

Army Regulation 385-62  
MCO P3570.2

Safety

# **Regulations for Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat**

Headquarters  
Departments of the Army,  
and the Marine Corps  
Washington, DC  
1 June 1983

**UNCLASSIFIED**

# ***SUMMARY of CHANGE***

AR 385-62/MCO P3570.2

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Effective 15 February 1977

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# Regulations for Firing Guided Missiles and Heavy Rockets for Training, Target Practice, and Combat

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By Order of the Secretary of the Army:

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*General, United States Army*  
*Chief of Staff*

Official:

**PAUL T. SMITH**  
*Major General, United States Army*  
*The Adjutant General*

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**History.** This publication has been reorganized to make it compatible with the Army electronic publishing database. No content has been changed.

**Summary.** This constitutes a major revision of the previous regulation to achieve greater consistency of surface danger zone distances. This has resulted in some changes to range safety guidelines and the addition of surface danger zones for new weapons systems such as the Improved HAWK, CHAPARRAL, LANCE, TOW, DRAGON, and SHILLELAGH guided missiles.

**Applicability.** This regulation is applicable to the US Army Reserve and the Army National Guard. This regulation is applicable to all Marine Corps activities

of the regular establishment and to all units of the Marine Corps Reserve.

**Proponent and exception authority.** The proponent agency of this regulation is the US Army Materiel Development and Readiness Command.

**Army management control process.** Not applicable.

**Supplementation.** Local limited supplementation of this regulation is permitted but is not required. If supplements are issued, Army Staff agencies and major Army commands will furnish one copy of each to Commander, US Army Materiel Development and Readiness Command, ATTN: DRC-SF, 5001 Eisenhower Avenue, Alexandria, VA 22333; other commands will furnish one copy to the next higher headquarters

**Suggested Improvements.** Users are invited to send comments and suggested improvements on DA Form 2028 (Recommended Changes to Publications and Blank Forms) direct to Commander, US Army Materiel Development and Readiness Command, ATTN: DRC-SF, 5001 Eisenhower Ave., Alexandria, VA 22333.

**Distribution.** *Active Army, ARNG, USAR:* To be distributed in accordance with DA Form 12-9A requirements for AR, SAFETY-D PLUS: DA Form 12-32 (2 cys each account).

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\*This regulation supersedes AR 385-62, 17 April 1967, including all changes.

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**RESERVED**

## Chapter 1 General

### 1-1. Scope and applicability.

a. This regulation prescribes the general safety precautions necessary in the firing of guided missiles and heavy rockets by troops in training, target practice, and, to the extent practicable, combat. (Range safety regulations for conventional artillery and light rockets are contained in AR 385-63.) The purpose is to minimize the possibility of accidents. This regulation has been prepared to cover general conditions, which will be encountered during firing of guided missiles and heavy rockets in training exercises. Under certain conditions, specific types of firing may be conducted at locations having less geographical area than required by this regulation. By the employment of local control techniques and limiting the type of firing, the purpose of the desired firing can sometimes be achieved under less restrictive conditions.

b. The range safety planning for the firing of any guided missile or heavy rocket must consider the available terrain, purpose of the firing, atmospheric conditions, and the adequacy and accuracy of range safety equipment required to insure that a guided missile, heavy rocket, or debris resulting therefrom will not violate the boundaries of the range. Monitoring the trajectory, velocity, or time of flight of guided missiles, or a combination thereof, is an essential means of determining where and/or when the missile should be destroyed or the thrust terminated.

c. Only personnel who have been thoroughly trained and qualified with inert or loaded components, simulated or actual propellants, and inert or loaded complete rounds will be allowed to participate in service firings and in combat firing exercises.

d. Except for paragraphs 5-6, 5-7, and 5-8, this regulation does not apply to firing ranges and laboratories of the US Army Materiel Development and Readiness Command; however, necessary precautions will be taken to insure the preservation of life and property. At ranges which are not under control of the US Army, this regulation will apply only to the extent it is not superseded by more stringent regulations of the host country. In situations where host country regulations are in conflict with this document, the major command exercising waiver authority will rule on the procedures to be followed.

e. This regulation prescribes surface danger zones (safety diagram) indicating specific danger areas and includes the latest available information and safety precautions necessary to insure the preservation of life and property during the firing of guided missiles and heavy rockets.

f. Requirements in this regulation will govern in the case of all training and target practice. In combat, the requirements are advisory in nature.

g. Precautions covering specific types of material, items, or components are given in the training publications pertaining thereto.

h. This regulation is applicable to the US Army Reserve and the Army National Guard.

i. This regulation is applicable to all Marine Corps activities of the regular establishment and to all units of the Marine Corps Reserve.

#### 1-1-1. Impact on New Manning System.

This regulation does not impact on the New Manning System.

#### 1-2. Explanation of terms.

As used in this regulation, the following explanations apply:

a. *Guided missile.* An unmanned vehicle moving above the surface of the earth, whose trajectory or flight path is, capable of being altered by an external or internal mechanism.

b. *Heavy rocket.* A stabilized, free ballistic trajectory, long range, field artillery type rocket with a range capability of greater than 100 kilometers when using a nonnuclear warhead.

c. *Probable error.* A measure of the impact distribution in the dispersion pattern around the mean point of impact; dimensionally expressed in firing tables as one interval of the dispersion pattern.

#### 1-3. Responsibilities.

a. Commanding General, US Army Training and Doctrine Command (TRADOC); Commanding General, US Army Forces Command (FORSCOM), Commanding General, US Army Materiel Development and Readiness Command (DARCOM); and the commanding generals of oversea commands are responsible for assuring that range safety procedures are established consistent with this regulation and for evaluating and authorizing any necessary waivers to this regulation.

b. Commander, US Army Training and Doctrine Command (TRADOC) is responsible for evaluating and authorizing any necessary waivers within TRADOC and for providing technical advice concerning this regulation to other army commands. The Commanding Generals of Fleet Marine Forces, Atlantic and Pacific; commanding generals of all supporting establishment commands; and the Commanding Generals of the 4th Marine Division and the 4th Marine Aircraft Wing are responsible for assuring that range safety procedures are established consistent with this regulation.

Commander MICOM; Confidential letter DRCPM-HAQ, dated 8 April 1980 and CMC message 071305Z April 80 levy additional firing regulations and restrictions on the Improved HAWK system designed to minimize the risk of compromise of critical classified Improved HAWK data.

*c.* The commanders of troop training range installations are responsible for establishing a range safety program which includes consideration of the following: maintenance and policing of ranges; selection of competent and qualified range personnel; preparation of detail maps and records (para 5-1); notification of firing; clearing of duds from ranges prior to permitting personnel access in accordance with AR 385-63; posting of range guards, barriers and signals; prescribing the wearing of steel helmets under certain conditions; stationing of ambulances, emergency type medical vehicles, and medical personnel; measures to protect downrange personnel; wearing of hearing protection devices in accordance with AR 40-5; taking suitable precautions to prevent unauthorized trespass or presence on ranges; the justification for conducting fire over the head of unprotected troops; and other duties and activities associated with the safe operation of ranges.

*d.* The senior safety officer is responsible for the safe conduct of all guided missile and rocket firings.

*e.* The range safety officer is responsible for assisting the senior safety officer and for clearing the entire range of unauthorized personnel and equipment prior to firing, and maintaining the clearance throughout the entire firing period. The individual will also be responsible for enforcing strict compliance with range safety standards and/or procedures.

*f.* The trajectory safety officer is responsible for assisting the senior safety officer and for observing the trajectory of the guided missile (or free ballistic rockets when provided with controllable destruct systems) to insure that the missile or rocket is retained within the boundaries of the danger area prescribed for the particular firing. Because of the responsibility delegated to the trajectory safety officer, the selection must be predicated upon the trajectory safety officer's experience with guided missile and rocket firings, and the trajectory safety officer should be thoroughly qualified both from the standpoint of technical knowledge and temperament to adequately discharge all responsibility. The surface danger zones prescribed in this regulation have been established on the assumption that the trajectory safety officer possesses these qualifications, and has the necessary controls and/or visible aids and communications means available to insure that missiles or rockets, or their debris, will not impact outside of the established surface danger zone. For this reason, surface danger zones have not been established in relation to the maximum range capabilities of the missiles or rockets involved which have guidance and/or destruct device installed. The maximum range capability will be considered when developing surface danger zones for guided missiles and heavy rockets whose trajectory and/or destruction cannot be controlled by the trajectory safety officer.

#### **1-4. Waivers.**

*a.* The commanding general of an oversea command, the CG, TRADOC, the Commanding General, US Army Materiel Development and Readiness Command (DARCOM); and the CG, FORSCOM may waive the safety criteria contained in this regulation at installations under their command when such waivers are considered to result in acceptably safe conditions and are in the best interests of the United States. The authority delegated to the above commanding generals may be subdelegated to general officers in command positions; however, this authority may not be further subdelegated and will be limited to granting waivers which—

(1) Reduce the dimensions of surface danger areas prescribed in this regulation when the nature of the terrain, artificial barriers, or other controlling factors make smaller areas safe;

(2) Modify prescribed firing procedures as may be appropriate to the state of training of participating troops in order to increase realism in training provided safety of personnel is not degraded; and

(3) Exempt personnel from evacuating the prescribed surface danger zones, in addition to those personnel actively engaged in firing and controlling missiles who are automatically exempted by this regulation. The number of personnel exempted will be held to the minimum compatible with efficient operations and maximum safety precautions will be observed by personnel so exempted, consistent with accomplishment of the particular mission or objective.

*a.1.* The Commanding Generals of Fleet Marine Forces, Atlantic and Pacific; commanding generals of all supporting establishment commands; and the Commanding Generals of the 4th Marine Division and the 4th Marine Aircraft Wing may waive the TOE and DRAGON safety criteria contained in this regulation at installations under their command when such waivers are considered to result in acceptably safe conditions and are in the best interest of the United States. Authority in the Marine Corps to waive HAWK, REDEYE, and STINGER missile systems safety criteria contained in this regulation rests solely with the Commandant of the Marine Corps. Requests for waivers concerning Improved HAWK, REDEYE and STINGER missile systems must be submitted via chain of command to CMC (Code APC) for approval.

*b.* The Commandant of the Marine Corps, the commanding general of an oversea command, the CG, DARCOM, and the CG FORSCOM are authorized to communicate directly with the Commander, US Army Training and Doctrine Command, ATTN: ATEN-S, Fort Monroe, VA 23651 for the purpose of obtaining technical information and data to assist in determining the advisability of granting waivers. When feasible, any range which fails to meet the criteria of this regulation and for which a waiver is granted will be reconstructed or relocated (programming therefore, if necessary) to meet the requirements of this regulation. Waivers so granted will be recorded at the approving level and

reviewed annually to determine corrective action taken. When the technical assistance of TRADOC is solicited, the following data should be furnished to facilitate evaluation:

- (1) A statement indicating the specific paragraph of this regulation to be waived.
- (2) Description of conditions (scaled maps showing distances to internal and external exposures), personnel involved and facilities exposed.
- (3) The specific type of ammunition and weapons involved as identified in appropriate technical manuals.
- (4) Map coordinates of a firing position and quadrant elevation of fire. The firing position and direction of fire will be plotted on the scaled map furnished and a scaled surface danger zone will be furnished as an overlay for the map. All distances will be shown in meters.
- (5) A standing operating procedure for the firing and range control.
- (6) Additional precautions that will be taken to achieve safety in operations too fully compensate for the lack of compliance with this regulation.

c. The waiver authority does not affect the waiver responsibility designated in AR 385-64 and will not be construed as permitting waiving airspace safety requirements (para 3-2) and water traffic requirements (para 3-3) of AR 385-63. Similarly, paragraphs 5-6, 5-7, and 5-8 of this regulation may not be waived.

d. The range safety planning for the firing of any ammunition and explosives must consider the specific types of ammunition or explosives involved, the available terrain, purpose of the firing, atmospheric conditions, and the adequacy and accuracy of safety equipment required to insure that the ammunition and explosives, or debris resulting therefrom will not violate the boundaries of the surface danger zone.

e. Only personnel who have been thoroughly trained and qualified with ammunition complete rounds or components thereof will be allowed to participate in combat firing exercises, or on special courses designated for mental conditioning of individuals for actual combat.

## **Chapter 2**

### **General Precautions**

#### **2-1. General.**

a. When several units are firing independently in the same general area, there will be a commissioned officer in charge of, and responsible for, each independent firing site. Safety at each firing site is the responsibility of the senior safety officer. A range safety officer and a trajectory safety officer will be designated to assist the senior safety officer. Additional personnel will be detailed, as required, to assist the safety officers.

b. Prior to firing guided missiles or heavy rockets, the range commander will establish a safety standing operating procedure (SOP) for the guided missile and heavy rocket being fired for the express purpose of providing guidance for the prevention of accidents. The SOP will relate to the special characteristics of the specific missile or rocket to be fired and to the existing location situation. Deviations from the established SOP are unauthorized unless approved by the range commander. A change in the type of missile or rocket to be fired, or a change in local conditions makes it mandatory that a revision to the SOP, or a new SOP, be prepared prior to firing. The SOP will enumerate the number of safety officers and personnel to be appointed and will contain complete and detailed instructions covering specific duties and responsibilities of each.

c. In all cases when firings are to be conducted, a warning order will be published to the entire installation at least 24 hours prior to the time of firing, showing the place where firing is to be conducted, the hour it is to begin and cease each day, and the boundaries of the surface danger zone. Similar warnings will be issued to aeronautical authorities. If there is a possibility that firings may cause undue alarm in nearby communities, local civil authorities, radio stations, and newspapers should also be furnished warnings concurrently.

d. All guided missiles and rockets must be fired within time limitations established by the range safety officer. When firings cannot be accomplished within the prescribed time limits because of technical difficulties, or for other reasons, a new firing schedule must be obtained from the range safety officer.

e. During prefiring preparations, all missiles, rockets, and explosives or hazardous components will be handled and assembled in a manner consistent with applicable safety regulations prescribed by the appropriate TM and FM.

f. Any alteration to guided missiles or heavy rockets and their associated equipment (except as authorized in appropriate publications and by the DARCOM) is hazardous and therefore is prohibited.

g. All guided missiles and heavy rockets, and components thereof, such as fuels, propellants, oxidizers, and explosives, in ready storage or at the firing site, must be so placed as to minimize the possibility of ignition or detonation caused by the motor exhaust or by an accident involving the guided missile or rocket being fired. Items should be stored in a dry place, protected from the direct rays of the sun by a fire resistant tarpaulin or other fire resistant covering and adequately ventilated.

h. An individual in the military service or any civilian employee of the Department of the Army who observes a condition which makes firing dangerous will immediately command CEASE FIRING and if at a distance from the

firing unit, will give the prescribed signal to CEASE FIRING. The prescribed signal for cease firing will be included in the firing SOP.

*i.* Situations may arise which are not considered in the regulation but, in the opinion of the safety officer, may result in unsafe firing. Conversely, situations may arise where firing the missile and then destroying it in the air is considered the safest course of action. Nothing in this regulation will be construed as authorization to fire or not to fire under such conditions. This decision must be made locally based upon prevailing conditions.

*j.* Accidents or incidents occurring during firing which may indicate that the regulations contained herein are not adequate, from a safety standpoint, will be reported immediately to Commander, TRADOC, ATTN: ATEN-S, Fort Monroe, VA 23651 (Exempt report, para 7-2y, AR 335-15.)

## **2-2. Overhead firing.**

During training or target practice, guided missiles and heavy rockets will not be fired in such a manner that their trajectories will pass over personnel or material objects except as specifically authorized in chapter 6.

## **2-3. Operational safety factors.**

*a.* The following safety precautions will be observed:

(1) The number of personnel engaged in handling, assembling, testing, or firing guided missiles or heavy rockets will be kept to the absolute minimum necessary to maintain efficient operations consistent with effective training.

(2) Shorting plugs and other safety devices should be removed only for conducting tests or in final preparation for firing.

(3) Smoking will be prohibited within 50 feet of firing pads, ready storage sites, or assembly sites, and signs to that effect must be prominently displayed. Smoking will also be prohibited on any vehicle used in transporting propellants or explosives. The possession of matches or other flame producing devices will be prohibited in "no smoking" areas.

(4) Suitable fire fighting equipment will be readily available during all guided missile and/or heavy rocket firings.

(5) An ambulance, suitably equipped, and at least two medical aidmen will be readily available during firing of guided missiles and rockets. Where crash firefighting, rescue, and medical crews (crash rescue helicopters) are maintained on an immediate alert status, an ambulance and medical aidmen are not required to be at the firing stage.

(6) Protective clothing and equipment (as prescribed by the appropriate TM) will be utilized by personnel engaged in handling hazardous materials or exposed to hazardous operations or conditions.

(7) 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 which might cause ignition of the propellant or electroexplosive devices by sparks, static discharge, or stray current.

(8) Operations involving the use of high-pressure air (or compressed gases) will be supervised by well-trained personnel and adequately covered in applicable standing operating procedures.

(9) Decontamination equipment appropriate for the type of propellant, oxidizers, active chemicals, batteries, or other hazardous fuels being used will be readily available during all operations of the missile/rocket firing.

*b.* Protection of persons in the vicinity of firing sites during training and target practice:

(1) Personnel will not be allowed to occupy positions in any portion of the surface danger zone except as specifically authorized in chapter 6.

(2) Personnel who, by the nature of their duties, must occupy positions within the surface danger zone, will be provided with protective shelters which will be inspected by the range safety officer to determine their adequacy.

(3) Positive protection, such as a keyed firing panel, will be provided to prevent premature firing of a guided missile or heavy rocket.

## **2-4. Malfunctions, misfires and hangfires.**

*a. General.* Malfunctions involving guided missiles and heavy rockets will be investigated, locally suspended, and reported as required by AR 75-1. Instructions contained in the applicable TM or FM must be included in the SOP for determining the cause, and/or authorized actions, involving items, which have malfunctions.

*b. Procedures to be followed in case of a failure to fire.* After a failure to fire, the following general precautions, as applicable, will be observed until the cause of failure has been determined or the guided missile or heavy rocket has been rendered safe:

(1) Keep the launcher directed to a safe field of fire and keep all personnel clear of the trajectory and path of motor exhaust.

(2) Wait the minimum safety interval prescribed in the appropriate TM or FM before approaching the guided missile or heavy rocket. If the prescribed safety interval is unknown, wait a minimum of 30 minutes.

## **2-5. Moving targets.**

Guided missiles or heavy rockets will not be fired for target practice at manned air or ground targets or at targets towed by manned vehicles or aircraft unless specifically authorized by Headquarters, DARCOM, ATTN: DRCSF. In certain types of command guidance systems, the "burst offset" technique may be employed against manned targets when the

burst offset is at least 1,000 mil and when specifically approved by the responsible officer. If moving targets are necessary for target practice, remote controlled air or ground targets or target rockets will be used.

#### **2-6. Command-destruct systems.**

The PERSHING, NIKE-HERCULES, NIKE-AJAX, HAWK, and SERGEANT guided missiles fired for training or target practice will be equipped with systems, which are capable of either destroying the missile during its trajectory or terminating powered trajectory of the missile. Other guided missiles will be equipped with a destruct system capable of being activated by the trajectory safety officer when such a system is furnished by the developing agency. The system may or may not be an integral part of the warhead for those missiles equipped with explosive warhead. Missiles as indicated above, equipped with inert or practice warheads must be furnished with a system capable of either terminating powered trajectory or destroying the aerodynamic characteristics of the missile to insure destruction. Command-destruct systems must be capable of being functioned by the trajectory safety officer independent of all action by firing or trajectory control crews.

#### **2-7. Guidance wires.**

The guided missile command guidance wires that are deployed behind some missiles (e.g., TOW, SS-11, DRAGON) offer a potential hazard to personnel riding in open vehicles or motorcycles and to low flying aircraft, especially helicopters. These command guidance wires should be recovered where possible and access to the range should be strictly controlled. Recovery should be made by ground personnel. Under no circumstances should helicopters be used to recover guidance wires.

#### **2-8. Target missiles.**

Target missiles will be launched and controlled in accordance with guidance outlined in paragraph 14-3, AR 385-63.

### **Chapter 3**

#### **Suspension of Guided Missiles and Heavy Rockets Involved in Malfunctions**

##### **3-1. Suspension of missiles and rockets involved in malfunctions.**

If any lot of guided missiles, heavy rockets, or components thereof has malfunctioned in such a way that the further use of that lot will probably result in injury to personnel or damage to property, the particular lot involved will be suspended from use. This suspension will be made by the unit commander or the senior safety officer, and will be substantiated by the local ordnance officer (chief technical officer of that service for an oversea command) who authorizes reissue of the item or otherwise directs its disposal. See AR 75-1 for procedure for reporting information concerning malfunctions involving ammunition and explosives during training and combat Missile and Rocket Malfunction Report (DA Form 4379-1), Requirement Control Symbol AMC-132 (MIN)). Upon receipt and review of the report of malfunction, if conditions warrant, DARCOM will immediately order the suspension of the lot throughout all commands.

##### **3-2. Disposition of materiel involved in malfunctions.**

The materiel involved in the malfunction and any evidence such as components or fragments of the missile or rocket involved will be carefully preserved until disposition is directed by DARCOM, unless, in the opinion of the local ordnance officer, the preservation or shipment of such materiel may endanger life or property. In the event disposition instructions for components or fragments are not furnished within 90 days after the malfunction has been reported, local disposition of such items is authorized. In cases where the cause of the malfunction is doubtful or undetermined, all affected material will be held until disposition instructions are furnished by DARCOM. When shipment of materiel involved in or affected by a malfunction is directed by DARCOM, copies of the shipping document will be immediately forwarded to the consignee and DARCOM as evidence that the material has been shipped. To insure correct routing, the shipping document will contain appropriate references to the report of malfunction.

### **Chapter 4**

#### **Suspension of Operations**

##### **4-1. Malfunctioning equipment.**

If any of the firing equipment, tracking equipment, guidance equipment, safety system equipment or components has malfunctioned or does not function properly during preparation for firing or during the firing sequence, operations will be suspended and the missile or rocket will not be fired until the equipment is repaired and functioning properly in accordance with FM's, TM's, and SOP's.

#### **4-2. Unauthorized entry into the surface danger zone.**

When it is known or suspected that any unauthorized personnel, vehicles, ships, or aircraft have entered into any part of the surface danger zone, operations will be suspended and no firing will be conducted until the unauthorized entrant has been removed or a thorough check of the suspected area has been performed.

#### **4-3. Atmospheric conditions.**

If atmospheric conditions interfere with the proper operation of the firing, guidance, tracking, or safety system equipment to the extent that proper surveillance or control cannot be assured, operations will be suspended until sufficiently favorable atmospheric conditions prevail.

## **Chapter 5 Firing Range Hazards**

### **5-1. Records.**

Permanent, detailed records on real estate used on range areas will be established by range control activities to—

- a.* Describe the range area using detailed maps, charts and overlays.
- b.* Provide information concerning the types and amounts of ammunition fired into each range area.
- c.* Indicate known or estimated number of unexploded ordnance located in range areas.

### **5-2. Policing of ranges.**

- a.* Policing of ranges will be accomplished as outlined in AR 385-63 and TM 9-1300-206. Established permanent impact areas will be policed under qualified explosive ordnance disposal supervision only.
- b.* Units using ranges will report all duds to the range control officer of the installation, indicating the type of missile or rocket, type of warhead involved, and location of dud.
- c.* Prior to allowing free access to a range area by authorized personnel, a clearance operation to remove or destroy all hazardous materials will be conducted.
- d.* Because of the possibility of contaminated or hazardous materials remaining in a missile or rocket body after impact or detonation of the warhead, it is imperative that all large pieces, especially those, which might conceal contaminated or hazardous materials, be removed from the range. "Render safe" decontamination and disposal procedures, which are outlined in applicable technical and EOD procedural manuals, will be followed.

### **5-3. Range safety limits.**

Safety limits (based upon prescribed danger areas) will be determined and defined prior to firing of all rockets and missiles. In relation to ammunition storage areas, these limits will be determined as follows:

- a.* Ranges will be so located that personnel engaged in firing activities will not be nearer than inhibited building distance to the ammunition storage areas (i.e., ammunition points containing large amounts of ammunition and pickup or turn-in activities). This does not include ammunition areas on the range itself or on adjacent ranges. Where available land areas are inadequate, the distance separating personnel at the firing areas from ammunition storage areas may be reduced to not less than public highway distance. These distances may be determined by referring to the explosives quantity-distance tables established in AR 385-64 and will be computed based on the quantity and class of ammunition in the limiting magazine or storage point within the ammunition storage area. The limiting magazine or storage point is defined as the one requiring the greater distance based on the quantity and/or class of the ammunition contained therein.
- b.* Guided missiles and heavy rockets will be fired in such a manner that their trajectory will not pass over the ammunition storage area. When possible, all firings should be conducted in a direction facing away from the ammunition storage area. If such cannot be done, the firing will be conducted in a manner that will assure the ammunition storage area is outside the surface danger zone for the missile or rocket being fired.

### **5-4. Trespassing on land ranges.**

- a.* In the interest of safety, local newspapers will be requested to publish warnings against trespassing on the range. Spot announcements by local radio and television stations may also be used.
- b.* Before firing guided missiles or heavy rockets, the danger areas of land ranges will be examined and suitable precautions will be taken to assure that all unauthorized persons are excluded. Livestock will also be excluded unless a written agreement has been established with the owner.
- c.* Precautions will be taken after firing to prevent entry into the impact area by all persons except those authorized by the senior safety officer or the range safety officer until the impact area has been policed as prescribed in paragraph 5-2 and declared safe for entry by one or both of these officers.
- d.* Precautions to prevent trespassing on firing ranges during or after firing and the unauthorized handling or removal

of guided missiles and heavy rockets, or components, by members of the command or by civilians are matters concerning public safety and must be diligently exercised.

#### **5-5. Range guards and barriers.**

Range guards, properly instructed concerning their duties, and/or appropriate barriers with signs affixed, will be posted to cover all normal approaches to the danger area.

#### **5-6. Warning signs and signals.**

*a.* Scarlet streamers and, when necessary, warning signs will be displayed at appropriate points to warn persons approaching a firing area which is being used.

*b.* The scarlet streamer used during daylight hours, and supplemented by blinking red lights during nighttime, will be displayed from a prominent point on all ranges during firing exercises. The scarlet streamer and blinking red lights as indicated above, will be displayed prior to firing, and firing will cease immediately in event the streamer is lowered or the blinking lights are turned off.

*c.* Signs warning persons of the danger from guided missiles and heavy rockets will be posted in the vicinity of the firing area at all times.

*d.* In addition to the warning signals and signs employed to prevent entry to the range during firings, the boundaries of all surface danger zones will be placarded with permanent signs at 200-meter intervals or less which emphasize the dangers connected with the handling of unexploded explosive items, fragments, or components of guided missiles and heavy rockets, and prohibit trespassing on ranges or the removal of items under penalties provided by law.

#### **5-7. Inland waterway safety requirements.**

Federal laws for the protection and preservation of navigable waters authorize the Secretary of the Army to prescribe regulations for the use and navigation of such waters endangered or likely to be endangered by the guided missiles or heavy rockets. Such regulations become necessary only when hazards and restrictions to navigation are contemplated. In any event, prior to firing over navigable waters, the district engineer for the locality will be notified of the type of operations to be conducted, the water area involved, and whether it is desired that the Secretary of the Army prescribe regulations for the protection of navigation. No guided missile or heavy rocket which contains phosphorous will be fired or dropped into any inland waterway, lake, bay, or any other inland body of water.

#### **5-8. Open sea safety requirements.**

Prior to firing a guided missile or heavy rocket on a range which extends over the open sea, rights and access to use the area must be obtained from US Coast Guard authorities. Provisions will be made for aerial reconnaissance and small watercraft patrol of the established danger area.

#### **5-9. Airspace safety requirements.**

*a.* Airspace, as referred to in this regulation, is that airspace overlying the United States and possessions of the United States including territorial waters.

*b.* Prior to firing any guided missile or heavy rocket under conditions in which the maximum ordinate will exceed 45 meters, the responsible commander will obtain approval from the Administrator, Federal Aviation Agency (FAA) This will be accomplished through the appropriate Army airspace representative as required by AR 95-50. The airspace may be approved as a permanent or temporary restricted area, or as a controlled firing area. Provision will be made for surveillance of the endangered airspace either by radar or patrol aircraft.

## **Chapter 6 Surface Danger Zones**

### **6-1. General.**

The surface danger zone for any firing range is generally composed of a firing area, a target area, impact area, and danger areas surrounding these locations. An additional area for occupation by personnel during firings may also be required. The shape and size of the surface danger zone varies with the type of missile or rocket being fired. Dimensions, or the means of obtaining dimensions, for the essential components of the surface danger zone are given in paragraphs 6-2 through 6-19 and in figures 6-1 through 6-20. The surface danger areas defined in c below are considered to provide a reasonable degree of safety and to be of practicable size. The danger areas established in this chapter are minimum requirements and are adequate only when employed with properly functioning safety equipment and/or devices which are operated by thoroughly trained and competent personnel. The specific dangers peculiar to firings involving guided missiles and heavy rockets are as follows:

*a.* Those hazards in the immediate vicinity of the launch are—

- (1) High velocity winds caused by the motor exhaust and debris propelled by these winds.

- (2) Noise levels, which exceed 140dB on an intermittent basis.
  - (3) Heat from direct impingement of the motor exhaust which reaches 4,000°F to 6,500°F. (Heat radiation is considered negligible.)
  - (4) The possibility of accidental detonation of warheads or propellants.
  - (5) The possibility of rupturing fuel and oxidizer tanks.
  - (6) The danger from rupturing of high pressure systems.
  - (7) The possibility of a malfunction causing a fired missile or booster to fall back onto the firing area.
- b.* Those hazards forward of the launcher are—
- (1) Impact of the missile or rocket and/or booster.
  - (2) Debris from the missile or rocket in flight.
  - (3) Debris caused by destruct of the missile or rocket during flight.
  - (4) Detonation of warheads.
- c.* Definitions of danger areas contained in the surface danger zone.
- (1) *Impact area.* The impact area (primary danger area) is established for receiving the initial impact (touching down to earth) of any missile, booster, or rocket, including warhead, and any debris attributable to the normal functioning of the missile or rocket during flight.
  - (2) *Target area.* The target area is a point, or area to which the weapon is to be fired and is wholly within the impact area.
  - (3) *Area A.* Area A (lateral secondary danger area) parallels laterally the impact area and is established to contain the lateral debris from missile intercepts, from missiles destroyed in flight, from the impact of fragments, from the impact of boosters, and from the effects of warheads functioned at the lateral edge of the impact area.
  - (4) *Area B.* Area B (far range secondary danger area) is an extension of the impact area and area A in the direction of firing. This area is established to contain the forward debris from missile intercepts, from missiles destroyed in flight, from the impact of fragments, and from the effects of a warhead functioned at the far edge of the impact area.
  - (5) *Area C.* Area C (near secondary danger area) is an area beginning at the near edge of the impact area and extending toward the launcher. It is established to contain the effects of a warhead functioning at the near (uprange) edge of the impact area.
  - (6) *Area D.* Area D (area permissible for occupancy) extends from the near limits of areas A and C in the direction of, but not to the launcher. Occupation of this area involves a risk of personnel; however, the area has been provided for use in training activities in which it is necessary to expose troops to the effects of overhead and flanking fire. The area is intended for this use exclusively and occupation by other personnel or for other reasons is prohibited.
  - (7) *Area E (primary danger area).* The area in front of the firing line or position which may be endangered by the effects of the weapon being fired. This area is usually between area D and the firing position (launch point).
  - (8) *Area F.* Area F (launcher danger area) is an area immediately adjacent to the launcher, which is endangered by motor debris and injurious noise level at the time of firing. This area is established to contain the effects of a normal functioning missile or rocket motor.

## **6-2. NIKE-AJAX and NIKE-HERCULES guided missiles.**

The basic diagram of the surface danger zone for the NIKE-AJAX and NIKE-HERCULES guided missiles has been established on the basis that destruct action may be initiated by the trajectory safety officer any time after 3 seconds from the time of launch.

*a.* The surface danger zone (fig. 6-1) consists of the impact area, area A and area B. The entire surface danger zone will be cleared of all personnel prior to firing a missile except as authorized in *f* below.

*b.* Impact area (primary danger area) will be constructed as depicted in figure 6-1. The size of this area must be varied by adjusting the angle of the line separating the impact area from area A (angle  $\theta$ ), depending upon the type of firing. An angle of between 0° and 10° may be necessary for firings at aerial targets. In this respect, an area extending 5,200 meters to either side of the "Direction of Fire" line (1,720 meters forward of the launcher for the NIKE-AJAX or 2,200 meters for the NIKE-HERCULES) and continuing to a point 5,200 meters to either side of and beyond the predicted point of intercept or maximum range is considered adequate for rings to aerial targets or a point in space when trajectory corridors as illustrated in figure 6-20 or safety masks are employed. Impact area to the rear of the launcher is defined by a semicircle of 720 meters radius for the NIKE-AJAX and 1,200 meters for the NIKE-HERCULES. Range (X) must be equal to the maximum ground impact range capability of the missile when trajectory corridors, such as illustrated in figure 6-20, do not provide destruction points to control the range as well as azimuth of the missile. Range (X) will be the predicted point of intercept or ground impact and may vary between minimum and maximum intercept or ground impact range capability of the missile if the missile can be destroyed upon departure from the predetermined trajectory path by employing techniques which will reliably predict "range to go."

*c.* Area A (secondary danger area) is an area of varying width depending on destruct or intercept altitudes of the missile and parallels the other perimeter of the impact area as depicted in figure 6-1. It should be noted that area A is not a true function of altitude in the immediate launching zone. The width of area A (table 6-1) is normally the

maximum lateral distances the missiles and debris will attain after intercept or destruction by the trajectory safety officer at the specified altitude. However, 1,000 meters for the NIKE-AJAX and NIKE-HERCULES may be used to the rear of the launcher when early prediction of missile trajectory and destruction of the missile can be accomplished in the event the missile is heading in the direction opposite to the planned trajectory. The distance does not necessarily provide protection should two of the NIKE-HERCULES booster motors fail to ignite. With adequate range controls, however, the probability of debris falling beyond area A is extremely remote.

d. Area B (far secondary danger area) is an area of varying length (table 6-1) depending on intercept or destruct altitudes of the missile and is an extension of the impact area and area A in the direction of firing.

**Table 6-1**  
**Dimension of Area A and B in Meters for the NIKE-HERCULES and the NIKE-AJAX**  
**Based on Altitudes at Intercept or Destruct**

<i>NIKE-AJAX (Feet)</i>	<i>Area A (Meters)</i>	<i>Area B (Meters)</i>
Below 40,000	4,800	11,500
40,000-50,000	5,300	12,500
Above 50,000	5,800	13,500
<i>NIKE-HERCULES (Feet)</i>	<i>Area A (Meters)</i>	<i>Area B (Meters)</i>
Below 40,000	8,100	19,300
40,000-50,000	8,900	20,900
50,000-60,000	9,700	22,500
60,000-70,000	11,300	25,700
70,000-80,000	12,900	28,900
Above 80,000	14,500	32,200

e. The trajectory safety officer must be provided with layouts of the range on which the surface danger zone and trajectory corridor for the particular firing have been defined. The trajectory safety officer must also be provided a means of accurately tracking and plotting the course of a missile during trajectory. Firing normally will be made to a moving aerial target rather than to a point in space as shown in figure 6-1. In this case, a composite surface danger zone, which is based on the two extreme azimuth intercept points, will be required. Target azimuth, target elevation, and target velocity will establish the intercept locus (path of the moving intercept point). Control of the time interval for launch will establish boundaries for the intercept locus. The basic diagram can be used for developing the composite surface danger zone. Maximum elevation for the predicted point of intercept will establish dimensions for area A and area B. Maximum range for predicted point of intercept will establish the inner boundary for area B (5,200 meters must be maintained between the "Predicted Point" of intercept and area B). Using the above data, construct a scaled surface danger zone diagram for each of the extreme azimuth intercept points. A composite of the two surface danger zones will establish the composite surface danger zone.

f. Only those personnel actively engaged in firing and controlling the missile will be permitted in the surface danger zone at the time of firing. The number of personnel thus engaged should be held to an absolute minimum compatible with efficient operation. These personnel should, when possible, take protective cover. If visitors are permitted to view the firing from a position in proximity to the rear danger zone, it is recommended that a protective cover be provided.

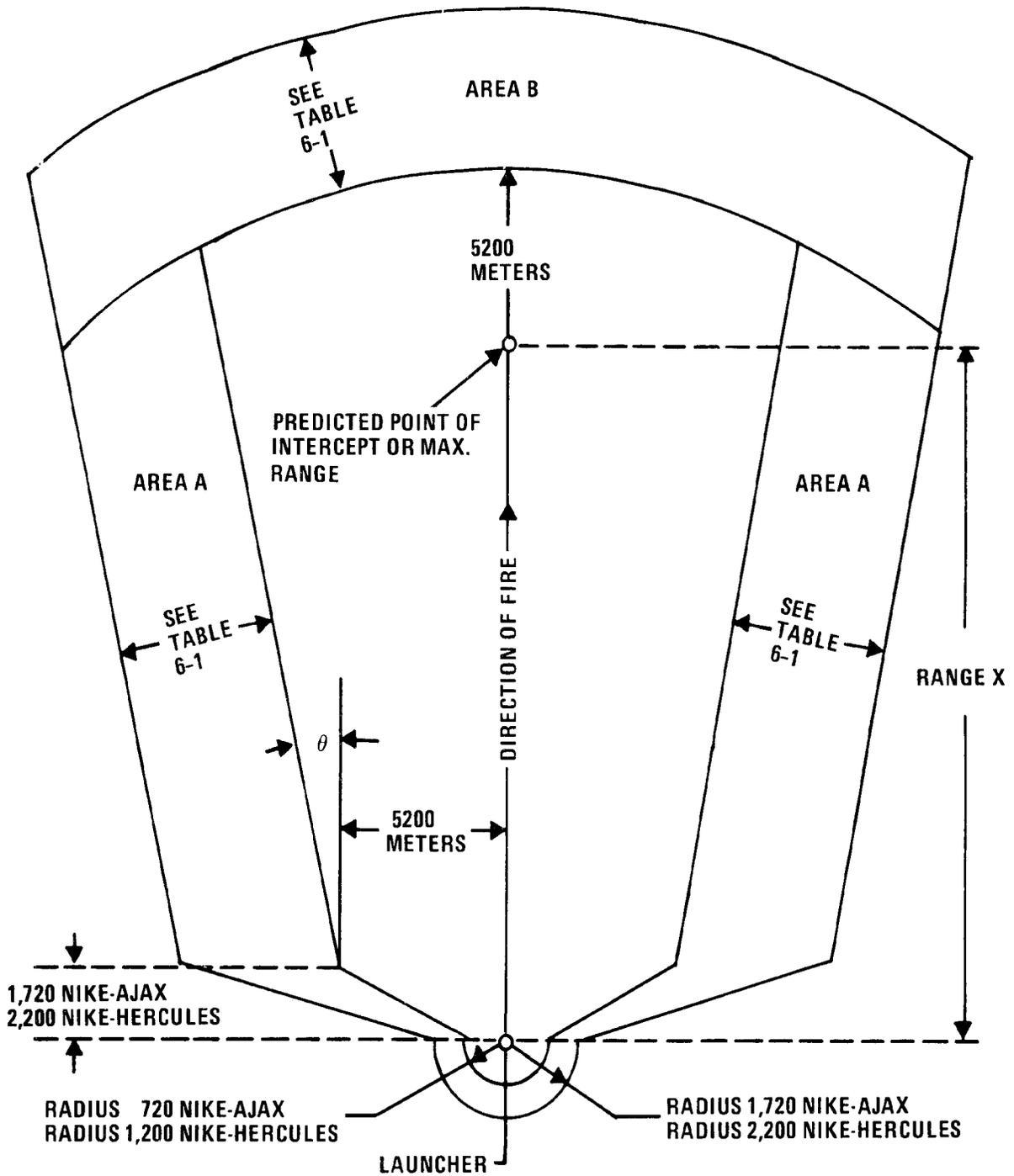
### **6-3. Improved HAWK guided missile.**

The diagram of the surface danger zone for the Improved HAWK guided missile is shown in Figure 6-2.

a. The surface danger zone (fig. 6-2) consists of the impact area and areas A and B and has been established on the basis that actual destruction of the missile may be accomplished by the trajectory safety officer only after 8.5 seconds from the time of firing or 5.5 seconds after leaving the trajectory corridor. The entire surface danger zone will be cleared of all personnel prior to firing a missile except as authorized in below.

b. The impact area (primary danger area) will be constructed as depicted in figure 6-2. This area is considered adequate to contain the debris from missiles and the impact of missiles which have a normal flight. The corridor dimension (R) includes the maximum lateral displacement of the missile due to lead angles and maneuvers associated with intercepting a moving aerial target. The area extends 2,500 meters to the rear of and to either side of the firing point, and opens to a varying distance, (R) meters at 15,000 meters downrange in the direction of fire, to either side of the direction of fire depending on the altitude of the intercept (table 6-2). This area is continued to a distance (W) meters beyond the intercept point, and to a distance (W) or (R), whichever is larger, to either side of the predicted intercept point (table 6-2). The resulting area is considered adequate for firings to a point in space when trajectory corridors as illustrated in figures 6-2 and 6-20 are employed. Range (X) will be the predicted point of ground impact or target intercept and may vary between minimum intercept and maximum ground impact range capability of the missile if the missile can be destroyed upon departure from the predetermined trajectory path by employing techniques which will reliably predict "range to go." Range (X) must be equal to the maximum ground impact range capability of

the missile only when trajectory corridors, such as figure 6-20 do not provide for destructive points to control the range as well as azimuth of the missile.



- NOTES:  
 1. ALL DIMENSIONS ARE IN METERS  
 2. NOT TO SCALE

Figure 6-1. Surface danger zone for firing the NIKE-HERCULES and NIKE-AJAX guided missiles at a point in space, or a fixed terrestrial target.

**Table 6-2**  
**Improved HAWK Corridor Dimensions**

Predicted intercept altitude (ft) above ground level)	R distance (meters)	W distance (meters)	Trajectory corridor (meters)
Ground level	4,600	610	4,000
10,000	6,000	2,000	4,000
20,000	7,400	3,400	4,000
30,000	8,700	4,700	4,000
40,000	10,200	6,200	4,000
50,000	11,700	7,700	4,000

c. Area A (lateral secondary danger area) is an area 4,200 meters wide paralleling the lateral edge of the impact area as depicted in figure 6-2. This area is normally adequate to contain the debris from missile intercepts, missile destroyed in trajectory and the impact of missiles which have an abnormal flight or go out of control and must be destroyed by the trajectory safety officer. The range to the rear of the firing point is adequate when early prediction of missile trajectory and destruction of the missile can be accomplished in the event the missile is heading in the direction opposite to the planned trajectory. The 4,200 meter width of area A is based on the use of trajectory corridors. If trajectory corridors are not used, the width of area A must be increased to 6,500 meters to provide time for the trajectory safety officer to recognize abnormal trajectory characteristics.

d. Area B (far secondary danger area) is an area 7,500 meters wide and is an extension of the impact area and area A in the direction of the firing.

e. Area F (launcher danger area) is defined as that area within 61 meters of the launcher, which is endangered at the time of launching. Hazards are the hot rocket exhaust and high-velocity aggregate. Area F is not shown in figure 6-2.

f. The trajectory safety officer must be provided with layouts of the range on which the surface danger zones and the trajectory corridor for the particular firing have been defined. The trajectory safety officer must also be provided a means of accurately tracking and plotting the course of a missile during trajectory. Firings normally will be made to a moving aerial target rather than a point in space as shown in figure 6-2. In this case, a composite surface danger zone which is based on the two extreme azimuth intercept points will be required. Target azimuth, target elevation, and target velocity will establish the intercept locus (path of moving intercept points). Control of the time interval for launch will establish boundaries for the intercept locus. Figure 6-2 can be used for developing a composite surface danger zone. Dimensions for area B will be as shown in figure 6-2. R distance and W distance will be based upon the maximum altitude for the predicted intercept as given in table 6-2. Maximum range for predicted intercept will establish the inner boundary for area B (W distance must be maintained between the "predicted intercept point" and area B). Using the above data, construct a scaled surface danger zone diagram for each of the extreme azimuth intercept points using the procedure in *i* below.

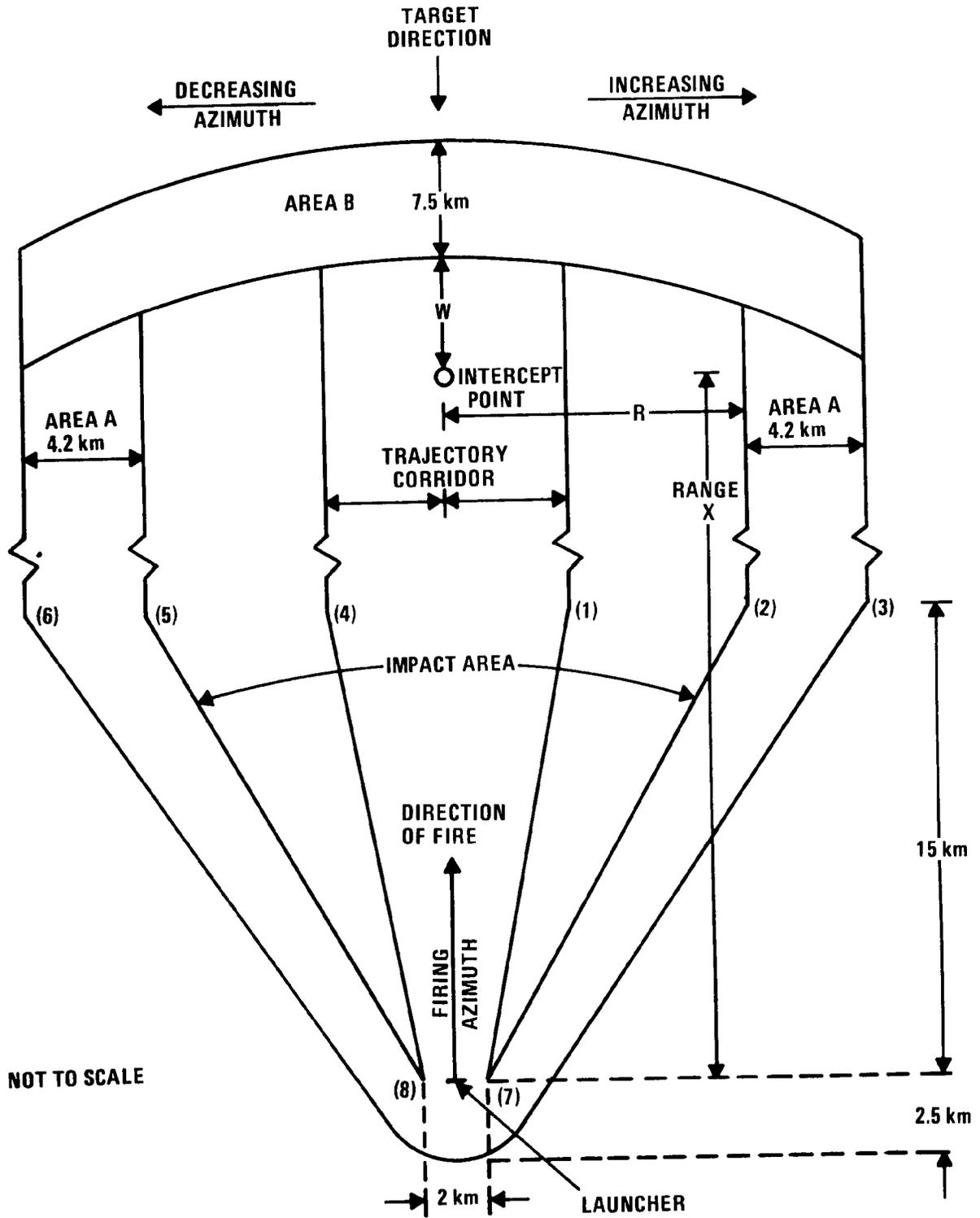


Figure 6-2. Surface danger zone for firing Improved HAWK surface to air guided missile at a point in space.

g. Only those personnel actively engaged in firing and control of the missile as specified by appropriate TM's and FM's will be permitted in the surface danger zone at the time of firing a missile. The number of personnel, thus engaged should be held to an absolute minimum compatible with efficient operation, and these personnel should, when possible, occupy appropriate protective shelters which have been located a minimum distance of 61 meters from the launcher and constructed in accordance with approved Corps of Engineers drawings.

h. The danger areas for debris from target drones which have normal flights should be contained within the impact area for the missile. However, areas of impact for target drones which have abnormal flights or which go out of control are not prescribed.

i. Construction of the surface danger zone.

(1) Lay out the target flight path on a map or scaled drawing of the firing range. Mark the minimum and maximum intercept points on the target flight path. The two lines joining the intercept points with the launcher define the minimum and maximum firing azimuths. (Alternatively the minimum and maximum firing azimuth define the appropriate intercept points).

(2) At a range of 15 Km from the launcher draw lines perpendicular to the firing azimuths.

(3) Along the line perpendicular to the maximum firing azimuth, in the direction of increasing azimuth, mark the point (1) at 4000 meters (trajectory corridor width), the point (2) at the distance R (maximum debris distance from table 6-2 as determined by intercept altitude) and the point (3) at a distance of R plus 4200 meters (the outer boundary of the lateral secondary danger area).

(4) Similarly, along the line perpendicular to the minimum firing azimuth, in the direction of decreasing azimuth, mark the points (4), (5), and (6) at 4000 meters, the distance R, and the distance R plus 4200 meters, respectively.

(5) Draw lines in the downrange direction from the points (1), (2), and (3) parallel to the maximum firing azimuth and from the points (4), (5), and (6) parallel to the minimum firing azimuth.

(6) At the firing section draw lines perpendicular to the firing azimuths. Along the line perpendicular to the maximum firing azimuth, in the direction of increasing azimuth, mark the point (7) at a distance of 1000 meters. Connect point (7) with points (1) and (2) with straight lines. Along the line perpendicular to the minimum firing azimuth, in the direction of decreasing azimuth mark the point (8) at a distance of 1000 meters. Connect point (8) with points (4) and (5) with straight lines.

(7) Draw a semicircle, with center at the firing section, with a radius of 2500 meters to the rear of the firing section.

(8) Draw straight lines tangent to the semicircle to the points (3) and (6).

(9) With the firing section as the center draw the arc of a circle with a radius equal to the sum of the maximum intercept range and the distance W (from table 6-2 as determined by intercept altitude) to intersect the lines defining the trajectory corridor, the primary danger area, and the lateral secondary danger area. This arc defines the maximum range boundary of the primary danger area.

(10) With the firing section as the center draw the arc of a circle with a radius equal to the sum of the maximum intercept range, the distance W, and 7500 meters (the width of area B) to intersect the lines defining the outer boundaries of the lateral secondary danger area. This arc defines the boundary of the maximum secondary danger area.

(11) If the intercept range is less than 15 Km, the inner boundary of area A is the distance R from the intercept point and the width of area A is 4200 meters at that range. All other procedures listed above apply.

#### **6-4. Basic HAWK guided missile.**

The diagram of the surface danger zone for the Basic HAWK is shown in figure 6-3.

a. The surface danger zone (fig. 6-3) consists of the impact area and areas A and B. The entire surface danger zone will be cleared of all personnel prior to firing a missile except as authorized in f below. The surface danger zone for the Basic HAWK guided missile has been established on the basis that actual destruction of the missile may be accomplished by the trajectory safety officer only after 6.5 seconds from the time of firing.

b. The impact area (primary danger area) will be constructed as depicted in figure 6-3. The size of the impact area must be varied by adjusting the angle of the line separating the impact area from area A (angle  $\theta$ ), depending upon the type of firing. An angle of between  $0^\circ$  and  $10^\circ$  or more may be necessary for firing at a moving aerial target. In this respect, an area extending 2000 meters to the rear of and to either side of the launch position opening to a varying distance, (R) meters at 2000 meters downrange in the direction of fire, to either side of the direction of fire depending on the altitude of the missile. This area is continued to a distance (W) meters to either side of and beyond the predicted intercept point (table 6-3). The resulting area is established for firings to a point in space when trajectory corridors as illustrated in figure 6-20 are employed. Range (X) will be the predicted point of ground impact or target intercept and may vary between minimum intercept and maximum ground impact range capability of the missile if the missile can be destroyed upon departure from the predetermined trajectory path by employing techniques which will reliably predict "range to go." Range (X) must be equal to the maximum ground impact range capability of the missile only when

trajectory corridors, such as illustrated in figure 6-20, do not provide for destruction points to control range as well as azimuth of the missile.

c. Area A (secondary danger area) is an area 5000 meters wide, paralleling the lateral edge of the impact area as depicted in figure 6-3. This area is normally adequate to contain the debris from missile intercepts, missiles destroyed in trajectory, and the impact of missiles which have an abnormal flight or go out of control and must be destroyed by the trajectory safety officer. The range to the rear of the firing point is adequate when early prediction of missile trajectory and destruction of the missile can be accomplished in the event the missile is heading in the direction opposite to the planned trajectory.

d. Area B (secondary danger area) is an area 6000 meters wide and is an extension of the impact area and area A in the direction of firing.

e. The trajectory safety officer must be provided with layouts of the range on which the surface danger zones and the trajectory corridor for the particular firing have been defined. The trajectory safety officer must also be provided a means of accurately tracking and plotting the course of a missile during trajectory. Firing normally will be made to a moving aerial target rather than a point in space as shown in figure 6-3. In this case, a composite surface danger zone which is based on the two extreme azimuth intercept points will be required. Target azimuth, target elevation, and target velocity will establish the intercept locus (path of the moving intercept point). Control of the time interval for launch will establish boundaries for the intercept locus. The basic diagram can be used for developing the new composite danger zone. Dimensions for Area A and B will be as shown in figure 6-3. Distances R and W will be based upon the maximum altitude for the predicted intercept. Maximum range for predicted intercept will establish the inner boundary for area B (W distance must be maintained between the "Predicted Intercept Point" and area B). Using the above data, construct a scaled surface danger zone diagram for each of the extreme azimuth intercept points. A composite of the two surface danger zones will establish the new surface danger zone.

**Table 6-3**  
**Basic HAWK Corridor Dimensions**

<i>Predicted intercept altitude (feet)</i>	<i>R distance (meters)</i>	<i>W distance (meters)</i>
Ground level	7,600	1,600
5,000	7,700	1,700
10,000	7,800	1,800
20,000	8,000	2,000
30,000	8,400	2,400
40,000	9,400	3,400
50,000	11,300	5,300

f. Only those personnel actively engaged in firing and control of the missile as specified by appropriate TM's and FM's will be permitted in the surface danger zone at the time of firing a missile. The number of personnel thus engaged should be held to an absolute minimum compatible with efficient operations, and these personnel should, when possible, occupy appropriate protective shelters which have been located and constructed in accordance with approved Corps of Engineers drawings.

### **6-5. CHAPARRAL guided missile.**

The surface danger zone for the CHAPARRAL guided missile is based on its maximum ballistic range since there is no provision for command destruct by the trajectory safety officer.

a. The surface danger zone (fig. 6-4) consists of the impact area and areas A, B, and F. The entire surface danger zone will be cleared of all personnel prior to firing a missile except as authorized in *f* below.

b. The impact area (primary danger area) will be constructed as shown in figure 6-4. The minimum impact area which includes the sector of fire and 20° on each side is utilized for firings at directly outgoing targets. When firings are made at off tail or crossing targets, the minimum impact area is increased by 20° 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 and all firings must be accomplished within these limit markers.

c. Area A is the lateral secondary danger area and is constructed as shown in figure 6-4. This area is normally adequate to contain the effects of warheads functioned at the edge of the impact area. The 600-meter width for this area and *f* or area B is the distance required for the MK 48 series warheads.

d. Area B is the forward secondary danger area and is constructed as shown in figure 6-4. This area is normally adequate to contain the effects of a warhead functioned at the forward edge of the impact area.

e. Area F, the back blast area, lies totally within area A. Area F is defined as an area bounded by lines 30° on each

side of the missile axis and extending 100 meters to the rear, which should adequately contain primary and secondary motor exhaust debris.

*f.* The procedures and precautions outlined in appropriate CHAPARRAL TM's and FM's will be followed during firings. Only the minimum personnel required to fire and maintain safety surveillance of the firing will be permitted in the surface danger zone at the time of firing a missile. All personnel except the fire unit gunner will occupy appropriate protective shelters, which have been located and constructed in accordance with Corps of Engineer drawings and will protect against any fragment or debris that may be expected from the missile as a result of warhead functioning. The protective shelters must be examined by the range safety officer who will determine that the shelters will provide adequate personnel protection.

*g.* The danger areas for debris from target missiles, which have normal controlled flights, should be contained within the impact area for the missile. Impact areas for target missiles which have abnormal flights or which, go out of control are not covered herein. In such cases the dimensions of the surface danger zone must be increased as required by the characteristics of the target missile.

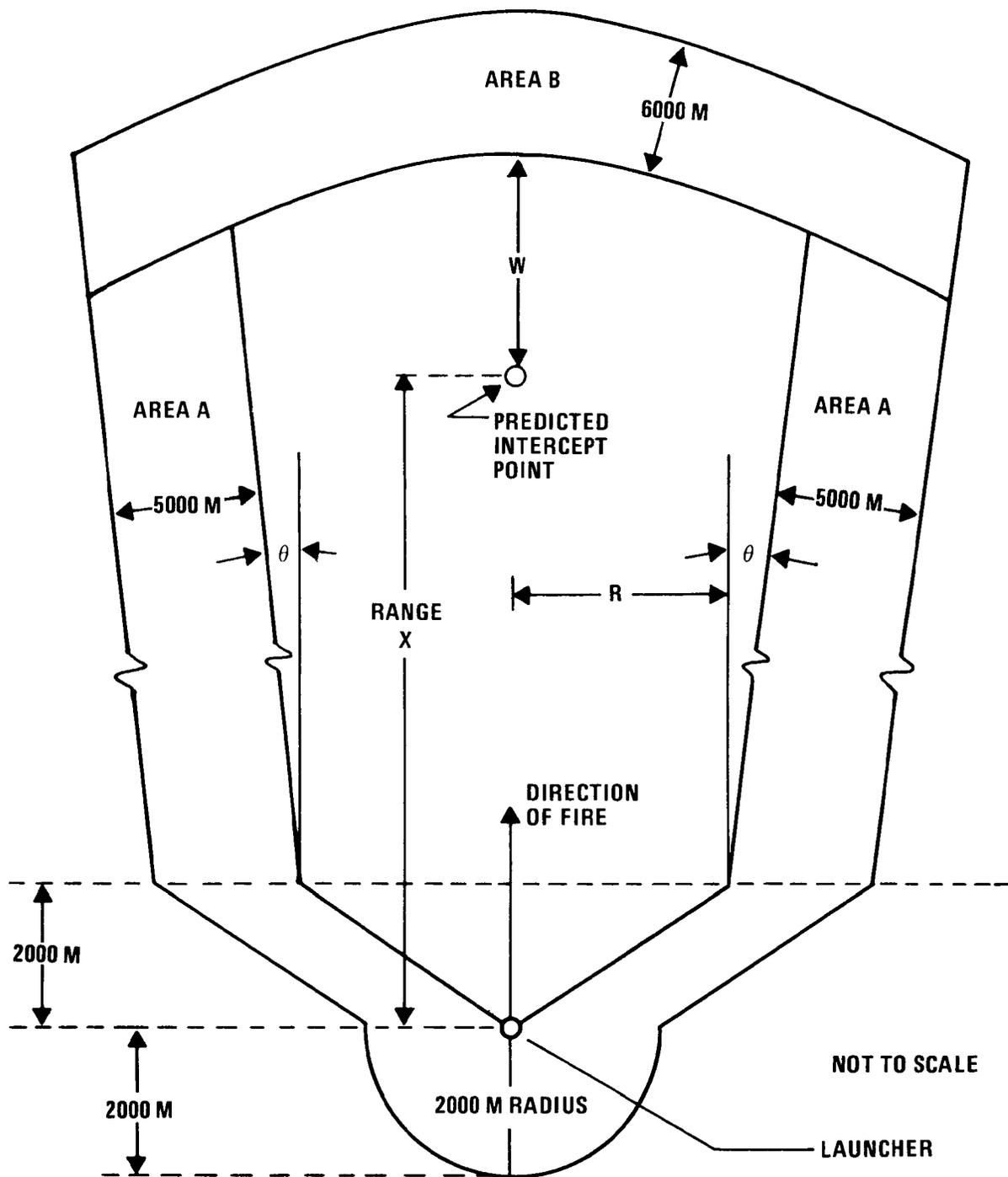


Figure 6-3. Surface danger zone for firing basic HAWK surface-to-air guided missile at a point in space.

**6-6. PERSHING guided missile.**

Annual service practice (ASP) and other firings with the PERSHING system conducted at or under the control of White Sands Missile Range will be conducted in accordance with the safety requirements of the Range. PERSHING missile firings conducted at locations not under the control of White Sands Missile Range will be conducted in accordance with range safety criteria furnished by the US Army Materiel Development and Readiness Command for the specific location and conditions prevailing at the time of the firing. Plans for troop firing to be conducted at a location not under control of White Sands Missile Range will be submitted to Commander, US Army Materiel Development and Readiness Command, ATTN: DRCSF, 5001 Eisenhower Ave., Alexandria, VA 22333, for development of range safety criteria at least 90 days prior to the scheduled firing.

**6-7. SERGEANT guided missile.**

The surface danger zone diagram for the SERGEANT missile is shown in figure 6-5.

a. The surface danger zone (fig. 6-5) consists of the impact area and areas A and B. The entire surface danger zone will be cleared of all personnel prior to firing a missile except as authorized in g below.

b. The impact area (primary danger area) will be constructed as depicted in figure 6-5. This area is considered adequate to contain the debris from the impact of missiles, which have a normal flight. The size of this area is to be varied longitudinally by use of table 6-4.

c. Area A (secondary danger area) is an area of varying width based on maximum wind velocity transverse to the direction of flight. Table 6-5 is used to calculate these outer limits. This area is normally adequate to contain the debris from missile destruction by the trajectory safety officer. The dimension of the area around the launcher, which is a continuation of area A, is determined by the earliest destruct capability. Table 6-6 will be used to determine the size of this area.

**Table 6-4  
Longitudinal Dispersion Dimensions in Kilometers for the SERGEANT Guided Missile System**

Monitoring capability (Range-elevation)*	With drag brake monitor		Without drag brake monitor	
	W	Z	W	Z
Monitor Until Impact	2.6	1.4	30.0	14.6
Monitor Until Summit	5.2	3.5	30.0	17.4
Monitor Until Burnout	7.5	9.7	30.0	21.0

Notes:

\*Complete range and elevation guidance expecting drag brakes.

**Table 6-5  
Lateral Dispersion Dimensions in Kilometers for SERGEANT Guided Missile System**

Monitoring Capability (Azimuth)	Maximum Transverse Wind Velocity (Miles/Hour)											
	0		10		20		30		40		50	
	R	Y	R	Y	R	Y	R	Y	R	Y	R	Y
Monitor Until Summit	1.9	9.3	2.8	10.2	3.8	11.2	4.8	12.2	5.7	13.1	6.6	14.0
Monitor Until Burnout	5.2	7.1	6.1	8.1	7.1	9.0	8.1	9.9	9.0	10.9	9.9	11.9
Monitor Until T + 20 Seconds	10.9	2.8	11.8	3.8	12.8	4.7	13.8	5.6	14.7	6.6	15.6	7.6

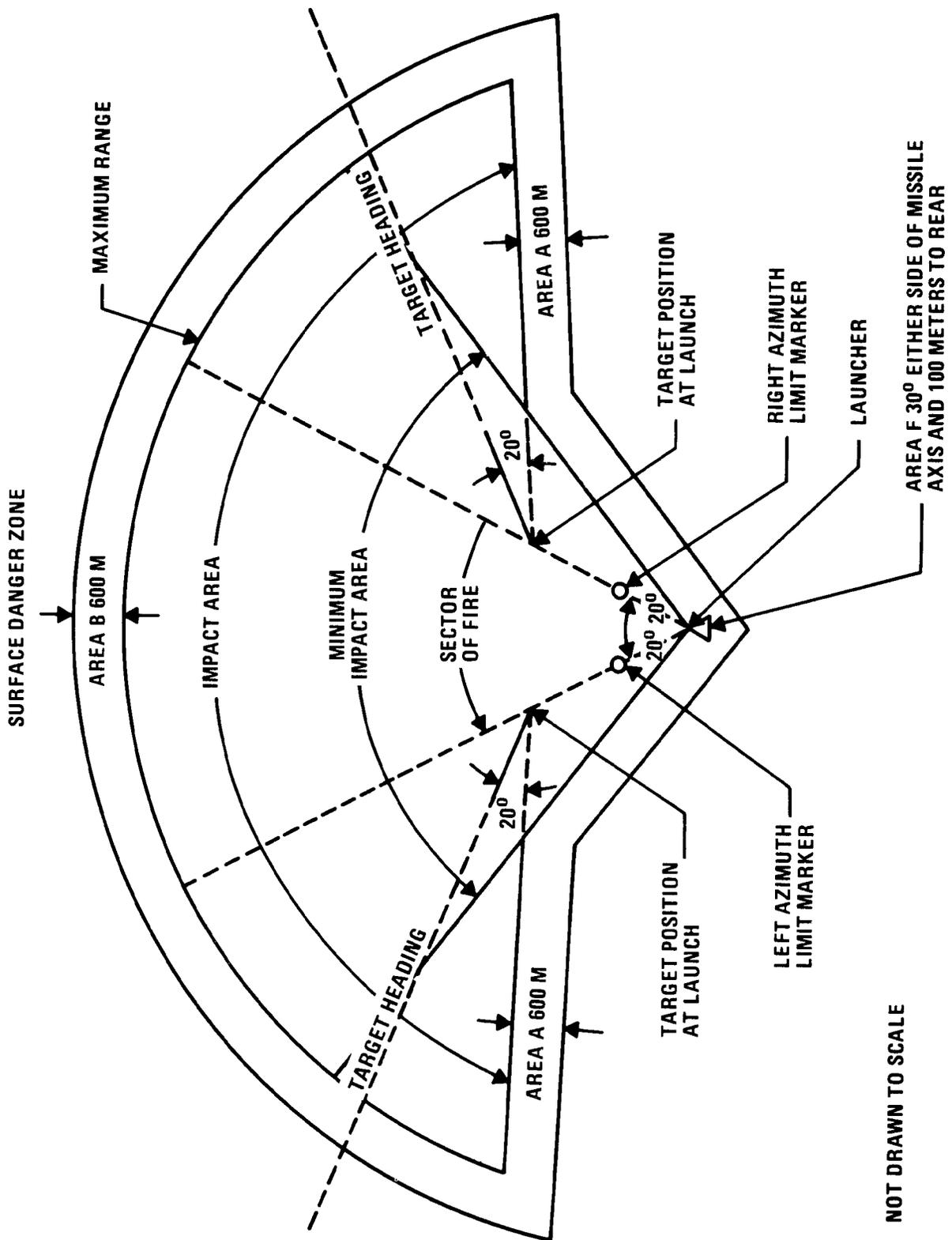


Figure 6-4. Surface danger area for firing CHAPARRAL surface-to-air guided missile moving target.

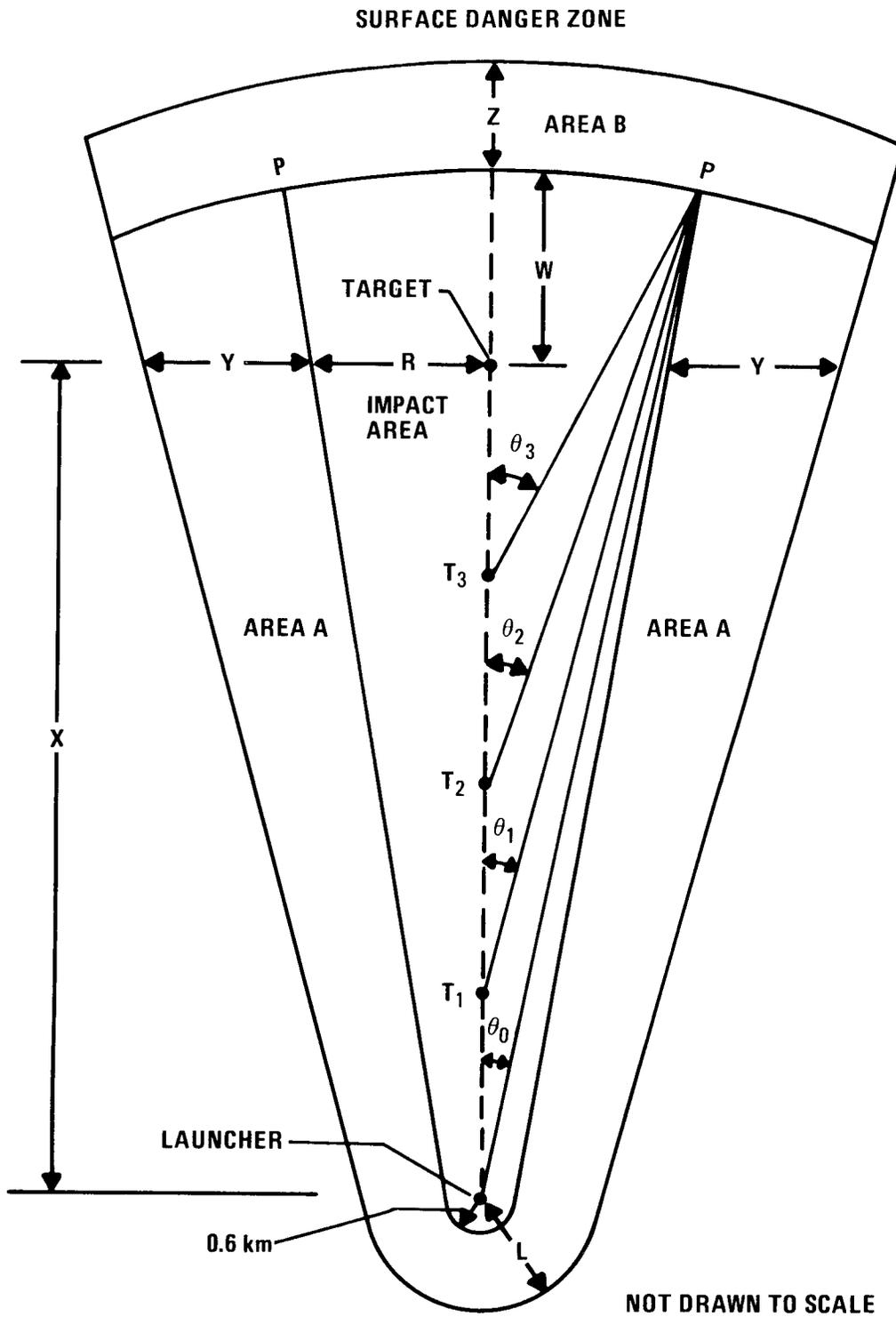


Figure 6-5. Surface danger zone for firing SERGEANT guided missile at terrestrial targets.

d. Area B (far secondary danger area) is an area of varying length dependent on the nature of the problem fired and is an extension of the impact area and area A in the direction of firing. Calculation of the depth of this area can be determined by table 6-4.

e. The trajectory safety officer must be provided with layouts of the range on which the surface danger zone and the trajectory corridor for this particular firing have been defined. The trajectory safety officer must also be provided a means of accurately tracking and plotting the course of a missile in terms of the monitoring capability selected from tables 6-4 through 6-6 for plotting the range. When the missile exceeds a predetermined critical angle, right or left of the intended line of flight that would cause the missile to impact outside the impact area, the range safety officer will be required to destroy the missile. The critical angle should be determined by the following method: determine where the missile will be at one-fourth the total estimated time of flight, at one-half the time of flight, and at three-fourths the time of flight. Designate the points at T1, T2, and T3, respectively, as shown on figure 6-5. Draw lines from the launch point to point "P," from "T1" to point "P," "T2" to point "P," and "T3" to point "P." The critical angle for the first one-quarter of flight will be  $\theta_0$ , which is the angle between a line drawn from the launcher to "P" and the intended line of flight. Angle  $\theta_1$ , which is the angle between the centerline and the line from T1 to P will be the critical angle for the one-fourth to one-half time phase of flight. Similarly, angle  $\theta_2$  will be the critical angle for the one-half to three-fourths time phase, and angle  $\theta_3$  will govern for the last quarter of flight.

f. When the surface danger zone is prepared for firing from table 6-4 "With Drag Brake Monitor" the trajectory safety officer will destruct the missile if there is no drag brake actuation.

g. Only those personnel actively engaged in firing and control of the missiles as specified by appropriate TM's and FM's and others specifically authorized by the responsible officer will be permitted in the surface danger zone at the time of firing a missile. Personnel actually engaged in firing the weapon should be positioned at a minimum distance of 60 meters to the side of predicted line of flight. The firing group must be protected by an intervening hill mass, slit trench, and/or sandbags. Other operational personnel should retire to a greater distance, at least 100 meters to the side, and must utilize suitable protective measures such as intervening hills, slit trenches, and/or sandbags if located within a secondary danger area.

#### 6-8. LANCE guided missile (M252).

The diagram of the surface danger zone for the LANCE missile is shown in figure 6-6. Details of the launcher area (described below) are shown in figure 6-7 and apply to all LANCE missile firings. The surface danger zones, as shown in figures 6-6 and 6-7, apply to normal firings and do not include tactical warhead effects or other potential hazards to personnel such as fire or liquid propellant leaks. Precautions to be observed against these hazards are detailed in pertinent technical manuals.

a. The surface danger zone (fig. 6-6 and 6-7) consists of the impact area and areas A, B, D, and F. The entire surface danger zone will be cleared of all personnel prior to firing a missile except as authorized in e and f below.

**Table 6-6**  
**Radial Dimension Around Launcher in Kilometers for the SERGEANT Guided Missile System**

<i>Earliest destruct capability (Destroy anytime after)</i>	<i>Dimension "L" (kilometers)</i>
4.5 ± 0.5 seconds	5.7
10.0 seconds	10.8

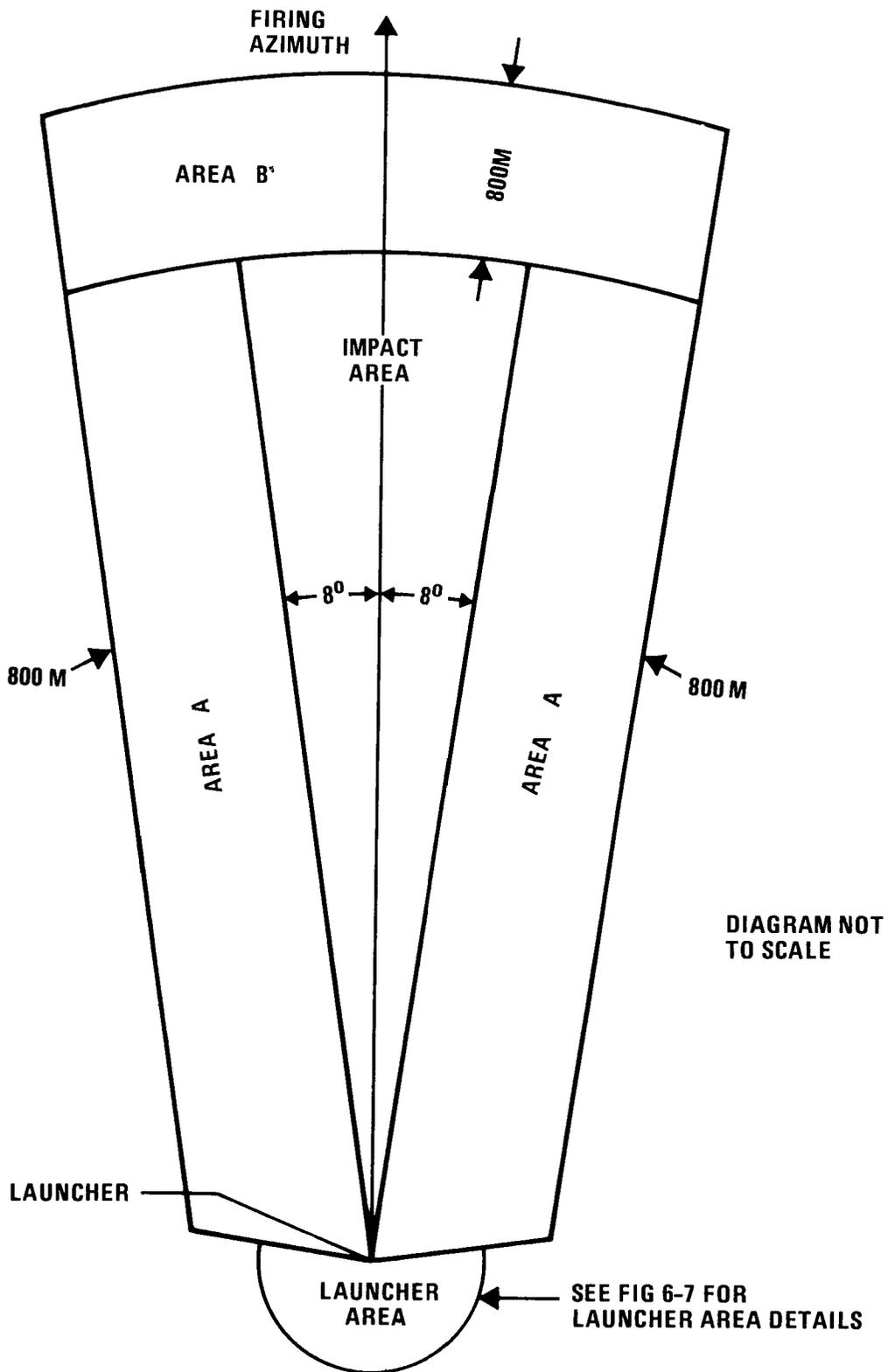


Figure 6-6. Surface danger area for firing the LANCE M252 missile at a fixed terrestrial target.

b. The range dimension of the impact area is dependent upon whether a M252 Lightweight Practice Warhead Section (LPWS) or a M198 Heavy Practice Warhead Section (HPWS) firing is planned. The entire impact area shown in figure 6-6 forward of the launcher is unsafe for personnel for all LANCE missile firings. The impact area is bounded by an 8° fan to the right and left of the firing azimuth as shown in figure 6-6 and terminates at maximum range plus 30 kilometers for M252 LPWS firings and at maximum range plus 35 kilometers for the M198 HPWS. The range extensions of 30 and 35 kilometers are based upon the rare possibility that all factors contributing to range capability would combine in a positive direction. This would include launches at 4,000 feet altitude, high ambient temperature, above normal tail winds, maximum propellants overload and usage, missile system operational failures, and unknown failure modes which may be experienced as the missile propulsion system ages in storage.

c. Area A (lateral danger area) is an area paralleling each side of the impact area. The outer boundary of this area is at a distance of 800 meters from the 8° fan outer boundary to the right and left of the firing azimuth and extends to the maximum possible range as defined in b above. This area is considered adequate to contain the impact of any errant missiles and associated debris.

d. Area B (far secondary danger area) is defined as an extension of the impact area and area A to a distance of 800 meters beyond those areas. Area B is considered adequate to contain the forward debris from the impacting missile.

e. Area D<sub>1</sub> (area D is divided into two sub-areas—D<sub>1</sub> and D<sub>2</sub>) is located to the right and left of the launcher. It is defined as a segment of a ring bounded by a 30° arch (fig. 6-7) with an inner radius of 90 meters and an outer radius of 100 meters. A firing pit (foxhole) may be located within area D<sub>1</sub>. When terrain conditions are such that the firing cable can not be extended 90 to 100 meters, personnel actually engaged in firing the missile round may be positioned at a point within the 30° arc which is not less than 80 meters from the launcher. These personnel must be protected by a solid barrier, which completely shields their bodies such as an intervening hill mass or sandbags. Under no circumstances will these personnel take cover in a trench or foxhole at a distance less than 90 meters unless the trench or foxhole is covered with a solid material capable of reducing the acoustical hazard by reflecting or absorbing the sounds generated by the missile.

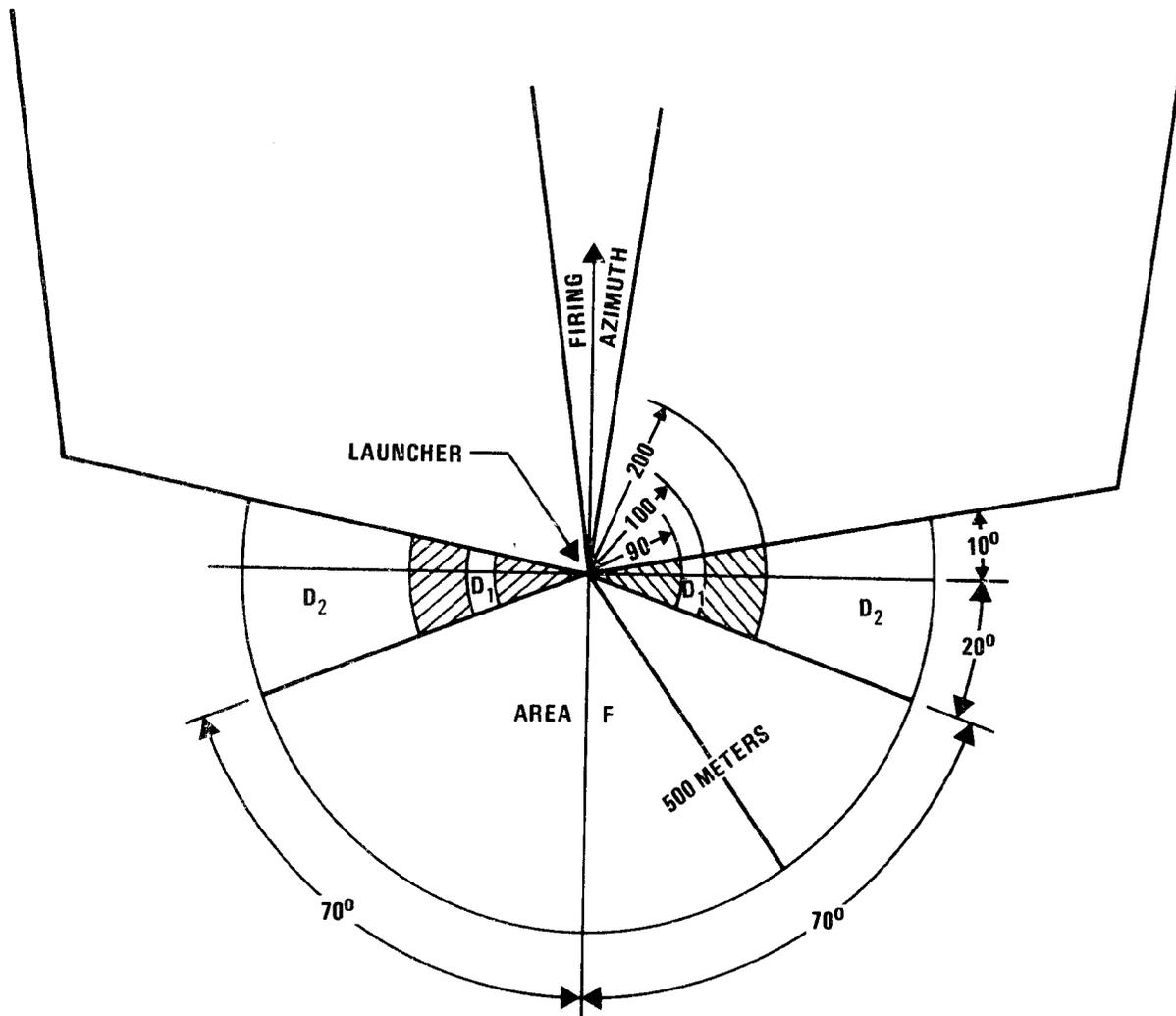
f. Area D<sub>2</sub> is located to the right and left of the launcher beyond area D<sub>1</sub>. It is defined as a segment of a ring bounded by a 30° arc (fig. 6-7) with an inner radius of 200 meters and an outer radius of 500 meters. Firing crew personnel who are not actually engaged in firing the missile may be positioned within area D<sub>2</sub>. These personnel will also provide themselves with adequate protection at the time of launch as required in TM 9-1425-485-10-2. Areas radially beyond Area F are considered safe for unprotected personnel and equipment.

g. Area F (launcher danger area) is defined as that area to the rear and to each side of the launcher, which is endangered at the time of firing. The area directly behind the launcher, having a radius of 500 meters and extending 70° to either side of the line of fire (fig. 6-7), is unsafe and considered extremely hazardous for personnel and equipment. This area receives the direct heat and stream of missile exhaust gases and is subjected to blast effects from flying debris such as the boattail end closure, dust, dirt, and rocks. Acoustic hazards to personnel are also prevalent in this area. Areas radially outside of area F are considered safe for unprotected personnel and equipment.

#### **6-9. 762MM rocket (HONEST JOHN).**

The surface danger zone diagram for the 762MM rocket is shown in figure 6-8. Dimensions of the surface danger areas will vary according to the type of warhead fired, as indicated in *c* below.

a. The surface danger zone (fig. 6-8) consists of the impact area and areas A, B, C, D, and E. The entire surface danger zone will be cleared of all personnel prior to firing a rocket except as authorized in *g* and *h* below.

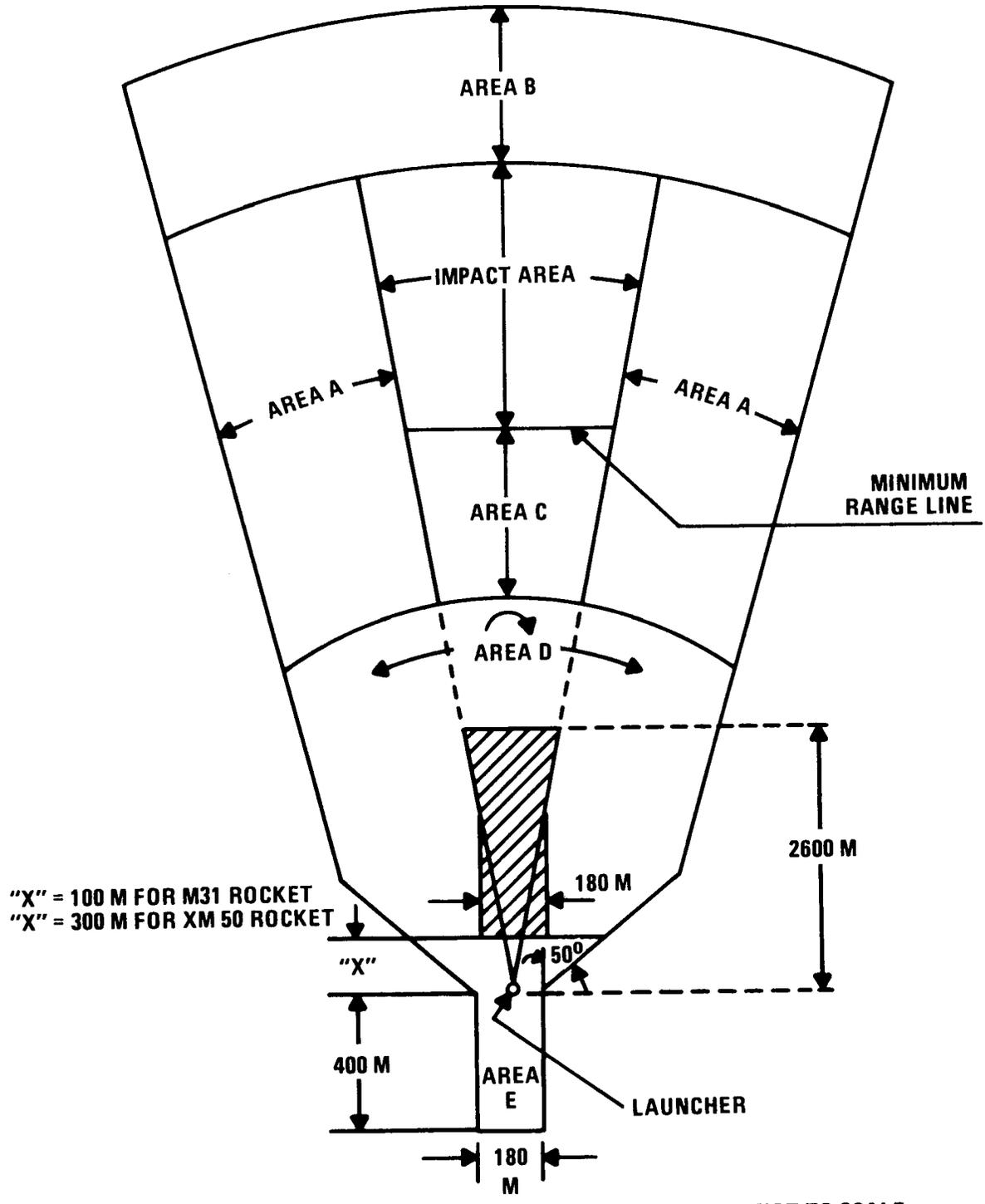


**NOTES:**

1. NO PERSONNEL ALLOWED IN SHADED AREA DUE TO ACOUSTICAL HAZARD
2. AREA D<sub>1</sub> – FIRE PIT LOCATION
3. AREA D<sub>2</sub> – RESUPPLY VEHICLES & OTHER CREW PERSONNEL AREA
4. AREA F – AREA ENDANGERED BY FLYING DEBRIS
5. NOT TO SCALE

Figure 6-7. Launcher area details LANCE surface danger area.

b. The dimensions of the impact area are dependent upon the nature of the firing planned. The impact area dimensions are plus 8 and minus 8 range probable errors in depth by right 8 and left 8 deflection probable errors in width. For chemical and high-explosive warheads which contain bomblets, the impact area dimensions are the same as above with the addition of the radius of the bomblet impact area on the ground plus the radius of the bomblets added to the width and depth dimensions. For these computations, the firing table range for ground impact probable error corresponding to the predicted point of impact will be used. Firing of the chemical warhead for training and target practice is prohibited.



**NOT TO SCALE**

Figure 6-8. Surface danger area for firing the 762MM rocket at a fixed terrestrial target.

c. Secondary danger areas A, B, and C are areas of varying width, depending upon the type of warhead to be fired. The following area A, B, and C distances for the warheads listed will be used in developing the surface danger zone for the 762MM rocket:

Warhead	Area A, B, and C distance in meters
M4	1800
M4A1	800
M38	800
M57	1300

d. Area A (lateral secondary danger area) is an area paralleling each side of the impact area, area C, and area D.

e. Area B (far secondary danger area) is defined as an extension of the impact area and area A which is required to contain fragments and debris from a warhead functioning at the downrange edge of the impact area.

Note. Ballast plates in the M38 Warhead Assembly may ricochet when the warhead is fired at low angles of elevation. In cases where the firing elevation angle is less than 259 mils for the M50 series rocket or 326 mils for the M31 series rocket, precautions should be taken to insure that impact occurs on uphill slopes or on terrain where the composition of the impact area is not conducive to ricochets. In the event that the impact area is determined by the range safety officer to be conducive to ricochets, a 4,000-meter safety area B should be used at firings where ranges are less than 17,000 meters for the M50 series rocket or less than 13,500 meters for the M31 series rocket.

f. Area C (near secondary danger area) is defined as an area extending from the minimum range line toward the launcher. The minimum range line is obtained by deducting 8 range probable errors from the range to the predicted point of impact. The minimum range line for the chemical and HE warheads is obtained by adding the radius of the bomblet impact area, the radius of the bomblets and 8 range probable errors (8PE,) and deducting the same from the range to the predicted point of impact.

g. Area D (area permissible for occupancy) extends from the rear limit of areas A and C to a line 300 meters for the M50 series rocket or 100 meters for the M31 series rocket forward of the launcher. When any part of this area is to be occupied, the trajectory of the rocket must clear any personnel or material objects by 60 meters. During training exercises, service practice, or practice firings, the shaded portion of area D will not be occupied. This shaded exclusion area extends to a distance 2600 meters forward of the launcher. The width of this exclusion area will be as follows:

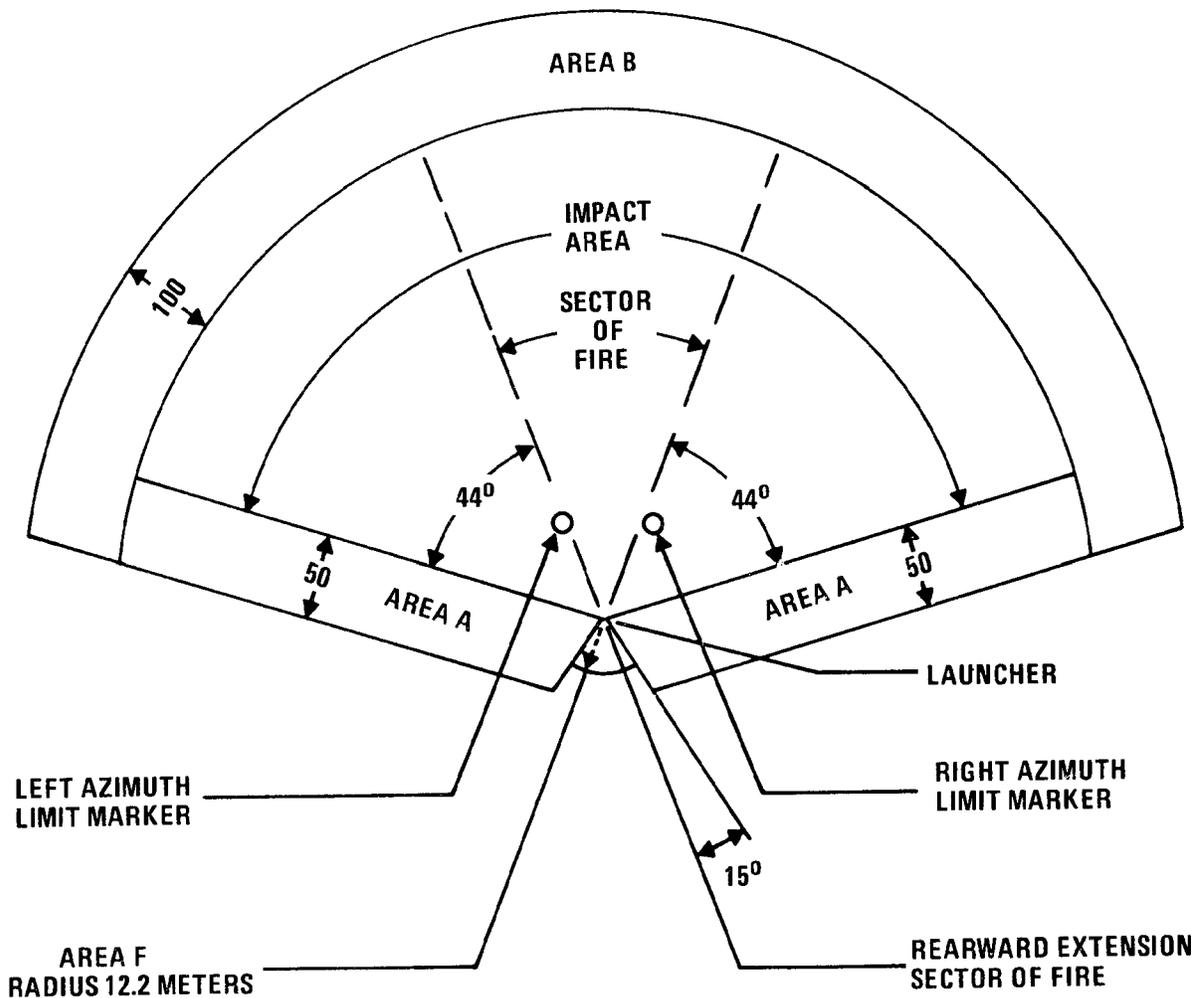
- (1) The minimum width will be 180 meters (90 meters on each side of the center line of fire).
- (2) When the width of the sector whose apex is at the launcher exceeds 180 meters, the sides of the sector will form the lateral boundaries of this exclusion area.

Note. The M6A1, M144, and M186 warheads will be fired on a closed surface danger zone. Firing of these warheads for training or target practice is prohibited.

h. Area E (launcher danger area) is defined as that area immediately forward, to the rear, and to each side of the launcher which is endangered at the time of firing. The minimum limits of this area are 300 meters for the M50 series rocket and 100 meters for the M31 series rocket to the front of the launcher, 90 meters to each side of the launcher and 400 meters to the rear of the launcher. The 400-meter dimension may be reduced to not less than 200 meters by the installation commander when terrain conditions, such as compacted soil or an intervening hill mass, would restrict, retard, or preclude the occurrence of small aggregate being propelled at high velocities by the rocket motor exhaust. Personnel actually engaged in firing the weapon may be positioned at a point, to the side of the launcher, which is less than 90 meters but will not be less than the maximum distance permitted by the full extension of the monitoring and firing cables. The firing group must be protected by an intervening hill mass, trench, and/or sandbags.

**6-10. REDEYE guided missile.**

The surface danger zone for the REDEYE guided missile is based on its maximum ballistic range since there is no provision for command destruct by the trajectory safety officer.



**NOTE:**  
 1. ALL DIMENSIONS ARE IN METERS  
 2. NOT TO SCALE

Figure 6-9. Surface danger zone for firing REDEYE surface to air guided missile at a moving target.

a. The surface danger zone, as shown in figure 6-9, consists of the impact area and areas A, B, and F. The entire surface danger zone will be cleared of all personnel except those actively engaged in the missile firing. This number should be held to the minimum compatible with efficient operations.

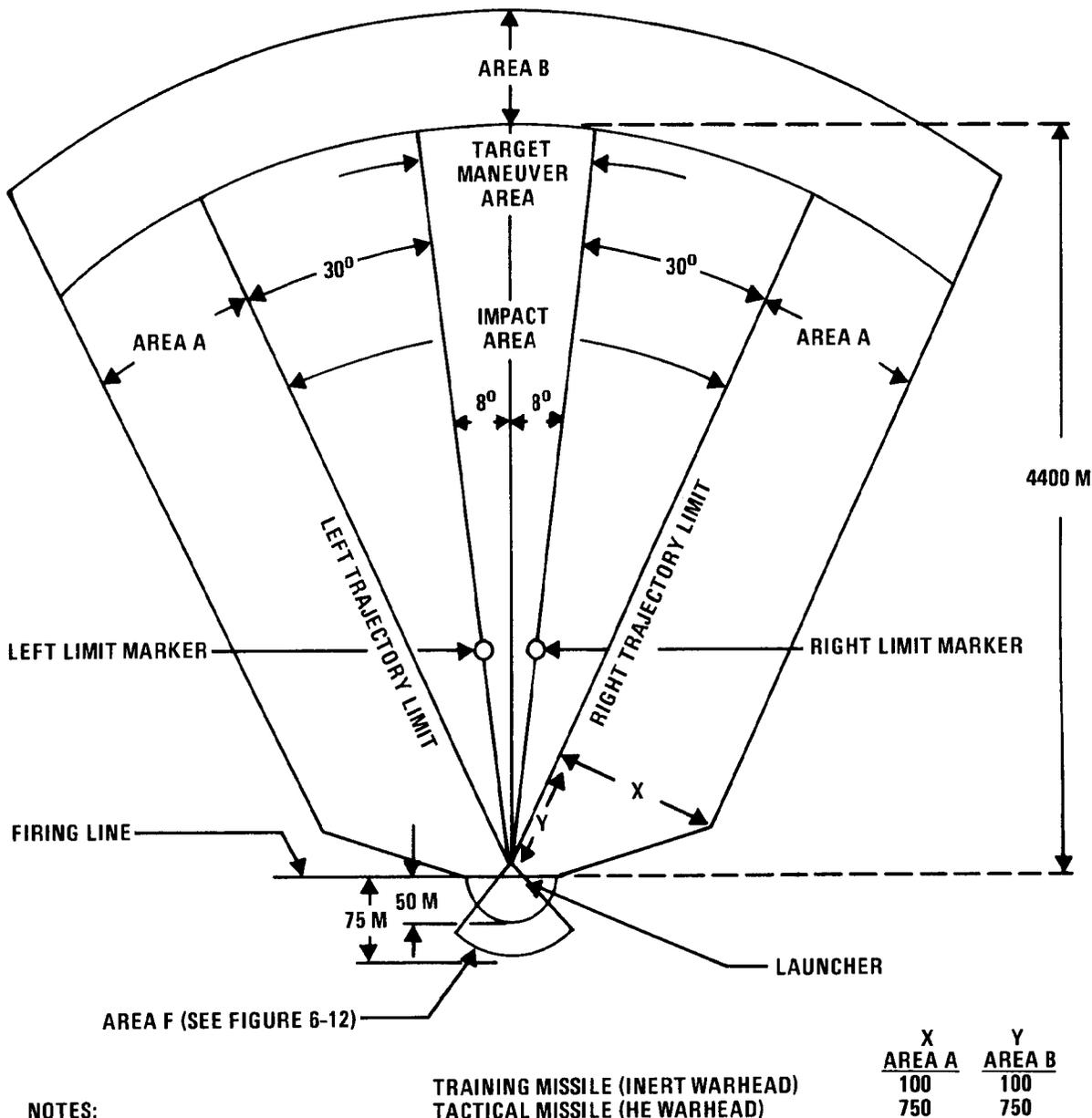
b. The impact area (primary danger area) will be constructed as shown. This area will normally contain the debris and impact of missiles, which are launched within its sector of fire. The sector of fire is that portion of the impact area in which targets may be engaged. The boundaries of the sector must be designated by positioning azimuth limit markers forward of the launcher position and all firings must be accomplished within these limit markers. The impact area consists of an area  $44^\circ$  to each side of the sector of fire and extending down range to the maximum ballistic range of the missile.

c. Area A is the lateral secondary danger area and is constructed as depicted. This area is normally adequate to contain the effects of warheads functioned at the edge of the impact area. It consists of areas 50 meters wide on each side of the impact area and extending down range to the maximum ballistic range capability of the missile.



d. Area B is the far secondary danger area and is constructed as shown. This area is normally adequate to contain the effects of a warhead functioned at the forward edge of the impact area. It consists of an area 100 meters in depth beyond the impact area and area A.

e. Area F is the launcher danger area extending to the rear of the firing position. It consists of an area 15' to the outside of the rearward extension of sector of fire boundaries (this angle also defines the rear limit of area A) and the area between the rearward extensions of the sector of fire. The rear distance in both cases will be a connecting radius 12.2 meters from the launcher.



NOTES:  
 1. ALL DIMENSIONS IN METERS  
 2. NOT TO SCALE

TRAINING MISSILE (INERT WARHEAD)  
 TACTICAL MISSILE (HE WARHEAD)

Figure 6-11. For terrestrial firing the TOW ATGM at a moving target.

*f.* The procedures and precautions in the appropriate TM's and FM's will be followed during REDEYE firings. No firings will be made on incoming targets which would normally pass over the launch area, allowing target debris or targets to impact in the area upon intercept. Coaches and any other personnel exposed to the rocket motor blast will wear the same personal protection equipment as is required for the gunner in the appropriate TM.

#### **6-11. TOW Antitank guided missile (ground) —fixed targets.**

The surface danger zone diagram for firing at a fixed target from a ground position is shown in figure 6-10. This danger zone is based on the maximum ballistic range of the TOW missile since there is no provision for command destruct by the trajectory safety officer. This surface danger zone is applicable to missiles with the HE or practice warheads. The dimensions for construction of areas A and B are included for each type of warhead.

*a.* The surface danger zone consists of the impact area and areas A, B, and F. The entire surface danger zone will be cleared of all personnel prior to firing of a missile except as authorized in *c* below. The impact area is constructed as depicted in figure 6-10.

(1) Areas A and B (secondary danger areas) are constructed to contain fragments and debris from missiles that impact on the lateral or downrange edge of the impact area and are constructed as shown in figure 6-10. In area A separate surface danger areas for HE and inert warhead firings may be constructed using X and Y values given in figure 6-10.

(2) Area F is the launcher danger area extending to the rear of the firing position. This area is depicted in figure 6-10 and constructed as shown in figure 6-12. It is further divided into a primary danger area and several caution areas.

*(a)* The primary danger area is a 90° included angle cone with the apex of the cone at the aft end of the missile launch motor. The radius of the cone is 50 meters. Serious casualties or fatalities are likely to occur to any personnel in the primary danger area during a firing. The hazards are launch motor blast, high noise levels, overpressures, and debris.

*(b)* Caution area 1 is an area extending radially from each side of the primary danger area to the firing line. Permanent ear damage could occur to personnel in this area during a firing; therefore, approved hearing protection devices will be worn by all personnel occupying this area. The hazards are high-noise levels and overpressures.

*(c)* Caution area 2 is a 25-meter-deep extension of the rear of the primary danger area. Permanent ear or eye damage could occur to personnel in caution area 2 during a firing because of high-noise levels and flying debris. Personnel authorized to remain in this area during combat firing should not face the launcher. Caution area 2 will be kept clear of all personnel during training exercises and noncombat firings.

*b.* The TOW antitank guided missiles (ATGM) will not be fired from any position which will permit the guidance wires to contact electrical power lines during a normal trajectory or as a result of an erratic trajectory that may be caused by malfunctions.

*c.* Only those personnel actively engaged in firing and control of the missiles as specified in appropriate TM's and FM's will be permitted in the surface danger zone at the time of firing the missile. Nonoperational personnel should retire to a distance of at least 50 meters to either side of the missile launch position.

*d.* Personnel will never stand or permit any part of their body to be directly behind or in front of the launcher while a missile is in the launcher.

*e.* The weapon will not be fired from within buildings or within 100 meters of a vertical or nearly vertical backstop.

*f.* Procedures and precautions in TOW technical manuals will be observed in all preparation and firing operations.

#### **6-12. TOW ATGM (ground)—moving targets.**

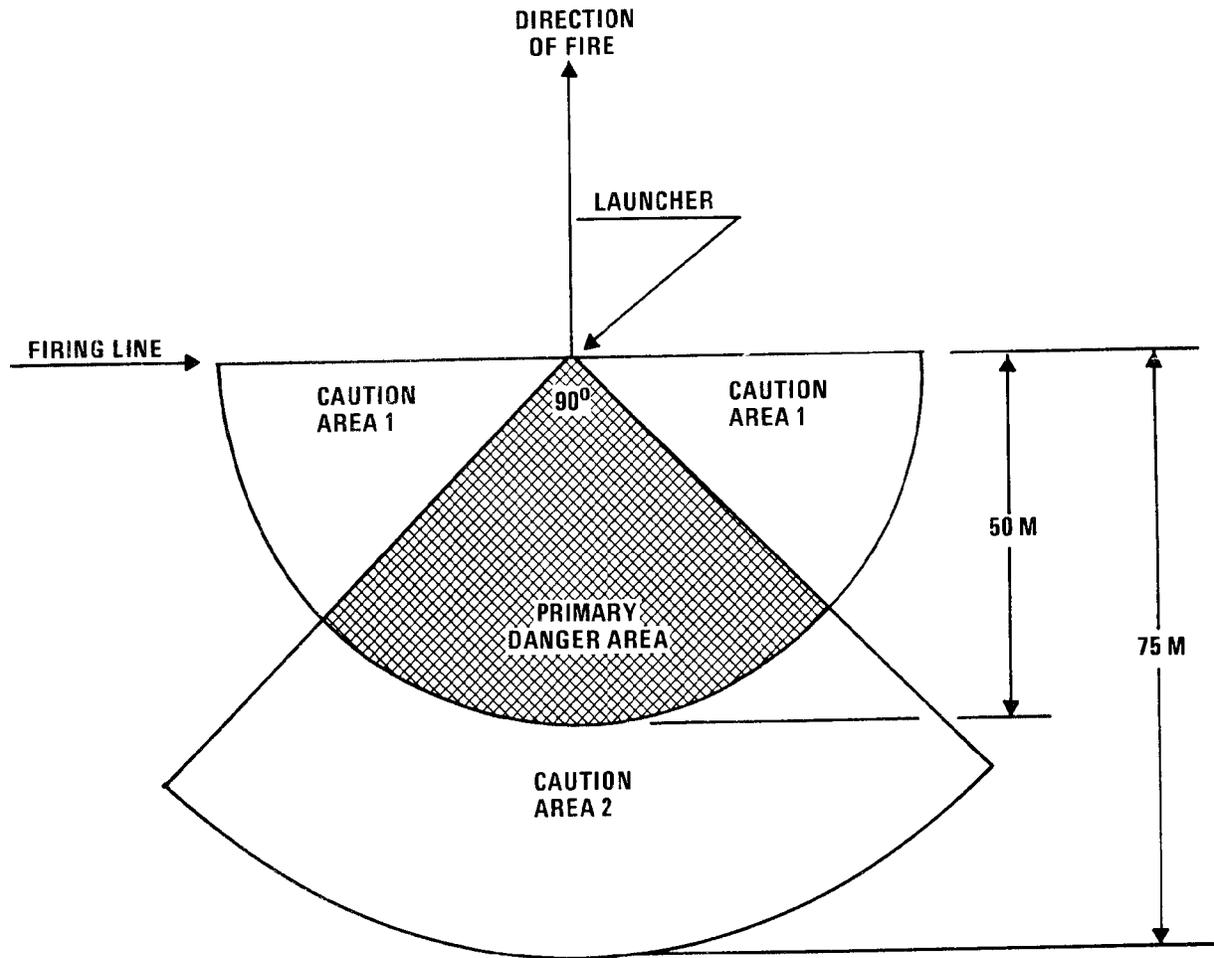
The surface danger zone diagram for firing at moving targets from a ground position is shown in figure 6-11. This surface danger zone is applicable to missiles with HE or practice warheads.

*a.* The surface danger zone is constructed generally in the same manner stipulated for the TOW ATGM firing outlined in paragraph 6-11, with the exception that a maneuver area for the moving target has been included. In area A, separate surface danger areas for HE and inert warhead firings may be constructed using X and Y values given in figure 6-11.

*b.* The target maneuver area consists of an area 8 degrees to either side of the centerline. The right and left limits of the target maneuver area will be marked to aid the gunner in determining these limits. Areas A and B are constructed as shown in figure 6-11 and described in paragraph 6-11.

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**SURFACE DANGER ZONE**



**NOT DRAWN TO SCALE**

Figure 6-12. Area F (rear danger area) for all TOW ATGM firings.

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c. Area F is the launcher danger area and is constructed as shown in figures 6-11 and 6-12. The hazards and construction of primary danger area and caution area portions of area F are outlined in paragraph 6-11a(2).

d. Requirements of paragraph 6-11b through f also apply to moving target firings.

e. The TOW ATGM will not be fired at manned target vehicles. Moving vehicles used, as targets must be operated by remote control with the operating personnel located in a protected area.

**6-13. TOW ATGM—airial firing from helicopter.**

a. The surface danger areas for the TOW Missile Subsystem are defined in figure 6-13 and table 6-7. The surface danger zone is to be used for all airborne firings from US Army helicopters. The dimensions of the surface danger zone are based on missile trajectory digital simulation, test-firing data, allowances for helicopter airspeed and altitude, and estimated safety margins. Since there is no provision for command destruct by a trajectory safety officer, the surface danger zone is based on the maximum ballistic range of the missile.

b. The surface danger zone consists of the target maneuver area, impact area, and areas A, B, and F. The entire

surface danger zone will be cleared of all personnel, except those directly associated with the firing, prior to the firing of a missile.

c. The target maneuver area is established by extending lines from the launch point, 8° to either side of the centerline. The right and left limits of the target maneuver area will be marked to aid the gunner in determining these limits. For moving targets the missile should be launched such that impact with the target occurs as near the centerline as possible.

d. The impact area is considered adequate to contain the impact of missiles and the resulting debris under normal conditions. This area is established by extending lines from the launch point, 38° to each side of the centerline.

e. Areas A and B (secondary danger areas) are designated to contain fragments and debris from missiles that impact on the lateral or downrange edge of the impact area.

f. Area F (launcher danger area) is the area in the immediate vicinity of the launcher, which is expected to contain the blast pressures and launch motor debris of a normal functioning motor. The area is a semicircle, immediately to the rear of the launcher, the radius (c) of which is 100 meters for a missile launch with the helicopter below 50 feet above ground level (AGL). At higher altitudes, the rearward dimension should be increased to 200 meters to allow for the longer trajectory of launch motor debris.

g. The firing of the TOW missile will always be accomplished within predetermined boundaries. The range safety officer will insure that a surface danger zone exists on the line of fire from each anticipated firing point within the predetermined boundaries.

h. The entire surface danger zone will be cleared of all personnel, except those directly associated with the firing, prior to the firing of a missile.

i. The TOW missile should not be fired from any range position, which will permit the guidance wires to contact electrical power lines.

j. The range shall be inspected after each firing mission to assure that all guidance wires, which would present a hazard to helicopters in the area, are removed.

k. The TOW missile will not be fired at manned target vehicles unless specifically permitted by the CG, DARCOM.

l. The user is referred to AR 385-63 for additional requirements on helicopter weapons firing.

**6-14. DRAGON guided missile—fixed and moving targets.**

a. The surface danger zone for firing the DRAGON guided missile with training and HEAT warheads at stationary and moving targets is shown in figure 6-14. Figure 6-15 shows the danger area to the rear of the launcher where noise, blast, and debris hazard exists for all firings. The entire surface danger zone will be cleared of all personnel, except as authorized in g below.

**Table 6-7  
Aerial TOW Missile Surface Danger Area Dimensions**

Airspeed (Knots) Altitude (feet)	Helicopter Flight Parameters				
	Hover 0-50	Hover-50 50-100	100 50-100	100 500	150 1000
Distance X (meters)	4,500	4,700	4,900	5,100	5,400
Radius C (meters)	100	200	200	200	200

b. The surface danger zone diagram consists of the impact area and areas A, B, and F. Construction of the danger areas will be as shown in figure 6-14.

c. The missile impact area encompasses an area of terrain within which 99.99 percent of all missiles will impact the ground. For firing at stationary targets, the target should be positioned on the range centerline (line of fire). For firing at moving targets, the round should be launched near the “right limit” if the target is going from right-to-left as viewed by the gunner or near the “left limit” if the target is going from left-to-right. Ideally, missile impact will then occur as the target approaches the range centerline. The right and left limit-of-fire will be marked to aid the gunner.

d. Area A and B (secondary danger areas) are designed to contain fragments and debris from missiles that impact on the lateral or downrange edges of the impact area.

e. Area F is the danger area to the rear of the launch position and consists of a primary danger area and several caution areas as shown in figure 6-15 and described below:

(1) The primary danger area is a 90° included angle extending 30 meters to the rear of the launcher. Serious casualties or fatalities are likely to occur to any personnel in the primary danger area at the time of firing. The hazards existing in this area during firing are overpressure, motor backblast, high poise levels, and debris. Personnel access to the area during firing is prohibited.

(2) Caution area 1 is extended 30 meters to the right and left of the launcher. The hazard is high noise levels and permanent damage to hearing could occur to individuals during firing if approved hearing protection devices are not worn. Only authorized personnel wearing hearing protection devices are permitted in this area during firing.

(3) Caution area 2 is an extension of caution area 1 and that portion of the 50-meter radius located outside the 90° included angle cone to the rear of the launcher excluding the primary danger area. The hazards are high noise levels and flying debris during launch. Personnel access to this area is prohibited during training and non-combat firing.

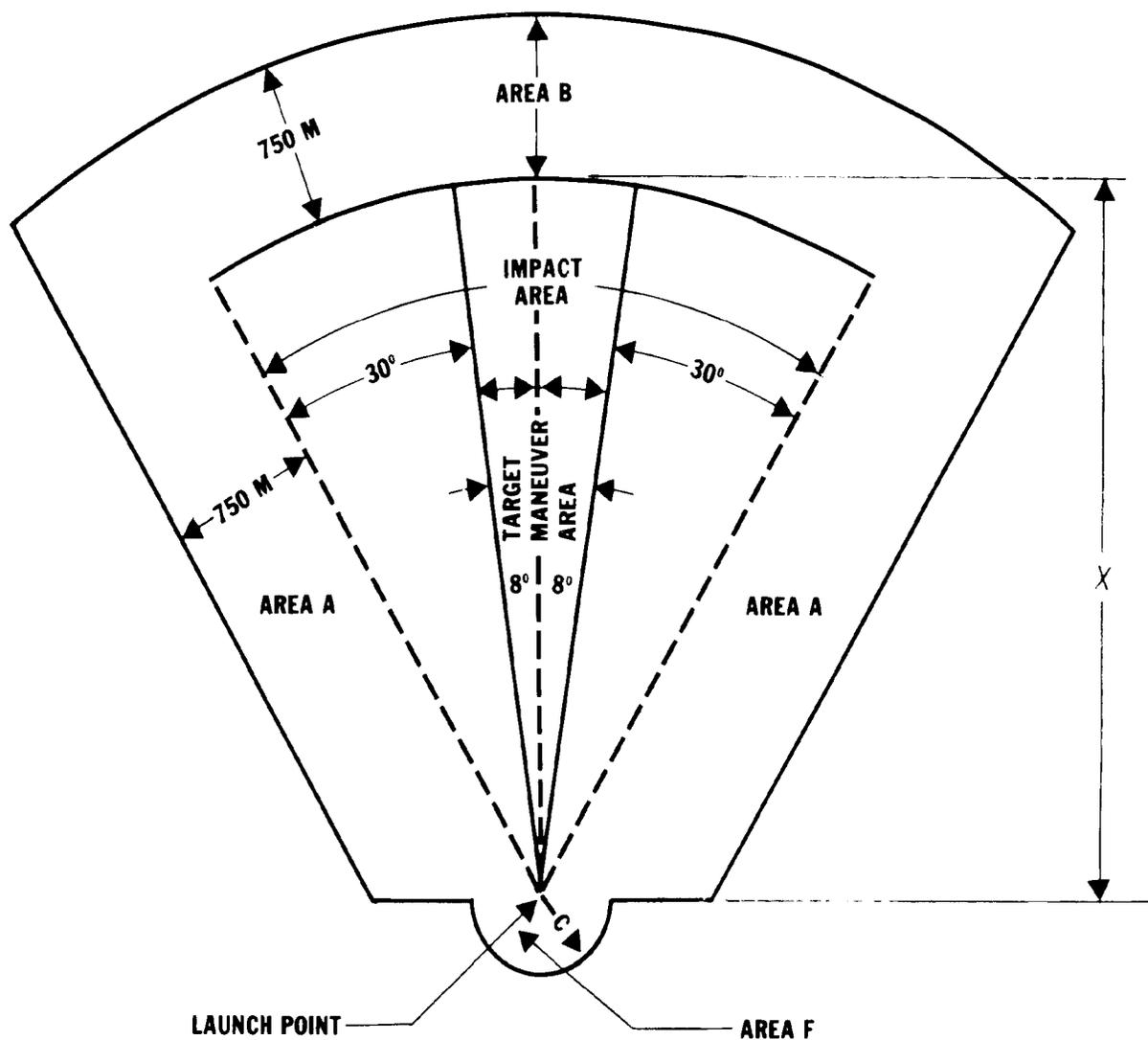
(4) Caution area 3 is applicable in the event of M222 HEAT warhead airburst at minimum arming distance (30 meters from the launch point). The hazards associated with this area are high velocity fragments from the warhead, and missile debris. Serious casualties may occur to exposed personnel in this area in the event of an early warhead airburst. Caution area 3 has a radius of 110 meters with its center located 30 meters uprange from the launch point. This does not include a safe sector located 23 degrees to either side of a line bisecting the missile at a point 30 meters uprange and extending rearwards from the primary danger area.

*f.* The DRAGON guided missile will not be fired from any position, which would cause the guidance wires to contact electrical power lines during a normal trajectory or as a result of an erratic trajectory that may be caused by component malfunctions.

*g.* Only those personnel actively engaged in firing and control of the rounds as specified by appropriate TM's and FM's will be permitted in the surface danger zone at the time of firing. Nonoperational personnel should retire to a distance of at least 50 meters to the side of the launcher (110 meters when firing M222 HEAT rounds).

*h.* Personnel will never stand or permit any portion of their bodies to be directly behind or in front of the launcher when the tracker and round are mated.

*i.* The weapon will not be fired from within buildings or other enclosures or within 50 meters of a vertical or nearly vertical backstop.



**NOTES:**

1. AREAS A AND B MAY BE REDUCED TO 100 METERS FOR PRACTICE MISSILES WITH INER WARHEADS.
2. SURFACE DANGER ZONE APPLIES TO BOTH STANDARD TWO MISSILE AND EXTENDED RANGE TWO MISSILE. NO INCREASE IN DIMENSIONS ARE NECESSARY FOR EXTENDED RANGE TWO MISSILE.
3. ALL DISTANCES ARE IN METERS.
4. DRAWING IS NOT TO SCALE.

Figure 6-13. Surface danger zone TOW missile—aerial firing.

*j.* Procedures and precautions in DRAGON TM's will be observed in all preparation and firing operations. In case of conflict, provisions of this regulation will govern.

**6-15. SS-11 ATGM (ground)—fixed targets.**

The diagram of the surface danger zone for the SS-11 ATGM is shown in figure 6-16. This surface danger zone is applicable to missiles equipped with either HE or practice warheads. This danger zone has been based on the fact that the majority of malfunctions will result in impact of the missile within the impact area. Not all malfunctions will result in such an impact, and strict adherence to the procedures stipulated in *g* below will be required.

*a.* The surface danger zone (fig. 6-16) consists of the impact area and areas A, B, and F. The entire surface danger zone will be cleared of all personnel prior to firing a missile except as authorized in *f* below.

## DANGER ZONE DIMENSIONS IN METERS

	<u>AREA A</u>	<u>AREA B</u>	<u>DIMENSION K</u>
M222 HEAT MSL	500	500	800
M223 PRACTICE MSL	100	100	325

DRAWING NOT TO SCALE

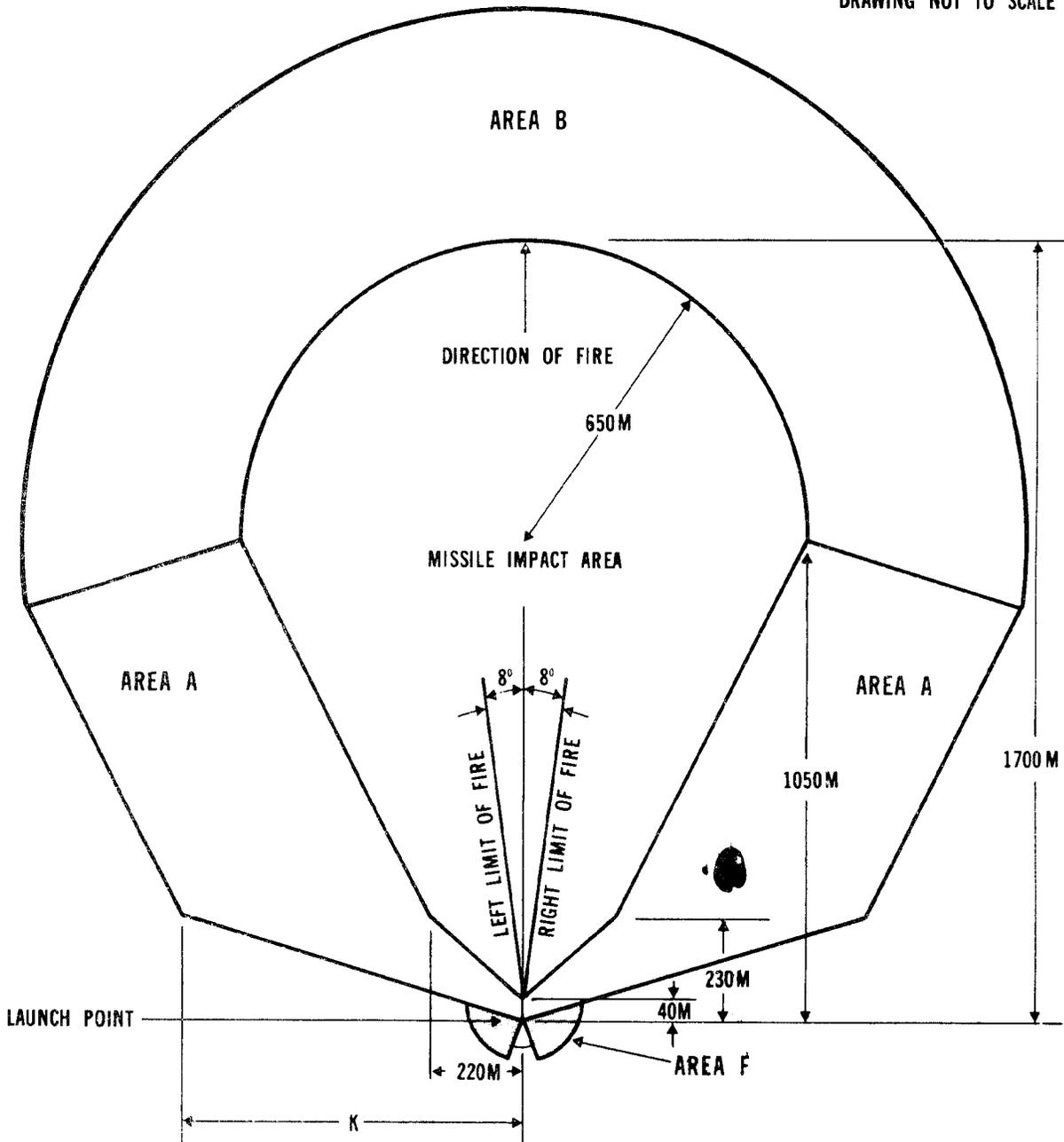


Figure 6-14. FOR FIRING OF DRAGON MISSILES AT FIXED AND MOVING GROUND TARGETS

*b.* The impact area is constructed as depicted in figure 6-16. The length of the impact area will not be less than the total range capability of the missile. The width of the impact area is determined by the type of firing and is governed by the position of the limit of azimuth boundaries. Azimuth limit markers must be positioned immediately forward of the launcher and must be positioned at not more than  $10^\circ$  to each side of the azimuth of firing. The impact area consists of an area 500 meters to each side of firing, beginning at the launcher and extending in the direction of and parallel to the azimuth of firing and intersecting with the limit of trajectory lines. From these points, the boundaries of the impact area are extended to the maximum range capability of trajectory lines. If the angle of trajectory of the missile exceeds the angle of the azimuth markers, action stipulated in *g* below must be followed.

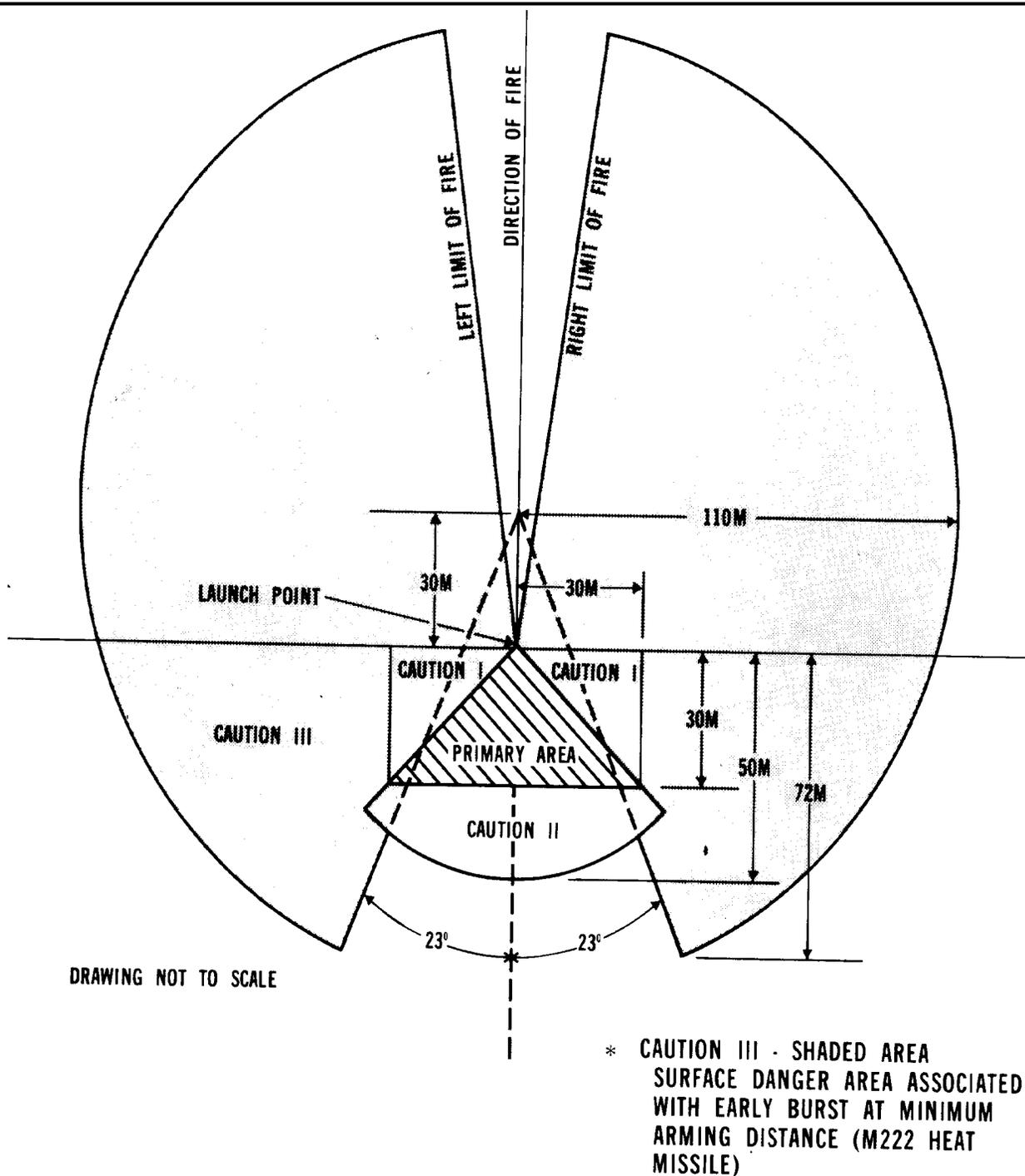


Figure 6-15. AREA F (REAR DANGER AREA) FOR FIRING ALL DRAGON ATGM ROUNDS\*

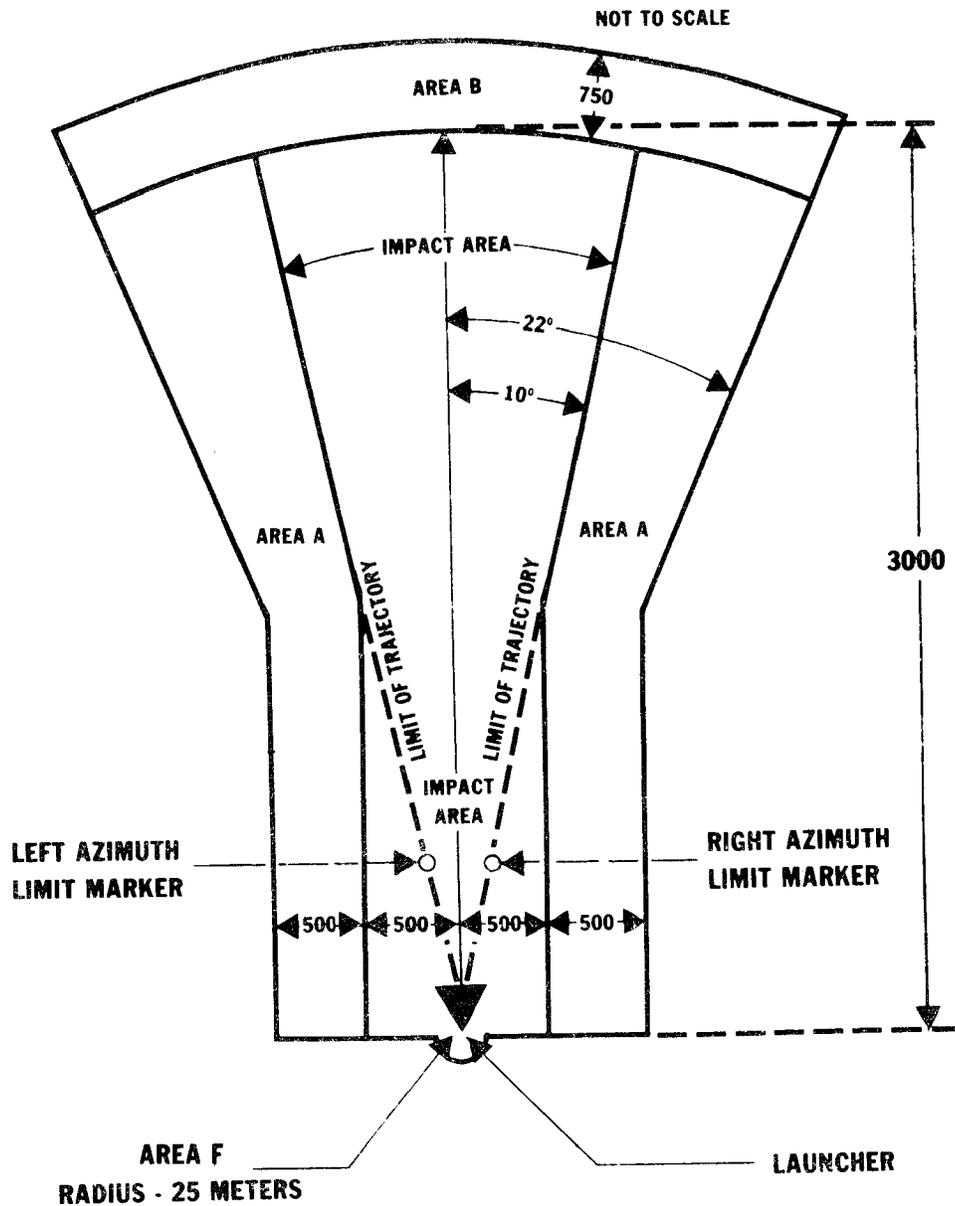


Figure 6-16. Surface danger area for terrestrial firing the SS-11 ATGM at a fixed terrestrial target on a known azimuth.

c. Area A is the lateral secondary danger area and is constructed as depicted in figure 6-16. It consists of an area on each side of the impact area and extending in the direction of firing, parallel to the azimuth of firing for approximately 2,500 meters at which point it intersects lines (from the firing position) drawn 22° to each side of the azimuth of firing. From these points, the outer boundary of area A is a line drawn 22° to each side of the azimuth of firing from the firing position. The area gradually increases in width until reaching the limits of area B.

d. Area B is the forward secondary danger area and is constructed as depicted in figure 6-16. It consists of an area beyond the impact area and area A.

e. Area F is the launcher danger area extending to the rear of the firing position. This area is constructed as depicted in figure 6-16. It consists of a semicircle immediately to the rear of the firing position, the radius of which is 25 meters. This radius may be reduced to not less than 15 meters by the installation commander when terrain conditions such as compact soil or an intervening hill mass would restrict, retard, or preclude the occurrence of the velocities of small aggregate caused by the rocket exhaust.

*f.* The gunner may be placed in area F when a bulletproof glass or plexiglass shield of adequate design strength is placed between the gunner and the missile.

*g.* As a result of certain malfunctions, the missile can attain an erratic trajectory. In certain cases, no action on the part of the gunner is required; however, in other cases action by the gunner will be required to prevent trajectory of the missile from exceeding the impact area. In the event of malfunctions, which result in the following trajectory paths, the gunner must take the indicated actions. No action is required by the gunner in the event of trajectory paths other than those stipulated below:

(1) Missile attains a maximum left or right path with no change in elevation. Gunner will give maximum down command on control stick. If this fails to ground missile, gunner will turn the power switch on the signal generator to the OFF position.

(2) Missile attains either a maximum up or down path with no change in azimuth. Gunner will guide the missile straight down-range in azimuth until impact. **WARNING—DO NOT TURN OFF POWER ON THE SIGNAL GENERATOR.** If the erratic flight is due to a malfunctioned pitch relay and the power is turned off, the missile will attain both a maximum up and maximum right trajectory.

(3) Missile attains either a maximum up or right or maximum up and left path of trajectory. Gunner will turn the power switch on the signal generator to the OFF position.

*h.* The SS-11 ATGM will not be fired from any range position which will permit the guidance control wire to contact electrical power lines either during normal trajectory or as a result of erratic trajectory that may be caused by malfunctions.

#### **6-16. SS-11 ATGM (ground)—moving targets.**

The diagram of the surface danger zone for the SS-11 ATGM is shown in figure 6-17. This surface danger zone is applicable to missiles equipped with either HE or practice warheads.

*a.* The surface danger zone is constructed generally in the same manner stipulated for the SS-11 firing in paragraph 6-15 with the exception that a maneuver area for the target has been included. The maneuver area is essentially the impact area and the size will be determined by the nature of the firing and area required to maneuver the target.

*b.* The limits of the maneuver area will be established to each side of the azimuth of the center of the area. To this, an additional area (equal to 10° to the right and left to the maneuver area) will be added as the limiting line of trajectory. Limit of trajectory markers will be placed on the range. When the missile exceeds these limits, action will be taken as stipulated in paragraph 6-15g.

*c.* Area A (lateral secondary danger area) will be added to this as depicted in figure 6-17. Area A is 1,000 meters in width.

*d.* Area B (far secondary danger area) is constructed as depicted in figure 6-17. It consists of an area 750 meters in depth beyond the impact area.

*e.* Area F (launcher danger area) is constructed as stipulated in paragraph 6-15e, and as depicted in figure 6-17.

*f.* The SS-11 ATGM will not be fired at manned vehicles. Moving vehicles used, as targets must be operated by remote control with the operating personnel located in a protected area.

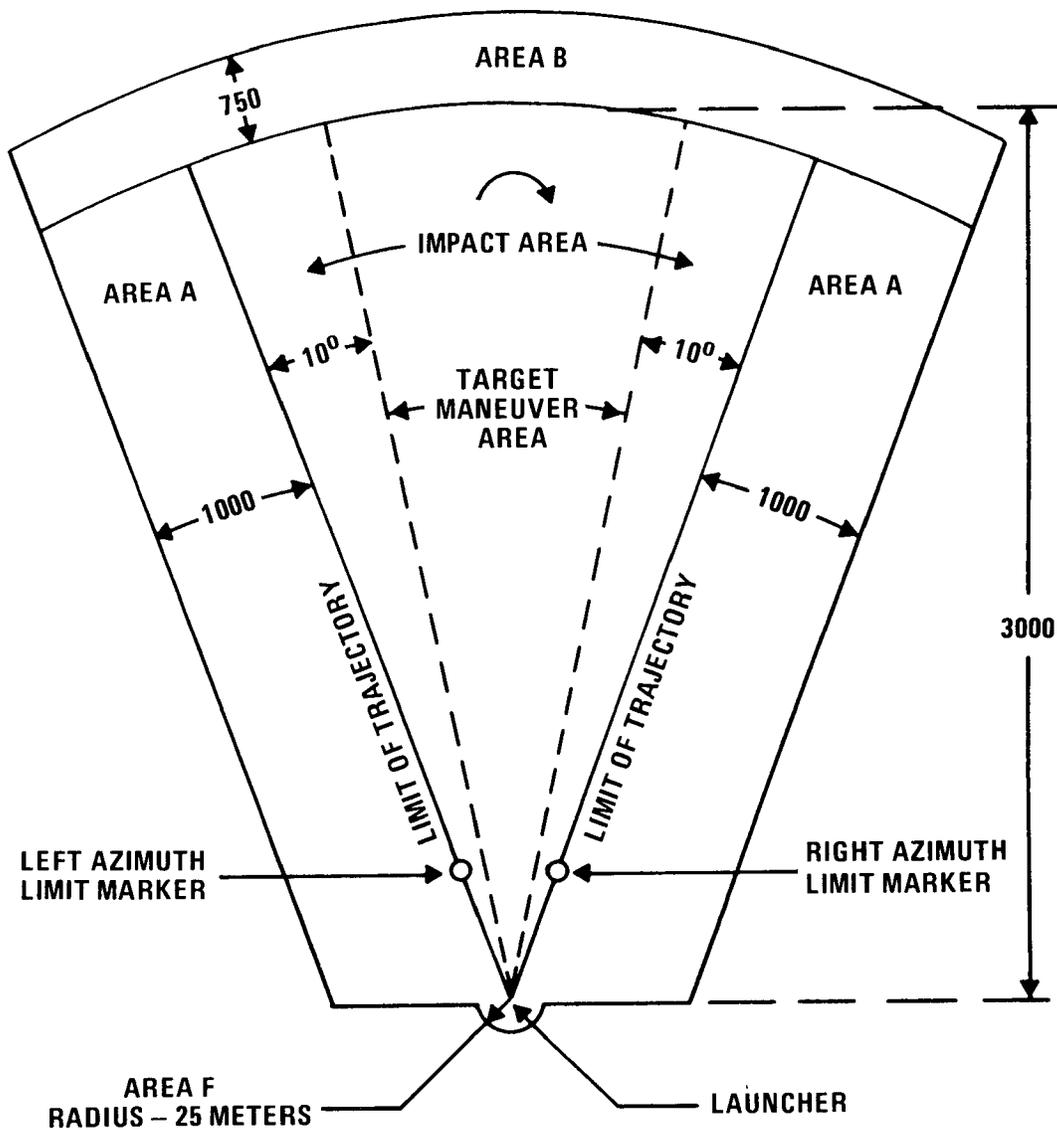
#### **6-17. SS-11 (M22) ATGM—airial firings.**

*a.* The surface danger zone shown in figure 6-18 represents the safety boundaries for controlled range firing of the SS-11 ATGM system mounted for aerial firing from a helicopter.

*b.* Safety procedures to be followed when firing the SS-11 are as follows:

(1) A range safety officer should be positioned at a safe vantage point. The range safety officer should maintain constant communication with the gunner in the helicopter.

(2) Large range markers should be set at the launch point and on both sides of the line of fire as noted on the inclosed diagram. If the angular position of the missile exceeds the markers, the gunner will take the appropriate action as described in paragraph 6-15g and as directed by the range safety officer.



- NOTES:
1. ALL DIMENSIONS ARE IN METERS
  2. NOT TO SCALE

Figure 6-17. Surface danger area for terrestrial firing the SS-11, ATGM at a moving target.

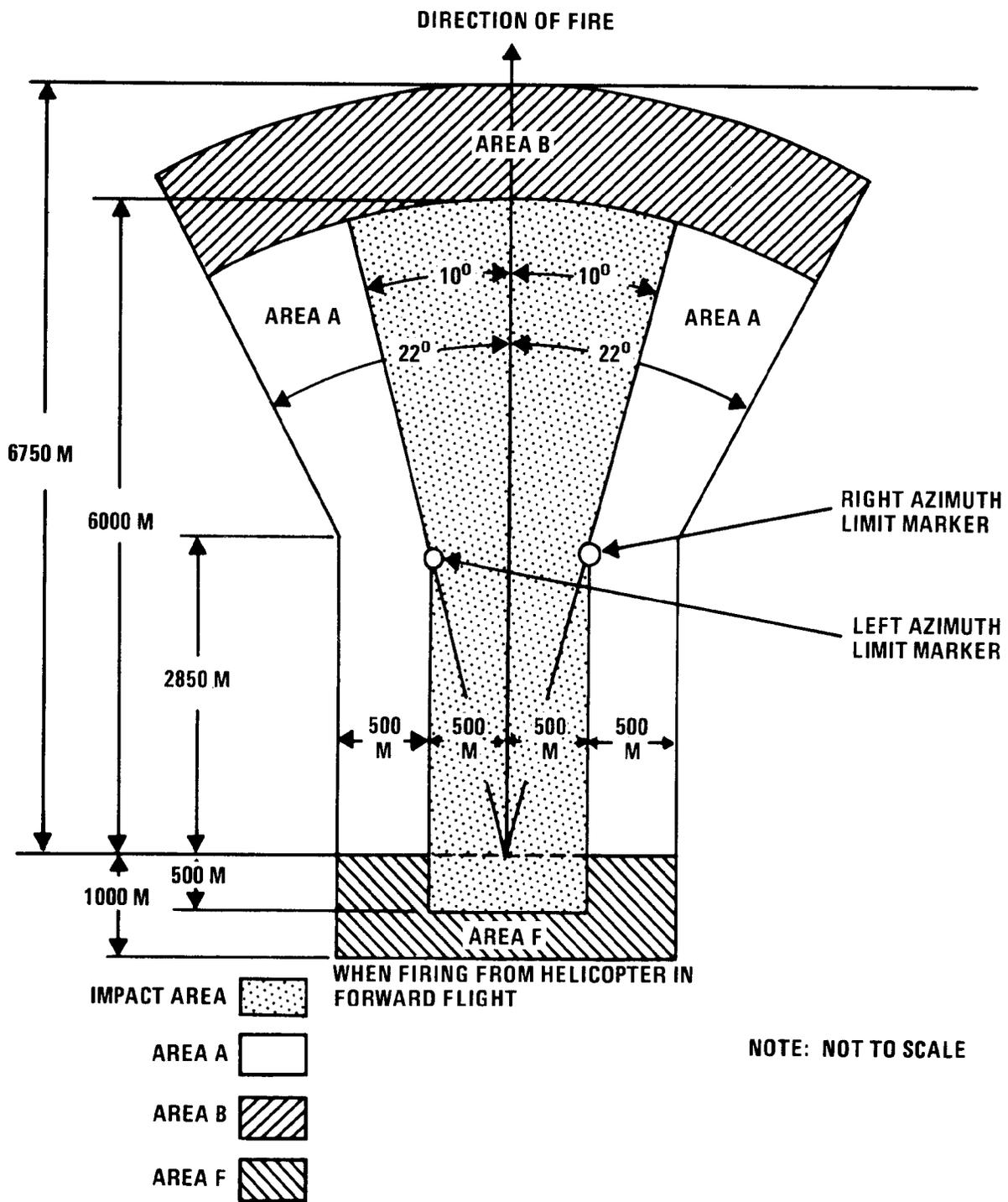
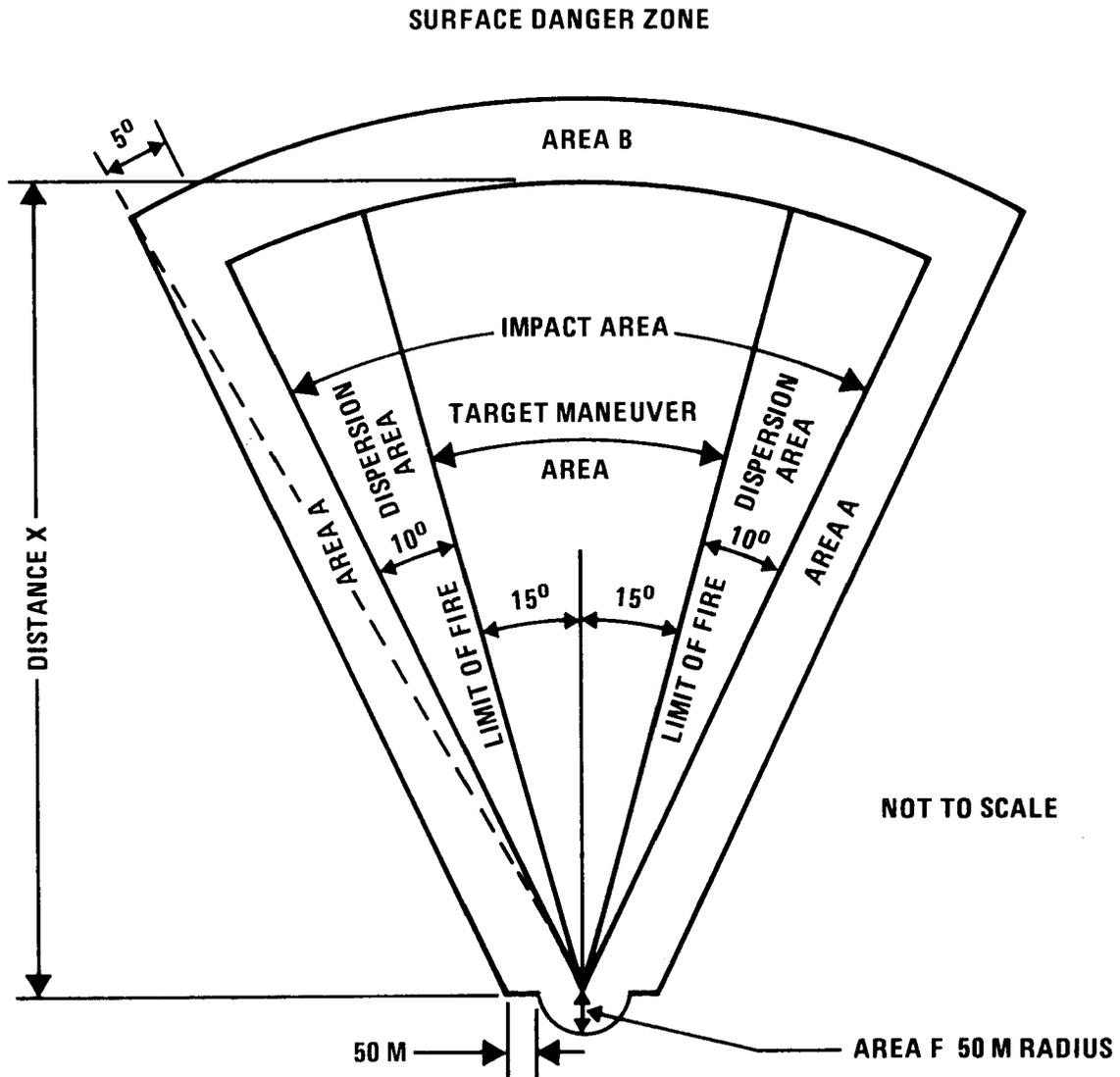


Figure 6-18. Surface danger zone for aerial firing the SS-11 ATGM at terrestrial targets.

(3) The gunner will fire only after clearance from the range safety officer.

(4) Personnel other than those engaged in actual firings should remain outside the areas indicated on the surface danger zone. The number of operating personnel should be kept to an absolute minimum compatible with efficient operation during firing.

(5) If a missile equipped with a high explosive warhead fails to detonate on impact, the fuze is, in all probability, armed and the missile is an extremely dangerous condition. Under these conditions the missile must not be moved as the slightest movement of the missile could cause the warhead to detonate. The missile should be destroyed in place by qualified personnel.



**NOTES:**

1. NOT TO SCALE
2. ALL DIMENSIONS IN METERS
3. THE ANGLE DEFINING AREA A MAY BE REDUCED TO 2° WHEN FIRING PRACTICE AMMUNITION WITH INERT PROJECTILE OR PROJECTILE WITH SPOTTING CHARGE.

Figure 6-19. For firing SHILLELAGH Missiles at moving targets (see table 6-8).

(6) The SS-11 wire guided missile should not be fired from any range position, which will permit the guidance wires to contact electrical power lines either during normal trajectory or as a result of erratic trajectory that may be caused by malfunctions.

c. The surface danger zone is depicted for a point firing only. If it is desired to fire from various points within a helicopter firing lane, a surface danger zone must be superimposed at each possible point of launch at each intended target. The extreme locus of points formed by the superimposition will form the surface danger zone required.

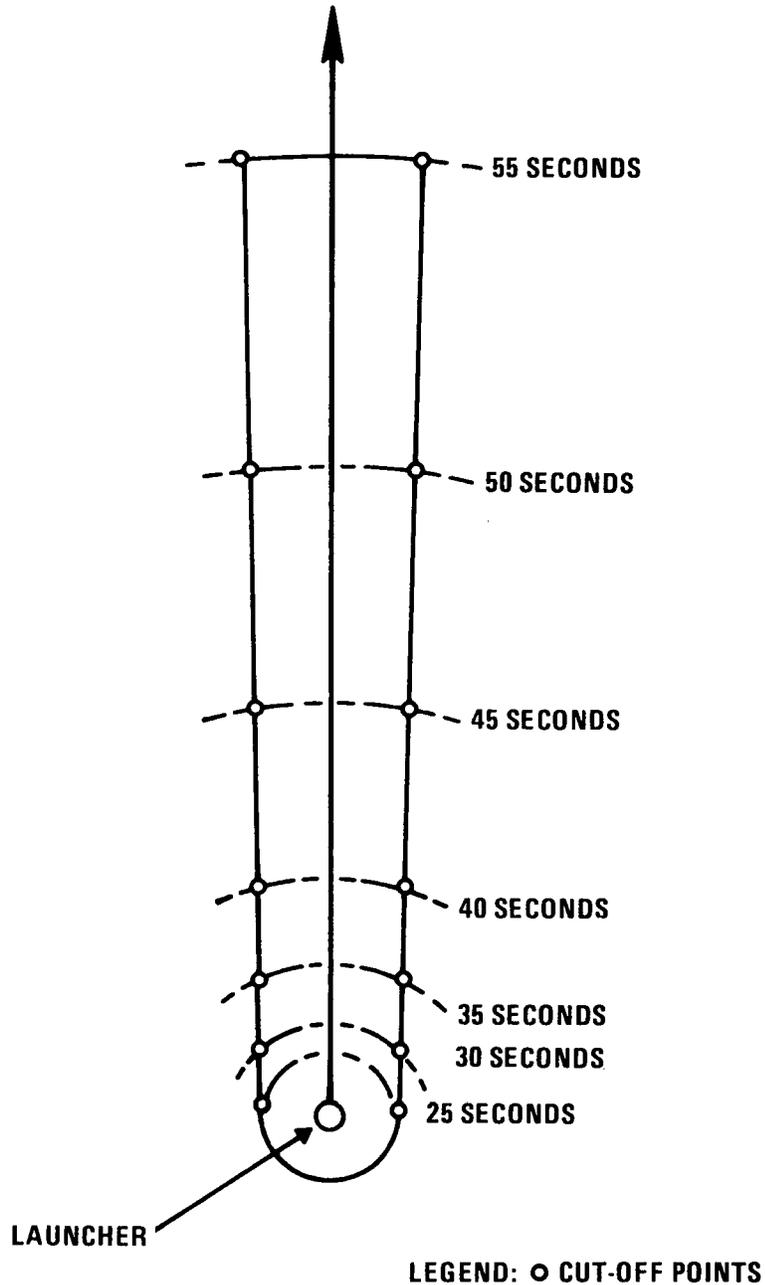


Figure 6-20. Typical trajectory corridor.

### 6-18. SHILLELAGH guided missile.

The surface danger zone shown in figure 6-19 provides for firing both the standard range and extended range missile at moving targets.

a. The surface danger zone (fig. 6-19) consists of the impact area containing a target maneuver area, a dispersion area, and areas A, B, and F. This surface danger zone is applicable to missiles equipped with either HE or practice warheads.

b. The impact area and areas A, B, and F will be constructed as shown in figure 6-19 depending on the missile being fired; i.e., standard or extended range.

c. The dimensions shown in table 6-8 will be used in construction of the surface danger zone.

d. A specific hazard to personnel is associated with direct viewing of the radiated energy from the transmitters. Authorized personnel entering the primary danger area prior to, or subsequent to, the firing of a SHILLELAGH missile should not view the transmitter from angles within 5° of the beam axis.

e. The SHILLELAGH missile will not be fired over the heads of personnel. The vehicle driver's hatch will be closed during all firings of the SHILLELAGH. All other crewmembers should be within the confines of the vehicle for live warhead firings to prevent possible fragment spray from early grounded missiles.

f. For firing at stationary targets, the maneuver area may be eliminated and the SHILLELAGH fired on a straight line of fire to the fixed target.

### 6-19. Trajectory corridor.

A trajectory corridor (fig. 6-20) is constructed by describing concentric semicircles indicating the position of the missiles for various times of trajectory. By computing the range to impact on a ballistic trajectory for the destruct times corresponding to the time interval for range positions selected, it is possible to establish destruct points which will insure that the missile will impact within the impact area. By calculating the angle of trajectory required to place a missile on the limits of the known impact area on each side of the line of firing, points may be fixed on the range-time semicircles, both to the right and left of the line of firing, indicating the position at which the missile must be destroyed if impact is to be within the impact area. By connecting these points with a solid line, the trajectory corridor may be established for any desired range. Missiles will not be permitted to go beyond the limits of the trajectory corridor. Application of the trajectory corridor is shown in figure 6-20. For an explanation as to the construction of this type corridor, see paragraph 6-7e.

**Table 6-8**  
**Dimensions for SHILLELAGH Surface Danger Areas**

	<i>Dimensions in Meters</i>			<i>Minimum distance to target</i>
	<i>Area A</i>	<i>Area B</i>	<i>X</i>	
SHILLELAGH missile:				
Standard range (HE) . . . . .	1	800	4400	700
Extended range (HE) . . . . .	1	800	5400	700

Notes:

<sup>1</sup> Area A is determined by construction of the diagram.

### 6-20. STINGER guided missile.

The surface danger zone for the STINGER guided missile is based on its maximum ballistic range. The self-destruct feature designed to terminate missile flight within the surface danger zone was not considered in establishing the range safety requirements. Ballistics data can be found in FM 44-1A.

a. The surface danger zone, as shown in figure 6-21, consists of the impact area and areas A, B, and F. The entire surface danger zone 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. In no case will the missile system be fired over the heads of unprotected persons because of the hazard from the launch motor impact and the sustainer motor plume.

b. The impact area (primary danger area) will be constructed as shown. This area will normally contain the debris and impact of missiles, which are 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 must be designated by positioning azimuth limit markers forward of the launcher position and all firings must be accomplished within these limit markers. The impact area consists of an area 45° to each side of the sector of fire and extending down range to the maximum ballistic range of the missile.

c. Area A is the lateral secondary danger area. The area is adequate to contain the effects of warheads functioning at

the edge of the impact area. It consists of areas 50 meters wide on each side of the impact area and extending down range to the maximum ballistic range capability of the missile.

*d.* Area B is the far secondary danger area. This area is adequate to contain the effects of a warhead functioning at the forward edge of the impact area. It consists of an area 100 meters in depth beyond the impact area and area A.

*e.* Area F is the launcher danger area extending to the rear of the firing position. This area is depicted in figure 6-21 and constructed as shown in figure 6-22. It is further divided into a primary danger area and two caution areas.

(1) The primary launcher danger area has a radius of 50 meters with boundaries, which lie along extensions of the impact area boundaries. Personnel are not permitted in this area during firings.

(2) Caution Area 1 also has a radius of 50 meters. Its boundaries are the primary launcher danger area and the impact area. Any personnel in this area must, be protected from high noise levels and flying ground debris.

(3) Caution Area 2 extends to the rear of the launcher with a radius of 125 meters. Its boundaries are straight lines drawn between the extension of Caution Area 1 and the intersection of the 125-meter radius. Personnel in this area are exposed to high noise levels only. Occupation of Caution Area 2 is permitted when all personnel are wearing required hearing protection.

*f.* To minimize the possibility of a malfunctioning missile traveling to the rear of the launch position, all training firings shall be limited to a maximum elevation angle of 50 degrees (40 degrees target elevation angle plus 10 degrees superelevation).

*g.* The procedures and precautions in the appropriate TM's and FM's will be followed during STINGER firings. No firings will be made on directly incoming targets, which would normally pass over the launch area, allowing target debris, or targets to impact in the area upon intercept. Coaches and any other personnel exposed to the rocket motor blast will wear the same personal protective equipment as is required for the gunner in the appropriate TM.

*h.* The STINGER surface danger zone does not insure protection from the various aerial targets, which may be used for training firings. Surface danger zones for these targets must be incorporated by the range safety officer.

# SURFACE DANGER ZONE

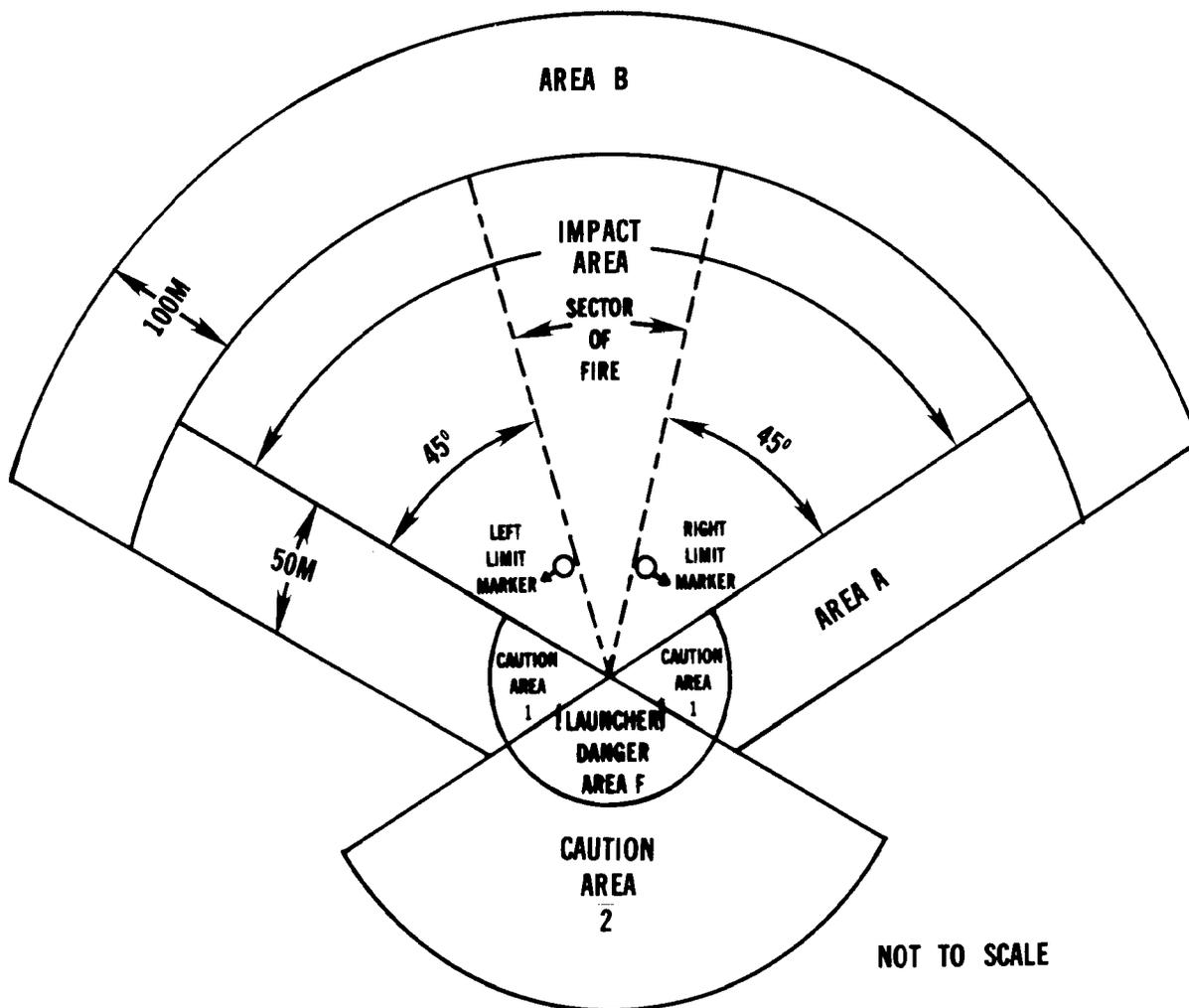


Figure 6-21. Surface danger zone for firing STINGER surface to air guided missile at a moving target.

# SURFACE DANGER ZONE

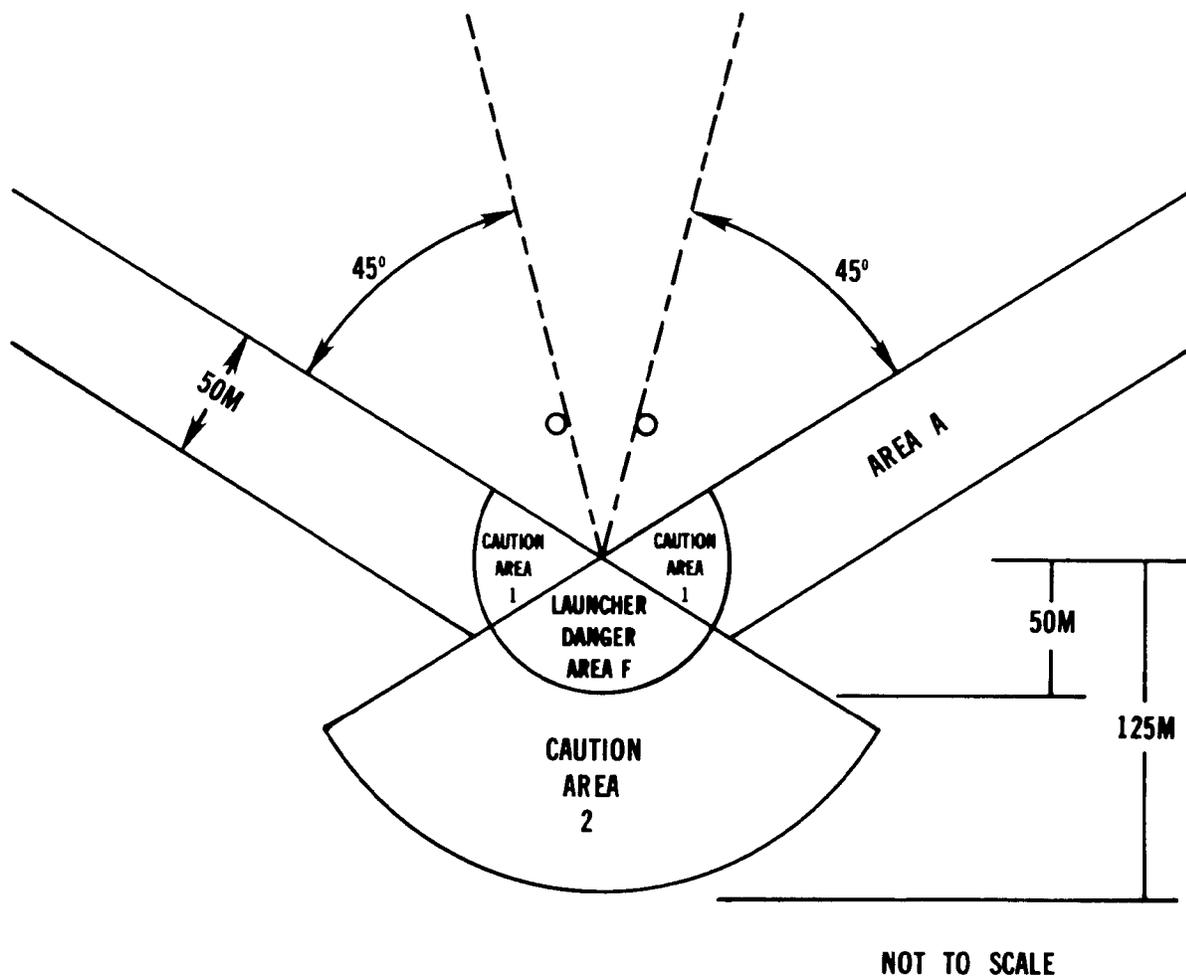


Figure 6-22. Danger and Caution Areas for firing STINGER surface to air guided missile.

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