -2,701 | -9,487 | -2,722 | -9,736 | | | | |
| 0 | -9,605 | 0 | -9,855 | | | | |

Note.

¹ Use 150 m columns for AGM–114 A, B, C, F, K, K2, and 400 m columns for AGM–114 FA, KA, K2A, M, N, and N5.

Table 12–26

Surface danger zone data for Army rotary-wing HELLFIRE, direct and indirect, cross-range and down-range point plots when fired 10,000 feet above the target¹

| Direct 10,000 ft 150 m CR (m) | Direct 10,000 ft 150 m DR (m) | Direct 10,000 ft 400 m CR (m) | Direct 10,000 ft 400 m DR (m) | Indirect 10,000 ft 150 m CR (m) | Indirect 10,000 ft 150 m DR (m) | Indirect 10,000 ft 400 m CR (m) | Indirect 10,000 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| 0 | -13,075 | 0 | -13,331 | 0 | -16,391 | 0 | -16,642 |
| 3,118 | -12,405 | 3,177 | -12,648 | 3,750 | -16,050 | 3,799 | -16,297 |
| 5,825 | -11,672 | 5,933 | -11,902 | 7,462 | -14,870 | 7,561 | -15,101 |
| 9,565 | -9,056 | 9,747 | -9,233 | 11,425 | -12,711 | 11,578 | -12,912 |
| 12,416 | -4,753 | 12,650 | -4,852 | 15,059 | -8,916 | 15,260 | -9,068 |
| 13,077 | -1,697 | 13,326 | -1,730 | 17,013 | -5,609 | 17,242 | -5,713 |
| 13,195 | 659 | 13,446 | 676 | 18,405 | -1,435 | 18,656 | -1,471 |
| 12,787 | 2,867 | 13,032 | 2,918 | 18,227 | 3,788 | 18,476 | 3,818 |
| 12,538 | 3,941 | 12,782 | 3,997 | 17,369 | 7,984 | 17,610 | 8,053 |
| 12,457 | 4,296 | 12,713 | 4,296 | 15,738 | 12,335 | 15,963 | 12,448 |
| 12,457 | 4,296 | 12,713 | 4,296 | 12,726 | 16,989 | 12,917 | 17,153 |
| 12,457 | 4,296 | 12,713 | 4,296 | 8,847 | 20,421 | 8,983 | 20,635 |
| 12,457 | 4,296 | 12,713 | 4,296 | 4,500 | 22,295 | 4,569 | 22,538 |
| 12,457 | 4,296 | 12,713 | 4,296 | 0 | 22,956 | 0 | 23,208 |
| 12,792 | 5,972 | 13,042 | 5,949 | -4,500 | 22,295 | -4,569 | 22,538 |
| 12,792 | 8,413 | 13,042 | 8,430 | -8,847 | 20,421 | -8,983 | 20,635 |
| 12,519 | 10,384 | 12,765 | 10,429 | -12,726 | 16,989 | -12,917 | 17,153 |
| 11,794 | 13,512 | 12,027 | 13,615 | -15,738 | 12,335 | -15,963 | 12,448 |
| 9,355 | 17,032 | 9,541 | 17,202 | -17,369 | 7,984 | -17,610 | 8,053 |
| 7,203 | 18,817 | 7,348 | 19,022 | -18,227 | 3,788 | -18,476 | 3,818 |
| 4,230 | 20,592 | 4,317 | 20,832 | -18,405 | -1,435 | -18,656 | -1,471 |
| 0 | 21,279 | 0 | 21,532 | -17,013 | -5,609 | -17,242 | -5,713 |

Table 12–26

Surface danger zone data for Army rotary-wing HELLFIRE, direct and indirect, cross-range and down-range point plots when fired 10,000 feet above the target¹

| Direct 10,000 ft 150 m CR (m) | Direct 10,000 ft 150 m DR (m) | Direct 10,000 ft 400 m CR (m) | Direct 10,000 ft 400 m DR (m) | Indirect 10,000 ft 150 m CR (m) | Indirect 10,000 ft 150 m DR (m) | Indirect 10,000 ft 400 m CR (m) | Indirect 10,000 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| -4,230 | 20,592 | -4,317 | 20,832 | -15,059 | -8,916 | -15,260 | -9,068 |
| -7,203 | 18,817 | -7,348 | 19,022 | -11,425 | -12,711 | -11,578 | -12,912 |
| -9,355 | 17,032 | -9,541 | 17,202 | -7,462 | -14,870 | -7,561 | -15,101 |
| -11,794 | 13,512 | -12,027 | 13,615 | -3,750 | -16,050 | -3,799 | -16,297 |
| -12,519 | 10,384 | -12,765 | 10,429 | 0 | -16,391 | 0 | -16,642 |
| -12,792 | 8,413 | -13,042 | 8,430 | | | | |
| -12,792 | 5,972 | -13,042 | 5,949 | | | | |
| -12,457 | 4,296 | -12,713 | 4,296 | | | | |
| -12,457 | 4,296 | -12,713 | 4,296 | | | | |
| -12,457 | 4,296 | -12,713 | 4,296 | | | | |
| -12,457 | 4,296 | -12,713 | 4,296 | | | | |
| -12,457 | 4,296 | -12,713 | 4,296 | | | | |
| -12,538 | 3,941 | -12,782 | 3,997 | | | | |
| -12,787 | 2,867 | -13,032 | 2,918 | | | | |
| -13,195 | 659 | -13,446 | 676 | | | | |
| -13,077 | -1,697 | -13,326 | -1,730 | | | | |
| -12,416 | -4,753 | -12,650 | -4,852 | | | | |
| -9,565 | -9,056 | -9,747 | -9,233 | | | | |
| -5,825 | -11,672 | -5,933 | -11,902 | | | | |
| -3,118 | -12,405 | -3,177 | -12,648 | | | | |
| 0 | -13,075 | 0 | -13,331 | | | | |

Note.

¹ Use 150 m columns for AGM–114 A, B, C, F, K, K2, and 400 m columns for AGM–114 FA, KA, K2A, M, N, and N5.

Table 12–27

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 10,000 feet above the target¹

| Expanded direct 10,000 ft 150 m CR (m) | Expanded direct 10,000 ft 150 m DR (m) | Expanded direct 10,000 ft 400 m CR (m) | Expanded direct 10,000 ft 400 m DR (m) | Expanded indirect 10,000 ft 150 m CR (m) | Expanded indirect 10,000 ft 150 m DR (m) | Expanded indirect 10,000 ft 400 m CR (m) | Expanded indirect 10,000 ft 400 m DR (m) |
|---|---|---|---|---|---|---|---|
| 0 | -14,609 | 0 | -14,860 | 0 | -16,369 | 0 | -16,619 |
| 3,115 | -14,474 | 3,136 | -14,723 | 3,956 | -16,124 | 3,991 | -16,373 |
| 5,420 | -14,191 | 5,458 | -14,438 | 8,003 | -15,237 | 8,074 | -15,478 |
| 7,172 | -13,870 | 7,226 | -14,114 | 12,467 | -13,548 | 12,586 | -13,770 |
| 10,069 | -13,103 | 10,149 | -13,341 | 17,091 | -10,240 | 17,262 | -10,425 |

Table 12–27

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 10,000 feet above the target¹

| Expanded direct 10,000 ft 150 m CR (m) | Expanded direct 10,000 ft 150 m DR (m) | Expanded direct 10,000 ft 400 m CR (m) | Expanded direct 10,000 ft 400 m DR (m) | Expanded indirect 10,000 ft 150 m CR (m) | Expanded indirect 10,000 ft 150 m DR (m) | Expanded indirect 10,000 ft 400 m CR (m) | Expanded indirect 10,000 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| 13,410 | -11,719 | 13,529 | -11,940 | 19,908 | -6,939 | 20,119 | -7,077 |
| 16,956 | -9,323 | 17,127 | -9,509 | 22,293 | -2,038 | 22,546 | -2,090 |
| 20,035 | -5,475 | 20,264 | -5,588 | 21,979 | 4,302 | 22,228 | 4,345 |
| 21,100 | -1,213 | 21,350 | -1,243 | 20,566 | 9,049 | 20,798 | 9,145 |
| 21,100 | 4,393 | 21,350 | 4,403 | 18,038 | 13,699 | 18,242 | 13,847 |
| 20,927 | 6,551 | 21,175 | 6,591 | 13,789 | 18,223 | 13,948 | 18,419 |
| 20,341 | 8,994 | 20,580 | 9,070 | 9,117 | 21,076 | 9,220 | 21,306 |
| 19,382 | 11,391 | 19,607 | 11,502 | 4,502 | 22,448 | 4,550 | 22,694 |
| 17,990 | 13,712 | 18,194 | 13,857 | 0 | 22,900 | 0 | 23,151 |
| 16,195 | 15,874 | 16,375 | 16,049 | -4,502 | 22,448 | -4,550 | 22,694 |
| 13,895 | 17,910 | 14,046 | 18,110 | -9,117 | 21,076 | -9,220 | 21,306 |
| 11,076 | 19,683 | 11,195 | 19,903 | -13,789 | 18,223 | -13,948 | 18,419 |
| 8,921 | 20,672 | 9,013 | 20,904 | -18,038 | 13,699 | -18,242 | 13,847 |
| 6,513 | 21,479 | 6,582 | 21,720 | -20,566 | 9,049 | -20,798 | 9,145 |
| 4,888 | 21,866 | 4,936 | 22,112 | -21,979 | 4,302 | -22,228 | 4,345 |
| 2,793 | 22,204 | 2,820 | 22,453 | -22,293 | -2,038 | -22,546 | -2,090 |
| 0 | 22,367 | 0 | 22,617 | -19,908 | -6,939 | -20,119 | -7,077 |
| -2,793 | 22,204 | -2,820 | 22,453 | -17,091 | -10,240 | -17,262 | -10,425 |
| -4,888 | 21,866 | -4,936 | 22,112 | -12,467 | -13,548 | -12,586 | -13,770 |
| -6,513 | 21,479 | -6,582 | 21,720 | -8,003 | -15,237 | -8,074 | -15,478 |
| -8,921 | 20,672 | -9,013 | 20,904 | -3,956 | -16,124 | -3,991 | -16,373 |
| -11,076 | 19,683 | -11,195 | 19,903 | 0 | -16,369 | 0 | -16,619 |
| -13,895 | 17,910 | -14,046 | 18,110 | | | | |
| -16,195 | 15,874 | -16,375 | 16,049 | | | | |
| -17,990 | 13,712 | -18,194 | 13,857 | | | | |
| -19,382 | 11,391 | -19,607 | 11,502 | | | | |
| -20,341 | 8,994 | -20,580 | 9,070 | | | | |
| -20,927 | 6,551 | -21,175 | 6,591 | | | | |
| -21,100 | 4,393 | -21,350 | 4,403 | | | | |
| -21,100 | -1,213 | -21,350 | -1,243 | | | | |
| -20,035 | -5,475 | -20,264 | -5,588 | | | | |
| -16,956 | -9,323 | -17,127 | -9,509 | | | | |
| -13,410 | -11,719 | -13,529 | -11,940 | | | | |
| -10,069 | -13,103 | -10,149 | -13,341 | | | | |
| -7,172 | -13,870 | -7,226 | -14,114 | | | | |

Table 12–27

Surface danger zone data for Army rotary-wing HELLFIRE, expanded direct and expanded indirect, cross-range and down-range point plots when fired 10,000 feet above the target¹

| Expanded direct 10,000 ft 150 m CR (m) | Expanded direct 10,000 ft 150 m DR (m) | Expanded direct 10,000 ft 400 m CR (m) | Expanded direct 10,000 ft 400 m DR (m) | Expanded indirect 10,000 ft 150 m CR (m) | Expanded indirect 10,000 ft 150 m DR (m) | Expanded indirect 10,000 ft 400 m CR (m) | Expanded indirect 10,000 ft 400 m DR (m) |
|--|--|--|--|--|--|--|--|
| -5,420 | -14,191 | -5,458 | -14,438 | | | | |
| -3,115 | -14,474 | -3,136 | -14,723 | | | | |
| 0 | -14,609 | 0 | -14,860 | | | | |

Note.

¹ Use 150 m columns for AGM–114 A, B, C, F, K, K2, and 400 m columns for AGM–114 FA, KA, K2A, M, N, and N5.

(1) *Direct weapon danger zone and surface danger zone.* See figure 12–4. This WDW and SDZ will be used for AGM–114 A/F HELLFIRE missiles with the following launch modes and conditions (see tables 12–16 through 12–19):

- (a) Lock-on before launch with remote designation.
- (b) Lock-on after launch with remote designation.
- (c) Lock-on after launch with autonomous designation and proper designation delay:
 1. For AGM–114A missiles, use a minimum delay of 3 seconds and a maximum delay of 10 seconds.
 2. For AGM–114B/F missiles, use a minimum delay of 3 seconds and a maximum delay of 5 seconds.
 3. For designation delay as calculated for range to target after missile separation, always add 1 second to the designation (separation) delay times when counting from trigger pull.

(2) *Indirect weapon danger zone and surface danger zone.* See figure 12–5. This WDW and SDZ will be used for AGM–114 A/F and AGM–114 K/N HELLFIRE missiles with the following launch modes and conditions:

(a) This WDW and SDZ will be used with all HELLFIRE missiles identified in tables 12–16 through 12–19 and with remote or autonomous designation. The HELLFIRE operational mode launch parameters and performance envelopes are described in TC 3–04.3 and the latest SOUM.

- (b) To minimize backscatter for LOBL autonomous engagements, use the following target offsets:
 1. Three- to 5-degree target offset.
 2. Always offset the missile launch angle toward the side of the launch platform on which the missile resides to reduce the chance of interference with autonomous tracking.
 3. No offset is necessary when using remote designation.

(3) *Expanded direct and expanded indirect weapon danger zones and surface danger zones Army rotary-wing aircraft.* Due to excessive missile roll rates induced by interactions between specific Army RW aircraft and their associated launchers, two additional WDWs and SDZs have been established to compensate for possible missile error (roll tip-off error). The expanded direct (AGM–114 A/F) and expanded indirect (AGM–114 A/F and K/N) WDWs and SDZs (see figs 12–6 and 12–7) are required for all Army RW aircraft. However, based on specific aircraft launcher configurations and firing modes, certain Army RW aircraft may be allowed to use the standard direct or indirect WDWs and SDZs as indicated in figures 12–4 and 12–5 (see tables 12–16 through 12–19 and the latest Army HELLFIRE SOUM to determine which aircraft and under which configurations and firing modes are acceptable for firing under the standard direct and indirect WDWs and SDZs).

c. *Altitude restrictions.* HELLFIRE WDWs and SDZs as depicted in figures 12–4 through 12–7 and tables 12–20 and 12–21 are based on a launch altitude of 300 ft AGL. If firing above 300 ft AGL, then the radial extent (that is, centered on the launch point) of the WDW or SDZ is increased by approximately 1 m per additional foot of launch altitude. These increases are depicted in tables 12–22 through 12–27. Minimum clearance airspace will be 20,000 ft above launch altitude. For the HELLFIRE models listed in tables 12–16 through 12–19, see the latest SOUM (for example, AMCOM–07–001) or ARSMM associated with HELLFIRE delivery to ensure appropriate parameters are met.

d. *Area F.* Area F is an area to the rear of the launch point 30 m wide (15 m to each side of the launcher) and 50 m long when aircraft are at or below 300 ft AGL (see fig 12–13). Hazards are launch motor blast, hazardous noise levels, overpressure, and debris. Serious casualties or fatalities may occur to personnel occupying Area F; therefore, occupation of it is not authorized.

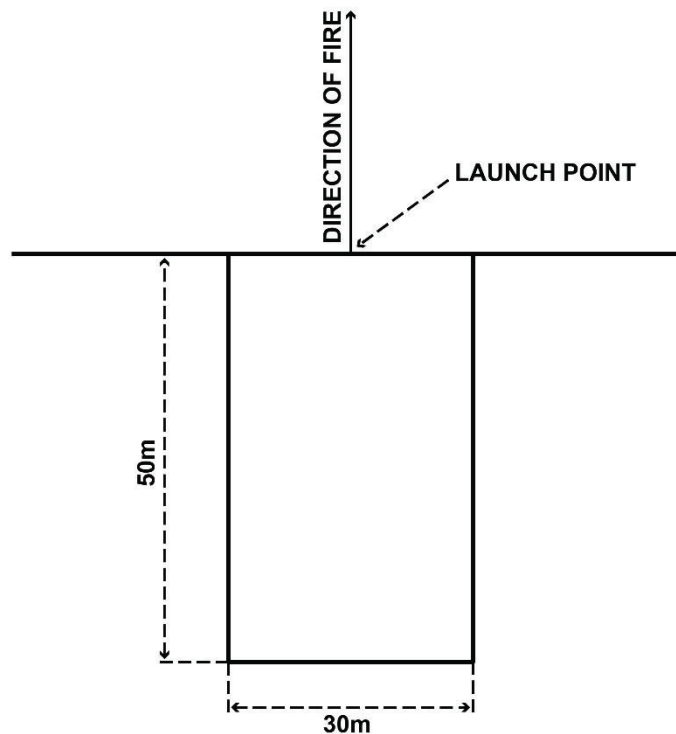


Figure 12–13. Surface danger zone, Area F, for HELLFIRE missile launches

12–12. Air-to-Ground Missile–114 L/L–5 Longbow HELLFIRE missile

These missiles will be fired in accordance with all applicable HELLFIRE SOUMs and ARSMM. For further information, contact the U.S. Army Project Manager, Joint Attack Munitions Systems Project Office.

12–13. Air-to-Ground Missile–114 P/P+ HELLFIRE missile

For United States Marine Corps platforms, WDZs and SDZs will be developed using the RMTK WDZ Tool. For Army platforms, contact the U.S. Army Project Manager, Joint Attack Munitions Systems Project Office. These missiles are authorized for high altitude firings to support additional platforms, such as UAS and AC–130 HERCULES aircraft, in accordance with all applicable HELLFIRE SOUMs and ARSMM.

12–14. Air-to-Ground Missile–114 R/R2 HELLFIRE missile

These missiles will be fired in accordance with all applicable SOUMs and ARSMM. AGM–114 R/R2 HELLFIRE can be fired in accordance with the SDZ guidance in table 12–28 if no WDZ is available. As shown in table 12–28, AGM–114 R/R2 SDZs are platform-specific and have configuration restrictions for RW LOBL engagements until further guidance is issued that provides relief for high roll-rate inducing load outs. An additional requirement to the SDZ restrictions is that the target be placed no closer to the range boundary than 2 km. Ensure designators comply with the location restrictions shown in figure 12–9.

Table 12–28**Army unmanned aircraft system and Rotary-Wing Air-to-Ground Missile–114 R/R2 HELLFIRE missile firing modes and restriction requirements—Continued**

| Aircraft | Launch mode | Configuration restrictions | SDZ | Alternate SDZ construction |
|--|-------------|----------------------------|-------------------|----------------------------|
| UAS | LOAL | No | See figure 12–12. | See table 12–29. |
| AH–64 Apache (R09) | LOBL | Yes | See figure 12–13. | See table 12–30. |
| AH–64 Apache (R09) | LOAL | No | See figure 12–14. | See table 12–31. |
| AH–64 Apache (Target Reference) | LOBL | Yes | See figure 12–15. | See table 12–32. |
| AH–64 Apache (Target Reference) | LOAL | No | See figure 12–14. | See table 12–31. |
| MH–6 MELB Little Bird | LOBL | Yes | See figure 12–16. | See table 12–33. |
| UH–60 IDAP Short Wing Black Hawk | LOBL | No | See figure 12–16. | See table 12–33. |
| UH–60 IDAP Short Wing Black Hawk/MH–6 MELB Little Bird | LOAL | No | See figure 12–14. | See table 12–31. |

Legend:

IDAP=Integrated Defensive Armed Penetrator

LOAL=lock-on after launch

LOBL=lock-on before launch

MELB=Mission Enhanced Little Bird

SDZ=surface danger zone

UAS=unmanned aircraft system

a. Rotary-wing lock-on before launch configuration restrictions. Configuration restrictions for RW LOBL engagements are—

(1) *Attack Helicopter–64 Apache.*

(a) Apache aircraft must be outfitted with HELLFIRE launchers (M299) on the inboard pylons and M261 Hydra–70 rocket launchers on the outboard pylons with or without rockets or another M299 HELLFIRE launcher with or without missiles.

(b) HELLFIRE missiles will be fired from only two rails left and right inboard pylons, upper inboard rails. The users may load or fire missiles on both rails or on just one rail.

(c) The other inboard pylon rails must contain either live tactical HELLFIRE missiles or M34 dummy HELLFIRE missiles.

(d) HELLFIRE missiles may be fired from approved configurations for hover and forward flight.

(2) *Military Helicopter–6 Mission Enhanced Little Bird.*

(a) HELLFIRE missiles will be fired from only two rails during forward flight left and right inboard rails.

(b) The outboard rails must contain either live tactical HELLFIRE missiles or M34 dummy HELLFIRE missiles.

(c) HELLFIRE missiles may be fired from approved configurations for hover and forward flight.

b. Use of Air-to-Ground Missile–114 R/R2 surface danger zones for aviation platforms. Use of AGM–114 R/R2 SDZs will be constrained to launch conditions used in the generation of the SDZs and should not be extrapolated beyond the dataset.

(1) *Unmanned aircraft system* platforms. AGM–114 R/R2 HELLFIRE SDZ contours have been generated for LOAL R09 target message-enhanced mode engagement altitudes from 5,000 ft to 25,000 ft MSL and airspeeds up to 160 knots true airspeed (KTAS). UAS platform offsets and launch airspeeds will not exceed AGM–114 R/R2 design constraints. HELLFIRE weapon engagement zone guidance should be followed to ensure good performance of the missile (see figure 12–14 for the UAS LOAL SDZ contours). No UAS LOBL SDZ contours are provided since LOBL capability is currently not implemented on UAS platforms (see table 12–29 for SDZ contours data for AGM–114–R UAS (LOAL only) CR and down-range point plots).

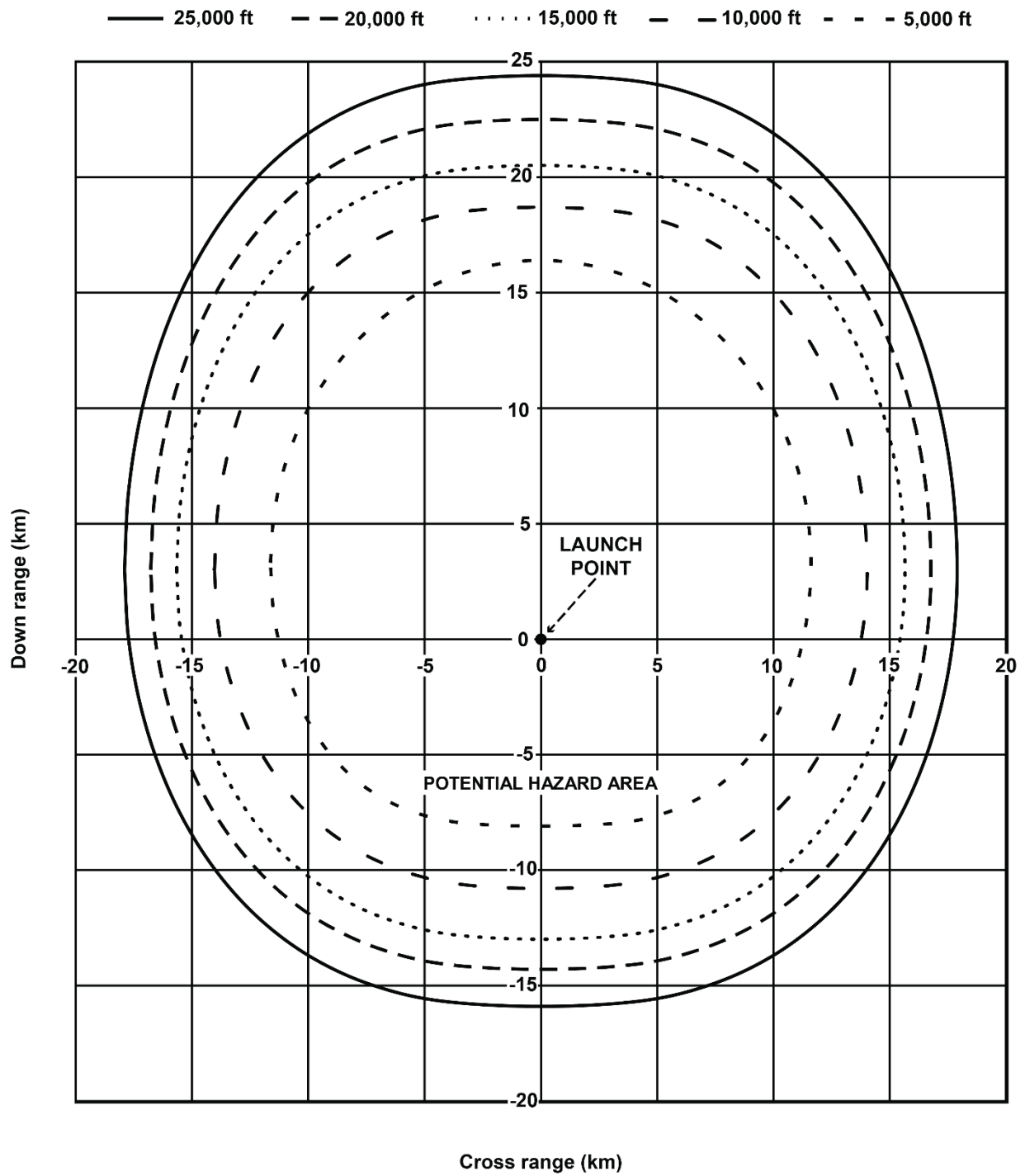


Figure 12–14. Surface danger zone for Air-to-Ground–114 R/R2 Unmanned Aerial System Lock-On After Launch only

Table 12–29

Surface danger zone contours data for Air-to-Ground–114–R Unmanned Aerial System (Lock-On After Launch only) cross-range and down-range point plots—Continued

| 25,000 ft CR (m) | 25,000 ft DR (m) | 20,000 ft CR (m) | 20,000 ft DR (m) | 15,000 ft CR (m) | 15,000 ft DR (m) | 10,000 ft CR (m) | 10,000 ft DR (m) | 5,000 ft CR (m) | 5,000 ft DR (m) |
|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-----------------------|-----------------------|
| -17,900 | 3,000 | -16,780 | 3,000 | -15,660 | 3,000 | -14,040 | 3,000 | -11,620 | 3,300 |
| -17,730 | 6,348 | -16,621 | 6,050 | -15,511 | 5,738 | -13,907 | 5,456 | -11,477 | 5,349 |
| -17,222 | 9,613 | -16,145 | 9,026 | -15,067 | 8,408 | -13,508 | 7,852 | -11,051 | 7,348 |
| -16,379 | 12,715 | -15,355 | 11,853 | -14,330 | 10,945 | -12,847 | 10,128 | -10,353 | 9,247 |
| -15,207 | 15,579 | -14,256 | 14,462 | -13,304 | 13,286 | -11,928 | 12,228 | -9,401 | 11,000 |
| -13,711 | 18,132 | -12,853 | 16,789 | -11,995 | 15,374 | -10,754 | 14,102 | -8,217 | 12,563 |
| -11,894 | 20,313 | -11,150 | 18,776 | -10,406 | 17,158 | -9,329 | 15,702 | -6,830 | 13,898 |
| -9,751 | 22,068 | -9,141 | 20,375 | -8,531 | 18,593 | -7,648 | 16,989 | -5,275 | 14,972 |
| -7,253 | 23,353 | -6,799 | 21,546 | -6,346 | 19,643 | -5,689 | 17,932 | -3,591 | 15,759 |
| -4,296 | 24,137 | -4,028 | 22,260 | -3,759 | 20,285 | -3,370 | 18,507 | -1,818 | 16,239 |
| 0 | 24,400 | 0 | 22,500 | 0 | 20,500 | 0 | 18,700 | 0 | 16,400 |
| 4,296 | 24,137 | 4,028 | 22,260 | 3,759 | 20,285 | 3,370 | 18,507 | 1,818 | 16,239 |
| 7,253 | 23,353 | 6,799 | 21,546 | 6,346 | 19,643 | 5,689 | 17,932 | 3,591 | 15,759 |
| 9,751 | 22,068 | 9,141 | 20,375 | 8,531 | 18,593 | 7,648 | 16,989 | 5,275 | 14,972 |
| 11,894 | 20,313 | 11,150 | 18,776 | 10,406 | 17,158 | 9,329 | 15,702 | 6,830 | 13,898 |
| 13,711 | 18,132 | 12,853 | 16,789 | 11,995 | 15,374 | 10,754 | 14,102 | 8,217 | 12,563 |
| 15,207 | 15,579 | 14,256 | 14,462 | 13,304 | 13,286 | 11,928 | 12,228 | 9,401 | 11,000 |
| 16,379 | 12,715 | 15,355 | 11,853 | 14,330 | 10,945 | 12,847 | 10,128 | 10,353 | 9,247 |
| 17,222 | 9,613 | 16,145 | 9,026 | 15,067 | 8,408 | 13,508 | 7,852 | 11,051 | 7,348 |
| 17,730 | 6,348 | 16,621 | 6,050 | 15,511 | 5,738 | 13,907 | 5,456 | 11,477 | 5,349 |
| 17,900 | 3,000 | 16,780 | 3,000 | 15,660 | 3,000 | 14,040 | 3,000 | 11,620 | 3,300 |
| 17,730 | 43 | 16,621 | 294 | 15,511 | 497 | 13,907 | 841 | 11,524 | 1,517 |
| 17,222 | -2,840 | 16,145 | -2,346 | 15,067 | -1,944 | 13,508 | -1,264 | 11,238 | -223 |
| 16,379 | -5,580 | 15,355 | -4,854 | 14,330 | -4,264 | 12,847 | -3,265 | 10,760 | -1,875 |
| 15,207 | -8,109 | 14,256 | -7,169 | 13,304 | -6,405 | 11,928 | -5,111 | 10,089 | -3,401 |
| 13,711 | -10,364 | 12,853 | -9,233 | 11,995 | -8,314 | 10,754 | -6,758 | 9,223 | -4,761 |
| 11,894 | -12,290 | 11,150 | -10,996 | 10,406 | -9,944 | 9,329 | -8,164 | 8,154 | -5,923 |
| 9,751 | -13,840 | 9,141 | -12,414 | 8,531 | -11,256 | 7,648 | -9,296 | 6,864 | -6,857 |
| 7,253 | -14,975 | 6,799 | -13,453 | 6,346 | -12,217 | 5,689 | -10,125 | 5,311 | -7,542 |
| 4,296 | -15,667 | 4,028 | -14,087 | 3,759 | -12,803 | 3,370 | -10,630 | 3,374 | -7,960 |
| 0 | -15,900 | 0 | -14,300 | 0 | -13,000 | 0 | -10,800 | 0 | -8,100 |
| -4,296 | -15,667 | -4,028 | -14,087 | -3,759 | -12,803 | -3,370 | -10,630 | -3,374 | -7,960 |
| -7,253 | -14,975 | -6,799 | -13,453 | -6,346 | -12,217 | -5,689 | -10,125 | -5,311 | -7,542 |
| -9,751 | -13,840 | -9,141 | -12,414 | -8,531 | -11,256 | -7,648 | -9,296 | -6,864 | -6,857 |
| -11,894 | -12,290 | -11,150 | -10,996 | -10,406 | -9,944 | -9,329 | -8,164 | -8,154 | -5,923 |
| -13,711 | -10,364 | -12,853 | -9,233 | -11,995 | -8,314 | -10,754 | -6,758 | -9,223 | -4,761 |
| -15,207 | -8,109 | -14,256 | -7,169 | -13,304 | -6,405 | -11,928 | -5,111 | -10,089 | -3,401 |

Table 12–29

Surface danger zone contours data for Air-to-Ground–114–R Unmanned Aerial System (Lock-On After Launch only) cross-range and down-range point plots—Continued

| 25,000 ft CR (m) | 25,000 ft DR (m) | 20,000 ft CR (m) | 20,000 ft DR (m) | 15,000 ft CR (m) | 15,000 ft DR (m) | 10,000 ft CR (m) | 10,000 ft DR (m) | 5,000 ft CR (m) | 5,000 ft DR (m) |
|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|------------------------|-----------------------|-----------------------|
| -16,379 | -5,580 | -15,355 | -4,854 | -14,330 | -4,264 | -12,847 | -3,265 | -10,760 | -1,875 |
| -17,222 | -2,840 | -16,145 | -2,346 | -15,067 | -1,944 | -13,508 | -1,264 | -11,238 | -223 |
| -17,730 | 43 | -16,621 | 294 | -15,511 | 497 | -13,907 | 841 | -11,524 | 1,517 |
| -17,900 | 3,000 | -16,780 | 3,000 | -15,660 | 3,000 | -14,040 | 3,000 | -11,620 | 3,300 |
| -17,900 | 3,000 | -16,780 | 3,000 | -15,660 | 3,000 | -14,040 | 3,000 | -11,620 | 3,300 |

(2) *AH–64 Apache (Enhanced Rotary-wing Mode-R09)*. AH–64 Apache missile firings that utilize enhanced RW mode’s R09 targeting message will use the SDZ restrictions shown in figures 12–15 and 12–16. The launch thresholds for the LOBL and LOAL SDZs will be constrained to a maximum launch altitude of 10,000 ft MSL and a maximum platform airspeed of 120 KTAS. Missile launches less than 1,000 ft height above target will utilize the 1,000 ft SDZ contours for LOBL and LOAL engagements (see tables 12–30 and 12–31 for SDZ contours data for Army AH–64 Apache Enhanced Mode-R09 AGM–114 R/R2 (LOBL R09 only) CR and down-range point plots and Army RW AGM–114 R/R2 LOAL CR and down-range point plots).

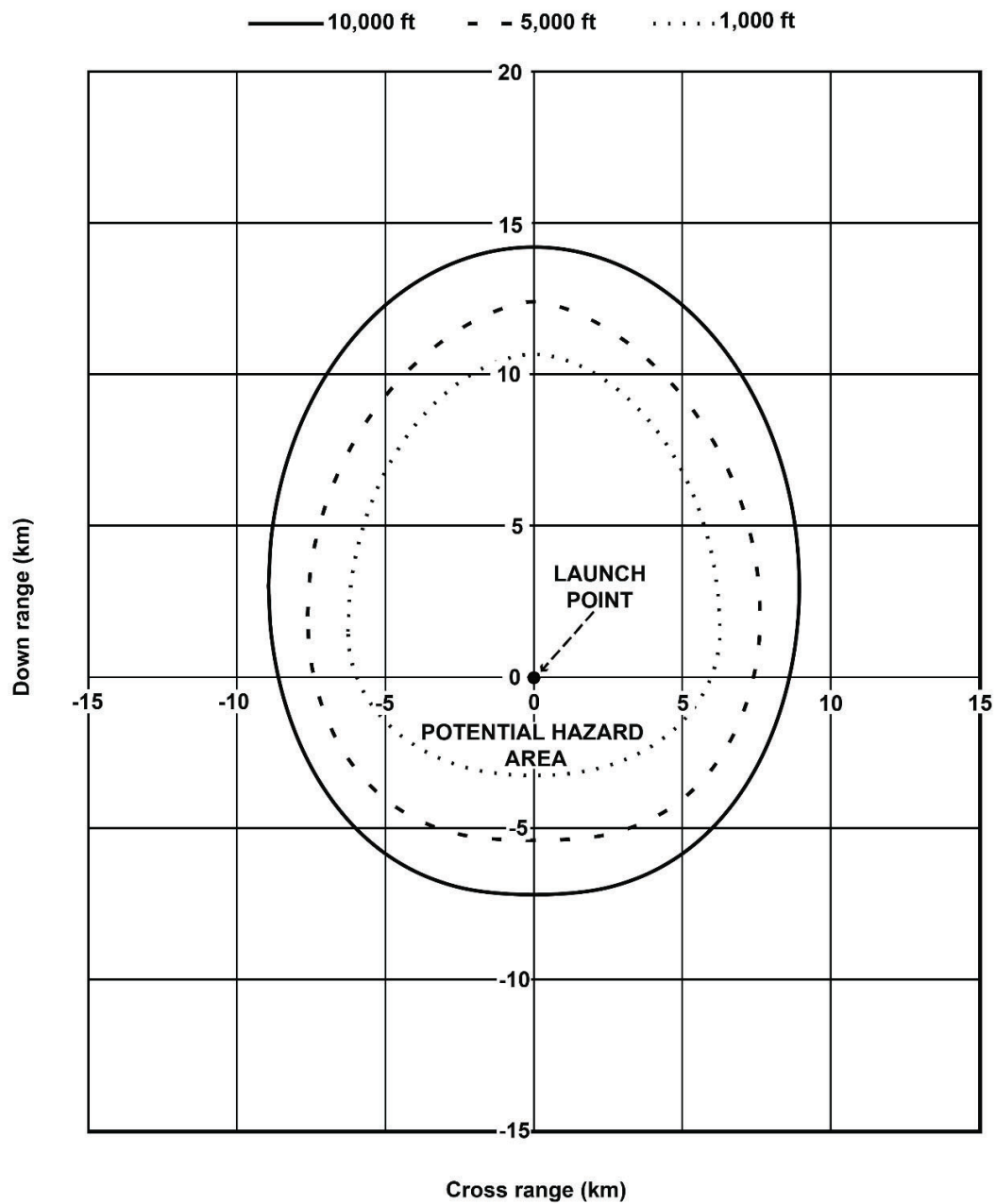


Figure 12–15. Surface danger zone for Army AH–64 Apache enhanced mode R09 Air-to-Ground–114 R/R2 Lock-On Before Launch R09 only

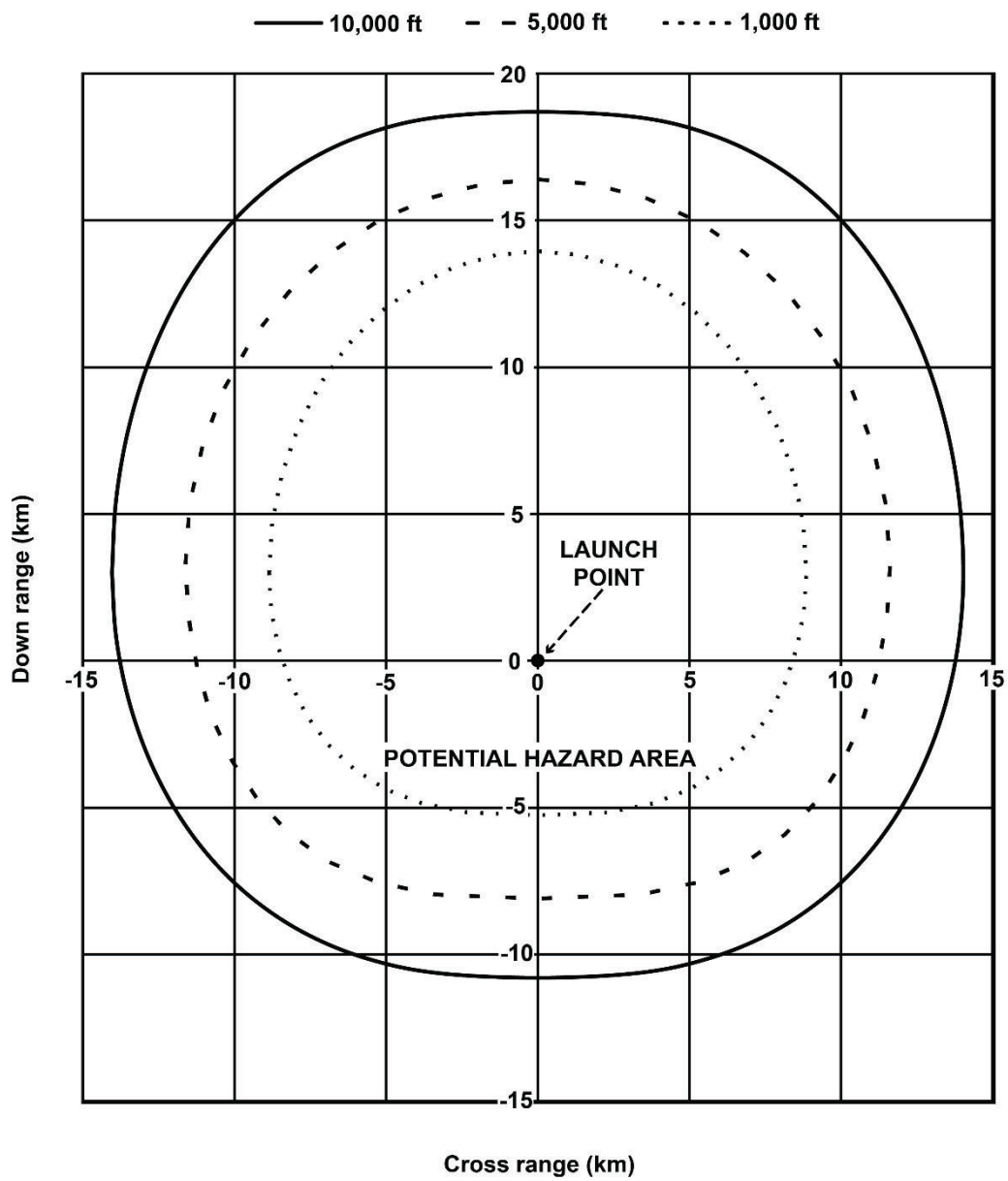


Figure 12-16. Surface danger zone for Army rotary-wing Air-to-Ground-114 R/R2 Lock-On After Launch

Table 12–30

Surface danger zone contours data for Army AH–64 Apache Enhanced Mode-R09 Air-to-Ground–114 R/R2 (Lock-On Before Launch R09 only) cross-range and down-range point plots

| 10,000 ft CR (m) | 10,000 ft DR (m) | 5,000 ft CR (m) | 5,000 ft DR (m) | 1,000 ft CR (m) | 1,000 ft DR (m) |
|---------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| -8,940 | 3,000 | -7,620 | 2,000 | -6,264 | 1,500 |
| -8,830 | 4,752 | -7,503 | 3,627 | -6,178 | 2,933 |
| -8,502 | 6,461 | -7,157 | 5,214 | -5,924 | 4,331 |
| -7,966 | 8,085 | -6,596 | 6,722 | -5,510 | 5,659 |
| -7,233 | 9,583 | -5,847 | 8,113 | -4,950 | 6,884 |
| -6,322 | 10,920 | -4,941 | 9,354 | -4,262 | 7,977 |
| -5,255 | 12,061 | -3,922 | 10,414 | -3,471 | 8,911 |
| -4,059 | 12,979 | -2,840 | 11,266 | -2,605 | 9,662 |
| -2,763 | 13,652 | -1,756 | 11,891 | -1,699 | 10,212 |
| -1,399 | 14,062 | -750 | 12,272 | -797 | 10,547 |
| 0 | 14,200 | 0 | 12,400 | 0 | 10,660 |
| 1,399 | 14,062 | 750 | 12,272 | 797 | 10,547 |
| 2,763 | 13,652 | 1,756 | 11,891 | 1,699 | 10,212 |
| 4,059 | 12,979 | 2,840 | 11,266 | 2,605 | 9,662 |
| 5,255 | 12,061 | 3,922 | 10,414 | 3,471 | 8,911 |
| 6,322 | 10,920 | 4,941 | 9,354 | 4,262 | 7,977 |
| 7,233 | 9,583 | 5,847 | 8,113 | 4,950 | 6,884 |
| 7,966 | 8,085 | 6,596 | 6,722 | 5,510 | 5,659 |
| 8,502 | 6,461 | 7,157 | 5,214 | 5,924 | 4,331 |
| 8,830 | 4,752 | 7,503 | 3,627 | 6,178 | 2,933 |
| 8,940 | 3,000 | 7,620 | 2,000 | 6,264 | 1,500 |
| 8,848 | 1,404 | 7,548 | 842 | 6,194 | 755 |
| 8,574 | -152 | 7,331 | -287 | 5,985 | 29 |
| 8,120 | -1,631 | 6,973 | -1,360 | 5,640 | -661 |
| 7,493 | -2,995 | 6,474 | -2,350 | 5,166 | -1,298 |
| 6,697 | -4,212 | 5,837 | -3,233 | 4,571 | -1,866 |
| 5,741 | -5,252 | 5,063 | -3,987 | 3,864 | -2,351 |
| 4,630 | -6,088 | 4,151 | -4,593 | 3,055 | -2,741 |
| 3,360 | -6,701 | 3,088 | -5,038 | 2,154 | -3,027 |
| 1,905 | -7,074 | 1,829 | -5,309 | 1,160 | -3,201 |
| 0 | -7,200 | 0 | -5,400 | 0 | -3,260 |
| -1,905 | -7,074 | -1,829 | -5,309 | -1,160 | -3,201 |
| -3,360 | -6,701 | -3,088 | -5,038 | -2,154 | -3,027 |
| -4,630 | -6,088 | -4,151 | -4,593 | -3,055 | -2,741 |
| -5,741 | -5,252 | -5,063 | -3,987 | -3,864 | -2,351 |
| -6,697 | -4,212 | -5,837 | -3,233 | -4,571 | -1,866 |

Table 12–30

Surface danger zone contours data for Army AH–64 Apache Enhanced Mode-R09 Air-to-Ground–114 R/R2 (Lock-On Before Launch R09 only) cross-range and down-range point plots—Continued

| 10,000 ft CR (m) | 10,000 ft DR (m) | 5,000 ft CR (m) | 5,000 ft DR (m) | 1,000 ft CR (m) | 1,000 ft DR (m) |
|------------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| -7,493 | -2,995 | -6,474 | -2,350 | -5,166 | -1,298 |
| -8,120 | -1,631 | -6,973 | -1,360 | -5,640 | -661 |
| -8,574 | -152 | -7,331 | -287 | -5,985 | 29 |
| -8,848 | 1,404 | -7,548 | 842 | -6,194 | 755 |
| -8,940 | 3,000 | -7,620 | 2,000 | -6,264 | 1,500 |

Table 12–31

Surface danger zone contours data for Army rotary-wing Air-to-Ground–114 R/R2 Lock-On After Launch cross-range and down-range point plots

| 10,000 ft CR (m) | 10,000 ft DR (m) | 5,000 ft CR (m) | 5,000 ft DR (m) | 1,000 ft CR (m) | 1,000 ft DR (m) |
|------------------------|------------------------|-----------------------|-----------------------|-----------------------|-----------------------|
| -14,040 | 3,000 | -11,620 | 3,300 | -8,864 | 3,000 |
| -13,907 | 5,456 | -11,477 | 5,349 | -8,755 | 4,715 |
| -13,508 | 7,852 | -11,051 | 7,348 | -8,430 | 6,387 |
| -12,847 | 10,128 | -10,353 | 9,247 | -7,898 | 7,976 |
| -11,928 | 12,228 | -9,401 | 11,000 | -7,171 | 9,442 |
| -10,754 | 14,102 | -8,217 | 12,563 | -6,268 | 10,750 |
| -9,329 | 15,702 | -6,830 | 13,898 | -5,210 | 11,867 |
| -7,648 | 16,989 | -5,275 | 14,972 | -4,024 | 12,765 |
| -5,689 | 17,932 | -3,591 | 15,759 | -2,739 | 13,424 |
| -3,370 | 18,507 | -1,818 | 16,239 | -1,387 | 13,825 |
| 0 | 18,700 | 0 | 16,400 | 0 | 13,960 |
| 3,370 | 18,507 | 1,818 | 16,239 | 1,387 | 13,825 |
| 5,689 | 17,932 | 3,591 | 15,759 | 2,739 | 13,424 |
| 7,648 | 16,989 | 5,275 | 14,972 | 4,024 | 12,765 |
| 9,329 | 15,702 | 6,830 | 13,898 | 5,210 | 11,867 |
| 10,754 | 14,102 | 8,217 | 12,563 | 6,268 | 10,750 |
| 11,928 | 12,228 | 9,401 | 11,000 | 7,171 | 9,442 |
| 12,847 | 10,128 | 10,353 | 9,247 | 7,898 | 7,976 |
| 13,508 | 7,852 | 11,051 | 7,348 | 8,430 | 6,387 |
| 13,907 | 5,456 | 11,477 | 5,349 | 8,755 | 4,715 |
| 14,040 | 3,000 | 11,620 | 3,300 | 8,864 | 3,000 |
| 13,907 | 841 | 11,524 | 1,517 | 8,786 | 1,708 |
| 13,508 | -1,264 | 11,238 | -223 | 8,552 | 448 |
| 12,847 | -3,265 | 10,760 | -1,875 | 8,163 | -750 |
| 11,928 | -5,111 | 10,089 | -3,401 | 7,619 | -1,855 |
| 10,754 | -6,758 | 9,223 | -4,761 | 6,920 | -2,841 |

Table 12–31
Surface danger zone contours data for Army rotary-wing Air-to-Ground–114 R/R2 Lock-On After Launch cross-range and down-range point plots—Continued

| 10,000 ft CR (m) | 10,000 ft DR (m) | 5,000 ft CR (m) | 5,000 ft DR (m) | 1,000 ft CR (m) | 1,000 ft DR (m) |
|---------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| 9,329 | -8,164 | 8,154 | -5,923 | 6,064 | -3,682 |
| 7,648 | -9,296 | 6,864 | -6,857 | 5,043 | -4,360 |
| 5,689 | -10,125 | 5,311 | -7,542 | 3,831 | -4,856 |
| 3,370 | -10,630 | 3,374 | -7,960 | 2,356 | -5,158 |
| 0 | -10,800 | 0 | -8,100 | 0 | -5,260 |
| -3,370 | -10,630 | -3,374 | -7,960 | -2,356 | -5,158 |
| -5,689 | -10,125 | -5,311 | -7,542 | -3,831 | -4,856 |
| -7,648 | -9,296 | -6,864 | -6,857 | -5,043 | -4,360 |
| -9,329 | -8,164 | -8,154 | -5,923 | -6,064 | -3,682 |
| -10,754 | -6,758 | -9,223 | -4,761 | -6,920 | -2,841 |
| -11,928 | -5,111 | -10,089 | -3,401 | -7,619 | -1,855 |
| -12,847 | -3,265 | -10,760 | -1,875 | -8,163 | -750 |
| -13,508 | -1,264 | -11,238 | -223 | -8,552 | 448 |
| -13,907 | 841 | -11,524 | 1,517 | -8,786 | 1,708 |
| -14,040 | 3,000 | -11,620 | 3,300 | -8,864 | 3,000 |

(3) *AH–64 Apache (Modified Legacy Mode-Target Reference)*. RW AH–64 Apache missile firings that do not utilize enhanced RW mode’s R09 targeting message will adhere to the SDZ boundaries shown in figures 12–14 and 12–15. The launch thresholds for the LOBL and LOAL SDZs will be constrained to a maximum launch altitude of 10,000 ft height above target and maximum platform airspeed of 120 KTAS. Missile launches less than 1,000 ft height above target will utilize the 1,000 ft SDZ contours for LOBL and LOAL engagements (see tables 12–32 and 12–33 for SDZ contours data for Army AH–64 Apache (Target Reference) AGM–114 R/R2 LOBL CR and down-range point plots and Army Little Bird/Black Hawk AGM–114 R/R2 LOBL R-Missile MH–6/UH–60 CR and down-range point plots) (see figs 12–17 and 12–18 for SDZ for Army AH–64 Apache Target Reference AGM–114 R/R2 LOBL and Army Little Bird/Black hawk AGM–114 R/R2 LOBL).

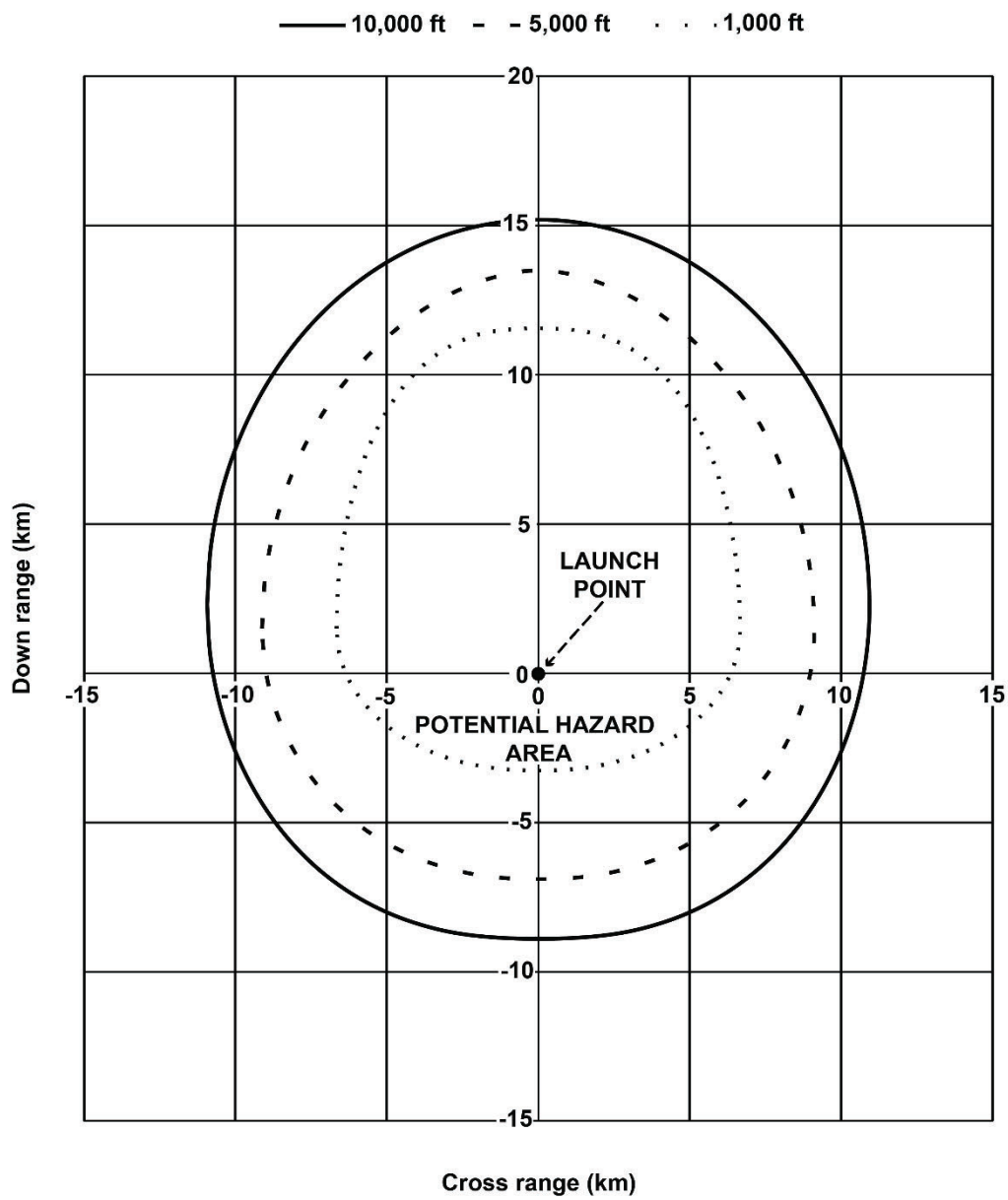


Figure 12–17. Surface danger zone for Army AH–64 Apache Target Reference Air-to-Ground–114 R/R2 Lock-On Before Launch

Table 12–32

Surface danger zone contours data for Army AH–64 Apache (Target Reference) Air-to-Ground–114 R/R2 Lock-On Before Launch cross-range and down-range point plots

| 10,000 ft CR (m) | 10,000 ft DR (m) | 5,000 ft CR (m) | 5,000 ft DR (m) | 1,000 ft CR (m) | 1,000 ft DR (m) |
|---------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| -10,940 | 2,300 | -9,120 | 1,500 | -6,664 | 1,500 |
| -10,805 | 4,318 | -8,995 | 3,377 | -6,601 | 3,074 |
| -10,405 | 6,286 | -8,625 | 5,208 | -6,412 | 4,609 |
| -9,748 | 8,156 | -8,022 | 6,948 | -6,098 | 6,067 |
| -8,851 | 9,882 | -7,207 | 8,553 | -5,662 | 7,413 |
| -7,736 | 11,422 | -6,205 | 9,985 | -5,105 | 8,613 |
| -6,430 | 12,736 | -5,053 | 11,208 | -4,428 | 9,639 |
| -4,967 | 13,794 | -3,793 | 12,192 | -3,630 | 10,464 |
| -3,381 | 14,569 | -2,473 | 12,913 | -2,700 | 11,068 |
| -1,711 | 15,041 | -1,161 | 13,352 | -1,600 | 11,436 |
| 0 | 15,200 | 0 | 13,500 | 0 | 11,560 |
| 1,711 | 15,041 | 1,161 | 13,352 | 1,600 | 11,436 |
| 3,381 | 14,569 | 2,473 | 12,913 | 2,700 | 11,068 |
| 4,967 | 13,794 | 3,793 | 12,192 | 3,630 | 10,464 |
| 6,430 | 12,736 | 5,053 | 11,208 | 4,428 | 9,639 |
| 7,736 | 11,422 | 6,205 | 9,985 | 5,105 | 8,613 |
| 8,851 | 9,882 | 7,207 | 8,553 | 5,662 | 7,413 |
| 9,748 | 8,156 | 8,022 | 6,948 | 6,098 | 6,067 |
| 10,405 | 6,286 | 8,625 | 5,208 | 6,412 | 4,609 |
| 10,805 | 4,318 | 8,995 | 3,377 | 6,601 | 3,074 |
| 10,940 | 2,300 | 9,120 | 1,500 | 6,664 | 1,500 |
| 10,828 | 548 | 9,018 | 186 | 6,589 | 755 |
| 10,492 | -1,161 | 8,713 | -1,096 | 6,367 | 29 |
| 9,937 | -2,785 | 8,212 | -2,314 | 6,000 | -661 |
| 9,169 | -4,283 | 7,522 | -3,437 | 5,496 | -1,298 |
| 8,196 | -5,620 | 6,655 | -4,440 | 4,863 | -1,866 |
| 7,026 | -6,761 | 5,626 | -5,296 | 4,111 | -2,351 |
| 5,665 | -7,679 | 4,449 | -5,984 | 3,251 | -2,741 |
| 4,112 | -8,352 | 3,136 | -6,489 | 2,291 | -3,027 |
| 2,331 | -8,762 | 1,689 | -6,797 | 1,234 | -3,201 |
| 0 | -8,900 | 0 | -6,900 | 0 | -3,260 |
| -2,331 | -8,762 | -1,689 | -6,797 | -1,234 | -3,201 |
| -4,112 | -8,352 | -3,136 | -6,489 | -2,291 | -3,027 |
| -5,665 | -7,679 | -4,449 | -5,984 | -3,251 | -2,741 |
| -7,026 | -6,761 | -5,626 | -5,296 | -4,111 | -2,351 |

Table 12–32**Surface danger zone contours data for Army AH–64 Apache (Target Reference) Air-to-Ground–114 R/R2 Lock-On Before Launch cross-range and down-range point plots—Continued**

| 10,000 ft CR (m) | 10,000 ft DR (m) | 5,000 ft CR (m) | 5,000 ft DR (m) | 1,000 ft CR (m) | 1,000 ft DR (m) |
|---------------------------------|---------------------------------|--------------------------------|--------------------------------|--------------------------------|--------------------------------|
| -8,196 | -5,620 | -6,655 | -4,440 | -4,863 | -1,866 |
| -9,169 | -4,283 | -7,522 | -3,437 | -5,496 | -1,298 |
| -9,937 | -2,785 | -8,212 | -2,314 | -6,000 | -661 |
| -10,492 | -1,161 | -8,713 | -1,096 | -6,367 | 29 |
| -10,828 | 548 | -9,018 | 186 | -6,589 | 755 |
| -10,940 | 2,300 | -9,120 | 1,500 | -6,664 | 1,500 |

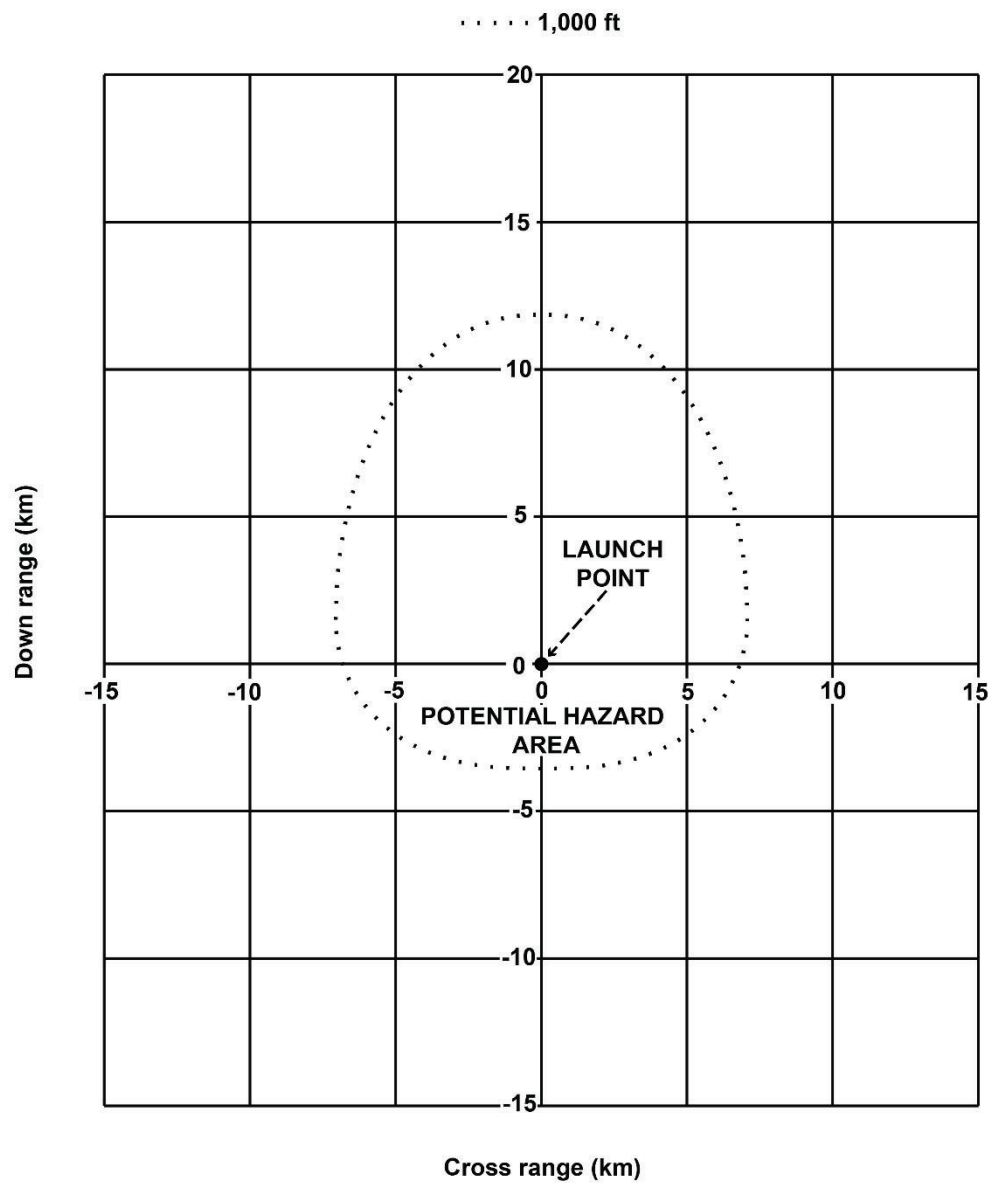


Figure 12–18. Surface danger zone for Army Little Bird/Blackhawk Air-to-Ground–114 R/R2 Lock-On Before Launch

Table 12–33
Surface danger zone data for Army Little Bird/Black Hawk Air-to-Ground–114 R/R2 Lock-On Before Launch R-Missile
MH–6/UH–60 cross-range and down-range point plots

| 1,000 ft CR (m) | 1,000 ft DR (m) |
|--------------------------------|--------------------------------|
| -7,064 | 1,500 |
| -6,985 | 3,121 |
| -6,749 | 4,701 |
| -6,360 | 6,203 |
| -5,826 | 7,589 |
| -5,155 | 8,826 |
| -4,358 | 9,881 |
| -3,446 | 10,731 |
| -2,429 | 11,353 |
| -1,308 | 11,732 |
| 0 | 11,860 |
| 1,308 | 11,732 |
| 2,429 | 11,353 |
| 3,446 | 10,731 |
| 4,358 | 9,881 |
| 5,155 | 8,826 |
| 5,826 | 7,589 |
| 6,360 | 6,203 |
| 6,749 | 4,701 |
| 6,985 | 3,121 |
| 7,064 | 1,500 |
| 6,997 | 708 |
| 6,797 | -64 |
| 6,464 | -797 |
| 6,001 | -1,474 |
| 5,411 | -2,078 |
| 4,694 | -2,594 |
| 3,848 | -3,008 |
| 2,862 | -3,312 |
| 1,696 | -3,498 |
| 0 | -3,560 |
| -1,696 | -3,498 |
| -2,862 | -3,312 |
| -3,848 | -3,008 |
| -4,694 | -2,594 |

Table 12–33

Surface danger zone data for Army Little Bird/Black Hawk Air-to-Ground–114 R/R2 Lock-On Before Launch R-Missile MH–6/UH–60 cross-range and down-range point plots—Continued

| 1,000 ft CR (m) | 1,000 ft DR (m) |
|--------------------------------|--------------------------------|
| -5,411 | -2,078 |
| -6,001 | -1,474 |
| -6,464 | -797 |
| -6,797 | -64 |
| -6,997 | 708 |
| -7,064 | 1,500 |

c. Cooperative remote-designation engagements with Air-to-Ground Missile–114 R/R2. Improvements designed into AGM–114 R/R2 have expanded HELLFIRE’s operational envelope on RW and UAS aircraft. For RW platforms using modified legacy missile mode (that is, without enhanced mode’s R09 targeting message), the minimum ground designator operator keep-away distance about the 30-degree designator exclusion cone is 400 m.

Chapter 13

Air Defense Artillery Weapon Systems

13–1. General

- a.* An SOP will be established to prevent mishaps during the firing of guided missiles and rockets. The SOP will—
 - (1) Expand the specific duties and responsibilities of the range OIC, RSO, and trajectory officer (if appropriate).
 - (2) Relate to the special characteristics of the specific missile or rocket to be fired and the physical characteristics of the firing area.
 - (3) Specify procedures for conducting operations involving the use of high-pressure air (or compressed gases). Operations will be supervised by well-trained personnel who are knowledgeable of the Air Defense Artillery Weapon Systems.
- b.* Changes in the type of missile or rocket to be fired or changes in local conditions make it mandatory that the SOP be revised or a new SOP prepared prior to firing.

13–2. Firing conditions-general requirements

The following safety precautions will be observed for firing guided missiles and heavy rockets:

- a.* When units are firing at independent locations in the same general area, a commissioned OIC will be responsible for each independent firing location (Marine Corps).
 - (1) Safety at each firing location is the responsibility of the SRSO. A RSO and trajectory safety officer will be designated to assist the SRSO. Additional personnel may be detailed to assist the SRSO, as required.
 - (2) Situations may arise that are not addressed in this regulation/order, but in the opinion of the SRSO, may result in an unsafe condition. Conversely, situations may arise in which firing a missile or rocket, rather than destroying a missile or rocket in flight, is considered the safest course of action. The decision must be made locally based upon prevailing conditions.
 - (3) Guided missiles and rockets will not be launched on a trajectory that allows the missile or rocket to pass over personnel or materiel, except as specifically authorized by the installation RMA (Army) or RCO (Marine Corps), this regulation/order, and the appropriate TM.
 - (4) Guided missiles and rockets will be fired within a time limitation (window) established by the installation range operations organization (Army) or range control organization (Marine Corps). If firings cannot be accomplished within the prescribed window, a new firing schedule will be obtained.
 - (5) Intermediate and high altitude guided missiles (such as the MIM–23B Improved Hawk (Army) or MIM–104 PATRIOT) fired for training will be equipped with self-destruct systems capable of destroying the missile during flight or terminating the trajectory in a safe area.
 - (6) Missiles equipped with inert or practice warheads will be provided with a system capable of terminating the powered trajectory or destroying the aerodynamic characteristics of the missile to ensure its destruction.

(7) When a flight termination system is used to control a system's SDZ, the trajectory safety officer will have the capability to command destruct missiles independently of all actions of firing and trajectory control crews.

(8) The number of personnel engaged in handling, assembling, or firing guided missiles and heavy rockets will be kept to the minimum required to maintain efficient operations and mission accomplishment.

(9) Shorting plugs and other safety devices will be removed only to conduct tests or in final preparation for firing.

(10) Smoking is prohibited at firing pads, ready storage sites, and assembly sites. No-smoking signs will be prominently displayed. Smoking is also prohibited on any vehicle used to transport propellants or explosives. The possession of matches or any other flame-producing devices while working with or transporting propellants or explosives is prohibited.

(11) Suitable firefighting equipment as determined by the installation fire marshal will be readily available during all firings.

(12) Personnel engaged in handling hazardous materials or exposed to hazardous operations or conditions will use protective clothing and equipment as prescribed by appropriate TMs and FMs. Appropriate hearing protection will be worn by all personnel within the hearing hazard zones defined in the manuals for each system.

(13) Except for the use of approved testing equipment in accordance with established procedures, guided missiles and heavy rockets will be isolated from sources of electrical energy (such as sparks, static discharges, or stray current) that may cause ignition of the propellant or electro-explosive devices.

(14) Decontamination equipment appropriate for the type of propellants, oxidizers, active chemicals, batteries, or hazardous fuels at the site will be readily available during firing operations.

b. Firing and support personnel will not occupy positions within any portion of the SDZ except as specifically authorized by this regulation/order.

c. When occupation of the SDZ is authorized, protective shelters will be used that have been inspected by the installation safety director and facility engineer.

d. Fire control personnel will employ positive protection, such as keyed firing panels, to prevent premature firing of a guided missile or heavy rocket.

13-3. FIM-92 Stinger guided missile

a. Firing conditions.

(1) The entire Stinger guided missile SDZ will be cleared of all personnel except those actively engaged in the missile firing. This number will be held to the minimum compatible with efficient operations.

(2) Stinger weapon systems will not be fired over the heads of unprotected personnel because of the hazards from launch motor impact and the sustainer motor plume.

(3) All training firings will be limited to a maximum elevation angle of 50 degrees (40 degrees target elevation angle plus 10 degrees super elevation) to minimize the possibility of a malfunctioning missile traveling to the rear of the launch position.

(4) Procedures and precautions in appropriate TMs and FMs will be followed during Stinger firings. No firings will be made on directly incoming targets that normally pass over the launch area allowing targets or target debris to impact in the area upon intercept. Instructors and any other personnel exposed to the rocket motor blast will wear PPE as required for the gunner in the appropriate TMs.

b. Surface danger zone.

(1) Stinger guided missile SDZ requirements in figures 13-1 and 13-2 apply to both air-to-air and ground-to-air launched missiles. This SDZ, based upon maximum ballistic range of the missile, consists of an impact area and Areas A, B, and F. Self-destruct features designed to terminate missile flight within the SDZ were not considered in establishing range safety requirements. See paragraphs 13-3b(1)(a) through 13-3b(1)(c) for maximum ballistic range (Distance X) for Stinger in each launch mode.

(a) Ground-to-air guided missiles.

1. Basic Stinger: 11,900 m.

2. Stinger Trainer Launch Simulator (STLS): 250 m.

3. Reprogrammable microprocessor Stinger: 13,000 m.

4. Reprogrammable microprocessor block 1 Stinger: 15,000 m.

(b) Maximum height above launch for firings launched at QE angle of 50 deg is 20,500 ft.

(c) Air-to-air guided missiles. Same as ground-to-air except Distance X increases 0.60 m for every 0.30 m of altitude AGL at time of launch.

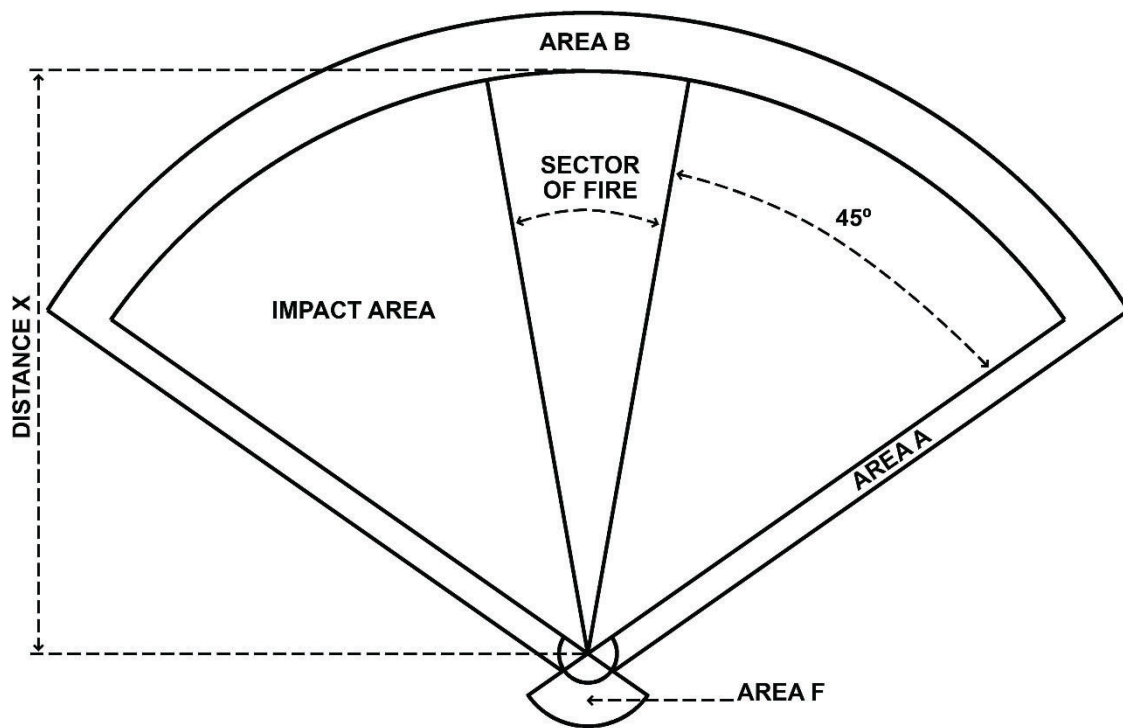


Figure 13-1. Surface danger zone for Stinger guided missiles at moving targets

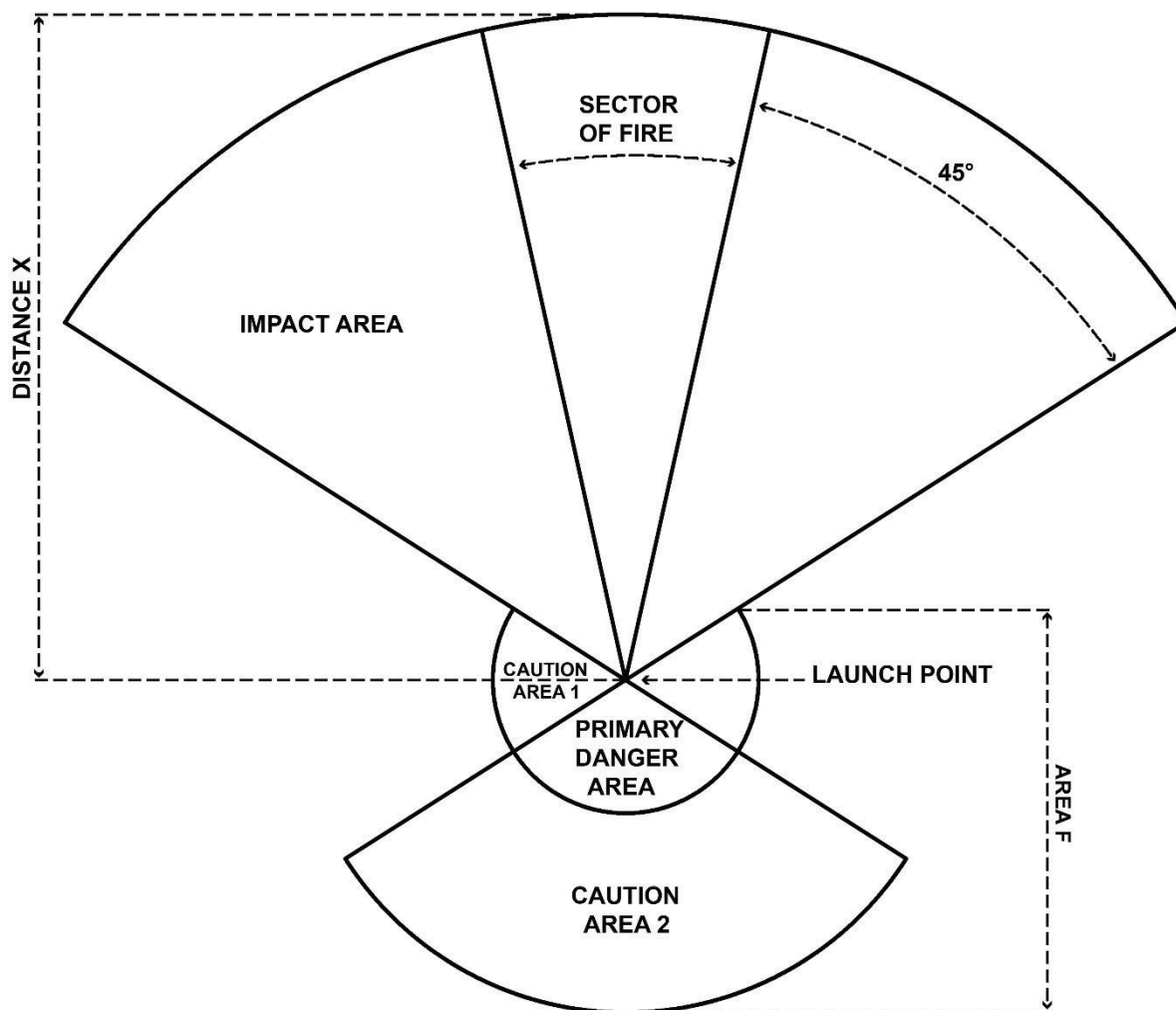


Figure 13–2. Surface danger zone for Stinger Tracking Launch Simulator at moving targets

(2) Impact areas will normally contain fragments and debris from missiles launched within its sector of fire. The sector of fire is that portion of the impact area in which targets may be engaged. The boundaries of the sector will be designated by positioning azimuth limit markers forward of the launcher position. All firings must be accomplished within these limit markers. The impact area for moving targets consists of an area 45 degrees to each side of the sector of fire and extending down range to the maximum ballistic range of the missile. For stationary (hovering) and directly outbound moving targets, the impact area may be reduced to 40 degrees on each side of the sector of fire.

(3) Area A is the lateral secondary danger zone that is adequate to contain the effects of warheads functioning at the edge of the impact area. It consists of areas 50 m wide on each side of the impact area and extending down range to the maximum ballistic range capability of the missile. Area A is not required for the STLS.

(4) Area B is the far secondary danger zone that is adequate to contain the effects of a warhead functioning at the down-range edge of the impact area. It consists of an area 100 m in depth beyond the impact area and Area A. Area B is not required for the STLS.

(5) Area F shown in figure 13–3 is the launcher danger zone extending to the rear of the firing position. It is further divided into a primary danger area and two caution areas.

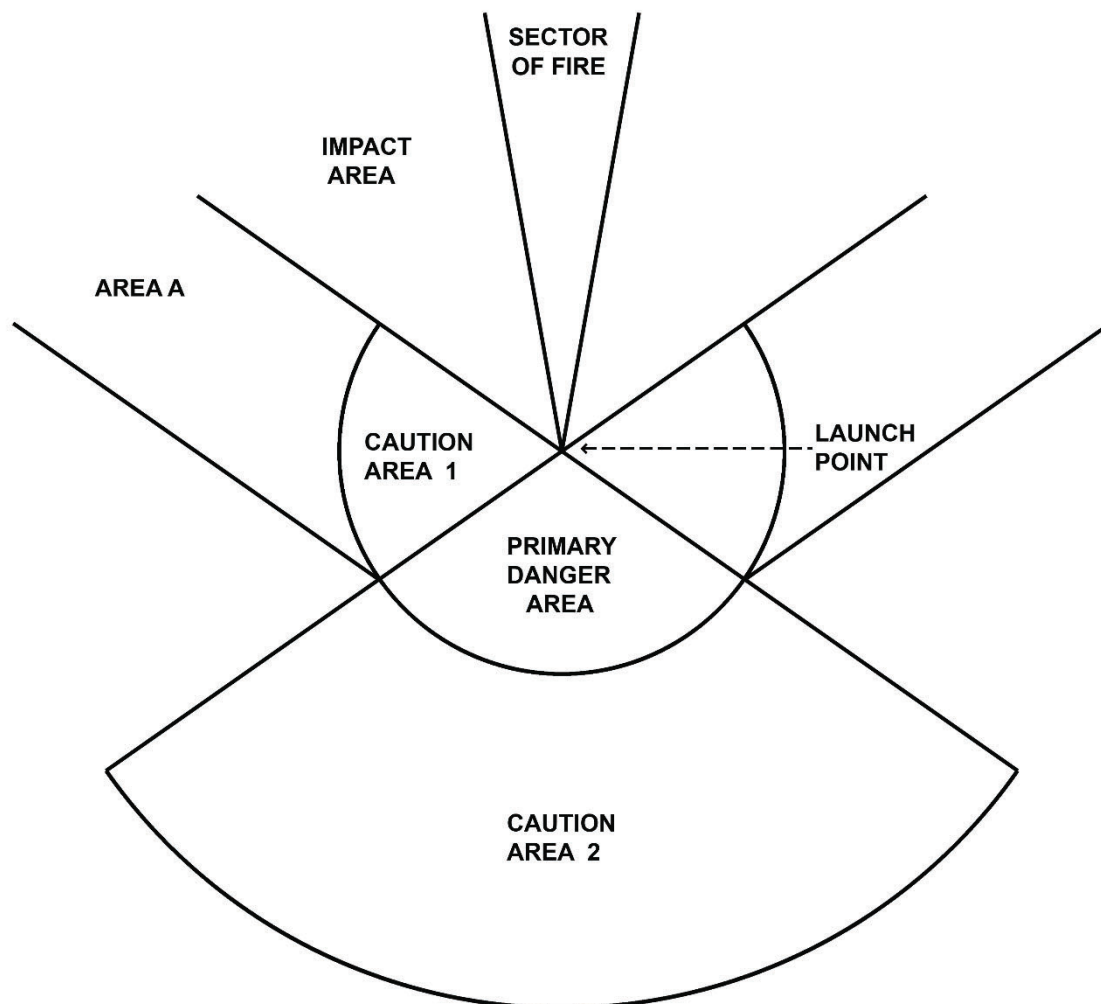


Figure 13–3. Surface danger zone, Area F, for Stinger guided missiles and Stinger Tracking Launch Simulator at moving targets

(a) The primary LDA has a radius of 50 m boundaries that lie along rearward extensions of the impact area boundaries. Personnel are not permitted in this area during firings.

(b) Caution Area 1 also has a radius of 50 m. Its boundaries are the primary LDA and the impact area. Any personnel in this area must be protected from hazardous noise levels and flying ground debris.

(c) Caution Area 2 extends to the rear of the launcher with a radius of 125 m. Its boundaries are straight lines drawn between the rearward extension of the impact area boundaries and the intersection of the 125 m radius. Occupation of Caution Area 2 is permitted when all personnel are wearing approved single-hearing protection.

(6) The Stinger SDZ does not ensure protection from aerial targets that may be used for training firings. Target SDZs must be incorporated into overall Stinger firing operations by the RSO.

c. *Stinger surface danger zone criteria.* These apply to the AN/TWQ–1 Avenger, M6 Linebacker, man-portable air defense systems, and Light Armored Vehicle launch platforms, both stationary and on the move. When firing on the move, extend the Stinger/Avenger SDZ along the route of maneuver. The target flight path establishes left and right limits of fire.

13–4. MIM–72 Chaparral guided missile

a. Firing conditions.

(1) The entire SDZ will be cleared of all personnel prior to firing a missile except as authorized in paragraphs 13–4a(2) and 13–4a(3).

(2) Procedures and precautions outlined in appropriate Chaparral TMs and FMs will be followed during firings. Only the minimum personnel required to fire and maintain safety surveillance of the firing will be permitted in the SDZ at the time of missile firing. All personnel, except the fire unit gunner, will occupy appropriate protective shelters that have been located and constructed in accordance with USACE drawings and will protect against any fragments or debris that may be expected from the missile as a result of warhead functioning. The protective shelters must be examined by the installation safety director and facility engineer to determine if the shelters will provide adequate personnel protection.

(3) Danger areas for debris from target drones with normal controlled flights should be contained within the impact area for the Chaparral missile. Impact areas for target drones that have abnormal flights or that go out of control are not covered herein.

b. Surface danger zone.

(1) Chaparral SDZ requirements in figure 13–4 consist of an impact area and Areas A, B, and F. This SDZ is based on the maximum ballistic range of the missile since there is no provision for command destruct by the trajectory safety officer.

(2) Impact areas, which include the sector of fire and 20 degrees on each side, are used for firings at directly outgoing targets. When firings are made at off-tail or crossing targets, the minimum impact area is increased by 20 degrees beyond the heading of the target. The boundaries of the sector of fire must be designated by positioning azimuth limit markers forward of the launcher position. All firings must be accomplished within these limit markers.

(3) Area A is the lateral secondary danger zone. This area is normally adequate to contain the effects of warheads functioning at the edge of the impact area. The 600-m width for this area and for Area B is the distance required for the MK48 series warheads.

(4) Area B is the down-range secondary danger zone. It is normally adequate to contain the effects of a warhead functioning at the forward edge of the impact area.

(5) Area F is the back-blast area that lies totally within Area A. Area F is defined as an area bounded by lines 30 degrees on each side of the missile axis and extending 100 m to the rear which should adequately contain primary and secondary motor exhaust and debris.

Note. LLL and RLL equals left and right lateral limit, respectively.

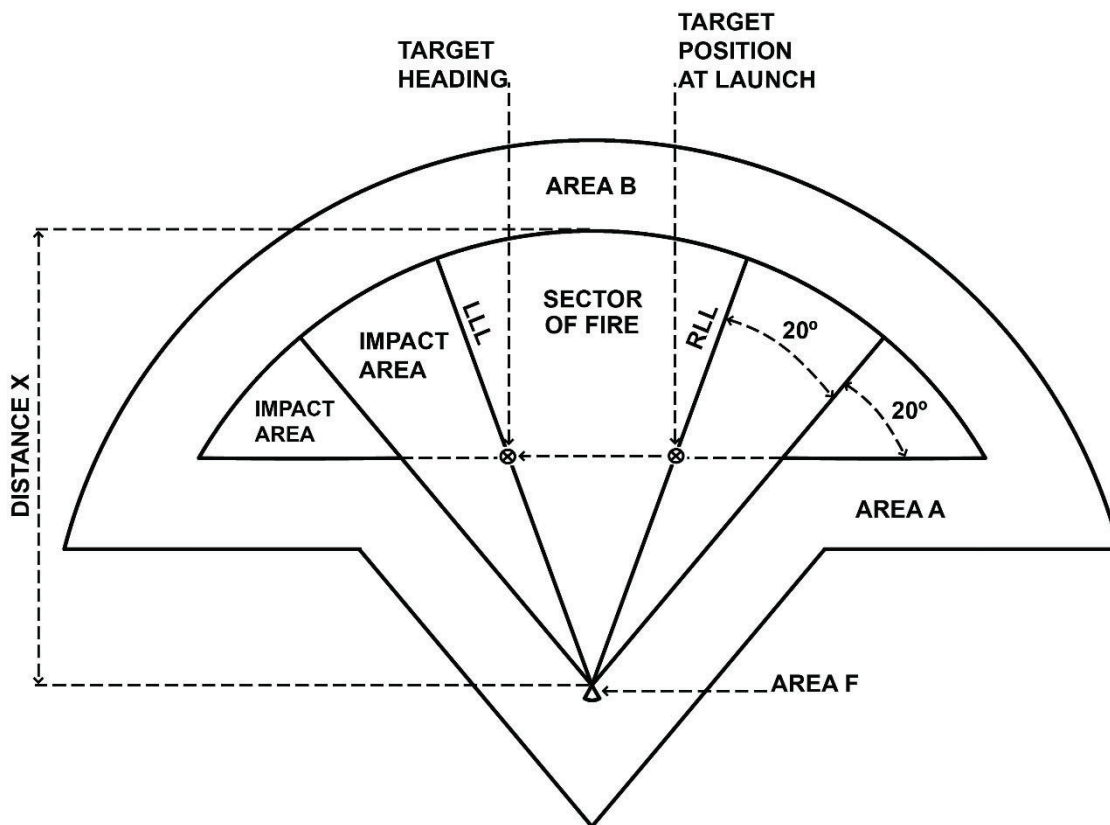


Figure 13-4. Surface danger zone for Chaparral guide missiles at a point in space

13-5. MIM-104 PATRIOT guided missile

The PATRIOT service practice and other firings with the PATRIOT guided missile weapon system conducted at or under the control of White Sands Missile Range, New Mexico, or McGregor Range, Fort Bliss, Texas, will be in accordance with the safety requirements of this regulation/order and the training or test range SOPs.

a. Firing conditions.

(1) The PATRIOT guided missile SDZ will be cleared of all personnel prior to firing a missile except as authorized in paragraph 13-5a(3).

(2) A missile flight corridor drawn on a map or a scale drawing of the firing range is provided for use by the trajectory safety officer. The trajectory safety officer is provided with a means of accurately tracking and plotting the course of the missile and a means of causing the destruction of the missile if the missile intersects the flight corridor boundary. The flight corridor has lateral boundaries that are parallel to and 2 km closer to the centerline than the lateral boundaries of the impact area. The lateral boundaries of the flight corridor extend to meet the boundary of the impact area beyond the intercept point. Flight corridor boundaries from the launch point intersect the lateral boundaries of the flight corridor at Distance L from the launch point.

(3) Only those personnel actively engaged in fire and control of the missile as specified by the appropriate TMs and FMs will be permitted in the SDZ at the time the missile is fired. The number of personnel authorized access should be the absolute minimum that is compatible with efficient operation. Personnel should, when possible, occupy shelters that are located a minimum of 90 m from the launcher and approved by the garrison safety manager.

(4) Danger areas for debris from target drones that have normal flight paths should be contained within the impact area for PATRIOT guided missiles. Impact areas for target drones that have abnormal flight paths or that go out of control are not covered herein.

b. Surface danger zone.

(1) The SDZ includes an impact area, Areas A and B (see fig 13–5), which represents the areas on the ground that will contain the debris from the PATRIOT missile that is destroyed in flight. Labels for SDZ areas are unique to the PATRIOT guided missile.

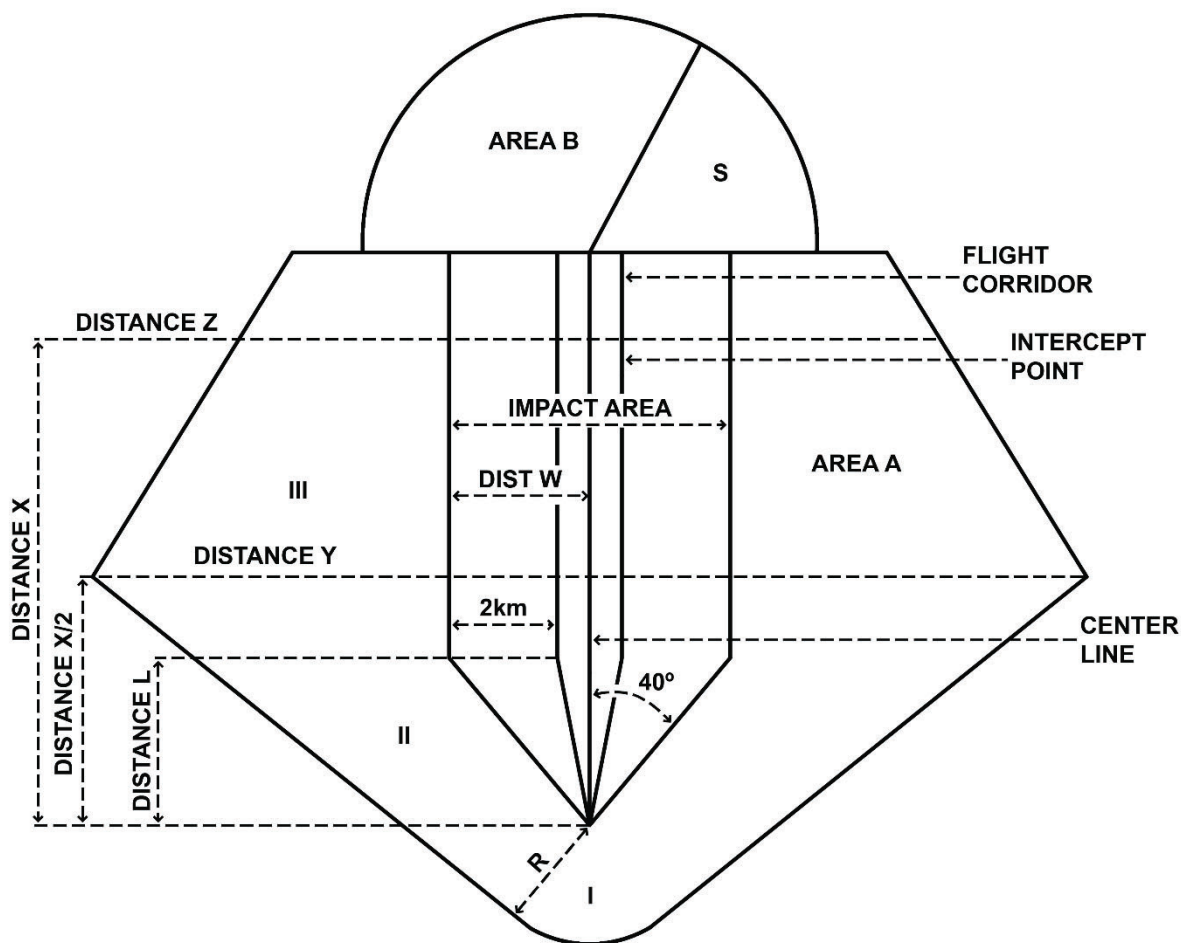


Figure 13–5. Surface danger zone for PATRIOT missiles

(2) The impact area is the area on the ground that contains the ground projections of all of the locations where the missile can be destroyed in flight. The boundary of the impact area is defined by the launch dispersion angle (A), the CR dispersion (W), and a line normally (90 degrees) to the centerline located 2 km greater than the intercept range. The azimuth dispersion angle (A) is 40 degrees on either side of the centerline. The lines that are drawn at angle A from the launch point intersect CR lines drawn parallel to the center line at a down-range distance of L meters from the launch point.

(3) Area A (lateral secondary buffer zone) is the area on the ground that contains debris from a missile that is destroyed on the lateral boundary of the impact area. Action is taken by the trajectory safety officer to initiate the destruction of the missile when the missile intersects the flight corridor boundary. The debris from the missile follows trajectories that are determined by the kinetic, gravitational, wind, and aerodynamic forces that act on the debris.

(4) Area B is the area beyond the intercept point that contains the debris from a missile that passes the intercept point without being destroyed by the fuze functioning. The missile is automatically destroyed within 2.2 seconds after passing the target if the missile is not destroyed by the warhead when the fuze functions. The debris from the missile that is destroyed after passing the intercept point impacts the ground within Area B. The automatic termination interval varies and is classified as confidential for MIM-104, MIM-104A, MIM-104B, and MIM-104C standoff jammer counter.

(5) Distances Y and Z are based upon missile altitude at detonation and speed of crosswinds.

13-6. MIM-104 PATRIOT guided missile variants (PATRIOT Advanced Capability-3 and PATRIOT Advanced Capability-3 Missile Segment Enhancement)

The PAC-3 missile and the upgraded PAC-3 Missile Segment Enhancement (MSE) are agile, high-velocity, “hit-to-kill” surface-to-air guided missiles designed to locate, intercept, and destroy tactical ballistic, tactical maneuvering, and air-breathing targets. The PAC-3 missile uses a single stage solid rocket motor, while the PAC-3 MSE uses a dual pulse solid rocket motor. Both systems include aerodynamic vane controls, attitude control motors, and inertial guidance to navigate to an intercept point specified by its ground-based fire solution computer prior to launch. Commands and trajectory data can be updated, if required, during missile fly-out by means of a RF uplink. A PAC-3/PAC-3 MSE firing mission requires a specialized target, extensive land area, and a complex range safety system for the target and the PAC-3 and PAC-3 MSE missiles. The specialized range safety office uses analysis and simulation to determine all necessary parameters of the SDZ for the particular mission scenario. Debris impact areas are also highly dependent upon the wind profile at the time of the mission. Contact the PAC-3 Product Office for assistance in PAC-3 and PAC-3 MSE training mission analysis and development.

a. Firing conditions.

(1) The PAC-3 and PAC-3 MSE guided missile SDZ will be cleared of all personnel prior to firing a missile except as authorized in paragraph 13-6a(3).

(2) PAC-3 and PAC-3 MSE are fired from a fixed PATRIOT launcher. The danger areas immediately surrounding the launcher and the distance out to safe separation are shown in figure 13-6. These areas do not vary significantly with the mission scenario, but the areas shown assume that the target is forward of the launcher in the general direction that the launcher is oriented.

(3) Only those personnel actively engaged in fire and control of the missile as specified by the appropriate TMs, FMs, and TCs will be permitted in the SDZ at the time the missile is fired. The number of personnel authorized access should be the absolute minimum that is compatible with efficient operation. Personnel should, when possible, occupy shelters that are located a minimum of 90 m from the launcher and approved by the garrison safety manager.

(4) Danger areas for debris from target drones that have normal flight paths should be contained within the impact area for PAC-3 and PAC-3 MSE guided missiles. Impact areas for target drones that have abnormal flight paths or that go out of control are not covered herein.

b. Surface danger zone.

(1) *Launch area surface danger zone.* Figure 13-6 shows the distances for Area E, Area F, and a safe separation distance contour for nominal missile profiles.

(a) Area E (primary forward danger area) is endangered by normal launch debris, overpressure, blast, and hazardous noise levels. It is a composite of a circle with a radius of 152 m to the left and right of the launcher and an ellipse (122 m minor axis left and right of the launcher) that extends 183 m in front of the launcher.

(b) Area F (rear danger area) is endangered by the solid rocket motor plume effects (back-blast debris, blast, overpressure, and hot gases) and hazardous noise levels. It is a composite of a circle with a radius of 152 m to the left and right of the launcher, an ellipse (122 m minor axis left and right of the launcher) that extends 183 m to the back of the launcher, and a triangle (152 m aft and 91 m wide).

(c) Personnel will not occupy Areas E or F for 5 minutes following launch without a self-contained air supply due to the presence of toxic gases produced by the launch.

(d) The safe separation distance is established by determining the minimum distance required for missile destruct and prevention of missile debris from striking the launcher. This is a radius of 442 m within an arc of 42 degrees either side of the launcher flight centerline. The vertex of the sector is at the launcher. All missile flight profiles remain inside this sector.

(2) *Intercept area and missile self-destruct area surface danger zones.* Intercept area and missile self-destruct area SDZs are not covered herein. Contact the PAC-3 Product Office for assistance.

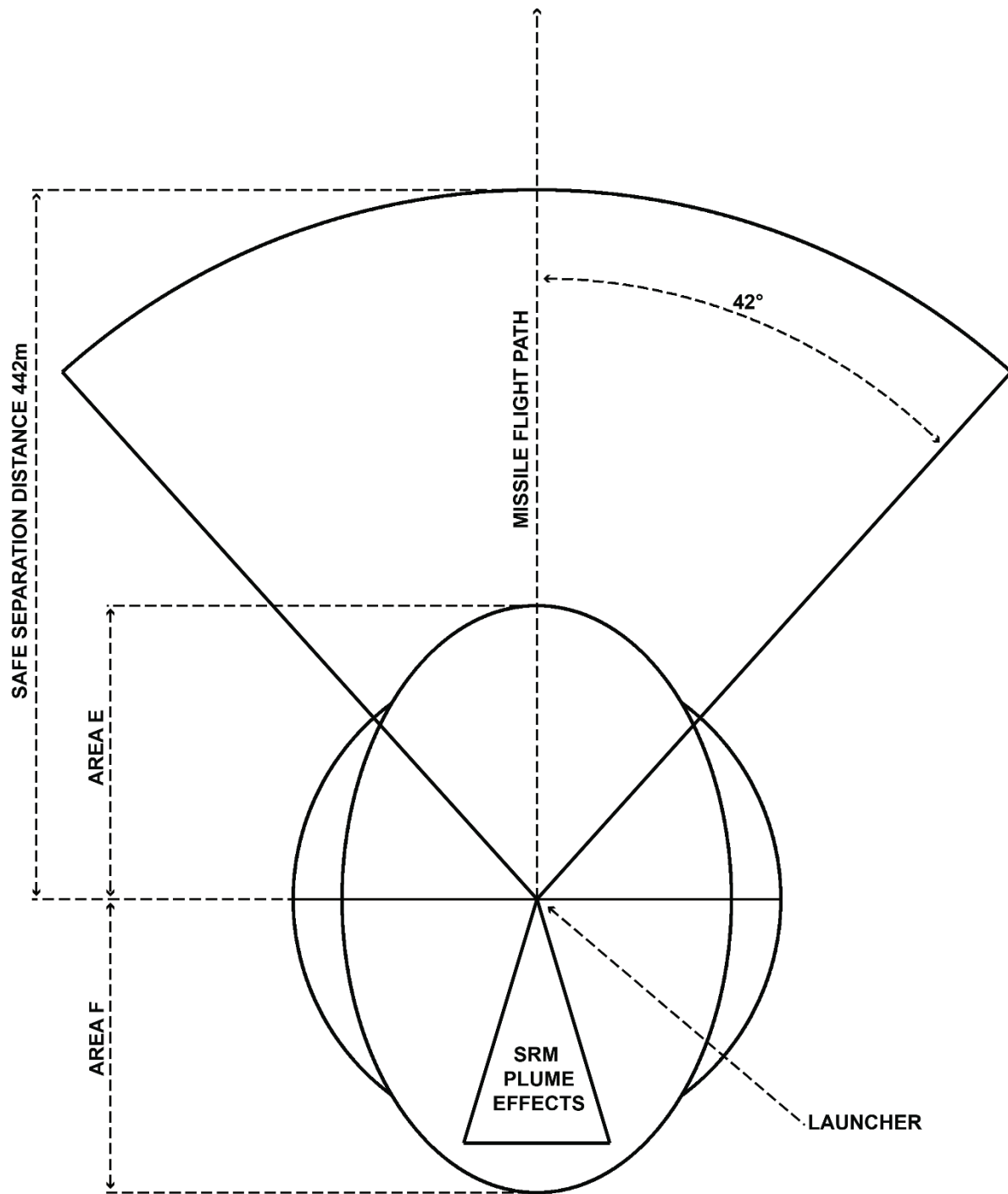


Figure 13–6. Surface danger zone, launch area, for MIM PATRIOT guided missile variants and PATRIOT Advanced Capability 3 and PATRIOT Advanced Capability 3 Missile Segment Enhancement

13–7. Counter-Rocket, Artillery, Mortar

The Army’s version of the Land-based Phalanx Weapon System (LPWS) is the Counter-Rocket, Artillery, Mortar (C–RAM).

- a. SDZ represents a single line of fire and must be rotated to account for weapon platform azimuth limits, as shown in fig 13–7.
- b. SDZ holds for firings from the 20mm C–RAM LPWS with QEs from 5 to 82 degrees.
- c. SDZ considered dispersion, ricochet, and adverse meteorological conditions. Fragmentation effects considered from 100 m to maximum self-destruct time and at ground impact.
- d. SDZ only holds for interceptor munition. Incoming threat hazards are not included.
- e. The M55A2 and M220 cartridges consist of non-explosive filled projectiles.
- f. See table 13–1 and figures 13–7 and 13–8 for the M940 Multipurpose Tracer-Self-Destruct cartridge.
- g. See table 13–2 and figures 13–7 and 13–8 for the M55A2–TP and M220 TP–T cartridges.

Table 13–1
Surface danger zone for Counter-Rocket, Artillery, Mortar 20mm, M940 Multipurpose Tracer-Self-Destruct

| Altitude (ft) | Dist X (m) | Variable down-range dist (m) | Variable cross-range dist (m) | Variable down-range angle (deg) | Variable dispersion angle (deg) | Area A (m) | Area B (m) | Vertical ricochet hazard (m) |
|---------------|------------|------------------------------|-------------------------------|---------------------------------|---------------------------------|------------|------------|------------------------------|
| 0 | 7,600 | 4,105 | 850 | 4.45 | 36.20 | 250 | 250 | 5,490 |
| 1,000 | 7,815 | 4,225 | 865 | 4.40 | 35.48 | 250 | 250 | 5,615 |
| 2,000 | 8,035 | 4,355 | 880 | 4.35 | 34.82 | 250 | 250 | 5,750 |
| 3,000 | 8,265 | 4,495 | 895 | 4.30 | 34.08 | 250 | 250 | 5,895 |
| 4,000 | 8,505 | 4,650 | 910 | 4.25 | 33.39 | 250 | 250 | 6,045 |
| 5,000 | 8,750 | 4,815 | 925 | 4.19 | 32.75 | 250 | 250 | 6,150 |
| 6,000 | 9,005 | 4,990 | 940 | 4.14 | 32.05 | 250 | 250 | 6,260 |
| 7,000 | 9,270 | 5,110 | 960 | 4.08 | 31.54 | 250 | 250 | 6,370 |

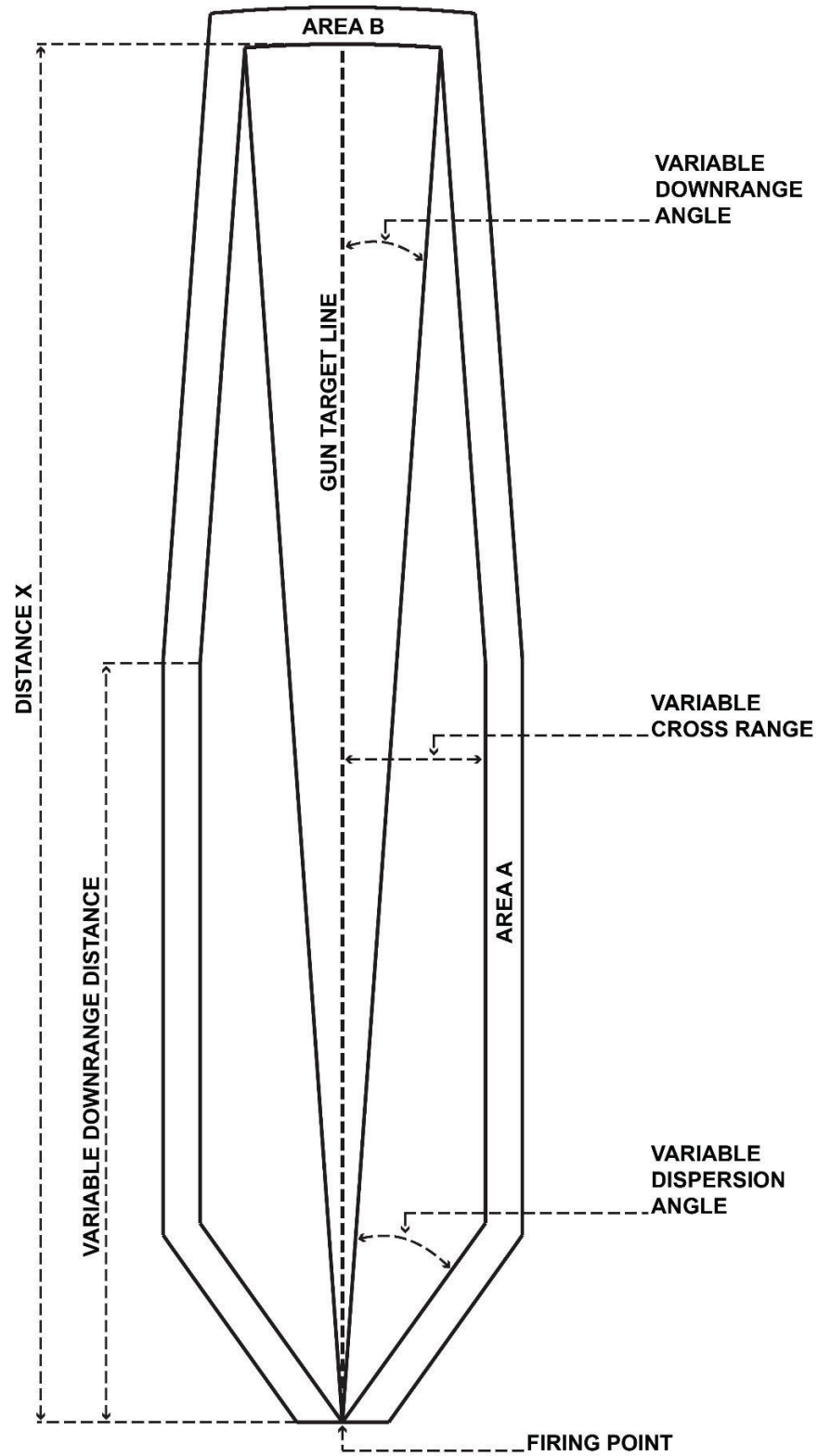


Figure 13-7. Surface danger zone for 20mm Counter-Rocket, Artillery, Mortar for a single target

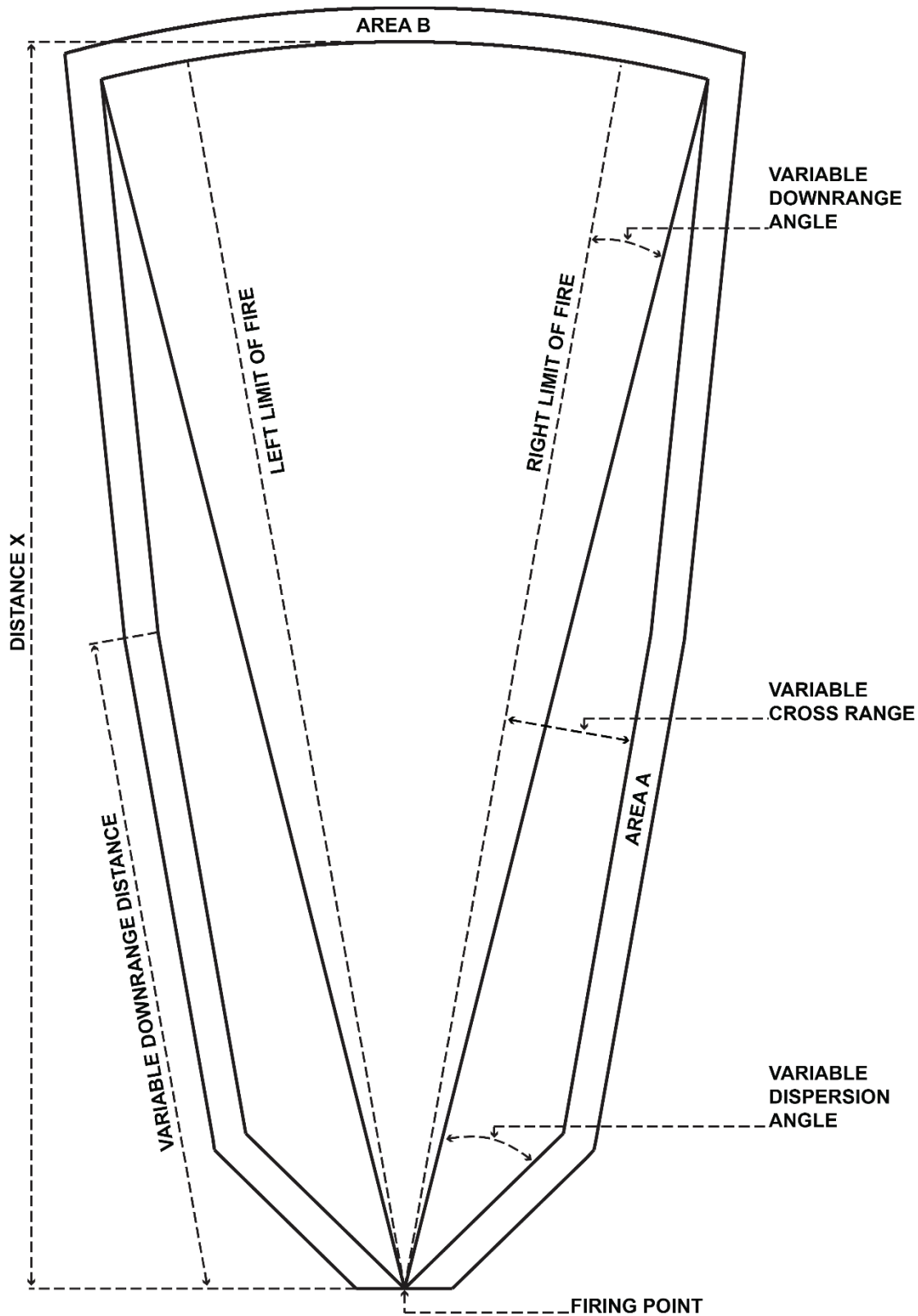


Figure 13–8. Surface danger zone for 20mm Counter-Rocket, Artillery, Mortar for moving target

Table 13–2
Surface danger zone data for M55A2-Target Practice and M220 Training Practice-Tracer, 20mm weapons

| Altitude (ft) | Dist X (m) | Variable down-range dist (m) | Variable cross-range dist (m) | Variable down-range angle (deg) | Variable dispersion angle (deg) | Area A (m) | Area B (m) | Vertical ricochet hazard (m) |
|---------------|------------|------------------------------|-------------------------------|---------------------------------|---------------------------------|------------|------------|------------------------------|
| 0 | 5,695 | 3,355 | 950 | 6.60 | 51.12 | NR | NR | 4,125 |
| 1,000 | 5,860 | 3,470 | 965 | 6.52 | 50.35 | NR | NR | 4,240 |
| 2,000 | 6,030 | 3,550 | 985 | 6.47 | 49.50 | NR | NR | 4,360 |
| 3,000 | 6,205 | 3,680 | 1,000 | 6.38 | 48.82 | NR | NR | 4,480 |
| 4,000 | 6,390 | 3,775 | 1,020 | 6.29 | 48.12 | NR | NR | 4,600 |
| 5,000 | 6,580 | 3,885 | 1,040 | 6.24 | 47.42 | NR | NR | 4,720 |
| 6,000 | 6,775 | 4,040 | 1,055 | 6.14 | 46.51 | NR | NR | 4,845 |
| 7,000 | 6,980 | 4,160 | 1,075 | 6.09 | 45.91 | NR | NR | 4,970 |

Chapter 14

Chemical Agents and Smoke

14–1. Chemical agents

The use of lethal or incapacitating chemical agents in training is not authorized. Chemical agent use must be addressed case-by-case in special safety analyses. The exception is the Chemical Decontamination Training Facility, Fort Leonard Wood, Missouri, where training regularly involves live chemical agents.

14–2. Riot control agents

a. Except when prohibited by regulations or higher authority, commanders may use riot control agents (RCAs) in training, subject to the following:

- (1) Use of RCAs in training is limited to CS. All other RCAs are prohibited for training use.
- (2) Use of RCAs in training requires supervision by personnel specially trained in field behavior, individual protection, and first aid for RCAs. Army personnel who meet these criteria are chemical officers (branch code 74), chemical NCOs (MOS 74D), or CBRN Defense Course trained personnel. Marine Corps personnel who meet these requirements are MOS 5702 CBRN systems defense officer and MOS 5769 (staff sergeant or above) CBRN defense specialist.
- (3) RCAs will not be used under conditions that are dangerous to life or property. MSDs to heavily traveled installation roads, railroad right of ways, airfields (including all aircraft landing areas), or inhabited areas are as follows—
 - (a) CS chambers will be at least 100 m away from heavily traveled roads; 500 m from aircraft operations and inhabited areas; and 1,000 m from the nearest installation boundary unless the CS chambers are designed to contain and filter all CS gas.
 - (b) Field training exercises involving RCAs will be 500 m or more away from public traffic routes and the nearest inhabited buildings and 1,000 m from installation boundaries.
- (4) Prior to a scheduled RCA exercise, training supervisors must conduct a readiness evaluation of personnel. Before being exposed to RCAs, all personnel with respiratory ailments, recent eye surgery or eye infections, open wounds, or severe facial acne or any active dermatitis and pregnant personnel must be referred to a medical officer for evaluation. The medical officer will evaluate the health records of these individuals and, when necessary, examine the personnel to determine their readiness to undergo training without undue medical risk. The examination results (which will state whether personnel can or cannot participate in training with RCAs only) will be documented in the personnel medical records.

(5) OICs and RSOs must ensure protective masks are available for all personnel participating in training.

(6) When CBRN protective equipment is worn, the OIC or RSO will consider the additional heat stress placed on personnel. When using the wet-bulb globe temperature to determine the heat category, add 10 degrees Fahrenheit if personnel are in body armor and mission-oriented protective posture level two through four. High ambient temperatures, high humidity, and heavy workload are factors that increase the potential for heat illness. To reduce the heat stress risk, commanders will—

- (a) Provide an ample water supply and encourage all personnel to drink plenty of water. OICs and RSOs will monitor personnel undergoing training to ensure personnel frequently drink water to replace lost fluids.
- (b) Reduce the mission-oriented protective posture level under high heat stress conditions when possible.
- (c) Schedule additional rest breaks during training to allow personnel to cool off. These periods also can be used for critiques. Where possible, use vehicles to move personnel who are wearing protective equipment.
- (d) Ensure subordinate commanders and leaders check their personnel for early signs of heat illness. Authorize frequent breaks while operating in protective equipment.
- (7) Unprotected personnel will not be exposed to RCAs longer than 15 seconds.
- b. Personnel specified in paragraph 14–2a(2) will supervise the mask confidence course.
- c. Employment conditions.
- (1) CS will be used in training only under the supervision of an officer, SNCO, or NCO who has received formal training in the characteristics, capabilities, and training applications of these agents.
- (2) Only CS in capsule form may be used in the CS chamber. The use of CS grenades and powder is not authorized.
- (3) For the Marine Corps, when CS is used in outdoor confidence courses, the RSO must have been trained in the CS chamber within the past year. The use of a 5702 CBRN defense officer and MOS 5769 (staff sergeant or above) CBRN defense specialist is not required.
- (4) RCAs will not be released when personnel without proper respiratory protective equipment located downwind will be affected, unless exposure to a controlled concentration is desired. CS agents will not be released within 50 m of spectators.
- (5) Marine Corps personnel handling or dispensing CS capsules will wear mission-oriented protective posture level four.
- (6) Army personnel handling or dispensing CS capsules will wear rubber boots; protective mask with hood; and field clothing secured at neck, wrists, and ankles.
- (7) Individuals affected by RCAs will move to fresh air and face into the wind for 5 to 10 minutes, avoid rubbing the eyes, and remain well-spaced from other affected personnel. If accidentally exposed to an RCA, clothing will be removed from the affected skin as soon as possible. Flush the exposed areas with large volumes of cool water for not less than 15 minutes, and then seek prompt medical attention. If available, mild soap should be used to cleanse the contaminated skin.
- (8) Hot water should not be used when showering as it will raise the vapor point of the CS, resulting in further spreading of contamination.
- (9) When eyes are contaminated with a CS agent, treat them with a 1-percent solution of sodium bicarbonate (baking soda). If not available, hold the eyes open with fingers, flush with water for not fewer than 15 minutes, then seek medical attention.
- (10) Contaminated clothing will be removed from the area to prevent accidental contamination of unprotected personnel.
- d. When RCAs are transported in Army or Marine Corps aircraft, compliance with AR 95–1, AR 95–27, and MCO 4030.40C is required.
- e. For the Marine Corps, the requirements for all CS exercises, whether garrison or field training, are as follows:
 - (1) Corpsman or medic with unit 5 medic bag.
 - (2) Designated safety vehicle with a driver who will not be in the chamber but will have a protective mask on hand.
 - (3) Instructors will be easily and readily identifiable while in the CS chamber.

14–3. Smoke

The use of smoke in training poses special health and safety issues. The following precautions apply to all smoke training with fog oil, HC smoke, red phosphorus, WP, plasticized WP, terephthalic acid (TA), and colored and diesel smokes.

- a. Personnel will carry a protective mask when participating in exercises that include the use of smoke. Personnel will mask—
 - (1) Before exposure to any concentration of smoke produced by M8 white smoke grenades, M83 smoke grenades (TA), smoke pots (HC and TA smoke), or metallic powder obscurants.
 - (2) When passing through or operating in dense (visibility less than 50 m) smoke, such as smoke blankets and smoke curtains.
 - (3) When operating in or passing through a smoke haze (visibility greater than 50 m) and the duration of exposure will exceed 4 hours.
 - (4) Any time exposure to smoke produces breathing difficulty, eye irritation, or discomfort. Such effects in one individual will serve as a signal for all similarly exposed personnel to mask.

(5) When using smoke during military operations in urban terrain training or when operating in enclosed spaces. The protective mask is not effective in oxygen-deficient atmospheres. Care must be taken not to enter areas where oxygen may have been displaced.

b. Clothing is to be laundered and personnel will shower after exercises involving exposure to smoke. Personnel exposed to smoke should reduce skin exposure by rolling down their sleeves.

c. Special care must be taken when using HC and TA smoke to ensure that appropriate protection is provided to all personnel who may be exposed. When planning for the use of HC smoke in training, consideration must be given to weather conditions and the potential downwind effects of the smoke. Positive controls (observation, control points, and communications) must be established to prevent exposure of unprotected personnel. Detailed hazard information is available on the appropriate safety data sheets.

d. Sulfur trioxide-chlorosulfonic acid solution and titanium tetrachloride smoke will not be used in training.

e. Smoke will not be used in public demonstrations, displays, or ceremonies unless positive dissipation of the smoke can be assured and no exposure to the public or nonparticipating personnel is expected. A RM plan will be developed by the agency conducting the public demonstration, in conjunction with the installation RMA (Army) or RCO (Marine Corps) and safety director, for all uses of smoke in demonstrations, displays, or ceremonies.

14-4. Smoke pots

a. Personnel manually firing HC and TA smoke pots will mask and keep their head well to one side to the top of the pot and out of the way of sparks and flames to prevent burn injuries. Once HC and TA smoke pots have ignited, personnel will quickly move away a minimum distance of 30 m.

b. Precautions will be taken to prevent ground fires. HC and TA smoke pots will not be fired inside buildings, tents, or other enclosed areas because of fire and health hazards from associated fumes. Exceptions are buildings or structures specially designed for smoke training and only after conducting a thorough risk assessment, developing and implementing controls, and acceptance of the residual risk by the appropriate commander.

c. HC and TA smoke pots must be kept dry. Any addition of water to HC and TA smoke mixtures may cause it to burn erratically, explode, or result in spontaneous combustion. HC smoke pots will not be ignited during visible precipitation (snow or rain).

d. The M4A2 smoke pot must be vented for at least 5 minutes within 24 hours before use in accordance with TB 3-1365-490-10.

e. When electrically firing the M5 HC smoke pot, at least 30 m of WD-1/TT wire will be used.

14-5. Oil smoke candles

Oil smoke candles (M6, SGF2) are used to produce nontoxic smoke in confined areas primarily to simulate fires in buildings or ships for fire drills and to train firefighters. The correct procedure for use is to place the candle on its base atop a stable platform away from combustible materials, pull the safety pin, and release the safety lever.

Chapter 15 Non-Lethal Weapons

15-1. Definition

DoDD 3000.03E defines non-lethal weapons (NLW) as weapons “that are explicitly designed and primarily employed to incapacitate targeted personnel or materiel immediately, while minimizing fatalities, permanent injury to personnel, and undesired damage to property in the target area or environment.” Furthermore, “unlike conventional lethal weapons that destroy their targets principally through blast, penetration, and fragmentation, NLW employ means other than gross physical destruction to prevent the target from functioning. NLW are intended to have relatively reversible effects on personnel or materiel.”

15-2. General

a. The term “non-lethal” does not mean zero mortality or nonpermanent damage. Fatal injuries can occur if munitions are employed at a distance that is less than the determined minimum safe engagement range.

b. The Inter-Service Non-Lethal Individual Weapons Instructor Course is the only course in DoD that is certified to produce instructors who will train individuals in the proper employment of NLWs.

c. For the Marine Corps, the use of NLW in force-on-force scenarios, with the exception of SESAMS, is authorized only under approved deviation in accordance with chapter 1 and when RM procedures have been completed in accordance with MCRP 1-10.1 and MCO 5100.29C.

- d.* For the Marine Corps, if force-on-force training with NLW is conducted under an approved deviation, Marines may be in the NLW danger zone but must remain outside the minimum target engagement distance at all times.
- e.* For the Army, Soldiers participating in force-on-force training with NLW may be in the NLW SDZ but must remain outside the minimum engagement distance at all times.
- f.* Head shots with NLW are not authorized.

15–3. Surface danger zones

- a.* Many non-lethal munitions have both a maximum effective range and minimum target engagement distance. Individuals short of the minimum target engagement distance may suffer severe injuries or death. The effects of most non-lethal munitions are greatly decreased at longer ranges.
- b.* Hazardous effects from certain NLW munitions can be experienced at or behind the firing line (for example, the rubber rounds described in paragraph 15–4 may bounce back when fired against a hard surface).
- c.* Area R is the portion of the SDZ behind the firer where personnel, equipment, and facilities may be endangered by ricochets to the rear of the firing line.

15–4. 12-gauge shotgun, M1012, M1013, and bean bag projectiles

- a.* The M1012 projectile is a fin-stabilized projectile made of rubber designed for point targets. The M1013 is a ball projectile and consists of 18 polyvinyl chloride rubber compound balls designed for crowds and groups.
- b.* For the M1012 and M1013, minimum engagement is 10 m with a maximum effective range of 20 m.
- c.* See table 15–1 for the tabular data for the M1012 and M1013 is contained.
- d.* See figure 15–1 for the SDZ for M1012 and M1013.
- e.* When firing the 12-gauge shotgun with the rubber ball grenade launch cup attached, carbon can build up in the barrel. This carbon build up may create a malfunction if the launcher cup is removed and the 12-gauge bean bag rounds are fired. Bean bag rounds may get stuck in the barrel.
- f.* Gas operated shotguns may malfunction when shooting nonlethal ammunition. This may result in increased stop-pages or malfunctions or require the weapon to be cycled manually.
- g.* PPE Level 0 is required.

Table 15–1
Surface danger zone for 12-gauge M1012 and M1013 hard and soft targets

| Ammunition | Dist X (m) | Dist Y (m) | Dist W (m) | Area R depth (m) | Area R width (m) | Angle P (deg) | Angle Q (deg) | Dispersion angle (deg) |
|------------|------------------|------------------|------------------|---------------------------|---------------------------|---------------------|---------------------|------------------------------|
| M1012 | 500 | 400 | 150 | 50 | 300 | 80 | 35 | 10 |
| M1013 | 180 | 160 | 75 | 20 | 150 | 75 | 60 | 15 |

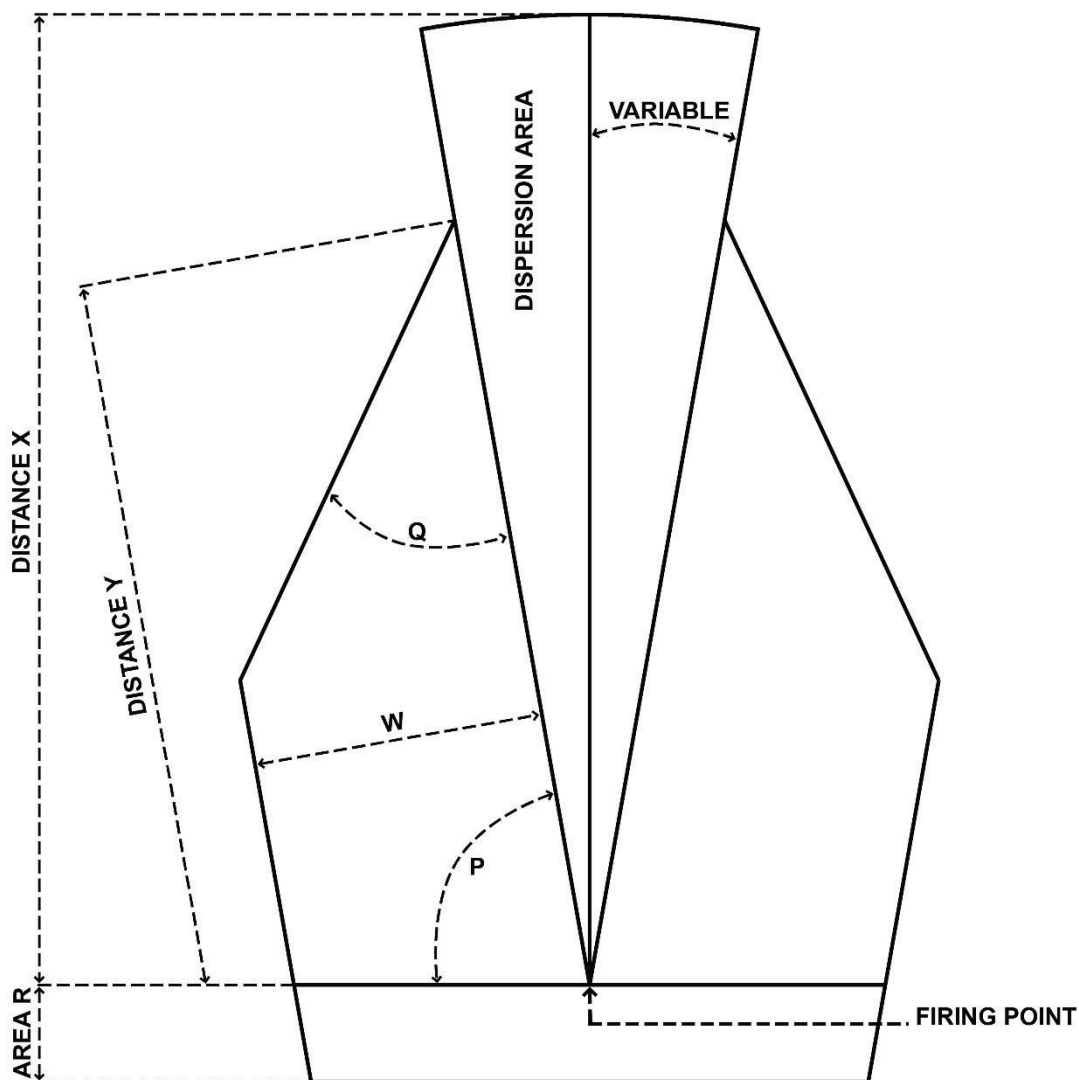


Figure 15–1. Surface danger zone for 12-gauge M1012 and M1013 hard and soft targets

15–5. 40mm M1006 sponge grenade

- a. The M1006 is a sponge grenade cartridge comprised of a 40mm bullet-shaped foam rubber round.
- b. Minimum engagement for this NLW is 10 m, with a maximum effective range of 20 m.
- c. See figure 15–2 for the SDZ for M1006.
- d. The round is most effective against point targets. At distances of 10 m to 50 m, aiming point should be center mass of target.
- e. Do not skip fire this round.
- f. PPE Level 0 is required.

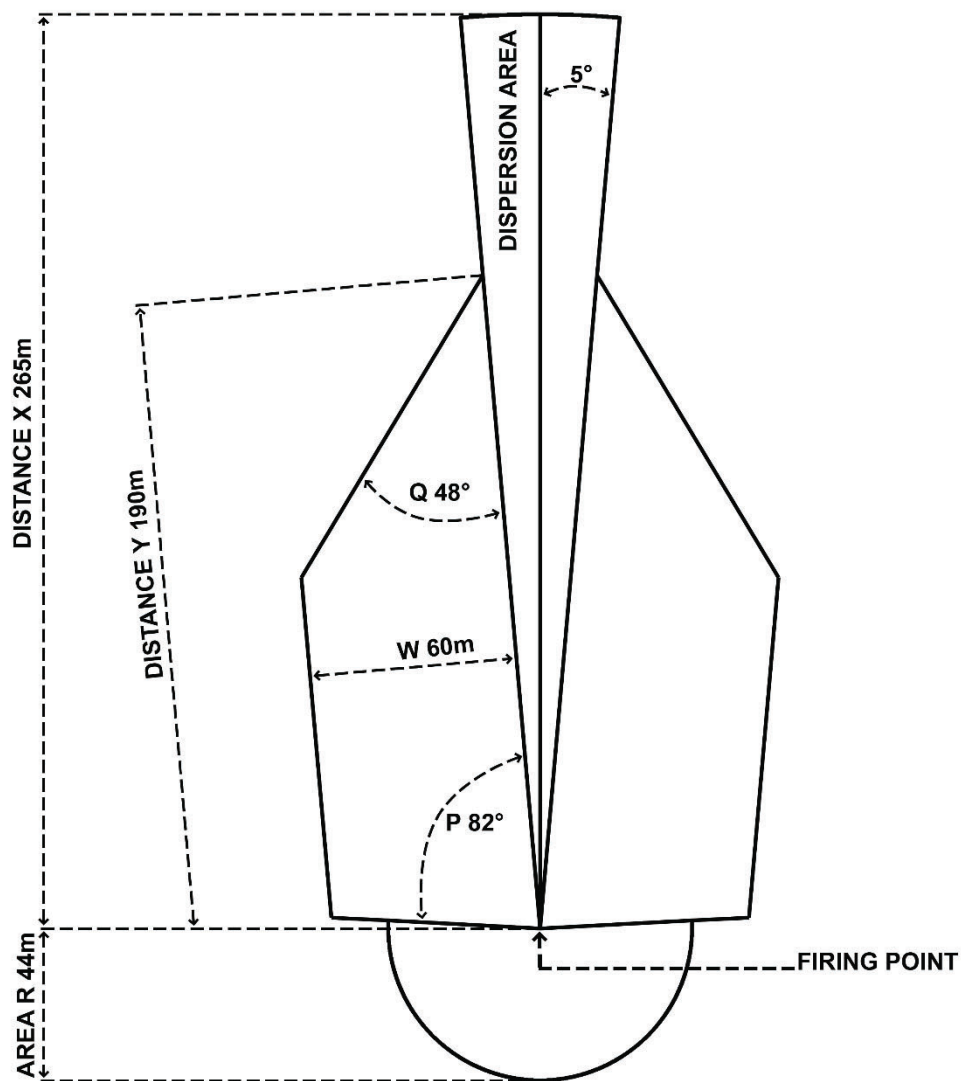


Figure 15–2. Surface danger zone for M1006 40mm sponge grenade

15–6. 40mm grenade foam rubber baton, rubber ball grenade, and M1029

- a. The BA07 is a foam rubber baton. The BA08 is a rubber ball grenade that will be superseded by the BA13. The M1029 (BA13) is a crowd-dispersal grenade consisting of 48 rubber balls.
- b. Minimum engagement range for this NLW is 10 m and the maximum effective range is 30 m.
- c. See figure 15–3 for the SDZ.
- d. At distances of 10 m to 30 m, the aiming point should be center mass of the group of individual targets.
- e. PPE Level 0 is required.

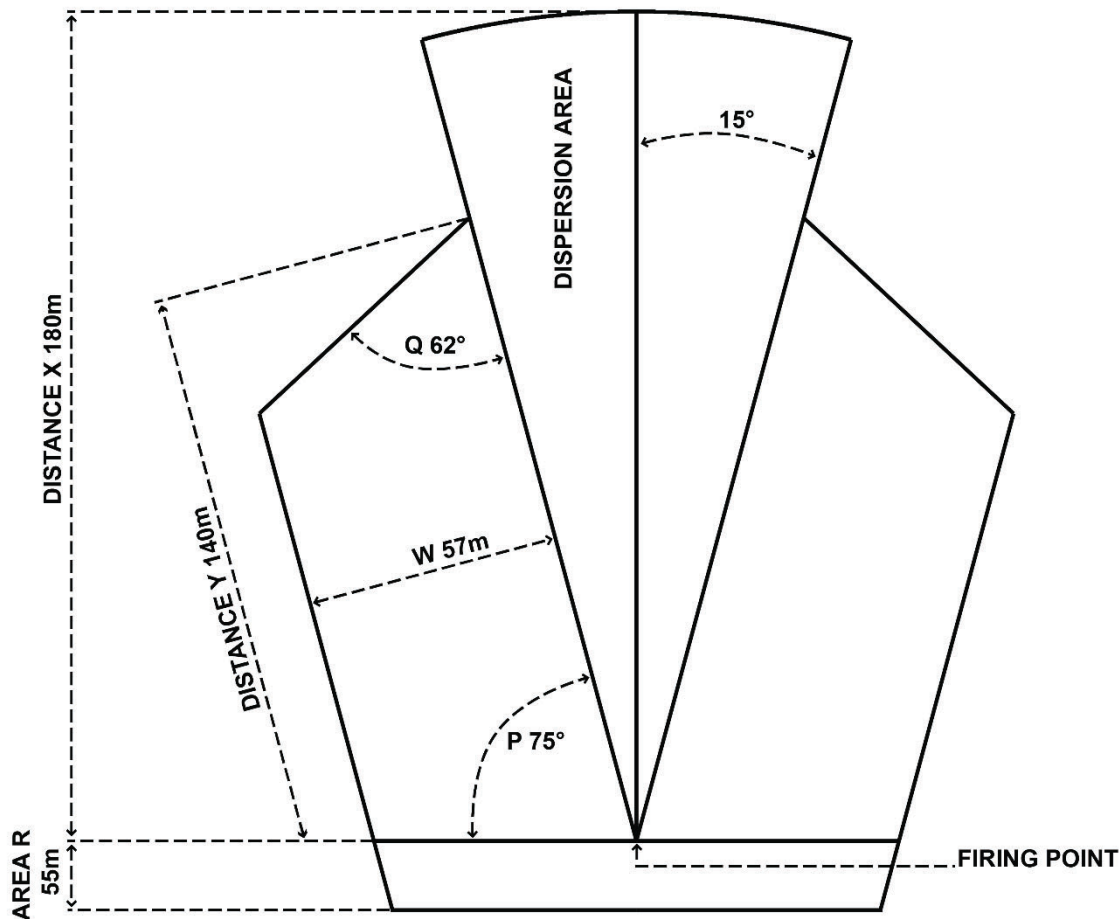


Figure 15-3. Surface danger zone for 40mm grenade foam rubber baton, rubber ball grenade and M1029

15-7. Rubber ball grenade

- a. The rubber ball grenade has a rubber molded body and consists of 100 rubber balls. The rubber ball grenade is both a hand-held and 12-gauge shotgun launched non-lethal device and is the only non-lethal munition that can be delivered in defilade. The rubber ball grenade is an area target munition.
- b. The employment distance for the hand thrown rubber ball grenade is 16 m (50 ft).
- c. The employment distance for the shotgun launched rubber ball grenade is 61 m (200 ft).
- d. The MSD for the rubber ball grenade hand thrown grenade is 3 m and has an effective range of 20 m. Debris may also travel out to a distance of 35 m.
- e. See figure 15-4 for SDZ data for the hand thrown rubber ball grenade.
- f. See figure 15-5 for SDZ data for the shotgun launched rubber ball grenade.
- g. When employing these grenades, local fire conditions must be considered due to possible fire hazards.
- h. PPE Level 0 is required.

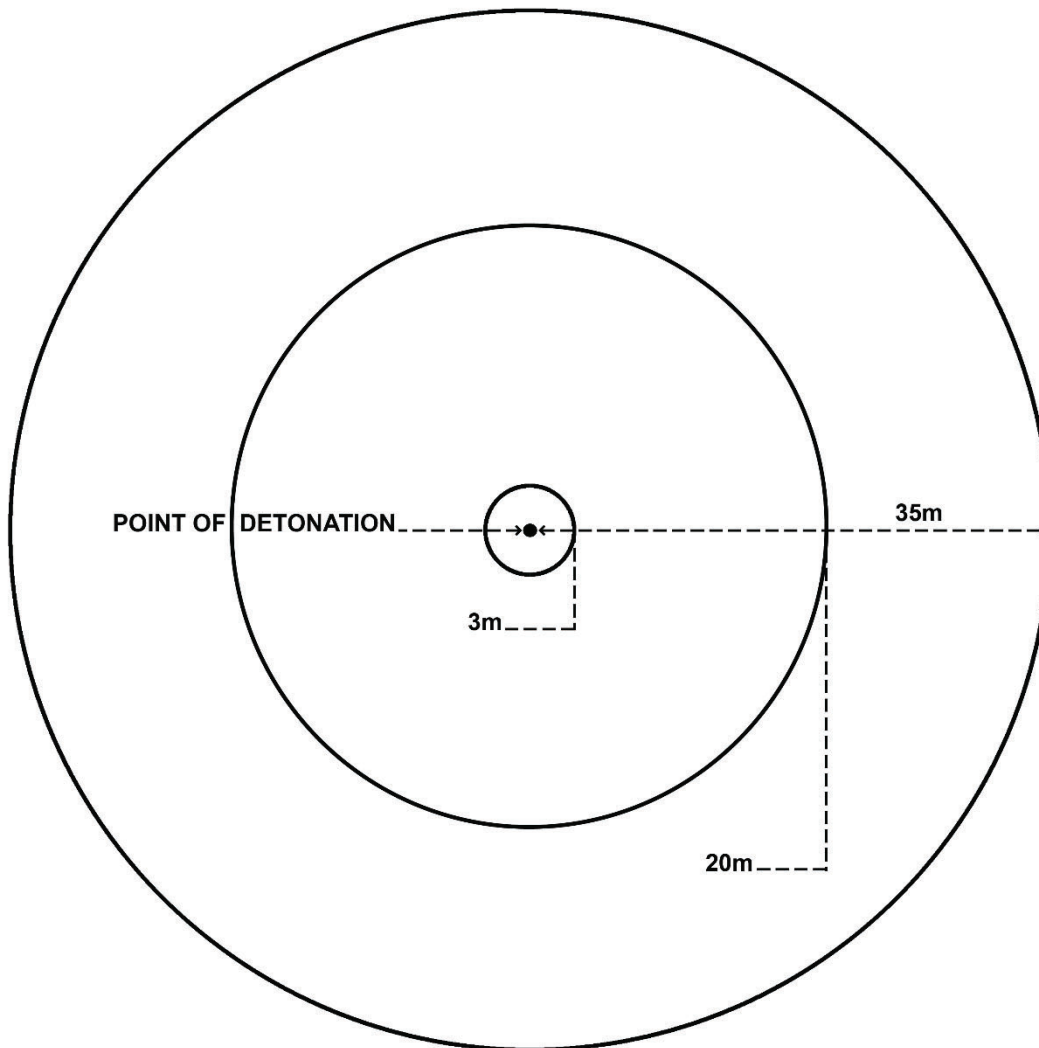


Figure 15–4. Surface danger zone for rubber ball grenade hand thrown

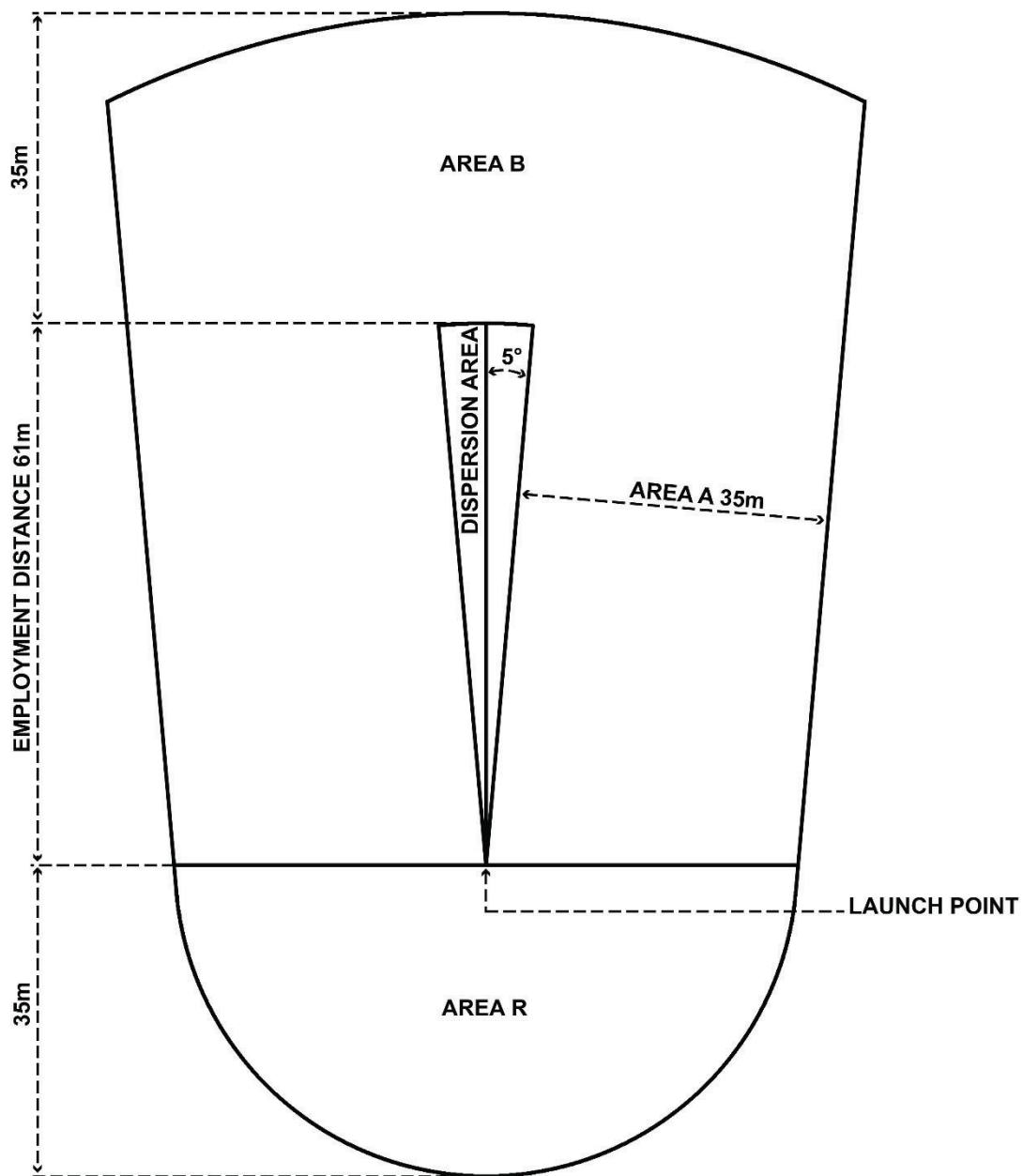


Figure 15–5. Surface danger zone for rubber ball grenade shotgun launched grenade

15–8. M5 modular crowd control munition

- a. The modular crowd control munition (MCCM) is a munition that resembles the M18A1 Claymore Mine. The rubber balls are launched in a fan-shaped distribution pattern.
- b. This weapon has a minimum engagement range of 5 m and a maximum effective range of 15 m.
- c. Detonation of the MCCM presents a rearward danger zone, Area R.
- d. The SDZ is shown in figure 15–6.

- e. When firing the MCCM from vehicles, use mounting systems in accordance with applicable TMs. Mount the MCCM on armor-hardened vehicles only.
- f. PPE Level 0 is required.
-

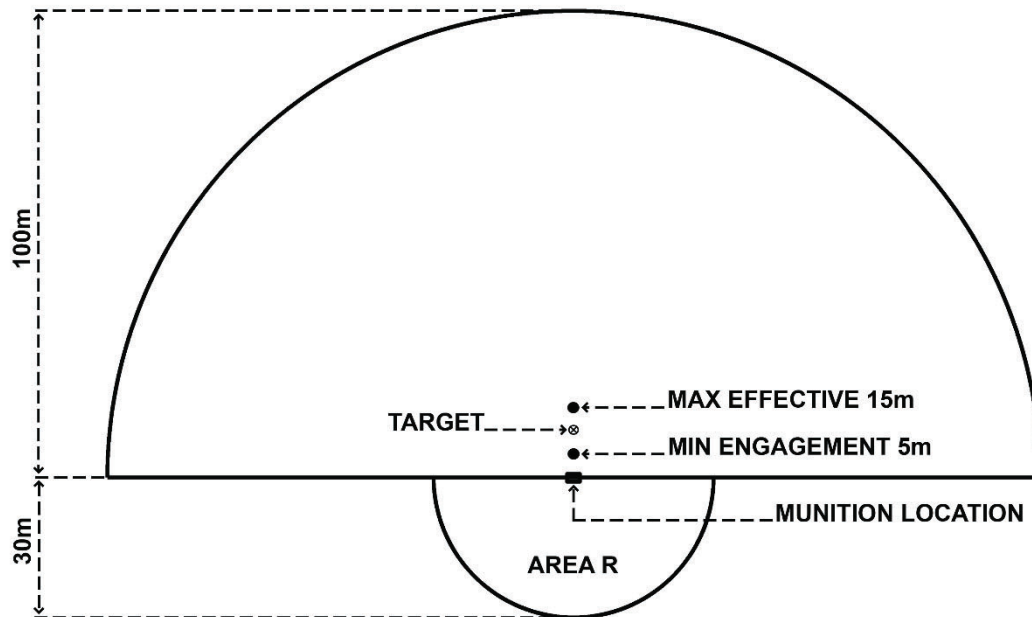


Figure 15–6. Surface danger zone for Modular Crowd Control Munition

15–9. M84 stun grenade

- a. The M84 stun grenade is a non-lethal diversionary device. It is used to apply the minimum force necessary by tactical and non-tactical forces while performing hostage rescue and capture of adversary missions. Stun grenades may cause fires under certain conditions.
- b. The daily exposure limit within the noise hazard contour is as follows:
- (1) Regarding hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/commnity/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.
 - (2) The SDZ is shown in figure 15–7.
- c. PPE Level 0 is required.

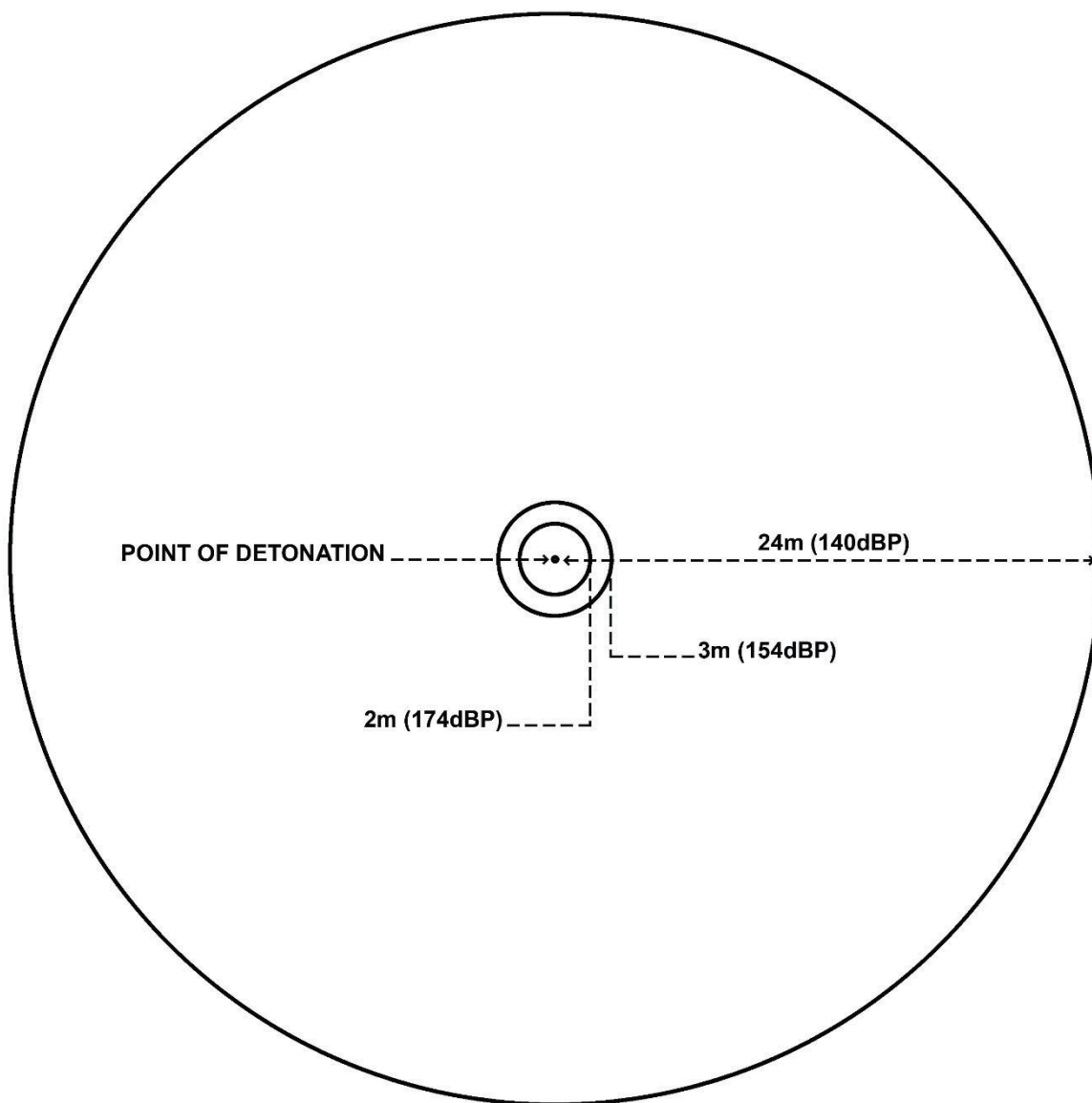


Figure 15–7. Surface danger zone for M84 stun grenade

15–10. Diversionary hand grenade, 6 Bang, MK 24 MOD 0

This is an improved, non-lethal diversionary hand grenade that fires six delayed sequential detonations when deployed to cause temporary incapacitation through flash blindness and hearing loss.

a. Operator should use a covered position, such as a wall or door. If training requires the deployment of the grenade in an open area where cover is not available, then the operator will apply the SDZ (see fig 15–9).

b. PPE Level 0 plus double-hearing protection is required within the 3.5 m noise hazard contour of greater than 165 dB (see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system).

c. PPE Level 0 with single-hearing protection is required for the 32.5 m (greater than 165 dB) to 155 m (greater than 140 dB) noise hazard contours (see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system).

d. There are individual daily exposure limits within the noise hazard contours (see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system).

15–11. MK 20 MOD 0 Improved Flash Bang Grenade (Marine Corps)

- a.* The Improved Flash Bang Grenade causes temporary incapacitation through flash blindness and hearing loss.
- b.* PPE Level 0 is required.
- c.* Regarding hearing conservation, see <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.
- d.* There are individual daily exposure limits within the noise hazard contours:
 - (1) See <https://ph.health.mil/pages/products-services.aspx> or <https://www.milsuite.mil/book/community/spaces/aphc/hha/sws> for the latest information on NHCs and ANOR per weapon system.
 - (2) See figure 15–8 for SDZ.

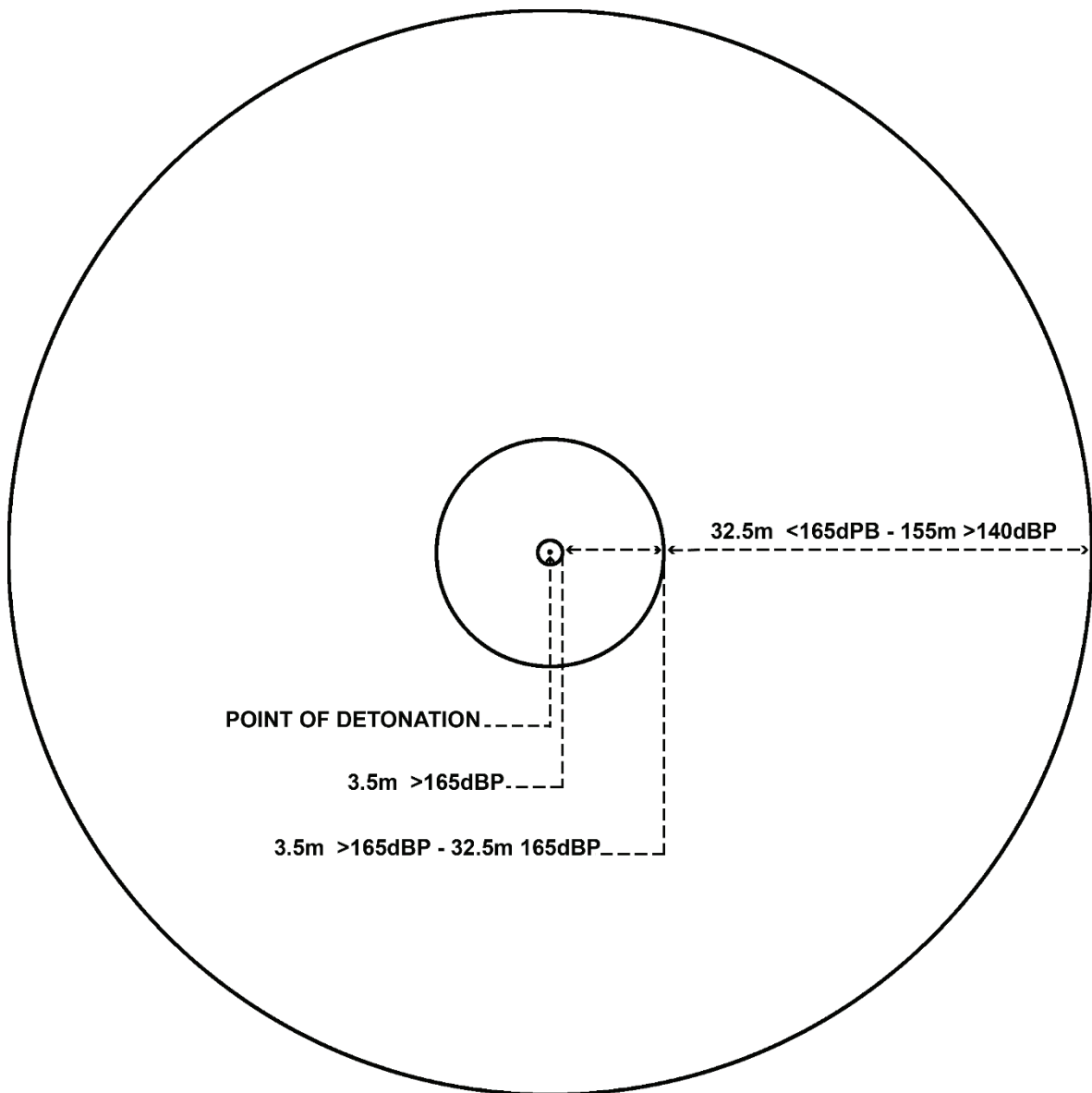


Figure 15–8. Surface danger zone for MK 20 MOD 0 Improved Flash Bang Grenade

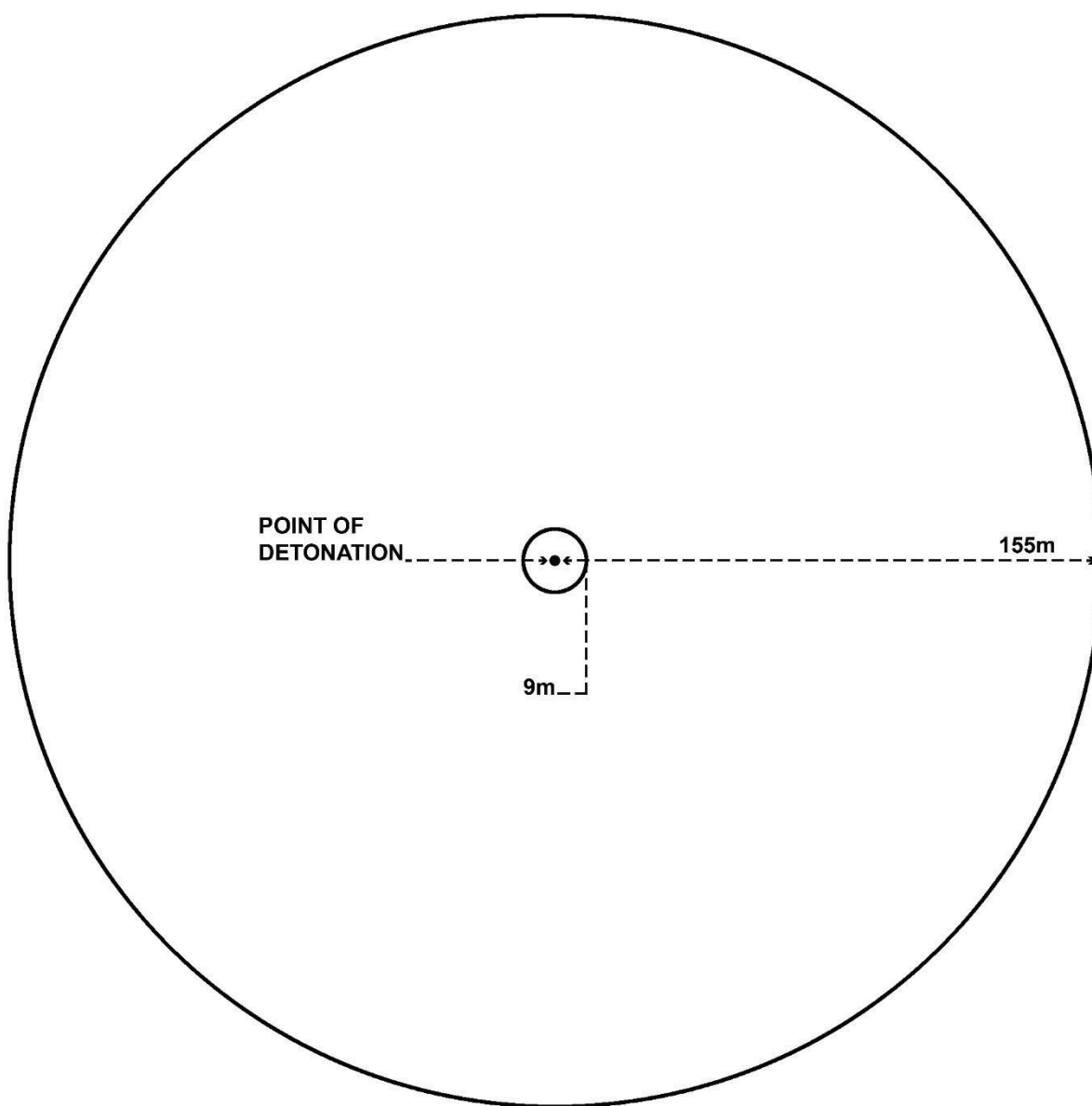


Figure 15–9. Surface danger zone for MK 24 MOD 0, Diversionary Hand Grenade, 6 Bang

15–12. M98 and M99 66mm non-lethal grenade

- a. The M98 and M99 66mm non-lethal grenades are launched from vehicle-mounted tubes. The grenades are packaged three to a tube.
- b. The non-lethal grenade M98 is a distraction grenade with a flash and a loud report shortly after impact.
- c. The non-lethal grenade M99 is a blunt-trauma grenade that functions with a similar flash or bang followed by the discharge of approximately 420 plastic balls (140 per canister).
- d. The SDZ is shown in figure 15–10. See table 15–2 for the tabular data for these grenades.
- e. PPE Level 0 is required.

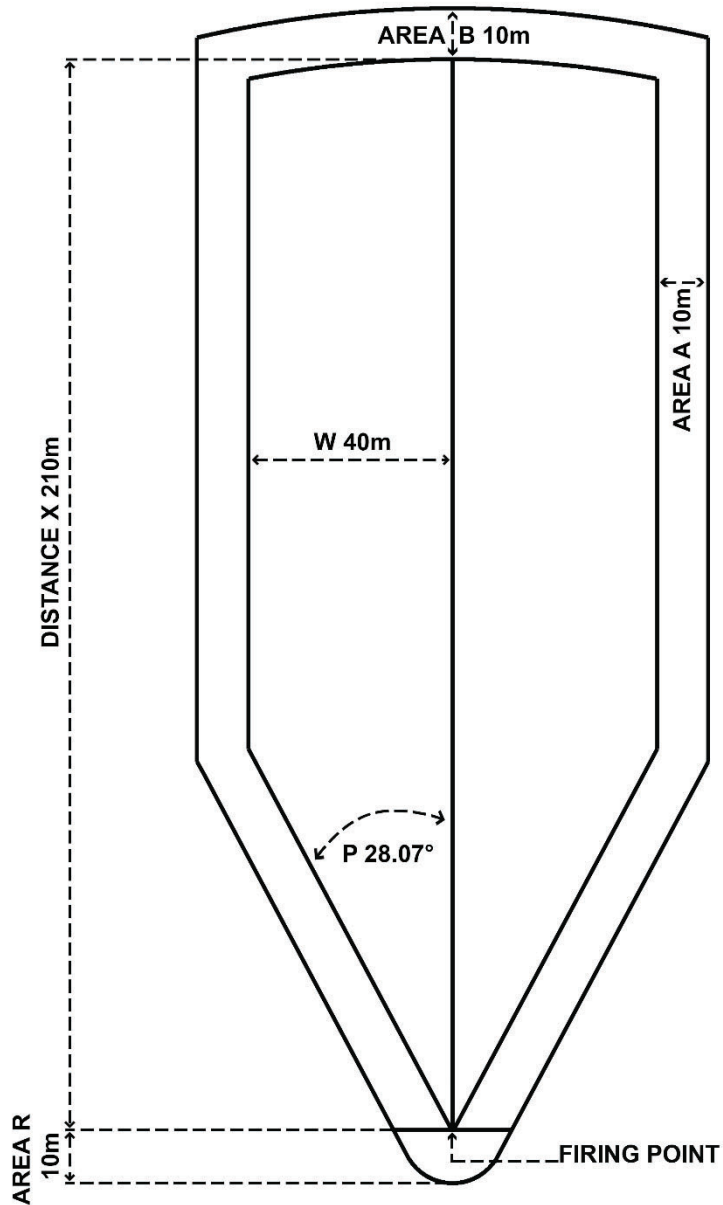


Figure 15–10. Surface danger zone for M98 and M99 grenades

Table 15–2
Surface danger zone data for the 66mm M98 and M99 Grenades

| Distance X (m) | Distance Y (m) | Area W (m) | Area A (m) | Area B (m) | Area R (m) | Angel P (deg) |
|-------------------|-------------------|---------------|---------------|---------------|---------------|------------------|
| 210 | 75 | 40 | 10 | 10 | 10 | 28.07 |

15–13. Launched electrode stun device

a. The device is used to propel wire probes that conduct energy to affect the sensory and motor functions of the nervous system. The launched electrode stun device provides the capability for non-lethal incapacitation of an individual at close range.

b. The two probes are propelled by compressed gas and are connected to the weapon by 25 or 35-ft long high voltage insulated wires.

c. The SDZ is shown in figure 15–11.

d. PPE Level 0 is required.

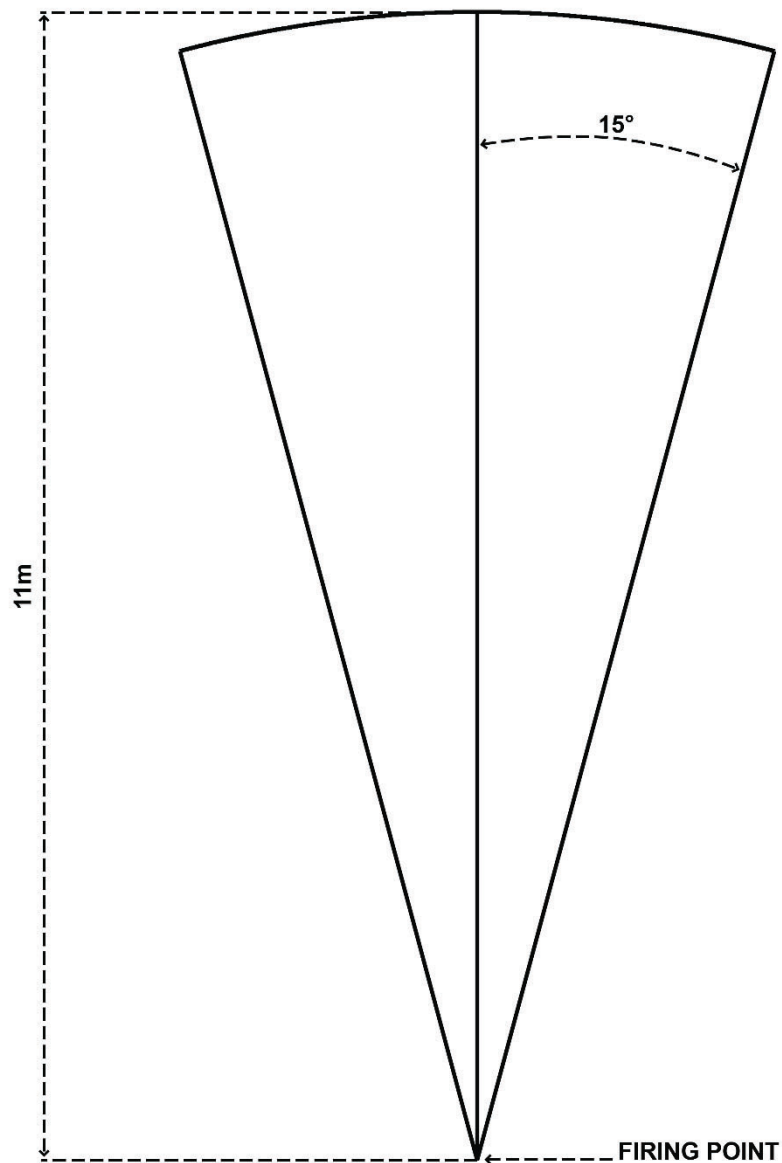


Figure 15–11. Surface danger zone for launched electrode stun device

15–14. M104 non-lethal bursting hand grenade

- a.* The M104 non-lethal bursting hand grenade has a rubber molded body and has an output that combines a bright flash and loud explosion that consists of 100 pliable rubber projectiles to disorient and confuse targeted personnel.
- b.* PPE Level 0 is required.
- c.* Single-hearing protection is required by all personnel within 195 m.
- d.* The SDZ is shown in figure 15–12.

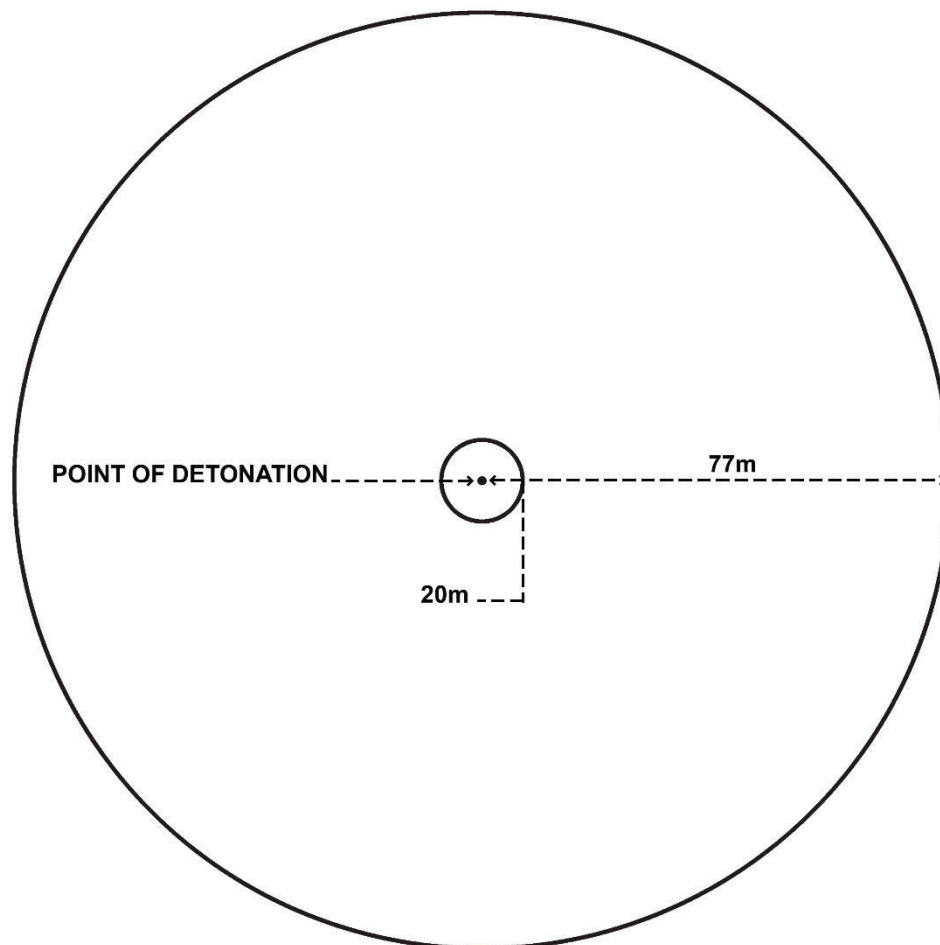


Figure 15–12. Surface danger zone for bursting hand grenade M104

15–15. Non-Lethal/Tube-Launched Munition System

a. The Non-Lethal/Tube-Launched Munition System (NL/TLMS) is a vehicle or ground-mounted, multi-shot, electrically actuated, non-lethal munitions grenade launcher. The system is a non-lethal addition to the force protection toolset. It provides the user with a non-lethal means of determining potential hostile intent at sufficient stand-off distance. It is composed of a 40mm multi-flash bang cartridge, launcher, and a family of bracket kits. The NL/TLMS will be fired into dedicated impact areas only.

b. The NL/TLMS may be mounted on the Gunner's Protective Kit, Objective-Gunner's Protective Kit, or the Marine Corps Transparent Armor Gun Shield. The NL/TLMS may also be ground-mounted on an M3 machine gun tripod. When vehicle-mounted, the NL/TLMS is co-axially mounted with either the M2.50 caliber machine gun, MK19 40mm machine gun, or the M240G machine gun. The use of the Marine Corps Transparent Armor Gun Shield with the NL/TLMS installed in an extended position is prohibited until an upgraded universal pintle and base frame bracket assembly is incorporated.

(1) In the extended configuration (pushed forward of the gunner position), a vibration hazard exists that creates the possibility of damage to the base frame.

(2) When used in the retracted configuration (pulled towards the gunner), the use of the M2.50 caliber machine gun and MK19 40mm grenade launcher is prohibited due to lack of space to mount the ammunition canisters.

c. Table 15–3 provides the frequency bands, maximum allowable environment (MAE) expressed in volts per meter (V/m), and S4 phases of NL/TLMS operation. It indicates the electromagnetic radiation to which the NL/TLMS may safely be exposed without a potential premature ignition of the munition.

Table 15–3
Non-Lethal/Tube-Launched Munition System maximum allowable environment

| Frequency (MHz) | MAE (V/m) | S4 Phases |
|-----------------|-----------|---|
| 2–32 | 15 | Handling and loading |
| 400–700 | 14.10 | Handling and loading |
| 700–790 | 36.30 | Handling and loading |
| 790–1000 | 46.90 | Handling and loading |
| 790–1000 | 387 | Handling and loading staged, or platform loaded |

Legend:

MAE=maximum allowable environment

MHz=megahertz

V/m=volts per meter

d. Minimum safe target engagement for the NL/TLMS is 31 m due to possibility of fragments or debris. Additionally, the stand-off distance will be 31 m for known transmitters, such as the AN/VRC–104, Counter Radio-Controlled Improvised Explosive Device Electronic Warfare (CREW), CREW training, and electronically fused counter-improvised explosive device (IED) systems, during handling and loading phases of the NL/TLMS.

e. All personnel will wear eye protection, single-hearing protection, and throat protector provided for the modular tactical vest. While the NL/TLMS is being fired from the vehicle platform, firing personnel will be fully seated in the turret using the turret harness (see fig 15–13).

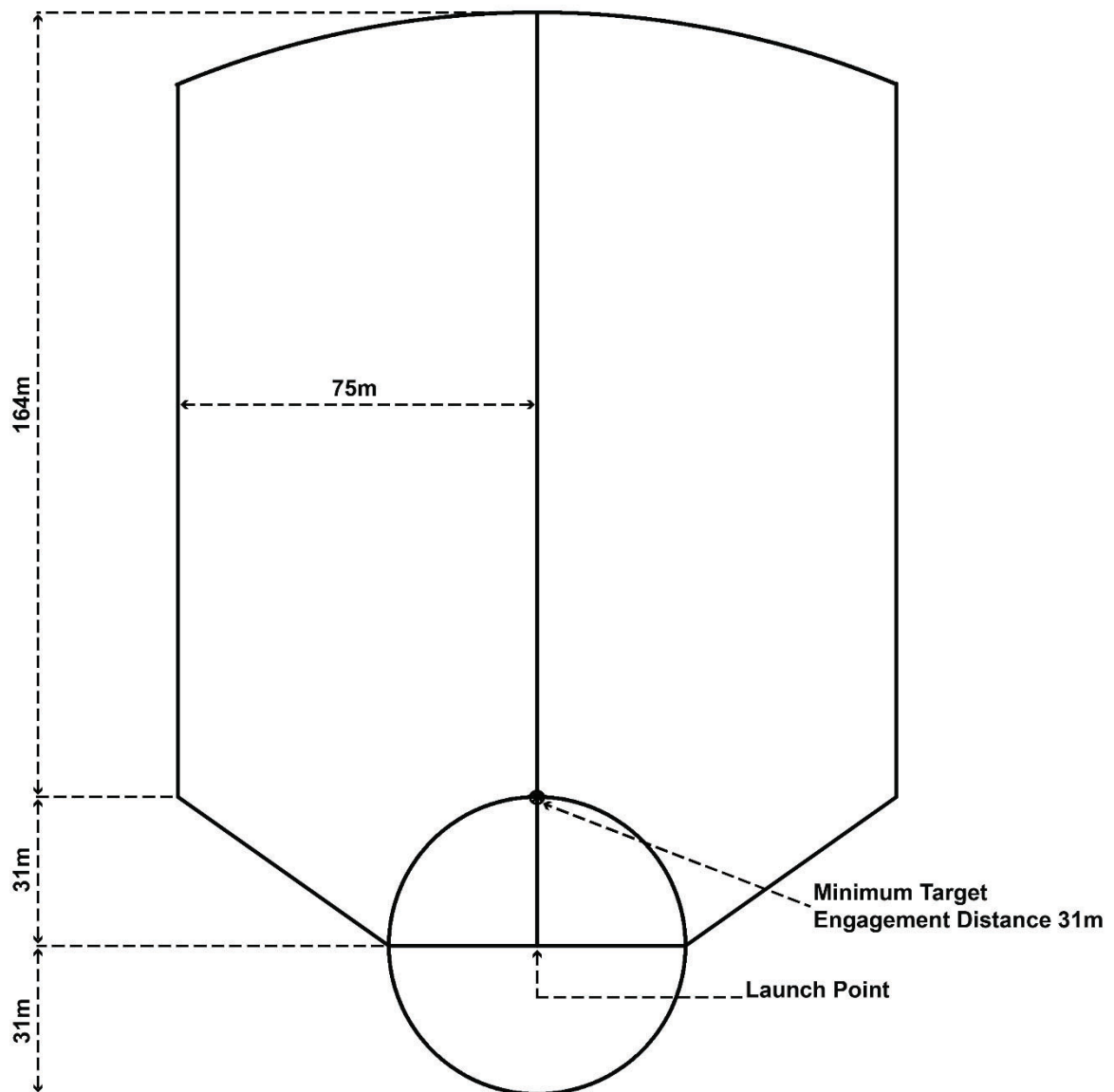


Figure 15–13. Surface danger zone for Non-Lethal/Tube-Launched Munition System

15–16. Special Effects Small Arms Marking System (Marine Corps)

- a. The SESAMS is a Marine Corps training system that fires a marking cartridge (colored dye) to enhance realism for force-on-force training. Improper use of the SESAMS training system may cause serious personal injury or damage to equipment.
- b. The mixing of live ammunition and SESAMS rounds is prohibited.
- c. Installation commanders should establish a RSO program that specifically addresses SESAMS training system requirements. SESAMS training systems will also be addressed in the installation's range SOP.
- d. Upon completion of the SESAMS RSO requirements, installation commanders will certify Marine staff sergeants (and above) or other Service equivalent as SESAMS RSO.
- e. Before SESAMS firing—
 - (1) Ensure that only Marine Corps procured adapter kits and marking cartridges are used.

(2) Force-on-force training with SESAMS 9mm DoDICs AA12 and AA21 is prohibited when temperatures are below 38 degrees Fahrenheit. Training with SESAMS 5.56mm DoDICs AB05 and AB06 is prohibited when temperatures are below 18 degrees or above 104 degrees Fahrenheit.

(3) Account for and remove all live ammunition from the designated training area prior to commencement of SESAMS training exercises.

(4) Instruct all participants that head shots are not authorized.

(5) Ensure that all personnel within the 150 m safety distance (zone) wear PPE Level 0 protective equipment and clothing. The use of groin protection and gloves is highly encouraged.

(a) The FX 9000 and 9003 Protective Face Masks are authorized for use. The FX 9003 Protective Face Mask is specifically authorized for use with DoDICs AB05 and AB06.

(b) The MCU-2A/P Chemical Biological Mask may be used for face and eye protection only if the hard outer eye shields and the C2 canister are attached prior to use with the SESAMS training system.

(c) A balaclava, towel, or neck scarf will be worn so as not to expose any portion of the neck and throat. A commercially-produced neck protector is also available from Simunition, the FX 8000 Protective Throat Collar.

(6) Ensure that the 150 m safety distance (zone) remains clear of unprotected personnel.

f. During SESAMS firing—

(1) Ensure that qualified medical personnel and appropriate medical equipment are available during all SESAMS training exercises (same as live-fire).

(2) Ensure all personnel wear appropriate hearing protection during all SESAMS training exercises.

(3) Ensure that a minimum safe engagement distance of 2 m (6.5 ft) for the 9mm SESAMS training system and 4 m (13 ft) for the 5.56mm system is established and maintained from the muzzle.

g. After SESAMS firing—

(1) Ensure all weapons are returned to their operational state and a function check is performed.

(2) Account for and return all unused ammunition to the appropriate location in accordance with current applicable directives.

15–17. Close combat mission capability kit (Army)

a. Personnel engaged in CCMCK force-on-force training will wear PPE in accordance with the procedures, restrictions, and other guidance in technical and operator manuals, references, and pamphlets (see TM 9–6920–3700–10). No personnel will be allowed within 75 m of the outermost boundary of the training area when force-on-force training is being conducted without meeting the minimum PPE safety requirements.

b. Participants will be instructed that no head shots will be taken.

c. The minimum engagement distance is 1.5 m (5 ft).

d. Participants will be inspected by the RSO, noncommissioned OIC, or OIC prior to the initiation of training to ensure that PPE is worn and that employed individual weapons (M16/M4/M249/M9/M11) have been properly converted to fire low-velocity marking ammunition.

e. Single-hearing protection is required to be worn within 5 m of 9mm and 5.56mm weapons using CCMCK marking ammunition during firing (see para 2–20c for eye protection requirements).

f. Ensure that the 60 m (9mm) or 75 m (5.56mm) safety distance (zone) remains clear of unprotected personnel.

g. Vertical ricochet hazard is 15 m (9mm) and 16 m (5.56mm).

Chapter 16

Mines, Firing Devices, Trip Flares, Simulators, and Explosive Charges

16–1. General

a. This chapter addresses basic procedures for handling and detonating explosives, mines, firing devices, trip flares, and simulators used by personnel in training. These procedures do not include projectiles, rockets, bombs, fuzes, or firing devices covered in other paragraphs of this regulation/order unless otherwise stated.

b. The following safe practices pertain to standard military and commercial explosives used by the Army and the Marine Corps, except where noted. They also pertain to items containing explosives, such as demolition blocks and mines. Marine Corps units will use the requirements in NAVSEA OP 5, Volume 1; NAVSEA SW060–AA–MMA–010; EODB/TM/technical order 60A series; and the Guidebook for Assault Entry Techniques.

(1) For the Army, general safe practices for handling and transporting explosives are prescribed in TM 9–1375–213–12, TM 3–34.82, and DA Pam 385–64. For Marine Corps units, information regarding transportation and handling of explosives are in NAVSEA OP 5; NAVSEA SW020–AF–HBK–010; NAVSEA

SW020-AC-SAF-010; NAVSEA SW020-AC-SAF-020; NAVSEA SW020-AC-SAF-030; and MCO 5100.29C, Volume 8.

(2) EOD demolition activities will be conducted in accordance with the provisions of AR 75-15 and EODB 60 series publications for U.S. Army EOD personnel and NAVSEA OP 5 and EODB 60 series publications for Marine Corps EOD personnel.

(3) Commercial dynamite will not be stored for prolonged periods at temperatures above 90 degrees because exudation of the nitroglycerin is likely to occur. Storage below 32 degrees tends to make it sensitive to shock. Dynamite will not be moved or transported if there is evidence of exudation or if it has been frozen. In such cases, the dynamite will be considered unserviceable and will be disposed of by EOD personnel. When possible, avoid the use of commercial dynamite in a combat environment due to its storage requirements, sensitivity to moving, and possible detonation from direct-fire rounds or artillery fragments. Commercial explosives cannot be burned without risk of explosion. EOD personnel will dispose of commercial explosives.

(4) Unserviceable AE and any AE not to be used as designated for training or operations will be returned to the issuing ASP for disposition.

(5) Some foreign military explosives are not as stable as U.S. explosives. EOD personnel will dispose of foreign explosives under U.S. military control, as appropriate.

(6) Gases released by detonation of explosives are toxic. Avoid exposure to fumes. Position personnel upwind from detonation points and wait until smoke and fumes disperse before proceeding down range.

(7) Buried charges will be primed with detonating cord leading to above-ground electric or non-electric blasting caps. Blasting caps will not be buried underground as they are sensitive to shock and may detonate if hit by a metal tool or other hard object.

(8) Detonating cord should be used to prime charges on above-ground charges to minimize the need to use blasting caps. Once the explosives charges are primed with detonating cord, the detonating cord will be initiated with an above-ground electric, non-electric blasting cap, or a modernized demolition initiator.

(9) Lightning and other sources of extraneous electricity (for example, static electricity, high power lines, radio transmitters, and cellular phones) can initiate electro-explosive devices. Electro-explosive devices are subject to hazards of electromagnetic radiation to munition. Non-electric blasting techniques are invulnerable to most extraneous electric signals but not to lightning. All demolition training operations must be discontinued at the approach of an electric or severe dust storm.

(10) Detonation circuits will not be connected or armed on any munition unless the intent is to detonate the munition. When munitions are to be detonated, the area will be cleared of all non-MEP with a minimum crew remaining to connect the detonation circuit. Live blasting caps or other live detonators will not be located at training sites if munitions are not to be detonated. All personnel within the SDZ will wear approved protective helmets and hearing protection for all detonations, including while in the confines of an approved protective shelter. Improved body armor, helmet, and hearing and eye protection (Army) or PPE Level 1 (Marine Corps) will be worn by personnel within the SDZ but outside the approved protective shelter. For the Marine Corps, facility designs must be approved by the RCO and RTAM (C 465) to ensure that the protective shelter provides protection against the hazards as they are designed.

(11) Only MEP (Army) or participating personnel (Marine Corps) will be allowed in SDZs during firing.

c. When temporary open storage of explosives is used, stacks will not exceed 227 kilograms (kg) (500 lbs) of explosives. Distance between stacks should not be less than 45 m (150 ft). The RMTK On Range Ammunition Handling (ORAH) Tool should be used to produce explosive danger zones for single or multiple DoDICs when the munitions to be stored are in total support of the training mission.

(1) For the Marine Corps, the RMTK ORAH Tool should be used to produce explosives danger zones for single or multiple DoDICs when the munitions to be stored are in total support of the training mission.

(2) For the Army, the RMTK ORAH Tool may be used to produce explosives danger zones for single or multiple DoDICs when the munitions to be stored are in total support of the training mission.

d. Live and inert munitions and demolitions will not be mixed.

e. Demolition effects simulators (DES) that contain live explosives and other simulators are considered live munitions.

f. Basic demolition training will follow the procedures in TM 3-34.82. Field expedient methods outlined in applicable FMs are authorized for use. Unit commanders will receive prior approval from the installation RMA (Army) or RCO (Marine Corps) with concurrence of the installation safety manager (Army) prior to conducting activities employing field expedient procedures or explosives. During basic or familiarization demolition training, instructors will supervise not more than five students while they are priming individual charges. Not more than five students will prime charges at a time. The remainder of students and observers will withdraw to a safe position before priming occurs. Single charges placed against steel, concrete, wood, or other solid material during training or demonstrations

will be emplaced on the side nearest observers so that major fragments are propelled away from the observers. Dual initiation systems are preferred over single initiation systems to increase reliability. Consult TM 3–34.82 and use the best combination of initiation systems to decrease the possibility of misfires.

(1) *Demolition training.* While engaging in demolition training, the minimum distances in paragraph 16–1g may be reduced to 50 m (165 ft) if bare charges of not more than 2.27 kg (5 lbs) are used on the surface of specially prepared sites that conform as follows:

(a) Bare charges will be detonated on a sand cushion that has been screened and is pebble or stone free (material passes through a #10 sieve). The sand cushion will not be less than that specified in table 16–1. Subsequent charges will not be placed where cratering from previous detonations has reduced the depth of sand.

Table 16–1
Dimensions of sand cushion

| Explosive (kg/lbs) | Sand depth (m) | Radius of sand surface (m) |
|--------------------|----------------|----------------------------|
| 0.10/0.25 | 0.60 | 0.20 |
| 0.23/0.50 | 1.00 | 0.30 |
| 0.45/1.00 | 1.30 | 0.50 |
| 0.91/2.00 | 1.60 | 0.60 |
| 1.9/4.00 | 2.00 | 1.00 |
| 2.27/5.00 | 2.30 | 1.10 |

(b) Bare charges will be detonated on soil free from gravel, rock, metal, or other possible debris to a depth of at least 0.15 m (6 inches). Ground preparation will include loosening and raking the soil. A barricade constructed of sandbags or other suitable protective material at least 1 m above the surrounding level of ground will be provided between the location of the charge and personnel. Charges will be placed not less than 1 m or more than 2 m from the barricade. The detonation site will be maintained to prevent formation of clods or exposure of gravel or rock on or near the surface. It is helpful to place a layer of porous, water permeable matting (geo-textile fabric consisting of woven nylon, and polyester) between a rocky layer of soil and the upper layer of soil that must be free of gravel, rock, metal, or other potential debris. This will help prevent contamination of the upper soil layer from the migration of gravel and rock and help reduce long-term maintenance costs.

(2) *Charges placed on steel.*

(a) The preferred method of employing steel-cutting charges is in a bunker designed for that purpose. Steel-cutting charges (amount of explosives and placement) will be calculated based on appropriate formulas and tables in TM 3–34.82.

(b) If a steel-cutting bunker is not available, charges will be fired in an excavated pit that is at least 1 m deep. Steel-cutting charges fired outside of a steel-cutting bunker will not exceed 0.9 kg (2 lbs).

(c) Personnel must be a minimum of 100 m from the charge at detonation in an approved protective shelter, 300 m in defilade, or 1,000 m if in the open.

(3) *Charges placed on concrete.*

(a) Charges placed on concrete will not exceed 18 kg (40 lbs) and should be placed on the side nearest observers.

(b) Observers must be at least 100 m away in an approved protective shelter, 300 m away in defilade, or 900 m away in the open.

(c) An unoccupied distance of 900 m will be provided on the opposite side of the charge where most missile hazards will be thrown.

(4) *Personal protective equipment Level 2.* Level 2 PPE is required (see table 2–2 for specific guidance).

g. Explosives can propel lethal fragments and debris hazards great distances.

(1) The distance explosion-propelled fragments or debris will travel in air depends mainly on the relationship between weight, shape, density, initial angle of projection, and initial velocity. Fragment and debris hazards from steel-cutting charges extend a greater distance under normal conditions than that from cratering, quarrying, or surface charges of bare explosives.

(2) Fragment and debris hazard distances at which personnel in the open are relatively safe from missiles created by bare charges placed in or on the ground, regardless of type or condition of the soil, are as follows:

(a) Charges more than 227 kg (500 lbs): minimum 800-m fragment and debris hazard distance.

- (b) Charges from 12 kg (27 lbs) to 227 kg (500 lbs), computed from the formula: safe distance in meters equals 100 times the cube root of the pounds of explosive (distance=100 x W^{1/3}).
- (c) Less than 12 kg (27 lbs): minimum 300-m fragment and debris hazard distance.
- (d) See table 16–2 for computed safe distances for personnel near bare charges.

Table 16–2
Safe distances for personnel near bare charges

| Charges | Missile hazard distance (m) |
|-----------------------------------|-----------------------------|
| More than 227 kg/500 lbs | Minimum 800 |
| 12.27 kg/27 lbs to 227 kg/500 lbs | Computed ¹ |
| Less than 12.27 kg/27 lbs | Minimum 300 ² |

Notes.

¹ Computed missile hazard distance in meters equals 100 times the cube root of the pounds of explosive: (distance=100 X W^{1/3}).

² When charges less than 5 pounds are placed on specially prepared or selected sites (see para 15–1f(2)(a)) to eliminate a missile hazard, distance may be reduced to not less than 50 m.

(3) For 0.25-lbs charges used to simulate enemy artillery fire and mortar fire that are detonated in specially constructed demolition pits constructed as described in paragraph 16–12e(8), the minimum distance may be reduced to not less than 3 m.

h. Blast effects generate hazards.

(1) Generally, the greatest danger to personnel is missiles thrown by an explosion. However, blast effect (such as an increase in air pressure) also generates hazards to personnel located within the SDZ. Special protective features used at detonation or demolition sites to eliminate or confine missiles may not reduce or mitigate overpressure and noise hazards.

(2) Hearing protection is required for any exposure to noise greater than 140 dBP. Follow the hearing protection recommendations listing in the TMs for the explosive devices used. If the hearing protection recommendations are not listed in the manuals, compute the 140 dBP contour from the formula: distance to 140 dBP contour in meters equals 300 times the cube root of the weight of explosive in kg (distance=300 x W^{1/3}). Table 16–3 contains the distances for various weights of explosives.

Table 16–3
Hearing protection distances

| Weight of explosives (kg) | Weight of explosives (lbs) | Distance to 140 dBP contour (m) |
|---------------------------|----------------------------|---------------------------------|
| 0.10 | 0.25 | 145 |
| 0.23 | 0.50 | 183 |
| 0.45 | 1.00 | 230 |
| 0.91 | 2.00 | 290 |
| 2.27 | 5.00 | 394 |
| 4.45 | 10.00 | 497 |
| 9.10 | 20.00 | 626 |
| 22.70 | 50.00 | 849 |
| 45.00 | 100.00 | 1,070 |
| 91.00 | 200.00 | 1,348 |

i. Explosive entry techniques are used when assault personnel require immediate access to the target. To train for this type of mission, individuals may be required to be closer to the detonation than authorized in paragraph 16–14. Such operations will require a deviation in accordance with chapter 4.

16–2. Firing devices

a. Electrical firing will be used with caution and will be replaced by non-electric firing systems when the possibility exists of unintentional detonation from extraneous electrical energy sources (for example, power transmission lines,

cellular telephones, generators, radios, or any weather conditions that produce static electricity or lightning). Electric blasting circuits must be checked for stray electromagnetic energy by using a test set. Test sets will not detect non-transmitting portable equipment that may be in the vicinity. Therefore, total reliance must not be placed on these detection methods to ensure the safety of personnel. Areas selected for demolition training sites will be surveyed for electromagnetic energy. This survey is an installation responsibility. Areas will be controlled to prevent entry of portable transmitting equipment from the surrounding area. The data in tables 16–4 through 16–6 showing transmitter and radiative power in watts and minimum separation distances to electric blasting operation apply to operation of a radio, radar, and television transmitting equipment.

Table 16–4
Minimum safe distances between radio frequency transmitters and electric blasting operations

| Transmitter power (watts) | Commercial AM broadcast transmitters (m) | HF transmitter other than AM broadcaster (m) |
|---------------------------|--|--|
| 100 | 229 | 229 |
| 500 | 229 | 519 |
| 1,000 | 229 | 732 |
| 4,000 | 229 | 1,464 |
| 5,000 | 259 | 1,678 |
| 10,000 | 397 | 2,318 |
| 25,000 | 610 | 3,360 |
| 50,000 ¹ | 854 | 5,185 |
| 100,000 | 1,190 | 7,320 |
| 500,000 ² | 2,684 | 16,755 |

Legend:

AM=amplitude modulation

HF=high frequency

Notes.

¹ Present maximum power of U.S. broadcast transmitters in commercial AM broadcast frequency range (535 to 1,605 kHz).

² Present maximum for international broadcast.

Table 16–5
Minimum safe distances between television and frequency modulation broadcast transmitters and electric blasting operations

| Effective radiative power (watts) | Channels 2 to 6 and FM (m) | Channels 7 to 13 (m) | UHF (m) |
|-----------------------------------|----------------------------|----------------------|---------|
| Up to 1,000 | 315 | 229 | 183 |
| 10,000 | 549 | 397 | 183 |
| 100,000 ¹ | 976 | 702 | 336 |
| 316,000 ² | 1,312 | 915 | 442 |
| 1,000,000 | 1,769 | 1,220 | 610 |
| 5,000,000 ³ | 2,745 | 1,891 | 915 |
| 10,000,000 | 3,111 | 2,257 | 1,068 |
| 100,000,000 | | | 1,803 |

Notes.

¹ Present maximum power, channels 2 to 6 and FM.

² Present maximum power, channels 7 to 13.

³ Present maximum power, channels 14 to 83.

Table 16–6
Minimum safe distances between mobile radio frequency transmitters and electric blasting operations—Continued

| Transmitter power (watts) | Medium frequency, 1.6 to 3.4Mhz, industrial (m) | HF, 28 to 29.7MHz amateur (m) | VHF, 35 to 36MHz public use; 42 to 44MHz public use; 50 to 54MHz, amateur (m) | VHF, 144 to 148Mhz, amateur; 150.8 to 161.6MHz public use; 222 to 225 MHz amateur (m) | UHF, 420 to 450MHz, amateur; 450 to 460MHz, public use (m) |
|---------------------------|---|-------------------------------|---|---|--|
| 5 ¹ | | 2 | | | |
| 10 | 12 | 31 | 12 | 5 | 3 |
| 50 | 28 | 67 | 28 | 11 | 6 |
| 100 | 38 | 95 | 40 | 15 | 9 |
| 180 ² | | | | 20 | |
| 250 | 61 | 150 | 63 | 23 | 14 |
| 500 ³ | | | 89 | | |
| 600 ⁴ | 92 | 232 | 96 | 35 | 21 |
| 1,000 ⁵ | 122 | 290 | 125 | 46 | 28 |
| 10,000 ⁶ | 382 | | 397 | | |

Notes.

¹ Citizens band radio (walkie-talkie) (26.96 to 27.41MHz) MSD is 1.52 m.

² Maximum power for two-way mobile units in VHF (150.8 to 161.6MHz) range and for two-way mobile and fixed-station units in UHF (450 to 460MHz) range.

³ Maximum power for major VHF two-way mobile and fixed-station units in 35 to 44MHz range.

⁴ Maximum power for two-way fixed-station units in VHF (150.8 to 161.1MHz) range.

⁵ Maximum power for amateur radio mobile units.

⁶ Maximum power for some base stations in 42 to 44 MHz band and 1.8MHz band.

b. Electric firing will not be used for demolition training when surveys show that the transmitted field strength exceeds energy levels shown in tables 16–4 through 16–6.

c. Static electricity will be eliminated or non-electric firing systems will be used.

d. Approved firing devices (for example, M1, M1A1, M3, M5, M122, XM122, M142, or M152) employed in accordance with Army and Marine Corps FMs, TCs, and TMs are authorized for use with practice mines. Since these firing devices can be configured with practice and HE activators, care must be taken to ensure the proper activator is assembled to the proper mine. HE activators will not be used with training mines.

e. A dual electric disconnect system will be used when installing electrical firing systems on demolitions. The main source of power will be turned off and a lockout device will be used.

16–3. Percussion-Actuated Neutralizer tool

This water-driven, percussion-actuated, command-initiated (by the use of shock-tube) device is used to defeat IEDs used in training on sites that have been approved by DDESB. The Percussion-Actuated Neutralizer (PAN) tool is authorized for use at sites that have not been approved by DDESB, provided the following specifications and safety considerations are met.

a. Only the following projectiles with the listed DoDICs will be fired from the PAN tool:

(1) AA64–MK 276 MOD 0, Low-Velocity Blank (Popper).

(2) AA66 Black Powder MK 278, Medium Velocity Blank.

(3) DWEC–MK 277 MOD 0, Enhanced Blank.

b. Only the current lightweight plastic plug that seals the water in the barrel is permitted to be used.

c. Only inert targets (items that are completely void of any and all energetic materials are identified as inert) will be targeted by the PAN tool during training evolutions.

d. A barricade is not required.

e. Mission-essential quantities of nonelectric pyrotechnic lead (shock-tube) and propellant cartridges necessary for the training evolution being conducted are permitted.

f. A MSD of 100 ft will be applied for non-participating personnel from PAN tool setup and firing locations.

g. As an additional precaution, the PAN tool barrel should be pointed in a direction that has the fewest facility and personnel exposures outside the 100-ft MSD.

h. MSD for participating personnel from PAN tool firing locations will be established by the on scene commander or RSO in accordance with TM 60A-2-1-77.

i. Units training with the PAN tool will coordinate with local RCOs for training events occurring off-range at sites that have not been approved by DDESB.

16-4. Shaped charges

a. Shaped charges will be oriented so that gas jets will be directed toward the target. When practical, charges should be placed on the side of the target nearest to observers, so that the blast is directed away from them. Observers will be at least 100 m away in an approved protective shelter, 275 m in defilade, or 1,000 m for unprotected personnel, from shaped charges when fired.

b. PPE Level 1 is required.

c. The MK47 Mod 1 demolition shaped charge requires a safe separation distance of 300 m for protected personnel. For unprotected personnel, the stand-off distance is 1,610 m.

16-5. Bangalore torpedoes and Brazier charges

a. Bangalore torpedoes will only be fired while on the ground in a horizontal position. Participating personnel will be in an approved protective shelter 100 m from the charge or 200 m away in defilade. For non-participating personnel, the MSD is 1,000 m of the Bangalore torpedo. If an improvised Bangalore torpedo (Brazier Charge), in which the explosive weight exceeds the standard, is used against a steel target, fragments (missiles) could be produced which may fly further than the MSD. In that case, the SDZ for steel-cutting charges should be used. Otherwise, the SDZ for a standard Bangalore torpedo may be used for an improvised Bangalore torpedo.

b. PPE Level 1 is required.

16-6. Mine-clearing line charge

a. *Firing conditions.*

(1) Because of high exhaust temperatures, the MCLIC will not be towed behind an M1 Abrams tank.

(2) Non-participating personnel will not be allowed within the MCLIC SDZ or noise hazard contour during firing.

(3) Only participating personnel are allowed within Area F. Such personnel will be in an armored vehicle in a button-up mode with approved single-hearing protection.

(4) The M68 inert charge should not be fired more than three times, as additional firings may result in breakage of charge blocks and erratic flight of the rocket. Units will record number of firings in accordance with unit SOP.

(5) When firing the M154 Kit, all amphibious assault vehicle hatches will be closed (Marine Corps).

b. *Surface danger zone.*

(1) See figure 16-1 for SDZ requirements for firing the MCLIC with M58 HE charge. See figure 16-2 for the SDZ requirements for firing the MCLIC with M68 inert charge.

(2) Distance X takes into account the most probable event of charge or cable separation or an unrestrained rocket motor impacting down range.

(3) If the detonation command link severs during a charge or cable separation, detonation of the HE charge will not occur.

(4) The fragmentation zone required for the HE charge is for containment of fragments and debris of a normal MCLIC impact.

(5) MCLIC will not be destroyed by burning. They contain booster charges that detonate when exposed to heat or pressure. Misfired or dud line charges will be destroyed by EOD personnel only after all misfire procedures have been performed by the firing unit. For the Marine Corps, if authorized by EOD, Range Control, and the RSO, Combat Engineer Battalion personnel can destroy a misfire or dud line charge.

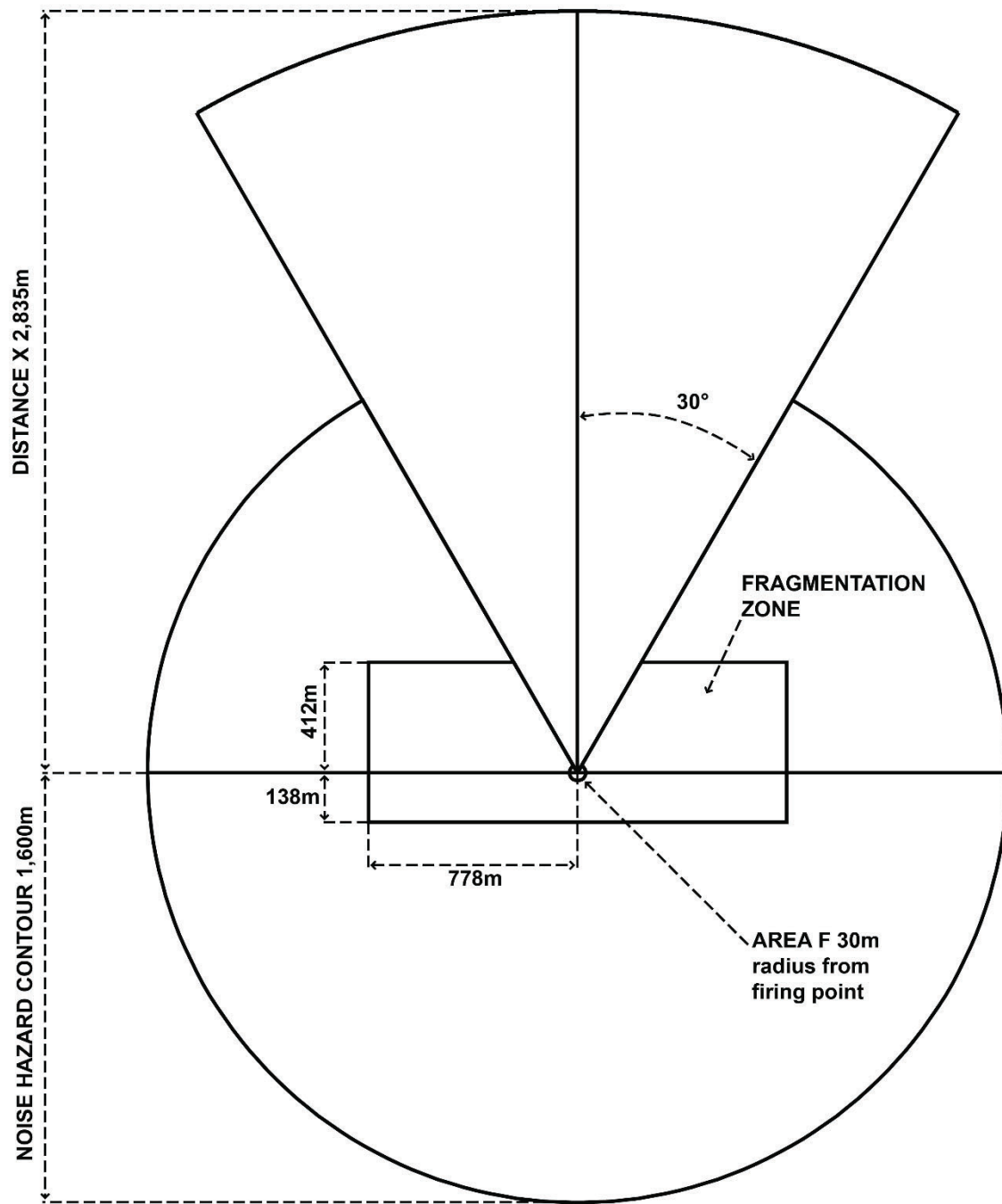


Figure 16–1. Surface danger zone for Mine-clearing Line Charge with M58 high-explosive charge

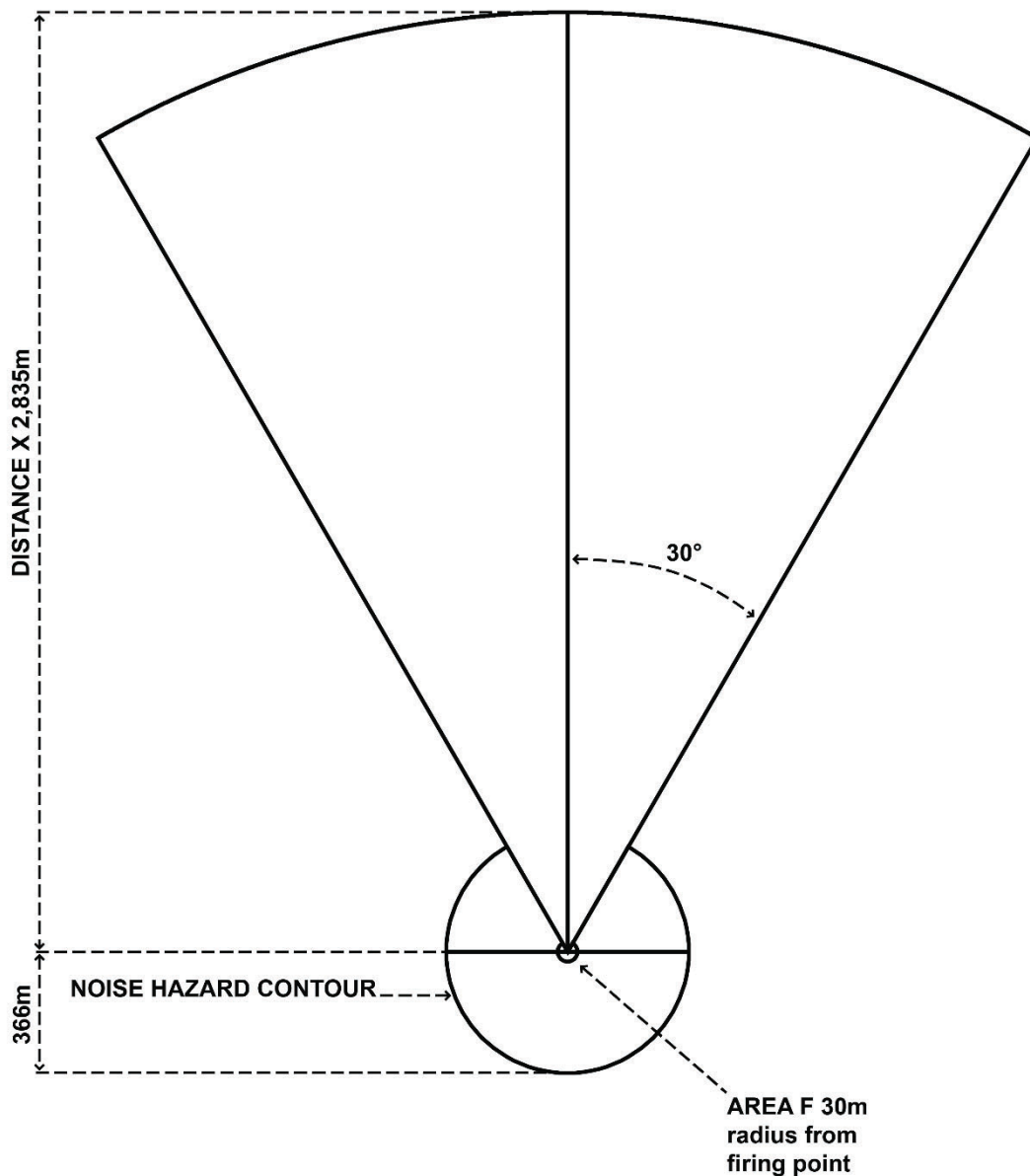


Figure 16–2. Surface danger zone for Mine-clearing Line Charge with M68 inert charge

c. Anti-Personnel Obstacle Breaching System.

- (1) Anti-Personnel Obstacle Breaching System (APOBS) firing personnel will be at least 50 m from the launch point and 75 m from the deployed grenades and in a prone position. In the event of a catastrophic detonation at the launch point, the rear exclusion area will protect personnel, provided that they are in the prone position and use hearing protection.
- (2) Personnel without hearing protection will not be permitted within 1,187 m of the launch point.
- (3) See figure 16–3 for SDZ requirements for firing the APOBS.
- (4) Vertical hazard for the APOBS is 1266 m.

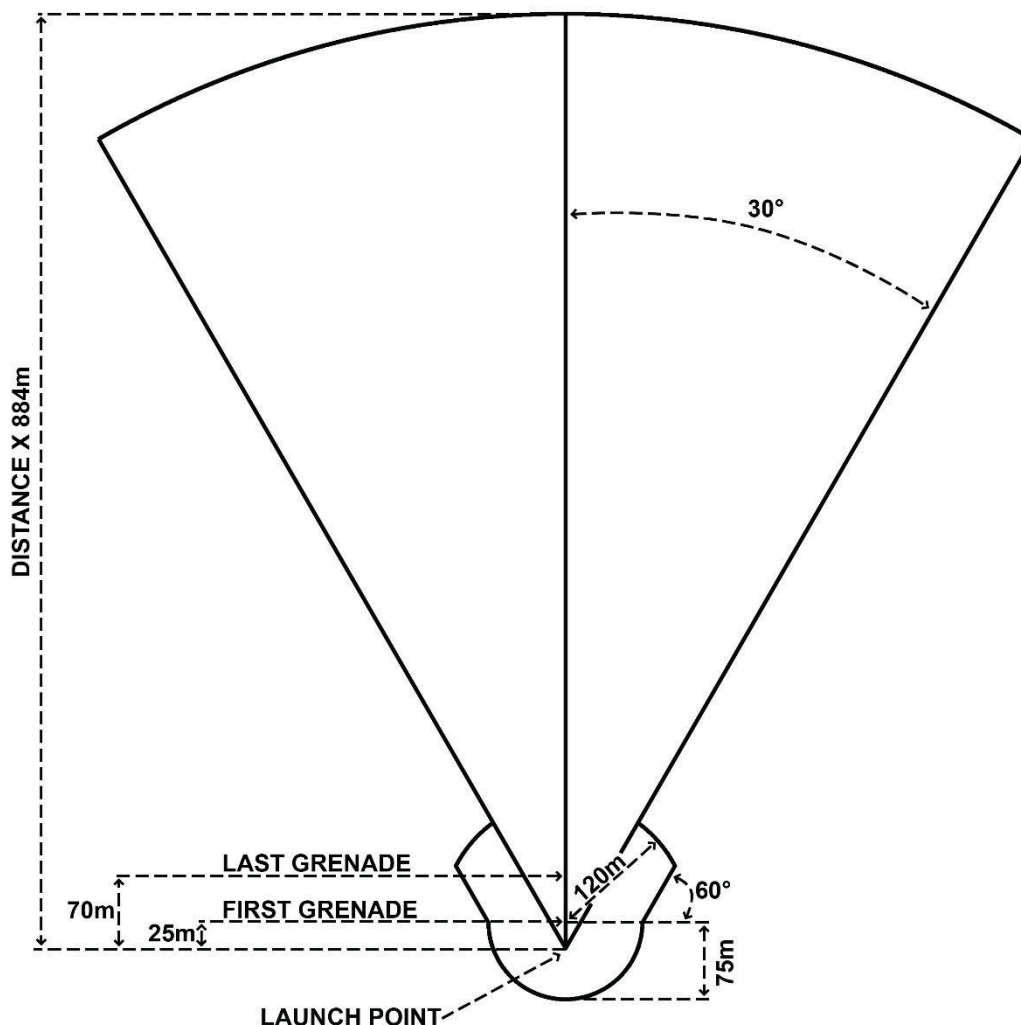


Figure 16–3. Surface danger zone for Anti-Personnel Obstacle Breaching System

16–7. Cratering charges

- a. The maximum charge to be fired in training will not exceed 145 kg (320 lbs).
- b. MSD for personnel not in approved protective shelters will depend on the net explosive weight of explosive used. MSD for up to 2 kg (5 lbs) is 100 m, for up to 30 kg (66 lbs) is 300 m, and over 30 kg (66 lbs) is 500 m.
- c. PPE Level 1 is required.
- d. Approved protective shelters, if strong enough to withstand any material propelled onto it by the detonation, located not less than 100 m from the detonation site may be occupied by personnel.
- e. All cratering charges will be dual primed with detonating cord. Blasting caps will not be placed underground. Electric or non-electric caps or modernized demolition initiator will be attached to the detonating cord above ground.

16–8. Homemade explosives (Marine Corps)

- a. Training with homemade explosives to meet training and readiness standards will be conducted on operational training ranges that are certified in accordance with MCO 3550.9A. This training is specifically for personnel with MOS 2305 and 2336 in the grades of sergeant to lieutenant colonel.

- b. Homemade explosives must not exceed the allowable net explosive quantity or net explosive weight for the installation or the range on which the explosive activity is being conducted in accordance with this order and Defense Intelligence Agency Homemade Explosives, to include training conducted on DDESB-sited ranges.
- c. PPE level will be in accordance with paragraph 2–20 and NAVMC DIR 5100.8.
- d. RM worksheet will be completed in accordance with MCO 5100.29C.
- e. Segregation of hazardous materials (hazard classes 1–8) during transportation and storage will be in accordance with 49 CFR 172.101 and 49 CFR 177.848.
- f. Mixed or cured precursors will not be stored with hazardous materials, regardless of class or division.

16–9. Mines

a. Practice and inert mines will be color-coded in accordance with MIL–STD–709D and will have the appropriate identification marking stenciled on them. Service, practice, and inert mines and fuzes will not be mixed.

(1) Inert mines and mine fuzes do not present a safety hazard. They will be color-coded and marked in accordance with MIL–STD–709D to prevent mixing with practice and HE mines.

(2) Practice mines and their fuzes contain a small, low explosive charge or a smoke producing increment. They will be color-coded in accordance with MIL–STD–709D.

b. Training with non-self-destruct mines is prohibited.

c. Claymore antipersonnel mines will be operated under the following conditions:

(1) *Firing conditions.*

(a) Range OIC will ensure mines are installed correctly and facing into the impact area.

(b) All mines will be secured until the range OIC directs their issue.

(c) Emplaced mines will not be disarmed except by order of the range OIC.

(d) Firing devices will only be connected at the command of the range OIC.

(e) When more than one mine is to be fired, the range OIC will ensure that previous firings have not dislodged the other mines in the impact area.

(f) After firing, the impact area will be inspected to ensure that all mines have detonated.

(g) Misfires will be handled in accordance with TC 3–22.23.

(h) Personnel will not be allowed within 16 m to the rear of the mine. Firing personnel may occupy an area between 16 and 100 m to the rear of the mine if they are located in a covered position, lying prone in a depression, or behind a physical barrier. All personnel will wear approved protective helmets, body armor, eye protection, and single-hearing protection. When the mine is tied to a tree or fired in an area that attenuates the secondary missile hazard, friendly troops within a 16 m to 50 m radius behind the mine must be in a covered position.

(2) *Surface danger zone.*

(a) See figure 16–4 for SDZ requirements for firing the M18 and M18A1 Claymore mine.

(b) Vertical hazard for the claymore is 400 m.

(c) Care must be exercised when installing mines to prevent the creation of secondary fragment and debris hazards.

(d) All personnel will wear PPE Level 1.

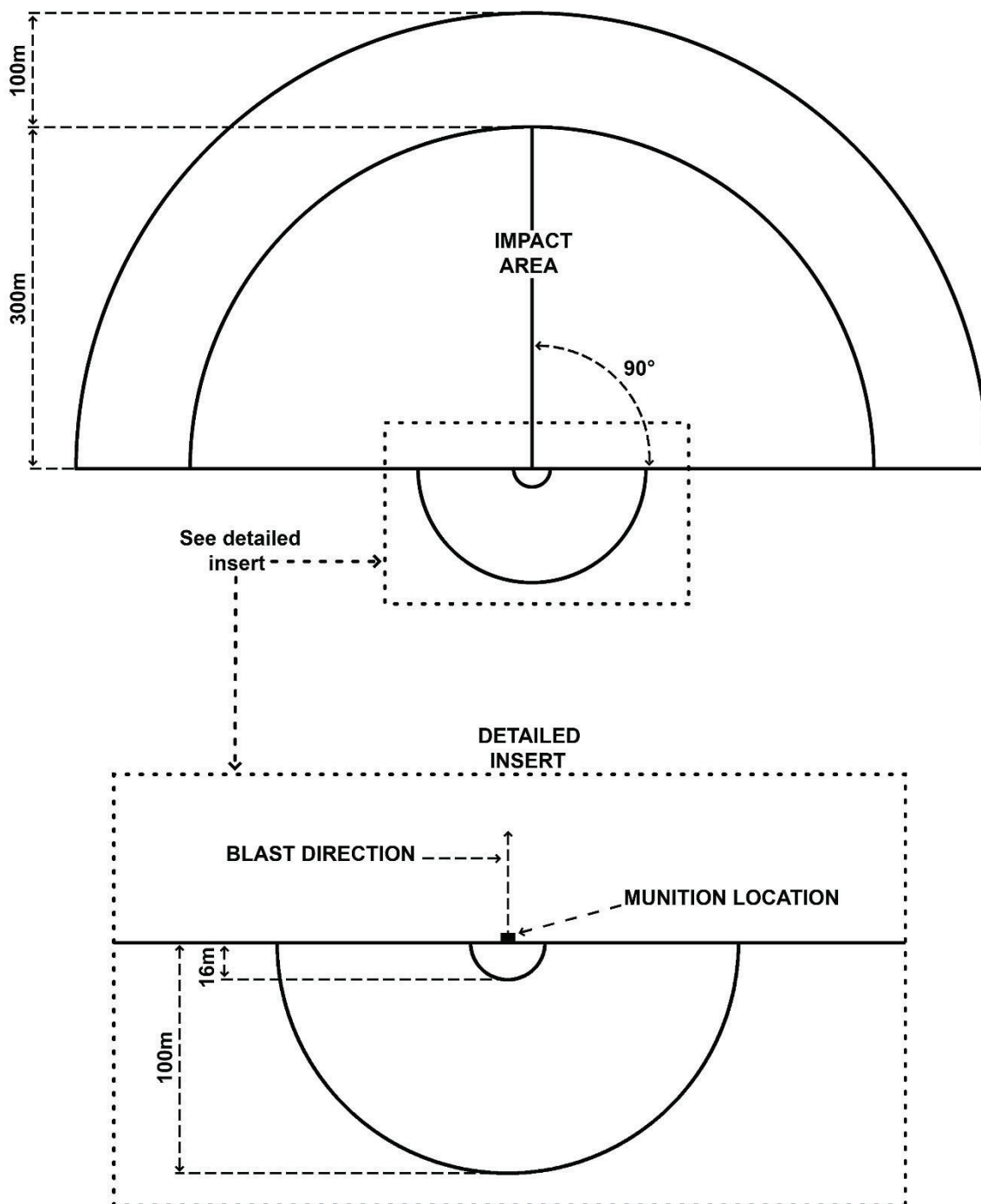


Figure 16–4. Surface danger zone for Claymore mines

d. The Volcano multiple delivery mine system is a rapid mine-dispensing system for launching anti-tank mines from various vehicles. The air system uses UH–60 Blackhawk helicopters (see figs 16–5 and 16–6 for SDZ requirements for the air system). The SDZ for the air system is dependent upon aircraft speed, altitude, and the dispenser

control setting. The ground system uses cargo or dump truck (see figs 16–7 and 16–8 for SDZ requirements for the ground system).

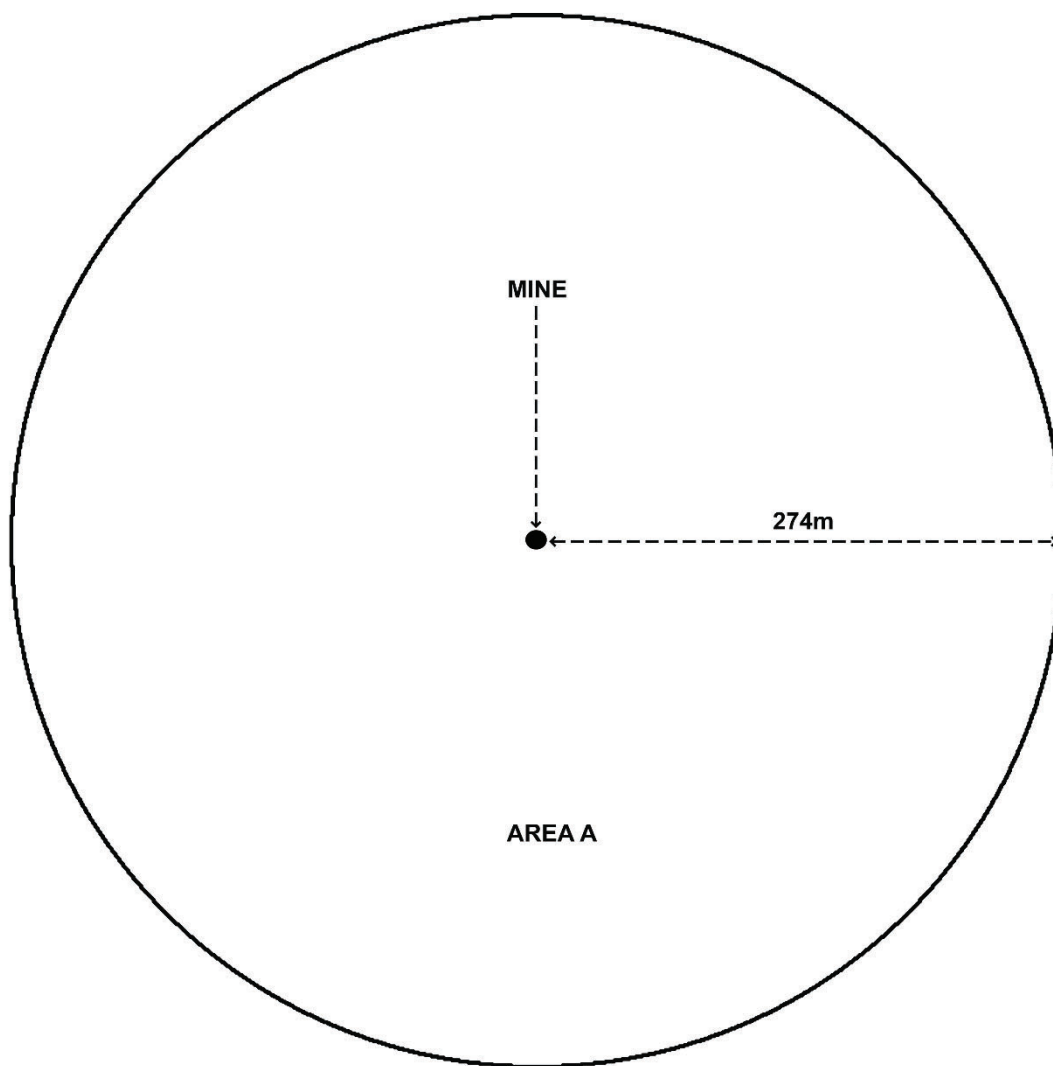


Figure 16–5. Surface danger zone for Air Volcano anti-personnel multiple delivery mine system

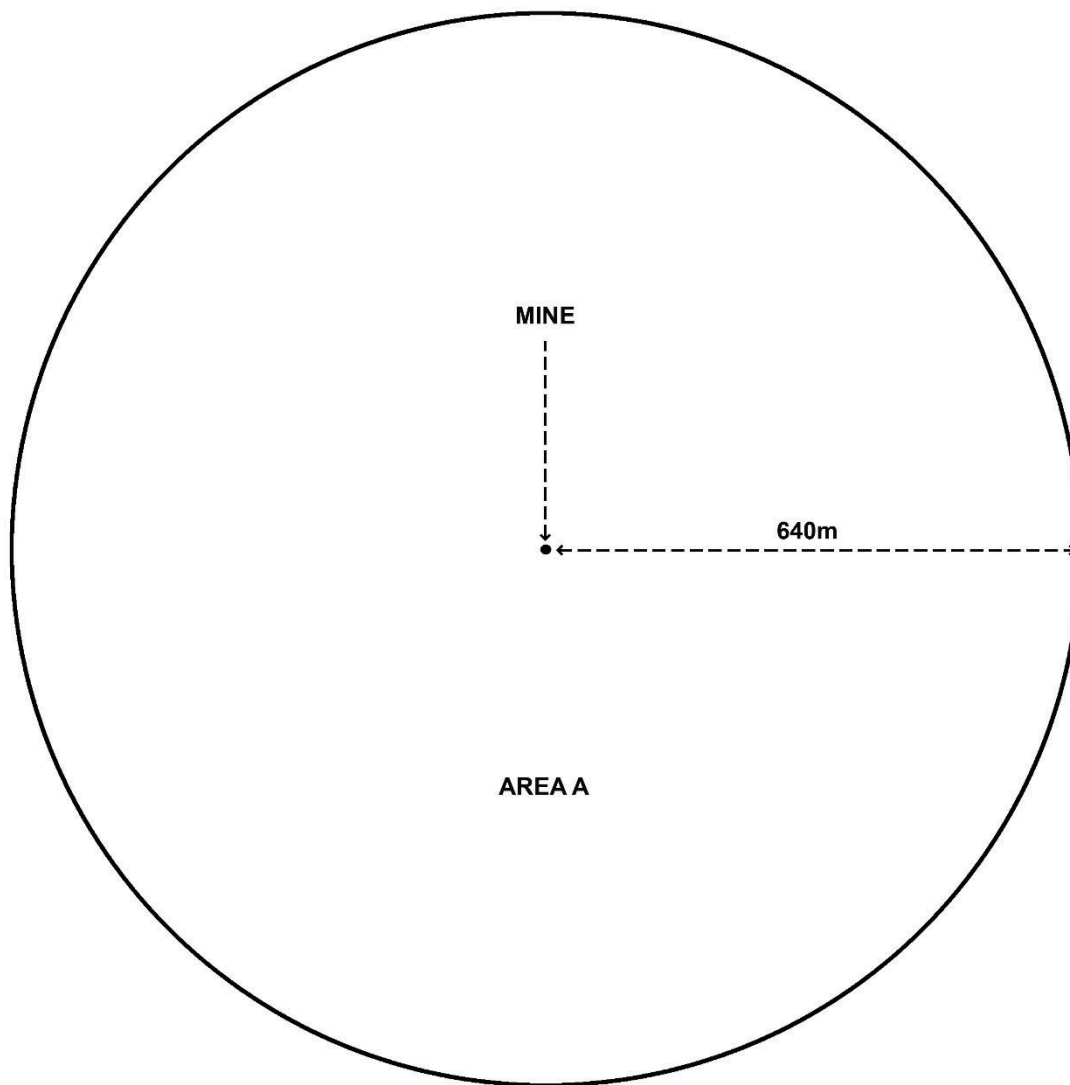


Figure 16–6. Surface danger zone for Air Volcano anti-tank multiple delivery mine system

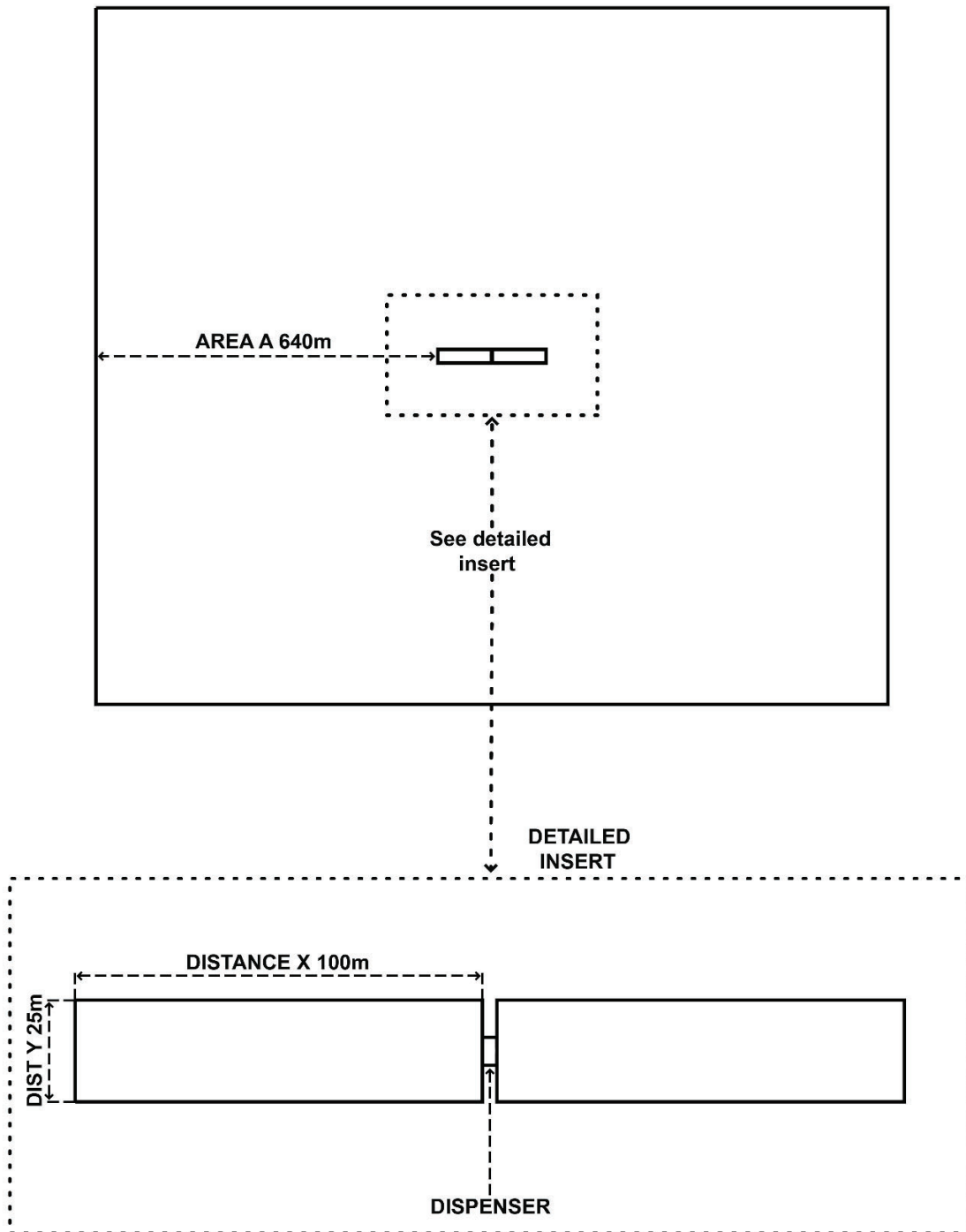


Figure 16-7. Surface danger zone for M87 and M87A1 ground Volcano multiple delivery mine system

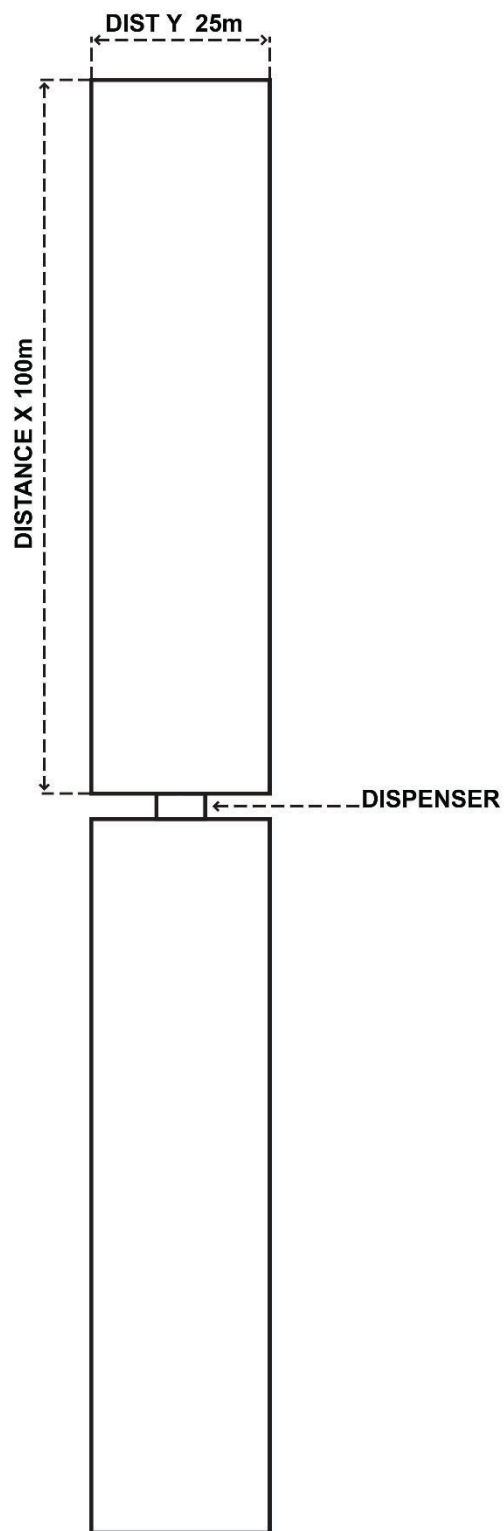


Figure 16–8. Surface danger zone for M88 ground Volcano multiple delivery mine system

e. Spider XM7 Network Command Munition is a remote-controlled APERS munition system. It is composed of three main components—

(1) The Remote Control Unit is a hand-held computer used to monitor and control the functioning of the Spider munition field.

(2) The Repeater is a relay device that is used, if necessary, to extend the down-range control of the Remote Control Unit.

(3) The Munition Control Unit can employ up to six miniature grenade launchers (MGLs). Each MGL has a MSD of 138 m.

(4) Instead of MGLs, the Munition Control Unit can employ up to six munition adapter modules (MAMs). A MAM provides the interface to fire attached lethal or non-lethal munitions (such as the M18 Claymore, the M5 MCCM, and modernized demolition initiator-initiated explosives, to include the shock-tube initiation devices such as the M11, M12, M13, M21, and M23). The SDZ for the Spider XM7 using the MAM will depend on what types of peripheral devices (either lethal or non-lethal) are connected.

16–10. Firing devices

a. Follow instructions in TM 9–1375–213–12 when installing, arming, and disarming firing devices.

b. Firing devices and fuzes, either with or without the standard bases, will not be pointed at personnel.

c. Standard bases containing unfired percussion caps, firing devices, and fuzes will not be carried in the pocket.

d. Standard bases containing unfired percussion caps will be kept separated from firing devices and fuzes until the firing device or fuze is ready to be installed in the mine or booby trap.

e. Safety pins on firing devices and fuzes should be checked for ease of movement before attaching the standard base. The safety pins for locking and positive safeties should easily move.

f. Before removing the tripwire, the positive safety will be installed on armed firing devices or fuzes having a tripwire attached.

g. The assembly, arming, and disarming of antipersonnel mine fuze M605 will be in accordance with TM 9–1345–203–12.

16–11. M48 and M49 trip flares

a. Use inert flares to instruct students in the use, emplacement, and fuzing of service flares. Safeguard trip flare to ensure training personnel do not inadvertently detonate device closer than 2 m of the emplaced flare.

b. Clear trip flare firing positions of flammable material to prevent accidental fires. Do not use the M48 trip flare in areas where fire could cause serious damage.

16–12. Simulators

a. M80 explosive simulators detonate 3 to 5 seconds after ignition of the fuse cord and are capable of causing serious injury. Fuse cord tips should not be split since this reduces burning time and increases the potential for injury to personnel. Do not use M1 and M2 type fuse igniters to ignite the M80 fuse cord or hold the M80 simulator when ignited.

b. Procedures for the safe use of other simulators are available in TM 9–1370–206–10, TM 9–1370–207–10, and TM 9–1370–208–10. No attempt will be made to disarm or disassemble simulators.

c. See TM 9–1370–207–10 for the M142 atomic explosion simulator firing precautions.

d. Commercially manufactured fireworks (designated for civilian use) will not be handled, stored, or used in any way by military personnel on an installation.

e. When explosive charges (TNT blocks or composition C4) are used to simulate detonation of mines and incoming artillery projectiles, mortars, and bombs during exercises or on the infiltration course, the following procedures will be used:

(1) Charges will be fired in specially prepared detonation pits with the charge positioned in the center of the pit (see para 16–12e(8) for demolition pit requirements).

(2) Only charges of standard-issue TNT blocks or composition C4 of one-quarter pound will be used. Composition C4 may be cut into 0.25-lbs blocks in accordance with TM 3–34.82. TNT blocks will be cut in accordance with the instructions in the corresponding TM.

(3) Charges will be detonated electrically from a position that allows a clear view of the pit and the immediate vicinity. Follow safety precautions in paragraph 16–2 and tables 16–1 through 16–3 when using electric blasting caps and circuits.

(4) Blasting circuit wires leading to charges in the detonation pits will be buried, preferably in conduit, or otherwise secured to prevent personnel from becoming entangled in or tripping over the wires.

- (5) Only one charge will be emplaced in a pit at a time.
- (6) Pits will be inspected and cleared of objects prior to emplacing charges to remove potential hazardous missiles.
- (7) Charges may only be detonated when crawling personnel are 3 m or more from the center of the pit and erect personnel are 25 m or more from the pit.
- (8) Detonation pits will be constructed in the following manner:
 - (a) Pits will be excavated in the shape of a cone at least 1.5 m in diameter by 0.6 m deep. Excavated pits will be backfilled 0.3 m with clean, clay-free sand that has passed through a #10 screen. Any object larger than sand grain size is considered a pebble. Pits will be free draining so that the sand filled area will quickly drain clear of water. Soil conditions may require that drains be constructed.
 - (b) A ring of sandbags or other suitable barrier material (for example, treated timbers) 0.6 m high with an inside diameter of 2 m will be constructed around each pit. Construct a barrier at least 1 m outside of the sandbag rings that does not project above the top of the sandbags. These detonation pit barriers will be physically different from any other barrier that personnel are expected to negotiate and will be sufficient to keep personnel 1 m away from the detonation pits.
 - (c) Dimensions in paragraphs 16–12e(8)(a) and 16–12e(8)(b) for detonation pits and sandbag rings with barriers are minimum requirements and will not survive extensive use without frequent maintenance. Larger diameters and depths and double-walled sandbag rings are recommended for detonation pits used more than once a week.
 - (d) A dual electrical disconnect system will be used when charges are being placed in the pits. The main source of power will be turned off by the individual placing the charge in the pit. Once the power is turned off, a lockout device will be used.
 - f. DES charges are explosives that use detonating cord, blasting caps, a modern demolition initiator, cardboard, and sand or chalk to simulate other explosives. Extreme care must be exercised when using DES. DES is an explosive and all safety guidance in this regulation/order and TM 3–34.82 must be followed. All procedures and MSDs for the charge that is simulated must be followed (for example, a DES Bangalore torpedo would require the same MSDs and procedures for an actual Bangalore torpedo). All DES must be marked as DES.
 - g. IED simulators provide visual and audible effects with minimal risk to participants. These devices can be remote-detonated or hard-wired for direct firing.
 - (1) The use of non-pyrotechnic IED simulators with pyrotechnics or explosives is not authorized.
 - (2) The use of flour or starch-based products in place of the recommended smoke simulation powders is not authorized. Flour and starch-based products can be flammable and the resulting plume of flour or starch-based product could ignite should an ignition source be present.
 - (3) Non-pyrotechnic IED simulators can produce extreme recoil reaction when initiated. Simulators must be secured using ground stakes or sandbags.
 - (4) Never attempt to alter non-pyrotechnic IED simulators or operate them with any altered, broken, or missing parts. The misuse of this equipment may cause serious injury or death.
 - (5) Remote initiators must be in the possession of the individual making the electrical or pneumatic connections. Initiators will not be connected to the non-pyrotechnic IED simulator until all safety requirements have been met.
 - (6) Hazard areas for IED simulators are available in equipment instruction manuals and must be enforced at all times. Personnel within the hazard area of a non-pyrotechnic IED simulator will wear the following PPE: eye protection, single-hearing protection, and helmet.
 - (7) Do not place a non-pyrotechnic IED simulator in such a manner that it will be pointed at personnel when initiated.
 - (8) Should a non-pyrotechnic IED simulator fail to function, a wait time of 10 minutes is to be observed prior to approaching the simulator. Simulators are to be disarmed (disconnect the device from the initiator) and approached from the base end. Ensure discharge end is pointed down range and that the device is secured to prevent movement.
 - (9) All setup, training, and disassembly involving live (armed) non-pyrotechnic IED simulators will be conducted outdoors.
 - (10) Non-pyrotechnic IED simulators will not be stored, carried, or transported live. They are not to be assembled until they are on site and being readied for immediate use.
 - (11) OICs, RSOs, and personnel using non-pyrotechnic IED simulators will receive training prior to receiving equipment and the use of it in training exercises. Only those personnel who complete the required training will be authorized to draw the equipment from issue sites.
 - (12) Strict accountability must be maintained of non-pyrotechnic IED simulators as they are functional and realistic in appearance.

(13) The compressed carbon dioxide gas used to activate the cuing devices can cause serious injury or death if improperly handled. Follow safety instructions in equipment instruction manuals regarding the use of the carbon dioxide gas and its containers.

h. The following must be observed for adequate protection of the various parts of the Man-portable Aircraft Survivability Trainer Weapon Effect Signature Simulator, XM176:

(1) The SDZ for the XM176 is a circle with a radius of 10 m from the WESS launcher. This distance will also provide the minimum 2 m safe distance for ultraviolet exposure and the minimum 6 m safe distance for IR exposure to the skin and eyes.

(2) Require everyone within 33 m of the WESS launcher to wear single-hearing protection.

16–13. Safety requirements for firing aerial pyrotechnics (Marine Corps only)

a. Personnel participating in exercises that include the firing of aerial pyrotechnics, such as Smokey Sams or Smokey Guns, will wear PPE Level 1 and other protective equipment required by SOPs.

b. Inspect Smokey Sam rockets prior to use and report all rockets that appear to have moisture damage. Damaged rockets will not be fired.

c. When firing these pyrotechnics, anyone may stop the firing sequence if it is not safe to fire or if the dispensing aircraft is within 610 m (2,000 ft) as prescribed in NAVAIR 11–75–63.

16–14. Training conducted in explosive entry techniques

a. Explosive entry techniques are used in operations where assault personnel require immediate access to the target or structure. To train for this mission, individuals must be closer to the detonation than is authorized elsewhere in this chapter. Because of the unique character and requirements of this training, the following special safety guidelines are established to support this training.

(1) MSD for personnel will be determined using the formula distance equals $K \times W^{1/3}$ where distance=minimum distance in feet, K =a constant (the K factor for explosive entry techniques is set at 18), and the $W^{1/3}$ =cube root of weight of the explosives in pounds. This is the limit at which the possibility of eardrum damage is less than 1 percent with single-hearing protection. This MSD is related to blast overpressure and does not reflect fragmentation or debris damage. When a barrier or shielding (such as a blast blanket) is used during training, the MSD from overpressure will be calculated using a K factor of 12.

(2) Fragmentation standoff will equal the blast standoff when a protective barrier is provided between the explosive and the personnel. This barrier may be in the form of cement, metal, or a ballistic blanket barrier. The barrier must be able to absorb all fragmentation.

(3) All personnel within the fragmentation distance of a detonation will wear PPE Level 2 with dual hearing protection. Personnel conducting the detonation will also wear fire-resistant hoods, coveralls, and gloves. Clothing with short sleeves is not authorized when conducting this training.

b. For the Marine Corps, SDZs for ranges dedicated to the conduct of explosives entry techniques will be set and approved by CG, TECOM (C 465).

16–15. M2 and M4A1 Selectable Lightweight Attack Munition and the M3 Demolition Attack Munition

a. The M2 and M4A1 Selectable Lightweight Attack Munition (SLAM) and the M3 Demolition Attack Munition (DAM) are multipurpose munitions with anti-disturbance and anti-tamper features, designed to be readily portable and hand-emplaced against lightly armored targets. The primary lethal mechanism is an explosively formed penetrator (EFP). The hazardous fragment distance of the EFP is highly dependent on the orientation of the munition and line of fire.

b. The M2 self-neutralizes and the M4A1 self-destructs. Do not attempt to change the setting after the activation lever is pulled. Once the activation lever is pulled, the time or mode on the selector switch is entered into memory and cannot be changed. Physically moving the selector switch after the activation lever is pulled appears to change the setting, but the original setting will remain in the memory.

c. The M3 DAM has one mode of operation, which is by command detonation. The DAM contains explosive but has no battery, electronics, or associated parts including sheer pin activation lever, or passive sensor. Manual warhead initiation is provided using M6 or M7 blasting caps with M1A4 priming adapter.

d. All personnel within 240 m (792 ft) of a detonating SLAM or DAM are required to wear single-hearing protection.

e. See figure 16–9 for SDZ for the M2 SLAM, M3 DAM, and M4A1 SLAM in bottom attack mode.

f. See figure 16–10 for SDZ for the M2 SLAM, M3 DAM, and M4A1 SLAM in side attack mode. Vertical hazard distance for the EFP is 2,969 m. Distance X is 236 m, except in the direction of the EFP, in which case it is 3,911 m, 20 degrees on either side of the anticipated line of travel of the EFP. Personnel outside that 40-degree cone protected by 3 in of armor may be as close as 100 m to the detonation point.

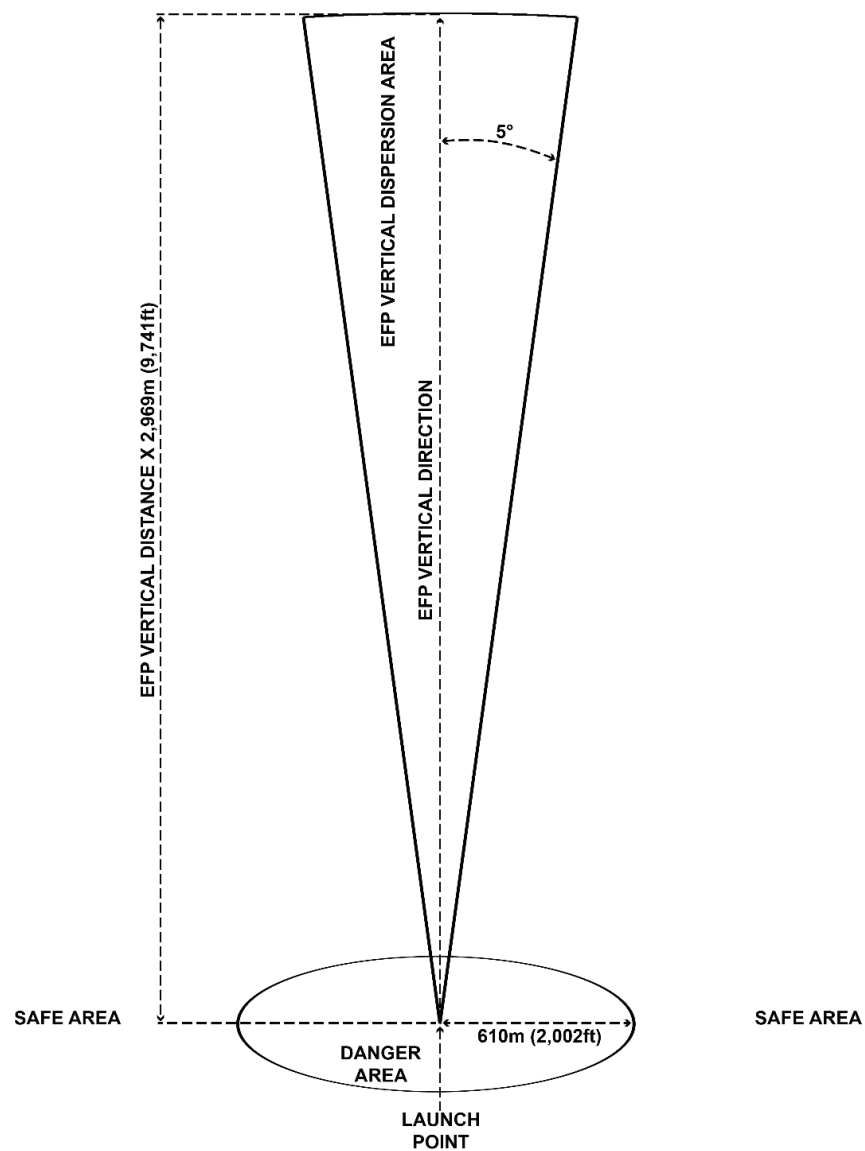


Figure 16–9. Surface danger zone for M2 and M4A1 Selectable Lightweight Attack Munition and M3 Demolition Attack Munition in bottom attack

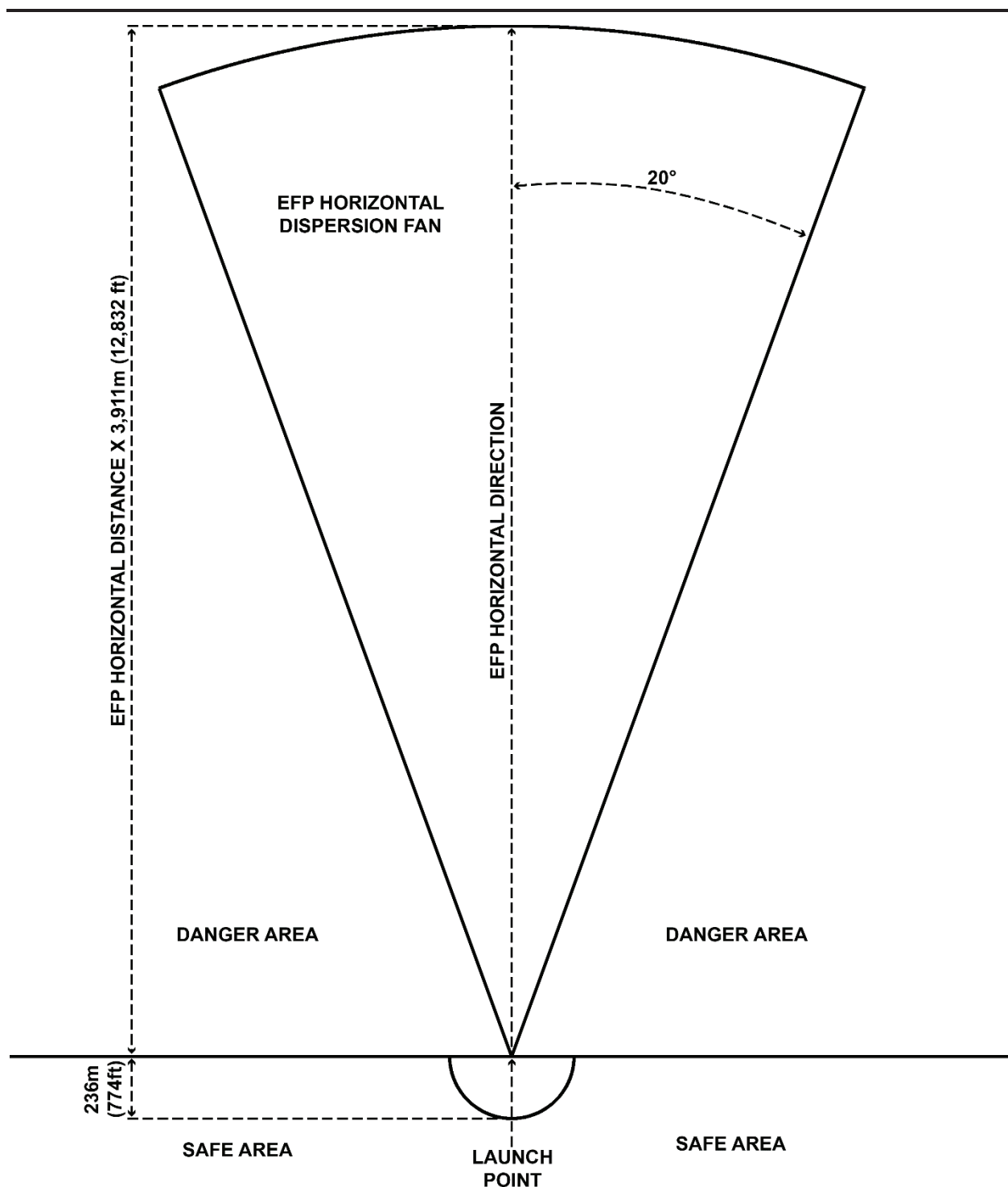


Figure 16–10. Surface danger zone for M2 and M4A1 Selectable Lightweight Attack Munition and M3 Demolition Attack Munition in side attack

16–16. Rifle Launched Entry Munition and Grenade, Rifle Entry Munition

a. The Rifle Launched Entry Munition (RLEM)/Grenade Rifle Entry Munition (GREM) M100 is a lightweight, muzzle-launched, rifle grenade designed to breakdown a door and allow the entry into a building or enclosed area with minimum hazard to the operator. The RLEM/GREM is fired from the muzzle of a personal weapon (M16-series rifles and M4-series weapons). It has a bullet trap that allows the use of 5.56mm Ball (M855 and M855A1) and M856

tracer rounds. The RLEM/GREM is launched by firing a round to a distance of at least 15 m. It has a standoff rod that provides optimal distance for initiation of the explosive charge. A disk on the end of the standoff rod prevents penetration of the rod into the target. The warhead has a plastic cover that eliminates the explosive splashing toward the gunner. The pyrotechnic adapter keeps the explosive away from the tail section, preventing flyback of the tail toward the gunner.

b. The Grenade Rifle Entry Munition-Target Practice (GREM-TP) M101 is a reusable training device used to train personnel for the GREM. The GREM-TP is externally similar in shape and form to the GREM, but it is nonexplosive. M195 grenade cartridges are used for firing because there is no bullet trap. Each GREM-TP comes with five standoff rods.

c. See table 16-7 for tabular data. See figure 16-11 for the SDZ requirements for firing the M100 and M101.

d. For personnel within 535 m of device functioning, PPE Level 1 is required.

Table 16-7
Surface danger zone data for Rifle Launched Entry Munition and Grenade Rifle Entry Munition (hard and soft targets)

| Munition | Dist X (m) | Dist W (m) | Area A (m) | Area B (m) | Angle P (deg) |
|----------|------------|------------|------------|------------|---------------|
| M100 | 135 | 25 | 90.4 | 90.4 | 33 |
| M101 | 135 | 25 | NR | NR | 33 |

Legend:
NR=not required

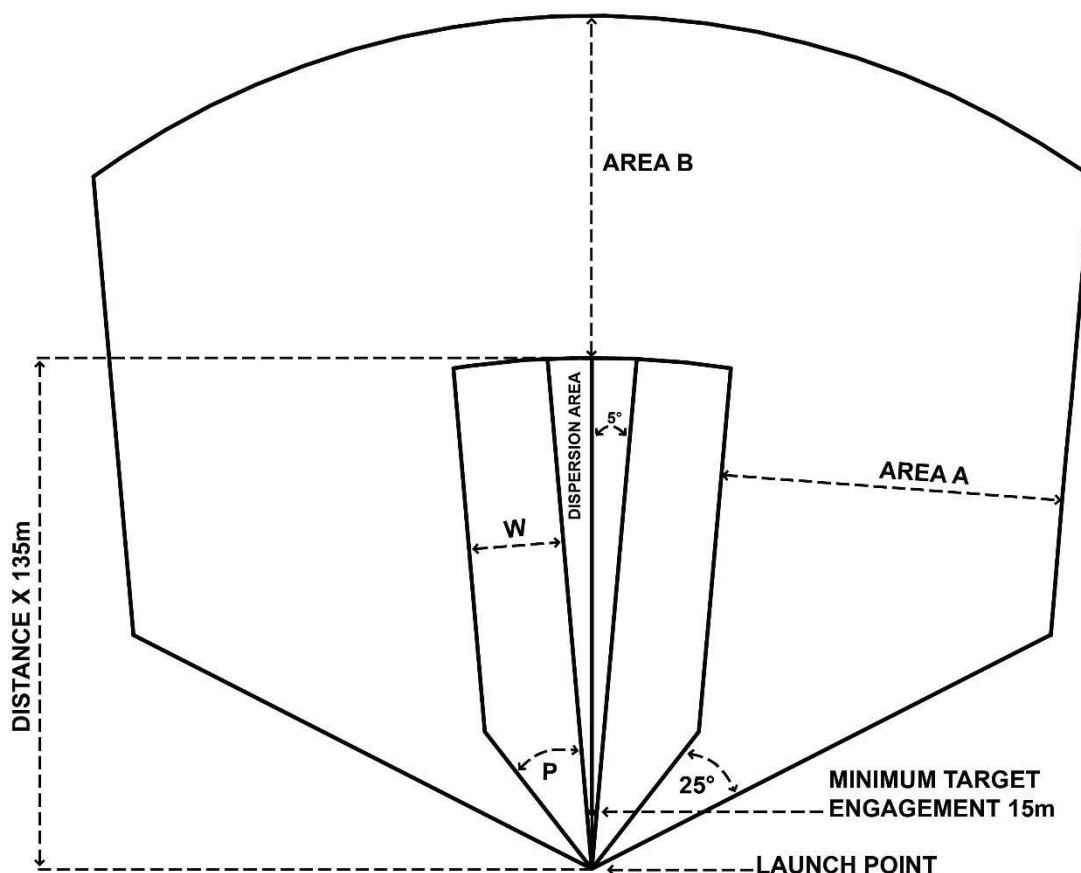


Figure 16–11. Surface danger zone for Rifle Launched Entry Munition and Grenade Rifle Entry Munition

Chapter 17

Laser Range Safety

17–1. General

The fundamental concept of laser range safety is to prevent direct and collateral injury or damage resulting from laser use. Personnel using or supervising the use of lasers will be thoroughly familiar with all aspects of laser operations, systems employed, and associated dangers during training.

a. Safe use of military lasers and laser systems. This chapter provides guidance for the safe use of military lasers and laser systems on military ranges as listed in MIL–HDBK–828C and JP 3–09.

b. Safe treatment of lasers. Lasers will be treated as direct-fire weapons.

c. Laser systems. Laser systems will be directed only at approved targets and from approved operating positions or areas or on designated headings and altitudes.

d. Laser usage. Unfiltered Class 3B or 4 lasers will be used only on certified laser ranges approved for laser usage in accordance with paragraph 17–3. These lasers will be operated only in restricted airspace.

e. Nominal ocular hazard distance. The nominal ocular hazard distance (NOHD) is the distance from an operating laser to the point where the laser is no longer an eye hazard (for example, the irradiance or radiant exposure during operation is not expected to exceed the appropriate maximum permissible exposure (MPE) level).

f. Unprotected personnel. Unprotected personnel must not be exposed to laser radiation within the NOHD of the laser system.

g. Protected personnel. Personnel within the LSDZ will wear laser eye protection during laser operations. Eyewear must be appropriate for the wavelength and optical density specific to the laser system utilized, as defined within the respective approval documents. Skin protection should be worn when appropriate.

h. Aided viewing. Aided viewing involves the use of optical devices (for example, binoculars, scopes, and range-finders). The magnification of laser energy can significantly increase the NOHD of the laser. The use of magnifying optical devices to observe the target during laser operation is permitted if specular surfaces have been removed from the LSDZ, appropriate laser filters are used, or it is being viewed beyond the NOHD-magnified. Optical devices not marked with the level of protection at the laser wavelength should be assumed to offer no protection unless verified. Personnel should not deliberately view direct laser radiation with magnifying optical instruments within NOHD-magnified unless the optical devices have the appropriate filtration to limit the exposure to below the MPE level.

i. Optical interrupt laser systems. Optical interrupt laser systems use intense light to cause visual field obscuration in targeted individuals. Optical interrupt laser systems are intended to be primarily a warning device with an inherent and secondary capability to achieve ocular suppression effects as the situation dictates. The optical interrupt device should meet stringent safety criteria and be able to deliver a warning effect to targeted personnel by obscuring their vision. The devices currently in use may be Class 3R or greater laser systems that can be safely employed for training. However, due to the intensity of the laser beam, it can pose an eye hazard within the NOHD if incorrectly employed. If exposure distances are known and briefed prior to use that are equal to or less than the NOHD of the system, the optical interrupt laser system must be terminated.

j. Backstops. Backstops, natural or manmade, are features down range from the target that terminate the beam, thus limiting the hazard distance. The optimal use of backstops is key to minimizing laser hazards.

k. Buffer zones. The buffer zone is a conical volume starting at the laser exit port and extending to the backstop or NOHD, expanding over this distance as defined by the divergence of the laser plus buffer angle. The buffer angle depends on the aiming accuracy and stability of the laser device and is usually greater than the divergence. The laser horizontal buffer zone could be partially or completely included in the danger zones of other weapons used on ranges.

l. Laser surface danger zone designation. The LSDZ is the designated region or ground area where laser radiation levels may exceed MPE levels, thereby requiring control during laser operation. When used in conjunction with live-fire weapons, the LSDZ might be more elongated than the SDZ or WDW if not terminated by an adequate backstop. LSDZs can be generated, either manually or by using the RMTK Laser Range Management Tool (LRMT), to support training plans, map data, information requests, and so forth. This effort includes inputting the laser system and range data (for example, firing points and targets) and performing analysis to mitigate risk to ensure the laser training can be safely conducted on a given operational training range. For the Marine Corps, when using a laser in conjunction with a live-fire weapon, if the LSDZ fits within the parameters of the SDZ of the weapon or munition being fired, then a separate LSDZ is not required. However, the range being used must be certified in accordance with MCO 3550.9A.

m. Hazardous laser output. Unless otherwise specifically authorized, when lasers are not in use, hazardous laser output should be prevented by removing batteries, installing such devices as output covers, or rotating the laser into the stowed position.

n. Laser exit port. The laser exit port must be covered or stowed and the device turned off when not engaged in training. Non-laser operations, such as viewing through common optics, can be conducted in a non-laser controlled area with the laser exit port cover removed if the laser is turned off.

o. Laser systems modes. When laser systems have both training and combat operating modes, the combat mode will be employed only if safely contained in the laser training range's controlled area. SOPs will enforce this measure.

p. Force-on-force operations. Force-on-force laser operations involve combat simulation, target acquisition, IL, pointing, target designation, weapons guidance, or range finding against friendly or opposing forces. Force-on-force laser tactical exercises are approved on a case-by-case basis, dependent on the scheme of maneuver (SOM) and risk assessment submitted by the using unit. Tactical exercises involving force-on-force units using laser systems other than the Multiple Integrated Laser Engagement System may require approval by the senior commander (Army) or installation commander (Marine Corps). Only Service-approved laser devices are used in force-on-force tactical exercises. RM procedures are completed in accordance with ATP 5-19, MCRP 1-10.1, and MCO 5100.29C.

17-2. Procedural guidance

The policies and responsibilities for laser usage on ranges and training areas are defined in chapter 1 and 2. This paragraph provides procedural guidance on how to fulfill those policies and responsibilities.

a. Specific institutional guidance for laser range safety. The institutional laser range authority provides guidance to installations via Service-specific regulations and orders. The institutional laser range authority maintains

publications relating to laser use on ranges and establishes or recommends the requirements for training programs. They ensure certification of ranges for laser use in accordance with paragraph 17–3.

(1) Army. A non-ionizing radiation protection study requested from the U.S. Army Medical Command DCS for Public Health and a safety confirmation by the Developmental Test Command of the U.S. Army Test and Evaluation Command should be performed on the laser system prior to use on laser ranges. Defense Health Agency expertise includes evaluation of laser systems and recommendations on policies and procedures to limit exposure to lasers on ranges.

(2) Marine Corps. The CG, TECOM (C 465) is responsible for Marine Corps range safety, of which laser safety is one component. CG, TECOM (C 465) serves as the proponent for all matters pertaining to the oversight and coordination of laser ranges with Marine Corps ranges and training areas. Additionally, CG, TECOM (C 465) has overall authority for all Marine Corps laser range management issues in coordination with installations and other Services for laser range requirements.

b. Specific installation guidance for laser range safety. For the Army, the senior commander has the authority to implement policies and procedures for safe laser operations in accordance with technical information provided in MIL–HDBK–828C series and other regulatory guidance. For the Army and Marine Corps, the senior or installation commander normally assigns responsibilities for the following laser range safety procedures to the RMA (Army) or RCO (Marine Corps):

(1) Develop SOPs pertaining to laser range safety that include proper controls of hazardous laser radiation. SOPs should include details on laser radiation and other laser-related hazards, such as systems that emit stray laser energy (SLE) releasing guided munition that may unintentionally acquire radiation sources within the field of detection other than the target or lasing an unapproved target. Update SOPs as necessary to account for new laser systems, laser range certification parameters and guidelines, training areas, and targets.

(2) Review the laser range certification process and range SOP annually or when changes are made.

(3) Use the RFMSS to record date, start and stop time for lasing periods, and type of laser or other appropriate information for each laser operation (such as laser firing log).

(4) Review unit laser training and use plans as part of the range approval process to identify potential deficiencies in the training plan and monitor compliance with safety policies and procedures. This chapter contains guidelines for unit laser training and use plans. The installation should ensure the following guidelines have been incorporated into the unit training and use plan.

(a) Laser systems are approved and appropriate for the designated range.

(b) Limits of the LSDZ and associated SLE, if applicable, are properly identified and are contained within the certified laser range area.

(c) Ground personnel locations requiring PPE are identified.

(d) Access to hazardous areas for unprotected personnel is limited.

(e) Targets; laser firing area, line, or points; orbit points; and laser-to-target orientation are verified to ensure they can be supported by the laser system and the range.

(f) PPE requirements are verified to ensure they are appropriate for the wavelength and optical density requirements of the laser and weapon systems being used.

(g) Training mode and filter requirements are evaluated and implemented if necessary.

(h) Signs warning of potential laser hazards are at the access points to the laser range.

(i) Emergency response procedures are identified and up to date.

(5) Provide laser briefings and indoctrination on laser operations and testing to the affected public. The information in the briefing will be at the user level (that is, complex scientific data or terminology will be minimized).

(6) Laser range incident investigations will—

(a) Review the incident in accordance with local SOP and training plan.

(b) Request technical advice on laser capabilities and laser hazard effects.

(c) Gather information about the incident.

(d) Prepare and submit data for the investigation report.

(e) Request unit perform a proper investigation that includes notification of the particular unit's chain of command and, for the Marine Corps, the institutional laser range authority.

c. Specific unit level guidance on laser range safety.

(1) *Laser policies.* Implement the policies and procedures set forth by the installation to ensure safe use of lasers.

(2) *Laser training plans.* Prepare and submit laser training plans for approval to perform laser activities on a specific laser range or training area. A unit laser training plan should include the following factors:

(a) Determine laser operations in support of training requirements.

(b) Review training to be accomplished against local SOPs.

(c) Coordinate to select a range whose laser range certification supports the laser systems to be used and training exercise to be accomplished.

(d) Review laser modes and tactics to be employed to ensure they support the laser system and range.

(e) Identify targets; laser firing area, line, and points; laser-to-target orientation; and orbit points that can be supported by the LSDZ. The laser must be terminated or the NOHD fully contained within the controlled area of the range.

(f) Identify ground personnel locations.

(g) Identify range hazard concerns (such as conflicts, impact areas, and clearing requirements).

(h) Employ RM to identify administrative controls to be implemented by the units.

(i) Identify PPE requirements.

(j) Identify communications requirements.

(k) Review the installation SOP to be aware of local emergency response procedures and laser injury response protocol.

(3) *Lasing above the horizon guidance.* Intentional lasing above the horizon where the NOHD of the laser exceeds restricted airspace or the installation boundary requires coordination with the Laser Clearinghouse at Kirtland Air Force Base, New Mexico, and the FAA. It also requires, as part of the event planning, measures to ensure aircraft are not lased.

(4) *Range laser safety inspection prior to use.* The unit will conduct laser safety inspections of the range and its operations prior to use and will confirm the following areas, at a minimum, are covered:

(a) Laser warning signs are posted.

(b) Range configuration is acceptable (targets and backstop; range boundaries; and laser firing area, line, or points).

(c) LSDZ is clear of specular reflectors. This can be conducted via range sweep in accordance with local SOPs.

(d) Laser range or training area is clear of non-participating personnel and equipment. This can be conducted via range sweep in accordance with local SOPs.

(e) Participating personnel in the area are aware of lasing activities and using appropriate PPE.

(f) Laser systems are authorized in accordance with the training plan.

(g) Training filters or modes are used, as applicable.

(h) Communication and terminology are agreed upon with range operations (Army) or range control (Marine Corps).

(i) Correct any discrepancies prior to training.

(5) *Safety brief or pre-mission brief.* The range OIC or laser RSO provides safety briefs or pre-mission briefs to laser range users and observers prior to laser operations. At a minimum, the brief should include as appropriate—

(a) Laser systems to be used and their purpose (for example, range finding, target acquisition or pointing, designing, and sensor disruption).

(b) Control measures specific to the lasers employed and the range upon which they are used.

(c) Authorized tactics, laser firing positions (ground and air), laser-to-target orientation, weapons release points, and weapon performance.

(d) Drawings, photographs, descriptions, or grid points of authorized targets.

(e) Communication procedures that include specific frequencies (or channels), controlling authorities, and standardized terminology.

(f) Acquisition, identification, and tracking procedures for targets.

(g) Missile or munition mode of operation.

(h) Requirements for SLE containment or mitigation beam termination and the means to accomplish each.

(i) Control measures to minimize the risk of unauthorized personnel, vehicles, or aircraft entering the range area.

(j) Run-in headings and flight profiles to be used for airborne laser operations or permissible LSDZ for ground-based laser operations.

(k) Review of mission profiles to prevent misdirection of laser-guided weapons.

(l) Type of eye protection to be worn and description of proper use.

(m) Potential hazards posed by the laser system (for example, backscatter, ignition of flammables, sensor disruption, and misdirection of laser-guided weapons) and any other associated non-laser hazards.

(n) Risk considerations for location of personnel within the SDZ or WDZ for observing or lasing the target area to weapons impact.

(o) A review of applicable range SOP information.

(6) *Guidance prior to laser operations.* The OIC and laser RSO also perform the following functions in advance of laser operations:

(a) Review and approve laser systems and targets.

- (b) Use only approved lasers on the range.
- (c) Laser systems are used only at the approved operating position or firing points and always pointed toward the target. Verify laser firing area, line, or points and laser-to-target orientation.
- (d) Laser systems engage only authorized targets.
- (e) Target is positively identified in accordance with appropriate safety procedures before operation of a laser system.
- (f) Ensure all non-participating personnel in the immediate area of the laser firing position are outside the LSDZ.
- (g) Target area is clear of all non-participating personnel.
- (h) Supervise pre-fire checks. Pre-fire checks that require operation of the laser system may be made in a controlled area with the laser beam terminated by an approved backstop. Pre-fire checks that do not require operation of the laser but require use of the optics may be safely made in any area. To use the optics without firing the laser, follow SOP to ensure power to the laser is turned off.
- (7) *Range laser operations.* General guidance during laser operations includes the following:
 - (a) Communications are maintained between the laser system operators, the range operations firing desk (Army) or range control (Marine Corps), and all affected range personnel.
 - (b) Personnel follow safety procedures in accordance with local SOP.
 - (c) Training filters or modes are used, as required.
 - (d) PPE is used, as required.
 - (e) Approved training plan is followed.
 - (f) Coordinate emergency response, as necessary.
- (8) *Cease-fire operations.* If unsafe conditions are observed, laser operations must be stopped. All personnel have the responsibility to call a “cease-fire” when appropriate. Reasons to cease laser operations include—
 - (a) Any specular reflection is detected in the target area.
 - (b) Poor target tracking is observed.
 - (c) Non-participating personnel or traffic enter the laser range or training area.
 - (d) Loss of communication with the range operations firing desk (Army) or range control (Marine Corps).
- (9) *Completion of laser range operations.* Guidance after laser operation includes the following:
 - (a) Laser will be powered down by removing batteries, installing output covers, or rotating the laser into its stowed position.
 - (b) PPE will be stowed in accordance with local SOP.
- (10) *Laser incident guidance.* Procedures for laser incident investigations include the following actions:
 - (a) Ensure laser system involved in the incident is quarantined.
 - (b) Report the incident to the installation laser range authority in accordance with paragraph 17–6 and local SOP.
 - (c) Provide information on training activity or exercise, as necessary.
 - (d) Provide information on what happened, where, when, and how.
 - (e) Provide information on personnel who may have been exposed to a laser hazard.
 - (f) Provide the essential parts of the pre-operational briefing.

17–3. Laser range certification

The certification process is the approval of a range or training area for laser usage.

a. Army. The Army does not certify, per se, ranges for laser use. For the purpose of this chapter, the term “certification” means the approval of a training event where lasers will be employed. This certification or approval is delegated to the installation as a normal part of approving training events on the range complex. The training request, along with the pertinent unit training plan and risk assessment, will be evaluated in accordance with the principles in this chapter and MIL–HDBK–828C. The RMTK LRMT may be used in this process. Questions regarding laser safety in the range complex should be directed to TPO Ranges.

b. Marine Corps.

(1) Certification of Marine Corps laser ranges will be accomplished by a range laser safety specialist or an approved Marine Corps laser range certifier in coordination with CG, TECOM (C 465). Laser ranges will be certified using guidelines in MIL–HDBK–828C and MCO 3550.9A, and in conjunction with the RMTK LRMT. The certification data will be held on file at the installation range control office and CG, TECOM (C 465) for future reference. Questions regarding laser safety or certification should be directed to the institutional laser range authority.

(2) The installation RCO will assist the institutional laser range authority in performing range certification for the safe use of lasers.

17-4. Laser range design

During the design phase of ranges upon which lasers will be used, the following procedures will be performed to ensure safe laser use. For the Army, this is done during site selection by the installation as a preliminary part of the laser range certification process. For the Marine Corps, the institutional laser range authority may be asked to provide input to the design of the range with regard to technical requirements.

- a.* Conduct site analysis to determine range design requirements.
- b.* Determine whether an existing range can be modified or a new range must be established to meet the training requirements.
- c.* Perform risk analysis.
- d.* Provide technical guidance on range design to support safety, mission, and environmental requirements.
- e.* Request technical guidance on construction requirements from the appropriate installation agency.
- f.* Consult the institutional range authority.

17-5. Other safety considerations

a. Laser-guided munitions and other laser detectors may unintentionally acquire radiation sources within the field of detection other than the target. Fields of detection vary and are specific to individual weapons and detectors or sensors. Training will be planned to ensure that the angle between the laser designator line of sight and laser detectors (such as laser-guided munitions or laser-spot trackers) will not allow the munitions to impact on the laser source or scattered radiation from the laser platform.

b. Extreme caution will be taken when using a target designating laser in conjunction with munition delivery aircraft. The potential exists for the laser seeker of the munition to lock onto the designator or its radiated energy (beam or reflected beam) instead of the target. The following procedures will be followed to reduce this risk.

(1) The pilot of the attacking aircraft will confirm the location of the designator and the target before releasing munitions.

(2) Approach paths will be designated and briefed to both the designating and forward air controller personnel and the aircrews prior to conducting the mission. Aircraft approach paths will be planned to preclude crossing laser designator beams with the laser seeker. The laser seeker should intersect the designator beam well forward of the laser firing point, angling toward the target.

(3) Only appropriately protected participating personnel will be within the danger zone of the weapon employed. Additionally, only appropriately protected participating personnel will be located at the designator or close to a direct or reflected beam of the laser designator during operations.

(4) Munitions will not be launched or released toward the laser designator (see applicable TMs, FMs, TCs current MIL-HDBK-828C, and doctrinal publications for recommended employment procedures).

c. NVDs can detect laser energy, but they will not be used for laser eye protection. These devices are not cover-all goggles. Laser energy may enter the eye from offset angles where protection is not afforded. The damage threshold for NVDs may be as low or lower than the damage threshold for the human eye. These devices can be bloomed (white out), damaged, or destroyed from exposure to laser radiation, thus creating ancillary safety hazards.

d. SLE is an undesirable and unavoidable occurrence resulting in unpredictable or predictable laser energy, potentially in excess of the MPE, being emitted from the laser system. The primary safety hazards and concerns are designation for laser-guided munitions and eye injury to aircrew or ground personnel during use of these SLE producing systems with stray energy that exceeds the MPE. As a result, the institutional laser range authority will provide safety of use guidance defining specific SLE hazard protection distances, usage procedures and restrictions, and so forth.

17-6. Laser mishap and incident reporting

Report all suspected laser mishaps and incidents, regardless of injury, in accordance with AR 385-10, DA Pam 385-40, TB MED 524, MCO 5104.1C, BUMEDINST 6470.23A, and AFI 48-139. The expeditious examination and treatment of laser eye injuries are critical in minimizing loss of visual acuity. In the event of exposure, contact local range authorities and request immediate medical support. Additional medical guidance is available through the Tri-Service Laser Injury Hotline at 1-800-473-3549 or 937-938-3764, DSN (312) 798-3764, or esoh.service.center@us.af.mil.

Chapter 18

Live-Fire Exercises

18–1. Safety during live-fire exercises

a. Live-fire phases of training exercises are conducted with maximum realism and safety. If safety or terrain limitations do require some unrealistic actions to be taken, personnel should be briefed in detail on why artificial actions are required and what the unit would do if confronted with a similar situation in combat.

b. CALFEX (Army) and CAX (Marine Corps) involve the participation of two or more combat arms or DoD services. Air and ground weapons will be used in accordance with current doctrine unless specifically prohibited from use by this regulation/order. Because of the dangers and complexities associated with CALFEXs and CAXs, commanders will thoroughly review training scenarios (SOM and fire support) and ensure close coordination among participants. Commanders will apply RM to all aspects of the CALFEX or CAX.

18–2. Information for commanders

a. Training to permit highly realistic maneuvers and live-fire exercises involves specific personnel safety requirements. Senior commanders (Army) and installation commanders (Marine Corps) will publish specific range guidance (for example, range regulations and SOPs) that applies specifically to their installations. This guidance will define safety requirements to support live-fire training exercises. Directives developed for a particular location are not authorized for use at a different location.

b. Commanders whose units participate in live-fire exercises will—

(1) Make certain that all individual gunners who will take part in live-fire exercises, including fighting vehicle, tank, and aviation gunners, have fired and passed a qualification course for the weapon or system they will fire in the exercise.

(2) When conducting live-fire and maneuver exercises, a day and night rehearsal (dry run) is required. The commander will assess the proficiency and experience level of their unit and the degree of risk involved to determine the scope and duration of the rehearsal and if it should be executed on the same range on which the live-fire and maneuver training will be conducted. The rehearsal should be scheduled as close to the actual event as is feasible to retain individual situational awareness and skills. Additionally, whenever feasible, rehearsals should replicate as closely as possible the conditions involved in the actual event. Rehearsals will be conducted based on the SOM that has been submitted and approved by Range Control. All personnel who will be participating in the exercise, to include range safety personnel (that is, ARSOs), will be part of the rehearsal. In the event the SOM changes, the unit commander will determine if additional rehearsals are required to ensure all participating personnel (including safety personnel) understand the changes to the SOM. Update range control of the SOM changes. In addition, rehearsals will include a review of range safety requirements for the live-fire and maneuver range. The review should include lateral limits, danger zones for weapons and AE used, air limitations and restrictions, both for live-fire and medical evacuation, and emergency and/or casualty evacuation procedures. For the Army, the CG, USASOC, may approve deviation from this requirement for ARSOF.

(3) Orient participants on the capabilities of the weapons used by other components in the CALFEX or CAX.

(4) Designate individuals (such as observer-controllers) who are not part of the tactical or administrative scheme to monitor safety. These individuals will maintain visual contact with maneuvering elements and should have some means of signaling a cease-fire. Communications with the tactical operations center is mandatory.

(5) For the Marine Corps, before live-fire training in low tactical light or darkness, NVDs will be tested for resolution for light tactical level criteria delineated in appropriate technical or operator manuals. A review of NVD focusing procedures should also be conducted to enable Marines to obtain the optimum NVD device.

c. For battalion, squadron, or larger exercises, a field grade commissioned officer will be appointed as the exercise OIC.

d. For the Marine Corps, the commander will assess the proficiency and experience level of their unit in determining the quantity of observers-controllers (that is, ARSOs) required for the event. Other factors influencing this decision should include the SOM, geometry of the attack, composition of forces, dispersion of forces, visibility, weather conditions, and fatigue. Marine Corps observers-controllers report to the exercise RSO and will have training in local range safety procedures and SDZ employment.

18–3. Exercise planning

a. Units will conduct live-fire exercises in support of properly identified and trained-to-standards mission-essential task list tasks. Tactics, techniques, and procedures employed during the live-fire exercises must be consistent with the standards published in the applicable Army Training and Leader Development Strategy mission training plan or battle

drills. Command approval from the next higher command is required for any live-fire exercise not consistent with the unit's established mission-essential task list.

b. Detailed written plans will be developed between the RMA (Army) or RCO (Marine Corps) and the exercise OIC. It will require submission of formal RM documentation prior to execution.

(1) When planning live-fire and maneuver/movement training, marking targets and personnel in the same manner or like devices (that is, chemlights) is not authorized. This includes splattering a target with the liquid from a broken chemlight.

(2) Targets and personnel can be marked but not with same type devices and need to be preplanned. Marking either targets or safety personnel is authorized and must be identified in the SOM and risk assessment (Army) and RM matrix (Marine Corps) and briefed to all personnel participating in that exercise during the range safety brief.

c. For the Army, if residual risk is extremely high, approval is required by the ACOM, ASCC, or DRU commander or designated official in accordance with risk decision authority (see DA Pam 385–30). The garrison safety manager will review the completed plan and RM documentation that will include—

- (1) A detailed plan of maneuver and fire support.
- (2) A list of weapons, AE (for example, ammunition, pyrotechnics, and smokes), and chemicals to be used.
- (3) Unit control measures, including means of communication.
- (4) Terrain feature and facilities required.
- (5) Emergency action plans. Include, as appropriate, the need for emergency equipment, such as litters or fire extinguishers, prepositioning of emergency responders, and coordination with medical treatment facilities.

d. Impact distance and limits of advance are as follows:

(1) The distances to which unprotected troops can safely move near the impact are (that is, Areas A, B, and C) indicated in the chapter on each weapon or weapons system.

(2) To determine how close unprotected troops may maneuver to the target area, an impact area and a danger zone must be established for each target area used. Danger zones must be computed and issued to leaders and safety personnel before starting the exercise. When several types of weapons are being fired into one target area, the combined total danger zone (composite danger zone) will govern. These restrictions normally should not preclude unit commanders from selecting tactically sound supporting weapon positions for their SOM, provided the positions and directions of fire do not exceed the total range area available for the exercise. When feasible, leaders and safety personnel will be shown the physical limits of the danger zone by ground survey.

(3) The short limit of the impact area may be moved in the direction of the target area by definite pre-arrangement to permit forward movement of troops.

(4) Demolitions may be used during live-fire exercises according to chapter 16.

(5) Selection of weapon positions will be the responsibility of unit leaders taking part in the exercise.

(6) Terrain will be used to enhance safety features when it is being selected for live-fire exercises involving overhead or flanking fire.

e. During live-fire exercises planning, the RM process must address possible hazards from friendly fire and control measures to reduce or eliminate them, while executing the mission-essential task list task to published standards.

f. A review of lessons learned may provide beneficial information to identify and mitigate risks (for example, U.S. Army Combat Readiness Safety Center website or Army Lessons Learned website).

18–4. Firing precautions

a. Overhead fire of personnel may be authorized, provided they have positive protection from the munitions being fired. Protected positions for personnel and vehicles are discussed in ATP 3–37.34/MCTP 3–34C.

b. The senior commander (Army) and installation commander (Marine Corps) or designated representative can authorize overhead fire above unprotected personnel except for specifically prohibited weapon systems, following the provisions of this section.

c. Weapons specifically authorized for overhead fire of unprotected personnel are—

- (1) All artillery cannon firing indirect fire (see chap 11 for safety precautions).
- (2) Machine guns (5.56mm, 7.62mm, and .50 caliber) on ground tripods or vehicle mounts (ring mounts excluded) firing from a stationary position.

d. Only ammunition certified for overhead fire will be used.

e. All firing of direct-fire weapons will be from positions that provide an unobstructed field of fire.

f. Overhead fire with machine guns in live-fire exercises will be as follows:

(1) Bullets will not be permitted to impact between the firing position and the rear of the line of unprotected personnel. All impacts should be a minimum of 50 m beyond the forward line of unprotected personnel.

(2) Positive stops must be used to prevent crossfire and depression of the muzzle during firing.

(3) A minimum clearance or safety limit must be established using the guidelines for overhead fire in TC 3–22.50. Marine Corps personnel use MCTP 3–01C.

(4) The rate of fire will not exceed 70 rounds per minute for 5.56mm and 7.62mm machine guns and 40 rounds per minute for .50 caliber machine guns.

(5) Weapons will be test fired before delivery of overhead fire to verify effectiveness of the positive traverse and depression stops.

(6) Tracer ammunition may be used as a check to track the projectile flight path.

g. In addition to the requirements of paragraph 18–4f, the following precautions will apply to overhead fire with machine guns for a confidence infiltration course:

(1) Firing will be from approved platforms as described in TC 3–21.75.

(2) Qualified field maintenance or ordnance personnel will inspect the mounts and weapons before being declared safe to deliver overhead fire.

(3) A minimum clearance of 2.5 m over the heads of personnel or the highest obstruction within the field of fire will be maintained. Minimum clearance is the distance between the lowest shot in the dispersion pattern (as determined by the test firing) and the bodies of individuals in erect positions on the highest point of ground, log, or other obstacle over which personnel must travel or heights of barbed wire strands or posts on the course, whichever is higher.

h. All firing of indirect-fire weapons will be from positions in which the site to mask allows engagement of the targets nearest to the forward line of troops. Selection of firing positions, direction of fire, and fall of shot must prevent the projectiles from striking trees or other obstacles in the area from the weapon position to a point forward of unprotected personnel. The forward point is defined as the bursting radius of the round plus 12 range Pes.

i. When field artillery is fired during CALFEX or CAX with maneuvering personnel, the impact area will be adjusted according to the maneuver location of troops to maintain safe separation distance. The troop side of the impact area will be determined in relation to the movement of the personnel. Unprotected troops must not be permitted to enter danger zones after firing has commenced.

j. Weapons will be grouped by muzzle velocity as cited in FM 6–40 or pertinent Marine Corps TMs. Weapons will be bore-sighted as prescribed in FM 6–50. Tubes will be clean and dry before start of exercise and will be cleaned during the exercise in accordance with appropriate weapon TMs.

k. All ammunition to be fired should be uniformly conditioned to ambient temperature consistent with the tactical situation.

l. For registration, at least two rounds should be fired. Targets should be selected in the central portion of the target area. After registration, corrections must be applied to deflection and QE limits. If no registration is fired, meteorological and velocity error corrections will be applied immediately before the exercise starts.

m. To compensate for drift in high-angle fire, the right deflection limit will be moved to the left by the amount of the maximum drift listed within the range limits for the charges being fired. The left limit will be moved to the right by the amount of the minimum drift listed within the range limits for the charges being fired. To determine the appropriate drift, the tabular firing table and graphical firing scale must be examined and the safer value used. If a drift value is not listed in the tabular firing table or on the graphical firing scale for the ranges to the near and far edge of the target area, the nearest safer value will be used.

n. Overhead fire above unprotected personnel from a moving vehicle or aircraft is prohibited, unless there is an approved deviation for the training.

o. Cannon and mortar flanking fire must not impact any closer to unprotected personnel than the fragmentation radius (Area A) prescribed for each weapon.

p. Small arms (5.56mm, 7.62mm, and .50 caliber), ground-mounted or vehicle-mounted machine guns may be fired at low angles of elevation (near the flank of an individual or unit). For the SDZ, there must be an angle of 15 degrees or distance of 100 m (whichever provides greater separation) between the limit of fire and the near flank of the closest individual or unit and all impacts are beyond the individual or unit. For the batwing SDZ, all non-participating personnel must be outside of the SDZ. Tripod, traversing, and depression stops will be used on machine guns to maintain the required angle and distance between the line of fire and the near flank of an individual or unit.

q. Range SOPs will address firing and maneuver unit locations to ensure no unprotected personnel are exposed to training fires.

18–5. Fire control

The unit commander makes the final decisions on fire control measures. The following conditions must be met:

a. The ammunition in paragraphs 18–5a(1) through 18–5a(8) may be authorized for use in live-fire exercises only when it is fired into designated (dedicated high-hazard) impact areas through which personnel are not permitted to maneuver.

- (1) 40mm (HE and HEDP).
- (2) 66mm LAW (HE).
- (3) Hand grenades (HE), except as noted in paragraph 18–5*d*.
- (4) MAAWS (HE, HEDP, and HEAT).
- (5) SMAW.
- (6) 25mm (HE).
- (7) M74 66mm TP.
- (8) HE ICM munitions (Marine Corps).
- b.* Final coordination lines must be identified to all participating units.
- c.* Weapons used in live-fire exercises will be controlled so that danger zones do not overlap areas in which unprotected personnel are maneuvering.
- d.* A RSO will directly supervise and control the throwing of fragmentation grenades. The following procedures apply:
 - (1) Hand fragmentation grenades may be thrown during live-fire exercises. Hand grenades will be carried in accordance with TC 3–23.30. The fragmentation characteristics of the grenades must be considered and appropriate safety precautions taken, to include—
 - (*a*) Impact areas will be free of obstacles (such as trees, thick vegetation, tank hulls, deep snow, or standing water).
 - (*b*) A minimum side-to-side distance of 5 m between each individual during the throwing exercise is required.
 - (*c*) Throwing positions will protect the throwers from fragments.
 - (*d*) EOD personnel will destroy dud grenades in place or safe and remove before troops enter the grenade impact area. If EOD personnel are unable to locate or destroy any dud grenades, troop maneuver through the impact area is not authorized.
 - (2) Individuals being transported by vehicle or aircraft will not carry fragmentation, offensive, or WP grenades attached to web equipment.

18–6. Maneuver in temporary impact areas

- a.* Senior commanders (Army) and installation commanders (Marine Corps) may approve maneuver through temporary impact areas containing unexploded munitions, except those identified in paragraph 18–5*a*.
- b.* Senior commanders (Army) and installation commanders (Marine Corps) may approve maneuver through temporary impact areas after reviewing a risk assessment and accepting residual risks. The following munitions, although not identified in paragraph 18–5*a*, may present high or extremely high risk if present:
 - (1) 50 caliber SLAP M903.
 - (2) 20mm HE.
 - (3) 30mm HE.
 - (4) All HEAT munitions because of type of fuze action and sensitivity.
 - (5) All munitions fuzed with mechanical time fuzes.

18–7. Air support

- a.* During live-fire exercises, the following control measures are required prior to firing aircraft-mounted weapons or dropping air-delivered munition:
 - (1) Positive identification of personnel locations.
 - (2) Positive identification of the targets.
 - (3) Positive clearance to drop or fire munition as given by the controlling ground or airborne forward air controller (Marine Corps).
 - (4) Approved abort procedures and locations to drop unexpended bombs when necessary.
 - (5) Attack flight paths, location of bomb safety lines, and access corridors will be known and visually verified by ground personnel and participating aircrews.
 - (6) Direct communications will be established and maintained between the OIC, the forward air controller, and the fire support coordination center that coordinates the direct support artillery fire in the vicinity of an air strike.
 - (7) Minimize danger to attacking aircraft from ricochet of ground-fired HE projectiles and ceasing fire of flat trajectory weapons in the vicinity of air targets under attack within the SDZ (see chap 4 for vertical hazard distances).
 - (8) Firing across, within, or through access corridors will not be permitted without coordination with the forward air controller.
 - (9) Close air support conducted by Army, Marine Corps, or contracted close air support FW and RW aircraft will be conducted in accordance with appropriate TMs, FMs, TCs, MAWTS–1 publications, training and readiness manuals, installation SOPs, and squadron SOPs.

b. Fire support by Air Force FW aircraft will be conducted in accordance with AFMAN 13–212, Volume 1.

Appendix A

References

Section I

Required Publications

Unless otherwise stated, all publications are available at <https://armypubs.army.mil/> or <https://rtam.tecom.usmc.mil/>.

AFMAN 13–212, Volume 1

Range Planning and Operations (Available at <https://www.e-publishing.af.mil/>.) (Cited in para 18–7*b*.)

AR 75–1

Malfunctions Involving Ammunition and Explosives (Cited in para 1–24*h*(3).)

AR 75–15

Policy for Explosive Ordnance Disposal (FOUO) (Cited in para 16–1*b*(2).)

AR 95–1

Flight Regulations (Cited in para 14–2*d*.)

AR 95–2

Air Traffic Control, Airfield/Heliport, and Airspace Operations (Cited in para 2–11*c*.)

AR 95–27

Operational Procedures for Aircraft Carrying Hazardous Materials (Cited in para 14–2*d*.)

AR 350–19

The Army Sustainable Range Program (Cited in para 1–6*a*.)

AR 385–10

The Army Safety and Occupational Health Program (Cited in para 1–19*c*.)

AR 405–80

Management of Title and Granting Use of Real Property (Cited in para 2–10*a*(4).)

AR 750–6

Army Equipment Safety and Maintenance Notification System (Cited in para 1–14*b*.)

ATP 3–04.17

Techniques for Forward Arming and Refueling Points (Cited in para 2–5*a*(2)(*b*).)

ATP 3–09.60

Techniques for Multiple Launch Rocket System (MLRS) and High-Mobility Artillery Rocket System (HIMARS) Operations (Cited in para 11–10*b*(1).)

ATP 3–37.34/MCTP 3–34C

Survivability Operations (Cited in para 18–4*a*.)

ATP 5–19

Risk Management (Cited in para 1–24*a*(8).)

BUMEDINST 6470.23A

Operational Non-Ionizing Radiation Health Protection (Available at <https://www.med.navy.mil/>.) (Cited in para 17–6.)

DA Pam 40–501

Army Hearing Program (Cited in para 2–20*b*.)

DA Pam 40–503

The Army Industrial Hygiene Program (Cited in para 2–1*a*.)

DA Pam 385–30

Risk Management (Cited in para 2–8.)

DA Pam 385–40

Army Mishap Investigations and Reporting (Cited in para 1–24*h*(3).)

DA Pam 385–64

Ammunition and Explosives Safety Standards (Cited in para 2–4a.)

DESR 6055.09, Edition 1

DoD Explosives Safety Standards (Available at <https://www.denix.osd.mil/>.) (Cited in para 1–16a.)

DoDD 4715.11

Environmental and Explosives Safety Management on Operational Ranges Within the United States (Available at <https://www.esd.whs.mil/dd/>.) (Cited in para 1–14a.)

DoDD 4715.12

Environmental and Explosives Safety Management on Operational Ranges Outside the United States (Available at <https://www.esd.whs.mil/dd/>.) (Cited in para 1–1.)

DoDI 1100.22

Policy and Procedures for Determining Workforce Mix (Available at <https://www.esd.whs.mil/dd/>.) (Cited in para 1–7a.)

DoDI 3200.16

Operational Range Clearance (ORC) (Available at <https://www.esd.whs.mil/dd/>.) (Cited in para 1–6a(6).)

MAWTS–1 Aerial Gunnery Manual

(Available from Marine Aviation Weapons and Tactics Squadron One, Marine Corps Air Station, Yuma, AZ 85369.) (Cited in para 12–8e(1).)

MCO 3550.9A

Operational Training Range Certification/Recertification Program (Available at <https://www.marines.mil/>.) (Cited in para 1–6a.)

MCO 3550.10

Policies and Procedures for Range and Training Area Management (Available at <https://www.marines.mil/>.) (Cited in para 1–6a.)

MCO 3550.12A

Operational Range Clearance (ORC) Program (Available at <https://www.marines.mil/>.) (Cited in para 1–24d(6).)

MCO 5100.29C

Marine Corps Safety Management System (Available at <https://www.marines.mil/>.) (Cited in para 1–24a(8).)

MCO 5100.29C, Volume 2

Risk Management (Available at <https://www.marines.mil/>.) (Cited in para 2–8.)

MCO 5100.29C, Volume 8

Marine Corps Explosives Safety Management Program (Available at <https://www.marines.mil/>.) (Cited in para 2–4b(2).)

MCO 5104.1C

Navy Laser Hazards Control Program (Available at <https://www.marines.mil/>.) (Cited in para 1–24j(6).)

MCO 6260.3A

Marine Corps Hearing Conservation Program (Available at <https://www.marines.mil/>.) (Cited in para 2–20b.)

MCO 8011.5B

Class V(W) Ammunition Policies, Procedures and Information for Training, Programmed Testing and Security (Available at <https://www.marines.mil/>.) (Cited in para 11–9a(2).)

MCO 8025.1E

Class V(W) Malfunction and Defect Reporting (Available at <https://www.marines.mil/>.) (Cited in para 1–24k(2)(p).)

MCRP 1–10.1

Organization of the United States Marine Corps (Available at <https://www.marines.mil/>.) (Cited in para 15–2c.)

MCTP 3–01C

Machine Guns and Machine Gun Gunnery (Available at <https://www.marines.mil/>.) (Cited in para 18–4f(3).)

MIL–HDBK–828C

Range Laser Safety (Available at <https://quicksearch.dla.mil/qssearch.aspx>.) (Cited in para 1–24d(7).)

MIL-STD-709D

Ammunition Color Coding (Available at <https://quicksearch.dla.mil/qssearch.aspx>.) (Cited in para 16–9a.)

NAVAIR 11-75-63

Launchers, Single Bay LMU-23/E and Four Bay LMU-24E (for Smokey Sam) (Available at <https://nossa.dc3n.navy.mil/nros>.) (Cited in para 16–13c.)

NAVMC DIR 5100.8

Marine Corps Occupational Safety and Health (OSH) Program Manual (Available at <https://www.marines.mil/>.) (Cited in para 16–8c.)

NAVSEA OP 5

Ammunition and Explosives Safety Ashore (Available at <https://nossa.dc3n.navy.mil/nros>.) (Cited in para 1–7g(2).)

NAVSEA SW060-AA-MMA-010

Demolition Materials (Available at <https://nossa.dc3n.navy.mil/nros>.) (Cited in para 1–7g(2).)

NAVSUP P-801

Ammunition, Unserviceable, Suspended and Limited Use (Available at <https://nll.navsup.navy.mil/>.) (Cited in para 1–24h(1).)

NEHC-TM 6290.99-10

Indoor Firing Ranges Industrial Hygiene Technical Guide (Available at <https://www.wbdg.org/space-types/firing-range>.) (Cited in para 2–15a.)

OPNAVINST 3770.2L

Department of the Navy Airspace Procedures and Planning (Available at <https://www.secnav.navy.mil/doni/default.aspx>.) (Cited in para 2–11c.)

TB MED 524

Occupational and Environmental Health: Control of Hazards to Health from Laser Radiation (Cited in para 1–24d(7).)

TB 3-1365-490-10

Operator Information for Smoke Pot, HC, 10-Pound, M1, and 30-Pound, ABC-M5; Smoke Pot, Floating, HC, M4A2; SGF2, AN-M7A1; Smoke Pot, Floating, MK7 MOD 0; and Smoke Pot, Floating, Screening, TA, Practice, M8 (Cited in para 14–4d.)

TB 9-1300-385

Munitions Restricted or Suspended (Cited in para 1–24h(1).)

TB 9-1310-251-10

Operator Information on Range Clearing Procedures for Cartridge 40 Millimeter: Target Practice, M918 (Cited in para 6–2b(10).)

TC 3-04.11

Commander's Aviation Training and Standardization Program (Cited in para 12–2c(2).)

TC 3-21.75

The Warrior Ethos and Soldier Combat Skills (Cited in para 18–4g(1).)

TC 3-22.23

M18A1 Claymore Munition (Cited in para 16–9c(1)(g).)

TC 3-22.50

Heavy Machine Gun M2 Series (Cited in para 18–4f(3).)

TC 3-23.30

Grenades and Pyrotechnic Signals (Cited in para 6–1a.)

TC 4-02.1

First Aid (Cited in para 6–1c(7).)

TC 25-8

Training Ranges (Cited in para 1–16a.)

TM 3-23.25

Shoulder-Launched Munitions (Cited in para 7–1a(1).)

TM 3–34.82

Explosives and Demolitions (Cited in para 16–1*b*(1).)

TM 9–1330–200–12

Operator’s and Unit Maintenance Manual for Grenades (Cited in para 6–1*c*(4).)

TM 9–1345–203–12

Operator’s and Unit Maintenance Manual for Land Mines (Cited in para 16–10*g*.)

TM 9–1370–207–10

Operator’s Manual for Pyrotechnic Simulators (Cited in para 16–12*b*.)

TM 43–0001–28

Army Ammunition Data Sheets Artillery Ammunition for Guns, Howitzers, Mortars, Recoilless Rifles, and 40mm Grenade Launchers (Federal Supply Class 1310, 1315, 1320, 1390) (Cited in para 10–1*m*.)

TM 43–0001–29

Army Ammunition Data Sheets for Grenades (Cited in para 6–1*c*(4).)

UFC 4–179–02

Small Arms Ranges (Available at <https://www.wbdg.org/ffc/dod/unified-facilities-criteria-ufc>.) (Cited in para 2–15*a*.)

USASOC Regulation 40–8

Occupational and Environmental Risk Management for Shoot Houses and Indoor Firing Ranges (Available from U.S. Army Special Operations Command, Fort Liberty, NC 28310.) (Cited in para 2–14*a*(3).)

USASOC Regulation 385–1

USASOC Safety Program (Available from U.S. Army Special Operations Command, Fort Liberty, NC 28310.) (Cited in para 2–20*e*.)

29 CFR 1910.1025

Lead (Available at <https://www.ecfr.gov/>.) (Cited in para 2–14*a*(3).)

29 CFR 1926.200

Accident prevention signs and tags (Available at <https://www.ecfr.gov/>.) (Cited in para 2–3*a*.)

33 CFR 334

Danger Zone and Restricted Area Regulations (Available at <https://www.ecfr.gov/>.) (Cited in para 2–13*a*.)

Section II**Related Publications**

A related publication is a source of additional information. The user does not have to read it to understand this regulation. DoD material is available at <https://www.esd.whs.mil/dd/>. CFR material is available at <https://www.ecfr.gov/>. USC material is available at <https://uscode.house.gov/>.

AFI 48–139

Laser and Optical Radiation Protection Program (Available at <https://www.e-publishing.af.mil/>.)

AR 11–2

Risk Management and Internal Control Program

AR 11–34

The Army Respiratory Protection Program

AR 15–6

Procedures for Administrative Investigations and Boards of Officers

AR 15–39

Department of the Army Intergovernmental and Intragovernmental Committee Management Program

AR 25–30

Army Publishing Program

AR 360–1

The Army Public Affairs Program

AR 405–10

Acquisition of Real Property and Interests Therein

DA Pam 25–403

Army Guide to Recordkeeping

DA Pam 385–10

Army Safety and Occupational Health Program Procedures

DLAR 4145.41/AR 700–143/NAVSUPINST 4030.55D/AFMAN 24–210_IP/MCO 4030.40C

Packaging of Hazardous Material (Available at <https://www.dla.mil/>.)

DoDD 3000.03E

DoD Executive Agent for Non-Lethal Weapons (NLW), and NLW Policy

DoDD 6055.09E

Explosives Safety Management (ESM)

DoDI 6055.01

DoD Safety and Occupational Health (SOH) Program

DoDI 6055.05

Occupational and Environmental Health (OEH)

DoDI 6055.15

DoD Laser Protection Program for Military Lasers

DoDM 4715.26

DoD Military Munitions Rule (MR) Implementation Procedures

DoDM 6055.05

Occupational Medical Examinations: Medical Surveillance and Medical Qualification

Guidebook for Assault Entry Techniques

(Available from U.S. Marine Corps Training and Education Command, Quantico, VA 22134.)

JP 3–09

Joint Fire Support (Available at <https://www.jcs.mil/>.)

NAVAIR 00–80T–109

Aircraft Refueling NATOPS Manual (Available from Naval Air Systems Command, AIR–4.4.5, Bldg. 2360, 22229 Elmer Rd., Unit 4, Patuxent River, MD 20670–1906.)

NAVSEA SW020–AC–SAF–010

Transportation and Storage Data for Ammunition, Explosives and Related Hazardous Material, Volume 1 (Available at <https://nossa.dc3n.navy.mil/nros>.)

NAVSEA SW020–AC–SAF–020

Transportation and Storage Data for Ammunition, Explosives and Related Hazardous Material, Volume 2 (Available at <https://nossa.dc3n.navy.mil/nros>.)

NAVSEA SW020–AC–SAF–030

Transportation and Storage Data for Ammunition, Explosives and Related Hazardous Material, Volume 3 (Available at <https://nossa.dc3n.navy.mil/nros>.)

NAVSEA SW020–AF–HBK–010

Motor Vehicle Driver and Shipping Inspector's Manual for Ammunition, Explosives and Related Hazardous Materials (Available at <https://nossa.dc3n.navy.mil/nros>.)

SECNAVINST 5720.44C

Department of the Navy Public Affairs Policy and Regulations (Available at <https://www.secnav.navy.mil/doni/default.aspx>.)

TC 3–04.3

Aviation Gunnery

TC 3-04.62

Small Unmanned Aircraft System Aircrew Training Program

TM 5-803-10

Planning and Design of Outdoor Sports Facilities (Available at <https://www.wbdg.org/ffc/army-coe/technical-manuals-tm>.)

TM 9-1370-206-10

Operator's Manual for Pyrotechnic Signals

TM 9-1370-208-10

Photoflash Cartridges, Surface Flares and Miscellaneous Pyrotechnic Items

TM 9-1375-213-12

Operator's and Unit Maintenance Manual (Including Repair Parts and Special Tools List): Demolition Materials

TM 9-6920-3700-10

Operator Manual for Close Combat Mission Capability Kit (CCMCK) for Training Device, Fire Dye Marking Ammo: M16/M4 (NSN 6920-01-564-9657) Training Device, Fire Dye Marking Ammo: M249 (NSN 6920-01-564-9655) Training Device, Fire Dye Marking Ammo: M9 (NSN 6920-01-564-9656) Training Device, Fire Dye Marking Ammo: M11 (NSN 6920-01-564-9658) Training Device, Fire Dye Marking Ammo: M17 (NSN 6920-01-695-3617) Training Device, Fire Dye Marking Ammo: M18 (NSN 6920-01-695-3580) and Close Combat Blank System (CCBS) for Blank Firing Kit: M17 (NSN 6920-01-695-3596) Lank Firing Kit: M18 (NSN 6920-01-695-3479)

TM 60A-2-1-77

PAN (Available at <https://nossa.dc3n.navy.mil/nros>.)

TM 08655B-10A

Operator's Manual LAV-M (Available at <https://nossa.dc3n.navy.mil/nros>.)

29 CFR 1960.6

Designation of agency safety and health officials

49 CFR 172.101

Purpose and use of the hazardous materials table

49 CFR 177.848

Segregation of hazardous materials

10 USC 2710(e)(3)

Definitions

29 USC Chapter 15

Occupational Safety and Health

Section III**Prescribed Forms**

This section contains no entries.

Section IV**Referenced Forms**

Unless otherwise indicated, DA forms are available on the Army Publishing Directorate website (<https://armypubs.army.mil>).

DA Form 11-2

Internal Control Evaluation Certification

DA Form 581

Request for Issue and Turn-in of Ammunition

DA Form 2028

Recommended Changes to Publications and Blank Forms

DA Form 7632

Deviation Approval and Risk Acceptance Document (DARAD)

Appendix B

Internal Control Evaluation

B–1. Function

The function covered by this evaluation is the safety on ranges used by the Army and the Marine Corps.

B–2. Purpose

The purpose of this checklist is to assist commanders and managers in evaluating their key internal controls. It is intended as a guide and does not cover all controls.

B–3. Instructions

Range safety programs are established and documented. Commanders and leaders are provided a risk assessment before range operations. Conscious RM decisions are made at the proper level of decision making. Deviations are processed when the conditions described in chapter 4 of this regulation are met. Answers must be based on actual testing of key internal controls (for example, document analysis, direct observation, sampling, or simulation). Answers that indicate deficiencies must be explained and the corrective action indicated in supporting documentation. These internal controls must be formally evaluated at least once every 5 years or as directed by the installation senior officer. Certification that this evaluation has been conducted must be accomplished on DA Form 11–2 (Internal Control Evaluation Certification).

B–4. Test questions

- a.* Are all conditions described in chapter 4 allowed only under an approved deviation?
- b.* Are range control and safety professionals qualified and trained?
- c.* Are risk decisions made at the proper command level and documented?
- d.* Is a range safety program documented?

B–5. Supersession

This evaluation replaces the evaluation previously published in AR 385–63/MCO 3570.1C, dated 30 January 2012.

B–6. Comments

Help make this a better tool for evaluating internal controls. Submit comments to the Director of Army Staff at usarmy.pentagon.hqda-aso.mbx.army-safety-office@army.mil.

Glossary

Section I

Abbreviations

ACOM

Army command

ADA

air defense artillery

AE

ammunition and explosives

AFI

Air Force instruction

AFMAN

Air Force Manual

AGL

above ground level

AGM

air-to-ground missile

AK

Avtomat Kalashnikova

AMC

U.S. Army Materiel Command

AMOUT

advanced military operations in urban terrain

ANOR

allowable number of rounds

AP

armor-piercing

APERS

anti-personnel

APERS-T

Anti-Personnel-Tracer

APFSDS-T

armor-piercing, fin-stabilized discarding sabot-tracer

API

armor-piercing incendiary

APMI

Accelerated Precision Mortar Initiative

APOBS

Anti-Personnel Obstacle Breaching System

AR

Army regulation

ARIMS

Army Records Information Management System

ARNG

Army National Guard

ARSMM

Army range safety messages/memoranda

ARSO

assistant range safety officer

ARSOF

Army special operations forces

ASA (ALT)

Assistant Secretary of the Army (Acquisition, Logistics and Technology)

ASA (IE&E)

Assistant Secretary of the Army (Installations, Energy and Environment)

ASCC

Army Service component command

ASOHP

Army Safety and Occupational Health Program

ASP

ammunition supply point

AT&A

air traffic and airspace

ATP

Army techniques publication

ATTP

Army tactics, techniques, and procedures

ATWESS

anti-tank weapons effect signature simulator

BB

Bunker Buster

BFA

blank-firing adapter

BHN

Brinell hardness rating

BUMEDINST

Navy Bureau of Medicine and Surgery instruction

CALFEX

combined arms live-fire exercise

CAMDV

control authority maximum divert

CAX

combined arms exercise

CBRN

chemical, biological, radiological, and nuclear

CCBS

Close Combat Blank System

CCMCK

close combat mission capability kit

CFR

Code of Federal Regulations

CG
commanding general

cm
centimeter

CMC
Commandant of the Marine Corps

CNGB
Chief, National Guard Bureau

COE
Chief of Engineers

COMMARFORRES
Commander, Marine Corps Forces Reserve

CPR
common practice round

CQC
close quarters combat

CR
cross-range

C-RAM
Counter-Rocket, Artillery, Mortar

CREW
Counter Radio-controlled improvised explosive device Electronic Warfare

CS
o-chlorobenzylidene malononitrile

CSA
Chief of Staff, Army

DA Pam
Department of the Army pamphlet

DAM
Demolition Attack Munition

DAR
Department of the Army representative

DARAD
Deviation Approval and Risk Acceptance Document (DA Form 7632)

DASAF
Director of Army Safety

dB
decibel

dBp
decibels peak pressure

DCS
Deputy Chief of Staff

DDESB
Department of Defense Explosives Safety Board

DDI
dummy, drill, and inert

DES

demolition effects simulators

DESR

Defense Explosives Safety Regulation

DoD

Department of Defense

DoDD

Department of Defense directive

DoDI

Department of Defense instruction

DoDIC

Department of Defense identification code

DR

down-range

DRU

direct reporting unit

DSN

Defense Switched Network

DZ

drop zone

EFP

explosively formed penetrator

ENA

exposure not allowed

EOD

explosive ordnance disposal

EODB

Explosive Ordnance Disposal Bulletin

EPR

Enhanced Performance Round

FAA

Federal Aviation Administration

FAH

final attack heading

FL

flechette

FM

field manual

FR

Federal Register

ft

feet

FW

fixed wing

GBU

Guided Bomb Unit

GMLRS

Guided Multiple Launch Rocket System

GPS

global positioning system

GREM

Grenade Rifle Entry Munition

GREM-TP

Grenade Rifle Entry Munition-Target Practice

GS

general schedule

GSL

gunner-shot-line

GTL

gun target line

HC

Hexachloroethane

HE

high-explosive

HEAA

high-explosive anti-armor assault

HEAT

high-explosive anti-tank

HEDP

High-Explosive Dual-Purpose

HEI-T

High-Explosive Incendiary-Tracer

HELLFIRE

Heliborne, Laser, Fire and Forget Missile

HEP

high-explosive plastic

HERCULES

Heavy Equipment Recovery Combat Utility Lift and Evacuation System

HIMARS

High-Mobility Artillery Rocket System

HMMWV

high-mobility multipurpose wheeled vehicle

I&L

installations and logistics

ICM

improved conventional munition

IDAP

integrated defensive armed penetrator (MH-60)

IED

improvised explosive device

IL

illumination

IMOIC

Improved Missile Ordnance Inhibit Circuit

IP

intersecting point

IR

infrared

JP

Joint Publication

JPADS

Joint Precision Airdrop System

JTAC

joint terminal attack controller

kg

kilogram

KTAS

knots true airspeed

LASER

light amplification by stimulated emission of radiation

LAW

light anti-tank weapon

lb

pound

LDA

launcher danger area

LOAL

lock-on after launch

LOAL-D

lock-on after launch-direct

LOBL

lock-on before launch

LPWS

Land-based Phalanx Weapon System

LRMT

Laser Range Management Tool

LSDZ

laser surface danger zone

LW

Lightweight

m

meter

m/s

meters per second

MAAWS

Multi-Role Anti-Armor Anti-Personnel Weapons System

MACS

Modular Artillery Charge System

MAE

maximum allowable environment

MAM

munition adapter module

MARCORSYSCOM

Marine Corps Systems Command

MARSOC

Marine Corps Special Operations Command

MAWTS-1

Marine Aviation Weapons and Tactics Squadron One

Max Ord

maximum ordinate

MCCM

modular crowd control munition

MCICOM

Marine Corps Installations Command

MCLIC

mine-clearing line charge

MCO

Marine Corps order

MCRP

Marine Corps Reference Publication

MCTP

Marine Corps Tactical Publication

MELB

Mission Enhanced Little Bird

MEP

mission-essential personnel

mg/m³

milligrams per cubic meter

MGL

Miniature Grenade Launcher

MHz

megahertz

MIL-HDBK

military handbook

MLRS

Multiple Launch Rocket System

mm

millimeter

MOIC

Missile Ordnance Inhibit Circuit

MOS

military occupational specialty

MP

multi-purpose

MPE
maximum permissible exposure

mph
miles per hour

MSD
minimum safe distance

MSE
Missile Segment Enhancement

MSL
mean sea level

MTL
missile target line

NAVAIR
Naval Air Systems Command

NAVFAC
Naval Facilities Engineering Systems Command

NAVMC DIR
Navy and Marine Corps Directive

NAVSEA
Naval Sea Systems Command

NAVSUP
Naval Supply Systems Command

NCO
noncommissioned officer

NE
novel-explosive

NEHC
Navy Environmental Health Center

NHC
noise hazard control

NL/TLMS
Non-Lethal/Tube-Launched Munition System

NLW
non-lethal weapons

NOHD
nominal ocular hazard distance

NVD
night vision device

OFS
operational flight software

OIC
officer in charge

OPAREA
operational area

OPNAVINST
Chief of Naval Operations instruction

ORAH

On Range Ammunition Handling

PAC

Phased Array Tracking Radar for Intercept on Target Advanced Capability

PAN

Percussion-Actuated Neutralizer

PATRIOT

Phased Array Tracking Radar for Intercept on Target

PE

probable error

PED

deflection probable error

PER

range probable error

PGK

precision guidance kit

PII

personally identifiable information

PPE

personal protective equipment

QE

quadrant elevation

RCA

riot control agent

RCO

range control officer

RF

radio frequency

RFMOIC

Radio Frequency Missile Ordnance Inhibit Circuit

RFMSS

Range Facility Management Support System

RLEM

Rifle Launched Entry Munition

RM

risk management

RMA

range management authority

RMTK

Range Managers Toolkit

RRPR

reduced range practice rocket

RRS-A

Records Retention Schedule-Army

RSO

range safety officer

RTA

range and training area

RTAM

Range and Training Area Management

RW

rotary-wing

SA

stay above

SACON

shock-absorbent concrete

SARSA

small arms range safety area

SB

stay below

SDZ

surface danger zone

SECNAVINST

Secretary of the Navy instruction

SESAMS

Special Effects Small Arms Marking System

SLAM

Selectable Lightweight Attack Munition

SLAP

saboted light armor penetrator

SLAP-T

Saboted Light Armor Penetrator-Tracer

SLE

stray laser energy

SMAW

shoulder-launched multipurpose assault weapon

SMAW-HEAA

Shoulder-Launched Multipurpose Assault Weapon-High-Explosive Anti-Tank Assault

SMAW-NE

Shoulder-Launched Multipurpose Assault Weapon Novel-Explosive

SME

subject matter expert

SNCO

staff noncommissioned officer (Marine Corps)

SOD-Vr

screening obscuration device-visual restricted

SOM

scheme of maneuver

SOP

standard operating procedure

SOUM

safety of use message

SRSO

senior range safety officer

SRT

steel reactive target

SRTA

Short-Range Training Ammunition

STLS

Stinger Trainer Launch Simulator

SUA

special use airspace

TA

terephthalic acid

TAMIS

Total Ammunition Management Information System

TB

technical bulletin

TB MED

technical bulletin medical

TC

training circular

TECOM

Marine Corps Training and Education Command

TM

technical manual

TMIT

trackless mobile infantry target

TNT

trinitrotoluene

TOW

tube-launched, optically-tracked, wire-guided

TP

training practice

TPCSDS-T

Target Practice, Cone-stabilized Discarding Sabot-Tracer

TP-DNT

Target Practice-Day Night Thermal

TPO

U.S. Army Training and Doctrine Command Proponent Office

TP-T

target practice-tracer

TRADOC

U.S. Army Training and Doctrine Command

TSG

The Surgeon General

TW

tilt wing

UAS

unmanned aircraft system

UFC

Unified Facilities Criteria

UHF

ultra high frequency

UL

Underwriter's Laboratory

USACE

U.S. Army Corps of Engineers

USASOC

U.S. Army Special Operations Command

USATCES

U.S. Army Technical Center for Explosives Safety

USC

United States Code

UXO

unexploded ordnance

V/m

volts per meter

VHF

very high frequency

VI

vertical interval

VT

variable time

WDZ

weapon danger zone

WESS

weapons effect signature simulator

WP

white phosphorous

3Rs

Recognize, Retreat, Report

Section II**Terms****Ammunition and explosives**

Includes all items of U.S.-titled (for example, owned by the U.S. Government through the DoD components) ammunition; propellants, liquid and solid; pyrotechnics; high explosives; guided missiles; warheads; devices; and chemical agent substances, devices, and components presenting real or potential hazards to life, property, and the environment. Excluded are wholly inert items and nuclear warheads and devices, except for considerations of storage and stowage compatibility, blast, fire, and non-nuclear fragment hazards associated with the explosives (see military munitions).

Ammunition lot

A quantity of components, each of which is manufactured by one manufacturer under uniform conditions, and which is expected to function in a uniform manner. The lot is designated and identified by assignment of an ammunition lot number and preparation of an ammunition data card.

Angle of deflection

The angle of travel of bullet fragments relative to the plane of the target surface towards the shooter.

Angle P

The angle beginning at the firing point, located to the left and right of the dispersion area, that defines the area that contains projectiles after making initial contact with the target medium.

Angle Q

The angle beginning at Distance Y, located to the left and right of the dispersion area, that defines the area that contains projectiles after making initial contact with the impact medium.

Appropriate hearing protector or protection

See DA Pam 40–501 for hearing protector types appropriate for use by the Army.

Area A

The secondary danger area (buffer zone) that laterally parallels the impact area or ricochet area (depending on the weapon system) and contains fragments, debris, and components from frangible or explosive projectiles and warheads functioning on the right or left edge of the impact area or ricochet area.

Area B

The secondary danger area (buffer zone) on the down-range side of the impact area and Area A that contains fragments, debris, and components from frangible or exploding projectiles and warheads functioning on the far edge of the impact area and Area A.

Area C

The secondary danger area (buffer zone) on the up-range side of the impact area and parallel to Area B that contains fragments, debris, and components from frangible or exploding projectiles and warheads functioning on the near edge of the impact area.

Area D

The safe area between Areas C and E for indirect, overhead fire of unprotected personnel in training.

Area E

The danger area between an indirect-fire weapon system and Area D. This area is endangered by muzzle debris, overpressure, blast, and hazardous impulse noise. Personnel in service batteries firing from approved tactical configurations may occupy Area E.

Area F

The danger area to the rear of a weapon system that is endangered by back-blast debris, overpressure, blast, and hazardous impulse noise.

Area G

The danger area between the CAMDV area and Area C that exists during the firing of artillery rounds equipped with a PGK. This area accounts for the possibility of a locked PGK canard resulting in a short round.

Area H

The area to the rear of a weapon system (for example, TOW missile) that contains warhead particles (collapsed shape charge and warhead fragments) during an eject only firing event.

Area I

The area immediately in front of certain missile weapon systems designated as the initial zone of impact for eject only firing events. Area I may not be occupied under deviation.

Area of critical concern

Any item or area deemed necessary to protect during range operations.

Area R

The portion of the SDZ behind the firer where personnel, equipment, and facilities may be endangered by ricochets to the rear of the firing line.

Army Special Operations Forces

Those Active Component and Reserve Component Army forces designated by the Secretary of Defense that are specifically organized, trained, and equipped to conduct and support special operations.

Assistant range safety officer

Officer, warrant officer, or NCO designated and briefed by the OIC and RSO, who assists the RSO in carrying out the safety responsibilities for the range or activity.

Autonomous designation

Designation of a target for a laser-guided munition conducted by the firing platform.

Backstop, laser

Opaque structures or terrain in the controlled area of a LSDZ, such as a hill, dense tree line, or a windowless building, that would completely obstruct any view beyond it and completely terminate a laser beam that may miss the target.

Barricade

An intervening natural or artificial barrier of such type, size, and construction that limits the effect of an explosion on nearby buildings or exposures in a prescribed manner.

Barrier

A permanent or temporary impediment to foot or vehicular traffic that personnel are prohibited to pass without approval from the RMA (Army) or range control (Marine Corps). A barrier may be sentinel, wire fencing, gate, sign, or other access-limiting device.

Body armor

A ballistic vest that absorbs the impact and stops the penetration small caliber projectiles. This body armor may also have side ballistic panels.

Buttoned-up

All hatch covers are in a closed and secure position.

Cease-fire

A command given by anyone observing an unsafe firing condition on any training complex to immediately terminate an active (hot or wet) firing status of a weapon system.

Central register

An official record of range safety deviations held at the respective ACOM, ASCC, or DRU.

Certified ammunition

Ammunition, to include fuzes, propellants, and projectiles, that has been cleared by AMC for overhead fire of unprotected personnel.

Cold firing status

A firing condition where authorization to fire a weapon system has not been given or has been revoked by the installation range operations firing desk (Army) or range control office (Marine Corps). Also referred to as a dry firing status.

Combined arms live-fire exercises (Army) or combined arms exercise (Marine Corps)

A combat exercise in which Army and Marine Corps combined arms teams in combat formation conduct coordinated combat firing and maneuver practice in executing the assault, seizure, and defense of appropriate objectives. Tactical air support may be included.

Command responsibility

As it relates to range safety, commanders down the entire chain of command are responsible for the safety of their personnel.

Conservation

The protection, improvement, and use of natural resources according to principles that will provide optimum public benefit and support of military operations.

Contaminated area

Any area where there are known or suspected unexploded munitions (dud ammunition or explosives) regardless of type.

Control authority maximum divert area

The additional danger area immediately surrounding the PE area that exists during the firing of artillery rounds equipped with a PGK.

Control tower

A structure usually situated behind the firing line or position from which range operations of a training event is controlled.

Cookoff

A functioning of any or all of explosive components due to high temperatures within a weapon system.

Crew-served weapon system

Any weapon system requiring two or more personnel to fire the system.

Cross-sectional terrain profile

A profile of the SDZ being considered for deviation at a point laterally down range where a hill mass is expected to attenuate projectiles or hazardous fragments.

Danger zone

General term to describe various types of danger zones (for example, SDZ and WDZ).

Decibel

A unit for expressing the relative intensity of sounds on a scale from zero for the average least perceptible sound to about 130 for the average pain level.

Decibel peak level

A logarithmic method of expressing the peak pressure caused by an explosion.

Dedicated impact area

See “impact area.”

Deviation

A departure from the requirements of this regulation/order.

Direct fire

Fire delivered on a target using the target itself as a point of aim for either the weapon or the director.

Dispersion area

The area within the SDZ located between the GTL and the ricochet area. This area accounts for human interaction with the weapon system, gun or cannon tube wear, propellant temperature, and so forth.

Distance D

Distance along specific angle, measured from the weapon target line, at the firing position down range for selected direct-fire weapons. Distance D defines maximum projectile distance along this line.

Distance L

The distance down range from the launch point where the launch dispersion angle intersects the flight corridor boundaries for the PATRIOT missile.

Distance W

The maximum lateral distance a projectile will ricochet after impacting within the dispersion area. Distance W defines the maximum lateral edge of the ricochet area.

Distance X

The maximum distance a projectile (to include guided missiles and rockets) will travel when fired or launched at a given QE with a given charge or propulsion system.

Distance Y

The maximum distance down range at which a lateral ricochet is expected to occur when a projectile is fired at a given QE.

Double-hearing protector (or protection)

Wearing earplugs in combination with noise muffs or noise attenuating helmets. Impulse levels can be so high that single-hearing protection does not adequately protect hearing.

Down-range

A descriptive term used to address the orientation of personnel, materiel, or property relative to the direction or path of ammunition or explosives (to include guided missiles and rockets) fired or launched from weapon systems. The direction of orientation is from the firing line or position toward the target.

Dud

An explosive item or component of a weapon system that fails to function as intended when fired.

Eject only firing event

A firing sequence where the launch motor of a missile functions, ejecting the missile out of the launcher, but the flight motor fails to ignite, causing the missile to tumble. As the missile tumbles and strikes the ground, sufficient G-force initiates the warhead, causing warhead particles to be projected outward.

Exposure

The frequency and length of time personnel and equipment are subjected to a hazard.

a. Severity. The expected consequence of an event, in terms of degree of injury, property damage, or other mission impairing factors (for example, loss of combat power or adverse publicity) that could occur.

b. Probability. The likelihood that a hazardous incident will occur.

Far edge

The boundary of the impact area that borders the outside edge of Area B and is farthest from the firing point or position.

Field expedient explosive device

A standard item of explosive that is combined with other standard explosive items or non-explosive items using techniques and procedures outlined in doctrinal publications (FMs and TMs).

Field of regard

Combines the seeker's instantaneous field of view as it moves along the seeker scan pattern, so it includes anything that could be in the seeker's field of view during scanning.

Final safety acceptance inspection

ACOMs, ASCCs, and DRUs safety inspection of new construction or modification of a range prior to release from the contractor or other contracting agent, Government or non-Government.

Firing Area

Multiple firing points contained in a designated area from which weapons such as artillery can be fired safely.

Firing lane

The area within which a weapon system is fired. It consists of a start-fire line, cease-fire disarm line, and left and right limits of fire.

Firing line

The line that consists of firing points or positions from which weapon systems are fired down range.

Firing position

The point or location at which a weapon system (excluding demolitions) is placed for firing. For demolitions, the firing position is the point or location at which the firing crew is located during demolition operations.

Fork

The change in angle of elevation necessary to produce a change to the center of impact equivalent to four PEs.

Guided missile

An unmanned vehicle moving above the surface of the earth whose trajectory or flight is capable of being altered by an external or internal mechanism.

Gun target line

An imaginary straight line from gun to target. Also referred to as the line of fire.

Gunshot line

The imaginary line off the nose of the firing aircraft, that is, the heading of the missile prior to launch. These terms are neither Apache- nor RW-specific.

Hang fire

An undesired delay in the functioning of a firing system. A hang fire for a rocket occurs if the rocket propellant is ignited by the firing impulse, but the rocket fails to exit the launcher within the expected time.

Hazard

Any actual or potential condition that can cause injury, illness, or death of personnel; damage to or loss of equipment, property, or mission degradation; or a condition or activity with potential to cause damage, loss, or mission degradation.

Hearing hazard, hearing hazard zone

The area where the impulse noise levels are 140 dBP or higher and hearing protection is required.

Hearing protection zone

Area on the range within which all personnel must wear hearing protection during weapons fire. It may be larger than the hearing hazard zone, but never smaller.

Hexachloroethane smoke

HC-zinc oxide used to generate screening smoke.

High-hazard impact area

See impact area.

Hot firing status

A firing condition where authorization to fire a weapon system has been given by the installation range operations firing desk (Army) or range control office (Marine Corps). Also referred to as a wet firing status.

Impact area

The ground and associated airspace within the training complex used to contain fired, placed, dropped, thrown, or launched AE and the resulting fragments, debris, and components from various weapon systems. Indirect-fire weapon system impact areas include PE for range and deflection. Direct-fire weapon system impact areas encompass the total SDZ from the firing point or position down range to Distance X. It also includes Area B when required.

a. Temporary impact area. An impact area within the training complex used for a limited period of time to contain fired, placed, dropped, thrown, or launched AE and the resulting fragments, debris, and components. Temporary impact areas are normally used for non-dud producing AE and should be able to be cleared and returned to other training support following termination of firing.

b. Dedicated impact area. An impact area that is permanently designated within the training complex and used indefinitely to contain fired, placed, dropped, thrown, or launched AE and the resulting fragments, debris, and components. Dedicated impact areas are normally used for non-sensitive AE.

c. High-hazard impact area. An impact area that is permanently designated within the training complex and used to contain sensitive HE AE and the resulting fragments, debris, and components. High-hazard impact areas are normally established as part of dedicated impact areas where access is limited and strictly controlled due to the extreme hazard of dud munition (for example, ICM, HEAT, 40-mm, or other highly sensitive AE).

Improved conventional munitions

Munitions characterized by the delivery of two or more antipersonnel or anti-materiel or anti-armor sub-munitions.

Indirect fire

Fire delivered on a target when the weapon system is not in line of sight with the target.

Installation

An aggregation of contiguous or near contiguous, common mission supporting real property holdings under the jurisdiction of the DoD within and outside the continental United States. Examples include posts, camps, bases, and stations.

Installation range management authority (Army) or range control officer (Marine Corps)

A commissioned officer, warrant officer, NCO, or civilian who serves as the central point of control and coordination for all activities conducted within the installation or community training complex and implements and enforces the installation or community range safety program. This may include the scheduling and maintenance of the training complex.

Instructor pilot

A qualified warrant or commissioned officer who is placed on military orders and is assigned the responsibility for the safe operation of assigned aircraft and associated weapon systems.

Intrabeam viewing

Looking directly into the path of a laser beam or reflected beam.

Intraline distances

The distance used for separating certain specified areas and locations within explosive establishments.

Large rocket

A stabilized, free ballistic trajectory, long range field artillery type rocket with a range capability of greater than 100 when using a nonnuclear warhead.

Laser

A device capable of producing a narrow beam of intense light (see TB MED 524, MIL–HDBK–828C, and JP 3–09 for more information on lasers).

Laser buffer zone

A safety margin on either side, above, and below the approved target area extending to a distance at which the beam is terminated by a backstop extending across the target zone or the NOHD limit is reached. A vertical buffer zone covers the angular distances below the highest point on a backstop or above the non-lasing area. The laser horizontal buffer zone covers the angular distance to the left of the left most target and to the right of the right most target.

Laser range finder

device that uses laser energy for determining the distance from the device to a place or object.

Laser safety eyewear

Protective eyewear designed specifically to permit the user to be exposed to either a direct or reflected laser beam from a specific laser device without eye injury.

Laser surface danger zone

A V-shaped zone designed to contain a laser beam (while lasing) with buffer zones on either side, above, and below the approved target.

Logistics assistance representative

Department of Army Civilian personnel in the grade of GS–11 and above who have received training in specific weapon systems and are qualified in accordance with AR 75–1 to assist in performing malfunction investigations.

Low-angle fire

Fire delivered at angles of elevation equal to or below the angle corresponding to the maximum range of the gun and ammunition.

Malfunction

Failure of an ammunition item to function as expected when fired or launched or when explosive items function under conditions that should not cause functioning. Malfunctions include hang fires, misfires, duds, abnormal functioning and premature functioning of explosive items under normal handling, maintenance, storage, transportation, and tactical deployment. Malfunctions do not include mishaps or incidents that arise solely from negligence, malpractice, or situations such as vehicle mishaps or fires.

Military munitions

All ammunition products and components produced for or used by the Armed Forces for national defense and security, including ammunition products or components under the control of the DoD, the Coast Guard, the Department of Energy, and the National Guard.

a. This term includes the following:

- (1) Confined gaseous, liquid, and solid propellants.
- (2) Explosives, pyrotechnics, chemical and RCAs, smokes, and incendiaries, including bulk explosives, and chemical warfare agents.
- (3) Chemical munitions, rockets, guided and ballistic missiles, bombs, warheads, mortar rounds, artillery ammunition, small arms ammunition, grenades, mines, torpedoes, depth charges, cluster munitions and dispensers, and demolition charges.

b. This term does not include the following:

- (1) Wholly inert items.
- (2) IEDs.
- (3) Nuclear weapons, nuclear devices, nuclear components, and other than non-nuclear components of nuclear devices that are managed under the nuclear weapons program of the Department of Energy after all required sanitization operations under the Atomic Energy Act of 1954 have been completed.

Military operations in urban terrain

A terrain complex where manmade construction impacts on the tactical options available to commanders. Military operations in urban terrain facilities replicate urban sprawl environments.

Misfire

A complete failure to fire that is not necessarily hazardous. Because it cannot be readily distinguished from a delay in functioning (hang fire), it must be handled as worst case in accordance with procedures for the weapon system.

Mission-essential area

The area within the SDZ located adjacent to the impact area that is allowed to be occupied only by essential personnel needed to accomplish the assigned task or mission.

Mission-essential personnel

Those individuals who are directly involved or in support of weapon systems firing without whom the firing mission could not take place.

Munitions constituents

Any materials originating from UXO, discarded military munitions, or other military munitions, including explosive and nonexplosive materials, and emission, degradation, or breakdown elements of such ordnance or munitions (see Section 2710(e)(3), Title 10, United States Code).

Navigable waterway

Any body of water open to the free movement of marine vessels.

Near edge

The boundary of the impact area that borders Area C and is nearest to the firing point or position.

Nominal ocular hazard distance

The intrabeam distance within which the laser beams irradiance or radiant exposure falls below the applicable exposure limit.

Nominal ocular hazard distance-magnified

The NOHD for intrabeam viewing through 7x50 binoculars that transmit 70 percent at 1064 nanometers and 85 percent at 694.3 nanometers.

Non-participating personnel

Personnel who are not under the direct OIC or RSO control or responsibility and are not involved in the overall exercise or training event in any way.

Nonstandard explosive item

An explosive device, material, or component that has not been through a DoD Service munitions qualification process, such as being type classified by AMC, or is a standard explosive item that has been altered to change its characteristics and function.

Officer in charge

The officer, warrant officer, or NCO responsible for personnel conducting firing or operations within the training complex.

Operational range

A range that is under the jurisdiction, custody, or control of the Secretary of Defense and that is used for range activities, or although not currently being used for range activities, is still considered by the Secretary to be a range and has not been put to a new use that is incompatible with range activities.

Overhead fire

Weapon system firing that is delivered over the heads of unprotected personnel in training or personnel located anywhere in the SDZ.

Participating personnel

Personnel who are under direct OIC or RSO control or responsibility participating in or part of an overall exercise or training event and directly involved in some or all of the tasks or events associated with the overall exercise or training.

Primary danger area

An area within the SDZ where hazards are known to exist and in which no unprotected Soldier or Marine or materiel is permitted since injury or death to such personnel and damage to materiel is probable. Target, dispersion, and ricochet areas are primary danger areas.

Probable error

A measure of the impact distribution in the dispersion pattern around the center of impact dimensionally expressed in firing tables as one interval of the dispersion rectangle.

Proper eye protection or eye armor

Approved eye protection, as a minimum, when required by safety and installation or community range regulations or standing operating procedures.

Proper hearing protection

Approved single- or double-hearing protection, as a minimum, when required by safety or installation range regulations or SOPs.

Protective shelter

A purpose built and designed shelter that will protect against fragments or debris that may be expected from a warhead functioning or explosive detonation. Must be designed to mitigate specific hazards presented for which the facility was designed. For the Marine Corps, facility designs must be approved by the RCO and RTAM (C 465) to ensure that the protective shelter provides protection against the hazards as they were designed.

Public traffic route distance

The distance in feet used to separate any public highway, navigable stream, passenger railroad, or aircraft taxiway from potential explosion sites (see DA Pam 385–64 for quantity-distance tables).

Quality assurance specialist (ammunition surveillance)

Department of Army Civilian personnel in the grade of GS–09 or above who have received 2 years of ammunition training and are qualified in accordance with AR 75–1 to assist in performing malfunction investigations.

Range

When used in a geographic sense, a designated land or water area that is set aside, managed, and used for range activities of the DoD. Includes the following:

- a.* Firing lines and positions, maneuver areas, firing lanes, test pads, detonation pads, impact areas, electronic scoring sites, buffer zones with restricted access, and exclusionary areas.
- b.* Airspace areas designated for military use in accordance with regulations and procedures prescribed by the Administrator of the FAA.

Range activities

Research, development, testing, and evaluation of military munitions, other ordnance, and weapon systems. The training of members of the Armed Forces in the use and handling of military munitions, other ordnance, and weapon systems.

Range error

Difference between the range to the point of impact of a particular projectile and the range to the mean point of impact of a group of artillery projectiles fired with the same data.

Range Facility Management Support System

The approved RTA scheduling system of record used to assist RMA or RCO with managing RTA operation by automating the scheduling process and facilitating fire desk operations.

Range Managers Toolkit

A set of automated tools that utilize geospatial datasets in a geographic information system environment. Allows users to construct digital geo-referenced danger zones with sub-meter accuracy. Available at <https://srp2.army.mil> or <https://rtam.tecom.usmc.mil>.

Range officer

See “installation range management authority (Army) or range control officer (Marine Corps).”

Range personnel

Persons designated to assist the RMA (Army) and RCO (Marine Corps) in executing the installation range safety program.

Range safety officer

The officer, warrant officer, or NCO who is the direct representative of the OIC of firing or other operations. Responsible to the OIC for insuring the adequacy of safety of firing and training operations and ensuring compliance with laser range safety requirements and local standing operating procedures.

Rear range

The orientation of personnel, materiel, or property to the rear of a weapon system.

Remote designation

Designation provided for laser-guided munitions by a source other than the firing platform.

Residual risk

The level of risk remaining after controls have been identified and selected for hazards that may result in loss of combat power.

Ricochet area

The area located to the left and right of the dispersion area that contains projectiles after making initial contact with the target medium. For SDZs having Angles P and Q, it is also the area located to the left and right of the dispersion area. The ricochet area is defined by Distance W.

Ricochet danger area

The area down range from an artillery target area that contains projectiles and projectile parts (for example, carrier shells) after making initial contact with the target medium when fired at low angle (less than 800 mils QE).

Right and left range

The orientation of personnel, materiel, or property within the SDZ relative to the GTL.

Risk

Chance of hazard or undesired consequences or the probability of exposure to chance of injury or loss from a hazard. Expressed in terms of hazard probability and severity.

Risk decision

The decision to accept or not accept the risks associated with an action made by the commander, leader, or individual responsible for performing that action.

Risk management

The process of identifying, assessing, and controlling risks arising from operational factors and making decisions that balance risk cost with mission benefits.

Risk management process

The process of identifying and assessing hazards; determining their risk; developing, evaluating, and selecting controls; making risk decisions; and implementing and managing those decisions to improve operational effectiveness and conserve resources.

Safe area

An area within the SDZ where the probability of injury is minimal to exposed Soldiers and Marines or those provided with protective cover.

Safety certification program

A program established and maintained by the battalion or squadron commander to ensure that personnel under their command designated as OICs and RSOs are competent and qualified to carry out the responsibilities and duties of the respective positions.

Secondary danger zone

An area outside of the primary danger area that provides containment of fragments, debris, and components from frangible or HE projectiles and warheads functioning on the far edge of the primary danger area. Areas A, B, and C are secondary danger areas.

Senior range safety officer

The officer designated as the RSO for crew-served guided missiles and heavy rockets, excluding direct-fire anti-tank missiles and rockets.

Single-hearing protector or protection

Wearing either earplugs, noise muffs, or noise attenuating helmets.

Special use airspace

Airspace of defined dimension identified by an area on the surface of the earth wherein activities must be confined because of their nature or wherein limitations may be imposed upon aircraft operations that are not a part of those activities.

Specular reflective surface

A mirror-like surface capable of reflecting a laser beam.

Subcaliber ammunition

Practice ammunition of a caliber smaller than standard for the weapon system. Economical and may be fired in relatively smaller areas. It is used with special subcaliber equipment and devices to simulate firing conditions with standard ammunition.

Surface danger zone

The ground and airspace designated within the training complex (to include associated safety areas) for vertical and lateral containment of projectiles, fragments, debris, and components resulting from the firing, launching, or detonation of weapon systems, to include explosives and demolitions.

Target area

The point or location within the SDZ where targets (static/moving and point/array) are emplaced for weapon system engagement. For demolitions, it is the point or location where explosive charges are emplaced.

Temporary impact area

See “impact area.”

Training complex

Firing ranges and weapons training facilities designated for firing AE, heavy rockets, and guided missiles for training and target practice and non-live-fire sites for maneuver exercises and operations.

Training site

A designated location to train, usually within the confines of the training complex. A specific firing range or weapons training facility designated for firing AE, heavy rockets, and guided missiles for training and target practice and non-live-fire sites for maneuver exercises and operations.

Trajectory safety officer

Assists the SRSO and is responsible for determining when crew-served guided missiles and heavy rockets should be destroyed or thrust terminated.

Triple check

A procedure to ensure correct weapon targeting has been verified by at least three independent checks prior to weapon release. Target verification may be a combination of procedures that mitigate human error producing erroneous weapon targeting.

Unexploded ordnance

AE that have been primed, fused, armed, or otherwise prepared for action and have been fired, dropped, launched, projected, or placed in such a manner as to constitute a hazard to operations, installations or communities, personnel, or materiel and remains unexploded either by malfunction or design or any other cause.

Unit commander

A commander of an Army or Marine Corps element whose structure is prescribed by competent authority, such as a table of organization and equipment.

Up-range

The orientation of personnel, materiel, or property relative to the direction or path of AEs (to include guided missiles and rockets) fired or launched from weapon systems. The orientation is from the target area or impact area toward the firing line or position.

Weapon danger zone

Encompasses the ground and airspace for lateral and vertical of impact and post impact effects (that is, projectiles, fragment, debris, and components) resulting from the firing, launching, or detonation of aviation-delivered ordnance. This three-dimensional zone accounts for weapon accuracy, failures, ricochets, and broaches or porpoising of a specific weapon or munition type delivered by a specific aircraft type. Represents the minimum safety requirements designed for aviation weapons training on DoD ranges.

Weapon system knowledgeable

An individual, military or civilian, who has completed a standard program of instruction for a particular weapon system or has completed familiarization training established by the senior commander. Familiarization training may involve live-fire training. Familiarization training should be approved by proponent school.

Weapon system qualified

An individual, military or civilian, who has completed a standard program of instruction for a particular weapon system.

140 decibels peak contour

The distance at which the impulse noise produced by the weapon or explosive is 140 dBP level. See also “hearing hazard zone.”

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