

US Army Range Safety Pocket Guide Version 2.2



This portable guide provides references to AR 385-63/MCO 3570.1B and DA PAM 385-63. It is not intended for use as a sole source of information for the AR 385-63/MCO 3570.1B and/or DA PAM 385-63. For further information, consult the full versions of AR 385-63/MCO 3570.1B and DA PAM 385-63.

Surface Danger Zone templates included in this guide are shown at a scale of 1:25,000 and 1:50,000 and are for reference only.

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Summary

This pocket guide provides revised range safety policy for the U.S. Army. It establishes:

- Surface danger zones as minimum safety standards;
- Range safety responsibilities for the unit commander, Officer in Charge (OIC), and Range Safety Officer (RSO) for all ranges, especially for live-fire operations;
- Procedures for ammunition and explosives: positioning and issuing; suspension of ammunition and explosives involved in malfunctions; UXO and misfire procedures and reporting; and disposition of ammunition and explosives involved in malfunctions and accidents;
- Risk-management principles and deviation authorities, and employs the composite risk management process to identify and control range hazards.

For guidance beyond this pocket guide, refer to AR 385-63/MCO 3570.1B and Department of the Army Pamphlet (DA PAM) 385-63.

Purpose of this Pocket Guide

The purpose of this pocket guide is to provide the user with a quick ready reference for the field, in order to assist in developing a training plan. It provides standards and procedures for the safe firing of ammunition, demolitions, lasers, guided missiles, and rockets for training. When standards conflict with those of other military services, Federal agencies, or host nations, the standards providing the higher degree of protection apply.

Excerpts from Army Regulation 385-63/MCO 3570.1B, 19 May 2003**Applicability**

- a. This regulation/order applies to:
 - (1) The Active Army, United States Military Academy, Army National Guard of the United States, the U.S. Army Reserve, and Department of the Army civilian employees and contractors. Contracts for work on Army ranges will include provision requiring compliance with applicable provisions of this regulation.
 - (2) Reserve Officer Training Corps participating students while training on an Army or Marine Corps controlled range.
 - (3) Any person or organization utilizing an Army or Marine Corps controlled real estate or range.
 - (4) Range training and target practice activities.
 - (5) Military real estate areas that are being or have been used as bombing ranges, artillery impact areas, or target areas.
 - (6) All areas designated for live-fire weapons firing, including laser ranges, recreational ranges, and rod and gun club ranges located on Army or Marine Corps property or property controlled by the Army or Marine Corps.
- b. During mobilization, chapters and policies contained in this regulation/order may be modified by the proponent. This regulation is advisory for deployed units engaged in combat operations.
- c. This regulation/order also applies to personnel training outside the United States. Army or Marine Corps commanders will apply the provisions of this regulation/order and host nation agreements as appropriate.

Excerpts from Army Regulation 385-63/MCO 3570.1B, 19 May 2003

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General

- a. The commander is responsible for the safe conduct of Soldiers/Marines involved in training operations.
- b. All military commands and all Federal, state, local, and/or private organizations using Army and USMC ranges will adhere to the provisions AR 385-63/MCO 3570.1B, DA PAM 385-63, and required publications.

Surface danger zones (SDZs)

- a. Surface danger zones shall be prepared and updated as appropriate according to DA PAM 385-63 for all munitions and laser systems. Munitions and hazardous laser systems (such as class 3b and 4 lasers) will not be fired or employed on training ranges except within the confines of approved SDZs. Deviations from this policy shall be in accordance with the provisions of Chapter 3, AR 385-63/MCO 3570.1B and DA PAM 385-63.
- b. SDZs published in DA PAM 385-63 represent Army and USMC 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.
- c. If a round exits an approved SDZ, firing of that munition and weapon will cease locally until the cause of the round-out-of-impact (ROI) has been determined.
- d. SDZs will be updated on the basis of data derived from research and development, testing, and/or actual firing experience. SDZs for new ammunition and weapons and modifications of existing SDZs will be approved and disseminated using the same procedures described in AR 385-63/MCO 3570.1B and DA PAM 385-63.

Deviation limitations

- a. Deviations are limited to:
 - (1) Reducing SDZ dimensions when terrain, artificial barriers, or other compensating factors make smaller SDZs safe.
 - (2) Modifying prescribed firing procedures to increase training realism (such as accepting increased risk when these risks have been incorporated into an approved SDZ) as appropriate for the proficiency of participating Soldiers and Marines.
 - (3) Allowing personnel who are not directly participating in the actual conduct of training within the SDZ.
- b. Deviations shall not be applied to other Federal agency directives/regulations such as airspace or water traffic requirements.
- c. For live-fire training operations conducted under an approved deviation by nonresident units, the host installation commander must approve training at a host installation.
- d. Deviations may be authorized by the following personnel:
 - (1) Army Command (ACOM), Army Service Component Command (ASCC), and Direct Reporting Unit (DRU) (formerly know as MACOMs) commanders
 - (2) The Director, Army National Guard (ARNG), National Guard Bureau (NGB)
- e. Delegation of deviation authority. For the Army, ACOM, ASCC, DRU commanders may sub-delegate, in writing, deviation authority to general officers in command positions, but not lower than installation commanding generals. This authority shall not be further sub-delegated.

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Excerpts from Department of the Army Pamphlet (DA PAM) 385-63, 4 August 2009**Range Safety Responsibilities****The unit commander:**

- a. Ensures compliance with AR 385-63/MCO 3570.1B and DA PAM 385-63; applicable Technical Manuals (TMs), Field Manuals (FMs), and Fleet Marine Force Manuals (FMFMs) (Marine Corps), installation range guidance, and applicable SOPs for safe training and firing for each weapon system within the command.
- b. Ensures all personnel within the command are briefed on and comply with installation range procedures and safety requirements including required personal protective equipment.
- c. Designates an OIC and RSO for each firing exercise and/or maneuver in accordance with Table 1. (Except as designated below, the RSO may have no additional duties during the firing exercise.)
- d. Ensures personnel performing duties of OIC and RSO are certified in accordance with established installation safety certification program.
- e. Complies with range safety certification program guidance in AR 385-63/MCO 3570.1B and DA PAM 385-63 for OICs and RSOs to ensure they are:
 - (1) Competent and properly instructed in the performance of their duties.
 - (2) Knowledgeable in the weapon systems for which they are held responsible and in safe ammunition handling and use procedures.
- f. Develops 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 Technical Bulletin (TB) MED 524 and MIL-HDBK 828A.
- g. Applies risk management and develops controls and procedures for all phases of training events.

Officer in Charge (OIC):

- a. **Qualifications:**
 - (1) Commissioned, warrant, or noncommissioned officer (NCO) or civilian. NCOs serving as OIC will be in the grade shown in Table 1 at a minimum.
 - (2) OICs will be certified in the weapon systems for which they are responsible. *(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 installation commander. Familiarization training may involve live fire training. Proponent school should approve familiarization training.)* 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. He/she must be able to fully influence the conduct of the event. For aviation weapons systems, the OIC must be weapons systems knowledgeable.

Excerpts from DA PAM 385-63, 4 August 2009

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b. Duties:

- (1) Ensures the overall safe conduct of training and proper use of the installation training complex.
- (2) Receives a range safety briefing from installation range control organization on use of the training complex.
- (3) Ensures the RSO is physically present at the training site.
- (4) Determines when it is safe to fire in accordance with applicable regulations and installation range requirements.
- (5) Ensures receipt of final clearance to fire from range control.
- (6) Ensures proper supervision of personnel performing misfire, hang-fire, and cookoff procedures.
- (7) Ensures required communications are established and maintained.
- (8) Ensures safe laser operations.
- (9) Ensures adequate medical support is available.
- (10) Ensures ammunition and explosives 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.
- (11) Ensures a written log is maintained of pertinent safety and control data concerning the operation of firing ranges, weapons training facilities, and maneuver areas, authorized operating times, impact areas entries and exits, and cease-fire authorizations.
- (12) Ensures plans for firing exercises and maneuvers are coordinated with range control.
- (13) Ensures control of target areas to prohibit entry by unauthorized personnel.
- (14) Ensures all ammunition malfunctions and accidents are reported to range control in accordance with AR 75-1 and AR 385-40.
- (15) Ensures coordination and approval has been gained from the range control agency for all civilian personnel that will be entering the training site.
- (16) Briefs the RSO on the duties to be performed in support of the training event. Clearly establishes 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.
- (17) Implements composite risk management in all phases of the training events.

The RSO:

a. Qualifications:

- (1) Commissioned officer, warrant officer, NCO, or civilian. For field artillery applications, the position commander or OIC may assume RSO duties. Grade requirements will be in accordance with Table 1. Personnel assigned as RSO will have no other duties during that period of training, except for aviation weapons systems training where instructor pilots may assume RSO duties. Assistant range safety officers (ARSO) may be appointed as required.
- (2) Weapon system qualified. (*Weapon System Qualified: An individual, military or civilian, who has completed a standard program of instruction for a particular weapon system.*)
- (3) Certification of satisfactory completion of unit or installation range safety certification program.

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b. Duties:

- (1) Receives range safety briefing from the installation range control organization on use of the ranges and training areas.
- (2) Ensures before granting clearance to fire:
 - (a) Weapons and personnel are properly positioned.
 - (b) Authorized ammunition and explosives to include proper charge, fuze, and fuze settings are used.
 - (c) Firing settings and weapons systems are within prescribed safety limits and verified.
 - (d) SDZ is clear of all unauthorized personnel.
 - (e) Personnel within noise-hazard areas wear proper hearing protection.
 - (f) Personnel within eye-hazard areas wear proper eye protection.
 - (g) Permission is received from range control to commence training and live-fire operations.
- (3) Prior to commencing live-fire operations, conducts 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 has been established, and that a "hot status" has been received from range control.
- (4) Orders immediate cease-fire or check-fire when any unsafe condition occurs.
- (5) Is physically present at the training site.
- (6) Reports all accidents and ammunition malfunctions to the range OIC.
- (7) Verifies, upon completion of firing or firing order, to the OIC that all weapons and weapon systems are clear and safe before allowing the removal of weapons from the firing area.
- (8) During laser operations, the Laser Range Safety Officer (LRSO):
 - (a) Ensures unit personnel employing lasers receive thorough safety briefings to include explanations of specific laser-related hazards, safety equipment, and detailed range safety procedures, and complies with procedures in Chapter 18, DA PAM 385-63.
 - (b) Knows and observes horizontal and vertical safety limits of the laser range.
 - (c) Follows unit SOPs for laser operations and training exercises.
 - (d) Ensures all personnel engaged in laser operations, to include personnel in target areas, maintain continuous communications.
 - (e) Ceases laser operations immediately if communications or positive control of the laser beam is lost.
 - (f) Allows the LRSO, as required, to serve as the RSO.
- (9) During ADA range firing with crew-served guided missiles and rockets:
 - (a) Receives missile and rocket firing advisory information from the senior RSO and advises the OIC accordingly.
 - (b) Ensures the entire range is clear of unauthorized personnel and equipment prior to firing and maintains clearance throughout the entire firing sequence.

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Table 1. OIC/RSO appointment requirements

Weapon System	OIC ¹			RSO ¹		
	OFF	WO	NCO	OFF	WO	NCO
Practice hand grenades; sub-caliber training devices; laser devices; firing devices; simulators and trip flares; small arms and machineguns	X	X	E-6	X	X	E-5
Chemical agents and smokes ²	X	X	E-6	X	X	E-5
Aerial gunnery and air defense weapons; flamethrowers, live grenades, grenade launchers, and grenade machineguns; live mines and demolitions; tank and fighting vehicle cannons; recoilless rifles	X	X	E-7	X	X	E-6
Field Artillery ³	X	X	E-7	X	X	E-6
Mortars	X	X	E-6	X	X	E-6 ⁶
ADA rockets and guided missiles		X			X ⁴	
Direct-fire antitank rockets and missiles	X	X	E-7	X	X	E-6
Live-fire exercises using organic weapons, squad through company, battery, troop	X	X	E-7	X	X	E-6
Combined arms live-fire exercises using outside fire support, troop, battery, squad, platoon, company; or battalion and larger ⁵	X	X	E-7	X	X	E-6
Notes:						
1. Civilians in the grade of GS-07 or above may act as OIC, and GS-05 or above, or equivalent for RSO. Civilian contractors may act as OIC/RSO when approved by the installation commander and in accordance with contract statement of work.						
2. OIC and RSO must be nuclear, biological, and chemical (NBC) qualified when conducting NBC or smoke training.						
3. Use of E-7s as OICs is authorized only when approved by the installation commander. Duties of the RSO are normally performed by either the battery executive officer or platoon leader.						
4. SRSO will be a field grade officer, CW4 or CW5 (Army) or civilian in the grade of GS-12 or above.						
5. OIC will be a field grade officer for battalion or larger CALFEX.						
6. RSO for Marine Corps can be E5 for mortar training activities.						

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Positioning and issuing ammunition and explosives

- a. Ammunition and explosives (to include pyrotechnics) will be positioned to minimize the potential for ignition from external sources, explosion, rapid burning, or sympathetic detonation and will be located and stored in accordance with this pamphlet and requirements AR/DA PAM 385-64.
- b. Training situations require ammunition and explosives at various locations that are temporary or transient by nature. It is not intended that these locations require approval by the Department of Defense Explosives Safety Board (DDESB) if ammunition and explosives are in total support of a training mission. Installation and service controls will be established to ensure quantity-distance standards are applied to the extent possible.
- c. Distribution of ammunition to personnel will occur only in areas designated for that purpose, for example, ammunition breakdown buildings, ready lines, firing lines, attack positions, assembly areas, or defilade positions. Blank and live-fire ammunition will not be stored in or issued from the same building at the same time.
- d. Fuel and ammunition re-supply operations and points shall be located a minimum of 300 meters apart. General officer installation commanders may authorize deviation from this standard based on quantity-distance (Q-D) criteria. Distances will not be reduced below the public traffic route (PTR) distance for troops in training. 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 the applicable FMs/TMs. Distance will not be reduced below the PTR distance for training.
- e. The quantity of ammunition unpacked at the breakdown building or firing line will be kept to the minimum number of rounds needed for efficient firing of the exercise. Packaging material, propelling increments and fuzes will be retained until firing is complete. Units will not burn wooden containers or indiscriminately fire or dispose of ammunition to preclude its return to a storage facility. (Exception: Smoky Sam rockets, a pyrotechnic, 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. All unpacked rockets must be expended and only full, unbroken cases returned to the ammunition supply point.) Broken and/or unserviceable increments (powder bags) will be handled in accordance with installation range and environmental requirements.
- f. 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 an accident involving the firing of a missile or rocket. Items will be stored in dry locations, protected from direct rays of the sun, and adequately ventilated.
- g. During pre-fire preparation, guided missiles, rockets, and components will be handled and assembled in a manner consistent with this pamphlet, local range requirements, 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 CG, Army Materiel Command (AMC).
- h. All ammunition, unpacked for firing but not fired, will be repackaged into its original packing configuration prior to return to the ammunition supply point.

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- i.* Ammunition that is easily degraded by short-term exposure to moisture, such as propelling charges, pyrotechnic signals, and simulators, will be unpacked only for the minimum amount of time consistent with mission requirements.

Suspension of ammunition and explosives involved in malfunctions

- a.* When any round or item of ammunition, explosives, or their components malfunctions, the firing unit will notify the range control office. The range control office will report the incident(s) to the installation ammunition officer. Appropriate action will be taken as required by AR 75-1. Firing suspensions and restrictions are published in TB 9-1300-385 and appropriate technical manuals.
- b.* For guided missiles, rockets, or components thereof that have malfunctioned and when it is evident that personnel safety or equipment is at risk, the affected lot will be locally suspended immediately. A missile and rocket malfunction report will be submitted in accordance with AR 75-1.
- c.* Any ammunition suspended and listed in TB 9-1300-385 and supplements will not be fired in training.
- d.* Firing of any ammunition listed in TB 9-1300-385 and supplements as being "restricted" will be conducted only in accordance with the restriction requirements.

Unexploded ordnance (UXO) and misfire procedures and reporting

- a.* The range OIC will report all UXO (dud) ammunition to the installation range control officer. In the case of grenades or other munitions that may be immediately hazardous to personnel (that is, 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 range control officer for data compilation and determination of clearance scope.
- b.* Misfire procedures in training manuals for the appropriate weapon system will be followed. In the event misfires present an immediate hazard to personnel or a ceasefire is necessary, they will be reported to range control.
- c.* When dud and misfire rates equal or exceed the rates given in appendix A of AR 75-1, the affected lot(s) will be reported as a malfunction.

Disposition of ammunition and explosives involved in malfunctions and accidents

- a.* Material involved in malfunctions or accidents and any evidence such as components or fragments of the weapon system, ammunition, missile, or rocket will be carefully preserved in the position and at the location it occupied at the time of the incident. If the material has been involved in a class A or B accident, as defined in AR 385-40, it will remain in position until disposition is directed by the investigating authority unless immediate hazard to life or property are present.
- b.* Damaged or malfunctioned guided missiles and rockets will be reported per AR 75-1 and handled per the applicable TM.

Police of the training complex

- a.* Removal of spent brass, unfired rounds, or components of fired rounds from UXO contaminated impact areas without the consent of the installation RCO is not authorized.
- b.* Dumping ammunition or explosives into impact areas or other unauthorized disposal or disposition areas is prohibited.

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- c. Unauthorized removal of ammunition, pyrotechnics, explosives, or residue from munitions or from the range or installation training complex is prohibited.
- d. The collection of spent brass is not required when ammunition is expended from mounted or dismounted weapons over extended terrain.

Small arms firing conditions

- a. Range safety information and small arms SDZs for direct fire weapons as listed in AR 385-63/MCO-3570.1B and DA PAM 386-63 (Chapter 6, cone) are the standard. When designing ranges that involve fire and movement, or where ricochet hazards outside the range complex boundary may endanger non-participating personnel or the general public, SDZs in Appendix B (batwing) of DA PAM 385-63 should be used.
- b. All personnel within the hearing hazard zone will wear approved single hearing protection. 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, will wear hearing protective devices. The following list of distances to the hazard contours for common military weapons is conservative:
 - (1) 0.50 caliber: 55m to the side; 12m to the rear
 - (2) 0.45 caliber: 12m to the side; 4.5m to the rear
 - (3) 9mm: 9m to the side; 6m to the rear
 - (4) 7.62mm: 20m to the side; 8m to the rear
 - (5) 5.56mm: 24m to the side; 6m to the rear
- c. Approved eye protection (or eye armor) shall be worn, especially during force-on-force training maneuvers or scenarios. The installation commander may, based on risk management, reduce or eliminate requirement for eye protection, if his/her decision is that reduced vision created by use of eye protection outweighs its value.

Table 2. Minimum thickness of material for positive protection against caliber ammunition listed

Nature of Cover	Thickness, in centimeters by ammunition caliber		
	5.56mm	7.62mm	.50 Cal
Concrete (5000 psi)	12.7	17.8	30.5
Broken stone	35.6	50.8	76.2
Dry sand	40.6	61.0	81.3
Wet sand	63.5	91.4	121.9
Wire oak logs	71.12	101.6	142.2
Packed earth	81.3	121.9	152.4
Undisturbed compact earth	88.9	132.1	167.6
Freshly turned earth	96.5	142.2	182.9
Plastic clay	111.8	165.1	254.0

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Overhead small arms fire

- a. Overhead small arms fire above protected troops is authorized when minimum protection shown in Table 2 is provided. Table 2 shows the thickness of various materials needed to positively protect against individual projectile impacts. The material thickness will provide adequate protection against single round impacts but not automatic fire. The data shown for 5.56mm is for M193 Ball ammunition. The 5.56mm M855 Ball ammunition may have greater penetration.
- b. Overhead fire above unprotected troops with small arms may be conducted when authorized by the installation commander and specifically approved by the installation range control officer.
- c. Weapon systems authorized for overhead fire of unprotected troops are 5.56mm, 7.62mm, and .50 caliber machineguns on ground tripods or vehicle mounts (ring mount excluded) firing from a stationary position.
- d. Only ammunition certified as cleared for overhead fire in TB 9-1300-385 will be used. Currently the only small arms ammunition certified for overhead fire is Department of Defense Identification Code (DODIC) A151 (7.62mm Ball/Tracer).
- e. Hand-held, shoulder-fired, or flex-mounted weapon systems will not be fired over the heads of troops on infiltration courses.
- f. Rates of fire will not exceed 70 rounds per minute for 5.56mm and 7.62mm machineguns and 40 rounds per minute for .50 caliber machineguns. Tracer ammunition may be used to assist in monitoring projectile paths.
- g. Overhead fire with machineguns in live-fire exercises will be as follows:
 - (1) Firing positions for weapons delivering overhead fire will provide unobstructed field(s) of fire.
 - (2) Applicable ballistic tabular firing tables will be used to determine the minimum angle of elevation for all overhead fire. Projectiles will not be permitted to impact between the firing position and unprotected troops downrange. All impacts shall be at least 30m beyond the personnel most distant from the weapon.
 - (3) Positive stops must be used to prevent crossfire and depression of weapon systems during overhead firing.
 - (4) Weapon systems will be test fired before delivery of overhead fire to verify the effectiveness of positive traverse and depression stops.
 - (5) Minimum vertical clearance requirements: A minimum vertical clearance of 2.5m over the heads of unprotected troops or the highest obstruction within the field of fire will be maintained. This minimum vertical clearance is the distance between the lowest shot in the dispersion pattern as determined by test firing and the highest point of ground, log, or other obstacle over which troops must travel or heights of barbed wire strands or posts on the course, whichever is higher.

Flanking fire

- a. Ground-mounted or vehicle-mounted small arms may be used to provide low angle flanking fire when a minimum angle of 15° between the limit of fire and exposed troops is maintained.
- b. Positive means will be employed to ensure that the firing unit knows the location of the maneuver units while fire support is being provided.

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- c. The route and location of maneuver units and the location of the weapons providing flanking fire support will be described in detail using recognizable natural and/or manmade terrain features or other positive identification features to all involved personnel.
- d. Because of the danger of lateral ricochets, flanking fire should be planned using the SDZ data (batwing) in Appendix B, DA PAM 385-63. However, if this is not feasible, the following minimum conditions apply:
 - (1) Weapons will be mounted on ground-mount tripods or vehicle mounts.
 - (2) Projectiles must not impact any closer to unprotected personnel than 100m.
 - (3) Only non-explosive and non-discarding sabot projectiles may be used.
 - (4) An angle of 15° or more must be maintained between the limit of fire and near flank of the closest individual or maneuvering unit.

Shotgun ranges

Training used for shotgun firing will be in accordance with SDZ requirements as found in DA PAM 385-63, Figure 6-1 and Table B-1.

Surface danger zone (batwing)

- a. Templates located at the rear of this pocket guide depict SDZs for weapons firing from a single firing position along the line of fire, also known as a gun target line (GTL), to a single target.
- b. When the nature or extent of training requires multiple firing positions, the SDZs in the included templates will be bisected longitudinally and the GTL expanded to accommodate multiple targets. This establishes left and right limits of fire.
- c. When the nature or extent of training requires moving targets, the SDZs in the included templates will be bisected longitudinally and the GTL expanded to accommodate moving targets. This establishes the left and right limits of fire.
- d. Live-fire maneuver areas requiring multiple or composite SDZs must be constructed based on each weapon, ammunition, and target engagement scenario.

Blank ammunition

- a. The following precautions will be observed during the use of blank ammunition:
 - (1) The blank firing attachment (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, 5m safe-separation distance (SSD) will not be reduced. This distance, with a dispersion angle of 10 degrees left and right of the GTL, does not exclude possible injury to the unprotected eye. Hearing protection (ear plugs) should be worn while firing blank ammunition.
 - (2) Army combat uniforms/battle dress uniforms (ACU/BDU) offer skin protection and should be worn at all times. Firers should use eye-protection.
- b. A violation of the SSD could result in serious injury. If the SSD is decreased to within .9m, fatal injuries may occur.

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Batwing surface danger zones

Firing conditions for batwing SDZs

Batwing SDZs provide for greater containment of all ricochets. They should be considered when designing ranges involving fire and movement or where ricochet hazards outside the range complex boundary may endanger non-participating personnel or the general public. Where batwing SDZs have already been applied or can be employed without significant impact on range operations, the batwing SDZs should be implemented.

Surface danger zone

- Templates located at the rear of this pocket guide depict SDZs for weapons firing from a single firing position along the GTL to a single target.
- When the nature or extent of training requires multiple firing positions or moving targets, bisect the GTL longitudinally and expand the GTL to accommodate multiple or moving targets. This establishes left and right limits of fire.
- Table 3 provides SDZ dimensions with corresponding deflection values (area *W*, angles *P* and *Q*) for engaging various target media, earth, water, steel, or concrete for small arms, machine guns, shotguns, and other direct-fire weapons without explosive projectiles.
- Table 3a provides SDZ dimensions for direct fire weapons with exploding projectiles.

Table 3. SDZs for direct-fire weapons without explosive projectiles

Caliber	Impact Media	Dist X	Dist Y	Area W	Vertical Hazard	Angle P	Angle Q
		(Meters)				(Degrees)	
12-gauge slug	Earth/Water	1073	710	125	136	21.96	33.34
	Steel/Concrete	1073	830	287	197	56.91	40.17
.22 cal Long Rifle M24	Earth/Water	1400	1033	155	96	24.00	15.90
	Steel/Concrete	1400	1125	386	245	63.40	30.30
.38 cal M 41 Ball	Earth/Water	1806	1110	153	89	22.57	16.07
	Steel/Concrete	1806	1258	389	245	60.95	35.36
9mm M882 Ball	Earth/Water	1800	1077	158	93	23.10	15.80
	Steel/Concrete	1800	1211	399	253	61.10	30.40
9mm CCMCK ¹	Earth/Water	60	N/A	N/A	15	N/A	N/A
	Steel/Concrete	60	N/A	N/A	15	N/A	N/A
.45 cal M1911 Pisto/SMG	Earth/Water	1690	1016	117	100	21.11	16.69
	Steel/Concrete	1690	1111	290	186	54.74	30.77
5.56mm M193 Ball	Earth/Water	3100	2004	458	319	35.20	23.10
	Steel/Concrete	3100	1666	323	219	19.00	26.90
5.56mm M196 Tracer	Earth/Water	3100	2066	362	355	35.10	26.80
	Steel/Concrete	3100	2023	243	243	19.20	22.80
5.56mm M855 Ball	Earth/Water	3437	2029	462	325	34.20	22.40
	Steel/Concrete	3437	1810	334	229	18.80	25.20

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Table 3. (Continued) SDZs for direct-fire weapons without explosive projectiles

5.56mm M856 Tracer	Earth/Water	3089	1607	355	261	32.80	23.20
	Steel/Concrete	3089	1592	277	261	18.60	21.00
5.56mm M862 Plastic	Earth/Water	250	165	24	16	15.40	20.00
	Steel/Concrete	250	136	5	4	3.30	7.30
5.56mm CCMCK ¹	Earth/Water	75	N/A	N/A	16	N/A	N/A
	Steel/Concrete	75	N/A	N/A	16	N/A	N/A
7.62mm M118 Special	Earth/Water	5288	4800	1545	752	43.81	38.73
	Steel/Concrete	5288	5137	990	490	20.17	41.29
7.62mm M80 Ball	Earth/Water	4100	4073	1461	706	43.54	38.90
	Steel/Concrete	4100	4053	861	447	20.04	75.54
7.62mm M973 SRTA Ball ²	Earth/Water	715	640	140	220	38	45
	Steel/Concrete	715	640	44	220	10	20
7.62mm M974 SRTA Tracer ²	Earth/Water	715	640	140	220	38	45
	Steel/Concrete	715	640	44	220	10	20
.50 cal M858 Ball, Plastic	Earth/Water	700	398	20	41	4.28	9.16
	Steel/Concrete	700	415	53	41	11.65	21.14
.50 cal M860 Tracer, Plastic	Earth/Water	700	398	20	41	4.28	9.16
	Steel/Concrete	700	415	53	41	11.65	21.14
.50 cal M2 AP	Earth/Water	6100	5142	1659	904	40.80	69.60
	Steel/Concrete	6100	4300	718	462	16.30	33.10
.50 cal M2 Ball	Earth/Water	6500	5211	1652	901	38.19	63.35
	Steel/Concrete	6500	4147	714	478	16.03	44.13
20mm M220 TP-T	Earth	3940	3340	581	317	25.83	22.83
	Water	3940	3040	558	311	26.08	30.96
	Steel	3940	3290	804	513	33.66	47.76
	Concrete	3940	3260	765	447	34.33	34.09
20mm M55A2 TP	Earth	4500	3780	733	357	25.74	33.20
	Water	4500	3500	737	350	26.16	36.66
	Steel	4500	4053	1025	585	38.14	36.82
	Concrete	4500	3750	969	509	34.12	37.87
30mm M788 TP-T	Earth	4020	3116	636	311	24.93	40.37
	Water	4020	3252	730	298	25.19	28.65
	Steel	4020	3631	1023	524	36.78	33.18
	Concrete	4020	3600	874	451	30.66	35.59

Notes:
1. Refer to Army Range Safety Message/Memorandum 290.
2. Refer to Army Range Safety Message/Memorandum 291. SDZ dimensions based on worst case altitude of 7,000 feet.

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Table 3a. SDZ for direct-fire weapons with explosive projectiles

Caliber	Impact Media	Dist. X	Dist. Y	Area W	Vert. Hazard	Area A	Area B	Angle	
								P	Q
(Meters)								(Degrees)	
20mm M246	Earth	4230	3537	685	360	156	156	26.73	39.83
	Water	4230	3316	716	354	156	156	25.81	35.87
HEI-T-SD	Steel	4230	3937	991	590	156	156	38.63	38.58
	Concrete	4230	3758	952	531	156	156	34.99	50.31
20mm M56a3 HEI	Earth	4250	3940	771	403	156	156	26.89	34.54
	Water	4250	3980	864	398	156	156	27.21	40.82
	Steel	4250	4160	1219	664	156	156	38.36	58.05
	Concrete	4250	4240	1189	577	156	156	34.65	43.79
30mm M789 HEDP	Earth	4122	3305	654	318	275	275	25.37	39.65
	Water	4122	3263	746	302	275	275	24.71	34.53
	Steel	4122	39.47	1058	534	275	275	36.26	39.59
	Concrete	4122	3684	886	460	275	275	31.56	42.14

Hand grenades**a. High explosive, loaded-type grenades (M67)**

- (1) These contain explosive charges that detonate after a short delay (3 to 5 seconds). Every precaution will be taken to prevent injury from flying fragments. For training purposes, fragmentation and offensive hand grenades will be thrown from a trench or barrier equivalent to a screen of sandbags 0.5m thick. When throwing bays are used for protection, they will be built to a minimum height of 1.5m and wide enough to accommodate one thrower and one ARSO. Bay height may be reduced to less than 1.5m if approved by the installation commander. However, it must provide positive protection against high-velocity, low-angle fragments. (See MIL HDBK 1027/3B for other dimensions and additional information.) Throwing bays will be separated from adjacent bays by a distance of 20m. If this requirement cannot be met, separation between throwing bays may be by physical barriers (that is, earthen berms, concrete walls, or wooden revetments) long and high enough to attenuate high-velocity, low-angle fragments.

b. Firing conditions for fragmentation and offensive grenades

- (1) Personnel within the 150m-danger area when casualty-producing hand grenades are thrown will wear approved protective helmets, protective body armor (flak jackets), single hearing protection, and proper eye protection.
- (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 at the command of the ARSO.

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- (3) All 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) is mandatory prior to live grenade training.
- (4) OIC, 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 downrange, SDZ, control of observers, misfire/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.
- (5) High explosive 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. Only EOD personnel will destroy dud grenades. Unauthorized personnel will not approach, move, touch, or handle dud grenades.
- (6) During demonstrations, fragmentation and blast/concussion type grenades will be thrown from a barricaded position so grenades burst at least 150m from unprotected personnel.
- (7) When direct viewing of hand grenade detonations is required within the 150m danger area, composite (laminated) viewing ports will be used.
 - (a) Viewing ports will be constructed to the following criteria or equivalent:
 1. 10mm glass (outside)
 2. 7mm polycarbonate
 3. 6mm glass
 4. 6mm polycarbonate
 5. 6mm glass
 6. 6mm polycarbonate
 - (b) These criteria provide minimum essential one-time protection against worst-case fragmentation detonated within 6m of the viewing port. Additionally, 12.7mm 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.
- (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 employments of grenades in a training scenario significantly increase the difficulty of determining the actual number of grenades that detonated. Dud grenades may be activated by subsequent training and generate an unplanned detonation.
- (11) The use of hand grenades during live-fire exercises shall conform to the provisions provided by Chapter 19, DA PAM 385-63.
- (12) For the DWBS, MK141 Mod O grenade is not authorized for Army use. See NAK 08-0019.

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c. **Firing conditions for chemical and incendiary hand grenades**

- (1) Chemical grenades will not be held in the hand after the safety lever is released. The incendiary hand grenade may be taped 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, 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 his/her face turned away from the grenade. After releasing the safety lever, the firer will quickly move at least 10m 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 25m 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. Specific fuze burning delay times and functioning characteristics are in TM 9-1330-200-12 and TM 43-0001-29. (See paragraph 16-3, DA PAM 385-63 for safety of use data for chemical smoke.
- (5) Burning type CS grenades will not be fired closer than 10m to other personnel or 50m to spectators upwind.
- (6) M8, Hexachloroethane (HC) smoke grenade restrictions are the same as those for HC smoke pots. These grenades will ignite combustible materials and will cause burns. A separation distance of at least 10m should be maintained from burning grenades. Personnel will wear protective respirators or masks before exposure to any concentration of smoke produced by M8 white smoke grenades. (See Chapter 16, DA PAM 385-63, for detailed information concerning smoke hazards.)
- (7) Burning particles of white phosphorous are frequently projected from the M34 grenade to a distance of 40m from the bursting point. Therefore, M34 grenades should be thrown only on standard live grenade ranges during training as prescribed in FM 3-23.30. White phosphorous particles cause serious, painful, slow-healing burns.
- (8) Direct viewing of thermite grenades will not be conducted due to the high potential of permanent eye damage.

d. **Surface danger zones.** Surface danger zone requirements for hand grenades are provided in Figure 7-1, DA PAM 385-63.

Grenade launchers and grenade machineguns**a. General firing conditions**

- (1) Personnel will be instructed in the proper use of grenade launchers and grenade machineguns and applicable safety precautions before firing with live ammunition.
- (2) All duds will be reported by the OIC to the range control office. When fired or launched HE grenades cannot be cleared from an impact area, the impact area must be designated as a dedicated, high-hazard impact area. Dedicated high hazard impact areas will be fenced off and posted with signs to warn and keep out unauthorized personnel.

b. Firing precautions for M79/M203 grenade launchers

- (1) Hazardous fragmentation from M433 HEDP grenade ammunition may be experienced to 165m from the point of detonation. Appropriate HE no-fire lines will be established. Training practice (TP) ammunition, M781, does not require areas A or B.
- (2) Although 40mm grenade launchers M79 and M203 are designed to prevent accidental chambering of 40mm high-velocity ammunition, OICs and RSOs will ensure only low-velocity grenade cartridges are fired from M79 and M203 grenade launchers.
- (3) Single hearing protection will be worn within 2m of firing these grenade launchers. A helmet and flak jacket must be used while conducting firing of HE M203 40mm grenades.
- (4) Snow depth of 10cm or more and standing water will increase the potential of 40mm duds. These conditions must be considered prior to firing.

c. General firing precautions for machinegun, MK19, MOD 3

- (1) Targets will be engaged only at ranges greater than 75m with TP ammunition.
- (2) Targets will be engaged only at ranges greater than 310m with HE ammunition.
- (3) Firing through obstructions will be avoided.
- (4) Personnel within a 310m radius of impact point will wear protective helmet, body armor/flak jacket, and ballistic eye protection at all times.
- (5) Range firing procedures and physical setup must be adequate to prevent rounds from impacting closer than 310m from the firing vehicle, other vehicles, or personnel.
- (6) Firing over open hatches is not authorized. Serious injury can result from burns caused by weapon flash or by expended or ejected cartridge cases striking personnel.
- (7) Approved single hearing protection is required for all personnel within the noise hazard contour of a 20m radius of the weapon system. Eye protection should be worn.
- (8) Daily exposure limit within the noise hazard contour is 1,000 rounds per day.

d. Static firing restrictions for vehicle mounted machinegun, MK19, MOD 3

- (1) A gunner's quadrant and/or MK64, MOD 7 mount depression stop will be used to keep the minimum elevation above 30 mil when firing.
- (2) M99BT interim squad carrier:
 - (a) Soft tops must be installed over the drivers and passenger compartments for safe operation of the vehicle when firing the MK19.

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- (b) Visual 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.
- e. **Moving firing restrictions for machinegun, MK19, MOD 3**
- (1) To preclude unintentional impacts of HE and HEDP ammunition at ranges less than 310m:
- (a) Restrict speeds to not greater than 16km per hour when firing from the HMMWV M1025/1026 armament carrier and the M998T interim squad carrier over paved and improved roads that are in good condition, and not greater than 8km per hour over rough roads, trails, and cross country.
- (b) Restrict speeds to not greater than 16km per hour when firing from the M113 and M106 family of armored carriers, and the M88A1 tracked recovery vehicle over roads, trails, and cross country.
- f. **Surface Danger Zone**
- (1) SDZ requirements for M79 and M203 grenade launchers are illustrated in Figure 7-2, DA PAM 385-63. A minimum separation distance of 6m is required between firing positions. Cartridge M433 requires an area A and B of 165m. All other M79 and M203 HE cartridges require 130m.
- NOTE: SDZ distance X for M203 grenade launcher increased to 470 meters per Army Range Safety Message/Memorandum 296.
- (2) SDZ criteria for the machinegun, MK19, MOD 3 are displayed in templates at the end of this pocket guide and shown in Table 4 below. Minimum target engagement range for HE cartridges is 310m.

Table 4. Surface danger zone dimensions for 40mm machinegun, MK 19, MOD 3

Cartridge	Impact Media	Distance X	Distance Y	Area W	Area A	Area B	Angle P	Angle Q
		(Meters)						(Degrees)
M383 HE	Earth	2,095	1,250	167	310	310	23	15
	Armor	2,095	1,250	471	310	310	60	28
M385A1 TP	Earth	1,984	1,250	167	N/R	N/R	23	15
	Armor	1,984	1,250	471	N/R	N/R	60	28
M430 HEDP	Earth	2,037	1,250	167	310	310	23	15
	Armor	2,037	1,250	471	310	310	60	28
M918 TP	Earth	2,095	1,250	167	N/R	N/R	23	15
	Armor	2,095	1,250	471	N/R	N/R	60	28
MK281 Mod 0 TP	Earth	2,200	1,250	167	N/R	N/R	23	15
	Armor	2,200	1,250	471	N/R	N/R	60	28
M1001 Canister	Earth	1,750	1,743	370	N/R	N/R	35	25
	Armor	1,750	1,743	370	N/R	N/R	35	25

Legend: NR = Not Required

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Antitank rocket firing conditions

- a. All loading and unloading for separate loading rockets (for example, 35mm, M73, practice rocket and 66mm M74 incendiary rocket) will be on the firing line with the muzzle pointed downrange. Procedures and precautions in appropriate FMs and TMs will be observed in all preparation and firing operations.
- b. Personnel will not stand or have any portion of the body directly in front of or behind a loaded rocket launcher.
- c. 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 antitank rockets is an isosceles triangle with the apex at the breech and the width of the triangle corresponding with a rearward extension of the gun target line.
- d. 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.

Mortar firing conditions

- a. Firing mortars over the heads of unprotected troops by Army units is not recommended. Overhead fire is allowed when Soldiers are in tanks with hatches closed 100 meters or more from the line of fire.
- b. Propellant increments removed from rounds before firing will be placed in metal or wooden covered containers located outside the firing vehicle or positioned a distance of at least 25m from the firing point when firing dismounted.
- c. Firing restrictions and limitations in TM 43-0001-28 apply to all cartridges and fuzes.
- d. The target engagement distance will not be less than the distance required for area B of the respective caliber of mortar to be fired from protected positions.
- e. Unused powder increments must be safeguarded and handled in accordance with installation range and environmental regulations.

Mortar surface danger zones

- a. Surface danger zone requirements for 60mm, 81mm, and 120mm mortars are provided in Table 5.
- b. Distance X will not be less than the maximum range of the greatest charge to be fired.
- c. Basic dimensions of the impact area will be computed as specified in Table 7.
- d. Firing table probable errors 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 nonstandard conditions.
- e. To compute the probable errors in range and deflection, multiply the constant (listed in the SDZ diagram) by the data found in the tabular firing tables. These data are drawn in meters from the downrange edge of the target area for PED and PER.
- f. When firing ammunition with explosive warheads at distances equal to or less than the lateral hazard area (area A), the angle between the weapon target line/lateral limits and the firing point will increase by the width of area A.
- g. The 25° angle for area A must be increased to 70° when firing HE ammunition at ranges equal to or less than 600m for 60mm mortars; 940m for 81mm mortars; and 1500m for 120mm mortars. Only the personnel required to fire the mortar system are authorized to be within this area.

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Table 5. Mortar surface danger zone criteria, in meters^{1,2,3}

Caliber	Area A	Area B
60mm	250	300
81mm	400	400
120mm	600	600

Notes:

1. Quadrant elevation 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 quadrant elevation limits.
2. Dimensions of areas A and B may be reduced by 50% when firing illumination cartridges.
3. Cartridges without HE filler (for example, M880, M931) do not require areas A and B.

Field Artillery firing conditions**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 the designated crewman has announced "READY." Unused powder increments must be safeguarded and handled in accordance with appropriate TMs and installation range regulations.

b. Fuzes

- (1) Alteration of fuzes is prohibited unless specifically authorized by the Commanding General, AMC, and supervised by a qualified AMC commissioned officer, warrant officer, or civilian.
- (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 correct 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.

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- (6) Fuzed projectiles fired during training exercises will be 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 white phosphorous (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 prohibited.

Field Artillery surface danger zones

- a. Surface danger zone requirements for 105mm and 155mm Howitzers are provided in Table 6.
- b. Computer generated SDZs are authorized if the software has been thoroughly tested and validated by survey and manual computations, approved for use by the artillery commander who trains the unit, and reviewed and verified by the installation RCO.
- c. Installation RCOs 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 prohibited in the target and associated hazard areas (areas A, B, C, and E) during firing.
- d. The size of the impact area depends upon the requirements of the firing exercises planned and the overall target area as defined by the installation range control officer.
- e. Firing table probable errors 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.
- f. Light field artillery fire, up to and including 105mm howitzer, may impact no closer than 100m to occupied bunkers. Medium and heavy field artillery fire, above 105mm, may impact no closer than 200m of 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.

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Table 6. Field Artillery surface danger zone criteria, in meters

Caliber	Area A ¹	Area B ^{1,2}	Area C Low Angle ³	Area C High Angle ³	Area E	Direct Fire Mode ¹
105mm Howitzer	550	550	300	350	550	650
155mm Howitzer	725 ⁵	725 ⁵	350 ⁸	550 ⁶	725	750

Notes:

- Dimensions of areas A and B may be reduced by 50 percent when firing illumination projectiles.
- Firing will be conducted only with charges that have a minimum range of at least 1,400m beyond the far edge of area C.
- 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.
- Distances in this column represent minimum target engagement distances when personnel at the firing position are unprotected.
- Areas A and B for M825, 155mm WP smoke projectiles may be reduced to 350m.
- Area C is increased to 2,400 meters when firing M107 HE ammunition filled with TNT. Refer to JMC AIN 036-09.

Table 7. Mortar and Field Artillery Basic impact area dimensions

Limits	Dimensions
Left	Eight deflection probable errors (PE _D) from the left limit of target area
Right	Eight deflection probable errors (PE _D) from the right limit of target area
Far edge	Eight range probable errors (PE _R) from the far edge of target area
Near edge ¹	Twelve range probable errors (PE _R) from the near edge of target area

Note:

- Normally used for Artillery only, however, may be used to support Mortar SDZ construction if necessary

Tank/Fighting Vehicle Gunnery**Tank cannon firing conditions**

- Tank cannon will not be fired above 5 degrees quadrant elevation (QE) (unless otherwise stated in DA PAM 385-63.) The following procedures will be employed.
 - Unit master gunners, in conjunction with range control personnel, will ensure that targets are placed at or less than 5 degrees elevation. Tank commanders will ensure that all weapon systems in a firing condition are pointed toward the impact area at or less than 5 degrees elevation.
 - Nonstabilized tank armament will not be fired while the tank is moving. This does not include machineguns.

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- b. When firing ranges and weapons training facilities with less than the prescribed safety limits must be used, 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. Cross-range 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. Limits of fire, combined dispersion, ricochet areas, and areas A and B (when required) must be adjusted to compensate for and accommodate such cross-range firing. On ranges that do not permit cross-range firing, internal (inside the range area) left and right limit of fire markers will be used, in addition to the left and right external range limit markers.
- e. Environmental containment materials (spill kits) will be available.
- f. Surface danger zone requirements for select tank cannon cartridges are in Table 8.

Table 8. Select tank cannon cartridge SDZ criteria

Cartridge Type	Impact Media ¹	Distance X at 10 ⁹²	Ricochet Angle P ³	Maximum deflection W	Area A ⁴	Area B ⁴	Vertical Hazard ⁵
105mm							
M393A1 TP-T ³	Earth	8,175	24	1,225	NR	NR	962
	Steel	8,175	20	1,225	NR	NR	1,090
M393A1/2/3 HEP-T ⁶	Earth	8,175	24	1,225	300	300	962
	Steel	8,175	20	1,225	300	300	1,090
M456 HEAT-T	Earth	6,436	17	1,080	615	615	
	Steel	6,436	12	600	615	615	
M467A1 TP-T ⁶	Earth	8,175	24	1,125	NR	NR	962
	Steel	8,175	20	1,125	NR	NR	1,090
M490 TP-T	Earth	6,445	17	1,080	NR	NR	
	Steel	6,445	12	600	NR	NR	
M724 TPDS-T	Earth	11,343	13	1,110	NR	NR	
	Steel	11,343	11	1,900	NR	NR	
M735 APFSDS-T	Earth	22,846	14	1,100	NR	NR	
	Steel	22,846	16	1,400	NR	NR	
M774 APFSDS-T ⁷	Earth	23,545	12	1,020	NR	NR	
	Steel	23,545	16	1,400	NR	NR	
M833 APFSDS-T ⁷	Earth	26,241	16	1,801	NR	NR	
	Steel	26,241	16	1,400	NR	NR	
M1040 Canister ⁸	Earth	1,300	40	550	NR	NR	415
	Steel	1,300	50	850	NR	NR	820

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Table 8 (Continued). Select tank cannon cartridge SDZ criteria

Cartridge Type	Impact Media ¹	Distance X at 10° ²	Ricochet Angle P° ³	Maximum deflection W	Area A ⁴	Area B ⁴	Vertical Hazard ⁵
120mm							
M829 APFSDS-T ⁷	Earth	29,392	11	1,070	NR	NR	
	Steel	29,392	16	1,400	NR	NR	
M829A2 APFSDS-T ⁷	Earth	30,261	26	2,400	NR	NR	
	Steel	30,261	21	1,764	NR	NR	
M829A3 APFSDS-T ⁷	Earth	30,418	26	2,400	NR	NR	
	Steel	30,418	21	1,764	NR	NR	
M830 HEAT-MP-T	Earth	6,589	17	1,080	1,125	1,125	
	Steel	6,589	12	600	1,125	1,125	
M830A1 HEAT-MP-T	Earth	10,069	22	1,239	1,377	1,377	
	Steel	10,069	20	1,061	1,377	1,377	
M831 HEAT-TP-T	Earth	6,589	17	1,080	NR	NR	
	Steel	6,589	12	600	NR	NR	
M865 TPCSDS-T	Earth	7,234	12	450	NR	NR	
	Steel	7,234	16	1,400	NR	NR	
M908 HE-OR-T ⁹	Earth	10,069	22	1,239	1,377	1,377	
	Steel	10,069	20	1,061	1,377	1,377	
M1002 MPAT-TP-T ¹⁰	Earth	7,200	30	975	NR	NR	1,252
	Steel	7,200	22	550	NR	NR	816
M1028 Canister ¹¹	Earth	1,650	30	550	NR	NR	1,050
	Steel	1,650	55	850	NR	NR	850

Notes:

- When engaging armor targets, recommend using earth impact media in those cases where earth impact values are larger due to the possibility of missing the target.
- The elevation of fire from the firing position to the target will not exceed 5°.
- Maximum deflection is maximum horizontal ricochet distance from the left and right limits of the dispersion angle.
- Practice ammunition with inert warheads and kinetic energy projectiles to not require (NR) area A because the ricochet area will contain all possible fragments out to the final rest position, or an area B since the total range is expected to contain ricocheting projectiles down range.
- When Vertical Hazard column has no entry, use value of distance W for Vertical Hazard.
- Refer to Army Range Safety Message/Memorandum 327.
- Ammunition is a wartime round. SDZ is advisory only. M774, M833, M829, M829A2, M829A3 projectiles contain a depleted uranium (DU) penetrator.
- Refer to Army Range Safety Message/Memorandum 143.
- HE-OR-T (high explosive obstacle-reduction tracer).
- Refer to Army Range Safety Message/Memorandum 144.
- Refer to Army Range Safety Message/Memorandum 330.

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Fighting vehicles

SDZ requirements for the M242 25-mm cannon are provided in Table 9.

Table 9. 25-mm SDZ criteria, in meters

Impact media	Area A ¹	Area B ¹	Area W ²	Angle P	Distance X ³	Ricochet range	15° elev range
M791 (APDS-T)							
Armor	N/A	N/A	1,510	24°	14,572	7,294	11,550
Concrete	N/A	N/A	2,208	34°	14,572	7,622	11,550
Earth	N/A	N/A	1,466	18°	14,572	7,402	11,550
Water	N/A	N/A	263	6°	14,572	5,665	11,550
M792 (HEL-T)							
Armor	300	400	1,373	28°	6,379	5,265	5,241
Concrete	300	400	1,290	27°	6,379	5,071	5,241
Earth	300	400	908	19°	6,379	4,792	5,241
Water	300	400	1,047	19°	6,379	4,823	5,241
M793 (TP-T)							
Armor	N/A	N/A	1,373	28°	6,047	5,265	5,112
Concrete	N/A	N/A	1,290	27°	6,047	5,071	5,112
Earth	N/A	N/A	908	19°	6,047	4,792	5,112
Water	N/A	N/A	1,047	19°	6,047	4,823	5,112
M910 (TPCSDS-T)							
Armor	N/A	N/A	799	20°	6,404	4,472	6,017
Concrete	N/A	N/A	1,143	27°	6,404	4,643	6,017
Earth	N/A	N/A	734	15°	6,404	4,592	6,017
Water	N/A	N/A	148	4°	6,404	3,724	6,017
M919 (APFSDS-T) * (Wartime only)							
Armor	N/A	N/A	1,289	25°	18,480	7,867	14,816
Concrete	N/A	N/A	1,289	25°	18,480	7,867	14,816
Earth	N/A	N/A	801	21°	18,480	7,725	14,816
Water	N/A	N/A	801	21°	18,480	7,725	14,816
Notes:							
1. Area A and area B are not applicable (N/A) for M791, (APDS-T), M793 (TP-T), M910 (TPCSDS-T), or M919 (APFSDS-T) cartridges.							
2. When firing at aerial targets and the gun elevation is greater than 15°, the ricochet area as defined by area W and angle P is not required.							
3. Distance X (maximum range) may be reduced to ricochet range when engaging ground targets at ranges up to 3,500m from stationary firing positions. When firing from a moving vehicle over level terrain at ground targets up to 3,500m, use the 15° elevation range. When firing on the move over rough terrain, use distance X.							
4. All personnel within 76m of M919, 25mm firing will wear approved hearing protection.							

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Fundamentals of laser range safety

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 must be thoroughly familiar with all aspects of laser operations and associated dangers. The following guidelines will be used in conjunction with the guidance provided in referenced publications when employing lasers.

- a. MIL-HDBK-828A and Joint Pub 3-09.1 are definitive guidance for laser operations, characteristics, and general procedures. MIL-HDBK-828A may be ordered from the following address: Standardization Documents Order Desk, Bldg 4D, 700 Robbins Avenue, Philadelphia, PA 19111-5094.
- b. Tactical lasers will be treated as direct-fire weapons. Precautions associated with direct-fire weapons shall be applied to all lasers operated on military ranges.
- c. RCOs will establish boundaries for laser range operations and strictly control laser use in training to conform to the provisions of this pamphlet and applicable TMs. Deviations may be approved after applying risk management techniques, minimizing hazards and accepting the residual risk at the appropriate command level. Reduced SDZs for lasers terminated within the range boundary do not require deviation.
- d. AR 11-9 and AR 40-5 outline general laser radiation safety requirements. A laser safety orientation will be given to all personnel who use or work with laser devices to include an explanation of hazards and safety requirements before they commence laser operations.

Army Range Safety Messages, Memoranda (ARSMMs)

To address updated range safety requirements, TCM-Live will publish ARSMMs. These may be directive or advisory in nature. ARSMMs will remain in effect until changed or rescinded by appropriate authority. For the complete list of ARSMMs, refer to SRP website: <https://srp.army.mil>.

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Composite Risk Management

Instructions and Sample Form

A-1. Instructions for completing DA Form 7566 (*Composite Risk Management Worksheet*) instructions are in Table A-1.

Table A-1. Worksheet Instructions

<i>Item</i>	<i>Instruction</i>
1 through 4	Self explanatory.
5	Subtask relating to the mission or task in Block 1.
6	Hazards – Identify hazards by reviewing METT-T factors for the mission or task. Additional factors include historical lessons learned, experience, judgment, equipment characteristics and warnings, and environmental considerations.
7	Initial Risk Level– Includes historical lessons learned; intuitive analyses, experience, judgment, equipment characteristics and warnings; and environmental considerations. Determine initial risk for each hazard by applying risk assessment matrix (Figure 2-4). Enter the risk level for each hazard.
8	Controls – Develop one or more controls for each hazard that will either eliminate the hazard or reduce the risk (probability and/or severity) of a hazardous incident. Specify who, what, where, why, when, and how for each control. Enter controls.
9	Residual Risk Level– Determine the residual risk for each hazard by applying the risk assessment matrix (Figure 2-4). Enter the residual risk level for each hazard.
10	How to Implement – Decide how each control will be put into effect or communicated to the personnel who will make it happen (written or verbal instruction; tactical, safety, garrison SOPs, rehearsals). Enter controls.
11	How to Supervise (Who) – This last step is not on the worksheet. Plan how each control will be monitored for implementation (continuous supervision, spot-checks) and reassess hazards as the situation changes. Determine if the controls worked and if they can be improved. Pass on lessons learned.
12	Was Control Effective – Indicate “Yes” or “No.”
13	Overall Risk Level – Select the highest residual risk level and circle it. This becomes the overall mission or task risk level. The commander decides whether the controls are sufficient to accept the level of residual risk. If the risk is too great to continue the mission or task, the commander directs development of additional controls or modifies, changes, or rejects the COA.

A-2. The worksheet (Figures A-1 and A-2) provides a starting point to logically track the process of hazards and risks. It can be used to document risk management steps taken during planning, preparation, and execution of training and combat missions and tasks. Composite Risk Assessment Matrix is at Figure A-3.

Composite Risk Management

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Composite Risk Assessment Matrix						
Severity		Probability				
		Frequent	Likely	Occasional	Seldom	Unlikely
		A	B	C	D	E
Catastrophic	I	E	E	H	H	M
Critical	II	E	H	H	M	L
Marginal	III	H	M	M	L	L
Negligible	IV	M	L	L	L	L
E – Extremely High Risk H – High Risk M – Moderate Risk L – Low Risk						

Figure A-3. Army Composite Risk Assessment Matrix

Probability is the likelihood of an event. This is your estimate, given what information you know and what others have experienced. The probability levels estimated for each hazard are based on the mission, COA, or frequency of a similar event. There are five levels of probability:

- Frequent** – Occurs very often, known to happen regularly.
- Likely** – Occurs several times, a common occurrence.
- Occasional** – Occurs sporadically, but is not uncommon.
- Seldom** – Remotely possible, could occur at some time.
- Unlikely** – Can assume will not occur, but not impossible.

Severity is expressed in terms of the degree to which an incident will impact combat power, mission capability, or readiness.

Catastrophic – Complete mission failure or the loss of ability to accomplish a mission. Death or permanent total disability. Loss of major or mission-critical systems or equipment. Major property or facility damage. Severe environmental damage. Mission-critical security failure. Unacceptable collateral damage.

Critical – Severely degraded mission capability or unit readiness. Permanent partial disability or temporary total disability exceeding three months time. Extensive major damage to equipment or systems. Significant damage to property or the environment. Security failure. Significant collateral damage.

Marginal – Degraded mission capability or unit readiness. Minor damage to equipment or systems, property, or the environment. Lost days due to injury or illness not exceeding three months. Minor damage to property or the environment.

Negligible – Little or no adverse impact on mission capability. First aid or minor medical treatment. Slight equipment or system damage, but fully functional or serviceable. Little or no property or environmental damage.

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Range Live-Fire Safety Brief (sample)

- a. This is your range _____ safety brief.
- b. The Officer in Charge (OIC) is _____.
- c. The Range Safety Officer (RSO) is _____.
- d. The four weapons safety rules are:
 - (1) Treat every weapon as if it were loaded.
 - (2) Never point your weapon at anything you do not intend to shoot.
 - (3) Keep your finger straight and off the trigger until you are ready to fire.
 - (4) Keep your weapon on "safe" until you are ready to fire.
- e. The misfire pit is located _____ (if required).
- f. Safety is paramount. **Safety will always be priority NUMBER ONE.** No movement on the range will be permitted before informing the RSO. All road guards will be briefed and placed by the RSO only. Anyone departing or entering the range will notify the RSO before doing so.
- g. Everybody is a safety officer. If you observe a situation that you feel is unsafe, call an immediate **cease-fire** (check fire for mortars) or **stop** (for individuals, Javelins, SMAWs, blasting caps). A cease-fire must be given verbally and physically by giving the hand-and-arm signal to cease fire. In the case of a cease-fire, all weapons will go to Condition 4. Do not wait to be told. OIC/RSOs will check the back blast area to ensure it is properly cleared.
- h. During firing, the ROIC will be located _____ and the RSO will be located _____. The corpsman/medic will be located _____.
- i. The dedicated safety vehicle is located _____. The safety driver is _____. Strip map to hospital. Vehicle keys are located _____.
- j. MEDEVAC will be handled by the safety medic and the OIC or RSO in conjunction with Range Control. All other personnel will stay clear of the emergency. (Go over routes to hospital or nearest LZ.) Muster at the assembly area for accountability.
- k. Duds (UXO) (are/are not) found on this range. Do not pick up, kick, or hit any ordnance on this range. Notify the RSO immediately of possible dud locations. Dud procedures for this range are as follows: _____.
- l. There (will be/will not be) maneuvering on this range. If a Soldier is within 15 degrees of your muzzle, **DO NOT FIRE.** Be aware of your position and the Soldiers around your position. If you are in doubt of the situation, **DO NOT FIRE.**
- m. Overhead fire (is/is not) authorized for this range. The overhead firing procedures for this range are as follows: _____.

Range Live-Fire Safety Brief (sample)

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- n.* If you should encounter a stoppage, apply immediate and/or remedial action (which ever is appropriate for the weapon being fired) and complete the drill. Continue with the drill until you hear the command to cease-fire, at which point you will comply unless told to do otherwise by a safety officer. (Go over immediate and/or remedial action for all weapons being fired on the range. If you should hear or feel an audible pop, immediately cease-fire and notify your OIC or RSO. *An audible pop is a strange noise made when a primer detonates but fails to ignite any or all of the propellant. This is sometimes accompanied by excessive smoke escaping from the chamber area. The primer has enough power to kick the projectile out of the case and if a small portion of the propellant ignites, it can lodge the projectile partway down the barrel.*)
- a.* The uniform for this range is _____. Hearing protection (is/is not) required on this range while conducting live fire.
- p.* Observe the downrange area. Your left limit is _____, your right limit is _____. Your internal limits are the left and right of your targets. Your limit of advance is _____. All of your rounds will impact in this SDZ. You will fire on your designated targets only. Muzzles will be pointed in a safe direction at all times.
- q.* The only types of ammunition that will be used on this range are _____.
Note: Brief any notice of ammunition re-classification or ammunition information notice. Information of this type will be in a message.
- r.* The weapons to be used on this range are _____.
- s.* Are there any left-handed shooters (or throwers for hand grenades)?
- t.* Does anybody wear glasses or contact lenses that do not have them?
- u.* Brief any local range regulations that might apply.
- v.* The designated smoking area is _____. Smoking is not allowed near ammunition.
- w.* Kevlar Helmets/Advanced Combat Helmet (ACH), Improved Body Armor (IBA), and hearing protection will be properly worn and used.
- x.* Ammunition issue point is located _____ and ammunition is properly stored and guarded.
- y.* No cross-range firing.
- z.* This concludes the range safety brief. Are there any questions?
- aa.* Continually check range impact area to ensure it is clear of all personnel and equipment. Be sure to check for low-flying aircraft and helicopters.
- bb.* Shakedown of all personnel will take place to ensure 100% accountability of ammunition. Note: Expenditure reports for ammunition will be filled out after the shakedown.
- cc.* All ammunition dunnage will be taken _____. Ensure it is separated.
- dd.* Report all Soldiers trained, ammunition expended, by type, to Range Control. Officer-in-Charge and Range Safety Officer.

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OIC/RSO Sample Checklists

Administrative tasks

- Ensure all range flags are up and red lights are set.
- Ensure gates are secured or manned, if necessary.
- Read SOP
- Ensure all targets are set up.
 - targets in stands.
 - Target type
- Establish solid/dual communication with range control via radio.
- Assign person to prepare ammo for issue for all relays.
 - Rounds per shooter
 - Relays
- Ensure the range is laid out correctly:
 - Range perimeters are within the SDZ.
 - Target line is in correct location; spot check.
 - Firing lines are in the correct location.
 - Ammo issue point is in the correct location.
 - First aid kit is in the correct location.

Pre-fire tasks/briefs

- Count off and assign relays, if necessary.
- Conduct a complete safety check (clear extra weapons!).
- Prepare weapons for firing.
- Brief the ammo NCO: will be the ammo NCO. Ammo NCO will break ammo down into piles of rounds each with one set of earplugs per pile. Ammo NCO will also be responsible for the first aid kit.
- OIC/RSO will read all local range regulations before firing.
- Brief the course of fire.
- Brief the conduct of fire.
- Brief the medical emergency plan.
- Brief the range-specific environmental policies and issues.
- Read the local safety brief.

Shooter briefs

Brief 1: Appointments

- The OIC is
- The RSO is
- The safety supervisors are
- The Ammo NCO is
- The medic is located
- The safety vehicle and driver are located

OIC/RSO Sample Checklist

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Brief 2: Range layout

Note: Read all local range regulations before firing.

- Brief the left and right limits of range.
- Brief the location of the ammo issue point.
- Brief the location of the first aid kit.

System of work

- Brief the scoring system.
- Brief the ammo issue.
- Brief road guard positions. Note: Road guards should be positioned in pairs.

Duties during live fire (sample)

- Ensure that shooters are wearing ear protection.
- Brief the details of each drill. Explain each drill before it is fired.
- Follow the course of fire. Do not deviate.
- Conduct the shoot safely. **As always, safety is paramount.**
- Check for errors and corrections. Ensure that NCOs conduct proper checks and use correct coaching techniques.
- Conduct radio checks.

After-firing duties (sample)

- Police call.
- Conduct a complete safety check.
- Unload, show-clear. Do not forget about extra weapons.
- Ensure details are appointed to take down targets, police call, etc.
- Return range property.
- Take down range flags. Regroup at a convenient location.

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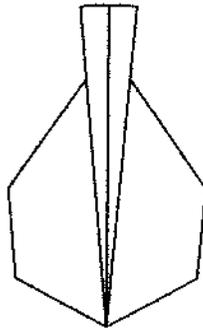
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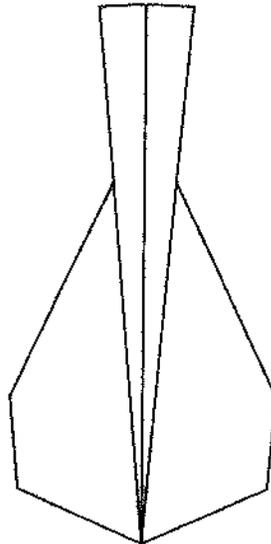
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12 Gauge Slug

Scale: 1:25,000
Distance X: 1,073m
Impact Media: Worst Case
Vertical Hazard: 197m



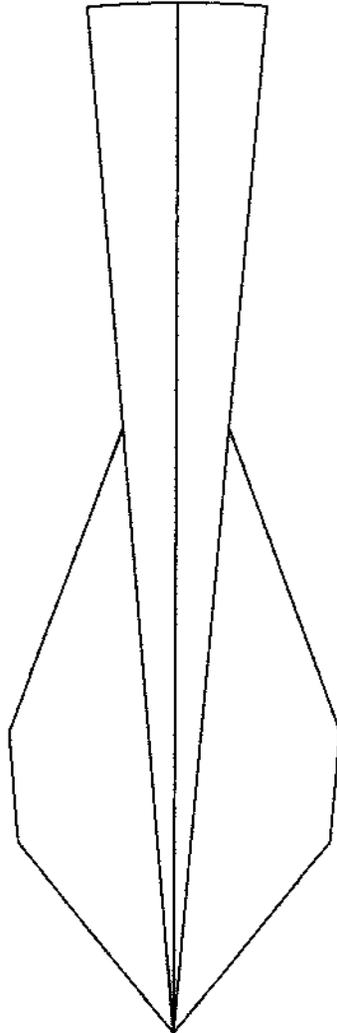
9mm M882

Scale: 1:25,000
Distance X: 1,800m
Impact Media: Worst Case
Vertical Hazard: 253m

ANNEX K - (US Army Range Safety Pocket Guide) to OPORD 470-XXX-16 (470 MI BDE Weapons Range Best Practices)

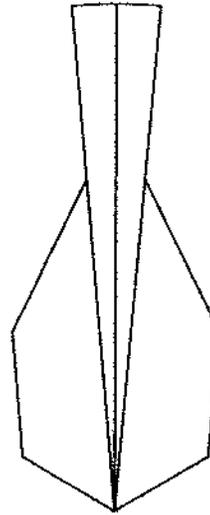
US Army Range Safety Pocket Guide

Version 2.2



5.56mm M855 Ball

Scale: 1:25,000
Distance X: 3,437m
Impact Media: Worst Case
Vertical Hazard: 325m



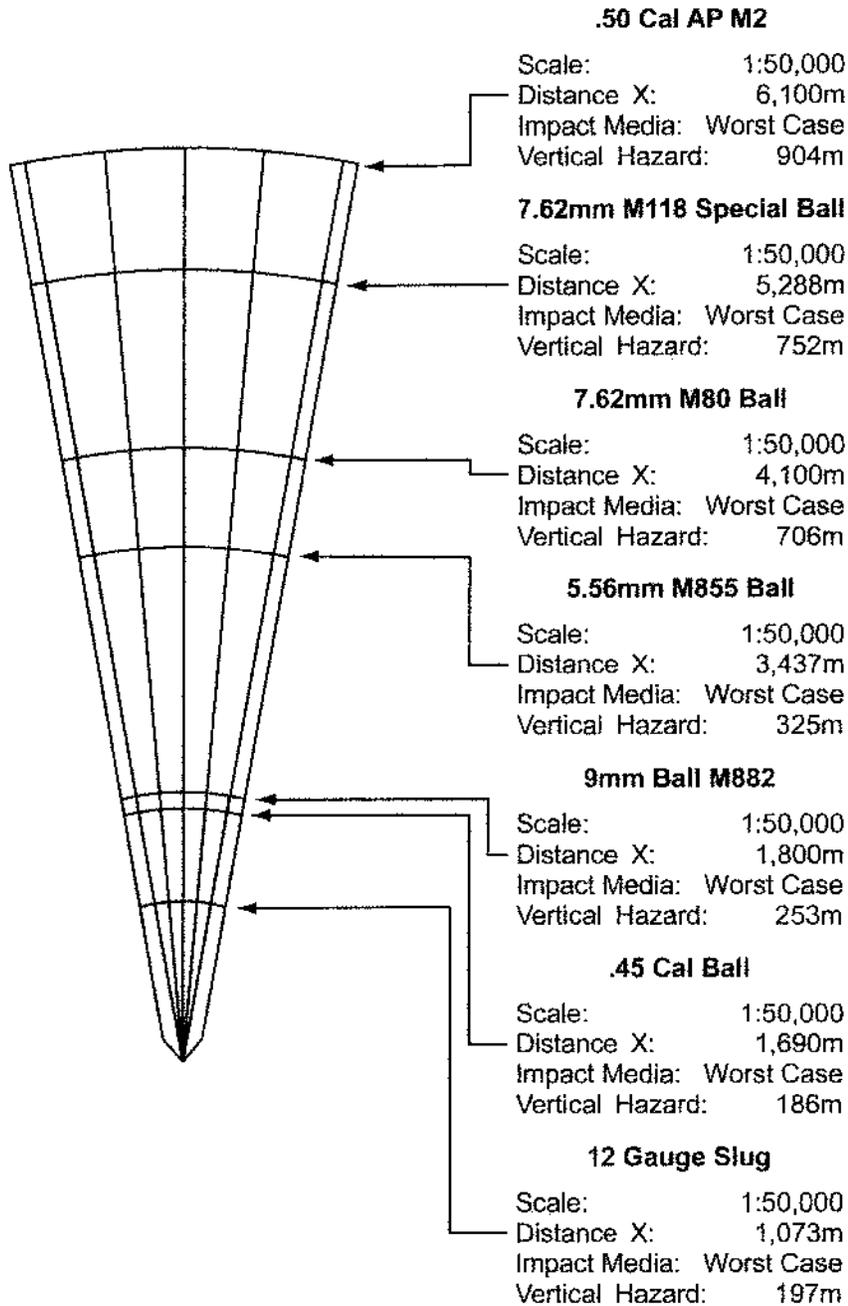
.45 Cal Ball

Scale: 1:25,000
Distance X: 1,690m
Impact Media: Worst Case
Vertical Hazard: 186m

ANNEX K - (US Army Range Safety Pocket Guide) to OPORD 470-XXX-16 (470 MI BDE Weapons Range Best Practices)

US Army Range Safety Pocket Guide

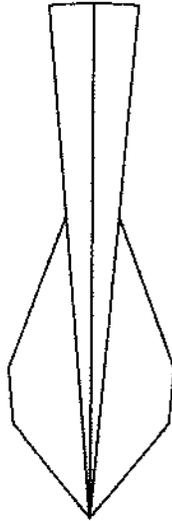
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ANNEX K - (US Army Range Safety Pocket Guide) to OPORD 470-XXX-16 (470 MI BDE Weapons Range Best Practices)

US Army Range Safety Pocket Guide

Version 2.2



5.56mm M855 Ball

Scale: 1:50,000
Distance X: 3,437m
Impact Media: Worst Case
Vertical Hazard: 325m



9mm Ball M882

Scale: 1:50,000
Distance X: 1,800m
Impact Media: Worst Case
Vertical Hazard: 253m



12 Gauge Slug

Scale: 1:50,000
Distance X: 1,073m
Impact Media: Worst Case
Vertical Hazard: 197m



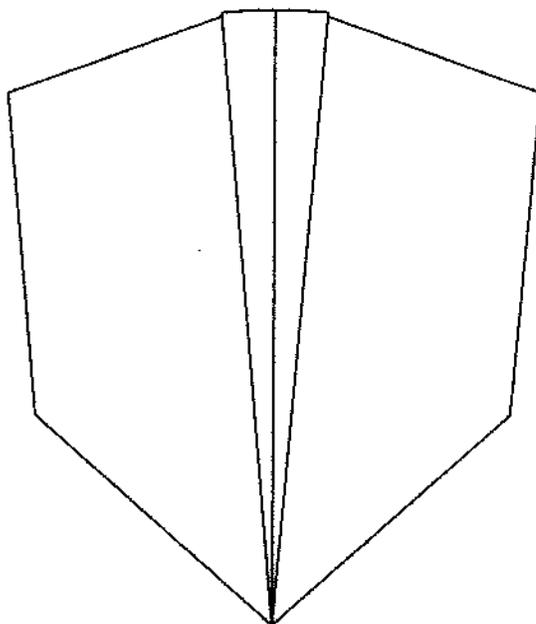
.45 Cal Ball

Scale: 1:50,000
Distance X: 1,690m
Impact Media: Worst Case
Vertical Hazard: 186m

ANNEX K - (US Army Range Safety Pocket Guide) to OPORD 470-XXX-16 (470 MI BDE Weapons Range Best Practices)

US Army Range Safety Pocket Guide

Version 2.2



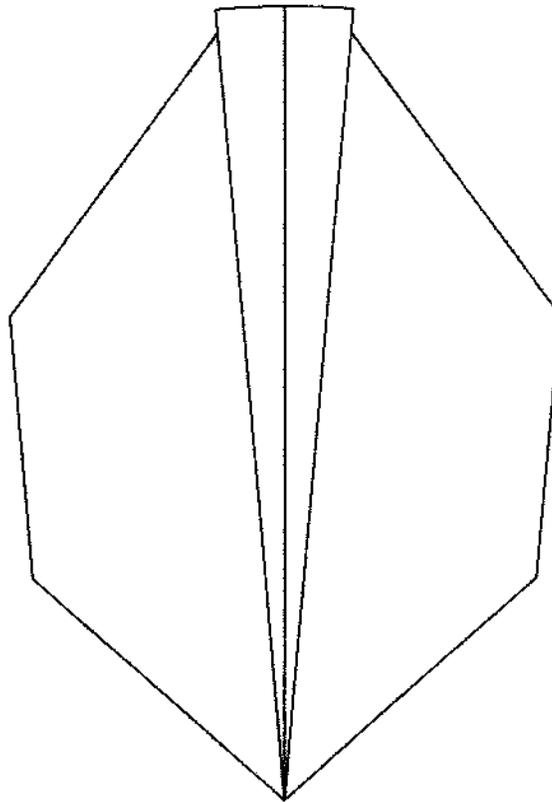
7.62mm M80 Ball

Scale: 1:50,000
Distance X: 4,100m
Impact Media: Worst Case
Vertical Hazard: 706m

ANNEX K - (US Army Range Safety Pocket Guide) to OPORD 470-XXX-16 (470 MI BDE Weapons Range Best Practices)

US Army Range Safety Pocket Guide

Version 2.2



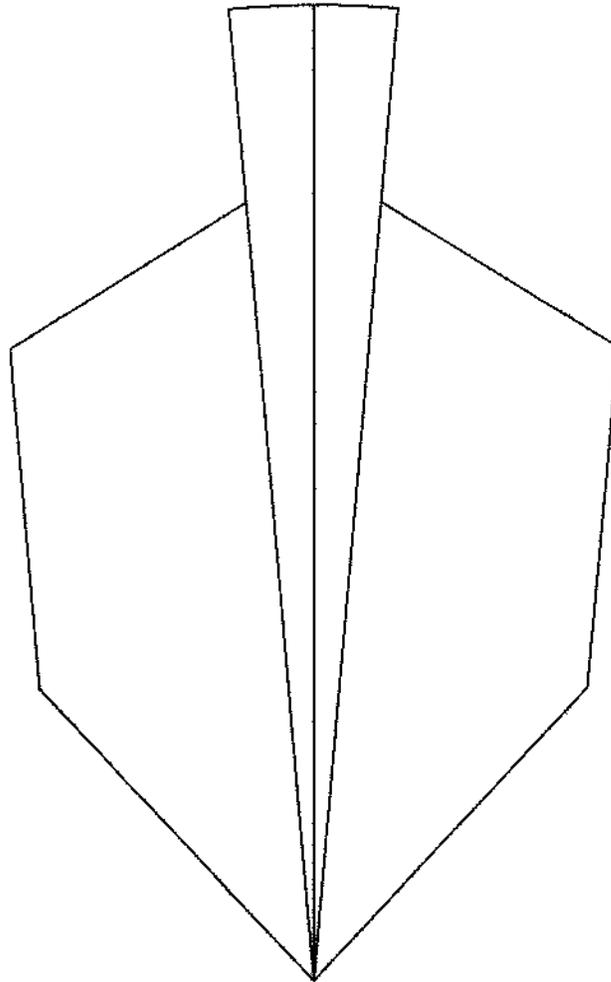
7.62mm M118 Special Ball

Scale: 1:50,000
Distance X: 5,288m
Impact Media: Worst Case
Vertical Hazard: 752m

ANNEX K - (US Army Range Safety Pocket Guide) to OPORD 470-XXX-16 (470 MI BDE Weapons Range Best Practices)

US Army Range Safety Pocket Guide

Version 2.2



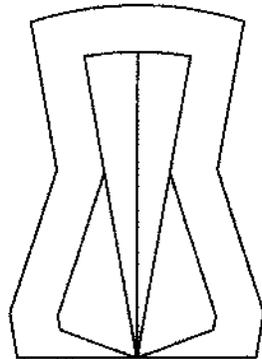
.50 Cal M2 Ball

Scale: 1:50,000
Distance X: 6,500m
Impact Media: Worst Case
Vertical Hazard: 901m

ANNEX K - (US Army Range Safety Pocket Guide) to OPORD 470-XXX-16 (470 MI BDE Weapons Range Best Practices)

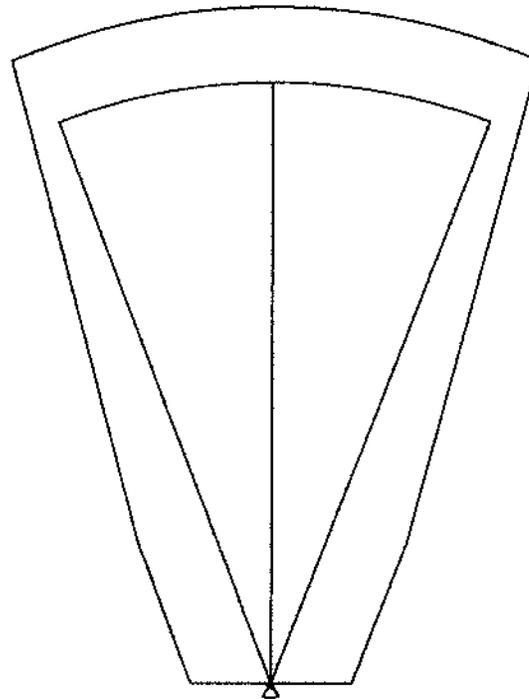
US Army Range Safety Pocket Guide

Version 2.2



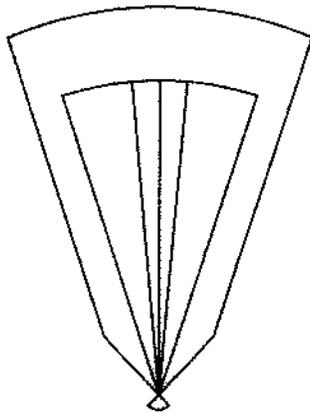
**40mm MK19 Mod3
M430 HEDP**

Scale: 1:50,000
Distance X: 2,037m
Impact Media: Worst Case



Javelin HE Warhead

Scale: 1:50,000
Distance X: 4,000m
Impact Media: Worst Case
Launcher Angle: 5 degrees



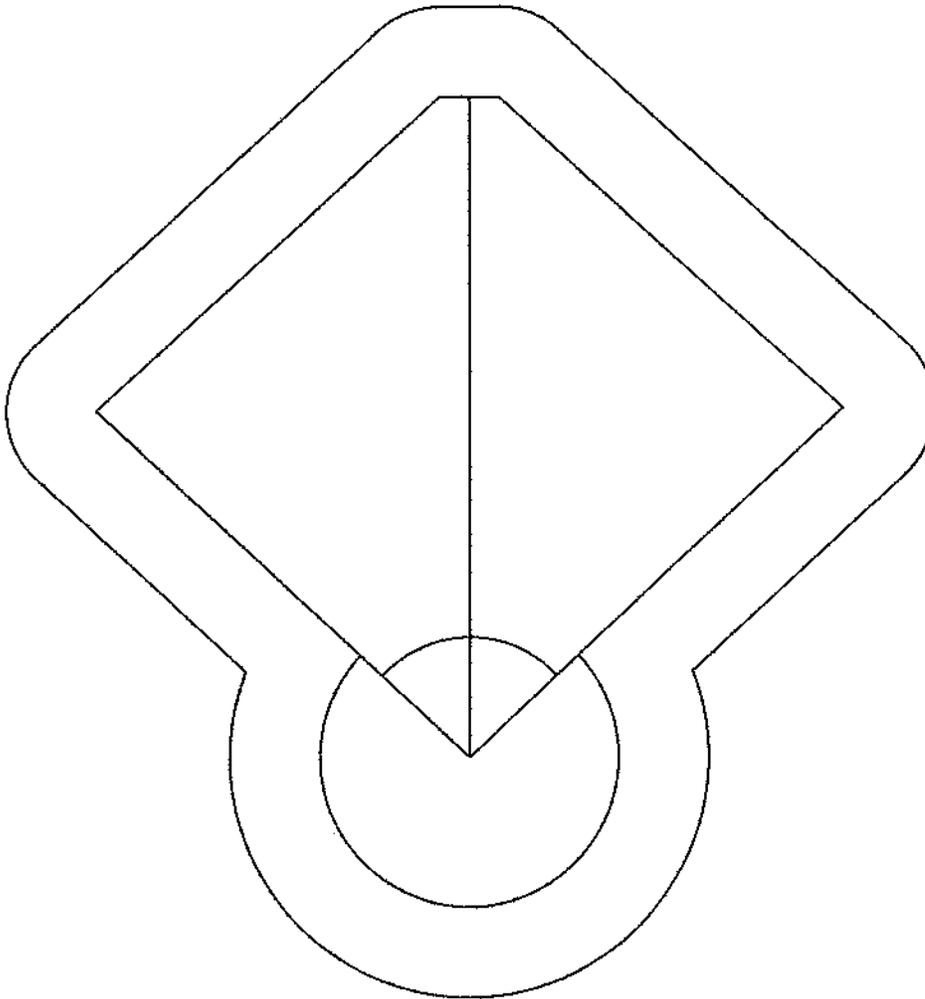
AT4 84mm HEAT

Scale: 1:50,000
Distance X: 2,100m
Impact Media: Worst Case
Rocket Angle: 5 degrees

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TOW 2B HE Warhead

Scale: 1:50,000
Distance X: 4,400m
Impact Media: Worst Case
Launcher Angle: 5 degrees

