APPENDIX G

AVIATION COUNTERMEASURE TECHNIQUES AND SURVIVABILITY EQUIPMENT

This appendix describes the aviation survivability equipment and countermeasures that enhance MEDEVAC aircrew survivability and sustainability on the modern battlefield. It provides an overview of nomenclatures and systems and a basic description of functions.

Section I. 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 AO. The survivability of Army aircraft depends on well-organized coordination with ground forces and the aircrew's ability to employ effective countermeasures.

G-1. Countermeasure Techniques Suppression

a. 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.

(1) During MEDEVAC operations, aircraft 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 this mission.

(2) 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.

b. 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 pickup area when helicopters are employed from *standoff* ranges. Wind speed and direction 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 considerations of the factors discussed above.

G-2. Terrain Flight Techniques

a. General.

(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 LOS limitations associated with radar provide an effective means of denying acquisition while aircraft are en route. A thorough intelligence briefing and a careful flight or map reconnaissance during pre-mission planning can help aircrews select the best routes for detection avoidance.

(2) To avoid acquisition by threat radars, 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.

b. Standoff Techniques. Aviators should use standoff flight techniques when they engage in flying near known or suspected 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.

c. Exposure Time.

(1) Aircrews can reduce exposure time by using available terrain to mask the aircraft. Aviators must always be aware of the range and effectiveness of threat radar weapon systems and the time the weapons require for target engagement. Because aircraft survivability equipment does not provide this information, aviators must memorize it.

(2) Medical evacuation aircraft depends on terrain flight, good route planning, and speed to surprise the enemy and reduce exposure time. The MEDEVAC missions requiring hoist operations (if aircraft exposure is necessary) must remain beyond the range of air defense weapons or rely on previously mentioned suppression techniques.

d. 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 from Plexiglas™ or metal parts. Flight routes, PZs, and/or LZs 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/coolest part) of the aircraft.

(1) *Doppler effect*. More advanced pulse Doppler radar 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 hoist 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 break lock is indicated, aviators should continue to alter their course and speed to prevent radars from predicating 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.

G-3. 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 a glint from aircraft canopies. Therefore, unit personnel should install canopy 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 as much as possible. Battlefield deception personnel from the division or corps can assist unit personnel with the deception operations and equipment.

a. *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 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:

(1) Acquisition of a cueing signal.

(2) Confirmation of the target.

(3) Development of an attack plan.

(4) 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 located 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-ground based electronic surveillance.

b. Locations.

(1) *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 can attack. Helicopter stay time in the PZ is usually about 10 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, poses a significant threat to helicopters in the PZ. 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, it is a threat to helicopters arriving and departing PZs.

(2) *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 ground forces.

(3) *Forward arming and refueling points.* The FARPs are vulnerable to detection by the means identified for PZs and LZs. The FARP will remain in place for an extended period, will use communications, and will produce thermal images from aircraft and fuel storage bladders. These may be sufficient to permit location by the enemy and result in an attack. 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 the FARP's location for an aerial attack. All FARP operations should be organized efficiently to reduce the time that aircraft will stay in the FARP. The 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 over equipment and helicopters at the FARP can preclude detection of the FARP. When available, ballistic nets should be used to protect fuel storage bladders.

(4) *Forward staging areas.* Helicopters may stay at forward staging areas (FSAs) long enough to permit detection by the enemy. All of the detection means identified for PZs and LZs should be considered a threat.

(5) *Command posts.* The detection threat to CPs is similar to that for FARPs. Communications from CPs will increase the threat or 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 countermeasure capability can degrade the enemy's electronic detection efforts.

(6) *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.

(7) *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.

c. 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 changes 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*) *On-board camouflage sets.* The on-board 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 on-board camouflage set.

(*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.

(*c*) *Freestanding camouflage set.* Camouflage sets must be rapidly erected in company and maintenance areas. In providing freestanding camouflage sets for helicopters, the covering of the rotors will require large structures. Despite the challenges of constructing freestanding camouflage sets, the possibility of increasing helicopter survivability appears to justify the effort.

(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, freestanding camouflage sets could contribute significantly to the survivability of helicopters. Some operations can be protected by the use of on-board camouflage sets. Easily transportable and employable, camouflage sets can be used at CPs, FSAs, FARPS, and downed aircraft positions.

d. Deception. Deception delays and/or diverts threat reconnaissance, intelligence, surveillance, and target acquisition efforts; it 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 FSAs, 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.

(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 G-3. 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 direct and/or indirect fires, 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 forward assembly area is normally moved every 40 to 165 minutes, then the decoy forward assembly area should be moved within that time. If camouflage is usually used on real aircraft 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 or unit type.

(*d*) *Coordinate with adjacent friendly units*. Coordinate the location of phony sites with adjacent friendly units to avoid collateral damage from hostile fire.

Section II. AVIATION SURVIVABILITY EQUIPMENT

The aircraft's 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 aircraft survivability equipment-training 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 on-board

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.

G-4. Radar Warning Receivers

a. 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.

b. 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 and designed especially for special electronic mission aircraft (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 is an upgraded version of the AN/APR-39(V)2. 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 the system's direction and lethality, along with an aural warning.

G-5. Radar Jammers

a. The AN/ALQ-136(V)1 countermeasures set is designed for the AH-1 aircraft. It is an automatic pulse radar jammer that analyzes incoming radar signals. When threat signals are identified, jamming begins automatically 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 with possible applications for the UH-60Q.

G-6. Chaff and Decoy Systems

The M-130 general-purpose chaff dispensing system uses the M1 chaff cartridge. It reduces or eliminates the threat's ability to detect, lock onto, 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.

G-7. 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.

G-8. Expandable Jammers

Electro-optical expendable jammers use smoke or other obscurants to degrade threat acquisition by aided or unaided means.

G-9. Infrared Jammers

a. AN/ALQ-144(V)1. The AN/ALQ-144(V)1 is an active, continuously operating, omni-directional, electrically fired infrared jammer system designed for 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.

c. AN/ALQ-144A(V)1 and (V)3. These models represent modular upgrades of the standard (V)1 and (V)3. They provide greater protection against threat infrared missiles.

G-10. Infrared Suppression

a. 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.

b. 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 a nap-of-the-earth flight. When used with an infrared suppressor, this low reflectance degrades the seeker lock-on capability of threat infrared missiles.