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AVIATION BATTLEFIELD SURVIVABILITY

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PREFACE

This manual describes the countermeasures, techniques, and procedures that enhance aircrew survivability and sustainability on the modern battlefield. It provides an overview of low-intensity conflict and Threat air defense, artillery, tactical aircraft, and electronic warfare systems. The manual describes directed energy weapons, combat search and rescue operations, and survival equipment and rescue devices. In addition, it describes critical planning elements that aircrews should consider during premission planning. Appendixes A, B, C and D provide supplemental material on NBC operations, IEW operations, A2C2, and risk management.

This publication is an unclassified information source for aviation personnel to refer to during institutional training. During unit training, it can complement the ASET programs II through IV. This manual is based on the doctrinal and tactical employment principles outlined in FMs 1-100, 1 111, 71-100, and 100-5. It applies primarily to aviation unit commanders, their staffs, and aircrews assigned to aviation units.

The proponent of this publication is HQ TRADOC. Send comments and recommendations on DA Form 2028 directly to Commander, US Army Aviation Center and Fort Rucker, ATTN: ATZQ DOT-DD, Fort Rucker, AL 36362-5263.

This publication implements the following international agreements:

STANAG 2083 (Edition Five) Commanders' Guide on Nuclear Radiation Exposure of Groups

STANAG 2889 (Edition Three) Marking of Hazardous Areas and Routes and QSTAG 742 Through Them

STANAG 2999 (Edition One) Use of Helicopters in Land Operations

STANAG 3497 (Edition One) Aeromedical Training of Aircrews in Aircrew NBC Equipment and Procedures

STANAG 3552 (Edition Seven) Search and Rescue (ATP-10) and AIR STD 51/4A

STANAG 3650 (Edition Two) Essential SAR Location Equipment and and AIR STD 51/7B Associated Characteristics (Aircraft)

STANAG 3805 (Edition Two) Doctrine and Procedures for Airspace and AIR STD 45/6B Control

STANAG 3873 (Edition Two,) Electronic Warfare (EW) in Air Operations (ATP-44)

QSTAG 586 Procedures to be Employed in the Event of Downed Helicopters

QSTAG 703 Procedures for Concealed Approach and Takeoff From Field Sites

QSTAG 768 Terrain Flight

APPENDIX A

NUCLEAR, BIOLOGICAL, AND CHEMICAL OPERATIONS

This appendix implements portions of STANAG 2083, STANAG 2889 and QSTAG 742, and STANAG 3497.

The anticipated use of nuclear, biological, and chemical weapons by Threat forces poses potential barriers to aviation operations on the modern battlefield. To minimize the effects of these weapons, aviation commanders and individual aviators must be able to use countermeasures appropriate to the NBC threat. This appendix describes how personnel, equipment, and overall mission accomplishment are affected by the use of NBC weapons on the battlefield. It also provides countermeasures to reduce the effects of these weapons.

Section I

NBC THREAT

A-1. THREAT DOCTRINE AND PREPAREDNESS

a. The NBC threat can exist almost anywhere, including Third World countries that increasingly have an NBC capability. However, the use of chemical warfare by the Soviets or their client states in Afghanistan and Southeast Asia attests to the Soviets' intent and willingness to use nuclear and chemical weapons. Soviet tactical doctrine is replete with guidance on the use of nuclear weapons.

b. Threat leaders know NBC weapons may alter tactics, advance rates, force and power ratios, and logistics. The Threat can produce and stockpile NBC weapons and employ them with a variety of delivery systems. Therefore, any future conflict involving the Soviets should be considered likely to include the employment of NBC weapons.

c. As part of their overall preparedness, the Soviets conduct extensive, realistic training for the NBC environment. However, NBC warfare will impose the same constraints on Soviet soldiers as it will on US soldiers; individual protective clothing and psychological factors will degrade the performance of both.

A-2. NUCLEAR WARFARE

a. The Soviet Union has a wide range of systems that can deliver nuclear weapons. As illustrated in Figure A-1, no area on the battlefield is free from the threat of a nuclear strike. The Soviets have stated priorities for nuclear strikes. In order of priority, targets include-

Enemy nuclear delivery means, aircraft, field artillery, missiles, and rockets.
Division and higher-level headquarters.
Defensive positions.
Reserves and troop concentrations.
Supply installations, especially nuclear ammunition storage points.
Command, control, and communication systems.

Figure A-1. Range of Threat delivery systems

b. Aviation brigade elements are not directly targeted for a nuclear strike. However, the brigade's mission may place elements in an area where they would become a target for nuclear weapons. Soviet forces may consider a unit equipped with AH-64 aircraft a sufficient threat to target it for a nuclear strike.

A-3. BIOLOGICAL WARFARE

a. Biological warfare is the intentional use of organisms to cause death or disease in people, animals, or plants. Examples of these living organisms--called germs--are viruses, bacteria, and fungi. Germs can be dispersed by artillery, rockets, aircraft, sprays, vectors, or covert operations. The possibility of biological warfare exists even though treaties prohibit it. The policy of the United States is to never engage in biological warfare.

b. The United States defines a biological agent as any living organism or toxin produced by an organism that can incapacitate, seriously injure, or kill personnel. The agents covered by biological treaties are bacteriological agents.

A-4. CHEMICAL WARFARE

a. In a nuclear war, chemical agents--including nerve, blood, blister, and choking--may be used to complement nuclear weapons. Normally, chemicals would be employed after a nuclear strike when protective equipment has been damaged and personnel are physiologically weak. Conventionally, chemicals would be used as weapons of surprise. A combination of agents can be used to complicate medical treatment or to compound the effects of individual chemical agents. FM 8-9 describes the effect that agents have on the human body. FM 8-285 describes self-aid, buddy-aid, and medical treatment for chemical agent contamination.

b. Soviet targeting priorities for chemical agent attack are nearly identical to Soviet priorities for nuclear strikes. The Soviets may target airfields and rear area lines of communication to disrupt US resupply and reinforcement operations. However, they might keep these points intact for later use by their forces. The Soviets may target frontline troops, such as reconnaissance or attack forces, with nonpersistent agents. The agents may be delivered by multiple rocket launchers. The Soviets may also target the flanks with persistent agents to act as obstacles and the intermediate rear area with semipersistent attacks to delay the retrograde of friendly forces.

Section II

NUCLEAR WEAPONS

A-5. THERMAL RADIATION EFFECTS

The energy released from a nuclear detonation interacts immediately with the surrounding air. Almost instantly with the detonation, an intense light pulse is emitted. Also, the air is heated to thousands of degrees Celsius, vaporizing even the unreacted bomb material. The sphere of superheated air is called the fireball; the heat and light are referred to as thermal radiation. Thermal radiation will continue to be emitted from the detonation for several seconds, depending on the yield of the weapon.

a. Heat Effects. Heat can affect personnel as well as equipment, supplies, and the environment.

(1) Skin burns.

(a) Unprotected or exposed skin is susceptible to thermal radiation burns. These may be first-, second-, or third-degree burns. First-degree burns are similar to a sunburn; they involve injury to the epidermis. In second-degree burns, the epidermal layer is destroyed but some viable tissue remains. These burns usually form blisters. In third-degree burns, the thick epidermis and underlying layer, or dermis, are destroyed. These burns have a dark brown or charred appearance.

(b) The severity of the burns depends on the yield of the weapon, proximity of personnel to ground zero, and level of individual protection. Wearing clothing that does not leave the skin exposed reduces the chance of burns. However, the dark color of the battle dress uniforms causes them to absorb more thermal radiation; therefore, early warning and defensive measures must begin as soon as a nuclear threat is discovered. Nomex flight suits somewhat protect aircrews from skin burns.

(2) Materiel damages. Thermal radiation is hazardous to ground support equipment and supplies as well as personnel. JP4 or JP8 stored in blivets is especially vulnerable. The black rubber in the blivets will absorb thermal radiation and may become heated and hardened. The blast may also puncture or stress the blivets, causing them to leak. Burning rubber, leaves, or grass might ignite the fuel, causing explosions and fires. Blivets at FARPs must be protected by burying them or covering them with tarpaulins.

(3) Fires. The heat from thermal radiation may cause fire storms in forests and urban areas. These fires may affect aviation units directly if they are in the path of the storm. Fires will affect aviation units indirectly if ground personnel are unable to evacuate these areas because of obstacles such as fallen trees.

b. Light Effects. The effects of light on aircrews range from flash blindness to retinal burns.

(1) Flash blindness.

(a) Visible light from a fireball may cause the visual pigments of the photoreceptors of the eye to bleach out; vision is briefly impaired. This effect is called flash blindness. It is more of a hazard at night than during the day, because the pupil is larger and admits more light at night. How flash blindness affects military operations depends on the tasks of affected personnel. While the temporary loss of vision may be hazardous to ground soldiers, it could be fatal for aircrews.

(b) The severity of flash blindness is directly related to the yield of the weapon, distance between the fireball and personnel, and atmospheric conditions. Low visibility will reduce the magnitude of the visible light pulse.

(c) Aircrews using night vision devices may experience tube burnout, but their eyes will be protected by the devices. In case of an attack, the night mission must be suspended or canceled because of the loss of night vision. How long the mission is delayed will be a function of the aircrew's ability to adapt to the darkness.

(2) Retinal burns. An excessive amount of light focused on the retina can cause retinal burns. The intense light burns the photoreceptors and causes a blind spot. The damage is permanent, because photoreceptors

cannot be replaced. The degree of incapacitation would vary from blindness caused by a person looking directly at the explosion to minor retinal burns caused by indirect exposure from flash effects. Soldiers facing a 1-kiloton detonation could receive retinal burns from as far away as 6.7 kilometers.

A-6. BLAST EFFECTS

The rapid expansion of the fireball creates a wave of compressed air. This is referred to as a shock wave or a blast wave. The blast wave causes damage by two kinds of pressure: dynamic pressure, referred to as winds, and static overpressure, referred to as overpressure. The compressed gases produced by a nuclear explosion expand outward in all directions from the point of detonation. This wave travels at about the speed of sound.

a. Dynamic Pressure.

(1) Wind velocity. The wind velocity can range from a few miles per hour to hundreds of miles per hour. The velocity will depend on the yield of the weapon, height of the burst, and distance from the point of detonation. Wind velocity decreases with distance. For example, a 100 mile-per-hour wind will occur about 6 miles from a 1-megaton detonation, 4 miles from a 300 kiloton detonation, or 1 mile from a 5-kiloton detonation.

(2) Drag forces. The winds cause damage by drag forces. Drag forces collapse buildings and overturn vehicles, creating missiles from flying debris such as rocks, sticks, or glass fragments. They also hurl exposed personnel against solid objects and blow down trees. For nuclear weapons, the time from the initial blinding flash of light until the blast wave reaches the area can be several seconds or longer. For large-yield weapons at great distances, the time can be longer than 30 seconds. Thus personnel will have some time to seek shelter before the blast wave hits.

(3) Wind phases. Winds have a positive phase and a negative phase. During the positive phase, winds travel outward from the point of detonation. As the fireball rises, a slight vacuum is created. This will cause the winds to reverse and blow back toward the detonation. The velocities of this reverse wind are mild compared to the positive phase. The reversal of the winds will keep missiles in the air longer and possibly cause more damage.

The missiles may fall back to the ground and settle after the positive phase and then be picked up again by the negative phase. Because of the turmoil, ground troops may not even notice the negative phase. Aircrews may notice it more because wind reversal will create more air instability for them to overcome.

(4) Aerodynamics. The effects of high winds on fixed- and rotary-wing aircraft have been studied in wind tunnels and in open-air testing. Nuclear blast winds have the same effects on aerodynamic surfaces and airframes as any other type of high wind. Nuclear weapons can produce enormous wind velocities, extreme turbulence, and wind shear. The winds persist longer than those produced by conventional munitions. Rotary-wing aircraft may experience sudden yaw, pitch, roll, and lift changes. Extreme effects can include blade flapping and bending, mast bumping, loss of tail rotor effectiveness, flameout, and airframe crushing.

b. Static Overpressure.

(1) Overpressure force. The compressed gases create a force that causes the ambient air pressure to increase; this is overpressure. The nuclear explosion creates overpressure that can be hundreds of times

greater than the ambient air pressure. As with the winds, the overpressure decreases as the distance from the point of detonation increases.

(2) Aircrew injury. Wind velocity and overpressure are interrelated. At overpressures of .5 psi (wind velocity of 17 miles per hour) and greater, windscreens begin to shatter and flying fragments may injure aircrews. At 35 miles per hour, glass fragments are a significant hazard to the eyes and the throat. At higher pressures, the wind velocity could cause casualties from fragments penetrating the flight suit and skin. Early warning by radio will give aircrews the best protection. They can then land their aircraft in the lowest terrain and place the rear of the aircraft in the direction of the

expected blast, thus increasing their survivability. The distance from the blast will determine the degree of damage to the aircraft. (3) Airframe damage.

(a) Airframes are vulnerable to overpressure effects. Glass (Plexiglas, safety Plexiglas, or safety glass) begins to shatter at .5 to 1 psi overpressure.

(b) The overpressure initially affects only the side facing the detonation. However, the blast wave envelops the aircraft within microseconds, exerting forces on the opposite side as well. The sequential occurrence creates buckling and twisting forces, resulting in skin wrinkling and internal frame stresses.

(c) Light damage to the airframe, other than glass, begins to occur at 3 to 5 psi overpressure. On rotary-wing aircraft, the tail boom weakens and may undergo slight separation. Subsequent severe flight maneuvers may result in tail boom failure. On all aircraft, the fuselage and internal frames undergo substantial stresses and skin panels rupture. Longerons, stringers, and frames may fail at these pressures.

A-7. NUCLEAR RADIATION EFFECTS

Nuclear radiation consists of all types of ionizing electromagnetic and particulate radiation; specifically, alpha, beta, neutron, and gamma. FM 8-9 describes the effects of each type of radiation on the human body. Nuclear radiation travels outward in all directions from the point of detonation. The effects of nuclear radiation are categorized as initial and residual.

a. Initial Effects. The initial effects are those manifested within 60 seconds after detonation. They consist of all types of electromagnetic and particulate ionizing radiation. For small yields, the initial radiation will cause numerous personnel casualties. However, an aircraft flown close enough to the nuclear detonation for the aircrew to receive incapacitating dosages would probably not survive the blast damage anyway. This initial radiation remains a concern for aircrews on the ground and personnel in FARPs, AVIM units, and headquarters.

b. Residual Effects. The residual effects are those that remain hazardous after 60 seconds. The most important residual effects are fallout and induced radiation or neutron-induced gamma activity.

(1) Fallout. The fireball continues to grow after a nuclear detonation, stabilizing within several minutes. Because hot air rises, it gains altitude as it grows. The rising and cooling of the fireball create an area of low pressure directly beneath the fireball. If the point of detonation is close to the earth's surface, then the dirt and debris are drawn up into the fireball. Vaporized bomb material then mixes with the dirt and debris. The mixture of radiological dirt and debris, called fallout, begins to fall back to earth and may cover hundreds of kilometers as it travels downwind. Fallout can result in significant radiation dose-rate levels and communication blackouts from large quantities of dust and debris in the atmosphere. Large particles may cause structural damage and foreign object damage to aircraft.

(2) Induced radiation or neutron-induced gamma activity. Neutron radiation occurs only during the initial nuclear reaction. However, neutrons can cause other elements to become radioactive. The ground directly below the point of detonation will most likely become radioactive. This induced pattern, usually not exceeding 2 kilometers in diameter, will present a significant

radiation hazard for ground personnel for two to five days after the burst. The extent of the hazard can be determined by reconnaissance or survey teams.

c. Radiation Exposure and Sickness. Aircrews exposed to radiation may exhibit certain symptoms. The onset of radiation symptoms, their severity, and their duration generally depend on the amount of radiation the individual receives and variables such as health, previous exposure, and injury. Before directing aircrews into areas of suspected or known radiation contamination, aviation commanders must evaluate the essentiality of the mission. Aircrews can use radiac meters in aircraft to measure total dose rates. Commanders can then evaluate the effects of aircrew exposure and anticipate aircrew ability to perform future missions. Table A-1 shows the biological effects of a range of radiation doses. The table

also shows the effects of mid-range doses on performance. An individual exposed to radiation may have alternating periods of performance degradation, combat effectiveness, and combat ineffectiveness.

(1) Radiation exposure. Radiation exposure considerations are much the same for aviation personnel as for ground personnel. However, the aviation commander has the more difficult job of determining when an aircrew becomes ineffective from radiation exposure. FM 101-31-1 contains additional information on radiation effects.

(2) Radiation sickness. Aviators must be alert to symptoms that impair their ability to fly. Leaders should observe their personnel closely to detect behavior that may necessitate grounding them. Initial symptoms of radiation sickness include nausea, fatigue, and listlessness that may mimic the symptoms of other illnesses. Flight surgeons should monitor radiation exposure and provide appropriate guidance to the commander.

A-8. ELECTROMAGNETIC PULSE EFFECTS

Electromagnetic pulse, or EMP, is a wave of electromagnetic energy produced by a nuclear detonation when gamma rays make contact with the atmosphere. It occurs immediately after nuclear detonation and travels outward in all directions. EMP presents no significant biomedical hazard to humans. However, it can damage electronic components.

a. Component and Aircraft Systems Damage.

(1) Component damage. A sudden surge of EMP will cause overvoltage, shorting out wiring and transistors. Vacuum tubes may be somewhat affected by EMP, but more energy is required to destroy them. EMP can enter through the casing of radios and destroy them. It can destroy circuitry even with radios turned off and antennas disconnected. The severity of the damage depends greatly on component design.

(2) Aircraft systems damage. Aircrews should know which aircraft electrical systems (aircraft instruments, radios, or navigational aids) are critical and how failure of those systems will affect the flight.

b. Communications Interference. EMP will affect the command and control communications nets of aviation units. Commanders must be prepared for EMP degradation by training with backup units and alternate means of communication.

Table A-1. Expected response to radiation

Section III

BIOLOGICAL AGENTS

A-9. LIVING ORGANISMS

Classical biological agents include anthrax, plague, cholera, smallpox, botulism, typhoid, and microtoxins. These agents are living organisms that usually require a host body to mature. Because the effects of these agents are usually delayed, a natural outbreak may be difficult to differentiate from a covert attack. Some agents are highly persistent, while others have a short life span outside the host body.

A-10. TOXINS

Toxins are poisonous chemical substances produced by living organisms. They are found in nature but only in small quantities. Microorganisms, plants, animals, reptiles, and insects produce toxins.

a. Common Toxins. Some commonly known lethal toxins that microorganisms produce are botulism, staphylococcus, and tetanus. Other toxins are produced by poison ivy, snakes, poisonous frogs, bees, spiders, and scorpions. Their toxicity ranges from extremely lethal to simple harassment such as an ant bite.

b. Yellow Rain. Tricothecene toxin is also known as yellow rain. T2, as it is commonly called, is a by-product of the respiration process of an organism that grows on decomposing grains. Individuals exposed to large doses of T2 soon experience an onset of violent itching, vomiting, dizziness, and distorted vision. Within a short time, they vomit blood-tinged material and later larger quantities of blood. The affected individuals die within hours, manifesting shock-like symptoms. Personnel may be exposed to smaller doses directly or indirectly through consumption of contaminated water or food. These individuals experience a slower onset of similar symptoms along with bloody diarrhea. Many die eventually of dehydration. Survivors may take several months to heal.

c. Botulism. Another highly lethal toxin is the by-product produced by clostridium botulinum. This agent causes botulism and is extremely lethal to humans. It is several times more lethal than any of the standard chemical agents.

A-11. EFFECTS

Mild exposures to biological agents can severely degrade performance. Many of the classical diseases have delayed effects, whereas the effects of most toxins are immediate. Toxins can create area contamination as well as downwind and vertical vapor hazards. Medical personnel, especially flight surgeons, must constantly monitor aviation personnel to detect unusual symptoms that may indicate exposure to a biological agent. FM 8-9 contains detailed information about the effects of biological agents.

A-12. PROTECTION

Commanders must be prepared to protect their personnel against biological agents used by an enemy. The United States has immunization programs for many of these agents.

Section IV

CHEMICAL AGENTS

A-13. NERVE AGENTS

a. Effects.

(1) Extremely low dosages of nerve agents can disable personnel. Low dosages can degrade the ability of aircrews to operate aircraft and ground personnel to support aviation operations.

(2) Nerve agents are lethal in either vapor or liquid form and can be employed as nonpersistent or persistent agents. They cause casualties through any portal of entry: respiratory tract, skin, eyes, or mouth. (They are usually ingested by mouth with contaminated food or water.) Within one to two breaths after aircrews have flown into a vapor cloud, they can inhale sufficient agents to cause convulsive movements of the extremities within 30 seconds. Collapse and unconsciousness occur within one minute with flaccid paralysis, respiratory failure, and death occurring within one to two minutes. When agents are ingested in contaminated food or water, symptoms may vary or be delayed.

(3) Low dosages of a nerve agent will also cause miosis. Symptoms of miosis are pinpointed pupils, blurred vision, and eye pain. The victim cannot adapt to night vision because the dark adaptation of the rods in the peripheral portion of the retina is restricted. Miosis may last for hours or several days. Full recovery may not occur for weeks.

(a) The absence of miosis does not exclude nerve agent poisoning, especially in cases of ingestion or skin exposure. Miosis may occur almost immediately after exposure, or it can be delayed 30 minutes or longer after a mild exposure. When drinking with the M24 mask on, personnel must shut their eyes until the mask is cleared. This will lessen the chance of the eyes absorbing tiny doses of nerve agents. Eye drops may be administered to relieve pain, but they do not return vision to normal. Recovery time depends on individual reactions. Near vision, night adaptation, far vision, and accommodation will slowly return to normal in varying degrees.

(b) During bright daylight, the only effect of miosis on vision may be dimness. During periods of low visibility and at night, dusk, and dawn, the impact of miosis may be significant. Aircrews may not be able to fly.

(c) The impact of miosis on personnel is not limited to aircrews. Ground support personnel in air traffic services and air defense units and command and control facilities will also be affected by miosis. This degradation of support capability will affect all aviation missions.

b. Antidotes. The nerve agent antidote treatment available for soldiers is the NAAK. Each NAAK includes one atropine autoinjector and one pralidoxime chloride autoinjector. FM 8-285, FM 21-11, and STP 21-1-SMCT describe the procedure for administering the nerve agent antidote.

(1) The NAAK will keep a nerve agent victim alive; every soldier must be thoroughly trained in its use. The NAAK must not be used on a person unless he has actually been exposed to a nerve agent.

(2) The effects of atropine and pralidoxime chloride on aircrews are being studied. Serious side effects may impact on a person's fitness for flying duty. When an adequate dose of atropine is injected for lifesaving measures, dryness of the mouth is a side effect. This side effect will also occur even if no agent is present in the body and atropine is injected. One autoinjection will probably not seriously degrade an aircrew's ability to function, but three autoinjections may cause hallucinations. Some side effects of atropine are denial of illness, loss of insight, and loss of consciousness. Other symptoms include perceptual difficulty, judgment and memory impairment, confusion, short attention span, slurred speech, and restlessness. These reactions are similar to the symptoms experienced from incapacitating agents such as psychochemicals, cocaine, and cannabis.

(3) The current nerve agent pretreatment drug is pyridostigmine. The unit commander determines when personnel should begin taking the drug. It is then taken every eight hours. FM 8 285 contains information about pretreatment procedures.

A-14. BLOOD AGENTS

Blood agents are nonpersistent agents that have an effective duration of ten minutes to two hours. Within one or two breaths, individuals can inhale a lethal dose of blood agents. Death may follow within one minute. Mild exposure will result in the same symptoms as those experienced from lack of oxygen. Soldiers who survive moderate to severe exposure may not be able to return to flying status for several weeks or longer. The damage to cells caused from the lack of oxygen may result in persistent fatigue, irrationality, loss of coordination, vertigo, and headaches. One type of blood agent, cyanogen chloride, causes chronic bronchitis. No current self-aid/buddy aid antidote exists for blood agents.

A-15. BLISTER AGENTS

Blister agents cause severe skin blisters and respiratory damage. These persistent chemical agents can cause injury in both liquid and vapor forms. The blisters damage the subdermal layers of skin and cell protein structure and take from weeks to months to heal. Very low concentrations of blister agents cause painful eye damage, to include conjunctivitis, edema of the lids, and a feeling of grit in the eye. In large concentration, mustard agents can cause permanent damage, corneal scars, or opacity. A tiny amount of liquid droplet (Lewisite or phosgene oxime) in the eyes may cause permanent injury or blindness. Blister agents cause systemic poisoning throughout the body and can impair performance. Some symptoms are blood pressure decrease, nausea, malaise, and dehydration. Blister agents are not usually lethal, but severe respiratory damage, secondary infection, or dehydration may cause death. FM 8-285 contains treatment procedures for blister agents.

A-16. CHOKING AGENTS

Choking agents are nonpersistent agents that can cause injury to unprotected personnel. The injury may result in mild eye irritation and damage to the lungs and respiratory tract. The initial choking effect may cause loss of aircraft control. In severe cases, membranes swell, lungs become filled with fluids, and death results from a lack of oxygen. FM 8-285 describes the treatment procedures for choking agents.

A-17. INCAPACITATING AND RIOT CONTROL AGENTS

Irritating agents and psychochemical agents employed by the Threat should not cause death unless personnel are exposed to much larger concentrations than would normally be used on the battlefield. FM 3-9 describes these agents in detail, and FM 8-285 describes the effects of these agents and the treatment procedures.

A-18. PROTECTION

Even a mild exposure to agents may be fatal to aircrews, because aircraft control may be lost. Also, the long-term, systemic effects of agents and treatments can degrade an aircrew's performance. Flight surgeons should monitor aircrews for symptoms of exposure to agents. When personnel are not wearing NBC protection and exposure to agents is suspected, they may be temporarily grounded and observed for symptoms. However, in the absence of actual symptoms, the tactical situation may preclude preventive grounding. Aircrews should wear full MOPP4 gear during flight, and ground troops should also have adequate protection. The unit commander makes this decision based on a risk analysis.

Section V

NBC DEFENSE FUNDAMENTALS

A-19. CONTAMINATION AVOIDANCE

Contamination avoidance--the first fundamental of NBC defense--means taking the appropriate action to reduce NBC hazards. The factors of METT-T are considered for all operations to include entering contaminated areas and preparing to encounter unknown contaminated areas. Aircrews should go into hazardous areas only when necessary. Aviation brigades use the NBC warning and reporting system and reconnaissance, monitoring, and survey to help locate contaminated areas.

a. Contamination Transfer.

(1) All soldiers should understand how they and their equipment become contaminated and how contamination spreads to other personnel and equipment. A unit may be the target of an NBC attack, or the downwind hazard from a contaminated unit may cause agents to drift into another unit's area. Aircrews may be required to fly into contaminated areas from which aircraft can transport contaminated equipment or personnel.

(2) Rotary-wing aircraft can transfer contamination from the ground into the aircraft or vice versa. This transfer occurs when the rotor wash picks up dust, sand, leaves, or other contaminated debris. The debris or liquid droplets are then scattered throughout the aircraft. Some agents are like a fine spray and, although suspended in the air, can settle on personnel or equipment like dew. Aircraft vibrations increase the settling of agents in remote areas of the airframe such as panel points or rivets. Alkyd-based paints on aircraft absorb the agents like sponges. Newer paints (such as agent-resistant coatings) are being developed that resist chemical agent absorption.

b. Principles. The principles of contamination avoidance are applying passive defensive measures;

warning and reporting; locating, identifying, and marking NBC hazards; limiting the spread of contaminants; and avoiding contaminants.

(1) Applying passive defensive measures. measures are not direct reactions to a specific attack but rather are measures taken to reduce vulnerability to being targeted. Aviation units must apply the principles of detection avoidance, dispersion, and training to protect personnel and materiel.

(a) Detection avoidance. Commanders must train their personnel in the principles of detection avoidance. Commanders should carefully choose unit positions and command post locations. They must ensure that their troops are protected as much as possible from detection by using natural concealment, cover, and camouflage. Aviation units can also use air routes and firing positions that take advantage of natural vegetation and terrain features.

(b) Dispersion. In cases where the terrain is not suitable for concealment, commanders can disperse their assets so that the unit presents a less lucrative target. Varying the pattern of unit deployment avoids stereotypic patterns that allow the Threat to identify the type of aviation unit being observed.

(c) Training. Units must train to survive initial NBC attacks and to continue their missions without slowing down.

(2) Warning and reporting. Once an NBC attack has occurred and personnel have located an area that is contaminated or is threatened by downwind hazards, they must inform affected units without delay. Early warning provides personnel with time to protect themselves against NBC hazards. The warning and reporting of attacks are done by simple, standard messages with the NBC warning and reporting system. The NBC warning and reporting system consists of standard reports, system management, and attack warnings. A recent addition to standard reports is an NBC-6 summary report on chemical and biological attacks. Another addition is a chemical downwind

message that gives surface meteorological data so that personnel can prepare fresh chemical downwind hazard predictions. FM 3-3 and GTA 3-6-3 show report formats.

(a) Collection sources. NBC information is collected from numerous sources. It may be obtained from an observed attack on a unit or after an attack through reconnaissance, monitoring, and survey operations conducted by the aviation brigade or a subordinate unit. Units in attack or hazardous areas will forward monitoring reports.

(b) Observers. Only designated observers will automatically forward reports on nuclear burst parameters. Nondesignated observers collect the information and hold it until it is requested. The squadron commander may select several aircrews as designated aerial observers. Their mission is to obtain nuclear burst information. Aviation units can obtain good visual data such as cloud parameters, approximate ground-zero location, and crater size. Utility or observation aircraft are probably best suited for the designated aerial observer mission.

(c) FARP elements. The commander must forward hazard information to FARPs and other separate activities. FARP elements use hazard information for selecting routes, setting up sites, and selecting clean areas for rest and relief. Unit SOPs should address how messages will be forwarded. Radio communications with ATS facilities may be used as an alternate method of relaying hazard information to FARPs. The FARP will probably become contaminated while support aircraft will remain clean. However, the opposite may also occur. Therefore, aircrews and FARP personnel should establish a standard method of communicating NBC hazard warnings between them. Hand-and-arm signals, panels,

flags, or any other type of standard signal should be included in unit SOPs.

(d) Attack warnings. Nuclear weapons pose significant hazards to aircraft. Commanders must have a thorough understanding of the attack warnings so that the capabilities of aviation assets are not degraded. Warnings of friendly nuclear and chemical attacks ensure that friendly forces have time to protect themselves from the attacks. These warnings are called STRIKWARNs or CHEMWARNs. FM 3-3 and GTA 3-6-3 outline the message formats. The executing commander is responsible for starting the warning. Messages must be sent to adjacent units and to the subordinate headquarters whose units are likely to be affected by the attack. When a nuclear strike is canceled, units warned previously must be notified without delay. Local policies may specify a wait time after the planned time of detonation when the message is automatically canceled. Aviation assets are dispersed throughout the battlefield. The supported unit may not be inside a STRIKWARN zone; therefore, it may not receive the warning. However, aircraft supporting that unit may be where overpressures will cause damage. Because of the long-distance hazard of nighttime flash blindness, aviation units must know when friendly nuclear weapons will be fired. For these reasons, executing commanders should send the attack warning to all aviation units. All aviation assets, including ground support, must receive information about friendly nuclear strikes. ATS facilities will be used to the maximum extent to relay STRIKWARNs to aircraft operating within the effective ranges of nuclear detonations. Units should develop alternate methods of passing an immediate warning to aircraft during flight.

(3) Locating, identifying, and marking NBC hazards.

(a) Once personnel detect an NBC hazard, they must mark and identify the hazard. Units must plan their area of operations outside the contaminated area when possible. The unit has three methods of determining the limits of a contaminated area: reconnaissance, monitoring, and survey.

Hazardous areas must be located, identified, and marked especially along defiles, routes, and point hazards. Marking may be immediate or hasty. Hazardous areas may be permanently marked later with standard NATO signs.

(b) Aviation assets are ideally suited for conducting reconnaissance and radiological surveys. FMs 1-117 and 3-3 discus radiological surveys.

(c) Chemical agent detectors or alarms are not mounted on aircraft. Using aircraft with point detectors in this role is not considered a feasible mission. Chemical reconnaissance with aircraft will be limited to flying a chemical detection team to selected areas.

(d) Aircrews can help identify contaminants on or in the aircraft. They can mount M8 or M9 detection paper on the inside or the outside of the airframe at various locations. Because the paper does not stick to the paint on the aircraft, it should be wrapped around a painted area with the ends of the paper overlapping. Recommended areas for mounting this paper include the inside and outside of Plexiglas, seat frames, landing gear, floor panels, or other areas where agents are likely to collect. When the paper is placed on exterior Plexiglas, the spots can be seen from inside the cockpit during the day. Ground support personnel can read the paper on other exterior surfaces. Personnel should not use the paper in a way that creates a foreign object damage hazard.

(4) Limiting the spread of contaminants. When operating in a contaminated area, all personnel must take

steps to limit further exposure to the hazard. When possible, aircrews should fly clear routes through contaminated areas to limit exposure to NBC hazards. An aircraft that hovers or lands in a contaminated area can splash contaminants onto itself. Likewise, contaminants can be transferred into the aircraft by contaminated passengers or ground crews. Therefore, aircrews should make every effort to avoid landing a contaminated aircraft at an uncontaminated FARP, airfield, or landing site.

(a) Aircraft can be contaminated by flying through an invisible vapor cloud while en route to a supported unit's location. Therefore, an aircraft flying through an area of suspected contamination should be screened for contaminants before it lands near personnel or equipment.

(b) If a contaminated aircraft must land, the unit should employ individual and collective protection measures to prevent casualties. If an aircraft must land in a contaminated area, a landing zone should be selected that will have a reduced splash effect.

(c) The same protective measures that are used for ground equipment can be used for aircraft on the ground. Almost any shelter that provides weather protection will protect somewhat from fallout and liquid chemical agents. Every effort possible should be made to limit the spread of contaminants into the interior of the aircraft. Aircraft ground protective measures include-

Providing overhead cover for parked aircraft when possible.

Parking aircraft near buildings in built-up areas for limited protection.

Ensuring doors, vents, and windows are closed when aircraft pick up or deliver troops in contaminated landing zones.

(d) Contaminated crews should conduct inspections without touching or shaking items. Many inspection points can be inspected visually.

(e) Personnel should make every effort to limit contamination transfer. This can be accomplished by-

Keeping equipment in original containers; for example, ammunition cans.

Placing equipment in covered vehicles or shelters and operating it from these locations.

Conducting arming and refueling operations at FARPs while aircrews and/or passengers remain in the aircraft.

Covering aircraft and ground equipment in the FARP and rear areas to avoid direct contact with contaminants and then discarding the covers to operate the equipment. (Examples of covers are tarpaulins, plastic bags, and cardboard boxes.)

(f) Aircraft that must operate in a contaminated area should be limited in number or to aircraft already contaminated.

(g) When transporting contaminated personnel or casualties, aircrews should line the troop compartment with plastic to limit the spread of contaminants. A plastic curtain can be fastened between the troop compartment and the cockpit with tape or Velcro to limit contamination transfer. The aircraft's heater can be used with the curtain to create an overpressure in the cockpit. This will limit vapors from entering the cockpit.

(h) M9 paper can be affixed to the landing gear of the aircraft so that FARP personnel can check for contaminants before servicing the aircraft. M9 paper also can be placed on the windscreen where the aircrew can check it.

(i) When flying aircraft out of contaminated areas into clean areas, aircrews should open all doors and windows. About 20 minutes of flight will rid the aircraft of accumulated vapor hazards and radioactive debris, but liquid contaminants will remain a hazard.

(5) Avoiding contaminants.

(a) Contamination should be avoided if possible because the decontamination process is difficult. The best way aircrews can keep aircraft free from contamination is to avoid flying them into contaminated areas. However, aircrews have no onboard means of determining, in the air or on the ground, which areas are contaminated. Therefore, they may be unable to avoid contaminated areas. Contamination avoidance also applies to ground support locations such as FARPs. FARPs are vulnerable because of their mission, but their mobility may lessen the chance of their being targeted by Threat forces. Aircraft are also vulnerable while being serviced at FARPs.

(b) Commanders must rely heavily on the NBC warning and reporting system and intelligence reports to learn what battlefield areas are contaminated. However, some areas may not be reported and new attacks may occur at any time.

(c) Another source of information comes from the supported unit. Commanders should select alternate locations where they can complete their mission if the area of operations becomes contaminated. The flexibility of aviation assets allows aircrews to "fly around" known contaminated areas and still accomplish the mission. When choosing among options, however, the commander knows the primary consideration is always mission accomplishment.

NOTE: M9 paper detects liquid agents; however, it may not show a significant reaction to a vapor or an aerosol hazard.

A-20. PROTECTIVE MEASURES

Protection--the second NBC defense fundamental--is both individual and collective. When the unit cannot avoid contamination or is under direct attack, soldiers must take appropriate actions to survive. Specific actions are taken before, during, and after an attack. To sustain operations in an NBC environment, unit personnel must understand and practice individual and collective protection. Individual protection involves those measures each soldier must take to survive and continue the mission. These include acting immediately upon observing a nuclear detonation, donning MOPP gear, and wearing other protective equipment and devices. Collective protection provides a contamination-free working environment for selected personnel and precludes the continuous wear of MOPP gear.

a. Individual Protective Equipment and Clothing.

(1) MOPP gear. Soldiers are issued MOPP gear to protect themselves from a chemical or biological hazard. MOPP gear consists of the CB protective mask, hood, overgarment, overboots, protective gloves, individual decontamination kit, detection equipment, and antidotes. FM 3-4 describes each item, to include service life and proper use.

(2) Nomex flight suit and gloves. Until a fire-retardant overgarment is fielded, aircrews will continue to wear the Nomex flight suit and gloves under the overgarment and protective gloves. When aircrews wear the Nomex gloves, they do not need to wear the white cotton inserts.

(3) Aviation life support equipment. All soldiers must be issued a mask, an overgarment, and protective gloves in the correct sizes. Soldiers should ensure that they have the correct glove size so that their tactile sensitivity is not degraded. The size of the overgarment depends on the unit's policy for wearing ALSE.

Usually, soldiers will wear the ALSE over the overgarment. During an emergency in a CB environment, aircrews need access to the contents of the survival vest. If the vest is worn under the overgarment, the soldier risks contamination to get to the vest. Commanders should carefully evaluate their policy and requisition overgarment sizes accordingly.

(4) Night vision devices. The AN/PVS-5 and AN/AVS-6 cannot be used with the present M24 aviator mask. Wearing the hood under the helmet with the M25 mask creates hot spots; individuals may need to be refitted with a larger size helmet.

(5) M10A1 canister. Commanders should carefully evaluate whether individuals should change their own canisters. Changing the M10A1 canister is currently an organizational-level maintenance task. However, aviation personnel are widely dispersed on the battlefield, and maintenance or NBC personnel may not be available to change the canisters. Blood agents will degrade the canister, requiring the operator to change it after an attack. Therefore, aircrews should receive training in the procedure for changing the canister.

(6) M24 mask. When wearing the M24 mask while operating the AH-1 telescopic sight unit, aviators should be careful not to scratch the mask lens. They should use a clear visor over the mask lens to prevent scratches. Some aviation units may receive M43 masks to replace the M24 masks.

(7) Mask carrier.

(a) In some aircraft, aircrews may not have room to wear the mask carrier during flight. If not, the items from the carrier that are needed during flight should be stored in the aircraft or in the protective clothing. Units should establish a policy so that aircrews know what procedures they are to follow for the type of aircraft they fly.

(b) Some of the items that will be needed during flight are the antifog kit, M258A1 skin decontamination kit, antiglare shield, and antidotes. Soldiers can take the packets of the decontamination kit from the hard plastic container and put them in overgarment pockets. Personnel can also make a storage area inside the cockpit for the carrier or the M258A1 kit and antidotes.

(8) Skull cap. Some personnel have procured the skull cap, a small cap of Nomex material worn under the flight helmet to keep the helmet from irritating the scalp. The skull cap can be worn under the mask head harness if it does not interfere with the seal of the mask about the face. If the cap is worn inside out, the seams will not dig into the scalp and cause more irritation.

(9) Overboots. Overboots can present a safety hazard (foot slippage) if personnel use laces stretched from wear or do not tie the laces properly.

(10) Gloves. During maintenance, such as preflight, postflight, and FARP operations, personnel can easily tear their protective gloves on the aircraft. When personnel perform maintenance tasks, they should consider wearing a leather glove over the CB protective glove; they should remove the leather glove before they fly.

(11) CB mask. The CB mask is required for protection against chemical agents. However, it can also protect aircrews from radioactive dust while they conduct aerial surveys or other missions over radiologically contaminated areas. The mask filters out dust or dirt that has radiological agents. In the absence of a CB threat, soldiers may wear other protection such as surgical masks or handkerchiefs.

Aircrews may elect to wear the CB mask to keep the large amounts of dust that are present from irritating the eyes.

(12) Faceform. A faceform is used to store the M24 mask to prevent face set. Units may elect to keep the faceform in place to lessen the damage when the mask is being carried. The unit SOP should specify when to carry or remove the faceform.

(13) External drinking adaptor. TM 3-4240-280-10 and STP 21-1-SMCT describe the procedures for drinking water when personnel wear the M24 mask.

b. Mission-Oriented Protective Posture. Commanders select a level of protection based on the chemical or biological threat, temperature, work rate, and mission. The levels of protection are MOPP zero through MOPP4 plus a mask-only option. FM 3-4 describes the MOPP levels and option.

(1) In-flight MOPP status. Aircrews fly in MOPP4 gear when a high threat of CB agent use exists or when agents have been used on the battlefield. Aircrews also fly in MOPP4 gear when they conduct NBC reconnaissance operations. Some of the reasons for this are-

Personnel cannot detect agents with their senses.

Agent clouds travel vertically as well as horizontally.

Aircrews exposed to CB agents may be grounded for an extended period.

Aircraft are not equipped with advanced warning or detection devices.

It is not practical to don CB equipment, including the mask, during flight.

Aircrews exposed to sublethal dosages of CB agents during flight may lose control of the aircraft and crash.

Rotor wash may transfer droplets or contaminated dust inside the cockpit, creating a skin contact hazard.

Aviation missions cover large areas, and agents may be present where troops are unavailable to report the attack.

Even when agent hazard areas are marked on a map, winds and temperature gradients may change during the mission.

(2) On-the-ground MOPP status. When aircrews are on the ground, the MOPP status will depend on the ground situation. Preflight and postflight inspections may be conducted with a lower MOPP level if the ground situation does not require MOPP4. When aircrews fly in MOPP4 gear in uncontaminated aircraft, they may fly into known clean areas for rest and relief. If ground support areas (such as a FARP and troop or maintenance area) are clean, aircrews may lower their MOPP status once they are on the ground.

c. Performance Degradation and Countermeasures. CB protective equipment will keep soldiers alive. However, the equipment degrades performance because it hinders dexterity, limits vision and movement, and increases heat stress. Commanders must weigh actual performance degradation against perceived problems with the equipment. MOPP gear has a physiological and psychological impact on personnel. Higher MOPP levels will significantly increase the time required to repair or maintain aircraft. Training is the key to limiting performance degradation. Thoroughly trained personnel can perform most required tasks while wearing MOPP4 gear.

(1) Vision. Use of the M24 protective mask reduces the peripheral vision of aircrews. To overcome this

limitation, aircrews must continuously scan in all directions. The normal range of motion for the head is 90 degrees from either side of the centerline. The mask limits this 180-degree range to a 140-degree range. Therefore, aircrews must turn their heads to scan and compensate for the lost visual range. The mask also blurs or distorts the aircrew's vision in the cockpit, especially during night operations.

(2) Fatigue. Each crew member must become familiar with the symptoms and causes of fatigue. To become more aware of these symptoms and causes, aircrews can refer to FM 1-301.

d. Collective Protection. Collective protection shelters are designed to keep out unfiltered outside air by means of positive overpressure. Personnel inside this shelter do not have to wear CB protective equipment. In a contaminated environment, either a shelter or clean terrain is needed for long-term rest and relief such as sleeping, showering, or eating. The continued integrity of the shelter depends on personnel following entry and exit procedures closely. The shelter becomes worthless if contamination is tracked in or carried in. Aviation forces are widely dispersed while operating throughout the battlefield. Therefore, they must carefully evaluate the number and placement of shelters.

e. Protective Actions.

(1) Aircraft protection while parked.

(a) Aircraft on the ground must be protected from strong winds. In a high-nuclear-threat environment, aircrews should park aircraft inside natural revetments or bunkers, barricades, or other man-made structures and then tie down the aircraft. Aircraft should also be covered as much as possible to protect them from toxic rain. Intelligence personnel can estimate what areas are likely to be targeted. When friendly nuclear strikes are planned, information on ground zero is given.

(b) Blast is not strictly a line-of-sight hazard as is thermal radiation. The blast wave bends around obstacles and rolls over hills in the same manner as normal winds. However, the reverse slope of a hill may substantially lessen the effect of winds. Aircraft cannot be effectively protected from the overpressure. Taping the windscreen may help, but it is not effective against higher pressures.

(2) Aircraft protection during terrain flight.

(a) Aircrews can take several immediate actions to protect aircraft during a nuclear attack. When a nuclear detonation occurs during the day, the aircrew will not immediately know the yield or distance. At night, the aircrew may become blinded. Immediate action depends on whether the aviator is blinded. During the day, flash blindness is not likely unless personnel actually focus on the fireball.

(b) For friendly nuclear strikes, aircrews should mark the areas on a map during premission planning so that they can stay outside minimum safe distance limits. When a nuclear detonation is observed, the rotary-wing aviator in terrain flight should turn away from the fireball immediately and land the aircraft as soon as possible. Even though nuclear detonation will be visible, the aircraft may not be within range to receive severe damage. Therefore, an aviator probably should not land immediately in the trees unless nearby landing areas are unavailable.

(c) The aviator has to make a split-second decision upon sighting the fireball. By immediately turning the aircraft away from the fireball, the aviator increases his chance of survival. Also, the missile effect on the Plexiglas is less hazardous to the aircrew because it travels away from the cockpit. In addition, the airframe provides protection from external missiles. After landing the aircraft, the aviator and crew

should remain inside because the aircraft offers some shielding against radiation. The aviator should keep the aircraft on the ground for several minutes to ensure that the blast wave has passed or that the aircraft is far enough away to be unaffected by the blast. The positive and negative phases of the blast will occur at about the same time. Therefore, the aircrew should wait until debris stops falling before exiting the aircraft. After checking the airframe to ensure that it is not damaged structurally, the aircrew can continue the mission.

(d) At night, 10-second flash blindness can occur at distances beyond the range of any other effect, including EMP. For large yield nuclear detonation, flash blindness can occur at the horizon. It will occur before individuals know they have retinal burns. For rotary-wing aircrews, protective measures are limited. However, when the aircrew wears the AN/PVS-5 that fits flush against the face, the amount of light that can enter around the goggles is reduced. Also, another protective measure is for one aviator to wear an eye patch over one eye. When either the AN/PVS-5 or the eye patch is worn, one aviator should have enough vision to land the aircraft. For the first few seconds after an aviator removes either the AN/PVS-5 or the eye patch, his immediate action is to gain altitude. (This is the same immediate action prescribed for goggle failure.) If the aviator is able to see, he should land the aircraft in the nearest suitable area. If the aviator is wearing no protection, he must immediately determine his vision limitations. If the aviator has little or no vision, he should gain altitude and attempt to wait until his vision returns. If the aviator has some peripheral vision, he should use night vision techniques to scan the area.

(3) Aircraft protection during cruise altitude. At night or during the day, aviators have the best chance of survival if they turn the aircraft away from the point of detonation and gain altitude. They should also protect their face and neck from Plexiglas fragments. In rotary-wing aircraft, aviators may be able to gain time until their vision returns. Nuclear detonations will probably affect enemy

electronic air defenses. Placing distance behind the point of detonation and the aircraft and gaining altitude will lessen the damage from the blast. If detonations are multiple, then the aviator can estimate the direction of the largest or closest detonation. Turning the aircraft away from the detonation will lessen the possibility of thermal radiation damage to the eyes. After the blast wave passes, the aviator should decrease altitude and attempt to estimate damage by control feedback. If the aviator suspects damage, he should land the aircraft as soon as possible to inspect it.

(4) Equipment protection against EMP. Equipment may be protected against EMP, but this protection must be installed by the manufacturer. Field-expedient methods of wrapping equipment in foil or burying it are not feasible. If electronic components have been EMP-hardened by the manufacturer, maintenance crews must be careful not to degrade this protection. Electrical equipment that meets specifications for protection against lightning strikes is not necessarily guarded against EMP, but any protection may help. Lightning strikes in milliseconds, whereas EMP effects occur in only nanoseconds (billionths of a second).

Section VI

DECONTAMINATION

A-21. DECONTAMINATION FUNDAMENTALS

a. In the past, Army doctrine dictated that when a unit became contaminated, soldiers stopped fighting, pulled out of battle, and found a chemical unit for the cleanup. This process was time-consuming and not tactically or logistically feasible. With the Threat's capability to contaminate large areas of terrain, a contamination-free environment after every chemical attack is impracticable if not impossible. Today's emphasis is on "fighting dirty" and conducting hasty decontamination along with natural weathering to reduce chemical or biological hazards.

b. The four principles of decontamination are as soon as possible, only what is necessary, as far forward as possible, and prioritized. The commander uses the factors of METT-T and some additional considerations to determine when, where, and how to conduct decontamination. When planning operations, commanders should consider-

The length of time that personnel have been operating in MOPP gear.
The missions that are planned in contaminated areas.
The capabilities of NBC personnel and the decontamination team.
The external support that is available from chemical units.
The decontamination support that the supported unit will provide.
The separated elements that must also receive support.

A-22. DECONTAMINATION LEVELS

Ground and aircraft decontamination techniques are shown in Table A-2. Unit personnel conduct basic skill tasks and hasty decontamination, whereas a chemical decontamination unit usually conducts deliberate decontamination. Although hasty decontamination reduces the hazard level, personnel must still use protective equipment. The goal of deliberate decontamination is to reduce the hazard level to a point where protective equipment is no longer required. When the tactical situation permits, deliberate decontamination may be performed during unit restoration operations in the rear area. Chemical decontamination units establish deliberate decontamination sites, and the supported unit assists in the operation. FM 3-5 describes decontamination techniques in detail.

Table A-2. Aviation decontamination techniques

A-23. DECONTAMINATION SUPPORT

Division chemical company personnel may be required to provide aircraft decontamination support in divisional AVIM areas. Chemical decontamination units provide hasty and deliberate decontamination support for aviation unit ground vehicles and equipment in their area of operations. The chemical unit and the aviation unit usually support the same combat unit.

a. Attached or OPCON aircraft units get decontamination support from the unit that they are supporting. The supported unit coordinates decontamination support for aircraft the same way it coordinates support for organic vehicles. However, aircrews must supervise the decontamination of their aircraft. Unit personnel conducting the decontamination may not have the skills or equipment to tow aircraft or the knowledge of proper aircraft decontamination techniques.

b. Basic soldier tasks are usually accomplished at FARPs and AVUM areas. The aircrew conducts spot and hasty decontamination operations in AVIM areas. Deliberate decontamination will probably be accomplished in divisional or corps AVIM areas.

A-24. AIRCRAFT DECONTAMINATION

The sensitivity of aircraft components to caustic solutions has necessitated the development of special decontamination procedures. Commanders must combine these special procedures with decontamination principles and determine where and when to conduct decontamination operations. Spot decontamination is the most cost-effective technique and will limit the spread of agents. Units may find that deliberate aircraft decontamination is not cost-effective when aircraft are in demand. Because aircrews fly in MOPP4 gear, commanders must compare how decontamination versus no decontamination will affect the mission.

a. Decontaminants.

(1) Only approved cleaning compounds may be used to decontaminate aircraft. Caustic decontaminants, such as DS2, STB, bleaches, or sodium hypochlorite, are not considered safe. DS2 corrodes rubber or plastic components and Plexiglas; STB corrodes aircraft skin and metal components.

(2) Soap and water, kerosene, JP4 or JP8, and diesel fuels are approved as decontaminants on selected parts of aircraft. JP4 or JP8 is effective in removing some agents from aircraft skin and components. However, it does not neutralize the agents. Personnel must use care when handling JP4

or JP8. When using a cloth soaked with JP4 or JP8 to wipe contaminated areas, personnel must avoid wiping internal components near the exhaust. If water is available, personnel should use it to rinse off the JP4 or JP8.

(3) When components are removed from the aircraft for repair, some contamination may remain. Personnel must decontaminate these components before cannibalization or overhaul. Once components have been decontaminated, personnel must rinse the components thoroughly before they are reinstalled on the aircraft. No guidelines exist on which decontaminants can be used on specific components. However, a general rule for choosing decontaminants is to use solvents that are normally applied to that component during routine maintenance. For example, hydraulic fluid may be used on hydraulic lines.

(4) Actual flight and aeration can help decontaminate external surfaces. The wind will blow some of the agent off the aircraft skin and expedite evaporation. However, some of the agent will remain in the paint and continue to be a hazard.

(5) Personnel must be careful when using pressurized water for decontamination. Aircraft skin and internal components can be damaged by moderate to high water pressures. Personnel must follow the guidelines in the appropriate aircraft maintenance manuals. Commanders should ensure that safety, maintenance, and NBC personnel coordinate decontamination operations.

b. Decontamination Techniques. When aircraft become contaminated, aircrews can rely on the protection provided by their MOPP gear. However, the wearing of MOPP gear for extended periods will adversely affect aircrew performance.

(1) Spot decontamination. The goal of spot decontamination is to limit the transfer and spread of contaminants by decontaminating aircraft surfaces that must be touched during flight operations. These surfaces include the landing gear, fuel ports, doors, and handholds. Either aircrews or ground personnel should conduct the spot decontamination. When possible, ground personnel should conduct the spot decontamination to limit the transfer and spread of contaminants into the aircraft interior. Table A-3 lists

guidelines for conducting a spot decontamination. Exact procedures and decontamination areas are described in FM 1-102 and the appropriate aircraft technical manual. Fuel and soap and water are probably the most common decontaminants.

(2) MOPP gear exchange. In a contaminated environment, MOPP gear exchange and rest and relief operations must be conducted. Every soldier must know how to change his MOPP gear to survive. Aircrews are often isolated from their parent unit and may not be able to return to their unit for MOPP gear exchange. Therefore, they will conduct the exchange with units in their area of operations. When the mission allows, aircrews may return to a unit decontamination area for the exchange.

(3) Aircraft washdown. Aircraft washdown is basically the same technique as spot decontamination. However, washdown involves more detailed and time-consuming procedures for interior and exterior decontamination. Units are encouraged to develop site layouts that are appropriate for their specific missions and the terrain. In addition, chemical units should develop procedures for assisting aviation units at washdown sites.

(4) Deliberate decontamination procedures. Decontamination sites are established by

chemical units, usually in the rear areas. The supported units conduct their own personnel and equipment decontamination. The chemical unit decontaminates vehicles, provides technical assistance, and supervises the entire site. Aviation units must be thoroughly familiar with their responsibilities at these sites. The supported aviation unit must coordinate closely with the chemical unit to ensure that aviators do not land contaminated aircraft in clean areas.

c. Decontamination Operations.

(1) Arming and refueling operations. Arming and refueling operations normally take place at the FARP. All areas that FARP personnel touch should be decontaminated. In most cases, these are fuel port areas. A more detailed decontamination is required for attack aircraft because of onboard weapon systems. Personnel should be careful to not soak areas of firing systems that are sensitive to the decontaminant.

Table A-3. Spot decontamination guidelines

Table A-3. Spot decontamination guidelines (continued)

(2) Entry and exit procedures. Commanders should outline entry and exit procedures for all types of aircraft because the procedures will vary with each type of aircraft. When procedures have been established, aircrews should practice them until they become proficient. In addition, FARP personnel must become familiar with the procedures. If aircrews intend to exit the aircraft, they should signal the FARP personnel. Then the FARP personnel can decontaminate most areas that the aircrews will touch in exiting the aircraft. The crew chiefs of most aircraft can conduct decontamination with equipment from the FARP. The possibility of transferring contamination into the cockpit is increased when aircrews exit the aircraft at the FARP. Aircrews should attempt to limit the amount of contamination transfer by using contamination avoidance measures. Before entering the aircraft, aircrews should use an M258A1 kit to decontaminate their gloves and overboots.

(3) Preflight and postflight inspections. When conducting preflight and postflight inspections on contaminated aircraft, aircrews must try to avoid becoming contaminated themselves. Spot decontamination helps reduce this possibility. Decontamination of gloves and overboots after the inspections will likewise reduce the chance of transferring contaminants into the aircraft. Aircrews may need to wear wet-weather clothing to keep most of the contamination off the overgarment. Preflight and

postflight inspections and decontamination operations during or after these inspections are physically demanding tasks that increase heat stress.

(4) Maintenance inspections. Personnel may conduct maintenance inspections before or after decontamination of the aircraft. Inspection crews use the decontamination techniques discussed in (2) and (3) above to avoid spreading contamination.

(5) Repair or recovery. Repair or recovery crews should be aware of the contamination level before they enter the area. Teams will evaluate the situation to determine when or if an aircraft component can undergo decontamination. Aircraft components must be properly tagged and documented in accordance with applicable technical manuals. Some items may be decontaminated before they are returned to the maintenance section if the maintenance area is clean. However, if the

maintenance area is contaminated, decontamination should occur there. Units may be able to move clean aircraft or components into clean facilities. Likewise, units may be able to direct contaminated aircraft or components to contaminated facilities. The management of clean and contaminated areas depends on the intensity of the battle and the availability of contamination information.

(6) Cannibalization and overhaul. The same decontamination considerations of clean versus contaminated aircraft and components also apply to cannibalization and overhaul maintenance activities. Maintenance unit leaders should closely evaluate specific repairs that require a clean area.

A-25. DECONTAMINATION SITES AND LAYOUTS

Aircraft decontamination poses unique challenges to commanders. They must decide when to conduct the various levels of decontamination. Most aviation units will conduct hasty decontamination operations. They may also conduct deliberate decontamination operations if the situation requires it and time is available. Aviation battalions or squadrons are responsible for selecting and securing decontamination sites as well as augmenting chemical personnel. Units select decontamination sites before hostilities begin. The location of these sites will be classified. Chemical units are responsible for operating decontamination sites. Only partial decontamination of Army aircraft is accomplished at decontamination sites. The decontamination protects aircrews, FARP and unit personnel, and equipment and ensures the unrestricted movement of aircraft to FARP and unit locations.

a. Site Selection Requirements.

(1) The decontamination area or site must accommodate the required aircraft, have a readily available water source, and allow for adequate drainage. The site should also be relatively secure but close enough to the FLOT or area of operations and FARP to facilitate a reasonably quick turnaround of aircraft. The site must have sufficient NOE routes no less than 2 to 3 kilometers from the station for entry and exit.

(2) All aircraft must descend to NOE when approaching and departing the Army aviation decontamination station, or AADS, to prevent enemy radar from detecting the site. The site also must have slope angles not exceeding the landing capabilities of the using aircraft. If the area is sloped, the AADS should be set up across slope. The using aircraft must not be forced to land uphill or downhill. The AADS may be sited to allow the use of a natural fresh water supply rather than the use of a mobile water vehicle. If so, drainage should not be allowed to contaminate the fresh water supply. Tentative decontamination sites, like tentative command post and FARP sites, must be considered and integrated into the tactical plan. Final approval of the AADS should be made by the NBC officer or NCO or an aviator designated by the commander.

b. Site Establishment. After the site is selected, reconnoitered, and secured, NBC defense personnel and the supporting chemical unit jointly establish the AADS. The unit commander may select a representative from the tactical command post or the S3 section to supervise the operation. As each company-level or troop-level unit is sequenced through the AADS, the remaining assets provide security. Table A-4 lists the personnel and equipment recommended for the establishment of an AADS.

c. Decontamination Methods. Deliberate decontamination consists of detailed aircrew and aircraft decontamination. The aircrew or aviation unit maintenance personnel must be available to supervise the aircraft decontamination. Any of three methods may be used for the detailed aircraft decontamination. They are the four-station pull, the four-station hop, and the one-station methods. The methods differ only in the setup of the decontamination site. The steps in decontaminating the aircraft are the same.

Table A-4. Recommended personnel and equipment for an Army aviation decontamination station

(1) Four-station pull method. In this method, aircraft are hooked to towing equipment and pulled through a decontamination line. Towing equipment and vehicles will become contaminated and must be decontaminated afterwards. This method is costly in terms of time and resources, but it is the most thorough way to remove contaminants. Figure A-2 shows a four-station pull decontamination site.

(a) Station 1. The aircrew remains onboard the aircraft after landing. The engine or engines are maintained at flight idle while decontamination personnel check the aircraft for contaminants with the M256 kit, M8 or M9 paper, or chemical agent monitor. The station should be large enough to preclude other aircraft from having to land in the same spot. This will help avoid contaminating uncontaminated aircraft during the decontamination operation.

Figure A-2. Four-station pull decontamination site

(b) Holding point. Aircraft land and shut down at a designated area. The aircrew exits the aircraft and goes through the personnel decontamination site. Aircraft are pulled from the holding point through stations 2 through 4.

(c) Station 2. Decontamination personnel use a spot decontaminant, such as JP4 or JP8, or wash the entire aircraft with hot, soapy water.

(d) Station 3 . The aircraft is rinsed with clean water. (Warm water is preferred.)

(e) Station 4. The exterior of the aircraft is deiced and/or dried, and the interior is decontaminated. If a hot air source, such as a Herman-Nelson heater, is available, decontamination personnel can use it to blow warm air into the cockpit. Drying the cockpit in this manner will reduce the amount of contaminants. However, hot air should not be directed onto instruments or gauges. After completing the decontamination, personnel should check the aircraft for additional contaminants.

(f) Release point. Aircraft are moved to a designated takeoff point. This will be the linkup point for the aircrew.

(2) Four-station hop method. This method is conducted the same as the four-station pull method except that station 1 is set up 1 to 5 kilometers from the other stations. The aviator is required to fly the aircraft to station 1 through station 4. Standard ground-guiding (hand) signals will be used per FM 21-60 during aircraft movement. Aviators must ensure that decontamination personnel approach and depart the aircraft

from the 45-degree forward position. Aviators must maintain engine RPM at flight idle at the decontamination stations. During movement between the stations, aircraft will take off from contaminated ground. However, the decontamination line can be spread out over a large area, increasing tactical survivability. Figure A-3 shows a four-station hop decontamination site.

(a) Station 1. The station should be large enough to preclude other aircraft from having to land in the same spot. This will help avoid contaminating uncontaminated aircraft during the decontamination operation. Upon arrival at station 1, the aviator will be ground-guided into position. After landing, the aviator should place the collective full down and maintain engine RPM at flight idle. Decontamination personnel check the aircraft for contaminants with the M256 kit, M8 or M9 paper, or chemical agent monitor. If the aircraft is contaminated, the aviator will reposition the aircraft to station 2 for the decontamination process.

(b) Station 2. Decontamination personnel use a spot decontaminant, such as JP4 or JP8, or wash the entire aircraft with hot, soapy water. Visible contaminants must be washed from the windscreen before the aircraft is moved to the next station. Aviators must ensure that windscreens are clear of suds.

Figure A-3. Four-station hop decontamination site

(c) Station 3. The aircraft is rinsed with clean water. (Warm water is preferred.) At no time will water be directed into the air intake system. Water will not be directed onto-windscreens unless they required decontamination in station 2.

(d) Station 4. Exterior areas that were washed and rinsed in stations 2 and 3 will be deiced and/or dried and checked for remaining contaminants. The aircraft's interior also will be decontaminated. If a hot air source, such as a Herman-Nelson heater, is available, decontamination personnel can use it to blow warm air into the cockpit. However, hot air must not be directed onto instruments and gauges because they are easily damaged. Aircraft will be checked for additional contaminants before they are released.

(3) One-station method. This station is established the same as the four-station methods, but the station itself is mobile. Aircraft arrive in flights of four to eight, depending on the size of the site. All aircraft in the flight land and shut down in a single area, and aircrews exit the aircraft. Decontamination personnel move equipment to the aircraft and perform the decontamination steps. Aircrews are decontaminated at a nearby decontamination area. The one-station method is relatively quick, but runoff from the aircraft will contaminate the ground. When an aircraft takes off, rotor wash may recontaminate the aircraft as well as personnel and equipment at the site. Pressurized water sources include the M12A1 power-driven decontaminating apparatus, the M17 sanator system, and the M13 decontaminating apparatus portable. Figure A-4 shows a one-station decontamination site.

d. Safety Precautions.

(1) At no time will station personnel cross in front of an aircraft that has a turret weapon system whether it is armed or not. If an aircraft has a weapon system of any type, the aircrew will ensure that the system is cleared and placed on SAFE before the aircraft enters the decontamination station. Station personnel also must not cross to the rear of a running aircraft unless a proper clearance distance from the turning tail rotor is maintained.

(2) The team leader will give all signals to aircrews. Before signaling the aircrews to move aircraft, the team leader will have visual contact with the other team member. Team leaders in each station will wear

white arm bands in the manner prescribed by the unit SOP.

Figure A-4. One-station decontamination site

Section VII

SUSTAINED OPERATIONS

A-26. FORWARD ARMING AND REFUELING POINTS

a. Aircrew Support. Forward arming and refueling points enable aviation units to apply continuous pressure on the Threat by decreasing turnaround times and by increasing loiter times. If FARPs are near or collocated with other units that have NBC support, NBC support for the aviation elements may be arranged with those units. In a CB environment, the commander will have difficulty keeping attack aircraft in operation. However, teams of aviation assets can rotate in and out of the MOPP gear exchange or rest and relief site after several turnarounds. Clean and contaminated FARPs may be established to facilitate rapid relief-on-station operations and prevent repetitive contamination. The mission and temperature will determine how often the crews visit a rest and relief station.

b. NBC Planning. Detailed preplanning is the key to successful FARP operations in an NBC environment. Because FARPs are vital to the aviation mission, the issues below are included to assist commanders in planning FARP operations. General, nuclear damage, and CB contamination considerations are covered in the issues listed below.

The manner by which friendly STRIKWARNs or CHEMWARNs will be passed to FARPs and to aircraft being serviced at the FARPs.

The use of smoke to lessen FARP vulnerability during site preparation and closure.

The training of at least one member of the FARP in the two previous considerations.

Dosage estimates when the FARP is operating in a radiologically contaminated area; how this dosage estimate will affect operational planning.

Awareness of FARP personnel concerning nuclear damage to aircraft. (They must be able to identify nuclear damage to armament systems.)

Knowledge of FARP personnel on how to minimize nuclear blast effects and thermal damage to fuel blivets and other FARP equipment.

Assistance of the supported or parent unit in hasty decontamination.

Guidance to FARP ground personnel concerning the best routes through or around contaminated areas.

Visual or radio communications FARP personnel may use to warn the aircrew on an incoming aircraft that a FARP site is contaminated. Also, the method by which an aircrew warns FARP personnel that the aircraft is contaminated.

In a chemically contaminated area, the individuals designated to dismount at the FARP.

If aircrews dismount, the provisions made for spot decontamination to lessen the transfer of contamination.

- The provisions made to keep contamination out of the cockpit (especially that carried in on

boots)
when aircrews enter the aircraft.
During high-sortie missions, how FARP personnel wearing MOPP4 gear can keep up with the workload; plans made for rest and relief or assistance.
When JP4 or JP8 is used as a spot decontaminant, the need for personnel to be trained in its hazards.

The training of FARP personnel to use covers in a manner that does not create foreign object damage hazards.
The preparation of FARP personnel to accept contaminated supplies.
The coordination and provision of personal needs for aircrews at the FARP.

A-27. ARMY AIRSPACE COMMAND AND CONTROL

The control of airspace is important during a conflict just as it is in peacetime. A2C2 elements must work closely with NBC elements or control centers. STRIKWARNs and CHEMWARNs may be passed through A2C2 networks as well as units. NBC personnel will use NBC contamination information and friendly nuclear minimum safe distances to establish air corridors.

A-28. SURVIVABILITY

a. Radiological Contamination. A nuclear strike may cause aircraft to crash or suffer a hard landing. Surviving aircrews should be alert for forest fires or other fires caused by thermal radiation. However, radiological contamination will be the aircrew's most significant hazard. If the aircraft goes down in a fallout area or the crew receives fallout, the dose rates can be high enough to cause casualties. Each aircraft will usually have an IM93 or a DT-236/PDR-75 that measures the total dose received by the aircrew.

b. Radiological Particle Ingestion. If the situation permits, the crew should attempt to dig a deep fighting position or find cover such as a cave, an upper story of a house, or an abandoned armored vehicle. Living off the land will pose long-term hazards from the ingestion of radiological particles. The best preventive measure for this is to wash the food. Heat will not reduce any radiological hazard. Running water will dilute radiological agents and reduce the risk of drinking contaminated water. Radiation weakens the body's ability to fight disease. One of the first symptoms of radiation sickness is diarrhea.

c. Lethal Chemical Agents. In a lethal chemical environment, surviving personnel will be faced with many additional hazards. The current overgarment is not made of fire-retardant materials. When the situation permits, the crew should readjust the CB protective gear and take action to find out if the area is contaminated. They can use the M8 or M9 detection paper onboard the aircraft to identify chemical agents and the M256 detection kit to identify vapors. However, these will not detect toxins or biological agents. The crew should look closely at wildlife or population centers for evidence of lethal chemical agents. If personnel do not have another set of MOPP gear, they should not remove the gear they are wearing. If a second set of MOPP gear is available and the situation permits, the crew should change into the new clothing.

Section VIII

SMOKE OPERATIONS

A-29. SMOKE EFFECTS

Smoke is more effective when it is used at night or with natural obscurants such as fog, rain, natural dust, or battlefield dust and debris. Smoke is the one obscurant that can be placed, within meteorological constraints, where the user wants it. Figure A-5 shows how smoke and other obscurants affect electro-optical systems.

a. Smoke is a suitable medium for hiding and dispersing CB agents. These agents may include irritants such as riot control agents, incapacitants, and other lethal CB agents. Smoke will prolong the life of CB agents by reducing the effects of sunlight or other weather conditions on agent persistency.

b. Smoke makes it difficult for personnel to see the target. The extent of visual difficulty depends on the type of smoke used and its mixture with natural obscurants. The Soviets possess smokes that deny visual identification and adversely affect light-intensifying devices and near-infrared devices. Mid- to far-infrared devices, thermal imaging, and heat seekers are degraded when the contrast between the target and the background is reduced.

c. Soviet doctrine regarding smoke emphasizes the employment of smoke with other decoy or deception operations. Smoke draws attention to a general area, but the observer must determine where the unit or target is in the smoke and whether the smoke really has targets.

Figure A-5. Smart weapon sensor frequencies and the electromagnetic spectrum

A-30. SMOKE EMPLOYMENT

a. Threat Employment. When the Threat employs smoke against maneuver forces, aviation missions must increase to assist with observation and command and control. When employed on terrain features, smoke can force aircraft up and into Threat air defense coverage. Smoke denies low-level corridors or possible landing zones for air assault operations. Large area smoke can obscure terrain features that serve as navigational aids. Silhouetting aircraft against smoke increases their vulnerability. Smoke employed on ground-based aviation support units, such as FARPs and maintenance, will disrupt aviation operations. FM 100-2-1 provides detailed information about the Threat's use of smoke.

b. US Employment.

(1) US forces can employ smoke to keep the Threat from observing and acquiring them. For

example, US forces use smoke for obscuring an enemy or for screening their units. They also use smoke for deception, identification, and signals. Properly employed smoke enhances unit survivability. Units have organic assets such as smoke pots and grenades and external assets such as artillery and generators. Large scale or sustained smoke can be employed with smoke-generating systems. FM 3-50 discusses deliberate smoke employment.

(2) When US forces employ smoke on Threat forces, their ability to observe and acquire targets will be affected. Because smoke draws attention, aircrews may tend to concentrate more on the smoke than on

the targets. Aircrews may have difficulty seeing targets in the smoke or seeing targets leave the smoke. When a ground vehicle leaves a smoke screen, it is easier to acquire because it is silhouetted against the smoke. Personnel need to be aware of how smoke affects their ability to see enemy targets.

Section IX

TRAINING

A-31. AIRCREW TRAINING

Aircrew training should be conducted in two phases: the ground phase and the air phase. The ground phase acclimatizes aircrews and ground personnel to wearing MOPP gear. The air phase is more flexible; commanders must determine how much of their units' flight time they can devote to NBC training. The concepts presented here can be applied to ground crews as well as aircrews. AR 350 42 explains the unit and individual training requirements for NBC defense.

a. Ground Phase.

(1) Acclimatization must be accomplished gradually, and once completed, it must be maintained. Therefore, before aircrews fly with MOPP4 gear, they should be able to operate in MOPP4 gear on the ground for a minimum of six hours without interruption. This figure is not intended to be a limiting factor but rather a guideline for the commander. When aircrews enter into the ground phase of training, they should understand that the purpose of the training is twofold. First, it allows them to acclimatize to the protective clothing. Second, it gives them an idea of their personal limitations. For aircrews to realize their personal limitations, they must conduct the same activities they normally do in an uncontaminated environment. The commander must stress this, because all activity does not cease when the unit goes into MOPP4 gear. Normal operations include-

Drinking.

Map indexing.

Flight planning.

Preflight checks.
Mission briefings.
Basic personal hygiene.
Flight clothing adjustment.
Operation overlay construction.
Routine maintenance such as scheduled or run-up maintenance.
Cockpit procedures such as tuning radios, adjusting switches, or completing checklist items.

(2) As individuals progress through the ground phase, they will identify those areas that affect them the most. After determining their limitations, individuals can find new ways in which to accomplish the task or modify existing procedures.

b. Air Phase. Flight time is a valuable asset to every unit. Although the air phase can be done during existing training, a commander may find that NBC training degrades his unit's ability to accomplish the

mission. General goals are recommended below, but the actual method to reach these goals is left up to the commander. The recommended goal for individuals is 6 continuous hours of operating in MOPP4 gear. The goal for units is 48 continuous hours of operating in a simulated NBC environment.

(1) For training to be realistic, commanders must rotate unit personnel, as they will in combat, through collective protection shelters. If enough shelters are available, 50 percent of the unit may be participating in rest and relief at any one time. Accordingly, unit effectiveness and mission accomplishment will be proportionally degraded. To achieve acceptable performance levels, commanders may have to move all or part of their units to a clear area.

(2) When implementing training programs, commanders should gradually increase the time that aircrews fly in MOPP4 gear over a given period. However, the training must be in line with individual crew member capabilities and safety requirements. Commanders should refer to the scheduling guide in AR 95-1 when developing crew work and rest schedules.

A-32. TRAINING CONSIDERATIONS

As with all training, the aircrew training program should be carried out aggressively, consistently, and realistically. However, commanders should remember that safety should never be sacrificed for realism. With this in mind, unit trainers and commanders must be aware of certain factors that will affect their units' success in carrying out their training program. Some factors are described below.

a. Ambient temperatures and humidity may be very high, thereby increasing the wet bulb globe temperature. Unit SOPs should specify that every soldier must be familiar with the symptoms of heat stress and other heat-related injuries. Soldiers should be encouraged to drink more water to avoid dehydration. Early morning and late evening hours are the best times to conduct NBC flight training because of the lower temperatures and decreased humidity.

b. AR 95-1 specifies the flight uniform requirements for aircrews. TC 1-210 specifies safety requirements for MOPP training. Aviators not on the controls must recognize when aviators on the controls begin to lose concentration so that they can take control of the aircraft. Every individual has a different physiological makeup; therefore, commanders should not expect every crew member to progress at the same rate.

c. Overall physical conditioning plays an important role in an individual's ability to perform in MOPP gear. Commanders should ensure that their units pursue an aggressive and challenging program of physical training along with MOPP training.

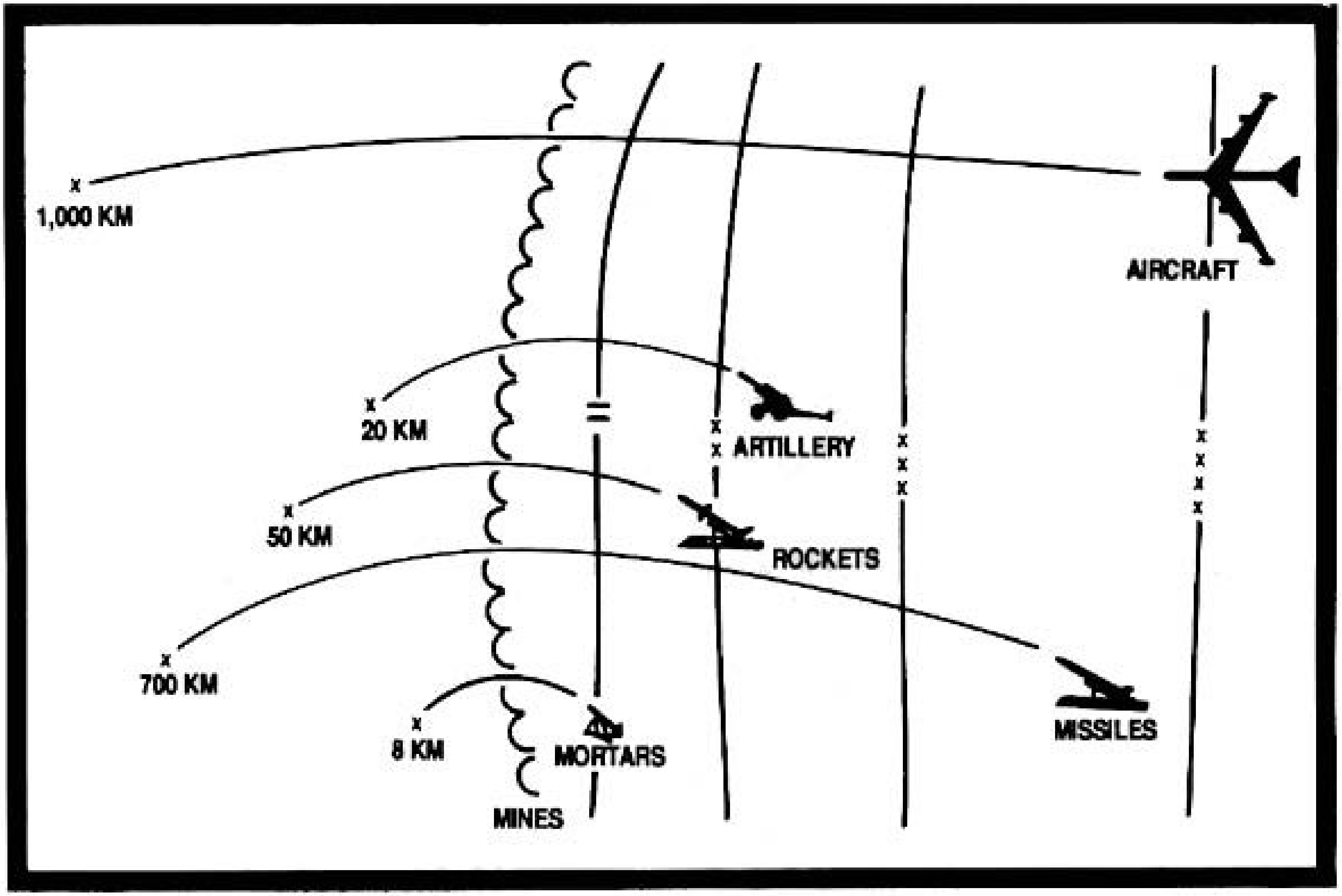


Figure A-1. Range of Threat delivery systems

Table A-1. Expected response to radiation

Free-in-Air Dose Range cGy (rads)	Initial Symptoms	Performance (Mid-Range Dose)	Medical Care and Disposition
0 to 70	From 6 to 12 hours: none to slight incidence of transient headache and nausea; vomiting in up to 5 percent of personnel in upper part of dose range.	Combat-effective.	No medical care; return to duty.
70 to 150	From 2 to 20 hours: transient mild nausea and vomiting in 5 to 30 percent of personnel.	Combat-effective.	No medical care; return to duty; no deaths anticipated.
150 to 300	From 2 hours to 2 days: transient mild to moderate nausea and vomiting in 20 to 70 percent of personnel; mild to moderate fatigability and weakness in 25 to 60 percent of personnel.	DT: PD from 4 hours until recovery. UT: PD from 6 hours to 1 day. PD from 6 weeks until recovery.	In 3 to 5 weeks: medical care for 10 to 50 percent. At low end of range, death may occur for less than 5 percent; at high end, death may occur for more than 10 percent; survivors return to duty.
300 to 500	From 2 hours to 3 days: transient moderate nausea and vomiting in 50 to 90 percent of personnel; moderate fatigability in 50 to 90 percent of personnel at high end of range.	DT: PD from 3 hours until death or recovery. UT: PD from 4 hours to 2 days. PD from 2 weeks until death or recovery.	In 2 to 5 weeks: medical care for 20 to 60 percent. At low end of range, death may occur for less than 10 percent; at high end, death may occur for more than 50 percent; survivors return to duty.
500 to 800	Within first hour: moderate to severe nausea, vomiting, fatigability, and weakness in 80 to 100 percent of personnel.	DT: PD from 1 hour to 3 weeks. CI from 3 weeks until death. UT: PD from 2 hours to 2 days. PD from 7 days to 4 weeks. CI from 4 weeks until death.	In 10 days to 5 weeks: medical care for 50 to 100 percent. At low end of range, death may occur for more than 50 percent in 6 weeks; at high end, death may occur for 90 percent in 3 to 5 weeks.
800 to 3,000	Within first 3 minutes: severe nausea, vomiting, fatigability, weakness, dizziness, and disorientation; moderate to severe fluid imbalance and headache.	DT: PD from 45 minutes to 3 hours. CI from 3 hours until death. UT: PD from 1 to 7 hours. CI from 7 hours to 1 day. PD from 1 to 4 days. CI from 4 days until death.	Medical care from 3 minutes until death. 1,000 cGy: 100 percent deaths in 2 to 3 weeks. 3,000 cGy: 100 percent deaths in 5 to 10 days.
3,000 to 8,000	Within first 3 minutes: severe nausea, vomiting, fatigability, weakness, dizziness, disorientation, fluid imbalance, headache, and collapse.	DT: CI from 3 to 35 minutes. PD from 35 to 70 minutes. CI from 70 minutes until death. UT: CI from 3 to 20 minutes. PD from 20 to 80 minutes. CI from 80 minutes until death.	Medical care from 3 minutes until death. 4,500 cGy: 100 percent deaths in 2 to 3 days.
Greater than 8,000	Within first 3 minutes: severe and prolonged nausea, vomiting, fatigability, weakness, dizziness, disorientation, fluid imbalance, headache, and collapse.	DT and UT: CI from 3 minutes until death.	Medical care needed immediately. 8,000 cGy: 100 percent deaths in 1 day.

LEGEND: CI--combat ineffective (less than 25 percent performance)
DT--demanding task
PD--performance degraded (25 to 75 percent performance)
UT--undemanding task

Table A-2. Aviation decontamination techniques

DECON TYPES	GROUND TECHNIQUES	AVIATION TECHNIQUES
Basic Soldier Skills	Skin Decon Personal Wipedown Operator Spraydown	Skin Decon Personal Wipedown Aircrew Spot Decon
Hasty	MOPP Gear Exchange Vehicle Washdown	MOPP Gear Exchange Aircraft Washdown
Deliberate	Detailed Troop Decon Detailed Equipment Decon	Detailed Troop Decon Detailed Aircraft Decon

Table A-3. Spot decontamination guidelines

Table A-3. Spot decontamination guidelines (continued)

Table A-3. Spot decontamination guidelines

ACTION AND LOCATION	DECONTAMINATION AREA OR AREAS	RESPONSIBLE PERSON OR PERSONS	DECONTAMINANT	PROCEDURE	REMAR
Refueling at FARP	Fuel ports and hatches and other areas that FARP personnel touch	POL handler	Diesel fuel; JP4 or JP8; or hot, soapy water	Apply decontaminant with sponge. Do not allow the decontaminant to enter the fuel system. Control runoff because agent will not be neutralized.	If FA conta duct befor
Arming at FARP	Armament system	Ammunition handler	JP4 or JP8 or hot, soapy water	Apply decontaminant with sponge. Control runoff because agent will not be neutralized.	Certa syste to de shoul techn which
Entering and exiting the aircraft anywhere	Door handles, steps, ladders, handholds, footholds, and other areas that aircrew is likely to touch	Aircrew or FARP personnel	JP4 or JP8 or hot, soapy water	Apply decontaminant with sponge. Avoid spreading liquid contaminants to the aircraft interior. Control runoff because agent will not be neutralized. (The crew chief may do the decontamination to avoid spreading contaminants into the cockpit.)	Proce for e Befor perso M258A glove decon membe
Preflight and postflight checks anywhere and maintenance inspections at AVIM facilities	Areas that must be touched during the inspection	Aircrew or maintenance personnel	Diesel fuel; JP4 or JP8; or hot, soapy water on exterior surfaces. Hot air on interior surfaces or parts not compatible with liquid decontaminants	Apply decontaminant with sponge. Wash gloves in decontaminant before touching uncontaminated surfaces. Decontaminate gloves with M258A1 kit after completing the inspection. Control runoff because agent will not be neutralized.	Perso air o crews weath contai overga

Table A-3. Spot decontamination guidelines (continued)

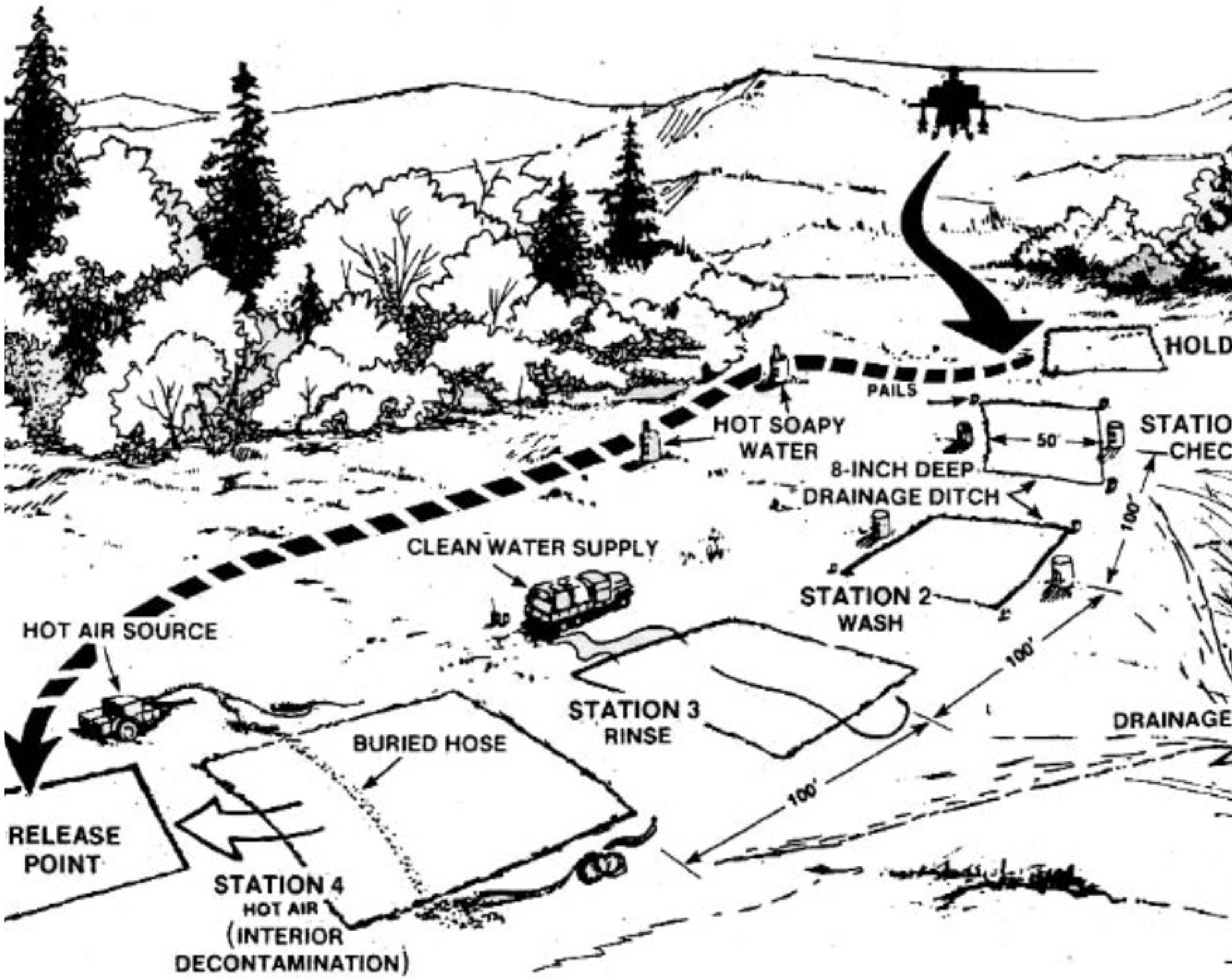
DECONTAMINATION AREA OR AREAS	RESPONSIBLE PERSON OR PERSONS	DECONTAMINANT	PROCEDURE	REMARKS
Any contaminated part that must be repaired	Battle damage repair team	Diesel fuel; JP4 or JP8; or hot, soapy water on exterior surfaces. Hot air on interior surfaces or parts not compatible with liquid decontaminants.	Depends on the situation. Decontaminate only those parts that are touched during the repair.	A contami not be br taminated
Parts that are being cannibalized	Maintenance personnel or other personnel who know what assembly is required	DS2; STB; diesel fuel; 5 percent chlorine solution; or hot, soapy water on exterior surfaces. Hot air on interior surfaces or parts not compatible with liquid or corrosive decontaminants.	Depends on the situation. Decontaminate only those parts that are touched during the repair.	Caustic d be used o blies tha from the must be t before th
All areas and equipment to be worked on to return aircraft to flight status	Maintenance personnel and/or a chemical decontamination platoon	DS2; STB; diesel fuel; 5 percent chlorine solution; or hot, soapy water. Hot air on surfaces easily destroyed by liquid or corrosive decontaminants.	Wash with diesel fuel and then hot, soapy water. Rinse thoroughly. Check with M8 paper or chemical agent monitor. If time permits, allow equipment to weather so that the chemical contaminant will be reduced to a negligible risk level.	Caustic d be used o blies tha from the must be t before the

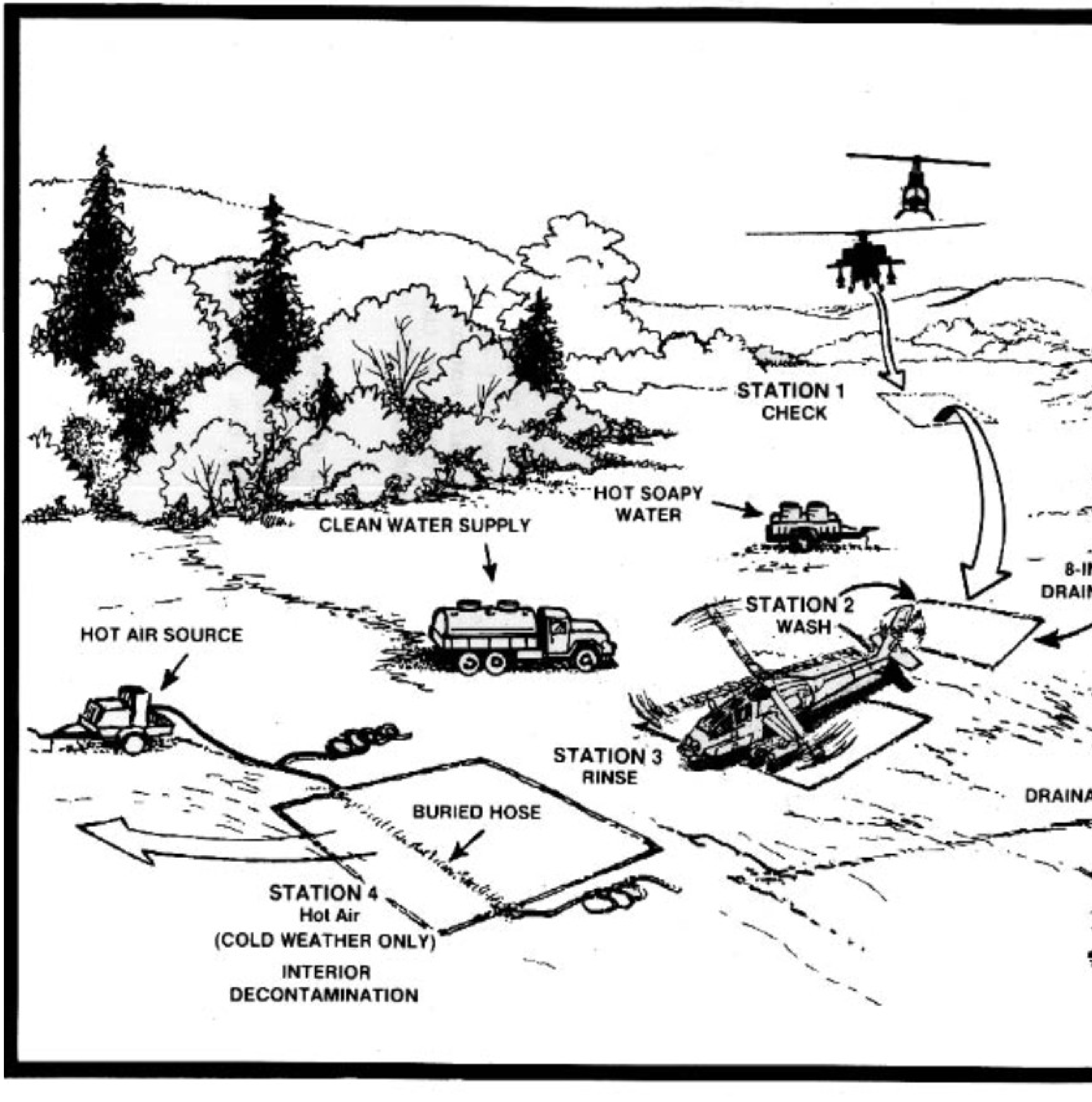
ACTION AND LOCATION	DECO AREA
Repair and recovery anywhere	Any part repa
Cannibalization anywhere	Part are cann
Overhaul at AVIM facilities	All equi work retu to f

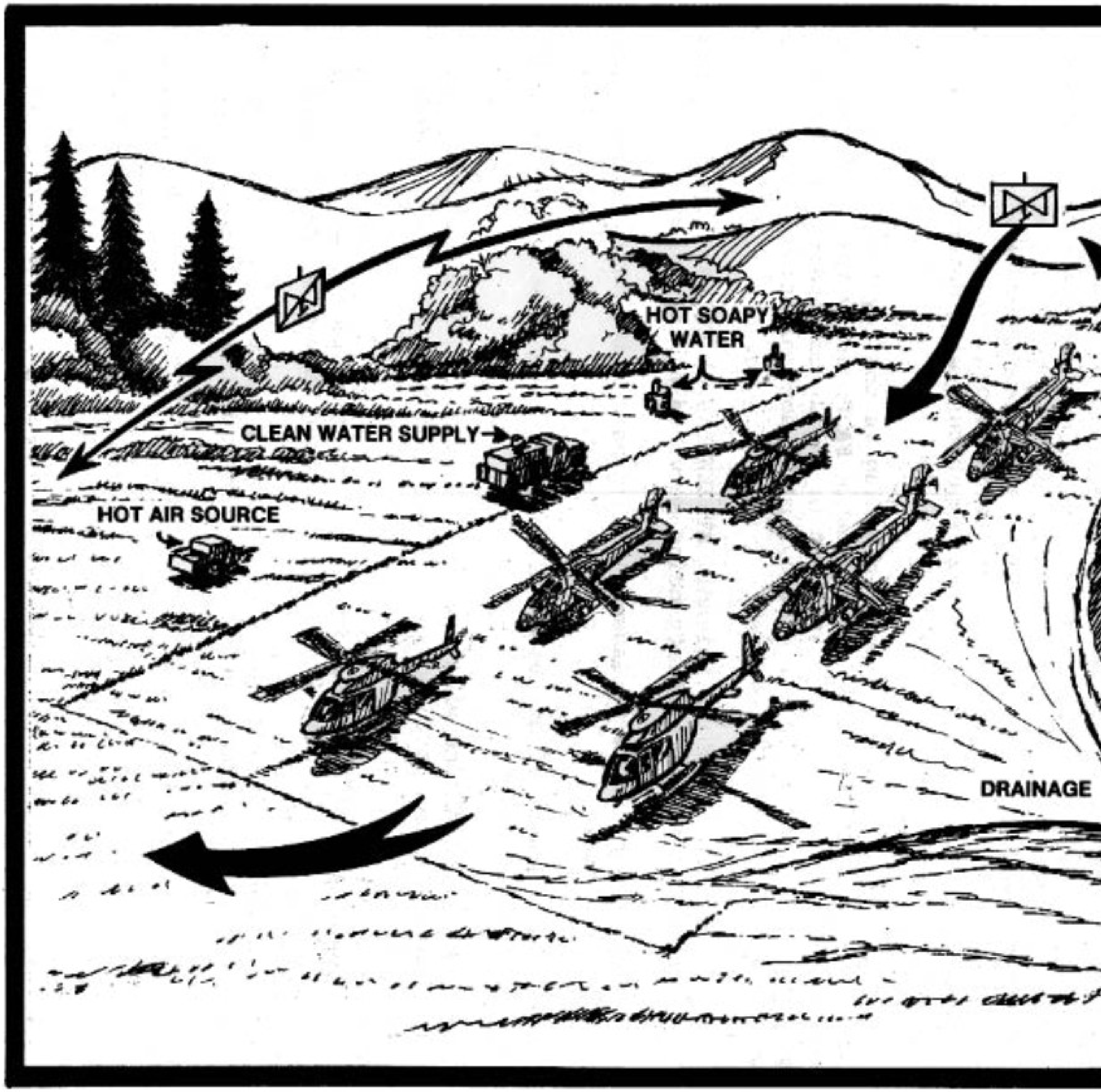
Table A-4. Recommended personnel and equipment for an Army aviation decontamination station

PERSONNEL	QUANTITY
Team leader, E5 or above[1]	1
Enlisted team members	10
EQUIPMENT	**QUANTITY**
Herman-Nelson heater	1
Water source, 400-gallon water trailer, M12 decontamination truck, pump system	1
Chemical overgarment to include boots and gloves	2
Axe, single-bit, 4-pound head, NSN: 5110-00-293-2336	2
Pick, mattock-type, 5-pound, NSN: 5120-00-243-2395	2
Hoe, garden, NSN: 3750-00-224-9467	2
Nozzle, garden hose, NSN: 4730-00-223-6731	2
Camouflage net with poles	3
Shovel, round point, large hole, NSN: 5120-00-188-8450	4
Hose, 50-foot, plastic, 3/4-inch diameter, NSN: 4720-00-729-5338[2]	5
Brush, cleaning, nylon fibers, NSN: 7920-00-054-7760	6
Pail, rubber, 3-gallon, NSN: 7240-00-246-1097	6
Can, trash and garbage, 32-gallon, NSN: 7240-00-160-0440	8
Cover, can, 32-gallon, NSN: 7240-00-161-1143	8

[1]A unit NBC NCO will not be used as a team leader.
[2]Rubber hoses should be used in cold climates.


HOLD
PAILS
HOT SOAPY WATER
STATIO
CHEC
50'
8-INCH DEEP DRAINAGE DITCH
100'
CLEAN WATER SUPPLY
STATION 2 WASH
HOT AIR SOURCE
100'
STATION 3 RINSE
DRAINAGE
BURIED HOSE
100'
RELEASE POINT
STATION 4 HOT AIR (INTERIOR DECONTAMINATION)


STATION 1
CHECK
HOT SOAPY
WATER
CLEAN WATER SUPPLY
HOT AIR SOURCE
STATION 2
WASH
STATION 3
RINSE
BURIED HOSE
STATION 4
Hot Air
(COLD WEATHER ONLY)
INTERIOR
DECONTAMINATION


HOT SOAPY WATER
CLEAN WATER SUPPLY
HOT AIR SOURCE
DRAINAGE

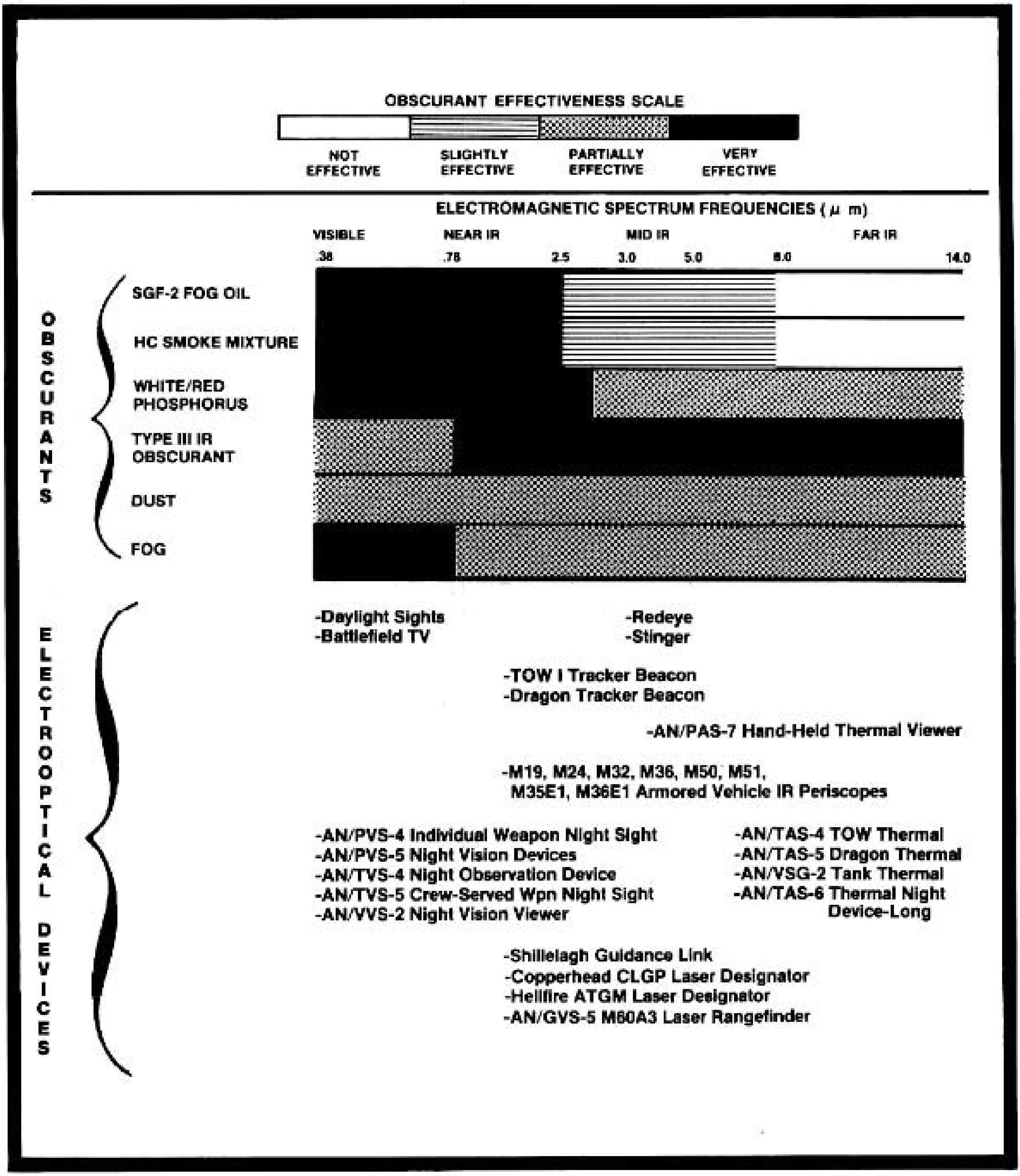


Figure A-5. Smart weapon sensor frequencies and the electromagnetic spectrum

APPENDIX B

INTELLIGENCE AND ELECTRONIC WARFARE OPERATIONS

Army aviation augments the intelligence-gathering and electronic warfare effort by providing forces and assets to strengthen intelligence, electronic warfare, target acquisition, reconnaissance, and counterintelligence missions. SEMA provide division and corps commanders with intelligence gathering capabilities not available elsewhere. IEW missions are conducted across the spectrum of conflict. This appendix describes the environment in which aircraft of the AEB, the Quick Fix platoon of the aviation brigade, and B Company of the MI Battalion (Light Infantry) conduct IEW operations. It also describes the vulnerabilities of SEMA and the survivability techniques aviators can use to counter Threat air defense weapons and tactical aircraft.

B-1. SEMA MISSION ENVIRONMENT

a. Aerial Exploitation Battalion. The AEB employs three SEMA platforms for IEW operations. They are the OV-1D, the RV-1D, and the RU-21H or RC-12D/K.

(1) The OV-1D with SLAR will fly missions between 10 and 50 kilometers from the FLOT at altitudes ranging from 5,000 to 12,000 feet AGL. Mission altitudes and standoff ranges will vary based on the threat and location of primary target areas.

(2) The RV-1D is equipped with the Quick Look II electronic intelligence system. It will fly basically the same mission profile as the OV-1D with SLAR.

(3) The AEB will deploy the RU-12H Guardrail V, the RC-12D improved Guardrail V, or the RC-12K GR/CS. One AEB currently deploys the RC-12H GR/CS(-) platform. The differences in mission environment between the GR/CS and the GR/CS(-) are negligible. RU-12H aircraft will fly missions at altitudes ranging from 10,000 to 23,000 feet AGL. RC-12D aircraft will fly missions at altitudes ranging from 25,000 to 31,000 feet AGL. Both aircraft will fly missions between 45 and 100 kilometers from the FLOT. Mission altitudes and standoff ranges will vary based on the threat and location of primary target areas. GR/CS aircraft will fly basically the same mission profile as the RC-12D.

b. Quick Fix Platoon. The MI battalion exercises OPCON over the Quick Fix platoon assigned to the supporting aviation unit of most active brigades; armored cavalry regiments; and infantry, airborne, and air assault divisions. EH-60A Quick Fix IIB aircraft provide aerial communications intercept and locating and jamming support. In high- and mid-intensity conflicts, the Quick Fix system requires line of sight to perform these missions. Quick Fix missions are flown over friendly controlled areas, and aircraft operate in a standoff mode some distance from the FLOT. The standoff distance is dictated by the terrain, weather, anticipated location of target emitters, and enemy air defense systems.

c. B Company, MI Battalion (Light Infantry). This company employs the RC-12G platform for the Crazy Horse mission. Mission altitudes will be between 24,000 and 30,000 feet AGL at standoff ranges between 0 and 20 kilometers. Because Crazy Horse is strictly an airborne collection system designed for a low-intensity conflict, its mission profiles will vary. The threat arrayed against airborne platforms in a low-intensity conflict is substantially less than that for mid- to high-intensity conflicts. Therefore,

overflight of the target area is a routine occurrence. The major limiting factor to standoff capability is the 40-kilometer, line-of-sight range of the high-frequency direction finder.

B-2. THREAT AIR DEFENSE WEAPONS

a. Air Defense Threat.

(1) Surface-to-air missiles. High-altitude SAMs, such as the SA-2, SA-3, and SA-11, represent a serious threat to fixed-wing SEMA and Airborne Warning and Control System aircraft that fly missions at high orbits. Aviators can avoid lower altitude SAMs, such as the SA-6, SA-7, SA-8, SA-9, SA-13, SA-14, SA-16, and SA-18, by orbiting outside their known coverage. The longer range SAMs, such as the SA-5 and SA-12B, generally defend locations of strategic importance. The SA-4 is being replaced with the SA-11, which has a speed estimated at Mach 7.0. The SA-11 can engage targets at altitudes from the surface to 100,000 feet. Like the SA-4, the SA 12B is mobile and self-contained, making its location difficult to verify. The SA-12B, like the SA-4, is expected to be found at army level. The SA-5 is a fixed-site strategic system with a range of 150 kilometers. Its range limitations can be determined if its location is known, and SEMA mission orbits can be planned accordingly.

(a) Threats to Quick Fix aircraft. Quick Fix aircraft can remain out of the range of SAM systems and still accomplish DF and ESM missions. However, the aircraft may have to move forward under the friendly air defense envelope to accomplish the missions. For electronic countermeasure missions, Quick Fix aircraft may fly as low as 50 to 100 feet AGL. (b) Threats to Crazy Horse missions. The expected threats to these missions are the SA-7, SA-14, and SA-16. These SAMs normally do not pose a threat to aircraft at mission altitudes. However, they are a substantial threat during mission launch and recovery because aircraft are at altitudes well within the effective ranges of these missiles.

(2) Antiaircraft artillery. The vulnerability of SEMA to antiaircraft artillery ranges from minimal to none at all because of high mission altitudes. The lower orbits of Quick Fix aircraft will make them vulnerable to antiaircraft artillery in a low-intensity conflict.

b. Airborne Intercept Aircraft Threat. All SEMA are vulnerable to airborne intercept aircraft. Because SEMA have no armament, the only defense is for aircrews to execute evasive maneuvers and confuse Threat radar and infrared missiles with flares and chaff or other onboard active countermeasure systems. Radar warning receivers on the SEMA will warn the aircrew

if an airborne intercept aircraft tracks and guides in on the aircraft with its onboard radar. The aircrew can then initiate evasive maneuvers. However, the Threat may guide in visually and launch an infrared missile or engage at close range with optically guided guns or missiles. In that case, no prior warning will be available except radar ground controlled interception personnel may possibly warn the aircrew of the threat. The aircrew's chance of surviving such an engagement by a Threat aircraft is slim.

c. Attack Helicopter Threat. SEMA mission orbits and altitudes are normally much greater than that of Threat attack helicopters. Therefore, Threat helicopters are not expected to pose a threat to SEMA.

B-3. SURVIVABILITY AND COUNTERMEASURES

a. Fixed-Wing SEMA. Numerous evasive maneuvers and onboard ASE can be used by fixed-wing SEMA aircrews to counter the effects of Threat weapons and aircraft. USAICS Pamphlet 95-1, including Change 1, describes survivability techniques in detail. It is classified SECRET/NOFORN/WNINTEL.
OV-1D and RV-1D aircraft can perform many evasive maneuvers because they are fully aerobatic. Change 1 to USAICS Pamphlet 95-1 describes RU-21H survivability tactics. RC-12 tactics are nearly identical to those for the RU-21H. RC-12 onboard ASE differs from that found on the RU 21H, so procedures involving onboard ASE will differ slightly. RC-12 and RU-21H aircraft are not fully aerobatic. Therefore, they are not able to perform the same evasive maneuvers as OV-1D and RV-1D aircraft.

b. Rotary-Wing SEMA. Survivability techniques used by Quick Fix aircrews are described in USAICS Pamphlet 95-1.

APPENDIX C

ARMY AIRSPACE COMMAND AND CONTROL

This appendix implements portions of STANAG 3805 and AIR STD 45/6B.

The command and control of airspace in the combat zone enhances combat operations by promoting safe, efficient, and flexible airspace use. Command and control must maximize combat effectiveness without impeding the maneuver or fires of friendly forces. Airspace command and control is the Army's operational approach to achieving this function. Airspace management coordinates, integrates, and regulates the use of airspace of defined geographical and altitudinal dimensions. It involves planning and executing tasks to control and employ air assets in concert with AirLand Battle doctrine. The command and control of airspace must contribute to the overall operational plan. Maneuver unit commanders must achieve maximum flexibility in employing organic and support assets within their airspace. They achieve this by standardizing airspace, minimizing restrictions, and maintaining close and continuous coordination. This appendix is an overview of airspace command and control. Aviation brigade and subordinate commanders and their staffs can use it as a planning guide.

C-1. A^2C^2 LINK

On future battlefields, the aviation brigade commander must employ his assets in coordination with the airspace command and control plan. To minimize the risk of engagement by friendly air defense forces, the commander must use the existing C3 structure and require his forces to adhere to directed control procedures. The commander must ensure that a strong link is established and maintained with A^2C^2 elements at division, corps, and echelons above corps.

C-2. A^2C^2 ORGANIZATION

a. The A^2C^2 system is linked with the ACA, who is the commander designated to assume overall responsibility for operations of the airspace control system in the airspace control area. Normally, the ACA is the joint force air component commander who has most of the air assets. This is usually the senior USAF commander in the theater of operations. The A^2C^2 system is linked with the ACA by communications, standardized procedures, acquisition systems, and liaison. This combination constitutes the theater integrated airspace control system.

b. Army units within the theater of operations, from maneuver battalions through the senior Army operational headquarters or land component commander level, differ in their organizational structure. Therefore, staff sections and liaison elements from which the A^2C^2 element is organized vary in personnel, grade structure, and equipment authorizations. The A^2C^2 element is created from the principal staff sections and liaison elements that represent the major functional users of airspace. The G3 organizes the A^2C^2 element. This element normally includes the G3 section (G3 Air who has supervisory responsibility for the element), fire support section, aviation section, air defense section, ATS facilities, and air liaison officer.

C-3. A^2C^2 ELEMENTS

Designated A^2C^2 elements are collocated with the fire support cell at the main command post from division through the senior land force headquarters. Aviation brigades of the division, corps, and EAC have dedicated TOE personnel to accomplish the required A^2C^2 functions. The A^2C^2 representation provided from the aviation brigade consists of an airspace management officer, an operations sergeant, and a flight operations specialist. Because this manning level cannot provide a 24-hour operational capability, proposals for changes to TOE (for example, light infantry division, aviation brigade) have authorized two ATS officers and two operations sergeants. No formal A^2C^2 element is established at the tactical command post. Therefore, airspace control functions are accomplished by designated representatives from selected staff and liaison elements. At a minimum, these personnel include a G3 assisted by a fire support officer, an aviation representative, and a USAF liaison officer. The G3 is responsible for the A^2C^2 effort. Coordination is maintained between the tactical command post and A^2C^2 element at the main command post so that airspace requirements generated by changes to the tactical situation are met in a timely, effective manner. These A^2C^2 elements form a vertical and horizontal channel through which airspace information and requirements are coordinated and disseminated.

a. EAC A^2C^2 Element. The A^2C^2 element for EAC is located at the senior Army operational headquarters. It operates under the staff supervision of the DCofS G3 or the JCS J3 operations (joint force). The element consists of representatives from ADA, Army aviation, USAF ASCE, fire support, ATS, and G3 operations. It also consists of representatives from the DCofS G2; DCofS G4; and, when required, the ANGLICO. Under the supervision of the G3, the A^2C^2 element publishes the theater airspace management plan. It integrates the command and control of theater airspace with the USAF TAC through the Army BCE located at the TACC.

(1) The land component commander coordinates airspace control within the theater of operations for those requirements that overlap the rear combat zone and the communications zone. He plans and executes ground combat operations, command and control, and A^2C^2 for assigned forces. Within a US unilateral theater, a BCE is established at the TACC to coordinate and integrate land and air operations. The theater army land component commander's guidance and intent are communicated to the TACC by the BCE. At the land component commander level, the G3 receives airspace control requirements from A^2C^2 elements within each command post. He then coordinates the requirements through the BCE to airspace planners of the tactical air force.

(2) Airspace planners of the tactical air force define the broad policies and procedures for operating the integrated airspace control system. As a theater is maturing, the growing complexity of combat operations and changing support force structure may result in the organization of an army group headquarters. If the army group commander is designated the land component commander, he commands the BCE and provides it with guidance and direction. Military operations may dictate a requirement to employ an intermediate headquarters (a field army) subordinate to the theater army. This field army will be responsible for the operational and tactical direction of the corps. When designated the land component commander, the field army commander works closely with the ASCE to coordinate all land force air support requirements. The land component commander interacts with senior and subordinate echelons or directly with the BCE to coordinate operations for the suppression of enemy air defenses.

b. Battlefield Coordination Element. The land (Army) component's BCE, located at the TACC, is commanded by the senior operational Army commander. It establishes priorities for the air effort. An A^2C^2 element representing the land component commander is located in the BCE. Under the current TOE, the BCE is authorized three officers and three NCOs for the air defense and A^2C^2 sections. One

officer and one NCO are specifically allocated for A^2C^2 functions. With only two personnel authorized, the A^2C^2 section requires additional personnel to sustain a 24-hour operational capability. Other sections of the BCE located with the offensive air section may provide these personnel. Information on all requests for control measures and restrictions is provided from the appropriate A^2C^2 element (EAC or corps) to the BCE for interface within the TACC's airspace control center. USAF and air defense operations are coordinated to prevent mutual interference, to exchange intelligence information, and to ensure the safety of friendly aircraft from air defense fires.

c. Corps A^2C^2 Element.

(1) The corps A^2C^2 element coordinates, integrates, and regulates Army users of the airspace. This element is located at the corps main command post. It consists of representatives from selected staff sections and liaison elements. These include the G3 section, air defense element, aviation element, FSE, USAF TACP, G2 collection management and dissemination section, G4 section, ANGLICO, and supporting ATS platoon. The corps A^2C^2 element-

Coordinates and integrates airspace use.

Coordinates airspace with outside agencies.

Develops and maintains the airspace utilization map.

Maintains A^2C^2 overlays within the main command post.

Identifies and resolves conflicts between airspace users.

Approves or staffs the requests for airspace control measures.

Develops plans, procedures, and SOPs and disseminates them to appropriate agencies.

Advises higher headquarters and subordinate units of significant airspace activities and the impact that airspace command and control will have on operations.

(2) At the main command post, the A^2C^2 element is under the supervision of the G3 Air (corps A^2C^2 officer). The element accomplishes all airspace control functions related to corps rear and deep operations and the plans for future operations. The corps A^2C^2 element is collocated with the fire support cell and is near or electronically connected to the ASOC. This facilitates continuous coordination should a fast-reaction capability be needed to satisfy immediate requests from Army forces for tactical air support. The element is equipped for secure communication with the tactical and rear command posts and has record traffic capability. It is linked to the maneuver control system through the G3 Air tactical computer terminal with additional work stations for ATS, fire support, and air defense representatives.

(a) During sustainment operations, the A^2C^2 element works with the CSS cell at the main command post and the staff at the rear command post to satisfy airspace control requirements. Operations such as USAF airlift missions require extensive coordination with the corps movement officer, transportation officer, and tactical airlift officer.

(b) During rear operations, the A^2C^2 element at the main command post and the operations and intelligence section at the rear command post monitor changes in the tactical situation. Tactical changes may require changes to airspace control measures established in the rear combat zone.

(3) The corps A^2C^2 element is represented at the tactical command post by an FSO, an aviation officer, an air defense officer or NCO, and an ALO from the TACP. The element may be augmented from the

corps main command post to conduct 24-hour operations. The responsibilities of the corps A^2C^2 element should be limited to monitoring current operations. The element maintains coordination with the main command post so that airspace requirements generated by changes to the tactical situation are met in a timely, effective manner.

d. Division A^2C^2 Element.

(1) The division A^2C^2 element in the main command post coordinates, integrates, and regulates division airspace users. Aviation representatives of the division A^2C^2 element are assigned

to the aviation brigade, but they function as part of the division staff. Within the tactical and main command posts, the organization and location of the A^2C^2 elements are similar to those of the corps. The division A^2C^2 element-

Develops and maintains the airspace utilization map.

Coordinates USAF tactical airlift airspace use and information.

Identifies and resolves potential conflicts in the use of airspace.

Disseminates information concerning enemy air defense activity to all aviation units.

Monitors and advises the commander on the status of air defense and aviation assets.

Coordinates selected identification requirements and IFF procedures for Army aircraft.

Coordinates and disseminates information about and changes in coordinating altitudes.

Coordinates requirements for airfield terminal control zones with the FCC element and the corps A^2C^2 element.

Coordinates requirements for flight plans, restricted areas, air defense, and aircraft weapons-free zones.

Maintains and disseminates the location and status of navigational aids and landing and pickup zones in the area of operations.

Develops, maintains, and disseminates recommended low-level transit routes and minimum risk routes throughout the division area of operations.

Coordinates and disseminates ATS and air defense procedures to be used by aviation units for cross-FLOT operations, to include return procedures.

Maintains and disseminates information about all restricted operation areas and zones, SAAFRs, WFZs, flight corridors, HIDACZs, and refueling point locations and status.

Maintains and disseminates information about significant preplanned field artillery fires, nuclear strikes, CAS strikes, USAF and Army reconnaissance missions, and major air assault operations.

Establishes and maintains an SAAFR system throughout the division area of operations. (This includes instrument recovery routes for each brigade area to recover aircraft that inadvertently fly into IMC. A full-strength ATS platoon can support up to two precision terminal approach sites in the division.)

(2) The division rear command post has no A^2C^2 representation. Airspace control functions are handled by the A^2C^2 element at the main command post. Should the tactical situation dictate, the main command post may displace A^2C^2 personnel to the rear command post to accomplish any required airspace control functions.

(3) The A^2C^2 element uses graphic displays that combine air defense, aviation, ATS, and fire support information. Data are maintained on current and planned restrictions and special joint-use requirements. The G3 resolves any airspace conflicts that cannot be resolved by command guidance, orders, and SOPs. The ATS elements supporting the division provide terminal, en route, and flight-following services to aircraft flying VFR and IFR below the coordinating altitude.

(4) The FCC may be employed in the division area. If so, it provides a communications link between terminal facilities of existing airfields, other nearby airfields, division command posts, other FCCs, and the corps FOC. The FCC provides flight-following as well as information on air traffic movement within its assigned area. It monitors Army aircraft operations and provides hostile activity warnings to Army aviation units operating in the airspace. The FCC also passes IFR flight

plans to the airspace management center for approval and VFR flight plans to the appropriate ATS facility. The FCC establishes the necessary liaison with the air defense command post. The air defense unit's radars receive real-time input from associated firing units. They provide the FCC with additional low-altitude radar coverage over the division and beyond the FLOT by voice and data links through the air defense system. FCC liaison with the air defense command post links Army air defense, Army aviation, and USAF systems.

e. Aviation Brigade A^2C^2 Element.

(1) The aviation brigade's three-person A^2C^2 element is augmented with additional personnel from the brigade as required. The element is composed of organic personnel that have other primary duties; for example, the S3 Air, FSCOORD, and air defense representative. However, the element represents the interests and coordinates the needs of brigade forces as a member of the division, corps, or EAC A^2C^2 element. Secure and nonsecure voice record copy, messenger, and host nation channels may be used for communication. The multichannel communications system, however, is the primary means of communication for this element. The aviation brigade A^2C^2 element-

Helps plan aviation brigade A2C~ requirements.

Keeps the S3 abreast of the most current A^2C^2 situation and changes.

Forwards requirements through the A^2C^2 element to the J3 or G3 for approval.

Advises the division, corps, or EAC A^2C^2 element about planned aviation operations.

Coordinates with other members of the A^2C^2 element to prevent conflicts in airspace usage.

Passes information received from other members of the division, corps, or EAC A^2C^2 element to the aviation brigade S3.

Advises the brigade commander and staff about actions required to implement and follow the required airspace control measures.

Reviews the airspace use and Army aviation plans and the graphics portion of the division, corps, or EAC operation plan or order.

Provides information to the J3 or G3 representative concerning the aviation brigade's input to the A^2C^2 annex of the division, corps, or EAC operation plan or order.

(2) The primary A^2C^2 function in the main battle area is performed at brigade level because most airspace users are under brigade control. The brigade commander or his designated representative,

normally the S3, is the airspace manager. The commander may form an A^2C^2 element, but it must come from within brigade assets. The A^2C^2 function will be performed by existing staff personnel, supporting liaison representatives, and fire support representatives. The brigade commander may retain subordinate battalion A^2C^2 responsibilities. A^2C^2 functions are the staff responsibility of the S3. The S3 Air, assisted by other staff personnel, has supervisory responsibility for A^2C^2 functions. Staff assistance may be provided by the S2, FSO, ALO, and LOs from supporting Army aviation and air defense units.

(3) Airspace command and control is accomplished primarily by procedural communication and visual control. At brigade level, A^2C^2 functions involve detailed coordination and integration of tactical air, indirect fire, organic air defense, and tactical fire and maneuver operations. The maneuver unit commander employs, controls, and coordinates the use of airspace by forces supporting or reinforcing his operations. The commander also coordinates his airspace activities

with other elements of the A^2C^2 system.

(4) In the brigade area, air operations are conducted on a "se and be seen" basis to prevent aircraft collisions. Fire support and aviation operations are conducted simultaneously. The S3 must ensure coordination among all airspace users to prevent conflicts in airspace usage.

(5) Aviation unit operations personnel, when possible, will provide advance entry information briefings to aircrews entering the brigade area. These briefings will include the supported or reinforced unit's tactical situation. The supported or reinforced unit (battalion or brigade) must know in advance when and where Army and other service aircraft will enter the area. Army aircraft operating in the battalion or brigade areas are routinely controlled through the chain of command. Commanders communicate directly with the supporting or reinforcing aviation unit commander to convey taskings and to coordinate missions.

f. Battalion Airspace Command and Control. A separate A^2C^2 element is not established at battalion level. Within the maneuver battalion, the commander is the airspace manager. Airspace control functions are performed at the main command post by staff representatives. Normally, these include the S3 or S3 Air, the TACP, and the FSO. The battalion S3 coordinates the use of airspace over the battalion's area of operation.

(1) The commander and the S3 know the tactical situation, including the location and configuration of those subordinate maneuver and supporting units that will use the battalion's airspace. Operations staff elements collect pertinent information to keep the commander and staff informed of potential conflicts among airspace users in the battalion area.

(2) When a ground maneuver battalion is being supported, aviation unit operations personnel will brief aircrews on the supported unit's tactical situation. When possible, the supported unit is told when and where supporting aircraft will enter its area. The air mission commander establishes communications with the supported battalion commander. Coordination between the two units is essential to the supported battalion commander's control of his airspace.

C-4. CONTROL AND COORDINATION PROCEDURES

Priorities and planning activities of the combined force commander, together with the requirements of subordinate commanders, are presented in the operational commander's ACP. The ACA, in coordination with subordinate commanders, develops the ACP. The subordinate commanders then prepare detailed plans to include air tasking orders that address the requirements of their respective areas.

a. Airspace Control Plan. The ACP explains the specific procedures of the airspace control system for a particular area of operation. FM 100-42 contains a checklist of recommended planning procedures for developing an ACP. Ideally, the ACP is prepared and published as a separate document such as an annex to the operation plan. If required, it may be distributed via teletype message or as an airspace control order. Aviation unit commanders, staff planners, and aircrews must be briefed and knowledgeable about the ACP, designated procedures, engagement rules, and air defense plan.

(1) Specific procedures. The ACP describes specific procedures for requesting and activating airspace control measures. It includes specific procedures for aircrews to meet the criteria of friendly

air defense weapons when aircraft operate under procedural control. Procedures are also provided for the positive control of aircraft throughout controlled airspace.

(2) Coordination. Airspace control is a compromise between a wide variety of conflicting demands for the use of airspace. Therefore, the ACP must be planned and coordinated with representatives from all components of the joint force. It must not result in undue restrictions upon friendly forces and must remain simple to avoid confusion. Aviation commanders and staff planners must ensure that airspace control procedures prevent mutual interference, ease air defense identification requirements, and expedite the flow of air traffic.

(3) Air defense interface. A limiting factor in designing the ACP is the air defense system. The location of air defense weapons; fighter, missile, and SHORAD engagement zones; and identification methods for each system will determine the airspace procedures for friendly aircraft. These factors provide planners with a tentative assessment of flying restrictions that determine the procedures for airspace control.

b. Air Tasking Order. The ATO is published by the air component commander. It specifies the missions to be flown and which aircraft will fly them. The ATO includes all jointly approved airspace control measures or restrictions. When a separate ACO is not published, airspace control information may be found in the ATO. The ATO ensures that all airspace users have information relevant to other missions. For example, listing the SEMA mission in the ATO is one way to achieve airspace coordination and help ensure safety and mutual operational efficiency.

c. Airspace Control Order. The ACO is the primary means by which the airspace control authority disseminates approved airspace control measures. The ACO complements the ATO and may be published several times daily. Airspace planners in the airspace control center of the TACC develop the ACO. A^2C^2 personnel within the BCE may assist in the development of the ACO.

d. A^2C^2 Planning. A^2C^2 planning is accomplished as part of the normal decision-making process. The goal of A^2C^2 planning is to identify potential conflicts among airspace users. The A^2C^2 plan establishes the tactics, techniques, and procedures required to resolve or minimize the potential for airspace conflicts. It may be an A^2C^2 annex to an operation plan or order, or it may be an A^2C^2 overlay with a fragmentary order.

(1) A^2C^2 annex or overlay. Planning will be as detailed as necessary and as the situation and time allow. The urgency of the situation and the time available will dictate whether an A^2C^2 annex is produced. The A^2C^2 annex contains only that information required to clarify or amplify the unit SOP or to specify the actions and procedures needed to synchronize the effective use of airspace. In many situations, the

fast-paced and dynamic tempo of combat operations will necessitate the use of an A^2C^2 overlay and verbal directives to subordinate units.

(2) Field SOPs. The use of field SOPs, ACOs, and the ACP standardizes procedures, reduces the amount of coordination, and provides implementing instructions. The need for an A^2C^2 annex is thus minimized in many situations.

e. A^2C^2 Operations. The A^2C^2 elements and the current operations cell must promptly attend to matters pertaining to the use of airspace at division, corps, and EAC. At these levels, the ability of the commander to influence the conduct of the battle is largely accomplished by the use of air assets. Air assets can be employed in a relatively short time, and requirements to coordinate and integrate their airspace requirements with the ongoing battle require immediate attention. A^2C^2 elements coordinate with other staff cells within the main command post to determine which maneuver, CS, and CSS activities, requirements, and missions affect A^2C^2.

(1) ATS data. The A^2C^2 element maintains data on ATS facilities, current and planned restrictive measures, and special joint use requirements. It also maintains data on the air defense situation, including air defense coverage for use by other TOC elements. Hostile air activity data obtained through the G2 and air defense channels are provided to the A^2C^2 element and other elements at the main command post. The A^2C^2 element advises the commander about how the air defense weapons control status will affect air operations.

(2) ATS support. The A^2C^2 element, with the supporting ATS unit, develops plans to provide ATS assistance to aircraft and tactical units operating within the area of operations. The ATS system supports aviation brigade units and aircraft of other component forces conducting tactical operations in the area. It also is the interface between aircraft in flight and the A^2C^2 element at the main command post. ATS support includes navigational and flight-following assistance, air threat warnings, weather information, artillery advisories, and airfield and landing site terminal control. This support also includes other assistance as required to ensure near real-time air traffic coordination and integration.

f. Command and Coordination. The maneuver commander manages the airspace over his area of responsibility through his staff and the A^2C^2 element. If the commander has no dedicated A^2C^2 element, he may form one from the air defense LO, the Army aviation LO, the FSO, the ALO, and the brigade S3 Air. The LOs function as special staff officers and advise the commander and staff about their functional areas and related A^2C^2 matters.

C-5. AIRSPACE CONTROL PROCEDURES

In future battles, Threat forces will attempt to degrade airspace control capabilities by direct attack or electronic means directed against control nodes or other specific targets. Therefore, any system of airspace control must be survivable through hardening and redundancy and must permit an effective combination of positive and procedural control measures. The airspace control procedures used must include identification methods compatible with those required for air defense. This will ensure the timely engagement of enemy aircraft, conservation of air defense resources, and reduction of risks to friendly forces. Examples of defined airspace control measures are given in FM 100-103.

a. Positive Control. Positive control is a method of airspace control using electronic means. It relies on detection, positive identification, and tracking of aircraft within the airspace. A rapid, reliable, and secure means of identification is the desired objective. Normally, the electronic method is the most rapid and reliable means of identification in the combat zone. Positive and continuous control of aircraft is provided by radar using IFF or SIF returns and by monitoring. Positive control is also maintained by the general surveillance of known air traffic movements by radar or other means.

b. Procedural Control and Methods.

(1) Procedural control. Procedural control is a method of airspace control that relies on a combination of previously agreed upon orders and procedures. Procedural control measures must be

employed when positive control measures cannot be used or are inappropriate for the situation. The procedural control means available to the A^2C^2 element include airspace control orders, special instructions in the ATO, and ACA techniques, procedures, and rules in the ACPs. Airspace control annexes to operation plans and orders and unit SOPs provide additional techniques for employing procedural controls.

(2) Procedural methods. Tactical operations require the commander to employ a combination of positive and procedural controls. The command and control system, A^2C^2 system, and USAF TACS provide the necessary organization and facilities to exercise positive control. Joint, Army-specific airspace control measures and standard Army operational procedures provide the necessary methods for the procedural control of airspace. The Army's airspace control methodology emphasizes the procedural control of airspace in the main battle area.

C-6. AIRSPACE CONTROL MEASURES

Airspace control measures are the rules and mechanisms put into effect by joint and allied doctrine and are defined in the theater ACP. Control measures are defined in general terms according to the normal use of the control measure. The precise details of control measures and their arrangement and application techniques are specified and defined by the theater ACP and ACA directives. Examples of defined airspace control measures and users of those measures are shown in Table C-1. Commanders inform the ACA of their requirements for temporary airspace control measures through the appropriate airspace control system. Aircraft requests contain a statement of requirements. These requirements include the location, lateral and vertical limits of the affected airspace, and time. The airspace control plan describes the procedures for requesting and activating special-use airspace. Requests are forwarded through the operational chain after review by the A^2C^2 element at each command echelon. This ensures that the measures support the commander's concept of operations. The A^2C^2 element and staff elements within the TACC review the requests, and the ACA approves the airspace control. The information is then disseminated to all appropriate elements of the joint force. The measures available to provide procedural control for airspace users are shown in Figure C-1. FM 100-103 contains additional information about the techniques that govern the use of airspace control measures.

Table C-1. Airspace control measures and users

Figure C-1. Airspace control measures

a. Common Control Measures.

(1) High-density airspace control zone. A HIDACZ is a defined area of airspace that reserves airspace and allows the commander to restrict a volume of airspace from users not involved with his operations.

The HIDACZ-

Requires joint approval.

Is requested by the maneuver commander.

Is controlled by the requesting commander.

Requires that users be controlled and that aircraft obtain approval before penetrating the airspace.

Requires that the maneuver commander control the air defense weapons control status.

(2) Coordinating altitude (level). The coordinating altitude (level) is designed to separate rotary-wing and fixed-wing aircraft. Coordinating altitudes may be designated by the airspace control authority and are normally specified in the ACP, unit SOP, or operation order. The coordinating altitude does not prohibit either aircraft from using airspace above or below the altitude. Approval or coordination acknowledgment is not required prior to aircraft penetrating the altitude. When an aircraft passes into the airspace above or below the coordinating altitude, control (positive or procedural) always reverts to the controlling authority for that airspace. Coordinating altitudes may be stepped down along prominent terrain features. Conflict avoidance is on a "see and be seen" basis during VMC. The height of the coordinating altitude is based on the tactical situation, mission requirements, and capabilities of the services involved. Penetration of the coordinating altitude by CAS sorties, flown in response to Army requests, is coordinated by the forward air controller or other TACS elements.

(a) Rotary-wing aircrews will normally operate below the coordinating altitude. When penetrating the altitude, rotary-wing aircrews must notify the FOC, the FCC, or an airspace control facility. The center or facility will then notify the AMLS at the CRC.

(b) Fixed-wing aircrews will normally operate above the coordinating altitude if a buffer zone is desired. When penetrating the altitude, fixed-wing aircrews must notify a TACS element. The TACS element will then pass this information to the AMLS at the CRC.

(3) Restricted operations zone. The terms airspace restricted area and restricted operations zone refer to the same control measure. An ROZ is a volume of airspace, of defined dimensions, developed for a specific mission. For example, it may be established around a tactical airfield, drop zone, search and rescue operation, or SEMA orbit. Other specific or local situations and requirements may pose hazards to the transit of friendly aircraft. They should be defined and promulgated as restricted operation areas by the ACA. Hazards include artillery, mortar, and naval gunfire support; aerial refueling; concentrated interdiction areas; and air defense areas. The commander informs the appropriate A^2C^2 facility of his requirement for a restricted operations zone. The A^2C^2 facility passes this requirement to the ACA. Before obtaining agreement and subsequent promulgation, the ACA will evaluate how the airspace restriction will affect other airspace users. Any designation of an ROZ should include the-

Periods of use.

Controlling authority.

Purpose (if security permits).

Dimensions in areas and height.

Use of positive and procedural control measures.

Location expressed in references easily identified by all users.

Applicability to friendly users (such as when entry may be permissible).

(4) Minimum risk route. An MRR is a temporary flight route recommended by the Army. It presents the minimum known hazards to low-flying aircraft transiting the combat zone. The airspace

control center forwards established MRRs to TACS elements, wing operations centers, and A^2C^2 elements within the corps. The ground commander's airspace management element recommends that MRRs be updated, altered, or canceled based on changes in the tactical situation. It also recommends that MRRs-

Receive ACA approval.

Extend below the coordinating altitude.

Be designed to minimize risk to friendly aircraft.

Start at the corps rear boundary and extend to the fire support coordination line.

Avoid fire support targets, air defense weapons, landing and pickup zones, FARPs, and Army airfields.

(5) Low-level transit route. An LLTR is a temporary bidirectional corridor through the areas of organic low-level air defenses of surface forces in a HIDACZ or an ROZ (area). It reduces the risk to friendly aircraft, yet minimizes constraints to organic air defenses in a condition of "weapons free." An LLTR is planned by representatives of both land and air forces in accordance with the operational commander's ACP. LLTRs are changed often to prevent compromise. Details of planned LLTRs and any changes to established LLTRs are passed to the ACA for coordination and promulgation. LLTRs include dimensions with specific restrictions to length, height, and width and consider the requirements and capabilities of surface air defense and other air user systems.

(a) Security. To counter enemy penetration of LLTRs while maintaining maximum safety for friendly aircraft, low-level weapon systems should be maintained at "weapons tight" within the LLTRs. The ACA can further guard against enemy compromise by a variety of route changes. These include-

Using time slots.

Closing one corridor and opening an alternate.

Reversing the direction of flow within each corridor.

Routing around the restricted or heavily defended areas to the rear.

Creating shallow dog legs to provide surface air defense cover against direct enemy penetration.

Using a matrix of alternative route entry points forward and turning points to the rear of the surface air defense area.

(b) Weapons control orders. Weapons control orders for surface air defense systems whose arcs of fire intercept the LLTR remain "weapons tight" over that part of the route at all times. Should it become necessary to change to "weapons free," that particular corridor must be closed.

(6) Standard-use Army aircraft flight route. An SAAFR is established below the coordinating altitude to facilitate the movement of Army aircraft during VMC. (Army aircraft movements in the rear operations area conducted during IMC will comply with established IFR procedures.) The SAAFR is normally located in the corps and the division rear areas and is a recognized Army airspace control measure that does not require joint approval. The A^2C^2 element develops SAAFRs to safely route Army aircraft conducting CS and CSS missions at terrain flight altitudes. SAAFRs are primarily intended for single aircraft or for small flights of aircraft operating routinely between base clusters in the division support area and the corps rear area. These routes will terminate in relatively secure areas. The CRC will ensure

that USAF aircraft avoid SAAFRs to the extent practicable and will advise USAF aircraft and the FOC of potential conflicts. This information will be passed to A^2C^2 and ATS elements for dissemination to rotary-wing aircrews using SAAFRs. Some considerations for establishing an SAAFR are discussed below.

(a) Routes in rear areas should provide terrain masking from enemy air defense systems to avoid compromising the SAAFR structure and facilities of key base clusters.

(b) SAAFRs may be extended to the brigade support area when numerous logistical missions will be flown into the brigade support area or forward support battalion.

(c) The corps A^2C^2 element is responsible for developing the SAAFR structure for the corps rear area. It also ensures that the corps structure links to its subordinate division's SAAFR structure.

(7) Base defense zone. A BDZ is an air defense zone established around an air base. It is limited to the engagement envelope of the SHORAD systems defending the base. Theater army aviation elements operating in the communications zone may encounter these control measures during airlift operations. BDZs have specified entry, exit, and IFF procedures that aircrews must follow.

(8) Weapons-free zone. A WFZ is an air defense zone established for the protection of key assets or facilities of the joint force other than air bases. ADA systems within a WFZ are normally maintained at a weapons control status of "weapons free." Aircrews must avoid active WFZs or coordinate their use with the designated control authority before entering or transiting the zone. Figure C-2 shows an example of a

BDZ and a WFZ.

Figure C-2. Base defense and weapons-free zones

(9) Air corridor. An air corridor is a restricted air route of travel specified for friendly aircraft use. It is established to prevent the use of friendly fires against friendly aircraft. Air corridors are employed within the terrain flight environment, normally in the division area of operations. They are temporary corridors established to route combat elements of the division and corps aviation brigade between such areas as assembly areas, battle positions, FARPs, and target engagement areas. Several factors involved in air corridors are discussed below.

(a) Air corridors are employed as control measures during air assault operations to designate routes for air assault forces during the air movement phase. They can be used to route aircraft conducting air movement operations in corps and division rear areas.

(b) The appropriate A^2C^2 element advises and coordinates with the airspace control center on the placement and use of air corridors.

(c) An air route is an airspace procedural control measure normally employed in the communications zone and corps rear area to control the movement of USAF and host nation air traffic.

b. Other Control Measures. Other control measures are used routinely to provide airspace users with greater freedom of operation and means of identification in the combat zone. These means include the use of traverse levels, time slots, and airspeed control.

(1) Traverse level. The traverse level is that height or altitude above a low-level air defense

system,

expressed both as AGL and above mean sea level, at which an aircraft can traverse the area. It is used when the aircrew is unable to obtain clearance from the air defense system or is unable to comply with other prearranged recovery or transit procedures. The traverse level is established to improve the effectiveness of air defense systems by assisting in aircraft identification while offering safe aircraft passage. It does not limit aircraft operating under positive control through another airspace control agency. The traverse level may be extended across one or more high-density airspace control zones or confined to the area over a restricted operations area. The traverse level is determined by a number of factors. These include-

Weather.
Terrain screening.
Tactical situation.
Possibility of compromise.
Type of aircraft using the area.
Low-level air defense resources in the area.
Capability of alternative air defense systems.

(2) Time slot. The declaration of a time slot should indicate the-

Height.
Period of restraint.
Specific area covered.
User system restrained.
Reason (if security permits).
Procedures for the cancellation or modification of the time slot in case of communications failure or degradation.

(3) Airspeed control. Airspeed control is an additional airspace control procedure used by aircraft to assist air defense systems in identifying them. It may be used with other considerations such as height, direction, area, and time. The declaration of the use of airspeed control should include-

Area.
Height.
Direction.
Speed band.
Period of applicability.
Aircraft number and type.
Reason (if security permits).

Table C-1. Airspace control measures and users

CONTROL MEASURES	USER
Corridors and Routes:	
Air route	NATO and ASCC
Low-level transit route	NATO and ASCC
Minimum risk route	US
Standard-use Army aviation flight route	US
Special corridor	NATO
Transit corridor	NATO
Zones:	
Base defense zone	NATO
High-density airspace control zone	US, NATO, and ASCC
Restricted operations zone	US, NATO, and ASCC
Weapons-free zone	NATO
Air combat engagement areas	US
Flight Levels:	
Coordinating altitude (level)	US and NATO
Traverse level	US and NATO
Other Airspace Subareas or Control Measures:	
Airspace coordination area	US and NATO
Amphibious objective area	US and NATO
Terminal control area (zone)	US and NATO
Weapons engagement zone	US and NATO
Control point	US and NATO
Way point	US and NATO
Time slot	NATO and ASCC

Way point	US and NATO
Time slot	NATO and ASCC

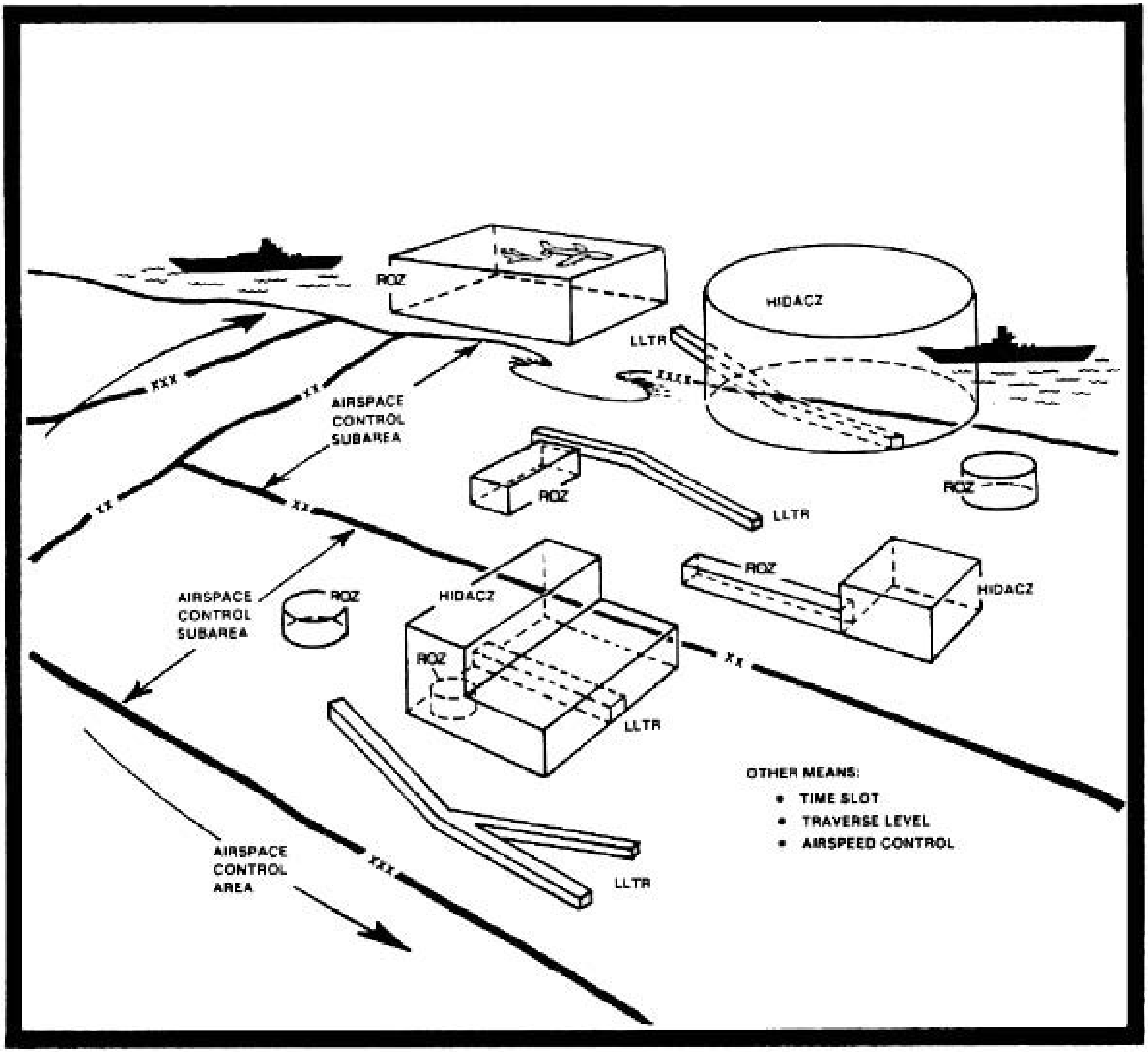


Figure C-1. Airspace control measures

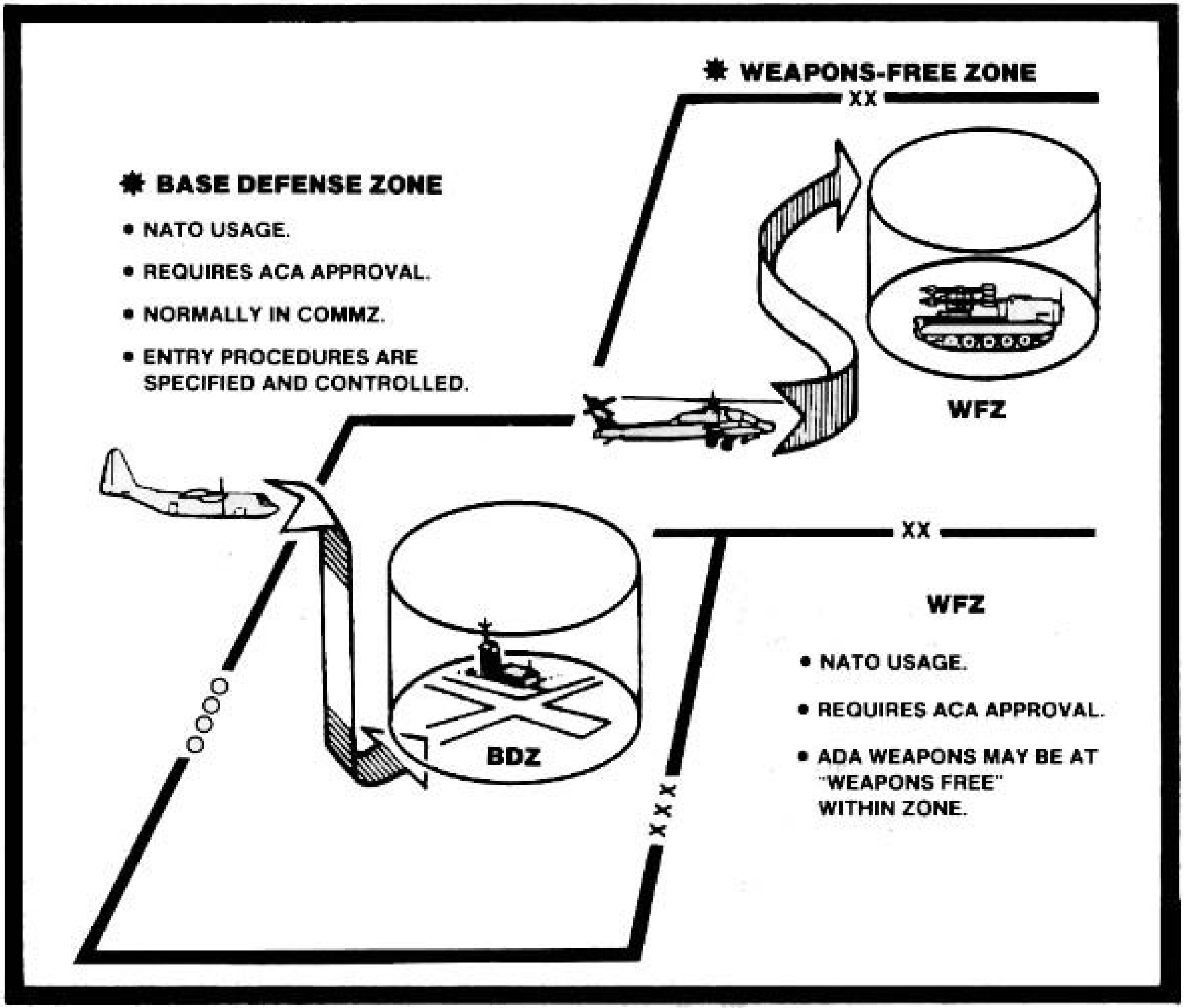


Figure C-2. Base defense and weapons-free zones

APPENDIX D

RISK MANAGEMENT

Tough, realistic training conducted to standard is the cornerstone of Army warfighting skills. An intense training environment stresses both soldiers and equipment, creating a high potential for accidents. The potential for accidents increases as training realism increases. Thus realistic training poses a serious drain on warfighting assets. Commanders must find ways to protect their soldiers and equipment from accidents during realistic training to prepare for war. An accidental loss in war is no different in its effects from a combat loss; the asset is gone. Commanders must compensate for the numerical advantages of the Threat by protecting their combat resources from accidental loss. How well they do this could be the decisive factor in winning or losing. Commanders and staffs can use this appendix as a guide for managing risk as it applies to their organization and mission.

D-1. CONCEPT

Risk management is a tool leaders can use to make smart risk decisions in tactical operations. It allows leaders to execute more realistic training scenarios not otherwise possible because of the high probability of accidents. Risk management is a commonsense way of accomplishing the mission with the least risk possible. It is a method of getting the job done by identifying the areas that present the highest risk and taking action to eliminate, reduce, or control the risk. Risk management thereby becomes a fully integrated part of mission planning and execution.

D-2. RESPONSIBILITIES

Risk management is not complex, technical, or difficult. It is a comparatively simple decision-making process--a way of thinking through a mission to balance mission demands against risks. Once understood, risk management is a way to put more realism into training without paying a price in deaths, injuries, or damaged equipment or all three. Risk management is not limited to training scenarios. It is performed during actual combat as well as in peacetime. Leaders must learn to assess risks during training events and apply the same techniques during combat actions. During combat, risks may be taken but only after they are evaluated and weighed as they are during training.

a. Commanders. As in all other areas, commanders are responsible for the effective management of risk. To meet this responsibility, commanders-

(1) Seek optimum, not just adequate, performance.
(2) Select from risk reduction options provided by the staff.
(3) Accept or reject residual risk based on the benefit to be derived.
(4) Train and motivate leaders at all levels to effectively use risk management concepts.

b. Staff. The staff-

(1) Assists the commander in assessing risks and in developing risk reduction options.
(2) Integrates risk controls in plans and orders.
(3) Eliminates unnecessary safety restrictions that diminish training effectiveness.

c. Troop Leaders. Troop leaders-

(1) Develop a total commitment to mission accomplishment and the welfare of subordinates.
(2) Consistently apply effective risk management concepts and methods to operations they lead.
(3) Report risk issues beyond their control or authority to their superiors for resolution.

D-3. PROCESS

a. Step 1: Identify Risks. Identify major events of the operational sequence and list them chronologically; then, if necessary, display them in a flow chart. This process will aid in the detection of specific risks associated with all specified and implied tasks. Safety can be built into an operation by first seeing the operation in its entirety. Operations invariably can be broken down into a series of phases, each with special characteristics and considerations. As soon as the commander states the mission and concept, it is usually possible to define the key events. Operations also have a time factor--a beginning-to-ending series of events in which the timing of events is often as significant as the events themselves. The operations analysis is a useful tool in quickly defining the flow and time sequencing of events in an operation. The objective is to reflect the total operation from the preparatory actions until the operation is completed or the next phase of operations is under way. The operations analysis is a simple but highly effective tool. It ensures that risk is evaluated in every aspect of the operation. Operations safety techniques are effective to a point, but they do not detect risk with the reliability required to achieve the degree of safety needed in today's Army.

b. Step 2: Assess Risks. Determine the magnitude of risks by estimating loss cost and probability. Assess each event, determine whether it is routine, and make an initial risk assessment. Ensure that standards for routine events are adequate to provide an acceptable level of risk.

(1) Consider the value of a risk matrix or decision guide for al or part of the operation. Risk matrices provide a quick and ready method of

breaking down an operation into its major operational aspects and eliminating or controlling the risks associated with it. Like other risk assessment tools, risk matrices can be used alone or with other risk analysis techniques to provide a quick overview of the risk situation. Risk matrices are simple enough to be routinely used by tactical leaders in operational planning. These matrices are nearly always more effective than intuitive methods in identifying the extent of risk. Figure D-1 illustrates a typical matrix that can be used to estimate the level of risk associated with an operation. When using risk matrices, the risk assessor should-

(a) Review each situation to ensure that all significant areas of concern are evaluated, even if they are not included in the matrices.

(b) Use the matrices to analyze the risk to target areas of concern for risk-reducing action.

(c) Review the individual areas of concern before recommending an option. (If an area of concern is off the scale in a particular situation, a higher decision level may be required than the risk gauge suggests.)

(d) Keep in mind that Figure D-1 represents arbitrary weighted factors; modify these factors to fit

particular missions and units.

(2) Consider using the METT-T format as another means to assess risks. Leaders can subjectively determine the likelihood and extent of accidental loss based on this type of analysis. When using the METT-T format, the risk assessor should-

(a) Determine mission complexity and difficulty.

(b) Assess the enemy situation and identify specific hazards.

(c) Consider all aspects of the terrain as well as weather and visibility.

(d) Determine the supervision required and evaluate the experience, training, morale, and endurance of troops; also determine the availability of equipment.

(e) Determine the time available for planning and executing the mission.

Figure D-1. Suggested format of a risk assessment work sheet

Figure D-1. Suggested format of a risk assessment work sheet (continued)

c. Step 3: Make Decisions and Develop Controls. Make risk acceptance decisions by balancing risk benefits against risk assessments. Eliminate unnecessary risks. Reduce the magnitude of mission-essential risks by applying controls. Controls range from hazard awareness to detailed operational procedures. Focus on high-hazard events and events not covered by a good set of standards. Complete a preliminary hazard analysis of these events. The preliminary hazard analysis is the initial examination of the hazards of an operation and their implications. It is normally based on the mission analysis and data-base review and takes place before the details of an operation have been completely defined. The objective of the preliminary hazard analysis is to define, at the earliest possible point in the operational life cycle, the hazards that can be expected. Doing this early means that these hazards can be addressed when they are still preliminary; that is, when the operation is still being planned.

(1) Based on the preliminary risk analysis and products of analytical aids, develop a roster of options for eliminating or controlling the risks. Select or offer options for command decision. Once risks are identified and measured as accurately as possible, the leader must act to eliminate or control them. These controls must not unnecessarily interfere with training objectives. The best options often come from reviewing the doctrinal publications relevant to the operation to glean information about the proper procedures for hazard control. Merely reviewing the analysis and assessment will often suggest options. Some options will be more effective than others. AR 385-10 provides a convenient list of actions that commanders can use as an aid in ranking options. In order of priority, commanders should-

(a) Eliminate the hazard totally, if possible. Engineer out the hazard or design equipment to eliminate the hazard or incorporate fail-safe devices.

(b) Guard or control the hazard. Use automatic monitoring or alarming devices. Provide containment or barriers.

(c) Change operational procedures to limit exposure. Modify operational procedures to minimize exposure (numbers and duration) consistent with mission needs.

(d) Train and educate personnel in hazard recognition and avoidance.

(e) Provide protective clothing or equipment that will minimize injury and damage potential.

(f) Use color coding and signs to alert personnel to hazards. Motivate personnel to use hazard avoidance actions.

(2) Leaders can detect and eliminate unnecessary safety restrictions that impede the realism or effectiveness of training. With proper controls, these restrictions can be eliminated or scaled back. Check for residual effects before implementing risk reduction options. Visualize what will happen once the option has been implemented. Sometimes reducing one risk will only introduce others.

d. Step 4: Implement Controls. Integrate specific controls into plans, OPORDs, SOPs, training performance standards, and rehearsals. Knowledge of risk controls, down to the individual soldier, is essential for the successful implementation and execution of these controls.

e. Step 5: Supervise. Determine the effectiveness of standards in controlling risk. The commander must enforce controls and standards. This is key to loss control. The commander may have approved a number of risk reduction procedures, but approval does not mean that the procedures are carried out. Leaders must monitor the situation to ensure that action is actually taken. The prudent leader then follows up to see that the doers understand and accept the guidance. Leaders should also monitor the effect of risk reduction procedures to verify that they really are good ideas. This is especially true for new and untested procedures.

(1) Leaders must always monitor the operational activities of subordinate elements. Only by seeing the character of operations can leaders fully appreciate risk implications. When monitoring operational activities, leaders should-

(a) Avoid administrative intrusions and not get in the way.

(b) Go where the risks are and spend time at the heart of the action.

(c) Analyze and think through issues, not just watch.

(d) Work with key personnel to improve operational procedures after the action and not hesitate to address imminent danger issues on the spot.

(e) Fix systemic problems that are hindering field effectiveness.

(2) Leaders must be able to balance the cost of the risk involved with the value of the outcome desired in an operation. They must consider and manage risk in making decisions. Three general rules apply when leaders select a tactical procedure. They are

(a) No unnecessary risk should ever be accepted. The leader who has the authority to accept or reject a risk is responsible for projecting his soldiers from unnecessary risk. If a risk can be eliminated or reduced and the mission still be accomplished, the risk is unnecessary and must not be accepted.

(b) Risk decisions must be made at the appropriate level. The leader who will answer for an accident is the person who should make the decision to accept or reject the risk. In some cases, this will be a senior officer. In other cases, it will be the first-line leader. Small-unit commanders and first-line leaders are going to make risk decisions in combat. Therefore, they should learn to make risk decisions in training.

(c) The benefits of taking a risk must outweigh the possible cost of the risk. Leaders must understand the

risk involved and have a clear picture of the benefits to be gained from taking the calculated risk.

Side A

Planning

CIRCLE ONE	Risk Value		SCORE _____
Guidance	Preparatory Time		
	Optimum	Adequate	Minimal
FRAGO	3	4	5
OPORD	2	3	4
OPLAN/LOI	1	2	3

Mission Control

CIRCLE ONE	Risk Value		SCORE _____
Task Organization	Training Event		
	Support Nontactical/ Garrison	Day Tactical	Night Tactical
OPCON	3	4	5
Attached	2	3	4
Assigned	1	2	3

Crew Endurance

CIRCLE ONE	Risk Value		SCORE _____
Environmental Preparation	Crew Preparation		
	Optimum	Adequate	Minimal
Tactical	3	4	5
Training	2	3	4
Garrison	1	2	3

Crew Selection

CIRCLE ONE	Risk Value		SCORE _____
Task	Experience Level		
	Highly Qualified	RL 1	RL 3
Complex	3	4	5
Routine	2	3	4
Simple	1	2	3

Side A Subtotal _____

Figure D-1. Suggested format of a risk assessment work sheet

Side B

Weather

CIRCLE ONE	Risk Value		SCORE ______
Wind Velocity	Ceiling/Visibility		
	>1000/3	<1000/3	Minimums
>30 kt	3	4	5
16-30 kt	2	3	5
0-15 kt	1	2	5

Terrain

CIRCLE ONE	Risk Value		SCORE ______
Type of Terrain	Modes of Flight		
	Low Level	Contour	NOE
Mountain	3	4	5
Desert/Jungle	2	3	4
Hills, Flat/Rolling	1	2	3

Equipment

CIRCLE ONE	Risk Value		SCORE ______
Equipment Age	Aircraft Status		
	FMC	PMC	Mission Equipped
Old	4	5	5
Average	2	4	4
New	1	2	2

Subtotal Side A ______ Subtotal Side B ______ Total ______

0 to 12 Low Risk	13 to 23 Caution	24 to 35 High Risk*

*High-risk operations assigned a value of 24-35 require coordination, before executing the mission, with the next higher level of command external to the organization making the assessment. When two or more areas are assigned a risk factor of 5, the overall rating is high risk.

Figure D-1. Suggested format of a risk assessment work sheet (continued) next higher level of command external to the organization making the assessment. When two or more areas are assigned a risk factor of 5, the overall rating is high risk.

Figure D-1. Suggested format of a risk assessment work sheet (continued)

CHAPTER 1

AIR DEFENSE THREAT

This chapter implements portions of STANAG 2999 and STANAG 3873.

This chapter discusses Threat objectives, employment tactics and techniques, and force structure. It describes Threat air defense weapon systems that may be employed against US Army aircraft. These weapon systems include antiaircraft artillery, surface-to-air missiles, small arms, armored combat vehicles, and antitank guided missiles. FM 100-2-3 contains additional information about Threat air defense systems. This chapter also discusses air countermeasure techniques, ground passive defense initiatives, and aircraft survivability equipment.

Section I

OBJECTIVES, EMPLOYMENT TACTICS AND TECHNIQUES, AND FORCE STRUCTURE

1-1. OBJECTIVES

a. World War II taught the Soviets a lesson in the destructive capability of modern tactical aircraft. The best evidence that the Soviets still remember that lesson can be found in their vigorous tactical air defense program. Since World War II, the Soviets have continuously updated, modernized, and fielded newer and more effective air defense weapons and equipment. The Threat combined arms team is trained to engage hostile air targets. The Soviets believe that air defense is an integral component of combined arms operations. They also believe that the air defense of ground forces is best achieved by employing a variety of weapons and equipment to form a complete air defense system.

b. The objective of Soviet tactical air defense is to protect maneuver force operations from enemy air attack. The Soviets seek to achieve this objective by forcing enemy aircraft to expend their ordnance beyond the effective or optimum range of their weapons. Their objective can also be achieved by destroying enemy aircraft when they come within the effective range of air defense weapons.

1-2. EMPLOYMENT TACTICS AND TECHNIQUES

a. Soviet air defense involves all branches of the Soviet armed forces employed in three stages. The stages may overlap and be conducted simultaneously. Each stage is briefly described below.

(1) The first stage attempts to destroy enemy aircraft at airfields or in marshaling areas. It includes strikes by rocket, aviation, and artillery forces and submarines or surface ships. The first stage also includes attacks by air and naval assault forces, special operations forces, and partisan groups. These attacks are launched against airfields, helicopter staging areas, and combat service support facilities. Moving columns of vehicles conducting sustainment operations will probably be key targets for air defense strikes. Soviet aviation resources and surface-to-surface missiles play a major role in the first stage.

(2) The second stage involves the neutralization of enemy aircraft while they are in flight but still at some distance from Soviet ground forces. These attacks are normally carried out by interceptor aircraft and medium-range air defense missile units. Radio electronic combat and directed energy weapons will also be employed in this stage. (Chapter 5 discusses radio electronic combat, and Chapter 6 discusses directed energy weapons.)

(3) The third stage entails the destruction of enemy rotary- and fixed-wing aircraft that have penetrated the airspace over Soviet maneuver elements. This role primarily belongs to Soviet tactical air defense forces.

b. Soviet ground air defense units protect forces and other potential targets in the area of military operations from air attack. Soviet air defense units are primarily responsible for protecting ground-based targets. However, they also protect rotary- and fixed-wing aircraft conducting air assault and airborne operations beyond the FLOT. The Soviets consider armed helicopters and fixed-wing, ground-attack aircraft operating at low altitudes (up to 40 meters) as the principal threats to their maneuver forces. They recognize the difficulties in accomplishing the air defense mission against these low-flying aircraft. "Dead zones" in radar detection and weapon engagement capabilities, created by terrain and vegetation masking, are major obstacles. To overcome these obstacles, the Soviets deploy a variety of air defense weapons with a suitable mix of capabilities.

1-3. FORCE STRUCTURE

a. Front through division air defense assets are strategically sited to create a system of radars that provide surveillance and targeting of enemy aircraft throughout the battlefield. Threat SAM and antiaircraft artillery units and radars are sited to provide unbroken detection and engagement envelopes that extend well beyond the FLOT and deep into enemy rear areas. Front SA-4 or SA-12a and Front and army SA-4 will probably be the first SAM fire units to engage enemy aircraft that get past Soviet fighters. Gaps may appear in the missile engagement envelope, but the Soviets will try to maintain continuous coverage. Air defense units protect assigned objectives from all forms of enemy activity, including air strikes, aerial reconnaissance, and air assaults. These systems form an air defense umbrella that moves with the supported ground forces. Figure 1-1 shows the Threat air defense coverage provided by Front and army air defense systems.

b. Soviet air defenses employ acquisition and fire control radars with air defense, antiaircraft artillery, and surface-to-air missile systems that can provide surveillance and targeting of enemy aircraft. Air defense weapon systems are sited to protect combat formations, installations, and troop movements from air attack. They may occupy carefully selected positions to ambush helicopters operating in terrain flight modes.

Figure 1-1. Front and army air defense coverage

c. Threat antiaircraft artillery units are organic to regiments and divisions. Figure 1-2 shows the air defense coverage of Threat antiaircraft artillery units organic to regiments and divisions. (Information on the SA-16 is not available for inclusion in the illustration.) Priority for protection is assigned to motorized rifle or tank units, command posts, and critical support activities. Threat antiaircraft artillery units have extensive and effective radar detection and fire control systems. Their target acquisition radars are concentrated in organizations at division and above. Target information on enemy aircraft is sent over dedicated warning nets or command and support radio nets when necessary. In defensive operations, the Soviets employ field telephones and use visual and pyrotechnic signals to enhance communications security.

Figure 1-2. Division and regimental air defense coverage

d. In the attack formation, reconnaissance units are responsible for locating the limits of enemy defensive positions. The main body in the attack is usually organized into echelons. The first echelon accomplishes the primary mission--the destruction of enemy forces, command posts, and trains areas. The second echelon may assist the first echelon in obtaining immediate and subsequent objectives and will sometimes be tasked to destroy bypassed enemy elements. Counterattacks, security, and unforeseen contingencies are assigned to a small reserve at regiment, division, or army level. Antiaircraft artillery is employed in all elements and rear areas. Figure 1-3 shows a typical battle disposition for a Threat motorized rifle division executing movement to contact with SAM and antiaircraft artillery elements. The frontages for main attacks will be less.

Figure 1-3. Motorized rifle division in a movement to contact

e. The Soviets consider the offense the decisive form of military activity. They also recognize that defensive action will be necessary at times on the combined arms battlefield. The goal of the defense is to disrupt or repulse the offense of a superior force, inflict significant losses on an enemy, and hold important terrain. Through defensive actions, the Soviets expect to create favorable conditions for making the transition to the offense. The defense can be assumed either in direct contact or out of direct contact with the enemy. Soviet commanders may assume the defense as a result of an unsuccessful stage in a meeting battle. They may also assume the defense when their forces attack an enemy to repel a counterattack or hold key terrain. The defense may likewise be assumed to secure open flanks or economize forces for the main thrust in another sector. Figure 1-4 shows an example of a motorized rifle regiment in the division's main defense belt.

Figure 1-4. Motorized rifle regiment in the division's main defense belt

Section II

THREAT AIR DEFENSE WEAPON SYSTEMS

1-4. AIR DEFENSE

Threat air defense weapon systems pose a significant threat to rotary- and fixed-wing aircraft operating on the battlefield. Aircrews conducting missions within the effective range of these weapons must be able to recognize each Threat system and take advantage of its engagement limitations. The capabilities, employment, and limitations of principal Threat air defense weapon systems are described below.

a. ZU-23 Antiaircraft Gun. The ZU-23 is a highly mobile, air-droppable, twin 23-millimeter towed system. It is normally fired from a stabilized position that requires leveling jacks on a three-point base. Figure 1-5 shows the ZU-23.

Figure 1-5. ZU-23

(1) Employment. The ZU-23 appears in many variations. It is organic to Soviet airborne assault brigades,
airborne regiments, and airborne divisions. (2) Capabilities. The ZU-23 can be fired from the traveling position in emergencies. Reloading is fast and uncomplicated. Optical sighting is used for targeting. The ZU-23 has an effective range of 2,500 meters against aircraft. It is also effective against lightly armored ground vehicles.

(3) Limitations. The ZU-23 fires only automatic fire.

b. ZSU-23-4 Antiaircraft Gun. The automatic 23-millimeter cannons of the ZSU-23-4 pose a significant threat to US aircraft and lightly armored ground vehicles. The ZSU-23-4 is equipped with Gundish radar and can acquire and track low-flying aircraft targets. It is NBC-protected and can be airlifted by Soviet An-22 Cock or IL-76 Candid transport aircraft. Figure 1-6 shows the ZSU 23-4.

Figure 1-6. ZSU-23-4

(1) Employment. A platoon of four ZSU-23-4s is assigned to the air defense missile and artillery battery of motorized rifle and tank regiments. Two ZSU-23-4s usually support each of the two first-echelon battalions. Each weapon is normally separated by 200 meters, traveling 40 meters

behind battalion lead elements.

(2) Capabilities. The ZSU-23-4 can fire on the move and is difficult to detect or evade. The frequency operation of the Gundish radar provides excellent aircraft tracking. Electronic target acquisition, tracking, and ranging are automated. An onboard computer determines elevation and azimuth lead. The ZSU-23-4 can acquire, track, and engage low flying aircraft at an effective antiaircraft range of 2,500 meters. Aircraft can also be targeted using conventional optical sights. Any detectable radar emissions are thereby reduced or completely eliminated. The ZSU-23-4 can fire two types of ammunition. Its high-explosive incendiary (tracer) rounds can defeat aircraft by blast, fragmentation, or incendiary effect. Its armor-piercing incendiary (tracer) rounds can penetrate light armor on aircraft and vehicles.

(3) Limitations. The ZSU-23-4 is vulnerable to electronic countermeasures. Heavy machine gun fire, artillery fire, or high-explosive fragmentation ordnance or a combination of these can penetrate the armor, destroy the radar dish, or rupture the liquid coolant sleeves of the 23-millimeter cannons. The ZSU-23-4 is not amphibious. It is being replaced by the 2S6, which is described in d below.

c. BMP-2 Amphibious Infantry Combat Vehicle. The BMP-2 has been configured with an enlarged two-man turret and fitted with additional armor. A 30-millimeter automatic gun is mounted on the turret. Figure 1-7 shows the BMP-2.

Figure 1-7. BMP-2

(1) Employment. The BMP-2 is considered a significant threat to Army aircraft operating at or below terrain flight altitudes.

(2) Capabilities. The BMP-2, an improved version of the BMP infantry combat vehicle, has been modified to perform other tactical roles. The addition of a layer of applique armor and the 30 millimeter, dual-purpose automatic gun improves both ballistic protection and employment capability against air and ground targets. The elevation and ballistic characteristics of the BMP-2 enable it to engage helicopters and low-flying, subsonic fixed-wing aircraft at an effective range of 3,000 meters. (The gun's suppressive fire range can be extended to 4,000 meters, depending on the type of ammunition used.) An antitank guided missile launcher atop the turret can employ AT-4 Spigot or AT-5 Spandrel missiles to engage

slow-flying or stationary aircraft. The launcher can be removed from the vehicle and employed while dismounted. The BMP-2 can use engine exhaust or the six 81-millimeter smoke grenade projectors mounted on the turret to generate screening smoke.

(3) Limitations. The BMP-2 vehicle has thin armor that protects it from .50-caliber armor-piercing rounds only over the 60-degree frontal arc and 23-millimeter ballistic protection within the turret. It is extremely vulnerable to antitank guided missile, 30-millimeter, and tank fire. The engine compartment and ammunition storage area, fuel cells, and troop compartment are located so that penetration anywhere on the vehicle will result in a mobility, firepower, or personnel kill.

d. 2S6 (M-1986) Air Defense Vehicle. The Soviets have begun fielding the 2S6 as a new air defense vehicle. The 2S6 carries twin 30-millimeter automatic cannons, which resemble the weapons carried on the BMP-2 vehicle, and four SAMs mounted on the -turret. Figure 1-8 shows the 2S6.

Figure 1-8. 2S6

(1) Employment. The 2S6 will reportedly replace ZSU-23-4 and SA-9 and/or SA-13 weapon

systems within the air defense missile and artillery battery of motorized rifle and tank regiments.

(2) Capabilities. The 2S6 closely resembles the West German Gepard air defense gun vehicle except for the missiles. Four 30-millimeter cannons (two on each side) are mounted on a turret, which appears to be 360-degree traversable. The 30-millimeter cannon probably fires the same ammunition as the 2A42 30-millimeter cannon on the BMP-2. This cannon fires high-explosive (tracer) and armor-piercing (tracer) ammunition at 200 to 300 or 500 rounds per minute. The 2S6 is fitted with an electro-optical tracking system and surveillance radar on the roof of the turret and a fire control radar in front of the turret. The gun system is believed to have an effective antiaircraft range of 3,800 meters for close-in targets with a maximum vertical range of 5,000 meters. A SAM system, consisting of eight SA-19 missiles (four on each side), is mounted atop the vehicle. The missiles have independent elevation and may be "fire and forget" or semiautomatic command to line of sight with an infrared terminal seeker. The 2S6 Hot Shot radar system uses separate surveillance and fire control radars. The surveillance radar has a maximum effective range of at least 15 kilometers and folds down to the turret rear when not in use. The fire control radar probably has a range of 8 to 10 kilometers. The combination of gun and missile, plus multisensor fire controls, makes the 2S6 a difficult target for electronic countermeasures.

(3) Limitations. The 2S6 is reportedly mounted on a heavily armored chassis, which is similar to the chassis on the SA-11. The 2S6 does not carry spare missiles. It should be vulnerable to tank, artillery, and antitank guided missile fire.

1-5. SURFACE-TO-AIR MISSILES

Surface-to-air missiles are the most common threat facing Army aircraft on the battlefield today. The Soviets' vigorous tactical air defense program demonstrates their concern over US technological advances in the development of tactical air support. Soviet long-range (strategic) SAM systems are not considered a direct threat to Army helicopters. The surveillance and acquisition radars associated with strategic systems do pose an indirect threat to Army helicopters. These radars can provide early warning to air defense elements equipped with short- to medium-range SAM systems. Strategic systems are discussed in Appendix B; short- to medium-range SAM systems are discussed below.

a. Short- to Medium-Range Surface-to-Air Missiles. These SAM systems are primarily used against attacking aircraft. Early warning radars provide almost instantaneous target data to shorter range SAM air defense systems such as the SA-6 and SA-8. Enemy aircraft moving in rear areas or advancing toward the FLOT are reported to other Threat air defense elements. This information can provide divisional air defense elements with enough azimuth and distance information to anticipate the precise point at which the system can engage enemy aircraft. Early warning methods, therefore, can reduce acquisition and engagement times. SAM systems with guidance systems other than radar may use alternative methods such as optical engagement techniques. These systems can engage enemy aircraft while remaining undetected by radar warning devices. Table 1-1 shows the characteristics and capabilities of Threat short- to medium-range SAM systems.

(1) SA-4 Ganef. The SA-4 is a medium- to high-altitude, radio-command system with

semiautomatic homing. It is mounted on a tracked transporter-erector-launcher with a 360-degree traverse. ZU-23 guns provide close air defense protection for the launchers. Figure 1-9 shows the SA-4 Ganef.

(a) Employment. The SA-4 is organic to Front and army SAM brigades. It provides high-altitude protection for the advancing army. The SA-4 supports army forward maneuver elements, thus filling the gap between low-altitude SA-6 and SA-8 batteries. SA-4s are normally positioned about 10 kilometers behind army forward forces. They are located in a belt 25 kilometers behind the front line.

(b) Capabilities. The SA-4 has a kill zone at altitudes between 100 and 25,000 meters. It is not considered a direct threat to low flying US helicopters. However, surveillance and reconnaissance aircraft that perform mission orbits at higher altitudes are vulnerable to fire from these missiles. The SA-4 includes the Pat Hand fire control radar and is supported by Thin Skin height-finding and Long Track target acquisition radar.

Limitations. The SA-4 is vulnerable to suppressive fires and electronic countermeasures. The transporter-erector-launcher does not have onboard radar.

Table 1-1. Short- to medium-range SAM systems

Figure 1-9. SA-4 Ganef

(2) SA-6 Gainful. The SA-6 is a low-altitude system. The SA-6a carries three missiles, which are launched from a three-rail mount atop a modified PT-76 tank chassis. In the travel position, the launcher is lowered atop the transporter-erector-launcher with the three missiles facing rearward. In 1979, the SA-6b began to appear within SA-6 batteries of divisional SAM regiments. It is mounted on a three-missile launcher with an integrated transporter-erector-launcher and radar that can operate independently. Figure 1-10 shows the SA-6 Gainful.

Figure 1-10. SA-6 Gainful

(a) Employment. Five SA-6 batteries are in an SA-6 regiment organic to motorized rifle and tank divisions. Each battery has one Straight Flush radar vehicle, two reload vehicles, and four triple launchers. SA-6s may support first-echelon regiments. Normally, SA-6 regiments deploy three batteries 5 kilometers behind the front line; the remaining two are deployed about 10 kilometers farther back.

(b) Capabilities The SA-6 regiment's Long Track surveillance radar acquires target data. Target acquisition and fire control are taken over by Straight Flush radar. Target tracking is by single-beam

radar, while final intercept is by radar homing using continuous-wave radar. The SA-6 can also track optically during electronic countermeasure operations. (c) Limitations. The SA-6a depends on acquisition and tracking data received from slaved Straight Flush and regimental Long Track radars. However, the SA-6b system, with its integrated transporter-erector-launcher radars, can operate independently for surveillance. A battery of four SA-6a missile launchers may be rendered less effective by eliminating the single Straight Flush engagement radar in each battery. (3) SA-7 Grail. The SA-7 is a shoulder-fired, infrared, heat seeking missile system similar to the US Army's

Redeye missile. The SA-7 primarily engages rotary- and fixed-wing aircraft flying at low altitudes. Figure 1-11 shows the SA-7 Grail.

Figure 1-11. SA-7 Grail

(a) Employment. Motorized rifle battalions have an organic air defense platoon in which nine SA-7 operators with gripstocks are transported by the platoon's three BTRs or BMPs. A SAM section, consisting of one vehicle and three SA-7 gripstocks, normally is attached to each of the battalion's three motorized rifle companies. Similar air defense platoons are organic at battalion level in airborne, air assault, and airmobile assault units. The SA-14, which can engage targets head-on and at great distances, is replacing the SA-7. The highly accurate SA-16, another handheld SAM, is also replacing the SA-7 in tactical units. (The SA-14 and SA-16 are described in b(1) and (3) below.) Shoulder-fired SAMs are available on the world's arms market and appear in the arsenals of some Third World countries. (b) Capabilities. The SA-7a and SA-7b are tail-chase missile systems. Both are effective against low-flying aircraft.

(c) Limitations. The effectiveness of the SA-7 depends on the operator's ability to visually acquire, aim at, and lock on to an infrared target. Because the missile's infrared seeker is limited to chase-down capability, the operator must be within limited azimuths for lock-on and engagement.

(4) SA-8 Gecko. The SA-8 is a short-range, low-altitude, all-weather system. It is deployed well forward with maneuver regiments. The SA-8a has four missiles mounted on launch rails. The SA-8b has six missile canisters mounted atop the rotatable turret. Both systems are configured on a six-wheeled transporter-erector-launcher, which is recognizable by its boat-like bow. Figure 1-12 shows the SA-8 Gecko.

Figure 1-12. SA-8 Gecko

(a) Employment. The SA-8 is found in the air defense regiment of some motorized rifle and tank divisions. Each regiment is organized into five batteries with a total of 20 transporter-erector launcher radars. The SA-8 also provides air defense for regimental and divisional command posts and rear areas.

(b) Capabilities. The SA-8 has onboard Land Roll target acquisition, fire control, and surveillance radars. These radars acquire and lock on to Army aircraft operating at low level and perhaps lower altitudes, depending on target distance, vegetation, and terrain relief. The two missile guidance radars make it possible to launch two missiles at the same target. Each radar responds to a different frequency to frustrate electronic countermeasure efforts. The SA-8 can track targets optically using a low-light-level television camera. Optical tracking eliminates the need to use radars that produce emissions detectable by radar warning receivers.

(c) Limitations. The SA-8 is vulnerable to suppressive fires and electronic countermeasures. Its exposed radar and wheels are especially vulnerable to artillery fire. In the optical tracking mode, the system is susceptible to battlefield obscuration.

(5) SA-9 Gaskin. The SA-9 is a short-range, low-altitude, passive-infrared system. SA-9s are housed in

boxlike canisters that are grouped usually in fours atop a modified BRDM-2 vehicle. Figure 1-13 shows the SA-9 Gaskin.

Figure 1-13. SA-9 Gaskin

(a) Employment. A platoon of four SA-9 vehicles is organic to the air defense battery of motorized rifle and tank regiments. The SA-9 platoon is teamed with a platoon of four ZSU-23-4s. SA-9 fire units will probably be deployed between regimental first and second echelons. The SA-13 Gopher has replaced the SA-9 in Soviet forward area units. (The SA-13 is described in (8) below.)

(b) Capabilities. An operator seated in the vehicle is alerted to an approaching target by a surveillance data link. The operator then tracks the target optically until the missile has locked on to the target and is ready to fire.

(c) Limitations. The SA-9 does not have onboard radar. Therefore, crew members must depend on preliminary target data broadcast over the division's early warning radar net until they can visually acquire the target. The infrared homing missile is restricted to chase-down capability. The vehicle hull provides armor protection of only 14 millimeters and is vulnerable to suppressive fire. The SA-9 is also vulnerable to battlefield obscurants.

(6) SA-11 Gadfly. The SA-11 is the successor to the SA-4. It is a low- to medium-altitude system. The SA-11 transporter-erector-launcher radar is mounted on a tracked chassis similar to that used for the radar vehicle associated with the SA-11. The chassis features a 360-degree traversable platform for omnidirectional missile launch. Figure 1-14 shows the general configuration of the SA 1 Gadfly.

Figure 1-14. SA-11 Gadfly

(a) Employment. The SA-11, which replaces the SA-4 Ganef, is deployed in army-level air defense brigades. It employs either Tube Arm or Snowdrift radar, which provides long-range early warning of aircraft movement. Surveillance information is relayed via command data links to divisional air defense assets.

(b) Capabilities. The SA-11 is probably radar-guided and is larger and more complex than the SA-8. The SA-11 is a significant improvement over the SA-6. It carries its own onboard guidance and target engagement radar on each launcher vehicle. Unlike the SA-6, each vehicle must be eliminated to suppress the battery.

(c) Limitations. The vehicle and its radar are vulnerable to suppressive fires. Reload missiles do not appear to be carried onboard the transporter-erector-launcher.

(7) SA-12a Gladiator and SA-12b Giant. The SA-12a and SA-12b are long-range, low- to high-altitude, tactical systems with some antitactical ballistic missile capability. The transporter-erector-launcher of the SA-12a is mounted on a modified MT-T heavy tracked transporter. It carries four missiles in cylindrical containers. The SA-12b, which is now in development, can intercept aircraft, cruise missiles, tactical ballistic missiles, and possibly some strategic ballistic missiles. Figure 1-15 shows the SA-12a and

SA-12b.

Figure 1-15. SA-12a Gladiator and SA-12b Giant

(a) Employment. The SA-12a is replacing the SA-4 Ganef in nondivisional SAM units. Initial deployment has been to Front-level SAM brigades.

(b) Capabilities. The SA-12a does not pose an immediate threat to US helicopters using terrain flight techniques. However, it does pose a significant threat to high-altitude reconnaissance platforms such as surveillance and Airborne Warning and Control System aircraft. The SA-12a and SA-12b provide air defense against unmanned aerial vehicles, aircraft, cruise missiles, and some ballistic missiles. The two radars on the system enable long-range surveillance and multiple aircraft monitoring from the deepest rear areas of the battlefield.

(c) Limitations. The system's radars, missiles, erector-launcher apparatus, and tracked vehicle are vulnerable to suppressive fires, especially artillery fire.

(8) SA-13 Gopher. The SA-13 is a short-range, low-altitude, improved infrared system. It is mounted atop an MT-LB armored tracked vehicle chassis. The launcher is pedestal-mounted and provides a 360-degree firing capability. The launchers can accommodate the canisters of either the SA-9 or the SA-13 missile. A circular parabolic radar antenna is located between the two pairs of missile canisters. Figure 1-16 shows the SA-13 Gopher.

Figure 1-16. SA-13 Gopher

(a) Employment. A platoon of four SA-13s is organic to the air defense battery of motorized rifle and tank regiments. This platoon is complemented by a platoon of four self-propelled antiaircraft guns. Targets for the SA-13 are acquired by the radars of the battery's self-propelled antiaircraft guns or by division-level radars.

(b) Capabilities. The SA-13 missile has a cooled infrared seeker that better discriminates against countermeasures than the SA-9. The operator tracks the target optically. He then uses the onboard ranging radar to inform the crew when the target is within the missile's range. Four box-shaped structures on the hull of the platoon leader's transport-erector-launcher radar house a passive receiver. The receiver provides 360 degrees of coverage around the vehicle.

(c) Limitations. The SA-13 depends primarily on visual acquisition by the crew and on data passed by data link from other radars of the battery. The operator's ability to track targets visually may be degraded by suppressive fires and battlefield obscuration. The vehicle hull provides armor protection of only 7 millimeters.

b. New Surface-to-Air Missiles. The success of the US Stinger missile against Soviet aircraft in Afghanistan has apparently resulted in a Soviet effort to develop a similar weapon. These new SAM systems have necessitated a new countermeasure effort by the US Army for attack helicopters and SEMA. The USAF has a similar effort under way for ground attack aircraft. These new SAM systems are a definite concern for US forces, but they will not be fielded throughout tactical units for some time. Some Soviet divisions still rely on older radar-directed guns. However, divisions facing NATO forces can be expected to receive first priority for the new systems. The capabilities and characteristics pertaining to the new systems discussed below are based on unofficial published sources and may or may

not be valid information. As these systems become available, older models can be bought by countries seeking to improve their air defense posture. Export models and Western designs will also appear in the arsenals of these countries.

(1) SA-14 Gremlin. The SA-14 is an infrared, shoulder-fired, air defense missile. It is a modernized version of the SA-7 Grail. The principal improvement appears to be the incorporation of seeker cooling to improve the sensitivity of the infrared guidance system. The SA-7 is a tail-chase system, which reduces its utility on the battlefield. Because infrared countermeasure systems have rendered the SA-7 nearly ineffective, the SA-14 probably incorporates anti-infrared countermeasure technology. The SA-14 can engage targets head-on at ranges up to 4,000 meters.

(2) SA-15. The Soviets have begun to deploy the SA-15 at division level. The SA-15 is a follow-on to the SA-8 Gecko. While the SA-8 is wheeled, the SA-15 is mounted on the MT-S tracked chassis. Although few details about the SA-15 are available, it is probably radar-guided.

(3) SA-16. The SA-16 is already in the field. It resembles the SA-14 in many respects but has a new gripstock and a longer missile fuselage. Like the SA-14, it undoubtedly incorporates anti-infrared countermeasure filters, improved seeker sensitivity, and greater range than its predecessor. Its performance, compared to the Stinger, is not yet known. Figure 1-17 shows a version of the SA 16.

Figure 1-17. SA-16

(4) SA-17. The Soviets will deploy the SA-17 to replace the SA-11 Gadfly. Few unclassified details about the SA-17 are available. The SA-17 is mounted on the same tracked chassis as the SA 11. It is probably configured in a similar fashion with an onboard engagement radar on the launcher vehicles. The SA-17 uses Snowdrift surveillance radar and will probably be deployed in army-level air defense brigades.

(5) SA-19. The SA-19 will be mounted atop the new 2S6 regimental air defense vehicle. The system is built on the tracked armored transporter MT-S chassis and probably has a four-man crew. It will probably be used primarily as an antiaircraft gun vehicle. The missile is semiactive radar-guided. The 2S6 is fitted with an electro-optical tracking system that can probably be slaved to the Hot Shot radar system. The missiles, if laser-guided, could use the radar system for automated tracking. They may also be "fire-and-forget" infrared-guided types with an estimated range of 8 to 10 kilometers. Missile canisters are sealed and have top and rear side protection. Figure 1-18 shows the general configuration of the 2S6

with SA-19 missiles. The model shown has two inboard 30-millimeter autocannons and four outboard SA-19 missile launchers.

Figure 1-18. 2S6 with SA-19 missiles

1-6. SMALL ARMS WEAPON SYSTEMS

Small arms weapon systems pose a significant air defense problem for Army aircrews. These weapons are employed in vast numbers and can be found almost anywhere on the battlefield. Therefore, an encounter within the effective range of even a single weapon can jeopardize both the aircraft and the aircrew.

a. Capabilities. Table 1-2 lists the most common Threat small arms and machine gun weapon

systems
and their capabilities. Table 1-3 shows the type and quantities of small arms weapons found within a typical Threat motorized rifle battalion reinforced by one tank company. It also shows the same information for a typical Threat tank battalion reinforced by a motorized rifle company.

Table 1-2. Threat small arms weapon systems

Table 1-3. Threat battalion small arms weapons 1-22

b. Employment and Tactics. In motorized rifle companies, a portion of the command is always designated to deliver massed fire on attacking aircraft. Small arms weapon systems and machine guns are employed by the individual soldier and motorized wheeled and tracked vehicles. Each combat soldier is trained in antiaircraft firing techniques and visual identification of hostile aircraft. Emphasis is placed on constant visual reconnaissance, followed by the rapid engagement of aircraft operating at terrain flight altitudes. Platoon-size elements engage rotary-wing aircraft while company-size units engage fixed-wing aircraft.

c. Grenade Launchers. Motorized rifle battalions have an automatic grenade launcher platoon with six AGS-17 launchers. These are carried in pairs in three armored vehicles. One vehicle could be allocated to each of the battalion's three motorized rifle companies. A platoon of six AGS-17s is also organic to airborne battalions and to assault and parachute battalions in air assault and airmobile assault brigades.

(1) Units equipped with the AK-74 or AKS-74 assault rifle are also equipped with BG-15 grenade launchers. The 40-millimeter launcher connects to the barrel of these weapons. The launcher's effective range is not confirmed.

(2) Slow-moving, low-altitude aircraft are especially susceptible to the blast effects from grenade launchers. Aircraft involved in air assault, reconnaissance, attack, and similar missions that require landing are also vulnerable.

(3) Antitank grenade and rocket launchers, such as the RPG-7V, RPG-18, and RPG-22, are not designed for engaging helicopters. However, a gunner experienced in engaging moving targets can be effective against slow-moving helicopters. Helicopters operating at NOE altitudes or performing takeoffs or landings are vulnerable to these types of weapons.

1-7. ARMORED COMBAT VEHICLE WEAPONS

a. The Soviets emphasize high rates of advance (30 to 50 kilometers per day when nonnuclear weapons are employed and 50 to 80 kilometers per day when nuclear weapons are employed). To achieve high rates of advance, the Soviets equip their maneuver forces with up-to-date armored combat vehicles. The number of tanks, infantry fighting vehicles, armored personnel carriers, and reconnaissance vehicles in the Soviet inventory has increased considerably in recent years. This increase, along with the improved accuracy of onboard weapon systems, makes the armored combat vehicle a formidable threat to US aviation operations. Table 1-4 shows the number of Threat armored combat vehicles in motorized rifle, tank, and airborne divisions. Table 1-5 lists Threat armored combat vehicle weapons.

Table 1-4. Threat armored combat vehicles in motorized rifle, tank, and airborne divisions

b. The Soviets know the capabilities of US attack helicopters and the threat they pose to Soviet armored formations. "Air spotters" are incorporated in combat formations to detect airborne targets. Target data is relayed to the commander who designates priority targets. Within seconds, the airborne targets can be engaged by one tank or several tanks. If the tanks use time-fused fragmentation rounds and 22 of the 40 rounds are high explosive, the kill probability is increased.

1-8. ANTITANK GUIDED MISSILES

The primary role of antitank guided missiles is the destruction of enemy armor. However, antitank guided missiles can also be used in the anti-helicopter role. The Soviets have continually improved the technology of antitank guided missiles and are fielding missiles with faster velocity, increased range, and greater armor penetration. Table 1-6 lists the characteristics and capabilities of Threat antitank guided missiles. The AT-6 Spiral and the AT-8 Songster are briefly described below.

a. AT-6 Spiral. The AT-6 mounted on the Mi-24 Hind E and F has replaced the AT-2 Swatter variant found on previous Hind models. The Hind E and F may carry up to 16 Spiral missiles. The greater velocity and increase in range to 5 kilometers mean the missile's primary targets may include not only tanks but also helicopters. The Mi-28 Havoc, which has not been deployed, may be able to carry 16 Spiral missiles. The Mi-28 probably has an antiarmor role comparable to the AH-64 Apache.

b. AT-8 Songster. The T-80 tank and a variant of the T-64 tank can fire the AT-8 through the main tube. The AT-8 has supersonic velocity and a range of 4 kilometers. It poses a serious threat to Army helicopters that are hovering or flying slow.

Table 1-5. Threat armored combat vehicle weapons

Table 1-6. Threat ATGM characteristics and capabilities

Section III

AIR COUNTERMEASURE,GROUND PASSIVE DEFENSE, AND AIRCRAFT SURVIVABILITY

1-9. AIR COUNTERMEASURE TECHNIQUES

Threat air defense weapons opposing Army aviation units are the most lethal ever faced in the history of military operations. These weapons may be encountered anywhere, even deep in the rear area of operations. The survivability of Army aircraft depends on well-organized coordination with ground forces and the aircrew's ability to employ effective countermeasures.

a. Suppression.

(1) Fire. Suppression by direct or indirect fire is the most effective active countermeasure against Threat weapons and their operators. During combined arms operations, direct and indirect fires are integral to the scheme of maneuver.

(a) During reconnaissance, logistics surveillance, or covering force operations, Army aviation may not have sufficient support from infantry, armor, or attack helicopter resources. However, indirect artillery fire support or tactical air support may be available to assist with these missions.

(b) When using fire suppression as a countermeasure, aircrews should first suppress the closest or most immediate threat while maneuvering to a standoff range. Firing first, firing in heavy volume, and firing accurately will gain the advantage. Fire suppression causes the enemy to button up and take cover, which limits its ability to deliver effective fire and denies visual acquisition. Fire suppression may also destroy enemy forces and their weapon systems.

(2) Smoke. Smoke is very effective in suppressing those weapons dependent on optical acquisition. Smoke can impair normal vision and degrade infrared optical devices used by many Threat weapon systems. However, smoke can also obscure the battlefield for friendly forces. For example, smoke suppression can obscure the target when helicopters are employed at standoff ranges. Wind speed and direction and other atmospheric conditions may work to the disadvantage of friendly forces. Smoke munitions can be delivered by mortar, artillery, and attack helicopter weapon systems. The employment of smoke requires careful consideration of the factors discussed above.

b. Terrain Flight Techniques.

(1) All air defense weapons depend on either visual or radar acquisition, and the most effective passive countermeasure is to avoid detection. Terrain flight techniques degrade the Threat's ability to acquire Army aircraft. Also, the basic line-of-sight limitations associated with radars provide an effective means of denying acquisition while aircraft are en route. A thorough intelligence briefing and a careful flight or map reconnaissance during premission planning can help aircrews select the best flight routes for detection avoidance.

(2) To avoid acquisition by Threat radar, aviators must keep terrain features between the aircraft and any known Threat radar weapon systems. Aviators should not assume that foliage or thinly wooded areas are an effective barrier against radar systems. A solid terrain feature, such as a hill, may reflect a radar image to reveal an aircraft's location even though the aircraft appears to be masked. Subsequent unmasking or repositioning of the aircraft can thereby be anticipated, thus reducing the time required for Threat radar acquisition and engagement.

c. Standoff Techniques. Aviators should use standoff flight techniques when they engage the enemy or fly near enemy positions. These techniques are important countermeasures against small arms, armored combat vehicle weapons, tanks, and antitank weaponry. Avoiding detection by using terrain flight techniques enables aircrews to surprise the enemy. Employing standoff techniques prevents engagement by enemy weapons.

d. Exposure Time.

(1) Aircrews can reduce exposure time by using available terrain to mask the aircraft. During attack helicopter operations, aviators should employ fire and maneuver using pop-up firing

techniques and preselected multiple firing points when engaging the enemy. Aviators must always be aware of the range and effectiveness of Threat weapons and the time these weapons require for target engagement. Because aircraft survivability equipment does not provide this information, aviators must memorize it.

(2) Fixed-wing aircraft depend on terrain flight, good route planning, and speed to surprise the enemy and reduce exposure time. SEMA performing high-altitude surveillance or reconnaissance missions must remain beyond the effective range of air defense weapons or rely on maneuvering and aircraft survivability equipment. (Aircraft survivability equipment is described in paragraph 1-11.)

e. Aircraft Signature. Aviators can take advantage of the surrounding environment to minimize aircraft signature. Terrain folds and shadows can avoid glint from the rotor and propeller and from Plexiglas or metal parts. Flight routes, pickup zones and/or landing zones, and reconnaissance and firing points should provide terrain backgrounds that prevent skylining and radar signatures. Aviators can also take advantage of color tones that blend with the terrain. Night flight is an effective means of avoiding detection by Threat forces. The avoidance of loose debris, dust, snow, and vegetation in the area prevents rotor wash signature. At high temperatures, hovering may produce a heat signature that enables the Threat system to detect aircraft masked behind vegetation. To avoid detection under these conditions, the aviator must either mask the aircraft or maintain some forward speed. The aviator can also reduce aircraft signature by presenting the Threat with the front (smallest part) of the aircraft.

(1) Doppler effect. More advanced pulse Doppler radars will detect the Doppler shift produced from the aircraft's rotating surfaces. The Doppler effect is prominent when helicopters are flown close to the ground such as in a masked or firing position. When aviators are aware that they are being acquired by radar, they should reposition the aircraft laterally before unmasking.

(2) Radar tracking. Some Threat radars have autotracking features that use computers to track aircraft movement. Once radar lock is established, computers predict the speed and direction of the aircraft. After breaklock is indicated, aviators should continue to alter their course and speed to prevent radars from predicting their new location. When the direction of Threat radars is known or suspected, aircrews should use signature reduction techniques to minimize the silhouette viewed by tracking radars. At a hover, this can be accomplished by presenting the smallest cross section possible toward the tracking radar (nose or tail of the aircraft). At speeds above a hover, aircrews can achieve the same result by changing the course or the flight path.

1-10. GROUND PASSIVE DEFENSE INITIATIVES

During combat operations, helicopters may be on the ground as much as two-thirds of the time. The enemy can use a variety of sensors to locate helicopters on the ground, and the enemy has a variety of weapons to attack targets that it detects. Helicopters will be used extensively on the battlefield. Therefore, they will be high-priority targets for air and artillery attacks. Aviation unit commanders must seize every opportunity to confuse enemy efforts to detect, locate, and destroy aviation support areas and aircraft on the ground. Unit personnel must use camouflage and concealment procedures that reduce the detectability of aviation assets. The enemy can easily detect glint from aircraft canopies. Therefore, unit personnel should install canopy (glare) covers as soon as possible after the engines and rotors stop. Deception and camouflage techniques include dispersing aircraft on the ground, parking aircraft in nonsymmetrical patterns, and camouflaging aircraft and support equipment with terrain features. (The use of terrain features will reduce the skylighting (silhouetting) of aircraft.) Battlefield-deception element personnel from the corps or division can assist unit personnel with deception operations and equipment.

a. Target Acquisition and Attack.

(1) Means. Helicopters on the ground can be acquired and attacked in several ways. The simplest scenario is observation of a target by an armed aircraft, followed immediately by an attack. The helicopter would be a target of opportunity for an aircraft that is flying a specified route based on some form of intelligence. A sophisticated scenario would have the following sequence of events: acquisition of a cuing signal, confirmation of the target, development of an attack plan, and the attack. Other scenarios may include observation of helicopters by enemy ground forces, followed by artillery or other ground-based fire or air-delivered fire. Helicopters on the ground can be acquired by any of these means:

- Radar.
- Television.
- Infrared detectors.
- Infrared surveillance.
- Visual (unaided and aided).
- Satellite and other photography.
- Human intelligence (visual and acoustic).
- Air- and ground-based electronic surveillance.

(2) Locations.

(a) Pickup zones. Radio communications are required to conduct operations at PZs. Detection of communication signals will enable the enemy to determine the approximate location of the PZ. However, the enemy will need to employ a secondary means of detection before it attacks. Helicopter stay time in the PZ is usually about ten minutes. This should be less time than the enemy needs to obtain confirmation of the PZ's location. Electronic surveillance, therefore, does not pose a significant threat if PZs are used on a one-time basis. Electronic acquisition is also less likely if communications in the PZ are limited to the period when pickups are actually conducted. Any detection means accompanied by an attack pose a significant threat to helicopters at PZs. These include armed aerial observers, artillery observers, and armed long-range reconnaissance patrols. Although radar is not a primary means for detecting helicopters on the ground at PZs, it is a threat to helicopters arriving and departing PZs.

(b) Landing zones. The same detection means to locate PZs also applies to LZs. However, LZs are more likely to be observed by armed aerial observers, artillery observers, and armed ground forces.

(c) Forward arming and refueling points. The FARP is vulnerable to detection by the means identified for PZs and LZs. The FARP will remain in place for an extended period, use communications, and produce thermal images from aircraft and fuel storage bladders. These may be sufficient to permit location by the enemy and result in an attack on the FARP. Helicopters at

FARPs will be high-priority targets for armed reconnaissance aircraft and armed ground observers. Ground observers who do not attack a FARP will probably report its location for aerial attack. FARP operations should be organized efficiently to reduce the time that aircraft will stay in the FARP. FARPs must be kept to the smallest size that can support the operational requirement and should be moved frequently. communications must be kept to a minimum, and aircrews should be familiar with and use approved approach and departure procedures. The use of infrared, thermal, and antiradar camouflage screens on equipment and helicopters at the FARP can help preclude detection of the FARP. When available, ballistic nets should be used to protect fuel storage bladders.

(d) Forward assembly areas. Helicopters stay at FAAs long enough to permit detection by the enemy. All of the detection means identified for PZs and LZs should be considered a threat.

(e) Command posts. The detection threat to CPs is similar to that for FARPs. Communications from CPs will increase the threat of electronic detection. Also, identification of a target as a CP will give it a high-attack priority. The use of secure communications equipment with an electronic

counter-countermeasures capability can degrade the enemy's electronic detection efforts.

(f) Downed aircraft positions. A downed helicopter is vulnerable to all of the identified target detection means. Other helicopters associated with rescue, removal, or repair may be detected by the same means.

(g) Company and maintenance areas. Helicopters at company and maintenance areas are lucrative targets within a corps. They are vulnerable to all of the detection means identified for PZs and LZs.

b. Camouflage and Concealment. The probability of detection and subsequent targeting of helicopters on the ground increases when helicopters are not camouflaged or when poor camouflage techniques are used. As the means of Threat detection change from visual to infrared, radar, and thermal detection systems, the more critical it becomes to conceal helicopters on the ground. Concealment is enhanced by the use of ultralight camouflage systems designed to degrade Threat detection capabilities.

(1) Camouflage sets. Camouflage sets are being developed to meet the demands of aviation units worldwide. The sets will be available in different sizes and designs. Colors and patterns will correspond to primary seasonal or environmental characteristics.

(a) Onboard camouflage set. The onboard camouflage set consists of a canopy (glare) cover and camouflage material. The crew emplaces the glare cover while the helicopter is on the ground and the engines are not running. Camouflage material can be used to cover or break up the shape of rotor blades or other portions of the helicopter. The use of helicopter camouflage paint would enhance the value of the onboard camouflage set. Figure 1-19 shows an AH-64 with the conventional three-color camouflage

pattern; Figure 1-20 shows the glare cover for the AH-64.

Figure 1-19. AH-64 with conventional three-color camouflage paint

Figure 1-20. Glare cover for AH-64 (b) Clamshell camouflage set. The clamshell camouflage set consists of prefabricated panels. The panels are kept close to the location of the helicopter to be camouflaged. Once the helicopter is in position, two people can put each panel in place. Figure 1-21 shows the clamshell camouflage set.

(c) Free-standing camouflage set. Camouflage sets must be rapidly erected in company and maintenance areas. In providing free-standing camouflage sets for helicopters, the covering of the rotors will require large structures. Despite the challenges of constructing free-standing camouflage sets, the possibility of increasing helicopter survivability appears to justify the effort. Figure 1-22 shows an example of a free-standing camouflage set.

Figure 1-21. Clamshell camouflage set

Figure 1-22. Example of a free-standing camouflage set

(2) Operational restrictions. Helicopters will occupy several locations while executing missions. This will place some restrictions on the use of camouflage. Camouflage sets cannot be used at PZs and LZs because of short stay times and other operational requirements. However, camouflage sets can be erected and used at company and maintenance areas where the stay times are longer. In more stable areas, free-standing camouflage sets could contribute significantly to the survivability of helicopters. Some operations can be protected by the use of onboard camouflage sets. Easily transportable and employable camouflage sets can be used at CPs, FAAs, FARPs, and downed aircraft positions.

c. Deception. Deception delays and/or diverts Threat reconnaissance, intelligence, surveillance, and target acquisition efforts; denies fire and maneuver opportunities; and provides false targets. Decoys and other special effect devices can be used to portray real items of equipment, personnel, or ground positions such as FAAs, FARPs, and maintenance areas. Decoys aid survivability because they draw fire from real assets. Aviation units can gain the advantage by deceiving the enemy's target detection efforts. Providing false information about helicopter ground positions may allow actual ground operations to continue unhindered by Threat targeting efforts.

(1) Devices.

(a) Aviation passive defense initiatives, such as aircraft silhouettes and inflatable decoys, are being developed and evaluated as deception products. These products represent actual FARP equipment, personnel, and helicopters.

(b) Decoys and other special effect devices are available from corps and division battlefield-deception elements. These elements may be contacted through the corps or division G3. Aviation units may also use unserviceable real assets for decoys or construct deception sites with the assistance of deception element personnel.

(2) Guidelines.

(a) Determine the purpose of the deception. Determine the purpose of the deception, and ensure that it supports the commander's scheme of maneuver. If the purpose is to draw indirect and/or direct fire, the decoy site must be located to avoid collateral damage to real assets.

(b) Reinforce preconceived notions. Prepare the decoy location to make the enemy believe something it wants to believe. For example, if an actual FAA is normally moved every 40 to 165 minutes, then the decoy FAA should be moved within that time. If camouflage is usually used on real aircraft and equipment, it should likewise be used on phony aircraft and equipment.

(c) Plan the site layout carefully. Construct the phony site so it looks real. Use only decoys of assets that are normally found at the real site.

(d) Coordinate with adjacent friendly units. Coordinate the location of phony sites with adjacent friendly units to avoid collateral damage from hostile fire. (A successful deception site will draw direct and/or indirect fire.)

(3) Operations.

(a) Aviation units may perform missions to enhance the authenticity of a phony FARP. Aircraft can fly to and from real airheads and conduct communications with controllers to reinforce the idea that a real supporting attack is the main attack. Deceptive uses of phony FARPs can influence the enemy's offensive and defensive operations.

(b) Most commanders avoid attacking strongpoints. Real FARPs, located behind main defensive positions, are one of several indicators of strength. Thus, phony FARPs can show strength where strength is not and may cause the enemy to avoid attacking weaker points.

(c) A phony FARP can be used to replace a real FARP. This ploy reinforces intelligence gained and diverts attention from the new location of the real FARP. Also, phony FARPs that draw fire offer the

opportunity to locate a real FARP at the same location after the strike.

(d) Many units combine assets in one staging area, including FARPs, maintenance areas, and aviation operation centers. The sudden appearance or movement of a staging area is a signal of pending operations that most Threat commanders will not overlook.

1-11. AIRCRAFT SURVIVABILITY EQUIPMENT

The aircraft survivability equipment discussed below has been fielded or is under development. The proper nomenclature of each system and a brief description of its basic function are provided. The applicable operator's manual contains specific information about the equipment's operation, characteristics, capabilities, and limitations. Also, aircrews can review the applicable ASET lesson to learn more about the equipment. Survival depends on the aircrew's action when the aircraft has been acquired or engaged by a Threat air defense system. Knowing the capabilities of onboard aircraft survivability equipment is only the first step toward survival. Aircrews must also know precisely how to employ the equipment within the time constraints dictated by the threat.

a. Radar Warning Receivers.

(1) AN/APR-39(V)1 and AN/APR-39A(V)1. The AN/APR-39(V)1 is a lightweight radar warning receiver for tactical aircraft. It provides visual, directional, and aural warnings of pulsed radar-directed threats. Proper response to the warnings allows the aircrew time to execute evasive maneuvers and deploy active countermeasures. The AN/APR-39A(V)1 is an upgraded version of the AN/APR-39(V)1. This system extends coverage into other frequencies. A digital processor accurately identifies Threat systems. It provides an alphanumeric display of a system's direction and lethality and a synthetic voice warning.

(2) AN/APR-39(V)2 and AN/APR-39A(V)2. The AN/APR-39(V)2 radar detecting set is a

version of the AN/APR-39(V) family designed especially for SEMA. Like the AN/APR-39(V)1, this system uses a digital processor and an alphanumeric display to warn of pulsed radar-directed threats. The AN/APR-39A(V)2, which is an upgraded version of the AN/APR-39(V)2, should be fielded soon. This system extends the frequency band of coverage. A dual-stack, high-capacity digital processor sorts and identifies radar-directed threats. It provides an alphanumeric display of a system's direction and lethality and an aural warning.

(3) AN/APR-44(V), (V)1, and (V)3. The AN/APR-44(V) radar warning system is a lightweight passive device that alerts the aircrew to continuous-wave radar threats from SAMs and airborne-intercept missiles. The AN/APR-44(V)1 provides continuous-wave warning of Threat SAM systems. The AN/APR-44(V)3 provides continuous-wave warning of Threat SAMs and airborne-intercept missiles.

(4) AN/APR-48.

The AN/APR-48 radar frequency interferometer is a passive, phase-comparison, direction-finding system. It can rapidly detect and precisely locate emitters associated with Threat air defense systems.

AH-64 aviators will use the AN/APR-48 for target acquisition.

b. Radar Jammers.

(1) AN/ALQ-136(V)1 and (V)2.

(a) The AN/ALQ-136(V)1 countermeasures set is designed for the AH-1. It is an automatic pulse radar jammer that analyzes incoming radar signals. When Threat signals are identified, jamming automatically begins and continues until the Threat radar breaks lock. The system then ceases jamming but continues to receive and analyze radar signals.

(b) The AN/ALQ-136(V)2 countermeasures set is an automatic radar jammer similar to the (V)1 version but is designed for SEMA. It has reprogrammable modules, covers a broad frequency range, and has built-in preplanned product improvement capabilities.

(2) AN/ALQ-162(V)2.

The AN/ALQ-162(V)2 countermeasures set is designed for SEMA. It will provide warning and protection against SAMs and airborne-intercept missiles that use continuous-wave radar for guidance.

The system detects continuous-wave signals, validates them, and initiates jamming or warns the crew.

The specific action taken by the system is determined by warning and jamming thresholds preprogrammed in the system. Jamming and/or warning data is visually displayed on the AN/APR-39(V)2 and AN/APR-39A(V)2. When deployed, this system will replace the AN/APR 44(V)3.

c. Chaff and Decoy Systems.

(1) M-130 general-purpose chaff dispensing system. The M-130 uses the M1 chaff cartridge. It reduces or eliminates the Threat's ability to detect, lock on to, and destroy aircraft with radar-controlled antiaircraft artillery. The M-130 is employed on SEMA and tactical aircraft. It is operated manually in the chaff mode of operation.

(2) XM-33 radio frequency expendable decoy. The XM-33 is designed for use with the M

130 on SEMA. It serves as a decoy against various air defense systems. The XM-33 must be controlled by a missile approach detector to provide the critical timing required for deployment.

d. Laser Detecting Set and Electro-Optical Countermeasures Set.

(1) AN/AVR-2 laser detecting set. The AN/AVR-2 is a passive laser warning system. It receives, processes, and displays information resulting from aircraft illumination by Threat lasers. Threat information is displayed on the AN/APR-39(V).

(2) AN/ALQ-191 directed energy/optical countermeasures set. The AN/ALQ-191 provides laser and optical warnings and optical countermeasures. The aircrew will be able to select one or all of the required functions. The AN/ALQ-191 will be employed by attack helicopters.

e. High-Energy Laser Coatings. Laser coatings can counter the effects of laser weapons. The canopy and airframe of the aircraft may be treated with laser-resistant substances to minimize the effects of lasers on the aircraft and crew.

f. Expendable Jammers. Electro-optical expendable jammers use smoke or other obscurants to degrade Threat acquisition by aided or unaided means.

g. Infrared Jammers.

(1) AN/ALQ-144(V)1 and (V)3 countermeasure sets.

(a) The AN/ALQ-144(V)1 is an active, continuously operating, omnidirectional, electrically fired

infrared jammer system designed for SEMA and tactical helicopters. It protects helicopters equipped with low reflectance paint and engine exhaust suppressors by confusing or decoying the seeker head of Threat infrared missiles.

(b) AN/ALQ-144(V)3. The AN/ALQ-144(V)3 is identical to the (V)1 except for the operator control unit. The (V)3 operator control unit also contains the power switch for the AN/ALQ 136(V)1. This system is designed for attack helicopters.

(2) AN/ALQ-144A(V)1 and (V)3 countermeasure sets.
The AN/ALQ-144A(V)1 and the AN/ALQ-144A(V)3 are modular upgrades of the standard AN/ALQ-144(V)1 and (V)3. They provide greater protection against Threat infrared missiles.

(3) AN/ALQ-147A(V)1 and (V)2 countermeasure sets.

(a) The AN/ALQ-147A(V)1 is an active, constantly operating, rear-aspect, fuel-fired infrared jammer system. The jammer uses a specially designed 12-gallon fuel tank that attaches to the outboard wing stores of the OV-1D. The jammer provides protection by confusing or decoying the seeker head of Threat infrared missiles.

(b) The AN/ALQ-147A(V)2 operates identically to the (V)1 and provides the same protection. It uses a variation of the standard 150-gallon fuel tank, which includes an internal 15 gallon tank dedicated to the countermeasures set. The AN/ALQ-147A(V)2 is designed for the RV 1D.

(4) M-130 general-purpose flare dispensing system. The M-130 protects SEMA and tactical aircraft against infrared-seeking missiles. The system can be operated manually or cued by a missile approach detector system such as the AN/ALQ-156(V)1 on the CH-47. This system dispenses the M-206 flare to decoy Threat infrared missiles.

h. Infrared Suppression.

(1) Exhaust-plume suppressors. Exhaust-plume suppressors are available for rotary- and

fixed-wing aircraft. They reduce the infrared radiation from hot-metal engine exhaust, thereby reducing the infrared signature. This reduction lessens the probability of an aircraft being acquired or tracked by heat-seeking missiles.

(2) Infrared suppressive paint. Infrared suppressive paint reduces sun glint and glare, making aircraft painted with infrared suppressive paint difficult to detect. Also, its low reflectance makes it blend with the background during NOE flight. When used with an infrared suppressor, this low reflectance degrades the seeker lock-on capability of Threat infrared missiles.

i. Missile Detectors.

(1) AN/ALQ-156(V)1. The AN/ALQ-156(V)1 countermeasures device is an active airborne radar system that detects the approach of antiaircraft missiles. The system is installed on CH-47s. When a missile approaches, the AN/ALQ-156(V)1 automatically triggers the M-130 system to eject flare decoys. This significantly enhances the survivability of the CH-47 against infrared guided missiles.

(2) AN/ALQ-156(V)2. The AN/ALQ-156(V)2 uses the same principles as the AN/ALQ 156(V)1. It protects RC-12, RU-21, and EH-60 aircraft against both air-launched and ground-launched missiles.

(3) AN/ALQ-156(V)3. The AN/ALQ-156(V)3 uses the same principles as the AN/ALQ 156(V)1 and (V)2. It protects OV-1, RV-1, and EH-1 aircraft against both air-launched and ground-launched missiles.

j. Advanced Weapon Systems. The Hellfire and the 30-millimeter chain gun significantly enhance the lethality of attack helicopters. The Hellfire provides better and more lethal firepower with its extended range capability.

k. Mast-Mounted Sight. The mast-mounted sight contains a television, thermal-imagery system, and laser range finder/designator. It significantly increases aeroscout survivability by enabling aircrews to remain masked while they observe the enemy at extended standoff ranges. The OH-58D will be in command aviation battalions and companies of the corps and divisions for target acquisition. It will be directly linked to tactical fire in artillery units. The mast-mounted sight enables the OH-58D to operate at night as well as during the day.

l. Airborne Target Handover System. The AH-64 and the OH-58D are equipped with the ATHS, which can send and receive communications via FM secure in the form of electrical burst messages. The ATHS gives aircrews an important advantage by denying the enemy the ability to obtain a direction finding fix on the aircraft.

CHAPTER 5

ELECTRONIC WARFARE THREAT

From the FEBA to the corps rear area, navigational equipment, command and control radios, air defense radars, and other equipment used by the US Army emit electromagnetic energy. The Threat can locate, track, and monitor this energy and destroy its source. As part of their overall combat plan, Threat forces will employ signal interception, direction finding, jamming, and electronic deception and will analyze US Army communication and noncommunication emissions. The Threat will also attempt to destroy one-third of US Army communication facilities, degrade another one-third by jamming, and leave one-third open for surveillance and intelligence gathering. This chapter describes Threat EW capabilities and employment methods. It also discusses those countermeasures and counter-countermeasures that aviation personnel can use to enhance their survivability and lessen the effects of the EW threat.

5-1. RADIO ELECTRONIC COMBAT

> *"Communications is the basic means to ensure troop control. Loss of communications is the loss of troop control, and the loss of troop control in battle invariably leads to defeat."*
>
> *--LTC L. Titov Voyenny Vestnik No. 7, 1971*

a. Capabilities. The Soviets have developed their EW capabilities into an integrated system called radio electronic combat. Basically, REC is the integration of EW assets with the capabilities of the unit to attack and destroy enemy organizations and systems.

b. Goal. The Threat will conduct REC to limit, delay, or nullify US Army radio transmissions and other command and control systems while protecting its own command and control means. An estimated goal of the system is to destroy or disrupt, either by jamming or direct attack, at least 50 percent of the opposing force's command and control and weapon system electronics.

5-2. SIGNAL INTERCEPTION

a. Capabilities. Signals intelligence includes information gathered from communication and noncommunication transmitters. The Threat considers SIGINT a primary source of information and employs forces within its combined arms framework to intercept and analyze enemy communications for intelligence purposes. Through pattern analysis, traffic analysis, and message content, Threat forces can determine the structure, composition, capabilities, and intentions of an opposing force. This signal interception capability of Threat forces spans a large frequency band. The Threat will conduct signal interception operations to-

Gain intelligence information for tactical operations.

Form a data base for the conduct of new and ongoing operations.

Gain information concerning the technical characteristics of enemy equipment and operating procedures.

b. Employment. Threat aircraft may penetrate US Army airspace to collect necessary data for attack or

EW support operations or to warn other engaged Threat forces. SAM and AAA systems are extremely mobile; thus the timeliness of the information collected by the SIGINT aircraft is important. In a fluid battle situation, the force commander must be informed of the changing EOB as quickly as it is known. The commander's tactical decisions are based, in part, on the enemy's EOB.

(1) SIGINT mission. Reconstruction of the SIGINT mission using navigation and signal location data provides intelligence for exploitation and planning factors for future SIGINT operations. Bearings from individual radars should all intersect near, or be resolved at, the radar site. The accurate location of the site depends on operator proficiency, signal characteristics, navigation data accuracy, and DF equipment capability. Signal characteristics are used to identify each signal. By comparing the intercepted signals with these typical characteristics, the Threat can determine the general type of radar (early warning, height finder, or fire control). Further comparison with the characteristics of known radar systems can result in identification of the emitter as a specific radar system or a new or modified radar.

(2) SIGINT operation. Once the Threat determines the locations and types of radars, it provides the information to its intelligence activities and operational users. The intelligence activities use this new information about specific enemy radars and associated weapons as input to the EOB. Planners and aircrews use it to plan and conduct operations.

c. Improved Systems. In a typical SIGINT mission, an aircraft flies the collection mission and returns. The collected data is then processed, evaluated, and disseminated. Several systems, operating in near real time, have been proposed to make SIGINT collection more efficient. One such system would relay the collected information to a ground site for evaluation and immediate implementation into current plans and operations. Another proposal is to employ aircraft precision location systems to determine the location of enemy emitters. These same aircraft, in a continuing ESM role, could direct attack aircraft to the emitters and support them during the attack. RPVs have a wide range of application in the ESM role and offer cost and operating advantages. An RPV may be sent into a high-threat area to perform the same mission that might expose an aircraft and crew to unacceptable risks. The Threat can be expected to use RPVs in both offensive and defensive operations. The use of RPVs will provide near-instantaneous collection and relay of intelligence to ground sites via onboard telemetric systems.

5-3. DIRECTION FINDING

Direction finding is a collective term. It applies to the technique of determining line bearings from one or more DF positions to radio or radar emitters, as shown in Figure 5-1.

Figure 5-1. DF techniques

a. Capabilities. Direction finding is an accurate and effective technique that serves a multitude of intelligence purposes. When Threat forces integrate DF with other intelligence sources such as ESM systems, they can easily detect the deployment of enemy units. DF locates unit positions, tracks unit movements, and identifies weakly defended areas. It also provides targeting data for suppressive fires, planning data for jamming operations, and intelligence data for planning future operations.

b. Target Areas. The mobility of Army aircraft will make them relatively immune to the DF threat. Stationary aviation assets, antennas, and transmitters, however, are vulnerable and should be considered Threat DF targets. Other targets for Threat DF operations are airfields, support areas, and unit positions. Figure 5-2 shows expected DF target areas for an enemy flanking attack and an enemy breakthrough

operation.

Figure 5-2. Expected DF target areas

5-4. JAMMING

Jamming is the deliberate radiation, reradiation, or reflection of electromagnetic energy to impair the enemy's use of electronic devices, equipment, or systems. The Threat will use jamming to disrupt, confuse, and deny US Army communications.

a. Causes of Radio Interference. Radio interference may not be the result of jamming. It can be caused by radio malfunction, antenna placement, atmospheric disturbances, or overcrowded radio nets. No radio operator should initiate counter-countermeasures until it is clear that jamming, not other types of interference, is taking place.

b. Types of Jamming Signals. Because jamming may take many forms, it may not be discernible to the untrained operator. All potential radio operators should be trained in Threat jamming techniques. Knowing the types of jamming signals described below will help operators determine if the interference is a result of intentional jamming.

(1) Babbled voice.[*] This signal is composed of mixed voices engaged in simultaneous conversations, usually in the same language. The voice characteristics are similar to those found in the victim communications net.

(2) Tone.[*] This signal is a single frequency of constant tone. It jams manually keyed Morse code, voice, and radio carrier circuits.

(3) Pulse.[*] This signal resembles the monotonous rumble of rotating machinery. Pulse jamming signals are a nuisance on voice communication circuits.

(4) Randomly keyed Morse code.[*] This jamming signal is produced by randomly keying a Morse code and mixing the keyed signal with spark noise. It is effective against voice and Morse code communications.

(5) Recorded sounds. Recorded sounds may be any, usually diverse, audible sounds that distract operators and disrupt communication circuits. Examples are music, screams, applause, whistles, machinery noise, and laughter.

(6) Spark. This signal is easily produced. Bursts of short duration and high intensity are repeated rapidly. The time required for receiver circuitry and for the human ear to recover after each spark burst makes this signal the most effective in disrupting radio communications.

(7) Gulls. The gull signal is generated by a quick rise and slow fall of a variable audio frequency. It is similar to the cry of a sea gull and is a nuisance on voice circuits.

(8) Random noise. This synthetic radio noise is random in amplitude and frequency. It is similar to normal background noise. It can be used to degrade all types of signals. However, a great amount of power is necessary to jam voice communications.

(9) Stepped tones. These tones, transmitted in increasing pitch, sound like bagpipes. Stepped tones

normally are used against single-channel AM and FM voice circuits.

(10) Wobbler. The wobbler signal is a single frequency with a low and slowly varying tone. The result is a howling sound that is a nuisance during voice communications.

(11) Random pulse. This pulse varies in amplitude, duration, and rate. Pulses disrupt teletypewriter, radar, and data transmission systems.

(12) Rotary. A low-pitched, slowly varying audio frequency produces grunting sounds. This signal is used against voice communications.

c. Techniques of Jamming. The three jamming techniques normally employed by the Threat are spot, barrage, and sweep. Each is discussed below. Figure 5-3 illustrates spot and barrage jamming techniques.

(1) Spot jamming. In this technique, most of the jamming power is concentrated on one selected frequency; thus power is not wasted on other frequencies. Spot jamming is useful for accurate, effective, controlled jamming of a specific frequency. It can be used within a frequency band without interfering with other transmissions.

(2) Barrage jamming. In barrage jamming, power is transmitted over a wide band of frequencies. Little needs to be known about the receivers being jammed. All frequencies within both the band and the transmission range are affected. Because the transmitted power is spread over a range of frequencies, barrage jamming does not saturate any single frequency. This method, however, not only wastes power by jamming unused frequencies but also interferes with all transmissions, both friendly and enemy.

Figure 5-3. Spot and barrage jamming techniques

(3) Sweep jamming. Sweep jamming is typified by rapid changes in the jamming frequencies through a wide frequency band. Most of the available power is concentrated on a single frequency. However, this concentration of power is for a short time only because the jammer repeatedly sweeps back and forth across the band. As the sweeper moves across the band, each frequency gets almost all the power of the jamming signal. Although the power of the jammer is only briefly concentrated on a frequency, the recovery of the receiver circuitry from the effects of the jamming signal takes time.

5-5. ELECTRONIC DECEPTION

Electronic deception is the deliberate radiation, reradiation, absorption, or reflection of electromagnetic energy to mislead enemy forces in the interpretation or use of information received by their electronic systems. The two major categories of electronic deception are manipulative and imitative.

a. Manipulative Deception. Manipulative deception is erroneous information purposely inserted into electronic transmissions to deceive the enemy. It is a form of tactical deception. Some examples of manipulative deception that may be used by the Threat are-

Exaggeration of battle damage or number of enemy losses or prisoners of war.

Bogus radio calls divulging nonexistent units, equipment, or locations for future employment.

Chaff, which gives false imagery to the radarscope used for radar guided antiaircraft systems.

Propagation of false intelligence information regarding the tactical plans or composition of friendly forces.

b. Imitative Deception. Imitative deception is intrusion into an enemy force's communications or navigation net to deceive it with traffic or signals imitating its own communications. Two examples are voice imitations and meaconing.

(1) Voice imitations. Voice imitations can be used by the Threat after monitoring a particular radio net. The Threat may mimic a particular person to pass bogus information or to gain intelligence information.

(2) Meaconing. Meaconing is the alteration of navigational signals to mislead aviators who depend on navigational aids for geographic orientation. Normally, the Threat blots out the desired signal and establishes a false beacon from another location. Thus aviators may be lured into ambush positions or may drop troops and ordnance into the wrong areas. Aviators should be alert, especially during tactical instrument flights, for unexplained changes in signal strength, ADF needle heading indications, and FM homing audible differentiations. They should also note unexplained changes in radar vector headings.

5-6. SURVIVABILITY, COUNTERMEASURES, AND COUNTER-COUNTERMEASURES

On the battlefield, Threat forces will attempt to monitor, disrupt, or destroy US Army communications. Therefore, the free use of communications will not be available to aviators. Aviation personnel must know Threat electronic warfare capabilities and those countermeasures and counter-countermeasures that can prevent or lessen their effects.

a. Signal Interception. Army aviation units constantly use a variety of tactical communications equipment for navigation and communication. The most crucial for aviation combined arms operations is the FM radio. The aviator's radio transmissions probably will be monitored. Threat forces intentionally will not destroy or jam about one-third of these communications. They believe that they can gain significant intelligence data through the surveillance of aviation and ground communications.

(1) Communication procedures. The Threat can listen to everything said. Although the Threat cannot maintain this capability throughout the battlefield, it can detect the electronic transmissions of airborne elements from great distances. Aircrews, therefore, must know and use proper communication procedures. When communicating, aircrews should-

Consider using an alternate means of communication if available.

Use approved and correct communication words, phrases, and codes.

Limit transmissions to ten seconds or less by being brief and to the point.

Plan what to say before keying the transmitter to eliminate confusion and reduce transmission time.

Use secure radio (FM, AM, and HF) equipment. (The Threat cannot monitor secure radio communications.)

Use electronic communications equipment only when absolutely necessary and ensure it is turned off when not needed.

Plan missions in enough detail to prevent unnecessary transmissions. (A communications SOP should be available to each crew member during aviation operations.)

(2) SOI codes and brevity lists. When operating in nonsecure modes, aircrews should use SOI codes and brevity lists to prevent the compromise of information. The use of codes and brevity lists will also decrease transmission times. Aircrews should never use makeshift codes.

(3) Authentication requirements. Requiring random authentication by operators will ensure that only friendly operators are using the net. Authentication is required when aviators-

Are challenged to authenticate.

Suspect the enemy is in their net.

Transmit to someone who is under radio listening silence.

Enter a radio net or resume transmitting after a long period.

Are authorized to transmit a classified message in the clear.

Tell a station to go to radio silence or ask it to break that silence.

Talk about enemy contact, give an early warning report, or issue a follow-up report.

Cancel a message by radio or visual means and the other station cannot recognize the aviators.

Transmit a message without getting a timely response. (If authenticating, aviators require another authentication.)

Transmit directions that affect the tactical situation; for example, "Change location," "Shift fire," "Change frequencies," or "Turn off the radio."

(4) Operating frequencies. The SOI establishes times for frequency changes. Aircrews should use alternate frequencies only as necessary.

(5) Alternate communication means. Hand-and-arm signals, smoke, pyrotechnics, placards, and lights are a few alternate means of communication. (Visual communication systems are discussed in e below.) Alternate means of communication can be very effective; however, teamwork and a good unit SOP are a must.

(6) Antenna masking. Masking antennas prevents signal radiation in the direction of the enemy.

(7) Directional antennas. Aviation ground antennas can be directionally rigged to preclude signal radiation into enemy territory. This technique is often used as a jamming countermeasure.

b. Direction Finding. The areas that are particularly vulnerable to the DF threat are stationary aviation assets, antennas, and transmitters. Airfields, support areas, and unit positions are also expected to be primary targets. To reduce the effectiveness of Threat DF operations, aviation personnel should-

Relocate assets often.

Turn on beacons only when needed.

Camouflage real antennas and beacons if possible.

Mask radiating antennas and beacons from the enemy.

Employ an alternate means of communication if available.
Use only secure voice or authorized codes when referring to locations.
Follow authentication rules when asked to identify friendly locations.
Reduce the signal radiation range by using low-power transmitting modes.
Place remote beacons and antennas as far away from unit locations as possible.
Use directional antennas, when feasible, to limit signal radiation to desired directions.

- Use communications equipment only when necessary and use other communication resources,

such as wire, when available.

Use codes, prearranged checkpoints, or azimuths rather than ground reference points or terrain features to identify targets.

Erect decoy antennas in credible locations (2 to 5 kilometers) away from actual unit locations if practical and the equipment is available.

Decrease transmission times by using codes, brevity lists, and abbreviated call signs (after initial contact). (Transmission times of ten seconds or less, separated by periods of radio silence, are effective in denying directional fixes by the Threat.)

c. Jamming. Aircrews must be trained in Threat jamming techniques, the procedures for detecting

jamming, and those counter-countermeasures that can stop or reduce the effects of jamming. Figure 5-4 shows the procedures ground radio operators can use to determine whether interference is in the receiver or comes from a local source. Jamming countermeasures and counter-countermeasures are described below.

(1) Jamming countermeasures. When selecting a technique to prevent jamming, aviation personnel should apply the rule, "The best defense is a good offense." Therefore, aviation personnel should-

Mask antennas to prevent the Threat from receiving signals it can jam.
Reduce transmission times by using brevity lists and abbreviated call signs.
Plan messages before keying the transmitter and transmit only when necessary.
Use an alternate means of communication to reduce dependency on radio communications.
Use communications equipment only when necessary and turn it of when no longer needed.
Use low power on ground radios to prevent the Threat from receiving signals that it can spot jam.
Use directional antennas with ground radios to limit the Threat's reception capabilities and strengthen US Army communications.

Figure 5-4. Radio check procedures for receiver and local interference

(2) Jamming counter-countermeasures. Radio operators who understand the various types of jamming and jamming signals will be able to recognize jamming at the onset of interference. If radio operators determine that they are being jammed, they should-

Use a relay, if possible, to work through the jamming.
Transmit briefly during lulls in jamming intensity if the jamming is a sweep type.

Switch to high power in an attempt to override the jamming signal if using ground radios.

Use messengers if the jamming is too intense to operate through and communication is a must.

Continue operating and never say anything to indicate to the Threat that the jamming is effective.

Try to work through the jamming by repeating the transmissions and stating "Say again," as necessary.

Continue dummy traffic on the jammed frequency to keep the Threat occupied while using the alternate frequency.

Have aviation unit communications-electronics personnel rig a directional antenna to preclude jamming if possible.

Mask the antenna by locating it between a natural obstacle and the enemy jammer if the direction of the jamming can be determined.

Try tuning the radio a few kilohertz above or below the operating frequency to decrease the jamming signal and then continue to operate.

Switch to VHF, UHF, or FM radio if possible. Use SOI brevity lists for the switch code and use alternate signals according to the unit SOP if possible.

Use an alternate frequency if all other options have failed and an emergency exists. (A frequency change is designated by an SOI brevity code, and authentication is required.)

(3) Reporting requirement. Radio operators should describe the jamming as soon as practical to higher

headquarters. They should send a MIJI report, as shown in Figure 5-5. Reporting Threat electronic interference or deception is the most important defense. This report enables US intelligence to locate, jam, or destroy the enemy.

d. Electronic Deception. The foremost deceptive threats to Army aviation are voice imitations and meaconing. Voice imitations can trick aviation personnel into compromising tactical information. Meaconing can lure aviators into ambushes or across geographical borders, resulting in capture or destruction of the aircraft.

Figure 5-5. MIJI report

(1) Voice imitations. To avoid being misled by the Threat, aviation personnel must guard against imitative deception. They should-

Authenticate randomly to detect intruders in the net.

Keep communications concise, accurate, and easy to understand.

Always require unknown stations to authenticate; that is, play strictly by the rules.

Use an alternate means of communication and rely on radio communication as little as possible.

Use a different challenge and again require authentication if stations are not able to authenticate within 20 seconds.

Use secure voice modes, when practical, to prevent the Threat from entering the net. (Range reduction may make this impractical for some missions.)

(2) Meaconing. The Threat may use meaconing techniques to draw aviators into ambush or to mislead them into placing soldiers, equipment, or ordnance at unintended locations. To guard against meaconing when using navigational aids, aviators should-

Require stations giving radar vectors and FM homing assistance to authenticate.

Submit a MIJI report to higher headquarters so that the meaconing station can be located, jammed, or destroyed.

Use checkpoints and time, distance, and heading as a backup for radar, radio beacons, or FM homing when conducting premission planning. (These aids will help aviators stay on the right course and prevent deception.)

Take two to three fixes from known locations along the flight path if meaconing is suspected. (If aviators know the location of friendly beacons and aircraft, they can locate the origin of the beacon by resection.)

e. Visual Communication Systems. Visual signaling is a viable alternative to using radios and other electronic equipment to communicate. However, aviation personnel must consider the limitations of visual communication systems and the conditions that affect their use. These considerations and the available systems are discussed below.

(1) Limitations. Visual signals are easily misunderstood. Also, they cannot be relied on in conditions of poor visibility. Other problems are range, reception errors, and the time required to encode and decode messages. To overcome these limitations, communicators can conduct extensive premission planning and use identical code definition sheets. They can reduce reception errors by using optical amplification devices, such as a telescopic sight unit or similar device, to read visual signals.

(2) Feasibility. At times, the use of visual communication systems may not be feasible or necessary. Communicators should use radios as a backup or primary means of communication-

After the attack has begun.

When transmitting perishable information.

When the enemy would not have enough time to react to the information.

When the success of a mission depends on passing information immediately and accurately.

When terrain masking will deny the enemy the capability to receive or interfere with the radio transmissions.

(3) Available systems. Several systems for communicating visually are available to aviation personnel. These include the SAM system, shielded flashlights, aircraft lighting systems, aircraft maneuvers, smoke and pyrotechnics, the TADS, and hand-and-arm signals.

(a) SAM system. Aircrews can pass messages both day and night without danger of electronic detection

or interference using the SAM system depicted in Figure 5-6. The system consists of a binder containing two sets of communication cards and two code definition sheets. The 5- by 8-inch colored communication cards have numbers 5 1/2 inches high of a contrasting color. A definition sheet allows the encoding or decoding of 36 words, letters, and numbers. A second (spare) definition sheet enables aircrews to either change codes or to double the number of coded messages. During the day, when held against the side window or canopy of an aircraft, the communication cards permit unaided viewing up to 150 meters away. At night, the codes are transmitted as dots and dashes using a flashlight. Receipt of messages may be acknowledged by repeating the message, sending a prearranged signal or code, or maneuvering the aircraft. The SAM system may also be used for air-to-ground and ground-to-ground communications when electrical communications are restricted. Other visual communication systems may be developed and used by a unit. However, care must be taken to ensure that higher and adjacent units are familiar with the systems. The inability to communicate can jeopardize the mission and the crew's safety.

(b) Shielded flashlights. Aviation personnel can communicate at night with a flashlight using Morse code or a predetermined code system. Covers or tubes may make the light more directional. Colored lenses can be used with the flashlights unless night vision devices are being used; all light sources appear green with night vision devices.

(c) Aircraft lighting systems. Some general applications of aircraft lighting could signal events, phases, or operational problems during a mission. However, aircraft lighting systems may not be practical for

night communications because of the possibility of enemy detection. Figure 5-6. Send-a message system

(d) Aircraft maneuvers. Aircraft maneuvers, such as yawing, up-and-down movement at a hover, and

side-by-side movement of the aircraft tail, can be used as a means of signaling. Figure 5-7 shows examples of aircraft position maneuvers.

Figure 5-7. Examples of aircraft position maneuvers

(e) Smoke and pyrotechnics. The use of smoke and pyrotechnics has many disadvantages. These means are best employed to signal general events such as attack, withdrawal, refueling, or rearming.

(f) Target acquisition and designation system. Although the TADS on the AH-64 was designed for detecting and engaging targets, the system's direct-view optics also offers other advantages. For example, it provides the copilot/gunner a magnified image, which can enable him to recognize smoke and other visual communication devices and systems at greater distances than otherwise possible.

(g) Hand-and-arm signals. The tactical situation may dictate the use of hand-and-arm signals to transmit messages over line-of-sight distance as an alternative to electronic communications.

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* signal can also be unintentional.

Figure 5-1. DF techniques

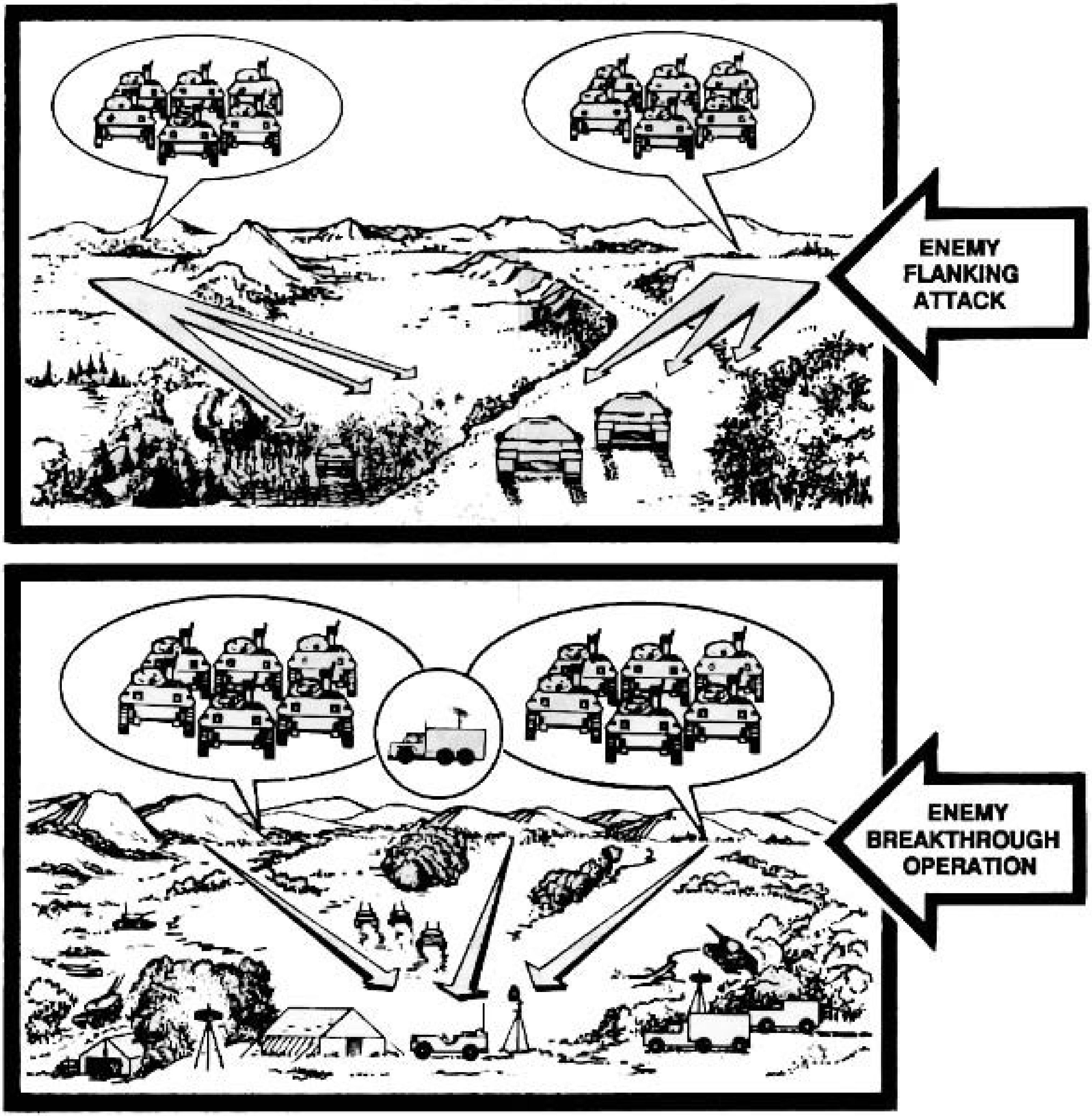


Figure 5-2. Expected DF target areas

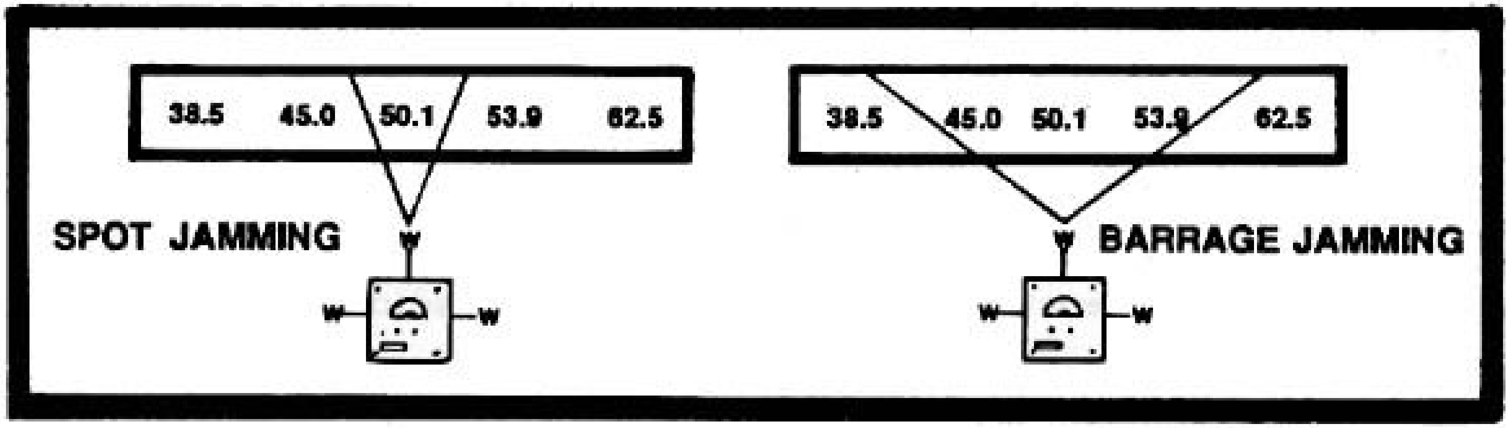


Figure 5-3. Spot and barrage jamming techniques

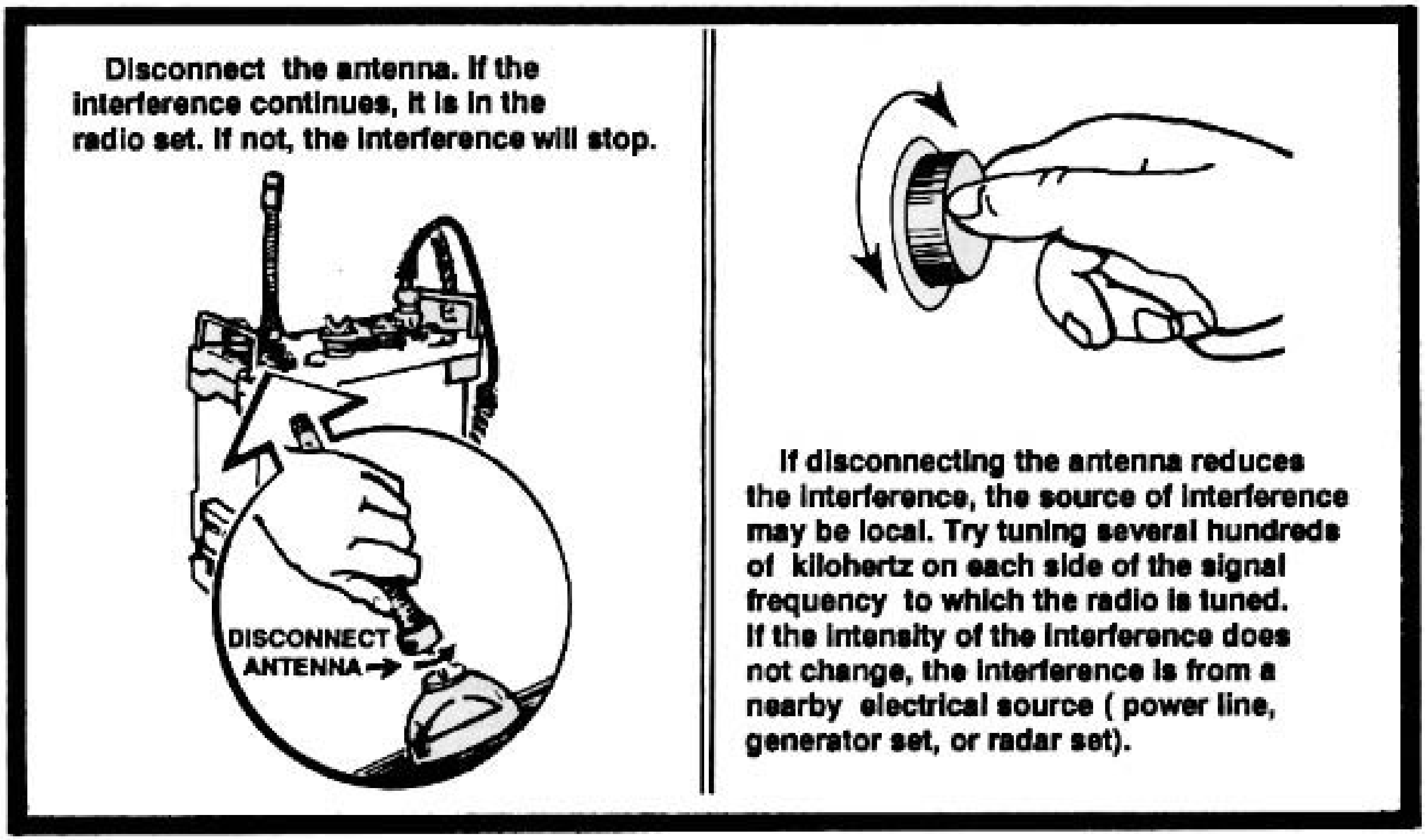


Figure 5-4. Radio check procedures for receiver and local interference

THE MIJI REPORT IS RENDERED BY LINE AS FOLLOWS:

1. Type of report: Meaconing, interference, jamming, or intrusion.

2. Affected station: Call sign and suffix.

3. Location: Grid location (encrypted).

4. Frequency affected: Frequency encrypted.

5. Type of equipment affected: UHF, VHF, FM, beacon, and so forth.

6. Type of interference: Type of jamming and type of signal.

7. Strength of interference: Strong, medium, or weak.

8. Time interference started and stopped: If continuing, so state.

9. Interference effectiveness: Estimate percent of transmission blockage.

10. Operator's name and rank: Self-explanatory.

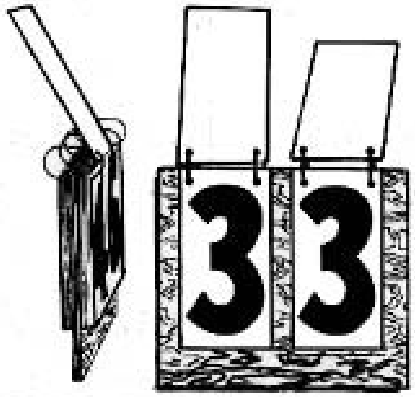
11. Remarks: List anything else that may be helpful in identifying or locating the source of interference.

NOTE: Refer to local SOP for exact format.

Figure 5-5. MIJI report

COLOR

Number	Number Color	Card Color
1	White	Blue
2	White	Green
3	Black	Orange
4	White	Red
5	Black	White
6	Orange	Black



Dots \ Dashes	1	2	3	4	5	6
1	1-1	1-2	1-3	1-4	1-5	1-6
2	2-1	2-2	2-3	2-4	2-5	2-6
3	3-1	3-2	3-3	3-4	3-5	3-6
4	4-1	4-2	4-3	4-4	4-5	4-6
5	5-1	5-2	5-3	5-4	5-5	5-6
6	6-1	6-2	6-3	6-4	6-5	6-6

NIGHT CODE SYSTEM

DEFINITION SHEET

Code	Letter	No.	Key Word	Code	Letter	No.	Key Word
1-1	A	1	Azimuth	4-1	S	19	Aircraft
1-2	B	2	Move-ing	4-2	T	20	Gas/CBR
1-3	C	3	Check point	4-3	U	21	Artillery
1-4	D	4	Distance	4-4	V	22	Danger (ADA, ambush)
1-5	E	5	Return	4-5	W	23	Cease fire
1-6	F	6	Follow me	4-6	X	24	Mine(s)
2-1	G	7	Grid	5-1	Y	25	On the road
2-2	H	8	Troops	5-2	Z	26	Camouflaged
2-3	I	9	Squad	5-3	AA	27	Stationary
2-4	J	10	Platoon	5-4	BB	28	Fire
2-5	K	11	Company	5-5	CC	29	All clear
2-6	L	12	Holding position	5-6	DD	30	Friendly
3-1	M	13	Atk helicopter	6-1	EE	31	Bridge/ford
3-2	N	14	BMP/APCs	6-2	FF	32	PZ/LZ
3-3	O	15	Tanks	6-3	GG	33	I spell
3-4	P	16	POL/refuel	6-4	HH	34	Recon
3-5	Q	17	HQ/CP	6-5	II	35	Need Medevac
3-6	R	18	Atk position	6-6	JJ	36	Spare

NOTE: Azimuth to nearest 10 degrees; distance to nearest 100 meters. Codes 1-1 through 2-4 correspond to numbers 1-9 and 0.

Figure 5-6. Send-a-message system

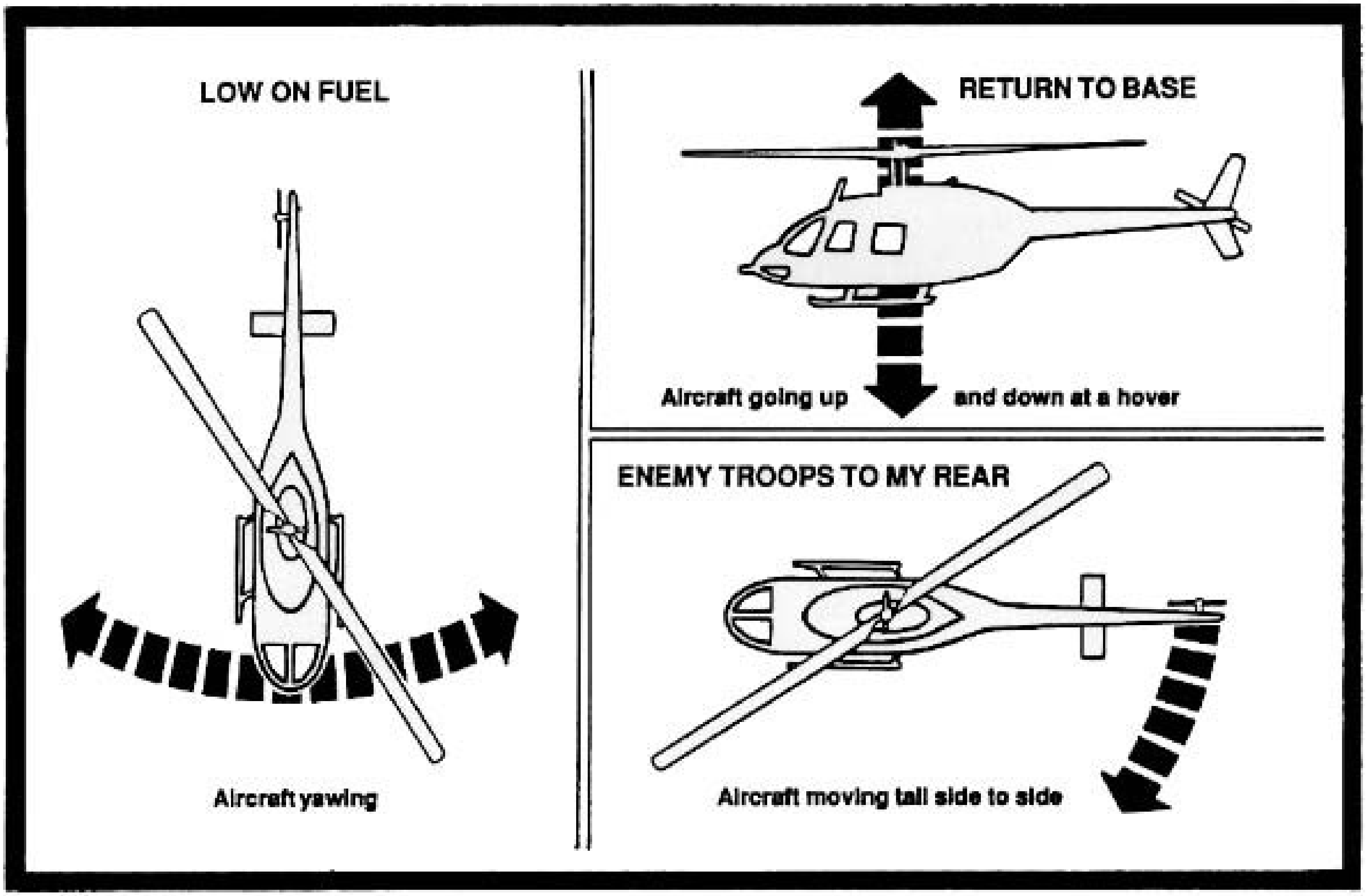


Figure 5-7. Examples of aircraft position maneuvers

CHAPTER 6

DIRECTED ENERGY THREAT

Advanced weaponry includes many new devices that improve the Threat's ability to communicate, deliver munitions, and detect personnel and equipment. Some of these devices use directed energy. This chapter discusses the types, uses, and effects of known and projected directed energy weapons. It also describes protective measures and countermeasures that may reduce the effects of laser weapons. Although directed energy weapons include lasers, radio frequency weapons, and particle beam emitters, this chapter concentrates on laser systems.

6-1. CONCEPT OF DIRECTED ENERGY WEAPONS

a. Directed energy weapons differ from conventional weapons in that they deliver concentrated electromagnetic energy, rather than bullets, to the target. Once a target absorbs this energy, it begins to heat up. If the target cannot dissipate the heat fast enough, thermal damage will occur. Under some circumstances, the directed energy could create shock waves as it hits the target, causing additional damage.

b. Conventional weapons defeat their targets by physically damaging structures. This structural damage is known as a hard kill. An example of a hard kill is the physical damage produced by a TOW missile hitting a tank. Directed energy weapons, on the other hand, result in soft or functional kills. They may destroy or disrupt a vital subsystem of the weapon, rendering it combat-ineffective, and leave major components intact. An example of a soft kill is the flash-blinding of a gunner by a laser so that the gunner is unable to acquire or track the target. Another example is the disruption of aircraft electronics by a high-powered microwave, causing the aircraft to deviate from its intended flight path or a missile to miss its target.

6-2. TYPES OF DIRECTED ENERGY WEAPONS

The Soviets have shown significant interest in directed energy weapon technology. First-generation laser weapons will be similar to the laser range finders/designators presently employed on Threat armored vehicles, tanks, and aircraft. The Soviets have also demonstrated a major interest in radio frequency weapons and have dedicated significant resources to producing them. Development of a third type of directed energy weapon, the particle beam weapon, has been set back by technical and engineering problems. These must be resolved before tactical particle beam weapons can be designed.

a. Laser Systems.

(1) High-energy laser systems. High-energy lasers have not yet been fielded and tested in a combat environment. Therefore, only speculation about their tactical employment is possible at this time. High-energy laser systems will extend the range of low-energy systems and cause damage at tactically significant ranges. Substances such as water, plastic, glass, and paint easily absorb high-energy laser radiation. Metal tends to reflect it.

Thermal (heat) effects on glass could include an instant blinding flash on the outside followed by cracking and a sandblasted or slightly melted appearance. Signs of heat may be noted such as burned or melted rubber sealant over a small area. Any high-energy laser weapon would be large with a power source in a separate vehicle. Therefore, it would be more suitable for the rear area defense of high-value targets than for use in a moving battle. Figure 6-1 shows an artist's concept of a high-energy laser system.

Figure 6-1. Threat high-energy laser system

(2) Low-energy laser systems. First-generation low-energy laser weapons will be similar to powered-up laser range finders/designators already used by Soviet ground forces. These low-energy systems are designed to cause flash blindness in troops and temporarily jam sensitive electro-optical

systems. Low-energy lasers usually emit visible (typically red) or invisible, near-infrared light and cause the same type of damage as laser range finders/designators. Some of them emit invisible, far infrared light that can be detected by thermal night sights. Because low-energy laser weapons are unable to produce a hard kill, they would have to be deployed with conventional weapon systems to be effective.

b. Radio Frequency Weapons. Radio frequency weapons are under development by the Soviets. These weapons can jam or destroy electrical systems or components. They emit high-powered microwaves or millimeter waves that overload aircraft electronic components with excessive amounts of energy. At long ranges, radio frequency weapons can jam components; at close ranges, they can cause electronic burnout.

c. Particle Beam Systems. No particle beam system has yet been demonstrated as an effective military weapon. Particle beam systems are not expected to be developed or fielded in the near future. When and if particle beam systems are developed, they may prove useful as strategic weapons.

6-3. BATTLEFIELD USES OF DIRECTED ENERGY WEAPONS

Lasers, high-powered microwaves, and particle beams are technologies that have potential military application as weapons to destroy equipment and injure personnel. This paragraph describes the Threat's application of these weapons on the modern battlefield.

a. Laser Systems. The Soviets are estimated to have about 35,000 to 40,000 lasers. Unclassified sources indicate that the Soviets intend to use already deployed lasers against troops and equipment in battle. The Soviets use lasers as range finders or designators on both aircraft and ground vehicles.

(1) Range finders. Lasers make superb range finders. The laser beam is switched on and off in a few billionths of a second, producing a very short pulse. The pulse travels to the target where some light is reflected. A timer inside the laser range finder measures how long the pulse took for the round trip. Time is then converted into a distance to the target. External laser range finders have been adapted to strap on to tanks and other Soviet vehicles. Variants of the T-64, T-72, and T-80 are equipped with laser range finders. Threat armed helicopters are expected to use this equipment soon.

(2) Designators. The fast switching of the beam on and off allows the pulses to be timed. Timing can be used to code the laser beam so that a sensing device will detect only the spot from that beam. The precise beam allows a very small light spot to be formed on a distant target. A small detector can be built into an artillery shell, a guided missile, or a bomb that will lock on to a single coded light spot and ignore all others. This procedure allows aircraft or artillery systems to be guided to a direct hit on a point target.

(3) Antipersonnel weapons. No specific rule or law of warfare prohibits the use of laser weapons. In fact, antipersonnel weapons are designed specifically to kill or disable combatants. Humans are susceptible to the effects of laser light in two wavelengths: the in-band and the out-of band. Known laser technologies

that have been used or could be used with Threat electro-optics can operate within these wavelengths.

(a) In-band lasers. In-band lasers operate in the visible and near-infrared portions of the electromagnetic spectrum. These lasers are referred to as in-band because of the focusing properties of the human cornea and lens. The laser light is focused on a very small retinal spot, increasing the energy per unit area on the retina. At these levels, the high concentration of light is enough to permanently damage the eye. The human eye is particularly susceptible to laser light in the visible and near-infrared portions of the electromagnetic spectrum.

(b) Out-of-band lasers. Lasers that produce electromagnetic wavelengths in the ultraviolet and infrared bands are known as out-of-band. They produce mainly surface effects to the eye (cornea and lens). These effects may vary from large corneal burns to deep, full-thickness skin burns. Personnel not protected from these lasers will be affected, and the mission may be interrupted or become impossible to continue because of personnel injuries or discomfort.

b. Radio Frequency Weapons. If successfully developed into weapons, microwaves will be able to damage the electronics of aircraft and ground vehicles. The microwave emission produced from such weapon systems can overload electronic and engine components and destroy target acquisition, avionic, and visionic systems.

c. Particle Beam Systems. Particle beam systems, if developed, could be used against aircraft and ground vehicles. They would cause direct physical damage to components and personnel.

6-4. EFFECTS OF DIRECTED ENERGY WEAPONS

Aviation personnel need to prepare for encounters with directed energy weapons in combat. This paragraph describes the effects of directed energy weapons on aviation personnel and their equipment. TB MED 524 contains specific information about the hazards caused by laser radiation.

a. Lasers. The hazards to personnel and equipment from lasers depend largely on the radiation wavelength, the beam intensity, and the exposure time. The danger to personnel results from either direct or reflected exposure to radiation, which could ignite clothing or damage unprotected skin or eyes. Lasers can also adversely affect optical systems. Both direct-view (binocular and weapon sights) and indirect-view (image conversion devices) optical systems can be damaged by the effects of far-, near-, and visible-infrared lasers.

(1) Effects on personnel. Only the visible- and near-infrared light entering the eye will harm the retina, as
shown in Figure 6-2. The eye is more vulnerable to damage at night as are optical systems that magnify and have no protective filters. Laser effects on the eyes include flash blindness, minor and major retinal burns, and impaired night vision. The effect of flash-blinding on vision is similar to the temporary effect of a flashbulb. The effects last from seconds to minutes and may leave colored spots in the eyes. Minor retinal burns may not be noticeable. They can cause discomfort and interfere with vision. Major retinal burns result in major damage to or loss of vision. The injuries involve bleeding inside the eye, immediate pain, and possible permanent loss of or impaired vision. Night vision acuity may be lost because of undetected damage. A laser attack that damages the fovea, where most of the cones are located, might go unnoticed because rod cells are used for night vision. Foveal damage may affect vision sharpness and color interpretation. Normal cockpit tasks, obstacle avoidance, and the use of acquisition or targeting devices could become difficult or

impossible.
Figure 6-2. Laser entering the eye (a) Directed laser energy. If an individual's eyes are struck by a visible light laser, the individual may experience flash blindness or other injury or both. The victim will feel nothing if the injury is minor. A common symptom is pain similar to that caused by a grain of dust in the eye. The victim may have difficulty seeing fine details and may experience disorientation or pain or see dots and streamers floating in his vision.

(b) Reflected laser energy. Burns may result from reflected laser light focused on the retina of the eye.

Figure 6-3 shows an example of hazardous laser reflection. The laser light may be reflected from water, aircraft canopies or windshields, or other reflective surfaces. Injury can also result from reflection, not from a polished surface but from an object like a wall or a tree. In-band laser light can penetrate aircraft canopies and reflect from lightly painted surfaces and glass instrument covers. The glare produced within the cockpit can make interpretation of instruments difficult or impossible. The reflected radiation can cause both eye and skin injuries.

(c) Magnifying optics and lasers. The use of magnifying optics in a laser environment can be extremely dangerous. The optics focus the beam to a much smaller area and concentrate the power of the beam. Binoculars, TSUs, TADS (direct-view optics), and handheld stabilized sights send more light into the eye. Figure 6-4 illustrates how magnification devices increase the vulnerability of the eyes to laser

damage. At tactical distances of 1 to 2 kilometers, exposure to lasers through unprotected optics (without filters) makes injury likely. However, the narrow field of view of optical systems and the small spot size reduce the likelihood that a laser beam will actually enter the system and damage the eye.

Figure 6-3. Hazardous laser reflection

Figure 6-4. Increased vulnerability of the eye

(2) Effects on direct-view optics. Direct-view optics are hard to damage with visible- and near-infrared lasers. These optics are designed to pass as much light as possible. If a laser is powerful enough or close enough, it may pit reticles, destroy protective filters, and crack lenses.

(a) Nonfiltered optics. The optical device may not have the right filter in place when lased. In this case, the viewer may suffer severe eye damage long before the optical sight is damaged.

(b) Ordinary optics. Far-infrared lasers do not penetrate ordinary optics. The energy is deposited on or in the lenses and windows. A far-infrared laser that is powerful or close enough can craze, crack, or shatter outside lenses or windows. Crazing results in a frosted or sandblasted appearance. A crack with no impact scar (like the scar from a rock on a windshield) may indicate laser damage.

(3) Effects on indirect-view optics. Image conversion devices, such as night vision devices and tracking systems on current weapon systems, are subject to damage from near-infrared and visible lasers. These systems are often called indirect-view optics. If the image converter is sensitive to light from the laser, the viewer will see a bright flash of light. Overloaded circuits may cause the

system to lose power and then restart. If the damage to the tube is not severe, the display will reappear with dark spots or lines. If the tube is destroyed, the display will remain dark. The flash from the display may dazzle the operator briefly. However, the operator is completely protected from eye injury by such systems.

b. Radio Frequency Weapons. The damage that a high-powered microwave weapon can cause depends on the power of the weapon, range to the target, and susceptibility of the target. The closer the target is to

the high-powered microwave weapon, the more energy can be concentrated on the target and the more damage it can cause. Effects of high-powered microwaves on the target range from no impact to hard kill as the distance between the weapon and the target decreases.

(1) Effects on personnel. The thermal effects of microwave energy are widely recognized. However, the long-term, low-power (nonthermal) effects of microwaves on humans are not as easily recognized. Nonthermal effects may be reported as fatigue, insomnia, headaches, dizziness, moodiness, confusion, memory loss, irritability, nervous disorders, behavioral changes, biochemical changes, immunological changes, and cardiovascular effects. Any exposure to tactical radio frequency weapons will seriously degrade an aircrew's performance. Three thermal effects of microwaves have been positively identified as potential biological hazards to personnel. They are ocular lens clouding and corneal endothelium damage (effects on vision) and microwave hearing (effects on hearing).

(a) Vision. The most serious hazards to personnel are the two ways high-powered microwaves can affect

the eye. They can damage the corneal endothelium and the lens. Figure 6-5 shows a side view of the eye. The corneal endothelium is the last layer of the cornea that separates it from the aqueous humor (fluid between the cornea and the lens). A pressure wave caused by a high-powered microwave can disrupt this layer and cause the fluid of the aqueous humor to contact the cornea. This contact will greatly reduce the victim's ability to see. It will also cause intense pain because of the numerous nerve endings in the cornea. The resulting reduction in vision would occur immediately and could be temporary or permanent, depending on the degree of damage to the endothelium. The second major injury or effect of a high-powered microwave would be the clouding of the lens, or cataracts.

Figure 6-5. Side view of the human eye

(b) Hearing. A pulsed high-powered microwave will produce thermoacoustic or thermal expansion. This expansion is the process whereby the microwave energy is absorbed by the cells of the body, causing a rapid increase in heat and expansion in those cells. The resulting pressure wave can damage the tissues. One example of damage at a low power is "microwave hearing." Microwave energy deposited on the brain stimulates the cochlea (a part of a bone in the ear), which causes a sound to be perceived. Such a phenomenon may disrupt performance because it could interfere with the aircrew's ability to hear. Any interference with the crew's hearing could result in the inability to communicate both inside and outside the cockpit.

(2) Effects on equipment. In the foreseeable future, a high-powered microwave weapon may produce a soft kill by causing electronic upset and, at close ranges, electronic burnout. Electronic

upset refers to a temporary jamming of the system or false imaging of onboard target acquisition screens. Electronic burnout occurs when a component is permanently damaged because it was thermally overloaded or when an electrical insulator breaks down because of a high-energy surge.

c. Particle Beam Systems. Particle beams may be able to melt holes in targets. Damage may be similar in appearance to that made by holding a welding torch for a long time in one place or the hole made in armor by a shaped charge. No blast or fragment marks should appear. Nearby electronics may stop working, and victims may display symptoms of radiation sickness.

6-5. PASSIVE COUNTERMEASURES AGAINST LASERS

Laser range finders/designators used by both Threat and friendly forces are sources of laser hazards within the combat environment. Laser emitters may be encountered almost anywhere on the battlefield, and they pose a serious threat to aircrews and acquisition, targeting, and visionic equipment onboard the aircraft. By following simple rules, employing basic protective measures, and taking advantage of existing weather conditions, aircrews should be able to avoid most laser hazards.

a. Education. Studies indicate a general ignorance of laser issues Armywide. Much of this ignorance can be attributed to the highly sensitive nature of laser weapons. The Soviets have begun to field some types of lasers. Therefore, aircrews must be educated in those measures they can take to reduce the effects of these weapons.

b. Recognition and Avoidance.

(1) Laser range finders/designators. If aircrews are to avoid hazards from laser range finders/designators, they must be able to recognize their presence on the battlefield. Unfortunately, each device can come in many possible sizes and shapes. However, some reliable clues can help determine whether a device is a laser range finder/designator.

(a) Laser range finders/designators used by personnel. The size of an LRF/D can vary from the size of binoculars (handheld) to the size of an orange crate (mounted on a vehicle). Laser range finders/designators used by personnel are easily recognized. Figure 6-6 illustrates two Threat laser range

finders.

Figure 6-6. Threat laser range finders

(b) Laser range finders/designators used on vehicles. The LRF/D system mounted on a vehicle can be an integral part of the platform with very few, if any, discernible physical characteristics. This is true of an LRF/D mounted on a tank. The best way to determine whether an armored vehicle has an LRF/D is to know which vehicles are equipped with these devices and to be able to recognize them. Figure 6-7 shows
Soviet tanks equipped with laser range finders.

Figure 6-7. Soviet tanks equipped with laser range finders

(2) Laser flash. A smokeless, red flash from a device is a clue that it is an LRF using a ruby laser. However, some lasers use invisible infrared light. Therefore, lack of a visible flash from a device does not mean that it is not an LRF. If a crew member detects an LRF flash, he should not look at it without laser-filtering protection.

(3) Employment. Sometimes an LRF can be identified by the way it is being employed, especially if it is used with a missile system. The way the LRF is handled and other specific things that occur while it is being used can help identify it.

c. Protective Measures and Devices. Whether laser use is deliberate (enemy) or accidental (friendly), the results will be the same. If a crew member uses an optical sight (direct-view) or scans without a laser filtering device and laser light enters his eyes, injury will probably occur. Protective measures and devices can prevent or reduce the severity of laser injuries on the battlefield. Night vision devices, such as the AN/PVS-5 and the AN/AVS-6, and thermal-imaging systems offer complete eye protection from low-energy lasers.

(1) Laser light.

(a) In-band. Laser light, which is in-band to direct-view (400 to 700 nanometers) optical devices, will pass directly through the system unaffected by the optical glass. Therefore, eyeglasses or sunglasses will not prevent eye injury from in-band lasers. Aircrews must wear specially designed protective visors on their helmets to obtain laser protection.

(b) Out-of-band. Out-of-band laser light is absorbed by the first optical source in the optical train. Thus aircrews wearing eyeglasses or sunglasses or looking through any optical device will be somewhat protected from eye injury. Some damage to a crew member's cornea may occur unless he places an optical lens in front of his eye or uses a protective visor.

(c) Reflected. When not in the laser beam, aircrews are safe from direct exposure. However, laser light can be reflected from any reflective surface and can result in eye injury. Aircrews should avoid exposure to reflective surfaces, especially standing water, glass windows, and aircraft canopies. Because the reflective angles cannot be anticipated, aircrews should always wear protective filters near known or suspected laser range finders or designators.

(2) Magnifying optics. Direct-view magnifying devices increase the severity of eye injury from lasers. Aircrews should use magnifying optical devices only when necessary for critical tasks such as Threat identification. The use of magnifying optics should be restricted to low magnification in unprotected (direct-view) equipment. In a known or suspected laser environment, indirect-view magnifying devices, such as the FLIR or the TADS operated in the day television mode, will protect the observer from eye injury.

(3) Laser filters. Laser light can be stopped by filters. These filters are pieces of glass or plastic that absorb or reflect light of a given color (wavelength). A good laser filter will absorb or reflect more than 99 percent of the laser light for which it is designed. A laser filter must allow all other colors to pass through except those that it protects against. Therefore, a laser filter is useful only against those lasers for which it is designed. Some laser filters resemble transparent colored mirrors which change color when tilted. The filters may be built into the equipment or come as clip-on additions to the eyepiece. The Army is fielding laser protective visors for crew member helmets.

(4) Electro-optical warning system. The AN/AVR-2 laser warning receiver will warn aircrews against laser-equipped Threat weapon systems. The AN/APR-39(V)1 will identify the quadrant from which the Threat laser range finder is lasing the aircraft.

d. Weather. Some weather conditions can reduce the effectiveness of laser weapons or prevent their use altogether. Weather conditions, such as clouds, fog, rain, and snow, affect the electro-optical characteristics of the target. They also affect the background and the atmosphere between the electro-optical system and the target. These environmental conditions inhibit or reduce the signal strength of the electro-optical system. Weather and humidity affect the temperature contrast between the target and its background. A target can be acquired only if the amount of infrared energy of the target differs significantly from that of the background. Certain weather elements can reduce the temperature contrast between the target and its background until the detection capability of the electro-optical system becomes ineffective. The temperature differential between a target and its background is usually minimal during early morning and early evening. As the wavelength of the light system used by the electro-optical system increases, the less it is affected by weather obscurants. Before using the weather as a countermeasure, aircrews must know the capabilities of the Threat electro-optical system under consideration. Table 6-1 shows the effects of weather on electro-optical devices.

Table 6-1. Weather effects on electro-optical devices

e. Tactical Expedients.

(1) Some tactical expedient protective measures will be effective against laser exposure. However, they may give aircrews a false sense of security in the wrong circumstances. They may also increase vulnerability to lethal weapon fire. Some expedients that reduce vulnerability and probability of injury are detection avoidance, observation techniques, and smoke (obscurants).

(a) Detection avoidance. Detection avoidance measures follow the rule of "what can be seen can be hit." Detection avoidance techniques maximize the benefits of terrain features for available cover and concealment. The masking provided by terrain and vegetation can prevent detection by Threat laser devices. The cardinal rules for detection avoidance are given in TC 1-201.

(b) Observation techniques. If aircrews detect the use of lasers, they should not observe the area unless all crew members use protective devices. These devices include laser protective visors or indirect-view observation devices.

(c) Smoke (obscurants). Smoke or thick, naturally occurring obscurants can block visible and near-infrared lasers.

(2) Aircrew reactions to laser hazards should comply with the unit SOP. Although the unique conditions that can develop in a combat situation may require deviations from the SOP, aircrews should follow the SOP when possible.

6-6. ACTIVE COUNTERMEASURES AGAINST LASERS

Lasers and other electro-optical systems depend on clear visual conditions for optimum performance. Dense atmospheric obscurants severely limit the capabilities of these systems. Thick smoke screens can defeat lasers. Counterfires can also be effective laser countermeasures.

a. Smoke. Vehicle- and artillery-deployed smoke can help absorb or block out laser energy. A heavy smoke screen between a laser weapon and a potential victim could also defeat the laser. The effectiveness of smoke depends on the wavelength of the laser and the size of the smoke particles. As the size of the smoke particles approaches the size of the wavelength, more laser energy will be scattered. Even with an intense amount of smoke protection, some lasers are powerful enough to penetrate through the smoke and cause eye damage.

b. Counterfires. The sophisticated subsystems of laser weapons make them highly susceptible to damage. Thus they are more sensitive and less rugged than other weapon systems. Mortar, rocket, and artillery fire may not require a hard kill to defeat them.

(1) Indirect fires. Vibration from indirect fire explosions may possibly cause an optical system to become misaligned and thus useless. If evasive tactics necessitate crossing rough terrain at high speeds, the associated vibration could damage the optical train and cause a breakdown. Thus diversionary tactics to keep Threat lasers moving from place to place on the battlefield may be effective. Artillery fire is an effective countermeasure to lasers. It creates a dust cloud around the laser vehicle and contaminates or shatters mirrors, limiting the effectiveness of the laser beam. (2) Direct fires. Another weakness of a laser weapon is the exit window or mirror for the laser. It is susceptible to damage because it is made of a transparent window or a highly reflective material. Breaking this window with small-arms fire could render the laser ineffective. Flechette or fragmentation artillery munitions could also be used to damage the exit window. The window or mirror must be kept clean to transmit the laser beam outward. Any dirt or film attached to the window or mirror would absorb the energy instead of transmitting it. Heat may also distort or crack the mirror. If aircrews use TOWs as a direct counterfire weapon against laser-equipped targets, they must take care to avoid possible eye injury. TOW gunners should use protective filters or an indirect-view device when a laser threat is present.

6-7. RESPONSE TO LASER INJURY

a. Positive Unit Training. Good leadership can prevent panic. Positive training before battle, setting an example during laser encounters, and knowing what to do are critical. Stress in eye-injured soldiers can best be treated by leader example. Fear of blindness will be a natural response. Increased knowledge of lasers will help build the soldiers' confidence and offset their fear about lasers, thereby reducing stress to a manageable level. Commanders must ensure that unit training programs include guidance on stress management. Stress management techniques are discussed in FM 26-2.

(1) Laser misinformation. The most serious obstacle to training and operating effectively on the directed energy weapon battlefield is the false impression many people have about lasers. Science fiction and sensational press are prime sources of misleading information about lasers. Unit training efforts should focus on common misimpressions and replace them with truths about lasers.

(2) Basic laser risks. Aviation personnel must be made aware of basic laser risks. Aircrews and aviation support personnel must be informed about the risks associated with the operation of aircraft laser equipment. Aircrews should be cautioned about the type and extent of injuries that can occur in and around areas where laser range finders/designators are operated. They must also be informed about the dangers associated with the deliberate ranging of friendly aircraft, vehicles, and

personnel. A laser beam focused near or on the aircrew's faces or optics or even on the side of a vehicle may allow laser energy to penetrate the unfiltered magnifying optics. Crew members not using filter protection devices may sustain serious eye injury. The severity of the injury will depend on the range, time of day, and visibility.

(3) Protective measures. Aviation unit training must emphasize aircrew use of the aviator's helmet laser visor when aircrews perform missions in an anticipated or a known laser environment. To reduce the chances of laser injury, aviation support personnel must be trained to wear laser protective spectacles when performing aviation ground support functions.

(4) Laser hazard reactions. Aviation unit SOPs must include the tactical reactions expected of unit personnel if laser hazards are encountered. Some guidelines to consider when developing a laser SOP are discussed below.

(a) If the laser spot is nearby but not on you, the laser may look like a single bright, pure-colored flash or a series of flashes.

(b) If you detect a laser beam while at the flight controls, close your eyes momentarily if it will not jeopardize the immediate safety of your aircraft and crew. Turn your head away or maneuver the aircraft to avoid viewing the laser directly. As soon as possible, use the protective visor or spectacles, submit the appropriate report, and continue the mission.

(c) If you detect a laser beam while not at the flight controls, momentarily close your eyes or look away from the laser. Use the protective visor or spectacles and take the flight controls if required. Assist the pilot in command as necessary in submitting the appropriate report and accomplishing the mission.

(d) If you experience a sudden blurring of vision or a feeling like sand in your eye, you may have been hit with an infrared laser. In extreme cases, sudden pain and loss of vision may occur. (You will not be forewarned because humans cannot see infrared laser light.) Pain or the inability to see may require the immediate transfer of the flight controls. The injury may be so severe that medical aid is required before continuation of the mission.

b. First Aid. Unit training should include first aid training for laser casualties. Aviation missions are frequently conducted in remote areas where medical assistance is not readily available. Therefore, crew members should be trained in the treatment of laser injuries. FM 8-50 discusses first aid for laser casualties in detail.

(1) Flash blindness. Flash-blinded crew members will recover in a matter of seconds to minutes if no other injury is present.

(2) Minimal retinal burns. Some disorientation and loss of fine vision may result from minimal burns. A crew member suffering from these injuries should not be assigned tasks that require fine visual acuity until his vision clears.

(3) Serious injury. If a crew member is seriously injured, the crew may proceed to a medical treatment facility if the mission allows. If the crew member can function (single eye injury and no shock or panic) and another crew member can assume aircraft control, then the crew should continue the mission. Uninjured crew members should watch injured crew members for signs of shock.

Figure 6-1. Threat high-energy laser system

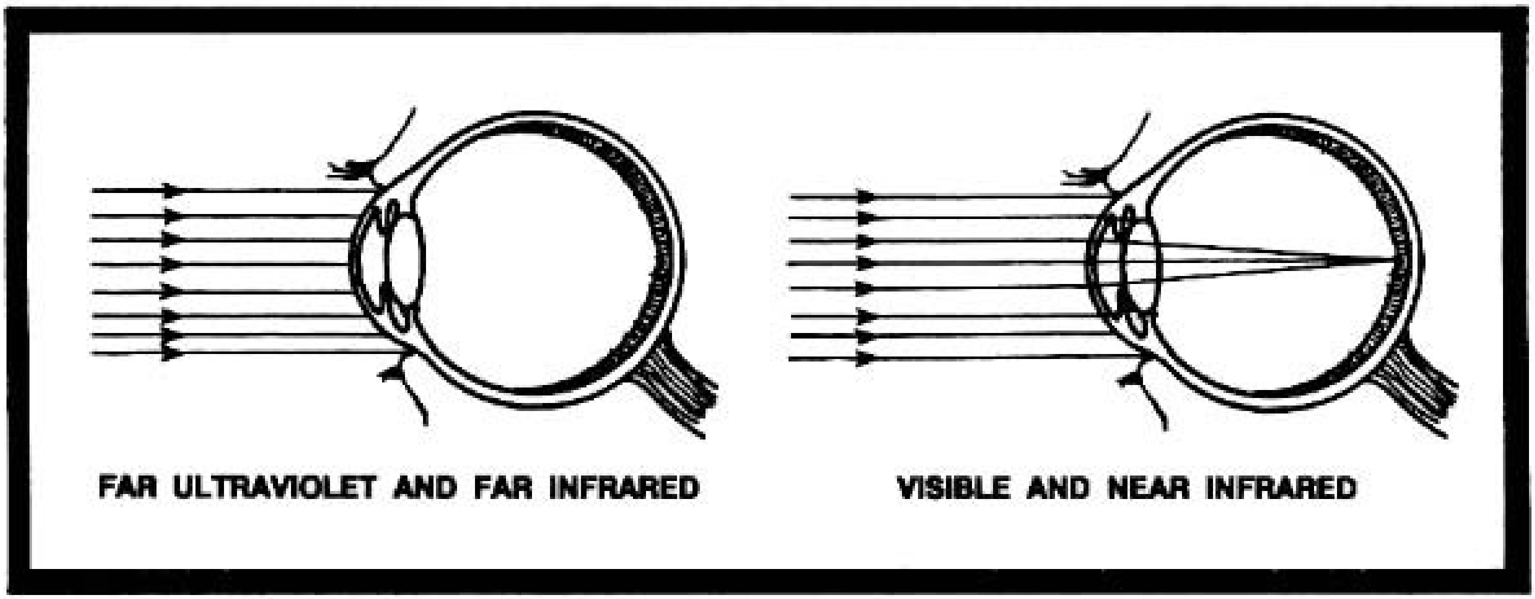


Figure 6-2. Laser entering the eye

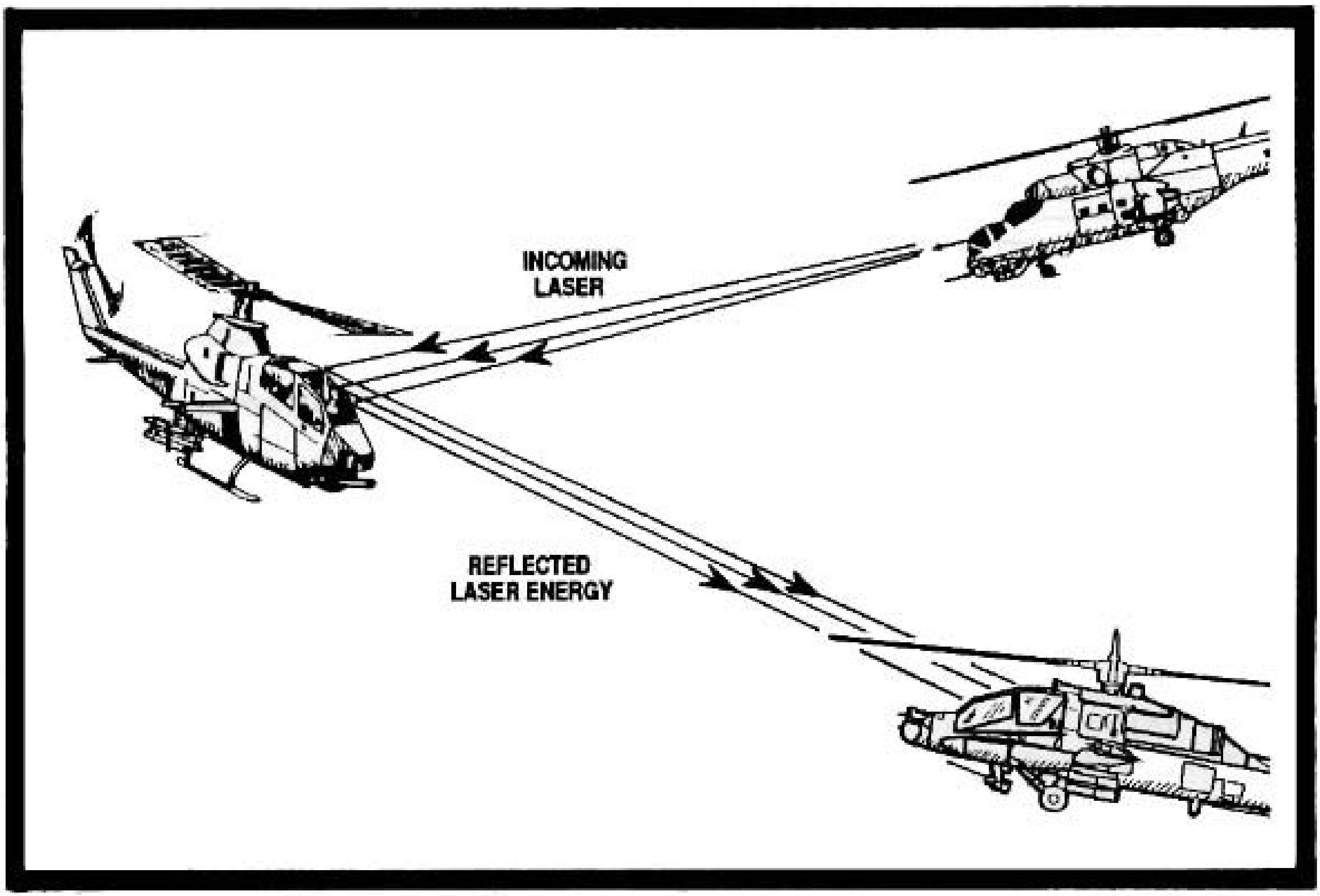


Figure 6-3. Hazardous laser reflection

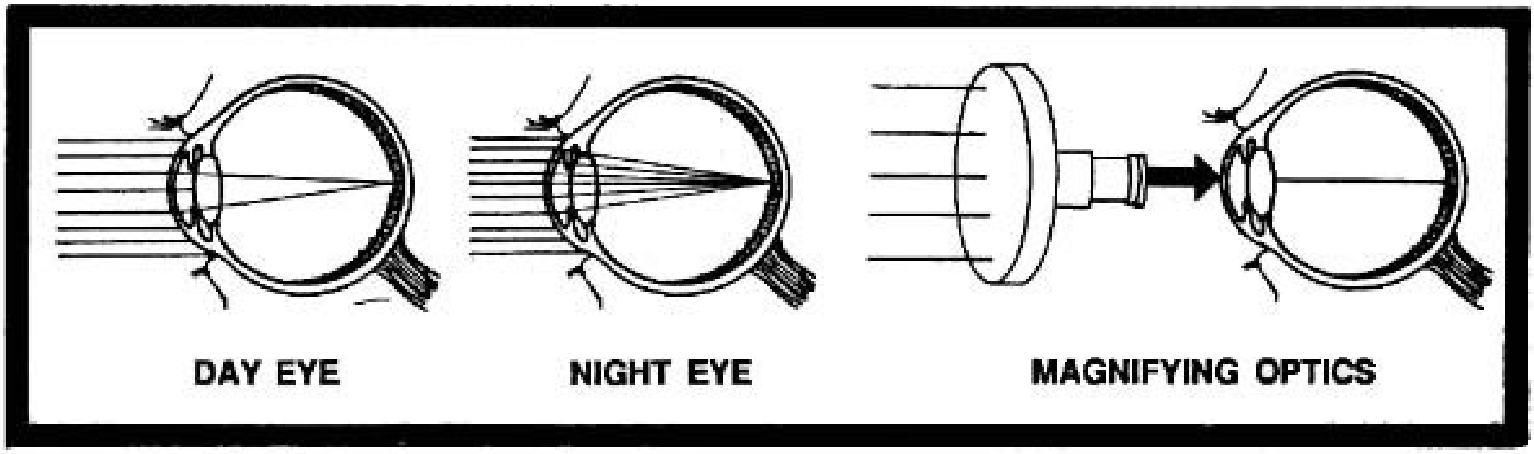


Figure 6-4. Increased vulnerability of the eye

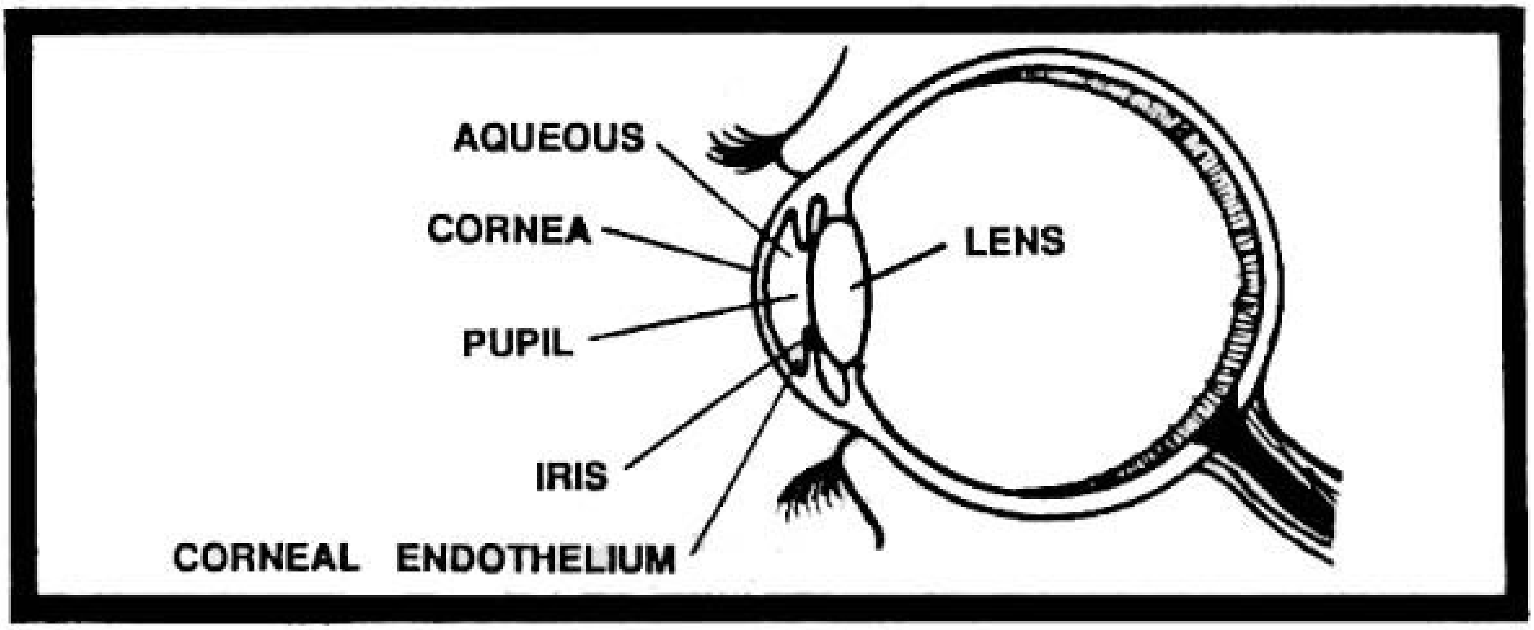


Figure 6-5. Side view of the human eye

Figure 6-6. Threat laser range finders

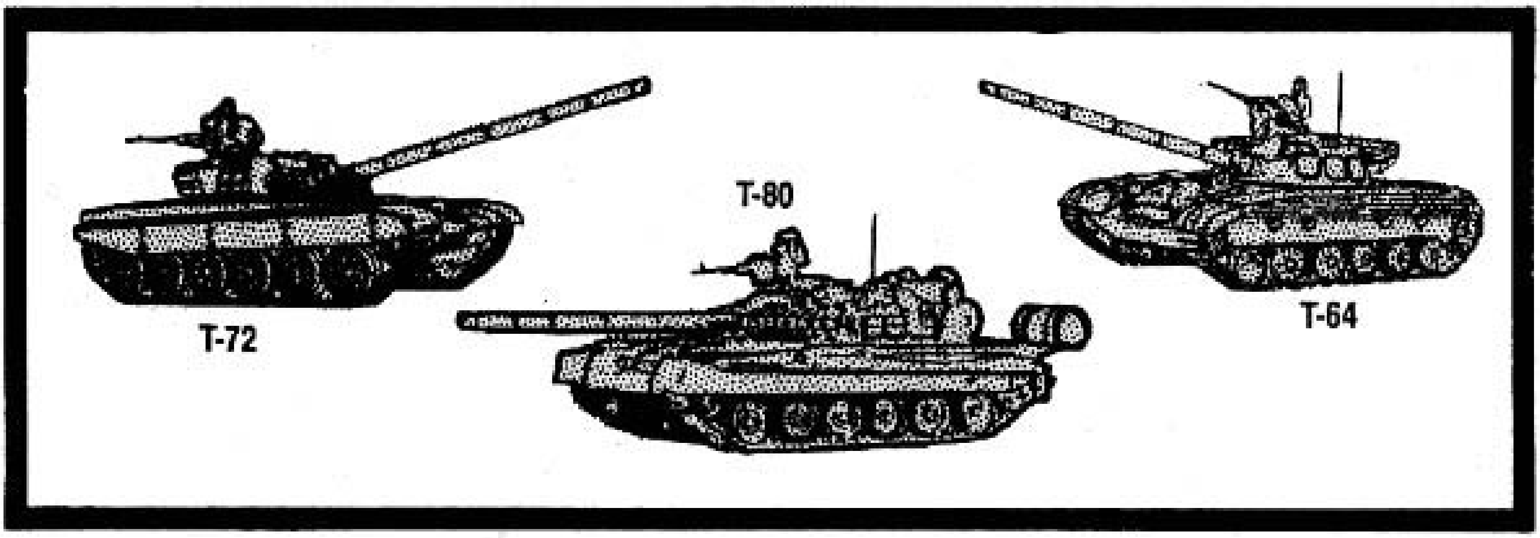


Figure 6-7. Soviet tanks equipped with laser range finders

Table 6-1. Weather effects on electro-optical devices

	SEVERE DEGRADATION				MODERATE DEGRADATION			
ENVIRONMENTAL PARAMETER	VISIBLE	NEAR IR	MID IR	FAR IR	VISIBLE	NEAR IR	MID IR	FAR IR
CLOUDS								
FOG	X	X	X	X				
ALL TYPES	X	X	X					X
PRECIPITATION								
LGT-MOD RAIN/SNOW					X	X	X	X
HVY RAIN/SNOW	X	X	X	X				
AEROSOLS (SMOKE, DUST, SAND)								
HEAVY DENSITY	X	X					X	X
MODERATE DENSITY						X	X	X
WATER VAPOR								
HIGH HUMIDITY	X	X					X	X

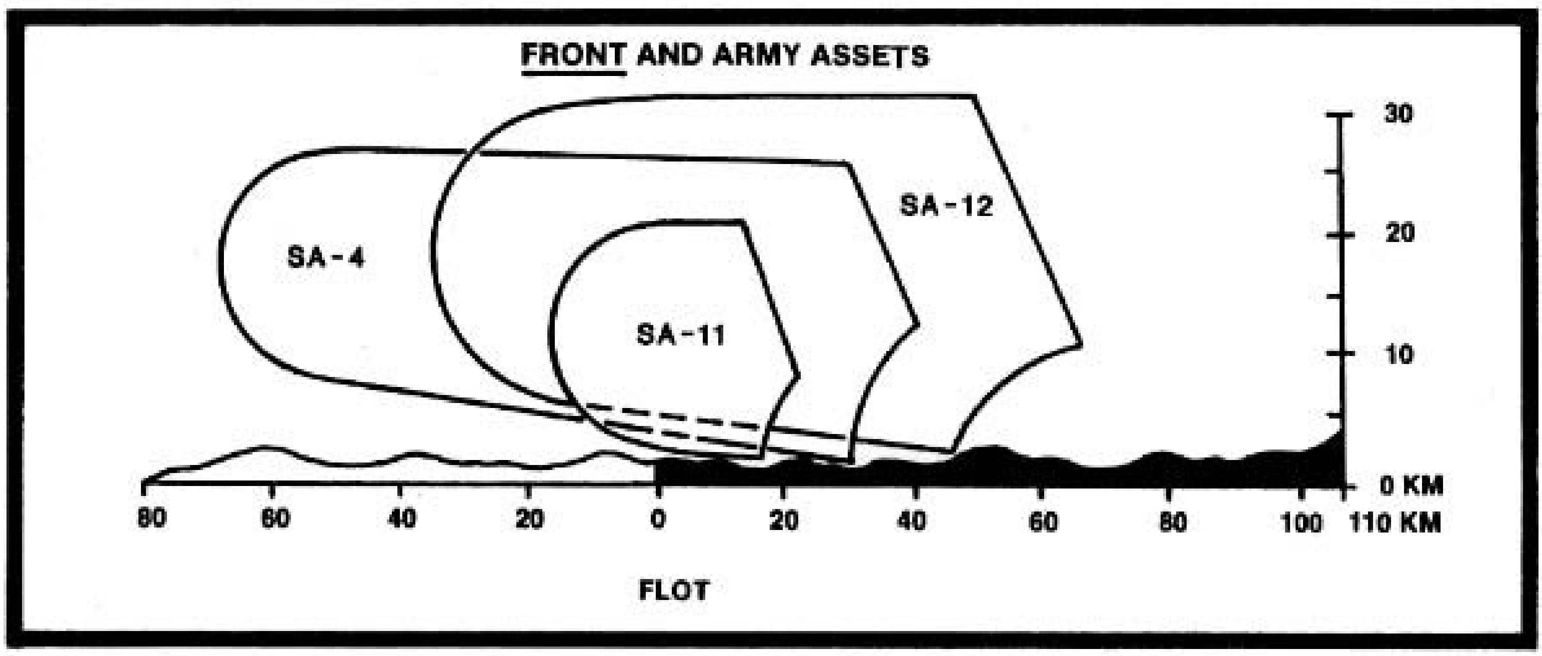


Figure 1-1. Front and army air defense coverage

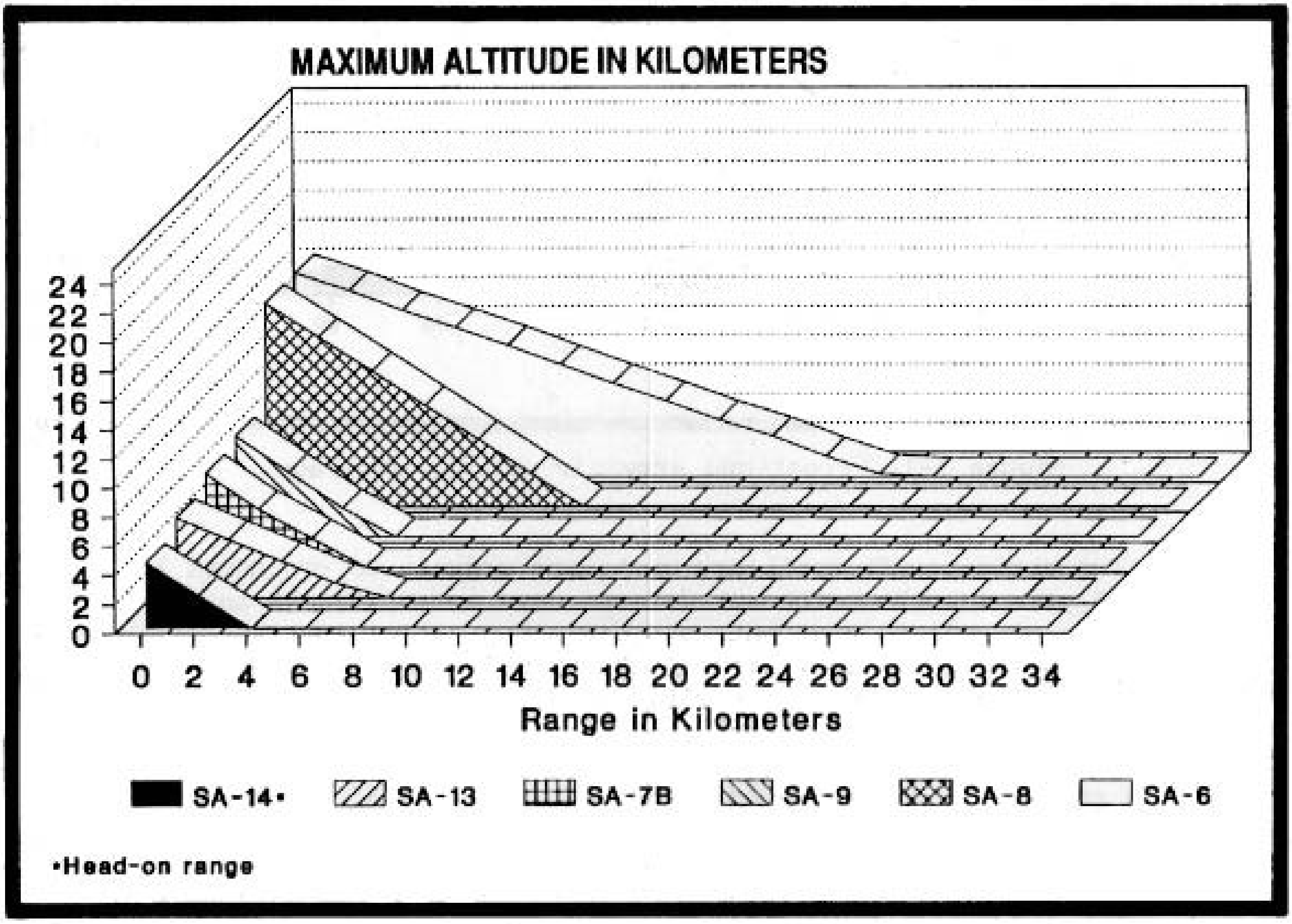


Figure 1-2. Division and regimental air defense coverage

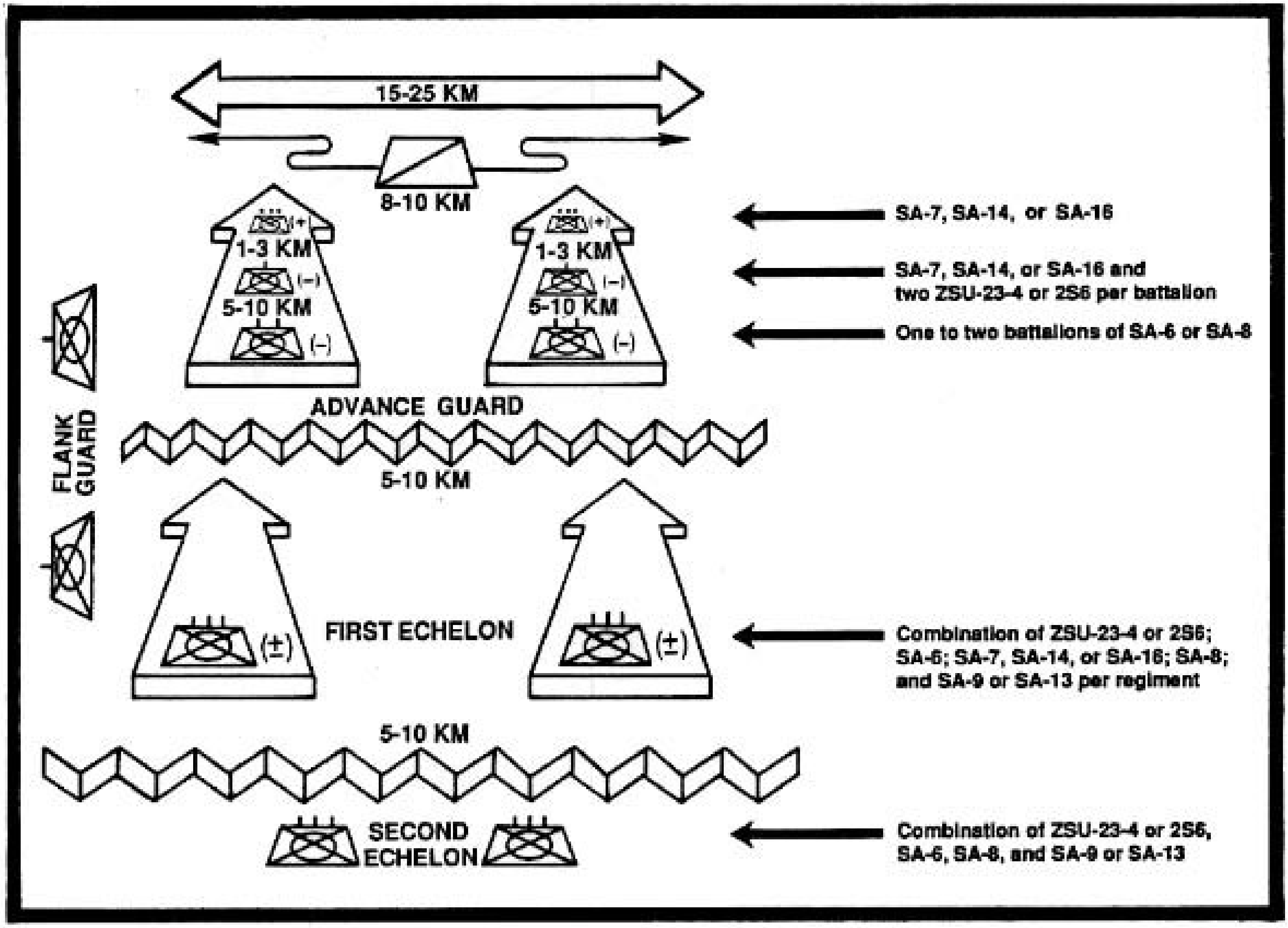


Figure 1-3. Motorized rifle division in a movement to contact

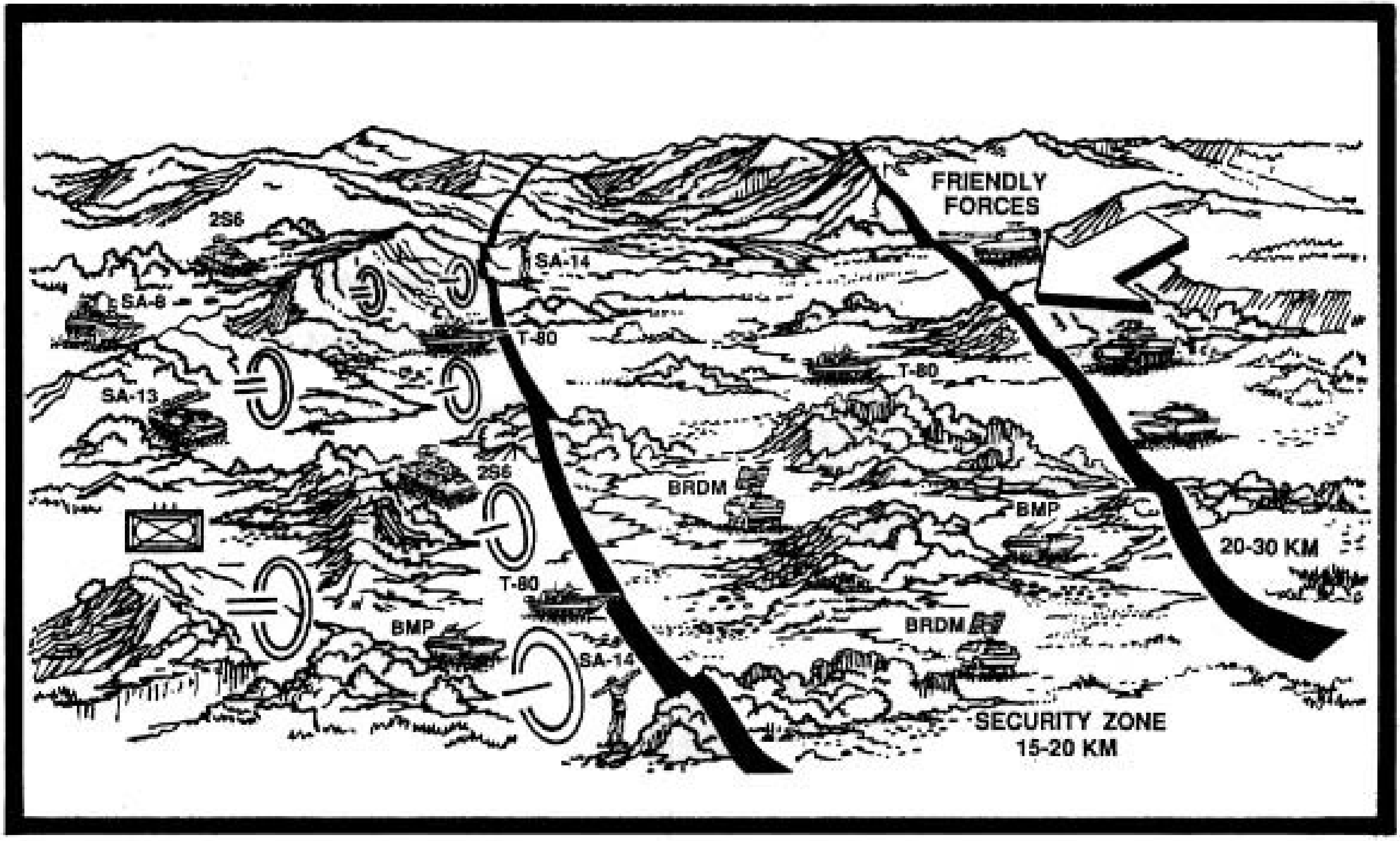


Figure 1-4. Motorized rifle regiment in the division's main defense belt

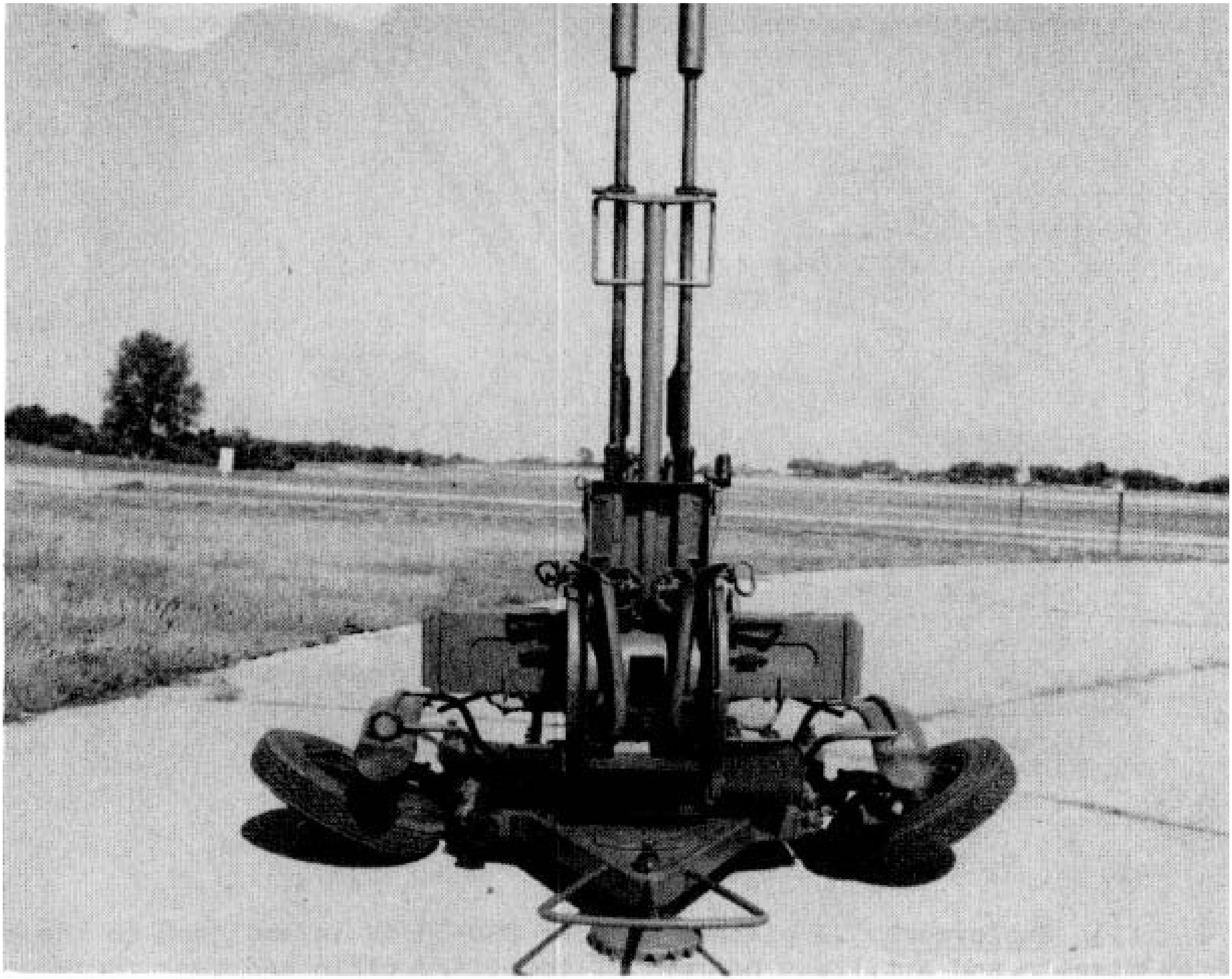


Figure 1-5. ZU-23

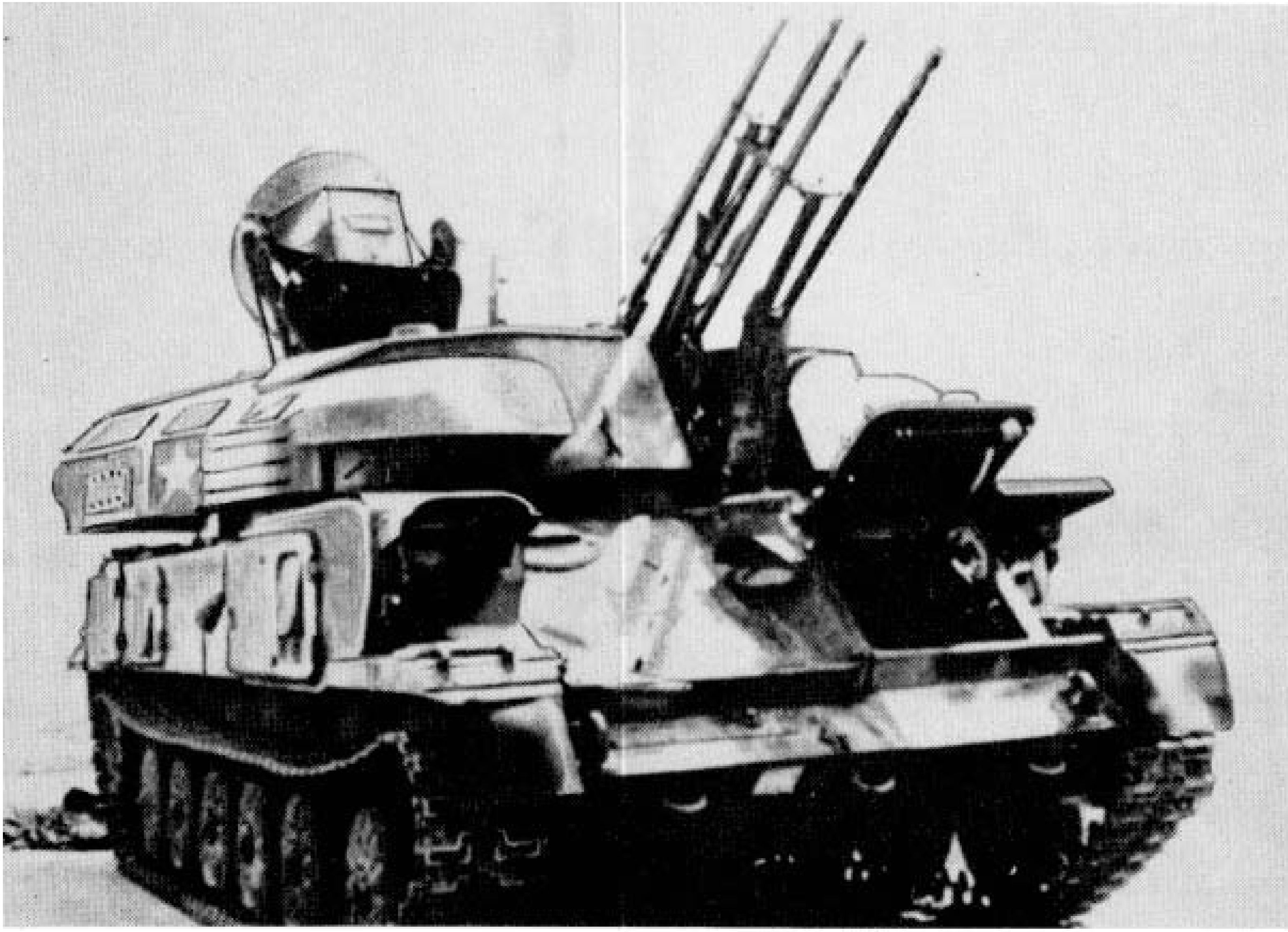


Figure 1-6. ZSU-23-4

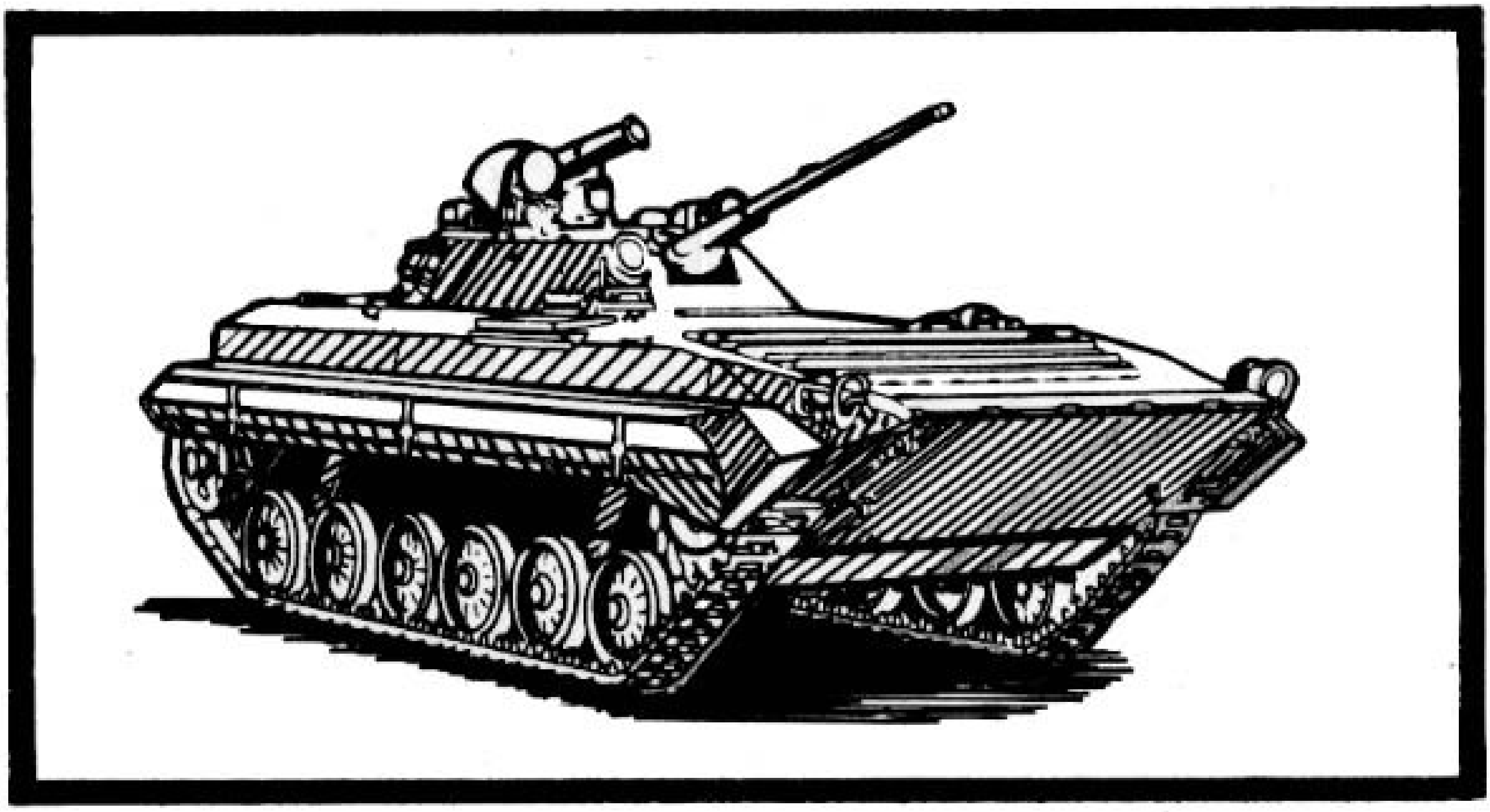


Figure 1-7. BMP-2

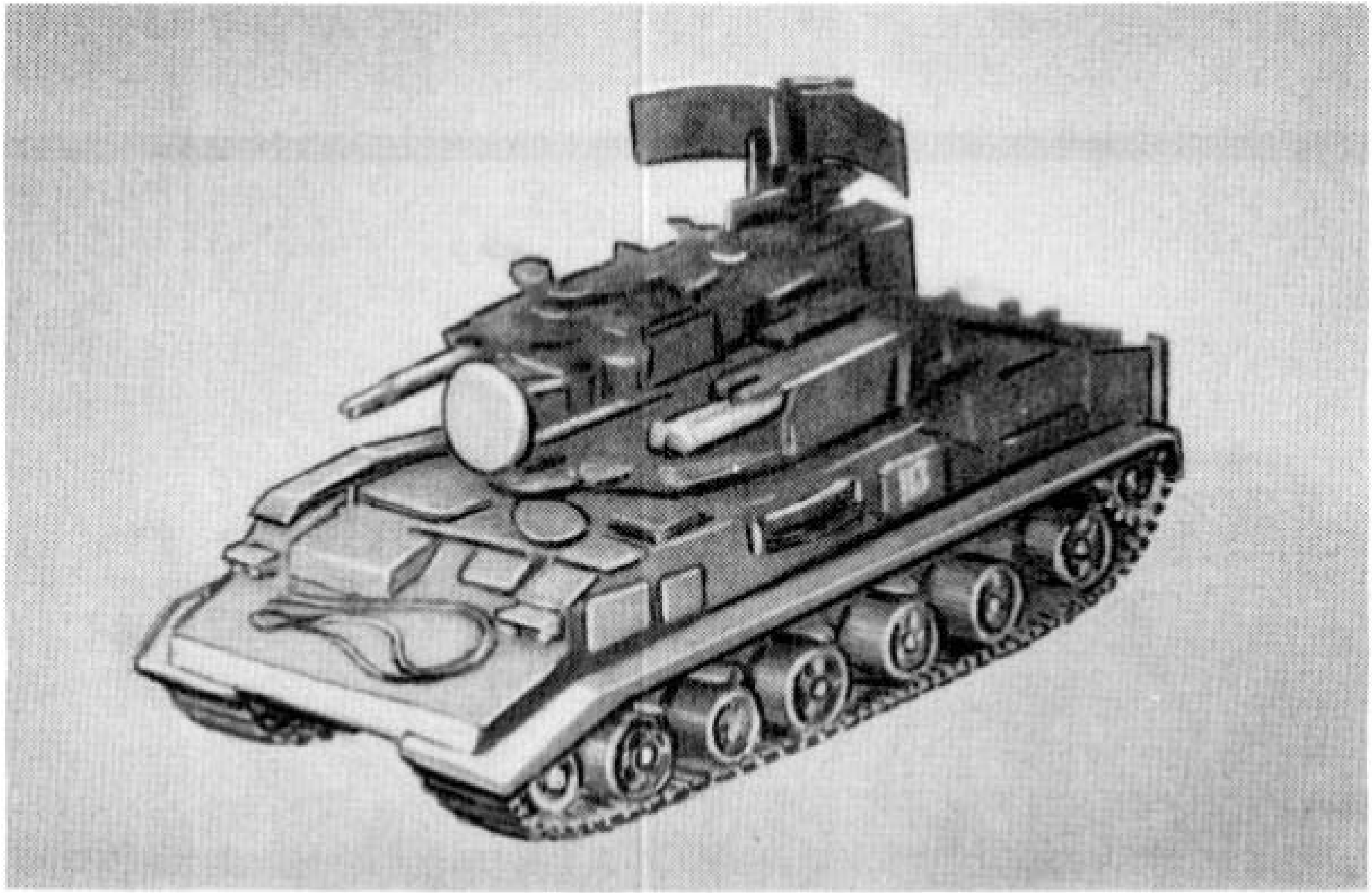


Figure 1-8. 2S6

Table 1-1. Short- to medium-range SAM systems

WEAPON SYSTEM	RANGE (KILOMETERS) MAXIMUM/ MINIMUM	ALTITUDE (METERS) MAXIMUM/ MINIMUM	GUIDANCE PRINCIPLE	ASSOCIATED RADARS	ASSIGNMENT
SA-7a Grail	3.6/0.5	3,500/15	Passive infrared homing	NA (optical)	Platoon man-portable
SA-7b Grail	5.5/0.5	4,500/15	Passive infrared homing	NA (optical)	Platoon man-portable
SA-9 Gaskin	6.0/0.6	5,000/10	Passive infrared homing	NA (optical)	Regiment (teamed with ZSU-23-4)
SA-13 Gopher	5 to 7 (est)	10,000	Passive infrared (cooled seeker, dual frequency)	UI range only radar	Regiment (teamed with ZSU-23-4)
SA-19	8 to 10 (est)	Unknown	SACLOS with infrared seeker	Hot Shot (tracking)	Motorized rifle and tank regiments
SA-8 Gecko	12/1.6 to 3	12,000/10	Command	Long Track Thin Skin Land Roll Flat Face	Division
SA-6 Gainful	24/4	12,000/50	Semiactive radar homing	Long Track Thin Skin Straight Flush	Division
SA-11 Gadfly	25 to 30/ 3 (est)	20,000 (est)/ 25 to 30 (est)	Semiactive monopulse radar homing	UI acquisition UI tracking	Army
SA-4 Ganef	80 to 100/ 9	25,000/100	Command/homing (possibly terminal)	Long Track Pat Hand Thin Skin	Front/army
SA-12 Gladiator	90 (est)	30,000 (est)/ 30 to 90 (est)	Unknown	UI phased array	Front/army

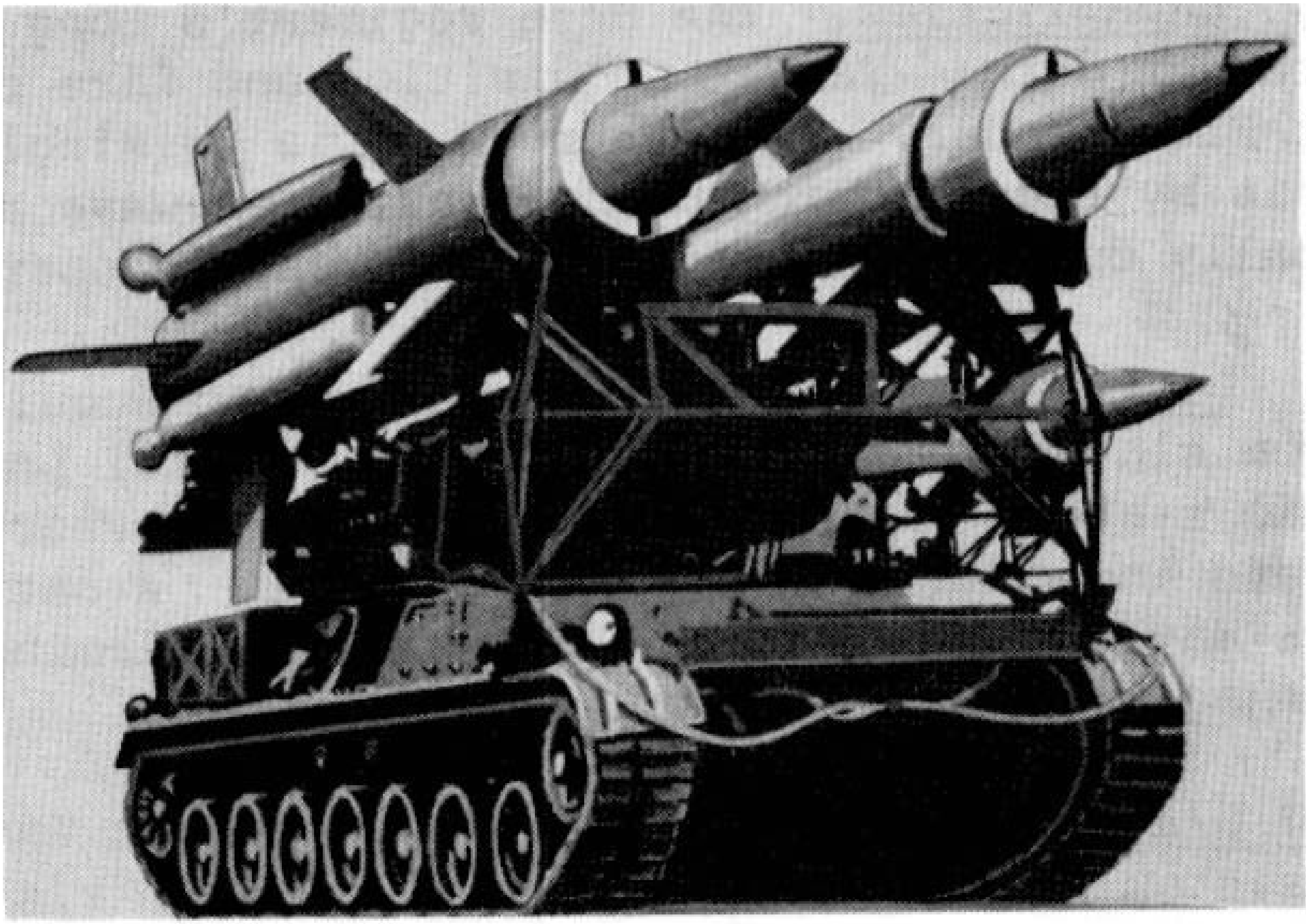


Figure 1-9. SA-4 Ganef

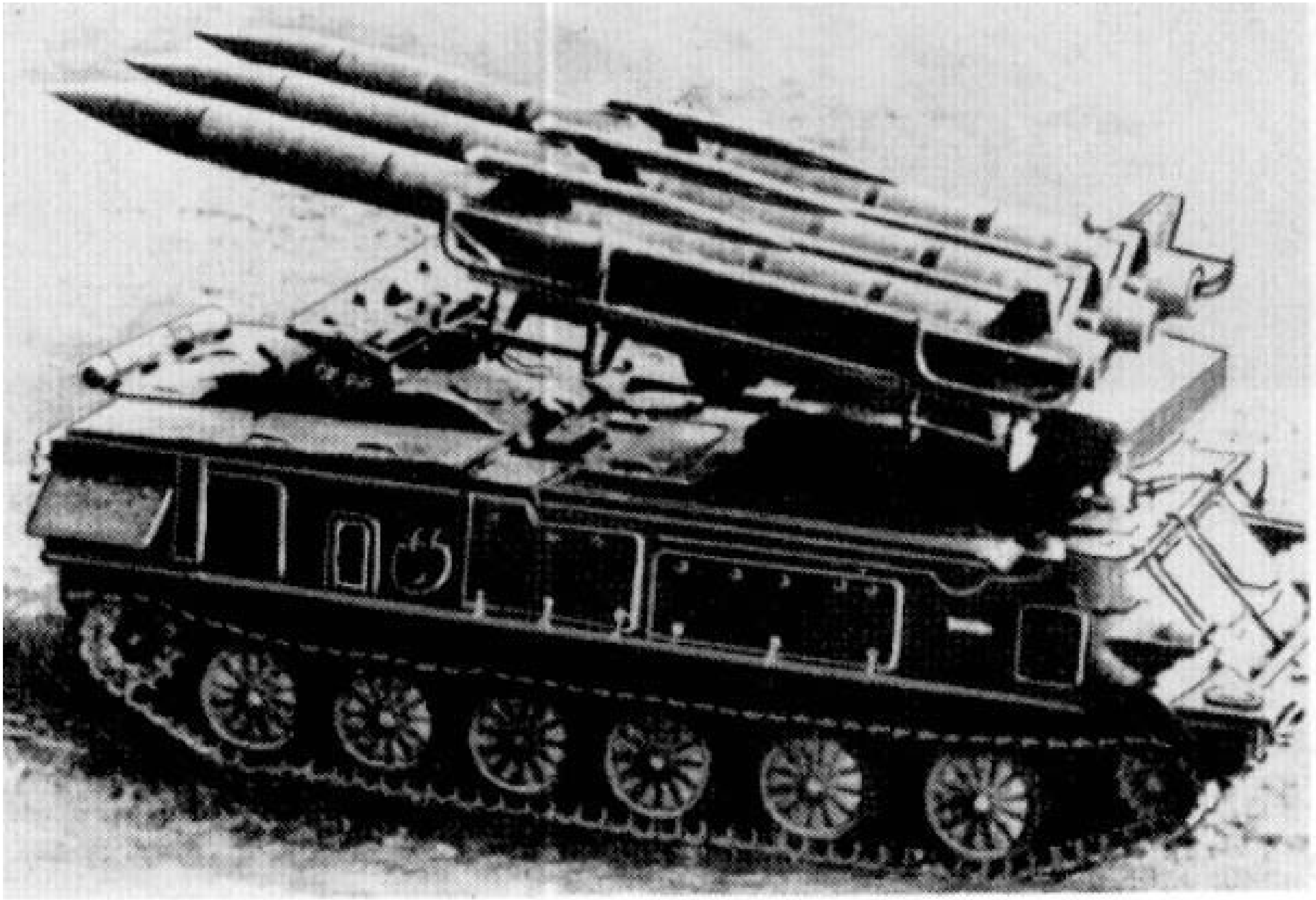


Figure 1-10. SA-6 Gainful

Figure 1-11. SA-7 Grail

Figure 1-12. SA-8 Gecko

Figure 1-13. SA-9 Gaskin

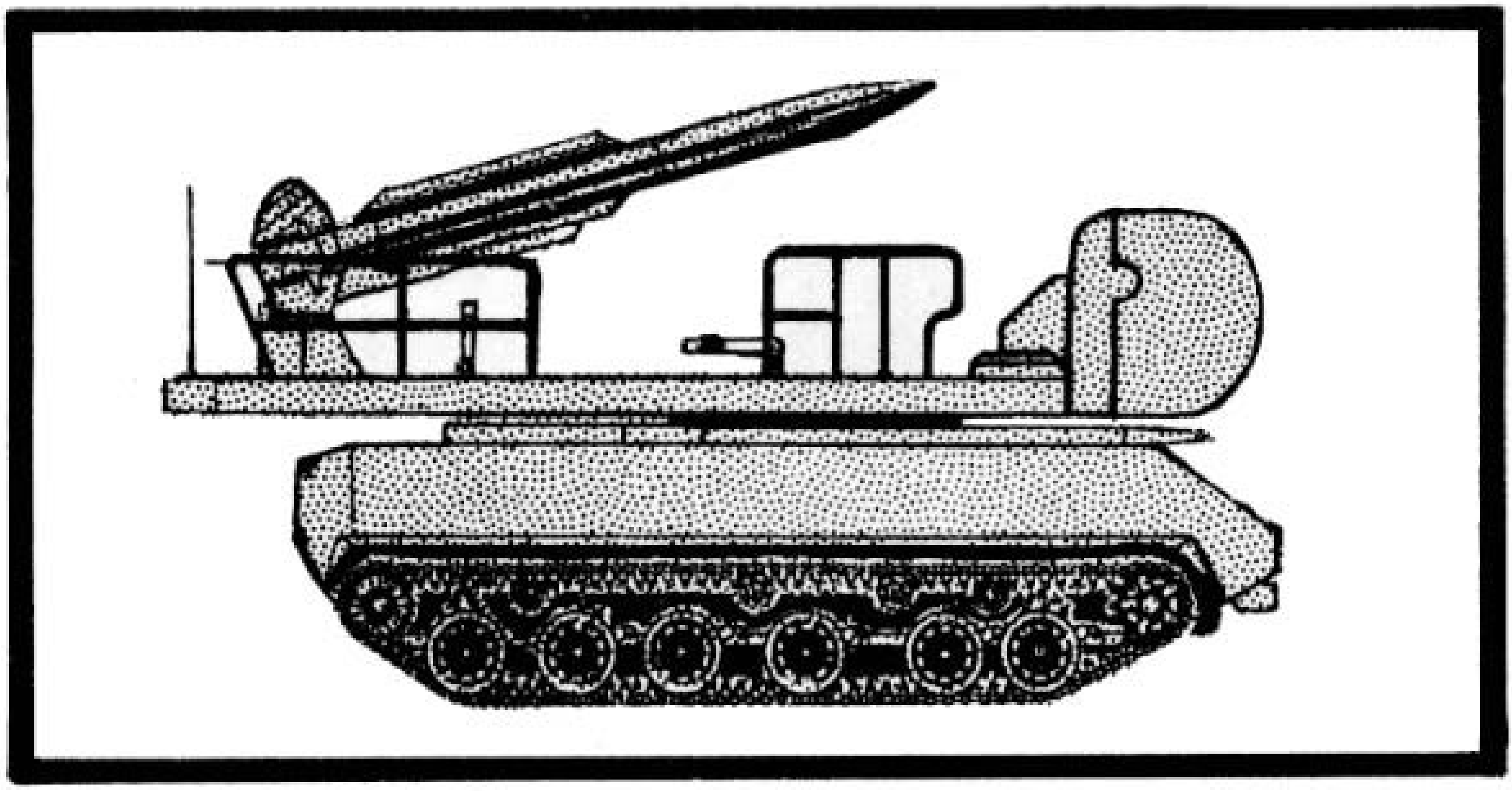


Figure 1-14. SA-11 Gadfly

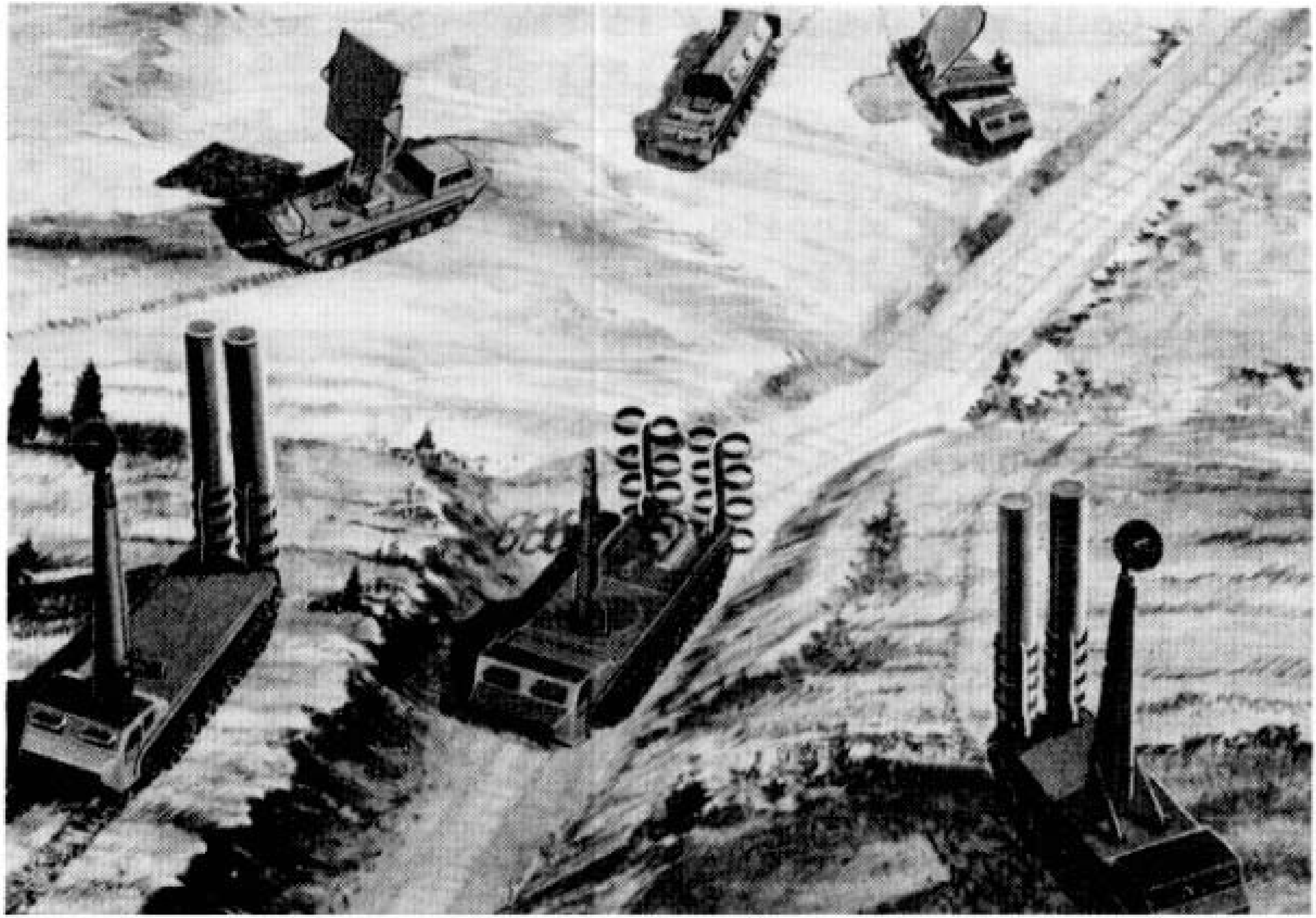


Figure 1-15. SA-12a Gladiator and SA-12b Giant

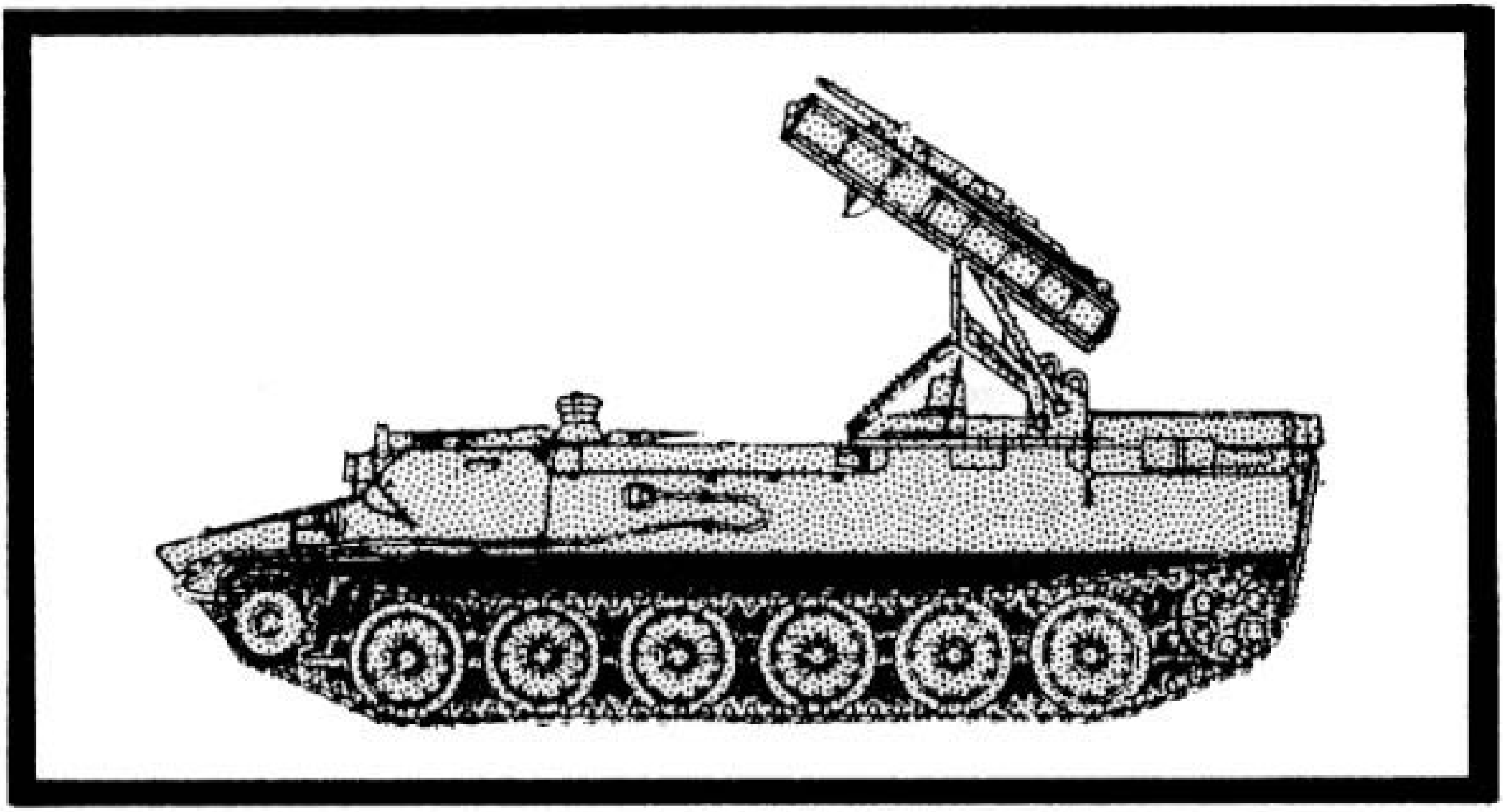


Figure 1-16. SA-13 Gopher

Figure 1-17. SA-16

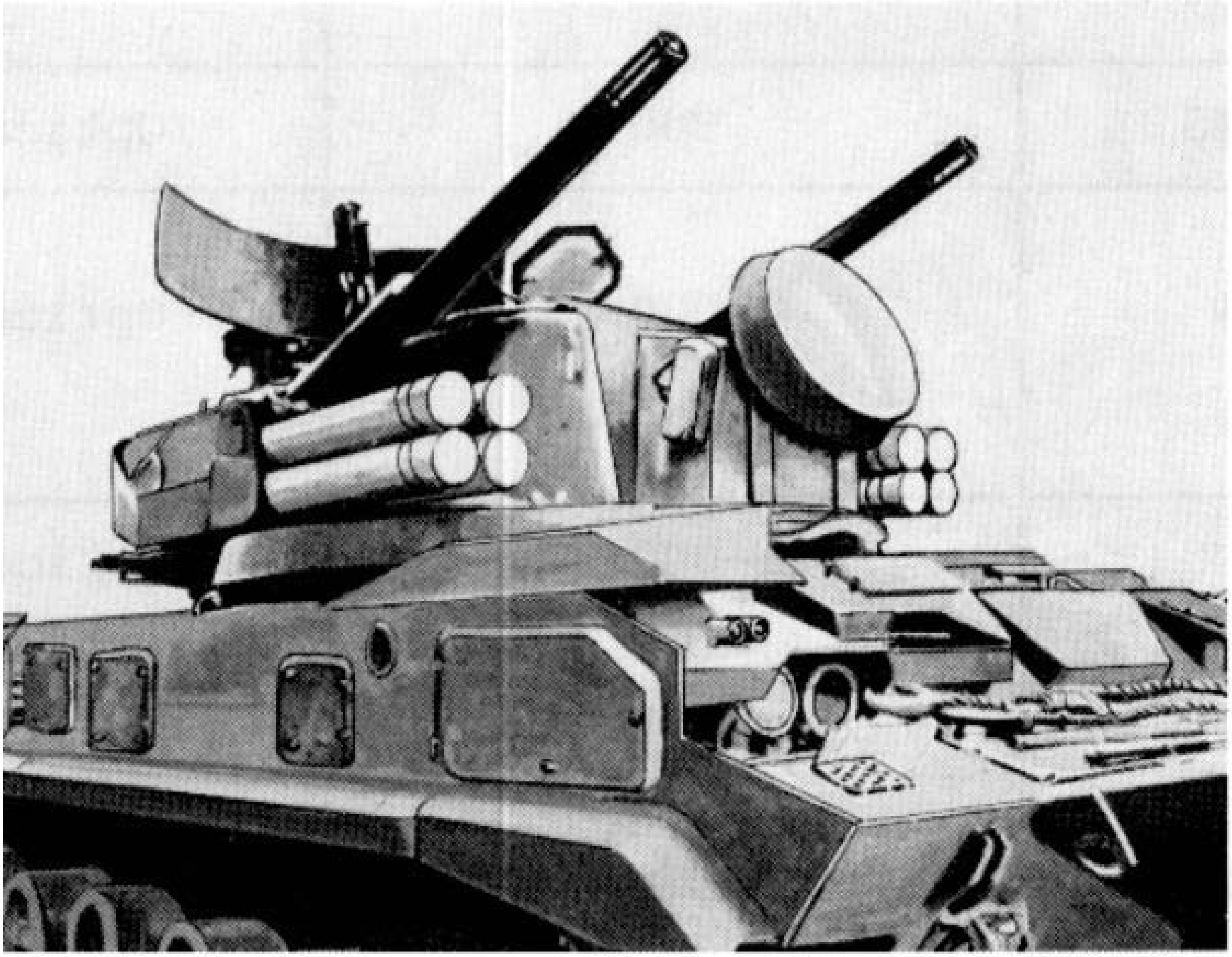


Figure 1-18. 2S6 with SA-19 missiles

Table 1-2. Threat small arms weapon systems

WEAPON NOMENCLATURE	MAXIMUM EFFECTIVE ANTIAIRCRAFT RANGE (METERS)	ACQUISITION MEANS	ASSIGNMENT
AK-74 5.45-mm	500	Optical	Individual soldier
AKM 7.62-mm	300	Optical	Individual soldier
RPK 7.62-mm LMG	800	Optical	Crew-served
PK 7.62-mm LMG	1,000	Optical	Crew-served Vehicle-mounted
12.7-mm MG	1,000	Optical	Vehicle-mounted
14.5-mm MG	1,400	Optical	Vehicle-mounted

Table 1-3. Threat battalion small arms weapons

TYPICAL THREAT MOTORIZED RIFLE BATTALION	
Rifle, AK-74 5.45-mm	209
LMG, PK 7.62-mm (BMP)	60
MG, COAX, 7.62-mm (BMP, tank)	44
HMG, 12.7-mm (tank)	10
TYPICAL THREAT TANK BATTALION	
Rifle, AK-74 5.45-mm	80
LMG, PK 7.62-mm (BMP)	20
MG, COAX, 7.62-mm (BMP)	41
HMG, 12.7-mm	31
HMG, 14.5-mm (BRDM)	2

Table 1-4. Threat armored combat vehicles in motorized rifle, tank, and airborne divisions

VEHICLE	MOTORIZED RIFLE DIVISION	TANK DIVISION	AIRBORNE DIVISION
BTR-50/60/70/80	306-312	23-29	NA
BMP-1/2	150	276	NA
ACRV BMP/BRDM/BTR	108	93	23
BMD	NA	NA	270
Medium tanks	220	328	NA
ASU-85	NA	NA	31

Table 1-5. Threat armored combat vehicle weapons

COMBAT VEHICLE	WEAPONS	EFFECTIVE RANGE (METERS)	COMBAT VEHICLE	WEAPONS	EFFECTIVE RANGE (METERS)
BRDM-2	14.5-mm AA HMG 7.62-mm COAX MG Sagger ATGM (AT-3) or Swatter ATGM (AT-3) Spandrel (AT-5)	1,400 1,000 3,000 3,000 4,000	T-55	7.62-mm COAX MG 12.7-mm AA MG 100-mm Gun	1,000 1,000 1,500
BTR-50/60/70/80	7.62-mm AA COAX MG 14.5-mm HMG	1,000 1,400	T-62	7.62-mm COAX MG 12.7-mm AA MG 115-mm Gun	1,000 1,000 1,600
BMP	7.62-mm MG 73-mm Gun Sagger ATGM (AT-3) Spigot (AT-4)	1,000 800 3,000 2,000	T-64 T-64B	7.62-mm COAX MG 12.7-mm AA MG or 14.5-mm AA MG 125-mm Gun Songster ATGM (AT-8)	1,000 1,000 1,400 2,100 4,000
BMP-2	7.62-mm MG 30-mm Gun Spandrel (AT-5) Spigot (AT-4)	1,000 3,000 4,000 2,000	T-72	7.62-mm COAX MG 12.7-mm AA MG 125-mm Gun	
BMD	7.62-mm MG (2) 7.62-mm COAX MG 73-mm Gun Sagger ATGM (AT-3) Spigot (AT-4)	1,000 1,000 800 3,000 2,000	T-80	7.62-mm COAX MG 12.7-mm AA MG 125-mm Gun Songster ATGM (AT-8)	1,000 1,000 2,100 4,000

Table 1-6. Threat ATGM characteristics and capabilit

WEAPON SYSTEM	RANGE (METERS)	GUIDANCE/ COMMAND LINK	ACQUISITION MEANS	LAUNCH PLATFORMS	ASSIG
AT-3 Sagger	3,000	MCLOS/wire	Optical	Manpack BRDM BRDM-2 BMP/BMD Hoplite Hip F Hind D	Antit of so rifle
AT-3c Sagger C	3,000	SACLOS/wire	Optical	BRDM-2 BMP/BMD Hoplite Hip F Hind D	Antit of so rifle
AT-4 Spigot	2,000	SACLOS/wire	Optical	Manpack BMP/BMD	Antit of so rifle
AT-5 Spandrel	4,000	SACLOS/wire	Optical	BRDM-2 BMP-2	Antit of so rifle
AT-6 Spiral	5,000 (est)	SACLOS/RF	Optical	Hind E/F	Divis squad
AT-7 Saxhorn	1,000	SACLOS	Unknown	Manpack	MG/AT BMP-/
AT-8 Songster	4,000	SACLOS	Unknown	T-64B/T-80 Tanks	Tanks

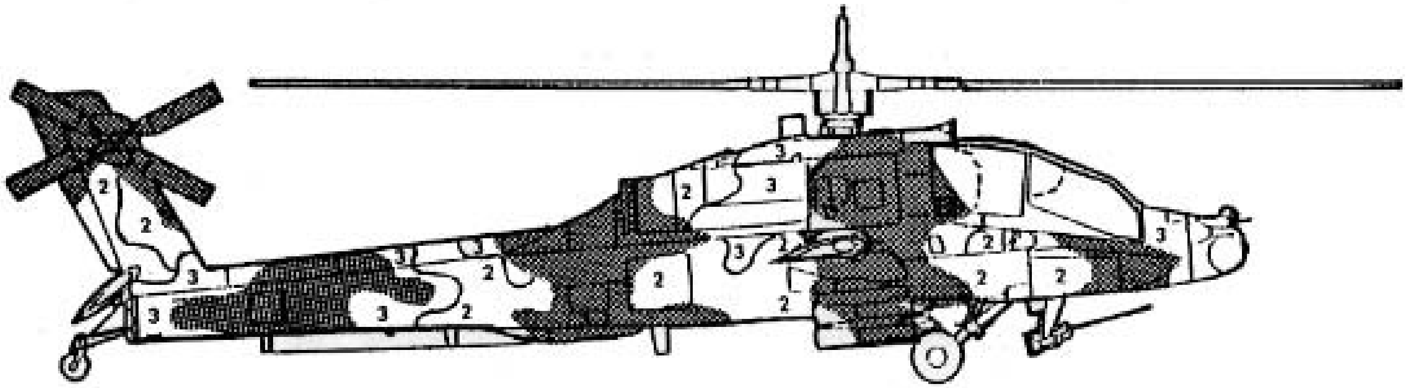


Figure 1-19. AH-64 with conventional three-color camouflage paint

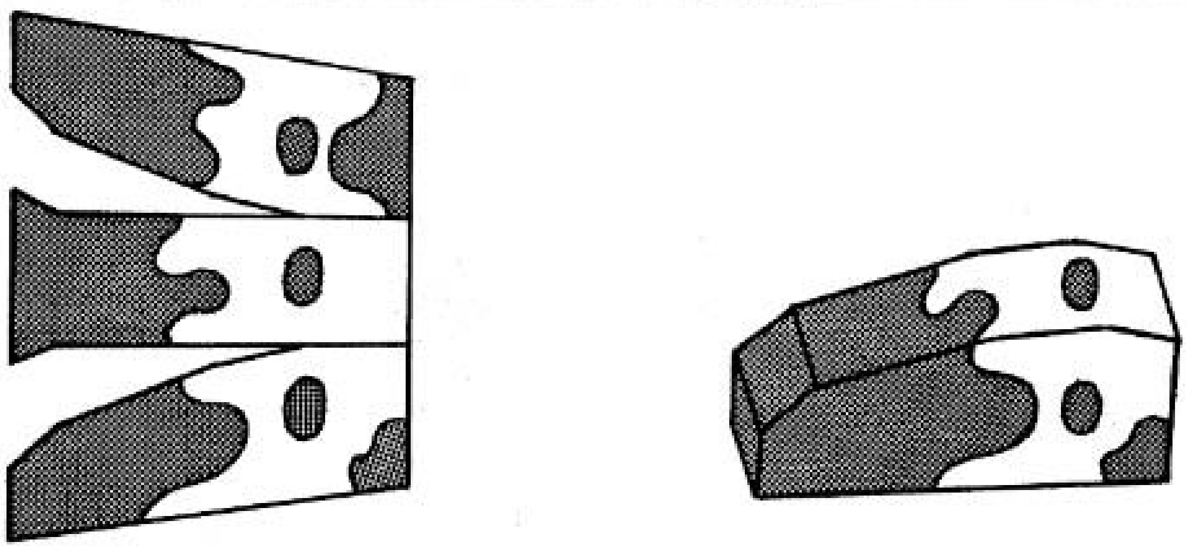


Figure 1-20. Glare cover for AH-64

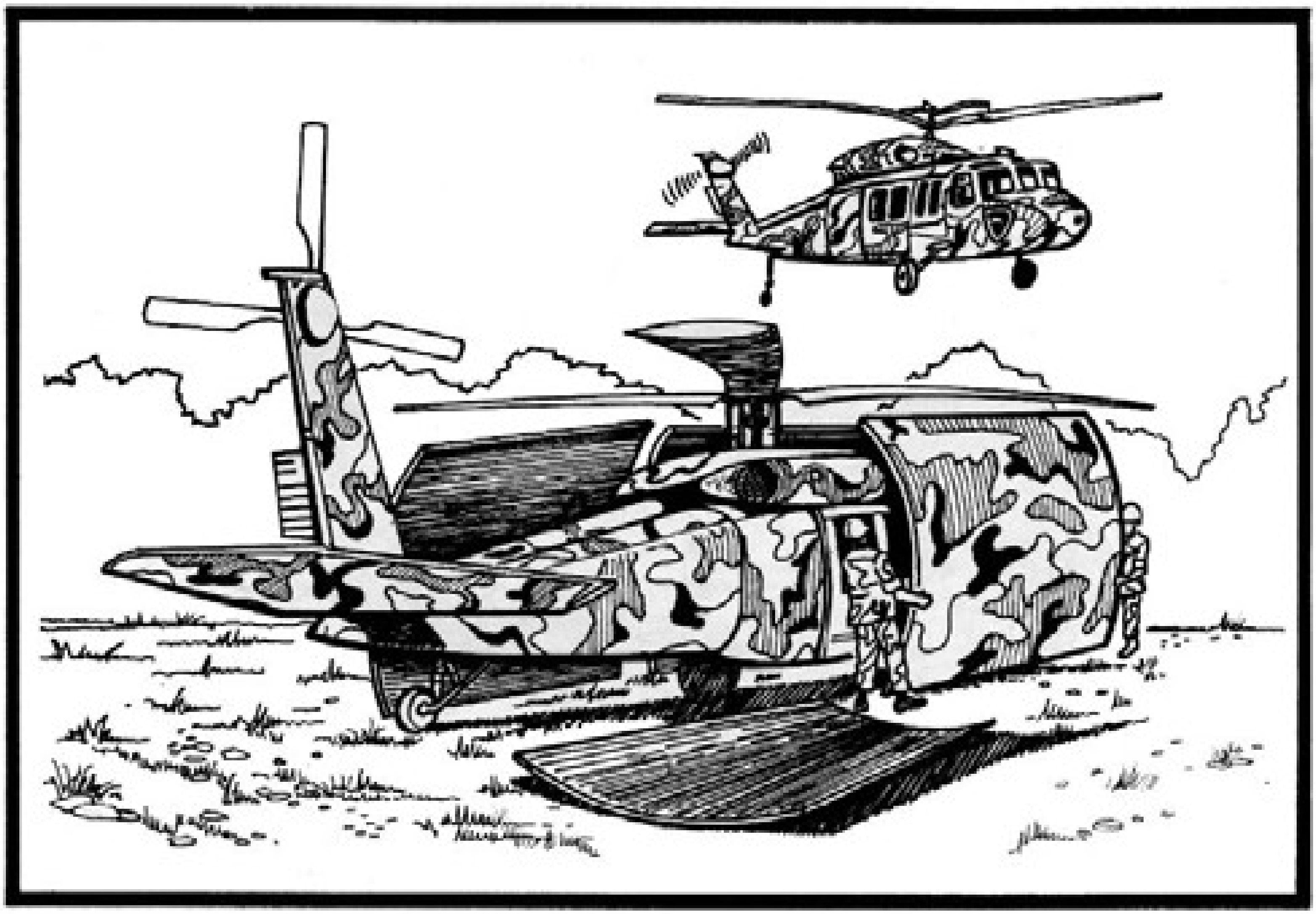


Figure 1-21. Clamshell camouflage set

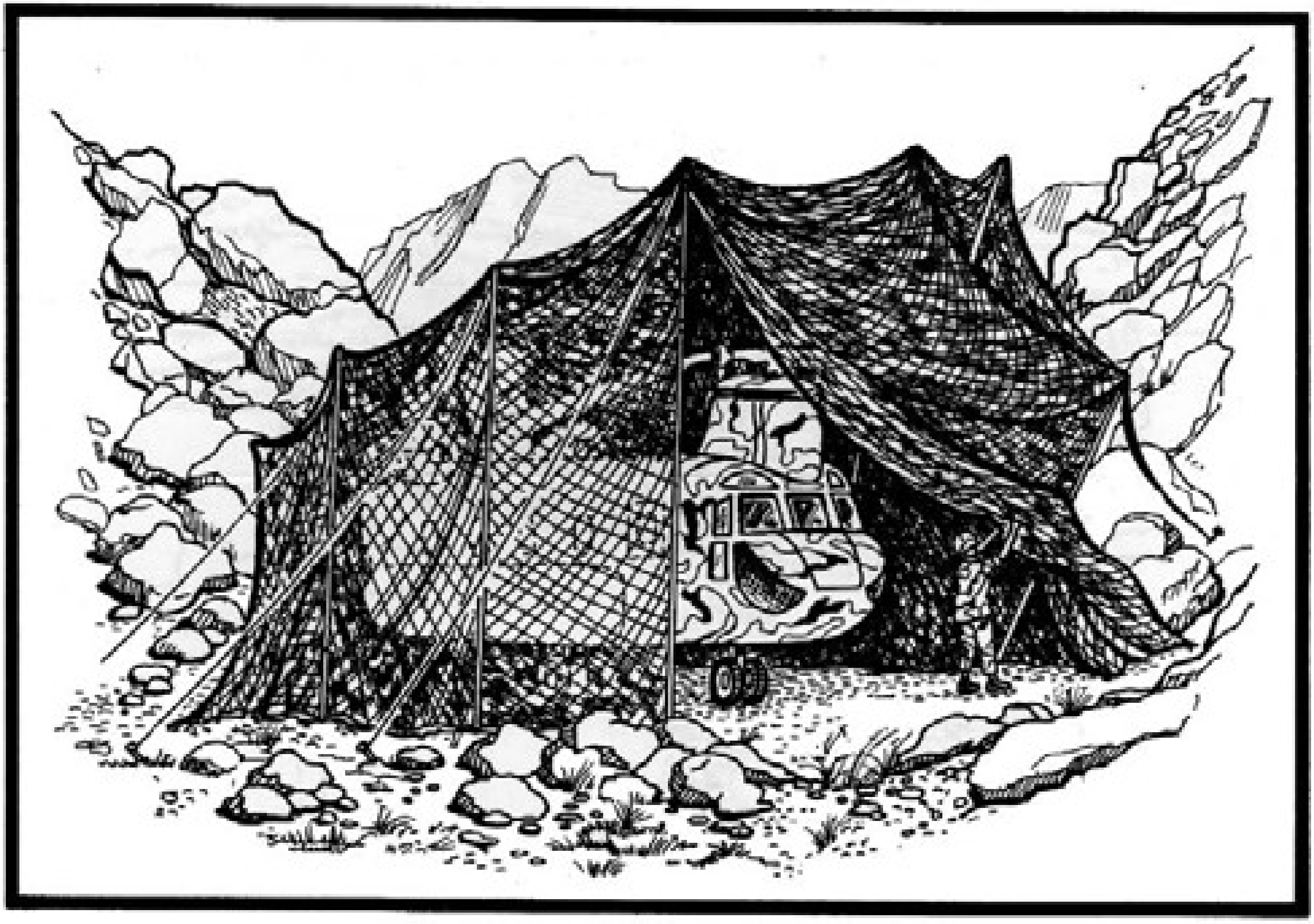


Figure 1-22. Example of a free-standing camouflage set

CHAPTER 2

LOW-INTENSITY CONFLICT

Low-intensity conflict is a political-military confrontation between contending states or groups below the level of conventional war and above the routine, peaceful competition among states. It often involves struggles between competing principles and ideologies. LIC ranges from subversive operations to armed conflict. It is waged by a combination of means employing political, economic, informational, and military instruments. Low-intensity conflicts are often localized, generally in the Third World, but can have regional or global security implications. This chapter is an overview of LIC. It discusses some unique planning considerations for aviation units. The chapter identifies the five world regions and the respective countries within each region. It also identifies the characteristics of surface-to-air missiles and antiaircraft artillery weapons that aviation forces may encounter during LIC operations in the regions.

2-1. ENVIRONMENT

Throughout their history, particularly since World War II, US Armed Forces have been assigned to assist other agencies of the US Government and friendly foreign governments and groups in low-intensity conflict. This assistance has ranged from advice, training, and transfer of materiel to participation in armed combat. The circumstances included international conflicts as well as insurgencies within a single country.

a. Aviation unit commanders and staffs must understand the nature of the conflict and US goals and methods to be effective in the LIC environment. They must understand that the objective in low-intensity conflict is to solve the problem by political, economic, and informational means with military support. Thus the military role is indirect and supportive. Doctrine, tactics, techniques, and procedures for military operations must be modified to fit the situation.

b. Low-intensity conflict challenges US national interests. A strategic consequence of unfavorable outcomes in low-intensity conflicts could be the isolation of the United States from its allies and global trading partners. This isolation could thus weaken the political and economic institutions of the free world.

c. An environment which could foster a low-intensity conflict may arise from a variety of contemporary conditions or factors. In many areas of the world, people are demanding change. Moreover, they are dissatisfied with the rate of change, the way change is managed, and the dislocations change creates. Progress for one class may create problems for another. It can cause resentment by upsetting traditional ways of doing things. When groups perceive that societal conditions are harming them and that those conditions are caused by or could be relieved by the government, they may organize into forces employing violence to achieve their goals. These same factors may contribute to conflict between states. United States policy is to assist peoples and their governments in managing change in an orderly and peaceful manner.

d. Drug trafficking is a criminal activity motivated by money. When drug lords become so rich and powerful that they develop a paramilitary capability sufficient to challenge the legitimate authority of governments, their activities become part of low-intensity conflict. The drug trade destroys the lives of

US citizens and undermines friendly governments and US international interests.

2-2. ARMY AVIATION'S ROLE

a. The US Armed Forces assist countries in the Third World by providing training, equipment, advice, and services. The United States may also commit its forces to combat operations in exceptional circumstances when directed by national command authorities. National policy and the nature of the conflict require that the Army operate in support of friendly foreign forces and other agencies of the US Government. Hence, aviation forces are usually employed as part of joint, combined, and interagency operations. Aviation has an active role in many current low-intensity conflicts throughout the world. LIC missions require both combat and noncombat forces. Army aviation operations in Central and South America have demonstrated aviation's vital role in military operations in low-intensity conflicts.

b. Army aviation may be the commander's best reconnaissance and surveillance capability, greatest firepower asset, and greatest source of mobility. In LIC operations, aviation forces conduct reconnaissance and security, air assault, and air movement of personnel, supplies, and equipment. US Army forces committed to operations in low-intensity conflict are task-organized to accomplish the assigned mission. The aviation unit commander may be the task force commander or may provide elements of his command to other task-organized forces.

2-3. OPERATIONAL CATEGORIES

The US Armed Forces engage in any of the four operational categories of a low-intensity conflict. They are support for insurgency/counterinsurgency, combating terrorism, peacekeeping, and peacetime contingency operations. The categories are not mutually exclusive and often overlap. For example, peacekeeping forces should take precautions against terrorism to protect the force. Also, a peacetime contingency operation may be executed to support an ally against an insurgency. The role of Army aviation in each category is discussed below.

a. Support for Insurgency/Counterinsurgency. Army aviation is ideally suited to provide support to an insurgency or for a friendly nation's counterinsurgency efforts. The outcome of such a conflict is determined by the ability of one side or the other to establish its legitimacy among the people. The aviation unit commander must keep in mind that the threat consists of the societal conditions that motivate the conflict as well as the insurgent forces that fight it. Success depends more on alleviating these conditions than on destroying the insurgent combat forces. Without motivation, the insurgent forces will not exist. Thus the side that seems better able to solve the people's problems will be the likely winner. This is the theory behind the Internal Defense and Development strategy, which is explained in FM 100-20.

(1) The offensive use of aviation in insurgency/counterinsurgency operations is seriously limited by the danger of death or injury to noncombatants and destruction of their property. Collateral damage from offensive operations is counterproductive and undermines the legitimacy of the side supported by the United States. While offensive operations may be used, they must be carefully controlled. The better course is usually to opt for a more discrete delivery system or to refrain from attacking altogether.

(2) Victory in an insurgency comes from balanced political, economic, and social development. In these efforts, the role of Army aviation--like that of the Armed Forces generally--is indirect and supporting. Army aviation can and should be used in support of other agencies of the United States and foreign

governments or supported groups. It can provide transportation for agricultural and other teams of the Agency for International Development. Aviation can fly civilian medical evacuation missions. Important economic data can be collected by aerial reconnaissance. Army aviation elements can provide invaluable air traffic services where they may have been almost nonexistent in a Third World country. The possible applications for Army aviation are limited only by the imagination.

(3) In exceptional circumstances, US forces may become directly involved in combat operations. The mobility and firepower of aviation can then be used to help protect all the targets that the insurgent may choose to attack. Ground forces can be deployed in widely separated small groups because aviation's rapid reaction capability can provide the necessary force to defend such groups should they be attacked.

b. Peacekeeping Operations. Peacekeeping operations involve the positioning of neutral forces between former belligerent parties with their consent to facilitate resolution of a conflict by diplomatic means. Army aviation provides reconnaissance, surveillance, air movement, and logistics support to peacekeeping operations. Aviation's role in C3 enhancement increases the commander's ability to observe operations directly. Aviation also provides radio relay support and transportation for courier service. Aviation can perform emergency medical evacuation of observers from remote sites. The rapid mobility of Army aviation enables peacekeeping forces to intervene quickly in a potential crisis. The forces can solve a dispute before it derails the diplomatic process. All of these functions have proved their worth in peacekeeping operations by the Sinai Multinational Force of Observers. Peacekeepers employ force only in self-defense. However, when force is necessary, aviation can deploy rapid reaction units when and where the need arises.

c. Combating Terrorism Operations. Terrorism is a tactic that can be employed by an enemy at any operational level. It consists of violence for psychological purposes. The target may be any person, unit, or installation.

Terrorism is intended to control the behavior of someone other than the victim. All Army organizations are responsible for counterterrorism, which consists of measures to protect the force from attack. Army aviation is a highly visible, symbolic target. Its personnel and equipment are therefore subject to attack on the ground and in the air by small arms, automatic weapons, and hand held air defense missiles. The Armed Forces support other agencies of government in combating terrorism. In the United States and its territories, the lead agency for counterterrorism is the Federal Bureau of Investigation. The Federal Aviation Administration deals with terrorist acts directed against aircraft in flight. Overseas, the Department of State is the responsible authority. Military participation in counterterrorism is executed in support of and in coordination with the lead agency. Aviation's primary role in counterterrorism operations is to protect its personnel, units, and facilities from terrorist acts. Intelligence, active and passive security measures, and individual awareness are essential elements of counterterrorism operations. Aviation conducts counterterrorism operations through intelligence preparation of the battlefield, reconnaissance, and surveillance. Aviation's role in offensive counterterrorism operations generally involves the support of special operations forces.

d. Peacetime Contingency Operations. This category includes a variety of situations and actions, some of which are warlike while others are not. All of them support political initiatives; violence is avoided or minimized. Operations in this category include-

Strikes and raids.

Unconventional warfare.

Peacemaking operations.
Disaster relief operations.
Security assistance surges.
Support for US civil authority.
Rescue and recovery operations.
Shows of force and demonstrations.
Noncombatant evacuation operations.
Support to eliminate drug trafficking.

(1) Aviation plays an indirect role in disaster relief operations, security assistance surges, unopposed rescue and recovery, and noncombatant evacuation operations. It can provide C3, transportation, and logistics support for US efforts.

(2) Army aviation can be used to support friendly governments' efforts to eliminate drug trafficking. It supports the Drug Enforcement Administration, the Department of State, and other agencies with airlift, reconnaissance, and surveillance. When directed by competent authority, Army aviation can also conduct direct combat operations to destroy drug-processing plants and drug traffickers' lines of communication.

(3) Aviation is a critical force multiplier in demonstrations and shows of force and opposed rescue and recovery and noncombatant evacuation operations. Use of aviation in support of peacetime contingency operations will vary depending on the threat and the mission. Aviation units can deploy rapidly with any combination of forces to provide command and control, to gather intelligence, to provide firepower, and to coordinate ground actions. Aviation units, along with light forces, have a vital role in peacetime contingency operations.

2-4. MISSION, ENEMY, TERRAIN, TROOPS, AND TIME AVAILABLE

The factors of METT-T are always considered in military operations. In a low-intensity conflict, METT-T factors are complemented by additional factors. These factors are political dominance, unity of action, adaptability, legitimacy, and perseverance.

a. Mission. The mission is to support the political, economic, and informational instruments of power. That mission has great implications for command and control. Some other agency of the US Government, usually the Department of State, will have the lead. The US ambassador has authority over all agencies of the US Government in the country to which he is accredited except military forces in the field operating under a unified commander. The ambassador exercises his authority through the country team. The country team is an executive committee consisting of the senior representative of each government agency in the country. The military mission must be accomplished within the context of the overall national aim. This constraint affects how operations are conducted. Political dominance becomes most apparent to the aviation unit commander in restrictive rules of engagement.

b. . The enemy is difficult to identify. Even those forces clearly opposed to the United States mix with the population and may not be recognized until they have committed a hostile act. Also, there may not be an actual enemy, only a potential enemy. For example, the armed forces of a nation on whose territory a rescue or recovery mission is executed may or may not oppose the operation. US actions must encourage them not to intervene. At the same time, US forces must be prepared to deal effectively with intervention

should it occur. Intelligence must identify not only capabilities but also intentions.

c. Terrain. The psychological "terrain" is as important as the physical setting. The US purpose is to influence attitudes and actions with minimum use of force. Also, the aviation unit commander and his intelligence staff must keep in mind that physical features may have different significance in a LIC operation than in a more conventional situation. Terrain that appears impassable and inhospitable may be the best avenue of approach for an enemy force or the location of a base area.This terrain must be the object of reconnaissance and surveillance. The enemy is likely to operate most effectively when flying conditions are at their worst.

d. Troops. The special character of low-intensity conflict requires that troops exercise great restraint under extreme provocation. Commanders must ensure that troops understand the reasons for the restrictions imposed on them. Commanders must also exercise influence over people not directly under their command, including host nation forces and civilian agencies of the US Government. Influence is gained by persuasiveness, force of personality, and logical arguments. The physical environment of the Third World may impose special burdens on US troops. They include temperature extremes, difficult terrains, and remoteness from familiar surroundings and support services. Commanders must also be prepared to deal with troop boredom when active operations become infrequent.

e. Time Available. Conventional wartime operations require intense levels of activity in short periods of time. This same level of activity may occur in LIC as well. However, in LIC, there also may be extended periods of relative inactivity and circumstances when action is better postponed. The LIC imperative of perseverance applies. It has two parts. First, it must be realized that the United States and its forces should be prepared to stay the course, understanding that the often complex issues of the LIC cannot be solved quickly. The other is that sometimes the best course of action is to do nothing. An example of the latter is an opportunity to destroy an enemy force that would possibly also cause friendly or neutral casualties or property damage. In those cases, it may be better to sacrifice short-term success for long-term goals.

2-5. WORLD REGIONS

In the past the Soviet Union has supported revolutionary leftist forces conducting insurgencies in Third World countries. The Soviets' covert support of terrorism has resulted in the training of terrorist organizations. Instruction in guerrilla warfare, assassination, sabotage, terrorism, and espionage has been conducted at special Soviet training facilities. Thousands of Palestinians, other Arab recruits, and selected non-Arabs and members of the South West African Peoples Organization and the African National Congress have received training in insurgent and terrorist techniques. The Soviet Union and its satellites have provided many countries with military equipment. Some of this equipment is illustrated in FMs 1-402, 44-30, and 100-2-3 and Chapter 1 of this publication. Potential threats to Army aviation exist in most regions of the world.

a. Asia and Australasia Region. Figure 2-1 shows the countries in the Asia and Australasia region. Tables 2-1 and 2-2 show the characteristics of surface-to-air missiles and antiaircraft artillery weapons in this region.

Figure 2-1. Countries in Asia and Australasia region Table 2-1. Characteristics of surface-to-air missiles in Asia and Australasia region Table 2-2. Characteristics of antiaircraft artillery weapons in Asia and Australasia region

b. Caribbean and Latin America Region. Figure 2-2 shows the countries in the Caribbean and Latin America region. Tables 2-3 and 2-4 show the characteristics of surface-to-air missiles and antiaircraft artillery weapons in this region.

Figure 2-2. Countries in Caribbean and Latin America region Table 2-3. Characteristics of surface-to-air missiles in Caribbean and Latin America region Table 2-4. Characteristics of antiaircraft artillery weapons in Caribbean and Latin America region Table 2-4. Characteristics of antiaircraft artillery weapons in Caribbean and Latin America region

(continued)

c. Sub-Saharan Africa Region. Figure 2-3 shows the countries in the Sub-Saharan Africa region. Tables 2-5 and 2-6 show the characteristics of surface-to-air missiles and antiaircraft artillery weapons in this region.

Figure 2-3. Countries in Sub-Saharan Africa region Table 2-5. Characteristics of surface-to-air missiles in Sub-Saharan Africa region Table 2-6. Characteristics of antiaircraft artillery weapons in Sub-Saharan Africa region Table 2-6. Characteristics of antiaircraft artillery weapons in Sub-Saharan Africa region (continued)

d. Middle East and North Africa Region. Figure 2-4 shows the countries in the Middle East and North Africa region. Tables 2-7 and 2-8 show the characteristics of surface-to-air missiles and antiaircraft artillery weapons in this region.

Figure 2-4. Countries in Middle East and North Africa region Table 2-7. Characteristics of surface-to-air missiles in Middle East and North Africa region

Table 2-8. Characteristics of antiaircraft artillery weapons in Middle East and North Africa region

e. Europe (Warsaw Pact) Region. Figure 2-5 shows the countries in the Europe (Warsaw Pact) region. Tables 2-9 and 2-10 show the characteristics of surface-to-air missiles and antiaircraft artillery weapons in this region.

Figure 2-5. Countries in Europe (Warsaw Pact) region Table 2-9. Characteristics of surface-to-air missiles in Europe (Warsaw Pact) region Table 2-10. Characteristics of antiaircraft artillery weapons in Europe (Warsaw Pact) region Table 2-4. Characteristics of antiaircraft artillery weapons in Caribbean and Latin America region

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Afghanistan	Indonesia	Papua (New Guinea)
Australia	Japan	Philippines
Bangladesh	Laos	Singapore
Brunei	Malasia	South Korea
Burma	Mongolia	Sri Lanka
Cambodia	Nepal	Taiwan
China	New Zealand	Thailand
Fiji	North Korea	Vietnam
India	Pakistan	

Figure 2-1. Countries in Asia and Australasia region

Table 2-1. Characteristics of surface-to-air missiles in Asia and Australasia region

WEAPON SYSTEM	RANGE (KILOMETERS) MAXIMUM/MINIMUM	ALTITUDE (METERS) MAXIMUM/MINIMUM	GUIDANCE PRINCIPLE
Hawk	40.0*	30/18	Semiactive radar homing
HN-5A	5.5/3.5	2,500/50	Infrared homing
Rapier	6.0+/0.5	3,000/ground	CLOS
RBS-70	7.0/0.2	4,000/ground	Modulated laser beam rider
Redeye	3.3/0.6	3,000/25	Infrared homing
SA-7 Grail	5.5/0.5	4,500/15	Infrared homing
Stinger	4.5/0.2	3,800/ground	Infrared homing
Tan (Type 81)	7.0/0.5	3,000*	Command/infrared homing

*Denotes maximum effective range only.

Table 2-2. Characteristics of antiaircraft artillery weapons in Asia and Australasia region

WEAPON NOMENCLATURE	RANGE (KILOMETERS) MAXIMUM	(EFFECTIVE)	ALTITUDE (METERS) MAXIMUM	(EFFECTIVE)	ACQUISITION MEANS
<u>14.5-mm</u>					
ZPU-2	8.0		5,000	(1,400)	Optical
ZPU-4	8.0		5,000	(1,400)	Optical
<u>23-mm</u>					
ZSU-23-4	7.0	(2.0)	5,100	(2,500)	Radar/optical
ZU-23	7.0	(2.0)	5,100	(2,500)	Optical
ZU-23-2	7.0	(2.0)	5,100	(2,500)	Optical
<u>35-mm</u>					
GDF-002	4.0		4,000		Optical
<u>37-mm</u>					
M-1939 (and variants)	9.5		6,700	(3,000)	Optical
<u>40-mm</u>					
Bofors L/60	3.7		INA		Optical
L170	12.0			(4,000)	Optical
M-42 SP	9.5			(5,000)	Radar
<u>57-mm</u>					
S-60	12.0	(6.0)	8,800		Radar
		(4.0)	8,800		Optical
ZSU-57-2 SP	12.0	(4.0)	8,800		Optical
<u>85-mm</u>					
KS-12	18.0		11,600	(10,000)	Radar
<u>100-mm</u>					
KS-19	21.0		15,000	(13,700)	Radar
<u>130-mm</u>					
M-1 Towed	4.8		4,660	(2,740)	Optical

M-1 Towed	4.8	4,660 (2,740)	Optical

Argentina Bahama Bolivia Brazil Chile Colombia Costa Rica Cuba Dominican Republic	Ecuador El Salvador Guatemala Guyana Haiti Honduras Jamaica Mexico Nicaragua	Panama Paraguay Peru Suriname Trinidad and Tobago Uruguay Venezuela

Figure 2-2. Countries in Caribbean and Latin America region

Table 2-3. Characteristics of surface-to-air missiles in Caribbean and Latin America region

WEAPON SYSTEM	RANGE (KILOMETERS) MAXIMUM/MINIMUM	ALTITUDE (METERS) MAXIMUM/MINIMUM	GUIDANCE PRINCIPLE
Blowpipe	3.5/0.7	2,500/10	CLOS
Roland	6.3/0.7	5,500/10	Command
SA-7 Grail	5.5/0.5	4,500/15	Infrared homing
SA-14 Gremlin	6.0/0.6	5,500/10	Infrared homing

Table 2-4. Characteristics of antiaircraft artillery weapons in Caribbean and Latin America region (continued)

Table 2-4. Characteristics of antiaircraft artillery weapons in Caribbean and Latin America region

WEAPON NOMENCLATURE	RANGE (KILOMETERS) MAXIMUM (EFFECTIVE)	ALTITUDE (METERS) MAXIMUM (EFFECTIVE)	ACQUISITION MEANS
<u>14.5-mm</u>			
ZPU-2	8.0	5,000 (1,400)	Optical
ZPU-4	8.0	5,000 (1,400)	Optical
<u>20-mm</u>			
M-55	5.5 (2.5)	4,000 (2,000)	Optical
M-167	(2.2)	(1,200)	Radar
TCM-20	5.7 (1.5)	4,500 (1,200)	Radar
<u>23-mm</u>			
ZSU-23-4	7.0 (2.0)	5,100 (2,500)	Radar/optical
ZU-23	7.0 (2.0)	5,100 (2,500)	Optical
<u>30-mm</u>			
M-53	9.7	6,300 (3,000)	Optical
<u>35-mm</u>			
GDF-002	4.0	4,000	Optical
<u>40-mm</u>			
Bofors L/60	3.7	INA	Optical
L170	12.0	(4,000)	Optical
M-42 SP	9.5	(5,000)	Radar
<u>57-mm</u>			
S-60	12.0 (6.0)	8,800	Radar
	(4.0)	8,800	Optical
ZSU-57-2 SP	12.0 (4.0)	8,800	Optical
<u>85-mm</u>			
KS-12	18.0	11,600 (10,000)	Radar

Table 2-4. Characteristics of antiaircraft artillery weapons in Caribbean and Latin America region (continued)

WEAPON NOMENCLATURE	RANGE (KILOMETERS) MAXIMUM (EFFECTIVE)	ALTITUDE (METERS) MAXIMUM (EFFECTIVE)	ACQUISITION MEANS
100-mm			
KS-19	21.0	15,000 (13,700)	Radar
130-mm			
M-1 Towed	4.8	4,660 (2,740)	Optical

Angola	Ghana	Senegal
Benin	Guinea	Senegambia
Botswana	Guinea-Bissau	Seychelles
Burkino Faso	Kenya	Sierra Leone
Burundi	Lesotho	South Africa
Cameroon	Liberia	Tanzania
Cape Verde	Madagascar	The Gambia
Central African Republic	Mali	Togo
Chad	Milawi	Uganda
Congo	Mozambique	Zaire
Cote d'Ivoire	Namibia	Zambia
Equatorial Guinea	Niger	Zimbabwe
Ethiopia	Nigeria	
Gabon	Rwanda	

Figure 2-3. Countries in Sub-Saharan Africa region

Table 2-5. Characteristics of surface-to-air missiles in Sub-Saharan Africa region

WEAPON SYSTEM	RANGE (KILOMETERS) MAXIMUM/MINIMUM	ALTITUDE (METERS) MAXIMUM/MINIMUM	GUIDANCE PRINCIPLE
Blowpipe	3.5/0.7	2,500/10	CLOS
SA-7 Grail	5.5/0.5	4,500/15	Infrared homing

Table 2-6. Characteristics of antiaircraft artillery weapons in Sub-Saharan Africa region

Table 2-6. Characteristics of antiaircraft artillery weapons in Sub-Saharan Africa region (continued)

Table 2-6. Characteristics of antiaircraft artillery weapons in Sub-Saharan Africa region

WEAPON NOMENCLATURE	RANGE (KILOMETERS) MAXIMUM (EFFECTIVE)	ALTITUDE (METERS) MAXIMUM (EFFECTIVE)	ACQUISITION MEANS
<u>14.5-mm</u>			
ZPU-2	8.0	5,000 (1,400)	Optical
ZPU-4	8.0	5,000 (1,400)	Optical
<u>20-mm</u>			
M-55	5.5 (2.5)	4,000 (2,000)	Optical
M-167	(2.2)	(1,200)	Radar
TCM-20	5.7 (1.5)	4,500 (1,200)	Radar
<u>23-mm</u>			
ZSU-23-4	7.0 (2.0)	5,100 (2,500)	Radar/optical
ZU-23	7.0 (2.0)	5,100 (2,500)	Optical
ZU-23-2	7.0 (2.0)	5,100 (2,500)	Optical
<u>30-mm</u>			
M-53	9.7	6,300 (3,000)	Optical
<u>37-mm</u>			
M-1939 (and variants)	9.5	6,700 (3,000)	Optical
<u>40-mm</u>			
L170	12.0	(4,000)	Optical

Table 2-6. Characteristics of antiaircraft artillery weapons in Sub-Saharan Africa region (continued)

WEAPON NOMENCLATURE	RANGE (KILOMETERS) MAXIMUM (EFFECTIVE)	ALTITUDE (METERS) MAXIMUM (EFFECTIVE)	ACQUISITION MEANS
57-mm			
S-60	12.0 (6.0)	8,800	Radar
	(4.0)	8,800	Optical
ZSU-57-2 SP	12.0 (4.0)	8,800	Optical
85-mm			
KS-12	18.0	11,600 (10,000)	Radar
100-mm			
KS-19	21.0	15,000 (13,700)	Radar

Algeria	Kuwait	Somali Republic
Bahrain	Lebanon	Sudan
Djibouti	Libya	Syria
Egypt	Mauritania	Tunisia
Iran	Morocco	United Arab Emirates
Iraq	Oman	Yemen Arab Republic
Israel	Qatar	
Jordan	Saudi Arabia	

Figure 2-4. Countries in Middle East and North Africa region

Table 2-7. Characteristics of surface-to-air missiles in Middle East and North Africa region

WEAPON SYSTEM	RANGE (KILOMETERS) MAXIMUM/MINIMUM	ALTITUDE (METERS) MAXIMUM/MINIMUM	GUIDANCE PRINCIPLE
Chaparral	6.0/0.5	3,000/15	Infrared homing
Hawk	40.0*	30/18	Semiactive radar homing
Rapier	6.0+/0.5	3,000/ground	CLOS
RBS-70	7.0/0.2	4,000/ground	Modulated laser beam rider
Redeye	3.3/0.6	3,000/25	Infrared homing
Roland	6.3/0.7	5,500/10	Command
SA-6 Gainful	24.0/4.0	12,000/50	Semiactive radar homing
SA-7 Grail	5.5/0.5	4,500/15	Infrared homing
SA-8 Gecko	12.0/1.6	12,000/10	Command
SA-9 Gaskin	6.0/0.6	5,000/10	Infrared homing
SA-13 Gopher	7.0/0.5	10,000/10	Infrared homing
SA-14 Gremlin	6.0/0.6	5,500/10	Infrared homing
Stinger	4.5/0.2	3,800/ground	Infrared homing

*Denotes maximum effective range only.

Table 2-8. Characteristics of antiaircraft artillery weapons in Middle East and North Africa region

WEAPON NOMENCLATURE	RANGE (KILOMETERS) MAXIMUM (EFFECTIVE)	ALTITUDE (METERS) MAXIMUM (EFFECTIVE)	ACQUISITION MEANS
14.5-mm			
ZPU-2	8.0	5,000 (1,400)	Optical
ZPU-4	8.0	5,000 (1,400)	Optical
20-mm			
M-163 SP	(3.0)	(1,600)	Gyro lead-computing
M-167	(2.2)	(1,200)	Radar
23-mm			
ZSU-23-4	7.0 (2.0)	5,100 (2,500)	Radar/optical
ZU-23	7.0 (2.0)	5,100 (2,500)	Optical
ZU-23-2	7.0 (2.0)	5,100 (2,500)	Optical
30-mm			
M-53 SP	9.7	6,300 (3,000)	Optical
37-mm			
M-1939 (and variants)	9.5	6,700 (3,000)	Optical
40-mm			
L170	12.0	(4,000)	Optical
57-mm			
S-60	12.0 (6.0)	8,800	Radar
	(4.0)	8,800	Optical
ZSU-57-2 SP	12.0 (4.0)	8,800	Optical
85-mm			
KS-12	18.0	11,600 (10,000)	Radar
100-mm			
KS-19	21.0	15,000 (13,700)	Radar

KS-19	21.0	15,000 (13,700)	Radar

Bulgaria Czechoslovakia	German Democratic Republic Hungary	Poland Romania

Figure 2-5. Countries in Europe (Warsaw Pact) region

Table 2-9. Characteristics of surface-to-air missiles in Europe (Warsaw Pact) region

WEAPON SYSTEM	RANGE (KILOMETERS) MAXIMUM/MINIMUM	ALTITUDE (METERS) MAXIMUM/MINIMUM	GUIDANCE PRINCIPLE
SA-6 Gainful	24.0/4.0	12,000/50	Semiactive radar homing
SA-7 Grail	5.5/0.5	4,500/15	Infrared homing
SA-8 Gecko	12.0/1.6	12,000/10	Command
SA-9 Gaskin	6.0/0.6	5,000/10	Infrared homing
SA-13 Gopher	7.0/0.5	10,000/10	Infrared homing

Table 2-10. Characteristics of antiaircraft artillery weapons in Europe (Warsaw Pact) region

WEAPON NOMENCLATURE	RANGE (KILOMETERS) MAXIMUM (EFFECTIVE)	ALTITUDE (METERS) MAXIMUM (EFFECTIVE)	ACQUISITION MEANS
<u>12.7-mm</u>			
DShK	7.0 (1.5)	1,500 (1,000)	Optical
<u>14.5-mm</u>			
KPVT	7.0 (2.0)	2,000 (1,400)	Optical
<u>23-mm</u>			
ZSU-23-4	7.0 (2.0)	5,100 (2,500)	Radar/optical
ZU-23	7.0 (2.0)	5,100 (2,500)	Optical
<u>30-mm</u>			
M-53 SP	9.7	6,300 (3,000)	Optical
<u>57-mm</u>			
S-60	12.0 (6.0)	8,800	Radar
	(4.0)	8,800	Optical
ZSU-57-2 SP	12.0 (4.0)	8,800	Optical
<u>85-mm</u>			
KS-12	18.0	11,600 (10,000)	Radar
<u>100-mm</u>			
KS-19	21.0	15,000 (13,700)	Radar

CHAPTER 3

ARTILLERY THREAT

This chapter implements portions of QSTAG 768.

The Soviets believe artillery is a decisive factor in the combat equation. They intend to use artillery to destroy or suppress opponents while their armor-heavy, fast-moving maneuver forces quickly penetrate enemy rear areas. Other armies have adopted the same principle and believe that greater firepower means greater mobility. If these tactics are successful, any future war will be over quickly. This chapter discusses Soviet employment tactics and techniques used in the formation of artillery groups to permit the maximum exploitation of artillery fire. It describes the criteria for the use of firing norms and discusses the inherent weaknesses common to Threat artillery that can be exploited by Army aviation.

3-1. DOCTRINE

a. Soviet offensive doctrine calls for brief, intense artillery preparations wherein a certain number of rounds, by type of target, are delivered to achieve destruction. Defensive doctrine calls for prolonged high volumes of artillery fire into the depth of an enemy formation to break up and destroy the enemy's attack.

b. Soviet artillery is prepared to fire a large number of projectiles in a short time in the offense and over a longer time in the defense. This is to achieve surprise and to limit vulnerability to enemy fires. Massive fires are concentrated on critical points in the offense or are dispersed throughout the sector in the defense. Defensive fires require not only a numerical superiority in artillery pieces and sufficient numbers of short-range ballistic missiles but also rapid fire, range, and mobility. Above all, the Soviets stress the importance of integrated fire and maneuver plans.

3-2. MODERNIZATION

The modernization of Soviet maneuver forces has created a structure that is ideally suited to conduct high-speed operations deep into enemy rear areas. Large-caliber, self-propelled and/or towed guns and mortars and long-range multiple rocket launchers have been added to the artillery available to commanders. The improvements to these weapons have expanded their area coverage as well as their range. The longer range and wider burst of these weapons make them a serious threat to helicopters during ground operations at FARPs, forward staging areas, and aviation maintenance facilities located in rear areas. Figure 3-1 shows the impact that a single salvo of a BM-21 multiple rocket launcher battery
has on an aviation maintenance target. FM 100-2-1 describes artillery employment at the tactical level.

Figure 3-1. Salvo effects of BM-21 rocket launcher system

3-3. EMPLOYMENT TACTICS AND TECHNIQUES

The Soviet command and organizational structure is designed to ensure flexibility in concentrating artillery fire in the direction of the main attack. It is established by temporary mission-oriented groups. The formation of artillery into army, divisional, and regimental artillery groups permits maximum exploitation of artillery by maneuver commanders. The formation also provides continuous artillery support while retaining the required degree of centralized control. Artillery groups usually consist of at least two battalions. They may be composed of similar or mixed units, to include mortars, field guns, howitzers, and multiple rocket launchers. Figure 3-2 shows an example of the formation of artillery groups.

Figure 3-2. Example formation of artillery groups

3-4. FIRING NORMS

a. Fire Coverage. The decision as to which norm to use is based on the expected area of coverage and the target effect achieved through varying expenditure rates and methods of fire. The Soviets calculate fire coverage in hectares. A hectare is 10,000 square meters; 100 hectares equals 1 square kilometer. Figure 3-3 shows fire coverage.

Figure 3-3. Fire coverage

b. Fire Concentration. Fire concentration may be conducted against either a single target or a group of targets located in the same area. If several batteries are employed, the target can be broken down into subareas for each battery. Fires also can be superimposed to achieve high densities of fire for a short time. For unobserved fire planning purposes, the Soviets designate minimum area targets based on target range and weapon dispersion factors.

(1) Minimum area targets. An actual target area may be smaller than the minimum area for a particular artillery unit to cover. It will, however, be attacked with the ammunition required for the designated minimum area to ensure coverage.

(2) Area neutralization. Each artillery weapon is assumed to be able to neutralize an area, given in hectares, depending on the time allotted and type of target. Table 3-1 shows the coverage of a 120-millimeter mortar battery and a 122-millimeter howitzer battalion.

Table 3-1. 120-millimeter mortar battery and 122-millimeter howitzer battalion (area coverage)

c. Successive Fire. The Soviets group targets in lines to deliver successive concentrations of fire in support of the attack and for fire support in depth. Each successive line falls somewhat deeper within the defensive position. Fire is delivered on a line for at least five minutes and then shifted on order to a subsequent line. The objective is to neutralize the target based on a prescribed expenditure of rounds per hectare per minute. For most weapons, the expenditure rate is two to three rounds per minute. Successive fire may be reduced when it follows intense preparatory fires. In successive fire concentrations, a battery normally has a minimum target area. Rocket launchers fire single salvos and are used only against the most important targets.

d. Barrage Fires.

(1) An offensive rolling barrage may be fired to a depth of about 4 to 5 kilometers. A combination of fires is delivered in succession on main and intermediate lines. For main lines, the fire is for a minimum of five minutes; for intermediate lines, it is one to two minutes. Table 3-2 shows the assigned sectors for offensive barrage fires.

Table 3-2. Assigned sectors for offensive barrage fires

(2) During the attack, Threat barrage fires are planned to interdict infantry or tank movement. Fire is for short periods on preplanned lines. Coverage is assumed to be 50 meters per weapon or 900 meters per battalion. Fire from multiple rocket launchers may be superimposed on other fires at important points.

3-5. SURVIVABILITY AND COUNTERMEASURES

Artillery may be one of the most significant threats to aviation units operating in the terrain flight mode. Aircraft damage sustained from direct hits, shrapnel, and flying debris can destroy or restrict the mission capability of aviation units. Aviation commanders and mission planners should anticipate hostile artillery fires in their areas of operation. Some passive and active countermeasures against Threat artillery are discussed below.

a. Passive Countermeasures.

(1) Some Threat artillery weapons are designed with a relatively low trajectory. Good terrain analysis before and during combat missions will enable aviators to avoid likely artillery targets. Artillery targets include prominent terrain features, troop assembly areas, likely avenues of approach, massed infantry and armored units, artillery units, trains areas, and command posts. To avoid becoming an artillery target, aviators should-

Disperse aircraft on the ground and in flight.

Ensure premission planning includes detailed signals and procedures for executing position changes and alternate landings.

Select primary and alternate reconnaissance and firing positions and landing zones for flexibility and protection from area artillery saturation.

Use terrain flight techniques to avoid detection and to ensure that Threat radar devices do not acquire FARPs, holding areas, assembly areas, maintenance facilities, and aviation units.

(2) Most Threat artillery fires are planned and controlled at higher echelons of command. They are somewhat less decentralized than those of US artillery. Also, Threat artillery doctrine stresses the employment of massive artillery strikes in both planned and on-call artillery support. Aviation commanders should analyze the main battle area for probable Threat target areas.

(3) The use of all available intelligence data and a thorough map reconnaissance aids in planning operations that avoid Threat artillery and other fires. Threat artillery locations and types of units should be reported promptly. This information helps in the identification and neutralization of Threat artillery.

b. Active Countermeasures.

(1) Active countermeasures can be employed against Threat artillery, especially towed artillery that does not have good overhead personnel cover. Threat observation posts and fire direction centers also may not employ overhead cover and are usually vulnerable targets. Suppression of Threat artillery systems is normally accomplished by the combined arms team and counterbattery artillery fires.

(2) Threat artillery components are particularly vulnerable to artillery fire using high-explosive projectiles with variable time fuzing. Attack helicopter and tactical air support may effectively suppress Threat artillery.

(3) Threat artillery ground observation posts are collocated with the supported units near the FLOT in positions with good fields of observation for adjusting artillery fires. Observation posts can be neutralized by smoke or fire suppression. However, well-camouflaged and well-constructed observation posts may be difficult to detect and suppress by fire. (4) Electronic counter-countermeasures may also aid in the suppression of Threat artillery. However, aviators cannot assume electronic counter-countermeasures will neutralize the artillery threat.

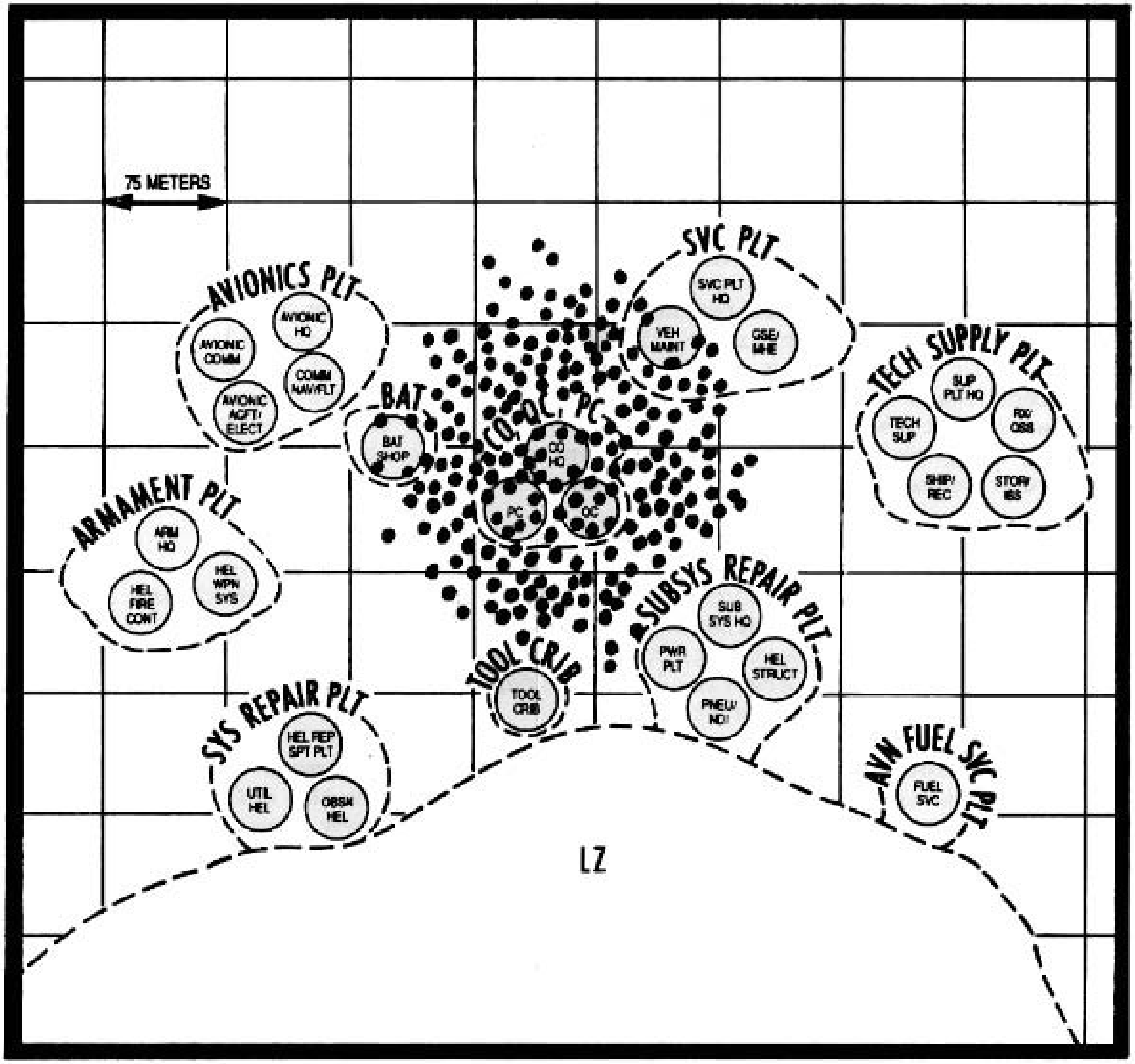

Figure 3-1. Salvo effects of BM-21 rocket launcher system

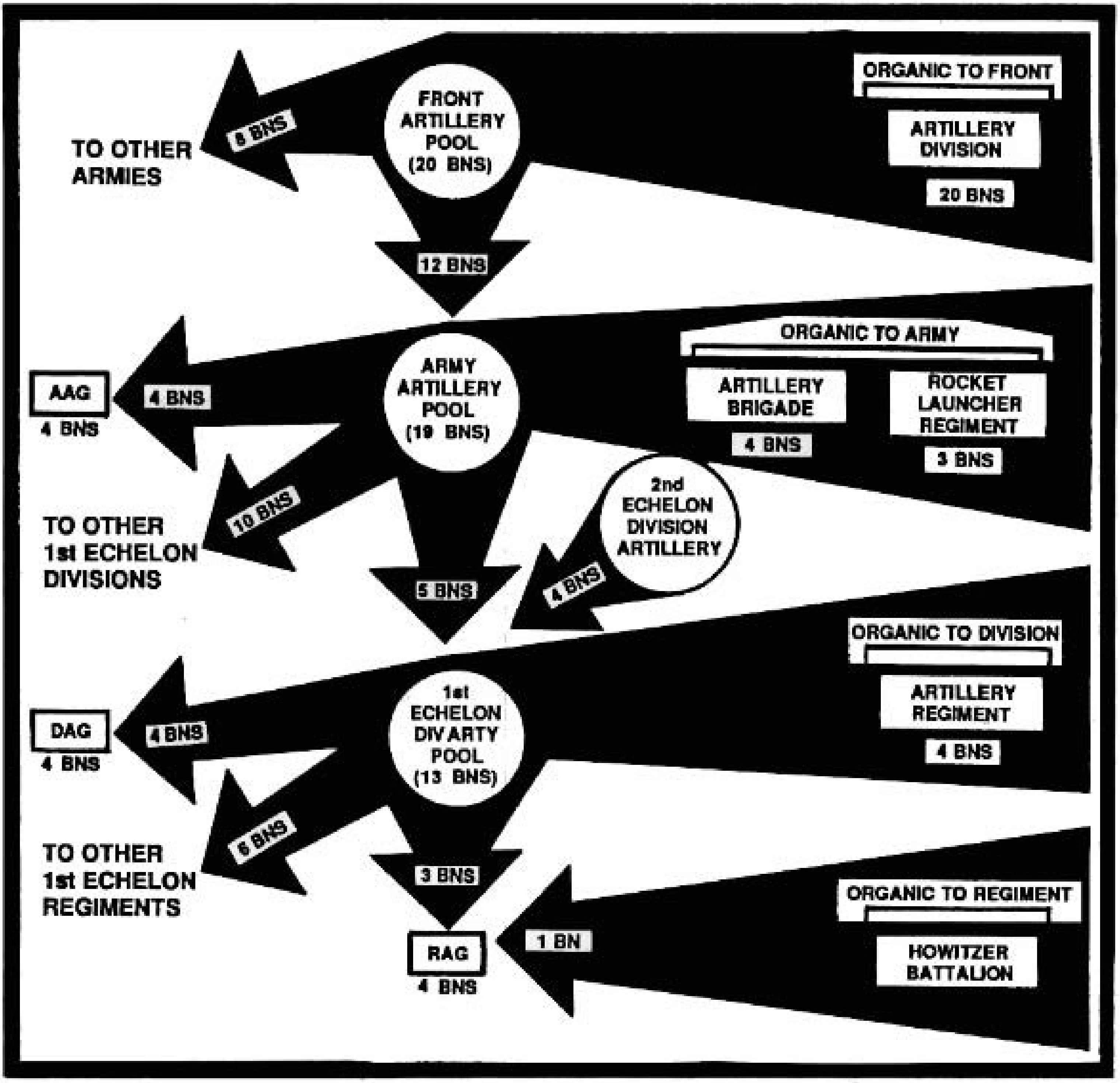

Figure 3-2. Example formation of artillery groups

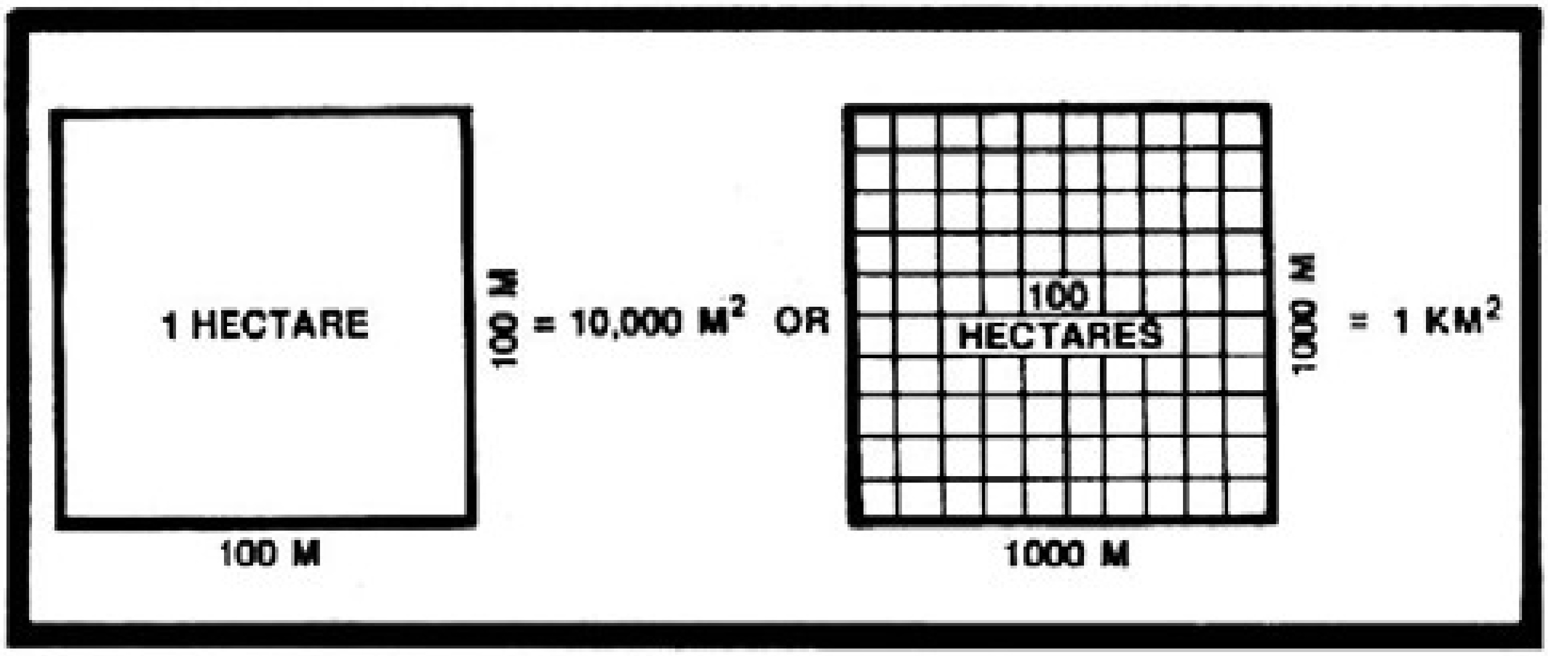

Figure 3-3. Fire coverage

Table 3-1. 120-millimeter mortar battery and 122-millimeter howitzer battalion (area coverage)

TYPE OF TARGET	ASSAULT LENGTH (MINUTES)	AREA COVERAGE (HECTARES)	
		120-mm Mortar Battery (6 Tubes)	122-mm Howitzer Battalion (18 Tubes)
Tanks and APCs	10	1-2	5-6
Exposed Personnel and Weapons	3-4	15	18
Personnel and Weapons Under Cover	5	1	3-4
	10	1-2	5-6
	15	2	7-8
	20	2-3	9

Table 3-2. Assigned sectors for offensive barrage fires

TYPE OF WEAPON	METERS PER WEAPON	METERS PER BATTERY	METERS PER BATTALION
100-mm and 130-mm Guns	20-25	150	450
Howitzers and Guns/Howitzers	35	200	600-650

CHAPTER 4

TACTICAL AIR THREAT

This chapter implements portions of STANAG 2999 and QSTAGs 703 and 768.

The modern battlefield will be characterized by high numbers of Soviet armed helicopters and high-performance fighters. Their presence will range from the close battle areas to rear areas near supply trains and installations. Army aircrews must be prepared for encounters with Soviet aircraft. To ensure survivability and mission success, aircrews must effectively engage or avoid Threat aircraft or successfully initiate evasive countermeasures. This chapter discusses Soviet helicopters and fighters and the threat they pose to Army aircrews on the modern battlefield. It also describes active and passive countermeasures that enhance aircrew survivability.

Section I

SOVIET AIR ASSETS AND OPERATIONS

4-1. AIR ASSETS

The threat from the air consists of armed helicopters, fighters, unmanned aerial vehicles, and drones.

These aviation assets, individually or collectively, provide air fire support and air reconnaissance support to enemy ground maneuver formations. Air support assets are an integral element of combined arms formations at Front, army, and division levels. These assets greatly enhance Threat offensive capabilities.

a. Frontal aviation constitutes the bulk of the Soviet air force. Soviet frontal aviation assets are assigned to and controlled by the Front commander.

b. Missions for air forces of the Front include air defense cover, air reconnaissance, air support, and air

interdiction. Figure 4-1 shows the aviation assets included within the air forces of the Front. Aviation assets have no fixed organization and may be tailored to meet specific needs. One type of air force of the Front may include two or three divisions of fighters and fighter-bombers. It may include one or more independent regiments of reconnaissance aircraft in addition to helicopter units. These assets may be combined during the forward movement, air preparation, air support, and air accompaniment stages of offensive ground operations.

Figure 4-1. Air forces of the Front

4-2. AIR OPERATIONS

a. Soviet air operations employ tactical aviation assets that are organized on a functional or mission-related basis. Homogenous formations of fighters and helicopters increase firepower and strike capability, promote firm control and maneuverability, and enhance the Threat's capability to conduct sustained operations.

b. The Soviets can be expected to launch a massive air operation in the initial stage of conventional,

theater wide hostilities. This tactic directly affects the air support provided to ground forces. The increasing numbers of Soviet ground attack aircraft and the ongoing improvements in their range, armament, and avionics give Soviet military strategists a viable, nonnuclear offensive option. Independent air operations are characterized by massive air strikes against priority theater targets and may last for three days. They are conducted to gain air superiority in the theater. The strikes are carried out by Soviet fixed-wing naval aircraft, intermediate-range aircraft, and ground attack aircraft. The ground attack may occur at the same time as or shortly after the independent air operation.

c. During the initial hours of the air operation, most fixed-wing aircraft will be committed to priority theater targets. Therefore, ground force commanders will rely heavily on combat helicopters for close air support.

Section II

HELICOPTERS

4-3. COMBAT ORGANIZATIONS

The increased numbers and modernization of Soviet helicopter forces enable combat helicopters to play a greater role in the support of ground forces. This frees fixed-wing aircraft for more extensive use against other targets in the theater of operations. Soviet helicopter units are located at two levels of organization in the armed forces. The highest and most centralized are the helicopter regiments of the tactical air army. The second level is the divisional helicopter squadron.

a. Army-Level Helicopter Forces. The helicopter regiment incorporates the squadron as its basic combat
unit. Figure 4-2 shows the organization of the Threat attack helicopter regiment. Within the combined arms and tank armies, the regiment includes 20 Hip and 40 Hind helicopters and a general purpose helicopter squadron equipped with 20 helicopters. Each squadron is organized into flights of three to four aircraft each, depending on the mission and forces available.

Figure 4-2. Threat attack helicopter regiment

b. Division-Level Helicopter Forces. These forces include the divisional helicopter squadron, which is
shown in Figure 4-3. A helicopter squadron normally consists of six Mi-2 Hoplite, six Mi-8 Hip, and six Mi-24 Hind helicopters. However, in some squadrons, the number of Hind aircraft has been increased. As the Mi-28 Havoc is fielded, it will probably replace some of the Hind aircraft within the squadron. The Soviet Army recognizes the need for flexible and responsive attack helicopter firepower and incorporates this at division level. Each helicopter squadron has its own command and support elements.

Figure 4-3. Divisional helicopter squadron

4-4. MISSIONS

Soviet helicopters may be used in both ATA combat and in traditional ground support roles. Combat helicopters will attack aerial targets in cooperation with ground forces or with other helicopters. Combat helicopters can destroy similar enemy helicopters. They can operate from ambushes by waiting under cover for an enemy air raid and then taking off and launching ATGMs or ATA missiles. Ambush tactics will be used often in a defensive battle, but offensive operations will call for bolder action.

a. Air-to-Air Combat. The Soviets will conduct helicopter ATA engagements while their attack helicopters are conducting ground attack missions. Soviet armed helicopters engage in ATA combat to provide security for heliborne assaults and ground units on the move. Army aircrews must be prepared for ATA combat that may ensue from either offensive or defensive operations. FM 1 107 contains detailed information about the tactics used by Soviet helicopters during these operations.

b. Air Support Roles. Threat helicopter units are assigned four primary missions. They are close air support, air assault force security, anti-helicopter operations, and antiarmor operations in support of the Front and army air defense plan. Soviet attack helicopter tactics rely heavily upon the wingman concept. In this concept, aircraft operate in pairs to facilitate command and control and mutual support. Whatever the leader does, the others follow. This style of command and control is rigidly adhered to in all phases of attack helicopter operations.

(1) Close air support. The Soviets consider fire support (artillery and air) the most decisive element in modern combat. Close air support for ground forces is the most common mission. Hip and Hind helicopters can deliver a heavy volume of fire on ground targets while maintaining standoff distances from some air defense weapons. Flights of four Hip or Hind aircraft will normally attack ground targets. The high speeds of these aircraft allow them to achieve surprise and reduce exposure time during CAS operations.

(2) Air assault security. Soviet doctrine calls for heliborne units to insert assault forces by day or night in positions as far as 50 kilometers beyond the line of contact. The force usually will be no larger than battalion size, and its objective will be within the range of artillery. The force may employ the assets of an entire transport helicopter regiment. The specific number of armed helicopters employed will be directly related to the size of the air assault force. Soviet heliborne forces are particularly vulnerable to attack during the landing phase. Therefore, attack helicopters will be crucial to the success of assault operations.

(3) Antihelicopter and antiarmor operations. Soviet commanders employ special engagement techniques to increase their air defense flexibility when assault forces operate beyond the range of air defense systems. These techniques include the use of air defense ambushes and roving air defense elements. Air defense elements are strategically sited to cover gaps in air defenses and to provide coverage on less likely approach routes for enemy aircraft. They deceive the enemy as to the disposition, number, and location of other air defense elements. The Soviets will also rely on the armament capability of their attack helicopters to engage enemy attack helicopters. Engagements between helicopters are expected to be rare because of Soviet emphasis on the CAS mission for helicopters. The Soviets have adopted tactics and techniques that may use pairs, flights, and even helicopter units for combat. Single helicopter combat cannot be ruled out but is unlikely.

4-5. WEAPON SYSTEMS

a. The Soviet approach to weapons development is to improve already proven systems. For example, air data-sensing devices and the twin 30-millimeter guns on the Mi-24 Hind appear to be similar to those on Soviet ground vehicles. Weapon pylons on the Hind are also identical to those on Soviet fighter aircraft. These pylons are routinely mounted with short-range infrared missiles. The Mi-8 Hip and Mi-24 Hind have the same type of missile-launch rails for AT-2, AT-3, or AT-6 antiarmor missiles. These rails probably can carry ATA missiles, which are short range and infrared guided. Likewise, the Hind probably has a simple lead-computing sight that can be used for short-range ATA combat.

b. Existing Hip and Hind helicopters have been upgraded with a variety of new gun, rocket, and aerial mine armament options. Also, all attack and armed transport helicopters that will operate near the front lines have active and passive self-protection jammers and flares. Some helicopters have been fitted with add-on armor plates to protect flight crews or vital components and with engine exhaust suppressors to counter heat-seeking surface-to-air missiles.

4-6. INDIVIDUAL AIRCRAFT CHARACTERISTICS

a. Mi-8 Hip. The Mi-8 Hip is a medium-transport and assault helicopter. It may be fitted with optional twin racks outboard of the fuel tanks on each side of the fuselage to carry a variety of external weapon systems. The Mi-8 C is the standard model. Variant models include the D, E, F, G, J, K, and T. All models can be configured for various support missions. Mi-8 missions include standard gunship, airborne command post, electronic countermeasures, and radio jamming. Figure 4-4 shows the Mi-8 Hip.

Figure 4-4.Mi-8 Hip

(1) Employment. The Hip C is found in division-level helicopter squadrons and in the Hip squadron of some army-level attack helicopter regiments. It is also found in the medium-lift squadrons of Front-level transport helicopter regiments. The Hip C and the Hip E are found in army-level attack helicopter regiments.

(2) Capabilities. The Mi-8 Hip is configured with a 12.7-millimeter machine gun in the right clamshell door in the rear or swivel-mounted in the nose. Each window in the transport section has a support bracket to allow infantrymen to fire their assault rifles or light machine guns at ground targets. The aircraft may be configured for minelaying and electronic intelligence collection roles. The standard gunship version, the Hip E, has six 32-shot, 57-millimeter rocket pods, bombs similar to those of the Hind, and racks for four radio-guided AT-2c Swatter C ATGMs. ATGM armament on the Hip F consists of six wire-guided AT-3 Saggers. Airborne command post, electronic countermeasures, and radio-jamming versions can be identified from antenna, electronic, and radar packages visible along the fuselage. FM 100-2-3 provides a detailed description of the capabilities and employment of all the Hip variants.

(3) Limitations. The internal cargo capacity of the Hip C is generally limited because of power limitations. The Hip C does not have the ATGM-carrying capability of the Hip E or F.

b. Mi-17 Hip H. The Hip H is an improved version of the Mi-8T. The Hip H is very similar in appearance to previous Mi-8s. However, its tail rotor has been moved from the right to the left side of the vertical stabilizer. The Hip H has particle separators and infrared suppressors and may be configured with strap-on infrared decoy flare dispensers. Figure 4-5 shows the Mi-17 Hip H.

Figure 4-5. Mi-17 Hip H

(1) Employment. The Hip H is found in army-level attack helicopter regiments and in the medium-lift squadron of Front-level transport helicopter regiments.

(2) Capabilities. The Hip H can perform a variety of military missions, including assault transport, cargo

transport, and air evacuation. Assault versions have been observed with 23-millimeter machine gun pods and 32-shot, 57-millimeter rocket pods at the inner pylon position. (The machine gun is mounted on the tail.) The lift capabilities of the Hip H are similar to those of the Mi-8.

However, the Hip H has a greater speed and range than the Mi-8.

(3) Limitations. The Hip H has not been observed carrying ATGMs. It probably will not be used as an antitank platform.

c. Mi-24 Hind. This attack helicopter is configured in three versions: D, E, and F. All versions have the same basic design except for modifications to the weapon and armament systems. Stub wings for carrying armament are common to all versions. Each stub wing has two universal pylons and a wingtip pylon designed for mounting ATGMs. Figure 4-6 shows the three versions of the Mi 24 Hind.

Figure 4-6. Mi-24 Hind

(1) Employment. The Hind is found in division-level helicopter squadrons and in army-level attack helicopter regiments. Hinds are generally employed in pairs or multiple pairs. Attacks are coordinated, frequently come from different directions, and are simultaneous or staggered. Contour and low level are the normal flight modes.

(2) Capabilities. The Hind is designed to provide primary CAS for Soviet ground forces, to include antitank missions. Hinds can escort troop carrying Mi-8s or Mi-17s during assault operations. Hinds will probably use onboard weapon systems, especially high-caliber machine guns or cannons and ATGMs, to engage enemy helicopters and CAS aircraft.

(a) Hind D. The Hind D has a four-barrel, turret-mounted, 12.7-millimeter machine gun under the nose. The four universal pylons normally mount four 32-shot, 57-millimeter rocket pods. Alternate pylon armament includes two 20-shot, 80-millimeter rocket pods with air-to-surface rockets or four 250-kilogram bombs or two 500-kilogram bombs that may be chemical or conventional. Launch rails are mounted on the two wingtip pylons for carrying a total of four AT-2c Swatter C ATGMs.

(b) Hind E. The Hind E has the same armament as the Hind D. However, the rail-launched AT-2c Swatter C ATGMs are replaced by distinctive I-shaped launch platforms with AT-6 Spiral ATGMs mounted on each wingtip.

(c) Hind F. The Hind F has a fixed 30-millimeter, twin-gun pod mounted on the right side of the fuselage that replaces the chin turret mounted 12.7-millimeter machine gun. The Hind E and F may carry a second AT-6 launch platform on the outboard universal pylon. This platform can carry up to 8 AT-6 Spirals. With "stacked" launch platforms on the wingtip pylon and the outboard universal pylon, the Hind F can carry up to 16 AT-6 Spirals.

(3) Limitations. The large size, distinctive profile, and operating altitudes of the Hind make it vulnerable to visual detection. Aircraft design and flight characteristics limit the Hind's ability to maneuver at low speeds or while at a hover. When firing ATGMs, the Hind must remain in the zone of antiaircraft fire long enough to guide the missile to its target. Exposure time depends on the type of ATGM being fired. This time can last up to 11 seconds for the Spiral or 23 seconds for the Swatter. Because of its wide turning radius at higher airspeeds, the Hind is ill-suited for ATA combat.

d. Mi-28 Havoc. The Mi-28 is similar in appearance to the AH-64 Apache. Armament includes a

30-millimeter cannon in a chin turret and wing stores for mounting rocket pods, ATGMs, and/or modified SAMs. The Mi-28 may be fitted with infrared suppressors, infrared decoy flare dispensers, and additional armor. Figure 4-7 shows the Mi-28 Havoc.

Figure 4-7. Mi-28 Havoc

(1) Employment. The Havoc is expected to be a ground attack partner and eventual successor to the Hind. It will probably be assigned to the Hind squadron of the attack helicopter regiment. Its primary targets will be tanks and antitank helicopters. The Havoc can probably engage targets from NOE and OGE altitudes. Mi-28s will probably provide flank security for offensive ground operations. The Havoc's standoff antitank or ATA missile capability will increase its potential to perform a variety of battlefield engagements.

(2) Capabilities. The Mi-28 is designed as a ground attack helicopter. It probably will be used primarily in an antitank role. Compared to the Hind, the Havoc has improved acceleration, low-altitude maneuverability, and low-speed flight characteristics. Its maneuverability, slim profile, and alternative ATA armament also enable it to engage antitank helicopters. The Mi-28 has limited night and near all-weather capability.

(3) Limitations. Because the Mi-28 is a new aircraft, its limitations are unknown.

e. Hokum. The Hokum is a special-purpose helicopter. It features a distinctive coaxial rotor system and a streamlined fuselage with a tapered nose that resembles a jet aircraft. The Hokum has a lightweight performance design and no observable ATGM hardware. Figure 4-8 shows the Hokum.

(1) Employment. The Hokum is thought to be designed primarily for the ATA role. Its primary targets will probably be CAS aircraft, to include antitank helicopters.

Figure 4-8. Hokum

(2) Capabilities. The Hokum will likely employ ATA missiles and a rapid-fire cannon. It probably has night and all-weather capability as a low-level, tactical counterair system. Design characteristics indicate the capability for high speed and good maneuverability.

(3) Limitations. Because the Hokum is a new aircraft, its limitations are unknown.

Section III

HIGH-PERFORMANCE AIRCRAFT

4-7. GROUND ATTACK CAPABILITY

a. The air forces of the Front have expanded their ground attack capability. For example, the number of fighter-bombers has increased from 2,100 in 1981 to 2,900 in 1989--an increase of 38 percent. This trend forcefully underscores the key role that Soviet military planners give to air power to ensure the success of their offensive operations.

b. Some of the increase in ground attack capability has been developed at the expense of counterair fighters. The number of counterair fighters has declined from 2,100 in 1981 to 1,800 in 1989--a decrease

of more than 14 percent. Nevertheless, the Soviets have gained more in ground attack capability

than they have lost in fighter capability. Reconnaissance and electronic countermeasure assets have stabilized at around 700 aircraft--the same level as in 1981. The Soviet air forces of today are better postured and more able to conduct conventional air operations than ever before. Figure 4-9 shows the current
inventory of Soviet air defense and ATA fighters, and Figure 4-10 shows some of the characteristics of fighter-bombers.

Figure 4-9. Soviet air defense and ATA fighters

Figure 4-10. Characteristics of fighter-bombers

4-8. SUPPORT OPERATIONS

The Soviets integrate the fires of artillery, attack helicopters, and operational and tactical missiles to create corridors through an enemy's forward air defenses. An air support operation is simultaneously initiated to establish air superiority over an enemy. The air support operation is unlike a general offensive in that the strikes are not in direct support of a coincident advance by ground maneuver formations. As the number of priority targets is reduced during the operation, ground attack aircraft are reassigned to the air support role according to a prearranged plan. Ground force commanders receive available air support resources according to this plan.

4-9. ENGAGEMENT METHODS

United States doctrine once considered Soviet high-performance fighters a rare threat to low-flying Army helicopters. This belief was based on the limited maneuverability of Threat fighter aircraft and their inability to detect and track enemy aircraft operating at terrain flight altitudes. However, new fighter aircraft designs feature high maneuverability and improved detection equipment. Three new fighters--the Su-27 Flanker, the MiG-29 Fulcrum, and the MiG-31 Foxhound--have look down/shoot-down capability. These aircraft can detect and track low-flying helicopters and CAS aircraft. Once fighter pilots acquire low-flying targets and decide to attack, they must determine the best method of engagement. Threat armed helicopters and fighters may attack with strafing, rockets, missiles, or bombs. FM 1-107 describes the methods of employment used by Threat aircraft.

Section IV

SURVIVABILITY AND COUNTERMEASURES

4-10. PREMISSION PLANNING

Thorough premission planning will help aircrews avoid detection by Threat aircraft. One important aspect of premission planning is to obtain all available information on the locations of enemy activity and the locations of friendly air defense elements. Aircrews must know the procedural control measures and IFF procedures that friendly air defense elements use as key engagement criteria. Procedural control measures are used to identify friendly aircraft should onboard IFF or communications equipment fail during the mission. Friendly air defense fires can be just as deadly as enemy fires. Therefore, aircrews must learn and practice detection and avoidance procedures and adhere to them. (Chapter 8 discusses premission planning considerations.)

4-11. AIRCRAFT SURVIVABILITY EQUIPMENT

a. Aircrews must use onboard ASE systems to the maximum extent during the mission. These systems must be operational before the mission. Also, they must be placed into operation in time to be used before aircraft enter the effective range of Threat weapons. Aircrews must know the capabilities and limitations of Threat weapon systems that will oppose them during aviation operations. Equally important, aircrews must understand the specific capabilities and operational characteristics of onboard active ASE systems. (Chapter 1 describes aircraft survivability equipment.)

b. Aircrews should use active ASE systems only when needed. This will prevent detectable emissions from being transmitted sooner than necessary. Early detection by surveillance equipment can forewarn Threat air defense or aviation elements of the aircraft's location or predicted movement. A good rule to follow is, "Do not use active ASE before you need it; when it is no longer required, turn it off or place it in the STBY position." The applicable ASET lesson contains specific details about the operation of ASE systems.

4-12. HELICOPTER COUNTERMEASURES AND DETECTION TECHNIQUES

The Soviets are aware of the threat that US attack helicopters and air assault forces pose to their armored and maneuver formations. The maneuverability and firepower of Soviet armed helicopters are primary threats to US Army helicopter operations. In addition to using USAF and air defense weapon systems, attack helicopter crews must be prepared to employ al available onboard weapon systems in their own defense against Soviet attack helicopters.

a. Countermeasures.

(1) Active. When aviators encounter Threat helicopters on the battlefield, they should consider suppression by fire as a self-defense measure or as a means of protecting combined arms assets. The attack of Threat helicopters by Army attack helicopters is not currently considered a primary mission of Army aviation. However, Army aviation strategy and tactics are in the process of change. Planned ATA combat roles are under consideration and being tested, and air ambushes and ATA attacks using missile systems are considered inevitable. The Soviets are arming some attack helicopters with ATA missiles. Therefore, Army aircrews can expect ATA missile attacks throughout the battlefield. The development of improved weapons on US attack and scout helicopters will give Army aircrews the opportunity to defeat this threat.

(a) Suppression by preplanned and immediate artillery. The ability of helicopters to operate under the air defense envelope may make suppression by artillery and air defense impractical or unfeasible. However, both artillery and air defense can be effective if combined with the element of surprise. For instance, Threat attack helicopters, lying in ambush in static NOE firing positions, can be extremely vulnerable to preplanned or immediate artillery suppression.

(b) Suppression by small arms fire. Threat helicopters attacking Army aircraft may be lured into friendly air defense envelopes for suppression. Locations and engagement sectors of friendly air defense and Stinger missile teams can be ascertained through coordination with the S3 or G3 of the supported combined arms maneuver unit. This should be part of good premission planning. Threat helicopters may

be lured into position for suppression by maneuver unit small arms fire. Friendly tactical air suppression may be requested through supported maneuver unit S3 (Air) channels. The availability of suppression and urgency of the mission will determine the means of suppression used against the threat.

(2) Passive. Passive countermeasures employed against helicopters will be much the same as those employed against ground maneuver units. Passive countermeasures include-

Minimizing exposure time by using terrain to mask the aircraft.

Using terrain flight techniques to avoid detection and gain surprise.

Using teamwork to observe, fire, and maneuver against Threat helicopters.

Dividing aircrew attention between ground and air sectors to detect a helicopter threat as soon as possible.

Employing fire and maneuver using pop-up firing techniques and preselected multiple firing points during engagements.

b. Detection Techniques.

(1) The techniques for detecting Threat fighters also work for detecting Threat helicopters. In fact, helicopters may be easier to detect because of the airspeed and altitude at which they normally operate. If the Threat continues to use present tactics and flies at 100 to 200 feet AGL, aircrews should be able to acquire the aircraft at 3 to 4 kilometers. A Threat helicopter traveling at 150 knots will cover 1 kilometer in about 12 seconds. At this rate of closure, if early detection has occurred, the Threat helicopter will be within its effective weapons range within 30 seconds. Should the Soviets change their tactics and begin operating at terrain flight altitudes, their helicopters will be harder to detect because of terrain masking.

(2) To detect the enemy first, aviation units must conduct systematic visual observation. Aircrews must be skilled in visual search techniques, object recognition, and navigation. FM 1-116 describes observation principles and techniques in detail. The observation pattern of the individual aircrews must complement the unit's overall security plan. Observation techniques are briefly discussed below.

(a) Pilots in command should assign each crew member an observation sector to ensure that assigned sectors overlap.

(b) Aircrews should use an effective scan rate consistent with such factors as atmospheric conditions, aspect, background, and movement.

(c) Several sets of eyes should scan the same sector or overlapping sectors. This will increase the chance for a timely attack warning.

(d) When scout and attack helicopters operate in teams, the leader or designated scout performs observation and security tasks during engagements.

(3) Aircrews must use visual clues that enhance their ability to detect Threat helicopters first.

These clues will enable aircrews to achieve security and to capitalize on the elements of concealment or, when appropriate, to achieve surprise. Detection clues include glint, shadows, shape, smoke, light, and movement.

4-13. FIGHTER COUNTERMEASURES

Threat tactical doctrine does not stress high-performance aircraft operations below 150 meters (about 500 feet AGL). This is mainly because the maneuverability and effectiveness of tactical aircraft increase with the altitude. Threat tactical aircraft flying at low altitude are extremely vulnerable to suppression. The best supportive countermeasure against high-performance aircraft is opposing high-performance aircraft.

a. Active Countermeasures.

(1) Tactical air support.

(a)Preplanned. For combined arms and air assault operations, friendly tactical air support usually will be planned by the task force commander through organic G3 or S3 (Air) channels. Plans will be coordinated with the tactical air control party located at the respective maneuver headquarters. The USAF provides the tactical air control party at brigade and battalion levels for planning, advisory, and control purposes.

(b) Immediate. In addition to planned tactical air support, the tactical air control party is responsible to the task force commander for immediate tactical air support. For immediate tactical air support during combined arms operations, the requestor must contact the supported maneuver battalion or brigade S3 (Air). The request for tactical air support includes target description and situation, target location, desired results, and latest allowable time for the tactical air strike.

(2) Suppression. Suppression can be provided by small arms and air defense weapons organic or assigned to ground maneuver forces. An attacking Threat high-performance aircraft may be lured into friendly Hawk, Chaparral, or Vulcan coverage zones. Assistance from these units must be preplanned. In addition to small arms, the infantry, armor, and artillery battalions and cavalry squadrons have Stinger missile teams organic to each line company, battery, or troop.

(3) Air self-defense.

(a) Aviation unit assets in static positions are extremely vulnerable to Threat tactical aircraft. Therefore, organic small arms and, when available, Stinger missile assets must be integrated into the area defense. When located near corps, division, and brigade command posts, air defense units may protect aviation assets to some extent.

(b) The G3 or S3 should check the air defense coverage plan for the area. When possible, FARPs should be located so that maneuver unit air defense assets provide some measure of coverage. When this is not possible, the commander can request Stinger teams through the G3 or S3.

(c) When conducting isolated missions, such as reconnaissance and surveillance, aviators may have to rely solely on organic onboard weaponry for the immediate suppression of the tactical air threat. However, aviators should only use these measures when evasive and passive countermeasures have failed.

b. Passive Countermeasures.

(1) Terrain flight techniques. Terrain flight techniques can exploit the weaknesses in design

and flight characteristics of Threat high performance aircraft. Cockpit visual limitations of Threat aircraft restrict the pilot's ability to visually acquire aircraft that are camouflaged or operating at terrain flight altitudes. Ground clutter at NOE altitudes helps deny Threat acquisition by radar and infrared systems. Threat onboard systems are designed primarily for long-range, high-altitude target acquisition and interdiction. The faster the speed and the lower the altitude of Threat tactical aircraft, the lesser the chance of visual

acquisition. Figure 4-11 shows the visibility limitations of Threat high-performance aircraft.

Figure 4-11. Visibility limitations

(2) Visual and electronic detection avoidance techniques. Army aircrews must know how to avoid visual and electronic detection. They must plan and practice detection avoidance techniques during training until they become second nature. TC 1-201 contains specific information about detection avoidance techniques. To avoid detection, aviators should-

Alter heading and plan flight routes to use cover and concealment.

Vary airspeed based on mission requirements, especially when operating in contour and low-level flight modes.

Select an altitude that prevents aircraft silhouetting and, when possible, fly along the reverse slope.

Avoid abrupt maneuvers such as sharp turns, rapid masking and unmasking, and quick decelerations.

Reduce shadows by keeping low and, when possible, by positioning the aircraft to reduce the size of shadows.

Use camouflage and low-reflective paint schemes to degrade the Threat's infrared and visual acquisition capability.

Use free cruise formations. (Tight geometric formations prohibit effective evasive maneuvers and can enable an enemy to hit a greater number of aircraft in one pass.)

(3) Engagement avoidance considerations. Aircraft operating at altitude must be prepared to avoid engagement by Threat fighters. Air traffic services will warn of approaching hostile aircraft when possible. Normally, the warning includes the number, location, altitude, direction, and possibly the type of aircraft. After receiving a warning, the aviator must immediately put as much distance as possible between his aircraft and the Threat aircraft. If the Threat aircraft is close by, the aviator may have to descend to NOE altitude. If the Threat aircraft is 50 miles away and headed straight to the rear, the Threat pilot may be preoccupied with US air defenses. If the Threat aircraft is only a couple of miles away, the aviator must descend quickly, stay low, and fly in valleys and between ridges using terrain flight techniques. At all times, the aviator should keep air traffic services informed about what he is doing.

(a) Approved maneuvers. Aviators should not conduct maneuvers that could be mistaken as hostile actions over friendly tactical units. Although Stinger gunners have IFF radar capability, aircraft IF equipment must be operating properly so gunners can distinguish friendly from enemy aircraft. Aviators must ensure that maneuvering airspeeds, altitudes, and locations coincide with the

IFF criteria that have been established with air defense elements and air traffic services. Unauthorized deviations from approved A2C2 procedures could result in identification as an enemy aircraft.

(b) Approved procedures. A Threat aircraft may not be detected early enough for the aviator to be warned. When the threat display warns the aviator that he has been picked up by Threat radar, he must act immediately. The aviator must dive away from the Threat aircraft and descend quickly to terrain flight altitude. The aviator must know where friendly air defense elements are located. Once NOE, the aviator flies toward air defense engagement sectors with his IFF equipment on. On the way down, the copilot or sensor operator should try to visually acquire the Threat aircraft and notify air defense units in the area.

(4) Concealed approach and takeoff procedures. Special CATO procedures have been established to avoid the disclosure of airstrips and landing sites in corps and division areas. Disclosure could result from Threat visual or radar observation either from the ground or the air. All aviators must use terrain flight techniques in areas close to the FLOT. If the aviator is not familiar with the AS or LS, he should conduct a map reconnaissance of the surrounding area before planning CATO procedures. When possible, the aviator should obtain a briefing on the AS or LS and its approach or departure routes. The flight route is determined by the location of natural features and vegetation that will provide masking and line features and pinpoint navigation landmarks. Altitudes and airspeeds depend on meteorological conditions (visibility and cloud base) and the ability of Threat forces to acquire and engage the aircraft. The flight pattern is decided by the procedures used for the control of landings and takeoffs. The pattern must avoid maneuvers that might suggest to the Threat that a landing or a takeoff is occurring. (These include circuits, turns, and obvious descents and climbs or lengthy maneuvering.) If the aviator believes the aircraft is under observation from the air, he must not land until he has been cleared to do so. The aviator should avoid descent areas in known locations of friendly troops. The CATO procedure to be employed and the route to be followed will depend on the aviator's familiarity with the terrain features near the airstrip or landing site.

(a) Sector approach procedure (rotary wing). In the sector approach, the aviator descends in an area some distance from the AS or LS and, when cleared to do so, executes the approach using terrain flight techniques. For simplicity, sectors and holding areas roughly align with compass quadrants and cardinal points respectively, consistent with the threat, terrain, and friendly locations. When approaching the holding area (normally about 5 kilometers from the AS or LS), the aviator transmits the appropriate code word for the holding area. After ensuring that he is not being observed by Threat forces, the aviator descends to a height sufficient to maintain communications with the controlling agency of the AS or LS. However, the extremely low altitudes used by aircraft near the FLOT may make these communications impossible. Therefore, approaches must be made to the AS or LS at the appointed time. The aviator must coordinate this time with the controlling agency when he reports arrival at the holding area. When radio silence is imposed, approaches can be made at prearranged times for each sector. Figure 4-12 illustrates an example of a sector approach procedure.

Figure 4-12. Sector approach procedure

(b) Deception approach procedure (rotary wing). The deception approach procedure allows the aviator to examine and land at an AS or LS without indicating his position to the Threat. In this approach, the aviator continues the mission while observing the area and selecting a CATO route. The deception approach is used for an initial reconnaissance when aviators land at an unfamiliar established location without the benefit of a briefing. While operating within the Threat air defense envelope, the aviator may not be able to increase altitude to maintain communications with the AS or LS. The aviator begins the approach from an altitude and a location as determined by the enemy situation. He approaches the AS or LS from the downwind position (teardrop approach) at mission altitude. Figure 4-13 illustrates the teardrop procedure. The aviator plans the approach, winds permitting, to present the smallest possible aircraft cross section toward the threat. If the AS or LS is manned, the aviator should look for the air sentry, pathfinder, or tower and note any visual signals. After identifying any aircraft in the vicinity, aviators should-

Maintain a constant heading after passing the landing site and select a descent area that provides the best masking (at least 1,0 meters from the landing site) from the direction of the enemy.

Identify a route back to the landing site that provides the best reference points and the fewest obstructions.

Select a route that will permit flight at the safest height while the aircraft is masked from electronic and visual detection.

Begin the approach by descending to the desired height and turning onto the selected course.

Avoid a second pass; if unavoidable, reverse course and fly past the landing site from a distance that will allow them to observe the landing site and begin another approach.

Use easily recognizable descent areas that allow them to make a straight-in approach without maneuvering at higher altitudes near the landing site.

Figure 4-13. Teardrop approach

(c) Terrain flight approach procedure (rotary wing). In the terrain flight approach, the aviator maintains terrain flight altitude and airspeed until within 500 meters of the AS or LS. (The aviator may need visual aids, such as smoke or balloons, to guide him to the AS or LS.) The aviator adjusts airspeed until he sees the area or point of touchdown and then executes a straight-in approach. When using the straight-in approach to an unfamiliar AS or LS, the aviator must consider the risk involved in arriving at an AS or LS without prior notification. He must also consider that his sudden arrival may conflict with other traffic and startle friendly defenders.

(d) Terrain flight approach procedure (fixed wing). Fixed-wing aircraft may use either the figure-eight method or the low-circuit method to approach the AS or LS. The specific procedures and considerations to be used by these aircraft are contained in QSTAG 703. The establishment of Army fixed-wing airfields depends entirely on METT-T. About three airfields or austere landing sites will probably be available within the corps for use by USAF aircraft, MI(AE) brigade aircraft, and command aviation aircraft. The establishment of airfields for fixed-wing aircraft within the division rear area will probably be temporary and austere in nature. The momentum and fluidity of the modern battlefield may preclude fixed or permanent landing sites for use by nontactical fixed-wing aircraft.

(e) After-landing concealment procedures. Aviators should take prompt action to conceal aircraft from aerial detection after landing. They should disperse the aircraft, position them close to the tree line, and camouflage them.

(f) Departure procedures. Aviators should depart airstrips or landing sites by following a route that is masked from Threat surveillance. When possible, they should follow a route different from the one they used for the approach. After departing the AS or LS, aviators should maintain terrain flight altitude. They should delay climbing to a higher altitude when going to the rear until they are at least 20 kilometers beyond the FLOT. (Aviators may use higher altitudes at less distance from the FLOT if terrain features will mask the aircraft from both visual and electronic detection.)

(g) Night landings and takeoffs. When night vision devices are being used and circumstances permit, aviators should use the procedures discussed above. Night flights conducted without night vision devices will require aviators to execute approaches and departures at higher altitudes. This will subject the aircraft to a higher probability of detection. Therefore, aviators should select final approach and takeoff

directions that will mask the aircraft from Threat surveillance. They should fly at the lowest altitude consistent with safety.

(5) Fighter detection techniques. Fighters usually fly in pairs or packs of four with one engaged element and one free element. Packs of four have two elements with two aircraft each. The free element usually directs the attack. However, the free element and the engaged element may alternate roles. Units and aircrews should not assume that a free element will not attack. Figure 4-14 illustrates tactical aircraft

roles and missions.

Figure 4-14. Tactical aircraft roles and missions

(a) Visibility. Fighters are difficult to see because of their high speed, and once visually acquired, they are not easy to keep in view. Fighters are also hard to detect because of the restricted visibility above and to the rear of most helicopters. Fighter pilots prefer to attack from the rear on the blind side, but they may attack from any aspect against a slow low-flying aircraft. Exhaust smoke and reflection from the canopy and skin of the fighter are often detected before the aircraft itself is seen. Friendly air defense fires may also indicate the presence of Threat aircraft.

(b) Aircraft survivability equipment. Radar warning receivers (AN/APR-39 series, AN/APR 44 series, and the AN/ALQ-162(V)2) can detect pulse and continuous-wave radars employed on Threat fighter aircraft for target acquisition. The AN/APR-39 series can provide directional information. (Chapter 1

briefly describes radar warning receivers.)

(c) Communication systems. Aircrews should monitor communication nets to learn about the location of Threat aircraft. Good information sources include air defense, early warning nets, field artillery, tactical air to ground, ground maneuver, and command nets.

(6) Defensive techniques. Upon sighting Threat high-performance aircraft, the aviator must

maneuver the aircraft to minimum altitude, blend into terrain features, and remain stationary. He maintains visual contact with the aircraft and reports the sighting to higher headquarters or air defense operations, if possible. Terrain permitting, the aviator masks the aircraft. If operating in platoon or larger flights, aircraft should disperse. Overwatch and lookout doctrine should be used to forewarn and protect.

(a) Once acquired by Threat high-performance aircraft, Army aircraft must be within the Threat aircraft's flight envelope to be engaged. Therefore, the aviator should try to outmaneuver the Threat aircraft. He must keep the attacking aircraft in sight while maneuvering on its blind side or out of the engagement envelope. Successful maneuvering against two Threat fighters may require maneuver instructions from other nearby friendly aircraft.

(b) After maneuvering to the Threat aircraft's blind side, the aviator should attempt to blend into the terrain, mask, and remain stationary to make reacquisition difficult. Threat tactical aircraft normally engage from a 5-degree to a 45-degree dive angle. Engagement could be by ATA missiles (infrared or radar guided), strafing, rockets, or bombs.

(c) Once Threat high-performance aircraft are committed to an attack angle, they are not able to maneuver quickly and still keep the target within the engagement envelope. This is because of their high speeds and flight characteristics. Therefore, the aviator should let the attacking aircraft commit itself to a dive angle. The aviator should then fly head-on to the attacking aircraft, causing it to increase its dive angle. Just before the Threat aircraft engages, the aviator should execute a sharp turn left or right. At the same time, he should try to keep the Threat aircraft in sight and maneuver to its blind side. Once in the Threat aircraft's blind side, the aviator should blend into the terrain, mask, and stay stationary. Figure 4-15 illustrates the evasive maneuver against an attacking fighter.

Figure 4-15. Evasive maneuver against missile, strafing, rocket, and bombing attack

(d) Once an aircraft is engaged by an ATA missile, survival will depend on the aviator's actions during the next few critical seconds. Without regard to ASE, the aviator must first get to NOE altitude as quickly as possible (if not already NOE). Ground clutter or a sharp turning maneuver (90 degrees or more to the missile's flight path) may cause the missile to break-lock. Figure 4-16 illustrates an ATA missile engagement.

Figure 4-16. ATA missile engagement

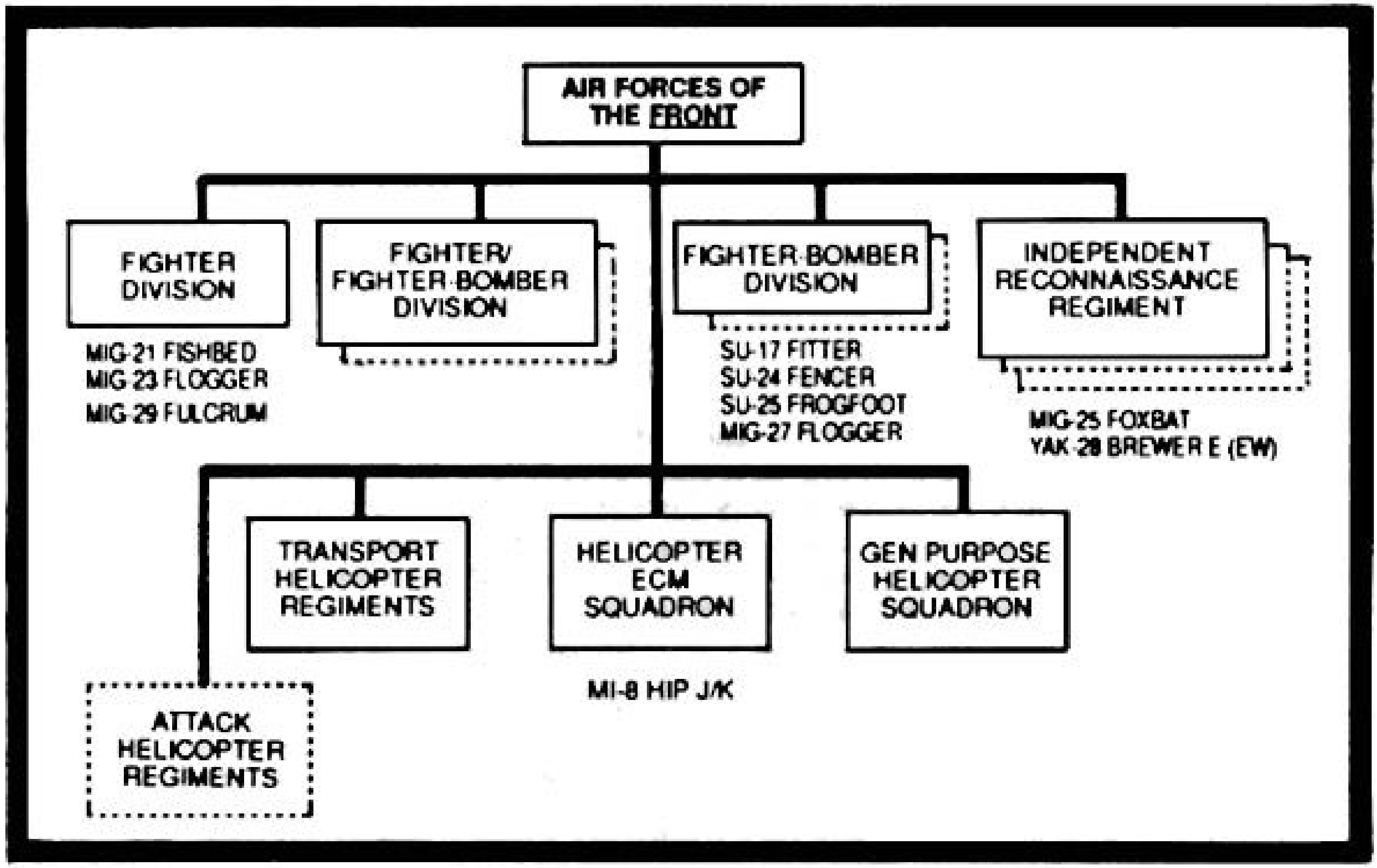

Figure 4-1. Air forces of the Front

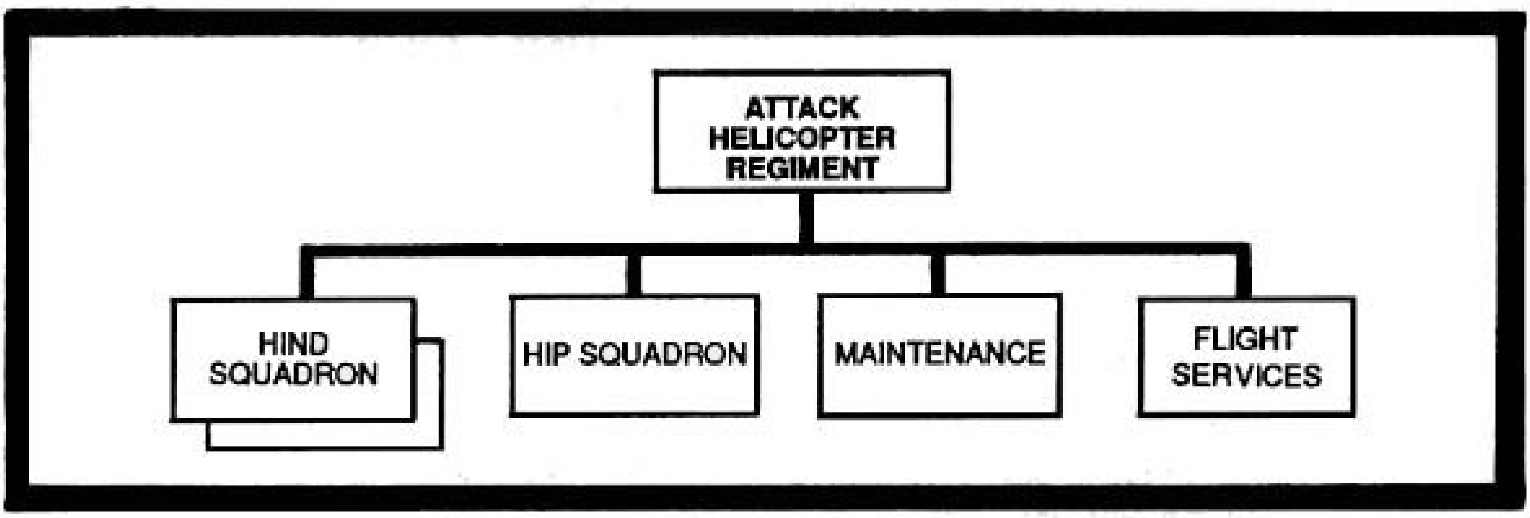

Figure 4-2. Threat attack helicopter regiment

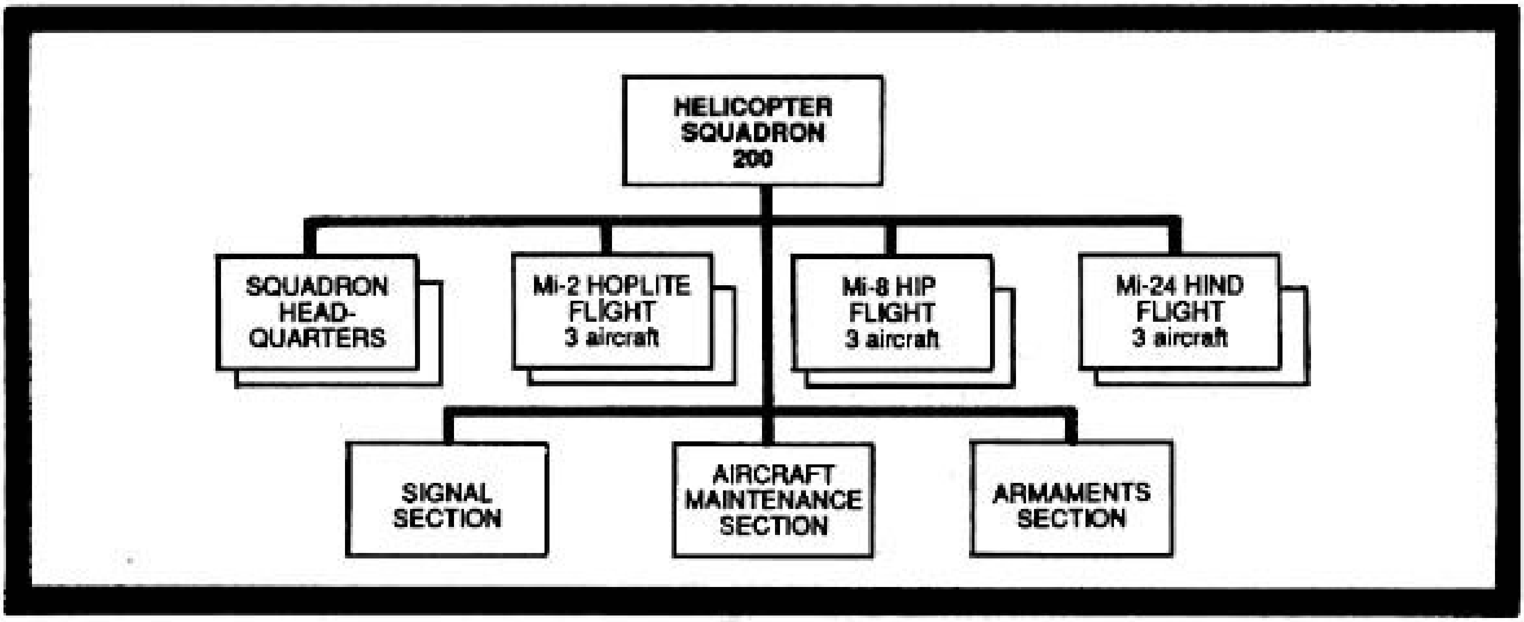

Figure 4-3. Divisional helicopter squadron

Figure 4-4. Mi-8 Hip

Figure 4-5. Mi-17 Hip H

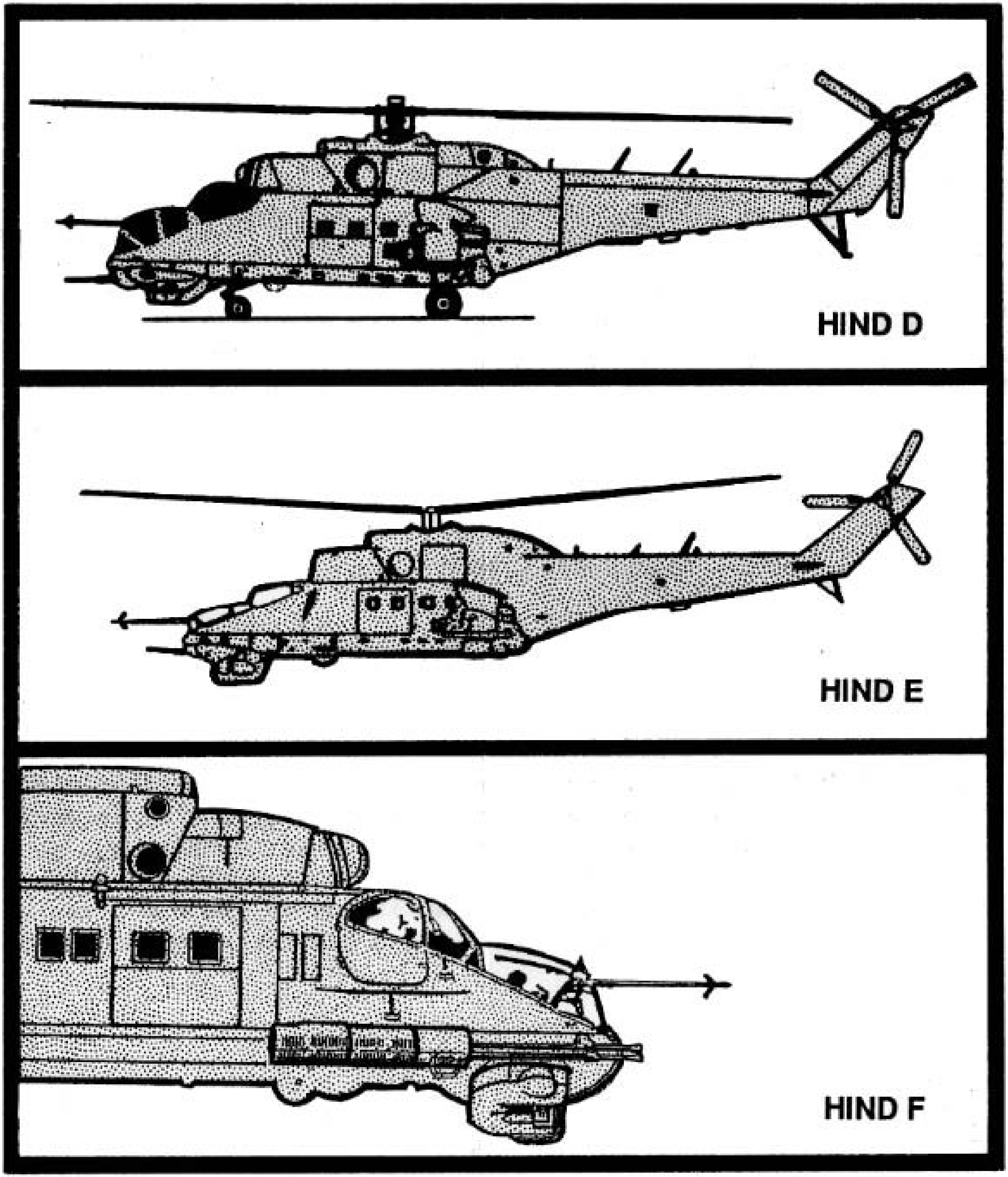

Figure 4-6. Mi-24 Hind

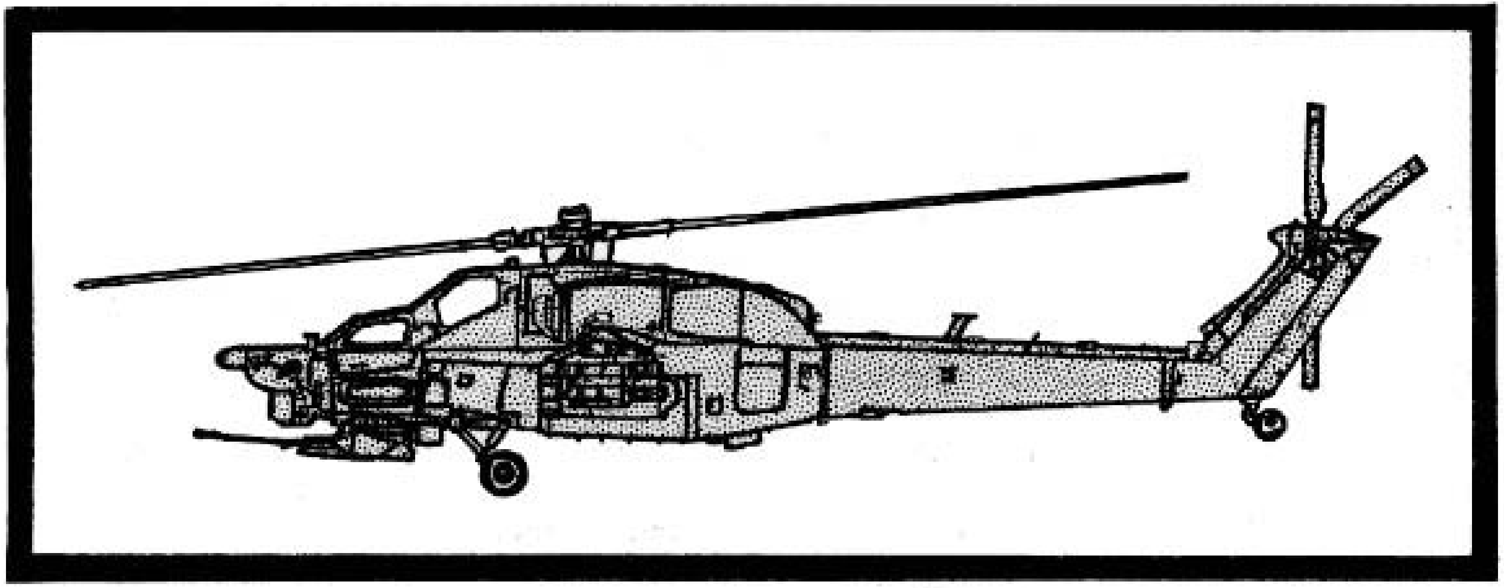

Figure 4-7. Mi-28 Havoc

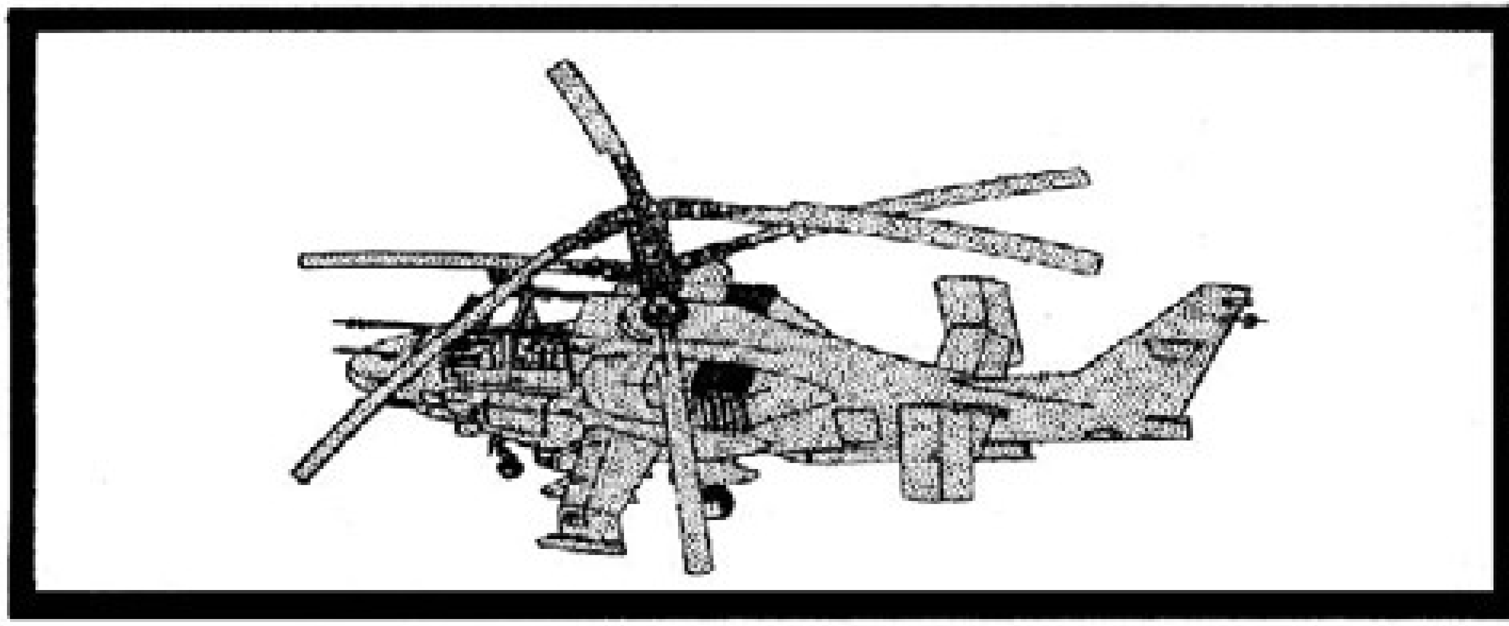

Figure 4-8. Hokum

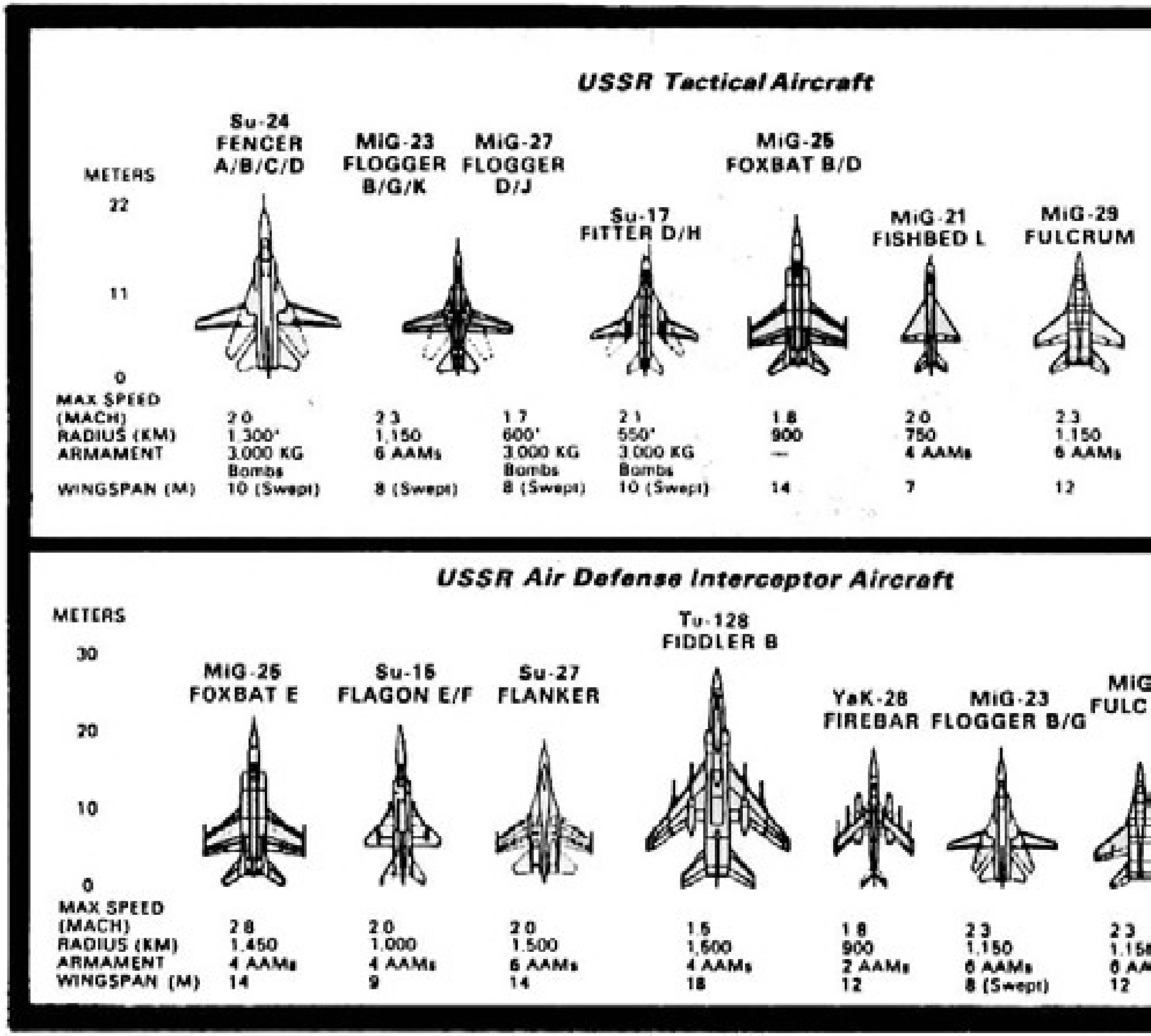

Figure 4-9. Soviet air defense and ATA fighters

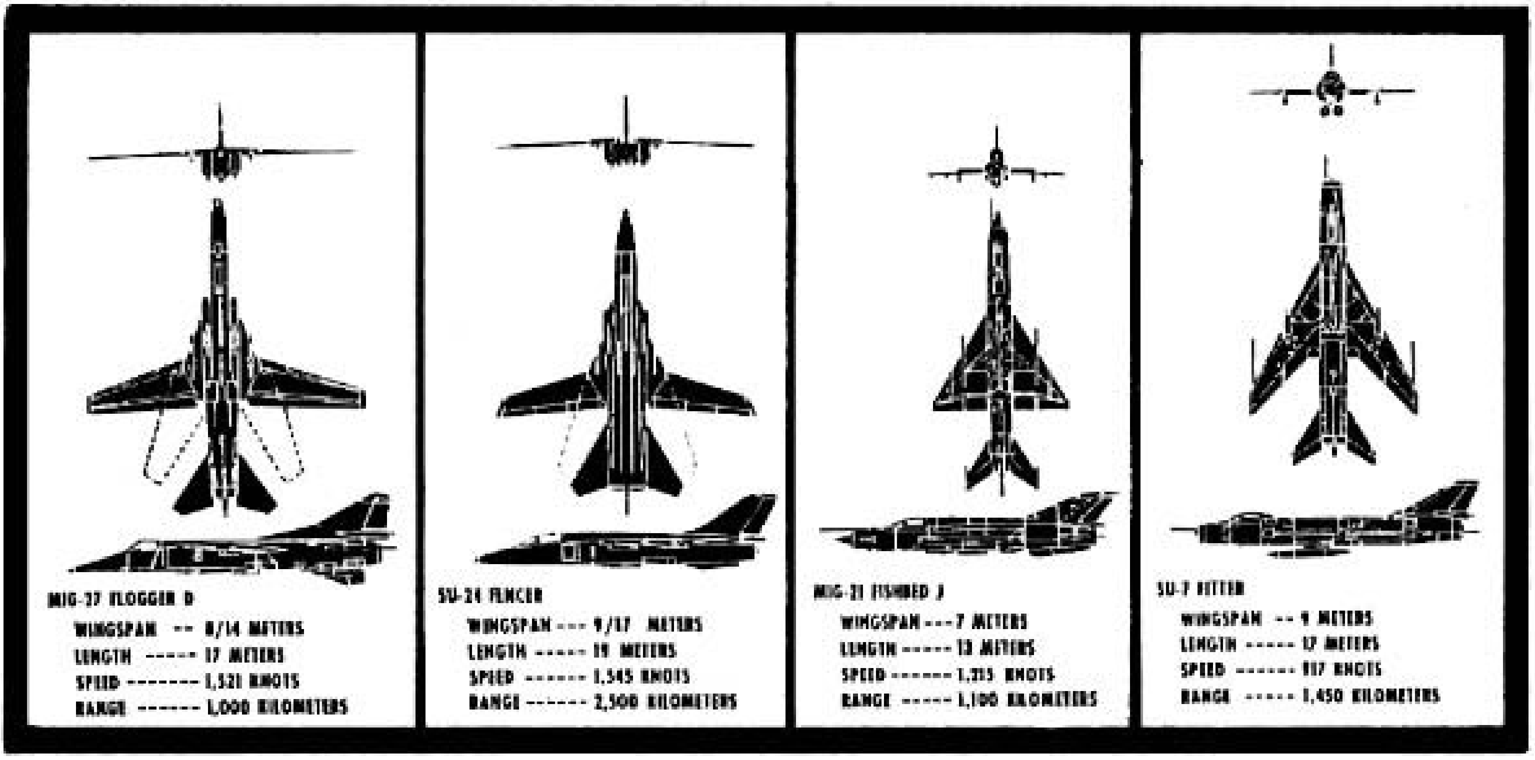

Figure 4-10. Characteristics of fighter-bombers

CHAPTER 8

PREMISSION PLANNING

Maneuver commanders can use the capabilities of Army aviation to perform missions that require a rapid response. Aviators will often receive new missions while they are in flight. Mission success may well depend on the individual aviator's ability to develop and execute plans in the shortest possible time. Familiarity with premission planning techniques, the area of operations, unit SOPs, and the current tactical situation can help compress both planning and reaction time. Aircrews must remain aware of and meet OPSEC requirements throughout all phases of premission planning.

8-1. EMPLOYMENT PRINCIPLES AND MISSION FACTORS

a. Employment Principles. Survival on the modern battlefield depends on the aircrew's ability to apply the principles of employment and use good judgment in implementing mission plans. The successful application of employment principles on the battlefield will depend to a great extent on how well the mission is planned. Each part of the combined arms team in the scheme of maneuver must work in harmony to achieve success. The principles of employment are-

Fight integrated on the combined arms team.

Exploit the capabilities of joint forces.
Capitalize on intelligence-gathering capabilities.
Suppress enemy weapons and acquisition means.
Exploit firepower.
Exploit mobility.
Integrate fire and maneuver.
Employ surprise.
Mass forces.
Use terrain for survivability.
Displace forward elements frequently.
Maintain flexibility.
Exercise staying power.

b. Mission Factors. To properly plan the mission, commanders must first consider the factors that will affect it. Unexpected factors will make each mission unique. Much of the unexpected, however, can be prepared for through training, coordination, planning, and the use of SOPs. Factors affecting the unit's ability to accomplish the mission include-

Thorough flight planning.
Training proficiency.
Proper aviation employment.
Weather and reduced visibility.
Time available.
Operational plan.
Friendly situation.
Enemy situation.
Equipment availability and condition.
Terrain analysis.
Proper briefings.
Aircrew coordination.
Combined arms support.
Command and control.
Fire support.
Smoke availability.

8-2. THOROUGH FLIGHT PLANNING

Mission planners must consider reconnaissance and other available information that will affect the mission. Aircrews must denote all mission requirements on the flight map that will enable them to perform the mission even if an unexpected situation should occur. This information includes normal tactical items such as routes, checkpoints, air control points, phase lines, unit boundaries, and pickup and landing zones. It also includes enemy and friendly positions, FARP locations, radio navigational aids, flight hazards, fire support preplans, and designated airspace areas. An example of an unexpected situation is a planned day mission that becomes a night mission. Other examples are adverse weather conditions and onboard equipment or systems failure. Aircrews can find detailed guidance on mission planning in TC 1-201.

8-3. TRAINING PROFICIENCY

Training proficiency will determine how well the aviator is able to apply the principles of employment, use onboard ASE, and work as a member of the combined arms team. The aviator's knowledge of the Threat (employment techniques, capabilities, and limitations) will determine whether he will succeed. The aviator must be able to react and use the right mix of onboard weapons and ASE systems at the right moment. The aviator also must be thoroughly familiar with coordinating agencies and procedures to obtain support when he needs it.

8-4. PROPER AVIATION EMPLOYMENT

To properly employ aviation assets, the combined arms commander must know the capabilities and limitations of Army aviation. When employing aviation assets, the commander considers mission effectiveness, command relationships, CS and CSS relationships, and aircraft availability. He also considers the weather, ATC requirements, logistics requirements, allowable cargo loads, fuel and ordnance mix, and aircraft vulnerabilities.

a. Mission Effectiveness. Mission effectiveness refers to the employment of aviation assets with the appropriate type of mission. For instance, using assault or attack helicopters to attack fortified or defensive areas is not mission-effective. On the other hand, the air cavalry troop of the divisional cavalry squadron is mission-effective in reconnaissance, intelligence-gathering, and security roles. The mission will determine the type and configuration of aviation assets that are most effective. Army aviation units have more influence on the course of the battle than other combat arms because they can perform all five functions of land combat with flexibility and speed. These functions are firepower, mobility, intelligence, command and control, and combat service support.

b. Command Relationships. The command relationship between the Army aviation unit and the ground force commander depends on friendly and enemy situations, logistical sustainability, and mission-critical support requirements. Aviation's extensive sustainment requirements for Class III(A) and Class V(A) and aviation-peculiar maintenance support requirements are primary considerations when command relationships are developed and assigned. Command relationships are established as assigned, attached, or operational control for each Army aviation unit. FM 1-100 contains the specific command, administrative, and support functions that are incurred with each of these relationships.

c. Combat Support and Combat Service Support Relationships. Support relationships are similar to command relationships in that they depend on friendly and enemy situations, logistical sustainability, and specific mission support requirements. Support relationships define the specific support responsibilities between the supporting aviation forces and the supported units. Direct support and general support are the only support relationships that apply to Army aviation CS and CSS operations. An Army aviation unit may be tasked to provide direct or general support to an entire force, a major subordinate maneuver force, a combat support element, or a major subordinate service support element. Aviation forces do not routinely provide direct or general support to maneuver, support, or service support elements of less than brigade size. The parent aviation headquarters, unless otherwise directed, retains overall command and logistical responsibilities. It also can task-organize aviation elements of the supporting force.

(1) Direct support. Direct support is used for flexible decentralized control of aviation forces or assets. An aviation element in a direct support role gives priority aviation support to a unit or force. A direct support mission is normally assigned an aviation force to support a specific major subordinate maneuver or support element.

(2) General support. An aviation element in the general support role provides aviation support to the force as a whole. General support is normally used when centralized control is practical or essential. It is also preferred when aviation elements must coordinate with and provide support to more than one of the force's major subordinate elements. FM 1-100 identifies the aviation requirements associated with direct and general support relationships.

d. Aircraft Availability. The number and type of available aircraft may affect the accomplishment of the mission or at least how the mission proceeds. If an aviation unit is assigned many tasks supporting another unit, the commander may have to establish priorities or request additional aviation support.

e. Weather. The commander must know how weather affects the capabilities and limitations of Army aviation units. New aircraft are giving Army aviation increased staying power and round-the-clock, all-weather capability. However, present capabilities may be affected by adverse weather. For multi-helicopter missions in adverse weather, time requirements may degrade mission effectiveness if slower flight modes are not considered during planning. Moreover, the use of attack helicopters in the armor-defeating role may not be mission-effective if decreased visibility degrades their standoff capability. Mission planners must study the total battlefield weather picture. A combination of altitude adjustment and route adjustment, to stay below or bypass low clouds, may be required to accomplish the mission.

f. A2C2 Requirements. Army aviation uses the airspace portion of the battlefield for maneuver. Aviation operations must be coordinated with other users of the same airspace. This coordination may be accomplished informally at the battalion or the brigade as part of the overall coordination of tactical operations. It also can be accomplished formally by dedicated A2C2 elements at division level or higher to avoid conflicts with other airspace users.

g. Air Traffic Control Requirements. The type of mission affects ATC requirements. Airspace control information should be disseminated to aviation units. Examples are air corridors, coordinating altitudes, restricted operations zones, minimum risk routes, air threat warnings, terminal control procedures, IFF codes, and available navigational aids. In some instances, tactical air control teams may assist in pathfinder operations and in the orderly conduct of the mission. FOCs or FCCs can assist in mission control by providing airspace control information updates and/or flight-following services. They can act as information and coordinating agencies by passing advisories and reports to higher headquarters. FOCs or FCCs can also disseminate advisories on hostile air traffic in the area. Air rescue assistance coordination may be effected through the FOC or

FCC.

h. Logistics Requirements. The commander must thoroughly coordinate the logistics requirements for Army aviation units. This aids in rapid turnaround times, on-the-spot maintenance, and timely aircraft recovery.

i. Allowable Cargo Loads. The type of aircraft, area of operations, and weather conditions will affect allowable cargo loads. Commanders must consider aircraft load capabilities and limitations to ensure a smooth, well-coordinated operation.

j. Fuel and Ordnance Mix. The same factors that affect allowable cargo loads can affect the fuel and ordnance mix capability of attack helicopters. The commander must be mindful of the fuel, time, and ordnance tradeoff required.

k. Aircraft Vulnerabilities. The commander must assess aircraft vulnerabilities. The type and amount of ASE onboard the aircraft may determine mission effectiveness. The size and shape of pickup or landing zones and their degree of security must be considered in relation to the size and number of aircraft. Terrain, vegetation, altitude, and temperature must be examined with regard to their influence on aircraft vulnerability. Aircraft are soft targets; therefore, they should be employed at standoff distances or with suppression against enemy ground units.

l. Medical Evacuation Requirements. The commander must assess the risks associated with the mission. Based on those risks, he may attach additional medical evacuation assets.

8-5. WEATHER AND REDUCED VISIBILITY

Adverse weather and reduced visibility can help or hinder Army aviation operations. The advantage in conducting combat operations in adverse weather or reduced visibility is the element of surprise. In addition, these conditions may hinder Threat high-performance aircraft operations, visual acquisition weapon systems, and infrared homing missiles. However, adverse weather and reduced visibility do not affect radar-guided weaponry. Aviation missions may be flown under four reduced visibility conditions. They are adverse weather, night and reduced visibility (smoke, haze, fog, rain, or snow), night tactical operations, or a combination (night and weather). Some methods that aviators can use in planning flights in adverse weather, at night, or in reduced visibility are discussed below.

a. Adverse Weather Considerations. If weather service is available, aviators should check the current and forecast weather conditions for takeoff, en route, and destination. If weather service is not available and the tactical situation permits, aviators may use radio reports from various unit locations along the planned route. Ceiling and visibility requirements are based on the urgency of the mission, nature of the threat, availability of navigational aids, type and number of aircraft, and proficiency of the pilot. In most cases, NOE flight is routine for helicopters operating near the FLOT.

(1) ATC/ATS support available. Aviators should check available ATC/ATS facilities, frequencies, and terminal control procedures. ATS platoons operating forward landing sites have GCA and NDB capabilities. Aviators must consider the enemy situation before selecting an emergency recovery site. The FCC may be helpful in providing en route flight-following and advisories, depending on the altitude and distance. The reliability of a tactical NDB signal for

navigational purposes also will depend on the altitude and distance. Forward airfields may activate NDBs on request.

(a) The ATS platoon supporting a division has tactical tower teams that extend the control and coordination of Army air traffic in forward battle areas. These teams provide advisory services and air traffic assistance at battalion and brigade command posts, heliports, resupply points, or temporary landing areas. When requested, through operations or the maneuver unit S3, the teams may be located in forward areas to provide navigational assistance (advisories or NDBs) for the mission. Aviators should check with operations or the maneuver unit S3 for tactical team locations and frequencies or request that the tactical teams be positioned to support the mission.

(b) The tactical air control team is equipped with the AN/TRN-30(V)1 NDB. The NDB is positioned to mask radiating signals toward the threat and to maximize usable signals toward the flight path. The normal power output for the NDB in forward areas will normally be in the pathfinder mode, which is below 500 feet AHO. To prevent enemy detection, the NDB may be available only on request. Table 8-1

shows the capabilities of the AN/TRN-30(V)1 NDB. The aviator should check the frequencies of nearby Hawk ADA units. When other navigational aids are unavailable, Hawk units may be able to provide radar vectors. However, ADA personnel are not trained in ATC procedures and cannot guarantee obstacle clearance or separation.

(2) Map preparation. Aviators should prepare the tactical map with time, distance, and heading information as a backup to navigational aids. An alternative is to use the map as the primary navigational source with navigational aids (as requested) for backup. This also reduces the possibility of enemy jamming and meaconing.

(3) Takeoff and approach planning. Aviators should plan the takeoff and approach according to terrain relief, elevation, and wind. The airfield ATS and tactical air control teams also can recommend the best approach path. Aviators should inform the FCC or FOC of the situation and the plan as soon as practical.

Table 8-1. AN/TRN-30(V)1 NDB

b. Night and Reduced Visibility Considerations. Planning considerations for night and reduced visibility can be just as demanding as those for marginal weather flight, depending on the ambient light level and visibility restrictions. For night operations, the effects of fog, haze, smoke, and overcast sky conditions limit the aviator's visibility even with the aid of night vision devices. Aviators should consider METT-T in planning their flights and ensure that visibility and basic flight safety requirements can be met. Then they should isolate the peculiar flight planning requirements outlined in TC 1-204.

(1) Map preparation. Aviators should prepare the tactical map with distance and heading tick marks and other information. For night flight, lines and information should be clean and uncluttered. For unaided night flight, colors should be used that can be seen with a red lens. Aviators should select air control points and Doppler navigation update points and use barrier landmarks on the map as backup orientation checks. During night and reduced visibility operations, prominent terrain features may not be visible. Other terrain features may appear different at night than during the day.

Aviators should conduct a thorough map reconnaissance of the flight path and mark natural and man-made obstacles.

(2) Communication requirements. Aviators should check unit locations at flight operations or maneuver unit operations and note call signs and frequencies. These frequencies may be needed for backup FM homing navigation. Aviators should also check the frequencies and navigational aids of ATS facilities in the area of operations. They should plan for positive identification procedures at destination landing sites or facilities.

8-6. TIME AVAILABLE

Each mission must be evaluated in terms of the required time to complete it. At NOE altitudes, fuel and power requirements to cover distances will be greater than at higher altitudes. If time requirements cannot be met for fuel, logistics support must be positioned to facilitate refueling. The threat or weather conditions may dictate time separation requirements for multihelicopter operations. This can influence whether enough troops and materiel can be massed at the right time to be effective. Fire support must also be obtained at the right time to support the mission.

8-7. OPERATIONAL PLAN

The supported commander may not be familiar with the capabilities and limitations of Army aviation. The aviation unit commander or staff officer must be prepared to advise the supported commander on how or if aviation assets can be used for a given operation. Ideally, the aviation unit commander or members of his staff provide direct input to development of the supported commander's operational plan. The supported commander can thereby become familiar with the aviation unit's capabilities and limitations. The aviation unit commander likewise becomes familiar with the supported commander's operational plan.

8-8. FRIENDLY SITUATION

The current friendly situation can be obtained from unit operations, the supported maneuver unit S2 or S3, or the division G2 or G3. When an aviation unit supports a maneuver unit, the maneuver unit commander or S3 briefs the air mission commander about the friendly situation. In planning the aviation mission in relation to the friendly situation, aviators must ask themselves, "Who, where, when, what, and how?"

8-9. ENEMY SITUATION

The enemy situation is an important consideration in premission planning. The nature of the threat will determine how the mission will be accomplished and the support needed. The enemy situation can be obtained from unit operations, the supported maneuver unit S2 or S3, or the division G2 or G3. The planner considers the basics of the enemy situation when planning maneuver, command and control, communication procedures, and needed equipment and armament. The basics are-

Current NBC capability and posture.

Tactical air capability and posture.
Tactical posture (defensive or offensive).
Electronic warfare capability and posture.
Strength, size, type, and locations of units.
Known or suspected air defense weapons (type and locations).

8-10. TERRAIN ANALYSIS

A good terrain analysis is necessary for a smooth, coordinated, and successful mission. If time and the enemy situation permit, the aviator should fly a reconnaissance mission. The reconnaissance will determine primary and alternate flight routes, hazards, flight techniques, checkpoints, start points, release points, air control points, pickup or landing zones, and battle positions. If time or the situation precludes a flight reconnaissance, aviators should conduct a thorough map reconnaissance. They must use terrain features to mask the aircraft during tactical takeoffs and approaches to ensure airfields or landing areas remain hidden from enemy visual and radar surveillance.

8-11. PROPER BRIEFINGS

Units or supported unit commanders must ensure that aviation personnel receive detailed mission briefings. Mission briefings should include intelligence, operational, and technical information pertinent to the mission. Time or the tactical situation may not permit a detailed briefing. In this case, participating aircrews must be provided with a condensed briefing. The condensed briefing should follow the format of a standard OPORD and include the minimum essential information to ensure mission accomplishment. A full five-paragraph OPORD, as outlined in Figure 8-1, is preferred. This will eliminate confusion and
contribute to a smoother and more successful operation.

8-12. AIRCREW COORDINATION

a. Many mission tasks have elements that require crew members to interact effectively. Crew interaction includes those communication skills and cooperative actions (sequence or timing) that facilitate the efficient, effective, and safe performance of flight tasks. An analysis of pilot-error accidents indicates that ineffective crew coordination has been a significant factor in failure to accomplish cockpit requirements. Inadequate aircrew briefings by PICs appear to be a consistent problem regardless of experience level. (In a large percentage of aircrew briefings, crew member responsibilities were not thoroughly understood or clearly explained.) The importance of thorough crew briefings, regardless of crew experience, cannot be overemphasized. Aviation unit commanders must ensure that aircrews use effective coordination procedures during all missions. Individual crew member responsibilities must be adequately addressed during the premission briefing and spelled out in unit SOPs.
Figure 8-1. Suggested format of a five-paragraph OPORD

(1) Communication. Communication can involve the exchange of both verbal and nonverbal information between the sender and the receiver. The key to effective communication is to ensure

any potential misunderstanding or disagreement is resolved as it occurs. The receiver must acknowledge the message, and when possible, the sender must confirm his understanding by observing the receiver's acknowledgment and subsequent actions.

(2) Cooperation. Crew members must execute appropriate actions in the cockpit to coincide with other crew member actions. The timing or the sequence of these actions is critical; they must not be executed too soon or too late.

(3) Interaction. Crew coordination consists of those communication actions necessary to accomplish interactive tasks that are essential to mission accomplishment. Some crew member actions that have significant coordination requirements are listed below.

(a) Transferring aircraft controls.

(b) Assigning crew member responsibilities during the premission briefing.

(c) Performing procedures according to the appropriate aircraft checklist; that is, read and respond.

(d) Managing the unplanned or unexpected situation. (Examples are mission or weather changes, inability of a crew member to continue performing assigned flight duties, and inability to communicate with supported units.)

(e) Maintaining aircraft clearance. (When providing clearance information, the crew member not on the controls must include distance, direction, and altitude relative to the aircraft. When asked if the aircraft is clear of a specific obstacle, merely saying "clear left or clear right" does not provide sufficient information to the crew member on the controls. Giving the distance and/or altitude from the obstacle provides the crew member on the controls better information and more response time to avoid the obstacle.)

(f) Performing a task assigned or understood to be the responsibility of another crew member. (Examples are when the crew member on the controls tunes radios or focuses attention solely inside the aircraft without directing the other crew member to clear outside the aircraft.)

b. A significant proportion of human-error accidents has been attributed to poor crew coordination. Crew coordination accidents are up, driven by increased night flying (aided and unaided). Crew coordination failures involve basic crew member skills that are not adequately addressed in current regulations or training. Therefore, aviation unit commanders must identify operational profiles and/or mission phases in which crew coordination failures are most likely to occur and address them in unit SOPs. They also must identify the types of crew coordination failures that are most likely to occur during a given operational profile and/or mission phase.

(1) Operational profiles and/or mission phases. Operational profiles and/or mission phases wherein crew coordination failures are most likely to occur, in order of frequency, are listed below.

(a) Night tactical missions.

(b) Day tactical terrain missions (en route phase).

(c) Day missions (landing phase).

(d) Day missions (other phases).

(e) Premission planning phase.

(f) Administrative or support missions (hover/taxi phase).

(2) Crew coordination failures. The types of crew coordination failures that are most likely to occur, in order of frequency, are discussed below.

(a) Failure to direct assistance. The crew member on the controls fails to properly direct assistance from the crew member not on the controls. (For example, he may need information about airspeed, altitude, rate of closure, and engine/flight instruments or assistance with aircraft clearance and control.) The increased demands of aided night tactical terrain missions require the crew member on the controls to use all available resources. All crew members must understand that crew coordination, especially for aircraft clearance, must take priority over tactical coordination requirements in operational situations critical to flight safety.

(b) Failure to announce decisions. A crew member fails to announce a decision or action that will affect the ability of other crew members to properly perform their duties. Examples are quitting aircraft clearance duties to tune radios or read maps, initiating NOE turns, and making flight control inputs or assuming the flight controls unannounced. A crew cannot be an effective team if any member acts independently.

(c) Failure to use positive communication. A crew member fails to use positive verbal and nonverbal communications. (For example, he uses nonstandard terminology with nonspecific qualifiers in transmissions, acknowledgments, and confirmations.) The receiver must clearly acknowledge that the message has been received and understood; the sender must confirm receipt and understanding by observing the receiver's acknowledgment and/or subsequent action. Communications critical to effective aircraft operation cannot be assumed to have been received simply because the message was transmitted.

(d) Failure to assign responsibilities. The PIC fails to properly assign crew responsibilities during the crew briefing or during the mission when new situations occur. Responsibilities for aircraft clearance and assistance to the crew member on the controls must be clearly assigned and understood during the crew briefing. The desired assistance to the crew member on the controls should be specified in terms of who, what, when, and how. For example, the PIC will brief who (which crew member) will provide what (aircraft clearance), when (priority), and how (technique).

(e) Failure to offer assistance. The crew member not on the controls fails to offer assistance or information that is needed or has been previously requested by the crew member on the controls. Crew members must anticipate when assistance will be needed and not wait until the crew member on the controls requests it. Also, each crew member must always be ready to assist in emergency situations requiring teamwork.

(f) Failure to sequence actions. The crew member on the controls fails to execute actions in proper sequence with actions of the crew member not on the controls. (For example, he initiates a taxi turn before another crew member can clear the tail, releases a slingload before receiving clearance, and takes off before performing before-takeoff checks.) Actions executed out of sequence--too soon or too late--can disrupt the entire flow of a mission or even bring it to an abrupt end.

8-13. COMBINED ARMS SUPPORT

The support desired to complete a mission may not always be available. The available tactical support may affect the method of maneuver, communication procedures, command and control procedures, organic ordnance loading, and reconnaissance capabilities and methods. Premission planners for combined arms support consider what kind of support is required for the mission and where the support is or where it can be most effectively located. Army aviation combined arms support can be classified into four categories. They are A2C2, fire support, electronic warfare support, and logistics support.

a. Air Assault Missions.

(1) Combined arms support for air assault operations will be distributed from the corps and division according to the operational plan. For air assault missions, the AATF commander should brief the AMC. The briefing should include-

What support is available.

Where the support is located.

What call signs, frequencies, and codes and modes will be used.

How and when the support will be worked into the scheme of maneuver.

(2) The AMC advises the AATF on how aviation elements can best support the scheme of maneuver. He also advises the AATF on additional support needed to accomplish the mission and recommends the locations for that support.

b. Other Missions. Aviation units will fly reconnaissance, combat service support, or general support missions for supported units. Support requests for the mission are based on friendly and enemy situations, flight routes, and meteorological conditions. The AMC or individual aviator conducts premission planning by coordinating with unit operations about various support unit locations and call signs, frequencies, and codes.

8-14. COMMAND AND CONTROL

Army airspace management of the combat zone begins at corps level. The responsibility for airspace management functions rests with commanders from corps through battalion level. Each commander should be knowledgeable of airspace and airspace command and control requirements and incorporate them into operational plans. The commander and the A2C2 staff element arrange for air traffic control and fire support and for the coordinated use of airspace during combat operations. Appendix C and FM 100-103 contain detailed discussions about A2C2 that may be useful to premission planners.

a. A2C2 Staff Representatives. Personnel and communication facilities are collocated at TOCs for the centralized coordination of tactical operations. Corps and division commanders establish an A2C2 element within their TOCs. The G3 has staff responsibility for the A2C2 element, which is supervised by the G3 Air. Members of this team are organized by the commander into the A2C2 element. The USAF provides liaison at the corps by collocating the ASOC with the TOC. At the division, the liaison function is provided by the TACP. The ASOC and TACP can rapidly respond to immediate requests for tactical air support from Army forces. Staffing of the A2C2 element should include an ADA officer, an aviation officer, a USAF liaison officer, and a fire support coordinator. It should also include an ATS liaison officer, a G4, a signal officer, and an ANGLICO officer when required.

b. A2C2 Functions. The TOC combines the command group and A2C2 elements that manage the joint use of airspace and fire support. It also disseminates rules of airspace use for combined arms operations. Through subordinate commands (battalion and brigade) and ATS agencies, the A2C2 element coordinates, plans, and disseminates-

IFF codes.
Flight corridors.
Minimum risk routes.
Coordinating altitudes.
TACAIR support operations.
Standard-use Army aircraft routes.
Tactical air control team operations.
Airfield terminal control procedures.
Electronic warfare control procedures.
Fire control procedures (artillery and air defense).

c. ATS Agencies . Subordinate ATS facilities are staffed with assets from the corps ATS battalion. They include a system of manual FOCs, FCCs, approach and departure control facilities, airfield control towers, and navigational aids. These facilities, provided throughout the corps area, control and coordinate Army air traffic services.

(1) The ATS company (forward) is normally organized with a company headquarters, a supply section, and three ATS platoons. Each platoon consists of a platoon headquarters, a tower team, a GCA radar team, and an en route FOC or FCC team. One of the FOC or FCC teams in the corps rear area is designated the FOC. As such, it interfaces between the A2C2 elements and the USAF control and reporting center. Tactical tower and GCA teams can be added to an ATS platoon to support additional tactical aviation operations at Army landing sites.

(a) Flight operations center (corps). The FOC is a corps level, en route ATC facility for Army air traffic services in the rear operations area. In its area of operations, the FOC-

Provides air rescue assistance.
Coordinates defensive and offensive operations.
Provides navigational and flight-following assistance.
Provides hostile aircraft warning to friendly aircraft.
Establishes a communications link with TACS, ADCPs, and subordinate FCCs.

(b) Flight coordination center (division). The FCC in division areas serves as a communications extension for the corps FOC. The FCC ensures continuity for the flow of information required for air defense and ATS operations. Normally, FCCs are located in each division area and are staffed or operated by corps assets from the ATS battalion. The FCC-

Provides air rescue assistance.
Provides general airspace management and coordination.
Provides navigational and flight-following assistance.
Provides hostile aircraft warning to friendly aircraft.
Establishes a communications link with division airfields, other tactical airfields and heliports, the division TOC, adjacent FCCs, and the corps FOC.

(2) The ATS company (forward) provides terminal and en route ATS, navigational aids, air warnings, and other assistance to aircraft. Two ATS companies (forward) are normally assigned to

each corps ATS battalion. As a rule, one ATS company (forward) employs its platoons to directly support corps aviation operations. The other ATS company (forward) platoons directly support division aviation operations. ATS platoons operate from dispersed locations within an assigned area. Normally, they are collocated with supported aviation units for security and responsiveness. Platoon leaders of ATS platoons provide ATS support at the division instrumented landing site and serve as ATS liaison officers with the division A2C2 element at the division TOC. They also coordinate division airspace user requirements and operations and assist in ATS planning. The platoons receive medical, logistics, transportation, POL, food service, and administrative and maintenance services support from the supported unit and its support activities. ATS companies-

Provide one FOC to manage the corps en route ATC system.

Provide liaison and coordination with the A2C2 element as directed.

Add or deploy platoon-size and individual teams independently to meet particular ATS requirements.

Provide FCCs and navigational aids for employment in the corps and division en route ATC system.

Perform organizational maintenance on organic equipment and perform up to GS-level, on-site maintenance on ATS-peculiar equipment.

Provide terminal air traffic services to include tower, approach control, GCA radar, and terminal navigational aids at corps or division landing sites.

Transmit and receive weather, notices to airmen, aircraft flight clearances, and operational data, using organic radio and division and corps signal communication systems.

d. Tactical air control teams. Tactical air control teams provide navigational assistance and aircraft control services during any phase of an operation that requires the sustained employment of Army aircraft. These teams normally select, improve, mark, and control drop, pickup, and landing zones. They also assist with rigging operations. In forward areas, tactical air control teams may provide lighting and short-range NDBs. However, their radio communications will be minimized because of threat considerations. Premission planning considerations include-

Requesting available ATS support.

Knowing established airspace controls.

Checking terminal control procedures for available navigational aids.

Knowing locations, frequencies, and call signs of available ATS support.

8-15. FIRE SUPPORT

a. Fire Support Agencies. The outside agencies that can provide fire support include artillery, mortars,
ADA, TACAIR, and naval gunfire. Table 8-2 shows available artillery support. Supporting artillery unit personnel are provided to each command level. Staff representation is provided in FSEs within the TOCs from corps through company/troop level. FSEs plan and coordinate supporting artillery fires for maneuver unit commanders. The individual artillery unit headquarters, with the artillery unit FDC and FOs, controls all fire support. Table 8-3 shows the coordinating levels for artillery fire support.

Table 8-2. Artillery support

Table 8-3. Coordinating levels for fire support

b. Preplanned and Immediate Fires.

(1) Preplanned fires. Preplanned artillery fires and targets are developed by each coordinating level for the operational plan or scheme of maneuver. These targets are then distributed throughout the fire support system to appropriate coordinating agencies and artillery unit headquarters and FDCs. Premission planning for combined arms operations or aviation unit operations involves-

Noting artillery unit, FDC, and FIST locations and their call signs and frequencies.

Coordinating the briefing tasks performed by the AMC and maneuver unit commander or S3.

Establishing a direct means of communication between the AMC and the supporting artillery unit.

Requesting planned artillery fires through unit operations channels to support aviation unit missions.

(2) Immediate fires. Artillery fires that are not preplanned are called immediate fires. If a trained FO is not available, the aviator initiates the request for fire and adjusts it on to the target. Call-for-fire procedures are discussed in c below. Priority of artillery fires is allocated to the supported unit according to the command relationship and the tactical mission. Premission planning for immediate artillery suppression involves-

Knowing weapon and munition capabilities.

Knowing the location of supporting artillery.

Knowing how to call for and adjust artillery fire.

Coordinating with the appropriate agency or unit with regard to artillery and mortar locations and FDC, FSE, and FO call signs and frequencies.

c. Fire Requests. Requests for artillery and mortar fires consist of observer identification, warning order, target location, and target description. The method of engagement and the method of fire and control are optional in the call-for-fire request. To achieve surprise and maximum effect on a target, aviators can request a fire for effect in the initial request. The call for fire is sent to the artillery unit FDC and the maneuver unit FSE or FIST by the fastest available means. FM 6-30 describes artillery observer techniques. Figure 8-2 shows the information included in the call for fire.

Figure 8-2. Information included in a call for fire

d. Weapon and Munition Capabilities. The aviator must know artillery unit locations, the type of unit, and range capabilities to plan for artillery coverage and to avoid flying into artillery coverage areas. Table 8-4 shows artillery and mortar weapon and munition capabilities. Table 8-5 shows which type of shell and fuze combinations are effective against various types of targets. This is important information in a target of opportunity situation. The shell and fuze action desired may be included in the call for fire. However, the coordinating agency fire direction officer will determine the best shell and fuze combination from the target description.

e. Air Defense Artillery. US Army ADA includes two categories of weapons based on altitude capabilities. They include SHORAD gun and missile systems and HIMAD missile systems. The integration of ADA weapons into the aviation scheme of maneuver accomplishes two goals. It prevents the accidental engagement of friendly aircraft and assists aviation in defensive ATA combat. Premission planning and coordination for ADA integration must be thorough.

(1) Engagement rules. The IFF system has a major role in air defense rules of engagement. Nonuse or misuse of electronic IFF is normally, designated as a criterion for declaring an aircraft hostile. Aviators must know IFF codes and modes and how to operate the IFF equipment. If IFF codes and modes have not been distributed, aviators should check with their unit operations or the supported unit operations. The information is also available from the A2C2 element and the TOC, FOC or FCC, and AADCP.

(a) An IFF transmission targets the aircraft to enemy radar if it is also being illuminated by enemy equipment. Local SOPs contain guidance in dealing with this shortcoming. Appropriate air defense weapon locations, frequencies, and call signs provide a protective suppression capability against the air threat. Rapid dispatch of a call to the local AADCP, FCC, or maneuver unit with organic Redeye or Stinger missile teams may ensure the safety of aviation personnel. However, the Stinger is the only US shoulder-fired air defense system with an IFF interrogator.

(b) The control of Vulcan, Redeye, and Stinger weapons differs from the control of longer range, more sophisticated weapons. The elapsed time from target detection and identification until target flyover is much shorter for the short-range systems. Also, short-range weapons are fired by squads and teams rather than by batteries or platoons. Each squad or team is individually positioned and separated from other squads in the same defense. The individual squad or team makes the firing decision based on the prescribed rules of engagement.

Table 8-4. Weapon and munition capabilities

Table 8-5. Effective shell and fuze combinations

(2) SHORAD gun and missile systems. SHORAD gun and missile systems include the Vulcan 20-millimeter gun and the Redeye, the Stinger, and the Chaparral infrared heat-seeking missiles. Ranges are 1,200, 3,000, 4,000, and 5,000 meters, respectively. These systems provide air defense protection against hostile aircraft operating at low altitude. The Vulcan and Stinger battalions are organic to infantry, armor, and mechanized infantry divisions. Each battalion has three Vulcan and Stinger batteries for a total of 36 gun and 60 Stinger missile teams. The towed Vulcan and Stinger battalion is organic to airborne and air assault divisions. It has three batteries of nine towed Vulcans and Stingers each. Nondivisional Chaparral and Vulcan battalions have two Chaparral and two Vulcan batteries with 24 guns and 24 missile systems. Composite Chaparral/Vulcan/Stinger battalions may help protect key air bases. However, the main role of the Vulcan is forward air defense for the division.

(a) The divisional ADA units provide liaison personnel to the supported unit commander to help plan and coordinate air defense coverage tailored to the tactical situation. Within a division, personnel from the

Vulcan and Stinger battalion command post join Army aviation and other staff personnel to form the A2C2 element. This element is an integral part of the division main command post. An ADA element is positioned with, and forms part of, the division tactical command post. In addition, a direct support mission requires the Hawk battalion to establish liaison and communications with the supported division. Therefore, it sends a liaison officer to the division main command post to work closely with Vulcan and Stinger personnel and aviation personnel in the division A2C2 element.

(b) The division A2C2 element and air defense elements at the division tactical command post serve as the focal point for the coordination of air defense operations with other division staff elements. They also perform airspace management functions. The A2C2 element plans and coordinates the immediate use of airspace over the division as a whole. Below division level, the ADA battery commander, platoon leader, or section leader will normally be the air defense advisor to the maneuver commander his unit is supporting. The air defense element at the tactical command post coordinates the immediate use of airspace and ADA operations in brigade areas. The air defense element and the division tactical command post must coordinate to ensure both are informed about-

IFF codes.
Enemy air activity.
Changes in ADA rules of engagement.
ADA unit plans, activities, and status.
Airspace control measures and restrictions.
Army aviation, joint, and combined operations.
Changes in air defense warnings and status of alerts.
Division and corps plans, activities, and protection priorities.

(c) Air defense artillery will warn friendly aircraft about hostile air incursions. Aviation units operating beyond the FLOT may also frequently observe hostile air incursions. When aviation personnel observe these incursions, they should provide direction of flight and altitude data to an ADA unit through normal reporting channels or directly, whichever is more practical. In some cases, the division early warning net can be used for this purpose. Divisional ADA units normally use the manual SHORAD control system as the overall early warning system. This system consists of the ADFCS, which provides liaison between the Hawk and the divisional ADA battalions. The ADFCS uses Hawk radar and sends aircraft data to the ABMOC, which is an additional TOC operated by the ADA battalion. The ABMOC relays early warning data, provided by Hawk and organic battalion forward area alerting radars, to all units in the division over the FM early warning net listed in the SOI.

(d) The section leader exercises command and control of the Redeye and Stinger (man portable air defense system) section from his command post. He positions his missile teams to defend units or other assets and to support the scheme of maneuver of the supported ground commander. The regional air defense commander controls these weapons by issuing air defense rules and procedures that teams must follow. When planning the use of ADA, premission planners should consider the locations of air defense assets within the area of operations and how these assets fit into the scheme of maneuver. They should also note ADA unit radio frequencies, appropriate air defense rules of engagement, and IFF modes. Finally, planners should include airspace control procedures and restrictions in the area of operations. This information is made available to maneuver unit and aviation commanders and operations sections. IFF codes and modes are distributed by the theater to the division or corps through classified information channels. The division or corps A2C2 element must ensure that IFF codes, modes, and rules reach all user units.

(3) HIMAD missile systems. The HIMAD missiles are the Hawk and Patriot systems. The medium-range ADA missile system is the Hawk radar-guided missile. The missile has a range of 40,000 meters. It provides area air defense coverage against a low- to medium-altitude air threat. Hawk battalions protecting assets in the corps rear area will normally be assigned general support missions. Hawk battalions allocated for air defense in the forward area are normally assigned tactical missions in direct support of committed divisions. Patriot missile battalions provide theater air defense coverage against a medium- to high-altitude air threat. The range of the Patriot missile is about 80,000 meters.

(a) All air defense forces follow rules and procedures that facilitate centralized management or command and control. Yet, each air defense unit must retain the flexibility to respond to the supported element. With this flexibility, the area air defense commander, normally the USAF component commander, divides the theater into air defense regions. The regional air defense commander is responsible for, and has full authority in, the air defense of his region. He normally delegates authority to the commanders of the major Army elements for the employment of organic Army air defense means. Air defense rules and procedures give the air defense unit commander the criteria to determine if an aircraft is hostile and to establish the degree of control placed on firing his weapons. Within Hawk and Patriot battalions, commanders exercise command and control of their batteries through a battalion operations center. Control of fires is accomplished through either the semiautomatic or manual control element of the battalion operations center.

(b) At the corps, the commander of the air defense brigade is the principal advisor to the corps commander on air defense matters. The chief of the air defense element may represent the brigade commander at the corps tactical command post. The brigade's air defense element joins the corps aviation and other elements to form the corps A2C2 element. It also provides an air defense planning and advisory service to the corps commander or G3.

(c) An air defense advisory staff is represented in the A2C2 element. As an aid to airspace management, the division may collocate an element from the aviation battalion with the Hawk battalion operations center. The battalion operations center has a communications tie-in with the USAF control and reporting center and post and the Hawk battalion's organic radars. This provides valuable advisory and assistance data to Army aircrews. The arrangement facilitates the exchange of radar information to USAF and Army aircraft. Air defense remains the Hawk's priority mission. When requested or in an emergency, the Hawk-associated FCC element can-

Assist in IFF transponder checkouts.

Help aircraft avoid known hazard areas.

Provide aircraft position-fixing and directional assistance service.

Distribute friendly aircraft locations based on IFF codes and positioning.

8-16. SMOKE AVAILABILITY

Smoke can be effective in denying the enemy visual observation and acquisition. Premission planners should consider all smoke-producing means available. Some aviation units may have utility helicopters equipped with the M52 smoke generator. Smoke requires careful planning and control to allow for unfavorable wind conditions and to avoid interference with friendly operations. Smoke rounds should be adjusted in relation to the target according to wind speed and direction. The rounds must be placed so that the smoke will drift across the area to be obscured. Wind speeds ranging from 4 to 14 knots are best for producing smoke screens. Figure 8-3 shows the effect of wind speed on smoke, and Figure 8-4 shows the effect of wind direction on smoke. Table 8-6 shows smoke coverage and duration.

Figure 8-3. Effect of wind speed on smoke

Figure 8-4. Effect of wind direction on smoke

Table 8-6. Smoke coverage and duration

Table 8-1. AN/TRN-30(V)1 NDB

CAPABILITIES	PATHFINDER MODE (V1)	TACTICAL MODE (V2)	SEMIFIXED MODE
Frequency range	200-535.5 kilohertz 1605-1750.5 kilohertz	200-535 kilohertz	200-535 kilohertz
Range below 500 feet AHO	15 kilometers with 15-foot mast antenna		
Range above 500 feet AHO	25 kilometers with whip antenna 40 kilometers with 30-foot mast antenna	85 kilometers with 60-foot mast antenna	180 kilometers with 60-foot mast antenna

1. SITUATION

(Provide information on current tactical situation.)

a. Enemy Forces.
b. Friendly Forces.
c. Attachments and Detachments.
d. Weather Forecast.

2. MISSION

(State clearly and concisely the task that is to be accomplished. Also state who, what, when, and as appropriate, why and where.)

3. EXECUTION

(Explain the commander's scheme to accomplish the mission.)

a. Concept of Operation.
b. Maneuver.
c. Artillery.
d. Combat Support and Combat Service Support.
e. Reserves.
f. Coordinating Instructions.

4. SERVICE SUPPORT

(Provide combat service support instructions and information on arrangements that support the operation.)

a. Supply (POL, ammunition, rations).
b. Transportation.
c. Services.
d. Special Equipment.
e. Maintenance and Recovery.
f. Medical Evacuation.
g. Personnel.

5. COMMAND AND SIGNAL

(Provide instructions relative to command and signal.)

a. Command (location of command posts, succession of command, other).
b. Signal (radio, telephone, visual, time).

Figure 8-1. Suggested format of a five-paragraph OPORD

Table 8-2. Artillery support

WEAPON	RANGE (METERS)	
	(NON-RAP)	(RAP)
105-mm howitzer towed M102	11,500	15,100
155-mm howitzer towed M114A1	14,600	19,400
155-mm howitzer SP M109A2/A3	18,100	23,500
155-mm howitzer towed M198	24,000	30,000
8-inch howitzer SP M110A2	22,900	30,000
227-mm MRLs	30,000	

Table 8-3. Coordinating levels for fire support

FORCE ECHELON	FIRE SUPPORT ORGANIZATION	FSCOORD	ASSISTED BY
Echelons Above Corps	Fire Support Section	FSO	Assistant FSO
Corps	FSE	Corps Arty Commander	Corps Deputy FSCOORD and AFSCOORD
Division	FSE	Div Arty Commander	Div Arty AFSCOORD
Brigade	FSE	FA Battalion Commander	Brigade FSO
Battalion/ Squadron	FSE	FSO	Fire Support NCO
Company/ Troop	FSE	FSO	Fire Support NCO

FIRST TRANSMISSION 1. Observer Identification 2. Warning Order
SECOND TRANSMISSION 3. Target Location
THIRD TRANSMISSION 4. Description of Target 5. Method of Engagement 6. Method of Fire and Control

Figure 8-2. Information included in a call for fire

Table 8-4. Weapon and munition capabilities

FIELD ARTILLERY WEAPONS	MAXIMUM RANGE (METERS)	MINIMUM RANGE (METERS)	MAXIMUM RATE (ROUNDS PER MINUTE FIRST 3 MINUTES)	SUSTAINED RATE (ROUNDS PER MINUTE)
105-mm how M101A1, towed	11,000 14,500 (RAP)	0	10	3
105-mm how M102, towed	11,500 15,100 (RAP)	0	10	3
155-mm how M114A1, towed	14,600	0	4	1
155-mm how M114A2, towed	14,600 19,400 (RAP)	0	4	1
155-mm how M198, towed	24,000 30,000 (RAP)	0	4	Temperature dependent
155-mm how M109, SP	14,600	0	4	1
155-mm how, M109A1/A2/A3, SP	18,100 23,500 (RAP)	0	4	1
175-mm gun M107, SP	32,800	0	1.5	0.5
203-mm how M115, towed	16,800	0	1.5	0.5
203-mm how M110, SP	16,800	0	1.5	0.5
203-mm how M110A1, SP	20,600	0	1.5	0.5
203-mm how M110A2, SP	22,900	0	1.5	0.5
MORTARS	MAXIMUM RANGE (METERS)	MINIMUM RANGE (METERS)	MAXIMUM RATE (ROUNDS PER MINUTE FIRST MINUTE)	SUSTAINED RATE (ROUNDS PER MINUTE)
60-mm	3,490 (HE) 1,472 (WP) 931 (illum)	70 (HE) 33 (WP) 725 (illum)	30	20
81-mm	4,595 (HE) 4,850 (HE, track) 4,737 (WP)	72 (HE) 70 (WP) 100 (illum)	30	20 for 2 min, then 8
107-mm	6,840 (HE) 5,650 (WP)	770 (HE) 920 (WP)	18	9 for 5 min, then 3

	4,850 (HE, track) 4,737 (WP)	70 (WP) 100 (illum)		then 8
107-mm	6,840 (HE) 5,650 (WP) 5,490 (illum)	770 (HE) 920 (WP) 400 (illum)	18	9 for 5 min. then 3

Table 8-5. Effective shell and fuze combinations

SHELL/WEAPON	FUZE	SUITABLE FOR
DPICM 155-mm, 203-mm	Time/base ejecting	Personnel in open Light armored vehicles in open
APICM 105-mm, 155-mm	Time/base ejecting	Personnel in open
HE 81-mm, 105-mm, 107-mm, 155-mm, 203-mm	Quick	Adjusting Personnel in open Light armored vehicles
HE	Delay 0.05 second	Targets in trees Unarmored vehicles Ricochet effect
HE	Concrete piercing 0.25-second delay	Bunkers (earth and log emplacements) Hard targets
HE	VT--radio activated M514 20-meter HOB M728/732 7-meter HOB No HOB adjustment required	Personnel in open in trenches in fighting positions Light armored vehicles
HE	Time--HOB adjustment required	Same as VT
WP 81-mm, 105-mm, 107-mm, 155-mm Tanks	Quick and super quick	Incendiary Marking Screening Obscuring Vehicles
WP	Time	Mark center sector
Smoke 105-mm, 155-mm	Time/base ejecting	Screening Obscuration
Illumination 81-mm, 105-mm, 107-mm, 155-mm	Time/base ejecting	Illumination Harassment Marking
CLGP (Copperhead) 155-mm	NA	Armored vehicles
RAP 105-mm, 155-mm, 203-mm	Quick, super quick, delay	Same as HE (used when increased range is necessary)
FASCAM ADAM, 155-mm RAAMS, 155-mm	 Time/base ejecting Time/base ejecting	 Denying territory to personnel Denying territory to vehicles

ADAM, 155-mm	Time/base ejecting	Denying territory to personnel
RAAMS, 155-mm	Time/base ejecting	Denying territory to vehicles
Beehive 105-mm	Time	Personnel--direct fire in battery defense

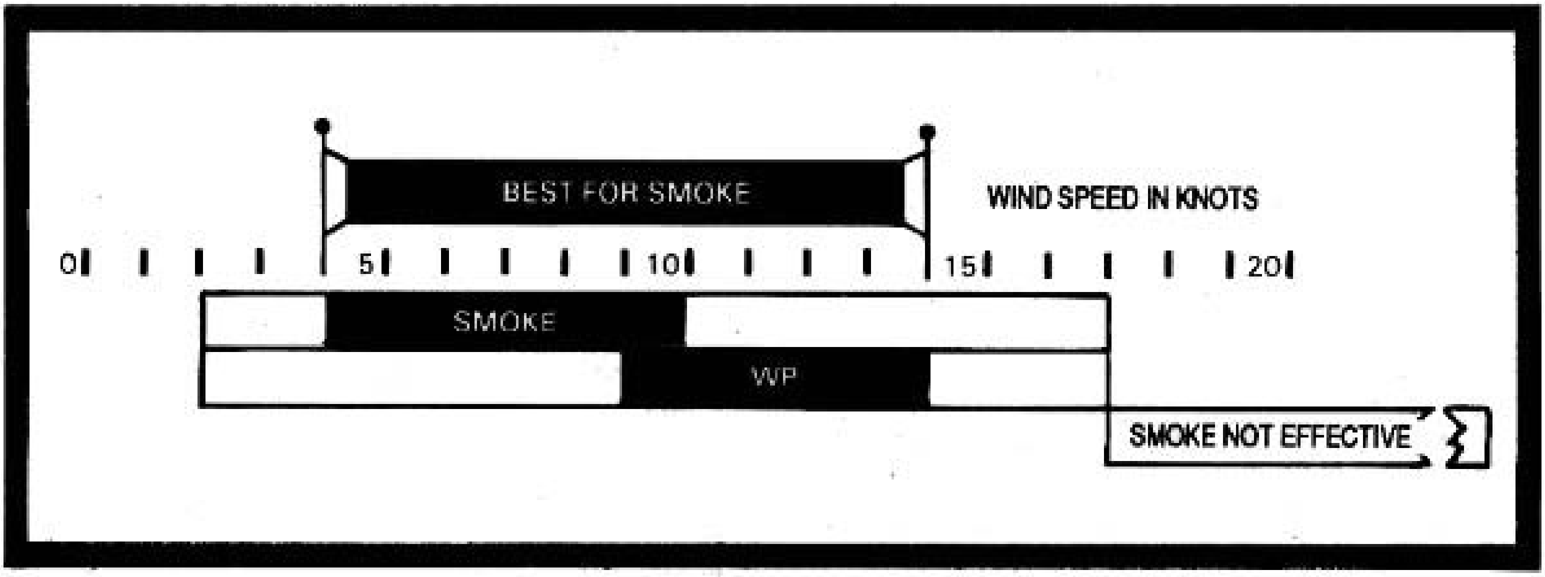

Figure 8-3. Effect of wind speed on smoke

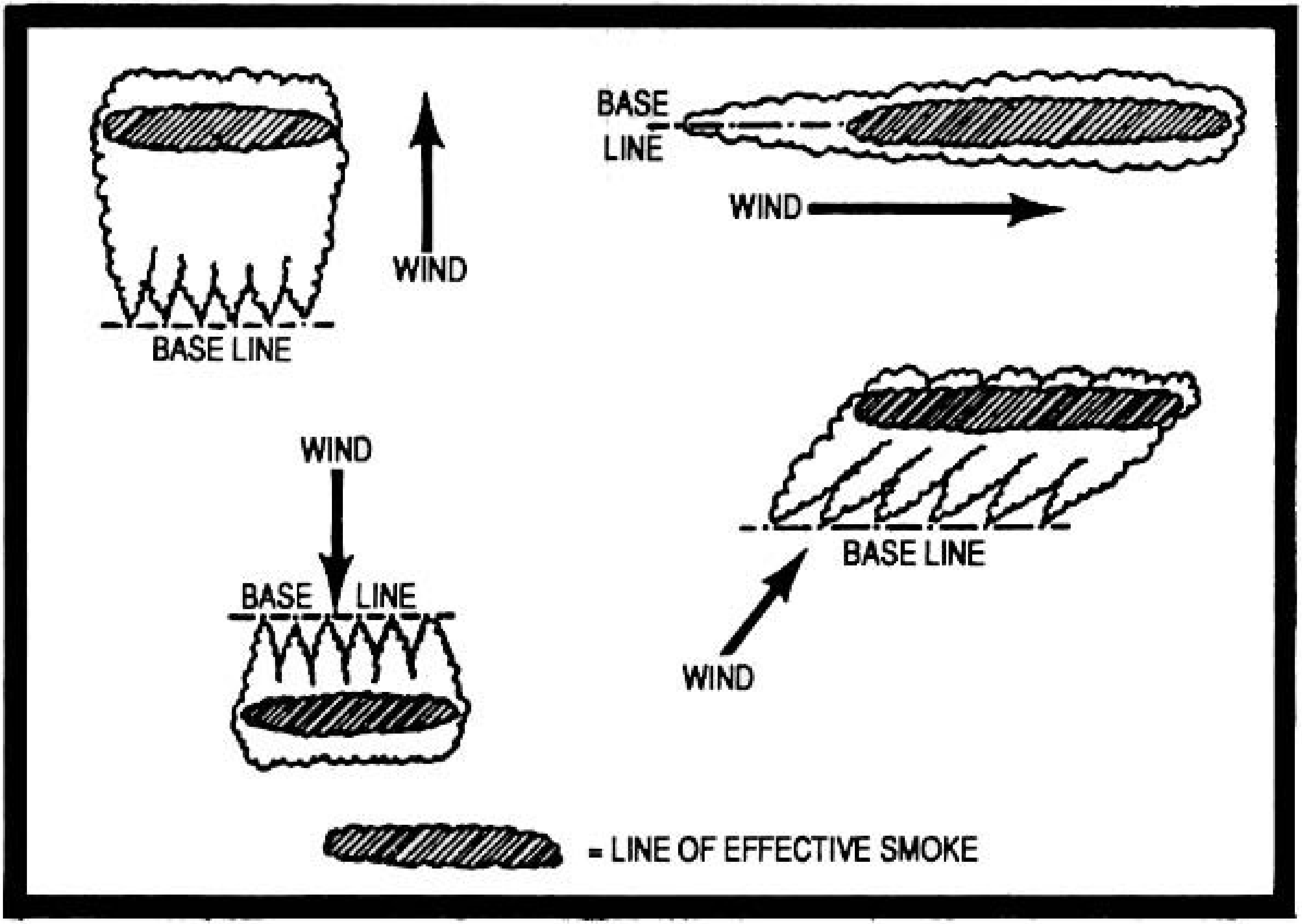

Figure 8-4. Effect of wind direction on smoke

Table 8-6. Smoke coverage and duration

DELIVERY SYSTEM	TYPE OF ROUND	NOMENCLATURE	FUZE	TIME TO BUILD EFFECTIVE SMOKE	AVERAGE BURNING TIME	AVERAGE OBS PER ROU WIND D
						CROSS
155-mm	WP	M110A2	M557	½ min	1-1½ min	100
	Smoke	M116B1	M501A1	1-1½ min	4 min	350
	Improved smoke	M825	M577	½ min	7 min	100
105-mm	WP	M60A1	M557	½ min	1-1½ min	75
	Smoke	M84B1	M501A1	1-1½ min	3 min	250
107-mm*	WP	M328A1	-	½ min	1 min	150
81-mm	WP	M375B2	-	½ min	1 min	100

*The 107-mm mortar WP projectile is a better smoker than the 105-mm howitzer WP projectile.

DELIVERY TECHNIQUE	TYPE OF TARGET	NUMBER OF GUNS	TYPE OF AMMUNITION	SHEAF	OBSCURATION TIME
Immediate smoke[1] (point/ suppression)	Point or small area, 150 meters or less	1 platoon[2] (2 guns)	1st rounds WP/smoke 2d rounds smoke	BCS	½-5 min
Quick smoke (small area/ suppression)	Small area 150-600 meters[3]	1-3 platoons[2]	smoke or WP	BCS	4-15 min
Immediate smoke (mortar)	150 meters or less	2	2 rounds (each) WP	parallel	1-3 min
Quick smoke (mortar)	150-600 meters	3 (81-mm section) 3 (107-mm section) 6 (107-mm platoon)	WP	parallel or open/special (as required)	4-15 min (depending on ammunition availability)

[1]The immediate smoke technique can be used in an immediate suppression mission on a target of opport
mix of WP and hydrochloroethane normally will follow the initial suppression rounds when immediate s
[2]Responsiveness dictates that the platoon fire both immediate and quick smoke missions.
[3]For larger areas, multiple aiming points and the quick smoke technique should be used.

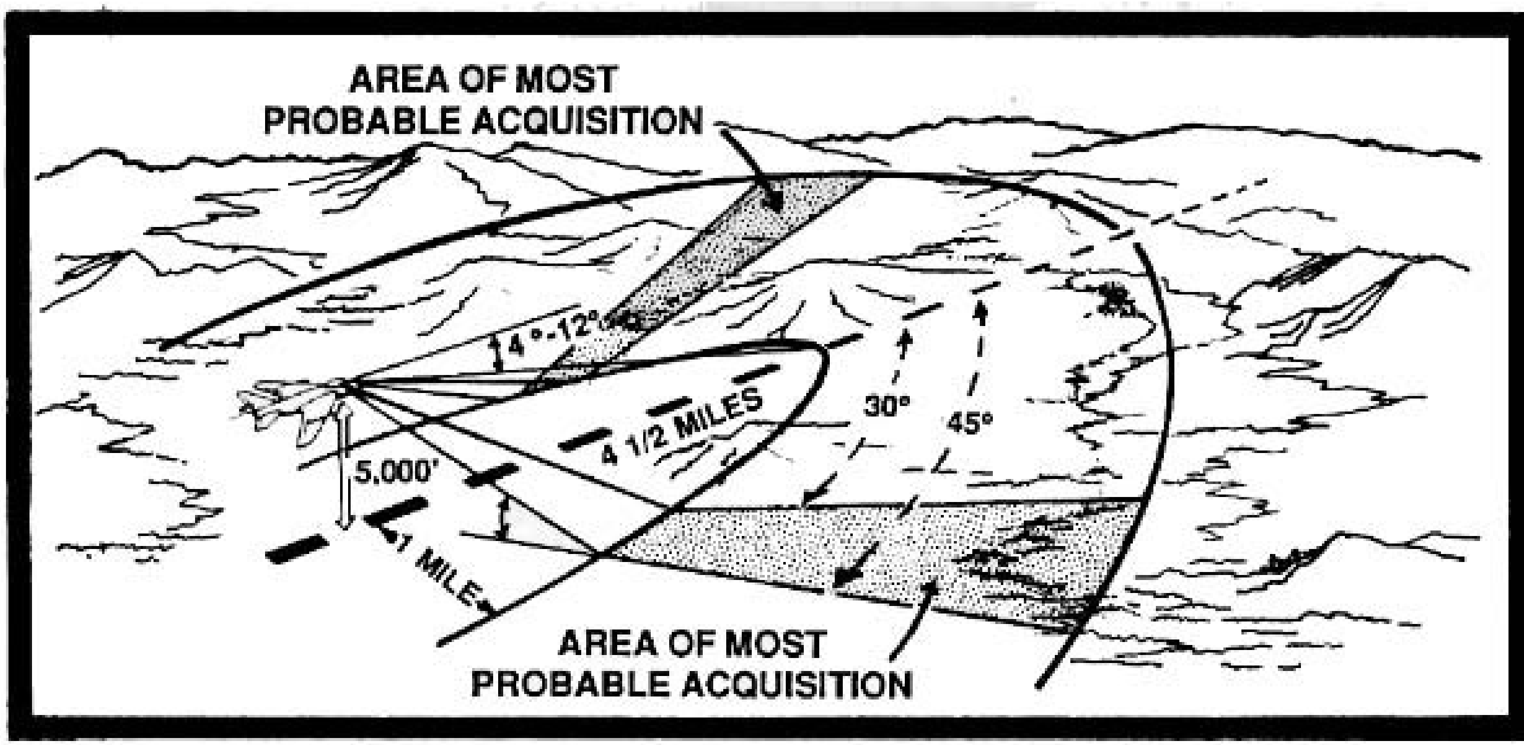

Figure 4-11. Visibility limitations

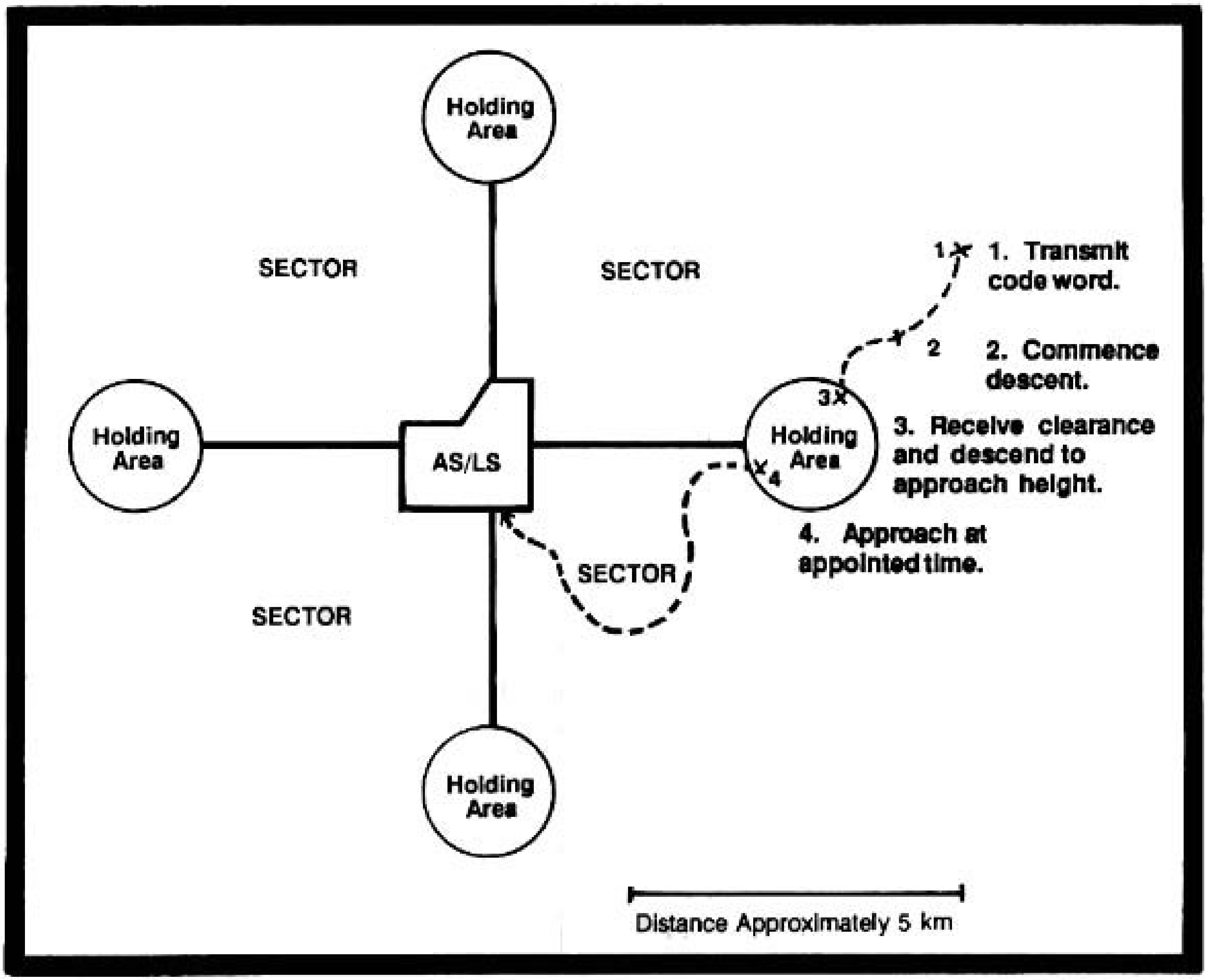

Figure 4-12. Sector approach procedure

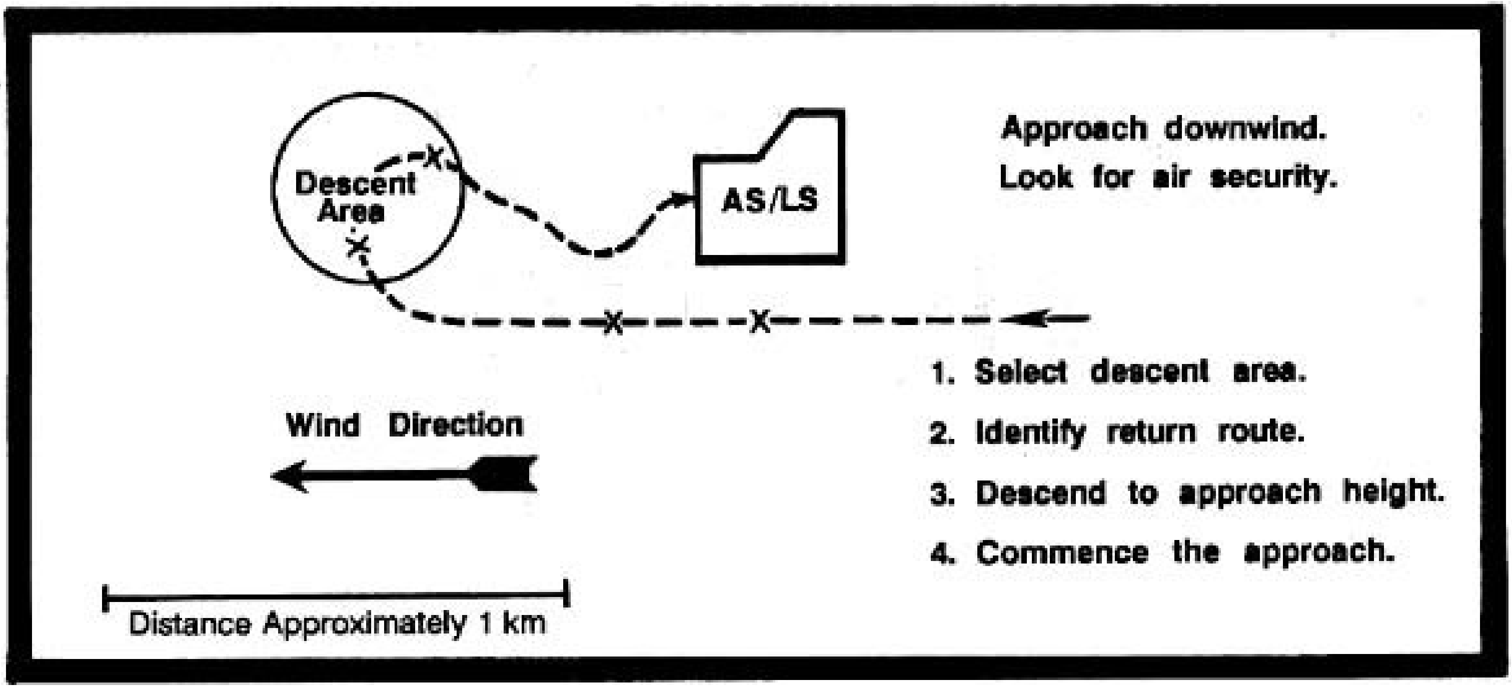

Figure 4-13. Teardrop approach

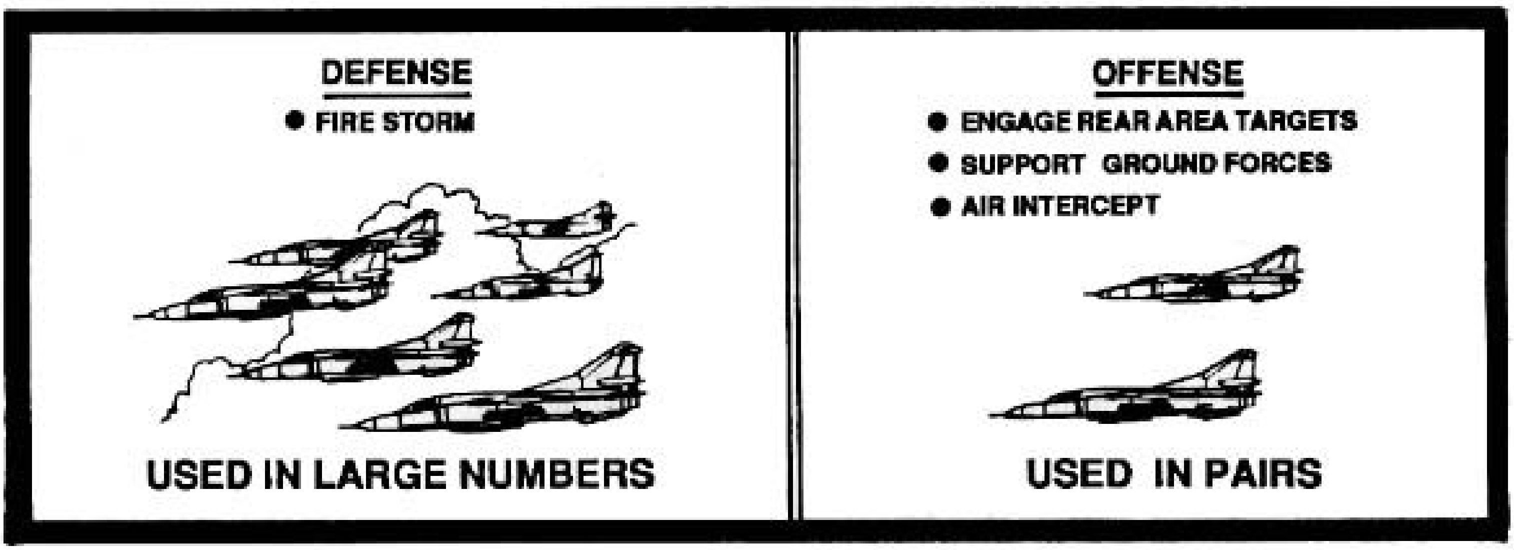

Figure 4-14. Tactical aircraft roles and missions

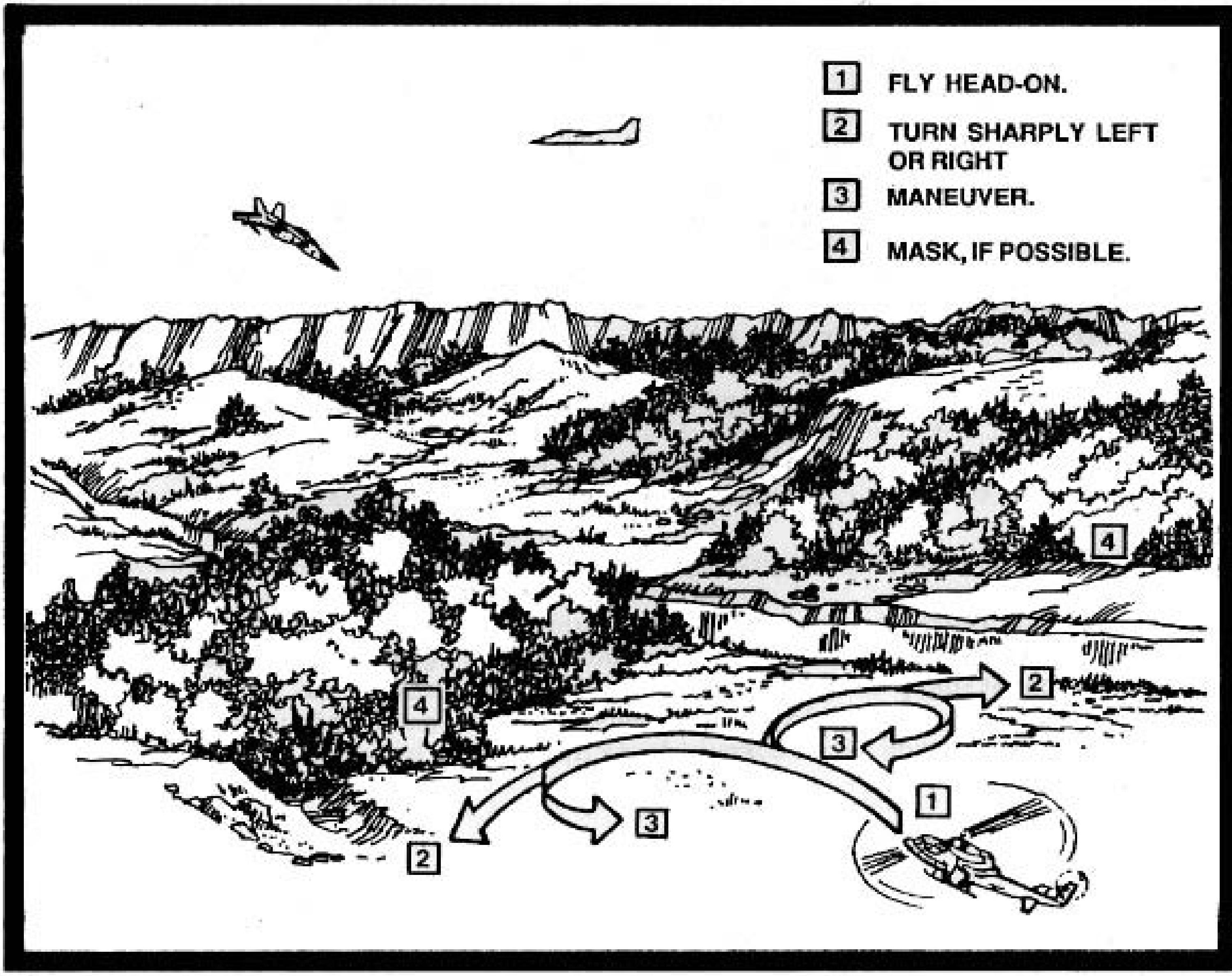

Figure 4-15. Evasive maneuver against missile, strafing, rocket, and bombing attack

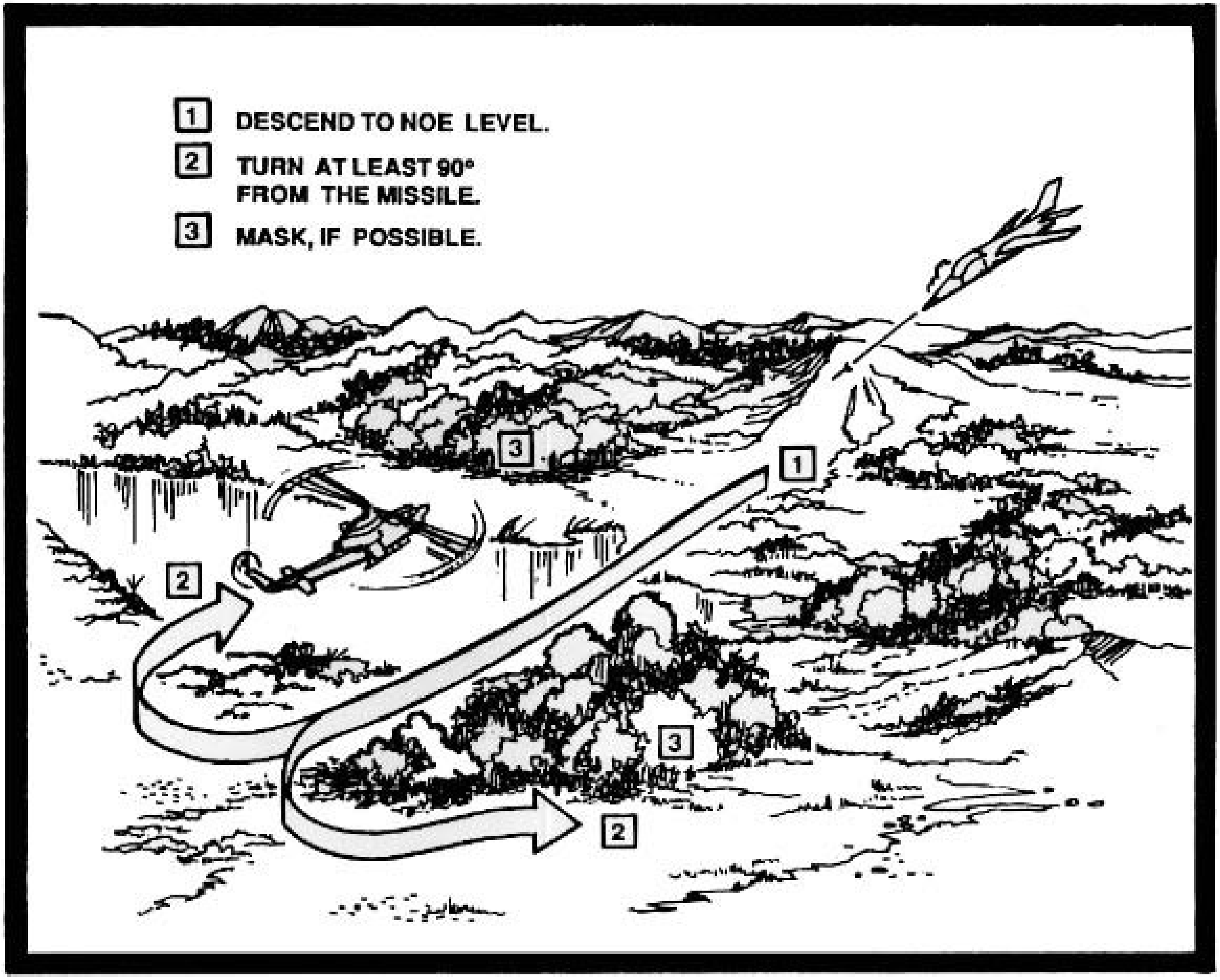

Figure 4-16. ATA missile engagement

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CHAPTER 7

COMBAT SEARCH AND RESCUE

This chapter implements portions of STANAG 2999, STANAG 3552 and AIR STD 51/4A, STANAG 3650 and AIR STD 51/7B, and QSTAG 586.

Army aviation will have to conduct CSAR operations on the next battlefield. CSAR will save lives, return downed aircrews to duty, and boost soldier morale. Army aviation must be able to perform CSAR missions during close, deep, and rear operations across the spectrum of conflict. Combat search and rescue requires specialized equipment, personnel, and procedures to effect successful rescue in hostile territory. This chapter describes CSAR operations to include CSAR objectives, commander responsibilities, and planning considerations. It also discusses special area environments, downed aircraft recovery procedures, and aircraft survival equipment and rescue devices.

Section I

SEARCH AND RESCUE OPERATIONS

7-1. MISSIONS

a. CSAR missions are conducted to locate survivors and to return them to friendly control before the survivors can be captured. The first request for CSAR assistance may come from any source. CSAR missions are normally conducted in unfamiliar terrain to rescue personnel whose injuries are not known in advance.

b. Army aircrews must be equipped, trained, and organized to conduct CSAR missions under severe environmental and battlefield conditions. The objectives of a SAR mission are to-

Recover personnel from hostile environments.
Preserve critical personnel and return them to duty.
Deny the enemy a source of intelligence information.
Contribute to the morale of combat forces.

7-2. OPERATIONAL STAGES

CSAR operations are divided into five stages: awareness, initial action, planning, operation, and mission conclusion. In the awareness stage, rescue personnel become aware that an emergency situation may exist. During the initial action stage, preliminary action is taken to alert SAR facilities and to obtain additional information. An effective plan of operation is developed in the planning stage. It includes the search plan, the rescue plan, and the final delivery plan. SAR facilities are moved to the scene during the operation stage to conduct a search, rescue survivors, and deliver injured personnel to a suitable medical facility. In the mission conclusion stage, SAR facilities are moved from the safe delivery point to their regular location where they are prepared for another mission.

7-3. COMMANDER RESPONSIBILITIES

a. To preserve combat power and promote high morale among aviation personnel, commanders must place a high priority on the recovery of downed aircrews. Downed aircraft recovery teams, or DARTs, are comprised of maintenance, medical, and security personnel. These teams must be trained to react in any mission profile. DART personnel are not provided for in the tables of organization and equipment. Therefore, commanders must form the teams out of existing resources. This includes providing dedicated UH-1 or UH-60 aircraft with personnel locator system equipment to use in DART missions. MEDEVAC units are only responsible for the evacuation of injured personnel. Therefore, aviation units must plan for and accomplish internal search and rescue operations as well as mass casualty evacuation. DART is not a command option; it is a command responsibility.

b. Commanders are responsible for training and alerting rescue personnel. They are also responsible for ensuring that essential SAR equipment is carried aboard all aircraft that operate within a combat environment. Commanders must ensure that all personnel are familiar with AR 525-90, which describes wartime SAR procedures. If commanders request active SAR assistance, they must furnish rescue personnel-

The type, number, tactical call sign, and radio frequency of aircraft, ships, or ground forces in distress.

The last known course and speed, position, and intended track.

The names and authenticators of distressed personnel.

The type and amount of survival equipment aboard the aircraft.

Any additional information that the SAR forces may need.

7-4. FORCE PREPARATION

Search and rescue forces may become isolated in enemy territory. Therefore, they must be aware of the enemy's capabilities. SAR forces should have the latest intelligence information about the area they will penetrate. Information useful to SAR forces includes the-

Location of enemy forces in areas pertinent to the mission.

Internal political situation.

Specific hostile areas in Threat and neutral countries.

Geography and climate of each country.

7-5. PROCEDURES

a. Distressed persons may help effect their rescue by following specific procedures. They must recognize that the basic requirement for recovery is information. The information distressed persons must provide to rescue personnel includes-

The need for assistance.

Their location and identity.

Adjacent recovery vehicle sites.

b. Combat search and rescue forces must be prepared to accomplish procedures listed in AR 525-90. They must be thoroughly familiar with-

Survival equipment and escape and evasion aids.

Bailout, ditching, crash landing, and other emergency procedures.
Survival techniques and procedures that apply to climate, terrain, and fallout contamination.
Communication equipment, combat rescue signals, and other actions necessary for evacuation to friendly control.
Rescue equipment, recovery subsystems, and operational techniques. (If not disabled, survivors function as the ground-based extension of the SAR team. They provide on-scene and recovery area intelligence and assist in the recovery operation.)
The location of removal areas, lifeguard stations, submarine pickup points, and aircraft on-station positions pertinent to their particular mission and procedures for using the areas or points.
Authentication system procedures. (These are discussed in paragraph 7-7f.)

c. Aviation unit commanders must be prepared to conduct internal search and rescue operations. Unit aviators must be familiar with evacuation procedures contained in unit OPORDs and be ready to implement them. Figure 7-1 shows the suggested format of a CSAR annex to an OPORD.

Figure 7-1. Suggested format of a CSAR annex to an OPORD

Figure 7-1. Suggested format of a CSAR annex to an OPORD (continued)

d. In-flight procedures consist of notification, bailout, and crash landing and ditching. Aircrews should attempt bailout over or near removal areas, lifeguard stations, submarine pickup points, or aircraft on-station positions. They should plan the bailout to facilitate regrouping on the ground. Upon reaching the ground, aircrews should initiate protective measures against enemy detection and hazardous NBC conditions. When the danger has passed, the crew moves toward removal areas or submarine pickup points. When the terrain or water necessitates a crash landing or ditching, aircrews should destroy or neutralize all classified equipment and documents on the aircraft and then destroy the aircraft.

7-6. AIR COVER

Rescue escort tactical aircraft and the rescue combat air patrol provide air cover to SAR units participating in recovery operations. Rescue escort aircraft that can operate within the same altitude, speed, and endurance regimes of the SAR and ACR forces will escort these forces to and from the recovery area.

a. Rescue Escort Tactical Aircraft. RESCORT aircraft-
Protect SAR vehicles en route to and from the recovery area from enemy ground fire.
Conduct short-range visual and electronic search sweeps to assist the SAR force in locating survivors.

Determine the level of enemy activity in the objective recovery area.
Suppress the enemy's interdiction capability in the objective recovery area.
Assume command and control functions for the SAR forces during area sanitation operations.
Coordinate activities of all SARTF elements when acting as the on-scene commander.

b. Rescue Combat Air Patrol Tactical Aircraft. RESCAP air-superiority tactical aircraft support the SARTF when the enemy attempts airborne interdiction of the SAR and ACR effort. RESCAP aircraft-

Patrol the area and protect survivors until the SARTF arrives.
Assist the SARTF in locating survivors.
Assist RESCORT aircraft in suppressing ground fire.
Protect against and suppress enemy air-to-air interdiction efforts.
Function as the on-scene commander for the SAR forces until SARTF elements arrive.

7-7. COMMUNICATIONS

Communications between distressed personnel and SAR personnel are essential to SAR operations. People in distress should use every means available to identify their locations and problems. In hostile territory, authentication is also required. The radio is the chief means of communication between rescue or combat forces and those in distress. If radio communication is lost, visual air-to ground and ground-to-air signals can be used.

a. Listening Overwatch. Unless the mission dictates otherwise, any aircraft operating in a hostile area will maintain a listening watch on emergency frequencies. Calls from distressed personnel are recorded verbatim and acknowledged if possible. When security conditions permit, the information is reported to the appropriate joint rescue coordination center.

b. In-Flight Emergency Communications. In-flight emergency communications are essential to SAR operations. If bailout, crash landing, or ditching appears imminent, the pilot attempts to establish radio contact. He calls on the frequency of the last contact, on an established common frequency, and on the international emergency frequencies. When the pilot has established communication or is "in the blind," he transmits the type of aircraft, tactical call sign, and position and course. He also transmits speed, altitude, nature of difficulties, and his intentions. The pilot continues to transmit a distress call on the appropriate emergency frequencies long enough to permit a direction finding plot of the aircraft's position if possible. He then turns the transponder to the emergency position.

c. Relay Transmissions. Relay support by friendly forces is an integral part of SAR operations. A friendly force (aircraft, ship, or submarine) receiving information concerning distressed aircraft or personnel forwards the information directly to the nearest friendly monitoring agency. However, relay transmissions should not interfere with the transmissions by people in distress. If a crash, bailout, or ditching is observed by another aircraft, that pilot relays the distress communication. He then transmits the call sign of the downed aircraft and the exact location, bearing, and distance from a well-known landmark. The pilot reports whether the downed crew is alive and under surveillance and whether he has radio contact with the crew. He also reports any enemy air or ground activity. The pilot remains in the area as long as fuel permits or until he is relieved.

d. Distress Calls and Signals. Personnel isolated in enemy territory will first concentrate on evading and surviving and then locating a suitable recovery site or area. Distressed personnel should not transmit distress calls "in the blind" or display international distress signals unless prebriefed to do so or friendly forces are known to be nearby.

(1) Distress calls.

(a) Precontact transmission. The initial distress call is a precontact transmission sequence followed by a listening period. First, the survivor turns on the locator beacon on the AN/PRC-90 for five to ten seconds and then turns it off. Next, he switches the radio to voice mode and makes emergency distress calls by repeating Mayday three times followed by his tactical call sign. Finally, the survivor listens for radio contact. Personnel isolated in hostile territory should not divulge their exact location, condition, or number of survivors unless they are certain of the authenticity of friendly forces. Even then, they should only divulge this information when requested to do so.

(b) After precontact transmission. Distressed personnel will remain alert for friendly aircraft, and CSAR aircraft will attempt to establish communication. SAR forces will require survivors to identify themselves, authenticate, and provide other information pertinent to the recovery. To make initial contact with CSAR forces, distressed personnel will use the call sign RESCUE followed by their tactical call sign. (For example, "RESCUE, this is KILLER 24.") The CSAR aircraft will then respond with its tactical call sign.

(2) Distress signals.

(a) Body signals. Figure 7-2 shows the body signals that survivors can use during the day once they have attracted the attention of CSAR aircrews. When making the signals, personnel should lie or stand in the open, go through each motion slowly, and repeat each signal until the SAR aircrew indicates it understands the signal. Figure 7-3 shows aircraft acknowledgment signals.

(b) International visual signals. Figure 7-4 shows ground-to-air signals for use by survivors, and Figure 7-5 shows ground-to-air signals for use by search party personnel. The symbols may be constructed from any available material that contrasts with the background; for example, parachute canopy strips, torn clothing, rocks, and sticks. The symbols should be at least 10 feet high.

e. Alternate Communications. The enemy may deny or hamper the use of radio communication. Therefore, distressed personnel may have to use other signaling devices such as mirrors, flares, colored panels, or lights to attract the attention of CSAR forces. Distressed personnel may also have to use alternate authentication methods that are theater approved.

f. Authentication Information. In wartime, the recovery of isolated personnel may depend on early authentication. Normally, isolated personnel will not receive assistance until their identity has been authenticated. Thus authentication information must be used in a manner that maintains security and viability.

(1) Security. Isolated personnel must not reveal authentication information to the enemy. Enemy forces may be able to use the authentication numbers or other information concerning an isolated person to deceive CSAR forces or keep them from properly authenticating an isolated person.

Figure 7-2. Body distress signals

Figure 7-3. Aircraft acknowledgment signals

Figure 7-4. Survivor ground-to-air signals Figure 7-5. Search party ground-to-air signals (2) Viability. Authentication information should be used in a manner that permits CSAR forces to authenticate isolated personnel over a long period. The techniques discussed in g(2) below will allow CSAR forces to authenticate an isolated person many times, if necessary.

g. Authentication System. Authentication of isolated personnel may be accomplished in several ways, depending on the situation. The principal method of authentication will probably be by radio using unit authentication numbers, data from the survivor's DD Form 1833, or locally developed authentication codes. Authentication can also be accomplished using visual signals or time-on target requirements. For personnel controlled or escorted in an escape and evasion net, authentication may also include fingerprints or a description of physical characteristics.

(1) Unit authentication. Tactical ground and aviation units are provided a unit authentication number consisting of four numbers. These numbers are assigned to units down to and including company or squadron level. Personnel assigned or attached to these units use the numbers for authentication purposes.

(2) Personal authentication. Aircrew authentication data consists of DD Form 1833. This form is completed by each person required to operate in or over hostile territory. It contains personal information for use by CSAR forces to positively identify survivors. After each crew member completes the card, it is classified CONFIDENTIAL and is maintained by appropriate unit intelligence or operations personnel. DD Form 1833 is completed in ink, except for items 3, 13, 14, 20 through 23, and 26 which are completed in pencil. An easily remembered four-digit number is entered in item 14. This is the individual's personal authentication number and should not be in the individual's military records or be public information. Aircrew members will review their DD Form 1833 at least semiannually. AR 525-90 contains additional information about DD Form 1833.

(a) When a member of the unit is missing or isolated in hostile territory, the unit forwards data from the individual's DD Form 183 to the appropriate RCC by the fastest secure means available. Information passed telephonically is followed by a message. The RCC or operations center disseminates data on the DD Form 1833 to other authorized agencies, including allied forces, who may assist in the SAR effort.

(b) When recovery operations prove unsuccessful or are abandoned, appropriate entries are made on DD Form 1833 and the information is filed. Copies of DD Form 1833 and other pertinent information are disseminated to other agencies according to theater directives.

(3) Local authentication codes. Units are encouraged to develop local SAR letters and colors for authentication codes. These additional authentication systems are published in the special instructions portion of the daily air tasking order and briefed to aircrews. The use of daily or frequently changed SAR letters and colors can immediately authenticate isolated personnel and increase the scope of the authentication system.

Section II

DOWNED AIRCRAFT PROCEDURES

7-8. COMMAND RESPONSIBILITIES

The procedures personnel follow in the event of a forced or crash landing will depend on the intensity of the threat and the organic capability of the aerial force. The proximity to the line of contact and the threat under which the recovery may be attempted will dictate the amount of time that is available to recover the aircraft and crew. Command responsibilities for executing downed aircraft procedures in low-threat, high-threat, and cross-FLOT areas are outlined below.

a. Low-Threat Area.

(1) The aviation unit commander-

Determines the extent of damage or injuries through communication or reconnaissance.

Notifies the controlling headquarters of the situation and requests assistance as required.

Coordinates the medical evacuation or evacuates injured personnel if medical assets are not available.

Coordinates with AVUM or AVIM units for battle damage assessment or repair teams.

Continues the mission.

(2) If able, the aircraft commander-

Administers first aid.

Removes, secures, or destroys critical items such as classified material, weapons, ammunition, and any other sensitive items.

Contacts the aviation unit commander on the emergency radio.

Assists in the recovery operation from the ground.

b. High-Threat Area.

(1) The aviation unit commander-

Determines the extent of damage or injuries through direct communication or, if time and mission allow, directs the reconnaissance.

Reports the situation to the appropriate authority and requests assistance.

Requests evacuation of the injured or evacuates the injured if medical assets are not available.

Evacuates all personnel if the mission allows.

Continues the mission.

(2) If able, the aircraft commander-

Administers first aid.

Removes, secures, or destroys critical items such as classified material, weapons, ammunition, and any other sensitive items.

Contacts the aviation unit commander on the emergency radio.

Assists in the recovery operation from the ground.

Secures the immediate area around the aircraft.

Prepares the aircraft for destruction on order or as dictated by circumstances.

Moves personnel, on order, to a rendezvous point or to the nearest friendly unit.

c. Cross-FLOT Area.

(1) The aviation unit commander-

Determines the crew's condition.

Records the aircraft's location.

Notifies the controlling headquarters or nearest ground forces when such communication is permitted or feasible.

Arranges for the dispatch of battle damage assessment or repair teams to recover the aircraft.

Arranges for the destruction of the aircraft if the crew is unable to destroy it.

Attempts evacuation of personnel if an air ambulance cannot be committed, if the mission will not be jeopardized, and if more aircraft will not be endangered unnecessarily.

Continues the mission.

(2) If able, the aircraft commander

Reports the situation to the aviation unit commander.

Destroys the aircraft and all sensitive equipment unless otherwise ordered.

Moves to a landing point indicated by rescue personnel.

Proceeds to a planned pickup point or follows the escape and evasion plan if evacuation is not immediate.

7-9. AIRCRAFT RECOVERY

The organic capability of the aerial force dictates whether a recovery can be attempted. If the tactical situation permits, the controlling headquarters of the downed aircraft-

Provides security for the downed aircraft and crew. (Ground forces may assist in providing security.)

Dispatches personnel and equipment to recover the aircraft.

Initiates rescue operations.

Authorizes destruction of the aircraft if it cannot be recovered.

NOTE: As a rule, the brigade or higher commander decides to destroy aircraft and associated equipment in imminent danger of capture.

7-10. AIRCRAFT DESTRUCTION

a. All units having aircraft and equipment that may be subject to capture must have a procedural plan. The plan outlines the extent of demolition to be performed; equipment destruction priorities; and, if applicable, explosives required. The plan addresses the time, equipment, and personnel required in any tactical situation.

b. To prevent the enemy from stripping equipment, unit personnel destroy essential aircraft equipment, including repair parts in stock, in priority sequence. When the lack of time prevents the complete destruction of equipment, priority goes to the destruction of essential parts. The same parts are destroyed

on all like items. Table 7-1 shows the priority sequence for the destruction of the aircraft and equipment.

Table 7-1. Destruction priorities for aircraft and equipment

7-11. DESTRUCTION METHODS

Aircrews follow established procedures for the destruction of aircraft by demolition, mechanical means, or fire. Aircrews remove and discharge all portable fire extinguishers and discharge permanently installed fire extinguishers. They activate all self-destruction devices and remove all publications and destroy them by fire. Aircrews can use natural surroundings to conceal equipment and repair parts.

a. Demolition. Self-destruction is an excellent way to destroy classified equipment. Built-in self-destruction devices should be given a chance to work before incendiaries or explosives are used to destroy the aircraft. An explosion might otherwise blow parts or classified material into enemy-held territory. Aircrews can request assistance in the use of demolitions from engineering units in the area.

b. Mechanical. Improper engine operation may be only a temporary condition. After the engine cools, it may be operative again. Aircrews can destroy auxiliary power unit engines by draining all oil from internal working parts and operating the engines until seizure occurs. They can also destroy an engine by firing a grenade launcher or small arms weapon into the front or rear case of the engine.

c. Fire. Fire is an effective method of destroying low-melting point metal items and equipment made from flammable materials. Aircrews should complete mechanical destruction before initiating destruction by fire. Aircrews can destroy metallic items by packing flammable materials, which have been soaked with a flammable petroleum product, under and around the items and igniting them. Concentrated flammable materials result in a hotter and more destructive fire.

CAUTION
Self-destruction devices should be displayed in a prominent location (usually a button marked in red) and shielded to prevent accidental activation.

WARNING
Explosives should be used in areas free of people to prevent injury caused by flying fragments.

WARNING
Improper destruction of aircraft and equipment can be extremely dangerous. In propeller-driven aircraft, engine seizure can cause the crankshaft or propeller shaft to fail. Crews should evacuate the aircraft and stay clear of the propeller and turbine wheel areas.

(1) Before igniting a fire, aircrews should-
Remove and invert the battery.

Remove the engine cowling and smash the fuel control and manifold.

Smash instruments and avionics equipment and cut control cables, wire bundles, and hydraulic lines.

- Break off antenna masts and pitot tubes, open oil and fuel drain cocks, break oil lines, and

puncture fuel cells outside the aircraft.

Soak the interior of the aircraft with fuel.

(2) To ignite the fire, aircrews can-

Discharge a signal cartridge, a flare, or an incendiary grenade into the vapor field from a safe distance.

Prepare a narrow fuel trail to a safe distance from the fuel vapor field and ignite the fuel with an ignited rag or paper attached to the end of a pole at least 6 feet long.

Create a spark within the fuel vapor field by placing an aircraft battery away from the field and positioning the bare ends of two insulated wires .020 inch apart (within the field) and touching the opposite bare ends of the wires to the battery posts.

d. Concealment. Aircrews can dispose of equipment and repair parts by using natural surroundings. They can submerge the items in water (lakes, ponds, bogs, and swamps). Personnel can also hide equipment in caves or bury it. If the surrounding area does not lend itself to such disposal, aircrews can disperse the material in heavy underbrush. This can deny or delay the enemy's discovery or use of the equipment.

WARNING
Petroleum products are highly flammable. Personnel must exercise extreme care when using them.

7-12. REPORTS

Reports of downed aircraft must be accurate and concise. They must include-

Aircraft identification and location.
Personnel injured and whether they can continue the mission.
Estimate of aircraft damage (total, major, minor).
Evidence of chemical contamination.
Enemy situation to include the air defense artillery threat.
Aircraft accessibility.
Pilot's intentions.

Section III

SIGNALING AND RESCUE DEVICES

7-13. STANDARD-ISSUE SIGNALING DEVICES

Emergency signaling equipment makes objects or people easier to find. It aids SAR forces by furnishing information about the plans, position, accessibility, and physical condition of downed aircrews. The type of signals and the speed with which they are sent may determine the time it takes for rescue. Signaling materials, whether natural or artificial, should be ready for immediate use. Therefore, the location for each signaling device should be selected carefully. Each crew member must know how to use the different types of signals. In friendly areas, any signaling methods may be used. In hostile areas, however, signaling methods may be limited because some devices alert enemy forces as well as friendly forces. Some standard-issue signaling devices are discussed below.

a. AN/PRC-90 Radio. The AN/PRC-90 radio, illustrated in Figure 7-6, is a dual-channel, battery-powered personal survival transceiver. It is used principally for two-way voice communication between downed aircrews and rescue aircrews. The AN/PRC-90 has a swept frequency beacon (243.0 megahertz) signal to guide rescue personnel. Battery life in the beacon mode is 14 hours. The AN/PRC-90 is issued to all Army aircrews. In an emergency or a tactical situation, aircrews should follow the procedures described below for operating the AN/PRC-90 in hostile territory.

(1) Select the highest exposed point (hill, rooftop, or uppermost portion of the aircraft). Set the radio in a secure upright position with the antenna oriented vertically and fully extended. Avoid placing the antenna near metal uprights or other antennas or rock formations that may contain conductive minerals. If the aircraft is in the water, keep the radio and the antenna as high as possible above the water.

(2) Set the function switch to the BCN 243.0 position. Leave the radio in this mode until search aircraft, ships, or vehicles appear. (Failure to do so will interfere with direction finding equipment and could terminate the search.) Use this mode for at least 14 hours or until the search vehicles are contacted.

(3) If there is reasonable doubt about beacon operation, make occasional brief voice or MCW Mayday/SOS transmissions. Limit transmissions to daylight hours for best dissemination. Follow a two-minute on, one-minute off; three-minute on, two-minute off; and ten-minute on procedure. Transmit the Mayday/SOS just after sunrise, at noon, and near sundown to take advantage of improved dissemination. Meteorological conditions will affect transmission range and quality.

Figure 7-6. AN/PRC-90 radio

(4) To transmit VOICE or MCW, set the function switch counterclockwise to the VOICE/MCW 243.0 position. Either repeat Mayday at two- or three-second intervals by pressing the PUSH-TO-TALK button or send a coded SOS by pressing the MCW button. Set the VOL control to the MAX position.

NOTE: Direction finding in the MCW mode is difficult. The primary purpose is to ensure that the search operation continues. Battery life is reduced by voice or MCW operation.

NOTE: Attempt to make the SOS code side-tone well defined and rapid enoug experienced operators to easily recognize it. It will have a "di-di-dit, dah-dah

dit" sound with spacing between the groups. The code explanation appears o panel of the AN/PRC-90 radio.

(5) When a rescue aircraft is within sight, call the rescue radio operator by turning the function switch clockwise to the VOICE/MCW 243.0 position and by using the calling procedure outlined in Table 7-2. Press the PUSH-TO-TALK button, speak in a normal voice, and stand near the microphone during transmissions. Adjust the VOL control to an adequate level for the speaker or earphone.

(6) Leave the controls set for voice operation until rescue personnel are within speaking distance or until otherwise directed.

> **NOTE: Widely separated aircrews may transmit simultaneously. Rescue operators will assign the transmission frequency to avoid carrier interference on the same channel or advise changing the function switch to the alternate channel (VOICE 282.8). If contact is broken, personnel should return to the VOICE/MCW 243.0 position and repeat the above procedure.**

Table 7-2. Recommended voice operating procedures

b. Personnel Locator System. The PLS is a set of airborne electronic equipment designed to quickly and precisely locate survivors equipped with the AN/PRC-112(V) radio set (survival radio). The PLS can indicate direction to any source of continuous wave UHF signals, such as the AN/PRC-90, and provide two-way UHF voice communication. The PLS radio operates in the UHF band between 225.0 and 300.0 megahertz and is tunable in 25-kilohertz increments. To locate a survivor, the PLS transmits short-coded messages to the AN/PRC-112(V). The internal transponder in the AN/PRC-112(V), which is designed to respond only to its ID code, transmits a coded message back to the PLS. The PLS decodes the message, and the RDU displays ranging and directional information. The PLS provides bearings to any AM, FM, or CW source that operates in the 225.0 to 300.0 megahertz band. It can store up to nine AN/PRC-112(V) ID codes simultaneously. Survivor frequencies and ID codes provided to rescue crews must be documented and safeguarded. To assist in the rescue, crews will be provided with additional information from DD Form 1833. (This form is discussed in paragraph 7-7g(2).)

(1) The voice, beacon, and covert transponder ID characteristics of the AN/PRC-112(V) survival radio enable it to do more than yield the precise location of downed aircrews. It also can be used when pinpoint location is needed for tracking combat patrols, locating forward controllers, performing MEDEVAC missions, conducting combat resupply, and performing all-weather approaches to assault zones. The AN/PRC-112(V) is easy to operate even under the most difficult conditions. It has two switches (an ON-OFF/VOL control and a MODE/FREQUENCY selector). The MODE/FREQUENCY selector has three operating modes: voice, swept-tone beacon, and DME transponder. Figure 7-7 shows the AN/PRC-112(V) survival radio.

Figure 7-7. AN/PRC-112(V) survival radio

(a) The AN/PRC-112(V) has five operating frequencies: 243.0 and 282.0 megahertz (UHF/AM band), 121.5 megahertz (UHF/AM band), and two programmable frequencies in the 225.0- to 300.0 megahertz UHF/AM band. A high-efficiency, flat-whip antenna can be wrapped around the radio for storage.

(b) The AN/PRC-112(V) weighs only 28 ounces and fits in the palm of the hand. It is waterproof to 50 feet under water and will operate from -40ø to +50øC. The predicted battery life is seven hours with 90 percent receive and 10 percent transmission time.

(2) The airborne equipment of the PLS is a guidance system that includes a compact radio transceiver, high-gain antenna set, control unit, and instrument panel display. The modular system is light and compact. It can be easily installed in 30 minutes in UH-1 or UH-60 aircraft. Figure 7-8 shows the

AN/ARS-6 control and display. The control and display are readable in sunlight and compatible with night vision devices. The AN/ARS-6(V) is controlled from the CDU. Operators program Channels A and B frequencies as desired (3,000 channels from 225.0 to 300.0 megahertz) or select preset 243.0 and 282.8 megahertz channels. Operators then enter ID codes for up to nine AN/PRC 112 transponders. When operators complete the programming, they select the operating mode. The CDU offers the rescue team three modes of operation: homing, continuous, and burst.

Figure 7-8. AN/ARS-6 control and display

(a) Homing. In the homing mode, the AN/ARS-6(V) operates as a simple direction finding receiver. It homes in on any transmitter operating on the selected frequency.

(b) Continuous. In the continuous mode, the transmitter repeatedly interrogates the transponder in the downed crew's radio. Because this mode requires continuous battery power, it reduces the battery life of the radio.

(c) . In the burst mode, the AN/ARS-6(V) uses spread-spectrum bursts. Rescue personnel trigger each interrogation with manual commands. Guidance information is displayed only momentarily using this mode. As a result, this mode requires less battery power from the survivor's AN/PRC-112 radio. It hampers enemy direction finding and other electronic warfare efforts.

(3) The RDU is mounted on the aircraft instrument panel. Range to target is presented in nautical miles when the distance to the survivor's AN/PRC-112(V) radio is more than 10,000 feet. Distances less than 10,000 feet are displayed in feet. Directional information is presented on a bar display that indicates the position of the target relative to the heading of the aircraft. A single bar display indicates that the aircraft is aligned with a direct bearing to the survivor's radio. More than one bar indicates that the aircraft must turn toward the bars to reestablish a direct bearing to the survivor's radio. Like the CDU, the RDU is readable in sunlight and compatible with night vision devices. Figure 7-9 shows the RDU with

indications that the survivor's radio is 5,900 feet from the aircraft. The bars indicate that the aircraft must turn right (toward the four bars) to reestablish a direct bearing to the survivor.

Figure 7-9. Remote display unit

(4) A continuous, real-time display of survivor positions is available when the AN/ARS-6(V) is integrated with other aircraft sensors. After initial positions are acquired, the latitude and longitude of each transponder are calculated and stored. The rescue aircrew then plans and flies a low-level approach, and the PLS remains silent. As the rescue team approaches the target, it may refine PLS position fixes and employ two-way voice radio communication with the downed aircrew. However, the PLS can bring rescuers within 50 feet of the target without voice communication. During testing, the PLS was 99 percent accurate on the first pass. The effective range of the PLS is estimated to be 100 nautical miles and is restricted to line-of-sight conditions.

c. AN/MK-13 Flare. The AN/MK-13 flare (mark 13, mode O) is available through supply channels. One version has plastic caps, and the other has cardboard caps. The plastic caps are color-coded to correspond with the day and night ends. The night end (red) has three protrusions for night recognition. The cardboard caps deteriorate and become detached through routine handling. A washer is attached to the night end lanyard for touch recognition if night operation is required and either of the caps is lost. The AN/MK-13 is identified as a Class C explosive. (TM 38-250 discusses the preparation of hazardous materials.) The flare or a similar pyrotechnic is carried aboard Army tactical aircraft.

d. MK-3 Signal Mirror. The MK-3 signal mirror, shown in Figure 7-10, is an excellent signaling device. Crews should practice using it in advance. They should flash the mirror in the direction of the sound of the aircraft even though they cannot see the aircraft. Even on hazy days, rescue personnel can see the

flash of a mirror before they can see the aircraft. If a signal mirror is not available, crews can signal with any object that is shiny on both sides. To use the MK-3, aircrews should-

Reflect sunlight from the mirror onto a nearby surface.

Bring the mirror up to eye level slowly and look through the sighting hole. (The bright light is the aim indicator.)

Hold the mirror near the eye, turn it slowly, and then manipulate it so that the bright light is on the aiming point.

Use the mirror freely in friendly areas and continue to sweep the horizon even though an aircraft or a ship is not in sight.

- Use the signal mirror only as an aimed signal in hostile

areas. Figure 7-10. MK-3 signal mirror

7-14. IMPROVISED SIGNALING DEVICES

a. Smoke.

(1) Fire with white or black smoke is the most effective improvised device for signaling aircraft flying overhead. White smoke can be produced by burning green vegetation such as leaves, moss, or ferns. Black smoke can be produced by burning fuels such as oil-soaked rags, rubber, or

electrical insulation. Laying these fires out in patterns makes an effective nighttime signal. In some cases, fires have been sighted as far as 50 miles away. The average range varies with the size and the presence or absence of other nearby light sources.

(2) To indicate an international distress, distressed personnel should arrange three evenly spaced fires in a triangle. At night, the flames should be as bright as possible; during the day, they should produce as much smoke as possible. Smoke signals, however, are ineffective during high winds, rain, or snow because the smoke is dispersed, which lessens the chance of detection. Smoke signals are more effective in open terrain than in heavily wooded areas. Smoke that contrasts with its background is more easily seen. For example, dark smoke is effective against snow, and white smoke is effective against dark vegetation. Distressed personnel should prepare the fire before the arrival of rescue personnel and start it after their arrival.

b. Rescue Panels. Emergency crash and rescue panels can be used for signaling. However, these panels can only be used in open terrain during the day. In windy conditions, the panels should be staked down.

WARNING

To avoid attracting the enemy, distressed personnel must consider the enemy situation and the terrain before using smoke.

7-15. RESCUE DEVICE (FOREST PENETRATOR)

The forest penetrator, shown in Figure 7-11, is one type of rescue device used to hoist conscious personnel. It may be used in clearings, in forests, and where a suitable landing area is unavailable. The Sked litter is used for personnel who are unconscious or unable to ride the forest penetrator because of their injuries.

a. Operation. The penetrator is equipped with three seats spring-loaded in a folded position against the body or main shaft. The seats must be pulled down to the locked position for use. A zippered fabric storage pouch is located on the main shaft or tube (above the seats). The body's safety straps are stored in this pouch. The forest penetrator may be equipped with a flotation collar. The hoist operator should release enough cable to contact the ground. Thus static electricity can be discharged when the penetrator is lowered to a survivor. **WARNING**

To avoid possible shock, personnel on the ground should not touch the penet it has contacted the ground.

Figure 7-11. Forest penetrator

(1) To secure himself on the forest penetrator, the distressed person should put the safety strap around himself. He should check to ensure that the safety strap does not become fouled in the hoist cable. After the strap is in place, the distressed person should pull the seat down sharply to engage the hook that holds it in the extended position. Then he should sit down. Once seated, he should tighten the adjustable safety strap, which is designed to act as a sling or horse collar. The distressed person should double-check to ensure that he is not entangled in the hoist cable and then give the

signal to be lifted.

(2) In a hostile area, the distressed person may be lifted out of the area with the cable suspended before he is brought into the helicopter. He should ensure that he is correctly and securely positioned on the pickup device. The distressed person should hold the seat tightly against his crotch to prevent injury when slack in the cable is taken up. He should also keep his hands below and away from the swivel on the cable, his arms around the penetrator's body, and his head close to the penetrator's body. In doing so, the distressed person ensures that obstructions do not come between him and the hoist cable.

(3) The hoist operator turns the distressed person's face away from the helicopter and pulls him inside when he is level with the floor. The distressed person should not attempt to help the hoist operator unless asked. This procedure lessens the chance of accidentally activating the hoist operator's cable cutter switch, which is mounted on the top of the hoist control box. Once the penetrator is safely inside the helicopter, the hoist operator disconnects it.

b. Payload Capability. The forest penetrator can accommodate three people on a single lift. However, the maximum lift capacity of the rescue hoist is 600 pounds. The lift capability of the aircraft may be reduced because of performance characteristics and density altitude.

c. Safety Guidelines. A distressed person should-

Avoid touching the penetrator until it has been grounded.

Put the safety strap on and fasten it as quickly as possible.

Hold the seat snugly against the crotch (as conditions permit) before being hoisted.

Ensure that the penetrator does not become fouled in the hoist cable.

Keep hands below the swivel to avoid possible injury from the air craft skids or the up-limit switch.

Keep head close to the penetrator's body.

Not assist the hoist operator unless requested to do so.

WARNING
To avoid possible injury, the distressed person should keep his arms down with his elbows locked against his body. He should not grab the cable or weighted snap link.

Section IV

SURVIVAL EQUIPMENT

7-16. INDIVIDUAL SURVIVAL KITS

Individual survival kits will be carried aboard all Army aircraft when operated in hot or cold climates or over water. The kit, which weighs 29 pounds and measures 5 1/2 x 15 x 19 inches, is stored in a canvas case with a webbed handle and two parachute attaching straps. The kit can be attached to a personnel parachute harness. Individual survival kits for hot and cold climates and overwater conditions include some of the same items.

7-17. SUPPLY AND EQUIPMENT AIRDROP

The RCC controller may have aircraft that can drop supplies and equipment to survivors at sea or on land. The crews involved are trained in the specialized techniques required to make these drops. The SOP for each aircraft should describe individual dropping techniques.

a. Supply Drop Requirements. When deciding if a supply drop is necessary, the RCC controller and SAR crews evaluate the location of the distress site in relation to the rescue forces. They also evaluate the expected elapsed time until the rescue can take place, the condition of the survivors, and the urgency of relief.

b. Survival Equipment Packages. Survival equipment packages should contain a listing of contents and self-explanatory symbols. Written instructions should be in English, French, and the local language. Survival equipment should be appropriate to the region where it is likely to be dropped. The packages should be color-coded (colored parachutes or streamers) to indicate the contents. Table 7-3 shows the

color coding of survival items.

Table 7-3. Color coding of survival items

c. Survival Equipment Maintenance. Survival equipment should be maintained in a fully serviceable condition. Personnel should inspect the equipment according to established maintenance schedules.

Section V

RESCUE METHODS AND PROCEDURES

7-18. RESCUE METHODS

a. A rescue effort starts immediately after a distress scene is located or when a ditching or crash landing is reported. The responsible SAR coordinator decides the method and facilities to use for the rescue attempt. The coordinator considers the-

Action that should be taken by the sighting facility and other facilities at the scene.

- Location of survivors (on land or water), type of terrain, and distance from the shore and operating
bases.

Condition of survivors and whether urgent medical attention is required.

Accountability of distressed personnel.

Rescue facilities available and their state of readiness.

Weather conditions and the time of day.

b. After the survivors are located, the SAR forces will do everything possible to make the RCC's task easier. They will assist those who conduct the rescue, conduct an investigation, and aid the survivors. The SAR crews will fly low over survivors and signal them that they have been located. Then they will drop communications equipment, survival stores, and a radio beacon. In reporting the sighting, the RCC will provide critical information. This information includes the-

Position of the distress site.

Conditions at the distress site.

Condition and number of survivors.

Aid (medical and other) required.

Type of survival equipment dropped and equipment needed.

Signals (air and ground) received from the survivors.

Current meteorological conditions.

Amount of fuel remaining on the search aircraft and estimated time of departure.

c. Search and rescue crews will direct other needed rescue personnel and equipment to the scene. They will remain on station until they are relieved or forced to return to base or the rescue is completed.

7-19. HELICOPTER RESCUE PROCEDURES

Helicopters accomplish rescues by landing or hovering. Landings are more likely to be required at high altitudes because helicopter power is limited at these altitudes. Hovering the helicopter while hoisting a survivor aboard requires even more power. This procedure further endangers the aircraft and survivor. It is dangerous for helicopters to operate near collapsed parachutes. A parachute could become inflated by rotor downwash and injure the survivor, damage the rotor, or even cause a crash.

CAUTION
Exercise extreme caution when hoisting survivors from flammable or explosive cargo carriers or near a flammable mixture spillage. Ground the hoist clear of the spillage or the carrier's tank venting area to preclude a possible fire or explosion.

a. Rescue Helicopter Capabilities. Large helicopters can effect rescues with speed and certainty. Small helicopters, however, have less endurance and limited navigational equipment. Larger helicopters (some can refuel air-to-air) have a useful search capability, which is secondary to the rescue role. Helicopter crews normally perform rescues by landing on or near distress sites or on a suitable surface craft and by using a rescue device (with hoist) to lift the survivors from the land or water.

(1) When landing the helicopter, the aviator must ensure that the site is-

As level as possible.

Located in an area with the least amount of wind turbulence.

Large enough (of sufficient diameter) to accommodate the rotor blades.

Clear enough to provide the helicopter with suitable approach and takeoff paths.

(2) The aviator can recover survivors by hovering over them and by using a hoist with a rescue device to lift the survivors aboard. He should consider the same factors for selecting a hovering site as he does for selecting a landing site. Survivors can be hoisted directly from the water

or from life rafts. They may be hoisted without assistance. However, a crew member will usually be lowered to assist them, particularly if the survivors are injured.

b. Casualty Evacuation and Ship Transfer. Helicopters can rapidly evacuate casualties from ships or transfer them from the water or life rafts onto a large vessel. The procedures for casualty evacuation and transfer are briefly discussed below.

(1) The ship steers a course with the wind about 10 to 30 degrees off the port (left) bow, depending on the type of helicopter. The ship maintains a relative wind of 20 to 30 knots over the deck and sufficient speed through the water to give adequate steerage.

(2) In high winds of 40 to 50 knots, the ship steams downwind with the wind up to 30 knots on the starboard quarter (right) and a 20- to 30-knot relative velocity. Transfer is carried out from the bow.

(3) Normal transfers are carried out from the aft part of the vessel, and hoisting areas are cleared of all obstructions. The helicopter's hoist cable should never be secured to or allowed to foul any part of the ship.

(4) A special stretcher may be used for the transfer. It should be unhooked while the casualty is being strapped in. A crew member will usually descend to supervise the casualty lift.

c. Mountain Rescues. When flying a helicopter in mountains for a rescue, the aviator should expect strong turbulence in high winds and reduced available power at high altitudes and temperatures. He should watch for and avoid power lines and cables.

Section VI

SURVIVOR TREATMENT

7-20. SURVIVOR EMOTIONS

The ordeal of a survival situation may cause the survivor to act irrationally. Therefore, survivors should not be left alone until their mental and physical conditions have been carefully evaluated. An uninjured person may be suffering from severe emotional stress because of something he witnessed. Victims of or witnesses to a disaster often go through shock. While in a state of shock, these people perform actions mechanically; that is, they only do what they have to do. In some cases, survivors are violently unruly. If this occurs, rescue personnel should consider-

Assigning a person to watch the survivor.

Strapping the survivor to a litter or bunk.

Obtaining medical advice about possible medication.

Placing a rolled-up piece of cloth between the survivor's teeth to prevent him from biting his tongue if he is having a convulsion.

7-21. MEDICAL EVACUATION

After survivors are located, rescued, and treated, they must be evacuated to a medical care facility.

The injured person is often subjected to aerial flight because this is usually the most expeditious means of transportation. Operational hazards involved in the medical evacuation of survivors must be explained to the consulting physician if he is not aware of them. The physician will then decide if medical evacuation will do more harm than good. Rescue officials should advise the attending physician about the fear inducing nature of air operations if the patient is to be evacuated.

Section VII

MISSION DEBRIEFING AND EVALUATION

7-22. MISSION DEBRIEFING

When the SAR mission is completed, a debriefing should be conducted. The debriefing should include the-

Position and conditions at the recovery site, the number and physical condition of survivors, and the actions taken.

Area searched and the search pattern flown.

Weather conditions if the mission is not successful.

Percentage of the search area covered and the crew's estimate of the effectiveness of the search.

7-23. EVALUATION

All relevant information about the SAR mission is discussed and evaluated. The RCC controller should study the debriefing data carefully to evaluate the effectiveness of the search. The data is used to assist in planning subsequent operations and determining whether a search should be continued, extended, or abandoned. The debriefing may reveal shortcomings in personnel efficiency or equipment performance. The RCC controller can use that data to support the need for additional training or better equipment.

CAUTION

Helicopters should only land aboard surface vessels that have satisfactory communications and suitable landing decks.

Figure 7-1. Suggested format of a CSAR annex to an OPORD

Figure 7-1. Suggested format of a CSAR annex to an OPORD (continued)

Copy ___ of ___ copies
3-227th Avn Regt
Fliegerhorst (MA 9757), AQ
161000 Apr 90
AF 01

ANNEX J (COMBAT SEARCH AND RESCUE) TO OPERATION ORDER NO 51-90

References: See OPORD 51-90.

Time Zone Used Throughout the Order: Alpha.

1. SITUATION

a. Enemy Forces. See Annex B (INTELLIGENCE).

b. Friendly Forces. See OPORD 51-90.

c. Attachments and Detachments. See OPORD 51-90.

2. MISSION

As required, downed aircrews in hostile or contested territory avoid capture and effect recovery to friendly control. Organic aviation assets attempt to recover downed aircrews or locate their position for other CSAR forces.

3. EXECUTION

a. Concept of Operation.

(1) Maneuver.

(a) Once established on the ground, downed aircrews will attempt contact with and recovery by aircraft in the flight. If this is not possible or practical, the downed aircrews will escape and evade to the appropriate designated area recovery/extraction point. If recovery is not accomplished at the DARE point, aircrews should move to SAFE LBH01 and execute procedures as briefed for LBH01.

(b) UH-60 crews should plan missions to service DARE points IAW the DARE procedures listed in b below.

(2) Fires. Downed aircrews may call for suppressive fires from aircraft as required. When CSAR assets arrive on the scene, the recovery aircraft will assume responsibility for suppressive fires to avoid conflict with CSAR aircraft.

b. Coordinating Instructions.

(1) DARE assignments.

(a) Air Corridor Eagle: DARE 7 NB 159119.

(b) Air Corridor Hawk: DARE 9 NB 250159.

(2) DARE service windows.

(a) DARE 7 at 0300-0310, 17 Apr 90/18 Apr 90.

(b) DARE 9 at 0345-0355, 17 Apr 90/18 Apr 90.

Figure 7-1. Suggested format of a CSAR annex to an OPORD

Figure 7-1. Suggested format of a CSAR annex to an OPORD

(3) DARE procedures.

(a) Select a suitable recovery site at the DARE point and remain concealed.

(b) Note any enemy activity or emplacements that will affect recovery.

(c) Begin transmitting on 282.8 UHF for 15 seconds each minute, starting 5 minutes before the DARE window and continue through the window.

(d) Once communication is established with rescue, provide authentication and enemy situation and vector aircraft to the recovery site.

(e) Approach recovery aircraft with both arms up if possible.

(f) If no recovery is made by 17 Apr, wait 24 hours and try again.

(g) If recovery is unsuccessful on 18 Apr, begin movement to SAFE LBH01 and execute SAFE NFH01 procedures.

4. SERVICE SUPPORT

See OPORD 51-90.

5. COMMAND AND SIGNAL

a. Primary SAR frequency. 282.8.

b. Color of the day. Blue.

c. Number of the day. 8.

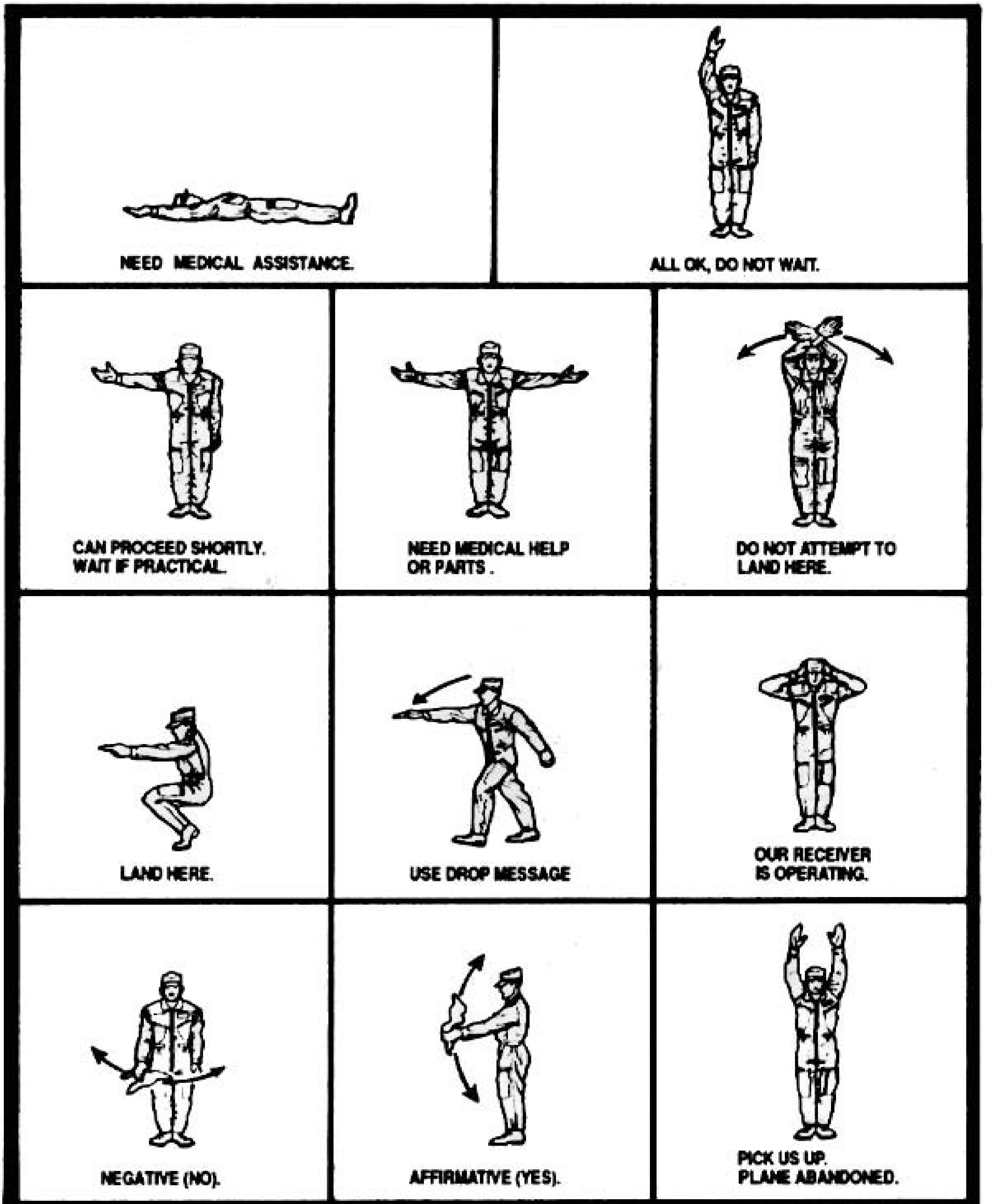
Acknowledge.

Signature

OFFICIAL:

S2

Figure 7-1. Suggested format of a CSAR annex to an OPORD (continued)


NEED MEDICAL ASSISTANCE.
ALL OK, DO NOT WAIT.
CAN PROCEED SHORTLY. WAIT IF PRACTICAL.
NEED MEDICAL HELP OR PARTS .
DO NOT ATTEMPT TO LAND HERE.
LAND HERE.
USE DROP MESSAGE
OUR RECEIVER IS OPERATING.
NEGATIVE (NO).
AFFIRMATIVE (YES).
PICK US UP. PLANE ABANDONED.

NEGATIVE (NO).	AFFIRMATIVE (YES).	PICK US UP. PLANE ABANDONED.

Figure 7-2. Body distress signals

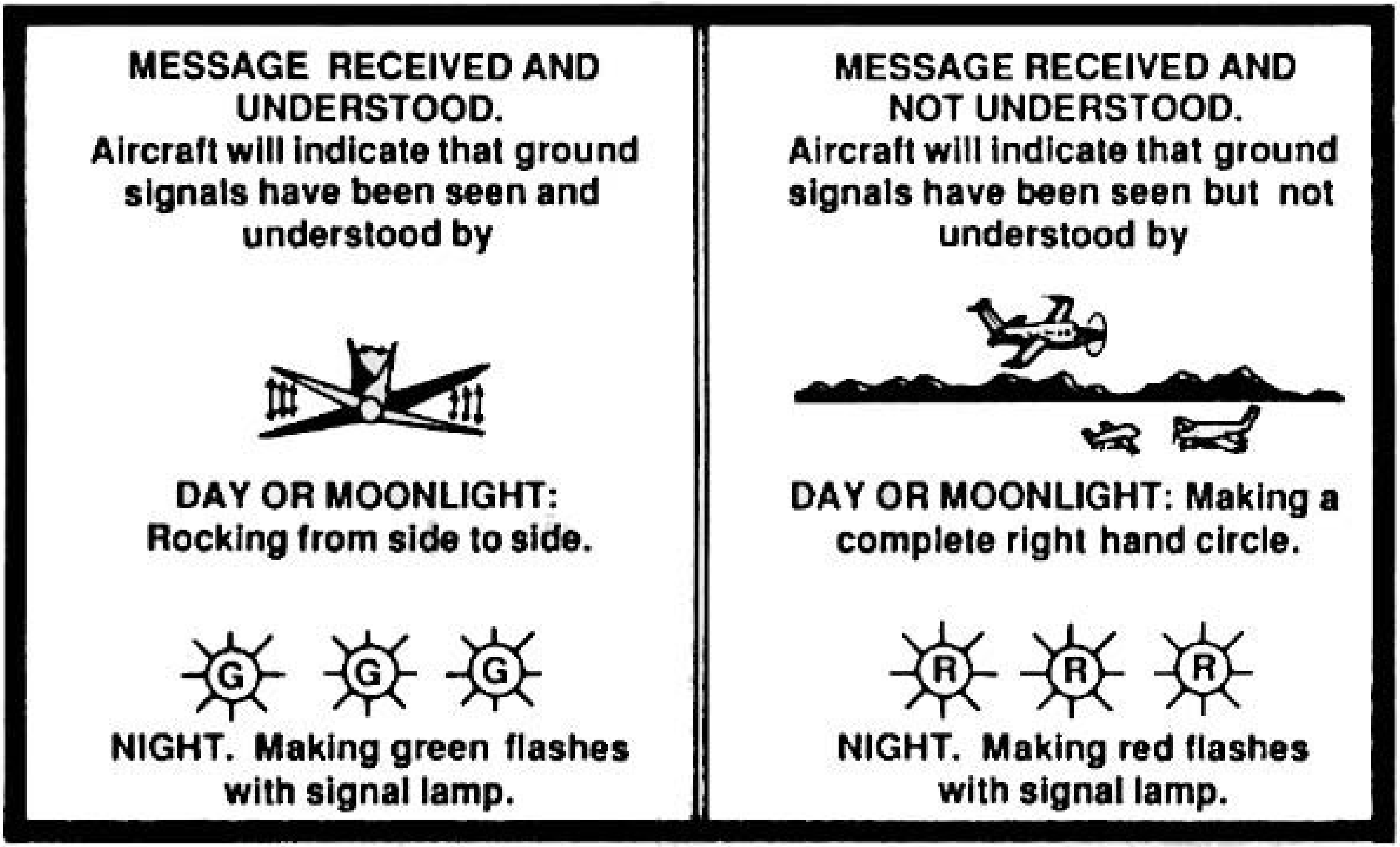


Figure 7-3. Aircraft acknowledgment signals

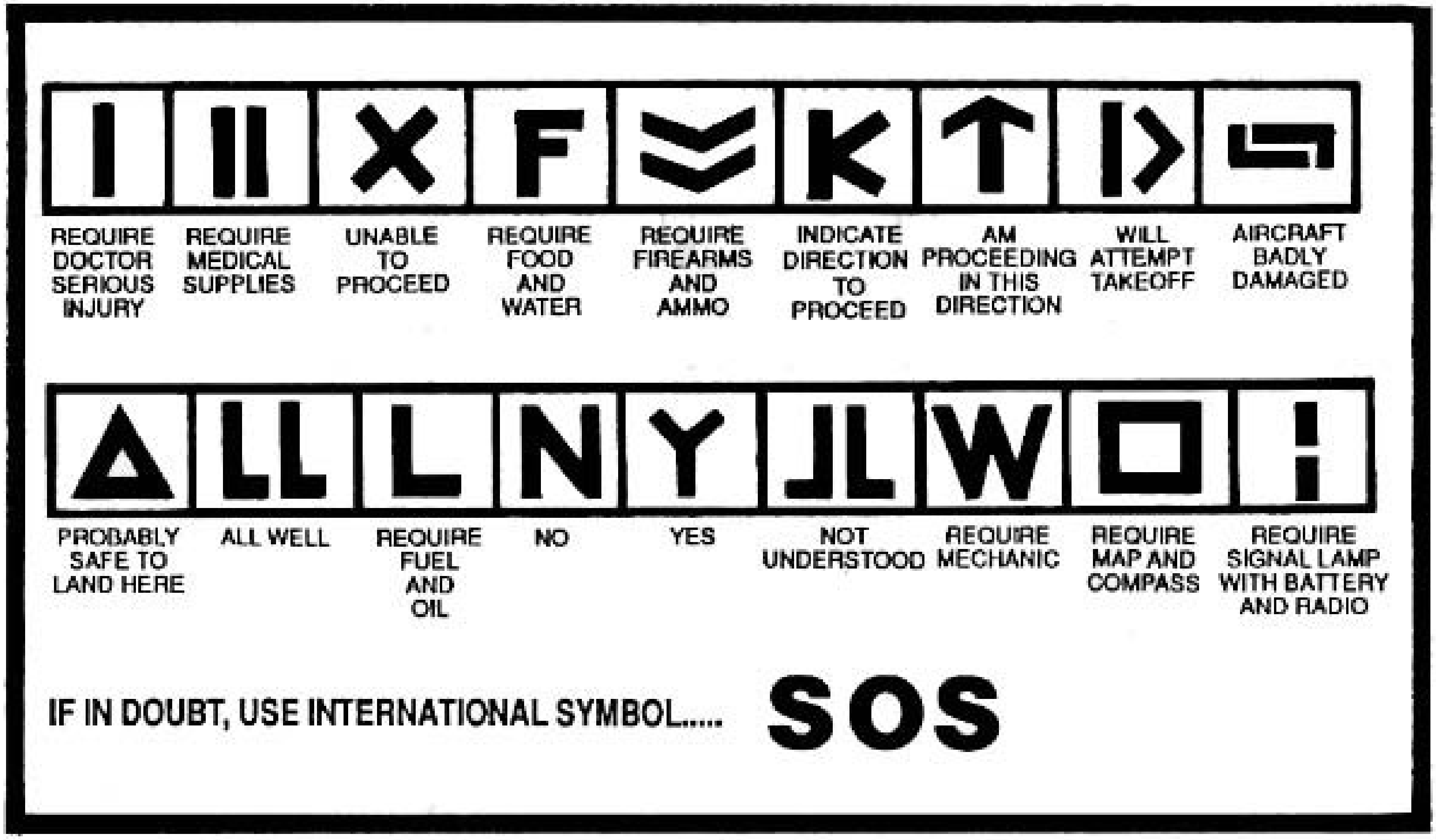


Figure 7-4. Survivor ground-to-air signals

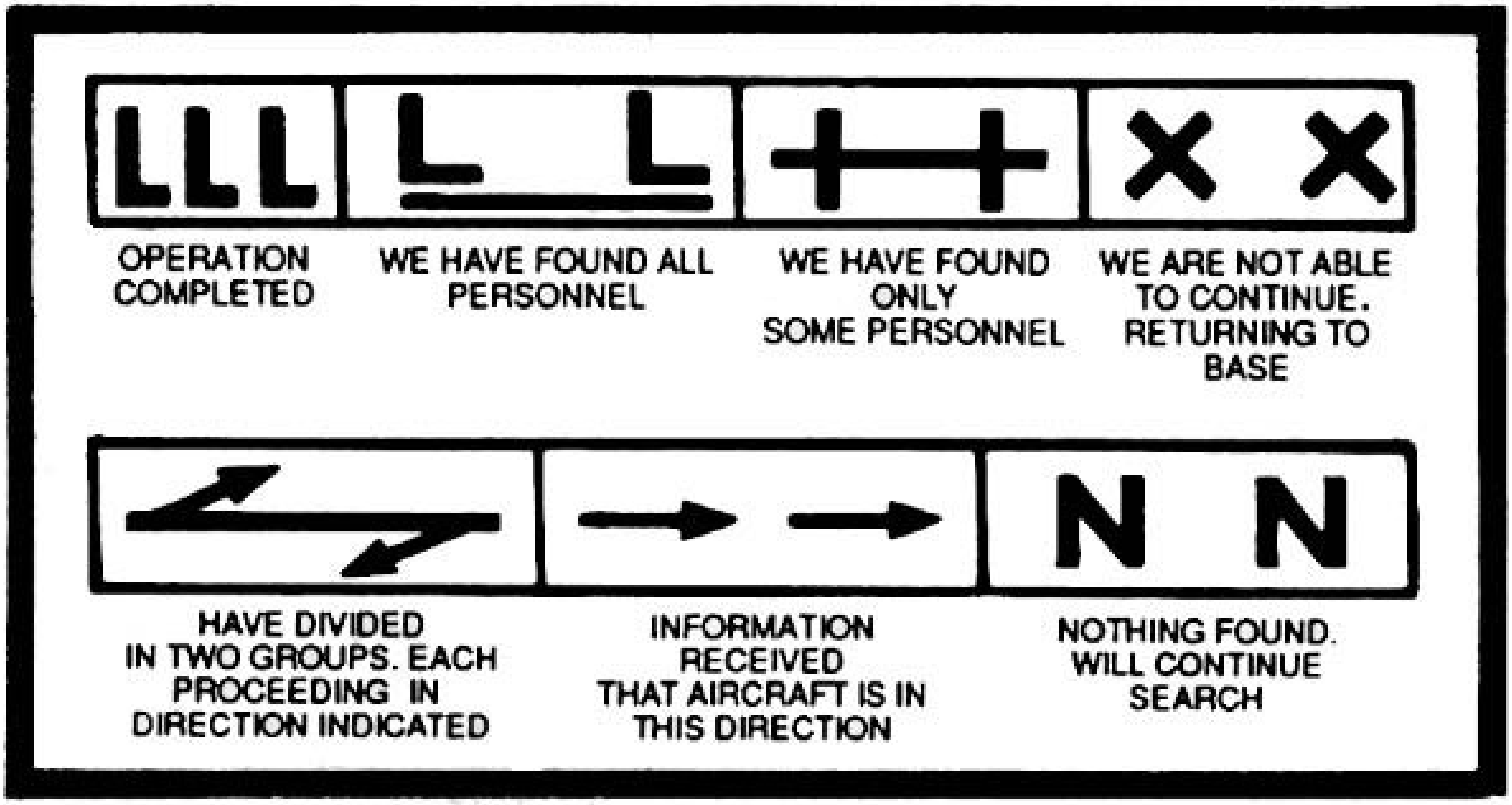


Figure 7-5. Search party ground-to-air signals

Table 7-1. Destruction priorities for aircraft and equipment

PRIORITY	PARTS
1	IFF equipment and classified electronic equipment with related publications and documents and other material as defined by the national government concerned
2	Installed armament
3	Engine assembly
4	Airframe, control surfaces, and undercarriage
5	Instruments, radios, and electronic equipment
6	Electrical, fuel, and hydraulic systems

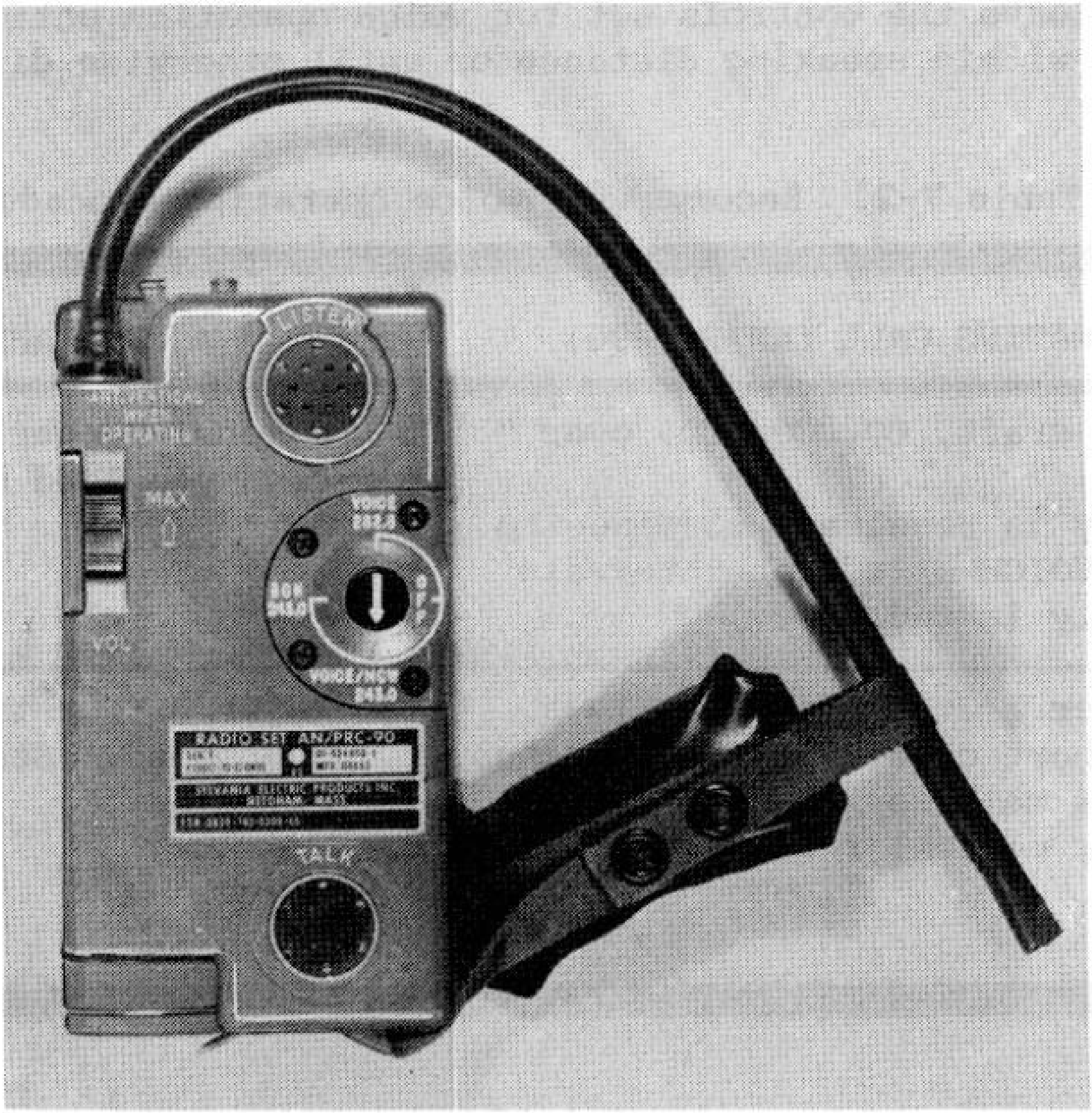


Figure 7-6. AN/PRC-90 radio

Table 7-2. Recommended voice operating procedures

ORIGINATING CALL (AN/PRC-90)	PROBABLE REPLY
"CQ rescue craft, CQ, CQ, CQ, over." (If no reply is received, continue to call CQ on VOICE or MCW at intervals until a reply is received.)	None or "Roger, roger, roger, read you loud and clear."
"Roger, roger. Crew status follows, over." (Report crew's physical status, missing crew members, and any emergency logistics or medical requirements.) "Roger, out."	"Roger. Your transmission understood. Stand by for reply, out."

Figure 7-7. AN/PRC-112(V) survival radio

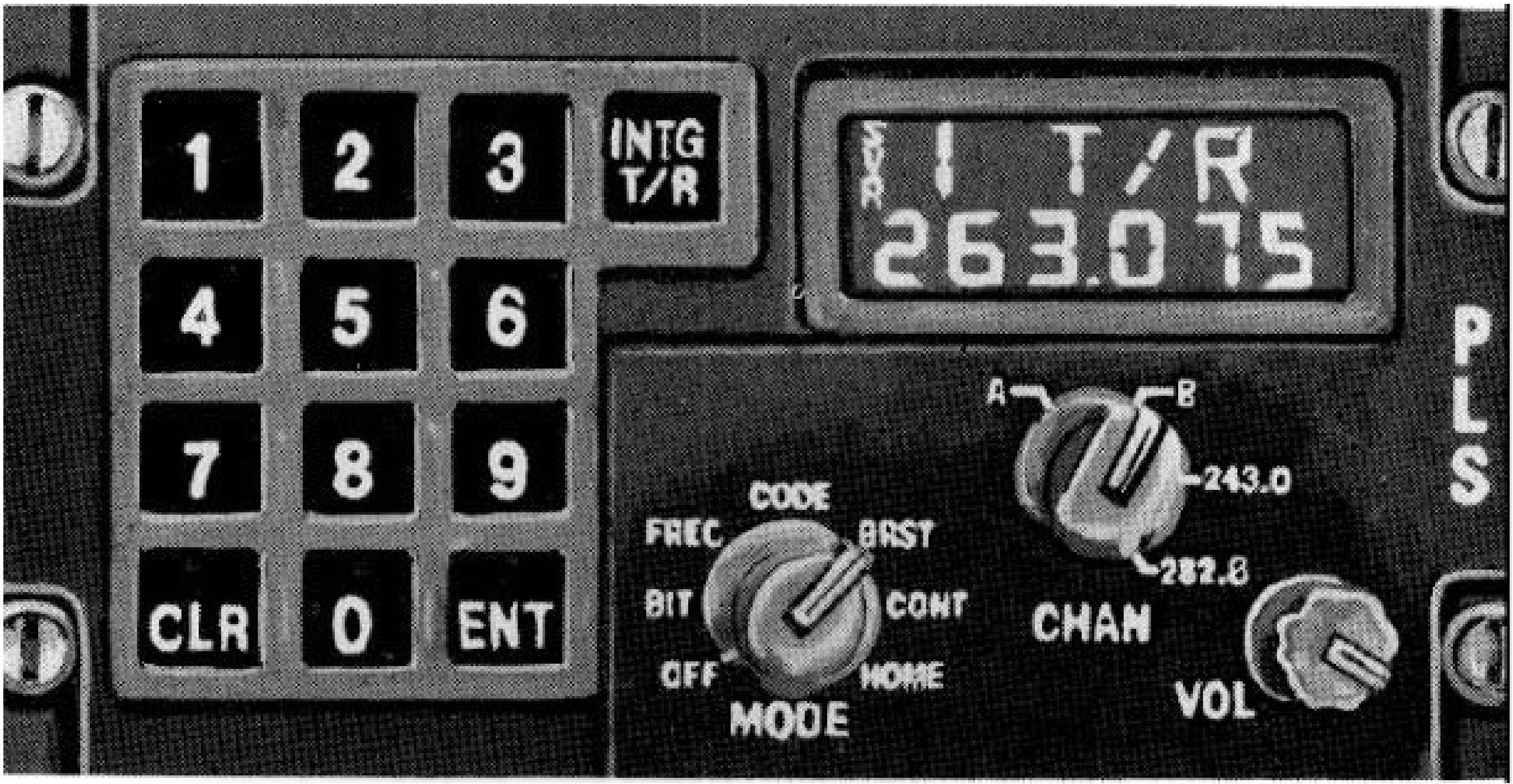


Figure 7-8. AN/ARS-6 control and display

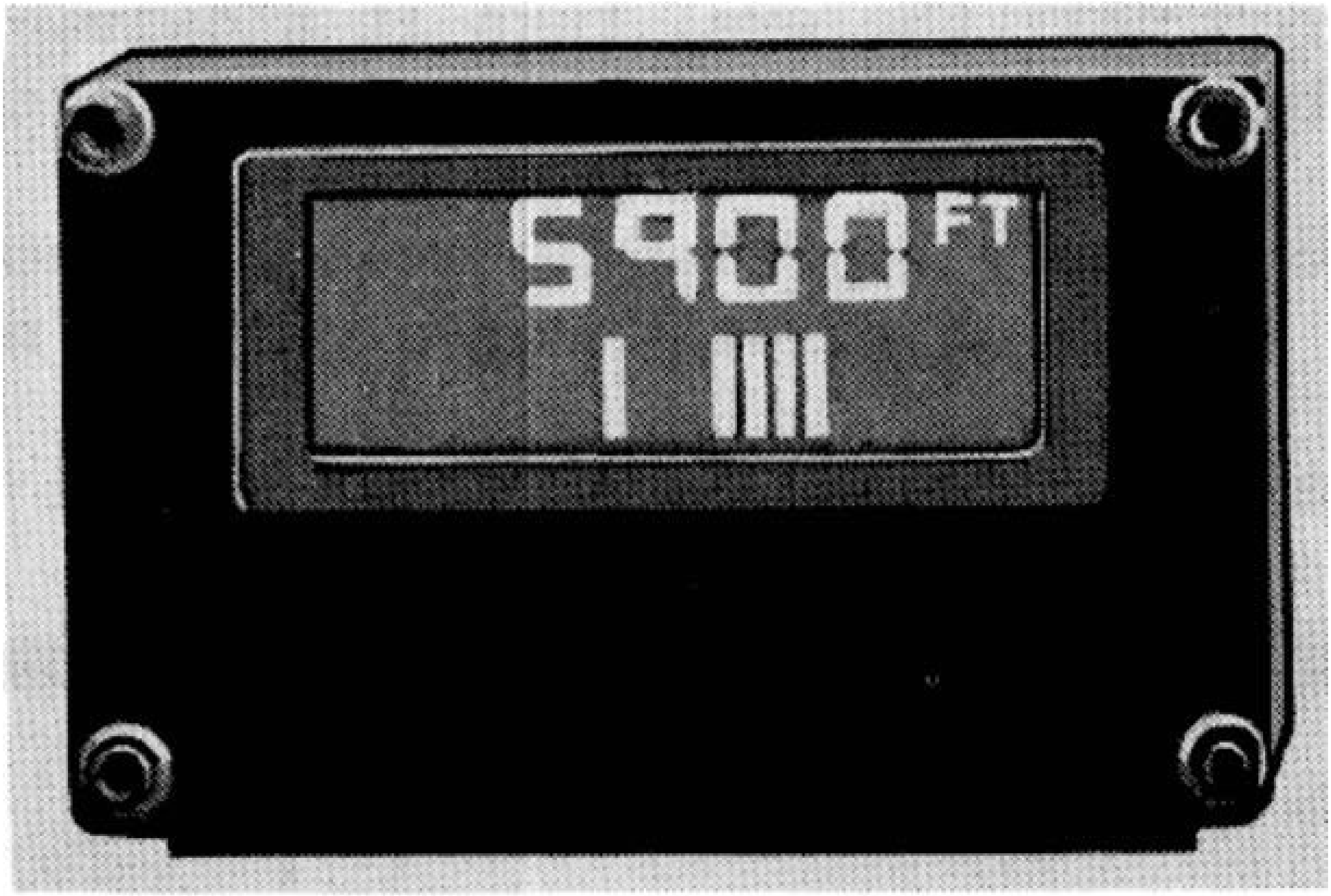


Figure 7-9. Remote display unit

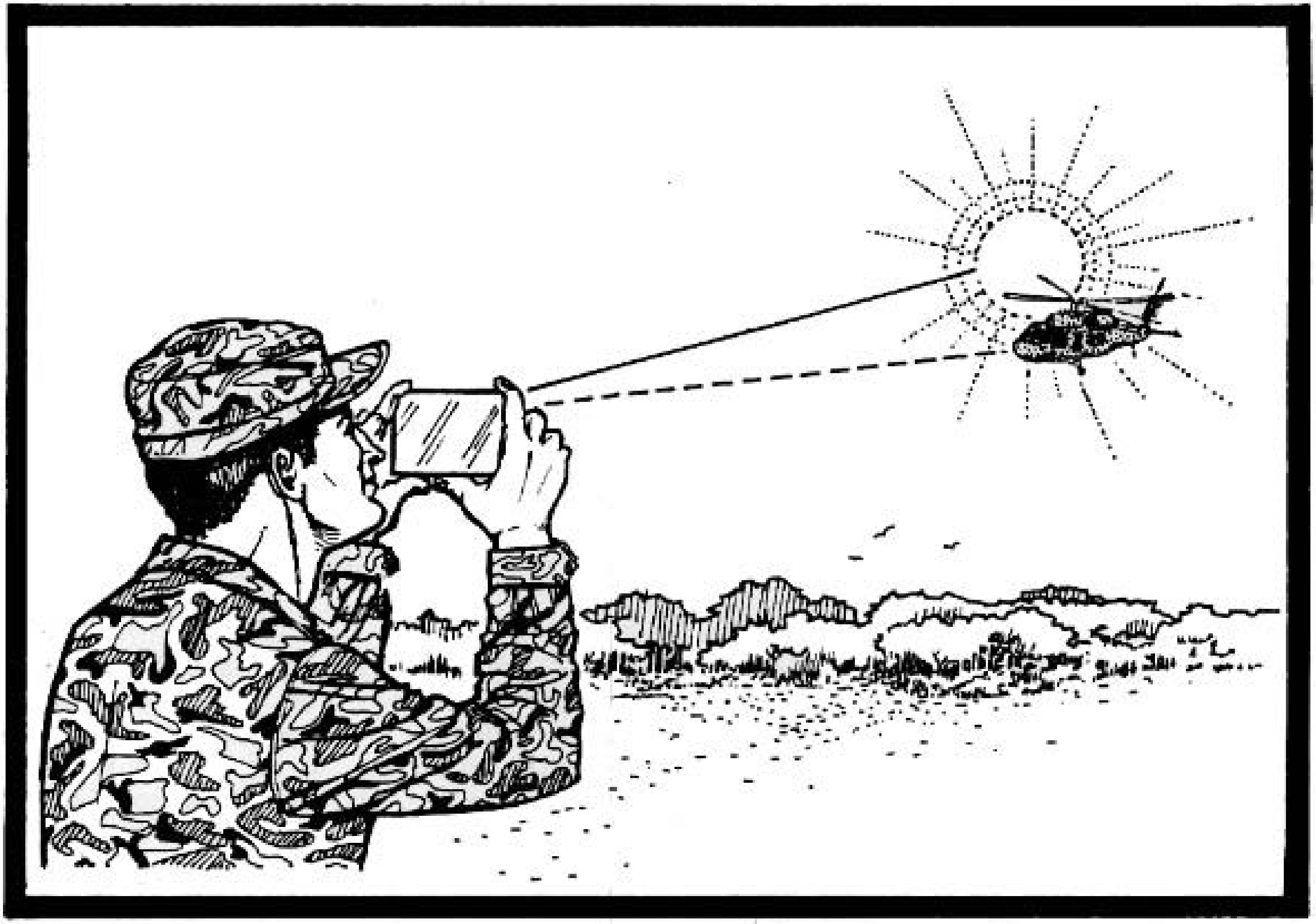


Figure 7-10. MK-3 signal mirror

Figure 7-11. Forest penetrator

Table 7-3. Color coding of survival items

CONTENTS	COLOR CODE
Medical supplies and first-aid equipment	Red or a red cross on a white background
Food and water	Blue
Blankets and protective clothing	Yellow
Miscellaneous equipment such as axes and compasses	Black
Mixed supplies	Combination of appropriate colors

GLOSSARY

ACRONYMS AND ABBREVIATIONS

AA antiaircraft AAA antiaircraft artillery A^2C^2 Army airspace command and control AADCP Army Air Defense Command Post AADS Army aircraft decontamination station AAG army artillery group (Soviet) AAM air-to air missile AATF air assault task force ABMOC air battle management operations center ACA airspace control authority acft aircraft ACO airspace control order ACP airspace control plan ACR armored cavalry regiment ACRV armored command and reconnaissance vehicle ADA air defense artillery ADAM

air defense antimissile ADCP air defense command post ADF automatic direction finder ADFCS air defense fire coordination section AE aerial exploitation AEB aerial exploitation battalion AFSCOORD assistant fire support coordinator AGL above ground level AH attack helicopter AHO above highest obstacle ALO air liaison officer ALSE aviation life support equipment AM amplitude modulated AMC air mission commander AMLS airspace management liaison section ammo ammunition ANGLICO air and naval gunfire liaison company APC armored personnel carrier APICM antipersonnel improved conventional munition AR Army regulation arm armament arty artillery AS airstrip ASCC air support coordination center ASCE air support coordination element ASE aircraft survivability equipment ASET aircraft survivability equipment trainer ASOC Air Support Operations Center AT antitank ATA air to air ATC air traffic control ATGM antitank guided missile ATHS airborne target handover system atk attack ATO air tasking order ATS air traffic services AVIM aviation intermediate maintenance avn

aviation AVUM

aviation unit maintenance BCE battlefield coordination element BCS battery computer system BDZ base defense zone BIT built-in test BMD Boyevaya Mashina Desantnika [literal Russian: combat vehicle, airborne] BMP Boyevaya Mashina Pekhoty [literal Russian: combat vehicle, infantry (amphibious armored)] bn battalion BRDM Boyevaya Razvedyvatel'naya

Dozornaya Mashina
[literal Russian: combat
reconnaissance patrol
vehicle (amphibious
armored scout)] BTR
Bronetransporter
[literal Russian:
amphibious armored
transporter personnel
carrier (series used as
APCs)]

Cel
sius C3
command,
control,
and
communic
ations
CAS close
air support
CATO
concealed
approach
and
takeoff
CB
chemical
and
biological
CBR
chemical,
biological,
radiologic
al CDU

control

display

unit

cGy centigray (radiation dosage measurement) CH

cargo helicopter chan channel CHEMWARN

chemical warning

combat-ineffective (less than 25 percent performance) CLGP cannon-launched guided projectile CLOS command line-of-sight clr clear co company coax coaxial comm communications COMMZ communications zone cont control CP command post CRC control and reporting center CS combat support or Common Sensor CSAR combat search and rescue CSS combat service support CW continuous wave DA Department of the Army DAG division artillery group (Soviet) DARE designated area recovery/extraction DART downed aircraft recovery team DCofS Deputy Chief of Staff decon decontamination DF direction finding div division DME distance measuring equipment DPICM dual-purpose improved conventional munition DS2 decontaminating solution number 2 DT demanding task EAC echelons above corps ECM electronic countermeasures EH electronic helicopter elect electronics EMP electromagnetic pulse EOB electronic order of battle ESM electronic warfare support measures est estimated EW electronic warfare FA field artillery FAA forward assembly area FARP forward arming and refueling point FASCAM family of scatterable mines FCC Flight Coordination Center FDC fire direction center FEBA forward edge of the battle area FIST fire support team FLIR forward-looking infrared radar FLOT forward line of own troops flt flight FM frequency modulated or field manual FMC fully mission capable FO forward observer FOC flight operations center

FRAGO

fragmentary order freq

frequency FSCOORD

fire support coordinator

FSE

fire support element

FSO

fire support officer

G2

Assistant Chief of Staff, G2 (Intelligence)

G3

Assistant Chief of Staff, G3 (Operations)

G4

Assistant Chief of Staff, G4 (Logistics)

GCA

ground-controlled approach

gen

general

GR

Guardrail

GS

general support

GSE

ground support equipment

GTA

graphic training aid

HE

high explosive

hel

helicopter

HF

high frequency

HIDACZ

high-density airspace control zone HIMAD

high- to medium-altitude air defense HMG

heavy machine gun

HOB
: height of burst

how
: howitzer

HQ
: headquarters

HTF
: how to fight

hvy
: heavy

IAW
: in accordance with

ID
: identification

IEW
: intelligence and electronic warfare

IFF
: identification, friend or foe (radar)

IFR
: instrument flight rules

illum
: illuminating

IMC
: instrument meteorology conditions

INA
: information not available

ir
: infrared

iss
: issue

J3
: Operations Directorate

JCS
: Joint Chiefs of Staff

JP

jet propulsion kg kilogram km kilometer(s) kt knot lgt light LIC low-intensity conflict LLTR low-level transit route LMG light machine gun LO liaison officer LOI letter of instruction LRF/D laser range finder/designator LS landing site LZ landing zone m meter(s) max maximum MCLOS manual command line-of-sight MCW modulated continuous wave MEDEVAC medical evacuation METT-T mission, enemy, terrain, troops, and time available

MG machine gun MHE materials handling equipment MHz megahertz MI military intelligence MIJI meaconing, intrusion, jamming, and interference min minute mm millimeter(s) mod moderate MOPP mission-oriented protective posture MRC motorized rifle company MRL multiple rocket launcher MRR minimum risk route MT-LB light combat, transport vehicle (Soviet) NA not applicable NAAK nerve agent antidote kit NATO North Atlantic Treaty Organization nav navigation NBC nuclear, biological, chemical NCO

noncommissioned officer NDB nondirectional radio beacon NDI nondestructive inspection no number NOE nap-of-the-earth NOFORN no foreign nationals NSN national stock member obsn observation OGE out-of-ground effect OH observation helicopter OPCON operational control OPLAN operation plan OPORD operation order OPSEC operations security OV observation airplane PC production control PD performance-degraded (25 to 75 percent performance) PIC pilot in command PLS personnel locator system

plt platoon PMC partially mission capable pneu pneudraulics POL petroleum, oils and lubricants psi pounds per square inch PZ pickup zone QC quality control QSS quick supply store QSTAG Quadripartite Standardization Agreement RAAMS remote

antiarmor mine system R AG regimental artillery group (Soviet)
RAP rocket assisted projectile RCC rescue coordination center
RDU remote display unit REC radio electronic combat recon
reconnaissance rep repair RESCAP rescue combat air patrol
RESCORT
rescue escort RF radio frequency RL
readiness level ROZ restricted
operations zone RPM revolutions per
minute RPV remotely piloted vehicle
RX repairable exchange S2 Intelligence
Officer (US Army) S3 Operations and
Training Officer (US Army) SAAFR
standard-use Army aircraft flight route
SACLOS semiautomatic command
line-of-sight SAFE selected area for
evasion SAM surface-to-air missile or
send a message (visual communication
system) SAR search and rescue SARTF
search and rescue task force SEMA
special electronic mission aircraft
SHORAD short-range air defense SIF
selective identification feature (used
with IFF) SIGINT signals intelligence
SLAR side-looking airborne radar SMCT soldier's manual of common
tasks SOI signal operation instructions SOP standing operating
procedure SOS international distress signal SP self-propelled STANAG
Standardization Agreement STB supertropical bleach stby standby std
standard stor storage STP soldier training product STRIKWARN strike
warning struct structure sup supply svc service sys system T2
tricothecene toxin (yellow rain) TACAIR
tactical air TACC tactical air control center TACP
tactical air control party TACS tactical air control
system TADS target acquisition and designation
system TB technical bulletin TC training circular TM

technical manual TOC tactical operations center TOE table(s) of organization and equipment TOW tube-launched, optically tracked, wire-guided TRADOC United States Army Training and Doctrine Command TSU telescopic sight unit TV television UH utility helicopter UHF ultrahigh frequency UI unidentified US United States (of America) USAF United States Air Force

USAICS

United States Army Intelligence Center and School

UT

undemanding task

uti

utility

veh

vehicle

VF

visual flight rules

VHF

visual meteorological conditions

vol

volume

variable time

WFZ

weapons-free zone

WP

white phosphorous

wp

weapon

REFERENCES

Section I

REQUIRED PUBLICATIONS

Required publications are sources that users must read in order to understand or to comply with this publication.

ARMY REGULATIONS

AR 95-1 Army Aviation: Flight Regulations

AR 350-42 Nuclear, Biological, and Chemical Defense and Chemical Warfare Training

AR 385-10 Army Safety Program

AR 525-90 Wartime Search and Rescue (SAR) Procedures

FIELD MANUALS

FM 1-100 Doctrinal Principles for Army Aviation in Combat Operations FM 1-102 Army

Aviation in an NBC Environment FM 1-107 Air-to-Air Combat FM 1-111 Aviation Brigades

FM 1-116 Tactics, Techniques, and Procedures for the Air Cavalry/ Reconnaissance Troop

FM 1-117 Air Reconnaissance Squadron FM 1-301 Aeromedical Training for Flight

Personnel FM 1-402 Aviator's Recognition Manual FM 3-3 NBC Contamination Avoidance

FM 3-4 NBC Protection FM 3-5 NBC Decontamination FM 3-9 Military Chemistry and Chemical Compounds FM 3-50 Deliberate Smoke Operations FM 6-30 Observed Fire Procedures FM 8-9 NATO Handbook on the Medical Aspects of NBC

Defensive Operations

FM 21-11 First Aid for Soldiers

FM 21-60 Visual Signals

FM 26-2 Management of Stress in Army Operations FM 44-30 Visual Aircraft Recognition FM 71-100(HTF) Armored and Mechanized Division Operations (How to Fight) FM 100-2-1 Soviet Army Operations and Tactics FM 100-2-3 The Soviet Army Troops Organization and Equipment FM 100-5 Operations FM 100-20 Low Intensity Conflict FM 100-42 US Air Force/US Army Airspace Management in an Area of Operations FM 100-103 Army Airspace Command and Control in a Combat Zone FM 101-31-1 Staff Officers Field Manual: Nuclear Weapons Employment Doctrine and

Procedures

SOLDIER TRAINING PUBLICATION

STP 21-1-SMCT Soldier's Manual of Common Tasks (Skill Level 1)

TRAINING CIRCULARS

TC 1-201 Tactical Flight Procedures

TC 1-204 Night Flight Techniques and Procedures

TC 1-210 Aircrew Training Program, Commander's Guide

TECHNICAL MANUALS

TM 3-4240-280-10 Operator's Manual for Mask, Chemical-Biological: Aircraft, ABC-M24 and Accessories and Mask, Chemical-Biological, Tank, M25A1 and Accessories

TM 38-250 Packaging and Materials Handling: Preparing of Hazardous Materials for Military Air Shipments

TECHNICAL BULLETIN

MED 524 Occupational and Environmental Health: Control of Hazards to Health From Laser Radiation

DEPARTMENT OF THE ARMY FORM

2028 Recommended Changes to Publications and Blank Forms

DEPARTMENT OF DEFENSE FORM

1833 Isolated Personnel Report (LRA) **GRAPHIC TRAINING AID** GTA 3-6-5 NBC Warning and Reporting System **NOTE: To obtain GTA 3-6-5, contact your local training audiovisual support center.**

US ARMY INTELLIGENCE CENTER AND SCHOOL PAMPHLET

(S) 95-1 Aviation Special Electronic Mission Aircraft Survivability (U)

NOTE: To obtain information about this publication, contact Commander, US Army Intelligence Center and School, ATTN: ATSI-TD-PAL, Fort Huachuca, AZ 85613-7000. Section II PROJECTED PUBLICATIONS

Projected publications are sources of additional information that are scheduled for printing but are not yet available. Upon print, they will be distributed automatically via pinpoint distribution. They may not be obtained from the US Army Publications Distribution Center, 2800 Eastern Boulevard, Baltimore, MD 21220-2896, until indexed in DA Pamphlet 25-30.

FIELD MANUALS

FM 1-107 Air Combat Operations (Approved Final Draft)

FM 8-50 Prevention and Medical Management of Laser Injuries

FM 8-285 Treatment of Chemical Agent Casualties and Conventional Military Chemical Injuries

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AUTHORIZATION LETTER

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Official: *THOMAS F. SIKORA* Brigadier General, United States Army The Adjutant General

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